THE CITY OF PLEASANTON

Water System Management Plan

Water System Management Plan

October 2024

carollo

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Abbreviations

10-Year CIP	10-Year Capital Improvement Program
AACE	Advancement of Cost Engineering
AC	asbestos cement
AWIA	American Water Infrastructure Act
BESS	battery energy storage systems
Carollo	Carollo Engineers
CI	cast iron
CIP	Capital Improvement Program
City	City of Pleasanton
CMMS	computerized maintenance management system
COF	consequence of failure
DDW	Department of Drinking Water
DER	Distributed Energy Resources
DI	ductile iron
EPA	Environmental Protection Agency
ERP	Emergency Response Plan
EUM	Effective Utility Management
fps	feet per second
ft	foot/feet
gpm	gallons per minute
hp	horsepower
kW	kilowatt(s)
LCRI	Lead and Copper Rule Improvements
MG	million gallons
mgd	million gallons per day
O&M	operations and maintenance
OT	operational technology
PFAS	polyfluoroalkyl substances
PGR	Pleasanton Generator Report
POF	probability of failure
PV	photovoltaic
PVC	polyvinyl chloride
R&R	rehabilitation and replacement
RCS	Residual Control System
ROW	right-of-way
RRA	Risk and Resilience Assessment
SCADA	supervisory control and data acquisition
TOU	time-of-use management

WDSCMP	Water Distribution System Capacity Master Plan
WQRR	Water Quality Regulatory Review
WSAS	Water Supply Alternatives Study
WSMP	Water System Management Plan
WTP	water treatment plant
WY	West Yost

SECTION 1 BACKGROUND AND PURPOSE OF THE WATER SYSTEM MANAGEMENT PLAN

The City of Pleasanton (City) is in the eastern San Francisco Bay Area region, South of Interstate 580, and East of Interstate 680 in Alameda County. The City owns and operates a potable water system that serves residential customers as well as commercial and industrial users within its City limits. The City has initiated the development of a Water System Management Plan (WSMP), that will be a living document to guide management of its water system.

1.1 Purpose of the WSMP

1.1.1 Initial WSMP

The main purpose of the WSMP is to define near-term and long-term spending and programmatic priorities as a basis for water rate and connection fee requirements. This WSMP focuses on capacity, operational, and rehabilitation and repair need to define costs and programmatic priorities designed to move the City's water utility to a sustainable operational framework. The two main outcomes of the initial WSMP, and future WSMP updates, is to define two critical operational elements.

1. Near, Mid, and Long-Term Capital Improvement Program (CIP).
2. List of recommended operations and maintenance (O&M) program improvements.

Both elements should be reviewed and updated on a 2-year-, and 6-year cycle respectively to account for changes in system priorities, as well as updates to the City's rates and connections fees.

1.1.2 Future WSMP Updates

Future updates should also include evaluations of the City's water utility structure and organizations using the United States Environmental Protection Agency's (EPA) Effective Utility Management (EUM) framework. The EUM was developed through a collaboration of ten regulatory and public utility partners to define a framework definition of effective utility operations, and prioritization. The EUM focuses on the ten EUM attributes listed below:

1. Product Quality.
2. Customer Satisfaction.
3. Stakeholder Understanding and Support.
4. Financial Viability.
5. Operational Optimization.
6. Employee Leadership and Development.
7. Enterprise Resilience.

8. Infrastructure Strategy and Performance.
9. Community Sustainability.
10. Water Resource Sustainability.

1.2 WSMP Updates

The WSMP will be reviewed and updated based on two-and six-year cycles.

2-Year WSMP Review Cycle: The WSMP should be reviewed on a 2-Year review cycle where project completion, project prioritization, and current funding are compared against the plan established in the initial WSMP. The 2-Year cycle will provide the City with an opportunity to evaluate progress towards the capital project completion and the implementation of new O&M programs. Additionally, the 2-year WSMP review provides an opportunity to consider if any new technical evaluations are needed to address issues not identified in the current WSMP so they can be initiated with results to be included in the 6-Year WSMP Update (described below).

6-Year WSMP Update: Every six years the City will undergo an update of the WSMP that is adopted by City Council. The first update in this six-year cycle will include an evaluation of the water utility using the EUM Primer (Appendix A). The EUM primer will evaluate and rate the water utility on the 10 attributes of utility management and develop recommendations for organization enhancements.

The review and updates are scheduled to coordinate with the City’s CIP and Operations budgeting process. This cycle is illustrated in Figure 1 below:

	FY24/25		FY25/26		FY26/27		FY27/28		FY28/29		FY29/30		FY30/31		FY31/32		FY32/33	
	July-Dec 2024	Jan-Jun 2025	July-Dec 2025	Jan-Jun 2026	July-Dec 2026	Jan-Jun 2027	July-Dec 2027	Jan-Jun 2028	July-Dec 2028	Jan-Jun 2029	July-Dec 2029	Jan-Jun 2030	July-Dec 2030	Jan-Jun 2031	July-Dec 2031	Jan-Jun 2032	July-Dec 2032	Jan-Jun 2033
WSMP Update Adoption	Δ												Δ					
WSMP Reviews					Δ				Δ								Δ	
Ops & CIP Budget Adoption		Δ				Δ				Δ				Δ				Δ

Figure 1 WSMP and CIP Budget Adoption Cycle

1.3 Existing Water Distribution System

The City's water distribution system includes water supply facilities, distribution system pipelines, pump stations, and water storage tanks. The City's existing water system is illustrated in Figure 2.

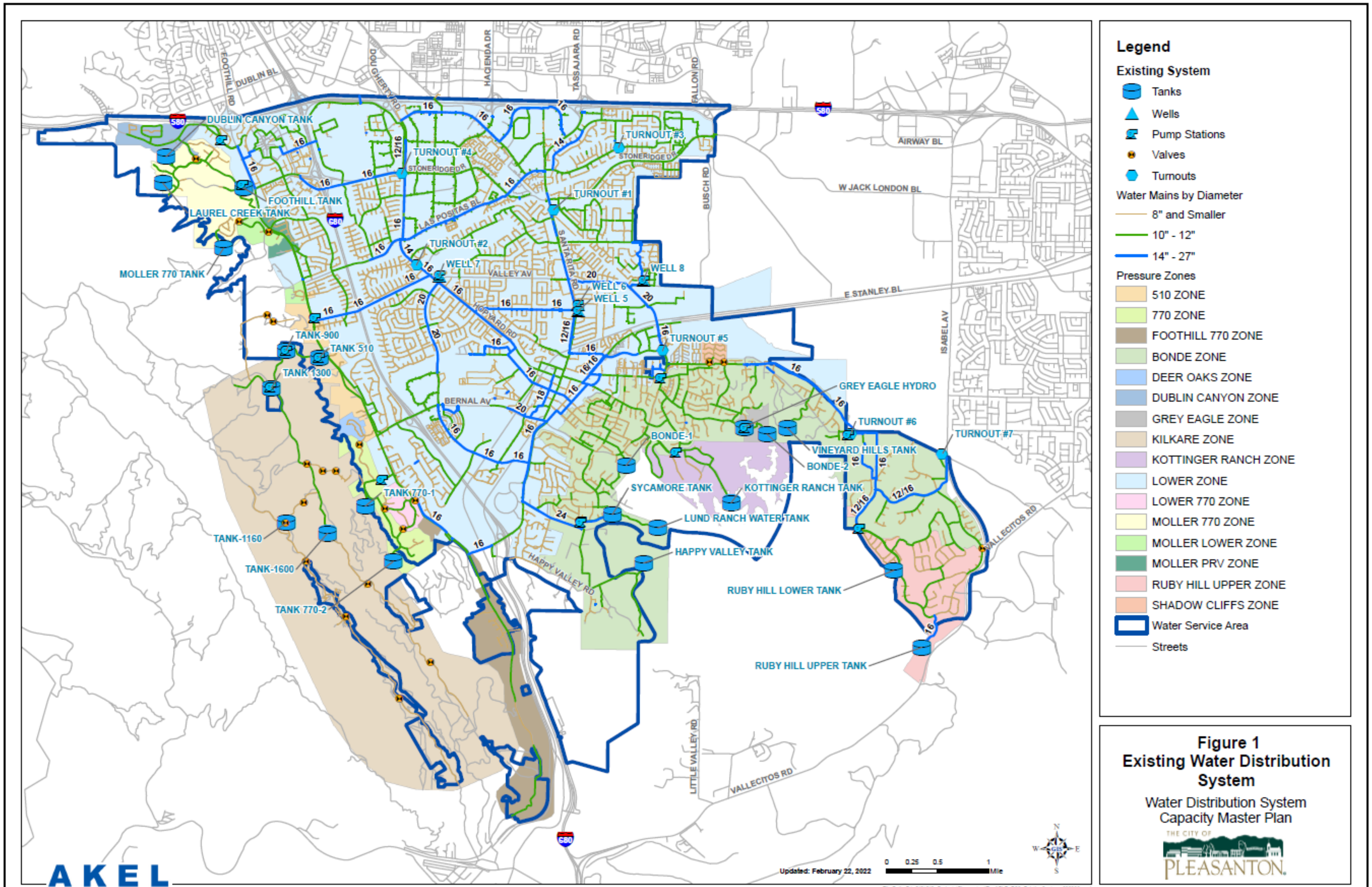

Figure 2 Existing Water Distribution System

1.3.1 Water Supply Facilities

The City's water supply comes from two sources: City owned groundwater supply wells and turnout connections to the Zone 7 Water Agency (Zone 7). The City has an allocation of 3,500 ac-ft of groundwater. However, the City is not currently utilizing all of that allocation due to Wells, 5, 6 and 8 having measurable amounts of PFAS contamination. In addition, Well 7 became inoperable in the 1990s due to turbidity and structural settlement of the building. All water sources are disinfected and fluoridated before delivery to customers.

The Turnouts from Zone 7 are summarized in Table 1.

Table 1 Water Supply - Zone 7 Turnouts

Turnouts	Type	Status
Turnout 1	Flow Control	Active
Turnout 2	Flow Control	Active
Turnout 3	Flow Control	Active
Turnout 4	Flow Control (Boosted in 2025)	Active
Turnout 5	Flow Control	Active
Turnout 6	Boosted	Active
Turnout 7	Boosted	Active

Water supply from Zone 7 comes from three primary sources: State Water Project supply via the South Bay Aqueduct, water from local watersheds via Lake Del Valle, and groundwater within the Livermore-Valley Groundwater Basin. Surface water sources are treated at both the Paterson Pass and Del Valle Water Treatment Plants (WTPs).

1.3.2 Water Distribution Pipelines

The City has approximately 339 miles of water system pipelines ranging from 2 to 27 inches in diameter. The City's pipeline materials vary from asbestos cement (AC), cast iron (CI), ductile iron (DI), polyvinyl chloride (PVC), steel, and welded steel. The breakdown of pipeline diameters, materials and age can be found in the Water Distribution System Capacity Master Plan (WDSCMP Akel, October 2024)

1.3.3 Water Booster Stations

The City's water booster stations are summarized in Table 2. For further details on the booster stations refer to the WDSCMP.

Table 2 Booster Station Inventory

Pump Station	Source Pressure Zone	Destination Pressure Zone
Longview (Foothill 1)	Lower	770
Foothill 2	Lower	510
Dublin Canyon	Lower	Dublin Canyon
Laurel Creek	Lower	Moller 770
Vineyard	Lower	Bonde

Pump Station	Source Pressure Zone	Destination Pressure Zone
North Sycamore	Lower	Bonde
Vineyard Hills	Zone 7	Bonde
McCloud (Inactive)	Lower	Bonde
Ruby Hill	Zone 7	Bonde
Gray Eagle	Bonde	Hydropneumatic
Kottinger Ranch	Bonde	Kottinger
Santos Ranch 510	510	Kilkare 900
Kilkare 900	Kilkare 900	Kilkare 1300
Kilkare 1300	Kilkare 1300	Kilkare 1600

1.3.4 Water Storage Tanks

The City has 19 storage tanks ranging in size from 0.25 to 8 million gallons (MG). A summary of the City's water storage tanks can be found in the WDSCMP.

SECTION 2 WATER SYSTEM PROGRAM EVALUATIONS AS PART OF THE WSMP

The City conducted a number of evaluations as part of the WSMP to help define the near and long-term needs. The evaluations covered a suite of topics including capacity evaluations for existing and currently planned long term conditions, overall water system condition, supervisory control and data acquisition (SCADA) and power, as well as water quality and existing and future regulations. The specific evaluations included the following:

1. **Water Quality Regulatory Review:** Carollo conducted a review of the existing and potential future federal and state of California water quality regulations. The report details water quality regulations that the City is subject to as of 2023 including but not limited to the lead and copper rule, PFAS, new requirements for the Consumer Confidence Report (CCR), and the requirements for water quality of new groundwater sources. The City is currently in compliance but will need to be diligent related to tracking the City’s water quality relative to these programs. The report also details the potential for new regulations regarding M/DBPR, PFAS, and Cr(VI) MCLS. The Water Quality Regulatory Review is included in Appendix B.
2. **Water Conservation Regulatory Review:** Carollo conducted a review of existing and proposed water conservations regulations as well as including a review of the new California Water Loss regulations. The main action items related to this report is the implementation of the water loss regulations and the need to implement a leak detection program. For upcoming water conservation regulations, the City is required to complete Commercial, Industrial, and Institutional (CII) Performance Measures. The water use objective includes calculations for each budget (residential indoor use, residential outdoor use, CII landscapes with dedicated irrigation meters (DIMs) or equivalent technology, real water losses, variances if applicable, temporary provisions if applicable, and bonus incentive for potable reuse if applicable). Additional data is needed to calculate what the water use objective will be,

considering the tightening of the efficiency standards (ex. standard for CII landscapes with DIMs is 0.80 starting 2020, 0.63 starting 2035, and 0.45 starting 2040). It should be noted that the state's update of the water conservation regulations are ongoing, and the City will need to track progress related to water conservation continually. The information documented in the WSMP may not be the most current status of the state's requirements. The Water Conservation Regulatory Review is included as Appendix C

3. **Condition Assessment Report:** Carollo conducted field condition assessments of all of the City's above ground water facilities over the course of multiple days. The results of the assessment were used to develop a prioritized list of rehabilitation-based capital projects. Carollo also conducted a desktop analysis of the distribution system pipelines and those results were used to develop the pipeline rehabilitation recommendations. The highest priority projects were identified based on risk. The Condition Assessment Report is included as Appendix D.
4. **Operations, Maintenance, and Management of the Water Distribution System:** Carollo conducted an evaluation of the City's Operations and Maintenance (O&M) practices and developed a list of recommended O&M programs to implement. Recommendations include but are not limited to, unidirectional flushing, water meter testing program, and others. The Operations, Maintenance, and Management, of the Water Distribution System Technical Memorandum is included in Appendix E
5. **SCADA Master Plan:** West Yost (WY) completed a planning study focused on evaluating improvements to the City's SCADA system including equipment, preventive maintenance, and cyber security. The report documents multiple projects and programs to improve and harden the SCADA system. The SCADA Master Plan also identified specific RTU upgrades. However, RTU upgrades are assumed to be included in the pump station rehabilitation and replacement improvement projects and thus is not specifically called out as a standalone project. If the City observes in the future that RTU replacement needs occur faster than implementation of pump station CIP projects, the City may want to consider implementing a dedicated project for RTU replacements. The SCADA Master Plan is included as Appendix F.
6. **Energy Master Plan:** West Yost also completed an analysis looking at the Distributed Energy Resources (DERs), microgrids, time-of-use management (TOU), as well as process control strategies to evaluate energy optimization. The analysis looks at maximum allowable downtime (MAD) to evaluate and develop mitigation measures related to system resilience. The Energy Master Plan is included as Appendix G.

The findings from these evaluations were used to inform the capital and O&M program recommendations.

SECTION 3 WATER SYSTEM PROGRAM EVALUATIONS OUTSIDE OF THE WSMP

There were four additional evaluations conducted outside of the WSMP where the findings were used to inform project recommendations and prioritization. The evaluations included the following:

1. **American Water Infrastructure Act (AWIA) of 2018, Risk and Resilience Assessment:** West Yost, Final Report April 2021. AWIA Section 2013 requires communities with greater than 3,300 people to develop a Risk and Resilience Assessment (RRA) and an Emergency Response Plan (ERP). The RRA and ERP identifies critical water infrastructure and develops a plan to mitigate potential disruptions to water service in the event of any number of issues.
2. **Water Distribution System Capacity Master Plan (WDSCMP):** Akel Engineering Group, Inc, Final October 2024. The WDSCMP evaluated the system's ability to provide adequate water supply and pressure for existing and future conditions during peak demand times. The WDSCMP identifies pipeline, storage, and pumping improvements required in the near and long term.
3. **Water Supply Alternatives Study (WSAS):** Brown and Caldwell, Final Report November 2023. The WSAS evaluated the City's options for long term water supply and developed a recommended approach for moving forward with required supply projects. The supply analysis was to develop a recommended approach to recover use of the City's Groundwater Pumping Quota that has been lost due to PFAS contamination. The report recommended the construction of new supply wells outside of the existing PFAS plume.
4. **Pleasanton Generator Report (PGR):** TJC and Associates, Final Report November 2023. The purpose of the PGR was to analyze and document the required functionality, design criteria, and execution approach for the integration of backup power systems at the City of Pleasanton Utilities Division potable water pump stations as well as critical sewer and storm stations. The report identified the size and location of new backup power supply through the City for the water, sewer, and storm drainage systems. On October 1, 2024, TJC and Associates provided a presentation of the results of the report to City staff. This presentation had slightly higher cost estimates from that contained in the report and serve as the basis for that included in this WSMP. A copy of the presentation is included in Appendix H.

All four of these efforts were used to inform the City's capital and O&M program recommendations.

SECTION 4 FUTURE EVALUATION EFFORTS

Additional evaluation efforts will be conducted by the City to inform future WSMP updates. Additional efforts can include but may not be limited to:

1. **Recycled Water Master Plan.** The goals of the recycled water master plan are to develop a system hydraulic model to better assess operational performance and aid decision making for possible system expansion; develop processes to expand cost effective service opportunities; and assess opportunities to work with DERWA to develop mutually beneficial outcomes
2. **2025 Urban Water Management Plan (UWMP).** The UWMP is a state mandated document that evaluates existing supply vs. proposed demands. The City must update the UWMP every five years.
3. **Asset Management Plan.** The City is currently in the process of developing a City-wide asset management program. The water utility will need to develop its approach for asset management that integrates with the City-wide effort.

SECTION 5 LONG-TERM CAPITAL IMPROVEMENT PROGRAM

The Long-Term Capital Improvement Program (CIP) is a prioritized list of recommended projects within multiple categories. The main categories include:

1. **Water Supply:** Water Supply requirements generally fall within two categories, volumetric/available daily rates, and water quality. This includes the City's recent action to proceed with developing an alternative water supply to replace the City's polyfluoroalkyl substances (PFAS) contaminated sources.
   a. California State standards target is that an agency's water supply is adequate to meet maximum day demand with the largest water supply source out of service. Peak hour demands are met through water in storage reservoirs.
   b. The California Department of Drinking Water (DDW) controls water quality standards related to regulated constituents of concern as mandated by the City's distribution system permit.
2. **Distribution:** Distribution system performance is based on City standards as well as additional criteria established by the water system management team through the WDSCMP.
3. **Rehabilitation and Replacement (R&R):** R&R projects fall into two categories, above ground facilities (pump stations, turnouts, tanks, etc.) and below ground (pipelines).
4. **Other:** Projects include those developed for SCADA, power, or other systems for both capital and O&M project and program recommendations.

5.1 Project Prioritization

Project recommendations were prioritized based on a system of categorization.

- **Priority Level A:** These projects are ranked the highest if they are required for health and safety; required by law, regulation, or contract; are under construction; and/or are funded by applicants or outside funding source.
- **Priority Level B:** These projects are those that provide measurable progress toward achieving the City's goals, but the City has a moderate level of control as to when these projects should be accomplished.
- **Priority Level C:** Projects not meeting the criteria for priority level A or B are ranked as priority level C. These are projects that are anticipated to be needed, but may not yet have defined scopes, and schedules.

5.2 Priority A Project Descriptions

5.2.1 Water Supply Projects

WS-1 Near Term Improvements for Water Supply Change

The project entails constructing distribution improvements as described in the WDSCMP to facilitate the City (in the near-term) receiving one hundred percent of its water supply from Zone 7 purchases that are delivered through the seven turnouts.

1. S-1. Construct 3,250 feet of 24-inch pipeline (the existing 12-inch to be abandoned) in Stoneridge Road between Hopyard Road and Johnson Drive.
2. S-2. Construct 1,600 feet of 18-inch pipeline in Bernal Avenue between Nevada Court and Vineyard Avenue.
3. S-3. Construct 4,650 feet of 20-inch pipeline in Sunol Boulevard between Bernal Avenue and Sycamore Road.
4. BS-1. Booster Station at Turnout 4 at Hopyard Road and Stoneridge Drive with a capacity of 5,200 gallons per minute.
5. I-2. Construct 160 feet of 18-inch pipeline in Stoneridge Drive from Turnout #4 to Hopyard Road
6. I-3. Replace 210 feet of existing 10-inch pipeline with a new 16-inch pipeline in Vineyard Avenue between the Vineyard Booster Station and Bernal Avenue.

WS-2 Long Term Improvements for Water Supply Change

Project entails constructing improvements to recover the use of the City's Groundwater Pump Quota. The City is considering a City owned option versus a regional option with Zone 7 as defined below.

City Owned Option:

1. New City groundwater wells W-1, and W-2 as defined in the WDSCMP.
2. Pipeline projects F-1 through F-5, as defined in the WDSCMP:

a. F-1 includes the replacement of 3,250 liner feet of existing 12-inch main on Stoneridge Drive with a new 24-inch diameter main.
b. F-2 includes the replacement of 310 linear feet of existing 12-inch main on Foothill Road with a new 24-inch diameter main.
c. F-3 includes 3,100 linear feet of new 12-inch diameter main on Valley Avenue from Pleasanton Avenue to Sunol Boulevard.
d. F-4 includes 975 linear feet of new 12-inch diameter main on Oak Vista Way from Cotton Mill Way to Valley Avenue.
e. F-5 includes 2,300 linear feet of new 16-inch diameter main on Hansen Drive between Del Prado Well to Valley Avenue.

Regional Zone 7 Options:

If the City decides to go with the regional supply project, W-1 and W-2 would be replaced with regional wells constructed and operated by Zone 7. Pipeline projects F-1 and F-2 would still be required. However, pipeline projects F-3 through F-5 would not be required and instead additional turnout and distribution improvements would be needed to receive the groundwater supply from Zone 7 via turnouts.

5.2.2 Distribution System Capacity Projects

DS-1 Existing Pipeline Deficiencies Improvements (I-1, I-4 through I-10 from Akel Report)

Descriptions from the WDSCMP Report. Does not include Projects I-2 and I-3, which are included in project WS-1.

1. I-1. Replace 200 feet of the existing 8-inch pipeline in Payne Road with a new 12-inch pipeline between Denker Drive and Payne Court.
2. I-4. Replace 310 feet of existing 6-inch pipeline with a new 8-inch pipeline in Hopkins Court between Hopkins Way and the end of Hopkins Way cul-de-sac.
3. I-5. Replace 410 feet of existing 6-inch pipeline with a new 8-inch pipeline in San Antonio Street between San Gabriel Court and the end of San Antonino Street cul-de-sac.
4. I-6. Replace 200 feet of existing 8-inch pipeline with a new 12-inch pipeline in Sycamore Creek Way between Dalton Creek Way and 200 feet east of Dalton Creek Way.
5. I-7. Replace 140 feet of existing 10- and 12-inch pipeline with a new 16-inch pipeline at the Sycamore Booster Station (suction and discharge pipelines).
6. I-8. Replace 200 feet of existing 8- and 10-inch pipeline with a new 12-inch pipeline at the Foothill Booster Station (suction and discharge pipelines).
7. I-9. Replace 2,225 feet of existing 6-inch pipeline with a new 10-inch pipeline in Sinbad Creek Trail between 410 feet west of Ridgeline Trail and Tank 1160.
8. I-10. Replace 200 feet of existing 8- and 10-inch pipeline with a new 12-inch pipeline in Pleasant Hill Road between Stoneridge and Baldwin Way extension.

Other distribution projects in the WDSCMP include the following:

1. **DS-4 Gray Eagle Connection to Kottinger Pressure Zone (FF-229 through FF-231):** Pipeline to move water from the Gray Eagle pressure zone to the Kottinger Pressure zone as described in the WDSCMP.
2. **DS-5 Lemoine Bypass Pipeline Project:** This project constructs piping improvements that reduced water age near the Lemoine development in the Moller 770 pressure zone. Refer to the WDSCMP for more details.

5.2.3 Distribution System Fire Flow Projects

The WDSCMP also identified fire flow improvements. The WDSCMP categorized fire flow capacity deficiencies above 30 percent deficient as Priority A. The Priority A fire flow improvements are documented in the WDSCMP.

1. **DS-2:** Priority A Fire Flow Deficiencies (Defined in the WDSCMP).
2. **DS-3:** Kilkare – Sunol Priority A Fire Flow Deficiencies (Defined in the WDSCMP).

5.2.4 Rehabilitation and Replacement Projects

The rehabilitation and replacement (R&R) projects have been developed based on the condition assessment effort. The facility condition assessment technical memorandum is included as Appendix D. Based on the findings of the condition assessment as well as the criticality evaluation that was conducted as part of the AWIA project, the following capital projects were developed and prioritized. The descriptions below include major drivers for rehabilitation, but it is intended that the entire facilities are rehabbed as part of each project to cost effectively extend their useful life.

1. **RR-1 Tank 1300:** Interior tank corrosion
2. **RR-2 McCloud Tank and Pump Station:** Decommissioning and demolition
3. **RR-3 Foothill Pump Station:** Rehabilitation includes electrical and instrumentation replacements and upgrades, pump and valve replacements, security and road improvements.
4. **RR-4 Tank Inspection Program:** Costs associated with the internal inspection of the City's storage tanks and reservoirs.
5. **RR-5 Vineyard Pump Station:** Rehabilitation includes electrical and instrumentation replacements and upgrades, pump and valve replacements. Project should include a preliminary design to evaluate breaking the City's largest pressure zone (Mega Zone) into three separate pressure zones. If so, the Vineyard Pump Station capacity will need to be increased as discussed in the WDSCMP.
6. **RR-6 Kottinger Pump Station:** Rehabilitation includes electrical and instrumentation upgrades, valve replacements and upgrades, lighting improvements, and crane improvements.
7. **RR-7 Grey Eagle:** Grey Eagle is assumed to be decommissioned since it will no longer be needed after construction of project DS-4. However, if the Grey Eagle connection to Kottinger Pressure Zone project does not occur in a timely manner, then rehabilitation of the pump station will be needed.

5.2.5 Other Projects

SP-1 Network Architecture Improvements: The SCADA Master Plan recommended conducting a phased approach to updating the City's network architecture. Reinforcing the network can be accomplished by rearchitecting the existing radio network, installing fiber connections between communication sites, utilizing cellular technology, or utilizing a hybrid of both cellular and radio technologies. The phased approach would include a network communications evaluation, design of the new system, and implementation.

SP-2 Generator Upgrades/Replacement: The Pleasanton Generator Report (PGR) detailed the recommendations related to the installation of backup power generators at water, sewer, and storm drain pumping facilities. The list of projects is included in Appendix H.

5.3 Priority B Project Descriptions

5.3.1 Distribution System Fire Flow Projects

The WDSCMP categorized fire flow capacity deficiencies between 15 percent and 30 percent as Priority B improvements. The fire flow improvements are documented in the WDSCMP.

1. **DS-6** Priority B Fire Flow Deficiencies: (Defined in the WDSCMP).

   There were three tank projects identified in the WDSCMP.

2. **DS-7** Increase total storage at the 510 tanks site by 0.25 million gallons (MG) to improve storage for operational, emergency, and fire flow conditions.
3. **DS-8** Increase total storage at the 770 tank site by 0.15 MG to improve storage for operational, emergency, and fire flow conditions.
4. **DS-9** Construct a new 4.5 MG tank in the Lower Zone to account for additional demands from new growth.

5.3.2 Rehabilitation and Replacement Projects

1. **RR-8** Customer Meter Replacement: Customer Meter Replacement: Project is to replace customer meters as they reach the end of their useful lives.
2. **RR-9** Laural Creek Pump Station: Electrical and instrumentation upgrades, pump upgrades, and security upgrades.
3. **RR-10** Ruby Hills Pump Station: Electrical and instrumentation replacements, valve replacements, and pump replacements.
4. **RR-11** Well 7 Decommissioning: Decommission and abandon well site.
5. **RR-12** Well 5 and Well 6: Decommission and abandon well sites.
6. **RR-13** Well 8: Decommission and abandon well site.
7. **RR-15** Pipeline Rehabilitation Backlog: The cost for the rehabilitation or replacement of the identified backlog (approximately 4.8 miles/year) .

5.3.3 Other Projects

5.3.3.1 DER Piloting Projects

SP-3 DER Piloting Projects: Distributed Energy Resources projects (DER) include a range of options related to energy management at above ground facilities. The Energy Master Plan (Appendix G) identified four potential sites for piloting of DER projects. The City is planning to move forward with DER system piloting at the Tassajara Tank site and Turnout No. 3. For the Tassajara site the piloting options include roof mounted solar panels, ground mounted solar arrays, and a solar canopy. For Turnout No. 3 the options include the potential for roof mounted panels, and a solar canopy.

5.4 Priority C Project Descriptions

5.4.1 Water Supply Projects

WS-3 Long Term Groundwater Supply Treatment: This project is a placeholder for additional costs related to groundwater treatment to address increasingly stringent water quality regulations in the future and/or to support sustainability of the groundwater basin.

WS-4 Permanent Residual Control System (RCS) Installation: This project includes moving the existing RCS equipment inside a building (not container type structure) and evaluating switching to bulk chemical from self-generation process at both the Foothill and Sycamore reservoirs. The RCS system has shown to improve the chlorine residual in the system and has allowed the City to minimize the draining and manual cycling of the water storage tanks. The City would like to make the RCS system improvements at both the Foothill and Sycamore reservoirs. Carollo conducted an evaluation of the performance of the RCS system. The evaluation is documented in Appendix I.

5.4.2 Distribution Projects

DS-10 Priority C Fire Flow Improvements. The WDSCMP categorized fire flow capacity deficiencies less than 15% as Priority C improvements. The fire flow improvements are documented in the WDSCMP.

DS-11 Upper Zone Tank Mixers. Distribution system water quality analysis has identified the potential need for tank mixers in the upper zones to mitigate the reduction in chlorine residual. Preliminary estimates included five mixers in the upper zone reservoirs. The evaluation of distribution system nitrification are included in the Nitrification Evaluation Project Memorandum (Appendix I).

5.4.3 Rehabilitation and Replacement Projects

RR-14 Other Facility Rehabilitation: Priority A and B projects for facility rehabilitation was developed based on the grouping of asset replacement and rehabilitation recommendations into capital projects based on facilities. There are many other assets identified in the Condition Assessment report that were not grouped into capital projects. Those asset replacement costs are captured in this project description as a placeholder for the additional funds needed in the long term.

RR-16 Pipeline Rehabilitation: Cost for the rehabilitation or replacement of the underground pipelines (approximately 3 miles/year) to extend the overall useful life of the City's water system piping. Identification of the specifics of these projects will be completed later.

SECTION 6 COST ESTIMATING ASSUMPTIONS

6.1 Planning Level Costs and Markups

Cost markups were applied to develop Class 5 planning level estimates per the Association for the Advancement of Cost Engineering (AACE). The resulting AACE class 5 estimates may represent an overestimate of cost by 100 percent or an underestimate of cost by 50 percent. The markup categories for R&R project are in Table 3. The markups for all other projects are included in Table 4.

Table 3 Indirect Cost Factors – Rehabilitation and Replacement

Markup Category	Percentage of Direct Cost Total
Installation	70 percent
Direct Cost Multiple(1)	**1.70**
Owner's Costs	30 percent
Subtotal Multiple(2)	**2.21**
Design/Construction Contingency	30 percent
Total Estimated Construction Cost Multiplier(3)	**2.87**

Notes:
(1) Direct Cost Multiple: 1*1.70=1.70.
(2) Subtotal Multiple: 1.70*1.30=2.21.
(3) Total Estimated Construction Cost Multiplier: 2.21*1.30 = 2.87.
(4) ENR Index for San Francisco, May 2024, 15418

Table 4 Indirect Cost Factors – Capacity Projects

Markup Category	Percentage of Direct Cost Total
Baseline Construction	1.0
Owner's Costs	30 percent
Subtotal Multiple(2)	**1.3**
Design/Construction Contingency	30 percent
Total Estimated Construction Cost Multiplier(3)	**1.69**

Notes:
(1) Baseline Construction is the cost for a contractor to build the project
(2) Subtotal Multiple: 1.0*1.30=1.30
(3) Total Estimated Construction Cost Multiplier: 1.30*1.30 = 1.69
(4) ENR Index for San Francisco, May 2024, 15418

The tables above demonstrate how to calculate the total estimated construction cost. Note that if the recommendation is to decommission the asset, then the material cost is $0; however, the installation cost is still based on the cost range for said asset class.

The construction cost also accounts for the owner's costs. These are the amounts included in the total program budget to cover the owner's expenses for engineering fees, and legal fees. These costs may also include property/easement/right-of-way (ROW) acquisition, bid advertising, etc., and can range from 15 to 40 percent of the total construction cost. For this project, we are assuming 30 percent.

SECTION 7 LONG TERM CIP COSTS

7.1 Long Term CIP Summary

The Long-Term CIP costs are included in Table 5. The City phasing and prioritization process involves developing implementation strategies that consider needed increases to City engineering staff to manage projects (not included in Table 5), O&M impacts/risks, and funding. A project memorandum that takes an initial look at these implementation strategies is included in Appendix J. Further development will occur as part of the upcoming water rate study.

Table 5 Capital Improvement Plan Summary

Project Type	Total Costs ($Millions)	
Water Supply Projects	$	52.00
Priority A Projects	$	40.00
WS -1 Near Term Improvements for Water Supply Change[3]	$	13.50
WS-2 Long Term Improvements for Water Supply Change[4]	$	26.50
Priority C Projects	$	12.00
WS-3 Future Water Supply Treatment	$	10.00
WS-4 RCS Permanent Installation	$	2.00
Distribution Capacity	$	81.50
Priority A Projects	$	44.06
DS-1 Existing Pipeline Deficiencies Improvements (I-1, I-4 through I-10 from Akel Report)	$	1.46
DS -2 Priority A Fire Flow (>30% Def)	$	16.71
DS-3 Kilkare - Sunol Fire Flow	$	23.78
DS-4 Gray Eagle Connection to Kottinger Pressure Zone	$	1.86
DS -5 Lemoine Bypass Pipeline Project	$	0.25
Priority B Projects	$	26.06
DS-6 Priority B Fire Flow	$	9.43
DS-7 Tank 510 Site (Additional 0.25 MG)	$	2.14
DS-8 Tank 770 Site (Additional 0.15 MG)	$	1.68
DS-9 New 4.5 MG Tanks	$	12.81
Priority C Projects	$	11.38
DS -10 Priority C Fire Flow	$	9.88
DS - 11 Upper Zone Tank Mixers	$	1.50
Rehabilitation and Replacement (Above Ground Facilities)	$	50.59
Priority A Projects	$	12.04
RR-1 Tank 1300 Rehab	$	2.54

Project Type	Total Costs ($Millions)	
RR-2 McCloud Tank/PS Decommission	$	1.24
RR- 3 Foothill PS Rehab	$	1.32
RR - 4 Tank Inspections	$	1.62
RR- 5 Vineyard PS Rehab	$	2.13
RR- 6 Kottinger PS Rehab	$	1.90
RR- 7 Decommission of Grey Eagle PS	$	1.29
Priority B Projects	$	15.75
RR - 8 Customer Meter Replacement	$	9.30
RR- 9 Laurel Creek PS Rehab	$	1.68
RR - 10 Ruby Hill PS Rehab	$	2.04
RR- 11 Decommission Well No. 7	$	0.81
RR- 12 Decommission Well 5 and 6	$	0.71
RR- 13 Decommission Well No. 8	$	1.21
Priority C Projects	$	22.80
RR- 14 Other Facility Rehabilitation	$	22.80
Rehabilitation and Replacement (Below Ground Facilities)	$	71.28
Priority B Projects	$	31.68
RR - 15 Pipeline Rehabilitation Backlog (4.8-miles/year)	$	31.68
Priority C Projects	$	39.60
RR - 16 Pipeline Rehabilitation (3-miles/year)	$	39.60
Other Projects	$	6.73
Priority A Projects	$	6.53
SP - 1 Network Architecture (SCADA)	$	1.01
SP - 2 Generator Projects[5]	$	5.52
Priority B Projects	$	0.20
SP - 3 DER Projects (Tassajara and TO3)	$	0.20
Project Total	**$**	**262.10**

Notes:
(1) Projects are in 2024 dollars.
(2) Costs are total project delivery costs. Increase in City engineering staff to manage is not included.
(3) Project includes S-1, S-2, S-3, BS-1, I-2, and I-3 from Akel Report. Costs provided by City supersede Akel Report.""
(4) City is considering one of two options: Project includes W-1, W-2, F-1, F-2, F-3, F-4, F-5 from Akel Report. Alternatively, City is evaluating a Regional Groundwater Facility project with Zone 7 with related distribution changes. Costs provided by City supersede the Akel report."
(5) Total costs for all generators including water, sewer, and storm is $9.39 million. "Costs show in this table is just for water".

Table 6 Capital Improvement Plan Summary by Project Type

Priority	Total Cost ($Million)	CIP Cost ($Million)			
		Water Supply	Distribution Capacity	Rehabilitation and Replacement	Other
Priority A	$ 102.63	$ 40.00	$ 44.06	$ 12.04	$ 6.53
Priority B	$ 73.69	$	$ 26.06	$ 47.43	$ 0.20
Priority C	$ 85.78	$ 12.00	11.38	$ 62.40	$
Total Costs	$ 262.10	$ 52.00	$ 81.50	$ 121.87	$ 6.73

SECTION 8 O&M PROGRAM IMPROVEMENTS

O&M project and program recommendations and priorities were developed as part of the WSMP effort. The recommendations were compiled based on a number of evaluation efforts. The recommendations are based on regulatory drivers, best practice approaches and O&M preventive maintenance projects. The projects have been grouped according to the evaluation effort used to determine the need.

8.1 O&M Project and Program Recommendations

8.1.1 Water Quality Regulatory Review

Carollo conducted an evaluation of the current and future water quality regulations. The Water Quality Regulatory Review (WQRR) technical memorandum is included in Appendix B. The recommendations from the WQRR include the following:

WQ-1 Lead and Copper Rule Program Tracking: Under the Lead and Copper Rule, the City will need to complete its initial service line inventory by October 16, 2024. By October 16, 2027, the City will need to:

- Develop and submit an LSL replacement plan.
- Revised sampling plan that captures updated sample tiers.
- Start sampling in schools and childcare facilities.
- Comply with revised Action level.
- Comply with updated public notification.

Actions required by the City will be based on findings from the Phase 1 survey currently being conducted by the City.

WQ-2 Cross Connection Control Plan: O&M funds allocated to update the City's cross connection control plan in compliance with new regulations.

WQ-3 Nitrification Response Plan: O&M funds allocated to update the City’s nitrification response plan to incorporate changes to the water system since installation of the residual control system and for better documentation of procedures related to monitoring and control of disinfection byproducts in areas of water system where free chlorination occurs.

8.1.2 Water Conservation and Water Loss

Carollo also developed a Water Conservation and Water Loss technical memorandum. Part of the new California water loss regulations revolves around data accuracy, leak detection, and water loss reduction through mitigation of water system leaks. The project recommendations from this memo include:

- **WC-1 Water Meter Testing Program:** The City should implement a water meter testing program to build accuracy in water usage data. The City can contract this service or train staff to conduct the meter testing program.
- **WC-2 Water Conservation Program:** This project includes funding for unknown changes and modifications to the current water conservation framework for California. Many of the current regulations are in draft form and things are changing annually.
- **WC-3 Water Loss Program:** The water loss regulations require full system leak detection every three years until compliance with the water loss standards. Leak Detection includes a complete system survey of all the City's pipelines before the compliance date of January 2028.
- **WC-4 Systematic Data Handling Error Audit:** This project included the evaluation of the City’s water meter data collection and handling program. This program will determine if errors in data collection are occurring and will develop programs to mitigate the issues.

8.1.3 Repair and Replacement Assessment

The condition assessment program identified additional evaluation needs associated with water system assets.

- **RR-4 Tank Inspection Program:** Costs associated with the internal inspection of the City's storage tanks and reservoirs. This project was included in the long-term CIP as a project.
- **RR-17 Asset Management:** The City is currently developing a City-wide asset management program. This project is to fund for the development of the water utility elements of the asset management program and to coordinate with the City-wide efforts.
- **RR-18 Corrosion Protection:** The City should implement a program to establish a corrosion protection strategy for water distribution piping and O&M program for steel tanks (i.e. monitoring and maintenance of cathodic protection systems).

8.1.4 O&M Review

Carollo conducted an O&M review based on the City's existing California Division of Drinking Water (DDW), and water utility best practices. Details on the O&M review are included in the Operations, Maintenance, and Management, of the Water Distribution System Technical Memorandum in Appendix E. The project and program recommendations include the following:

- **OM-1 Unidirectional Flushing Program:** Develop a single unidirectional flushing program. Valve exercising and hydrant maintenance to be integrated with flushing program.
- **OM-2 Utility Training Program:** Incorporate/implement utility training program recommendations prepared by DKF into overall Public Works training program and continue to develop elements including SOPs and training materials. Costs shown are water related only (does not include sewer and storm related tasks).

- **OM-3 Water System Operations Manual:** The City should update its Water System Operations Manual to reflect current conditions and practices.

8.1.5 SCADA Master Plan

The following projects and programs were developed as part of the SCADA Master Plan. Additional details for all these recommendations are included in the SCADA Master Plan located in Appendix F.

- **SP-4 SCADA Standards Development:** The City currently does not have an official set of comprehensive SCADA standards. Development of SCADA standards is a vital component for any SCADA system. The City should formalize standards that can be provided to internal or external resources. SCADA standards encompass items such as instrumentation standards, PLC/OITs, PLC cabinet hardware and layouts, SCADA software, SCADA hardware, and SCADA programming.
- **SP-5 SCADA Preventive Maintenance Program:** The City should develop a formalized preventative maintenance program for critical electrical, instrumentation, and controls assets, and re-evaluate third-party maintenance contracts to include these activities.
- **SP-6 Backup Core Server Relocation:** The City should diversify and relocate its core SCADA server to the virtual environment and eliminate the risk of the current server hardware access locations.
- **SP-7 Remote Access Improvements:** The City should implement remote SCADA access solutions to offer granular access control, enabling customized control per protocol, per user activity, and per seat, with continuous monitoring and enforcement for the duration of every session.
- **SP-8 Operational Technology (OT) System Monitoring Implementation:** The City should investigate implementing an OT focused cybersecurity monitoring solution that provides OT-specific asset visibility and inventory, vulnerability management, threat detection and investigation tools. The implementation of such a monitoring tool would considerably improve overall monitoring coverage and additionally assist the City in being compliant with new EPA cybersecurity requirements released in March of 2023.

8.1.6 O&M Recommendations Summary

The recommendations included in Section 8.1 are summarized in Table 7

Table 7 O&M Program

Project Type	Cost
WQ – 1 Lead and Copper Rule Program Tracking	$250,000 for initial implementation
WQ - 2 Cross Connection Control Plan	$250,000 for initial implementation plan
WQ - 3 Nitrification Response Plan	$50,000
WC- 1 Water Meter Testing Program	$100,000 for initial implementation followed by annual costs of $10,000.
WC- 2 Water Conservation Program	$250,000 for initial implementation
WC - 3 Water Loss	$550,000 for initial leak detection program (pipe repairs assumed to be included in CIP)
WC – 4 Systematic Data Handling Error Audit	$50,000
RR-17 Asset Management Program	$250,000 for initial implementation followed by annual costs of $10,000.
RR - 4 Tank Inspection Program	Costs included in Long-Term CIP
RR - 18 Corrosion Protection	$200,000 initial, then $10,000 annually
OM – 1 Unidirectional Flushing Program	$75,000 for initial study, then followed by annual costs of $50,000 (major valve replacements assumed to be included in CIP)
OM – 2 Utility Training Program	$50,000 annually
OM – 3 Water System Operations and Maintenance Manual	$150,000 one-time
SP - 4 SCADA Standards Development:	$169,000
SP – 5 SCADA Preventive Maintenance Program	$100,000 initial with 50,000 per year after
SP – 6 Backup Core Server Relocation	$211,000
SP – 7 Remote Access Improvements	$371,000
SP- 8 OT System Monitoring Implementation	$850,000
Full Time Employees	$12.00 million over a 20-year period.(2)

Notes:
(1) Projects are in 2024 dollars.
(2) Five Operator FTEs to facilitate programs.
-2 FTEs starting in FY24/25 which has already been approved and included in baseline operating expenses (not included here).
-Additional 3 FTEs starting in FY 26/27 which is included in this line item.

APPENDIX A EUM PRIMER

Effective Utility Management

A Primer for Water and Wastewater Utilities

January 2017

United States Environmental Protection Agency
Association of Metropolitan Water Agencies
Association of State Drinking Water Administrators
American Water Works Association
NACWA
NAWC National Association of Water Companies
Water Environment Federation the water quality people
Water Environment & Reuse Foundation WE&RF
Water Research Foundation

MESSAGE FROM THE EUM UTILITY LEADERSHIP GROUP

DEAR WATER LEADER:

Every day you provide the leadership to deliver vital services that protect public health and support the vitality of your communities, natural environment, and economy; your organizations are truly anchor institutions in your communities. Today's water sector utilities also face a broad range of complex challenges, including rising costs and affordability, aging infrastructure, on-going regulatory requirements, enhanced customer expectations, and rapidly evolving technology. Utilities need a common sense, replicable, and proactive set of approaches to meet these current and future challenges.

Since 2008, a unique coalition representing the "Collaborating Organizations," which include the U.S. Environmental Protection Agency and a growing number of major water sector associations, has supported an approach developed by water sector leaders for water utility management. The approach is based around the Ten Attributes of an Effectively Managed Utility and Five Keys to Management Success—known as Effective Utility Management (EUM). EUM is now the most widely recognized water sector utility management program in the country, and this *Primer* is the foundation of EUM. The *Primer* will help your utility comprehensively assess current operations and identify a path to improving in key areas that are the highest priorities.

EUM, as embodied in this *Primer*, is more relevant than ever before to help meet the challenges that we face. EUM is a starting point for any utility's path to effective and sustainable operations. It can help your utility to respond to and plan for current and future challenges, supporting your mission of being a successful 21st century service provider. The *Primer* allows you to address these challenges in a step-wise process, at a pace that you control based on the capacity of your utility.

Key Messages to the Water Sector

EUM and this *Primer* are the keys to unlock the potential of your utility to protect public health and the environment in the 21st century:

- EUM helps you take a 360-degree look at your utility and then set priorities that work for you and your community.
- It helps you protect your current infrastructure investments and ensure that your workforce is motivated and able to address the challenges that they face every day.
- It moves you from reacting only to the "hot priorities" of the day to proactively planning for the future.
- It helps you engage your staff in the process of assessing and charting your own course for the future.
- It is simple, actionable, affordable, and scalable to meet the needs of all utilities.
- Finally, YOU CAN DO THIS. Staff across all levels of your utility can use the *Primer*, helping them collaborate internally and work with the community to provide affordable and sustainable services.

In closing, thank you for all you do every day. Please consider using the EUM *Primer* and chart a sustainable course for the future. We encourage you to join the growing group of utility leaders implementing EUM!

Sincerely,

THE EUM UTILITY LEADERSHIP GROUP

EUM UTILITY LEADERSHIP GROUP

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This product was developed with assistance from Rob Greenwood, Morgan Torres, and Sarah Shadid with Ross Strategic (www.rossstrategic.com), under contract EP-C-11-009 with the Office of Wastewater Management at U.S. EPA.

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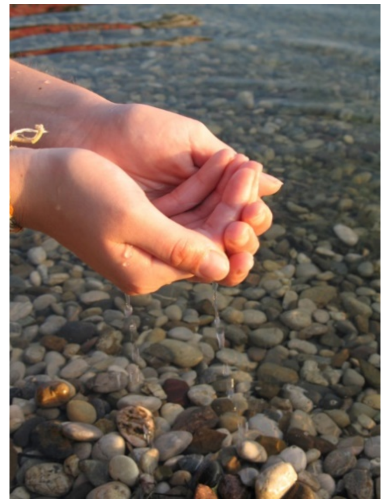
I. Effective Utility Management



The *Effective Utility Management: A Primer for Water and Wastewater Utilities* (“*Primer*”) is the foundation of Effective Utility Management (EUM). It is designed to help water and wastewater utility managers make informed decisions and practical, systematic changes to achieve excellence in utility performance in the face of everyday challenges and long-term needs for the utility and the community it serves. It was produced by utility leaders who are committed to helping other utilities improve water and wastewater management. The *Primer* distills the expertise and experience of these utility leaders into a framework intended to help utilities identify and address their most pressing needs through an incremental, continual improvement management approach.

All water and wastewater utilities can benefit from applying this *Primer*. Each utility has unique management opportunities and challenges, and this *Primer* provides a common sense way of assessing, managing, and measuring a utility’s performance to address these opportunities and challenges. The steps described in the document and associated resources are relevant to any water or wastewater utility, regardless of size, budget, or other capacity.

The *Primer* has four primary components which, when taken together, form the basis for a complete cycle of effective and sustainable utility management:

- **The Ten Attributes of Effectively Managed Water Sector Utilities (Attributes).** These Attributes provide a clear set of reference points and are intended to help utilities maintain a balanced focus on all important operational areas rather than reactively moving from one problem to the next or focusing on the “problem of the day.”
- **Five Keys to Management Success.** These proven approaches help utilities maximize their resources and improve performance. By embedding the Five Keys to Management Success into their workplace culture, utilities create a robust foundation for strong, ongoing performance in the Ten Attribute areas.
- **Where to Begin – A Self-Assessment Tool**. The rigorous and systematic self-assessment tool described in the *Primer* helps utility managers and staff evaluate their operations and identify where to begin improvement efforts. By assessing how a utility performs relative to the Attributes, utility managers can gain a more balanced and comprehensive picture of their organization.
- **Getting to Work – Implementation of Effective Utility Management.** The Implementation section is a central connecting point between multiple elements of Effective Utility Management. It focuses on an overall continual improvement cycle (the “EUM cycle”), and describes how a utility’s self-assessment results can lead into a cycle of planning, implementation of effective practices, measuring performance, and making adjustments over time. It includes the following components:
    1. A description of the essential components of the EUM cycle;
    2. A guide for measuring performance;
    3. Resources to support Effective Utility Management implementation; and
    4. Steps for creating an Improvement Plan.

Throughout the *Primer,* utilities will learn about the Ten Attributes of Effectively Managed Utilities and the Five Keys to Management Success, and how these important elements work in tandem to support successful utilities in today's challenging operating contexts.

The Ten Attributes of Effectively Managed Utilities and Five Keys to Management Success

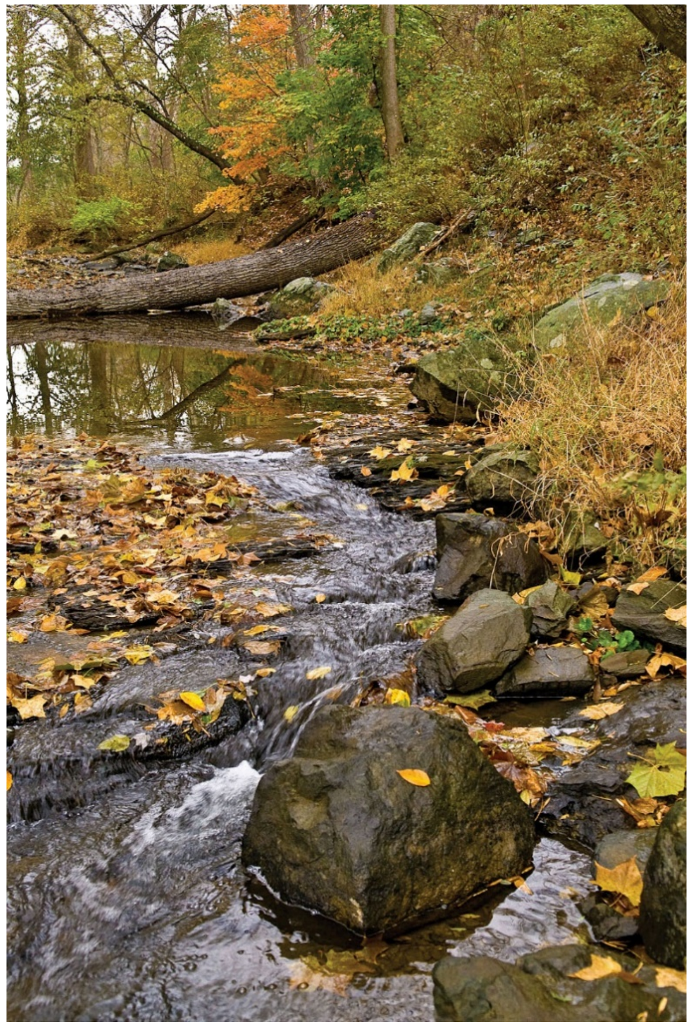
This *Primer* is the product of a decade-long collaboration between the Collaborating Organizations and group of respected water and wastewater utility leaders from across the nation. Originally released in 2008, and updated in 2017 to reflect changes to the context in which water sector utilities operate, the *Primer* is a powerful tool for water sector utilities of all sizes, types, and geographies. A brief history of Effective Utility Management is included on the following page.

A Brief History of Effective Utility Management

MAY 2006	**Seven Collaborating Organizations sign a Statement of Intent to establish a framework for working together to advance understanding of the principles and practices of effective utility management, and to encourage and promote their wider application.**
MAY 2007	***Findings and Recommendations*** **report delivered from a utility Steering Committee to the seven collaborating organizations. The report recommends a variety of activities be initiated, including the development of a stand-alone primer that outlines a strategy for effective utility management.**
JUNE 2008	***Effective Utility Management: A Primer for Water and Wastewater Utilities*** **is released.**
2009 - 2015	**The Collaborating Organizations develop and sponsor a wide range of EUM-based workshops, webinars, case examples, and award programs to promote and support EUM implementation by the water sector.**
APRIL 2015	**The Association of Clean Water Agencies and the Association of State Drinking Water Administrators join as new EUM Collaborating Organization partners.** **Collaborating Organizations convene a group of utility leaders to explore how the operating context of water sector utilities has changed since the** ***Primer*** **was released in 2008, and to consider refinements to the EUM framework.**
FEB 2016	***Taking the Next Step: Findings of the Effective Utility Management Review Steering Group*** **report released. The report outlines key operating shifts in the water sector since 2008, and recommends a series of updates to the** ***Primer.***
JULY–DEC 2016	**Collaborating Organizations convene a group of utility leaders to update the** ***Primer.***
OCT 2016	**The Water Research Foundation and the Water Environment & Reuse Foundation join as new EUM Collaborating Organization partners.**
JAN 2017	**The Collaborating Organizations release the newly updated** ***Primer.***
2017 & BEYOND	**The Collaborating Organizations sponsor ongoing education and promotional efforts to support implementation of EUM by the water sector, including webinars, workshops, and the development of other learning resources.**

II. Ten Attributes of an Effectively Managed Utility

The Ten Attributes of an Effectively Managed Utility provide useful and concise goals for water sector utility managers seeking to improve organization-wide performance. The Attributes describe desired outcomes that are applicable to all water and wastewater utilities. They comprise a comprehensive framework related to operations, infrastructure, customer satisfaction, community sustainability, natural resource stewardship, and financial performance.



Water and wastewater utilities can use the Attributes to select priorities for improvement, based on each organization's strategic objectives and the needs of the community it serves. The Attributes are not presented in a particular order, but rather can be viewed as a set of opportunities for improving utility management and operations. **Section IV** provides a basic self-assessment tool to help utilities easily identify their priorities and opportunities based on the Attributes. Over time, utilities will be able to deliver increasingly efficient, high-quality service by addressing more, and eventually all, of the Attributes. **Section V** provides several example performance measures for each of the Attributes.

Ten Attributes of an Effectively Managed Utility

Product Quality

Produces "fit for purpose" water and other recovered resources (e.g., energy, nutrients, biosolids) that meet or exceed full compliance with regulatory and reliability requirements and consistent with customer, public health, ecological, and economic needs. Products include treated drinking water, treated wastewater effluent, recycled water, stormwater discharge, and recovered resources.

Customer Satisfaction

Provides reliable, responsive, and affordable services in line with explicit, customer-derived service levels. Utilizes a mix of evolving communication technologies to understand and respond to customer needs and expectations, including receiving timely customer feedback and communicating during emergencies. Provides tailored customer service and outreach to traditional residential, commercial, and industrial customers, and understands and exercises as appropriate the opportunities presented by emergent customer groups (e.g., high strength waste producers, power companies).

Stakeholder Understanding and Support

Engenders understanding and support from stakeholders (anyone who can affect or be affected by the utility), including customers, oversight bodies, community and watershed interests, and regulatory bodies for service levels, rate structures, operating budgets, capital improvement programs, and risk management decisions. Actively promotes an appreciation of the true value of water and water services, and water's role in the social, economic, public and environmental health of the community. Actively engages in partnerships, involves stakeholders in the decisions that will affect them, understands what it takes to operate as a "good neighbor," and positions the utility as a critical asset (anchor institution) to the community.

Financial Viability

Understands and plans for the full life-cycle cost of utility operations and value of water resources. Establishes and maintains an effective balance between long-term debt, asset values, operations and maintenance expenditures, and operating revenues. Establishes predictable rates—consistent with community expectations and acceptability—adequate to recover costs, provide for reserves, maintain support from bond rating agencies, plan and invest for future needs, and taking into account affordability and the needs of disadvantaged households. Implements sound strategies for collecting customer payments. Understands the opportunities available to diversify revenues and raise capital through adoption of new business models, including revenues from resource recovery.

Operational Optimization

Ensures ongoing, timely, cost-effective, reliable, and sustainable performance improvements in all facets of its operations in service to public health and environmental protection. Makes effective use of data from automated and smart systems, and learns from performance monitoring. Minimizes resource use, loss, and impacts from day-to-day operations, and reduces all forms of waste. Maintains awareness of information and operational technology developments to anticipate and support timely adoption of improvements.

Employee and Leadership Development

Recruits, develops, and retains a workforce that is competent, motivated, adaptive, and safety-focused. Establishes a participatory, collaborative organization dedicated to continual learning, improvement, and innovation. Ensures employee institutional knowledge is retained, transferred, and improved upon over time. Emphasizes and invests in opportunities for professional and leadership development, taking into account the differing needs and expectations of a multi-generational workforce and for resource recovery operations. Establishes an integrated and well-coordinated senior leadership team.

Enterprise Resiliency

Ensures utility leadership and staff work together internally, and coordinate with external partners, to anticipate, respond to, and avoid problems. Proactively identifies, assesses, establishes tolerance levels for, and effectively manages a full range of business risks (including interdependencies with other services and utilities, legal, regulatory, financial, environmental, safety, physical and cyber security, knowledge loss, talent, and natural disaster-related) consistent with industry trends and system reliability goals. Plans for and actively manages around business continuity.

Infrastructure Strategy and Performance

Understands the condition of and costs associated with critical infrastructure assets. Plans infrastructure investments consistent with community needs, anticipated growth, system reliability goals, and relevant community priorities, building in a robust set of adaptation strategies (e.g., for changing weather patterns, customer base). Maintains and enhances the condition of all assets over the long-term at the lowest possible life-cycle cost and acceptable risk consistent with customer, community, and regulator-supported service levels. Assures asset repair, rehabilitation, and replacement efforts are coordinated within the community to minimize disruptions and other negative consequences.

Community Sustainability

Takes an active leadership role in promoting and organizing community sustainability improvements through collaboration with local partners (e.g., transportation departments, electrical utilities, planning departments, economic development organizations, watershed and source water protection groups). Manages operations, infrastructure, and investments to support the economic, environmental, and social health of its community. Integrates water resource management with other critical community infrastructure, social and economic development planning to support community-wide resilience, support for disadvantaged households, community sustainability, and livability.

Water Resource Sustainability

Ensures the availability and sustainable management of water for its community and watershed, including water resource recovery. Understands its role in the complete water cycle, understands fit for purpose water reuse options, and integrates utility objectives and activities with other watershed managers and partners. Understands and plans for the potential for water resource variability (e.g., changing weather patterns, including extreme events, such as drought and flooding), and utilizes as appropriate a full range of watershed investment and engagement strategies (e.g., Integrated Planning). Engages in long-term integrated water resource management, and ensures that current and future customer, community, and ecological water-related needs are met.

III. Keys to Management Success

The Keys to Management Success represent frequently used management approaches and systems that experience indicates help water and wastewater utilities manage more effectively. They create a supportive context for a utility as it works towards the outcomes outlined in the Attributes, and they can help integrate the utility's improvement efforts across the Attributes. The Keys to Management Success are listed below.

Leadership

Leadership must respond to both internal organizational and broader external community imperatives. It is critical to effective utility management, particularly in the context of leading and inspiring change within an organization and in its surrounding community.

"Leadership" refers both to individuals who can be effective champions for improvement, and to teams that provide resilient, day-to-day management continuity and direction. Effective leadership establishes and communicates a long-term vision for the organization and embodies a commitment to cultivating the organization's culture, helping to ingrain methods to achieve the utility's vision into the organization's day-to-day operations.

Leaders have an important responsibility to engage proactively with stakeholders and community decision makers, promote the utility as a valued, competent, and trustworthy environmental steward and community asset, and collaborate with external partners (including new and nontraditional partners, like the agricultural sector). Leaders should drive an awareness and commitment to workplace safety, organizational diversity, ethical conduct, and positive morale. Leadership further reflects a commitment to organizational excellence, leading by example to establish and reinforce an organizational culture that embraces positive change, providing new opportunities for emerging leaders, and planning for and assuring a seamless transition to new leadership when required. Organizational improvement efforts require a commitment to continual improvement from the utility's leadership, including the celebration of small and large victories for the utility.

Strategic Business Planning

Strategic business planning directs and helps to achieve balance and cohesion across the Ten Attributes. A strategic business plan provides a framework for decision making by:

- Assessing current conditions and conducting a strengths, weaknesses, opportunities, and threats (SWOT analysis);
- Characterizing a continuum of possible and likely future conditions;
- Assessing underlying causes and effects of future conditions; and
- Establishing vision, objectives, strategies, and underlying organizational values.

A successful strategic business plan is dynamic and adaptable, allowing the utility to capitalize on new and emerging opportunities. It is made more robust by engaging with staff and external stakeholders, and by utilizing planning methods that can accommodate and address a variety of future operating scenarios (e.g., managing for uncertainty through "stress testing" a plan's ability to hold up during extreme events, such as extended drought).

A strong plan reflects specific implementation steps that will move a utility from its current level of performance to achieving its vision. Preparation of a strategic business plan involves taking a longer-term view of utility goals and operations and establishing a clear vision and mission. The plan, through engagement with external stakeholders, should reflect key community values, needs, and interests. When developed, the strategic business plan should drive and guide utility objectives, measurement efforts, investments, and operations. A strategic business plan can also help explain the utility's conditions, goals, and plans to staff and stakeholders, stimulate change, and increase engagement and support for improvement efforts. After developing a strategic business plan, it is important that the utility integrates tracking of progress and clear accountability into its management framework, and revisits the plan on a regular basis.

Knowledge Management

Knowledge management is another cornerstone of effective utility management, and is critical to ensuring reliable utility operations. It spans standard operating procedures, human resource management, and business systems and operating systems data integration and utilization to support dependable operations and continual improvement across the Ten Attributes.

By ensuring that processes are well documented through writing down "this is how we do things" and regularly updating standard operating procedures and creating shared knowledge among various employee categories, a utility is able to respond effectively to the inevitable knowledge loss brought on by employee turnover or unexpected absences. An effective knowledge management system is flexible to the use of new and evolving technologies, and should be updated on an ongoing basis. Automated "smart" systems and data integration/management capabilities are an increasingly important aspect of efficient and effective continual improvement management. These systems and capabilities are available across all areas of utility management, and can substantially improve the ability of utilities to track performance in real time, identify variability, and manage performance more effectively and precisely.

Measurement

Measurement is critical to management improvement efforts associated with the Attributes and is the backbone of successful continual improvement management and strategic business planning. A measurement system serves many vital purposes, including focusing attention on key issues, clarifying

> "If you can't measure it, you can't improve it."
>
> *Peter Drucker*

expectations, facilitating decision making, supporting learning and improving, establishing and maintaining accountability, and, most importantly, communicating effectively internally and externally. Always keep in mind the management adage, “If you can’t measure it, you can’t improve it.” Successful measurement efforts should be:

- Carefully select a limited number of performance measures that are used to focus the organization on the achievement of the Strategic Business Plan goals;
- Viewed as a continuum starting with basic internal tracking, and moving to more sophisticated baselining and trend analysis as necessary, with development of key performance indicators, and inclusion of externally oriented measures which address community sustainability interests;
- Informed by staff input, driven by and focused on answering questions critical to effective internal management and external stakeholder needs, including information needed to allow governing bodies to comfortably support large capital investments; and
- Supported by a well-defined decision framework assuring results are evaluated, communicated, and addressed in a timely manner.

Continual Improvement Management

Continual improvement management is usually implemented through a complete, start-to-finish management system, also referred to as a “Plan-Do-Check-Act” framework. Continual improvement plays a central role in effective utility management and is critical to making progress on the Attributes. Continual improvement management includes:

- Conducting an honest and comprehensive self- assessment – informed through staff engagement – to identify management strengths, areas for improvement, priority needs, etc.;
- Conducting frequent sessions among interested parties (stakeholders) to identify improvement opportunities;
- Following up on improvement projects underway;
- Establishing and implementing performance measures and specific internal targets associated with those measures;
- Defining and implementing related operational requirements, practices, and procedures;
- Defining supporting roles and responsibilities to derive clear accountability for conducting assessments and implementing performance improvements;
- Implementing measurement activities such as regular evaluation through operational and procedural audits; and
- Responding to evaluations through the use of an explicit change management process.

Continual improvement management is further supported by gap analysis, establishment of standard operating procedures, internal trend analysis and external benchmarking where appropriate, best practice review and adoption, and other continual improvement tools. It can be used as a framework to help utilities understand improvement opportunities and establish explicit service levels, guide investment and operational decisions, form the basis for ongoing measurement, and provide the ability to communicate clearly with customers and key stakeholders.

IV. Where to Begin: A Self-Assessment Tool

There are many ways to improve utility performance and each utility is unique. Many utilities may choose to start small and make improvements step-by-step, perhaps by working on projects that will yield early successes. Other utilities may choose to take on several improvement efforts simultaneously. Some may prefer to enhance their strengths, while others will prefer to focus on addressing areas for improvement. Each utility should determine for itself the most important issue to address, based on its own strategic objectives, priorities, and the needs of the community it serves.

A thorough assessment of current performance based on the Attributes is a useful first step in identifying options for improvement. It also establishes a quantifiable baseline from which to measure progress. As conditions change, future reassessments will reveal new opportunities and new priorities.

The following Self-Assessment tool can help water and wastewater managers use the EUM Attributes to evaluate their utility's current performance against internal goals or specific needs and determine where to focus improvement efforts. While it can be completed initially by an individual manager, it is more effective when used as a vehicle for conversation and consensus building among the utility's management team and key staff. As appropriate, other stakeholders might be invited to participate in the assessment, including oversight bodies, community and watershed interests, and regulatory authorities.

STEP 1

Candidly Assess Current Conditions

STEP 2

Rank Importance of Each Attribute to Your Entity

STEP 3

Graph Attributes to Determine Importance and Level of Achievement

STEP 4

Choose Attributes

The assessment has four steps: 1) Assess current conditions based on the Attributes; 2) Rank the importance of each Attribute for your utility; 3) Chart the results; and 4) Choose one or more Attributes to focus on. Following completion of the Self-Assessment, a guide for taking action on the results is included in the next section, **Getting to Work: Implementation of Effective Utility Management.**

A blank copy of the Self-Assessment worksheet is available in **Appendix B.**

Step 1: Assess Current Level of Achievement

Using the blank worksheet in **Appendix B**, assess current conditions by rating your utility's systems and approaches and current level of achievement for each Attribute, using a 1 (high achievement) to 5 (low achievement) scale. Consider the degree to which your current management systems effectively support each of the Attributes and their component parts. Consider all components of each Attribute and gauge your rating accordingly. Use these descriptions to guide your rating. You will note that each Attribute has several components represented by the bullet points listed for each.

Your rating can either reflect the lowest level of achievement of all of the bullet points for that Attribute (for example, if you believe that your achievement in one of the bullet points for that Attribute was "5," but another bullet point you rated as "2," your rating for achievement under that Attribute would be "5"), or an average across all of the bullet points for that Attribute. For whatever approach you choose to use when rating, make sure to be consistent in this approach across all Attributes.

Rating	Description
1.	Effective, systematic approach and implementation; consistently achieve goals.
2.	Workable systems in place; mostly achieve goals.
3.	Partial systems in place with moderate achievement, but could improve.
4.	Occasionally address this when specific need arises.
5.	No system for addressing this.

Step 2: Rank Importance of Attributes

Rank the importance of each Attribute to your utility, based on your utility's vision, goals, and specific needs. The ranking should reflect the interests and considerations of all stakeholders (managers, staff, customers, regulators, elected officials, community and watershed interests, and others).

There are Ten Attributes. Considering long-term importance to your utility, rank the most important Attribute 1, the second most important 2, and so on. The least important Attribute would be ranked 10. Your ranking of each Attribute's importance may be influenced by current or expected challenges in that particular area, recent accomplishments in addressing these issues, or other factors. Importance ranking is likely to change over time as internal and external conditions change.

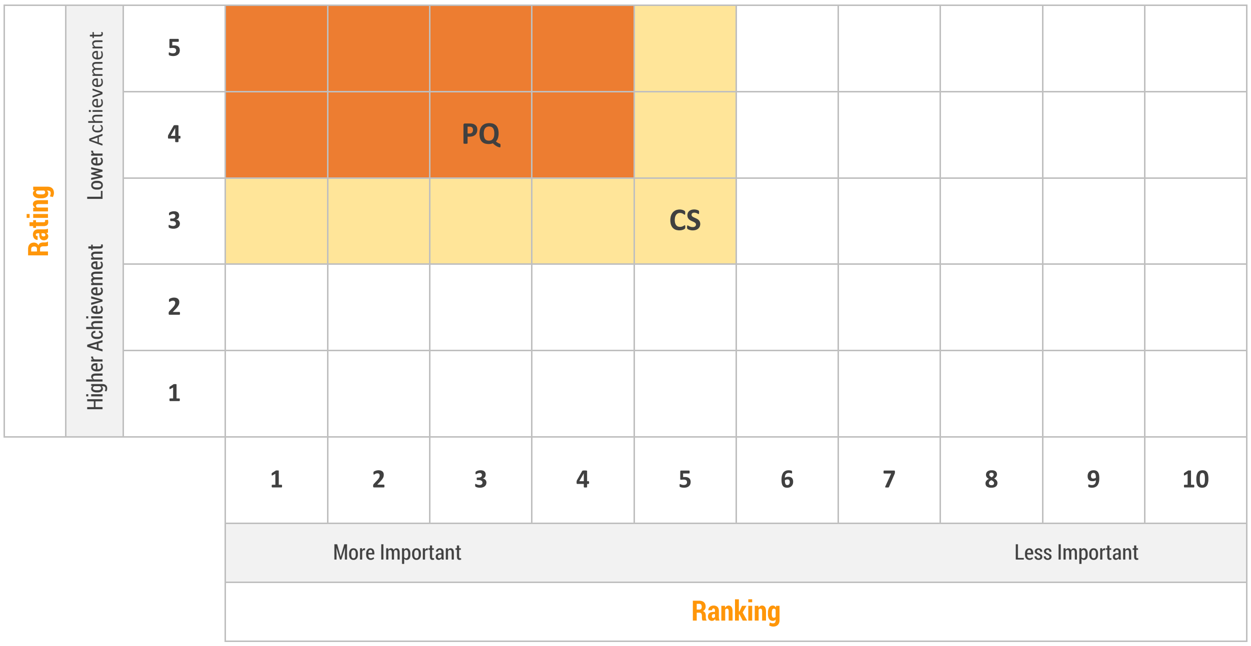
As you fill in numbers on the worksheet in **Appendix B**, please note that your analysis for Step 1 (rating achievement) should be separate and independent from your analysis for Step 2 (ranking importance).

Attribute	Attribute Components
Product Quality (PQ)	• Meets or exceeds regulatory and reliability requirements. • Operates consistent with customer, public health, economic, and ecological needs.
Customer Satisfaction (CS)	• Provides reliable, responsive, and affordable services. • Receives timely customer feedback. • Is responsive to customer needs and emergencies. • Provides tailored customer service and outreach to a range of customer groups (e.g., residential, commercial, industrial, and newly emerging groups such as high-strength waste producers or power companies)
Employee and Leadership Development (ED)	• Recruits, develops, and retains a competent, safety-focused workforce. • Is a collaborative organization dedicated to continual learning, improvement, and adaptation. • Implements procedures for institutional knowledge retention, workplace safety, and continual learning (e.g., standard operating procedures). • Invests in/provides opportunities for professional and leadership development. • Supports an integrated and well-coordinated senior leadership team.
Operational Optimization (OO)	• Conducts ongoing performance improvements informed by performance monitoring. • Minimizes resource use and loss from day-to-day operations. • Is aware of and adopts in a timely manner operational and technology improvements, including operational technology and information technology. • Manages and utilizes data from automated and smart systems.
Financial Viability (FV)	• Understands and plans for full life-cycle cost of utility. • Effectively balances long-term debt, asset values, operations and maintenance expenditures, and operating revenues. • Sets predictable and adequate rates to support utility current needs and plans to invest in future needs, taking into account affordability and the needs of disadvantaged households when setting rates. • Understands opportunities for diversifying revenue and raising capital.
Infrastructure Strategy and Performance (IS)	• Understands the condition of and costs associated with critical infrastructure assets. • Maintains and enhances assets over the long-term at the lowest possible life-cycle cost and acceptable risk. • Coordinates repair efforts within the community to minimize disruptions. • Plans infrastructure investments consistent with community needs, anticipated growth, system reliability goals, and with a robust set of adaptation strategies.
Enterprise Resiliency (ER)	• Works together with staff internally and coordinate with external partners to anticipate and avoid problems. • Proactively establishes tolerance levels and effectively manages risks (including legal, regulatory, financial, environmental, safety, security, cyber, knowledge-loss, talent, and natural disaster-related). • Plans for and actively manages to maintain business continuity.

Attribute	Attribute Components
Community Sustainability (SU)	• Actively leads in promoting and organizing improvements to community and watershed health within utility and with external community partners. • Actively leads in promoting welfare within the community for disadvantaged households. • Uses operations to enhance natural environment. • Efficiently uses water and energy resources, promotes economic vitality, and engenders overall community improvement. • Maintains and enhances ecological and community sustainability including pollution prevention, watershed and source water protection.
Water Resource Sustainability (WS)	• Ensures water availability through long-term resource supply and demand analysis, conservation, fit for purpose water reuse, integrated water resource management, watershed management and protection, and public education initiatives. • Manages operations to provide for long-term aquifer and surface water sustainability and replenishment. • Understands and plans for future water resource variability (e.g., changing weather patterns, including extreme events, such as drought and flooding).
Stakeholder Understanding and Support (SS)	• Engenders understanding and support from oversight bodies, community and watershed interests, and regulatory bodies for service levels, rate structures, operating budgets, capital improvement programs, and risk management decisions. • Actively engages in partnerships and involves stakeholders in the decisions that will affect them. • Actively promotes an appreciation of the true value of water and water services, and water's role in the social, economic, public and environmental health of the community.

Step 3: Graph Results

Graph each Attribute based on your rating and ranking. For example, if you rated Product Quality (PQ) 4 for achievement and ranked it 3 for importance, you would place it on the graph as illustrated below. Similarly, if you rated Customer Satisfaction (CS) 3 for achievement and ranked it 5 for importance, you would place it on the graph as illustrated below. A blank graph is provided in **Appendix B**.



Step 4: Choose Attributes to Focus On

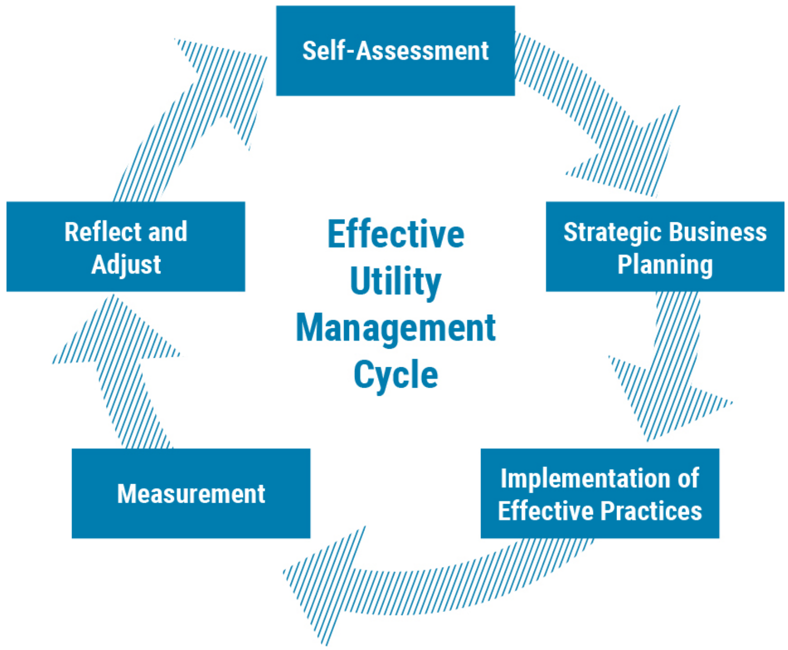
The goal of Effective Utility Management is to establish high-achieving systems and approaches for each Attribute. Ultimately, utilities should strive to improve performance for all Attributes until each can be charted in the lower half of the table (high achieving). Utility managers may wish to focus on one or a few Attributes at a time, aiming to eventually ensure that all Attributes have been addressed and improved upon over time.

Examining the results of the charting exercise in Step 3 can help identify Attributes for focused attention. Attributes that graph into the orange shaded quadrant are both very important (ranked 1-4), and have low achievement (rated 4-5), and would typically be selected as the highest priority Attribute areas for moving forward with improvement actions. Attributes that graph into the yellow shaded area indicate medium importance, and a moderate level of current achievement; these would typically be selected as additional strong candidates for improvement efforts.

Attributes that fall in the lower left-hand quadrant are both important and high-achieving areas for the utility. Some utilities may choose to focus on these areas to continue further improving upon important and high-achieving areas, due to their long-term importance (e.g., water resource adequacy). Specifically examining these areas may also help a utility identify success factors which would be helpful in addressing areas needing improvement. Others may choose to focus on Attributes that would lead to early successes to build confidence in effecting change, Attributes that maximize benefit relative to the utility's key goals, or Attributes that minimize risks (e.g., fines, penalties, lawsuits, poor public perception).

The choice to embark on improvements in one or more areas is up to the judgment of utility managers, and may also involve consideration of resources (staff and financial), leadership support, and other competing activities. Applying strategic business planning, measurement, and other Keys to Management Success is very important for moving each Attribute over time to the "high-achievement" quadrants.

V. Getting to Work: Implementation of Effective Utility Management



This section focuses on the specific steps that utilities are encouraged to go through to implement Effective Utility Management. The section includes a description of each element of the Effective Utility Management (EUM) cycle, and explains how utilities can take the results of their self-assessment, identify and implement effective practices, measure progress in priority Attribute areas, and do this through an improvement plan.

The EUM self-assessment (see page 11 for more information) serves as a comprehensive starting point for utilities, and the EUM cycle reflects how a utility's self-assessment results can build into a continual improvement management process. **Continual improvement** is one of the five Keys to Management Success for Effective Utility Management, and it operates throughout and supports the entire EUM cycle. The water sector is a rapidly evolving world, and utilities must stay abreast of new technologies, changes in the workforce, transforming customer needs, and much more. To adapt to these shifts, an effective utility must continually assess its performance and priorities, update its strategic plan, and make adjustments where necessary.

Two other Keys are reflected directly in the EUM cycle, **strategic business planning** and **measurement**; these are explained in greater detail later in this section. The two remaining Keys are also important to supporting all aspects of the EUM cycle: **leadership** and **knowledge management**. Leadership can exist at any level of a utility's organizational structure, and can encourage and enable active participation in an Effective Utility Management culture. Knowledge management supports the critical information and operating needs of each step of the cycle of Effective Utility Management. All five of the Keys to Management Success (see page 8 for more information) are integral to Effective Utility Management, and they work in tandem with the Ten Attributes (see page 4 for more information) to support successful utilities.

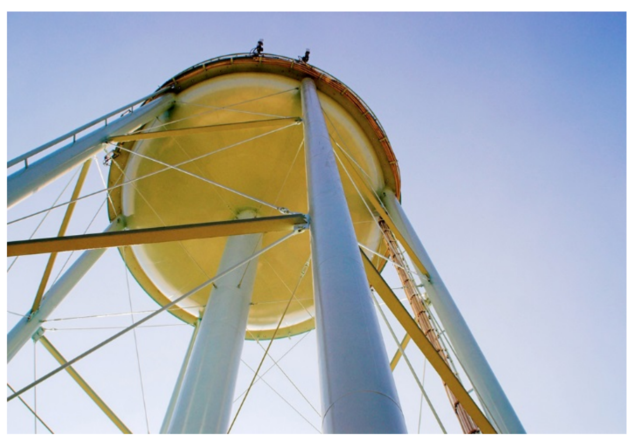
Beginning with the **self-assessment** exercise in **Section IV**, the EUM cycle is a self-reinforcing progression of assessment, planning, implementation, measurement, and adjusting over time. Each element of the cycle is described below.

Strategic Business Planning

Following completion of the self-assessment, utilities will now have a holistic picture of their current performance and priorities for the future relative to the Ten Attributes. Using these results as a starting point, a utility can begin to move through a strategic business planning process. Strategic business planning provides a framework for decision making and planning for the future. A strategic business plan could include, or be complemented by, an asset management plan and a financial plan for the utility.

Implementation of Effective Practices

After the utility has determined its priority Attribute areas for improvement and established a vision, goals, and objectives for the future through its strategic business plan, it is time to identify and implement effective practices linked to the Attributes in support of these objectives. Effective practices can also be identified in many ways: through learning activities (e.g., conferences, training events, webinars), through interactions and benchmarking activities with other utilities, and through resources created specifically to guide utilities in this area.



Two key resources to help utilities link the Attributes to specific practices are *Moving Toward Sustainability: Sustainable and Effective Practices for Creating Your Water Sector Roadmap,* developed by EPA with extensive input from water sector leaders, and *Performance Benchmarking for Effectively Managed Utilities* (Water Research Foundation), also prepared with extensive utility participation. Both are available at www.WaterEUM.org.

Measurement

To gauge performance and progress on the utility's strategic plan and practice implementation, the next step in the cycle is to establish performance measures relative to key activities. The adage of "you can't improve what you don't measure" applies here. Measurement is a key focus of this *Primer*, with approaches and example measures that utilities can implement addressed in greater depth later in this section and in **Appendix C**.

Reflect and Adjust

At regular intervals, the utility should reflect on its progress toward the goals set forth in its strategic business plan and its improvement plan relative to the Attributes, and determine if adjustments in course are needed, accounting for any changes in the utility's operating context.

Utilities can implement the cycle of Effective Utility Management in a variety of ways. It can be integrated into processes already in place as a part of the utility's operations and management, incorporated into a long-term planning process, or undertaken independently. A short guide for creating an improvement plan based on the self-assessment results follows at the end of this section.

Measuring Performance

Measuring performance is one of the keys to utility management success. This section of the *Primer* provides ideas about how to approach measurement and then offers measures for each Attribute to help utilities understand their current status and measure their progress.

Approaching Measurement

There are two general approaches to performance measurement: internal and external benchmarking. This *Primer* focuses on internal performance measurement. Internal performance measurement focuses on evaluating current internal utility performance status and trends. A robust measurement system will be built around a combination of leading, lagging, and coincidental performance indicators.

- **Leading indicators** provide an indication of the future state of a performance parameter of keen interest to the utility – for example an increase in near misses relative to safety violations can foretell of an increased risk of workplace injuries. Leading indicators provide a utility with the diagnostic ability to proactively manage for its desired performance outcomes. *Leading indicators drive preventative actions.*
- **Lagging indicators** typically reflect a performance parameter of keen interest to a utility (such as compliance rate or water quality conditions) while, at the same time providing performance information that can only be reacted to, making it sometimes challenging to proactively adjust operations before performance moves into an unacceptable range. These indicators, however, are critical to an overall measurement system as they typically focus on key performance outcomes that the utility, by necessity, must document (e.g., compliance with permit limits). *Lagging indicators drive immediate, corrective actions that could have been prevented by using leading and coincidental indicators.*

LEADING, LAGGING, AND COINCIDENTAL INDICATORS

A real-life example of applying indicators when analyzing body mass:

Lagging: At the end of the day, stepping on a scale and recording your weight.

Leading: Tracking the number of calories consumed and the number of calories expended through exercise.

Coincidental: Analyzing the two measurements, calories consumed and calories expended holistically. This will allow you to predict that if calories go up and exercise goes down, you can expect an increase in weight.

- **Coincidental indicators** are a form of leading indicator that draws on the behavior of two or more parameters to signal the future state of a key performance parameter (such as phosphorus discharge concentration). These indicators are important to both proactive management of key performance outcomes, but also to conducting root cause analysis when key performance outcomes vary outside of desirable ranges. *Coincidental indicators drive proactive process control actions.*

Benchmarking is the overt comparison of similar measures or processes across organizations to identify best practices, set improvement targets, and measure progress within or sometimes across sectors. A utility may decide to engage in benchmarking for its own internal purposes or in a coordinated fashion with others.

While performance measures should be tailored to the specific needs of your utility, the following guidelines can help you identify useful measures and apply them effectively.

1. Select measures that support the organization's strategic objectives, mission, and vision, as well as the ten Attributes.
2. Select the right number, level, and type of measures for your organization. Consider how measures can be integrated as a cohesive group (e.g., start with a small set of measures across broad categories and increase number and specificity over time as needed), and consider measures that can be used by different audiences within the organization.
3. Measuring performance will not necessarily require additional staff, but will require resources. Allocate adequate resources to get the effort off to a good start, and fine tune over time to balance the level of measurement effort with the benefit to the organization.
4. Develop clear, consistent definitions for each measure. Identify who is responsible for collecting the data, and how the data will be tracked and reported.
5. Engage the organization at all levels in developing, tracking, and reporting measures, but also assign someone in the organization the role of championing and coordinating the effort.
6. Set targets rationally, based on criteria such as customer expectations, improvement over previous years, industry performance, or other appropriate comparisons. Tie targets to improving performance in the Attributes.
7. Select and use measures in a positive way to improve decision making, clarify expectations, and focus attention, not just to monitor, report, and control.
8. When selecting measures, consider how they relate to one another. Look for cause-and-effect relationships; for example, how improvements in product quality could result in increased customer satisfaction.
9. Develop an effective process to evaluate and respond to results. Identify how, when, and to whom you will communicate results.
10. Incorporate the "Plan-Do-Check-Act" cycle approach into evaluating both the specific measures and the system as a whole. Regularly review the performance measurement system for opportunities to improve.

*... **and remember to celebrate your measured and documented successes!***

Attribute-Related Measures

The list on the following page provides examples of targeted, Attribute-related measures. Taken as a whole, the measures provide a utility with a cohesive, approachable, and generally applicable starting place for gauging progress relative to the Ten Attributes. The list, for brevity, contains measure "headlines" for each

Attribute. Utilities should also reference information in **Appendix C**, which provides further explanation and, where applicable, example calculations.

You can choose and tailor the measures to your own needs and unique, local circumstances. They are intended for your own internal use, even as certain measures (e.g., those noted as Benchmarking Performance Indicators) can support benchmarking purposes. In these cases, the measures have been selected because they are relevant to the Attributes, have been tested and are in use by utilities, are supported by reference information useful for implementation, and generally can act as a good starting point for Attribute-related progress assessment.

The measures presented are both quantitative and qualitative. Most are quantitative, focus on outcomes typically of interest to utility managers (e.g., compliance rate), and include generally applicable example calculations. The qualitative "measures" encourage active assessment of the practices in place to support effective management in each Attribute area. These are mostly "activity measures" and typically have a "yes/no" format. Like the Attributes themselves, certain measures focus on core utility operations. Several measures reflect emerging utility issues, challenges, or opportunities that have received increasing attention from a growing number of utility managers. Other measures may reflect broader interests that are worthy of consideration from a broader community perspective.

List of Attribute-Related Utility Measures

The list below includes a limited number of example measures that can be used to assess performance in each of the Attribute areas. See **Appendix C** for measure descriptions and details.

Product Quality

1. Regulatory compliance
2. Service delivery

Customer Satisfaction

1. Customer complaints
2. Customer service delivery
3. Customer satisfaction

Employee and Leadership Development

1. Employee retention and satisfaction
2. Management of core competencies
3. Workforce development

Operational Optimization

1. Resource optimization
2. Water management efficiency

Financial Viability

1. Budget management effectiveness
2. Financial procedure integrity
3. Bond ratings
4. Rate adequacy

Infrastructure Stability

1. Asset inventory
2. Asset (system) renewal/replacement
3. Water distribution/collection system integrity
4. Infrastructure planning and maintenance

Enterprise Resiliency

1. Recordable incidents of injury or illnesses
2. Insurance claims
3. Risk assessment and response preparedness
4. Ongoing operational resiliency
5. Operational resiliency under emergency conditions

Community Sustainability

1. Watershed-based infrastructure planning
2. Green infrastructure
3. Greenhouse gas emissions
4. Service affordability
5. Community economic development

Water Resource Sustainability

1. Water supply adequacy
2. Supply and demand management
3. Watershed sustainability

Stakeholder Understanding and Support

1. Stakeholder consultation
2. Stakeholder satisfaction
3. Internal benefits from stakeholder input
4. Comparative rate rank
5. Media/press coverage
6. Partnering in your community

Resources to Support Effective Utility Management Implementation

Effective Utility Management is designed as a broad framework to complement and enhance other prominent utility management initiatives currently in use. In addition to this EUM *Primer*, a wide range of resources exist across the water sector to support each step of the cycle of Effective Utility Management. The resources listed below are examples of materials that can support each step of the EUM cycle.

- **Benchmarking Performance Indicators for Water and Wastewater** (American Water Works Association)
- **Moving Toward Sustainability: Sustainable and Effective Practices for Creating Your Water Utility Roadmap** (U.S. EPA)
- **The Partnership for Clean Water** (American Water Works Association)
- **The Partnership for Safe Water** (American Water Works Association)
- **Performance Benchmarking for Effectively Managed Water Utilities** (Water Research Foundation)
- **Planning for Sustainability: A Handbook for Water and Wastewater Utilities** (U.S. EPA)
- **Resource Guide to Effective Utility Management and Lean: Improving Performance and Addressing Key Management Priorities at Water-Sector Utilities** (U.S. EPA)
- **The Water Resources Utility of the Future: A Blueprint for Action** (National Association of Clean Water Agencies, Water Environment & Reuse Foundation, and Water Environment Federation)

THE DIAGRAM ON THE FOLLOWING PAGE IS A DEPICTION OF HOW EACH RESOURCE FROM THE LIST CAN RELATE TO THE VARIOUS STEPS IN THE CYCLE.

HOW IT FITS TOGETHER

Creating an Improvement Plan

Once you have chosen to improve one or more Attributes, the next step is to develop and implement a plan for making the desired improvements. Improvement plans support the implementation of effective practices in your chosen attribute area(s). An effective improvement plan will:

Set Near- and Long-term Goals	Set goals as part of the improvement plan to help define what is being worked toward. Near- and long-term goals for the utility should be linked to the strategic business plan, asset management plan, and financial plan. Goals should also be "SMART." **S – Specific:** *What exactly will be achieved?* **M – Measurable:** *Can you measure whether you are achieving the objective?* **A – Assignable:** *Can you specify who will be responsible for each segment of the objective?* **R – Realistic:** *Do you have the capacity, funding, and other resources available?* **T – Time-Based:** *What is the timeframe for achieving the objective?*
Identify Effective Practices	Each Attribute area for improvement will be supported by effective practices implemented by the utility. A substantial number of water sector resources exist that detail effective utility practices for each of the Attributes.
Identify Resources Available and Resources Needed	For each practice/activity to be implemented as part of the improvement plan, identify resources (financial, informational, staff, or other) that exist on-hand, and those that are needed, to support implementation.
Identify Challenges	For the overall improvement plan and for specific practices/activities to be implemented, identify key challenges that will need to be addressed.
Assign Roles and Responsibilities	For each improvement action, identify roles and responsibilities for bringing the implementation to completion.
Define a Timeline	Establish start date, milestones, and a completion target for each activity/improvement action.
Establish Measures	Establish at least one (or more) measure of performance for items to be implemented under the improvement plan.

VI. Utility Management Resources

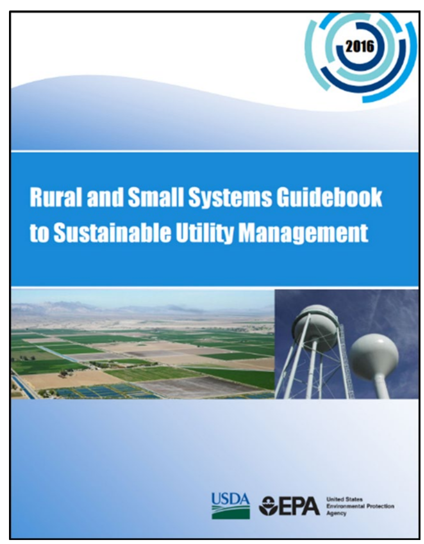
As a companion resource to this Primer, the Collaborating Organizations developed an online Resource Toolbox, which offers additional information and guidance on effective utility management. The Toolbox provides a compilation of resources from the eleven Collaborating Organizations designed to help the water and wastewater utility community further improve the management of its infrastructure.

The Resource Toolbox is organized according to the Ten Attributes of Effectively Managed Water Sector Utilities and five Keys to Management Success, providing a set of resources relevant to each Attribute and Key. The Toolbox also includes information on where to find these resources.

The Resource Toolbox is located at www.WaterEUM.org.

Effective Utility Management for Small and Rural Systems

Small and rural utilities seeking to implement EUM are served by a variety of resources specifically designed for them, including the *Rural and Small Systems Guidebook to Sustainable Utility Management.* The *Guidebook* is a resource jointly developed by EPA and the United States Department of Agriculture (USDA), which adapts the Ten Attributes for use by small and rural systems.



VII. For More Information

This Primer was developed through a collaborative partnership with the following groups. More information about this partnership can be found on their websites or by contacting specific individuals directly.

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VIII. Appendix A: Key Definitions

Attribute: A basic building block of effective utility management for water sector utilities. Attributes describe characteristics or outcomes of a utility that indicate effective performance.

Benchmarking: The comparison of similar processes or measures across or within organizations and/or sectors to identify best practices, set improvement targets, and measure progress.

Continual Improvement: A systematic approach that supports ongoing efforts to improve products, services, or processes, through incremental steps over time or through "breakthrough" advances all at once.

Effective Utility Management: A comprehensive water sector utility performance assessment and management framework, endorsed by the U.S. Environmental Protection Agency and ten national water sector associations dedicated to improving products and services, increasing community support for water services, and ensuring a strong and viable utility into the future.

Gap analysis: Defining the present state of an enterprise's operations, the desired or "target" state, and the gap between them.

Knowledge Management: The multi-disciplinary process of creating, sharing, using, managing, and preserving the knowledge and information of an organization.

Life-cycle cost: The total of all internal and external costs associated with a product, process, activity, or asset throughout its entire life cycle – from raw materials acquisition to manufacture/construction/installation, operation and maintenance, recycling, and final disposal.

Performance measurement: Evaluation of current status and trends; can also include comparison of outcomes or outputs relative to goals, objectives, baselines, targets, standards, other organizations' performance or processes (typically called benchmarking), etc.

Operations and maintenance expenditure: Expenses used for day-to-day operation and maintenance of a facility.

Operating revenue: Revenue realized from the day-to-day operations of a utility.

Performance measure: A particular value or characteristic designated to measure input, output, outcome, efficiency, or effectiveness.

Source water protection: Efforts to prevent water quality degradation in streams, rivers, lakes, or underground aquifers used as public drinking water supplies.

Standard operating procedure: A prescribed set of actions to be followed routinely; a set of instructions having the force of a directive, covering those features of operations that lend themselves to a definite or standardized procedure without loss of effectiveness.

Strategic plan: An organization's process of defining its goals and strategy for achieving those goals. This often entails identifying an organization's vision, goals, objectives, and targets over a multi-year period of time, as well as setting priorities and making decisions on allocating resources, including capital and people, to pursue the identified strategy.

Stewardship: The careful and responsible management of something entrusted to a designated person or entity's care; the responsibility to utilize its resources properly, including its people, property, and financial and natural assets.

Sustainability: The use of natural, community, and utility resources in a manner that satisfies current needs without compromising future needs or options.

Watershed health: The ability of ecosystems to provide the functions needed by plants, wildlife, and humans, including the quality and quantity of land and aquatic resources.

IX. Appendix B: Self-Assessment

Step 1: Assess Current Conditions

Assess current conditions by rating your utility's systems and approaches and current level of achievement for each Attribute, using a 1 (high achievement) to 5 (low achievement) scale. Consider the degree to which your current management systems effectively support each of the Attributes and their component parts. Consider all components of each Attribute and gauge your rating accordingly. Use these descriptions to guide your rating. You will note that each Attribute has several components represented by the bullet points listed for each.

Your rating can either reflect the lowest level of achievement of all of the bullet points for that Attribute (for example, if you believe that your achievement in one of the bullet points for that Attribute was "5," but another bullet point you rated as "2," your rating for achievement under that Attribute would be "5"), or an average across all of the bullet points for that Attribute. For whatever approach you choose to use when rating, make sure to be consistent in this approach across all Attributes. Mark your answers in the Step 1 column of the table on the next page.

Rating	Description
1.	Effective, systematic approach and implementation; consistently achieve goals.
2.	Workable systems in place; mostly achieve goals.
3.	Partial systems in place with moderate achievement, but could improve.
4.	Occasionally address this when specific need arises.
5.	No system for addressing this.

Step 2: Rank Importance of Attributes

Rank the importance of each Attribute to your utility, based on your utility's vision, goals, and specific needs. The ranking should reflect the interests and considerations of all stakeholders (managers, staff, customers, regulators, elected officials, community and watershed interests, and others).

There are Ten Attributes; considering long-term importance to your utility, rank the most important Attribute 1, the second most important 2, and so on. The least important Attribute would be ranked 10. Your ranking of each Attribute's importance may be influenced by current or expected challenges in that particular area, recent accomplishments in addressing these issues, or other factors. Importance ranking is likely to change over time as internal and external conditions change.

Mark your answers in the Step 2 column of the table on the next page. As you fill in numbers, please note that your analysis for Step 1 (rating achievement) should be separate and independent from your analysis for Step 2 (ranking importance).

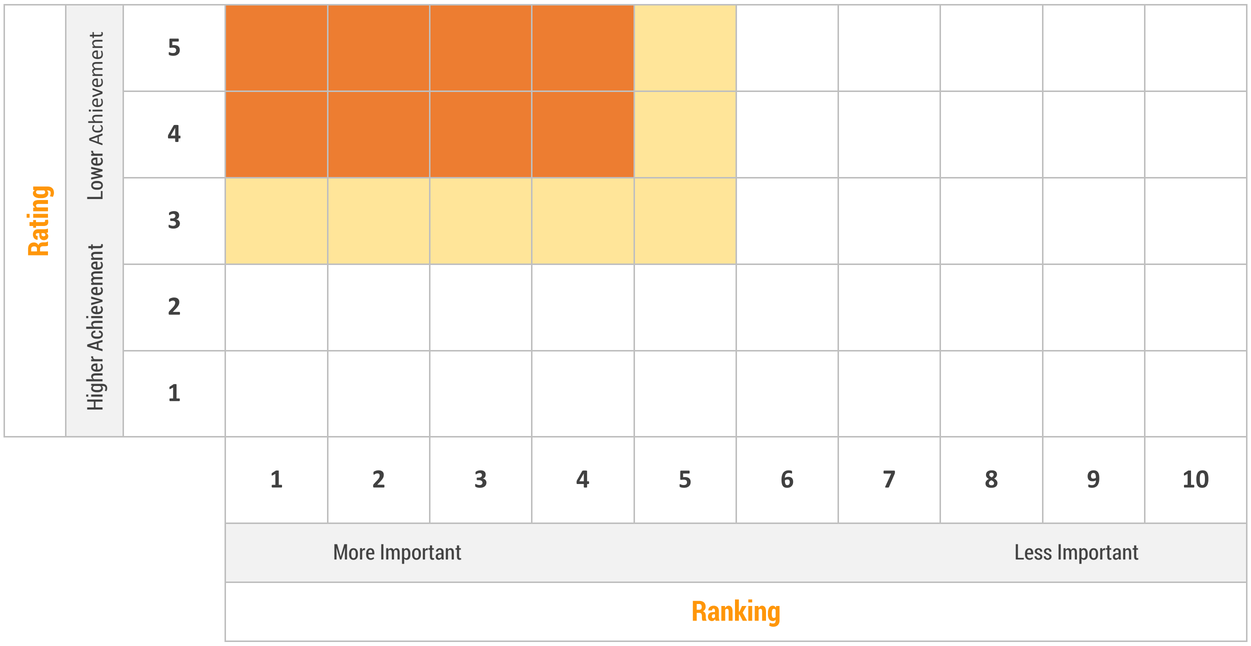
Attribute	Attribute Components	Step 1: Rate Achievement (1-5)	Step 2: Rank Importance (1-10)
Product Quality (PQ)	• Meets or exceeds regulatory and reliability requirements. • Operates consistent with customer, public health, economic, and ecological needs.		
Customer Satisfaction (CS)	• Provides reliable, responsive, and affordable services. • Receives timely customer feedback. • Is responsive to customer needs and emergencies. • Provides tailored customer service and outreach to a range of customer groups (e.g., residential, commercial, industrial, and newly emerging groups such as high-strength waste producers or power companies)		
Employee and Leadership Development (ED)	• Recruits, develops, and retains a competent, safety-focused workforce. • Is a collaborative organization dedicated to continual learning, improvement, and adaptation. • Implements procedures for institutional knowledge retention, workplace safety, and continual learning (e.g., standard operating procedures). • Invests in/provides opportunities for professional and leadership development. • Supports an integrated and well-coordinated senior leadership team.		
Operational Optimization (OO)	• Conducts ongoing performance improvements informed by performance monitoring. • Minimizes resource use and loss from day-to-day operations. • Is aware of and adopts in a timely manner operational and technology improvements, including operational technology and information technology. • Manages and utilizes data from automated and smart systems.		

Attribute	Attribute Components	Step 1: Rate Achievement (1-5)	Step 2: Rank Importance (1-10)
Financial Viability (FV)	• Understands and plans for full life-cycle cost of utility. • Effectively balances long-term debt, asset values, operations and maintenance expenditures, and operating revenues. • Sets predictable and adequate rates to support utility current needs and plans to invest in future needs, taking into account affordability and the needs of disadvantaged households when setting rates. • Understands opportunities for diversifying revenue and raising capital.		
Infrastructure Strategy and Performance (IS)	• Understands the condition of and costs associated with critical infrastructure assets. • Maintains and enhances assets over the long-term at the lowest possible life-cycle cost and acceptable risk. • Coordinates repair efforts within the community to minimize disruptions. • Plans infrastructure investments consistent with community needs, anticipated growth, system reliability goals, and with a robust set of adaptation strategies.		
Enterprise Resiliency (ER)	• Works together with staff internally and coordinate with external partners to anticipate and avoid problems. • Proactively establishes tolerance levels and effectively manages risks (including legal, regulatory, financial, environmental, safety, security, cyber, knowledge-loss, talent, and natural disaster-related). • Plans for and actively manages to maintain business continuity.		

Attribute	Attribute Components	Step 1: Rate Achievement (1-5)	Step 2: Rank Importance (1-10)
Community Sustainability (SU)	• Actively leads in promoting and organizing improvements to community and watershed health within utility and with external community partners. • Actively leads in promoting welfare within the community for disadvantaged households. • Uses operations to enhance natural environment. • Efficiently uses water and energy resources, promotes economic vitality, and engenders overall community improvement. • Maintains and enhances ecological and community sustainability including pollution prevention, watershed and source water protection.		
Water Resource Sustainability (WS)	• Ensures water availability through long-term resource supply and demand analysis, conservation, fit for purpose water reuse, integrated water resource management, watershed management and protection, and public education initiatives. • Manages operations to provide for long-term aquifer and surface water sustainability and replenishment. • Understands and plans for future water resource variability (e.g., changing weather patterns, including extreme events, such as drought and flooding).		
Stakeholder Understanding and Support (SS)	• Engenders understanding and support from oversight bodies, community and watershed interests, and regulatory bodies for service levels, rate structures, operating budgets, capital improvement programs, and risk management decisions. • Actively engages in partnerships and involves stakeholders in the decisions that will affect them. • Actively promotes an appreciation of the true value of water and water services, and water's role in the social, economic, public and environmental health of the community.		

Step 3: Graph Results

Graph each Attribute based on your rating and ranking.

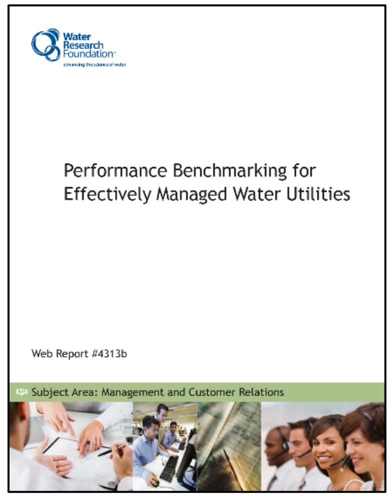


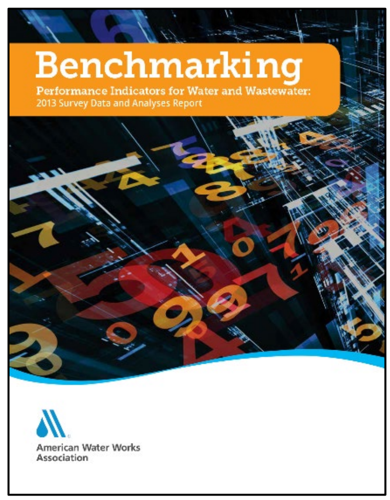
X. Appendix C: Attribute-Related Water Utility Measures

Performance measurement is critical to effectively managing a utility. This section of the *Primer* provides detailed information on a range of measures that utilities can consider, including descriptions and example calculations and questions.

In addition to the example measures described in this section, utilities can reference a variety of resources available to the sector which provide additional specific measures for a variety of practices. Resources available to utilities include:

- **Benchmarking Performance Indicators for Water and Wastewater Utilities** (American Water Works Association)
- **Effective Utility Management Benchmarking Tool** (Water Research Foundation)





For each of the Attributes, a variety of example calculations and questions are provided in this Appendix for use by water sector utilities. This is not meant to serve as an exhaustive list, but rather a starting point for utilities as they begin to think about how performance can be measured for each Attribute.

Product Quality

1. Regulatory compliance

Description: This measure assesses water product quality compliance, particularly with regard to 40 CFR Part 141 (the National Primary Drinking Water Regulations), the National Pollutant Discharge Elimination System, and any other relevant federal (Clean Water Act, Safe Drinking Water Act, etc.) or state statute/regulations and permit requirements. The scope can include the quality of all related products, including drinking water, fire suppression water, treated effluent, reused water, and biosolids (EPA 503 Regulations), as well as quality related to operating requirements such as pressure and number of sewer overflows.

Example performance measures:

- Drinking water compliance rate (percent): 100 X (number of days in full compliance for the year ÷ 365 days). *This is a Benchmarking Performance Indicator*.

- Wastewater treatment effectiveness rate (percent): 100 X (365 – total number of noncompliance days ÷ 365 days). *This is a Benchmarking Performance Indicator.*
- Number, type, and frequency of “near (compliance) misses”: For example, reaching 80-95% of allowable levels of “X” during reporting period, typically per month. Tracking this type of measure could be used to improve performance in these “near miss” areas before violations occur.

2. Service delivery

Description: This measure assesses delivery of quality service based on utility-established objectives and service level targets.

Example performance measures:

- Drinking water flow and pressure (percent): 100 X [number of customers with less than (flow of “X” gallons per minute (gpm) and pressure of “Y” pounds per square inch (psi)—levels set by utility) ÷ total number of customers] (during reporting period, typically per month).
- Fire suppression water flow and pressure (percent): 100 X [hours of time when (flow of “X” gpm and pressure of “Y” psi—levels set by utility) is available for fire suppression at maximum day demand ÷ total number of hours when fire suppression water should be available at maximum day demand] (during reporting period, typically per month).
- Service interruptions (percent): 100 X (number of active account customers experiencing a service interruption of greater than 1 hour ÷ total number of customers during reporting period) (typically per month). Note: the utility may elect to measure planned and unplanned interruptions separately.
- Water quality goals met/not met: Number of days in reporting period (typically one month) where utility-defined beyond-compliance targets are met/not met.
- Sewer backups (amount and percent): Number of customers experiencing backups each year; 100 X (number of customers experiencing backups each year ÷ total number of customers).
- Sewer overflows: Number of sewer overflows per 100 miles of collection system piping, or number of sewer overflows per million gallons treated.
- Water reuse (amount and percent):
    - Amount: Amount of water supplied that is from reused/recycled sources.
    - Percent: 100 X (amount of water supplied that is from reused/recycled water ÷ total amount of water supplied).
    - Then, as desired, these amounts can be broken into recipients/applications (e.g., irrigation, agriculture, industrial processes, etc.).
- Biosolids put to beneficial use (percent): 100 X (amount of biosolids produced that are put to a beneficial use ÷ total amount of biosolids produced) (in wet tons per year).
- Percent of recovered resources that meet customer specifications or regulatory requirements: 100 X (amount of efficiently recovered material ÷ total amount of potentially recovered material).

Customer Satisfaction

1. Customer complaints

Description: This measure assesses the complaint rates experienced by the utility, with individual quantification of customer service and core utility service complaints (note that "service complaints" would not include routine service requests by customers).[1] As a "passive measure," it will not likely be numerically representative (i.e., a statistically valid customer sample group) and is a "starting point" measure for understanding customer service problems.

Example performance measures:

- Number of complaints per 1,000 customers (or other appropriate value based on size of population served) per reporting period, recorded as either customer service or technical quality complaints.
  - Customer service complaint rate: 1,000 X (customer service associated complaints ÷ number of active customer accounts). *This is a Benchmarking Performance Indicator*.
  - Technical quality complaint rate: 1,000 X (technical quality associated complaints ÷ number of active customer accounts). *This is a Benchmarking Performance Indicator*.

For both calculations, utilities may wish to subcategorize complaints by type and aspect (e.g., customer service into billing, problem responsiveness, interruptions, etc., and technical quality into service deficiencies such as taste, odor, appearance, flow/pressure, etc.) and by type of customer (e.g., residential, industrial, commercial, etc.)

2. Customer service delivery

Description: This measure requires the utility, based on internal objectives and customer input, to set desirable customer service levels, then determine an appropriate (target) percentage of time to meet the performance levels. Once established, the utility can track how often it meets the service levels, helping the utility to determine how well customer needs are being satisfied (e.g., have 95 percent of service calls received a response within 60 minutes). A utility can average across individual measures to determine the overall percentage of service level commitments met.

Example performance measures:

- Call responsiveness (percent): 100 X (number of calls responded to within "X" minutes ÷ total number of calls during reporting period) (typically per month).
- Error-driven billing adjustment rate (percent): 100 X (number of error-driven billing adjustments during reporting period ÷ number of bills generated during reporting period). *This is a Benchmarking Performance Indicator*.
- Service start/stop responsiveness (percent): 100 X (number of stop/start service orders processed within "X" days ÷ total number of stop/start service orders during reporting period).

[1] From AWWA and AwwaRF, *Selection and Definition of Performance Indicators for Water and Wastewater Utilities*, p. 41. 2004. Note: This material is copyrighted and any reprinting must be by permission of the American Water Works Association.

- First call resolution (percent): 100 X (number of calls for which problem was resolved/fixed/scheduled to be fixed at the time of the first call ÷ total number of calls during reporting period).

3. Customer satisfaction

Description: This is an overarching customer satisfaction measure based on requested customer feedback (surveys), not calls received or internal customer satisfaction service level commitments. A utility can measure customer satisfaction immediately after service provision or use a periodically performed, more comprehensive customer satisfaction survey. After-service surveys are simpler and easier for the utility to develop and implement without professional advice, but they tend to over represent the most satisfied (e.g., those who just received service) and the most dissatisfied (e.g., those who just called with complaints) customers. Comprehensive surveys can provide statistical validity enabling extrapolation to the population served. A utility can verify survey information through customer conversations, either as follow up to a survey, during public meetings or focus groups, or by some other method (e.g., individual telephone calls).

Example performance measures:

- Overall customer satisfaction: Percent of positive or negative customer satisfaction survey responses based on a statistically valid survey or on an immediately after-service survey. Satisfaction responses can be divided into categories such as: highly satisfied/satisfied/moderately satisfied/unsatisfactory; exceeding expectations/meeting expectations/not meeting expectations; numerical scales (e.g., 1-5); or other divisions. Customer satisfaction information is often also gathered and assessed by topic areas such as product quality, service reliability, billing accuracy, customer service, costs/rates/value, crew courtesy, notification around street construction/service interruptions, etc.

Employee and Leadership Development

1. Employee retention and satisfaction

Description: This measure gauges a utility's progress toward developing and maintaining a competent and stable workforce, including utility leadership.

Example performance measures:

- Employee turnover rate (percent): 100 X (number of employee departures ÷ total number of authorized positions per year). Can be divided into categories such as:
    - Voluntary turnover (percent): 100 X (number of voluntary departures ÷ total number of authorized positions per year). (Perhaps the best indicator of retention problems.)
    - Retirement turnover (percent): 100 X (number of retirement departures ÷ authorized positions per year). (Measures vulnerability to loss/retention of institutional knowledge.)
    - Experience turnover (percent): 100 X (number of years of experience represented by all departures ÷ total years of experience with the organization) (at the beginning of the year). (These are harder data to collect but provide a good assessment of institutional knowledge loss potential and therefore the need to retain/capture institutional knowledge.)

- Employee job satisfaction (percent): 100 X (number of employees with "X" job satisfaction level ÷ total number of employees) (based on implementation and monitoring over time of a comprehensive employee survey). Can be divided into work type or job classification categories, etc., and cover overall satisfaction and topics deemed relevant to longer-term employee satisfaction and retention, such as:
    - Compensation and benefits
    - Management
    - Professional development and long-term advancement opportunities
    - Work and teamwork
    - Procedures
    - Fairness and respect
    - Communication
    - Positive work environment
    - Recognition for achievements
- Employee salary competitiveness relative to market rate: Average percentile rank of employee salaries compared to salaries in surrounding service areas, as determined by a market rate comparison.

2. Management of core competencies

Description: This measure assesses the utility's investment in and progress toward strengthening and maintaining employee core competencies.

Example performance measures:

- Presence of job descriptions and performance expectations: Percentage of classifications with current job descriptions and related performance expectations.
- Training hours per employee: Total of qualified formal training hours for all employees ÷ total FTEs (FTE = 2,080 hours per year of employee time equivalent) worked by employees during the reporting period. *This is a Benchmarking Performance Indicator*.
- Certification coverage (percent): 100 X (number of certifications achieved or maintained ÷ number of needed certifications per year) (across the utility).
- Employee evaluation results (assumes utility evaluates employee performance in a routine way and documents results): Results of employee evaluations (e.g., employee growth not clearly demonstrated, employee growth only demonstrated in certain areas or for certain labor categories, etc.).
- Presence of employee-focused objectives and targets: Percentage of employees with written employee-focused organizational objectives and targets.(Targets could be, for instance, related to quantity, quality, timeliness, or cost. A timeliness target could, for example, relate to the number of hours it takes on average to complete a routine task.)

3. Workforce development

Description: This measure assesses utility long-term workforce succession planning efforts to ensure critical skills and knowledge are retained and enhanced over time, particularly in light of anticipated retirement volume in coming years. Focus is on preparing entire groups or cohorts for needed workforce succession, including continued training and leadership development.

Example performance measures:

- Key position vacancies: Average time that critical-skill positions are vacant due to staff departures per vacancy per year.
- Key position internal/external recruitment (percent): 100 X (number of critical-skill positions that are filled internally (through promotion, transfer, etc. rather than outside recruitment) versus filled through outside recruitment ÷ total number of positions filled per year). (This will help the utility to understand if internal workforce development is covering long-term succession needs.)
- Long-term succession plan coverage (percent): 100 X (number of employees (or cohorts, work units, etc.) covered by a long-term workforce succession plan that accounts for projected retirements and other vacancies in each skill and management area ÷ total number of employees) (or cohorts, work units, etc.).
- Internal leadership development:
    - Percentage of staff and leadership positions with defined competencies.
    - Are internal or external leadership development/training/skills development opportunities provided to employees (yes/no)?

Operational Optimization

1. Resource optimization

Description: This measure examines resource use efficiency, including labor and material per unit of output or mile of collection/distribution system.

Example performance measures:

- Customer accounts per employee: Number of accounts ÷ number of FTEs. (FTE = 2,080 hours per year of employee time equivalent.) *This is a Benchmarking Performance Indicator*.
- MGD water delivered/processed per employee: Average MGD delivered/processed ÷ FTEs per year. *This is a Benchmarking Performance Indicator*.
- Chemical use per volume delivered/processed: Amount of chemicals used ÷ MG delivered/processed during reporting period. (Alternatively can use dollar amount spent on chemicals ÷ MG delivered/processed; in this case a rolling average for amount spent would account for periodic bulk purchases.)
- Energy use per volume delivered/processed: KWH ÷ MG delivered/processed during reporting period. (Alternatively can use dollar amount spent on energy ÷ MG delivered/processed.)
- O&M cost per volume delivered/processed: Total O&M cost ÷ MG delivered/processed during reporting period.

A utility can also apply the above resource use per volume delivered/processed calculations to resource use per mile (or 100 miles) of collection/distribution system, (i.e., chemical use per mile, energy use per mile, or O&M cost per mile).

2. Water management efficiency

Description: This measure assesses drinking water production and delivery efficiency by considering resources as they enter and exit the utility system.

Example performance measures:

- Production efficiency: Ratio of raw water volume taken into the treatment system to treated water produced.
- Meter function (percent): 100 X (total number of active billable meters minus stopped or malfunctioning meters ÷ total number of active billable meters).

Financial Viability

1. Budget management effectiveness

Description: This measure has short-term and long-term aspects. The short-term calculations are commonly used financial performance indicators, and the long-term calculation is a more comprehensive analytical approach to assessing budget health over the course of several decades.

Example performance measures:

Short-term (typically per year):

- Revenue to expenditure ratio: Total revenue ÷ total expenditures.
- O&M expenditures (percent): 100 X (O&M expenditures ÷ total operating budget).
- Capital expenditures (percent): 100 X (capital expenditures ÷ total capital budget).
- Debt ratio: Total liabilities ÷ total assets. Total liabilities are the entire obligations of the utility under law or equity. Total assets are the entire resources of the utility, both tangible and intangible. Utilities often have different debt-risk acceptability levels, thus the ratio itself should be considered within each utility's unique circumstances. *This is a Benchmarking Performance Indicator*.
- Current level of operating reserves as a percentage of goal.

Long-term:

- Life-cycle cost accounting: Has the utility conducted a life-cycle cost accounting analysis[2] that explicitly incorporates accepted service level risks, asset condition, budget needs based on the values (net present values) of utility current and future assets, etc., and made financial and budget management decisions accordingly (yes/no)?

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[2] Section 707 of Executive Order 13123 defines life-cycle costs as, "…the sum of present values of investment costs, capital costs, installation costs, energy costs, operating costs, maintenance costs, and disposal costs over the life-time of the project, product, or measure." Life-cycle cost analysis (LCCA) is an economic method of project evaluation in which all costs arising from owning, operating, maintaining, and disposing of a [facility/asset] are considered important to the decision. LCCA is particularly suited to the evaluation of design alternatives that satisfy a required performance level, but that may have differing investment, operating, maintenance, or repair costs; and possibly different life spans. LCCA can be applied to any capital investment decision, and is particularly relevant when high initial costs are traded for reduced future cost obligations. See also: https://energy.gov/nepa/downloads/eo-13148-greening-government-through-leadership-environmental-management-2000, http://www.wbdg.org/resources/lcca.php.

2. Financial procedure integrity

Description: This measure gauges the presence of internal utility processes to ensure a high level of financial management integrity.

Example performance measures:

- Number of control deficiencies and material weaknesses reported on annual audits.
- Does the utility have financial accounting policies and procedures (yes/no)?
- Are financial results and internal controls audited annually (yes/no)?
- Have the number of control deficiencies and material weaknesses been reduced from previous audits (yes/no)?
- Does the utility have a formal policy for the bill collection process (yes/no)?

3. Bond ratings

Description: This measure uses bond ratings as a general indicator of financial viability; however, they are not always within a utility's control and are less important if a utility is not participating in capital markets. Smaller utilities often struggle to obtain high ratings. Even though a higher bond rating is desirable and this provides a general indicator of financial health, the bond rating should not be considered alone. It should be considered in light of other factors such as the other measures suggested for this Attribute.

Example performance measure:

- Bond ratings.
- Change in bond ratings: Does the change reflect the utility's financial management in a way that can and should be acknowledged and, if need be, addressed?

4. Rate adequacy

Description: This measure helps the utility to consider its rates relative to factors such as external economic trends, short-term financial management, and long-term financial health. It recognizes that a "one size fits all" calculation would not be realistic due to each utility's unique situation and the number of variables that could reasonably be considered. The following three questions prompt assessment of key components of rate adequacy.

Example performance measures:

- How do your rate changes compare currently and over time with the inflation rate and the Consumer Price Index (CPI) or Consumer Price Index for All Urban Consumers (CPI-U)? (Rate increases below CPI for very long may suggest rates are not keeping up with utility costs.) (Using a rolling rate average over time will adjust for short-term rate hikes due to capital or O&M spending needs.)
- Have you established rates that fully consider the full life-cycle cost of service and capital funding options? (See the life-cycle cost accounting discussion, above.)
- Does your utility maintain a rate stabilization reserve to sustain operations during cycles of revenue fluctuation, in addition to 60- (or 90-) day operating reserves?

Infrastructure Strategy and Performance

1. Asset inventory

Description: This measure gauges a utility's efforts to assess assets and asset conditions, as the first steps towards building a comprehensive asset management program.

Example performance measures:

- Inventory coverage (percent): 100 X (total number of critical assets inventoried within a reasonable period of time (e.g., 5-10 years) ÷ total number of critical assets). A utility will need to first define what it considers to be a critical asset. Typically, critical assets are those that you decide would have major consequences if they were to fail (major expense, system failure, safety concerns, etc.). A complete inventory will involve understanding the following for each asset:
    - Age and location;
    - Asset size and/or capacity;
    - Valuation data (e.g., original and replacement cost);
    - Installation date and expected service life;
    - Maintenance and performance history; and
    - Construction materials and recommended maintenance practices.[3]
- Condition assessment coverage (percent): 100 X (total number of critical assets with condition assessed and categorized into condition categories within a reasonable period of time (e.g., 5-10 years) ÷ total number of critical assets). Condition categories could include: unacceptable, improvement needed, adequate, good, and excellent to reflect expected service levels and acceptable risks.

2. Asset (system) renewal/replacement

Description: This measure assesses asset renewal/replacement rates over time. The measure should reflect utility targets, which will vary depending on each utility's determinations of acceptable risks for different asset classes. An asset class may consist of a cohort of pipe based on age/material, or a particular component of plants or lift stations. Generally, an asset class would have an expected service life, and this should be factored into calculations for an appropriate asset renewal/replacement rate. Decisions on asset replacement typically factor in internally agreed-upon risks and objectives, which may differ by asset class and other considerations. For instance, a utility may decide to run certain assets to failure based on benefit-cost analysis.

Example performance measures:

- Asset renewal/replacement rate (percent): 100 X (total number of assets replaced per year for each asset class ÷ total number of assets in each asset class). For example, a two percent per year replacement target (50-year renewal) for a particular asset class could be identified as the basis for performance monitoring.

  — or —

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[3] From the U.S. General Accounting Office, *Water Infrastructure: Comprehensive Asset Management Has Potential to Help Utilities Better Identify Needs and Plan Future Investments*. GAO-04-461. March 2004. Available: http://www.gao.gov/new.items/d04461.pdf.

- Asset (system) renewal/replacement rate: 100 X (total actual expenditures or total amount of funds reserved for renewal and replacement for each asset group ÷ total present worth for renewal and replacement needs for each asset group). *This is a Benchmarking Performance Indicator*.

3. Water distribution/collection system integrity

Description: For drinking water utilities, this measure quantifies the number of pipeline leaks and breaks. Distribution system integrity has importance for health, customer service, operational, and asset management reasons. For wastewater utilities, this measure examines the frequency of collection system failures. When tracked over time, a utility can evaluate whether its failure rate is decreasing, stable, or increasing. When data are maintained to characterize failures by pipe type and age, type of failure, and cost of repairs, decisions regarding routine maintenance and replacement/renewals can be better made.

Example performance measure (drinking water utilities):[4]

- Non-revenue water (NRW): Water supplied to the network that does not return revenue to the utility, including unbilled authorized consumption, apparent losses (theft, customer metering inaccuracies, systematic data handling errors), and real losses (leakage from the pipe network and distribution storage) as defined in the AWWA M36 Manual. May be expressed as volume or value:
  - Volume:
    - Total volume for audit year; and/or
    - Volume per connection per year; and/or
    - Volume per connection per day.
  - Value:
    - Total cost of NRW by total cost of water system operations; and/or
    - Cost of NRW per connection per year.
- Infrastructure leakage index (ILI): Current Annual Real Loss ÷ Unavoidable Annual Real Loss (at current average system operating pressure. Measure would be expressed as a unitless ratio. *Automatic derivation of this measure provided in the AWWA Free Water Audit Software from annual water audit inputs.*
- Audit Validation Level: Level of validation (self-reported, 1, 2 or 3) conducted on the most recent water audit, as defined by Water Research Foundation Project 4639A.[5]

Example performance measure (wastewater utilities):

- Collection system failure rate (percent): 100 X (total number of collection system failures ÷ total miles of collection system piping per year). *This is a Benchmarking Performance Indicator*.

4. Infrastructure planning and maintenance

Description: This measure addresses planning for future infrastructure needs and ongoing maintenance for existing infrastructure, which is critical to overall infrastructure strategy and performance. Planned maintenance includes both preventive and predictive maintenance. Preventive maintenance is performed

[4] For more information, visit: http://www.awwa.org/store/productdetail.aspx?productid=51439782 and http://www.awwa.org/resources-tools/water-knowledge/water-loss-control.aspx.
[5] For more information, visit: *http://www.waterrf.org/Pages/Projects.aspx?PID=4639*

according to a predetermined schedule rather than in response to failure. Predictive maintenance is initiated when signals indicate that maintenance is due. All other maintenance is categorized as corrective or reactive.

Example performance measures:

This measure can be approached in different ways. Calculating costs may be preferable to encourage business decisions based on total cost; however, the reliability of costs is uncertain. Hours are likely to be less variable than costs, but not all utilities track hours. Thus, cost and hours ratios are desirable, where possible.

- Planned maintenance ratio by hours (percent): 100 X (hours of planned maintenance ÷ (hours of planned + corrective maintenance)). *This is a Benchmarking Performance Indicator*.
- Planned maintenance ratio by cost (percent): 100 X (cost of planned maintenance ÷ (cost of planned + corrective maintenance)). *This is a Benchmarking Performance Indicator*.
- Is there a formal process to prioritize infrastructure needs/future investments and allocate the necessary funding (yes/no)?
- Is there a formal process for identifying areas of uncertainty and building in needed flexibility during the infrastructure planning phase (yes/no)?

Enterprise Resiliency

1. Recordable incidents of injury or illnesses

Description: This measure addresses incidence rates, which can be used to show the relative level of injuries and illnesses and help determine problem areas and progress in preventing work-related injuries and illnesses.

Example performance measure:

The U.S. Bureau of Labor Statistics has developed instructions for employers to evaluate their firm's injury and illness record. The calculation below is based on these instructions, which can be accessed at: http://www.bls.gov/iif/osheval.htm. The 200,000 hours used in the formulas below represent the equivalent of 100 employees working 40 hours per week, 50 weeks per year, and provides the Bureau of Labor Statistics' standard base for the incidence rates.

- Total recordable incident rate: (Number of work-related injuries and illnesses X 200,000) ÷ employee hours worked.
- Number of near misses: A "near miss" is an unsafe situation or condition where no personal injury was sustained and no property was damaged, but where, given a slight shift in time or position, injury and/or damage could have occurred.

2. Insurance claims

Description: This measure examines the number, type, and severity of insurance claims to understand insurance coverage strength/vulnerability.

Example performance measures:

- Number of insurance claims: Number of general liability and auto insurance claims per 200,000 employee hours worked.

- Severity of insurance claims: Total dollar amount of general liability and auto insurance claims per 200,000 employee hours worked.

3. Risk assessment and response preparedness

Description: This measure asks whether utilities have assessed their all-hazards (natural and human-caused) vulnerabilities and risks and made corresponding plans for critical needs. Risk assessment in this context includes a vulnerability assessment regarding, for example, power outages, lack of access to chemicals, cybersecurity, extreme weather events, curtailed staff availability, etc.

Example performance measures:

- Emergency Response Plan (ERP) coverage and preparedness:
  - Does the utility have an ERP in place (yes/no)?
  - Number and frequency of ERP exercises per year: 100 X (number of critical employees who participate in ERP exercises ÷ total number of critical employees).
  - Frequency with which the ERP is reviewed and updated.
  - Does the utility discuss/coordinate ERP with other agencies/departments (e.g., city, state, police, fire, public health) (yes/no)?
- Vulnerability management: Is there a process in place for identifying and addressing system deficiencies (e.g., deficiency reporting with an immediate remedy process, established intervals between comprehensive vulnerability assessments) (yes/no)?

4. Ongoing operational resiliency

Description: This measure assesses a utility's operational reliability during ongoing/routine operations.

Example performance measure:

- Uptime for critical utility components on an ongoing basis (percent): 100 X (hours of critical component uptime ÷ hours that critical components have the physical potential to be operational). Note: a utility can apply this measure on an individual component basis or summed across all identified critical components. Also, a utility can make this measure more precise by adjusting for planned maintenance periods.
- Cybersecurity:
  - Does the utility document and periodically review network architecture (including defining network boundaries and network asset inventory)? (yes/no) *This is a Benchmarking Performance Indicator.*
  - Does the utility implement formal, written cybersecurity policies that include specific operational aspects associated with service delivery and assurance (not enterprise)? (yes/no) *This is a Benchmarking Performance Indicator.*

5. Operational resiliency under emergency conditions

Description: This measure assesses the operational preparedness and expected responsiveness in critical areas under emergency conditions.

Example performance measures (all apply to emergency conditions and, where relevant, factor in anticipated downtimes relative to required/high demand times):

- Power resiliency: Period of time (e.g., hours or days) for which backup power is available for critical operations (i.e., those required to meet 100 percent of minimum daily demand). (Note: "minimum daily demand" is the average daily demand for the lowest production month of the year.)
- Treatment chemical resiliency: Period of time (e.g., hours or days) minimum daily demand can be met with water treated to meet SDWA standards for acute contaminants (i.e., E.coli, fecal coliform, nitrate, nitrite, total nitrate and nitrite, chlorine dioxide, turbidity as referenced in the list of situations requiring a Tier 1 Public Notification under 40 CFR 141.202), without additional treatment chemical deliveries. (Note: "minimum daily demand" is the average daily demand for the lowest production month of the year.)
- Critical parts and equipment resiliency: Current longest lead time (e.g., hours or days) for repair or replacement of operationally critical parts or equipment (calculated by examining repair and replacement lead times for all identified critical parts and equipment and taking the longest single identified time).
- Critical staff resiliency: Average number of response-capable backup staff for critical operation and maintenance positions (calculated as the sum of all response-capable backup staff ÷ total number of critical operation and maintenance positions).
- Treatment operations resiliency (percent): Percent of minimum daily demand met with the primary production or treatment plant offline for 24, 48, and 72 hours. (Note: "minimum daily demand" is the average daily demand for the lowest production month of the year.)
- Sourcewater resiliency: Period of time (e.g., hours or days) minimum daily demand can be met with the primary raw water source unavailable. (Note: "minimum daily demand" is the average daily demand for the lowest production month of the year.)

Community Sustainability

1. Watershed-based infrastructure planning

Description: This measure addresses utility efforts to consider watershed-based approaches when making management decisions affecting infrastructure planning and investment options. Watershed protection strategies can sometimes, for example, protect source water quality limiting the need for additional or enhanced water treatment capacity.

Example performance measure:

- Does the utility employ alternative, watershed-based approaches to align infrastructure decisions with overall watershed goals and potentially reduce future infrastructure costs (yes/no)? Watershed-based approaches include, for example: centralized management of decentralized systems; stormwater management; source water protection programs; and conjunctive use of groundwater, source water, and recycled water to optimize resource use at a basin scale. (See also "green infrastructure" below.)

2. Green infrastructure

Description: This measure addresses green infrastructure, which includes both the built and natural/unbuilt environment. Utilities may promote source water protection and conservation green infrastructure approaches in support of water conservation (e.g., per capita demand reduction) and water quality protection objectives. Green infrastructure approaches can include: low-impact development techniques (e.g., minimization of impervious surfaces, green roofs); protection of green spaces and wildlife habitat; incentives for water-efficient domestic appliance use and landscaping; green building standards such as those promoted through the Leadership in Energy and Environmental Design (LEED) program; management of energy, chemical, and material use; etc.[6] Utilities often coordinate these efforts with community planning offices.

Example performance measures:

- Has the utility explored green infrastructure approaches and opportunities that are aligned with the utility's mandate, goals, and objectives and community interests (yes/no)?
- Does the utility have procedures that incorporate green infrastructure approaches and performance into new infrastructure investments (yes/no)?

3. Greenhouse gas emissions

Description: This measure will help drinking and wastewater utilities to understand and reduce their individual contributions to area greenhouse gas emissions. Trends indicate that water utility emissions of these gases will likely be of interest to stakeholders. Monitoring of these emissions is becoming more common among water sector utilities, and some utilities are beginning voluntary efforts to reduce their emissions (e.g., through production of reusable methane energy by wastewater utilities).

Example performance measures:

- Net (gross minus offsets) greenhouse gas emissions in tons of carbon dioxide (CO2), nitrous oxide (N2O), methane (CH4), and, as applicable, hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs). Start by establishing an emissions baseline and then track emission trends in conjunction with minimizing/reducing emissions over time, where possible.[7] Emissions inventories often incorporate indirect emissions such as those generated during the production and transport of materials and chemicals.
- Percent of utility energy demand met by renewable energy resources.

4. Service affordability

Description: This measure addresses drinking water and wastewater service affordability, which centers on community members' ability to pay for water services. The true cost of water/wastewater services may be higher than some low-income households can afford, particularly when rates reflect the full life-cycle cost of water services. To the extent possible within its operating and regulatory contexts, the utility will want to

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[6] For more information about green infrastructure, visit https://www.epa.gov/npdes/green-infrastructure.

[7] EPA's industry-government "Climate Leaders" partnership involves completing a corporate-wide inventory of their greenhouse gas emissions. Information and related guidance is available at http://www.epa.gov/stateply/index.html.

consider and balance keeping water services affordable while ensuring the rates needed for long-term infrastructure and financial integrity.

Example performance measures:

- Bill affordability (households for which rates may represent an unaffordable level) (percent): 100 X (number of households served for which average water bill is > “X” percent (often 2-2.5%) of median household income[8] ÷ total number of households served).

Coupled with:

- Low-income billing assistance program coverage (percent): 100 X (number of customers enrolled in low-income billing assistance program ÷ number of customers who are eligible for enrollment in low-income billing assistance program). (The utility can try to increase participation in the program for eligible households that are not participating).

5. Community economic development

Description: This measure assesses the extent to which utility operations play a role in local economic development (e.g., by attracting new employers to the area, enabling residential or commercial growth, or through job creation).

Example performance measures:

- Change in tax base (dollars or percent change) related to new water infrastructure.
- Number of jobs created by utility infrastructure investments. Jobs may be:
    - Internal to the utility;
    - Contracted by the utility; or
    - Through a new employer brought to the community as a result of utility infrastructure.
- Green infrastructure economic benefits:
    - Crime reduction (percent change); and
    - Increase in local property values (percent change).

Water Resource Sustainability

1. Water supply adequacy

Description: This measure assesses short-term and long-term water supply adequacy and explores related long-term supply considerations.

Example performance measures:

- Short-term water supply adequacy: Period of time for which existing supply sources are adequate. This can be measured as a ratio of projected short-term (e.g., 12-month rolling average) monthly

[8] This calculation focuses on identifying low-income households based median household incomes (MHI); however, MHI is not strongly correlated with the incidence of poverty or other measures of economic need. Further, populations served by small utilities in rural settings tend to have lower MHI and higher poverty rates, but fewer options for diversifying water/wastewater service rates based on need compared to larger municipal systems.

supply to projected short-term monthly demand. Often an index or scale is used, for example, short-term supply relative to severe drought (assigned a "1") to abundant supply conditions (assigned a "5").

- Long-term water supply adequacy: Projected future annual supply relative to projected future annual demand for at least the next 50 years (some utilities project out as far as 70-80 years). Statistical forecasting and simulation modeling and forecasting techniques are typically used for such long-term projections. Analysis variables in addition to historical record (e.g., historical and year-to-date reservoir elevation data), forecasted precipitation, and flows (including surface and groundwater, as applicable) can include:
    - Future normal, wet, dry, and very dry scenarios;
    - Anticipated population changes;
    - Future service areas;
    - Availability of new water supplies including both traditional, and alternative supplies, such as recycled water, groundwater banking, desalinization, or groundwater highest and best use; and
    - Levels of uncertainty around the above.
- Water Reuse (water beneficially reused):
    - Amount (percentage or gallons) of reclaimed water used in place of fresh water or drinking water for non-potable uses.
    - Amount (percentage or gallons) of reclaimed water used for potable purposes.
    - Amount (gallons or acre feet) of reclaimed water added to drinking water reservoir(s).
    - Area (acres) of land irrigated using only recycled water.

2. Supply and demand management

Description: This measure explores whether the utility has a strategy for proactive supply and demand management in the short and long terms. Strategy needs will depend on community circumstances and priorities, anticipated population growth, future water supply in relation to anticipated demand, demand management and other conservation options, and other local considerations.

Example performance measures:

- Does the utility have a demand management/demand reduction plan (yes/no)? Does this plan track per capita water consumption and, where analytical tools are available to do so, accurately attribute per capita consumption reductions to demand reduction strategies (such as public education and rebates for water-efficient appliances) (yes/no)?
- Do demand scenarios account for changes in rates (which can change for many reasons) and conservation-oriented, demand management pricing structures (yes/no)?
- Does the utility have policies in place that address, prior to committing to new service areas, the availability of adequate dry year supply (yes/no)? Alternatively, does the utility have a commitment to denying service commitments unless a reliable drought-year supply, with reasonable drought use restrictions, is available to meet the commitment (yes/no)?

3. Watershed sustainability

Description: This measure explores whether the utility has a strategy for proactive watershed management and/or partnerships to ensure an effective integration of utility and watershed investments and practices, to achieve overall optimized performance for the community and the utility.

Example performance measures:

- Amount of pollutants/contaminants managed through source control practices (avoiding the need for treatment plant upgrades, etc.).
- Has the utility developed a source water protection plan (yes/no)?
- Does the utility partner with regional stakeholders to protect and enhance its watershed (yes/no)?
- Percent of wet weather impacts (e.g., flooding, CSOs, SSOs, gallons of infiltrated water not reaching collection systems) managed through watershed (natural treatment) processes: 100 X (Number of wet weather impacts managed through watershed processes ÷ total number of wet weather impacts).
- Area (in acres) of enhancements to wetland areas for treatment/storage of wet weather flows.
- Amount of nutrient removal via watershed approaches:
    - Cost savings derived from nutrient control through watershed processes as an alternative to treatment plant nutrient removal; and
    - Percent of nutrient removal requirements met through watershed processes rather than treatment at the plant.
- Environmental benefits:
    - Amount of movement or reduction of saltwater front (in feet).
    - Amount of avoided freshwater diversion from sensitive ecosystems.

Stakeholder Understanding and Support

1. Stakeholder consultation

Description: This measure addresses utility actions to reach out to and consult with stakeholders about utility matters, including utility goals, objectives, and management decisions.

Example performance measures:

- Does the utility identify stakeholders, conduct outreach, and actively consult with stakeholders about utility matters (yes/no)? Elements of this plan can include:
    - Number of active contacts with stakeholders in key areas (e.g., from local government, business, education, non-governmental groups)?
    - Does the utility actively seek input from stakeholders (yes/no)?
    - Frequency with which the utility actively consults with stakeholders. This measure should go beyond counting the number of calls or times information is sent out or posted on websites to items such as number of stakeholder outreach and education activities, number of opportunities for stakeholders to provide input, participation of stakeholders on utility committees, etc.
- Does the utility actively consider and act upon stakeholder input (yes/no)?

2. Stakeholder satisfaction

Description: This measure addresses stakeholder perceptions of the utility. Stakeholder satisfaction can be measured through surveys sent to stakeholders, formal feedback surveys distributed to stakeholders at events, etc.

Example performance measures:

- Overall satisfaction (percent): 100 X (number of stakeholders who annually rate the overall job of the utility as positive ÷ total number of stakeholders surveyed).
- Responsiveness (percent): 100 X (number of stakeholders who annually rate utility responsiveness to stakeholder needs as positive ÷ total number of stakeholders surveyed).
- Message recollection for outreach programs targeted to specific stakeholder groups (percent): (a) 100 X (number of stakeholders who recall key messages ÷ total number of stakeholders surveyed); and (b) 100 X (number of stakeholders who recall the message source (TV, utility mailers, newsletters, etc.) ÷ total number of stakeholders surveyed).

3. Internal benefits from stakeholder input

Description: This measure addresses the value utility employees believe stakeholder engagement has provided to utility projects and activities. Measurement by the utility can focus on surveying utility employees running projects that have stakeholder involvement.

Example performance measures:

- 100 X (number of utility projects or activities where stakeholders participated and/or provided input for which utility employees believe there was value added as a result of stakeholder participation and input ÷ total number of projects where stakeholders participated and/or provided input).
- Overall value added (percent): 100 X (number of utility employees who rated their overall sense of value added from stakeholder participation and input as (high value added, some value added, little value added, no value added) ÷ total number of utility employees surveyed).

4. Comparative rate rank

Description: This measure depicts how utility rates compare to similar utilities (e.g., utilities of the same type (drinking water, wastewater) that are similar in terms of geographic region, size of population served, etc.). A utility can use the measure internally or to educate stakeholders. It should be noted that the lowest rate is not necessarily best (see Financial Viability). When comparing rates with other utilities, it is important to make sure to account for other variables that can affect rates to ensure that you are comparing “apples to apples.” For example, when comparing a wastewater collection and treatment utility's rates to a utility providing treatment only, include the average rate of the separate wastewater collection utility in a combined rate.

Example performance measure:

- Typical monthly bill for the average household as a percentage of typical monthly bills for similar utilities.

5. Media/press coverage

Description: This measure captures media portrayal of the utility (newspaper, TV, radio, etc.) in terms of awareness, accuracy, and tone.

Example performance measures:

- Amount of coverage: Total number of media stories (social media, newspaper, TV, radio, etc.) concerning the utility per year.
- Media coverage tone (percent): 100 X (number of media stories concerning the utility that portray the utility in a positive way ÷ total number of media stories concerning the utility) per year.
- Media coverage accuracy (percent): 100 X (number of media stories that accurately describe the utility ÷ total number of media stories concerning the utility) per year.
- Number of outreach events conducted to build support for utility, value of water, and value of water services.

6. Partnering in your community

Description: This measure assesses how the utility actively engages with community organizations to advance important initiatives, engage partners in decision making, and to position the utility as an anchor institution in the community. Partnering in this manner can result in many different types of benefits for the utility and the community, including the increased understanding and support for utility needs and the value of water and water services to the community.

Example performance measures:

- Performance improvements resulting from a partnership (e.g., reduced volume of flooding or greenhouse gas emissions).
- Number and type of specific projects completed associated with partnerships (e.g., rain gardens installed, innovative technologies implemented, innovative practices adopted).
- Level of partner/community support for utility and the value of water (e.g., number of community members/partners participating in utility events or providing positive feedback for utility services).

ADDITIONAL ATTRIBUTE-SPECIFIC MEASUREMENT RESOURCES

The following resources provide additional measures that are specific to various Attributes. The list is not meant to be exhaustive, but rather, serves as a starting place for utilities seeking additional resources for measures.

- **The Energy Roadmap** (Water Environment Federation)
- **National Biosolids Partnership** (Water Environment Federation)
- **The Nutrient Roadmap** (Water Environment Federation)
- **On-Demand WasteWater Library (OWWL)** (Water Environment Federation)
- **The Value of Water** (http://thevalueofwater.org/)
- **Work for Water** (American Water Works Association and Water Environmental Federation)
- **Water Advocates** (Water Environment Federation)
- **AWWA Water and Wastewater Rate Survey** (American Water Works Association) *subscriber only*
- **AWWA Compensation Survey** (American Water Works Association) *subscriber only*
- **NACWA Financial Survey** (National Association of Clean Water Agencies)

Effective Utility Management: A Primer for Water and Wastewater Utilities

January 2017

APPENDIX B WATER QUALITY REGULATORY REVIEW

THE CITY OF PLEASANTON

Water System Management Plan

TECHNICAL MEMORANDUM

Water Quality Regulatory Review

Final DRAFT / September 2024

carollo

Water System Management Plan

TECHNICAL MEMORANDUM

Regulatory Review

DRAFT / September 2024

This document is released for the purpose of information exchange review and planning only under the authority of Timothy J. Loper, April 19, 2023, State of California, PE 70847.

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Abbreviations

AL	action level
AWIA	American Water Infrastructure Ace
Carollo	Carollo Engineers
CCL	Contaminant Candidate List
CCR	Consumer Confident Reports
CCT	corrosion control treatment
CFU	colony forming units
City	City of Pleasanton
D/DBPR	Disinfectant and Disinfection By-Product Rules
DDW	California State Water Resources Control Board Division of Drinking Water
DVWTP	Del Valley Water Treatment Plant
EPA or USEPA	United States Environmental Protection Agency
GWR	groundwater rule
HA	health advisory
HAA5	haloacetic acids
IESWTR	Interim Enhanced Surface Water Treatment Rule
µg/L	micrograms per liter
µm	micrometer(s)
LCR	Lead and Copper Rule
LCRI	Lean and Copper Rule Improvements
LCRR	Lean and Copper Rule Revisions
LRAA	locational running annual average
LSL	lead service linePQL
LT1	Long Term 1 Enhanced Surface Water Treatment Rule
LT2ESWTR	Long-Term 2 Enhanced Surface Water Treatment Rule
MCLs	maximum contaminant levels
MCLGs	maximum contaminant level goals
M/DBPs	Microbial / Disinfection Byproducts Rules
mL	milliliter(s)
Mocho DMWTP	Mocho Demineralization WTP (Mocho DMWTP)
mrem	millirem (milli-roentgen equivalent man)
NA	not applicable
NDWAC	National Drinking Water Advisory Council
ng/L	nanogram per liter
NL	notification levels
NPDWR	National Primary Drinking Water Regulations
NSDWR	National Secondary Drinking Water Regulations
NTU	nephelometric turbidity unit

OEHHA	California Office of Environmental Health Hazard Assessment
PAH	polycyclic aromatic hydrocarbon
pCI/L	picocuries per liter
PFAS	per- and polyfluorinated alkyl substances
PFBS	perfluorobutane sulfonate
PFHxS	perfluorohexane sulfonic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanoic acid
PHGs	public health goals
PQL	practical quantitation level
ppm	parts per million
PPWTP	Patterson Pass Water Treatment Plant
RRA	running annual average
SDWA	Safe Drinking Water Act
SDWIS	Safe Drinking Water Information System
SWTR	Surface Water Treatment Rule
SWRCB	State Water Resources Control Board Division
TCR	Total Coliform Rule
TT	treatment technique
TTHM	total trihalomethane
UCMR	Unregulated Contaminant Monitoring Rule
UV	ultraviolet
WQP	water quality parameter
WSMP	water system management plan
WTP	water treatment plant

SECTION 1 INTRODUCTION

This technical memorandum reviews current and upcoming water quality regulations that could impact the City's water system program during the span of the initial water system management plan (WSMP) (i.e., 5 years).

SECTION 2 SYSTEM CHARACTERISTICS

The City's drinking water supply is a combination of treated water purchased from Zone 7 and groundwater wells own and operated by the City. Sources of supply are included in Table 1. A map of the City's distribution system is shown in Figure 1. The figure shows the location of the City's turnouts where Zone 7 water is delivered, City owned wells, storage tanks, and pump stations.

Table 1 City of Pleasanton Water Sources

Source	Water Type	Supplier
Patterson Pass WTP (PPWTP)	surface water	Zone 7
Del Valle WTP (DVWTP)	surface water	Zone 7
Mocho Groundwater Demineralization Plant (MGDP)	groundwater	Zone 7
Mocho Wellfield	groundwater	Zone 7
Hopyard Wellfield	groundwater	Zone 7
Chain of Lakes Wellfield	groundwater	Zone 7
Stoneridge Wellfield	groundwater	Zone 7
Wells 5/6	groundwater	Pleasanton
Well 8	groundwater	Pleasanton

Zone 7 water typically comprises approximately 75 to 80 percent of the City's annual water supply, with the remaining water supply coming from the City's 3,500 AF/year groundwater pumping allotment. Zone 7 water can be a blend of treated surface water and groundwater. The proportion of surface and groundwater provided by Zone 7 varies, as outlined in a Nitrification Evaluation for the City (Carollo, 2019). The City's groundwater is disinfected and fluoridated prior to distribution. Chloramines are used to maintain the distributions system disinfection residual.

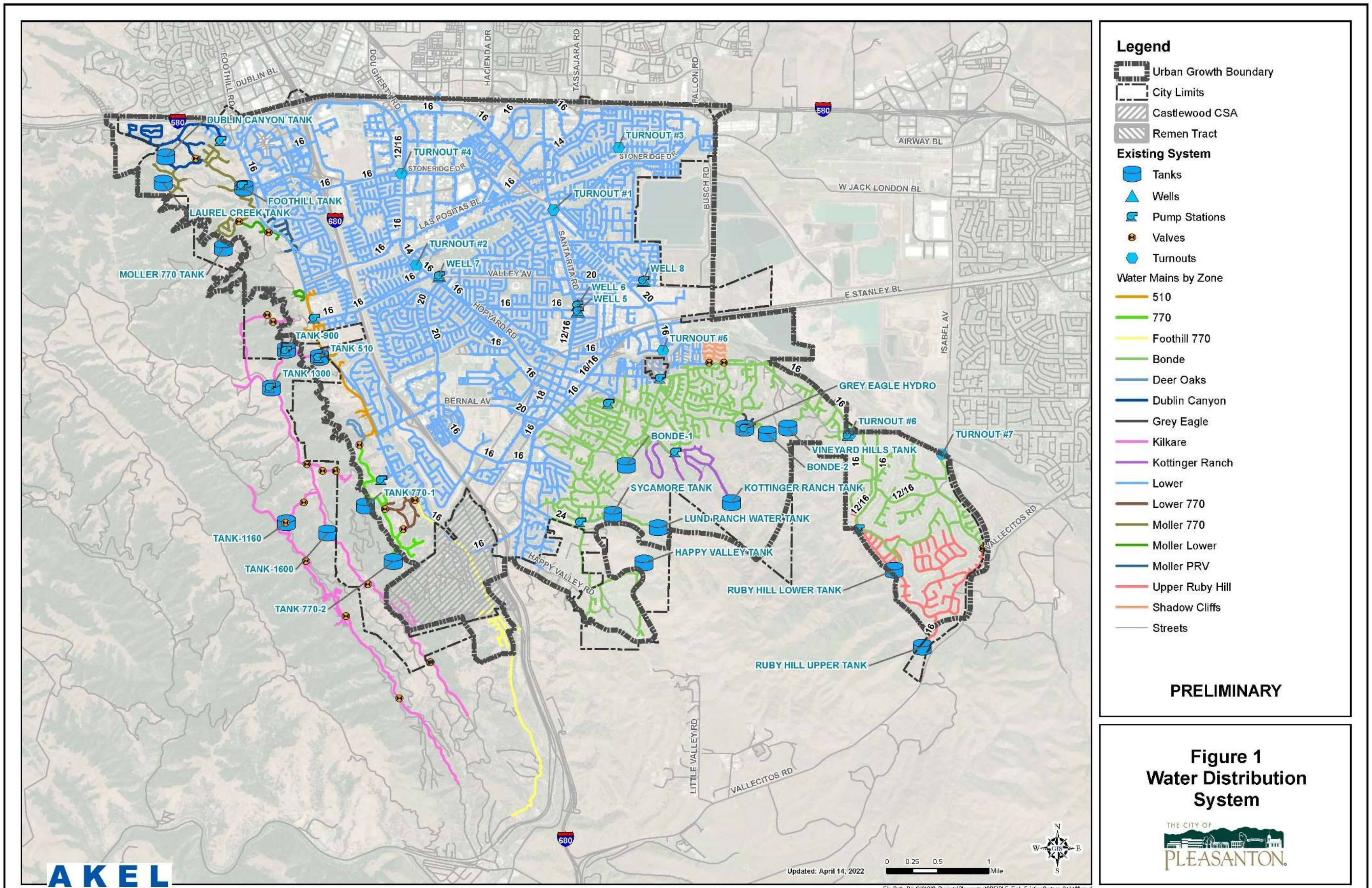

Figure 1 City of Pleasanton Distribution System

SECTION 3 CURRENT DRINKING WATER REGULATIONS

Drinking water quality in the United States is governed by legislation enacted by the federal and state governments. Statutes, more commonly known as laws, direct the appropriate government agency to develop and publish regulations or rules to implement the requirements of the law. Standards specify the amount or concentration of a particular constituent that is legally allowed in drinking water. At the federal level, the United States Environmental Protection Agency (EPA) is primarily responsible for developing and enforcing drinking water regulations, whereas state health departments typically regulate drinking water quality at the state level.

Any drinking water regulations promulgated by a state are required to include standards that are at least as stringent as those imposed by comparable federal regulations; states may implement regulations in addition to those mandated by federal statutes or standards that are more restrictive than federal ones. The State of California has adopted and codified these rules, along with several state-specific requirements. The State Water Resources Control Board (SWRCB) Division of Drinking Water (DDW) administers and enforces these rules. The following subsections present an overview of federal and state regulations, followed by a discussion of current regulations that warrant consideration for continued City compliance with all drinking water regulations.

3.1 National Primary and Secondary Drinking Water Regulations

The Safe Drinking Water Act (SDWA) of 1974 and its amendments (1986 and 1996) provide a regulatory framework that specifies how National Primary Drinking Water Regulations (NPDWR) are developed, promulgated, and implemented. Elements of this regulatory framework require that EPA periodically review existing NPDWRs for continued protection of public health, evaluate potential risks associated with unregulated contaminants that are known to occur in drinking water supplies, and monitor the occurrence of contaminants in drinking water supplies.

The NPDWRs established by the EPA are legally enforceable primary standards applicable to all potable water systems and intended to protect the public from consuming water containing contaminants that present a risk to human health. The regulations set maximum contaminant levels (MCLs), maximum contaminant level goals (MCLGs), and treatment technique requirements for a total of 94 contaminants. As shown in Figure 2, the number of contaminants regulated has increased dramatically from the original 22 listed in 1975 and 1976.

The USEPA has also established National Secondary Drinking Water Regulations (NSDWRs), adopted by California's SWRCB, that set non-mandatory water quality standards for 15 contaminants. Secondary regulations are not legally enforceable and function as guidelines for water utilities to provide aesthetically pleasing drinking water and avoid cosmetic effects such as tooth discoloration. Taste and odor, for example, are aesthetic issues, as opposed to health issues, and secondary drinking water regulations are therefore applicable. The secondary standards set secondary MCLs for a total of 15 compounds that do not present a health risk at such levels.

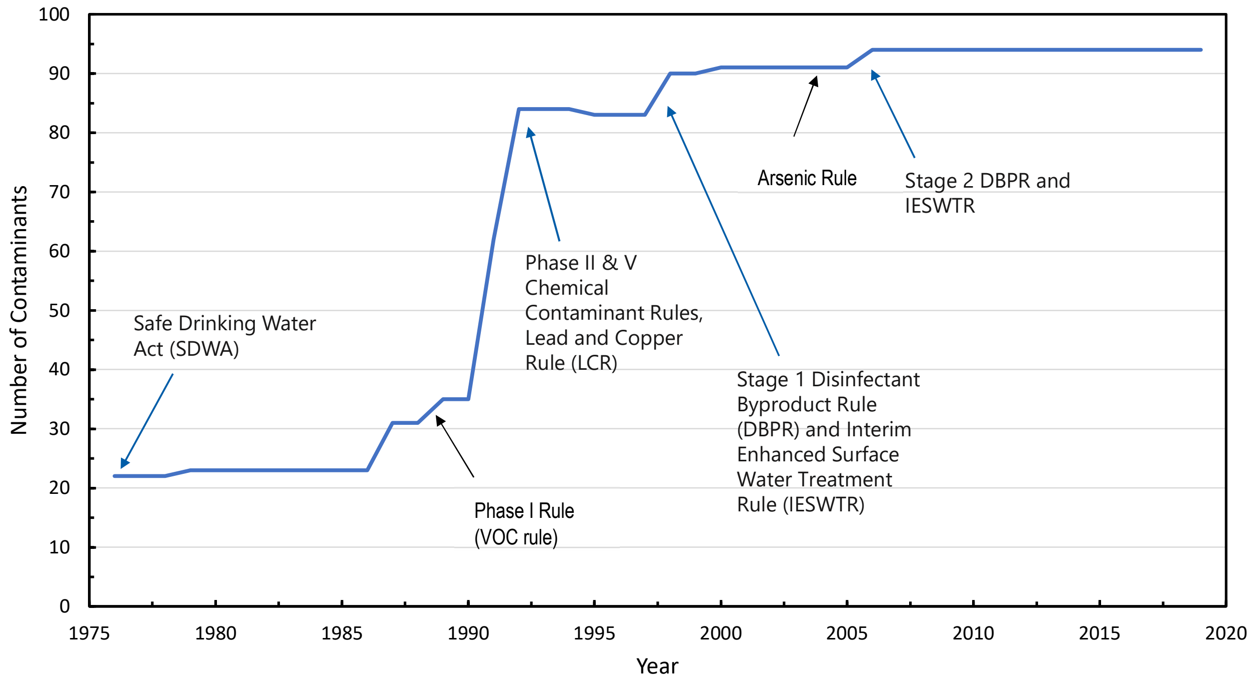

Figure 2 Water Quality Regulations and Drinking Water Standards

The national primary and secondary drinking water standards are listed in Appendix A. Some regulations are based on compliance at the entry point to the distribution system, whereas others are based on compliance within the distribution system (e.g., chlorine residuals, disinfection by-products (DBPs), and at household taps (e.g., lead and copper). Zone 7 is required to meet NPDWRs in its groundwater and surface water supplies for contaminants with compliance points at the entry point to the distribution system. The City is required to meet NPDWRs for its groundwater supplies for contaminants with compliance points at the entry point to the distribution system. The City is also required to meet NPDWRs for contaminants that are regulated within the distribution system, and at household taps. The City has forty-eight (48) distribution system sample points that are used to monitor water quality for compliance with the Total Coliform Rule (TCR), Stage 1 and 2 Disinfectant and Disinfection By-Product Rules (D/DBPR), and for nitrification monitoring and control.

3.2 California Drinking Water Regulations

The State of California has established several drinking water standards that are additive to the NPDWRs, including for perchlorate, nickel, and strontium. Appendix B lists both the Federal and California MCLs. Contaminants that are regulated in California, but not federally, are highlighted in yellow. Contaminants for which California has established more stringent standards are highlighted in blue.

Appendix B also lists the public health goals (PHGs) corresponding to the different regulated contaminants. PHGs are established by the California Office of Environmental Health Hazard Assessment (OEHHA). These are concentrations of drinking water contaminants at or below which no significant public health risk is presented from consumption of the water over a lifetime, based on current risk assessment principles, practices, and methods. OEHHA establishes PHGs pursuant to Health & Safety Code §116365(c) for contaminants with MCLs, and for those for which MCLs will be adopted. PHGs are analogous to

MCLGs, with the exception that California requires that water systems provide information on contaminants that exceed the PHG in their annual Consumer Confidence Reports. Certain public water systems must provide a report to their customers about health risks from a contaminant that exceeds its PHG and about the cost of treatment to meet the PHG and hold a public hearing on the report.

3.3 Health Advisory and Notification Levels

In recent years, the USEPA has issued health advisory (HA) levels for emerging contaminants such as cyanotoxins and per- and polyfluorinated alkyl substances (PFAS). While HAs are not enforceable, they can prompt state and/or local action. For example, the USEPA established a combined 70 nanogram per liter (ng/L) HAs for PFOS plus PFOA on May 25, 2016.

The California State Water Resources Control Board Division of Drinking Water (DDW) has established health-based notification levels (NLs) for chemicals in drinking water that lack MCLs. There are currently 32 chemicals with NLs, including chlorate, manganese, three nitrosamines, and four PFAS. The chemicals with NLs, and the corresponding NL, are listed on DDW's website: Drinking Water Notification Levels and Response Levels: An Overview. Certain requirements and recommendations apply when chemicals are found at concentrations above their NLs. DDW has also established response levels (see DDW Website link above) corresponding for chemicals with NLs. Water systems are required to treat, take out of service or notify public if continuing to supply source water where a contaminant is detected at a concentration above the response level. As an example, the response level for NDMA is 30 times the NL, W\whereas the response level for PFOA and PFOS is currently 100 times the cancer risk. Relevant requirements that the City must meet for PFAS are discussed below.

3.4 City Compliance with Current Regulations, Health Advisory and Notification Levels

The City meets all current federal and state drinking water standards. A review of the Safe Drinking Water Information System (SDWIS) indicated that the City has not been in violation of any drinking water standard since late 1995 when the City experienced a compliance violation related to the TCR. However, there are several regulations that warrant consideration for the City's continued compliance, either in anticipation of new regulations, or changes to the City's supplies:

- Lead and Copper Rule
- Groundwater Rule
- Stage 1 and 2 D/DBPR
- Per- and Polyfluoroalkyl Substances
- American Water Infrastructure Act (AWIA) requirements for Consumer Confident Reports (CCR)

This section summarizes these rules and their implications for the City.

3.4.1 Lead and Copper Rule Revisions (LCRR)

The final Lead and Copper Rule Revisions (LCRR) were published in the Federal Register on January 15, 2021 (86 FR 4198), with the rules placed in effect beginning on December 16, 2021. The final rule lists a compliance date of October 16, 2024. Notably, the USEPA is also developing Lead and Copper Rule Improvements (LCRI) that could further impact requirements for public water system compliance.

The LCRR includes revisions in the following key areas:

- Identifying areas most impacted.
- Strengthening treatment requirements.
- Systematically replacing lead service lines.
- Increasing sample reliability.
- Improving risk communication.
- Protecting children in schools and childcare facilities.

Table 2 summarizes rule requirements within each of the six key areas. The requirements that are anticipated to most significantly impact the City include: development of a lead service line (LSL) inventory, potential action in the event of an individual lead concentration above 15 µg/L, potential revisions to the lead and copper compliance sampling locations, notification requirements until all service line materials are confirmed, and sampling requirements for schools and childcare facilities.

The City developed an inventory of the publicly-owned service lines to meet state requirements. Of the 22,229 service lines inventoried, none were identified as lead, and none were identified as unknown. The City will need to update the inventory to include a review of records and potential field inspections to characterize the material for the privately-owned portion of the service line.

The City is on a reduced triennial sampling schedule for lead and copper. Ninetieth (90^{th}) percentile lead concentrations have been below the 5 microgram per liter (µg/L) practical quantitation level (PQL) for the past three triennial sampling events. In the most recent 2019 compliance sampling event, 1 of 58 samples had lead above 15 µg/L. Following the October 16, 2024 compliance deadline, individual samples with lead above 15 µg/L will be subject to “find-and-fix” requirements. Initial proactive recommended steps are to evaluate where in the distribution system the individual sample above 15 µg/L from 2019 is located and the likely source of lead serving that area.

Table 2 Summary for Lead Copper Rule Revisions

Focus Area	Rule Requirement
Identifying areas most impacted	▪ Complete an LSL inventory. ▪ Systems without LSLs must demonstrate their absence.
Strengthening treatment requirements	▪ 10 µg/L trigger level (TL) in addition to the current 15 µg/L Action level (AL). ▪ If the TL is exceeded based on 90th percentile lead concentrations, systems must re-optimize corrosion control treatment (CCT) or conduct a study if CCT is not currently in place. ▪ Calcium hardness adjustment is no longer a lead CCT option and phosphate inhibitors must be orthophosphate. ▪ Calcium, conductivity, and temperature analyses are no longer required as part of the water quality parameter (WQP) sampling. ▪ If an individual tap sample exceeds 15 µg/L, systems must collect a follow-up sample, conduct WQP monitoring at or near the site (0.5-mile radius, similar pressure zone), and perform a corrective action. This is termed a "find-and-fix" approach.

Focus Area	Rule Requirement
Systematically replacing lead service lines	▪ Systems with lead above the TL must develop a goal for LSL replacement; 3% LSL replaced per year with systems above the AL. ▪ No partial LSLs can be conducted. ▪ Utilities must replace their portion of an LSL within 45 days if the customer replaces their portion.
Increasing sample reliability	▪ Prioritize sample collection from sites served by LSLs. ▪ For sites with LSLs, the 5th liter should be collected. ▪ Collect samples in wide-mouth bottles with no cleaning, flushing, etc. prior to sample collection.
Improving risk communication	▪ Utilities must notify individual tap sample consumers within 3 days of a 15 µg/L sample detection. ▪ Utilities must inform customers served by an LSL or lead status unknown service line. ▪ CCR must provide updated health effects language and information regarding LSL replacement programs. ▪ Utilities must notify system-wide customers of lead AL exceedance within 24 hours. ▪ Systems must improve public access to lead information, including LSL locations, and respond to requests for LSL information, deliver educational materials to customers during water-related work that could disturb LSLs, and provide increased information to health care providers.
Protecting children in schools and childcare facilities	▪ Develop a list of schools and childcare facilities by the 2024 compliance deadline. ▪ Test 20% of licensed childcare facilities and elementary schools each year. ▪ Provide testing to secondary schools on request. ▪ Provide information and communicate results to users of the facility, parents, Primacy Agency, and the local or state health department.

3.4.2 Groundwater Rule

The groundwater rule (GWR) applies to public water systems that use groundwater as a source of drinking water. This rule was put in place to minimize public health risk associated with potential occurrence of microbial pathogens (e.g., virus) in groundwater supplies. The GWR requires that public water systems using groundwater complete the following steps (USEPA, 2022):

1. Perform routine sanitary surveys to identify any significant deficiencies.
2. Monitor systems that identified a positive sample during regular Total Coliform monitoring or assessment monitoring targeted at high-risk systems. This is triggered if the drinking water is not treated to remove 4-log of viruses.
3. Implement corrective action for any system with a significant deficiency or source water fecal contamination.
4. Monitor compliance with 4-log inactivation or removal of viruses by treatment technique.

The City has already completed steps for compliance with the GWR for existing wells. However, if the City were to construct any new wells (e.g., following demolition of Wells 5 and 6), the City would need to complete steps for continued compliance with the GWR. New groundwater sources would require monitoring after construction if they can't prove 4-log inactivation or removal of viruses.

3.4.3 Stage 1 and 2 D/DBPR

The Stage 1 and 2 D/DBPR Rules provide protection from DBPs. These are part of the EPA's suite of Microbial and Disinfection Byproducts Rules (M/DBPs). Disinfectants can combine with naturally occurring materials found in the water and form DBPs that can pose risks to public health.

The Stage 1 D/DBPR was finalized in December 1998 and became effective on January 1, 2002. All public water systems serving populations greater than 500 and using a primary disinfectant other than ultraviolet (UV) light are subject to the Stage 1 D/DBPR.

The Stage 1 D/DBPR reduced the total trihalomethane (TTHM) MCL to 80 µg/L and established MCLs for a group of haloacetic acids (HAA5) at 60 µg/L, bromate, and chlorite. Under the Stage 1 D/DBPR, compliance with the TTHM and HAA5 MCLs was established based on the running annual averages (RAAs) across all monitoring sites.

The Stage 2 D/DBPR was finalized in December of 2005 and became effective on January 4, 2006. Compliance monitoring for the Stage 2 D/DBPR was phased in from April 2012 to October 2013. This rule was established to strengthen the requirements of the Stage 1 D/DBPR by reducing occurrences of DBP concentration spikes in distribution systems. The MCLs for TTHM and HAA5 remained the same; however, the method used to calculate MCL compliance was altered. Under the Stage 2 D/DBPR, TTHM and HAA5 MCLs must be met as locational running annual averages (LRAAs) - the average concentration at each individual monitoring location, rather than RAAs of the system as a whole. Furthermore, monitoring samples must be collected at distribution system locations with high DBP concentrations as determined by an Initial Distribution System Evaluation, and during peak months of TTHM and HAA5 occurrence. LRAAs are calculated by collecting quarterly samples at each monitoring location and taking the average of the most recent sample and the three preceding samples.

Table 3 summarizes the TTHM and HAA5 compliance concentrations in City distribution system samples collected since 2013, based on data reported in the City's annual water quality reports. The highest LRAA TTHM concentration was within 1 µg/L of the MCL in 2013. TTHM LRAA concentrations have been lower in all subsequent years, and generally below 80 percent of the MCL. However, the maximum TTHM concentrations each year can exceed the MCL, indicating the City will need to plan for any changes in source water quality (e.g., wildfire impacted supplies) or treatment on DBP formation and implement any mitigation strategies required for continued compliance. HAA5 LRAA concentrations are well below 60 percent of the MCL and maximum HAA5 concentrations are also below the MCL.

Zone 7 recently implemented ozone at their surface water treatment plants. In 2021, the maximum running annual average bromate concentration in the treated surface water was 8 µg/L, 80 percent of the MCL. The City should closely track bromate compliance data from Zone 7 to confirm that they are providing water that meets the MCL.

The Stage 2 D/DBPR requires that systems consult with the State regulatory agency to determine if changes in DBP sample locations are needed in response to a source water or treatment modification. If the City adjusts the water supply strategy to solely rely on Zone 7, the City should meet with DDW to discuss whether any changes to the Stage 2 D/DBPR monitoring plan are required.

Table 3 Summary of TTHM and HAA5 Concentrations

Year	Highest Locational Running Annual Average			
	TTHM (µg/L)	TTHM Range	HAA5 (µg/L)	HAA5 Range
2013	79	ND-117	32	ND-56
2014	67	ND-94	30	ND-43
2015	51	ND-52	19	ND-24
2016	40	ND-54	20	ND-21
2017	55	ND-62	27	ND-40
2018	45	ND-59	18	ND-27
2019	52	ND-97.6	16	ND-29.2
2020	66	ND-68	20	ND-24

3.4.4 Per- and Polyfluoroalkyl Substances (PFAS)

The USEPA released lifetime HA levels for several PFAS compounds in 2022 while the agency simultaneously worked on establishing a federal drinking water regulation. Table 4 lists the federal HAs.

California SWRCB has established NLs and RLs for four PFAS, which are also listed in Table 4. Zone 7 and the City (Wells 5, 6, and 8) are included in the latest order from DDW requiring monitoring for PFAS.

Table 4 PFAS Federal and State Health Advisory Levels (USEPA, 2022; CA SWRCB, 2023).

Chemical	USEPA Lifetime HAs (ng/L)	CA SWRCB NLs (ng/L)	CA SWRCB RLs (ng/L)
Perfluorooctanoic acid (PFOA)	0.004	5.1	10
Perfluorooctanoic acid (PFOS)	0.02	6.5	40
GenX Chemicals	10	--	--
PFHxS and potassium perfluorobutane sulfonate (PFBS)	2,000	500	20
PFHxS	NA	3	5000

Zone 7 has some groundwater wells that have tested above the response level for PFOS and PFHxS. For Mocho wells, Zone 7 is treating at its Mocho Groundwater Demineralization Facility and/or blending so that delivered drinking water is below Response Levels. Stoneridge well and and Chain-of-Lake wells have been taken offline and are currently under construction for added PFAS treatment. All other wells and surface water treatment plants have not detected PFAS.

For the City, Well 8 has tested above the response level for PFOS and PFHxS and as a result has been put in Standby Service with DDW and has not operated since 2019.

September 2022, the City Council authorized a Water Supply Alternatives Study to evaluate water supply alternatives for the portion of water supply currently sourced by the City's local groundwater wells. These alternatives include continuing to utilize the City's local groundwater (by adding PFAS treatment or constructing new wells) or purchasing water in lieu of local groundwater pumping. These alternatives will be evaluated against multiple criteria including cost, water supply reliability, regulatory compliance, operational complexity, administration, and implementation feasibility to determine the preferred alternative. The results of this effort are scheduled to be available at the end of 2023.

On March 14, 2023, the USEPA released its proposed regulation for PFAS in drinking water. The draft NPDWR proposes a MCL of 4 ng/L for PFOA and PFOS. Four additional PFAS (GenX, PFBS, PFNA, and PFHxS) are also included under the draft regulation. The EPA proposes the use of a Hazard Index, a tool to evaluate public health risks based on exposure to chemical mixtures. Although hazard indices have been used in other government programs, like the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the EPA has not previously used this on drinking water standards. The Hazard Index for the PFAS mixture is 1.0 (unitless Hazard Index). MCLGs for each PFAS are 0 ppt for PFOA and PFOS and 1 (unitless Hazard Index) for the PFAS mixture.

The proposed regulation will undergo a public comment period for the next 60 days. Then, the USEPA will review the provided feedback and finalize the regulation. The City will be required to provide PFAS treatment for Well 5, 6, and 8 to keep wells operational under the proposed regulations.

3.4.5 Consumer Confidence Reports

On March 28, 2023, the USEPA released a proposed rulemaking to strengthen the CCR. The draft rulemaking would change several aspects of the CCR including more electronic delivery options and increased risk communication. Most notably, the CCR would require reports to be issued twice a year, instead of annually, and states will be required to submit compliance monitoring data to the USEPA (USEPA, 2023).

The proposed regulation will undergo a public comment period for the next 60 days. Then, the USEPA will review the provided feedback and finalize the regulation. The City will need to comply with the finalized CCR rulemaking once it has been established.

SECTION 4 POTENTIAL FUTURE REGULATIONS

The 1986 Amendments to the SDWA established requirements for the USEPA to publish a list of chemical and microbial contaminants (the Contaminant Candidate List, CCL) every five years to review for potential regulation. Every five years, the USEPA is required to identify five of the contaminants from that list for regulation determination. The regulatory determination could either be a decision to regulate, or decision not to regulate, in which case the contaminant is removed from future CCLs. The Unregulated Contaminant Monitoring Rule (UCMR), also set forth in the 1986 SDWA Amendments, requires that the USEPA publish a list every five years of contaminants designated for occurrence monitoring to support assessment of whether regulation would provide meaningful health risk reduction. Figure 3 illustrates the CCL and UCMR process.

The third principal component of the 1986 SDWA Amendments establishing the process for USEPA to continually assess the need for drinking water regulations to protect public health is the Six Year Review process. The US EPA is required to review existing NPDWRs every six years to evaluate the efficacy of rule revisions based on new information on occurrence or public health risks.

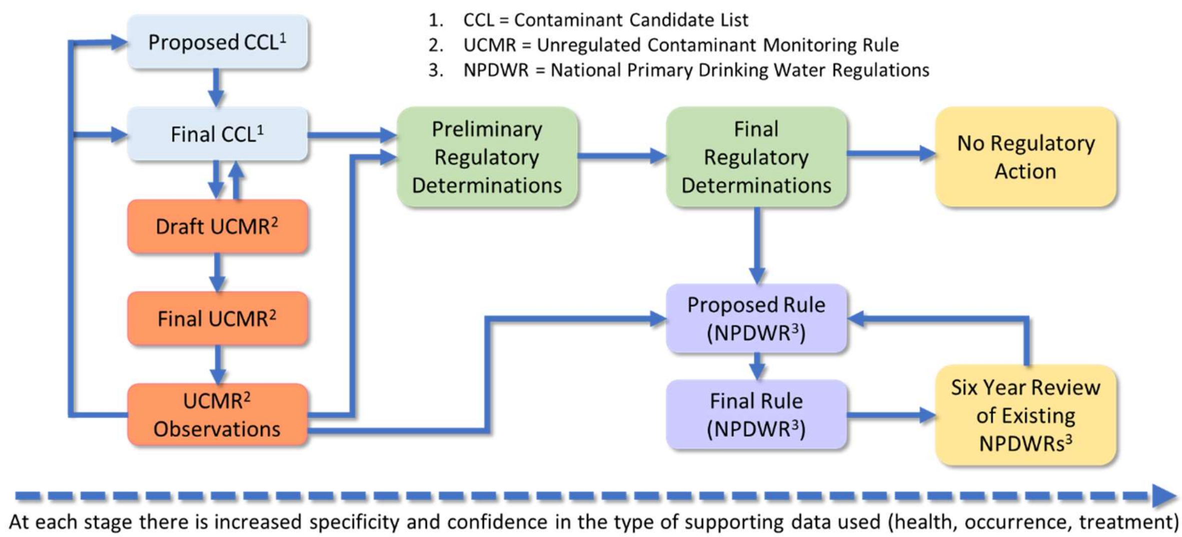

Figure 3 USEPA Process for Establishing New Drinking Water Regulations (AWWA, 2015)

Table 5 summarizes the contaminants included in each CCL and resulting regulatory determinations. To date, five CCLs have been reviewed and prepared. USEPA began the process of developing CCL 6 in February 2023 by requesting nomination of chemicals, microbes, or other materials for consideration. As a result of the first four CCL processes, the USEPA has determined not to regulate 29 different chemical contaminants and 1 microbial contaminant. The USEPA made a decision to regulate perchlorate[1] as an outcome of CCL2, strontium as an outcome of CCL3, and PFOS and PFOA as an outcome of CCL4.

Table 5 Contaminant Candidate List History

	Year Published	Contaminants Included	Proposed Regulations	Regulatory Determinations
CCL1	1998	▪ 10 microbial ▪ 50 chemical	▪ 8 chemicals (including manganese) and 1 microorganism (Acanthamoeba)	▪ Not to advance regulation of 8 chemicals (including manganese) and 1 microorganism (Acanthamoeba)
CCL2	2005	▪ 9 microbial ▪ 42 chemical	▪ 12 chemicals	▪ Not to advance regulation of 11 chemicals ▪ More information needed on perchlorate
CCL3	2009	▪ 12 microbial ▪ 104 chemicals	▪ 5 chemicals	▪ Preliminary determination to regulate strontium ▪ Not to regulate 4 chemicals
CCL4	2016	▪ 12 microbial ▪ 97 chemicals	▪ 8 chemicals	▪ Preliminary determinations to regulate PFOS & PFOA ▪ Not to regulate 6 chemicals

[1] The USEPA published a proposed NPDWR for perchlorate on June 26, 2019, but requested public comment on whether the proposed MCLG of 56 µg/L should instead by 18 µg/L, 90 µg/L, or that USEPA should withdraw the 2011 decision to regulate based on more recent occurrence and health effects data.

	Year Published	Contaminants Included	Proposed Regulations	Regulatory Determinations
CCL5	2022	▪ 12 microbial ▪ 66 chemicals and 3 chemical groups	▪ Proposed regulations for CCL5 have not been made at this time	▪ Regulatory determination has not been made for CCL5 at this time.

The data collected through the UCMR program is stored in the National Drinking Water Contaminant Occurrence Database (NCOD) to facilitate analysis and review. To date, there have been four UCMR datasets published by EPA. Water systems have begun to monitor for UCMR5 contaminants, which includes twenty-nine PFAS and lithium. Table 6 summarizes the five UCMR, their monitoring schedule, and the type of contaminants included in the list.

Table 6 Unregulated Contaminant Monitoring Rule History

	Monitoring Schedule	Contaminants Included
UCMR1	2001 – 2005	▪ 12 chemicals on List 1(1) ▪ 14 chemicals on List 2(2)
UCMR2	2007 – 2011	▪ 10 chemicals on List 1(1) ▪ 15 chemicals on List 2(3)
UCMR3	2012 – 2016	▪ 21 chemicals on List 1(1) ▪ 7 hormones on List 2(3) ▪ 2 viruses on List 3(4) pre-screening
UCMR4	2018 – 2020	▪ 10 cyanotoxins on List 1(1) ▪ 20 chemicals on List 1(1)
UCMR5	2023 – 2025	▪ 30 chemicals on List(5)

Notes:
(1) All public water systems serving more than 10,000 people performed assessment monitoring for List 1 contaminants, along with a representative selection of 800 public water systems serving less than 10,000 people.
(2) A selection of 120 systems serving more than 10,000 people and 180 systems (a subset of the 800 List 1 systems) serving less than 10,000 people were assigned to monitor for List 2 contaminants.
(3) All public water systems serving more than 100,000 people, along with 320 public water systems serving 10,000 to 100,000 people and 480 public water systems serving less than 10,000 people, performed screening surveys for List 2 contaminants.
(4) A representative selection of 800 undisinfected groundwater serving public water systems serving 1,000 or fewer people participated in monitoring for two viruses and related pathogen indicators.
(5) All public water systems serving more than 33,000 people, along with a representative selection of 800 public water systems serving less than 10,000 people, would perform monitoring for listed contaminants.

Table 7 lists regulatory actions anticipated to occur within the next 1 to 5 years. Most potential regulatory actions come from the CA SWRCB DDW except for the microbial / disinfection byproduct rule. Each anticipated regulation is discussed in more detail in this section.

Table 7 List of Recent and Anticipated Near-Term Regulatory Actions

Regulation	Recent Action	Anticipated Near-Term Actions
Microbial / Disinfection Byproducts (M-DBP) Rule	M/DBPRs were identified for potential revision as a result of the third Six Year Review	NDWAC working group is developing recommended revisions to the M/DBPRs for the USEPA to consider
Arsenic Rule	DDW regulation for arsenic is under review.	Proposed revisions to the arsenic MCL expected in 2023.
Hexavalent Chromium (CR(VI))	Draft regulations for CR(VI) are being prepared.	Proposed regulation is anticipated in 2023.

Regulation	Recent Action	Anticipated Near-Term Actions
Manganese (Mn)	DDW revised notification and response levels for Mn.	Additional notifications to customers are required.
Microplastics	SWRCB released guidance on testing and reporting for microplastics.	Test and reporting of microplastic levels will potentially lead to a new regulation.

4.1 Microbial / Disinfection Byproducts (M/DBP) Rule

The EPA identified eight contaminants covered by the M/DBPRs as candidates for regulatory revision as part of the six-year review process. The eight candidates are: Chlorate, *Cryptosporidium*, HAA5, heterotrophic bacteria, *Giardia lamblia*, *Legionella*, TTHMs, and viruses. These contaminants are including in several M/DBP rules:

- Stage 1 and Stage 2 D/DBPR
- Surface Water Treatment Rule
- Interim Enhanced Surface Water Treatment Rule (IESWTR)
- Long Term 1 Enhanced Surface Water Treatment Rule (LT1)

The National Drinking Water Advisory Council (NDWAC), a federal advisory committee that provides the EPA with advice and recommendations related to drinking water, created a working group to discuss and collect public feedback on the MDBP revisions (USEPA, 2023). As of March 2023, the working group has met seven times since May 2022 to discuss how to improve the existing regulations. In addition, the EPA is conducting analyses to further evaluate the eight contaminants. Unregulated DBPs, like chlorate and nitrosamines, are also being evaluated in this effort (USEPA, 2023).

The USEPA's decision on the M-DBP rule may adjust how the City treats contaminants captured under the rule. Potential revisions could include, but are not limited to:

- A numeric value for the minimum disinfectant residual
- Revised MCLs for HAAs to encompass brominated species (e.g., an MCL for HAA9 or HAA6Br)
- Chlorate MCL
- *Legionella* monitoring

Nitrification can result in a disinfectant residual loss. The City's Nitrification Evaluation (Carollo, 2019) provided recommendations to monitor parameters for early warning of a nitrification event and identified potential control measures. Nitrification control will be an important aspect of complying with any revised numeric disinfectant residual level.

Based on a review of the City's UCMR4 data, maximum HAA6Br and HAA9 concentrations are low (22 and 29 μg/L, respectively). Despite elevated bromate concentrations in some supplies (see Carollo, 2019), a revised HAA MCL that encompasses brominated species is not anticipated to result in compliance hurdles for the City.

Chlorate concentrations in UCMR3 distribution system samples collected from areas receiving treated surface water were higher than the 210 μg/L health reference level. If USEPA regulates chlorate, methods to minimize chlorate in Zone 7 surface water supplies may be needed.

4.2 Arsenic Rule

The current MCL for arsenic is 10 µg/L, which was set by the USEPA in 2006. However, OEHHA's PHG is 0.004 µg/L (SWRCB, 2023). Although the USEPA is not currently reviewing the federal set arsenic regulation, the California DDW is currently reviewing its MCL to see if it technically and economically feasible to reduce the MCL, so the standard is closer to the PHG goal.

Recent data from the City shows that arsenic levels in Wells 5, 6, and 8 are undetectable. However, the City should continue to monitor arsenic water quality data in the groundwater wells.

4.3 Hexavalent Chromium (Cr(VI))

Hexavalent chromium is regulated under the California MCL for total chromium at 0.05 mg/L whereas the federal MCL is 0.1 mg/L. The State of California used to have a specific Cr(VI) of 10 µg/L, but this regulation was invalidated by the Superior Court of Sacramento in 2017. The court found that the MCL was invalid because there was no determination of economic feasibility in the regulatory process. The court ordered SWRCB to write a new regulation for Cr(VI) (SWRCB, 2022).

The City met the state MCL for Cr(VI) when it was in effect from 2011 to 2017. Recorded levels of Cr(VI) ranged from 3.6-5.5 µg/L in Wells 5, 6, and 8. If the new regulation results in a Cr(VI) MCL of 10 µg/L, resulting impacts to the City would be limited to monitoring requirements. However, if the MCL is lowered, the City would need to evaluate treatment or blending options.

4.4 Manganese

The City is currently required to notify and respond to Mn levels of 500 µg/L and 5,000 µg/L respectively. Additionally, a secondary MCL exists at 50 µg/L, which is based off aesthetic concerns (SWRCB, 2023). In February 2023, the DDW proposed new notification and responses levels for Mn of 20 µg/L and 200 µg/L (SWRCB, 2023). The City does not have detectable levels of Mn in their groundwater wells, so no adjustments are needed to the City's current treatment for Mn.

4.5 Microplastics

In August 2022, the SWRCB released a handbook which established methods for testing and reporting of microplastics in drinking water. This provides the foundation for Phase 1 of the CA Microplastics Monitoring Program. This is a four-year program for selected surface waters occurring in two phases. The first phase includes collecting four raw water samples per year for two years: two samples in rainy season and two samples during dry season. DDW will present a public workshop for systems required to monitor to be held in May 2023. Phase Monitoring is anticipated to occur 2024 to 2026. Phase 2, hinging on the result of Phase 1 is likely to include treated water sampling.

Groundwater sources are anticipated to be less impacted by microplastics than surface water systems. As a result, the impacts of this future regulation are anticipated to be outside of the planning horizon of this document for the City's wells.

Zone 7's surface water supplies will need to monitor, and depending on results, may need to implement improvements.

SECTION 5 CONCLUSIONS AND RECOMMENDATIONS

The City meets all current federal and state primary drinking water standards, with no violations since 1995, close to three decades ago. Several current regulations will require that the City complete steps for continued compliance:

- LCRR. The City will need to complete its LSL inventory (for privately owned portions) and update its lead and copper sampling protocol (i.e., locations to reflect revised tiering structure, use of wide-mouthed bottles, etc.) by October 16, 2024. Additionally, the City will need to comply with the requirements for sampling in schools and childcare facilities, and update communication materials to meet the rule requirements for public education. Based on historical lead and copper compliance data, the City is not anticipated to be impacted by the new 10 μg/L trigger level, but could be subject to find-and-fix requirements for any individual sample results above 15 μg/L.
- PFAS. The City will need to comply with the CA SWRCB NLs and response levels for PFAS. Once the USEPA PFAS regulations are finalized, Zone 7 and the City will need to comply with those MCLs / hazard index. For now, the City should inform customers if PFAS levels meet or exceed the notification requirements and continue to monitor and confirm ability to operate Wells 5 and 6 below response levels. Zone 7 is installing treatment to remove PFAS from its contaminated groundwater supplies. The City will need to install treatment to meet CA SWRCB response levels and the USEPA propose MCLs if it elects to continue use of any of its wells.
- CCR. The City will need to comply with the CCR rulemaking once it has been finalized.
- GWR. The City will need to complete steps for continued compliance if any new wells are constructed.
- Upcoming UCMR 5 Testing
- In the future, if the City modifies its source water and/or treatment (i.e. install new wells, add PFAS treatment, add new Zone 7 turnouts) it should consult with DDW to determine if adjustments to DBP monitoring are required.
- Distribution system water quality data should be carefully tracked for continued compliance. For example, TTHM concentrations have approached the MCL. The City should continue to monitor and manage DBPs in the distribution system. As the City continues to improve disinfectant residuals in the distribution system to help manage nitrification, the nitrification monitoring plan should be updated to reflect modifications and changing conditions.

As a consecutive system, the City will also need to remain vigilant in verifying Zone 7's continued compliance with all regulations.

Potential future federal and state regulations could lead to additional requirements or steps for compliance:

- M/DBPR revisions. Potential revisions to the M/DBPRs that have been discussed within the NDWAC working group that could impact the City include changes to the minimum disinfectant residual, a chlorate MCL, and any requirements for opportunistic pathogen monitoring. Despite bromide occurrence in some supplies at higher concentrations (see Nitrification Evaluation, Carollo, 2019), the brominated HAA concentrations in City distribution system samples collected for UCMR4 were below 30 μg/L. The City is not anticipated to be impacted by an HAA9 or HAA6Br MCL.

- PFAS. Once the USEPA PFAS regulations are finalized, Zone 7 and the City will need to comply with those MCLs.
- Cr(VI) MCL. The City will need to comply with the Cr(VI) state standard if and when it is established. Since Cr(VI) concentrations are low in the City's supplies, compliance will most likely be limited to monitoring and reporting.

SECTION 6 REFERENCES

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APPENDIX A NATIONAL PRIMARY DRINKING WATER REGULATIONS

The national primary and secondary drinking water standards are presented in Table A1 and A2 respectively. All 94 contaminants regulated under the NPDWR are presented in Error! Reference source not found.A1, and the 15 contaminants regulated under the National Secondary Drinking Water Regulations (NSDWR) are presented in A2. Table 1A1 lists the regulation that resulted in the corresponding standard for a given contaminant. The regulations include MCLs or treatment technique (TT) requirements for inorganic and organic chemical contaminants, and microorganisms. The corresponding MCLG is also listed.

Table A1 National Primary Drinking Water Standards (as of 4/2023)

Contaminant	Regulation	MCL or TT(1) (ppm)(2)	MCLG (ppm)(2)
Organic Chemicals			
Acrylamide	Chemical Contaminant Rule (Phase II)	(TT)	Zero
Alachlor	Chemical Contaminant Rule (Phase II)	0.002	Zero
Atrazine	Chemical Contaminant Rule (Phase II)	0.003	0.003
Benzene	VOC Rule (Phase I)	0.005	Zero
Benzo(a)pyrene (PAHs)	Chemical Contaminant Rule (Phase V)	0.0002	Zero
Carbofuran	Chemical Contaminant Rule (Phase II)	0.04	0.04
Carbon tetrachloride	VOC Rule (Phase I)	0.005	Zero
Chlordane	Chemical Contaminant Rule (Phase II)	0.002	Zero
Chlorobenzene	Chemical Contaminant Rule (Phase II)	0.1	0.1
2,4-D	Chemical Contaminant Rule (Phase II)	0.07	0.07
Dalapon	Chemical Contaminant Rule (Phase V)	0.2	0.2
1,2-Dibromo-3-chloropropane (DBCP)	Chemical Contaminant Rule (Phase II)	0.0002	Zero
o-Dichlorobenzene	Chemical Contaminant Rule (Phase II)	0.6	0.6
p-Dichlorobenzene	VOC Rule (Phase I)	0.075	0.075
1,2-Dichloroethane	VOC Rule (Phase I)	0.005	Zero
1,1-Dichloroethylene	VOC Rule (Phase I)	0.007	0.007
cis-1,2-Dichloroethylene	Chemical Contaminant Rule (Phase II)	0.07	0.07
trans-1,2-Dichloroethylene	Chemical Contaminant Rule (Phase II)	0.1	0.1
Dichloromethane	Chemical Contaminant Rule (Phase V)	0.005	Zero
1,2-Dichloropropane	Chemical Contaminant Rule (Phase II)	0.005	Zero
Di(2-ethylhexyl) adipate	Chemical Contaminant Rule (Phase V)	0.4	0.4
Di(2-ethylhexyl) phthalate	Chemical Contaminant Rule (Phase V)	0.006	Zero
Dinoseb	Chemical Contaminant Rule (Phase V)	0.007	0.007
Dioxin (2,3,7,8-TCDD)	Chemical Contaminant Rule (Phase V)	0.00000003	Zero
Diquat	Chemical Contaminant Rule (Phase V)	0.02	0.02

Contaminant	Regulation	MCL or TT(1) (ppm)(2)	MCLG (ppm)(2)
Endothall	Chemical Contaminant Rule (Phase V)	0.1	0.1
Endrin	Chemical Contaminant Rule (Phase V)	0.002	0.002
Epichlorohydrin	Chemical Contaminant Rule (Phase II)	(TT)	Zero
Ethylbenzene	Chemical Contaminant Rule (Phase II)	0.7	0.7
Ethylene dibromide	Chemical Contaminant Rule (Phase II)	0.00005	Zero
Glyphosate	Chemical Contaminant Rule (Phase V)	0.7	0.7
Heptachlor	Chemical Contaminant Rule (Phase II)	0.0004	Zero
Heptachlor epoxide	Chemical Contaminant Rule (Phase II)	0.0002	Zero
Hexachlorobenzene	Chemical Contaminant Rule (Phase V)	0.001	Zero
Hexachlorocyclopentadiene	Chemical Contaminant Rule (Phase V)	0.05	0.05
Lindane	Chemical Contaminant Rule (Phase II)	0.0002	0.0002
Methoxychlor	Chemical Contaminant Rule (Phase II)	0.04	0.04
Oxamyl (Vydate)	Chemical Contaminant Rule (Phase V)	0.2	0.2
Pentachlorophenol	Chemical Contaminant Rule (Phase II)	0.001	Zero
Picloram	Chemical Contaminant Rule (Phase V)	0.5	0.5
Polychlorinated biphenyls (PCBs)	Chemical Contaminant Rule (Phase II)	0.0005	Zero
Simazine	Chemical Contaminant Rule (Phase V)	0.004	0.004
Styrene	Chemical Contaminant Rule (Phase II)	0.1	0.1
Tetrachloroethylene	Chemical Contaminant Rule (Phase II)	0.005	Zero
Toluene	Chemical Contaminant Rule (Phase II)	1	1
Toxaphene	Chemical Contaminant Rule (Phase II)	0.003	Zero
2,4,5-TP (Silvex)	Chemical Contaminant Rule (Phase II)	0.05	0.05
1,2,4-Trichlorobenzene	Chemical Contaminant Rule (Phase V)	0.07	0.07
1,1,1-Trichloroethane	VOC Rule (Phase I)	0.2	0.2
1,1,2-Trichloroethane	Chemical Contaminant Rule (Phase V)	0.005	0.003
Trichloroethene	VOC Rule (Phase I)	0.005	Zero
Vinyl chloride	VOC Rule (Phase I)	0.002	Zero
Xylenes (total)	Chemical Contaminant Rule (Phase II)	10	10
Inorganic Substances			
Antimony	Chemical Contaminant Rule (Phase V)	0.006	0.006
Arsenic	Arsenic Rule	0.010	Zero
Asbestos (fibers/L > 10 µm)	Chemical Contaminant Rule (Phase II)	7 million fibers/L	7 million fibers/L
Barium	Chemical Contaminant Rule (Phase II)	2	2
Beryllium	Chemical Contaminant Rule (Phase V)	0.004	0.004
Cadmium	Chemical Contaminant Rule (Phase II)	0.005	0.005

Contaminant	Regulation	MCL or TT(1) (ppm)(2)	MCLG (ppm)(2)
Chromium (total)	Chemical Contaminant Rule (Phase II)	0.1	0.1
Copper	LCR and LCRR	(TT) AL=1.3	1.3
Cyanide	Chemical Contaminant Rule (Phase V)	0.2 (as free cyanide)	0.2
Fluoride	NPDWR	4	4
Lead	LCR and LCRR	(TT) AL = 0.015	Zero
Mercury (inorganic)	Chemical Contaminant Rule (Phase II)	0.002	0.002
Nitrate (as N)	Chemical Contaminant Rule (Phase II)	10	10
Nitrite (as N)	Chemical Contaminant Rule (Phase II)	1	1
Selenium	Chemical Contaminant Rule (Phase II)	0.05	0.05
Thallium	Chemical Contaminant Rule (Phase V)	0.002	0.0005
Radionuclides			
Gross Alpha	Radionuclides Rule	15 pCi/L	Zero
Beta and photon radioactivity	Radionuclides Rule	4 mrem/yr	Zero
Radium-226 + Radium-228	Radionuclides Rule	5 pCi/L	Zero
Uranium	Radionuclides Rule	0.030	Zero
Microorganisms			
Cryptosporidium	LT2ESWTR	(TT) oocyst/100L	Zero
Fecal coliforms and *E. coli*	RTCR	MCL(3)	Zero
Giardia lamblia	SWTR	(TT) cyst/100L	Zero
Heterotrophic plate count (HPC)	SWTR	(TT) CFU/mL	NA
Legionella	SWTR	(TT) #/mL	Zero
Total coliforms	RTCR	5.0 percent(4) #/mL	Zero
Turbidity	SWTR	0.3 NTU(5)	NA
Viruses	SWTR and GWR	(TT) #/mL	Zero
Disinfectant Byproducts			
Bromate	Stage 1 DBPR	0.010	Zero
Chlorite	Stage 1 DBPR	1	0.8
Haloacetic Acids (HAA5(6))	Stage 2 DBPR	0.060(7)	NA(8)
Trihalomethanes (total)	Stage 2 DBPR	0.080(7)	NA(8)
Bromodichloromethane	Stage 1 DBPR	-	Zero
Bromoform	Stage 1 DBPR	-	Zero
Chloroform	Stage 2 DBPR	-	0.07
Dibromochloromethane	Stage 1 DBPR	-	0.06
Dichloroacetic acid	Stage 1 DBPR	-	Zero
Monochloroacetic acid	Stage 2 DBPR	-	0.07
Trichloroacetic acid	Stage 2 DBPR	-	0.02

Contaminant	Regulation	MCL or TT(1) (ppm)[(2)]	MCLG (ppm)[(2)]
Disinfectant Residuals			
Chloramines (as Cl_2)	Stage 1 DBPR	4[(9)]	4[(10)]
Chlorine (as Cl_2)	Stage 1 DBPR	4[(9)]	4[(10)]
Chlorine dioxide (as ClO_2)	Stage 1 DBPR	0.8[(9)]	0.8[(10)]

Notes:
(6) Treatment Technique (TT): A required process intended to reduce the level of a contaminant in drinking water.
(7) Units are ppm unless otherwise noted.
(8) Routine samples containing fecal coliform or *E. coli* triggers a repeat sampling event. If the repeat sample is fecal coliform-positive, an acute MCL violation occurs. If the repeat sample is negative, another repeat sampling is triggered. If the repeat sample is fecal coliform-positive, an acute MCL violation occurs.
(9) No more than 5 percent of samples total coliform-positive in a month. Every sample that is coliform-positive must be analyzed for fecal coliforms and *E. coli*. If two consecutive samples are total coliform-positive and one is fecal coliform-positive, an acute MCL violation occurs.
(10) Performance standard: no more than 5 percent of monthly samples may exceed 0.3 NTU.
(11) Sum of concentrations of five haloacetic acid species (monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, dibromoacetic acid).
(12) Measured as locational running annual average at each monitoring site.
(13) The group itself does not have an MCLG, but some individual contaminants have an MCLG as shown in the table (bromodichloromethane, bromoform, chloroform, dibromochloromethane, dichloroacetic acid, monochloroacetic acid, trichloroacetic acid).
(14) Maximum Residual Disinfectant Level.
(15) Maximum Residual Disinfectant Level Goal.
Abbreviations: µm = micrometer(s); AL = action level; CFU = colony forming units; LCR = lead and copper rule; LT2ESWTR = Long-Term 2 Enhanced Surface Water Treatment Rule; mL = milliliter(s); mrem = millirem (milli-roentgen equivalent man); NA = not applicable; NTU = nephelometric turbidity unit; PAH = polycyclic aromatic hydrocarbon; pCi/L = picocuries per liter; ppm = parts per million; SWTR = Surface Water Treatment Rule.

Table A2 National Secondary Drinking Water Standards (as of 1/7/2021)

Contaminant	Secondary Maximum Contaminant Level (SMCL) (ppm)[(1)]
Aluminum	0.05 - 0.2
Chloride	250
Color	15 Color Units
Copper	1
Corrosivity	Non-corrosive
Fluoride	2
Foaming Agents	0.5
Iron	0.3
Manganese	0.05
Odor	3 Threshold Odor Units
pH	6.5 – 8.5 standard units
Silver	0.10
Sulfate	250
Total Dissolved Solids	500
Zinc	5

Notes:
(1) Units are parts per million (ppm) unless otherwise noted.

APPENDIX B CALIFORNIA DRINKING WATER REGULATIONS

MCLs, DLRs, PHGs, for Regulated Drinking Water Contaminants

(Units are in milligrams per liter (mg/L), unless otherwise noted.)

Last Update: January 3, 2023

The following tables includes California's maximum contaminant levels (MCLs), detection limits for purposes of reporting (DLRs), public health goals (PHGs) from the Office of Environmental Health Hazard Assessment (OEHHA). For comparison, Federal MCLs and Maximum Contaminant Level Goals (MCLGs) (USEPA) are also displayed.

Inorganic Chemicals Table, Chemicals with MCLs in 22 CCR §64431

State Regulated Inorganic Chemical Contaminant	State MCL	State DLR	State PHG	State Date of PHG	Federal MCL	Federal MCLG
Aluminum	1	0.05	0.6	2001	--	--
Antimony	0.006	0.006	0.001	2016	0.006	0.006
Arsenic	0.010	0.002	0.000004	2004	0.010	zero
Asbestos (MFL = million fibers per liter; for fibers >10 microns long)	7 MFL	0.2 MFL	7 MFL	2003	7 MFL	7 MFL
Barium	1	0.1	2	2003	2	2
Beryllium	0.004	0.001	0.001	2003	0.004	0.004
Cadmium	0.005	0.001	0.00004	2006	0.005	0.005
Chromium, Total - OEHHA withdrew the 0.0025-mg/L PHG	0.05	0.01	withdrawn Nov. 2001	1999	0.1	0.1

State Regulated Inorganic Chemical Contaminant	State MCL	State DLR	State PHG	State Date of PHG	Federal MCL	Federal MCLG
Chromium, Hexavalent - 0.01-mg/L MCL & 0.001-mg/L DLR repealed September 2017	--	--	0.00002	2011	--	--
Cyanide	0.15	0.1	0.15	1997	0.2	0.2
Fluoride	2	0.1	1	1997	4.0	4.0
Mercury (inorganic)	0.002	0.001	0.0012	1999 (rev2005)*	0.002	0.002
Nickel	0.1	0.01	0.012	2001	--	--
Nitrate (as nitrogen, N)	10 as N	0.4	45 as NO3 (=10 as N)	2018	10	10
Nitrite (as N)	1 as N	0.4	1 as N	2018	1	1
Nitrate + Nitrite (as N)	10 as N	--	10 as N	2018	--	--
Perchlorate	0.006	0.002	0.001	2015	--	--
Selenium	0.05	0.005	0.03	2010	0.05	0.05
Thallium	0.002	0.001	0.0001	1999 (rev2004)	0.002	0.0005

Copper and Lead Table, 22 CCR §64672.3

Values referred to as MCLs for lead and copper are not actually MCLs; instead, they are called “Action Levels” under the lead and copper rule.

State Regulated Copper and Lead Contaminant	State MCL	State DLR	State PHG	State Date of PHG	Federal MCL	Federal MCLG
Copper	1.3	0.05	0.3	2008	1.3	1.3
Lead	0.015	0.005	0.0002	2009	0.015	zero

Radiological Table, Radionuclides with MCLs in 22 CCR §64441 and §64443

[units are picocuries per liter (pCi/L), unless otherwise state; n/a = not applicable]

State Regulated Radionuclides Contaminant	State MCL	State DLR	State PHG	State Date of PHG	Federal MCL	Federal MCLG
Gross alpha particle activity - OEHHA concluded in 2003 that a PHG was not practical	15	3	none	n/a	15	zero
Gross beta particle activity - OEHHA concluded in 2003 that a PHG was not practical	4 mrem/yr	4	none	n/a	4 mrem/yr	zero
Radium-226	--	1	0.05	2006		
Radium-228	--	1	0.019	2006		
Radium-226 + Radium-228	5	--	--	--	5	zero

State Regulated Radionuclides Contaminant	State MCL	State DLR	State PHG	State Date of PHG	Federal MCL	Federal MCLG
Strontium-90	8	2	0.35	2006	--	--
Tritium	"20,000"	"1,000"	400	2006	--	--
Uranium	20	1	0.43	2001	30 µg/L	zero

Organic Chemicals Table, Chemicals with MCLs in 22 CCR §64444

Volatile Organic Chemicals (VOCs)

State Regulated Volatile Organic Contaminants	State MCL	State DLR	State PHG	State Date of PHG	Federal MCL	Federal MCLG
Benzene	0.001	0.0005	0.00015	2001	0.005	zero
Carbon tetrachloride	0.0005	0.0005	0.0001	2000	0.005	zero
1,2-Dichlorobenzene	0.6	0.0005	0.6	1997 (rev2009)	0.6	0.6
1,4-Dichlorobenzene (p-DCB)	0.005	0.0005	0.006	1997	0.075	0.075
1,1-Dichloroethane (1,1-DCA)	0.005	0.0005	0.003	2003	--	--
1,2-Dichloroethane (1,2-DCA)	0.0005	0.0005	0.0004	1999 (rev2005)	0.005	zero
1,1-Dichloroethylene (1,1-DCE)	0.006	0.0005	0.01	1999	0.007	0.007

State Regulated Volatile Organic Contaminants	State MCL	State DLR	State PHG	State Date of PHG	Federal MCL	Federal MCLG
cis-1,2-Dichloroethylene	0.006	0.0005	0.013	2018	0.07	0.07
trans-1,2-Dichloroethylene	0.01	0.0005	0.05	2018	0.1	0.1
Dichloromethane (Methylene chloride)	0.005	0.0005	0.004	2000	0.005	zero
1,2-Dichloropropane	0.005	0.0005	0.0005	1999	0.005	zero
1,3-Dichloropropene	0.0005	0.0005	0.0002	1999 (rev2006)	--	--
Ethylbenzene	0.3	0.0005	0.3	1997	0.7	0.7
Methyl tertiary butyl ether (MTBE)	0.013	0.003	0.013	1999	--	--
Monochlorobenzene	0.07	0.0005	0.07	2014	0.1	0.1
Styrene	0.1	0.0005	0.0005	2010	0.1	0.1
1,1,2,2-Tetrachloroethane	0.001	0.0005	0.0001	2003	0.1	0.1
Tetrachloroethylene (PCE)	0.005	0.0005	0.00006	2001	0.005	zero
Toluene	0.15	0.0005	0.15	1999	1	1
1,2,4-Trichlorobenzene	0.005	0.0005	0.005	1999	0.07	0.07

State Regulated Volatile Organic Contaminants	State MCL	State DLR	State PHG	State Date of PHG	Federal MCL	Federal MCLG
1,1,1-Trichloroethane (1,1,1-TCA)	0.200	0.0005	1	2006	0.2	0.2
1,1,2-Trichloroethane (1,1,2-TCA)	0.005	0.0005	0.0003	2006	0.005	0.003
Trichloroethylene (TCE)	0.005	0.0005	0.0017	2009	0.005	zero
Trichlorofluoromethane (Freon 11)	0.15	0.005	1.3	2014	--	--
"1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)"	1.2	0.01	4	1997 (rev2011)	--	--
Vinyl chloride	0.0005	0.0005	0.00005	2000	0.002	zero
Xylenes	1.750	0.0005	1.8	1997	10	10

Non-Volatile Synthetic Organic Chemicals (SOCs)

State Regulated Non-Volatile Synthetic Organic Contaminants	State MCL	State DLR	State PHG	State Date of PHG	Federal MCL	Federal MCLG
Alachlor	0.002	0.001	0.004	1997	0.002	zero
Atrazine	0.001	0.0005	0.00015	1999	0.003	0.003
Bentazon	0.018	0.002	0.2	1999 (rev2009)	--	--

State Regulated Non-Volatile Synthetic Organic Contaminants	State MCL	State DLR	State PHG	State Date of PHG	Federal MCL	Federal MCLG
Benzo(a)pyrene	0.0002	0.0001	0.000007	2010	0.0002	zero
Carbofuran	0.018	0.005	0.0007	2016	0.04	0.04
Chlordane	0.0001	0.0001	0.00003	1997 (rev2006)	0.002	zero
Dalapon	0.2	0.01	0.79	1997 (rev2009)	0.2	0.2
1,2-Dibromo-3-chloropropane (DBCP)	0.0002	0.00001	0.000003	2020	0.0002	zero
2,4-Dichlorophenoxyacetic acid (2,4-D)	0.07	0.01	0.02	2009	0.07	0.07
Di(2-ethylhexyl)adipate	0.4	0.005	0.2	2003	0.4	0.4
Di(2-ethylhexyl)phthalate (DEHP)	0.004	0.003	0.012	1997	0.006	zero
Dinoseb	0.007	0.002	0.014	1997 (rev2010)	0.007	0.007
Diquat	0.02	0.004	0.006	2016	0.02	0.02
Endothal	0.1	0.045	0.094	2014	0.1	0.1

State Regulated Non-Volatile Synthetic Organic Contaminants	State MCL	State DLR	State PHG	State Date of PHG	Federal MCL	Federal MCLG
Endrin	0.002	0.0001	0.0003	2016	0.002	0.002
Ethylene dibromide (EDB)	0.00005	0.00002	0.00001	2003	0.00005	zero
Glyphosate	0.7	0.025	0.9	2007	0.7	0.7
Heptachlor	0.00001	0.00001	0.000008	1999	0.0004	zero
Heptachlor epoxide	0.00001	0.00001	0.000006	1999	0.0002	zero
Hexachlorobenzene	0.001	0.0005	0.00003	2003	0.001	zero
Hexachlorocyclopentadiene	0.05	0.001	0.002	2014	0.05	0.05
Lindane	0.0002	0.0002	0.000032	1999 (rev2005)	0.0002	0.0002
Methoxychlor	0.03	0.01	0.00009	2010	0.04	0.04
Molinate	0.02	0.002	0.001	2008	--	--
Oxamyl	0.05	0.02	0.026	2009	0.2	0.2
Pentachlorophenol	0.001	0.0002	0.0003	2009	0.001	zero
Picloram	0.5	0.001	0.166	2016	0.5	0.5

State Regulated Non-Volatile Synthetic Organic Contaminants	State MCL	State DLR	State PHG	State Date of PHG	Federal MCL	Federal MCLG
Polychlorinated biphenyls (PCBs)	0.0005	0.0005	0.00009	2007	0.0005	zero
Simazine	0.004	0.001	0.004	2001	0.004	0.004
Thiobencarb	0.07	0.001	0.042	2016	--	--
Toxaphene	0.003	0.001	0.00003	2003	0.003	zero
1,2,3-Trichloropropane	0.000005	0.000005	0.0000007	2009	--	--
2,3,7,8-TCDD (dioxin)	3x10-8	5x10-9	5x10-11	2010	3x10-8	zero
2,4,5-TP (Silvex)	0.05	0.001	0.003	2014	0.05	0.05

Disinfection Byproducts Table, Chemicals with MCLs in 22 CCR §64533

State Regulated Disinfection Byproducts Contaminants	State MCL	State DLR	State PHG	State Date of PHG	Federal MCL	Federal MCLG
Total Trihalomethanes	0.080	--	--	--	0.080	--
Bromodichloromethane	--	0.0010	0.00006	2020	--	zero
Bromoform	--	0.0010	0.0005	2020	--	zero

State Regulated Disinfection Byproducts Contaminants	State MCL	State DLR	State PHG	State Date of PHG	Federal MCL	Federal MCLG
Chloroform	--	0.0010	0.0004	2020	--	0.07
Dibromochloromethane	--	0.0010	0.0001	2020	--	0.06
Haloacetic Acids (five) (HAA5)	0.060	--	--	--	0.060	--
Monochloroacetic Acid	--	0.0020	0.053	2022	--	0.07
Dichloroacetic Acid	--	0.0010	0.0002	2022	--	zero
Trichloroacetic Acid	--	0.0010	0.0001	2022	--	0.02
Monobromoacetic Acid	--	0.0010	0.025	2022	--	--
Dibromoacetic Acid	--	0.0010	0.00003	2022	--	--
Bromate	0.010	0.0050**	0.0001	2009	0.01	zero
Chlorite	1.0	0.020	0.05	2009	1	0.8

Chemicals with PHGs established in response to DDW requests. These are not currently regulated drinking water contaminants.

State Regulated Disinfection Byproducts Contaminants	State MCL	State DLR	State PHG	State Date of PHG	Federal MCL	Federal MCLG
N-Nitrosodimethylamine (NDMA)	--	--	0.000003	2006	--	--

*OEHHA's review of this chemical during the year indicated (rev20XX) resulted in no change in the PHG.

**The DLR for Bromate is 0.0010 mg/L for analysis performed using EPA Method 317.0 Revision 2.0, 321.8, or 326.0.

APPENDIX C CURRENT AND FUTURE WATER CONSERVATION REGULATIONS MEMO

PROJECT MEMORANDUM

CITY OF PLEASANTON

Water System Management Plan

Project No.: 201264

Date: September 18, 2023

Prepared By: Brianna Barton, Tim Loper

Reviewed By: Nicola Fontaine

Subject: Current and Future State of California Water Conservation Regulations

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The purpose of this Project Memorandum is to summarize current and future State of California water conservation regulations to help inform the City of Pleasanton (City) in planning and budgeting for the future.

Current State Water Conservation Emergency Regulations

The State Water Resources Control Board (State Water Board) has two emergency regulations in effect that prohibit certain wasteful water use practices statewide and encourage Californians to use water wisely. Local water suppliers may adopt stricter water conservation measures than the State Water Board. Refer to Appendix A for a summary of the current State water conservation emergency regulations.

The California Water Code (CWC) requires urban water suppliers within the state to prepare and adopt an Urban Water Management Plan (UWMP), including a Water Shortage Contingency Plan (WSCP), every five years for submission to the Department of Water Resources (DWR). The purpose of the UWMP is to maintain efficient use of urban water supplies, continue to promote conservation programs and policies, ensure that sufficient water supplies are available for future beneficial use, and provide a mechanism for response during water drought conditions. The goal of the WSCP is to have a procedure for managing and mitigating shortages, allowing the supplier to respond in an efficient and timely manner.

The Annual Water Supply and Demand Assessment Report, also known as the Annual Water Shortage Assessment Report, Annual Shortage Report, Water Shortage Report, or Shortage Assessment Report, is due to DWR on or before July 1 of each year as required by the CWC. The annual water supply and demand assessment is a recurring process for determining the supply reliability each year and to prepare suppliers with tools to deal with anticipated water shortages.

Refer to https://www.waterboards.ca.gov/water_issues/programs/conservation_portal/regs/emergency_regulation.html for additional information about current State water conservation emergency regulations.

Future State Water Conservation Regulations

In 2018, the California State Legislature passed Senate Bill 606 and Assembly Bill 1668 directing the State Water Board to establish a new foundation for long-term improvements in water conservation and drought planning to adapt to climate change. In response, *Making Conservation a California Way of Life*[1] is the regulatory framework proposed by State Water Board staff. The proposed regulation would require urban retail water suppliers (suppliers) to calculate and adhere to urban water use objectives (objectives), implement commercial, industrial, and institutional (CII) performance measures, and submit annual progress reports.

The proposed regulation is expected to save a significant amount of water and would help to realize California's Water Supply Strategy[2] goal to reduce annual water demand by at least 500,000 acre-feet by 2030. The proposed regulation will also lessen the need for the emergency water use reduction targets that were important in recent droughts (such as the Water Conservation Emergency Regulations adopted in May 2022 to implement Governor's Executive Order N-7-22[3] which required suppliers to implement Level 2 actions [up to 20 percent shortage]).

The objective would be calculated as the sum of standard-based budgets for efficient water use (residential indoor use, residential outdoor use, CII landscapes with dedicated irrigation meters (DIMs) or equivalent technology, real water losses), variances (if applicable), temporary provisions (if applicable), and bonus incentive for potable recycled water use (if applicable). Suppliers would need to meet the overall objective, not each individual budget. The one exception is the budget for water loss which was set by a separate regulation. Individual households and businesses would not be subject to the proposed regulation. Refer to Appendix B for a summary of the objective components.

Per the proposed regulation, each supplier shall submit the supplier's calculated objective along with relevant and supporting data no later than January 1, 2025, and by January 1 every year thereafter. The calculation shall be based on the supplier's water use conditions for the previous state fiscal year.

The proposed regulation provides suppliers with flexibility to implement locally appropriate solutions. To meet annual objectives, suppliers may use a wide variety of tools to encourage customers to use water wisely, indoors and outdoors. Examples include education and outreach, leak detection, rate reform, incentives to plant "climate ready" landscapes, and rebates to replace old and inefficient fixtures and appliances.

Costs to the supplier include development of water reduction strategies, implementation of water use efficiency measures, annual calculation of the objective, preparation of annual progress reports, and lost revenues due to the water use reductions. Additional costs could include wastewater operations and maintenance or wastewater infrastructure improvements due to decreased influent volumes or increased influent concentrations.

Benefits include reduced water purchases or reduced water production, avoided stormwater measures, and energy cost savings. Additional benefits may include protecting human health and water resources, supporting practices that keep trees healthy, mitigating and adapting to climate change, accelerating nature-based solutions, diverting organic waste from landfills, building healthy soils, and advancing equity.

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[1] https://www.waterboards.ca.gov/conservation/regs/docs/2023/proposed-reg-text-081723.pdf

[2] https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Water-Resilience/CA-Water-Supply-Strategy.pdf

[3] https://www.gov.ca.gov/wp-content/uploads/2022/03/March-2022-Drought-EO.pdf

The State Water Board has predicted that statewide benefits will outweigh costs but that most of the costs will be incurred in earlier years while most of the benefits will be accrued in later years. Suppliers and wastewater agencies are expected to pass on costs and benefits of the proposed regulation to customers by adjusting their rates to customers over time.

The State Water Board has made a Water Use Objective Exploration Tool[4] available to help suppliers learn how the proposed regulation may affect urban water use. The tool includes 2017-2021 water use data for suppliers, as well as residential landscape area measurement and annual evapotranspiration and precipitation data provided by DWR. Refer to Appendix C for the tool results for the City of Pleasanton which shows that the City may not need to initially make any reductions to current water use in order to comply with the calculated objective (objective-based total).

Demands excluded from the objective include "other" uses, CII indoor use, CII landscape without DIMs, and apparent water losses which are caused by revenue meter under-registration, water theft and billing errors. Although CII indoor use and CII landscape without DIMs are excluded from the objective, they are subject to CII performance measures included in the proposed regulation. Refer to Appendix D for a summary of the CII performance measures.

The regular rulemaking process for the proposed regulation to *Making Conservation a California Way of Life* is underway. The notice of proposed rulemaking was released on August 18, 2023, and the first public comment period is open through October 17, 2023. The State Water Board will host a public hearing on the proposed regulation on October 4, 2023, starting at 9:30AM. To watch the meeting, join https://video.calepa.ca.gov/. The hearing will include an overview of the proposed regulation, the regulatory timeline and process, presentations from interested parties, and opportunity for public comment. The State Water Board will consider adopting the proposed regulation in 2024.

Refer to https://www.waterboards.ca.gov/conservation/regs/water_efficiency_legislation.html for additional information about the proposed *Making Conservation a California Way of Life* regulation.

California Water Loss Regulations

The State of California has adopted new regulations focused on water loss for urban water retailers as directed by California Water Code Section 10608.34. The regulations include a formulaic approach to the calculation of urban water retailers water loss standards and the percent reduction targets. The reduction targets are calculated based on a complex set of rules and economic factors as well as agency specific default factors. The economic model incorporates a multitude of inputs into its calculations. The inputs come from City submitted Annual Water Loss Audits, additional data submitted by the City, and factors provided by the State Water Board. The economic model inputs are summarized in Table 1.

[4] https://www.waterboards.ca.gov/water_issues/programs/conservation_portal/water-use-explorer/

Table 1 – Economic Model Inputs

Annul Water Audits	City Provided "Default" Data	Board Provided Data
• Average Baseline Real Loss • Average Length of Mains • Average Number of Service Connections • Average variable production cost of water • Average operating pressure	• Rate of Rise of Leakage • Infrastructure Condition Factor (ICF) • Annual Background Leakage • Annual Reported Leakage • Annual Unreported Leakage • Average Leak Detection Survey Frequency • Unit Average Cost of Leak Detection • Leak Detection Efficiency Average • Unit Leak Repair Costs • Marginal Avoided Cost of Water • Average Annual Rise in Price of Water*	Real discount rate (3.5%) Time period for lifecycle benefit-cost rat

*Average annual rise in price of water updates must at least as high as the real discount rate (3.5%) and be developed and certified by a licensed professional engineer.

The City can update the default factors based on a prescriptive approach provided in the regulation documentation. The economic model is the basis for the development of the benefit cost ratio. The benefit cost ratio is the calculation of the relative value of leak detection and the amount of leakage that can be reduced with a positive net benefit.

Published Water Loss Standards

Based on data provided by the City in it's annual water loss audits, and the output of the economic model the State has published water loss reduction standards and reduction goals. The standards and goals can be found on the California State Water Board Website[5]. There is significant detail related to the calculation of the City's standards and goals contained in the regulation documentation.

Specific Standards and required reductions for the City of Pleasanton are summarized in Table 2. The City's current baseline real loss is 30.9 gallons per service connection per day (gpscd). The current standard is 18.8 gpscd, which equates to a 39 percent reduction goal.

Table 2 – Pleasanton Real Loss Reduction Goals

Baseline Real Loss (gpscd)[1]	Real Loss Standard (gpscd)	Required Real Loss Reduction from Baseline (%)	30-Year Benefit Cost Ratio	5-Year Benefit Cost Rati
30.9	**18.8**	**39**	**6.4**	**3.7**

[5] https://www.waterboards.ca.gov/conservation/water_loss_control.html#water-loss-model

1. gpscd = gallons per service connection per day

Compliance Guidelines and Schedule

The State's compliance timeline is included in Figure 1. The City's needs to meet compliance guidelines by January 1, 2028.

Figure 1 – State Water Board Water Loss Compliance Timeline

Compliance can be achieved in two ways. The City will need to calculate its real water loss in the annual audits for years 2024, 2025, 2026, and 2027. Real losses are calculated based on the average of three of the four previous years, the highest year can be thrown out. The City will be in compliance by reducing the real loss from the 30.9 gpscd to 18.8 gpscd. If that goal is met, the City would need to maintain a real loss rate that is within 5 gpscd measure every three years to maintain compliance. If the City can't meet the real loss reduction targets, there is a second compliance pathway. The second compliance pathway is summarized in Table 3 below.

Table 3 – Alternative Compliance Pathway

Compliance Action	Notes
1. Alternative compliance pathways obtainable if real loss goal is greater than or equal to 30% of baseline.	Currently the City's goal is 39%
2. Show a 30% reduction in real losses over the baseline	This is equivalent to a 77% reduction of the current baseline loss.
3. Water Loss Audit Data Validity Score of 3 or demonstration of improved data quality.	Consideration will be given to data validity score reductions related to water audits prepared using different versions of the water auditing software.
4. Completed one full cycle of leak detection survey	Would require a complete system survey in a three year period between 2025 and January. 1

	2028
5. City has submitted a written request to follow the secondary compliance request by January 1, 2028.	Need to include: 1. Reason why City was unable to meet standard. 2. List of leakage prevention activities the City has engaged in to limit water loss. 3. Demonstrate how the City is being a good steward of the water code WRT Div 6, 2.25, Chapter 9. (Sustainable water use and demand reduction: Urban Water Use Objectives and Water Use Reporting) 4. A plan for how it will meet its real water loss standard no later than January 1, 2031.

The alternative compliance pathway requires significant effort to achieve, even if the City can't reach the current standard. With the alternative compliance pathway, the City will still needs to meet its standard by 2031. Essentially the City would have six years to reach the 39% reduction goals.

Water Loss Questionnaires

As part of the regulations, urban water suppliers will be required to submit responses to three questionnaires related to the City's water loss tracking and data management activities. The list of questionnaires and the submission deadlines are listed in Table 4. The City has missed the deadlines for the Data Quality and Pressure Management deadlines. The details related to the questionnaires can be found in the documentation included in Appendix E.

Table 4 – Water Loss Questionnaires

Questionnaire	Submission Deadline
Data Quality	December 31, 2023
Pressure Management	December 31, 2023
Asset Management	July 2024, with Update in July 2027

Water Loss Recommendations

Real water loss, as documented by the State of California can occur in three forms.

- Reported leakage that occurs in the form of visible failures over the ground. ·
- Unreported leakage that is not visible above ground but detectable by surveying the distribution system through specialized leak detection equipment. ·
- Background leakage that is too small to be detected with leak detection equipment but can be reduced by replacing or rehabilitating infrastructure or managing operational pressure.

These forms of real loss can be mitigated through the following methods.

1. Active leak detection and repair
2. Timely repair of leaks after identification
3. Pressure management that reduces high pressures or spikes in pressure that strain the distribution system
4. Systematic asset management and replacement through prioritization of mains and appurtenances with the highest rates of leakage.

As required by the regulations The City will need to implement a leak detection program. Pressure management is currently part of the State's questionnaire and needs to be further investigated. The City is currently developing a City wide asset management plan that will ultimately integrate the water utility. At this point the most important thing is for the City to make sure they move towards compliance. Implementing a full system leak detection program over the next three years will be critical to finding and fixing leaks, but also will allow the City to achive the alternate compliance pathway in 2028.

Leak Detection

As part of the economic model the State conducted a study of leak detection vendors including costs. Carollo has also been working with other vendors for other agencies across the Country. The cost for leak detection can be estimated to be approximalty $750/mile. At 295 miles the cost for system wide leak detection could range between $225,000 and $300,000 for vendor costs. Including contingencies the total costs could be $370,00 to $500,000. For budgetary planning purposes, the City should allocate $500,000 as a CIP costs.

Appendix A

Summary of Current State Water Conservation Emergency Regulations

- The decorative grass watering (non-functional turf irrigation) ban for commercial, institutional, and common areas of homeowners' associations remains in effect (effective since June 2022). The Emergency Regulation to Ban Decorative Grass Watering is set to expire in June 2024, unless the State Water Board takes further action. The State Water Board may continue to enforce these prohibitions and may consider readopting them.
  - *"Non-functional turf" or "decorative grass" refers to ground cover surface of mowed grass that is ornamental and not otherwise used for human recreation purposes.*
- For all Californians, prohibition on wasteful water uses remains in effect (effective since January 2022). The Emergency Regulation to Prohibit Wasteful Water Uses is set to expire in December 2023, unless the State Water Board takes further action. The State Water Board may continue to enforce these prohibitions and may consider readopting them. The prohibited water uses include:
  - *Hosing off sidewalks, driveways, and other hardscapes.*
  - *Washing automobiles with hoses not equipped with a shut-off nozzle.*
  - *Using non-recirculated water in a fountain or other decorative water feature.*
  - *Watering lawns in a manner that causes runoff, or within 48 hours after measurable precipitation.*
  - *Irrigating ornamental turf on public street medians.*

Appendix B

Summary of Urban Water Use Objective Components

- Standard-based budgets for efficient water use:
  - *Residential indoor use.*
    - The residential indoor use budget is calculated as the residential indoor standard multiplied by the number of people in the supplier’s service area multiplied by the number of days in the year.
  - *Residential outdoor use.*
    - The residential outdoor use budget is calculated as the residential outdoor standard (landscape efficiency factor) multiplied by the net evapotranspiration (reference evapotranspiration minus effective precipitation) multiplied by the residential landscape area multiplied by a unit conversion factor. Suppliers may add the volume of water associated with newly constructed residential landscapes to its residential outdoor use budget.
    - Residential landscape area includes residential “Irrigable Irrigated” area plus approved “Irrigable Not Irrigated area.” “Irrigable Irrigated Area” refers to area presumed to be maintained and managed through active irrigation. “Irrigable Not Irrigated” refers to area that is not currently being irrigated, but was irrigated in the past, or may be managed with irrigation in the future.
    - Through June 30, 2027, a supplier may include in its residential landscape area up to twenty percent of the supplier’s “Irrigable Not Irrigated” area, if the supplier’s actual urban water use for the reporting year is greater than the calculated objective without inclusion of “Irrigable Not Irrigated” area.
    - A supplier may, for each reporting year, use and report an alternative data source for residential landscape area, if it demonstrates to the State Water Board that the data is equivalent, or superior, in quality and accuracy to the provided data.
    - “Residential special landscape area” means residential areas dedicated solely to edible plants and residential areas irrigated with recycled water. If a supplier delivers water to residential special landscape areas, the supplier may calculate its residential outdoor use budget accounting for the residential special landscape area and standard.
  - *CII landscapes with DIMs.*
    - Through June 30, 2028, a supplier’s budget for CII landscapes with DIMs shall be the supplier’s actual deliveries associated with landscape irrigation.
    - Beginning July 1, 2028, the CII landscapes with DIMs is calculated as the standard (landscape efficiency factor) multiplied by the irrigated area of CII landscapes with DIMs multiplied by the net evapotranspiration multiplied by a unit conversion factor. A supplier may add the volume of water associated with newly constructed landscapes to its CII landscapes with DIMs budget.
    - CII landscapes with DIMs that are special landscape areas includes slopes designed and constructed with live vegetation as an integral component of stability, ponds or lakes receiving supplemental water for purposes of sustaining wildlife, recreation, or other public benefit, plant collections, botanical gardens, and arboretums, public swimming pools and similar recreational water features, and cemeteries built before 2015. If a supplier delivers water to CII landscapes with DIMs that are special landscape areas, the supplier may calculate its CII landscapes with DIMs budget accounting for the special landscape area and standard.
  - *Real water losses.*
    - Distribution system water losses ("real" losses) are the physical water losses from the water distribution system and the supplier's storage facilities, up to the point of customer consumption.
    - The real water loss budget is calculated as the system-specific standard (gallons per connection per day or gallons per mile per day) multiplied by the number of connections served by the supplier (or number of miles) multiplied by the number of days in the year.

   - Suppliers must comply with individual volumetric loss standards over a three-year period beginning on January 1, 2028. Prior to this, the supplier's water loss budget may, alternatively, be equal to its previous year's real water losses reported in its annual water loss audit.

- Variances (if applicable).
  - *"Variance" means an additional volume of water that a supplier may request to add to its objective for a unique use that has a material effect on a supplier's objective.*
  - *Examples include:*
    - Residential indoor use: Significant fluctuations in seasonal population or significant use of evaporative coolers.
    - Residential outdoor use: Populations of horses and other livestock, water for dust control on horse corrals or other animal exercise arenas, water for irrigating agricultural landscapes that are within residential areas but have not been classified as irrigable irrigated, water used to respond to emergency events not including drought, water for landscapes irrigated with recycled water containing high levels of total dissolved solids (TDS), and water to supplement ponds and lakes to sustain wildlife as required by existing regulations or local ordinances.
    - CII landscapes with DIMs or equivalent technology: Water used to respond to emergency events not including drought, water for landscapes irrigated with recycled water containing high levels of TDS, and water to supplement ponds and lakes to sustain wildlife as required by existing regulations or local ordinances.
  - *Most of the time, the associated water use, for any individual variance, must represent 5 percent or more of the sum of the budgets associated with the standards (residential indoor and outdoor use, CII landscapes with DIMs, and real water losses).*
  - *Requests for variances must be submitted to the State Water Board annually by October 1. Requests must include information showing how the request is warranted and protects beneficial water uses, demonstrating that the amount of water requested was delivered by the supplier for the requested use, and verifying that the approval of the request would not jeopardize the ability to comply with existing permit requirements within the supplier's service area.*

- Temporary provisions (if applicable).
  - *"Temporary provision" means an additional volume of water that a supplier may request to add to its objective for a limited time for a specified beneficial use that would require less water over time.*
  - *Examples include:*
    - Residential indoor use: To respond to negative impacts to wastewater collection, treatment, and reuse systems.
    - Residential outdoor use: Water for existing pools, spas, and similar water features, water for the planting of new, climate-ready trees, and water for the establishment of qualifying landscapes. Qualifying landscapes are those that require temporary irrigation and are associated with low-impact development, ecological restoration, and mined-land reclamation projects.
    - CII landscapes with DIMs or equivalent technology: Water for the planting of new, climate-ready trees and water for the establishment of qualifying landscapes.
  - *Requests for temporary provisions must be submitted to the State Water Board annually by October 1 and must include the same information as requests for variances.*
    - The request for temporary provision for residential indoor use must also show to the satisfaction of the State Water Board that meeting the objective would require adhering to the applicable residential indoor standard and that meeting the budget for efficient residential indoor use is causing challenges within wastewater collection, treatment, and reuse systems.

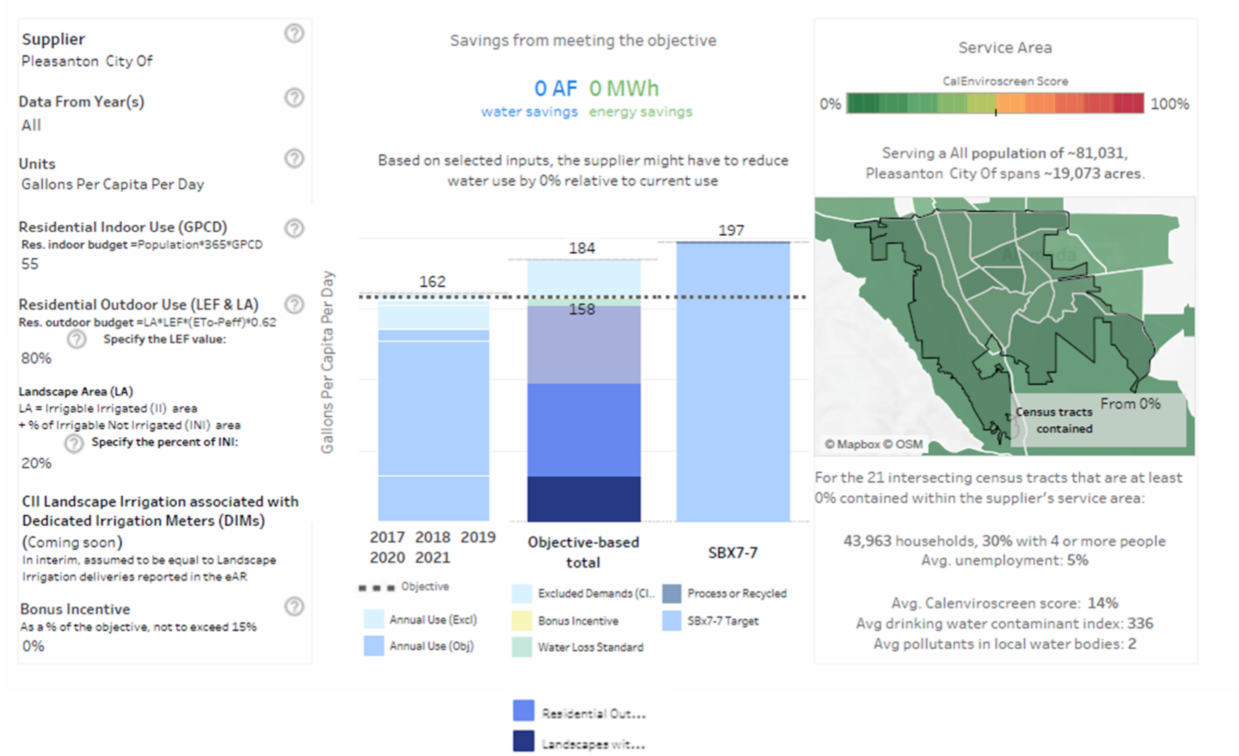
    - The request for temporary provision for residential outdoor use must also include a description of efforts to prioritize water for existing trees, including, but not limited to rebate, direct install, and educational programs focused on transitioning from turf- to tree-centric irrigation systems that promote deep and healthy root growth. Tree-centric irrigation systems include but are not limited to soaker hoses, deep drip watering stakes, drip tubing, and emitters.

- Bonus incentive for potable recycled water use (if applicable).
  - *If a supplier delivers water from a groundwater basin, reservoir, or other source that is augmented by potable reuse water, the supplier may add to its objective a bonus incentive.*
    - For existing facilities, may be up to 15 percent of objective.
    - For all other facilities, may be up to 10 percent of objective.

Refer to the proposed text of regulations (https://www.waterboards.ca.gov/conservation/regs/docs/2023/proposed-reg-text-081723.pdf) for additional information including methods to calculate standard-based budgets, variances, temporary provisions, and bonus incentives and reporting requirements.

Appendix C

Water Use Objective Exploration Tool Results



Source: https://www.waterboards.ca.gov/water_issues/programs/conservation_portal/water-use-explorer/.

Appendix D

Summary of Commercial, Industrial, and Institutional (CII) Performance Measures

- Classification system.
  - *Supplier shall classify at least twenty percent of its CII customers by 2026, at least sixty percent by 2028, and one hundred percent by 2030. After 2030, the supplier shall maintain at least a 95 percent classification rate.*
- Dedicated Irrigation Meters (DIMs) or "in-lieu" tech for qualifying landscapes.
  - *Supplier shall identify all CII large landscapes that have mixed-use meters and shall either install DIMs or employ in-lieu water technologies for these large landscapes with at least twenty percent compliance by 2026, at least sixty percent compliance by 2028, and one hundred percent compliance by 2030. After 2030, the supplier shall ensure at least 95 percent of large landscapes either have a DIM installed or are employing in-lieu water technologies.*
- Best Management Practices for qualifying customers.
  - *Supplier shall identify all disclosable buildings in their service area by January 1, 2025. Disclosable Building refers to a covered Building of any property type that has more than 50,000 square feet of gross floor area. Supplier shall provide meter and water use information to the owners or Owner's Agents of disclosable buildings for at least twenty percent of disclosable buildings by 2026, at least sixty percent by 2028, and one hundred percent by 2030.*
  - *Supplier shall design and implement a conservation program including best management practices for customers at or above the 80th percentile for water use, excluding process water, by January 1, 2025. Suppliers shall make annual progress in meeting requirements with at least twenty percent compliance by 2026, at least sixty percent compliance by 2028, and one hundred percent compliance by 2030. After 2030, the supplier shall ensure at least 95 percent compliance.*
  - *Supplier shall ban the irrigation of non-functional turf with potable water on all CII landscapes in its service area, including homeowners' associations, common interest developments, community service organizations, and other similar entities, by July 1, 2025. A supplier is not required to ban the irrigation of non-functional turf on CII landscapes in its service area that is necessary to ensure the health of trees and other perennial non-turf plantings or that is necessary to address an immediate health and safety need. A supplier may approve a request for continued irrigation of non-functional turf where the user certifies that the turf is a low water use plant with a plant factor of 0.3 or less, and demonstrates the actual use is less than 40 percent of reference evapotranspiration.*

Refer to the proposed text of regulations (https://www.waterboards.ca.gov/conservation/regs/docs/2023/proposed-reg-text-081723.pdf) for additional information and reporting requirements.

Appendix E – Water Loss Questionnaires

Asset Management Questionnaire

Urban retail water suppliers are required to complete this system-level questionnaire administered by the State Water Resource Control Board (California Code of Regulations, title 23, division 3, chapter 3.5, section 983). If a supplier has multiple systems, it must complete this questionnaire once for each system.

This system-level questionnaire asks for information on asset management practices.

* Required

Water System Information

The Water Board will reach out through the email provided if response clarifications are needed.

1. Name of the urban retail water supplier that owns the system for which you are completing this survey. *

2. Water system name *

   If a supplier only owns one system, the supplier name and system name may be the same.

3. Water system number (Starts with CA with seven numerical digits; for example, CA1234567) *

   Only one system (and system number) should be associated with this survey. Please complete this survey separately for each system owned by the supplier.

4. Submitter's name *

5. Submitter's email address *

   Used for follow-up communication. Please be prepared to respond to emails.

Asset Management

Systematic, priority-based pipe replacement and other forms of asset management provide leakage reduction. Asset management is one of the four industry-established approaches for water loss control.

Though capital investment for asset management is planned based on several potential benefits and factors, several suppliers rely on asset management for their system to reduce water loss, and asset management remains a recommended and established approach for water loss control.

The questions below referencing distribution infrastructure are targeting main lines, service laterals and appurtenances such as valves, meters, air vac assemblies, hydrants, etc. The questions are not intended to capture asset management approaches for sources, storage, or treatment facilities.

6. Does your agency maintain records of breaks on different sections of main and other distribution infrastructure? *

- ◯ Yes, the agency maintains break history records.
- ◯ No, the agency plans to begin maintaining break history records by a certain year.
- ◯ No, the agency does not plan to maintain break history records in the next 10 years.

7. By what year are you planning to begin maintaining break history records? *

[ ]

Number must be between 2024 ~ 2035

8. Which data fields pertaining to the distribution infrastructure components (for example, pipe sections, valves, meters, etc.) does your agency include in the break history record? *

- ☐ Geographical location
- ☐ Material or type as applicable
- ☐ Size
- ☐ Age
- ☐ Average operational pressure
- ☐ Maximum operational pressure
- ☐ Soil conditions
- ☐ Installation conditions
- ☐ Type of break (for example, longitudinal, circular, etc.)
- ☐ Time passed between reporting of break and repair
- ☐ Other

9. Please provide any other additional information regarding the maintenance of records of breaks on mains and other distribution infrastructure. *

10. Does your agency have an approach to identify and prioritize the replacement, rehabilitation, or protection of water distribution infrastructure components that break or leak frequently based on break history or consequence of failure? *

- ◯ Yes, the agency uses a prioritization approach for asset management.
- ◯ No, the agency plans to have a prioritization approach for asset management by a certain year.
- ◯ No, the agency does not plan to have a prioritization approach for asset management in the next 10 years.

11. By what year are you planning to have a prioritization approach for asset management? *

Number must be between 2024 ~ 2035

12. On which system and environmental factors is your agency's asset management approach based? *

Answer only for the leak reduction portion of your asset management plan, if available.

- ☐ Break/failure/leak history of distribution infrastructure component
- ☐ Distribution infrastructure component material
- ☐ Distribution infrastructure component age
- ☐ Distribution infrastructure component size
- ☐ Maximum operating pressure
- ☐ Average operating pressure
- ☐ Occurrence of pressure transients
- ☐ Local soil conditions
- ☐ Other

13. Please provide any other additional information regarding this system's use of prioritization approaches in asset management. *

Data Quality Questionnaire

This is a document summarizing the questions asked in the data quality questionnaire. To submit the questionnaire, please respond here https://forms.office.com/g/apdgLcBGcu

Water System Information

1. Name of the urban retail water supplier that owns the system for which you are completing this survey.
2. Water system name.
3. Water system number.
4. Submitter's name.
5. Submitter's e-mail address.

Program for Volumetric Flow Testing of Production Meters

6. What percent of production meters have been flow tested in the past 5 years?
7. Please provide any additional information regarding your answer to question 6.
8. All meters flow tested within the past 5 years account for what percent of the total annual production water volume?
9. Does the system currently have a program for regular volumetric flow testing of production meters?
10. Please provide any other relevant information regarding volumetric flow testing programs.

Written Program for Volumetric Flow Testing of Production Meters

Please provide your system's program for volumetric flow testing by filling out the following excel sheet (https://www.waterboards.ca.gov/conservation/docs/data_quality_excel_submission.xlsx) and emailing it to ORPP-WaterLossControl@waterboards.ca.gov with "Program for Volumetric Flow Testing" as the subject header.

Program for Regular Electronic Calibration of Secondary Instrumentation

11. What percent of current production meters have been calibrated in the last 5 years?
12. The current production meters calibrated within the past 5 years produce what annual volume?
13. Does the system currently have a program for regular calibration of production meters?
14. What percent of production meters were scheduled for calibration in the last 5 years?
15. Please provide any other additional information regarding electronic calibration programs.

Program for Volumetric Flow Testing of Customer Meters

16. What percent of current customer meters were tested in the past 5 years? This refers to all customer meters regardless of size.
17. In the past 5 years, on average, how many customer meters were replaced each year?
18. A representative sample of meters is flow tested every _______ years. If you do not regularly test a representative sample, enter 0.
19. What methods are used to verify that the meters sampled are representative?
20. As of today, does the system have a program for regular flow testing of customer meters?
21. Please provide any additional information regarding question 20.

22. Please provide any other relevant information regarding customer meter testing programs.

Written Program of Volumetric Flow Testing of Customer Meters

Please provide your system's program for volumetric flow testing of customer meters by filling out the following excel sheet (https://www.waterboards.ca.gov/conservation/docs/data_quality_excel_submission.xlsx) and emailing it to ORPP-WaterLossControl@waterboards.ca.gov with "Program for Volumetric Flow Testing" as the subject header.

Systematic Data Handling Errors

23. Some customer billing systems allow accounts that are not active (such as a vacant house) to exist in “non-billed” status, under which a bill is not issued. Water used in inactive or “non-billed” accounts can sometimes result in apparent losses. This type of systematic data handling accounts can sometimes result in apparent losses. This type of systematic data handling accounts for approximately what percent of apparent losses?
24. Please provide any additional information regarding question 23.
25. Some customer billing system programming create monetary credits to customers by employing negative values in consumption readings for the billing period. This type of systematic data handling accounts for approximately what percent of apparent losses?
26. Please provide any additional information regarding question 25.
27. Some municipally owned properties do not have water meters or annual readings of water consumption, thereby consuming water that is not tracked in the billing process. This accounts for approximately what percent of apparent losses?
28. Please provide any additional information regarding question 27.

Pressure Management Questionnaire

This is a document summarizing the questions asked in the data quality questionnaire. To submit the questionnaire, please respond here https://forms.office.com/g/Fj8kTwS1th

Water System Information

1. Name of the urban retail water supplier that owns the system for which you are completing this survey.
2. Water system name.
3. Water system number.
4. Submitter's name.
5. Submitter's e-mail address.

Pressure Control Devices

6. Does this system utilize any pressure control devices in the water distribution system (on a temporary or permanent basis)?
7. Which pressure control devices does this system utilize in the distribution system? Check all that apply. (Variable frequency drives (VFD) on distribution system pumps, pressure control valves (including any kind of pressure control valve), Water storage tanks(including surge tanks), Hydro-pneumatic tanks, Pressure transient control (in-pipe monitoring and dampening of pressure transients)
8. On average, this system inspects variable frequency drives (VFD) on distribution system pumps once every _____ years.
9. On average, this system inspects pressure control valves once every _____ years.
10. On average, this system inspects water storage tanks once every _____ years.
11. On average, this system inspects hydro-pneumatic tanks once every ____ years.
12. On average, this system inspects pressure transient control devices once every _____years.
13. Does this system currently have a program to regularly inspect, maintain, and repair installed pressure control devices to ensure they are maintained in working condition?
14. Does the current program specifically address regularly inspecting, maintaining, and repairing installed pressure control valves?

High Leakage Zones

15. Have you identified areas of the distribution system that have higher rates of water loss than others?
16. For areas of the distribution system that have higher rates of water loss, has the system evaluated controlling pressure to reduce leakage?
17. What challenges has your system faced in reducing pressure for the purpose of reducing leakage?

APPENDIX D

WATER FACILITY CONDITION ASSESSMENT

Water System Management Plan

TECHNICAL MEMORANDUM

Water Facility Condition Assessment

October 2024

THE CITY OF PLEASANTON

Water System Management Plan

TECHNICAL MEMORANDUM

Water Facility Condition Assessment

October 2024

This document is released for the purpose of information exchange review and planning only under the authority of Michelle L. Eckard, May 31, 2024, California PE 90107.

Contents

Appendices

Tables

Figures

Abbreviations

AACE	Association for the Advancement of Cost Engineering
ARV	automatic release valve
ATS	automatic transfer switch
AWWA	American Water Works Association
Carollo	Carollo Engineers, Inc.
CIP	capital improvement projects
City	City of Pleasanton
COF	consequence of failure
EI&C	electrical, instrumentation, and controls
EUL	estimated useful life
evRUL	evaluated remaining useful life
MCC	motor control center
O&M	Operations and Maintenance
PLC	programmable logic controller
POF	probability of failure
QAQC	quality assurance/quality control
R&R	Rehabilitation and Replacement
ROW	right-of-way
RRA	Risk and Resilience Assessment
RTU	remote terminal unit
RUL	remaining useful life
VFD	variable frequency drive
WSMP	Water System Management Plan

SECTION 1 WATER FACILITY CONDITION ASSESSMENT AND 10-YEAR CIP

1.1 Introduction

The City of Pleasanton (City) is in the eastern San Francisco Bay Area region south of Interstate 580, and east of Interstate 680 in Alameda County. The City owns and operates a potable water system that serves residential customers as well as commercial and industrial users within its City limits. The water system is illustrated on Figure 1. City staff recognize the need for a comprehensive water facility condition assessment to develop a 10-Year Capital Improvement Project (CIP). The recommendations will be incorporated into the Water System Management Plan (WSMP).

1.1.1 Objectives

The City's primary objectives for implementing a condition assessment for the water facilities include:

- Improving the cost-effective management of assets throughout their life cycle.
- Promoting data sharing and interconnectivity within and across departments.
- Demonstrating fiscal responsibility.
- Identifying and prioritizing projects for the 10-year CIP.

1.1.2 Background

The WSMP is being implemented in three phases:

Phase 1 consisted of a high-level assessment of the City's water system program that includes the development of evaluation guidelines, evaluation of the existing performance of the City's current management of the water system, and identification of short- and long-term priorities for improvement as documented in the *Technical Memorandum - High Level Utility Assessment Summary* (April 2023) prepared by Carollo Engineers, Inc. (Carollo).

Phase 2 involved reviewing the high-level assessment results and findings of Phase 1 to identify short- and long-term work plan priorities. This resulted in initiating condition assessments of water system facilities in the field and conducting a desktop assessment for the water mains. Additionally, a review of current and upcoming regulations was conducted to identify potential impacts to the City's water system program. The results of the regulatory review and the condition assessments inform the recommendations to be developed for the initial WSMP in Phase 3.

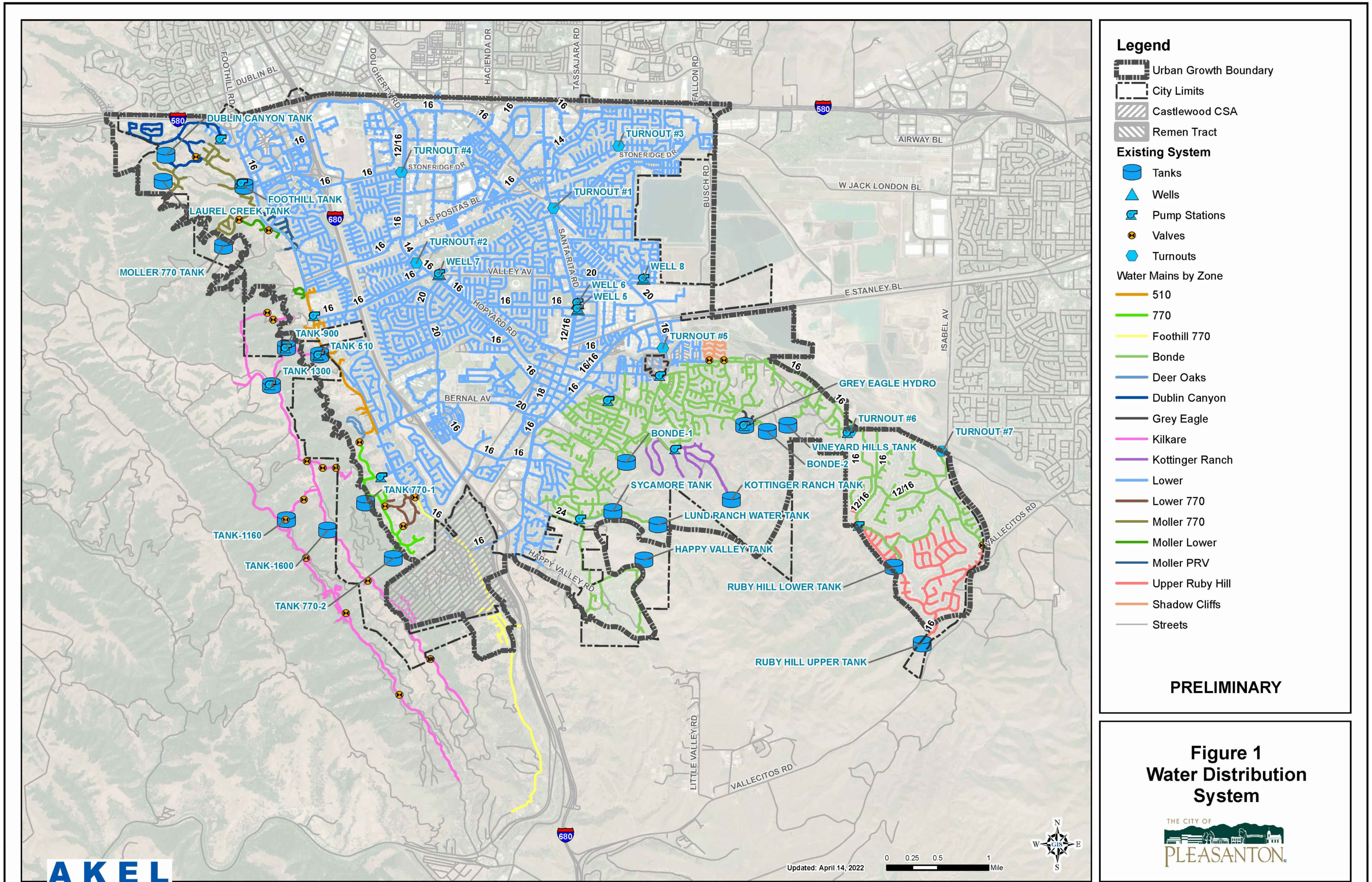


Figure 1 Water System Overview (Source: Akel Engineering Group, Inc.)

Phase 3 is the preparation of the initial WSMP. An integral component of the WSMP, is the development of activities that support asset management business practices. These activities are documented within this TM and summarized below:

- Water Facility Renewal and Replacement:
  - Develop a register of water facility assets.
  - Analyze the results of the field condition assessment of water facilities.
  - Rank (or prioritize) replacement needs.
- Operations and Maintenance (O&M):
  - Recommend a prioritized list of O&M practices and program improvements for managing water system assets.
- Capital Improvements:
  - Recommend and prioritize the next 10-years of capital improvement projects with implementation cost estimates.

1.2 Water Facility State of the Assets

The City's water facilities include 14 booster stations, 21 reservoirs, four groundwater wells, and seven turnouts that supply the water from Zone 7.

1.2.1 Probability of Failure

The Probability of Failure (POF) is the measure of likelihood that an asset will fail or degrade to a point where it is not meeting its required level of service. This section covers the estimated useful life (EUL), the condition of the assets (POF approach) and the results of the condition assessment and estimated remaining useful life (RUL) (POF results).

1.2.1.1 Estimated Useful Life

The EUL is the starting point for understanding the current state of the assets. For above ground assets, an EUL value is assigned by asset class based on industry standards and the American Water Works Association (AWWA) Effective Useful Life Tool. The EUL can be adjusted based on conditions that are outside of assumed normal operating conditions. For example, the EUL may be adjusted down if an asset has an unusually high or low number of start and stop cycles. Conversely, an older asset that is performing optimally may have its EUL extended. The EUL by asset class is in Table 1 and Appendix A.

Using the EUL and the age of the asset, which is determined using Equation 1, the RUL, represented in years, can then be calculated as shown in Equation 2. If no installation date is available, then the installation date has been assumed using the facility commissioning date.

Equation 1

$$Age\ (years) = Today's\ date - Installation\ date$$

Equation 2

$$RUL\ (years) = EUL - Age$$

The RUL represents an age-based assessment of the assets and is characterized as the time frame by which an asset is expected to need rehabilitation or replacement. For assets that are older than their EUL, the RUL is set to zero. The RUL can also be translated into a percent life consumed by way of Equation 3. Assets with an RUL value of zero are considered to have 100 percent of their life consumed.

Equation 3

$$\%\ Life\ Consumed = \left(1 - \frac{RUL}{EUL}\right) \times 100$$

Table 1 Water Facility Asset Classes and EUL

Discipline	Asset Class	EUL
EI&C	Analyzer	15
EI&C	ATS	20
EI&C	Breaker	20
EI&C	Control Panel	20
EI&C	Controller	15
EI&C	Engine	20
EI&C	Generator Receptacle	30
EI&C	MCC	30
EI&C	PLC	15
EI&C	RTU	15
EI&C	Switch	30
EI&C	Switchboard	25
EI&C	Terminal Box	20
EI&C	Transducer	15
EI&C	Transformer	35
EI&C	Transmitter	15
EI&C	VFD	15
EI&C	Water Meter	15
Mechanical	Actuator	15
Mechanical	ARV	15
Mechanical	Chemical Dosing System	20
Mechanical	Chemical Metering Pump	10
Mechanical	Circulation System	20
Mechanical	Compressor	20
Mechanical	Crane	30
Mechanical	Fan	20
Mechanical	Generator	25
Mechanical	Mixer	20
Mechanical	Pipe	50
Mechanical	Pump	25

Discipline	Asset Class	EUL
Mechanical	Pump – Sump	10
Mechanical	Strainer	15
Mechanical	Valve	15
Mechanical	Valve (CLA)	15
Structural	Building	60
Structural	Drainage	25
Structural	Hydropneumatic Tank	50
Structural	Reservoir	50
Structural	Road	30
Structural	Shed	30
Structural	Site Security	25
Structural	Tank	50
Structural	Vault	60
Structural	Well	30

Notes:
PLC – programmable logic controller; EI&C - electrical, instrumentation, and controls; VFD – variable frequency drive;
ARV – automatic release valve; ATS – automatic transfer switch; MCC – motor control center; RTU – remote terminal unit.

1.2.1.2 Approach

The POF is determined using data collected through field evaluations or, when not available, a desktop evaluation. These evaluations are described as follows:

- **Field Evaluations**: A physical evaluation of assets in the City including visual interpretation of the general condition, deterioration, components, coating, corrosion, etc. (*condition-based approach*). Additionally, during the field visit, Carollo discipline leads talked to operations staff about asset performance, reliability, O&M, and obsolescence (*performance-based approach*). The field evaluations occurred September 29, 2022, and October 5-6, 2022; and May 11-12, 2023 and May 18, 2023, by Carollo discipline leads for electrical, mechanical, and structural assets.
- **Desktop Evaluation**: A RUL evaluation of the assets using available attribute information and the EUL as determined by asset class (*age-based approach*). This approach is used where a field evaluation was not conducted.

For both evaluations, a POF score on a scale of one to five is assigned to each asset. This score is defined in Table 2.

For field evaluations, the score POF score assigned in the field can be translated to a percent life consumed. For desktop evaluations, the percent life consumed that is calculated based on asset age and EUL can be translated to a POF score. In this way, assets can be compared using the same system whether they were evaluated in the field or on a computer. Figure 2 shows how the score can be translated to a percent life consumed, or vice versa, for assets using the upper value of each range listed in the table above.

Table 2 Translating Percent Life Consumed and POF Score

Percent Life Consumed	POF Score	Description of POF Score
0 – 39	1	**Good:** Asset is in good condition (no defects).
40 – 64	2	**Acceptable:** Asset has minor defects.
65 – 79	3	**Fair:** Asset has significant defects that will affect reliability or efficiency.
80 - 89	4	**Poor:** Asset is highly unreliable or inefficient.
90 - 100	5	**Very Poor:** Asset is no longer able to function in its current condition.

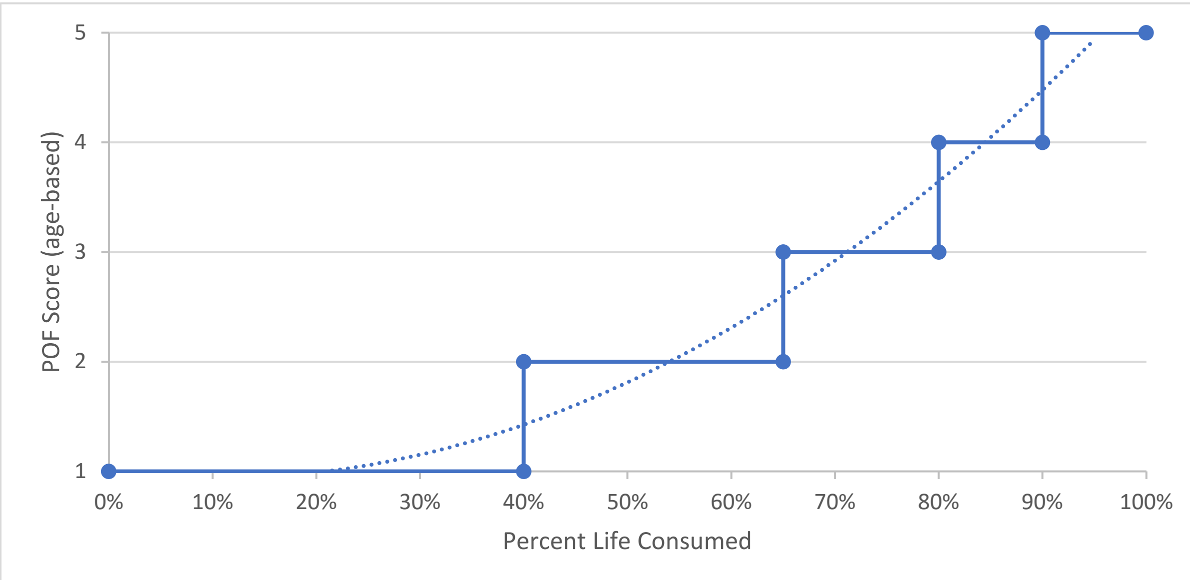


Figure 2 Translating Percent Life Consumed and POF Score

When the RUL is calculated from a POF score, we call it an evaluated RUL (evRUL) estimate. The evRUL, represented in years, is calculated using Equation 4.

Equation 4

$$evRUL = \%\,Life\ Consumed\ \times EUL$$

The evRUL is the result of the percent life consumed (from Table 2) and the EUL. The EUL value is assigned by asset class. The evRUL plus the current year (2024) is then used to determine the reinvestment year timing for the asset as shown in Equation 5.

Equation 5

$$Reinvestment\ Year\ = 2024 + evRUL$$

Field Evaluations

For assets that have been evaluated in the field (i.e., through condition assessments, inspections, or other tests), a condition-based assessment POF score is used. This score is determined in the field by condition assessment discipline leads. The lead scores the asset based on discipline specific criteria for condition and performance. The maximum (worst) score from each condition and performance assessment represents the overall POF score (field-based) for the asset as shown in Equation 6:

Equation 6

$$POF\ (field\ based) = MAX(Condition\ score, Performance\ score)$$

Using the maximum score (rather than the average) provides conservative results because this approach includes all assets in need of attention that might otherwise be lost due to averaging. This is important for identifying assets and issues that represent a high risk due to the POF score. In some cases, the cost to improve an individual POF score may be minor yet could have a significant impact on reducing risk.

The **CONDITION SCORE** is determined by the discipline lead scoring the asset on a one to five scale for the categories in Table 3. The condition question categories vary by discipline.

Table 3 Summary of Condition Question Categories by Discipline

Discipline	Condition Question Categories
Electrical/Instrumentation	▪ General Condition ▪ Deterioration ▪ Wiring/Cable Condition ▪ Enclosure ▪ Equipment ▪ Functionality ▪ Fasteners, Belts, Caps, Washers, etc.
Mechanical	▪ General Condition ▪ Corrosion ▪ Exterior ▪ Vibration ▪ Functionality ▪ Elements ▪ Temperature ▪ Piping ▪ Fasteners, Belts, Caps, Washers, etc.
Structural	▪ General Condition ▪ Foundation ▪ Movement ▪ Joint ▪ Coating/Lining/Paint ▪ Safety Components ▪ Silt(1) ▪ Interior Coating(1) ▪ Exterior Coating(1)

Notes:
(1) Imported from the City's Reservoir Inspection Log.

For each asset, the highest condition score among all applicable category responses is used to represent the overall condition of the asset as shown in Equation 7. The descriptions of the score vary depending on the question; however, the scoring scale of one to five remains consistent.

Equation 7

$$Condition\ score = MAX(Discipline\ Specific\ Condition\ Question\ Categories)$$

The **PERFORMANCE SCORE** is determined by the discipline lead scoring the asset on a one to five scale using the following categories:

- Performance.
- Operations and Maintenance.
- Reliability.
- Redundancy.
- Obsolescence.
- Estimated Life Remaining.

The scores for performance, O&M, reliability, and obsolescence are incorporated into an overall performance score as shown in Equation 8:

Equation 8

$$Performance\ score = MAX(\ Performance, O\&M, Reliability, Obsolescence)$$

Redundancy is captured for documentation purposes and the estimated life remaining is used for quality assurance/quality control (QAQC) purposes. Assets with significant differences between the estimated life remaining observations and the replacement timing results are flagged for further review.

Desktop Evaluation

For assets not evaluated in the field, an age-based desktop evaluation is used to calculate the POF score using the installation date and its EUL to calculate the POF score (i.e., the POF score is determined using equations 1 through 3), then the percent life consumed is translated to a POF score as shown in Figure 3.

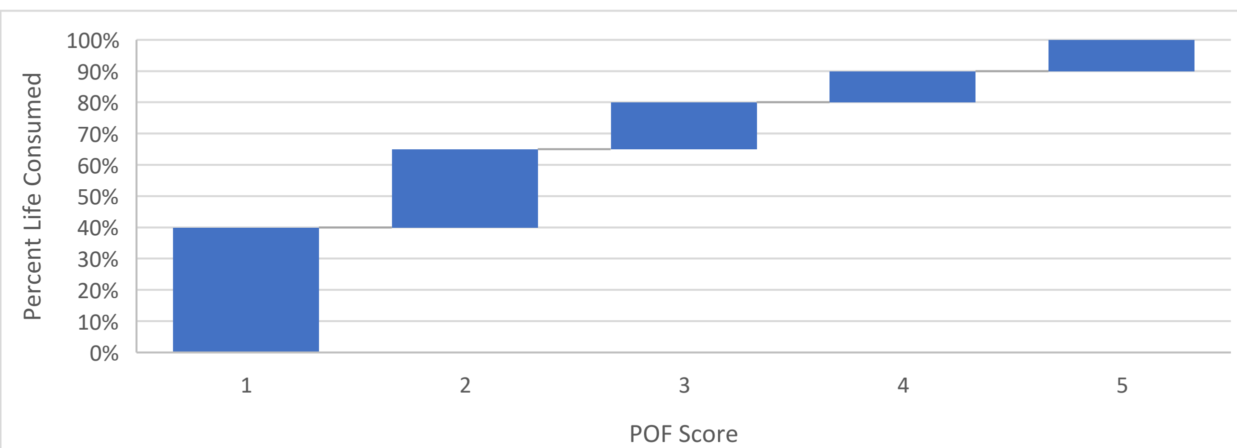


Figure 3 Translating Percent Life Consumed to POF

The condition-based POF evaluation method (field evaluation approach) provides a more representative assessment because of the nature of the POF score being based on visual observations of the asset, as well as feedback from staff on the asset performance. Nevertheless, it is not always practical to visually assess every asset. Hence, the age-based POF evaluation method (desktop evaluation approach) is useful in providing a generally conservative estimate for projecting asset replacement timing.

1.2.1.3 Results

POF scores are identified for each asset using field evaluation (condition-based and performance-based) results, or, if not available, desktop evaluation (age-based) results.

Across the water facilities there are 525 assets included in the assessment. Of those assets, 452 were assessed using condition information derived from a visual inspection and the remaining 24 were assessed in the desktop evaluation because they were unable to be accessed. The combined evaluations have resulted in a POF score for each asset, which is shown in Figure 4.

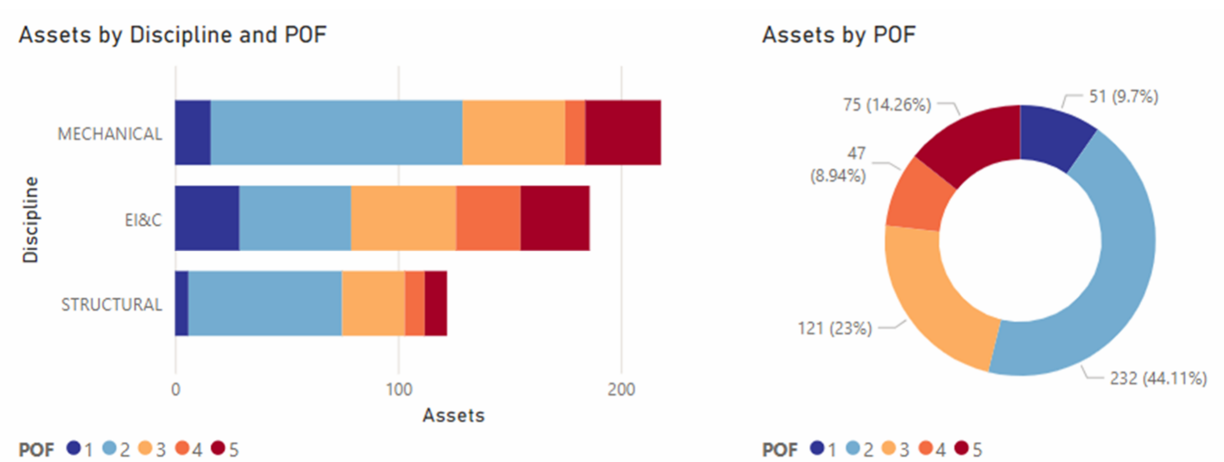


Figure 4 Water Facility POF Scores

Over 75 percent of assets are in good (score of one), acceptable (two), or fair (three) condition. Typically, these assets do not need immediate attention and are operating as desired with a few recommendations for improvement (namely for assets with scores of three). On the other hand, almost a quarter of assets are in poor (four) or very poor (five) condition indicating that reinvestment is needed now or very soon.

Of the 75 assets assigned very poor condition scores, 35 were assigned a score of five through the age-based evaluation. The age-based evaluation represents six percent of all the assets, but nearly 44 percent of the assets with a score of five. This example helps demonstrate the variability between the desktop and field evaluations. The findings from the field are generally better than the desktop POF scores. This indicates that the assets are well maintained and appear to function well despite their apparent age. Some methods that will improve the desktop evaluation results in the future are to use accurate asset installation dates, consider additional factors (i.e., O&M history) that may impact the EUL, and updating EULs.

The POF score and EUL for each asset were used to calculate RUL and associate each asset to a reinvestment year. Figure 5 presents the number of assets by reinvestment year.

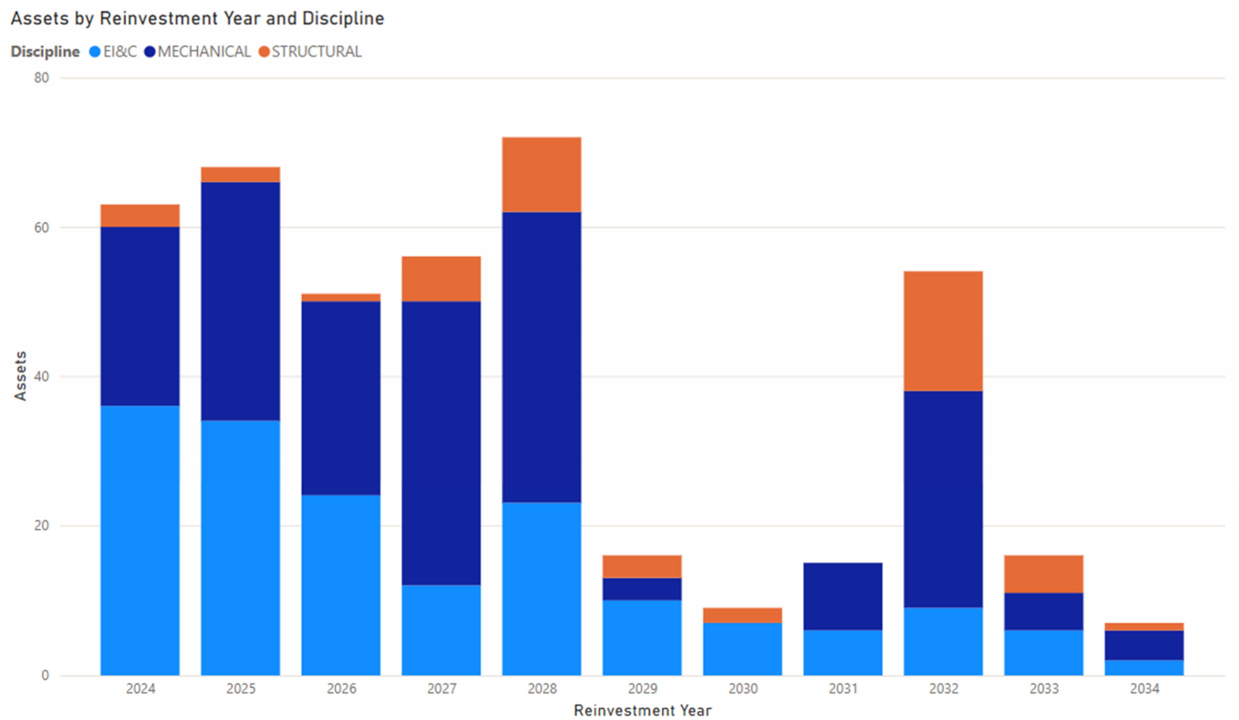


Figure 5 Water Facility Assets by Reinvestment Year

The earliest reinvestment year represented is 2024, if there were any recommendations that occurred before 2024, they were reassigned to 2024.

The following sections take a closer look at the results by facility. For a list of all assets by site and their POF score, reinvestment timing, and any observations and recommendations refer to Appendix B.

Booster Stations

There are 14 booster stations representing a total of 246 assets. A figure for each booster station is shown below in Figures 6 through 19.

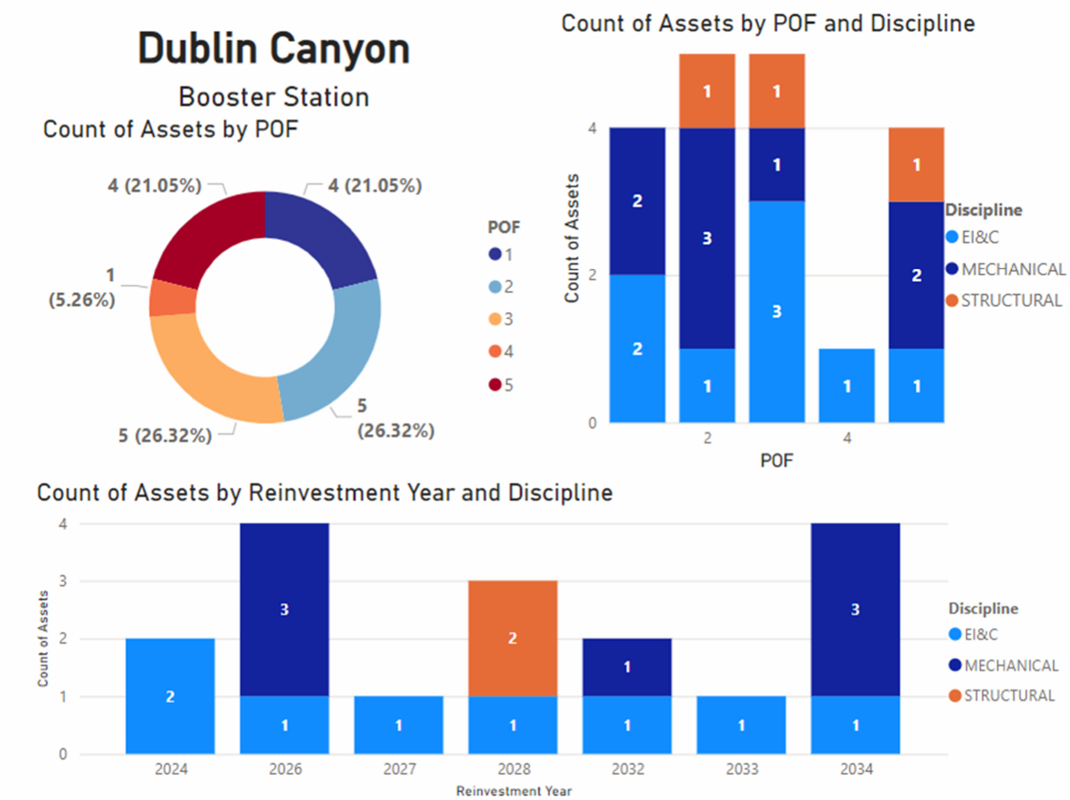


Figure 6 Dublin Canyon Booster Station POF Results

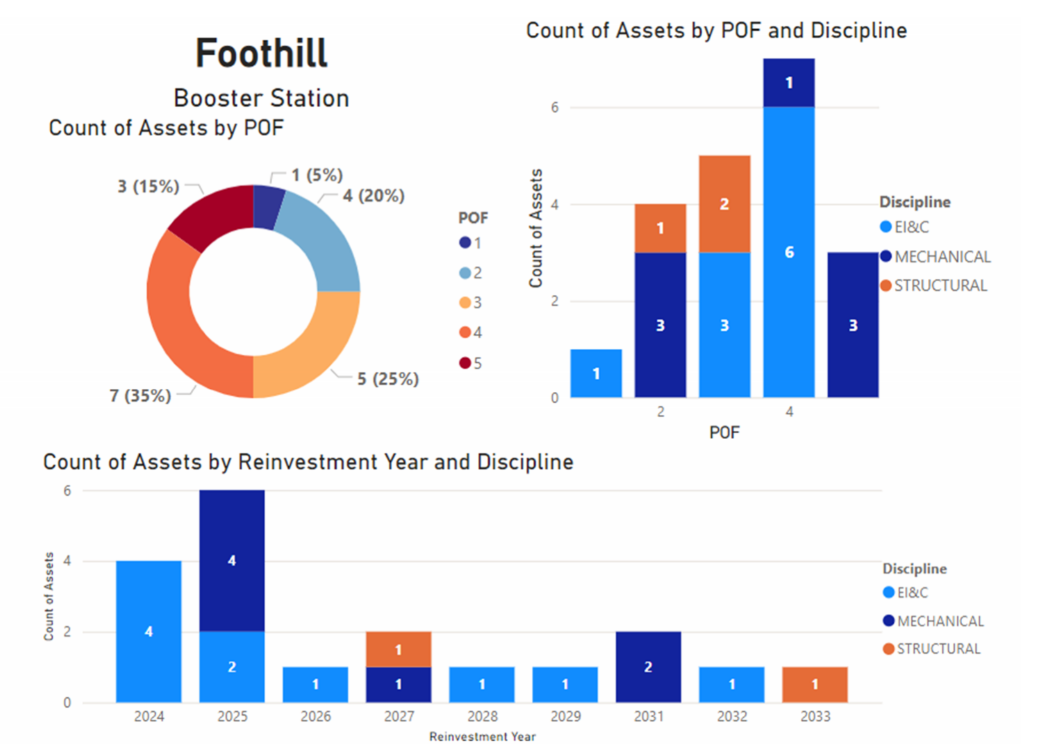


Figure 7 Foothill Booster Station POF Results

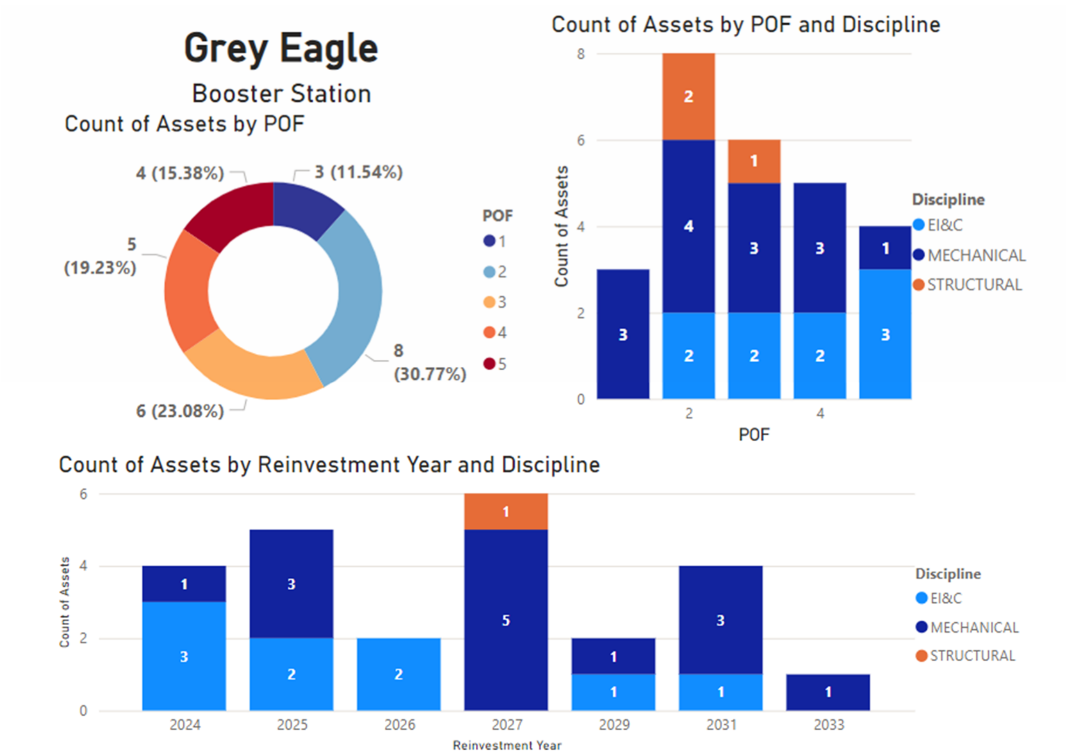


Figure 8 Grey Eagle Booster Station POF Results

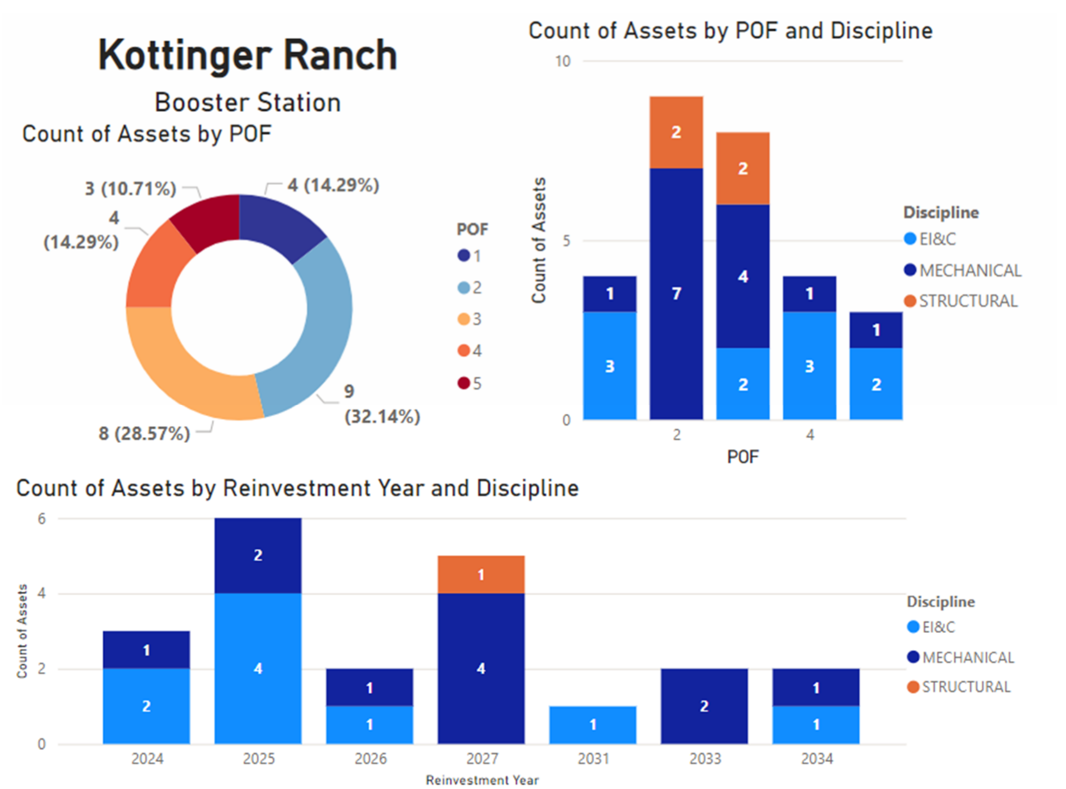


Figure 9 Kottinger Ranch Booster Station POF Results

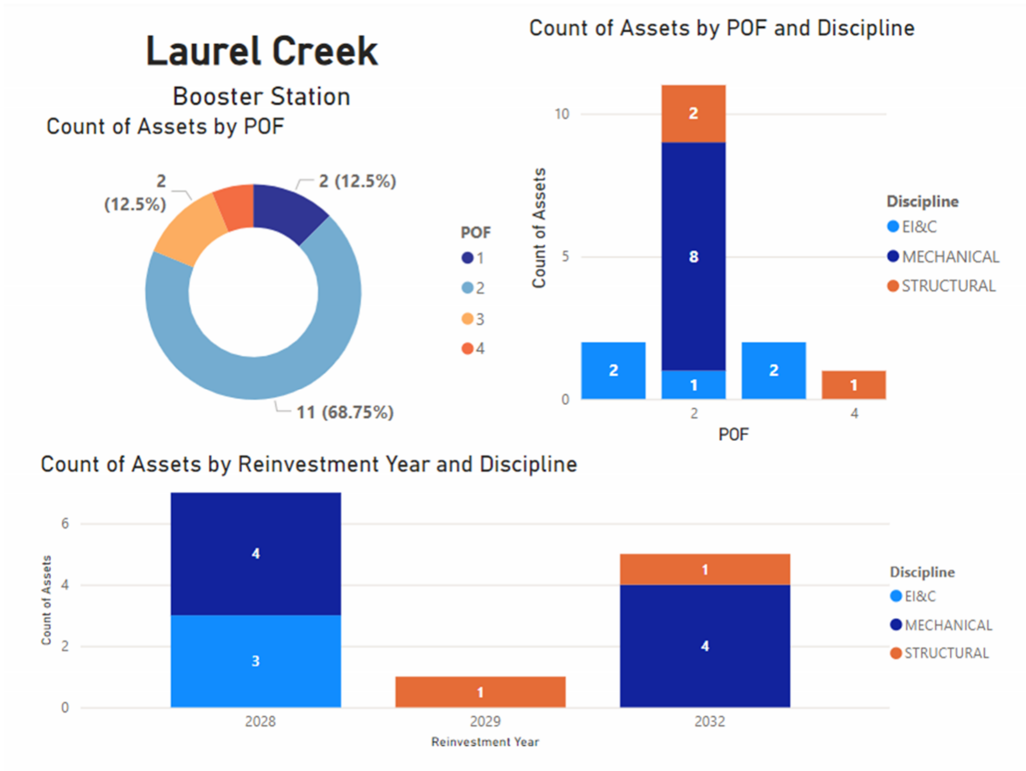


Figure 10 Laurel Creek Booster Station POF Results

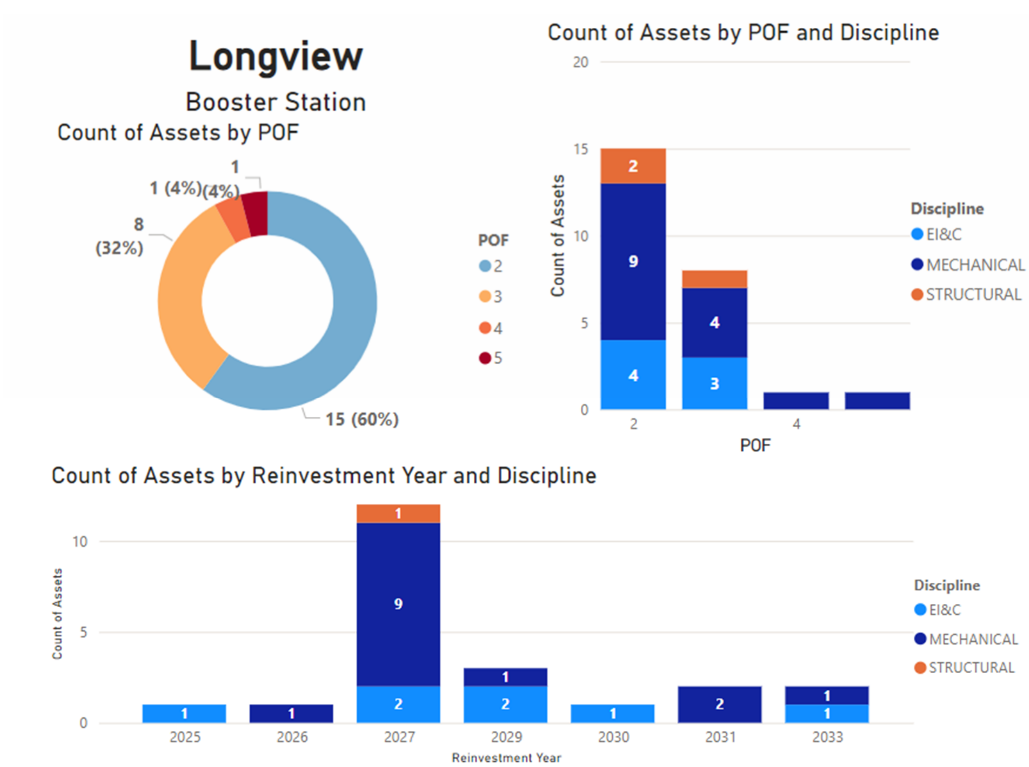


Figure 11 Longview Booster Station POF Results

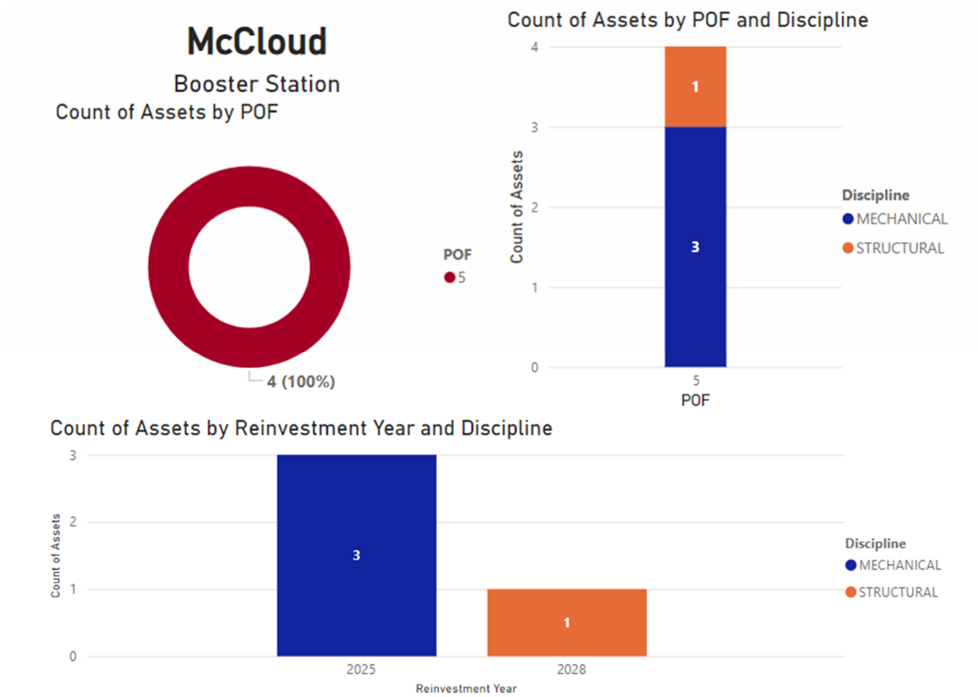


Figure 12 McCloud Booster Station POF Results

McCloud Booster Station is no longer in service and it is recommended that the facility is decommissioned.

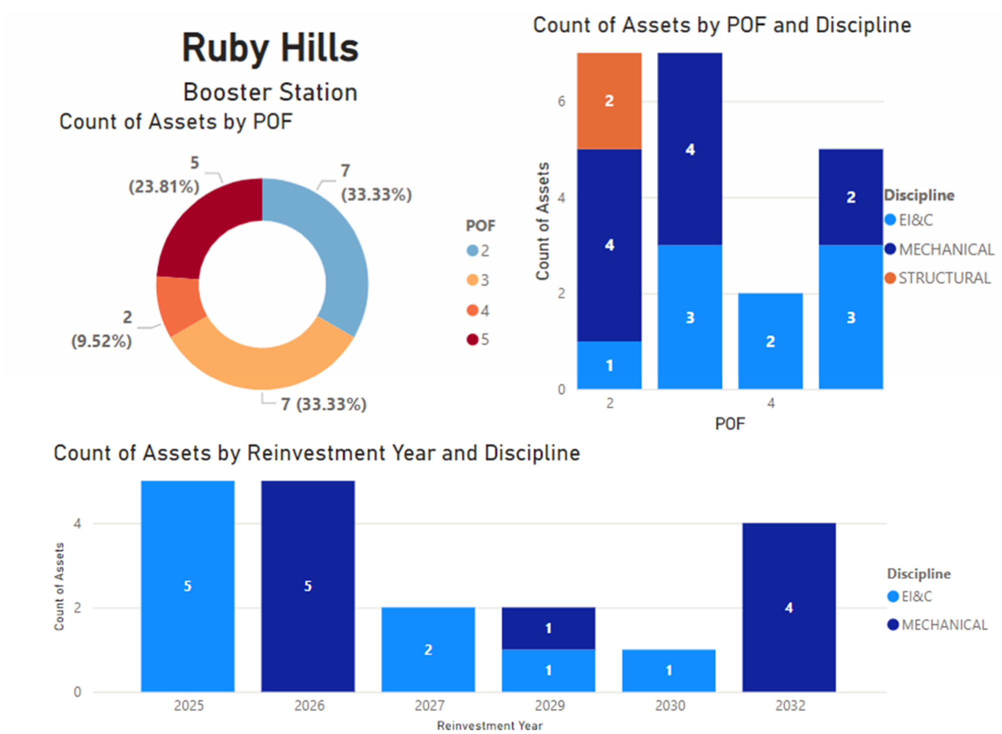


Figure 13 Ruby Hills Booster Station POF Results

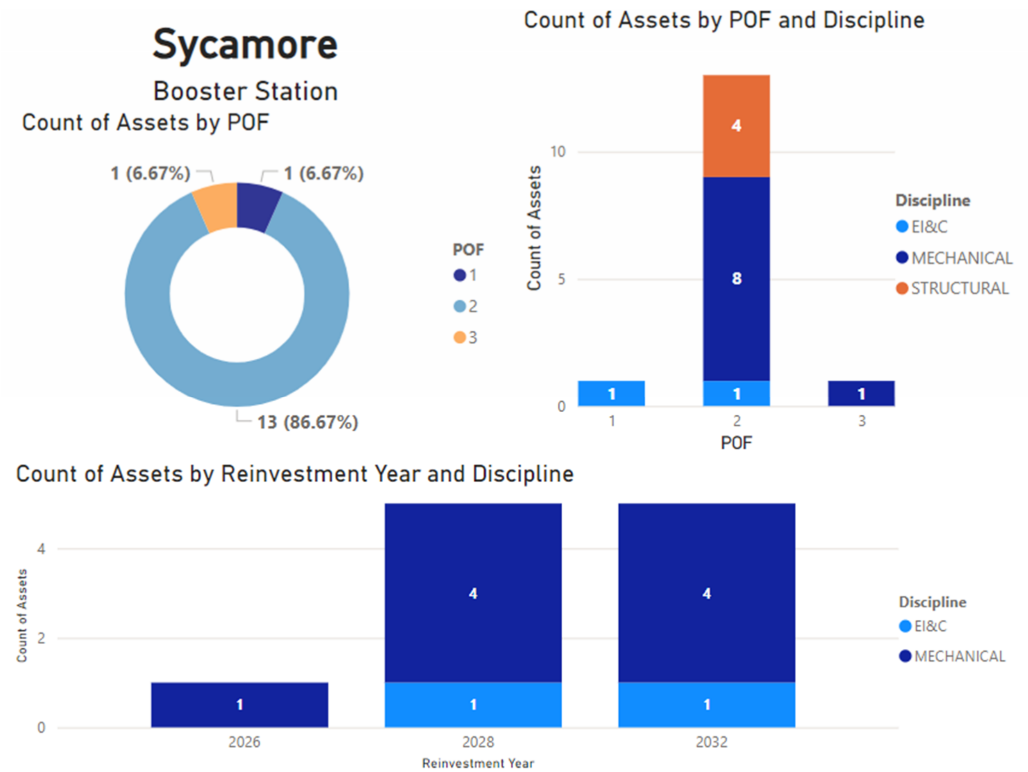


Figure 14 Sycamore Booster Station POF Results

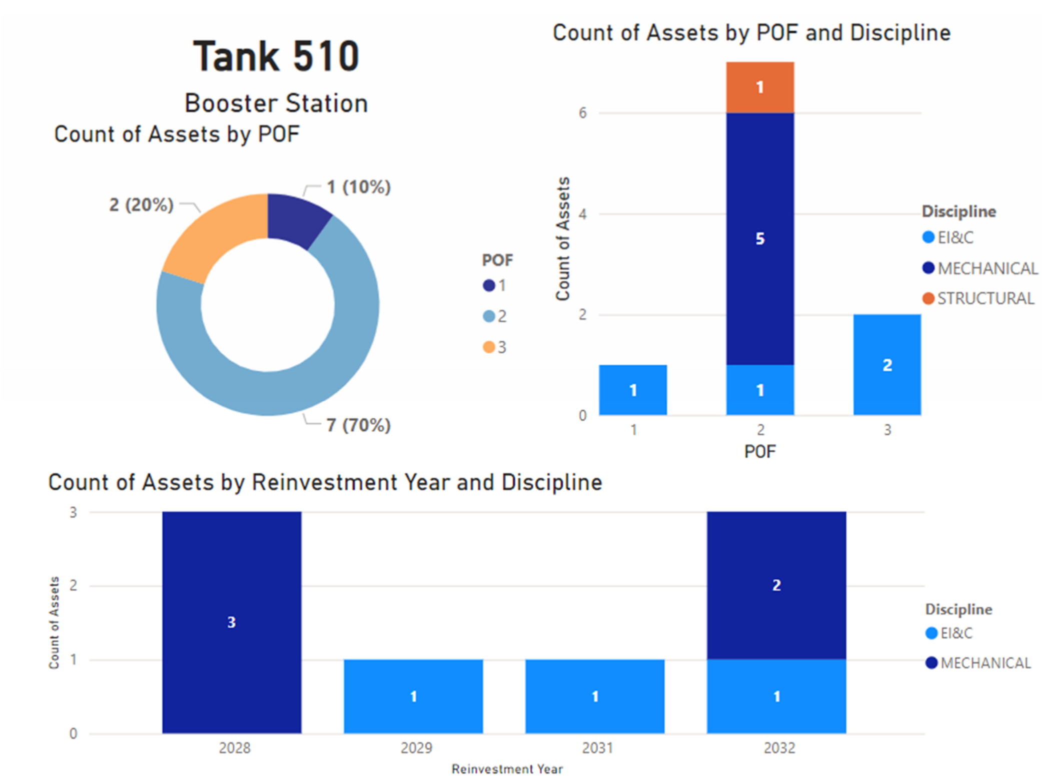


Figure 15 Tank 510 Booster Station POF Results

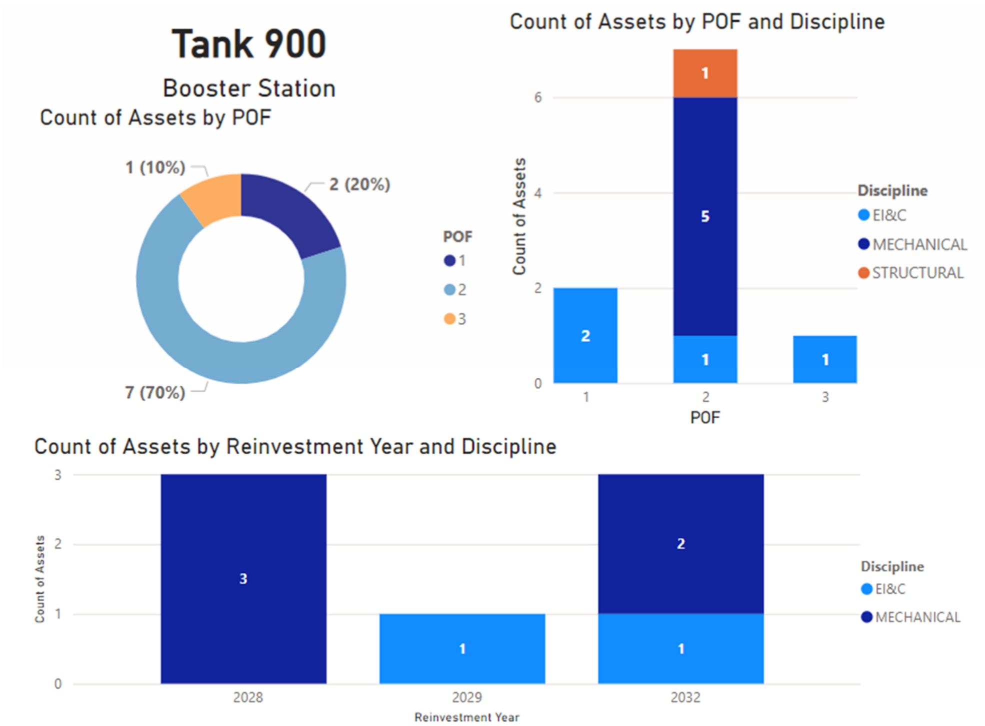


Figure 16 Tank 900 Booster Station POF Results

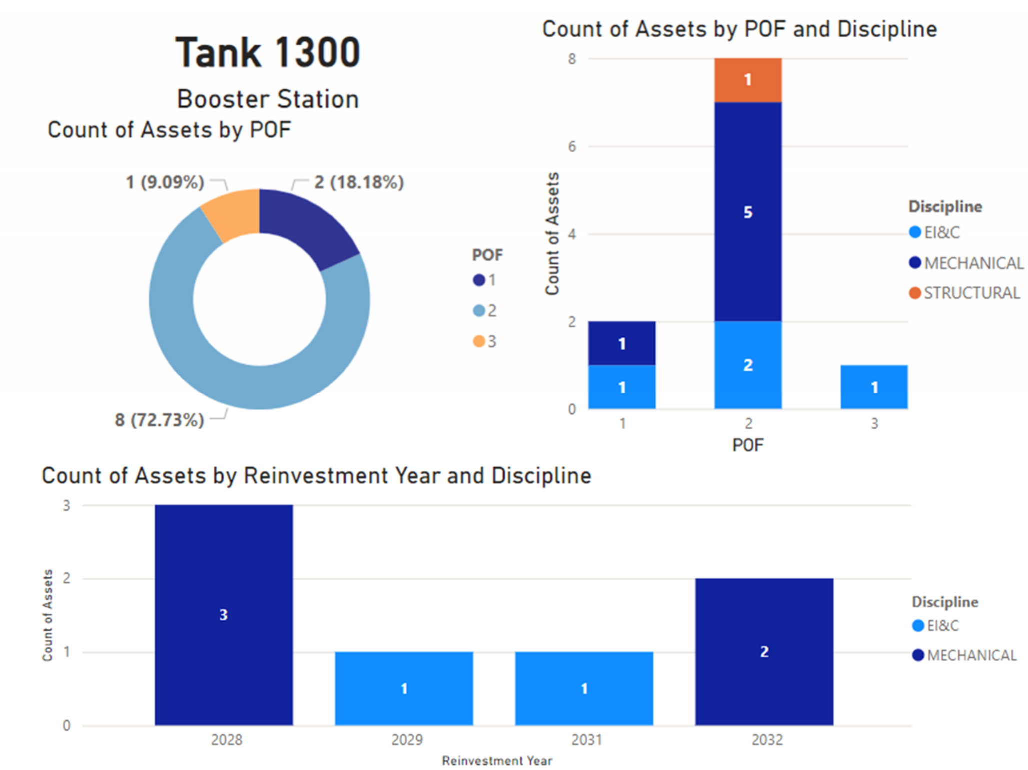


Figure 17 Grey Eagle Booster Station POF Results

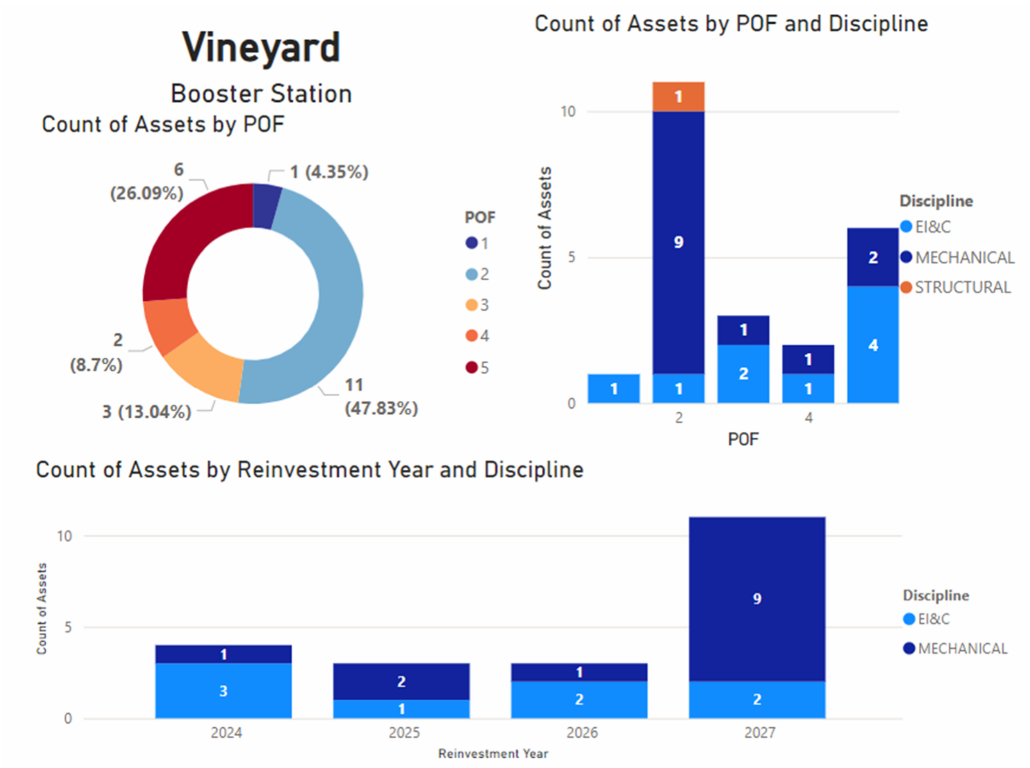


Figure 18 Vineyard Booster Station POF Results

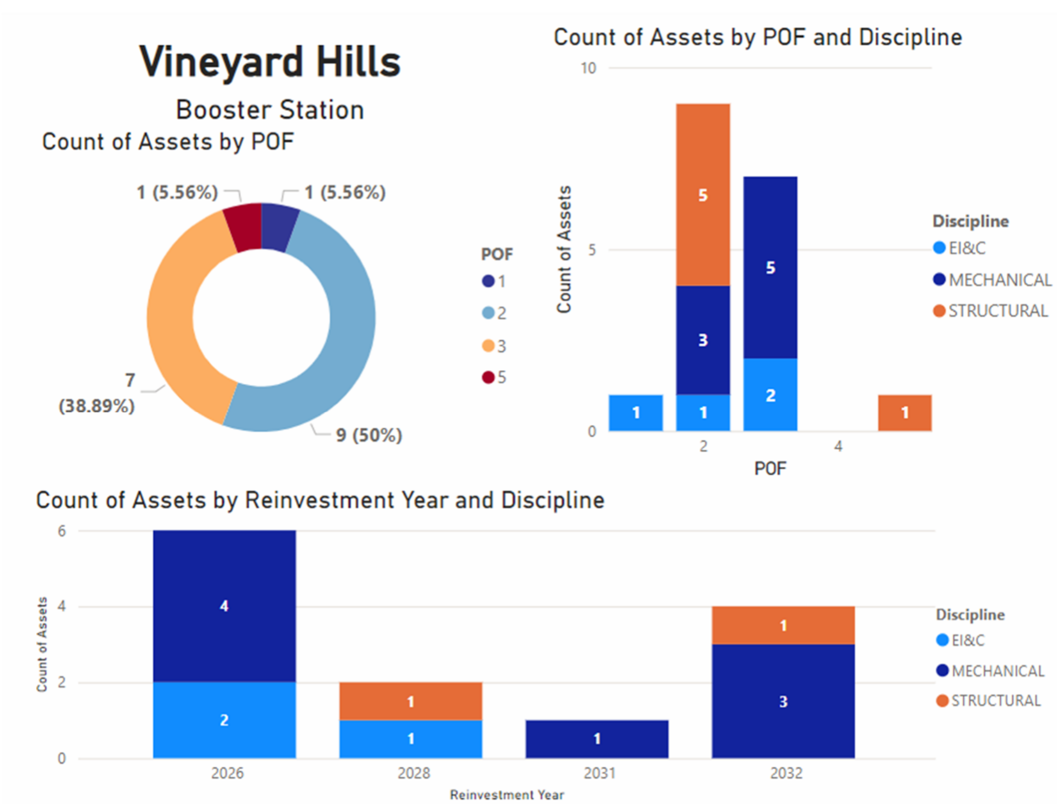


Figure 19 Vineyard Hills Booster Station POF Results

Reservoirs

There are 21 reservoirs representing a total of 161 assets. A figure for each reservoir is shown below in Figures 20 through 41.

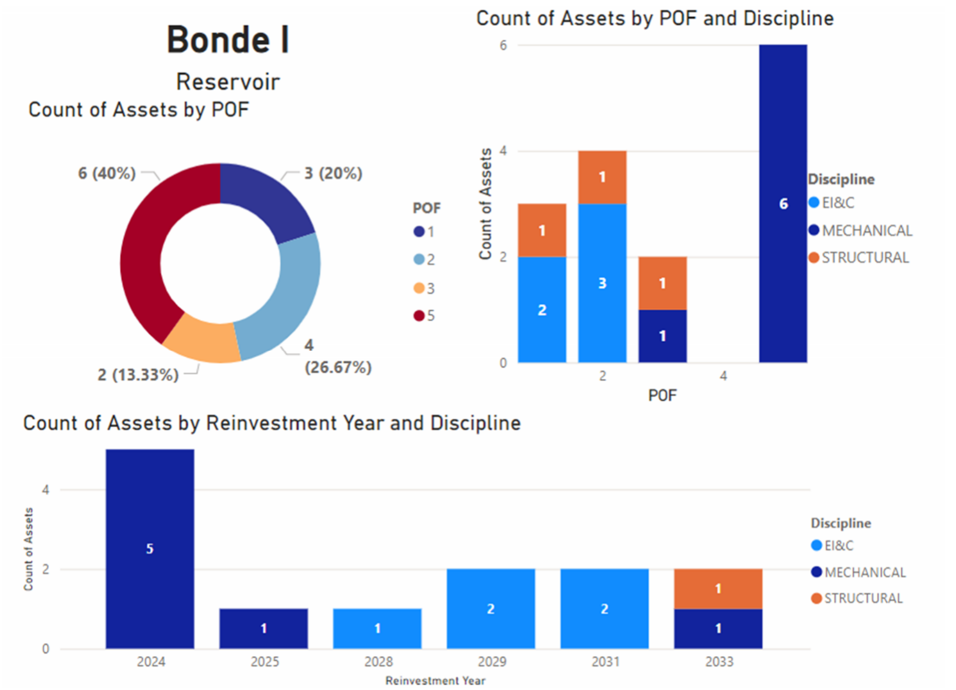


Figure 20 Bonde I Reservoir POF Results

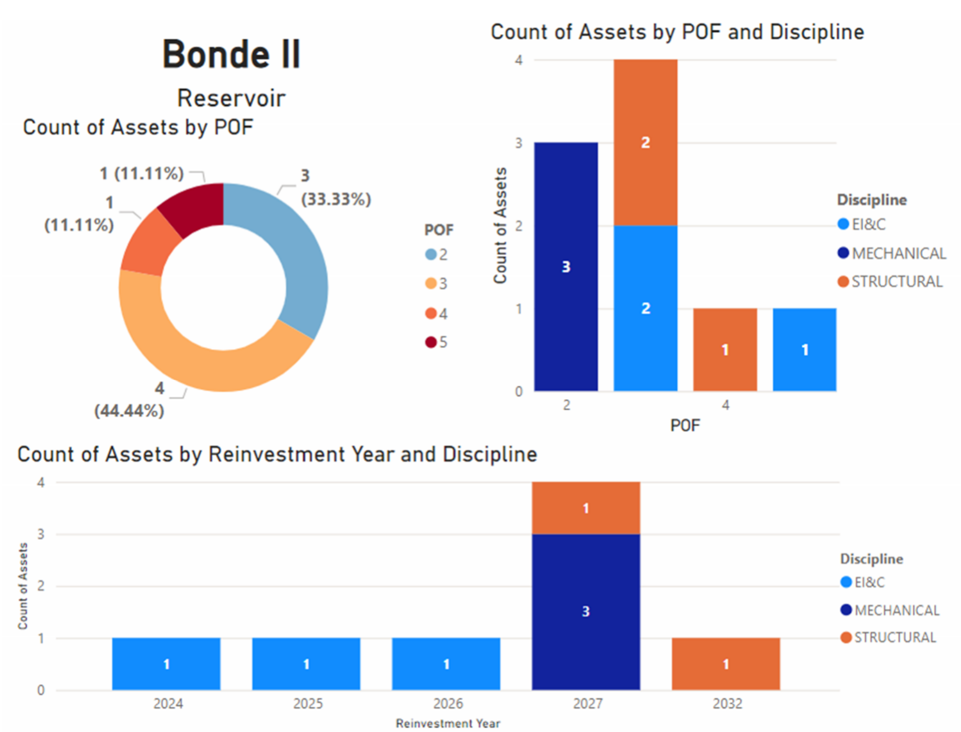


Figure 21 Bonde II Reservoir POF Results

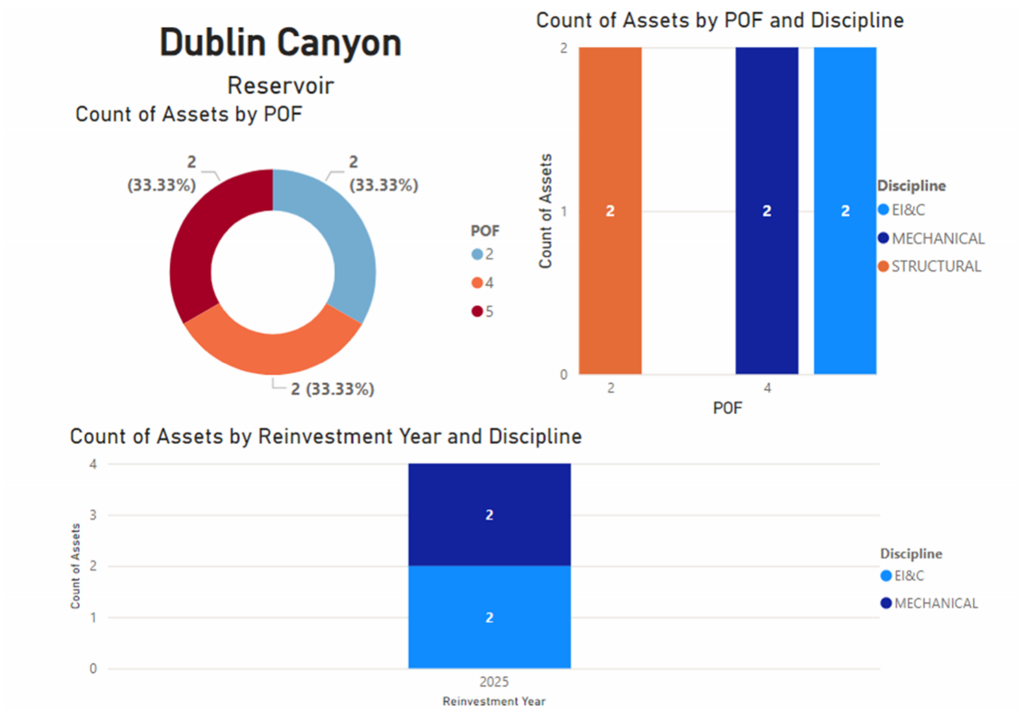


Figure 22 Dublin Canyon Reservoir POF Results

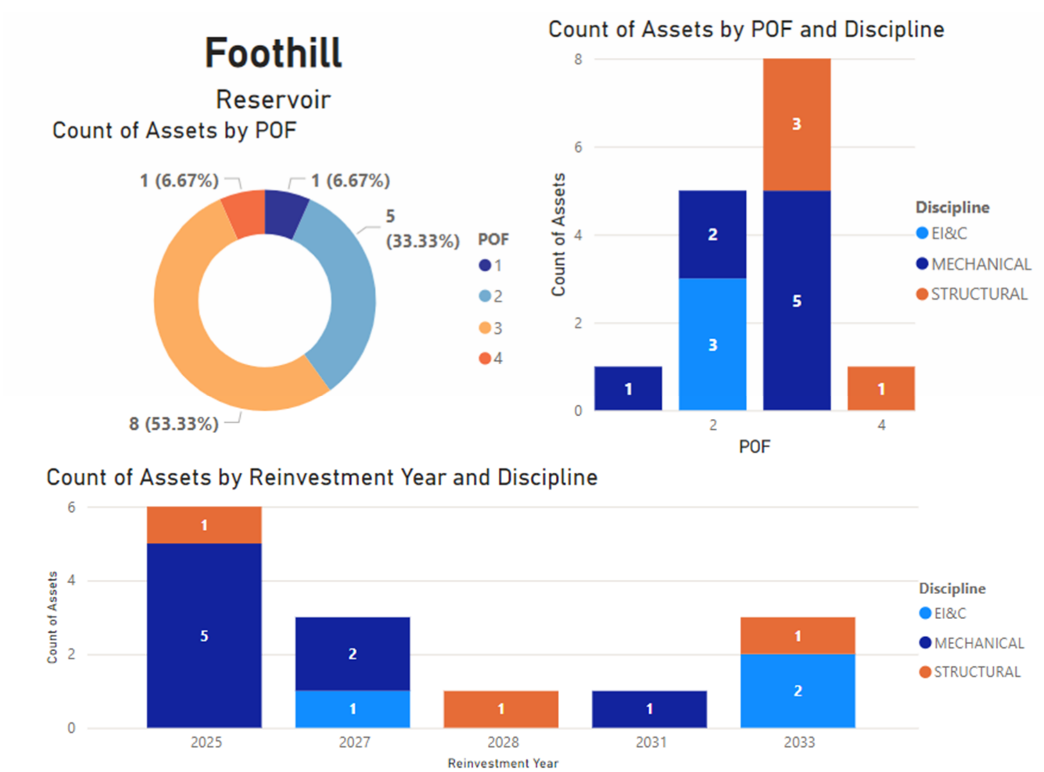


Figure 23 Foothill Reservoir POF Results

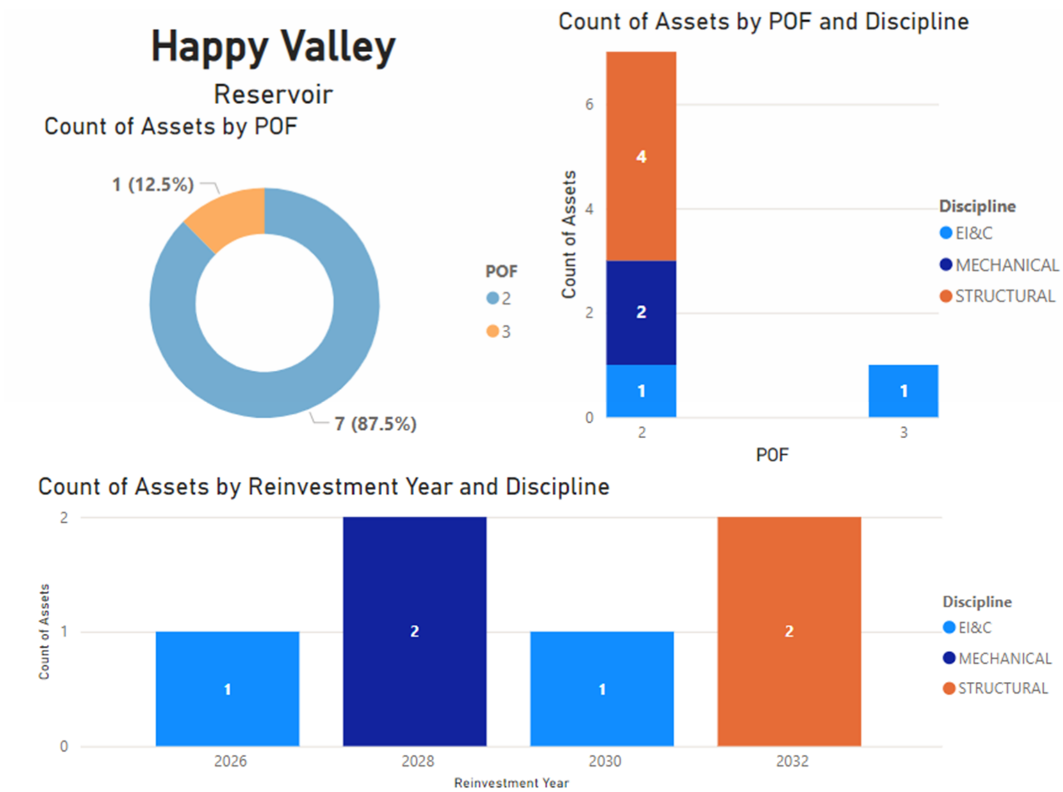


Figure 24 Happy Valley Reservoir POF Results

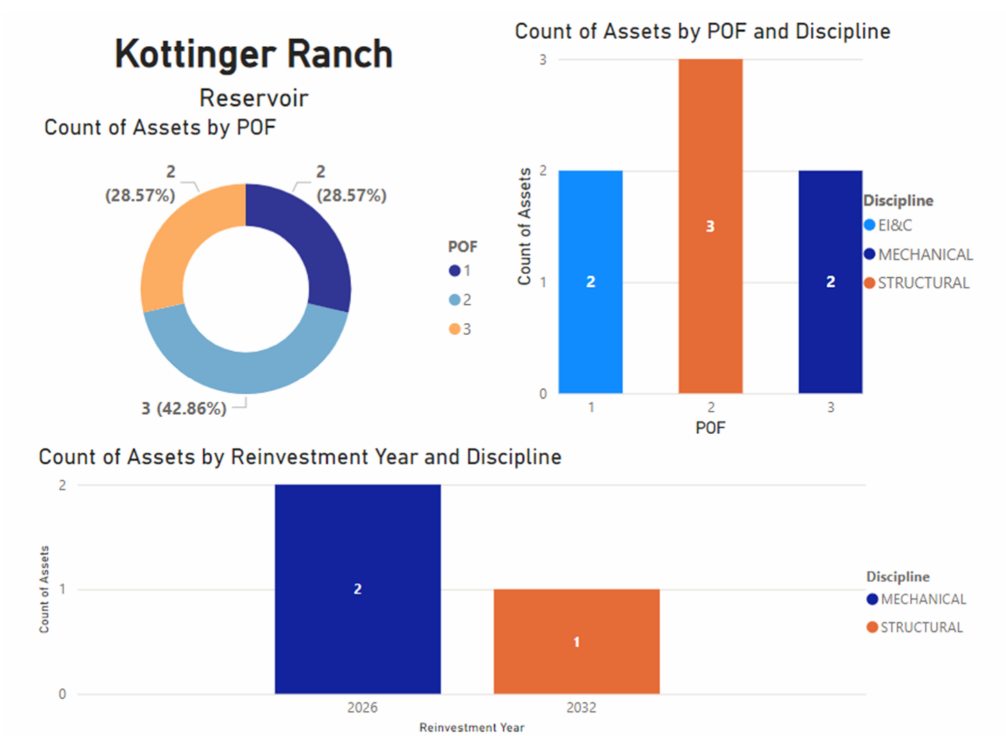


Figure 25 Kottinger Ranch Reservoir POF Results

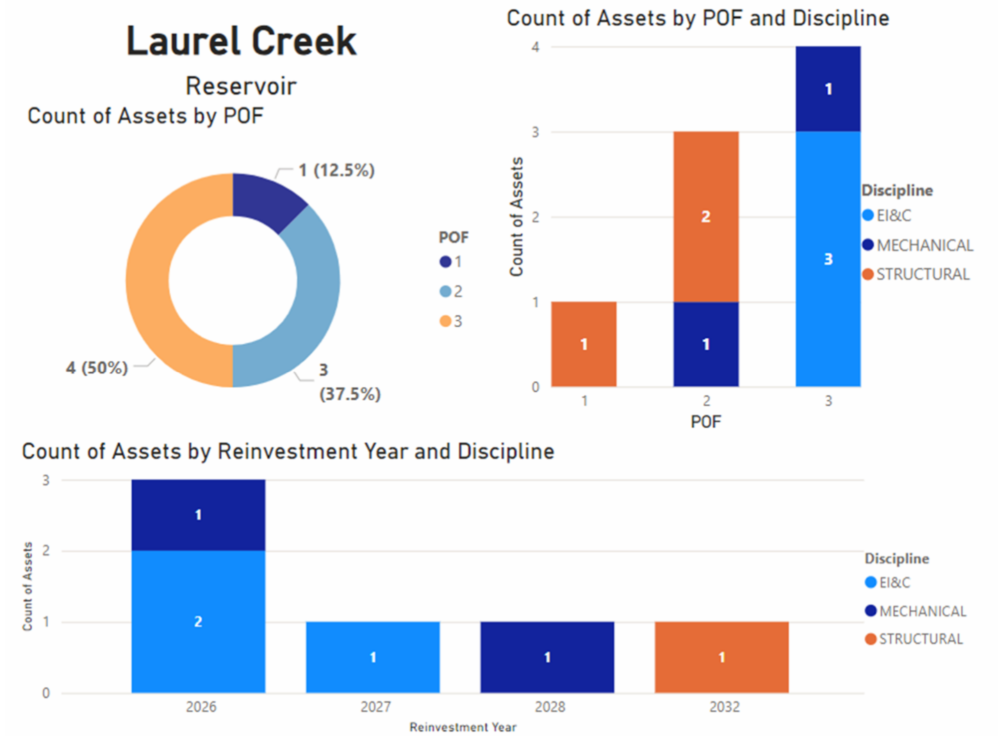


Figure 26 Laurel Creek Reservoir POF Results

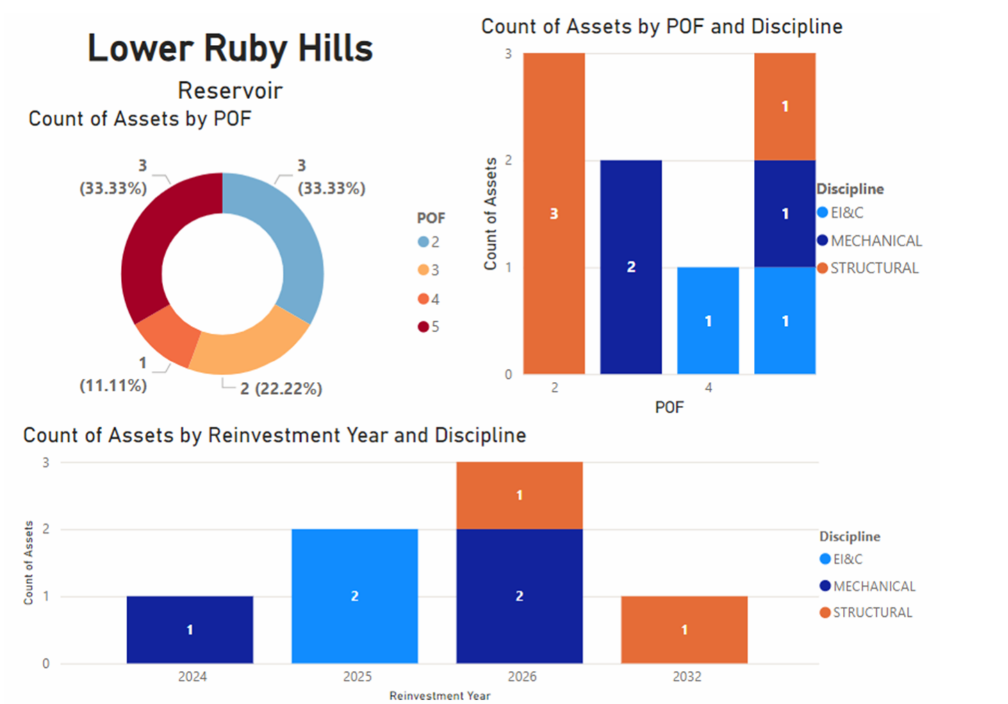


Figure 27 Lower Ruby Hills Reservoir POF Results

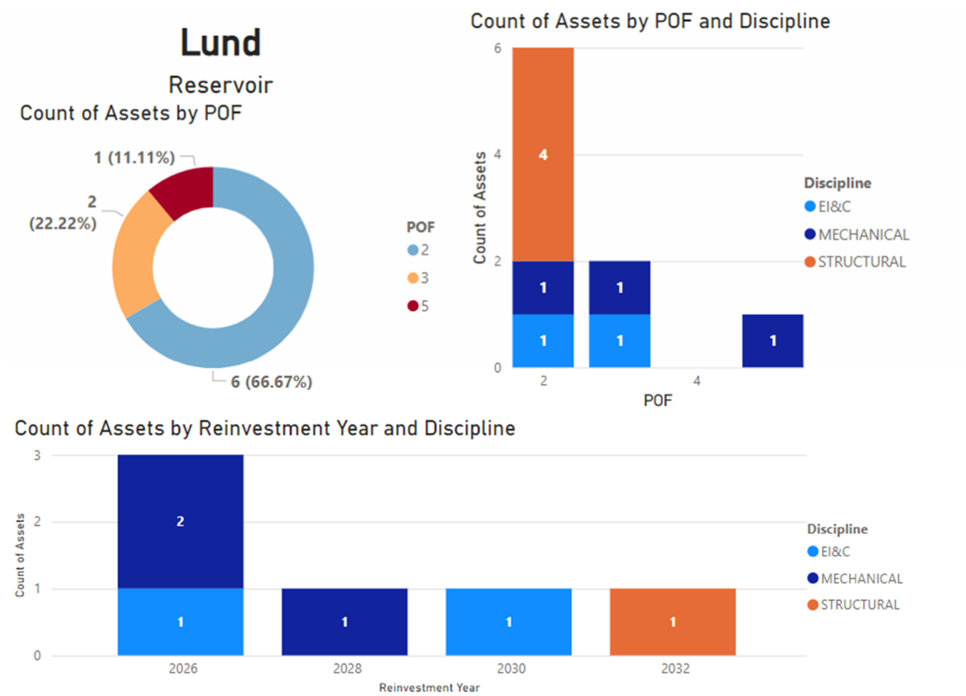


Figure 28 Lund Reservoir POF Results

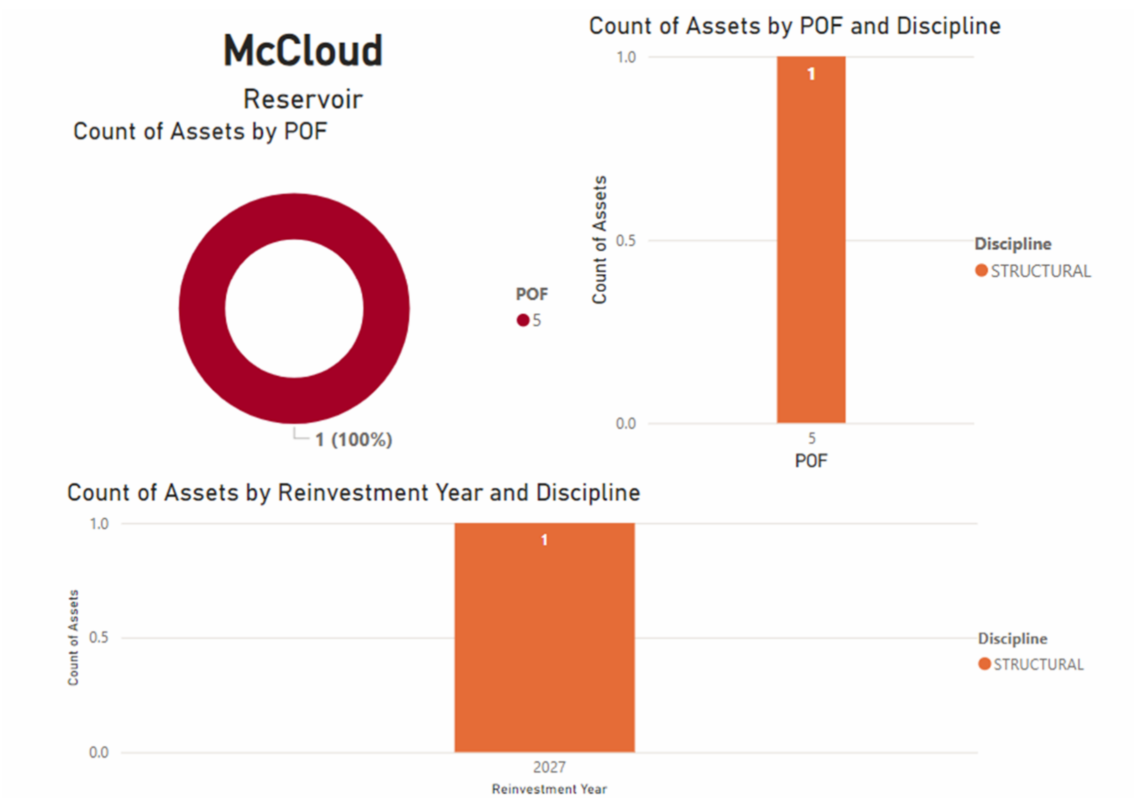


Figure 29 McCloud Reservoir POF Results

McCloud Reservoir is on the same site as the booster station and is no longer in service. Decommissioning this facility is recommended.

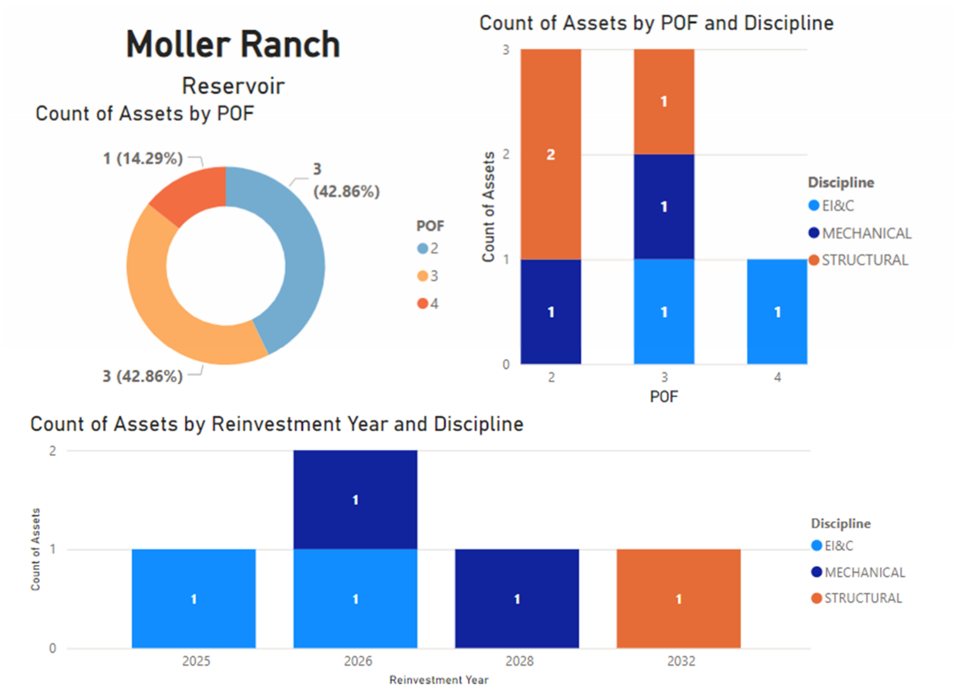


Figure 30 Moller Ranch Reservoir POF Results

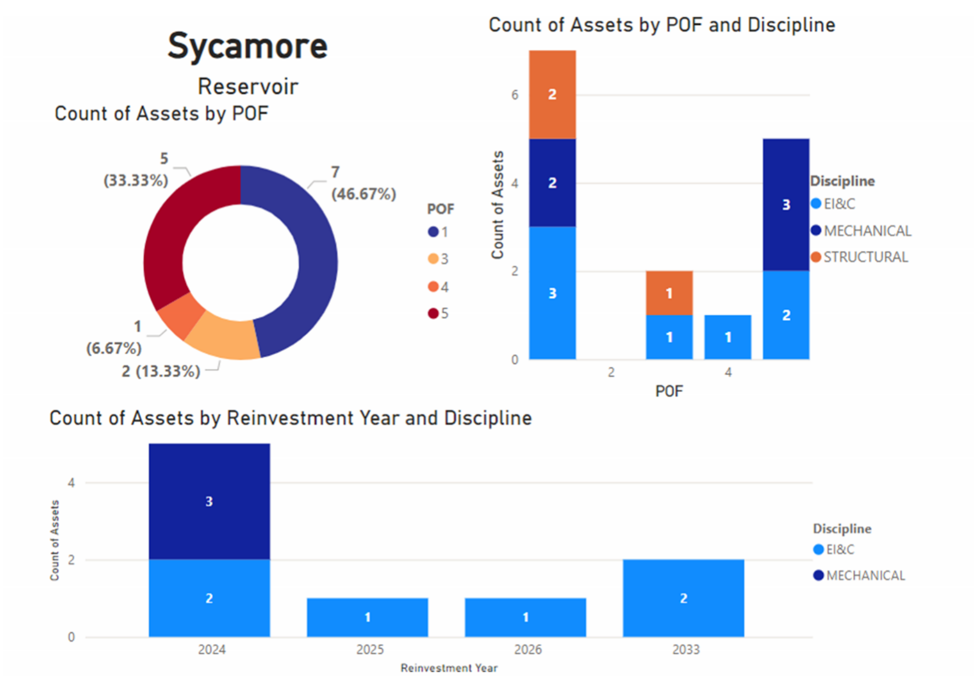


Figure 31 Sycamore Reservoir POF Results

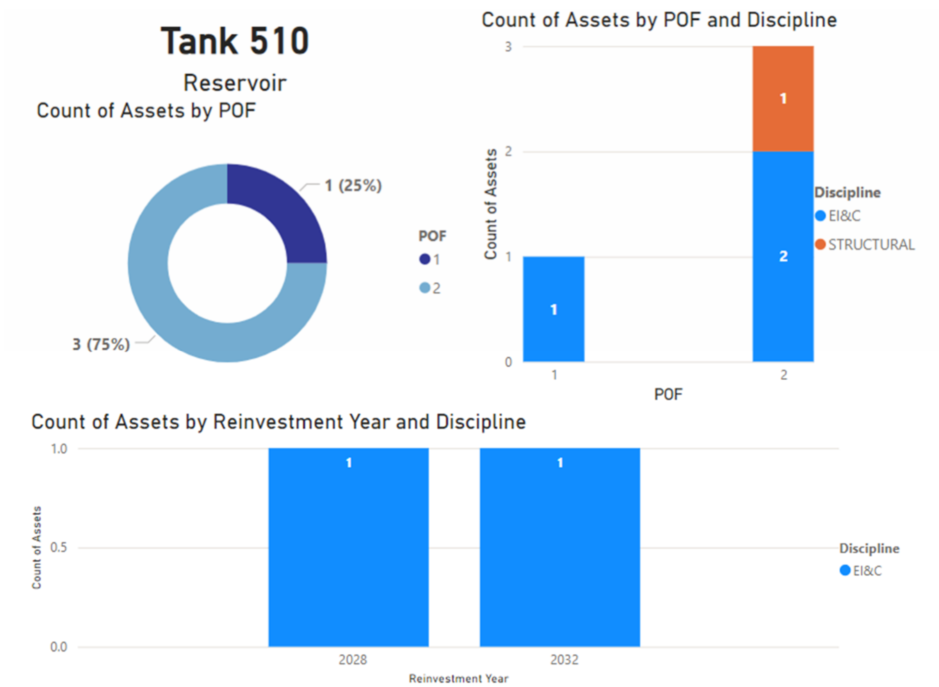


Figure 32 Tank 510 Reservoir POF Results

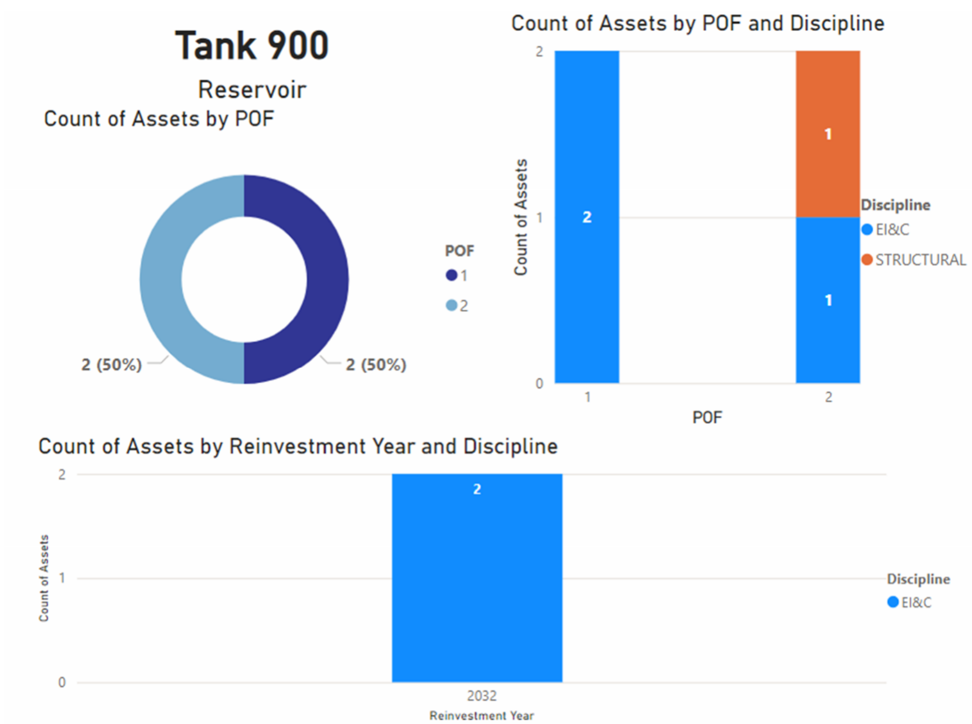


Figure 33 Tank 900 Reservoir POF Results

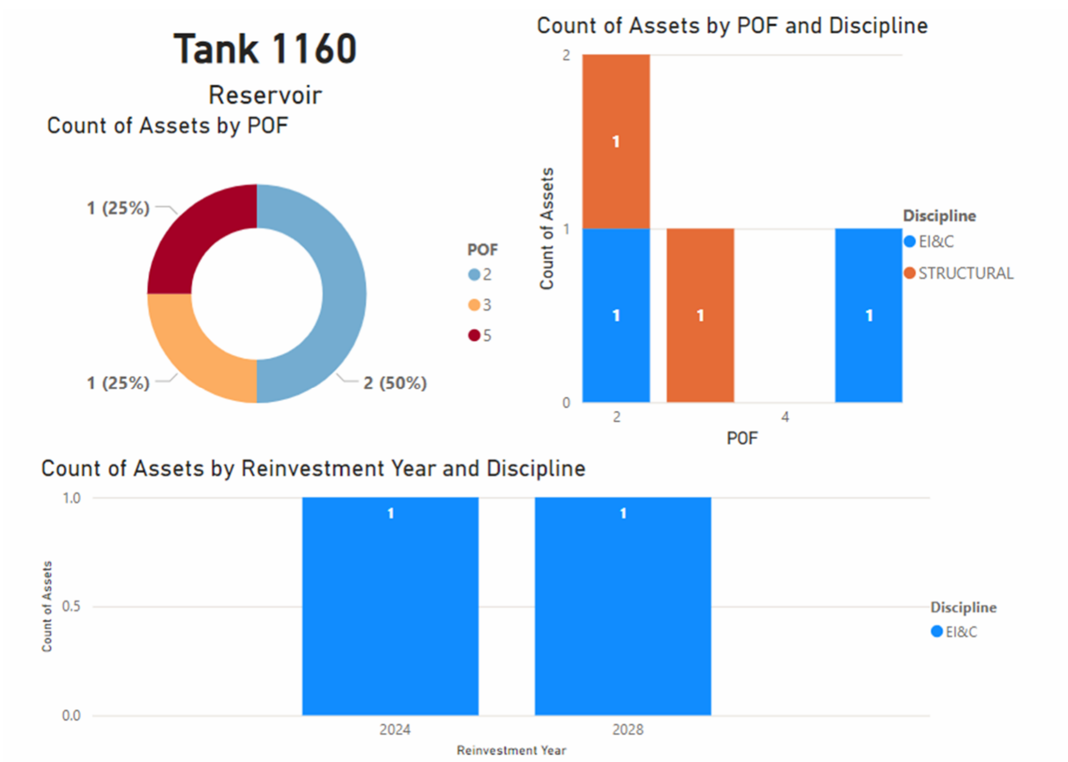


Figure 34 Tank 1160 Reservoir POF Results

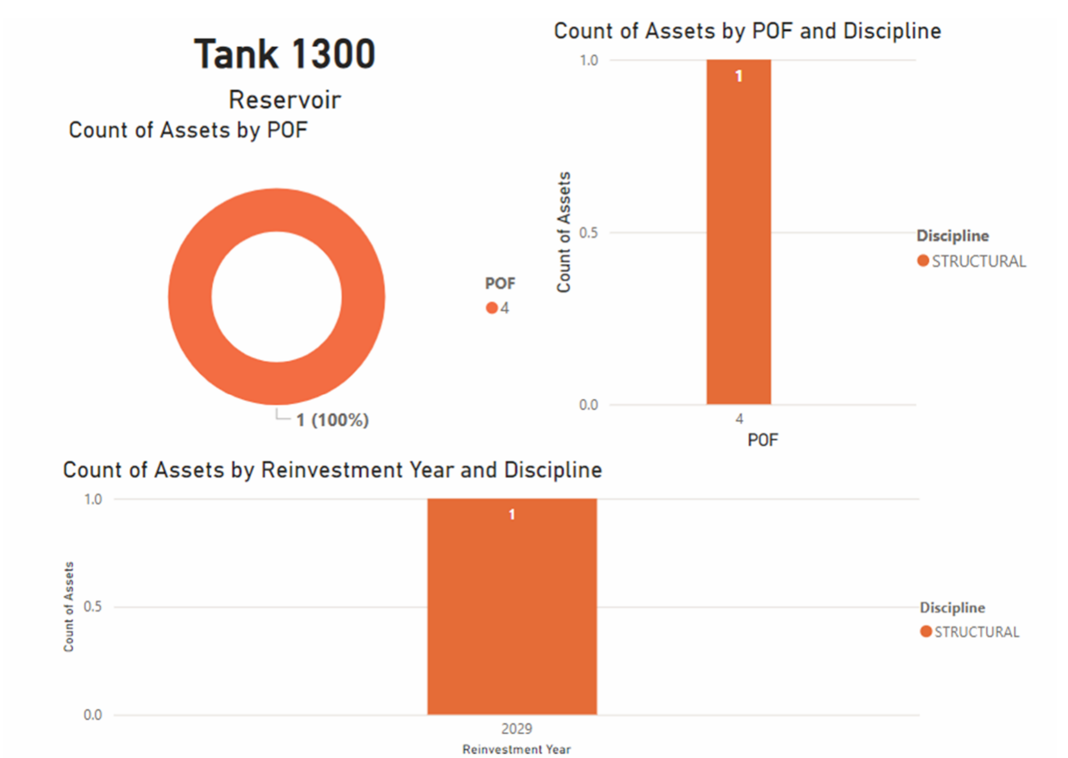


Figure 35 Tank 1300 Reservoir POF Results

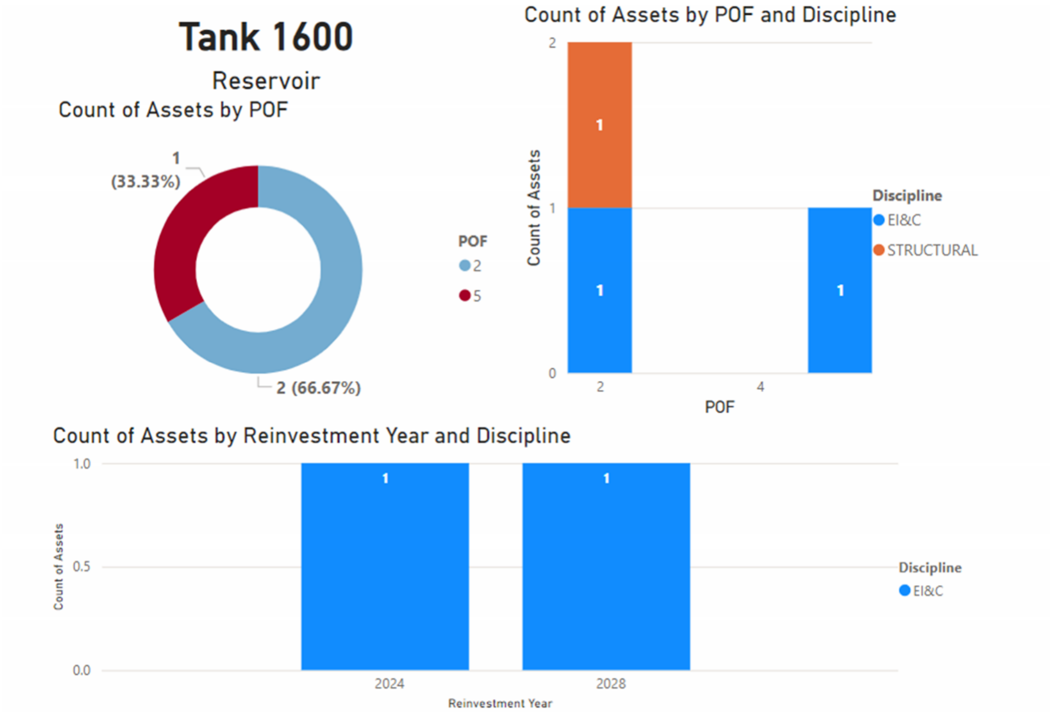


Figure 36 Tank 1600 Reservoir POF Results

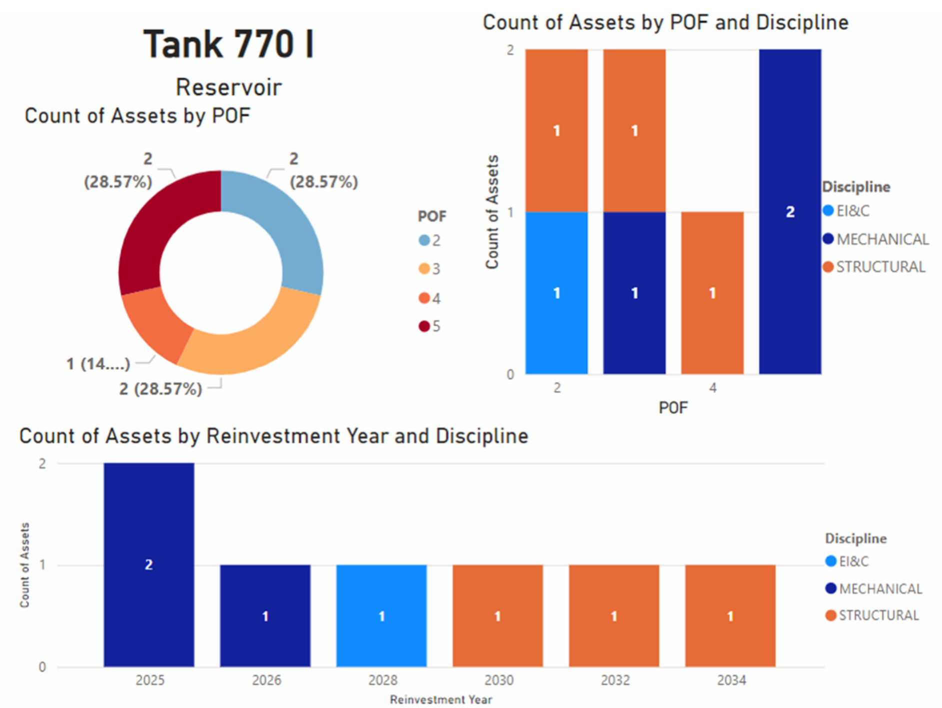


Figure 37 Tank 770 I Reservoir POF Results

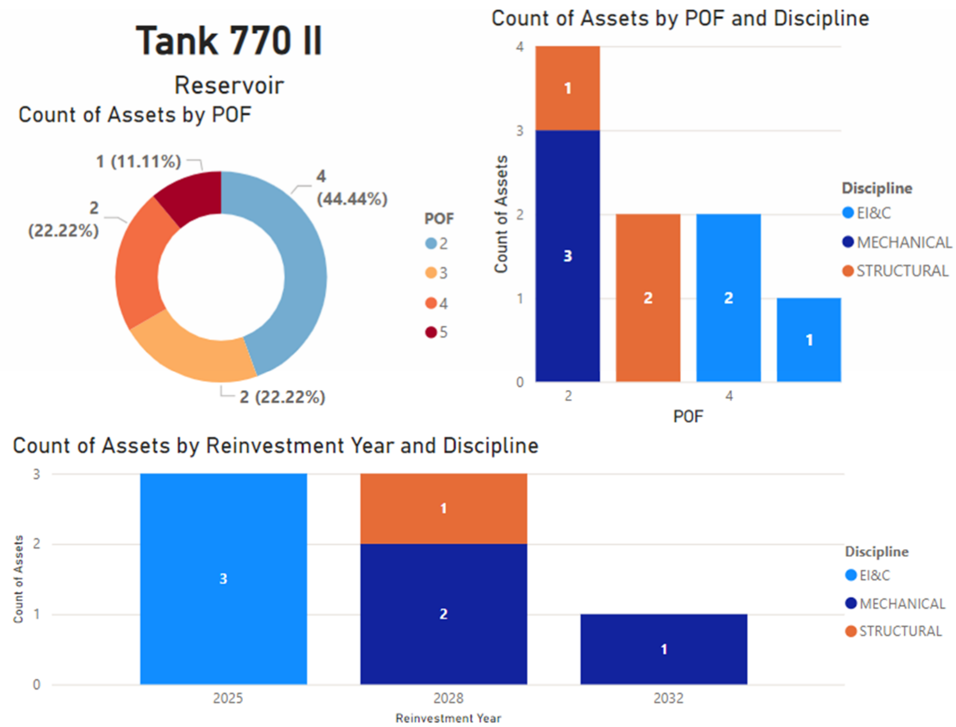


Figure 38 Tank770 II Reservoir POF Results

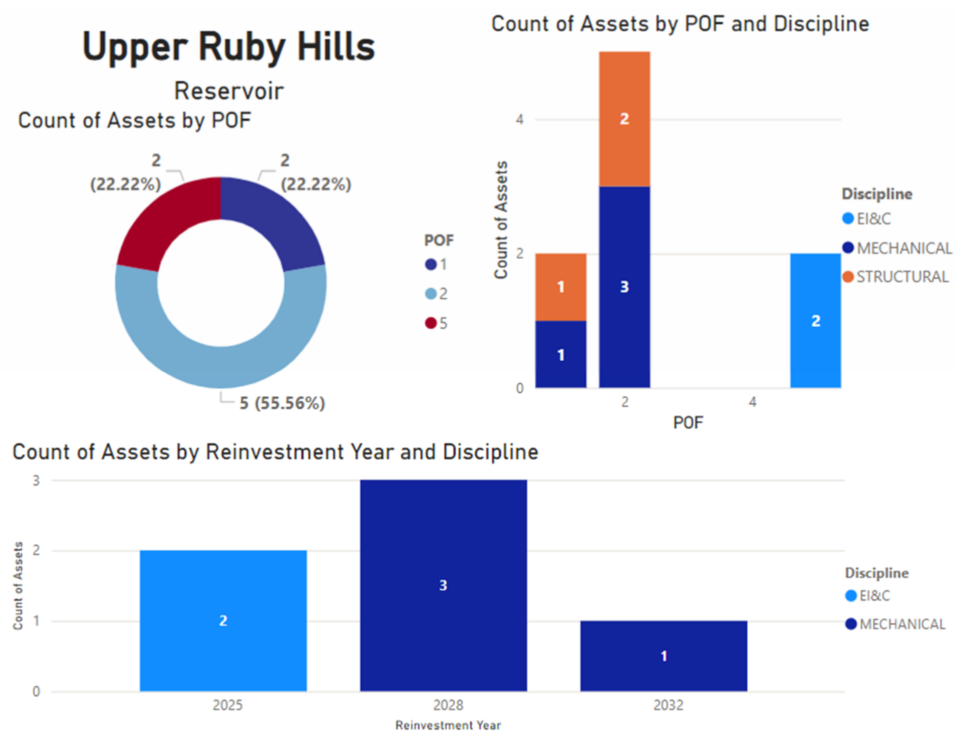


Figure 39 Upper Ruby Hills Reservoir POF Results

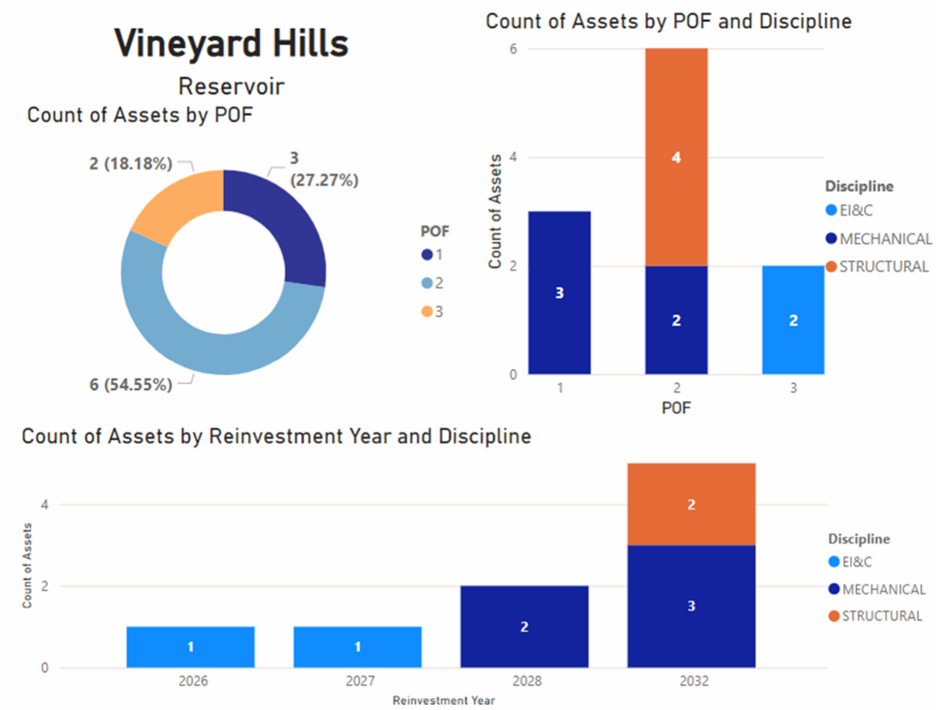


Figure 40 Vineyard Hills Reservoir POF Results

Turnouts

There are seven turnouts representing a total of 73 assets. A figure for each turnout is shown below in Figures 41 through 47.

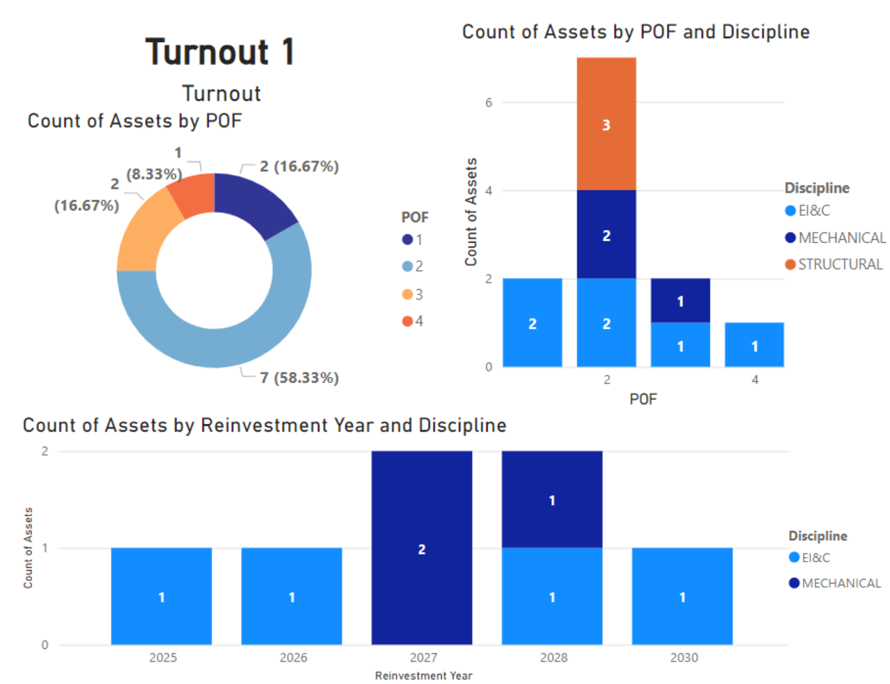


Figure 41 Turnout 1 Turnout POF Results

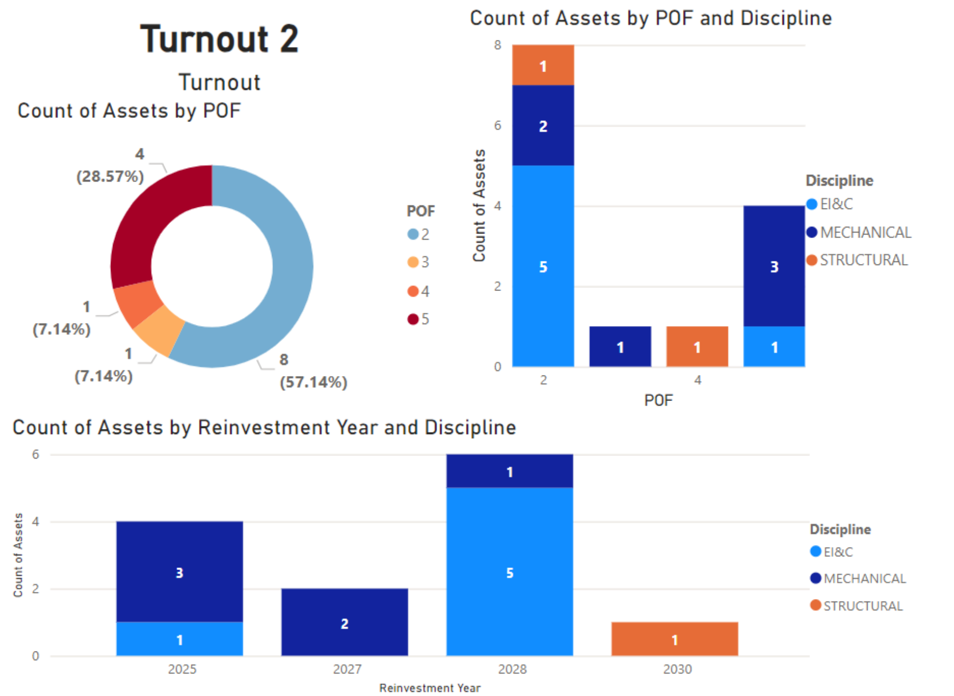


Figure 42 Turnout 2 Turnout POF Results

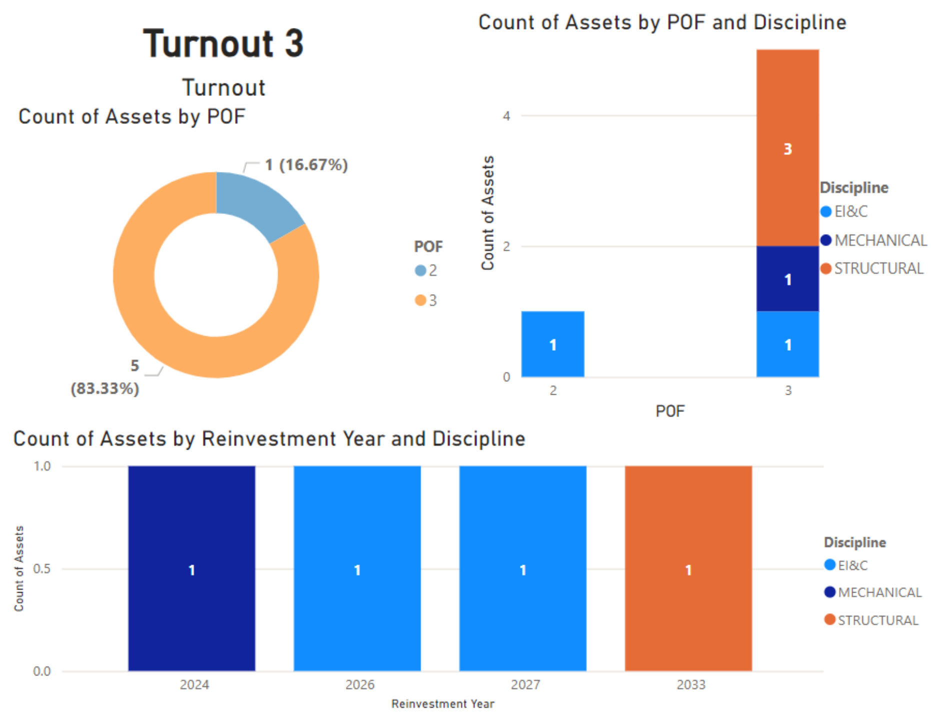


Figure 43 Turnout 3 Turnout POF Results

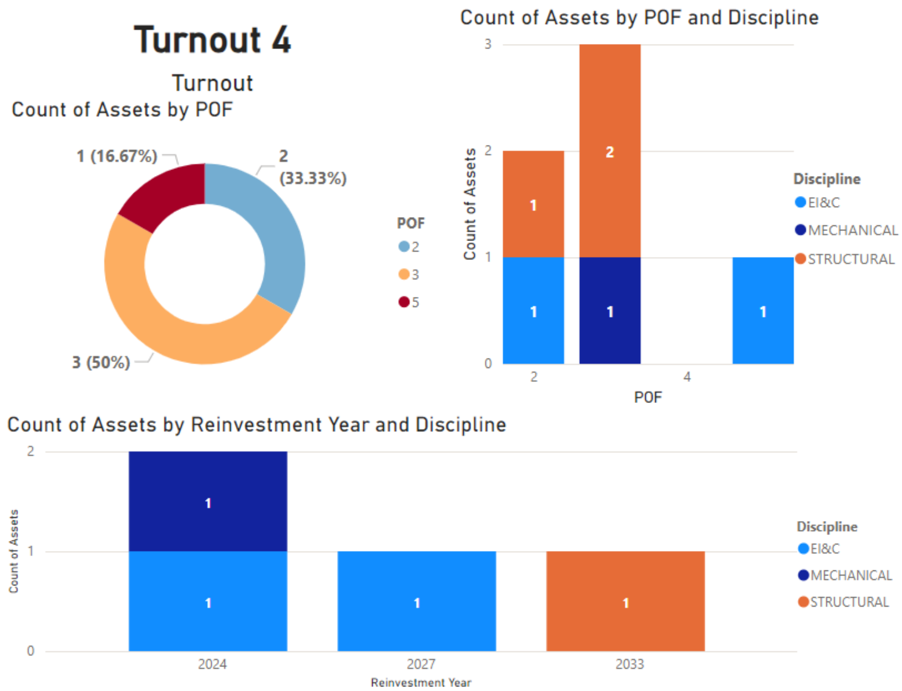


Figure 44 Turnout 4 Turnout POF Results

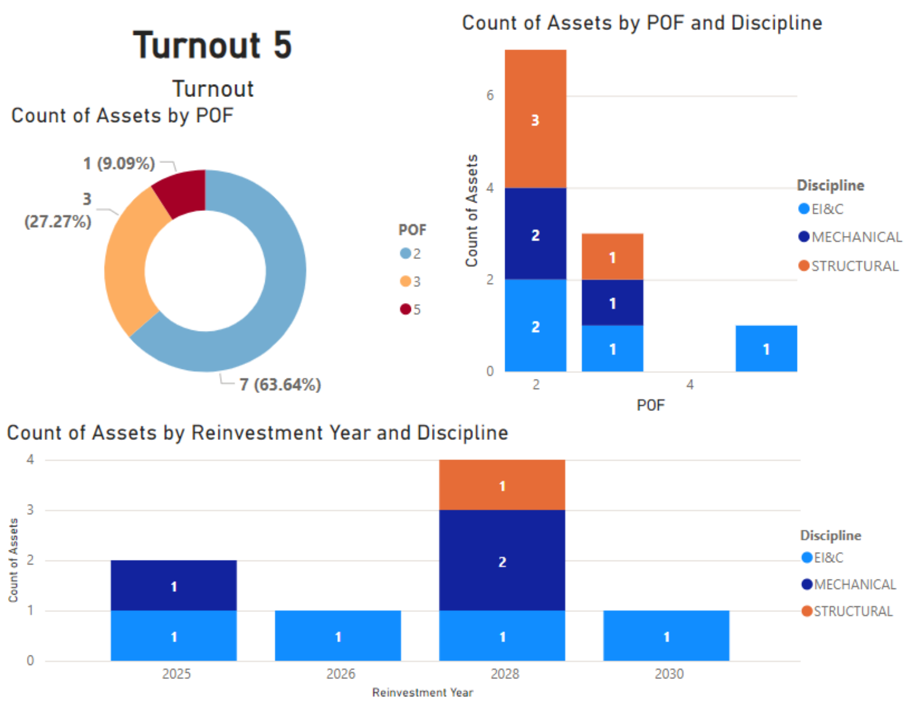


Figure 45 Turnout 5 Turnout POF Results

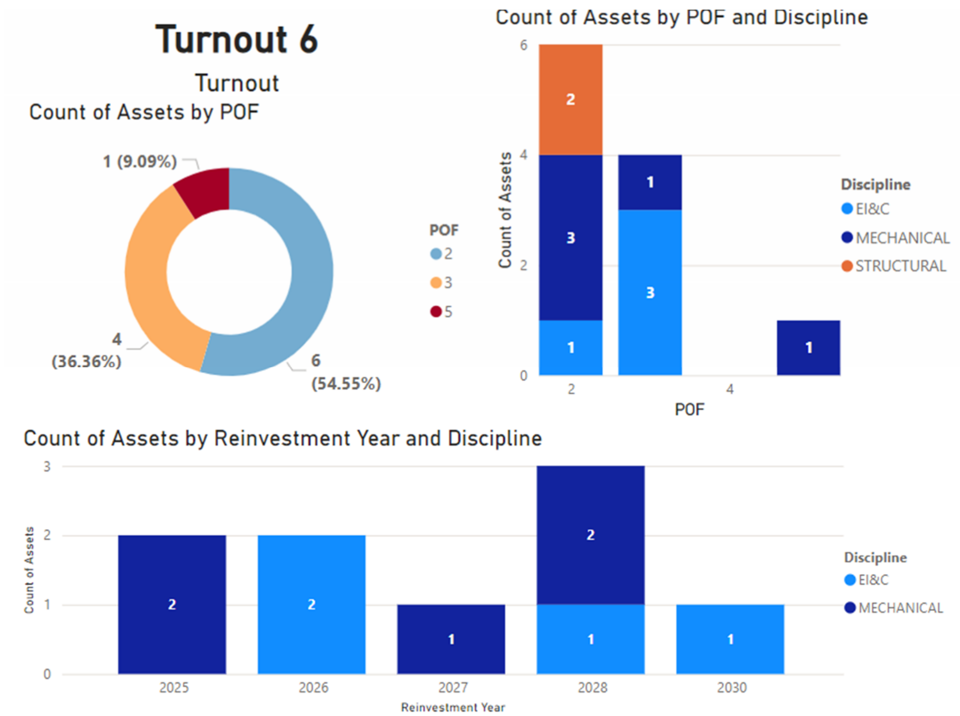


Figure 46 Turnout 6 Turnout POF Results

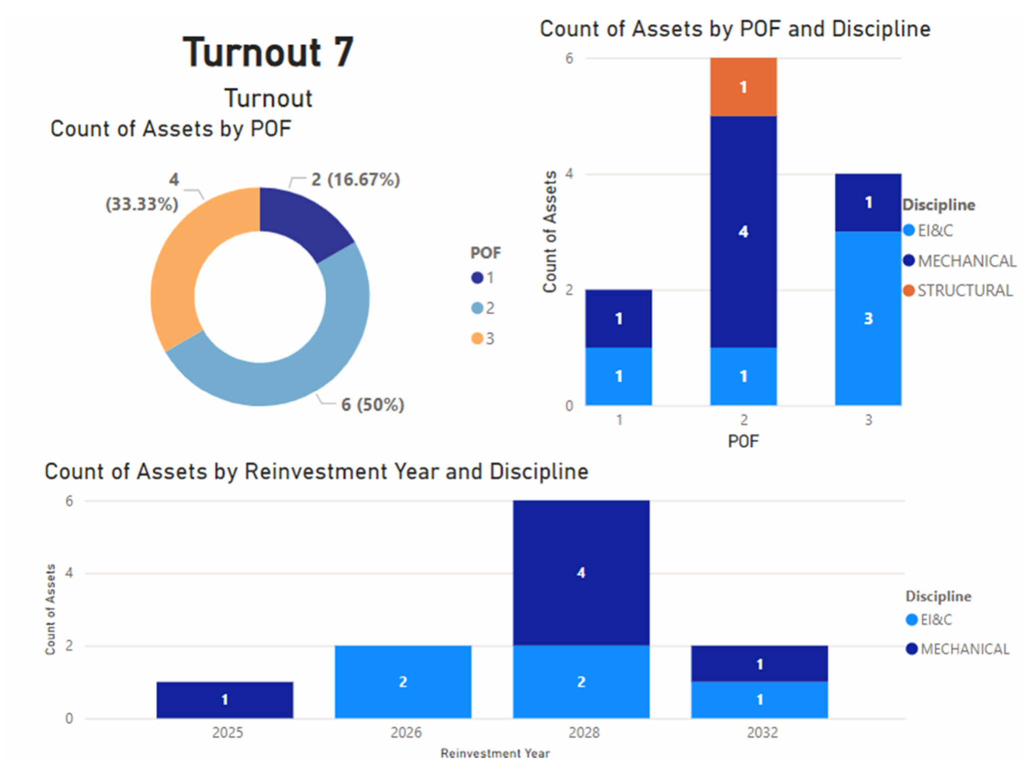


Figure 47 Turnout 7 Turnout POF Results

Wells

There are four production well sites: Wells 5, 6, 7, and 8. Wells 5, 6, and 8 were evaluated as part of the Water Quality Evaluation Project (July 2020) and the results of that assessment have been included herein. Well 7 was evaluated under this project on September 29, 2022. Across the well sites there are 45 assets. A figure for each well site is below in Figures 48 through 50. Well sites 5 and 6 are combined due to shared assets.

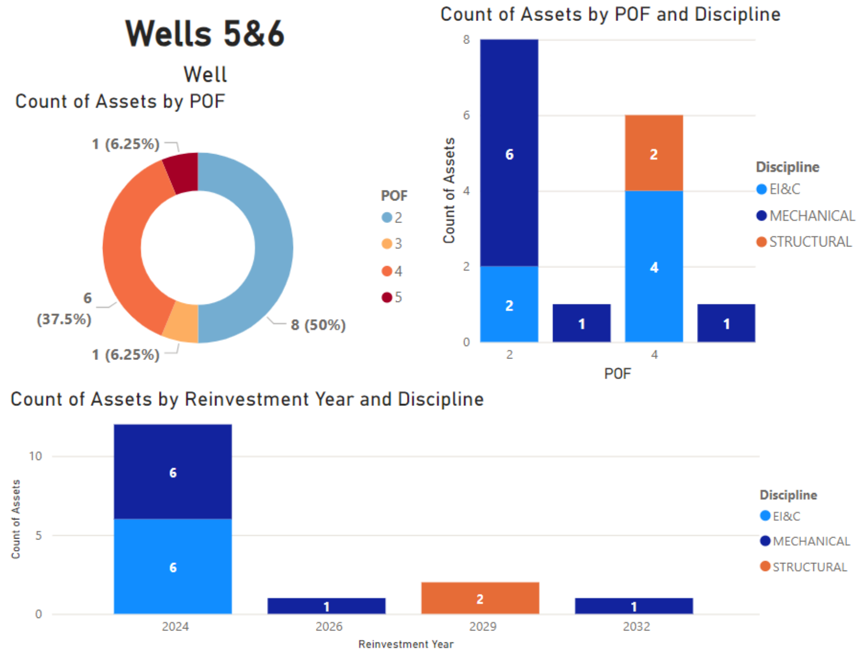


Figure 48 Wells 5&6 Well POF Results

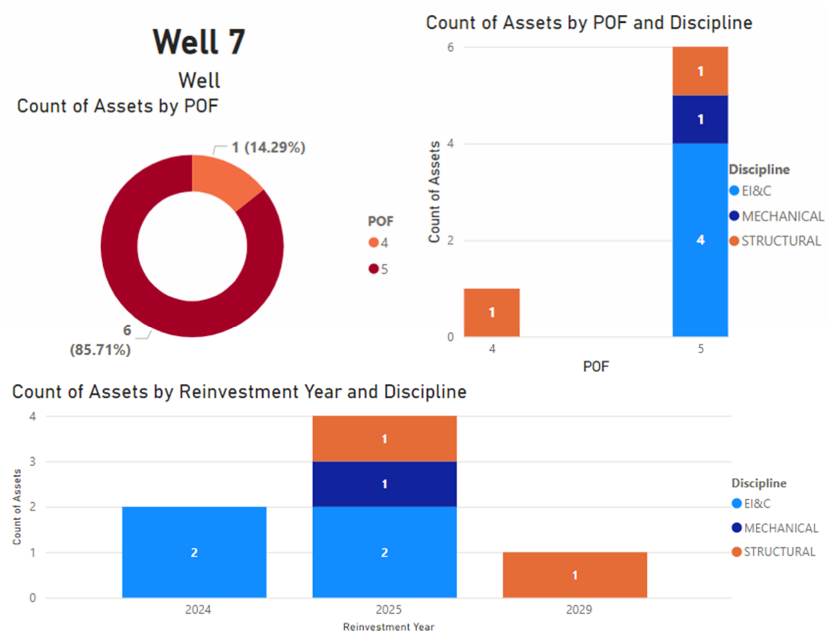


Figure 49 Well 7 Well POF Results

Well 7 is no longer in service. Decommissioning this facility is recommended.

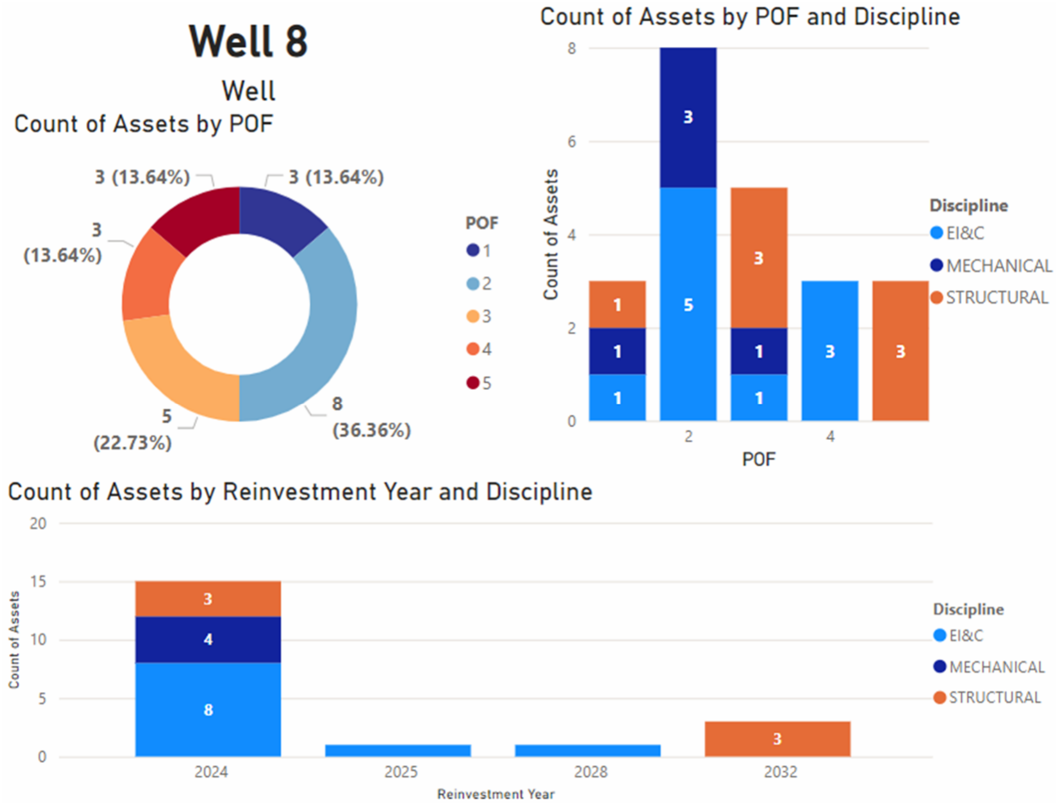


Figure 50 Well 8 Well POF Results

1.2.2 Consequence of Failure (COF)

COF represents the relative impacts to the City if an asset were to fail (i.e., a higher COF score indicates greater repercussions).

As part of the City's AWIA Risk and Resilience Assessment (RRA), consequence metrics of low, medium, or high were assigned to eight categories that represent relative financial, social, and environmental effects of an asset or system failing for each facility location:

1. Financial losses to the utility.
2. Economic losses to the community.
3. Impacts to essential critical infrastructure (non-agency).
4. Impacts to the environment.
5. Impacts to water quality.
6. Impacts to public confidence.
7. Fatalities.
8. Serious injuries.

Building on the eight RRA categories above, a ninth one was established for this effort to capture operator input. Operators' firsthand experience makes them invaluable in identifying areas where capital investments can yield the most significant improvements. The operator input was discussed and assigned at the Water Asset Rehabilitation and Replacement (R&R) Workshop on April 30, 2024. The workshop materials are in Appendix C.

9. Operator input.

The consequence metrics for the water facilities represent the worst reasonable consequences resulting from the destruction or loss of each facility. For each facility, it was determined if the destruction or loss of the asset has a high, medium, or low potential to cause the associated consequence. These are further defined as follows:

- High - The destruction or loss of this asset has a high likelihood of causing the consequence.
- Medium - The destruction or loss of this asset has a medium likelihood of causing the consequence.
- Low - The destruction or loss of this asset has a low likelihood of causing the consequence.
- N/A - This consequence is not applicable to the asset.

The sum of the consequence among the categories was used to represent the COF score where a COF score of 1 represents low, a COF of 2 represents medium, and a COF score of 3 represents high. The COF categories and consequence metric assignments were developed in 2020 by the City and West Yost are provided as Appendix D and in Table 4.

The total COF score by facility is presented in Figure 51.

Table 4 COF by Facility Location

Facility	Financial Losses to the Utility	Economic Losses to the Community	Impacts to Essential Critical Infrastructure	Impacts to the Environment	Impacts to Water Quality	Impacts to Public Confidence	Fatalities	Serious Injuries	Operator Input	Cumulative COF Score(1)
Bonde I	2	2	1	1	1	2	1	1	1	**12**
Bonde II	2	2	1	1	1	2	1	1	1	**12**
Dublin Canyon	1	1	1	1	1	1	1	1	1	**9**
Foothill	3	3	3	1	3	3	1	1	1	**19**
Grey Eagle	1	1	1	1	1	1	1	1	0	**8**
Happy Valley	1	1	1	1	1	2	1	1	1	**10**
Kottinger Ranch	1	1	1	1	1	2	1	1	1	**11**
Laurel Creek	2	1	1	1	1	2	1	1	1	**11**
Longview	2	1	1	1	1	2	1	1	1	**11**
Lund	2	1	1	1	1	2	1	1	1	**11**
McCloud	1	1	1	1	1	1	1	1	0	**8**
Moller Ranch	2	1	1	1	1	2	1	1	1	**11**
Ruby Hills	2	1	1	1	1	2	1	1	1	**11**
Lower Ruby Hills	2	1	1	1	1	2	1	1	1	**11**
Upper Ruby Hills	2	1	1	1	1	2	1	1	1	**11**
Sycamore	3	3	3	1	3	3	1	1	1	**19**
Tank 510	1	1	1	1	1	2	1	1	1	**10**
Tank 900	1	1	1	1	1	2	1	1	1	**10**

Facility	Financial Losses to the Utility	Economic Losses to the Community	Impacts to Essential Critical Infrastructure	Impacts to the Environment	Impacts to Water Quality	Impacts to Public Confidence	Fatalities	Serious Injuries	Operator Input	Cumulative COF Score(1)
Tank 1160	1	1	1	1	1	2	1	1	1	**10**
Tank 1300	1	1	1	1	1	2	1	1	1	**10**
Tank 1600	1	1	1	1	1	2	1	1	1	**10**
Tank 770 I	2	1	1	1	1	2	1	1	1	**11**
Tank 770 II	2	1	1	1	1	2	1	1	1	**11**
Vineyard	2	1	1	1	1	1	1	1	2	**11**
Vineyard Hills	2	1	1	1	1	2	1	1	1	**11**
Turnout 1	1	1	1	1	1	1	1	1	0	**8**
Turnout 2	1	1	1	1	1	1	1	1	1	**9**
Turnout 3	2	2	3	1	2	2	1	2	1	**16**
Turnout 4	3	3	3	1	2	3	1	2	1	**19**
Turnout 5	3	3	3	1	3	3	1	2	3	**22**
Turnout 6	3	3	3	1	3	3	1	2	2	**21**
Turnout 7	3	3	3	1	3	3	1	2	2	**21**
Well 5	1	1	1	1	1	1	1	1	0	**8**
Well 6	1	1	1	1	1	1	1	1	0	**8**
Well 7	1	1	1	1	1	1	1	1	0	**8**
Well 8	1	1	1	1	1	1	1	1	0	**8**

Note:
(1) Scores have been updated from AWIA to reflect that facility is no longer used or needed.

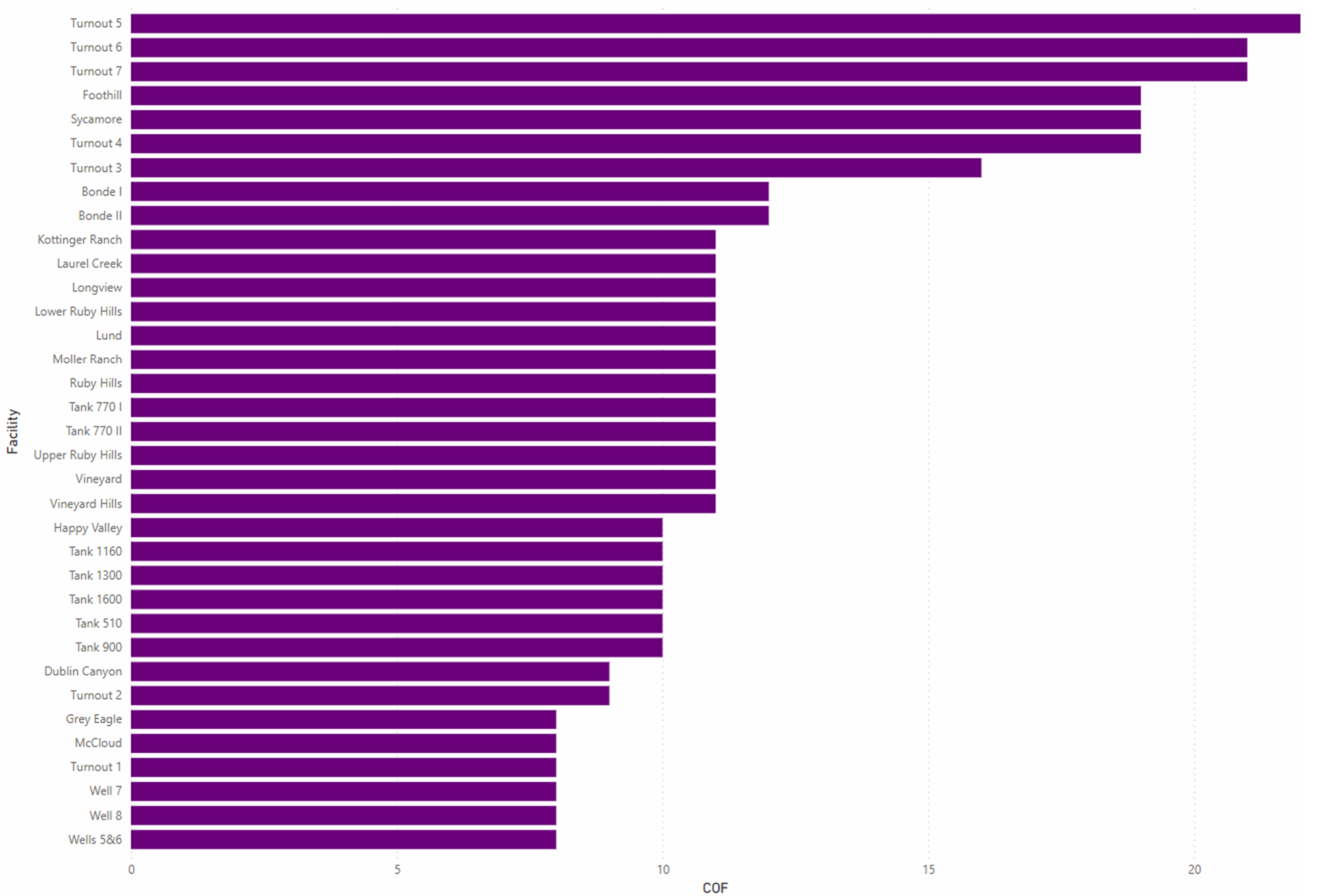


Figure 51 Water Facility COF

1.3 Water Facility CIP and O&M Investment Strategies

The CIP investment strategy is a plan that outlines a water utility's capital improvement needs and spending priorities over a 10-year horizon that should be updated on an annual basis to reflect changing conditions and priorities. The O&M investment strategy is a plan that outlines a water utility's spending on the O&M of its infrastructure and typically occurs on a 1–3-year basis. Both strategies are based on the current state of the assets.

CIP and O&M investment strategies are complementary and should be developed in a coordinated manner. CIP investments can help to reduce O&M costs over the long-term by improving the efficiency and reliability of infrastructure. Moreover, inadequate O&M investment can lead to increased infrastructure deterioration and higher CIP costs in the future.

Costs have also been developed at the asset level so that the City can make informed decisions for R&R based on available resources. The following sections identify the cost estimating methodology, and the capital improvement and O&M investment strategies.

1.3.1 Cost Estimating Methodology

This section describes how the costs were developed for the water facilities.

1.3.1.1 Water Facilities

Material costs were assigned at the asset class level using the replacement cost ranges in Table 5.The replacement cost range was determined by Carollo's discipline leads that participated in the field assessment and from Carollo's in-house references for material costs from previous studies, projects, and vendor quotes. Appendix A shows the replacement cost range and assumed cost by asset class.

Table 5 Replacement Cost Ranges

Replacement Cost Range	Assumed Material Cost(1)
(1) <$5,000	$2,500.00
(2) $5,000-$9,999	$7,500.00
(3) $10,000-$49,999	$30,000.00
(4) $50,000-$99,999	$75,000.00
(5) ≥$100,000	Asset Specific

Notes:
(1) Cost assumed for calculation may vary by asset type.

1.3.1.2 Planning Level Cost Markups

Cost markups were applied to the replacement cost assignments to develop Class 5 planning level estimates per the Association for the Advancement of Cost Engineering (AACE) definitions of the five class estimates. The resulting AACE class 5 estimates may represent an overestimate of cost by 100 percent or an underestimate of cost by 50 percent. The markup categories are in Table 6.

Table 6 Indirect Cost Factors

Markup Category	Percentage of Direct Cost Total
Installation	70 percent
Direct Cost Multiple(1)	**1.70**
Owner's Costs	30 percent
Subtotal Multiple(2)	**2.21**
Design/Construction Contingency	30 percent
Total Estimated Construction Cost Multiplier(3)	**2.87**

Notes:
(1) Direct Cost Multiple: 1*1.70=1.70.
(2) Subtotal Multiple: 1.70*1.30=2.21.
(3) Total Estimated Construction Cost Multiplier: 2.21*1.30 = 2.87.

The table above demonstrates how to calculate the total estimated construction cost. Note that if the recommendation is to decommission the asset, then the material cost is $0; however, the installation cost is still based on the cost range for said asset class.

The construction cost also accounts for the owner's costs. These are the amounts included in the total program budget to cover the owner's expenses for engineering fees, legal fees, and the owner's internal administrative expenses. These costs may also include property/easement/right-of-way (ROW) acquisition, bid advertising, etc., and can range from 15 to 40 percent of the total construction cost. For this project, we are assuming 30 percent.

1.3.2 Capital Improvement Strategies

Establishing CIPs is a key component of a CIP investment strategy because they are long-term plans for construction, rehabilitation, and replacement of infrastructure assets. CIPs through 2034 were identified using observations from the field condition assessments and asset management analyses. Table 7 includes the prioritized list of CIP projects. These projects were identified and prioritized at the R&R Workshop based on the current state of the assets.

Table 7 10-Year CIP Projects for Water Facilities

CIP Project	Year	Cost[1]	COF Score
Rehabilitation of Tank 1300	2025	$2,543,000	10
Decommission of McCloud Tank/PS	2025	$1,238,000	8
Rehabilitation of Foothill Pump Station	2026	$1,320,000	19
Decommission of Well 7	2026	$811,000	8
Tank Inspection	2027	$1,606,000	N/A
Rehabilitation of Vineyard Pump Station[2]	2027	$2,127,000	11
Rehabilitation of Kottinger Ranch Pump Station	2028	$1,903,000	11
Decommission of Well 5 and 6[3]	2028	$701,000	8
Rehabilitation of Laurel Creek Pump Station	2029	$1,681,000	11
Rehabilitation of Ruby Hill Pump Station	2029	$2,042,000	11

CIP Project	Year	Cost[1]	COF Score
Rehabilitation of Tanks Placeholder	2030	$2,873,000	N/A
Decommission of Grey Eagle[4]	2031	$1,293,000	8
Decommission of Well 8	2032	$1,207,000	8

Notes:
(1) Rounded to the nearest thousandth.
(2) Consider upsizing pump capacity to split Bonde Zone into smaller zones as desired by operations. Refer to Appendix I in the AKEL report.
(3) Wells 5 and 6 can be decommissioned when the Zone 7 project is completed.
(4) Grey Eagle is assumed to not need to be rehabilitated; however, if the Grey Eagle Connection to Kottinger Pressure Zone project does not occur in a timely manner, then rehabilitation of the pump station will be needed.

The total 10-Year CIP cost is nearly $21.4 million. Figure 52 is a graphical representation of the 10-year CIP forecast for water facilities. The breakdown of the assets within each project are in Appendix E. Note that the project year may change based on the timing of related projects and available resources.

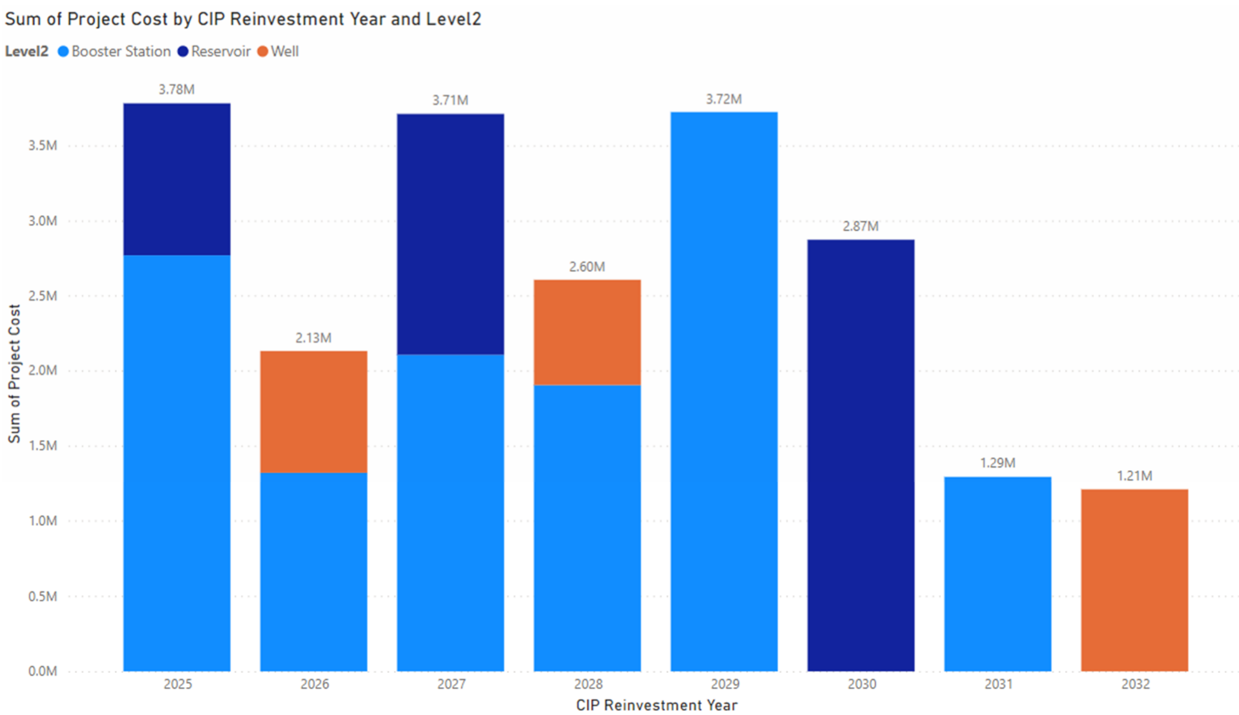


Figure 52 10-year Capital Improvement Plan for Water Facilities

The 10-year CIP list also considered whether R&R needs are or will be addressed in other projects. These considerations are as follows:

- Turnout 1 R&R will be addressed during the Regional Project. The Regional Project also includes funding for a new turnout.
- Turnout 4 R&R will be addressed during the current Interim Project.
- Generator deficiencies are identified in the Generator Report and are to be replaced in the Generator Improvements Project identified in the WSMP.
- Capacity issues identified in the AKEL report for Tanks 550 and 770 are addressed in the Tank 510 Storage Capacity Increase and Tank 770 Storage Capacity Increase projects identified in the WSMP.

These projects should also consider the O&M needs and include asset R&R at these sites where needed.

- PLCs should be replaced in facility rehabilitations; however, if not addressed in a timely manner, then a PLC replacement project is needed.

1.3.3 O&M Investment Strategies

O&M investments are essential for keeping a water utility's infrastructure in good working order, so the City can continue to deliver reliable service to their customers. They may include activities such as preventative maintenance and corrective maintenance.

The R&R needs that are not captured in the 10-Year CIP are addressed as O&M R&R needs. Figure 53 shows the projected O&M needs over the next ten years based on the current state of the assets. The cost is estimated to be $12.8M. Refer to Appendix F for list of assets included in the O&M forecast.

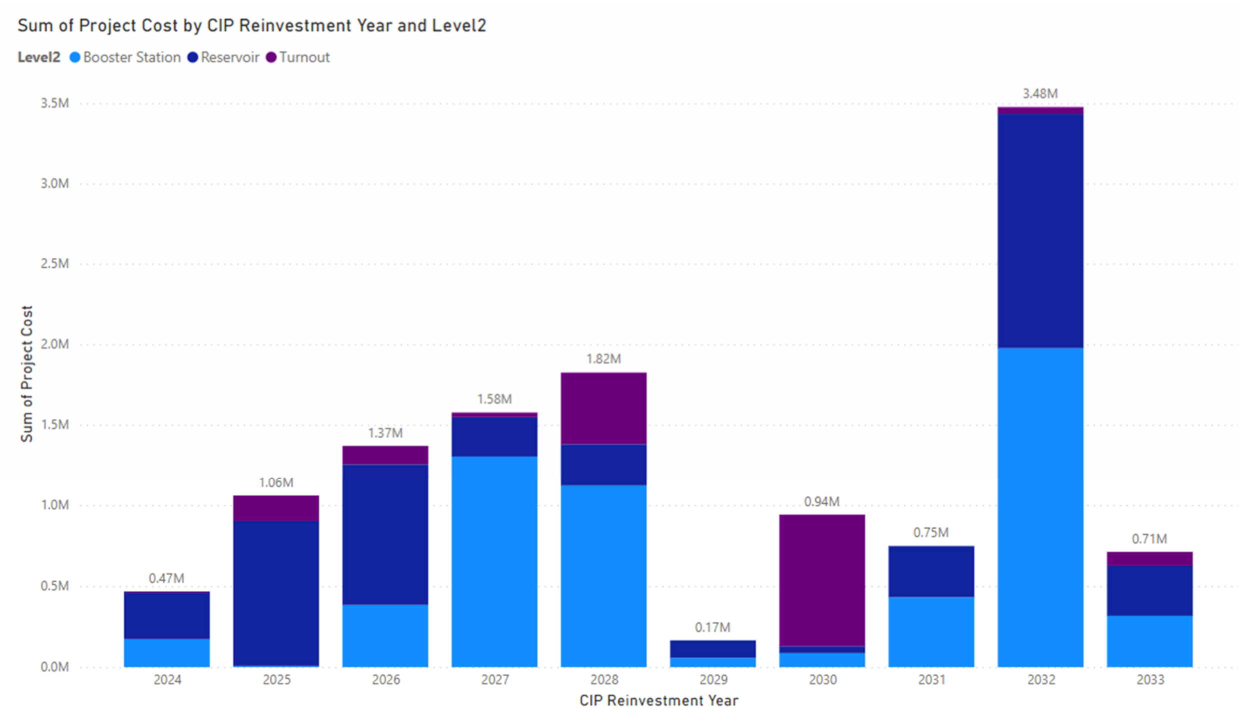


Figure 53 10-Year O&M Plan for Water Facilities

1.3.4 Next Steps

For the water facilities, the City should continue to refine the recommendations in the 10-year CIP. Next steps include reviewing and refining the proposed projects, defining and prioritizing the projects by risk, and developing a budget for implementing the CIP. It is important to monitor the CIP implementation progress and routinely re-evaluate project needs and priorities as asset condition changes and areas of improvement are identified.

APPENDIX A ASSET CLASS TABLE

Table B.1 Asset Class Table

Discipline	Asset Class	EUL (years)	Cost Range	Assumed Cost
EI&C	ANALYZER	15	2 - $5,000 - $9,999	$7,500
EI&C	ATS	20	3 - $10,000 - $49,999	$30,000
EI&C	BREAKER	20	2 - $5,000 - $9,999	$7,500
EI&C	CONTROL PANEL	20	3 - $10,000 - $49,999	$30,000
EI&C	CONTROLLER	15	2 - $5,000 - $9,999	$7,500
EI&C	ENGINE	20	3 - $10,000 - $49,999	$30,000
EI&C	GENERATOR RECEPTACLE	30	1 - $0-$5,000	$2,500
EI&C	MCC	30	5 - >$100,000	$100,000
EI&C	PLC	15	5 - >$100,000	$100,000
EI&C	RTU	15	1 - $0-$5,000	$2,500
EI&C	SWITCH	30	1 - $0-$5,000	$2,500
EI&C	SWITCHBOARD	25	5 - >$100,000	$250,000
EI&C	TERMINAL BOX	20	1 - $0-$5,000	$2,500
EI&C	TRANSDUCER	15	1 - $0-$5,000	$2,500
EI&C	TRANSFORMER	35	3 - $10,000 - $49,999	$30,000
EI&C	TRANSMITTER	15	1 - $0-$5,000	$2,500
EI&C	VFD	15	3 - $10,000 - $49,999	$30,000
EI&C	WATER METER	15	2 - $5,000 - $9,999	$7,500
MECHANICAL	ACTUATOR	15	2 - $5,000 - $9,999	$7,500
MECHANICAL	ARV	15	1 - $0-$5,000	$2,500
MECHANICAL	CHEMICAL DOSING SYSTEM	20	3 - $10,000 - $49,999	$30,000
MECHANICAL	CHEMICAL METERING PUMP	10	1 - $0-$5,000	$2,500
MECHANICAL	CIRCULATION SYSTEM	20	3 - $10,000 - $49,999	$30,000
MECHANICAL	COMPRESSOR	20	2 - $5,000 - $9,999	$7,500
MECHANICAL	CRANE	30	3 - $10,000 - $49,999	$30,000
MECHANICAL	FAN	20	1 - $0-$5,000	$2,500
MECHANICAL	GENERATOR	25	5 - >$100,000	$250,000
MECHANICAL	MIXER	20	2 - $5,000 - $9,999	$7,500
MECHANICAL	PIPE	50	2 - $5,000 - $9,999	$7,500
MECHANICAL	PUMP	25	4 - $50,000 - $99,999	$75,000
MECHANICAL	PUMP (SUMP)	10	1 - $0-$5,000	$2,500
MECHANICAL	STRAINER	15	2 - $5,000 - $9,999	$7,500
MECHANICAL	VALVE	15	2 - $5,000 - $9,999	$7,500
MECHANICAL	VALVE (CLA)	15	3 - $10,000 - $49,999	$20,000
STRUCTURAL	BUILDING	60	5 - >$100,000	$250,000
STRUCTURAL	DRAINAGE	25	2 - $5,000 - $9,999	$7,500
STRUCTURAL	HYDROPNEUMATIC TANK	50	3 - $10,000 - $49,999	$30,000
STRUCTURAL	RESERVOIR	50	5 - >$100,000	$250,000
STRUCTURAL	ROAD	30	2 - $5,000 - $9,999	$7,500
STRUCTURAL	SHED	30	2 - $5,000 - $9,999	$7,500
STRUCTURAL	SITE SECURITY	25	3 - $10,000 - $49,999	$30,000
STRUCTURAL	TANK	50	3 - $10,000 - $49,999	$30,000
STRUCTURAL	VAULT	60	4 - $50,000 - $99,999	$75,000
STRUCTURAL	WELL	30	4 - $50,000 - $99,999	$75,000

Abbreviations: EI&C - Electrical, Instrumentation & Controls

APPENDIX B

WATER FACILITY CONDITION ASSESSMENT OBSERVATIONS AND RECOMMENDATIONS

Level2	Level3	Type2	Asset_ID	POF	COF	Observations	Recommendations	Year
Booster Station	Dublin Canyon	ATS	BS-DC-17	5	9	Transfer switch is in very poor condition.	Replace within one year.	2024
Booster Station	Dublin Canyon	BREAKER	BS-DC-08	3	9	Panel is becoming obsolete.	Replace within five years.	2027
Booster Station	Dublin Canyon	BUILDING	BS-DC-01	2	9	1. S. Wall at SW corner has crack originating from penetration for 12 in Disc pipe, DI. 2. Lot of stains on N wall. Stains on the N wall may be due to roof leaking. 3. Concrete spalling at top of trench wall at grating rebate near west door and east door. Extents of spalling is minor. 4. Pump bases have rust, not detrimental.	1. Epoxy injection of crack can prevent further propagation. 2. Investigate if the roof is leaking and repair as needed. 3. Monitor rebate and anchor	2045
Booster Station	Dublin Canyon	GENERATOR	BS-DC-06	5	9	Generator is non-compliant and decommissioned. Instead, there i	Install quick connects outside for portable generator.	2026
Booster Station	Dublin Canyon	PUMP	BS-DC-04	5	9	No longer in service.	Consider removal of pump, motor, and associated piping.	2026
Booster Station	Dublin Canyon	RTU	BS-DC-15	3	9	RTU prompt replacement is recommended to improve functionality. RTU replacement within the next 10 years is necessary due to age.	Consider replacing RTU to improve functionality.	2026
Booster Station	Dublin Canyon	SITE SECURITY	BS-DC-19	3	9	There are security concerns at this site. Currently there is only a local intrusion alarm.	Install security cameras.	2028
Booster Station	Dublin Canyon	TANK	BS-DC-07	5	9	No longer in service.	Consider removal.	2028
Booster Station	Dublin Canyon	TRANSFORMER	BS-DC-09	4	9	Transformer is obsolete. There are concerns about the asset's performance and reliability.	Replace within one year.	2024
Booster Station	Dublin Canyon	VALVE	BS-DC-16	3	9	Valve is maintained by Cla-Val. Fittings are not stainless steel.	Replace fittings with stainless steep fittings.	2026
Booster Station	Foothill	BREAKER	BS-F-20	3	19	Panelboard is becoming obsolete and the circuit breakers have exceeded their useful life.	Replace within five years.	2026
Booster Station	Foothill	GENERATOR	BS-F-04	4	19	Overall, generator is in poor condition. It is used when there are PG&E shut-offs (including PSPS).	Replace generator. May need to consider a portable generator given permitting requirements.	2025
Booster Station	Foothill	MCC	BS-F-12	4	19	Operations staff reported difficulties with repair and maintenance due to age and lack of manufacturer support.	Replace MCC within five years.	2026
Booster Station	Foothill	PUMP	BS-F-03	5	19	Scheduled for replacement.	-	2026
Booster Station	Foothill	PUMP	BS-F-05	2	19	City reported that there is not sufficient redundancy for the pumps. There is also no lifting mechanism at this site for pump removal/installation.	Consider installing an additional pump.	2026
Booster Station	Foothill	PUMP	BS-F-07	5	19	No longer in service. Associated valve is leaking.	Consider removing pump and replacing locked out valve with piping.	2026
Booster Station	Foothill	PUMP	BS-F-08	5	19	No longer in service.	Consider removal.	2026
Booster Station	Foothill	SITE SECURITY	BS-F-10	3	19	Fence does not meet current City standard.	Consider replacing fence to meet new City standard.	2026
Booster Station	Foothill	SWITCH	BS-F-13	4	19	Switch is in deteriorated condition and becoming obsolete.	Replace within five years.	2026
Booster Station	Foothill	TRANSFORMER	BS-F-11	3	19	Transformer has exceeded useful life and is obsolete.	Replace within five years.	2026
Booster Station	Foothill	TRANSMITTER	BS-F-15	4	19	Transmitter is in deteriorated condition and becoming obsolete.	Replace within five years.	2026
Booster Station	Foothill	TRANSMITTER	BS-F-16	4	19	Transmitter is in deteriorated condition and becoming obsolete.	Replace within five years.	2026
Booster Station	Foothill	WATER METER	BS-F-17	4	19	Scheduled for replacement.	-	2026
Booster Station	Grey Eagle	ATS	BS-GE-03	4	8	ATS has exceeded its useful life . This ATS is integrated into MCC-A.	Replace.	2031
Booster Station	Grey Eagle	BUILDING	BS-GE-06	2	8	Wood frame building and roof with asphalt shingle roofing. Roof appears to be in acceptable condition. Building entrance needs a step.	Install a step at the entrance.	2031
Booster Station	Grey Eagle	Compressor	BS-GE-28	5	8	Air compressor does not supply enough air pressure and has exceeded its useful life.	Replace.	2031
Booster Station	Grey Eagle	CONTROL PANEL	BS-GE-04	3	8	Panel is in good condition, however the breakers have exceeded their useful life and should be replaced.	Replace breakers within one year and consider complete panelboard replacement within the next 10 years.	2031
Booster Station	Grey Eagle	CONTROL PANEL	BS-GE-16	5	8	Panel is in failed condition and not connected.	Replace.	2031
Booster Station	Grey Eagle	GENERATOR	BS-GE-07	4	8	In poor condition.	Replace.	2025
Booster Station	Grey Eagle	HYDROPNEUMATIC TANK	BS-GE-11	2	8	Piping and valving have minor corrosion.	-	2031

Level2	Level3	Type2	Asset_ID	POF	COF	Observations	Recommendations	Year
Booster Station	Grey Eagle	MCC	BS-GE-12	4	8	MCC has exceeded its useful life and may no longer be reliable.	Replace MCC within five years.	2031
Booster Station	Grey Eagle	PIPE	BS-GE-19	3	8	Minor coating delamination and corrosion on the piping.	-	2031
Booster Station	Grey Eagle	PUMP	BS-GE-08	3	8	Staff are concerned about the design of the system, including the capacity.	Evaluate the capacity and efficiency of the BS.	2031
Booster Station	Grey Eagle	PUMP	BS-GE-09	4	8	Leaks on shaft seal packing. Support is corroded significantly.	Replace components.	2031
Booster Station	Grey Eagle	PUMP	BS-GE-10	3	8	The coupling is an area of concern.	Rehabilitate or replace the coupling.	2031
Booster Station	Grey Eagle	RTU	BS-GE-05	5	8	Panel has exceeded useful life and is becoming obsolete. Panel may be unreliable given age.	Replace.	2031
Booster Station	Grey Eagle	SITE SECURITY	BS-GE-27	3	8	Fence does not meet current City standard. No intrusion alarm system.	Consider replacing fence to meet new City standard.	2031
Booster Station	Grey Eagle	TRANSFORMER	BS-GE-14	5	8	Transformer has exceeded its useful life and is obsolete.	Replace.	2031
Booster Station	Grey Eagle	VALVE	BS-GE-21	4	8	Exterior requires rehabilitation. Interior is in unknown condition.	Replace.	2031
Booster Station	Grey Eagle	WATER METER	BS-GE-15	3	8	Meter is in moderate condition and approaching the end of useful life.	Replace within five years.	2031
Booster Station	Kottinger Ranch	BREAKER	BS-KR-26	4	11	Panel is becoming obsolete and the circuit breakers have exceeded their useful life.	Replace within one year.	2028
Booster Station	Kottinger Ranch	MCC	BS-KR-19	4	11	MCC has exceeded its useful life and equipment malfunctions were observed. For example, the sump pumps cannot run simultaneously because loss of phase occurs.	Manufacturer shall inspect and repair sump pump drives or starters immediately. Replace MCC within five years.	2028
Booster Station	Kottinger Ranch	PUMP	BS-KR-07	4	11	Pump has exceeded useful life and shaft is leaking.	Scheduled to be replaced when demand reduces.	2028
Booster Station	Kottinger Ranch	SITE SECURITY	BS-KR-25	3	11	Site has a local intrusion alarm. There is no site fencing.	-	2028
Booster Station	Kottinger Ranch	SWITCHBOARD	BS-KR-16	5	11	Switchboard has exceeded its useful life and may no longer be reliable.	Replace.	2028
Booster Station	Kottinger Ranch	TANK	BS-KR-04	3	11		(blank)	2038
Booster Station	Kottinger Ranch	TRANSFORMER	BS-KR-23	4	11	Transformer has exceeded its useful life and is obsolete.	Replace.	2028
Booster Station	Kottinger Ranch	TRANSMITTER	BS-KR-20	3	11	Staff reported that a digital transmitter is preferable.	Replace with digital pressure transmitter.	2028
Booster Station	Kottinger Ranch	PUMP - SUMP	BS-KR-08	5	11	Staff reported that sump pump does not work.	Replace.	2028
Booster Station	Laurel Creek	SITE SECURITY	BS-LC-14	2	11	Removal of public access to parking and addition of fence has reduced security issues. However, there are no cameras.	Install cameras.	2029
Booster Station	Laurel Creek	TANK	BS-LC-06	4	11	Enclosure roof is in bad condition. Staff reported issues with fuel leak sensor.	Replace roof and fuel leak sensor.	2029
Booster Station	Longview	GENERATOR	W_BS_LV-25	5	11	Booster station is impacted by shutdowns, but does not have a pe	Consider installing permanent generator.	2026
Booster Station	Longview	RTU	BS-LV-18	3	11	Panel has exceeded useful life and is becoming obsolete.	Replace within five years.	2025
Booster Station	Longview	SITE SECURITY	BS-LV-01	3	11	Fence does not appear to serve its purpose since it does not completely surround the building. No intrusion alarm.	Consider replacing the fence.	2027
Booster Station	McCloud	BUILDING	BS-MC-01	5	8	No longer in service.	Decommission.	2025
Booster Station	Ruby Hills	ATS	BS-RH-16	3	11	Transfer switch is in moderate condition and approaching the end of useful life.	Workshop 4/30/24: ATS has been replaced.	2029
Booster Station	Ruby Hills	BREAKER	BS-RH-13	3	11	Panel is becoming obsolete and is approaching end of its useful life.	Replace within five years.	2029
Booster Station	Ruby Hills	BUILDING	BS-RH-01	2	11	There were stains on floor, minor corrosion on base plates of pump, and minor corrosion on clamps for small tubing.	Periodic inspection recommended.	2045
Booster Station	Ruby Hills	CONTROL PANEL	BS-RH-21	5	11	No longer in service.	Decommission.	2029
Booster Station	Ruby Hills	MCC	BS-RH-18	3	11	The MCC buckets for pumps 1 and 2 are not properly covered and live parts are exposed.	Provide proper MCC bucket covers to eliminate live part exposure.	2029
Booster Station	Ruby Hills	PLC	BS-RH-19	4	11	PLC has exceeded useful life and may no longer be reliable.	Replace within five years.	2029
Booster Station	Ruby Hills	PUMP	BS-RH-03	2	11	Pumps 1 and 2 are no longer in service and locked out.	Decommission pumps and piping.	2029
Booster Station	Ruby Hills	RTU	BS-RH-20	4	11	Panel has exceeded useful life and is becoming obsolete. Panel may be unreliable given age.	Replace within five years.	2029

Level2	Level3	Type2	Asset_ID	POF	COF	Observations	Recommendations	Year
Booster Station	Tank 1300	BUILDING	BS-T1300-01	2	10	There were stains and hairline cracks on the wall, hairline cracks on the foundation, and corrosion on the pump base plates.	Periodic inspection recommended.	2025
Booster Station	Tank 510	BUILDING	BS-T510-03	2	10	Minor cracks were observed on the masonry.	-	2045
Booster Station	Tank 900	BUILDING	BS-T900-02	2	10	Stains on the floor, hairline cracks on the foundation, and minor rust on pump baseplates were observed.	Periodic inspection recommended.	2045
Booster Station	Tank 900	VALVE	BS-T900-10	2	10	Minor leak on bolt.	Remove and reinstall bolt.	2028
Booster Station	Tank 900	VALVE (CLA)	BS-T900-08	2	10	Minor leak observed on valves. Valve is maintained by third party.	Have third party address leak.	2028
Booster Station	Vineyard	ATS	BS-V-21	3	11	Meter is in moderate condition and approaching the end of useful life.	Replace within five years.	2027
Booster Station	Vineyard	BREAKER	BS-V-01	5	11	Panelboard is becoming obsolete and the circuit breakers have exceeded their useful life.	Replace.	2027
Booster Station	Vineyard	BUILDING	BS-V-05	2	11	Roofing material looks original and there is signs of leakage in the interior.	Investigate if the roof is leaking and repair as needed.	2044
Booster Station	Vineyard	MCC	BS-V-07	5	11	MCC has exceeded its useful life and may no longer be reliable.	Replace MCC within five years.	2027
Booster Station	Vineyard	PLC	BS-V-13	5	11	-	Replace when MCC is replaced.	2027
Booster Station	Vineyard	PUMP	BS-V-08	5	11	Staff reported that pump station capacity is not sufficient and there is no redundancy. Additionally, staff have concerns for lead time (8+ months) on getting a replacement pump.	In the short term, have a spare pump on hand and in the long-term, consider upsizing pumps to meet capacity needs.	2027
Booster Station	Vineyard	PUMP	BS-V-09	5	11	Staff reported that pump station capacity is not sufficient and there is no redundancy. Additionally, staff have concerns for lead time (8+ months) on getting a replacement pump. Pump 2 is exhibiting signs of an oil leak.	In the short term, have a spare pump on hand and in the long-term, consider upsizing pumps to meet capacity needs. Identify source of oil leak and repair.	2027
Booster Station	Vineyard	RTU	BS-V-14	5	11	Panel has exceeded useful life and is becoming obsolete. Panel may be unreliable given age.	Replace.	2027
Booster Station	Vineyard	TRANSFORMER	BS-V-06	4	11	Transformer has exceeded its useful life and runs hot or intermittently	Replace.	2027
Booster Station	Vineyard	VALVE	BS-V-04	2	11	Maintained by third party and scheduled to be rebuilt.	-	2027
Booster Station	Vineyard	VALVE	BS-V-20	2	11	Maintained by third party and scheduled to be rebuilt.	-	2027
Booster Station	Vineyard	PUMP - SUMP	BS-V-11	4	11	There is water in the containment. Sump pump at breaker was off	Sump pump float will be replaced in house.	2027
Booster Station	Vineyard Hills	SITE SECURITY	BS-VH-17	2	11	Site has no fence but security is not a concern here since building is shared with the fire department. There are also intrusion alarms.	-	2032
Booster Station	Vineyard Hills	TANK	BS-VH-12	5	11	Broken, $8000 ordered parts, currently fixing.	-	2028
Booster Station	Vineyard Hills	VALVE	BS-VH-18	3	11	Valve is maintained by Cla-Val. Fittings are not stainless steel.	Replace fittings with stainless steep fittings.	2026
Booster Station	Vineyard Hills	VAULT	BS-VH-11	2	11	Vault is wet and filled with debris (leaves).	-	2045
Booster Station	Vineyard Hills	VAULT	BS-VH-19	2	11	4/30/24 Workshop: The vaults were flooded out and the motor control valves are not functioning.	Repair the MOVs in the valve vault.	2045
Reservoir	Bonde I	BREAKER	Res-B I-15	2	12	Circuit breakers are near the end of their life and testing or replacement should be considered.	Test or replace circuit breakers. Replace panel within 10 years.	2029
Reservoir	Bonde I	CONTROL PANEL	Res-B I-11	2	12	Enclosure fan is near end of life and needs replacement to prevent down time.	Replace enclosure fan.	2029
Reservoir	Bonde I	GENERATOR	Res-B I-14	5	12	Propane generator that is used for tank and radio communications. Generator has exceeded its useful life and is high maintenance (have a hard time firing it). During site visit, it was out of service.	Replace with diesel generator.	2025
Reservoir	Bonde I	PIPE	Res-B I-09	3	12	There is an overflow pipe for the tank that goes into neighborhoo	Confirm that there is v-ditch for the overflow pipe or install	2033
Reservoir	Bonde I	VAULT	Res-B I-05	2	12	Unable to access vault due to confined space entry. The vault lid is made of redwood and is high maintenance. The vault fills with water during rain events and board replacement is needed every 8 years.	Replace vault lid and install fall protection.	2044

Level2	Level3	Type2	Asset_ID	POF	COF	Observations	Recommendations	Year
Reservoir	Bonde I	RESERVOIR	Res-B I-03	3	12	The tank is half buried but visible concrete looks to be in acceptable condition. Tank requires near full depth cycling for water quality. Mixers were recently installed to see if this reduces the cycling.	-	2027
Reservoir	Bonde II	CONTROL PANEL	Res-B II-05	5	12	Panel is in deteriorating condition and has exceeded its useful life.	Replace.	2024
Reservoir	Bonde II	TRANSMITTER	Res-B II-06	3	12	Transmitter is in moderate condition and becoming obsolete.	Replace within five years.	2025
Reservoir	Bonde II	VAULT	Res-B II-09	3	12	Did not enter vault, but viewed from above. Vault is damp and has poor ventilation. There is no hand hold to get out of vault.	Improve vault ventilation. Install hand hold for vault ingress/egress.	2043
Reservoir	Bonde II	RESERVOIR	Res-B II-04	4	12	1. Coating is cracked and stucco will eventually start peeling off. 2. No exterior ladder. 3. PVC piping exposed to sun. 4. There is no seal between the tank and perimeter v-ditch.	1. Recoat. 2. Install ladder. 3. Replace pvc piping and paint. 4. Add a seal between v-ditch and tank.	2027
Reservoir	Dublin Canyon	BREAKER	Res-DC-03	5	9	Panel has excessive corrosion and has exceeded its useful life.	Replace.	2025
Reservoir	Dublin Canyon	RTU	Res-DC-04	5	9	Panel has excessive corrosion and has exceeded its useful life.	Replace.	2025
Reservoir	Dublin Canyon	VALVE	Res-DC-01	4	9	Corroded pipe support.	Replace pipe support.	2025
Reservoir	Dublin Canyon	VALVE	Res-DC-02	4	9	Corroded pipe support.	Replace pipe support.	2025
Reservoir	Foothill	ROAD	Res-F-05	3	19	The road has some cracking and spalling. Staff reported there are also drainage issues.	Rehab and regrade road to eliminate drainage concerns.	2028
Reservoir	Foothill	SITE SECURITY	Res-F-15	4	19	Fence around the tank does not meet current City standard and there is evidence of previous graffiti.	Replace fence around tank.	2025
Reservoir	Foothill	VALVE	Res-F-10	3	19	-	Valves should be exercised at least annually.	2025
Reservoir	Foothill	VAULT	Res-F-06	3	19	Need ventilation. Actuator was replaced because of dampness. Ladder could use safety improvements.	Improve vault ventilation. Install hand hold for vault ingress/egress.	2042
Reservoir	Foothill	RESERVOIR	Res-F-01	3	19	Riser is no longer needed and is an operational concern. Due to the riser, the tank must be kept full because the turnouts do not have the head needed to fill the tank. The tank under drain area has some missing coating.	Remove riser. Coat the underdrain area.	2027
Reservoir	Happy Valley	DRAINAGE	Res-HV-05	2	10	The swale is filled with sediment and there is evidence of gopher/ground squirrel holes against wall, which could eventually compromise the wall and piping.	Fill in the holes and clear the swale. Periodic inspection recommended.	2032
Reservoir	Happy Valley	SITE SECURITY	Res-HV-07	2	10	Evidence of previous graffiti.	-	2032
Reservoir	Happy Valley	RESERVOIR	Res-HV-01	2	10	Pipe supports are rusted.	Periodic inspection recommended.	2027
Reservoir	Kottinger Ranch	SITE SECURITY	Res-KR-07	2	11	Entrance gate has minor coating flaking and there is evidence of previous graffiti. Additionally, there is minor soil erosion at the north corner.	-	2032
Reservoir	Laurel Creek	BREAKER	Res-LC-03	3	11	Panel is currently in moderate condition but approaching end of useful life.	Replace within five years.	2027
Reservoir	Laurel Creek	PLC	Res-LC-04	3	11	PLC is currently in moderate condition but approaching end of useful life.	Replace within five years.	2026
Reservoir	Laurel Creek	RTU	Res-LC-05	3	11	RTU is currently in moderate condition but approaching end of useful life.	Replace within five years.	2026
Reservoir	Laurel Creek	VAULT	Res-LC-08	2	11	Pipe supports for inlet and outlet pipes are corroded.	Replace pipe supports.	2045
Reservoir	Lower Ruby Hills	CONTROL PANEL	Res-LRH-03	4	11	Panel is approaching end of useful life and is becoming obsolete.	Replace.	2025
Reservoir	Lower Ruby Hills	SITE SECURITY	Res-LRH-05	2	11	The coating on the fence posts are peeling.	Re-coat the fence posts.	2032
Reservoir	Lower Ruby Hills	VAULT	Res-LRH-09	2	11	Lot of water accumulation in vault, possibly due to rain. Surface rust on pipes. Hatch cover dampers are broken and severely rusted	Periodic inspection of piping recommended. Replace dampers on hatch cover.	2045
Reservoir	Lower Ruby Hills	SHED	Res-LRH-04	5	11	Structure is not durable and is a safety concern. There are signs of joints and wall failure.	Demo enclosure and replace if desired.	2026

Level2	Level3	Type2	Asset_ID	POF	COF	Observations	Recommendations	Year
Reservoir	Lower Ruby Hills	RESERVOIR	Res-LRH-01	2	11	Minor corrosion was observed at the base of the tank, on the restraint pipe coupling harness and all bolts on the pipe harness, and on the box near the pipe.	Periodic inspection recommended.	2027
Reservoir	Lund	RTU	Res-L-07	3	11	RTU is becoming obsolete and approaching end of useful life.	Replace within five years.	2026
Reservoir	Lund	SITE SECURITY	Res-L-08	2	11	The coating is flaking on the horizontal beams.	Recoat the horizontal beams.	2032
Reservoir	McCloud	RESERVOIR	Res-MC-01	5	8	The tank is not structurally sound and was leaking through the sidewalls. The tank was officially flanged off this year from the water system and is empty. There is evidence of painted over graffiti on the tank. O&M is still expected to maintain the tank and they spend time painting it.	Decommission.	2025
Reservoir	Moller Ranch	BREAKER	Res-MR-03	4	11	Panel has deteriorated and is in poor condition.	Replace.	2025
Reservoir	Moller Ranch	RTU	Res-MR-05	3	11	RTU is in moderate condition but is approaching end of useful life and is becoming obsolete.	Replace within five years.	2026
Reservoir	Moller Ranch	SITE SECURITY	Res-MR-06	2	11	Fence does not meet current City standard.	Consider replacing fence to meet new City standard.	2032
Reservoir	Moller Ranch	VAULT	Res-MR-07	3	11	Vault cover support frame has significant corrosion. Cover plate at some locations are not flush or tightly closed.	Periodic inspection recommended. Consider replacing cover with aluminum cover.	2036
Reservoir	Sycamore	BREAKER	Res-S-08	5	19	Panel is in deteriorated condition, require lots of maintenance and is becoming obsolete.	Replace.	2024
Reservoir	Sycamore	CONTROL PANEL	Res-S-12	3	19	There is equipment inside the panel that is no longer in service, i.e., the irrigation panel.	Remove equipment that is no longer in service.	2026
Reservoir	Sycamore	FAN	Res-S-14	5	19	Fan is scheduled to be replaced. The associated control panel has also exceeded its useful life and should also be replaced.	-	2024
Reservoir	Sycamore	PUMP - SUMP	Res-S-10	5	19	Gear has exceeded its useful life.	Replace.	2024
Reservoir	Tank 1160	VAULT	Res-T1160-03	3	10	-	Periodic inspection recommended.	2036
Reservoir	Tank 1160	BATTERY	W_Res_T1160-0	5	10	Tanks 1160 and 1600 have no power source and rely on batteries.	Install solar panels.	2024
Reservoir	Tank 1300	RESERVOIR	Res-T1300-01	4	10	Updated findings based on 4/30/24 workshop: Staff reported that an internal inspection of the tank and review of the vapor zone indicates that the interior of the tank is in poor condition and needs to be rehabilitated.	Rehabilitate tank.	2025
Reservoir	Tank 1600	BATTERY	W_Res_T1600-0	5	10	Tanks 1160 and 1600 have no power source and rely on batteries.	Install solar panels.	2024
Reservoir	Tank 510	RESERVOIR	Res-T510-02	2	10	Updated findings based on 4/30/24 workshop: AKEL report identified this zone to have an existing deficiency of insufficient capacity.	Increase storage capacity. Refer to AKEL report.	2027
Reservoir	Tank 770 I	VALVE	Res-T770 I-02	5	11	Not functioning.	Replace.	2025
Reservoir	Tank 770 I	VALVE	Res-T770 I-03	5	11	Not functioning.	Replace.	2025
Reservoir	Tank 770 I	VAULT	Res-T770 I-07	4	11	Unsafe hatch. There are no hinges.	Replace vault with standard.	2030
Reservoir	Tank 770 II	BREAKER	Res-T770 II-06	4	11	Obsolete and deteriorating condition.	Replace.	2025
Reservoir	Tank 770 II	RTU	Res-T770 II-07	4	11	Panel has exceeded useful life and is becoming obsolete. Panel may be unreliable given age.	Replace.	2025
Reservoir	Tank 770 II	SITE SECURITY	Res-T770 II-08	3	11	The coating on the fence posts are peeling. There is vegetation growing along the fence.	Cut back vegetation to reduce fire risk and improve fence maintenance.	2028
Reservoir	Tank 770 II	VAULT	Res-T770 II-09	3	11	Vault is a concrete box with a metal cover and no hinge.	Replace vault with standard.	2036
Reservoir	Tank 770 II	RESERVOIR	Res-T770 II-01	2	11	Updated findings based on 4/30/24 workshop: AKEL report identified this zone to have an existing deficiency of insufficient capacity.	Increase storage capacity. Refer to AKEL report.	2027
Reservoir	Upper Ruby Hills	SITE SECURITY	Res-URH-09	1	11	No security concerns, located inside a gated community.	-	2046
Reservoir	Upper Ruby Hills	RESERVOIR	Res-URH-01	2	11	Minor corrosion observed at the base of the tank.	Periodic inspection recommended.	2027
Reservoir	Vineyard Hills	RTU	Res-VH-08	3	11	Access to the PLC is via overgrown vegetation. The PLC is in moderate condition and becoming obsolete.	Clear a path in the vegetation. Replace the PLC within five years.	2026
Reservoir	Vineyard Hills	SITE SECURITY	Res-VH-09	2	11	No security concerns at this site.	-	2032
Reservoir	Vineyard Hills	VALVE	Res-VH-04	1	11	Missing label.	Label the drain valve.	2032
Turnout	Turnout 1	BREAKER	Turnout-T1-06	4	8	Panel is deteriorating and in poor condition. It has exceeded its useful life.	Replace.	2025
Turnout	Turnout 2	BREAKER	Turnout-T2-07	5	9	Panel is deteriorating and in poor condition. It has exceeded its us	Replace.	2025

Level2	Level3	Type2	Asset_ID	POF	COF	Observations	Recommendations	Year
Turnout	Turnout 2	BUILDING	Turnout-T2-01	4	9	Building tilting towards NE, left when facing the door. Tilt is significant and can be felt when entered.	Requires periodic inspection and complete replacement in future.	2030
Turnout	Turnout 2	VAULT	Turnout-T2-15	2	9	In close proximity to tilting building.	Periodic inspection recommended.	2045
Turnout	Turnout 3	BREAKER	Turnout-T3-04	3	16	Panel is becoming obsolete and the circuit breakers have exceeded their useful life.	Replace circuit breakers. Replace panel within 10 years.	2026
Turnout	Turnout 3	BUILDING	Turnout-T3-03	3	16	Northwest corner of the building is damaged and rebar is exposed. Unknown if there is adequate ventilation for fluoride - one fan. There is not a lot of room in the building.	Recommend converting existing building to electrical room and installing new tank room.	2035
Turnout	Turnout 3	CHEMICAL METERING PUMP	Turnout-T3-01	3	16	Metering pump is located in the secondary containment on a rusted bracket with a plastic tub underneath. Pump is high maintenance.	Consider improving pump mounting. Consider moving away from a pressurized chemical injection system and replacing with peristaltic pumps.	2024
Turnout	Turnout 3	RTU	Turnout-T3-05	2	16	There is a lack of surge suppression on antenna cable.	-	2027
Turnout	Turnout 3	TANK	Turnout-T3-06	3	16	Would like to have a second tank for redundancy and to confirm the concentration in the tank.	Add a redundant tank. Test existing tank's concentration.	2033
Turnout	Turnout 3	VAULT	Turnout-T3-02	3	16	Minor corrosion observed on the lifting mechanism.	-	2035
Turnout	Turnout 4	BREAKER	Turnout-T4-03	5	19	Panelboard is excessively corroded.	Replace.	2024
Turnout	Turnout 4	BUILDING	Turnout-T4-02	3	19	Unknown if there is adequate ventilation for fluoride. There is not a lot of room in the building. Concrete sidewalk/entrance to the building shows signs of settlement.	Consider expansion of building (horizontally/vertically) because building is cramped.	2037
Turnout	Turnout 4	CHEMICAL METERING PUMP	Turnout-T4-05	3	19	Metering pump is mounted on the floor of the secondary containment. Pump is high maintenance.	Consider improving pump mounting. Consider moving away from a pressurized chemical injection system and replacing with peristaltic pumps.	2024
Turnout	Turnout 4	RTU	Turnout-T4-01	2	19	There is a lack of surge suppression on antenna cable.	-	2027
Turnout	Turnout 4	TANK	Turnout-T4-06	3	19	Secondary containment was filled with water at time of visit due to fire testing. Secondary containment does not have a drain. Staff would like to have a second tank for redundancy and to confirm the concentration in the tank.	Consider installing redundant tank.	2033
Turnout	Turnout 5	BREAKER	Turnout-T5-09	5	22	Panel will reach end of its life within the next 10 years. However immediate replacement is suggested due to excessive corrosion and deterioration. NEMA 4X enclosure shall be provided given the environment is very corrosive.	Replace and provide NEMA 4X enclosure	2025
Turnout	Turnout 5	BUILDING	Turnout-T5-02	2	22	Pipe supports and anchors are moderately corroded.	Periodic inspection recommended to monitor progress of corrosion.	2045
Turnout	Turnout 5	CHEMICAL METERING PUMP	Turnout-T5-10	3	22	Frequent leaks in tubing joints due to high pressure dosing. Current pumps are high maintenance.	Consider moving away from a pressurized chemical injection system and replacing with peristaltic pumps.	2025
Turnout	Turnout 5	SITE SECURITY	Turnout-T5-12	3	22	There are security concerns at this site. Building has an intrusion alarm that communicates to central SCADA.	Consider installing a fence, if feasible.	2028
Turnout	Turnout 5	TERMINAL BOX	Turnout-T5-15	2	22	Analyzer IO terminal box replacement within the next 10 years is recommenced due to age. This is important to avoid signal interruption.	Replace within 10 years.	2030
Turnout	Turnout 5	VAULT	Turnout-T5-04	2	22	Pipe supports and anchors are moderately corroded.	Periodic inspection recommended to monitor progress of corrosion.	2045
Turnout	Turnout 6	ANALYZER	Turnout-T6-06	3	21	This model of analyzer is high maintenance.	Consider upgrading analyzer to newer model that is used.	2028
Turnout	Turnout 6	ANALYZER	Turnout-T6-09	3	21	This model of analyzer is high maintenance.	Consider upgrading analyzer to newer model that is used.	2026
Turnout	Turnout 6	CHEMICAL METERING PUMP	Turnout-T6-08	3	21	Frequent leaks in tubing joints due to high pressure dosing. Current pumps are high maintenance.	Consider moving away from a pressurized chemical injection system.	2025
Turnout	Turnout 7	ANALYZER	Turnout-T7-05	3	21	This model of analyzer is high maintenance.	Consider upgrading analyzer to newer model that is used.	2028
Turnout	Turnout 7	ANALYZER	Turnout-T7-07	3	21	This model of analyzer is high maintenance. Latch is broken.	Consider upgrading analyzer to newer model that is used.	2026
Turnout	Turnout 7	ANALYZER	Turnout-T7-10	3	21	This model of analyzer is high maintenance.	Consider upgrading analyzer to newer model that is used.	2026

Level2	Level3	Type2	Asset_ID	POF	COF	Observations	Recommendations	Year
Turnout	Turnout 7	CHEMICAL METERING PUMP	Turnout-T7-06	3	21	Frequent leaks in tubing joints due to high pressure dosing. Current pumps are high maintenance.	Consider moving away from a pressurized chemical injection system.	2025
Well	Well 7	ATS	Well-W7-06	5	8	This gear is not operable and functional. It should be demolished.	Decommission.	2026
Well	Well 7	BUILDING	Well-W7-05	4	8	Located in busy plaza. Challenging to access. Dry rot in beams. Not suitable for chemical storage. Minimal ventilation.	Decommission, or if desired, replaced with a new building ir	2026
Well	Well 7	GENERATOR RECEPTACLE	Well-W7-07	5	8	This gear is not operable nor functional. It should be demolished.	Decommission.	2026
Well	Well 7	PUMP	Well-W7-03	5	8	Unknown if pump is pulled. Casing failed.	Decommission.	2026
Well	Well 7	RTU	Well-W7-08	5	8	Panel is not operable and should be demolished.	Decommission.	2026
Well	Well 7	SWITCHBOARD	Well-W7-02	5	8	This gear is not operable, and functional. It should be demolished.	Decommission.	2026
Well	Well 7	WELL	Well-W7-01	5	8	Foundation was majorly buckling. Structurally failed.	Decommission.	2026

APPENDIX C

REHABILITATION AND REPLACEMENT WORKSHOP MATERIALS

MEETING MINUTES

CITY OF PLEASANTON

Water System Management Plan

Prepared By:	Michelle Eckard	**Issued Date:**	May 6, 2024
Meeting Date:	April 30, 2024	**Project No.:**	201264
Location	OSC Remillard Room, City of Pleasanton		
Subject:	Water Asset Rehabilitation and Replacement Workshop		
Attendees:	Client: Todd Yamello, Ryan Ravalin		
	Carollo: Michelle Eckard, Tim Loper		

The following is our understanding of the subject matter. If this differs from your understanding, please notify us within 10 business days of receipt.

COF Prioritization Ranking

Updated based on discussions during the workshop.

Facility	SUM (COF)	AVG (POF)	Notes
Turnout 5	22	2.55	Project: O&M
Turnout 6	21	2.44	Project: O&M
Turnout 7	21	2.18	Project: O&M
Foothill Booster Station	19	3.18	Project
Foothill Reservoir	19	2.64	
Sycamore Booster Station	19	2.07	
Sycamore Reservoir	19	2.36	
Turnout 4	19	3.00	Project: Interim
Turnout 3	16	2.83	Project: O&M
Bonde I Reservoir	12	3.23	
Bonde II Reservoir	12	3.14	
Kottinger Ranch Booster Station	11	2.84	Project
Kottinger Ranch Reservoir	11	2.00	
Laurel Creek Booster Station	11	2.13	Project
Laurel Creek Reservoir	11	2.38	

Facility	SUM (COF)	AVG (POF)	Notes
Longview Booster Station	11	2.41	
Lower Ruby Hills Reservoir	11	3.00	
Lund Reservoir	11	2.56	
Moller Ranch Reservoir	11	2.71	
Ruby Hills Booster Station	11	2.88	
Tank 770 I Reservoir	11	3.67	Capacity project
Tank 770 II Reservoir	11	2.75	Capacity project
Upper Ruby Hills Reservoir	11	1.71	
Vineyard Booster Station	11	3.10	Project
Vineyard Hills Booster Station	11	2.53	
Vineyard Hills Reservoir	11	1.91	
Happy Valley Reservoir	10	2.13	
Tank 1160 Reservoir	10	2.33	
Tank 1300 Booster Station	10	1.91	Project
Tank 1300 Reservoir	10	2.00	Project
Tank 1600 Reservoir	10	2.00	
Tank 510 Booster Station	10	2.10	Capacity project
Tank 510 Reservoir	10	1.75	Capacity project
Tank 900 Booster Station	10	1.90	
Tank 900 Reservoir	10	1.50	
Dublin Canyon Booster Station	9	2.47	
Dublin Canyon Reservoir	9	3.60	
Turnout 2	9	3.07	Redundant; not used.
Grey Eagle Booster Station	8	2.96	Project: Decommission
McCloud Booster Station	8	5.00	Project: Decommission
McCloud Reservoir	8	5.00	Project: Decommission
Turnout 1	8	2.17	Project: Decommission

Facility	SUM (COF)	AVG (POF)	Notes
Well 5	8	3.00	Project: Decommission
Well 6	8	3.00	Project: Decommission
Well 7	8	4.83	Project: Decommission
Well 8	8	2.90	Project: Decommission

Operator input line added to AWIA COF scores to adjust the sum (COF). Booster stations and reservoirs should be treated separately.

Water Facilities – Wells

1. Assume that the Zone 7 project will be done. It is already on the CIP list.
   a. *Then Wells 5 and 6 can be decommissioned.*
2. **ACTION**: Rank all wells as lowest COF (7) under the assumption they should all be decommissioned.

Water Facilities – Turnouts

1. Turnout 1:
   a. *Project: Regional.*
      i. The reg. project also includes a new turnout.
      ii. Add footnote to CIP about regional project.
2. Turnout 2: Not being used. It is a back-up to Turnout 4. Hydraulically the station does not perform.
   a. *Project: N/A.*
   b. ***ACTION**: Lowest COF (7).*
3. Turnout 3:
   a. *Project: O&M.*
   b. *There is a recommendation to replace the chemical metering pump with a peristaltic pump. However, the City cannot identify a manufacturer of peristaltic pumps that has tubing appropriate for acid (H2S).*
4. Turnout 4:
   a. *Project: Interim.*
      i. Total rehabilitation project occurring now. Includes two new tanks, chemical system, etc. Adams is the contact.
5. Turnout 5:
   a. *Project: O&M.*
   b. ***ACTION**: Highest COF (1).*
6. Turnout 6:
   a. *Project: O&M.*
   b. ***ACTION**: Follow Turnout 5 in COF ranking (2).*

7. Turnout 7:
    a. *Project: O&M.*
    b. ***ACTION**: Follow Turnout 5 in COF ranking (2).*

Water Facilities – Reservoirs

1. All recommendations for reservoirs should start with an inspection project.
    a. ***ACTION**: Create a CIP project for the structural internal inspection of reservoirs. Can also create a tank rehab project placeholder based on outcome of inspection.*
2. There is a reservoir that has cathodic issues.
    a. ***ACTION**: Ryan will talk to Robert to ID site and review if there are any other CIPs needed at reservoirs.*

Tank 1300

1. The interior of the tank is concerning. There is a recommendation from the state to rehabilitate this site based on diving footage from an inspection of the interior of the tank and review of the vapor zone. High priority.
    a. *Project: 10-Year CIP.*
    b. ***ACTION**: Update POF score to reflect interior condition of the tank.*

Capacity Issues - Tanks 510, 770

1. AKEL report found that these two zones have an existing deficiency of insufficient capacity (need storage improvements). Both tanks are 0.25 MG. The current budget is $2.1M.
    a. ***ACTION**: Tim to review budget with AKEL. The cost should be for a new tank and include rehabilitation of other assets (valve vault, etc.).*
    b. *Project: 10-Year CIP (based on capacity).*
2. Vault at 770 that needs to be replaced is not a CIP project in itself.

Kilkare Tanks

1. Fire flow concerns are related to the piping and not the tanks.
    a. ***ACTION**: Update finding in report.*
2. Tanks 1160 and 1600 have no power source and rely on batteries. City would like to have a solar panel project to address lack of power. This is also in the energy recommendations (a wishlist project).
    a. ***ACTION**: Add to project list in condition assessment report.*

McCloud

1. Safety concern. Additionally, have received multiple calls this year regarding concerns about the tank in relation to buying a house in the area.
2. Project: Decommission.

Water Facilities – Booster Stations

Grey Eagle

1. Small service area, antiquated station (was supposed to be temporary), hydropneumatics issues (refer to AKEL report).
2. Site can be decommissioned with CIP project to install a pipeline to Kottinger Ranch and a PRV.
   a. *Project: Decommission.*
   b. *Add footnote to CIP: Grey Eagle is assumed to not need to be rehabilitated; however, if pipeline project does not occur in a timely manner, then rehabilitation of BS will be needed.*

Vineyard

1. Supplemental LS only.
2. Need pump capacity improvements at this site to be able to split up the megazone (refer to Appendix I in the AKEL report).
   a. *Add footnote to CIP: Consider upsizing pump capacity to split Bonde Zone into smaller zones as desired by operations.*
3. Project: Full rehabilitation project needed.

Laurel Creek

1. Have had issues with this BS. Needs a new generator and many electrical findings.
2. Project: 10-Year CIP.

Longview

1. BS rehabbed 12 years ago. The reservoir was rehabbed 3-4 years ago.

Foothill

1. Average POF: 3.35.
2. Site does have redundancy (can be fed water from elsewhere). Start of the daisy chain.
3. Project: 10-Year CIP.

Ruby Hills

1. ATS replaced already.
   a. ***ACTION**: Update findings.*
2. Shed at Upper Ruby Hills Reservoir is an O&M project.

Vineyard Hills

1. The motor control valve vaults were flooded out and are currently not functioning.
   a. ***ACTION**: Add to condition assessment report.*

Kottinger Ranch

1. Average POF: 2.75
2. COF will increase if Grey Eagle is decommissioned. Would like 3 pumps because 2 are needed during peak demand. Not in AKEL report. Pump info used for report may not be correct.
3. As critical as Foothill and Grey Eagle?
4. MCC from the 70s. Ready for CIP.

Other

Generators

1. Need generator project that is supported by project memo. Todd to send so it can be incorporated into the findings. Lots of recommendations (mostly regarding portable generators).
2. Currently renting generators, which has been costly.
3. Non-compliant with permits and insufficient for PSPS (category A in priority).
   a. ***ACTION****: Add to CIP.*

PLC

1. Add footnote to CIP: PLCs should be replaced in facility rehabilitation; however, if not addressed in a timely manner, then a PLC replacement project is needed.

Water Loss

1. Conservation memo. Tim provided the water loss presentation to Todd. City needs to add leak detection program.

Next Steps

1. Prepare updated Water Facility Condition Assessment TM which will include projects discussed in this workshop, and updated costs.

APPENDIX D

AWIA CONSEQUENCE METRICS TABLE

	Consequence Metrics Potential for: City of Pleasanton									
Asset Name	Financial Losses to the Utility	Economic Losses to the Community	Impacts to the Environment	Impacts to Public Confidence	Impacts to Water Quality	Impacts to Essential Critical Infrastructure (non-agency)	Fatalities	Serious Injuries	Cumulative Consequence Score	Discussed In Workshop vs. WY Estimate
Example Asset	H	M	L	H	L	L	L	L	13	
Source Water										
Turnout 1	L	L	L	L	L	L	L	L	8	Discussed In Workshop
Turnout 2	L	L	L	L	L	M	L	M	10	Discussed In Workshop
Turnout 3	M	M	L	M	M	H	L	M	15	Discussed In Workshop
Turnout 4	H	H	L	H	M	H	L	M	18	Discussed In Workshop
Turnout 5	H	H	L	H	H	H	L	M	19	Discussed In Workshop
Turnout 6	H	H	L	H	H	H	L	M	19	Discussed In Workshop
Turnout 7	H	H	L	H	H	H	L	M	19	Discussed In Workshop
Well 5	H	H	L	H	M	H	L	M	18	Discussed In Workshop
Well 6	H	H	L	H	M	H	L	M	18	Discussed In Workshop
Well 8	H	H	L	H	M	M	L	L	16	Discussed In Workshop
Finished Water Pump Station										
Lower Pressure Zone										
Canyon Meadows	L	L	L	L	L	L	L	L	8	Discussed In Workshop
Laurel Creek	M	L	L	M	L	L	L	L	10	Discussed In Workshop
Longview	M	L	L	M	L	L	L	L	10	Discussed In Workshop
Foothill 2	L	L	L	M	L	L	L	L	9	Discussed In Workshop
McCloud (Kottinger on hydraulic profile)	L	L	L	L	L	L	L	L	8	Discussed In Workshop
Vineyard	M	L	L	L	L	L	L	L	9	Discussed In Workshop
Vineyard Hills	M	L	L	M	L	L	L	L	10	Discussed In Workshop
North Sycamore	M	L	L	M	L	L	L	L	10	Discussed In Workshop
Bonde Pressure Zone										
Grey Eagle	L	L	L	L	L	L	L	L	8	Discussed In Workshop
Grey Eagle Fire Pump	L	L	L	M	L	L	L	L	9	Discussed In Workshop
Kottinger Ranch	L	L	L	M	L	L	L	L	9	Discussed In Workshop
Ruby Hill Upper/Lower	M	L	L	M	L	L	L	L	10	Discussed In Workshop
PS 510	L	L	L	M	L	L	L	L	9	Discussed In Workshop
PS 900	L	L	L	M	L	L	L	L	9	Discussed In Workshop
PS 1300	L	L	L	M	L	L	L	L	9	Discussed In Workshop
Storage Reservoirs										
Lower Pressure Zone										
Foothill	H	H	L	H	H	H	L	L	18	Discussed In Workshop
Sycamore	H	H	L	H	H	H	L	L	18	Discussed In Workshop
Tassajara (Recycled Water)	M	L	L	M	L	M	L	L	11	Discussed In Workshop
McCloud (Kottinger on hydraulic profile)	L	L	L	L	L	L	L	L	8	Discussed In Workshop
Dublin Canyon (OWN P ZONE)	L	L	L	L	L	L	L	L	8	Discussed In Workshop
Moller 770 Pressure Zone										
Laurel Creek	M	L	L	M	L	L	L	L	10	WY Estimate
Moller 770	M	L	L	M	L	L	L	L	10	WY Estimate
Pressure Zone 770										
770-1	M	L	L	M	L	L	L	L	10	WY Estimate
770-2	M	L	L	M	L	L	L	L	10	WY Estimate
510	M	L	L	M	L	L	L	L	10	WY Estimate
Bonde Pressure Zone										
Bonde-1	M	M	L	M	L	L	L	L	11	WY Estimate
Bonde-2	M	M	L	M	L	L	L	L	11	WY Estimate
Happy Valley	L	L	L	M	L	L	L	L	9	WY Estimate
Lund	M	L	L	M	L	L	L	L	10	WY Estimate
Kottinger Ranch	L	L	L	M	L	L	L	L	9	WY Estimate

Source: West Yost (2020)

Asset Name	Consequence Metrics Potential for: City of Pleasanton Financial Losses to the Utility	Economic Losses to the Community	Impacts to the Environment	Impacts to Public Confidence	Impacts to Water Quality	Impacts to Essential Critical Infrastructure (non-agency)	Fatalities	Serious Injuries	Cumulative Consequence Score	Discussed In Workshop vs. WY Estimate
Lower Ruby Hill	M	L	L	M	L	L	L	L	10	WY Estimate
Upper Ruby Hill	M	L	L	M	L	L	L	L	10	WY Estimate
Pressure Reducing Stations										
Foothill 770 from Lower 770-Madden Station	L	L	L	M	L	L	L	L	9	Discussed In Workshop
Upper Golden Eagle to Mid 770 - North	L	L	L	M	L	L	L	L	9	WY Estimate
Upper Golden Eagle to Mid 770 - South	L	L	L	M	L	L	L	L	9	WY Estimate
Twelve Oaks Drive - Deer Oaks from 770	L	L	L	M	L	L	L	L	9	WY Estimate
Serenity Terrace	L	L	L	M	L	L	L	L	9	WY Estimate
Moller Ranch Rd @ EVA	L	L	L	M	L	L	L	L	9	WY Estimate
Kilkare #1	L	L	L	M	L	L	L	L	9	WY Estimate
Kilkare #2	L	L	L	M	L	L	L	L	9	WY Estimate
Kilkare #3	L	L	L	M	L	L	L	L	9	WY Estimate
JP Station	L	L	L	M	L	L	L	L	9	WY Estimate
Nipper Station	L	L	L	M	L	L	L	L	9	WY Estimate
Grapevine Drive @ Vineyard	L	L	L	M	L	L	L	L	9	WY Estimate
El Capitan Drive @ Vineyard	L	L	L	M	L	L	L	L	9	WY Estimate
Laurel Creek to Dublin Canyon Zone	L	L	L	M	L	L	L	L	9	WY Estimate
Finished Water Transmission Main										
277 miles 6-in to 27-in										
T4 at Stone Ridge and Hopyard (~3 miles)	M	M	L	M	L	M	L	L	12	WY Estimate
T5 to Sycamore	M	M	L	M	M	M	L	L	13	WY Estimate
Mains associated with turnouts										WY Estimate
T3 (West Las Pacitas)	L	L	L	L	L	M	L	L	9	WY Estimate
Main up the ridge to Killkare	L	L	L	M	L	L	L	L	9	WY Estimate
Pleasanton Canal Crosstown Main (out of T2)	L	L	L	L	L	L	L	L	8	WY Estimate
T7 to Ruby Hill	M	M	L	M	M	M	L	L	13	WY Estimate
Castlewood and Foothill Road (770 Zone)	M	L	L	M	L	L	L	L	10	WY Estimate
Distribution System	M	M	L	M	M	M	L	L	13	WY Estimate
Admin and Ops Building										
Operations Service Center (incl main SCADA)	H	M	L	H	L	L	L	L	13	WY Estimate
Generators	H	H	L	H	H	H	L	L	18	Per City: to match Foothill tank due to PSPS events
SCADA System	H	H	M	H	H	H	L	M	20	Per City comments - to match TO#5 plus "M" for impacts to environment
Business/IT System	H	L	L	H	L	M	L	L	13	WY Estimate
Organization/Water System Field/Operations Staff	H	L	L	M	L	L	L	M	12	WY Estimate

Worst Reasonable Consequences:
Estimate the worst reasonable consequences resulting from the destruction or loss of each asset, without regard to threat. For each of the assets, determine if the destruction or loss of the asset has a high, medium or low potential to cause the associated consequence. Enter H, M or L in the cooresponding cells. :

1) **High** - (H) The destruction or loss of this asset has a high likelihood of causing the consequence. Quantitative score: 3.
2) **Medium** - (M) The destruction or loss of this asset has a medium likelihood of causing the consequence. Quantitative score: 2.
3) **Low** - (L) The destruction or loss of this asset has a low likelihood of causing the consequence. Quantitative score: 1.
4) **N/A** - (N) This consequence is not applicable to the asset. Quantitative score: 0.

Prioritize the critical assets using the sum of the estimated consequences. The sum of the associated quantitative score can be found in column I. The higher the score, the more critical the asset.

Source: West Yost (2020)

APPENDIX E

WATER FACILITY CAPITAL IMPROVEMENT PROJECT

CIP Project	Asset_Name	POF	Year	Sum of Project Cost
Decommission of Grey Eagle	Grey Eagle Booster Station 3-in Butterfly Valve, Pump 1	1	2031	$ 8,873
	Grey Eagle Booster Station 3-in Butterfly Valve, Pump 2	4	2031	$ 8,873
	Grey Eagle Booster Station 6” Pump Control Valve	2	2031	$ 8,873
	Grey Eagle Booster Station 8" Pump Control Valve	2	2031	$ 8,873
	Grey Eagle Booster Station 8-in Check Valve	2	2031	$ 8,873
	Grey Eagle Booster Station Air Compressor	5	2031	$ 8,873
	Grey Eagle Booster Station Air Compressor Control Panel	5	2031	$ 35,490
	Grey Eagle Booster Station Automatic Transfer Switch (ATS)	4	2031	$ 35,490
	Grey Eagle Booster Station Building	2	2031	$ 295,750
	Grey Eagle Booster Station Check Valve, Pump 1	1	2031	$ 8,873
	Grey Eagle Booster Station Check Valve, Pump 2	1	2031	$ 8,873
	Grey Eagle Booster Station Control Panel LP-1	3	2031	$ 35,490
	Grey Eagle Booster Station Controller/RTU	5	2031	$ 2,958
	Grey Eagle Booster Station Exhaust Fan	2	2031	$ 2,958
	Grey Eagle Booster Station Flow Meter	3	2031	$ 8,873
	Grey Eagle Booster Station Hydropneumatic Tank	2	2031	$ 35,490
	Grey Eagle Booster Station Lighting Panel	2	2031	$ 8,873
	Grey Eagle Booster Station Lighting Transformer	5	2031	$ 35,490
	Grey Eagle Booster Station MCC-A	4	2031	$ 118,300
	Grey Eagle Booster Station Piping	3	2031	$ 8,873
	Grey Eagle Booster Station Pump 1	3	2031	$ 88,725
	Grey Eagle Booster Station Pump 2	4	2031	$ 88,725
	Grey Eagle Booster Station Pump 3 Fire Pump	3	2031	$ 88,725
	Grey Eagle Booster Station Site Security	3	2031	$ 35,490
	Grey Eagle Booster Station Spare parts: pump, motor, check	5	2031	$ 8,873
	Grey Eagle Booster Station Switchboard	2	2031	$ 295,750
Decommission of McCloud Tank/PS	McCloud Booster Station Building	5	2025	$ 295,750
	McCloud Booster Station Pump 1	5	2025	$ 215,475
	McCloud Booster Station Pump 2	5	2025	$ 215,475
	McCloud Booster Station Pump 3	5	2025	$ 215,475
	McCloud Reservoir Tank	5	2025	$ 295,750
Decommission of Well 5 and 6	Well 5	4	2028	$ 88,725
	Well 5 Check Valve	2	2028	$ 8,873
	Well 5 Dump Control Valve	2	2028	$ 8,873
	Well 5 Dump Isolation Valve	2	2028	$ 8,873
	Well 5 Flowmeter	2	2028	$ 8,873
	Well 5 Pump	3	2028	$ 88,725
	Well 5&6 Lighting Panel	4	2028	$ 35,490
	Well 5&6 MCC	4	2028	$ 2,958
	Well 5&6 Motor Control Center	4	2028	$ 118,300
	Well 5&6 PLC Panel	4	2028	$ 118,300
	Well 6	4	2028	$ 88,725
	Well 6 Check Valve	2	2028	$ 8,873
	Well 6 Dump Control Valve	2	2028	$ 8,873
	Well 6 Dump Isolation Valve	2	2028	$ 8,873
	Well 6 Flowmeter	2	2028	$ 8,873
	Well 6 Pump	5	2028	$ 88,725
Decommission of Well 7	Well 7	5	2026	$ 88,725
	Well 7 Building	4	2026	$ 295,750
	Well 7 Generator Transfer Switch	5	2026	$ 35,490
	Well 7 Main Switchboard	5	2026	$ 295,750
	Well 7 Portable Generator Connection	5	2026	$ 2,958
	Well 7 Pump	5	2026	$ 88,725
	Well 7 RTU	5	2026	$ 2,958
Decommission of Well 8	Well 8	5	2032	$ 88,725
	Well 8 Ammonia Dosing System Components	3	2032	$ 2,958
	Well 8 Ammonia Injection Vault	3	2032	$ 88,725
	Well 8 Ammonia Storage Shed	5	2032	$ 8,873
	Well 8 Building	3	2032	$ 295,750

CIP Project	Asset_Name	POF	Year	Sum of Project Cost
Decommission of Well 8	Well 8 Chlorine Dosing System Components	5	2032	$ 35,490
	Well 8 Chlorine Dosing System Shed	5	2032	$ 8,873
	Well 8 Chlorine/Fluoride Injection Vault	3	2032	$ 88,725
	Well 8 Dump Control Valve	2	2032	$ 8,873
	Well 8 Dump Isolation Valve	2	2032	$ 8,873
	Well 8 Flow Meter	1	2032	$ 8,873
	Well 8 Flow Switch 1	3	2032	$ 2,958
	Well 8 Flow Switch 2	3	2032	$ 2,958
	Well 8 Fluoride Analyzer 1	2	2032	$ 8,873
	Well 8 Fluoride Analyzer 2	4	2032	$ 8,873
	Well 8 Fluoride Dosing System Components	4	2032	$ 35,490
	Well 8 Free Chlorine Analyzer	2	2032	$ 8,873
	Well 8 Generator Hookup	3	2032	$ 2,958
	Well 8 PLC Panel	4	2032	$ 118,300
	Well 8 Pressure Transducer	2	2032	$ 2,958
	Well 8 Pump	1	2032	$ 88,725
	Well 8 Pump Check Valve	2	2032	$ 8,873
	Well 8 Pump Pressure Switch High	3	2032	$ 2,958
	Well 8 Pump Pressure Switch Low	3	2032	$ 2,958
	Well 8 Pump VFD	2	2032	$ 35,490
	Well 8 Switchboard	4	2032	$ 295,750
	Well 8 Total Chlorine Analyzer	2	2032	$ 8,873
	Well 8 Water Circulation Shed	1	2032	$ 8,873
	Well 8 Water Circulation System Components	2	2032	$ 35,490
Rehabilitation of Foothill Pump Station	Foothill Booster Station Diesel Fuel Tank	3	2026	$ 86,190
	Foothill Booster Station Electric Sump Pump	5	2026	$ -
	Foothill Booster Station Flow Meter	4	2026	$ -
	Foothill Booster Station Generator Transfer Switch (000719)	4	2026	$ 86,190
	Foothill Booster Station Lighting Panel (LP-1)	3	2026	$ 21,548
	Foothill Booster Station Lighting Transformer	3	2026	$ 86,190
	Foothill Booster Station MCC	4	2026	$ 287,300
	Foothill Booster Station Pressure Switch	4	2026	$ 7,183
		3	2026	$ 7,183
	Foothill Booster Station Pressure Transmitter 1	4	2026	$ 7,183
	Foothill Booster Station Pressure Transmitter 2	4	2026	$ 7,183
	Foothill Booster Station Pump 1	2	2026	$ 215,475
	Foothill Booster Station Pump 2	2	2026	$ 215,475
	Foothill Booster Station Pump 3	5	2026	$ 88,725
	Foothill Booster Station Pump 4	5	2026	$ 88,725
	Foothill Booster Station RTU 7	1	2026	$ 7,183
	Foothill Booster Station Site Security	3	2026	$ 86,190
	Foothill Booster Station Surge Anticipator Valve	2	2026	$ 21,548
Rehabilitation of Kottinger Ranch Pump Station	Kottinger Ranch Booster Station ARVs	1	2028	$ 7,183
	Kottinger Ranch Booster Station Butterfly Valves	2	2028	$ 21,548
	Kottinger Ranch Booster Station Control Valve, Pump 1	2	2028	$ 21,548
	Kottinger Ranch Booster Station Control Valve, Pump 2	2	2028	$ 21,548
	Kottinger Ranch Booster Station Crane/Hoist	2	2028	$ 86,190
	Kottinger Ranch Booster Station Diesel Engine	5	2028	$ 35,490
	Kottinger Ranch Booster Station Exhaust Fan	3	2028	$ 7,183
	Kottinger Ranch Booster Station Exterior 10" Butterfly Valve	3	2028	$ 21,548
	Kottinger Ranch Booster Station Exterior Piping	3	2028	$ 21,548
	Kottinger Ranch Booster Station Flow Meter	1	2028	$ 21,548
	Kottinger Ranch Booster Station Lighting Panel	4	2028	$ 21,548
	Kottinger Ranch Booster Station Lighting Transformer	4	2028	$ 86,190
	Kottinger Ranch Booster Station MCC	4	2028	$ 287,300
	Kottinger Ranch Booster Station Pressure Transmitter	3	2028	$ 7,183
	Kottinger Ranch Booster Station Pump 1	3	2028	$ 215,475
	Kottinger Ranch Booster Station Pump 2	4	2028	$ -

CIP Project	Asset_Name	POF	Year	Sum of Project Cost
Rehabilitation of Kottinger Ranch	Kottinger Ranch Booster Station Site Security	3	2028	$ -
	Kottinger Ranch Booster Station Sump Pump	5	2028	$ 7,183
	Kottinger Ranch Booster Station Switchboard	5	2028	$ 718,250
	Kottinger Ranch PLC	3	2028	$ 287,300
	Kottinger Ranch Pump Station RTU	1	2028	$ 7,183
Rehabilitation of Laurel Creek Pump Station	Laurel Creek Booster Station Diesel Fuel Tank	4	2029	$ 86,190
	Laurel Creek Booster Station Flow Meter	2	2029	$ 21,548
	Laurel Creek Booster Station Pump 1	2	2029	$ 215,475
	Laurel Creek Booster Station Pump 1 Cla-Val	2	2029	$ 57,460
	Laurel Creek Booster Station Pump 2	2	2029	$ 215,475
	Laurel Creek Booster Station Pump 2 Cla-Val	2	2029	$ 57,460
	Laurel Creek Booster Station Pump 3	2	2029	$ 215,475
	Laurel Creek Booster Station Pump 3 Cla-Val	2	2029	$ 57,460
	Laurel Creek Booster Station RTU	3	2029	$ 7,183
	Laurel Creek Booster Station Site Security	2	2029	$ 7,183
	Laurel Creek Booster Station Surge Anticipator	2	2029	$ 21,548
	Laurel Creek Booster Station Switchboard	3	2029	$ 718,250
Rehabilitation of Ruby Hill Pump Station	Ruby Hills Booster Station Chemical Injection Control Panel	5	2029	$ 86,190
	Ruby Hills Booster Station Cla-Val 3	3	2029	$ 57,460
	Ruby Hills Booster Station Cla-Val 4	3	2029	$ 57,460
	Ruby Hills Booster Station Cla-Val 5	3	2029	$ 57,460
	Ruby Hills Booster Station Crane	3	2029	$ 86,190
	Ruby Hills Booster Station Electrical Panel Board	3	2029	$ 21,548
	Ruby Hills Booster Station Fan Control Panel	2	2029	$ 86,190
	Ruby Hills Booster Station Generator Transfer Switch	3	2029	$ -
	Ruby Hills Booster Station Main Circuit Breaker	5	2029	$ 21,548
	Ruby Hills Booster Station MCC	3	2029	$ 287,300
	Ruby Hills Booster Station PLC	4	2029	$ 287,300
	Ruby Hills Booster Station Pump 1	2	2029	$ 88,725
	Ruby Hills Booster Station Pump 2	5	2029	$ 215,475
	Ruby Hills Booster Station Pump 3	2	2029	$ 215,475
	Ruby Hills Booster Station Pump 4	2	2029	$ 215,475
	Ruby Hills Booster Station Pump 5	2	2029	$ 215,475
	Ruby Hills Booster Station RTU	4	2029	$ 7,183
	Ruby Hills Booster Station VFD Control Panel	5	2029	$ 35,490
Rehabilitation of Tank 1300	Tank 1300	4	2025	$ 718,250
	Tank 1300 Booster Station Building	2	2025	$ 718,250
	Tank 1300 Booster Station Generator Docking Station	3	2025	$ 7,183
	Tank 1300 Booster Station Main Service Panel	1	2025	$ 21,548
	Tank 1300 Booster Station MCC 13	2	2025	$ 287,300
	Tank 1300 Booster Station Pump 1	2	2025	$ 215,475
	Tank 1300 Booster Station Pump 1 Cla-Val	2	2025	$ 57,460
	Tank 1300 Booster Station Pump 2	1	2025	$ 215,475
	Tank 1300 Booster Station Pump 2 Cla-Val	2	2025	$ 57,460
	Tank 1300 Booster Station Recirculation Pump	2	2025	$ 215,475
	Tank 1300 Booster Station RTU 13	2	2025	$ 7,183
	Tank 1300 Booster Station Surge Anticipator	2	2025	$ 21,548
Rehabilitation of Tanks Placeholder	Tank Rehabilitation Placeholder	5	2030	$ 2,873,000
Rehabilitation of Vineyard Pump Station	Vineyard Booster Station 10" Control Valve 1	2	2027	$ -
	Vineyard Booster Station 10" Control Valve 2	2	2027	$ 21,548
	Vineyard Booster Station Automatic Transfer Switch	3	2027	$ 86,190
	Vineyard Booster Station Butterfly Valve 1	2	2027	$ 21,548
	Vineyard Booster Station Butterfly Valve 2	2	2027	$ 21,548
	Vineyard Booster Station Butterfly Valve 3	2	2027	$ 21,548
	Vineyard Booster Station Butterfly Valve 4	2	2027	$ 21,548
	Vineyard Booster Station Butterfly Valve 5	2	2027	$ 21,548

CIP Project	Asset_Name	POF	Year	Sum of Project Cost
Rehabilitation of Vineyard Pump	Vineyard Booster Station Exhaust fan	3	2027	$ 7,183
	Vineyard Booster Station Flow Meter	2	2027	$ 21,548
	Vineyard Booster Station Lighting Panel	5	2027	$ 21,548
	Vineyard Booster Station Lighting Transformer	4	2027	$ 86,190
	Vineyard Booster Station MCC	5	2027	$ 287,300
	Vineyard Booster Station PLC	5	2027	$ 287,300
	Vineyard Booster Station Pump 1	5	2027	$ 215,475
	Vineyard Booster Station Pump 1 ARV	2	2027	$ 7,183
	Vineyard Booster Station Pump 2	5	2027	$ 215,475
	Vineyard Booster Station Pump 2 ARV	2	2027	$ 7,183
	Vineyard Booster Station RTU	5	2027	$ 7,183
	Vineyard Booster Station Service Switchboard	3	2027	$ 718,250
	Vineyard Booster Station Sump Piping	3	2027	$ 21,548
	Vineyard Booster Station Sump Pump	4	2027	$ 7,183
Tank Inspection	Bonde I Tank	3	2027	$ 84,500
	Bonde II Tank	4	2027	$ 84,500
	Dublin Canyon Reservoir Tank	2	2027	$ 84,500
	Foothill Reservoir Tank	3	2027	$ 84,500
	Happy Valley Reservoir Tank	2	2027	$ 84,500
	Kottinger Ranch Reservoir Tank	2	2027	$ 84,500
	Laurel Creek Reservoir Tank	1	2027	$ 84,500
	Lower Ruby Hills Tank	2	2027	$ 84,500
	Lund Reservoir Tank	2	2027	$ 84,500
	Moller Ranch Reservoir Tank	2	2027	$ 84,500
	Sycamore Reservoir Tank	3	2027	$ 84,500
	Tank 1160	2	2027	$ 84,500
	Tank 1600	2	2027	$ 84,500
	Tank 510	2	2027	$ 84,500
	Tank 770 I	3	2027	$ 84,500
	Tank 770 II	2	2027	$ 84,500
	Tank 900	2	2027	$ 84,500
	Upper Ruby Hills Tank	2	2027	$ 84,500
	Vineyard Hills Reservoir Tank	2	2027	$ 84,500

APPENDIX F

WATER FACILITY OPERATIONS AND MAINTENANCE FORECAST

CIP Project	Asset_Name	Asset_ID	POF	Year	Sum of Project Cost
Booster Station O&M	Dublin Canyon Booster Station Building	BS-DC-01	2	2045	$ 718,250
	Dublin Canyon Booster Station Crane 2 Ton	BS-DC-18	2	2034	$ 86,190
	Dublin Canyon Booster Station Flow Meter	BS-DC-05	1	2032	$ 21,548
	Dublin Canyon Booster Station Generator	BS-DC-06	5	2026	$ 7,183
	Dublin Canyon Booster Station Hydropneumatic Tank	BS-DC-07	5	2028	$ 35,490
	Dublin Canyon Booster Station Lighting Panel	BS-DC-08	3	2027	$ 21,548
	Dublin Canyon Booster Station LP-1 Transformer	BS-DC-09	4	2024	$ 86,190
	Dublin Canyon Booster Station Main Switchboard	BS-DC-10	3	2028	$ 718,250
	Dublin Canyon Booster Station MCC-A	BS-DC-11	2	2034	$ 287,300
	Dublin Canyon Booster Station Pressure Transmitters	BS-DC-12	1	2033	$ 7,183
	Dublin Canyon Booster Station Pump 1	BS-DC-02	2	2038	$ 215,475
	Dublin Canyon Booster Station Pump 1 Cla-Val	BS-DC-13	1	2034	$ 57,460
	Dublin Canyon Booster Station Pump 2	BS-DC-03	2	2032	$ 215,475
	Dublin Canyon Booster Station Pump 2 Cla-Val	BS-DC-14	1	2034	$ 57,460
	Dublin Canyon Booster Station Pump 3	BS-DC-04	5	2026	$ 88,725
	Dublin Canyon Booster Station RTU 15	BS-DC-15	3	2026	$ 7,183
	Dublin Canyon Booster Station Surge Anticipator	BS-DC-16	3	2026	$ 21,548
	Dublin Canyon Booster Station Transfer Switch	BS-DC-17	5	2024	$ 86,190
	Dublin Canyon Site Security	BS-DC-19	3	2028	$ 7,183
	Longview Booster Station Control Valve 1	BS-LV-02	2	2027	$ 21,548
	Longview Booster Station Control Valve 2	BS-LV-03	2	2027	$ 21,548
	Longview Booster Station Control Valve 3	BS-LV-04	2	2027	$ 21,548
	Longview Booster Station Discharge Piping	BS-LV-09	3	2033	$ 21,548
	Longview Booster Station Exhaust Fans	BS-LV-21	2	2029	$ 7,183
	Longview Booster Station Flow Meter	BS-LV-15	2	2027	$ 21,548
	Longview Booster Station Gate Valve 1	BS-LV-17	2	2027	$ 21,548
	Longview Booster Station Gate Valve 2	W_BS_LV-24	2	2027	$ 21,548
	Longview Booster Station Gate Valve 3	W_BS_LV-23	2	2027	$ 21,548
	Longview Booster Station Lighting Panel	BS-LV-16	2	2029	$ 21,548
	Longview Booster Station Lighting Transformer	BS-LV-22	3	2030	$ 86,190
	Longview Booster Station MCC	BS-LV-11	2	2033	$ 287,300
	Longview Booster Station Power Panel	BS-LV-20	2	2029	$ 21,548
	Longview Booster Station Pump 1	BS-LV-12	3	2027	$ 215,475
	Longview Booster Station Pump 2	BS-LV-13	3	2031	$ 215,475
	Longview Booster Station Pump 3	BS-LV-14	3	2031	$ 215,475
	Longview Booster Station RTU	BS-LV-18	3	2025	$ 7,183
	Longview Booster Station Service Entrance Switchboa	BS-LV-07	3	2027	$ 718,250
	Longview Booster Station Site Security	BS-LV-01	3	2027	$ 86,190
	Longview Booster Station Surge Valve	BS-LV-05	2	2027	$ 21,548
	Longview Booster Station Temporary Bypass Pump St	BS-LV-06	4	2027	$ 88,725
	Sycamore Booster Station Building	BS-S-01	2	2045	$ 718,250
	Sycamore Booster Station Check Valve	BS-S-06	3	2026	$ 21,548
	Sycamore Booster Station Chlorine Injection Vault	BS-S-07	2	2045	$ 215,475
	Sycamore Booster Station Cla-Val 1	BS-S-08	2	2028	$ 57,460
	Sycamore Booster Station Cla-Val 2	BS-S-09	2	2028	$ 57,460
	Sycamore Booster Station Cla-Val 3	BS-S-10	2	2028	$ 57,460
	Sycamore Booster Station Control Valve Vault	BS-S-14	2	2045	$ 215,475
	Sycamore Booster Station Flow Meter	BS-S-11	2	2028	$ 21,548
	Sycamore Booster Station Flowmeter Vault	BS-S-15	2	2045	$ 215,475
	Sycamore Booster Station Pressure Transmitter	BS-S-12	1	2032	$ 7,183
	Sycamore Booster Station Pump 1	BS-S-02	2	2032	$ 215,475
	Sycamore Booster Station Pump 2	BS-S-03	2	2032	$ 215,475
	Sycamore Booster Station Pump 3	BS-S-04	2	2032	$ 215,475
	Sycamore Booster Station Surge Valve	BS-S-13	2	2028	$ 21,548
	Tank 900 Booster Station Building	BS-T900-02	2	2045	$ 718,250
	Tank 900 Booster Station MCC 9	BS-T900-01	2	2036	$ 287,300
	Tank 900 Booster Station MSB 9	BS-T900-05	1	2038	$ 718,250
	Tank 900 Booster Station Portable Generator Docking	BS-T900-06	3	2029	$ 7,183
	Tank 900 Booster Station Pump 1	BS-T900-03	2	2032	$ 215,475
	Tank 900 Booster Station Pump 1 Cla-Val	BS-T900-07	2	2028	$ 57,460
	Tank 900 Booster Station Pump 2	BS-T900-04	2	2032	$ 215,475
	Tank 900 Booster Station Pump 2 Cla-Val	BS-T900-08	2	2028	$ 57,460
	Tank 900 Booster Station RTU 9	BS-T900-09	1	2032	$ 7,183
	Tank 900 Booster Station Surge Anticipator	BS-T900-10	2	2028	$ 21,548
	Vineyard Hills Booster Station Building	BS-VH-02	2	2045	$ 718,250
	Vineyard Hills Booster Station Cla-Val 1	BS-VH-07	3	2026	$ 57,460

CIP Project	Asset_Name	Asset_ID	POF	Year	Sum of Project Cost
Booster Station O&M	Vineyard Hills Booster Station Cla-Val 2	BS-VH-08	3	2026	$ 57,460
	Vineyard Hills Booster Station Cla-Val 3	BS-VH-09	3	2026	$ 57,460
	Vineyard Hills Booster Station Diesel Fuel Tank	BS-VH-10	2	2041	$ 86,190
	Vineyard Hills Booster Station Flowmeter Vault	BS-VH-11	2	2045	$ 215,475
	Vineyard Hills Booster Station Fuel Oil Day Tank	BS-VH-12	5	2028	$ -
	Vineyard Hills Booster Station MCC	BS-VH-01	1	2041	$ 287,300
	Vineyard Hills Booster Station Meter for Ruby Hills	BS-VH-14	3	2026	$ 21,548
	Vineyard Hills Booster Station Meter for Vineyard Hill	BS-VH-15	3	2026	$ 21,548
	Vineyard Hills Booster Station Pump 1	BS-VH-04	2	2032	$ 215,475
	Vineyard Hills Booster Station Pump 2	BS-VH-05	2	2032	$ 215,475
	Vineyard Hills Booster Station Pump 3	BS-VH-06	2	2032	$ 215,475
	Vineyard Hills Booster Station RTU	BS-VH-16	2	2028	$ 7,183
	Vineyard Hills Booster Station Site Security	BS-VH-17	2	2032	$ -
	Vineyard Hills Booster Station Surge Anticipator	BS-VH-18	3	2026	$ 21,548
	Vineyard Hills Booster Station Valve Vault	BS-VH-19	2	2045	$ 215,475
Reservoir O&M	Bonde I 10" Altitude Valve	Res-B I-01	5	2024	$ 21,548
	Bonde I Air and Vacuum Valve Assembly	Res-B I-02	5	2024	$ 21,548
	Bonde I Bypass Valve (10" Butterfly Valve)	Res-B I-04	5	2024	$ 21,548
	Bonde I Control Panel	Res-B I-11	2	2029	$ 86,190
	Bonde I Main In-Outlet Valve Vault	Res-B I-05	2	2044	$ 215,475
	Bonde I Main Power Panel	Res-B I-15	2	2029	$ 21,548
	Bonde I PLC & Relays	Res-B I-12	1	2031	$ 287,300
	Bonde I Pressure Transmitter	Res-B I-13	2	2028	$ 7,183
	Bonde I RTU & Main Radio Repeater	Res-B I-08	1	2031	$ 7,183
	Bonde I Shutoff Valve 1 (10" Butterfly Valve)	Res-B I-06	5	2024	$ 21,548
	Bonde I Shutoff Valve 2 (10" Butterfly Valve)	Res-B I-07	5	2024	$ 21,548
	Bonde I Site Security	Res-B I-10	1	2044	$ -
	Bonde I Tank Overflow Pipe	Res-B I-09	3	2033	$ -
	Bonde II 12" Altitude Valve	Res-B II-01	2	2027	$ 21,548
	Bonde II 12" Check Valve	Res-B II-02	2	2027	$ 21,548
	Bonde II Air and Vacuum Relief Valve	Res-B II-03	2	2027	$ 21,548
	Bonde II Metering and Service Disconnect Panel	Res-B II-05	5	2024	$ 86,190
	Bonde II Pressure Transmitter	Res-B II-06	3	2025	$ 7,183
	Bonde II Site Security	Res-B II-07	3	2027	$ 86,190
	Bonde II Tank RTU Panel	Res-B II-08	3	2026	$ 86,190
	Bonde II Valve Vault	Res-B II-09	3	2043	$ 215,475
	Dublin Canyon Reservoir Check Valve	Res-DC-01	4	2025	$ 21,548
	Dublin Canyon Reservoir Globe Valve	Res-DC-02	4	2025	$ 21,548
	Dublin Canyon Reservoir Main Panel	Res-DC-03	5	2025	$ 21,548
	Dublin Canyon Reservoir RTU	Res-DC-04	5	2025	$ 7,183
	Dublin Canyon Reservoir Vault	Res-DC-06	2	2045	$ 215,475
	Foothill Reservoir Intrusion Level Switch	Res-F-09	2	2033	$ 7,183
	Foothill Reservoir Level Switch	Res-F-02	2	2033	$ 7,183
	Foothill Reservoir Road	Res-F-05	3	2028	$ 21,548
	Foothill Reservoir Site Security	Res-F-15	4	2025	$ 86,190
	Foothill Reservoir Valve Vault	Res-F-06	3	2042	$ 215,475
	Foothill Reservoir Valve Vault 16" BV No. 1	Res-F-10	3	2025	$ 21,548
	Foothill Reservoir Valve Vault 16" BV No. 2	Res-F-11	3	2025	$ 21,548
	Foothill Reservoir Valve Vault 16" BV No. 3	Res-F-12	3	2025	$ 21,548
	Foothill Reservoir Valve Vault 16" BV No. 4	Res-F-13	3	2025	$ 21,548
	Foothill Reservoir Valve Vault 16" BV No. 5	Res-F-14	3	2025	$ 21,548
	Foothill Reservoir Valve Vault 16” Check Valve No. 1	Res-F-07	2	2027	$ 21,548
	Foothill Reservoir Valve Vault 16” Check Valve No. 2	Res-F-08	2	2027	$ 21,548
	Foothill Reservoir Vault Actuator	Res-F-03	1	2031	$ 21,548
	Foothill Reservoir Vault Pressure Transmitter	Res-F-04	2	2027	$ 7,183
	Happy Valley Reservoir Altitude Valve	Res-HV-02	2	2028	$ 21,548
	Happy Valley Reservoir Check Valve	Res-HV-03	2	2028	$ 21,548
	Happy Valley Reservoir Main Electrical Panel	Res-HV-04	2	2030	$ 21,548
	Happy Valley Reservoir Retention Wall and Drainage	Res-HV-05	2	2032	$ 21,548
	Happy Valley Reservoir RTU	Res-HV-06	3	2026	$ 7,183
	Happy Valley Reservoir Site Security	Res-HV-07	2	2032	$ 86,190
	Happy Valley Reservoir Valve Vault	Res-HV-08	2	2045	$ 215,475
	Kottinger Ranch Reservoir Altitude Valve	Res-KR-02	3	2026	$ 21,548
	Kottinger Ranch Reservoir Cathodic Protection	Res-KR-03	3	2029	$ -
	Kottinger Ranch Reservoir Check Valve	Res-KR-04	3	2026	$ 21,548
	Kottinger Ranch Reservoir Main Electrical Panel	Res-KR-05	1	2035	$ 21,548
	Kottinger Ranch Reservoir RTU	Res-KR-06	1	2035	$ 7,183

CIP Project	Asset_Name	Asset_ID	POF	Year	Sum of Project Cost
Reservoir O&M	Kottinger Ranch Reservoir Site Security	Res-KR-07	2	2032	$ 86,190
	Kottinger Ranch Reservoir Vault	Res-KR-08	2	2045	$ 215,475
	Laurel Creek Booster Station Check Valve	Res-LC-01	3	2026	$ 21,548
	Laurel Creek Booster Station Globe Valve	Res-LC-02	2	2028	$ 21,548
	Laurel Creek Reservoir Main Service Panel	Res-LC-03	3	2027	$ 21,548
	Laurel Creek Reservoir PLC	Res-LC-04	3	2026	$ 287,300
	Laurel Creek Reservoir RTU	Res-LC-05	3	2026	$ 7,183
	Laurel Creek Reservoir Site Security	Res-LC-07	2	2032	$ 86,190
	Laurel Creek Reservoir Vault	Res-LC-08	2	2045	$ 215,475
	Lower Ruby Hills Altitude Valve	Res-LRH-02	3	2026	$ 21,548
	Lower Ruby Hills Control Panel - RTU and Breakers	Res-LRH-03	4	2025	$ 86,190
	Lower Ruby Hills Enclosure for Elec Panel	Res-LRH-04	5	2026	$ 8,873
	Lower Ruby Hills Site Security	Res-LRH-05	2	2032	$ 86,190
	Lower Ruby Hills Sump Pump	Res-LRH-06	5	2024	$ 7,183
	Lower Ruby Hills Tank Check Valve	Res-LRH-07	3	2026	$ 21,548
	Lower Ruby Hills UPS, Tank Level Sensors	Res-LRH-08	5	2025	$ 86,190
	Lower Ruby Hills Vault	Res-LRH-09	2	2045	$ 215,475
	Lund Reservoir Altitude Valve	Res-L-02	3	2026	$ 21,548
	Lund Reservoir Cathodic Protection	Res-L-03	2	2034	$ -
	Lund Reservoir Check Valve	Res-L-04	2	2028	$ 21,548
	Lund Reservoir Irrigation Booster Pump	Res-L-05	5	2026	$ 215,475
	Lund Reservoir Main Service Panel	Res-L-06	2	2030	$ 21,548
	Lund Reservoir RTU	Res-L-07	3	2026	$ 7,183
	Lund Reservoir Site Security	Res-L-08	2	2032	$ 86,190
	Lund Reservoir Valve Vault	Res-L-09	2	2059	$ 215,475
	Lund Reservoir Vault	Res-L-10	2	2045	$ 215,475
	Moller Ranch Reservoir Check Valve	Res-MR-01	3	2026	$ 21,548
	Moller Ranch Reservoir Globe Valve	Res-MR-02	2	2028	$ 21,548
	Moller Ranch Reservoir Main Service Panel	Res-MR-03	4	2025	$ 21,548
	Moller Ranch Reservoir RTU	Res-MR-05	3	2026	$ 7,183
	Moller Ranch Reservoir Site Security	Res-MR-06	2	2032	$ 86,190
	Moller Ranch Reservoir Vault	Res-MR-07	3	2036	$ 215,475
	Sycamore Reservoir Control Panel	Res-S-12	3	2026	$ 86,190
	Sycamore Reservoir Leak Detection Vault	Res-S-03	1	2079	$ 215,475
	Sycamore Reservoir MCC	Res-S-04	4	2025	$ 118,300
	Sycamore Reservoir PAX Mixer	Res-S-01	1	2039	$ 21,548
	Sycamore Reservoir PG&E Transformer	Res-S-05	1	2043	$ 86,190
	Sycamore Reservoir PLC	Res-S-09	1	2033	$ 287,300
	Sycamore Reservoir Power Panel	Res-S-08	5	2024	$ 21,548
	Sycamore Reservoir Pressure Transmitter	Res-S-15	5	2024	$ 7,183
	Sycamore Reservoir RTU	Res-S-13	1	2033	$ 7,183
	Sycamore Reservoir Site Security	Res-S-07	1	2037	$ 86,190
	Sycamore Reservoir Submersible Pump	Res-S-06	1	2044	$ 215,475
	Sycamore Reservoir Valve Vault Fan	Res-S-14	5	2024	$ -
	Sycamore Reservoir Valve Vault Sump Pump 1	Res-S-10	5	2024	$ 7,183
	Sycamore Reservoir Valve Vault Sump Pump 2	Res-S-11	5	2024	$ 7,183
	Tank 1160 RTU Panel	Res-T1160-02	2	2028	$ 7,183
	Tank 1160 Vault	Res-T1160-03	3	2036	$ 215,475
	Tank 1600 RTU	Res-T1600-03	2	2028	$ 7,183
	Tank 900 MCC-9	Res-T900-02	1	2041	$ 287,300
	Tank 900 MSB-9	Res-T900-03	2	2032	$ 718,250
	Tank 900 RTU	Res-T900-04	1	2032	$ 7,183
	Upper Ruby Hill Vault	Res-URH-02	2	2045	$ 215,475
	Upper Ruby Hills Altitude Valve	Res-URH-03	2	2028	$ 21,548
	Upper Ruby Hills Check Valve	Res-URH-04	1	2032	$ 21,548
	Upper Ruby Hills Main Circuit Breaker, UPS	Res-URH-05	5	2025	$ 21,548
	Upper Ruby Hills PLC	Res-URH-06	5	2025	$ 287,300
	Upper Ruby Hills Reservoir Butterfly Valve 1	Res-URH-07	2	2028	$ 21,548
	Upper Ruby Hills Reservoir Butterfly Valve 2	Res-URH-08	2	2028	$ 21,548
	Upper Ruby Hills Site Security	Res-URH-09	1	2046	$ -
	Vineyard Hills Reservoir Altitude Valve	Res-VH-02	2	2028	$ 21,548
	Vineyard Hills Reservoir Check Valve	Res-VH-03	2	2028	$ 21,548
	Vineyard Hills Reservoir Drain Valve	Res-VH-04	1	2032	$ 21,548
	Vineyard Hills Reservoir Drainage	Res-VH-11	2	2032	$ 21,548
	Vineyard Hills Reservoir Inlet Butterfly Valve	Res-VH-05	1	2032	$ 21,548
	Vineyard Hills Reservoir Main Service Panel	Res-VH-06	3	2027	$ 21,548
	Vineyard Hills Reservoir Outlet Butterfly Valve	Res-VH-07	1	2032	$ 21,548

CIP Project	Asset_Name	Asset_ID	POF	Year	Sum of Project Cost
Reservoir O&M	Vineyard Hills Reservoir RTU	Res-VH-08	3	2026	$ 7,183
	Vineyard Hills Reservoir Site Security	Res-VH-09	2	2032	$ 86,190
	Vineyard Hills Reservoir Vault	Res-VH-10	2	2045	$ 215,475
	Tank 1160 Battery	W_Res_T1160-04	5	2024	$ 21,548
	Tank 1600 Battery	W_Res_T1600-04	5	2024	$ 21,548
Turnout O&M	Turnout 2 14" Butterfly Valve	Turnout-T2-03	5	2025	$ 21,548
	Turnout 2 16" Butterfly Valve	Turnout-T2-02	5	2025	$ 21,548
	Turnout 2 16" Plug Valve with Electric Motor Operato	Turnout-T2-04	2	2028	$ 21,548
	Turnout 2 20" Butterfly Valve	Turnout-T2-05	5	2025	$ 21,548
	Turnout 2 Acid Building	Turnout-T2-01	4	2030	$ 718,250
	Turnout 2 Electrical Meter Box	Turnout-T2-06	4	2025	$ 7,183
	Turnout 2 Electrical Panel	Turnout-T2-07	5	2025	$ 21,548
	Turnout 2 Exhaust Fan	Turnout-T2-08	3	2027	$ 7,183
	Turnout 2 Flow Meter	Turnout-T2-09	2	2028	$ 21,548
	Turnout 2 Fluoride Analyzer	Turnout-T2-10	2	2028	$ 21,548
	Turnout 2 Free Chlorine Analyzer	Turnout-T2-11	2	2028	$ 21,548
	Turnout 2 Metering Pump	Turnout-T2-12	2	2027	$ 7,183
	Turnout 2 RTU	Turnout-T2-13	2	2028	$ 7,183
	Turnout 2 Total Chlorine Analyzer	Turnout-T2-14	2	2028	$ 21,548
	Turnout 3 Building	Turnout-T3-03	3	2035	$ 718,250
	Turnout 3 Fluoridation Vault	Turnout-T3-02	3	2035	$ 215,475
	Turnout 3 Fluorosilic Acid Tank	Turnout-T3-06	3	2033	$ 86,190
	Turnout 3 Lighting Panel	Turnout-T3-04	3	2026	$ 21,548
	Turnout 3 Metering Pump	Turnout-T3-01	3	2024	$ 7,183
	Turnout 3 RTU	Turnout-T3-05	2	2027	$ 7,183
	Turnout 5 Field Instrument IO Terminal Box	Turnout-T5-15	2	2030	$ 7,183
	Turnout 5 Flow Meter	Turnout-T5-06	2	2028	$ 21,548
	Turnout 5 Fluoride Analyzer	Turnout-T5-07	3	2028	$ 21,548
	Turnout 5 Fluoride Pump House	Turnout-T5-02	2	2045	$ 718,250
	Turnout 5 Free Chlorine Analyzer	Turnout-T5-08	3	2026	$ 21,548
	Turnout 5 Lighting Panel	Turnout-T5-09	5	2025	$ 21,548
	Turnout 5 Line Valve Vault	Turnout-T5-04	2	2045	$ 215,475
	Turnout 5 Metering Pump	Turnout-T5-10	3	2025	$ 7,183
	Turnout 5 PG&E Transformer	Turnout-T5-03	5	2027	$ 86,190
	Turnout 5 Rate Control Station Vault	Turnout-T5-05	2	2045	$ 215,475
	Turnout 5 RTU	Turnout-T5-11	3	2026	$ 7,183
	Turnout 5 Site Security	Turnout-T5-12	3	2028	$ 86,190
	Turnout 5 Total Chlorine Analyzer	Turnout-T5-13	3	2026	$ 21,548
	Turnout 5 Valve	Turnout-T5-01	2	2028	$ 21,548
	Turnout 5 Valve Actuator	Turnout-T5-16	2	2028	$ 21,548
	Turnout 5 Zone 7 PLC	Turnout-T5-14	2	2028	$ 287,300
	Turnout 6 10" Butterfly Valve	Turnout-T6-02	2	2028	$ 21,548
	Turnout 6 10" Swing Check Valve	Turnout-T6-04	2	2028	$ 21,548
	Turnout 6 Flourosilic Acid Tank	Turnout-T6-12	2	2041	$ 86,190
	Turnout 6 Flow Meter	Turnout-T6-03	3	2026	$ 21,548
	Turnout 6 Fluoride Analyzer	Turnout-T6-06	3	2028	$ 21,548
	Turnout 6 Fluoride Injection Pump Control Panel	Turnout-T6-07	2	2030	$ 86,190
	Turnout 6 Free Chlorine Analyzer	Turnout-T6-09	3	2026	$ 21,548
	Turnout 6 Metering Pump	Turnout-T6-08	3	2025	$ 7,183
	Turnout 6 Sump Pump	Turnout-T6-05	2	2027	$ 7,183
	Turnout 6 Valve	Turnout-T6-01	5	2025	$ 21,548
	Turnout 6 Vault	Turnout-T6-10	2	2045	$ 215,475
	Turnout 6 Zone 7 PLC/RTU	Turnout-T6-11	2	2028	$ 7,183
	Turnout 7 Check Valve	Turnout-T7-02	2	2028	$ 21,548
	Turnout 7 Detector Check Valve	Turnout-T7-03	2	2028	$ 21,548
	Turnout 7 Flow Meter	Turnout-T7-04	1	2032	$ 21,548
	Turnout 7 Fluoride Analyzer	Turnout-T7-05	3	2028	$ 21,548
	Turnout 7 Fluoride Metering Pump	Turnout-T7-06	3	2025	$ 7,183
	Turnout 7 Free Chlorine Analyzer	Turnout-T7-07	3	2026	$ 21,548
	Turnout 7 Plug Valve	Turnout-T7-08	1	2032	$ 21,548
	Turnout 7 Pressure Transmitter	Turnout-T7-09	2	2028	$ 7,183
	Turnout 7 Strainer	Turnout-T7-01	2	2028	$ 21,548
	Turnout 7 Total Chlorine Analyzer	Turnout-T7-10	3	2026	$ 21,548
	Turnout 7 Valve Actuator	Turnout-T7-11	2	2028	$ 21,548
	Turnout 7 Zone 7 PLC	Turnout-T7-13	2	2028	$ 287,300

APPENDIX E O&M EVALUATION MEMO

THE CITY OF PLEASANTON

Water System Management Plan

TECHNICAL MEMORANDUM

Operations, Maintenance and Management of the Water Distribution System

September 2024

This document is released for the purpose of information exchange review and planning only under the authority of Timothy J. Loper, April 19, 2023, State of California, PE 70847.

Contents

Appendices

Abbreviations

AL	action level
AWIA	American Water Infrastructure Ace
AWWA	American Water Works Association
Carollo	Carollo Engineers
CCL	Contaminant Candidate List
CCR	Consumer Confident Reports
CCT	corrosion control treatment
CFU	colony forming units
City	City of Pleasanton
CMMS	Computerized Maintenance Management System
D/DBPR	Disinfectant and Disinfection By-Product Rules
DDW	California State Water Resources Control Board Division of Drinking Water
DVWTP	Del Valley Water Treatment Plant
EPA or USEPA	United States Environmental Protection Agency
GWR	groundwater rule
HA	health advisory
HAA5	haloacetic acids
IESWTR	Interim Enhanced Surface Water Treatment Rule
µg/L	micrograms per liter
µm	micrometer(s)
LCR	Lead and Copper Rule
LCRI	Lean and Copper Rule Improvements
LCRR	Lean and Copper Rule Revisions
LRAA	locational running annual average
LSL	lead service line
LT1	Long Term 1 Enhanced Surface Water Treatment Rule
LT2ESWTR	Long-Term 2 Enhanced Surface Water Treatment Rule
MCLs	maximum contaminant levels
MCLGs	maximum contaminant level goals
M/DBPs	Microbial / Disinfection Byproducts Rules
mL	milliliter(s)
NA	not applicable
NDWAC	National Drinking Water Advisory Council
ng/L	nanogram per liter
NL	notification levels
NPDWR	National Primary Drinking Water Regulations
NSDWR	National Secondary Drinking Water Regulations
NTU	nephelometric turbidity unit

RRA	running annual average
SCADA	Supervisory Control and Data Acquisition
SDWA	Safe Drinking Water Act
SDWIS	Safe Drinking Water Information System
SWTR	Surface Water Treatment Rule
SWRCB	State Water Resources Control Board Division
TCR	Total Coliform Rule
TT	treatment technique
TTHM	total trihalomethane
UCMR	Unregulated Contaminant Monitoring Rule
UV	ultraviolet
WQP	water quality parameter
WSMP	water system management plan
WTP	water treatment plant

SECTION 1 INTRODUCTION

The City of Pleasanton (City) is in the eastern San Francisco Bay Area region, south of Interstate 580, and west of Interstate 680 in Alameda County. The City owns and operates a potable water distribution system that serves approximately 80,000 residential customers as well as commercial and industrial users within its city limits. The City staff recognizes the need for a comprehensive evaluation of the current operations and management of the water system and selected Carollo Engineers (Carollo) to perform an assessment of the water system program. The evaluation not only includes a review of the operations of the water system, but also the City's ability to deliver potable water to customers at an adequate supply and pressure, implement capital improvement programs, communicate with internal and external stakeholder groups, finance existing and future operations and capital improvement projects, and predict and analyze the risks from existing and future regulatory drivers.

This technical memorandum reviews current operations, maintenance and management of the City's water distribution system. The memo reviews current practices using industry standards and includes recommendations to improve water distribution maintenance and water quality.

SECTION 2 DISTRIBUTION SYSTEM CHARACTERISTICS

The City of Pleasanton receives treated water from Zone 7 and treats its own groundwater wells operated by City staff. The sources of supply are included in **Error! Reference source not found.**. A map of the City's distribution system is shown in Figure 1. The figure shows the location of the City's turnouts where Zone 7 water is delivered, the City owned wells, the storage tanks, and key distribution sample locations.

The City of Pleasanton has 22, 369 water connections and ____ miles of pipeline ranging in size from 6 inch to ____ inch water mains.

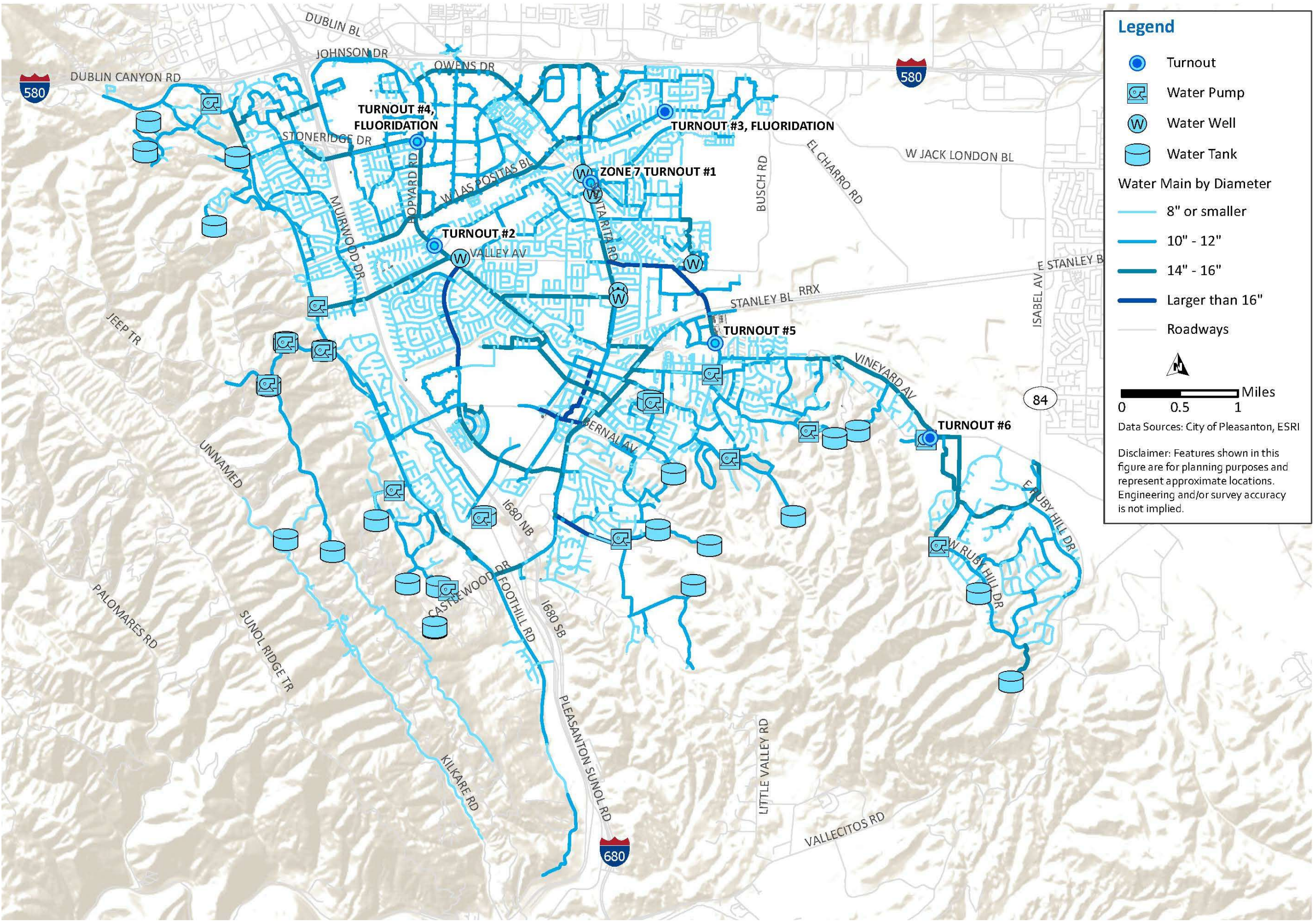


Figure 1 City of Pleasanton Distribution System

SECTION 3 DISTRIBUTION SYSTEM MAINTENANCE

This section focuses on a non-regulatory potable drinking water system using best practices and current levels of maintenance. A note of some of these maintenance activities are reported in the City's annual report to the State Water Resources Control Board Department of Health Services.

3.1 Valve Exercising, Main Flushing and Hydrant Maintenance

Per the City's revised water supply permit approved by the Department of Health services dated October 1997, "The City of Pleasanton shall conduct a program of regular valve exercise and maintenance to ensure the reliability of the distribution system. The City of Pleasanton shall conduct a program of regular distribution system flushing to maintain the quality of water delivered to the distribution system."

An annual unidirectional distribution system flushing is performed to maintain water quality by scouring pipes surfaces to remove loose sediment, biofilm and scale. Unidirectional flushing is a planned, organized, sequential technique that begins from a clean starting point moving which minimizes the spread of sediment and higher velocity flow. Flushing will lower disinfectant demand, heterotrophic bacterial counts and concentrations of disinfection byproducts.

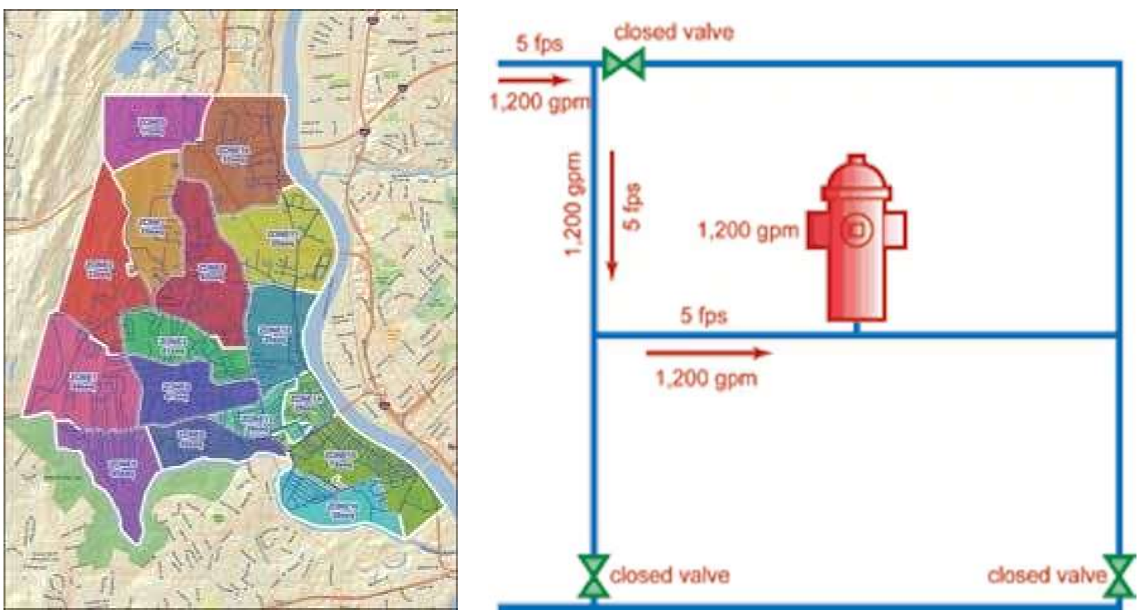


Figure 2. Examples of Unidirectional Flushing Program Zones

To minimize water quality complaints and optimize staffing, water distribution valve exercising, unidirectional flushing and hydrant maintenance activities are often completed simultaneously. Public notices are provided prior to flushing as sediment and color complaints are common. On-site dechlorination is required and storm drain maintenance crews should be notified prior to starting. GIS based hydraulic mapping software programs are available to develop scheduled distribution system maintenance and provide detailed mapping for field use.

Water main flushing programs consist of closing system valves and directing flows to obtain minimum of 2.5 ft/sec velocities, or greater and minimum flows per Figure 2. Hydrants can be inspected for flow and mechanical issues at time of flushing. Distribution system flushing is accomplished during low water demand months due to the amount of water required.

Table 64575-A. Minimum Flushing Flows for Different Size Water Mains.

Nominal Main Size *Diameter (inches)*	*Minimum Flushing Flow* *(gallons per minute)*
2	25
3	50
4	100
6	225
8	400
10	600
12	900
14	1200
16	1600

Figure 3 Minimum Flushing Velocities for Water Mains

The City GIS contains valve, water main and hydrant locations. The GIS system is a key for developing a unidirectional flushing plan and should be updated annually. The City is currently flushing dead ends on a needed basis to prohibit nitrification. The key to a valve exercising, hydrant maintenance, and flushing plan is a goal. The goal must be manageable given staffing levels and the size of distribution system. The program sets a goal for the number of transmission valves/hydrants to be exercised based on the percentage of total valves/hydrants in the system. The entire system flushing plan could take years to complete due to seasonal capacity restraints. The capital improvement plan (CIP) includes annual valve repair and replacement funding for valves/hydrants identified during the flushing program.

3.2 Potable Water Storage Tank Inspections

American Water Works Association (AWWA) recommends dewatering, diving or Remote Operated Vehicle (ROV) tank inspections every five (5) years. Tanks should be cleaned a minimum of every 5 years or as inspection dictates. Steel tank coating inspection results are evaluated against the current coating system design parameters per AWWA D102-21 to determine the lifespan of the coating. Annual tank inspections include a full external visual inspection seasonally to assess and repair external damage and verify integrity of vents, screens and security. Impressed current cathodic protection systems in storage tanks are recorded monthly and inspected annually. Failure to monitor current levels can cause premature coating and steel failures.

Figure 4 Foothill Water Storage Tank

The City routinely inspects potable water storage facilities according to AWWA standards through diving and visual inspections. Once the inspection video and report are final, the City currently has no mechanism to convert these findings to a capital improvement plan. Failure to recoat water tanks as needed leads to costly structural rehabilitation or replacement and degrades water quality. Integrating an operations and maintenance plan for a cathodic protection system for both potable and recycled systems should be addressed.

3.3 Preventative Maintenance Program (CMSS)

Every well managed utility includes a preventative maintenance program, often in a software format such as a CMSS system. These programs require input from the manufacturer's O&Ms, historical system knowledge and industry standards. The program disseminates work orders for reoccurring maintenance and can log emergency responses to water leaks, pump station failures, etc. The number of water main leaks and repairs are calculated annually and reported to the SWRCB as part of the annual water system report. The CMSS assists in workload management and staffing deficiencies.

Pump station maintenance, hydrants, tanks, wells and water main replacement schedules are included in the CMSS. Each utility should include system maintenance in the annual operating budget allowing funding for routine and emergency repairs.

3.4 Residential and Commercial Meter Calibration Program

The City currently has over 23,000 residential water meters and commercial meters. The backbone of the water enterprise fund depends on accurate billing and collection. The meter calibration program ensures residential and commercial billing is accurate and defensible. Large meters should be calibrated biannually, and residential meters should be calibrated according to the manufacturer's recommendations.

Utility testing equipment is often capable of testing higher flow rates, such as commercial meters. A third-party contractor is the most cost-effective method to calibrate lower flow residential meters. All fire-service meters should be tested by a third-party contractor due to fire insurance requirements.

Record keeping is the critical component of a meter calibration and replacement system. Technicians, working with billing staff to identify abnormal monthly meter readings, is the number one reason for meter replacements. The water maintenance budget should include annual funding for maintenance and replacement of a percentage of residential and commercial water meters. Recording monthly meter readings will reduce water loss for rate payers and utility by identifying system leaks and large water users.

3.5 Energy Management Program

The City should have a robust energy management program to review and optimize energy usage at the pump stations and wells. The following are elements of a robust energy management plan.

- Identification of energy use trends and cost tracking versus time.
- Consideration of energy efficiency and costs in the evaluation of new distribution system facilities.
- Changes to the existing system to enhance effective utilization of energy.
- Record keeping for future federal and state energy grants.
  The energy management system can be a simple recorded history of usage, trends and optimization plans. Other methods include a SCADA based energy management system that tracks energy usage in real time. This system will allow for the largest payback with the ability to optimize based on the electrical utility rate schedule.

3.6 Pipeline Rehabilitation and Replacement Program

Per AWWA and RWQCB operation and management standards, each utility shall have a program for evaluating and upgrading water distribution pipelines. Historically, pipelines have long life spans but are expensive to replace and are critical to maintaining water quality and fire flow standards. Below are the keys to a rehabilitation and replacement program for pipelines.

1. Base prioritization of transmission and distribution mains on critical infrastructure matrix. Which pipelines affects the most residents, firefighting capabilities and water quality.

2. Track water main breaks by area, size, pressure zone and soil type. Establish an annual tracking of benchmarks based on breaks/100 miles/year of distribution pipe.

3. Keep accurate electronic as-builts. Electronic as-builts can be utilized by multiple field crews during emergency or routine operations. Annually updating water modeling software and GIS systems are critical to maintaining distribution infrastructure.

4. Record flow and pressure readings during unidirectional flushing periods. Historical records can determine problem areas before a catastrophic water main break.

SECTION 4 CONCLUSIONS AND RECOMMENDATIONS

The City desires to develop a distribution maintenance program that meets industry standards. One of the critical components to a successful maintenance program is the staff's ability and desire to implement change. The recommendations are based on short- and long-term goals with an idea to build program momentum as additional funding and staffing are available.

Short Term Recommendations

1. Develop a single unidirectional flushing program section map with clean water source identified. Start in the first area closest to a clean water source. Using the new water model, identify valves to close to achieve 2.5 ft/sec and desired flow rates. Perform the flushing, valve exercising and hydrant inspections in this area. Record findings and notes for developing full unidirectional flushing program software. Identify staffing levels required, traffic control, public notification, and tools and equipment required.
2. Implement a commercial water meter testing section with equipment and record keeping capabilities. This team should work closely with water billing to determine inconsistent metering locations and focus initial testing.
3. Select a well and potable water pumping station to implement a monthly, quarterly, semi annual and annual maintenance program. Record all maintenance activities to include tasks required, number of staff to complete each task, number of hours to complete each task and record keeping. This can be used as a "template" to design a full CMMS maintenance program for all facilities and aid in utilities staffing plan.
4. Develop a standard management matrix for identifying planned and emergency projects, mechanism for budget inclusion, and responsibility for project completion.

Long Term Recommendations

1. Develop a multi-year capital improvement program for unidirectional flushing software, tools, equipment and staffing to implement. Design and procure unidirectional flushing software program and continue water distribution GIS data entry.
2. Develop a capital improvement program to staff and equip a water meter section to test all commercial meters annually. Solicit bids for third party residential water meter testing over multiple years as funding allows based on industry standards.
3. Procure a CMMS maintenance program for all water distribution mechanical locations. Recommended staffing include a dedicated administrative position for record keeping and data input.
4. Implement an energy consumption record for each large electrical demand location in the distribution system. Work with local electrical utility on large user energy management plans which target peak cost reductions.
5. Develop a long-term staffing plan incorporating new maintenance programs, software and financing.
6. Develop a pipeline rehabilitation and replacement program utilizing water modeling software and GIS to identify capital improvement projects.

SECTION 5 REFERENCES

1. AWWA Standard M6 Meters – Selection, Installation, Testing and Maintenance (2021)
2. AWWA Standard D102-21 – Coating Steel Water Storage Tanks (2021)
3. City of Pleasanton. (2021). *2021 Annual Water Quality Report*.
4. City of Pleasanton Draft 2020 Urban Water Management Plan (2020)
5. City of Pleasanton Water Supply Permit
6. Carollo Engineers, Inc. – TM City of Pleasanton Regulatory Review (2022)
7. AWWA Management Standard G200-21 – Distribution Systems Operation and Management (2021)

APPENDIX F SCADA MASTER PLAN

FINAL REPORT | OCTOBER 2023

SCADA Management Plan

PREPARED FOR

City of Pleasanton

PREPARED BY

WEST YOST
Water. Engineered.

SCADA Management Plan

Prepared for

City of Pleasanton

Project No. 125-70-23-21

REGISTERED PROFESSIONAL ENGINEER
DANIEL A. GROVES
No. 7454
Exp. 3-31-25
CONTROL SYSTEM ENGINEER
STATE OF CALIFORNIA

Project Manager: Michael Gruenbaum	October 12, 2023 Date
QA/QC Review: Daniel Groves, PE	October 12, 2023 Date

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WEST YOST
Water. Engineered.

FINAL REPORT | OCTOBER 2023

HANDLING INSTRUCTIONS

The information, records, meetings, analysis, and reporting information described in this master plan are considered confidential and exempt from applicable laws and rules requiring public access and disclosure. The following warning applies to this document:

WARNING: For Official Use Only Information contained in this document is exempt from the Freedom of Information Act requests under: FEDERAL: America's Water Infrastructure Act of 2018 Section 2013(b) Amendment to Safe Drinking Water Act Section 1433 STATE: California Government Code §6254(aa)-(ab)

This master plan contains highly sensitive information on the utility, its assets, and its operations. All of the information in this document and its attachments should be stored and transmitted in a manner consistent with the most confidential information currently managed by the utility. Examples include such information as personnel records and detailed supervisory control and data acquisition(SCADA) network drawings. If the organization has a formal organization wide information security policy, it is recommended that this document receive the highest categorization of confidentiality available. In the absence of a formal organization wide information security policy, recommended handling instructions are included below.

Under no circumstances is this document to be released in response to a public records request.

General Master Plan Handling Instructions:

1. Limit the number of staff who have access to the master plan document.
2. Do not share this document with any regulatory agency.
3. Notify any sharing instructions/policies with business partners (i.e. future consultants).
   a. Non-Disclosure and Confidentiality agreements should be signed with 3rd party business partners.
   b. Master plans should only be shared with 3rd parties for the purposes of 5-year master plan updates and subsequent planning.

Physical Master Plan Copy Handling Instructions:

1. Print the absolute minimum number of copies required. Ideally, this would be a single copy.
2. Store any copies in a locked cabinet within a locked office/room.
3. Check out/Check in Procedures should be strictly documented and enforced (Information Security Policy developed).
4. At no times should a master plan be left in an unsecured location.
5. If disposal of a printed copy is required, shred and/or incinerate the entire master plan document.

Electronic Master Plan Copy Handling Instructions:

1. Password protect the directory/file. Use current password best practices.
2. Store in a directory with limited staff access.
3. If sharing is required, a secure file sharing application (e.g., SharePoint) should be used to provide temporary access. As soon as the need for sharing is complete, the file should be removed from the file sharing application.
4. The file shall not be copied.

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LIST OF ACRONYMS AND ABBREVIATIONS

AACE	Association for the Advancement of Cost Engineering
AD	Active Directory
Assessment	SCADA System Baseline Assessment
AWIA	America's Water Infrastructure Act of 2018
AWWA	American Water Works Association

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AWWA Tool	AWWA Cybersecurity Tool and Guidance
BOM	Bill of Materials
Carollo	Carollo Engineers
CCE	Consequence-driven, Cyber-informed Engineering
CIP	Capital Improvement Program
CISA	Cybersecurity and Infrastructure Security Agency
Cyber-RRA	Cyber Risk and Resilience Assessment
DER	Distributed Energy Resources
DERWA	Dublin San Ramon Services District and East Bay Municipal Utility District Regional Water Authority
DHS	Department of Homeland Security
DSRSD	Dublin San Ramon Service District
EBMUD	East Bay Municipal Utility District
EEW	Earthquake Early Warning
EPA	Environmental Protection Agency
FirstNet	First Responder Network
HMI	Human Machine Interface
I&C	Instrumentation & Controls
I/O	Input/Output
ICS-CERT	Industrial Control Systems - Cyber Emergency Response Team
IDMZ	Industrial Demilitarized Zone
INL	Idaho National Laboratory
IT	Information Technology
MCC	Motor Control Centers
MDM	Mobile Device Management
MFA	Multi-factor Authentication
NTP	Network Time Protocol
O&M	Operations & Maintenance
OIT	Operator Interface Terminal
OSC	Operation Service Center
OT	Operations Technology
PCS	Process Control System
PFAS	Per- and Polyfluoroalkyl Substances
PG&E	Pacific Gas and Electric
PgM	Program Manager
PLC	Programmable Logic Controllers
PQM	Power Quality Monitor
Program	SCADA Improvements Program
PRV	Pressure Reducing Valves
RDP	Remote Desktop Protocol
RFI	Request for Information
RTU	Remote Terminal Unit
SCADA	Supervisory Control and Data Acquisition

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SI	Systems Integrator
SIEM	Security Information and Event Management
SLA	Service Level Agreements
ST	Structured Text
Tesco	Tesco Controls
TM	Technical Memorandum
UPS	Uninterruptable Power Supply
USGS	United States Geological Survey
VFD	Variable Frequency Drives
VLAN	Virtual Local Area Networks
VM	
VPN	Virtual Private Network
WaterISAC	Water Information Sharing and Analysis Center
WSMP	Water Systems Management Plan
Zone 7	Zone 7 Water Agency

1.0 EXECUTIVE SUMMARY

The City of Pleasanton (City) selected West Yost to develop a Supervisory Control and Data Acquisition (SCADA) Management Plan for the upgrade of the City's existing SCADA system. Key drivers for this project include coordination with other simultaneous planning activities, replacement of obsolete hardware and equipment, improving documentation of existing systems (ie. Record drawings, control strategies, as-builts, etc.), an improved approach to preventative maintenance, and improving the City's cybersecurity posture. The goals of this SCADA Management Plan include a baseline assessment of the existing SCADA system, development of detailed recommendations for system improvements, and development of an implementation plan.

The City contracted with Carollo Engineers (Carollo) for development of a Water System Management Plan (WSMP). The City simultaneously engaged West Yost for development of this SCADA Management Plan and the Energy Management Plan. The goal of this project is to provide the City with an in-depth analysis of the City's needs related to the SCADA system. The projects identified in this implementation plan will be integrated into the Capital Improvements Program (CIP) developed through the WSMP. The outcomes from this SCADA Management Plan are also closely coordinated with the outcomes identified in the Energy Management Plan developed by West Yost.

This report identified the following key outcomes associated with the City's SCADA system:

1. The existing SCADA system is obsolete with key cybersecurity vulnerabilities identified.
2. The City should migrate from proprietary process control components.
3. Improve documentation of existing systems.
4. Improve the approach to preventative maintenance.

Implementation Schedule and Costs. The Implementation Plan provides recommendations for 42 near-term projects to be implemented over a 5-year period with an overall estimated budget of $27.6M. In addition, there are 40 long-term projects to be implemented beyond the initial 5-year period. These projects were listed in the implementation plan, but without project costs. Additional information related to implementation can be found in Section 5.0.

This TM recommends providing the management, coordination and delivery of projects through a Program Manager (PgM) who will use traditional Design-Bid-Build (DBB) methods for construction.

2.0 BACKGROUND

The following sections provide an overview of the City's Water Distribution System, Sewer Collection System, Storm Drainage System, and Recycled Water System. In addition, this section defines commonly used SCADA-related terminology in this report.

2.1 Service Areas and Facilities

The City's Water Distribution System, Sewer Collection System, Storm Drainage System, and Recycled Water System are all managed and operated within the City's Operations Services Department by the Utilities Division. West Yost was contracted to provide an assessment of the SCADA systems as it pertains to each system. Each system is explained in greater detail in the following sections.

2.1.1 Water Distribution System Overview

The City's Water Distribution System is divided into sixteen pressure zones. The pressure zones are supplied by twenty-one reservoirs (1 inactive, 20 active), fourteen booster pump stations (1 inactive, 13 active), four production wells (1 inactive, 3 active), and seven turnouts.

The three active production wells are operationally impacted due to Per- and Polyfluoroalkyl Substances (PFAS), requiring the City's distribution system to be more heavily reliant on imported water through Zone 7 Water Agency (Zone 7). This is accomplished through the turnouts.

For more information, see **Appendix A – Existing Hydraulic Profile**.

2.1.2 Sewer Collection System Overview

The City's Sewer Collection System consists of fifteen (4 inactive, 11 active) sewer lift stations that pump sewage to wastewater treatment plants. The majority of the sewage is pumped to Dublin San Ramon Service District (DSRSD) whereas a small portion from the Ruby Hill area is pumped to the City of Livermore for wastewater treatment.

For more information, see **Appendix B – Sewer Collection System Overview**.

2.1.3 Storm Drain System Overview

The City's Storm Drain System consists of 4 storm drains that capture water runoff collected in the storm drains.

2.1.4 Recycled Water System Overview

The City's Recycled Water System consists of three turnouts, one pump station and one reservoir. Two of the turnouts are from the Dublin San Ramon Services District and East Bay Municipal Utility District (DSRSD-EBMUD) Regional Water Authority (DERWA), and one is from the City of Livermore. The singular pump station is primarily for Ken Mercer Sports Park.

2.2 Terminology

SCADA consists of any devices used to control or monitor physical treatment or distribution processes, such as Programmable Logic Controllers (PLCs), Human Machine Interface (HMI), SCADA workstations, Operator Interface Terminals (OITs), and network and communication devices. These acronyms are defined below.

PLCs are industrial controllers connected to field input devices (e.g. switches and transmitters) and output devices (e.g. motors and valves). PLCs are usually located in the field near the process equipment being monitored and controlled. These controllers house the “logic” that controls the field equipment based on control strategies defined by an engineer during design of the facility or by the equipment manufacturer. PLC logic is programmed using PLC software provided by the PLC hardware vendor. The PLC program will automatically read inputs, process programmed logic and update outputs based on the decisions made by the logic. There are several different protocols for connecting PLCs to the SCADA network, with Ethernet being the most common connection option.

HMI software functions as the end user or operator visual interface with the control system and related processes/systems on the SCADA network, including viewing equipment status, alarms, and historical data, starting and stopping equipment, and entering setpoints. The software allows operators to monitor and control multiple systems across a large geographic footprint in one location.

A SCADA workstation is usually a fixed computer workstation equipped with an operating system and the HMI software. SCADA workstations are usually connected to the process control network through Ethernet. Typically, a SCADA workstation provides access to SCADA data for Utilities staff while the primary functionality is provided by SCADA servers that perform the actual data collection directly with SCADA field or plant controllers. SCADA servers are typically hosted on more robust server-grade Information Technology (IT) hardware and are in a separate, secure room to prevent damage or tampering.

OIT refers to industrial-grade hardware that provides the HMI software functions described above except that it is a panel-mounted touchscreen display located in the field, near the process equipment.

Network gear and communication devices consist of all Layer 2 and 3 network switches, firewalls, routers or other devices managing or monitoring the flow of traffic on the process control network. It also includes any devices connected to the network switches. Examples of devices connected to SCADA network switches include Variable Frequency Drives (VFD), Smart Motor Control Centers (MCC), valve actuators, media converters, protocol converters, and field instrumentation (flowmeters, gas detectors, pressure transmitters, level transmitters, etc.).

3.0 SCADA SYSTEM BASELINE ASSESSMENT

The SCADA System Baseline Assessment (Assessment) describes the current state of the City's SCADA system and identifies gaps that should be addressed to improve the resiliency and support of the SCADA system. The assessment provides a basis for developing system and support recommendations including staffing, technology improvements, network architecture improvements, cybersecurity and resilience improvements, and implementation planning.

3.1 Approach

West Yost staff conducted site visits on February 22nd (Day 1) and 23rd (Day 2), 2023 and were accompanied by City Utilities Staff who were available to answer operational questions and discuss potential areas of improvement.

Prior to the arrival of West Yost staff, City staff developed a list of representative sites intended to give West Yost a comprehensive, overall understanding of the City's water distribution, sewer collection, storm drain, and recycled water systems. Both days began with an initial meeting between West Yost and City Utilities Staff at the Operation Service Center (OSC). The content of the list of sites was not changed during the site visit process, but the order was altered slightly to visit the sites more efficiently.

Following the initial meeting at the OSC on Day 1, West Yost staff commenced the visits by traveling to Turnout 3. Turnout 3 was followed by visits to Tassajara Recycled Water Station, Laurel Creek Pump Station and Foothill Tank, Sewer Lift Station 6 (S6), Sewer Lift Station 4 (S4), and Vineyard Booster Pump Station. After the site visits, West Yost staff visited the SCADA Room as well as the maintenance shop to obtain an understanding of the core SCADA system as well as the City's repository of record drawings and Operations & Maintenance (O&M) manuals.

Following the initial meeting at the OSC on Day 2, West Yost and City Utilities Staff continued through the site visit list. The site visits began at Tank 1600, in which only a portion of the West Yost staff were able to visit due to road conditions and vehicle capacities. Following Tank 1600, West Yost and City Utilities Staff visited Storm Drain 1 (SD1), Bonde-1 Reservoir and finally Grey Eagle Pump Station.

3.2 Baseline Assessment & Gap Analysis

3.2.1 Instrumentation Standards

The City's instrumentation standards were evaluated by means of physical inspections and informal staff interviews during the site visits. Instrumentation standards are important to supporting maintenance activities, including troubleshooting, and keeping shelf spare parts for replacement of faulty field instrumentation in a timely manner. Instrumentation standards are most often relevant when procuring replacement devices and in stocking a supply of standby devices for backup.

During site visits, it was observed that the City does not have any established instrumentation standards covering the procurement and installation of field instrumentation across their system. For O&M changes, instrumentation components are procured based on Utilities staff's preferences, product availability, and unique requirements for each specific application. For capital projects, field instrumentation is procured through a low-bid process whereby the most competitively priced instrumentation equipment that meets minimum specifications and availability requirements is chosen.

The list of instrumentation components and associated vendors below represent what was observed during the remote site visits:

- **Analyzers**
  - **Chlorine:** Hach
  - **Flouride:** Hach
  - **Miscellaneous other analyzers:** Primarily Hach
- **Flowmeters:** Rockwell Act-Pak, RoseMount
- **Fuel Meter:** Warrick Controls
- **Level Transmitters:** Pulsar
- **VFDs:** FlyGT
- **Power Quality Monitors:** Eaton
- **Pressure Transmitters:** Duratran
- **Pressure Switches:** Dwyer Instruments
- **Runtime Trackers:** Engler

Power Quality Monitors (PQM) were not installed at most sites. At Sewer Lift Station S-6, a newer site), the City had a PQM installed as part of the installation project. Integration of PQMs at all sites will give Utilities staff real-time data on the quality and reliability of the power received from Pacific Gas & Electric (PG&E). This, in turn, will improve the City's energy resilience by enabling them to implement Distributed Energy Resources (DERs) at sites with power quality or reliability issues. See West Yost's Energy Management Plan for additional information on DERs.

3.2.2 SCADA Hardware Evaluation

West Yost evaluated the City's PLC controller hardware to determine the age and support status. PLCs and other hardware that are no longer supported or that use outdated communications media could create difficulties in maintenance situations without extensive planning or stocking replacement hardware.

The following sections address the support status of the existing PLC hardware, OITs and the current state of the control cabinet layouts.

3.2.2.1 PLC Controller Hardware

During the site visits, West Yost observed that each remote site is equipped with a Tesco PLCs. Many of the sites have PLCs that are in excess of 20 years old and some sites have PLCS that are closer to 30 years old. Most of the installed PLCs are end-of-life and can only be maintained by Tesco Controls (Tesco). Table 1 below displays what PLC hardware was observed at each remote site. City staff indicated that they have experienced challenges with Tesco being the only integrator that can support and maintain these PLCs.

The City's use of Tesco PLCs presents maintenance and supply chain challenges to the City. Tesco Controls has committed to continuing to provide support for the existing L-1000, L-2000 and L-3000 PLCs. However, the City has expressed a desire to migrate away from Tesco's PLCs towards a PLC that is supported by a wider breadth of systems integrators. This is due, in part, to the fact that Tesco's programming software is not available on the open market. Furthermore, only Tesco can perform any programming changes to their PLCs and all spare and maintenance parts must come through Tesco. If the City is not able to obtain replacement or spare parts through Tesco, the City could face significant challenges with keeping their PLCs operational.

Tesco's role in maintaining hardware and software is further discussed in *3.2.5.3 — Roles and Responsibilities*.

Table 1 Representative Remote Sites PLC Inventory documents the PLC hardware currently in use at each facility visited by West Yost. It should be noted that this table is not all-inclusive but lists only the representative sites visited during the site visit process.

Table 1. Representative Remote Sites PLC Inventory

Location	PLC Model	PLC Support Status	OIT Model
Turnout 3	Tesco L-2000	End of Life	Tesco L-2000
Tassajara Recycled Water Station	Tesco L-3000	Mature	Tesco L-3000
Laurel Creek Pump Station	Tesco L-3000	Mature	Automation Direct Touch Panel Tesco L-3000 *(inside cabinet)*
Sewer Lift Station 6 (S6)	Tesco L-2000	End of Life	Tesco L-2000
Sewer Lift Station 4 (S4)	Tesco Liquitronic 5	End of Life	Tesco Liquitronic 5
Vineyard Booster Pump Station	Tesco Liquitronic 4	End of Life	Tesco Liquitronic 4
Tank 1600	Tesco L3000	Mature	Tesco L3000
Storm Drain 1	Tesco Liquitronic 3	End of Life	Tesco Liquitronic 3
Bonde 1	Tesco L3000	Mature	Tesco L3000
Grey Eagle	Tesco Liquitronic 4	End of Life	Tesco Liquitronic 4

3.2.2.2 Operator Interface Terminals

West Yost staff observed primarily Tesco LIQ operator interface terminals or all-in-one L-2000 or L-3000 panels in use during the site visits. A more detailed breakdown of what hardware was observed at each remote site is available above in Table 1. Similar to the Tesco PLCs, the Tesco LIQs can only be supported and maintained by Tesco. Only one site that was visited, Laurel Creek Pump Station, made use of an Automation Direct OIT.

3.2.2.3 Control Cabinets Layout and Sizing

In general, control panels lacked consistent layout and organization. Panel sizes, layouts, and orientation of standard components vary significantly based on application. Good internal wire management and panel housekeeping was also missing. Many wireways didn't have covers, weren't being properly utilized, and wiring was being routed outside of wireways. The general size of the control panels varies by site but is relatively consistent. Radios and some network equipment had dedicated enclosures at some sites.

3.2.3 SCADA Software and Documentation

West Yost evaluated the City's SCADA software system and associated standards during the site visits. The following sections address the City's implemented SCADA software, the status of SCADA Standards within the City and the status of their equipment Control Strategies.

3.2.3.1 SCADA Software

The City utilizes AVEVA's InTouch 1.3.3 HMI software to visualize the process equipment of their system. Out of all remote sites visited, Laurel Creek Pump Station was the only site equipped with an OIT connected to the SCADA HMI.

3.2.3.2 SCADA Standards

Development of SCADA standards is a vital component for any SCADA system. The SCADA standards establish formalized standards that can be provided to all resources, internal or external, providing support to the SCADA environment. SCADA standards encompass items such as instrumentation standards, controller programming standards, tagging standards, graphical standards, networking standards, alarming standards, and reporting standards.

The City currently does not have an official set of comprehensive SCADA standards or a repository for storing the SCADA standards.

Upgrades to SCADA components such as PLCs and OITs are typically done as part of capital improvement projects at remote sites. These projects have resulted in poorly documented standards and procedures. As a result, City staff often have to rely on the institutional knowledge of key City staff. In the absence of these staff, key operational information is not readily available due to a lack of documentation and a wider dispersal of system knowledge.

3.2.3.3 Control Strategies

With Tesco being the de facto Systems Integrator (SI) on all capital improvement projects, all project documentation related to process control integration is contained within Tesco binders in hard-copy paper format that are turned over to the City as part of project closeout. These binders contain control panel drawings and Bill of Materials (BOM), control strategies, textual description of PLC programs (similar to Structured Text (ST) format), and O&M manuals. These binders are stored in the Maintenance Warehouse at the OSC.

While this approach has some benefits, there are some key issues as well:

1. *Tesco binders are out-of-date.* Subsequent O&M changes and additions do not result in site documentation being updated. As a result, this documentation becomes outdated relatively quickly. This makes troubleshooting and knowledge transfer challenging.
2. *PLC programming documentation format.* The ST programming printout format is hard to read and challenging to troubleshoot or reverse-engineer, especially when in printed format. The City reportedly may have copies of some of the PLC programs on their servers. However, these programs are out-of-date. The City additionally doesn't have access to the programming software needed to make modifications to the existing Tesco PLC programs.

The result of these issues is that the Maintenance Warehouse at OSC contains in excess of 25 years' worth of control strategies, panel drawings and IO lists with no indication of what information is outdated and no longer useful. City staff expressed a strong desire for updated, coherent documentation that reflect current, as-built conditions multiple times during the site visit process.

City staff expressed challenges associated with how sites are currently documented. Since record drawings, control strategies, and PLC program records are not kept up to date, most system operational knowledge is passed down from one operator to another informally by word-of-mouth. Some communications failover capabilities between sites are unknown because they aren't thoroughly documented and haven't been tested.

3.2.4 Network Architecture and Standards

An evaluation of the City's network architecture was conducted to understand the condition of the existing network architecture and any enhancements that have been made since the previous design was implemented, including communications media, protocols, and network communications standards. This evaluation is critical to the identification and potential recommendation of alternative network architectures.

The following sections outline the City's existing network architecture, control network standards, and remote access protocols being used by the City.

3.2.4.1 Network Architecture

The core network is comprised of Layer3 Ruckus switches for routing and switching and Palo Alto firewalls configured in a high-availability pair for boundary protection. Virtual Local Area Networks (VLAN) are implemented to segment traffic and the subnet gateways exist on the Palo Alto firewalls. Traffic control and monitoring is managed on the Palo Alto firewalls. An Industrial Demilitarized Zone (IDMZ) exists to provide outside services and proxy traffic to the business network and/or Internet resources.

The primary 5.8Ghz radio link to Bonde-1 is connected to the Rukus switch stack and is segmented using a firewall zone. All traffic from this radio to remote sites flows through the firewalls. There are two single points of failure in the communications network that would negatively impact all operations – the Bonde-1 and Tassajara reservoirs. The remote site communications are based on a mix of Ethernet and Serial radios using multiple frequencies (150MHz, 450MHZ, 900MHz, 5.8GHz). Most of the remote sites are connected to repeater sites. If the radios at the Ops Service Center or Bonde-1 failed, all remote site communications would be impacted, and if Tassajara Tank radios failed twelve (12) sites would be impacted. This is further impacted by power redundancy limitations at these sites (see Sections *3.2.5.2 Disaster Recovery* and *4.5.2 Disaster Recovery*). Therefore, either a failure of the network equipment or backup power being unavailable could result in a system-wide SCADA outage. See **Appendix C – As-Is Communications Diagram.**

The Network Time Protocol (NTP) source for SCADA devices in the control room is a GPS based device in the IDMZ. The SMS and voice gateways used for alarming also reside in the IDMZ.

Virtualization is deployed on VMWare ESXi hypervisor and uses the VMWare vSAN feature to share disk storage across the nodes in the cluster. The SCADA zone and IDMZ zone virtual servers (VM) are hosted on a shared cluster, but the network connectivity is physically separated. A Cohesity appliance is implemented to provide SMB file share services and backup services for the VMs. The backup data is replicated to a Cohesity device in the IDMZ and then replicated to storage in the City business network.

Microsoft Active Directory (AD) has been implemented for authentication, authorization and auditing of users and devices. AD has not been integrated with Wonderware InTouch so authentication to the HMI screens is based on InTouch application authentication.

A Jumpbox exists in the IDMZ specifically for IT staff to perform routine management and maintenance of devices in the SCADA network.

3.2.4.2 Control Network Standards

West Yost staff observed several brands and models of unmanaged network switches at field sites. These unmanaged network switches do not provide any visibility or control of network traffic routing.

For the core SCADA network, there is standardization of network and server components.

3.2.4.3 Remote Access

Mobile access using tablets requires a virtual private network (VPN) connection via the City firewall which is then routed to an InTouch Access Gateway in the SCADA IDMZ. The InTouch Access Gateway provides access to HMI using Remote Desktop Protocol (RDP) connection. The credentials used for VPN are different than the ones used to access the SCADA HMI software and the tablets are under Meraki Mobile Device Management (MDM) control.

3.2.5 System Maintenance and Support

An evaluation of the City's maintenance and support structure was evaluated to determine which, if any, system monitoring tools are in place, how disasters are recovered from, how roles and responsibilities are assigned to Utilities staff, what training is available to Utilities staff, and how maintenance activities are carried out. This evaluation is important because all SCADA systems require continued, ongoing support and maintenance activities. Staff need the proper training and access so that they can maintain the SCADA system appropriately.

The following sections outline the City's existing system monitoring requirements, disaster recovery protocols and procedures, as-is roles and responsibilities, training programs and preventative maintenance.

3.2.5.1 System Monitoring Requirements

In general, the concept of system monitoring can be broken down into two related disciplines: the monitoring of field process control equipment and the monitoring of the core SCADA network. The City monitors system processes and related equipment by means of the PLCs and OITs in the field which display information locally and also relay information to central SCADA. Of the ten representative remote sites visited, all but one site (SD1) had a Tesco PLC that was connected back to central SCADA.

The City uses *Whatsup Gold* to monitor network and device health. This monitoring solution has also been deployed in the SCADA environment. The agents in the SCADA environment forward the information to a proxy server in the IDMZ and IT monitors the environment. *Crowdstrike Falcon* monitors cybersecurity related traffic and it is also deployed in the SCADA environment reporting out to a central portal for IT to monitor.

3.2.5.2 Disaster Recovery

The representative remote sites that West Yost visited showed some limited amount of installed redundancy features. Some critical sites (ie. Bonde-1 or Laurel Creek Pump Station) had permanent generators installed on the premises that were able to provide power to the site in the case that external power was lost. Some sites, like Grey Eagle, had generators that were undersized for the site and would not be able to provide the needed power. Other critical sites, such as Tassajara Recycled Water Station, didn't have any generators but did have a quick connect fitting where a portable generator could be connected to power critical equipment. Most sites relied on City Utilities Staff driving out with portable generators to provide power in the case of power failure or emergency.

While Tassajara Recycled Water Station is not critical from a process equipment perspective, it is one of the City's communication hubs and captures much of the SCADA network traffic and relays it to Bonde-1 reservoir. It should be noted that the City does not have enough generator power (from portable, rented, or permanent in-place generators) to power all their sites should their entire system fail.

The majority of the remote sites visited had Uninterruptible Power Supplies (UPSs) installed inside the control panels. These devices are able to provide emergency power to the PLC in the event of a normal input power failure. As they are emergency devices, UPSs are not designed to be used for long periods of time. Additionally, UPSs lose capacity over time and should be periodically replaced. Further conversations with the City revealed that a UPS replacement program or schedule does not exist for any of the remote sites.

The SCADA core server and network infrastructure are in a locked room in the main control room. Some local redundancy exists for the network and server infrastructure - there are redundant firewalls, core switches and virtual compute and storage resources. If this location was inaccessible or the critical equipment failed, there is no alternate location or equipment to support the SCADA system. The City creates data backups following the 3-2-1 strategy, in which three copies (original and two backups) exist on two different types of media, and one of those backup media types is stored offsite. This is accomplished using a Cohesity backup solution and the offsite location is the City Data Center. However, there isn't a procedure to conduct regular recovery tests.

3.2.5.3 Roles and Responsibilities

'Roles and Responsibilities' refers to the system of tiered response order for internal staff, vendors, or consultants who are responsible for troubleshooting, maintaining or otherwise addressing operational issues across a variety of situations. This section is intended to document current roles and responsibilities related to maintenance and support of the SCADA system.

The City is heavily reliant upon outside consultants, vendors, and Tesco for any maintenance and support needed for their system. City Utilities Staff made it clear that Tesco is the first source contacted and that they are relied upon to be the responder in most failure situations. All representative remote sites visited utilized Tesco PLCs and OITs, which necessitates Tesco as the primary source of maintenance and support. During the site visits, City staff expressed concern with this approach to maintenance and expressed interest in either developing some internal resources for maintenance and/or increasing their use of contractor and consultant firms while minimizing reliance on Tesco as the only means of SCADA support. Other external firms (ie. SD Electric) are also heavily relied upon for operational maintenance.

The City contracted with West Yost in July 2020 to conduct a Roles and Responsibilities assessment. This assessment formally documented As-Is Roles and Responsibilities and proposed Recommended Roles and Responsibilities for SCADA system maintenance and support moving forward in a technical memorandum (TM) format. City staff indicated that they reference the Roles and Responsibilities periodically, but that they should be using it more frequently. As the field sites still utilize Tesco PLCs, it can be seen that the Recommended Roles and Responsibilities have not been fully implemented yet.

See **Appendix D: Pleasanton Roles and Responsibilities TM** for additional information.

3.2.5.4 Preventative Maintenance

City Utilities Staff do not have a system in place to perform preventative maintenance across their system. Most equipment is currently run to failure instead of being checked, maintained, and repaired on recurring intervals. Maintenance is generally performed on an as-needed basis at which point equipment is either repaired or replaced. If the cost to repair equipment is prohibitive or the equipment is likely to fail again soon, the equipment is usually replaced.

It should be noted that, due to other competing services provided by the City, the funds needed to adequately maintain the SCADA system for the water distribution, wastewater collection, storm drain, and recycled water system are not always readily available. This results in maintenance and projects being deferred or canceled.

3.2.5.5 Training

Because most O&M support for the SCADA system is currently provided externally through Tesco, the City does not have a formal program established to train staff on PLC programming, HMI configuration, and various OT support tasks.

The establishment of a formal training program is extremely important for IT and Operations Technology (OT) support staff to be able to provide and maintain expected service reliably and consistently for their customers. Additionally, a formal regimented training program will align with both the City's goals and soon-to-be established SCADA standards.

3.2.6 Planned Projects and Initiatives

The SCADA Implementation Plan, developed later during this project, will be informed by any currently planned projects so that the implementation of SCADA improvements does not present unnecessary operational challenges for City staff. In addition, the SCADA Implementation Plan should leverage currently planned projects at remote sites so that SCADA upgrades can be streamlined with these projects and minimize the impact to City Utilities Staff.

City staff indicated that there are currently no planned projects in the Capital Improvements Program (CIP). The City is currently contracting with Carollo Engineers (Carollo) to develop a Water Systems Management Plan (WSMP) which is intending to develop a 10-year CIP. Projects identified during the

Recommendations phase of this project will be closely coordinated with the WSMP to streamline upgrades at each site and minimize the impact to Operations.

3.2.7 AWIA Compliance Cyber Risk and Resilience Assessment (Cyber-RRA) Gaps

The City recently executed a project to assess the risk towards and resiliency of their system using the American Water Works Association (AWWA) Cybersecurity Guidance and Assessment Tool for the evaluation of their SCADA system and staff responses.

> *AWWA's Cybersecurity Guidance and Assessment Tool have been updated and revised to maintain alignment with the NIST Cybersecurity Framework and Section 2013 of America's Water Infrastructure Act (AWIA) of 2018. Collectively these resources provide the water sector with a voluntary, sector specific approach for implementing applicable cybersecurity controls and recommendation. AWWA's Cybersecurity Guidance and Assessment Tool have been recognized by the USEPA, DHS, NIST and several states for aiding water systems in evaluating cybersecurity risks.*

The Control Status Summary table from the RRA-Controls Status Summary has been replicated below in Table 2. Further detail and breakdown of the controls is available in the AWWA tool itself, but the key areas of necessary improvement include the following:

1. Policies and procedures need to be developed, implemented, and maintained. Operation and Administration staff should review and maintain these documents on a regular basis.
2. Access control system and methodologies need to be improved, including unique user IDs, appropriate passwords, tiered access, and implementation of least privileged access.
3. Roles and Responsibilities for operation staff need to be formally defined and recorded. These should be reviewed periodically.
4. Formal cybersecurity awareness training, both general and job-specific, needs to be both made available to all employees and enforced.
5. Stronger remote access security protocols such as Multi-Factor authentication (MFA) and data encryption need to be developed and implemented. The use of wireless mobile devices should be regulated.
6. Hardware standards for instrumentation devices, network equipment and other SCADA hardware need to be developed, implemented, and maintained. These standards should be periodically reviewed and kept up to date.
7. Emergency Response Plans and Business Continuity Plans need to be developed and understood by all staff. Many utilities have found it beneficial to conduct simulation exercises of a cyber-attack on their SCADA system to test a utility's response.
8. The City needs to develop and maintain relationships with authorities, professional associations, and relevant interest groups. At a minimum, they should connect with the local Department of Homeland Security (DHS) Cybersecurity and Infrastructure Security Agency (CISA) point of contact and leverage free-of-charge CISA services. Additionally, many utilities subscribe to the WaterISAC mailing list, which provides up-to-date situational awareness on current cyber threats in the OT environment.

These findings will be integrated as part of the recommendations in second section of this report. The specific recommendations and findings from the cybersecurity assessment can again be found in the AWWA Tool full report.

Table 2 AWWA Tool Pleasanton Control Status Summary

Control Priority Level	Total Controls Not Fully Implemented	Not Planned and/or Not Implemented	Planned and Not Implemented	Controls Partially Implemented	Fully Implemented and Maintained
Priority 1	28	1	22	6	12
Priority 2	25	0	13	12	0
Priority 3	19	1	13	6	0
Priority 4	5	1	5	0	3

Percent Recommended controls that are "fully implemented and maintained."	16
Percent Recommended controls that are "partially implemented" or "planned and not implemented"	81
Percent Recommended controls that are "not planned and/or not implemented- Risk Accepted"	3
Controls missing implementation status:	0

Not Planned and/or Not Implemented	Controls that are not implemented nor planned for implementation. Risk has been accepted.
Planned and Not Implemented	Priority 1 or 2 controls that are not implemented but are planned to be implemented.
Planned and Not Implemented	Priority 1 or 2 controls that are partially implemented by internal or external resources. Priority 3 or 4 controls are neither planned nor implemented.
Controls Partially Implemented	Priority 3 or 4 controls that are partially implemented by internal or external resources.
Fully Implemented and Maintained	The controls are fully implemented and actively maintained by internal or external resources.

4.0 RECOMMENDATIONS

This section will outline specific recommendations based on options evaluated and system information gathered within the City of Pleasanton. The following sections identify recommendations related to field instrumentation, PLC controller hardware, OIT hardware, control cabinets layout and sizing, SCADA software platform, network architecture and standards, SCADA system support, operation staff training, addressing AWIA-related cybersecurity gaps, SCADA System Response to an Earthquake, and Program Implementation approach.

4.1 Instrumentation Standards

West Yost recommends establishing manufacturer standards for instrumentation components and enforcing the standards when new instrumentation components are procured. Work done during the first implementation projects can be utilized to address said instrumentation standards. Instrumentation standards are important to supporting maintenance activities, troubleshooting, and replacing faulty field instrumentation in a timely manner. West Yost recommends maintaining and expanding the City's current spare component shelf backstock and establishing sole-source manufacturers for instrumentation components. West Yost recommends that the City perform an internal evaluation process to determine which equipment they wish to standardize upon and what manufacturers will be established as the standard for each. Standardization of instrumentation components will reduce the time and effort needed when designing and implementing upgrade projects.

Since applications, products, and needs change over time, the instrumentation standards will need to be reviewed and updated periodically to reflect the latest desired instrumentation components. West Yost recommends establishing a schedule by which the instrumentation standards list is audited and reviewed by City staff. The list below captures frequently used instrumentation components that should be standardized on a specific manufacturer. It is recommended that the City utilize the initial implementation projects to discuss manufacturers and establish instrumentation standards for their system.

- **Analyzers (Chlorine, Fluoride, etc.)**
- **Flowmeters**
- **Level Transmitters**
- **VFDs**
- **Pressure Transmitters**
- **Pressure Switches**

4.2 SCADA Hardware

The following sections identify recommendations related to PLC controller hardware, OITs, and control cabinets layout and sizing.

4.2.1 PLC Controller Hardware

Select PLCs in the City's system should be replaced with City-standard Modicon PLCs following the completion of the testing period if the City deems the Modicon PLCs' performance satisfactory. West Yost recommends that the City eventually aim to replace all existing PLCs with non-proprietary PLCs that can more easily be supported by a wider array of PLC technicians. This will minimize dependency on any single system integrator.

The City has identified Modicon as the preferred replacement PLC manufacturer and is currently installing Modicon PLCs at select locations within the system. These sites should serve as a pilot trial for a period of twelve (12) months. If, at the end of the pilot, the City is satisfied with the performance and integration of Modicon PLCs, the City should proceed with replacement of PLCs at all remaining sites using the new City-standard Modicon PLCs.

Upgrading the PLCs at each site will improve cyber resilience by utilizing the newer PLCs with the latest software patches and updates, newer cybersecurity features, and implementation of secure network design. Modicon PLCs are supported by a larger number of systems integrators will not only be easier to maintain and find supporting documentation for, but the City can also select between and leverage the multiple systems integrators for maintenance and upgrade tasks, potentially decreasing project turn-around time. In addition to utilizing external resources, City Utilities Staff can be trained to perform routine, minor programming tasks. See Section *4.5.4 Training* for additional information on training.

4.2.2 Operator Interface Terminals

West Yost recommends that the City standardize on OITs and install City-standard OITs at all sites. Most existing OITs are integral to the existing PLCs, meaning replacement would be mandatory if the PLC was to be replaced. Touch panel OITs like the one seen at the Laurel Creek Pump Station allow for greater system transparency and improved information delivery to Operations staff, especially if tied into Central SCADA. The City should conduct a comparison of possible vendors for OIT hardware to determine which OITs will best suit the needs of the City long-term.

4.2.3 Control Cabinets Layout and Sizing

West Yost recommends that the City implement standards (see Section 4.3.2 SCADA Standards) associated with control panel design and layout, including standardization of sizes, organization, and orientation of equipment. Internal wire management should be appropriately sized, better organized and utilized fully at each site. This standardization will deliver consistent control panels, regardless of the project size or contractor selected. Standardized internal organization will also streamline and simplify routine maintenance activities.

Furthermore, where control equipment is located within the same enclosure as electrical equipment, internal voltage dividers should be implemented to meet safety requirements and prevent interference between medium- and high-voltage with control power.

To implement consistent control panel layout and sizing, the City should have standard drawings and specifications developed for small, medium, and large control panels. Panels can be categorized based on complexity of processes, number of processes, or quantity of Input/Output (I/O) signals being controlled by the PLC. The City may elect to have the first Remote Terminal Unit (RTU) upgrade projects develop these drawings and specifications as part of the upgrade project.

4.3 SCADA Software and Documentation

The following sections provide key recommendations associated with SCADA software, SCADA standards, and control strategies.

4.3.1 SCADA Software

West Yost recommends that the City evaluate their SCADA Software systems every five (5) years, potentially issuing a SCADA Software Request for Information (RFI) to better make strategic decisions. West Yost staff have learned through industry experience that SCADA software needs to be regularly reviewed or replaced every three to five years. This necessary upgrade cycle is driven by software advances, operating system changes, evolving cybersecurity standards and other shifts in software development and the overall OT environment. The City recently completed a SCADA software upgrade hence it is recommended that the City re-evaluate and upgrade SCADA software every five years going forward.

The City will greatly benefit by periodically evaluating their software to determine if it is still the best fit for its system and for the City's operational needs. The City can evaluate SCADA software by issuing an RFI. Using this approach, the City will be able to gather information and score the respondents based on their answers to a standard list of questions. Factors to consider when issuing an RFI may include but should not be limited to cybersecurity features, operating system compatibility, service and support, available training resources, ease-of-use, reputation in the water sector, innovative technology, and integration with other systems. The City should also consider a vendor's support structure and maintenance agreement terms and if product acquisition might change said structure and terms.

Following issuance of the RFI and evaluation of responses, the City should make a formal selection on SCADA software and implement the selected software. If the City decides to continue to use the existing SCADA software, it should be upgraded to the latest version in close coordination with Operations every five years.

4.3.2 SCADA Standards

West Yost recommends that the City develop formal SCADA standards and leverage the standards during future upgrade projects. The City currently does not have any formalized SCADA standards due to the fact that all SCADA programming and configuration activities are currently performed by Tesco. West Yost recommends that the City develop formal SCADA standards including, but not limited to:

- Control panel design and equipment selection
- Instrumentation selection
- PLC programming
- HMI configuration
- Database configuration
- Reporting
- Alarming

By developing and implementing SCADA standards, internal staff, external support staff, and consultants will be able to configure and maintain the City's SCADA system in a consistent fashion. As the SCADA standards will establish a baseline expectation of how the SCADA system should be configured, the desired result is that SCADA system maintenance and projects will be implemented consistently, regardless of who is performing the work. This approach will result in all SCADA screens having a uniform appearance, all PLC logic functioning in a similar manner, and all databases, reports, and alarming being implemented consistently.

In addition to the initial development of SCADA standards, the standards will have to be periodically audited and updated. West Yost recommends setting and adhering to a periodic schedule by which City staff evaluate and update the SCADA standards.

4.3.3 As-Built Documentation and Control Strategies

West Yost recommends establishing and maintaining an updated set of system documents, including but not limited to control strategies, panel drawings, Input/Output (I/O) lists and PLC logic. The City would greatly benefit from maintaining an up-to-date set of control strategies (in electronic format) documenting the operation of each facility or remote site. Control strategies should be periodically reviewed and updated as facilities are upgraded or modified over time.

West Yost recommends that the City closely coordinate the development of control strategies with the implementation of DERs. As the City looks to implement DERs, a control strategy specific to emergency power operations will need to be developed. For example, a site with multiple pumps may not be able to run all three pumps on emergency power. The emergency power control strategy can define the level of automation such that equipment is automatically ramped up/down as needed to facilitate a transfer to or from emergency power. Implementation of emergency power control strategies will allow the City to transition to DERs with minimal staff intervention and resources.

The City should additionally update and standardize their records for panel drawings. A single, fully updated set should be created for each site within the City's system. As with the control strategies, these panel drawings should be periodically reviewed and consistently updated as changes are made. This will ensure their continued relevancy and usefulness. If not included as an appendix to the site control strategies, updated I/O lists should be a priority for the City to create and maintain. Copies of the most updated PLC programs should be accessible to reference by City staff. The PLC programs will provide staff with a detailed view into equipment operations if they ever need it, while control strategies should present the same information at a higher level. All of this documentation will provide City staff with vital sources of updated operational knowledge that may be valuable to external contractors during maintenance and upgrade projects.

These documentation changes will additionally facilitate knowledge transfer to newer operators joining the City as well as knowledge transfer from one generation to the next. All documentation should be consistently updated in coordination with capital improvement projects at a given site. Following the completion of any capital improvement project, staff should ensure that all changes have been recorded and merged into the updated set of documentation for that site.

4.4 Network Architecture and Standards

This section provides key recommendations associated with network architecture, control network standards, and remote access.

4.4.1 Network Architecture

West Yost recommends reinforcing the remote field sites communications network to improve redundancy and resilience through a comprehensive network communications evaluation. One of the primary benefits of a network redesign is to remove vulnerable single points of failure in the communications network. Bonde-1 and Tassajara Tank are the two single points of failure in the communications network that would negatively impact all operations if they were to become unresponsive or attacked. Reinforcing the network can be accomplished by rearchitecting the existing radio network, installing fiber connections between communication sites, utilizing cellular technology, or utilizing a hybrid of both cellular and radio technologies. Cellular communication in this context refers to 4G/5G LTE technology. Rearchitecting the existing radio system may involve the setup of additional radio communication sites to provide multiple redundant paths and remove the single points of failure.

Both Verizon and ATT provide special 4/5G services for critical services, though site surveys will need to be conducted to verify coverage is available at each site. FirstNet (First Responder Network) operates on the ATT network and provides nationwide wireless broadband dedicated to public safety. A similar service is provided by Verizon and is marketed as Verizon Frontline. Many of the industrial 4G routers can support multiple carriers providing robust backup capabilities. Additionally, PLC logic at each site will enable the local PLC to continue to operate the site through any communications disruptions.

West Yost has noted a trend in the industry towards a hybrid cellular and radio architecture. Therefore, it is West Yost's recommendation that enhancing and reinforcing the network communications using a combination of cellular technology and the existing radio system be strongly considered. To better understand the potential benefits and drawbacks of each communication system, West Yost recommends that the City conduct a comprehensive network communications evaluation before a final decision is made.

4.4.2 Control Network Standards

West Yost recommends implementing a hardware refresh cycle of seven to ten (7-10) years for critical OT components to improve performance and reliability, reduce downtime, and strengthen security. The City will need to determine a reasonable refresh cycle that balances cost, performance, and reliability. All implemented hardware should be under active vendor maintenance to ensure support for all production equipment. This will involve coordination and communication with multiple vendors as the City OT components are supplied by different vendors (Rukus, Palo Alto, Dell, etc.) and each vendor provides different support and lifecycles for their equipment. Some vendors provide replacement coverage, but for some critical components West Yost encourages keeping spare components stocked and readily available.

4.4.3 Remote Access

West Yost recommends implementing a purpose-built OT remote access solution. Remote access is often considered to be a vital component of operations as it permits increased system visibility and faster response times for maintenance and troubleshooting activities. Remote Access solutions offer granular access control, with far more precision than conventional VPNs, enabling customized control per protocol, per user activity, and per seat, with continuous monitoring and enforcement for the duration of every session. Any remote access solution should include the use of multi-factor authentication when interfacing with the SCADA environment. When choosing a remote access solution to implement, it is critical to consider potential impacts to the City's cybersecurity stature.

Possible suggestions for secure remote access solutions include OPSWAT MetaAccess, Claroty SRA or Dispel. For further information on remote access OT solutions, West Yost recommends reading the Dragos article "*A Matter of Trust: Remote Access for ICS*." [1]

4.5 System Maintenance and Support

The following sections outline recommendations associated with System Monitoring Requirements, Disaster Recovery Protocols and Procedures, Roles and Responsibilities, Training, and Preventative Maintenance.

4.5.1 System Monitoring Requirements

West Yost recommends that the City upgrade their system monitoring tools to allow for proactive monitoring, alerting, and forensic analysis if a cyber event were to occur. System monitoring tools allow staff to monitor, detect and respond to events in the environment. Solutions generally fall into two categories:

1. Infrastructure monitoring (network connectivity, server health, etc.)
2. Security Information and Event Management (SIEM).

Between the City's use of *Whatsup Gold* to monitor infrastructure health and *Crowdstrike Falcon* to monitor cybersecurity related traffic, the City has established a reasonable level of monitoring coverage. A SIEM tool would allow the City to not only automatically recognize potential cyber threats before they have a chance to impact the system but also investigate vulnerabilities and what went wrong after an event occurred.

To further increase their cybersecurity standing, West Yost recommends the City investigate implementing an OT focused cybersecurity monitoring solution that provides OT-specific asset visibility & inventory, vulnerability management, threat detection and investigation tools. The implementation of such a monitoring tool would considerably improve overall monitoring coverage and additionally assist the City in being compliant with new EPA cybersecurity requirements released in March of 2023. Examples of such a tool include Dragos, Claroty and SCADAFence.

[1] Dragos 2020: "*A Matter of Trust: Remote Access for ICS*."
https://www.dragos.com/blog/industry-news/a-matter-of-trust-remote-access-for-ics/

4.5.2 Disaster Recovery

West Yost recommends implementing communication redundancy features and establishing procedures and regular testing exercises to verify failover capabilities in addition to installing more reliable and permanent backup power solutions. As discussed in Section *3.2.5.2 Disaster Recovery*, the City currently utilizes portable generators along with some permanent generators to provide power redundancy at critical sites. In the case of a complete power failure, the City does not have enough generators to power all of their sites. West Yost recommends following the strategic recommendations identified in the Energy Management Plan to address this deficiency.

All core SCADA servers and network infrastructure are contained in a single locked room in the main SCADA operations room. If this location and its equipment were to fail, there is no alternate location or equipment to support the SCADA system. For this reason, West Yost recommends extending the virtualization environment and enabling high availability features to enable the migration of servers from one location to another.

Finally, West Yost recommends that internal staff routinely perform testing exercises to establish baselines and to maintain the City's failover capabilities over time. These periodic tests of the recovery process should be done at least once annually and should include the explicit testing of restoration from routinely captured system backups.

4.5.3 Roles and Responsibilities

West Yost recommends that the City follow the recommendations and guidelines identified in the Roles & Responsibilities Technical Memo previously provided by West Yost. The City desires to support some routine SCADA activities using internal resources. However, the City would like to maintain the majority of Tier-1 and Tier-2 support from vendors. See **Appendix D: Pleasanton Roles and Responsibilities TM** for expanded information on the suggested roles and responsibilities.

To be able to support their system using internal resources, City staff will benefit from training aimed at equipping them with the technical knowledge needed to support the SCADA system. This is explained in greater detail in Section *4.5.4 Training*.

4.5.4 Preventative Maintenance

West Yost recommends that the City develop a formalized maintenance program for critical electrical, instrumentation, and controls assets, and re-evaluate third-party maintenance contracts to include these activities. Implementing a proactive approach to preventative maintenance will increase the longevity of equipment, improve performance, and will no longer require equipment to be run to failure. The City would be well-served at this time by a preventative maintenance program that is driven by external contractors' efforts, resources, and knowledge. A cost analysis comparing full equipment replacement versus occasional periodic preventative maintenance and considering efficiency losses from failing equipment will show that the City could conserve resources by establishing a maintenance schedule. Preventative maintenance activities should be informed by manufacturer recommendations, including initial warranty and ongoing repair intervals. For control system components, maintenance activities are based on regular updates, useful life, manufacturer support, and proactive maintenance to avoid unplanned outages.

The City should re-evaluate and modify the service level agreements (SLA) of third-party vendors and integrators to include a proactive approach to preventative maintenance. When system facilities are shut down for physical equipment maintenance activities, the City and third-party vendors and integrators should utilize these same time windows to perform maintenance activities for Process Control System (PCS) assets, such as hardware updates and replacement as well as software patches and updates.

An example of City system hardware that would benefit from a preventative maintenance program are the city UPSs. UPSs are emergency devices and are not designed to be used for long periods of time; they lose capacity through their installed lifecycle and should be periodically replaced. Without a preventative maintenance program, the City may find that when a UPS is needed in a critical situation it does not have the necessary capacity to maintain operations.

4.5.5 Training

Training is an important component of system maintenance and support. City staff should be provided with proper training to fulfill their respective roles and responsibilities. Training can be divided into two types: Technical Training and Consequence-Driven Cyber-Informed Engineering (CCE) Training.

4.5.5.1 Technical Training

City staff should be provided with high-level training regarding PLC programming activities, HMI configuration activities, networking configuration, maintenance activities, and implementation and maintenance of SCADA standards. Routine maintenance and upgrade activities will likely continue to be completed by outside integrators, vendors, and consultants. However, City staff would greatly benefit from high-level awareness training which will allow staff to better interact with consultants, diagnose problems and perform emergency fixes. Some of this training may be obtained from PLC and SCADA software vendors (See Sections *4.2.1 PLC Controller Hardware* and *4.3.1 SCADA Software*).

In addition to the technical training provided by vendors, West Yost recommends City staff be provided with on-the-job training during the implementation of this SCADA Management Plan. As control panels are replaced at field sites and new PLCs are brought online, this presents an excellent opportunity for City staff to receive on-the-job training for routine SCADA maintenance activities.

In addition to an initial technical training, City staff will need periodic refresher trainings. The City should develop a plan and allocate resources to make periodic training available to support staff on a recurring basis. This is critical as SCADA technologies and methodologies evolve relatively quickly over time and training needs to be adapted accordingly.

4.5.5.2 Consequence-Driven Cyber-Informed Engineering (CIE-CCE) Training

West Yost recommends that all City staff involved in critical process systems undergo CCE training to better help them reduce the consequences associated with a cyberattack. Idaho National Laboratory (INL) recently developed a methodology called Consequence-Driven, Cyber-Informed Engineering (CCE). The primary objective of this methodology is to change how organizations understand and manage their strategic cyber risks with a focus on their most critical systems and processes. These changes must occur throughout the organization including engineers, operators, and senior leaders.

CCE requires the integration of many disciplines and departments, including IT, OT/SCADA, Cybersecurity, Instrumentation & Controls (I&C), Electrical, Process Mechanical, and Civil. In practice and in the Water Sector, CCE involves:

1. Designing process equipment such that:

   a. It has out-of-band protections from a cyberattack. These could be such things as:
      i. Valves that are geared in such a way that they cannot be controlled to open too slowly or too quickly and cause damage or injuries.
      ii. Integration of hardwired interlocks directly into the motor start/stop circuitry instead of being wired through the PLC. In this way, if the PLC were to fail or become compromised, the hardwired interlocks would still protect the motor in the absence of the PLC.
      iii. For well operations, integration of a backspin timer in the physical MCC or VFD instead of in the PLC program. By integrating the backspin timer into the physical electrical equipment, the backspin timer is not dependent on the PLC for operation.
   b. Equipment can be operated in the absence of automation (e.g. SCADA). Process equipment is also designed in a simple manner so that equipment can be operated in local manual, without SCADA controls.
2. Maintaining the organizational capacity and capabilities to respond and recover from a cyber-attack. This includes operate without automation for an extended period of time. These response capabilities should be regularly exercised and documented.
3. Dependencies (system integrators, NSF chemicals, etc.) are identified and minimized to the extent possible.
4. An organized asset management system is in place so that a utility has a living, up-to-date inventory of all cyber assets including software version, updates, etc. This is important so that IT/OT staff can:
   a. Identify unauthorized devices
   b. Find and use relevant information through monitoring applicable resources (WaterISAC, ICS-CERT, etc.) for potential vulnerabilities and patching requirements.

It is recommended that all City staff responsible for the engineering, design, installation, and maintenance of critical systems be provided with training. This will enable engineering staff to design, or review designs, with CCE concepts in mind. Details on CCE training are included in the project portfolio.

4.6 AWIA Compliance Cyber-RRA Gaps

West Yost recommends implementing all Priority 1 and Priority 2 controls identified by the AWWA tool to improve the City's cybersecurity posture. West Yost assisted the City in completing a Cyber-RRA using the AWWA tool in mid-2020. It should be noted that while the AWIA assessment does not explicitly require the City to take further action, the Environmental Protection Agency (EPA) released legislation in March of 2023 emphasizing "…the need for states to assess cybersecurity risk at drinking water systems." (epa.gov, 2023) It is yet to be seen how California will interpret and enforce the new legislation, but it is recommended that at a minimum the Priority 1 and Priority 2 controls, identified in the Cyber-RRA, be implemented as they would significantly enhance the cyber resilience posture of the City's OT/IT system. Priority 3 and 4 controls should be pursued as the City is able to, but after Priority 1 and 2 controls are addressed. Ultimately, utilities that recognize the changes in the global OT threat environment and that do their due diligence in planning and make their best efforts in making cybersecurity improvements will be well prepared for whatever decisions are made regarding the EPA's cybersecurity legislation.

A significant number of the design-related controls recommended by the AWWA Tool are incorporated into the recommendations presented in Section 4.4 Network Architecture. Additional examples of cybersecurity recommendations included in this report are consequence-driven cyber-informed engineering (CCE), access control improvements, remote access improvements, development of policies and procedures, and cybersecurity awareness training.

The overarching intent of this SCADA Management Plan is to streamline the recommendations from the AWWA tool with the recommendations in the SCADA Management Plan. By implementing the recommendations in this document, the City will address key SCADA requirements while at the same time addressing as many as possible of the findings from the AWIA cybersecurity assessment.

4.7 SCADA System Response to Earthquake Events

West Yost recommends that the City considers how their SCADA system would respond to an earthquake event and investigate the options expanded on below to increase their readiness and ability to rebound from a seismic event. An earthquake can cause severe damage to process equipment such as reservoirs, pumps, and process piping. If automated equipment is operating during an earthquake, there is the potential for additional damage to rotating equipment such as pumps.

During recent years, a new technology called ShakeAlert® has been developed by the United States Geological Survey (USGS). ShakeAlert® is an earthquake early warning (EEW) system that detects significant earthquakes so quickly that alerts can reach many people before shaking arrives. ShakeAlert® is not earthquake prediction, rather a ShakeAlert® message indicates that an earthquake has begun, and shaking is imminent. The USGS along with a coalition of State and university partners are now implementing Phase 3 of operations of the ShakeAlert® Earthquake Early Warning System for the West Coast of the United States. Many partnerships to utilize ShakeAlert® in authentic environments such as utilities, hospitals, transportation systems, and educational environments are active today and more are being developed. The USGS and its partners are continuing to expand these applications in coordination with state agencies in Washington, Oregon, and California. ShakeAlert® has licensed with commercial partners to provide commercial applications for ShakeAlert®.

One of the options is a product that can provide a digital input signal to the master PLC, which can be used to activate the City's earthquake control strategy at all participating sites. This requires detailed coordination with City Utilities Staff to determine how process equipment at each site should be handled. Process equipment should be evaluated on a case-by-case basis to determine which equipment should be deenergized, which equipment should simply be dialed back to a lower output, and in which order this sequence of operations shall occur. The results of the evaluation and coordination with City Utilities Staff should be detailed in a Process Control Strategy. Following development of the control strategy, programming changes to the PLCs will be developed and implemented. In addition, there will need to be minor changes made to the SCADA HMI.

The City may utilize an automated EEW system, local seismic detection system, or simply a pushbutton input to the SCADA system (or any combination of these) to trigger the appropriate response. In either case, the most important element is the evaluation of appropriate SCADA system responses and implementation in the SCADA system.

In addition to the EEW system described in the preceding paragraphs, another option for utilities to consider is a post-disaster assessment and monitoring system that will automatically compare before and after data for process equipment such as well pumps, reservoirs, booster pumps, and process piping. This post-disaster assessment of process equipment compares data before and after an event to determine health and operational capability of equipment, indicating whether any equipment has been damaged. Similar to the EEW system, this post-disaster system provides a digital input health status to the local PLC for each piece of process equipment. A Process Control Strategy should be detailed in coordination with City Utilities Staff to determine how the health status may be used to inhibit process equipment compromised by a disaster. Following development of the control strategy, programming changes to each local PLC will be developed and implemented. In addition, there will need to be minor changes made to the SCADA HMI.

West Yost recommends that the City implement ShakeAlert® technology and develop an earthquake control strategy. West Yost recommends that the City select one or two critical sites and implement the ShakeAlert® technology by means of a pilot project at these sites. At the end of the pilot, City staff can determine whether they would like to extend the technology to other sites.

4.8 Program Implementation

Due to the highly technical nature of the projects proposed in this TM, the proposed schedule, and high requirements for coordination between projects, *West Yost recommends that the City execute key projects as an overall SCADA Improvements Program (Program) and select a Program Manager (PgM) to assist the City in the management, design, and delivery of the projects.* The PgM is typically responsible for the following services for each project contained in the Program Implementation Plan:

- Engineering/Design
- Bidding Support
- Construction Management/Support, including consistency and accuracy of as-built documentation
- PLC Programming
- SCADA Configuration
- Network Deployment and Configuration
- Project/Program Management, including ensuring that the overall program budget and schedule is being adhered to

Refer to **Section 5.0 Program Implementation Plan** for additional information related to the implementation of the Recommendations in this SCADA Management Plan.

5.0 PROGRAM IMPLEMENTATION PLAN

The Implementation Plan was created with input from City staff. The implementation plan has been separated into two phases: (1) Near-Term Projects, and (2) Long-Term Projects. Most projects have predecessor projects which will need to be fully executed before the next project may begin. Near-Term Projects are planned for execution within the next five years while Long-Term Projects will be executed more than five years from the date of this report.

West Yost recommends using traditional Design-Bid-Build delivery methods for construction. Each project identified in this report should be closely coordinated with the projects identified in the Energy Management Plan (also developed by West Yost) and in the Water System Management Plan (developed by Carollo Engineers) such that infrastructure improvement projects, SCADA projects, and energy projects can be bundled together under a single construction contract to minimize impacts to Operations.

A total of 82 projects have been identified for the implementation of the City's SCADA Management Plan. Forty-two (42) of these projects are contained in Phase 1, while 40 projects are included in Phase 2. Implementation costs have been developed consistent with an Association for the Advancement of Cost Engineering (AACE) Class 5 cost estimate for all Phase 1 projects. These cost estimates include thirty percent contingency in the Project Cost and cost escalation at four percent over a period of five years. Since no implementation schedule is included, cost escalation was assumed at five years as a worst-case scenario. No cost estimates were developed for Phase 2 projects.

Appendix E: SCADA Program Implementation Plan outlines the complete portfolio of projects contained in the SCADA Upgrade Program. The Program Implementation Plan contains all projects required to implement the recommendations contained in this TM, including Project IDs, Project Names, Project Durations, Predecessors, and Total Costs.

Appendix A

Existing Hydraulic Profile

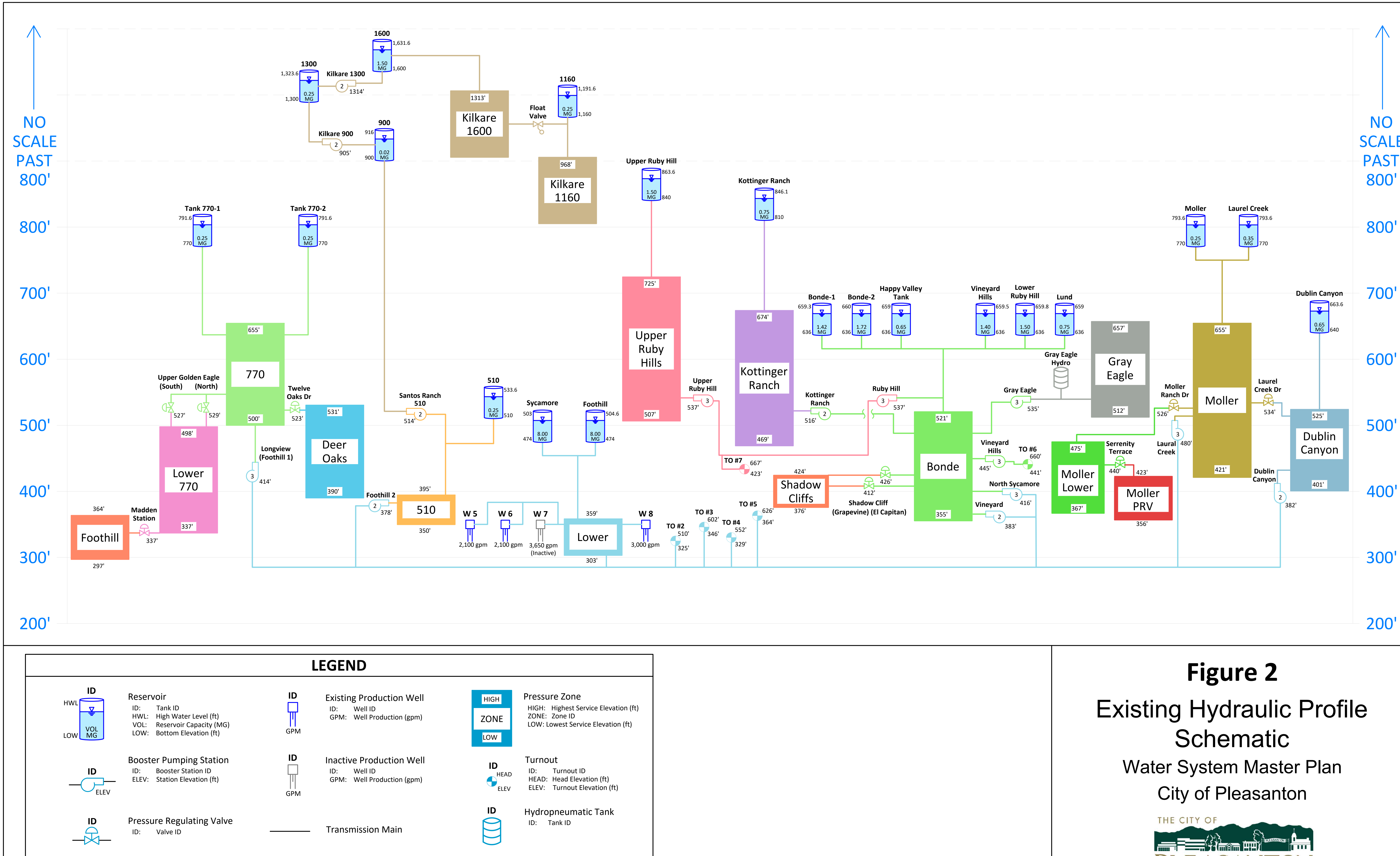


Figure 2
Existing Hydraulic Profile Schematic
Water System Master Plan
City of Pleasanton

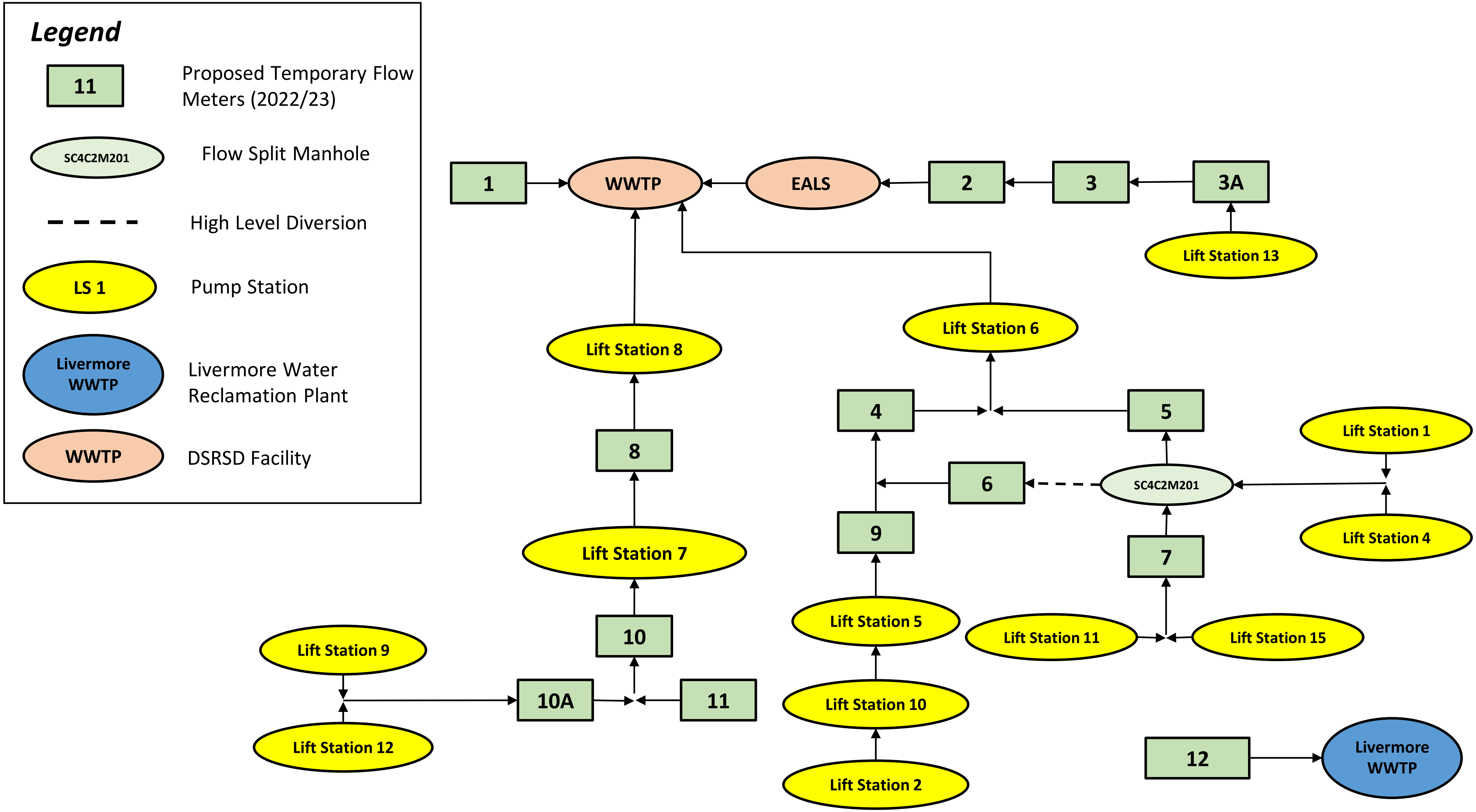
Last Updated: 10/19/2022

AKEL ENGINEERING GROUP, INC.

THE CITY OF PLEASANTON

Appendix B

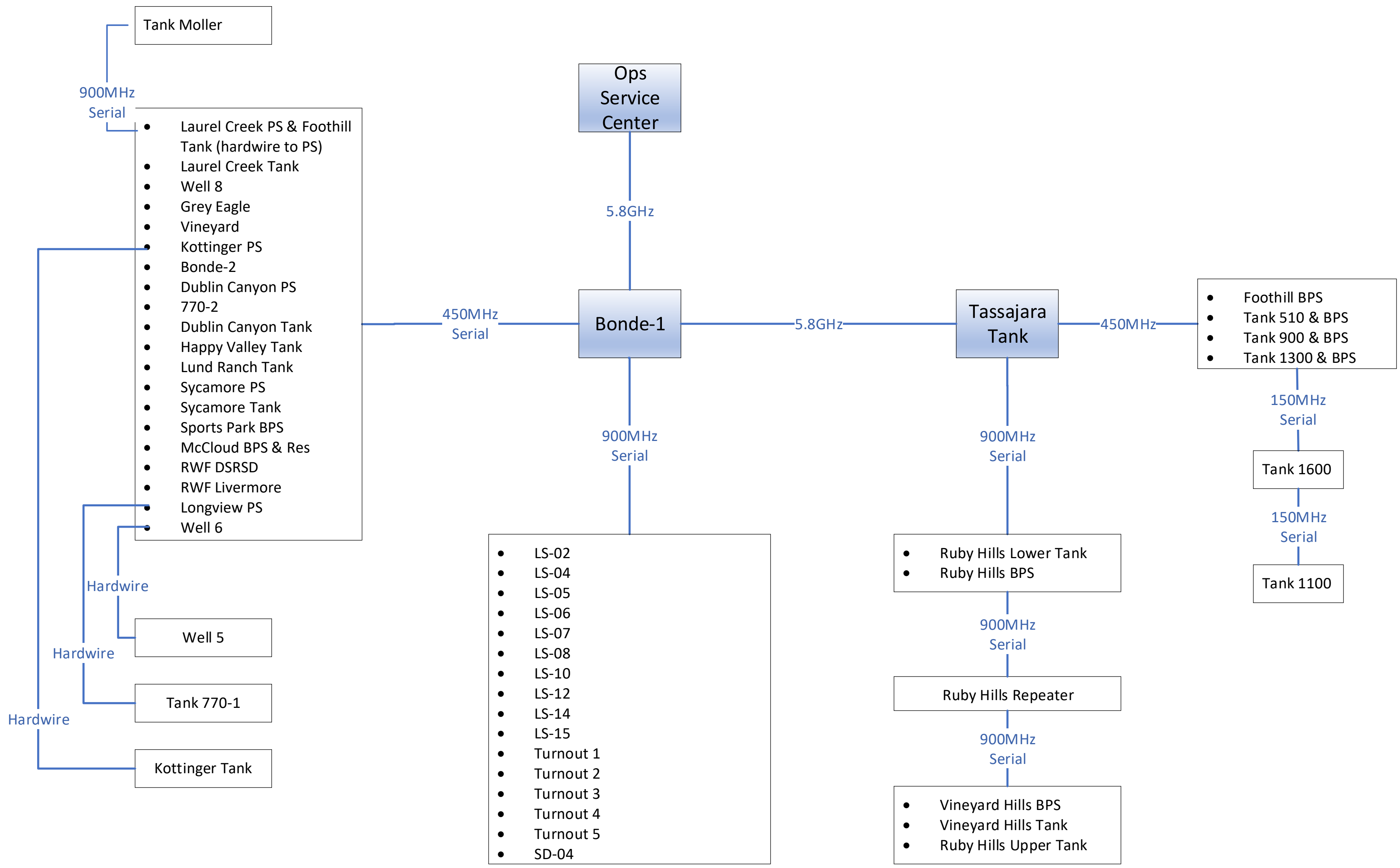
Sewer Collection System Overview


Legend
11
Proposed Temporary Flow Meters (2022/23)
SC4C2M201
Flow Split Manhole
High Level Diversion
LS 1
Pump Station
Livermore WWTP
Livermore Water Reclamation Plant
WWTP
DSRSD Facility
1
WWTP
EALS
2
3
3A
Lift Station 13
Lift Station 8
Lift Station 6
4
5
Lift Station 1
8
6
SC4C2M201
9
7
Lift Station 4
Lift Station 7
Lift Station 5
Lift Station 11
Lift Station 15
10
Lift Station 9
10A
11
Lift Station 10
Lift Station 12
Lift Station 2
12
Livermore WWTP

Appendix C

As-Is Communications Diagram

As-is Communications Design



No communications:

- LS-13
- SD-1,2,3
- TO-6,7 (flow metered at respective pump stations)

Appendix D

Pleasanton Roles and Responsibilities Technical Memorandum

FINAL REPORT

SCADA System Support Roles and Responsibilities

PREPARED FOR

City of Pleasanton

July 2020

WEST YOST ASSOCIATES

FINAL REPORT | JULY 2020

SCADA System Support Roles and Responsibilities

Prepared for

City of Pleasanton

Project No. 680-70-20-03

Project Manager: Joel Cox, GICSP, CCNA, GPEN	Date
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Table of Contents

List of Appendices

List of Acronyms and Abbreviations

AWIA	America's Water Infrastructure Act
City	City of Pleasanton
ERP	Enterprise Resource Planning
GHz	Gigahertz
HMI	Human Machine Interface
IT	Information Technology
MHz	Megahertz
OIT	Operator Interface Terminal
PLC	Programmable Logic Controller
RRA	Risk and Resiliency Assessment
SCADA	Supervisory Control and Data Acquisition
SViB	Site Visit in a Bag
West Yost	West Yost Associates

SCADA SYSTEM SUPPORT ROLES AND RESPONSIBILITES

1.0 BACKGROUND

The City of Pleasanton (City) is currently replacing some obsolete components in the existing Supervisory Control and Data Acquisition (SCADA) system including computers and software. The City Information Technology (IT) department is engaged in the process and is working to improve the cybersecurity and maintainability of the system through the design process. The City realized they wanted a better understanding of their current operational support model and how it would change based on planned enhancements to their SCADA computers and software. West Yost Associates (West Yost) helped define and clarify the roles and responsibilities for the upgraded SCADA system between City IT, City Operations Staff and external vendors including Systems Integrators. The roles and responsibilities include system maintenance, monitoring, and security vulnerability management.

West Yost conducted virtual site visits to key facilities as part of the America's Water Infrastructure Act (AWIA) Risk and Resilience Assessment (RRA) project and was able to utilize these visits for the roles and responsibilities work as well. This information was used to conduct workshops focused on support roles and responsibilities with the City.

1.1.1 Site Visits

Using the West Yost Site Visit in a Bag (SViB) solution and support from the City, we virtually visited sites that represented the typical site type and design. This provided a visual of the components and a better understanding of how technology was used to support the process. The following sites were selected:

- Wells 5 and 6
- Turnout #5
- Bonde Tank-1
- Foothill 2 Pump Station
- Laurel Creek Pump Station/Foothill Tank
- Laurel Creek Tank

1.1.2 Workshops

Two workshops were conducted with the City team, which included the Utilities Planning Manager, the Utilities Division Manager, and the IT Director. The first workshop focused on the As-Is Roles and Responsibilities and the second focused on the Recommended Roles and Responsibilities. The Recommended Roles and Responsibilities focused on how the City intends to maintain the system after upgrades to the SCADA computers and servers. The output of the workshops is documented in Section 2.0.

1.1.3 Remote Site Communications Network

The City provided West Yost with drawings that included detailed information on process control communications. West Yost reviewed those drawings to better understand the technology used and the point of integration with other City networks.

2.0 ROLES AND RESPONSIBILITIES

West Yost conducted workshops with City staff to review the desired roles and responsibilities for SCADA system maintenance and security. A roles and responsibilities table prepopulated with key system elements and categorization of support and security responsibilities was reviewed during the workshops. The workshops included City Operations and IT staff to ensure a collaborative discussion was facilitated to document the City's As-is and Recommended support responsibilities.

2.1.1 As-Is Roles and Responsibilities

Currently, the City mostly relies on an external systems integrator to perform maintenance and support for the SCADA system, including radio communications, Programable Logic Controller (PLC) programming and SCADA screen development and updates. See Appendix A. As-Is Roles and Responsibilities for the agreed-upon current support model.

2.1.2 To-Be Vision Summary

The City is currently taking steps to move some SCADA support activities in house and is developing a working relationship with IT to assist with hardware and software support. Therefore, after the As-Is workshop was completed, we discussed with the City their thoughts on a To-Be vision and captured the highlights. Below is a list of items that provides the foundation for the City's SCADA system To-Be vision:

- Increase collaboration/support with IT for SCADA including remote network communications to improve reliability and cybersecurity
- Obtain support from multiple systems integrators for PLC/OIT support
- Implement and maintain standards for programming, instrumentation, hardware, software, etc.
- Improve use of automation to achieve industry norms
- Address potential safety issues
- Address network design issues
- Bring field equipment up to current supported versions
- Align with Utilities Strategic Plan

2.1.3 Recommended Roles and Responsibilities

The City is currently engaged in a significant SCADA upgrade project. The scope of this project will involve upgrading the Human Machine Interface (HMI) software (Wonderware) and all associated hardware. It will also include the addition of new features and functionality, remote access methods, and cybersecurity improvements. Remote site network communications and field equipment are not in the scope of the project. We used these new design and equipment specifications in the workshop to develop the Recommended Roles and Responsibilities table (see Appendix B. Recommended Roles and Responsibilities).

3.0 PRELIMINARY RECOMMENDATIONS

Using the data collected via site visits, drawings, and workshops, West Yost prepared a list of preliminary recommendations for the City to consider. These recommendations require more detailed analysis to determine scope, budget, and timing of each recommendation. The following are West Yost preliminary recommendations based on our observations during site visits and subsequent discussions with the City.

1. Design and upgrade remote site communications network using industry best practices in collaboration with IT
2. Upgrade PLCs and Operator Interface Terminal (OITs) in field. Consider using a platform with multiple vendor support (versus single support)
3. Develop As-Is and To-Be control strategies for key sites
4. Evaluate internal utilities support resources for SCADA system support
5. Develop new external support agreements
6. Establish standards for instrumentation, hardware, software, programming, etc.
7. Conduct electrical equipment safety review and improvements (Arc Flash)
8. Upgrade site surveillance and security

The recommendation for communications network design and upgrade is based on a high-level analysis of the network drawings provided by the City. Appendix C. As-is Radio Communications provides an overview of the communication paths. The following observations were made to support this recommendation:

- Limited use of standards (vendors and models); radio frequencies (150, 450, 900 megahertz (MHZ) and 5.8 gigahertz (GHz))
- Networking best practices not implemented (i.e. subnetting); flat network
- Multiple single points of failure:
  - Bonde to Service Center 5.8GHz (100 percent of sites)
  - Bonde 450MHZ (44 percent of sites)
  - Bonde 900 MHz (31 percent of sites)
  - Tassajara to Bonde 5.8GHz (23 percent of sites)
  - Tassajara 450MHz (11 percent of sites)
  - Tassajara 900MHz (10 percent of sites)
- Unnecessary complexity that increases attack surface and support requirements
- Multiple protocols are in use (Modbus, ModbusTCP, EthernetIP, serial, Ethernet, etc.)
- Communications with equipment owned by other organizations (partners)

- Use of public IP addresses (owned by organization in China) on equipment owned by others at the RWF Livermore site. A Moxa EDR-810 router is bridging a partner owned AB CompactLogix PLC to a Digi OneIAP protocol converter in the Pleasanton network.
- Boundary protection
  - Router with firewall services to remote sites
  - SCADA servers
  - Protection to City network (may change with new project)
- Some sites do not currently have communications

In order to address the key recommendations in a planned and coordinated manner, we recommend that the City execute a SCADA Master Plan that is aligned with the Utilities Strategic Plan, and helps the City to develop a roadmap to upgrade and maintain the rest of the SCADA system and associated equipment.

Typically, a SCADA Master Plan will have the following key deliverables:

- Baseline Assessment and Gap Analysis
- Alternatives and Recommendations
- Project Portfolio
- Cost Estimates for planning purposes
- Detailed Implementation Plan
- As-Needed Implementation Services

For schedule and budgetary purposes, we recommend the City assume a SCADA Master Plan would require six to eight months to complete with a budget estimate of $300,000. The City may also consider including implementation services to assist the City with execution of initial foundational projects that set the stage for implementation of the remainder of the Master Plan projects.

APPENDIX A
As-Is Roles and Responsibilities

Table A1. As-Is Roles and Responsibilities

Tier	Support Description		
1	First responders. Evaluate situation and attempt basic responses.		
2	Second level response after basic troubleshooting does not resolve the issues.		
3	Issue determined to be potential hardware or application level problem.		
Category	**Equipment/Software**	**Support Responsibilities**	**Comments**
Remote Access	Remote access for operations staff through PC/tablets/phones	Tier 1 – Utilities Tier 2 – Utilities/IT – Utilities Team Tier 3 – IT/Vendor (Palo Alto)	VPN connection; TeamViewer to SCADA workstation
Application Software	Server – HMI, Historian, Alarming, and Alarm Callout, HMI Client	Tier 1 – Utilities Tier 2/3 – Utilities/Vendor (Tesco)	No Wonderware support currently; includes routine updates (screen, alarms, etc.)
Report Development	Report Development	Tier 1 – Utilities Tier 2/3 – Utilities/Vendor	
Computer Hardware – Desktop	For Business Systems	Tier 1 – IT (Tier 1) Tier 2 – IT (Tier 2) Tier 3 – IT/Vendor	
Computer Hardware – Server	For Business Systems	Tier 1 – IT (Tier 2) Tier 2/3 – IT/Vendor	
Computer Hardware – Desktop	For SCADA Systems	Tier 1 – Utilities Tier 2 – Utilities/IT – Utilities Team Tier 3 – IT/Vendor	
Computer Hardware – Server	Host Server Hardware for SCADA Systems	Tier 1 – Utilities Tier 2 – Utilities/IT – Utilities Team Tier 3 – IT/Vendor	
Communications Network	Core Routers and Switches – Business Systems	Tier 1 – IT (Tier 2) Tier 2/3 – IT/Vendor	
Communications Network	Network/Server Uninterruptible Power Supply (UPS) – Data Rooms	Tier 1 – IT – Utilities Team Tier 2 – IT (Tier 2) Tier 3 – Vendor	

Table A1. As-Is Roles and Responsibilities

Tier	Support Description		
1	First responders. Evaluate situation and attempt basic responses.		
2	Second level response after basic troubleshooting does not resolve the issues.		
3	Issue determined to be potential hardware or application level problem.		
Category	**Equipment/Software**	**Support Responsibilities**	**Comments**
Communications Network	Panel-mounted Switches	Tier 1 – Utilities Tier 2 – Utilities/Vendor (Tesco) Tier 3 – Vendor	
Communications Network	Radios	Tier 1 – Utilities Tier 2 – Utilities/Vendor (Tesco) Tier 3 – Vendor	
Communications Network	Cellular Routers	Tier 1 – Tier 2 – Tier 3 –	Serial radios; couple of hub/repeater sites; currently have a health status screen
Communications Network	Industrial DMZ Support – Network Hardware	Tier 1 – Tier 2 – Tier 3 –	Not currently
Communications Network	Industrial DMZ Support – PLC Hardware	Tier 1 – Tier 2 – Tier 3 –	Not currently
Control Panel Components	Programmable Logic Controller (Tesco PLCs)	Tier 1 – Utilities Tier 2 – Utilities/Vendor (Tesco) Tier 3 – Vendor	
Control Panel Components	Operator Interface Terminal (Tesco RTU)	Tier 1 – Utilities Tier 2 – Utilities/Vendor (Tesco) Tier 3 – Vendor	Includes routine program changes
Instrumentation and Equipment	Instrumentation (Flow, pressure, etc.)	Tier 1 – Utilities Tier 2 – Utilities/Vendor Tier 3 – Vendor	

Table A1. As-Is Roles and Responsibilities

Tier	Support Description		
1	First responders. Evaluate situation and attempt basic responses.		
2	Second level response after basic troubleshooting does not resolve the issues.		
3	Issue determined to be potential hardware or application level problem.		
Category	**Equipment/Software**	**Support Responsibilities**	**Comments**
Equipment	Pumps/Valves	Tier 1 – Utilities Tier 2 – Utilities/Vendor Tier 3 – Vendor	
Instrumentation and Equipment	Control Panel Uninterruptible Power Supply (UPS)	Tier 1 – Utilities Tier 2 – Utilities/Vendor Tier 3 – Vendor	
Instrumentation and Equipment	Motor Control Center (MCC) Variable Frequency Drive (VFD)	Tier 1 – Utilities Tier 2 – Utilities/Electrical Contractor Tier 3 – Electrical Contractor/Vendor	
Active Directory	SCADA Active Directory Support	Tier 1 – Tier 2 – Tier 3 –	Not currently
Security	Cameras	Tier 1 – Tier 2 – Tier 3 –	Not currently used; IT will support future video surveillance systems; some legacy camera systems
Security	Access Control	Tier 1 – Utilities Tier 2 – Support Services Tier 3 – Vendor	Padlocks, gates, card access, PD gets alarm if there's intrusion – not sure if the system works

APPENDIX B

Recommended Roles and Responsibilities

Table B1. Recommended Roles and Responsibilities

Tier	Support Description		
1	First responders. Evaluate situation and attempt basic responses.		
2	Second level response after basic troubleshooting does not resolve the issues.		
3	Issue determined to be potential hardware or application level problem.		
Category	**Equipment/Software**	**Support Responsibilities**	**Comments**
Remote Access	InTouch Access Gateway application; VPN access	Tier 1 – Utilities Tier 2 – Utilities/Vendor Tier 3 – Vendor/IT	
Application Software	Server – InTouch 2017, Wonderware Historian, TopView (Alarming)	Tier 1 – Utilities Tier 2/3 – Utilities/Vendor	Includes routine updates (screen, alarms, etc.)
Report Development	Wonderware Reporting and 3rd Party Reporting	Tier 1 – Utilities Tier 2/3 – Utilities/Vendor	
Computer Hardware – Desktop	For Business Systems	Tier 1 – IT (Tier 1) Tier 2 – IT (Tier 2) Tier 3 – IT/Vendor	
Computer Hardware – Server	For Business Systems	Tier 1 – IT (Tier 2) Tier 2/3 – IT/Vendor	
Computer Hardware – Desktop, Thin clients, tablets, etc.	For SCADA Systems	Tier 1 – IT (Tier 1) Tier 2 – IT (Tier 2) Tier 3 – IT/Vendor	
Computer Hardware – Server	VMWare Host Server Hardware for SCADA Systems	Tier 1 – IT (Tier 2) Tier 2/3 – IT/Vendor	
Computer Hardware – Network Storage	Cohesity; QNAP	Tier 1 – IT (Tier 2) Tier 2/3 – IT/Vendor	
Computer Hardware – Miscellaneous	Voice and cellular (SMS) modems, NTP Server	Tier 1 – Utilities Tier 2/3 – Utilities/Vendor	
Communications Network	Core Routers and Switches – Business Systems	Tier 1 – IT (Tier 2) Tier 2/3 – IT/Vendor	
Communications Network	Ruckus Core Switches and Access Switches (panel mounted)	Tier 1 – IT (Tier 2) Tier 2/3 – IT/Vendor	

Table B1. Recommended Roles and Responsibilities

Tier	Support Description		
1	First responders. Evaluate situation and attempt basic responses.		
2	Second level response after basic troubleshooting does not resolve the issues.		
3	Issue determined to be potential hardware or application level problem.		
Category	**Equipment/Software**	**Support Responsibilities**	**Comments**
Communications Network	Cisco Router – SCADA Systems(Remote sites)	Tier 1 – Utilities Tier 2/3 – Utilities/Vendor	
Communications Network – Security	Palo Alto Firewall – SCADA	Tier 1 – IT (Tier 2) Tier 2/3 – IT/Vendor	
Communications Network – Power	Network/Server Uninterruptible Power Supply (UPS) – Data Rooms	Tier 1 – IT – Utilities Team Tier 2 – IT (Tier 2) Tier 3 – Vendor	
Communications Network	Radios (Ethernet & Serial)	Tier 1 – Utilities Tier 2 – Utilities/Vendor Tier 3 – Vendor	Hub/repeater sites; currently have a health status screen
Communications Network	Industrial DMZ Support – Server and Network Hardware	Tier 1 – IT (Tier 2) Tier 2/3 – IT/Vendor	
Active Directory	SCADA Active Directory Support	Tier 1 – Utilities Tier 2 – Utilities/IT (Tier 2) Tier 3 – IT/Vendor	Agree on change management and best practices between IT and Utilities
Remote Desktop Services (RDS)	SCADA Systems	Tier 1 – Utilities Tier 2 – IT (Tier 1) Tier 3 – IT (Tier 2)	
VMWare Guests	Virtual Application Servers – SCADA Systems	Tier 1 – IT (Tier 2) Tier 2/3 – IT/Vendor	
Database	SQL Server 2016 – SCADA Systems	Tier 1 – Utilities/Vendor Tier 2 – IT (Tier 2) Tier 3 – IT (Tier 2)/Vendor	
Operating System Support	Windows Server 2016 and Windows 10 – SCADA Systems	Tier 1 – Utilities Tier 2 – IT (Tier 1) Tier 3 – IT (Tier 2)/Vendor	
VMWare Hypervisor Management	vCenter	Tier 1 – IT (Tier 2)	

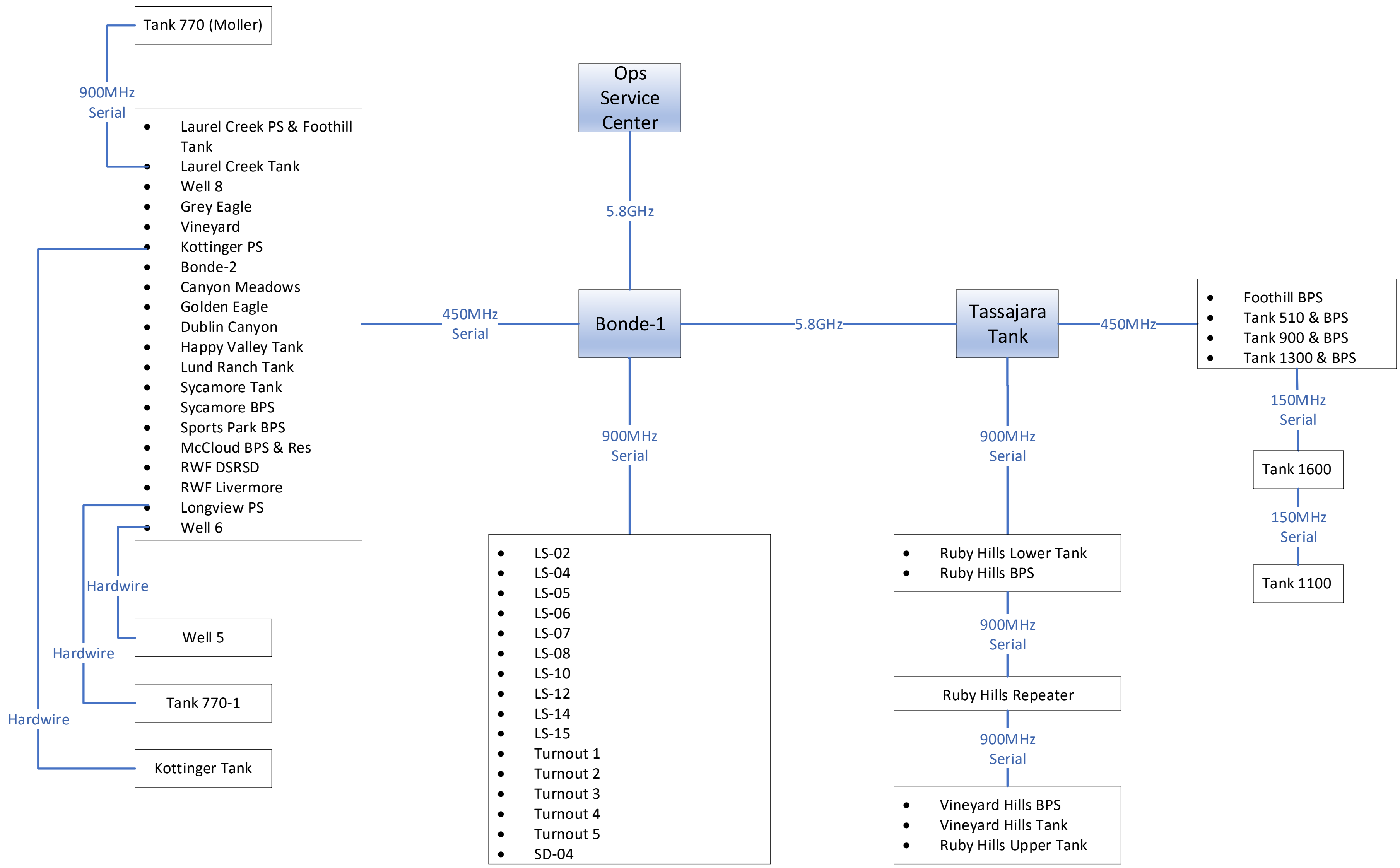
Table B1. Recommended Roles and Responsibilities

Tier	Support Description		
1	First responders. Evaluate situation and attempt basic responses.		
2	Second level response after basic troubleshooting does not resolve the issues.		
3	Issue determined to be potential hardware or application level problem.		
Category	**Equipment/Software**	**Support Responsibilities**	**Comments**
		Tier 2/3 – IT (Tier 2)/Vendor	
Control Panel Components	Programmable Logic Controller (PLCs)	Tier 1 – Utilities Tier 2 – Utilities/Vendor Tier 3 – Vendor	Includes routine program changes
Control Panel Components	Operator Interface Terminal	Tier 1 – Utilities Tier 2 – Utilities/Vendor Tier 3 – Vendor	
Instrumentation and Equipment	Instrumentation (Flow, pressure, etc.)	Tier 1 – Utilities Tier 2 – Utilities/Vendor Tier 3 – Vendor	
Equipment	Pumps/Valves	Tier 1 – Utilities Tier 2 – Utilities/Vendor Tier 3 – Vendor	
Instrumentation and Equipment	Control Panel Uninterruptible Power Supply (UPS)	Tier 1 – Utilities Tier 2 – Utilities/Vendor Tier 3 – Vendor	
Instrumentation and Equipment	Motor Control Center (MCC) Variable Frequency Drive (VFD)	Tier 1 – Utilities Tier 2 – Utilities/Electrical Contractor Tier 3 – Electrical Contractor/Vendor	
Security	Intrusion Detection	Tier 1 – Utilities Tier 2 – Utilities/Vendor Tier 3 – Vendor	Captured via PLC and HMI systems.
FUTURE TO-BE	Remote network communications		

APPENDIX C

As-Is Radio Communications

As-is Communications Design



No communications:

- LS-13
- SD-1,2,3
- TO-6,7 (flow metered at respective pump stations)

Appendix E

SCADA Program Implementation Plan

Project ID	Project Title	Near-Term / Long-Term	Project Cost (Incl. 30% Contingency)	Escalation (4% x 5 years)	Estimated Total Project Cost	Executed in Combination with other project(s)	Notes
PHASE 1: Near-Term Projects							
P1-1	**Network Architecture Improvements**	**Near-Term**	**$780,000**	**$156,000**	**$936,000**		Includes network study, design, and implementation
P1-2	**Backup Core SCADA Server Relocation**	**Near-Term**	**$162,500**	**$32,500**	**$195,000**		
P1-3	**Remote Access Improvements**	**Near-Term**	**$286,000**	**$57,200**	**$343,200**		Includes evaluation, selection, and implementation
P1-4	**OT System Monitoring Implementation Project**	**Near-Term**	**$650,000**	**$130,000**	**$780,000**		Includes evaluation, selection, and implementation
P1-5	**SCADA Standards Development**	**Near-Term**	**$130,000**	**$26,000**	**$156,000**		
P1-6	**RTU Replacements**	**Near-Term**	**$21,013,200**	**$4,202,640**	**$25,215,840**	**P1-1.2, P1-3.2**	Update Control Strategies and Cabinet Drawings during PLC site upgrades. See Standards, P2-1.
P1-6.1	Bonde 1 Reservior	Near-Term	$694,200	$138,840	$833,040		
P1-6.2	Tassajara Recyc. Water Reservior	Near-Term	$694,200	$138,840	$833,040		
P1-6.3	Turnout 1	Near-Term	$585,000	$117,000	$702,000		
P1-6.4	Turnout 2	Near-Term	$585,000	$117,000	$702,000		
P1-6.5	Turnout 3	Near-Term	$585,000	$117,000	$702,000		
P1-6.6	Turnout 4	Near-Term	$585,000	$117,000	$702,000		
P1-6.7	Turnout 5	Near-Term	$585,000	$117,000	$702,000		
P1-6.8	Vineyard Pump Station	Near-Term	$694,200	$138,840	$833,040		
P1-6.9	Longview Pump Station	Near-Term	$694,200	$138,840	$833,040		
P1-6.10	770-1 Reservior	Near-Term	-	-	-		Shared PLC Longview PS
P1-6.11	Knottinger Ranch Pump Station	Near-Term	$694,200	$138,840	$833,040		
P1-6.12	Knottinger Ranch Reservior	Near-Term	-	-	-		Shared PLC Knottinger PS
P1-6.13	Santos Ranch 510 Pump Station	Near-Term	$694,200	$138,840	$833,040		
P1-6.14	510 Reservior	Near-Term	-	-	-		Shared PLC Santos Ranch 510 PS
P1-6.15	Kilkare 900 Pump Station	Near-Term	$694,200	$138,840	$833,040		
P1-6.16	900 Reservior	Near-Term	-	-	-		Shared PLC Kilkare 900 PS
P1-6.17	Kilkare 1300 Pump Station	Near-Term	$694,200	$138,840	$833,040		
P1-6.18	1300 Reservior	Near-Term	-	-	-		Shared PLC Kilkare 1300 PS
P1-6.19	Foothill Pump Station	Near-Term	$694,200	$138,840	$833,040		
P1-6.20	Foothill Reservior	Near-Term	$694,200	$138,840	$833,040		
P1-6.21	Laurel Creek Pump Station	Near-Term	$694,200	$138,840	$833,040		
P1-6.22	Laurel Creek Reservior	Near-Term	$694,200	$138,840	$833,040		
P1-6.23	Ruby Hill Pump Station	Near-Term	$694,200	$138,840	$833,040		
P1-6.24	Lower Ruby Hill Reservior	Near-Term	$694,200	$138,840	$833,040		
P1-6.25	Upper Ruby Hill Reservior	Near-Term	$694,200	$138,840	$833,040		
P1-6.26	North Sycamore Pump Station	Near-Term	$694,200	$138,840	$833,040		
P1-6.27	Sycamore Reservior	Near-Term	$694,200	$138,840	$833,040		
P1-6.28	Dublin Canyon Pump Station	Near-Term	$694,200	$138,840	$833,040		
P1-6.29	Dublin Canyon Reservior	Near-Term	$694,200	$138,840	$833,040		
P1-6.30	Vineyard Hills Pump Station	Near-Term	$694,200	$138,840	$833,040		

Project ID	Project Title	Near-Term / Long-Term	Project Cost (Incl. 30% Contingency)	Escalation (4% x 5 years)	Estimated Total Project Cost	Executed in Combination with other project(s)	Notes
P1-6.31	Vineyard Hills Reservior	Near-Term	$694,200	$138,840	$833,040		
P1-6.32	S-2 SLS	Near-Term	$585,000	$117,000	$702,000		
P1-6.33	S-4 SLS	Near-Term	$585,000	$117,000	$702,000		Assumed representative of S-2, S-5, S-10, S-14, S-15.
P1-6.34	S-5 SLS	Near-Term	$585,000	$117,000	$702,000		
P1-6.35	S-10 SLS	Near-Term	$585,000	$117,000	$702,000		
P1-6.36	S-14 SLS	Near-Term	$585,000	$117,000	$702,000		
P1-6.37	S-15 SLS	Near-Term	$585,000	$117,000	$702,000		
Phase 2: Long-Term Projects							
P3-1	**RTU Replacements**	**Long-Term**				**P1-6**	Update Control Strategies and Cabinet Drawings during PLC site upgrades. See Standards, P2-1.
P3-1.1	Laurel Creek Pump Station	Long-Term					
P3-1.2	Foothill Reservior	Long-Term					Shared PLC Laurel Creek PS
P3-1.3	Greyeagle Pump Station	Long-Term					
P3-1.4	S-6 SLS	Long-Term					Assumed representative of S-7, S-8.
P3-1.5	S-7 SLS	Long-Term					
P3-1.6	S-8 SLS	Long-Term					
P3-1.7	SD-4	Long-Term					Confirm SD-4 has the newer PLC
P3-1.8	Bonde 2 Reservior	Long-Term					
P3-1.9	Happy Valley Reservior	Long-Term					
P3-1.10	Lund Reservior	Long-Term					
P3-1.11	770-2 Reservior	Long-Term					
P3-1.12	Moller Reservior	Long-Term					
P3-1.13	1600 Reservior	Long-Term					
P3-1.14	1160 Reservior	Long-Term					
P3-1.15	Well 6	Long-Term					
P3-1.16	Well 8	Long-Term					
P3-2	**RTU Installations at Sites Without SCADA**	**Long-Term**				**P3-1**	Update Control Strategies and Cabinet Drawings during PLC site upgrades. See Standards, P2-1.
P3-2.1	Turnout 6	Long-Term					
P3-2.2	Turnout 7	Long-Term					
P3-2.3	SD-1	Long-Term					Assumed representative of SD-2, SD-3.
P3-2.4	SD-2	Long-Term					
P3-2.5	SD-3	Long-Term					
P3-2.6	S-13 SLS	Long-Term					
P3-2.7	Well 5	Long-Term					
P3-2.8	Well 7	Long-Term					

Project ID	Project Title	Near-Term / Long-Term	Project Cost (Incl. 30% Contingency)	Escalation (4% x 5 years)	Estimated Total Project Cost	Executed in Combination with other project(s)	Notes
P3-2.9	Well 3	Long-Term					
P3-2.10	Well 9	Long-Term					
P3-2.11	DERWA Recyc. Water Turnout	Long-Term					
P3-2.12	Livermore Recyc. Water Turnout	Long-Term					
P3-2.13	Sports Park Recyc. Water Pump Station	Long-Term					
P3-3	**AWIA Cyber-RRA Gaps**	**Long-Term**					
P3-3.1	Develop Policies and Procedures	Long-Term					Includes: AT-3, AU-2, AU-3, AU-4, AU-6, RA-1, RA-2, AU-8, PM-4, IA-4, SC-3, SI-1, IA-10, SC-13, and SI-2.
P3-3.2	Physical Security and Access Control Improvements	Long-Term					Includes: PE-4, PE-5, PE-6, PE-7, IA-1, IA-3, IA-5, IA-6, IA-9, SC-9, SC-11, and SI-5.
P3-3.3	Cybersecurity Awareness Training	Long-Term					Includes: AT-1 and AT-2.
P3-3.4	Encryption and Data Security Improvements	Long-Term					Includes: DS-1, DS-2, SC-11, and SC-23.
P3-4	**City Training Programs**	**Long-Term**					
P3-4.1	SCADA Training	Long-Term					
P3-4.2	CCE Training	Long-Term					
P3-5	**Governance and Risk Management Initiaitives**	**Long-Term**					
P1-5.1	Preventative Maintenance Program Establishment	Long-Term					
P1-5.2	Disaster Recovery Exercises	Long-Term					Simulate system recovery from backups. Continued effort.
P1-5.3	SCADA Software Evaluation	Long-Term					To be completed every 5 years
P1-5.4	Roles and Responsibilities Definition	Near-Term					
P3-6	**SCADA Earthquake Response Preparedness**	**Long-Term**					

Concord

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Concord CA 95420
925-949-5800

Davis

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Davis CA 95618
530-756-5905

Lake Forest

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Lake Forest CA 92630
949-420-3030

Lake Oswego

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Lake Oswego OR 97035
503-451-4500

Oceanside

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Oceanside CA 92054
760-795-0365

Phoenix

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Phoenix AZ 85048
602-337-6110

Pleasanton

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Pleasanton CA 94566
925-426-2580

Sacramento

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Sacramento CA 95826
916-306-2250

San Diego

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San Diego CA 92127
858-505-0075

Santa Rosa

2235 Mercury Way, Suite 105
Santa Rosa CA 95407
707-543-8506

APPENDIX G ENERGY MASTER PLAN

FINAL REPORT | OCTOBER 2023

Energy Management Plan

PREPARED FOR

City of Pleasanton

THE CITY OF PLEASANTON

PREPARED BY

WEST YOST
Water. Engineered.

Energy Management Plan

Prepared for

City of Pleasanton

Project No. 125-70-23-21

REGISTERED PROFESSIONAL ENGINEER
DANIEL A. GROVES
No. 7454
Exp. 3-31-25
CONTROL SYSTEM ENGINEER
STATE OF CALIFORNIA

	October 5, 2023
Project Manager: Michael Gruenbaum	Date
	October 5, 2023
QA/QC Review: Daniel Groves	Date

WEST YOST
Water. Engineered.

FINAL REPORT | OCTOBER 2023

HANDLING INSTRUCTIONS

The information, records, meetings, analysis, and reporting information described in this master plan are considered confidential and exempt from applicable laws and rules requiring public access and disclosure. The following warning applies to this document:

WARNING: For Official Use Only
Information contained in this document is exempt from the Freedom of Information Act requests under:
FEDERAL: America's Water Infrastructure Act of 2018 Section 2013(b) Amendment to Safe Drinking Water Act Section 1433
STATE: California Government Code §6254(aa)-(ab)

This master plan contains highly sensitive information on the utility, its assets, and its operations. All of the information in this document and its attachments should be stored and transmitted in a manner consistent with the most confidential information currently managed by the utility. Examples include such information as personnel records and detailed information on emergency backup power assets. If the organization has a formal organization wide information security policy, it is recommended that this document receive the highest categorization of confidentiality available. In the absence of a formal organization wide information security policy, recommended handling instructions are included below.

Under no circumstances is this document to be released in response to a public records request.

General Master Plan Handling Instructions:

1. Limit the number of staff who have access to the master plan document.
2. Do not share this document with any regulatory agency.
3. Notify any sharing instructions/policies with business partners (i.e. future consultants).
   a. Non-Disclosure and Confidentiality agreements should be signed with 3rd party business partners.
   b. Master plans should only be shared with 3rd parties for the purposes of 5-year master plan updates and subsequent planning.

Physical Master Plan Copy Handling Instructions:

1. Print the absolute minimum number of copies required. Ideally, this would be a single copy.
2. Store any copies in a locked cabinet within a locked office/room.
3. Check out/Check in Procedures should be strictly documented and enforced (Information Security Policy developed).
4. At no times should a master plan be left in an unsecured location.
5. If disposal of a printed copy is required, shred and/or incinerate the entire master plan document.

Electronic Master Plan Copy Handling Instructions:

1. Password protect the directory/file. Use current password best practices.
2. Store in a directory with limited staff access.
3. If sharing is required, a secure file sharing application (e.g., SharePoint) should be used to provide temporary access. As soon as the need for sharing is complete, the file should be removed from the file sharing application.
4. The file shall not be copied.

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LIST OF ACRONYMS AND ABBREVIATIONS

A	Ampere
AACE	Advancement of Cost Engineering
AC	Alternative Current
AI	Artificial Intelligence
ATS	Automatic Transfer Switch
BESS	Battery Energy Storage Systems
BoS	Balance of System
BPS	Booster Pump Station
BTU	British Thermal Units
CAISO	California Independent System Operator
City	City of Pleasanton
CMEP	Community Microgrid Enablement Program
CPUC	California Public Utilities Commission
DC	Direct Current
DER	Distributed Energy Resource
DOL	Direct On-Line
DSRSD	Dublin San Ramon Service District
EMP	Energy Management Plan
EMS	Emergency Management System
ESS	Energy Storage System
FERC	Federal Energy Regulatory Commission
GFCI	Ground Fault Circuit Interrupter
GPM	Gallons Per Minutes
HP	Horsepower
HVAC	Heating, Ventilation, and Air Conditioning
IDPS	Intrusion Detection and Prevention Systems
ISO	Independent System Operator
ITC	Investment Tax Credit
kW	Kilowatts
kWh	Kilowatt hour
MAD	Maximum Allowable Downtime
MCC	Motor Control Center
MG	Million-Gallon
MGD	Million Gallons Per Day
MPPT	Maximum Power Point Tracking
MSB	Main Switchboard
NEM	Net Energy Metering
NREL	National Renewable Laboratory
PBI	Performance Based Incentive

PG&E	Pacific Gas and Electric Company
PQM	Power Quality Monitors
PQM	Power Quality Monitor
PRV	Pressure Relief Valve
PS	Pump Station
PSI	Pounds Per Square Inch
PSPS	Public Safety Power Shutoff
PV	Solar Photovoltaic
RTO	Recovery Time Objective
RTU	Remote Terminal Unit
RVSS	Reduced Voltage Soft Starter
SCADA	Supervisory Control and Data Acquisition
SES	Service Entrance Switchboard
SGIP	Self-Generation Incentive Program
SOC	State of Charge
SSL	Secure Socket Layer
SWP	State Water Project
TLS	Transport Layer Security
TOU	Time-of-Use
UPS	Uninterruptible Power Supply
V	Volt
VAC	Volts Alternating Current
VFD	Variable Frequency Drive
VLAN	Virtual Local Area Network
Wh	Watt-Hours
WWT	Wastewater Treatment
Zone 7	Zone 7 Water Agency

EXECUTIVE SUMMARY

The energy management plan for Pleasanton prioritizes resilience and lays the foundation for a sustainable energy future. This plan leverages Distributed Energy Resources (DERs), microgrids, Time-of-Use (TOU) management, and process control strategies to optimize energy usage and uninterrupted operations.

DERs, such as battery energy storage systems (BESS), solar photovoltaic (PV) systems and microturbines are integral components of the plan. Decentralized energy generation and storage systems enhance the reliability and sustainability of a water facility by reducing dependency on traditional energy sources and promoting the use of clean, renewable energy.

Microgrids play a vital role in enhancing resilience by creating localized energy systems that can operate independently during grid outages. With a microgrid controller managing the flow of energy, the water facility can seamlessly transition between different energy sources, enabling uninterrupted power supply and enabling efficient utilization of DERs.

Additionally, TOU management strategies are employed to optimize energy consumption based on varying electricity prices throughout the day. By using DERs to facilitate TOU arbitrage, the water facility can reduce operational expenses and contribute to grid stability.

This report covers the specific design criteria, considerations, and recommendations associated with DER integration, microgrid implementation, TOU management, and the overall energy future of Pleasanton. Through these measures, the energy management plan aims to optimize energy usage, enhance resilience, and pave the way for a more resilient and sustainable future for the City.

The City consists of 56 sites, 50 of which are associated with the City's Pacific Gas and Electric (PG&E) account. Of the 35 sites analyzed, 26 of those services have max kW less than 75kW, and 9 have a max Kw consumption between 75-499kW. Applicable tariffs are B-1, B-6, B-10. West Yost reviewed the maximum consumption per site and verified that each site falls within the appropriate tariff. Appendix D: Site Criticality summarizes site priorities in an outage scenario involving multiple sites.

West Yost performed an analysis of boundary conditions for representative sites. With input from the City, each site was assigned a maximum allowable downtime (MAD) – there are potential impacts if MAD is exceeded, including water use restrictions, inability to monitor, and sewer/storm system overflow.

The Energy Management Plan report presents a series of actionable potential projects that aim to implement renewable energy solutions and build a resilient future for Pleasanton. These projects focus on enhancing the reliability and sustainability of the energy infrastructure. Table 33 from Section 3.8: Cost Estimating and Cost Benefit Analysis provides the identified projects for representative sites along with the estimated costs for each project. For a breakdown of the costs included in the estimates, see Section 3.8.

Table 1. Cost Summary Data							
Site	BESS Power, kW	BESS Capacity, kWh	PV Power, kW	Installed Cost Including 50% Contingency, $	Potential ITC Funding (Up to 30% of Solar and BESS Costs), $	Potential SGIP Funding (Up to $850/kWh of BESS Capacity), $	Annual Maintenance Costs, $
Sycamore BPS	640	1280	50	2,648,389	794,516	938,114	20,000
Sewer Pump S-6	250	558	20	1,607,295	482,189	358,841	20,000
Tassajara Tank	5	10	5	97,500	29,250	8,500	5,000
Turnout 3	5	10	5	97,500	29,250	8,500	5,000

These projects demonstrate the commitment to building a resilient and sustainable future for Pleasanton. By implementing micro-hydro, BESS, and solar solutions, the energy infrastructure will become more reliable, creating a safer future with more ease of operations for the City.

The following general recommendations are intended to guide the design and implementation of renewable energy and energy storage systems, ensuring robustness, reliability, and resilience. By embracing these recommendations, the City can enhance the operational efficiency and sustainability of their energy infrastructure while maximizing the financial benefits through incentive programs. Key considerations include prioritizing resilience, exploring net energy metering opportunities, and leveraging incentive programs such as the Investment Tax Credit (ITC), SGIP, and Community Microgrid Enablement Program (CMEP). By following these recommendations, the City can make informed decisions and optimize the effectiveness of their renewable energy initiatives.

General Recommendations:

- Embrace a resilience-first, operations-focused design approach for all projects. Prioritize robustness, reliability, and redundancy in the design and implementation of renewable energy and energy storage systems. Consider the specific operational requirements and criticality of each site to ensure the energy infrastructure can effectively withstand and recover from disruptions and emergencies.
- Apply for Net Energy Metering (NEM) with PG&E for all sites that would have excess generation from solar systems or other generating resources. Engage in discussions with PG&E to understand the specific requirements and procedures for NEM enrollment. Analyze NEM program eligibility criteria, including system size limitations and interconnection requirements, to ensure alignment with program guidelines. Maximize the financial benefits and operational efficiency of the projects by leveraging the potential incentives provided through NEM.
- Explore and apply to incentive programs such as the ITC under the Inflation Reduction Act, SGIP, and CMEP. These programs can provide financial support and incentives to offset the costs of implementing renewable energy and energy storage solutions. Thoroughly research program requirements, eligibility criteria, and application procedures to optimize the utilization of available incentives.

The Energy Management Plan (EMP) serves as a strategic framework for the City's energy resilience. It emphasizes the role of pilot sites, which are integral to the implementation, usage, and maintenance of DER.

These pilot sites, chosen to reflect diverse conditions and challenges, are equipped with various DER technologies such as BESS, solar panels, and micro-hydro turbines. Monitoring and evaluation of these technologies are essential to gather data and insights.

The success of the pilot sites is vital in validating the feasibility of DER and in deriving lessons to enhance strategies and techniques for DER implementation. Insights from successful pilots contribute to the development of City standards for DER, ensuring safe, reliable, and efficient systems.

The EMP, as a dynamic document, directs the City towards a sustainable energy future, allowing for continuous refinement. It embodies a comprehensive approach to energy management, laying the groundwork for resilience, innovation, and sustainability in the City's energy landscape.

1.0 INTRODUCTION

The City of Pleasanton (City), located in Alameda County, California, covers an area of 24.3 square miles and is surrounded by Interstate 580 on the north, Isabel Avenue on the east, Highway 84 on the south, and Pleasanton Ridge on the west. The city provides water service to around 79,000 customers, including incorporated areas within the city and unincorporated areas in Kilkare Canyon and the northern part of Sunol Valley.

The City’s three groundwater wells are undergoing decommissioning. To meet its water demand, Pleasanton purchases 100 percent of its water supply from the Zone 7 Water Agency (Zone 7), which is a State Water Project (SWP) contractor. Zone 7 supplies treated water to four retail water agencies, including Pleasanton, Dublin San Ramon Service District (DSRSD), City of Livermore, and Cal Water Livermore District. Zone 7 primarily relies on imported surface water, which accounts for more than 80 percent of its largest water source. The SWP water mainly comes from the Feather River watershed, is collected from Lake Oroville, and flows through the Delta before being conveyed by the South Bay Aqueduct to Zone 7 and other SWP contractors. After filtering and disinfecting the surface water supply, Zone 7 distributes it to its retailers.

The City's water distribution system consists of 18 pressure zones, including storage tanks, pressure reducing stations, and pump stations. The system is operated on a weekly fill/draw cycle, with tanks being filled from Thursday through Monday and drained from Monday through Wednesday. This operation method allows for the required turnover of water in the storage tanks to mitigate the potential for nitrification. The City is limited to purchasing 3,500-acre-feet per year of groundwater from Zone 7, which is equivalent to an average daily production of 3.12 million gallons per day (MGD).

The City has a recycled water program that provides approximately 1,800-acre-feet per year of non-potable water supply for large landscapes and sports fields. Pleasanton has constructed approximately 54,000 linear feet of recycled water pipeline connecting DSRSD's Recycled Water Treatment Facility to the Tassajara Reservoir, an 8 million-gallon (MG) City-owned former potable water tank converted to a recycled water reservoir.

2.0 BASELINE ASSESSMENT

The baseline assessment describes the current state of City infrastructure pertaining to distributed energy resources (DERs). Assessments were performed for the purpose of identifying areas of recommended improvement or future optimization.

West Yost conducted site visits on February 22 and 23, 2023 and was accompanied by operations staff who answered questions about operations and potential improvements. For the sites that were visited in person, a more in-depth analysis is presented, including detailed analysis of the electrical infrastructure and a summary of the site. In cases where site visits were not possible, the energy utilization profile is broken down in a chart based on interval data retrieved from UtilityAPI.

The major topics addressed in this report include the following:

- Site Visit Overview
- Representative Site Profiles: Electrical Summary and Energy Overview
- Representative Sites: Boundary Conditions
- Representative Sites: Energy Cost Analysis
- System-Wide Outage Impact Evaluation and Energy Profile

2.1 PG&E Tariffs

An analysis was conducted on the Pacific Gas and Electric (PG&E) tariffs at each of the selected water facilities. The analysis involved gathering information on the usage of each facility and ensuring the kW usage corresponded with the assigned tariff criteria.

Table 1 below provides a high-level overview of all sites and verifies the rate tariffs as requested by the City.

Table 2. City Sites

Site	Tariff	Max kW	Notes
Sewer Pump Station S-1	N/A	N/A	Station out of service; PG&E disconnected
Sewer Pump Station S-2	B1	5.25	-
Sewer Pump Station S-3	B1	N/A	No available interval data in UtilityAPI
Sewer Pump Station S-4	N/A	N/A	Billed to nearby commercial district
Sewer Pump Station S-5	N/A	N/A	No available interval data in UtilityAPI
Sewer Pump Station S-6	B6	54.4	-
Sewer Pump Station S-7	B6	47.42	-
Sewer Pump Station S-8	B6	85.92	Exempt from 75 kW review
Sewer Pump Station S-9	B1	0	-
Sewer Pump Station S-10	N/A	N/A	Billed to Alameda County
Sewer Pump Station S-11	N/A	N/A	Station out of service; PG&E disconnected
Sewer Pump Station S-12	B10	N/A	No available interval data in UtilityAPI

Table 2. City Sites			
Site	Tariff	Max kW	Notes
Sewer Pump Station S-13	N/A	N/A	OSD PD Target Range paid by Support Service
Sewer Pump Station S-14	B6	30.76	-
Sewer Pump Station S-15	B1	19.29	-
Storm Pump Station SD-1	B1	12.94	-
Storm Pump Station SD-2	B1	13.74	-
Storm Pump Station SD-3	B1	124.96	Exempt from 75kW review
Storm Pump Station SD-4 (Electric)	B1	12.66	-
Dublin Canyon Booster Station	B6	149.76	Exempt from 75kW review
Foothill Booster Station	B6	N/A	No available interval data in UtilityAPI
Grey Eagle Booster Station	B6	64.64	-
Kottinger Ranch Booster Station	B6	56.64	-
Laurel Creek Booster Station	B6	N/A	No available interval data in UtilityAPI
Longview Booster Station	B6	122.56	-
McCloud Booster Station	B6	2.88	-
Ruby Hill Booster Station	B6	169.92	Exempt from 75 kW review
Sycamore Booster Station	B6	218.24	Exempt from 75 kW review
Tank 1300 Booster Station	B10	91.94	-
Tank 510 Booster Station	B10	112	-
Tank 900 Booster Station	B10	27.04	-
Vineyard Booster Station	B6	90.56	Exempt from 75 kW review
Vineyard Hills Booster Station	B6	128	Exempt from 75 kW review
Turnout 1	B1	1.16	-
Turnout 2	B1	N/A	No available interval data in UtilityAPI
Turnout 3	B1	1.63	-
Turnout 4	—	N/A	Billed to Zone 7
Turnout 5	B1	1.1	-
Wells 5 & 6	B6	N/A	Decommissioned
Well 7	B6	N/A	Decommissioned
Well 8	B6	N/A	Decommissioned
Bonde 1 Tank	B1	1.06	-
Bonde 2 Tank	B1	0.06	-
Dublin Canyon Tank	B1	N/A	No available interval data in UtilityAPI
Golden Eagle Tank	B1	1.4	-
Happy Valley Golf Course Tank	B1	0.36	-

Table 2. City Sites			
Site	Tariff	Max kW	Notes
Kottinger Ranch Tank	B1	N/A	No available interval data in UtilityAPI
Laurel Creek Tank	B1	2.23	-
Lower Ruby Hill Tank	B1	0.45	-
Lund Tank	B1	N/A	No available interval data in UtilityAPI
Moller Tank	B1	0.46	-
Sycamore 8MG Tank	B1	17.1	-
Tassajara Tank	B1	0.8	-
Upper Ruby Hill Tank	B1	1.45	-
Vineyard Hills Tank	B1	0.15	-

The B-1 tariff is a small general service tariff offered by PG&E that is applicable to customers with a maximum demand of up to 75 kW for three consecutive months. This tariff is designed for small businesses or residential customers who have relatively lower electricity consumption. It utilizes a standard rate structure with tiered pricing, meaning that the electricity usage is divided into different tiers. As the consumption increases, customers move into higher tiers, which have higher rates.

In contrast, the B-6 tariff is a small general time-of-use (TOU) service tariff also applicable to customers with a maximum demand of up to 75 kW for three consecutive months. However, there is an exception to this rule. If customers were previously enrolled in the A-6 tariff and are grandfathered in, they can continue to use the B-6 tariff and be exempt from the 75kW review. The B-6 tariff encourages customers to take advantage of lower electricity rates during off-peak hours. It means that the pricing varies based on the time of day and day of the week. Typically, off-peak hours occur during the night when electricity demand is lower.

Lastly, the B-10 tariff is designed for customers with a maximum demand ranging from 75 kW to 499 kW. It caters to commercial and industrial customers with relatively higher electricity consumption needs. The B-10 tariff utilizes a demand-based pricing structure, which means it includes a demand charge based on the highest average electricity usage within a specified period. In addition to the demand charge, there are energy charges that apply based on the actual electricity consumed. This tariff allows businesses to manage and control their peak demand to optimize energy costs and is suitable for larger-scale operations.

Table 2 provides a breakdown of PG&E TOU periods pertaining to the B-1, B-6 and B-10 tariffs.

Table 3. B-1, B-6, B-10S TOU		
B-1		
Summer (June-September)		
Peak	4:00 pm to 9:00 pm	Every day, including weekends and holidays
Partial-Peak	2:00 pm to 4:00 pm and 9:00 pm to 11:00 pm	Every day, including weekends and holidays
Off-Peak	All other hours	-
Winter (October-May)		
Peak	4:00 pm to 9:00 pm	Every day, including weekends and holidays
Super Off-Peak	9:00 am to 2:00 pm	Every day in March, April and May only, including weekends and holidays
Off-Peak	All other hours	-
B-6		
Summer (June-September)		
Peak	4:00 pm to 9:00 pm	Every day, including weekends and holidays
Off-Peak	All other hours	-
Winter (October-May)		
Peak	4:00 pm to 9:00 pm	Every day, including weekends and holidays
Super Off-Peak	9:00 am to 2:00 pm	Every day in March, April and May only, including weekends and holidays
Off-Peak	All other hours	-
B-10S		
Summer (June-September)		
Peak	4:00 pm to 9:00 pm	Every day, including weekends and holidays
Partial-Peak	2:00 pm to 4:00 pm and 9:00 pm to 11:00 pm	Every day, including weekends and holidays
Off-Peak	All other Hours.	-
Winter (October-May)		
Peak	4:00 pm to 9:00 pm	Every day, including weekends and holidays
Super Off-Peak	9:00 a.m. to 2:00 p.m.	Every day in March, April and May only, including weekends and holidays
Off-Peak	All other Hours.	-

This table will serve as a benchmark for comparing energy usage patterns at each representative site against the TOU periods specified in the site tariff. This methodology applies to sites with higher power consumption such as booster pump stations and sewer lift stations. To analyze site specific energy usage patterns, see Appendix C: TOU Heat Maps.

2.2 Site Visit Overview

During the site visits, the West Yost team members assessed the electrical infrastructure and physical layout for hosting DERs at each of the sites. The selection of the sites was based on the objective of obtaining comprehensive representation of the complete utility system. Table 3 is a summary of the representative site data.

Table 4. Representative Site Data

Site	Function	Address
Laurel Creek Booster	Potable Booster Pump Station	5800 Foothill Rd
Vineyard BPS	Potable Booster Pump Station	3502 Vineyard Ave
Grey Eagle Booster	Potable Booster Pump Station	55 Red Feather Ct
Sewer Pump S-6	Sewer Lift Station	6900 W Las Positas
Sewer Pump S-4	Sewer Lift Station	1065 Serpentine Ln
Turnout 3	Potable Turnout	3699 W Las Positas
Tassajara Tank	Recycled Water Storage Tank	5450 Tassajara Dr
Bonde 1 Tank	Potable Storage Tank	900 Abbie St
1600 Tank	Remote Potable Storage Tank	N/A
SD-1	Storm Pump Station	4950 Bernal Ave

2.3 Representative Site Profiles: Electrical Summary and Energy Overview

This section presents key information related to booster pump stations, sewer lift stations, turnouts, storage tanks, and storm pump stations. Electrical assessments and energy utilization and outage profiles are presented for each facility evaluated.

2.3.1 Potable Water Booster Pump Stations

The City operates multiple booster stations that are essential for maintaining a reliable water distribution system. These booster stations employ pumps, motors, control panels, and other equipment to regulate water pressure and flow, ensuring that residents and businesses have a steady supply of water.

2.3.1.1 Laurel Creek Pump Station and Foothill Tank

The Laurel Creek BPS pumps from the Zone 7 filled 8 MG Foothill Tank into the Moller Zone on the northwest side of Pleasanton. Laurel Creek BPS is the only distribution pump station that services the Moller 770 Zone and is considered a priority 2 site for power outages.

The site has a notable footprint, featuring distinct, sizable, fenced areas that encompass both the tank and pump building. Of note is the enclosure surrounding the tank, which is devoid of tree cover and characterized by a flattened earth perimeter within a secure fence. Figure 1 provides an aerial view of the site.

A new chemical trailer was installed recently as solution to prevent nitrification in the tank. There is an active initiative within the City to eventually erect a permanent structure to replace the trailer. The addition of the chemical trailer allowed the City to change their operational strategy, where previously they would have to ensure required turnover of water in the tank. If the chemical trailer were to lose power, operators could resort to their former operational strategy while a solution is found. The City has placed a strong emphasis on ensuring that the site can maintain a reliable and uninterrupted power supply in order to accommodate the new operational standards that the site will need to meet in the coming years.

Figure 1. Laurel Creek BPS Site Overview

2.3.1.1.1 Electrical

The BPS operates on three-phase, 300A 480V, underground-fed PG&E power from the locked PG&E service entrance and main switchboard (MSB) located outside the building. From the MSB, power flows through an ATS which is also connected to a fixed 223kW diesel generator before entering the motor control center (MCC).

The MCC powers three RVAT-controlled 50 horsepower (HP) pumps, which are arranged in a lead/lag/standby configuration. The MCC also powers the Foothill Tank inlet valve and a 480 volt (V) to 120/240V step-down transformer that feeds to a 120/240V panelboard.

The 120/240V panelboard supplies power to the lighting and receptacle circuits, motor heaters for the pumps, and other miscellaneous loads.

The fixed Cat™ diesel generator, located in the east room of the pump building, has a rated output of 223 kW and can run the whole station at full capacity during an outage. The diesel storage tank is filled by the City and the level in the tank is checked manually using a dip stick. The tank is filled on an as-needed basis.

The chemical trailer is fed by three phase, 480V PG&E power from the Laurel Creek BPS main switchboard. Power flows into a 480 volts alternating current (VAC), 100-Ampere (A) panel board which powers a 1HP metering variable frequency drive (VFD) and metering pump, a 480V to 120/240V step down transformer that powers a 120/240V, 125A panel board, and a 9.6KVA transformer that feeds a 480V cam-lock for a portable generator connection.

The 120/240VAC panel board powers the PLC panel and 1/2HP blower, mixer panel and 3HP mixer, 1HP sample pump, lighting and receptacle circuits, and two 15,000 British Thermal Units (BTU) air handlers.

2.3.1.1.2 Energy Utilization

Due to PG&E error this account was deactivated. Although it has been reactivated, the interval data was unavailable in UtilityAPI. The kilowatt hour (kWh) calculations in Table 4 below are based on monthly billing data covering 21 months, February 2021 to October 2022.

Table 5. Laurel Creek BPS Energy Profile

kWh	Maximum	Average	Minimum
Monthly kWh	18,575.56	10,639.38	4,268.32

A thorough analysis of load shifting opportunities at the site could not be performed due to the unavailability of energy interval data. Without interval data, it is difficult to accurately assess the patterns of energy usage at the site and determine when load shifting strategies would be most effective.

2.3.1.2 Vineyard BPS

Vineyard BPS is one of three other booster stations including Vineyard Hills BPS and North Sycamore BPS that fills the several storage tanks within the Bonde Zone on the east side of Pleasanton. The City has marked the site to have a high probability for renovation.

Although there are multiple pump stations to feed this zone that provide redundancy, the City has indicated that criticality of this station has increased with McCloud Pump Station (PS) out of service and with the desire by operations in the future to break the larger zone into more discretely operated subzones. The City considers this a priority 2 site for power outages. The site footprint is relatively small, shaded by trees, and is located adjacent to a busy roadway. Figures 2 and 3 present an aerial and ground level front facing view of Vineyard BPS.

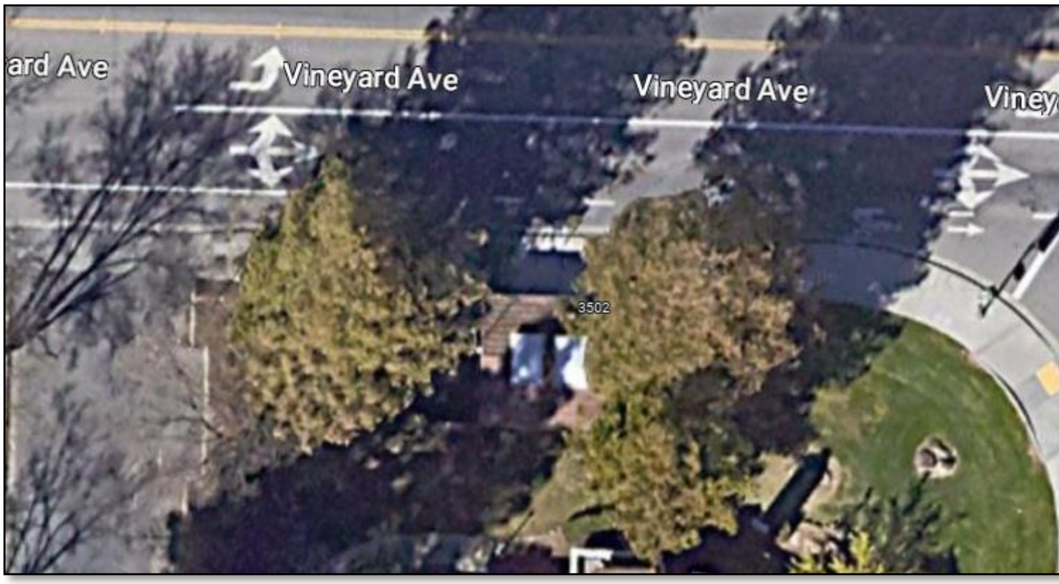


Figure 2. Vineyard BPS Site Overview

Figure 3. Vineyard BPS Site Overview — Street View

2.3.1.2.1 Electrical

Three phase, 400A, 480V PG&E power flows from the service entrance and meter through a manual transfer switch for a portable generator connection into the MCC. The MCC powers two 60HP reduced voltage soft starter (RVSS) pumps that operate in a lead/lag configuration and a 480V – 208V step down transformer that powers a 208V panelboard.

The 208V panelboard powers the lights, receptacles, sump pump, control circuits, and other miscellaneous loads.

The portable generator connection is compatible with the 150 kW rental generators that the City keeps stored at various sites throughout the City.

2.3.1.2.2 Energy Utilization

Table 5 presents energy utilization data covering 24 months from March 2021 to February 2023.

Table 6. Vineyard BPS Energy Profile

kWh/kW	Maximum	Average	Minimum
Daily kWh	1,475.72	312.05	6.04
Monthly kWh	16,374.02	9,024.93	2,757.24
15 Minute kW	90.56	13.00	0.16
Note: There were no outages during the 24-month period.			

After analyzing the energy consumption patterns at the pump station, it has been observed that the energy usage does not entirely align with the most favorable TOU windows specified under tariff B6, particularly during the summer season. The energy consumption during peak hours, which are from 4:00 pm to 9:00 pm, is relatively high, resulting in increased energy costs due to the higher rates charged during these hours.

2.3.1.3 Grey Eagle Pump Station

The Grey Eagle pump station is located in a residential area and was intended to be temporary but is still in operation and is now considered a permanent facility. The pump station supplies water to 33 homes in the Grey Eagle Zone. This City considers this a priority 2 site for power outages.

The footprint of the site is minimal, with a small, fenced area containing a hydro pneumatic tank and the backup generator. The roof area is relatively small but is well irradiated throughout the day. Figure 4 presents and aerial view of Grey Eagle BPS.

Figure 4. Grey Eagle BPS Site Overview

2.3.1.3.1 Electrical

Three phase, 600A, 480V power flows from a nearby PG&E transformer through the service entrance to the automatic transfer switch (ATS), which is also connected to a 60kW fixed diesel generator. Power then flows from the ATS to the MCC.

The MCC powers two 10HP RVSS pumps for normal operation, a 100HP RVSS fire flow pump, and a 9KVA step down transformer that feeds power into the 208V lighting panel.

The 208V lighting panel powers the lighting and receptacle circuits, MCC control circuits, flow meter, generator block heater, and other miscellaneous loads.

The City indicated that the current stationary generator is rated at 60kw and is not sized to run the fire flow pump.

2.3.1.3.2 Energy Utilization and Outage Profile

Table 6 presents energy utilization data covering 36 months from February 2020 to January 2023.

Table 7. Grey Eagle BPS Energy Profile			
kWh/kW	Maximum	Average	Minimum
Daily kWh	125.84	67.69	38.40
Monthly kWh	3,386.60	2,030.72	353.60
15 Minute kW	64.64	2.83	0.96
Note: There were no outages during the 36-month period.			

After analyzing the energy consumption patterns at the pump station, it has been observed that the energy usage does not entirely align with the most favorable TOU windows specified under tariff B6, particularly during the summer season. The energy consumption during peak hours, which are from 4:00 pm to 9:00 pm, is relatively high, resulting in increased energy costs due to the higher rates charged during these hours.

2.3.2 Sewer Lift Stations

The City operates several lift stations that play a critical role in the transportation of wastewater from lower to higher elevations in the city's sewer system. These lift stations are equipped with pumps, motors, control panels, and other equipment that work together to pump the wastewater up to a higher elevation where it can continue to flow by gravity.

2.3.2.1 S-6 Sewage Lift Station

The S-6 lift station is a conveys a major portion of City sewage to the DSRSD Wastewater Treatment (WWT) and therefore is considered a priority 1 site for power outages. During the site visits, the City indicated that S-6 exemplifies the City's vision for its lift stations, including S-7 and S-8. S-6 is relatively modern compared to other sites in the City's portfolio.

There are several measures in place for redundancy at the site, including the existing fixed backup generator and the ability for S-7 to take flows from S-6 in the event of an outage.

A medium sized fenced area encloses a small building that hosts the electrical room and generator room. The site is well irradiated throughout the day. Figure 5 presents an aerial view of Sewer Lift Station S-6.

Figure 5. Sewer Lift Station S-6 Site Overview

2.3.2.1.1 Electrical

The site is powered by a 400A 480V PG&E supply that flows from a utility power pole through the service entrance. The main breaker in the MSB is KIRK-key interlocked with a spare breaker on the switchboard bus, which can be connected to a 150 kW portable generator in case of a power emergency.

From the MSB, power flows through an ATS that is also connected to a fixed 200kW diesel generator before entering the MCC. The MCC powers a system of five 20HP VFD-controlled pumps and a 480V to 208V step-down transformer that powers the 208V lighting panel.

The 208V lighting panel powers the lights and receptacles, heating, ventilation, and air conditioning (HVAC) system, control circuits, and other miscellaneous loads.

In the event of an outage, the existing fixed 200kW generator can fully power the site. The 200-gallon diesel storage tank is filled and maintained by the City on an as-needed basis. There is a Loadtec ODL2-0100.1 480V, three phase, three wire 100kW load bank available for simulating electrical loads on the generator.

2.3.2.1.2 Energy Utilization

Table 7 presents utilization data covering 36 months from February 2020 to January 2023.

Table 8. Sewer Lift Station S-6 Energy Profile			
kWh/kW	Maximum	Average	Minimum
Daily kWh	1,043.36	343.83	242.87
Monthly kWh	15,410.20	10,246.67	1,583.84
15 Minute kW	54.40	14.36	6.08

After analyzing the energy consumption patterns at the lift station, it has been observed that the energy usage does not entirely align with the most favorable TOU windows specified under tariff B6, particularly during the summer season. The energy consumption during peak hours, which are from 4:00 pm to 9:00 pm, is relatively high, resulting in increased energy costs due to the higher rates charged during these hours.

2.3.2.2 S-4 Sewage Lift Station

The S-4 Sewage Lift Station is a small lift station that services a nearby commercial district and is equipped with two small pumps and a portable generator connection. It has a small footprint with significant tree cover and is considered a priority 2 site by the City with a 4 – 8 hour recovery time objective (RTO). In an outage scenario involving multiple sites, S-4 would take low priority due to low flows at the site and the ability to use a vacuum truck to prevent an overflow during an outage. Figures 6 and 7 provide an aerial and front facing ground view of Sewer Lift Station S-4.

Figure 6. Sewer Lift Station S-4 Site Overview

Figure 7. Sewer Lift Station S-4 Front View

2.3.2.2.1 Electrical

Three phase, 4 wire delta 480V PG&E power flows from the service entrance through a transfer switch and a 480V delta to 208/120V step-down transformer to the 120/240V G1224ML3125CU Siemens main panel board within the control building, which powers the lights, receptacles, uninterruptible power supply (UPS), and two RVSS controlled 3HP sewage pumps.

The current utilization of the portable generator connection is infrequent at best, with precedence given to other sites during power outages that impact multiple locations.

2.3.2.2.2 Energy Utilization and Outage Profile

Because the PG&E account for the site is not City-owned, we were unable to obtain the actual energy usage data for the site. Therefore, we had to rely on estimations based on the known equipment and its estimated operating hours. While these estimations provide a rough estimate of the energy usage, it should be noted that the actual energy usage may differ from these estimates due to factors such as equipment efficiency, varying operating conditions, and other unforeseen variables.

To estimate the daily energy usage of the S-4 lift station, we used the formula:

$$\text{Energy (kWh)} = \text{Power (kW)} \times \text{Time (hours)}$$

The two 3HP sewage pumps in the station have a total estimated power consumption of 4.5 kW (two 3HP pumps x 2.24 kW per 1HP). Assuming each pump runs for an average of 30 minutes per day, the daily energy usage for the pumps alone would be:

Energy (kWh) = Power (kW) x Time (hours) = 4.5 kW x 0.5 hours = 2.25 kWh

For the miscellaneous loads, we estimated a total power consumption of 0.1 kW. Assuming these loads run continuously for 24 hours, the daily energy usage for the miscellaneous loads would be:

Energy (kWh) = Power (kW) x Time (hours) = 0.1 kW x 24 hours = 2.4 kWh

Therefore, the total estimated daily energy usage for the S-4 lift station would be:

Total Energy (kWh) = Energy from pumps (kWh) + Energy from miscellaneous loads (kWh)
= 2.25 kWh + 2.4 kWh = 4.65 kWh

It is important to note that this is preliminary estimate and actual energy consumption may vary based on factors such as pump efficiency, variations in daily operation times, and maintenance issues. However, this estimate provides a baseline for understanding the energy consumption of the site and can be useful in identifying opportunities for energy efficiency improvements and exploring the potential for implementing distributed energy resources.

Unfortunately, a thorough analysis of load shifting opportunities at the site could not be performed due to the unavailability of energy data. Without energy data, it is difficult to accurately assess the patterns of energy usage at the site and determine when load shifting strategies would be most effective.

2.3.3 Potable Water Turnouts

The turnouts are currently the sole source of water supply for the City. Turnout 3 was identified as a representative configuration of Turnouts 1-5, all of which are considered priority 1 sites for power outages.

2.3.3.1 Turnout 3

The site consists of a control valve with a discharge pressure of 60 pounds per square inch (PSI) and flows fluctuating between 100 gallons per minute (GPM) and 5000 GPM. Additionally, there is a fluoride treatment system and chemical feed pump, a TESCO control panel, and a radio system. The control valve and associated equipment is owned by Zone 7, though the PG&E meter and service entrance is shared with the City. The City is the PG&E account holder for the site and bears the entire cost of energy consumption.

The City has marked the site as a high priority for a complete renovation. Currently, there is limited space for additional equipment in the interior of the building. It should be noted that the site is located next to a bus stop in a highly trafficked area, raising concerns about the potential for tampering with outdoor equipment. Figure 8 presents an aerial view of Turnout 3.

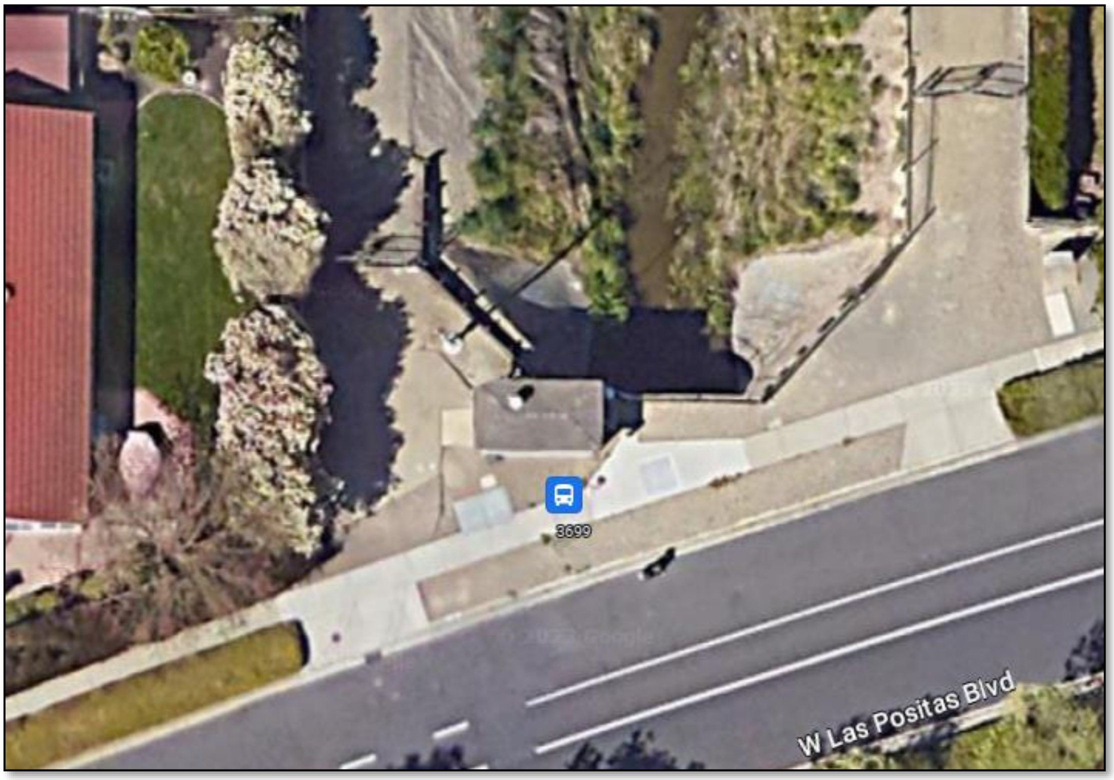


Figure 8. Turnout 3 Site Overview

2.3.3.1.1 Electrical

The site operates on a single-phase, 3-wire 120/240V, 200A electrical system from an underground PG&E power feed. The meter and service entrance are shared by the City and Zone 7.

On the City side, PG&E power flows from a 100A main breaker in the service entrance panel to a City-owned 100A internal subpanel. The internal subpanel showed signs of decay, which West Yost staff thought was caused by its proximity to the fluoride system. The only existing loads in the subpanel are the UPS/RTU, the chemical feed pump for fluoride treatment, lights, outlets, analyzers, and an irrigation repeater.

On the Zone 7 side, PG&E power flows from a single-pole, 40A breaker in the service entrance to the pressure relief valve (PRV) control panel and associated equipment.

The City indicated that backup power is easy to obtain, with an S2000 Honda 2000w generator being sufficient to power the site. Backup power from the City does not power the Zone 7-owned PRV and control panel. There is no generator connection at the site. The current portable generator backup configuration only provides power to the City side of the power system. There are no other generation sources at the site.

2.3.3.1.2 Energy Utilization

Table 8 presents energy utilization data covering 36 months from February 2020 to January 2023.

Table 9. Turnout 3 Energy Profile

kWh/kW	Maximum	Average	Minimum
Daily kWh	16.61	7.08	5.63
Monthly kWh	263.33	211.54	33.70
15 Minute kW	1.63	0.30	0.28

2.3.4 Storage Tanks

In radio network architecture, the storage tanks serve as the backbone. Specifically, the Tassajara Tank and Bonde 1 Reservoir together act as relay back to central Supervisory Control and Data Acquisition (SCADA) for 100 percent of the City's sites, ensuring reliable communication across the network.

A series of sequential storage tanks are located at increasing elevations along Pleasanton Ridge, culminating with the remote 1600 Tank on the western side of Pleasanton that services the Kilkare Canyon area.

2.3.4.1 Tassajara Recycled Water Tank

While the Tassajara Recycled Water Tank itself is not itself considered highly critical by the City, the site radio system acts as a relay back to SCADA for about 10 percent of the City's sites thus making it a priority 1 site for power outages. All of the site equipment and control panels are located in an underground vault. Much of the equipment was retired when the reservoir was converted to a recycled water reservoir, including the washdown pump located within the vault.

Figure 9. Tassajara Recycled Water Tank Site Overview

2.3.4.1.1 Electrical

PG&E electrical service to the site is underground fed from a nearby PG&E transformer. The PG&E service entrance and meter is located adjacent to the south side of the concrete pad. 3-phase, 4 -wire , 200A 120/240 VAC power flows from the service entrance through a 100A main breaker within the service entrance switchboard (SES) to a 100A panelboard in the vault which powers the control panel, lighting and receptacle circuits, Tassajara inlet valve, a decommissioned 10HP washdown pump, an exhaust fan, HVAC, and lighting circuits.

There is a manual transfer switch and a 120/240V portable generator connection for a small generator adjacent to the service entrance on top of the vault.

2.3.4.1.2 Energy Utilization

Table 9 presents utilization data covering 36 months from February 2020 to January 2023.

Table 10. Tassajara Tank Energy Profile

kWh/kW	Maximum	Average	Minimum
Daily kWh	15.36	5.83	3.75
Monthly kWh	292.38	174.36	24.00
15 Minute kW	0.80	0.24	0.28

2.3.4.2 Bonde 1 Potable Water Tank

The Bonde 1 Tank is located at the heart of the Bonde Zone, which comprises three booster pump stations (Vineyard, Vineyard Hills, and North Sycamore) responsible for filling several storage tanks situated on the south side of the city. Although the reservoir itself benefits from redundancy through the presence of other storage tanks in the zone, the radio system located on this site plays a crucial role as a relay to central SCADA for 90 percent of the City's radio sites. Therefore, it is considered a priority 1 site for backup power.

All the site equipment is located inside a recently erected security fence, which was installed to reduce vandalism at the site.

Figure 10. Bonde 1 Reservoir Site Overview

2.3.4.2.1 Electrical

200A, 120/240V PG&E power flows in an underground feed to the site from a utility transformer on the south side of Bernal Ave. Power feeds into a manual transfer switch along with a Cummins RS12000 fixed liquid petroleum generator, which was marked as a high priority for replacement. There is also a receptacle for a portable generator connection adjacent to the transfer switch.

There is a 120/240V panelboard within the control panel that powers air conditioners and heaters for the control panel, the control panel UPS, a lighting and receptacle circuit for the site's vault, a ground fault circuit interrupter (GFCI) receptacle, a radio repeater, and a fluorescent lighting circuit.

2.3.4.2.2 Energy Utilization

Table 10 presents energy utilization data covering 36 months from February 2020 to January 2023.

Table 11. Bonde 1 Reservoir Energy Profile

kWh/kW	Maximum	Average	Minimum
Daily kWh	17.70	6.76	2.76
Monthly kWh	328.47	202.35	23.03
15 Minute kW	1.06	0.28	0.24

Upon analyzing the energy consumption patterns at the site, it has been observed that the site's energy usage does not entirely fall within the most advantageous TOU windows specified in the site's tariff (B1), especially during the summer season. The site's energy consumption during the peak hours of 4:00 pm to 9:00 pm is relatively high.

2.3.4.3 1600 Tank

The site hosts a 1.5-million-gallon potable water tank and is located on Pleasanton Ridge at 37°38'23.9"N 121°54'59.2"W. It services hundreds of homes and cabins in the Kilkare Canyon area and is filled by a chain of booster pump stations and storage tanks ordered sequentially by their corresponding elevation: Santos Ranch 510, Kilkare 900, and Kilkare 1300. The City considers the site priority 2 for power outages.

The site has no formal address, as it is completely remote. In the wet season, operators explained having to use ATVs to reach the site to get through the mud for site maintenance. If the site goes down, operators are able to calculate the level in the tank based on the head pressure from the Kilkare 1300 BPS.

Figure 11. 1600 Tank Site Overview

2.3.4.3.1 Electrical

The site is powered using two 12V marine/RV deep cycle lead-acid batteries wired in series and two solar arrays, one array of 3 50w modules mounted on a pole, and one array of 2 80w modules on the tank. Power flows from the solar arrays through a direct current (DC) transducer that sends a 4-20ma signal to a Morningstar ProStar PS-30 charge controller to regulate the charging of the batteries, which also features low voltage disconnect and overcurrent protection. The only loads at the site are the instruments for the level in the tank and the control panel. The 2018 TESCO site upgrade documentation denotes an existing AI slot for a future turbine DC transducer.

The TESCO design denotes that the batteries are sized to sustain roughly 2 days of autonomy. The system is designed to only drain the batteries to 50 percent to lengthen the life span of the lead acid battery bank. During long periods of overcast, the batteries can drain, causing the site to lose communication with central SCADA. The City keeps a set of batteries charging in their operations center in the event that the batteries drain completely and need replacement.

2.3.4.3.2 Energy Utilization

With an ~200-watt solar array and two 12-volt batteries, the estimated daily generation capacity would be around 1 kWh, assuming 4-5 hours of peak sunlight. However, as mentioned earlier, outages can occur during periods of overcast, which can significantly reduce the amount of energy generated by the solar array.

The two 12-volt batteries would provide a total energy storage capacity of 2400 watt-hours (Wh) per day, with the assumption of a 50 percent depth of discharge. This means that the batteries can store up to 1200 Wh of usable energy, which can be used during periods of low solar generation.

Overall, the estimated daily consumption of 1-2 kWh can be met by the 200-watt solar array and two 12-volt batteries, with the caveat that outages can occur during periods of overcast due to reduced energy generation from the solar array.

2.3.5 Storm Pump Stations

The City operates a storm drain system that is responsible for collecting and transporting rainwater and other runoff from streets, parking lots, and other impervious surfaces to local waterways. SD-1 was selected as a representative of 4 other storm drain sites. It should be noted that SD-1, SD-2, and SD-3 all lack a communication path to central SCADA.

2.3.5.1 SD-1 Storm Drain

Located adjacent to the S-7 sewer lift station, which hosts one of the City’s rental portable generators, SD-1 is a small site that is not connected to the city’s central SCADA system. In the event of recent flooding at the site, operators came out to the site to place the pumps in local at full speed, as the automatic control modes do not properly modulate the speed of the pumps. SD-1 is a priority 3 for power outages (with consideration that power outage priorities are primarily assigned based on summer season and PG&E public safety power shutoff (PSPS) events).

Figure 12. SD-1 Site Overview

2.3.5.1.1 Electrical

Three phase, 4 wire 480V underground fed PG&E power flows from the utility transformer through a transfer switch for a portable generator connection to a 480V panel, which powers two 10HP pumps.

A 480V – 240V step down transformer feeds the interior lighting panel, which powers a blower, the control panel, lights and receptacles, and sump pump.

2.3.5.1.2 Energy Utilization

Table 11 presents utilization data covering 36 months from February 2020 to January 2023.

Table 12. Storm Pump SD-1 Energy Profile

kWh/kW	Maximum	Average	Minimum
Daily kWh	57.16	1.12	0.01
Monthly kWh	486.60	33.77	0.04
15 Minute kW	12.94	0.05	0.04

The SD-1 storm drain site operates on the B1 PG&E tariff and consists of pumping loads that frequently run during peak TOU periods. While load shifting or curtailing the storm drain system during peak hours may seem like an attractive option to reduce energy costs, it is important to note that the storm drain must operate during large rain events, which often occur during peak hours.

2.4 Power Quality Monitoring

Power Quality Monitors (PQM) were not installed at most sites. At Sewer Lift Station S-6, a newer site), the City had a PQM installed as part of the installation project. Integration of PQMs at all sites will give Utilities staff real-time data on the quality and reliability of the power received from PG&E. This, in turn, will improve the City's energy resilience by enabling them to implement DERs at sites with power quality or reliability issues. See West Yost's Energy Management Plan for additional information on DERs.

2.5 Representative Sites: Boundary Conditions

The purpose of the site boundary conditions table is to outline the boundary conditions of different sites with regards to outages in data, recovery time, desired RTO (recovery time objective), maximum allowable downtime, and site layout/irradiation. The table provides information on representative sites including their footprint size, level of irradiation, and generator availability. It also lists the number and duration of outages at each site, as well as the recovery times for each. Table 12 can be used to inform decisions about site management and maintenance to minimize downtime and improve system resilience.

Table 13. Representative Site Boundary Conditions						
Site	Priority Level	Outages in Data	Desired RTO	Maximum Allowable Downtime	Consequence of Exceeding MAD	Site Layout/Irradiation
Turnout 3	1	None	Immediate	4-8 hours	Water use restrictions or cancellation on downstream customers	Small footprint, sufficiently irradiated
Bonde 1 Tank	1	2 total (5 hr each)	Immediate	1-2 hours	Inability to monitor and control all sites via SCADA	Medium footprint, sufficiently irradiated
Tassajara Tank	1	4 total (3 x 15 min, 1 x 2 hr)	Immediate	1-2 hours	Inability to monitor and control many sites via SCADA	Large footprint, sufficiently irradiated
Sewer Lift Station S-6	1	1 total (1.5 hr)	Immediate	8-12 hours	Sewer overflow	Medium footprint, sufficiently irradiated
Sewer Lift Station S-4	2	No data	4-8 hours	24 hours	Sewer overflow – mitigated by vacuum truck option	Small footprint, insufficiently irradiated
Laurel Creek BPS	2	No data	Immediate	4-8 hours	Water use restrictions or cancellation on downstream customers	Large footprint, sufficiently irradiated
Grey Eagle BPS	2	None	Immediate	1-2 hours	Water use restrictions or cancellation on downstream customers	Small footprint, sufficiently irradiated
Vineyard BPS	2	None	Immediate	1 week	Water use restrictions or cancellation on downstream customers	Small footprint, insufficiently irradiated
1600 Tank	2	No data	4 hours	24 hours	Loss of monitoring capability	Large footprint, sufficiently irradiated
SD-1	3	Meter error	2-4 hours	8-12 hours	Storm drain overflow	Small footprint, sufficiently irradiated

2.6 Representative Sites: Energy Cost Analysis

The purpose of the energy cost section is to provide a detailed analysis of the monthly usage and costs associated with various sites. This analysis was performed representative sites to obtain a representative cross-section of energy costs associated with comparable sites. The findings of this analysis will serve as a baseline for evaluating the effectiveness of any future DER projects or initiatives. The analysis includes both energy consumption and cost data, which will be used to identify potential opportunities for cost savings and energy efficiency improvements. The results of the analysis are presented in Table 13.

Table 14. Energy Usage and Costs for Representative Sites

Site	Average Monthly Consumption, kWh	Average Monthly Energy Cost, dollars
Laurel Creek BPS	10,639.38	3,054.99
Sewer Lift Station S-6	10,246.67	2,951.66
Sewer Lift Station S-4	N/A	N/A
Vineyard BPS	9,024.93	2,564.44
Grey Eagle BPS	2,030.72	562.30
Turnout 3	211.54	72.97
Bonde 1 Tank	202.35	71.83
Tassajara Tank	174.36	76.77
1600 Tank	N/A	N/A
Storm Drain 1	33.77	41.77

2.7 System-Wide Outage Impact Evaluation and Energy Profile

The purpose of the system-wide outage impact evaluation is to assess the potential impact of power outages on critical sites within the system. The evaluation includes a review of historical power outage data and identifies facilities impacted by the most outages. In addition, the evaluation summarizes the maximum, minimum, and average daily kWh consumption for each site to provide a comprehensive system-wide analysis. This information is necessary to inform the development of mitigation strategies and plans that can reduce the impact of outages on critical sites. Table 14 presents the results of the system-wide analysis.

Table 15. System-Wide Energy and Outage Profile						
Site	Total Outages	Max Outage Length, Hours	Min Outage Length, Hours	Max Hourly kWh	Average Hourly kWh	Minimum Hourly kWh
Sewer Lift Station S-14	38	128.5	0.25	27.91	0.67	0.01
Sycamore BPS	19	13.5	0.25	189.04	20.12	0.01
Sewer Lift Station S-2	12	39.25	0.25	2.52	0.89	0.02
Sewer Lift Station S-8	7	1	0.25	82.2	15.49	0.04
Longview BPS	6	6.25	0.25	121.32	16.63	0.01
Tank 1300 BPS	5	375.25[1]	0.25	82.55	11.43	0.16
Upper Ruby Hills Tank	5	19.5	0.25	1.14	0.14	0.01
Lower Ruby Hill Tank	4	14.75	4	0.4	0.15	0.03
Ruby Hill BPS	4	18.75	0.25	168.96	31.57	0.16
Tassajara Recyled Water Tank	4	2.25	0.25	0.65	0.24	0.04
Laurel Creek Tank	3	39.25	0.5	1	0.19	0.04
Sewer Lift Station S-7	3	4	3.75	44.16	8.38	1.53
Vineyard Hills Tank	3	30.75	1.25	0.15	0.05	0.01
Bonde 1 Tank	2	5.25	5.25	1.05	0.28	0.03
Golden Eagle Tank	2	5.5	0.25	1.26	0.18	0.04
Happy Valley Golf Course Tank	2	29.5	7.75	0.24	0.14	0.03
Sewer Lift Station S-15	2	0.25	0.25	18.4	1.26	0.04
Sycamore Tank	2	1.5	0.25	16.6366	1.69	0.007
Turnout 5	2	26	0.25	1.08	0.40	0.04
Bonde 2 Tank	1	0.5	0.5	0.06	0.04	0.01
Kottinger Ranch BPS	1	28.75	28.75	56.56	4.17	0.04
Sewer Lift Station S-6	1	1.5	1.5	54.32	14.34	1.95
Storm Pump SD-4	1	0.25	0.25	12.64	0.43	0.04
Tank 900 BPS	1	1.25	1.25	107.6	6.64	0.0168
Vinyard Hills BPS	1	44	44	127.28	19.79	0.2
Grey Eagle BPS	0	0	0	24.24	2.82	0.24
McCloud BPS	0	0	0	2.6	1.23	0.06
Moller Tank	0	0	0	0.4256	0.16	0.0132
Sewer Lift Station S-9	0	0	0	0	0	0
Turnout 1	0	0	0	0.59	0.07	0.01
Turnout 2	0	0	0	1.1127	0.34	0.0376
Storm Pump SD-3	29491[(a)]	7.75	0.25	106.36	0.18	0.04
Dublin Canyon BPS	19279[(a)]	1.5	0.25	186.56	4.41	0.008
Tank 510 BPS	13538[(a)]	20.5	0.25	111.28	6.65	0.01
Storm Pump SD-1	4661[(a)]	324.75[1]	0.25	9.05	0.05	0.01
Recycled Water Pump Station	4252[(a)]	2917	0.25	42.48	2.11	0.08

(a) Station experienced long periods of sustained outage or otherwise had intermittent fluctuations between zero and nonzero kWh.

To better understand the historical frequency of PSPS events, West Yost analyzed available data and found that there have been a total of four historical PSPS events that affected the City of Pleasanton, with two occurring in 2019 and two occurring in 2020. Table 15 summarizes the count and dates of each PSPS event.

Table 16. Historical PSPS Events

Year	PSPS Event Count	Dates
2020	2	October 14, 2020
		October 25, 2020
2019	2	October 9, 2019
		October 26, 2019

The PSPS map, represented in Figure 13, displays the areas that are at risk of experiencing power shutoffs during high fire-risk conditions. Tier 3 areas within the map are those with the highest fire risk. These tier 3 areas potentially affect the eligibility for the Community Microgrid Enablement Program (CMEP), explained further in Energy Market Participation Mechanisms.

Since tier 3 areas have a higher likelihood of power shutoffs, they face significant challenges in maintaining a reliable power supply during emergencies. Community microgrids, which are part of the CMEP initiative, can provide a solution by offering localized power generation and distribution capabilities. Consequently, communities located in tier 3 areas may be given priority or have a higher chance of being eligible for CMEP support and resources.

CMEP eligibility for tier 3 areas recognizes the need to enhance energy resiliency in high fire-risk regions. By enabling the implementation of community microgrids, the program aims to ensure that these areas have alternative power sources and can maintain critical services, including medical equipment, emergency response systems, and other essential infrastructure, during power shutoff events.

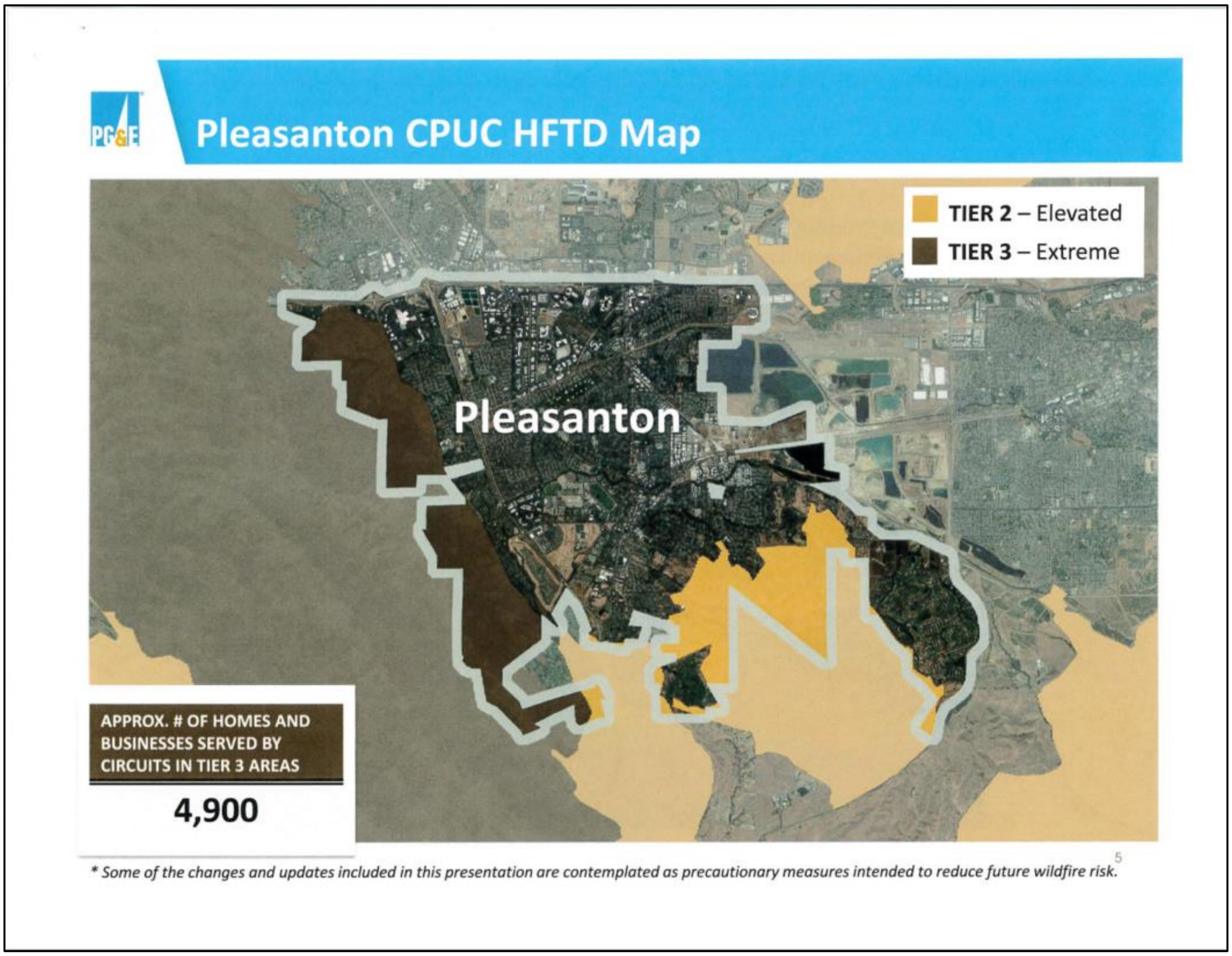


Figure 13. PSPS Map

3.0 RECOMMENDATIONS

The recommendations presented in this section aim to provide clear guidance on the most effective strategies and actions to be undertaken for optimal energy management and resilience enhancement. By considering the findings and insights gathered throughout the baseline assessment, these recommendations offer a roadmap for implementing practical and sustainable solutions. Through a balanced approach that prioritizes resilience, the following recommendations serve as actionable steps towards achieving efficient energy utilization, backup power configurations, integration with emergency backup power, system design best practices, self-generation opportunities, time-of-use management, and energy market participation. The recommendations in the report were coordinated with the ongoing TJC generator report, ensuring a cohesive and integrated approach to the proposed solutions. Emphasizing the importance of adaptability and scalability, these recommendations set the stage for a resilient and future-proof energy management framework that aligns with the goals and objectives of the City.

3.1 Technology Assessment

The technology assessment aims to provide a comprehensive analysis of various renewable energy technologies that can be implemented by the City. By exploring and evaluating different renewable options, the City can make informed decisions about the most suitable technologies to achieve its energy goals and enhance energy resilience. This assessment will consider the technical feasibility, economic viability, and environmental benefits of renewable energy sources, including solar photovoltaic (PV), micro-hydro turbines, and battery energy storage systems (BESS). The assessment will also address integration considerations, such as grid interconnection, system scalability, and regulatory compliance, to ensure the seamless integration and effective operation of renewable energy systems.

3.1.1 Microgrid

A microgrid refers to a collection of interconnected loads and DERs such as solar panels, batteries, and generators. It acts as a unified and controllable entity in relation to the main power grid. A microgrid has the flexibility to connect or disconnect from the grid, allowing it to function in both grid-connected and island-mode scenarios. Island-mode operation ensures continued power supply to site loads during grid outages. A microgrid can operate independently of the grid for a duration determined by the battery charge and available generating resources.

Design Methodology: The microgrid controller plays a crucial role in integrating and managing the resources and loads within a microgrid. It acts as a central control system that oversees various DERs such as energy storage, solar inverters or microturbines. Individual DERs may have their own local controllers for equipment-level control, such as solar inverters, that communicate with the central microgrid controller.

Grid Parallel Mode: Microgrids primarily operate in grid parallel mode, which is the standard mode of operation. In this mode, the microgrid controller efficiently manages the available DERs, ensuring they provide their maximum output. During grid parallel mode, excess power generated by the microgrid can be exported to the main grid.

Islanding Mode: In the event of a grid outage, the microgrid seamlessly transitions into islanding mode, enabling it to operate autonomously (see Seamless Transfer). During this mode, the microgrid adjusts its operation to meet the power demands of the site loads. If generating resources such as solar panels or microturbines are part of the microgrid, they provide maximum output to meet the load requirements of the islanded equipment and, if necessary, charge the BESS. A microgrid can be configured to activate a standby generator to provide additional power when the BESS reaches its minimum state of charge (SOC). Excess power generated by solar panels and the generator is utilized to charge the BESS until it reaches its maximum SOC, at which point the genset output is reduced.

3.1.2 Battery Energy Storage Systems

BESS technology offers versatile energy storage capabilities, enabling efficient energy utilization, load management, and grid integration. This overview explores the key aspects of BESS technology, including battery types, system configurations, and available options.

Battery Types: BESS systems utilize different battery chemistries, each with unique characteristics. Table 16 highlights some commonly used battery types in BESS applications.

Table 17. BESS Types

Battery Type	Energy Density	Cycle Life	Efficiency	Cost
Lithium-ion	High	Long	High	Moderate to High
Lead-acid	Moderate	Moderate	Moderate	Low
Flow Battery	Moderate to High	Long	Moderate to High	Moderate to High
Sodium-ion	High	Long	High	Moderate
Nickel-cadmium	Moderate	Long	Moderate	High

System Configurations: BESS systems can be configured in various ways to meet specific requirements, as shown in Table 17.

Table 18. BESS Configurations

System Configuration	Description	Advantages	Limitations
Centralized	A single large-scale BESS unit located at a central facility.	Simplified management and maintenance, scalability.	Limited flexibility, potential single point of failure.
Distributed	Multiple smaller BESS units distributed across a facility or several facilities.	Enhanced flexibility, redundancy, and localized energy management.	Higher initial investment, additional coordination and communication requirements.
Hybrid	Integration of BESS with other renewable energy sources or generators.	Enhanced reliability, optimized power generation and storage.	Complex system design, additional control and integration challenges.

Available Options and Technologies: Beyond battery types and system configurations, BESS technology consists of several important criteria to be considered during BESS selection, as shown in Table 18.

Table 19. BESS Criteria		
BESS Option	Description	Benefits
Power Rating (kW)	Range of power outputs that the BESS system can deliver.	Flexibility to meet different load demands and grid requirements.
Energy Capacity (kWh)	Total amount of energy the BESS system can store.	Longer discharge duration and enhanced energy management capabilities.
Scalability	Ability to expand the BESS system's capacity as needed.	Future-proofing, cost-effective system expansion.
Energy Management System	Software platform that monitors, controls, and optimizes the BESS operation. (Often included as part of the Microgrid Controller)	Real-time monitoring, efficient energy utilization, and integration with other systems.
Grid Services	Ability to provide grid support services such as frequency regulation, voltage control, and peak shaving.	Revenue generation opportunities and enhanced grid stability.

BESS technology plays a vital role in energy management, offering efficient energy storage, load management, and grid integration capabilities. By understanding the diverse battery types, system configurations, and available options, the City can make informed decisions to leverage BESS technology effectively. Collaboration with experienced BESS integrators and energy experts will ensure the successful integration of BESS into the energy management plan, facilitating sustainable energy usage and grid optimization.

3.1.2.1 Advanced BESS Solutions: Innovative Technologies and Options

BESS performance can be enhanced by various new and advanced technologies. This section will discuss three options, each with its own advantages and challenges. These technologies can offer significant benefits for BESS in terms of flexibility, optimization, and cost-effectiveness.

Advanced Underground Storage System: An innovative underground storage system for energy storage has emerged as a game-changer in the clean energy sector. Unlike conventional surface-mounted battery systems, this advanced solution offers significant advantages. It provides the flexibility to install BESS in various locations without the need for extensive real estate. This underground storage system enhances grid stability and enables emergency backup power capabilities, ensuring heightened resilience.

Artificial Intelligence (AI)-Powered Energy Management Software: AI-powered energy management software has can optimize energy consumption and adapt to evolving customer requirements. This software operates continuously with BESS configurations, monitoring and optimizing energy usage. By harnessing the power of artificial intelligence, energy management becomes more efficient and tailored to specific client goals.

Cost-Effective Infrastructure Upgrades: A cost-effective strategy has been developed to minimize the need for extensive electrical infrastructure upgrades. Spare MCC buckets are utilized as interconnection points, eliminating the necessity for significant modifications. This approach reduces overall costs and enhances the feasibility of implementing DERs, making them more accessible and economically viable.

3.1.3 Solar PV

Solar PV technology harnesses the power of sunlight to generate clean and sustainable electricity, offering numerous benefits such as reduced greenhouse gas emissions, cost savings, and energy independence.

At the core of a solar PV system are solar panels, also known as photovoltaic modules. These panels consist of semiconductor materials, typically silicon, which convert sunlight into electricity through the photovoltaic effect. When sunlight strikes the surface of the solar panel, photons liberate electrons from the semiconductor material, creating a flow of electrons and generating DC electricity.

To make the generated electricity compatible with standard electrical systems, inverters are employed to convert the DC electricity into alternating current (AC) electricity. Inverters also optimize the power output of the solar PV system and ensure synchronization with the utility grid, if applicable. Advanced inverters offer features such as maximum power point tracking (MPPT) to maximize energy extraction from the solar panels.

Panels are mounted on racks or structures to position them at an optimal angle and orientation for maximum sunlight exposure. Various racking and mounting options are available, each with its advantages and considerations. Table 19 provides an overview of different racking/mounting options for Pleasanton's solar PV installations.

Table 20. Solar Installation Options

Racking/Mounting Option	Description	Pros	Cons
Roof-Mounted	Panels installed on the roof of buildings.	Efficient use of space, minimal land requirement, protection from theft/vandalism.	Potential shading issues, may require structural assessment, limited tilt/angle adjustments.
Ground-Mounted	Panels installed on the ground or open areas.	Optimal tilt and orientation, easy maintenance access, scalability.	Land use requirement, potential ground disturbance, additional infrastructure needed.
Carport/Canopy	Panels integrated into carport structures or canopies.	Dual-purpose utilization, shading protection for vehicles, aesthetics.	Space constraints, structural considerations, increased cost.

In addition to solar panels and inverters, solar PV systems incorporate balance of system (BoS) components. These include wiring, junction boxes, combiner boxes, fuses, breakers, meters, and monitoring systems. BoS components ensure safe and efficient operation, facilitate performance monitoring, and enable net metering arrangements. Net metering allows the excess electricity generated by the solar PV system to be fed back into the grid, resulting in credits that offset energy consumption during low sunlight periods.

In addition to larger-scale installations, there are small form-factor options available for sites with smaller power consumption. These smaller solar power systems can be customized to fit the specific needs of each location, making them suitable for sites with lower energy requirements. 1600 Tank, Bonde-1 Tank and Tassajara Tank are examples of sites that might benefit from a smaller form factor solution.

3.1.4 Micro-Hydro Turbines

Micro-hydro turbines operate by converting the kinetic energy of flowing water into mechanical energy, which is then transformed into electrical energy. In the water sector, this solution could be used at PRV sites. The working principle involves the following steps:

Water Resource Assessment: Conduct a thorough evaluation of the available water resources, including flow rate, pressure differential, and seasonal variations. This assessment will determine the potential energy generation capacity of the micro-hydro turbine system.

Design and Installation: Develop a customized design that suits the specific site conditions and water resource characteristics. This includes selecting an appropriate turbine type, sizing the penstock and turbine, and designing the water intake structure.

Key Components: Micro-hydro turbine systems consist of essential components that enable efficient energy conversion. Table 20 highlights these components and their functions.

Table 21. Micro-Hydro Turbine Components

Component	Function
Water Intake Structure	Controls water intake, prevents debris, and protects aquatic life
Penstock	Transports water from the intake to the turbine
Turbine	Converts water's kinetic energy into mechanical energy
Generator	Converts mechanical energy from the turbine into electrical energy
Control System	Monitors and regulates turbine operation for optimal performance
Power Distribution	Transmits generated electricity to loads or the electrical grid

Integrating micro-hydro turbines into the energy management plan requires careful consideration of the following factors:

Maintenance and Monitoring: Establish a comprehensive maintenance and monitoring program to ensure the efficient and reliable operation of the micro-hydro turbine system. Regular inspections, equipment servicing, and performance monitoring are crucial for optimal performance.

Grid Integration: Determine the strategy for integrating the generated electricity into the existing power grid. Assess the grid connection requirements, such as voltage compatibility and grid stability considerations, to ensure seamless integration and power export, if applicable.

Economic Viability: Conduct a thorough economic analysis, including the evaluation of capital costs, operational expenses, and potential revenue streams from electricity sales or incentives. This analysis will determine the financial viability and return on investment of the micro-hydro turbine project.

By incorporating micro-hydro turbines into the energy management plan, the City can tap into the potential of sustainable energy generation, reduce reliance on external power sources, and contribute to the overall resilience goals of the city.

Using an online estimation tool with specific parameters such as an estimated average flow of 600 GPM, 75 percent operational time, a 40-psi differential, it is projected that approximately 47,304 kWh per year could be generated by each PRV utilizing a micro-hydro solution. While this estimation is approximate and may vary between turnouts, it highlights the substantial opportunity for harnessing hydraulic energy to produce electricity, thereby reducing dependence on external energy sources and potentially providing cost savings for the City.

3.2 System Design

West Yost recommends establishing clear design criteria for planning and deploying DER technologies. These criteria include ensuring system capacity and scalability, seamless integration and interoperability, compliance with grid interconnection standards, streamlined permitting processes, incorporation of resilience and redundancy measures, advanced energy management and control, adherence to safety and regulatory compliance, and conducting comprehensive lifecycle cost analysis for financial viability evaluation.

To ensure the successful implementation of DERs within the energy management plan, it is essential to establish clear design criteria that align with the goals, requirements, and constraints of the project.

System Capacity and Scalability: Design the DER system with adequate capacity to meet the expected energy demands while allowing for future scalability. Consider factors such as load growth, expansion plans, and the potential addition of new DER technologies. Ensure that the system can accommodate increased energy production or storage capacity as the energy needs of the facility or community evolve.

Integration and Interoperability: Ensure seamless integration of DER technologies into the existing energy infrastructure. Prioritize interoperability by selecting DER components that comply with industry standards and protocols, facilitating smooth communication and coordination among different systems. Compatibility with utility grids, smart meters, and energy management systems should be considered to enable efficient monitoring, control, and optimization of DER assets.

Grid Interconnection and Stability: Design the DER system to comply with grid interconnection standards and regulations. Assess the requirements set by the local utility or grid operator, including voltage and frequency regulations, anti-islanding protection, and power quality standards. Incorporate necessary control and protection mechanisms to ensure grid stability and prevent any adverse impact on the overall power network.

Permitting: The process of DER permitting in California is regulated by the California Public Utilities Commission (CPUC) and is aimed at simplifying the interconnection process for DERs while providing valuable transparency for project developers.

The DER permitting process involves the following steps:

1. Development and submission of an application to the electric utility company
2. Electric utility company’s review of the application
3. Interconnection agreement
4. Permission to operate

The CPUC has also developed a "limited generation profile" approach that would allow a DER to be designed using a generation profile. By utilizing the limited generation profile approach, DER projects can be designed to operate within predefined limits that account for grid conditions, load patterns, and other factors specific to each month. This helps to alleviate potential strain on the system and ensures that the DER's generation capacity aligns with the system's capabilities during different periods of the year.

Resilience and Redundancy: Incorporate resilience and redundancy measures to enhance the reliability of the DER system. Consider backup power capabilities, such as energy storage systems or backup generators, to provide uninterrupted power supply during grid outages or emergencies. Design the system to accommodate fault tolerance, load balancing, and automated switching to maintain continuous energy supply.

Energy Management and Control: Implement an advanced energy management and control system to optimize the operation and performance of the DER assets. Incorporate real-time monitoring, data analytics, and control algorithms to maximize energy efficiency, minimize energy waste, and optimize the use of renewable energy sources. Consider demand response capabilities to participate in grid programs and achieve demand-side management goals.

Safety and Regulatory Compliance: Ensure compliance with safety codes, regulations, and industry best practices. Incorporate safety features such as overcurrent protection, fault detection, and emergency shutdown mechanisms. Adhere to local and national regulations regarding DER deployment, including electrical codes, building permits, and environmental requirements.

Lifecycle Cost Analysis: Perform a comprehensive lifecycle cost analysis to evaluate the financial viability of the DER implementation. Consider upfront capital costs, ongoing operational and maintenance expenses, expected energy savings, and potential revenue streams. Compare the total cost of ownership with the projected benefits and determine the payback period and return on investment for the DER system.

3.2.1 Resilience-First Backup Power Configurations

West Yost strongly advises adopting a resilience-first approach when embarking on the development of new DER projects.

In the face of increasing climate-related events and the need for reliable and resilient energy systems, the City recognizes the importance of incorporating resilience into its DER configurations. Resilience-first DER configurations prioritize the ability to withstand and quickly recover from disruptions, ensuring a reliable power supply during emergencies and grid outages.

One approach to resilience-first DER configurations is to integrate energy storage systems, such as batteries, into the DER infrastructure. These energy storage systems can provide backup power during grid outages, allowing critical facilities and essential services to continue operating seamlessly. By strategically locating energy storage systems within the distribution system, the City can create localized microgrids that enhance the resilience of specific areas, reducing the impact of power outages and minimizing downtime.

Another aspect of resilience-first DER configurations is the consideration of energy generation sources that are less vulnerable to disruptions. Renewable energy technologies, such as solar PV systems and micro-hydro turbines, offer inherent resilience advantages compared to traditional fossil fuel-based power generation. By expanding the deployment of these renewable energy sources and integrating them with energy storage, the City can create a robust and resilient energy infrastructure to support its water infrastructure.

3.2.2 Integration with Emergency Backup Power Generation Capacity

West Yost recommends integrating DERs with existing emergency backup generators to enhance the reliability and resilience of the energy system. If replacing the primary emergency backup generator with a larger BESS is not financially feasible, West Yost recommends implementing a smaller BESS to support critical loads that integrates with the onsite emergency generator, still ensuring seamless transfer during power outages.

Two approaches can be considered for integration with existing emergency backup power infrastructure, each offering unique benefits and functionalities.

Generator Replacement Approach: In this approach, the existing emergency backup generator is replaced with a larger BESS serving as the primary backup power source. The BESS acts as the main energy storage and supply system during power outages or emergencies. It can be charged during normal grid operation or through renewable energy sources, ensuring a sustainable and clean backup power solution.

In this setup, a generator can be used as a secondary backup option. The generator serves as a backup to the BESS, providing additional support during prolonged outages or high-demand periods. This dual backup configuration ensures a reliable power supply during emergencies for highly critical sites.

BESS as Critical Loads Backup Approach: Alternatively, the DER integration can involve using a smaller BESS as a critical load backup system. In this configuration, the smaller BESS provides capabilities to assist in system shutdowns, load balancing, and maintaining steady-state operation. This approach is addressed in further detail in the Critical Load Support Methodology section. During the Recommendations review workshop with the City, it was identified that this methodology would be something the City would be interested in pursuing only after a successful pilot to avoid more complex control strategies during early implementation, reducing operational strain.

In the recommendations review workshop with the City, it was suggested that it would be beneficial to designate sites as either "DER synced" or "DER not synced" in the early stages of DER implementation. This designation would indicate whether a site would benefit more from having a generator that is synchronized with the existing DER solution. The purpose of this designation is to highlight sites where the existing portable generator connection is not compatible with newer DER technology or where the portable generator could serve as a backup system in case of a failure in the BESS.

All approaches offer advantages in terms of enhanced system reliability, reduced reliance on fossil fuel-based backup generators, and increased utilization of renewable energy sources. The choice between the two approaches depends on factors such as available space, system requirements, budget considerations, and the desired level of energy independence.

3.2.3 Critical Load Support Methodology

Critical load support can be employed to design a BESS that is smaller in capacity but focused on sustaining critical loads during an outage. This approach prioritizes providing power to essential equipment and systems necessary for maintaining critical operations rather than attempting to support the entire facility's load.

The objective of this methodology is to identify and prioritize the critical loads that must remain operational during an outage. These critical loads could include essential equipment, such as SCADA systems, emergency lighting, communication systems, or specific equipment required for critical operations, such as pumps and ventilation systems.

By assessing the power requirements and runtime duration of these critical loads, the BESS can be sized accordingly to ensure continuity of operations during power outages. The goal is to ensure that the battery system has enough capacity to sustain these critical loads throughout the duration of the outage, while also considering factors such as efficiency losses and any additional power required for maintaining SCADA communications.

By adopting this approach, a smaller BESS can be utilized, optimizing the cost and resources required for the energy storage system. It allows for efficient allocation of battery capacity, focusing on sustaining critical operations rather than attempting to provide power to the entire facility during an extended outage.

3.2.4 Seamless Transfer

Seamless transfer intends to provide uninterrupted power supply during an outage or transition between power sources. It refers to the seamless and instantaneous switching of electrical loads from one power source to another without any disruption or downtime. Whether it's transferring from the grid to a backup generator, a BESS, or another power source, the seamless transfer mechanism ensures that critical loads and essential systems remain powered without interruption, maintaining continuity of operations and preventing any negative impact on equipment, processes, or services.

In the scenario where a BESS is designed to support critical loads during an outage, the loads that are not designated as critical can be safely shut down. The primary focus of the BESS is to provide continuous power to the critical loads, ensuring uninterrupted operation during the outage.

Once the grid is restored and power is available, the BESS can be configured to facilitate the seamless transition of the entire site back online. While the initial design may prioritize sustaining critical loads, the BESS can be integrated with the site's electrical infrastructure and control systems to enable a smooth transition from relying solely on battery power to resuming normal operations using grid-supplied electricity.

During the outage, the BESS and microgrid controller can continue supplying power to the critical loads while monitoring the grid status. Once the grid is restored and stable, the BESS can be programmed to automatically synchronize with the grid and initiate a controlled reconnection of the non-critical loads. This process can involve gradually restoring power to different sections or circuits of the site to avoid sudden surges in demand.

By configuring the BESS and the site's electrical systems appropriately, it is possible to bring the whole site back online once the grid is restored, even if the BESS was initially sized to support only critical loads during the outage. This allows for a seamless transition from relying on battery power to utilizing the grid, ensuring the resumption of normal operations across the entire facility.

One advantage of this configuration is minimizing the need for emergency site visits to perform manual restarts in the event of a power outage. By incorporating a minimum configuration of DERs, the system can automatically restart once the grid is restored, eliminating the need for manual intervention.

In addition to providing operational efficiency, this automated restart process can save significant time and resources, since manual restarts often require dispatching personnel to the site, which can be time-consuming and costly.

For a resilience-focused project, the main goal of a DER system is to provide high-quality, reliable power to site equipment while minimizing energy-related operational deficiencies.

3.2.4.1 Hypothetical Outage Scenario

To demonstrate the concept of seamless transfer, a hypothetical scenario has been developed. In this hypothetical scenario, we will explore an outage event at a booster pump station that consists of three 20HP pumps. Within the station, one of the pumps is designated as a fire flow pump, along with essential systems such as SCADA systems, emergency lighting, and HVAC. We will examine how a BESS can be utilized to ensure uninterrupted power supply to the critical load and essential systems during an outage, maintaining critical operations until grid power is restored. The following list outlines the hypothetical scenario step by step:

1. Normal Operation: The booster pump station is running smoothly, with all three 20HP pumps operational, supplying water to the distribution system. The SCADA system is actively monitoring and controlling the pumps, ensuring optimal performance and pressure regulation. Emergency lighting and HVAC systems are functioning normally, providing a safe and comfortable working environment.
2. Power Outage Occurs: Suddenly, a power outage affects the booster pump station, resulting in a loss of grid electricity. The microgrid controller senses the loss of power and initiates the automatic transfer of critical loads to the BESS within milliseconds. The BESS seamlessly takes over and starts supplying power to the critical load pump, SCADA systems, emergency lighting, and HVAC systems.
3. BESS Powers Critical Load: The BESS provides the necessary power to sustain the critical load, ensuring continuous water supply to the distribution system. Despite the outage, the booster pump station maintains its critical operations, maintaining pressure and meeting the demand requirements.
4. SCADA Systems and Monitoring: The SCADA systems remain operational, allowing operators to monitor the status of the pumps, pressure levels, and other critical parameters. Real-time data on pump performance and water flow is still accessible, enabling operators to make informed decisions and respond to any anomalies.
5. Emergency Lighting and HVAC: The emergency lighting continues to illuminate the booster pump station, ensuring visibility and safety for personnel. The HVAC system keeps running, maintaining a comfortable environment within the facility, even during the outage.
6. Duration of BESS Operation: The BESS sustains the critical loads for the predetermined backup duration, as designed during the battery sizing methodology. The BESS capacity and energy stored are sufficient to power the critical load pump and support the SCADA systems, emergency lighting, and HVAC systems throughout the outage period.
7. Grid Restoration: Once the grid power is restored, the islanding switch detects the availability of grid electricity and seamlessly transfers the loads back to the grid. The BESS stops supplying power, and the booster pump station transitions back to normal operation with grid power, at which point the BESS is recharged and prepared for the next discharge cycle.

In this hypothetical scenario, the properly sized and configured BESS enables the booster pump station to maintain critical operations during a power outage. The BESS powers the fire flow pump while supporting the SCADA systems, emergency lighting, and HVAC systems, ensuring uninterrupted water supply, monitoring, and a safe working environment. Figure 14 further demonstrates the concept of seamless transfer in a timing diagram comprised of the grid, an islanding switch, a BESS, solar PV, a generator, and load consumption.

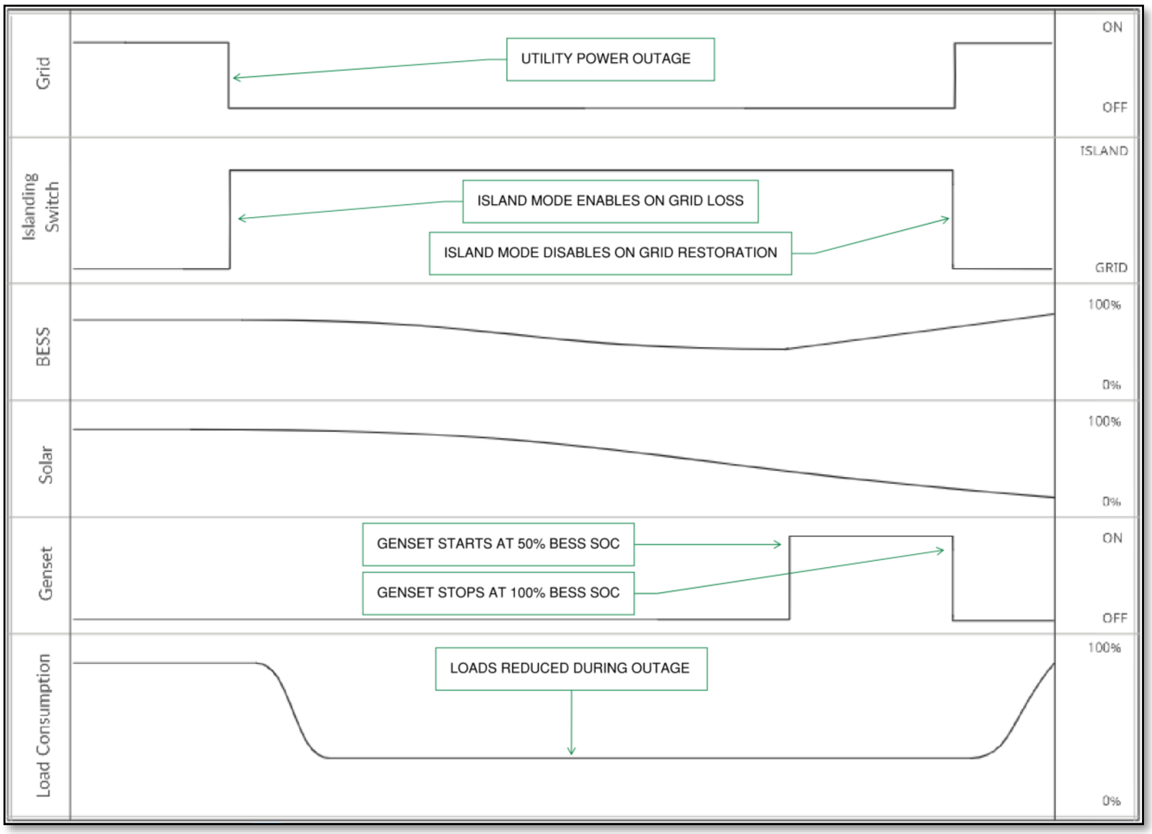


Figure 14. DER Resilience Scenario Timing Diagram

3.2.5 DER Cybersecurity

West Yost recommends prioritizing cybersecurity measures for DERs. To enhance the security of DER systems, the following measures should be implemented.

It is crucial to create a separate Virtual Local Area Network (VLAN) dedicated to the DERs. This isolated network segment ensures that DER devices are segregated from the main network and other critical systems. By implementing an isolated VLAN, the potential attack surface is minimized, reducing the risk of unauthorized access to the DER infrastructure.

Limited control capabilities should be enforced from the SCADA system to the DERs. By restricting control capabilities, only authorized actions are allowed, reducing the risk of unauthorized or malicious control commands being executed. Access control mechanisms, such as role-based access control, should be implemented to enforce appropriate permissions and privileges for SCADA operators.

Secure communication protocols, such as Secure Socket Layer (SSL) or Transport Layer Security (TLS), should be deployed to protect data transmitted between the SCADA system and DER devices. Encryption and authentication mechanisms should be in place to ensure the confidentiality and integrity of data exchanged.

To detect and prevent potential cybersecurity threats, Intrusion Detection and Prevention Systems (IDPS) should be deployed. These systems continuously monitor the network traffic and behavior of DER devices, promptly detecting and preventing any suspicious or malicious activities.

Regular security audits and assessments should be conducted to identify vulnerabilities in the DER infrastructure and implement necessary updates and patches. Staying up to date with the latest security standards and best practices is essential to ensure the ongoing resilience and protection of the DER systems.

Comprehensive cybersecurity training and awareness programs should be provided to employees and operators responsible for managing and maintaining the DER infrastructure. By educating them about common cybersecurity threats, best practices for secure operations, and the importance of adhering to established security policies and procedures, the overall security posture of the DER infrastructure can be significantly enhanced.

In the Recommendations workshop, the City expressed the need to have the capability to manually and securely disable DERs in the event of a cyberattack. This requirement emphasizes the importance of having a controlled response mechanism in place. The ability to manually intervene provides a layer of security that can be crucial in mitigating the effects of a cyberattack, allowing for immediate action to isolate affected systems and prevent further damage.

By implementing these cybersecurity measures, such as an isolated VLAN for DERs and limited control capabilities from SCADA, the energy management plan can effectively mitigate risks and enhance the overall security of the DER infrastructure. It is crucial to proactively prioritize and invest in robust cybersecurity measures to safeguard critical energy assets and ensure the reliability and resilience of the energy management system.

3.2.6 Power Quality Monitoring

Of particular importance is the installation and implementation of PQMs at all sites. A PQM monitors the health and quality of the utility power feed to a station and can engage a backup power source, if needed. When implemented in conjunction with DERs, PQMs allow sites to monitor and protect against power outages or power quality issues. Implementation of PQMs in conjunction with DERs can facilitate a smooth transition between power sources and will keep the site running through a power outage or power quality issue.

3.3 System Maintenance

West Yost recommends implementing a comprehensive system maintenance approach for DERs, including regular inspections, performance optimization, safety protocols, and collaborations with industry experts, to ensure optimal performance, reliability, and longevity.

During the recommendations workshop, the City made it clear that they plan to establish a maintenance contract for DERs and will not be performing maintenance in-house. A comprehensive BESS contract maintenance program costs approximately $10,000 per year, which includes warranty coverage.

To ensure optimal performance, reliability, and longevity of DERs, establish a comprehensive monitoring and maintenance program. This program should include regular inspections, proactive maintenance, and real-time monitoring of key performance indicators.

Continuously evaluate and optimize DER performance through data analysis and benchmarking. Identify opportunities for efficiency improvements, system upgrades, or technology advancements to maximize energy generation, storage capacity, and overall system efficiency.

Prioritize safety protocols and compliance with relevant regulations and standards. Develop and implement comprehensive safety procedures, conduct regular equipment inspections, and provide staff training programs to ensure a safe working environment and compliance with industry best practices.

Foster partnerships with industry experts, technology providers, and energy service companies. Leverage their expertise and stay updated with the latest advancements in DER technologies and maintenance practices. Collaborate with these stakeholders to align system maintenance strategies with industry best practices and innovation.

By implementing these actionable recommendations, the City can establish a robust system maintenance framework for DERs. This approach will ensure the optimal performance, reliability, and longevity of DER assets while maximizing their benefits in terms of energy generation, storage, and cost savings.

3.3.1 Technology-Specific Maintenance Requirements

West Yost recommends implementing regular maintenance and inspections for the renewable energy systems as a crucial step to ensure their optimal performance and longevity. To achieve this, it is recommended to establish a maintenance contract with qualified service providers. By adhering to a proactive maintenance approach, the renewable energy systems can operate efficiently and effectively, maximizing their benefits and contributing to the overall success of the energy management plan.

Solar PV: For solar PV systems, it is recommended to conduct regular inspections to identify and address shading, debris, or any obstructions that might affect the sunlight reaching the panels. Electrical connections, wiring, and inverters should be inspected for any signs of damage or malfunction. Regular cleaning of the solar panels is also necessary to remove dust, dirt, or other accumulations that can reduce their efficiency. Additionally, testing and recalibration of system components and monitoring equipment should be done periodically to ensure accurate performance monitoring.

BESS: BESS require regular monitoring to check the SOC, voltage levels, and temperature. Adequate ventilation and temperature control should be maintained to optimize battery performance and lifespan. Following the manufacturer's guidelines for maintenance procedures is crucial, which may include equalizing charges, balancing cell voltages, and checking electrolyte levels. Periodic inspections should be conducted to identify any signs of damage, leakage, or other issues.

Micro-Hydro: In the case of micro-hydro systems, regular inspections and cleaning of turbine blades are necessary to ensure optimal efficiency and prevent damage caused by debris. The turbine structure, mechanical components, and bearings should be checked for signs of wear, damage, or corrosion. Proper lubrication of bearings and other moving parts is essential, and water intake structures, screens, and debris removal systems should be inspected and maintained for efficient water flow.

It is crucial to maintain detailed records of all maintenance activities, including dates, findings, and actions taken. By following these maintenance recommendations, renewable energy systems can be effectively managed and sustained, ensuring their long-term reliability, performance, and durability.

3.4 Time-of-Use

West Yost recommends the strategic use of BESS at high-load sites, such as potable water booster pump stations, to optimize energy usage in accordance with TOU schedules detailed in Appendix C: TOU Heat Maps.

We recommend that BESS be configured to discharge during TOU peak periods, providing an essential buffer and reducing dependence on the grid during these high-demand intervals. This approach ensures energy savings without necessitating alterations to the existing pumping schedules, while simultaneously offering a more efficient and sustainable use of energy resources.

3.5 Representative Sites – Recommendations

This section provides targeted recommendations for representative City booster pump stations, sewer lift stations, turnouts, storage tanks, and storm water pump stations. The recommendations serve as a blueprint, offering strategies that can be applied across similar sites throughout the City.

For pilot sites, the National Renewable Laboratory (NREL) ReOpt web tool was utilized to analyze load data and determine the minimum configuration of BESS and solar resources to support a specified outage length. This analysis allowed for the identification of the best combination of BESS and solar capacity to meet the specific load demands of these sites, taking into account factors such as energy generation, storage capacity, resilience, and cost-effectiveness. Additionally, the City-provided site criticality documentation assisted in formulating recommendations tailored to the specific needs of each site. In the recommendations tables in the following sections, sites are called out as Priority 1, Priority 2, or Priority 3, with Priority 1 sites being the most critical. For the full site criticality documentation, see Appendix D: Site Criticality.

The recommendations of the NREL ReOpt analyses were used as a starting point for BESS/PV sizing, but additional capacity was added in some instances. Additionally, an off-grid analysis was created for 1600 Tank, using the address of 1300 Tank - the ReOpt tool only allows for valid street addresses. The results of the ReOpt analyses are presented in Appendix F.

VFDs (Variable Frequency Drives) may need to be paired with an isolation transformer when used in a system containing DERs with respective inverters. This is because the harmonics generated by the inverters of renewable sources can affect the performance of the VFD. The isolation transformer helps mitigate the harmonics and ensures proper operation of the VFD in the presence of DERs. VFDs help to manage inrush current which is an important consideration for BESS sizing.

RVSS, by gradually ramping up the voltage during motor startup, can reduce the initial current surge. This can potentially allow for the use of a smaller BESS capacity since the reduced starting current demand lowers the peak power requirement.

On the other hand, direct on-line (DOL) starters, which provide full voltage directly to the motor, may result in higher starting currents. This may necessitate a larger BESS capacity to accommodate the higher power demand during motor startup. The choice of starter type should be considered when sizing a BESS to ensure it can handle the required power demands effectively.

By employing these tailored approaches for sites with varying load requirements, the energy management plan can optimize the use of renewable energy resources, minimize costs, and ensure the seamless and uninterrupted operation of critical equipment at each site.

3.5.1 Potable Water Booster Pump Stations

This section provides specific recommendations for representative potable water booster pump stations within the energy management plan.

3.5.1.1 Laurel Creek Pump Station and Foothill Tank

West Yost recommends implementing an island-able microgrid with 20kW canopy-mounted solar shading and a 300kW/300kWh BESS to sustain at least a 3-hour outage with potential for TOU peak shaving using the BESS system. It is recommended that the existing standby generator can synchronize with other DERs. Additionally, it is recommended to obtain energy interval data for the site to ease system modeling. Table 21 provides more detailed insight, offering an analysis of the benefits and rationale for each specific recommendation.

Table 22. Laurel Creek BPS/Foothill Tank Recommendations

Recommendation	Y/N/Potential	Rationale	System Configuration	Benefit
Microgrid	Yes	Priority 2 site with substantial physical footprint.	BESS: 300kW/300kWh Solar PV: 20Kw shade structure for BESS Islanded Duration: 3 hours	Immediate transfer to backup power. Achieves desired RTO and + synchronizes with standby generator.
TOU Management	Potential	Large power consumption site. Based on the operational strategy documents provided by the City, the pumping strategy for this station is already built around off-peak periods. If interval data can be obtained, further analysis is recommended.	Configure BESS to discharge during peak TOU pricing periods, using a separate minimum SOC.	Reduces net energy consumption during peak pricing with minimal impact to operations.
Obtain Energy Interval Data	Yes	The energy interval data was not able to be collected as part of the baseline assessment due to a PG&E meter error.	—	Accurate analysis of energy usage patterns at the site.

3.5.1.2 Vineyard BPS

Due to the site being categorized as priority 2 and having very limited physical footprint to accommodate larger loads, West Yost recommends retaining existing portable generator configuration. TOU Management strategies should be implemented to coordinate pumping schedules around peak and partial peak pricing periods, informed by Appendix C: TOU Heatmaps. Additionally, it is recommended to consider future mobile BESS solutions as they become available. Table 22 provides more detailed insight, offering an analysis of the benefits and rationale for each specific recommendation.

Table 23. Vineyard BPS Recommendations

Recommendation	Y/N/Potential	Rationale	System Configuration	Benefit
Microgrid	No	Priority 2 site with limited physical footprint	BESS: N/A Solar PV: N/A Islanded Duration: N/A	N/A
TOU Management	Yes	Large power consumption site that occurs during TOU peak pricing.	—	Reduces net energy consumption during peak pricing with minimal impact to operations.

3.5.1.3 Grey Eagle Pump Station

Due to the site being categorized as priority 2 and as a fire flow and hydropneumatics site with limited physical footprint, it is recommended to implement an island-able microgrid with 400kW/400kWh BESS to sustain at least 2 hours of grid outage, with the assumption of an underground BESS installation to address space constraints at the site. It is recommended that the existing standby generator is replaced, and a backup portable generator receptacle is retained as a non-synchronized backup to the DER solution. Table 23 provides more detailed insight, offering an analysis of the benefits and rationale for each specific recommendation.

Table 24. Grey Eagle BPS Recommendations				
Recommendation	Y/N/Potential	Rationale	System Configuration	Benefit
Microgrid	Yes	Priority 2 hydropneumatics site with limited physical footprint	BESS: 400Kw/400kWh Solar PV: N/A Islanded Duration: 2 hours	Immediate transfer to backup power Achieves desired RTO without need for standby generator Reduce system surges during power outages Sufficient backup power for fire-flow pump
TOU Management	Potential	Medium power consumption site that occurs during TOU peak pricing.	Configure BESS to discharge during peak TOU pricing periods, using a separate minimum SOC	Reduces net energy consumption during peak pricing with minimal impact to operations.

3.5.2 Sewer Lift Stations

This section offers tailored recommendations for representative sewage lift stations within the energy management plan.

3.5.2.1 S-6 Sewage Lift Station

West Yost recommends implementing island-able microgrid with 20kW shade structure solar covering 250kW/558kWh BESS to sustain, at a minimum, a 12-hour outage while also configuring BESS to discharge during peak TOU pricing periods, using a separate minimum SOC. It is recommended that the existing standby generator has the ability to synchronize with other DERs. Table 24 provides more detailed insight, offering an analysis of the benefits and rationale for each specific recommendation.

Table 25. S-6 Sewer Lift Station Recommendations				
Recommendation	Y/N/Potential	Rationale	System Configuration	Benefit
Microgrid	Yes	Priority 1 site with sufficient physical footprint.	BESS: 250kW/558kWh Solar PV: 20kW shade structure Islanded Duration: 12 hours	Immediate transfer to backup power. Achieves desired RTO without need for standby generator. Black start capability. BESS sizing accounts for future pump (6 total @ 20HP each).
TOU Management	Yes	Medium power consumption site that occurs during TOU peak pricing.	Configure BESS to discharge during peak TOU pricing periods, using a separate minimum SOC.	Reduces net energy consumption during peak pricing with minimal impact to operations.

3.5.2.2 S-4 Sewage Lift Station

West Yost recommends implementing an island-able microgrid with 20kW/20kWh BESS to sustain at least a 4-hour outage. It is recommended that the existing portable generator receptacle is retained as a non-synchronized backup to the DER solution. Table 25 provides more detailed insight, offering an analysis of the benefits and rationale for each specific recommendation.

Table 26. S-4 Sewer Lift Station Recommendations

Recommendation	Y/N/Potential	Rationale	System Configuration	Benefit
Microgrid	Potential	Priority 2 site with limited physical footprint. Low power consumption.	BESS: 20kW/20kWh Solar PV: N/A Islanded Duration: 4 hours	Immediate transfer to backup power. Achieves desired RTO without need for portable generator.
TOU Management	No	Low power consumption.	N/A	N/A

3.5.3 Potable Water Turnouts

This section presents targeted recommendations for representative potable water turnouts within the energy management plan.

3.5.3.1 Turnout 3

West Yost recommends implementing an island-able microgrid with 5kW canopy mounted solar and 5kW/10kWh BESS to sustain at least 168 hour (1 week) outage. It is recommended that the existing portable generator receptacle is retained as a non-synchronized backup to the DER solution. Table 26 provides more detailed insight, offering an analysis of the benefits and rationale for each specific recommendation.

Table 27. Turnout 3 Recommendations

Recommendation	Y/N/Potential	Rationale	System Configuration	Benefit
Microgrid	Yes	Priority 1 site with limited physical footprint. Low power consumption.	BESS: 5kW/10kWh Solar PV: 5kW Islanded Duration: 168+ hours	Immediate transfer to backup power. Achieves desired RTO without need for portable generator.
TOU Management	No	Low power consumption.	N/A	N/A

3.5.4 Storage Tanks

This section presents targeted recommendations for representative storage tanks within the energy management plan.

3.5.4.1 Tassajara Recycled Water Tank

West Yost recommends Implementing an island-able microgrid with 2kW canopy mounted solar and 1kW/6kWh BESS to sustain at least 168-hour (1 week) outage. It is recommended that the existing portable generator receptacle is retained as a non-synchronized backup to the DER solution. Table 27 provides more detailed insight, offering an analysis of the benefits and rationale for each specific recommendation.

Table 28. Tassajara Tank Recommendations

Recommendation	Y/N/Potential	Rationale	System Configuration	Benefit
Microgrid	Yes	Priority 1 site with substantial physical footprint. Low power consumption Radio comms hub.	BESS: 1kW/6kWh Solar PV: 2kW Islanded Duration: 168 hours	Immediate transfer to backup power. Achieves desired RTO without need for portable generator. Backs up system-wide radio communications.
TOU Management	No	Low power consumption.	N/A	N/A

3.5.4.2 Bonde 1 Potable Water Tank

West Yost recommends Implementing an island-able microgrid with 5kW canopy mounted solar and 5kW/10kWh BESS to sustain at least 168-hour (1 week) outage. It is recommended that the existing portable generator receptacle is retained as a non-synchronized backup to the DER solution. Table 28 provides more detailed insight, offering an analysis of the benefits and rationale for each specific recommendation.

Table 29. Bonde 1 Tank Recommendations

Recommendation	Y/N/Potential	Rationale	System Configuration	Benefit
Microgrid	Yes	Priority 1 site with substantial physical footprint. Low power consumption Radio comms hub.	BESS: 5kW/10kWh Solar PV: 5kW Islanded Duration: 168 hours	Immediate transfer to backup power. Achieves desired RTO without need for portable generator. Backs up system-wide radio communications.
TOU Management	No	Low power consumption.	N/A	N/A

3.5.4.3 1600 Potable Water Tank

West Yost recommends upgrading off grid system to 1kW pole mounted or ballasted tank-mounted solar and 1kW/5kWh BESS to sustain indefinite operation. Table 29 provides more detailed insight, offering an analysis of the benefits and rationale for each specific recommendation.

Table 30. 1600 Tank Recommendations				
Recommendation	Y/N/Potential	Rationale	System Configuration	Benefit
Microgrid	Yes	Priority 2 site with substantial physical footprint. Off-grid site. Low power consumption.	BESS: 1kW/5kWh Solar PV: 1kW Islanded Duration: Indefinite	Continuity of site monitoring capabilities. Potential to convert to 120VAC equipment – lights/outlet, security camera.
TOU Management	No	Off – grid site.	N/A	N/A

3.5.5 Storm Pump Stations

This section presents targeted recommendations for representative storage tanks within the energy management plan.

3.5.5.1 Storm Pump SD-1

West Yost recommends implementing an island-able microgrid with a 120kW/120kWh BESS to sustain at least a 12-hour outage. It is recommended that the existing portable generator receptacle is retained as a non-synchronized backup to the DER solution. Table 30 provides more detailed insight, offering an analysis of the benefits and rationale for each specific recommendation.

Table 31. Storm Pump SD-1 Recommendations				
Recommendation	Y/N/Potential	Rationale	System Configuration	Benefit
Microgrid	Yes	Priority 3 site with limited physical footprint. Medium power consumption.	BESS: 120kW/120kWh Solar PV: N/A Islanded Duration: 12+ hours	Immediate transfer to backup power. Achieves desired RTO without need for portable generator. Black-start capability.
TOU Management	N/A	N/A	N/A	N/A

3.6 Representative Sites – Recommendations Summary

Table 31 presents a comprehensive summary of the recommendations for various sites within the energy management plan.

Table 32. Recommendations Summary

Site	Priority Level	Solar PV	BESS -Primary	TOU Management	Microgrid
Turnout 3	1	Yes	Yes	No	Yes
Sewer Lift Station S-6	1	Yes	Yes	Yes	Yes
Bonde 1 Tank	1	Yes	Yes	No	Yes
Tassajara Tank	1	Yes	Yes	No	Yes
Laurel Creek BPS	2	Yes	Potential	Yes	Yes
Vineyard BPS	2	No	No	Yes	No
Grey Eagle BPS	2	Potential	Potential	Yes	Potential
Sewer Lift Station S-4	2	No	Potential	No	Potential
Tank 1600	2	Yes	Yes	N/A	Yes
SD-1	3	Potential	Potential	No	Potential

Table 32 below displays the feasibility of various solar installation options, including rooftop solar panels, ground-mounted solar arrays, and solar canopy systems, for different sites.

Table 33. Solar Installation Feasibility by Site

Site Name	Rooftop/Tank-Mount Solar Panels	Ground Mounted Arrays	Solar Canopy
Turnout 3	Potential	No	Yes
Sewer Lift Station S-6	Potential	Potential	Yes
Bonde 1 Tank	Yes	Yes	Potential
Tassajara Tank	Yes	Yes	Yes
Laurel Creek BPS	Yes	Yes	Yes
Vineyard BPS	No	No	No
Grey Eagle BPS	Potential	No	Potential
Sewer Lift Station S-4	No	No	No
Tank 1600	Yes	No	No
SD-1	No	Potential	Potential

3.7 Energy Market Participation Mechanisms

The energy market is undergoing a significant transformation, driven by the increasing deployment of DERs and the growing importance of clean and renewable energy sources. To fully leverage the potential of DERs and participate in the evolving energy landscape, it is essential for the City to explore energy market participation mechanisms. These mechanisms enable the City to actively engage in energy markets, optimize the value of their DER assets, and contribute to a more sustainable and resilient energy system. This section provides an overview of key energy market participation mechanisms and explores how the City can harness these mechanisms to enhance energy management, reduce costs, and support their renewable energy goals. By embracing energy market participation, the City can unlock new opportunities and play an active role in shaping the future of the energy industry.

3.7.1 Federal Programs

West Yost recommends exploring federal programs for energy market participation as DERs become integral to City systems. The Federal Energy Regulatory Commission (FERC) approved Order 2222 on September 17th, 2020, allowing DER aggregators to compete in regional wholesale electric markets. Order 2222 requires Regional Transmission Organizations and Independent System Operators (ISOs) to develop market rules that allow DERs to participate in the wholesale markets on a level playing field with traditional electric utilities. This means that DERs, such as solar PV systems, energy storage systems, and demand response resources, can potentially participate in selling electricity, providing grid services, and receiving compensation for their contributions to grid reliability and resilience. While the implementation of this regulatory requirement will take time to benefit the City directly, it is important to prepare through planning and positioning projects to be ready when the State of California mandates compliance.

The application of Order 2222 can create opportunities for the City to maximize the value of its DER investments. By participating in the wholesale electricity markets, the City can potentially generate additional revenue streams by selling excess energy produced by its DERs back to the grid.

Moreover, Order 2222 encourages coordination and collaboration among stakeholders to optimize the use of DERs and promote grid reliability. It emphasizes the importance of coordination between the distribution utilities, DER aggregators, and the wholesale market operators. This can facilitate the integration of the City's DERs into the broader energy ecosystem, ensuring seamless interaction between local DER assets and the wholesale markets.

To leverage the benefits of Order 2222, the City should engage with relevant stakeholders, such as the local utility, DER aggregators, and the California Independent System Operator (CAISO). By actively participating in the stakeholder processes and engaging in discussions, the City can ensure its interests are represented and its DER assets are given the opportunity to participate effectively in the wholesale markets.

3.7.2 State Programs

West Yost recommends exploring state programs for energy market participation as DERs become integral to City systems. As part of its efforts to support California’s Senate Bill 100, a landmark policy that targets 100 percent renewable electric retail sales by 2045, the CPUC developed and approved the Distributed Energy Resources Action Plan 2.0 (DER Action Plan 2.0) on April 21, 2022. The plan aims to coordinate DER policy implementation across various proceedings related to grid planning, affordability, load flexibility, market integration, and customer programs to ensure a streamlined approach. Through the DER Action Plan 2.0, the CPUC seeks to align its vision and actions to maximize the ratepayer and societal value of a high-DER future.

To explore specific incentives under the DER Action Plan 2.0, the City should consider engaging with relevant stakeholders to identify and evaluate available programs and initiatives. These may include:

Financing Options: The City can explore financing programs or incentives that support the installation and adoption of DERs. This could include low-interest loans, grants, or other financial mechanisms that help reduce the upfront costs associated with DER projects.

Incentive Programs: The City can inquire about rebate programs offered by local utility providers or government agencies. These programs often provide financial incentives to customers who install qualifying DER technologies, such as solar PV systems or energy storage systems.

Technical Assistance: The City can explore opportunities for technical assistance programs that provide guidance, expertise, and resources for DER project planning, design, and implementation. This support can help streamline the process and ensure that DER projects meet the necessary technical requirements.

Community Solar Programs: The City can investigate the feasibility of community solar programs, where multiple customers can collectively participate in a shared solar project. This allows residents or businesses without suitable rooftops for solar installation to access the benefits of solar energy.

3.7.3 PG&E

West Yost recommends that the City explores DER incentive programs offered by PG&E. PG&E offers financial incentives for installing battery storage or generation equipment through the Self-Generation Incentive Program (SGIP). Third-party Demand Response Providers offer demand response programs for PG&E electricity customers, who can also participate in the Capacity Bidding Program where customers can bid into an auction to offer up their unused or curtailed energy usage capacity to the grid operator. If their bid is accepted, they can receive financial compensation for the capacity they offer. This program is designed to encourage customers to have excess energy capacity available during periods of high demand so that they can help to balance the grid and prevent blackouts or brownouts.

Additionally, through the CMEP, PG&E provides technical support resources and cost offsets to eligible communities seeking critical facility resilience solutions. CMEP prioritizes high-priority multi-customer microgrids serving vulnerable customers and critical facilities. The program's framework components have been approved by the CPUC in D.20-06-017, and PG&E is collaborating with external stakeholders to finalize the program details and eligibility criteria.

PG&E offers several specific programs that the City may qualify for to support the integration of DERs. Some of these programs include:

Net Energy Metering (NEM): The NEM program allows customers to generate their own electricity from renewable energy systems and receive a credit for any excess electricity that is exported back to the grid. The City should explore this program to incentivize the installation of solar PV systems for residential, commercial, and municipal buildings.

Demand Response (DR) Programs: PG&E offers various DR programs that allow customers to reduce their electricity usage during peak demand periods in exchange for financial incentives. The City can participate in these programs to optimize energy consumption, contribute to grid reliability, and potentially earn financial rewards.

Self-Generation Incentive Program (SGIP): SGIP provides financial incentives for the installation of energy storage systems, including batteries, to support renewable energy integration and enhance grid resiliency (up to $850/kWh for public agencies). The City could leverage this program to assist the deployment of energy storage solutions. Incentive payment structures for energy storage projects are delineated based on capacity. For small storage projects with a capacity less than 10 kW, the entire incentive will be paid upfront. Conversely, larger projects with a capacity greater than 10 kW will receive a portion of the incentive upfront, with the remaining balance paid as a Performance Based Incentive (PBI) over a 5-year period. Additionally, Equity Budget incentive levels for large systems (greater than 10 kW) are subject to reduction under the following conditions: (a) if the Energy Storage System (ESS) capacity exceeds 2 MWh; (b) if the ESS duration is greater than 4 hours; and/or (c) if the system cycles fewer than 104 times per year.

Energy Efficiency Programs: PG&E offers a range of energy efficiency programs that provide incentives, rebates, and technical assistance to improve energy efficiency in buildings and facilities. The City should explore these programs to implement energy-saving measures and reduce overall energy consumption.

It's important for the City to regularly check PG&E's website and contact their customer service to obtain the most up-to-date information on available programs, eligibility criteria, and application processes. Additionally, PG&E may periodically introduce new programs or update existing ones, so staying informed and actively engaging with the utility provider is crucial to maximize the benefits and opportunities for DER integration.

3.8 Cost Estimating and Cost-Benefit Analysis

While the focus of this study is focused on the resilience capabilities of DERs, there are significant potential financial considerations that are available for each site.

DER projects for these sites may be eligible for Investment Tax Credit incentive, payable directly to municipalities in lieu of tax credits because of an important provision of the Bi-partisan Inflation Reduction Act.[1] An additional incentive from the California SGIP may be available for the City to decrease the cost of BESS for communities “at risk for fire” impacts. The CPUC has authorized an “Equity” incentive of $850/kWh of BESS capacity that may be available for these projects.

Unlike a traditional generator, a DER is continuously online and operating. A BESS installation coupled with a demand charge management and TOU arbitrage may reduce site energy costs by approximately 30 percent without any additional self-generation through solar PV or other DERs. TOU arbitrage and demand charge management may be implemented via the existing SCADA system and/or as part of a separate Energy Management System (EMS).

Finally, the BESS and PV systems are sized for resilience over cost savings. In summary the BESS is sized to support off-grid functionality of key equipment, including large pumps that have significant inrush currents (depending on the starting equipment). This approach leads to the potential selection of a larger BESS than is required for the financial savings while operating on-grid.

We have included potential financial incentives and a summary of anticipated costs for equipment and installation. The cost of the microgrid controller is included in the installed cost, estimated at $200,000 for any site with a BESS capacity greater than 100kWh (booster pump station, sewer lift station) and

[1] The Inflation Reduction Act includes a provision that provides non-taxable entities participating in clean energy incentives with a direct payment option in lieu of tax credits. See page 20 whitehouse.gov/wp-content/uploads/2022/12/Inflation-Reduction-Act-Guidebook.pdf and, https://www.nlc.org/article/2022/09/23/inflation-reduction-act-clean-energy-project-eligibility-for-local-governments/

$10,000 for any site with a BESS capacity less than 100kWh (storage tank, turnout). The following list details all costs that have been included:

- Preliminary and Detailed Design
  - Utility Coordination
  - Financial incentives confirmation and applications
  - Equipment selection
  - Preliminary Control Strategy Development
  - Levelized Cost of Energy calculations for existing generator and DER systems
- Construction, including but not limited to
  - BESS, which includes AC to DC inverter(s) (for charging the battery) and DC to AC inverter(s) for discharging the battery. Costs are based on EnergyToolBase modelling/estimation software
  - Microgrid Controller including grid isolation equipment.
  - Solar Photovoltaic cells and support structures
  - Isolation transformers to protect the BESS from harmonics generated by the VFDs.
  - Modifications to the existing Motor Control Centers
  - Addition of mobile generator hookup
  - Modification of existing generator controls to be DER compatible
  - Development of detailed control strategies and implementation of integration between the BESS and the existing SCADA system
  - Modifications to the existing SCADA system for DER integration
  - Site specific costs
  - Startup and Testing
- Operation and Maintenance
  - BESS Maintenance
  - PV Maintenance
  - City staff training (operation and safety)

Table 33 summarizes the Engineer's Estimate of Probable Construction Costs for each site included in the recommendations, including potential funding and maintenance costs. These costs are provided as an AACE Class 5 estimate for construction only with a 30 percent contingency.

Table 34. Cost Summary Data

Site	BESS Power, kW	BESS Capacity, kWh	PV Power, kW	Installed Cost Including 50% Contingency, $	Potential ITC Funding (Up to 30% of Solar and BESS Costs), $	Potential SGIP Funding (Up to $850/kWh of BESS Capacity), $	Annual Maintenance Costs, $
Sycamore BPS	640	1280	50	2,648,389	794,516	938,114	20,000
Sewer Pump S-6	250	558	20	1,607,295	482,189	358,841	20,000
Tassajara Tank	5	10	5	97,500	29,250	8,500	5,000
Turnout 3	5	10	5	97,500	29,250	8,500	5,000

4.0 IMPLEMENTATION PLAN

The Implementation Plan was created with input from City staff. The implementation plan has been separated into two phases: (1) Near-Term Projects, and (2) Long-Term Projects. Near-Term Projects are planned for execution within the next five years while Long-Term Projects will be executed more than five years from the date of this report.

West Yost recommends using traditional Design-Bid-Build delivery methods for construction. Each project identified in this report should be closely coordinated with the projects identified in the SCADA Management Plan (also developed by West Yost) and in the Water System Management Plan (developed by Carollo Engineers) such that infrastructure improvement projects, SCADA projects, and energy projects can be bundled together under a single construction contract to minimize impacts to Operations.

West Yost recommends executing a pilot DER project for each City-selected site (five sites in total). The pilot projects are included in Phase 1. Upon successful implementation of Phase 1, West Yost recommends proceeding with implementation of DER projects at the remainder of the City's sites. The balance of these sites is included in Phase 2.

A total of 49 projects have been identified for the implementation of the City's Energy Management Plan. Five of these projects are contained in Phase 1, while 44 projects are included in Phase 2. Implementation costs have been developed consistent with an Association for the Advancement of Cost Engineering (AACE) Class 5 cost estimate for all Phase 1 projects. No cost estimates were developed for Phase 2 projects.

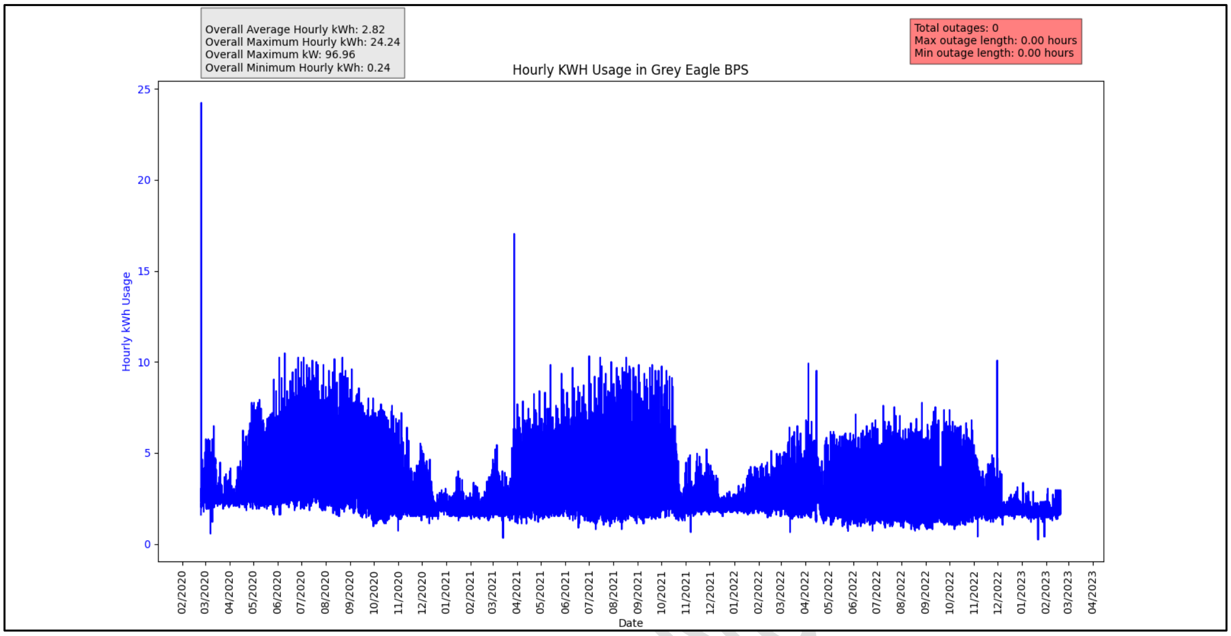
Appendix H Implementation Plan outlines the complete portfolio of projects contained in the Energy Management Plan. The Implementation Plan contains all projects required to implement the recommendations contained in this report, including Project IDs, Project Titles, Project Timelines and Durations, Predecessors, and Total Costs (for Near-Term Projects).

Appendix A

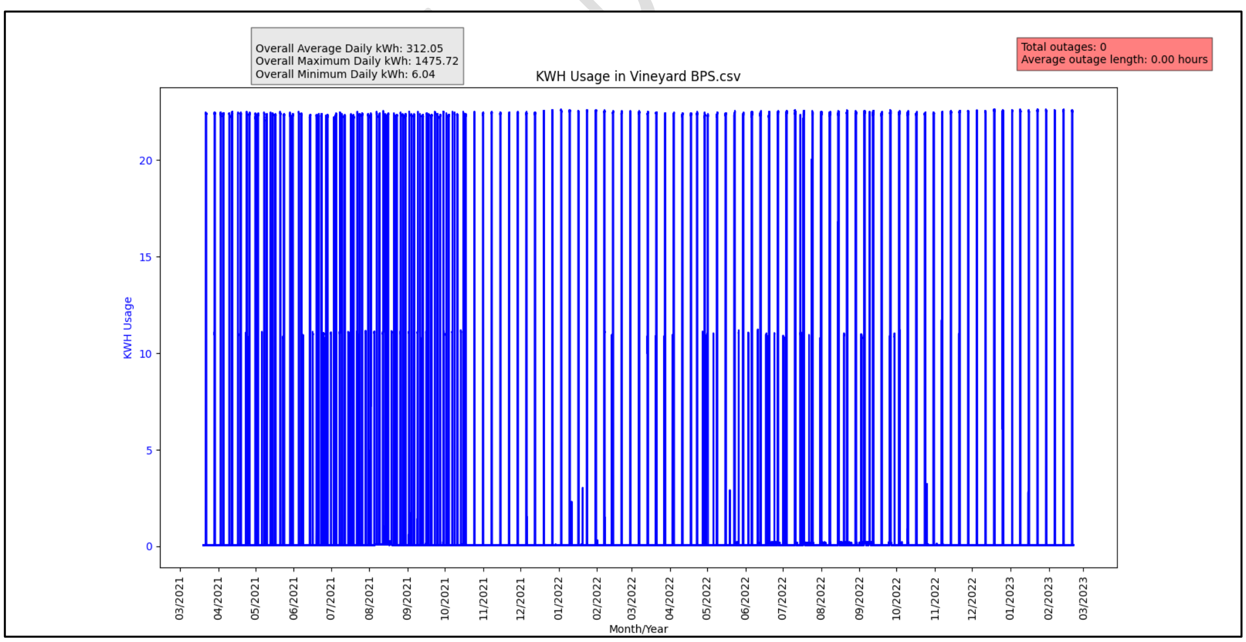
Hourly Interval Outage Analysis

Potable Water Booster Pump Stations

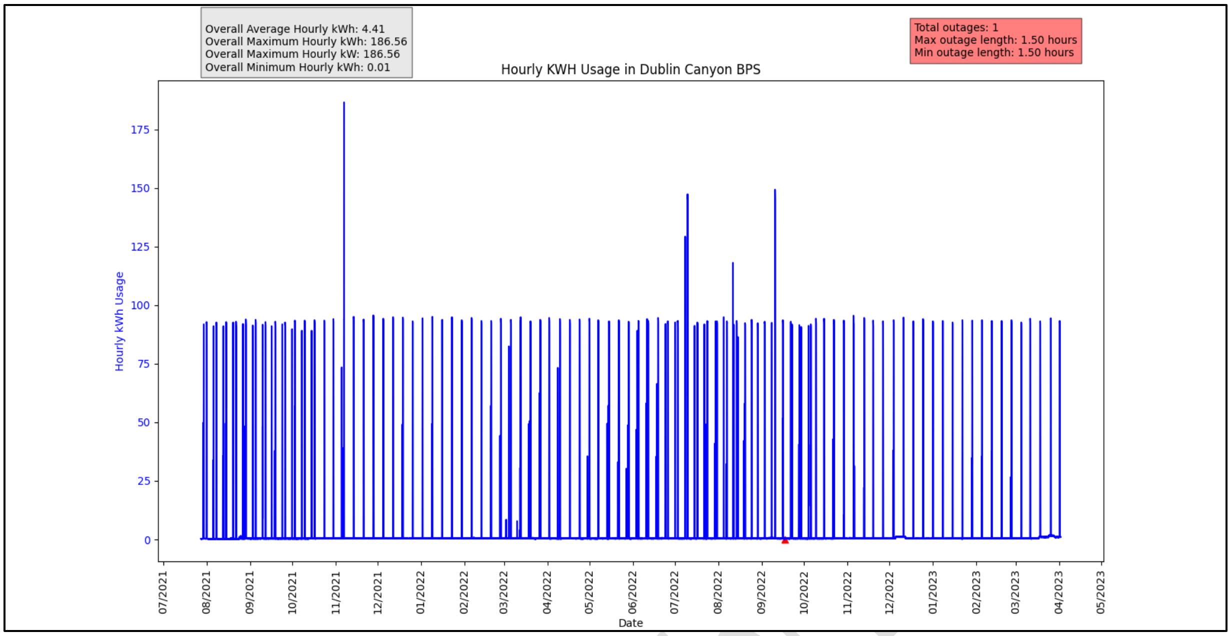
Grey Eagle BPS Energy and Outage Profile



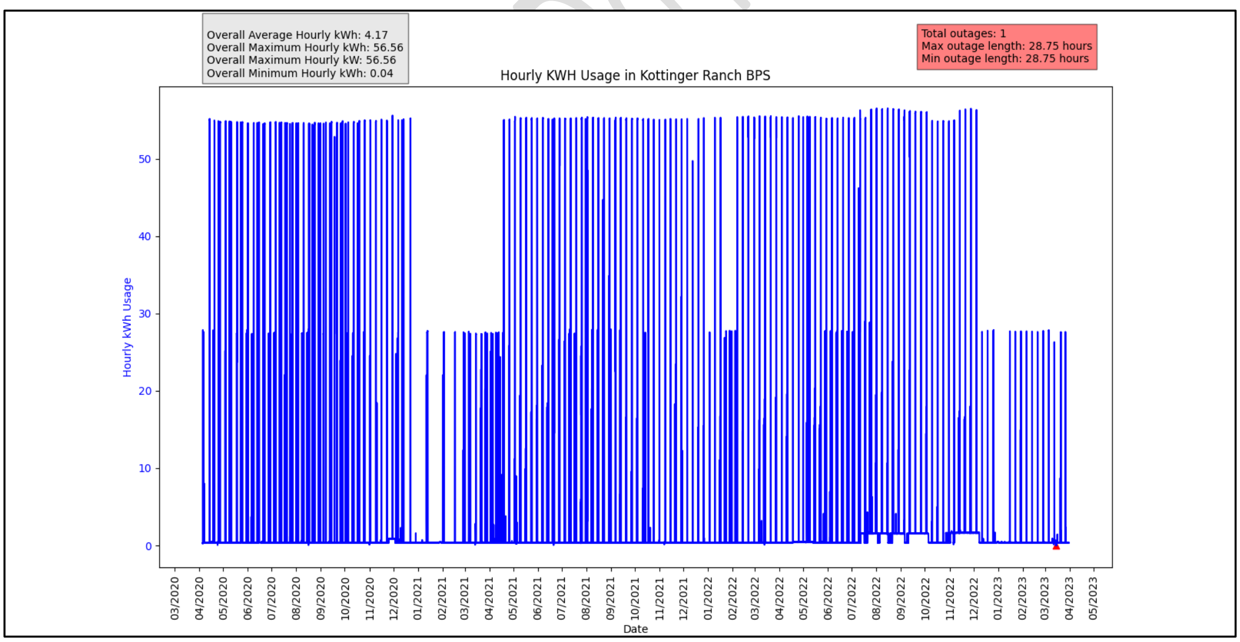
Vineyard BPS Energy and Outage Profile



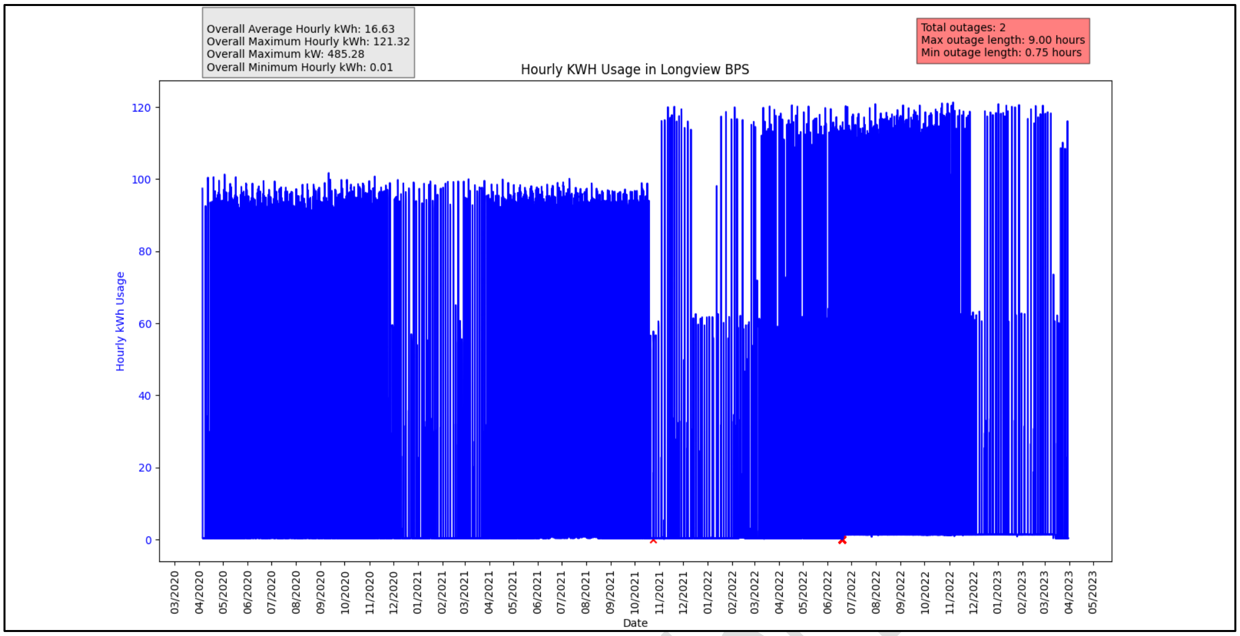
Dublin Canyon BPS Energy and Outage Profile



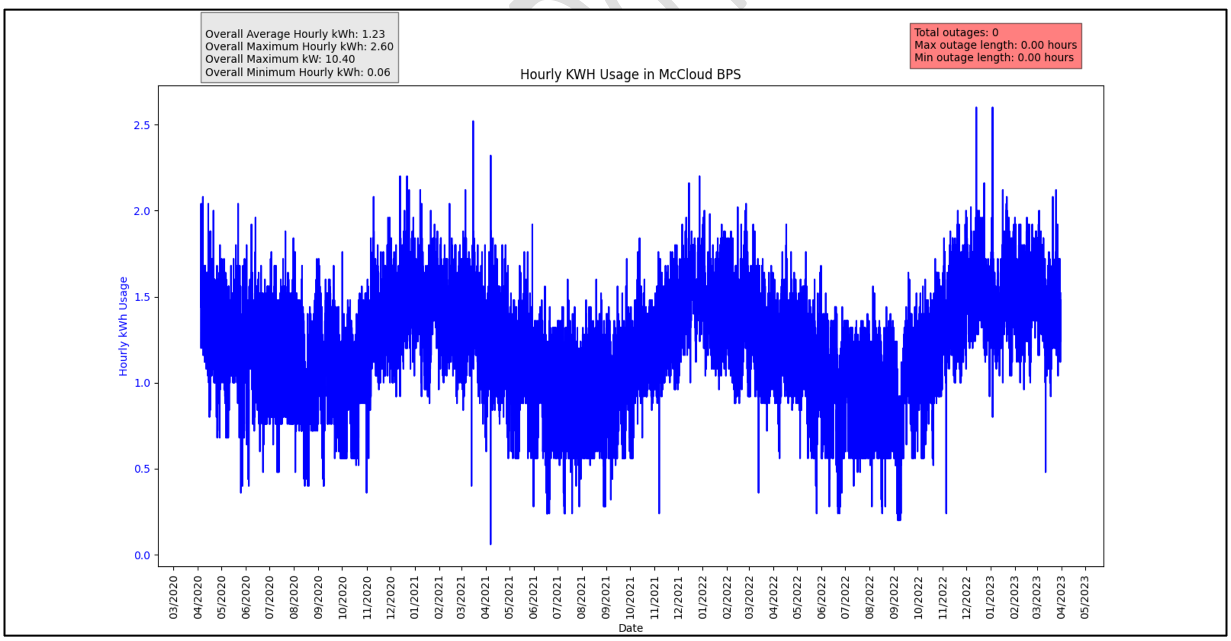
Kottinger Ranch BPS Energy and Outage Profile



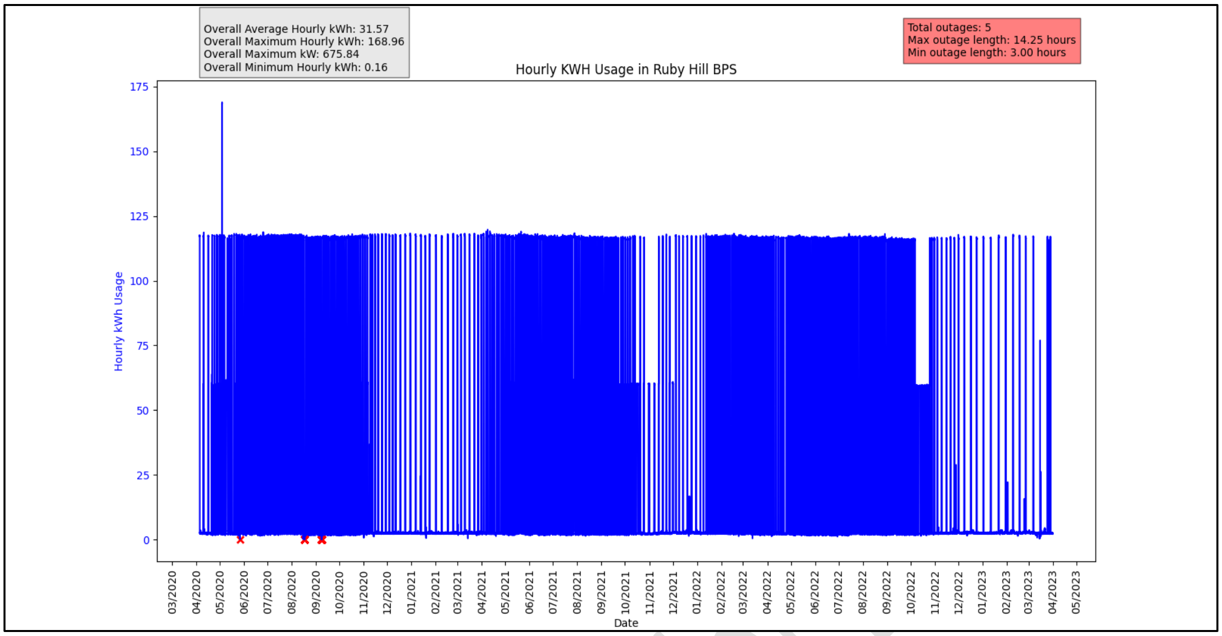
Longview BPS Energy and Outage Profile



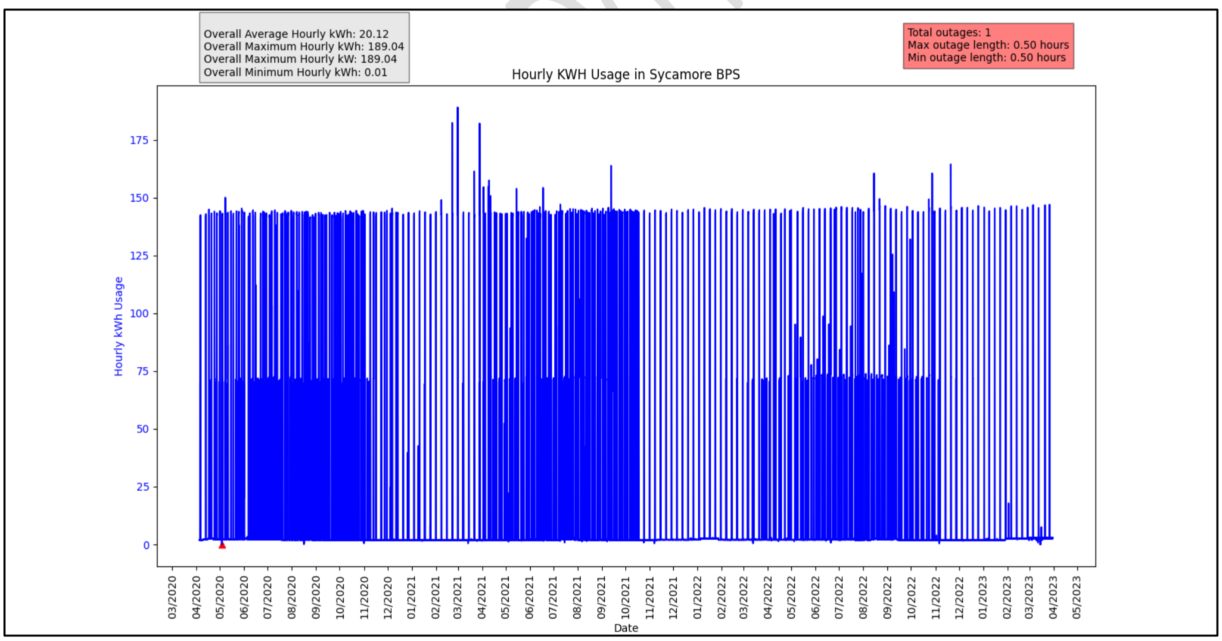
McCloud BPS Energy and Outage Profile



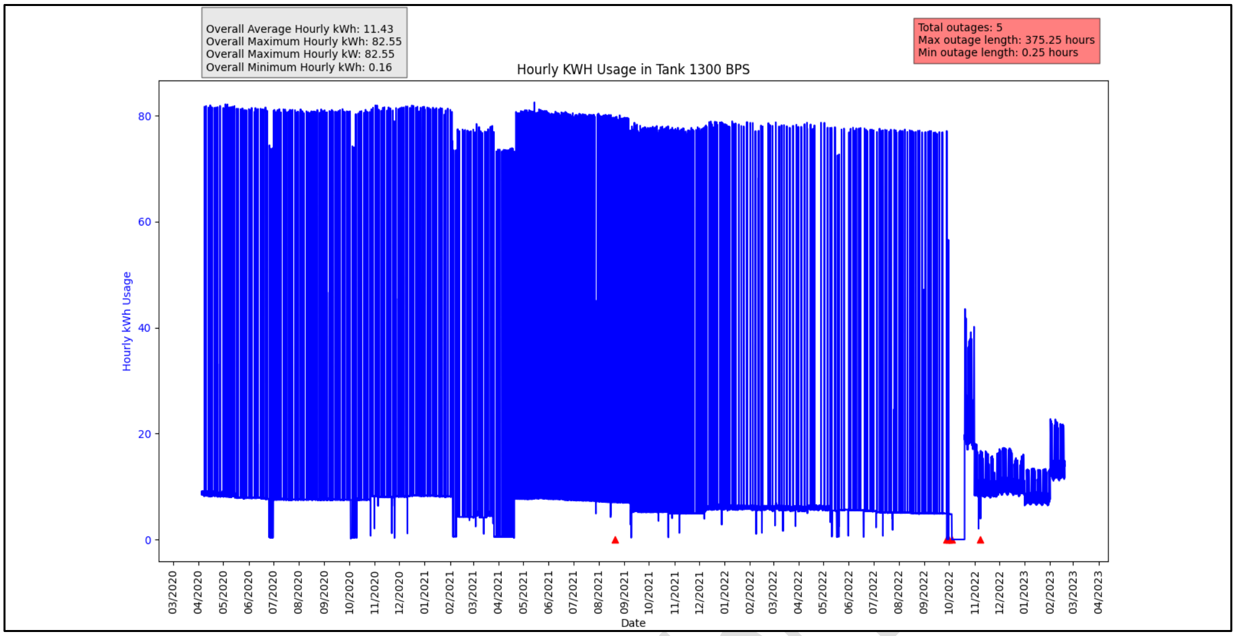
Ruby Hill BPS Energy and Outage Profile



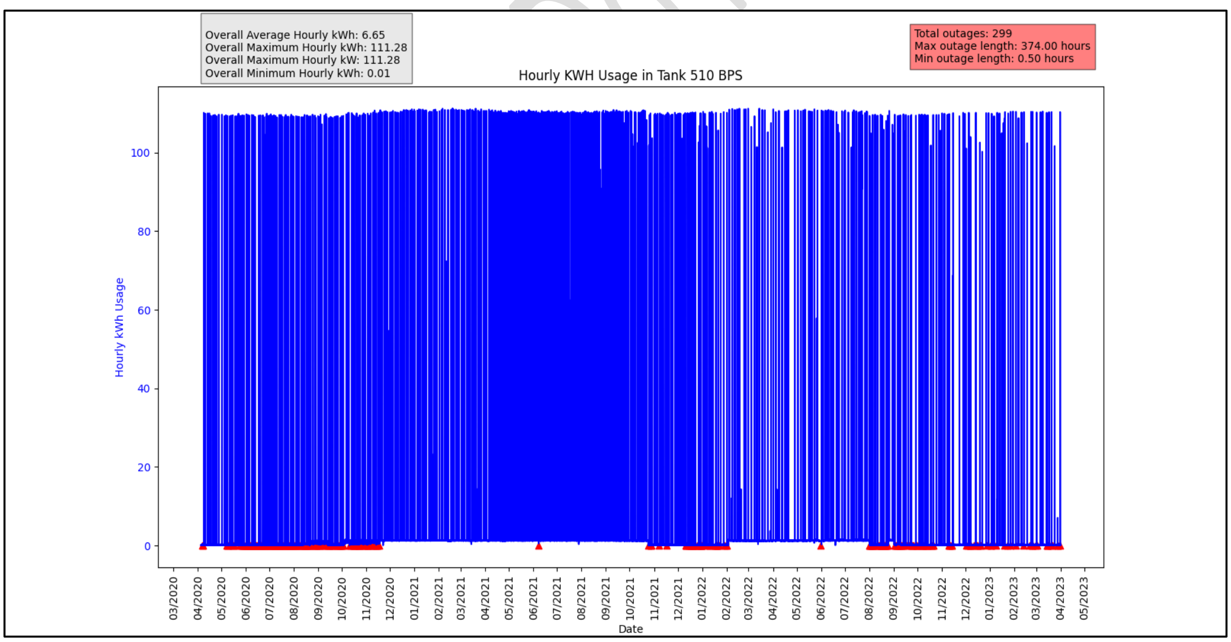
Sycamore BPS Energy and Outage Profile



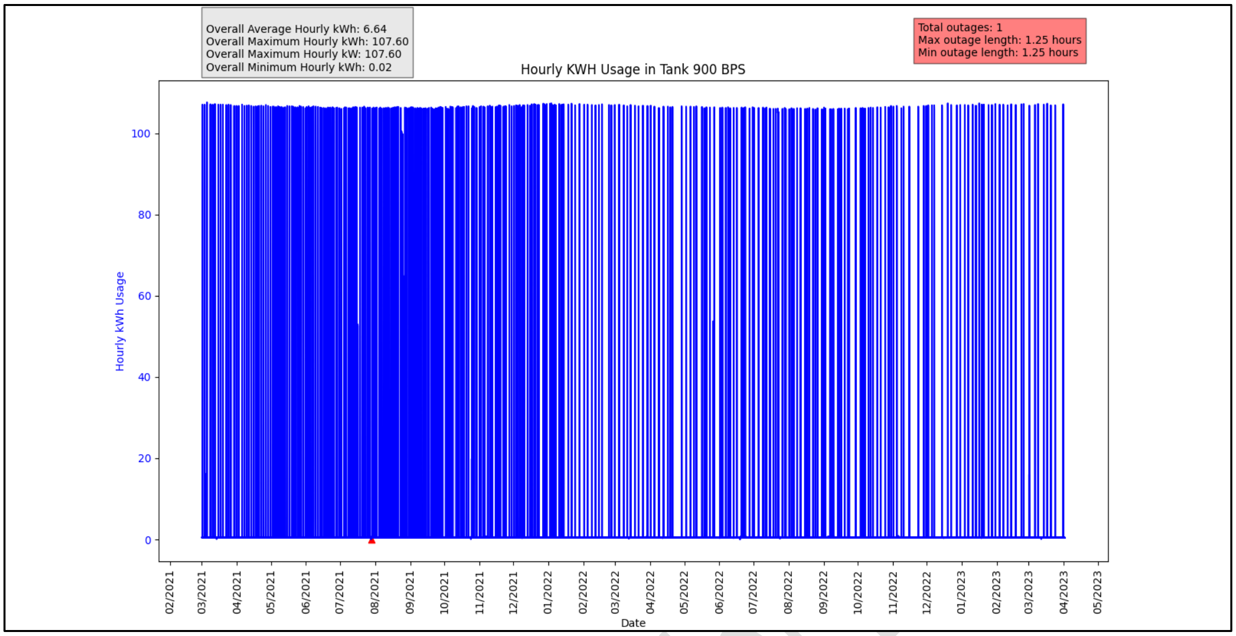
Tank 1300 BPS Energy and Outage Profile



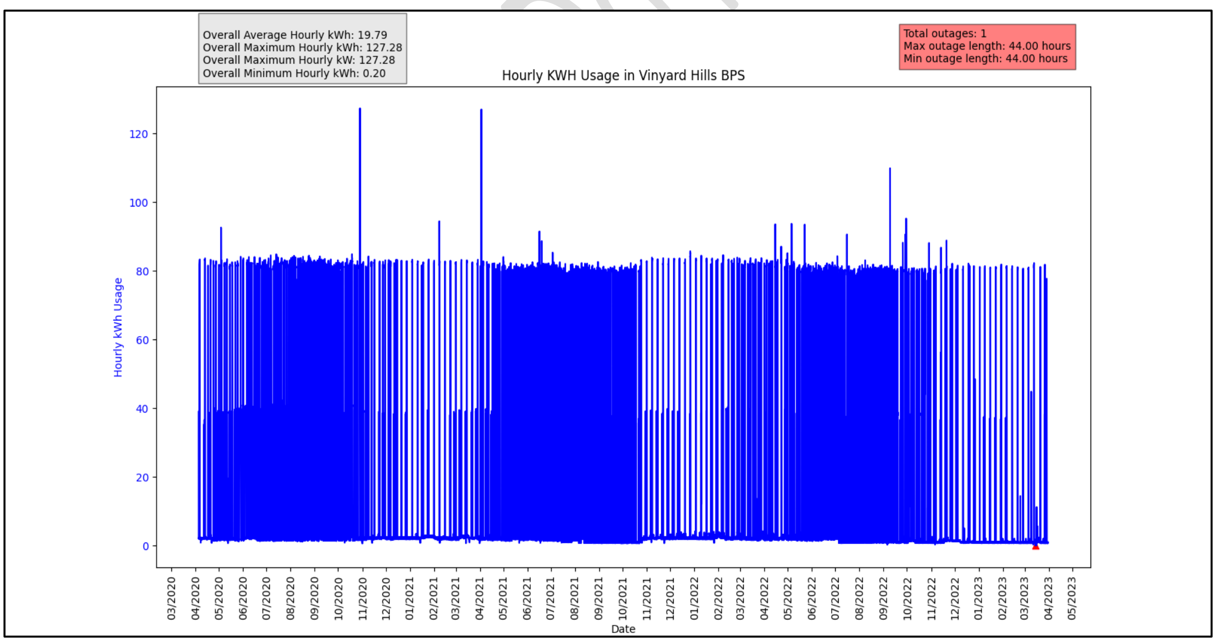
Tank 510 BPS Energy and Outage Profile



Tank 900 BPS Energy and Outage Profile

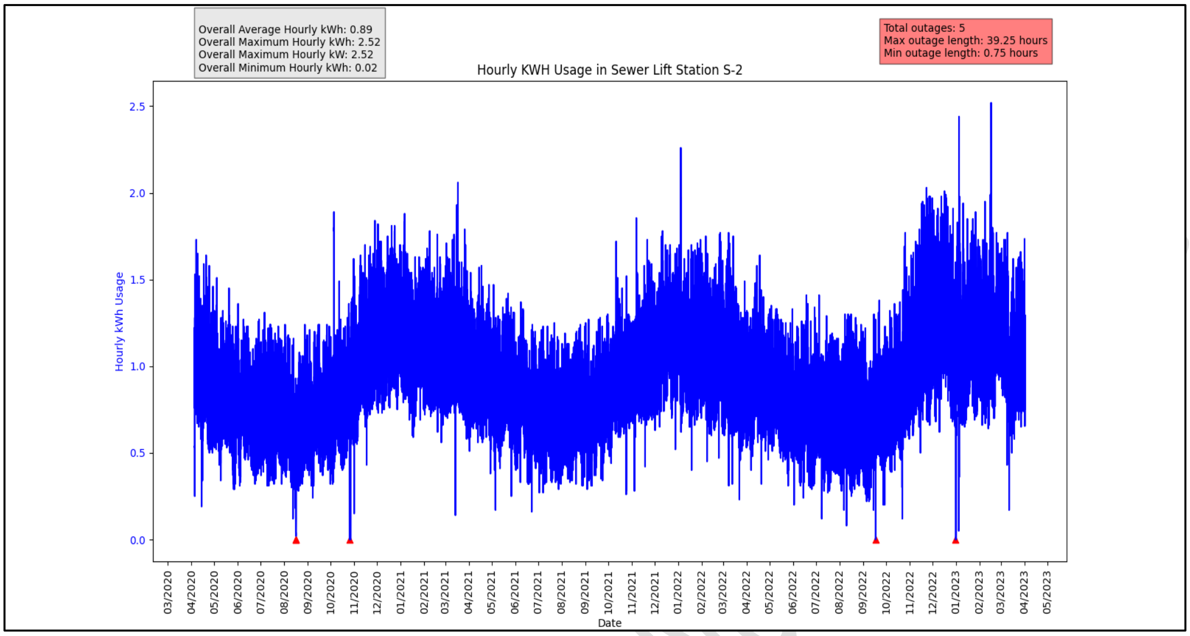


Vineyard Hills BPS Energy and Outage Profile

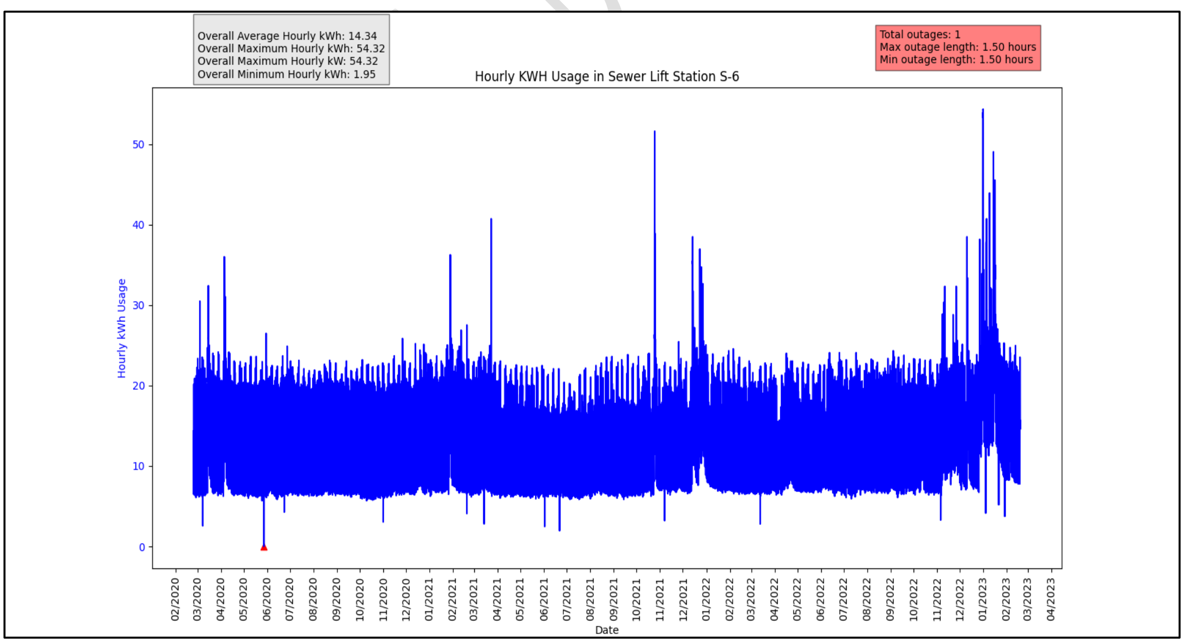


Sewer Lift Stations

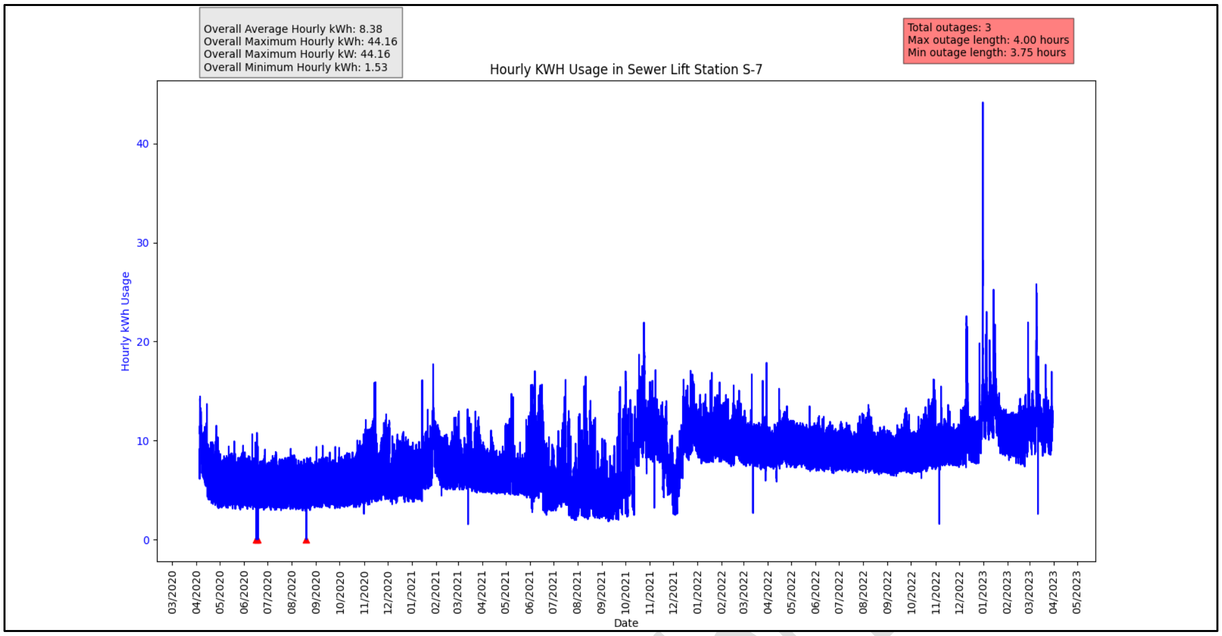
Sewer Lift Station S-2 Energy and Outage Profile



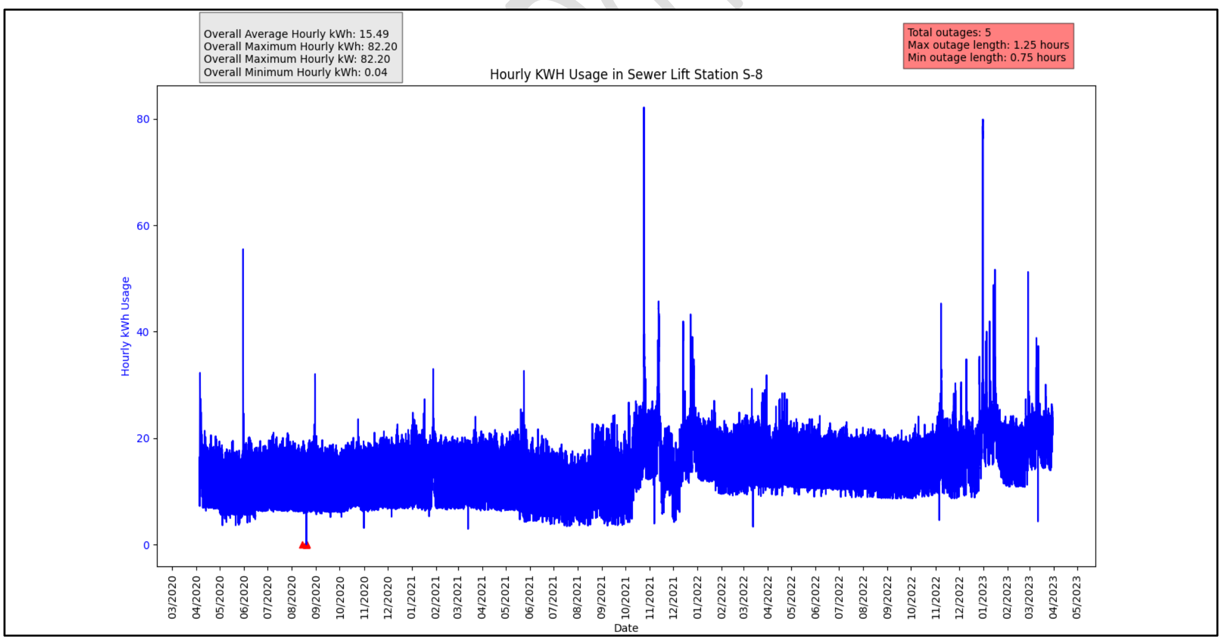
Sewer Lift Station S-6 Energy and Outage Profile



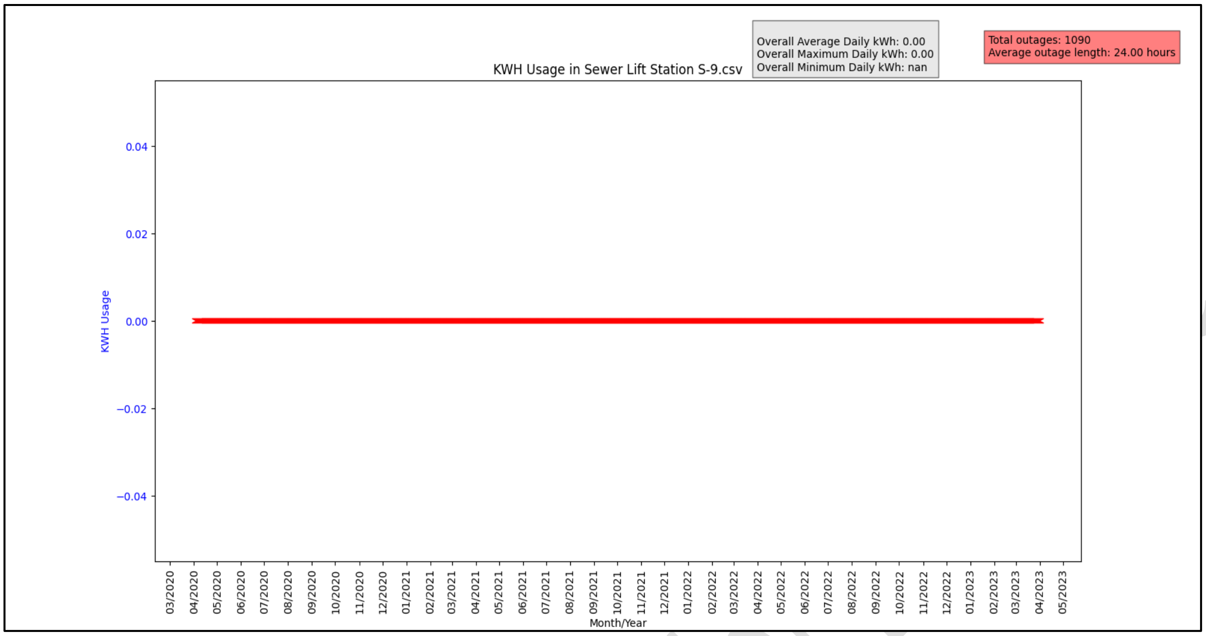
Sewer Lift Station S-7 Energy and Outage Profile



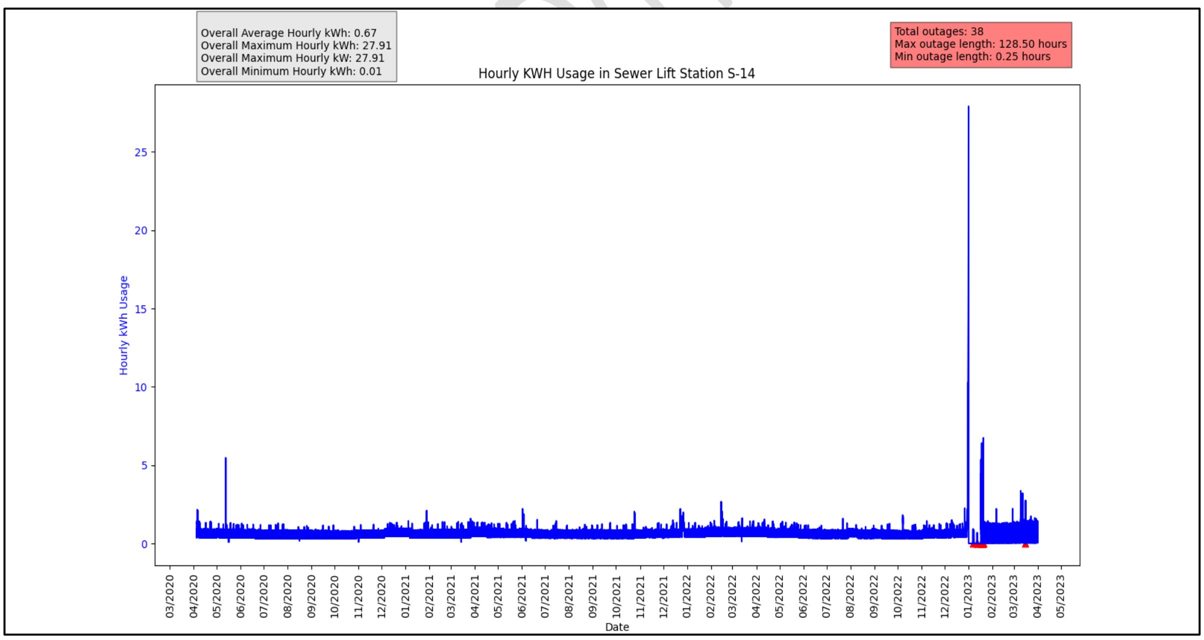
Sewer Lift Station S-8 Energy and Outage Profile



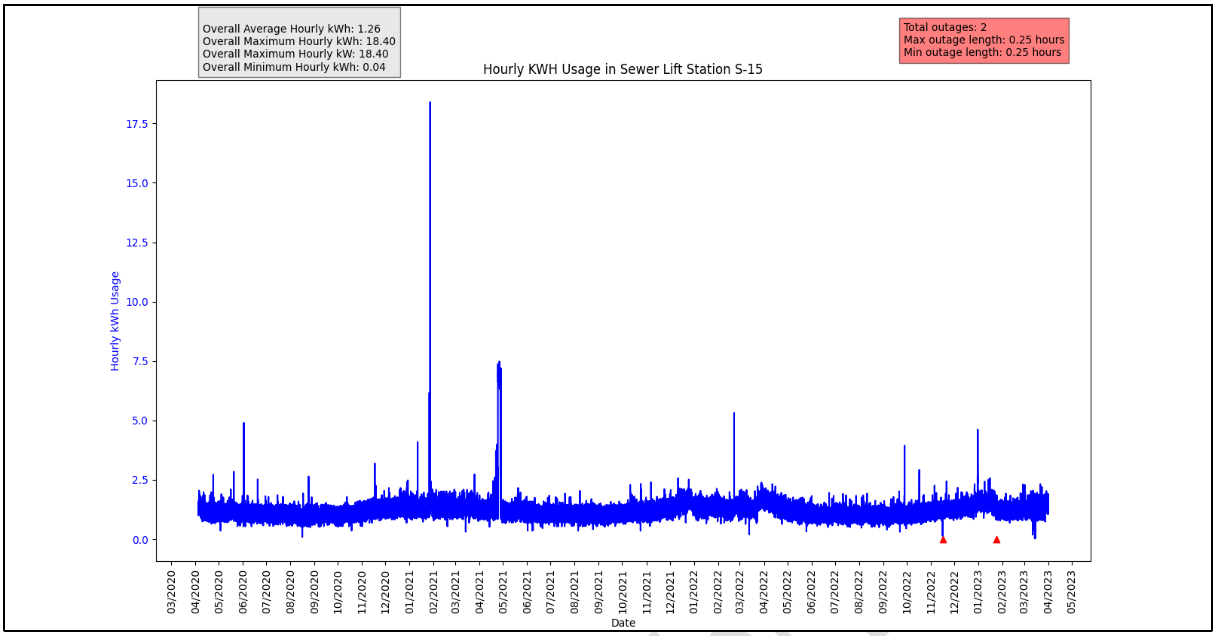
Sewer Lift Station S-9 Energy and Outage Profile



Sewer Lift Station S-14 Energy and Outage Profile

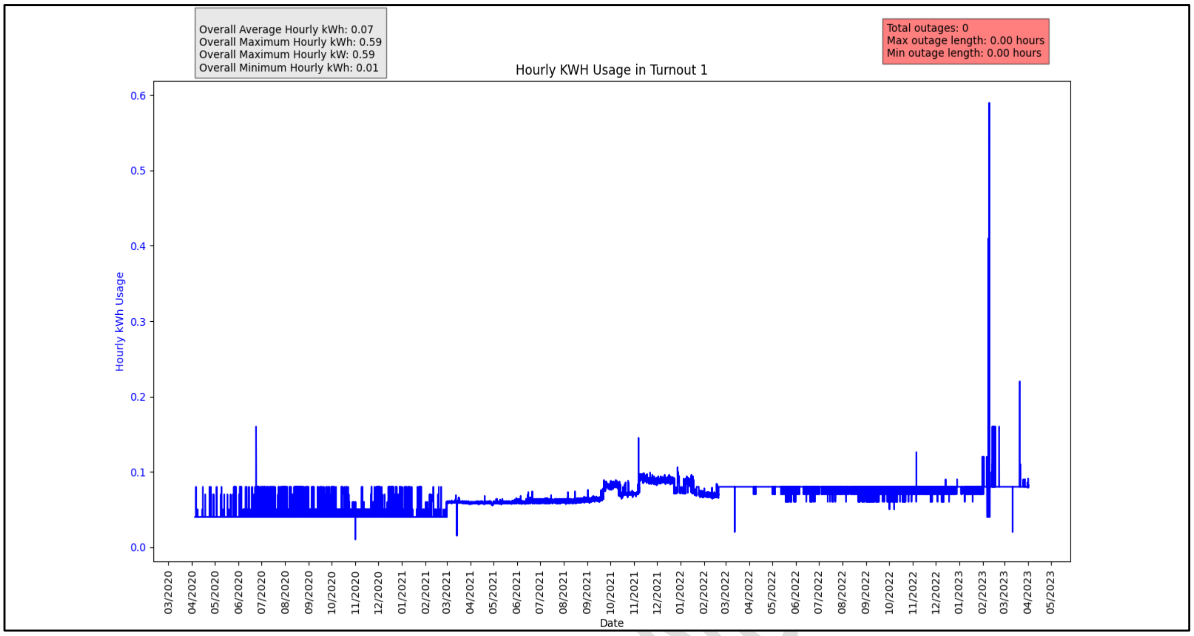


Sewer Lift Station S-15 Energy and Outage Profile

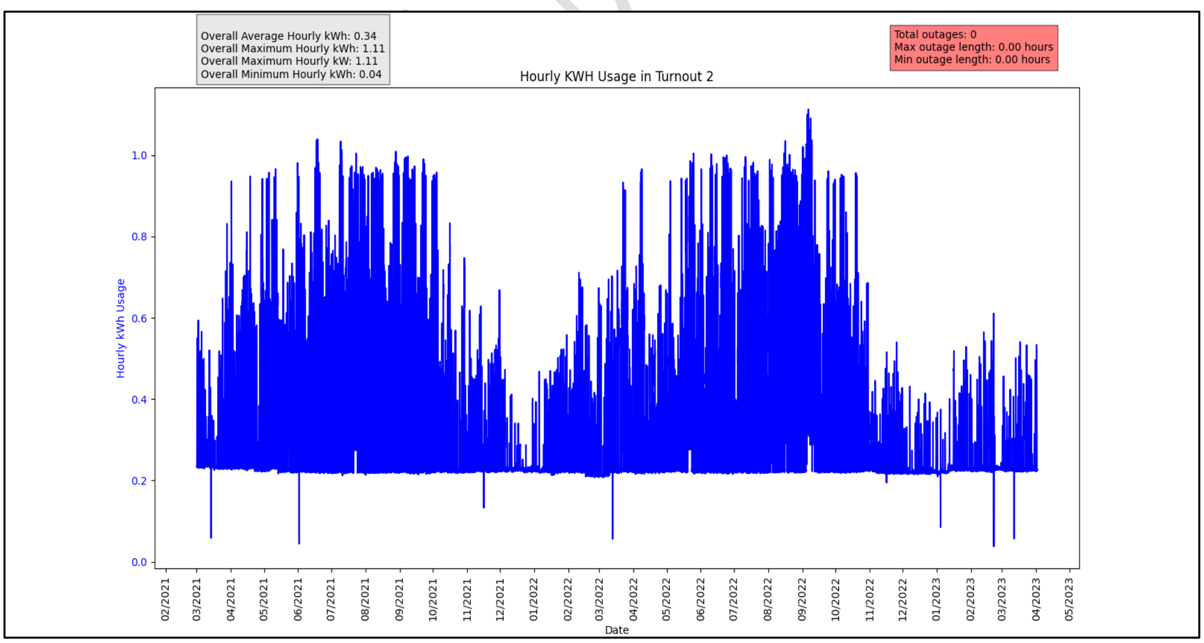


Potable Water Turnouts

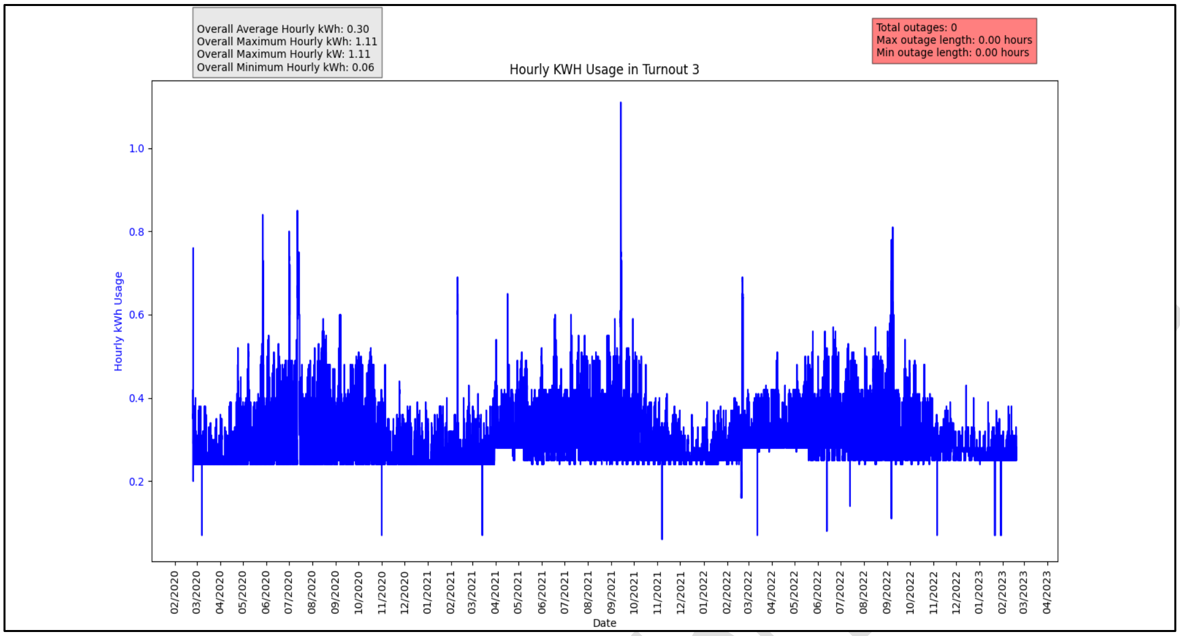
Turnout 1 Energy and Outage Profile



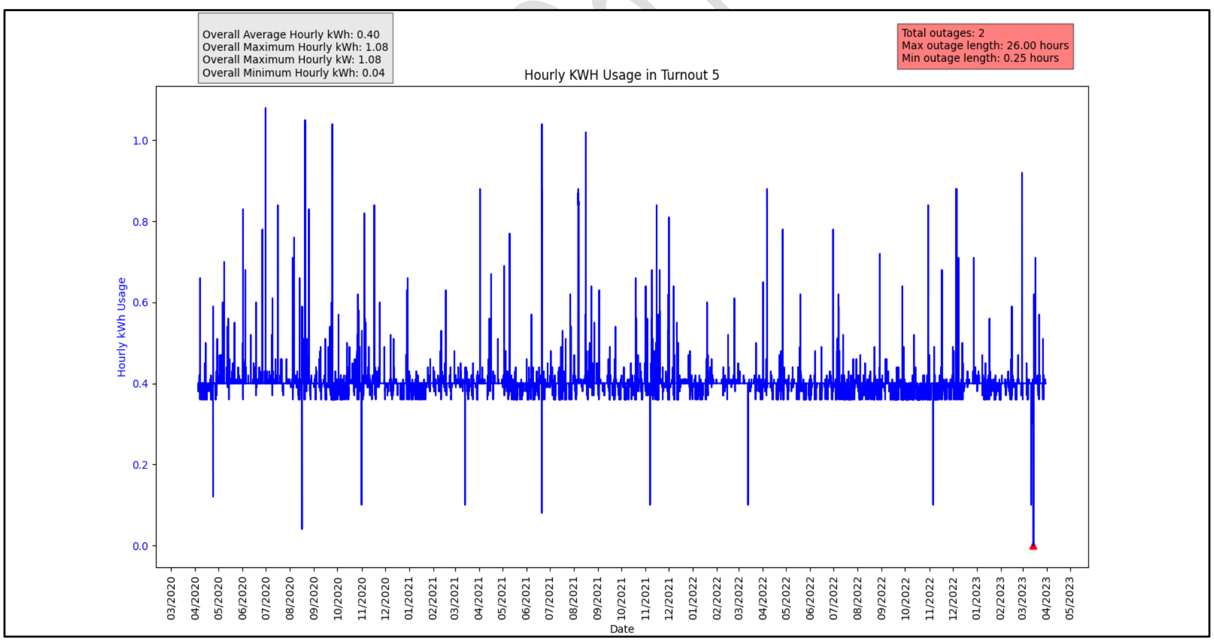
Turnout 2 Energy and Outage Profile



Turnout 3 Energy and Outage Profile

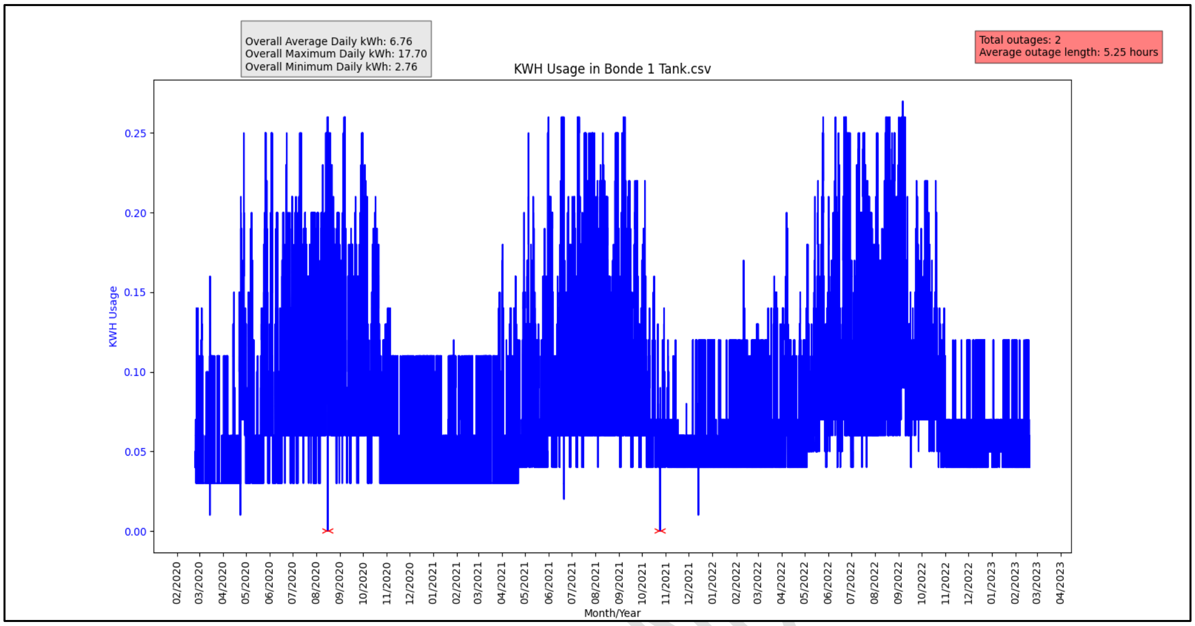


Turnout 5 Energy and Outage Profile

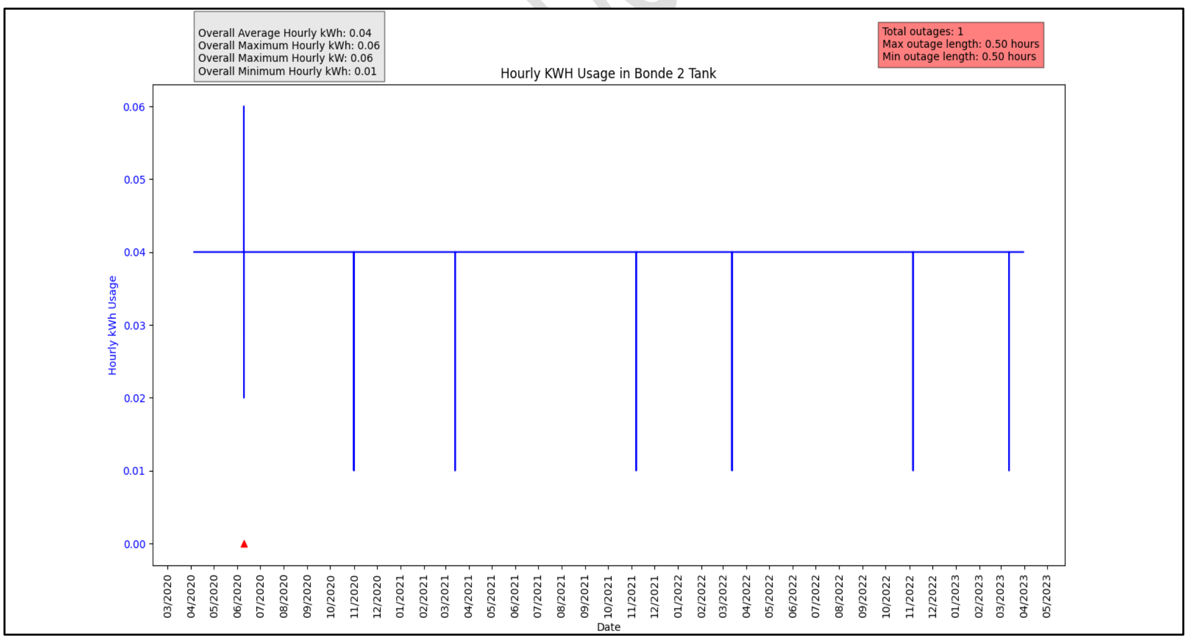


Storage Tanks

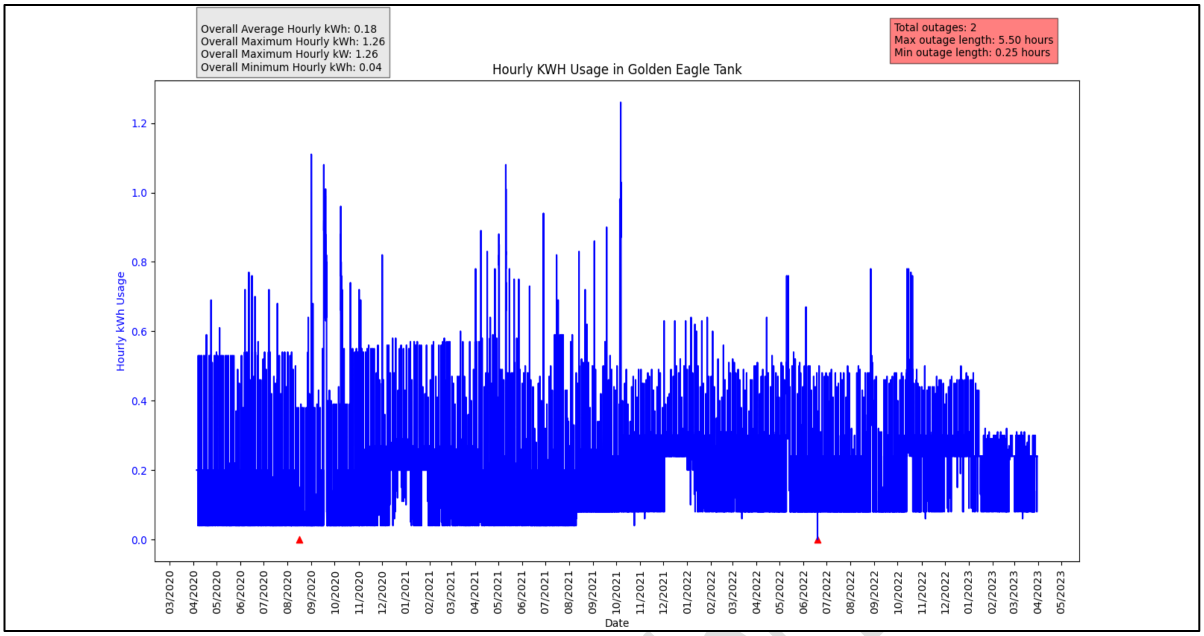
Bonde 1 Tank Energy and Outage Profile



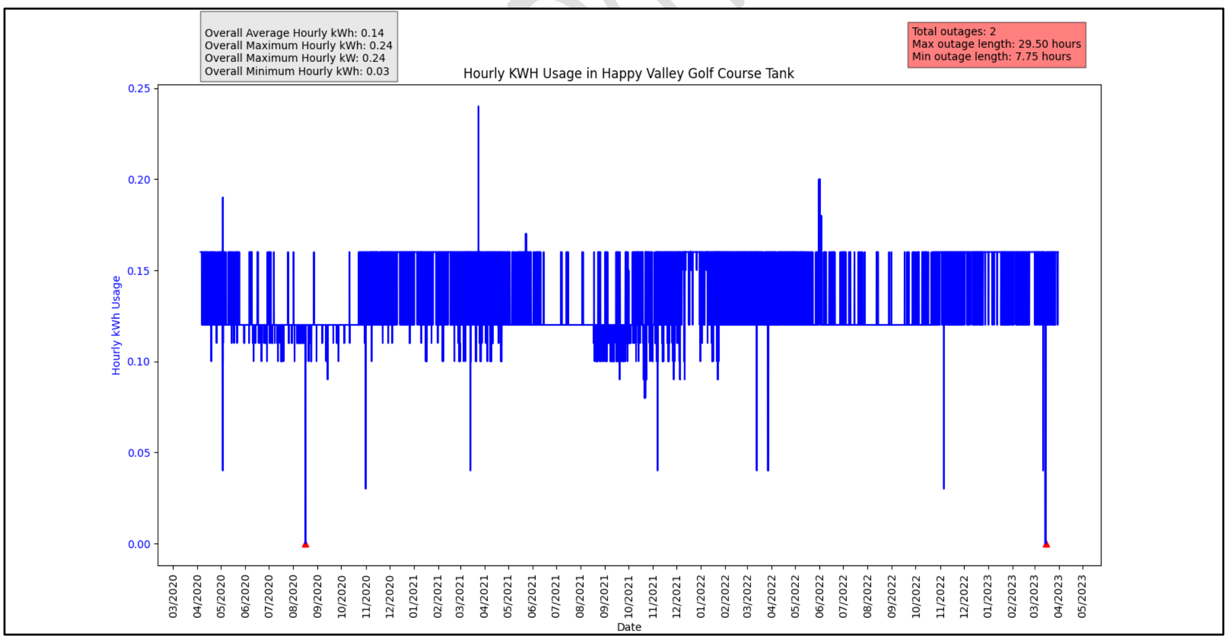
Bonde 2 Tank Energy and Outage Profile



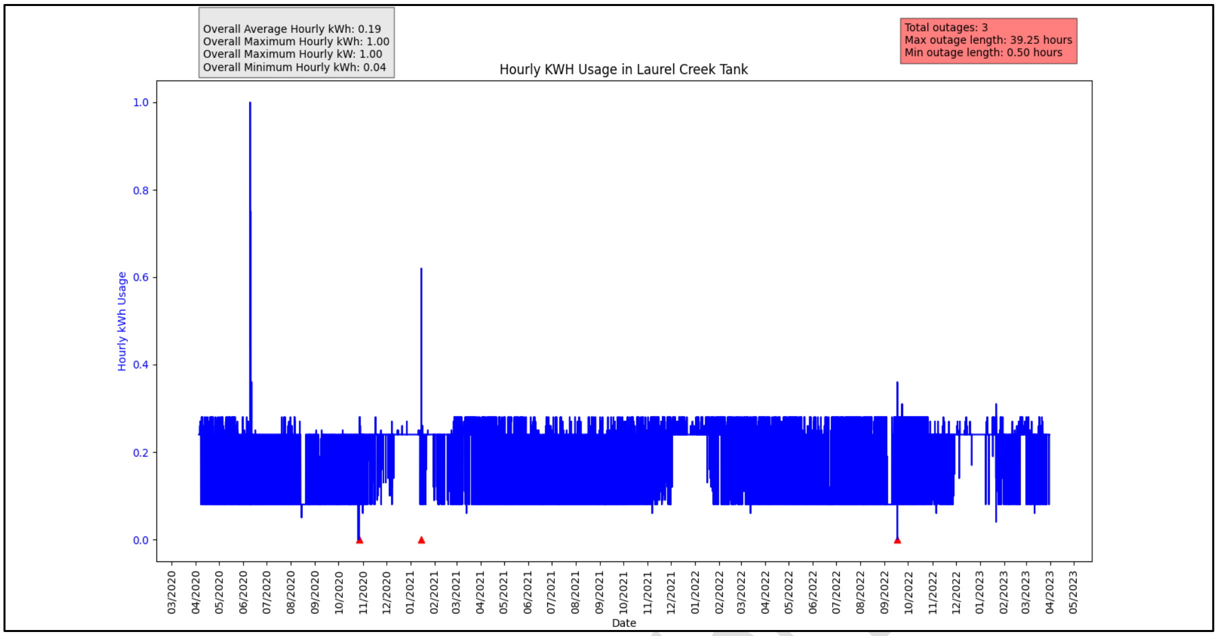
Golden Eagle Tank Energy and Outage Profile



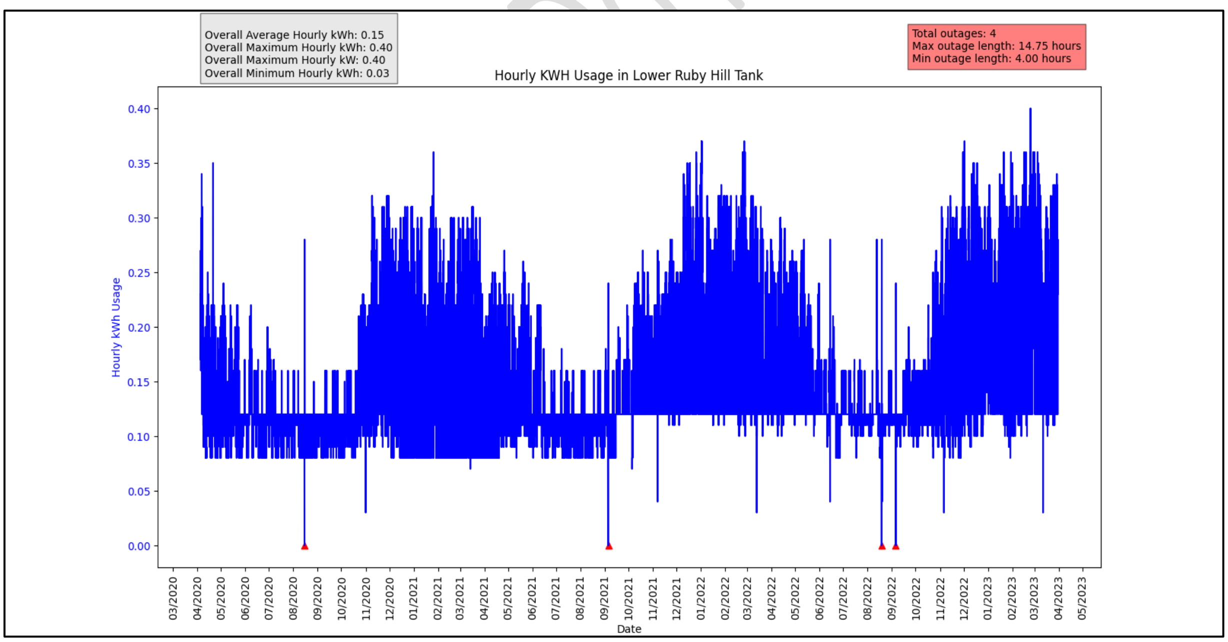
Happy Valley Golf Course Tank Energy and Outage Profile



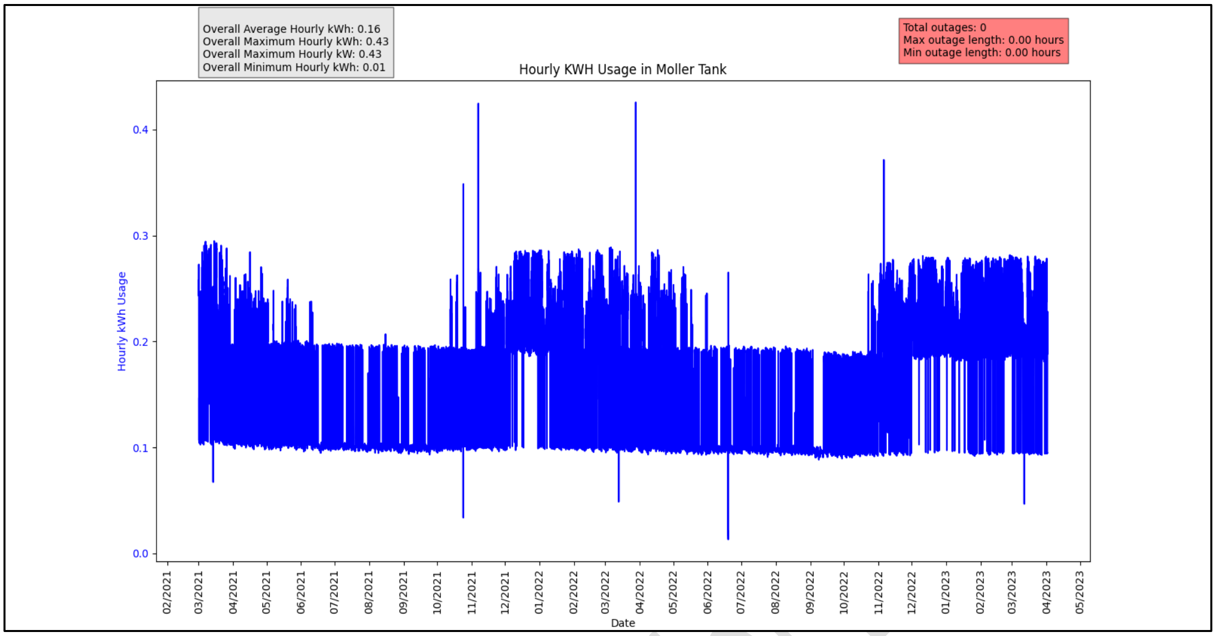
Laurel Creek Tank Energy and Outage Profile



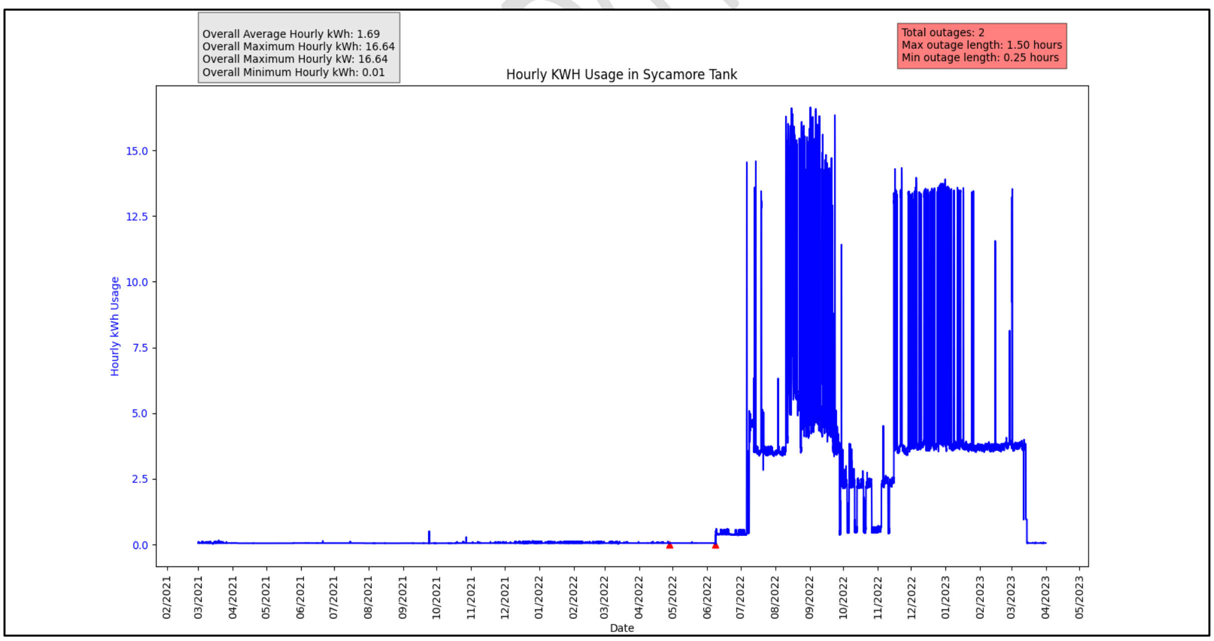
Lower Ruby Hill Tank Energy and Outage Profile



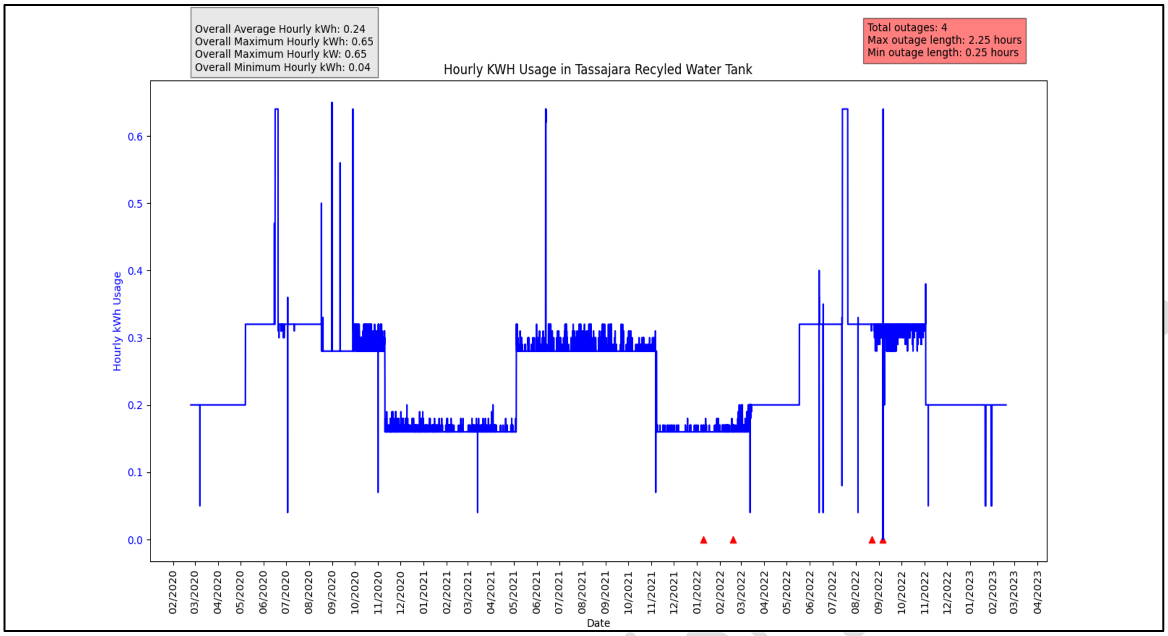
Moller Tank Energy and Outage Profile



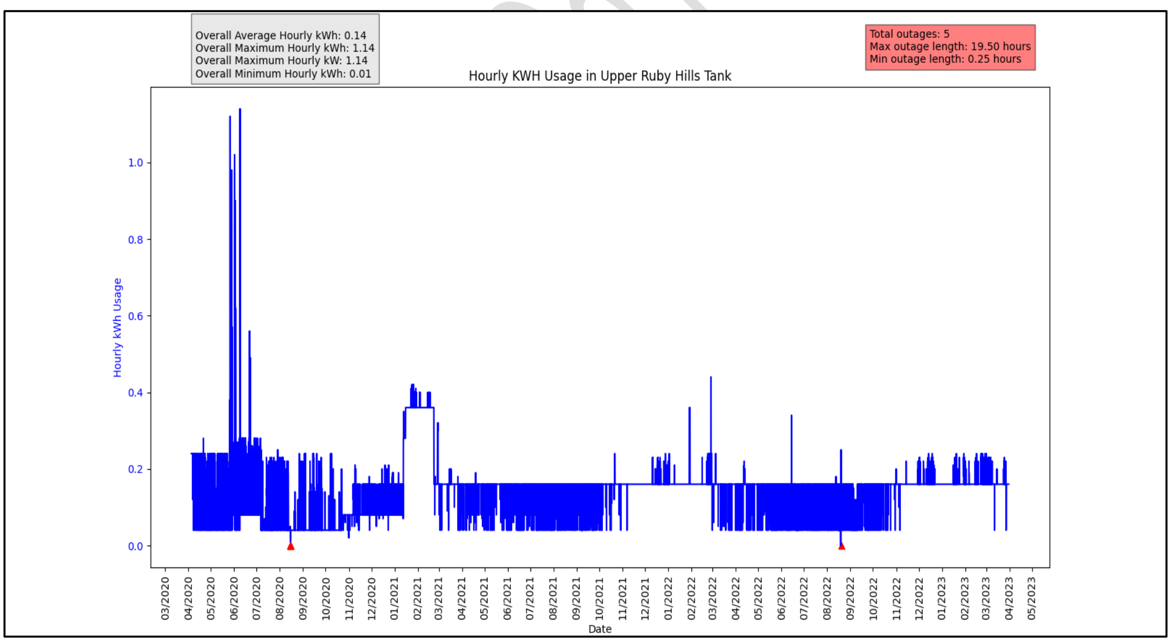
Sycamore 8MG Tank Energy and Outage Profile



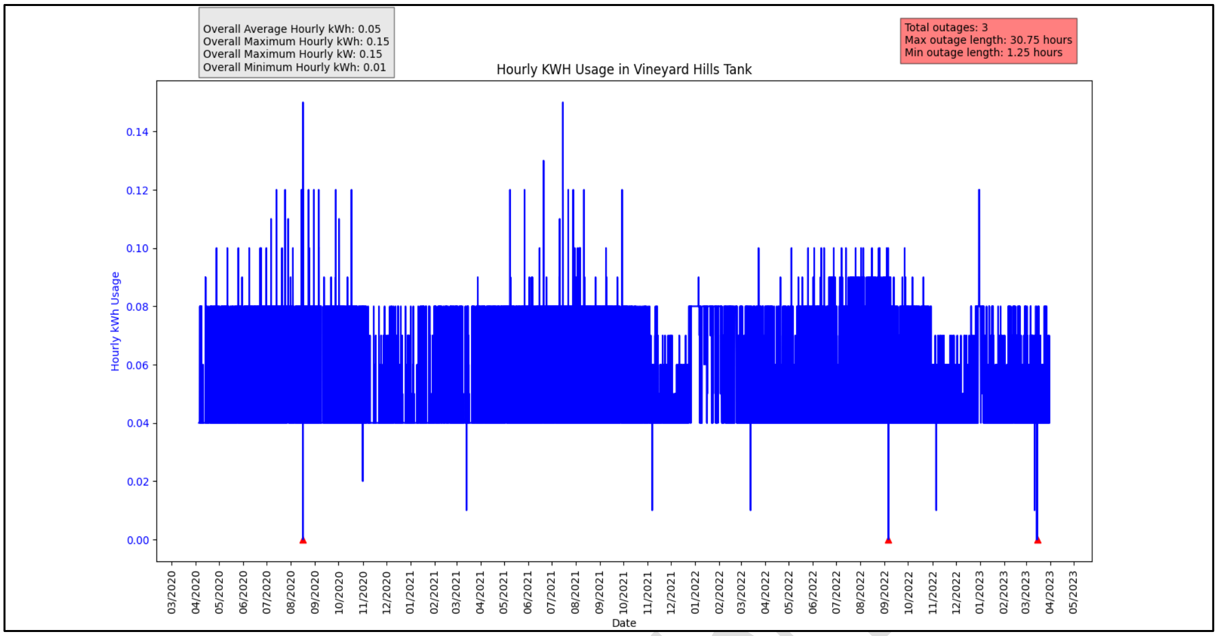
Tassajara Tank Energy and Outage Profile



Upper Ruby Hill Tank Energy and Outage Profile

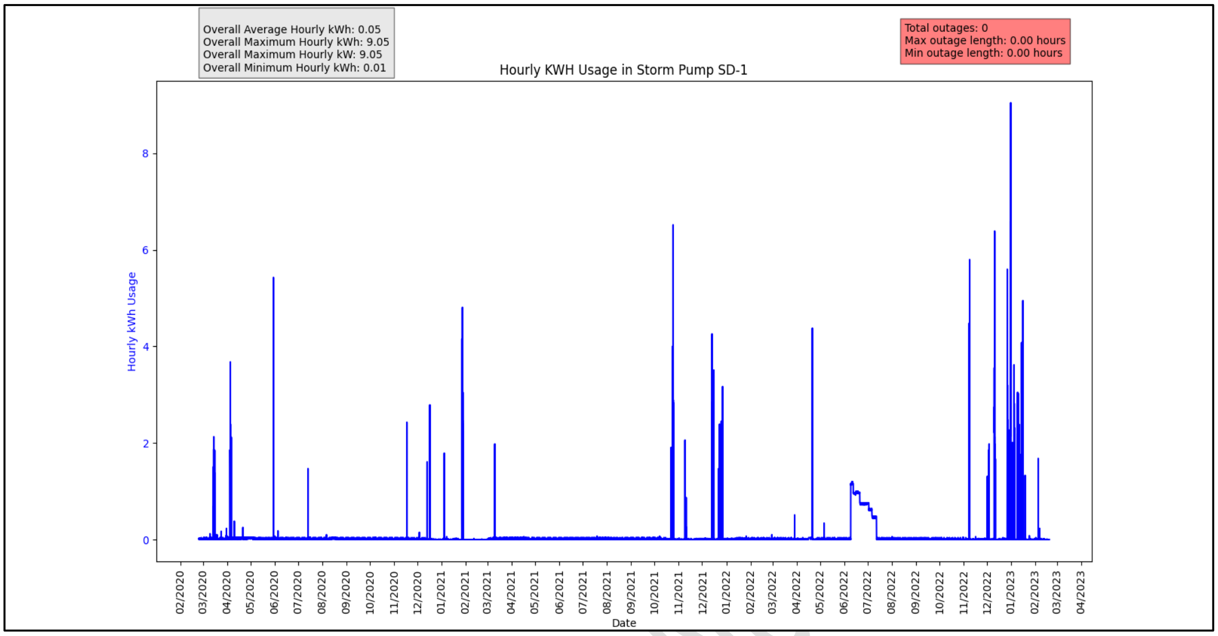


Vineyard Hills Tank Energy and Outage Profile

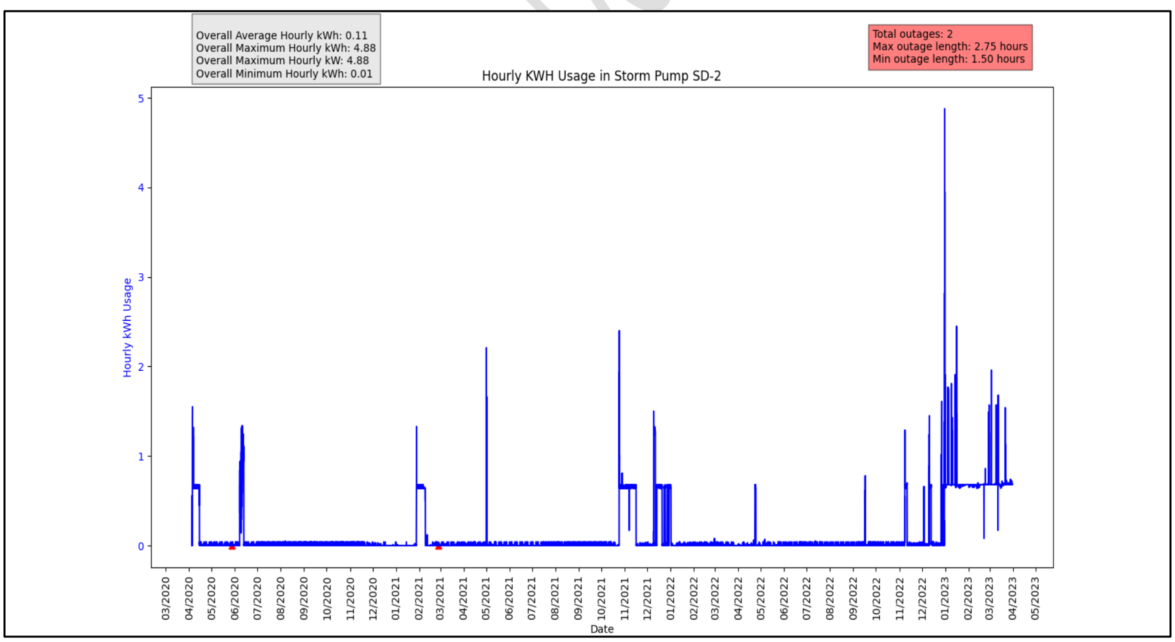


Storm Pump Stations

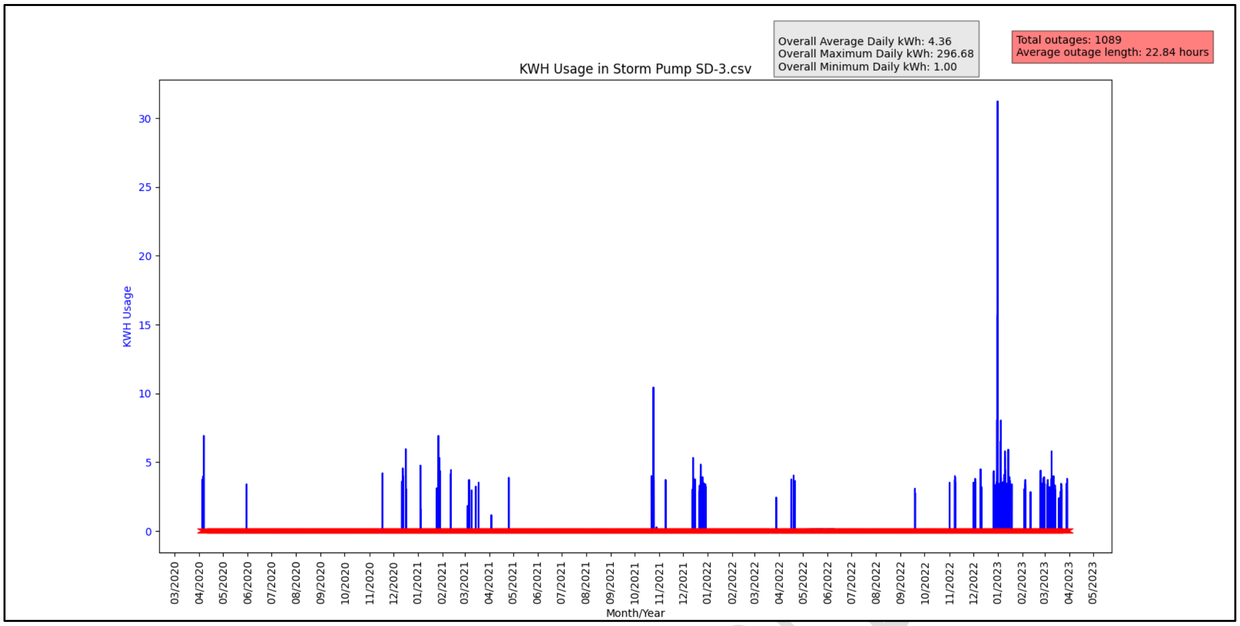
Storm Pump Station SD-1 Energy and Outage Profile



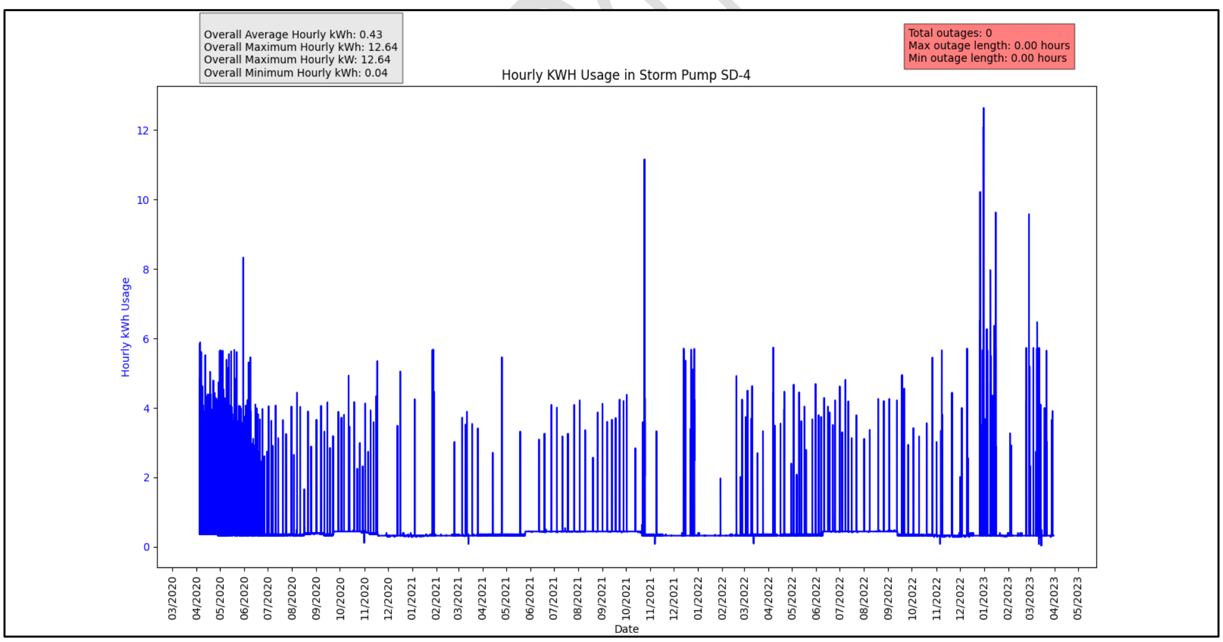
Storm Pump Station SD-2 Energy and Outage Profile



Storm Pump Station SD-3 Energy and Outage Profile

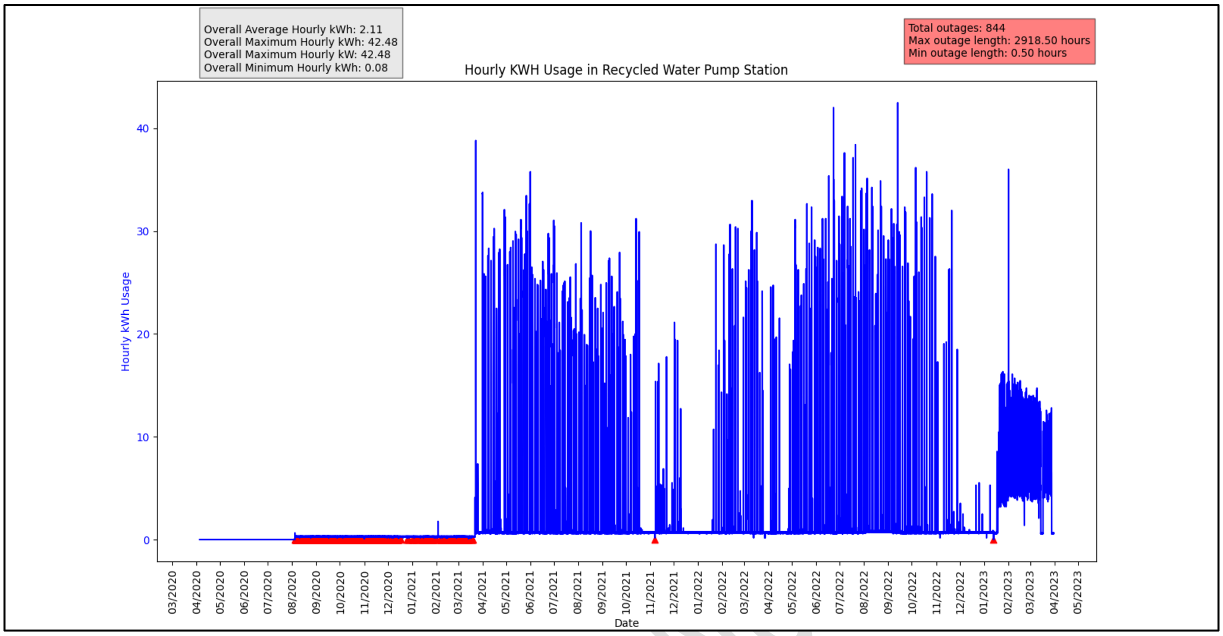


Storm Pump Station SD-4 Energy and Outage Profile



Recycled Water Pump Station

Recycled Water Pump Station Energy and Outage Profile

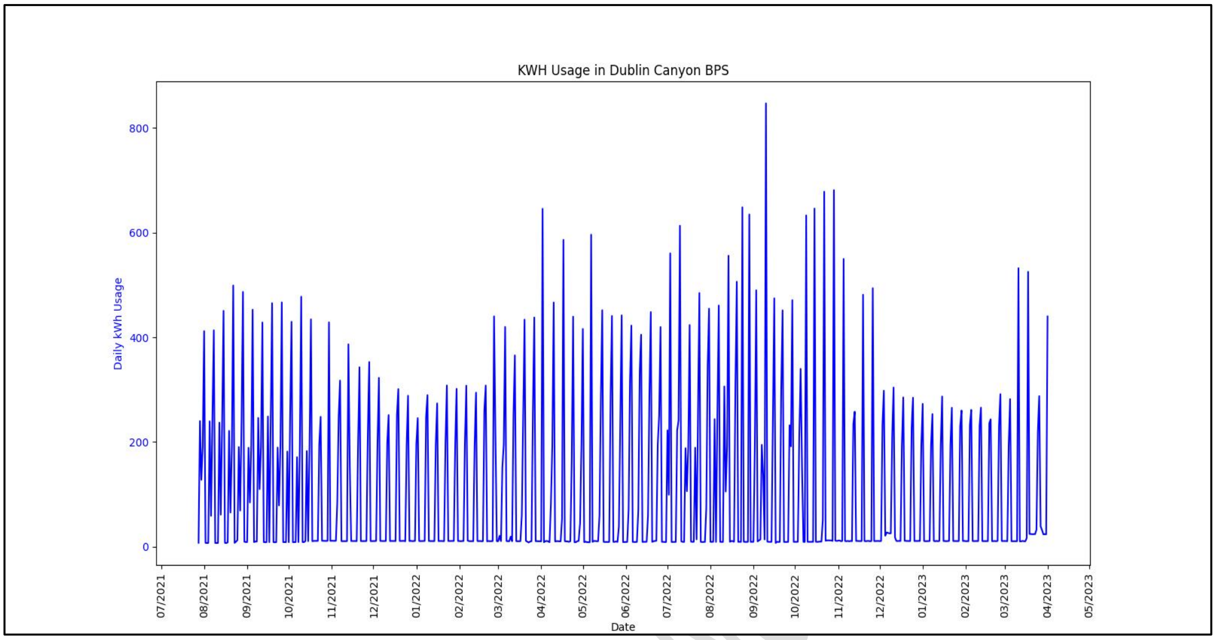


Appendix B

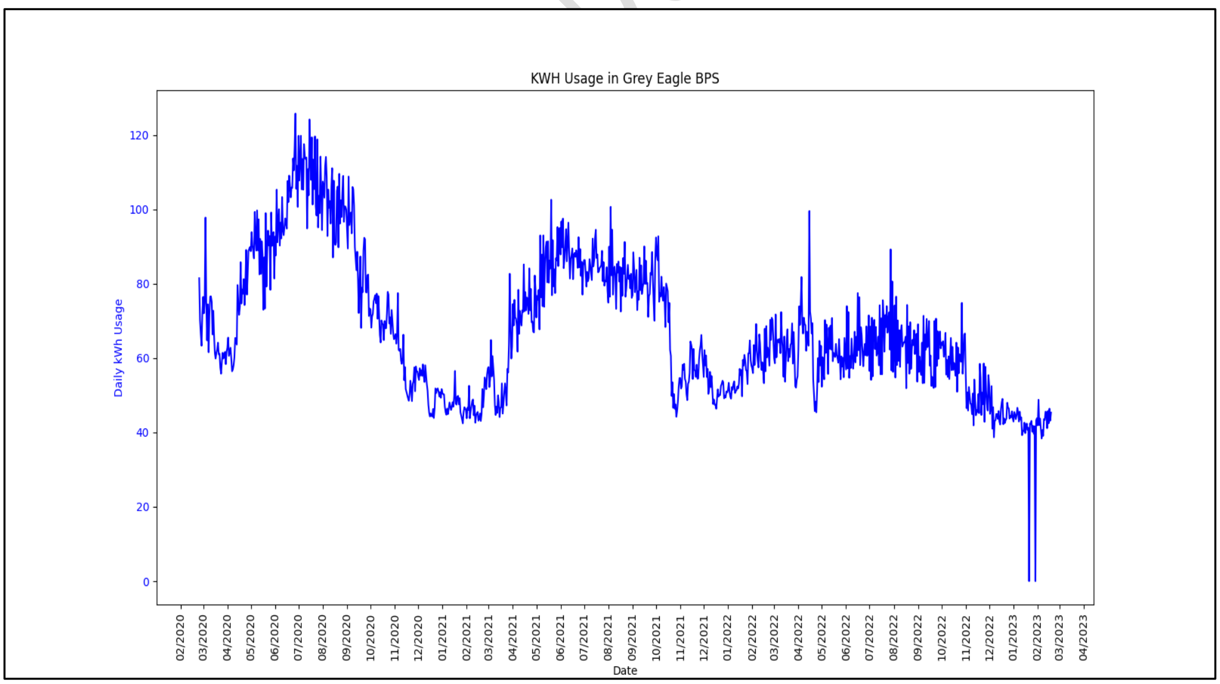
Daily Consumption Analysis

Potable Water Booster Pump Stations

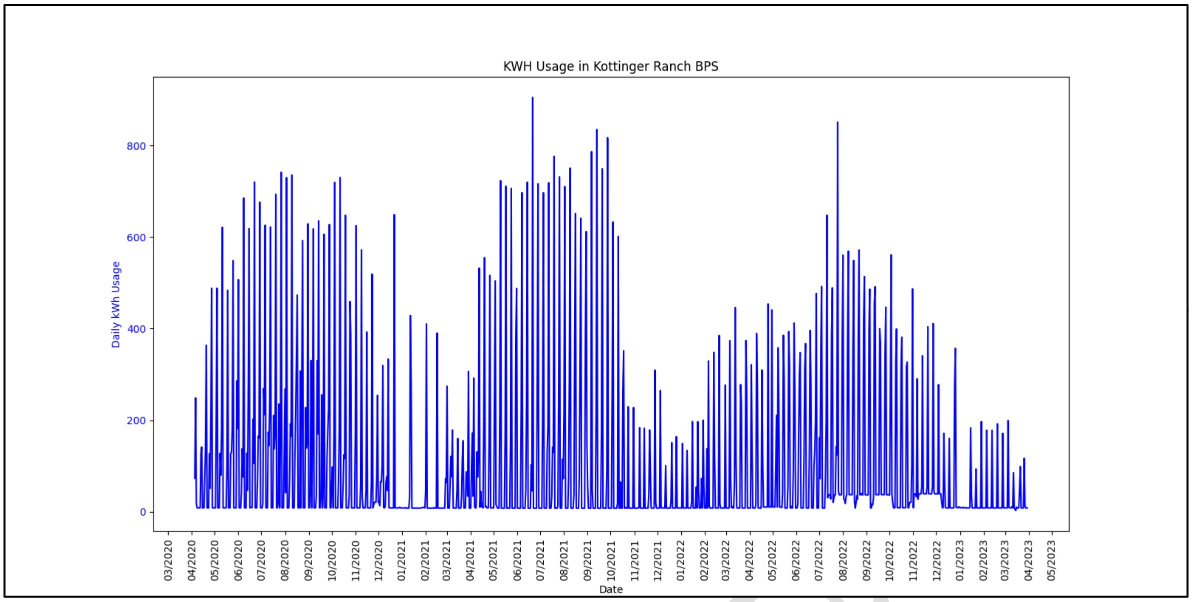
Dublin Canyon BPS Daily Energy Profile



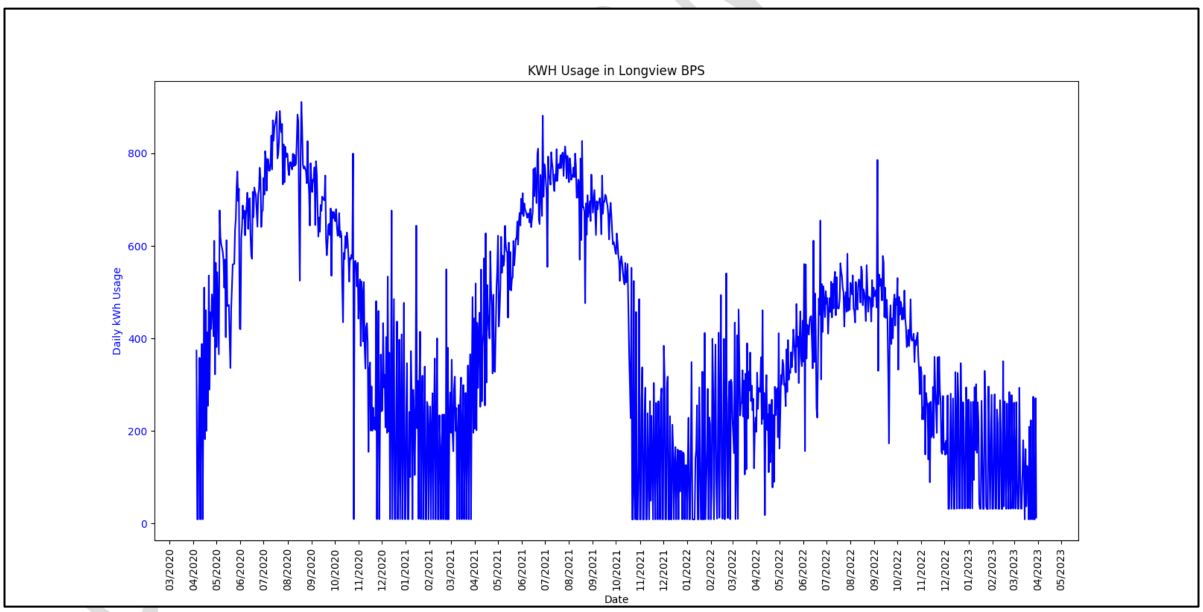
Grey Eagle BPS Daily Energy Profile



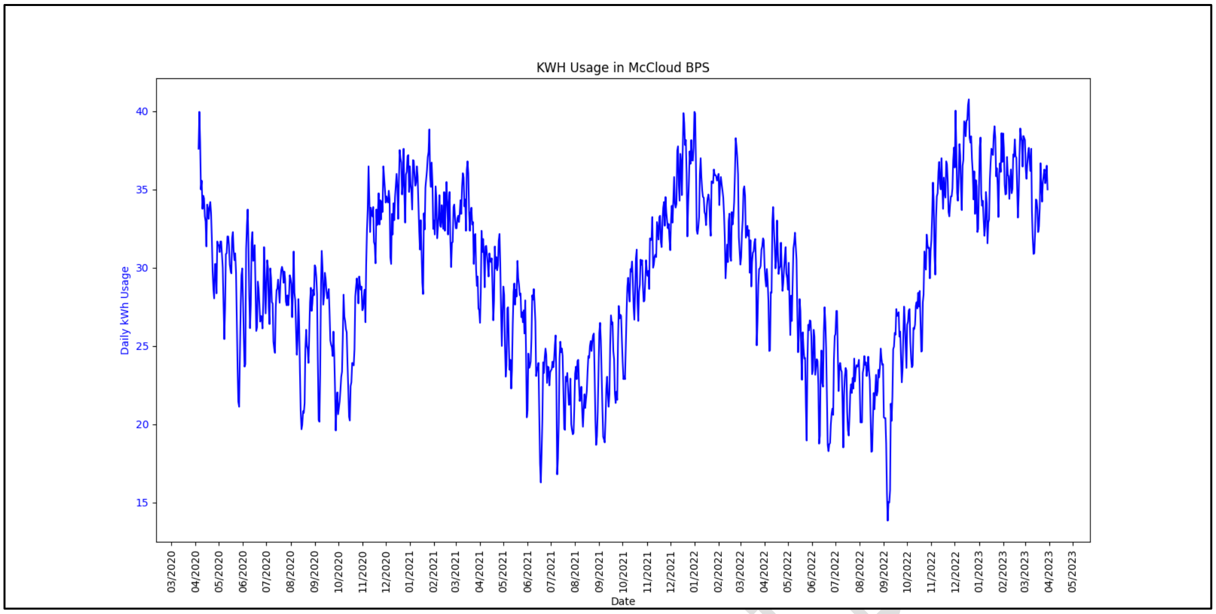
Kottinger Ranch BPS Daily Energy Profile



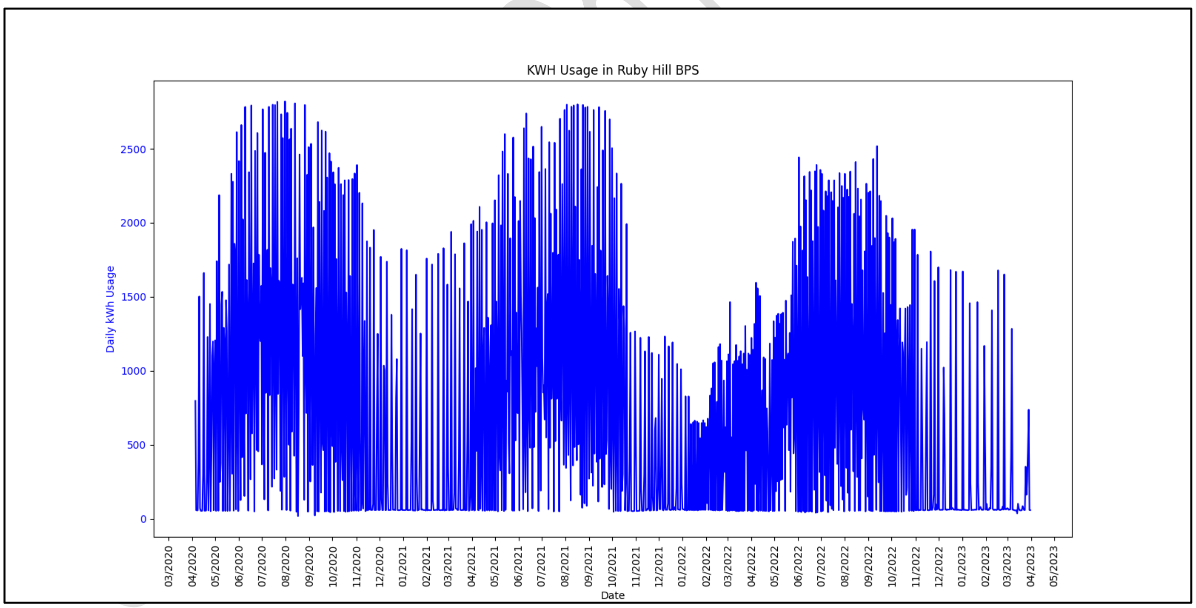
Longview BPS Daily Energy Profile



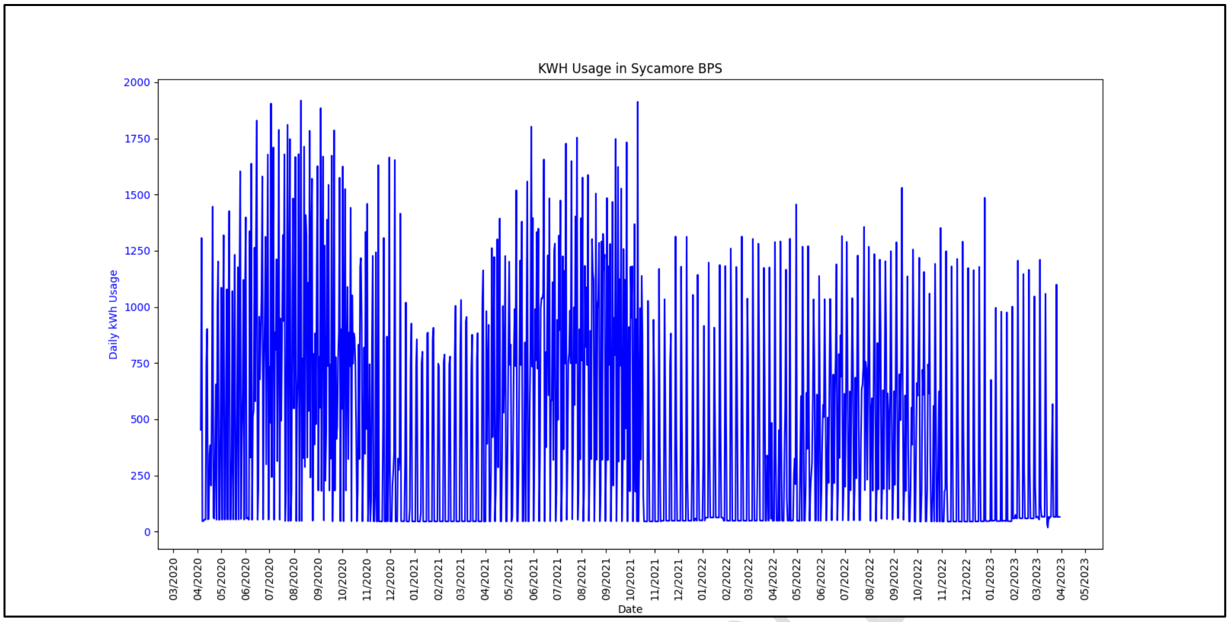
McCloud BPS Daily Energy Profile



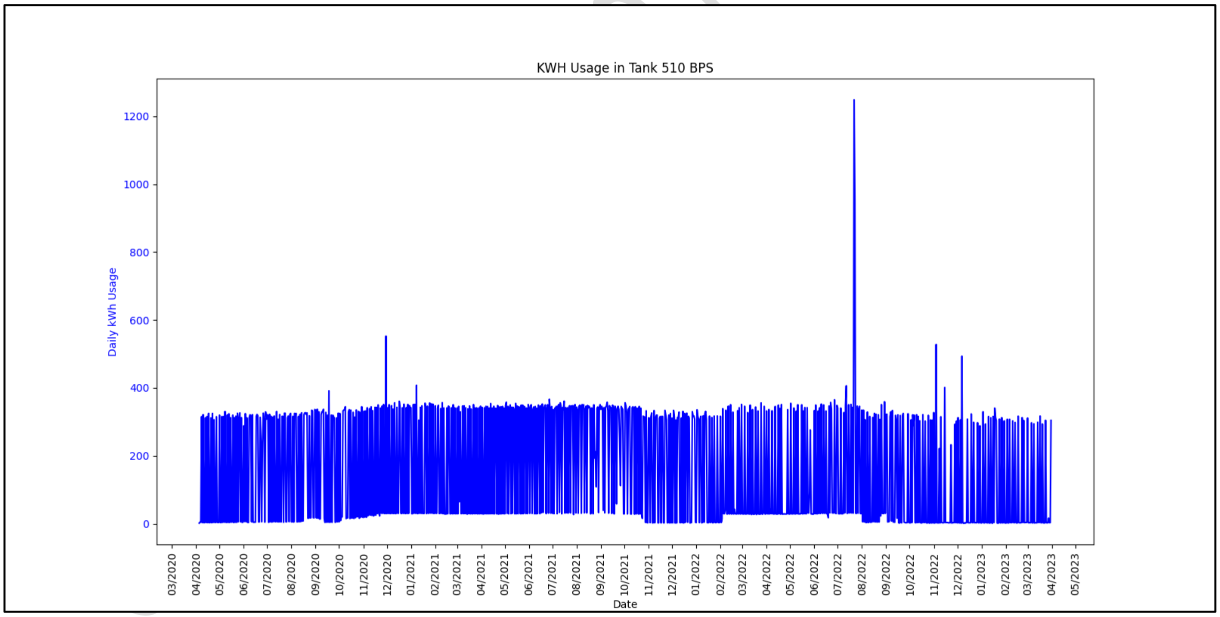
Ruby Hill BPS Daily Energy Profile



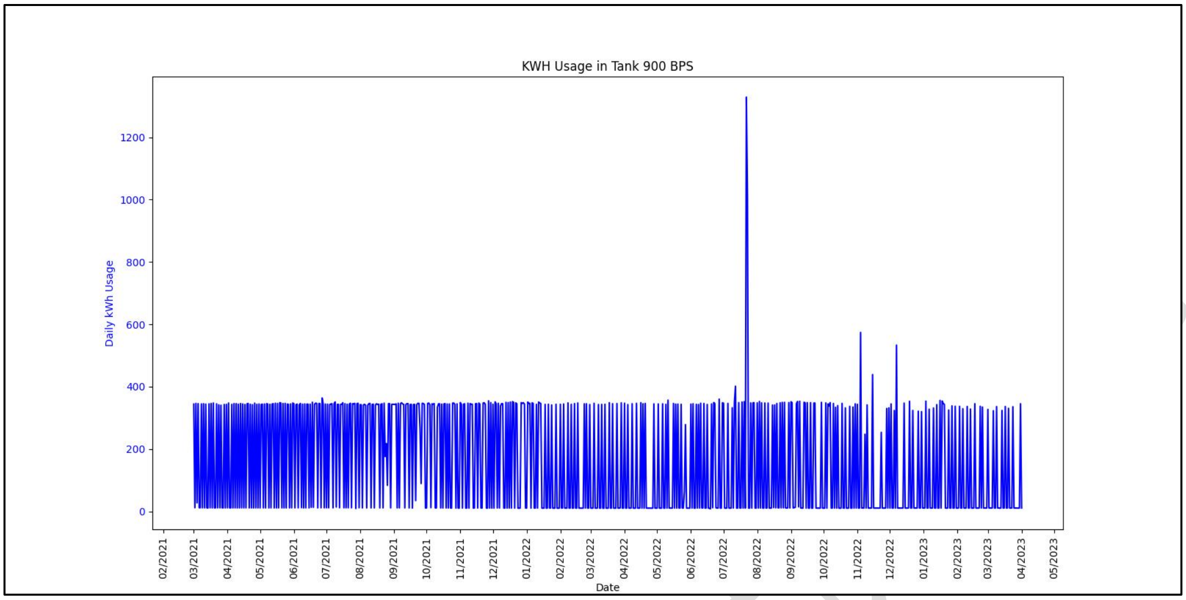
Sycamore BPS Daily Energy Profile



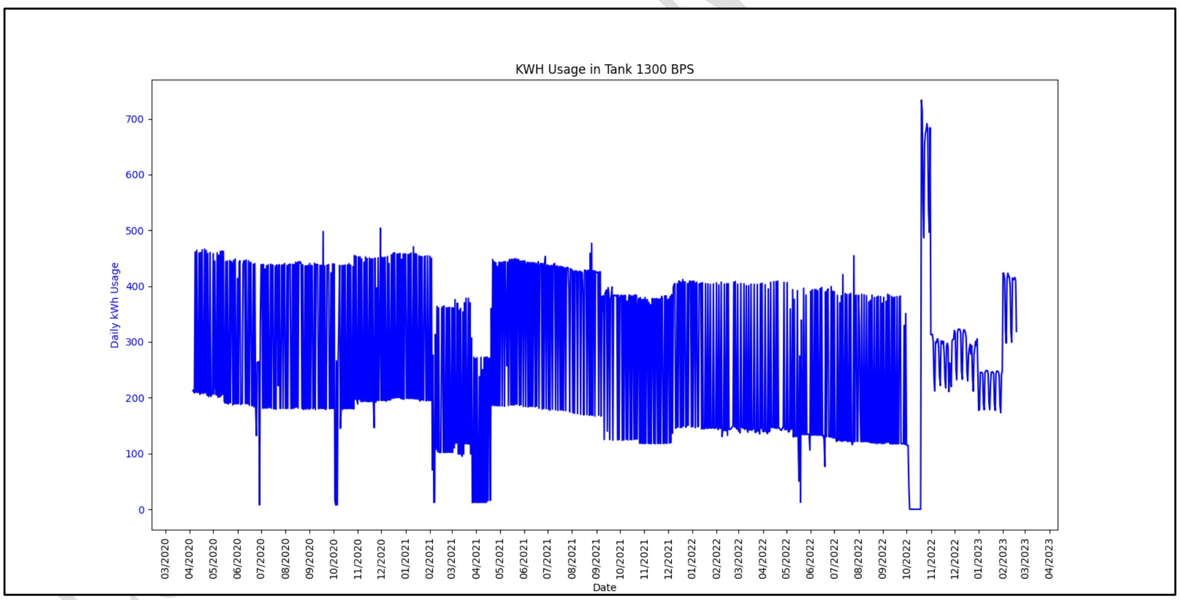
Tank 510 BPS Daily Energy Profile



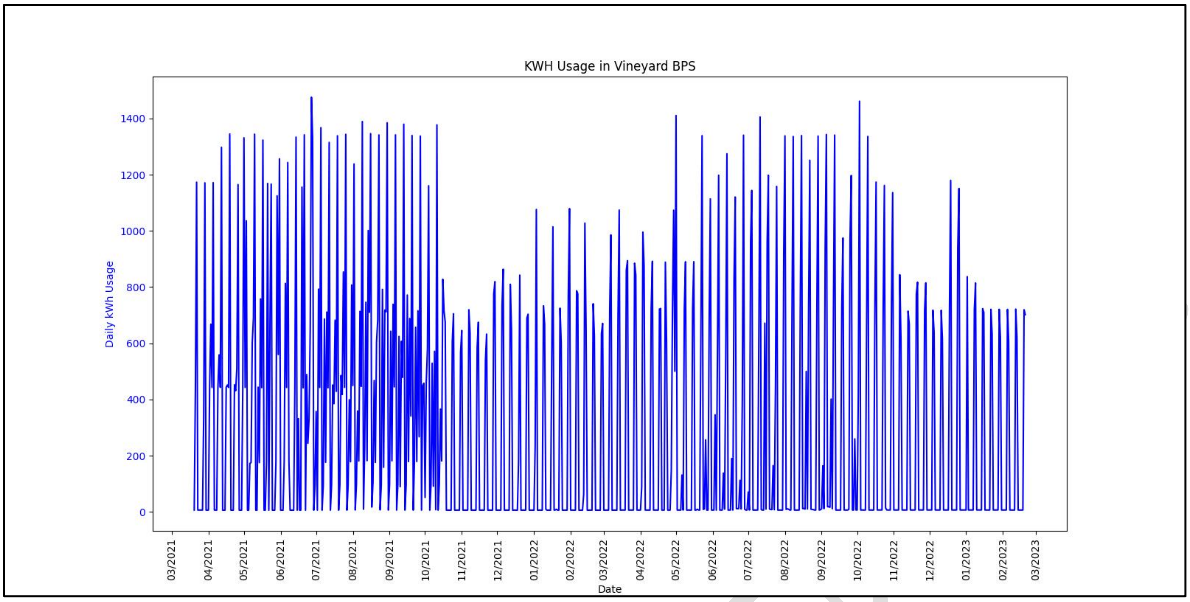
Tank 900 BPS Daily Energy Profile



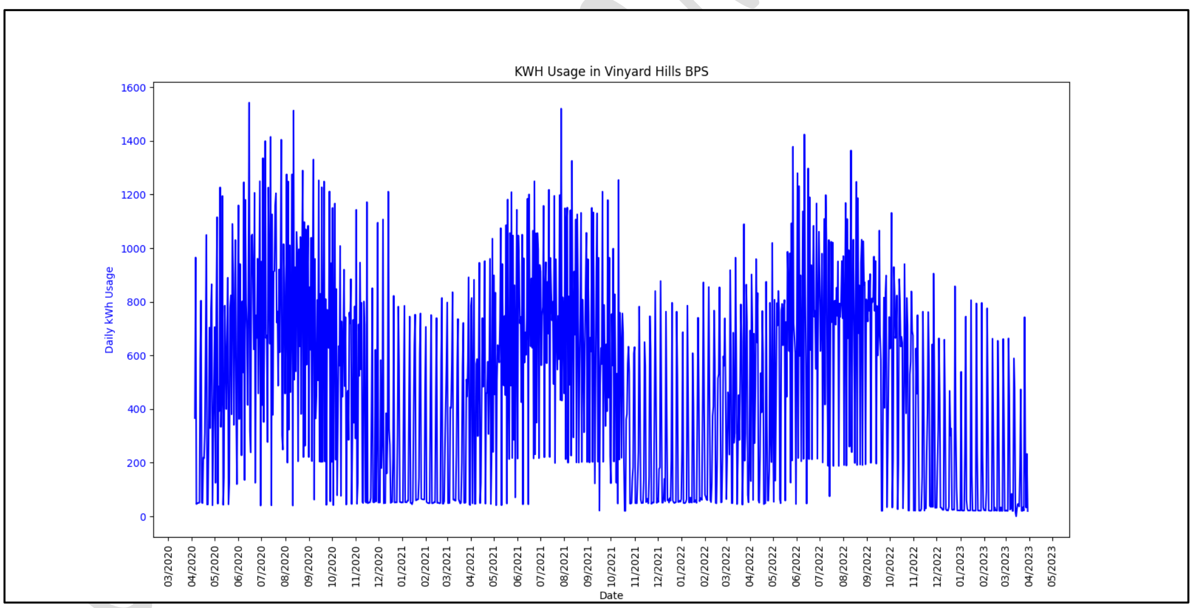
Tank 1300 BPS Daily Energy Profile



Vineyard BPS Daily Energy Profile

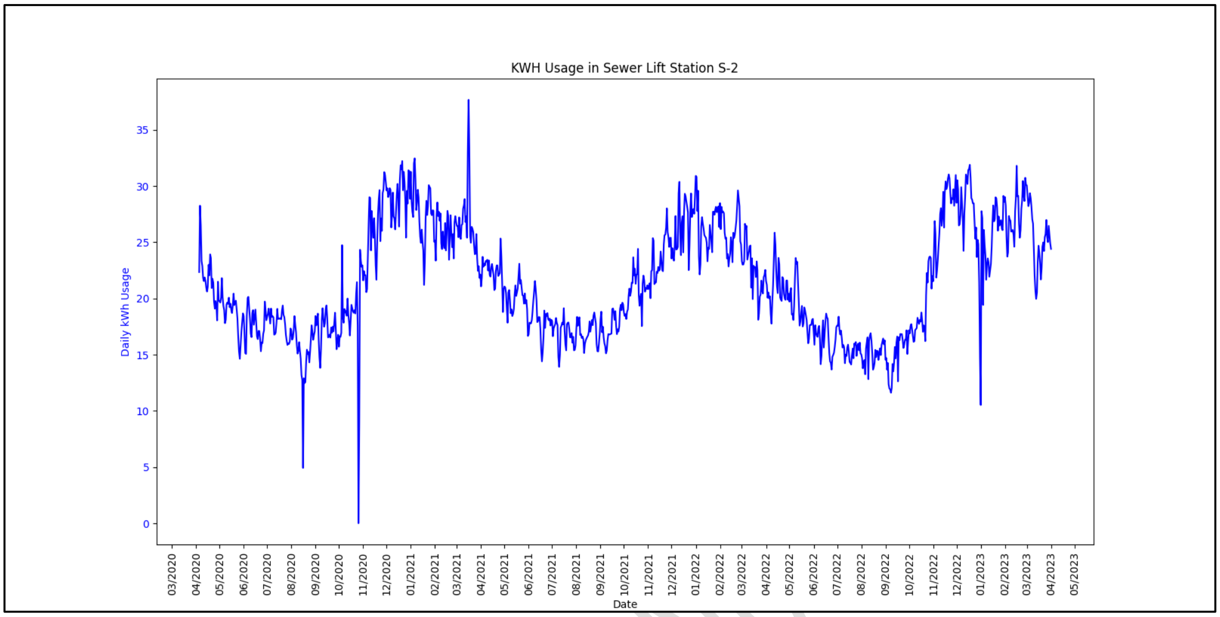


Vineyard Hills BPS Daily Energy Profile

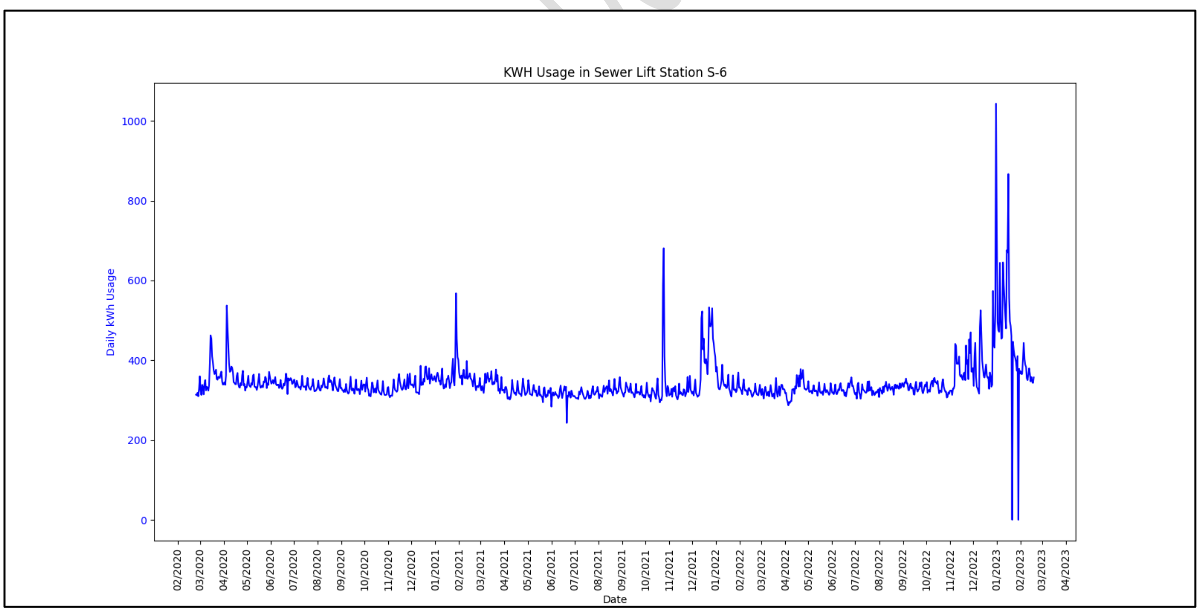


Sewer Lift Stations

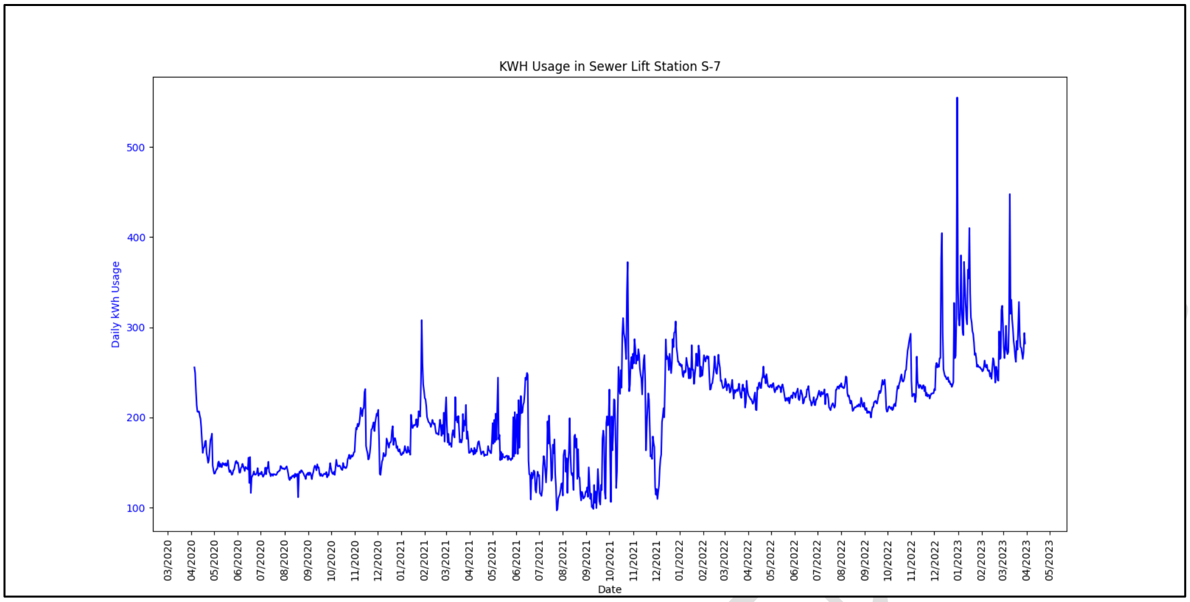
Sewer Lift Station S-2 Daily Energy Profile



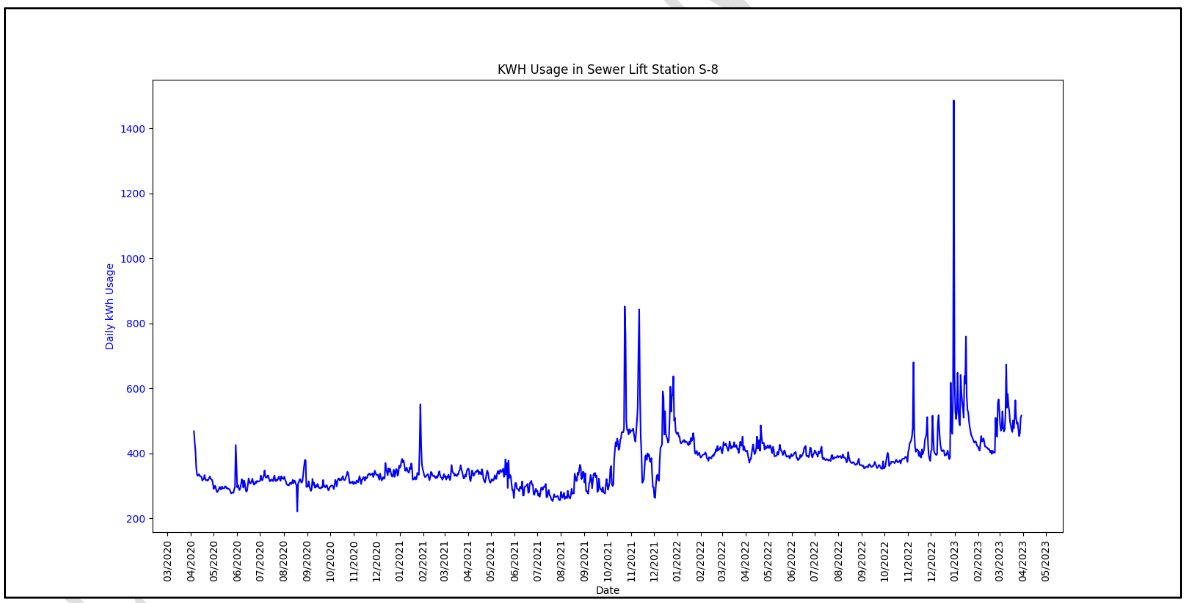
Sewer Lift Station S-6 Daily Energy Profile



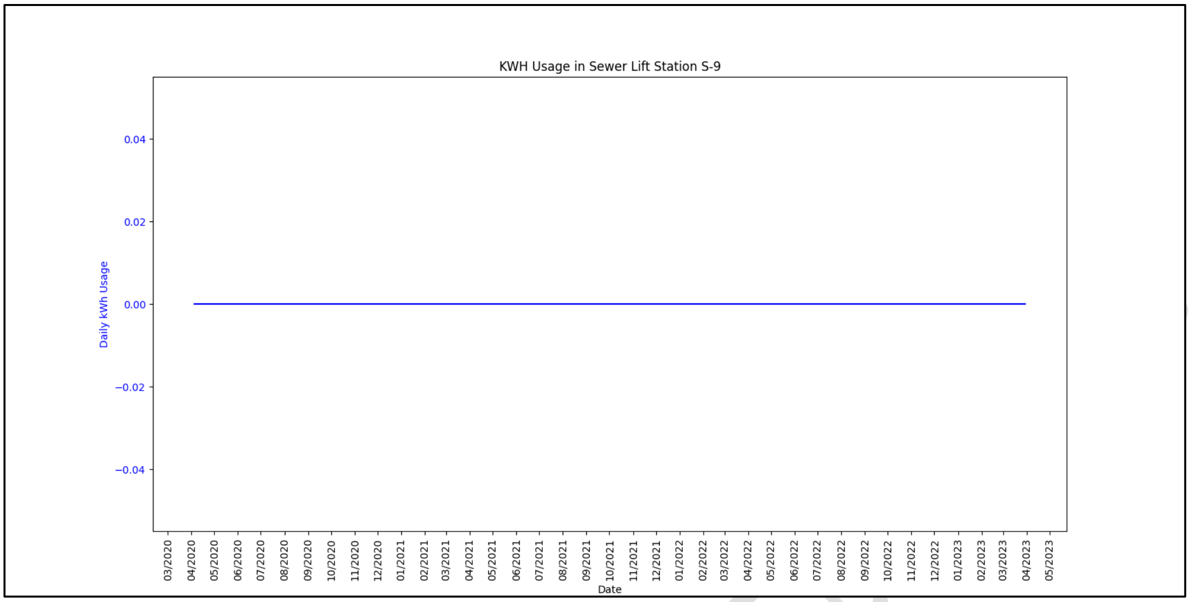
Sewer Lift Station S-7 Daily Energy Profile



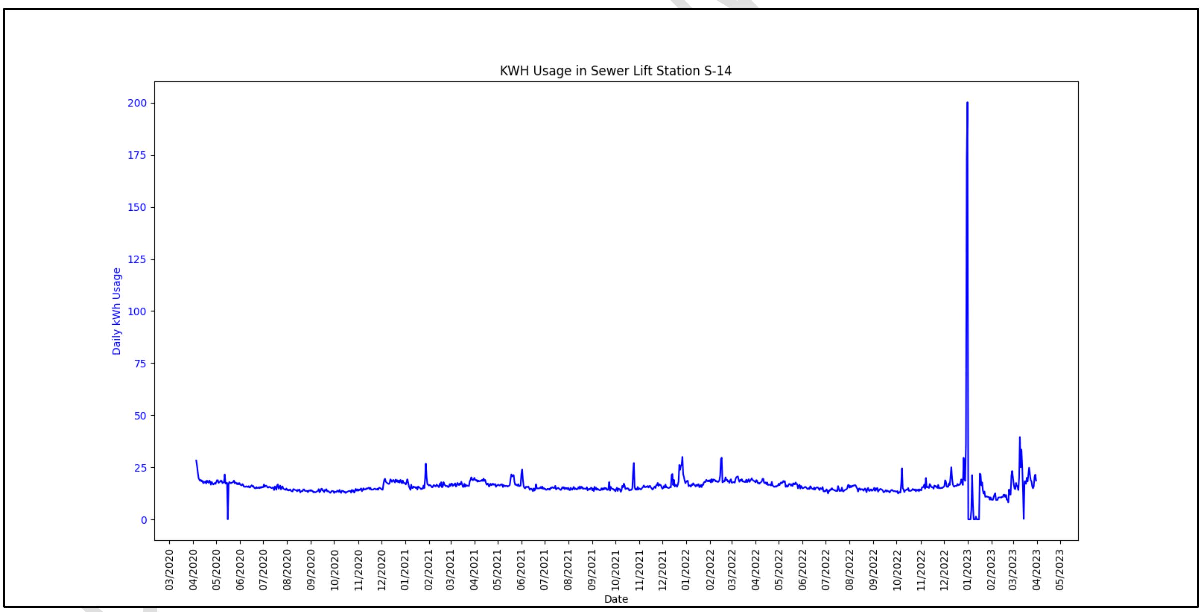
Sewer Lift Station S-8 Daily Energy Profile



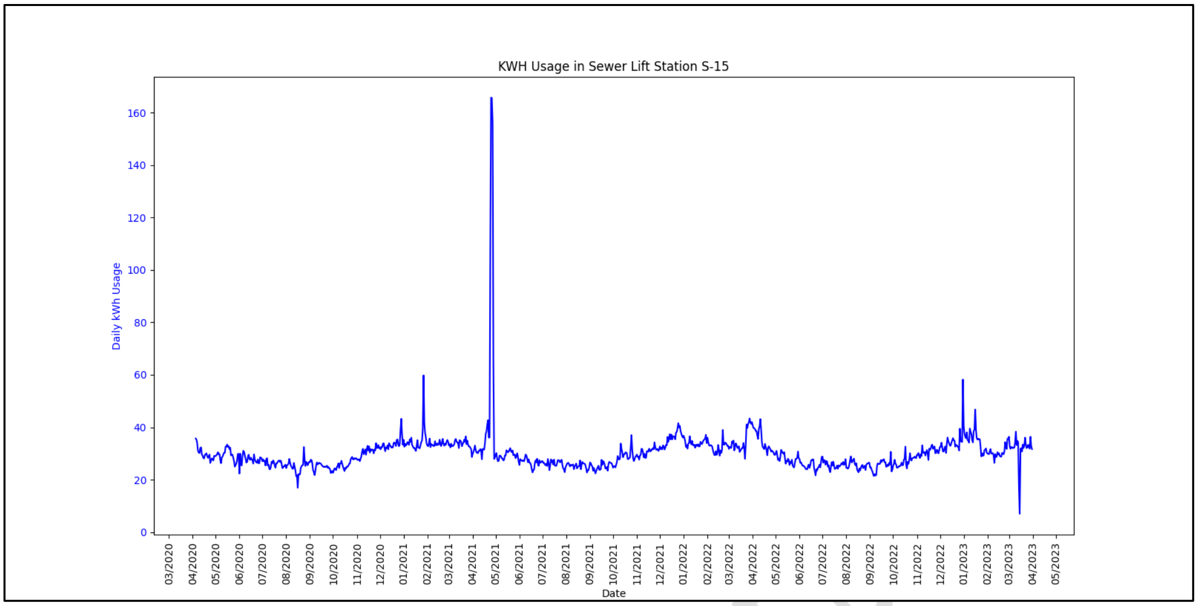
Sewer Lift Station S-9 Daily Energy Profile



Sewer Lift Station S-14 Daily Energy Profile

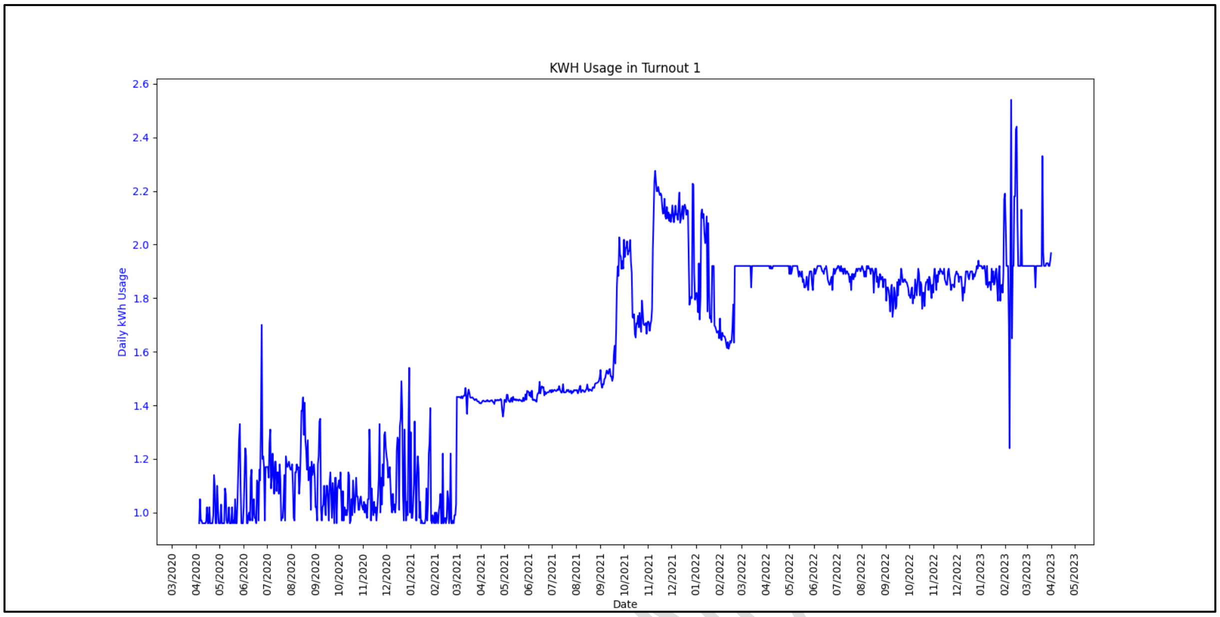


Sewer Lift Station S-15 Daily Energy Profile

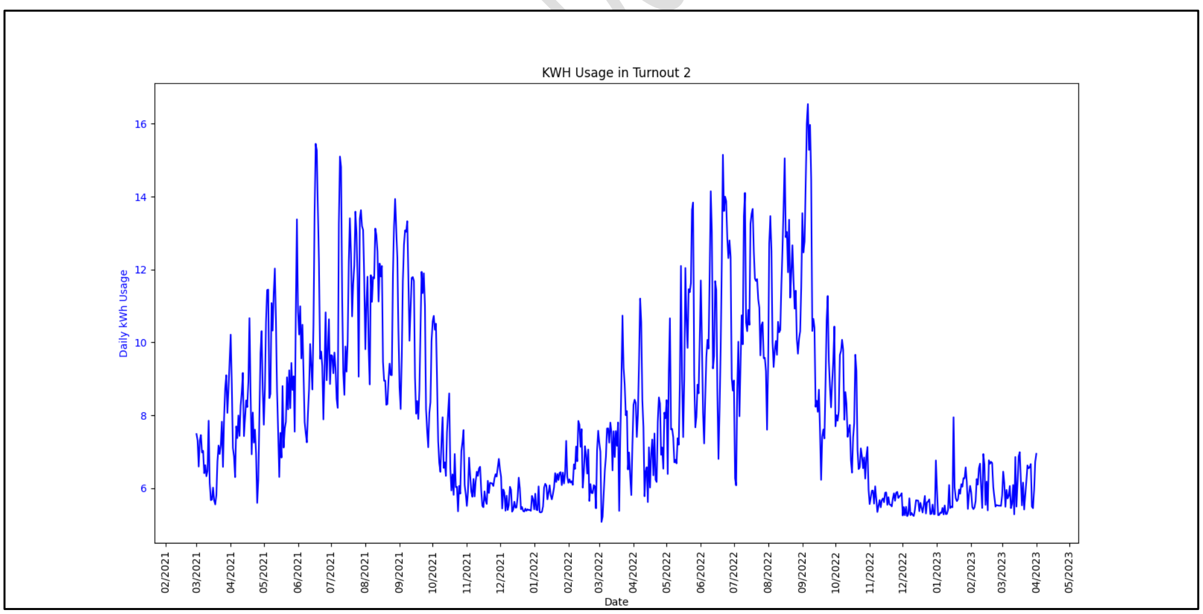


Potable Water Turnouts

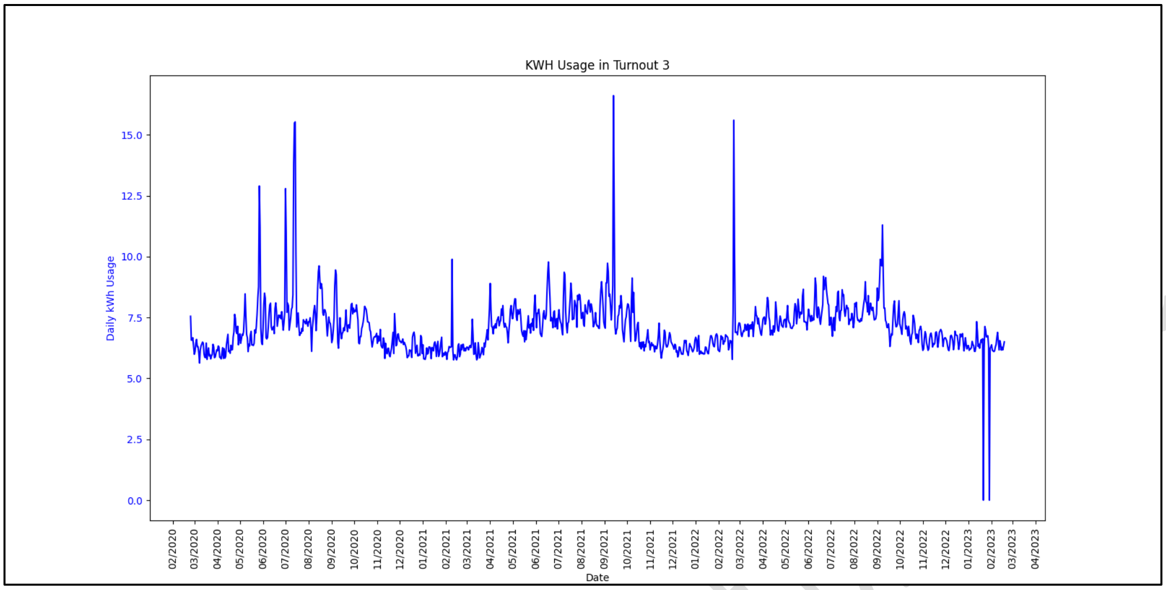
Turnout 1 Daily Energy Profile



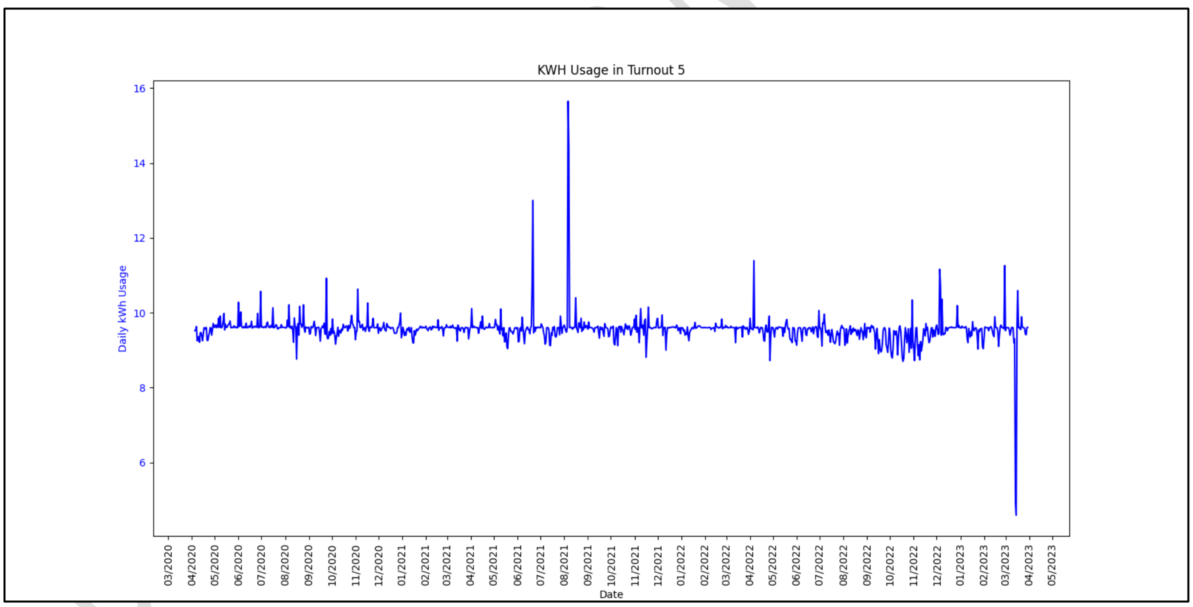
Turnout 2 Daily Energy Profile



Turnout 3 Daily Energy Profile

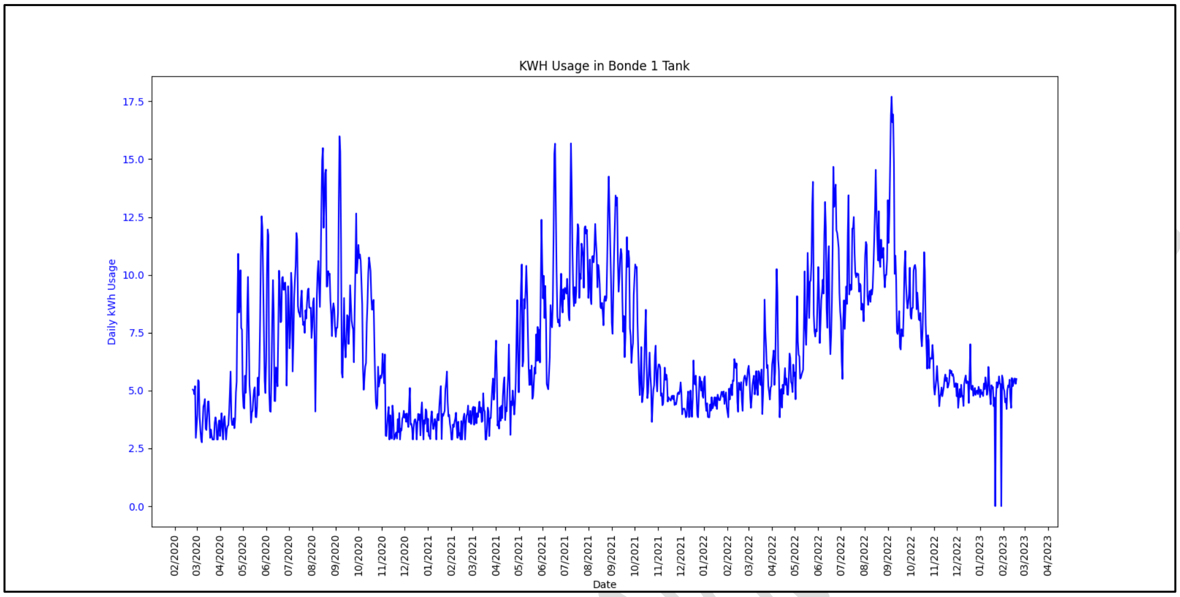


Turnout 5 Daily Energy Profile

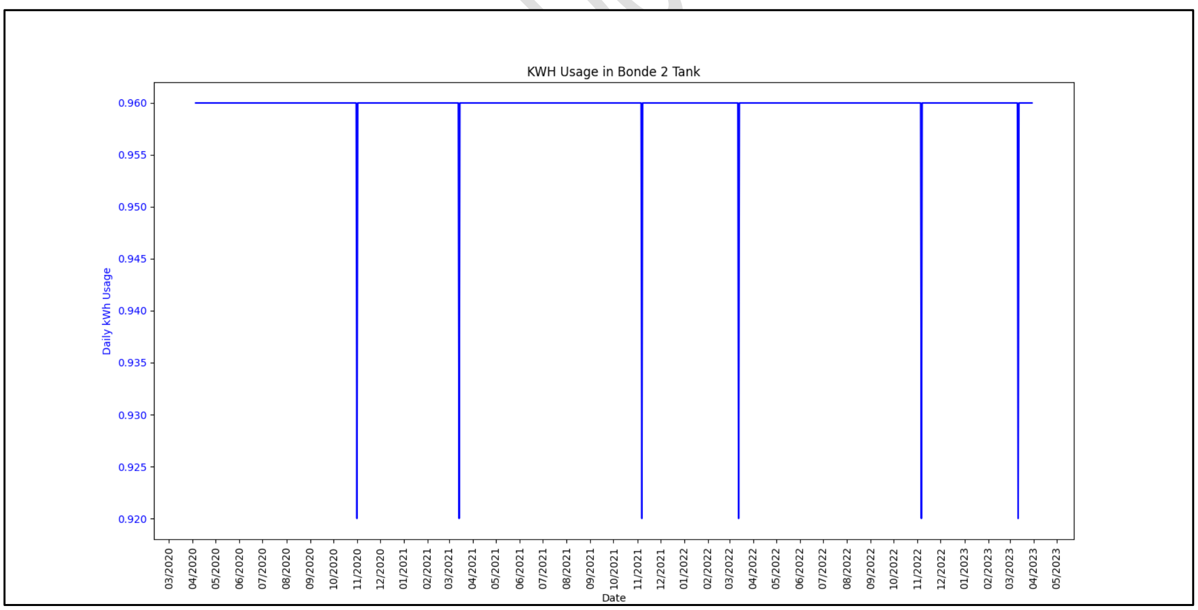


Storage Tanks

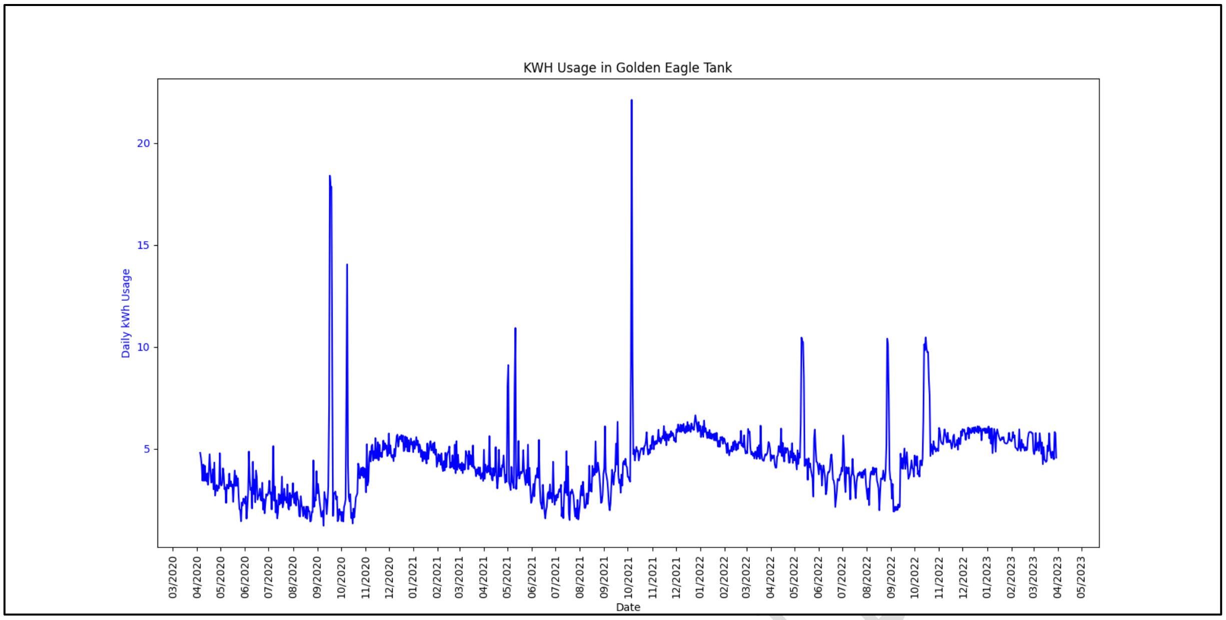
Bonde 1 Tank Daily Energy Profile



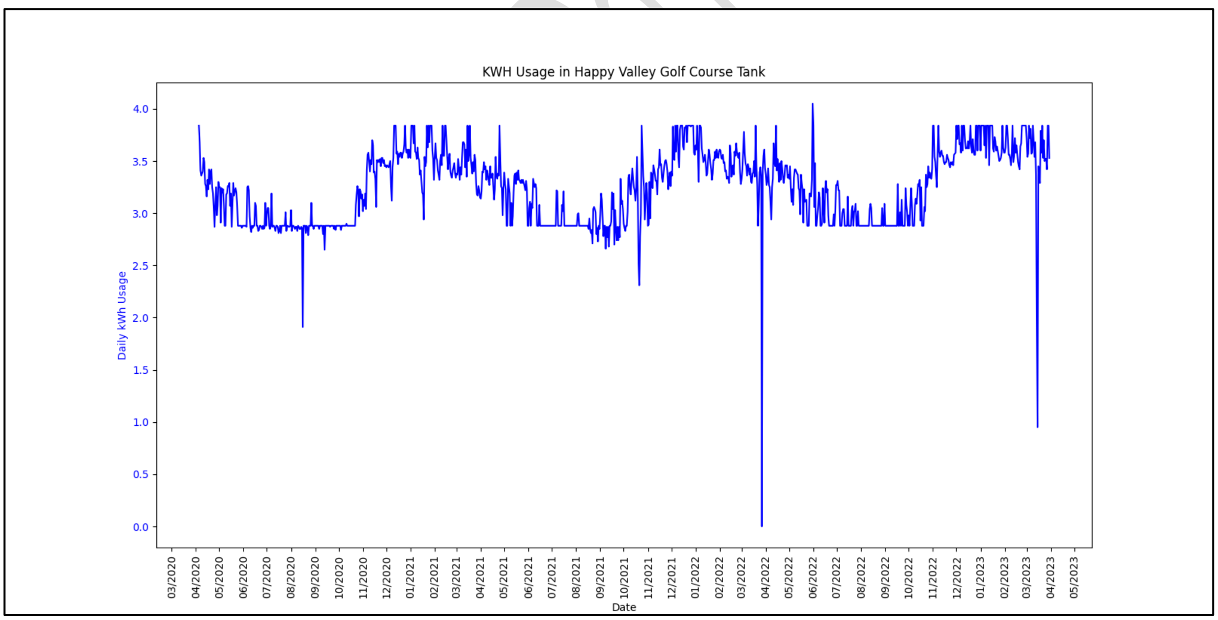
Bonde 2 Tank Daily Energy Profile



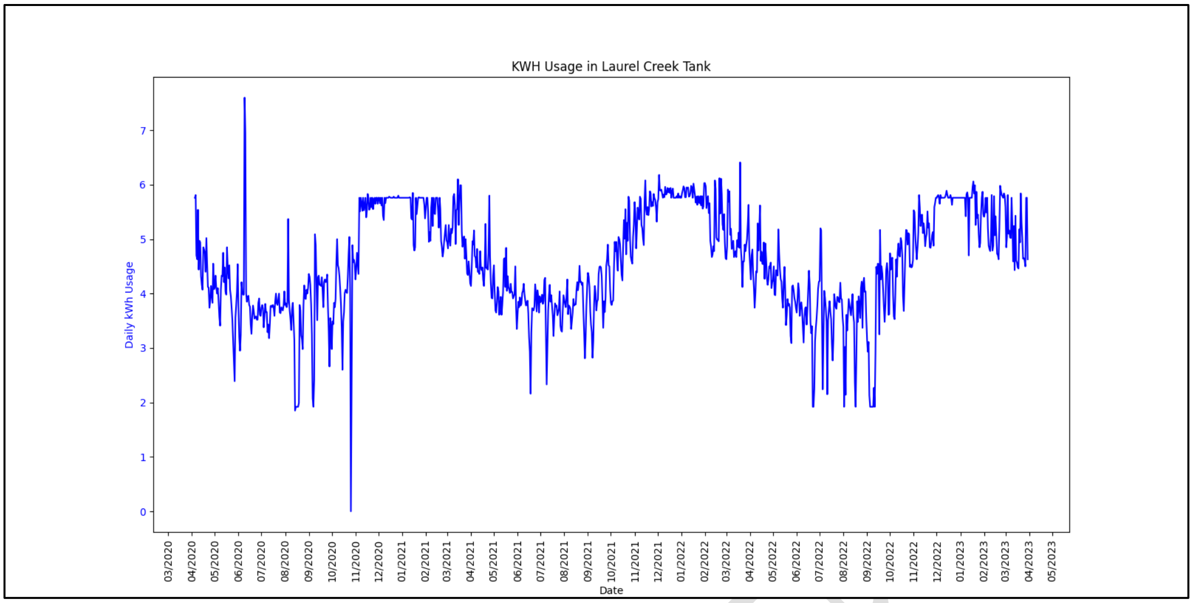
Golden Eagle Tank Daily Energy Profile



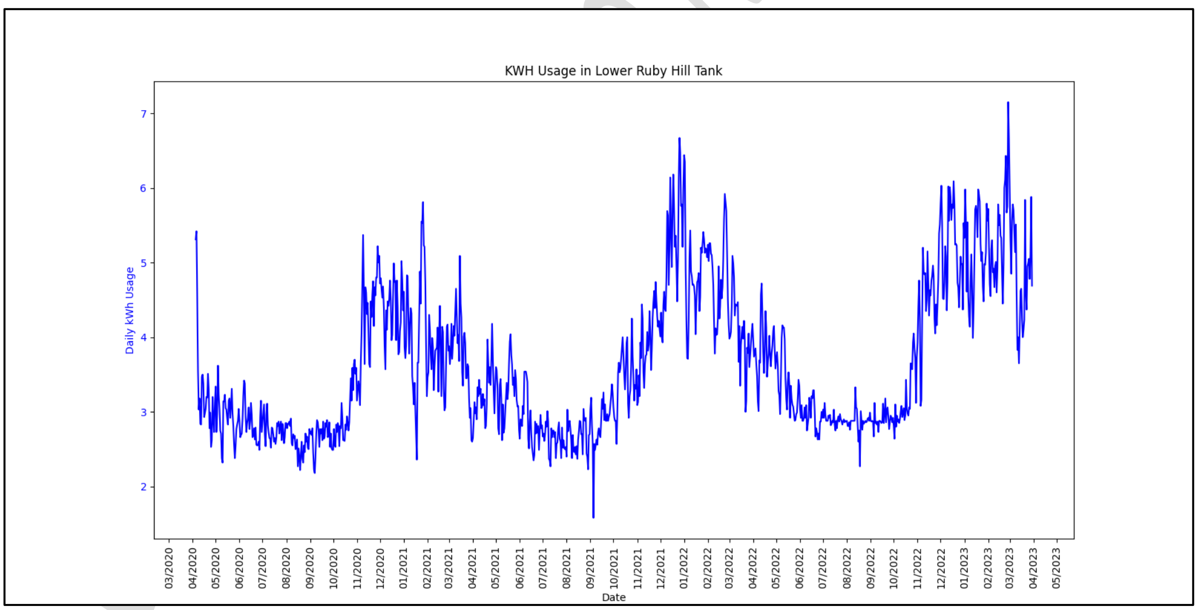
Happy Valley Golf Course Tank Daily Energy Profile



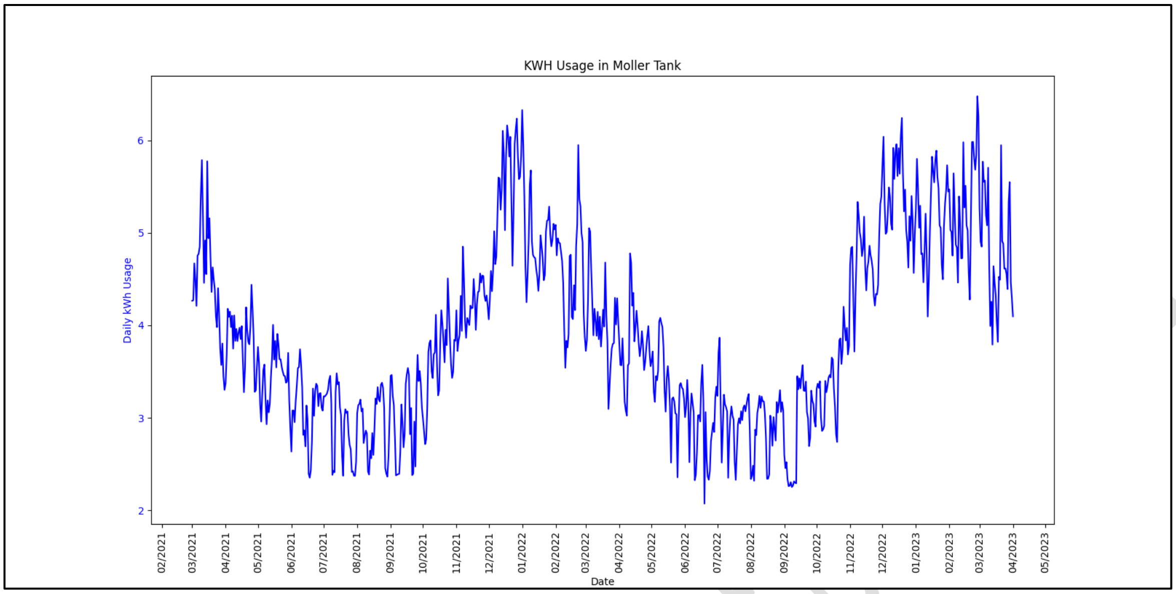
Laurel Creek Tank Daily Energy Profile



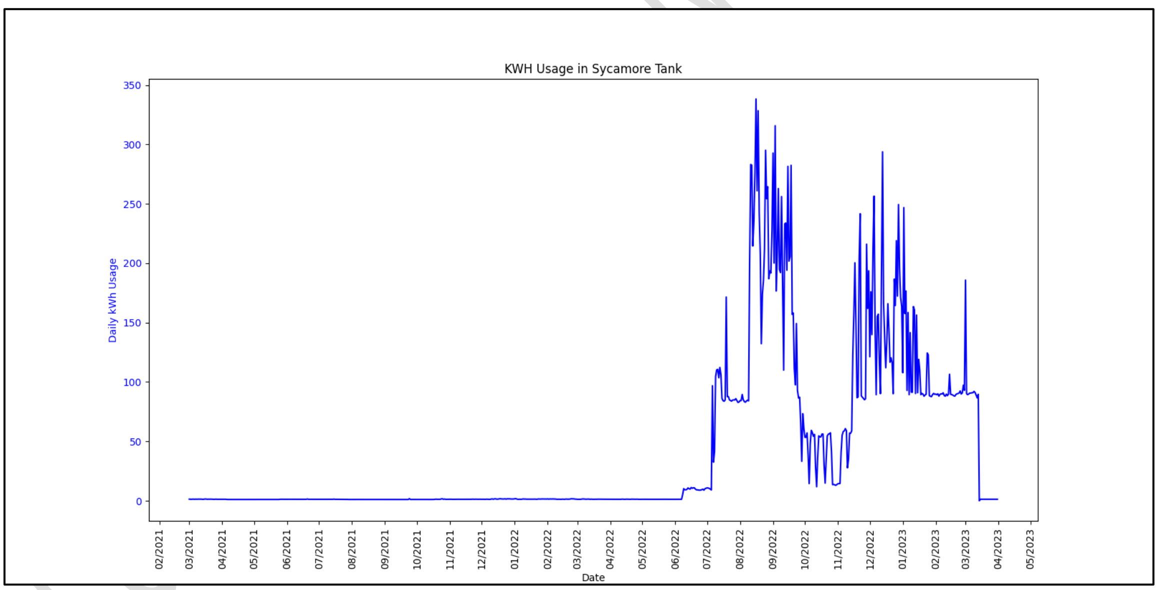
Lower Ruby Hill Tank Daily Energy Profile



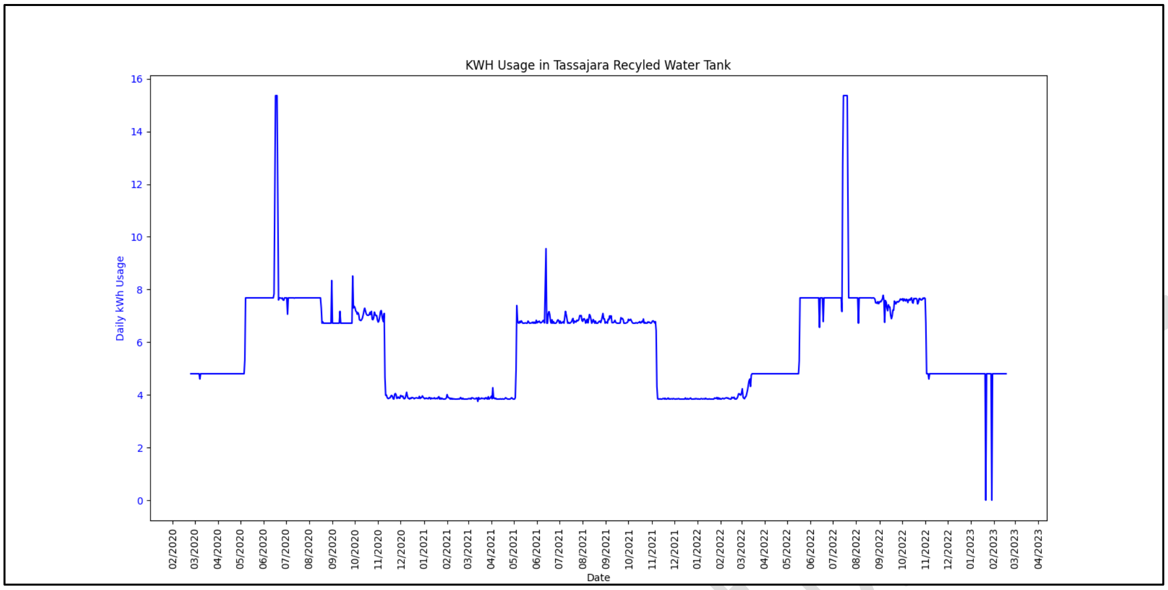
Moller Tank Daily Energy Profile



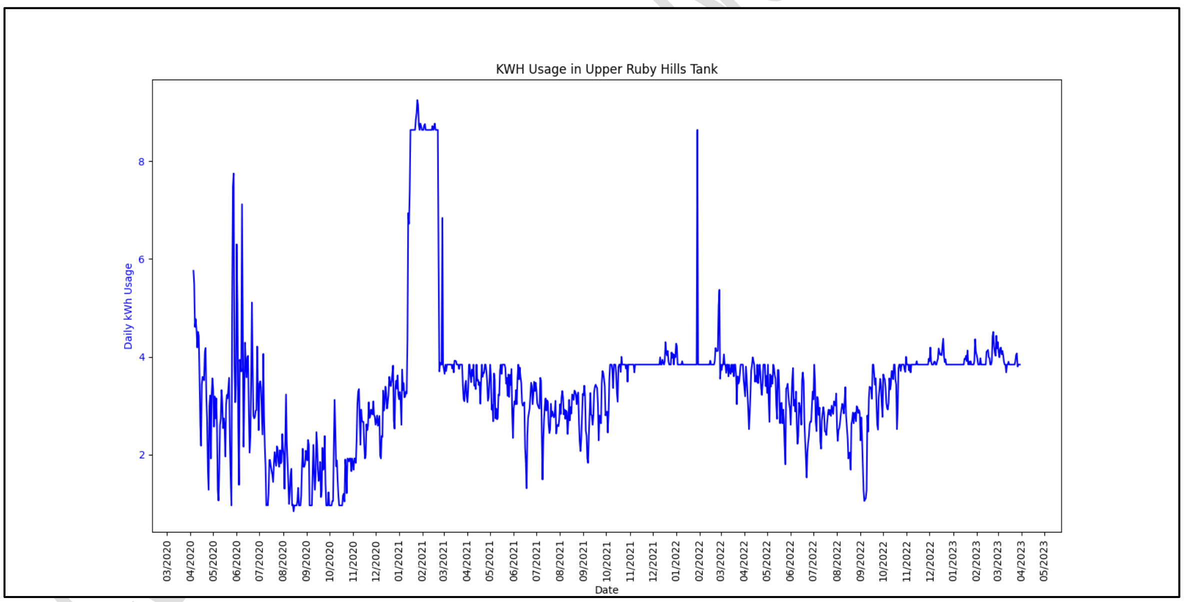
Sycamore Tank Daily Energy Profile



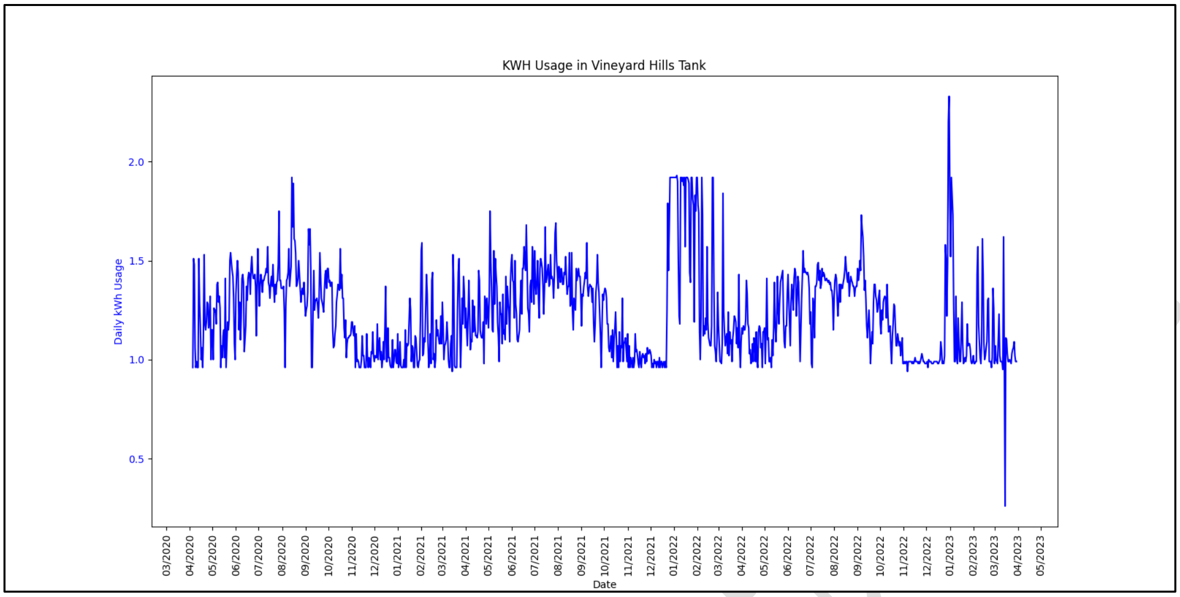
Tassajara Tank Daily Energy Profile



Upper Ruby Hills Tank Daily Energy Profile

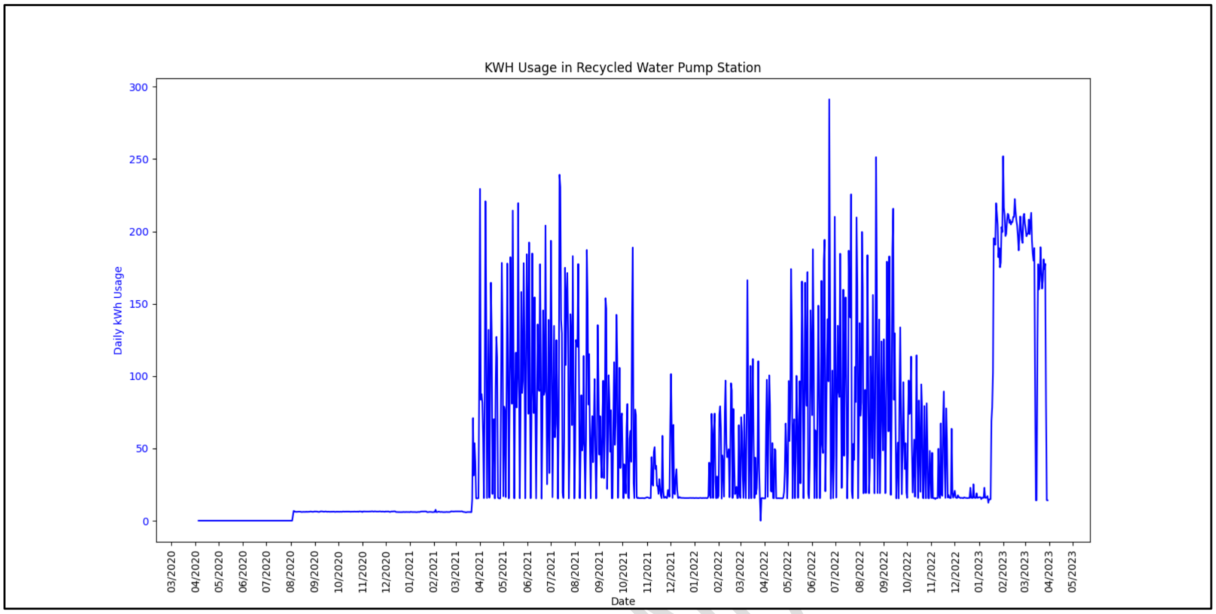


Vineyard Hills Tank Daily Energy Profile

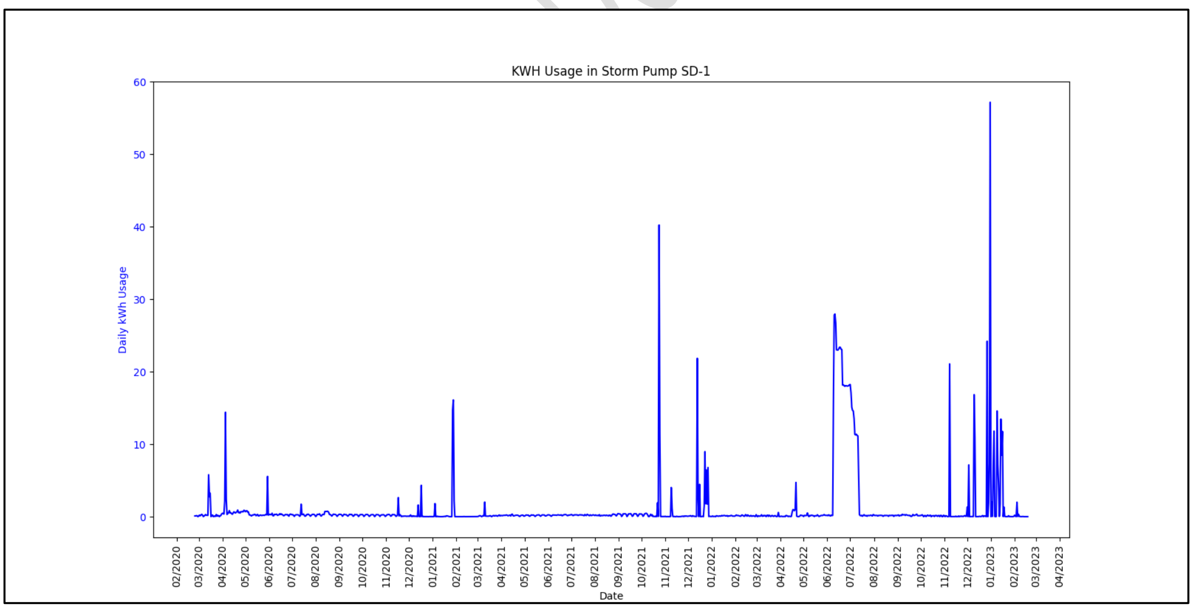


Storm Pump Stations, Recycled Water BPS

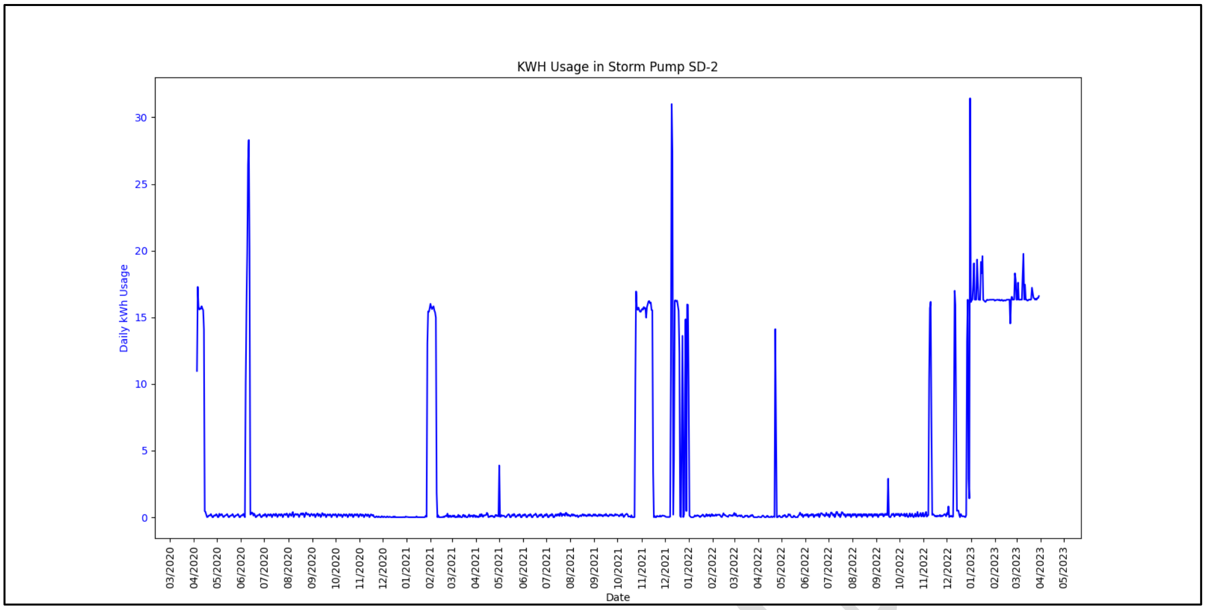
Recycled Water Pump Station Daily Energy Profile



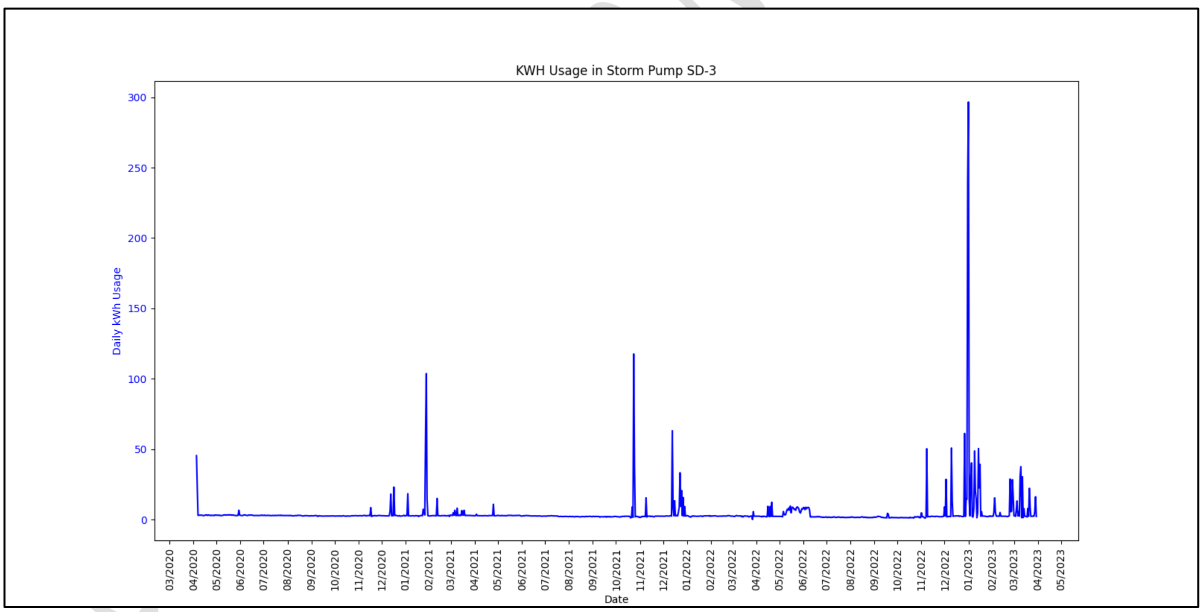
Storm Pump SD-1 Daily Energy Profile



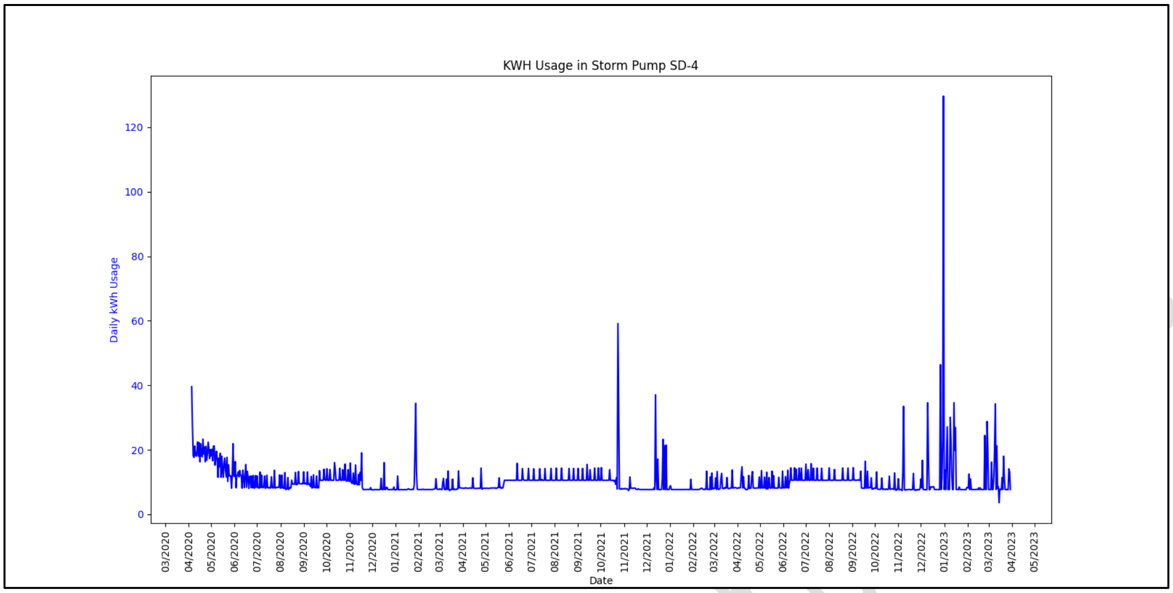
Storm Pump SD-2 Daily Energy Profile



Storm Pump SD-3 Daily Energy Profile



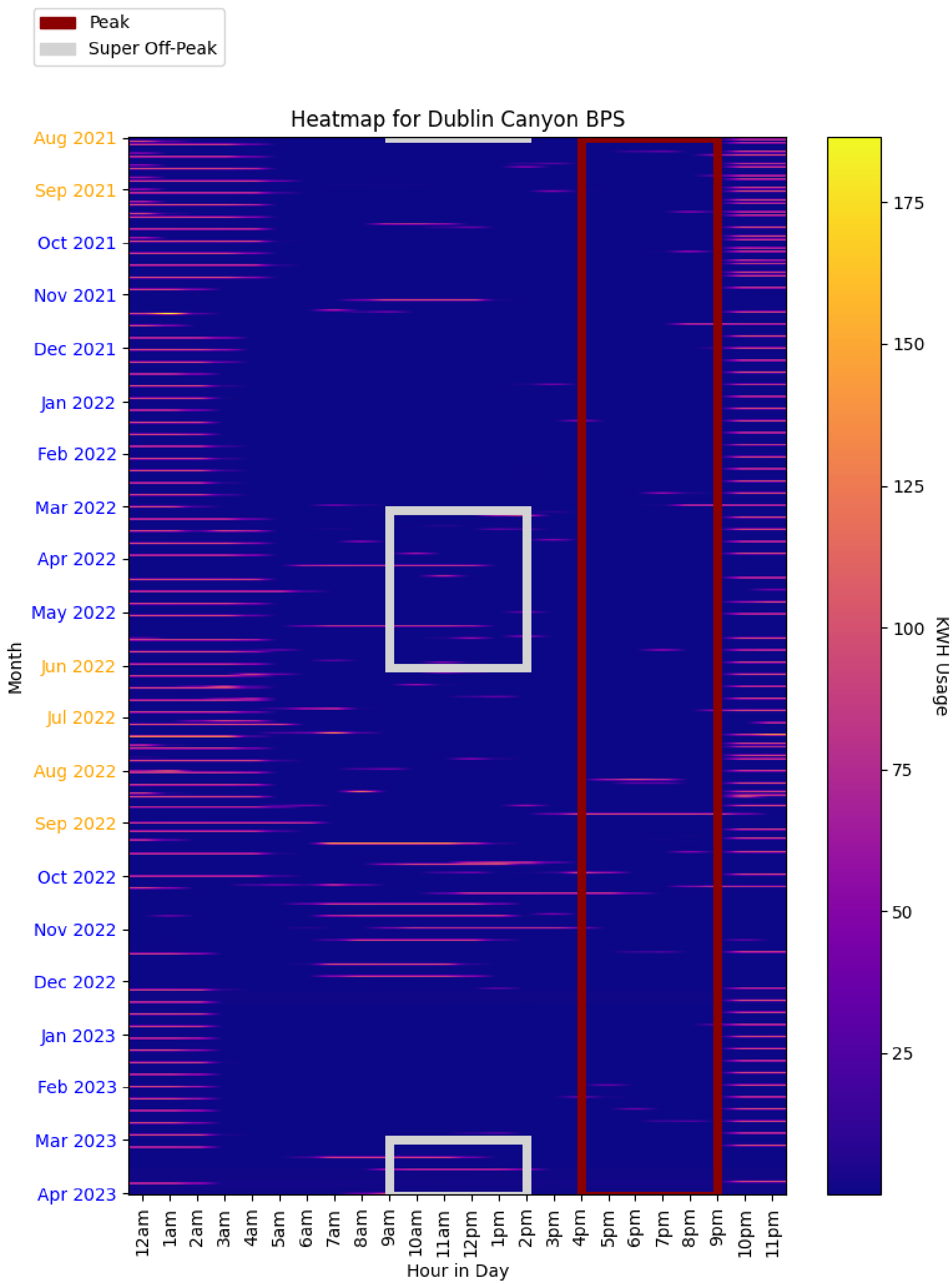
Storm Pump SD-4 Daily Energy Profile

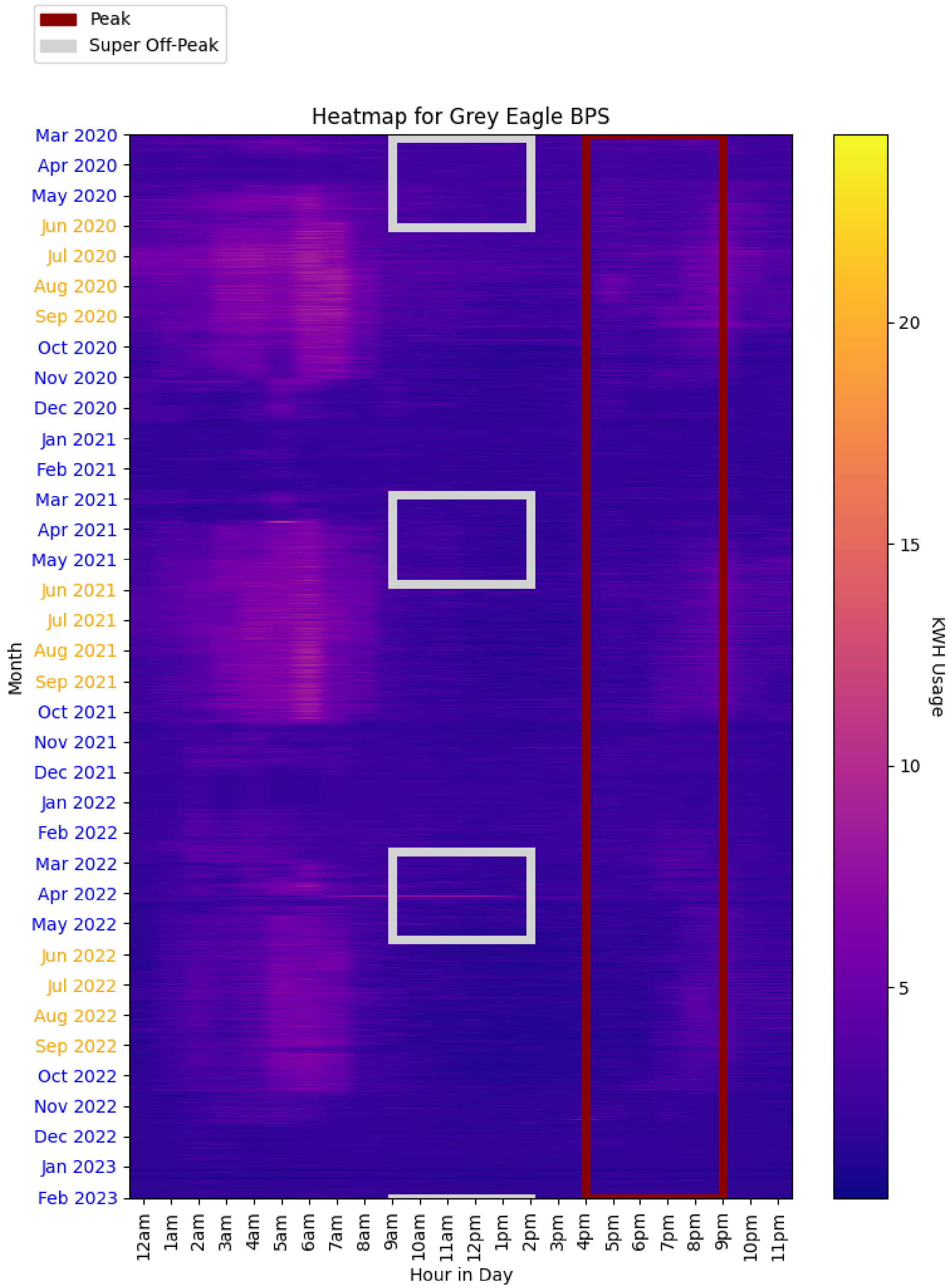


Appendix C

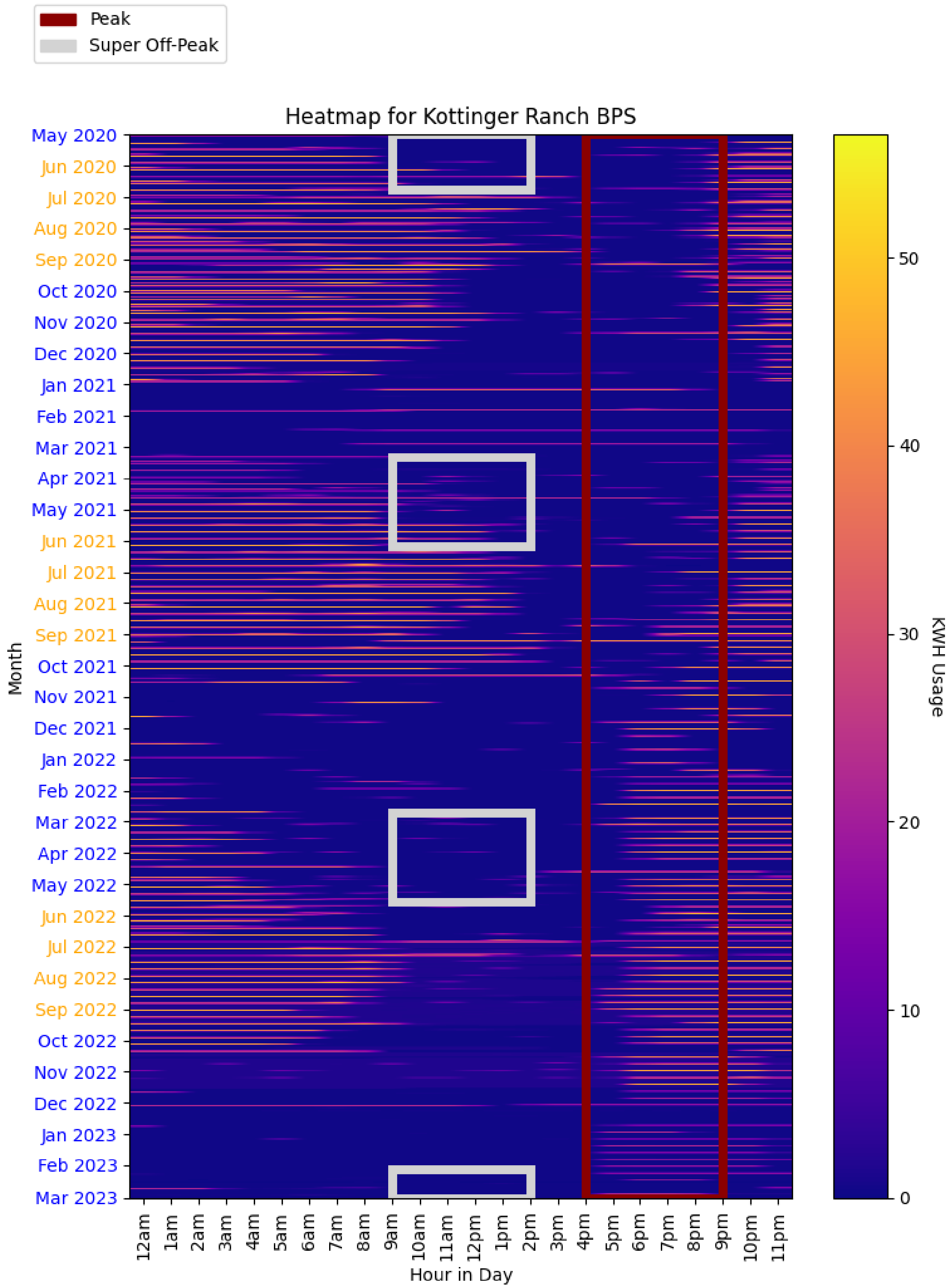
TOU Heat Maps

Potable Water Booster Pump Stations

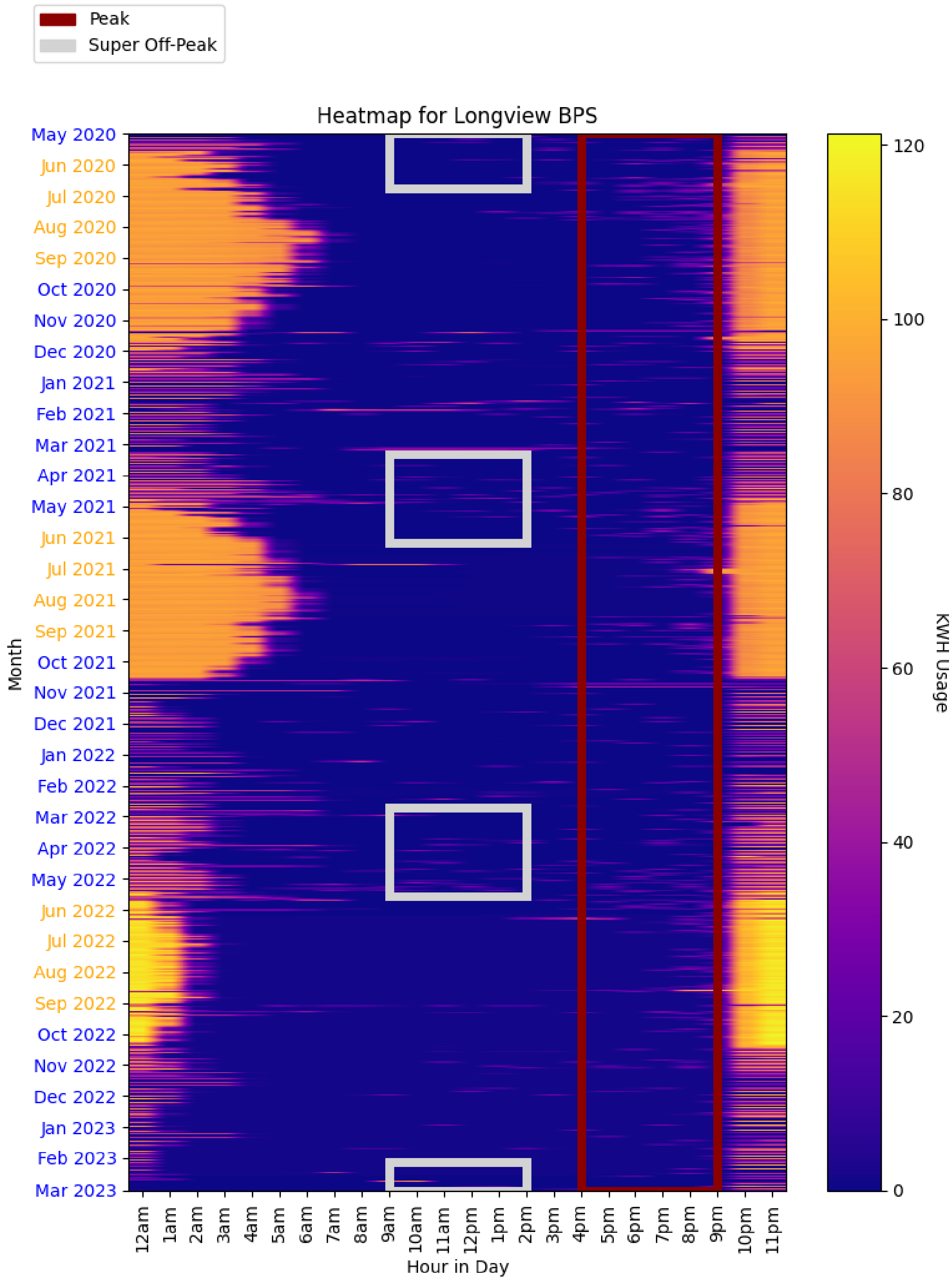




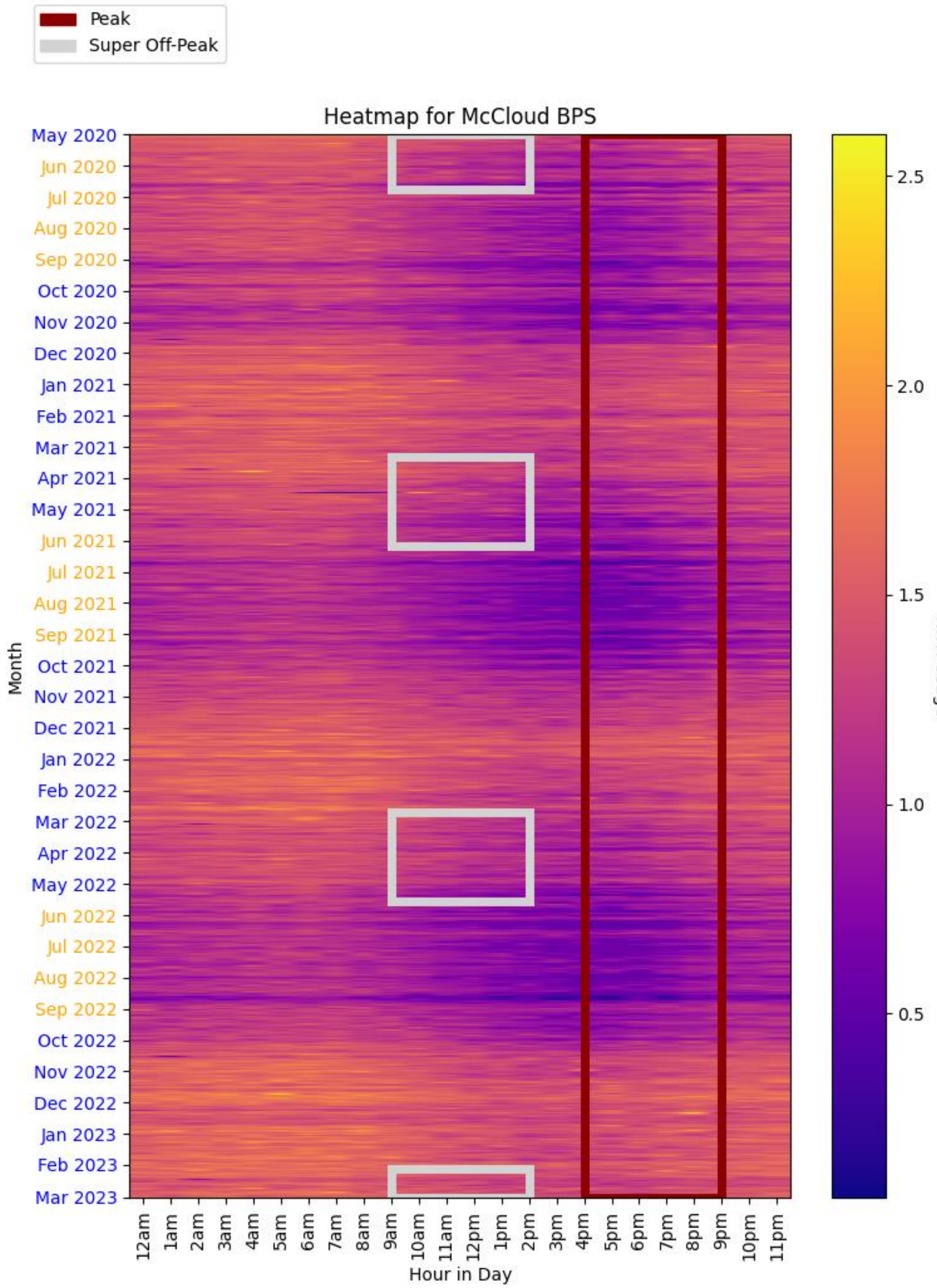
Peak
Super Off-Peak
Heatmap for Grey Eagle BPS
Mar 2020
Apr 2020
May 2020
Jun 2020
Jul 2020
Aug 2020
Sep 2020
Oct 2020
Nov 2020
Dec 2020
Jan 2021
Feb 2021
Mar 2021
Apr 2021
May 2021
Jun 2021
Jul 2021
Aug 2021
Sep 2021
Oct 2021
Nov 2021
Dec 2021
Jan 2022
Feb 2022
Mar 2022
Apr 2022
May 2022
Jun 2022
Jul 2022
Aug 2022
Sep 2022
Oct 2022
Nov 2022
Dec 2022
Jan 2023
Feb 2023
Month
12am
1am
2am
3am
4am
5am
6am
7am
8am
9am
10am
11am
12pm
1pm
2pm
3pm
4pm
5pm
6pm
7pm
8pm
9pm
10pm
11pm
Hour in Day
20
15
10
5
KWH Usage



Peak
Super Off-Peak
Heatmap for Kottinger Ranch BPS
May 2020
Jun 2020
Jul 2020
Aug 2020
Sep 2020
Oct 2020
Nov 2020
Dec 2020
Jan 2021
Feb 2021
Mar 2021
Apr 2021
May 2021
Jun 2021
Jul 2021
Aug 2021
Sep 2021
Oct 2021
Nov 2021
Dec 2021
Jan 2022
Feb 2022
Mar 2022
Apr 2022
May 2022
Jun 2022
Jul 2022
Aug 2022
Sep 2022
Oct 2022
Nov 2022
Dec 2022
Jan 2023
Feb 2023
Mar 2023
Month
12am
1am
2am
3am
4am
5am
6am
7am
8am
9am
10am
11am
12pm
1pm
2pm
3pm
4pm
5pm
6pm
7pm
8pm
9pm
10pm
11pm
Hour in Day
50
40
30
20
10
0
KWH Usage



Peak
Super Off-Peak
Heatmap for Longview BPS
May 2020
Jun 2020
Jul 2020
Aug 2020
Sep 2020
Oct 2020
Nov 2020
Dec 2020
Jan 2021
Feb 2021
Mar 2021
Apr 2021
May 2021
Jun 2021
Jul 2021
Aug 2021
Sep 2021
Oct 2021
Nov 2021
Dec 2021
Jan 2022
Feb 2022
Mar 2022
Apr 2022
May 2022
Jun 2022
Jul 2022
Aug 2022
Sep 2022
Oct 2022
Nov 2022
Dec 2022
Jan 2023
Feb 2023
Mar 2023
Month
12am
1am
2am
3am
4am
5am
6am
7am
8am
9am
10am
11am
12pm
1pm
2pm
3pm
4pm
5pm
6pm
7pm
8pm
9pm
10pm
11pm
Hour in Day
120
100
80
60
40
20
0
KWH Usage


Peak
Super Off-Peak
Heatmap for McCloud BPS
May 2020
Jun 2020
Jul 2020
Aug 2020
Sep 2020
Oct 2020
Nov 2020
Dec 2020
Jan 2021
Feb 2021
Mar 2021
Apr 2021
May 2021
Jun 2021
Jul 2021
Aug 2021
Sep 2021
Oct 2021
Nov 2021
Dec 2021
Jan 2022
Feb 2022
Mar 2022
Apr 2022
May 2022
Jun 2022
Jul 2022
Aug 2022
Sep 2022
Oct 2022
Nov 2022
Dec 2022
Jan 2023
Feb 2023
Mar 2023
Month
12am
1am
2am
3am
4am
5am
6am
7am
8am
9am
10am
11am
12pm
1pm
2pm
3pm
4pm
5pm
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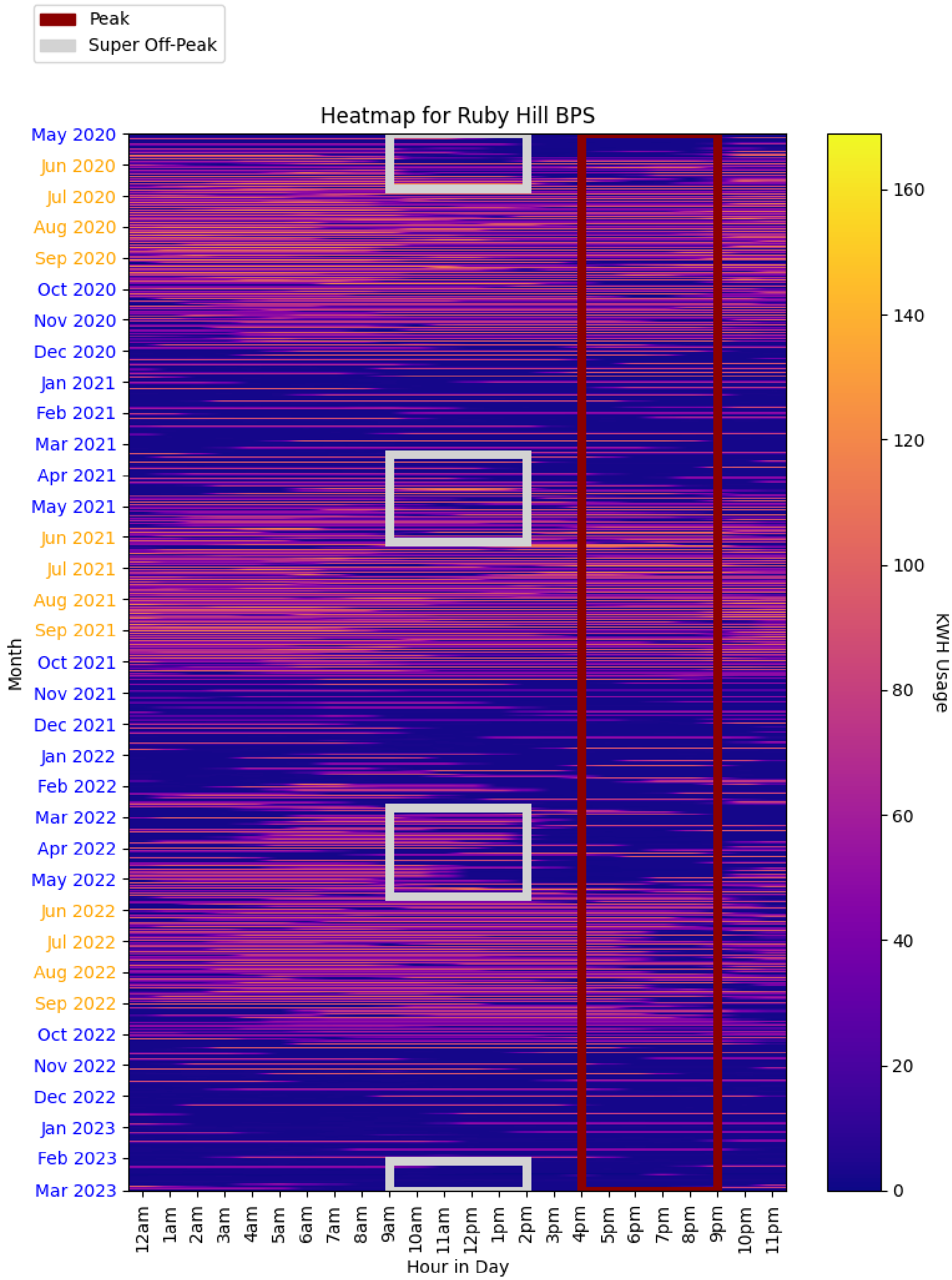
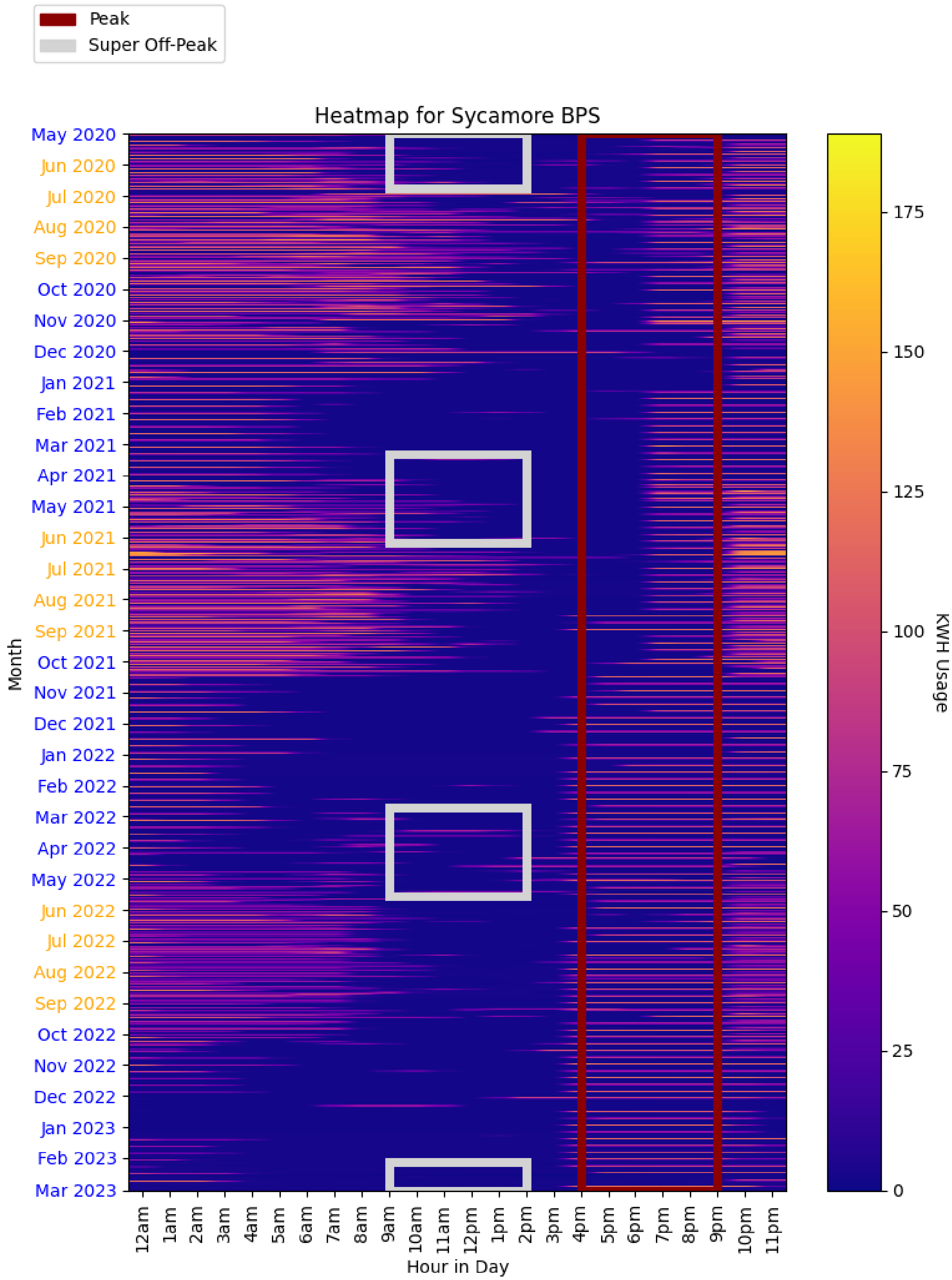
1.0
0.5
KWH Usage



Peak
Super Off-Peak
Heatmap for Ruby Hill BPS
May 2020
Jun 2020
Jul 2020
Aug 2020
Sep 2020
Oct 2020
Nov 2020
Dec 2020
Jan 2021
Feb 2021
Mar 2021
Apr 2021
May 2021
Jun 2021
Jul 2021
Aug 2021
Sep 2021
Oct 2021
Nov 2021
Dec 2021
Jan 2022
Feb 2022
Mar 2022
Apr 2022
May 2022
Jun 2022
Jul 2022
Aug 2022
Sep 2022
Oct 2022
Nov 2022
Dec 2022
Jan 2023
Feb 2023
Mar 2023
Month
12am
1am
2am
3am
4am
5am
6am
7am
8am
9am
10am
11am
12pm
1pm
2pm
3pm
4pm
5pm
6pm
7pm
8pm
9pm
10pm
11pm
Hour in Day
160
140
120
100
80
60
40
20
0
KWH Usage


Peak
Super Off-Peak
Heatmap for Sycamore BPS
May 2020
Jun 2020
Jul 2020
Aug 2020
Sep 2020
Oct 2020
Nov 2020
Dec 2020
Jan 2021
Feb 2021
Mar 2021
Apr 2021
May 2021
Jun 2021
Jul 2021
Aug 2021
Sep 2021
Oct 2021
Nov 2021
Dec 2021
Jan 2022
Feb 2022
Mar 2022
Apr 2022
May 2022
Jun 2022
Jul 2022
Aug 2022
Sep 2022
Oct 2022
Nov 2022
Dec 2022
Jan 2023
Feb 2023
Mar 2023
Month
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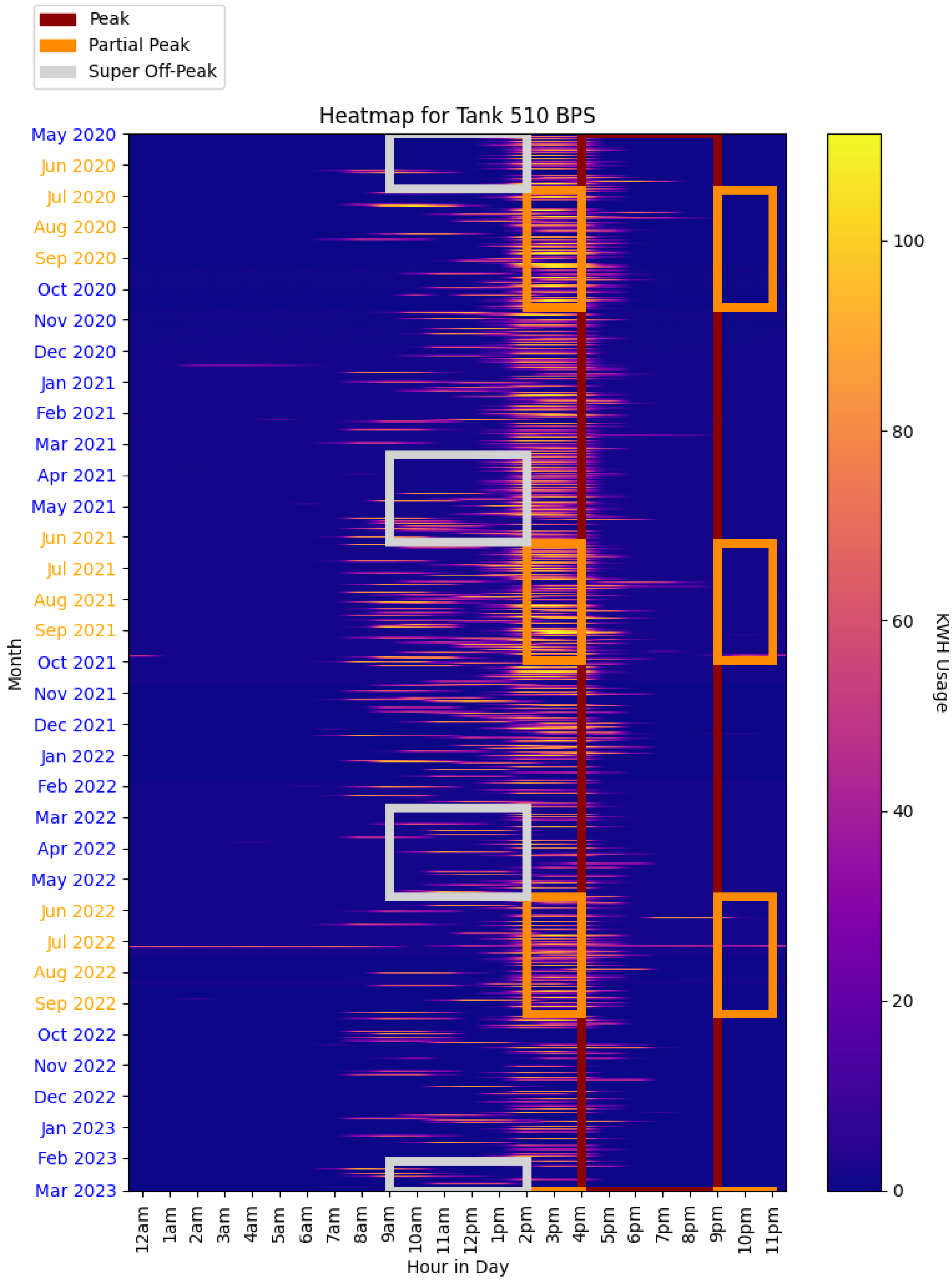
KWH Usage



Peak
Partial Peak
Super Off-Peak
Heatmap for Tank 510 BPS
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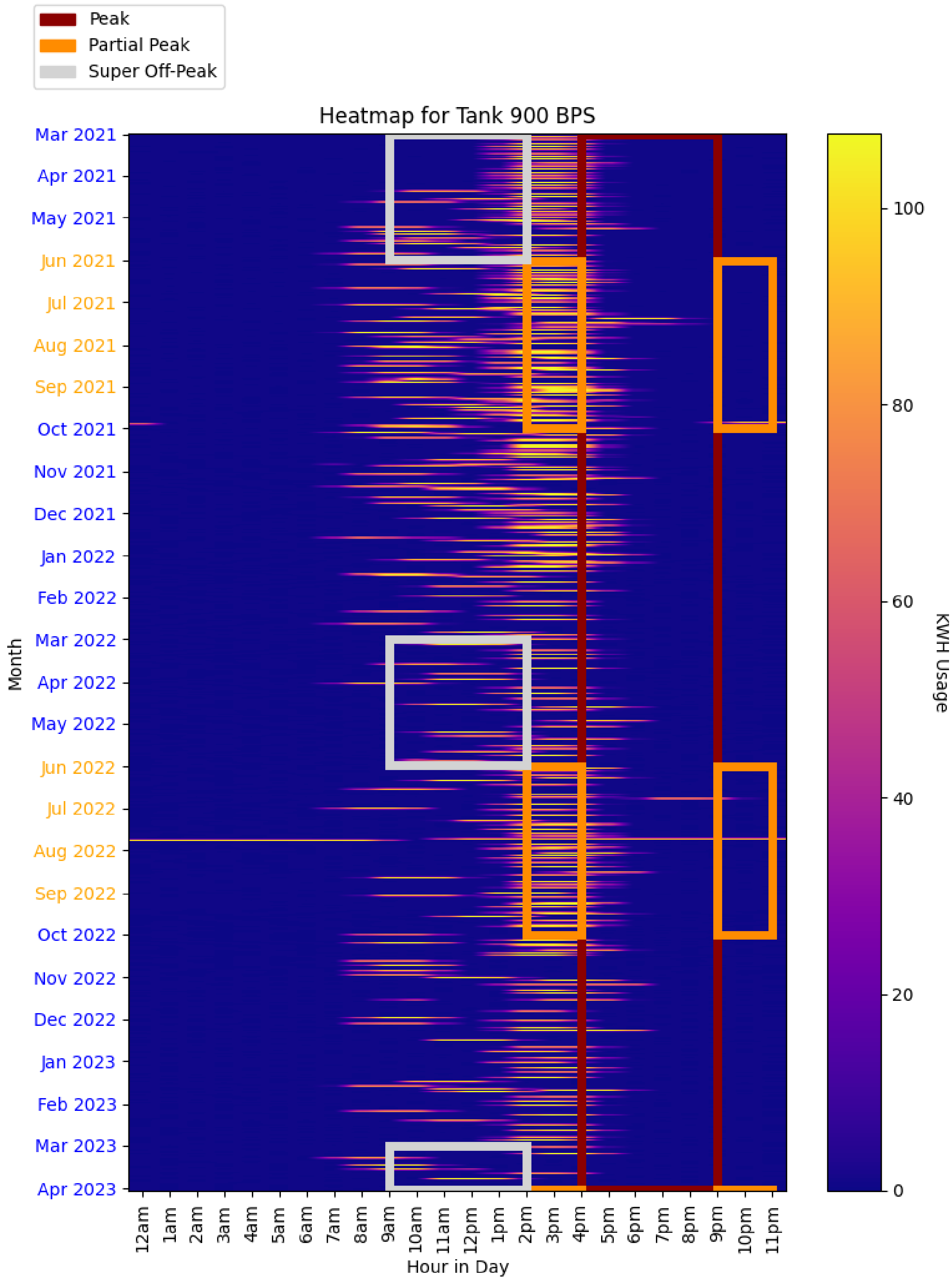

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Partial Peak
Super Off-Peak
Heatmap for Tank 900 BPS
Mar 2021
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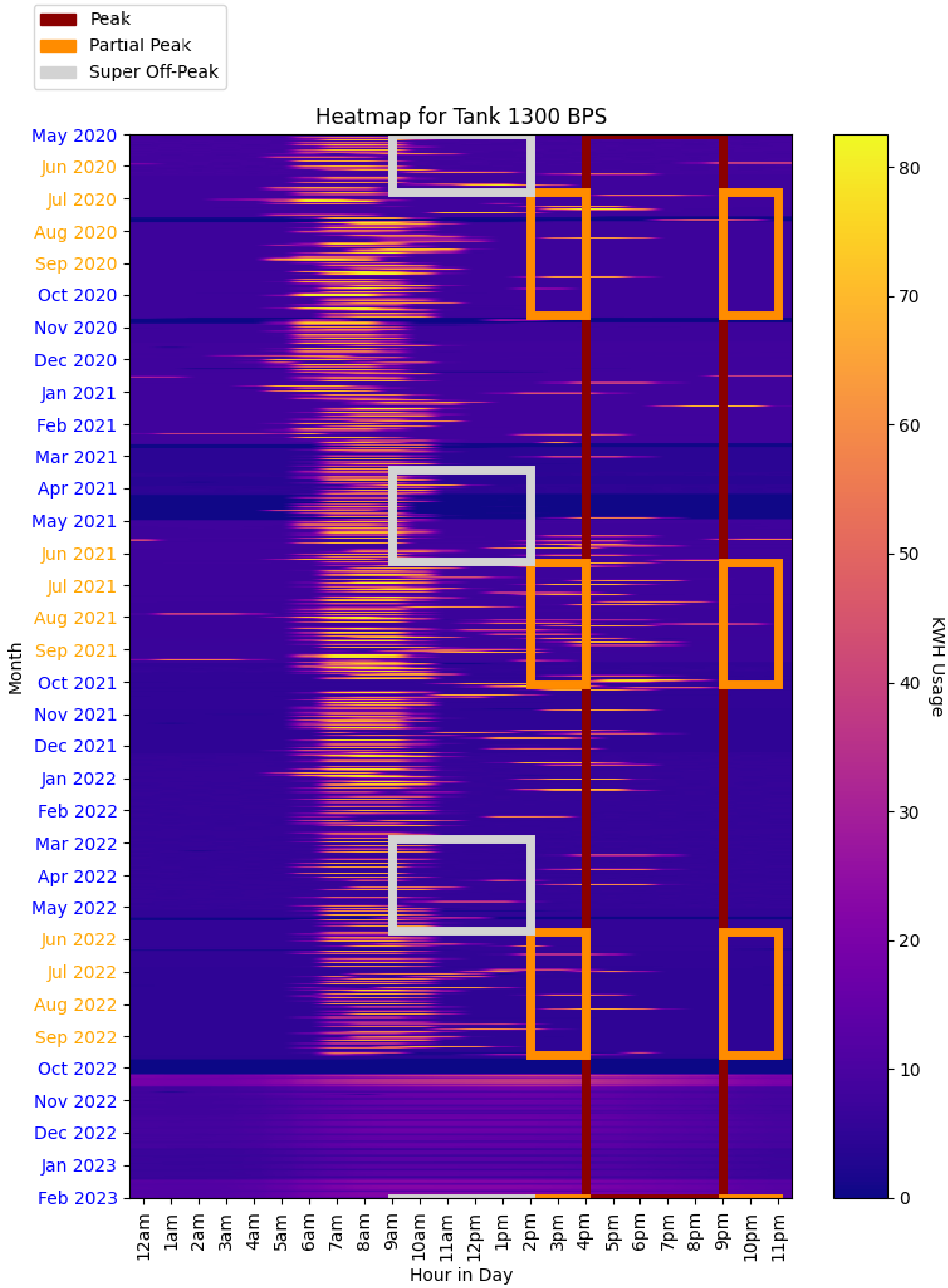
KWH Usage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Partial Peak
Super Off-Peak
Heatmap for Tank 1300 BPS
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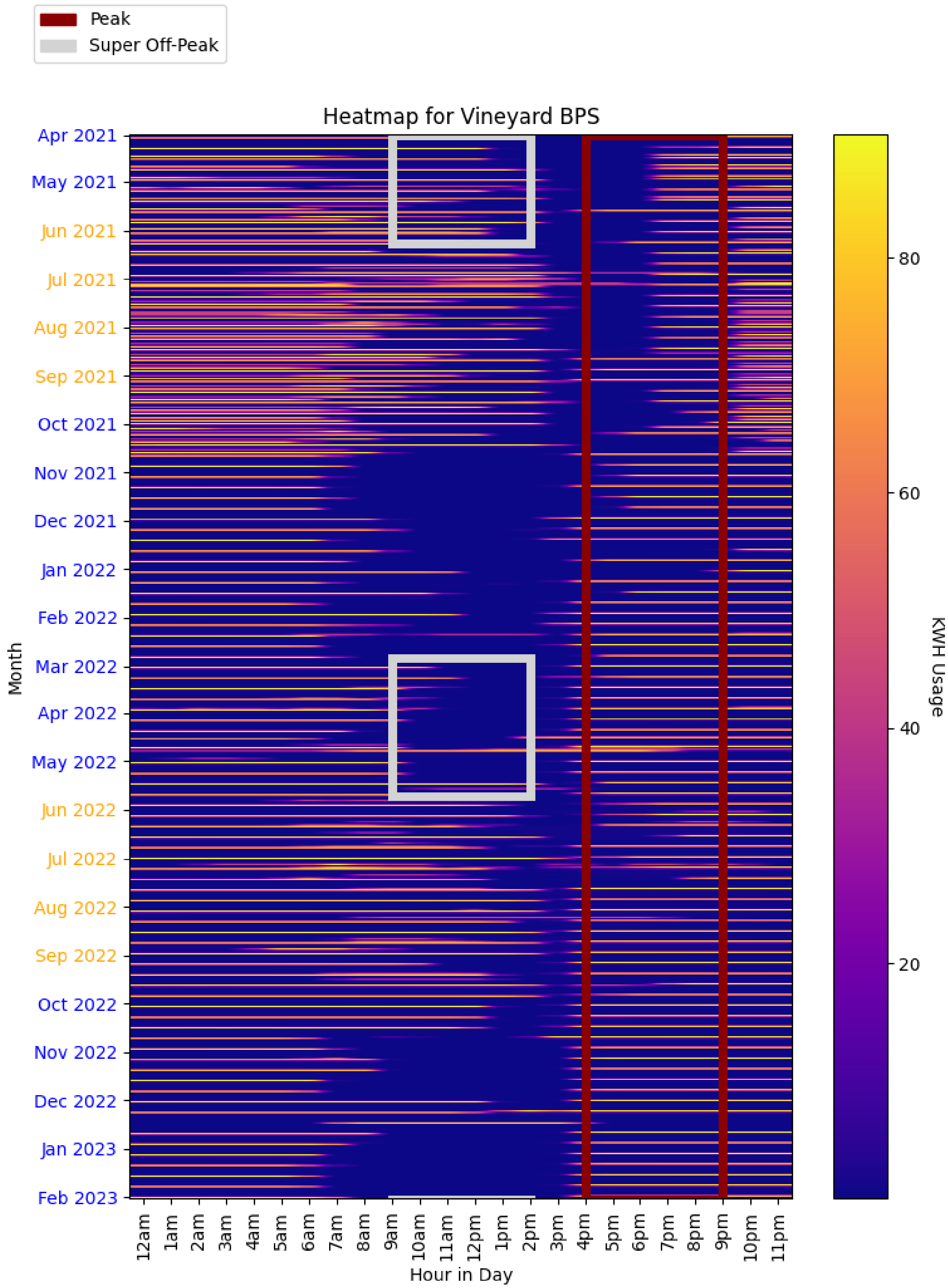
Peak
Super Off-Peak
Heatmap for Vineyard BPS
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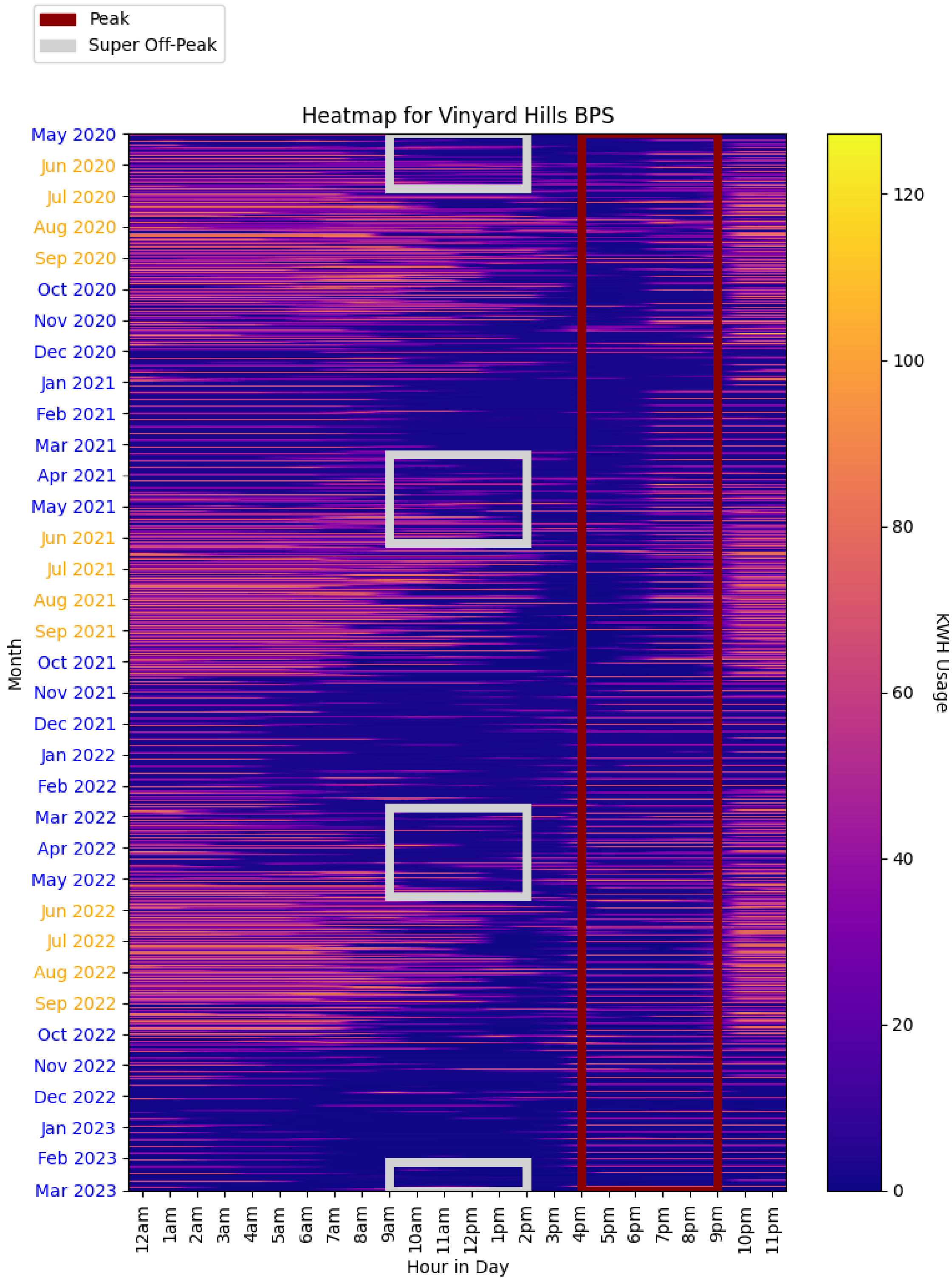
KWH Usage


Peak
Super Off-Peak
Heatmap for Vinyard Hills BPS
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Hour in Day
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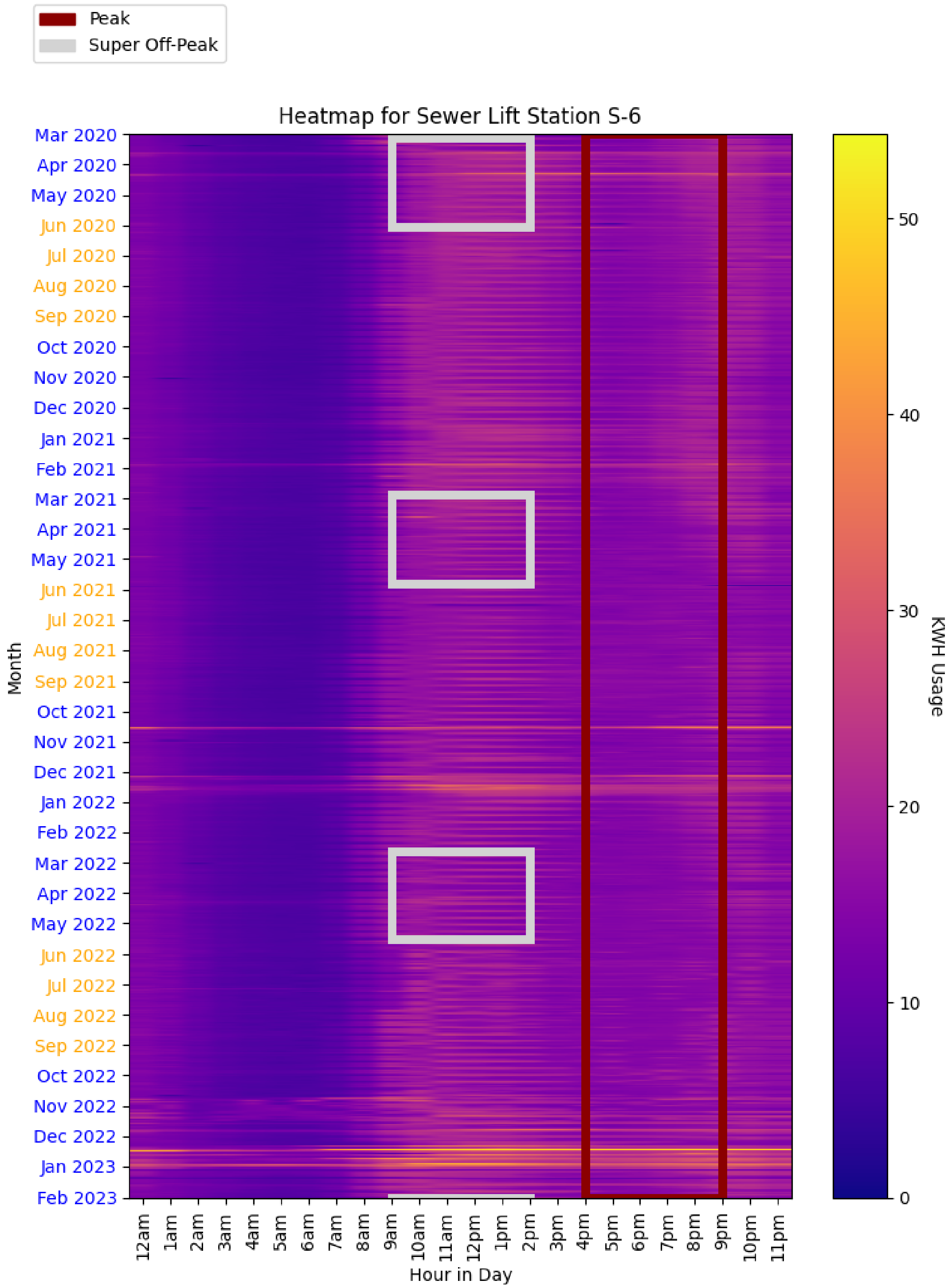
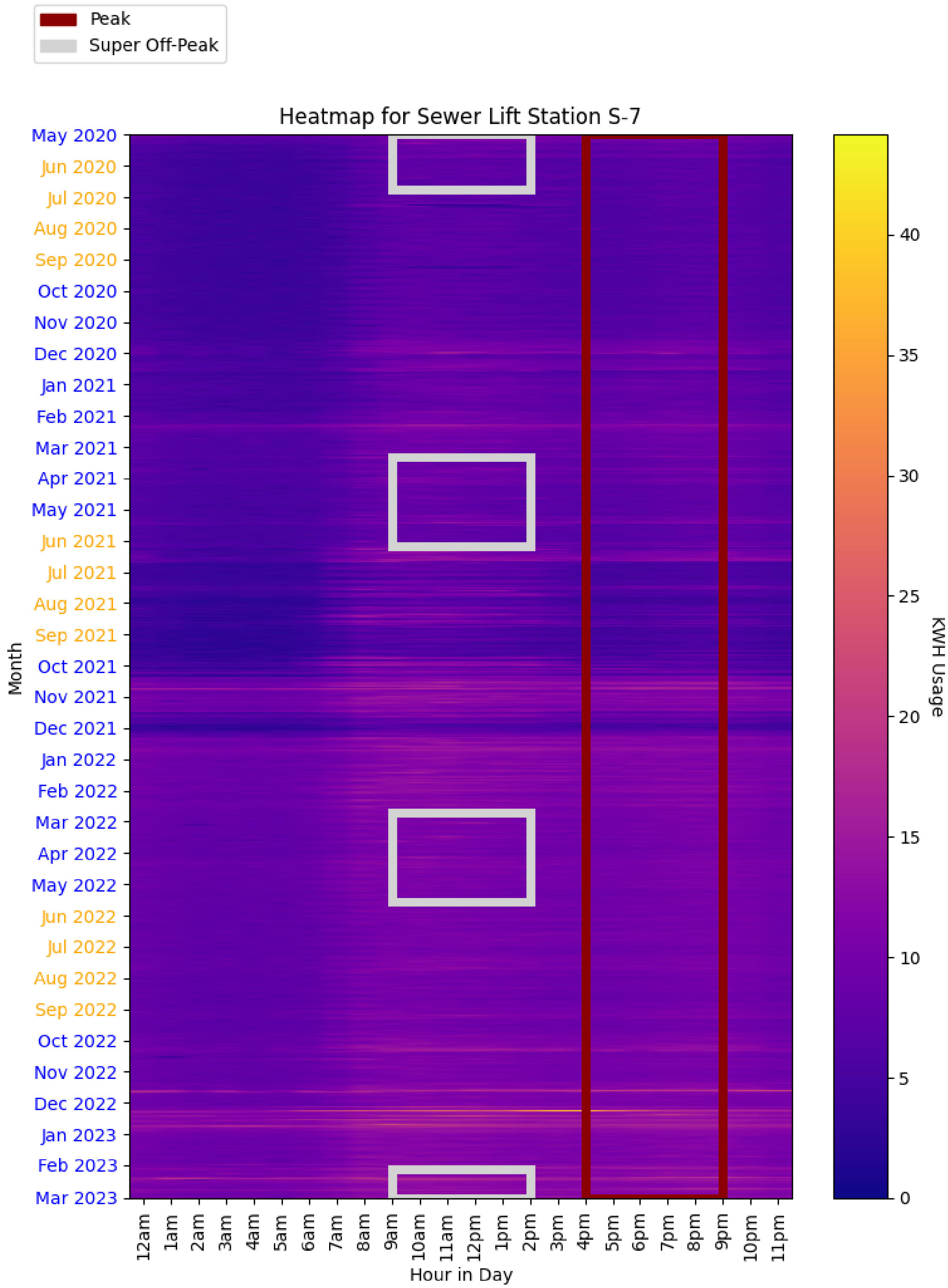
KWH Usage

Sewer Lift Stations




Peak
Super Off-Peak
Heatmap for Sewer Lift Station S-7
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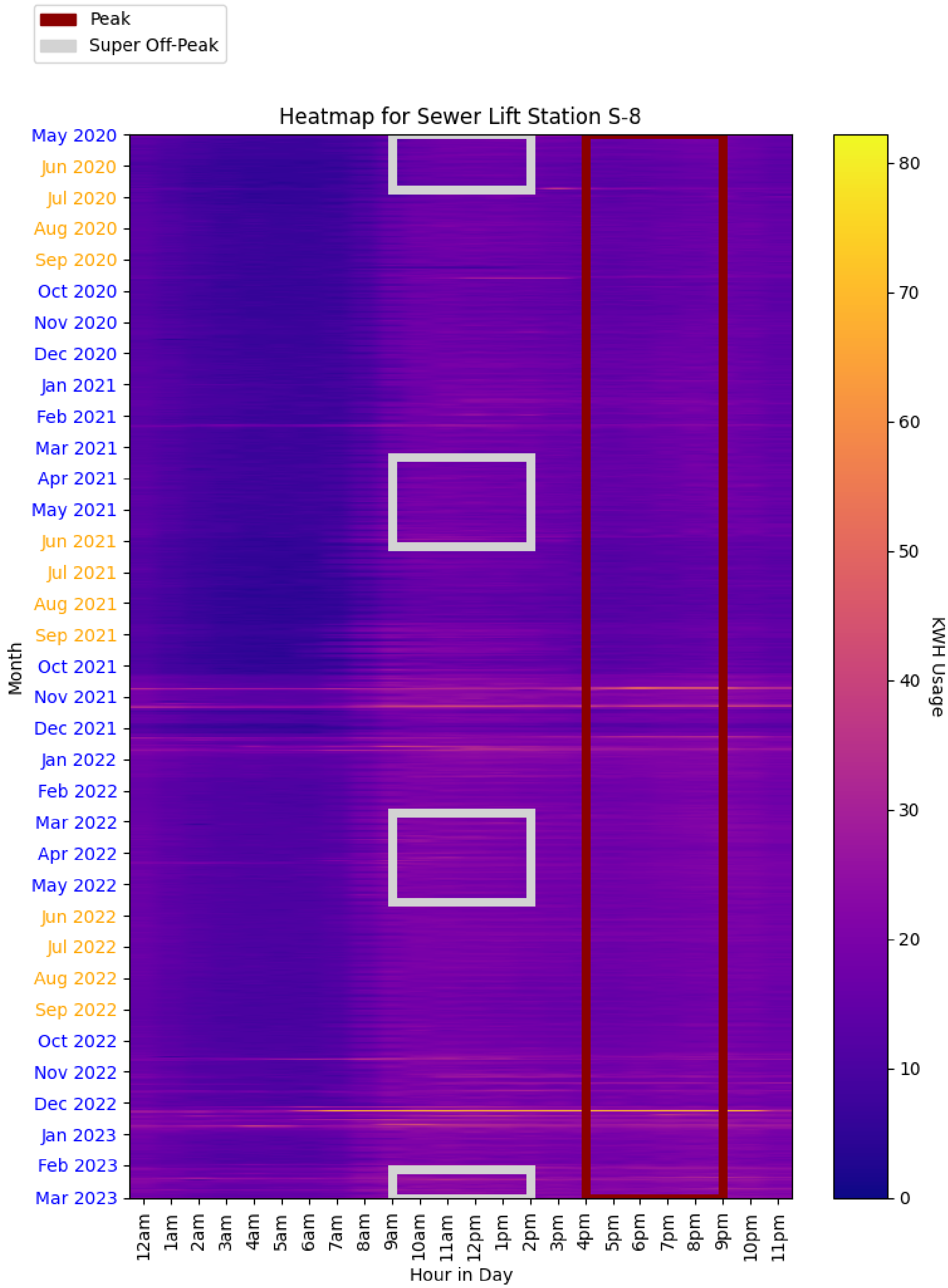
35
40
KWH Usage


Peak
Super Off-Peak
Heatmap for Sewer Lift Station S-8
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Hour in Day
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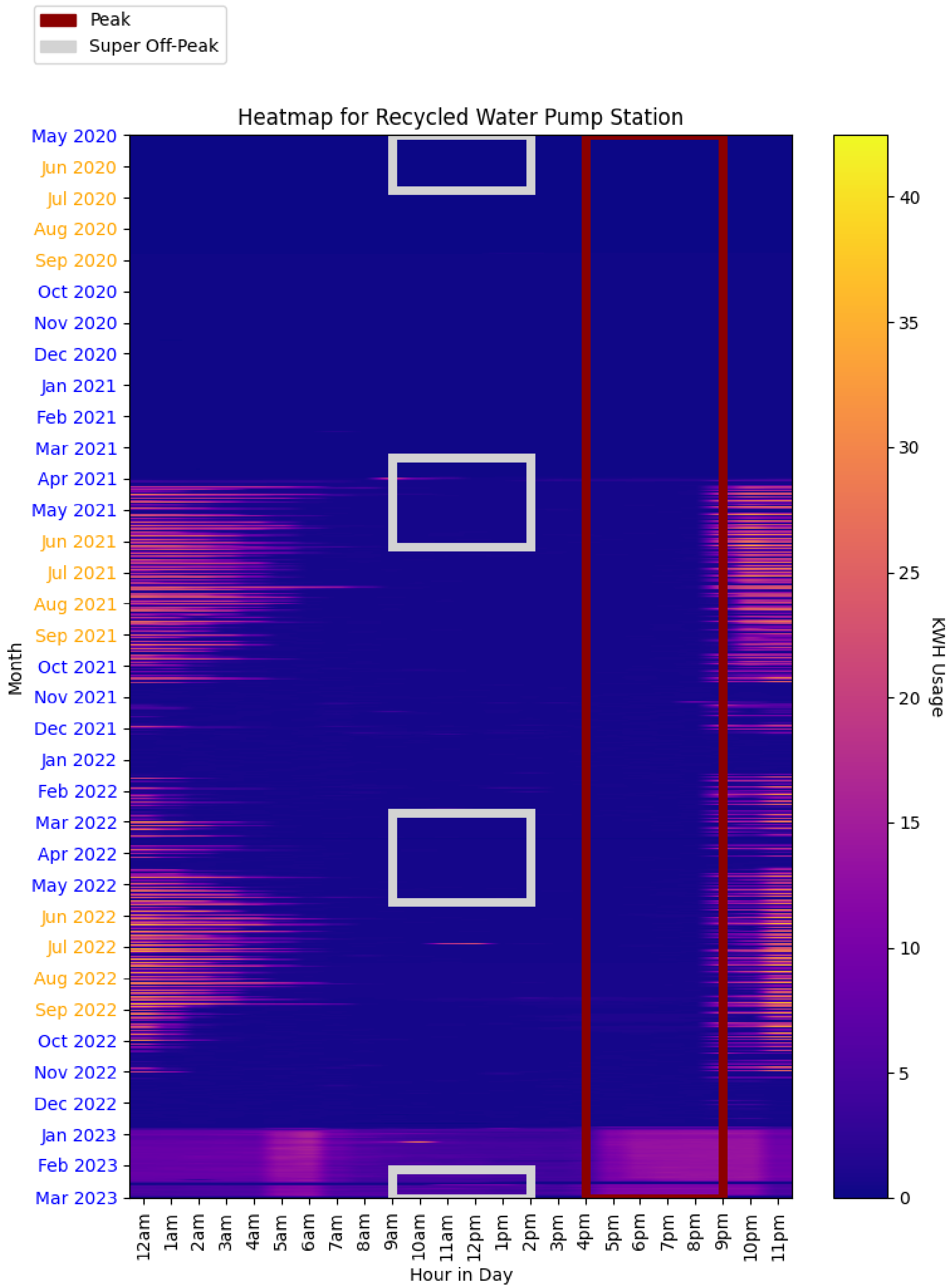
KWH Usage

Recycled Water Booster Station



Appendix D

Site Criticality

Priority 1 — Water/Sewer/Storm Stations and Facilities

Any facility in Priority 1 is considered mission critical and may require operation on a portable generator.

Facility	Address
PS/Tank 1300- Ridgeline Repeater Site and pump station	9400 Santos Ranch Rd
Well 5&6- Pleasanton Source water	1450 Santa Rita Rd
Turnout 2- Zone 7 feed to Pleasanton water system	3400 Hopyard Rd.
Turnout 3- Zone 7 feed to Pleasanton water system	3699 W Las Positas
Turnout 4- Zone 7 feed to Pleasanton water system	4790 Hopyard Rd
Turnout 5- Zone 7 feed to Pleasanton water system	3550 Nevada St
Turnout 6- Zone 7 feed to Pleasanton water system	1202 Machado Pl
Turnout 7- Zone 7 feed to Pleasanton water system	3033 W Ruby Hill Dr
Bonde 1- Radio Repeater Site	900 Abbie St
Tassajara- Radio Repeater site	5450 Tassajara Dr
S-6- Large Sewer Lift Station	6900 W Las Positas
S-7- Large Sewer Lift Station	4950 Bernal Ave
S-8- Large Sewer Lift Station	6890 Koll Center Pkwy

Priority 1 – Emergency Power Plan for Facilities							
Utility	Facility Type	Facility Name	Pressure Zone Served	Facility Power	Backup Power	Primary Plan with loss of power	Secondary Plan with loss of power
Water	Pump Station	PS 1300	Kilkare Zone	480V 3 Phase	None	Dedicate 1 of 4 rented 150kW portable generator	-
Water	Tanks	Tank 1300	Kilkare Zone	Same as PS 1300	-	-	
Water	Source Water	Well 5&6	Lower Zone	480V 3 Phase	None	Dedicate City owned 400kW portable generator	--
Water	Source Water	Turnout 2	Lower Zone	120V	UPS Backup & 12 V Battery	Share 1 of 7 2500-Watt Generators for extended outages beyond UPS backup capacity	Can still flow with no power. Lose ability for fluoride addition.
Water	Source Water	Turnout 3	Lower Zone	120V	UPS Backup & 12 V Battery	Share 1 of 7 2500-Watt Generators for extended outages beyond UPS backup capacity	Can still flow with no power. Lose ability for fluoride addition.
Water	Source Water	Turnout 4	Lower Zone	120V	UPS Backup & 12 V Battery	Share 1 of 7 2500-Watt Generators for extended outages beyond UPS backup capacity	Can still flow with no power. Lose ability for fluoride addition.
Water	Source Water	Turnout 5	Lower Zone	120V	UPS Backup & 12 V Battery	Share 1 of 7 2500-Watt Generators for extended outages beyond UPS backup capacity	Can still flow with no power. Lose ability for fluoride addition.
Water	Source Water	Turnout 6	Vineyard Hills PS	120V	UPS Backup & 12 V Battery	Share 1 of 7 2500-Watt Generators for extended outages beyond UPS backup capacity	Can still flow with no power. Lose ability for fluoride addition.
Water	Source Water	Turnout 7	Ruby Hill PS	120V	UPS Backup & 12 V Battery	Share 1 of 7 2500-Watt Generators for extended outages beyond UPS backup capacity	Can still flow with no power. Lose ability for fluoride addition.
Water	Tanks	Bonde 1	Mega Zone	120V	Stationary Generator	Share 1 of 7 2500-Watt Generators if a failure occurs to the stationary Generator.	Main radio Repeater site for communications to the Water & Sewer system.

Priority 1 – Emergency Power Plan for Facilities							
Utility	Facility Type	Facility Name	Pressure Zone Served	Facility Power	Backup Power	Primary Plan with loss of power	Secondary Plan with loss of power
Recycled Water	Tanks	Tassajara	The only Recycled Water Storage Facility/Tank for the Recycled Water System. RW system Feeds Irrigation water to Hacienda Business Park, Sports Park, Tennis Park and a few Hydrants on W. Las Positas.	120V	UPS Backup & 12 V Battery	Dedicate 1 of 7 2500-Watt Generators for extended outages beyond UPS backup capacity. Note that major SCADA communication Radio is located at this site for all utilities system. Use of generator at this site should be prioritized.	Tank can remain operational with no power. May require manual monitoring and operation of related pumps
Sewer	Pump Station	S-6	-	480V 3 Phase	Stationary Generator	-	-
Sewer	Pump Station	S-7	-	480V 3 Phase	Stationary Generator	-	-
Sewer	Pump Station	S-8	-	480V 3 Phase	Stationary Generator	-	-

Priority 2 — Water/Sewer/Storm Stations and Facilities

Any facility in Priority 2 generally does not require immediate action and may require portable generator power.

Facility	Address
Canyon Meadows PS	11599 Dublin Canyon Rd
Laurel Creek PS	5800 Foothill Rd
Moller Tank	8207 Moller Ranch Dr
Foothill 2 PS	4301 Foothill Rd
PS 510	8251 Santos Ranch Rd
Tank 510	8251 Santos Ranch Rd
PS 900	9000 Santos Ranch Rd
Tank 900	9000 Santos Ranch Rd
Longview PS	8999 Longview Dr
North Sycamore PS	937 Sycamore Creek Way
Vineyard PS	3502 Vineyard Ave
Vineyard Hills PS	1202 Machado Pl
Ruby Hill (Lower and Upper) PS	3033 W Ruby Hill Dr
Kottinger Ranch PS	1201 Hearst Dr
Grey Eagle PS	55 Red Feather Ct
Tank 1100	South of Santos Ranch Rd. in EBRP.
Tank 1600	Pleasanton Ridge
S-2	8019 Foothill Rd
S-4	1065 Serpentine Ln
S-5	Across from 1705 Laguna Creek Ln
S-10	7341 Foothill Rd
S-12	302 Happy Valley Rd
S-13	3333 Busch Rd
S-14	6614 Alisal St
S-15	2299 Vineyard Ave
Castlewood- Lower Pump Station	North of 303 Castlewood Drive
Castlewood- Upper Pump Station	Above 707 Country Club Circle, Castlewood

Priority 2 – Emergency Power Plan for Facilities							
Utility	Facility Type	Facility Name	Pressure Zone Served	Facility Power	Backup Power	Primary Plan with loss of power	Secondary Plan with loss of power
Water	Pump Station	Canyon Meadows	Dublin Canyon Zone	480V 3 Phase	None	Utilize City owned 400kW portable generator if available (i.e. may be already used for Well 5 & 6.	Feed applicable pressure zone from Moller Zone
Water	Pump Station	Laurel Creek	Moller 770 Zone	480V 3 Phase	Stationary Generator	-	-
Water	Tanks	Moller	Moller 770 Zone	120V	UPS Backup & 12 V Battery	Share 1 of 7 2500-Watt Generators for extended outages beyond UPS backup capacity	Can remain operational with no power. May require manual monitoring and operation of related pumps
Water	Pump Station	Foothill 2	510 Zone	480V 3 Phase	Stationary Generator	-	-
Water	Pump Station	PS 510	Kilkare Zone	480V 3 Phase	None	Dedicate 1 of 4 rented 150kW portable generator	-
Water	Pump Station	PS 900	Kilkare Zone	480V 3 Phase	None	Dedicate 1 of 4 rented 150kW portable generator	
Water	Pump Station	Longview	Lower 770 Zone	480V 3 Phase	None	Dedicate City owned 300kW portable generator	--
Water	Pump Station	North Sycamore	Mega Zone	480V 3 Phase	Stationary Generator	-	-
Water	Pump Station	Vineyard	Mega Zone	480V 3 Phase	None	Feed applicable pressure zone from other pump stations.	Bring McCloud PS online if available (not reliable)
Water	Pump Station	Vineyard Hills	Mega Zone	480V 3 Phase	Stationary Generator	-	-
Water	Pump Station	Ruby Hill (Lower and Upper)	Mega Zone / Upper Ruby Hill	480V 3 Phase	Stationary Generator	-	-
Water	Pump Station	Kottinger Ranch	Kottinger Ranch Zone	480V 3 Phase	None	Dedicate 1 of 4 rented 150kW portable generator	-

Priority 2 – Emergency Power Plan for Facilities							
Utility	**Facility Type**	**Facility Name**	**Pressure Zone Served**	**Facility Power**	**Backup Power**	**Primary Plan with loss of power**	**Secondary Plan with loss of power**
Water	Pump Station	Grey Eagle	Grey Eagle Hydro-Pneumatic Zone	480V 3 Phase	Stationary Generator for normal demand pumps. No backup for fire pump.	The electrical system is not currently configured to run the high flow pump on a generator. Fire flow to come from alternate means to be discussed with LPFD.	Point of risk for fire flow demands.
Water	Tanks	Tank 1100	Kilkare Zone	Solar	Deep Cell 12 V Battery	Replace Battery	-
Water	Tanks	Tank 1600	Kilkare Zone	Solar	Deep Cell 12 V Battery	Replace Battery	-
Sewer	Pump Station	S-2	-	480V 3 Phase	Stationary Generator	-	-
Sewer	Pump Station	S-4	-	480V 3 Phase	None	Utilize 150kW rental if available (i.e. may already be used for water system)	Collection system backup. Point of risk for SSOs.
Sewer	Pump Station	S-5	-	480V 3 Phase	None	Utilize 150kW rental if available (i.e. may already be used for water system)	-
Sewer	Pump Station	S-10	-	208 Delta	Stationary Generator	-	-
Sewer	Pump Station	S-12	-	480V 3 Phase	Stationary Generator	-	-
Sewer	Pump Station	S-13	-	Part of OSC Power	Part of OSC Backup Power	-	-
Sewer	Pump Station	S-14	-	480V 3 Phase	None	Monitor Wet wells Levels and Use Vacuum Truck to maintain wet well. Only utilize 150kw rental generator for Isolated extended outages.	Collection system backup. Point of risk for SSOs.

Priority 2 – Emergency Power Plan for Facilities							
Utility	Facility Type	Facility Name	Pressure Zone Served	Facility Power	Backup Power	Primary Plan with loss of power	Secondary Plan with loss of power
Sewer	Pump Station	S-15	-	480V 3 Phase	Stationary Generator	-	-
Water	Pump Station	Castlewood-Lower Pump Station	-	480V 3 Phase	None	Dedicate 1 of 2 rented 150kW portable generator (Rented by County)	-
Water	Pump Station	Castlewood-Upper Pump Station	-	480V 3 Phase	None	Dedicate 1 of 2 rented 150kW portable generator (Rented by County)	-

Priority 3 — Water/Sewer/Storm Stations and Facilities

Any facility in Priority 3 generally does not require immediate action and has temporary back-up battery power. These facilities will require remote monitoring and site visits to replace batteries or connect a small generator.

Facility	Address
Foothill Tank	5800 Foothill Rd
Sycamore Tank	1100 Sycamore Creek Way
McCloud PS	501 Kottinger Dr
McCloud Tank	501 Kottinger Dr
Tank 1600	South of Santos Ranch Rd. in EBRP.
Tank 770-1	8999 Longview Dr
Tank 770-2	8200 Golden Eagle Wy
Happy Valley Tank	4500 Clubhouse Dr
Laurel Creek Tank	9700 Crosby Dr
Dublin Canyon Tank	6220 Detjen Ct
Lund Tank	1700 Minnie St
Bonde 2 Tank	30 Grey Eagle Ct
Vineyard Hills	99 Winding Oaks Way
Lower Ruby Hill Tank	3599 Valenza Way
Upper Ruby Hill Tank	4001 W Ruby Hill Dr
Kottinger Ranch Tank	1399 Benedict Ct
Sports Park	5800 Parkside Dr
DSRSD Turnout	Stoneridge at Johnson Drive (Val Vista Park)
Livermore Turnout	Stoneridge Dr @ El Charro Rd (NW Corner)
SD-01	4950 Bernal Ave
SD-02	4000 Del Valle Pkwy
SD-03	3090 Valley Ave
SD-04	1040 Valley Ave

Priority 3 – Emergency Power Plan-for Facilities							
Utility	Facility Type	Facility Name	Pressure Zone Served	Facility Power	Backup Power	Primary Plan with loss of power	Secondary Plan with loss of power
Water	Tanks	Foothill	Lower Zone	Same as Laurel Creek PS	Standby Generator at Laurel Creek Station	-	-
Water	Tanks	Sycamore	Lower Zone	120V	UPS Backup & 12 V Battery	Share 1 of 7 2500-Watt Generators for extended outages beyond UPS backup capacity	Can remain operational with no power. May require manual monitoring and operation of related pumps
Water	Pump Station	McCloud	Mega Zone	Pump Station Off-line	Stationary Generator	-	-
Water	Tanks	McCloud	Lower Zone	Tank Off-line	Offline	-	-
Water	Tanks	Tank 1600	Kilkare Zone	Solar	Deep Cell 12 V Battery	Replace Battery	-
Water	Tanks	Tank 770-1	770 Zone	Same as Longview PS	UPS Backup & 12 V Battery at Station	Dedicate City owned 300kW portable generator at Longview Station	-
Water	Tanks	Tank 770-2	770 Zone	120V	UPS Backup & 12 V Battery	Share 1 of 7 2500-Watt Generators for extended outages beyond UPS backup capacity	Can remain operational with no power. May require manual monitoring and operation of related pumps
Water	Tanks	Happy Valley	Mega Zone	120V	UPS Backup & 12 V Battery	Share 1 of 7 2500-Watt Generators for extended outages beyond UPS backup capacity	Can remain operational with no power. May require manual monitoring and operation of related pumps

Priority 3 – Emergency Power Plan-for Facilities							
Utility	Facility Type	Facility Name	Pressure Zone Served	Facility Power	Backup Power	Primary Plan with loss of power	Secondary Plan with loss of power
Water	Tanks	Laurel Creek	Moller 770 Zone	120V	UPS Backup & 12 V Battery	Share 1 of 7 2500-Watt Generators for extended outages beyond UPS backup capacity	Can remain operational with no power. May require manual monitoring and operation of related pumps
Water	Tanks	Dublin Canyon	Dublin Canyon Zone	120V	UPS Backup & 12 V Battery	Share 1 of 7 2500-Watt Generators for extended outages beyond UPS backup capacity	Can remain operational with no power. May require manual monitoring and operation of related pumps
Water	Tanks	Lund	Mega Zone	120V	UPS Backup & 12 V Battery	Share 1 of 7 2500-Watt Generators for extended outages beyond UPS backup capacity	Can remain operational with no power. May require manual monitoring and operation of related pumps
Water	Tanks	Bonde 2	Mega Zone	120V	UPS Backup & 12 V Battery	Share 1 of 7 2500-Watt Generators for extended outages beyond UPS backup capacity	Can remain operational with no power. May require manual monitoring and operation of related pumps
Water	Tanks	Vineyard Hills	Mega Zone	120V	UPS Backup & 12 V Battery	Share 1 of 7 2500-Watt Generators for extended outages beyond UPS backup capacity	Can remain operational with no power. May require manual monitoring and operation of related pumps

Priority 3 – Emergency Power Plan-for Facilities							
Utility	Facility Type	Facility Name	Pressure Zone Served	Facility Power	Backup Power	Primary Plan with loss of power	Secondary Plan with loss of power
Water	Tanks	Lower Ruby Hill	Mega Zone	120V	UPS Backup & 12 V Battery	Share 1 of 7 2500-Watt Generators for extended outages beyond UPS backup capacity	Can remain operational with no power. May require manual monitoring and operation of related pumps
Water	Tanks	Upper Ruby Hill	Upper Ruby Hill Zone	120V	UPS Backup & 12 V Battery	Share 1 of 7 2500-Watt Generators for extended outages beyond UPS backup capacity	Can remain operational with no power. May require manual monitoring and operation of related pumps
Water	Tanks	Kottinger Ranch	Kottinger Ranch Zone	120V	UPS Backup & 12 V Battery	Share 1 of 7 2500-Watt Generators for extended outages beyond UPS backup capacity	Can remain operational with no power. May require manual monitoring and operation of related pumps
Recycled Water	Pump Station	Sports Park		480V 3 Phase	None	Can run off tanks without boosting under reduced irrigation flowrates	-
Recycled Water	Source Water	DSRSD Turnout		120V	UPS Backup & 12 V Battery	Can maintain flow without power	-
Recycled Water	Source Water	Livermore Turnout		120V	UPS Backup & 12 V Battery	Can maintain flow without power	-
Storm	Pump Station	SD-01		480V 3 Phase	None	During summer, no need anticipated	During winter use city owned or rented generator
Storm	Pump Station	SD-02		480V 3 Phase	None	During summer, no need anticipated	During winter use city owned or rented generator

Priority 3 – Emergency Power Plan-for Facilities							
Utility	Facility Type	Facility Name	Pressure Zone Served	Facility Power	Backup Power	Primary Plan with loss of power	Secondary Plan with loss of power
Storm	Pump Station	SD-03		480V 3 Phase	None	During summer, no need anticipated	During winter use city owned or rented generator
Storm	Pump Station	SD-04		480V 3 Phase	None	During summer, no need anticipated	During winter use city owned or rented generator

Appendix E

TJC Electrical Pump Site Load Demand

Table 1. Electrical Pump Site Load Demand

Facilities	Water Station Generators							
	Aux. XFMR	Total Amps	System Voltage	Generator size kW	Generator Total Load Demand, %	No. of Pumps	Total Pump, HP	Total Pump, kW
937 Sycamore Creek Way Booster	30KVA	391	480V	350	88	3	300	225
5875 Laurel Creek Booster	25KVA	254	480/277V	250	80	3	150	113
4301 Foothill Rd. Foothill Booster	9KVA	50	480V	56	70	4	40	30
3033 W Ruby Hills Dr. Booster	15KVA	332	480/277V	350	75	5	305	229
1202 Machado Vineyard Hills Booster	15KVA	201	480V	200	79	3	180	135
3502 Vineyard Ave.	9KVA	133	480V	176	60	2	120	90
11599 Dublin canyon Rd.	15KVA	274	480V	240	90	2	250	188
1201 Hearst Dr.	9KVA	92	480/277V	120	60	2	80	60
8999 Longview Dr.	15KVA	248	480V	240	82	3	225	169
3998 Foothill Rd.	9KVA	165	480V	176	74	2	150	113
9000 Santos Ranch Road	9KVA	165	480V	176	74	2	150	113
9400 Santos Ranch Road	9KVA	105	480/277V	176	47	2	100	75
Sewer Station Generators								
S-2 8019 Foothill Rd	15KVA	38	120/240V	30	50	2	6	5
S-4 1065 Serpentine Lane	15KVA	19	480V	56	27	2	6	5
S-5 1723 Laguna Creek Lane	15KVA	37	480V	56	51	3	22.5	17
S-6 6900 W. Las Positas	30KVA	130	480V	200	51	5	100	75
S-7 4950 Bernal Ave	15KVA	76	480V	120	50	3	60	45
S-8 6890 Koll Center	15KVA	201	480V	200	79	3	180	135
S-12 302 Happy Valley Rd.	75KVA	211	120/240V	120	69	2	40	30
S-13 3333 Busch Road	45KVA	43	480/277V	56	60	2	4	3
S-14 6614 Alisal St.	45KVA	119	120/240V	120	39	2	20	15
S-15 2299 Vineyard Ave	10KVA	40	480V	56	56	2	30	23
Storm Station Generators								
SD-1 - 4950 Bernal Ave.	45KVA	60	480V	120	39	2	20	15
SD-2 - 4000 Del Valle Pkwy	45KVA	60	480V	120	39	2	20	15
SD-3 - 3090 Valley Ave.	45KVA	195	480V	176	87	2	150	113
SD-4 - 1040 Valley Ave.	15KVA	29	480V	56	40	2	15	11
Bold denotes Portable Generator Needed								

Appendix F

NREL ReOpt Summaries

REopt

Results for Your Off-grid Site

Your site at 9400 Santos Ranch Rd Pleasanton CA 94588 USA evaluated on July 7, 2023

These results from REopt summarize the economic viability of PV, wind, storage, CHP, and/or GHP at your site. You can edit your inputs to see how changes to your energy strategies affect the results.

Your recommended solar installation size

1 kW
PV size

Measured in kilowatts (kW) of direct current (DC), this recommended size minimizes the life cycle cost of energy at your site.

This optimized size may not be commercially available. The user is responsible for finding a commercial product that is closest in size to this optimized size.

Your recommended battery power and capacity

1 kW
battery power

5 kWh
battery capacity

This system size minimizes the life cycle cost of energy at your site. The battery power (kW-AC) and capacity (kWh) are optimized for economic performance.

This optimized size may not be commercially available. The user is responsible for finding a commercial product that is closest in size to this optimized size.

Your total life cycle cost (25 years)

$2,004

Your levelized cost of electricity (25 years)

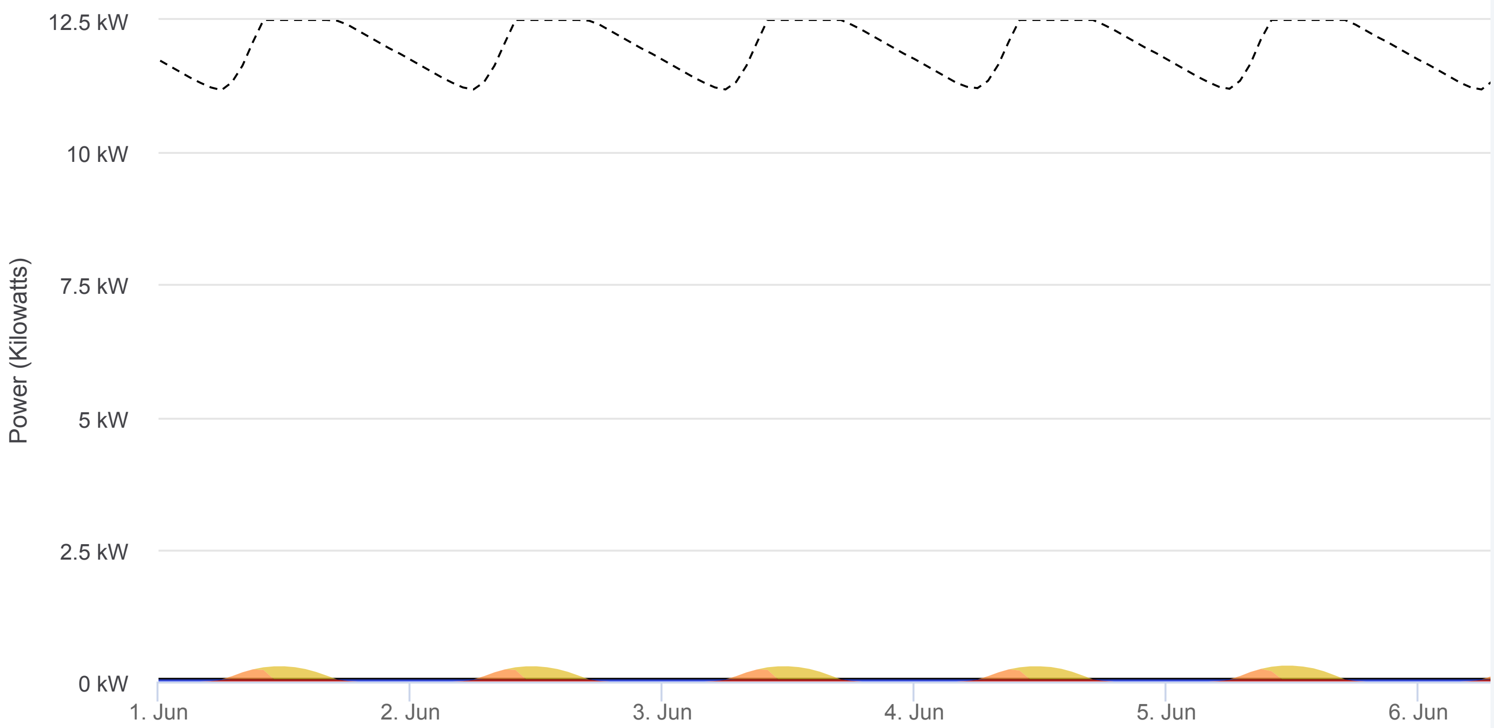
$0.415 per kWh

View citation

System Performance Year One

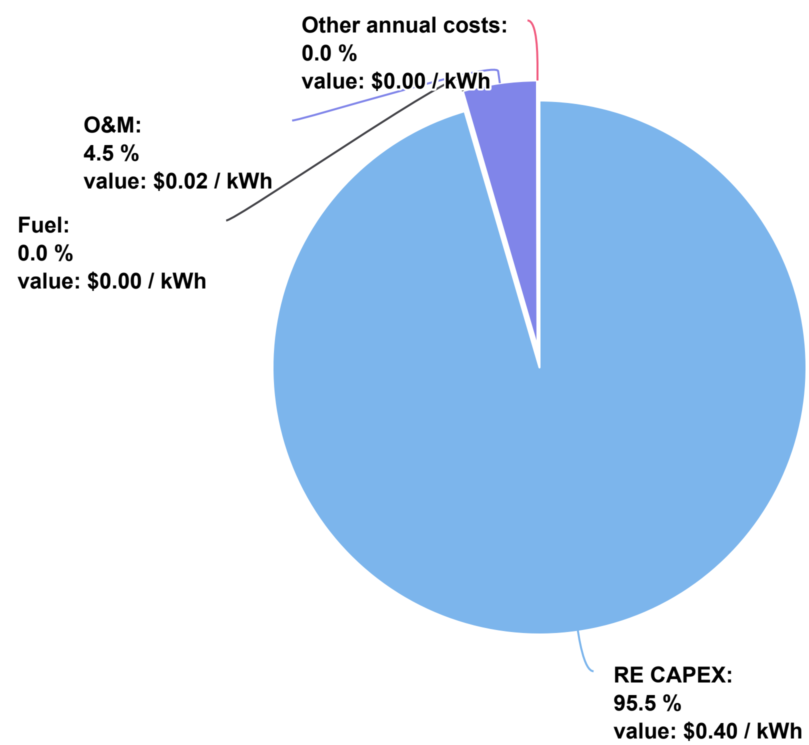
System Performance Year One

This interactive graph shows the dispatch strategy optimized by REopt for the specified outage period as well as the rest of the year. To zoom in on a date range, click and drag right in the chart area or use the "Zoom In a Week" button. To zoom out, click and drag left or use the "Zoom Out a Week" button.



LCOE Breakdown

This interactive pie chart shows the levelized cost of energy breakdown by REopt for the specified off-grid site.



Download All Dispatch Data

Results Summary

Results Summary

	Optimized
System Size	
PV Size	1 kW
Battery Power	1 kW
Battery Capacity	5 kWh
Energy Production and Fuel Use	
Annual Site Load	365 kWh
Annual Load Met	100 %
Average Annual PV Energy Production	648 kWh
Annual Operating Reserves Required	76 kWh
Annual Operating Reserves Provided	76 kWh
Emissions and Renewable Energy	
Total CO_2 Emissions in Year 1	0 tons
Lifecycle Costs of Climate Emissions	$0
Lifecycle Costs of Health Emissions	$0
Annual Renewable Electricity (% of electricity consumption) (%)	100%
Summary Financial Metrics	
Total Upfront Capital Cost Before Incentives	$2,749
Year 1 O&M Cost	$7
Total Life Cycle Costs	$2,004

Levelized Cost of Energy	$0.415/kWh
Life Cycle Cost Breakdown	
Technology Capital Costs + Replacements, after incentives	$1,914
O&M Costs	$90
Additional Capital Costs	$0
Additional Annual Costs	$0
Lifecycle Costs of Climate Emissions (included in objective)	$0
Lifecycle Costs of Health Emissions (included in objective)	$0

Clean Energy Outputs

Inputs

Your Inputs

The results are based on the following user supplied inputs.

Energy Goals
Cost-Savings $

Technologies Selected		
Off-grid	PV	Battery

Site and Utility

Site Location	9400 Santos Ranch Rd, Pleasanton, CA 94588, USA (37.6632342, -121.9259815)
PV & wind space available	Land

Load Profile	
Typical electric load profile type	simulated building
Type of building	24/7 Schedule Flat Load
Annual electric energy consumption (kWh)	365

PV	
Array type	Ground Mount, Fixed

Battery	
Minimum energy capacity (kWh)	5.0

Defaults

Default Inputs

The results are based on the following default inputs.

Site and Utility	
Land available for PV (acres)	Unlimited
Existing heating system fuel type	natural gas
Solver optimality tolerance (%)	5%

Load Profile	
Load adjustment (%)	100%

Minimum load met (%)	99.9%
Load operating reserve requirement (%)	10%

Financial	
Analysis period (years)	25
Host discount rate, nominal (%)	5.64%
Host effective tax rate (%)	26%
O&M cost escalation rate (%)	2.5%
Third Party Ownership	false
Third-party owner discount rate, nominal (%)	5.64%
Third-party owner effective tax rate (%)	26%
Additional capital costs ($)	$0
Additional annual costs ($/year)	$0

Renewable Energy & Emissions	
CO_2 cost ($/t CO_2)	$51.00
On-site fuel burn NOx cost ($/t NOx)	$27,684.53
On-site fuel burn SO_2 cost ($/t SO_2)	$46,551.14
On-site fuel burn PM2.5 cost ($/t PM2.5)	$524,876.00
CO_2 cost escalation rate, nominal (%)	4.22%
NOx cost escalation rate, nominal (%)	3.65%
SO_2 cost escalation rate, nominal (%)	4.63%
PM2.5 cost escalation rate, nominal (%)	4.30%

PV	
System capital cost ($/kW-DC)	$1,592

Existing PV systems size (kW-DC)	N/A
Type of load profile	N/A
O&M cost ($/kW-DC per year)	$17
Minimum new PV size (kW-DC)	0
Maximum new PV size (kW-DC)	Unlimited
Module type	Standard
Array azimuth (deg)	180
Array tilt (deg)	38
DC to AC size ratio	1.2
System losses (%)	14%
PV generation profile	N/A
Federal percentage-based incentive (%)	30%
Federal maximum incentive (%)	Unlimited
Federal rebate ($/kW-DC)	$0
Federal maximum rebate ($)	Unlimited
State percentage-based incentive (%)	0%
State maximum incentive ($)	Unlimited
State rebate ($/kW-DC)	$0
State maximum rebate ($)	Unlimited
Utility percentage-based incentive (%)	0%
Utility maximum incentive ($)	Unlimited
Utility rebate ($/kW-DC)	$0
Utility maximum rebate ($)	Unlimited
Production incentive ($/kWh)	$0

Incentive duration (years)	1
Maximum incentive ($)	Unlimited
System size limit (kW-DC)	Unlimited
MACRS bonus depreciation	80%
MACRS schedule	5 years
PV Station Search Radius (mi)	Unlimited
PV operating reserve requirement (%)	25%

Battery	
Energy capacity cost ($/kWh)	$388
Power capacity cost ($/kW)	$775
Energy capacity replacement cost ($/kWh)	$220
Battery Replacement Year	10
Power capacity replacement cost ($/kW)	$440
Inverter Replacement Year	10
Maximum energy capacity (kWh)	Unlimited
Minimum power capacity (kW)	0
Maximum power capacity (kW)	Unlimited
Rectifier efficiency (%)	96%
Round trip efficiency (%)	97.5%
Inverter efficiency (%)	96%
Minimum state of charge (%)	20%
Initial state of charge (%)	100%
Total percentage-based incentive (%)	30%
Total power capacity rebate ($/kW)	$0

MACRS bonus depreciation	80%
MACRS schedule	7 years

Caution

Caution

Investment decisions should not be made on REopt results alone. These results assume perfect prediction of solar irradiance, wind speed, and electrical and thermal loads. In practice, actual savings may be lower based on the ability to accurately predict solar irradiance, wind speed, and load, and the control strategies used in the system. And, when modeling a grid outage the results assume perfect foresight of the impending outage, allowing the battery system to charge in the hours leading up the outage. If a natural gas-fueled CHP system is included, the resiliency results assume the natural gas supply is not disrupted during an electrical grid outage.

The results include both expected energy and demand savings. However, the hourly model does not capture intra-hour variability of the PV and wind resource. Because demand is typically determined based on the maximum 15-minute peak, the estimated savings from demand reduction may be exaggerated. The hourly simulation uses one year of load data and one year of solar and wind resource data. Actual demand charges and savings will vary from year to year as load and resource vary.

Asset dispatch decisions are determined by the model as part of the cost-minimization objective. In application, some aspects of these operational decisions may not work well with the existing infrastructure or may not follow best practices. For example, in results with CHP, boiler dispatch may result in short cycling or periodic boiler use that is not possible without hot-standby. The user should review the dispatch results with these limitations in mind.

PV system performance predictions calculated by PVWatts include many inherent assumptions and uncertainties and do not reflect variations between PV technologies nor site-specific characteristics except as represented by inputs. For example, PV modules with better performance are not differentiated within PVWatts from lesser-performing modules.

Next Steps

Next Steps

This model provides an **estimate** of the techno-economic feasibility of solar, wind, battery, and/or CHP but investment decisions should not be made based on these results alone. **Before moving ahead with project development, verify:**

- The utility rate tariff is correct.
    - Note that a site may have the option or may be required to switch to a different utility rate tariff when installing a renewable energy system.
    - Contact your utility for more information.
- Actual load data is used rather than a simulated load profile.
- The load adjustment is entered as intended. (To learn more about achieving energy efficiency savings, visit the Better Buildings Solution Center).
- PV, wind, battery, and CHP costs and incentives are accurate for your location.
    - There may be additional value streams not included in this analysis such as ancillary services or capacity payments.
- Financial inputs are accurate, especially discount rate and utility escalation rate.
- Other factors that can inform decision-making, but are not captured in this model, are considered. These may include:
    - roof integrity
    - shading considerations
    - obstacles to wind flow
    - ease of permitting
    - mission compatibility
    - regulatory and zoning ordinances
    - utility interconnection rules
    - availability of funding.
- Multiple systems integrators are consulted and multiple proposals are received. These will help to refine system architecture and projected costs and benefits. REopt results can be used to inform these discussions.

Contact NREL at reopt@nrel.gov for more detailed modeling and project development assistance.

REopt: Renewable Energy Integration & Optimization

Link to Results Page

Disclaimer

Results for Your Site

Your site at 3502 Vineyard Ave Pleasanton CA 94566 USA evaluated on July 5, 2023

These results from REopt summarize the most cost-effective combination of PV, wind, battery storage and/or diesel generator designed to sustain a critical load at your site. You can edit your inputs to see how changes to your energy strategies affect the results.

Your recommended solar installation size

20 kW

PV size

Measured in kilowatts (kW) of direct current (DC), this recommended size minimizes the life cycle cost of energy at your site.

This optimized size may not be commercially available. The user is responsible for finding a commercial product that is closest in size to this optimized size.

Your recommended battery power and capacity

200 kW
battery power

384 kWh
battery capacity

This system size minimizes the life cycle cost of energy at your site. The battery power (kW-AC) and capacity (kWh) are optimized for economic performance.

This optimized size may not be commercially available. The user is responsible for finding a commercial product that is closest in size to this optimized size.

Your potential life cycle savings (25 years)

This is the net present value of the savings (or costs if negative) realized by the project based on the difference between the total life cycle costs of doing business as usual compared to the optimal case.

If you did not choose the resilience focus or input minimum required technology sizes for this evaluation, your life cycle cost savings is negative due to the tolerance settings in the model which may result in savings as low as -$4,616. In this case, your best solution is business as usual.

-$132,154

View citation

Your Potential Resilience

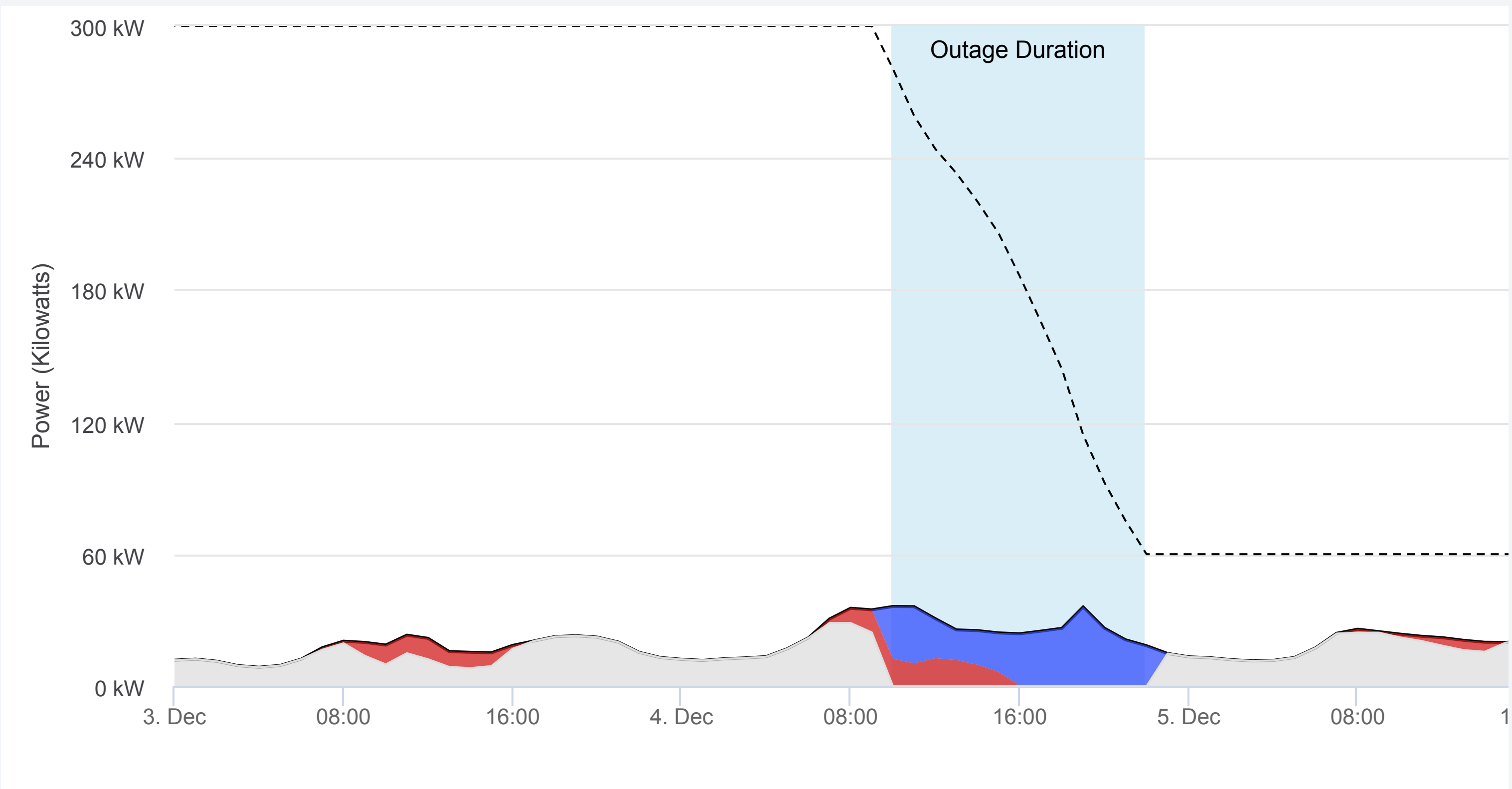
This system sustains the 100% critical load during the specified outage period, from December 4 at 10 am to December 4 at 10 pm.

System survives specified 12-hour outage

System Performance Year One

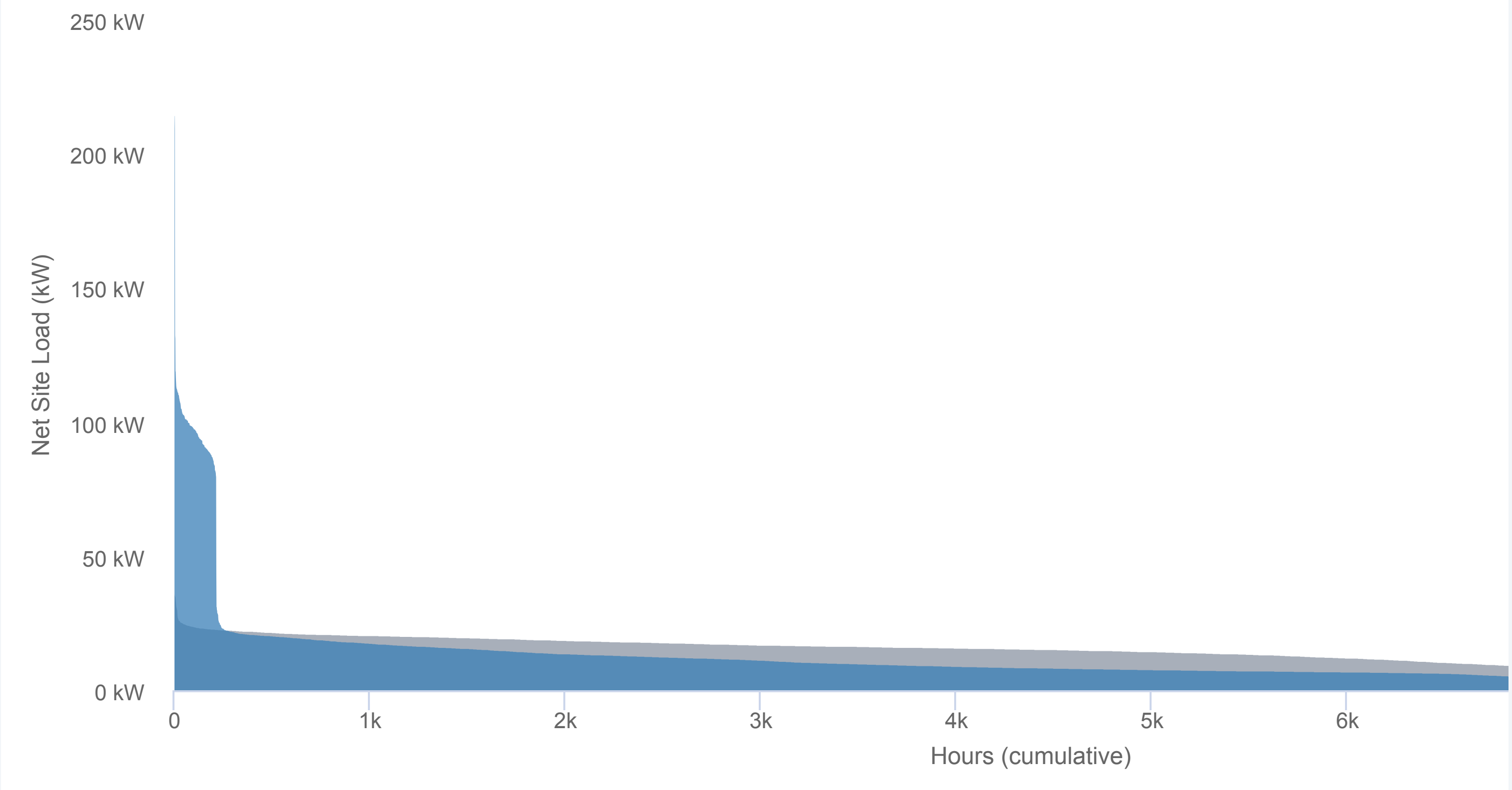
System Performance Year One

This interactive graph shows the dispatch strategy optimized by REopt for the specified outage period as well as the rest of the year. To zoom in on a date range, click and drag right in the chart area or use the "Zoom In a Week" button. To zoom out, click and drag left or use the "Zoom Out a Week" button.



Net Load Duration

This interactive graph shows the reduction in peak load that occurs when the REopt recommended technologies are implemented. To zoom in on a date range, click and drag right in the chart area. To zoom out, click and drag left or use the "Reset zoom" button.



Download Load Duration Spreadsheet

Download All Dispatch Data

Resilience vs. Financial

Resilience Benefits

This system was designed to sustain the critical load during the outage period specified at lowest cost. The results below show how the system performs during outages occurring at other times of the year. Outages are simulated starting at every hour of the year and amount of time the system can sustain the critical load during each outage is calculated. The resilient system is compared to the business as usual system and a system designed for maximum financial benefits.

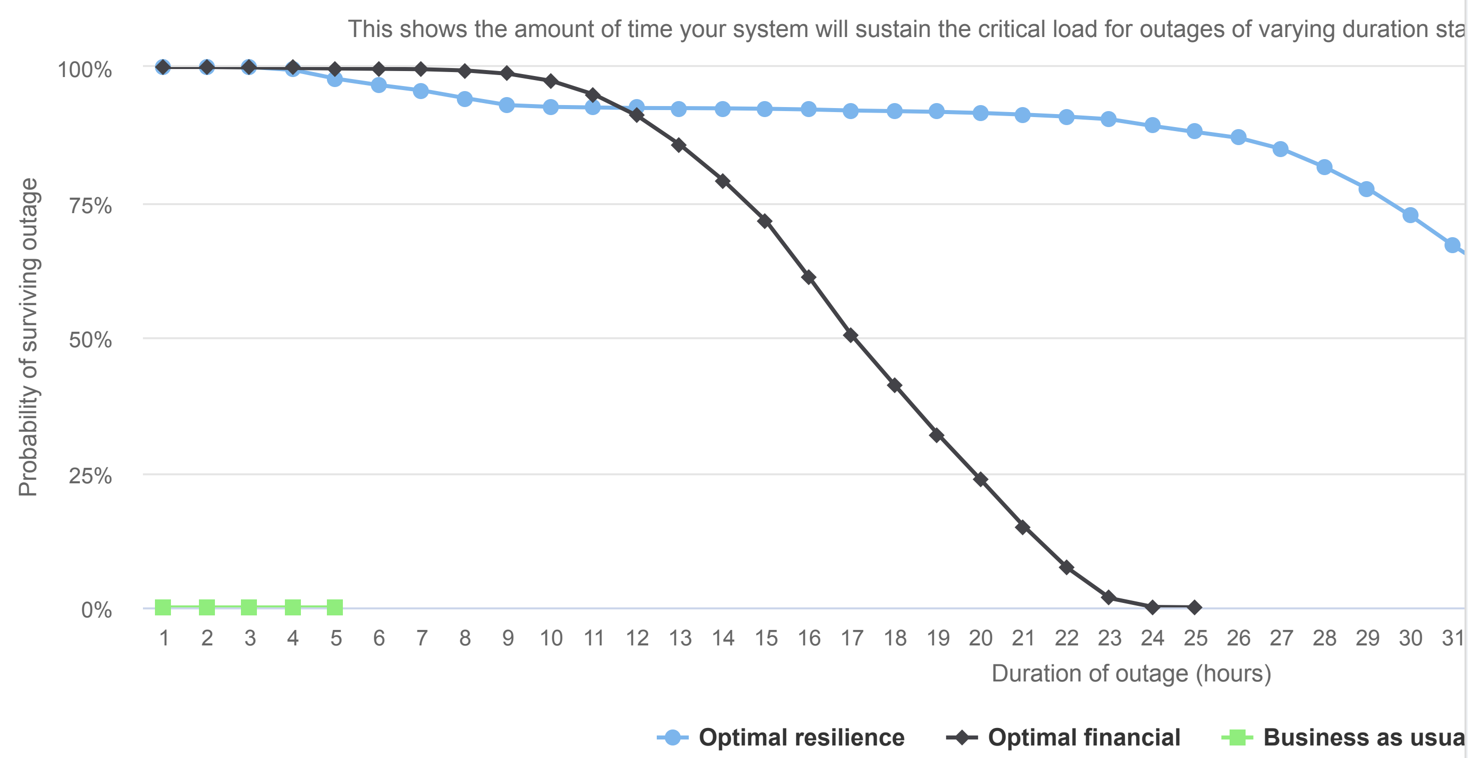
	Business As Usual	Resilience	Financial
System	None	20 kW PV 200 kW Battery 384 kWh Battery	20 kW PV 200 kW Battery 200 kWh Battery
NPV	$0	-$132,154	-$77,172

Outage Simulation

Evaluate the amount of time that your system can survive grid outages.

	Business As Usual	Resilience	Financial
System	None	20 kW PV 200 kW Battery 384 kWh Battery	20 kW PV 200 kW Battery 200 kWh Battery
Survives Specified Outage	No	Yes	No
Average	0 hrs	32 hrs	16 hrs
Minimum	0 hrs	2 hrs	2 hrs
Maximum	0 hrs	46 hrs	25 hrs

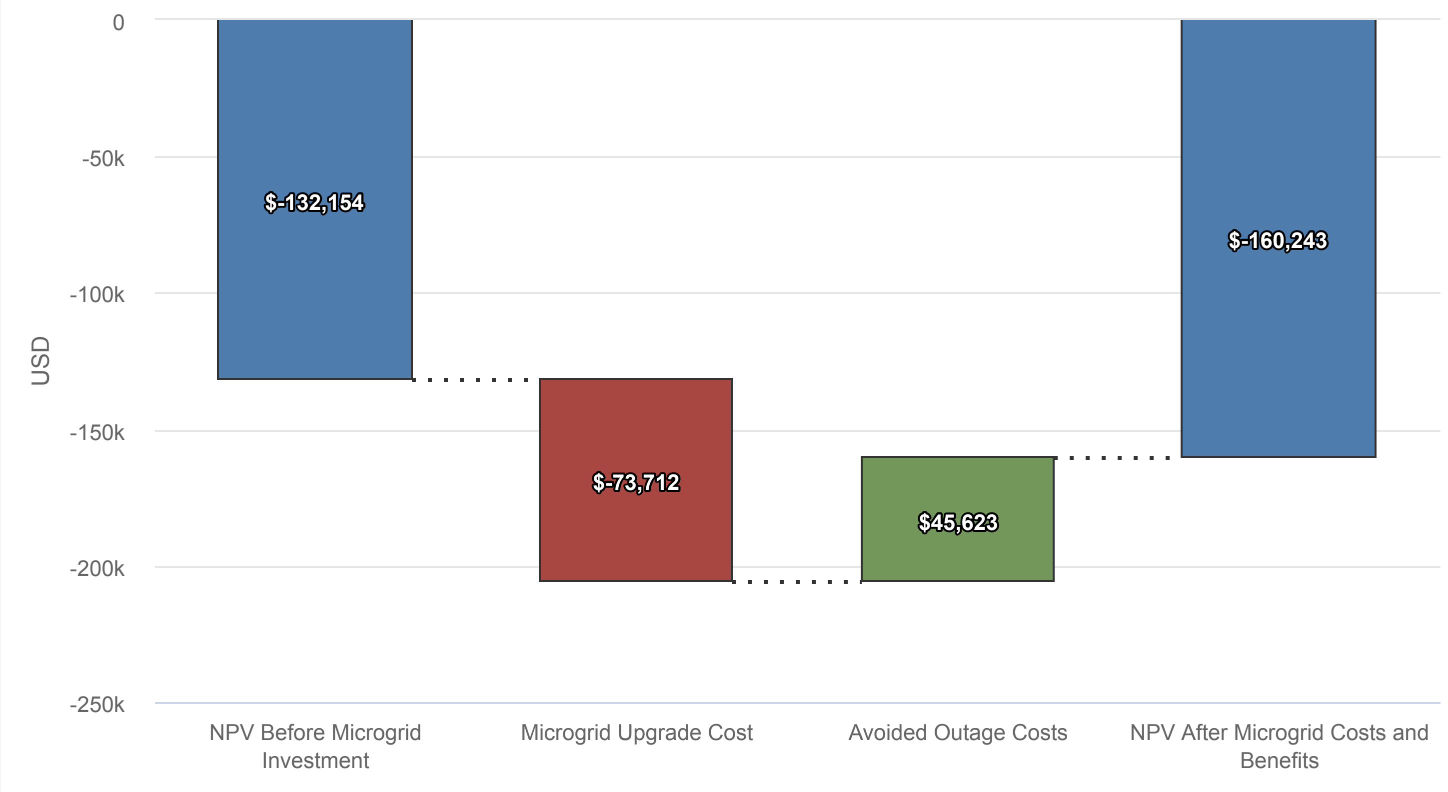
Yearly



Download Outage Data

Effect of Resilience Costs and Benefits

This interactive waterfall chart allows the user to consider the cumulative effect of extra costs and benefits of increased resilience on the project's net present value (NPV). Upgrading the recommended system to a microgrid allows a site to operate in both grid-connected and island-mode. This requires additional investment, which may include extra equipment such as controllers, distribution system infrastructure and communications upgrades. Economic benefit is observed when the value of avoiding the costs of an outage are considered. These microgrid upgrade costs and avoided outage costs are not factored into the optimization results. The sliders under the chart allow the user to change the Microgrid Upgrade Cost and the Avoided Outage Costs to analyze the impact on the NPV after Microgrid Costs and Benefits, while the NPV Before Microgrid Investment, which is determined by the optimization results, remains static.



Microgrid Upgrade Cost

30% of system capital cost

Avoided Outage Costs

$100 per kWh

Results Comparison

Results Comparison

These results show how doing business as usual compares to the optimal case.

	Business As Usual	Resilience	Financial
System Size			
PV Size	0 kW	20 kW	20 kW
Battery Power	0 kW	200 kW	200 kW
Battery Capacity	0 kWh	384 kWh	200 kWh
Energy Production and Fuel Use			

Average Annual PV Energy Production	0 kWh	30,918 kWh	30,918 kWh
Average Annual Energy Supplied from Grid	125,520 kWh	96,703 kWh	96,729 kWh
Renewable Energy Metrics			
Annual Renewable Electricity (% of electricity consumption)	0%	25%	25%
Climate & Health Emissions			
Total CO_2 Emissions in Year 1	62 tons	48 tons	48 tons
Percent Reduction in CO_2 Emissions from BAU	N/A	22.99%	23.15%
Lifecycle Costs of Climate Emissions	$58,107	$44,748	$44,778
Lifecycle Costs of Health Emissions	$24,232	$18,981	$18,963
Year 1 Utility Electricity Cost — Before Tax			
Utility Energy Cost	$38,254	$28,407	$28,422
Utility Demand Cost	$0	$0	$0
Utility Fixed Cost	$300	$300	$300
Utility Minimum Cost Adder	$0	$0	$0
Total Year 1 Utility Cost - Before Tax	$38,554	$28,707	$28,722
Life Cycle Cost Breakdown			
Technology Capital Costs + Replacements, After Incentives	N/A	$245,706	$191,820

O&M Costs	$0	$4,350	$4,350
Total Utility Electricity Cost	$461,643	$343,741	$343,912
Lifecycle Costs of Climate Emissions (included in objective)	$0	$0	$0
Lifecycle Costs of Health Emissions (included in objective)	$0	$0	$0
Summary Financial Metrics			
Total Upfront Capital Cost Before Incentives	N/A	$335,851	$264,440
Year 1 O&M Cost, Before Tax	$0	$340	340
Total Life Cycle Costs	$461,643	$593,797	$540,082
Net Present Value	$0	-$132,154	-$77,172
Payback Period	N/A	N/A	N/A
Internal Rate of Return	N/A	N/A	N/A
PV Levelized Cost of Energy	N/A	$0.050/kWh	$0.050/kWh

Clean Energy Outputs

Inputs

Your Inputs

The results are based on the following user supplied inputs.

Energy Goals

Cost-Savings $ Resilience

Technologies Selected

PV Battery

Site and Utility

Site Location	3502 Vineyard Ave, Pleasanton, CA 94566, USA (37.6627429, -121.8572231)
PV & wind space available	Land
URDB rate	Pacific Gas & Electric Co - B-6 Small General Service TOU Poly Phase

Load Profile

Typical electric load profile type	uploaded
Uploaded typical electric load profile	S-6 ReOpt hourly

PV

Maximum new PV size (kW-DC)	20.0
Array type	Ground Mount, Fixed

Battery

Minimum energy capacity (kWh)	200.0
Minimum power capacity (kW)	200.0

Resilience

Outage start date	Dec 4

Outage start time	10 am
Outage duration (hours)	12
Critical load profile type	Percent
Critical load factor	100.0%

Defaults

Default Inputs

The results are based on the following default inputs.

Site and Utility	
PV & wind land space available	Unlimited
Existing heating system fuel type	natural gas
Net metering system size limit (kW)	N/A
Wholesale rate ($/kWh)	N/A
Solver optimality tolerance (%)	0.1%

Load Profile	
Load adjustment (%)	100%

Financial	
Analysis period (years)	25
Host discount rate, nominal (%)	5.64%
Host effective tax rate (%)	26%
Electricity cost escalation rate, nominal (%)	1.9%
O&M cost escalation rate (%)	2.5%

Third Party Ownership	false
Third-party owner discount rate, nominal (%)	5.64%
Third-party owner effective tax rate (%)	26%

Renewable Energy & Emissions	
Source of hourly grid emissions factors	USE EPA AVERT California Region
Include Climate In Objective	false
Include Health In Objective	false
Count renewable electricity (RE) exported to the grid towards annual RE goals?	true
Count electricity exported to the grid towards emissions offsets?	true
CO_2 cost (\$/t CO_2)	51.0
On-site fuel burn NOx cost (\$/t NOx)	27,685
On-site fuel burn SO_2 cost (\$/t SO_2)	46,551
On-site fuel burn PM2.5 cost (\$/t PM2.5)	524,876
Grid emissions NOx cost (\$/t NOx)	25,705
Grid emissions SO_2 cost (\$/t SO_2)	45,107
Grid emissions PM2.5 cost (\$/t PM2.5)	272,013
CO_2 cost escalation rate, nominal (%)	4.22%
NOx cost escalation rate, nominal (%)	3.65%
SO_2 cost escalation rate, nominal (%)	4.63%
PM2.5 cost escalation rate, nominal (%)	4.30%

PV	
System capital cost (\$/kW-DC)	\$1,592

Existing PV systems size (kW-DC)	N/A
Type of load profile	N/A
O&M cost ($/kW-DC per year)	$17
Minimum new PV size (kW-DC)	0
Module type	Standard
Array azimuth (deg)	180
Array tilt (deg)	38
DC to AC size ratio	1.2
System losses (%)	14%
PV generation profile	N/A
Federal percentage-based incentive (%)	30%
Federal maximum incentive (%)	Unlimited
Federal rebate ($/kW-DC)	$0
Federal maximum rebate ($)	Unlimited
State percentage-based incentive (%)	0%
State maximum incentive ($)	Unlimited
State rebate ($/kW-DC)	$0
State maximum rebate ($)	Unlimited
Utility percentage-based incentive (%)	0%
Utility maximum incentive ($)	Unlimited
Utility rebate ($/kW-DC)	$0
Utility maximum rebate ($)	Unlimited
Production incentive ($/kWh)	$0
Incentive duration (years)	1

Maximum incentive ($)	Unlimited
System size limit (kW-DC)	Unlimited
MACRS bonus depreciation	80%
MACRS schedule	5 years
PV Station Search Radius (mi)	Unlimited
Can Net Meter	Yes

Battery	
Energy capacity cost ($/kWh)	$388
Power capacity cost ($/kW)	$775
Energy capacity replacement cost ($/kWh)	$220
Energy capacity replacement year	10
Power capacity replacement cost ($/kW)	$440
Power capacity replacement year	10
Maximum energy capacity (kWh)	Unlimited
Maximum power capacity (kW)	Unlimited
Rectifier efficiency (%)	96%
Round trip efficiency (%)	97.5%
Inverter efficiency (%)	96%
Minimum state of charge (%)	20%
Initial state of charge (%)	50%
Allow grid to charge battery	true
Total percentage-based incentive (%)	30%
Total power capacity rebate ($/kW)	$0
MACRS bonus depreciation	80%

MACRS schedule	7 years

Resilience
Critical load factor

Caution

Caution

Investment decisions should not be made on REopt results alone. These results assume perfect prediction of solar irradiance, wind speed, and electrical and thermal loads. In practice, actual savings may be lower based on the ability to accurately predict solar irradiance, wind speed, and load, and the control strategies used in the system. And, when modeling a grid outage the results assume perfect foresight of the impending outage, allowing the battery system to charge in the hours leading up the outage. If a natural gas-fueled CHP system is included, the resiliency results assume the natural gas supply is not disrupted during an electrical grid outage.

The results include both expected energy and demand savings. However, the hourly model does not capture intra-hour variability of the PV and wind resource. Because demand is typically determined based on the maximum 15-minute peak, the estimated savings from demand reduction may be exaggerated. The hourly simulation uses one year of load data and one year of solar and wind resource data. Actual demand charges and savings will vary from year to year as load and resource vary.

Asset dispatch decisions are determined by the model as part of the cost-minimization objective. In application, some aspects of these operational decisions may not work well with the existing infrastructure or may not follow best practices. For example, in results with CHP, boiler dispatch may result in short cycling or periodic boiler use that is not possible without hot-standby. The user should review the dispatch results with these limitations in mind.

PV system performance predictions calculated by PVWatts include many inherent assumptions and uncertainties and do not reflect variations between PV technologies nor site-specific characteristics except as represented by inputs. For example, PV modules with better performance are not differentiated within PVWatts from lesser-performing modules.

Next Steps

Next Steps

This model provides an **estimate** of the techno-economic feasibility of solar, wind, battery, and/or CHP but investment decisions should not be made based on these results alone. **Before moving ahead with project development, verify:**

- The utility rate tariff is correct.
  - Note that a site may have the option or may be required to switch to a different utility rate tariff when installing a renewable energy system.
  - Contact your utility for more information.
- Actual load data is used rather than a simulated load profile.
- The load adjustment is entered as intended. (To learn more about achieving energy efficiency savings, visit the Better Buildings Solution Center).
- PV, wind, battery, and CHP costs and incentives are accurate for your location.
  - There may be additional value streams not included in this analysis such as ancillary services or capacity payments.
- Financial inputs are accurate, especially discount rate and utility escalation rate.
- Other factors that can inform decision-making, but are not captured in this model, are considered. These may include:
  - roof integrity
  - shading considerations
  - obstacles to wind flow
  - ease of permitting
  - mission compatibility
  - regulatory and zoning ordinances
  - utility interconnection rules
  - availability of funding.
- Multiple systems integrators are consulted and multiple proposals are received. These will help to refine system architecture and projected costs and benefits. REopt results can be used to inform these discussions.

Contact NREL at reopt@nrel.gov for more detailed modeling and project development assistance.

Results for Your Site

Your site at 937 Sycamore Creek Way Pleasanton CA 94566 USA evaluated on August 10, 2023

These results from REopt summarize the most cost-effective combination of PV, wind, battery storage and/or diesel generator designed to sustain a critical load at your site. You can edit your inputs to see how changes to your energy strategies affect the results.

Your recommended solar installation size

50 kW
PV size

Measured in kilowatts (kW) of direct current (DC), this recommended size minimizes the life cycle cost of energy at your site.

This optimized size may not be commercially available. The user is responsible for finding a commercial product that is closest in size to this optimized size.

Your recommended battery power and capacity

640 kW
battery power

1,280 kWh
battery capacity

This system size minimizes the life cycle cost of energy at your site. The battery power (kW-AC) and capacity (kWh) are optimized for economic performance.

This optimized size may not be commercially available. The user is responsible for finding a commercial product that is closest in size to this optimized size.

Your potential life cycle savings (25 years)

This is the net present value of the savings (or costs if negative) realized by the project based on the difference between the total life cycle costs of doing business as usual compared to the optimal case.

If you did not choose the resilience focus or input minimum required technology sizes for this evaluation, your life cycle cost savings is negative due to the tolerance settings in the model which may result in savings as low as -$5,685. In this case, your best solution is business as usual.

-$533,188

View citation

Your Potential Resilience

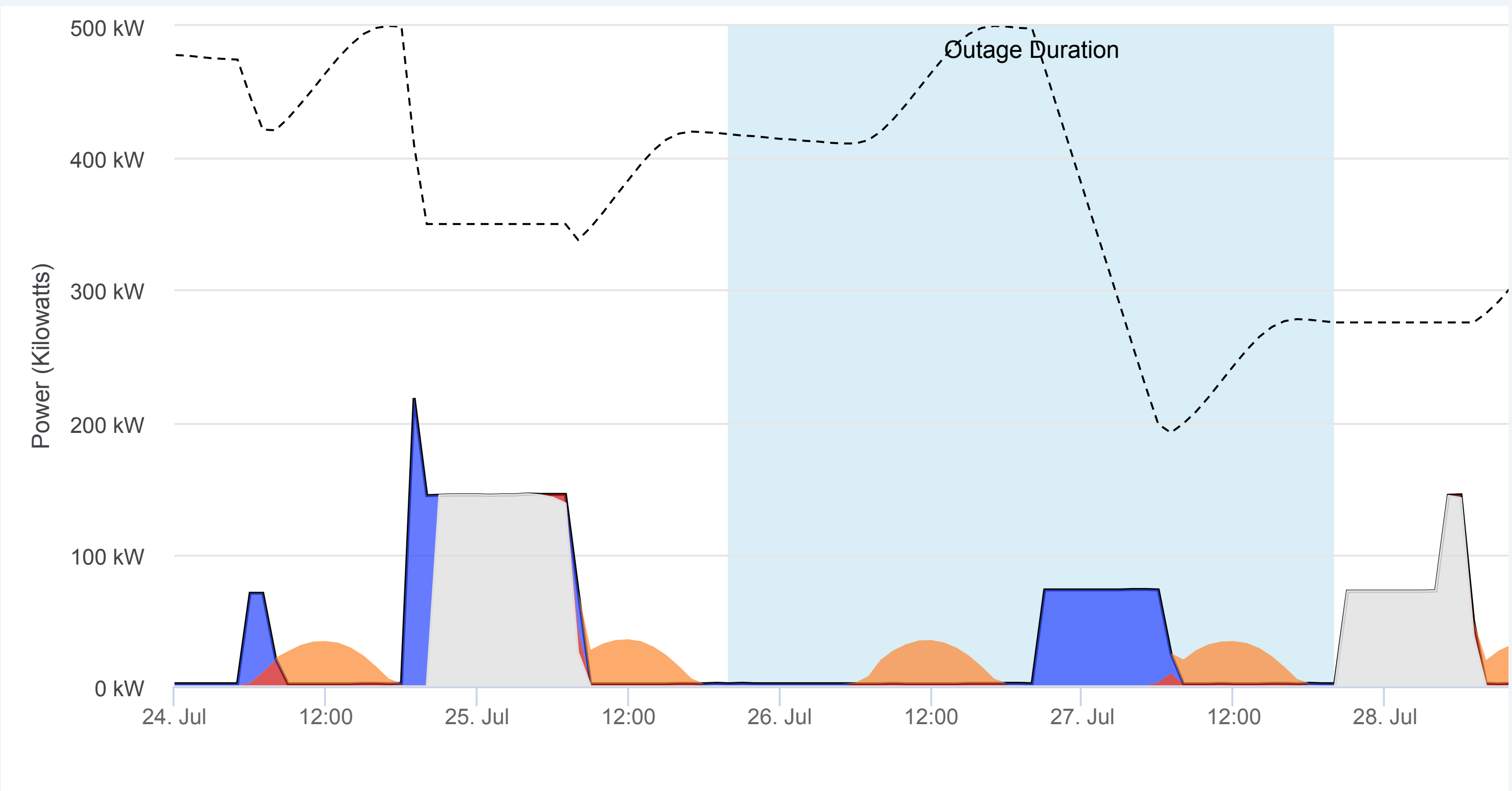
This system sustains the 100% critical load during the specified outage period, from July 25 at 8 pm to July 27 at 8 pm.

[System survives specified 48-hour outage]

System Performance Year One

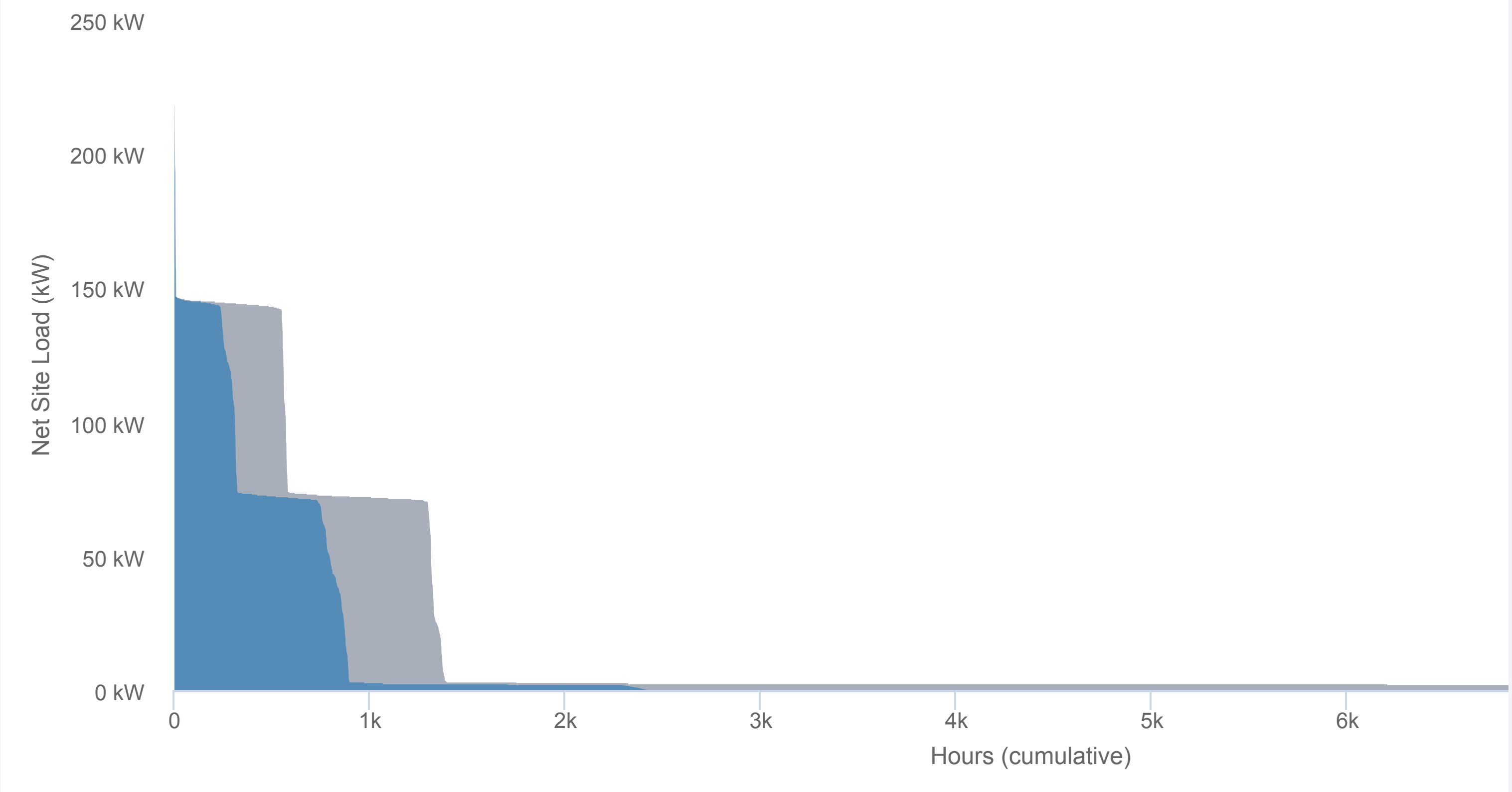
System Performance Year One

This interactive graph shows the dispatch strategy optimized by REopt for the specified outage period as well as the rest of the year. To zoom in on a date range, click and drag right in the chart area or use the "Zoom In a Week" button. To zoom out, click and drag left or use the "Zoom Out a Week" button.



Net Load Duration

This interactive graph shows the reduction in peak load that occurs when the REopt recommended technologies are implemented. To zoom in on a date range, click and drag right in the chart area. To zoom out, click and drag left or use the "Reset zoom" button.



Download Load Duration Spreadsheet

Download All Dispatch Data

$ Resilience vs. Financial

Resilience Benefits

This system was designed to sustain the critical load during the outage period specified at lowest cost. The results below show how the system performs during outages occurring at other times of the year. Outages are simulated starting at every hour of the year and amount of time the system can sustain the critical load during each outage is calculated. The resilient system is compared to the business as usual system and a system designed for maximum financial benefits.

	Business As Usual	Resilience	Financial
System	None	50 kW PV 640 kW Battery 1,280 kWh Battery	50 kW PV 640 kW Battery 1,280 kWh Battery
NPV	$0	-$533,188	-$530,172

Outage Simulation

Evaluate the amount of time that your system can survive grid outages.

Simulate outages

Results Comparison

Results Comparison

These results show how doing business as usual compares to the optimal case.

	Business As Usual	Resilience	Financial
System Size			
PV Size	0 kW	50 kW	50 kW
Battery Power	0 kW	640 kW	640 kW
Battery Capacity	0 kWh	1,280 kWh	1,280 kWh
Energy Production and Fuel Use			
Average Annual PV Energy Production	0 kWh	77,297 kWh	77,297 kWh
Average Annual Energy Supplied from Grid	153,294 kWh	84,307 kWh	84,307 kWh
Renewable Energy Metrics			
Annual Renewable Electricity (% of electricity consumption)	0%	46%	46%
Climate & Health Emissions			
Total CO_2 Emissions in Year 1	76 tons	42 tons	42 tons

Percent Reduction in CO_2 Emissions from BAU	N/A	45.17%	45.53%
Lifecycle Costs of Climate Emissions	$70,830	$38,836	$38,808
Lifecycle Costs of Health Emissions	$30,659	$17,229	$17,098
Year 1 Utility Electricity Cost — Before Tax			
Utility Energy Cost	$47,176	$24,835	$24,835
Utility Demand Cost	$0	$0	$0
Utility Fixed Cost	$300	$300	$300
Utility Minimum Cost Adder	$0	$0	$0
Total Year 1 Utility Cost - Before Tax	$47,476	$25,135	$25,135
Life Cycle Cost Breakdown			
Technology Capital Costs + Replacements, After Incentives	N/A	$789,827	$789,827
O&M Costs	$0	$10,876	$10,876
Total Utility Electricity Cost	$568,479	$300,964	$300,964
Lifecycle Costs of Climate Emissions (included in objective)	$0	$0	$0
Lifecycle Costs of Health Emissions (included in objective)	$0	$0	$0
Summary Financial Metrics			

Total Upfront Capital Cost Before Incentives	N/A	$1,072,240	$1,072,240
Year 1 O&M Cost, Before Tax	$0	$850	850
Total Life Cycle Costs	$568,479	$1,101,667	$1,101,667
Net Present Value	$0	-$533,188	-$530,172
Payback Period	N/A	N/A	N/A
Internal Rate of Return	N/A	N/A	N/A
PV Levelized Cost of Energy	N/A	$0.050/kWh	$0.050/kWh

Clean Energy Outputs

Inputs

Your Inputs

The results are based on the following user supplied inputs.

Energy Goals	
Cost-Savings	Resilience

Technologies Selected	
PV	Battery

Site and Utility	
Site Location	937 Sycamore Creek Way, Pleasanton, CA 94566, USA (37.6420777, -121.8711263)

PV & wind space available	Land
URDB rate	Pacific Gas & Electric Co - B-6 Small General Service TOU Poly Phase

Load Profile	
Typical electric load profile type	uploaded
Uploaded typical electric load profile	Sycamore ReOpt hourly max

PV	
Maximum new PV size (kW-DC)	50.0
Array type	Ground Mount, Fixed

Battery	
Minimum energy capacity (kWh)	1280.0
Minimum power capacity (kW)	640.0

Resilience	
Outage start date	Jul 25
Outage start time	8 pm
Outage duration (hours)	48
Critical load profile type	Percent
Critical load factor	100.0%

Defaults

Default Inputs

The results are based on the following default inputs.

Site and Utility	
PV & wind land space available	Unlimited
Existing heating system fuel type	natural gas
Net metering system size limit (kW)	N/A
Wholesale rate ($/kWh)	N/A
Solver optimality tolerance (%)	0.1%

Load Profile	
Load adjustment (%)	100%

Financial	
Analysis period (years)	25
Host discount rate, nominal (%)	5.64%
Host effective tax rate (%)	26%
Electricity cost escalation rate, nominal (%)	1.9%
O&M cost escalation rate (%)	2.5%
Third Party Ownership	false
Third-party owner discount rate, nominal (%)	5.64%
Third-party owner effective tax rate (%)	26%

Renewable Energy & Emissions	
Source of hourly grid emissions factors	USE EPA AVERT California Region
Include Climate In Objective	false
Include Health In Objective	false
Count renewable electricity (RE) exported to	true

the grid towards annual RE goals?	
Count electricity exported to the grid towards emissions offsets?	true
CO_2 cost (\$/t CO_2)	51.0
On-site fuel burn NOx cost (\$/t NOx)	27,685
On-site fuel burn SO_2 cost (\$/t SO_2)	46,551
On-site fuel burn PM2.5 cost (\$/t PM2.5)	524,876
Grid emissions NOx cost (\$/t NOx)	25,705
Grid emissions SO_2 cost (\$/t SO_2)	45,107
Grid emissions PM2.5 cost (\$/t PM2.5)	272,013
CO_2 cost escalation rate, nominal (%)	4.22%
NOx cost escalation rate, nominal (%)	3.65%
SO_2 cost escalation rate, nominal (%)	4.63%
PM2.5 cost escalation rate, nominal (%)	4.30%

PV	
System capital cost (\$/kW-DC)	\$1,592
Existing PV systems size (kW-DC)	N/A
Type of load profile	N/A
O&M cost (\$/kW-DC per year)	\$17
Minimum new PV size (kW-DC)	0
Module type	Standard
Array azimuth (deg)	180
Array tilt (deg)	38
DC to AC size ratio	1.2

System losses (%)	14%
PV generation profile	N/A
Federal percentage-based incentive (%)	30%
Federal maximum incentive (%)	Unlimited
Federal rebate ($/kW-DC)	$0
Federal maximum rebate ($)	Unlimited
State percentage-based incentive (%)	0%
State maximum incentive ($)	Unlimited
State rebate ($/kW-DC)	$0
State maximum rebate ($)	Unlimited
Utility percentage-based incentive (%)	0%
Utility maximum incentive ($)	Unlimited
Utility rebate ($/kW-DC)	$0
Utility maximum rebate ($)	Unlimited
Production incentive ($/kWh)	$0
Incentive duration (years)	1
Maximum incentive ($)	Unlimited
System size limit (kW-DC)	Unlimited
MACRS bonus depreciation	80%
MACRS schedule	5 years
PV Station Search Radius (mi)	Unlimited
Can Net Meter	Yes

Battery	
Energy capacity cost ($/kWh)	$388

Power capacity cost ($/kW)	$775
Energy capacity replacement cost ($/kWh)	$220
Energy capacity replacement year	10
Power capacity replacement cost ($/kW)	$440
Power capacity replacement year	10
Maximum energy capacity (kWh)	Unlimited
Maximum power capacity (kW)	Unlimited
Rectifier efficiency (%)	96%
Round trip efficiency (%)	97.5%
Inverter efficiency (%)	96%
Minimum state of charge (%)	20%
Initial state of charge (%)	50%
Allow grid to charge battery	true
Total percentage-based incentive (%)	30%
Total power capacity rebate ($/kW)	$0
MACRS bonus depreciation	80%
MACRS schedule	7 years

Resilience
Critical load factor

⚠ Caution

⚠ Caution

Investment decisions should not be made on REopt results alone. These results assume perfect prediction of solar irradiance, wind speed, and electrical and thermal loads. In practice, actual savings may be lower based on the ability to accurately predict solar irradiance, wind speed, and load, and the control strategies used in the system. And, when modeling a grid outage the results assume perfect foresight of the impending outage, allowing the battery system to charge in the hours leading up the outage. If a natural gas-fueled CHP system is included, the resiliency results assume the natural gas supply is not disrupted during an electrical grid outage.

The results include both expected energy and demand savings. However, the hourly model does not capture intra-hour variability of the PV and wind resource. Because demand is typically determined based on the maximum 15-minute peak, the estimated savings from demand reduction may be exaggerated. The hourly simulation uses one year of load data and one year of solar and wind resource data. Actual demand charges and savings will vary from year to year as load and resource vary.

Asset dispatch decisions are determined by the model as part of the cost-minimization objective. In application, some aspects of these operational decisions may not work well with the existing infrastructure or may not follow best practices. For example, in results with CHP, boiler dispatch may result in short cycling or periodic boiler use that is not possible without hot-standby. The user should review the dispatch results with these limitations in mind.

PV system performance predictions calculated by PVWatts include many inherent assumptions and uncertainties and do not reflect variations between PV technologies nor site-specific characteristics except as represented by inputs. For example, PV modules with better performance are not differentiated within PVWatts from lesser-performing modules.

Next Steps

Next Steps

This model provides an **estimate** of the techno-economic feasibility of solar, wind, battery, and/or CHP but investment decisions should not be made based on these results alone. **Before moving ahead with project development, verify:**

- The utility rate tariff is correct.
  - Note that a site may have the option or may be required to switch to a different utility rate tariff when installing a renewable energy system.
  - Contact your utility for more information.
- Actual load data is used rather than a simulated load profile.
- The load adjustment is entered as intended. (To learn more about achieving energy efficiency savings, visit the Better Buildings Solution Center).

- PV, wind, battery, and CHP costs and incentives are accurate for your location.
    - There may be additional value streams not included in this analysis such as ancillary services or capacity payments.
- Financial inputs are accurate, especially discount rate and utility escalation rate.
- Other factors that can inform decision-making, but are not captured in this model, are considered. These may include:
    - roof integrity
    - shading considerations
    - obstacles to wind flow
    - ease of permitting
    - mission compatibility
    - regulatory and zoning ordinances
    - utility interconnection rules
    - availability of funding.
- Multiple systems integrators are consulted and multiple proposals are received. These will help to refine system architecture and projected costs and benefits. REopt results can be used to inform these discussions.

Contact NREL at reopt@nrel.gov for more detailed modeling and project development assistance.

Results for Your Site

Your site at 5450 Tassajara Rd Dublin CA 94568 USA evaluated on June 14, 2023

These results from REopt summarize the most cost-effective combination of PV, wind, battery storage and/or diesel generator designed to sustain a critical load at your site. You can edit your inputs to see how changes to your energy strategies affect the results.

Your recommended solar installation size

2 kW

PV size

Measured in kilowatts (kW) of direct current (DC), this recommended size minimizes the life cycle cost of energy at your site.

This optimized size may not be commercially available. The user is responsible for finding a commercial product that is closest in size to this optimized size.

Your recommended battery power and capacity

1 kW
battery power

5 kWh
battery capacity

This system size minimizes the life cycle cost of energy at your site. The battery power (kW-AC) and capacity (kWh) are optimized for economic performance.

This optimized size may not be commercially available. The user is responsible for finding a commercial product that is closest in size to this optimized size.

Your potential life cycle savings (25 years)

This is the net present value of the savings (or costs if negative) realized by the project based on the difference between the total life cycle costs of doing business as usual compared to the optimal case.

$3,734

View citation

Your Potential Resilience

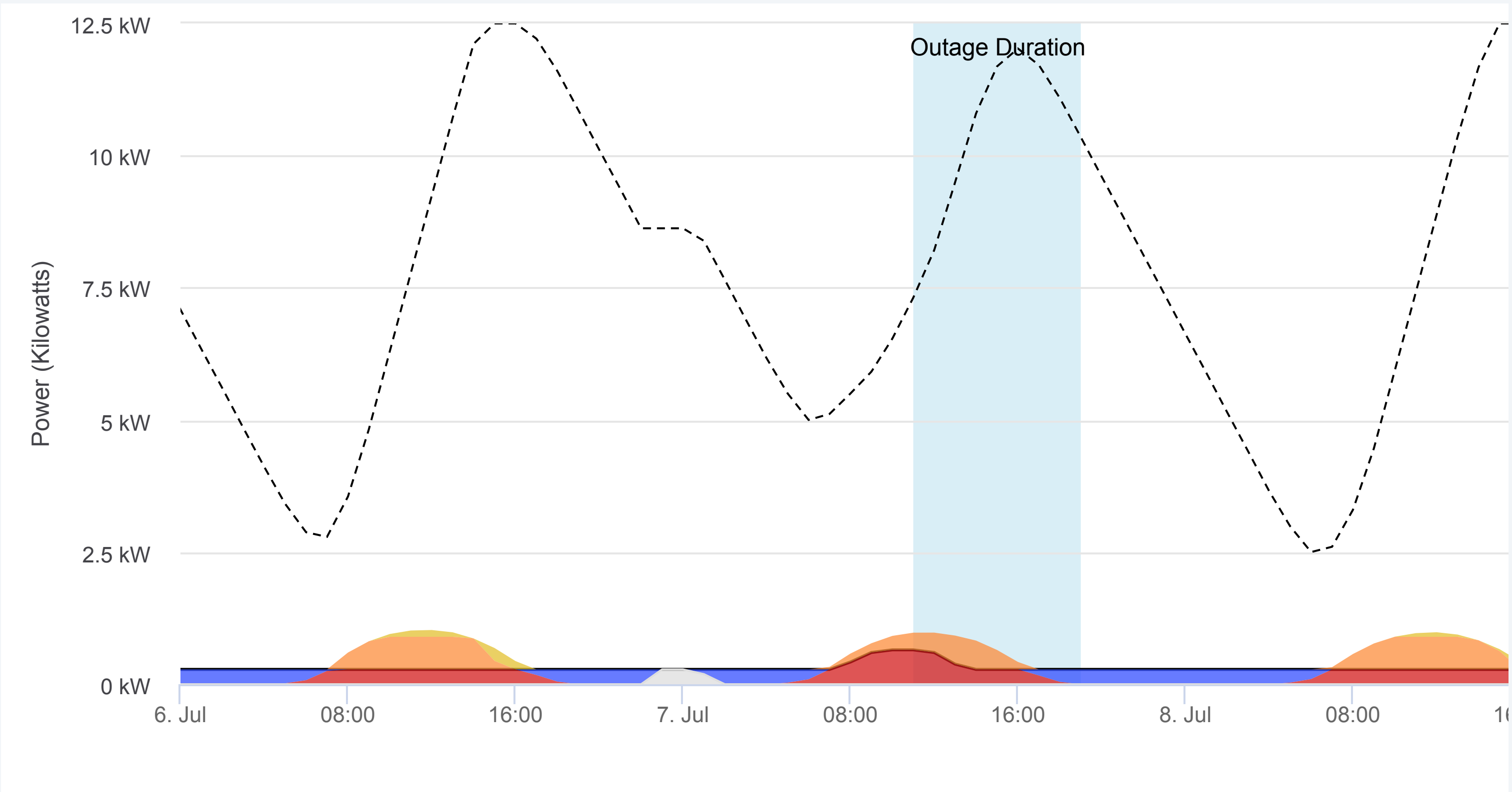
This system sustains the 100% critical load during the specified outage period, from July 7 at 11 am to July 7 at 7 pm.

System survives specified 8-hour outage

System Performance Year One

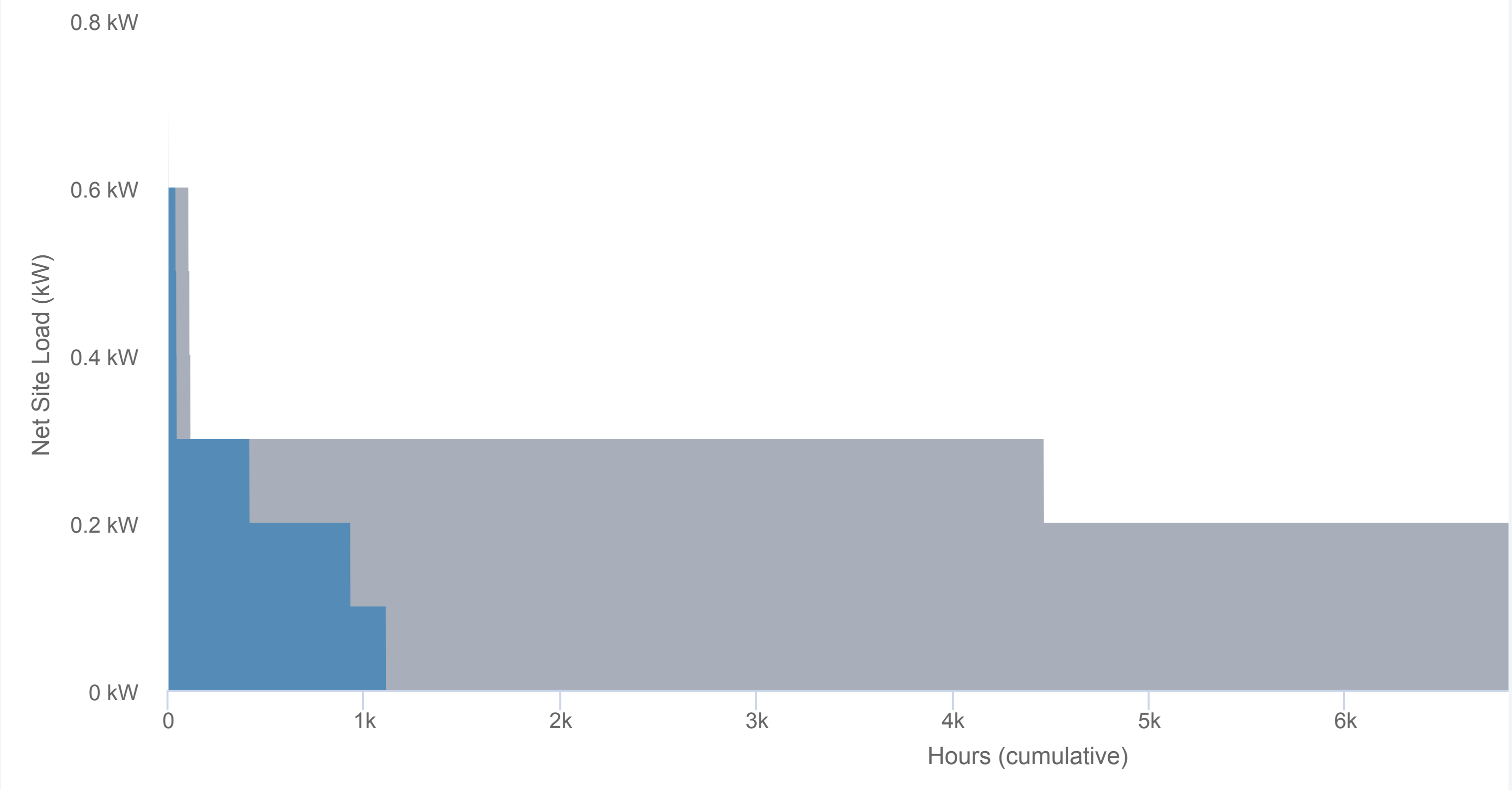
System Performance Year One

This interactive graph shows the dispatch strategy optimized by REopt for the specified outage period as well as the rest of the year. To zoom in on a date range, click and drag right in the chart area or use the "Zoom In a Week" button. To zoom out, click and drag left or use the "Zoom Out a Week" button.



Net Load Duration

This interactive graph shows the reduction in peak load that occurs when the REopt recommended technologies are implemented. To zoom in on a date range, click and drag right in the chart area. To zoom out, click and drag left or use the "Reset zoom" button.



Download Load Duration Spreadsheet

Download All Dispatch Data

Resilience vs. Financial

Resilience Benefits

This system was designed to sustain the critical load during the outage period specified at lowest cost. The results below show how the system performs during outages occurring at other times of the year. Outages are simulated starting at every hour of the year and amount of time the system can sustain the critical load during each outage is calculated. The resilient system is compared to the business as usual system and a system designed for maximum financial benefits.

	Business As Usual	Resilience	Financial
System	None	2 kW PV 1 kW Battery 5 kWh Battery	2 kW PV 1 kW Battery 5 kWh Battery
NPV	$0	$3,734	$3,748

Outage Simulation

Evaluate the amount of time that your system can survive grid outages.

Simulate outages

Results Comparison

Results Comparison

These results show how doing business as usual compares to the optimal case.

	Business As Usual	Resilience	Financial
System Size			
PV Size	0 kW	2 kW	2 kW
Battery Power	0 kW	1 kW	1 kW
Battery Capacity	0 kWh	5 kWh	5 kWh
Energy Production and Fuel Use			
Average Annual PV Energy Production	0 kWh	2,344 kWh	2,344 kWh
Average Annual Energy Supplied from Grid	2,155 kWh	258 kWh	258 kWh
Renewable Energy Metrics			
Annual Renewable Electricity (% of electricity consumption)	0%	88%	88%
Climate & Health Emissions			
Total CO_2 Emissions in Year 1	1 tons	1 tons	1 tons

Percent Reduction in CO_2 Emissions from BAU	N/A	88.21%	88.23%
Lifecycle Costs of Climate Emissions	$998	$118	$118
Lifecycle Costs of Health Emissions	$403	$45	$45
Year 1 Utility Electricity Cost — Before Tax			
Utility Energy Cost	$672	$77	$77
Utility Demand Cost	$0	$0	$0
Utility Fixed Cost	$120	$120	$120
Utility Minimum Cost Adder	$0	$0	$0
Total Year 1 Utility Cost - Before Tax	$792	$197	$197
Life Cycle Cost Breakdown			
Technology Capital Costs + Replacements, After Incentives	N/A	$3,053	$3,053
O&M Costs	$0	$332	$332
Total Utility Electricity Cost	$9,481	$2,362	$2,362
Lifecycle Costs of Climate Emissions (included in objective)	$0	$0	$0
Lifecycle Costs of Health Emissions (included in objective)	$0	$0	$0
Summary Financial Metrics			

Total Upfront Capital Cost Before Incentives	N/A	$4,831	$4,831
Year 1 O&M Cost, Before Tax	$0	$26	26
Total Life Cycle Costs	$9,481	$5,747	$5,747
Net Present Value	$0	$3,734	$3,748
Payback Period	N/A	5.25 yrs	5.24 yrs
Internal Rate of Return	N/A	15.9%	15.9%
PV Levelized Cost of Energy	N/A	$0.050/kWh	$0.050/kWh

Clean Energy Outputs

Inputs

Your Inputs

The results are based on the following user supplied inputs.

Energy Goals	
Cost-Savings $	Resilience

Technologies Selected	
PV	Battery

Site and Utility	
Site Location	5450 Tassajara Rd, Dublin, CA 94568, USA (37.7219784, -121.8726007)

PV & wind space available	Land
URDB rate	Pacific Gas & Electric Co - B-1 Small General Service TOU (Single-Phase)

Load Profile	
Typical electric load profile type	uploaded
Uploaded typical electric load profile	Tassajara ReOpt

PV	
Array type	Ground Mount, Fixed

Resilience	
Outage start date	Jul 7
Outage start time	11 am
Outage duration (hours)	8
Critical load profile type	Percent
Critical load factor	100.0%

Defaults

Default Inputs

The results are based on the following default inputs.

Site and Utility	
PV & wind land space available	Unlimited
Existing heating system fuel type	natural gas
Net metering system size limit (kW)	N/A

Wholesale rate ($/kWh)	N/A
Solver optimality tolerance (%)	0.1%

Load Profile	
Load adjustment (%)	100%

Financial	
Analysis period (years)	25
Host discount rate, nominal (%)	5.64%
Host effective tax rate (%)	26%
Electricity cost escalation rate, nominal (%)	1.9%
O&M cost escalation rate (%)	2.5%
Third Party Ownership	false
Third-party owner discount rate, nominal (%)	5.64%
Third-party owner effective tax rate (%)	26%

Renewable Energy & Emissions	
Source of hourly grid emissions factors	USE EPA AVERT California Region
Include Climate In Objective	false
Include Health In Objective	false
Count renewable electricity (RE) exported to the grid towards annual RE goals?	true
Count electricity exported to the grid towards emissions offsets?	true
CO_2 cost ($/t CO_2)	51.0
On-site fuel burn NOx cost ($/t NOx)	27,685

On-site fuel burn SO_2 cost (\$/t SO_2)	46,551
On-site fuel burn PM2.5 cost (\$/t PM2.5)	524,876
Grid emissions NOx cost (\$/t NOx)	25,705
Grid emissions SO_2 cost (\$/t SO_2)	45,107
Grid emissions PM2.5 cost (\$/t PM2.5)	272,013
CO_2 cost escalation rate, nominal (%)	4.22%
NOx cost escalation rate, nominal (%)	3.65%
SO_2 cost escalation rate, nominal (%)	4.63%
PM2.5 cost escalation rate, nominal (%)	4.30%

PV	
System capital cost (\$/kW-DC)	\$1,592
Existing PV systems size (kW-DC)	N/A
Type of load profile	N/A
O&M cost (\$/kW-DC per year)	\$17
Minimum new PV size (kW-DC)	0
Maximum new PV size (kW-DC)	Unlimited
Module type	Standard
Array azimuth (deg)	180
Array tilt (deg)	38
DC to AC size ratio	1.2
System losses (%)	14%
PV generation profile	N/A
Federal percentage-based incentive (%)	30%
Federal maximum incentive (%)	Unlimited

Federal rebate ($/kW-DC)	$0
Federal maximum rebate ($)	Unlimited
State percentage-based incentive (%)	0%
State maximum incentive ($)	Unlimited
State rebate ($/kW-DC)	$0
State maximum rebate ($)	Unlimited
Utility percentage-based incentive (%)	0%
Utility maximum incentive ($)	Unlimited
Utility rebate ($/kW-DC)	$0
Utility maximum rebate ($)	Unlimited
Production incentive ($/kWh)	$0
Incentive duration (years)	1
Maximum incentive ($)	Unlimited
System size limit (kW-DC)	Unlimited
MACRS bonus depreciation	80%
MACRS schedule	5 years
PV Station Search Radius (mi)	Unlimited
Can Net Meter	Yes

Battery	
Energy capacity cost ($/kWh)	$388
Power capacity cost ($/kW)	$775
Energy capacity replacement cost ($/kWh)	$220
Energy capacity replacement year	10
Power capacity replacement cost ($/kW)	$440

Power capacity replacement year	10
Minimum energy capacity (kWh)	0
Maximum energy capacity (kWh)	Unlimited
Minimum power capacity (kW)	0
Maximum power capacity (kW)	Unlimited
Rectifier efficiency (%)	96%
Round trip efficiency (%)	97.5%
Inverter efficiency (%)	96%
Minimum state of charge (%)	20%
Initial state of charge (%)	50%
Allow grid to charge battery	true
Total percentage-based incentive (%)	30%
Total power capacity rebate ($/kW)	$0
MACRS bonus depreciation	80%
MACRS schedule	7 years

Resilience
Critical load factor

Caution

Caution

Investment decisions should not be made on REopt results alone. These results assume perfect prediction of solar irradiance, wind speed, and electrical and thermal loads. In practice, actual savings may be lower based on the ability to accurately predict solar irradiance, wind speed, and load, and the control strategies used in the system. And, when modeling a grid outage the results assume perfect foresight of the impending outage, allowing the battery system to charge in the hours leading up the outage. If a natural gas-fueled CHP system is included, the resiliency results assume the natural gas supply is not disrupted during an electrical grid outage.

The results include both expected energy and demand savings. However, the hourly model does not capture intra-hour variability of the PV and wind resource. Because demand is typically determined based on the maximum 15-minute peak, the estimated savings from demand reduction may be exaggerated. The hourly simulation uses one year of load data and one year of solar and wind resource data. Actual demand charges and savings will vary from year to year as load and resource vary.

Asset dispatch decisions are determined by the model as part of the cost-minimization objective. In application, some aspects of these operational decisions may not work well with the existing infrastructure or may not follow best practices. For example, in results with CHP, boiler dispatch may result in short cycling or periodic boiler use that is not possible without hot-standby. The user should review the dispatch results with these limitations in mind.

PV system performance predictions calculated by PVWatts include many inherent assumptions and uncertainties and do not reflect variations between PV technologies nor site-specific characteristics except as represented by inputs. For example, PV modules with better performance are not differentiated within PVWatts from lesser-performing modules.

Next Steps

Next Steps

This model provides an **estimate** of the techno-economic feasibility of solar, wind, battery, and/or CHP but investment decisions should not be made based on these results alone. **Before moving ahead with project development, verify:**

- The utility rate tariff is correct.
  - Note that a site may have the option or may be required to switch to a different utility rate tariff when installing a renewable energy system.
  - Contact your utility for more information.
- Actual load data is used rather than a simulated load profile.
- The load adjustment is entered as intended. (To learn more about achieving energy efficiency savings, visit the Better Buildings Solution Center).
- PV, wind, battery, and CHP costs and incentives are accurate for your location.
  - There may be additional value streams not included in this analysis such as ancillary services or capacity payments.
- Financial inputs are accurate, especially discount rate and utility escalation rate.

- Other factors that can inform decision-making, but are not captured in this model, are considered. These may include:
    - roof integrity
    - shading considerations
    - obstacles to wind flow
    - ease of permitting
    - mission compatibility
    - regulatory and zoning ordinances
    - utility interconnection rules
    - availability of funding.
- Multiple systems integrators are consulted and multiple proposals are received. These will help to refine system architecture and projected costs and benefits. REopt results can be used to inform these discussions.

Contact NREL at reopt@nrel.gov for more detailed modeling and project development assistance.

REopt: Renewable Energy Integration & Optimization

Link to Results Page

Disclaimer

Results for Your Site

Your site at 3699 W Las Positas Blvd Pleasanton CA 94588 USA evaluated on June 14, 2023

These results from REopt summarize the most cost-effective combination of PV, wind, battery storage and/or diesel generator designed to sustain a critical load at your site. You can edit your inputs to see how changes to your energy strategies affect the results.

Your recommended solar installation size

2 kW

PV size

Measured in kilowatts (kW) of direct current (DC), this recommended size minimizes the life cycle cost of energy at your site.

This optimized size may not be commercially available. The user is responsible for finding a commercial product that is closest in size to this optimized size.

Your recommended battery power and capacity

1 kW
battery power

5 kWh
battery capacity

This system size minimizes the life cycle cost of energy at your site. The battery power (kW-AC) and capacity (kWh) are optimized for economic performance.

This optimized size may not be commercially available. The user is responsible for finding a commercial product that is closest in size to this optimized size.

Your potential life cycle savings (25 years)

This is the net present value of the savings (or costs if negative) realized by the project based on the difference between the total life cycle costs of doing business as usual compared to the optimal case.

$4,625

View citation

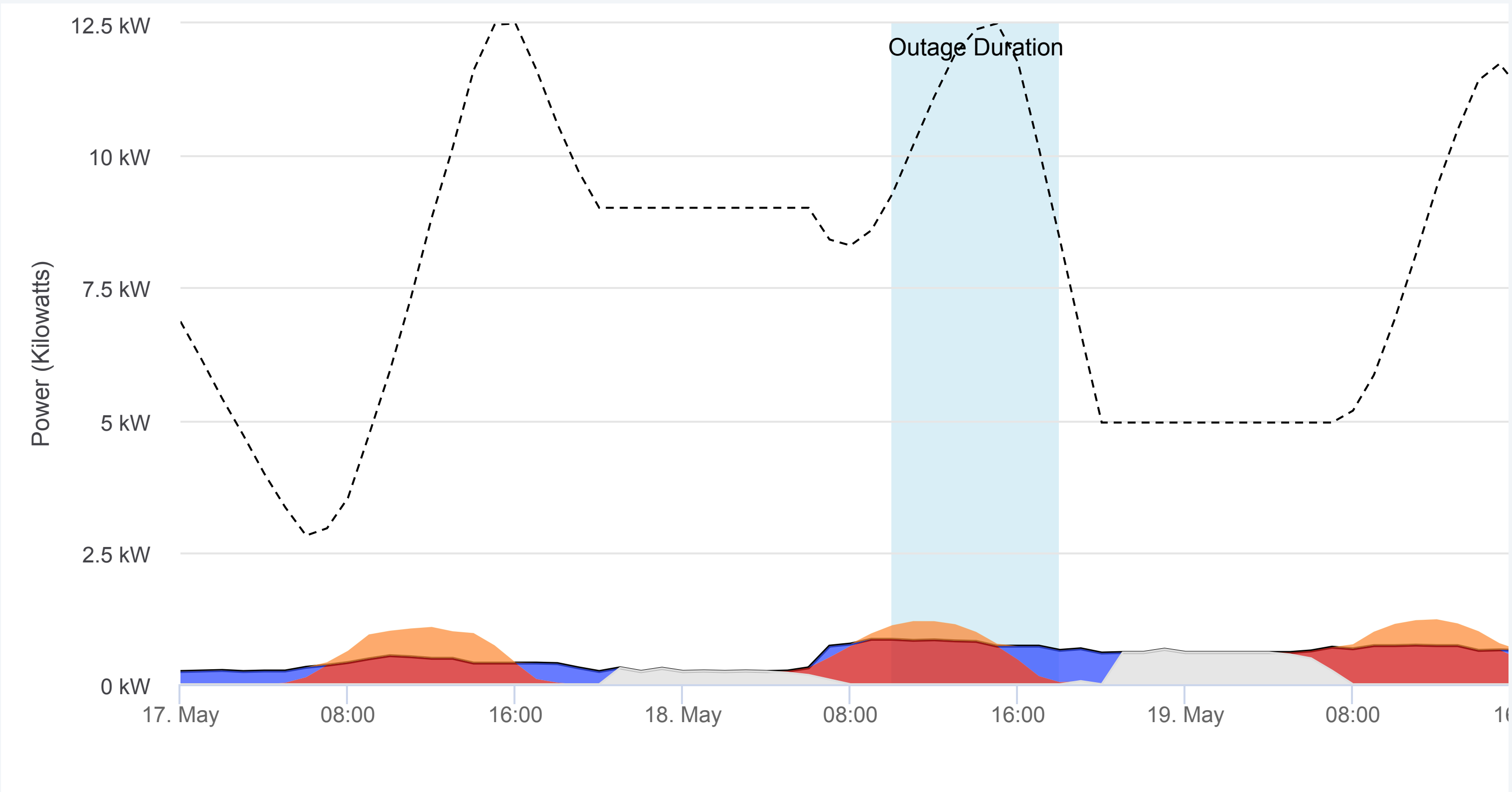
Your Potential Resilience

This system sustains the 100% critical load during the specified outage period, from May 18 at 10 am to May 18 at 6 pm.

System survives specified 8-hour outage

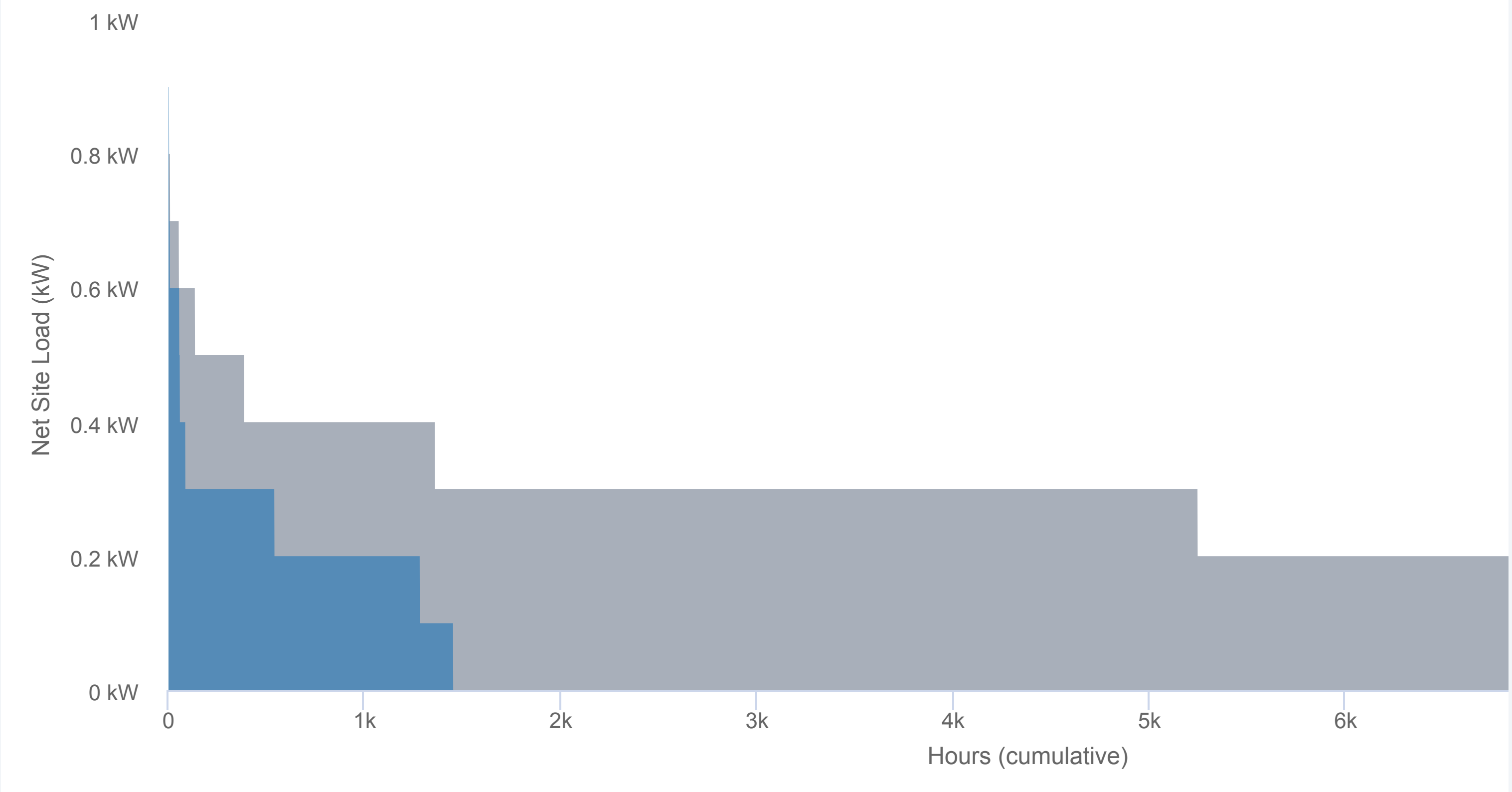
System Performance Year One

This interactive graph shows the dispatch strategy optimized by REopt for the specified outage period as well as the rest of the year. To zoom in on a date range, click and drag right in the chart area or use the "Zoom In a Week" button. To zoom out, click and drag left or use the "Zoom Out a Week" button.



Net Load Duration

This interactive graph shows the reduction in peak load that occurs when the REopt recommended technologies are implemented. To zoom in on a date range, click and drag right in the chart area. To zoom out, click and drag left or use the "Reset zoom" button.



Download Load Duration Spreadsheet

Download All Dispatch Data

Resilience vs. Financial

Resilience Benefits

This system was designed to sustain the critical load during the outage period specified at lowest cost. The results below show how the system performs during outages occurring at other times of the year. Outages are simulated starting at every hour of the year and amount of time the system can sustain the critical load during each outage is calculated. The resilient system is compared to the business as usual system and a system designed for maximum financial benefits.

	Business As Usual	Resilience	Financial
System	None	2 kW PV 1 kW Battery 5 kWh Battery	2 kW PV 1 kW Battery 5 kWh Battery
NPV	$0	$4,625	$4,650

Outage Simulation

Evaluate the amount of time that your system can survive grid outages.

Simulate outages

Results Comparison

Results Comparison

These results show how doing business as usual compares to the optimal case.

	Business As Usual	Resilience	Financial
System Size			
PV Size	0 kW	2 kW	2 kW
Battery Power	0 kW	1 kW	1 kW
Battery Capacity	0 kWh	5 kWh	5 kWh
Energy Production and Fuel Use			
Average Annual PV Energy Production	0 kWh	2,659 kWh	2,659 kWh
Average Annual Energy Supplied from Grid	2,526 kWh	358 kWh	358 kWh
Renewable Energy Metrics			
Annual Renewable Electricity (% of electricity consumption)	0%	86%	86%
Climate & Health Emissions			
Total CO_2 Emissions in Year 1	1 tons	1 tons	1 tons

Percent Reduction in CO_2 Emissions from BAU	N/A	85.87%	85.92%
Lifecycle Costs of Climate Emissions	$1,170	$165	$165
Lifecycle Costs of Health Emissions	$482	$75	$75
Year 1 Utility Electricity Cost — Before Tax			
Utility Energy Cost	$782	$106	$106
Utility Demand Cost	$0	$0	$0
Utility Fixed Cost	$120	$120	$120
Utility Minimum Cost Adder	$0	$0	$0
Total Year 1 Utility Cost - Before Tax	$902	$226	$226
Life Cycle Cost Breakdown			
Technology Capital Costs + Replacements, After Incentives	N/A	$3,098	$3,098
O&M Costs	$0	$374	$374
Total Utility Electricity Cost	$10,806	$2,709	$2,709
Lifecycle Costs of Climate Emissions (included in objective)	$0	$0	$0
Lifecycle Costs of Health Emissions (included in objective)	$0	$0	$0
Summary Financial Metrics			

Total Upfront Capital Cost Before Incentives	N/A	$4,992	$4,992
Year 1 O&M Cost, Before Tax	$0	$29	29
Total Life Cycle Costs	$10,806	$6,181	$6,181
Net Present Value	$0	$4,625	$4,650
Payback Period	N/A	4.8 yrs	4.78 yrs
Internal Rate of Return	N/A	17.6%	17.6%
PV Levelized Cost of Energy	N/A	$0.050/kWh	$0.050/kWh

Clean Energy Outputs

Inputs

Your Inputs

The results are based on the following user supplied inputs.

Energy Goals	
Cost-Savings	Resilience

Technologies Selected	
PV	Battery

Site and Utility	
Site Location	3699 W Las Positas Blvd, Pleasanton, CA 94588, USA (37.6954309, -121.8645676)

PV & wind space available	Land
URDB rate	Pacific Gas & Electric Co - B-1 Small General Service TOU (Single-Phase)

Load Profile	
Typical electric load profile type	uploaded
Uploaded typical electric load profile	Turnout 3

PV	
Array type	Ground Mount, Fixed

Resilience	
Outage start date	May 18
Outage start time	10 am
Outage duration (hours)	8
Critical load profile type	Percent
Critical load factor	100.0%

Defaults

Default Inputs

The results are based on the following default inputs.

Site and Utility	
PV & wind land space available	Unlimited
Existing heating system fuel type	natural gas
Net metering system size limit (kW)	N/A

Wholesale rate ($/kWh)	N/A
Solver optimality tolerance (%)	0.1%

Load Profile	
Load adjustment (%)	100%

Financial	
Analysis period (years)	25
Host discount rate, nominal (%)	5.64%
Host effective tax rate (%)	26%
Electricity cost escalation rate, nominal (%)	1.9%
O&M cost escalation rate (%)	2.5%
Third Party Ownership	false
Third-party owner discount rate, nominal (%)	5.64%
Third-party owner effective tax rate (%)	26%

Renewable Energy & Emissions	
Source of hourly grid emissions factors	USE EPA AVERT California Region
Include Climate In Objective	false
Include Health In Objective	false
Count renewable electricity (RE) exported to the grid towards annual RE goals?	true
Count electricity exported to the grid towards emissions offsets?	true
CO_2 cost ($/t CO_2)	51.0
On-site fuel burn NOx cost ($/t NOx)	27,685

On-site fuel burn SO_2 cost (\$/t SO_2)	46,551
On-site fuel burn PM2.5 cost (\$/t PM2.5)	524,876
Grid emissions NOx cost (\$/t NOx)	25,705
Grid emissions SO_2 cost (\$/t SO_2)	45,107
Grid emissions PM2.5 cost (\$/t PM2.5)	272,013
CO_2 cost escalation rate, nominal (%)	4.22%
NOx cost escalation rate, nominal (%)	3.65%
SO_2 cost escalation rate, nominal (%)	4.63%
PM2.5 cost escalation rate, nominal (%)	4.30%

PV	
System capital cost (\$/kW-DC)	\$1,592
Existing PV systems size (kW-DC)	N/A
Type of load profile	N/A
O&M cost (\$/kW-DC per year)	\$17
Minimum new PV size (kW-DC)	0
Maximum new PV size (kW-DC)	Unlimited
Module type	Standard
Array azimuth (deg)	180
Array tilt (deg)	38
DC to AC size ratio	1.2
System losses (%)	14%
PV generation profile	N/A
Federal percentage-based incentive (%)	30%
Federal maximum incentive (%)	Unlimited

Federal rebate ($/kW-DC)	$0
Federal maximum rebate ($)	Unlimited
State percentage-based incentive (%)	0%
State maximum incentive ($)	Unlimited
State rebate ($/kW-DC)	$0
State maximum rebate ($)	Unlimited
Utility percentage-based incentive (%)	0%
Utility maximum incentive ($)	Unlimited
Utility rebate ($/kW-DC)	$0
Utility maximum rebate ($)	Unlimited
Production incentive ($/kWh)	$0
Incentive duration (years)	1
Maximum incentive ($)	Unlimited
System size limit (kW-DC)	Unlimited
MACRS bonus depreciation	80%
MACRS schedule	5 years
PV Station Search Radius (mi)	Unlimited
Can Net Meter	Yes

Battery	
Energy capacity cost ($/kWh)	$388
Power capacity cost ($/kW)	$775
Energy capacity replacement cost ($/kWh)	$220
Energy capacity replacement year	10
Power capacity replacement cost ($/kW)	$440

Power capacity replacement year	10
Minimum energy capacity (kWh)	0
Maximum energy capacity (kWh)	Unlimited
Minimum power capacity (kW)	0
Maximum power capacity (kW)	Unlimited
Rectifier efficiency (%)	96%
Round trip efficiency (%)	97.5%
Inverter efficiency (%)	96%
Minimum state of charge (%)	20%
Initial state of charge (%)	50%
Allow grid to charge battery	true
Total percentage-based incentive (%)	30%
Total power capacity rebate ($/kW)	$0
MACRS bonus depreciation	80%
MACRS schedule	7 years

Resilience
Critical load factor

Caution

Caution

Investment decisions should not be made on REopt results alone. These results assume perfect prediction of solar irradiance, wind speed, and electrical and thermal loads. In practice, actual savings may be lower based on the ability to accurately predict solar irradiance, wind speed, and load, and the control strategies used in the system. And, when modeling a grid outage the results assume perfect foresight of the impending outage, allowing the battery system to charge in the hours leading up the outage. If a natural gas-fueled CHP system is included, the resiliency results assume the natural gas supply is not disrupted during an electrical grid outage.

The results include both expected energy and demand savings. However, the hourly model does not capture intra-hour variability of the PV and wind resource. Because demand is typically determined based on the maximum 15-minute peak, the estimated savings from demand reduction may be exaggerated. The hourly simulation uses one year of load data and one year of solar and wind resource data. Actual demand charges and savings will vary from year to year as load and resource vary.

Asset dispatch decisions are determined by the model as part of the cost-minimization objective. In application, some aspects of these operational decisions may not work well with the existing infrastructure or may not follow best practices. For example, in results with CHP, boiler dispatch may result in short cycling or periodic boiler use that is not possible without hot-standby. The user should review the dispatch results with these limitations in mind.

PV system performance predictions calculated by PVWatts include many inherent assumptions and uncertainties and do not reflect variations between PV technologies nor site-specific characteristics except as represented by inputs. For example, PV modules with better performance are not differentiated within PVWatts from lesser-performing modules.

Next Steps

Next Steps

This model provides an **estimate** of the techno-economic feasibility of solar, wind, battery, and/or CHP but investment decisions should not be made based on these results alone. **Before moving ahead with project development, verify:**

- The utility rate tariff is correct.
  - Note that a site may have the option or may be required to switch to a different utility rate tariff when installing a renewable energy system.
  - Contact your utility for more information.
- Actual load data is used rather than a simulated load profile.
- The load adjustment is entered as intended. (To learn more about achieving energy efficiency savings, visit the Better Buildings Solution Center).
- PV, wind, battery, and CHP costs and incentives are accurate for your location.
  - There may be additional value streams not included in this analysis such as ancillary services or capacity payments.
- Financial inputs are accurate, especially discount rate and utility escalation rate.

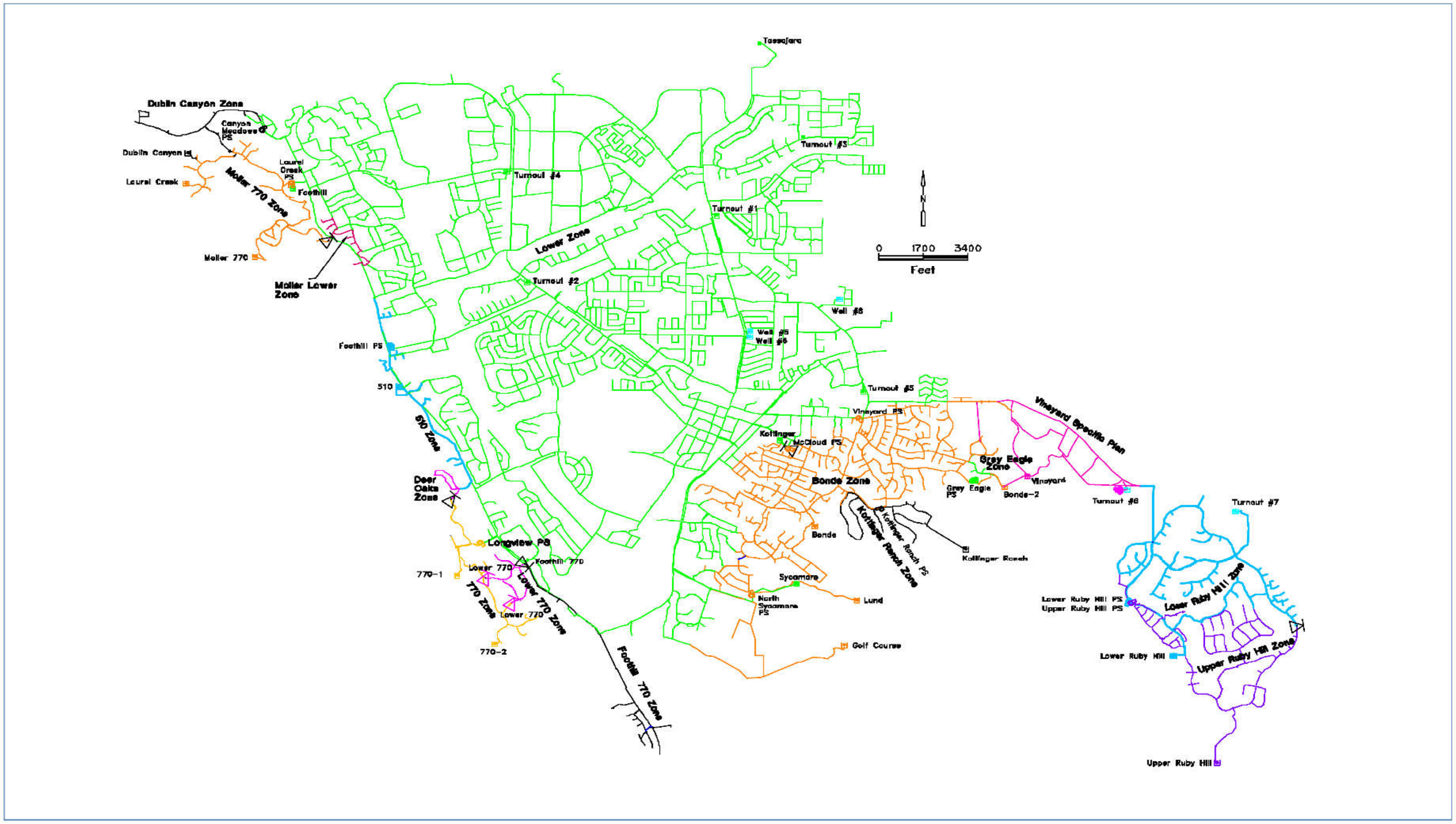
- Other factors that can inform decision-making, but are not captured in this model, are considered. These may include:
    - roof integrity
    - shading considerations
    - obstacles to wind flow
    - ease of permitting
    - mission compatibility
    - regulatory and zoning ordinances
    - utility interconnection rules
    - availability of funding.
- Multiple systems integrators are consulted and multiple proposals are received. These will help to refine system architecture and projected costs and benefits. REopt results can be used to inform these discussions.

Contact NREL at reopt@nrel.gov for more detailed modeling and project development assistance.

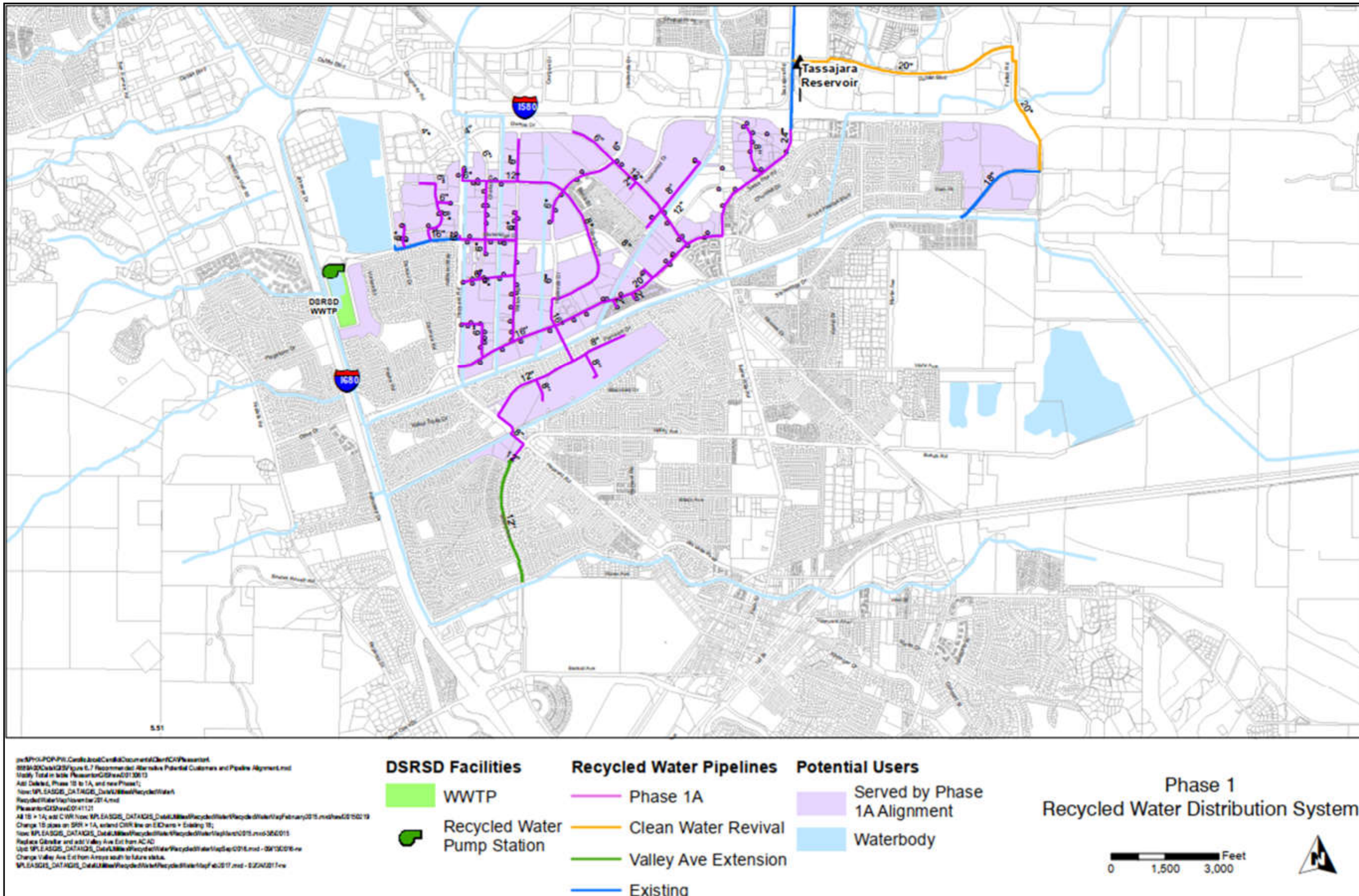
Appendix G

System Overview

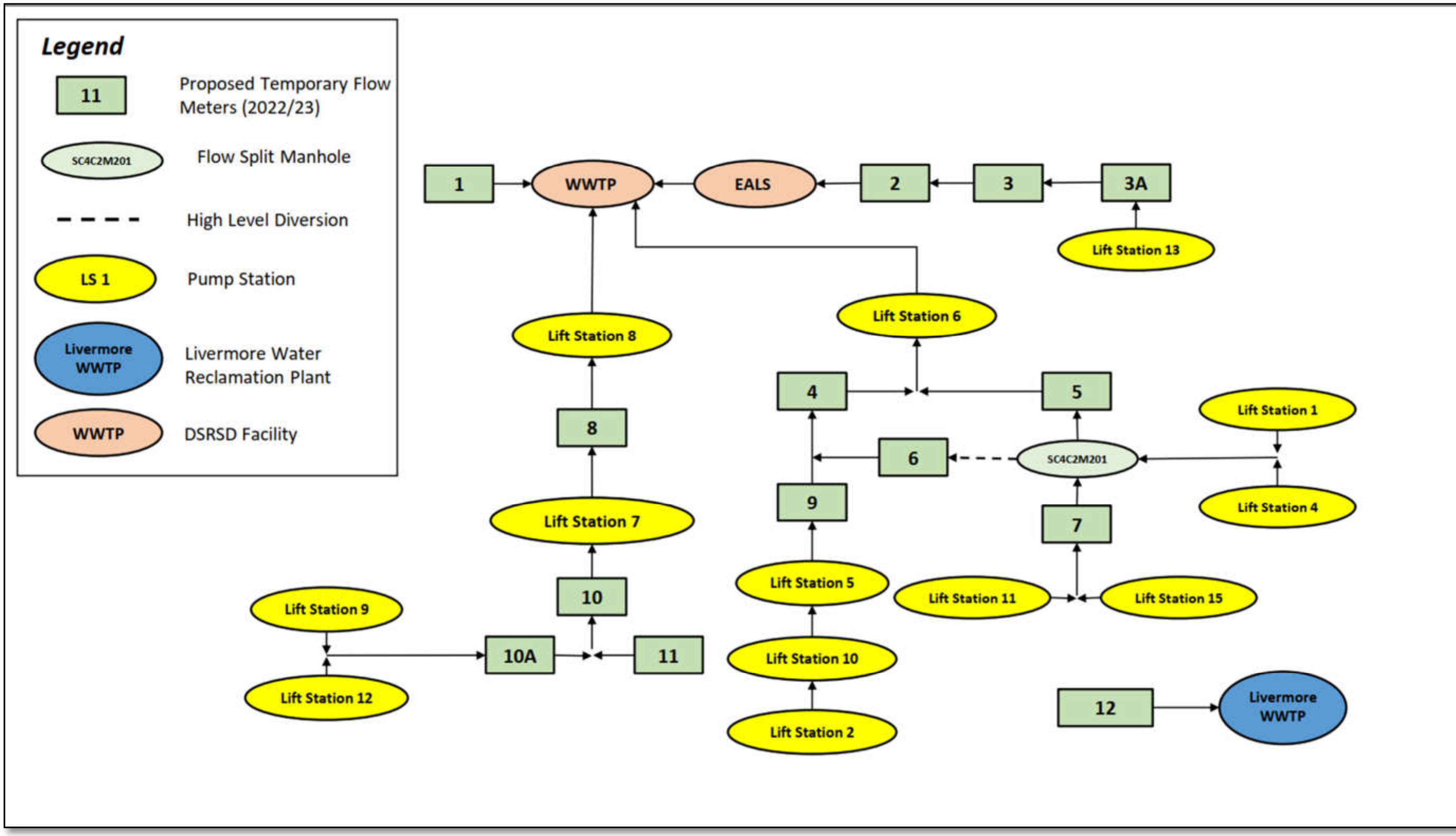
Distribution System Overview



Recycled Water System Overview



Sewer System Overview



Appendix H

Implementation Plan

Project ID	Project Title	Near-Term / Long-Term	Funding Source (Capital or Ops)	Estimated Project Cost	Executed in Combination with other project(s)	Notes
PHASE 1: Near-Term Projects						
P1-1	**Pilot DER Projects**	**Near-Term**		**$4,450,684**		
P1-1.1	Tassajara Recyc. Water Reservior	Near-Term		$97,500		
P1-1.2	Turnout 3	Near-Term		$97,500		
P1-1.3	S-6 SLS	Near-Term		$1,607,295		
P1-1.4	North Sycamore Pump Station	Near-Term		$2,648,389		
P1-1.5	Kilkare Ridge PRV Micro Hydro Pilot	Near-Term		$200,000		
Phase 2: Long-Term Projects						
P2-1	**DER Projects**	**Long-Term**		**NA**		
P2-1.1	Bonde 1 Reservior	Long-Term		NA		
P2-1.2	Turnout 1	Long-Term		NA		
P2-1.3	Turnout 2	Long-Term		NA		
P2-1.4	Turnout 4	Long-Term		NA		
P2-1.5	Turnout 5	Long-Term		NA		
P2-1.6	Vineyard Pump Station	Long-Term		NA		
P2-1.7	Vineyard Hills Pump Station	Long-Term		NA		
P2-1.8	Vineyard Hills Reservior	Long-Term		NA		
P2-1.9	Foothill Pump Station & Reservior	Long-Term		NA		
P2-1.10	Dublin Canyon Pump Station	Long-Term		NA		
P2-1.11	Dublin Canyon Reservior	Long-Term		NA		
P2-1.12	Laurel Creek Pump Station	Long-Term		NA		
P2-1.13	Laurel Creek Reservior	Long-Term		NA		
P2-1.14	Sycamore Reservior	Long-Term		NA		
P2-1.15	Ruby Hill Pump Station	Long-Term		NA		
P2-1.16	Lower Ruby Hill Reservior	Long-Term		NA		
P2-1.17	Upper Ruby Hill Reservior	Long-Term		NA		
P2-1.18	Kottinger Ranch Pump Station	Long-Term		NA		
P2-1.19	SD-1	Long-Term		NA		
P2-1.20	SD-2	Long-Term		NA		
P2-1.21	SD-3	Long-Term		NA		
P2-1.22	SD-4	Long-Term		NA		
P2-1.23	Longview Pump Station	Long-Term		NA		
P2-1.24	Santos Ranch 510 Pump Station	Long-Term		NA		
P2-1.25	Kilkare 900 Pump Station	Long-Term		NA		
P2-1.26	Kilkare 1300 Pump Station	Long-Term		NA		
P2-1.27	Greyeagle Pump Station	Long-Term		NA		
P2-1.28	S-2 SLS	Long-Term		NA		
P2-1.29	S-4 SLS	Long-Term		NA		
P2-1.30	S-5 SLS	Long-Term		NA		
P2-1.31	S-7 SLS	Long-Term		NA		
P2-1.32	S-8 SLS	Long-Term		NA		

Project ID	Project Title	Near-Term / Long-Term	Funding Source (Capital or Ops)	Estimated Project Cost	Executed in Combination with other project(s)	Notes
P2-1.33	S-10 SLS	Long-Term		NA		
P2-1.34	S-14 SLS	Long-Term		NA		
P2-1.35	S-15 SLS	Long-Term		NA		
P2-1.36	Bonde 2 Reservior	Long-Term		NA		
P2-1.37	Happy Valley Reservior	Long-Term		NA		
P2-1.38	Lund Reservior	Long-Term		NA		
P2-1.39	770-2 Reservior	Long-Term		NA		
P2-1.40	Moller Reservior	Long-Term		NA		
P2-1.41	1600 Reservior	Long-Term		NA		
P2-1.42	1160 Reservior	Long-Term		NA		
P2-1.43	Well 6	Long-Term		NA		
P2-1.44	Well 8	Long-Term		NA		

APPENDIX H GENERATOR RECOMMENDATIONS

Standby Generator Report

Preliminary Design and Standby Power Planning Review Workshop

October 1, 2024
Paul Giorsetto, P.E.
TJC and Associates

Workshop Agenda

- Introductions
- Project Scope of Work
- Approach
- Summary Results
- Results Breakdown by Department
- Results Breakdown: Ops and CIP
- Q&A

Generator Preliminary Design
Scope of Work

Replacement of ten stationary diesel generators that are past their expected operational life (Water and Sewer)

a. Water Sites (Stationary)

- 937 Sycamore Creek Way Booster
- 5875 Laurel Creek Booster
- 4301 Foothill Road, Foothill Booster
- 3033 West Ruby Hills Drive Booster
- 1202 Machado Vineyard Hills Booster

b. Sewer Sites (Stationary)

- 8019 Foothill Road, S-2
- 6900 West Las Positas, S-6
- 4950 Bernal Avenue, S-7
- 6890 Koll Center, S-8
- 302 Happy Valley Rd, S-12
- 3333 Busch Road, S-13
- 2299 Vineyard Ave, S-15

Generator Preliminary Design
Scope of Work

Development of a City-wide Public Works strategy for portable generators used to support Water, Sewer, and Storm Water stations

- Water Sites (Portables)
  - 3502 Vineyard Ave, Vineyard Booster
  - 11599 Dublin Canyon Rd, Dublin Booster
  - 1201 Hearst Drive, Kottinger Ranch Booster
  - 8999 Longview Drive, Longview Booster
  - 3998 Foothill Road
  - 9000 Santos Road
  - 9400 Santos Road
- Sewer Sites (Portables)
  - Valley Business Park, S-4
  - San Francisco, S-5
  - OSC Gun Range, S-13
  - Alisal, S-14
- Stormwater Sites (Portables)
  - 4950 Bernal Avenue, SD-1
  - 4000 Del Valle Parkway, SD-2
  - 3090 Valley Avenue, SD-3
  - 1040 Valley Avenue SD-4

Approach

- Task 1: Review Existing Documentation and Site Visits
  - Record Drawings from City
  - Large library of photographs for each site provided separately to City
- Task 2: Stationary Generators - Preliminary Design
  - Sizing calculations, schematic 1-line diagrams, runtime and fueling requirements, identify possible sensitive receptors (air quality and noise), final design criteria, lead time and alternative delivery methods, cost estimate
- Task 3: Portable Generators – Fleet Strategy
  - Sizing calculations, fleet configuration, site plans, schematic 1-line diagrams, connection methods and locations, runtime and fueling requirements, identify possible sensitive receptors (air quality and noise), lead times and alternative delivery methods, cost estimate
- Task 4: Preliminary Design Report

Final Report TOC

Table of Contents

Approach: Application Criteria

- Priority 1: Mission Critical Pump Station: Functionality during a PSPS or other power outage is required for meeting Utility Division objectives and performance criteria
  - Stationary generator may be required (unless insufficient space is available for unit installation or interim arrangement of portable is necessary for expediency); automatic transfer if paired with stationary; 24-hour minimum runtime
- Priority 2: Less-critical Pump Stations: Functionality during a PSPS or other power outage does not require immediate action
  - May require mobilization of a portable generator during an extended outage; manual (local) power transfer; 24-hour minimum runtime
- Priority 3: Important Sites (typically not pump stations): Functionality during a PSPS or other power outage does not require immediate action; temporary back-up battery power for basic functions is available (e.g., status monitoring and alarming)
  - Will require remote monitoring and periodic site visits during outages to replace batteries or connection of a small portable generator; manual (local) power transfer; 24-hour minimum runtime (if required)

From: City Emergency Protocol-Public Safety Power Shut-Off Appendix A

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Approach: Application Criteria

Table 1.1 – City of Pleasanton Standby Generator Summary Results

Site	Priority	Stationary /Portable	Recommended Size (kW)
WATER STATION GENERATORS			
N Sycamore PS - 937 Sycamore Creek Way	Priority 2	Stationary	350
Laurel Creek PS – 5800 Foothill Rd	Priority 2	Stationary	250
Foothill 2 PS - 4301 Foothill Rd.	Priority 2	Stationary	56
Ruby Hill PS - 3033 W Ruby Hills Dr.	Priority 1	Stationary	350
Vineyard Hills PS - 1202 Machado Pl.	Priority 1	Stationary	200
Vineyard Station - 3502 Vineyard Ave.	Priority 2	Portable[3]	176
Dublin Canyon - 11599 Dublin canyon Rd.	Priority 2	Portable[3]	240
Kottinger Ranch - 1201 Hearst Dr.	Priority 2	Portable[3]	120
Longview PS - 8999 Longview Dr.	Priority 2	Portable[3]	240
510, 3998 Foothill Rd.	Priority 2	Portable[3]	176
900, 9000 Santos Ranch Road	Priority 2	Portable[3]	176
1300, 9400 Santos Ranch Road	Priority 1	Stationary[4]	176
SEWER STATION GENERATORS			
S-2 8019 Foothill Rd	Priority 2	Stationary	30
S-4 1065 Serpentine Lane	Priority 2	Portable[3]	56
S-5 1723 Laguna Creek Lane	Priority 2	Portable[3]	56
S-6 6900 W. Las Positas	Priority 1	Stationary	200
S-7 4950 Bernal Ave	Priority 1	Stationary	120
S-8 6890 Koll Center	Priority 1	Stationary	200
S-12 302 Happy Valley Rd.	Priority 2	Stationary	120
S-13 3333 Busch Road	Priority 2	Portable[3]	56
S-14 6614 Alisal St.	Priority 2	Portable[3]	120
S-15 2299 Vineyard Ave	Priority 2	Stationary	56
STORM STATION GENERATORS			
SD-1 - 4950 Bernal Ave.	Priority 3	Portable[3]	120
SD-2 - 4000 Del Valle Pkwy	Priority 3	Portable[3]	120
SD-3 - 3090 Valley Ave.	Priority 3	Portable[3]	176
SD-4 - 1040 Valley Ave.	Priority 3	Portable[3]	56

Table 1.1 Notes

1. Grey Eagle PS not included: "Fire Pump" is no longer functional.
2. S-10 facilities not included: shared facility with Alameda County.
3. Portable recommended size based on recommended fleet selection ratings per Appendix E.
4. Portable unit parked at site – recommend replacement with stationary.

TJC AND ASSOCIATES, INC.

THE CITY OF PLEASANTON.

Sizing Calculations

- Unit sizing using Caterpillar (> 150 kW) and Generac (< 150kW)
- All pumps in operation with nominal auxiliary loads
- Pump loads started in step to alleviate inrush current effects
- Electrical Criteria: 20% voltage dip and 20% frequency dip

CAT

Load Report

Project Name	1202 Machado Vineyard Hills Booster	Electricity Supply	60 Hz 480/277 V
Customer Name	CofP	Rating Type	Standby
Region	U.S.	Max. Ambient Temperature	50.0 C
Prepared By	TJC and Associates	Altitude	152.4 M.A.S.L.
Modified Date	8-Mar-2023	Humidity	30%
Engine Model	(1) of C9	Nameplate Rating	200.0 ekW / 250.0 kVA / 0.8 PF

Load Details		Permitted		Predicted		Transient Inrush		Running		Resultant Peak		Cumulative Running	
Load Step	Load Description	FDip	VDip	FDip	VDip	SkVA	SkW	kVA	kW	SkVA	SkW	kVA	kW
Step 1													
1.1	1x15.00 kVA - Auxiliary Transformer: Steady State Magnetization, 95% Efficiency, 240V Secondary Voltage	-	-			0.0	0.0	0.8	0.1				
	Step 1 Total	-	-			0.0	0.0	0.8	0.1				
	Total Through Step 1									0.0	0.0	0.8	0.1
Step 2													
2.1	1x60.00 HP - Pump 1: NEMA, 3-Phase Motor, Soft Starter, 300% Current Limit , 29.1 THDI%	20%	20%			165.8	59.7	55.3	48.6				
	Step 2 Total	20%	20%	<5%	11.6%	165.8	59.7	55.3	48.6				
	Total Through Step 2									166.5	78.7	55.7	48.7
Step 3													
3.1	1x60.00 HP - Pump 2: NEMA, 3-Phase Motor, Soft Starter, 300% Current Limit , 29.1 THDI%	20%	20%			165.8	59.7	55.3	48.6				
	Step 3 Total	20%	20%	<5%	11.6%	165.8	59.7	55.3	48.6				
	Total Through Step 3									214.8	127.3	111.0	97.3
Step 4													
4.1	1x60.00 HP - Pump 3: NEMA, 3-Phase Motor, Soft Starter, 300% Current Limit , 29.1 THDI%	20%	20%			165.8	59.7	55.3	48.6				
	Step 4 Total	20%	20%	<5%	11.6%	165.8	59.7	55.3	48.6				
	Total Through Step 4									265.8	175.9	166.2	146.0
Load Analysis Summary : Generator set meets site requirements													

GENERAC

S45W29290 Hwy 59 Waukesha, WI 53189

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03/17/2023

Generator and Load Summary

Selected Generator & Alternator

Product Family Method :	Auto Select
Product Family :	SD/MD Diesel
Sizing Method :	Auto Select
Generator :	1 x 130 kW, 6.7L
Quantity :	1
Alternator :	K0130124Y21 - 130kW

Model
130 kW, 6.7L

130 kw, Diesel Genset -- Site rated 127 kw
6.7 L Engine with Standard (K0130124Y21 - 130kW) Alternator

Load Level		Transients		Harmonics	
Running :	65 %	Fdip (Hz):	1.4	THVD Cont:	0.0 %
Peak :	62	Vdip (%):	16.9	THVD Peak :	5.3 %

Load Summary -- Connected Load of 82.50 kW

Running		Transients		Harmonics	
kW:	82.5	kW (Step):	26.64	kVA:	84.4
kVA:	93.48	kW (Peak):	82.5	THID Cont:	0%
PF:	0.88	kVA (Step):	139.2	THID Peak :	12.5%

Solution Limits

Max Loading :	80 %	Fdip (Hz):	15	THVD Cont:	11 %
		Vdip (%):	35	THVD Peak :	13 %

Load List		Starting		Running		Harmonic Current Distortion			Limits	
Sequence	Description	kW	kVA	kW	kVA	Peak	Cont.	kVA	Vdip	Fdip
Step 1 (Concurrent)	Resistive : XFMR 1 X 9.00 kVA @ 1.00 PF , Harmonics: THID = 0.00%	9	9	9	9	0 %	0 %	0	20.00 %	12 Hertz
Step 1 (Concurrent) Summary	All loads on (sequence starting) 9.0kW All loads on (sequence starting) 9 kW Application Peak	9	9	9	9	0 %	0 %	0	20 % 48 volts	20 % 12 hertz
Step 2 (Concurrent)	Motor : Pump 1 1 X 40.00 HP Code G (6 kVA/Hp) 350% Current Limit Soft Starter Voltage Stepped Rated torque at start running at 100% ,	26.64	139.2	36.75	42.24	25 %	0 %	42.2	20.00 %	12 Hertz
Step 2 (Concurrent) Summary	All loads on (sequence starting) 36.8kW All loads on (sequence starting) 45.8 kW Application Peak	26.64	139.2	36.75	42.24	25 %	0 %	42.2	20 % 48 volts	20 % 12 hertz
Step 3 (Concurrent)	Motor : Pump 2 1 X 40.00 HP Code G (6 kVA/Hp) 350% Current Limit Soft Starter Voltage Stepped Rated torque at start running at 100% ,	26.64	139.2	36.75	42.24	25 %	0 %	42.2	20.00 %	12 Hertz
Step 3 (Concurrent) Summary	All loads on (sequence starting) 36.8kW All loads on (sequence starting) 82.5 kW Application Peak	26.64	139.2	36.75	42.24	25 %	0 %	42.2	20 % 48 volts	20 % 12 hertz

TJC ASSOCIATES, INC.

Results Summary - Water

- Preliminary Design Report – Table 1

FACILITES								
WATER STATION GENERATORS	**Aux. XFMR**	**Total Amps**	**System Voltage**	**Generator size kW**	**Generator Total Load Demand**	**No. of Pumps**	**Total Pump HP**	**Total Pump kW**
937 Sycamore Creek Way Booster	30KVA	391	480V	350	88%	3	300	225
5875 Laurel Creek Booster	25KVA	254	480/277V	250	80%	3	150	113
4301 Foothill Rd. Foothill Booster	9KVA	50	480V	56	70%	4	40	30
3033 W Ruby Hills Dr. Booster	15KVA	332	480/277V	350	75%	5	305	229
1202 Machado Vineyard Hills Booster	15KVA	201	480V	200	79%	3	180	135
3502 Vineyard Ave.	9KVA	133	480V	**176**	60%	2	120	90
11599 Dublin canyon Rd.	15KVA	274	480V	**240**	90%	2	250	188
1201 Hearst Dr.	9KVA	92	480/277V	**120**	60%	2	80	60
8999 Longview Dr.	15KVA	248	480V	**240**	82%	3	225	169
3998 Foothill Rd.	9KVA	165	480V	**176**	74%	2	150	113
9000 Santos Ranch Road	9KVA	165	480V	**176**	74%	2	150	113
9400 Santos Ranch Road	9KVA	105	480/277V	**176**	47%	2	100	75

Bold denotes portable generator needed

Results Summary - Sewer

- Preliminary Design Report – Table 1

FACILITES								
SEWER STATION GENERATORS								
S-2 8019 Foothill Rd	15KVA	38	120/240V	30	50%	2	6	5
S-4 1065 Serpentine Lane	15KVA	19	480V	**56**	27%	2	6	5
S-5 1723 Laguna Creek Lane	15KVA	37	480V	**56**	51%	3	22.5	17
S-6 6900 W. Las Positas	30KVA	130	480V	200	51%	5	100	75
S-7 4950 Bernal Ave	15KVA	76	480V	120	50%	3	60	45
S-8 6890 Koll Center	15KVA	201	480V	200	79%	3	180	135
S-12 302 Happy Valley Rd.	75KVA	211	120/240V	120	69%	2	40	30
S-13 3333 Busch Road	45KVA	43	480/277V	56	60%	2	4	3
S-14 6614 Alisal St.	45KVA	119	120/240V	**120**	39%	2	20	15
S-15 2299 Vineyard Ave	10KVA	40	480V	56	56%	2	30	23

Bold denotes portable generator needed

Results Summary - Stormwater

- Preliminary Design Report – Table 1

FACILITES								
STORM STATION GENERATORS								
SD-1 - 4950 Bernal Ave.	45KVA	60	480V	**120**	39%	2	20	15
SD-2 - 4000 Del Valle Pkwy	45KVA	60	480V	**120**	39%	2	20	15
SD-3 - 3090 Valley Ave.	45KVA	195	480V	**176**	87%	2	150	113
SD-4 - 1040 Valley Ave.	15KVA	29	480V	**56**	40%	2	15	11

Bold denotes portable generator needed

Results Summary - Stationary

FACILITES								
WATER STATION GENERATORS	**Aux. XFMR**	**Total Amps**	**System Voltage**	**Generator size kW**	**Generator Total Load Demand**	**No. of Pumps**	**Total Pump HP**	**Total Pump kW**
937 Sycamore Creek Way Booster	30KVA	391	480V	350	88%	3	300	225
5875 Laurel Creek Booster	25KVA	254	480/277V	250	80%	3	150	113
4301 Foothill Rd. Foothill Booster	9KVA	50	480V	56	70%	4	40	30
3033 W Ruby Hills Dr. Booster	15KVA	332	480/277V	350	75%	5	305	229
1202 Machado Vineyard Hills Booster	15KVA	201	480V	200	79%	3	180	135
SEWER STATION GENERATORS								
S-2 8019 Foothill Rd	15KVA	38	120/240V	30	50%	2	6	5
S-6 6900 W. Las Positas	30KVA	130	480V	200	51%	5	100	75
S-7 4950 Bernal Ave	15KVA	76	480V	120	50%	3	60	45
S-8 6890 Koll Center	15KVA	201	480V	200	79%	3	180	135
S-12 302 Happy Valley Rd.	75KVA	211	120/240V	120	69%	2	40	30
S-13 3333 Busch Road	45KVA	43	480/277V	56	60%	2	4	3
S-15 2299 Vineyard Ave	10KVA	40	480V	56	56%	2	30	23
STORM STATION GENERATORS				(NONE)				

Results Summary - Portables

FACILITES								
WATER STATION GENERATORS	**Aux. XFMR**	**Total Amps**	**System Voltage**	**Generator size kW**	**Generator Total Load Demand**	**No. of Pumps**	**Total Pump HP**	**Total Pump kW**
3502 Vineyard Ave.	9KVA	133	480V	**176**	60%	2	120	90
11599 Dublin canyon Rd.	15KVA	274	480V	**240**	90%	2	250	188
1201 Hearst Dr.	9KVA	92	480/277V	**120**	60%	2	80	60
8999 Longview Dr.	15KVA	248	480V	**240**	82%	3	225	169
3998 Foothill Rd.	9KVA	165	480V	**176**	74%	2	150	113
9000 Santos Ranch Road	9KVA	165	480V	**176**	74%	2	150	113
9400 Santos Ranch Road	9KVA	105	480/277V	**176**	47%	2	100	75
SEWER STATION GENERATORS								
S-4 1065 Serpentine Lane	15KVA	19	480V	**56**	27%	2	6	5
S-5 1723 Laguna Creek Lane	15KVA	37	480V	**56**	51%	3	22.5	17
S-14 6614 Alisal St.	45KVA	119	120/240V	**120**	39%	2	20	15
STORM STATION GENERATORS								
SD-1 - 4950 Bernal Ave.	45KVA	60	480V	**120**	39%	2	20	15
SD-2 - 4000 Del Valle Pkwy	45KVA	60	480V	**120**	39%	2	20	15
SD-3 - 3090 Valley Ave.	45KVA	195	480V	**176**	87%	2	150	113
SD-4 - 1040 Valley Ave.	15KVA	29	480V	**56**	40%	2	15	11

Results Summary – Portable Fleet Strategy

- Minimize number of unit ratings to four
  - Two @ 56 kW for coverage of three sites
  - Two @ 120 kW for coverage of four sites
  - Three @ 176 kW for coverage of five sites
  - One @ 240 kW for coverage of two sites
- Ratings selected to avoid “wet stacking” of oversized equipment
- Attempt to limit total number (stationary and portable) ratings for commonality of spare parts and simplified maintenance
- Includes DOT highway rated trailers for portables
- Includes infrastructure for simplified and safe connection
  - “Cam-Lock” tap boxes with secure enclosures
  - Manual transfer switches

Results Summary – Portable Fleet Strategy

FACILITES								
WATER STATION GENERATORS	Aux. XFMR	Total Amps	System Voltage	Generator size kW	Generator Total Load Demand	[illegible]	[illegible] HP	Pump kW
3502 Vineyard Ave.	9KVA	133	480V	**176**	60%	2	120	90
11599 Dublin canyon Rd.	15KVA	274	480V	**240**	90%	2	250	188
1201 Hearst Dr.	9KVA	92	480/277V	**120**	60%	2	80	60
8999 Longview Dr.	15KVA	248	480V	**240**	82%	3	225	169
3998 Foothill Rd.	9KVA	165	480V	**176**	74%	2	150	113
9000 Santos Ranch Road	9KVA	165	480V	**176**	74%	2	150	113
9400 Santos Ra[illegible]	9KVA	105	480/277V	**176**	47%	2	100	75
SEWER STA[illegible]								
S-4 1065 Serpentine Lan[illegible]	[illegible]	1[illegible]	480V	**56**	27%	2	6	5
S-5 1723 Laguna Creek Lane	[illegible]	[illegible]	480V	**56**	51%	3	22.5	17
S-14 6614 Alisal St.	45KVA	[illegible]	120/240V	**120**	39%	2	20	15
STORM STATION GENERATORS								
SD-1 - 4950 Bernal Ave.	45KVA	60	480V	**120**	39%	2	20	15
SD-2 - 4000 Del Valle Pkwy	45KVA	60	480V	**120**	39%	2	20	15
SD-3 - 3090 Valley Ave.	45KVA	195	480V	**176**	87%	2	150	113
SD-4 - 1040 Valley Ave.	15KVA	29	480V	**56**	40%	2	15	11

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THE CITY OF PLEASANTON

Results Summary – Site Specific Costs (Water)

WATER STATION GENERATORS	Aux. XFMR	Total Amps	System Voltage	Generator size kW	Generator Total Load Demand	No. of Pumps	Total Pump HP	Total Pump kW	Estimated Site Specific Costs
937 Sycamore Creek Way Booster	30KVA	391	480V	350	88%	3	300	225	$1,160,000
5875 Laurel Creek Booster	25KVA	254	480/277V	250	80%	3	150	113	$526,000
4301 Foothill Rd. Foothill Booster	9KVA	50	480V	56	70%	4	40	30	$241,000
3033 W Ruby Hills Dr. Booster	15KVA	332	480/277V	350	75%	5	305	229	$1,160,000
1202 Machado Vineyard Hills Booster	15KVA	201	480V	200	79%	3	180	135	$526,000
3502 Vineyard Ave.	9KVA	133	480V	**176**	60%	2	120	90	$280,000
11599 Dublin canyon Rd.	15KVA	274	480V	**240**	90%	2	250	188	$284,000
1201 Hearst Dr.	9KVA	92	480/277V	**120**	60%	2	80	60	$215,000
8999 Longview Dr.	15KVA	248	480V	**240**	82%	3	225	169	$284,000
3998 Foothill Rd.	9KVA	165	480V	**176**	74%	2	150	113	$280,000
9000 Santos Ranch Road	9KVA	165	480V	**176**	74%	2	150	113	$280,000
9400 Santos Ranch Road	9KVA	105	480/277V	**176**	47%	2	100	75	$280,000

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The City of Pleasanton

Results Summary – Site Specific Costs (Sewer)

SEWER STATION GENERATORS	Aux. XFMR	Total Amps	System Voltage	Generator size kW	Generator Total Load Demand	No. of Pumps	Total Pump HP	Total Pump kW	Estimated Site Specific Costs
S-2 8019 Foothill Rd	15KVA	38	120/240V	30	50%	2	6	5	$158,000
S-4 1065 Serpentine Lane	15KVA	19	480V	**56**	27%	2	6	5	$161,000
S-5 1723 Laguna Creek Lane	15KVA	37	480V	**56**	51%	3	22.5	17	$161,000
S-6 6900 W. Las Positas	30KVA	130	480V	200	51%	5	100	75	$526,000
S-7 4950 Bernal Ave	15KVA	76	480V	120	50%	3	60	45	$383,000
S-8 6890 Koll Center	15KVA	201	480V	200	79%	3	180	135	$526,000
S-12 302 Happy Valley Rd.	75KVA	211	120/240V	120	69%	2	40	30	$383,000
S-13 3333 Busch Road	45KVA	43	480/277V	56	60%	2	4	3	$241,000
S-14 6614 Alisal St.	45KVA	119	120/240V	**120**	39%	2	20	15	$225,000
S-15 2299 Vineyard Ave	10KVA	40	480V	56	56%	2	30	23	$241,000

Results Summary – Site Specific Costs (Storm)

STORM STATION GENERATORS	Aux. XFMR	Total Amps	System Voltage	Generator size kW	Generator Total Load Demand	No. of Pumps	Total Pump HP	Total Pump kW	Estimated Site Specific Costs
SD-1 - 4950 Bernal Ave.	45KVA	60	480V	**120**	39%	2	20	15	$215,000
SD-2 - 4000 Del Valle Pkwy	45KVA	60	480V	**120**	39%	2	20	15	$215,000
SD-3 - 3090 Valley Ave.	45KVA	195	480V	**176**	87%	2	150	113	$280,000
SD-4 - 1040 Valley Ave.	15KVA	29	480V	**56**	40%	2	15	11	$161,000

BAAQMD Developments

California Air District Requirements - Stationary, Emergency Standby Diesel Engines
Best Available Control Technology (BACT) Standard by EPA Tier

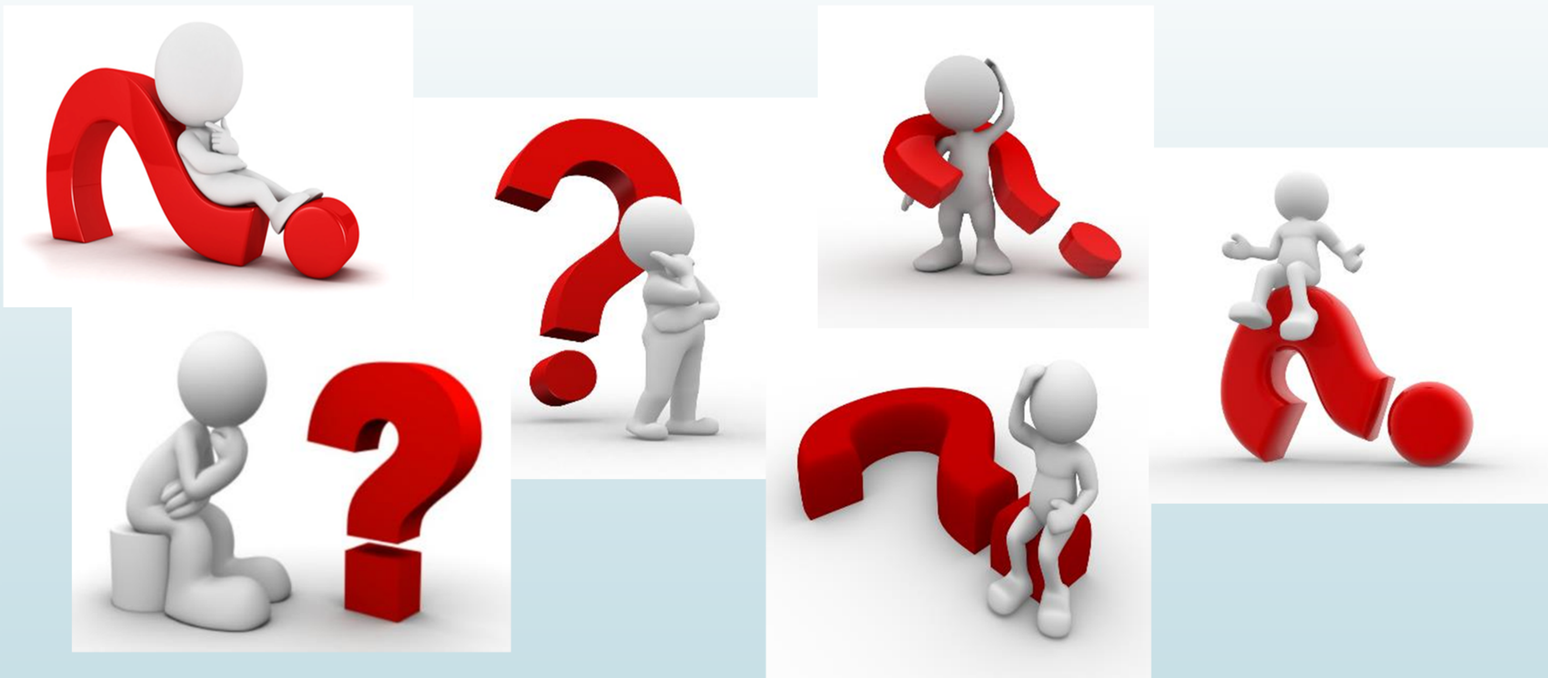
AIR DISTRICT	MAX ENGINE RATING (HP) / MAX GENERATOR ELECTRICAL RATING (kW)					MAX RATING - MINOR SOURCE	MAX RATING - MAJOR SOURCE	VERIFICATION DATE	COMMENTS
	> 50 hp	50 ≤ hp < 100	100 ≤ hp < 175	175 ≤ hp < 750	750 ≤ hp < 1,000	hp ≥ 1,000	hp ≥ 1,000		
	> 37 kW	37 ≤ kW < 75	75 ≤ kW < 130	130 ≤ kW < 560	560 ≤ kW < 750	kW ≥ 750	kW ≥ 750		
California ARB - ATCM[1]	Exempt	**Tier 3**	**Tier 3**	**Tier 3**	**Tier 2**	**Tier 2**	**Tier 2**	2/13/2023	See Note 1.
Amador County APCD	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 2	Tier 2	3/8/2023	Per David Estey, no planned changes to current BACT
Antelope Valley AQMD	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 2	Tier 2	3/8/2023	Per Barbara Lods, no planned changes to current BACT
Bay Area AQMD - Current	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 4	Tier 4	2/13/2023	***See proposed changes to BACT, below.***
Bay Area AQMD - Proposed	Exempt	***Tier 4***	***Tier 4***	***Tier 4***	***Tier 4***	***Tier 4***	***Tier 4***	***3/6/2023***	***Per Isis Virrueta, AQMD drafting new guideline, effective date pending***
Butte County AQMD	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 2	Tier 2	2/13/2023	Per Riley Peacock, no planned changes to current BACT
Calaveras County APCD	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 2	Tier 2	3/8/2023	Per Michelle Turner, no planned changes to current BACT
Colusa County APCD	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 2	Tier 2	3/8/2023	Per Casey Ryan, no planned changes to current BACT
Eastern Kern APCD	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 2	Tier 2	3/8/2023	Per Samuel Johnson, no planned changes to current BACT
El Dorado County AQMD[2]	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 2	Tier 2	2/21/2023	Per Lisa Petersen, latest EPA Tier available. See Note 2.
Feather River AQMD	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 2	Tier 2	3/9/2023	Per Robin Demma, no planned changes to current BACT
Glenn County APCD	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 2	Tier 2	3/8/2023	Per Pakou Cha, no planned changes to current BACT
Great Basin Unified APCD	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 2	Tier 2	3/8/2023	Per Tom Schaniel, no planned changes to current BACT
Imperial County APCD	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 2	Tier 2	3/8/2023	Per Mario Gonzalez, no planned changes to current BACT
Lake County AQMD	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 4	Tier 4	3/8/2023	Per Doug Earhart, no planned changes to current BACT.
Lassen County APCD	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 2	Tier 2	3/9/2023	Per Erik Edholm, no planned changes to current BACT
Mariposa County APCD	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 2	Tier 2	3/8/2023	Per Rachelle Ziegenfuss, no planned changes to current BACT. See Note 6.
Mendocino County AQMD	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 2	Tier 2	3/9/2023	Per Doug Gearhart, no planned changes to current BACT
Modoc County APCD	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 2	Tier 2	3/8/2023	Per Jennifer White, no planned changes to current BACT
Mojave Desert AQMD[3]	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 2	Tier 4	3/7/2023	Per Roseana Brasington, AQMD defers to BAAQMD, SJVAPCD & SCAQMD. See Note 3.
Monterey Bay ARD	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 2	Tier 2	2/13/2023	Per Amy Clymo, no planned changes to current BACT
North Coast Unified AQMD	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 2	Tier 2	3/7/2023	Per Winslow Condon, no planned changes to current BACT
Northern Sierra AQMD	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 2	Tier 2	3/7/2023	Per Joe Fish, no planned changes to current BACT
Northern Sonoma County APCD	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 2	Tier 2	3/7/2023	Per Craig Tallman, no planned changes to current BACT
Placer County APCD	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 2	Tier 2	3/6/2023	Per Emmanuel Orozco, no planned changes to current BACT
Sac Metro AQMD - Current	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 4	Tier 4	2/16/2023	***See proposed changes to BACT, below.***
Sac Metro AQMD - Proposed	Exempt	***Tier 4***	***Tier 4***	***Tier 4***	***Tier 4***	***Tier 4***	***Tier 4***	***3/5/2023***	***Per Jeff Weiss, AQMD drafting new guideline (expected adoption by 6/4/23)***
San Diego County APCD	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 2	Tier 2	3/7/2023	Per John Annicchiarico, no planned changes to current BACT
San Joaquin Valley APCD	Exempt	Tier 4	Tier 4	Tier 4	Tier 4	Tier 4	Tier 4	2/15/2023	Tier 4F adopted as "Achieved in Practice" for engines ≥50 bhp 4/29/22
San Luis Obispo County APCD	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 4	Tier 4	3/9/2023	Per Sarah Wade, no planned changes to current BACT
Santa Barbara County APCD[4]	Exempt	Tier 4	Tier 4	Tier 4	Tier 4	Tier 4	Tier 4	3/8/2023	Per William Sarraf, APCD will defer to SJVAPCD for BACT. See Note 4.
Shasta County AQMD	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 2	Tier 2	3/8/2023	Per Chad Peterson, no planned changes to current BACT
Siskiyou County APCD	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 2	Tier 2	3/9/2023	Per Irene Miranda, no planned changes to current BACT
South Coast AQMD	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 2	Tier 4	2/17/2023	Per Bahareh Farahani, no planned changes to current BACT
Tehama County APCD	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 2	Tier 2	3/9/2023	Per Brian Marquardt, no planned changes to current BACT
Tuolumne County APCD	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 2	Tier 2	3/9/2023	Per Cheydi Gonzales, no planned changes to current BACT. See Note 6.
Ventura County APCD[5]	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 4	Tier 4	3/8/2023	Per Chris Harlin, no planned changes to current BACT. See Note 5.
Yolo-Solano AQMD	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 2	Tier 2	3/7/2023	Per Christopher Goodwin, no planned changes to current BACT

BAAQMD Developments

AIR DISTRICT	MAX ENGINE RATING (HP) / MAX GENERATOR ELECTRICAL RATING (kW)					MAX RATING - MINOR SOURCE	MAX RATING - MAJOR SOURCE	VERIFICATION DATE	COMMENTS
	> 50 hp	50 ≤ hp < 100	100 ≤ hp < 175	175 ≤ hp < 750	750 ≤ hp < 1,000	hp ≥ 1,000	hp ≥ 1,000		
	> 37 kW	37 ≤ kW < 75	75 ≤ kW < 130	130 ≤ kW < 560	560 ≤ kW < 750	kW ≥ 750	kW ≥ 750		
Bay Area AQMD - Current	Exempt	Tier 3	Tier 3	Tier 3	Tier 2	Tier 4	Tier 4	2/13/2023	*See proposed changes to BACT, below.*
Bay Area AQMD - Proposed	Exempt	**Tier 4**	**Tier 4**	**Tier 4**	**Tier 4**	**Tier 4**	**Tier 4**	**3/6/2023**	***Per Isis Virrueta, AQMD drafting new guideline, effective date pending***

- Enforcement date is unknown but could be as early as 1'st quarter 2025
- Manufacturers have limited options
- Option – Diesel with mitigation
  - Catalytic converter, passive particulate filter, active particulate filter
  - Additional maintenance
  - Reliability impacts
- Option – Natural gas fired
  - PG&E supply
  - Code exemption required to avoid on site propane storage tank (NEC 701.12(C)(3) limits systems that are "… solely dependent on a public gas service…"

Any Final Questions or Comments



TJC AND ASSOCIATES, INC.

THE CITY OF PLEASANTON

APPENDIX I NITRIFICATION EVALUATION

PROJECT MEMORANDUM

CITY OF PLEASANTON

Water System Management Plan

Project No.: 201264
Date: September 24, 2024
Prepared By: Tim Loper
Reviewed By:
Subject: Nitrification Evaluation

This document is released for the purpose of information exchange review and planning only under the authority of Timothy J Loper, September 24, 2024, CA PE C-70847.

1.0 BACKGROUND

Carollo Engineers (Carollo) evaluated nitrification in the City's distribution system as part of the Water Supply and Distribution Facilities Improvements Project (Project). The results of the nitrification evaluation are summarized in Technical Memorandum 2 – Nitrification Evaluation (Carollo, 2020). Recommendations and the status of each are summarized in Table 1.

Table 1 Nitrification Evaluation Recommendations

No.	Recommendation	Status
1	Develop a long-term nitrification monitoring plan.	Implemented as part of a future project.
2	Develop a hydraulic model of the distribution system.	Completed in 2023.
3	Install residual control systems in the Foothill and Sycamore storage tanks.	Completed in 2022.
4	Improve chemical feed control and increase chloramine dose at the City's wells.	City's wells are not operational due to PFAS concentrations above the MCL. Chemical feed and Chloramine residual will be optimized as part of ongoing regional well project.
5	Increase chloramine residual form Zone 7's groundwater supply.	Zone 7 began increasing the residual in the groundwater supply in January 2020.
6	Develop a nitrification response plan.	Preliminary plan completed in 2020 and updated in 2022. Finalized as part of a future project.

2.0 PROGRAM RECOMMENDATIONS

One of the key recommendations was to install chloramine boosting systems at the Foothill and Sycamore Reservoirs to allow the City to reduce the frequency of tank cycling currently required to maintain residuals in the distribution system. These systems allow both sodium hypochlorite, which is generated onsite, and liquid ammonium sulfate (LAS) to be dosed to maintain target chloramine residuals in the storage reservoirs. These systems also consist of monitoring equipment with control algorithms to monitor and maintain the target residual without exceeding a 5:1 Cl_2/N ratio.

The RCS systems are set to maintain chloramine residuals between 2.5 and 2.75 in both the Foothill and Sycamore Tanks. Data from the distribution system before and after the RCS systems began operation were analyzed. Distribution system residual data is compared in Figure 1 – Figure 3 for three different time periods:

- Average residuals between January 2019 and April 2019 are shown in Figure 1. During this time period, a high percentage of groundwater was supplied at the turnouts by Zone 7 and the City's wells were also online. This resulted in low residuals across the system since chloramine decay in the local groundwater supplies is more rapid than in the surface water supplies.
- Average residuals between April 2019 and March 2020 are shown in Figure 2. During this time period, Zone 7 provided a high percentage of surface water to the City's turnouts and the City's wells were online. Comparing this data to Figure 1 illustrates the impact of Zone water supply (majority surface vs. majority groundwater) on chloramine residuals in the City's distribution system. Residuals were higher across the distribution system, but still low near the storage tanks.
- Average residuals between April 2023 and September 2023 are shown in Figure 3. During this time period, the RCS in the Sycamore and Foothill tanks were operational. Since consistent operation of the RCS began in 2023, residuals have increased in the distribution system, particularly near the foothill and sycamore storage tanks. The RCS systems have also allowed the City to reduce the frequency of tank cycling required to maintain distribution system residuals. Weekly fill and drain cycles are used in the lower zone to reduce the water age in the storage tanks. Prior to RCS installation, the tanks were cycled from 6 feet to 25-28 feet. Current operations, with the RCS systems in service and the City's wells offline, tanks are cycled from 18-25 feet.

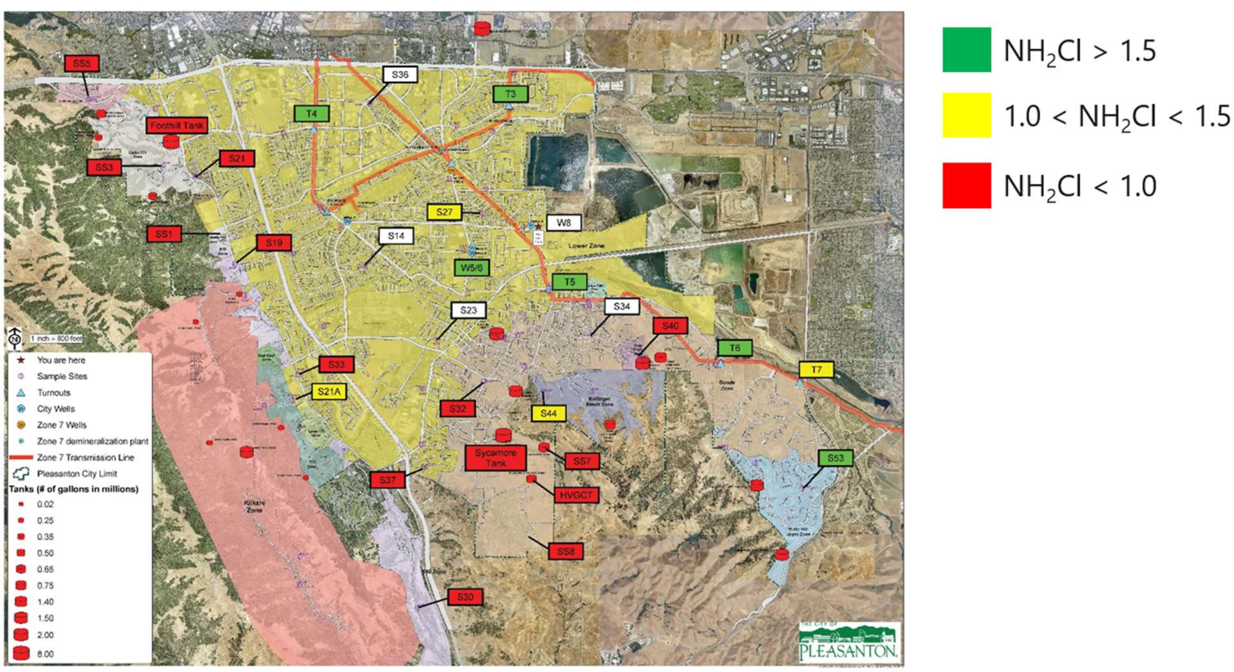


Figure 1Average Distribution System Residuals (January 2019 – April 2019)

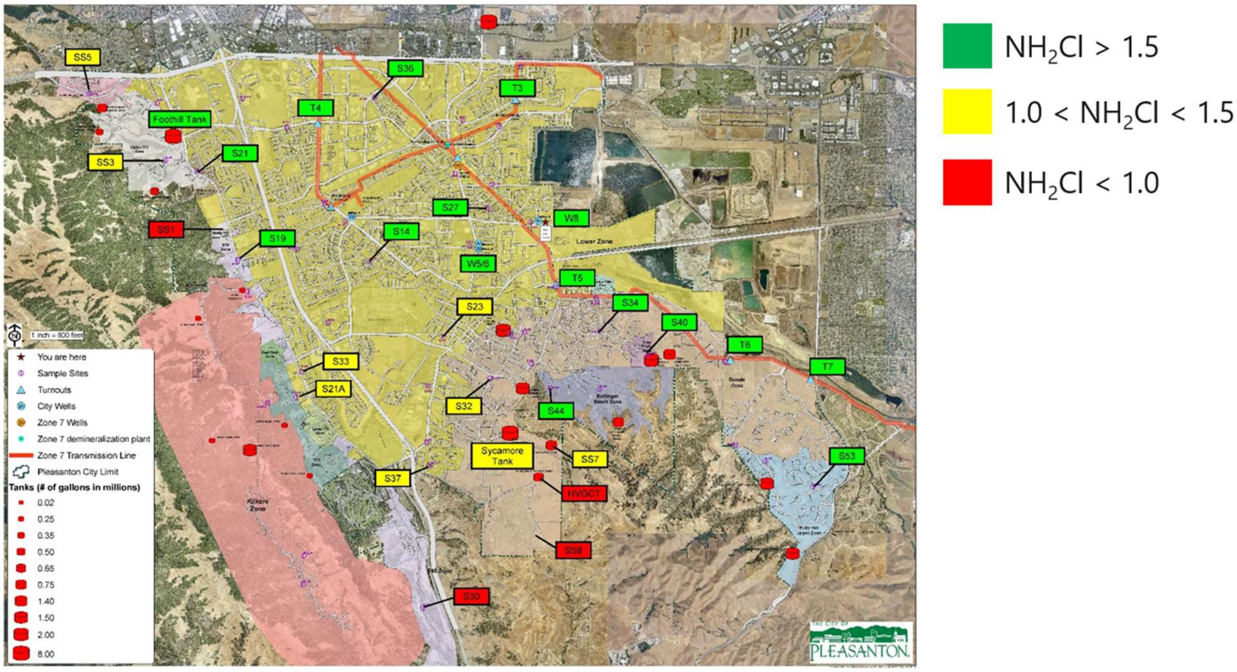


Figure 2Average Distribution System Residuals (April 2019 – March 2020)

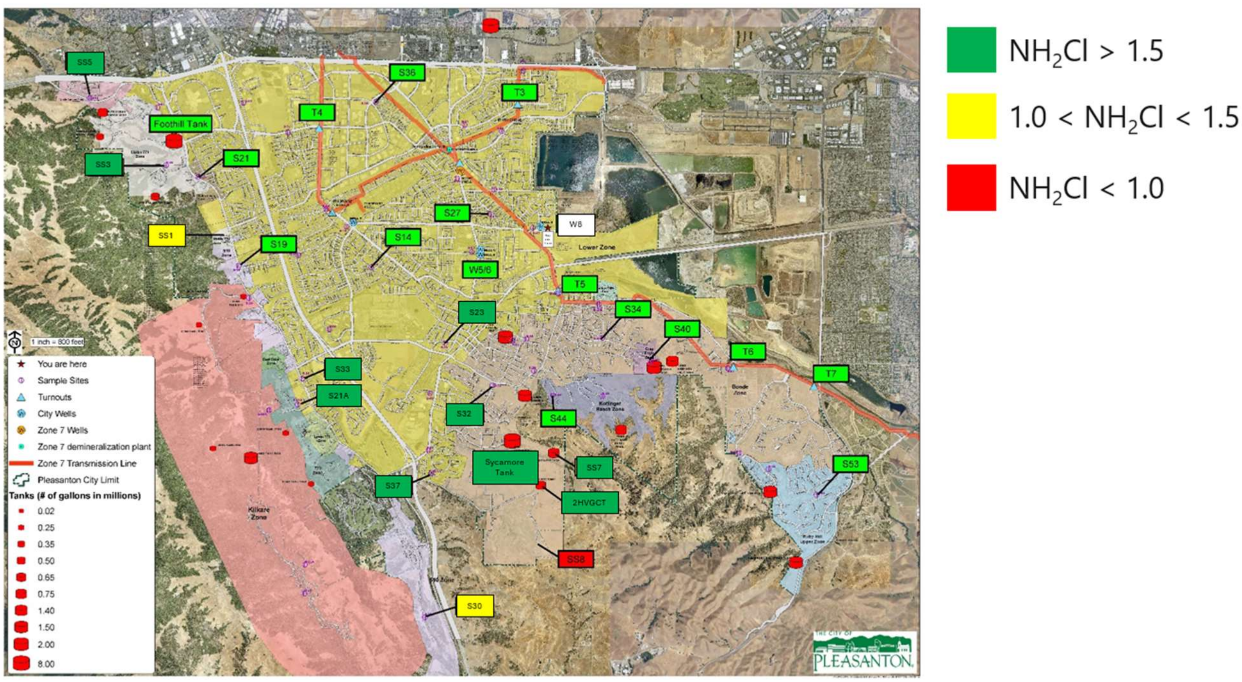


Figure 3Average Distribution System Residuals (April 2023 – September 2023)

Implementation of the RCS systems in the Sycamore and Foothill Tanks was effective at increasing distribution system residuals and decreasing the tank cycling required. These installations are currently temporary and housed in trailers. It is recommended that these installations be upgraded to permanent installations.

A majority of the recommendations listed in Table 1 have been implemented since the completion of the Nitrification Evaluation in 2020. Based on reviewing distribution system residuals, the residuals have increased since the implementation of the RCS in the Sycamore and Foothill Tanks. The City also now has a working hydraulic model to estimate source water blend (Zone 7 vs. City wells) and water age. Therefore, it is recommended that the City develop a formal nitrification monitoring and response plan that incorporates these changes. The plan should:

- Define monitoring frequency and locations for key water quality to track nitrification.
- Update and expand the preliminary response plan previously developed.
- Incorporate detailed plans and monitoring strategies for free chlorination of areas of the distribution to manage nitrification.
- Consider the installation of tank mixers in the upper zone reservoirs.

APPENDIX J CIP IMPLEMENTATIOM MEMO

PROJECT MEMORANDUM

CITY OF PLEASANTON

Water System Management Plan

REGISTERED PROFESSIONAL ENGINEER
TIMOTHY J. LOPER
No. 70847
CIVIL
STATE OF CALIFORNIA

Project No.:	201264
Date:	September 24, 2024
Prepared By:	Tim Loper
Reviewed By:	
Subject:	CIP Rate Implementation Strategies

1.0 BACKGROUND

The City of Pleasanton (City) as part of the Water System Management Plan (WSMP) has identified both Capital and O&M projects and programs that have been recommended for the improvement and enhancement of the City water system utility operations. Critical to the implementation of the Capital and O&M projects and programs is the coordination with the City's rate consultant on the development of varying phased CIP program costs scenarios. This project memorandum summarizes the CIP and O&M recommendations, and three phased funding scenarios as well as a qualitative assessment of the pros and cons of each alternative.

2.0 CAPITAL PROJECTS

The Capital projects have been developed based on multiple assessments conducted by the City and as part of the WSMP. The CIP projects have been prioritized based on three priority definitions.

1. **Priority A** – These projects are ranked the highest if they are required for health and safety; required by law, regulation, or contract; are under construction; and/or are funded by applicants or outside funding source.
2. **Priority B** – These projects are those that provide measurable progress toward achieving the City's goals, but the City has a moderate level of control as to when these projects should be accomplished.
3. **Priority C** - Projects not meeting the criteria for priority level A or B are ranked as priority level C. These are projects that are anticipated to be needed, but may not yet have defined scopes and schedules.

The projects have also been categorized based on specific facility categories including:

1. Water Supply.
2. Water Distribution.
3. Rehabilitation and Replacement (Above Ground).
4. Rehabilitation and Replacement (Below Ground).
5. Other Projects.

The overall CIP project recommendations are summarized below in Table 1.

Table 1 Capital Improvement Plan Summary – Implementation Scenario 1

Project Type	Total Costs ($Millions)
Water Supply Projects	$52.00
Priority A Projects	$40.00
WS -1 Near Term Improvements for Water Supply Change[3]	$13.50
WS-2 Long Term Improvements for Water Supply Change[4]	$26.50
Priority C Projects	$12.00
WS-3 Future Water Supply Treatment	$10.00
WS-4 RCS Permanent Installation	$2.00
Distribution Capacity	$81.50
Priority A Projects	$44.06
DS-1 Existing Pipeline Deficiencies Improvements (I-1, I-4 through I-10 from Akel Report)	$1.46
DS -2 Priority A Fire Flow (>30% Def)	$16.71
DS-3 Kilkare - Sunol Fire Flow	$23.78
DS-4 Gray Eagle Connection to Kottinger Pressure Zone	$1.86
DS -5 Lemoine Bypass Pipeline Project	$0.25
Priority B Projects	$26.06
DS-6 Priority B Fire Flow	$9.43
DS-7 Tank 510 Site (Additional 0.25 MG)	$2.14
DS-8 Tank 770 Site (Additional 0.15 MG)	$1.68
DS-9 New 4.5 MG Tanks	$12.81
Priority C Projects	$11.38
DS -10 Priority C Fire Flow	$9.88
DS - 11 Upper Zone Tank Mixers	$1.50
Rehabilitation and Replacement (Above Ground Facilities)	$50.59
Priority A Projects	$12.04
RR-1 Tank 1300 Rehab	$2.54
RR-2 McCloud Tank/PS Decommission	$1.24
RR- 3 Foothill PS Rehab	$1.32
RR - 4 Tank Inspections	$1.62
RR- 5 Vineyard PS Rehab	$ 2.13
RR- 6 Kottinger PS Rehab	$1.90
RR- 7 Decommission of Grey Eagle PS	$1.29
Priority B Projects	$15.75
RR - 8 Customer Meter Replacement	$9.30
RR- 9 Laurel Creek PS Rehab	$1.68

Project Type	Total Costs ($Millions)
RR - 10 Ruby Hill PS Rehab	$2.04
RR- 11 Decommission Well No. 7	$0.81
RR- 12 Decommission Well 5 and 6	$0.71
RR- 13 Decommission Well No. 8	$1.21
Priority C Projects	$22.80
RR- 14 Other Facility Rehabilitation	$22.80
Rehabilitation and Replacement (Below Ground Facilities)	$71.28
Priority B Projects	$31.68
RR - 15 Pipeline Rehabilitation Backlog (4.8-miles/year)	$31.68
Priority C Projects	$39.60
RR - 16 Pipeline Rehabilitation (3-miles/year)	$39.60
Other Projects	$6.73
Priority A Projects	$6.53
SP - 1 Network Architecture (SCADA)	$1.01
SP - 2 Generator Projects[5]	$5.52
Priority B Projects	$0.20
SP - 3 DER Projects (Tassajara and TO3)	$0.20
Project Total	**$262.10**

Notes:
(1) Projects are in 2024 dollars.
(2) Costs are total project delivery costs. Increase in City engineering staff to manage is not included.
(3) Project includes S-1, S-2, S-3, BS-1, I-2, and I-3 from Akel Report. "Costs provided by City supersede Akel Report.
(4) City is considering one of two options: Project includes W-1, W-2, F-1, F-2, F-3, F-4, F-5 from Akel Report. Alternatively, City is evaluating a Regional Groundwater Facility project with Zone 7 with related distribution changes. "Costs provided by City supersede the Akel report."
(5) Total costs for all generators including water, sewer, and storm is $9.39 million. "Costs show in this table is just for water".

3.0 O&M PROJECT AND PROGRAMS

The O&M projects and programs were developed based on coordination with City Staff, and the O&M evaluation conducted by Carollo. The O&M programs were categorized based on the following:

1. Water Quality Regulations.
2. Water Conservation and Water Loss.
3. Rehabilitation and Replacement Assessment.
4. O&M Evaluations.
5. SCADA Master Plan.

The O&M project and programs are summarized in Table 2.

Table 2 O&M Project and Programs

Project Type	Project Descriptions	Total 20-Year Program Costs ($ Million)	CIP Phasing ($Million)						
			Near Term					Mid Term	Long Term
			2024/2025	2025/2026	2026/2027	2027/2028	2028/2029	2029/2030 - 2033/2034	2034/2035 - 2043/2044
Water Quality Regs									
WQ – 1 Lead and Copper Rule Program Tracking	Under the LCRR, after the initial survey has been completed the City will need to complete the following. Costs to be reevaluated after initial phases of the program are completed. ▪ Develop and submit an LSL replacement plan. ▪ Revised sampling plan that captures updated sample tiers ▪ Start sampling in schools and childcare facilities ▪ Comply with revised Action level Comply with updated public notification	$0.25	$0.05	$0.05	$0.05	$0.05	$0.05	$-	$-
WQ - 2 Cross Connection Control Plan	Initial budgetary estimates will need to be revised for adequacy after initial planning phases	$0.25	$0.05	$0.05	$0.05	$0.05	$0.05	$-	$-
WQ - 3 Nitrification Response Plan	Update and enhance nitrification response plan	$0.05	$-	$0.05	$-		$-		$-
Water Conservation and Water Loss									
WC- 1 Water Meter Testing Program:	Establish Water Meter Testing Program	$0.24	$	$	$0.05	$0.02	$0.02	$0.05	$0.10
WC- 2 Water Conservation Program	Enhance water conservation program based on developing California Regulations	$0.25	$0.05	$0.05	$0.05	$0.05	$0.05	$-	$-
WC - 3 Water Loss	Contracted leak detection of entire water system by 2028	$0.55	$0.05	$ 0.25	$0.25	$-	$-	$-	$-
WC – 4 Systematic Data Handling Error Audit:	Data error audit. Related to data accuracy and annually water loss audits.	$0.05	$-	$0.05	$-	$-	$-	$-	$-
Rehabilitation and Replacement Assessment									
RR-17 Asset Management Program	Funded for water system portion. Coordination with City-wide asset management efforts	$0.40	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.10
RR - 4 Tank Inspection Program	Inspection of interior of all tanks and reservoirs	$-	$-	$-	$-	$-	$-	$-	$-
RR - 18 Corrosion Protection:	Annual inspection of cathodic protection systems	$0.37	$-	$-	$0.20	$0.01	$0.01	$0.05	$0.10
O&M Evaluation									
OM – 1 Unidirectional Flushing Program	Implement a Unidirectional Flushing pilot by hiring a consultant to develop an initial plan based on a single pressure zone. Includes valve exercising	$0.98	$-	$0.08	$0.05	$0.05	$0.05	$0.25	$0.50
OM – 2 Utility Training Program	Continue using contractors to conduct staff training, and develop SOPs	$1.00	$0.05	$0.05	$0.05	$0.05	$0.05	$0.25	$0.50
OM – 3 Water System Operations and Maintenance Manual	Hire consultant to develop electronic O&M manual	$0.15	$-	$0.15	$-	$-	$-	$-	$-
SCADA Master Plan									
SP - 4 SCADA Standards Development:	Development of SCADA stands	$0.17	$	$0.17	$	$	$	$	$
SP – 5 SCADA Preventive Maintenance Program	Development and Implementation of a preventative maintenance program	$0.95	$-	$-	$0.10	$0.05	$0.05	$0.25	$0.50
SP – 6 Backup Core Server Relocation	Relocate core SCADA servers to a cloud-based structure	$0.21	$-	$-	$0.21	$	$	$	$
SP – 7 Remote Access Improvements	Development of remote SCADA access options	$0.37	$	$	$	$0.37	$	$	$
SP- 8 OT System Monitoring Implementation	Implementation of OT focused cybersecurity monitoring	$0.86	$	$	$0.43	$0.43	$	$	$
	Increased FTE Costs(2)	**$12.00**	**$**	**$**	**$0.67(3)**	**$0.67**	**$0.67**	**$3.33**	**$6.67**
	Total Costs	**$19.09**	**$0.30**	**$0.99**	**$2.20**	**$1.85**	**$1.05**	**$4.23**	**$8.47**

Notes:
Projects are in 2024 dollars.
(1) Five Operator FTEs to facilitate programs.
- 2 FTEs starting in FY24/25 which has already been approved and included in baseline operating expenses (not included here).
- 3 Additional FTEs starting in FY26/27 which is included in this line item.

4.0 IMPLEMENTATION SCENARIOS

Three project phasing scenarios were developed for the evaluation of rate increases. The implementation scenarios are summarized in Table 3.

Table 3 CIP Phasing Implementation Scenarios

Scenario 1 **Deferrals to Steady ENG FTE Requirements (3 FTE / Year)**	Scenario 2 **No Deferrals**	Scenario 3 **Maximum Deferrals**
▪ Priority A in Near- Term with some deferral into Mid-Term ▪ Priority B in Mid-Term with some deferral into Long-term ▪ Priority C in Long-Term	▪ All Priority A in Short-Term ▪ All Priority B in Mid-Term ▪ All Priority C in Long-Term	▪ Priority A spread between Near and Mid-Terms ▪ Priority B and C in Long-Term

4.1 Implementation Scenario Comparison

The implementation scenarios, pros, cons, and risks are summarized in Table 4. Detailed tables of each CIP scenario are included as attachments to this memorandum. As can be seen in Figure 1, Scenario 2 has the highest near-term costs, while Scenario 3 has the lowest with the highest costs in the long term. Scenario 1 slowly ramps up over the near and mid-terms, and then ramps down over the long term.

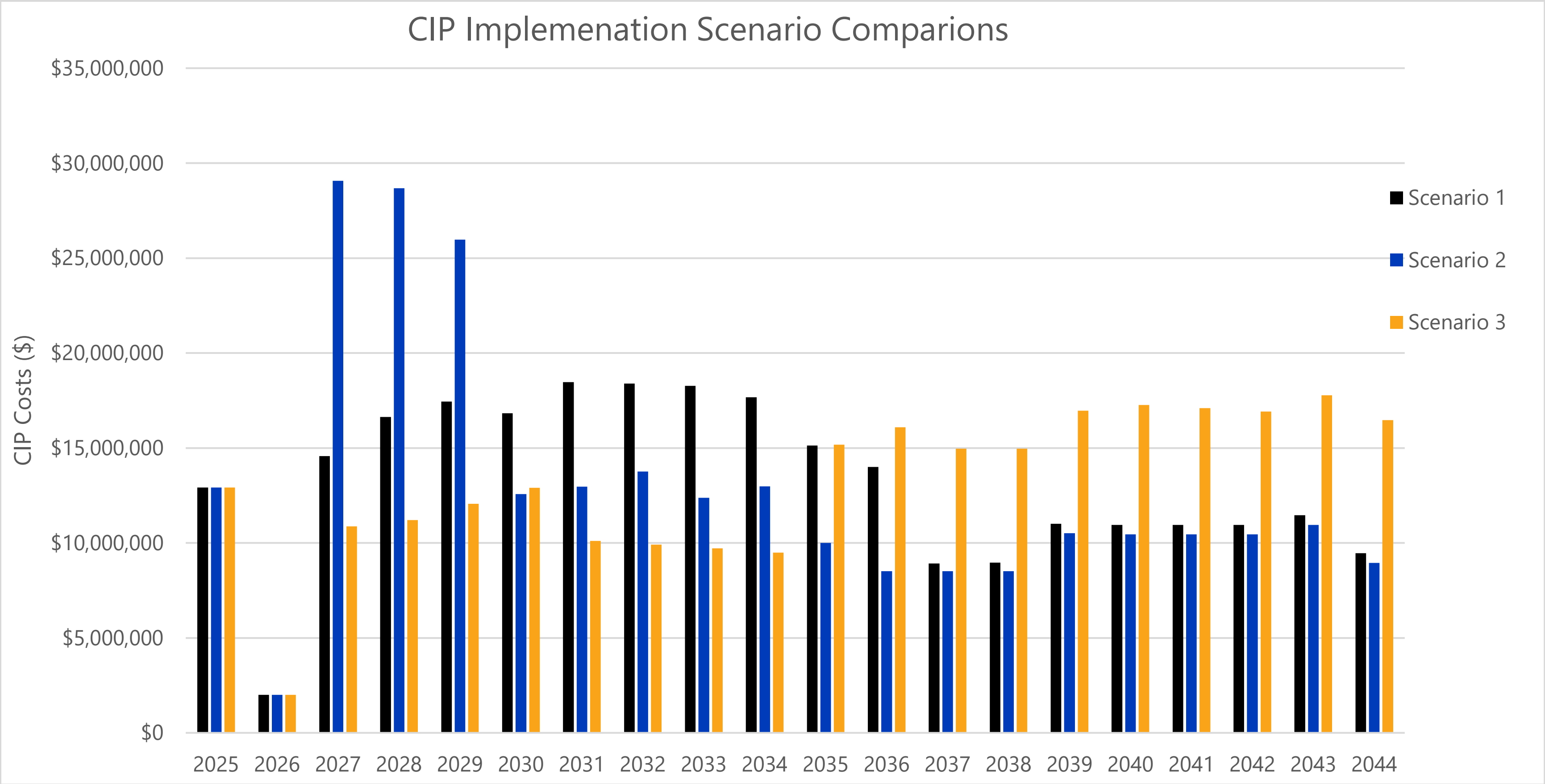
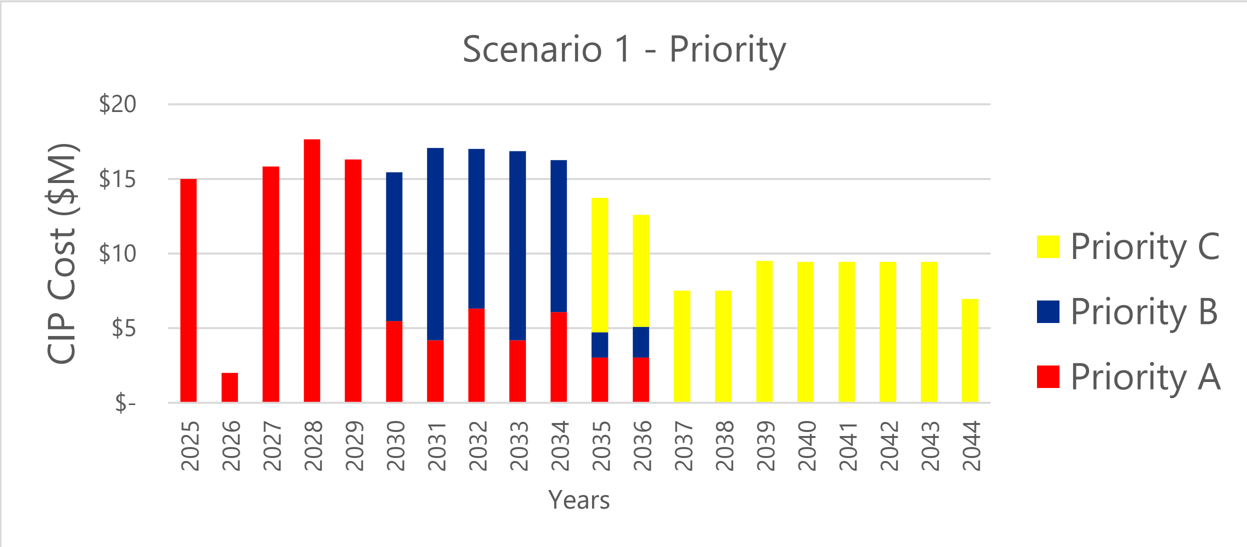
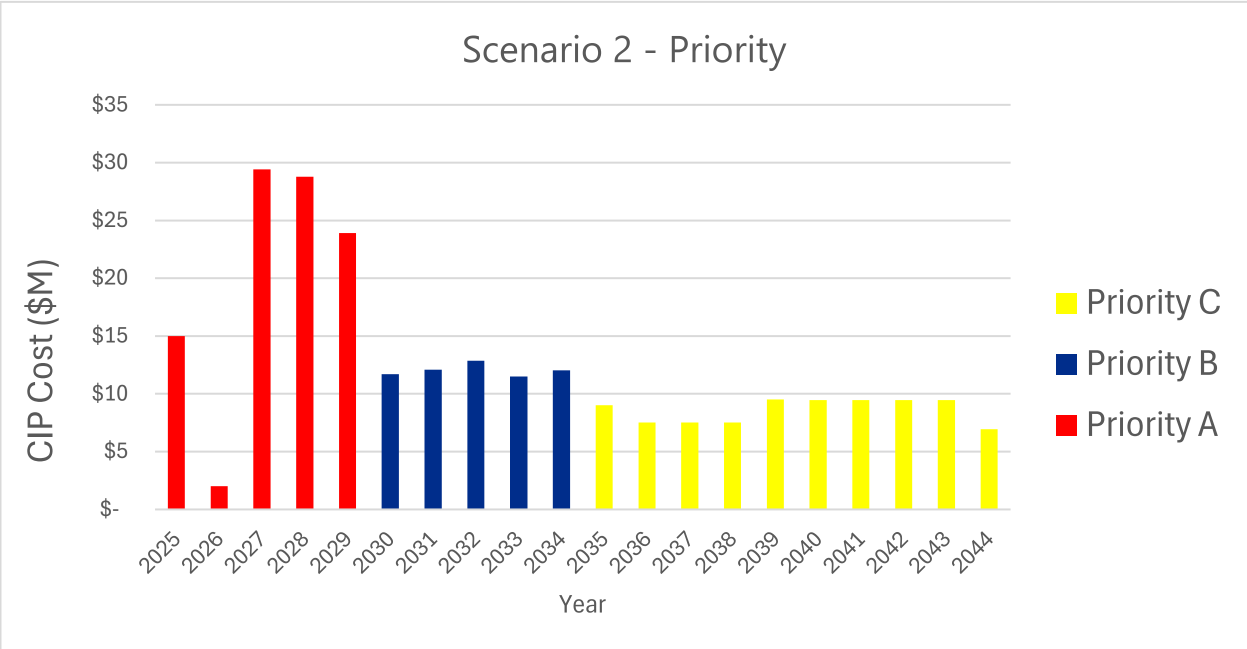


Figure 1 Summary of CIP Implementation Scenario Comparisons


Scenario 1 - Priority
CIP Cost ($M)
$20
$15
$10
$5
$-
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
2041
2042
2043
2044
Years
Priority C
Priority B
Priority A


Scenario 2 - Priority
CIP Cost ($M)
$35
$30
$25
$20
$15
$10
$5
$-
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
2041
2042
2043
2044
Year
Priority C
Priority B
Priority A

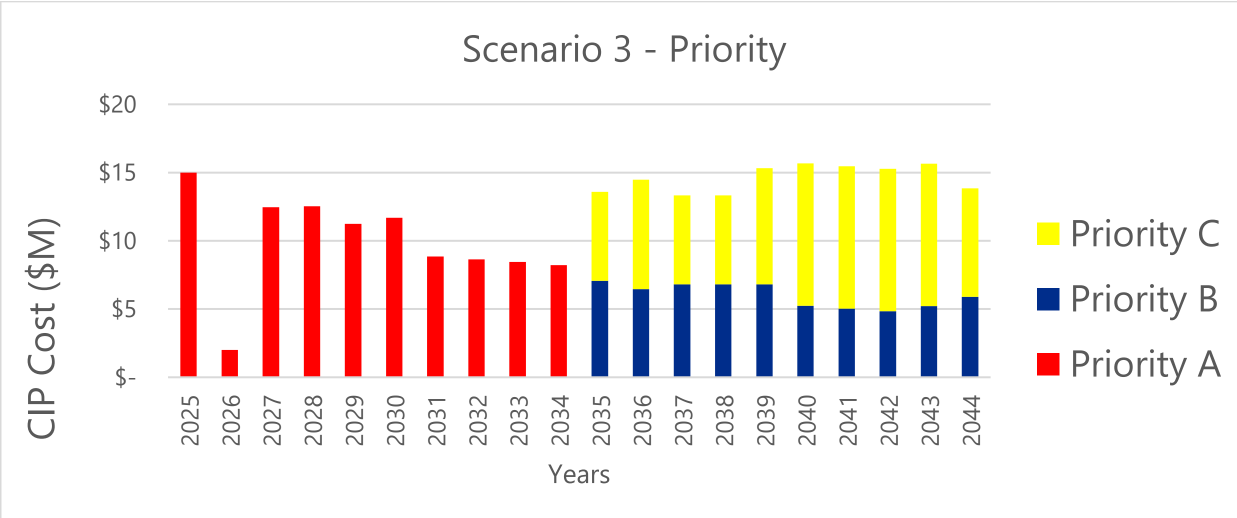


Table 4 CIP Phasing Implementation Risks, Pros, and Cons

Scenario 1 – Risks, Pros, Cons	Scenario 2 - Risks, Pros, Cons	Scenario 3 - Risks, Pros, Cons
Pros: ▪ Program and project load can be handled by existing public works structure ▪ Only partial deferment of Priority A R&R projects ▪	Pros: ▪ All priority A projects completed in the Near-Term ▪ No Priority A R&R projects deferred beyond 2029	Pros: ▪ Slowest implementation rate makes meeting CIP schedule more obtainable ▪ Potentially lower near-term rate impacts
Cons: ▪ While some Priority A projects are completed in the Near-term, some high risk R&R projects are deferred for over 5-years. ▪ Risk of deferred could increase annual O&M costs for identified R&R projects	Cons: ▪ Near Term Priority A project schedule will require outside engineering assistance (i.e., program manager) to complete all project by 2029 ▪ Public impacts due to multiple projects being completed in Near-term ▪ Highest Near-term rate impacts ▪ Largest Financing Requirement	Cons: ▪ Potential deferment of Priority A R&R projects for up to 10-years ▪ Increased O&M cost due to deferment of Priority A R&R projects ▪ Highest rate of spending over years 6-20 (2029 to 2044)
Risk: ▪ Facility failure due to deferment ▪ Increased O&M costs	Risk: ▪ Not meeting CIP schedules after high rates increases creates public and institutional challenges	Risks: ▪ Facility failure due to deferment ▪ Increased O&M costs

ATTACHMENT A CIP DETAIL SHEETS

CAPITAL IMPROVEMENT PLAN SUMMARY - IMPLEMENTATION SCENARIO 1

City of Pleasanton

Water System Management Plan

Project Type	Total Costs ($Millions)	CIP Phasing ($Million)							Cost Sharing	
		Near Term					Mid Term	Long Term	Existing Customers	Future Customers
		2024/2025	2025/2026	2026/2027	2027/2028	2028/2029	2029/2030 - 3033/2034	2034/2035 - 2038/2044	($Million)	($Million)
Water Supply Projects	$ 52.00	$ 15.00	$ 2.00	$ 12.00	$ 11.00	$ -	$ -	$ 12.00	$ 46.14	$ 5.86
Priority A Projects	$ 40.00	$ 15.00	$ 2.00	$ 12.00	$ 11.00	$ -	$ -	$ -	$ 34.14	$ 5.86
WS -1 Near Term Improvements for Water Supply Change[3]	$ 13.50	$ 13.50	$ -	$ -	$ -	$ -	$ -	$ -	$ 11.42	$ 2.08
WS-2 Long Term Improvements for Water Supply Change[4]	$ 26.50	$ 1.50	$ 2.00	$ 12.00	$ 11.00	$ -	$ -	$ -	$ 22.72	$ 3.78
Priority C Projects	$ 12.00	$ -	$ -	$ -	$ -	$ -	$ -	$ 12.00	$ 12.00	$ -
WS-3 Future Water Supply Treatment	$ 10.00	$ -	$ -	$ -	$ -	$ -	$ -	$ 10.00	$ 10.00	$ -
WS-4 RCS Permanent Installation	$ 2.00	$ -	$ -	$ -	$ -	$ -	$ -	$ 2.00	$ 2.00	$ -
Distribution Capacity	$ 81.50	$ -	$ -	$ 3.80	$ 4.34	$ 7.87	$ 35.19	$ 30.30	$ 65.12	$ 16.39
Priority A Projects	$ 44.06	$ -	$ -	$ 3.80	$ 4.34	$ 7.87	$ 21.94	$ 6.11	$ 41.49	$ 2.58
DS-1 Existing Pipeline Deficiencies Improvements (I-1, I-4 through I-10 from Akel Report)	$ 1.46	$ -	$ -	$ 0.46	$ 1.00	$ -	$ -	$ -	$ 1.46	$ -
DS -2 Priority A Fire Flow (>30% Def)	$ 16.71	$ -	$ -	$ 3.34	$ 3.34	$ 3.34	$ 6.69	$ -	$ 14.21	$ 2.50
DS-3 Kilkare - Sunol Fire Flow	$ 23.78	$ -	$ -	$ -	$ -	$ 2.42	$ 15.25	$ 6.11	$ 23.71	$ 0.08
DS-4 Gray Eagle Connection to Kottinger Pressure Zone	$ 1.86	$ -	$ -	$ -	$ -	$ 1.86	$ -	$ -	$ 1.86	$ -
DS -5 Lemoine Bypass Pipeline Project	$ 0.25	$ -	$ -	$ -	$ -	$ 0.25	$ -	$ -	$ 0.25	$ -
Priority B Projects	$ 26.06	$ -	$ -	$ -	$ -	$ -	$ 13.25	$ 12.81	$ 12.53	$ 13.53
DS-6 Priority B Fire Flow	$ 9.43	$ -	$ -	$ -	$ -	$ -	$ 9.43	$ -	$ 8.91	$ 0.52
DS-7 Tank 510 Site (Additional 0.25 MG)	$ 2.14	$ -	$ -	$ -	$ -	$ -	$ 2.14	$ -	$ 2.12	$ 0.02
DS-8 Tank 770 Site (Additional 0.15 MG)	$ 1.68	$ -	$ -	$ -	$ -	$ -	$ 1.68	$ -	$ 1.50	$ 0.18
DS-9 New 4.5 MG Tanks	$ 12.81	$ -	$ -	$ -	$ -	$ -	$ -	$ 12.81		$ 12.81
Priority C Projects	$ 11.38	$ -	$ -	$ -	$ -	$ -	$ -	$ 11.38	$ 11.10	$ 0.28
DS -10 Priority C Fire Flow	$ 9.88	$ -	$ -	$ -	$ -	$ -	$ -	$ 9.88	$ 9.60	$ 0.28
DS - 11 Upper Zone Tank Mixers	$ 1.50	$ -	$ -	$ -	$ -	$ -	$ -	$ 1.50	$ 1.50	
Rehabilitation and Replacement (Above Ground Facilities)	$ 50.59	$ -	$ -	$ 0.54	$ 0.54	$ 5.64	$ 17.35	$ 26.52	$ 50.59	$ -
Priority A Projects	$ 12.04	$ -	$ -	$ 0.54	$ 0.54	$ 5.64	$ 5.32	$ -	$ 12.04	$ -
RR-1 Tank 1300 Rehab	$ 2.54	$ -	$ -	$ -	$ -	$ 2.54	$ -	$ -	$ 2.54	$ -
RR-2 McCloud Tank/PS Decommission	$ 1.24	$ -	$ -	$ -	$ -	$ 1.24	$ -	$ -	$ 1.24	$ -
RR- 3 Foothill PS Rehab	$ 1.32	$ -	$ -	$ -	$ -	$ 1.32	$ -	$ -	$ 1.32	$ -
RR - 4 Tank Inspections	$ 1.62	$ -	$ -	$ 0.54	$ 0.54	$ 0.54	$ -	$ -	$ 1.62	$ -
RR- 5 Vineyard PS Rehab	$ 2.13	$ -	$ -	$ -	$ -	$ -	$ 2.13	$ -	$ 2.13	$ -
RR- 6 Kottinger PS Rehab	$ 1.90	$ -	$ -	$ -	$ -	$ -	$ 1.90	$ -	$ 1.90	$ -
RR- 7 Decommission of Grey Eagle PS	$ 1.29	$ -	$ -	$ -	$ -	$ -	$ 1.29	$ -	$ 1.29	$ -
Priority B Projects	$ 15.75	$ -	$ -	$ -	$ -	$ -	$ 12.03	$ 3.72	$ 15.75	$ -
RR - 8 Customer Meter Replacement	$ 9.30	$ -	$ -	$ -	$ -	$ -	$ 9.30	$ -	$ 9.30	$ -
RR- 9 Laurel Creek PS Rehab	$ 1.68	$ -	$ -	$ -	$ -	$ -	$ -	$ 1.68	$ 1.68	$ -
RR - 10 Ruby Hill PS Rehab	$ 2.04	$ -	$ -	$ -	$ -	$ -	$ -	$ 2.04	$ 2.04	$ -
RR- 11 Decommission Well No. 7	$ 0.81	$ -	$ -	$ -	$ -	$ -	$ 0.81	$ -	$ 0.81	$ -
RR- 12 Decommission Well 5 and 6	$ 0.71	$ -	$ -	$ -	$ -	$ -	$ 0.71	$ -	$ 0.71	$ -
RR- 13 Decommission Well No. 8	$ 1.21	$ -	$ -	$ -	$ -	$ -	$ 1.21	$ -	$ 1.21	$ -
Priority C Projects	$ 22.80	$ -	$ -	$ -	$ -	$ -	$ -	$ 22.80	$ 22.80	$ -
RR- 14 Other Facility Rehabilitation	$ 22.80	$ -	$ -	$ -	$ -	$ -	$ -	$ 22.80	$ 22.80	$ -
Rehabilitation and Replacement (Below Ground Facilities)	$ 71.28	$ -	$ -	$ -	$ -	$ -	$ 31.68	$ 39.60	$ 71.28	$ -
Priority B Projects	$ 31.68	$ -	$ -	$ -	$ -	$ -	$ 31.68	$ -	$ 31.68	$ -
RR - 15 Pipeline Rehabilitation Backlog (4.8-miles/year)	$ 31.68	$ -	$ -	$ -	$ -	$ -	$ 31.68	$ -	$ 31.68	$ -
Priority C Projects	$ 39.60	$ -	$ -	$ -	$ -	$ -	$ -	$ 39.60	$ 39.60	$ -
RR - 16 Pipeline Rehabilitation (3-miles/year)	$ 39.60	$ -	$ -	$ -	$ -	$ -	$ -	$ 39.60	$ 39.60	$ -
Other Projects	$ 6.73	$ -	$ -	$ -	$ 2.76	$ 3.77	$ 0.20	$ -	$ 6.73	$ -
Priority A Projects	$ 6.53	$ -	$ -	$ -	$ 2.76	$ 3.77	$ -	$ -	$ 6.53	$ -
SP - 1 Network Architecture (SCADA)	$ 1.01	$ -	$ -	$ -	$ -	$ 1.01	$ -	$ -	$ 1.01	$ -
SP - 2 Generator Projects[7]	$ 5.52	$ -	$ -	$ -	$ 2.76	$ 2.76	$ -	$ -	$ 5.52	$ -
Priority B Projects	$ 0.20	$ -	$ -	$ -	$ -	$ -	$ 0.20	$ -	$ 0.20	$ -
SP - 3 DER Projects (Tassajara and TO3)	$ 0.20	$ -	$ -	$ -	$ -	$ -	$ 0.20	$ -	$ 0.20	$ -
Project Total	$ 262.10	$ 15.00	$ 2.00	$ 16.34	$ 18.64	$ 17.28	$ 84.42	$ 108.42	$ 239.87	$ 22.25
Engineering/Administration FTE's[5]	$ 11.09			0.62	0.62	0.62	3.08	6.16		
Increased O&M Needs[6]	$ 15.02	$ -	$ -	$ -	$ 0.25	$ 0.53	$ 3.90	$ 10.34		
Total CIP	$ 288.23	$ 15.00	$ 2.00	$ 16.96	$ 19.51	$ 18.43	$ 91.40	$ 124.92		

Notes:

1. Projects are in 2024 dollars.

2. Costs are total projectdelivery costs

3. Project includes:
"Project includes S-1, S-2, S-3, BS-1, I-2, and I-3 from Akel Report. Costs provided by City supersede Akel Report."

4. City is considering one of two options:
Project includes W-1, W-2, F-1, F-2, F-3, F-4, F-5 from Akel Report. Alternatively, City is evaluating a Regional Groundwater Facility project with Zone 7 with related distribution changes. Costs provided by City supersede the Akel report.

5. Engineering FTE to Implement CIP
- 1 FTE starting in FY24/25 which has already been approved and included in baseline operating expenses (not included here)
- 2 Additional FTE starting in FY26/27 which is included in this line item.

6. Includes increase in O&M for new facilities, and a 2.5% increase in O&M annually for project deferment.

7. Total costs for all generators including water, sewer, and storm is $9.39 million. "Costs show in this table is just for water".

CAPITAL IMPROVEMENT PLAN SUMMARY - IMPLEMENTATION SCEANRIO 2

City of Pleasanton

Water System Management Plan

Project Type	Total Costs ($Millions)	CIP Phasing ($Million)							Cost Sharing	
		Near Term					Mid Term	Long Term	Existing Customers ($Million)	Future Customers ($Million)
		2024/2025	2025/2026	2026/2027	2027/2028	2028/2029	2029/2030 - 3033/2034	2034/2035 - 2038/2044		
Water Supply Projects	$ 52.00	$ 15.00	$ 2.00	$ 12.00	$ 11.00	$ -	$ -	$ 12.00	$ 46.14	$ 5.86
Priority A Projects	$ 40.00	$ 15.00	$ 2.00	$ 12.00	$ 11.00	$ -	$ -	$ -	$ 34.14	$ 5.86
WS -1 Near Term Improvements for Water Supply Change[3]	$ 13.50	$ 13.50	$ -	$ -	$ -	$ -	$ -	$ -	$ 11.42	$ 2.08
WS-2 Long Term Improvements for Water Supply Change[4]	$ 26.50	$ 1.50	$ 2.00	$ 12.00	$ 11.00	$ -	$ -	$ -	$ 22.72	$ 3.78
Priority C Projects	$ 12.00	$ -	$ -	$ -	$ -	$ -	$ -	$ 12.00	$ 12.00	$ -
WS-3 Future Water Supply Treatment	$ 10.00	$ -	$ -	$ -	$ -	$ -	$ -	$ 10.00	$ 10.00	$ -
WS-4 RCS Permanent Installation	$ 2.00	$ -	$ -	$ -	$ -	$ -	$ -	$ 2.00	$ 2.00	$ -
Distribution Capacity	$ 81.5	$ -	$ -	$ 13.96	$ 14.50	$ 15.60	$ 26.06	$ 11.38	$ 65.12	$ 16.39
Priority A Projects	$ 44.06	$ -	$ -	$ 13.96	$ 14.50	$ 15.60	$ -	$ -	$ 41.49	$ 2.58
DS-1 Existing Pipeline Deficiencies Improvements (I-1, I-4 through I-10 from Akel Report)	$ 1.46	$ -	$ -	$ 0.46	$ 1.00	$ -	$ -	$ -	$ 1.46	$ -
DS -2 Priority A Fire Flow (>30% Def)	$ 16.71	$ -	$ -	$ 5.57	$ 5.57	$ 5.57	$ -	$ -	$ 14.21	$ 2.50
DS-3 Kilkare - Sunol Fire Flow	$ 23.78	$ -	$ -	$ 7.93	$ 7.93	$ 7.92	$ -	$ -	$ 23.71	$ 0.08
DS-4 Gray Eagle Connection to Kottinger Pressure Zone	$ 1.86	$ -	$ -	$ -	$ -	$ 1.86	$ -	$ -	$ 1.86	$ -
DS -5 Lemoine Bypass Pipeline Project	$ 0.25	$ -	$ -	$ -	$ -	$ 0.25	$ -	$ -	$ 0.25	$ -
Priority B Projects	$ 26.06	$ -	$ -	$ -	$ -	$ -	$ 26.06	$ -	$ 12.53	$ 13.53
DS-6 Priority B Fire Flow	$ 9.43	$ -	$ -	$ -	$ -	$ -	$ 9.43	$ -	$ 8.91	$ 0.52
DS-7 Tank 510 Site (Additional 0.25 MG)	$ 2.14	$ -	$ -	$ -	$ -	$ -	$ 2.14	$ -	$ 2.12	$ 0.02
DS-8 Tank 770 Site (Additional 0.15 MG)	$ 1.68	$ -	$ -	$ -	$ -	$ -	$ 1.68	$ -	$ 1.50	$ 0.18
DS-9 New 4.5 MG Tanks	$ 12.81	$ -	$ -	$ -	$ -	$ -	$ 12.81	$ -		$ 12.81
Priority C Projects	$ 11.38	$ -	$ -	$ -	$ -	$ -	$ -	$ 11.38	$ 11.10	$ 0.28
DS -10 Priority C Fire Flow	$ 9.88	$ -	$ -	$ -	$ -	$ -	$ -	$ 9.88	$ 9.60	$ 0.28
DS - 11 Upper Zone Tank Mixers	$ 1.50	$ -	$ -	$ -	$ -	$ -	$ -	$ 1.50	$ 1.50	
Rehabilitation and Replacement (Above Ground Facilities)	$ 50.59	$ -	$ -	$ 4.32	$ 1.86	$ 5.86	$ 15.75	$ 22.80	$ 50.59	$ -
Priority A Projects	$ 12.04	$ -	$ -	$ 4.32	$ 1.86	$ 5.86	$ -	$ -	$ 12.04	$ -
RR-1 Tank 1300 Rehab	$ 2.54	$ -	$ -	$ 2.54	$ -	$ -	$ -	$ -	$ 2.54	$ -
RR-2 McCloud Tank/PS Decommission	$ 1.24	$ -	$ -	$ 1.24	$ -	$ -	$ -	$ -	$ 1.24	$ -
RR- 3 Foothill PS Rehab	$ 1.32	$ -	$ -	$ -	$ 1.32	$ -	$ -	$ -	$ 1.32	$ -
RR - 4 Tank Inspections	$ 1.62	$ -	$ -	$ 0.54	$ 0.54	$ 0.54	$ -	$ -	$ 1.62	$ -
RR- 5 Vineyard PS Rehab	$ 2.13	$ -	$ -	$ -	$ -	$ 2.13	$ -	$ -	$ 2.13	$ -
RR- 6 Kottinger PS Rehab	$ 1.90	$ -	$ -	$ -	$ -	$ 1.90	$ -	$ -	$ 1.90	$ -
RR- 7 Decommission of Grey Eagle PS	$ 1.29	$ -	$ -	$ -	$ -	$ 1.29	$ -	$ -	$ 1.29	$ -
Priority B Projects	$ 15.75	$ -	$ -	$ -	$ -	$ -	$ 15.75	$ -	$ 15.75	$ -
RR - 8 Customer Meter Replacement	$ 9.30	$ -	$ -	$ -	$ -	$ -	$ 9.30	$ -	$ 9.30	$ -
RR- 9 Laurel Creek PS Rehab	$ 1.68	$ -	$ -	$ -	$ -	$ -	$ 1.68	$ -	$ 1.68	$ -
RR - 10 Ruby Hill PS Rehab	$ 2.04	$ -	$ -	$ -	$ -	$ -	$ 2.04	$ -	$ 2.04	$ -
RR- 11 Decommission Well No. 7	$ 0.81	$ -	$ -	$ -	$ -	$ -	$ 0.81	$ -	$ 0.81	$ -
RR- 12 Decommission Well 5 and 6	$ 0.71	$ -	$ -	$ -	$ -	$ -	$ 0.71	$ -	$ 0.71	$ -
RR- 13 Decommission Well No. 8	$ 1.21	$ -	$ -	$ -	$ -	$ -	$ 1.21	$ -	$ 1.21	$ -
Priority C Projects	$ 22.80	$ -	$ -	$ -	$ -	$ -	$ -	$ 22.80	$ 22.80	$ -
RR- 14 Other Facility Rehabilitation	$ 22.80	$ -	$ -	$ -	$ -	$ -	$ -	$ 22.80	$ 22.80	$ -
Rehabilitation and Replacement (Below Ground Facilities)	$ 71.28	$ -	$ -	$ -	$ -	$ -	$ 31.68	$ 39.60	$ 71.28	$ -
Priority B Projects	$ 31.68	$ -	$ -	$ -	$ -	$ -	$ 31.68	$ -	$ 31.68	$ -
RR - 15 Pipeline Rehabilitation Backlog (4.8-miles/year)	$ 31.68	$ -	$ -	$ -	$ -	$ -	$ 31.68	$ -	$ 31.68	$ -
Priority C Projects	$ 39.60	$ -	$ -	$ -	$ -	$ -	$ -	$ 39.60	$ 39.60	$ -
RR - 16 Pipeline Rehabilitation (3-miles/year)	$ 39.60	$ -	$ -	$ -	$ -	$ -	$ -	$ 39.60	$ 39.60	$ -
Other Projects	$ 6.7	$ -	$ -	$ -	$ 2.76	$ 3.77	$ 0.20	$ -	$ 6.73	$ -
Priority A Projects	$ 6.53	$ -	$ -	$ -	$ 2.76	$ 3.77	$ -	$ -	$ 6.53	$ -
SP - 1 Network Architecture (SCADA)	$ 1.01	$ -	$ -	$ -	$ -	$ 1.01	$ -	$ -	$ 1.01	$ -
SP - 2 Generator Projects[7]	$ 5.52	$ -	$ -	$ -	$ 2.76	$ 2.76	$ -	$ -	$ 5.52	$ -
Priority B Projects	$ 0.20	$ -	$ -	$ -	$ -	$ -	$ 0.20	$ -	$ 0.20	$ -
SP - 3 DER Projects (Tassajara and TO3)	$ 0.20	$ -	$ -	$ -	$ -	$ -	$ 0.20	$ -	$ 0.20	$ -
Project Total	$ 262.10	$ 15.00	$ 2.00	$ 30.28	$ 30.12	$ 25.23	$ 73.69	$ 85.78	$ 239.86	$ 22.25
Engineering/Administration FTE's[5]	$ 9.24			1.54	1.54	1.54	1.54	3.08		
Increased O&M Needs[6]	$ 12.42	$ -	$ -	$ -	$ 0.25	$ 0.53	$ 2.95	$ 8.69		
Total CIP	$ 283.77	$ 15.00	$ 2.00	$ 31.82	$ 31.91	$ 27.30	$ 78.18	$ 97.55		

Notes:

1. Projects are in 2024 dollars.

2. Costs are total projectdelivery costs

3. Project includes:
Project includes S-1, S-2, S-3, BS-1, I-2, and I-3 from Akel Report. Costs provided by City supersede Akel Report.

4. City is considering one of two options:
Project includes W-1, W-2, F-1, F-2, F-3, F-4, F-5 from Akel Report. Alternatively, City is evaluating a Regional Groundwater Facility project with Zone 7 with related distribution changes. Costs provided by City supersede the Akel report.

5. Engineering FTE to Implement CIP
- 1 FTE starting in FY24/25 which has already been approved and included in baseline operating expenses (not included here)
- 1 Additional FTE starting in FY26/27 which is included in this line item.
- 4 Limited duration FTE between FY26/27 and FY28/29

6. Includes increase in O&M for new facilities

7. Total costs for all generators including water, sewer, and storm is $9.39 million. "Costs show in this table is just for water.

CAPITAL IMPROVEMENT PLAN SUMMARY - IMPLEMENTATION SCENARIO 3

City of Pleasanton

Water System Management Plan

Project Type	Total Costs ($Millions)	CIP Phasing ($Million)							Cost Sharing	
		Near Term					Mid Term	Long Term	Existing Customers ($Million)	Future Customers ($Million)
		2024/2025	2025/2026	2026/2027	2027/2028	2028/2029	2029/2030 - 3033/2034	2034/2035 - 2038/2044		
Water Supply Projects	$ 52.00	$ 15.00	$ 2.00	$ 12.00	$ 11.00	$ -	$ -	$ 12.00	$ 46.14	$ 5.86
Priority A Projects	$ 40.00	$ 15.00	$ 2.00	$ 12.00	$ 11.00	$ -	$ -	$ -	$ 34.14	$ 5.86
WS -1 Near Term Distribution Capacity Improvements[3]	$ 13.50	$ 13.50	$ -	$ -	$ -	$ -	$ -	$ -	$ 11.42	$ 2.08
WS-2 Long Term Improvements for Water Supply Change[4]	$ 26.50	$ 1.50	$ 2.00	$ 12.00	$ 11.00	$ -	$ -	$ -	$ 22.72	$ 3.78
Priority C Projects	$ 12.00	$ -	$ -	$ -	$ -	$ -	$ -	$ 12.00	$ 12.00	$ -
WS-3 Future Water Supply Treatment	$ 10.00	$ -	$ -	$ -	$ -	$ -	$ -	$ 10.00	$ 10.00	$ -
WS-4 RCS Permanent Installation	$ 2.00	$ -	$ -	$ -	$ -	$ -	$ -	$ 2.00	$ 2.00	$ -
Distribution Capacity	$ 81.5	$ -	$ -	$ 0.46	$ 1.00	$ 8.85	$ 33.75	$ 37.44	$ 65.12	$ 16.39
Priority A Projects	$ 44.06	$ -	$ -	$ 0.46	$ 1.00	$ 8.85	$ 33.75	$ -	$ 41.49	$ 2.58
DS-1 Existing Pipeline Deficiencies Improvements (I-1, I-4 through I-10 from	$ 1.46	$ -	$ -	$ 0.46	$ 1.00	$ -	$ -	$ -	$ 1.46	$ -
DS -2 Priority A Fire Flow (>30% Def)	$ 16.71	$ -	$ -	$ -	$ -	$ 2.78	$ 13.93	$ -	$ 14.21	$ 2.50
DS-3 Kilkare - Sunol Fire Flow	$ 23.78	$ -	$ -	$ -	$ -	$ 3.96	$ 19.82	$ -	$ 23.71	$ 0.08
DS-4 Gray Eagle Connection to Kottinger Pressure Zone	$ 1.86	$ -	$ -	$ -	$ -	$ 1.86	$ -	$ -	$ 1.86	$ -
DS -5 Lemoine Bypass Pipeline Project	$ 0.25	$ -	$ -	$ -	$ -	$ 0.25	$ -	$ -	$ 0.25	$ -
Priority B Projects	$ 26.06	$ -	$ -	$ -	$ -	$ -	$ -	$ 26.06	$ 12.53	$ 13.53
DS-6 Priority B Fire Flow	$ 9.43	$ -	$ -	$ -	$ -	$ -	$ -	$ 9.43	$ 8.91	$ 0.52
DS-7 Tank 510 Site (Additional 0.25 MG)	$ 2.14	$ -	$ -	$ -	$ -	$ -	$ -	$ 2.14	$ 2.12	$ 0.02
DS-8 Tank 770 Site (Additional 0.15 MG)	$ 1.68	$ -	$ -	$ -	$ -	$ -	$ -	$ 1.68	$ 1.50	$ 0.18
DS-9 New 4.5 MG Tanks	$ 12.81	$ -	$ -	$ -	$ -	$ -	$ -	$ 12.81		$ 12.81
Priority C Projects	$ 11.38	$ -	$ -	$ -	$ -	$ -	$ -	$ 11.38	$ 11.10	$ 0.28
DS -10 Priority C Fire Flow	$ 9.88	$ -	$ -	$ -	$ -	$ -	$ -	$ 9.88	$ 9.60	$ 0.28
DS - 11 Upper Zone Tank Mixers	$ 1.50	$ -	$ -	$ -	$ -	$ -	$ -	$ 1.50	$ 1.50	
Rehabilitation and Replacement (Above Ground Facilities)	$ 50.59	$ -	$ -	$ -	$ 0.54	$ 0.54	$ 10.96	$ 38.55	$ 50.59	$ -
Priority A Projects	$ 12.04	$ -	$ -	$ -	$ 0.54	$ 0.54	$ 10.96	$ -	$ 12.04	$ -
RR-1 Tank 1300 Rehab	$ 2.54	$ -	$ -	$ -	$ -	$ -	$ 2.54	$ -	$ 2.54	$ -
RR-2 McCloud Tank/PS Decommission	$ 1.24	$ -	$ -	$ -	$ -	$ -	$ 1.24	$ -	$ 1.24	$ -
RR- 3 Foothill PS Rehab	$ 1.32	$ -	$ -	$ -	$ -	$ -	$ 1.32	$ -	$ 1.32	$ -
RR - 4 Tank Inspections	$ 1.62	$ -	$ -	$ -	$ 0.54	$ 0.54	$ 0.54	$ -	$ 1.62	$ -
RR- 5 Vineyard PS Rehab	$ 2.13	$ -	$ -	$ -	$ -	$ -	$ 2.13	$ -	$ 2.13	$ -
RR- 6 Kottinger PS Rehab	$ 1.90	$ -	$ -	$ -	$ -	$ -	$ 1.90	$ -	$ 1.90	$ -
RR- 7 Decommission of Grey Eagle PS	$ 1.29	$ -	$ -	$ -	$ -	$ -	$ 1.29	$ -	$ 1.29	$ -
Priority B Projects	$ 15.75	$ -	$ -	$ -	$ -	$ -	$ -	$ 15.75	$ 15.75	$ -
RR - 8 Customer Meter Replacement	$ 9.30	$ -	$ -	$ -	$ -	$ -	$ -	$ 9.30	$ 9.30	$ -
RR- 9 Laurel Creek PS Rehab	$ 1.68	$ -	$ -	$ -	$ -	$ -	$ -	$ 1.68	$ 1.68	$ -
RR - 10 Ruby Hill PS Rehab	$ 2.04	$ -	$ -	$ -	$ -	$ -	$ -	$ 2.04	$ 2.04	$ -
RR- 11 Decommission Well No. 7	$ 0.81	$ -	$ -	$ -	$ -	$ -	$ -	$ 0.81	$ 0.81	$ -
RR- 12 Decommission Well 5 and 6	$ 0.71	$ -	$ -	$ -	$ -	$ -	$ -	$ 0.71	$ 0.71	$ -
RR- 13 Decommission Well No. 8	$ 1.21	$ -	$ -	$ -	$ -	$ -	$ -	$ 1.21	$ 1.21	$ -
Priority C Projects	$ 22.80	$ -	$ -	$ -	$ -	$ -	$ -	$ 22.80	$ 22.80	$ -
RR- 14 Other Facility Rehabilitation	$ 22.80	$ -	$ -	$ -	$ -	$ -	$ -	$ 22.80	$ 22.80	$ -
Rehabilitation and Replacement (Below Ground Facilities)	$ 71.28	$ -	$ -	$ -	$ -	$ -	$ -	$ 71.28	$ 71.28	$ -
Priority B Projects	$ 31.68	$ -	$ -	$ -	$ -	$ -	$ -	$ 31.68	$ 31.68	$ -
RR - 15 Pipeline Rehabilitation Backlog (4.8-miles/year)	$ 31.68	$ -	$ -	$ -	$ -	$ -	$ -	$ 31.68	$ 31.68	$ -
Priority C Projects	$ 39.60	$ -	$ -	$ -	$ -	$ -	$ -	$ 39.60	$ 39.60	$ -
RR - 16 Pipeline Rehabilitation (3-miles/year)	$ 39.60	$ -	$ -	$ -	$ -	$ -	$ -	$ 39.60	$ 39.60	$ -
Other Projects	$ 6.7	$ -	$ -	$ -	$ -	$ 2.76	$ 3.76	$ 0.20	$ 6.72	$ -
Priority A Projects	$ 6.52	$ -	$ -	$ -	$ -	$ 2.76	$ 3.76	$ -	$ 6.52	$ -
SP - 1 Network Architecture (SCADA)	$ 1.00	$ -	$ -	$ -	$ -	$ -	$ 1.00	$ -	$ 1.00	$ -
SP - 2 Generator Projects[7]	$ 5.52	$ -	$ -	$ -	$ -	$ 2.76	$ 2.76	$ -	$ 5.52	$ -
Priority B Projects	$ 0.20	$ -	$ -	$ -	$ -	$ -	$ -	$ 0.20	$ 0.20	$ -
SP - 3 DER Projects (Tassajara and TO3)	$ 0.20	$ -	$ -	$ -	$ -	$ -	$ -	$ 0.20	$ 0.20	$ -
Project Total	$ 262.10	$ 15.00	$ 2.00	$ 12.46	$ 12.54	$ 12.15	$ 48.47	$ 159.47	$ 239.85	$ 22.25
Engineering/Administration FTE's[5]	$ 8.62			0.31	0.31	0.31	1.54	6.16		
Increased O&M Needs[6]	$ 17.36	$ -	$ -	$ -	$ 0.25	$ 0.50	$ 4.75	$ 11.86		
Total CIP	$ 288.09	$ 15.00	$ 2.00	$ 12.77	$ 13.10	$ 12.96	$ 54.76	$ 177.49		

Notes:

1. Projects are in 2024 dollars.

2. Costs are total project delivery costs

3. Project includes:
Project includes S-1, S-2, S-3, BS-1, I-2, and I-3 from Akel Report. Costs provided by City supersede Akel Report.

4. City is considering one of two options:
Project includes W-1, W-2, F-1, F-2, F-3, F-4, F-5 from Akel Report. Alternatively, City is evaluating a Regional Groundwater Facility project with Zone 7 with related distribution changes. Costs provided by City supersede the Akel report.

5. Engineering FTE to Implement CIP
- 1 FTE starting in FY24/25 which has already been approved and included in baseline operating expenses (not included here)
- 1 Additional FTE starting in FY26/27 which is included in this line item.
- 1 Additional FTE starting in FY34/35 which is included in this line item.

6. Includes increase in O&M for new facilities, and a 5% increase in O&M annually for project deferment.

7. Total costs for all generators including water, sewer, and storm is $9.39 million. "Costs show in this table is just for water.