F I N A L

CAPITAL IMPROVEMENT PLAN
FOR
4S RANCH AND RANCHO CIELO
WASTEWATER SYSTEMS

Prepared for:

OLIVENHAIN
Municipal Water District
1966 Olivenhain Road
Encinitas, CA 92024
Contact: George Briest, PE

Prepared by:

DUDEK
605 Third Street
Encinitas, California 92024
Contact: Tom Falk, PE

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ACKNOWLEDGMENTS

This *Capital Improvement Plan for Rancho Cielo & 4S Ranch Wastewater Systems* is a result of the combined efforts of the management and staff of the Olivenhain Municipal Water District and the Dudek Study Team. This partnership has resulted in a comprehensive evaluation of the wastewater systems, operations, and establishes framework for long-term planning to ensure sustainable, high-quality service to the District's customers. In particular, the efforts of the following individuals are acknowledged and greatly appreciated:

Olivenhain Municipal Water District

George Briest, PE .... Engineering Manager
Cari Dale .... Operations Manager
John Onkka .... Water Reclamation Facilities Supervisor
Gabriel Hernandez .... Water Reclamation Operator IV

Dudek Study Team

Tom Falk, PE .... Project Manager
Steve Deering, PE .... Principal-In-Charge
Wyatt Troxel, Grade V .... Senior Technical Advisor
Steve Jepsen .... Senior Technical Advisor
Phil Giori .... Lead Project Engineer
Amanda Combs, PE .... Project Engineer/Collection System
Greg Guillen, PhD .... Project Engineer/WRF Process Evaluation
Andrew Greis and Randy Deodat .... GIS Graphics
Jim Hudson (Rockwell Construction Services) .... Condition Assessment/I&C
Tom Klein (Rockwell Construction Services) .... Condition Assessment/I&C
Shane Trussell, PhD, PE (Trussell Technologies) .... Task Lead/Filtration Evaluation
Brett Faulkner (Trussell Technologies) .... Project Engineer/Filtration Evaluation

ABBREVIATIONS

AACE	The Association for Advancement of Cost Estimating International
CCI	Construction Cost Index
CIP	Capital Improvement Plan
CIPP	Cured-In-Place-Pipe
CoF	Consequence of Failure
EAAS	Extended Aeration, Activated Sludge
EAM	Enterprise Asset Management
ENR	Engineering News Record's
FMEA	Failure Mode and Effects Analysis
GASB	Governmental Accounting Standards Board
H_2S	Hydrogen Sulfide gas
I/I	Infiltration and Inflow
LOS	Level of Service
NaOCl	Sodium Hypochlorite
NaOH	Sodium Hydroxide
OH&P	Overhead and Profit
OMWD, District	Olivenhain Municipal Water District
PDCA	Plan-Do-Check-Act
PFD	Process Flow Diagram
PoF	Probability of Failure
R&R	Replacement and Rehabilitation
RAS	Return Activated Sludge
RUL	Remaining Useful Life
RWQCB	Regional Water Quality Control Board
SCADA	Supervisory Control and Data Acquisition
UVT	Ultraviolet Transmittance
WAS	Waste Activated Sludge
WRF	Water Reclamation Facility

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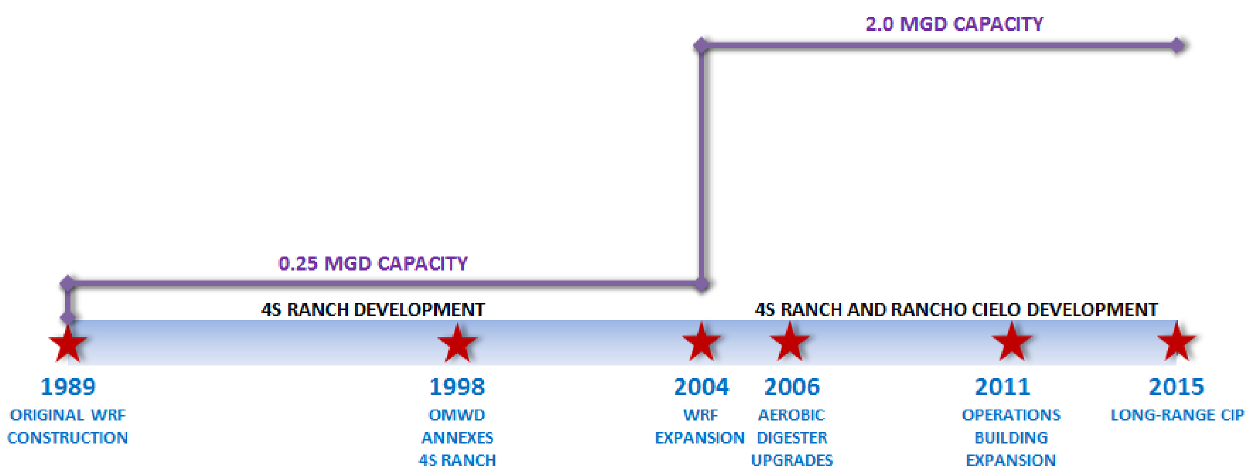
EXECUTIVE SUMMARY

Introduction

Olivenhain Municipal Water District (OMWD, District) is a Municipal Water District organized and operating pursuant to Water Code Sections 71000 et seq. OMWD was incorporated on April 9, 1959, as a water purveyor for landowners and residents in North-San Diego County. In 1998, OMWD annexed the 4S Ranch Sanitation District from the County of San Diego and subsequently expanded sewer service to the 4S Ranch and the Rancho Cielo developments. Figure ES-1 presents the major infrastructure development phases with significant milestones and upgrades over the past 25 years.

Figure ES-1. OMWD Wastewater System Development Timeline



The District's wastewater system, valued at approximately $102 million, includes the 2.0 million gallon per day 4S Ranch WRF, 60 miles of wastewater collection system piping, and 14 pump stations, providing sewer service to 6,600 customers in the 4S Ranch and Rancho Cielo service areas. Figure ES-2 presents the OMWD wastewater service area and major facilities including the 4S Ranch WRF, collection systems, and pump stations.

The purpose of this Capital Improvement Plan (CIP) is to develop long-range (10-yr and 20-yr) infrastructure planning and budgeting for the 4S Ranch and Rancho Cielo wastewater systems in order to ensure continued high-quality service to OMWD wastewater customers. The CIP is intended to support long-term financial planning including wastewater rate adjustments and includes a description of the study methodology, descriptions of unique and programmatic CIP projects and estimated budgets, and a time-based implementation plan. The technical analysis that provides backup to the defined projects is included in a series of technical memoranda, located in the appendices of the CIP report.

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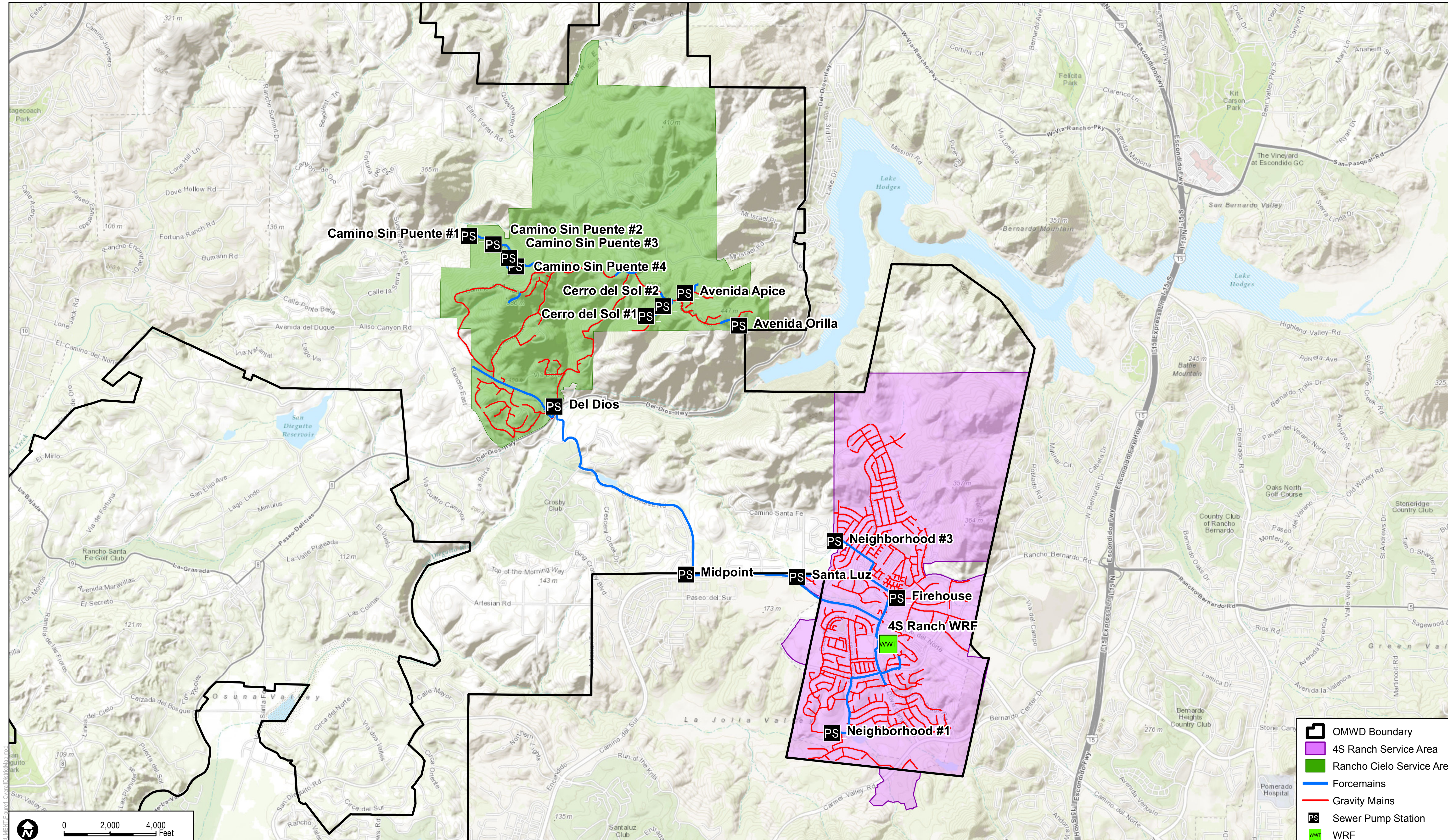

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SOURCE: Olivenhain MWD 2014; SanGIS 2015; ESRI Basemap 2015

Olivenhain MWD Project

FIGURE ES-2

Overall District Map

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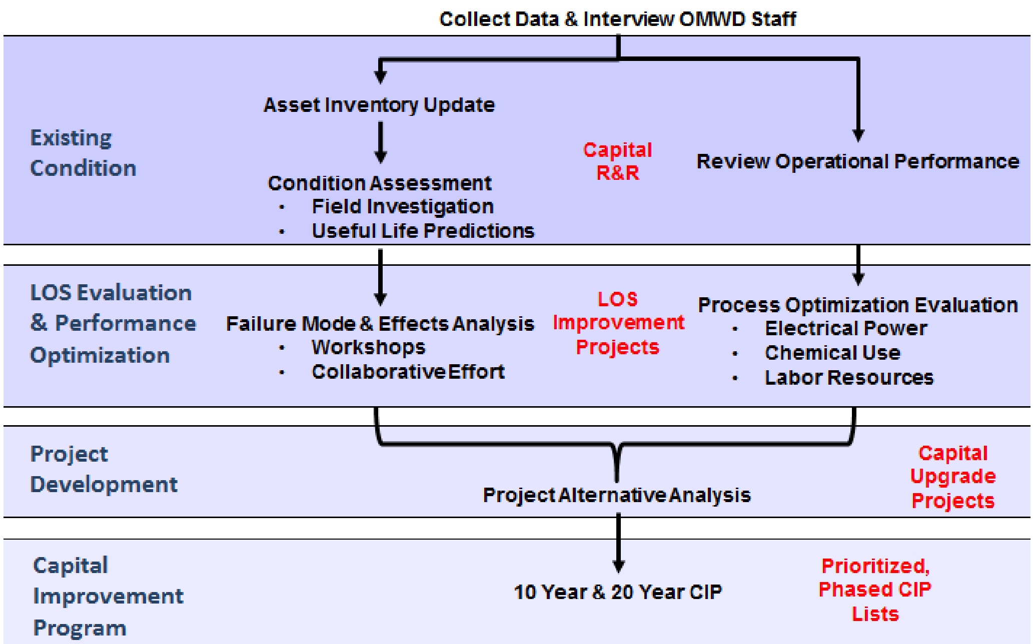
Methodology

The scope of work for development of this CIP pursued two parallel tracks of evaluation and data analysis to identify and define CIP projects. Figure ES-3 depicts the approach to the CIP development. On the left-hand track, existing assets were inventoried and condition assessed to identify replacement and rehabilitation (R&R) projects. Using data derived from review of existing conditions and operational performance, failure mode and effects analyses (FMEA) were performed along with process optimization studies to identify "Level of Service" (LOS) improvement projects. On the right-hand track, operational performance data was reviewed to identify capital projects while process optimization opportunities were evaluated to identify potential savings and LOS improvement projects. As project alternatives were identified, analyses were performed balancing R&R and LOS goals to develop a CIP project list.

Figure ES-3. Capital Improvement Project Definition Flow Chart



The District's Enterprise Asset Management database was updated to include approximately 850 unique assets, excluding the collection system piping. Asset management principles were used to define expected useful life based on condition assessments and defined life expectancy data. The updated EAM database will be used by the District to support its computer maintenance management system.

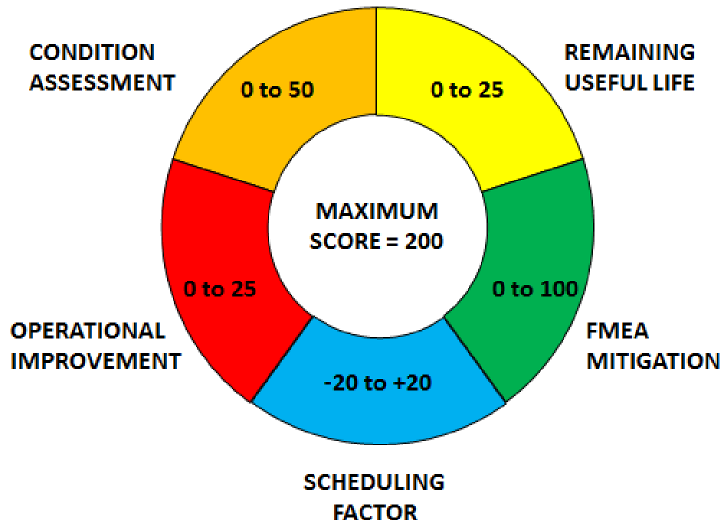
Cost estimates were prepared for CIP projects, defined as unique projects with values greater than $50,000. Cost estimates built off the asset inventory database accounted for major equipment and material quantities and unit prices with multipliers for local sales tax, delivery, installation, and contractor overhead and profit. Sub-disciplines (e.g., electrical, controls) were estimated using analogous multipliers. Soft costs (e.g., engineering, construction support services, and administration) and contingency were added to the construction cost subtotal based on project complexity and scale.

Estimates are defined as Class 5 or Class 4 per the *Association for Advancement of Cost Estimating International.*

Prioritized CIP List

Once the list was defined, projects were prioritized based on weighted criteria as illustrated in Figure ES-4. The primary drivers of project need are based on the technical analyses including remaining useful life, condition assessment, operations assessment, and the failure modes and effects analysis. An additional scheduling factor was applied to allow for adjustments to priority scores in order to smooth the multi-year CIP. The scoring corresponds directly with the technical analysis. For example, if a major asset or process was observed to be in "poor" condition during condition assessment, the replacement project would receive a "50" point contribution from condition assessment, therefore significantly increasing the priority score representative of the relative urgency to complete the improvement project in the near-term.

Figure ES-4. CIP Project Prioritization Factors



The maximum priority score is theoretically "200"; however, of the 80 defined projects, 75% received priority scores less than 50. The scheduling factor is not applied to score a project above a "200" or below a "0" score. Projects in the upper quartile, those receiving priority scores between 50 and 145, were programmed for implementation over the first 5-year period (2016 to 2020). For smaller components, those not satisfying the $50,000 CIP definition, annualized programmatic budgets were defined. For example, the WRF contained over 110 small pumps, an additional 40 small motors, and nearly 90 unique instruments. These components were grouped into annual replacement budgets for "Pumps and Motors" and "Instrumentation" using asset management principles.

The highest priority projects are prioritized for implementation within the first five years of the CIP. These projects are listed by implementation year in Table ES-1. Individual project costs in Table ES-1 reflect the total project cost, and are not spread over multiple fiscal years to reflect planning, design, and construction scheduling. The following section, Implementation Plan, and Figure ES-5 reflect the project costs spread over multiple fiscal years with consideration of schedule.

Table ES-1. Highest Priority Project List

PROJECT NO.	PROJECT NAME	IMPLEMENTATION YEAR	COST
WRF - 9.1	Upgrade UV Disinfection System[1]	2016	$ 2,163,000
WRF - 7.1	Upgrade Flow Equalization Basins	2016	$ 789,000
WRF - 11.2	Overflow Pond Upgrades	2016	$ 948,000
4S - 5.0	Upgrade Neighborhood #1 Sewer Pump Station	2016	$ 780,000
RC - 4.5	Odor Control Improvements at Midpoint SPS	2016	$ 256,000
2016 Implementation Year Total			**$ 4,936,000**
WRF - 8.0	Replace Tertiary Filters[1]	2017	$ 3,825,000
WRF - 11.4	Replace Overflow Pond Strainer	2017	$ 191,000
WRF - 1.1	Replace Existing Headworks Screenings Equipment	2017	$ 576,000
4S - 4.0	CIPP Line Root Impacted Hot Spot Collection System Pipe	2017	$ 35,000
2017 Implementation Year Total			**$ 4,627,000**
WRF - 2.1	Biological Treatment Upgrade (Process Study & Pre-Design)	2018	$ 50,000
2018 Implementation Year Total			**$ 50,000**
WRF - 2.2	Upgrade Plant B Oxidation Ditch Aeration System	2019	$ 960,000
WRF - 6.1	Dewatering Technology Study (Process Study and Pre-Design)	2019	$ 50,000
WRF - 6.2	Upgrade Dewatering System	2019	$ 1,766,000
4S - 6.5	Neighborhood #3 Sewer Pump Station Improvements	2019	$ 124,000
RC - 4.6	Midpoint Sewer Pump Station Improvements	2019	$ 174,000
RC - 5.5	Del Dios Sewer Pump Station Improvements	2019	$ 132,000
2019 Implementation Year Total			**$ 3,206,000**
4S - 2.0	Line Manholes Subject to High H_2S Exposure	2020	$ 48,000
RC - 2.0	Line Manholes Subject to high H_2S exposure	2020	$ 240,000
2020 Implementation Year Total			**$ 288,000**
5-Year Total by Implementation			**$ 13,107,000**

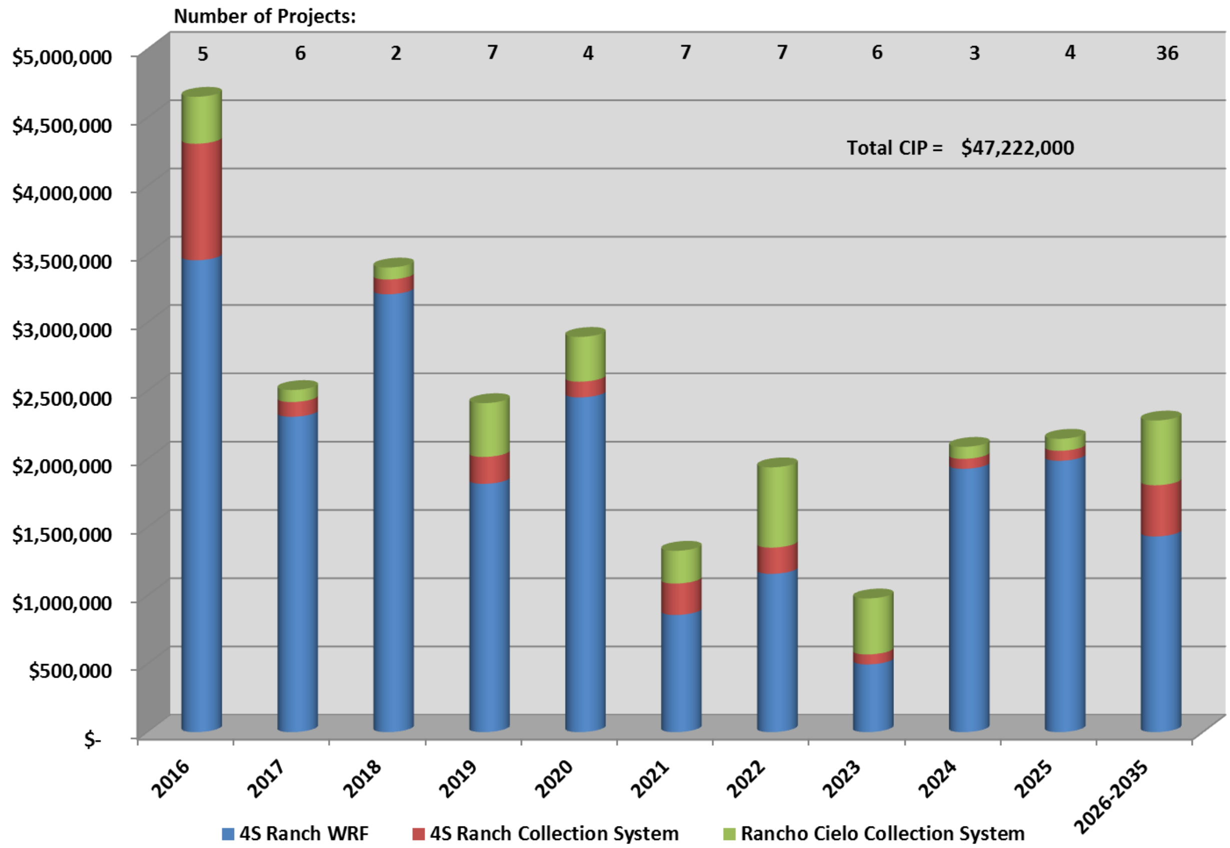
[1] Alternative planning approach, schedule, and cost have been adopted by the District in a 10 year Capital Spending Plan

Implementation Plan

Based on the project prioritization, a CIP implementation plan was developed. The CIP schedules high priority projects in the early years, equipment replacements as useful life expectancy expires, and establishes annualized budgets for replacement of non-CIP assets. Figure ES-5 presents the 20-year CIP budget, with individual budgets for years 1through 10 and an average annual budget for years 11 through 20. The annualized budgets are segregated by cost center: 4S Ranch WRF, 4S Ranch Collection System, and Rancho Cielo Collection System to assist the District in preparing financing plans and rate studies in compliance with Proposition 218.

The 20-year CIP totals $47.2 million, consisting of several significant facility upgrades in the initial 5-year planning period and an average expenditure forecast of $2.4 million per year over the 20-year CIP.

Figure ES-5. Capital Improvement Plan, 20-Year Budget[2]



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[2] Individual Project Costs spread over multiple fiscal years to reflect planning, design, and construction schedules

Approved Budget

The District has utilized the workshops, CIP recommendations, and cost estimates made in this report and tailored the information to create an OMWD Board-approved 10 Year Capital Spending Plan starting in the 2015-16 fiscal year. The approved plan contains projects similar in cost and scope to project recommendations made herein as well as other projects determined by District needs outside of the scope of this report. The technical analysis and project recommendations made in this report and subsequent appendices have been preserved for the District's reference when revisiting the capital improvement budget in future years. It is expected that over time, the budget may be modified to meet the immediate needs of the District, therefore, projects recommended in this report that are not included in the 2015-16 fiscal year budget may serve as a guide for in future year budgets.

The complete OMWD Board-approved 10 Year Capital Spending Plan is presented in Appendix I. The OMWD 10 Year Capital Spending Plan includes all planned projects within the 4S WRF, 4S Collection System, and Rancho Cielo System combined.

The District has adopted an alternative process and timing approach to the recommended projects described in this report particularly with regard to the tertiary treatment and disinfection process upgrades at the 4S Ranch WRF. The alternative planning allows the District to spread the cost of these major improvements over a longer period of time.

A summary of the top ten projects in the OMWD Board-approved budget by highest total cost allocation are presented in Table ES-2 without regard to spread of cost over multiple years.

Table ES-2. Project List by Highest Total Cost Allocation

PROJECT NAME	IMPLEMENTATION YEAR	COST
Replace Ultra-Violet System	2023	$ 3,732,000
Replace Neighborhood #1 Pump Station	2019	$ 3,478,000
Replace Wet Weather Storage Pond Liner	2016	$ 2,928,000
Replace Tertiary Filters	2017	$ 1,591,000
Biosolids Process and Handling Upgrades	2024	$ 1,413,000
Plant Odor Control Modifications	2020	$ 1,193,000
Complete Campus – Building D	2016	$ 1,072,000
Equalization Basin Improvements	2016	$ 808,000
Replace Headworks	2016	$ 628,000
Replacement Program – Pumps and Motors	2016	$ 599,000

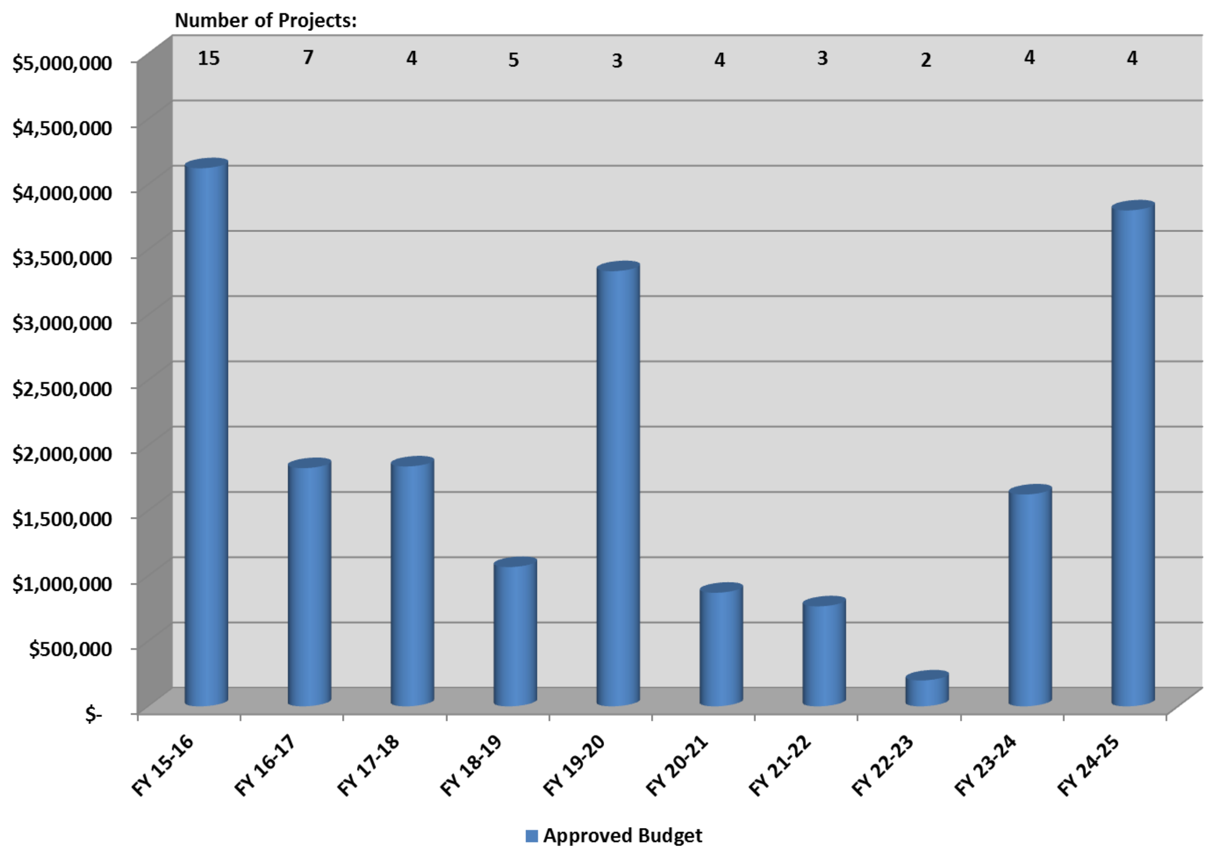
The OMWD Board-approved 10 Year Capital Spending Plan annual budget allocations are presented in Figure ES-6.

The Capital Spending Plan includes fifteen capital projects with funds allocated for the 2015-16 fiscal year. Of these, seven projects have funds allocated for the subsequent 2016-17 fiscal year. For the following eight fiscal years there is budgeting allocated for no more than five projects per year.

This Capital Spending Plan includes a total of twenty-six unique projects, ranging in cost from $15,000 to $3,732,000. The total budget for the 10 Year Capital Spending Plan is $19,444,000 for an average annual projected budget of $1,944,400 per fiscal year.

As can be compared in Figure ES-6, there is a wide variation in budget from year to year with higher budget years driven by the scheduling of several high value projects separated by four to five years of lower annual budgets.

Figure ES-6. Approved 10 Year Capital Spending Plan



1 INTRODUCTION

1.1 Background

Olivenhain Municipal Water District is a Municipal Water District organized and operating pursuant to Water Code Sections 71000 et seq. OMWD was incorporated on April 9, 1959, to develop an adequate water supply for landowners and residents in North-San Diego County communities including portions of the City of Carlsbad, City of Encinitas, Cardiff, Olivenhain, La Costa, Fairbanks Ranch, 4S Ranch, Rancho Cielo, and Elfin Forest. On June 14, 1960, residents of OMWD voted to become a member of the San Diego County Water Authority, thus becoming eligible to purchase water transported into San Diego County via the aqueducts of SDCWA and its wholesaler, Metropolitan Water District of Southern California. At over 48 square miles, OMWD currently serves a population of approximately 80,000 residents in northern San Diego County.

During the economic boom of the late 1980s, San Diego County experienced substantial growth. During this time, the first portion of 4S Ranch was developed. In order to serve the sanitation needs of this development, the County of San Diego built a small wastewater treatment plant. In 1998, OMWD annexed the sanitation district from the County. Further development of 4S Ranch and the Rancho Cielo developments prompted an expansion to the 4S Ranch Water Reclamation Facility (WRF) and extension of wastewater collection facilities to serve those areas. The District's wastewater and recycled water operations now include the 2.0 million gallon per day 4S Ranch WRF, 60 miles of wastewater collection system piping, 46 miles of recycled water pipeline, and sewer service to 6,600 connections in 4S Ranch and Rancho Cielo.

1.2 Purpose

The purpose of this CIP is to develop long-range (10-yr and 20-yr) infrastructure asset management planning and budgeting for the 4S Ranch and Rancho Cielo wastewater systems in order to ensure continued high-quality service to the OMWD wastewater customers. The CIP is aligned with OMWD's Vision and Mission (see inset, right) and is intended to support long-term financial planning including wastewater rate adjustments.

OMWD Vision

Olivenhain Municipal Water District aspires to cost-effectively provide high-quality services garnering the trust and respect of its customers, employees, partners, and fellow water agencies.

OMWD Mission

Olivenhain Municipal Water District is a mutli-functioning public agency that is dedicated and committed to preserving present and future customers by:

Water

Providing safe, reliable, high-quality drinking water while exceeding all regulatory requirements in a cost-effective and environmentally responsive manner.

Recycled Water/Wastewater Treatment

Providing recycled water and wastewater treatment in the most cost-effective and environmentally responsive method.

Parks

Safely operating the Elfin Forest Recreational Reserve and providing all users with a unique recreational, educational, and environmental experience.

Emergency Management

Complying with policies and procedures that adhere to local, state, and federal guidelines for national security and disaster preparedness.

Sustainable Operations

Pursuing alternative and/or renewable resources with the most sustainable, efficient, and cost-effective approach

- OMWD 2014 Strategic Plan

1.3 Methodology

The 4S Ranch and Rancho Cielo wastewater systems are master-planned communities with the majority of the built infrastructure completed within the last 15 years. Much of the infrastructure was built by the respective developers and dedicated to OMWD through development services agreements. Aside from entitlement documentation and record drawings, no other relevant facility planning documents exist for these systems. Because the service areas are fully defined by the respective developments, the District has not been required to prepare service expansion or capacity analyses for the wastewater systems. This Capital Improvement Plan compiles record information and through the use of asset management principles, develops a long-range plan to ensure sustainable operations and capital reinvestment.

1.3.1 Capital Improvement Project Definition

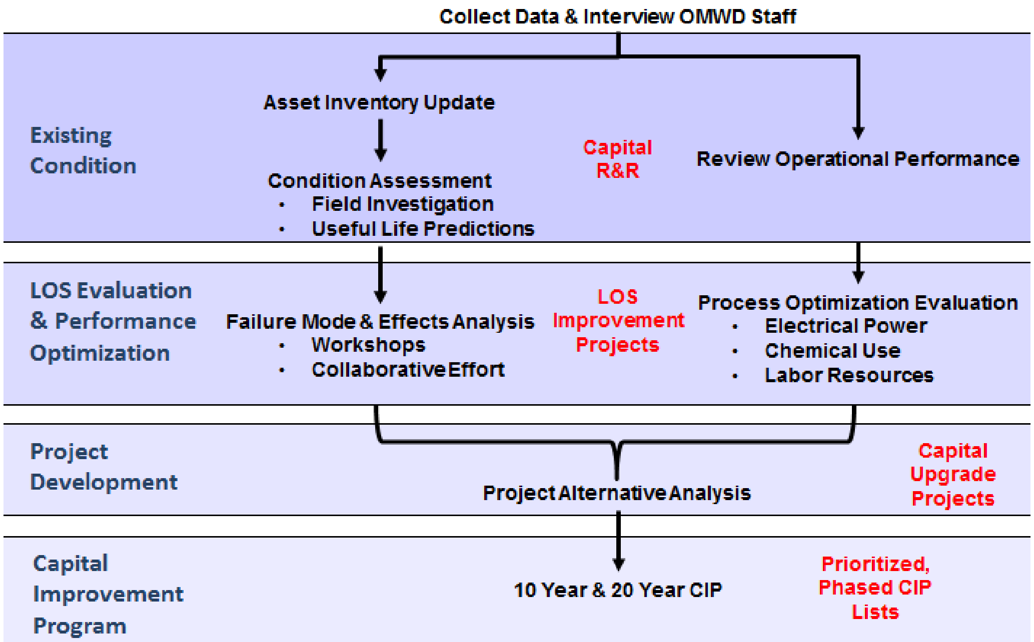
The scope of work for development of this CIP pursued two parallel tracks of evaluation and data analysis to identify and define CIP projects. Figure 1-1 depicts the approach to the CIP development. On the left-hand track, existing assets were inventoried and their condition assessed to identify replacement and rehabilitation (R&R) projects. Using data derived from review of existing conditions and operational performance, failure mode and effects analyses (FMEA) were performed along with process optimization studies to identify "Level of Service" (LOS) improvement projects. On the right-hand track, operational performance data was reviewed to identify capital projects while process optimization opportunities were evaluated to identify potential savings and LOS improvement projects. As project alternatives were identified, analyses were performed balancing R&R and LOS goals to develop a CIP project list. Once the list was defined, projects were prioritized based on weighted criteria: Remaining Useful Life, Asset Condition, Operational Improvements, FMEA Risk Mitigation, and a CIP Scheduling Factor. The projects are then sorted into a 20-year CIP program with emphasis on the 10-year planning horizon.

The Governmental Accounting Standards Board (GASB) Statement No. 34, *Basic Financial Statements – and Management's Discussion and Analysis – for State and Local Governments*, Paragraph 19 provides the following authoritative definition of capital assets:

> The term *capital assets* include land, improvements to land, easements, buildings, building improvements, vehicles, machinery, equipment, works of art and historical treasures, infrastructure, and all other tangible or intangible assets that are used in operations and that have initial useful lives extending beyond a single reporting period.

For accounting purposes, if a cost benefits only the current period then it is considered an "expendable" item and categorized as an operating expense, not a capital asset. Conversely, if a cost benefits more than one period, then a portion of that cost can be allocated to each benefitting period (depreciated) and thus forms the basis for a capital asset or "durable" item. For the purposes of defining projects in this CIP, the asset inventory is limited to tangible capital assets (e.g., structures, equipment, infrastructure), excluding land which is inferred to benefit operations indefinitely and therefore is never recognized as an expense. Intangible capital assets (e.g., computer software, water rights, easements) are excluded from this CIP.

Figure 1-1. Capital Improvement Project Definition Flow Chart



Capital Projects, as defined in this CIP, consist of replacement or upgrades to tangible assets with estimated project valuation exceeding $50,000. Upgrades identified through the course of the work that do not meet the criteria of a capital project are either grouped with related facility improvements or grouped as "programmatic" project line items. Criteria and examples of capital projects and non-capital projects are presented in Table 1-1.

Table 1-1. Capital vs. Non-Capital Project Criteria

Criteria	Capital Project	Non-Capital Project
Estimated Value	Greater than $50,000	Less than $50,000
Reoccurrence	Greater than 1 year (Durable)	Less than 1 year (Expendable)
Engineering	Specifications Required	No Specifications Required
Procurement	Competitive Bid	Sole Source or Competitive Proposals
Installer	Contractor	District Staff or Contractor
Examples	Major Equipment Replacement Facility or System Upgrade Minor Asset Replacement Programs	Minor Equipment Replacement Routine Maintenance Rehabilitation of Minor Assets

1.3.2 PROPOSITION 218

This CIP will support the District's initiatives to set wastewater system fees which are subject to Proposition 218. Proposition 218, the "Right to Vote on Taxes Act" was passed by California voters in November 1996, requiring voter approval prior to imposition or increase of general taxes, assessments, and certain user fees. Wastewater service fees are subject to Proposition 218 regulations which carefully define rules and restricts for benefit assessments. As it applies to wastewater service providers, rates must be tied to the specific benefit realized by the fee payer. Fees charged to property owners may not exceed the cost of providing the service which includes maintaining infrastructure.

This CIP will establish long-term planning budgets for sustainable operations of the OMWD wastewater facilities. The development of this CIP is founded on asset management practices, which aim to maximize return on capital investments, allow for sustainable capital expenditure planning. These budgets will support a rate structure that generates revenue necessary to maintain the facilities in operable condition.

1.3.3 Asset Inventory and Condition Assessments

The initial task in development of this CIP was an update to the District's existing asset inventory database. OMWD maintains an Enterprise Asset Management (EAM) program to inventory and organize preventative maintenance operations on documented assets. The asset inventory has been populated by District staff over the past five years and as of November 2014, contained 1,008 registered assets, ranging from individual pressure gauges to major process equipment. Upon review of the asset registry, nearly 400 assets were re-coded as components of a "parent" asset. Through review of available record drawings and field investigations, the asset registry was updated to consist of 844 unique assets for inclusion in the CIP. Figure 1-2 presents the Updated Asset Registry Categories. The "Other" category consists of hoists and cranes, vehicles, generators, and miscellaneous equipment.

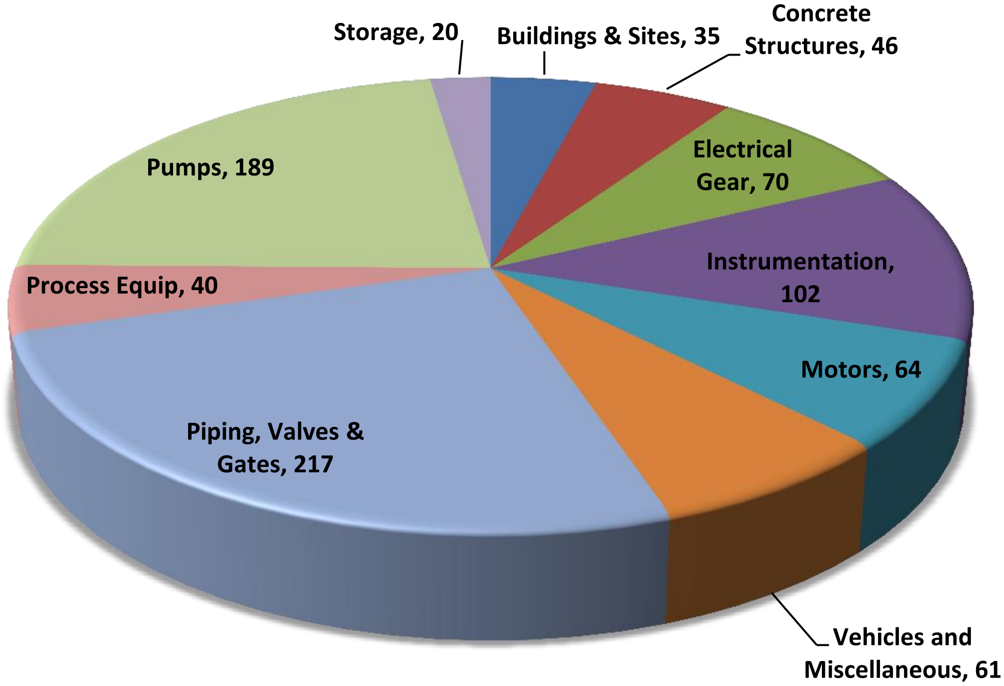
Refer to Technical Memorandum No. 1 in Appendix A for a complete asset inventory list.

Collection system piping was excluded from the asset registry as it is inventoried in GIS. The collection system assets in both the 4S Ranch and Rancho Cielo service areas include: approximately 347,000 linear feet (66 miles) of gravity mains, 1,215 manholes, 14 sewer pump stations in the collection system, ranging in size from 60 gpm to 1,700 gpm, and approximately 62,600 linear feet (12 miles) of forcemains.

The WRF and pump stations were visited during the months of November 2014 and January 2015 to perform condition assessments of the major assets and infrastructure. The condition assessment team performed visual observations of the physical assets including the civil/structures, mechanical systems, and electrical systems. Through discussions with District staff, an assessment was made of the existing Supervisory Control and Data Acquisition (SCADA) system.

Refer to Technical Memorandum Nos. 2A, 2B, 2C in Appendix B for condition assessments of the WRF, Pump Stations, and Collection Systems, respectively.

Figure 1-2. Asset Registry Categories



1.3.4 Failure Mode and Effects Analysis

4S Ranch Water Reclamation Facility: Through a series of collaborative workshops and onsite meetings with District Staff, a Failure Mode and Effects Analysis (FMEA) was performed on the WRF. The FMEA analyzed process unit functions at a system level and evaluated the probability and consequences of system failure. Using installation dates determined in the asset inventory (TM No. 1) and asset conditions (TM No. 2A), remaining useful life (RUL) was estimated for each WRF asset. The RUL and asset condition were used to estimate probability of failure. The product of the "Consequence of Failure" (CoF) and "Probability of Failure" (PoF) with consideration for system redundancy determines an assets "criticality" or "risk" factor. Mitigation measures were recommended for systems or components that exhibited high criticality factors.

Collection System Pump Stations: To complete the FMEA for the pump stations, a desktop gap analysis was performed. All pump stations perform a common function, to collect and convey wastewater within the collection system, and generally contain similar components, therefore, all pump stations exhibit similar failure modes. A spreadsheet model was created to highlight specific pump station design "best practices," representing "equivalent redundancy measures" that mitigate failure of a pump station component. For example, an emergency generator with automatic transfer switch provides redundancy to the primary utility power. For the FMEA, it is assumed that an unmitigated functional failure at any pump station would result in a sewer overflow which is unacceptable and does not meet the District's level of service goal of "zero overflows." The consequence of failure for all failure modes received a score ranging from "7" to "10", depending on the pump station capacity and thus relative consequence of failure. Probability of failure was based on asset age and an unmitigated criticality score. Each pump station was then screened for the best design practices in order to identify high criticalities and to identify mitigation measures or "equivalent redundancy measures" necessary to reduce criticality to an acceptable level.

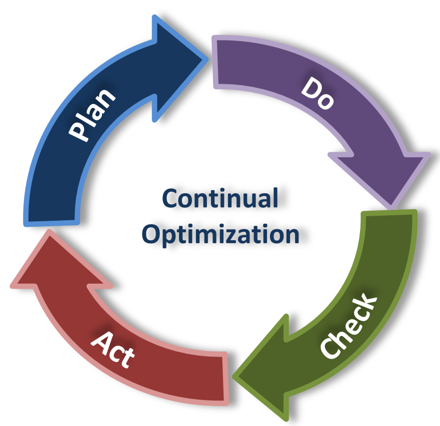
The FMEA for the WRF and Pump Stations is documented in Technical Memorandum No. 4 in Appendix H.

1.3.5 Process Evaluation

A high-level evaluation of the WRF process performance was completed to benchmark plant performance and to identify potential opportunities for process optimization and/or capital upgrade projects to improve performance or efficacy of unit processes. The Process Evaluation considered plant loading, current compliance profile, and benchmarked electrical power usage, chemical usage, and sludge handling. Anticipating that the tertiary treatment system is nearing the end of its useful life, focused studies on the filtration and disinfection systems were also performed.

The Process Evaluation studies are documented in Technical Memorandum Nos. 3, 3A, and 3B located in Appendices E, F and G.

1.3.6 Operational Changes



Based on evaluation of the current operating profile, a series of operational adjustments are recommended to improve efficiency through reduction in power consumption and chemical usage while maintaining or improving plant performance. Implementing operational changes are most productive if executed in a methodical approach that allows for ongoing performance evaluation and adjustments. The "Plan-Do-Check-Act" (PDCA) approach, also known as the iterative 4-step "Deming Cycle", is recommended for the execution of proposed operational adjustments. As OMWD staff prepares to implement operational changes, it is recommended that thorough implementation plans be prepared in advance. The implementation plans will allow evaluation of performance improvements and should include step-wise approach with monitoring protocols that continuously check process performance against expected outcomes to allow adjustments to be made that effectively produce the anticipated results and so that unanticipated consequences do not jeopardize goals.

1.4 Budgetary Cost Estimating

For each defined project, a budgetary cost estimate is presented. The cost estimates are based on anticipated construction cost values with contingency and soft cost multipliers added to define a total "project cost".

Procedures and guidelines used in the preparation of estimates of probable construction costs were based on:

- Vendor quotes and published catalog costs for major equipment and mechanical components. Sales tax of 8% is added to material and equipment quotes. Multipliers for delivery, in-field services, and installation tools, parts, labor, and contractor overhead and profit (OH&P) were applied to derive an installed unit cost.
- Parametric unit cost values derived from recent similar projects for demolition, piping, civil work, and electrical work. Scaling factors were applied to adjust for size and complexity.
- Estimates from previously completed studies for the District.
- Unit cost factors developed for specific components of the project, as applicable.
- Project location factors used to normalize costs to the appropriate locale using RS Means.

1.4.1 Cost Indices

In developing project cost estimates, it is common to use historical data from similar projects (e.g., detailed cost estimates, bids from constructed projects). To be relevant to the immediate project, one must consider the date and geographical region of the cost data. The industry standard barometer of changes in construction market conditions over time is the Engineering News Record's (ENR) Construction Cost Index (CCI). This index is computed from constant quantities of structural steel (weighted 15%), portland cement (2%), lumber (10%), and common labor (73%) in 20 cities, the average of which is considered to be the national average and based on a value of 100 in 1913 (Sanks, 852). Reference costs are normalized to December 2014 dollars using published historical cost data from Engineering News Record, Construction Cost Index (ENR-CCI). <u>The Los Angeles ENR-CCI for December 2014 is 10747.68</u>.

1.4.2 Cost Estimate Classifications

The Association for Advancement of Cost Estimating International provides guidelines for cost estimating practices and classification. The *Cost Estimate Classification System – As Applied in Engineering,* *Procurement, and Construction for the Process Industries* (AACE International Recommended Practice No. 18R-97) provides guidelines for applying the principles of estimate classification to infrastructure projects such as those defined in this CIP. A summary of the AACE classification system is presented in Table 1-2.

For the development of CIP projects, Class 5 estimates are used for "minor" assets (less than $50,000) while Class 4 estimates are used for "major" assets (more than $50,000). The complete description of each estimate classification level is documented in Technical Memorandum 1 located in Appendix A.

Table 1-2. Summary of Cost Estimate Classification System

	Primary Characteristic	Secondary Characteristic			
Estimate Class	**Level of Project Definition** Expressed as % of complete definition	**End Usage** Typical purpose of estimate	**Methodology** Typical estimating method	**Expected Accuracy Range [a]** Typical variation in low and high ranges	**Preparation Effort [b]** Typical degree of effort relative to least cost index of 1
Class 5	0% to 2%	Concept Screening	Capacity Factored, Parametric Models, Judgement or Analogy	L: -20% to -50% H: +30% to +100%	1
Class 4	1% to 15%	Study or Feasibility	Equipment Factored or Parametric Models	L: -15% to -30% H: +20% to +50%	2 to 4
Class 3	10% to 40%	Budget, Authorization, or Control	Semi-detailed Unit Costs with Assembly Level Line Items	L: -10% to -20% H: +10% to +30%	3 to 10
Class 2	30% to 70%	Control or Bid/Tender	Detailed Unit Cost with Forced Detailed Take-Off	L: -5% to -15% H: +5% to +20%	4 to 20
Class 1	50% to 100%	Check Estimate or Bid Tender	Detailed Unit Cost with Detailed Take-Off	L: -3% to -10% H: +3% to +15%	5 to 100

Notes:

[a] The state of process technology and availability of applicable reference cost data affect the range markedly. The +/- value represents typical percentage variation of actual costs from the cost estimate after application of contingency (typically at a 50% level of confidence) for a given scope.

[b] If the range index value of "1" represents 0.0005% of project costs, then an index value of 100 represents 0.5%. Estimate preparation effort is highly dependent upon the size of the project and the quality of estimating data and tools.

1.4.3 Contingency

Project contingencies are applied to cover uncertainties in the estimating practice including unknown or unforeseen costs. Industry standard contingencies can range from 10% to +30%, depending on the confidence level of the estimate (i.e., project stage, risk, scope development, engineering constraints, etc.,). Unless noted otherwise, for these alternative analyses, a 20% contingency was added to the estimated construction cost.

1.4.4 Implementation Costs

Implementation cost allowances (a.k.a. "soft costs") are included in project estimates for costs directly associated with delivering a project from planning through construction that are not included in the construction estimate (i.e., Planning, Design, Permitting, Construction Management/Inspection, Project Administration, and Commissioning and Closeout). It is recognized that projects with smaller construction costs have a larger percentage of project delivery (soft) costs, while the larger projects have a smaller percentage of soft costs. This is primarily due to the number of implementation cost tasks that have relatively fixed costs such as contract processing, permit fees, bidding, etc. These fixed costs have a greater impact on the smaller projects.

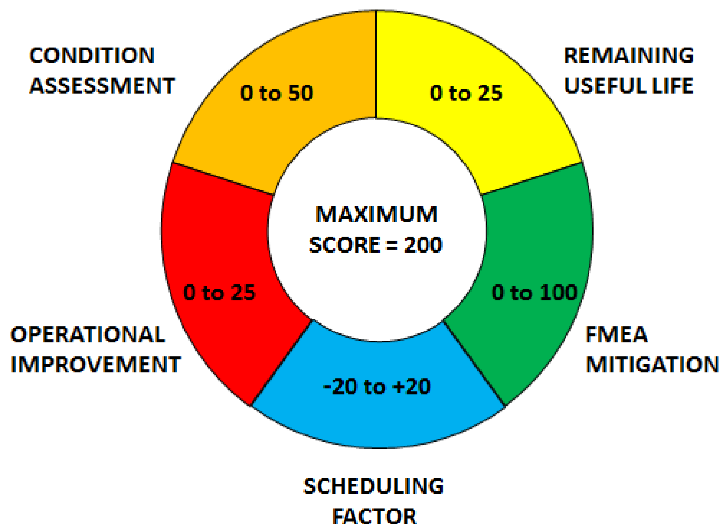
Seven of the largest municipalities in California (Cities of Long Beach, Los Angeles, Oakland, Sacramento, San Diego, San Jose, and the City and County of San Francisco) have collaborated to study over the last 10 years, the actual cost of delivering capital improvement projects. *The California Multi-Agency CIP Benchmarking Study* was first published in 2002 and has been updated yearly to reflect a larger number of projects. The results of this benchmarking study provide insight into soft costs of California projects as a function of project type and size. Of 112 municipal projects (median construction value of $3.32 million) including reservoirs and treatment plants, and 252 pipeline projects (median construction value of $0.86 million), the project implementation or delivery costs averaged 36% to 37% of the construction costs. Table 1-3 presents the project implementation allowances (soft cost) classification system utilized in the CIP development. Each project is assigned a "Soft Cost Class" of A, B, C, or D, depending on the project size and complexity.

Table 1-3. Summary of Cost Estimate Classification System

Soft Cost Class	Category	% of Constr. Cost	Comments
A	Engineering CM & ESDC Administration *Total Soft Costs*	8% 15% 2% *25%*	Projects that are relatively simple (e.g., long pipelines, large pond liners, large (+$300k) equipment replacement) and/or larger (e.g., full treatment plant design), possibly with repetitive aspects.
B	Engineering CM & ESDC Administration *Total Soft Costs*	10% 18% 3% *31%*	Projects of average size and/or complexity (e.g., new pump stations, treatment plant component design, major equipment replacement)
C	Engineering CM & ESDC Administration *Total Soft Costs*	15% 20% 5% *40%*	Complex and/or small projects (e.g., electrical upgrades, SCADA upgrades, small pump station replacement/rehab)
D	Engineering CM & ESDC Administration *Total Soft Costs*	5% 5% 5% *15%*	District replaced/installed equipment (e.g., small pump replacement, instrument replacement projects)
Engineering = Study, Preliminary and Final Design CM = Construction Management (Contract management and inspection) ESDC = Engineering Services During Construction Administration = District administrative and legal costs			

1.5 Prioritization

Figure 1-3. CIP Project Prioritization Factors



Capital improvement projects were prioritized using a numerical weighting system designed to reflect the relative urgency of the project needs. The primary drivers of project need are based on the technical analyses including remaining useful life, condition assessment, operations assessment, and the failure modes and effects analysis. An additional scheduling factor was applied to allow for adjustments to priority scores in order to smooth the multi-year CIP. Prioritization factors are presented in and explained in detail in the following sections.

1.5.1 Asset Management (Expected Useful Life Remaining)

Assets were assigned an expected useful life according to the methodology described in Technical Memorandum #1 (Appendix A). The expected useful life of an asset minus the age of the asset provides a remaining useful life value which provides a target date to replace the asset. Remaining useful life priority scores were applied according to Table 1-4.

Table 1-4. Priority Weighted Scores for Expected Useful Life Remaining

Remaining Useful Life	Priority Weighted Score
0-5 years	25
6-10 years	10
11-20 years	5
20+ years	0

1.5.2 Condition Assessment

Assets were assigned a condition rating according to the methodology described in Technical Memorandum #2A, 2B, and 2C (Appendix B). The condition of the asset is especially important when an Asset is in "poor" condition. Condition assessment priority scores were applied according to Table 1-5.

Table 1-5. Priority Weighted Scores for Condition Assessment

Condition Assessment	Priority Weighted Score
Poor	50
Fair	10
Good	5
Excellent	0

1.5.3 Operational Improvements

The 4S Ranch WRF operations were reviewed and process data was analyzed to identify optimization opportunities at the WRF. The operations assessment findings and technical analysis is described in Technical Memorandum #3, 3A, and 3B (Appendix C). Similarly, operational improvements for the pump stations and collection system are documented in the condition assessment Technical Memorandum #2B and 2C, respectively. Projects that provide improvements to current operations are designated as "yes" (having operational benefits) whereas projects that do not explicitly provide for improvements to operations are designated as "no" (not having operational benefits). The operational improvement benefit priority scores were applied according to Table 1-6.

Table 1-6. Priority weighted scores for Operations Assessment

Operations Assessment	Priority Weighted Score
Yes	25
No	0

1.5.4 Failure Modes and Effects Analysis

Major assets in the District's WRF and collection systems were evaluated through a failure modes and effects analysis that produced a "criticality" score calculated from a life expectancy based probability of failure score and a collaborative consensus based consequence of failure score. The scale of PoF and CoF provided for criticality scores of 0 to 100, with scores above 30 being considered "high risk". Detailed analysis and scoring is described in Technical Memorandum #4 (Appendix D). The FMEA priority scores applied to these "criticality" scores is described in Table 1-7.

Table 1-7. Priority weighted scores for Operations Assessment

FMEA "Criticality" Score	Priority Weighted Score
75-100	100
60-74	75
50-59	45
40-49	35
30-39	25

FMEA "Criticality" Score	Priority Weighted Score
20-29	10
10-19	5
0-9	0

1.5.5 Scheduling Factor

Project implementation in the CIP requires additional adjustments to represent realistic scheduling and implementation. Additionally, the scheduling factor allows for priority weighting adjustment for project drivers not explicitly represented by the weighted scores in the other areas. The scheduling factor will adjust the weighted score by subtracting or adding from 1 up to 20 points, as applicable. The scheduling factor is not applied to score a project with a total otherwise above a “200” or below a “0” score.

1.6 Wastewater Facilities

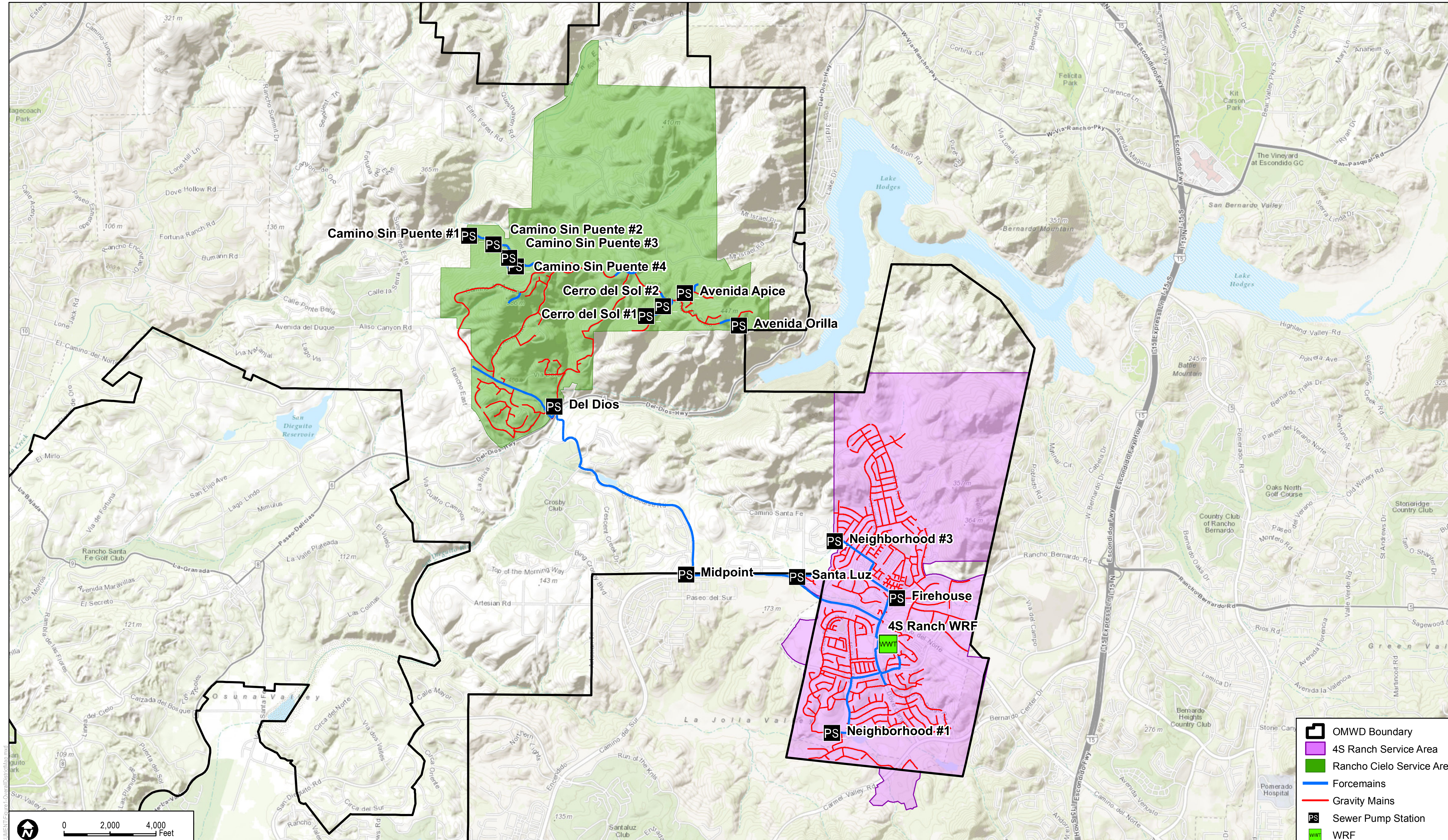
The District’s wastewater facilities include the 2.0 million gallons per day (mgd) 4S Ranch WRF, approximately 60 miles of collection system pipelines, and 14 sewer pump stations. The wastewater system is divided into two distinct service areas: the 4S Ranch Service Area and the Rancho Cielo Service Area. Wastewater generated from both service areas is conveyed to the 4S Ranch WRF. Figure 1-4 presents the two service areas and location of the major wastewater facilities.

This CIP is organized in accordance with the three major wastewater system cost centers:

- 4S Ranch Water Reclamation Facility
- 4S Ranch Collection System
- Rancho Cielo Collection System

The CIP project numbers are also defined by the cost center (e.g., WRF, 4S, and RC) with CIP costs and prioritization sorted accordingly.

The following sections describe the specific and programmatic CIP projects including discussion of the background, project need, detailed project descriptions and cost estimates. The last sections of this CIP presents an implementation plan based on project prioritization and scheduling.



DUDEK

8664

SOURCE: Olivenhain MWD 2014; SanGIS 2015; ESRI Basemap 2015

Olivenhain MWD Project

FIGURE 1-4

Overall District Map

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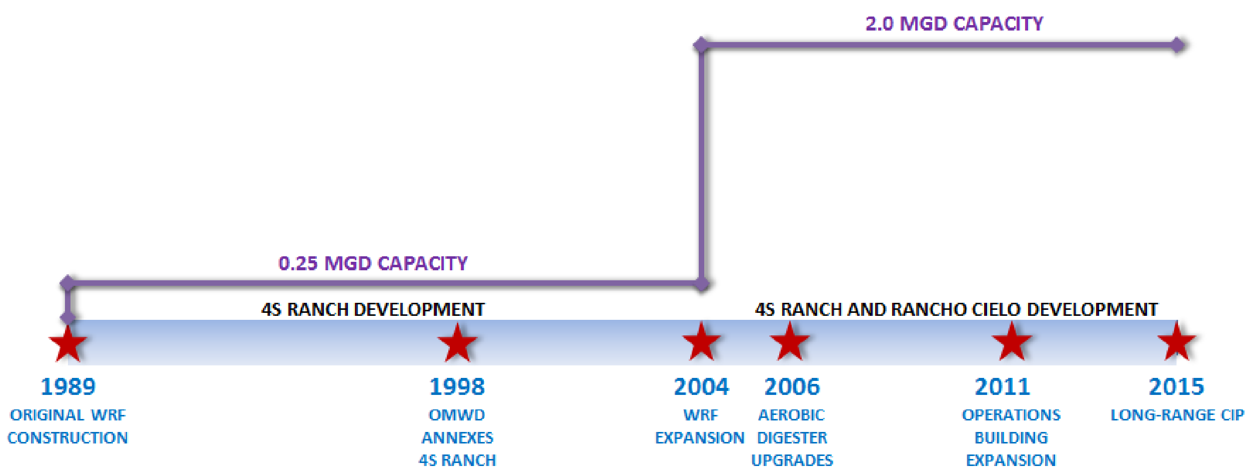
The OMWD wastewater systems were built in two major phases with several significant milestones and upgrades over the past 25 years. Figure 1-5 presents the major infrastructure development phases and corresponding wastewater system capacities.

Figure 1-5. OMWD Wastewater System Development Timeline



Because the wastewater systems were primarily constructed by developers and originally dedicated to the County of San Diego and later to OMWD, historic construction values are not readily available. In order to provide context for long-term reinvestment planning, an order-of-magnitude valuation of the existing infrastructure was prepared. The total asset valuation, excluding property, is estimated to be $102 million. Figure 1-6 presents the cost center distribution and Table 1-8 presents the estimated value of major system components.

Figure 1-6. OMWD Wastewater System Cost Allocation

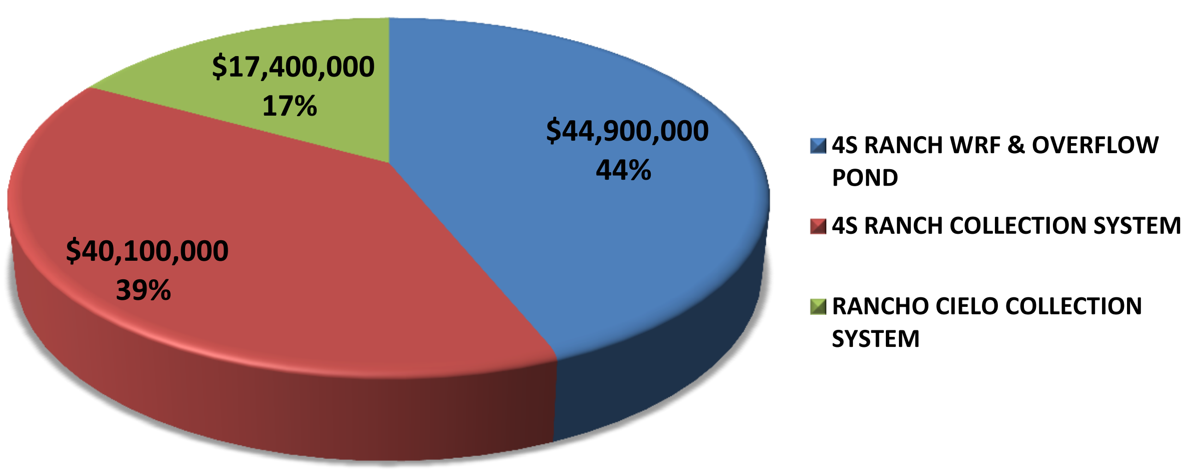


Table 1-8. OMWD Wastewater System Valuation

Asset	Valuation
4S Ranch WRF	$ 33,900,000
Overflow Pond	$ 10,000,000
Overflow Pond liner	$ 1,000,000
WRF & OVERFLOW POND TOTAL	**$ 44,900,000**
4S Ranch Collection System (gravity pipe)	$ 30,800,000
4S Ranch Collection System (forcemains)	$ 4,200,000
4S Ranch Pump Stations:	
Neighborhood #1	$ 1,700,000
Neighborhood #3	$ 2,000,000
Fire House	$ 1,100,000
Santa Luz	$ 300,000
4S COLLECTION SYSTEM TOTAL	**$ 40,100,000**
Rancho Cielo Collection System (gravity pipe)	$ 5,300,000
Rancho Cielo Collection System (forcemains)	$ 7,000,000
Rancho Cielo Pump Stations:	
Del Dios	$ 1,500,000
Midpoint	$ 1,200,000
Camino Sin Puente #1	$ 300,000
Camino Sin Puente #2	$ 300,000
Camino Sin Puente #3	$ 300,000
Camino Sin Puente #4	$ 300,000
Avenida Apice	$ 300,000
Avenida Orilla	$ 300,000
Cerro Del Sol #1	$ 300,000
Cerro Del Sol #2	$ 300,000
RANCHO CIELO COLLECTION SYSTEM TOTAL	**$ 17,400,000**
TOTAL	**$ 102,400,000**

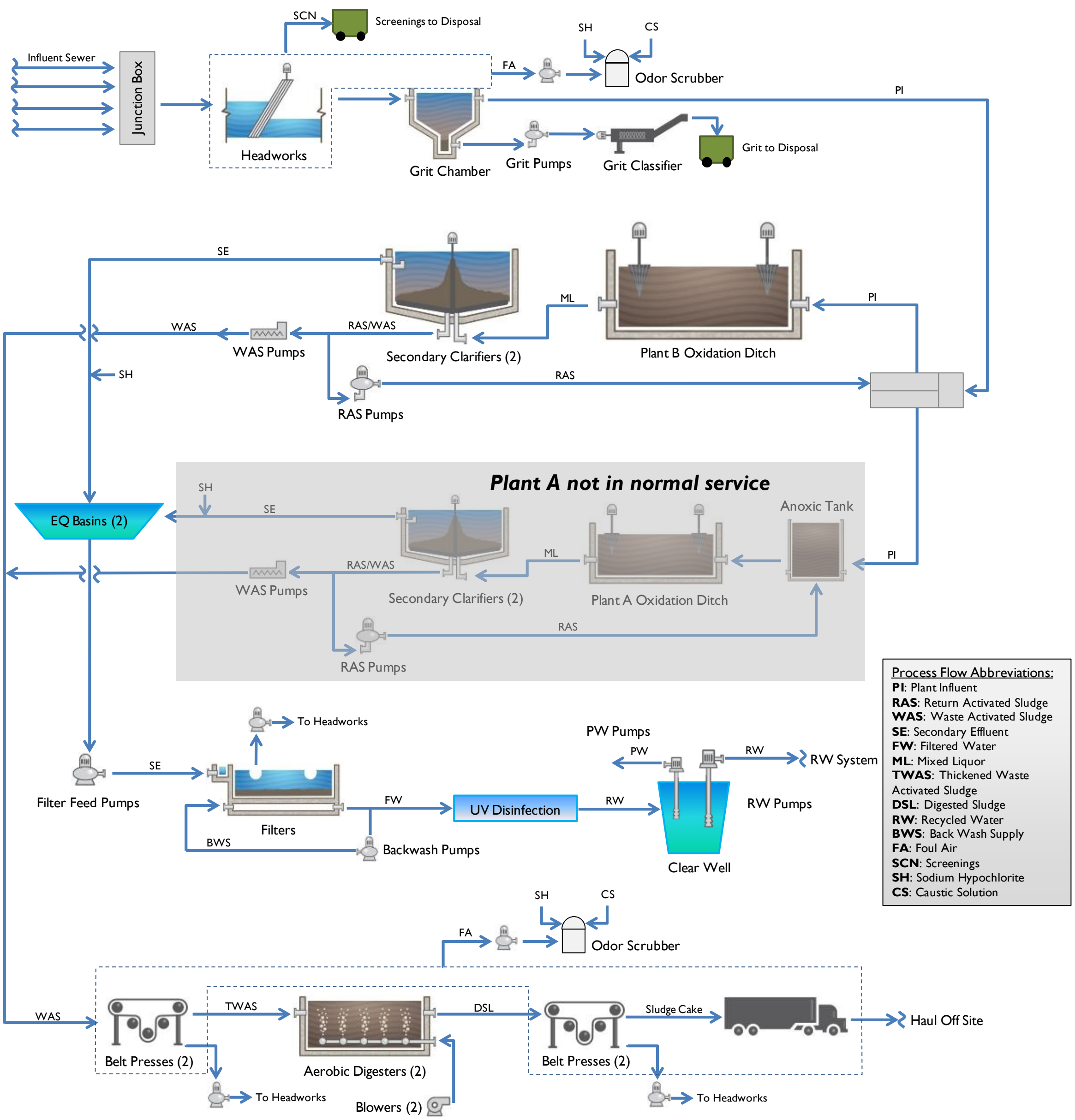
2 4S RANCH WRF AND OVERFLOW POND CIP

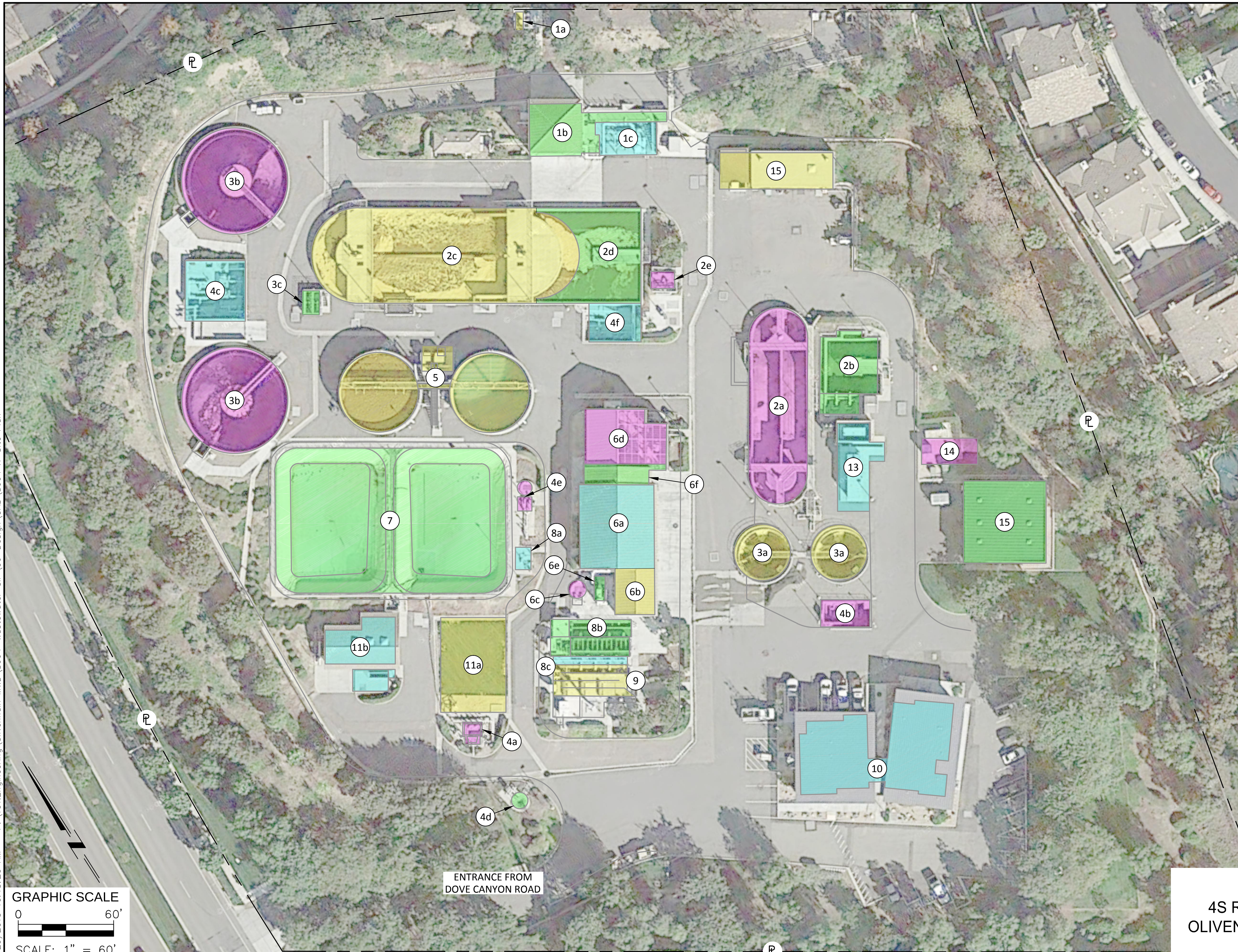
The 4S Ranch Water Reclamation Facility (WRF), built in two major phases since the mid-1980s, is a 2.0 mgd capacity treatment plant operated under a Master Reclamation Permit with Waste Discharge Requirements (Order No. R9-2003-0007) issued by the San Diego Regional Water Quality Control Board. Raw wastewater is conveyed to the 4S Ranch WRF from four forcemains and a single gravity sewer pipeline that convene at the influent junction structure, from plant influent flows to the headworks. The headworks consists of screening and grit removal. Plant influent is conveyed from the headworks to a splitter box that splits flow to two parallel biological treatment process trains; Plant A and Plant B with rated capacities of 0.5 mgd and 1.5 mgd, respectively. Plant A and Plant B treatment technology consists of oxidation ditches with upstream anoxic selectors and two clarifiers, each. Secondary effluent is conveyed to a flow equalization basin from which secondary effluent is pumped to tertiary filters and then flows by gravity through an open channel ultraviolet disinfection system to the recycled water forebay. Recycled water is pumped to a distribution system to serve customers for irrigation uses. Recycled water in excess of the daily demand overflows by gravity to a nearby seasonal storage pond. Waste activated sludge (WAS) is pumped from the secondary clarifiers to the gravity section of a belt filter press for thickening and then to aerobic digesters where thickened WAS is digested to meet Class B Biosolids requirements. Aerobically digested sludge is dewatered on belt filter presses and then is hauled to Arizona for land application. Figure 2-1 presents the major process flow diagram. It should be noted that due to current capacity needs, Plant A has not been operated since Plant B was brought online in 2005.

The 4S Ranch WRF is a 100% reclamation facility, serving irrigation customers in the 4S Ranch development and portions of Rancho Santa Fe. During the wet season, recycled water in excess of the WRF production rate is stored in a seasonal storage facility. The seasonal storage pond is approximately 410 acre-feet (~134 million gallons), satisfying 84-day storage for a plant production rate of 1.6 mgd, and is a lined earthen basin. A seasonal storage pond pump station returns stored water to the WRF during the dry season. Stored water can be delivered directly to the recycled water system via the forebay and recycled water pump station. Alternatively, stored water can be returned to the WRF for further treatment, either to the secondary effluent equalization basin for re-treatment through the tertiary system (filters and disinfection) or to the headworks for re-treatment through the entire treatment process. In practice, the District typically returns stored water directly to the distribution system, returning only poorer quality water from the bottom of the seasonal storage pond to the WRF for re-treatment, when the pond is near empty.

The 4S Ranch WRF is located at 16595 Dove Canyon Road, south of Camino Del Norte and north of Camino San Bernardo, approximately 2 miles west of the I-15. Figure 2-2 presents the site plan with major process areas defined. The seasonal storage pond is located immediately across the street from the WRF on the west side of Dove Canyon Road.

Figure 2-1. 4S Ranch WRF Process Flow Diagram





PLANT AREA

- 1a INFLUENT JUNCTION BOX
- 1b HEADWORKS (SCREENINGS & GRIT REMOVAL)
- 1c HEADWORKS ODOR CONTROL
- 2a PLANT A OXIDATION DITCH
- 2b PLANT A ANOXIC TANK
- 2c PLANT B OXIDATION DITCH
- 2d PLANT B ANOXIC ZONE
- 2e INFLUENT FLOW SPLITTER
- 3a PLANT A SECONDARY CLARIFIERS
- 3b PLANT B SECONDARY CLARIFIERS
- 3c PLANT B SPLITTER BOX
- 4a NON-POTABLE WATER PUMP STATION
- 4b PLANT A RAS & WAS PUMP STATION
- 4c PLANT B RAS & WAS PUMP STATION
- 4d STORMWATER PUMP STATION
- 4e FILTER INFLUENT PUMP STATION
- 4f WAS PS & DIGESTED SLUDGE PS
- 5 AEROBIC DIGESTERS AND BLOWERS
- 6a BELT PRESS FACILITY (THICKENING & DEWATERING)
- 6b SLUDGE LOADING ROOM
- 6c FILTRATE AND BACKWASH PUMP STATION
- 6d CHEMICAL AREA (POLYMER, NAOCL, NAOH)
- 6e DEWATERING BUILDING ODOR CONTROL
- 6f ELECTRICAL ROOM
- 7 SECONDARY EFFLUENT EQUALIZATION BASINS
- 8a FLASH MIX (PUMP)
- 8b FILTERS (4 UNITS)
- 8c BACKWASH PUMP STATION
- 9 ULTRAVIOLET DISINFECTION SYSTEM
- 10 ADMINISTRATION BUILDING
- 11a RECYCLED WATER FOREBAY
- 11b RECYCLED WATER PUMP STATION
- 13 EMERGENCY GENERATOR
- 14 MAIN ELECTRICAL ENTRANCE AND SWITCHBOARD
- 15 STORAGE & MAINTENANCE AREA

FIGURE 2-2
4S RANCH WRF EXISTING SITE PLAN
OLIVENHAIN MUNICIPAL WATER DISTRICT
DUDEK

4/29/2015 10:15:20 AM P:\101.Engineering\Olivenhain MWD\8664-Wastewater CIP\06-Design\CAD\8664 X-Site Plan

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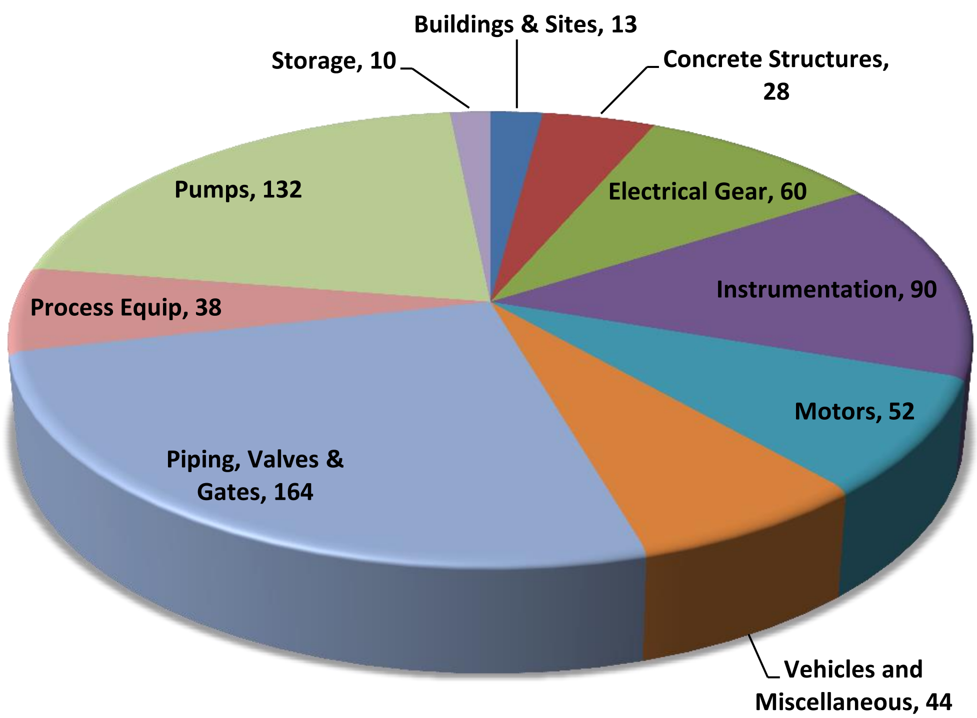
2.1 Asset Inventory

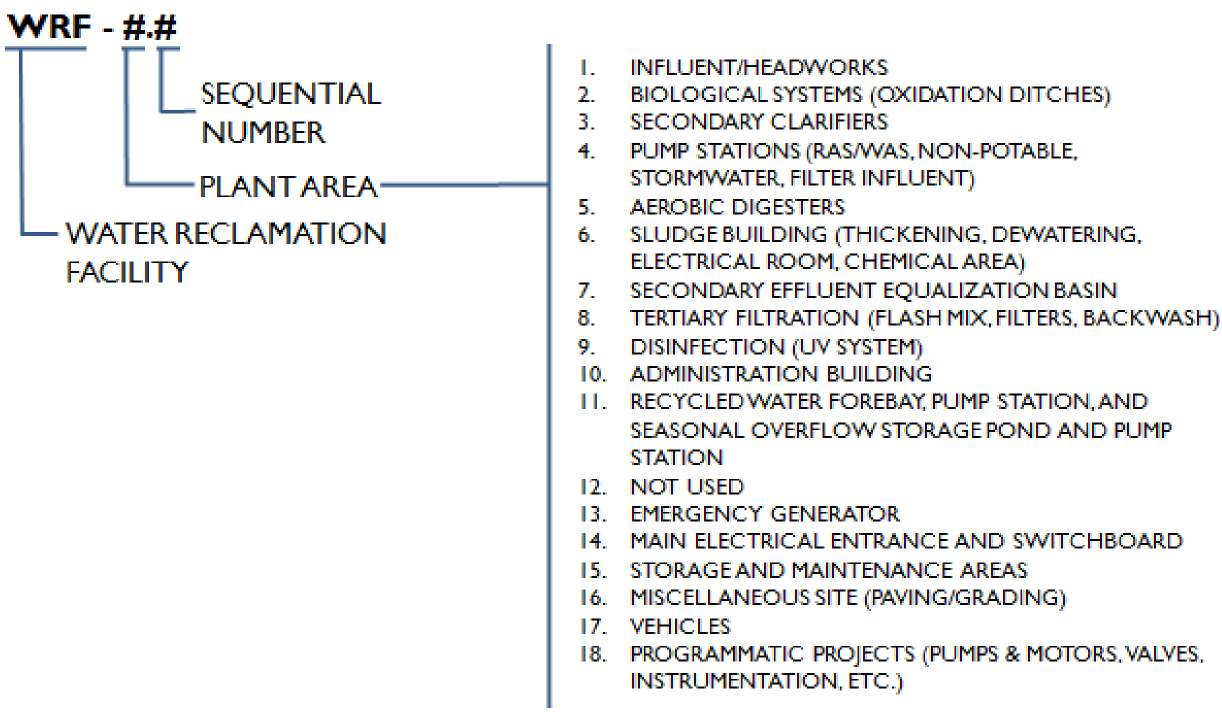
The District owns and operates approximately 631 assets at the 4S WRF, recycled water pump station, and overflow pond and pump station across the street from the WRF. The Asset Inventory was established from data exported from the District's Enterprise Asset Management Program (EAM) for use in this study. Dudek has reviewed the EAM database which is intentionally focused on maintenance functions, and therefore contains part and component entries that are not relevant to the development of a CIP program. To satisfy the goals of the CIP, Dudek has classified assets as components of a "parent" asset; parts and components will be accounted for and should continue to be monitored and maintained through the District's current Preventative Maintenance program; however the database was modified to code these entries as "components" to filter them out of CIP development and inventory valuation. Additionally, Dudek has updated the asset inventory to include wastewater assets not yet added to the inventory. The resulting distribution of wastewater assets at the 4S WRF, recycled water pump station, and overflow pond and pump station are depicted in Figure 2-3.

Figure 2-3. WRF Asset Distribution



2.2 Capital Improvement Projects

The following sections present specific and programmatic CIP projects identified for the 4S Ranch WRF facility. The projects are organized by plant area in accordance with the following project numbering sequence:



The WRF CIP includes a total of 36 defined projects and programs with a total 20-year cost of $35 million. Of the 36 projects, 29 are unique CIP projects with total value of $26.3 million. The CIP also identifies 6 programmatic projects accounting for a total cost of $7.7 million or approximately $384,000 per year. The WRF CIP is somewhat front loaded with approximately 40% of the 20-year CIP occurring in the first 5 years and 60% occurring in the first 10 years. This cost distribution is attributed to several significant, high priority projects programmed for completion in the early years of the CIP:

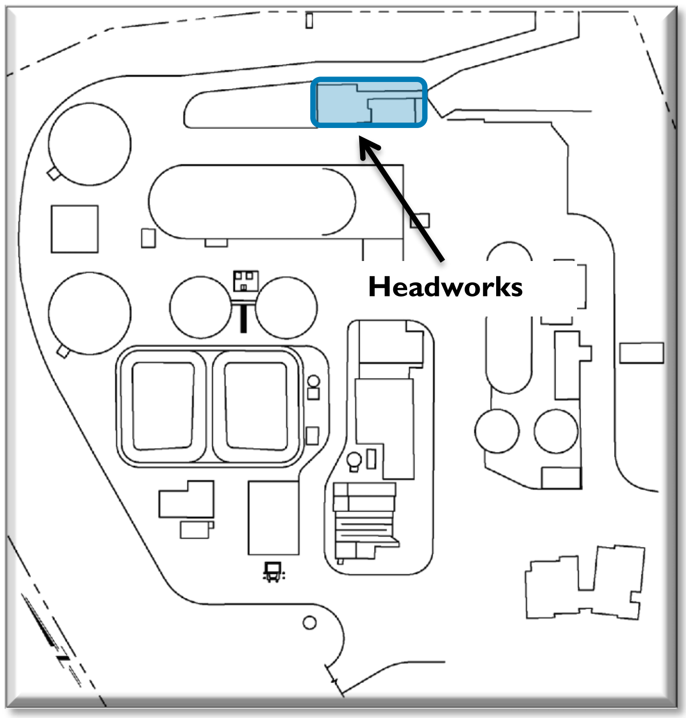
- WRF-1.1: Replace Existing Headworks Screenings Equipment ($0.57 Million)
- WRF-2.1/2.2: Upgrade Biological Treatment System ($1 Million)
- WRF-6.1/6.2: Dewatering System Upgrades ($1.8 Million)
- WRF-7.1: Upgrade Flow Equalization Basins ($0.79 Million)
- WRF-8.0: Replace Tertiary Filters ($3.8 Million)
- WRF-9.1: UV Disinfection System Replacement ($2.2 Million)
- WRF-11.2: Overflow Pond Upgrades ($0.95 Million)

2.2.1 Headworks Improvements

Background

The headworks provides preliminary treatment includes screenings and grit removal. Screenings are removed from the raw wastewater with a single bandscreen and screenings wash/press. Grit is removed in a vortex grit chamber. The headworks is designed for the full plant capacity of 2.0 mgd with a peak factor of 3.0 for a peak hydraulic load of 6 mgd. Foul air from the headworks area (screenings building and headspace over influent channels and splitter box) is treated by a LO/PRO® chemical odor control system. The chemical odor control scrubber, also called a "wet scrubber," utilizes Sodium Hypochlorite (NAOCl) and Sodium Hydroxide (NaOH) to react with and remove the odorous compounds present in the airstream, particularly hydrogen sulfide gas (H_2S).

Figure 2-4. Headworks



Project Needs

The existing bandscreen and wash/press equipment, now approximately 10 years old, were observed to be in poor condition due to corrosion and reported equipment maintenance intensity. The existing screening equipment should be replaced in the near-term future with like or similar equipment.

Furthermore, the screenings equipment is arranged in a single-duty arrangement with a manual bar rack for bypass when automatic screening equipment is offline for service. When bypassing through the bar rack, significant raw screenings pass through the headworks, impacting downstream processes, in particular:

- Clogging pumps, especially sludge pumps, resulting in loss of biological process reliability and elevating maintenance intensity;
- Ragging together and become entangled on submerged rotating equipment (e.g., vertical and submersible mixers) inhibiting equipment performance and possibly resulting in electrical overload faults and/or mechanical damage;
- Accumulating in secondary clarifiers and digesters, diminishing treatment efficiency and reducing capacity.

Through the FMEA, it was identified that the automatic screening equipment has a failure rate of approximately four times per year in addition to two scheduled maintenance cycles per year. The single-duty screenings train is therefore offline for at least six periods per year with an average downtime of 2 days. The screenings pass-through has a prolonged impact on operations as the screenings accumulation in downstream processes requires attention for weeks after each bypass event. De-ragging pumps, mixers, and general maintenance to remove screenings that pass-through the headworks is estimated to cost the District approximately 300 staff-hours per year with an estimated annual operating impact of approximately $15,000.

Due to the high CoF and PoF scores in the FMEA, the headworks ranked as one of the higher criticality scores at the WRF (Criticality score of 31 out of 100). A redundant screenings train (parallel screen) is recommended to mitigate the probability of failure which will reduce the criticality score to better align with acceptable level of service goals.

The grit handling equipment and odor control system were found to be in fair condition and will ultimately reach the end of their expected useful life within the CIP planning timeframe and will need to be replaced at that time.

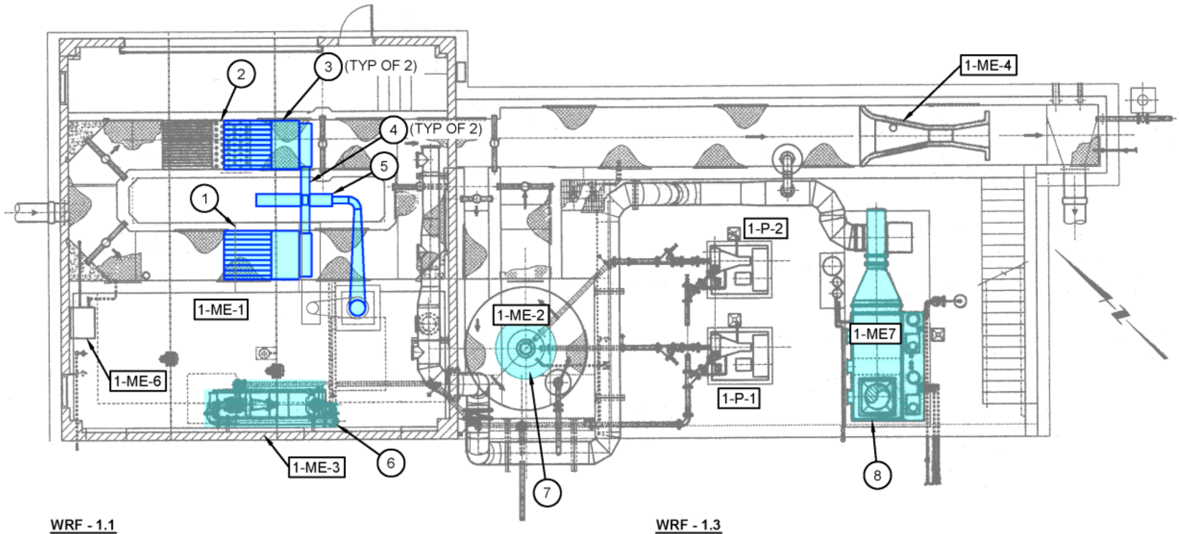
Projects

Capital improvement projects identified for the headworks are summarized in Table 2-1. Headworks Improvements Projects and depicted in Figure 2-5. Project descriptions including cost estimate, prioritization and implementation schedule are provided on the following pages.

Table 2-1. Headworks Improvements Projects

Projects	Cost
WRF – 1.1, Replace Headworks Screenings Equipment	$576,000
WRF – 1.2, Retrofit Existing Headworks Structure to Install Redundant Screenings Equipment	$784,000
WRF – 1.3, Replace Existing Headworks Grit Handling Equipment	$464,000
WRF – 1.4, Replace Existing Headworks Odor Control Scrubber	$713,000
Total	$2,537,000

Figure 2-5. Headworks Improvements Projects



WRF - 1.1

1 REPLACE HEADWORKS SCREENING EQUIPMENT

WRF - 1.2

2 REMOVE EXISTING BAR RACK AND RELOCATE IN DOWNSTREAM CHANNEL

3 INSTALL NEW PARALLEL BAR SCREEN

4 INSTALL NEW RAW SCREENINGS CONVEYANCE

5 INSTALL NEW DUTY WASH/PRESS

WRF - 1.3

6 REPLACE GRIT CLASSIFIER

7 REPLACE VORTEX GRIT MIXING ASSEMBLY

WRF - 1.4

8 REPLACE HEADWORKS ODOR CONTROL SCRUBBER

NOTE:

1. SEE PROJECT NO. WRF-18.1 FOR VALVE AND GATE REPLACEMENT PROGRAM.

Project No:	**WRF - 1.1**			
Project Name:	**Replace Existing Headworks Screenings Equipment**			
Description:	Replace existing headworks screenings equipment (Bandscreen and Washpress) as existing equipment reaches the end of its useful life. Replace screenings equipment control panel and instrumentation (e.g., level controls). Engineering design is recommended to evaluate appropriate screen type, size, and materials of construction. Equipment selection should be coordinated with WRF-1.2 (Parallel Screen).			
Priority:	85			
Location/Facility:	4S Ranch WRF			

Project Type(s):		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	X
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	X

Project Cost:				
Capital Costs:				
General			$	20,000
Civil & Mechanical			$	17,500
Structural			$	-
Electrical & Controls			$	25,000
Equipment			$	318,710
Capital Cost Subtotal:			**$**	**381,210**
Soft Costs:				
Classification 'B'				
Engineering	10 %	of capital costs	$	38,121
CM & ESDC	18 %	of capital costs	$	68,618
Administration	3 %	of capital costs	$	11,436
Soft Cost Subtotal:			**$**	**118,175**
Contingency:				
Contingency	20 %	of project cost	$	76,242
Total Project Cost:			**$**	**576,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2017	$	576,000
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	1				

Project No:	**WRF - 1.2**
Project Name:	**Retrofit Existing Headworks Structure to Install Redundant Screenings Equipment**
Description:	The existing headworks includes a single duty automatic screen and wash press. When the screen is offline for repair or maintenance, raw wastewater is bypassed through manual bar rack. Addition of a parallel automatic screen was identified as a preferred plant improvement to mitigate FMEA criticality and to improve operational performance of the headworks. The parallel screen would be installed in place of the manual bar rack and raw screenings conveyance would be installed to convey screenings to the wash/press. Screen equipment should acccomodate easy removal of equipment for emergency bypass (e.g., lift-out style).
Priority:	50
Location/Facility:	4S Ranch WRF

Project Type(s):		**Origin(s) of Project:**	
Rehab/Replacement		Predicted Useful Life Expiration	
Facility/Equip Upgrade	X	Condition Assessment	
Engineering Study	X	Operations Assessment	X
Expansion		Failure Modes & Consequences	X

Project Cost:				
Capital Costs:				
General			$	20,000
Civil & Mechanical			$	17,500
Structural			$	-
Electrical & Controls			$	45,000
Equipment			$	407,500
Capital Cost Subtotal:			**$**	**490,000**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	73,500
CM & ESDC	20 %	of capital costs	$	98,000
Administration	5 %	of capital costs	$	24,500
Soft Cost Subtotal:			**$**	**196,000**
Contingency:				
Contingency	20 %	of project cost	$	98,000
Total Project Cost:			**$**	**784,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2021	$	86,000
Project Delivery Method:	Design-Bid-Build		2022	$	698,000
Project Duration (Years):	2				

Project No:	**WRF - 1.3**		
Project Name:	**Replace Existing Headworks Grit Handling Equipment**		
Description:	The existing vortex grit removal system was installed in c.2004. Headworks equipment is subjected to relatively aggressive conditions and replacement is scheduled according to estimated remaining useful life. Project will replace existing headworks grit handling equipment (grit classifier and grit chamber mechanical equipment). Replace grit handling controls and instrumentation. Grit pumps replacement is covered under Project No. WRF - 18.2		
Priority:	30		
Location/Facility:	4S Ranch WRF		

Project Type(s):		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	X
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	20,000
Civil & Mechanical			$	20,000
Structural			$	-
Electrical & Controls			$	30,000
Equipment			$	219,800
Capital Cost Subtotal:			**$**	**289,800**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	43,470
CM & ESDC	20 %	of capital costs	$	57,960
Administration	5 %	of capital costs	$	14,490
Soft Cost Subtotal:			**$**	**115,920**
Contingency:				
Contingency	20 %	of project cost	$	57,960
Total Project Cost:			**$**	**464,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2023	$	51,000
Project Delivery Method:	Design-Bid-Build		2024	$	413,000
Project Duration (Years):	2				

Project No:	**WRF - 1.4**		
Project Name:	**Upgrade Headworks Odor Control Scrubber**		
Description:	Headworks odor control scrubber (wet/chemical, NaOH & NaOCl) was installed c.2005. The existing system is a Siemens LoPro rated for 3,500 cfm. Odor control systems are subjected to aggressive operating conditions and are expected to be replaced at the end of useful life. Project will replace packaged odor control system including tower, fan, pumps, chemical systems, and controls. Preliminary design study should evaluate effectiveness of system, confirm loading, and consider contemporary technologies and operational needs to select best-fit system.		
Priority:	25		
Location/Facility:	4S Ranch WRF		

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	45,000
Civil & Mechanical			$	17,500
Structural			$	-
Electrical & Controls			$	20,000
Equipment			$	363,000
Capital Cost Subtotal:			**$**	**445,500**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	66,825
CM & ESDC	20 %	of capital costs	$	89,100
Administration	5 %	of capital costs	$	22,275
Soft Cost Subtotal:			**$**	**178,200**
Contingency:				
Contingency	20 %	of project cost	$	89,100
Total Project Cost:			**$**	**713,000**

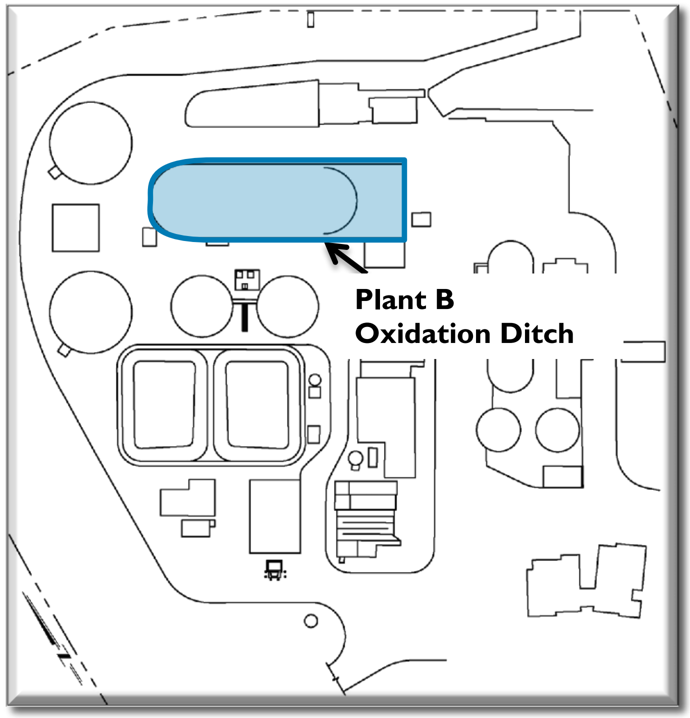
Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2025	$	713,000
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	1				

2.2.2 Oxidation Ditch and Anoxic Tank Improvements

Background

The Plant B biological process consists of a single oxidation ditch and anoxic tank. Oxidation ditches are characterized as extended aeration, activated sludge (EAAS) and are robust and simple systems. EAAS is commonly employed in small (<5 mgd) facilities for which primary settling and ancillary digestion processes are not cost effective. The oxidation ditch (Carrousel® equipment provided by EIMCO, now OVIVO) includes a pre-anoxic basin mixed with a single vertical mixer suspended from a concrete pier. Raw wastewater and return activated sludge (RAS) are mixed in the influent splitter box and then conveyed into the pre-anoxic basin where these streams are mixed with internal mixed liquor recycle. The oxidation ditch aeration zone is mixed and aerated with two "vertical turbine" surface aerators. The two 125 HP aerators are driven by variable speed drives.

Figure 2-6. Oxidation Ditch



Project Needs

The existing oxidation ditch and anoxic tank mechanical equipment, now approximately 13 years old, were observed to be in fair to good condition showing minor to moderate corrosion. The equipment should be replaced in the near to mid-term future.

Due to high PoF and CoF scores in the FMEA, the oxidation ditch aerators and anoxic tank vertical mixer were ranked two of the highest "criticality" in the WRF (criticality score of 44 and 34 out of 100, respectively).

Additionally, the oxidation ditch aerators are programmed for a minimum speed in order to maintain mixing energy or motive force to keep the mixed liquor moving and the biomass in suspension within the reactor. By constraining the minimum speed, the aerators are often unable to turndown fully to meet minimum diurnal oxygen demand, thereby over-aerating during significant portions of the day. The current operating profile of the oxidation ditch and anoxic tank suggests significant potential for optimization.

A detailed process study and pre-design is recommended to determine the most economical and reliable biological upgrade for the existing oxidation ditch and anoxic tank with the goal of reducing the criticality of the equipment and optimizing operational performance and power consumption.

Projects

Capital improvement projects identified for the oxidation ditch and anoxic tank are summarized in Table 2-2.

Table 2-2. Oxidation Ditch and Anoxic Tank Improvements Projects

Projects	Cost
WRF – 2.1, Biological Treatment Upgrade (Process Study & Pre-Design)	$50,000
WRF – 2.2, Upgrade Plant B Oxidation Ditch Aeration System	$960,000
Total	$1,010,000

Project No:	**WRF - 2.1**		
Project Name:	**Biological Treatment Upgrade (Process Study & Pre-Design)**		
Description:	As identified in Process Evaluation, perform detailed process study and pre-design of biological treatment system to confirm and select aeration system upgrade needs. Options include replacement of mechanical surface aerators in kind, mechanical aerators right-sized for future loading, or retrofit to diffused aeration. Study should evaluate re-rating Plant B to maximize treatment capacity and efficiency. Recommendations from Study/Pre-Design should be implemented in Project No. WRF-2.2.		
Priority:	80		
Location/Facility:	4S Ranch WRF		

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement		Predicted Useful Life Expiration	
Facility/Equip Upgrade		Condition Assessment	
Engineering Study	X	Operations Assessment	X
Expansion		Failure Modes & Consequences	X

Project Cost:	
Capital Costs:	
General	$ -
Civil & Mechanical	$ -
Structural	$ -
Electrical & Controls	$ -
Equipment	$ -
Capital Cost Subtotal:	**$ -**
Soft Costs:	
Project Specific	
Engineering	$ 50,000
CM & ESDC	N/A
Administration	N/A
Soft Cost Subtotal:	**$ 50,000**
Contingency:	
Contingency	N/A
Total Project Cost:	**$ 50,000**

Project Implementation (Schedule & Expenditure Timeline)				
Project Implementation:	One-Time Project	Expenditures:	2018	$ 50,000
Project Delivery Method:	Engineering Report			
Project Duration (Years):	1			

Project No:	**WRF - 2.2**
Project Name:	**Upgrade Plant B Oxidation Ditch Aeration System**
Description:	Upgrade Oxidation Ditch based on recommendation of biological process study in Project Number WRF-2.1. Defined project cost assumes replacement of oxidation ditch aerators, motors, and mechanical weir gate in-kind. Equipment modifications and/or retrofit to diffused aeration should be implemented if economic payback is confirmed.
Priority:	80
Location/Facility:	4S Ranch WRF

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade	X	Condition Assessment	
Engineering Study		Operations Assessment	X
Expansion		Failure Modes & Consequences	X

Project Cost:				
Capital Costs:				
General			$	30,000
Civil & Mechanical			$	35,000
Structural			$	-
Electrical & Controls			$	50,000
Equipment			$	485,250
Capital Cost Subtotal:			**$**	**600,250**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	90,038
CM & ESDC	20 %	of capital costs	$	120,050
Administration	5 %	of capital costs	$	30,013
Soft Cost Subtotal:			**$**	**240,100**
Contingency:				
Contingency	20 %	of project cost	$	120,050
Total Project Cost:			**$**	**960,000**

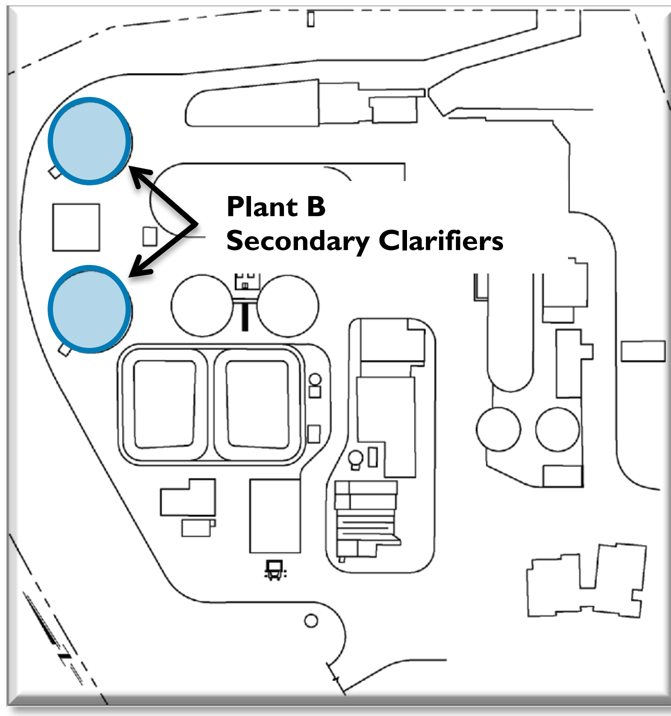
Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2019	$	525,000
Project Delivery Method:	Design-Bid-Build		2020	$	435,000
Project Duration (Years):	2				

2.2.3 Secondary Clarifiers Improvements

Background

Mixed liquor from the oxidation ditches is settled in two 65-ft diameter circular secondary clarifiers. The District currently operates both clarifiers at all times and reported concerns about operating a single clarifier at current operating flowrates. Plant B clarifiers are presently loaded at hydraulic surface loading rate well below the recommended range, yet the clarifiers reportedly experience sludge rising issues under certain loading scenarios.

Figure 2-7. Plant B Secondary Clarifiers



Project Needs

The existing secondary clarifier mechanical equipment, approximately 13 years old, is in good condition with minor corrosion observed on the drive, located at a coating breach, and on the weirs and scum beach. The mechanical equipment will reach the end of its expected useful life in the mid-term future and need to be replaced at that time.

Due to the high CoF and PoF scores in the FMEA, the secondary clarifiers ranked as one of the higher criticality scores at the WRF (Criticality score of 37 out of 100). The Secondary Clarifiers were evaluated under perceived current operating conditions of no redundancy. Operational adjustments in upstream processes should result in the plant's ability to operate through a single clarifier, thereby mitigating criticality through redundancy.

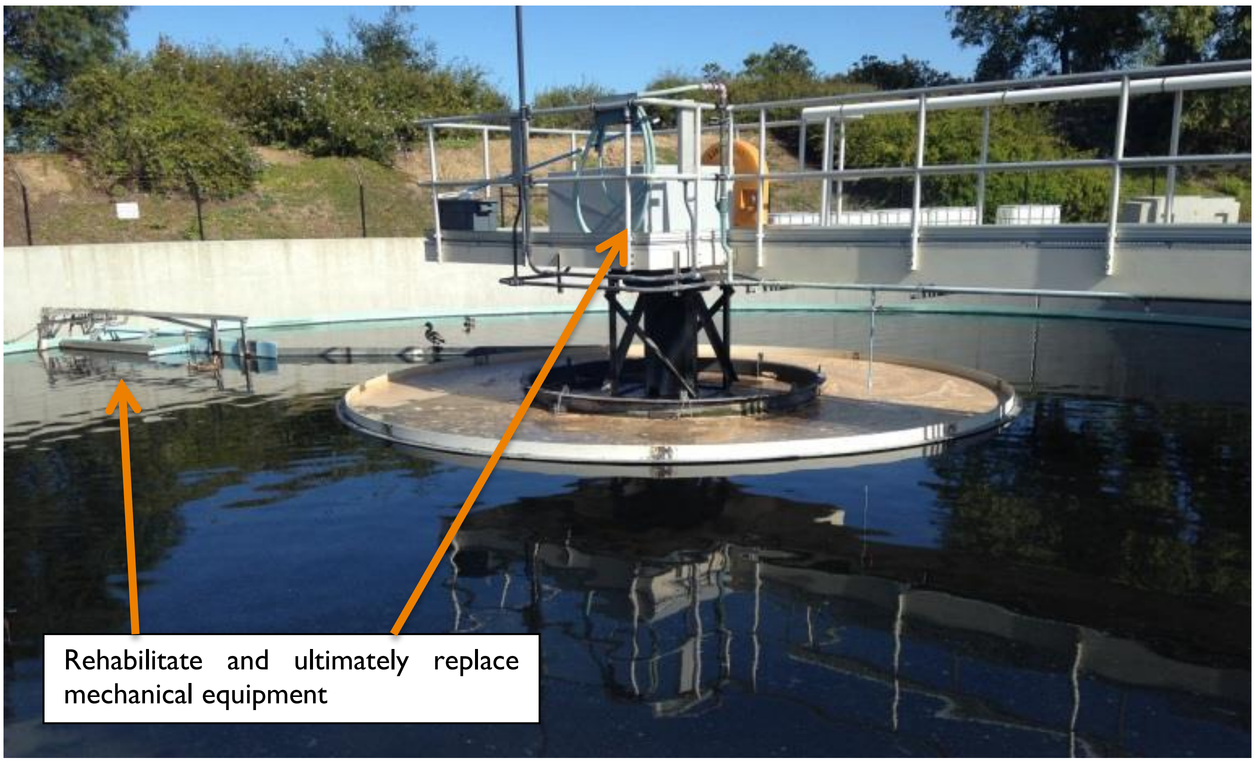
Projects

Capital improvement projects identified for the secondary clarifiers are summarized in Table 2-3 and depicted in Figure 2-8.

Table 2-3. Secondary Clarifiers Improvements Projects

Projects	Cost
WRF – 3.0, Replace Existing Secondary Clarifier Mechanical Equipment	$976,000

Figure 2-8. Secondary Clarifiers Improvements Projects



Project No:	**WRF - 3.0**				
Project Name:	**Replace Plant B Secondary Clarifier Equipment**				
Description:	Replace the existing secondary clarifier mechanical equipment including skimmer, scraper, sludge rake, and drive on both Plant B secondary clarifiers.				
Priority:	35				
Location/Facility:	4S Ranch WRF				

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:

Capital Costs:				
General			$	30,000
Civil & Mechanical			$	106,280
Structural			$	-
Electrical & Controls			$	50,000
Equipment			$	486,700
Capital Cost Subtotal:			**$**	**672,980**
Soft Costs:				
Classification 'A'				
Engineering	8 %	of capital costs	$	53,838
CM & ESDC	15 %	of capital costs	$	100,947
Administration	2 %	of capital costs	$	13,460
Soft Cost Subtotal:			**$**	**168,245**
Contingency:				
Contingency	20 %	of project cost	$	134,596
Total Project Cost:			**$**	**976,000**

Project Implementation (Schedule & Expenditure Timeline)

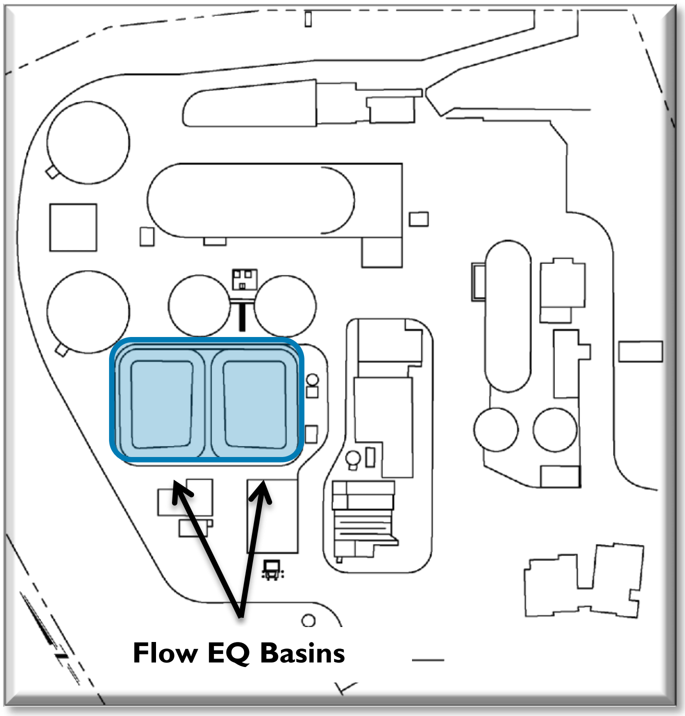
Project Implementation:	One-Time Project	Expenditures:	2023	$	61,000
Project Delivery Method:	Design-Bid-Build		2024	$	915,000
Project Duration (Years):	2				

2.2.4 Flow Equalization Basin Improvements

Background

Secondary effluent from the secondary clarifiers flows by gravity to the equalization basins where diurnal flows are equalized to regulate loading to the tertiary treatment systems. The District is currently preparing a project to increase the equalization basin capacity and re-arrange the flow regime through the basin. Presently, sodium hypochlorite is applied to the open basins for algae control. The equalization basins are presently earthen basins with a polyurethane liner.

Figure 2-9. Flow EQ Basins



Project Needs

The existing flow equalization basin liner was observed to have moderate to severe deterioration located in sodium hypochlorite application areas. The chemical application has damaged the liner, and the liner has required repairs in numerous locations. It is recommended that the District cover the flow equalization basins to alleviate the need for sodium hypochlorite application for algae control and reduce chemical costs and corrosion potential in the downstream filter structure and ultraviolet disinfection channels.

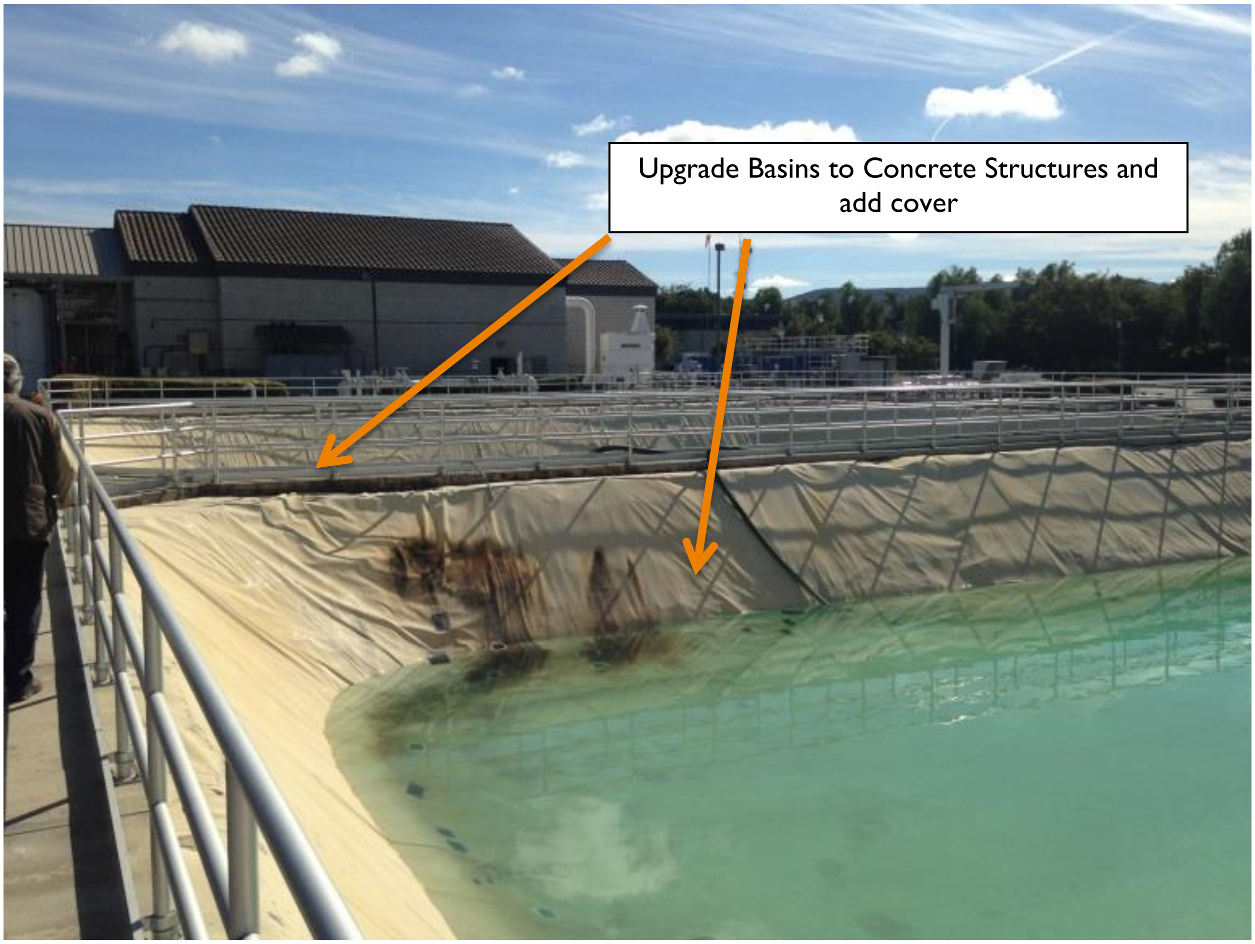
Projects

Capital improvement projects identified for the flow equalization basins are summarized in Table 2-4 and depicted in Figure 2-10.

Table 2-4. Flow Equalization Basins Improvements Projects

Projects	Cost
WRF – 7.1, Upgrade Flow Equalization Basins	$789,000
WRF – 7.2, Cover Flow Equalization Basins	$216,000
Total	$1,005,000

Figure 2-10. Flow Equalization Basins Improvements Projects



Project No:	**WRF - 7.1**
Project Name:	**Upgrade Flow Equalization Basins**
Description:	Upgrade the flow equalization basins to include piping & structural changes including vertical reinforced concrete walls and floors. Project will revise piping to direct secondary effluent through the basins before entering the filter influent pump station (inline instead of offline equalization) to improve basin turnover and water quality. Project costs are definined in the District's FY 14-15 Capital Spending Plan.
Priority:	105
Location/Facility:	4S Ranch WRF

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement		Predicted Useful Life Expiration	X
Facility/Equip Upgrade	X	Condition Assessment	X
Engineering Study		Operations Assessment	X
Expansion		Failure Modes & Consequences	

Project Cost:	
Capital Costs:	
General	$ -
Civil & Mechanical	$ -
Structural	$ 789,000
Electrical & Controls	$ -
Equipment	$ -
Capital Cost Subtotal:	**$ 789,000**
Soft Costs:	
Project Specific	
Engineering	N/A
CM & ESDC	N/A
Administration	N/A
Soft Cost Subtotal:	**N/A**
Contingency:	
Contingency	N/A
Total Project Cost:	**$ 789,000**

Project Implementation (Schedule & Expenditure Timeline)				
Project Implementation:	One-Time Project	Expenditures:	2016	$ 789,000
Project Delivery Method:	Design-Bid-Build			
Project Duration (Years):	1			

Project No:	**WRF - 7.2**		
Project Name:	**Cover Flow Equalization Basins**		
Description:	The Process Evaluation identified current high use of sodium hypochlorite to control algae in the existing equalization basins. Covering the basins will reduce chlorine demand which will reduce operating costs and mitigate corrosion potential of filter structures. Project will construct floating covers over the two flow equalization basins. Floating covers should be engineered and include ventilation and manways.		
Priority:	30		
Location/Facility:	4S Ranch WRF		

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement		Predicted Useful Life Expiration	
Facility/Equip Upgrade	X	Condition Assessment	
Engineering Study		Operations Assessment	X
Expansion		Failure Modes & Consequences	

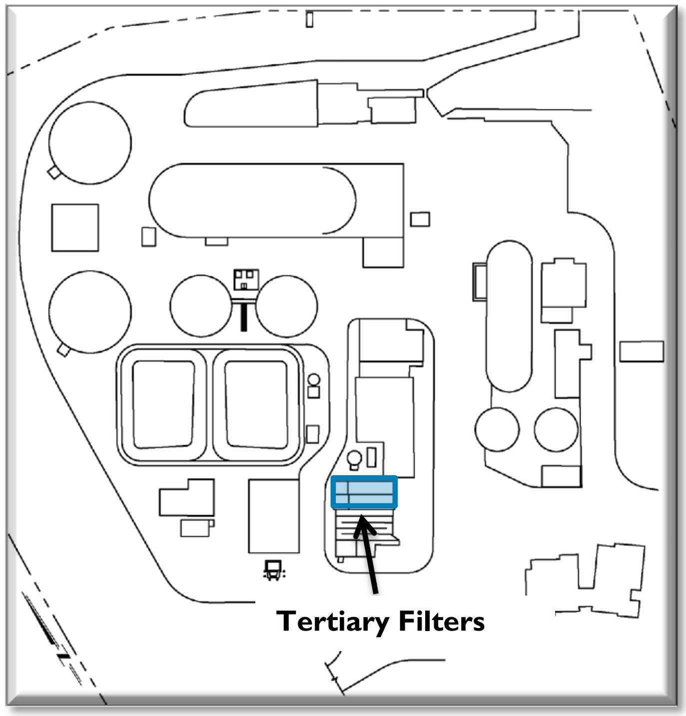
Project Cost:			
Capital Costs:			
General			$ 70,000
Civil & Mechanical			$ -
Structural			$ 65,000
Electrical & Controls			$ -
Equipment			$ -
Capital Cost Subtotal:			**$ 135,000**
Soft Costs:			
Classification 'C'			
Engineering	15 %	of capital costs	$ 20,250
CM & ESDC	20 %	of capital costs	$ 27,000
Administration	5 %	of capital costs	$ 6,750
Soft Cost Subtotal:			**$ 54,000**
Contingency:			
Contingency	20 %	of project cost	$ 27,000
Total Project Cost:			**$ 216,000**

Project Implementation (Schedule & Expenditure Timeline)				
Project Implementation:	One-Time Project	Expenditures:	2024	$ 216,000
Project Delivery Method:	Design-Bid-Build			
Project Duration (Years):	1			

2.2.5 Tertiary Filtration Improvements

Background

Figure 2-11. Tertiary Filers



The 4S Ranch WRF utilizes Hydro Clear mono-media, pulse-bed filters to produce Title 22 recycled water. The filters are packaged systems consisting of four filter cells, blowers for media bed pulsing, and a compressor for pneumatic systems. The packaged filter system is contained in a steel structure. The filters effectively remove turbidity, reliably meeting the recycled water limitation of 2 NTU. The filters are benefitted by relatively low hydraulic loading and consistently high quality feed water.

Project Needs

Although the existing filters effectively remove turbidity, operate at reasonable filtration rates, and do not require excessive backwashing, they are nearing the end of their useful life due to physical degradation. The painted carbon steel filters show significant corrosion damage, and need to be replaced in the near-term. Corrosion of carbon steel tanks is common in wastewater treatment facilities; especially when the paint or coating is not regularly maintained. Because all of the flow through the plant is treated and used as recycled water, maintenance that requires the filters to be offline for extended periods of time is not practical.

Furthermore, due to the high CoF and PoF scores in the FMEA, the tertiary filters structure ranked as one of the higher criticality scores at the WRF (Criticality score of 41 out of 100). New concrete filter tanks are recommended to mitigate the probability of failure which will reduce the criticality score to better align with acceptable level of service goals.

Projects

Capital improvement projects identified for the tertiary filters are summarized in Table 2-5. The filtration alternative analysis identified deep-bed granular media filters as the preferred alternative and serves as the basis for the filter system upgrade project.

Table 2-5. Tertiary Filtration Improvements Projects

Projects	Cost
WRF – 8.0, Replace Tertiary Filters	$3,825,000

Alternative Approach

TM-3A evaluated current condition of the filters and recommended an upgrade. Acceptable upgrade alternatives included granular-media filtration, cloth disk filtration, and membrane filtration with a recommendation to install new deep-bed granular media filters.

OMWD staff further considered the cost to benefit analysis for filtration alternatives and came to a conclusion that the cloth filters would be technically acceptable, cost-effective and preferred. As a result, the OMWD Board-approved 10 year Capital Spending Plan includes a budget for replacing the current filters with less expensive Cloth Disk Filters. The timing of the proposed capital expenditure is similar to that proposed in this report. The District plans to begin design of the new tertiary filter system in the 2016-17 fiscal year. A more detailed project description and complete Board-approved Capital Spending Plan is included in Appendix I to this report.

Project No:	**WRF - 8.0**			
Project Name:	**Replace Tertiary Filters**			
Description:	Process Evaluation and Condition Assessment identified deficiencies and limited remaining useful life in existing HydroClear filters. Project will construct new tertiary filters adjacent to existing tertiary filters. Filter evaluation study identified deep-bed granular media filters as preferred technology. Project cost assumes new reinforced concrete structure, underdrains, 6-ft filter media, mechanical piping and control valves, and onsite piping modifications. Backwash pumps will be upgraded and new blowers will be installed. Install new packaged control system and panels for new system.			
Priority:	90			
Location/Facility:	4S Ranch WRF			

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	X
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	X

Project Cost:				
Capital Costs:				
General			$	150,000
Civil & Mechanical			$	630,000
Structural			$	385,144
Electrical & Controls			$	400,000
Equipment			$	967,890
Capital Cost Subtotal:			**$**	**2,533,034**
Soft Costs:				
Classification 'B'				
Engineering	10 %	of capital costs	$	253,303
CM & ESDC	18 %	of capital costs	$	455,946
Administration	3 %	of capital costs	$	75,991
Soft Cost Subtotal:			**$**	**785,241**
Contingency:				
Contingency	20 %	of project cost	$	506,607
Total Project Cost:			**$**	**3,825,000**

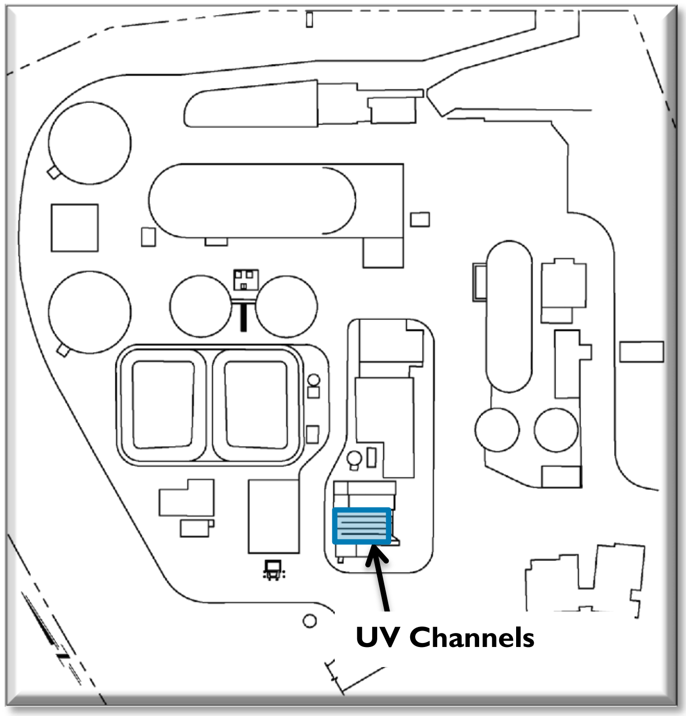
Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2017	$	329,000
Project Delivery Method:	Design-Bid-Build		2018	$	2,772,000
Project Duration (Years):	3		2019	$	724,000

2.2.6 Ultraviolet Disinfection Improvements

Background

The District currently utilizes a Trojan UV3000 ultraviolet disinfection system at its 4S Ranch Water Reclamation Facility (WRF). Originally commissioned in 2002, the Trojan UV3000 system was designed to treat 2.0 mgd of tertiary effluent using six duty UV banks with a UV transmittance (UVT) of 55%. Images of the existing Trojan UV3000 system are shown below. For additional details regarding the existing Trojan UV3000 system, refer to Appendix G (Technical Memorandum #3B).

Figure 2-12. UV Channels



Project Needs

The existing Trojan UV3000 system, now thirteen years old, is nearing the end of its useful life and needs to be replaced. The equipment was observed to be in poor condition. The District has received notice from Trojan that they are ceasing service support including replacement parts and components for the existing control system in the near future. Furthermore, the permitted bulbs have been discontinued and the availability of permit-compliant replacement bulbs beyond the next year is uncertain.

Due to the high CoF and PoF scores in the FMEA, the UV disinfection system and control panel ranked as one of the higher criticality scores at the WRF (Criticality score of 47 and 52 out of 100, respectively).

An upgrade to a new Trojan UV3000Plus system is recommended as a replacement for the existing system. The Trojan UV3000Plus system was preferred over other disinfection alternatives after a life-cycle cost alternatives analysis. The detailed alternatives analysis selecting the upgraded UV disinfection process is provided in Technical Memorandum #3B (Appendix G).

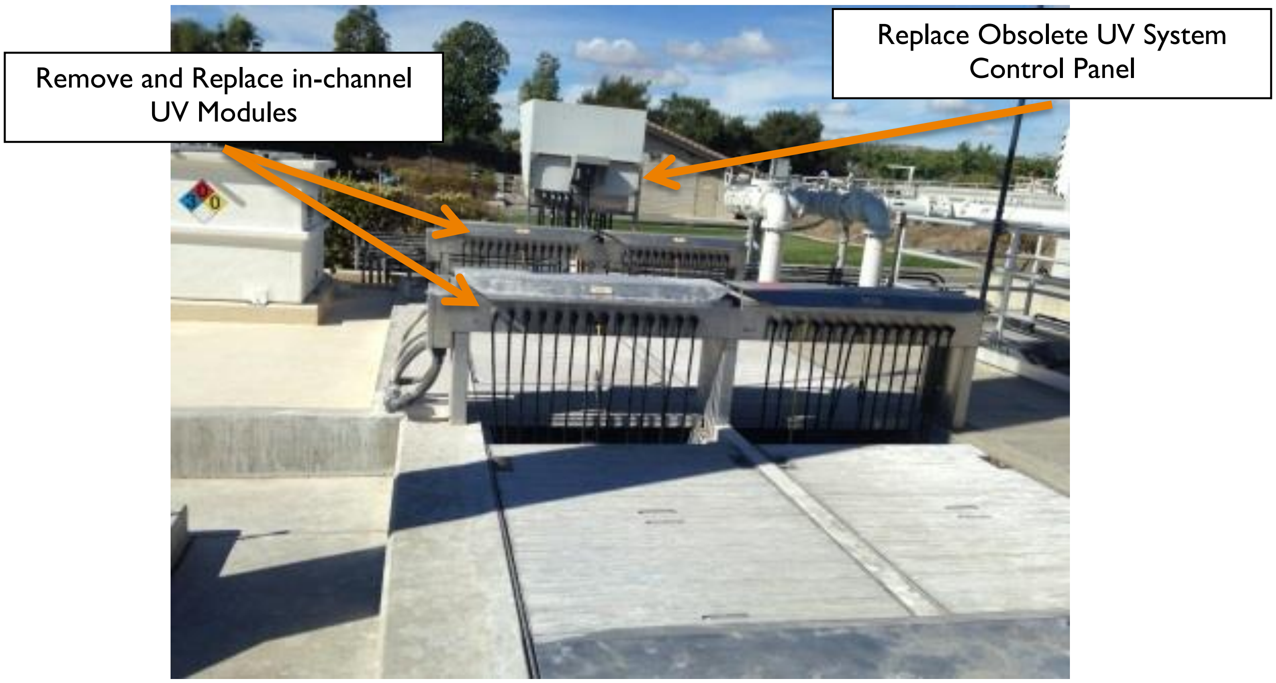
Projects

Capital improvement projects identified for the ultraviolet disinfection system are summarized in Table 2-6 and depicted in Figure 2-13.

Table 2-6. Ultraviolet Disinfection Improvements Projects

Projects	Cost
WRF – 9.1, Upgrade UV Disinfection System	$2,163,000
WRF – 9.2, Upgrade Disinfection System	$2,148,000
Total	$4,311,000

Figure 2-13. Ultraviolet Disinfection Improvements Projects



Alternative Approach

TM3B evaluated the current condition of the UV disinfection system and recommended an upgrade. Feasible upgrade alternatives included a new UV disinfection system or a chlorine disinfection system by sodium hypochlorite or on-site generation and recommended a new UV disinfection system.

The District has adopted an alternative phased-approach to the recommended disinfection system upgrades at the 4S Ranch WRF. The District plans to complete immediate 2015-16 electrical and control rehabilitation upgrades to the existing UV system to extend the useful life of this system for roughly 8 to 10 years. This will allow replacement as scheduled in the OMWD Board-approved 10 year Capital Spending Plan in fiscal years 2023-24 and 2024-25. The District plans to replace the UV disinfection process at that time with a chlorine disinfection system. District staff has determined that a chlorine disinfection system should provide a simpler and extremely effective system. In this way, labor currently required for UV lamp maintenance would be eliminated. The complete OMWD Board-approved Capital Spending Plan with immediate UV system repairs and later replacement with a chlorine process system are included for reference in Appendix I to this report.

Project No:	**WRF - 9.1**			
Project Name:	**Upgrade UV Disinfection System**			
Description:	Existing UV system controls are reaching obsolecence, permitted bulbs are no longer available, and manual cleaning is undesirable. Project will replace UV disinfection system with contemporary system including self-cleaning capability and new controls. Collect and analyze data to confirm design UVT criteria for new UV disinfection system. Perform validation testing and obtain WDR permit modification for new UV disinfection system. Phase installation or bypass existing disinfection system with temporary UV system or chlorine contact baker tanks in series to meet Title 22 disinfection requirements during construction.			
Priority:	145			
Location/Facility:	4S Ranch WRF			

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement		Predicted Useful Life Expiration	X
Facility/Equip Upgrade	X	Condition Assessment	X
Engineering Study		Operations Assessment	X
Expansion		Failure Modes & Consequences	X

Project Cost:				
Capital Costs:				
General			$	140,000
Civil & Mechanical			$	20,000
Structural			$	-
Electrical & Controls			$	200,000
Equipment			$	1,072,500
Capital Cost Subtotal:			**$**	**1,432,500**
Soft Costs:				
Classification 'B'				
Engineering	10 %	of capital costs	$	143,250
CM & ESDC	18 %	of capital costs	$	257,850
Administration	3 %	of capital costs	$	42,975
Soft Cost Subtotal:			**$**	**444,075**
Contingency:				
Contingency	20 %	of project cost	$	286,500
Total Project Cost:			**$**	**2,163,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2016	$	1,658,000
Project Delivery Method:	Design-Bid-Build		2017	$	505,000
Project Duration (Years):	2				

Project No:	**WRF - 9.2**			
Project Name:	**Upgrade Disinfection System**			
Description:	UV System Expected Useful Life is 15 years. With upgraded UV system installed in 2015-2016, significant upgrades and/or replacement is anticipated in 20-year CIP planning horizon. Future disinfection system upgrades should consider available technologies, evaluate alternatives and select "best-fit" disinfection system strategy to meet plant needs at that time. The cost estimate is based on assumption that UV disinfection will be retained as the disinfection system of choice.			
Priority:	5			
Location/Facility:	4S Ranch WRF			

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	130,000
Civil & Mechanical			$	20,000
Structural			$	-
Electrical & Controls			$	200,000
Equipment			$	1,072,500
Capital Cost Subtotal:			**$**	**1,422,500**
Soft Costs:				
Classification 'B'				
Engineering	10 %	of capital costs	$	142,250
CM & ESDC	18 %	of capital costs	$	256,050
Administration	3 %	of capital costs	$	42,675
Soft Cost Subtotal:			**$**	**440,975**
Contingency:				
Contingency	20 %	of project cost	$	284,500
Total Project Cost:			**$**	**2,148,000**

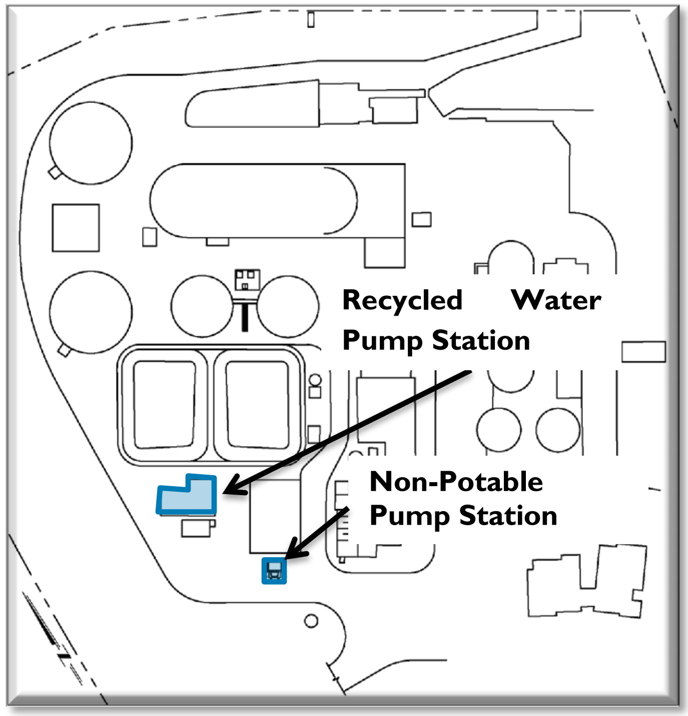
Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2030	$	1,647,000
Project Delivery Method:	Design-Bid-Build		2031	$	501,000
Project Duration (Years):	2				

2.2.7 Recycled Water and Non-Potable Water Pump Station Improvements

Background

The District currently operates three 75 HP Fairbanks Morse vertical turbine pumps for distribution of their recycled water and three 25 HP Fairbanks Morse vertical turbine pumps for backup distribution of their plant water (non-potable water). The recycled water pump station is located at the 4S Ranch WRF site in an independent enclosed building with an onsite Motor Control Center, Variable Frequency Drives and controls. The non-potable water pump station is located outside, adjacent to the clear well forebay. The District normally operates the recycled water pumps during the nighttime due to the lower energy cost associated with the energy intensive pumps.

Figure 2-14. Pump Stations



Project Needs

The existing recycled water pumps and non-potable water pumps, now approximately 12 years old, were observed to have minor to moderate corrosion. The pumps will reach the end of their expected useful life in the mid-term future and need to be replaced at that time.

Projects

Capital improvement projects identified for the recycled water and non-potable water pump stations are summarized in Table 2-7.

Table 2-7. Recycled Water and Non-Potable Water Pump Station Improvements Projects

Projects	Cost
WRF – 4.0, Replace Non-Potable Water Pumps	$268,000
WRF – 11.1, Replace Existing Recycled Water Pump Station Pumps	$515,000
WRF – 11.4, Upgrade Overflow Pond Return Strainer	$191,000
Total	$974,000

Project No:	**WRF - 4.0**		
Project Name:	**Replace Non-Potable Water Pumps**		
Description:	Replace the Non-Potable Water pumps at the 4S Ranch WRF. Includes vertical turbine pumps, motor, electrical, and controls.		
Priority:	15		
Location/Facility:	4S Ranch WRF		

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	15,000
Civil & Mechanical			$	20,000
Structural			$	-
Electrical & Controls			$	15,000
Equipment			$	117,600
Capital Cost Subtotal:			**$**	**167,600**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	25,140
CM & ESDC	20 %	of capital costs	$	33,520
Administration	5 %	of capital costs	$	8,380
Soft Cost Subtotal:			**$**	**67,040**
Contingency:				
Contingency	20 %	of project cost	$	33,520
Total Project Cost:			**$**	**268,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2026	$	29,000
Project Delivery Method:	Design-Bid-Build		2027	$	239,000
Project Duration (Years):	2				

Project No:	**WRF - 11.1**		
Project Name:	**Replace Existing Recycled Water Pump Station Pumps**		
Description:	Recycled Water Pumps were installed c.2004. Prior to replacement, pump efficiency testing should be performed and operational intent reviewed to confirm pump capacity requirements. Replace all three existing recycled water pump station vertical turbine pumps, motors, and VFD's. Phase installation to keep recycled water pump station operational during construction and commissioning.		
Priority:	20		
Location/Facility:	4S Ranch WRF		
Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:			
Capital Costs:			
General			$ 30,000
Civil & Mechanical			$ 30,000
Structural			$ -
Electrical & Controls			$ 68,400
Equipment			$ 212,850
Capital Cost Subtotal:			**$ 341,250**
Soft Costs:			
Classification 'B'			
Engineering	10 %	of capital costs	$ 34,125
CM & ESDC	18 %	of capital costs	$ 61,425
Administration	3 %	of capital costs	$ 10,238
Soft Cost Subtotal:			**$ 105,788**
Contingency:			
Contingency	20 %	of project cost	$ 68,250
Total Project Cost:			**$ 515,000**

Project Implementation (Schedule & Expenditure Timeline)				
Project Implementation:	One-Time Project	Expenditures:	2026	$ 275,000
Project Delivery Method:	Design-Bid-Build		2027	$ 241,000
Project Duration (Years):	2			

Project No:	**WRF - 11.4**
Project Name:	**Replace Overflow Pond Strainer**
Description:	Recycled Water stored in the overflow seasonal storage pond is returned to the WRF recycled water forebay. The return water forcemain is filtered through a manual strainer near the non-potable water pump station. The manual strainer should be replaced with a new automatic strainer.
Priority:	85
Location/Facility:	4S Ranch WRF

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade	X	Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	20,000
Civil & Mechanical			$	-
Structural			$	-
Electrical & Controls			$	50,000
Equipment			$	49,500
Capital Cost Subtotal:			**$**	**119,500**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	17,925
CM & ESDC	20 %	of capital costs	$	23,900
Administration	5 %	of capital costs	$	5,975
Soft Cost Subtotal:			**$**	**47,800**
Contingency:				
Contingency	20 %	of project cost	$	23,900
Total Project Cost:			**$**	**191,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2017	$	191,000
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	1				

2.2.8 Overflow Pond Improvements

Background

The District maintains a 410 acre-foot (134.4 million gallon) seasonal storage pond and return pump station. The overflow pond is critical to the District as a storage reservoir to contain recycled water during the low demand season (wet season) and provide adequate recycled water during the high demand season (dry season). The overflow pond is an earthen reservoir with a liner. The overflow pond pump station contains three (3) 40 HP submersible pumps, and two (2) 20 HP submersible pumps.

Project Needs

The existing overflow pond liner and pump station will reach the end of its expected useful life and need to be replaced within the CIP timeframe.

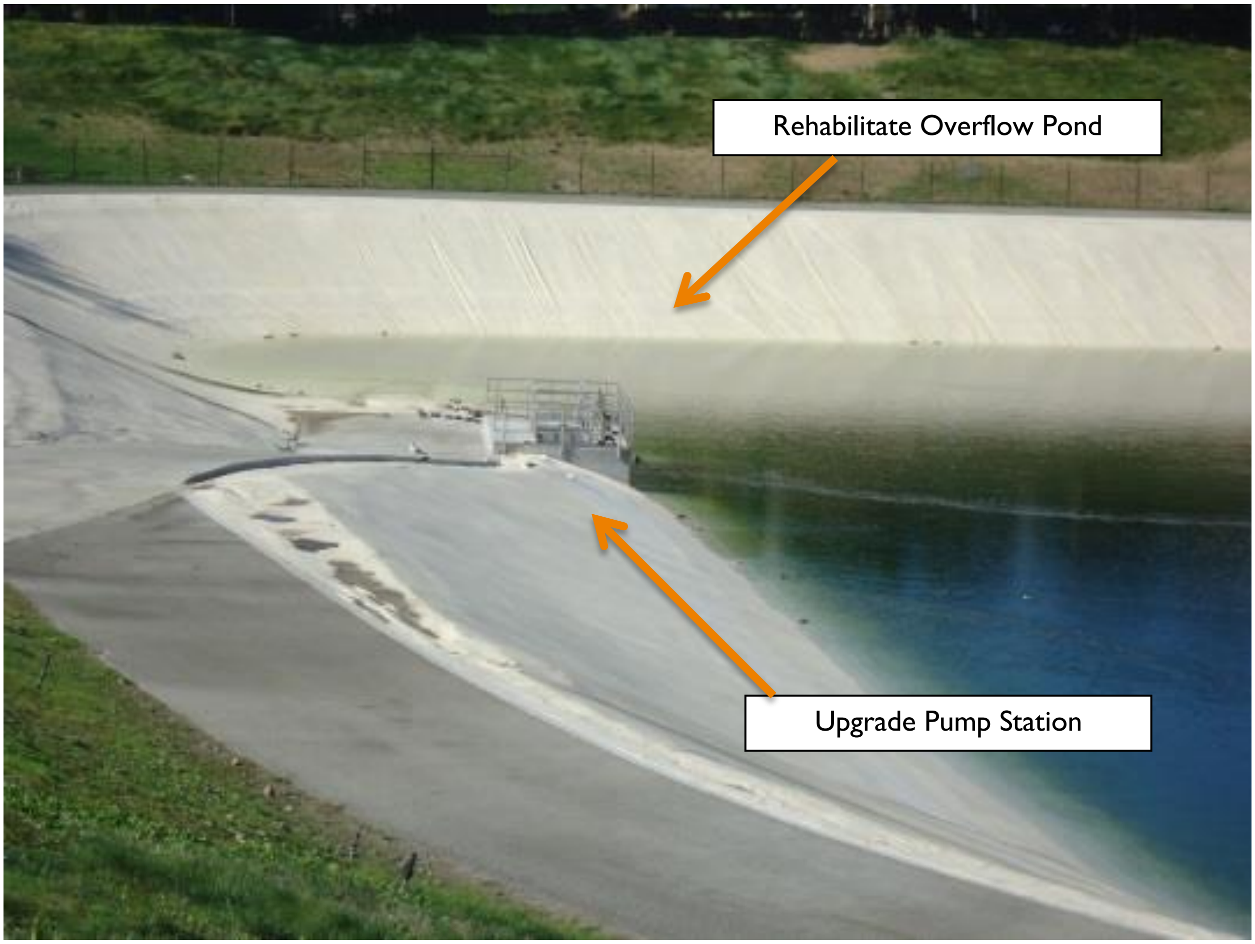
Projects

Capital improvement projects identified for the overflow pond are summarized in Table 2-8 and depicted in Figure 2-15.

Table 2-8. Recycled Water Pump Station Improvements Projects

Projects	Cost
WRF – 11.2, Overflow Pond Upgrades	$948,000
WRF – 11.3, Rehabilitate Overflow Pond Pump Station	$1,503,000
Total	$2,451,000

Figure 2-15. Recycled Water Pump Station Improvements Projects



Project No:	**WRF - 11.2**		
Project Name:	**Overflow Pond Upgrades**		
Description:	Overflow Pond was built in c.2002. Replace the Overflow Pond liner. Construct new concrete access ramp. Miscellaneous facility improvements. Project costs defined in the District's FY 14-15 Capital Spending Plan with expenditures planned to begin in FY 15-16.		
Priority:	95		
Location/Facility:	4S Ranch WRF		

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade	X	Condition Assessment	
Engineering Study		Operations Assessment	X
Expansion		Failure Modes & Consequences	

Project Cost:		
Capital Costs:		
General	$	-
Civil & Mechanical	$	948,000
Structural	$	-
Electrical & Controls	$	-
Equipment	$	-
Capital Cost Subtotal:	**$**	**948,000**
Soft Costs:		
Project Specific		
Engineering		N/A
CM & ESDC		N/A
Administration		N/A
Soft Cost Subtotal:	**$**	**-**
Contingency:		
Contingency		N/A
Total Project Cost:	**$**	**948,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2016	$	624,000
Project Delivery Method:	Design-Bid-Build		2017	$	324,000
Project Duration (Years):	2				

Project No:	**WRF - 11.3**			
Project Name:	**Rehabilitate Overflow Pond Pump Station**			
Description:	Rehabilitate the Overflow Pond and upgrade the overflow pond pump station with new pumps, electrical, and controls. Cost to replace pumps included in the "Small Pump Replacement Program" project. Project cost of overflow pond rehabilitation defined in the District's FY 14-15 Capital Spending Plan.			
Priority:	15			
Location/Facility:	4S Ranch WRF			

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade	X	Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:

Capital Costs:				
General			$	15,000
Civil & Mechanical			$	960,500
Structural			$	-
Electrical & Controls			$	20,000
Equipment			$	-
Capital Cost Subtotal:			**$**	**995,500**
Soft Costs:				
Classification 'B'				
Engineering	10 %	of capital costs	$	99,550
CM & ESDC	18 %	of capital costs	$	179,190
Administration	3 %	of capital costs	$	29,865
Soft Cost Subtotal:			**$**	**308,605**
Contingency:				
Contingency	20 %	of project cost	$	199,100
Total Project Cost:			**$**	**1,503,000**

Project Implementation (Schedule & Expenditure Timeline)

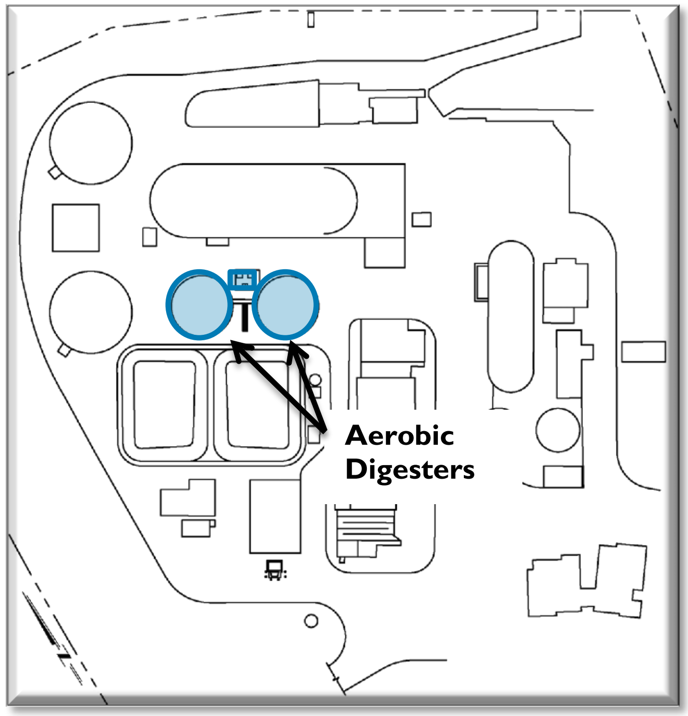
Project Implementation:	One-Time Project	Expenditures:	2028	$	1,152,000
Project Delivery Method:	Design-Bid-Build		2029	$	351,000
Project Duration (Years):	2				

2.2.9 Aerobic Digestion Improvements

Background

The 4S Ranch WRF aerobically digests thickened waste activated sludge in two circular aerobic digesters. The digesters were originally constructed with mechanical aerator/mixers that were subsequently replaced with blowers and diffusers. The switch to forced aeration was prompted by deficiencies with the mechanical aerators including the inability to maintain dissolved oxygen in the digesters that resulted in odor issues. Two blowers are currently installed – a 75 HP and a 150 HP. The blowers are typically not operated concurrently. Magnesium hydroxide is routinely added to the aerobic digester in order to raise pH. The observed pH depression is likely a result of alkalinity depletion in upstream processes.

Figure 2-16. Aerobic Digesters



Project Needs

The District installed the existing blowers and diffusers approximately 10 years ago, and since then, has reported maintenance issues with the larger Kaeser blower. Although the blowers are currently in fair condition, they installed outdoors and affected by seasonal weather conditions. The blowers will likely need to be replaced in the near- to mid-term future. The current blower/diffuser operation represents one of the largest electrical demands on the plant resulting in high operations costs. The opportunity for significant electrical power savings is available if the District pursues an alternate digestion technology, such as facultative digestion.

Projects

Capital improvement projects identified for the aerobic digesters are summarized in Table 2-9.

Table 2-9. Aerobic Digestion Improvements Projects

Projects	Cost
WRF – 5.1, Replace Existing 150 HP Digester Blower	$229,000
WRF – 5.2, Replace Existing 75 HP Digester Blower	$159,000
WRF – 5.3, Replace Existing Digester Diffusers	$205,000
Total	$593,000

Project No:	**WRF - 5.1**		
Project Name:	**Replace Existing 150 HP Digester Blower**		
Description:	Replace the existing 150 HP digester blower at the 4S Ranch WRF.		
Priority:	60		
Location/Facility:	4S Ranch WRF		

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	X
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:		
Capital Costs:		
General	$	15,000
Civil & Mechanical	$	7,500
Structural	$	-
Electrical & Controls	$	15,000
Equipment	$	107,250
Capital Cost Subtotal:	**$**	**144,750**
Soft Costs:		
Project Specific		
Engineering	$	20,000
CM & ESDC	$	30,000
Administration	$	5,000
Soft Cost Subtotal:	**$**	**55,000**
Contingency:		
Contingency 20 % of project cost	$	28,950
Total Project Cost:	**$**	**229,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2021	$	229,000
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	1				

Project No:	**WRF - 5.2**		
Project Name:	**Replace Existing 75 HP Digester Blower**		
Description:	Replace the existing 75 HP digester blower at the 4S Ranch WRF.		
Priority:	60		
Location/Facility:	4S Ranch WRF		

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	X
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:			
Capital Costs:			
General		$	15,000
Civil & Mechanical		$	7,500
Structural		$	-
Electrical & Controls		$	15,000
Equipment		$	49,500
Capital Cost Subtotal:		**$**	**87,000**
Soft Costs:			
Project Specific			
Engineering		$	20,000
CM & ESDC		$	30,000
Administration		$	5,000
Soft Cost Subtotal:		**$**	**55,000**
Contingency:			
Contingency	20 % of project cost	$	17,400
Total Project Cost:		**$**	**159,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2021	$	159,000
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	1				

Project No:	**WRF - 5.3**		
Project Name:	**Replace Existing Digester Diffusers**		
Description:	Replace the existing aerobic digester diffusers at the 4S Ranch WRF.		
Priority:	20		
Location/Facility:	4S Ranch WRF		

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	15,000
Civil & Mechanical			$	18,250
Structural			$	-
Electrical & Controls			$	3,300
Equipment			$	99,000
Capital Cost Subtotal:			**$**	**135,550**
Soft Costs:				
Classification 'B'				
Engineering	10 %	of capital costs	$	13,555
CM & ESDC	18 %	of capital costs	$	24,399
Administration	3 %	of capital costs	$	4,067
Soft Cost Subtotal:			**$**	**42,021**
Contingency:				
Contingency	20 %	of project cost	$	27,110
Total Project Cost:			**$**	**205,000**

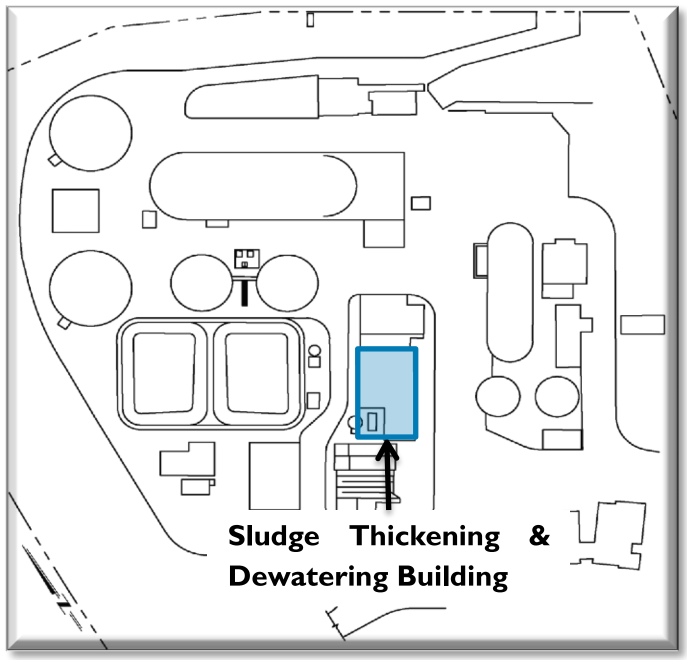
Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2027	$	205,000
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	1				

2.2.10 Sludge Thickening and Dewatering Improvements

Background

The 4S Ranch WRF operates two one meter belt filter presses, typically using one for thickening and the other for dewatering. The District uses polymer for thickening. The belt filter press is achieving approximately 17% dry solids cake on average, which is reasonable performance for a belt filter press dewatering aerobically digested sludge. Both belt filter presses are housed in the Sludge Dewatering Building, the largest process building at the WRF. The belt filter presses deploys dewatered Class B biosolids to a truck, where the biosolids are hauled to Arizona for disposal. Odors generated in the sludge dewatering building are treated by a LO/PRO® chemical odor control system. The chemical odor control scrubber, also called a "wet scrubber," utilizes Sodium Hypochlorite (NAOCl) and Sodium Hydroxide (NaOH) to react with and remove the odorous compounds present in the airstream, particularly hydrogen sulfide gas (H_2S).

Figure 2-17. Sludge Thickening & Dewatering



Project Needs

The belt filter presses, now approximately 12 years old, will reach the end of their expected useful life in the mid-term and need to be replaced at that time. In order to achieve higher sludge cake dryness, more energy-intensive equipment would be required. It is recommended that alternative dewatering technologies (e.g., screw presses and centrifuges) be evaluated prior to replacing the belt presses in order to minimize life cycle cost of the unit process operation. The existing sludge dewatering building odor control scrubber is approximately 12 years old and will reach the end of its expected useful life and need to be replaced around the same time as the belt filter presses.

Projects

Capital improvement projects identified for the sludge thickening and dewatering system are summarized in Table 2-10.

Table 2-10. Sludge Thickening and Dewatering Improvements Projects

Projects	Cost
WRF – 6.1, Dewatering Technology Study (Process Study & Pre-Design)	$50,000
WRF – 6.2, Upgrade or Replace Existing Belt Filter Presses	$1,766,000
WRF – 6.3, Replace Existing Solids Dewatering Building Odor Control Scrubber	$635,000
Total	$2,451,000

Project No:	**WRF - 6.1**
Project Name:	**Dewatering Technology Study (Process Study and Pre-Design)**
Description:	Prior to reinvesting in the sludge handling facilities, conduct an engineering study to evaluate specific facility needs and compare available dewatering technologies. Consider replacing belt filter presses in kind, or upgrade to screw press or centrifuge.
Priority:	65
Location/Facility:	4S Ranch WRF

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement		Predicted Useful Life Expiration	
Facility/Equip Upgrade		Condition Assessment	
Engineering Study	X	Operations Assessment	X
Expansion		Failure Modes & Consequences	

Project Cost:

Capital Costs:		
General	$	-
Civil & Mechanical	$	-
Structural	$	-
Electrical & Controls	$	-
Equipment	$	-
Capital Cost Subtotal:	**$**	**-**
Soft Costs:		
Project Specific		
Engineering	$	50,000
CM & ESDC		N/A
Administration		N/A
Soft Cost Subtotal:	**$**	**50,000**
Contingency:		
Contingency		N/A
Total Project Cost:	**$**	**50,000**

Project Implementation (Schedule & Expenditure Timeline)

Project Implementation:	One-Time Project	Expenditures:	2019	$	50,000
Project Delivery Method:	Engineering Report				
Project Duration (Years):	1				

Project No:	**WRF - 6.2**		
Project Name:	**Upgrade Dewatering System**		
Description:	Subsequent to dewatering technology engineering study (WRF-10.1), replace existing belt filter presses or upgrade to new technology. Cost estimate assumes replacing the existing belt filter presses, electrical and controls. TWAS Pump replacement cost included in Project No. WRF - 25.0.		
Priority:	65		
Location/Facility:	4S Ranch WRF		

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade	X	Condition Assessment	
Engineering Study		Operations Assessment	X
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	100,000
Civil & Mechanical			$	60,000
Structural			$	50,000
Electrical & Controls			$	150,000
Equipment			$	809,750
Capital Cost Subtotal:			**$**	**1,169,750**
Soft Costs:				
Classification 'B'				
Engineering	10 %	of capital costs	$	116,975
CM & ESDC	18 %	of capital costs	$	210,555
Administration	3 %	of capital costs	$	35,093
Soft Cost Subtotal:			**$**	**362,623**
Contingency:				
Contingency	20 %	of project cost	$	233,950
Total Project Cost:			**$**	**1,766,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2019	$	135,000
Project Delivery Method:	Design-Bid-Build		2020	$	1,632,000
Project Duration (Years):	2				

Project No:	**WRF - 6.3**		
Project Name:	**Upgrade Solids Dewatering Building Odor Control Scrubber**		
Description:	Dewatering Building odor control scrubber (wet/chemical, NaOH & NaOCl) was installed c.2005. The existing system is a Siemens LoPro rated for ### cfm. Odor control systems are subjected to aggressive operating conditions and are expected to be replaced at the end of useful life. Project will replace packaged odor control system including tower, fan, pumps, chemical systems, and controls. Preliminary design study should evaluate effectiveness of system, confirm loading, and consider contemporary technologies and operational needs to select best-fit system.		
Priority:	25		
Location/Facility:	4S Ranch WRF		
Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	45,000
Civil & Mechanical			$	17,500
Structural			$	-
Electrical & Controls			$	20,000
Equipment			$	338,250
Capital Cost Subtotal:			**$**	**420,750**
Soft Costs:				
Classification 'B'				
Engineering	10 %	of capital costs	$	42,075
CM & ESDC	18 %	of capital costs	$	75,735
Administration	3 %	of capital costs	$	12,623
Soft Cost Subtotal:			**$**	**130,433**
Contingency:				
Contingency	20 %	of project cost	$	84,150
Total Project Cost:			**$**	**635,000**

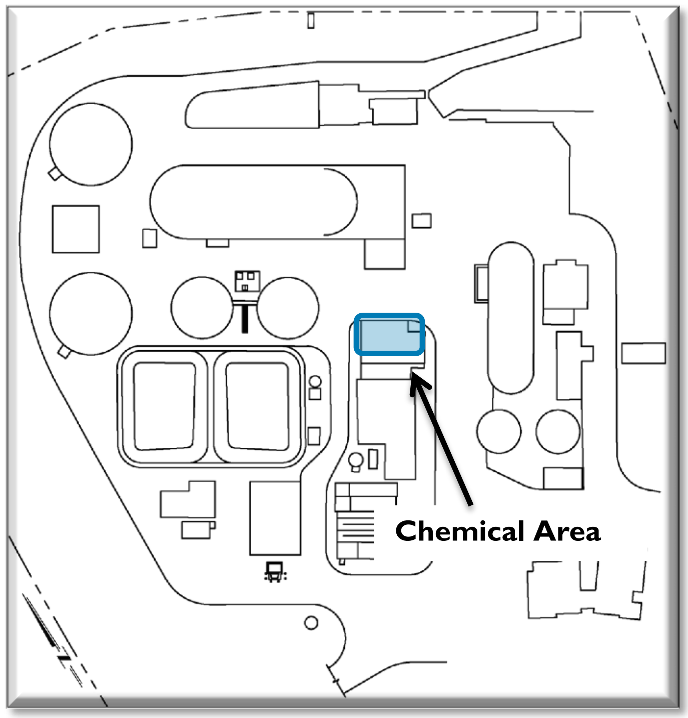
Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2025	$	635,000
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	1				

2.2.11 Chemical Feed System Improvements

Background

The 4S Ranch WRF maintains the majority of their chemical pumps, tanks, and controls their chemical feed and containment area, adjacent to the electrical room. The facility contains 26 chemical feed pumps and four primary chemical tanks. Two tanks store sodium hypochlorite, used in the two odor control scrubbers, secondary effluent equalization basins, and recycled water residual. One tank stores polymer (Clarifloc by Polydyne) used in sludge thickening and dewatering, and the other stores sodium hydroxide (caustic) used in the two odor control scrubbers. The two sodium hypochlorite tanks have been replaced, while the polymer tank and caustic tank remain as the same tanks installed in the 2002 expansion.

Figure 2-18. Chemical Area



Project Needs

The Caustic and Polymer chemical storage tanks, now 12 years old, will reach the end of their expected useful life in the mid-term and need to be replaced at that time.

Projects

Capital improvement projects identified for the chemical feed system are summarized in Table 2-11.

Table 2-11. Chemical Feed System Improvements Projects

Projects	Cost
WRF – 6.4, Replace Caustic and Polymer Tanks	$77,000

Project No:	**WRF - 6.4**			
Project Name:	**Replace Caustic and Polymer Tanks**			
Description:	Replace caustic soda and alum tanks at the 4S Ranch WRF.			
Priority:	40			
Location/Facility:	4S Ranch WRF			

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	X
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	-
Civil & Mechanical			$	8,000
Structural			$	-
Electrical & Controls			$	3,000
Equipment			$	33,000
Capital Cost Subtotal:			**$**	**44,000**
Soft Costs:				
Project Specific				
Engineering	20 %	of capital costs	$	8,800
CM & ESDC	25 %	of capital costs	$	11,000
Administration	10 %	of capital costs	$	4,400
Soft Cost Subtotal:			**$**	**24,200**
Contingency:				
Contingency	20 %	of project cost	$	8,800
Total Project Cost:			**$**	**77,000**

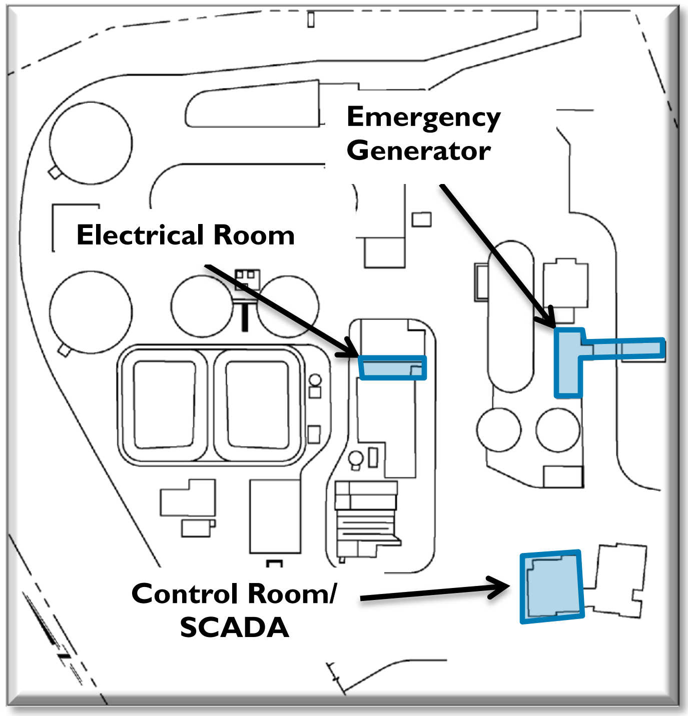
Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2022	$	77,000
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	1				

2.2.12 Electrical and SCADA System Improvements

Background

The 4S Ranch WRF maintains the majority of their electrical gear in the electrical room, in between the sludge dewatering building and the chemical feed and containment area. The 4S WRF central SCADA is located in the operations building. The SCADA HMI software products are in the process of being replaced and upgraded. The plant has allocated close to the maximum power available from their current utility service. The WRF emergency generator provides backup power for the WRF in case of a utility power failure.

Figure 2-19. Electrical Room, Generator, and SCADA



Project Needs

The existing WRF electrical gear and emergency generator, now 12 years old, will reach the end of its expected useful life in the long-term. Although the central SCADA system is currently being upgraded, SCADA control software typically becomes obsolete after approximately fifteen (15) years, and will need to be upgraded again approximately 15 years from now.

Due to the high CoF and PoF scores in the FMEA, the motor control centers and switchgear and automatic transfer switch ranked as one of the higher criticality scores at the WRF (Criticality score of 32 and 33 out of 100, respectively). It is recommended that the District perform annual testing of the automatic transfer switch to verify that it is functioning properly in case of a utility power failure. It is also recommended that the District test and certify main circuit breakers, and perform infrared testing on the motor control centers every three years to monitor the performance of this critical equipment.

Projects

Capital improvement projects identified for the electrical and SCADA system are summarized in Table 2-12.

Table 2-12. Electrical and SCADA System Improvements Projects

Projects	Cost
WRF – 6.5, Upgrade WRF Electrical Gear	$3,840,000
WRF – 10.0, Upgrade SCADA Control System	$800,000
WRF – 13.0, Replace Emergency Generator	$670,000
Total	$5,310,000

Project No:	**WRF - 6.5**				
Project Name:	**Upgrade Existing WRF Electrical Gear**				
Description:	Full upgrade for all existing WRF electrical gear including MCC's. Project does not include SCADA upgrades and other control upgrades.				
Priority:	24				
Location/Facility:	4S Ranch WRF				

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement		Predicted Useful Life Expiration	X
Facility/Equip Upgrade	X	Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	-
Civil & Mechanical			$	-
Structural			$	-
Electrical & Controls			$	2,400,000
Equipment			$	-
Capital Cost Subtotal:			**$**	**2,400,000**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	360,000
CM & ESDC	20 %	of capital costs	$	480,000
Administration	5 %	of capital costs	$	120,000
Soft Cost Subtotal:			**$**	**960,000**
Contingency:				
Contingency	20 %	of project cost	$	480,000
Total Project Cost:			**$**	**3,840,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2032	$	210,000
Project Delivery Method:	Design-Bid-Build		2033	$	210,000
Project Duration (Years):	4		2034	$	2,550,000
			2035	$	870,000

Project No:	**WRF - 10.0**
Project Name:	**Upgrade SCADA Control System**
Description:	Implement full SCADA control system upgrade for the central system and PLC's at the 4S Ranch WRF. Project does not include upgrade for electrical gear.
Priority:	5
Location/Facility:	4S Ranch WRF

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement		Predicted Useful Life Expiration	X
Facility/Equip Upgrade	X	Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:

Capital Costs:				
General			$	-
Civil & Mechanical			$	-
Structural			$	-
Electrical & Controls			$	500,000
Equipment			$	-
Capital Cost Subtotal:			**$**	**500,000**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	75,000
CM & ESDC	20 %	of capital costs	$	100,000
Administration	5 %	of capital costs	$	25,000
Soft Cost Subtotal:			**$**	**200,000**
Contingency:				
Contingency	20 %	of project cost	$	100,000
Total Project Cost:			**$**	**800,000**

Project Implementation (Schedule & Expenditure Timeline)

Project Implementation:	One-Time Project	Expenditures:	2033	$	46,000
Project Delivery Method:	Design-Bid-Build		2034	$	396,000
Project Duration (Years):	3		2035	$	358,000

Project No:	**WRF - 13.0**			
Project Name:	**Replace Emergency Generator**			
Description:	Replace the emergency generator at the 4S Ranch WRF.			
Priority:	20			
Location/Facility:	4S Ranch WRF			

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	-
Civil & Mechanical			$	30,000
Structural			$	-
Electrical & Controls			$	125,000
Equipment			$	288,750
Capital Cost Subtotal:			**$**	**443,750**
Soft Costs:				
Classification 'B'				
Engineering	10 %	of capital costs	$	44,375
CM & ESDC	18 %	of capital costs	$	79,875
Administration	3 %	of capital costs	$	13,313
Soft Cost Subtotal:			**$**	**137,563**
Contingency:				
Contingency	20 %	of project cost	$	88,750
Total Project Cost:			**$**	**670,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2027	$	357,000
Project Delivery Method:	Design-Bid-Build		2028	$	313,000
Project Duration (Years):	2				

2.2.13 Site Paving Improvements

Background

The 4S Ranch WRF site is primarily paved with additional landscaping around the perimeter.

Project Needs

The existing paving will need to be maintained and improved over the course of the next 20 years for functionality and aesthetics.

Projects

Capital improvement projects identified for site paving are summarized in Table 2-13.

Figure 2-20. Site Paving

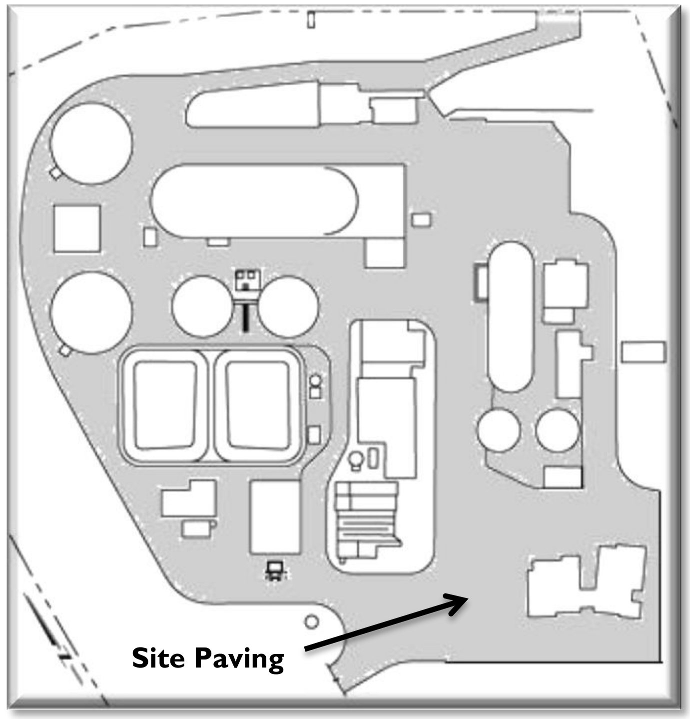


Table 2-13. Site Paving Improvements Projects

Projects	Cost
WRF – 16.0, Paving Maintenance and Improvements	$225,000

Project No:	**WRF - 16.0**			
Project Name:	**Paving Maintenance and Improvements**			
Description:	Grind and overlay paving improvements to the 4S Ranch WRF site.			
Priority:	10			
Location/Facility:	4S Ranch WRF			

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	20,000
Civil & Mechanical			$	135,382
Structural			$	-
Electrical & Controls			$	-
Equipment			$	-
Capital Cost Subtotal:			**$**	**155,382**
Soft Costs:				
Classification 'A'				
Engineering	8 %	of capital costs	$	12,431
CM & ESDC	15 %	of capital costs	$	23,307
Administration	2 %	of capital costs	$	3,108
Soft Cost Subtotal:			**$**	**38,846**
Contingency:				
Contingency	20 %	of project cost	$	31,076
Total Project Cost:			**$**	**225,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	Multiple-Time Project	Expenditures:	2025	$	113,000
Project Delivery Method:	Design-Bid-Build		2035	$	113,000
Project Duration (Years):	2				

2.2.14 Vehicle Replacements

Background

The operations and maintenance crew require trucks for transportation to and from remote sites.

Project Needs

Trucks and fleet vehicles will need to be replaced when they break down.

Projects

Capital improvement projects identified for vehicle replacements are summarized in Table 2-14.

Table 2-14. Vehicle Replacements Projects

Projects	Cost
WRF – 17.0, Replace Vehicles in Fleet	$569,000

Project No:	**WRF - 17.0**
Project Name:	**Replace Vehicles in Fleet**
Description:	Replace trucks and other vehicles in the fleet with new models.
Priority:	25
Location/Facility:	4S Ranch WRF

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:		
Capital Costs:		
General	$	474,000
Civil & Mechanical	$	-
Structural	$	-
Electrical & Controls	$	-
Equipment	$	-
Capital Cost Subtotal:	**$**	**474,000**
Soft Costs:		
Project Specific		
Engineering		N/A
CM & ESDC		N/A
Administration		N/A
Soft Cost Subtotal:	**$**	**-**
Contingency:		
Contingency 20 % of project cost	$	94,800
Total Project Cost:	**$**	**569,000**

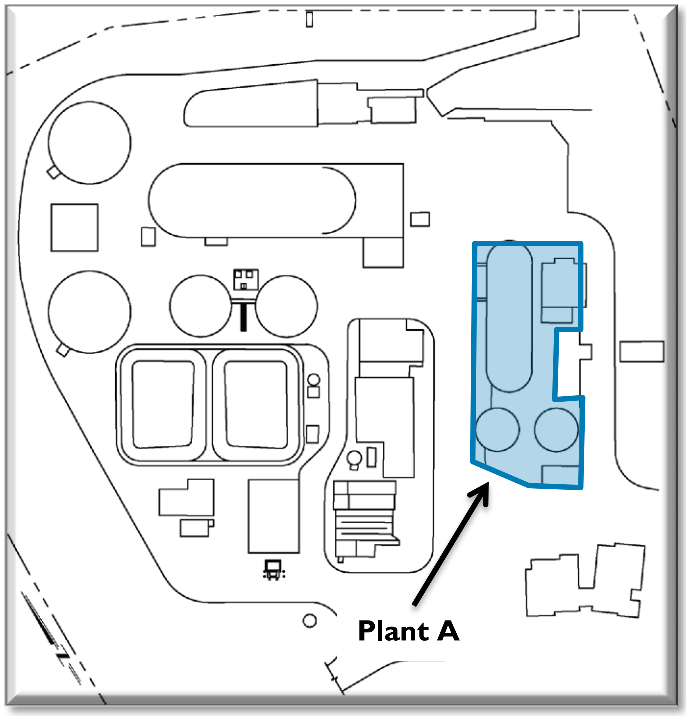
Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2025	$	142,000
Project Delivery Method:	In-House Installation		2030	$	427,000
Project Duration (Years):	2				

2.2.15 Plant A Rehabilitation

Background

The 4S Ranch WRF contains a secondary biological treatment process train named "Plant A." Plant A consists of a single oxidation ditch with pre-anoxic basin, mixed liquor return for biological nutrient removal, and two clarifiers. Plant A is rated at 0.5 mgd. Plant A has not been operated over the past ten years and therefore, operating Plant A will require rehabilitation and ongoing maintenance to keep the facility available for operation.

Figure 2-21. Plant A Rehabilitation



Project Needs

Plant A has not been operated over the past ten years and therefore no current operating data is available. Plant A is the oldest area of the WRF, and will require rehabilitation and ongoing maintenance to ensure that the process train is functional.

Projects

Capital improvement projects identified for Plant A rehabilitation are summarized in Table 2-15.

Table 2-15. Plant A Rehabilitation Projects

Projects	Cost
WRF – 2.3, Plant A Rehabilitation and On-Going Maintenance	$2,325,000

Project Derivation

The Plant A asset list was established in the Asset Inventory (Appendix A). The Plant, however, has not been operated since the construction of Plant B, and therefore condition assessment, operations assessment, and failure modes and effects analysis were not performed for Plant A. Furthermore, age of Plant A equipment is unrepresentative of its remaining useful life due to the long hiatus of full operation. Therefore, to represent the cost associated with maintaining Plant A, all equipment, from small pumps and instrumentation to process equipment and concrete structures, is annually programmed for replacement according to its asset valuation divided by its expected useful life. For example, a Plant A

RAS pump is valued at $15,000, and has an expected useful life of 20 years. The pump is budgeted for replacement from an annual contribution of $15,000/20 years = $750 per year. This methodology is applied for all Plant A assets to complete the annual budget required to maintain Plant A.

Project No:	**WRF - 2.3**			
Project Name:	**Plant A Rehabilitation and On-Going Maintenance**			
Description:	Rehabilitate and maintain the Plant A process train at the 4S Ranch WRF.			
Priority:	0			
Location/Facility:	4S Ranch WRF			

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement		Predicted Useful Life Expiration	X
Facility/Equip Upgrade	X	Condition Assessment	
Engineering Study		Operations Assessment	X
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	1,540,000
Civil & Mechanical			$	-
Structural			$	-
Electrical & Controls			$	-
Equipment			$	-
Capital Cost Subtotal:			**$**	**1,540,000**
Soft Costs:				
Classification 'B'				
Engineering	10 %	of capital costs	$	154,000
CM & ESDC	18 %	of capital costs	$	277,200
Administration	3 %	of capital costs	$	46,200
Soft Cost Subtotal:			**$**	**477,400**
Contingency:				
Contingency	20 %	of project cost	$	308,000
Total Project Cost:			**$**	**2,325,000**

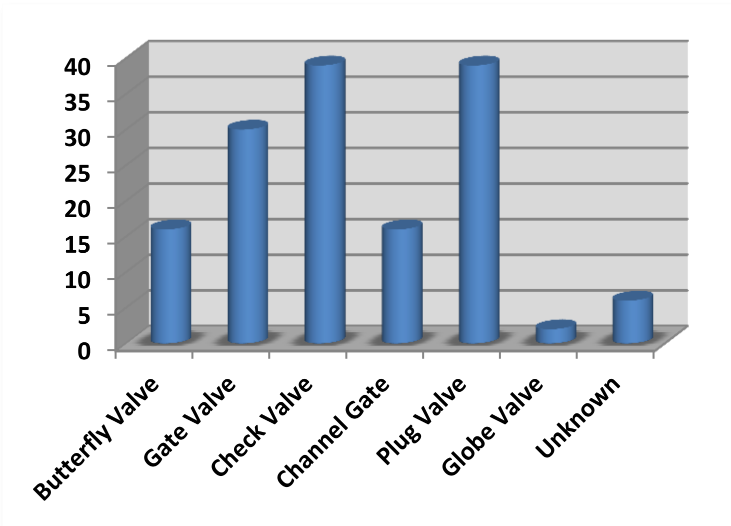
Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	Annual Program	Expenditures:	Annual	$	116,250
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	20				

2.2.16 Valve and Gate Replacements

Background

The 4S Ranch WRF contains 148 valves and gates, including valves at the recycled water pump station, and the overflow pond pump station across the street from the WRF. The distribution of valves and gates by type is seen in Figure 2-22 on the right. Valves are used to control flow through mechanical piping in a variety of ways. Gates are generally used to control larger flows between and among process areas. Valves and gates are integral to the overall successful operation of the WRF. The valve and gate replacements program does not apply to Plant A.

~~**Figure 2-22. Distribution of Valves and Gates**~~



Project Needs

Valves and gates will depreciate and fail over time due to wear of the seat, seal, and stem, corrosion, cavitation, and abrasion from particles in the fluid. Valves and gates are generally replaced as-needed.

Projects

Capital improvement projects identified for valve and gate replacements are summarized in Table 2-16.

Table 2-16. Valve and Gate Replacements Projects

Projects	Cost
WRF – 18.1, Valve and Gate Replacement Program	$945,000

Project Derivation

The valve list was established in the Asset Inventory (Appendix A), and budget quotes for valve replacement were supplied by an experienced local sales representative for each valve. The cost per valve was then divided by the expected useful life of the valve (i.e., 25 years) to calculate the annual savings required to replace the valve. The sum of these annual savings values determines an annual budget required to replace all valves at the WRF at the end of their expected useful life. This cost applied over the 20-year CIP timeframe is the capital cost for the project. The soft costs for the project were estimated to fall under "Classification D" assuming that the District staff will procure and replace the majority of valves at the WRF. A typical 20% contingency was applied to the capital cost. The annual total project cost is not expected to coordinate exactly with valve replacement expenditures on a year-to-year basis, but provide adequate savings during low replacement years for higher expenditures on high replacement years.

Project No:	**WRF - 18.1**		
Project Name:	**Valve and Gate Replacement Program**		
Description:	Replace existing valves at the 4S Ranch WRF on an as-needed basis. Replacement program budgets for the average valve replacement cost on an annual basis assuming an average useful life of 25 years for valves and 30 years for sluice gates. Includes valve actuators. Does not include Plant A.		
Priority:	0		
Location/Facility:	4S Ranch WRF		

Project Type(s):		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:			
Capital Costs:			
General			$ -
Civil & Mechanical			$ 845,000
Structural			$ -
Electrical & Controls			$ 10,000
Equipment			$ -
Capital Cost Subtotal:			**$ 855,000**
Soft Costs:			
Classification 'D'			
Engineering	5 %	of capital costs	$ 42,750
CM & ESDC	5 %	of capital costs	$ 42,750
Administration	5 %	of capital costs	$ 42,750
Soft Cost Subtotal:			**$ 128,250**
Contingency:			
Contingency	20 %	of project cost	$ 171,000
Total Project Cost:			**$ 1,154,000**

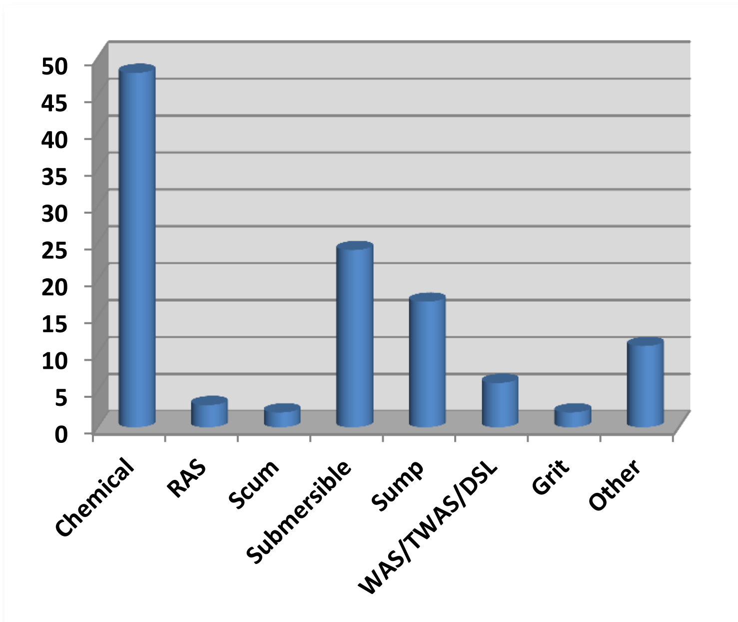
Project Implementation (Schedule & Expenditure Timeline)				
Project Implementation:	Annual Program	Expenditures:	Annual	$ 57,700
Project Delivery Method:	In-House Installation			
Project Duration (Years):	20			

2.2.17 Small Pump and Motor Replacements

Background

The 4S Ranch WRF contains 113 small pumps (pumps valued to be less than $50,000) and 37 small motors (in the case that the motor is not an integral part of the pump and can be easily detached and replaced as-needed) including small pumps and motors at the recycled water pump station, and the overflow pond pump station across the street from the WRF. The "small pumps" range from 1 HP sump pumps to 40 HP submersible pumps at the overflow pond pump station with individual asset values ranging from $2,000 to $20,000. The distribution of small pumps at the WRF is shown in Figure 2-23 to the right. Pumps are utilized in the treatment process to lift water into, during, and out of the processes and to provide pressure in piping. Pumps are utilized as support systems as well, such as sump pumps for storm water and chemical pumps for chemical metering and dosing. Motors convert electrical energy into mechanical energy, utilized in pumps and other mechanical equipment for their various functions. The small pump and motor replacements program does not apply to Plant A.

Figure 2-23. Distribution of Small Pumps



Project Needs

Small pumps and motors wear over time. Routine maintenance is required to maintain operability throughout the assets life. While routine maintenance including lubrication, replacement of seals and bearings, long-term wear of motors and pump casings and impellers due to corrosion, cavitation, and abrasion will eventually cause equipment to operate outside of acceptable parameters. While larger pumps are typically re-built and large motors re-wound to extend useful life, the cost of such overhauls for small pumps and motors can often exceed the cost of a new replacement. This project establishes an annual budget for replacement of small pumps and motors.

Projects

Capital improvement projects identified for small pump replacements are summarized in Table 2-17.

Table 2-17. Small Pump Replacements Projects

Projects	Cost
WRF – 18.2, Small Pump and Motor Replacement Program	$2,748,000

Project Derivation

The pump list was established in the Asset Inventory (Appendix A), and budget quotes for small pump replacement were obtained from local sales representatives or through sales catalogs. The cost of each pump was then divided by the expected useful life of the pump (i.e., 8-20 years) to calculate the annual budget anticipated for a rotating pump and motor replacement program. The expected useful life values for small pumps used to calculate the annual budget are described in Table 2-18.

Table 2-18. Small Pump Expected Useful Life

Type of Pump	Expected Useful Life
Chemical	8
RAS	20
Scum	8
Submersible	15
Sump	15
WAS/TWAS/DSL	10
Grit	10
Other	20

The total pump and motor replacement cost over the 20-year CIP timeframe is the defined "capital" cost for the project. It is assumed that the District's in-house personnel will perform small pump and motor replacements such that the soft costs for the project were estimated to fall under "Classification D" (District replaced/installed equipment). Due to pump usage (run times) and exposure condition, equipment may require replacement sooner than or later than the specified expected useful life. The intent of this annualized budget is to provide funding for equipment replacement as it is required. It is anticipated that the District will perform routine inspections and track equipment maintenance and replacement in the Enterprise Asset Management software so that precise pump and motor replacement budgets can be programmed during each annual budget cycle.

Project No:	**WRF - 18.2**		
Project Name:	**Small Pump and Motor Replacement Program**		
Description:	Replace existing smaller pumps and motors (less than $50,000 value) at the 4S Ranch WRF, Recycled Water Pump Station, and Overflow Pond Pump Station on an as needed basis. Pump and motor replacement program budgets for replacement of Grit, RAS, WAS, TWAS, Filter Influent, Scum, Sump, chemical pumps, etc. Does not include Plant A.		
Priority:	0		
Location/Facility:	4S Ranch WRF		

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	-
Civil & Mechanical			$	40,000
Structural			$	-
Electrical & Controls			$	200,000
Equipment			$	1,795,600
Capital Cost Subtotal:			**$**	**2,035,600**
Soft Costs:				
Classification 'D'				
Engineering	5 %	of capital costs	$	101,780
CM & ESDC	5 %	of capital costs	$	101,780
Administration	5 %	of capital costs	$	101,780
Soft Cost Subtotal:			**$**	**305,340**
Contingency:				
Contingency	20 %	of project cost	$	407,120
Total Project Cost:			**$**	**2,748,000**

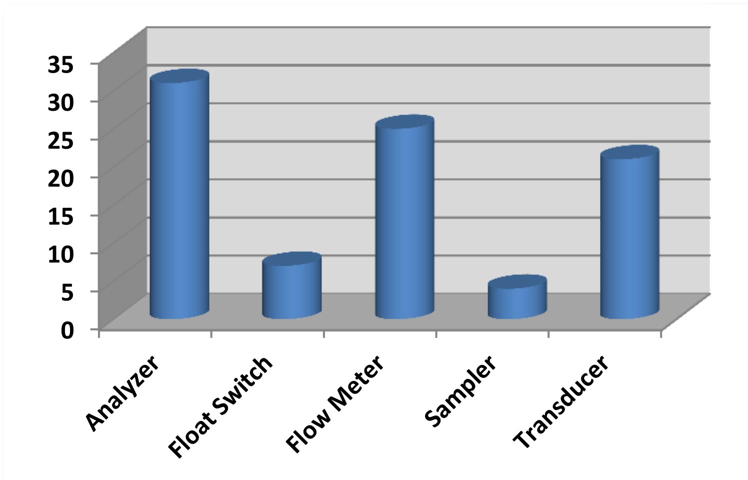
Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	Annual Program	Expenditures:	Annual	$	137,400
Project Delivery Method:	In-House Installation				
Project Duration (Years):	20				

2.2.18 Instrumentation Replacements

Background

The 4S Ranch WRF contains 88 instruments including float switches, level transmitters, flow meters, analyzers, samplers, sensors, and more. The distribution of instrumentation is shown in Figure 2-24 to the right. Instrumentation is utilized at the WRF for measuring, monitoring, and controlling flow and conditions of the processes. Instrumentation is also used for regulatory purposes, sampling effluent quality and measuring water constituents. Instrumentation is integral to the control and operation of the WRF, as well as complying with regulations mandated by the Regional Water Quality Control Board (RWQCB). The Instrumentation replacement program does not include Plant A.

~~Figure 2-24. Distribution of Instrumentation~~



Project Needs

Instrumentation will depreciate and fail over the course of five to fifteen years, due to the relatively inexpensive nature and operating environment of the equipment. In many cases, it is less expensive to replace smaller instrumentation instead of attempting to repair broken equipment.

Projects

Capital improvement projects identified for instrumentation replacements are summarized in Table 2-18.

Table 2-18. Instrumentation Replacements Projects

Projects	Cost
WRF – 18.3, Instrumentation Replacement Program	$1,401,000

Project Derivation

The instrumentation list was established in the Asset Inventory (Appendix A), and budget quotes for instrumentation replacement were supplied by an experienced local sales representative or published catalog costs. The cost per instrument was then divided by the expected useful life of the instrument (i.e., 7-15 years) to calculate the annual savings required to replace the instrument. The sum of these annual savings values determines an annual budget required to replace all instrumentation at the WRF at the end of their expected useful life. This cost applied over the 20-year CIP timeframe is the capital cost for the project. The soft costs for the project were estimated to fall under "Classification D" assuming that the District staff will procure and replace the majority of instrumentation at the WRF. A typical 20% contingency was applied to the capital cost. The annual total project cost is not expected to coordinate exactly with instrumentation replacement expenditures on a year-to-year basis, but provide adequate savings during low replacement years for higher expenditures on high replacement years.

Project No:	**WRF - 18.3**		
Project Name:	**Instrumentation Replacement Program**		
Description:	Program to replace existing instrumentation equipment at the 4S Ranch WRF on an as-needed basis. Instrumentation includes floats, level switches, level transmitters, level transducers, flow meters, analyzers, and samplers. Does not include Plant A.		
Priority:	0		
Location/Facility:	4S Ranch WRF		
Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:			
Capital Costs:			
General			$ -
Civil & Mechanical			$ -
Structural			$ -
Electrical & Controls			$ 180,000
Equipment			$ 857,600
Capital Cost Subtotal:			**$ 1,037,600**
Soft Costs:			
Classification 'D'			
Engineering	5 %	of capital costs	$ 51,880
CM & ESDC	5 %	of capital costs	$ 51,880
Administration	5 %	of capital costs	$ 51,880
Soft Cost Subtotal:			**$ 155,640**
Contingency:			
Contingency	20 %	of project cost	$ 207,520
Total Project Cost:			**$ 1,401,000**

Project Implementation (Schedule & Expenditure Timeline)				
Project Implementation:	Annual Program	Expenditures:	Annual	$ 70,050
Project Delivery Method:	In-House Installation			
Project Duration (Years):	20			

2.2.19 Miscellaneous Equipment Replacements

Background

The 4S Ranch WRF contains 34 miscellaneous equipment items including mobile equipment, hoists, small generators, and compressors. Miscellaneous Equipment is utilized at the WRF for unique purposes, for example, air compressors are used during filter backwash and hoists are used to lift equipment out of their installation place for maintenance or replacement. This miscellaneous equipment is necessary to maintain smooth operations and maintenance schedules, and play a role in operations processes. The miscellaneous equipment replacement program does not include Plant A.

Project Needs

Miscellaneous Equipment will depreciate and fail over time. The majority of miscellaneous equipment at the WRF is not critical to the process, and can be replaced as-needed.

Projects

Capital improvement projects identified for miscellaneous equipment replacements are summarized in Table 2-19.

Table 2-19. Miscellaneous Equipment Replacements Projects

Projects	Cost
WRF – 18.4, Miscellaneous Equipment Replacement Program	$172,000

Project Derivation

The miscellaneous equipment list was established in the Asset Inventory (Appendix A), and budget quotes for miscellaneous equipment replacement were supplied by an experienced local sales representative or published catalog costs. The cost per equipment item was then divided by the expected useful life of the equipment (i.e., 15-30 years) to calculate the annual savings required to replace the equipment. The sum of these annual savings values determines an annual budget required to replace all miscellaneous equipment at the WRF at the end of their expected useful life. This cost applied over the 20-year CIP timeframe is the capital cost for the project. The soft costs for the project were estimated to fall under "Classification D" assuming that the District staff will procure and replace the majority of miscellaneous equipment at the WRF. A typical 20% contingency was applied to the capital cost. The annual total project cost is not expected to coordinate exactly with miscellaneous equipment replacement expenditures on a year-to-year basis, but provide adequate savings during low replacement years for higher expenditures on high replacement years.

Project No:	**WRF - 18.4**			
Project Name:	**Miscellaneous Equipment Replacement Program**			
Description:	Program to replace miscellaneous equipment at the 4S Ranch WRF on an as-needed basis. Miscellaneous equipment includes but is not limited to compressors, conveyor belts, hoists, and cranes.			
Priority:	0			
Location/Facility:	4S Ranch WRF			

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	-
Civil & Mechanical			$	-
Structural			$	-
Electrical & Controls			$	20,000
Equipment			$	107,200
Capital Cost Subtotal:			**$**	**127,200**
Soft Costs:				
Classification 'D'				
Engineering	5 %	of capital costs	$	6,360
CM & ESDC	5 %	of capital costs	$	6,360
Administration	5 %	of capital costs	$	6,360
Soft Cost Subtotal:			**$**	**19,080**
Contingency:				
Contingency	20 %	of project cost	$	25,440
Total Project Cost:			**$**	**172,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	Annual Program	Expenditures:	Annual	$	8,600
Project Delivery Method:	In-House Installation				
Project Duration (Years):	20				

2.2.20 Mechanical and Yard Piping Replacements

Background

The 4S Ranch WRF utilizes a network of mechanical and yard piping to convey water through the process. The total length of mechanical and yard piping at the WRF was estimated to be approximately 14,000 linear feet. The Mechanical and Yard Piping is used for either gravity flow or pressurized flow, depending on the application. The majority of mechanical piping is coated ductile iron pipe, while the yard piping is primarily PVC. Mechanical and Yard piping is vital to the successful operation of the WRF as the primary method of conveyance.

Project Needs

Mechanical and Yard piping is expected to last for upwards of 100 years, however, corrosive conditions, coating deterioration, interior deterioration, and thermal expansions and contractions will eventually cause failure of a pipe. Although the mechanical and yard piping at the WRF is expected to last beyond the CIP timeframe, pipe breaks are expected to occur, and savings will be required to replace or rehabilitate the pipe.

Projects

Capital improvement projects identified for mechanical and yard piping replacements are summarized in Table 2-20.

Table 2-20. Mechanical and Yard Piping Replacements Projects

Projects	Cost
WRF – 18.5, Mechanical and Yard Piping Replacement Program	$105,000

Project Derivation

The estimated valuation of mechanical and yard piping at the WRF was derived from unit costs applied to the total estimated length of piping. A sinking fund factor, assuming 3% interest over a 100 year useful life was applied to the total valuation to derive an annual sinking fund allowance that would provide adequate savings to replace all of the mechanical and yard piping at the WRF at the end of the useful life. The annual sinking fund contribution over 20 years is the capital cost for the project. This sinking fund should grow over the years and be used to replace mechanical and yard piping at the WRF as needed.

Project No:	**WRF - 18.5**			
Project Name:	**Mechanical and Yard Piping Replacement Program**			
Description:	Sinking fund to replace mechanical and yard piping at the 4S Ranch WRF. Estimate does not include valve replacement.			
Priority:	0			
Location/Facility:	4S Ranch WRF			

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	-
Civil & Mechanical			$	69,391
Structural			$	-
Electrical & Controls			$	-
Equipment			$	-
Capital Cost Subtotal:			**$**	**69,391**
Soft Costs:				
Classification 'B'				
Engineering	10 %	of capital costs	$	6,939
CM & ESDC	18 %	of capital costs	$	12,490
Administration	3 %	of capital costs	$	2,082
Soft Cost Subtotal:			**$**	**21,511**
Contingency:				
Contingency	20 %	of project cost	$	13,878
Total Project Cost:			**$**	**105,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	Sinking Fund	Expenditures:	Annual	$	5,250
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	20				

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3 4S RANCH COLLECTION SYSTEM

The District's 4S Ranch collection system was generally constructed since the late 1980s in conjunction with the master planned community of 4S Ranch. The collection system conveys municipal wastewater through a network of pipes, manholes, and pump stations to the 4S Ranch WRF, where the wastewater is treated and reclaimed for beneficial reuse. Figure 3-1 illustrates the District's 4S Ranch service area.

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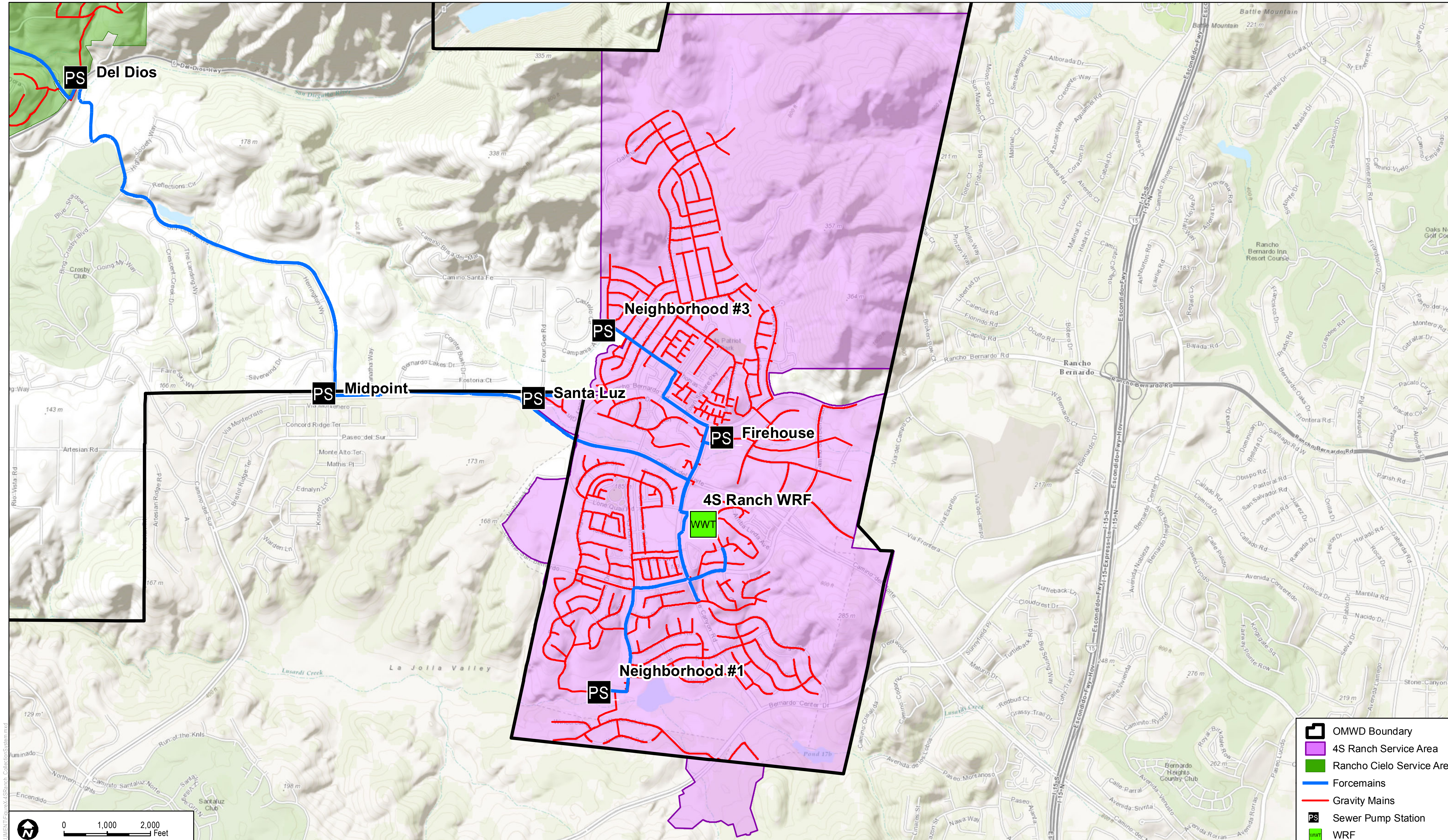

DUDEK

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SOURCE: Olivenhain MWD 2014; SanGIS 2015; ESRI Basemap 2015

Olivenhain MWD Project

FIGURE 3-1

4S Ranch Collection System

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3.1 Asset Inventory

The 4S Ranch collection system is comprised of approximately 210,000 linear feet (39.7 miles) of gravity mains, 870 manholes, four sewer pump stations, and approximately 16,700 linear feet (3.2 miles) of forcemains. The pump stations, all owned and operated by the District, are described in Table 3-1, while Table 3-2 provides the diameter, pipe material, and length of the forcemains associated with each pump station.

Table 3-1. 4S Ranch Sewer Pump Stations

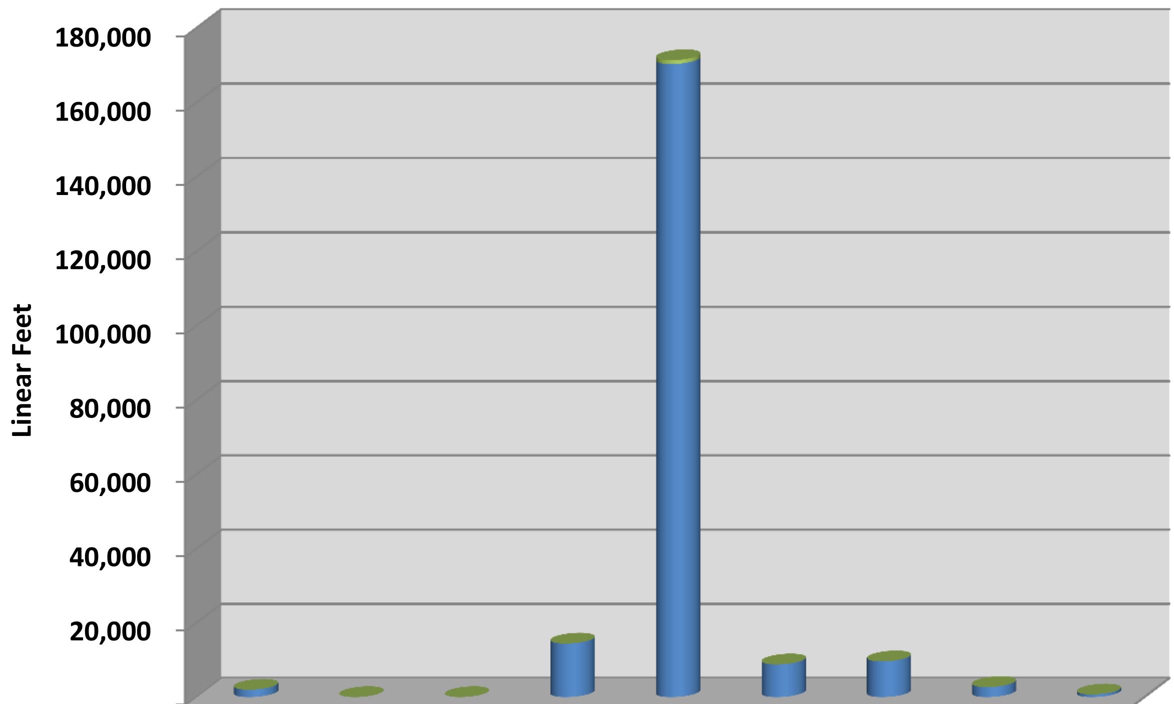
Pump Station	Year Built	Description
Fire House	2009	Wet well/Dry well pump station, with 2 submersible solids handling pumps in the dry well. (Webb) 50 HP pumps with approximate firm pumping capacity of 750 gpm at 120 ft.
Neighborhood #1	2001	Wet well/pump room pump station; 2+1 two-stage pumping station. 2 submersible pumps in wet well feed 2 horizontal centrifugal pumps in the pump room. (MWH) Two-stage pumping arrangement pairs 125 HP pumps to produce approximate firm pumping capacity of 1360 gpm at 225 ft.
Neighborhood #3	2004	Wet well/Dry well pump station, with 2 horizontal centrifugal solids handling pumps in the dry well. (PBS&J) 125 HP pumps with approximate firm pumping capacity of 1600 gpm at 209 ft.
Santaluz	2004	Wet well pump station with 3 submersible solids handling pumps in the wet well. (PBS&J) 7.5 HP pumps with approximate firm pumping capacity of 120 gpm.

Table 3-2. 4S Ranch Forcemains

Pump Station Forcemain	Diameter (in)	Material	Length (ft)
Fire House	10	DIP	2,830
Neighborhood #1	10	PVC	6,160
Neighborhood #3	12	PVC	6,410
Santaluz	4	PVC	1,310

Figure 3-2 illustrates the distribution of gravity pipe by size and material in the 4S Ranch service area.

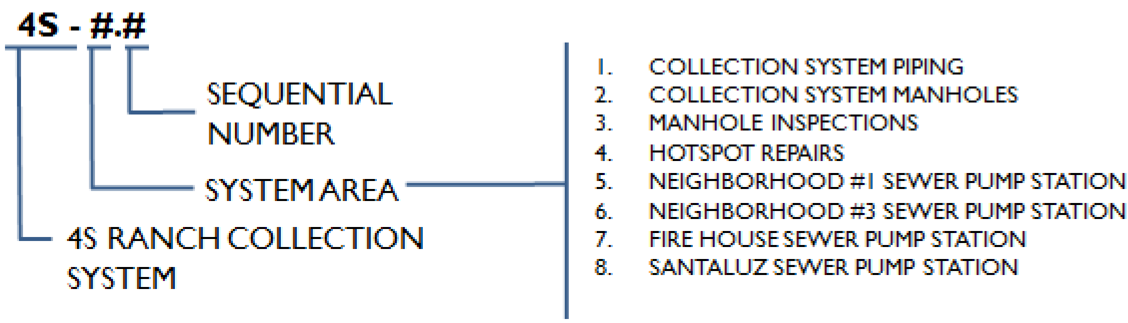
Figure 3-2. 4S Ranch Collection System Gravity Mains



	2"	3"	4"	6"	8"	10"	12"	15"	18"
Unknown	-	-	-	-	1,030	-	-	-	-
DIP	-	-	-	-	-	-	-	-	-
PVC	2,000	-	-	14,430	170,380	8,800	9,630	2,700	710

3.2 Capital Improvement Projects

The following sections present specific and programmatic CIP projects identified for the 4S Ranch collection system. The projects are organized by system area in accordance with the following project numbering sequence:



The 4S Ranch Collection System CIP includes a total of 18 defined projects and programs with a total 20-year cost of $5 million. Of the 18 projects, 17 are unique CIP projects with total value of $4.3 million. The CIP also identifies one programmatic project, a collection system pipe rehabilitation and replacement sinking fund with a total 20-year cost of $0.68 million or approximately $34,000 per year.

3.2.1 Collection System Pipe Rehabilitation and Replacement

Background

The 4S Ranch gravity collection system is comprised of approximately 209,673 linear feet (39.7 miles) of primarily PVC pipe ranging from 6-inch to 18-inch diameter. The 4S Ranch forcemains consist of approximately 16,710 linear feet of primarily PVC pipe ranging from 4-inch to 12-inch diameter. The only forcemain in the system not constructed of PVC pipe is the 10-inch glass-lined DIP Fire House Pump Station forcemain constructed in 2009.

Project Needs

Well-constructed PVC gravity sewer mains are expected to have a useful life of at least 100 years, and PVC forcemains are expected to have a useful life of 50 years. The useful life of ductile iron wastewater forcemains can vary significantly depending on the quality of the interior and exterior corrosion protection but a useful life of 50-years is achievable for a glass-lined pipe with carefully applied polyethylene exterior wrapping and functional air release valves. Poor construction (e.g. under-compaction and over-belling), soil movement, thermal expansion and contraction, root intrusions and interior and exterior corrosion of DIP can eventually cause a pipe defects that block flow or a pipe break. Although the sewers and forcemains in the 4S Ranch collection system are expected to last well beyond the CIP timeframe, isolated pipe defects and breaks are expected to occur within the timeframe. Therefore, savings will be required to replace or rehabilitate gravity mains and forcemains as needed.

Projects

Capital improvement projects identified for collection system pipe rehabilitation and replacement are summarized in Table 3-3.

Table 3-3. Collection System Pipe Rehabilitation and Replacements Projects

Projects	Cost
4S – 1.0, Collection System Pipe Rehabilitation and Replacement	$1,470,000

Project Derivation

The estimated cost is based on rehabilitating 75 percent of PVC gravity sewers in the 4S Ranch collection system with cured-in-place pipe (CIPP) and replacing the other 25 percent and 100 percent of forcemains with open trench construction. A sinking fund factor, assuming 3% interest over a 100-year useful life for gravity mains, and 50-year useful life for forcemains, is applied to the total rehabilitation and replacement valuation to derive an annual sinking fund allowance that will provide adequate savings to rehabilitate and replace the entire 4S Ranch collection system at the end of its useful life. The annual sinking fund contribution over 20 years is the capital cost for the project. This sinking fund will be used to rehabilitate and replace gravity mains and forcemains in the 4S Ranch collection system as needed.

Project No:	**4S - 1.0**		
Project Name:	**Collection System Pipe Rehabilitation and Replacement**		
Description:	Establish a sinking fund to rehabilitate or replace PVC collection system piping including forcemains as-needed. Estimate assumes that 75% of gravity pipes can be rehabilitated using trenchless cured-in-place pipe (CIPP) lining and 25% of gravity pipes require replacement in place, including manholes. Estimate assumes that 100% of forcemains require replacement.		
Priority:	0		
Location/Facility:	4S Ranch Collection System		
Project Type:		Origin(s) of Project:	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Redundancy		Condition Assessment	X
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	
		Corrosion & Exposure	

Project Cost:				
Capital Costs:				
General			$	-
Manhole Rehabilitation			$	-
Pipeline Rehabilitation			$	190,969
Pipeline Construction (including Manholes)			$	769,618
Capital Cost Subtotal:			**$**	**960,587**
Soft Costs:				
Classification 'B'				
Engineering	10 %	of capital costs	$	96,059
CM & ESDC	18 %	of capital costs	$	172,906
Administration	3 %	of capital costs	$	28,818
Right of Way	1 %	lump sum	$	9,606
Permitting	1 %	lump sum	$	9,606
Soft Cost Subtotal:			**$**	**316,994**
Contingency:				
Contingency	20 %	of project cost	$	192,117
Total Project Cost:			**$**	**1,470,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	Sinking Fund	Expenditures:	Annual	$	73,500
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	20				

3.2.2 Manhole Lining

Background

The 4S Ranch collection system contains approximately 870 manholes. Manhole construction is primarily cast in place concrete base with pre-cast concrete shafts. The interior of thirty-seven (37) manholes in the 4S Ranch collection system are lined with either T-lock PVC or spray-on coating (polyurethane).

Project Needs

Although the District has previously lined a number of manholes, H_2S modeling from predicted sulfide generation indicates that ten (10) additional manholes are subject to corrosive environments caused by H_2S exposure, and require lining protection. Additionally, manholes damaged from root intrusion require lining to increase the longevity of the manhole. Previously lined manholes require periodic special inspection at a recommended interval of five years to determine if re-lining or repair is needed. On average, manholes with spray-on polyurethane coating will need to be re-lined approximately every ten years.

Projects

Capital improvement projects identified for manhole lining are summarized in Table 3-4.

Table 3-4. Manhole Lining Projects

Projects	Cost
4S – 2.0, Line Manholes Subject to High H_2S Exposure	$48,000
4S – 3.1, Special Inspection of Lined Manholes	$59,000
4S – 3.2, Re-Line Manholes Recommended from Special Inspection	$424,000
Total	$531,000

Project No:	**4S - 2.0**			
Project Name:	**Line Manholes Subject to High H_2S Exposure**			
Description:	Line ten (10) manholes subject to high H_2S exposure in the 4S Ranch collection system. Manhole lining determined from H_2S generation and residual model.			
Priority:	55			
Location/Facility:	4S Ranch Collection System			

Project Type:		Origin(s) of Project:	
Rehab/Replacement	X	Predicted Useful Life Expiration	
Redundancy		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	
		Corrosion & Exposure	X

Project Cost:				
Capital Costs:				
General			$	-
Manhole Rehabilitation			$	30,000
Pipeline Rehabilitation			$	-
Pipeline Construction (including Manholes)			$	-
Capital Cost Subtotal:			**$**	**30,000**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	4,500
CM & ESDC	20 %	of capital costs	$	6,000
Administration	5 %	of capital costs	$	1,500
Right of Way		lump sum		
Permitting		lump sum		
Soft Cost Subtotal:			**$**	**12,000**
Contingency:				
Contingency	20 %	of project cost	$	6,000
Total Project Cost:			**$**	**48,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2020	$	42,000
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	1				

Project No:	**4S - 3.1**
Project Name:	**Special Inspection of Lined Manholes**
Description:	Hire a special inspector for the thirty-seven (37) existing lined manholes and ten (10) new lined manholes on a five-year frequency. Forty-seven (47) manhole lining inspections occuring three separate times for a total of 141 special inspections of lined manholes.
Priority:	45
Location/Facility:	4S Ranch Collection System

Project Type:		Origin(s) of Project:	
Rehab/Replacement		Predicted Useful Life Expiration	X
Redundancy		Condition Assessment	
Engineering Study	X	Operations Assessment	
Expansion		Failure Modes & Consequences	
		Corrosion & Exposure	X

Project Cost:				
Capital Costs:				
General			$	-
Manhole Rehabilitation			$	42,300
Pipeline Rehabilitation			$	-
Pipeline Construction (including Manholes)			$	-
Capital Cost Subtotal:			**$**	**42,300**
Soft Costs:				
Project Specific				
Engineering	15 %	of capital costs	$	6,345
CM & ESDC	0 %	of capital costs	$	-
Administration	5 %	of capital costs	$	2,115
Right of Way		lump sum		
Permitting		lump sum		
Soft Cost Subtotal:			**$**	**8,460**
Contingency:				
Contingency	20 %	of project cost	$	8,460
Total Project Cost:			**$**	**59,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	Multiple-Time Project	Expenditures:	2021	$	17,000
Project Delivery Method:	Inspection Report		2026	$	17,000
Project Duration (Years):	3		2031	$	17,000

Project No:	**4S - 3.2**			
Project Name:	**Re-Line Manholes Recommended from Special Inspection**			
Description:	Re-line approximately twenty-five (25) percent of lined manholes following special inspection of lined manholes (Project 4S - 3.1). Total manhole re-linings is estimated to be approximately 106.			
Priority:	45			
Location/Facility:	4S Ranch Collection System			

Project Type:		Origin(s) of Project:	
Rehab/Replacement		Predicted Useful Life Expiration	X
Redundancy		Condition Assessment	
Engineering Study	X	Operations Assessment	
Expansion		Failure Modes & Consequences	
		Corrosion & Exposure	X

Project Cost:				
Capital Costs:				
General			$	-
Manhole Rehabilitation			$	265,000
Pipeline Rehabilitation			$	-
Pipeline Construction (including Manholes)			$	-
Capital Cost Subtotal:			**$**	**265,000**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	39,750
CM & ESDC	20 %	of capital costs	$	53,000
Administration	5 %	of capital costs	$	13,250
Right of Way		lump sum		
Permitting		lump sum		
Soft Cost Subtotal:			**$**	**106,000**
Contingency:				
Contingency	20 %	of project cost	$	53,000
Total Project Cost:			**$**	**424,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	Multiple-Time Project	Expenditures:	2021	$	140,000
Project Delivery Method:	Design-Bid-Build		2026	$	140,000
Project Duration (Years):	3		2031	$	144,000

3.2.3 Gravity Main CIPP Lining

Background

The District has identified two gravity sewer segments (totaling 607 linear feet) with root intrusion that should be addressed. Figure 3-3 depicts the project location of the root impacted pipes.

Project Needs

Gravity mains damaged from root intrusion are the number one cause of blockages resulting in sewer system overflows, and should therefore be addressed immediately. It is recommended that any pipe segment with root intrusion be lined with cured-in-place-pipe (CIPP). Pipe segments severely damaged by roots that are unable to be lined should be replaced.

Projects

Capital improvement projects identified for gravity main CIPP lining are summarized in Table 3-5.

Figure 3-3. Gravity Main CIPP Lining Map

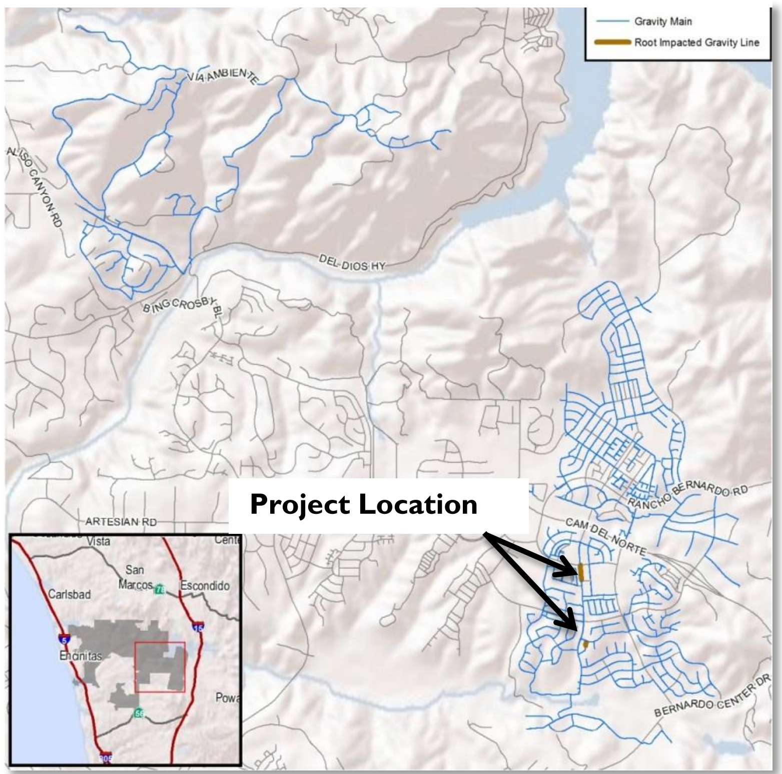


Table 3-5. Collection System Pipe Lining Projects

Projects	Cost
4S – 4.0, CIPP Line Root Impacted Collection System Pipe	$35,000

Project No:	**4S - 4.0**		
Project Name:	**CIPP Line Root Impacted Hot Spot Collection System Pipe**		
Description:	CIPP line root impacted hot spot collection system pipe. District Hot Spot list includes two segments totaling 607 ft of root impacted pipeline.		
Priority:	85		
Location/Facility:	4S Ranch Collection System		
Project Type:		Origin(s) of Project:	
Rehab/Replacement	X	Predicted Useful Life Expiration	
Redundancy		Condition Assessment	X
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	
		Corrosion & Exposure	

Project Cost:			
Capital Costs:			
General			$ -
Manhole Rehabilitation			$ -
Pipeline Rehabilitation			$ 21,852
Pipeline Construction (including Manholes)			$ -
Capital Cost Subtotal:			**$ 21,852**
Soft Costs:			
Classification 'C'			
Engineering	15 %	of capital costs	$ 3,278
CM & ESDC	20 %	of capital costs	$ 4,370
Administration	5 %	of capital costs	$ 1,093
Right of Way		lump sum	
Permitting		lump sum	
Soft Cost Subtotal:			**$ 8,741**
Contingency:			
Contingency	20 %	of project cost	$ 4,370
Total Project Cost:			**$ 35,000**

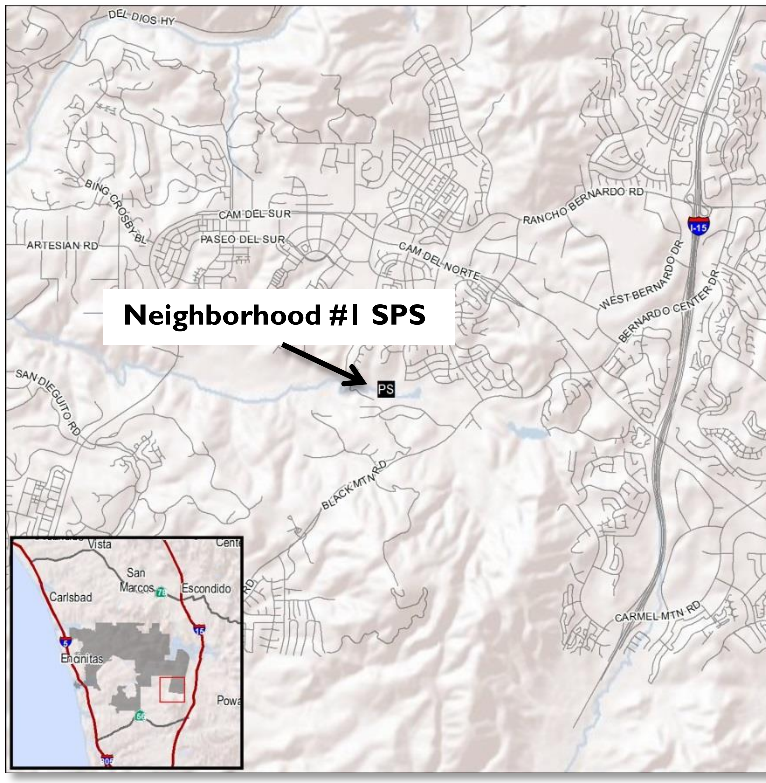
Project Implementation (Schedule & Expenditure Timeline)				
Project Implementation:	One-Time Project	Expenditures:	2017	$ 35,000
Project Delivery Method:	Design-Bid-Build			
Project Duration (Years):	1			

3.2.4 Neighborhood #1 Sewer Pump Station Improvements

Background

The Neighborhood #1 Sewer Pump Station is a wet well/pump room pump station located behind the "Boys and Girls Club" at the South end of the 4S Ranch Pkwy. Designed by MWH and constructed in 2001, the site consists of a concrete emergency overflow pond, a 22 foot deep wet well, and pump room. Flows into the wet well are generated from residential, public and overflow pond land uses within the service area. Two (2) 75-hp submersible pumps in the wet well provide suction pressure to two (2) 125-hp horizontal centrifugal pumps in the pump room. Each series of submersible to horizontal pump configuration is equipped with a nameplate capacity of 1360 gpm for a maximum pump station capacity of 2720 gpm. The station pumps directly to the 4S Ranch WRF influent junction box through a 10-inch PVC forcemain. A 750-gallon surge tank is incorporated to help maintain pressure in the forcemain during pump shut-off. Figure 3-4 to the right shows the Neighborhood #1 sewer pump station location.

Figure 3-4. Neighborhood #1 SPS Location Map



Project Needs

Corrosion was observed on mechanical piping, cracking was observed on the concrete in the emergency storage pond, and the outside switchboard has water ingress from flooding issues at the site. Most of the major equipment in the pump station is nearing the end of its expected useful life and needs to be replaced. The current two-stage pumping design is undesirable for operations, and the District prefers a more traditional wet well/dry well large pump station design.

Projects

Capital improvement projects identified for the Neighborhood #1 sewer pump station are summarized in Table 3-6.

Table 3-6. Neighborhood #1 Sewer Pump Station Improvements Projects

Projects	Cost
4S – 5.0, Upgrade Neighborhood #1 Sewer Pump Station	$780,000

Project No:	**4S - 5.0**		
Project Name:	**Upgrade Neighborhood #1 Sewer Pump Station**		
Description:	Upgrade the Neighborhood #1 sewer pump station per ongoing design project. Project is defined and cost is estimated in the Districts FY 14-15 10 year Capital Spending Plan. Project includes full pump station redesign and upgrades to the overflow containment area.		
Priority:	100		
Location/Facility:	4S Ranch Collection System		

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement		Predicted Useful Life Expiration	X
Facility/Equip Upgrade	X	Condition Assessment	X
Engineering Study		Operations Assessment	X
Expansion		Failure Modes & Consequences	

Project Cost:	
Capital Costs:	
General	$ 780,000
Civil & Mechanical	$ -
Structural	$ -
Electrical & Controls	$ -
Equipment	$ -
Capital Cost Subtotal:	**$ 780,000**
Soft Costs:	
Project Specific	
Engineering	N/A
CM & ESDC	N/A
Administration	N/A
Soft Cost Subtotal:	**$ -**
Contingency:	
Contingency	N/A
Total Project Cost:	**$ 780,000**

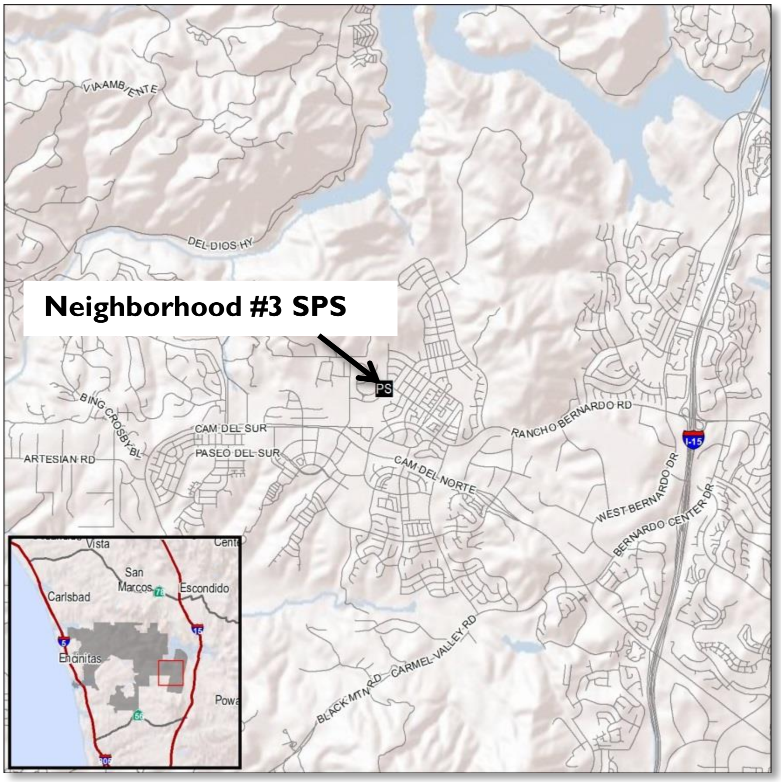
Project Implementation (Schedule & Expenditure Timeline)				
Project Implementation:	One-Time Project	Expenditures:	2016	$ 780,000
Project Delivery Method:	Design-Bid-Build			
Project Duration (Years):	1			

3.2.5 Neighborhood #3 Sewer Pump Station Improvements

Background

The Neighborhood #3 Sewer Pump Station is an underground wet well/dry well facility located at the intersection of Campania Ave and Camino San Thomas. The pump station was designed by PBS&J and was constructed in 2004. It incorporates two (2) 124-hp, non-clog pumps rated at 1600-gpm at 209-ft TDH. The wet well is a 25-foot deep, hoppered bottom, precast concrete structure with a supplemental emergency storage wet well for peak flow conditions. The station pumps into a 12-inch forcemain leading to the 4S Ranch WRF. Figure 3-5 to the right shows the Neighborhood #3 sewer pump station location.

Figure 3-5. Neighborhood #3 SPS Location Map



Project Needs

The pump station has adequate capacity and is well maintained, but most of the major equipment in the pump station will reach the end of its expected useful life within the CIP timeframe. Bypass pumping connections and an Emergency Response Plan are recommended to mitigate risk associated with various pump station failure modes.

Projects

Capital improvement projects identified for the Neighborhood #1 sewer pump station are summarized in Table 3-7.

Table 3-7. Neighborhood #3 Sewer Pump Station Improvements Projects

Projects	Cost
4S – 6.1, Replace Pumps in the Neighborhood #3 Sewer Pump Station	$495,000
4S – 6.2, Replace the Neighborhood #3 Sewer Pump Station Emergency Generator	$288,000
4S – 6.3, Upgrade Electrical Gear at the Neighborhood #3 Sewer Pump Station	$336,000
4S – 6.4, Upgrade SCADA Control System at the Neighborhood #3 Sewer Pump Station	$80,000
4S – 6.5, Neighborhood #3 Sewer Pump Station Improvements	$124,000
Total	$1,323,000

Project No:	**4S - 6.1**		
Project Name:	**Replace Pumps in the Neighborhood #3 Sewer Pump Station**		
Description:	Replace the two 125 horsepower pumps in the Neighborhood #3 sewer pump station.		
Priority:	15		
Location/Facility:	4S Ranch Collection System		
Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	25,000
Civil & Mechanical			$	10,000
Structural			$	-
Electrical & Controls			$	30,000
Equipment			$	262,500
Capital Cost Subtotal:			**$**	**327,500**
Soft Costs:				
Classification 'B'				
Engineering	10 %	of capital costs	$	32,750
CM & ESDC	18 %	of capital costs	$	58,950
Administration	3 %	of capital costs	$	9,825
Soft Cost Subtotal:			**$**	**101,525**
Contingency:				
Contingency	20 %	of project cost	$	65,500
Total Project Cost:			**$**	**495,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2026	$	495,000
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	1				

Project No:	**4S - 6.2**		
Project Name:	**Replace the Neighborhood #3 Sewer Pump Station Emergency Generator**		
Description:	Replace the Neighborhood #3 sewer pump station emergency generator.		
Priority:	15		
Location/Facility:	4S Ranch Collection System		

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	-
Civil & Mechanical			$	15,000
Structural			$	-
Electrical & Controls			$	25,000
Equipment			$	140,250
Capital Cost Subtotal:			**$**	**180,250**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	27,038
CM & ESDC	20 %	of capital costs	$	36,050
Administration	5 %	of capital costs	$	9,013
Soft Cost Subtotal:			**$**	**72,100**
Contingency:				
Contingency	20 %	of project cost	$	36,050
Total Project Cost:			**$**	**288,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2031	$	288,000
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	1				

Project No:	**4S - 6.3**			
Project Name:	**Upgrade Electrical Gear at the Neighborhood #3 Sewer Pump Station**			
Description:	Upgrade the Electrical gear at the Neighborhood #3 sewer pump station. Project does not include SCADA control system upgrades.			
Priority:	15			
Location/Facility:	4S Ranch Collection System			

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement		Predicted Useful Life Expiration	X
Facility/Equip Upgrade	X	Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	10,000
Civil & Mechanical			$	-
Structural			$	-
Electrical & Controls			$	200,000
Equipment			$	-
Capital Cost Subtotal:			**$**	**210,000**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	31,500
CM & ESDC	20 %	of capital costs	$	42,000
Administration	5 %	of capital costs	$	10,500
Soft Cost Subtotal:			**$**	**84,000**
Contingency:				
Contingency	20 %	of project cost	$	42,000
Total Project Cost:			**$**	**336,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2026	$	37,000
Project Delivery Method:	Design-Bid-Build		2027	$	299,000
Project Duration (Years):	2				

Project No:	**4S - 6.4**		
Project Name:	**Upgrade SCADA Control System at the Neighborhood #3 Sewer Pump Station**		
Description:	Upgrade the SCADA control system at the Neighborhood #3 sewer pump station. Project does not include electrical gear upgrades.		
Priority:	15		
Location/Facility:	4S Ranch Collection System		

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement		Predicted Useful Life Expiration	X
Facility/Equip Upgrade	X	Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:			
Capital Costs:			
General		$	-
Civil & Mechanical		$	-
Structural		$	-
Electrical & Controls		$	50,000
Equipment		$	-
Capital Cost Subtotal:		**$**	**50,000**
Soft Costs:			
Classification 'C'			
Engineering	15 % of capital costs	$	7,500
CM & ESDC	20 % of capital costs	$	10,000
Administration	5 % of capital costs	$	2,500
Soft Cost Subtotal:		**$**	**20,000**
Contingency:			
Contingency	20 % of project cost	$	10,000
Total Project Cost:		**$**	**80,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2026	$	9,000
Project Delivery Method:	Design-Bid-Build		2027	$	71,000
Project Duration (Years):	2				

Project No:	**4S - 6.5**			
Project Name:	**Neighborhood #3 Sewer Pump Station Improvements**			
Description:	Install pump station bypass connections and develop an emergency response plan. Modify dry well lighting for easier maintenance access. Replace the lockout on the emergency generator main disconnect. Additionally, install VFD bypass starters/contactors, install a third level control instrument, test and certify the main circuit breaker, perform infrared testing of the circuit breakers, starters, and motors, and replace the existing door-mounted OIT with a door-mounted iPC for complete SCADA control from remote pump stations.			
Priority:	75			
Location/Facility:	4S Ranch Collection System			

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade	X	Condition Assessment	X
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	X

Project Cost:				
Capital Costs:				
General			$	5,000
Civil & Mechanical			$	39,600
Structural			$	-
Electrical & Controls			$	33,000
Equipment			$	-
Capital Cost Subtotal:			**$**	**77,600**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	11,640
CM & ESDC	20 %	of capital costs	$	15,520
Administration	5 %	of capital costs	$	3,880
Soft Cost Subtotal:			**$**	**31,040**
Contingency:				
Contingency	20 %	of project cost	$	15,520
Total Project Cost:			**$**	**124,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2019	$	124,000
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	1				

3.2.6 Fire House Sewer Pump Station Improvements

Background

The Fire House Sewer Pump Station was originally a packaged facility located in an empty lot on Rancho Bernardo Rd near the intersection at Dove Canyon Rd. The pump station was re-constructed in 2009. Designed by Infrastructure Engineering Corporation, it incorporates two (2) submersible solids handling pumps in the drywell. Figure 3-6 to the right shows the Fire House sewer pump station location.

Figure 3-6. Fire House SPS Location Map

Project Needs

The pump station is relatively new and well-maintained and should provide the District with reliable service for another 15 years; however, the major equipment in the pump station will reach the end of its expected useful life within the CIP timeframe. An Emergency Response Plan is recommended to mitigate risk associated with various pump station failure modes.

Projects

Capital improvement projects identified for the Fire House sewer pump station are summarized in Table 3-8.

Table 3-8. Fire House Sewer Pump Station Improvements Projects

Projects	Cost
4S – 7.1, Replace Pumps in the Fire House Sewer Pump Station	$364,000
4S – 7.2, Replace the Fire House Sewer Pump Station Emergency Generator	$288,000
4S – 7.3, Upgrade Electrical Gear at the Fire House Sewer Pump Station	$336,000
4S – 7.4, Upgrade SCADA Control System at the Fire House Sewer Pump Station	$80,000
4S – 7.5, Fire House Sewer Pump Station Improvements	$231,000
Total	$1,299,000

Project No:	**4S - 7.1**		
Project Name:	**Replace Pumps in the Fire House Sewer Pump Station**		
Description:	Replace the two 50 horsepower pumps in the Fire House sewer pump station.		
Priority:	10		
Location/Facility:	4S Ranch Collection System		

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	25,000
Civil & Mechanical			$	15,000
Structural			$	-
Electrical & Controls			$	30,000
Equipment			$	171,150
Capital Cost Subtotal:			**$**	**241,150**
Soft Costs:				
Classification 'B'				
Engineering	10 %	of capital costs	$	24,115
CM & ESDC	18 %	of capital costs	$	43,407
Administration	3 %	of capital costs	$	7,235
Soft Cost Subtotal:			**$**	**74,757**
Contingency:				
Contingency	20 %	of project cost	$	48,230
Total Project Cost:			**$**	**364,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2028	$	364,000
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	1				

Project No:	**4S - 7.2**		
Project Name:	**Replace the Fire House Sewer Pump Station Emergency Generator**		
Description:	Replace the Fire House sewer pump station emergency generator.		
Priority:	10		
Location/Facility:	4S Ranch Collection System		

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	-
Civil & Mechanical			$	15,000
Structural			$	-
Electrical & Controls			$	25,000
Equipment			$	140,250
Capital Cost Subtotal:			**$**	**180,250**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	27,038
CM & ESDC	20 %	of capital costs	$	36,050
Administration	5 %	of capital costs	$	9,013
Soft Cost Subtotal:			**$**	**72,100**
Contingency:				
Contingency	20 %	of project cost	$	36,050
Total Project Cost:			**$**	**288,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2030	$	288,000
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	1				

Project No:	**4S - 7.3**			
Project Name:	**Upgrade Electrical gear at the Fire House Sewer Pump Station**			
Description:	Upgrade the Electrical gear at the Fire House sewer pump station. Project does not include SCADA control system upgrades.			
Priority:	5			
Location/Facility:	4S Ranch Collection System			

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement		Predicted Useful Life Expiration	X
Facility/Equip Upgrade	X	Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	10,000
Civil & Mechanical			$	-
Structural			$	-
Electrical & Controls			$	200,000
Equipment			$	-
Capital Cost Subtotal:			**$**	**210,000**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	31,500
CM & ESDC	20 %	of capital costs	$	42,000
Administration	5 %	of capital costs	$	10,500
Soft Cost Subtotal:			**$**	**84,000**
Contingency:				
Contingency	20 %	of project cost	$	42,000
Total Project Cost:			**$**	**336,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2032	$	37,000
Project Delivery Method:	Design-Bid-Build		2033	$	299,000
Project Duration (Years):	2				

Project No:	**4S - 7.4**
Project Name:	**Upgrade the SCADA Control System at the Fire House Sewer Pump Station**
Description:	Upgrade the SCADA control system at the Fire House sewer pump station. Project does not include electrical gear upgrades.
Priority:	5
Location/Facility:	4S Ranch Collection System

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement		Predicted Useful Life Expiration	X
Facility/Equip Upgrade	X	Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	-
Civil & Mechanical			$	-
Structural			$	-
Electrical & Controls			$	50,000
Equipment			$	-
Capital Cost Subtotal:			**$**	**50,000**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	7,500
CM & ESDC	20 %	of capital costs	$	10,000
Administration	5 %	of capital costs	$	2,500
Soft Cost Subtotal:			**$**	**20,000**
Contingency:				
Contingency	20 %	of project cost	$	10,000
Total Project Cost:			**$**	**80,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2032	$	9,000
Project Delivery Method:	Design-Bid-Build		2033	$	71,000
Project Duration (Years):	2				

Project No:	**4S - 7.5**			
Project Name:	**Fire House Sewer Pump Station Improvements**			
Description:	Develop an emergency response plan in case of a pump station failure, install site lighting at the wetwell area for operator safety, and install a wetwell conditioning system for reoccuring grease issues. Additionally, install a bridge crane or additional monorail to access piping and valves in the dry well and extend rail outside of building for loading, install a large double-leaf hatch over the wet well for better access for maintenance, and replace the existing door-mounted OIT with a door-mounted iPC for complete SCADA control from remote pump stations.			
Priority:	15			
Location/Facility:	4S Ranch Collection System			

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement		Predicted Useful Life Expiration	
Facility/Equip Upgrade	X	Condition Assessment	X
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	X

Project Cost:				
Capital Costs:				
General			$	6,500
Civil & Mechanical			$	-
Structural			$	105,000
Electrical & Controls			$	33,000
Equipment			$	-
Capital Cost Subtotal:			**$**	**144,500**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	21,675
CM & ESDC	20 %	of capital costs	$	28,900
Administration	5 %	of capital costs	$	7,225
Soft Cost Subtotal:			**$**	**57,800**
Contingency:				
Contingency	20 %	of project cost	$	28,900
Total Project Cost:			**$**	**231,000**

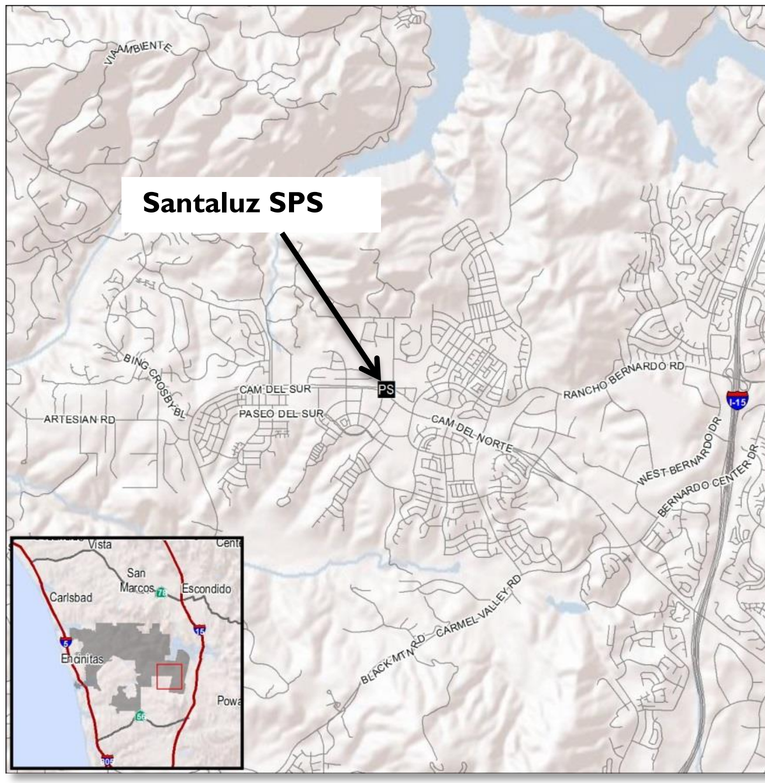
Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2026	$	231,000
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	1				

3.2.7 Santaluz Sewer Pump Station Improvements

Background

The Santaluz Sewer Pump Station is a submersible facility located on 4 Gee Rd just North of Camino Del Sur. The pump station was designed by PBS&J and was constructed in 2004. It consists of a 7-foot diameter precast concrete operational wet well with an approximate 20-foot depth. A pair of 8-foot by 16-foot by 15-foot deep precast concrete structures tie into the wet well bottom and serve as emergency storage vaults. The submersible pumps are triplex 3.4-hp grinder type pumps. Figure 3-7 to the right shows the Santaluz sewer pump station location.

Figure 3-7. Santaluz SPS Location Map



Project Needs

The pump station is in good condition and is well-maintained, but the major equipment in the pump station will reach the end of its expected useful life within the CIP timeframe. Bypass pumping connections and an Emergency Response Plan are recommended to mitigate risk associated with various pump station failure modes.

Projects

Capital improvement projects identified for the Santaluz sewer pump station are summarized in Table 3-9.

Table 3-9. Santa Luz Sewer Pump Station Improvements Projects

Projects	Cost
4S – 8.1, Replace Santa Luz Sewer Pump Station	$198,000
4S – 8.2, Santa Luz Sewer Pump Station Improvements	$119,000
Total	$317,000

Project No:	**4S - 8.1**			
Project Name:	**Replace Santaluz Sewer Pump Station**			
Description:	Replace Santaluz sewer pump station. Project includes replacing pumps, piping, valves, electrical gear, control system, guide rails and miscellaneous equipment. Project also includes wet well rehabilitation.			
Priority:	15			
Location/Facility:	4S Ranch Collection System			

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:

Capital Costs:				
General			$	5,000
Civil & Mechanical			$	55,000
Structural			$	10,000
Electrical & Controls			$	20,000
Equipment			$	34,000
Capital Cost Subtotal:			**$**	**124,000**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	18,600
CM & ESDC	20 %	of capital costs	$	24,800
Administration	5 %	of capital costs	$	6,200
Soft Cost Subtotal:			**$**	**49,600**
Contingency:				
Contingency	20 %	of project cost	$	24,800
Total Project Cost:			**$**	**198,000**

Project Implementation (Schedule & Expenditure Timeline)

Project Implementation:	One-Time Project	Expenditures:	2027	$	22,000
Project Delivery Method:	Design-Bid-Build		2028	$	177,000
Project Duration (Years):	2				

Project No:	**4S - 8.2**		
Project Name:	**Santaluz Sewer Pump Station Improvements**		
Description:	Install pump station bypass connections, develop emergency response plan in case of a failure, install a wash water booster pump for additional wash water pressure, install site lighting for operator safety, install canopy over electrical gear for safety and equipment protection, and install a flow meter. Additionally, install a third level control device.		
Priority:	40		
Location/Facility:	4S Ranch Collection System		
Project Type:		**Origin(s) of Project:**	
Rehab/Replacement		Predicted Useful Life Expiration	
Facility/Equip Upgrade	X	Condition Assessment	X
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	X

Project Cost:				
Capital Costs:				
General			$	21,500
Civil & Mechanical			$	36,300
Structural			$	-
Electrical & Controls			$	16,500
Equipment			$	-
Capital Cost Subtotal:			**$**	**74,300**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	11,145
CM & ESDC	20 %	of capital costs	$	14,860
Administration	5 %	of capital costs	$	3,715
Soft Cost Subtotal:			**$**	**29,720**
Contingency:				
Contingency	20 %	of project cost	$	14,860
Total Project Cost:			**$**	**119,000**

Project Implementation (Schedule & Expenditure Timeline)				
Project Implementation:	One-Time Project	Expenditures:	2022 $	119,000
Project Delivery Method:	Design-Bid-Build			
Project Duration (Years):	1			

4 RANCHO CIELO COLLECTION SYSTEM CIP

The District's Rancho Cielo collection system was generally constructed in conjunction with the master planned community of Rancho Cielo in the early 2000s. The collection system conveys municipal wastewater through gravity flow, for some areas assisted by small pump stations, to the Del Dios sewer pump station at the entrance of the community and the bottom of the catchment. The Del Dios sewer pump station and subsequent Midpoint sewer pump station pumps all of the wastewater from the Rancho Cielo collection system to the 4S WRF. Figure 4-1 illustrates the District's Rancho Cielo service area.

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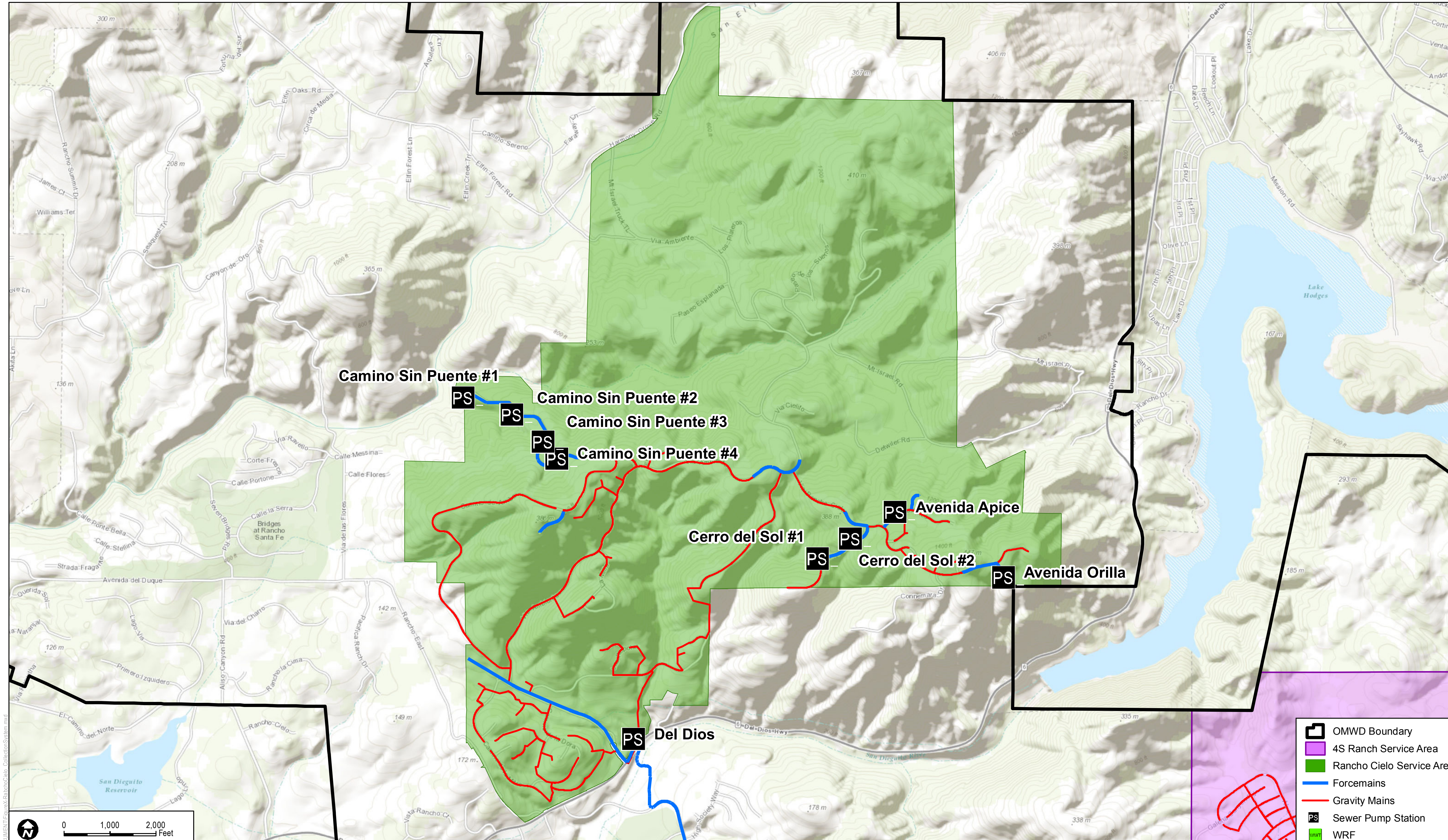

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SOURCE: Olivenhain MWD 2014; SanGIS 2015; ESRI Basemap 2015

Olivenhain MWD Project

FIGURE 4-1

Rancho Cielo Collection System

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4.1 Asset Inventory

The system is comprised of approximately 137,289 linear feet (26.0 miles) of gravity mains, 345 manholes, 10 sewer pump stations, and 30,419 linear feet of forcemains (5.8 miles). The pump stations, all owned and operated by the District, are described in Table 4-1, while Table 4-2 provides the diameter, pipe material, and length of the forcemains associated with each pump station.

Table 4-1. Rancho Cielo Sewer Pump Stations

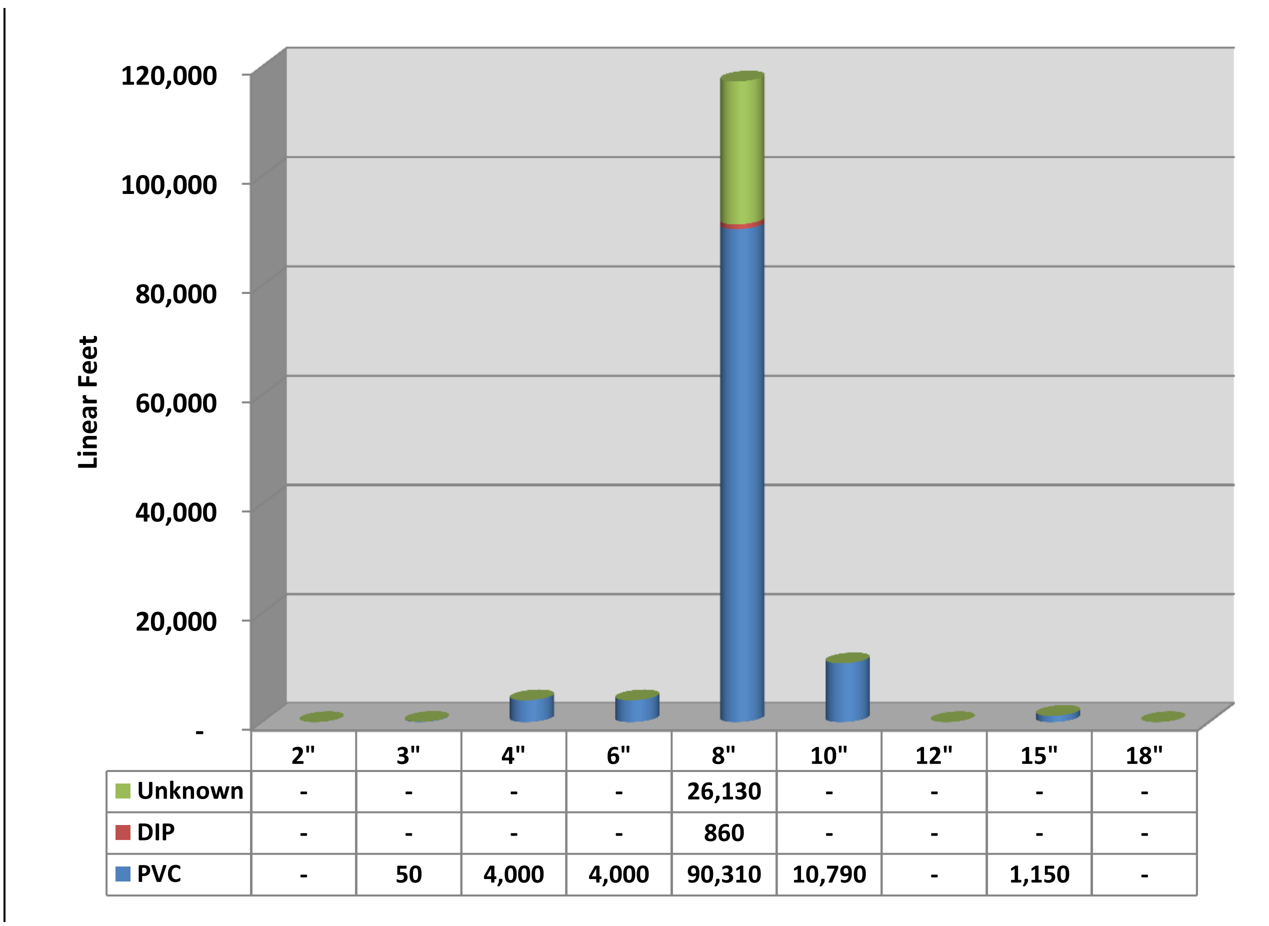
Pump Station	Year Built	Description
Avenida Apice	2008	Wet well pump station with 2 submersible solids handling pumps in the wet well. (PBS&J) 3 HP pumps with approximate firm pumping capacity of 60 gpm.
Avenida Orilla	2008	Wet well pump station with 2 submersible solids handling pump sin the wet well. (PBS&J) 10 HP pumps with approximate firm pumping capacity of 60 gpm.
Camino Sin Puente #1	2004	Wet well pump station with 2 submersible solids handling pumps in the wet well. (PBS&J) 7.5 HP pumps with approximate firm pumping capacity of 60 gpm at 150 ft.
Camino Sin Puente #2	2004	Wet well pump station with 2 submersible solids handling pumps in the wet well. (PBS&J) 7.5 HP pumps with approximate firm pumping capacity of 60 gpm at 150 ft.
Camino Sin Puente #3	2004	Wet well pump station with 2 submersible solids handling pumps in the wet well. (PBS&J) 7.5 HP pumps with approximate firm pumping capacity of 60 gpm at 150 ft.
Camino Sin Puente #4	2004	Wet well pump station with 2 submersible solids handling pumps in the wet well. (PBS&J) 7.5 HP pumps with approximate firm pumping capacity of 60 gpm at 150 ft.
Cerro Del Sol #1	2008	Wet well pump station with 2 submersible solids handling pumps in the wet well. (PBS&J) 10 HP pumps with approximate firm pumping capacity of 100 gpm.
Cerro Del Sol #2	2008	Wet well pump station with 3 submersible solids handling pumps in the wet well. (PBS&J) 10 HP pumps with approximate firm pumping capacity of 200 gpm.
Del Dios	2005	Wet well/pump room pump station; 2+1 two-stage pumping station. 2 submersible solids handling pumps in wet well feed 2 horizontal centrifugal pumps in the pump room. (PBS&J) 125 HP pumps with approximate firm pumping capacity of 1000 gpm.
Midpoint	2005	Wet well/dry well pump station, 3 vertical solids handling pumps in the dry well. (Daniel Boyle) 75 HP pumps with approximate firm pumping capacity of 1700 gpm at 185 ft.

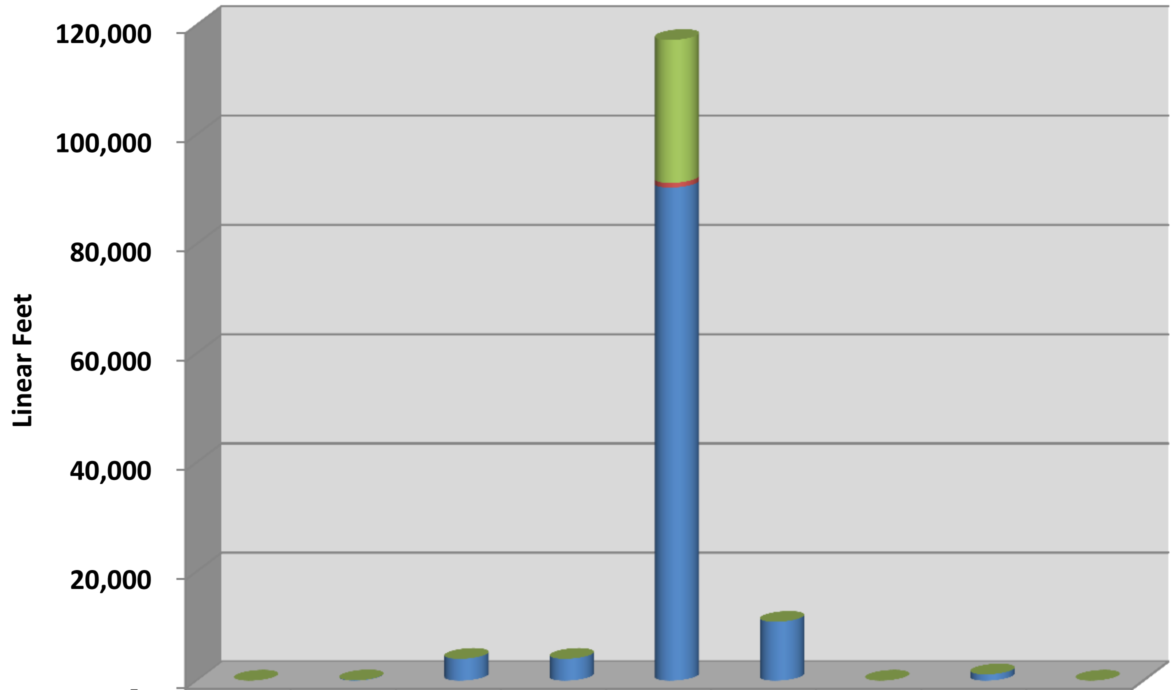
Table 4-2. Rancho Cielo Forcemains

Pump Station Forcemain	Diameter (in)	Material	Length (ft)
Avenida Apice	4	PVC	429
Avenida Orilla	3	PVC	1,220
Camino Sin Puente #1	3	PVC	1,260
Camino Sin Puente #2	3	PVC	1,080
Camino Sin Puente #3	3	PVC	1,060
Camino Sin Puente #4	3	PVC	1,310
Cerro del Sol #1	3	PVC	930
Cerro del Sol #2	4	PVC	1,150
Del Dios	12	DIP and PVC	11,660
Midpoint	12	PVC	10,320

Figure 4-2 illustrates the distribution of gravity pipe size and material in the Rancho Cielo service area.

Figure 4-2. Rancho Cielo Collection System Gravity Mains

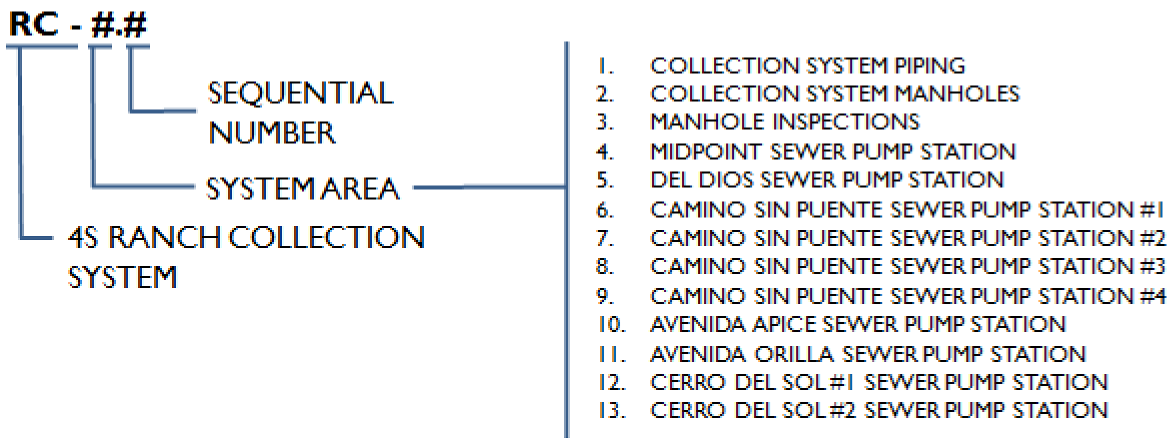




	2"	3"	4"	6"	8"	10"	12"	15"	18"
Unknown	-	-	-	-	26,130	-	-	-	-
DIP	-	-	-	-	860	-	-	-	-
PVC	-	50	4,000	4,000	90,310	10,790	-	1,150	-

4.2 Capital Improvement Projects

The following sections present specific and programmatic CIP projects identified for the Rancho Cielo collection system. The projects are organized by system area in accordance with the following project numbering sequence:



The Rancho Cielo Collection System CIP includes a total of 27 defined projects and programs with a total 20-year cost of $6 million. Of the 27 projects, 26 are unique CIP projects with total value of $5.7 million. The CIP also identifies one programmatic project, a collection system pipe rehabilitation and replacement sinking fund with a total 20-year cost of $0.45 million or approximately $23,000 per year.

4.2.1 Collection System Pipe Rehabilitation and Replacement

Background

The Rancho Cielo gravity collection system is comprised of approximately 137,289 linear feet (26.0 miles) of primarily PVC pipe ranging from 6-inch to 15-inch diameter. The Rancho Cielo forcemains consist of approximately 30,652 linear feet of primarily PVC pipe ranging from 3-inch to 12-inch diameter. A segment of the Del Dios Pump Station forcemain, constructed in 2005, is the only forcemain in the system that consists of DIP.

Project Needs

Well-constructed PVC gravity sewer mains are expected to have a useful life of at least 100 years and PVC forcemains are expected to have a useful life of 50 years. The useful life of ductile iron wastewater forcemains can vary significantly depending on the quality of interior and exterior corrosion protection, but a useful life of 50-years is achievable for a glass-lined pipe with carefully applied polyethylene exterior wrapping and functional air release valves. Poor construction (e.g. under-compaction and over-belling), soil movement, thermal expansion and contraction, root intrusions, and internal and external corrosion of DIP can eventually cause pipe defects that block flow or a pipe break. Although the sewers and forcemains in the Rancho Cielo collection system are expected to last well beyond the CIP timeframe, isolated pipe defects and breaks are expected to occur within the timeframe, and savings will be required to replace or rehabilitate gravity mains and forcemains as needed.

Projects

Capital improvement projects identified for collection system pipe rehabilitation and replacement are summarized in Table 4-3.

Table 4-3. Collection System Pipe Rehabilitation and Replacement Projects

Projects	Cost
RC – 1.0, Collection System Pipe Rehabilitation and Replacement	$1,758,000

Project Derivation

The estimated cost is based on rehabilitating 75 percent of PVC gravity sewers in the Rancho Cielo collection system with CIPP and replacing the other 25 percent and 100 percent of forcemains with open trench construction. A sinking fund factor, assuming 3% interest over a 100-year useful life for gravity mains, and 50-year useful life for forcemains, is applied to the total rehabilitation and replacement valuation to derive an annual sinking fund allowance that will provide adequate savings to rehabilitate and replace the entire Rancho Cielo collection system at the end of its useful life. The annual sinking fund contribution over 20 years is the capital cost for the project. This sinking fund will be used to rehabilitate and replace gravity mains and forcemains in the 4S Ranch collection system as needed.

Project No:	**RC - 1.0**
Project Name:	**Collection System Pipe Rehabilitation and Replacement**
Description:	Establish a sinking fund to rehabilitate or replace PVC collection system piping including forcemains as-needed. Estimate assumes that 75% of gravity pipes can be rehabilitated using trenchless cured-in-place pipe (CIPP) lining and 25% of gravity pipes require replacement in place, including manholes. Estimate assumes that 100% of forcemains require replacement.
Priority:	0
Location/Facility:	Rancho Cielo Collection System

Project Type:		Origin(s) of Project:	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Redundancy		Condition Assessment	X
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	
		Corrosion & Exposure	

Project Cost:				
Capital Costs:				
General			$	-
Manhole Rehabilitation			$	-
Pipeline Rehabilitation			$	121,131
Pipeline Construction (including Manholes)			$	1,027,977
Capital Cost Subtotal:			**$**	**1,149,108**
Soft Costs:				
Classification 'B'				
Engineering	10 %	of capital costs	$	114,911
CM & ESDC	18 %	of capital costs	$	206,839
Administration	3 %	of capital costs	$	34,473
Right of Way	1 %	lump sum	$	11,491
Permitting	1 %	lump sum	$	11,491
Soft Cost Subtotal:			**$**	**379,206**
Contingency:				
Contingency	20 %	of project cost	$	229,822
Total Project Cost:			**$**	**1,758,000**

Project Implementation (Schedule & Expenditure Timeline)				
Project Implementation:	Sinking Fund	Expenditures:	Annual	$ 87,900
Project Delivery Method:	Design-Bid-Build			
Project Duration (Years):	20			

4.2.2 Manhole Lining

Background

The Rancho Cielo collection system contains approximately 345 manholes. Manhole construction is primarily cast in place concrete base with pre-cast concrete shafts. The interior of three (3) manholes in the collection system are currently lined with either T-lock PVC or spray-on coating (polyurethane).

Project Needs

Although the District has previously lined a number of manholes, H_2S modeling from predicted sulfide generation indicates that fifty (50) additional manholes are subject to corrosive environments caused by H_2S exposure, and require lining protection. Additionally, manholes damaged from root intrusion require lining to increase the longevity of the manhole. Previously lined manholes require periodic special inspection at a recommended interval of five years to determine if re-lining is needed. On average, manholes with spray-on polyurethane coating will need to be re-lined approximately every ten years.

Projects

Capital improvement projects identified for manhole lining are summarized in Table 4-4.

Table 4-4. Manhole Lining Projects

Projects	Cost
RC – 2.0, Line Manholes Subject to High H_2S Exposure	$240,000
RC – 3.1, Special Inspection of Lined Manholes	$67,000
RC – 3.2, Re-Line Manholes Recommended from Special Inspection	$453,000
Total	$760,000

Project No: **RC - 2.0**

Project Name: **Line Manholes Subject to high H_2S exposure**

Description: Line fifty (50) manholes subject to high H_2S exposure in the Rancho Cielo collection system. Manhole lining determined from H_2S generation and residual model.

Priority: 55

Location/Facility: Rancho Cielo Collection System

Project Type:		Origin(s) of Project:	
Rehab/Replacement	X	Predicted Useful Life Expiration	
Redundancy		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	
		Corrosion & Exposure	X

Project Cost:

Capital Costs:				
General			$	-
Manhole Rehabilitation			$	150,000
Pipeline Rehabilitation			$	-
Pipeline Construction (including Manholes)			$	-
Capital Cost Subtotal:			**$**	**150,000**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	22,500
CM & ESDC	20 %	of capital costs	$	30,000
Administration	5 %	of capital costs	$	7,500
Right of Way		lump sum		
Permitting		lump sum		
Soft Cost Subtotal:			**$**	**60,000**
Contingency:				
Contingency	20 %	of project cost	$	30,000
Total Project Cost:			**$**	**240,000**

Project Implementation (Schedule & Expenditure Timeline)

Project Implementation:	One-Time Project	Expenditures:	2020	$	240,000
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	1				

Project No:	**RC - 3.1**		
Project Name:	**Special Inspection of Lined Manholes**		
Description:	Hire a special inspector for the three (3) existing lined manholes and fifty (50) new lined manholes on a five-year frequency. Fifty-three (53) manhole lining inspections occuring three separate times for a total of 159 special inspections of lined manholes.		
Priority:	45		
Location/Facility:	Rancho Cielo Collection System		

Project Type:		Origin(s) of Project:	
Rehab/Replacement		Predicted Useful Life Expiration	X
Redundancy		Condition Assessment	
Engineering Study	X	Operations Assessment	
Expansion		Failure Modes & Consequences	
		Corrosion & Exposure	X

Project Cost:				
Capital Costs:				
General			$	-
Manhole Rehabilitation			$	47,700
Pipeline Rehabilitation			$	-
Pipeline Construction (including Manholes)			$	-
Capital Cost Subtotal:			**$**	**47,700**
Soft Costs:				
Project Specific				
Engineering	15 %	of capital costs	$	7,155
CM & ESDC	0 %	of capital costs	$	-
Administration	5 %	of capital costs	$	2,385
Right of Way		lump sum		
Permitting		lump sum		
Soft Cost Subtotal:			**$**	**9,540**
Contingency:				
Contingency	20 %	of project cost	$	9,540
Total Project Cost:			**$**	**67,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	Multiple-Time Project	Expenditures:	2021	$	22,000
Project Delivery Method:	Inspection Report		2026	$	22,000
Project Duration (Years):	3		2031	$	23,000

Project No:	**RC - 3.2**		
Project Name:	**Re-Line Manholes Recommended from Special Inspection**		
Description:	Re-line approximately twenty-five (25) percent of lined manholes following special inspection of lined manholes (Project RC - 3.1). Total manhole re-linings is estimated to be approximately 120.		
Priority:	45		
Location/Facility:	Rancho Cielo Collection System		

Project Type:		Origin(s) of Project:	
Rehab/Replacement		Predicted Useful Life Expiration	X
Redundancy		Condition Assessment	
Engineering Study	X	Operations Assessment	
Expansion		Failure Modes & Consequences	
		Corrosion & Exposure	X

Project Cost:				
Capital Costs:				
General			$	-
Manhole Rehabilitation			$	300,000
Pipeline Rehabilitation			$	-
Pipeline Construction (including Manholes)			$	-
Capital Cost Subtotal:			**$**	**300,000**
Soft Costs:				
Classification 'B'				
Engineering	10 %	of capital costs	$	30,000
CM & ESDC	18 %	of capital costs	$	54,000
Administration	3 %	of capital costs	$	9,000
Right of Way		lump sum		
Permitting		lump sum		
Soft Cost Subtotal:			**$**	**93,000**
Contingency:				
Contingency	20 %	of project cost	$	60,000
Total Project Cost:			**$**	**453,000**

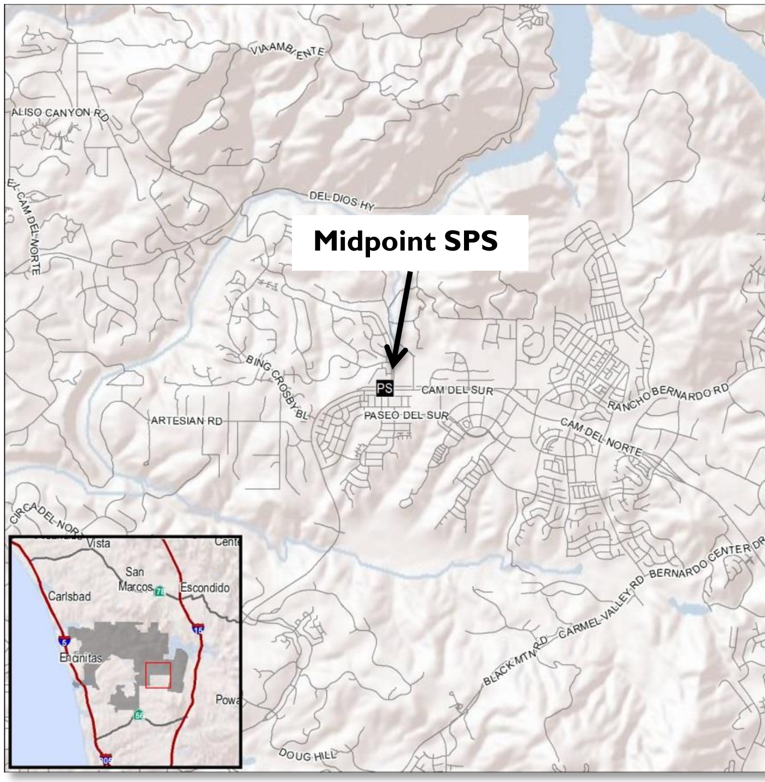
Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	Multiple-Time Project	Expenditures:	2021	$	130,000
Project Delivery Method:	Design-Bid-Build		2026	$	130,000
Project Duration (Years):	3		2031	$	134,000

4.2.3 Midpoint Sewer Pump Station Improvements

Background

The Midpoint Sewer Pump Station is a packaged underground wet well/dry well facility located at the intersection of Camino Del Sur and Old Course Rd. Designed by Daniel Boyle Engineering and constructed in 2005, the pump station incorporates three (3) 75-hp, vertical non-clog pumps rated at 850 gpm at 185-ft TDH. The wet well is a 22-foot deep, hoppered bottom, precast concrete structure. Discharge lines tie into a 12-inch forcemain. Figure 4-3 to the right shows the Midpoint sewer pump station location.

Figure 4-3. Midpoint SPS Location Map



Project Needs

The pump station is in good condition and is well-maintained, but the major equipment in the pump station will reach the end of its expected useful life within the CIP timeframe. Bypass pumping connections and an Emergency Response Plan are recommended to mitigate risk associated with various pump station failure modes.

Projects

Capital improvement projects identified for the Midpoint sewer pump station are summarized in Table 4-5.

Table 4-5. Midpoint Sewer Pump Station Improvements Projects

Projects	Cost
RC – 4.1, Replace Pumps in the Midpoint Sewer Pump Station	$644,000
RC – 4.2, Replace the Midpoint Sewer Pump Station Emergency Generator	$272,000
RC – 4.3, Upgrade Electrical Gear at the Midpoint Sewer Pump Station	$320,000
RC – 4.4, Upgrade SCADA Control System at the Midpoint Sewer Pump Station	$80,000
RC – 4.5, Odor Control Improvements at Midpoint SPS	$256,000
RC – 4.6, Midpoint Sewer Pump Station Improvements	$174,000
Total	$1,746,000

Project No:	**RC - 4.1**			
Project Name:	**Replace Pumps in the Midpoint Sewer Pump Station**			
Description:	Replace the three 75 horsepower pumps in the Midpoint sewer pump station.			
Priority:	10			
Location/Facility:	Rancho Cielo Collection System			

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	25,000
Civil & Mechanical			$	20,000
Structural			$	-
Electrical & Controls			$	40,000
Equipment			$	341,250
Capital Cost Subtotal:			**$**	**426,250**
Soft Costs:				
Classification 'B'				
Engineering	10 %	of capital costs	$	42,625
CM & ESDC	18 %	of capital costs	$	76,725
Administration	3 %	of capital costs	$	12,788
Soft Cost Subtotal:			**$**	**132,138**
Contingency:				
Contingency	20 %	of project cost	$	85,250
Total Project Cost:			**$**	**644,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2028	$	644,000
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	1				

Project No:	**RC - 4.2**		
Project Name:	**Replace the Midpoint Sewer Pump Station Emergency Generator**		
Description:	Replace the Midpoint sewer pump station emergency generator.		
Priority:	10		
Location/Facility:	Rancho Cielo Collection System		

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:			
Capital Costs:			
General			$ -
Civil & Mechanical			$ 15,000
Structural			$ -
Electrical & Controls			$ 25,000
Equipment			$ 140,250
Capital Cost Subtotal:			**$ 180,250**
Soft Costs:			
Classification 'B'			
Engineering	10 %	of capital costs	$ 18,025
CM & ESDC	18 %	of capital costs	$ 32,445
Administration	3 %	of capital costs	$ 5,408
Soft Cost Subtotal:			**$ 55,878**
Contingency:			
Contingency	20 %	of project cost	$ 36,050
Total Project Cost:			**$ 272,000**

Project Implementation (Schedule & Expenditure Timeline)				
Project Implementation:	One-Time Project	Expenditures:	2029	$ 272,000
Project Delivery Method:	Design-Bid-Build			
Project Duration (Years):	1			

Project No:	**RC - 4.3**		
Project Name:	**Upgrade Electrical gear at the Midpoint Sewer Pump Station**		
Description:	Upgrade the Electrical gear at the Midpoint sewer pump station. Project does not include SCADA control system upgrades.		
Priority:	10		
Location/Facility:	Rancho Cielo Collection System		

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement		Predicted Useful Life Expiration	X
Facility/Equip Upgrade	X	Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	-
Civil & Mechanical			$	-
Structural			$	-
Electrical & Controls			$	200,000
Equipment			$	-
Capital Cost Subtotal:			**$**	**200,000**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	30,000
CM & ESDC	20 %	of capital costs	$	40,000
Administration	5 %	of capital costs	$	10,000
Soft Cost Subtotal:			**$**	**80,000**
Contingency:				
Contingency	20 %	of project cost	$	40,000
Total Project Cost:			**$**	**320,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2032	$	35,000
Project Delivery Method:	Design-Bid-Build		2033	$	285,000
Project Duration (Years):	2				

Project No:	**RC - 4.4**			
Project Name:	**Upgrade the SCADA control system at the Midpoint Sewer Pump Station**			
Description:	Upgrade the SCADA control system at the Midpoint sewer pump station. Project does not include electrical gear upgrades.			
Priority:	10			
Location/Facility:	Rancho Cielo Collection System			

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement		Predicted Useful Life Expiration	X
Facility/Equip Upgrade	X	Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:			
Capital Costs:			
General			$ -
Civil & Mechanical			$ -
Structural			$ -
Electrical & Controls			$ 50,000
Equipment			$ -
Capital Cost Subtotal:			**$ 50,000**
Soft Costs:			
Classification 'C'			
Engineering	15 %	of capital costs	$ 7,500
CM & ESDC	20 %	of capital costs	$ 10,000
Administration	5 %	of capital costs	$ 2,500
Soft Cost Subtotal:			**$ 20,000**
Contingency:			
Contingency	20 %	of project cost	$ 10,000
Total Project Cost:			**$ 80,000**

Project Implementation (Schedule & Expenditure Timeline)				
Project Implementation:	One-Time Project	Expenditures:	2032	$ 9,000
Project Delivery Method:	Design-Bid-Build		2033	$ 71,000
Project Duration (Years):	2			

Project No:	**RC - 4.5**		
Project Name:	**Odor Control Improvements at Midpoint SPS**		
Description:	Remove existing biological odor scrubber (Biocube) and replace with new activated carbon scrubber sized for minimum 500 CFM to maintain minimum 6 AC/HR in the wetwell and capacity for peak H2S load of up to 600 ppm. Major components include new odor control vessel, activated carbon media, new corrosion-resistant blower, new ducting from foul air collection system to new odor control system, new control panel and instrumentation, electrical connections, and integration into SCADA.		
Priority:	90		
Location/Facility:	Rancho Cielo Collection System		

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement		Predicted Useful Life Expiration	X
Facility/Equip Upgrade	X	Condition Assessment	X
Engineering Study		Operations Assessment	X
Expansion		Failure Modes & Effects	X

Project Cost:				
Capital Costs:				
General			$	5,000
Civil & Mechanical			$	10,000
Structural			$	-
Electrical & Controls			$	15,000
Equipment			$	132,000
Capital Cost Subtotal:			**$**	**162,000**
Soft Costs:				
Project Specific				
Engineering	25 %	of capital costs	$	40,500
CM & ESDC	10 %	of capital costs	$	16,200
Administration	3 %	of capital costs	$	4,860
Soft Cost Subtotal:			**$**	**61,560**
Contingency:				
Contingency	20 %	of project cost	$	32,400
Total Project Cost:			**$**	**256,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2015	$	256,000
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	1				

Project No:	**RC - 4.6**			
Project Name:	**Midpoint Sewer Pump Station Improvements**			
Description:	Install pump station bypass connections and develop an emergency response plan in case of a failure. Access Road Improvements per District's FY 14-15 Capital Spending Plan. Additionally, relocate j-box and routing cables to mezzanine to avoid damage to pumps and electrical system in case of a dry well flooding incident and replace the existing door-mounted OIT with a door-mounted iPC for complete SCADA control from remote pump stations.			
Priority:	75			
Location/Facility:	Rancho Cielo Collection System			

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement		Predicted Useful Life Expiration	
Facility/Equip Upgrade	X	Condition Assessment	X
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	X

Project Cost:				
Capital Costs:				
General			$	5,000
Civil & Mechanical			$	70,550
Structural			$	-
Electrical & Controls			$	33,000
Equipment			$	-
Capital Cost Subtotal:			**$**	**108,550**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	16,283
CM & ESDC	20 %	of capital costs	$	21,710
Administration	5 %	of capital costs	$	5,428
Soft Cost Subtotal:			**$**	**43,420**
Contingency:				
Contingency	20 %	of project cost	$	21,710
Total Project Cost:			**$**	**174,000**

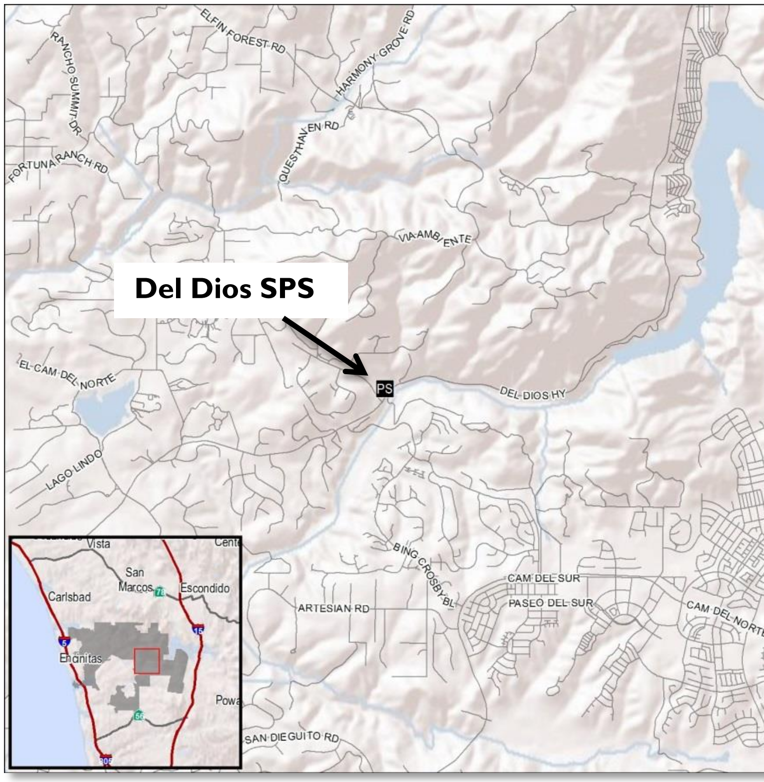
Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2019	$	174,000
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	1				

4.2.4 Del Dios Sewer Pump Station Improvements

Background

The Del Dios Sewer Pump Station is a wet well/pump room pump station located on Del Dios Hwy Northeast of Calle Ambiente. The pump station was designed by PBS&J and constructed in 2004. Within the wet well, duplex 125-hp submersible pumps provide suction pressure to another duplex set of 125-hp horizontal centrifugal pumps in the pump room. Each series of submersible to horizontal pump configuration is equipped to handle a flow of 1800 gpm. Figure 4-4 to the right shows the Del Dios sewer pump station location.

Figure 4-4. Del Dios SPS Location Map



Project Needs

The pump station is in good condition and is well-maintained, but the major equipment in the pump station will reach the end of its expected useful life within the CIP timeframe. Bypass pumping connections and an Emergency Response Plan are recommended to mitigate risk associated with various pump station failure modes.

Projects

Capital improvement projects identified for the Del Dios sewer pump station are summarized in Table 4-6.

Table 4-6. Del Dios Sewer Pump Station Improvements Projects

Projects	Cost
RC – 5.1, Replace Pumps in the Del Dios Sewer Pump Station	$999,000
RC – 5.2, Replace the Del Dios Sewer Pump Station Emergency Generator	$288,000
RC – 5.3, Upgrade Electrical Gear at the Del Dios Sewer Pump Station	$320,000
RC – 5.4, Upgrade SCADA Control System at the Del Dios Sewer Pump Station	$80,000
RC – 5.5, Del Dios Sewer Pump Station Improvements	$132,000
Total	$1,819,000

Project No:	**RC - 5.1**		
Project Name:	**Replace Pumps in the Del Dios Sewer Pump Station**		
Description:	Replace the four 125 horsepower pumps (2 submersible & 2 horizontal centrifugal) in the Del Dios sewer pump station.		
Priority:	15		
Location/Facility:	Rancho Cielo Collection System		

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:

Capital Costs:				
General			$	60,000
Civil & Mechanical			$	8,000
Structural			$	-
Electrical & Controls			$	60,000
Equipment			$	533,750
Capital Cost Subtotal:			**$**	**661,750**
Soft Costs:				
Classification 'B'				
Engineering	10 %	of capital costs	$	66,175
CM & ESDC	18 %	of capital costs	$	119,115
Administration	3 %	of capital costs	$	19,853
Soft Cost Subtotal:			**$**	**205,143**
Contingency:				
Contingency	20 %	of project cost	$	132,350
Total Project Cost:			**$**	**999,000**

Project Implementation (Schedule & Expenditure Timeline)

Project Implementation:	One-Time Project	Expenditures:	2026	$	999,000
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	1				

Project No:	**RC - 5.2**			
Project Name:	**Replace the Del Dios Sewer Pump Station Emergency Generator**			
Description:	Replace the Del Dios sewer pump station emergency generator.			
Priority:	15			
Location/Facility:	Rancho Cielo Collection System			

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	-
Civil & Mechanical			$	15,000
Structural			$	-
Electrical & Controls			$	25,000
Equipment			$	140,250
Capital Cost Subtotal:			**$**	**180,250**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	27,038
CM & ESDC	20 %	of capital costs	$	36,050
Administration	5 %	of capital costs	$	9,013
Soft Cost Subtotal:			**$**	**72,100**
Contingency:				
Contingency	20 %	of project cost	$	36,050
Total Project Cost:			**$**	**288,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2029	$	288,000
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	1				

Project No:	**RC - 5.3**			
Project Name:	**Upgrade Electrical gear at the Del Dios Sewer Pump Station**			
Description:	Upgrade the Electrical gear at the Del Dios sewer pump station. Project does not include SCADA control system upgrades.			
Priority:	15			
Location/Facility:	Rancho Cielo Collection System			
Project Type:		**Origin(s) of Project:**		
Rehab/Replacement		Predicted Useful Life Expiration	X	
Facility/Equip Upgrade	X	Condition Assessment		
Engineering Study		Operations Assessment		
Expansion		Failure Modes & Consequences		

Project Cost:				
Capital Costs:				
General			$	-
Civil & Mechanical			$	-
Structural			$	-
Electrical & Controls			$	200,000
Equipment			$	-
Capital Cost Subtotal:			**$**	**200,000**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	30,000
CM & ESDC	20 %	of capital costs	$	40,000
Administration	5 %	of capital costs	$	10,000
Soft Cost Subtotal:			**$**	**80,000**
Contingency:				
Contingency	20 %	of project cost	$	40,000
Total Project Cost:			**$**	**320,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2031	$	35,000
Project Delivery Method:	Design-Bid-Build		2032	$	285,000
Project Duration (Years):	2				

Project No:	**RC - 5.4**
Project Name:	**Upgrade SCADA Control System at the Del Dios Sewer Pump Station**
Description:	Upgrade the SCADA control system at the Del Dios sewer pump station. Project does not include electrical gear upgrades.
Priority:	15
Location/Facility:	Rancho Cielo Collection System

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement		Predicted Useful Life Expiration	X
Facility/Equip Upgrade	X	Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	-
Civil & Mechanical			$	-
Structural			$	-
Electrical & Controls			$	50,000
Equipment			$	-
Capital Cost Subtotal:			**$**	**50,000**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	7,500
CM & ESDC	20 %	of capital costs	$	10,000
Administration	5 %	of capital costs	$	2,500
Soft Cost Subtotal:			**$**	**20,000**
Contingency:				
Contingency	20 %	of project cost	$	10,000
Total Project Cost:			**$**	**80,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2031	$	9,000
Project Delivery Method:	Design-Bid-Build		2032	$	71,000
Project Duration (Years):	2				

Project No:	**RC - 5.5**		
Project Name:	**Del Dios Sewer Pump Station Improvements**		
Description:	Install pump station bypass connections, develop an emergency response plan in case of a failure, change air-vacuum valves to sewage-type with connect to drain back to wet well, investigate and fix seating and shut down timing issues of the submersible pumps. Additionally, install a third level control instrument, perform infrared testing of the main circuit breakers, starters, and motors, test and certify the main circuit breaker, and replace the existing door-mounted OIT with a door-mounted iPC for complete SCADA control from remote pump stations.		
Priority:	75		
Location/Facility:	Rancho Cielo Collection System		

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement		Predicted Useful Life Expiration	
Facility/Equip Upgrade	X	Condition Assessment	X
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	X

Project Cost:				
Capital Costs:				
General			$	5,000
Civil & Mechanical			$	44,550
Structural			$	-
Electrical & Controls			$	33,000
Equipment			$	-
Capital Cost Subtotal:			**$**	**82,550**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	12,383
CM & ESDC	20 %	of capital costs	$	16,510
Administration	5 %	of capital costs	$	4,128
Soft Cost Subtotal:			**$**	**33,020**
Contingency:				
Contingency	20 %	of project cost	$	16,510
Total Project Cost:			**$**	**132,000**

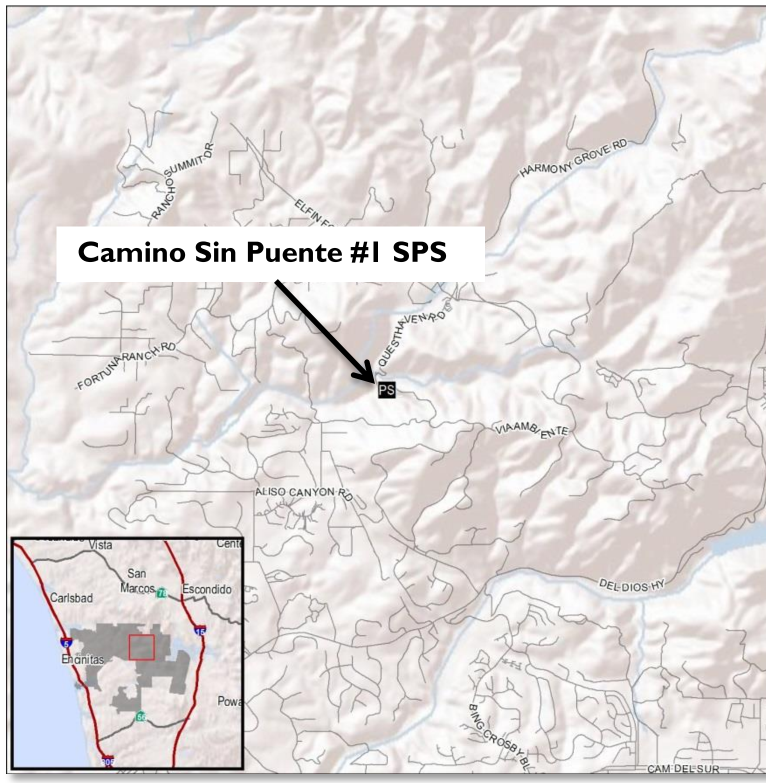
Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2019	$	132,000
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	1				

4.2.5 Camino Sin Puente #1 Sewer Pump Station Improvements

Background

The Camino Sin Puente #1 Sewer Pump Station is a submersible facility located at the end of Camino Sin Puente. The pump station was designed by PBS&J and was constructed in 2004. It consists of a 7-foot diameter by 16-foot deep precast concrete operational wet well. An 8-foot by 16-foot precast construct structure serves as an emergency storage vault. The submersible pumps are duplex 7.5-hp grinder type pumps. Figure 4-5 to the right shows the Camino Sin Puente #1 sewer pump station location.

Figure 4-5. Camino Sin Puente #1 SPS Location Map



Project Needs

The pump station is in good condition and is well-maintained, but the major equipment in the pump station will reach the end of its expected useful life within the CIP timeframe. Bypass pumping connections and an Emergency Response Plan are recommended to mitigate risk associated with various pump station failure modes.

Projects

Capital improvement projects identified for the Camino Sin Puente #1 sewer pump station are summarized in Table 4-7.

Table 4-7. Camino Sin Puente #1 Sewer Pump Station Improvements Projects

Projects	Cost
RC – 6.1, Replace Camino Sin Puente Sewer Pump Station #1	$138,000
RC – 6.2, Camino Sin Puente Sewer Pump Station #1 Improvements	$125,000
Total	$263,000

Project No:	**RC - 6.1**			
Project Name:	**Replace Camino Sin Puente Sewer Pump Station #1**			
Description:	Replace Camino Sin Puente sewer pump station #1. Project includes replacing pumps, piping, valves, electrical gear, control system, guide rails and miscellaneous equipment. Project also includes wet well rehabilitation.			
Priority:	15			
Location/Facility:	Rancho Cielo Collection System			

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	5,000
Civil & Mechanical			$	25,000
Structural			$	10,000
Electrical & Controls			$	20,000
Equipment			$	26,000
Capital Cost Subtotal:			**$**	**86,000**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	12,900
CM & ESDC	20 %	of capital costs	$	17,200
Administration	5 %	of capital costs	$	4,300
Soft Cost Subtotal:			**$**	**34,400**
Contingency:				
Contingency	20 %	of project cost	$	17,200
Total Project Cost:			**$**	**138,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2029	$	15,000
Project Delivery Method:	Design-Bid-Build		2030	$	123,000
Project Duration (Years):	2				

Project No:	**RC - 6.2**		
Project Name:	**Camino Sin Puente Sewer Pump Station #1 Improvements**		
Description:	Install pump station bypass connections, develop emergency response plan in case of a failure, install site lighting for operator safety, install a canopy over electrical gear for operator safety and to protect gear, and install flow meter on pump discharge. Additionally, replace Hydromatic pumps to District preferred Myers pumps and install double-leaf access hatches to wet well, emergency storage, and valve vault instead of manholes.		
Priority:	40		
Location/Facility:	Rancho Cielo Collection System		

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement		Predicted Useful Life Expiration	
Facility/Equip Upgrade	X	Condition Assessment	X
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	X

Project Cost:				
Capital Costs:				
General			$	5,000
Civil & Mechanical			$	23,760
Structural			$	-
Electrical & Controls			$	49,500
Equipment			$	-
Capital Cost Subtotal:			**$**	**78,260**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	11,739
CM & ESDC	20 %	of capital costs	$	15,652
Administration	5 %	of capital costs	$	3,913
Soft Cost Subtotal:			**$**	**31,304**
Contingency:				
Contingency	20 %	of project cost	$	15,652
Total Project Cost:			**$**	**125,000**

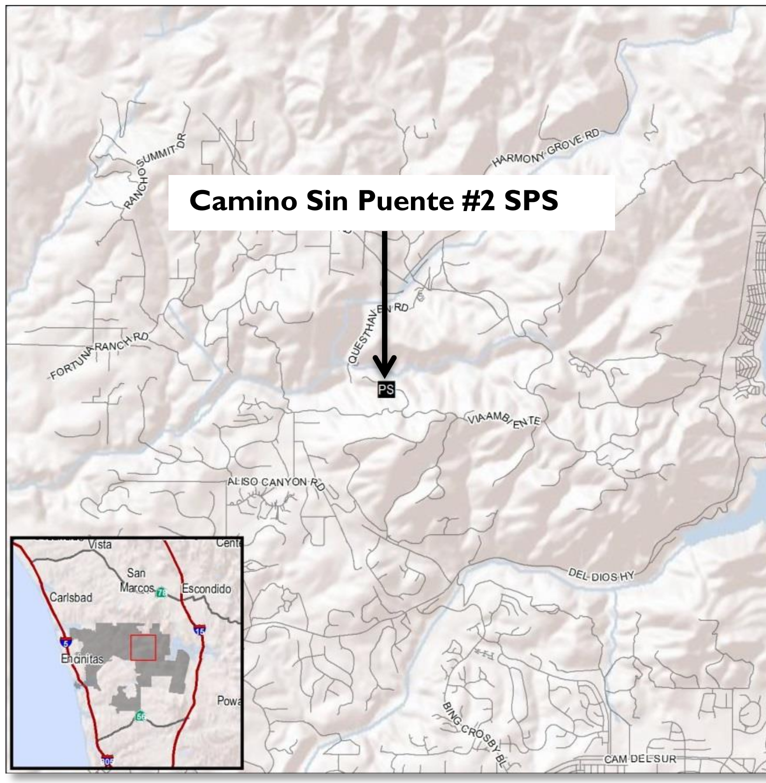
Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2022	$	125,000
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	1				

4.2.6 Camino Sin Puente #2 Sewer Pump Station Improvements

Background

The Camino Sin Puente #2 Sewer Pump Station is a submersible facility located along Camino Sin Puente. The pump station was designed by PBS&J and was constructed in 2004. It consists of a 7-foot diameter by 12-foot deep precast concrete operational wet well. The submersible pumps are duplex 7.5-hp grinder type pumps. Figure 4-6 to the right shows the Camino Sin Puente #2 sewer pump station location.

Figure 4-6. Camino Sin Puente #2 SPS Location Map



Project Needs

The pump station is in good condition and is well-maintained, but the major equipment in the pump station will reach the end of its expected useful life within the CIP timeframe. Bypass pumping connections and an Emergency Response Plan are recommended to mitigate risk associated with various pump station failure modes.

Projects

Capital improvement projects identified for the Camino Sin Puente #2 sewer pump station are summarized in Table 4-8.

Table 4-8. Camino Sin Puente #2 Sewer Pump Station Improvements Projects

Projects	Cost
RC – 7.1, Replace Camino Sin Puente Sewer Pump Station #2	$138,000
RC – 7.2, Camino Sin Puente Sewer Pump Station #2 Improvements	$125,000
Total	$263,000

Project No:	**RC - 7.1**			
Project Name:	**Replace Camino Sin Puente Sewer Pump Station #2**			
Description:	Replace Camino Sin Puente sewer pump station #2. Project includes replacing pumps, piping, valves, electrical gear, control system, guide rails and miscellaneous equipment. Project also includes wet well rehabilitation.			
Priority:	15			
Location/Facility:	Rancho Cielo Collection System			

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	5,000
Civil & Mechanical			$	25,000
Structural			$	10,000
Electrical & Controls			$	20,000
Equipment			$	26,000
Capital Cost Subtotal:			**$**	**86,000**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	12,900
CM & ESDC	20 %	of capital costs	$	17,200
Administration	5 %	of capital costs	$	4,300
Soft Cost Subtotal:			**$**	**34,400**
Contingency:				
Contingency	20 %	of project cost	$	17,200
Total Project Cost:			**$**	**138,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2028	$	15,000
Project Delivery Method:	Design-Bid-Build		2029	$	123,000
Project Duration (Years):	2				

Project No:	**RC - 7.2**			
Project Name:	**Camino Sin Puente Sewer Pump Station #2 Improvements**			
Description:	Install pump station bypass connections, develop emergency response plan in case of a failure, install site lighting for operator safety, install a canopy over electrical gear for operator safety and to protect gear, and install flow meter on pump discharge. Additionally, replace Hydromatic pumps to District preferred Myers pumps and install double-leaf access hatches to wet well, emergency storage, and valve vault instead of manholes.			
Priority:	40			
Location/Facility:	Rancho Cielo Collection System			
Project Type:		**Origin(s) of Project:**		
Rehab/Replacement		Predicted Useful Life Expiration		
Facility/Equip Upgrade	X	Condition Assessment	X	
Engineering Study		Operations Assessment		
Expansion		Failure Modes & Consequences	X	

Project Cost:				
Capital Costs:				
General			$	5,000
Civil & Mechanical			$	23,760
Structural			$	-
Electrical & Controls			$	49,500
Equipment			$	-
Capital Cost Subtotal:			**$**	**78,260**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	11,739
CM & ESDC	20 %	of capital costs	$	15,652
Administration	5 %	of capital costs	$	3,913
Soft Cost Subtotal:			**$**	**31,304**
Contingency:				
Contingency	20 %	of project cost	$	15,652
Total Project Cost:			**$**	**125,000**

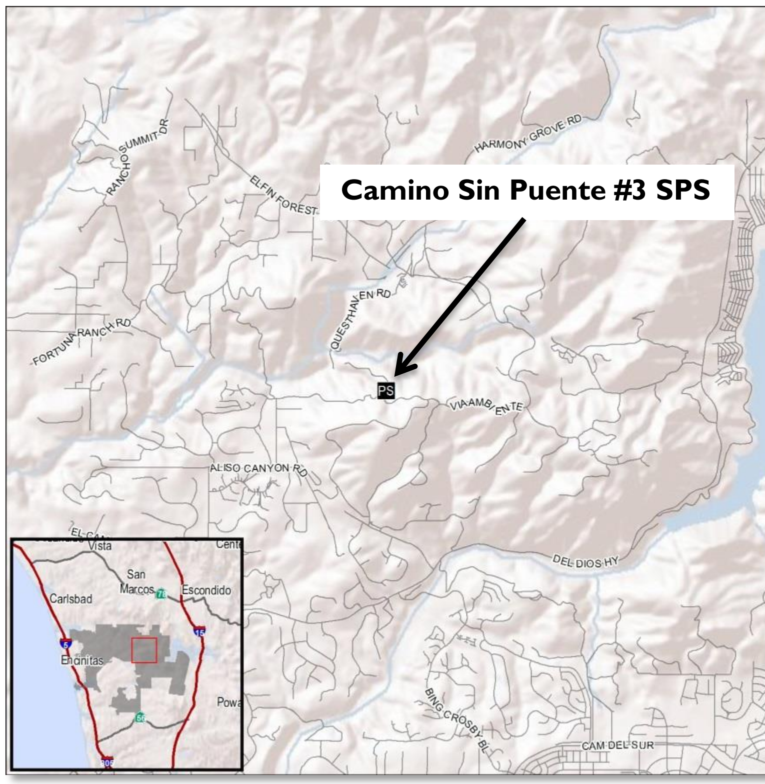
Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2022	$	125,000
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	1				

4.2.7 Camino Sin Puente #3 Sewer Pump Station Improvements

Background

The Camino Sin Puente #3 Sewer Pump Station is a submersible facility located along Camino Sin Puente. The pump station was designed by PBS&J and was constructed in 2004. It consists of a 7-foot diameter by 13-foot deep precast concrete operational wet well. The submersible pumps are duplex 7.5-hp grinder type pumps. Figure 4-7 to the right shows the Camino Sin Puente #3 sewer pump station location.

Figure 4-7. Camino Sin Puente #3 SPS Location Map



Project Needs

The pump station is in good condition and is well-maintained, but the major equipment in the pump station will reach the end of its expected useful life within the CIP timeframe. Bypass pumping connections and an Emergency Response Plan are recommended to mitigate risk associated with various pump station failure modes.

Projects

Capital improvement projects identified for the Camino Sin Puente #3 sewer pump station are summarized in Table 4-9.

Table 4-9. Camino Sin Puente #3 Sewer Pump Station Improvements Projects

Projects	Cost
RC – 8.1, Replace Camino Sin Puente Sewer Pump Station #3	$138,000
RC – 8.2, Camino Sin Puente Sewer Pump Station #3 Improvements	$125,000
Total	$263,000

Project No:	**RC - 8.1**		
Project Name:	**Replace Camino Sin Puente Sewer Pump Station #3**		
Description:	Replace Camino Sin Puente sewer pump station #3. Project includes replacing pumps, piping, valves, electrical gear, control system, guide rails and miscellaneous equipment. Project also includes wet well rehabilitation.		
Priority:	15		
Location/Facility:	Rancho Cielo Collection System		
Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:			
Capital Costs:			
General			$ 5,000
Civil & Mechanical			$ 25,000
Structural			$ 10,000
Electrical & Controls			$ 20,000
Equipment			$ 26,000
Capital Cost Subtotal:			**$ 86,000**
Soft Costs:			
Classification 'C'			
Engineering	15 %	of capital costs	$ 12,900
CM & ESDC	20 %	of capital costs	$ 17,200
Administration	5 %	of capital costs	$ 4,300
Soft Cost Subtotal:			**$ 34,400**
Contingency:			
Contingency	20 %	of project cost	$ 17,200
Total Project Cost:			**$ 138,000**

Project Implementation (Schedule & Expenditure Timeline)				
Project Implementation:	One-Time Project	Expenditures:	2028	$ 15,000
Project Delivery Method:	Design-Bid-Build		2029	$ 123,000
Project Duration (Years):	2			

Project No:	**RC - 8.2**		
Project Name:	**Camino Sin Puente Sewer Pump Station #3 Improvements**		
Description:	Install pump station bypass connections, develop emergency response plan in case of a failure, install site lighting for operator safety, install a canopy over electrical gear for operator safety and to protect gear, and install flow meter on pump discharge. Additionally, replace Hydromatic pumps to District preferred Myers pumps and install double-leaf access hatches to wet well, emergency storage, and valve vault instead of manholes.		
Priority:	40		
Location/Facility:	Rancho Cielo Collection System		

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement		Predicted Useful Life Expiration	
Facility/Equip Upgrade	X	Condition Assessment	X
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	X

Project Cost:				
Capital Costs:				
General			$	5,000
Civil & Mechanical			$	23,760
Structural			$	-
Electrical & Controls			$	49,500
Equipment			$	-
Capital Cost Subtotal:			**$**	**78,260**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	11,739
CM & ESDC	20 %	of capital costs	$	15,652
Administration	5 %	of capital costs	$	3,913
Soft Cost Subtotal:			**$**	**31,304**
Contingency:				
Contingency	20 %	of project cost	$	15,652
Total Project Cost:			**$**	**125,000**

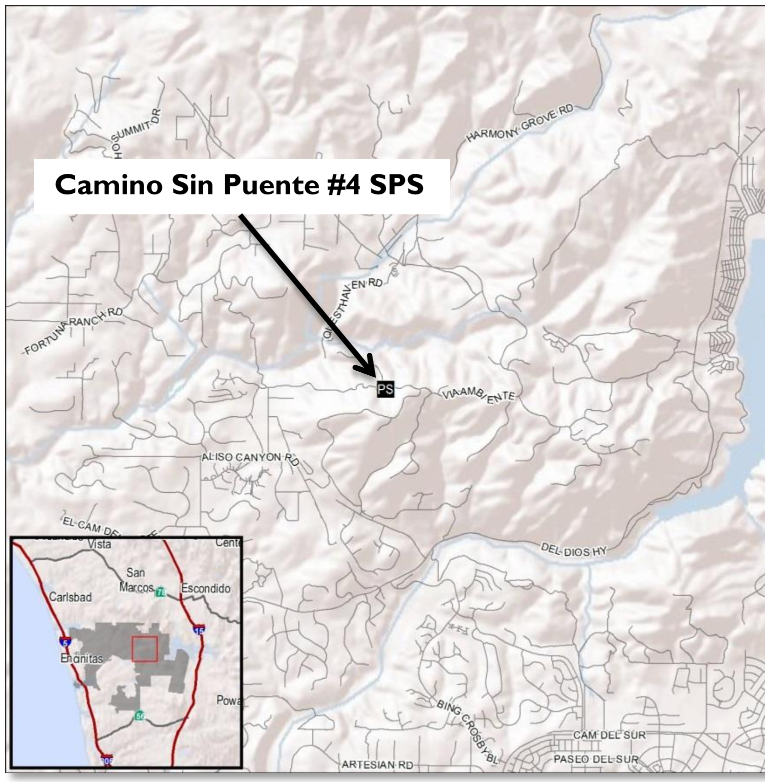
Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2022	$	125,000
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	1				

4.2.8 Camino Sin Puente #4 Sewer Pump Station Improvements

Background

The Camino Sin Puente #4 Sewer Pump Station is a submersible facility located along Camino Sin Puente. The pump station was designed by PBS&J and was constructed in 2004. It consists of a 7-foot diameter by 16-foot deep precast concrete operational wet well. An 8-foot by 16-foot precast construct structure serves as an emergency storage vault. The submersible pumps are duplex 7.5-hp grinder type pumps. Figure 4-8 to the right shows the Camino Sin Puente #3 sewer pump station location.

Figure 4-8. Camino Sin Puente #4 SPS Location Map



Project Needs

The pump station is in good condition and is well-maintained, but the major equipment in the pump station will reach the end of its expected useful life within the CIP timeframe. Bypass pumping connections and an Emergency Response Plan are recommended to mitigate risk associated with various pump station failure modes.

Projects

Capital improvement projects identified for the Camino Sin Puente #4 sewer pump station are summarized in Table 4-10.

Table 4-10. Camino Sin Puente #4 Sewer Pump Station Improvements Projects

Projects	Cost
RC – 9.1, Replace Camino Sin Puente Sewer Pump Station #4	$138,000
RC – 9.2, Camino Sin Puente Sewer Pump Station #4 Improvements	$125,000
Total	$263,000

Project No:	**RC - 9.1**
Project Name:	**Replace Camino Sin Puente Sewer Pump Station #4**
Description:	Replace Camino Sin Puente sewer pump station #4. Project includes replacing pumps, piping, valves, electrical gear, control system, guide rails and miscellaneous equipment. Project also includes wet well rehabilitation.
Priority:	15
Location/Facility:	Rancho Cielo Collection System

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement	X	Predicted Useful Life Expiration	X
Facility/Equip Upgrade		Condition Assessment	
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	

Project Cost:				
Capital Costs:				
General			$	5,000
Civil & Mechanical			$	25,000
Structural			$	10,000
Electrical & Controls			$	20,000
Equipment			$	26,000
Capital Cost Subtotal:			**$**	**86,000**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	12,900
CM & ESDC	20 %	of capital costs	$	17,200
Administration	5 %	of capital costs	$	4,300
Soft Cost Subtotal:			**$**	**34,400**
Contingency:				
Contingency	20 %	of project cost	$	17,200
Total Project Cost:			**$**	**138,000**

Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2028	$	15,000
Project Delivery Method:	Design-Bid-Build		2029	$	123,000
Project Duration (Years):	2				

Project No:	**RC - 9.2**			
Project Name:	**Camino Sin Puente Sewer Pump Station #4 Improvements**			
Description:	Install pump station bypass connections, develop emergency response plan in case of a failure, install site lighting for operator safety, install a canopy over electrical gear for operator safety and to protect gear, and install flow meter on pump discharge. Additionally, replace Hydromatic pumps to District preferred Myers pumps and install double-leaf access hatches to wet well, emergency storage, and valve vault instead of manholes.			
Priority:	40			
Location/Facility:	Rancho Cielo Collection System			

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement		Predicted Useful Life Expiration	
Facility/Equip Upgrade	X	Condition Assessment	X
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	X

Project Cost:				
Capital Costs:				
General			$	5,000
Civil & Mechanical			$	23,760
Structural			$	-
Electrical & Controls			$	49,500
Equipment			$	-
Capital Cost Subtotal:			**$**	**78,260**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	11,739
CM & ESDC	20 %	of capital costs	$	15,652
Administration	5 %	of capital costs	$	3,913
Soft Cost Subtotal:			**$**	**31,304**
Contingency:				
Contingency	20 %	of project cost	$	15,652
Total Project Cost:			**$**	**125,000**

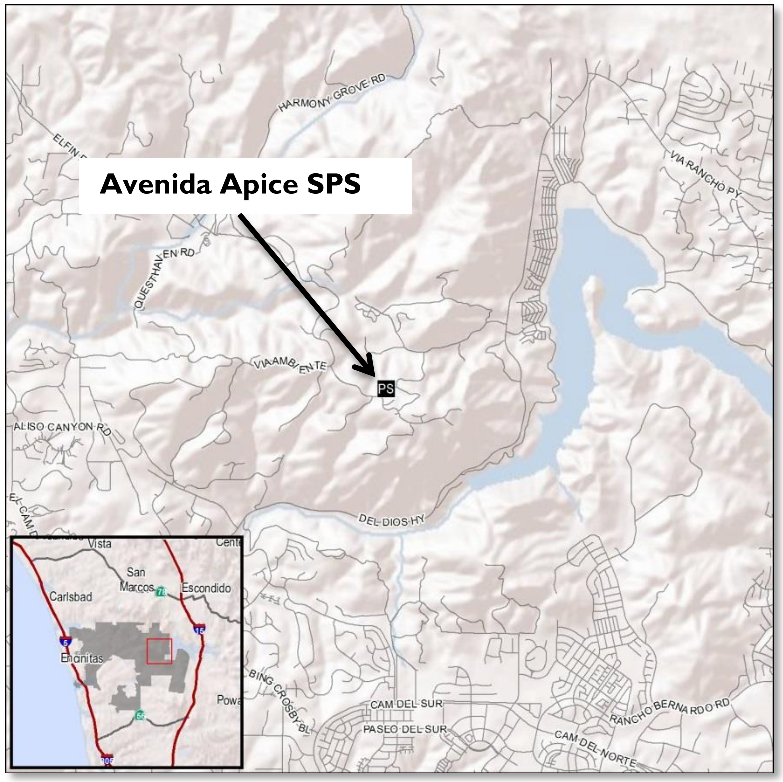
Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2022	$	125,000
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	1				

4.2.9 Avenida Apice Sewer Pump Station Improvements

Background

The Avenida Apice Sewer Pump Station is a submersible facility located along Avenida Apice. The pump station was designed by PBS&J and was constructed in 2008. It consists of a 7-foot diameter by 16-foot deep precast concrete operational wet well. An 8-foot by 16-foot precast construct structure serves as an emergency storage vault. The submersible pumps are duplex 3-hp grinder type pumps. Figure 4-9 to the right shows the Avenida Apice sewer pump station location.

Figure 4-9. Avenida Apice SPS Location



Project Needs

The pump station is in excellent condition, is well-maintained, and the major equipment in the pump station is expected to last beyond the CIP timeframe. However, minor improvement projects are recommended to mitigate risk and improve operations and maintenance efforts.

Projects

Capital improvement projects identified for the Avenida Apice sewer pump station are summarized in Table 4-11.

Table 4-11. Avenida Apice Sewer Pump Station Improvements Projects

Projects	Cost
RC – 10.0, Avenida Apice Sewer Pump Station Improvements	$58,000

Project No:	**RC - 10.0**		
Project Name:	**Avenida Apice Sewer Pump Station Improvements**		
Description:	Install pump station bypass connections, develop emergency response plan in case of a failure, install site lighting for operator safety, install a canopy over electrical gear for operator safety and to protect gear, replace PVC pump discharge piping with flanged ductile iron (ceramic epoxy lined) or 316 stainless steel pipe, and install flow meter on pump discharge.		
Priority:	35		
Location/Facility:	Rancho Cielo Collection System		

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement		Predicted Useful Life Expiration	
Facility/Equip Upgrade	X	Condition Assessment	X
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	X

Project Cost:			
Capital Costs:			
General			$ 5,000
Civil & Mechanical			$ 31,350
Structural			$ -
Electrical & Controls			$ -
Equipment			$ -
Capital Cost Subtotal:			**$ 36,350**
Soft Costs:			
Classification 'C'			
Engineering	15 %	of capital costs	$ 5,453
CM & ESDC	20 %	of capital costs	$ 7,270
Administration	5 %	of capital costs	$ 1,818
Soft Cost Subtotal:			**$ 14,540**
Contingency:			
Contingency	20 %	of project cost	$ 7,270
Total Project Cost:			**$ 58,000**

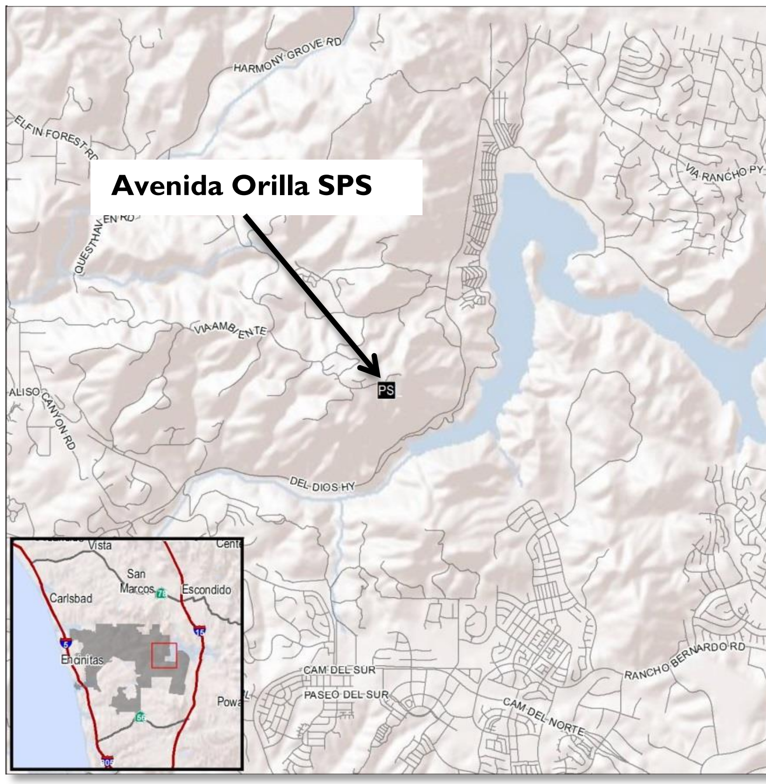
Project Implementation (Schedule & Expenditure Timeline)				
Project Implementation:	One-Time Project	Expenditures:	2023	$ 58,000
Project Delivery Method:	Design-Bid-Build			
Project Duration (Years):	1			

4.2.10 Avenida Orilla Sewer Pump Station Improvements

Background

The Avenida Orilla Sewer Pump Station is a submersible facility located along Avenida Orilla. The pump station was designed by PBS&J and was constructed in 2008, however, the sewer pump station has not yet been operated despite completed construction. At the time of this report, the District has not yet received possession of the pump station. It consists of a 7-foot diameter by 16-foot deep precast concrete operational wet well. An 8-foot by 14-foot precast construct structure serves as an emergency storage vault. The submersible pumps are duplex 10-hp grinder type pumps. Figure 4-10 to the right shows the Avenida Orilla sewer pump station location.

Figure 4-10. Avenida Orilla SPS Location Map



Project Needs

The pump station is brand new and in excellent condition. The major equipment in the pump station is expected to last beyond the CIP timeframe. However, minor improvement projects are recommended to mitigate risk and improve future operations and maintenance efforts.

Projects

Capital improvement projects identified for the Avenida Orilla sewer pump station are summarized in Table 4-12.

Table 4-12. Avenida Orilla Sewer Pump Station Improvements Projects

Projects	Cost
RC – 11.0, Avenida Orilla Sewer Pump Station Improvements	$58,000

Project No:	**RC - 11.0**			
Project Name:	**Avenida Orilla Sewer Pump Station Improvements**			
Description:	Install pump station bypass connections, develop emergency response plan in case of a failure, install site lighting for operator safety, install a canopy over electrical gear for operator safety and to protect gear, replace PVC pump discharge piping with flanged ductile iron (ceramic epoxy lined) or 316 stainless steel pipe, and install flow meter on pump discharge.			
Priority:	35			
Location/Facility:	Rancho Cielo Collection System			

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement		Predicted Useful Life Expiration	
Facility/Equip Upgrade	X	Condition Assessment	X
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	X

Project Cost:				
Capital Costs:				
General			$	5,000
Civil & Mechanical			$	31,350
Structural			$	-
Electrical & Controls			$	-
Equipment			$	-
Capital Cost Subtotal:			**$**	**36,350**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	5,453
CM & ESDC	20 %	of capital costs	$	7,270
Administration	5 %	of capital costs	$	1,818
Soft Cost Subtotal:			**$**	**14,540**
Contingency:				
Contingency	20 %	of project cost	$	7,270
Total Project Cost:			**$**	**58,000**

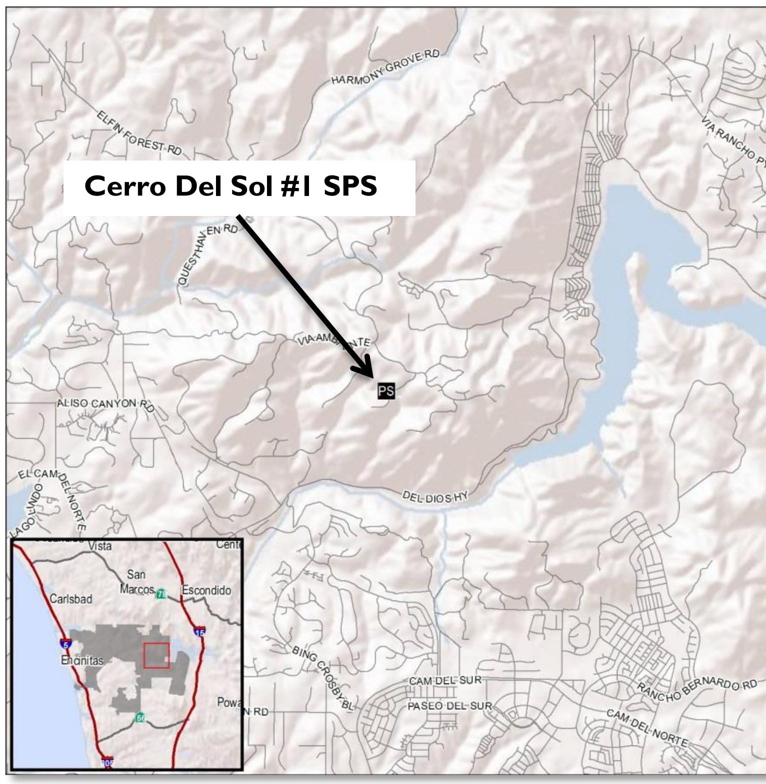
Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2023	$	58,000
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	1				

4.2.11 Cerro Del Sol #1 Sewer Pump Station Improvements

Background

The Cerro Del Sol #1 Sewer Pump Station is a submersible facility located along Cerro Del Sol. The pump station was designed by PBS&J and was constructed in 2008. It consists of a 7-foot diameter by 16-foot deep precast concrete operational wet well. Two 8-foot by 20-foot precast construct structures serve as emergency storage vaults for Cerro Del Sol #1 and Cerro Del Sol #2 sewer pump stations. The submersible pumps are duplex 10-hp grinder type pumps. Figure 4-11 to the right shows the Cerro Del Sol #1 sewer pump station location.

Figure 4-11. Cerro Del Sol #1 SPS Location Map



Project Needs

The pump station is in excellent condition, is well-maintained, and the major equipment in the pump station is expected to last beyond the CIP timeframe. However, minor improvement projects are recommended to mitigate risk and improve operations and maintenance efforts.

Projects

Capital improvement projects identified for the Cerro Del Sol #1 sewer pump station are summarized in Table 4-13.

Table 4-13. Cerro Del Sol #1 Sewer Pump Station Improvements Projects

Projects	Cost
RC – 12.0, Cerro Del Sol #1 Sewer Pump Station Improvements	$103,000

Project No:	**RC - 12.0**
Project Name:	**Cerro Del Sol #1 Sewer Pump Station Improvements**
Description:	Install pump station bypass connections, develop emergency response plan in case of a failure, install site lighting for operator safety, install a canopy over electrical gear for operator safety and to protect gear, replace PVC pump discharge piping with flanged ductile iron (ceramic epoxy lined) or 316 stainless steel pipe, and install flow meter on pump discharge. Additionally, pave site with concrete and install slow closing solenoids for make-up water to alleviate slamming of the backflow preventers and resulting seal damage.
Priority:	35
Location/Facility:	Rancho Cielo Collection System

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement		Predicted Useful Life Expiration	
Facility/Equip Upgrade	X	Condition Assessment	X
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	X

Project Cost:				
Capital Costs:				
General			$	5,000
Civil & Mechanical			$	59,400
Structural			$	-
Electrical & Controls			$	-
Equipment			$	-
Capital Cost Subtotal:			**$**	**64,400**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	9,660
CM & ESDC	20 %	of capital costs	$	12,880
Administration	5 %	of capital costs	$	3,220
Soft Cost Subtotal:			**$**	**25,760**
Contingency:				
Contingency	20 %	of project cost	$	12,880
Total Project Cost:			**$**	**103,000**

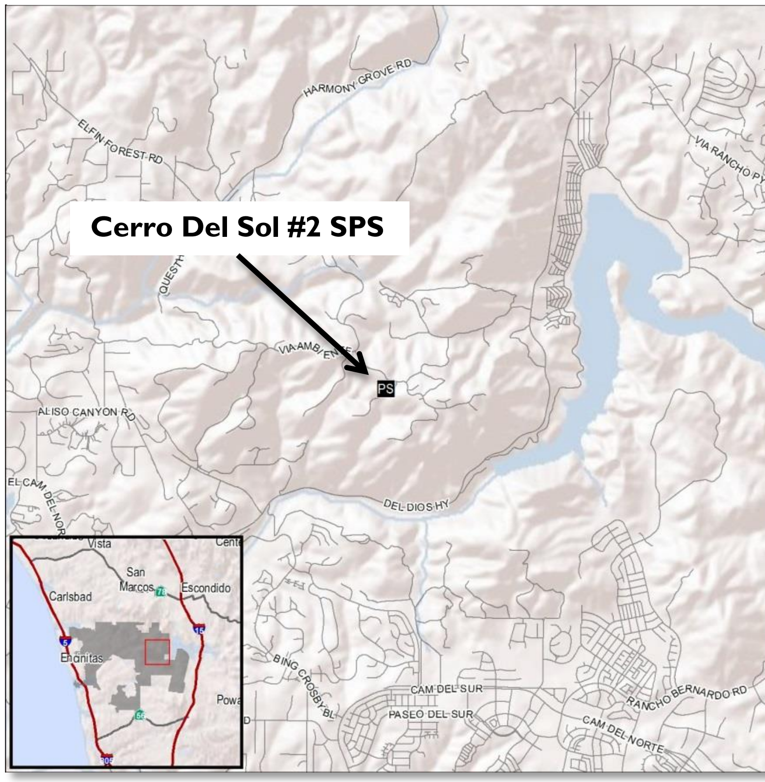
Project Implementation (Schedule & Expenditure Timeline)					
Project Implementation:	One-Time Project	Expenditures:	2023	$	103,000
Project Delivery Method:	Design-Bid-Build				
Project Duration (Years):	1				

4.2.12 Cerro Del Sol #2 Sewer Pump Station Improvements

Background

The Cerro Del Sol #2 Sewer Pump Station is a submersible facility located along Cerro Del Sol. The pump station was designed by PBS&J and was constructed in 2008. It consists of a 7-foot diameter by 16-foot deep precast concrete operational wet well. No emergency storage is maintained on site; however, the pump station was designed to backflow to emergency storage vaults maintained at the Cerro Del Sol #1 sewer pump station in a failure scenario. The submersible pumps are triplex 10-hp grinder type pumps. Figure 4-12 shows the Cerro Del Sol #2 sewer pump station location.

Figure 4-12. Cerro Del Sol #2 SPS Location Map



Project Needs

The pump station is in excellent condition, is well-maintained, and the major equipment in the pump station is expected to last beyond the CIP timeframe. However, minor improvement projects are recommended to mitigate risk and improve operations and maintenance efforts.

Projects

Capital improvement projects identified for the Cerro Del Sol #2 sewer pump station are summarized in Table 4-14.

Table 4-14. Cerro Del Sol #2 Sewer Pump Station Improvements Projects

Projects	Cost
RC – 13.0, Cerro Del Sol #2 Sewer Pump Station Improvements	

Project No:	**RC - 13.0**		
Project Name:	**Cerro Del Sol #2 Sewer Pump Station Improvements**		
Description:	Install pump station bypass connections, develop emergency response plan in case of a failure, install site lighting for operator safety, install a canopy over electrical gear for operator safety and to protect gear, replace PVC pump discharge piping with flanged ductile iron (ceramic epoxy lined) or 316 stainless steel pipe, and install flow meter on pump discharge. Additionally, pave site with concrete and install slow closing solenoids for make-up water to alleviate slamming of the backflow preventers and resulting seal damage.		
Priority:	40		
Location/Facility:	Rancho Cielo Collection System		

Project Type:		**Origin(s) of Project:**	
Rehab/Replacement		Predicted Useful Life Expiration	
Facility/Equip Upgrade	X	Condition Assessment	X
Engineering Study		Operations Assessment	
Expansion		Failure Modes & Consequences	X

Project Cost:

Capital Costs:				
General			$	5,000
Civil & Mechanical			$	59,400
Structural			$	-
Electrical & Controls			$	-
Equipment			$	-
Capital Cost Subtotal:			**$**	**64,400**
Soft Costs:				
Classification 'C'				
Engineering	15 %	of capital costs	$	9,660
CM & ESDC	20 %	of capital costs	$	12,880
Administration	5 %	of capital costs	$	3,220
Soft Cost Subtotal:			**$**	**25,760**
Contingency:				
Contingency	20 %	of project cost	$	12,880
Total Project Cost:			**$**	**103,000**

Project Implementation (Schedule & Expenditure Timeline)

Project Implementation:	One-Time Project	Expenditures:	2029	$	11,000
Project Delivery Method:	Design-Bid-Build		2030	$	92,000
Project Duration (Years):	2				

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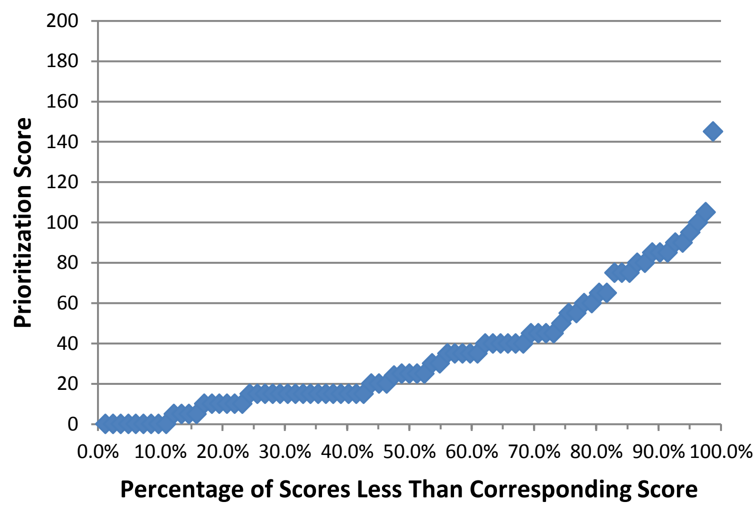
5 IMPLEMENTATION PLAN

5.1 Prioritized Scheduling

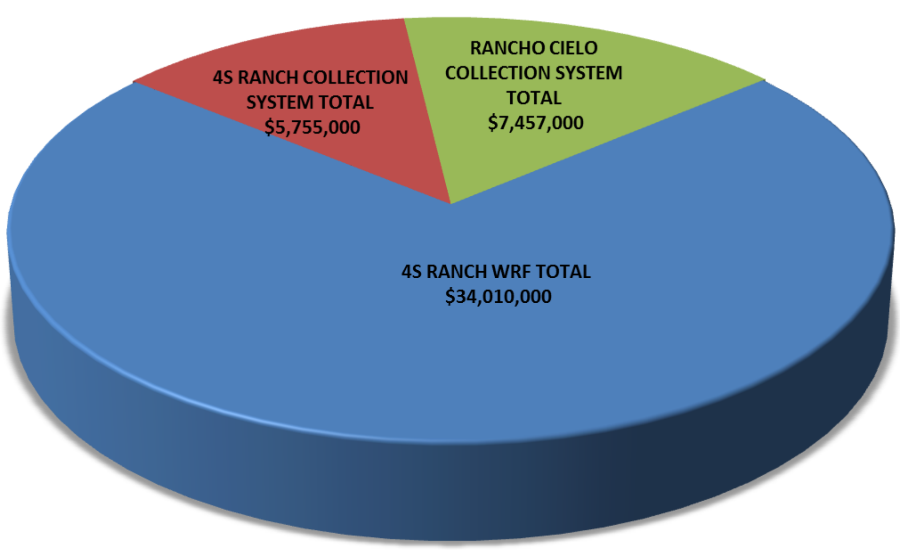
Figure 5-1. Priority Scores Distribution Plot



Using the prioritization factors described in Chapter 1, a summed priority score was derived for each defined CIP project. The summed priority score is presented in the individual project description pages of Chapters 2, 3, and 4. While the priority scale ranges from 0 to 200, of the 80 defined projects, 60 of them (75%) received priority scores of 50 or less. The highest priority projects, defined as the top quartile, received scores between 55 and 145. These projects are scheduled to be completed in the first five years of the program. Figure 5-1 presents the priority scores distribution plot to illustrate the range and relative priorities of the defined projects.

5.2 CIP Cost Distribution

Figure 5-2. Capital Improvement Plan Annualized Budget



The 20-year CIP includes a total project value of $47.2 million. Figure 5-2 presents the distribution of CIP budget between the three service area cost centers: 4S Ranch WRF, 4S Ranch Collection System, and Rancho Cielo Collection System. The 4S Ranch WRF represents 73% of the total CIP with Rancho Cielo and 4S Ranch Collection systems accounting for approximately 15% and 12%, respectively.

Figure 5-3 presents the year-to-year capital budget for the 10-year CIP, and the average annual budget for the 10-20-year CIP. Due to several high-priority CIP projects planned for implementation in the next several years, the CIP appears to be somewhat front-loaded with approximately $15.8 million (approximately 33%) of the total 20-year CIP programmed for the first 5 years. The first five years of the CIP results an average annual cost of $3.2 million compared with the 10-year average annual cost of $2.4 million and the 20-year average annual cost of $2.4 million. The total number of projects in each year is also provided along the top of the bar chart, showing a relatively consistent number of projects, averaging 4 per year for the 20-year CIP.

Figure 5-3. Capital Improvement Plan Annualized Budget by Cost Center

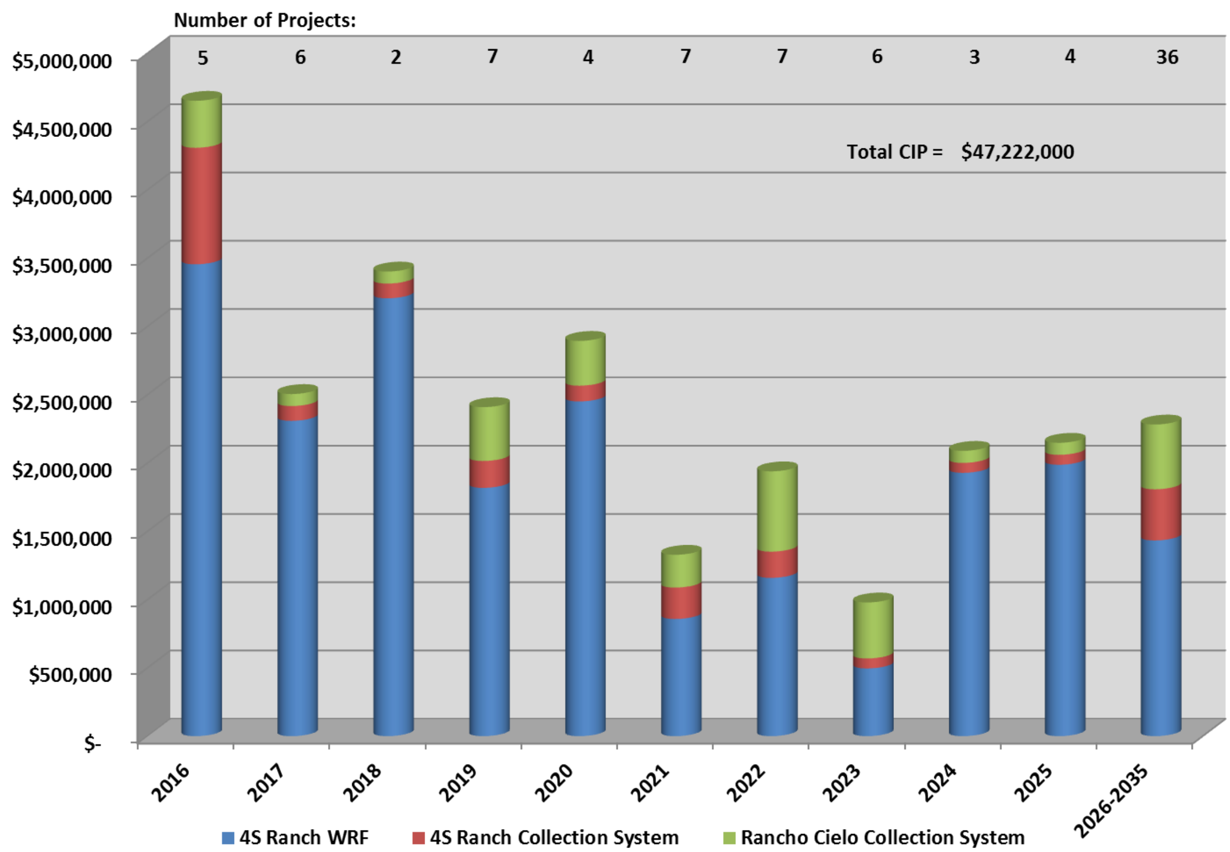
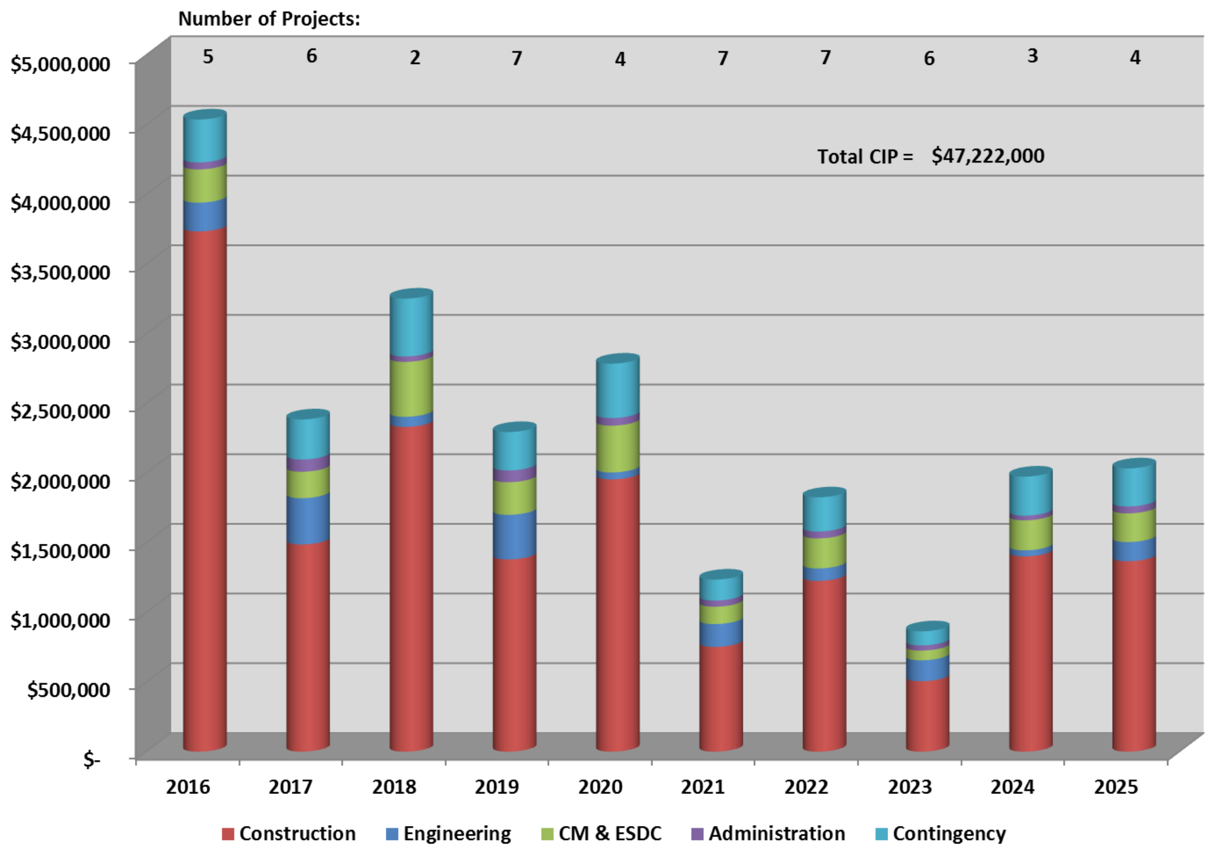


Figure 5-4 presents 10-year CIP with annualized project phase costs – e.g., engineering, construction, construction support services and administrative costs. This graph shows a surge of construction-phase projects in the first several years due to backlog of projects ready to be constructed. The number of projects in a given year is again presented at the top of the bar chart. As the number of projects is relatively consistent, averaging 5 per year for the first 10-year period, the annual variability in project costs can be attributed to construction activity and the scale of specific projects.

Figure 5-4. Capital Improvement Plan Annualized Budget by Phase



Project costs are presented and distributed for each project according to priority ranking and anticipated implementation schedule. The CIP implementation schedule for the 4S Ranch WRF, 4S Ranch Collection System, and Rancho Cielo Collection System projects is presented in Table 5-1, Table 5-2 and Table 5-3, respectively.

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Table 5-1. 4S Ranch WRF 20-year CIP

Project No.	Project Name	Priority	Total Cost	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026-2035
4S Ranch Water Reclamation Facility (WRF) CIP Project List														
WRF - 9.1	Upgrade UV Disinfection System	145	$ 2,163,000	$ 1,658,000	$ 505,000									
WRF - 7.1	Upgrade Flow Equalization Basins	105	$ 789,000	$ 789,000										
WRF - 11.2	Overflow Pond Upgrades	95	$ 948,000	$ 624,000	$ 324,000									
WRF - 8.0	Replace Tertiary Filters	90	$ 3,825,000		$ 329,000	$ 2,772,000	$ 724,000							
WRF - 11.4	Replace Overflow Pond Strainer	85	$ 191,000		$ 191,000									
WRF - 1.1	Replace Existing Headworks Screenings Equipment	85	$ 576,000		$ 576,000									
WRF - 2.1	Biological Treatment Upgrade (Process Study & Pre-Design)	80	$ 50,000			$ 50,000								
WRF - 2.2	Upgrade Plant B Oxidation Ditch Aeration System	80	$ 960,000				$ 525,000	$ 435,000						
WRF - 6.1	Dewatering Technology Study (Process Study and Pre-Design)	65	$ 50,000				$ 50,000							
WRF - 6.2	Upgrade Dewatering System	65	$ 1,766,000				$ 135,000	$ 1,632,000						
WRF - 5.1	Replace Existing 150 HP Digester Blower	60	$ 229,000						$ 229,000					
WRF - 5.2	Replace Existing 75 HP Digester Blower	60	$ 159,000						$ 159,000					
WRF - 1.2	Retrofit Existing Headworks Structure to Install Redundant Screenings Equipment	50	$ 784,000						$ 86,000	$ 698,000				
WRF - 6.4	Replace Caustic and Polymer Tanks	40	$ 77,000							$ 77,000				
WRF - 3.0	Replace Plant B Secondary Clarifier Equipment	35	$ 976,000								$ 61,000	$ 915,000		
WRF - 1.3	Replace Existing Headworks Grit Handling Equipment	30	$ 464,000								$ 51,000	$ 413,000		
WRF - 7.2	Cover Flow Equalization Basins	30	$ 216,000									$ 216,000		
WRF - 1.4	Upgrade Headworks Odor Control Scrubber	25	$ 713,000										$ 713,000	
WRF - 6.3	Upgrade Solids Dewatering Building Odor Control Scrubber	25	$ 635,000										$ 635,000	
WRF - 16.0	Paving Maintenance and Improvements	25	$ 225,000										$ 113,000	$ 113,000
WRF - 17.0	Replace Vehicles in Fleet	25	$ 569,000										$ 142,000	$ 427,000
WRF - 6.5	Upgrade Existing WRF Electrical Gear	24	$ 3,840,000											$ 3,840,000
WRF - 11.1	Replace Existing Recycled Water Pump Station Pumps	20	$ 515,000											$ 516,000
WRF - 5.3	Replace Existing Digester Diffusers	20	$ 205,000											$ 205,000
WRF - 13.0	Replace Emergency Generator	20	$ 670,000											$ 670,000
WRF - 4.0	Replace Non-Potable Water Pumps	15	$ 268,000											$ 268,000
WRF - 11.3	Rehabilitate Overflow Pond Pump Station	15	$ 1,503,000											$ 1,503,000
WRF - 9.2	Upgrade Disinfection System	5	$ 2,148,000											$ 2,148,000
WRF - 10.0	Upgrade SCADA Control System	5	$ 800,000											$ 800,000
WRF - 2.3	Plant A Rehabilitation and On-Going Maintenance	0	$ 2,325,000	$ 116,000	$ 116,000	$ 116,000	$ 116,000	$ 116,000	$ 116,000	$ 116,000	$ 116,000	$ 116,000	$ 116,000	$ 1,160,000
WRF - 18.1	Valve and Gate Replacement Program	0	$ 945,000	$ 47,000	$ 47,000	$ 47,000	$ 47,000	$ 47,000	$ 47,000	$ 47,000	$ 47,000	$ 47,000	$ 47,000	$ 470,000
WRF - 18.2	Small Pump and Motor Replacement Program	0	$ 2,748,000	$ 137,000	$ 137,000	$ 137,000	$ 137,000	$ 137,000	$ 137,000	$ 137,000	$ 137,000	$ 137,000	$ 137,000	$ 1,370,000
WRF - 18.3	Instrumentation Replacement Program	0	$ 1,401,000	$ 70,000	$ 70,000	$ 70,000	$ 70,000	$ 70,000	$ 70,000	$ 70,000	$ 70,000	$ 70,000	$ 70,000	$ 700,000
WRF - 18.4	Miscellaneous Equipment Replacement Program	0	$ 172,000	$ 9,000	$ 9,000	$ 9,000	$ 9,000	$ 9,000	$ 9,000	$ 9,000	$ 9,000	$ 9,000	$ 9,000	$ 90,000
WRF - 18.5	Mechanical and Yard Piping Replacement Program	0	$ 105,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 50,000
35	4S RANCH WRF TOTAL		$ 34,010,000	$ 3,455,000	$ 2,309,000	$ 3,206,000	$ 1,818,000	$ 2,451,000	$ 858,000	$ 1,159,000	$ 496,000	$ 1,928,000	$ 1,987,000	$ 14,330,000

Table 5-2. 4S Ranch Collection System 20-year CIP

Project No.	Project Name	Priority	Total Cost		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026-2035
4S Ranch Collection System CIP Project List															
4S - 5.0	Upgrade Neighborhood #1 Sewer Pump Station	100	$ 780,000		$ 780,000										
4S - 4.0	CIPP Line Root Impacted Hot Spot Collection System Pipe	85	$ 35,000			$ 35,000									
4S - 6.5	Neighborhood #3 Sewer Pump Station Improvements	75	$ 124,000					$ 124,000							
4S - 2.0	Line Manholes Subject to High H2S Exposure	55	$ 48,000						$ 42,000						
4S - 3.1	Special Inspection of Lined Manholes	45	$ 59,000							$ 17,000					$ 34,000
4S - 3.2	Re-Line Manholes Recommended from Special Inspection	45	$ 424,000							$ 140,000					$ 284,000
4S - 8.2	Santaluz Sewer Pump Station Improvements	40	$ 119,000								$ 119,000				
4S - 6.1	Replace Pumps in the Neighborhood #3 Sewer Pump Station	15	$ 495,000												$ 495,000
4S - 6.2	Replace the Neighborhood #3 Sewer Pump Station Emergency Generator	15	$ 288,000												$ 288,000
4S - 6.3	Upgrade Electrical Gear at the Neighborhood #3 Sewer Pump Station	15	$ 336,000												$ 336,000
4S - 6.4	Upgrade SCADA Control System at the Neighborhood #3 Sewer Pump Station	15	$ 80,000												$ 80,000
4S - 7.5	Fire House Sewer Pump Station Improvements	15	$ 231,000												$ 231,000
4S - 8.1	Replace Santaluz Sewer Pump Station	15	$ 198,000												$ 199,000
4S - 7.1	Replace Pumps in the Fire House Sewer Pump Station	10	$ 364,000												$ 364,000
4S - 7.2	Replace the Fire House Sewer Pump Station Emergency Generator	10	$ 288,000												$ 288,000
4S - 7.3	Upgrade Electrical gear at the Fire House Sewer Pump Station	5	$ 336,000												$ 336,000
4S - 7.4	Upgrade the SCADA Control System at the Fire House Sewer Pump Station	5	$ 80,000												$ 80,000
4S - 1.0	Collection System Pipe Rehabilitation and Replacement	0	$ 1,470,000		$ 73,000	$ 73,000	$ 73,000	$ 73,000	$ 73,000	$ 73,000	$ 73,000	$ 73,000	$ 73,000	$ 73,000	$ 730,000
18	**4S RANCH COLLECTION SYSTEM TOTAL**		**$ 5,755,000**		**$ 853,000**	**$ 108,000**	**$ 73,000**	**$ 197,000**	**$ 115,000**	**$ 230,000**	**$ 192,000**	**$ 73,000**	**$ 73,000**	**$ 73,000**	**$ 3,745,000**

Table 5-3. Rancho Cielo Collection System 20-year CIP

Project No.	Project Name	Priority	Total Cost		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026-2035
Rancho Cielo Collection System CIP Project List															
RC - 4.5	Odor Control Improvements at Midpoint SPS	90	$ 256,000		$ 256,000										
RC - 4.6	Midpoint Sewer Pump Station Improvements	75	$ 174,000					$ 174,000							
RC - 5.5	Del Dios Sewer Pump Station Improvements	75	$ 132,000					$ 132,000							
RC - 2.0	Line Manholes Subject to high H2S exposure	55	$ 240,000						$ 240,000						
RC - 3.1	Special Inspection of Lined Manholes	45	$ 67,000							$ 22,000					$ 45,000
RC - 3.2	Re-Line Manholes Recommended from Special Inspection	45	$ 453,000							$ 130,000					$ 264,000
RC - 6.2	Camino Sin Puente Sewer Pump Station #1 Improvements	40	$ 125,000								$ 125,000				
RC - 7.2	Camino Sin Puente Sewer Pump Station #2 Improvements	40	$ 125,000								$ 125,000				
RC - 8.2	Camino Sin Puente Sewer Pump Station #3 Improvements	40	$ 125,000								$ 125,000				
RC - 9.2	Camino Sin Puente Sewer Pump Station #4 Improvements	40	$ 125,000								$ 125,000				
RC - 10.0	Avenida Apice Sewer Pump Station Improvements	35	$ 58,000									$ 58,000			
RC - 11.0	Avenida Orilla Sewer Pump Station Improvements	35	$ 58,000									$ 58,000			
RC - 12.0	Cerro Del Sol #1 Sewer Pump Station Improvements	35	$ 103,000									$ 103,000			
RC - 13.0	Cerro Del Sol #2 Sewer Pump Station Improvements	35	$ 103,000									$ 103,000			
RC - 5.1	Replace Pumps in the Del Dios Sewer Pump Station	15	$ 999,000												$ 999,000
RC - 5.2	Replace the Del Dios Sewer Pump Station Emergency Generator	15	$ 288,000												$ 288,000
RC - 5.3	Upgrade Electrical gear at the Del Dios Sewer Pump Station	15	$ 320,000												$ 320,000
RC - 5.4	Upgrade SCADA Control System at the Del Dios Sewer Pump Station	15	$ 80,000												$ 80,000
RC - 6.1	Replace Camino Sin Puente Sewer Pump Station #1	15	$ 138,000												$ 138,000
RC - 7.1	Replace Camino Sin Puente Sewer Pump Station #2	15	$ 138,000												$ 138,000
RC - 8.1	Replace Camino Sin Puente Sewer Pump Station #3	15	$ 138,000												$ 138,000
RC - 9.1	Replace Camino Sin Puente Sewer Pump Station #4	15	$ 138,000												$ 138,000
RC - 4.1	Replace Pumps in the Midpoint Sewer Pump Station	10	$ 644,000												$ 644,000
RC - 4.2	Replace the Midpoint Sewer Pump Station Emergency Generator	10	$ 272,000												$ 272,000
RC - 4.3	Upgrade Electrical gear at the Midpoint Sewer Pump Station	10	$ 320,000												$ 320,000
RC - 4.4	Upgrade the SCADA control system at the Midpoint Sewer Pump Station	10	$ 80,000												$ 80,000
RC - 1.0	Collection System Pipe Rehabilitation and Replacement	0	$ 1,758,000		$ 88,000	$ 88,000	$ 88,000	$ 88,000	$ 88,000	$ 88,000	$ 88,000	$ 88,000	$ 88,000	$ 88,000	$ 880,000
27	**RANCHO CIELO COLLECTION SYSTEM TOTAL**		$ 7,457,000		$ 344,000	$ 88,000	$ 88,000	$ 394,000	$ 328,000	$ 240,000	$ 588,000	$ 410,000	$ 88,000	$ 88,000	$ 4,744,000

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F I N A L

APPENDICIES TO
CAPITAL IMPROVEMENT PLAN
FOR
4S RANCH AND RANCHO CIELO
WASTEWATER SYSTEMS

Prepared for:

Olivenhain Municipal Water District
1966 Olivenhain Road
Encinitas, CA 92024
Contact: George Briest, PE

Prepared by:

DUDEK
605 Third Street
Encinitas, California 92024
Contact: Tom Falk, PE

SEPTEMBER 2015

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APPENDIX A

TM1 – Asset Inventory and Protocols

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TECHNICAL MEMORANDUM #1

To: George Briest, Olivenhain Municipal Water District

Author(s): Phil Giori

Reviewer(s): Tom Falk, P.E.

Date: December, 2014

Subject: Operations and Condition Assessment and Capital Improvement Plan - Asset Inventory and Protocols

1 INTRODUCTION

The Olivenhain Municipal Water District (District) contracted with Dudek to assist with preparation of an Operations and Condition Assessment and Capital Improvement Plan for the 4S Ranch and Rancho Cielo Sanitation Districts that will guide strategic planning and investments for the District's collection, treatment, and reuse programs.

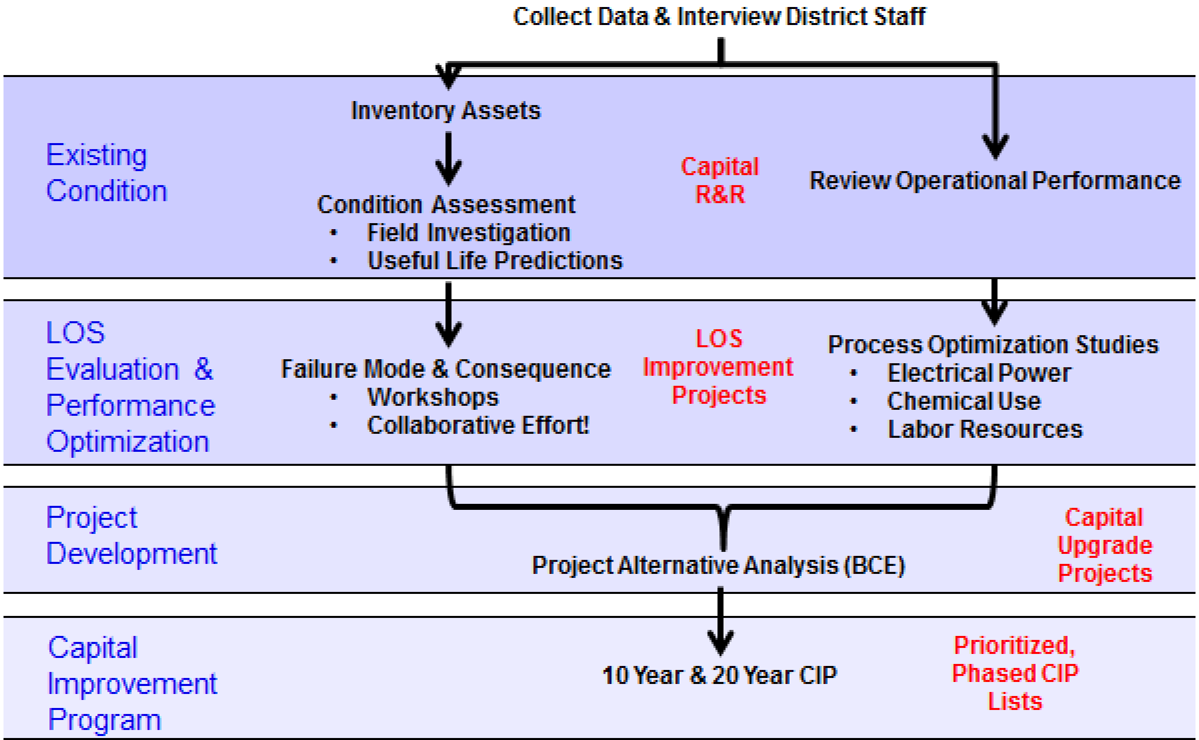
2 DOCUMENT PURPOSE

This Technical Memorandum #1 (TM1) documents the compiled asset list, life expectancy methodology, cost estimating methodology, and approach to the development of a comprehensive capital improvement program.

3 CAPITAL IMPROVEMENT PLAN DEVELOPMENT

The Capital Improvement Plan will be developed through concurrent, parallel processes of data collection and assessments of existing asset condition and evaluation of existing performance and level of service. Figure 1 illustrates the methodology of parallel tracks of evaluation that will identify projects categorized as "rehabilitation and replacement" (R&R) or Level of Service (LOS) improvements. The identified capital upgrade projects will be organized into a project list and then prioritized into phased implementation plans for 10-year and 20-year planning horizons.

Figure 1: Capital Improvement Plan Development Methodology



Based on asset inventory and condition assessments of the wastewater facilities (documented in subsequent Technical Memorandum 2 – Condition Assessment), useful life expectancy will be estimated and capital upgrades identified for rehabilitation and replacement. Useful life expectancy will create a base budget for the CIP, predicting replacement timeframes and costs for specific major assets. When applicable, a project or study associated with an asset or system (group of assets) that offers an improved solution different than simply replacing the asset may be recommended. The protocols for asset inventory, condition assessment, and expected useful life are described in the following sections.

A high level operational analysis will be completed to benchmark the 4S Ranch WRF performance and identify opportunities to optimize efficiency while maintaining the defined level of service. The operational analysis will be focused on energy use, chemical use, odor control, and solids processing. The process evaluation and subsequent capital improvement projects will be developed in subsequent Technical Memorandum 3 – Operations Evaluation.

Following the asset inventory and condition assessment effort, a failure mode and effects analysis (FMEA) workshop will be carried out focused on the treatment plant processes, pump stations, and forcemains to establish LOS goals and to evaluate capital improvements and/or operational changes necessary to mitigate risk and reduce operating costs while maintaining the desired LOS. The LOS goals and FMEA will be documented in subsequent Technical Memorandum 4 – Level of Service.

4 ASSET INVENTORY

4.1 Background

The Olivenhain Municipal Water District was established in 1959 and now provides water, wastewater, and recycled water services to North-San Diego County communities including portions of the City of Carlsbad, City of Encinitas, Cardiff, Olivenhain, La Costa, Fairbanks Ranch, 4S Ranch, Rancho Cielo, and Elfin Forest. The District's Wastewater and Recycled Water Operations include the 4S Ranch Water Reclamation Facility (WRF), 46 miles of recycled water pipeline, and sewer service to 6600 dwellings in 4S Ranch and Rancho Cielo.

4.2 Existing Sewer Collection System

Shown on Figures 2 and 3, the District's collection system was generally constructed since the late 1980s in conjunction with master planned communities of Rancho Cielo (early 2000s) and 4S Ranch (late 1980s). Based on GIS data obtained from the District, the systems are comprised of approximately 347,000 linear feet (almost 66 miles) of gravity mains, 1,215 manholes, approximately 62,600 linear feet of forcemains (12 miles), and 14 pump stations.

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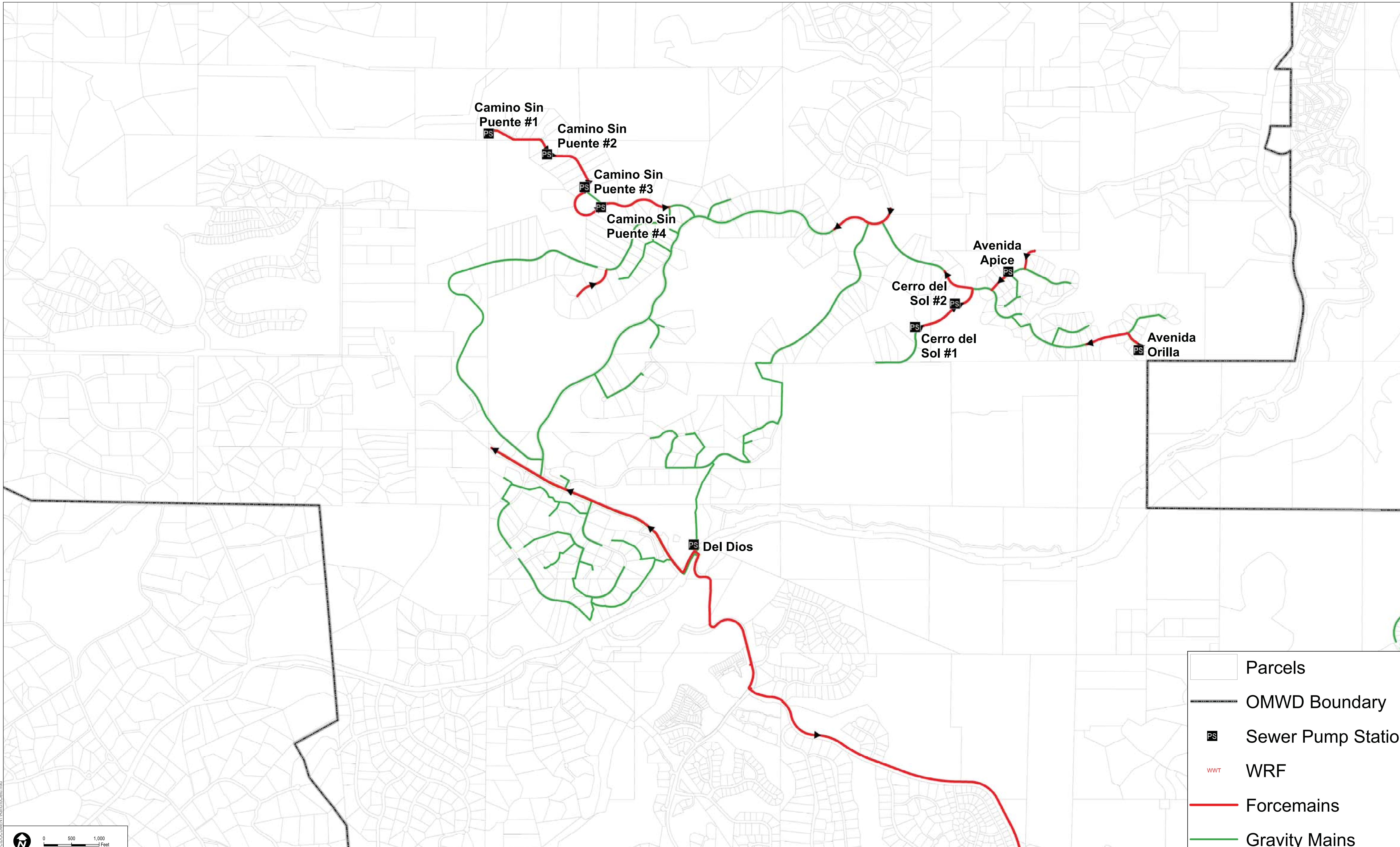

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DECEMBER 2014

SOURCE: OMWD; Bing Aerial

OMWD

FIGURE 2

Rancho Cielo Collection System

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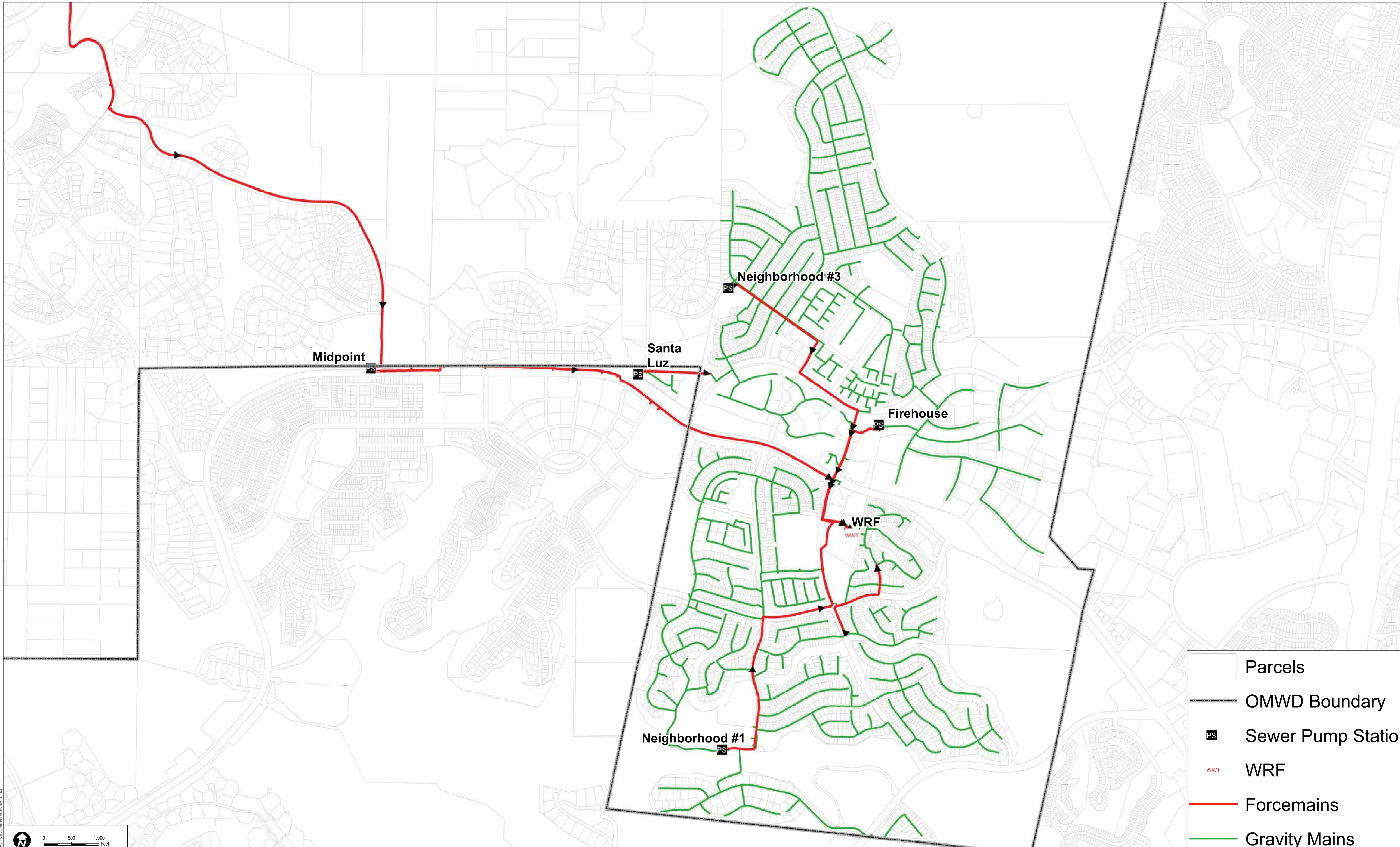

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DECEMBER 2014

SOURCE: OMWD; Bing Aerial

OMWD

FIGURE 3

4S Ranch Collection System

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A review of GIS data indicates that the District's gravity mains range in diameter from 2-inch to 18-inch, although it is believed that 2-inch, 3-inch, and likely 4-inch pipes represent errors in the data. Eighty five percent of the gravity mains are 8-inch diameter and nearly all are PVC pipe (only 5 ductile iron pipes (DIP) are indicated in the GIS data). Figures 4, 5, and 6 illustrate the distribution of pipe diameters, material, and age, respectively, in the Rancho Cielo and 4S Ranch service areas.

Figure 4: Linear Footage of Gravity Mains by Diameter

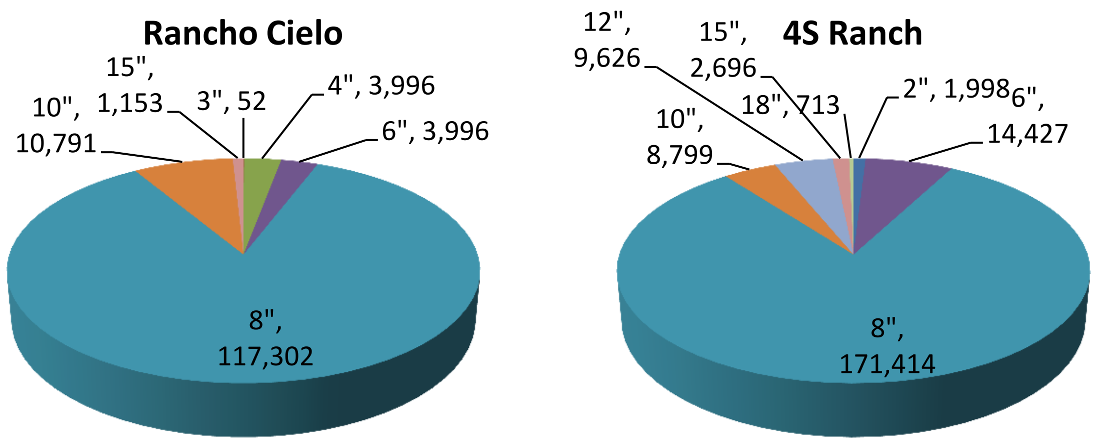


Figure 5: Linear Footage of Gravity Mains by Material

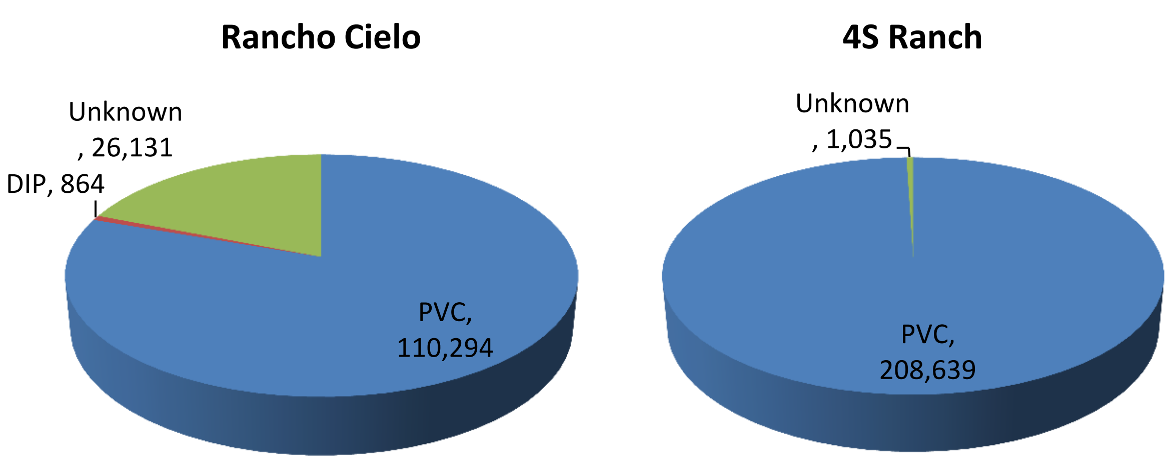
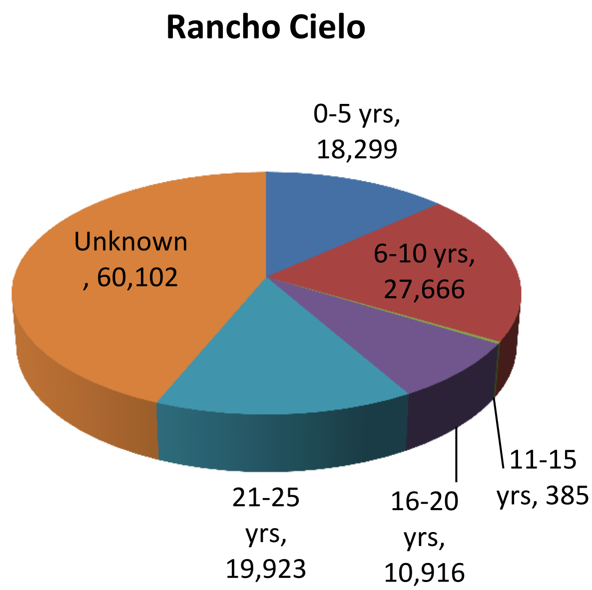


Figure 6: Linear Footage of Gravity Mains by Age



Manhole construction is primarily cast in place concrete base with pre-cast concrete shafts. The interior of some manholes in the collection system are lined with either T-lock PVC or spray on coatings (polyurethane or epoxy). At the time of this writing, Dudek has not obtained an inventory of lined manholes. Dudek will investigate with the District whether this information is readily available for incorporation into the GIS database.

The 14 sewer pump stations operated by the District are summarized in Table 1. Each station was visited by Dudek engineers on November 6th, 2014 to document the condition and operational functionality of key assets. The District's forcemains are summarized in Table 2. They range in diameter from 2-inch to 18-inch and are constructed of either PVC or DIP. Forcemains not associated with a District operated sewer pump station are presumed to collect flow from private lateral pumps/pump stations.

Table 1: OMWD Collection System Sewer Pump Station List

No.	Sewer Pump Station	Capacity			Year Built	Description
		Q (gpm)	H (ft)	HP		
1	Avenida Apice	100	50	3	2008	Wetwell pump station with 2 submersible solids handling pumps in the wetwell. (PBS&J)
2	Avenida Orilla	115	165	10	2008	Wetwell pump station with 2 submersible solids handling pumps in the wetwell. (PBS&J)
3	Camino Sin Puente #1	50	150	7.5	2004	Wetwell pump station with 2 submersible solids handling pumps in the wetwell. (PBS&J)
4	Camino Sin Puente #2	50	150	7.5	2004	Wetwell pump station with 2 submersible solids handling pumps in the wetwell. (PBS&J)
5	Camino Sin Puente #3	50	150	7.5	2004	Wetwell pump station with 2 submersible solids handling pumps in the wetwell. (PBS&J)
6	Camino Sin Puente #4	50	150	7.5	2004	Wetwell pump station with 2 submersible solids handling pumps in the wetwell. (PBS&J)
7	Cerro Del Sol #1	135	150	10	2008	Wetwell pump station with 2 submersible solids handling pumps in the wetwell. (PBS&J)
8	Cerro Del Sol #2	145	120	10	2008	Wetwell pump station with 3 submersible solids handling pumps in the wetwell. (PBS&J)
9	Del Dios	1014	435	125	2005	Wetwell/Pump Room pump station; 2+1 two-stage pumping station. 2 Submersible Pumps in wetwell feed 2 horizontal centrifugal pumps in the Pump Room. (PBS&J)
10	Firehouse	750	120	50	2009	Wetwell/Drywell Pump Station with 2 submersible solids handling pumps in the drywell. (Webb)
11	Midpoint	850	185	75	2005	Wetwell/Drywell Pump Station, 3 vertical solids handling pumps in drywell. (Daniel Boyle)
12	Neighborhood #1	1360	225	125	2001	Wetwell/Pump Room pump station; 2+1 two-stage pumping station. 2 submersible pumps in wetwell feed 2 horizontal centrifugal pumps in the pump room. (MWH)
13	Neighborhood #3	1600	209	150	2004	Wetwell/Drywell Pump Station, 2 horizontal centrifugal solids handling pumps in drywell. (PBS&J)
14	Santaluz	120	45	7.5	2004	Wetwell Pump station with 3 submersible solids handling pumps in the wetwell. (PBS&J)

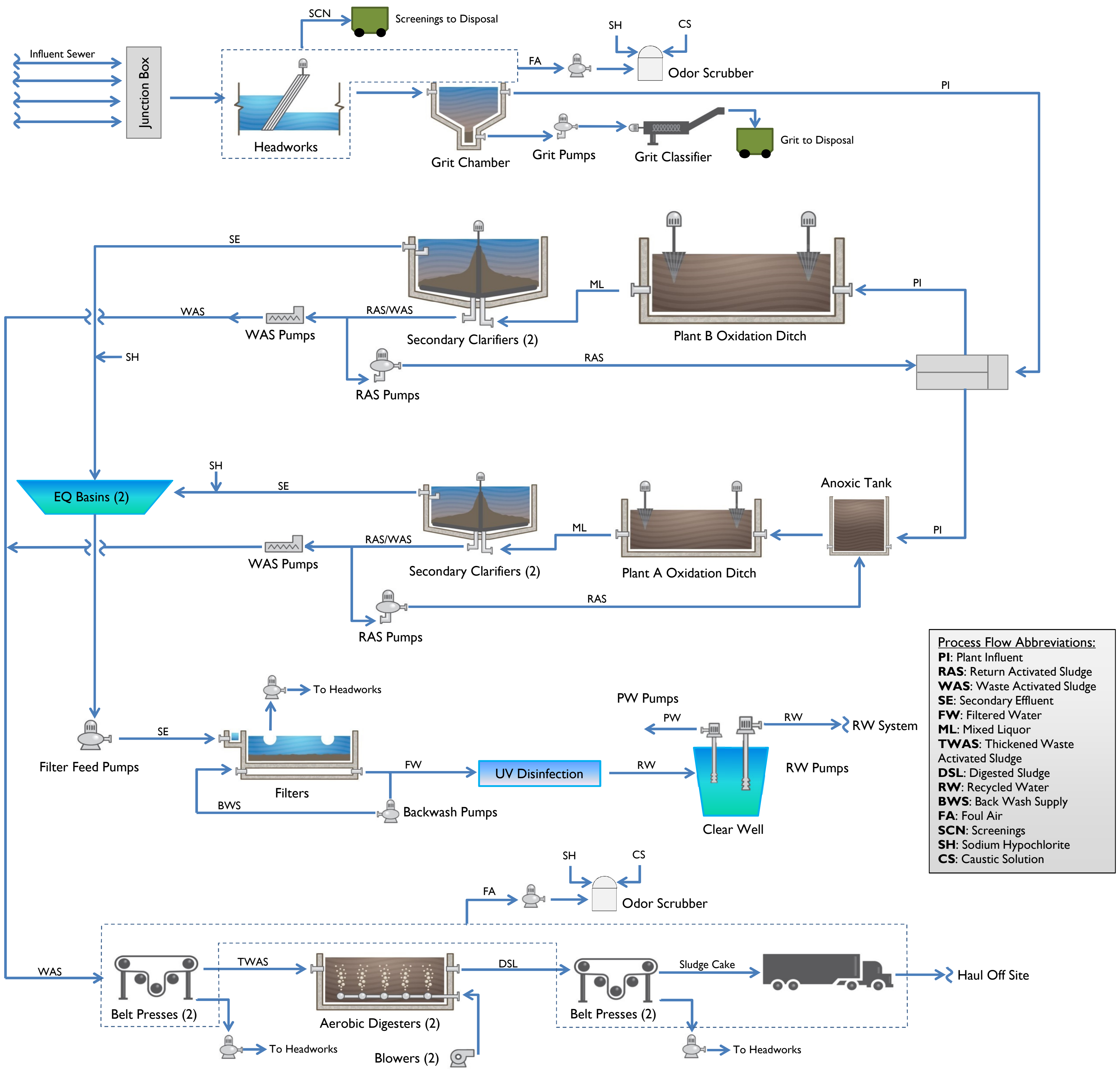
Table 2: Forcemain Summary

Pump Station Forcemain	Diameter (in)	Material	Length (ft)
Avenida Apice	4	PVC	429
Avenida Orilla	3	PVC	1,220
Camino Sin Puente #1	3	PVC	1,260
Camino Sin Puente #2	3	PVC	1,080
Camino Sin Puente #3	3	PVC	1,060
Camino Sin Puente #4	3	PVC	1,310
Cerro del Sol #1	3	PVC	930
Cerro del Sol #2	4	PVC	1,150
Del Dios	12	DIP and PVC	11,660
Firehouse	10	DIP	2,830
Midpoint	12	PVC	10,320
Neighborhood #1	10	PVC	6,160
Neighborhood #3	12	PVC	6,410
Santaluz	4	PVC	1,310

4.3 Existing Wastewater Treatment System

The District treats wastewater collected within its service area at the 4S Ranch Water Reclamation Facility. The 4S Ranch WRF was originally constructed in 1989 and underwent an extensive upgrade in 2002. The WRF currently uses an Oxidation Ditch, Secondary Clarifiers, Filters, and UV Disinfection technology for its main processes. The treatment plant uses a Belt-Press for sludge dewatering. A process-flow-diagram representing the 4S Ranch Water Reclamation Facility is presented in Figure 7.

OMWD 4S Ranch WRF
Process Flow Diagram



DUDEK
Figure 7

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The District utilizes an Enterprise Asset Management program (EAM) to inventory and organize preventative maintenance operations on all of their documented assets. The EAM contains available data for each asset such as: Asset ID, Description, Status, Position, Department, Class, and Commission Date. In some instances, assets included data such as rated horsepower, voltage, etc. Dudek has conducted site visits to assess the general condition of major asset. Desktop Analysis will be conducted to determine expected useful life and develop CIP projects as described herein.

The District exported the asset inventory from the EAM system to an Excel spreadsheet for use in this study. The wastewater system database contains 1,008 registered wastewater assets ranging from pressure gauges to major process equipment. The EAM is used by District staff to document equipment, parts and components, track maintenance, generate work orders for routine O&M, and purchase replacement parts. The EAM serves as a valuable O&M tool for routine maintenance and the asset list will provide the basis for building the asset inventory for this CIP study.

Dudek has reviewed the EAM database which is intentionally focused on maintenance functions, and therefore contains part and component entries that are not relevant to the development of a CIP program. To satisfy the goals of the CIP, Dudek has classified 378 assets as components of a "parent" asset; parts and components will be accounted for and should continue to be monitored and maintained through the District's current Preventative Maintenance program; however, the database will be modified to code these entries as "components" so that they can be filtered out of the CIP development. The remaining 630 assets will be included in the CIP including an individual asset registry for the following assets:

- Process Equipment (e.g., screens, blowers, aerators, clarifier mechanisms, compressors)
- Concrete Structures (e.g., pump stations, wetwells, process tanks)
- Large Pumps and Motors 40 HP and above
- Tanks (e.g., chemical storage)
- Motor Control Centers (MCC)
- Vehicles
- Hoists and Cranes

The EAM system was put into service in 2009 and has been updated as part of the District's current PM procedures. However, the system is still relatively new to the District and does not include every wastewater asset. Dudek cross-referenced the asset registry against the 4S Ranch WRF and pump station record drawings and added 214 assets to the inventory, bringing the asset inventory total up to 844 assets. These additions include omitted process equipment, concrete structures, hoists, cranes, valves, gates, etc. Currently, the District operates using in some cases "parent" or grouping assets, such as "Headworks Valves". In order to develop a complete CIP, Dudek has eliminated these grouping assets from the working Asset Inventory, and added individual line items for each of the omitted minor assets (e.g. valves 4 inches and above). This system is used to better budget for valve replacement in the CIP.

Some of the assets will be included in the CIP and individually budgeted for replacement. Assets with replacement value greater than $50,000 will be the benchmark for an individually budgeted CIP asset while the remaining assets (e.g., valves, pressure gauges, level sensors, small pumps and motors, flow meters, etc.) with individual costs less than $50,000 will be grouped together into categories of assets and rolled into an annual replacement program. This distinction is explained in Table 3.

Table 3: Major vs. Minor Asset Summary

Asset Type	Replacement Value	Engineering Required
Major	> $50,000	Yes
Minor	< $50,000	No

A budget for the general population of each asset category will be developed based on the number of assets in the category and the expected useful life of that type of asset. For Example, the District's asset registry includes 6 analyzers. A cost estimate for replacement will be assigned to the analyzers to represent the average cost. The expected useful life for the average analyzer is determined to be 7 years. The CIP will include the budget based on the cost to replace 0.86 analyzers per year (6 analyzers / 7 year expected life).

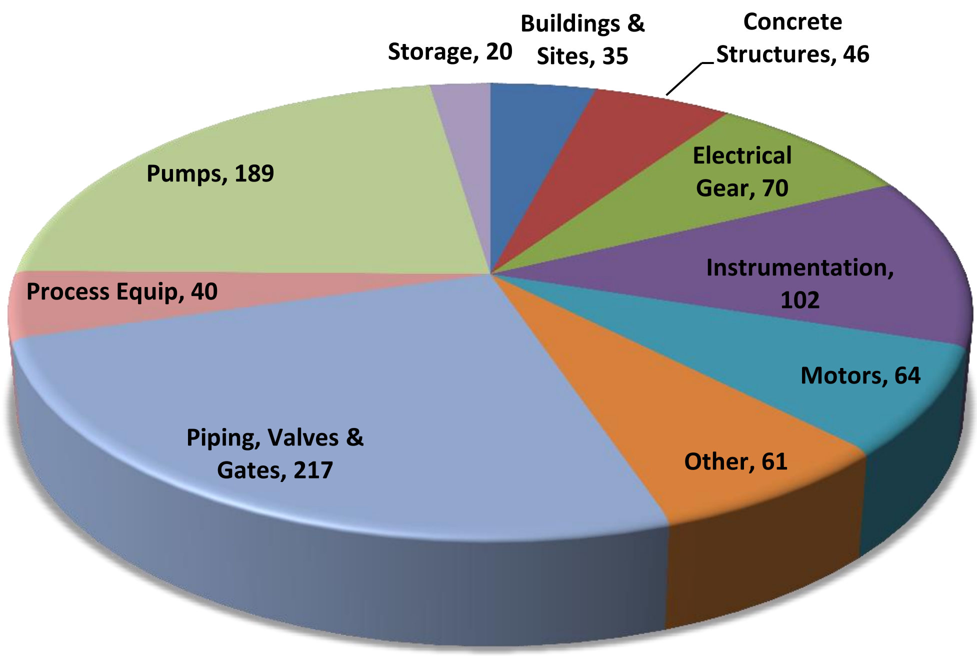
The analyzers are a part of the "Instrumentation" asset category. Although the budget assigned to analyzers is unique, the annual investment to replace analyzers will be combined with the other types of instrumentation to create a more general instrumentation budget. The actual spending by the District relative to the annual budget on replacing instrumentation equipment will be less than the budget in some years, and greater in others, but over time the budget will provide an average savings to accommodate the high and low spending years. As part of the annual budget cycle, the District should review the predicted remaining useful life model, and perform asset-specific assessments in order to ensure proper expenditures.

The asset categories formed to accommodate the District's minor assets will be:

- Collection System
- Electrical Gear
- Instrumentation
- Motors
- Piping, Valves, and Gates
- Pumps
- Storage
- Other

Each category will receive its own annual budget for replacement based on the number and cost of each minor asset that makes up the category, replicating the "analyzers" in "Instrumentation" example from above. These category budgets will provide the District with budgeting guidance for the minor asset system in addition to the major assets to cover the complete scope of the wastewater assets. A breakdown of the number of assets that make up each category is presented in Figure 8.

Figure 8: Asset List Summary Chart



4.4 Existing Reuse System

The District is permitted to provide up to 2.0 million gallons of recycled water per day to irrigation customers in the 4S Ranch community, HOA common areas, schools, parks, streetscapes, and golf courses throughout the District's service area. The 4S Ranch WRF produces the recycled water, storing seasonal surplus in excess of daily demands in the Recycled Water Seasonal Storage Pond (located across the street from the 4S Ranch WRF) or in the Thelma Miller Recycled Water Reservoir. The District also purchases additional recycled water from Ranch Santa Fe CSD, Vallecitos Water District, and the San Elijo Joint Powers Authority to serve customers in portions of Encinitas and Carlsbad. The District plans to continue to expand recycled water service through recycled water purchases and partnerships with neighboring agencies.

4.5 Regulatory Considerations

The wastewater and recycled water systems operate under the San Diego Region Water Quality Control Board's following permit:

- Master Reclamation Permit with Waste Discharge Requirements Order No. R9-2003-0007

5 USEFUL LIFE EXPECTANCY METHODOLOGY

5.1 Collection System Predictive Remaining Life Modeling

Using data from the District's existing GIS system, record drawings, and additional information gathered from District staff, Dudek will create predictive life models for the collection system gravity mains, manholes, and forcemains.

For gravity mains, the following factors will be considered in predicting the remaining useful life:

- Material: Pipes will be assigned a baseline useful life value of 100 years for PVC and 50 years for DIP. A 50-year useful life for DIP assumes the exterior of the pipe is uniformly protected from contact with the soil and the interior coating is intact and not subject to high hydrogen sulfide concentrations. In many cases, these ideal conditions are not present due to manufacturing and construction defects and exposure to a corrosive sewer environment. The remaining useful life of DIP segments with known issues will be reduced accordingly.
- CCTV Inspection: The District currently inspects one third of the gravity mains in its system per year. In addition to identifying pipe defects, these regular inspections are used to track "hot spots", which are sections of sewer with grease, roots, or debris that require more frequent inspection and maintenance. Dudek will review the inspection videos and record drawings for the District's identified defects and hot spots and, if appropriate, develop prioritized rehabilitation or repair projects for the CIP based on the predicted remaining useful life, risk of failure or maintenance reduction costs. For debris, repairs typically consist of replacing pipe with sags or severe offset joints. For grease, a review of the District's FOG policies and enforcement is anticipated. Roots are typically remediated by lining pipes and manholes to eliminate joints.
- Interviews with District Staff: In addition to reviewing know hot spots, Dudek will utilize the knowledge of District engineering and operations staff to identify pipes with known issues that may lead to a higher probability of failure or maintenance issues.

Concrete manholes will be assigned a baseline useful life value of 100 years. Manholes subject to roots (as identified in the District's "hot spots") and accelerated corrosion due to high hydrogen sulfide exposure will be identified for increased monitoring and condition assessment and potentially prioritized into a manhole lining program. Using the existing pump station and forcemain configurations, Dudek will model hydrogen sulfide (H2S) generation in the collection system to identify areas of high exposure (i.e., average sulfide concentrations greater than 5 ppm). Because the expected life of a spray-on liner is 5 to 15 years depending on the quality of installation and environment, manholes prioritized for lining will require additional periodic inspection and maintenance of the liner itself. In addition, an effort will be made to identify existing manholes with T-lock or spray-on liners so that these manholes can be included in a regular liner inspection and maintenance program.

The predicted useful life for forcemains will be based on the following factors:

- Material: All forcemains in the District's collection system are either PVC or DIP. Again, baseline useful lives of 100 years for PVC and 50 years for DIP will be assigned as a starting point. For DIP forcemains, the type of lining (i.e., cement mortar or ceramic epoxy) and cathodic protection measures (i.e., polyethylene encasement, impressed current, sacrificial anode, etc.) will be considered in predicting and potentially reducing the remaining useful life.

- Pressure: Higher pressure pipes should be inspected and replaced/rehabilitated at more frequent intervals.
- Interviews with District Staff: Pipes with known construction or maintenance issues will evaluated with respect to predicted remaining useful life.

5.2 Facility (Pump Station and WRF) Predictive Remaining Life Modeling

For pump stations and the 4S Ranch WRF, predictive remaining life modeling will be performed based on asset type, characteristics, and condition. The predictive remaining life modeling will utilize estimated useful life values and subtracting age. For assets with predicted remaining life of less than 5 years, asset-specific condition assessment will be performed in order to confirm life expectancy, evaluate R&R requirements, and to prioritize near-term future CIP planning. As an ongoing protocol, the District should perform condition assessment on major assets as they approach 5 years of predicted remaining life, update the predictive remaining life model and capital improvement planning documents. For the purposes of budgeting for 10-year and 20-year CIP horizons, the calculated asset replacement value based on predicted remaining life will be programmed into annual CIP budgets.

The expected useful life for an asset must be determined in preparation of a comprehensive capital improvement plan. The cost associated with replacing the asset, combined with the expected useful life remaining will create a timetable in which to budget the cost necessary for replacement. These values have been generated from industry-standard life expectancy values for wastewater facility components based in part on *The Clean Water and Drinking Water Infrastructure Gap Analysis* (EPA-816-R-02-020) and similar reports. These values have been supplemented by: online research, professional experience, manufacturer's recommendations, and previous reports.

The District in part categorized the assets in their EAM through a "Class" designation. There were 67 different designations created for the asset inventory. Dudek has preserved this designation in part, but modified some and added new designations for clarity and consistency. The "Class" designation provides a basis in which to assign a uniform expected useful life value to a group of similar assets.

After new additions and modifications, the new asset inventory includes 78 unique "Class" designations for which expected useful life values were assigned. The list of "Class" designations and the associated expected useful life values are presented in Table 4.

Table 4: Expected Useful Life Index

OMWD CLASS	Asset Category	Description	Expected Useful Life
ACTUATOR	Piping, Valves & Gates	Valve or Gate Actuator	15
ANALYZER	Instrumentation	Analyzer	7
ANTENNA	Other	Radio Antenna	10
BACKFLOW	Other	Backflow Prevention	25
BANDSCRN	Process Equip	Bandscreen	15
BATT	Electrical Gear	Battery	7
BELTPRES	Process Equip	Belt Press	20
BLOWER	Process Equip	Blower	20
BRUSH	Process Equip	Algae Sweep System Brush	15
BUILDING	Buildings & Sites	Facility Building	50
CATHODRW	Other	Cathodic Protection	5
COLLECTI	Collection System	Various Collection System Components	50
COMPRESS	Other	Air Compressor	10
CONTROL	Instrumentation	Control Systems & Panels	15
CONVEY	Process Equip	Conveyor Belt	20
CTLVALWW	Piping, Valves & Gates	Wastewater Control Valve	30
DI	Instrumentation	Floats & Float switches	7
DIFFUSER	Process Equip	Aeration Diffuser	15
ELEC	Electrical Gear	Misc. Electric Equipment	10
EQUIP	Other	Misc. Operational Equipment	30
FACILITY	Concrete Structures	Facility Building or Site	50
FILTER	Process Equip	Tertiary Sand Filter	25
FRCEMAIN	Collection System	Forcemain in Collection System	50
GAUGE	Instrumentation	Pressure Gauge	5
GEARBOX	Other	Mechanical Gear Box	10
GENERATE	Other	Emergency Generator	25
GRINDER	Process Equip	Grinder Component	15
GRIT	Process Equip	Grit Classifier	15
HOIST	Other	Crane or Hoist Equipment	25
HVAC	Other	Air Conditioners, dehumidifiers, ducting, etc.	15
ICEQUIP	Instrumentation	Wet Well Floats	5
IRRIG	Other	Irrigation System	20
LAB	Other	Lab Equipment	5
LIGHT	Other	General Lighting	10
M LIFT	Other	Man Lift	25
MCC	Electrical Gear	Motor Control Center	30
MECHANICAL	Process Equip	Mechanical Equipment	20
METER	Instrumentation	Flow Meter	15
METERRW	Instrumentation	Reclaimed Water Flow Meter	15
MIXER	Process Equip	Mechanical Mixer	15
MOTOR	Motors	Motor	20
NETWORK	Instrumentation	Network Switches and Ethernet Cables	10

OMWD CLASS	Asset Category	Description	Expected Useful Life
ODOR	Process Equip	Odor Control System Components	10
OIT	Electrical Gear	Operator Interface Terminal	10
PIPING	Piping, Valves & Gates	Misc. Piping	50
PIPING-CHEM	Piping, Valves & Gates	Chemical Piping	15
PIPING-MECH	Piping, Valves & Gates	Mechanical Piping	50
PS	Electrical Gear	Uninterruptable Power Supply	10
PUMP	Pumps	Misc. Pump	20
PUMP-AIR	Pumps	Air Pump	10
PUMP-CHEM	Pumps	Chemical Pump	8
PUMP-RAS	Pumps	RAS Pump	20
PUMP-SCUM	Pumps	Scum Pump	8
PUMP-SEWER	Pumps	Sewer Pump Station Pumps	15
PUMP-SUBMR	Pumps	Submersible Pump	15
PUMP-SUMP	Pumps	Sump Pump	15
PUMP-VERTT	Pumps	Vertical Turbine Pump	20
PUMP-WAS	Pumps	WAS Pump	10
RADIO	Other	Radio	7
RWFACILI	Buildings & Sites	Recycled Water Facility	50
SAFETY	Other	Safety Equipment	15
SAMPLER	Instrumentation	Water Sampler	7
SEAL	Pumps	Seal Water Pump	15
SECURITY	Other	Security System	15
SENSOR	Instrumentation	Sensor (e.g. DO probe)	5
SITE	Buildings & Sites	Site or Facility	50
SOFTENER	Other	Water Softener	5
SOFTWARE	Electrical Gear	Data Archive	10
SOLVALVE	Piping, Valves & Gates	Solenoid Valve	10
STRUCTURE	Concrete Structures	Process Tanks and Major Concrete Structures	50
TANK	Storage	Storage Tank (e.g. Chemical Storage)	25
UVLIGHT	Process Equip	UV Lamps	15
UVSYSTEM	Buildings & Sites	UV Disinfection System (Facility)	50
VALVE	Piping, Valves & Gates	Misc. Valves	25
VEHICLE	Other	Fleet Trucks and Vehicles	10
VFD	Electrical Gear	Variable Frequency Drive	10
WETWELL	Concrete Structures	Pump Station Wet Well	50
XDUCER	Instrumentation	Level Transducer	7

The expected useful life index will be applied to generate a predicted useful life model for all of the major and minor CIP assets in the asset inventory. The age of the asset will be subtracted from the expected useful life to determine a predictive remaining life of each asset. The major assets will be budgeted for replacement in the CIP by the end of the predictive remaining life. The cost to replace these assets will be determined using the methodology in the following section.

6 COST ESTIMATING METHODOLOGY

Cost estimating will be used in preparation of CIP projects recommended for the District. Procedures and guidelines used in the preparation of estimates of probable construction cost (cost estimates) will be based on:

- Estimates from previously completed studies for the District.
- Unit cost factors derived from data available from recent similar projects.
- Unit cost factors developed for specific components of the project, as applicable.
- Incorporation of a project complexity factor applied to unit prices to adjust for expected challenges associated with site and work conditions.
- Project location factors will be used to normalize costs to the appropriate locale using RS Means.
- Reference costs will be normalized to December 2014 dollars using published historical cost data from Engineering News Record, Construction Cost Index (ENR-CCI).

The Association for Advancement of Cost Estimating International provides guidelines for cost estimating practices and classification. The *Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries* (AACE International Recommended Practice No. 18R-97) provides guidelines for applying the principles of estimate classification to projects such as the District's Alternative Analyses. A summary of the recommended classification system is presented in Table 5.

Table 5. Summary of Cost Estimate Classification System

Estimate Class	Primary Characteristic	Secondary Characteristic			
	Level of Project Definition *Expressed as % of complete definition*	**End Usage** *Typical purpose of estimate*	**Methodology** *Typical estimating method*	**Expected Accuracy Range [a]** *Typical variation in low and high ranges*	**Preparation Effort [b]** *Typical degree of effort relative to least cost index of 1*
Class 5	0% to 2%	Concept Screening	Capacity Factored, Parametric Models, Judgement or Analogy	L: -20% to -50% H: +30% to +100%	1
Class 4	1% to 15%	Study or Feasibility	Equipment Gactored or Parametric Models	L: -15% to -30% H: +20% to +50%	2 to 4
Class 3	10% to 40%	Budget, Authorization, or Control	Semi-detailed Unit Costs with Assembly Level Line Items	L: -10% to -20% H: +10% to +30%	3 to 10
Class 2	30% to 70%	Control or Bid/Tender	Detailed Unit Cost with Forced Detailed Take-Off	L: -5% to -15% H: +5% to +20%	4 to 20
Class 1	50% to 100%	Check Estimate or Bid Tender	Detailed Unit Cost with Detailed Take-Off	L: -3% to -10% H: +3% to +15%	5 to 100

Notes:

[a] The state of process technology and availability of applicable reference cost data affect the range markedly. The +/- value represents typical percentage variation of actual costs from the cost estimate after application of contingency (typically at a 50% level of confidence) for a given scope.

[b] If the range index value of "1" represents 0.0005% of project costs, then an index value of 100 represents 0.5%. Estimate preparation effort is highly dependent upon the size of the project and the quality of estimating data and tools.

For the development of CIP projects, Class 5 estimates will be used for "minor" assets (less than $50,000) while Class 4 estimates will be used for "major" assets (more than $50,000) and unique project definitions.

The estimates classified as Class 5 Estimates ("Order of Magnitude") is defined by AACE International as follows:

<u>*Description:*</u>

Class 5 estimates are generally prepared based on very limited information, and subsequently have wide accuracy ranges. As such, some companies and organizations have elected to determine that due to the inherent inaccuracies, such estimates cannot be classified in a conventional and systematic manner. Class 5 estimates, due to the requirements of end use, may be prepared within a very limited amount of time and with little effort expended – sometimes requiring less than an hour to prepare. Often, little more than a proposed plant type, location, and capacity are known at the time of estimate preparation.

<u>*Estimating Methods Used:*</u>

Class 5 estimates virtually always use stochastic estimating methods such as cost/capacity curves and factors, scale of operations factors, Lang factors, Hand factors, Chilton factors, Peters-Timmerhaus factors, Guthrie factors, and other parametric and modeling techniques.

<u>*Expected Accuracy Range:*</u>

Typical accuracy ranges for Class 5 estimates are -20% to -50% on the low side, and +30% to +100% on the high side, depending on the technological complexity of the project, appropriate *reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances.*

End Usage:

Class 5 estimates are prepared for any number of strategic business planning purposes, such as but not limited to market studies, assessment of initial viability, evaluation of alternate schemes, project screening, project location studies, evaluation of resource needs and budgeting, long-range capital planning, etc.

The estimates classified as Class 4 Estimates ("Order of Magnitude") is defined by AACE International as follows:

Description:

Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Typically, engineering is from 1% to 15% complete, and would comprise at a minimum the following: plant capacity, block schematics, indicated layout, process flow diagrams (PFDs) for main process systems, and preliminary engineered process and utility equipment lists.

Estimating Methods Used:

Class 4 estimates virtually always use stochastic estimating methods such as equipment factors, Lang factors, Hand factors, Chilton factors, Peters-Timmerhaus factors, Guthrie factors, the Miller method, gross unit costs/ratios, and other parametric and modeling techniques.

Expected Accuracy Range:

Typical accuracy ranges for Class 4 estimates are -15% to -30% on the low side, and +20% to +50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances.

End Usage:

Class 4 estimates are prepared for a number of purposes, such as but not limited to, detailed strategic planning, business development, project screening at more developed stages, alternative scheme analysis, confirmation of economic and/or technical feasibility, and preliminary budget approval or approval to proceed to next stage.

The estimates classified as Class 3 Estimates ("Order of Magnitude") is defined by AACE International as follows:

Description:

Class 3 estimates are generally prepared to form the basis for budget authorization, appropriation, and/or funding. As such, they typically form the initial control estimate against which all actual costs and resources will be monitored. Typically, engineering is from 10% to 40% complete, and would comprise at a minimum the following: process flow diagrams, utility flow diagrams, preliminary piping and instrument diagrams, plot plan, developed layout drawings, and essentially complete engineered process and utility equipment lists.

<u>Estimating Methods Used:</u>

Class 3 estimates usually involve more deterministic estimating methods than stochastic methods. They usually involve a high degree of unit cost line items, although these may be at an assembly level of detail rather than individual components. Factoring and other stochastic methods may be used to estimate less-significant areas of the project.

<u>Expected Accuracy Range:</u>

Typical accuracy ranges for Class 3 estimates are -10% to -20% on the low side, and +10% to +30% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances.

<u>End Usage:</u>

Class 3 estimates are typically prepared to support full project funding requests, and become the first of the project phase "control estimates" against which all actual project costs and resources will be monitored for variations to the budget. They are used as the project budget until replaced by more detailed estimates. In many owner organizations, a Class 3 estimate may be the last estimate required and could well form the only basis for cost/schedule control.

The estimates classified as Class 2 Estimates ("Order of Magnitude") is defined by AACE International as follows:

<u>Description:</u>

Class 2 estimates are generally prepared to form a detailed control baseline against which all project work is monitored in terms of cost and progress control. For contractors, this class of estimate is often used as the "bid" estimate to establish contract value. Typically, engineering is from 30% to 70% complete, and would comprise at a minimum the following: process flow diagrams, utility flow diagrams, piping and instrument diagrams, heat and material balances, final plot plan, final layout drawings, complete engineered process and utility equipment lists, single line diagrams for electrical, electrical equipment and motor schedules, vendor quotations, detailed project execution plans, resourcing and work force plans, etc.

<u>Estimating Methods Used:</u>

Class 2 estimates always involve a high degree of deterministic estimating methods. Class 2 estimates are prepared in great detail, and often involve tens of thousands of unit cost line items. For those areas of the project still undefined, an assumed level of detail takeoff (forced detail) may be developed to use as line items in the estimate instead of relying on factoring methods.

<u>Expected Accuracy Range:</u>

Typical accuracy ranges for Class 2 estimates are -5% to -15% on the low side, and +5% to +20% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances.

<u>End Usage:</u>

Class 2 estimates are typically prepared as the detailed control baseline against which all actual costs and resources will now be monitored for variations to the budget, and form a part of the change/variation control program.

The estimates classified as Class 1 Estimates ("Order of Magnitude") is defined by AACE International as follows:

Description:

Class 1 estimates are generally prepared for discrete parts or sections of the total project rather than generating this level of detail for the entire project. The parts of the project estimated at this level of detail will typically be used by subcontractors for bids, or by owners for check estimates. The updated estimate is often referred to as the current control estimate and becomes the new baseline for cost/schedule control of the project. Class 1 estimates may be prepared for parts of the project to comprise a fair price estimate or bid check estimate to compare against a contractor's bid estimate, or to evaluate/dispute claims. Typically, engineering is from 50% to 100% complete, and would comprise virtually all engineering and design documentation of the project, and complete project execution and commissioning plans.

Estimating Methods Used:

Class 1 estimates involve the highest degree of deterministic estimating methods, and require a great amount of effort. Class 1 estimates are prepared in great detail, and thus are usually performed on only the most important or critical areas of the project. All items in the estimate are usually unit cost line items based on actual design quantities.

Expected Accuracy Range:

Typical accuracy ranges for Class 1 estimates are -3% to -10% on the low side, and +3% to +15% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances.

End Usage:

Class 1 estimates are typically prepared to form a current control estimate to be used as the final control baseline against which all actual costs and resources will now be monitored for variations to the budget, and form a part of the change/variation control program. They may be used to evaluation bid checking, to support vendor/contractor negotiations, or for claim evaluations and dispute resolution.

7 REFERENCES

Olivenhain Municipal Water District Website

AACE International Recommended Practice No. 18R-97

The Clean Water and Drinking Water Infrastructure Gap Analysis (EPA-816-R-02-020)

8 ATTACHMENTS

OMWD Wastewater Asset Inventory

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Row	EAM "Position" (Tag No.)	Asset	Description	Facility	Sub-Facility	EAM "Class"	Category	Exp. Use. Life
1	MOBILE EQUIPMENT	HL02	10'INTERSTATE SPILL RESPONSE TRAILER	4S WRF		VEHICLE	Other	10
2		FB22	1993 CHEV 3/4 TON PICKUP	4S WRF		VEHICLE	Other	10
3		WWNBHD1-1025	2" RPP / BACKFLOW	4S WRF		BACKFLOW	Piping, Valves & Gates	25
4		PU07	2002 F-250 8800GVW PICK-UP	4S WRF		VEHICLE	Other	10
5		PU13	2004 FORD F350/SD PU WW PLANT	4S WRF		VEHICLE	Other	10
6		PU81	2013 FORD F-150 EXTRA CAB - DUTY WWTF	4S WRF		VEHICLE	Other	10
7		WWNBHD1-1021	Air Gap Tank	4S WRF		BACKFLOW	Piping, Valves & Gates	25
8		WW54102	ALUM CONTROL SYSTEM	4S WRF	Chem Feed	CONTROL	Electrical Gear	15
9		WW5131	ALUM TANK LEVEL	4S WRF	Chem Feed	XDUCER	Instrumentation	7
10		WW-SAFETY-5	ASI ELECTRIC BLOWER	4S WRF		SAFETY	Other	15
11		WW89102	BOOM PORTABLE	4S WRF		HOIST	Other	25
13		WW21063	BP BLDG ODOR SCRUB RECYCLE PMP STAGE 1	4S WRF	Odor Control	PUMP-CHEM	Pumps	8
14		WW2901	CATHODIC PROTECTION	4S WRF		CATHODRW	Other	5
15		WW89101	CHAIN HOIST	4S WRF		HOIST	Other	25
16		WW8001	CMP PANEL (CONTROL,ALM, RCDR PLANT A)	4S WRF	General	CONTROL	Electrical Gear	15
17		WW2711	CONDUCTANCE PROBE	4S WRF		ANALYZER	Instrumentation	7
18		WW12311	DRY WELL PUMP CONTROL PANEL	4S WRF	General	CONTROL	Electrical Gear	15
19		WW12206	DSL SUMP PUMP CONTROL PANEL	4S WRF	Belt Press	CONTROL	Electrical Gear	15
22		WW89011	ELECTRIC HOIST	4S WRF		HOIST	Other	25
23		WW1812	FLOAT SWITCHES	4S WRF		DI	Instrumentation	7
24		WW1811	FLOAT SWITCHES	4S WRF		DI	Instrumentation	7
25		WW5721	FLOW INDICATOR SWITCH	4S WRF		DI	Instrumentation	7
26		WW5722	FLOW INDICATOR SWITCH	4S WRF		DI	Instrumentation	7
27		WW2223	FLOW SPLIT BOX IFFERENTIAL LEVEL	4S WRF	General	XDUCER	Instrumentation	7
28		WW17202	GENERATOR SWITCH GEAR	4S WRF		ELEC	Electrical Gear	10
29		WW2501-A	Hach sc200 Chlorine analyzer	4S WRF		ANALYZER	Instrumentation	7
30		G104	HONDA GEN MODEL#EU-1000 #6 - WASTE WATER	4S WRF		EQUIP	Other	30
31		G105	HONDA GEN MODEL#EU-1000 #8 - WASTE WATER	4S WRF		EQUIP	Other	30
32		WWHYPOLIT-2	HYPO TANK 2 LIT 691-2	4S WRF	Chem Feed	XDUCER	Instrumentation	7
33		WW3301	INFLUENT CONDUCTIVITY METER	4S WRF		ANALYZER	Instrumentation	7
34		WW5001	INFLUENT FLOW METER	4S WRF		METER	Instrumentation	15
35		WW3202	INFLUENT PH METER	4S WRF		ANALYZER	Instrumentation	7
36		74202-1	Mag Hydroxide System	4S WRF		PUMP-CHEM	Pumps	8
37		WW12502	MAIN CIRCUIT BREAKER	4S WRF		ELEC	Electrical Gear	10
38		WW11010	MAIN SWITCH BOARD 6 SWBD 6	4S WRF		MCC	Electrical Gear	30
39		WW90001	MAN LIFT	4S WRF		M LIFT	Other	25
40		WW11006	MCC 6M	4S WRF	General	MCC	Electrical Gear	30
41		WW11007	MCC 7M	4S WRF	General	MCC	Electrical Gear	30
42		WW21705	METER VAULT SUMP PUMP #1	4S WRF		PUMP-SUMP	Pumps	15
43		WW21706	METER VAULT SUMP PUMP #2	4S WRF		PUMP-SUMP	Pumps	15
44		WW29040	METERING PUMP PULSAFEEDER #1	4S WRF	Chem Feed	PUMP-CHEM	Pumps	8
45		WW29041	METERING PUMP PULSAFEEDER #2	4S WRF	Chem Feed	PUMP-CHEM	Pumps	8
46	MOBILE EQUIPMENT	WWMOBILE-4	MOBILE EQUIPMENT, FORKLIFT	4S WRF		EQUIP	Other	30
49	MOBILE EQUIPMENT	WWMOBILE-1	MOBILE EQUIPMENT, GOLF CART	4S WRF		EQUIP	Other	30
50	MOBILE EQUIPMENT	WWMOBILE-3	MOBILE EQUIPMENT, KUBOTA UTILITY VEHICLE	4S WRF		EQUIP	Other	30
51	MOBILE EQUIPMENT	WWMOBILE-2	MOBILE EQUIPMENT, MUSTANG LOADER	4S WRF		EQUIP	Other	30
52		WW97402	MOISTURE ANALYZER	4S WRF		ANALYZER	Instrumentation	7
54		WW2722	ORP ANALYZER	4S WRF		ANALYZER	Instrumentation	7
55		WWPOLCTRL	Polymer control system	4S WRF	Chem Feed	CONTROL	Electrical Gear	15
56		WW29911	PORTABLE GAS PUMP 12 VOLTS DC	4S WRF		PUMP	Pumps	20
57		WW93204	PORTABLE SUBMERSIBLE PUMP (BARNES)	4S WRF		PUMP-SUBMR	Pumps	15
58		WW93202	PORTABLE SUBMERSIBLE PUMP (TEEL)	4S WRF		PUMP-SUBMR	Pumps	15
60		WW93201	PORTABLE SUBMERSIBLE PUMP (TEEL)	4S WRF		PUMP-SUBMR	Pumps	15
61		WW93203	PORTABLE SUBMERSIBLE PUMP (ZOELLER)	4S WRF		PUMP-SUBMR	Pumps	15
62		WW93206	PORTABLE SUMP PUMP (ZOELLER) OLD	4S WRF		PUMP-SUMP	Pumps	15
63		WW5201	POTABLE WATER FLOW METER	4S WRF		METER	Instrumentation	15
64		WW2211	PRESSURE INDICATOR	4S WRF		XDUCER	Instrumentation	7
65		WW2212	PRESSURE SWITCHES	4S WRF		DI	Instrumentation	7
66		PU31	PU 31 - 2006 F150	4S WRF		VEHICLE	Other	10
67	MOBILE EQUIPMENT	WW31073	PUMP, 4" TRASH, GAS POWER, TRAILER MOUNT	4S WRF		PUMP	Pumps	20
68	4S WRF INVENTORY	WW3101	SAMPLER, REFRIGERATED, ALL WEATHER	4S WRF		SAMPLER	Instrumentation	7
69	4S WRF INVENTORY	WW3111	SAMPLER, REFRIGERATED, PORTABLE	4S WRF		SAMPLER	Instrumentation	7
70		WW12212	SANITARY PUMP STATION CONTROL PANEL	4S WRF		CONTROL	Electrical Gear	15
71		WW11011	SERVICE SWITCH BOARD SWBD S	4S WRF		MCC	Electrical Gear	30
72		WW77201	SHOP	4S WRF		SITE	Buildings & Sites	50
74		WW2226	SOLIDS SCRUBBER STAGE 1 FLOW METER	4S WRF	Odor Control	METER	Instrumentation	15
75		WW2227	SOLIDS SCRUBBER STAGE 2/3 FLOW METER	4S WRF	Odor Control	METER	Instrumentation	15
76		WW5133	SPLIT STRUCTURE DIFFERENTIAL LEVEL	4S WRF		XDUCER	Instrumentation	7
77		WW12213	STORM WATER PUMP STATION CONTROL PANEL	4S WRF	General	CONTROL	Electrical Gear	15
78		WW69806	STORM WATER SUMP	4S WRF	General	PUMP-SUMP	Pumps	15
79		WW2401	SUBMERSIBLE PRESSURE TRANSDUCER	4S WRF		XDUCER	Instrumentation	7
80		WW5122	THICKENED SLUDGE FLOW METER	4S WRF	Belt Press	METER	Instrumentation	15
81	MOBILE EQUIPMENT	VAC3	TRAILER VAC, 500 GAL, PACIFIC TEK, TRAILER #1243413	4S WRF		EQUIP	Other	30
82		WW5011	ULTRASONIC FLOW MODULE	4S WRF		METER	Instrumentation	15
83		WW SANDFILTERLEVELXDCR	Wastewater Sand Filter Level Transducer	4S WRF		XDUCER	Instrumentation	7
84		WW5126	WET LEVEL	4S WRF		XDUCER	Instrumentation	7
85	4S WRF SHOP	WW89103	MOBILE FLOOR CRANE 2,200 lb	4S WRF	General	HOIST	Other	25
86	4S WRF SHOP	WW89104	MOBILE FLOOR CRANE 4,400 LB	4S WRF	General	HOIST	Other	25
87	9-ME-10	WW3121	SAMPLER, REFRIGERATED, ALL WEATHER, 9-ME-10	4S WRF	General	SAMPLER	Instrumentation	7
88		WW21061	HDWKS ODOR SCRUB RECYCLE PMP STAGE 1	4S WRF	Odor Control	PUMP-CHEM	Pumps	8
89		WW21062	HDWKS ODOR SCRUB RECYCLE PMP STAGE 2/3	4S WRF	Odor Control	PUMP-CHEM	Pumps	8
90		WW12208	HEADWORKS ODOR SCRUBBER CONTROL PANEL	4S WRF	Odor Control	CONTROL	Electrical Gear	15
91		WW2224	HEADWORKS SCRUBBER STAGE 1 FLOW METER	4S WRF	Odor Control	METER	Instrumentation	15
92		WW2225	HEADWORKS SCRUBBER STAGE 2/3 FLOW METER	4S WRF	Odor Control	METER	Instrumentation	15
93		WWTP ADMIN P/S CP	4S Admin Sewage P/S Control Panel	4S WRF	General	CONTROL	Electrical Gear	15
94		WW69808	4S RANCH LIFT STATION DRY-WELL SUMP	4S WRF	General	PUMP-SUMP	Pumps	15
95		WW93205	4S RANCH LS SUMP PUMP (ZOELLER)	4S WRF	General	PUMP-SUMP	Pumps	15
96		CHEMICAL PUMP 6-FD-1	4S WWTP CHEMICAL METERING PUMP 6-FD-1	4S WRF	Chem Feed	PUMP-CHEM	Pumps	8
97		CHEMICAL PUMP 6-FD-2	4S WWTP CHEMICAL METERING PUMP 6-FD-2	4S WRF	Chem Feed	PUMP-CHEM	Pumps	8
98		CHEMICAL PUMP 6-FD-3	4S WWTP CHEMICAL METERING PUMP 6-FD-3	4S WRF	Chem Feed	PUMP-CHEM	Pumps	8
99		CHEMICAL PUMP 6-FD-4	4S WWTP CHEMICAL METERING PUMP 6-FD-4	4S WRF	Chem Feed	PUMP-CHEM	Pumps	8
100		CHEMICAL PUMP 6-FD-5	4S WWTP CHEMICAL METERING PUMP 6-FD-5	4S WRF	Chem Feed	PUMP-CHEM	Pumps	8
101		WW99802	ALUM PIPING SYSTEM	4S WRF	Chem Feed	PIPING-CHEM	Piping, Valves & Gates	15
102		WW3205	ANOXIC ZONE D.O. METER/SENSOR NE	4S WRF	Plnt B Aeration Basin	ANALYZER	Instrumentation	7
103	1-ME-1	WWBANDSCREENLEVEL2	Bandscreen Level Down Stream 2	4S WRF	Headworks	XDUCER	Instrumentation	7
104	1-ME-1	WWBANDSCREENLEVEL1	Bandscreen Level Up Stream 1	4S WRF	Headworks	XDUCER	Instrumentation	7
105		WW12209	BELT PRESS ODOR SCRUBBER CONTROL PANEL	4S WRF	Belt Press	CONTROL	Electrical Gear	15
106		WW12210	BELT PRESS SLUDGE FILTRATE PUMP CONTROL PANEL	4S WRF	Belt Press	CONTROL	Electrical Gear	15
107		WW5125	CHEM STORAGE TANK LEVEL	4S WRF	Chem Feed	XDUCER	Instrumentation	7
108		WW2501	CHLORINE ANALYZER	4S WRF	Chem Feed	ANALYZER	Instrumentation	7
109		WW73001	CLARIFIER NO1, PLANT A Equipment	4S WRF	Plnt A Sec. Clarifiers	MECHANICAL	Process Equip	20
110	3-ME-1	WW73004	CLARIFIER NO1, PLANT B 3-ME-1	4S WRF	Plnt B Sec. Clarifiers	MECHANICAL	Process Equip	20
111		WW73002	CLARIFIER NO2, PLANT A Equipment	4S WRF	Plnt A Sec. Clarifiers	MECHANICAL	Process Equip	20
112	3-ME-2	WW73005	CLARIFIER NO2, PLANT B 3-ME-2	4S WRF	Plnt B Sec. Clarifiers	MECHANICAL	Process Equip	20
113		WW12204	CLARIFIER SCUM PUMP CONTROL PANEL PLANT A	4S WRF	Plnt A Sec. Clarifiers	CONTROL	Electrical Gear	15
114		WW12205	CLARIFIER SCUM PUMP CONTROL PANEL PLANT B	4S WRF	Plnt B Sec. Clarifiers	CONTROL	Electrical Gear	15
115		WW99911	CLARIFIER SPLITTER BOX FLOATS	4S WRF	Plnt B Sec. Clarifiers	DI	Instrumentation	7
116		WW5123	DIGESTED SLUDGE FLOW METER	4S WRF	Belt Press	METER	Instrumentation	15
117		WW12501	FILTER CONTROL SYSTEM	4S WRF	Sand Filters	CONTROL	Electrical Gear	15
118		WW2281	FILTER PS WW LEVEL INDICATOR	4S WRF	Sand Filters	CONTROL	Electrical Gear	15
119		WW12207	GRIT SUMP PUMP CONTROL PANEL	4S WRF	Headworks	CONTROL	Electrical Gear	15
120		WW3206	DIGESTER 2 D.O. METER/SENSOR	4S WRF	Plnt B Aerobic Digesters	ANALYZER	Instrumentation	7
121		WW3203	DIGESTER D.O. METER/SENSOR	4S WRF	Plnt B Aerobic Digesters	ANALYZER	Instrumentation	7
122		WW36101	ELECTRIC VALVE OPERATOR BP #1 WASHWATER	4S WRF	Belt Press	ACTUATOR	Piping, Valves & Gates	15
123		WW36102	ELECTRIC VALVE OPERATOR BP #2 WASHWATER	4S WRF	Belt Press	ACTUATOR	Piping, Valves & Gates	15
124	6-EF-122	WW83102	FAN, CENTRIFUGAL, BELT DRIVE, 10 HP, ODOR SCUBBER 6-EF-122	4S WRF	Odor Control	HVAC	Other	15
125	1-EF-222	WW83101	FAN, CENTRIFUGAL, BELT DRIVE, 15 HP, ODOR SCRUBBER 1-EF-222	4S WRF	Odor Control	HVAC	Other	15
126		WW83103	FAN, CENTRIFUGAL, DIRECT DRIVE, 7 HP, ODOR SCRUBBER 1-EF-111	4S WRF	Odor Control	HVAC	Other	15
127		WW29016	FERRIC METERING PUMP	4S WRF	Chem Feed	PUMP-CHEM	Pumps	8
128		WW29015	FERRIC METERING PUMP	4S WRF	Chem Feed	PUMP-CHEM	Pumps	8
129		WW29501	FILTER CHEM WASH PUMP	4S WRF	Sand Filters	PUMP-CHEM	Pumps	8
130		WW54103	NAOCL CONTROL SYSTEM	4S WRF	Chem Feed	CONTROL	Electrical Gear	15
131		WW5082	FILTER EFF FLOW METER (UV)	4S WRF	UV Disinfection	METER	Instrumentation	15
132		WW3506	FILTER EFF TURB METER (UV)	4S WRF	UV Disinfection	ANALYZER	Instrumentation	7
133	4-M-1	WW5081	FILTER INF FLOW METER	4S WRF	Sand Filters	METER	Instrumentation	15
134		WW3505	FILTER INF TURBIDITY METER	4S WRF	Sand Filters	ANALYZER	Instrumentation	7
135		WW5134	FILTER INFLUENT PUMP STATION LEVEL	4S WRF	Sand Filters	XDUCER	Instrumentation	7
136		WW22305	FILTER INFLUENT TURBIDITY SAMPLE PUMP	4S WRF	Sand Filters	PUMP-CHEM	Pumps	8
137		WW54101	NAOH CONTROL SYSTEM	4S WRF	Chem Feed	CONTROL	Electrical Gear	15
138		WW3501	FILTER TURBIDITY METER #1	4S WRF	Sand Filters	ANALYZER	Instrumentation	7
139		WW3502	FILTER TURBIDITY METER #2	4S WRF	Sand Filters	ANALYZER	Instrumentation	7
140		WW3503	FILTER TURBIDITY METER #3	4S WRF	Sand Filters	ANALYZER	Instrumentation	7
141		WW3504	FILTER TURBIDITY METER #4	4S WRF	Sand Filters	ANALYZER	Instrumentation	7
142		WW12218	PLANT A ANOXIC SUMP PUMP CONTROL PANEL	4S WRF	Plnt A Aeration Basin	CONTROL	Electrical Gear	15
143		WW5121	FLOW METER PLANT B	4S WRF	General	METER	Instrumentation	15
144	4-M-4	WW5002	FLOW METER, MAGNETIC, RAS 4-M-4	4S WRF	Plnt B RAS/WAS PS	METER	Instrumentation	15
145	4-M-5	WW5003	FLOW METER, MAGNETIC, RAS 4-M-5	4S WRF	Plnt B RAS/WAS PS	METER	Instrumentation	15
146	4-M-6	WW5004	FLOW METER, MAGNETIC, RAS 4-M-6	4S WRF	Plnt B RAS/WAS PS	METER	Instrumentation	15
147	6-M-1	WWTPTWASFLOWMTR	FLOW METER, MAGNETIC, TWAS 6-M-1	4S WRF	Belt Press	METER	Instrumentation	15
148	4-M-7	WW5124	FLOW METER, MAGNETIC, WAS 4-M-7	4S WRF	Plnt B RAS/WAS PS	METER	Instrumentation	15
149		WW17201	GEN SWITCH GEAR PLANT A	4S WRF	General	ELEC	Electrical Gear	10

Row	EAM "Position" (Tag No.)	Asset	Description	Facility	Sub-Facility	EAM "Class"	Category	Exp. Use. Life
150		WW2291	UV CHANNEL LEVEL IND	4S WRF	UV Disinfection	CONTROL	Electrical Gear	15
151		WW2622-1	Headworks Comb gas sensors	4S WRF	Headworks	SENSOR	Instrumentation	5
152		WWINFLUENTFLOAT	Headworks Influent Hi level float	4S WRF	Headworks	DI	Instrumentation	7
153		UVLOCALCONTROL	UV Local Control Monitor light install	4S WRF	UV Disinfection	CONTROL	Electrical Gear	15
154		WW99803	NAOCL PIPING SYSTEM	4S WRF	Chem Feed	PIPING-CHEM	Piping, Valves & Gates	15
155		WW5130	NAOCL TANK LEVEL	4S WRF	Chem Feed	XDUCER	Instrumentation	7
156		WW5129	NAOCL TANK LEVEL	4S WRF	Chem Feed	XDUCER	Instrumentation	7
157		WWEQCONTREOLPNL	WWTP EQ Basin Control Panel	4S WRF	EQ Basins	CONTROL	Electrical Gear	15
158		WW99801	NAOH PIPING SYSTEM	4S WRF	Chem Feed	PIPING-CHEM	Piping, Valves & Gates	15
159		WW29001	NAOH PUMP (6-FD-14)	4S WRF	Chem Feed	PUMP-CHEM	Pumps	8
160		WW29002	NAOH PUMP (6-FD-15)	4S WRF	Chem Feed	PUMP-CHEM	Pumps	8
161		WW29003	NAOH PUMP (6-FD-16)	4S WRF	Chem Feed	PUMP-CHEM	Pumps	8
162		WW5132	NAOH TANK LEVEL	4S WRF	Chem Feed	XDUCER	Instrumentation	7
163		WW3204	OXIDATION DITCH "B" D.O. METER/SENSOR SW	4S WRF	Plnt B Aeration Basin	ANALYZER	Instrumentation	7
164		WW2721	pH ANALYZER	4S WRF	General	ANALYZER	Instrumentation	7
165		WW3801	pH METER	4S WRF	General	ANALYZER	Instrumentation	7
166		WW12215	RAS/WAS SUMP PUMP CONTROL PANEL	4S WRF	Plnt B RAS/WAS PS	CONTROL	Electrical Gear	15
167		WW5135	PLANT EFFLUENT FLOW	4S WRF	General	METER	Instrumentation	15
168		WW3507	PLANT EFFLUENT TURBIDITY METER	4S WRF	General	ANALYZER	Instrumentation	7
169		WW28011	POLYMER PUMP #1 FILTER	4S WRF	Chem Feed	PUMP-CHEM	Pumps	8
170		WW28012	POLYMER PUMP #2 FILTER	4S WRF	Chem Feed	PUMP-CHEM	Pumps	8
171	8-P-11	WW22306	PUMP, PERISTALTIC, FILTER 8-P-11	4S WRF	Sand Filters	PUMP-CHEM	Pumps	8
172	8-P-6	WW22301	PUMP, PERISTALTIC, FILTER 8-P-6	4S WRF	Sand Filters	PUMP-CHEM	Pumps	8
173	8-P-7	WW22302	PUMP, PERISTALTIC, FILTER 8-P-7	4S WRF	Sand Filters	PUMP-CHEM	Pumps	8
174	8-P-8	WW22303	PUMP, PERISTALTIC, FILTER 8-P-8	4S WRF	Sand Filters	PUMP-CHEM	Pumps	8
175	8-P-9	WW22304	PUMP, PERISTALTIC, FILTER 8-P-9	4S WRF	Sand Filters	PUMP-CHEM	Pumps	8
176	4-P-17	WW21151	PUMP, SUMP, DSL 4-P-17	4S WRF	Belt Press	PUMP-SUMP	Pumps	15
177	4-P-18	WW21152	PUMP, SUMP, DSL 4-P-18	4S WRF	Belt Press	PUMP-SUMP	Pumps	15
178	1-P-3	WW21701	PUMP, SUMP, HEADWORKS 1-P-3	4S WRF	Headworks	PUMP-SUMP	Pumps	15
179	1-P-4	WW21702	PUMP, SUMP, HEADWORKS 1-P-4	4S WRF	Headworks	PUMP-SUMP	Pumps	15
180	2-P-3	WW21709	PUMP, SUMP, OX DITCH A 2-P-3	4S WRF	Plnt A Aeration Basin	PUMP-SUMP	Pumps	15
181	2-P-4	WW21710	PUMP, SUMP, OX DITCH A 2-P-4	4S WRF	Plnt A Aeration Basin	PUMP-SUMP	Pumps	15
182	4-P-26	RAS PS SUMP PUMP NO1	PUMP, SUMP, RAS 4-P-26	4S WRF	Plnt A RAS/WAS PS	PUMP-SUMP	Pumps	15
183	4-P-27	RAS PS SUMP PUMP NO2	PUMP, SUMP, RAS 4-P-27	4S WRF	Plnt A RAS/WAS PS	PUMP-SUMP	Pumps	15
184	4-P-15	WW21703	PUMP, SUMP, RAS/WAS 4-P-15	4S WRF	Plnt B RAS/WAS PS	PUMP-SUMP	Pumps	15
185	4-P-16	WW21704	PUMP, SUMP, RAS/WAS 4-P-16	4S WRF	Plnt B RAS/WAS PS	PUMP-SUMP	Pumps	15
186	4S WRF PUMP	WW83001-3	PUMP, VERTICAL CENTRIFUGAL, ODOR SCRUBBER	4S WRF	Odor Control	PUMP-CHEM	Pumps	8
187	1-RP-201	WW83001-1	PUMP, VERTICAL CENTRIFUGAL, ODOR SCRUBBER 1-RP-201	4S WRF	Odor Control	PUMP-CHEM	Pumps	8
188	1-RP-202	WW83001-2	PUMP, VERTICAL CENTRIFUGAL, ODOR SCRUBBER 1-RP-202	4S WRF	Odor Control	PUMP-CHEM	Pumps	8
189	6-RP-101	WW83002-1	PUMP, VERTICAL CENTRIFUGAL, ODOR SCRUBBER 6-RP-101	4S WRF	Odor Control	PUMP-CHEM	Pumps	8
190	4S WRF PUMP	WW83002-3	PUMP, VERTICAL CENTRIFUGAL, ODOR SCUBBER	4S WRF	Odor Control	PUMP-CHEM	Pumps	8
191	6-RP-102	WW83002-2	PUMP, VERTICAL CENTRIFUGAL, ODOR SCUBBER 6-RP-102	4S WRF	Odor Control	PUMP-CHEM	Pumps	8
192		WW5127	TWAS HOPPER 1 LEVEL	4S WRF	Belt Press	XDUCER	Instrumentation	7
193		WW5128	TWAS HOPPER 2 LEVEL	4S WRF	Belt Press	XDUCER	Instrumentation	7
194		WW5136	UV BANK LEVEL	4S WRF	UV Disinfection	XDUCER	Instrumentation	7
195		WWUVSAMPLEPUMP	UV Channel Sample Pump	4S WRF	UV Disinfection	PUMP-CHEM	Pumps	8
196		WW5053	WAS FLOW METER PLANT A	4S WRF	Plnt A RAS/WAS PS	METER	Instrumentation	15
197		WW69802	WAS/DSL PIT SUMP PUMP PLANT A	4S WRF	Plnt A RAS/WAS PS	PUMP-SUMP	Pumps	15
198		WW51001	WATER SOFTENER(HEADWORKS	4S WRF	Headworks	SOFTENER	Other	5
199	WWTP CONTROL ROOM	WWTPUPS	WWTP APC SMART UPS 1400RM	4S WRF	General	PS	Electrical Gear	10
200	WWTP CONTROL ROOM	WWTPUPS1	WWTP APC SMART UPS 1500	4S WRF	General	PS	Electrical Gear	10
201		WWTP DIGESTER ORP	WWTP Digester #1 ORP	4S WRF	Plnt B Aerobic Digesters	ANALYZER	Instrumentation	7
202		WWTP DIGESTER PH	WWTP Digester #1 PH	4S WRF	Plnt B Aerobic Digesters	ANALYZER	Instrumentation	7
203		WWTP DIGESTER 2 DO	WWTP Digester #2 DO	4S WRF	Plnt B Aerobic Digesters	ANALYZER	Instrumentation	7
204		WWTP DIGESTER1 LEVEL	WWTP Digester 1 Level transducer	4S WRF	Plnt B Aerobic Digesters	XDUCER	Instrumentation	7
205		WWTP EFFLUENT PH SENSOR	WWTP Effluent PH Sensor in UV Channel	4S WRF	UV Disinfection	ANALYZER	Instrumentation	7
206		WWINFLUENTCONDUCTIVITY	WWTP Influent channel conductivity	4S WRF	General	ANALYZER	Instrumentation	7
207		WWINFLUENTPH	WWTP Influent channel PH	4S WRF	General	ANALYZER	Instrumentation	7
208	WWTPMCCUPS	WWTPUPS4	WWTP MCC PLC APC 1000 Backups	4S WRF	General	PS	Electrical Gear	10
209		WWMIXEDLIQUORPROBE	WWTP Mixed Liquor Probe	4S WRF	Plnt B Aeration Basin	ANALYZER	Instrumentation	7
210		WADIEJESTER1PH	WWTP PH analyzer Diejester1	4S WRF	Plnt B Aerobic Digesters	ANALYZER	Instrumentation	7
211	6-P-7	WWTPCL2PUMP	WWTP Sodium Hypo transfer pump (6-P-7)	4S WRF	Chem Feed	PUMP-CHEM	Pumps	8
212		WW11012	WWTP/SDG&E CONTROL SWITCHGEAR	4S WRF	General	ELEC	Electrical Gear	10
213	13-T-1		2000 gal Double Wall Fuel Tank	4S WRF	General	TANK	Storage	25
214		4S TREATMENT PLANT	4s Treatment Plant Operations	4S WRF	General	RWFACILI	Buildings & Sites	50
215		WW77101	4S WRF ADMINISTRATION BUILDING	4S WRF	General	BUILDING	Buildings & Sites	50
216		WW INFLUENT JUNCTION BOX	4S WRF Influent Junction Box	4S WRF	Headworks	STRUCTURE	Concrete Structures	50
217	6-T-4	4S WW HYDROXIDE TANK	4S WW Sodium Hydroxide Tank (Caustic Soda Storage Tank)	4S WRF	Chem Feed	TANK	Storage	25
218		WWTP ADMIN P/S	4S WWTP ADMIN BLDG SEWAGE PUMP STATION	4S WRF	General	WETWELL	Concrete Structures	50
219		4S WWTP STORAGE	4S WWTP Storage Building	4S WRF	General	BUILDING	Buildings & Sites	50
220		WW72101	AERATION BASIN PLANT A (OXIDATION DITCH)	4S WRF	Plnt A Aeration Basin	STRUCTURE	Concrete Structures	50
221		WW72102	AERATION BASIN PLANT B (OXIDATION DITCH)	4S WRF	Plnt B Aeration Basin	STRUCTURE	Concrete Structures	50
222		WW33201	AERATOR MOTOR 2-ME-8 (PLANT A)	4S WRF	Plnt A Aeration Basin	MOTOR	Motors	20
223		WW33202	AERATOR MOTOR 2-ME-9 (PLANT A)	4S WRF	Plnt A Aeration Basin	MOTOR	Motors	20
224		WW27001	AIR COMPRESSOR PORTABLE	4S WRF	General	COMPRESS	Other	10
225		WW27002	AIR COMPRESSOR STATIONARY	4S WRF	General	COMPRESS	Other	10
226		WW53101	ALGAE SWEEP SYSTEM	4S WRF	Plnt B Sec. Clarifiers	BRUSH	Other	15
227	6-FD-8	WW29011	ALUM METERING PUMP 6-FD-8	4S WRF	Sludge Dewatering Building	PUMP-CHEM	Pumps	8
228	6-FD-9	WW29012	ALUM METERING PUMP 6-FD-9	4S WRF	Sludge Dewatering Building	PUMP-CHEM	Pumps	8
229	6-T-3	WW71022	ALUM STORAGE TANK	4S WRF	Chem Feed	TANK	Storage	25
230		WW52212	ALUM/POLYMER TOTE MIXER	4S WRF	Chem Feed	MIXER	Process Equip	15
231		WW52201	ANOXIC MIXER PLANT A	4S WRF	Plnt A Aeration Basin	MIXER	Process Equip	15
232		WW33306	ANOXIC TANK MIXER MOTOR PLANT A 2-ME-7	4S WRF	Plnt A Aeration Basin	MOTOR	Motors	20
233	1-ME-5		Bar Screen	4S WRF	Headworks	MECHANICAL	Process Equip	20
234	6-ME-1	WW65201	BELT FILTER PRESS #1	4S WRF	Belt Press	BELTPRES	Process Equip	20
235	6-ME-2	WW65202	BELT FILTER PRESS #2	4S WRF	Belt Press	BELTPRES	Process Equip	20
236		WW76801	BELT PRESS BUILDING	4S WRF	Belt Press	BUILDING	Buildings & Sites	50
237	5-ME-1	WW27805	BLOWER, ROTARY LOBE, POSITIVE PRESSURE, DIGESTER 5-ME-1	4S WRF	Plnt B Aerobic Digesters	BLOWER	Process Equip	20
238	5-ME-2	WW27806	BLOWER, ROTARY LOBE, POSITIVE PRESSURE, DIGESTER 5-ME-2	4S WRF	Plnt B Aerobic Digesters	BLOWER	Process Equip	20
239	8-ME-11	WW27804	BLOWER, ROTARY LOBE, POSITIVE PRESSURE, FILTER 8-ME-11	4S WRF	Sand Filters	BLOWER	Process Equip	20
240	8-ME-12	WW27803	BLOWER, ROTARY LOBE, POSITIVE PRESSURE, FILTER 8-ME-12	4S WRF	Sand Filters	BLOWER	Process Equip	20
241		WW10034	BP #1 VARIABLE FREQUENCY DRIVE	4S WRF	Belt Press	VFD	Electrical Gear	10
242		WW10033	BP #2 VARIABLE FREQUENCY DRIVE	4S WRF	Belt Press	VFD	Electrical Gear	10
243	3-P-3	WW21143	CLARIFIER SCUM PUMP 3-P-3 PLANT A	4S WRF	Plnt A Sec. Clarifiers	PUMP-SCUM	Pumps	8
244		WW31406	CLARIFIER SCUM PUMP MOTOR 3-P-3 PLANT A	4S WRF	Plnt A Sec. Clarifiers	MOTOR	Motors	20
245		WW75102	CLARIFIER SPLITTER BOX	4S WRF	Plnt A Sec. Clarifiers	STRUCTURE	Concrete Structures	50
246	1-ME-3	WW59101	CLASSIFIER, GRIT 1-ME-3	4S WRF	Headworks	GRIT	Process Equip	15
247	WRF SHOP	4S TREATMENT PLANT-4	COMPRESSOR, AIR, 2 STAGE RECIPRICATING, 60 GAL	4S WRF	General	COMPRESS	Other	10
248	8-ME-13 NO.1	WW27800	COMPRESSOR, AIR, 2 STAGE RECIPRICATING, 60 GAL, FILTER 8-ME-13	4S WRF	Sand Filters	COMPRESS	Other	10
249	8-ME-13 NO.2	WW27802	COMPRESSOR, AIR, 2 STAGE RECIPRICATING, 60 GAL, FILTER 8-ME-13	4S WRF	Sand Filters	COMPRESS	Other	10
250	6-ME-4	WWBLTPRSCONV	CONVEYOR, BELT, 6-ME-4	4S WRF	Belt Press	CONVEY	Other	20
251		WW35001	DC MOTOR FOR TURBIDIMETER #1	4S WRF	Sand Filters	MOTOR	Motors	20
252		WW35002	DC MOTOR FOR TURBIDIMETER #2	4S WRF	Sand Filters	MOTOR	Motors	20
253		WW35003	DC MOTOR FOR TURBIDIMETER #3	4S WRF	Sand Filters	MOTOR	Motors	20
254		WW35004	DC MOTOR FOR TURBIDIMETER #4	4S WRF	Sand Filters	MOTOR	Motors	20
255		WW35005	DC MOTOR FOR TURBIDIMETER #5	4S WRF	Sand Filters	MOTOR	Motors	20
256		WW31411	DIGESTED SLUDGE PUMP MOTOR	4S WRF	Belt Press	MOTOR	Motors	20
257		WW31412	DIGESTED SLUDGE PUMP MOTOR	4S WRF	Belt Press	MOTOR	Motors	20
258		WW63001	DIGESTER DIFFUSERS	4S WRF	Plnt B Aerobic Digesters	DIFFUSER	Process Equip	15
259		WW74201	DIGESTER PLANT A	4S WRF	Plnt A Aerobic Digesters	STRUCTURE	Concrete Structures	50
261		WW77801	DSL PIT	4S WRF	General	STRUCTURE	Concrete Structures	50
262		WW10037	DSL PUMP #1 VFD	4S WRF	Belt Press	VFD	Electrical Gear	10
263		WW10038	DSL PUMP #2 VFD	4S WRF	Belt Press	VFD	Electrical Gear	10
264		WW71301	EQUALIZATION BASIN #1	4S WRF	EQ Basins	STRUCTURE	Concrete Structures	50
265		WW71302	EQUALIZATION BASIN #2	4S WRF	EQ Basins	STRUCTURE	Concrete Structures	50
266		WW31085	FILTER CHEM WASH MOTOR	4S WRF	Chem Feed	MOTOR	Motors	20
267		WW70701-2	FILTER #1 BW VAVLE 8-V-1 ACTUATOR	4S WRF	Sand Filters	ACTUATOR	Piping, Valves & Gates	15
268		WW70701-1	FILTER #1 EFF VALVE 8-V-2 ACTUATOR	4S WRF	Sand Filters	ACTUATOR	Piping, Valves & Gates	15
269		WW70702-1	FILTER #2 EFF VALVE 8-V-5 ACTUATOR	4S WRF	Sand Filters	ACTUATOR	Piping, Valves & Gates	15
270		WW70703-2	FILTER #3 BW VALVE 8-V-7 ACTUATOR	4S WRF	Sand Filters	ACTUATOR	Piping, Valves & Gates	15
271		WW70703-1	FILTER #3 EFF VALVE 8-V-8 ACTUATOR	4S WRF	Sand Filters	ACTUATOR	Piping, Valves & Gates	15
272		WW70704-2	FILTER #4 BW VALVE 8-V-10 ACTUATOR	4S WRF	Sand Filters	ACTUATOR	Piping, Valves & Gates	15
273		WW70704-1	FILTER #4 EFF VALVE 8-V-11 ACTUATOR	4S WRF	Sand Filters	ACTUATOR	Piping, Valves & Gates	15
274		WW27081	FILTER AIR COMP #1	4S WRF	Sand Filters	COMPRESS	Other	10
275		WW27401	FILTER AIR COMP RECEIVER TANK	4S WRF	Sand Filters	COMPRESS	Other	10
276		WW33081	FILTER BACKWASH MOTOR	4S WRF	Sand Filters	MOTOR	Motors	20
277		WW33082	FILTER BACKWASH MOTOR	4S WRF	Sand Filters	MOTOR	Motors	20
278	8-V-1	WW79201	FILTER BW VALVE #1, 8-V-1, 10" Butterfly	4S WRF	Sand Filters	VALVE	Piping, Valves & Gates	25
279	8-V-4	WW79202	FILTER BW VALVE #2, 8-V-4, 10" Butterfly	4S WRF	Sand Filters	VALVE	Piping, Valves & Gates	25
280	8-V-7	WW79203	FILTER BW VALVE #3, 8-V-7, 10" Butterfly	4S WRF	Sand Filters	VALVE	Piping, Valves & Gates	25
281	8-V-10	WW79204	FILTER BW VALVE #4, 8-V-10, 10" Butterfly	4S WRF	Sand Filters	VALVE	Piping, Valves & Gates	25
282	8-V-3	WW79209	FILTER BW WASTE VALVE #1, 8-V-3, 14" Butterfly	4S WRF	Sand Filters	VALVE	Piping, Valves & Gates	25
283	8-V-6	WW79210	FILTER BW WASTE VALVE #2, 8-V-6, 14" Butterfly	4S WRF	Sand Filters	VALVE	Piping, Valves & Gates	25
284	8-V-9	WW79211	FILTER BW WASTE VALVE #3, 8-V-9, 14" Butterfly	4S WRF	Sand Filters	VALVE	Piping, Valves & Gates	25
285	8-V-12	WW79212	FILTER BW WASTE VALVE #4, 8-V-12, 14" Butterfly	4S WRF	Sand Filters	VALVE	Piping, Valves & Gates	25
286	8-T-1		Filter Chemical Tank	4S WRF	Sand Filters	TANK	Storage	25
287	8-V-2	WW79205	FILTER EFF VALVE #1, 8-V-2, 10" Butterfly	4S WRF	Sand Filters	VALVE	Piping, Valves & Gates	25
288	8-V-5	WW79206	FILTER EFF VALVE #2, 8-V-5, 10" Butterfly	4S WRF	Sand Filters	VALVE	Piping, Valves & Gates	25
289	8-V-8	WW79207	FILTER EFF VALVE #3, 8-V-8, 10" Butterfly	4S WRF	Sand Filters	VALVE	Piping, Valves & Gates	25
290	8-V-11	WW79208	FILTER EFF VALVE #4, 8-V-11, 10" Butterfly	4S WRF	Sand Filters	VALVE	Piping, Valves & Gates	25
291		WW-4-P-6-VFD	Filter Inf.VFD 4-P-6	4S WRF	Filter Feed Pump Station	VFD	Electrical Gear	10

Row	EAM "Position" (Tag No.)	Asset	Description	Facility	Sub-Facility	EAM "Class"	Category	Exp. Use. Life
292	4-V-1		Filter Influent Pump Station Valve 4-V-1, 8" Gate	4S WRF		VALVE	Piping, Valves & Gates	25
293	4-V-2		Filter Influent Pump Station Valve 4-V-2, 8" Gate	4S WRF		VALVE	Piping, Valves & Gates	25
294	4-V-3		Filter Influent Pump Station Valve 4-V-3, 8" Swing Check	4S WRF		VALVE	Piping, Valves & Gates	25
295	4-V-4		Filter Influent Pump Station Valve 4-V-4, 8" Swing Check	4S WRF		VALVE	Piping, Valves & Gates	25
296	4-V-5		Filter Influent Pump Station Valve 4-V-5, 8" Gate	4S WRF		VALVE	Piping, Valves & Gates	25
297	4-V-7		Filter Influent Pump Station Valve 4-V-7, 6" Swing Check	4S WRF		VALVE	Piping, Valves & Gates	25
298	4-V-8		Filter Influent Pump Station Valve 4-V-8, 6" Swing Check	4S WRF		VALVE	Piping, Valves & Gates	25
299	4-V-9		Filter Influent Pump Station Valve 4-V-9, 6" Swing Check	4S WRF		VALVE	Piping, Valves & Gates	25
300	8-V-13		Filter Pad, Backwash water, 8-V-13, 8" Swing Check	4S WRF	Sand Filters	VALVE	Piping, Valves & Gates	25
301	8-V-14		Filter Pad, Backwash water, 8-V-14, 8" Swing Check	4S WRF	Sand Filters	VALVE	Piping, Valves & Gates	25
302	8-V-15		Filter Pad, Backwash water, 8-V-15, 8" Butterfly Check	4S WRF	Sand Filters	VALVE	Piping, Valves & Gates	25
303	8-V-16		Filter Pad, Backwash water, 8-V-16, 8" Butterfly Check	4S WRF	Sand Filters	VALVE	Piping, Valves & Gates	25
304		WW20000	FLASH MIXER PUMP	4S WRF	General	PUMP	Pumps	20
305	7-G-1		Flow EQ Basin Junction Box Sluice Gate 7-G-1	4S WRF	EQ Basins	CTLVALWW	Piping, Valves & Gates	30
306	7-G-2		Flow EQ Basin Junction Box Sluice Gate 7-G-2	4S WRF	EQ Basins	CTLVALWW	Piping, Valves & Gates	30
307	1-G-3		GATE, CHANNEL, HEADWORKS 1-G-3	4S WRF	Headworks	CTLVALWW	Piping, Valves & Gates	30
308	1-G-4		GATE, CHANNEL, HEADWORKS 1-G-4	4S WRF	Headworks	CTLVALWW	Piping, Valves & Gates	30
309	1-G-5		GATE, CHANNEL, HEADWORKS 1-G-5	4S WRF	Headworks	CTLVALWW	Piping, Valves & Gates	30
310	1-G-6		GATE, CHANNEL, HEADWORKS 1-G-6	4S WRF	Headworks	CTLVALWW	Piping, Valves & Gates	30
311	1-G-7		GATE, CHANNEL, HEADWORKS 1-G-7	4S WRF	Headworks	CTLVALWW	Piping, Valves & Gates	30
312	1-G-1	WWTP-1-G-1	GATE, CHANNEL, MOTOR OPERATED, HEADWORKS 1-G-1	4S WRF	Headworks	CTLVALWW	Piping, Valves & Gates	30
313	1-G-2	WWTP-1-G-2	GATE, CHANNEL, MOTOR OPERATED, HEADWORKS 1-G-2	4S WRF	Headworks	CTLVALWW	Piping, Valves & Gates	30
314	4-G-1		GATE, CHANNEL, Non Pot Water Pump Station 4-G-1	4S WRF	General	CTLVALWW	Piping, Valves & Gates	30
315	2-G-2		GATE, CHANNEL, OX Ditch Splitter Box 2-G-2	4S WRF	Plnt A Aeration Basin	CTLVALWW	Piping, Valves & Gates	30
316	2-G-3		GATE, CHANNEL, OX Ditch Splitter Box 2-G-3	4S WRF	Plnt B Aeration Basin	CTLVALWW	Piping, Valves & Gates	30
317	3-G-1		GATE, CHANNEL, Plant B Secondary Clarifier Splitter Box 3-G-1	4S WRF	Plnt B Sec. Clarifiers	CTLVALWW	Piping, Valves & Gates	30
318	3-G-2		GATE, CHANNEL, Plant B Secondary Clarifier Splitter Box 3-G-2	4S WRF	Plnt B Sec. Clarifiers	CTLVALWW	Piping, Valves & Gates	30
319	2-G-1	WW78806	GATE, SWING, MANUALLY OPERATED, OX DITCH B 2-G-1	4S WRF	Plnt B Aeration Basin	CTLVALWW	Piping, Valves & Gates	30
320	13-ME-1	WW14104	GENERATOR, EMERGENCY, WWTP (13-ME-1)	4S WRF	General	GENERATE	Other	25
321	1-ME-2	WW71801	GRIT CHAMBER 1-ME-2	4S WRF	Headworks	GRIT	Process Equip	15
322	1-ME-1		Headworks Bandscreen 1-ME-1	4S WRF	Headworks	BANDSCRN	Process Equip	15
323		WW69601	HEADWORKS STRUCTURE	4S WRF	Headworks	STRUCTURE	Concrete Structures	50
324	1-ME-9		Headworks Trolley Hoist No. 1	4S WRF	Headworks	HOIST	Other	25
325	1-ME-10		Headworks Trolley Hoist No. 2	4S WRF	Headworks	HOIST	Other	25
326	1-V-1		Headworks Valve 1-V-1, 4" Swing Check	4S WRF	Headworks	VALVE	Piping, Valves & Gates	25
327	1-V-2		Headworks Valve 1-V-2, 4" Swing Check	4S WRF	Headworks	VALVE	Piping, Valves & Gates	25
328		WW81601	HYDROPNEUMATIC TANK (SURGE)	4S WRF	General	TANK	Storage	25
329			Mechanical Piping - 4S Ranch WRF	4S WRF	General	PIPING-MECH	Piping, Valves & Gates	50
330		WW31407	MIXED LIQUOR RECIRC PUMP #1 MOTOR	4S WRF	General	MOTOR	Motors	20
331	1-ME-4	WW75501	INFLUENT PARSHALL FLUME, 1-ME-4	4S WRF	Headworks	STRUCTURE	Concrete Structures	50
332		WW11001	MCC-1 PLANT A	4S WRF	General	MCC	Electrical Gear	30
333		WW11002	MCC-2 PLANT A	4S WRF	General	MCC	Electrical Gear	30
334		WW31408	MIXED LIQUOR RECIRC PUMP #2 MOTOR	4S WRF	General	MOTOR	Motors	20
335	2-P-1	WW20003	MIXED LIQUOR RECIRC PUMP 2-P-1 (PLANT A)	4S WRF	Plnt A RAS/WAS PS	PUMP-RAS	Pumps	20
336	2-P-2	WW20004	MIXED LIQUOR RECIRC PUMP 2-P-2 (PLANT A)	4S WRF	Plnt A RAS/WAS PS	PUMP-RAS	Pumps	20
337	2-V-1		Mixed Liquor Recycle Pump Station Valve 2-V-1, 8" Gate	4S WRF	Plnt B Aeration Basin	VALVE	Piping, Valves & Gates	25
338	2-V-2		Mixed Liquor Recycle Pump Station Valve 2-V-2, Unk.	4S WRF	Plnt B Aeration Basin	VALVE	Piping, Valves & Gates	25
339	2-V-3		Mixed Liquor Recycle Pump Station Valve 2-V-3, Unk.	4S WRF	Plnt B Aeration Basin	VALVE	Piping, Valves & Gates	25
340	2-V-4		Mixed Liquor Recycle Pump Station Valve 2-V-4, 8" Check	4S WRF	Plnt B Aeration Basin	VALVE	Piping, Valves & Gates	25
341	8-P-14	WW71301-3	MIXER, SUBMERSIBLE, EQ #1 8-P-14	4S WRF	EQ Basins	MIXER	Process Equip	15
342	8-P-15	WW71302-3	MIXER, SUBMERSIBLE, EQ #2 8-P-15	4S WRF	EQ Basins	MIXER	Process Equip	15
343	1-ME-3	WW59102	MOTOR, HORIZONTAL BASE, .5 HP, 1765 RPM, FR-56C, GRIT CLASSIFIER 1-ME-3	4S WRF	Headworks	MOTOR	Motors	20
344	4-P-1	WW31403	MOTOR, HORIZONTAL BASE, 10 HP, 1170 RPM, FR-256TC, RAS 4-P-1	4S WRF	Plnt B RAS/WAS PS	MOTOR	Motors	20
345	4-P-2	WW31404	MOTOR, HORIZONTAL BASE, 10 HP, 1170 RPM, FR-256TC, RAS 4-P-2	4S WRF	Plnt B RAS/WAS PS	MOTOR	Motors	20
346	4-P-3	WW31405	MOTOR, HORIZONTAL BASE, 10 HP, 1170 RPM, FR-256TC, RAS 4-P-3	4S WRF	Plnt B RAS/WAS PS	MOTOR	Motors	20
347	6-EF-122	WW31510-1	MOTOR, HORIZONTAL BASE, 10 HP, 1760 RPM, FR-215T, ODOR SCUBBER (6-EF-122	4S WRF	Odor Control	MOTOR	Motors	20
348	1-EF-222	WW31509	MOTOR, HORIZONTAL BASE, 15 HP, 1765 RPM, FR-215T, ODOR SCRUBBER 1-EF-222	4S WRF	Odor Control	MOTOR	Motors	20
349	6-ME-4	WW61302	MOTOR, HORIZONTAL BASE, 2 HP, 1730 RPM, FR-45TC, CONVEYOR 6-ME-4	4S WRF	Belt Press	MOTOR	Motors	20
350	8-ME-11	WW31410	MOTOR, HORIZONTAL BASE, 3 HP, 1750 RPM, FR-182T, FILTER 8-ME-11	4S WRF	Sand Filters	MOTOR	Motors	20
351	8-ME-12	WW31409	MOTOR, HORIZONTAL BASE, 3 HP, 1750 RPM, FR-182T, FILTER 8-ME-12	4S WRF	Sand Filters	MOTOR	Motors	20
352	8-ME-13 NO.1	WW31301	MOTOR, HORIZONTAL BASE, 3/4 HP, 1750 RPM, FR-143T, FILTER 8-ME-13	4S WRF	Sand Filters	MOTOR	Motors	20
353	8-ME-13 NO.2	WW31302	MOTOR, HORIZONTAL BASE, 3/4 HP, 1750 RPM, FR-143T, FILTER 8-ME-13	4S WRF	Sand Filters	MOTOR	Motors	20
354	1-P-1	WW31401	MOTOR, HORIZONTAL BASE, 7.5 HP, 1170 RPM, FR-254T, GRIT 1-P-1	4S WRF	Headworks	MOTOR	Motors	20
355	1-P-2	WW31402	MOTOR, HORIZONTAL BASE, 7.5 HP, 1170 RPM, FR-254T, GRIT 1-P-2	4S WRF	Headworks	MOTOR	Motors	20
356	4-P-4	WW31505	MOTOR, HORIZONTAL FACE, 10 HP, 1740 RPM, FR-DT79, WAS 4-P-4	4S WRF	Plnt B RAS/WAS PS	MOTOR	Motors	20
357	4-P-5	WW31506	MOTOR, HORIZONTAL FACE, 10 HP, 1740 RPM, FR-DT79, WAS 4-P-5	4S WRF	Plnt B RAS/WAS PS	MOTOR	Motors	20
358	4S WRF INVENTORY	WW33102	MOTOR, HORIZONTAL FACE, 5 HP, 1160 RPM, FR-DV132M6	4S WRF	General	MOTOR	Motors	20
359	6-ME-1	WW33101	MOTOR, HORIZONTAL FACE, 5 HP, 1160 RPM, FR-DV132M6, BELTPRESS 6-ME-1	4S WRF	Belt Press	MOTOR	Motors	20
360	6-ME-1	WW33304	MOTOR, VERTICAL FACE, 1 HP, 1200 RPM, FR-145TC, BELTPRESS 6-ME-1	4S WRF	Belt Press	MOTOR	Motors	20
361	6-ME-2	WW33305	MOTOR, VERTICAL FACE, 1 HP, 1200 RPM, FR-145TC, BELTPRESS 6-ME-2	4S WRF	Belt Press	MOTOR	Motors	20
362	4S WRF INVENTORY	WW33203	MOTOR, VERTICAL FACE, 125 HP, 1200 RPM, FR-447LP, OX DITCH	4S WRF	Plnt B Aeration Basin	MOTOR	Motors	20
363	2-ME-3	WW33401	MOTOR, VERTICAL FACE, 15 HP, 1765 RPM, FR-254LP, OX DITCH B 2-ME-3	4S WRF	Plnt B Aeration Basin	MOTOR	Motors	20
364	4-P-12	WW20025	MOTOR, VERTICAL FACE, 25 HP, 3600 RPM, FR-L265, NON POT 4-P-12	4S WRF	General	MOTOR	Motors	20
365	2-ME-1	WW33205	MOTOR, VERTICAL FACE, 125 HP, 1200 RPM, FR-447LP, OX DITCH B 2-ME-1	4S WRF	Plnt B Aeration Basin	MOTOR	Motors	20
366	2-ME-2	WW33206	MOTOR, VERTICAL FACE, 125 HP, 1200 RPM, FR-447LP, OX DITCH B 2-ME-2	4S WRF	Plnt B Aeration Basin	MOTOR	Motors	20
367	4-P-13	WW20023	MOTOR, VERTICAL FACE, 25 HP, 3600 RPM, FR-L265, NON POT 4-P-13	4S WRF	General	MOTOR	Motors	20
369	4-P-14	WW20024	MOTOR, VERTICAL FACE, 25 HP, 3600 RPM, FR-L265, NON POT 4-P-14	4S WRF	General	MOTOR	Motors	20
370			Non Potable Water Pump Station 4" Butterfly Valve (Unmarked)	4S WRF		VALVE	Piping, Valves & Gates	25
371			Non Potable Water Pump Station 4" Butterfly Valve (Unmarked)	4S WRF		VALVE	Piping, Valves & Gates	25
372	6-FD-7	WW29031	NAOCL METERING PUMP 6-FD-7 (SCRUBBER)	4S WRF	Chem Feed	PUMP-CHEM	Pumps	8
373	6-FD-1	WW29037	NAOCL METERING PUMP 6-FD-1	4S WRF	Chem Feed	PUMP-CHEM	Pumps	8
374	6-FD-2	WW29036	NAOCL METERING PUMP 6-FD-2	4S WRF	Chem Feed	PUMP-CHEM	Pumps	8
375	6-FD-3	WW29035	NAOCL METERING PUMP 6-FD-3	4S WRF	Chem Feed	PUMP-CHEM	Pumps	8
377	6-FD-4	WW29034	NAOCL METERING PUMP 6-FD-4	4S WRF	Chem Feed	PUMP-CHEM	Pumps	8
378	6-FD-5	WW29033	NAOCL METERING PUMP 6-FD-5 (SCRUBBER)	4S WRF	Chem Feed	PUMP-CHEM	Pumps	8
379	6-FD-6	WW29032	NAOCL METERING PUMP 6-FD-6 (SCRUBBER)	4S WRF	Chem Feed	PUMP-CHEM	Pumps	8
380			Non Potable Water Pump Station 4" Butterfly Valve (Unmarked)	4S WRF		VALVE	Piping, Valves & Gates	25
381			Non Potable Water Pump Station 6" Gate Valve (Unmarked)	4S WRF		VALVE	Piping, Valves & Gates	25
382	4-V-6		Non-Potable Water Pump Station Valve 4-V-6, 6" MOV Butterfly	4S WRF		VALVE	Piping, Valves & Gates	25
383		WW71025	ODOR CONTROL CHEMICAL	4S WRF	Chem Feed	TANK	Storage	25
384		WW69000	Non-Potable Water Pump Station	4S WRF		SITE	Buildings & Sites	50
385	1-ME-7	WW83001	ODOR SCRUBBER, HEADWORKS 1-ME-7	4S WRF	Odor Control	ODOR	Process Equip	10
386	6-ME-3	WW83002	ODOR SCRUBBER, SOLIDS BLDG 6-ME-3	4S WRF	Odor Control	ODOR	Process Equip	10
387			Plant A Anoxic Tank	4S WRF	Plnt A Aeration Basin	STRUCTURE	Concrete Structures	50
388	5-V-5		Plant A DSL Pump Station 4" Check Valve 5-V-5	4S WRF	Plnt A RAS/WAS PS	VALVE	Piping, Valves & Gates	25
389	5-V-6		Plant A DSL Pump Station 4" Check Valve 5-V-6	4S WRF	Plnt A RAS/WAS PS	VALVE	Piping, Valves & Gates	25
390			Plant A DSL Pump Station 4" Eccentric Plug Valve (Unmarked)	4S WRF	Plnt A RAS/WAS PS	VALVE	Piping, Valves & Gates	25
391			Plant A DSL Pump Station 4" Eccentric Plug Valve (Unmarked)	4S WRF	Plnt A RAS/WAS PS	VALVE	Piping, Valves & Gates	25
392			Plant A DSL Pump Station 6" Eccentric Plug Valve (Unmarked)	4S WRF	Plnt A RAS/WAS PS	VALVE	Piping, Valves & Gates	25
393			Plant A DSL Pump Station 6" Eccentric Plug Valve (Unmarked)	4S WRF	Plnt A RAS/WAS PS	VALVE	Piping, Valves & Gates	25
394	2-ME-8		Plant A Oxidation Ditch Aerator No. 1	4S WRF	Plnt A Aeration Basin	MECHANICAL	Process Equip	20
395	2-ME-9		Plant A Oxidation Ditch Aerator No. 2	4S WRF	Plnt A Aeration Basin	MECHANICAL	Process Equip	20
396			Plant A RAS Pump Station 6" Eccentric Plug Valve (Unmarked)	4S WRF	Plnt A RAS/WAS PS	VALVE	Piping, Valves & Gates	25
397			Plant A RAS Pump Station 6" Eccentric Plug Valve (Unmarked)	4S WRF	Plnt A RAS/WAS PS	VALVE	Piping, Valves & Gates	25
398			Plant A RAS Pump Station 6" Eccentric Plug Valve (Unmarked)	4S WRF	Plnt A RAS/WAS PS	VALVE	Piping, Valves & Gates	25
399			Plant A RAS Pump Station 6" Eccentric Plug Valve (Unmarked)	4S WRF	Plnt A RAS/WAS PS	VALVE	Piping, Valves & Gates	25
400			Plant A RAS Pump Station 6" Eccentric Plug Valve (Unmarked)	4S WRF	Plnt A RAS/WAS PS	VALVE	Piping, Valves & Gates	25
401	4-V-22		Plant A RAS Pump Station Valve 4-V-22, 4" Check	4S WRF	Plnt A RAS/WAS PS	VALVE	Piping, Valves & Gates	25
402	4-V-23		Plant A RAS Pump Station Valve 4-V-23, 4" Check	4S WRF	Plnt A RAS/WAS PS	VALVE	Piping, Valves & Gates	25
403	4-V-24		Plant A RAS Pump Station Valve 4-V-24, 4" Check	4S WRF	Plnt A RAS/WAS PS	VALVE	Piping, Valves & Gates	25
404			Plant A RAS/WAS Pump Station Pit Structure	4S WRF	Plnt A RAS/WAS PS	STRUCTURE	Concrete Structures	50
405			Plant A Secondary Clarifier Splitter Box	4S WRF	Plnt A Sec. Clarifiers	STRUCTURE	Concrete Structures	50
406			Plant A Secondary Clarifier Structure No. 1	4S WRF	Plnt A Sec. Clarifiers	STRUCTURE	Concrete Structures	50
407			Plant A Secondary Clarifier Structure No. 2	4S WRF	Plnt A Sec. Clarifiers	STRUCTURE	Concrete Structures	50
408			Plant A WAS Pump Station 4" Eccentric Plug Valve (Unmarked)	4S WRF	Plnt A RAS/WAS PS	VALVE	Piping, Valves & Gates	25
409			Plant A WAS Pump Station 4" Eccentric Plug Valve (Unmarked)	4S WRF	Plnt A RAS/WAS PS	VALVE	Piping, Valves & Gates	25
410			Plant A WAS Pump Station 6" Eccentric Plug Valve (Unmarked)	4S WRF	Plnt A RAS/WAS PS	VALVE	Piping, Valves & Gates	25
411			Plant A WAS Pump Station 6" Eccentric Plug Valve (Unmarked)	4S WRF	Plnt A RAS/WAS PS	VALVE	Piping, Valves & Gates	25
412	4-V-25		Plant A WAS Pump Station Valve 4-V-25, 4" Check	4S WRF	Plnt A RAS/WAS PS	VALVE	Piping, Valves & Gates	25
413	4-V-26		Plant A WAS Pump Station Valve 4-V-26, 4" Check	4S WRF	Plnt A RAS/WAS PS	VALVE	Piping, Valves & Gates	25
414	5-V-1		Plant B Aereobic Digesters Valve 5-V-1, 4" MOV	4S WRF	Plnt B Aerobic Digesters	VALVE	Piping, Valves & Gates	25
415	5-V-2		Plant B Aereobic Digesters Valve 5-V-2, 4" MOV	4S WRF	Plnt B Aerobic Digesters	VALVE	Piping, Valves & Gates	25
416	5-V-3		Plant B Aereobic Digesters Valve 5-V-3, 4" MOV	4S WRF	Plnt B Aerobic Digesters	VALVE	Piping, Valves & Gates	25
417	5-V-4		Plant B Aereobic Digesters Valve 5-V-4, 4" MOV	4S WRF	Plnt B Aerobic Digesters	VALVE	Piping, Valves & Gates	25
418	2-ME-3		Plant B Anoxic Zone Mixer	4S WRF	Plnt B Aeration Basin	MIXER	Process Equip	15
419	2-ME-1		Plant B Oxidation Ditch Aerator No. 1	4S WRF	Plnt B Aeration Basin	MECHANICAL	Process Equip	20
420	2-ME-2		Plant B Oxidation Ditch Aerator No. 2	4S WRF	Plnt B Aeration Basin	MECHANICAL	Process Equip	20
421	2-ME-4		Plant B Oxidation Ditch Motorized Weir Gate	4S WRF	Plnt B Aeration Basin	MECHANICAL	Process Equip	20
422			Plant B RAS/WAS Pump Station 6" Eccentric Plug Valve (Unmarked)	4S WRF	Plnt B RAS/WAS PS	VALVE	Piping, Valves & Gates	25
423			Plant B RAS/WAS Pump Station 6" Eccentric Plug Valve (Unmarked)	4S WRF	Plnt B RAS/WAS PS	VALVE	Piping, Valves & Gates	25
424			Plant B RAS/WAS Pump Station 6" Eccentric Plug Valve (Unmarked)	4S WRF	Plnt B RAS/WAS PS	VALVE	Piping, Valves & Gates	25
425			Plant B RAS/WAS Pump Station 6" Eccentric Plug Valve (Unmarked)	4S WRF	Plnt B RAS/WAS PS	VALVE	Piping, Valves & Gates	25
426			Plant B RAS/WAS Pump Station 6" Eccentric Plug Valve (Unmarked)	4S WRF	Plnt B RAS/WAS PS	VALVE	Piping, Valves & Gates	25
427			Plant B RAS/WAS Pump Station 6" Eccentric Plug Valve (Unmarked)	4S WRF	Plnt B RAS/WAS PS	VALVE	Piping, Valves & Gates	25
428			Plant B RAS/WAS Pump Station 6" Eccentric Plug Valve (Unmarked)	4S WRF	Plnt B RAS/WAS PS	VALVE	Piping, Valves & Gates	25
429	4-V-10		Plant B RAS/WAS Pump Station Valve 4-V-10, 8" Eccentric Plug	4S WRF	Plnt B RAS/WAS PS	VALVE	Piping, Valves & Gates	25
430	4-V-11		Plant B RAS/WAS Pump Station Valve 4-V-11, 8" Eccentric Plug	4S WRF	Plnt B RAS/WAS PS	VALVE	Piping, Valves & Gates	25
431	4-V-12		Plant B RAS/WAS Pump Station Valve 4-V-12, 8" Eccentric Plug	4S WRF	Plnt B RAS/WAS PS	VALVE	Piping, Valves & Gates	25
432	4-V-13		Plant B RAS/WAS Pump Station Valve 4-V-13, 8" Eccentric Plug	4S WRF	Plnt B RAS/WAS PS	VALVE	Piping, Valves & Gates	25
433	4-V-14		Plant B RAS/WAS Pump Station Valve 4-V-14, 8" Eccentric Plug	4S WRF	Plnt B RAS/WAS PS	VALVE	Piping, Valves & Gates	25
434	4-V-15		Plant B RAS/WAS Pump Station Valve 4-V-15, 6" Swing Check	4S WRF	Plnt B RAS/WAS PS	VALVE	Piping, Valves & Gates	25

Row	EAM "Position" (Tag No.)	Asset	Description	Facility	Sub-Facility	EAM "Class"	Category	Exp. Use. Life
435	4-V-16		Plant B RAS/WAS Pump Station Valve 4-V-16, 6" Swing Check	4S WRF	Plnt B RAS/WAS PS	VALVE	Piping, Valves & Gates	25
436	4-V-17		Plant B RAS/WAS Pump Station Valve 4-V-17, 6" Swing Check	4S WRF	Plnt B RAS/WAS PS	VALVE	Piping, Valves & Gates	25
437	4-V-18		Plant B RAS/WAS Pump Station Valve 4-V-18, 6" Swing Check	4S WRF	Plnt B RAS/WAS PS	VALVE	Piping, Valves & Gates	25
438	4-V-19		Plant B RAS/WAS Pump Station Valve 4-V-19, 6" Swing Check	4S WRF	Plnt B RAS/WAS PS	VALVE	Piping, Valves & Gates	25
439	4-V-20		Plant B RAS/WAS Pump Station Valve 4-V-20, 8" Eccentric Plug	4S WRF	Plnt B RAS/WAS PS	VALVE	Piping, Valves & Gates	25
440	4-V-21		Plant B RAS/WAS Pump Station Valve 4-V-21, 8" Eccentric Plug	4S WRF	Plnt B RAS/WAS PS	VALVE	Piping, Valves & Gates	25
441	3-ME-3		Plant B Secondary Clarifier No. 1 Jib Crane	4S WRF	Plnt B Sec. Clarifiers	HOIST	Other	25
442	3-ME-4		Plant B Secondary Clarifier No. 2 Jib Crane	4S WRF	Plnt B Sec. Clarifiers	HOIST	Other	25
443			Plant B Secondary Clarifier Structure No. 1	4S WRF	Plnt B Sec. Clarifiers	STRUCTURE	Concrete Structures	50
444			Plant B Secondary Clarifier Structure No. 2	4S WRF	Plnt B Sec. Clarifiers	STRUCTURE	Concrete Structures	50
445		WW21141	PUMP #1 PLANT WASTE	4S WRF	General	PUMP	Pumps	20
446		WW21156	PUMP #1 SANITARY STATION	4S WRF	General	PUMP	Pumps	20
447		WW77802	PLANT WASTE PIT	4S WRF	General	STRUCTURE	Concrete Structures	50
448	6-FD-10	WW28001	POLYMER PUMP, METERING, SOLIDS 6-FD-10	4S WRF	Chem Feed	PUMP-CHEM	Pumps	8
449	6-FD-11	WW28002	POLYMER PUMP, METERING, SOLIDS 6-FD-11	4S WRF	Chem Feed	PUMP-CHEM	Pumps	8
450	6-FD-12	WW28003	POLYMER PUMP, METERING, SOLIDS 6-FD-12	4S WRF	Chem Feed	PUMP-CHEM	Pumps	8
451	6-FD-13	WW28004	POLYMER PUMP, METERING, SOLIDS 6-FD-13	4S WRF	Chem Feed	PUMP-CHEM	Pumps	8
452		WW21155	PUMP #1 SANITARY STATION	4S WRF	General	PUMP	Pumps	20
453		WW21142	PUMP #2 PLANT WASTE	4S WRF	General	PUMP	Pumps	20
454	4-P-2	WW20006	PUMP, HORIZONTAL CUTTER, RAS 4-P-2	4S WRF	Plnt B RAS/WAS PS	PUMP-RAS	Pumps	20
455	4-P-3	WW20005	PUMP, HORIZONTAL CUTTER, RAS 4-P-3	4S WRF	Plnt B RAS/WAS PS	PUMP-RAS	Pumps	20
456	6-P-3	WW31071	PUMP, HORIZONTAL, BELTPRESS 6-P-3	4S WRF	Belt Press	PUMP-WAS	Pumps	10
457	6-P-4	WW31072	PUMP, HORIZONTAL, BELTPRESS 6-P-4	4S WRF	Belt Press	PUMP-WAS	Pumps	10
458	1-P-1	WW20001	PUMP, HORIZONTAL, TORQUE FLOW, GRIT 1-P-1	4S WRF	Headworks	PUMP-WAS	Pumps	10
459	1-P-2	WW20002	PUMP, HORIZONTAL, TORQUE FLOW, GRIT 1-P-2	4S WRF	Headworks	PUMP-WAS	Pumps	10
460	4-P-1	WW20007	PUMP, HORZONTAL CUTTER, RAS 4-P-1	4S WRF	Plnt B RAS/WAS PS	PUMP-RAS	Pumps	20
461	4-P-4	WW22003	PUMP, PROGRESSIVE CAVITY, G1 FLANGED, WAS 4-P-4	4S WRF	Plnt B RAS/WAS PS	PUMP-WAS	Pumps	10
462	4-P-5	WW22004	PUMP, PROGRESSIVE CAVITY, G1 FLANGED, WAS 4-P-5	4S WRF	Plnt B RAS/WAS PS	PUMP-WAS	Pumps	10
463	6-P-1	WW22002	PUMP, PROGRESSIVE CAVITY, G2 OPEN THROAT, TWAS 6-P-1	4S WRF	Belt Press	PUMP-WAS	Pumps	10
464	6-P-2	WW22001	PUMP, PROGRESSIVE CAVITY, G2 OPEN THROAT, TWAS 6-P-2	4S WRF	Belt Press	PUMP-WAS	Pumps	10
465	5-P-1	WW22021	PUMP, PROGRESSIVE CAVITY, SN: 4909304-1, DSL (5-P-1)	4S WRF	Belt Press	PUMP-WAS	Pumps	10
466	3-P-1	WW12205-1	PUMP, SELF PRIMING, CENTRIFUGAL, SCUM 3-P-1	4S WRF	Plnt B Sec. Clarifiers	PUMP-SCUM	Pumps	8
467	5-P-2	WW22021-1	PUMP, PROGRESSIVE CAVITY, SN: 40755921-1, DSL (5-P-2)	4S WRF	Belt Press	PUMP-WAS	Pumps	10
468	3-P-2	WW12205-2	PUMP, SELF PRIMING, CENTRIFUGAL, SCUM 3-P-2	4S WRF	Plnt B Sec. Clarifiers	PUMP-SCUM	Pumps	8
469	4S WRF INVENTORY	WW21081	PUMP, SUBMERSIBLE, 10HP, FILTER BACKWASH	4S WRF	Sand Filters	PUMP-SUBMR	Pumps	15
470	4-P-6	WW33083	PUMP, SUBMERSIBLE, 20HP, FILTER 4-P-6	4S WRF	Sand Filters	PUMP-SUBMR	Pumps	15
471	8-P-2	WW21087	PUMP, SUBMERSIBLE, 10HP, BACKWASH 8-P-2	4S WRF	Sand Filters	PUMP-SUBMR	Pumps	15
472	8-P-3	WW21086	PUMP, SUBMERSIBLE, 10HP, BACKWASH 8-P-3	4S WRF	Sand Filters	PUMP-SUBMR	Pumps	15
474	4-P-7	WW33084	PUMP, SUBMERSIBLE, 20HP, FILTER 4-P-7	4S WRF	Sand Filters	PUMP-SUBMR	Pumps	15
475	8-P-4	WW21161	PUMP, SUBMERSIBLE, 3 HP, MUDWELL 8-P-4	4S WRF	Sand Filters	PUMP-SUBMR	Pumps	15
476	8-P-5	WW21162	PUMP, SUBMERSIBLE, 3 HP, MUDWELL 8-P-5	4S WRF	Sand Filters	PUMP-SUBMR	Pumps	15
477	2-P-5	WWTP 11-P-11	PUMP, SUBMERSIBLE, 3.8 HP, ADMIN 2-P-5	4S WRF	General	PUMP-SEWER	Pumps	15
478	2-P-6	WWTP 11-P-12	PUMP, SUBMERSIBLE, 3.8 HP, ADMIN 2-P-6	4S WRF	General	PUMP-SEWER	Pumps	15
479	4-P-12	WW-4-P-12	PUMP, VERTICAL TURBINE, NON POT 4-P-12	4S WRF	General	PUMP-VERTT	Pumps	20
480	4-P-13	WW-4-P-13	PUMP, VERTICAL TURBINE, NON POT 4-P-13	4S WRF	General	PUMP-VERTT	Pumps	20
483	8-P-12	WW71301-2	PUMP, SUBMERSIBLE, 5 HP, EQ BASIN 8-P-12	4S WRF	EQ Basins	PUMP-SUBMR	Pumps	15
484	8-P-13	WW71302-2	PUMP, SUBMERSIBLE, 5 HP, EQ BASIN 8-P-13	4S WRF	EQ Basins	PUMP-SUBMR	Pumps	15
485	6-P-5	WW12210-1	PUMP, SUBMERSIBLE, 7.5HP, FILTRATE 6-P-5	4S WRF	Sand Filters	PUMP-SUBMR	Pumps	15
486	6-P-6	WW12210-2	PUMP, SUBMERSIBLE, 7.5HP, FILTRATE 6-P-6	4S WRF	Sand Filters	PUMP-SUBMR	Pumps	15
487		WW10024	RAS PUMP 4-P-1 VFD PLANT B	4S WRF	Plnt B RAS/WAS PS	VFD	Electrical Gear	10
488	4-P-19	WW20901	RAS PUMP 4-P-19 PLANT A	4S WRF	Plnt A RAS/WAS PS	PUMP-RAS	Pumps	20
489	4-P-14	WW69000-1	PUMP, VERTICAL TURBINE, NON POT 4-P-14	4S WRF	General	PUMP-VERTT	Pumps	20
490		WW10023	RAS PUMP 4-P-2 VFD PLANT B	4S WRF	Plnt B RAS/WAS PS	VFD	Electrical Gear	10
491	4-P-20	WW20902	RAS PUMP 4-P-20 PLANT A	4S WRF	Plnt A RAS/WAS PS	PUMP-RAS	Pumps	20
492	4-P-21	WW20903	RAS PUMP 4-P-21 PLANT A	4S WRF	Plnt A RAS/WAS PS	PUMP-RAS	Pumps	20
493		WW10025	RAS PUMP 4-P-3 VFD PLANT B	4S WRF	Plnt B RAS/WAS PS	VFD	Electrical Gear	10
494		WW31502	RAS PUMP MOTOR 4-P-19 PLANT A	4S WRF	Plnt A RAS/WAS PS	MOTOR	Motors	20
495		WW31503	RAS PUMP MOTOR 4-P-20 PLANT A	4S WRF	Plnt A RAS/WAS PS	MOTOR	Motors	20
496		WW31504	RAS PUMP MOTOR 4-P-21 PLANT A	4S WRF	Plnt A RAS/WAS PS	MOTOR	Motors	20
497		WW69003	RAS WAS PIT STRUCTURE	4S WRF	Plnt B RAS/WAS PS	STRUCTURE	Concrete Structures	50
498	8-ME-1	WW70701	SAND FILTER CELL 8-ME-1	4S WRF	Sand Filters	FILTER	Process Equip	25
499	8-ME-2	WW70702	SAND FILTER CELL 8-ME-2	4S WRF	Sand Filters	FILTER	Process Equip	25
500	1-ME-6	WW3102	SAMPLER, REFRIGERATED, ALL WEATHER, HEADWORKS 1-ME-6	4S WRF	Headworks	SAMPLER	Instrumentation	7
501	8-ME-3	WW70703	SAND FILTER CELL 8-ME-3	4S WRF	Sand Filters	FILTER	Process Equip	25
502	8-ME-4	WW70704	SAND FILTER CELL 8-ME-4	4S WRF	Sand Filters	FILTER	Process Equip	25
503			Sludge Dewatering Building 4" Check Valve (Unmarked)	4S WRF	Belt Press	VALVE	Piping, Valves & Gates	25
504			Sludge Dewatering Building 4" Check Valve (Unmarked)	4S WRF	Belt Press	VALVE	Piping, Valves & Gates	25
505			Sludge Dewatering Building 4" Eccentric Plug Valve (Unmarked)	4S WRF	Belt Press	VALVE	Piping, Valves & Gates	25
506			Sludge Dewatering Building 4" Eccentric Plug Valve (Unmarked)	4S WRF	Belt Press	VALVE	Piping, Valves & Gates	25
507			Sludge Dewatering Building 4" Eccentric Plug Valve (Unmarked)	4S WRF	Belt Press	VALVE	Piping, Valves & Gates	25
508			Sludge Dewatering Building 6" Eccentric Plug Valve (Unmarked)	4S WRF	Belt Press	VALVE	Piping, Valves & Gates	25
509			Sludge Dewatering Building 6" Eccentric Plug Valve (Unmarked)	4S WRF	Belt Press	VALVE	Piping, Valves & Gates	25
510			Sludge Dewatering Building 6" Eccentric Plug Valve (Unmarked)	4S WRF	Belt Press	VALVE	Piping, Valves & Gates	25
511	6-V-1		Sludge Dewatering Building Valve 6-V-1, 6" MOV Eccentric Plug	4S WRF	Belt Press	VALVE	Piping, Valves & Gates	25
512	6-V-2		Sludge Dewatering Building Valve 6-V-2, 6" MOV Eccentric Plug	4S WRF	Belt Press	VALVE	Piping, Valves & Gates	25
513			Sludge Filtrate Pump Station Valve 6" Eccentric Plug (Unmarked)	4S WRF	Belt Press	VALVE	Piping, Valves & Gates	25
514			Sludge Filtrate Pump Station Valve 6" Eccentric Plug (Unmarked)	4S WRF	Belt Press	VALVE	Piping, Valves & Gates	25
515			Sludge Filtrate Pump Station Valve 6" Swing Check (Unmarked)	4S WRF	Belt Press	VALVE	Piping, Valves & Gates	25
516			Sludge Filtrate Pump Station Valve 6" Swing Check (Unmarked)	4S WRF	Belt Press	VALVE	Piping, Valves & Gates	25
517			Stormwater Pump Station 4" Eccentric Plug Valve (Unmarked)	4S WRF	General	VALVE	Piping, Valves & Gates	25
518			Stormwater Pump Station 4" Eccentric Plug Valve (Unmarked)	4S WRF	General	VALVE	Piping, Valves & Gates	25
519	4-V-27		Stormwater Pump Station Valve 4-V-27, 4" Check	4S WRF	General	VALVE	Piping, Valves & Gates	25
520	4-V-28		Stormwater Pump Station Valve 4-V-28, 4" Check	4S WRF	General	VALVE	Piping, Valves & Gates	25
521		WW75101	SPLITTER BOX AERATION PLANT B	4S WRF	Plnt B Aeration Basin	STRUCTURE	Concrete Structures	50
522	4-P-24	WW12213-1	STORM WATER PUMP 4-P-24	4S WRF	General	PUMP-SUBMR	Pumps	15
523	4-P-25	WW12213-2	STORM WATER PUMP 4-P-25	4S WRF	General	PUMP-SUBMR	Pumps	15
524		WW69022	STORM WATER PUMP STATION	4S WRF	General	SITE	Buildings & Sites	50
525		WW21083	TCCB SUBPUMP #1(NOW MUDWELL PUMP)	4S WRF	General	PUMP-SUBMR	Pumps	15
526		WW31511	THICKENED SLUDGE PUMP MOTOR #1	4S WRF	Belt Press	MOTOR	Motors	20
527		WW31512	THICKENED SLUDGE PUMP MOTOR #2	4S WRF	Belt Press	MOTOR	Motors	20
528	9-ME-6	WW19201	UV BANK A 9-ME-6	4S WRF	UV Disinfection	UVLIGHT	Process Equip	15
529	2-T-1	WW ANOXIC ZONE	TANK, ANOXIC ZONE B 2-T-1	4S WRF	Plnt B Aeration Basin	STRUCTURE	Concrete Structures	50
530	6-T-1	WW71023-1	TANK, CHEMICAL, SODIUM HYPOCHLORITE NO1 6-T-1	4S WRF	Chem Feed	TANK	Storage	25
531	6-T-2	WW71024-1	TANK, CHEMICAL, SODIUM HYPOCHLORITE NO2 6-T-2	4S WRF	Chem Feed	TANK	Storage	25
532	5-T-1	WW74202	TANK, DIGESTER NO1 5-T-1	4S WRF	Plnt B Aerobic Digesters	STRUCTURE	Concrete Structures	50
533	5-T-2	WW74203	TANK, DIGESTER NO2 5-T-2	4S WRF	Plnt B Aerobic Digesters	STRUCTURE	Concrete Structures	50
534	2-T-2	OXIDATION DITCH	TANK, OXIDATION DITCH B 2-T-2	4S WRF	Plnt B Aeration Basin	STRUCTURE	Concrete Structures	50
535	9-T-1	WW81121	TANK, UV CLEANING 9-T-1	4S WRF	UV Disinfection	STRUCTURE	Concrete Structures	50
536	9-ME-5	WW19202	UV BANK B 9-ME-5	4S WRF	UV Disinfection	UVLIGHT	Process Equip	15
537	9-ME-4	WW19203	UV BANK C 9-ME-4	4S WRF	UV Disinfection	UVLIGHT	Process Equip	15
538	9-ME-3	WW19204	UV BANK D 9-ME-3	4S WRF	UV Disinfection	UVLIGHT	Process Equip	15
539		WW19001	ULTRAVIOLET SYSTEM	4S WRF	UV Disinfection	UVSYSTEM	Buildings & Sites	50
540	9-ME-2	WW19205	UV BANK E 9-ME-2	4S WRF	UV Disinfection	UVLIGHT	Process Equip	15
541	9-ME-1	WW19206	UV BANK F 9-ME-1	4S WRF	UV Disinfection	UVLIGHT	Process Equip	15
542	9-ME-7	WW89801	UV GANTRY CRANE 9-ME-7	4S WRF	UV Disinfection	HOIST	Other	25
543	9-ME-8		UV Hoist	4S WRF	UV Disinfection	HOIST	Other	25
544	9-T-1		UV Lamp Clean FRP Tank	4S WRF	UV Disinfection	TANK	Storage	25
545	9-ME-9	WW25501	UV RINSE TANK BLOWER	4S WRF	UV Disinfection	BLOWER	Process Equip	20
546	4-P-22	WW22005	WAS PUMP 4-P-22 PLANT A	4S WRF	Plnt A RAS/WAS PS	PUMP-WAS	Pumps	10
547		WW10039	WAS PUMP 4-P-22 VFD PLANT A	4S WRF	Plnt A RAS/WAS PS	VFD	Electrical Gear	10
548	4-P-23	WW22006	WAS PUMP 4-P-23 PLANT A	4S WRF	Plnt A RAS/WAS PS	PUMP-WAS	Pumps	10
549		WW10040	WAS PUMP 4-P-23 VFD PLANT A	4S WRF	Plnt A RAS/WAS PS	VFD	Electrical Gear	10
550		WW10026	WAS PUMP 4-P-4 VFD PLANT B	4S WRF	Plnt B RAS/WAS PS	VFD	Electrical Gear	10
551		WW10027	WAS PUMP 4-P-5 VFD PLANT B	4S WRF	Plnt B RAS/WAS PS	VFD	Electrical Gear	10
552		WW31513	WAS PUMP MOTOR 4-P-22 PLANT A	4S WRF	Plnt A RAS/WAS PS	MOTOR	Motors	20
553		WW31514	WAS PUMP MOTOR 4-P-23 PLANT A	4S WRF	Plnt A RAS/WAS PS	MOTOR	Motors	20
554		WW14301	WWTP EMERG GEN FUEL TANK	4S WRF	General	TANK	Storage	25
555		WW5005	RAS FLOW METER PLANT A	4S WRF	Plnt A RAS/WAS PS	METER	Instrumentation	15
556		SAND FILTERS	WW Sand Filtration System	4S WRF	Sand Filters	SITE	Buildings & Sites	50
557		WW - FILTER INFLUENT PS	WWTP Filter Influent Pump Station	4S WRF		SITE	Buildings & Sites	50
558		WWTP SITE	WWTP Site	4S WRF	General	SITE	Buildings & Sites	50
559		PU47	2010 FORD F-450 / WW PLANT	4S WRF	General	VEHICLE	Other	10
560	1-ME-8		Gas Monitoring System, 1-ME-8	4S WRF	Headworks	ANALYZER	Instrumentation	7
561		WW69021	PLANT SANITARY LIFT STATION	4S WRF		SITE	Buildings & Sites	50
562		WW52211	PORTABLE DRUM MIXER	4S WRF		EQUIP	Other	30
563		WW10030	OX DITCH AERATOR #1 VFD	4S WRF	Plnt B Aeration Basin	VFD	Electrical Gear	10
564		WW10031	OX DITCH AERATOR #2 VFD	4S WRF	Plnt B Aeration Basin	VFD	Electrical Gear	10
565			Avenida Apice SPS Wet Well	Avenida Apice SPS		WETWELL	Concrete Structures	50
566			Mechanical Piping - Avenida Apice SPS	Avenida Apice SPS		PIPING-MECH	Piping, Valves & Gates	50
567	AASPS / P-1	WA50602	PUMP, SUBMERSIBLE GRINDER, MYERS, 3 HP, S/N: SBX-791202	Avenida Apice SPS		PUMP-SEWER	Pumps	15
568	AASPS / P-2	WA50603	PUMP, SUBMERSIBLE GRINDER, MYERS, 3 HP, S/N: SBX-791203	Avenida Apice SPS		PUMP-SEWER	Pumps	15
569		WW-AVENIDA APICE SPS	Avenida Apice SPS Site	Avenida Apice SPS		SITE	Buildings & Sites	50
570			Avenida Orilla SPS Wet Well	Avenida Orilla SPS		WETWELL	Concrete Structures	50
571			Mechanical Piping - Avenida Orilla SPS	Avenida Orilla SPS		PIPING-MECH	Piping, Valves & Gates	50
572		WA50029	CSPSPS1 ODOR CONTROL FAN NO1	Camino Sin Puente SPS #1		HVAC	Other	15
573			Camino Sin Puente SPS #1 Wet Well	Camino Sin Puente SPS #1		WETWELL	Concrete Structures	50
574			Mechanical Piping - Camino Sin Puente SPS #1	Camino Sin Puente SPS #1		PIPING-MECH	Piping, Valves & Gates	50
575		CSPSPS1-SITE	CSP SPS #1 Site	Camino Sin Puente SPS #1		SITE	Buildings & Sites	50
576	CSPSPS-1 / P-1	WA50589	PUMP, SUBMERSIBLE GRINDER, HYDROMATIC, 7.5 HP, S/N: G78736	Camino Sin Puente SPS #1		PUMP-SEWER	Pumps	15
577	CSPSPS-1 / P-2	WA50594	PUMP, SUBMERSIBLE GRINDER, HYDROMATIC, 7.5 HP, S/N: G78744	Camino Sin Puente SPS #1		PUMP-SEWER	Pumps	15
578			Camino Sin Puente SPS #2 Wet Well	Camino Sin Puente SPS #2		WETWELL	Concrete Structures	50

Row	EAM "Position" (Tag No.)	Asset	Description	Facility	Sub-Facility	EAM "Class"	Category	Exp. Use. Life
579			Mechanical Piping - Camino Sin Puente SPS #2	Camino Sin Puente SPS #2		PIPING-MECH	Piping, Valves & Gates	50
580	CSPSPS-2 / P-2	WA50127	PUMP, SUBMERSIBLE GRINDER, HYDROMATIC, 7.5 HP, S/N: G78746	Camino Sin Puente SPS #2		PUMP-SEWER	Pumps	15
581	CSPSPS-2 / P-1	WA50128	PUMP, SUBMERSIBLE GRINDER, HYDROMATIC, 7.5 HP, S/N: G78747	Camino Sin Puente SPS #2		PUMP-SEWER	Pumps	15
582		CSPSPS2-SITE	CSP SPS #2 Site	Camino Sin Puente SPS #2		SITE	Buildings & Sites	50
583			Camino Sin Puente SPS #3 Wet Well	Camino Sin Puente SPS #3		WETWELL	Concrete Structures	50
584			Mechanical Piping - Camino Sin Puente SPS #3	Camino Sin Puente SPS #3		PIPING-MECH	Piping, Valves & Gates	50
585		CSPSPS3-SITE	CSP SPS #3 Site	Camino Sin Puente SPS #3		SITE	Buildings & Sites	50
586	CSPSPS-3 / P-1	WA50591	PUMP, SUBMERSIBLE GRINDER, HYDROMATIC, 7.5 HP, S/N: G78740	Camino Sin Puente SPS #3		PUMP-SEWER	Pumps	15
587	CSPSPS-3 / P-2	WA50592	PUMP, SUBMERSIBLE GRINDER, HYDROMATIC, 7.5 HP, S/N: G78745	Camino Sin Puente SPS #3		PUMP-SEWER	Pumps	15
588			Camino Sin Puente SPS #4 Wet Well	Camino Sin Puente SPS #4		WETWELL	Concrete Structures	50
589			Mechanical Piping - Camino Sin Puente SPS #4	Camino Sin Puente SPS #4		PIPING-MECH	Piping, Valves & Gates	50
590			Mechanical Piping - Cerro del Sol SPS #1	Camino Sin Puente SPS #4		PIPING-MECH	Piping, Valves & Gates	50
591			Mechanical Piping - Cerro del Sol SPS #2	Camino Sin Puente SPS #4		PIPING-MECH	Piping, Valves & Gates	50
592	CSPSPS-4 / P-1	WA50126	PUMP, SUBMERSIBLE GRINDER, HYDROMATIC, 7.5 HP, S/N: G78742	Camino Sin Puente SPS #4		PUMP-SEWER	Pumps	15
593		WWCSPPS	Camino Sin Puente Pump Station	Camino Sin Puente SPS #4		SITE	Buildings & Sites	50
594		WA50131	CSP SPARE P1	Camino Sin Puente SPS #4		PUMP-SCUM	Pumps	8
595		CSPSPS4-SITE	CSP SPS #4 Site	Camino Sin Puente SPS #4		SITE	Buildings & Sites	50
596	CSPSPS-4 / P-2	WA50601	PUMP, SUBMERSIBLE GRINDER, HYDROMATIC, 7.5 HP, S/N: G04966	Camino Sin Puente SPS #4		PUMP-SEWER	Pumps	15
597			Cerro Del Sol SPS #1 Wet Well	Cerro Del Sol SPS #1		WETWELL	Concrete Structures	50
598	CDSSPS-1 / P-1	WA50607	PUMP, SUBMERSIBLE GRINDER, MYERS, 10 HP, S/N: G62311	Cerro Del Sol SPS #1		PUMP-SEWER	Pumps	15
599	CDSSPS-1 / P-2	WA50608	PUMP, SUBMERSIBLE GRINDER, MYERS, 10 HP, S/N: G62312	Cerro Del Sol SPS #1		PUMP-SEWER	Pumps	15
600		WW - CERRO DEL SOL SPS 1	Cerro Del Sol SPS 1	Cerro Del Sol SPS #1		SITE	Buildings & Sites	50
601			Cerro Del Sol SPS #2 Wet Well	Cerro Del Sol SPS #2		WETWELL	Concrete Structures	50
602		WA50609	PUMP, SUBMERSIBLE GRINDER, MYERS, 10 HP, S/N: 10028689	Cerro Del Sol SPS #2		PUMP-SEWER	Pumps	15
603		WA50610	PUMP, SUBMERSIBLE GRINDER, MYERS, 10 HP, S/N: 10028690	Cerro Del Sol SPS #2		PUMP-SEWER	Pumps	15
604		WW - CERRO DEL SOL SPS 2	Cerro Del Sol SPS 2	Cerro Del Sol SPS #2		SITE	Buildings & Sites	50
605		WA50028	DELDIOS ODOR CONTROL FAN NO1	Del Dios SPS		HVAC	Other	15
606			Del Dios SPS Wet Well	Del Dios SPS		WETWELL	Concrete Structures	50
607		WA50001	DELDIOS AIR COMPRESSER ACP-1	Del Dios SPS		COMPRESS	Other	10
608		WA50156	DELDIOS AIR COMPRESSER TANK ACP-1	Del Dios SPS		TANK	Storage	25
609		WA50009	DELDIOS CRANE NO1	Del Dios SPS		HOIST	Other	25
610		WA50119	DELDIOS INFLUENT RAW SEWAGE PUMP 1A	Del Dios SPS		PUMP-SEWER	Pumps	15
611		WA50121	DELDIOS INFLUENT RAW SEWAGE PUMP 1B	Del Dios SPS		PUMP-SEWER	Pumps	15
612		WWDDSPS	Del Dios Pump Station Site	Del Dios SPS		SITE	Buildings & Sites	50
613		WWDELDIOS-SITE	Del Dios Sewer Pump Station	Del Dios SPS		SITE	Buildings & Sites	50
614		DDSPS BUILDING	Del Dios SPS Building	Del Dios SPS		BUILDING	Buildings & Sites	50
615		WA50120	DELDIOS INFLUENT RAW SEWAGE PUMP 2A	Del Dios SPS		PUMP-SEWER	Pumps	15
616		DDSPS FLOW METER	Del Dois P/S Flow Meter	Del Dios SPS		METER	Instrumentation	15
617		WA50122	DELDIOS INFLUENT RAW SEWAGE PUMP 2B	Del Dios SPS		PUMP-SEWER	Pumps	15
618		WA50071	DELDIOS INFLUENT RAW SEWAGE PUMP MOTOR 1A	Del Dios SPS		MOTOR	Motors	20
619		WA50073	DELDIOS INFLUENT RAW SEWAGE PUMP MOTOR 1B	Del Dios SPS		MOTOR	Motors	20
620		WA50072	DELDIOS INFLUENT RAW SEWAGE PUMP MOTOR 2A	Del Dios SPS		MOTOR	Motors	20
621		WA50074	DELDIOS INFLUENT RAW SEWAGE PUMP MOTOR 2B	Del Dios SPS		MOTOR	Motors	20
622		WW14103	GENERATOR, EMERGENCY, DEL DIOS SPS	Del Dios SPS		GENERATE	Other	25
623			Mechanical Piping - Del Dios SPS	Del Dios SPS		PIPING-MECH	Piping, Valves & Gates	50
625	CSPSPS SPARE PUMP	WA50598	PUMP, SUBMERSIBLE GRINDER, HYDROMATIC, 7.5 HP, S/N: G04965	Del Dios SPS		PUMP-SEWER	Pumps	15
626	CSPSPS SPARE PUMP	WA50123	PUMP, SUBMERSIBLE GRINDER, HYDROMATIC, 7.5 HP, S/N: G78739	Del Dios SPS		PUMP-SEWER	Pumps	15
627	CSPSPS SPARE PUMP	WA50124	PUMP, SUBMERSIBLE GRINDER, HYDROMATIC, 7.5 HP, S/N: G78741	Del Dios SPS		PUMP-SEWER	Pumps	15
628	CIELO SPS SPARE PUMP	WA50605	PUMP, SUBMERSIBLE GRINDER, MYERS, 10 HP, S/N: G62310	Del Dios SPS		PUMP-SEWER	Pumps	15
629	CIELO SPS SPARE PUMP	WA50604	PUMP, SUBMERSIBLE GRINDER, MYERS, 3 HP, S/N: SBX-791204	Del Dios SPS		PUMP-SEWER	Pumps	15
630	CIELO SPS SPARE PUMP	WA50606	PUMP, SUBMERSIBLE GRINDER, MYERS, 7.5 HP, S/N: G62320	Del Dios SPS		PUMP-SEWER	Pumps	15
631		WW11033	DELDIOS SPS MOTOR CONTROL CENTER	Del Dios SPS		MCC	Electrical Gear	30
632	CIELO SPS SPARE PUMP	WA50611	PUMP, SUBMERSIBLE GRINDER, MYERS, 10 HP, S/N: 10028691	Del Dios SPS		PUMP-SEWER	Pumps	15
633		WW-SAFETY-6	FCP SELF RETRACTING LIFELINE	Fire House SPS		SAFETY	Other	15
634		WW2201	FIRE HOUSE LEVEL CONTROL SYSTEM	Fire House SPS		CONTROL	Electrical Gear	15
637		WW14302	FIRE HOUSE EMERGENCY GEN FUEL TANK	Fire House SPS		TANK	Storage	25
638		WW10021	FIRE HOUSE PUMP #1 VFD	Fire House SPS		VFD	Electrical Gear	10
639		WW10022	FIRE HOUSE PUMP #2 VFD	Fire House SPS		VFD	Electrical Gear	10
640		WW-FIREHOUSE FLOAT CONTROL	FIREHOUSE SPS SEWAGE WETWELL FLOATS	Fire House SPS		DI	Instrumentation	7
641		WW99912	Fire House AirComp/Air System	Fire House SPS		COMPRESS	Other	10
642			Fire House SPS Dry Well	Fire House SPS		STRUCTURE	Concrete Structures	50
643		WW77001	FIRE HOUSE MCC BUILDING	Fire House SPS		BUILDING	Buildings & Sites	50
644		WW11021	FIRE HOUSE MCC PANEL	Fire House SPS		MCC	Electrical Gear	30
645		WW33023	FIRE HOUSE SPS PUMP #1	Fire House SPS		PUMP-SEWER	Pumps	15
646		WW33024	FIRE HOUSE SPS PUMP #2	Fire House SPS		PUMP-SEWER	Pumps	15
647		WW14102	GENERATOR, EMERGENCY, FIREHOUSE SPS	Fire House SPS		GENERATE	Other	25
648			Mechanical Piping - Fire House SPS	Fire House SPS		PIPING-MECH	Piping, Valves & Gates	50
649		WW69101	FIRE HOUSE WET WELL	Fire House SPS		WETWELL	Concrete Structures	50
650		WW-FIREHOUSE SPS-3	FIREHOUSE SPS SUMP PUMP NO1	Fire House SPS		PUMP-SUMP	Pumps	15
651		WW-FIREHOUSE SPS-4	FIREHOUSE SPS SUMP PUMP NO2	Fire House SPS		PUMP-SUMP	Pumps	15
652		WW-FIREHOUSE SPS	FIREHOUSE SPS SITE	Fire House SPS		SITE	Buildings & Sites	50
653		ACCT - 18095820010	RPP MIDPOINT PUMP STATION	Midpoint SPS		BACKFLOW	Piping, Valves & Gates	25
654		WW51501	CARBON ODOR ABSORBER	Midpoint SPS		ODOR	Process Equip	10
655	MIDPOINT CRANE	WA50007	MIDPOINT SPS CRANE NO1	Midpoint SPS		HOIST	Other	25
656	MIDPOINT CRANE	WA50008	MIDPOINT SPS CRANE TROLLEY NO1	Midpoint SPS		HOIST	Other	25
657	MIDPOINT SUMP PUMP	WA50117	MIDPOINT SPS DRYWELL SUMP PUMP NO1	Midpoint SPS		PUMP-SUMP	Pumps	15
658	MIDPOINT SUMP PUMP	WA50118	MIDPOINT SPS DRYWELL SUMP PUMP NO2	Midpoint SPS		PUMP-SUMP	Pumps	15
659		MIDPOINT FLOW METER	MIDPOINT SPS FLOW METER	Midpoint SPS		METER	Instrumentation	15
660	MIDPOINT PLC	WWMIDPOINT1006	MIDPOINT SPS OPERATOR INTERFACE TERMINAL	Midpoint SPS		OIT	Electrical Gear	10
663	MIDPOINT BLDG	WWMIDPOINT1032	MIDPOINT SPS TRANSFER SWITCH	Midpoint SPS		ELEC	Electrical Gear	10
664	MIDPOINT GENERATOR	WW14106	GENERATOR, EMERGENCY, MIDPOINT SPS	Midpoint SPS		GENERATE	Other	25
665			Mechanical Piping - Midpoint SPS	Midpoint SPS		PIPING-MECH	Piping, Valves & Gates	50
668	MIDPOINT GENERATOR	WW14307	MIDPOINT SPS DIESEL FUEL TANK	Midpoint SPS		TANK	Storage	25
669			Midpoint SPS Dry Well	Midpoint SPS		STRUCTURE	Concrete Structures	50
670	MIDPOINT P-1	WA50060	MIDPOINT SPS INFLUENT RAW SEWAGE PUMP MOTOR NO1	Midpoint SPS		MOTOR	Motors	20
671	MIDPOINT P-2	WA50061	MIDPOINT SPS INFLUENT RAW SEWAGE PUMP MOTOR NO2	Midpoint SPS		MOTOR	Motors	20
672	MIDPOINT GAS MONITORING	WWMIDPOINT1001	MIDPOINT SPS GAS MONITOR	Midpoint SPS		SENSOR	Instrumentation	5
673	MIDPOINT GAS MONITORING	WWMIDPOINT1003	MIDPOINT SPS H2S GAS SENSOR	Midpoint SPS		SENSOR	Instrumentation	5
674	MIDPOINT GAS MONITORING	WWMIDPOINT1004	MIDPOINT SPS LEL GAS SENSOR	Midpoint SPS		SENSOR	Instrumentation	5
675	MIDPOINT GAS MONITORING	WWMIDPOINT1005	MIDPOINT SPS O2 GAS SENSOR	Midpoint SPS		SENSOR	Instrumentation	5
677	MIDPOINT P-3	WA50062	MIDPOINT SPS INFLUENT RAW SEWAGE PUMP MOTOR NO3	Midpoint SPS		MOTOR	Motors	20
678		WA50063	MIDPOINT SPS INFLUENT RAW SEWAGE PUMP MOTOR SPARE	Midpoint SPS		MOTOR	Motors	20
679	MIDPOINT WETWELL	WWMIDPOINT1027	MIDPOINT SPS REACTIVE AIR LEVEL TRANSMITTER	Midpoint SPS		XDUCER	Instrumentation	7
680	MIDPOINT WETWELL	WWMIDPOINT1034	MIDPOINT SPS SUBMERSABLE LEVEL TRANSMITTER	Midpoint SPS		XDUCER	Instrumentation	7
681	MIDPOINT P-1	WA50113	MIDPOINT SPS INFLUENT RAW SEWAGE PUMP NO1	Midpoint SPS		PUMP-SEWER	Pumps	15
682	MIDPOINT WETWELL	WWMIDPOINT1033	MIDPOINT SPS ULTRASONIC LEVEL TRANSMITTER	Midpoint SPS		XDUCER	Instrumentation	7
683	MIDPOINT WETWELL	WWMIDPOINT1035	MIDPOINT SPS WETWELL FLOAT CONTROL	Midpoint SPS		DI	Instrumentation	7
684	MIDPOINT P-2	WA50114	MIDPOINT SPS INFLUENT RAW SEWAGE PUMP NO2	Midpoint SPS		PUMP-SEWER	Pumps	15
686	MIDPOINT P-3	WA50115	MIDPOINT SPS INFLUENT RAW SEWAGE PUMP NO3	Midpoint SPS		PUMP-SEWER	Pumps	15
687	MIDPOINT BLDG	MIDPOINT BUILDING	MIDPOINT SPS BUILDING	Midpoint SPS		BUILDING	Buildings & Sites	50
688		WA50116	MIDPOINT SPS INFLUENT RAW SEWAGE PUMP SPARE	Midpoint SPS		PUMP-SEWER	Pumps	15
689	MIDPOINT ODOR CONTROL	WWMIDPOINT ODOR SCRUBBER	MIDPOINT SPS ODOR CONTROL SYSTEM	Midpoint SPS		ODOR	Process Equip	10
690			Midpoint SPS Wet Well	Midpoint SPS		WETWELL	Concrete Structures	50
691	MIDPOINT MCC	WWMIDPOINT1036	MIDPOINT SPS MCC	Midpoint SPS		MCC	Electrical Gear	30
692	MIDPOINT SIT	MIDPOINT SITE	MIDPOINT SPS SITE	Midpoint SPS		SITE	Buildings & Sites	50
693	12-V-2	NBHD1MOV-12-V-2	ACTUATOR, ELECTRIC, NBHD1 12-V-2	Neighborhood #1 SPS		ACTUATOR	Piping, Valves & Gates	15
694	12-P-7	WA50106	PUMP, SUMP, 1/2HP, NBHD1 12-P-7	Neighborhood #1 SPS		PUMP-SUMP	Pumps	15
695	12-ME-1	WW27083	COMPRESSOR, AIR, 2 STAGE RECIPRICATING, 80 GAL, NBHD1 12-ME-1	Neighborhood #1 SPS		COMPRESS	Other	10
696	12-T-2		FERRIC CHLORIDE TANK, FRP TANK	Neighborhood #1 SPS		TANK	Storage	25
697	12-ME-2	WW14101	GENERATOR, EMERGENCY, NBHD1 SPS (12-ME-2)	Neighborhood #1 SPS		GENERATE	Other	25
698			Mechanical Piping - Neighborhood #1 SPS	Neighborhood #1 SPS		PIPING-MECH	Piping, Valves & Gates	50
699	12-P-3	WA50048	MOTOR, HORIZONTAL BASE, 125 HP, 1800 RPM, FR-, NBHD1 12-P-3	Neighborhood #1 SPS		MOTOR	Motors	20
700	12-P-4	WA50049	MOTOR, HORIZONTAL BASE, 125 HP, 1800 RPM, FR-, NBHD1 12-P-4	Neighborhood #1 SPS		MOTOR	Motors	20
701		WW69807	N1 STORM WATER SUMP	Neighborhood #1 SPS		PUMP-SUMP	Pumps	15
702		WW21193	N1 STORMWATER PUMP	Neighborhood #1 SPS		PUMP-SUBMR	Pumps	15
703		WW71202	NBHD1 GLAND SEAL WATER TANK	Neighborhood #1 SPS		TANK	Storage	25
704			Neighborhood #1 SPS Wet Well	Neighborhood #1 SPS		WETWELL	Concrete Structures	50
705		WW14303	NEIGHBORHOOD 1 EMERG GEN FUEL TANK	Neighborhood #1 SPS		TANK	Storage	25
706			Neighborhood 1 SPS, Isolation Valve, Unspecified	Neighborhood #1 SPS		VALVE	Piping, Valves & Gates	25
707			Neighborhood 1 SPS, Isolation Valve, Unspecified	Neighborhood #1 SPS		VALVE	Piping, Valves & Gates	25
708	12-P-3	WA50102	PUMP, HORIZONTAL, NBHD1 12-P-3	Neighborhood #1 SPS		PUMP-SEWER	Pumps	15
709	12-P-4	WA50103-1	PUMP, HORIZONTAL, NBHD1 12-P-4	Neighborhood #1 SPS		PUMP-SEWER	Pumps	15
710	12-P-1	WA50101-2	PUMP, SUBMERSIBLE, 75HP, NBHD1 12-P-1	Neighborhood #1 SPS		PUMP-SEWER	Pumps	15
711	12-P-2	WA50101	PUMP, SUBMERSIBLE, 75HP, NBHD1 12-P-2	Neighborhood #1 SPS		PUMP-SEWER	Pumps	15
712	NBHD1 SPARE	WA50100	PUMP, SUBMERSIBLE, FAIRBANKS MORSE, 75HP (NBHD1 SPARE)	Neighborhood #1 SPS		PUMP-SEWER	Pumps	15
713	12-T-1		SURGE TANK, VERTICAL STEEL TANK	Neighborhood #1 SPS		TANK	Storage	25
714		WW11022	MCC PANEL M12M (NH1)	Neighborhood #1 SPS		MCC	Electrical Gear	30
715	12-V-9	NBHD1VALVE-12-V-9	VALVE, PLUG, 10" NBHD1 12-V-9	Neighborhood #1 SPS		VALVE	Piping, Valves & Gates	25
716	12-V-8	NBHD1VALVE-12-V-8	VALVE, PLUG, 10", NBHD1 12-V-8	Neighborhood #1 SPS		VALVE	Piping, Valves & Gates	25
717	12-V-1	NBHD1VALVE-12-V-1	VALVE, PLUG, MOTOR ACTUATED, 10", NBHD1 12-V-1	Neighborhood #1 SPS		VALVE	Piping, Valves & Gates	25
718	12-V-2	NBHD1VALVE-12-V-2	VALVE, PLUG, MOTOR ACTUATED, 10", NBHD1 12-V-2	Neighborhood #1 SPS		VALVE	Piping, Valves & Gates	25
719	12-V-6	NBHD1VALVE-12-V-6	VALVE, SWING CHECK, 10", NBHD1 12-V-6	Neighborhood #1 SPS		VALVE	Piping, Valves & Gates	25
720	12-V-7	NBHD1VALVE-12-V-7	VALVE, SWING CHECK, 10", NBHD1 12-V-7	Neighborhood #1 SPS		VALVE	Piping, Valves & Gates	25
721		NBHD1-SITE	NBHD #1 Site	Neighborhood #1 SPS		SITE	Buildings & Sites	50
722	12-G-1		WASTE WATER, MANUAL GEAR SLUICE GATE 16X16	Neighborhood #1 SPS		CTLVALWW	Piping, Valves & Gates	30
723	12-G-2		WASTE WATER, MANUAL GEAR SLUICE GATE 16X16	Neighborhood #1 SPS		CTLVALWW	Piping, Valves & Gates	30
724	12-M-1		WASTEWATER, MAGNETIC, 10", 0-2000 GPM	Neighborhood #1 SPS		METER	Instrumentation	15
725	12-V-1	NBHD1MOV-12-V-1	ACTUATOR, ELECTRIC, NBHD1 12-V-1	Neighborhood #1 SPS		ACTUATOR	Piping, Valves & Gates	15
726		NBHD1 BUILDING	Neighborhood #1 SPS Building	Neighborhood #1 SPS		BUILDING	Buildings & Sites	50
727	12-P-5	WW20701	PUMP, TURBINE, 2HP, NBHD1 12-P-5	Neighborhood #1 SPS		PUMP-SEWER	Pumps	15
728	12-P-6	WW20702	PUMP, TURBINE, 2HP, NBHD1 12-P-6	Neighborhood #1 SPS		PUMP-SEWER	Pumps	15

Row	EAM "Position" (Tag No.)	Asset	Description	Facility	Sub-Facility	EAM "Class"	Category	Exp. Use. Life
729	12-V-3	NBHD1VALVE-12-V-3	VALVE, PLUG, 10", NBHD1 12-V-3	Neighborhood #1 SPS		VALVE	Piping, Valves & Gates	25
730	12-V-4	NBHD1VALVE-12-V-4	VALVE, PLUG, 10", NBHD1 12-V-4	Neighborhood #1 SPS		VALVE	Piping, Valves & Gates	25
731	12-V-5	NBHD1VALVE-12-V-5	VALVE, PLUG, 10", NBHD1 12-V-5	Neighborhood #1 SPS		VALVE	Piping, Valves & Gates	25
732	12-V-10	NBHD1VALVE-12-V-10	VALVE, PLUG, 8", NBHD1 12-V-10	Neighborhood #1 SPS		VALVE	Piping, Valves & Gates	25
733		WA50006	NBHD3 CRANE NO1	Neighborhood #3 SPS		HOIST	Other	25
734		WA50005	NBHD3 CRANE NO1	Neighborhood #3 SPS		HOIST	Other	25
735		WA50109	NBHD3 DRYWELL SUMP PUMP NO1	Neighborhood #3 SPS		PUMP-SUMP	Pumps	15
736		WA50110	NBHD3 DRYWELL SUMP PUMP NO2	Neighborhood #3 SPS		PUMP-SUMP	Pumps	15
737		WA50020	NBHD3 ODOR CONTROL FAN NO1	Neighborhood #3 SPS		HVAC	Other	15
738			10" PLUG VALVE, 250 PSI, DI BODY, LUBRICATED PLUG VALVE	Neighborhood #3 SPS		VALVE	Piping, Valves & Gates	25
739			12" FONTAINE STAINLESS STEEL SLIDE GATES	Neighborhood #3 SPS		CTLVALWW	Piping, Valves & Gates	30
740			12" FONTAINE STAINLESS STEEL SLIDE GATES	Neighborhood #3 SPS		CTLVALWW	Piping, Valves & Gates	30
741			12" FONTAINE STAINLESS STEEL SLIDE GATES	Neighborhood #3 SPS		CTLVALWW	Piping, Valves & Gates	30
742			12" PLUG VALVE, 250 PSI, DI BODY, LUBRICATED PLUG VALVE	Neighborhood #3 SPS		VALVE	Piping, Valves & Gates	25
743			12" PLUG VALVE, 250 PSI, DI BODY, LUBRICATED PLUG VALVE	Neighborhood #3 SPS		VALVE	Piping, Valves & Gates	25
744			12" PLUG VALVE, 250 PSI, DI BODY, LUBRICATED PLUG VALVE	Neighborhood #3 SPS		VALVE	Piping, Valves & Gates	25
745			12" PLUG VALVE, 250 PSI, DI BODY, LUBRICATED PLUG VALVE	Neighborhood #3 SPS		VALVE	Piping, Valves & Gates	25
746			8" PLUG VALVE, 250 PSI, DI BODY, LUBRICATED PLUG VALVE	Neighborhood #3 SPS		VALVE	Piping, Valves & Gates	25
747			8" PLUG VALVE, 250 PSI, DI BODY, LUBRICATED PLUG VALVE	Neighborhood #3 SPS		VALVE	Piping, Valves & Gates	25
748			8" PLUG VALVE, 250 PSI, DI BODY, LUBRICATED PLUG VALVE	Neighborhood #3 SPS		VALVE	Piping, Valves & Gates	25
749			8" PLUG VALVE, 250 PSI, DI BODY, LUBRICATED PLUG VALVE	Neighborhood #3 SPS		VALVE	Piping, Valves & Gates	25
750			8" PLUG VALVE, 250 PSI, DI BODY, LUBRICATED PLUG VALVE	Neighborhood #3 SPS		VALVE	Piping, Valves & Gates	25
751			8" SWING CHECK VALVES, 250 PSI, DI BODY	Neighborhood #3 SPS		VALVE	Piping, Valves & Gates	25
752			8" SWING CHECK VALVES, 250 PSI, DI BODY	Neighborhood #3 SPS		VALVE	Piping, Valves & Gates	25
753		WA50111	NBHD3 CHEMICAL FEED NO1	Neighborhood #3 SPS		PUMP-CHEM	Pumps	8
754		WA50112	NBHD3 CHEMICAL FEED NO2	Neighborhood #3 SPS		PUMP-CHEM	Pumps	8
755			8" SWING CHECK VALVES, 250 PSI, DI BODY	Neighborhood #3 SPS		VALVE	Piping, Valves & Gates	25
756			8" SWING CHECK VALVES, 250 PSI, DI BODY	Neighborhood #3 SPS		VALVE	Piping, Valves & Gates	25
757			8" SWING CHECK VALVES, 250 PSI, DI BODY	Neighborhood #3 SPS		VALVE	Piping, Valves & Gates	25
758			Mechanical Piping - Neighborhood #3 SPS	Neighborhood #3 SPS		PIPING-MECH	Piping, Valves & Gates	50
759		WW14306	N3 DIESEL FUEL	Neighborhood #3 SPS		TANK	Storage	25
760		WA50055	NBHD3 INFLUENT RAW SEWAGE PUMP MOTOR WP-1	Neighborhood #3 SPS		MOTOR	Motors	20
761		WA50056	NBHD3 INFLUENT RAW SEWAGE PUMP MOTOR WP-2	Neighborhood #3 SPS		MOTOR	Motors	20
762		WA50107	NBHD3 INFLUENT RAW SEWAGE PUMP WP-1	Neighborhood #3 SPS		PUMP-SEWER	Pumps	15
763		WA50108	NBHD3 INFLUENT RAW SEWAGE PUMP WP-2	Neighborhood #3 SPS		PUMP-SEWER	Pumps	15
764			Neighborhood #3 SPS Dry Well	Neighborhood #3 SPS		STRUCTURE	Concrete Structures	50
765			Neighborhood #3 SPS Wet Well	Neighborhood #3 SPS		WETWELL	Concrete Structures	50
766		WW14304	NEIGHBORHOOD 3 EMERG GEN FUEL TANK	Neighborhood #3 SPS		TANK	Storage	25
767		WW14105	NEIGHBORHOOD 3 EMERGENCY GEN	Neighborhood #3 SPS		GENERATE	Other	25
768			PLUG VALVE, 250 PSI, DI BODY, LUBRICATED PLUG VALVE	Neighborhood #3 SPS		VALVE	Piping, Valves & Gates	25
769			PLUG VALVE, 250 PSI, DI BODY, LUBRICATED PLUG VALVE	Neighborhood #3 SPS		VALVE	Piping, Valves & Gates	25
770			PLUG VALVE, 250 PSI, DI BODY, LUBRICATED PLUG VALVE	Neighborhood #3 SPS		VALVE	Piping, Valves & Gates	25
771			PLUG VALVE, 250 PSI, DI BODY, LUBRICATED PLUG VALVE	Neighborhood #3 SPS		VALVE	Piping, Valves & Gates	25
772			SURGE TANK, 600 GALLON BLADDER TYPE WITH LOAD CELL	Neighborhood #3 SPS		TANK	Storage	25
773		NBHD3-SITE	NBHD #3 Site	Neighborhood #3 SPS		SITE	Buildings & Sites	50
774		WA-NBHD3 BUILDING	NBHD3 BUILDING	Neighborhood #3 SPS		BUILDING	Buildings & Sites	50
775		WW11032	NH3 MOTOR CONTROL CENTER	Neighborhood #3 SPS		MCC	Electrical Gear	30
776	11-M-3	WWOPOND1020	FLOW METER, MAGNETIC, POND 11-M-3	RW/OP Pump Station		METER	Instrumentation	15
777		WW5137	FOREBAY LEVEL	RW/OP Pump Station		XDUCER	Instrumentation	7
778		WW2221	FINAL EFFLUENT TANK LEVEL CONTROL	RW/OP Pump Station		CONTROL	Electrical Gear	15
779		WW3302	EFFLUENT CONDUCTIVITY METER	RW/OP Pump Station		ANALYZER	Instrumentation	7
780		WW5101	EFFLUENT FLOW METER	RW/OP Pump Station		METER	Instrumentation	15
781		WW5093	EFFLUENT FLOW METER	RW/OP Pump Station		METER	Instrumentation	15
782		WW5093-A	EFFLUENT FLOW METER FIT 1103	RW/OP Pump Station		METER	Instrumentation	15
783		WW12217	OP SUMP PUMP CONTROL PANEL	RW/OP Pump Station		CONTROL	Electrical Gear	15
784		WW12216	OP UNDERDRAIN SUMP PUMP CONTROL PNL	RW/OP Pump Station		CONTROL	Electrical Gear	15
785	WWTPRWPSUPS	WWTPUPS3	WWTP RWPS MCC-11m 750 UPS	RW/OP Pump Station		PS	Electrical Gear	10
786		4S RECYCLED PS	4S Treatment Plant Recycled Pump Station	RW/OP Pump Station		SITE	Buildings & Sites	50
787		WWFOREBAY	4S WRF FOREBAY WET WELL	RW/OP Pump Station		WETWELL	Concrete Structures	50
788		WW71201	FINAL EFFLUENT TANK	RW/OP Pump Station		STRUCTURE	Concrete Structures	50
789		WW10030	RECLAIM WATER PUMP #1 VFD	RW/OP Pump Station		VFD	Electrical Gear	10
790		WW10031	RECLAIM WATER PUMP #2 VFD	RW/OP Pump Station		VFD	Electrical Gear	10
791		WW11031	RECLAIM WATER MCC IIM	RW/OP Pump Station		MCC	Electrical Gear	30
792		WW10032	RECLAIM WATER PUMP #3 VFD	RW/OP Pump Station		VFD	Electrical Gear	10
793	11-P-1	WW31041	RECLAIM WATER PUMP 11-P-1	RW/OP Pump Station		PUMP-VERTT	Pumps	20
794	11-P-2	WW31042	RECLAIM WATER PUMP 11-P-2	RW/OP Pump Station		PUMP-VERTT	Pumps	20
795	11-P-3	WW31043	RECLAIM WATER PUMP 11-P-3	RW/OP Pump Station		PUMP-VERTT	Pumps	20
796		WW20031	RECLAIM WATER PUMP MOTOR 11-P-1	RW/OP Pump Station		MOTOR	Motors	20
797		WW20032	RECLAIM WATER PUMP MOTOR 11-P-2	RW/OP Pump Station		MOTOR	Motors	20
798		WW20033	RECLAIM WATER PUMP MOTOR 11-P-3	RW/OP Pump Station		MOTOR	Motors	20
799		WW12214	RECLAIM VAULT SUMP PUMP CONTROL PANEL	RW/OP Pump Station		CONTROL	Electrical Gear	15
800		WW78902	FLOW RATE CONTROL VALVE OVERFLOW POND	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
801		WWOPOND10010	OVERFLOW POND PS Flow meter	RW/OP Pump Station		METER	Instrumentation	15
802		WW69805	OVERFLOW PUMP STATION SUMP	RW/OP Pump Station		PUMP-SUMP	Pumps	15
803	11-P-5	WW21842	PUMP, SUMP, 1 HP, RECLAIM 11-P-5	RW/OP Pump Station		PUMP-SUMP	Pumps	15
804	11-P-12	WWOPOND1030	PUMP, SUMP, POND 11-P-12	RW/OP Pump Station		PUMP-SUMP	Pumps	15
805		WW79110	RECLAIM WATER MOTOR OPERATED VALVE	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
806	11-M-2	WW5202	RWPS Flow Meter FIT 1115	RW/OP Pump Station		METER	Instrumentation	15
807	11-V-4		12" Resilient Seated Gate Valve, 150 PSI	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
808	11-V-5		12" Resilient Seated Gate Valve, 150 PSI	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
809	11-V-6		12" Resilient Seated Gate Valve, 150 PSI	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
810	11-V-2		14" Resilient Seated Gate Valve, 150 PSI	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
811	11-V-3		14" Resilient Seated Gate Valve, 150 PSI	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
812	11-V-1		20" Resilient Seated Gate Valve, 150 PSI	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
813	11-V-30		4" Ball Check Valve, 150 PSI	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
814	11-V-31		4" Ball Check Valve, 150 PSI	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
815	11-V-28		4" Resilient Seated Gate Valve, 150 PSI	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
816	11-V-29		4" Resilient Seated Gate Valve, 150 PSI	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
817	11-V-17		8" Ball Check Valve, 150 PSI	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
818	11-V-18		8" Ball Check Valve, 150 PSI	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
819	11-V-25		8" Globe Valve, 150 PSI	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
820	11-V-16		8" Globe Valve, 250 PSI	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
821	11-V-20		8" Resilient Seated Gate Valve, 150 PSI	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
822	11-V-21		8" Resilient Seated Gate Valve, 150 PSI	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
823	11-V-22		8" Resilient Seated Gate Valve, 150 PSI	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
824		WW11030	MCC 11MA POND	RW/OP Pump Station		MCC	Electrical Gear	30
825		WW5138	OVERFLOW POND LEVEL TRANSDUCER	RW/OP Pump Station		XDUCER	Instrumentation	7
826	11-V-23		8" Resilient Seated Gate Valve, 150 PSI	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
827	11-V-24		8" Resilient Seated Gate Valve, 150 PSI	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
828	11-FD-1	WW29038	PUMP, CHEMICAL METERING, POND 11-FD-1	RW/OP Pump Station		PUMP-CHEM	Pumps	8
829	11-FD-2	WW29039	PUMP, CHEMICAL METERING, POND 11-FD-2	RW/OP Pump Station		PUMP-CHEM	Pumps	8
830	11-P-4	WWSUMPPUMP11-P-4	PUMP, SUMP, 1 HP, RECLAIM 11-P-4	RW/OP Pump Station		PUMP-SUMP	Pumps	15
831	11-V-26		8" Resilient Seated Gate Valve, 150 PSI	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
832	11-P-11	WWOPOND1004	PUMP, SUMP, POND 11-P-11	RW/OP Pump Station		PUMP-SUMP	Pumps	15
833	11-V-27		8" Resilient Seated Gate Valve, 150 PSI	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
834	11-V-10		8" Resilient Seated Gate Valve, 250 PSI	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
835	11-V-11		8" Resilient Seated Gate Valve, 250 PSI	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
836	11-ME-1	WW70201	STRAINER, DUPLEX, BASKET, 8", RECLAIM 11-ME-1	RW/OP Pump Station		EQUIP	Other	30
837	11-V-41	WWOPOND1035	VALVE, 12" GATE OS&Y, AVR, POND 11-V-41	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
838	11-V-42	WWOPOND1034	VALVE, 12" GATE OS&Y, AVR, POND 11-V-42	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
839	11-V-43	WWOPOND1036	VALVE, 12" GATE OS&Y, AVR, POND 11-V-43	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
840	11-V-12		8" Resilient Seated Gate Valve, 250 PSI	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
841	11-V-13		8" Resilient Seated Gate Valve, 250 PSI	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
842	11-V-15		8" Resilient Seated Gate Valve, 250 PSI	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
843	11-V-7		8" Swing Check Valve, 250 PSI	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
844	11-V-8		8" Swing Check Valve, 250 PSI	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
845	11-V-9		8" Swing Check Valve, 250 PSI	RW/OP Pump Station		VALVE	Piping, Valves & Gates	25
846			Mechanical Piping - RW/OP Pump Station	RW/OP Pump Station		PIPING-MECH	Piping, Valves & Gates	50
847	11-P-6	WW21708	PUMP, SUBMERSIBLE, 40 HP, POND S/N: 194764-0 (11-P-6)	RW/OP Pump Station		PUMP-SUBMR	Pumps	15
848	4S WRF INVENTORY	WW21707	PUMP, SUBMERSIBLE, 40 HP, POND S/N: 194764-1 (SPARE)	RW/OP Pump Station		PUMP-SUBMR	Pumps	15
849	11-M-1	WW5203	RECLAIM WATER FLOW METER	RW/OP Pump Station		METER	Instrumentation	15
850	11-G-1	WWVALVE11-G-1	POND LOWER SLUICE GATE VALVE 11-G-1	RW/OP Pump Station		CTLVALWW	Piping, Valves & Gates	30
851	11-G-2	WWVALVE11-G-2	POND MIDDLE SLUICE GATE VALVE 11-G-2	RW/OP Pump Station		CTLVALWW	Piping, Valves & Gates	30
852	11-G-3	WWVALVE11-G-3	POND TOP SLUICE GATE VALVE 11-G-3	RW/OP Pump Station		CTLVALWW	Piping, Valves & Gates	30
853	11-P-10	WWOPOND1002	PUMP, SUBMERSIBLE, 20 HP, POND 11-P-10	RW/OP Pump Station		PUMP-SUBMR	Pumps	15
854	11-P-9	WWOPOND1017	PUMP, SUBMERSIBLE, 20 HP, POND 11-P-9	RW/OP Pump Station		PUMP-SUBMR	Pumps	15
855	11-P-8	WWOPOND1014	PUMP, SUBMERSIBLE, 4.7 HP, POND 11-P-8	RW/OP Pump Station		PUMP-SUBMR	Pumps	15
856	11-P-7	WW21708-1	PUMP, SUBMERSIBLE, 40 HP, POND S/N: 20555993 (11-P-7)	RW/OP Pump Station		PUMP-SUBMR	Pumps	15
857			Mechanical Piping - SantaLuz SPS	SantaLuz SPS		PIPING-MECH	Piping, Valves & Gates	50
858	SANTA LUZ SPS P-1	WA50599	PUMP, SUBMERSIBLE GRINDER, HYDROMATIC, 7.5 HP, S/N: G04964	SantaLuz SPS		PUMP-SEWER	Pumps	15
859	SANTA LUZ SPS P-2	WA50600	PUMP, SUBMERSIBLE GRINDER, HYDROMATIC, 7.5 HP, S/N: G04967	SantaLuz SPS		PUMP-SEWER	Pumps	15
860	SANTA LUZ SPS SPARE PUMP	WA50125	PUMP, SUBMERSIBLE GRINDER, HYDROMATIC, 7.5 HP, S/N: G78737	SantaLuz SPS		PUMP-SEWER	Pumps	15
861			Santaluz SPS Wet Well	SantaLuz SPS		WETWELL	Concrete Structures	50
862	SANTA LUZ SPS SPARE PUMP	WA50590	PUMP, SUBMERSIBLE GRINDER, HYDROMATIC, 7.5 HP, S/N: G78738	SantaLuz SPS		PUMP-SEWER	Pumps	15
863	SANTA LUZ SPS P-3	WA50593	PUMP, SUBMERSIBLE GRINDER, HYDROMATIC, 7.5 HP, S/N: G78743	SantaLuz SPS		PUMP-SEWER	Pumps	15
864		SLSPS-SITE	SL SPS Site	SantaLuz SPS		SITE	Buildings & Sites	50
865		WWRWPOND	Wet Weather Overflow Pond	Seasonal Storage Reservoir		STRUCTURE	Concrete Structures	50
866		TMILLER BUILDING	Thelma Miller Reservoir Building	Thelma Miller Reservoir		BUILDING	Buildings & Sites	50
867		TMILLER SITE	Thelma Miller Reservoir Site	Thelma Miller Reservoir		SITE	Buildings & Sites	50

APPENDIX B

TM2A – 4S Ranch WRF Condition Assessments

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TECHNICAL MEMORANDUM #2A

To: **George Briest, Olivenhain Municipal Water District**
Author(s): **Phil Giori, Tom Klein (RCS), Jim Hudson (RCS)**
Reviewer(s): **Michael Hill, P.E.; Tom Falk, P.E.**
Date: **April 2, 2015**
Subject: **4S Ranch WRF Condition Assessment**

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1 INTRODUCTION

The Olivenhain Municipal Water District (District) contracted Dudek to prepare an Operations and Condition Assessment and Capital Improvement Plan for the 4S Ranch and Rancho Cielo Sanitation Districts that will guide strategic planning and investments for the District's collection, treatment, and reuse programs.

This Technical Memorandum #2A (TM2A) presents the findings from the condition assessment field investigations for the 4S Ranch Water Reclamation Facility. Technical Memorandum #2B (TM2B) presents the findings from the condition assessment field investigations for each of the District's fourteen sewer pump station facilities. Technical Memorandum #2C (TM2C) presents the findings from the condition assessment of the collection system.

2 CONDITION ASSESSMENT

2.1 Field Investigation Overview

Dudek staff performed condition assessment field investigations on November 21, 2014 and January 7, 2015 to observe and assess condition of process equipment, structures, and mechanical piping at the 4S Ranch Water Reclamation Facility. Dudek sub-consultant Rockwell Construction Services performed field investigations on January 7, 2015 to observe and assess condition of the electrical systems and components. Plant staff assisted with the investigations by providing access to facilities and providing insight relating to the operational performance and history of particular equipment units and process areas. Dudek staff and/or sub-consultants performing site investigations are hereinafter referred to as "inspector."

2.2 Condition Assessment Protocol

The condition assessment field investigations consisted of visual inspection for rust, corrosion, cracking, leaks, wear and other indications suggesting deterioration to gauge the condition of the facility components. In some cases, the Plant staff provided information regarding the condition of mechanical and electrical equipment which the inspector would not otherwise see or detect, such as operating performance, historical failures, reoccurring maintenance issues, prior rehabilitation and/or replacement, or retrofits. This information from Plant staff is included in the observations for the respective facility area as applicable. Based on the inspections, the equipment, structures, and electrical components were assigned condition designations to describe relative condition. The condition designations are explained in **Table 1**.

Table 1. Condition Assessment Designations

Condition	Description
Excellent	Observed to be new or like new. No corrosion, rust, painting deterioration or structural deficiencies detected during inspection. Wear and maintenance of the facility is appropriate for age and use intensity. Plant staff does not report any operations or maintenance deficiencies or concerns.
Good	Observed to be operating as intended with minimal corrosion, rust, painting deterioration, and no structural deficiencies. Normal wear and maintenance of the facility or components is observed but does not appear to be inhibiting performance. Plant staff does not report any significant operations or maintenance deficiencies or concerns.
Fair	Observed to be in satisfactory operating condition while containing minor corrosion, rust, painting deterioration, or structural deficiencies. Normal wear and maintenance of the facility or components is observed and more frequent inspection and monitoring by Plant Staff may be warranted. Plant staff may have reported significant operations or maintenance deficiencies related to the equipment, structure, or gear.
Poor	Observed to be functioning below acceptable operating conditions and/or exhibiting high levels of corrosion, rust, painting deterioration, or structural deficiencies. More frequent monitoring and maintenance is required. Plant staff has reported significant operations or maintenance deficiencies and concerns.

It is recommended that the District maintain its normal schedule for operating and maintenance and regular frequency of monitoring the condition of the facility equipment, structures, or gear with an "Excellent" or "Good" assessed condition. More frequent monitoring and/or maintenance may be warranted for equipment assessed to be in "Fair" condition. It is recommended that the District rehabilitate or replace equipment, structures, or gear with a "Poor" assessed condition within two to five years and more frequently maintain and monitor the condition until rehabilitation or replacement.

2.3 Condition Assessment Results

The results of the condition assessment for the treatment plant facilities are summarized in **Table 2**.

Table 2. Condition Assessment Results for Treatment Plant Facilities

Facility	Site	Mechanical	Structural	Electrical & Instrumentation
Headworks	Good	Poor to Fair	Good	Good
Splitter Box	Good	Fair	Good	Poor
Oxidation Ditch and Anoxic Tank	Good	Good	Good	Good
Secondary Clarifiers	Good	Fair to Good	Good	Good
Equalization Basins	Good	Good	Poor	Good
Tertiary Filters	Good	Fair to Good	Poor	Good
Ultraviolet Disinfection	Good	Poor	Good	Fair
Recycled Water Pump Station	Good	Fair to Good	Excellent	Fair
RAS / WAS Pump Station	Good	Good	Excellent	Good
Aerobic Digesters	Good	Fair to Good	Good	Good
Sludge Dewatering Building	Good	Fair	Excellent	Fair to Good
Chemical Feed	Good	Fair to Excellent	Excellent	Good
Non-Potable Water Pump Station	Good	Poor to Fair	Good	Good
SCADA System	Excellent	N/A	N/A	Good to Excellent
Electrical Room	Good	N/A	Excellent	Fair to Good
ATS and Switchboard	Good	N/A	N/A	Unknown
Yard/Site Electrical & Instrumentation	Good	N/A	N/A	Poor to Good

The majority of the District's wastewater treatment facilities were observed to be in "Good" to "Excellent" condition. For detailed descriptions, observations, and site photographs, see attachments. Mechanical, Structural, or Electrical condition assessments resulting in a "Poor" and "Fair" condition designations are summarized with recommendations in **Table 3**. Recommendations for replacement or rehabilitation CIP projects are defined the Capital Improvement Plan.

Table 3. Summary of "Poor" and "Fair" Condition Assessments

Category/Condition	Deficiency	Recommendation
Headworks		
Mechanical/Poor	Bandscreen and Wash/Press observed to be heavily corroded and prone to failure	Replace bandscreen in 5-yr CIP.
Mechanical/Fair	Grit Classifier exhibited moderate corrosion	Routine inspection and maintenance of Grit Classifier electrical and rotating components to maintain in proper working order. Clean equipment and restore protective coatings, as required, to prevent excessive corrosion. Replace grit classifier in 10-yr CIP.
Splitter Box		
Electrical & Instrumentation/Poor	Differential level instrumentation observed to have failed	Replace differential level instrumentation.
Mechanical/Fair	Slide gates exhibited moderate corrosion	Routine inspection and maintenance of slide gates regular exercising to maintain in proper working order. Clean gate surfaces, remove rust and apply protective coatings, as required to prevent excessive corrosion or mechanical failure.
Secondary Clarifiers		
Mechanical/Fair	Secondary Clarifier mechanical equipment exhibited moderate corrosion	Routine inspection and maintenance of clarifier mechanisms to maintain in proper working order. Establish routine clarifier inspections (3-5 year basis) and plan for rehabilitation, as required. Clean exposed surfaces, remove rust and restore protective coatings, as required to prevent excessive corrosion or mechanical failure.
Equalization Basins		
Structural/Poor	Equalization Basin liner observed to have heavy wear and discoloration from chemical dosing	Replace Basin liner or convert to concrete tanks in 5-yr CIP.
Tertiary Filters		
Mechanical/Fair	Filter blower exhibited moderate to severe corrosion	Maintain filter blower, replace as needed for interim operation. Replace equipment in recommended tertiary process upgraded in 5-yr CIP.

Category/Condition	Deficiency	Recommendation
Mechanical/Fair	Filter backwash pumps anodes observed to be heavily corroded, coating observed to be bubbled and/or cracked	Maintain filter backwash pumps. Replace anodes. Consider re-coating backwash pumps.
Structural/Poor	Steel filter tanks exhibited moderate to severe corrosion and repair frequency has increased in recent years.	Restore protective coating in interim until filter structures can be replaced. Replace tertiary filters per recommendation in Technical Memorandum #3A in 5-yr CIP.
Ultraviolet Disinfection		
Mechanical/Poor	UV Banks have tendency to fail, equipment becoming obsolete	Replace disinfection system per recommendation in Technical Memorandum #3B in 5-yr CIP.
Electrical & Instrumentation/Fair	UV Transformers exhibited corrosion Controls are obsolete and serviceability and manufacturer support is expiring	Replace UV disinfection per recommendation in Technical Memorandum #3B in 5-yr CIP.
Recycled Water Pump Station		
Mechanical/Fair	Moderate corrosion observed on pump baseplate, likely due to a leaking seal	Fix leaking seal, remove corrosion and re-coat pump base to mitigate corrosion potential and extend life.
Electrical & Instrumentation/Fair	VFD's nearing obsolescence	Replace VFD's in 10-yr CIP.
Aerobic Digesters		
Mechanical/Fair	Blowers have tendency to fail	Maintain blowers. Monitor blower temperature and construct housing for blowers to protect them from the elements.
Solids Handling Building		
Mechanical/Fair	Mechanical Piping exhibited minor to moderate corrosion and coating deterioration due to aggressive environment	Maintain mechanical piping. Remove corrosion and re-coat all piping.
Mechanical/Fair	TWAS pumps exhibited minor to moderate corrosion	Maintain TWAS pumps according to typical preventative maintenance practices. Remove corrosion and restore protective coatings, as necessary to extend useful life.

Category/Condition	Deficiency	Recommendation
Mechanical/Fair	Polymer feed pumps and skid exhibited minor to moderate rust	Maintain Polymer feed pumps and skid. Consider replacing polymer pumps on increased frequency.
Mechanical/Fair	Belt Filter Press exhibited typical wear of equipment at 10 years of use in corrosive environment	Anticipate increased monitoring and maintenance of Belt Filter Presses to ensure reliability. Recommend dewatering technology study to replace or change thickening/dewatering technology as equipment approaches end of useful life. See Technical Memorandum #3 for additional analysis and recommendation.
Chemical Feed		
Mechanical/Fair	Caustic Soda storage tank: Observed deteriorating insulation	Maintain caustic soda storage tank until replacement at end of useful life. Consider switching to lower concentration caustic when replacing tank to alleviate the need for insulation and heat-tracing.
Mechanical/Fair	Chemical pumps exhibited moderate corrosion, coating deterioration, and wear	Maintain chemical pumps, rebuild or replace as-required.
Non-Potable Water Pump Station		
Mechanical/Fair	Pumps and Mechanical Piping exhibited moderate corrosion and coating deterioration	Maintain pumps and mechanical piping. Remove rust and recoat corroded segments. Plan for complete recoating in 10-yr CIP.
Electrical Room		
Electrical & Instrumentation/Fair	Telemanique VFD's are unreliable and approaching obsolescence	Maintain VFD's while scheduling programmatic replacement of remaining Telemanique VFD's in 5-yr CIP.
Service Switchboard "S" and ATS		
Electrical & Instrumentation/Unknown	Condition of the Automatic Transfer Switch is unknown.	Perform a detailed ATS evaluation. This evaluation will require taking the entire plant offline. The recommended long-term plan is to replace the existing ATS with a two source transfer switch with bypass isolation for both sources.

Category/Condition	Deficiency	Recommendation
Electrical & Instrumentation/Unknown	Main circuit breakers have not been tested and certified since original installation in 2002.	Test and certify all main breakers through independent NETA testing. Perform regular testing for all main breakers. Ground fault testing to be performed every 2 years and full breaker testing to be performed every 3-5 years. Replace Service Switchboard "S" Main Breaker and Switchboard "6" Main Breaker.
SCADA System		
Electrical & Instrumentation/Fair	Allen-Bradley is anticipating discontinuing the production of the SLC 500 PLC Line and reducing long-term support of the MicroLogix 1400 PLC.	Replace SLC 500 PLCs with redundant ControlLogix PLCs with redundant SCADA communications media and redundant media remote I/O communications. Replace MicroLogix 1400 PLCs with CompactLogix PLCs.
Yard/Site Electrical & Instrumentation		
Electrical & Instrumentation/Poor	Bases of site lighting poles are severely corroded near sprinklers	Replace bases that are beyond salvageable. Inspect anchoring hardware below bases and replace, as required. Adjust irrigation system to reduce overspray, as applicable.

3 ATTACHMENTS

Attached are the documented observations for condition assessment of each process area within the wastewater treatment plant facility. The observations include the overview and brief description of the facility, site observations, and site visit photographs.

Headworks			
Year Built:	2002	**Major Upgrades**:	Replaced influent channel grinder with Bandscreen

Description: The headworks functions to remove screenings and grit from the raw wastewater influent before flow enters downstream biological treatment processes. The screenings removal consists of a single duty travelling band screen (JWC Bandscreen Monster) with 2 mm openings and integral grinder and wash/press. A manual bar screen is installed in a parallel bypass channel. Screened influent flows through a mechanically induced vortex-type grit chamber for grit removal before flowing by gravity into the biological treatment process. Removed grit is dewatered in a Grit Classifier.

Observations	
Site	***Condition***
General: The headworks building is accessible through a large steel roll up door and an alternate framed door entrance. Minimal cracking and no potholes were observed on the site paving.	Good
Mechanical	***Condition***
General: More corrosion was observed in the headworks than any other facility within the WRF. Corrosion in the headworks is common due to the hydrogen sulfide generation in the collection system releasing into the headspace just upstream of the headworks. Hydrogen Sulfide generation creates foul odors and corrosive conditions for mechanical equipment in the headworks. Headworks mechanical equipment should be proactively maintained to prevent excessive corrosion on equipment. Corrosive rust formation on steel or stainless steel equipment can be counteracted with commercial chemicals and mechanical abrasion. Heavily corroded hardware requires replacement.	Poor to Fair
Piping, Valves, and Gates: Minor corrosion observed on painted steel gate frames. Routine maintenance, corrosion control, and exercising should allow for extended useful life. Stainless steel material should be used when gates reach the end of useful life and must be replaced.	Good
Odor Control: The LO/PRO wet chemical scrubber odor control system was observed to be operational; foul odors were detected within the headworks, but emissions were not detected outside the building. Wet chemical scrubbers are robust and generally provide excellent odor control. Odor control vents were observed to have minor to moderate corrosion. Localized minor corrosion was observed on elements of the exterior of the primary odor control fan.	Good
Bandscreen (1-ME-1): Plant staff informed the inspector that the existing bandscreen has required more frequent maintenance as the screen has been approaching the end of its useful life. Moderate to severe corrosion was observed on the exterior stainless steel panels, fittings, enclosures, bases, hardware, and anchor bolts. It is recommended that future automatics screenings equipment should be constructed of type 316 stainless steel and be proactively maintained against corrosion to extend useful life of equipment.	Poor
Bar Screen (1-ME-5): The manual bar screen is used as a bypass screen in the event that the automatic bandscreen fails. Minimal corrosion was observed on the manual bar screen.	Good

Grit Classifier (1-ME-3): The Grit Classifier was observed to have minor to moderate corrosion; District staff reported that the equipment had been recently overhauled including new conveyor screw; grit equipment tends to wear faster than other headworks equipment and increased monitoring and maintenance is recommended to keep the single duty unit operational.	Fair
Grit Chamber (1-ME-2): The interior of the grit chamber was not inspected. Minimal corrosion observed on mechanical drive and motor of the vertical turbine grit chamber mixer. Corrosion observed on gear drive nuts and bolts. Recommend replacing corroded nuts and bolts prior to excessive corrosion causing inconvenient maintenance due to nut and bolt sticking.	Good
Grit Pumps (1-P-1, 1-P-2): Minimal corrosion observed on the Wemco grit pumps. District staff did not note any performance deficiencies or concerns with the existing pumps. Current maintenance practices appear to be effective at prolonging the useful life of the pumps.	Good
Structural	***Condition***
General: Hydrogen Sulfide generation creates corrosive conditions for structural channels and concrete. No cracking, chipping, or corrosion of the concrete observed on the headworks building or structure. No structural deficiencies were identified on the slump block CMU headworks building. The steel roll-up door was observed to have minor to moderate corrosion.	Good
Structural Channels: The headworks channels are concrete with T-lock liner. No cracking or bubbling of the liner and no indications of concrete corrosion behind the liner were observed. The channel liner should be monitored for bubbling or tears exposing the concrete to the corrosive influent wastewater.	Good
Grit Chamber: The interior of the grit chamber was not inspected.	Unknown
Electrical & Instrumentation	***Condition***
General: More corrosion was observed in this area than other plant areas due to the more aggressive corrosive environment. Instrumentation was observed to be operational.	Good
Lighting: The existing high pressure sodium lighting within the Headworks Building is outdated and inefficient. Newer, more energy efficient lighting and skylights could improve lighting within the building and additionally reduce electrical usage and costs.	Fair
Recommendations	
1. Replace bandscreen in 5-yr CIP. 2. Routine inspection and maintenance of Grit Classifier electrical and rotating components to maintain in proper working order. Clean equipment and restore protective coatings, as required, to prevent excessive corrosion. Replace grit classifier in 10-yr CIP. 3. Replace outdated and inefficient high pressure sodium lights with more energy efficient lights (e.g. LED lights) and install skylights to minimize daytime on-peak electrical usage in the headworks building.	

Site Photographs	
 Corrosion on chute from screen to grinder, wash/press	 Corrosion on Bandscreen and fittings
 Corrosion on wash/press	 Corrosion on Bandscreen

Corrosion on Grit Classifier

Corrosion on Bandscreen

Outdoor local control panel pitted operators

Outdoor local control panel

Headworks Odor Control Scrubber

Minor corrosion on headworks odor control fan

Splitter Box			
Year Built:	2002	**Major Upgrades**:	None

Description: The splitter box is a concrete structure that directs Plant Influent to the Plant B or Plant A biological process train.

Observations	
Site	***Condition***
General: The splitter box is accessible by a short stairway to the top of the splitter box. Landscaping around the splitter box was in good condition.	Good
Mechanical	***Condition***
General: Minor corrosion observed. Splitter box does not contain any large mechanical equipment.	Good
Piping, Valves, and Gates: Minor corrosion observed on painted steel gate frames. Routine maintenance, corrosion control, and exercising should allow for extended useful life. Stainless steel material should be used when gates reach the end of useful life and must be replaced.	Good
Structural	***Condition***
General: No cracking or corrosion was observed on the exterior of the splitter box structure. The interior concrete was not inspected. No corrosion or structural deficiencies were observed on the steel stairway, railings, and grating.	Good
Electrical & Instrumentation	***Condition***
General: Instrumentation was observed to have failed.	Poor
Flow measurement: The Milltronics differential level system installed for measuring Plant B flow is not operational. The Milltronics flow measurement would have to be repaired or replaced to put Plant A online. The total measured flow minus the Plant B flow measured at the Splitter Box equals the Plant A calculated flow.	Poor

Recommendations

1. Replace differential level instrumentation.
2. Routine inspection and maintenance of slide gates regular exercising to maintain in proper working order. Clean gate surfaces, remove rust and apply protective coatings, as required to prevent excessive corrosion or mechanical failure.

Site Photographs	
	
Splitter Box Milltronics Level (Flow) Sensor	Rust on Steel gate frame

Oxidation Ditch and Anoxic Tank			
Year Built:	2002	**Major Upgrades**:	None

Description: The Plant B biological treatment process train is an extended aeration activated sludge (EAAS) process utilizing an Oxidation Ditch with two vertical turbine mechanical aerators and a pre-anoxic tank for denitrification. The anoxic tank is mixed by a single vertical turbine mechanical mixer. The two oxidation ditch aerators are controlled by variable frequency drives (VFD's) to control aeration input for better process control.

Observations	
Site	***Condition***
General: The oxidation ditch is a large concrete structure mostly below grade, with an approximately five foot extension above grade. The area surrounding the tank is asphalt paved. Minimal cracking and potholes were observed on the site paving. The anoxic tank mixer is accessed by a concrete pier extending out to the center of the tank, while the oxidation ditch aerators are accessed on two separate platforms, accessible by stairs on either side, that extend across the width of the oxidation ditch. All access stairs and platforms have safety railings surrounding the perimeter. No safety concerns or site deficiencies were observed.	Good
Mechanical	***Condition***
General: Foaming was observed in both the Anoxic Tank and Oxidation Ditch and the District has installed sprinklers in both areas in attempt to reduce foaming. The District has not shut down the Oxidation Ditch since it began operations in 2002; as a result, the Oxidation Ditch has not been cleaned.	Good
Oxidation Ditch Aerators (2-ME-1, 2-ME-2): No performance deficiencies or excessive noise or vibration were observed during inspection; however, Plant staff indicated that failure of the main aerators has occurred in the past resulting in major operational inconveniences and treatment performance challenges. District staff reported that both the 125 horsepower vertical turbine aerator motors were replaced approximately two years ago (c.2013). Minimal corrosion was observed on the aerator motors, mechanical drive, anchor bolts, and fittings.	Good
Anoxic Tank Mixer (2-ME-3): No deficiencies were observed during inspection; however, Plant staff indicated that failure of the anoxic tank mixer has occurred in the past resulting in major operational inconveniences and treatment performance challenges. Minor to moderate corrosion was observed on the base of the Anoxic Tank mixer and should be corrected to preserve reliability of this critical, singular-duty equipment component.	Fair
Structural	***Condition***
General: Slime buildup was observed at the waterline of the Anoxic Tank and Oxidation Ditch – although no concrete corrosion was observed, this slime layer, if not proactively controlled, can create conditions suitable for sulfate reducing bacteria to proliferate and create potential for concrete corrosion. No corrosion or structural deficiencies were observed on the steel stairways, railings, or platforms.	Good

<table>
<tr><td><u>Concrete</u>: Staining of the Oxidation Ditch concrete structure was observed in areas of higher exposure to mixed liquor near mechanical aerators. The discoloration of the concrete is common from long exposure to the aerated mixed liquor. The concrete should be monitored for chipping, cracking, or holes exposing structural reinforcement to corrosive conditions. No chipping, cracking, or holes were observed on the concrete structure.</td><td>Good</td></tr>
<tr><th>Electrical & Instrumentation</th><th>Condition</th></tr>
<tr><td><u>General</u>: The two-speed aerator motors were replaced with single-speed motors driven by VFD's. The control variable for the VFD speed is Dissolved Oxygen (DO) and an interlocked loop intended to adjust effluent weir in order to control vertical turbine aerator submergence. The responsiveness and effectiveness of the DO control program could not be confirmed.</td><td>Good</td></tr>
<tr><th colspan="2">Recommendations</th></tr>
<tr><td colspan="2">1. Clean corrosive rust off base of Anoxic Tank mixer. Rust can be removed from steel surfaces using commercial chemicals and/or mechanical abrasion.</td></tr>
<tr><th colspan="2">Site Photographs</th></tr>
<tr><td>
Anoxic Tank</td><td>
Oxidation Ditch</td></tr>
</table>

 Corrosion on base of Anoxic Tank Mixer	 Oxidation Ditch Aerator

Secondary Clarifiers			
Year Built:	2002	**Major Upgrades**:	None

Description: Secondary clarification is used for solids separation to settle mixed liquor solids for recycling and wasting and separate floatables and scum for removal. The plant utilizes two circular center feed clarifiers.

Observations	
Site	***Condition***
General: The secondary clarifiers are two circular 65 foot diameter large concrete structures mostly below grade, with an approximately five foot extension above grade. The area surrounding the tanks are primarily asphalt paved, with some landscaping along the northwest sides. Minimal cracking and potholes were observed on the site paving. The secondary clarifier mechanical equipment is accessed by a steel pier extending out to the center of the tank. All access stairs and platforms have safety railings surrounding the perimeter. No safety concerns or site deficiencies were observed.	Good
Mechanical	***Condition***
General: District operations staff did not report any operational deficiencies with the Secondary Clarifiers. Reportedly, the District took the secondary clarifiers offline approximately 2 years ago (c.2013) for inspection and re-coating. In general minimal corrosion was observed.	Good
Clarifiers Mechanical Equipment (3-ME-1, 3-ME-2): Minor to moderate corrosion was observed on the mechanical equipment. Current observed minor corrosion is cosmetic and not expected to hinder operational performance; however, preventative maintenance should correct these deficiencies to prolong useful life and ensure operational reliability. Minor rust was observed on the Secondary Clarifier weirs. Skimmer was observed to be operating effectively in both clarifiers, and no significant jolting, bouncing, or wavering was observed.	Fair
Scum Pumps: Scum Pumps are Wemco Self-Priming Centrifugal style pumps. Original scum pumps were recently replaced with current Wemco pumps about 2 years ago (c.2013). No corrosion or operational deficiencies observed.	Excellent
Structural	***Condition***
General: Minimal to no structural corrosion observed. Both secondary clarifiers were in operation during inspection.	Good
Concrete: Minimal concrete staining observed along the top of the concrete clarifiers structure. No cracking, chipping, or holes observed in the concrete. No structural reinforcement corrosion observed.	Good
Electrical & Instrumentation	***Condition***
General: No major electrical equipment installed at this facility. No electrical or instrumentation performance deficiencies observed during inspection or noted by District staff.	Good

Recommendations

1. Routine inspection and maintenance of clarifier mechanisms to maintain in proper working order. Establish routine clarifier inspections (3-5 year basis) and plan for rehabilitation, as required. Clean exposed surfaces, remove rust and restore protective coatings, as required to prevent excessive corrosion or mechanical failure.

Site Photographs	
 Secondary Clarifier	 Secondary Clarifier
 Minor Rust on Secondary Clarifier Mechanical and Weirs	 Minor Rust on Secondary Clarifier Drive, localized at coating breach
 Scum Pumps	 Clarifier structure and skimmer

Equalization Basins			
Year Built:	2002	**Major Upgrades**:	None

Description: The plant utilizes two flow equalization basins to equalize secondary effluent flow prior to tertiary filtration. The basins are instrumental in regulating flow to the tertiary filters and allowing for optimized filter influent pumping schedule during off-peak electric hours.

Observations	
Site	***Condition***
General: The flow equalization basins are two earthen ponds with a liner. The basins are surrounded by guard railings for safety. The surrounding site is primarily paved, and minimal cracking was observed in the site pavement.	Good
Mechanical	***Condition***
General: The facility does not contain any visible significant mechanical components. No performance deficiencies were observed during inspection or noted by District staff.	Good
Structural	***Condition***
General: Minimal concrete and structural elements at this facility. No deficiencies observed.	Good
Concrete: Minimal concrete located at this facility. Minimal to no cracking, chipping, or holes observed in site concrete surrounding the equalization basins.	Good
EQ Basin Liner: Deterioration of basin liners was observed. The liner on the basins' walls and floor had been repaired at multiple locations. Repair patches for the liner are visible in both equalization ponds. Discoloration and wear of the liner was observed, especially in locations where the District doses the basins with sodium hypochlorite for algae control and pre-filtration oxidation. The District is currently pursuing a project which will modify the equalization basins by constructing new straight wall concrete structures and re-routing inlet and outlet piping to promote mixing and basin turnover.	Poor
Electrical & Instrumentation	***Condition***
General: No major electrical equipment installed at this facility. No electrical or instrumentation performance deficiencies observed during inspection or noted by District staff.	Good

Recommendations
1. Replace Basin liner or convert to concrete tanks in 5-yr CIP.

Site Photographs	
 Equalization Basin	 Equalization Basin
 Equalization basin liner wear and discoloration	 Equalization basin liner wear and discoloration

Tertiary Filters			
Year Built:	2002	**Major Upgrades**:	None
Description: The tertiary filters treat secondary effluent with turbidity and particulate removal to condition effluent for disinfection. The plant operates four granular media tertiary filters (Hydroclear) in above-grade painted steel tanks			

Observations	
Site	***Condition***
General: The granular media tertiary filters are comprised of four coated steel filter tanks with common wall construction. The filter tanks are on grade, and can be accessed by a stairway to a grated platform that runs along the four cells. The site is in close proximity to the sludge dewatering building and the ultraviolet disinfection channel.	Good
Mechanical	***Condition***
General: Reportedly, the filter's granular media has not been replaced for about ten years (c.2004). No performance deficiencies were observed.	Good
Piping, Valves, and Gates: Minimal corrosion was observed on the mechanical piping and valves for the tertiary filters. Minimal to no coating deterioration was observed. Valves and valve actuators were observed to be functioning properly and no reported problems were noted by District staff.	Good
Filter Blowers: Moderate corrosion was observed on one of the filter blowers. Preventative maintenance should correct these deficiencies to prolong useful life and ensure operational reliability.	Fair
Filter Backwash Pumps: The tertiary filters were Coating on both filter backwash pumps was observed to be bubbled and cracked. Coating bubbling and cracking on submersible pumps can be caused by overheating. The pumps should be continually monitored for signs of wear and performance loss. Severe corrosion was observed on both of the filter backwash pump anodes.	Fair
Structural	***Condition***
General: No corrosion or structural deficiencies were observed on the stairway, grating, and handrails.	Good
Painted Steel Tanks (8-ME-1, 8-ME-2, 8-ME-3, 8-ME-4): Moderate to severe corrosion was observed on the interior of the steel filter tank and weirs and operations staff reported the need for spot repairs in recent years. While steel tanks are commonly used in the water industry, the filter tank configuration (square with internal and external reinforcement), intricate jointing, and equipment mounting make the application, maintenance, and rehabilitation of a competent coating difficult. Corrosion should be removed and protective coating repaired as soon as observed to extend useful life and mitigate potential of structural failure.	Poor
Electrical & Instrumentation	***Condition***
General: The US Filter Control Panel includes an Allen-Bradley SLC 5/05 PLC. US Filter did not provide an annotated program to the District which is needed for maintenance purposes.	Good

Recommendations
1. Maintain filter blower, replace as needed for interim operation. Replace equipment in recommended tertiary process upgraded in 5-yr CIP. 2. Maintain filter backwash pumps. Replace anodes. Re-coat backwash pumps. 3. Restore protective coating in interim until filter structures can be replaced. Replace tertiary filters per recommendation in Technical Memorandum #3A in 5-yr CIP.

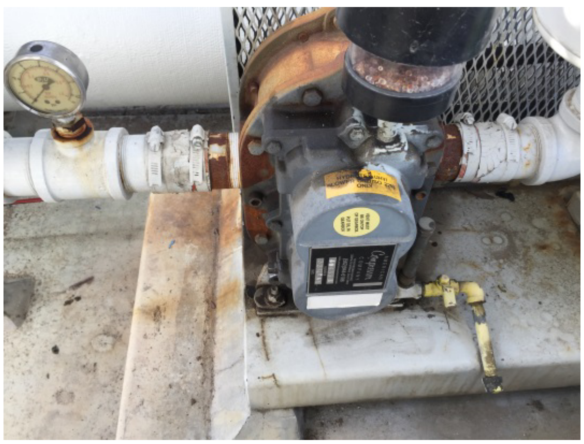
Site Photographs

Tertiary Filters and mechanical piping

Filter bed corrosion and wear

Filter bed corrosion and wear

Filter bed corrosion and wear

 **Filter turbidity analyzers**	 **Filter panel SLC 5/05 PLC**
 **Rust on filter blower**	 **Corrosion of anode and bubbling/cracking of filter backwash pump coating**

Ultraviolet Disinfection	
Year Built: 2002	**Major Upgrades**: None
Description: Ultraviolet radiation is utilized to disinfect filtered water to achieve Title 22 standards for unrestricted reuse. Six ultraviolet light banks (Trojan UV 3000) are installed in a retrofitted open channel previously used for chlorine disinfection.	
Observations	
Site	***Condition***
General: The Trojan UV3000 ultraviolet disinfection system was retrofitted into the pre-existing chlorine contact channel during the major plant expansion in 2002. The site is paved with concrete, and the ultraviolet disinfection channels are covered with steel plates. A large jib crane is installed to hoist the UV disinfection banks out of the channel for cleaning and maintenance. A tank for phosphoric acid is used for dunking the UV banks to clean scum buildup on the bulbs. No cracking or structural deficiencies were observed in the site concrete.	Good
Mechanical	***Condition***
General: Minor to moderate corrosion was observed on the UV bank fittings and hardware. Steel hardware used to secure the UV disinfection banks are corroding and require cleaning. Corrosive rust formation on steel or stainless steel equipment can be counteracted with commercial chemicals and mechanical abrasion. Heavily corroded hardware requires replacement.	Fair
UV Disinfection System (9-ME-1…9-ME-6): The current Trojan UV 3000 system has been discontinued and soon will not be supported by the manufacturer. Cleaning the UV lamps is labor intensive. No corrosion was observed on the banks of lamps; however, corrosion is forming on the steel hardware securing the banks to the disinfection channel. The Plant staff reported concerns of occasional premature UV bulb failure and associated unreliability of modules. This unit process is designated as poor condition due to obsolescence of the Trojan UV 3000 system and discontinuation of the singularly permitted UV lamp. Refer to companion TM3B for detailed evaluation of disinfection system alternatives.	Poor
Structural	***Condition***
General: No severe structural deficiencies were observed. No corrosion or deficiencies observed on hand railing separating the tertiary filters facility and the UV disinfection facility.	Good
Concrete: Concrete discoloration and small holes were observed in the unlined UV disinfection channel. Discoloration patters suggests minimal water infiltration through the concrete is present. The concrete channel is vulnerable to concrete corrosion because the channel is unlined, and should be monitored for cracking, chipping, and corrosion. Overall, minimal concrete corrosion and deterioration was observed in the disinfection channel.	Good
Electrical & Instrumentation	***Condition***
General: Wear and corrosion was observed on the UV transformers due to outdoor installation. Transformers are installed outside without additional protection.	Fair
Recommendations	
1. Replace disinfection system per recommendation in Technical Memorandum #3B in 5-yr CIP.	

Site Photographs

UV disinfection banks

On-line UV bank in channel

Rust on UV transformer

UV disinfection banks

Recycled Water Pump Station			
Year Built:	2002	**Major Upgrades**:	None

Description: The recycled water pump station consists of three 75 HP Fairbanks Morse vertical turbine pumps housed in a pump building on the west side of the WRF site near the entrance from Dove Canyon Road. The recycled water pumps draw recycled water from the forebay and pump recycled water from the water reclamation facility to the Thelma Miller Reservoir and recycled water customers.

Observations	
Site	***Condition***
General: The site is clean and well maintained. No graffiti or vandalism was observed. Minimal site concrete cracking or deficiencies. The pump building is locked for additional security.	Good
Mechanical	***Condition***
General: The recycled water pumps are typically operated at night to take advantage of off-peak electric rates.	Fair to Good
Piping, Valves, and Gates: Minimal corrosion was observed on the mechanical piping and valves. Minor corrosion and coating deterioration was observed on the mechanical piping and valves outside of the pump building. Deteriorating or chipped coatings should be cleaned and re-coated as soon as observed. To extend useful life of the piping and valves.	Good
Recycled Water Pumps (11-P-1, 11-P-2, 11-P-3): Minor to moderate corrosion was observed on the baseplate of the pumps, especially pump 11-P-2, which appeared to be the result of a leaking seal. Leaking seal should be fixed and corrosion should be removed and protective coating repaired as soon as observed to extend useful life. The recycled water pumps were not operated during inspection. Operations staff did not identify any mechanical or performance deficiencies associated with the recycled water pumps.	Fair
Structural	***Condition***
General: A stairway leads from outside the recycled water pump station building down into the valve vault. No corrosion or structural deficiencies with the stairway were observed.	Excellent
Vault Structure: No concrete deterioration, cracking, or corrosion was observed in the vault structure.	Excellent
Electrical & Instrumentation	***Condition***
General: The recycled water pump station contains on-site motor control centers (MCCs) variable frequency drives (VFD's) and programmable logic controllers (PLC's).	Good
PLC: The PLC Control Section within the MCC includes an Allen-Bradley SLC 5/05 PLC and N-Tron Industrial Ethernet switch with integral fiber optic ports. No deficiencies observed in this control section. It is recommended that the SLC 5/05 PLC is replaced with ControlLogix PLC's in the mid to long term, since the SLC 5/05 PLC's are to be discontinued in about 5 years.	Good
Lighting: The lighting panel is full and the District should consider expanding to two lighting panels or one larger lighting panel to allow for spare breaker locations if expansion of this facility is required in the future.	Good

VFD's: The District should consider replacing the thirteen year old Telemecanique VFDs. The Telemecanique VFDs do not have isolated control sections which produces unsafe maintenance routines. Electrical gear reaches obsolescence around 15 years resulting in challenges with procuring spare parts and manufacturer support.	Fair

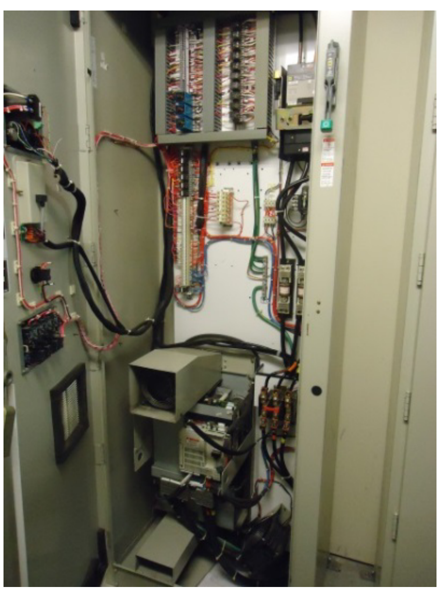
Recommendations

1. Fix leaking seal on pump 11-P-2, remove corrosion and re-coat pump base to mitigate corrosion potential and extend life.
2. Replace VFD's in 10-yr CIP.

Site Photographs

Recycled water pumps

Minor Rust on baseplate of recycled water pump



Telemecanique VFD

PLC-3 control panel interior view

Pump station water quality analyzers

Mini power station, combo transformer and panelboard

RAS/WAS Pump Station			
Year Built:	2002	**Major Upgrades**:	None

Description: The RAS/WAS pump station is located in between the two large circular secondary clarifiers in a below grade concrete structure. The facility consists of three 10 HP Vaughn Chopper RAS pumps, two duty, one standby, and two 10 HP Moyno progressive cavity WAS pumps, one duty, one standby. The pump station pumps Return Activated Sludge (RAS) to the Plant B splitter box and Waste Activated Sludge (WAS) to the solids handling building for thickening.

Site Observations	
Site	***Condition***
General: The RAS/WAS pump station is located in a below grade concrete structure. No graffiti or vandalism was observed. No cracking or deficiencies observed in site concrete.	Good
Mechanical	***Condition***
General: Pipe supports and hardware were generally observed to be in good condition with minimal corrosion.	Good
Piping, Valves, and Gates: Localized, minor to moderate corrosion was observed on the mechanical piping and valves, primarily at exposed metallic surfaces where external coating has been breached. One of the RAS pumps had been removed during the inspection, allowing for inspection of the interior of the mechanical piping. No corrosion or lining deficiencies were observed on the interior of the mechanical piping.	Good
RAS Pumps (4-P-1, 4-P-2, 4-P-3): RAS pumps are Vaughn Chopper pumps (horizontal cutter style). Minor corrosion was observed on the RAS pumps. No operational deficiencies were observed during inspection. District staff noted that the RAS pumps have a tendency to clog in the instance of a bandscreen failure in the headworks resulting in operational and maintenance nuisance.	Good
WAS Pumps (4-P-4, 4-P-5): WAS pumps are Moyno G1 flanged progressive cavity pumps. Minor corrosion was observed on the WAS pumps. No operational deficiencies were observed.	Good
Structural	***Condition***
General: No corrosion or structural deficiencies was observed on grating, stairs, and handrails.	Excellent
Concrete: No cracking, chipping, holes, or corrosion was observed on the concrete structure.	Excellent
Electrical & Instrumentation	***Condition***
General: No major electrical equipment installed at this facility. No electrical or instrumentation performance deficiencies observed during inspection or noted by District staff.	Good

Recommendations
No recommendations.

Site Photographs

RAS/WAS pump station structure

Removed RAS pump

Interior of RAS piping

WAS Pumps

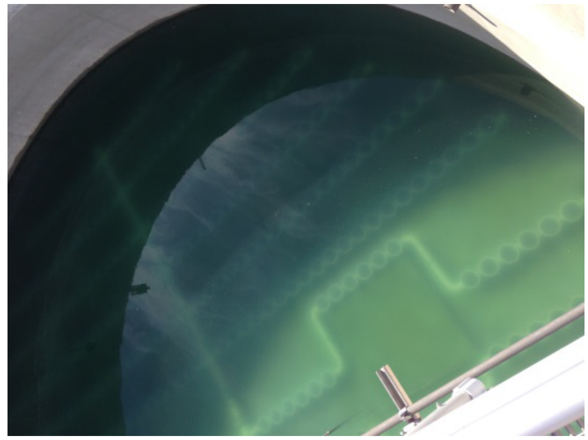
RAS Pump

RAS/WAS pump station

Aerobic Digesters	
Year Built: 2002	**Major Upgrades:** 2005
Description: The District operates two large circular aerobic digesters. The digesters were originally built in 2002 with mechanical aerators. The District had reoccurring performance issues with the mechanical aerators, and retrofitted the digesters to diffused aeration with blowers in 2005. The diffusers are membrane disc diffusers. The digesters digest thickened WAS to meet Class B Biosolids, prior to sludge dewatering.	

Site Observations	
Site	***Condition***
General: The site around the digesters is asphalt paved, with minimal cracking or holes observed. The blowers are installed outside on concrete housekeeping pads. No graffiti or vandalism was observed.	Good
Mechanical	***Condition***
General: Most of the equipment was observed to have minimal corrosion; however, operational deficiencies suggest that the blowers are depreciating faster than expected.	Fair to Good
Piping, Valves, and Gates: Minimal corrosion or coating deterioration was observed on the mechanical piping and valves.	Good
Blowers (5-ME-1, 5-ME-2): No deficiencies were observed on the exterior of the blowers; however, Plant staff indicated that one of the blowers had two prior sudden failures resulting in complete motor rebuild on both occasions. The blowers are installed outside, exposing them to seasonal weather conditions, which could be contributing to operational deficiencies.	Fair
Diffusers: The digester diffusers were not inspected up close, but it is recommended that the Plant Staff clean the membrane disc diffusers for maintenance and to improve aeration efficiency. The membrane disk diffusers are approaching 10 years old and should be inspected and membranes replaced as required.	Good
Structural	***Condition***
General: A single steel stairway leads up to a steel platform that spans over and connects the two digester tanks. No corrosion or structural deficiencies were observed on the steel stairway, platform, or handrails.	Good
Concrete: At the time of inspection the offline digester was clean and no visual indications of concrete degradation were observed by the inspector. Slime buildup was observed to be forming at the waterline of the digester tank. No cracking or deterioration was observed on the concrete structures.	Good
Electrical & Instrumentation	***Condition***
General: Blowers, Blower Panel, and PLC Control Panel were added about 5 years ago. The PLC Control Panel includes an Allen-Bradley SLC 5/05 PLC. The power distribution for this area should be reviewed for a possible upgrade. It is recommended that the SLC 5/05 PLC is replaced with ControlLogix PLC's in the mid to long term, since the SLC 5/05 PLC's are to be discontinued in about 5 years.	Good

Recommendations
1. Maintain blowers. Monitor blower temperature and construct housing for blowers to protect them from the elements.

Site Photographs	
 On-line aerobic digester	 Off-line digester
 150-HP problematic digester blower	 Blower control panel

 **Blower PLC panel interior view**	 **Mechanical piping and electric actuator**

Sludge Dewatering Building			
Year Built:	2002	**Major Upgrades**:	None

Description: The sludge dewatering building is a large slump block CMU building that houses the sludge thickening and dewatering equipment, along with TWAS pumps and polymer pumps. Separate segments of the building purpose as a truck loading and an electrical room. Two belt filter presses are utilized to thicken WAS and dewater sludge.

Observations	
Site	***Condition***
General: Access to the building is available through framed doorways on either side of the building or a large roll-up door on the east side of the building. The belt filter presses, which operate as both sludge thickening and dewatering equipment, are installed about five to ten feet above grade, and accessed by a large steel platform surrounding the equipment for operation and maintenance. The TWAS pumps, polymer feed pumps and containment are all installed at the floor of the building. Spilled polymer was observed within the polymer feed containment area collecting deleterious material that presents an unkempt appearance – although not a corrosive or hazardous material, polymer is particularly slippery and should be cleaned up immediately to avoid slip hazards.	Good
Mechanical	***Condition***
General: Corrosion was observed in the sludge dewatering building. Although not as aggressive as the headworks, corrosion in the sludge dewatering building is common due to the hydrogen sulfide generation in the sludge releasing into the building. Hydrogen Sulfide generation creates foul odors and corrosive conditions for mechanical equipment. Mechanical equipment should be proactively maintained to prevent excessive corrosion. Corrosive rust formation on steel or stainless steel equipment can be counteracted with commercial chemicals and mechanical abrasion. Heavily corroded hardware requires replacement. One of the polymer feed pumps exhibited moderate to severe corrosion.	Fair
Piping, Valves, and Gates: Minor to moderate corrosion was observed on segments of mechanical piping, primarily located at fittings and joints. Minimal coating deterioration on the mechanical piping and valves was observed. Observed corrosion on mechanical piping and valves should be removed and segments re-coated to extend useful life of piping and valves.	Fair
Odor Control: The LO/PRO wet chemical scrubber odor control system was observed to be operational; foul odors were detected within the sludge dewatering building, but emissions were not detected outside the building. Wet chemical scrubbers are robust and generally provide excellent odor control. Odor control vents were observed to have minimal corrosion. Localized minor corrosion was observed on elements of the exterior of the primary odor control fan.	Good
Belt Filter Presses (6-ME-1, 6-ME-2): Minor corrosion was observed on the Belt Filter Presses and they were observed to be operating effectively during inspection. The Plant staff informed the inspector that each belt is commonly replaced once per year. The Belt Filter Presses are now approximately twelve years old.	Fair to Good
TWAS Pumps (6-P-1, 6-P-2): Moderate corrosion was observed on the TWAS pumps, primarily located at the base of the pumps. Plant staff installed a cover for the TWAS pumps to reduce corrosion of the pump and baseplate.	Fair

Structural	***Condition***
General: No structural deficiencies, defects, or corrosion was observed on the steel platform, stairways, and handrails. Minor corrosion was observed on the building's steel roll-up doors.	Excellent
Concrete: No structural deficiencies or concrete cracking, chipping, or holes were observed in the Sludge Dewatering Building.	Excellent
Electrical & Instrumentation	***Condition***
General: The conduits underneath the belt press platform were heavily corroded and were replaced within the last year (c.2014). No deficiencies observed.	Fair to Good

Recommendations

1. Maintain mechanical piping. Remove corrosion and re-coat all piping with moderate corrosion observed.
2. Maintain TWAS pumps according to typical preventative maintenance practices. Remove corrosion and restore protective coatings, as necessary to extend useful life.
3. Maintain Polymer feed pumps and skid. Consider replacing polymer pumps on increased frequency.
4. Anticipate increased monitoring and maintenance of Belt Filter Presses to ensure reliability. Recommend dewatering technology study to replace or change thickening/dewatering technology as equipment approaches end of useful life. See Technical Memorandum #3 for additional analysis and recommendation.

Site Photographs

Belt Filter Press

Polymer skid

Minor corrosion on polymer skid and equipment

Minor corrosion on TWAS pump

Conveyor Belt

Belt Press control panel

Sludge Dewatering Building odor control scrubber

Sludge Dewatering Building odor control fan

<table>
<tr><th colspan="4">Chemical Feed</th></tr>
<tr><td>Year Built:</td><td>2002</td><td>Major Upgrades:</td><td>None</td></tr>
<tr><td colspan="4"><u>Description</u>: The area contains four tanks, two for sodium hypochlorite (chorine), one for polymer (Clarifloc), and another for Sodium Hydroxide (caustic soda). The chemical feed area is utilized to store and pump chemical to the different treatment plant processes.</td></tr>
<tr><th colspan="4">Observations</th></tr>
<tr><td colspan="3">Site</td><td>Condition</td></tr>
<tr><td colspan="3"><u>General</u>: The chemical feed and containment area is located adjacent to the electrical room and the sludge dewatering building. The area is covered by a steel pergola that has a partially closed roof and offers partial shade for the area. The chemical feed and containment area was observed to be kept clean. The area is painted with a protective coating to protect the concrete in case of a chemical spill. No graffiti or vandalism was observed. No additional security is in place for this area.</td><td>Good</td></tr>
<tr><td colspan="3">Mechanical</td><td>Condition</td></tr>
<tr><td colspan="3"><u>General</u>: The facility consists of a network of chemical metering pumps, storage tanks, and PVC piping. The facility was observed to be kept clean.</td><td>Fair to Excellent</td></tr>
<tr><td colspan="3"><u>Piping, Valves, and Gates</u>: The mechanical piping is primarily small 1-inch PVC pipe. The small PVC pipe was observed to be in good condition. The District should attempt to limit the PVC pipe exposure to sunlight because UV exposure over time will decrease the impact resistance of the PVC pipe.</td><td>Good</td></tr>
<tr><td colspan="3"><u>Chemical Metering Pumps (6-FD-1 through 15)</u>: A number of the chemical metering pumps exhibited minor to moderate corrosion and coating deterioration. District staff informed the inspector that many of the chemical pumps had been replaced or rebuilt at least once over the past 12 years, suggesting a practical useful life of approximately 5 to 7 years. The District maintains installed redundant chemical pumps for each chemical in case of a pump failure.</td><td>Fair</td></tr>
<tr><td colspan="3"><u>Chemical Storage Tanks (6-T-1 through 4)</u>: The caustic storage tank (6-T-4) was observed to have degrading insulation and piping. District staff informed the inspector that the two larger sodium hypochlorite tanks had been replaced within the past couple years (c. 2013) and were observed to be like new.</td><td>Fair to Excellent</td></tr>
<tr><td colspan="3">Structural</td><td>Condition</td></tr>
<tr><td colspan="3"><u>General</u>: No structural deficiencies were observed on the partially closed roof of the steel pergola, however, minor corrosion was observed on the steel pergola located at fittings and joints. Ultimately, when the pergola needs to be replaced, it is recommended that the District install a more robust patio cover structure with a completely closed roof to provide additional protection of chemical pumps, motors, tanks, and fittings from rain.</td><td>Excellent</td></tr>
<tr><td colspan="3"><u>Concrete</u>: No cracking, chipping, holes, or coating deterioration was observed in the concrete foundation and containment structure.</td><td>Excellent</td></tr>
</table>

Electrical & Instrumentation	*Condition*
General: The two electrical lighting panels LP-6 and LP-7 are the only two 120/240 VAC power distribution panels in the plant. The District should consider installation of additional power distribution panels if additional electrical demands are added to the plant. The DC controllers within the US Filter Panel (NaOH and NaOCl) for DC motor chemical metering pumps are reported to fail frequently. The District should consider replacing these motors.	Good

Recommendations

1. Maintain caustic soda storage tank until replacement at end of useful life. Consider switching to lower concentration caustic when replacing tank to alleviate the need for insulation and heat-tracing.
2. Maintain chemical pumps, rebuild or replace as-required.

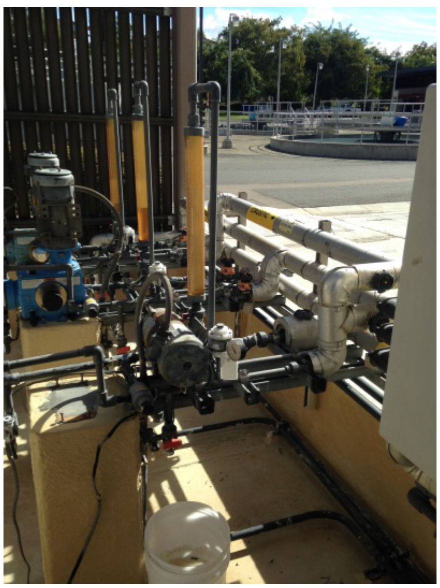
Site Photographs

Moderate corrosion and coating deterioration on chemical pump

Chemical pumps

Recently replaced Sodium Hypochlorite Tanks

Insulation deterioration on caustic soda storage tank



Chemical pumps

NEMA 4X SS chemical metering pump control panel

	
Lighting panels LP-6 and LP-7	**Chemical pump electrical conduits**

Non-Potable Water Pump Station			
Year Built:	2002	**Major Upgrades**:	None

Description: The non-potable water pump station was originally constructed to supply non-potable water for a variety of needs around the WRF, primarily belt filter press and gravity belt thickener wash water; screenings wash water, hose bibs and spray down, and sprayers on the clarifiers and anoxic tank. The Non-Potable Water Pump Station now serves as a backup supply for the plant water system; currently, plant water is supplied primarily by the Thelma Miller Recycled Water Reservoir via the recycled water distribution system connection to the 4S Ranch WRF. Plant staff has since changed the primary non-potable water supply to water supplied by the Thelma Miller recycled water reservoir because the non-potable water pumps do not provide the desired pressure to the plant's non-potable water demands.

Observations	
Site	***Condition***
General: The non-potable water pump station is located adjacent to the below grade recycled water forebay, from which it draws its supply water. The pump station is located outdoors, with no structure providing cover for the pumps and other equipment.	Good
Mechanical	***Condition***
General: The mechanical components of the non-potable water pump station are generally corroding faster than other areas of the treatment plant. Presumably, this is due to the outdoor installation of equipment, and the less frequent operation and maintenance of the equipment.	Poor to Fair
Piping, Valves, and Gates: Minor to moderate corrosion was observed on the mechanical piping and valves. Although the pump station now functions as a redundant unit and is uncommonly operated, the piping and valves should be exercised and maintained in case the pump station is needed for service.	Fair
Non-Potable Water Pumps (4-P-12, 4-P-13, 4-P-14): Coating failure and emerging rust was observed on the bases of two of the three pumps; the third pump appeared to have been replaced in recent past. The gate valves on the discharge side of the pumps were different colors than the rest of the mechanical piping, indicating that they had been replaced. It is recommended that when the non-potable water pumps are replaced that the District install new pumps that will provide adequate pressure to the non-potable water demands around the plant.	Fair
Duplex Strainer: Recycled water stored in the overflow seasonal storage pond is returned to the WRF recycled water forebay. The return water forcemain is filtered through a manual duplex strainer near the non-potable water pump station. The manual strainer was observed to have moderate corrosion, and is reportedly difficult to operate and maintain. Installing a new automatic strainer would improve ease of operation and maintenance.	Poor
Structural	***Condition***
General: No deficiencies were observed for steel hardware, pipe supports, grating, and covers.	Good
Concrete: Minor concrete staining was observed around the pump's concrete pad and duplex strainer housekeeping pad. No cracking, chipping, or holes were observed in the concrete structure.	Good

Electrical & Instrumentation	*Condition*
General: No major electrical equipment installed at this facility. No electrical or instrumentation performance deficiencies observed during inspection or noted by District staff.	Good

Recommendations

1. Maintain pumps and mechanical piping. Remove rust and recoat corroded segments. Plan for complete recoating in 10-yr CIP.

Site Photographs

Non-potable water pumps and piping

Non-potable water pumps

Moderate Corrosion on Duplex Strainer

Minor concrete staining

Non-potable water pump station from afar

Minor rust on non-potable water pump

SCADA System			
Year Built:	2002	**Major Upgrades**:	2015

Description: The central Supervisory control and data acquisition (SCADA) system is located within the operations building located on the south side of the plant. SCADA acts as the primary control system for the treatment plant processes. The process monitoring and control PLCs are distributed throughout the plant.

Observations	
Site	***Condition***
General: The operations room where the central SCADA system is located is clean and secure.	Excellent
Mechanical	***Condition***
General: No observations.	N/A
Structural	***Condition***
General: No observations.	N/A
Electrical & Instrumentation	***Condition***
General: The SCADA System consists of SCADA Central equipment, communications network, and PLC's distributed within the 4S Ranch WRF and PLC's at 14 remote Lift Station facilities.	Good to Excellent
SCADA Central Equipment: The SCADA Central equipment currently includes SCADA servers and two SCADA Workstations. The SCADA HMI software products are in the process of being replaced/upgraded from Wonderware Intouch to Ignition by Inductive Automation. The software development for the software replacement project is mostly complete, but the new products and equipment have not yet been installed and/or commissioned. The Ignition HMI package will allow for roll-out of additional clients at low/no cost due to their Java-based browser functionality for clients as part of their base software package, with no limit on number of clients. This browser style client feature will support the door-mounted iPC function mentioned below for the larger lift station OIT upgrade. The condition of the new software products and associated equipment will be excellent when installed.	Excellent
Plant Communications Network: The existing plant communications network consists of Ethernet connectivity via fiber optic cable. The existing communications system in the plant is not redundant. When there is a communications failure, SCADA connectivity for monitoring, alarm and historical functions are affected, along with possible interlocks between PLCs that are necessary to keep the process operational. The upgrade to redundant ControlLogix PLCs would allow for redundant communications capabilities via redundant Ethernet media for Remote I/O and redundant ring SCADA communications. Refer to Technical Memorandum #4 Attachments for block diagrams showing existing, phased, and fully transitioned plant communications networks.	Good

Remote Lift Stations Communications Network: The communications network for communications to/from the (14) remote facilities consists of Ethernet connectivity via Cisco and MDS Ethernet radios and fiber optic cable. A possible upgrade of the communications network to enhance existing functionality may be considered. The upgraded system would provide a larger bandwidth to support existing functionality, and would allow for additional services, such as HMI clients at selected lift stations and/or additional security features such as Ethernet cameras at selected sites, for monitoring by SCADA or by a dedicated security system.	Good
Plant PLC's: The distributed PLC's within 4S WRF have recently been upgraded to latest version of Allen-Bradley SLC 5/05's with larger memory than originally installed, and Allen-Bradley MicroLogix 1400 at three vendor panels. The PLCs are in good condition. For short term mitigation, it is recommended that spares are on hand for quick repair of any existing PLC component malfunction that may occur prior to mid-to-long term modifications. In the mid-to-long term, it is recommended that the existing PLCs are replaced and transitioned to PLC products that will have longevity and Allen-Bradley's long term support. Also, a more robust PLC system is preferred that would provide redundant hot backup PLCs, Distributed I/O over redundant media, and a redundant SCADA communications network. This would be more consistent with the District's David C. McCollom Water Treatment Plant, and would assist in establishing a standard for the District's plants. The Allen-Bradley SLC 500 PLC line has a limited life span. Allen-Bradley is anticipating discontinuing the production of the SLC 500 PLC line in about 5 years, with support and repair concluding about 5 years after discontinuation. It is recommended that the SLC 500 PLCs at the 4S Ranch WRF are replaced with ControlLogix PLC products. The ControlLogix PLCs will have production longevity and Allen-Bradley's long term support. The ControlLogix PLCs have PLC redundancy capabilities and communications redundancy capabilities. The migration to ControlLogix PLCs should take place within 10 years or less. Allen-Bradley is not currently anticipating discontinuing production on the MicroLogix 1400 & the MicroLogix 1400 product line should be in production for more than 5 years. Although this is true, the CompactLogix products are expected to have production longevity and Allen-Bradley's long term support. It is recommended that the MicroLogix 1400 PLCs at the 4S Ranch WRF are replaced with CompactLogix PLC products. Refer to Technical Memorandum #4 Attachments for block diagrams showing existing, phased, and fully transitioned plant PLC's.	Good
Remote Lift Station PLC's: It is recommended that the SLC 500 PLCs at the Lift Stations are replaced with CompactLogix PLC products and possibly non-redundant ControlLogix for the larger lift stations. The migration to CompactLogix/ControlLogix PLCs should take place within 10 years or less.	Good

<u>Remote Lift Station OIT's</u>: There are Allen-Bradley Panelview Plus Operator Interface Terminals (OIT's) at the larger Lift Stations, which are Firehouse, Neighborhood #1, Neighborhood #3, Midpoint, and Del Dios. The existing Allen-Bradley Panelview Operator Interface Terminals (OITs) run Allen-Bradley RSView graphic display software, for local access of monitoring, alarming, and control functions. Each existing OIT only monitors the local lift station. If the existing or upgraded communications system allows for enough bandwidth, the District should consider replacing the existing door-mounted OITs with door-mounted Industrial PCs (iPCs) that would run Inductive Automation Ignition clients. The new iPCs with Ignition clients would provide access to the local lift station for monitoring, alarming, and control functions, similar to the existing OITs. In addition, the new iPCs would allow access to the entire Wastewater SCADA system. Level of access for individual operators would be according to their username & password and associated security log-in level. This technology has already been implemented at the District's David C. McCollom Water Treatment Plant.	Good

Recommendations

1. Replace SLC 500 PLCs with redundant ControlLogix PLCs with redundant SCADA communications media and redundant media remote I/O communications.
2. Replace MicroLogix 1400 PLCs with CompactLogix PLCs.

Site Photographs

SCADA central HMI color screen

Remote site PLC control panel

 **Remote site operator interface terminal (OIT)**	 **4S Ranch communications tower**

Electrical Room			
Year Built:	2002	**Major Upgrades**:	None

Description: The Electrical room houses Motor Control Centers (MCCs), Programmable Logic Controllers (PLC's) and Variable Frequency Drives (VFD's) for the treatment plant.

Observations	
Site	***Condition***
General: The electrical room is located as a separate room within the Sludge Dewatering Building. The room has framed doors for entry on both sides of the room, and is shaped as a long narrow corridor with electrical gear on both sides. The electrical room is secured by locked doors, and no security concerns were observed for this critical facility.	Good
Mechanical	***Condition***
General: No observations.	N/A
Structural	***Condition***
General: No deficiencies observed.	Excellent
Electrical & Instrumentation	***Condition***
General: The Electrical Room does not have space available to install any additional electrical equipment. During the original project installation, some of the electrical equipment was installed outside of the electrical room since there was not enough space within the electrical room for installation of the required switchgear and Motor Control Centers. The Electrical Room includes the majority of electrical equipment for Plant A and Plant B. There have been modifications to the plant that required additional power distribution to various areas, such as addition of the blowers in the Digester area, and all power feeders are currently fed from the electrical room. Future upgrades and expansions may require distributed power and distributed MCCs. Alternatively, abandonment of existing facilities (e.g., Plant A) could relieve load constraints and physical space for future plant upgrades. A full electrical study is recommended for the 4S Ranch WRF to identify expansion constraints and parameters.	Fair to Good
Lighting: The District should consider improving the lighting within the electrical room by adding skylights or windows to allow for natural light in the room. High pressure sodium lights have been replaced with fluorescent lights.	Good
Programmable Logic Controllers (PLC's): The Electrical Room includes PLC-2A and PLC-2B, which are the main PLC's within the plant that service the majority of plant signals. The PLC's within the PLC-2 Control Panel have already been upgraded to a larger memory Allen-Bradley SLC 5/05 PLC. The Ethernet switches and fiber optic converters have been replaced and upgraded with N-Tron Industrial Ethernet switches with fiber ports. It is recommended that the SLC 5/05 PLC's are replaced with ControlLogix PLC's in the mid to long term, since the SLC 5/05 PLC's are to be discontinued in about 5 years.	Good

Variable Frequency Drives (VFD's): The Telemecanique Variable Frequency Drives (VFDs) are being replaced with Mitsubishi VFDs when the Telemecanique VFDs fail. Mitsubishi VFDs are the District's drive of preference, since the Mitsubishi VFDs are reliable and the District has been receiving good support for this product. The District should consider a structured replacement plan for the remaining Telemecanique VFDs.	Fair to Good

Recommendations

1. Maintain VFD's while scheduling programmatic replacement of remaining Telemanique VFD's in 5-yr CIP.

Site Photographs

Electrical room MCC's lineup

PLC-2 control panel

MCC installed outside of electrical room

Mitsubishi VFD operator keypad

Service Switchboard "S" and ATS			
Year Built:	2002	**Major Upgrades**:	None

Description: Service Switchboard "S" includes the Main SDG&E Utility Disconnect Breaker and an Automatic Transfer Switch (ATS).

Observations	
Site	***Condition***
General: Service Switchboard "S" and the ATS are located on the east side of the plant site adjacent to and among the remaining Plant A processes. The ATS and switchboard are both in enclosed steel cabinets and locked for security.	Good
Mechanical	***Condition***
General: No observations.	N/A
Structural	***Condition***
General: No observations.	N/A
Electrical & Instrumentation	***Condition***
General: The condition of the Automatic Transfer Switch (ATS) and Switchboard are dependent on detailed evaluation during a plant shutdown and independent NETA testing, respectively. For this reason, the condition of the ATS and Switchboard are unknown.	Unknown
Automatic Transfer Switch: The Automatic Transfer Switch (ATS) is obsolete and it is difficult to find maintenance parts. The District should consider a detailed ATS evaluation. The ATS has not been maintained properly due to the inconvenience of taking the entire plant offline for maintenance. There is currently no way to bypass the ATS for periodic maintenance. The condition of the ATS can only be accurately assessed during a plant shut down for detailed evaluation and maintenance. It is recommended to replace the existing ATS with a new ATS. The new ATS would include bypass functions for utility power and emergency generator power. The recommendation would be a two-source transfer switch with bypass isolation for both sources. Source 1 would be SDG&E power and Source 2 would be Generator power. Drawout power case switches/breakers would allow for maintenance, inspection, and testing to be performed while maintaining continuous power to the load. This configuration will provide safe system maintenance without any power disruptions to the plant. Refer to Technical Memorandum #4 Attachments for a single-line diagram showing a new ATS with bypass isolation, and for an EATON Magnum ATS manual, which was utilized as a guideline for the single-line diagram.	Unknown

<table>
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Service Switchboard "S" Main Breaker: The breakers within the Switchboard have not been tested since May 2002. The District should consider a regular testing schedule for all main breakers. Condition of the breakers would be assessed during independent NETA testing.

Failure of the main breaker would produce unacceptable failure mode results since the plant would not be able to run on utility power until the breaker is repaired and re-commissioned, or a new breaker is installed and commissioned. There is concern that if the breaker is turned off and cannot be turned back on during testing or maintenance, the plant would not be able to run on utility power until the breaker was repaired or replaced.

To assist in mitigating this problem, a short-term plan was discussed to purchase a new breaker and then replace the existing breaker with the new breaker. The new breaker would be NETA tested. Once removed, the existing breaker would be sent out to be refurbished & then put on the shelf as a spare. The plan for replacing the breaker would include disconnecting SDG&E utility power and running on the existing standby generator during breaker replacement. This would allow the plant to continue to run during the breaker replacement.

(Note: There is an existing Main Breaker within Main Switchboard "6" with same concerns as the existing Main Breaker within Service Switchboard "S". A similar replacement plan is recommended for the Main Breaker within Main Switchboard "6". The plan for replacing the breaker should include disconnecting the Main Switchboard "6" feeder, fed from the ATS, and running on a temporary generator during breaker replacement. The temporary generator would be wired downstream of the Switchboard "6" Main Breaker. This would allow the plant to continue to run during the breaker replacement.)

</td>
<td>Unknown</td>
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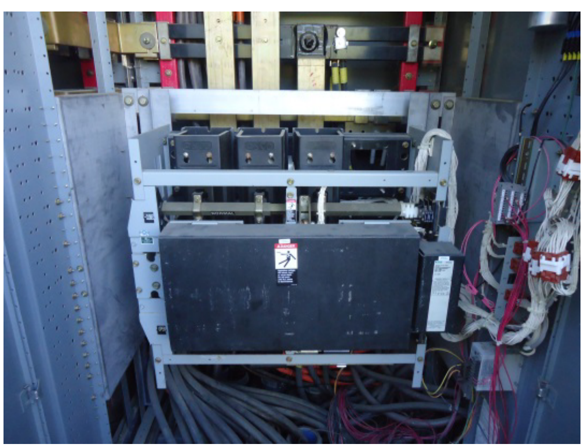
</table>

Recommendations

1. Perform a detailed ATS evaluation. This evaluation will require taking the entire plant offline. The recommended long-term plan is to replace the existing ATS with a two source transfer switch with bypass isolation for both sources.
2. Test and certify all main breakers through independent NETA testing. Perform regular testing for all main breakers. Ground fault testing to be performed every 2 years and full breaker testing to be performed every 3-5 years.
3. Replace Service Switchboard "S" Main Breaker and Switchboard "6" main breaker.

Site Photographs



ATS interior view

Service disconnect outdated electrical testing sticker

ATS exterior view

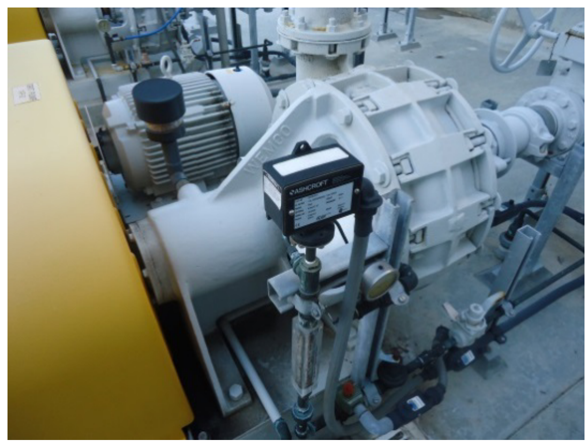
Yard/Site Electrical & Instrumentation			
Year Built:	2002	**Major Upgrades**:	Varying

Description: Site lighting, general electrical, and instrumentation such as level, flow, pressure, and temperature devices.

Observations	
Site	***Condition***
General: The yard and site electrical and instrumentation are located around the treatment plant site. The majority of yard lighting is provided by steel light poles shining on paved areas and walkways around the plant.	Good
Mechanical	***Condition***
General: No observations.	N/A
Structural	***Condition***
General: No observations.	N/A
Electrical & Instrumentation	***Condition***
General: Moderate to severe corrosion on the bases of site lighting requires replacement of the bases. The yard/site electrical and instrumentation should be monitored through the District's preventative maintenance program, and generally replaced as needed.	Poor to Good
Yard/Site Lighting: Bases on the site lighting are heavily rusted in areas close to sprinklers. The District should consider replacing the heavily rusted bases soon because they are a potential safety issue. Most of the site lighting and internal building lighting are High Pressure Sodium (HPS) vapor lights, which are inefficient and require time to warm up and illuminate. The District should consider replacing/retrofitting existing vapor lights with more efficient lights (e.g. LED lights).	Poor to Good
Instrumentation: The instrumentation at the 4S Ranch WRF consists of level devices, flow devices, pressure devices, temperature, gas detection equipment, and various analyzers. Instrumentation has been replaced on an as-needed basis as various instruments fail to function properly. Many of the Mercoid pressure switches have been replaced with Ashcroft pressure switches as the District has experienced failure issues with the Mercoid pressure switches. Most of the instrumentation is in good condition.	Good
Control Panels: The metallic Cutler-Hammer NEMA 4X door-mounted operators are pitting, but are operational. No deficiencies were observed on the exterior or interior of the outdoor control panels.	Good

Recommendations

1. Replace yard/site lighting bases that are beyond salvageable.
2. Inspect anchoring hardware below bases and replace, as required.
3. Adjust irrigation system to reduce overspray, as applicable.

Site Photographs	
 Pitted outdoor panel operators	 Interior of outdoor control panel in good condition
 Rust on base of site lighting pole	 Ashcroft pressure switch

Mercoid pressure switch

Hach SC100 Analyzer

Rosemount Flowmeter Element

Tiger Mag Flowmeter

APPENDIX C

TM2B – Pump Station Condition Assessments

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TECHNICAL MEMORANDUM #2B

To: George Briest, Olivenhain Municipal Water District

Author(s): Phil Giori, Marius Jaskula, P.E., Tom Klein (RCS), Jim Hudson (RCS); Michael Hill, P.E.;

Reviewer(s): Tom Falk, P.E.; Steve Jepsen

Date: May, 2015

Subject: Rancho Cielo and 4S Ranch Wastewater Collection System Pump Stations Condition Assessment

1 INTRODUCTION

The Olivenhain Municipal Water District (District) contracted Dudek to prepare an Operations and Condition Assessment and Capital Improvement Plan for the 4S Ranch and Rancho Cielo Sanitation Districts that will guide strategic planning and investments for the District's collection, treatment, and reuse programs.

This Technical Memorandum #2B (TM2B) presents the findings from the condition assessment field investigations for each of the District's fourteen sewer pump station facilities. Technical Memorandum #2A (TM2A) presents the findings from the condition assessment field investigations for the 4S Ranch Water Reclamation Facility. Technical Memorandum #2C (TM2C) presents the condition assessment of the collection system.

A summary of the 14 pump stations (Name, Year Built, Service Area, and Capacity) is shown in **Table 1** and the location of each pump station, and service area designations are presented in **Figure 1**.

Table 1. Sewer Pump Station Summary

No.	Name	Year	Service Area	Capacity
1	Avenida Apice	2008	Rancho Cielo	100 gpm @ 50 ft TDH
2	Avenida Orilla	2008	Rancho Cielo	115 gpm @ 165 ft TDH
3	Camino Sin Puente #1	2008	Rancho Cielo	50 gpm @ 150 ft TDH
4	Camino Sin Puente #2	2008	Rancho Cielo	50 gpm @ 150 ft TDH
5	Camino Sin Puente #3	2008	Rancho Cielo	50 gpm @ 150 ft TDH
6	Camino Sin Puente #4	2008	Rancho Cielo	50 gpm @ 150 ft TDH
7	Cerro Del Sol #1	2008	Rancho Cielo	135 gpm @ 150 ft TDH
8	Cerro Del Sol #2	2008	Rancho Cielo	145 gpm @ 120 ft TDH
9	Del Dios	2005	Rancho Cielo	1014 gpm @ 435 ft TDH
10	Midpoint	2005	Rancho Cielo	850 gpm @ 193 ft TDH
11	Fire House	2009	4S Ranch	750 gpm @ 120 ft TDH
12	Neighborhood #1	2001	4S Ranch	1,360 gpm @ 225 ft TDH
13	Neighborhood #3	2004	4S Ranch	1,600 gpm @ 209 ft TDH
14	SantaLuz	2004	4S Ranch	120 gpm @ 45 ft TDH

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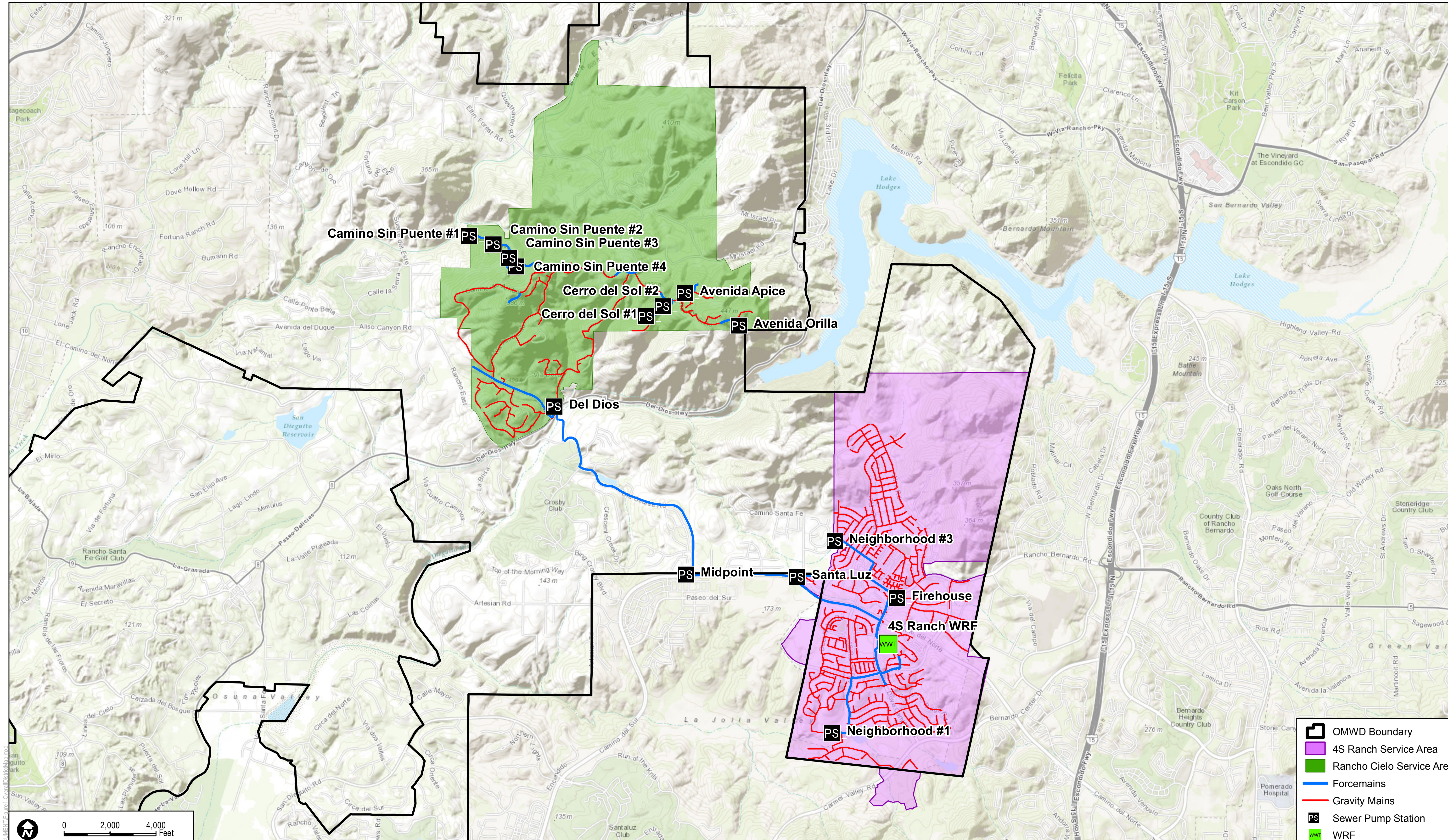

DUDEK

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SOURCE: Olivenhain MWD 2014; SanGIS 2015; ESRI Basemap 2015

FIGURE 1

Overall District Map

Olivenhain MWD Project

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2 CONDITION ASSESSMENT

2.1 Field Investigation Overview

Dudek staff performed condition assessment field investigations on November 6, 2014 to observe and assess condition of mechanical equipment, structures, and piping, at the fourteen sewer pump stations. Dudek sub-consultant Rockwell Construction Services performed field investigations on January 8, 2015 to observe and assess condition of the electrical systems and components at the pump stations. District staff assisted with the investigations by providing access to facilities and providing insight relating to the operational performance and history of particular equipment and process areas. Dudek staff or sub-consultants performing site investigations are hereinafter referred to as "inspector."

2.2 Condition Assessment Methodology

The condition assessment field investigations consisted of visual inspection for rust, corrosion, cracking, leaks, and other indications suggesting wear to gauge the relative condition of the facility. In some cases, the District staff provided information regarding the condition of mechanical and electrical equipment which the inspector would not otherwise see or detect, such as historical failures, reoccurring issues, prior rehabilitation and/or replacement, retrofits. This information from District staff is included in the observations for each facility as applicable. Following inspection, equipment, structures, and electrical gear were assigned one of four condition designations to describe relative condition. The condition designations are explained in **Table 1**.

Table 1. Condition Assessment Designations

Condition	Description
Excellent	Observed to be new or like new. No corrosion, rust, coating deterioration or structural deficiencies detected during inspection. Wear and maintenance of the facility is appropriate for age and use intensity. Plant staff does not report any operations or maintenance deficiencies or concerns such as excessive noise, vibration, or leaks.
Good	Observed to be operating as intended with minimal corrosion, rust, painting deterioration, and no structural deficiencies. Normal wear and maintenance of the facility or components is observed but does not appear to be inhibiting performance. Plant staff does not report any significant operations or maintenance deficiencies or concerns.
Fair	Observed to be in satisfactory operating condition while containing minor corrosion, rust, painting deterioration, or structural deficiencies. Normal wear and maintenance of the facility or components is observed and more frequent inspection and monitoring by Plant Staff may be warranted. Plant staff may have reported significant operations or maintenance deficiencies related to the equipment, structure, or gear.
Poor	Observed to be functioning below acceptable operating conditions and/or exhibiting high levels of corrosion, rust, painting deterioration, or structural deficiencies. More frequent monitoring and maintenance is required. Plant staff has reported significant operations or maintenance deficiencies and concerns.

It is recommended that the District maintain its normal schedule for operating and maintenance and frequency of monitoring the condition of the facility equipment, structures, or gear, with an "Excellent" or "Good" assessed condition. More frequent monitoring and/or maintenance may be warranted for equipment assessed to be in "Fair" condition. It is recommended that the District rehabilitate or replace equipment, structures, or gear with a "Poor" assessed condition within two years and more frequently maintain and monitor the condition until rehabilitation or replacement.

2.3 Condition Assessment Results

The results of the observed condition assessment for the sewer pump stations are summarized in **Table 2**. Facilities conditions were organized according to the following:

- **Site**: Civil elements including grading, paving, perimeter fencing, access, and utilities.
- **Mechanical**: Equipment, piping, and valves within the pump station.
- **Structural**: Facility structures including below-grade concrete structures, wetwell, pump station, vaults, and superstructures, as applicable.
- **Electrical & Instrumentation**: Electrical service, emergency power, motor controls, instruments, and control panels.

Table 2. Condition Assessment Results for Sewer Pump Stations

Sewer Pump Station	Site	Mechanical	Structural	Electrical & Instrumentation
Avenida Apice	Excellent	Excellent	Excellent	Good
Avenida Orilla	Excellent	Excellent	Excellent	Excellent
Camino Sin Puente #1	Good	Good	Good	Good
Camino Sin Puente #2	Good	Good	Good	Good
Camino Sin Puente #3	Good	Good	Good	Good
Camino Sin Puente #4	Good	Good	Good	Good
Cerro Del Sol #1	Excellent	Excellent	Excellent	Good
Cerro Del Sol #2	Fair	Excellent	Excellent	Good
Del Dios	Good	Fair to Good	Good	Good
Fire House	Good	Good	Good	Excellent
Midpoint	Good	Good	Good	Good
Neighborhood #1	Good	Fair	Fair to Good	Poor
Neighborhood #3	Good	Good	Good	Good
Santaluz	Good	Good	Fair	Good

The majority of the District's sewer pump stations were observed to be in "Good" to "Excellent" condition. For detailed descriptions, observations, and site photographs, see attachments. Mechanical, Structural, or Electrical condition assessments resulting in a "Poor" and "Fair" condition designations with recommendations are summarized in **Table 3**.

Table 3. Summary of "Poor" and "Fair" Condition Assessments

Category/Condition	Deficiency	Recommendation
Camino Sin Puente #1		
Mechanical/Fair	Existing 7.5 HP Hydromatic pumps have issues with seating and require repair to pins and seals.	Replace existing Hydromatic pumps with District preferred Myers submersible pumps.
Camino Sin Puente #2		
Mechanical/Fair	Existing 7.5 HP Hydromatic pumps have issues with seating and require repair to pins and seals.	Replace existing Hydromatic pumps with District preferred Myers submersible pumps.
Camino Sin Puente #3		
Mechanical/Fair	Existing 7.5 HP Hydromatic pumps have issues with seating and require repair to pins and seals.	Replace existing Hydromatic pumps with District preferred Myers submersible pumps.
Camino Sin Puente #4		
Mechanical/Fair	Existing 7.5 HP Hydromatic pumps have issues with seating and require repair to pins and seals.	Replace existing Hydromatic pumps with District preferred Myers submersible pumps.
Cerro Del Sol #1		
Site/Fair	The site is not paved resulting in site vulnerability due to erosion and runoff. In addition, paving improves safety and aesthetics of the pump station.	Pave site with concrete. Site constraints would inhibit quality asphalt paving. Site is less than 5,000 sq. feet and will not require permanent water quality BMP.
Del Dios		
Mechanical/Fair	Horizontal centrifugal pump (dry-side of 2-stage pumping configuration) is exhibiting wear and excessive noise during shut-down	Maintain existing pump. Correct shut-down timing sequence between horizontal centrifugal pump and submersible pump.

Category/Condition	Deficiency	Recommendation
Neighborhood #1		
Electrical/Poor	Switchboard and electrical components observed to be impacted by water ingress to electrical gear resulting in corrosion and unsafe operating conditions	Maintain equipment until pump station replaced. Provide interim protection from the elements to alleviate unsafe operating conditions until pump station is replaced.
Mechanical/Fair	Corrosion observed on the mechanical piping and valves	Maintain mechanical piping and valves until pump station replaced.
Structural/Fair	Cracking and groundwater intrusion observed in the emergency storage pond	Maintain overflow pond until pump station replaced. Rehabilitate overflow pond if re-purposed.
Santaluz		
Mechanical/Fair	Existing 7.5 HP Hydromatic pumps have issues with seating and require repair to pins and seals.	Replace existing Hydromatic pumps with District preferred Myers submersible pumps.
Structural/Fair	Grout and concrete around pipe penetrations are corroded and appears to be the result of water infiltration corroding either steel reinforcement or ductile iron pipe within the wall.	Chip away grout surrounding valve vault pipe penetration to investigate cause of concrete corrosion (corroding metal within wall, pipe, or steel reinforcing). Clean and re-grout and protect against water infiltration and corrosive environment.

3 PUMP STATION EFFICIENCY EVALUATIONS

The pump station condition assessments presented herein document a baseline evaluation of the physical condition of the facilities inspected. It is recommended that the District consider implementing routine pump performance testing to gather data on pump performance and to prioritize preventive maintenance activities. A variety of factors can affect pump performance, reducing efficiency and increasing energy use intensity over time. Routine pump efficiency evaluations provide valuable information to operations and maintenance staff on trending of the facilities efficiency, adequacy of installed equipment, and electro-mechanical condition.

Pump efficiency testing uses three measured values to determine the pumping system's "wire to water" efficiency, accounting for combined efficiencies of the motor controller (soft start or VFD), motor efficiency, and pump hydraulic efficiency. A routine pump efficiency test will generally collect concurrent (1) operating pressure, (2) flowrate, and (3) power draw (kW, volts, amps) at various operating conditions by throttling valves or adjusting speed at the VFD. The data can then be plotted against the manufacturer's pump curve to compare the field performance with the intended efficiency. An overall pump performance factor, reported as kWh (or cost) per mgd can then be calculated to benchmark against industry standards and to identify opportunities for energy efficiency improvements.

Routine pump efficiency testing can be performed by the District staff or can be contracted to specialty testing firms (e.g., Pump Check, Inc.). Southern California Edison has provided a no-cost pump efficiency testing program to its customers for over 100 years. San Diego Gas & Electric has also offered similar programs in the past but they currently are not providing such services. Since this data collection and analysis has a cost associated with it, routine pump performance testing is only recommended for pump stations that exhibit high "load factors" (i.e., significant daily runtimes), significant motor loads, and/or high-head operations (e.g., two-stage pumping stations). For context, the SCE program generally focuses on motors 50 HP and greater and for higher duty pumping stations such as well pumps and booster pumps that operate relatively more frequently and at higher discharge pressures.

It is recommended that the District implement a pump efficiency testing program that would consist of the following measures:

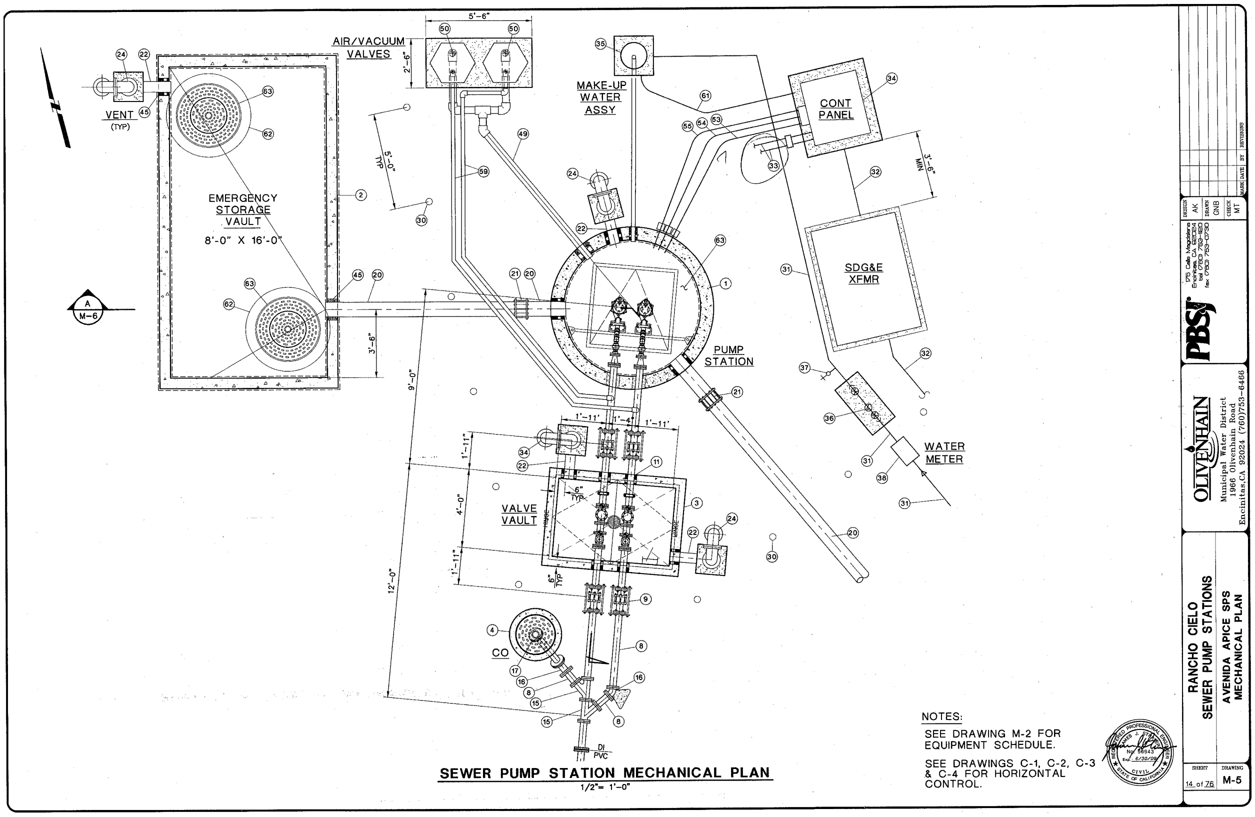
- For small pump stations consider installing flowmeters and pressure gauges at pump stations to allow for field collection of flow and pressure data for routine pump performance analysis.
- For large pump stations (Greater than 50 HP) install flowmeters and pressure transducers with inputs to local control panels and SCADA to record flow and pressure measurements. Route pump power draw (amps or kW) from motor starter or VFD to local control panels and SCADA.
- Contract with a pump efficiency contractor (e.g., Pump Check, Inc.) to perform annual pump efficiency testing for large pump stations.
- Use pump efficiency data to optimize pump maintenance and replacement programs, focusing District resources on pumps that exhibit relatively lower performance or higher specific operating costs.

4 ATTACHMENTS

Attached are the documented observations for condition assessment of each sewer pump station. The observations include the overview and brief description of the facility, site observations, and site visit photographs.

Avenida Apice SPS		
Service Area: Rancho Cielo	**Year Built:** 2008	**Major Upgrades:** None

Description: Duplex submersible pump station with emergency storage. Wetwell is a 7-foot diameter, 19-foot deep, reinforced pre-cast concrete wetwell with T-Lock PVC Liner. Two submersible pumps (3 HP Myers Grinder Pumps) pump through 3" discharge pipes, a below grade valve vault, and then a common 4" PVC, 429-foot long forcemain. The Avenida Apice SPS is currently running on make-up water, pumping one to two times per day. The site contains a 9,574 gallon emergency storage tank.



Observations	
Site	***Condition***
General: Access to the pump station is good. Minimal to no cracking or potholes observed in the site paving. Steel bollards are well placed along the street side of the site for protection. The water meter is exposed above grade of meter box and vulnerable to breaking if kicked or knocked. No signs of vandalism or graffiti observed. No indications of stormwater ponding observed. No fencing is installed around perimeter of the site. Site is located within a gated residential community and no security is in place other than common locks on access hatches and electrical and control boxes.	Excellent

Mechanical	Condition
General: The pump station has been operated using make-up water since its commissioning date because tributary residential development has not yet been constructed. Above grade air vents are epoxy coated and not UV resistant; consider re-coating with UV resistant coating such as polyurethane when coating deteriorates. No leakage or corrosion observed.	Excellent
Piping and Valves: No corrosion or coating deterioration observed on the ductile iron piping, fittings, and valves (check valve and shutoff valve) that are inside the valve vault. Glued/Threaded joint PVC pipe is currently used for pump discharge piping, however, PVC pump discharge piping is not recommended because it is brittle and susceptible to leaks and cracking when subjected to cyclical operation and vibration.	Excellent
Pumps: The pump station operates two Myers submersible pumps (3 HP) and the pumps are reported to be providing reliable service. The pumps have run times of 7 and 8 hours, respectively.	Excellent
Structural	***Condition***
General: Wet well is constructed of pre-cast concrete with a T-lock liner. Minor corrosion observed on stainless steel pump guide rails. Ladder provides access to the valve vault. No corrosion observed on the wet well and valve vault access hatches.	Excellent
Concrete: No signs of water infiltration or concrete corrosion in the valve vault. No observed indications of concrete corrosion behind wet well liner.	Excellent
Wet Well Liner: The PVC T-Lock wet well liner is in excellent condition. No cracking or bubbling of the liner observed. Fitting and access hatch terminations are well done and no coating breach observed.	Excellent
Electrical & Instrumentation	***Condition***
General: No leakage, corrosion, or visual deficiencies observed in the electrical and control box. All gear is affixed to the pump station correctly. Electrical and instrumentation connections to the pumps and wet well floats are installed correctly.	Good
PLC: The District utilizes an Allen-Bradley SLC 5/05 PLC at the pump station. Discussions with Allen-Bradley distributors regarding the longevity of the Allen-Bradley SLC 500 family of processers suggests that Allen-Bradley is anticipating to produce the SLC 500 PLC line and sell new for at least 5 years, with support and repair for an additional 5 years.	Good
OIT: None	N/A
Communications: The District utilizes Ethernet via MDS iNet Radio for their communications at the pump station. The current communications network provides adequate bandwidth to support the requirements of the pump station.	Good

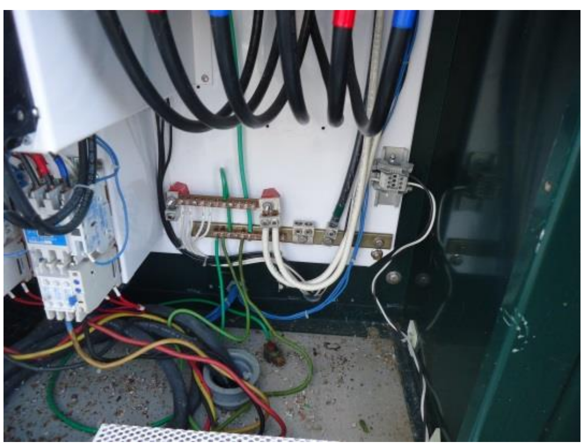
Recommendations

1. Replace PVC pump discharge piping with flanged ductile iron (ceramic epoxy lined) or type 316 stainless steel pipe.
2. Install site lighting for nighttime operations surveillance and safety for emergency work.
3. Install canopy over electrical panel for safety during emergency electrical work in the rain.
4. Install flowmeter on pump discharge to allow flow monitoring which provides useful operational data and serves as indication of diminishing pump performance over time.
5. Provide permanent solution for above grade water supply meter by adding additional support or protection.
6. Replace SLC 5/05 PLC at the pump station with a newer, supported, CompactLogix PLC within the next 10 years.

Site Photographs

Avenida Apice site

Avenida Apice wet well in excellent condition



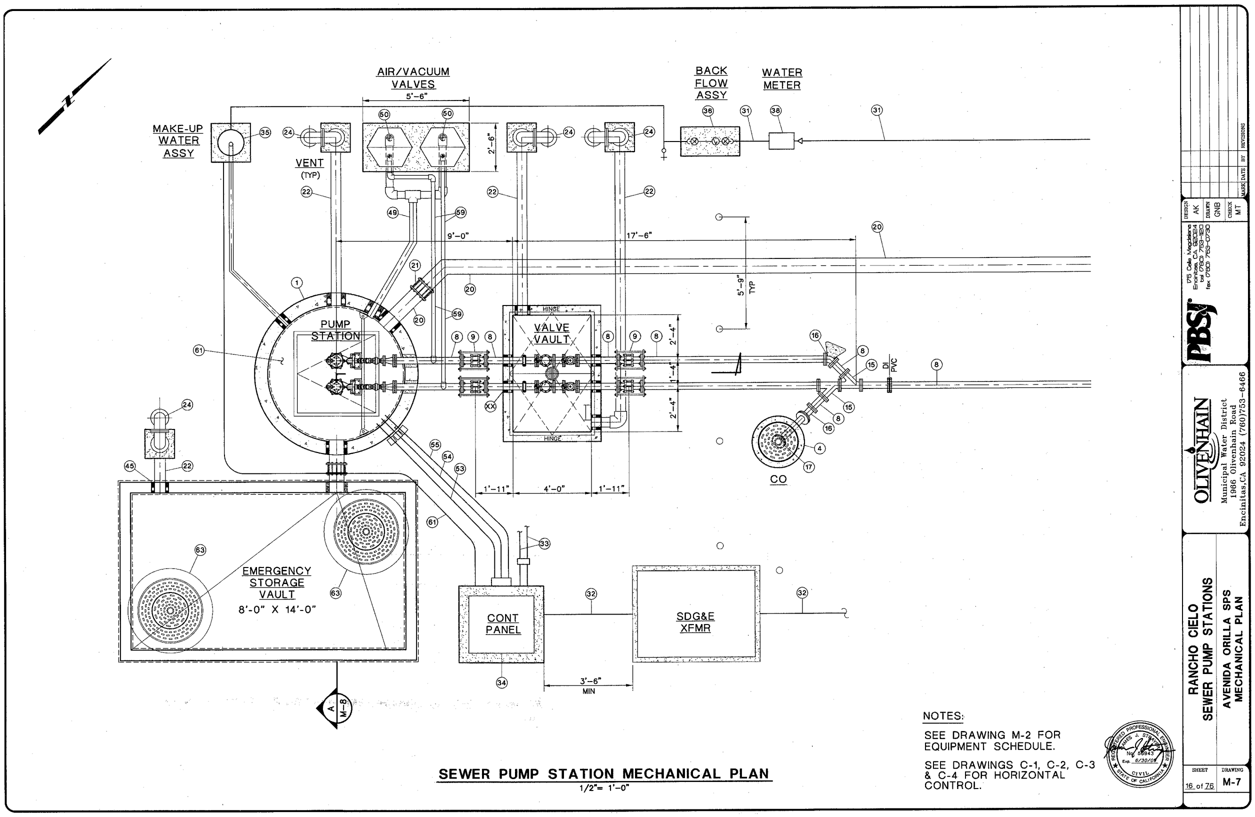
Control panel neutral and ground bus

MDS iNet Ethernet radio

Avenida Orilla SPS

Service Area:	Rancho Cielo	**Year Built:**	2008	**Major Upgrades:**	None

Description: Duplex submersible pump station with emergency storage. Wetwell is a 7-foot diameter, 25-foot deep, precast concrete wetwell with T-Lock PVC liner. Two submersible pumps (10 HP Myers Grinder Pumps) pump through 3” discharge pipes, a below grade valve vault, and then a common 3” PVC, 1,220-foot long forcemain. The Avenida Orilla SPS is not yet operational, although construction of the pump station is complete. The site contains an 8,378 gallon emergency storage tank.



Observations

Site	Condition
General: Access to the pump station is good. Minimal to no cracking or potholes observed in the site paving. Steel bollards are well placed along the site for protection. No indications of stormwater ponding observed. No signs of vandalism or graffiti observed. No fencing is installed around perimeter of the site. Site is located within a gated residential community and no security is in place other than common locks on access hatches and electrical and control boxes.	Excellent

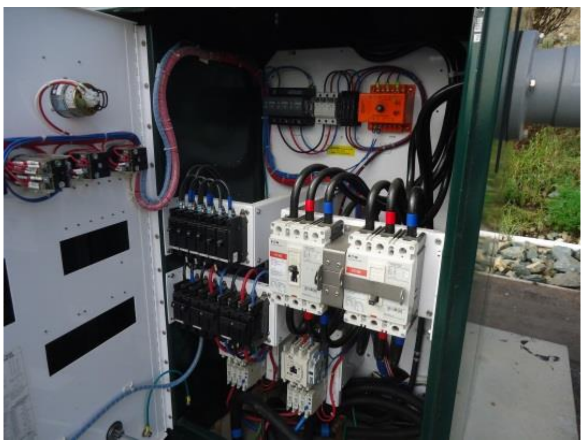
Mechanical	Condition
General: The pump station is new and not yet operated by the District. Although it appears to be complete it has not been officially turned over to the District so no information is available on the performance of the pump station. All coatings on exposed above grade piping are excellent with no observed deterioration.	Excellent

<u>Piping and Valves</u>: No observed corrosion or coating deterioration on the ductile iron piping, fittings, and valves (check valve and shutoff valve) inside the valve vault. Glued/Threaded joint PVC pipe is currently used for pump discharge piping, however, PVC pump discharge piping is not recommended because it is brittle and susceptible to leaks and cracking when subjected to cyclical operation and vibration.	Excellent
<u>Pumps</u>: The pump station is not yet operational and the pumps are new and have not yet been used. The pump station has two Myers submersible pumps installed (10 HP).	Excellent
Structural	***Condition***
<u>General</u>: Wet well is constructed of pre-cast concrete with a T-lock liner. Minimal corrosion observed on stainless steel pump guide rails. A ladder provides access to the valve vault. No corrosion observed on the wet well and valve vault access hatches. Emergency storage tank is PVC T-locked lined with no liner deficiencies observed.	Excellent
<u>Concrete</u>: No signs of water infiltration or concrete corrosion in the valve vault or flow meter vault. No observed indications of concrete corrosion behind wet well and emergency storage tank liner.	Excellent
<u>Wet Well Liner</u>: The PVC T-Lock wet well liner is in excellent condition. No cracking or bubbling of the liner observed. Fitting and access hatch terminations are well done and no coating breach observed.	Excellent
Electrical & Instrumentation	***Condition***
<u>General</u>: No leakage, corrosion, or visual deficiencies observed in the electrical and control box. All gear is affixed to the pump station correctly. Electrical and instrumentation connections to the pumps and wet well floats are installed correctly.	Excellent
<u>PLC</u>: The District utilizes an Allen-Bradley SLC 5/05 PLC at the pump station. Discussions with Allen-Bradley distributors regarding the longevity of the Allen-Bradley SLC 500 family of processers suggests that Allen-Bradley is anticipating to produce the SLC 500 PLC line and sell new for at least 5 years, with support and repair for an additional 5 years.	Good
<u>OIT</u>: None	N/A
<u>Communications</u>: The District utilizes Ethernet via MDS iNet Radio for their communications at the pump station. The current communications network provides adequate bandwidth to support the requirements of the pump station.	Good
Recommendations	
1. Replace PVC pump discharge piping with flanged ductile iron (ceramic epoxy lined) or type 316 stainless steel pipe. 2. Install site lighting for nighttime operations surveillance and safety for emergency work. 3. Install canopy over electrical panel for safety during emergency electrical work in the rain. 4. Replace SLC 5/05 PLC at the pump station with a newer, supported, CompactLogix PLC within the next 10 years.	

Site Photographs

Avenida Orilla site

Avenida Orilla wet well in excellent condition



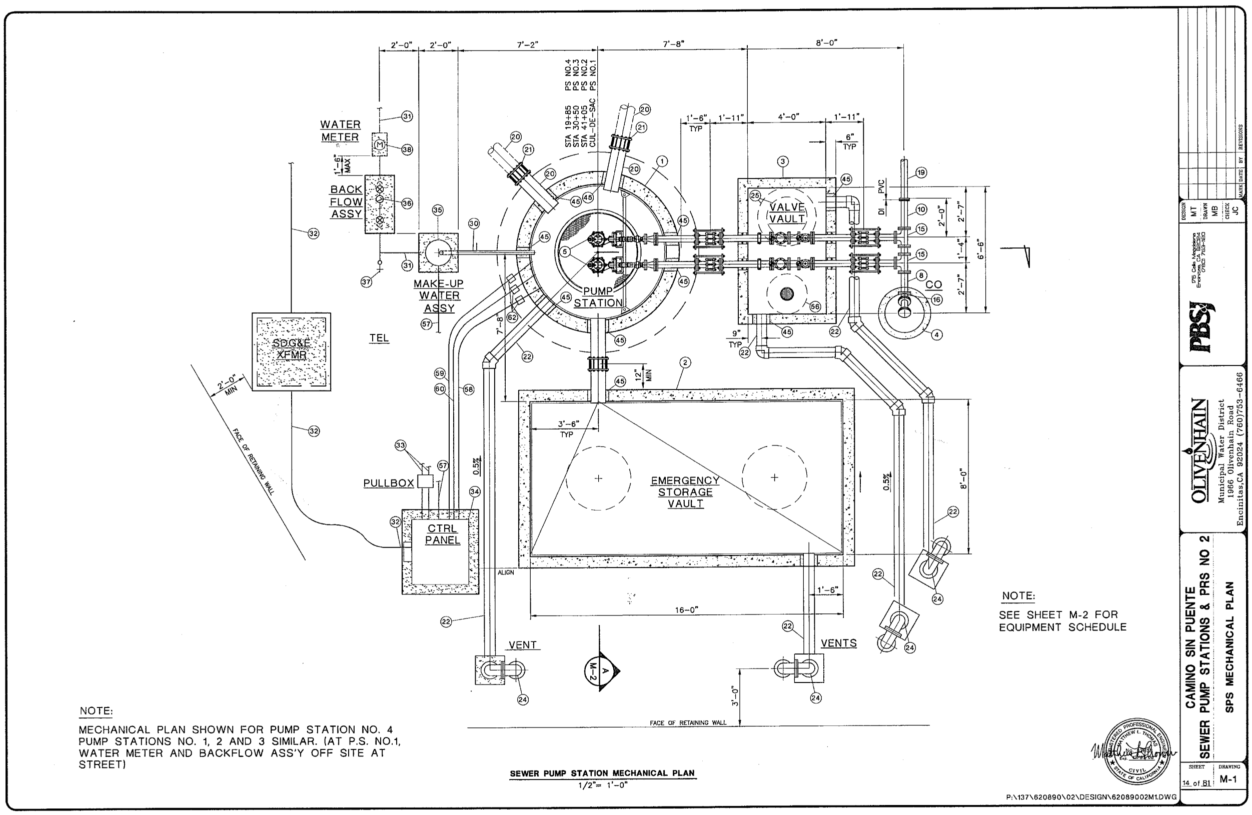
Motor power and controls

Flow transmitter mounted in control panel side-mounted enclosure

Camino Sin Puente #1 SPS

Service Area:	Rancho Cielo	Year Built:	2004	Major Upgrades:	None

Description: Duplex submersible pump station with emergency storage. Wetwell is a 7-foot diameter, 16-foot deep, precast concrete wetwell with T-Lock PVC liner. Two submersible pumps (7.5 HP Hydromatic Grinder Pumps) pump through 3" discharge pipes, a below grade valve vault, and then a common 3" PVC, 1,260-foot long forcemain. The Camino Sin Puente #1 SPS is currently operating on makeup water and pumping one to three times per day. The site contains a 9,096 gallon emergency storage tank which retains flow from downstream pump stations Camino Sin Puente #2 and Camino Sin Puente #3 which do not have dedicated storage tanks.



Observations

Site	Condition
General: Access to the pump station is good. Minimal to no cracking or potholes observed in the site paving. Steel bollards are placed along the street side of the site for protection. Stormwater drainage swales surrounding pump station site have collected dirt, rocks, and debris over time. The debris blocking the drainage swales could result in stormwater running through the pump station site and infiltrating the valve vault, wet well, and emergency storage, causing corrosion and unsafe conditions during a storm event. No signs of vandalism or graffiti observed. No fencing is installed around perimeter of the site. Site is located within a gated residential community and no security is in place other than common locks on electrical and control boxes.	Good

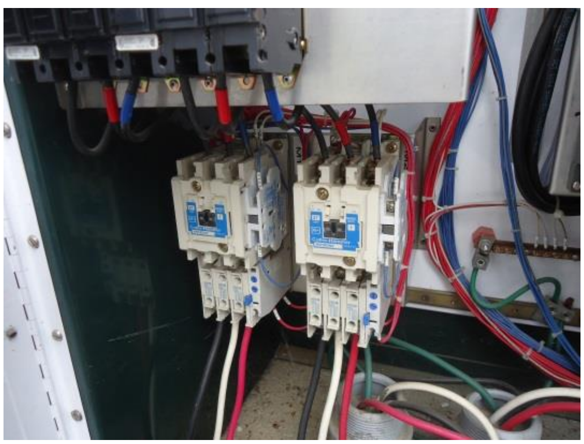
Mechanical	Condition
General: Currently, the pump station operates exclusively on make-up water and odors were not detected during inspection. Manhole covers for wet well, emergency storage and valve vault are moderately corroded which is not uncommon for similar pump stations.	Good
Piping and Valves: Minimal observed corrosion or coating deterioration on the ductile iron piping, fittings, and valves (check valve and shutoff valve) inside the valve vault. Glued/Threaded joint PVC pipe is currently used for pump discharge piping, however, PVC pump discharge piping is not recommended because it is brittle and susceptible to leaks and cracking when subjected to cyclical operation and vibration.	Good
Pumps: Existing 7.5 HP Hydromatic pumps have had issues with seating and require repair to pins and seals. Pump run times are currently at 267 hours and 249 hours respectively. The District has noted a preference for Myers submersible pumps.	Fair
Structural	***Condition***
General: Wet well is constructed of pre-cast concrete with a T-lock liner. Access to the T-Lock wet well is available through one manhole. The limited access to the wet well provided by manholes makes maintaining the wet well difficult. Stainless Steel Access hatches installed at other District pump stations are preferred and offer easier and better access to the wet well for maintenance. Minor corrosion observed on stainless steel pump guide rails.	Good
Concrete: No signs of water infiltration or concrete corrosion in the valve vault. No observed indications of concrete corrosion behind wet well liner.	Good
Wet Well Liner: The PVC T-Lock wet well liner is in good condition. T-Lock discoloration observed, however, discoloration of the liner does not indicate a performance deficiency. No cracking or bubbling of the liner observed. Fitting and manhole terminations are well done and no coating breach observed.	Good
Electrical & Instrumentation	***Condition***
General: Storm water was observed to have leaked into the control box and pool at the bottom of the box. Corrosion at the bottom of the control box was observed. Control Panel and electrical are in fair to good condition and corrective action to alleviate incidental water infiltration should alleviate corrosion potential and extend useful life. All gear is affixed to the pump station correctly. Electrical and instrumentation connections to the pumps and wet well floats are installed correctly.	Good
PLC: The District utilizes an Allen-Bradley SLC 5/05 PLC at the pump station. Discussions with Allen-Bradley distributors regarding the longevity of the Allen-Bradley SLC 500 family of processers suggests that Allen-Bradley is anticipating to produce the SLC 500 PLC line and sell new for at least 5 years, with support and repair for an additional 5 years.	Good
OIT: None	N/A
Communications: The District utilizes Ethernet via Fiber Optic Cable for their communications at the pump station. The current communications network provides adequate bandwidth to support the requirements of the pump station.	Good

Recommendations
1. Replace existing Hydromatic pumps with District preferred Myers submersible pumps.
2. Replace PVC pump discharge piping with flanged ductile iron (ceramic epoxy lined) or type 316 stainless steel pipe.
3. Install site lighting for nighttime operations surveillance and safety for emergency work.
4. Install canopy over electrical panel for safety during emergency electrical work in the rain.
5. Install flowmeter on pump discharge to allow flow monitoring which provides useful operational data and serves as indication of diminishing pump performance over time.
6. Replace existing 4-ft manhole frame and double lids with double leaf hatches for wet well, emergency storage, and valve vault.
7. Periodically clean out debris accumulated in the stormwater drainage swales.
8. Replace SLC 5/05 PLC at the pump station with a newer, supported, CompactLogix PLC within the next 10 years.

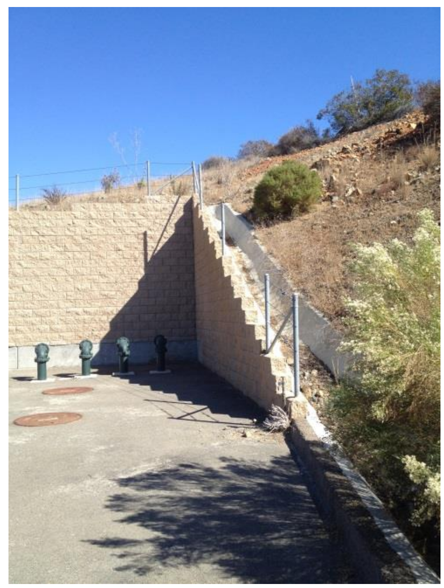
Site Photographs	
	
Camino Sin Puente #1 site	**Camino Sin Puente #1 wet well**

Fiber optic termination closet

Water accumulated inside base of control panel



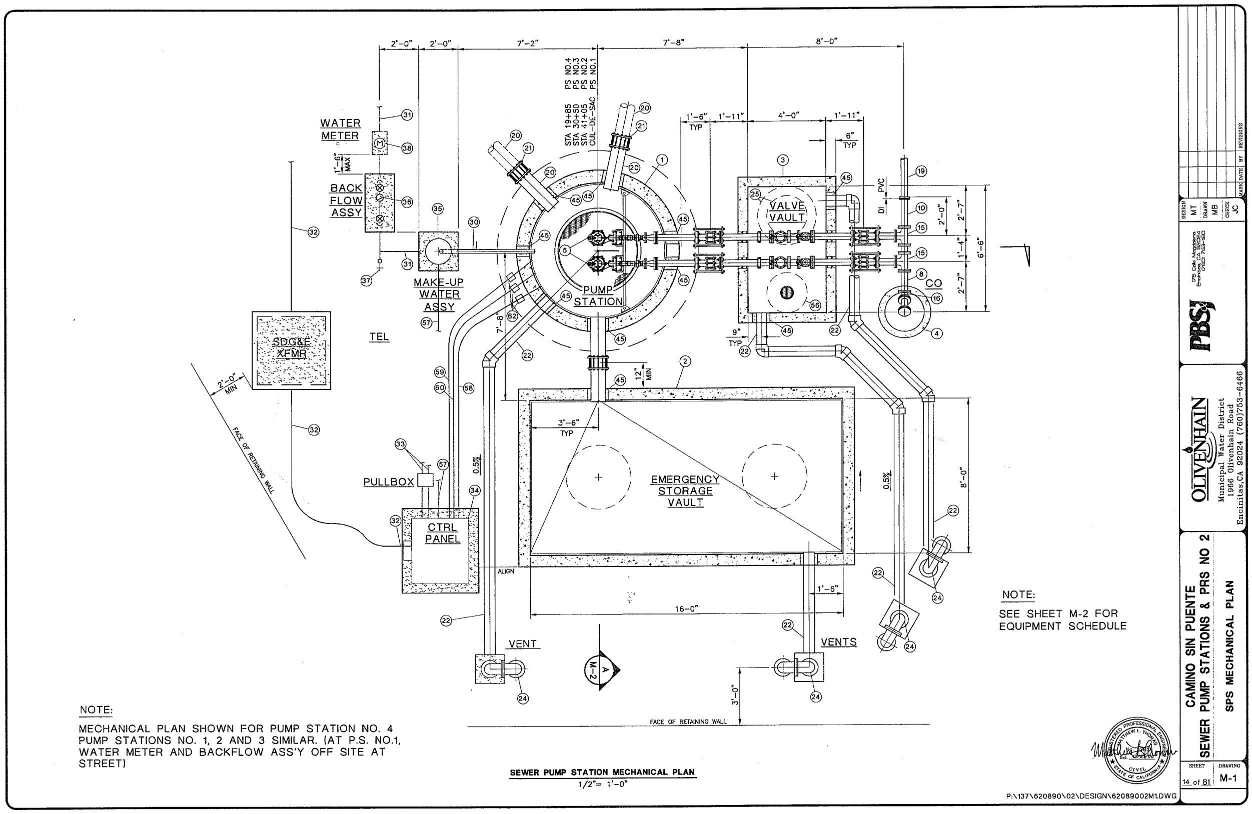
Cutler Hammer motor starters



Debris accumulation in stormwater drainage swale

Camino Sin Puente #2 SPS					
Service Area:	Rancho Cielo	**Year Built:**	2004	**Major Upgrades:**	None

Description: Duplex submersible pump station with emergency storage. Wetwell is a 7-foot diameter, 12-foot deep, precast concrete wetwell with T-Lock PVC liner. Two submersible pumps (7.5 HP Hydromatic Grinder Pumps) pump through 3" discharge pipes, a below grade valve vault, and then a common 3" PVC, 1,080-foot long forcemain. The Camino Sin Puente #2 SPS is constant speed operating 0.4 to 0.7 hours per day in draw/fill control sequence with an average of one to three pump starts per day (maximum of 3 pump starts per hour). The Camino Sin Puente #2 SPS does not have a flowmeter – based on pump starts and runtime, it is estimated that it pumps 600 to 900 gallons per day. The site does not contain emergency storage, however, in the event of an emergency, some tributary flow can be retained upstream at Camino Sin Puente #1.



Observations

Site	*Condition*
General: Access to the pump station is good. Minimal to no cracking or potholes observed in the site paving. Steel bollards are placed along the street side of the site for protection. No signs of vandalism or graffiti observed. No fencing is installed around perimeter of the site. Site is located within a gated residential community and no security is in place other than common locks on electrical and control boxes.	Good

Mechanical	***Condition***
General: Foul odors were detected on site during inspection. The operator noted that the pump station has had problems with grease buildup in the wet well. The pump station is lightly loaded receiving wastewater from four (4) residences in the Cielo Development. The observed odor is likely attributable to the light hydraulic loading resulting in sewage aging in the wet well. The District did not report odor complaints at this location. Minor indications of sulfide-induced corrosion were observed and due to the sulfide generation potential, it is recommended that this site be monitored for signs of excessive corrosion as part of routine maintenance. Manhole covers for wet well, emergency storage and valve vault are moderately corroded which is not uncommon for similar pump stations.	Good
Piping and Valves: Minimal observed corrosion or coating deterioration on the ductile iron piping, fittings, and valves (check valve and shutoff valve) inside the valve vault. Glued/Threaded joint PVC pipe is currently used for pump discharge piping, however, PVC pump discharge piping is not recommended because it is brittle and susceptible to leaks and cracking when subjected to cyclical operation and vibration.	Good
Pumps: Existing 7.5 HP Hydromatic pumps have had issues with seating and require repair to pins and seals. Pump run times are currently at 1,219 hours and 1,075 hours respectively. The District has noted a preference for Myers submersible pumps.	Fair
Structural	***Condition***
General: Wet well is constructed of pre-cast concrete with a T-lock liner. Access to the T-Lock wet well is available through one manhole. The limited access to the wet well provided by manholes makes maintaining the wet well difficult. Stainless Steel Access hatches installed at other District pump stations are preferred and offer easier and better access to the wet well for maintenance. Minor corrosion observed on stainless steel pump guide rails.	Good
Concrete: No concrete corrosion observed in the valve vault, however, minor indications of water infiltration were observed. No observed indications of concrete corrosion behind wet well liner.	Good
Wet Well Liner: The PVC T-Lock wet well liner is in good condition. T-Lock discoloration observed, however, discoloration of the liner does not indicate a performance deficiency. No cracking or bubbling of the liner observed. Moderate coating corrosion observed on the manhole terminations. The liner terminations at the top of the wet well are commonly the first to corrode and deteriorate, and should be monitored and re-coated before a breach begins to corrode the concrete structure.	Good
Electrical & Instrumentation	***Condition***
General: No leakage, corrosion, or visual deficiencies observed in the electrical and control box. All gear is affixed to the pump station correctly. Electrical and instrumentation connections to the pumps and wet well floats are installed correctly.	Good
PLC: The District utilizes an Allen-Bradley SLC 5/05 PLC at the pump station. Discussions with Allen-Bradley distributors regarding the longevity of the Allen-Bradley SLC 500 family of processers suggests that Allen-Bradley is anticipating to produce the SLC 500 PLC line and sell new for at least 5 years, with support and repair for an additional 5 years.	Good

OIT: None	N/A
Communications: The District utilizes Ethernet via Fiber Optic Cable for their communications at the pump station. The current communications network provides adequate bandwidth to support the requirements of the pump station.	Good

Recommendations

1. Replace existing Hydromatic pumps with District preferred Myers submersible pumps.
2. Replace PVC pump discharge piping with flanged ductile iron (ceramic epoxy lined) or type 316 stainless steel pipe.
3. Install site lighting for nighttime operations surveillance and safety for emergency work.
4. Install canopy over electrical panel for safety during emergency electrical work in the rain.
5. Install flowmeter on pump discharge to allow flow monitoring which provides useful operational data and serves as indication of diminishing pump performance over time.
6. Replace existing 4-ft manhole frame and double lids with double leaf hatches for wet well, emergency storage, and valve vault.
7. Replace SLC 5/05 PLC at the pump station with a newer, supported, CompactLogix PLC within the next 10 years.

Site Photographs

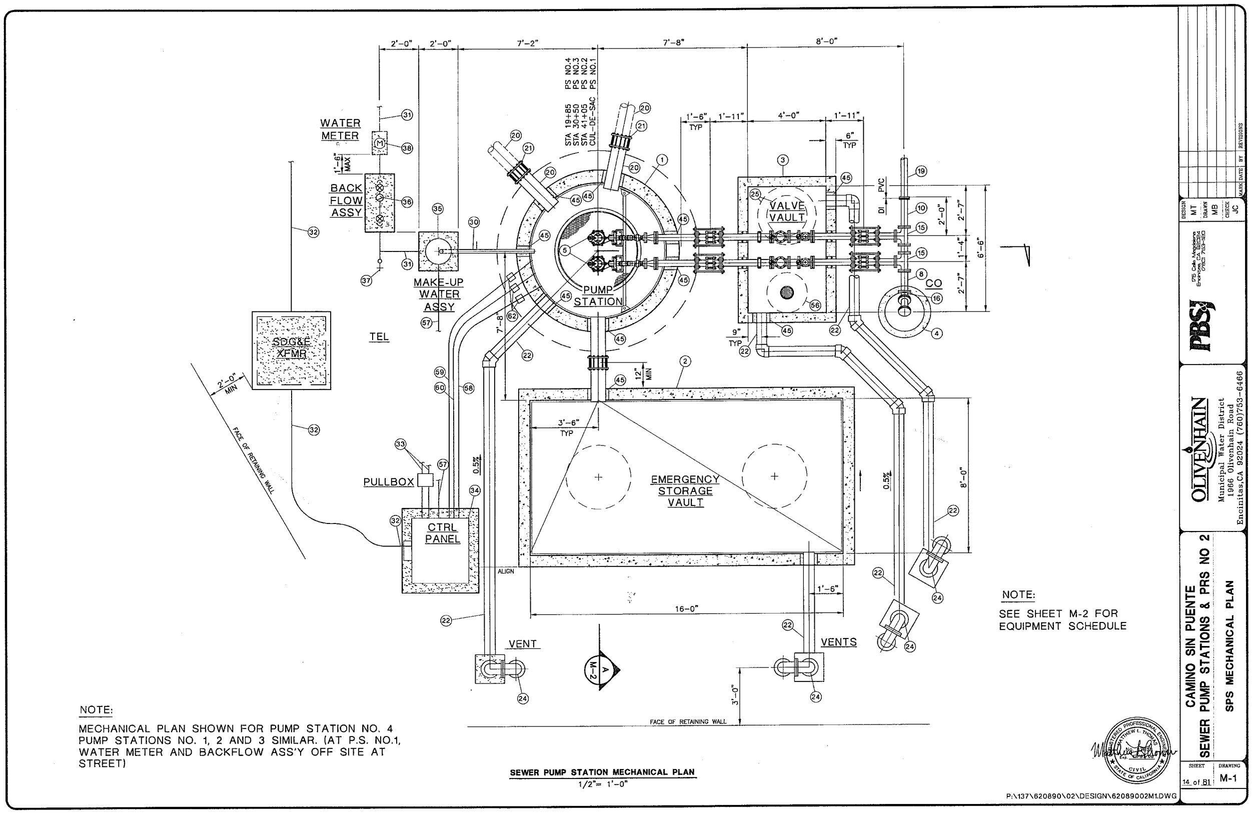
Camino Sin Puente #2 site

Camino Sin Puente #2 wet well

 **Control panel**	 **Valve Vault Piping, Fittings, and Valves**

Camino Sin Puente #3 SPS		
Service Area: Rancho Cielo	**Year Built:** 2004	**Major Upgrades:** None

Description: Duplex submersible pump station with emergency storage. Wetwell is a 7-foot diameter, 13-foot deep, precast concrete wetwell with T-Lock PVC liner. Two submersible pumps (7.5 HP Hydromatic Grinder Pumps) pump through 3" discharge pipes, a below grade valve vault, and then a common 3" PVC, 1,060-foot long forcemain. The Camino Sin Puente #3 SPS is constant speed operating 0.1 to 1.5 hours per day in draw/fill control sequence with an average of 1 to 4 pump starts per day (maximum of 2 pump starts per hour). The Camino Sin Puente #3 SPS does not have a flowmeter – based on pump starts and runtime, it is estimated that it pumps 300 to 1,000 gallons per day The site does not contain emergency storage, however, in the event of an emergency, some tributary flow can be retained upstream at Camino Sin Puente #1.



Observations

Site	*Condition*
General: Access to the pump station is good. Minimal to no cracking or potholes observed in the site paving. Steel bollards are placed along the street side of the site for protection. No signs of vandalism or graffiti observed. No fencing is installed around perimeter of the site. Site is located within a gated residential community and no security is in place other than common locks on electrical and control boxes.	Good

Mechanical	Condition
General: The operator noted problems with grease mat forming in the wet well. Foul odors were detected at the site during inspection. The pump station is lightly loaded receiving wastewater from two (2) residences in the Cielo Development. The observed odor is likely attributable to the light hydraulic loading resulting in sewage aging in the wet well. The District did not report odor complaints at this location. Minor to moderate sulfide-induced corrosion was observed on stainless steel guide rails and support beams inside the wet well. Due to the sulfide generation potential, it is recommended that this site be monitored for signs of excessive corrosion as part of routine maintenance. Manhole covers for wet well, emergency storage and valve vault are moderately corroded which is not uncommon for similar pump stations.	Good
Piping and Valves: Minimal observed corrosion or coating deterioration on the ductile iron piping, fittings, and valves (check valve and shutoff valve) inside the valve vault. Glued/Threaded joint PVC pipe is currently used for pump discharge piping, however, PVC pump discharge piping is not recommended because it is brittle and susceptible to leaks and cracking when subjected to cyclical operation and vibration.	Good
Pumps: Existing 7.5 HP Hydromatic pumps have had issues with seating and require repair to pins and seals. Pump run times are currently at 1,269 hours and 1,343 hours respectively. The pumps should be inspected once per year to ensure effective operation. The District has noted a preference for Myers submersible pumps.	Fair
Structural	***Condition***
General: Wet well is constructed of pre-cast concrete with a T-lock liner. Access to the T-Lock wet well is available through one manhole. The limited access to the wet well provided by manholes makes maintaining the wet well difficult. Stainless Steel Access hatches installed at other District pump stations are preferred and offer easier and better access to the wet well for maintenance. Minor to moderate corrosion observed on stainless steel pump guide rails.	Good
Concrete: No concrete corrosion or indications of water infiltration were observed in the valve vault. No observed indications of concrete corrosion behind wet well liner.	Good
Wet Well Liner: The PVC T-Lock wet well liner is in good condition. T-Lock discoloration observed, however, discoloration of the liner does not indicate a performance deficiency. No cracking or bubbling of the liner observed. Moderate coating corrosion observed on the manhole terminations. The liner terminations at the top of the wet well are commonly the first to corrode and deteriorate, and should be monitored and re-coated before a breach begins to corrode the concrete structure.	Good
Electrical & Instrumentation	***Condition***
General: No leakage, corrosion, or visual deficiencies observed in the electrical and control box. All gear is affixed to the pump station correctly. Electrical and instrumentation connections to the pumps and wet well floats are installed correctly.	Good
PLC: The District utilizes an Allen-Bradley SLC 5/05 PLC at the pump station. Discussions with Allen-Bradley distributors regarding the longevity of the Allen-Bradley SLC 500 family of processers suggests that Allen-Bradley is anticipating to produce the SLC 500 PLC line and sell new for at least 5 years, with support and repair for an additional 5 years.	Good

OIT: None	N/A
Communications: The District utilizes Ethernet via Fiber Optic Cable for their communications at the pump station. The current communications network provides adequate bandwidth to support the requirements of the pump station.	Good

Recommendations

1. Replace existing Hydromatic pumps with District preferred Myers submersible pumps.
2. Replace PVC pump discharge piping with flanged ductile iron (ceramic epoxy lined) or type 316 stainless steel pipe.
3. Install site lighting for nighttime operations surveillance and safety for emergency work.
4. Install canopy over electrical panel for safety during emergency electrical work in the rain.
5. Install flowmeter on pump discharge to allow flow monitoring which provides useful operational data and serves as indication of diminishing pump performance over time.
6. Replace existing 4-ft manhole frame and double lids with double leaf hatches for wet well, emergency storage, and valve vault.
7. Replace SLC 5/05 PLC at the pump station with a newer, supported, CompactLogix PLC within the next 10 years.

Site Photographs

Camino Sin Puente #3 site

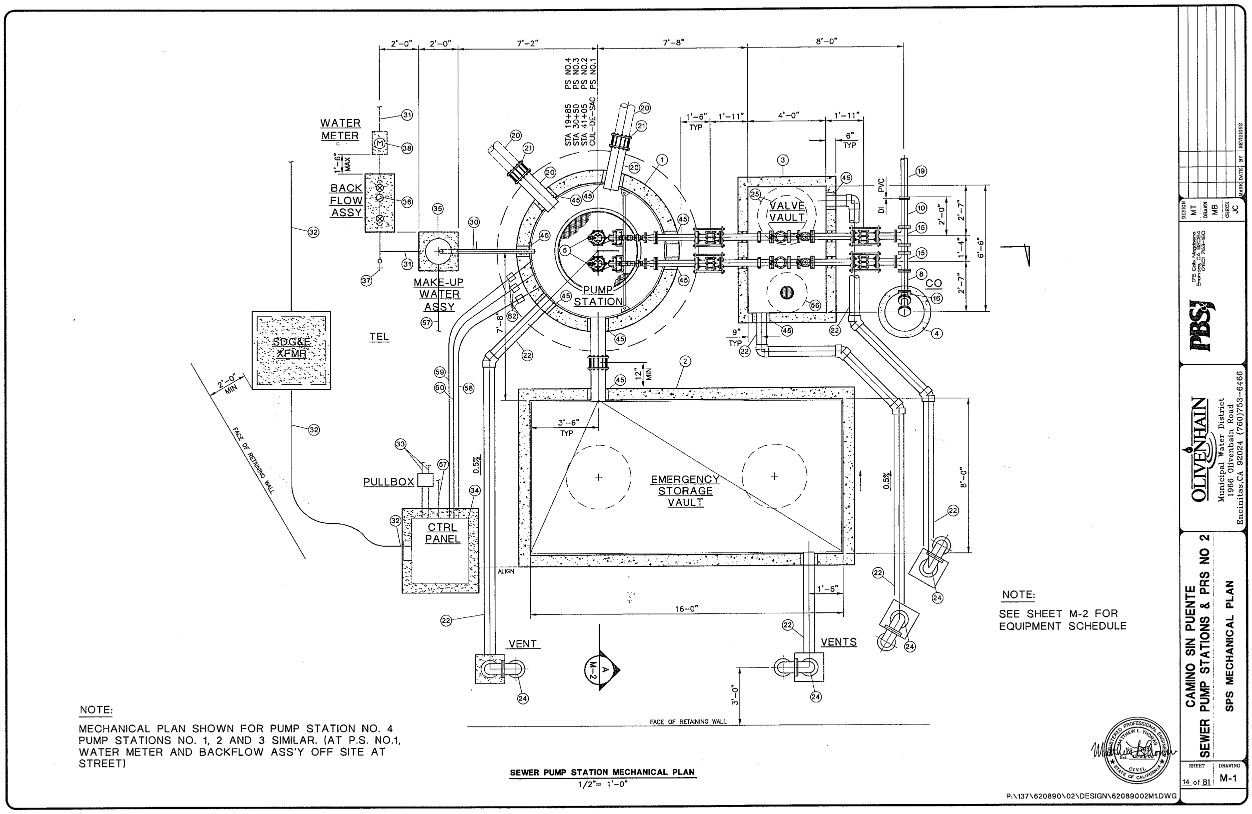
Camino Sin Puente #3 wet well

	
Control panel	**Control panel inner door with operators**

Camino Sin Puente #4 SPS

Service Area:	Rancho Cielo	**Year Built:**	2004	**Major Upgrades:**	None

Description: Duplex submersible pump station with emergency storage. Wetwell is a 7-foot diameter, 16-foot deep, precast concrete wetwell with T-Lock PVC liner. Two submersible pumps (7.5 HP Hydromatic Grinder Pumps) pump through 3" discharge pipes, a below grade valve vault, and then a common 3" PVC, 1,310-foot long forcemain. The Camino Sin Puente #4 SPS is constant speed operating 0.4 to 1.2 hours per day in draw/fill control sequence with an average of 1 to 3 pump starts per day (maximum of 3 pump starts per hour). The Camino Sin Puente #4 SPS does not have a flowmeter – based on pump starts and runtime, it is estimated that it pumps 600-1,700 gallons per day. The site contains a 9,096 gallon emergency storage tank.



Observations

Site	***Condition***
General: Access to the pump station is good. Minimal to no cracking or potholes observed in the site paving. Steel bollards are placed along the street side of the site for protection. No signs of vandalism or graffiti observed. No fencing is installed around perimeter of the site. Site is located within a gated residential community and no security is in place other than common locks on electrical and control boxes.	Good

Mechanical	***Condition***
General: According to the operator, the BioCube odor control system has never been used. Foul odors were detected during inspection at the site. Manhole covers for wet well, emergency storage and valve vault are moderately corroded which is not uncommon for similar pump stations.	Good

Piping and Valves: Minimal observed corrosion or coating deterioration on the ductile iron piping, fittings, and valves (check valve and shutoff valve) inside the valve vault. Glued/Threaded joint PVC pipe is currently used for pump discharge piping, however, PVC pump discharge piping is not recommended because it is brittle and susceptible to leaks and cracking when subjected to cyclical operation and vibration.	Good
Pumps: Existing 7.5 HP Hydromatic pumps have had issues with seating and require repair to pins and seals. Pump run times are currently at 1,487 hours and 1,526 hours respectively. The District has noted a preference for Myers submersible pumps.	Fair
Structural	***Condition***
General: Wet well is constructed of pre-cast concrete with a T-lock liner. Access to the T-Lock wet well is available through one manhole. The limited access to the wet well provided by manholes makes maintaining the wet well difficult. Stainless Steel Access hatches installed at other District pump stations are preferred and offer easier and better access to the wet well for maintenance. Minor to moderate corrosion observed on stainless steel pump guide rails.	Good
Concrete: No concrete corrosion or indications of water infiltration were observed in the valve vault. No observed indications of concrete corrosion behind wet well liner.	Good
Wet Well Liner: The PVC T-Lock wet well liner is in good condition. T-Lock discoloration observed, however, discoloration of the liner does not indicate a performance deficiency. No cracking or bubbling of the liner observed. Moderate coating corrosion observed on the manhole terminations. The liner terminations at the top of the wet well are commonly the first to corrode and deteriorate, and should be monitored and re-coated before a breach begins to corrode the concrete structure.	Good
Electrical & Instrumentation	***Condition***
General: No leakage, corrosion, or visual deficiencies observed in the electrical and control box. All gear is affixed to the pump station correctly. Electrical and instrumentation connections to the pumps and wet well floats are installed correctly.	Good
PLC: The District utilizes an Allen-Bradley SLC 5/05 PLC at the pump station. Discussions with Allen-Bradley distributors regarding the longevity of the Allen-Bradley SLC 500 family of processers suggests that Allen-Bradley is anticipating to produce the SLC 500 PLC line and sell new for at least 5 years, with support and repair for an additional 5 years.	Good
OIT: None	N/A
Communications: The District utilizes Ethernet via Fiber Optic Cable for their communications at the pump station. The current communications network provides adequate bandwidth to support the requirements of the pump station.	Good

Recommendations

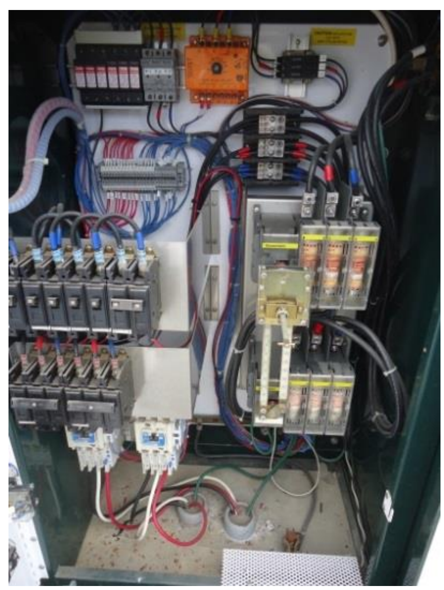
1. Replace existing Hydromatic pumps with District preferred Myers submersible pumps.
2. Replace PVC pump discharge piping with flanged ductile iron (ceramic epoxy lined) or type 316 stainless steel pipe.
3. Install site lighting for nighttime operations surveillance and safety for emergency work.
4. Install canopy over electrical panel for safety during emergency electrical work in the rain.
5. Install flowmeter on pump discharge to allow flow monitoring which provides useful operational data and serves as indication of diminishing pump performance over time.
6. Replace existing 4-ft manhole frame and double lids with double leaf hatches for wet well, emergency storage, and valve vault.
7. Replace SLC 5/05 PLC at the pump station with a newer, supported, CompactLogix PLC within the next 10 years.

Site Photographs

Camino Sin Puente #4 site

Camino Sin Puente #4 wet well

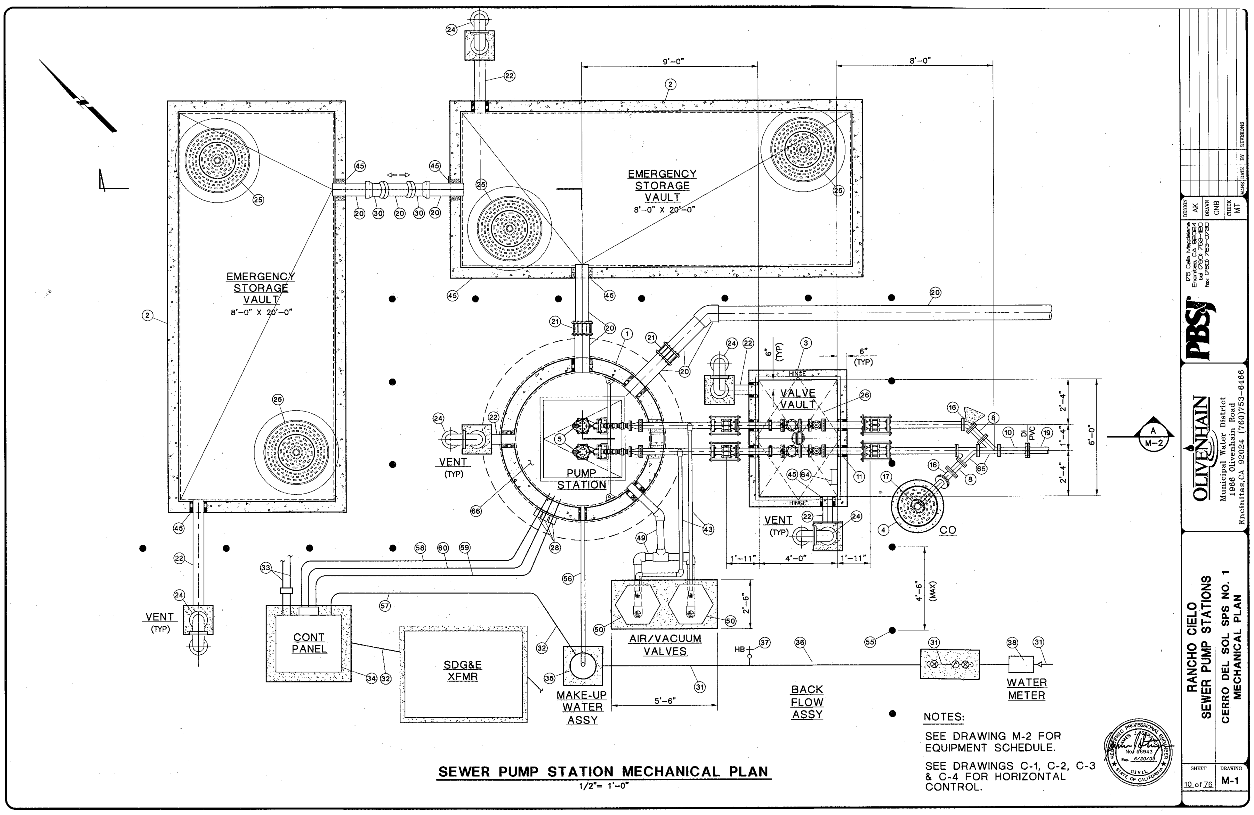
Control panel



Control panel power section

Cerro Del Sol #1 SPS					
Service Area:	Rancho Cielo	**Year Built:**	2008	**Major Upgrades:**	None

Description: Duplex submersible pump station with emergency storage. Wetwell is a 7-foot diameter, 24-foot deep, precast concrete wetwell with T-Lock PVC liner. Two submersible pumps (10 HP Myers Grinder Pumps) pump through 3" discharge pipes, a below grade valve vault, and then a common 3" PVC, 930-foot long forcemain. The Cerro Del Sol #1 SPS is currently operating on makeup water and operates one to three times per day. The site contains 23,936 gallons of emergency storage in two tanks.



Observations

Site	*Condition*
General: Access to the pump station is good. Minimal to no cracking or potholes observed in the site paving. Steel bollards are placed along the street side of the site for protection. No signs of vandalism or graffiti observed. No fencing is installed around perimeter of the site. Site is located within a gated residential community and no security is in place other than common locks on electrical and control boxes.	Excellent
Mechanical	***Condition***
General: At the time of inspection, the pump station was operating exclusively on make-up water and running two to three times per day. The District was previously operating the pumps station only one time per day, but increased pumping due to a local odor complaint. Above grade air vents are epoxy coated and not UV resistant; consider re-coating with UV resistant coating such as polyurethane when coating deteriorates.	Excellent

Piping and Valves: No corrosion or coating deterioration observed on the ductile iron piping, fittings, and valves (check valve and shutoff valve) that are inside the valve vault. Glued/Threaded joint PVC pipe is currently used for pump discharge piping, however, PVC pump discharge piping is not recommended because it is brittle and susceptible to leaks and cracking when subjected to cyclical operation and vibration.	Excellent
Pumps: The pump station operates two Myers submersible pumps (10 HP) and the pumps are reported to be providing reliable service.	Excellent
Structural	***Condition***
General: Wet well is constructed of pre-cast concrete with a T-lock liner. No corrosion observed on stainless steel pump guide rails. Ladder provides access to the valve vault. No corrosion observed on the wet well and valve vault access hatches.	Excellent
Concrete: No concrete corrosion or indications of water infiltration were observed in the valve vault. No observed indications of concrete corrosion behind wet well liner.	Excellent
Wet Well Liner: The PVC T-Lock wet well liner is in excellent condition. No cracking or bubbling of the liner observed. Fitting and access hatch terminations are well done and no coating breach observed.	Excellent
Electrical & Instrumentation	***Condition***
General: No leakage, corrosion, or visual deficiencies observed in the electrical and control box. All gear is affixed to the pump station correctly. Electrical and instrumentation connections to the pumps and wet well floats are installed correctly.	Good
PLC: The District utilizes an Allen-Bradley SLC 5/05 PLC at the pump station. Discussions with Allen-Bradley distributors regarding the longevity of the Allen-Bradley SLC 500 family of processers suggests that Allen-Bradley is anticipating to produce the SLC 500 PLC line and sell new for at least 5 years, with support and repair for an additional 5 years.	Good
OIT: None	N/A
Communications: The District utilizes Ethernet via (2) MDS iNet Radios for their communications at the pump station. The current communications network provides adequate bandwidth to support the requirements of the pump station.	Good

Recommendations

1. Install slow closing solenoids for make-up water to alleviate slamming of the backflow preventers and resulting seal damage.
2. Replace PVC pump discharge piping with flanged ductile iron (ceramic epoxy lined) or type 316 stainless steel pipe.
3. Install site lighting for nighttime operations surveillance and safety for emergency work.
4. Install canopy over electrical panel for safety during emergency electrical work in the rain.
5. Install flowmeter on pump discharge to allow flow monitoring which provides useful operational data and serves as indication of diminishing pump performance over time.
6. Replace SLC 5/05 PLC at the pump station with a newer, supported, CompactLogix PLC within the next 10 years.

Site Photographs

Cerro Del Sol #1 site

Cerro Del Sol #1 wet well in excellent condition

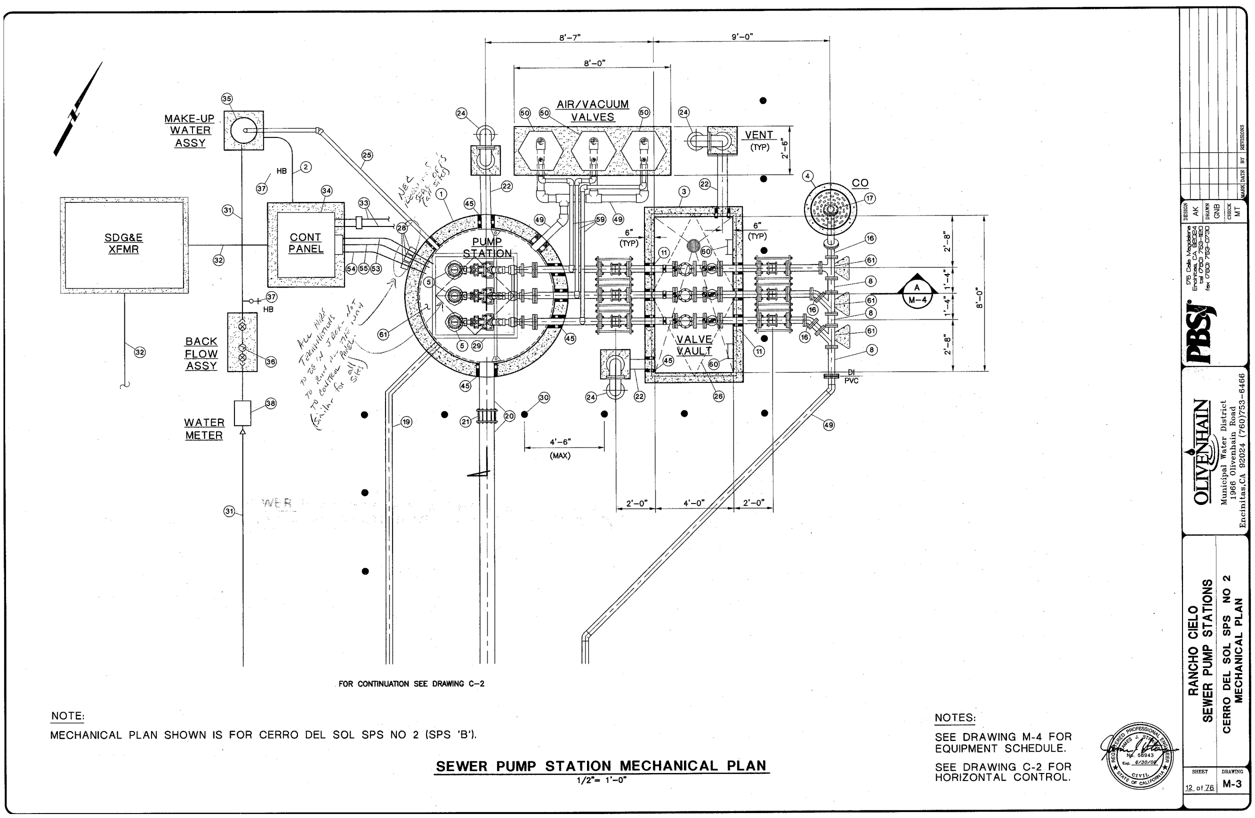
Control panel PLC section

Dual iNet Ethernet radios

Cerro Del Sol #2 SPS

Service Area: Rancho Cielo	**Year Built:** 2008	**Major Upgrades:** None

Description: Triplex submersible pump station with emergency storage. Wetwell is a 7-foot diameter, 17.5-foot deep, precast concrete wetwell. Three submersible pumps (10 HP Myers Grinder Pumps) pump through 3” discharge pipes, a below grade valve vault, and then a common 4” PVC, 1,150-foot long forcemain. The Cerro Del Sol #2 SPS is constant speed operating 0.1 hours per day in draw/fill control sequence with an average of 3 pump starts per day (maximum of 3 pump starts per hour). The Cerro Del Sol #2 SPS does not have a flowmeter – based on pump starts and runtime, it is estimated that it pumps 300 to 500 gallons per day. The site does not contain emergency storage, however, in an emergency situation, wastewater will backflow to the Cerro Del Sol #1 emergency storage tank.



Observations

Site	*Condition*
General: Access to the pump station is good. The site is not paved; however, site constraints would inhibit quality asphalt paving. Concrete paving would improve site access and erosion control. Steel bollards are placed along the street side of the site for protection. No signs of vandalism or graffiti observed. No fencing is installed around perimeter of the site. Site is located within a gated residential community and no security is in place other than common locks on electrical and control boxes.	Fair

Mechanical	*Condition*
General: Foul odors were detected during inspection. The pump station is lightly loaded receiving wastewater from four (4) residences in the Cielo Development. The observed odor is likely attributable to the light hydraulic loading resulting in sewage aging in the wet well. The District did not report odor complaints at this location and no indication of sulfide-induced corrosion was observed; however, due to the sulfide generation potential, it is recommended that this site be monitored for signs of premature corrosion as part of routine maintenance. Operators had noticed excessive noise from the pumps when turned on, but the source of the concerning sound was unknown and no indications of poor performance have been identified. A broken PVC Schedule 80 union was found on horizontal piping exiting wet well on Pump #2. Above grade air vents are epoxy coated and not UV resistant; consider re-coating with UV resistant coating such as polyurethane when coating deteriorates.	Excellent
Piping and Valves: No corrosion or coating deterioration observed on the ductile iron piping, fittings, and valves (check valve and shutoff valve) that are inside the valve vault. Glued/Threaded joint PVC pipe is currently used for pump discharge piping, however, PVC pump discharge piping is not recommended because it is brittle and susceptible to leaks and cracking when subjected to cyclical operation and vibration.	Excellent
Pumps: The pump station operates three Myers submersible pumps (10 HP) and the pumps are reported to be providing reliable service. The pumps have run times of 47, 51, and 43 hours, respectively. The pumps should be inspected at least once per year to ensure effective operation.	Excellent
Structural	*Condition*
General: Wet well is constructed of pre-cast concrete with a T-lock liner. No corrosion observed on stainless steel pump guide rails. Ladder provides access to the valve vault. No corrosion observed on the wet well and valve vault access hatches.	Excellent
Concrete: No concrete corrosion or indications of water infiltration were observed in the valve vault. No observed indications of concrete corrosion behind wet well liner.	Excellent
Wet Well Liner: The PVC T-Lock wet well liner is in excellent condition. No cracking or bubbling of the liner observed. Fitting and access hatch terminations are well done and no coating breach observed.	Excellent
Electrical & Instrumentation	*Condition*
General: The isolated neutral bus should be bonded to ground but is not. No leakage, corrosion, or visual deficiencies observed in the electrical and control box. Electrical and instrumentation connections to the pumps and wet well floats are installed correctly.	Good
PLC: The District utilizes an Allen-Bradley SLC 5/05 PLC at the pump station. Discussions with Allen-Bradley distributors regarding the longevity of the Allen-Bradley SLC 500 family of processers suggests that Allen-Bradley is anticipating to produce the SLC 500 PLC line and sell new for at least 5 years, with support and repair for an additional 5 years.	Good
OIT: None	N/A

Communications: The District utilizes Ethernet via MDS iNet Radio for their communications at the pump station. The current communications network provides adequate bandwidth to support the requirements of the pump station.	Good

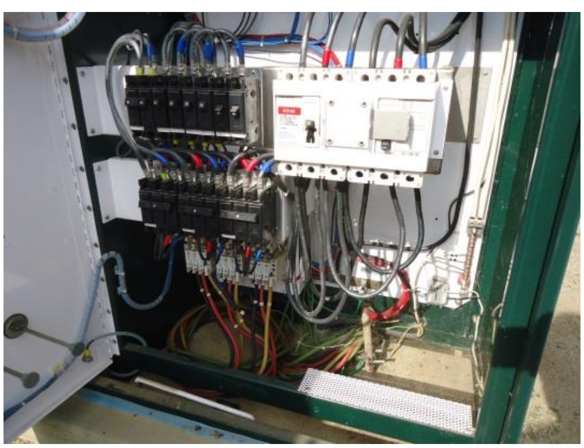
Recommendations

1. Pave site with concrete.
2. Install slow closing solenoids for make-up water to alleviate slamming of the backflow preventers and resulting seal damage.
3. Replace PVC pump discharge piping with flanged ductile iron (ceramic epoxy lined) or type 316 stainless steel pipe.
4. Install site lighting for nighttime operations surveillance and safety for emergency work.
5. Install canopy over electrical panel for safety during emergency electrical work in the rain.
6. Install flowmeter on pump discharge to allow flow monitoring which provides useful operational data and serves as indication of diminishing pump performance over time.
7. Replace SLC 5/05 PLC at the pump station with a newer, supported, CompactLogix PLC within the next 10 years.

Site Photographs

Cerro Del Sol #2 site

Cerro Del Sol wet well in excellent condition

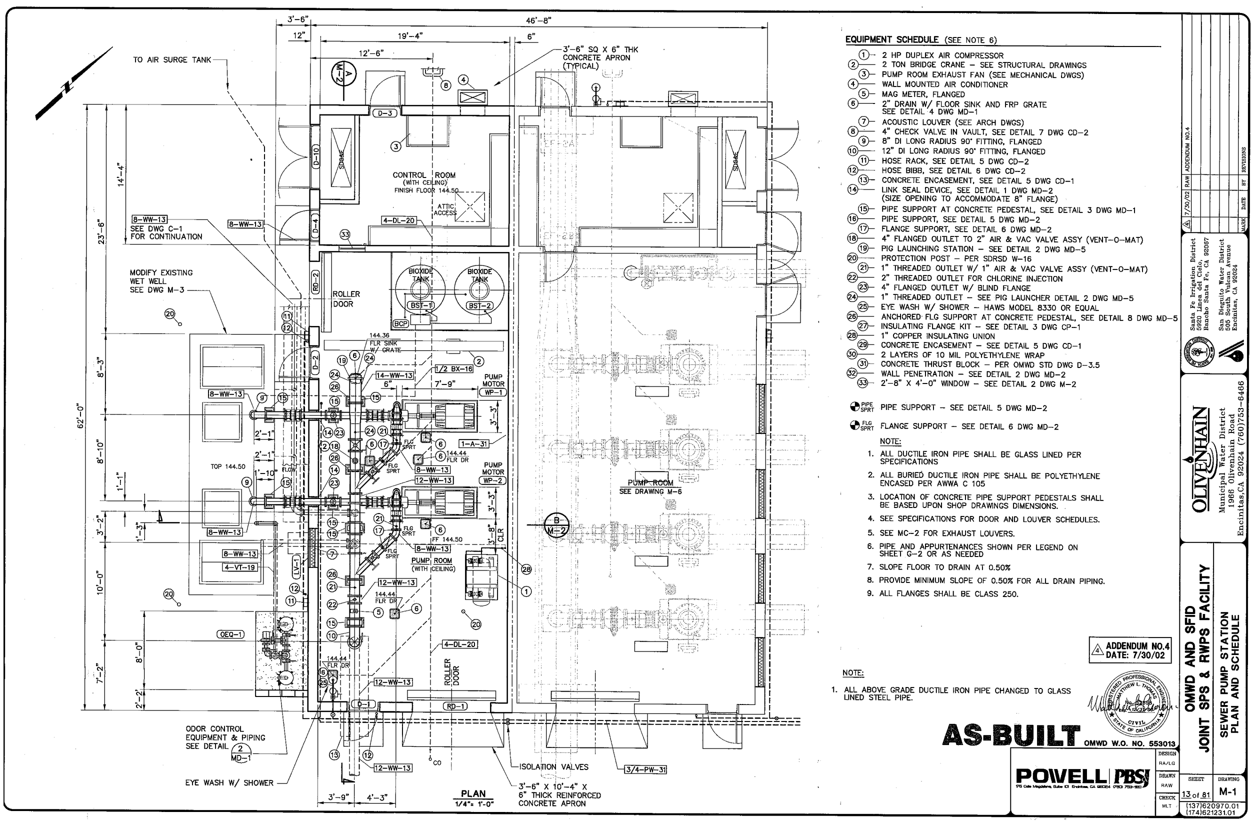


Control panel power section

PLC section with Tesco reactive air level system

Del Dios SPS					
Service Area:	Rancho Cielo	**Year Built:**	unknown	**Major Upgrades:**	2005

Description: Wetwell/Drywell, double-stage pump station with emergency storage. Wetwell is a 24-feet by 6-feet, 23.5-foot deep, reinforced concrete wetwell. Two submersible solids handling pumps (1014 gpm @ 217.5-ft, 125HP, Fairbanks Morse Model D5434MT) pump in series from the wetwell to horizontal solids centrifugal pumps (1014 gpm @ 217.5-ft, 125HP, Fairbanks Morse Model B5424 Type T40) within the pump room and then through a common 12” glass-lined Ductile Iron and PVC, 11,660-foot long forcemain. The Del Dios SPS is effectively constant speed as the 1st-stage pumps operate on draw/fill operation and the 2nd-stage pumps operate on variable speed to control pumping rate. The Del Dios SPS operates approximately 0.9 hours per day in draw/fill control sequence with an average of 21 pump starts per day (maximum of 4 pump starts per hour). The Del Dios SPS has an inline magnetic flowmeter – average daily flowrate is 35,000 to 45,000 gallons per day. The site contains 77,667 gallons of emergency storage in two tanks. Assuming peak hour flowrate of 83 gallons per minute (roughly 3x current average daily flow), the emergency storage tank provides 15.5 hours of emergency storage.



Observations	
Site	***Condition***
General: Access to the pump station is difficult driving eastbound on the Del Dios Highway. Access requires a left-handed turn across a double-yellow with no left hand turn pocket. The pump station is located on a busy street with a fast speed limit, making eastbound access dangerous for a potential rear-end collision. Minimal to no cracking or potholes observed in the site paving. No signs of vandalism or graffiti observed. Site is shared with the Rancho Santa Fe Irrigation District, who uses half of the site for a potable water pump station. The site is secured by tall walls surrounding the site and remote-controlled security gates. The pump building and electrical room are locked for additional security. The Del Dios pump building serves as a make-shift storage facility for spare pumps, bearings, o-rings, seals, and more for the smaller pump stations in the Rancho Cielo service area. Consideration should be given to storing these pumps and parts off site or in a separate storage structure to avoid cluttering the pump room.	Good
Mechanical	***Condition***
General: The Del Dios sewer pump station is a collection hub for the entire Rancho Cielo development. The Del Dios pump station is a high-head pump station consisting of 2-stage pumping. It pumps from Rancho Cielo directly to the Midpoint Sewer Pump Station which then pumps to the 4S Ranch WRF. The District doses calcium nitrate (Bioxide®) into the Del Dios SPS wet well to control odors and prevent odor generation and release in the long forcemain to Midpoint SPS. The Bioxide system is in good condition, although the District may want to consider upsizing the storage tank to allow for larger deliveries that would reduce chemical unit costs.	Fair to Good
Piping and Valves: Air vacuum valves at suction side of piping to horizontal pumps were not in use; operations staff stated that the air vacuum model was not rated for sewage and therefore release sewage when they exhaust. The existing air vacuum valves need to be replaced with sewage rated air vacuum valves. Generally minimal corrosion or coating deterioration observed on the ductile iron piping, fittings, and valves. Minor corrosion observed on check valve observed presumably due to a leak. Moderate corrosion observed on the steel influent slide gate. These slide gates should be operated periodically to prevent stem corrosion and sticking.	Good
Pumps: Excessive noise was detected from one of the two 125 HP Fairbanks Morse horizontal centrifugal pumps (WP-1B) in the pump room when it shut down; this pump recently had the mechanical seal, impeller, and front face plate replaced and the rebuilt. The onsite pump and motor technician suggested that the noise was associated with the timing between the shutdown of the submersible booster pump and the horizontal centrifugal pump. Submersible pumps tend not to seat properly due to offset discharge configuration with unequal weight distribution and are difficult to maintain. Recommend further investigation and review of alternative pump types or models. The troublesome pump has significant coating deterioration and needs to be recoated. The other Fairbanks Morse pumps, including the two 125 HP submersible pumps in the wet well were reported to be providing reliable service. The pumps have run times between 944 and 1,085 hours. Given the two-stage, 250HP pump rating, and high-head operation, the Del Dios SPS is recommended for routine (annual) pump efficiency testing to monitor performance. Routine testing will provide performance trending information that will facilitate preventative maintenance and allow for energy efficiency optimization including potential pump "right-sizing" when equipment is due for replacement.	Fair to Good

Structural	***Condition***
General: Wet well and influent manhole is constructed of pre-cast concrete with a T-lock liner. Minimal corrosion observed on stainless steel pump guide rails. Access to wet well is easy through 4 separate access hatches. No corrosion observed on the wet well access hatches.	Good
Concrete: No concrete corrosion or indications of water infiltration were observed in the pump building. No observed indications of concrete corrosion behind wet well liner.	Good
Wet Well Liner: The PVC T-Lock wet well liner is in good condition. T-Lock discoloration observed, however, discoloration of the liner does not indicate a performance deficiency. No cracking or bubbling of the liner observed. Minimal coating corrosion observed on the access hatch terminations.	Good
Electrical & Instrumentation	***Condition***
General: The District operator mentioned that the pressure transducer level sensor has not provided satisfactory performance and an alternative level sensor should suit their application better. Electrical and instrumentation connections to the pumps and wet well floats are installed correctly. All gear was observed to be in good condition.	Good
PLC: The District utilizes an Allen-Bradley SLC 5/05 PLC at the pump station. Discussions with Allen-Bradley distributors regarding the longevity of the Allen-Bradley SLC 500 family of processers suggests that Allen-Bradley is anticipating to produce the SLC 500 PLC line and sell new for at least 5 years, with support and repair for an additional 5 years.	Good
OIT: The District utilizes an Allen-Bradley Panelview Plus operator interface terminal (OIT). The current Operator Interface Terminal (OIT) provides access to the local lift station for monitoring, alarming, and control functions, however, a door-mounted Industrial PC (iPC) that would run an Inductive Automation Ignition client would provide similar local access and, in addition, the new iPC would allow access to the entire Wastewater SCADA system. Level of access for individual operators would be according to their username and password and associated security log-in level. Evaluation for appropriate communication bandwidth would be required prior to a change from the existing Panelview Plus to a new iPC.	Good
Communications: The District utilizes Ethernet via Cisco Aironet Radio for their communications at the pump station. The current communications network provides adequate bandwidth to support the requirements of the pump station, however, a future upgrade of the OIT may require a communications upgrade to support larger bandwidth requirements of iPC's running SCADA clients because the servers for the upgraded HMI graphics interface are located at the 4S Ranch WRF.	Good

Recommendations
1. Change air-vacuum valves to sewage –type with connect to drain back to wet well. 2. Investigate and fix seating and shut down timing issues of the submersible pumps. 3. Re-coat Sewage Pump WP-1B. 4. Perform routine (annual) pump efficiency testing. 5. Change existing pressure transducer level sensor to a new alternative level monitoring technology to match the District's operations requirements. 6. Replace the existing door-mounted OIT with a door-mounted Industrial PCs (iPCs) that would run an Inductive Automation Ignition client. 7. Replace SLC 5/05 PLC at the pump station with a newer, supported, CompactLogix PLC within the next 10 years. 8. Upgrade Ethernet connectivity, if necessary, to accommodate bandwidth requirements of upgrade from existing door-mounted OIT to iPC.

Site Photographs

Del Dios pump building and site

Del Dios pumps and mechanical piping

Del Dios wet well

Del Dios influent manhole

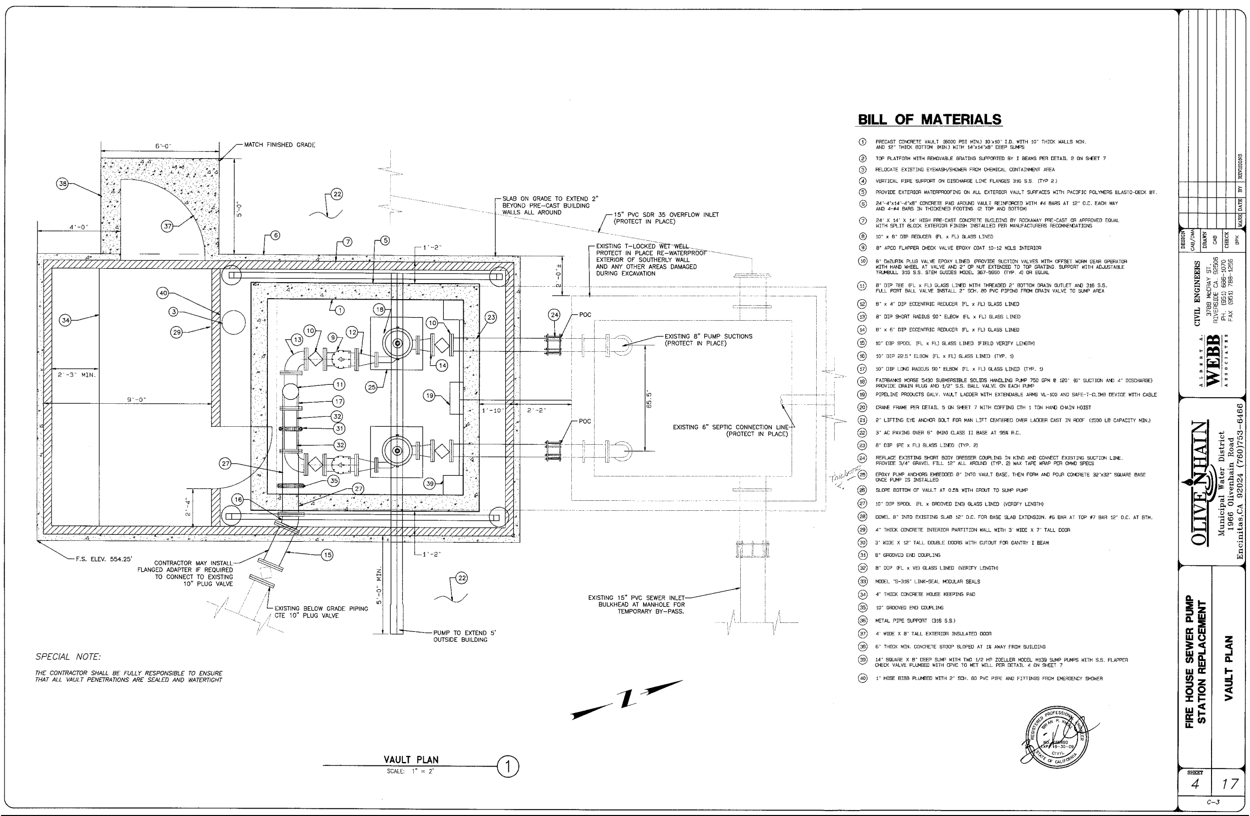
PLC panel with Cisco Aironet Ethernet radio

Benshaw motor controller

Fire House SPS

Service Area:	4S Ranch	**Year Built:**	unknown	**Major Upgrades:**	2004, 2009

Description: Wetwell/Drywell pump station with emergency storage. Wetwell is a 10-feet by 8-feet, 22-foot deep, reinforced concrete wetwell. Two drypit non-clog pumps (Fairbanks Morse Model D 5433 WD, 750 gpm @ 120-ft; 50HP) through a common 10" glass-lined ductile iron, 2,830-foot long forcemain. The Fire House SPS is constant speed operating on draw/fill operation. The Fire House SPS operates approximately 3.8 hours per day in draw/fill control sequence with an average of 4.7 pump starts per day (maximum of 7 pump starts per hour). The Fire House SPS does not have a flowmeter – based on pump starts and runtime, it is estimated that it pumps 160,000 to 190,000 gallons per day. The site contains a 144,000 gallon emergency storage pond. Assuming peak hour flowrate of 365 gallons per minute (roughly 3x current average daily flow), the emergency storage pond provides 6.5 hours of emergency storage.



Observations

Site	*Condition*
General: Access to the pump station is good. The pump station is located at the end of a gated private access road. Minimal to no cracking or potholes observed in the site paving. No signs of vandalism or graffiti observed. The site is secured by chain link fence surrounding the site with three wire corner barbwire arms on top for additional site security. The pump building and electrical room are locked for additional security. A small creek runs adjacent to the pump station site, which uses an exposed concrete-lined basin for emergency storage. An overflow of the containment basin would flow directly into this small creek. Construction of a recycled water pipeline alignment through the sewer pump station site was in progress during the site visit.	Good

Mechanical	*Condition*
General: The Firehouse Sewer Pump Station was originally a packaged pump station that was replaced with the current pump station in 2009. The T-Locked wet well was salvaged from the original design; the new design consists of two 50 HP submersible solids handling pumps in the new dry well. This lift station receives inflow from several restaurants. Apparently those facilities do not have an effective FOG (Fats Oils Grease) program to preclude the discharge of such materials because there is an ongoing problem with removal of FOG from the wet well. The grease mat buildup develops quickly in the wet well which requires the District staff to clean the wet well quarterly, or more as needed. Access to the dry well is inconvenient due to a 20 foot ladder descent into the drywell. A safety harness was used to descend, limiting access to one person at a time. Odors were not observed to be an issue at the pump station. The pump station has no odor control system in place. Mild foul odors were noticed during inspection; however, no foul odors were detected while walking around the site.	Good
Piping and Valves: No corrosion or coating deterioration observed on the ductile iron piping, fittings, and valves (check valve and shutoff valve) inside the dry well.	Good
Pumps: Reportedly, both 50 HP Fairbanks Morse submersible pumps have problems with ragging and both have periodically been shut down to be de-ragged. The operator commented that flushable wipes have often been the cause for clogging the pumps. Consideration should be given to replacing the pumps with more robust solids handling or grinder style pumps when the existing pumps reach the end of their useful life. The Pumps have run times of approximately 2,800 hours. Given the 50HP pump rating, the Fire House SPS is recommended for routine (annual) pump efficiency testing to monitor performance. Routine testing will provide performance trending information that will facilitate preventative maintenance and allow for energy efficiency optimization including potential pump “right-sizing” when equipment is due for replacement.	Good
Structural	*Condition*
General: Wet well is constructed of pre-cast concrete with a T-lock liner. Access to wet well is limited through one manhole. The limited access to the wet well makes maintaining the problematic wet well difficult. Stainless Steel Access hatches installed at other District pump stations are preferred and offer easier and better access to the wet well for maintenance. Moderate corrosion observed on the wet well access manhole, with the most corrosion occurring at the liner termination at the top of the manhole.	Good
Concrete: No concrete corrosion or indications of water infiltration were observed in the dry well. No observed indications of concrete corrosion behind wet well liner. No observed degradation of site concrete.	Good
Wet Well Liner: The PVC T-Lock wet well liner is in good condition. T-Lock discoloration observed, however, discoloration of the liner does not indicate a performance deficiency. No cracking or bubbling of the liner observed. The liner terminations at the top of the wet well are commonly the first to corrode and deteriorate, and should be monitored and re-coated before a breach begins to corrode the concrete structure.	Good
Electrical & Instrumentation	*Condition*
General: The current electrical gear was installed in 2009 and is in excellent condition. Electrical and instrumentation connections to the pumps and wet well floats are installed correctly.	Excellent

PLC: The District utilizes an Allen-Bradley SLC 5/05 PLC at the pump station. Discussions with Allen-Bradley distributors regarding the longevity of the Allen-Bradley SLC 500 family of processers suggests that Allen-Bradley is anticipating to produce the SLC 500 PLC line and sell new for at least 5 years, with support and repair for an additional 5 years.	Good
OIT: The District utilizes an Allen-Bradley Panelview Plus operator interface terminal (OIT). The current Operator Interface Terminal (OIT) provides access to the local lift station for monitoring, alarming, and control functions, however, a door-mounted Industrial PC (iPC) that would run an Inductive Automation Ignition client would provide similar local access and, in addition, the new iPC would allow access to the entire Wastewater SCADA system. Level of access for individual operators would be according to their username and password and associated security log-in level. Evaluation for appropriate communication bandwidth would be required prior to a change from the existing Panelview Plus to a new iPC.	Good
Communications: The District utilizes Ethernet via MDS iNet Radio for their communications at the pump station. The current communications network provides adequate bandwidth to support the requirements of the pump station, however, a future upgrade of the OIT may require a communications upgrade to support larger bandwidth requirements of iPC's running SCADA clients because the servers for the upgraded HMI graphics interface are located at the 4S Ranch WRF.	Good

Recommendations

1. Install bridge crane or additional monorail to access piping and valve in drypit and extend rail to outside of building for loading.
2. Install site lighting at the wet well area for operator safety during nighttime emergency work.
3. Install large double-leaf hatch over wet well for better access for maintenance due to large volume of grease and rags.
4. Install a FOG control system such as is offered by Anue or by DO2E (a wet well aeration system that agitates the wet well surface to preclude the formation of a scum layer).
5. Replace existing door-mounted OIT with a door-mounted Industrial PC (iPC) that would run an Inductive Automation Ignition client.
6. Consideration should be given to requiring a signed Best Management Practices (BMP) agreement by each food handling business and the property owner. Also, consider requiring the installation of a grease interceptor by each upstream food handling business separate from their sanitary lateral.
7. Replace SLC 5/05 PLC at the pump station with a newer, supported, CompactLogix PLC within the next 10 years.
8. Upgrade Ethernet connectivity, if necessary, to accommodate bandwidth requirements of upgrade from existing door-mounted OIT to iPC.

Site Photographs

PLC panel

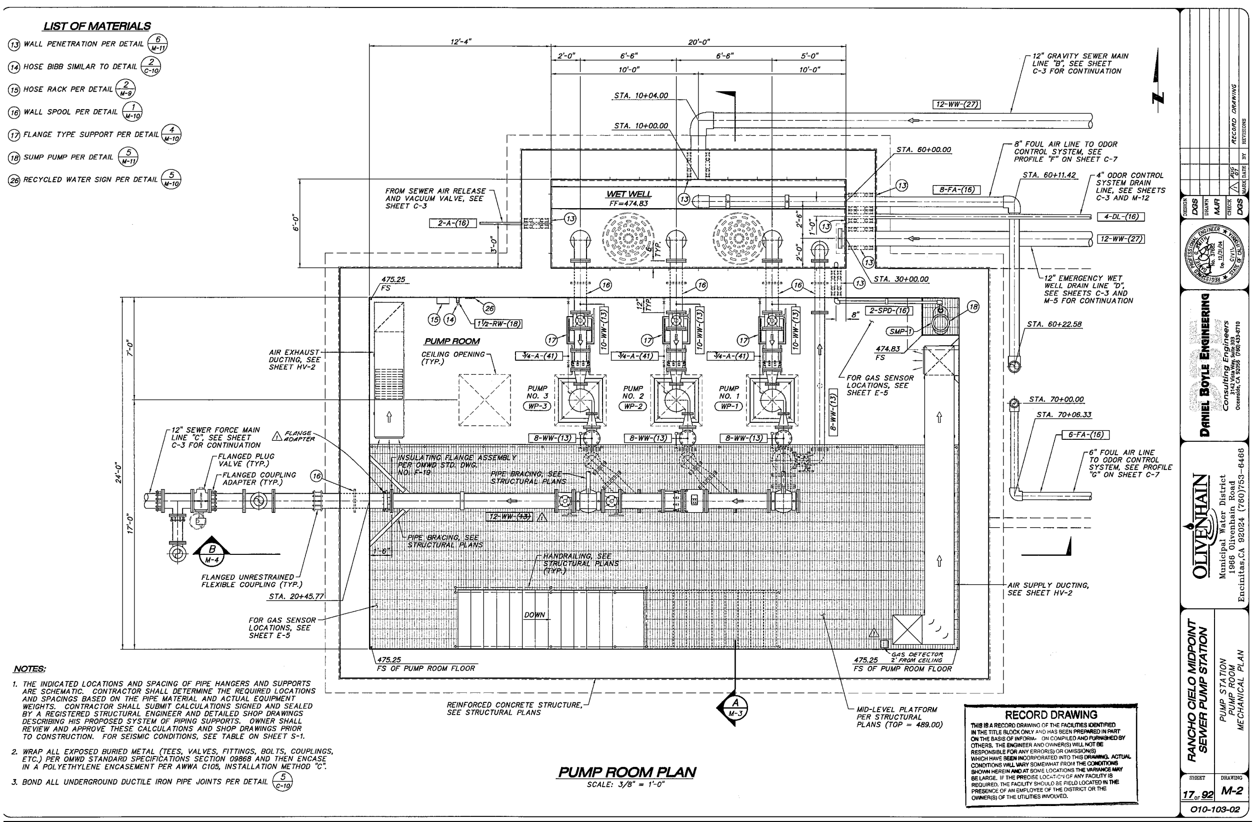
Fire House dry well submersible pump

Fire House emergency storage and site

Pump 2 motor control bucket

Midpoint SPS					
Service Area:	Rancho Cielo	**Year Built:**	2005	**Major Upgrades:**	None

Description: Wetwell/Drywell pump station with emergency storage. Wetwell is a 20-feet by 6-feet, 24-foot deep, reinforced concrete wetwell. Three drypit non-clog pumps (Fairbanks Morse Model A5435WD, 850 gpm @ 193-ft; 75HP) through a common 12" PVC, 10,320-foot long forcemain. The Midpoint SPS is constant speed operating on draw/fill operation. The Midpoint SPS operates approximately 0.5 hours per day in draw/fill control sequence with an average of 20 pump starts per day (maximum of 3 pump starts per hour). The Midpoint SPS has an inline magnetic flowmeter – average daily flowrate is 35,000 to 45,000 gallons per day. The site contains a 101,317 gallon emergency storage tank. Assuming peak hour flowrate of 83 gallons per minute (approximately 3x current average daily flow), the emergency storage tank provides 20.2 hours of emergency storage.



Observations	
Site	***Condition***
General: Access to the pump station is good. The pump station is located on the corner of a busy street, but the side street is not busy and the pump station can be accessed easily from that access point. Minimal to no cracking or potholes observed in the site paving. No signs of vandalism or graffiti observed. The site is secured by a tall CMU wall with steel extension or steel fencing around the perimeter and remote controlled steel security gates. The pump building and electrical room are locked for additional security.	Good

Mechanical	*Condition*
General: The Midpoint Sewer Pump station operates in series with the Del Dios Sewer Pump station to pump wastewater from the Cielo development to the 4S Ranch WRF. No odors were detected while observing the site. The Midpoint pump station only receives sewer from the Del Dios pump station forcemain.	Good
Piping and Valves: Minor corrosion or coating deterioration observed on the ductile iron piping, fittings, and valves (check valve and shutoff valve) inside the dry well.	Good
Pumps: The three 75 HP Fairbanks Morse vertical centrifugal pumps are reported to be providing reliable service. The pumps are installed on housekeeping pads at the bottom of the dry well, along with the attached motor, j-box, and routing cables. Generally it is recommended to install motors and electrical gear above grade or above the dry well floor in the event the dry well floods. A fourth, spare pump and motor sit at the bottom of the dry well adjacent to the three installed pumps. The District should consider relocating the spare pump and motor above grade in a separate storage facility in the event the dry well floods. Given the 75HP pump rating, the Midpoint SPS is recommended for routine (annual) pump efficiency testing to monitor performance. Routine testing will provide performance trending information that will facilitate preventative maintenance and allow for energy efficiency optimization including potential pump “right-sizing” when equipment is due for replacement.	Good
Structural	*Condition*
General: Wet well and influent manhole is constructed of pre-cast concrete with a T-lock liner. Access to the T-Lock wet well is available through two manholes. The limited access to the wet well provided by manholes makes maintaining the wet well difficult. Stainless Steel Access hatches installed at other District pump stations are preferred and offer easier and better access to the wet well for maintenance. A steel stairway provides access from the pump building down to a suspended steel mezzanine level for access to flow meter, plug valves and pipe fittings. The steel stairway continues down to the base of the dry well for access to the pumps, motors, piping, and valves located there. No corrosion was observed on the steel stairway and mezzanine level.	Good
Concrete: Minor indications of water infiltration were observed in the dry well, however, no concrete corrosion was observed. No observed indications of concrete corrosion behind wet well liner.	Good
Wet Well Liner: The PVC T-Lock wet well liner is in good condition. T-Lock discoloration observed, however, discoloration of the liner does not indicate a performance deficiency. No cracking or bubbling of the liner observed. The liner terminations at the top of the wet well are commonly the first to corrode and deteriorate, and should be monitored and re-coated before a breach begins to corrode the concrete structure.	Good
Electrical & Instrumentation	*Condition*
General: Electrical and instrumentation connections to the pumps and wet well floats are installed correctly.	Good

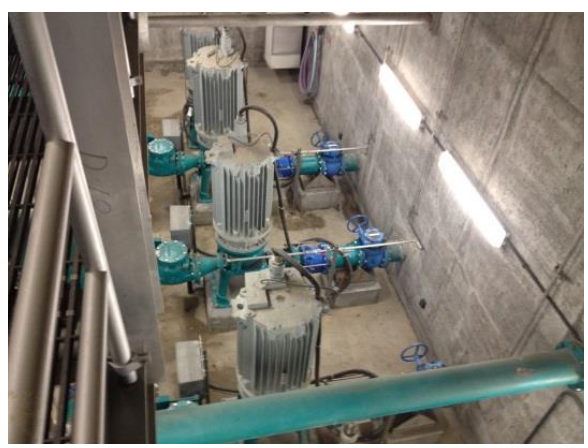
PLC: The District utilizes an Allen-Bradley SLC 5/05 PLC at the pump station. Discussions with Allen-Bradley distributors regarding the longevity of the Allen-Bradley SLC 500 family of processers suggests that Allen-Bradley is anticipating to produce the SLC 500 PLC line and sell new for at least 5 years, with support and repair for an additional 5 years.	Good
OIT: The District utilizes an Allen-Bradley Panelview Plus operator interface terminal (OIT). The current Operator Interface Terminal (OIT) provides access to the local lift station for monitoring, alarming, and control functions, however, a door-mounted Industrial PC (iPC) that would run an Inductive Automation Ignition client would provide similar local access and, in addition, the new iPC would allow access to the entire Wastewater SCADA system. Level of access for individual operators would be according to their username and password and associated security log-in level. Evaluation for appropriate communication bandwidth would be required prior to a change from the existing Panelview Plus to a new iPC.	Good
Communications: The District utilizes Ethernet via Cisco Aironet Radio for their communications at the pump station. The current communications network provides adequate bandwidth to support the requirements of the pump station, however, a future upgrade of the OIT may require a communications upgrade to support larger bandwidth requirements of iPC's running SCADA clients because the servers for the upgraded HMI graphics interface are located at the 4S Ranch WRF.	Good

Recommendations

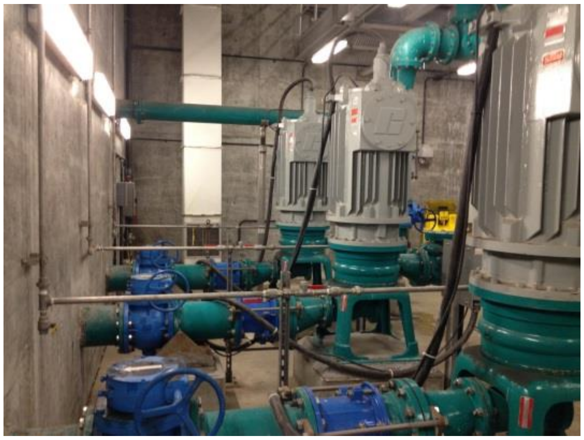
1. Relocate the j-box and routing cables to the mezzanine to avoid damage to pumps and electrical system in case of drypit flooding. Drypit submersible power/control cables currently connect to unsealed j-box in drywell floor.
2. Replace the existing door-mounted OIT with a door-mounted Industrial PCs (iPCs) that would run an Inductive Automation Ignition client.
3. Install two large double-leaf hatches over wet well for better access for maintenance.
4. Replace SLC 5/05 PLC at the pump station with a newer, supported, CompactLogix PLC within the next 10 years.
5. Upgrade Ethernet connectivity, if necessary, to accommodate bandwidth requirements of upgrade from existing door-mounted OIT to iPC.

Site Photographs

Midpoint pump building and site



Pumps (from above)



Pumps (from level), mechanical piping

Midpoint wet well

Square-D MCC

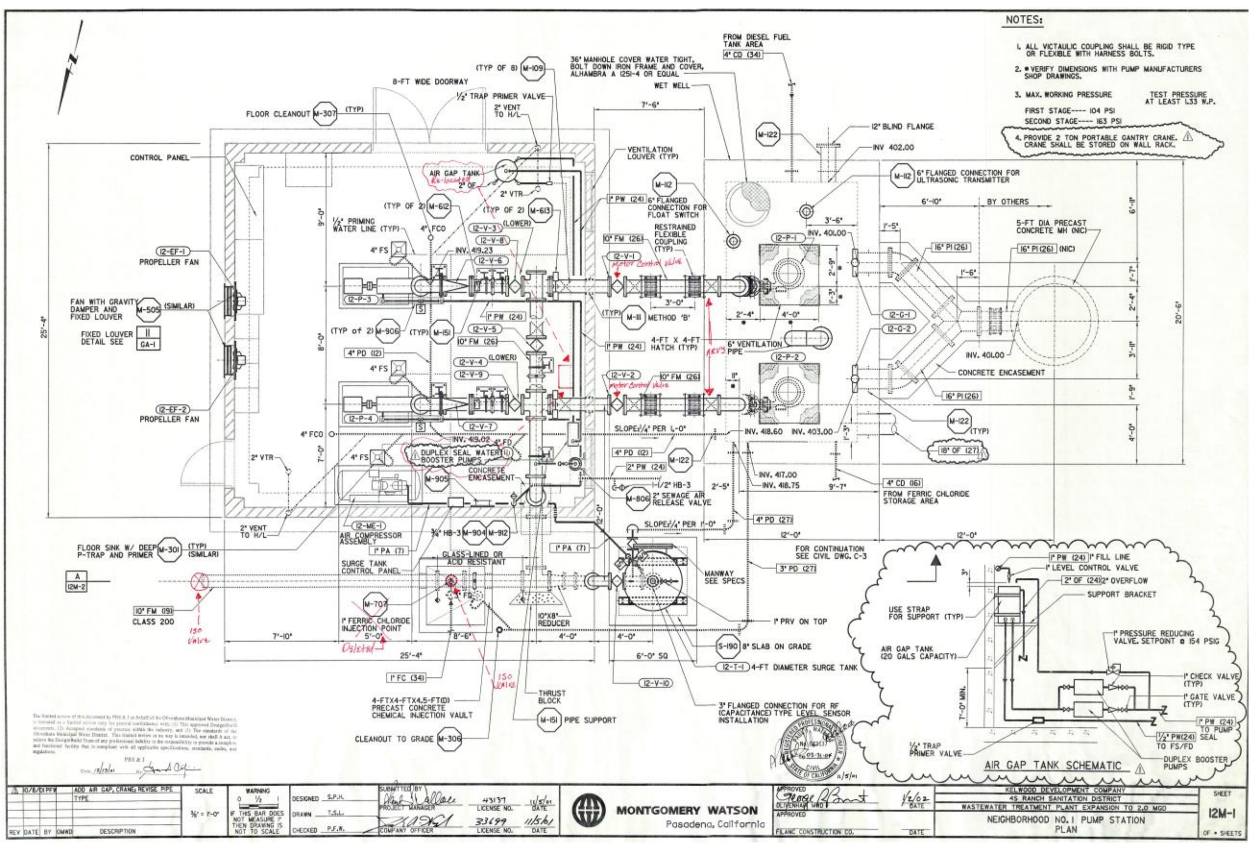
Tesco reactive air level system

Neighborhood #1 SPS

Service Area: 4S Ranch	**Year Built:** 2001	**Major Upgrades:** None

Description: Wetwell/Drywell, double-stage pump station with emergency storage. Wetwell is a 16-feet 8-inch by 9-feet, 26.5-foot deep, reinforced concrete wetwell. Two submersible solids handling pumps (1500 gpm @ 116-ft, 75HP, Fairbanks Morse Model D5434MV) pump in series from the wetwell to horizontal solids centrifugal pumps (1360 gpm @ 225-ft, 125HP, Fairbanks Morse Model B5424) within the pump room and then through a common PVC, 6,160-foot long forcemain. The Neighborhood #1 SPS is effectively constant speed as the 1st-stage pumps operate on draw/fill operation and the 2nd-stage pumps operate on variable speed to control pumping rate. The Neighborhood #1 SPS operates approximately 5 hours per day in draw/fill control sequence with an average of 71 pump starts per day (maximum of 6 pump starts per hour). The Neighborhood #1 SPS has an inline magnetic flowmeter – average daily flowrate is 230,000 to 400,000 gallons per day. The site contains 594,000 gallons of emergency storage in a concrete storage pond. Assuming peak hour flowrate of 656 gallons per minute (approximately 3x current average daily flow), the emergency storage tank provides 15 hours of emergency storage.

The District is currently evaluating a complete pump station replacement, separate from this assessment and CIP study.



Observations

Site	*Condition*
General: Access to the pump station is good. Minimal to no cracking or potholes observed in the site paving. No signs of vandalism or graffiti observed. The site is secured by a chain link fence with barbed wire on top around the perimeter and a locked fence gate along the access road. The pump building and electrical room are locked for additional security.	Good

Mechanical	*Condition*
General: The operator stated that the pumps have not had clogging issues and were observed during inspection to be operating without any visible issues. More corrosion was observed at Neighborhood 1 than the other pump stations. Visual indications of stormwater ponding were observed on site with significant drainage issues noted near electrical service panel. Facility lacks proper overhead hoisting system resulting in poor access for mechanical components.	Fair
Piping and Valves: Minor to moderate corrosion and coating deterioration observed on the ductile iron piping, fittings, and valves inside the pump room and outside above grade. Many anchor bolts and fittings are moderately to severely corroded, while some have been replaced recently and are in good condition.	Fair
Pumps: The pump station has four Fairbanks Morse pumps, two 75 HP submersible pumps (12-P-1 and 12-P-2) and two 125 HP horizontal centrifugal pumps (12-P-3 and 12-P-4). Pump 12-P-4 is very loud at shutdown. Series pumping with sequencing motor operated valves is problematic and should be reconsidered in major pump station upgrades. Water seals on horizontal pumps are also problematic. The District should consider using mechanical seals during pump station upgrades. Given the two-stage, 200HP pump rating, relatively high load factor (average 5 hours of operation per day), and high-head operation, the Neighborhood #1 SPS is recommended for routine (annual) pump efficiency testing to monitor performance. Routine testing will provide performance trending information that will facilitate preventative maintenance and allow for energy efficiency optimization including potential pump "right-sizing" when equipment is due for replacement.	Fair
Structural	***Condition***
General: Wet well is constructed of pre-cast concrete with a T-lock liner. Access to the T-Lock wet well is available through two access hatches.	Fair to Good
Concrete: Cracking and indications of groundwater intrusion were observed on the concrete in the emergency storage pond. Concrete staining was observed on exposed concrete above the wet well, and at the base of the electrical switchboard from stormwater ponding. No observed indications of concrete corrosion behind wet well liner.	Fair
Wet Well Liner: The PVC T-Lock wet well liner is in good condition. T-Lock discoloration observed, however, discoloration of the liner does not indicate a performance deficiency. No cracking or bubbling of the liner observed. The liner terminations at the top of the wet well are commonly the first to corrode and deteriorate, and should be monitored and re-coated before a breach begins to corrode the concrete structure.	Good

Electrical & Instrumentation	*Condition*
General: The electrical components are in poor condition and require attention. The outside switchboard has water ingress from the incoming utility conduits. The flooding issues around the switchboard produce an unsafe operations situation. The switchboard is also mounted directly on slab and does not have a housekeeping pad to keep the gear out of the ponding water. The water ponding in the base of the gear has severely corroded the base of the switchboard. The ATS within the switchboard is old and needs to be replaced. A non-compliant code situation was observed with the ATS not allowing proper space to work on the ATS interior. The generator power quality is low. The generator power quality issues do not allow the level controls on the Milltronics Ultrasonic to function properly while on generator power. Some of the outside conduits on the back wall are in need of replacement. The District should consider providing air conditioning for the electrical room to reduce dust accumulation within the building.	Poor
VFD's: The original Square-D Altivar VFDs have been replaced Eaton VFDs. The District does not have any documentation on the VFDs or the Square-D MCC line-up. There are general code violations within the VFD cabinets. It is not safe to work in the VFD cabinets where the controls are mounted on the top-left-side above the 460VAC electrical equipment.	Poor
PLC: The District utilizes an Allen-Bradley SLC 5/05 PLC at the pump station. Discussions with Allen-Bradley distributors regarding the longevity of the Allen-Bradley SLC 500 family of processers suggests that Allen-Bradley is anticipating to produce the SLC 500 PLC line and sell new for at least 5 years, with support and repair for an additional 5 years.	Good
OIT: The District utilizes an Allen-Bradley Panelview Plus operator interface terminal (OIT). The current Operator Interface Terminal (OIT) provides access to the local lift station for monitoring, alarming, and control functions, however, a door-mounted Industrial PC (iPC) that would run an Inductive Automation Ignition client would provide similar local access and, in addition, the new iPC would allow access to the entire Wastewater SCADA system. Level of access for individual operators would be according to their username and password and associated security log-in level. Evaluation for appropriate communication bandwidth would be required prior to a change from the existing Panelview Plus to a new iPC.	Good
Communications: The District utilizes Ethernet via MDS iNet Radio for their communications at the pump station. The current communications network provides adequate bandwidth to support the requirements of the pump station, however, a future upgrade of the OIT may require a communications upgrade to support larger bandwidth requirements of iPC's running SCADA clients because the servers for the upgraded HMI graphics interface are located at the 4S Ranch WRF.	Good
Recommendations	
1. Replace the Neighborhood #1 sewer pump station per separate/independent evaluation and recommendations.	

Site Photographs

Neighborhood #1 site and pump building

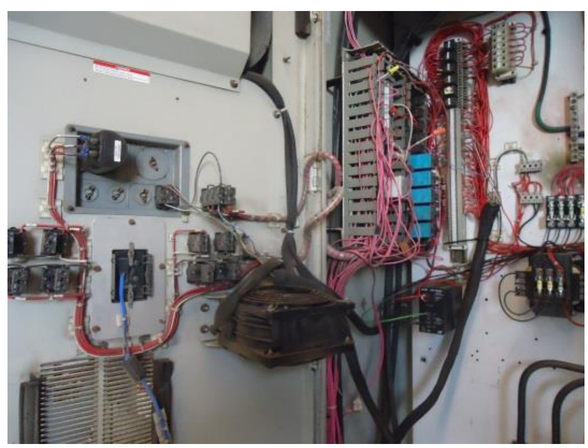
Rust and corrosion on mechanical piping and isolation valve

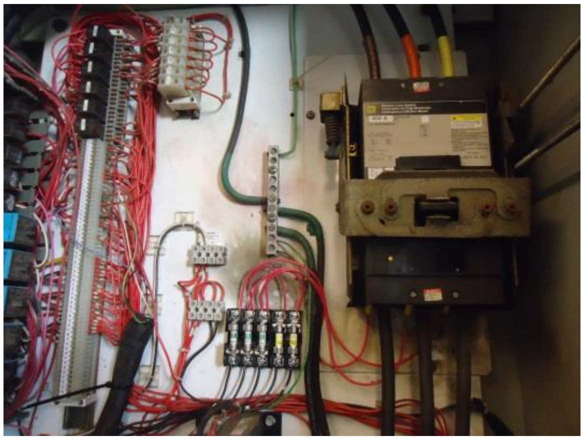
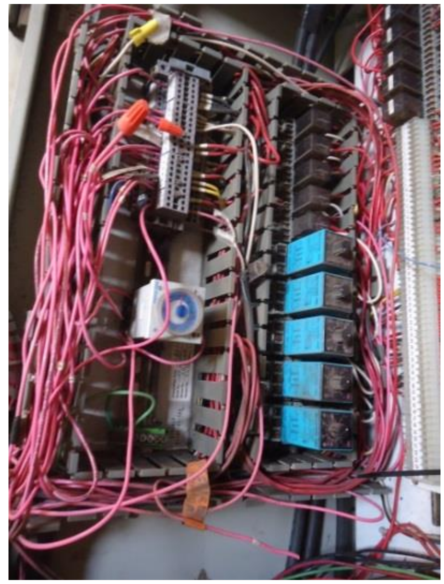
Neighborhood #1 wet well

Neighborhood #1 pump and motor

Cracking observed in emergency storage pond

Groundwater intrusion and discoloration observed in emergency storage pond

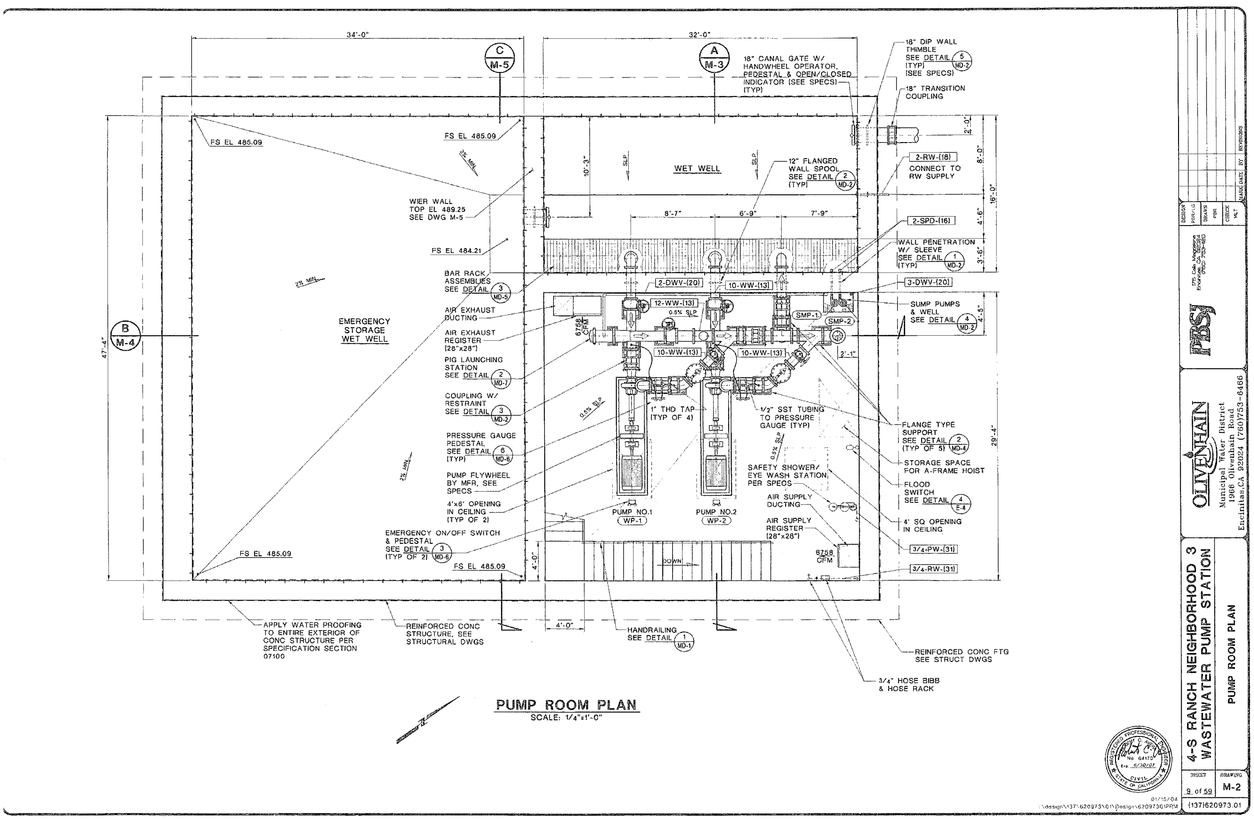
 **Outside switchboard corrosion from water ingress**	 **Outside switchboard corrosion from water ingress**
 **Outside switchboard ATS section**	 **Outside switchboard lineup**
 **VFD's**	 **VFD control section above 480VAC power**

 **VFD interior corroded and in poor condition**	 **VFD control section wire mess**

Neighborhood #3 SPS

Service Area: 4S Ranch	**Year Built:** 2004	**Major Upgrades:** None

Description: Wetwell/Drywell pump station with emergency storage. Wetwell is a 32-feet by 16-feet, 25-foot deep, reinforced concrete wetwell. Two drypit horizontal centrifugal pumps (Fairbanks Morse Model C5426 Type T60 (with Fly Wheel), 1594 gpm @ 209-ft; 150HP) pump through a common 12" PVC, 6,410-foot long forcemain. The Neighborhood #3 SPS is constant speed operating on draw/fill operation. The Neighborhood #3 SPS operates approximately 5.5 hours per day in draw/fill control sequence with an average of 52 pump starts per day (maximum of 5 pump starts per hour). The Neighborhood #3 SPS has an inline magnetic flowmeter – average daily flowrate is 380,000 to 450,000 gallons per day. The site contains a 249,609 gallon emergency storage tank. Assuming peak hour flowrate of 865 gallons per minute (3x current average daily flow), the emergency storage tank provides 4.8 hours of emergency storage.



Observations

Site	*Condition*
General: Access to the pump station is good. Minimal to no cracking or potholes observed in the site paving. No signs of vandalism or graffiti observed. The site is secured by a tall CMU masonry wall around the perimeter and a remote controlled security gate at the entrance. The pump building and electrical room are locked for additional security.	Good

Mechanical	***Condition***
General: According to the operator, the odor control system at the pump station did not function for the District and has not been used. The operator did not recall any trouble with clogging or operation of the pumps.	Good
Piping and Valves: Minor corrosion or coating deterioration observed on the ductile iron piping, fittings, and valves (check valve and shutoff valve) inside the dry well.	Good
Pumps: The two 125 HP Fairbanks Morse horizontal centrifugal pumps are reported to be providing reliable service. The pumps are installed on housekeeping pads at the bottom of the dry well, along with the attached motor, j-box, and routing cables. Generally it is recommended to install submersible pumps in the dry well or install motors and electrical gear above grade or above the dry well floor in the event the dry well floods. Given 125HP pump rating and relatively high load factor (average 5.5 hours of operation per day) the Neighborhood #3 SPS is recommended for routine (annual) pump efficiency testing to monitor performance. Routine testing will provide performance trending information that will facilitate preventative maintenance and allow for energy efficiency optimization including potential pump "right-sizing" when equipment is due for replacement.	Good
Structural	***Condition***
General: The District had problems with the T-Lock liner in the influent manhole and it had since been replaced with a spray-on liner. Wet well and is constructed of pre-cast concrete with a T-lock liner. Access to the T-Lock wet well is available through four manholes. The limited access to the wet well provided by manholes makes maintaining the wet well difficult. Due to the large size and depth of the wet well, easier access would improve maintenance crew's ability to remove rags and other debris from the wet well. The Stainless Steel Access hatches installed at other District pump stations are preferred and offer easier and better access to the wet well for maintenance.	Good
Concrete: Minor water intrusion was observed in the lined influent manhole and in the dry well, however, no concrete staining or corrosion was observed. No observed indications of concrete corrosion behind wet well liner.	Good
Wet Well Liner: The PVC T-Lock wet well liner is in good condition. T-Lock discoloration observed, however, discoloration of the liner does not indicate a performance deficiency. No cracking or bubbling of the liner observed. The liner terminations at the top of the wet well are commonly the first to corrode and deteriorate, and should be monitored and re-coated before a breach begins to corrode the concrete structure.	Good
Electrical & Instrumentation	***Condition***
General: The lights in the lower dry well area are too high for easy maintenance because they cannot be reached with a typical ladder. Consideration should be given to lowering the lights on pendant mounts or relocating the lights to the side walls for easier access. The lockout on the Kohler generator main disconnect does not work and is a safety concern.	Good

PLC: The District utilizes an Allen-Bradley SLC 5/05 PLC at the pump station. Discussions with Allen-Bradley distributors regarding the longevity of the Allen-Bradley SLC 500 family of processers suggests that Allen-Bradley is anticipating to produce the SLC 500 PLC line and sell new for at least 5 years, with support and repair for an additional 5 years.	Good
OIT: The District utilizes an Allen-Bradley Panelview Plus operator interface terminal (OIT). The current Operator Interface Terminal (OIT) provides access to the local lift station for monitoring, alarming, and control functions, however, a door-mounted Industrial PC (iPC) that would run an Inductive Automation Ignition client would provide similar local access and, in addition, the new iPC would allow access to the entire Wastewater SCADA system. Level of access for individual operators would be according to their username and password and associated security log-in level. Evaluation for appropriate communication bandwidth would be required prior to a change from the existing Panelview Plus to a new iPC.	Good
Communications: The District utilizes Ethernet via Cisco Aironet Radio for their communications at the pump station. The current communications network provides adequate bandwidth to support the requirements of the pump station, however, a future upgrade of the OIT may require a communications upgrade to support larger bandwidth requirements of iPC's running SCADA clients because the servers for the upgraded HMI graphics interface are located at the 4S Ranch WRF.	Good

Recommendations

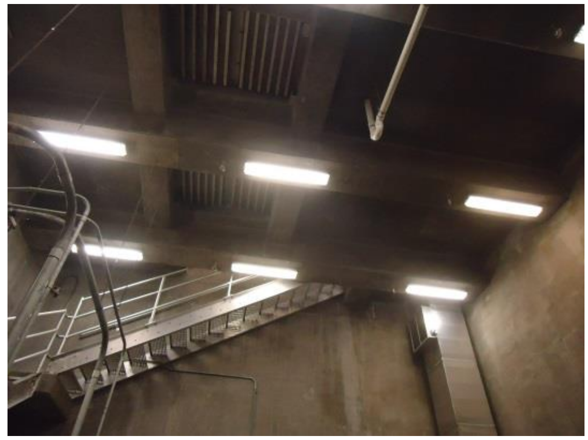
1. Replace the lockout on the emergency generator disconnect.
2. Replace the existing door-mounted OIT with a door-mounted Industrial PCs (iPCs) that would run an Inductive Automation Ignition client.
3. Replace pumps and motors in the dry well at the end of their useful life with submersible pumps or submersible motors to protect equipment from dry well flooding incident.
4. Replace SLC 5/05 PLC at the pump station with a newer, supported, CompactLogix PLC within the next 10 years.
5. Upgrade Ethernet connectivity, if necessary, to accommodate bandwidth requirements of upgrade from existing door-mounted OIT to iPC.

Site Photographs

Neighborhood #3 pump building and site

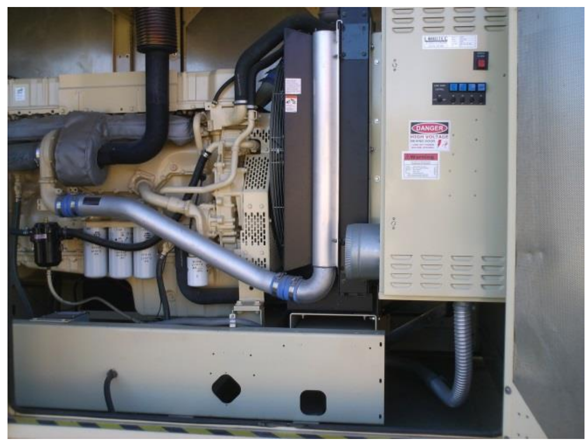
Neighborhood #3 influent manhole

Neighborhood #3 pumps, motors, and mechanical piping (from above)



Lights in lower dry well area

Generator main disconnect lockout (not working)

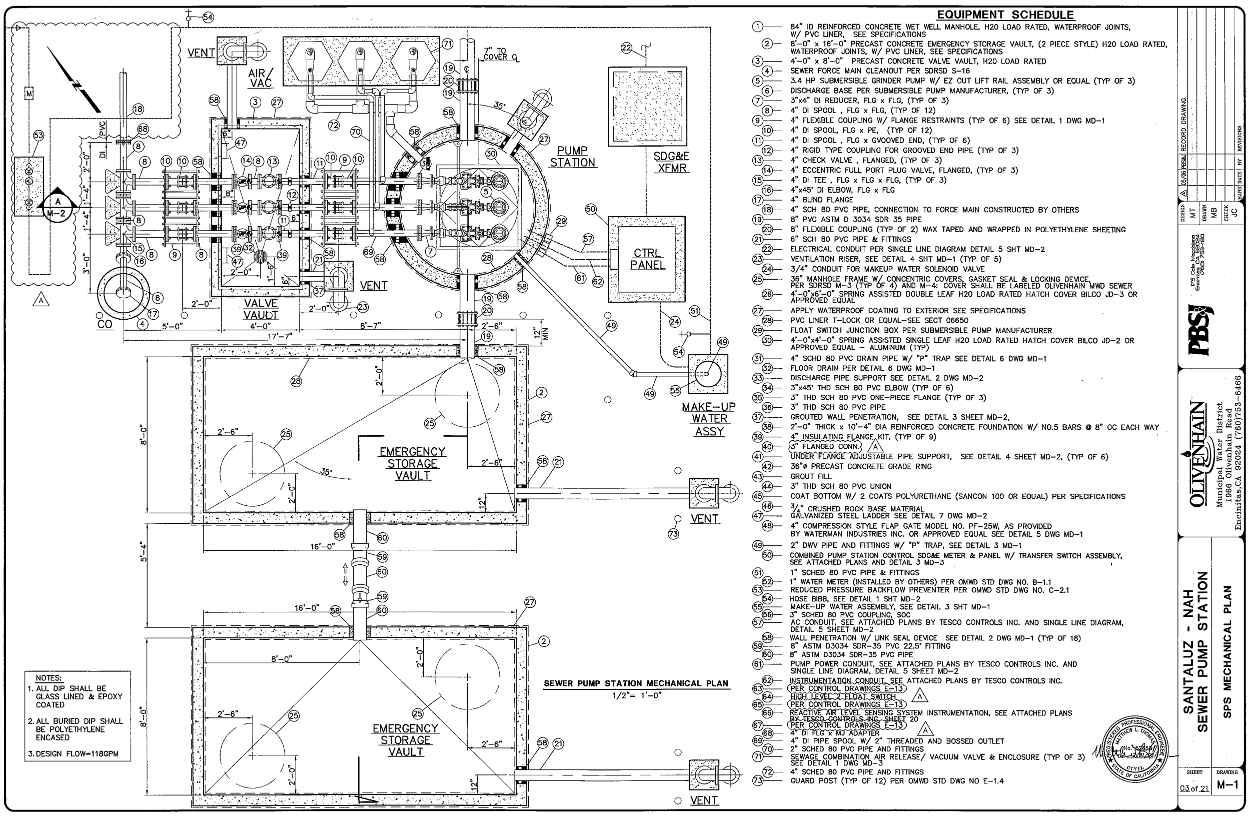


Emergency Generator

Santaluz SPS

Service Area:	4S Ranch	**Year Built:**	2004	**Major Upgrades:**	None

Description: Triplex submersible pump station with emergency storage. Wetwell is a 7-foot diameter, 19-foot deep, precast concrete wetwell. Three submersible pumps (7.5 HP Hydromatic Grinder Style Pumps) pump through 3" discharge pipes, a below grade valve vault, and then a common 4" PVC, 1,310-foot long forcemain. The Santaluz SPS is constant speed operating 5.0 hours per day in draw/fill control sequence with an average of 71 pump starts per day (maximum of 7 pump starts per hour). The Santaluz SPS does not have a flowmeter – based on pump starts and runtime, it is estimated that it pumps 20,000 to 30,000 gallons per day. The site contains 24,262 gallons of emergency storage in two tanks. Assuming peak hour flowrate of 52 gallons per minute (roughly 3x current average daily flow), the emergency storage tank provides 7.75 hours of emergency storage.



Observations

Site	*Condition*
General: Access to the pump station is good. Minimal to no cracking or potholes observed in the site paving. No signs of vandalism or graffiti observed. The site is secured by a roughly 5 foot CMU masonry wall around the perimeter and a wooden access gate. The electrical and control box is locked for additional security.	Good

Mechanical	*Condition*
General: The District operator informed the inspector that one of the pumps has been replaced due to clogging issues from rags. The wet well is equipped with a washing system to keep the grease mat down, but the washing can produce instances in which the pumps do not have enough capacity to pump sewage influent and the washing system water. Wastewater conditioning system was not working properly – appears to need booster pump for increased pressure and additional head on opposite side to function as intended. Existing above grade vent piping is PVC. PVC piping is not recommended for exposed above grade piping because it is not UV resistant. Consideration should be given to replacing with coated ductile iron piping when piping is replaced.	Good
Piping and Valves: Minimal observed corrosion or coating deterioration on the ductile iron piping, fittings, and valves (check valve and shutoff valve) inside the valve vault. Glued/Threaded joint PVC pipe is currently used for pump discharge piping, however, PVC pump discharge piping is not recommended because it is brittle and susceptible to leaks and cracking when subjected to cyclical operation and vibration.	Good
Pumps: Existing three 7.5 HP Hydromatic pumps have had issues with seating and require repair to pins and seals. Pump run times are currently between 4,245 hours and 5,494 hours. The District has noted a preference for Myers submersible pumps.	Fair
Structural	***Condition***
General: Wet well is constructed of pre-cast concrete with a T-lock liner. Access to the T-Lock wet well is available through a stainless steel access hatch. Corrosion on the underside of the access hatch to the wet well was observed. Minor to moderate corrosion observed on stainless steel pump guide rails.	Good
Concrete: Concrete corrosion and indications of water infiltration were observed in the valve vault around pipe penetrations. Grout and concrete around pipe penetrations are corroded and appears to be the result of water infiltration corroding either steel reinforcement or ductile iron pipe within the wall. No observed indications of concrete corrosion behind wet well liner.	Fair
Wet Well Liner: The PVC T-Lock wet well liner is in good condition. T-Lock discoloration observed, however, discoloration of the liner does not indicate a performance deficiency. No cracking or bubbling of the liner observed. Moderate corrosion was observed at the liner terminations at the top of the emergency storage tank. Liner terminations are commonly the first to corrode and deteriorate, and should be monitored and re-coated before a breach begins to corrode the concrete structure.	Good
Electrical & Instrumentation	***Condition***
General: No leakage, corrosion, or visual deficiencies observed in the electrical and control box. All gear is affixed to the pump station correctly. Electrical and instrumentation connections to the pumps and wet well floats are installed correctly.	Good
PLC: The District utilizes an Allen-Bradley SLC 5/05 PLC at the pump station. Discussions with Allen-Bradley distributors regarding the longevity of the Allen-Bradley SLC 500 family of processers suggests that Allen-Bradley is anticipating to produce the SLC 500 PLC line and sell new for at least 5 years, with support and repair for an additional 5 years.	Good

OIT: None	N/A
Communications: The District utilizes Ethernet via Cisco Aironet Radio for their communications at the pump station. The current communications network provides adequate bandwidth to support the requirements of the pump station.	Good

Recommendations

1. Install site lighting for nighttime operations surveillance and safety for emergency work.
2. Install canopy over electrical panel for safety during emergency electrical work in the rain.
3. Install a wash water booster pump for additional wash water pressure.
4. Chip away grout surrounding valve vault pipe penetration to investigate cause of concrete corrosion. Re-grout and protect against water infiltration and corrosive environment.
5. Replace PVC pump discharge piping with flanged ductile iron (ceramic epoxy lined) or type 316 stainless steel pipe.
6. Replace existing Hydromatic pumps with District preferred Myers submersible pump.
7. Replace SLC 5/05 PLC at the pump station with a newer, supported, CompactLogix PLC within the next 10 years.

Site Photographs

Santaluz site

Santaluz wet well

 Control panel	 Cisco Aironet Ethernet radio
 Corrosion on underside of wet well hatch	 Concrete corrosion around valve vault pipe penetration

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APPENDIX D

TM2C – Collection System Condition Assessments

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TECHNICAL MEMORANDUM #2C

To: George Briest, Olivenhain Municipal Water District
Author(s): Phil Giori, Steve Jepsen
Reviewer(s): Tom Falk, P.E., Amanda Combs, P.E.
Date: May, 2015
Subject: Collection System Condition Assessment

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1 INTRODUCTION

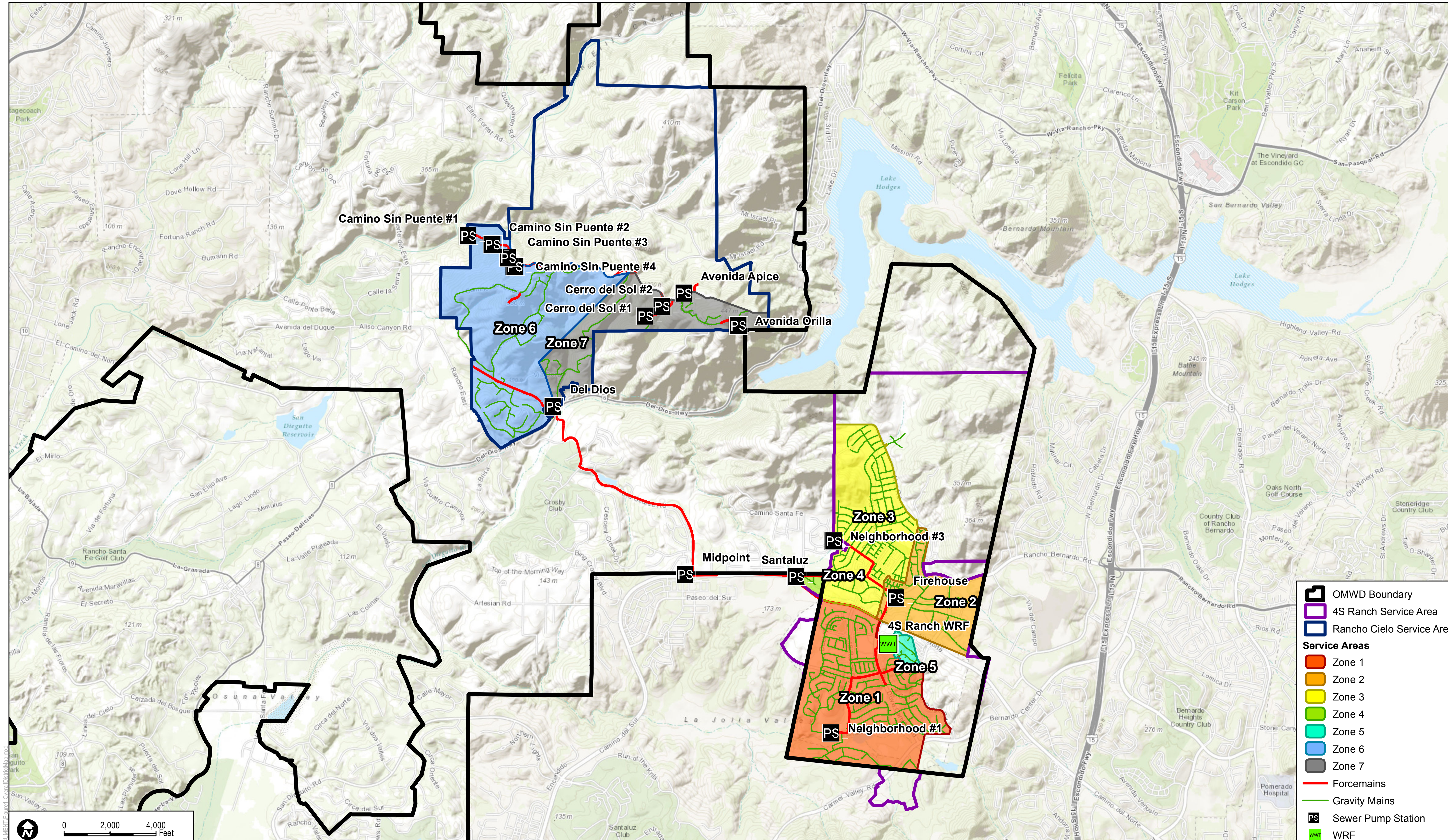
The Olivenhain Municipal Water District (District) contracted Dudek to prepare an Operations and Condition Assessment and Capital Improvement Plan for the 4S Ranch and Rancho Cielo Sanitation Districts that will guide strategic planning and investments for the District's wastewater collection, treatment, and reuse programs.

This Technical Memorandum #2C (TM2C) presents the findings from the condition assessment of the collection system. Technical Memorandum #2A presents findings from the condition assessment field investigations for the 4S Ranch Water Reclamation Facility. Technical Memorandum #2B presents the findings from the condition assessment field investigations for each of the District's fourteen sewer pump stations.

The District's collection system is organized into seven distinct "zones." The zones refer to a section of the collection system, presumably constructed around the same time, encompassing a catchment or region of the collection system. The zones are described in **Table 1** and depicted graphically in **Figure 1**.

Table 1. Summary of Collection System Zones

Zone	Collection System	Summary of Zone
Zone 1	4S Ranch	Primarily residential homes connect to this zone. All flow generated in Zone 1 flows to the Neighborhood #1 sewer pump station, where it is pumped directly to the 4S Ranch WRF influent junction structure.
Zone 2	4S Ranch	Primarily business and restaurants connect to this zone. All flow generated in Zone 2 flows to the Fire House sewer pump station, where it is pumped directly to the 4S Ranch WRF influent junction structure.
Zone 3	4S Ranch	Primarily residential homes connect to this zone. All flow generated in Zone 3 flows to the Neighborhood #3 sewer pump station, where it is pumped directly to the 4S Ranch WRF influent junction structure.
Zone 4	4S Ranch	Primarily multi-family housing units connect to this zone. All flow generated in Zone 4 flows to the Santaluz sewer pump station, where it is pumped into Zone 3. From the discharge manhole, wastewater flows by gravity to the Neighborhood #3 sewer pump station, where it is pumped directly to the 4S Ranch WRF influent junction structure.
Zone 5	4S Ranch	Primarily residential homes connect to this zone. All flow generated in Zone 5 flows by gravity into the 4S Ranch WRF influent junction structure.
Zone 6	Rancho Cielo	Primarily residential homes connect to this zone. All flow generated in Zone 6 ultimately flows by gravity to the Del Dios sewer pump station, where it is pumped to the Midpoint sewer pump station. The Midpoint sewer pump station pumps to the 4S Ranch WRF influent junction structure. The four Camino Sin Puente pump stations are located in this collection system zone.
Zone 7	Rancho Cielo	Primarily residential homes connect to this zone. All flow generated in Zone 6 ultimately flows by gravity to the Del Dios sewer pump station, where it is pumped to the Midpoint sewer pump station. The Midpoint sewer pump station pumps to the 4S Ranch WRF influent junction structure. The Avenida Apice, Avenida Orilla, Cerro Del Sol #1, and Cerro Del Sol #2 sewer pump stations are located in this collection system zone.



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SOURCE: Olivenhain MWD 2014; SanGIS 2015; ESRI Basemap 2015

FIGURE 1

Service Area Zone Map

Olivenhain MWD Project

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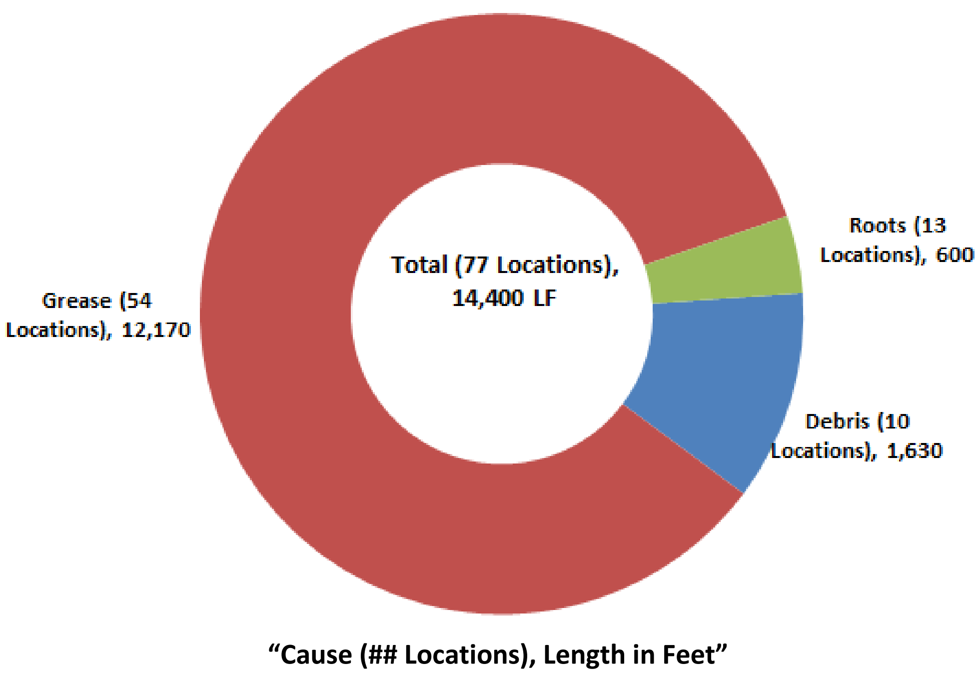
2 CONDITION ASSESSMENT

2.1 Gravity Collection System Hot Spots

2.1.1 Existing Hot Spots

The gravity collection system is typically less than 20 years old and with only a few exceptions is constructed out of PVC pipe. The District inspects and cleans the entire 66 miles of gravity pipe on a three-year cycle. Field investigations were determined to not be necessary as part of this study in consideration of the general age, life expectancy, material makeup, and minor maintenance issues reported by the District. The District provided Dudek with a listing of 77 gravity collection system "Hot Spots", representing approximately 2.7 miles of pipeline or 4% of the total gravity collection system. The hot spots are described in **Table 2**, depicted geographically in **Figures 3** and **4**, and summarized in **Figure 2** by total length and number of locations. Of the 77 total hot spots identified, 70 percent of the occurrences are attributed to grease, 13 percent to debris and 17 percent to roots. Recommendations are provided for addressing the District's gravity collection system hot spots in the following section.

Figure 2. Gravity Collection System Hot Spot Summary



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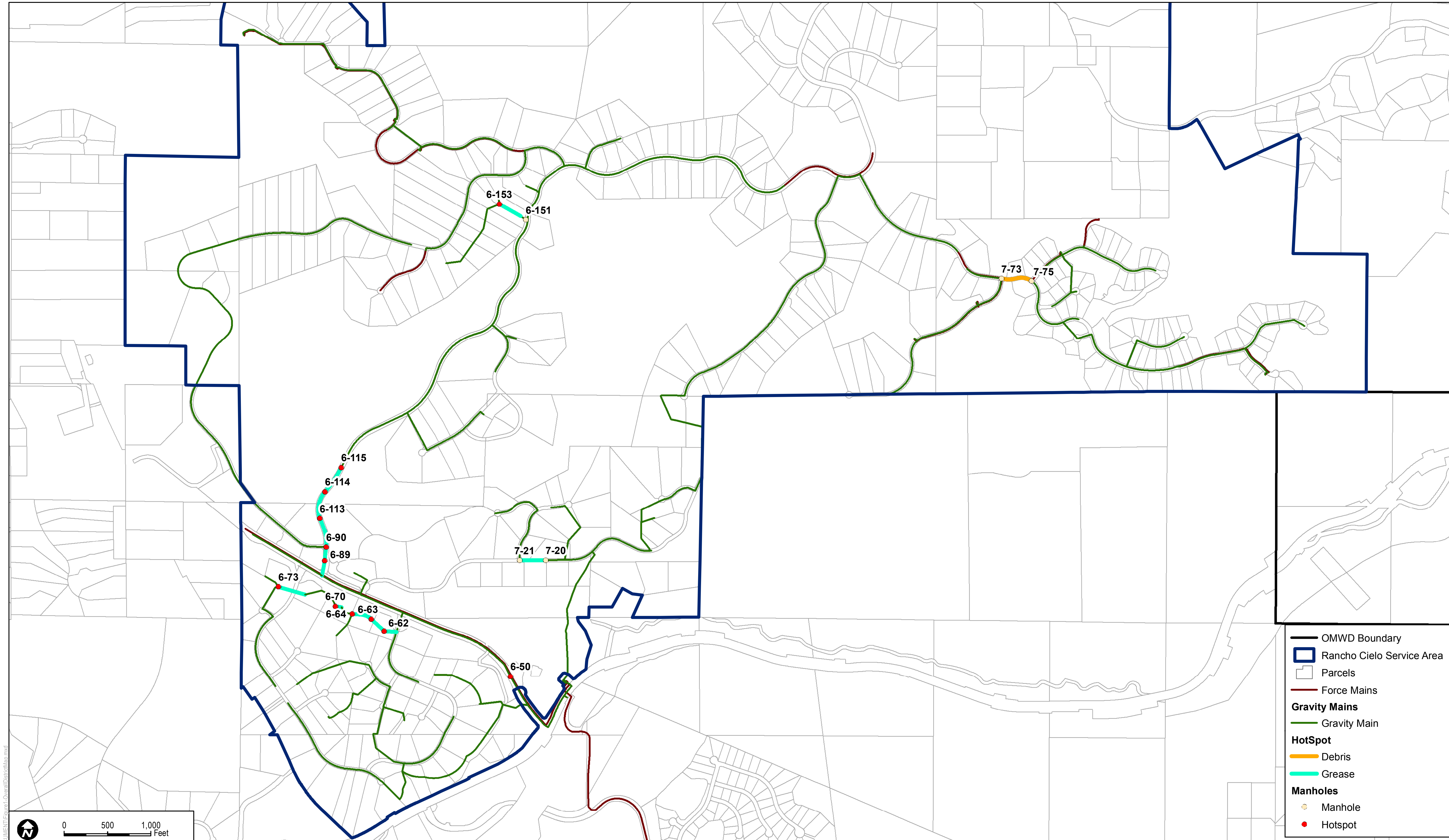

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SOURCE: Olivenhain MWD 2014; SanGIS 2015; ESRI Basemap 2015

FIGURE 3

Rancho Cielo Service Area Hot Spots

Olivenhain MWD Condition Assessment

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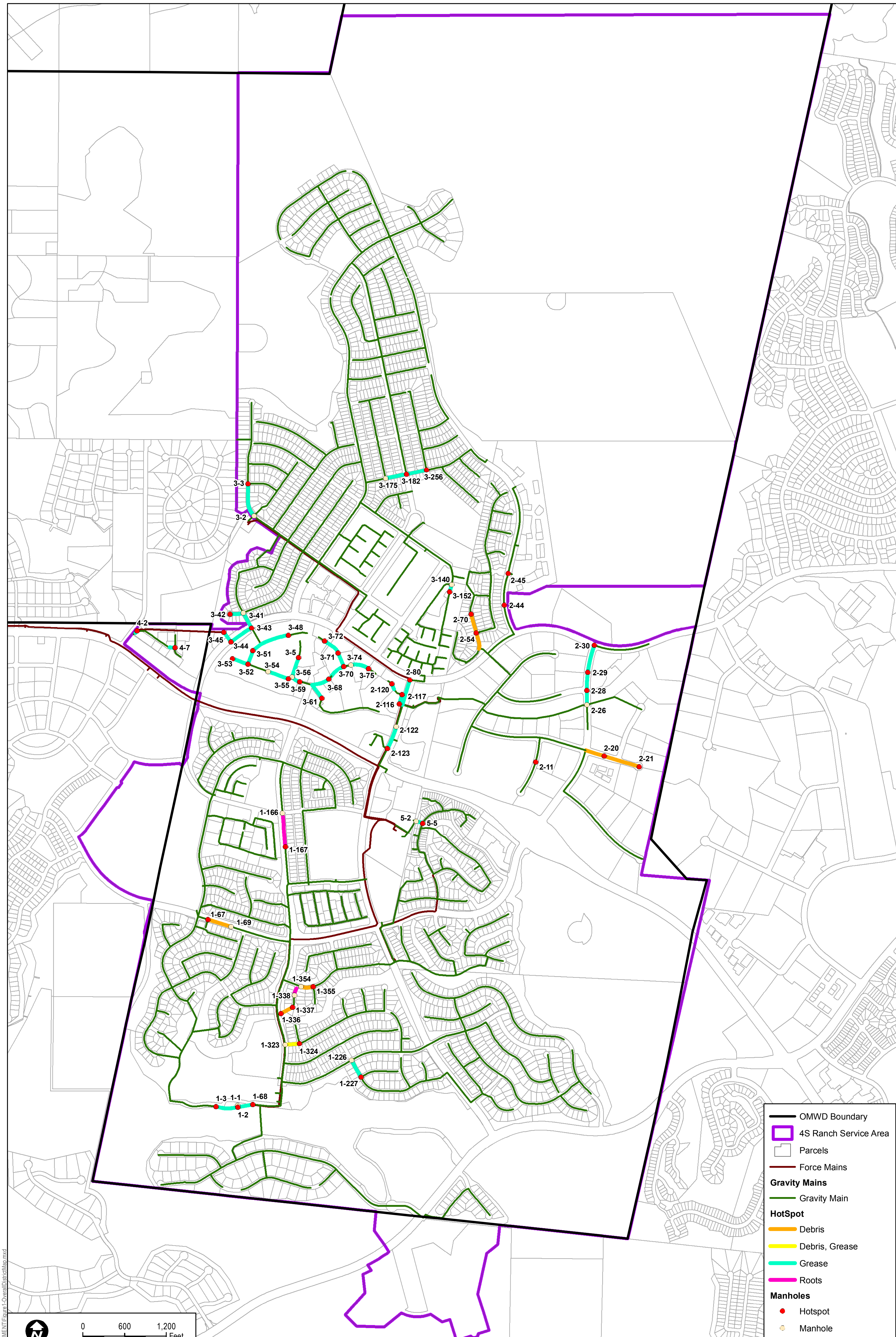

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JUNE 2015

SOURCE: Olivenhain MWD 2014; SanGIS 2015; ESRI Basemap 2015

FIGURE 4

4S Ranch Service Area Hot Spots

Olivenhain MWD Condition Assessment

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Table 2. Gravity Collection System Hot Spots

Road	Map Page	US MH	DS MH	Pipe Length	Pipe Size	Problem	Comments
Zone 1 Hot Spots							
Easement	T18/S18	1-3	1-2	319.2	15	Grease	
Easement	T18	1-168	1-2	221	15	Grease	
Alipaz Court	U17	1-393	n/a	n/a	n/a	Roots	In Manhole 1-393
Alipaz Court	U17	1-391	n/a	n/a	n/a	Roots	In Manhole 1-391
4S Ranch Parkway	T18	1-220	n/a	n/a	n/a	Roots	In Manhole 1-220
Lone Bluff Court	T18	1-336	n/a	n/a	n/a	Roots	In Manhole 1-336
Palomino Mesa Road	T18	1-324	1-323	208.9	8	Debris	
Lone Bluff Court	T18	1-337	1-336	198.2	8	Debris	
Lone Bluff Drive	T18	1-355	1-354	179.6	8	Debris	
Palomino Valley Road	T18	1-227	1-226	276.1	8	Grease	
Palomino Mesa Road	T18	1-324	1-323	209.3	8	Grease	
Lone Bluff Court	T18	1-339	1-338	106.7	8	Roots	
4S Ranch Parkway	T18	1-168	1-2	221.7	15	Grease	
Deer Trail Place	S18	1-35	n/a	n/a	n/a	Roots	In manhole 1-35
Deer Trail Way	S18	1-14	n/a	n/a	n/a	Roots	In manhole 1-14
Deer Trail Drive	T18	1-3	1-2	322	8	Grease	
Deer Trail Drive	T18	1-2	1-1	22.1	8	Debris	
4S Ranch Parkway	T17/T16	1-167	1-166	499.8	8	Roots	
Camino San Bernardo	T17	1-67	1-69	350.9	12	Debris	
Zone 2 Hot Spots							
Road	Map Page	US MH	DS MH	Pipe Length	Pipe Size	Problem	Comments
Patina Street	U15	2-70	2-54	289.3	8	Grease	
Thornmint Road	V16/U16	2-21	2-20	530.0	8	Grease	
Thornmint Road	U16	2-20	2-14	283.9	8	Grease	
Caminito San Bernardo	U15/U16	2-28	2-26	206.3	8	Grease	
Caminito San Bernardo	U15	2-29	2-28	267.0	8	Grease	
Caminito San Bernardo	U15	2-30	2-29	397.4	8	Grease	
Dove Canyon Road	T15/U15	2-80	2-79	381.7	12	Grease	
Craftsman Way	T15	2-120	2-119	82.3	6	Grease	
Dove Canyon Way	T15	2-117	2-116	137.3	6	Grease	
Dove Canyon Way	T15	2-116	2-79	46.0	8	Grease	
Dove Canyon Road	T16	2-123	2-122	337.2	12	Grease	

Road	Map Page	US MH	DS MH	Pipe Length	Pipe Size	Problem	Comments
Alva Road	U14	2-46	n/a	n/a	n/a	Roots	In Manhole 2-46
Mesamint Street	U16	2-11	2-10	352.0	8	Debris	
Patina Street	U15	2-54	2-49	227.0	8	Grease	
Alva Road	U15	2-45	2-44	460.0	8	Debris	
Alva Road	U15	2-44	2-43	446.0	8	Debris	
ZONE 3 HOT SPOTS							
Road	Map Page	US MH	DS MH	Pipe Length	Pipe Size	Problem	Comments
New Rochelle Way	U15	3-152	3-140	111.4	8	Grease	
Montery Ridge Dr	U14/T14	3-256	3-182	294.7	8	Grease	
Montery Ridge Dr	T14	3-182	3-175	310.8	10	Grease	
Camino San Thomas	T14	3-3	3-2	487.1	8	Grease	
Silver Crest	T15	3-42	3-41	202.3	8	Grease	
Rancho Bernardo Rd	T15	3-44	3-43	364.8	8	Grease	
Rancho Bernardo Rd	T15	3-45	3-44	166.7	8	Grease	
4S Commons	T15	3-75	3-74	263.2	6	Grease	
4S Commons	T15	3-70	3-69	232.0	6	Grease	
4S Commons	T15	3-68	3-60	250.2	6	Grease	
4S Commons	T15	3-72	3-71	265.5	6	Grease	
4S Commons	T15	3-71	3-70	213.6	6	Grease	
4S Commons	T15	3-61	3-60	238.0	6	Grease	
Ralphs Ranch Road	T15	3-57	3-56	296.2	8	Grease	
Reserve Dr	T15	3-48	3-47	417.4	8	Grease	
Craftsman Way	T15	3-59	3-56	128.0	8	Grease	
Craftsman Way	T15	3-55	3-54	305.3	8	Grease	
Craftsman Way	T15	3-53	3-52	243.1	8	Grease	
Reserve Dr	T15	3-52	3-51	212.7	8	Grease	
Reserve Dr	T15	3-51	3-47	143.6	8	Grease	
Silver Crest	T15	3-43	3-41	250.0	12	Grease	
ZONE 4 HOT SPOTS							
Road	Map Page	US MH	DS MH	Pipe Length	Pipe Size	Problem	Comments
Tallus Glenn	S15	4-7	4-6	75.7	8	Grease	
Tallus Glenn	S15	4-2	4-1	35	8	Grease	
ZONE 5 HOT SPOTS							
Road	Map Page	US MH	DS MH	Pipe Length	Pipe Size	Problem	Comments
Corte Mason	U16	5-5	5-2	100.4	8	Grease	
La Alberca Avenue	U16	5-21	n/a	n/a	n/a	Roots	In Manhole 5-21
La Alberca Avenue	U17	5-44	n/a	n/a	n/a	Roots	In Manhole 5-44
Corte Mason	U16	5-2	n/a	n/a	n/a	Roots	In Manhole 5-2

ZONE 6 HOT SPOTS							
Road	Map Page	US MH	DS MH	Pipe Length	Pipe Size	Problem	Comments
Cam De La Mitra	O11	6-73	6-72	327.8	8	Grease	
Cam De La Mitra	O11	6-70	6-69	70	8	Grease	
Via Ambiente Easement	O11	6-64	6-63	243.9	8	Grease	
Via Ambiente Easement	O11	6-63	6-62	200.1	8	Grease	
Cam De La Dora	O11	6-62	6-57	139.8	8	Grease	
Calle Ambiente	O11	6-50	n/a	n/a		Roots	In Manhole 6-50
Camino De Arriba	O9	6-153	6-152	376.2	8	Grease	
Via Ambiente	O11	6-89	6-84	181.3	10	Grease	
Via Ambiente	O11	6-90	6-89	156.5	10	Grease	
Via Ambiente	O10/O11	6-113	6-90	341.9	10	Grease	
Via Ambiente	O10	6-114	6-113	333.6	10	Grease	
Via Ambiente	O10	6-115	6-114	340.9	10	Grease	
ZONE 7 HOT SPOTS							
Road	Map Page	US MH	DS MH	Pipe Length	Pipe Size	Problem	Comments
Via Rancho Cielo	Q9	7-074	7-073	124	8	Debris	Construction trap?
Via Rancho Cielo	Q9	7-075	7-074	222.5	8	Debris	Construction trap?
Via Dora	O11/P11	7-021	7-020	296.3	8	Grease	

2.1.2 Recommendations

The District has experienced collection system issues attributed to three specific causes, in order of magnitude: grease, roots, and debris. The following sections outline recommendations to manage these challenges in the collection system.

2.1.2.1 Grease (54 locations; 12,170 linear feet impacted)

Grease is commonly referred to as fats, oil, and grease (FOG). FOG is most commonly introduced to the sewer through kitchen wastes in liquid form; however FOG is temperature and pH dependent and will tend to solidify and float in the collection system. Severe FOG occurrences can cause blockages in gravity sewer lines, reduce capacity in forcemains, and accumulate to cause nuisance and odor issues at pump station wet wells. FOG that makes it to the wastewater treatment plant can impinge on treatment performance by consuming oxygen, binding on equipment (e.g., screens, weirs) and exacerbating foaming issues.

Pipe segments with FOG buildup are a typical problem for the District, especially in the vicinity of commercial developments. It is recommended that the District investigate the source of FOG in each area. Grease can collect in the collection system due to mismanagement and negligence of FOG by businesses and lack of public awareness. Sags in sewer pipes tend to exacerbate FOG issues. It is recommended that the District increase their FOG public awareness outreach to their customers by including information with sewer bills or by other means and investigate businesses suspected of mismanaging their FOG interception practices. Restaurants are a common culprit in chronic FOG issues, introducing liquid FOG to the sanitary sewer through the kitchen waste. Best management practices do not allow dishwashers to be connected to the grease traps as the hot water discharge can liquefy FOG, allowing it to pass through the grease trap to the sewer. Public outreach and awareness programs directed to restaurants can be effective in establishing best practices to reduce the impact of FOG on the collection system. It is recommended that the District clean the grease from the collection system if the source of the grease is unknown or unavoidable after source investigation.

2.1.2.2 Roots (13 locations, 600 linear feet and 11 manholes impacted)

Pipe segments and manholes with root intrusion should be addressed immediately. It is recommended that any pipe segment with root intrusion be lined with cured-in-place-pipe (CIPP). Pipe segments severely damaged by roots and unable to be lined should be replaced.

2.1.2.3 Debris (10 locations, 1,630 linear feet impacted)

Debris commonly accumulates in sags of a sewer or on long, flat sewer stretches with low velocities. The District should review CCTV videos to ascertain the cause of the debris accumulation. If the debris is accumulating in a sag, it is recommended that the District replace the segment. If the debris is accumulating in a flat sewer, it is recommended that the sewer be cleaned more regularly to reduce the risk of blockage.

2.2 Gravity Collection System Corrosion Control

2.2.1 Background

Wastewater collection systems are subject to corrosive environments caused by hydrogen sulfide (H_2S). Hydrogen sulfide is a byproduct of anaerobic decomposition of organic matter by microorganisms. Municipal wastewater contains vast amounts of microorganisms ready to consume the organic matter (waste) in the sewer. These microbes function in the anaerobic (lack of air/oxygen) conditions commonly found in sewers. The presence of hydrogen sulfide in sewers causes manhole corrosion on non-submerged surfaces where the gas is converted to corrosive sulfuric acid.

Most of the hydrogen sulfide production occurs in a biological slime layer on the pipe walls or in any sludge and silt deposits in the pipe (U.S. EPA, 1985). The Pomeroy-Parkhurst equation (U.S. EPA, 1985) predicts sulfide generation in full pipes, such as forcemains or inverted siphons, based on three main variables: hydraulic detention time, Biological Oxygen Demand (BOD) (the strength of the wastewater), pipe diameter, and temperature.

While the generation of hydrogen sulfide gas is inevitable in the sewer, certain situations in a collection system can exacerbate the problem. Long-detention time wastewater, that has had significant contact time with the sulfide generating slime layer, has a greater potential for hydrogen sulfide generation. For example, sulfide generation is more significant in forcemains servicing pump stations with low flows and intermittent pumping where biologically active slime layers develop, dissolved oxygen is quickly depleted, and detention times are inherently long. In full-pipe systems, hydrogen sulfide is released at the point of discharge of the force main such as a manhole, another wet well, or influent junction structure. When the pumps of such lift stations turn on, a surge of sulfide laden wastewater is discharged from the forcemain to a gravity sewer, oftentimes with significant release of hydrogen sulfide gas.

The release of hydrogen sulfide into the sewer headspace is accelerated when wastewater containing dissolved sulfide is agitated in turbulent portions of the collection system. Turbulent conditions are common at forcemain discharge manholes, drop structures or falls into wet wells and where hydraulic jumps form because of transitions from steep to mild sewer pipe slopes.

2.2.2 Existing Corrosion Control

A widely used method to counteract hydrogen sulfide induced corrosion in manholes is lining the vulnerable concrete with a material resistant to sulfuric acid corrosion, such as polyurethane, epoxy, or PVC. The District currently lines manholes in corrosive areas of the collection system with a spray on polyurethane liner. **Table 3** summarizes the District's existing lined manholes.

Table 3. Existing Lined Manholes

Existing Lined Manholes			
4S Ranch Collection System		Total:	37
Zone 1	1-373, 1-383, 1-336, 1-387, 1-220,	Total:	5
Zone 2	2-2, 2-3, 2-25, 2-73, 2-4, 2-5, 2-22, 2-1, 2-23, 2-24, 2-74, 2-75, 2-26, 2-33, 2-42, 2-47, 2-46, 2-44, 2-79, 2-117, 2-118, 2-119, 2-120	Total:	23
Zone 3	3-41, 3-39, 3-38, 3-37, 3-36	Total:	5
Zone 4	4-2	Total:	1
Zone 5	5-2, 5-20, 5-21	Total:	3
Rancho Cielo Collection System		Total:	3
Zone 6	6-66, 6-18, 6-19	Total:	3
Combined Collection System		Total:	40

2.2.3 Results and Recommendations

Although the District has previously lined manholes subject to corrosive conditions caused by hydrogen sulfide, additional manholes are at risk of corrosion due to the long detention times in a number of the District's forcemains. Four of the District's sewer pump stations, Avenida Apice, Cerro Del Sol #2, Camino Sin Puente #4, and Santaluz, discharge into a manhole and return to gravity flow, creating potential for corrosive hydrogen sulfide releases into the sewer headspace, and promoting manhole corrosion.

To evaluate corrosion potential, the four pump stations were analyzed through a desktop analysis using the Pomeroy-Parkhurst equation to determine sulfide potential at the forcemain discharge and corresponding downstream manholes. The potential number of manholes impacted was estimated using air-water transfer of hydrogen sulfide equations (Yongsiri, 2004). Any manhole subject to a sulfide concentration exceeding 0.3 mg/l was labeled as potentially impacted (U.S. EPA, 1985). Calculations were performed using averaged monthly flow data. The results are hypothetical and serve primarily as a means to identify corrosion potential in the gravity collection system for monitoring. The summary of results is presented in **Table 4.**

Table 4. Results of Sulfide Generation in Forcemain Discharges into Gravity Sewer

Pump Station	Avenida Apice	Cerro Del Sol #2	Camino Sin Puente #4	Santaluz
Average Theoretical Dissolved Sulfide at Forcemain, mg/l	392	181	41	6
Utilized Dissolved Sulfide at Forcemain, mg/l***	83.4	83.4	61.9	9.5
Number of Potentially Impacted Manholes	6	33	31	15

***The majority of sulfide formed in a wastewater forcemain is due to the reduction of sulfate by Sulfate-Reducing-Bacteria (SRB). The Pomeroy/Parkhurst equation does not account for sulfate as a limiting agent. The equation assumes unlimited quantities of sulfate to be reduced by SRBs. Assuming a sulfate limit of 250 mg/l (170-180 mg/l per 2013 OMWD Consumer Confidence Report for drinking water), a **maximum sulfide generation potential is 83.4 mg/l at pH 7.** Therefore if theoretical sulfide values exceed 83.4 mg/l, a value of 83.4 mg/l is utilized. If theoretical sulfide values are under 83.4 mg/l, a safety factor of 1.5 is utilized to account for peak sulfide values.

Although the results of the sulfide generation calculation predict a high number of potentially impacted manholes, the District has not identified many instances of manhole corrosion in their collection system. For this reason, it is recommended that the District line the forcemain discharge manholes of the four pump stations evaluated, which will be exposed to the highest sulfide concentrations and therefore have the highest corrosion potential. The four forcemain discharge manholes recommended for lining are:

- Manhole 7-75 (Avenida Apice Forcemain discharge manhole)
- Manhole 7-70 (Cerro Del Sol #2 Forcemain discharge manhole)
- Manhole 6-170 (Camino Sin Puente #4 Forcemain discharge manhole)
- Manhole 3-45 (Santaluz Forcemain discharge manhole)

It is also recommended that the District monitor the manholes immediately downstream of forcemain discharge manholes for corrosion in conjunction with their gravity pipeline inspection program and line them as-needed. These potentially impacted manholes (including the discharge manholes), as identified by the theoretical sulfide generation calculations, are listed in **Table 5**.

Table 5. Manholes Potentially Subject to Corrosion

Rancho Cielo Collection System		
Avenida Apice Forcemain Potentially Impacted Manholes		
7-75, 7-74, 7-73, 7-119, 7-120, 7-121	Total:	6
Cerro Del Sol #2 Forcemain Potentially Impacted Manholes		
7-70, 7-69, 7-68, 7-67, 7-66, 7-65, 7-64, 7-63, 7-62, 7-61, 7-60, 7-59, 7-58, 7-57, 7-56, 7-55, 7-54, 7-53, 7-52, 7-51, 7-50, 7-49, 7-48, 7-47, 7-46, 7-45, 7-44, 7-43, 7-42, 7-41, 7-40, 7-39, 7-38	Total:	33
Camino Sin Puente #4 Forcemain Potentially Impacted Manholes		
6-170, 6-169, 6-166, 6-165, 6-164, 6-163, 6-160, 6-159, 6-150, 6-149, 6-198, 6-147, 6-146, 6-139, 6-138, 6-129, 6-128, 6-127, 6-118, 6-117, 6-116, 6-115, 6-114, 6-113, 6-90, 6-89, 6-84, 6-83, 6-82, 6-81, 6-56	Total:	31
Rancho Cielo Collection System	Total:	70
4S Ranch Collection System		
Santaluz Forcemain Potentially Impacted Manholes		
3-45, 3-44, 3-43, 3-41**, 3-40, 3-39**, 3-38**, 3-37**, 3-36**, 3-35, 3-34, CST9, 3-16, 3-2, 3-1	Total:	15
4S Ranch Collection System	Total:	15
** Potentially impacted manhole is an existing lined manhole.		

2.3 Collection System Asset Management

2.3.1 Background

Based on the findings of the District's regular system-wide CCTV inspection and cleaning program, the 4S Ranch and Rancho Cielo gravity sewer mains are generally in good condition. There are currently no inspection or condition assessment data for the forcemains. The gravity mains and forcemains are almost entirely constructed of PVC pipe, which is widely accepted as premier pipe for sewer systems. Only short segments of the forcemains immediately adjacent to the Del Dios and Firehouse pumps stations are constructed of ductile iron pipe (protected from internal and external corrosion with glass lining and polyethylene wrap). Well-constructed PVC gravity sewer mains are expected to have a useful life of at least 100 years, and PVC forcemains are expected to have a useful life of up to 50 years depending on operating conditions and pressure. The useful life of ductile iron wastewater forcemains can vary significantly depending on the quality of the interior and exterior corrosion protection but a useful life of 50-years is achievable for a glass-lined pipe with carefully applied polyethylene exterior wrapping and functional air release valves. Poor construction (e.g. under-compaction, over-belling, and poorly applied corrosion protection), soil movement, thermal expansion and contraction, and root intrusions are common and can eventually cause pipe defects that block flow or cause a gravity sewer or forcemain pipe to break. In addition, static and dynamic stresses on PVC pressure pipes due to surge events, frequent cycling, and higher than anticipated operating pressures, can cause premature failure. Therefore, although the sewers and forcemains in the 4S Ranch and Rancho Cielo collection systems are expected to last well beyond the 20-year CIP timeframe, isolated pipe defects and breaks could occur within the timeframe.

2.3.2 Recommendation

Defects in gravity mains should be identified through the District's existing system-wide CCTV inspection program and addressed as needed with a rehabilitation method such as cured-in-place-pipe or open trench repair or replacement. It is recommended that the service level of the District's PVC forcemains be evaluated through operating pressure, surge, and cyclical analyses to identify piping subject to high stresses that should potentially be derated and scheduled for early replacement. The highest priority forcemains for such assessment are the 10- and 12-inch PVC forcemains, which total approximately 37,000 linear feet. In addition, it is recommended that the condition of the DIP forcemain segments be assessed with a combination of soil corrosivity testing, air valve inspection, and internal and external pipe inspection. Nondestructive testing methods best suited for condition assessment of ductile iron pressure pipe include CCTV inspection for visible internal defects, spot excavation and visual inspection for external corrosion, and remote field testing (electromagnetic) to detect metal loss. Given that the ductile iron portion of the Firehouse forcemain was constructed in 1988 and the Del Dios forcemain was constructed in 2005, it is recommended that condition assessment of the District's two DIP forcemain segments be conducted by the end of 2016 and under the same program.

3 REFERENCES

U.S. EPA, “Odor and Corrosion Control in Sanitary Sewerage Systems and Treatment Plants.” U.S. EPA, Washington D.C., 1985.

Yongsiri, Chaturong, Jes Vollertsen, Michael Rasmussen, and Thorkild Hvitved–Jacobsen. "Air–Water Transfer of Hydrogen Sulfide: An Approach for Application in Sewer Networks." *Water Environment Research* 76.1 (2004): 81-88.

U.S EPA, “The Clean Water and Drinking Water Infrastructure Gap Analysis” U.S. EPA, Washington D.C., 2002.

New Zealand Asset Management Support, “New Zealand Infrastructure Asset Valuation and Depreciation Guidelines” New Zealand Asset Management Support, Wellington, New Zealand, 2006.

APPENDIX E

TM3 – 4S Ranch WRF Process Evaluation

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TECHNICAL MEMORANDUM #3

To: George Briest, Olivenhain Municipal Water District

Author(s): Tom Falk, PE, Greg Guillen, PhD, PE

Reviewer(s): Wyatt Troxel, SWRCB – Grade V Operator

Date: June 26, 2015

Subject: 4S Ranch Water Reclamation Facility, Process Evaluation

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1 INTRODUCTION

The Olivenhain Municipal Water District (District) retained Dudek to prepare an Operations and Condition Assessment and Capital Improvement Plan for the 4S Ranch and Rancho Cielo Sanitation Districts that will guide strategic planning and investments for the District's collection, treatment, and reuse programs.

This Technical Memorandum #3 (TM3) presents a high level review and benchmarking of the 4S Ranch Water Reclamation Facility (WRF) operations for the major process units and equipment. Through this review, several opportunities are identified for process optimization and potential projects that could reduce operating costs.

2 OPERATIONS ASSESSMENT

2.1 Operations Assessment Overview

2.1.1 Existing Conditions

The 4S Ranch WRF is a 2.0 mgd capacity treatment plant built in two major phases since the mid-1980s. Raw wastewater is conveyed to the 4S Ranch WRF from four forcemains and a single gravity sewer pipeline that convene at the influent junction structure, from which it conveys to the headworks. The headworks consists of screening and grit removal. Plant influent is conveyed from the headworks to a splitter box that splits flow to two parallel biological treatment process trains, Plant A and Plant B with rated capacities of 0.5 mgd and 1.5 mgd, respectively. Plant A and Plant B are oxidation ditches with upstream anoxic selectors and two clarifiers, each. Secondary effluent is conveyed to a flow equalization basin from which secondary effluent is pumped to tertiary filters and then flows by gravity through an open channel ultraviolet disinfection system to the recycled water forebay. Recycled water is pumped to a distribution system to serve customers for irrigation uses. Recycled water in excess of the daily demand overflows by gravity to a neighboring seasonal storage pond. Waste activated sludge (WAS) is pumped from the secondary clarifiers to the gravity section of a belt filter press for thickening and then to aerobic digesters where thickened WAS is digested to meet Class B Biosolids requirements. Aerobically digested sludge is dewatered on a belt filter press and then hauled to Arizona for disposal. **Figure 1** presents the major process flow diagram. **Table 1** represents the major WRF construction projects. **Figure 2** presents the site plan and plant area designations.

Figure 1 – 4S Ranch WRF Process Flow Diagram

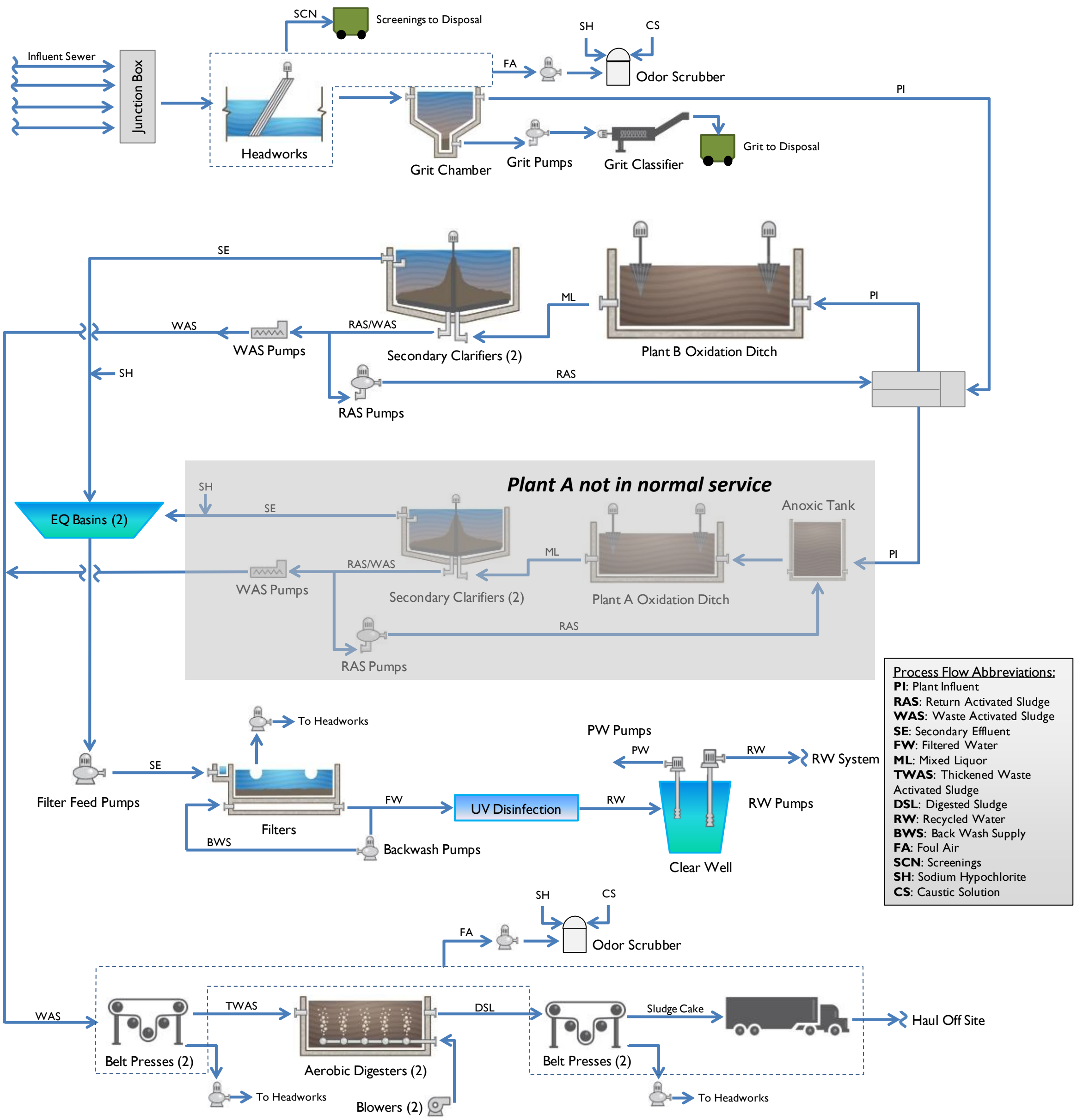

Table 1 – 4S Ranch WRF Major Capital Improvement Projects

Project	General Description
4S Ranch Wastewater Reclamation Plant (Luke-Dudek Civil Engineers, 1989)	Original plant construction with rated capacity of 0.25 mgd. Constructed oxidation ditch and clarifiers, now referred to as Plant A, media filtration and chlorine contact basin and sludge drying beds. Constructed reverse osmosis process that has since been decommissioned.
4S Ranch WWTP Expansion and Related Projects Reclaimed Water and Overflow Pond Pump Stations (Montgomery Watson, 2000)	Constructed 410 acre-foot (134.4 million gallon) seasonal storage pond and return pump station. Constructed recycled water pump station at 4S Ranch WRF site.
4S Ranch WWTP Expansion and Related Projects Wastewater Treatment Plant Expansion to 2.0 MGD (Montgomery Watson, 2002)	Plant expansion to 2.0 mgd. Constructed oxidation ditch and clarifiers, now referred to as Plant B. Added anoxic tank to Plant A and re-rated to 0.5 mgd. Constructed headworks (screening and grit removal) and odor control. Replaced tertiary filters and repurposed chlorine contact basin to ultraviolet disinfection channel. Constructed recycled water storage and pump station. Constructed aerobic digesters and biosolids dewatering building.
Aerobic Digester Modifications (Herwit Engineering, 2005)	Replaced mechanical mixer/aerator system with blowers and diffused aeration system.
Modifications of the 4S Ranch Water Reclamation Facility (IEC, 2005)	Added secondary scum forcemain to headworks; revised non-potable water pump station and piping; demolished Plant A headworks; Plant A modifications; Added electric motor operator and scum baffle to Plant B oxidation ditch effluent weir; constructed new equipment storage building; rehabilitated Plant B clarifiers including cathodic protection.
Construction of Septage Dump Station and Catwalk Addition (Webb Associates, 2010)	Constructed septage receiving station between the Plant B secondary clarifiers.
Olivenhain Municipal Water District, 4S Ranch WRF Operations Building Expansion (obr, March 2011)	Constructed a single-story 2,700 sqft addition to the existing single-story 1,500 sqft operations center. Expansion includes lobby, offices, control room, meeting room, storage/equipment rooms, locker room and handicap accessible restrooms.

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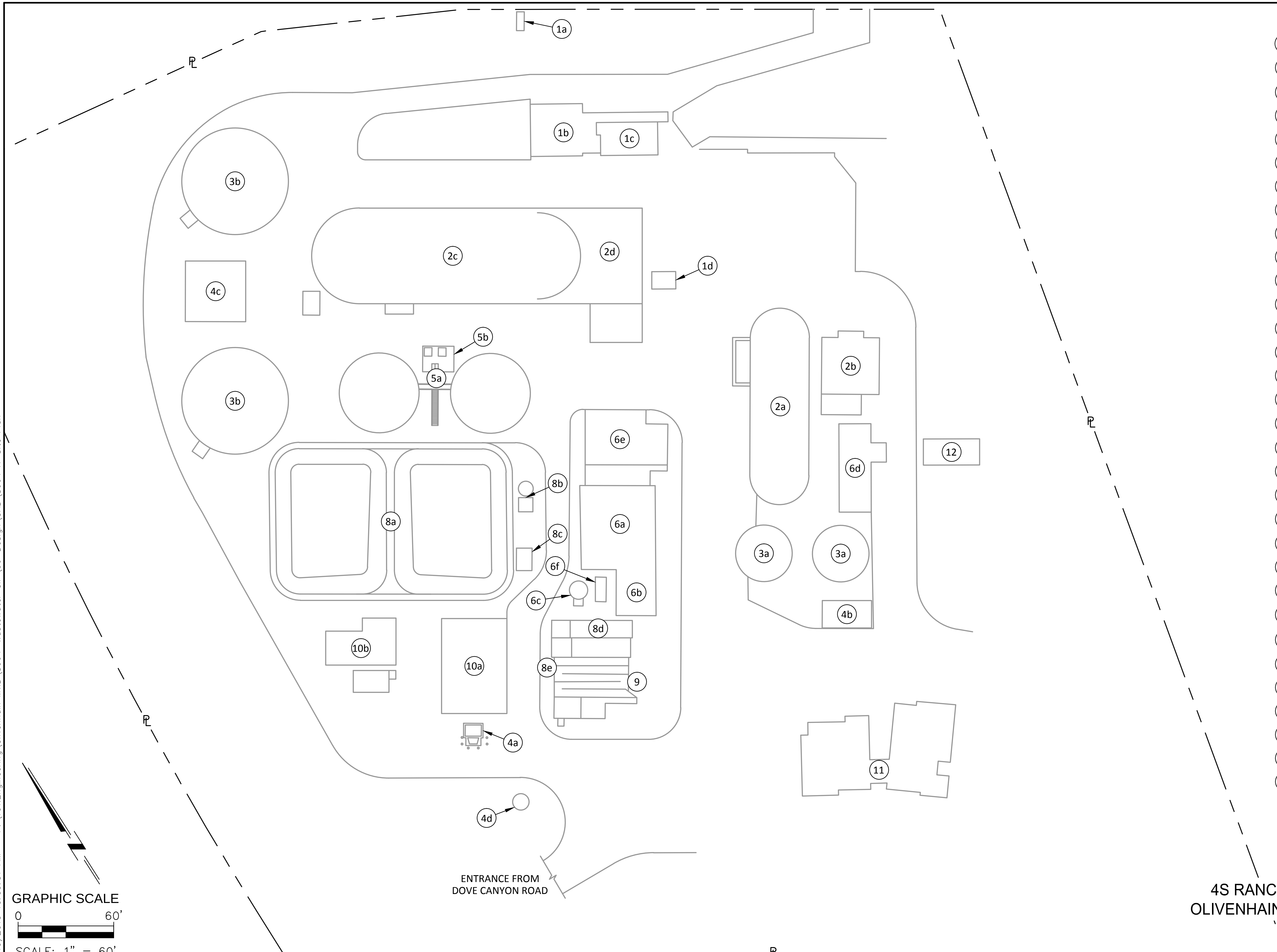

FACILITY LOCATION

- 1a INFLUENT JUNCTION BOX
- 1b HEADWORKS (SCREENINGS & GRIT REMOVAL)
- 1c HEADWORKS ODOR CONTROL
- 1d INFLUENT FLOW SPLITTER
- 2a PLANT A OXIDATION DITCH
- 2b PLANT A ANOXIC TANK
- 2c PLANT B OXIDATION DITCH
- 2d PLANT B ANOXIC ZONE
- 3a PLANT A SECONDARY CLARIFIERS
- 3b PLANT B SECONDARY CLARIFIERS
- 4a NON-POTABLE WATER PUMP STATION
- 4b PLANT A RAS & WAS PUMP STATION
- 4c PLANT B RAS & WAS PUMP STATION
- 4d STORMWATER PUMP STATION
- 5a AEROBIC DIGESTERS AND BLOWERS
- 5b DIGESTED SLUDGE PUMP STATION
- 6a BELT PRESS FACILITY (THICKENING & DEWATERING)
- 6b SLUDGE LOADING ROOM
- 6c FILTRATE AND BACKWASH PUMP STATION
- 6d EMERGENCY GENERATOR
- 6e CHEMICAL AREA (POLYMER, NAOCL, NAOH, ALUM)
- 6f DEWATERING BUILDING ODOR CONTROL
- 8a SECONDARY EFFLUENT EQUALIZATION BASINS
- 8b FILTER FEED PUMP STATION
- 8c FLASH MIX (PUMP)
- 8d FILTERS (4 UNITS)
- 8e BACKWASH PUMP STATION
- 9 ULTRAVIOLET DISINFECTION SYSTEM
- 10a RECYCLED WATER FOREBAY
- 10b RECYCLED WATER PUMP STATION
- 11 ADMINISTRATION BUILDING
- 12 MAIN ELECTRICAL ENTRANCE AND SWITCHBOARD

FIGURE 2

4S RANCH WRF EXISTING SITE PLAN
OLIVENHAIN MUNICIPAL WATER DISTRICT

DUDEK

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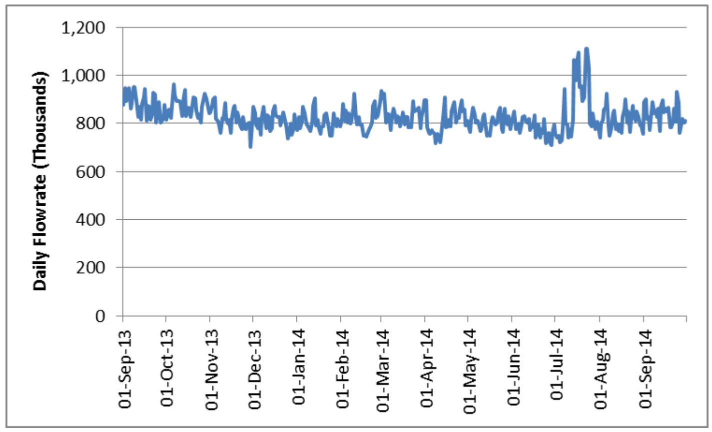
2.1.2 Plant Hydraulic Loading

The current average daily influent flowrate is approximately 825,000 gallons per day (gpd). A modest 3% variation in weekday to weekend flowrates, 815,000 gpd to 840,000 gpd, respectively is observed, characteristic of a typical residential community. No significant seasonal variation was observed. **Figure 3** presents influent flowrate over the period of September 2013 to September 2014.

Figure 3 – 4S Ranch WRF Influent Flowrates

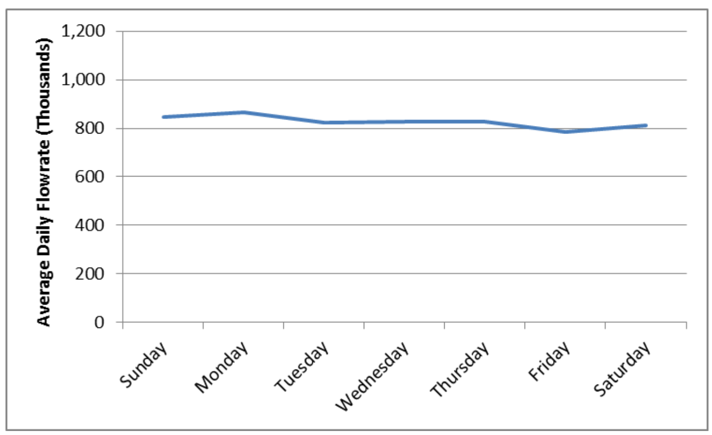
Daily Flowrate

Comments: Consistent average daily flowrate of 0.825 mgd. Daily flowrates ranged from low of 0.7 mgd to high of 1.1 mgd with the 90th percentile flowrate of 0.898 mgd. The relatively high flowrates during July-August are attributed to seasonal return flows from Wet Weather Storage Pond.



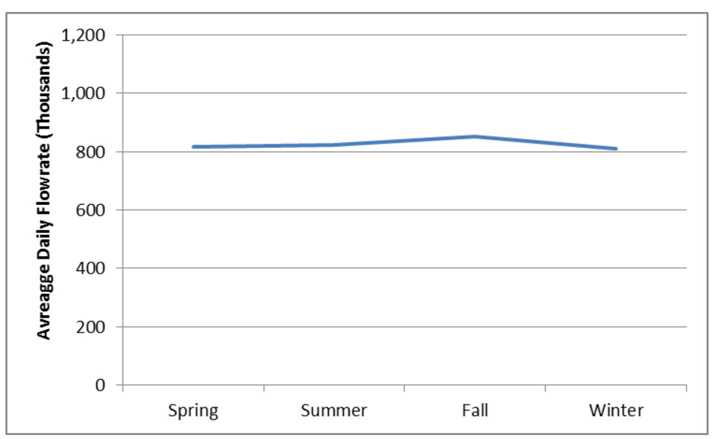
Average Day-of-the-Week Flowrate

Comments: Observe slightly elevated average weekend flowrates of 0.84 mgd, a 3% increase over average weekday flowrates of 0.815. Note that weekend flowrates reach the headworks beginning Saturday and carry through Monday.



Average Seasonal Flowrate

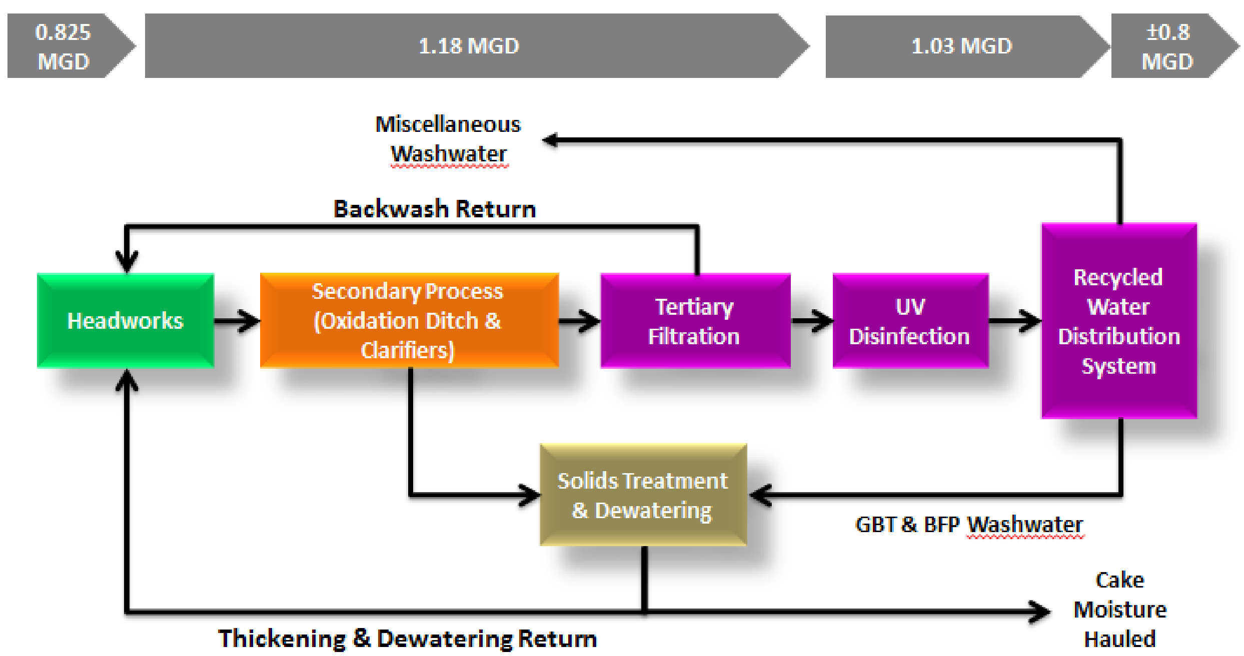
Comments: Negligible seasonal influence. Slight (4%) increase of average Fall flowrates over Winter, Spring and Summer flowrates is attributed to annual cleaning of seasonal storage pond that increases headworks loading in September and October.



The District completed a wastewater system capacity study[1] in 2008 that concluded the buildout capacity of the 4S Ranch and Rancho Cielo service areas would result in an ultimate average daily flowrate to the 4S Ranch WRF of 1.62 mgd. The 4S Ranch service area is projected to contribute 1.37 mgd and the Rancho Cielo service area is projected to contribute 0.25 mgd. Additional capacity would therefore be available for expansion of the District's wastewater service area.

Plant flowrate is recorded at several locations in the process train. Influent is measured at the headworks (Parshall Flume, FE/FIT-141), filter flow is measured at the filter influent pump station (magnetic meter, FE/FIT-419), and disinfection flow is measured at the UV chamber inlet weir (ultrasonic level transmitter, FE/FIT-914). The average hydraulic loading (September 2013 to September 2014) through the treatment plant and major plant return flowrates are illustrated in **Figure 4**. This flowrate audit suggests an average daily internal return of nearly 43% of the influent flow (0.355 mgd returned for 0.825 mgd influent flowrate). Excessive plant return flowrates are common in under-loaded plants, as certain washwater systems and equipment require specific washwater rates regardless of hydraulic throughput – examples include foam control sprayers, routine washwater, filter backwash, and equipment cleaning. For example, the foam sprayers[2] on the Plant B secondary clarifiers (6 Total, 3 per clarifier), produce up to 14 gpm each at 60 psi. Use of these surface sprayers could result in 80 gpm or more return flow or 120,000 gpd (14.5% of total flow) if left on continuously. Furthermore, it is understood that recycled water storage is seasonally returned to the WRF and partially re-treated. It is recommended that flow measurements be validated (re-calibrated, if necessary) and that internal washwater uses be monitored and controlled to reduce this internal recycle volume – areas of interest include the filter backwash, sludge thickening and dewatering, and plant washwater.

Figure 4 – Hydraulic Balance



[1] *Olivenhain Municipal Water District 4S Ranch/Rancho Cielo Sewer Build-Out Flow Study – Draft Technical Memorandum No. 1* (Infrastructure Engineering Corporation, March 25, 2008)
[2] Spraying Systems Company, Model No. 1/2K60 Floodjet; Reference Record Drawing Detail A, Dwg. 3M-1 (MWH, 2000)

2.1.3 Plant Biological Loading

The 4S Ranch WRF is designed to treat organic and nitrogen loads. **Table 2** presents current operating data in comparison to design criteria stated in the project Record Drawings. The influent BOD loading matches the 90th percentile design organic loading. However, as discussed in Section 2.4.8, the apparent solids yield of 0.94 suggests some discrepancy in the influent loading and solids generation factor suggesting that the influent sampling may not be representative of true load on the plant with operational implications to both aeration demand and solids treatment assumptions; solids yield is more typically in the range of 0.7 to 0.8. The oxidation ditches are designed to treat for nitrogen removal, however, the record drawings do not indicate design criteria for nitrogen loading. Since the District's recycled water discharge permit does not include a nitrogen limit, it is assumed that the oxidation ditch was designed to include denitrification in order to optimize treatment performance (i.e., filament control to improve floc formation and settleability, denitrification oxygen credit to minimize energy demand, and alkalinity recovery to maintain stable biological activity).

Table 2 – 4S Ranch WRF Influent Loading

Parameter	Unit	Current Operating Value[3]	Design Criteria[4]
Influent BOD_5			
Average	mg/L (lb/d)	182 (1,260)	--
90th Percentile		247 (1,710)	240
Influent TSS	mg/L	261	213
Nitrogen Species			
Total Kjeldahl Nitrogen, TKN	mg/L	49.6	n/a
Ammonia-Nitrogen	mg/L	13.7	n/a

2.2 Regulatory Review

2.2.1 Discharge Permitting (Recycled Water)

The 4S Ranch WRF is operated under a Master Reclamation Permit with Waste Discharge Requirements (WDR), Order No. R9-2003-0007. The plant produces 100% recycled water compliant with Title 22 recycled water requirements for unrestricted reuse. The recycled water permit limitations are summarized in **Table 3**. It is noted that although the design capacity is stated as 2.0 mgd, the average daily effluent flowrate from the 4S Ranch WRF is limited to 1.6 mgd based on seasonal storage capacity; additional storage capacity would be required in order to accept flows that would cause the daily effluent flowrate to exceed 1.6 mgd[5].

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[3] BOD and TSS based on operating data, 9/1/2013 to 9/30/2014; Nitrogen data based on focused sampling program 12/4/14 to 12/16/14.

[4] MWH, 2000. Dwg. G-7.

[5] Board Order No. R9-2003-0007, Page 5, Paragraph 21, "Pursuant to the Basin Plan, this Regional Board requires recycled water projects lacking a fail-safe land outfall to an ocean outfall to have 84 days of storage capacity unless the discharger documents that an exception to this requirement is justified. The RWD indicates that the facilities of 4SRWWTP include a 410 acre-foot overflow pond, which has 84-day effluent capacity at a production rate of 1.6 MGD. Additional seasonal storage capacity will need to be added if the 4SRWWTP produces effluent at its maximum rated flow of 2.0 MGD."

Table 3 – 4S Ranch WRF Recycled Water Quality Requirements

Constituent	Unit	Daily Maximum	Monthly Average	12-month Average
Biochemical Oxygen Demand (BOD_5 @ 20 ^oC)	mg/L	45	30	--
Total Suspended Solids	mg/L	45	30	--
pH	within the limits of 6.0 to 9.0 at all times			
Total Dissolved Solids	mg/L	1,200	--	
Chloride	mg/L	350	--	--
Sulfate	mg/L	350	--	--
Percent Sodium	mg/L	65	--	60
Iron	mg/L	1.0	0.85	--
Manganese	mg/L	0.2	0.15	--
Methylene Blue Active Substances	mg/L	0.6	0.5	--
Boron	mg/L	1.0	--	
Fluoride	mg/L	1.2	1.0	--
Turbidity	NTU	< 2.0 (Daily Average) < 5% (95% of 24-hr period) < 10 (100% of time)		
Total Coliform Bacteria	MPN	2.2 per 100 mL (7-day median) 23 per 100 mL (1x in 30-day period) 240 per 100 mL (maximum)		

Additionally, Board Order No. R9-2003-0007 incorporates by reference, recycled water requirements contained in California Code of Regulations (CCR), Title 22, of which stipulations relevant to the operation of the 4S Ranch WRF include:

- Surface loading rates for direct filtration (no flocculation or sedimentation) not to exceed 5 gpm/sqft;
- Addition of, or ability to automatically initiate and control, pre-filtration coagulant;
- Adoption of Recycled Water Rules & Regulations;
- Reliability and redundancy provisions.

Addendum No. 2 to Order No. R9-2003-0007 provides revisions to the permit requirements for the ultraviolet disinfection system including the following:

- Provide continuous, reliable monitoring of the flowrate, UV transmittance (UVT), and turbidity;
- Maintain filtered effluent UVT (245 nanometers) greater than 55% at all times;
- Apply a minimum UV dose of 100 mJ/cm^2 at all times and divert wastewater to alternative disposal facility if treatment process does not provide the minimum dose;
- Limit operational hours of any UV lamp to less than 18,500 hours with the lamp age of a group determined by the oldest lamp in the group;
- Clean the UV lamp quartz sleeves a minimum of every 2 months (within 4 days);

- Maintain the UV lamp loading in the range of 3.75 to 12.5 gallons per minute per lamp;
- Incorporate into the UV process logic controller the UV dose calculation using the following empirically derived, multiple linear equation (based on Phillips lamps model # G64T5L, Trojan Part # 302511),

$$\text{UV Dose} = 10^{[1.59+0.42*\log(UVT)-0.78*\log(flow)]},$$

  where UVT is in % transmittance and flow = gpm/lamp, determined by dividing the flow by the number of lamps in operation; the UV Dose calculated by the equation above shall be adjusted with a 0.91 end of lamp life (EOLL) factor and a 0.8 fouling factor to ensure an adequate number of banks are in operation;
- The dose delivered shall be multiplied by the number of banks in operation to determine the delivered dose;
- An adequate stock of essential replacement parts must be maintained at all times.

The 4S Ranch WRF consistently meets the discharge permit requirements. Notable permit compliance concerns include the following:

- Obsolescence of the Phillips bulb model specified in the discharge permit – this issue is addressed in separate disinfection system alternative technical memorandum.

2.2.2 Air Quality Permitting (Generator and Odor Control)

The 4S Ranch WRF also maintains the following air quality permits through the County of San Diego, Air Pollution Control District (APCD):

- "Permit(s) to Operate" for the 1,000 kW diesel fueled emergency generator (APCD2008-PTO-997763). Requires use of a diesel particulate filter (DPF) to reduce emission diesel particulate matter by at least 85% by weight from baseline emission levels and shall not cause an increase of carbon monoxide greater than 10% from baseline levels. The use of the DPF shall not cause an increase in hydrocarbons or oxides of nitrogen (NOx) emissions greater than 10% from baseline levels; nor any increase in non-methane hydrocarbon plus NOx emissions above baseline levels. Engine operation during non-emergency situations shall be less than 200 hours per calendar year; however, operation during emergency situations shall not be limited. Permit includes typical provisions for permanently installed engines and limits fuel to CARB diesel fuel. The District shall maintain a monthly operating log which shall be maintained onsite for 3 years.
- "Permit to Operate" the 5,700 cfm headworks odor control scrubber (APCD2003-PTO-972242). Requires first stage recirculation flowrate be greater than 72 gpm and second and third stage recirculation flowrates be greater than 108 gpm. The pH shall be greater than or equal to 10.0 and chemical addition shall be controlled by ORP which shall be maintained above 575 MV. District must record recirculation rates daily and operating records be maintained on site for 3 years. At no time shall the equipment cause or contribute to public nuisance and equipment shall be maintained in good operating conditions and in accordance with the O&M manual.
- "Permit to Operate" the 3,600 cfm dewatering building odor control scrubber (APCD2003-PTO-973994). Requires first stage recirculation flowrate be greater than 64 gpm and second and third stage recirculation flowrates be greater than 128 gpm. The pH shall be greater than or equal to 10.0 and chemical addition shall be controlled by ORP which shall be maintained above 575 MV.

District must record recirculation rates daily and operating records be maintained on site for 3 years. At no time shall the equipment cause or contribute to public nuisance and equipment shall be maintained in good operating conditions and in accordance with the O&M manual.

2.2.3 Biosolids Permitting

The production, treatment, and disposal or reuse of Biosolids is regulated through a complex array of federal, state, and local regulations. The 4S Ranch WRF Master Reclamation Permit (Order No. R9-2003-0007) includes the following stipulations under Section E Biosolids Specifications:

- Management of all solids and sludge must comply with all applicable requirements of 40 CFR Parts 257,258, 501, and 503; CWA Part 405(d), and Title 27, CCR including all record keeping and reporting;
- Permits biosolids disposal to municipal solid waste landfill, reused by land application, or disposed of in a sludge-only landfill in accordance with applicable regulations;
- Design requirements related to protection from erosion, flooding, and conveyance to waters of the state
- Operations requirements related to avoidance of nuisances such as objectionable odors, flies and groundwater contamination;
- Operations requirements related to annual reporting to USEPA with respect to quantity, quality, and disposition of sludge.

The regulatory framework relevant to the 4S Ranch WRF operation includes:

- Federal standards governing biosolids are promulgated by the Environmental Protection Agency (EPA) in 40 CFR 503 for production and use and in 40 CFR 257-258 for landfill disposal. 40 CFR 503 establishes minimum national requirements that govern land application, surface disposal, and incineration, addressing:
  - Pollutant limitations for metals within Biosolids stipulated as “Ceiling Concentration Limits”, “Pollutant Concentration Limits”, and “Land Application Loading Rates”;
  - Reduction of pathogens in biosolids to meet “Pathogen Density Limits” using prescribed treatment processes;
  - Reduction of vector attraction through one of ten prescribed treatment processes;
- 40 CFR 503 further defines biosolids classification in accordance with level of treatment and reduction of pathogens and vector attraction:
  - <u>Class A</u>: Meet pollutant ceiling concentration limits; use an approved pathogen reduction treatment process to meet pathogen density limits for total coliform density less than 1,000 organisms per gram of dry solids <u>OR</u> density of *Salmonella sp* bacteria less than 3 organisms per 4 grams of dry solids; and demonstrate Vector Reduction in accordance with one of the approved options.
  - <u>Class A Exceptional Quality (EQ)</u>: Class A Biosolids that further meet the pollutant concentration limits (generally a reduced level of metals) are classified as Exceptional Quality and are not subject to most land application requirements and management activities and may generally be used like any other fertilizer or soil amendment product.

- Class B: Meet pollutant ceiling concentration limits; use an approved pathogen reduction treatment process to meet pathogen density limits for fecal coliform density less than 2 million per gram of dry solids; and demonstrate Vector Reduction in accordance with one of the approved options.
- Unclassified: Biosolids that do not meet the above definitions.

- The State of Arizona Department of Environmental Quality's (ADEQ) Biosolids Management Program (Title 18, Chapter 9, Article 10 of *Arizona Administrative Code*) includes further requirements for biosolids disposed of in Arizona:
  - Treatment, transportation, land application, management of biosolids use areas, record-keeping, monitoring, and reporting requirements, in conformance with 40 CFR 503;
  - An entity generating, transporting or applying Biosolids in Arizona (including contractors accepting biosolids from California POTWs) must register with ADEQ;
  - Biosolids activities within Arizona can be regulated by ADEQ under (1) site-specific Arizona Pollutant Discharge Elimination System (AZDES) permits or (2) the ADEQ "General Permit for Treatment Works Treating Domestic Sewage as Biosolids for Land Application (AZGP2013-001)".
- State of California regulatory standards governing landfills promulgated within the California *Code of Regulations*:
  - Landfill regulations within Title 27, Division 2, Chapter 1;
  - Toxic or hazardous substances including State of California Wet Weight Total Threshold Limit Concentrations (TTLC) within Title 22, Division 4.5, Chapter 11, Article 3.
- Regulation of biosolids land application through SWRCB Order No. 2004-012-DWQ which governs discharge and use as soil amendment through the implementation of 40 CFR 503 pollutant and ceiling concentration limits and establishes additional site management and discharge specifications governing the use of Class B Biosolids at regulated sites.
- Local regulations within the San Diego County for enforcement of landfills that dictate which landfills accept biosolids and specific quantities and qualities (e.g., moisture content and solids processing parameters).

2.3 Plant-Wide Electrical Power and Chemical Usage Audit

2.3.1 Electrical Power Usage

Power bills for the period of August 2013 through October 2014 were reviewed. The 4S Ranch WRF uses approximately 3.1 million kWh per year at an annual cost of approximately $420,000. The annual average daily power usage is approximately 8,600 kWh/day. **Figure 5** shows a discernable seasonal trend is observed with power usage in the summer averaging approximately 9,000 kWh/day and winter averaging approximately 8,000 kWh/day. The increased summer load is attributed primarily to recycled water pumping and possibly temperature influence on aeration requirements. At 8,000 kWh/day for an annual average flowrate of 0.825 mgd, the annual average energy use per volume treated is approximately 9,600 kWh/MG. This value provides a means for benchmarking the 4S Ranch WRF operations to other comparable facilities.

It is also observed that 55% of the average daily electrical usage is “off-peak”, 32% is “semi-peak”, and only 13% is “on-peak”, suggesting that load shifting would not yield significant electrical bill savings. The disproportionate “off-peak” usage is attributed to recycled water pumping which occurs most typically at night when customers are taking recycled water and the current operational strategy that stores secondary effluent during the day to be filtered and disinfected at night.

Figure 5 – Annual Electrical Power Usage

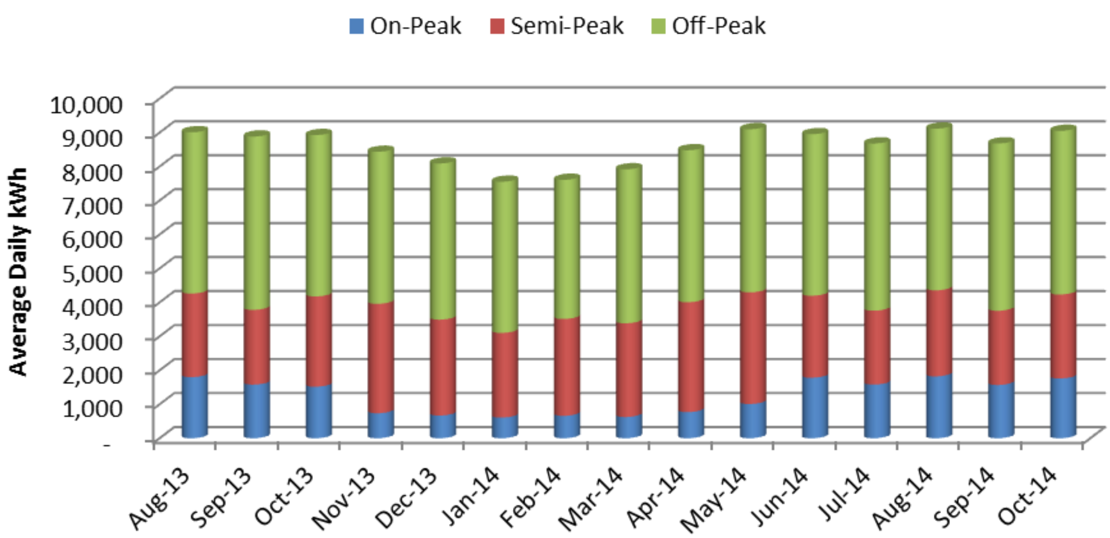
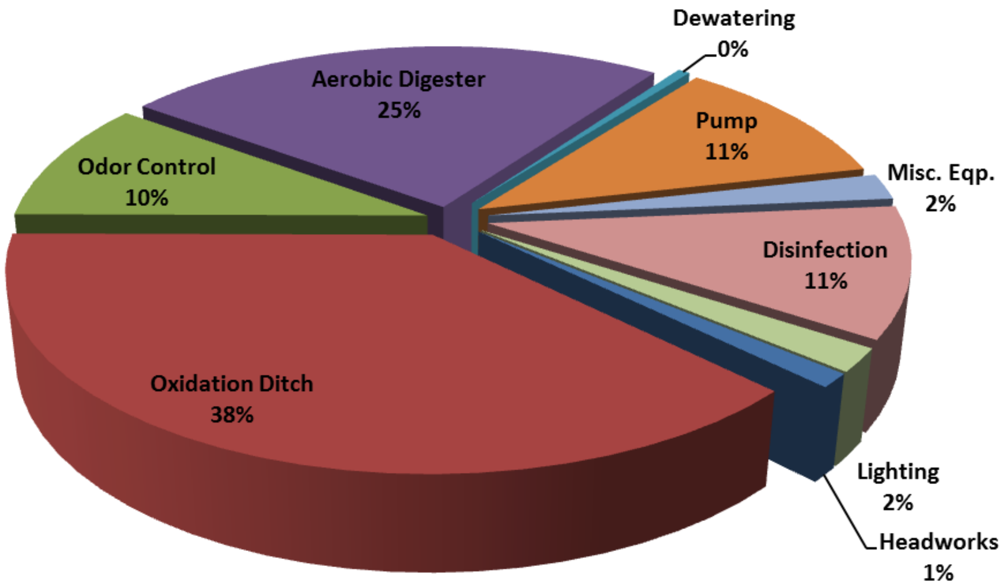


Figure 6 presents electrical usage grouped by functional process area based on an analysis of the plant equipment loads and current operating strategy as described in meetings and site observations. Excluding the assumed recycled water electrical power usage (e.g., recycled water pump station and seasonal storage pond return), the average annual power usage is approximately 8,000 kWh per day. Normalizing for plant flowrate, the annual average plant flowrate is approximately 9,640 kWh/MG. It is observed that approximately 60% to 65% of the electrical power is attributed to aeration in the oxidation ditches and the aerobic digesters. Ultraviolet disinfection, pumping (recycled water pumps and intra-plant pumping), and odor control each consume approximately 10%.

Figure 6 – Electrical Load Summary



The electrical use intensity of 10,320 kWh/MG (WRF + Recycled Water Pumping) is relatively high[6],[7],[8] compared to plants of similar capacity, loading, and process type suggesting opportunities for energy optimization and could lend to a level of service goal to reduce usage by 25% to 50% which would realize a net annual operating cost reduction of more than $100,000 per year. The following recommendations are offered based on this preliminary review of electrical use data:

- Perform an energy audit to confirm electrical load uses at each process area.
- Evaluate opportunities to reduce aeration electrical usage – see Section 2.4.3 below.
- Evaluate opportunities to reduce disinfection electrical usage – see Section 2.4.6 below.
- Evaluate ventilation rates at headworks and dewatering buildings and consider revising strategy to reduce air flowrate when spaces are unoccupied.

2.3.2 Chemical Usage

The District provided Dudek with chemical purchase records for October 2013 through October 2014. Chemicals are summarized in **Table 4** include Clarifloc polymer, chlorine, Aqua Mag magnesium hydroxide, phosphoric acid, and sodium hydroxide. The District's calculated average cost per year breakdown of chemical usage is presented in **Figure 7.**

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[6] *Refining Estimates of Water-Related Energy Use in California* (California Energy Commission, CEC-500-2006-118, December 2006) reports high range of energy intensity for wastewater treatment and recycled water treatment and distribution at 5,800 kWh/MG.

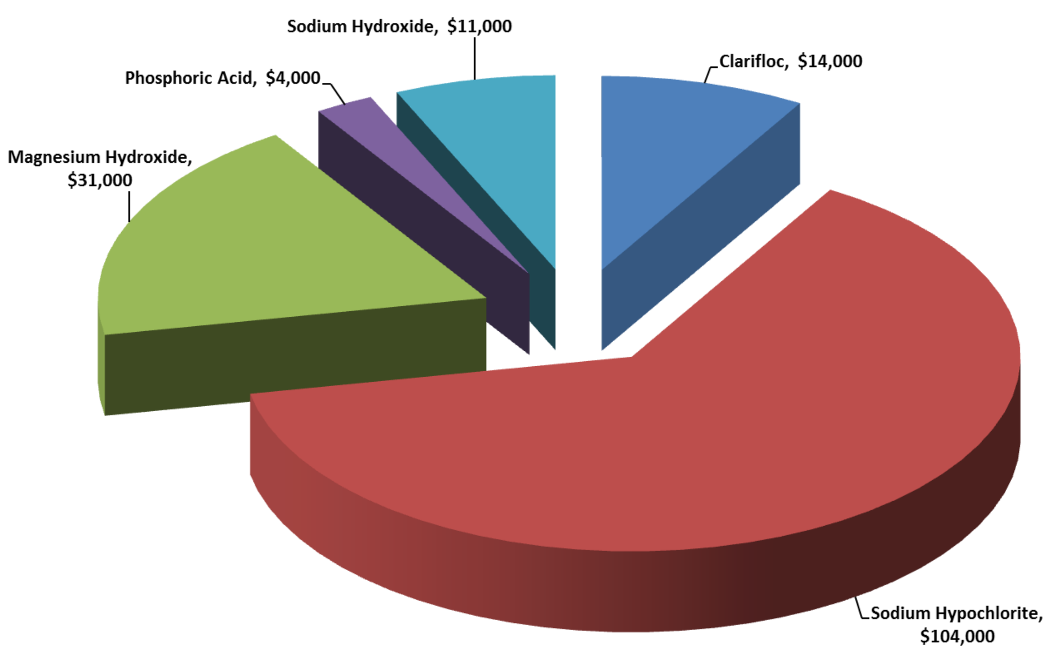
[7] *Water & Wastewater Industry Energy Best Practice Guidebook* (Focus on Energy, 2006), a public utilities study in Wisconsin reports average oxidation ditch energy use at 6,895 kWh/MG with "best practice benchmark" of 4,320 kWh/MG.

[8] Dudek's review of sub-1.0 mgd reclamation facilities operating in extended aeration strategy in southern California suggests a typical energy intensity averaging between 5,000 to 8,000 kWh/MG.

Table 4 – Chemical Use Summary

Chemical (Supplier)	Uses	Use data
Polymer (Clarifloc by Polydyne)	Sludge dewatering	Approximately 1,600 gallons per year. 40% active polymer.
Sodium Hypochlorite (Hasa)	Odor scrubber at Headworks Odor scrubber at Dewatering Building Secondary Effluent/pre-filter conditioning Recycled Water residual	Approximately 106,000 gallons per year. 12.5% solution. Estimate 75% used for odor control; 25% for disinfection.
Magnesium Hydroxide (Aquamag by Hills Brother)	Add alkalinity/pH buffering in Aerobic Digesters	Approximately 7,230 gallons per year. 50% solution.
Phosphoric Acid (Brenntag)	UV Sleeve cleaning	Approximately 800 gallons per year.
Sodium Hydroxide (Brenntag)	Odor scrubber at Headworks Odor scrubber at Dewatering Building	Approximately 3,250 gallons per year. 50% solution.

Figure 7 – Annual Chemical Cost Summary



Total: $ 164,000

The sodium hypochlorite is the largest single chemical used, accounting for approximately 63% of the total chemical budget at the 4S Ranch WRF. Sodium hypochlorite delivery is not metered at the point of use, so the chemical usage cannot be directly evaluated. Assuming that the sodium hydroxide is dedicated to odor scrubbers (no other uses at the WRF), and applying a NaOCl : NaOH ratio[9] of between 3.66:1 to 4:1, it is derived that the sodium hypochlorite demand of the odor scrubbers accounts for approximately 75% of the average annual usage. It is assumed that approximately 75 gallons per day is used for pre-filter conditioning and disinfection, resulting in an annual cost of approximately $25,000 per year.

The following recommendations are offered based on this preliminary review of chemical use data:

- Evaluate aerobic digestion process to identify opportunities to eliminate the use of Magnesium Hydroxide at $31,000 per year – See Section 2.4.7 below.
- Confirm sodium hypochlorite usage and evaluate wet chemical scrubber setpoints and efficiency. Consider odor control strategies that include collection system treatments that reduce headworks H_2S loading.
- Consider covering the secondary effluent equalization basins to alleviate the need for sodium hypochlorite application for algae control; this would have the additional benefit of reducing the corrosivity of feed water to filters and minimize the filter structure corrosion potential.

2.4 Current Process Unit Evaluation

2.4.1 Headworks (Screening and Grit Removal)

The headworks provides preliminary treatment including screenings and grit removal. Screenings are removed from the raw wastewater with a single band-screen and screenings wash/press. Grit is removed in a vortex grit chamber. Foul air from the headworks area (screenings building and headspace over influent channels and splitter box) is treated in a wet chemical scrubber located adjacent to the headworks building.

The headworks is designed for the full plant capacity of 2.0 mgd with a peak factor of “3” for a peak hydraulic load of 6 mgd. No hydraulic capacity issues have been reported by the operations staff.

According to District staff, the headworks effectively removes inert materials including rough screenings and grit, as evidenced by minimal downstream impacts when the screen and grit chamber are operational. The most significant headworks issue is the lack of redundancy in the critical screenings equipment. When the screenings equipment is inoperable or removed from service for routine maintenance, raw wastewater is bypassed through a parallel channel with a manual bar rack. Bypassing through the bar rack results in undesirable operator attention associated with cleaning the manual bar rack and removing screenings in downstream processes (e.g., grit chamber, anoxic tank vertical mixer, and sludge pumps). Reliability and redundancy of the headworks area is addressed in a subsequent Failure Mode and Effects Analysis scope element.

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[9] The stoichiometric requirement for conversion of odorous compounds (e.g., H_2S) to non-odorous salts is 2.4 lbs of NaOH per lb of H_2S and 8.8 lbs of NaOCl per lb of H_2S (*Control of Odors and Emissions from Wastewater Treatment Plants, WEF Manual of Practice 25*), resulting in a ratio of 3.66:1. Understanding the chemistry won’t be precise in this application due to chemical degradation and inefficiencies, a range is considered appropriate.

2.4.2 Plant A Oxidation Ditch/Clarifiers

Plant A consists of a single oxidation ditch with pre-anoxic basin, mixed liquor return for biological nutrient removal, and two clarifiers. Plant A is rated at 0.5 mgd. Plant A has not been operated over the past ten years and therefore no current operating data are available. Analysis of Plant A's performance is not possible at this time.

The ultimate disposition of Plant A should consider ultimate plant flowrate and cost of ownership of this stranded asset. If ultimate plant flowrate exceeds the Plant B capacity (e.g., 1.62 mgd per IEC planning study vs. 1.5 mgd design capacity) or if the ultimate plant hydraulic and/or organic loading exceeds the Plant B capabilities, then Plant A may be required for treatment capacity.

2.4.3 Plant B Oxidation Ditch/Clarifiers/RAS Pumping

Plant B consists of a single oxidation ditch, two circular secondary clarifiers, and return activated sludge pump station. Oxidation ditches are characterized as extended aeration, activated sludge (EAAS) and are robust and simple systems. EAAS is commonly employed in small (<5 mgd) facilities for which primary settling and ancillary digestion processes are not cost effective. As is the case for the 4S Ranch WRF, EAAS are designed to treat all influent organic loads and rely on sludge ages of sufficient length to fully nitrify; this is especially true for facilities in warmer climates like the San Diego region. While the EAAS process is robust in treatment of organic loads, managing nitrification in a consistent and energy-efficient manner can be a challenge. Oxidation ditches commonly exhibit higher electrical usage than alternative treatment processes and alkalinity deficiency can cause biological treatment process upsets.

The 4S Ranch WRF oxidation ditch (equipment provided by EIMCO, now OVIVO) includes a pre-anoxic basin mixed with a single vertical mixer suspended from a concrete pier. Raw wastewater and return activated sludge (RAS) are mixed in the influent splitter box and then conveyed into the pre-anoxic basin where these streams are mixed with internal mixed liquor recycle. The pre-anoxic zone is intended to serve as a biological selector by selecting out filaments that can interfere with floc settleability. The pre-anoxic basin promotes denitrification which is the reduction of nitrate produced in the oxidation ditch to nitrogen gas. The denitrification process provides an "oxygen" credit as anoxic bacteria utilize nitrate rather than oxygen as an electron acceptor in the biodegradation of BOD. Denitrification also restores approximately 1/2 of the alkalinity that is consumed by the nitrification process in the oxidation ditch. The pre-anoxic basin is a critical process element for maintaining a robust and reliable secondary treatment process.

The oxidation ditch aeration zone is mixed and aerated with two "vertical turbine" surface aerators. The two 125 HP aerators are driven by variable speed drives and are designed to provide up to 3.5 lbs O_2 per HP-hour (i.e., 21,000 lbs O_2 per day) which theoretically could provide twice the peak daily oxygen demand[10]. However, the stated oxygen transfer rates are understood to be "standard" rates (i.e., 20^oC, 14.7 lb/in^2 and initial Dissolved Oxygen = 0 mg/L) and industry-standard publications suggest actual field transfer rates of approximately one half of the standard rates[11]. In the absence of project-specific oxygen transfer efficiency or testing data it can only be concluded that the original design intent provided aeration capacity for up to 1.5 mgd such that the parallel aerators do not provide redundant firm aeration capacity.

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[10] MWH, 2000, Dwg. GM-10

[11] Metcalf & Eddy, Page 446 and Table 5-31

Oxygen transfer for surface aerators is a function of speed and mixer submergence, the combination of which results in varying power draw. The VFD-driven aerators in conjunction with an adjustable outlet weir are controlled through the system control panel to maintain a dissolved oxygen setpoint in the oxidation ditch. The dissolved oxygen control is intended to match oxygen demand to optimize energy usage and to avoid over-aeration that can result in oxygen bleed-through to the anoxic zone which prohibits denitrification.

Commonly, these types of oxidation mechanical aerators are programmed for a minimum speed in order to maintain mixing energy or motive force to keep the mixed liquor moving and the biomass in suspension within the reactor. By constraining the minimum speed, the aerators are often unable to turndown fully to meet minimum diurnal oxygen demand, thereby over-aerating during significant portions of the day. This turndown limitation is exacerbated in underloaded plants, as is the case with the 4S Ranch WRF (i.e., currently operating at approximately 55% capacity).

Mixed liquor from the oxidation ditches is settled in two 65-ft diameter circular secondary clarifiers. The District currently operates both clarifiers at all times and reported concerns about operating a single clarifier at current operating flowrates.

The current operating profile of the oxidation ditch and clarifiers suggests significant potential for optimization. **Table 5** presents operating parameters for the oxidation ditches and **Table 6** presents operating parameters for the secondary clarifiers.

Table 5 – Plant B Oxidation Ditch Operations Performance

Parameter	Unit	Value: Ox.Ditch	Value: Design Std.[1]
Plant B			
Oxidation Ditch	No	1	n/a
Volume	gallons	750,000	
	cu.ft.	100,267	
Clarifiers	No	2	
Volume, Each	gallons	347,493	
	cu.ft.	46,456	
Total Ox.Ditch & 2x Clarifier Volume	gallons	1,444,986	
	cu.ft.	193,180	
Hydraulic Retention Time, HRT (@ ADF)	hrs	12.0	
Sidewater Depth	ft	12.65	
Average Daily Flowrate, ADF (2014)	mgd	0.825	
Design Capacity	mgd	1.5	
Peak Hour Factor, PHF	--	2.5	
Influent Loading, BOD_5 (2014)[2]	mg/L	182	
Design Influent Loading, BOD_5	mg/L	240	
MLSS Concentration	mg/L	4000	
Food : Microorganism (F:M) Ratio (Including Clarifier Mass)[3]			
@ 1.5 mgd (Design Flowrate & Loading)[4]	lbs BOD/d / lbs MLVSS	0.07	0.04-0.10
@ 0.825 mgd (Current Flowrate & Loading)		0.03	
Hydraulic Retention Time, HRT in Oxidation Ditch (@ ADF)			
@ 1.5 mgd (Design Flowrate)	hours	12.0	18-30
@ 0.825 mgd (Current Flowrate)	hours	21.8	
Solids Retention Time, SRT			
@ 1.5 mgd (Design Flowrate & Loading)	days	15.0	15-30
@ 0.825 mgd (Current Flowrate & Loading)	days	26.0	

Notes:
1. Common Design Criteria for "Extended Aeration" treatment process per *Wastewater Engineering Treatment and Reuse,* 4th Edition, Metcal & Eddy, Table(s) 8-16 (BOD Removal) and 8-22 (BNR)
2. Average daily BOD_5 Loading (2014 Operating Data)
3. MLVSS/MLSS = 84% (Volatile Fraction) per 2014 Operating Data
4. Design Flowrate = 1.5 mgd and Design Loading = 240 mg/L (90th Percentile)

Table 6 – Plant B Secondary Clarifiers Operations Performance

Parameter	Unit	Value		
		1 Clarifier	2 Clarifier	Design Std.[1]
Plant B				
Clarifiers	No	2		n/a
Diameter	ft	65		
Surface Area	sqft	3,318		
Sidewater Depth	ft	14		
Average Daily Flowrate, ADF (2014)	mgd	0.825		
Average Current Daily Internal Recycle Rate (2014)[2]	mgd	0.355		
Design Capacity	mgd	1.5		
Peak Hour Factor, PHF	--	2.5		
MLSS Concentration (2014 Operating Target)	mg/L	4000		
Recycle Flowrate	% Qi	100%		
Surface Loading Rate - Average				
@ 1.5 mgd (Design Flowrate)	gpd/sqft	452	226	200-400
@ 1.18 mgd (Current Flowrate)	gpd/sqft	356	178	
Surface Loading Rate - Peak [3]				
@ 1.5 mgd (Design Flowrate)	gpd/sqft	1130	565	600-800
@ 1.18 mgd (Current Flowrate)	gpd/sqft	729	364	
Solids Loading Rate - Average				
@ 1.5 mgd (Design Flowrate)	lbs/sqft/hr	1.3	0.6	0.2-1.0
@ 1.18 mgd (Current Flowrate)	lbs/sqft/hr	0.8	0.4	
Solids Loading Rate - Peak [4]				
@ 1.5 mgd (Design Flowrate)	lbs/sqft/hr	2.2	1.1	1.4
@ 1.18 mgd (Current Flowrate)	lbs/sqft/hr	1.4	0.7	

Notes:
1. Common Design Criteria for "Extended Aeration" treatment process per *Wastewater Engineering Treatment and Reuse,* 4th Edition, Metcal & Eddy, Table 8-7
2. 2014 operations data indicates up to 43% internal return rate resulting in average daily hydraulic load on the clarifiers of up to 1.18 mgd.
3. Peak Surface Loading Rate assumes 2.5 Peak Hour Factor applied to Qi + Internal Recycle; RAS is not considered
4. Peak Solids Loading Rate assumes 2.5 PHF applied to Qi + 100% RAS + Internal Recycle

The following observations are provided to identify areas of potential further study:

- Plant B is operating at approximately 55% of its hydraulic design capacity and approximately 45% of the organic loading design capacity – average influent flow is 0.825 mgd vs. 1.5 mgd Plant B design capacity and current influent BOD loading is 180 mg/L (2014 Annual Average) vs. 240 mg/L (90^{th} Percentile) design criteria.
- The mechanical surface mixer/aerators are notably inefficient with respect to oxygen transfer efficiency and due to the plant being under-loaded, limits the ability to control aeration resulting in undesirable energy use. Conversion of the oxidation ditch mixer/aerators to fine bubble

diffuser with retrofit of mixers could reduce energy demand by at least 400,000 kWh per year ($50,000 per year savings). Refer Attachment A of this Technical Memorandum for preliminary proposal and product literature provided by Ovivo to convert the oxidation ditch to fine bubble diffusers. This retrofit should be thoroughly evaluated and considered for implementation when the existing mechanical aerator/mixer equipment is ready to be replaced.

- At 0.825 mgd and 182 mg/L influent BOD5, the current mixed liquor concentration of 4,000 mg/L results in a food to micro-organism (F:M) ratio of 0.03 lbs-BOD per lb-MLVSS and an solids retention time (SRT) of 26 days. The F:M ratio is below the low end of the recommended range for oxidation ditches[12] while the SRT is on the high end and approximately 75% greater than the design criteria. Reducing the mixed liquor concentration could improve sludge volume index (SVI), reduce solids loading on the clarifier, and reduce foaming issues.
- Plant B clarifiers are presently loaded at hydraulic surface loading rate of 178 to 364 gpd/sqft, which is well below recommended range, yet the clarifiers reportedly experience sludge rising issues under certain loading scenarios. This suggests SVI issues that are likely attributed to excessively long sludge age. Rising sludge may also be due to denitrification in the clarifiers caused by anoxic zones within the sludge blanket.
- Sludge age of 26 days is more than necessary for BOD removal and full nitrification which could be accomplished with an SRT of 10 to 15 days. Reducing SRT would reduce oxygen demand on the oxidation ditch, improve sludge settleability (reduce SVI), and transfer volatile solids reduction responsibility to the aerobic digester.

2.4.4 Secondary Effluent Equalization

Secondary effluent from the secondary clarifiers flows by gravity to the equalization basins where diurnal flows are equalized to regulate loading to the tertiary treatment systems. The District is currently preparing a project to increase the equalization basin capacity and re-arrange the flow regime through the basin. The District should also consider covering the equalization basins with this project to alleviate the need for sodium hypochlorite application for algae control which would reduce chemical costs and reduce corrosion potential in the downstream filter structure.

2.4.5 Filtration

The 4S Ranch WRF operates Hydro Clear monomedia, pulse-bed filters. The filters are packaged systems consisting of four filter cells, blowers for media bed pulsing, and a compressor for pneumatic systems. The packaged filter system is contained in a steel structure that is exhibiting excessive corrosion. The condition of the existing filters is poor and should be replaced in the near-term future. A separate technical memorandum (TM #3A) provides review of the tertiary filtration system with recommendations for replacement.

2.4.6 Disinfection

The 4S Ranch WRF operates a Trojan 3000 ultraviolet disinfection system. The UV system controls will soon be obsolete, the UV dosage cannot be efficiently regulated, and the system does not include clean-in-place function. The UV system should be replaced in the near-term future. A separate technical

[12] Metcalf & Eddy Table 8-16, Page 747 recommends an F:M ratio between 0.04 to 0.1 and an SRT between 15-30 days for EAAS and oxidation ditches.

memorandum (TM #3B) provides review of the disinfection system alternatives and with recommendations for replacement.

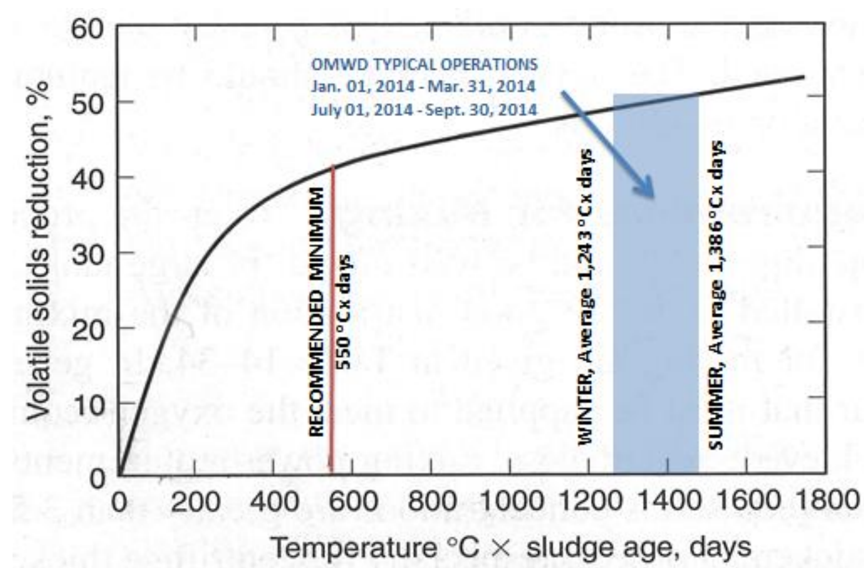
2.4.7 Sludge Treatment

The 4S Ranch WRF aerobically digests thickened waste activated sludge in two circular aerobic digesters. The digesters were originally constructed with mechanical aerator/mixers that were subsequently replaced with blowers and diffusers. The switch to forced aeration was prompted by deficiencies with the mechanical aerators including the inability to maintain dissolved oxygen in the digesters that resulted in odor issues. Two blowers are currently installed – a 75 HP and a 150 HP. The blowers are typically not operated concurrently. The District has reported mechanical maintenance issues with the larger Kaeser blower. The current blower/diffuser operation represents one of the largest electrical demands on the plant with an estimated annual cost of approximately $100,000.

Magnesium hydroxide is routinely added to the aerobic digester in order to raise pH. The observed pH depression is likely a result of alkalinity depletion associated with the nitrification of organic nitrogen contained in the volatile solids. The need to boost pH suggests insufficient alkalinity, which could be a result of the excessive sludge age of the oxidation ditch and insufficient denitrification, and the aerobic digester solids treatment scenario. The alkalinity balance across the biological system should be considered in conjunction with any operational changes implemented in the oxidation ditch and/or aerobic digester.

The District currently produces Class B Biosolids and disposes of dewatered biosolids through a contractor to land disposal site(s) in Arizona. Through the use of aerobic digestion where biosolids are aerated and maintained at a mean cell residence time and temperature between 40 days at 20 ^{o}C and 60 days at 15 ^{o}C, the Vector Attraction Reduction “Option 1” is satisfied per 40 CFR 503 by reducing the mass of volatile solids by a minimum of 38%. **Figure 8** plots volatile solids reduction against a “design factor” of the product of temperature and sludge age. Based on review of operating data from September 2013 to September 2014, the typical waste activated sludge volatile solids fraction was determined to be 84% (median, 50th percentile) and the typical digested sludge volatile solids fraction was determined to be 74% (median, 50th

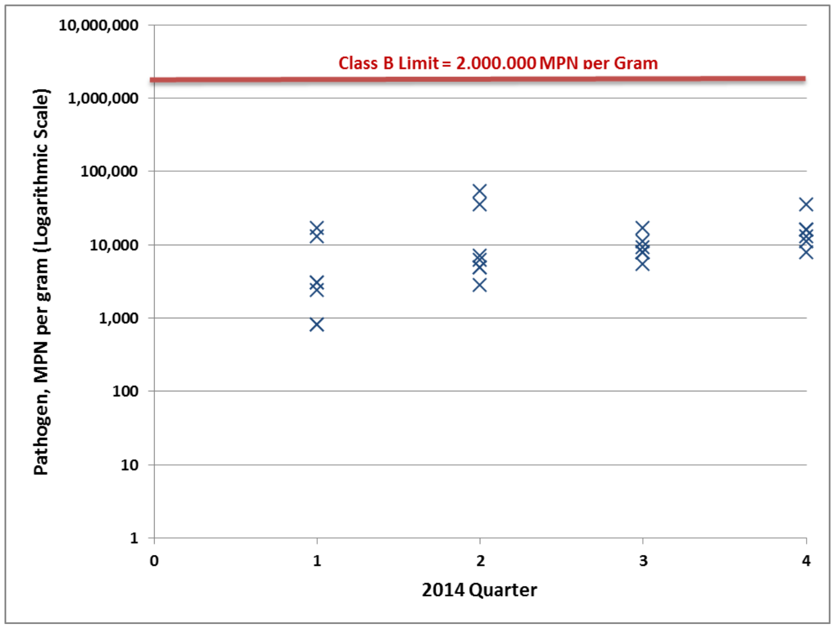
Figure 8 – Volatile Solids Reduction vs. Temperature & Sludge Age



percentile). Using the Van Kleeck method[13], the volatile solids reduction is calculated to be 45.8%, also consistent with the design factor curve presented in **Figure 8**, and well in excess of the Class B biosolid requirement of 38% VSR.

In year 2014, the District also began sampling and testing for pathogens in cake product. Per 40 CFR 503, Section 503.32 Pathogens, Class B Biosolids can be demonstrated by collecting seven representative samples of which the geometric mean of the density of fecal coliform is less than either 2,000,000 Most Probable Number (MPN) per gram of total solids (dry weight basis) or 2,000,000 Colony Forming Units per gram of total solids (dry weight basis). **Figure 9** presents the quarterly samples for 2014 (7 samples per quarter), demonstrating Total Coliform concentrations consistently below the Class B Limit of 2,000,000 MPN per gram.

Figure 9 – Pathogen Data, 2014



The analysis of the aerobic digester operation presented in Figures 8 and 9 confirm that the current operation is comfortably meeting Class B Biosolids per the 40 CFR 503 regulations. However, the current operation is energy intensive, requires addition of supplemental alkalinity (magnesium hydroxide), and because it is a completely aerobic process, the resulting sludge is relatively difficult to dewater. Areas for optimization could include increasing the workload of the aerobic digesters by reducing SRT in the oxidation ditch, decreasing the SRT in the aerobic digester to take advantage of the warm digester operating temperature, or converting the aerobic digester to a facultative biological system.

Figure 10 – Camarillo WWTP Facultative Digestion Pond

The following recommendations are offered for sludge treatment:

- Consider conversion to a facultative biological system using proprietary enzyme/microorganism treatment (i.e., Ennix) that will allow the digester blowers to be shut off. Camarillo WWTP has successfully operated this process for over ten years – See for photo in **Figure 10** of facultative digestion pond at Camarillo WWTP. Prior to implementing this novel biological treatment

[13] $VSR_{VK} = (VS_i - Vs_e) / (VS_i - Vs_i \times VS_e)$, where VSR_{VK} is the "Volatile Solids Reduction" (VSR), VS_i is the Fraction of influent Volatile Solids and VS_e is the fraction of effluent Volatile Solids.

system the District should develop a comprehensive implementation plan that would include a thorough evaluation by District staff and process specialists including review of product information, visits to and discussions with operators at operating facilities (e.g., Camarillo WWTP and Western Municipal Water District's WRCWRA Plant), satisfactory performance of a pilot-scale operation to identify site-specific operating parameters and to gain operator experience. Following the pilot study and confirmation of benefit/cost analysis, the District would need to negotiate an agreement with the system supplier and prepare a conversion plan that includes detailed staging, process control and monitoring plans, and mitigation plans should results deviate from expected.

- As assets reach the end of useful life, optimize aeration system including replacement of blowers to improve reliability and efficiency.
- Investigate the inter-relationship of biological treatment in the oxidation ditch with the aerobic digestion operation. Consider lowering the SRT in the oxidation ditch to reduce oxygen demand on that process train and thereby transferring the volatile solids reduction work to the more efficient and capable aerobic digesters.
- Consider sludge treatment technologies that may be compatible with achieving Class A Biosolids goals (e.g., FKC screw press with integral lime and pasteurization treatment).

2.4.8 Sludge Dewatering

Solids generated from the activated sludge process at 4S Ranch WRF are settled and wasted from the circular secondary clarifiers. The sludge produced in the secondary process is entirely aerobic, activated sludge with a target sludge age of 15 days. However, the sludge age has averaged 26 days between September 2013 and September 2014. Current sludge generation at 4S Ranch WRF was evaluated and compared to other extended aeration activated sludge facilities to develop a basis for establishing the fundamental sludge loading criteria for this Technical Memorandum.

4S Ranch WRF sludge dewatering records for September 2013 through July 2014 were reviewed. In this 11-month time period, 4S Ranch WRF hauled approximately 1,154 wet tons at an average dry solids concentration (dewatered cake) of 17%, which equates to approximately 105 wet-tons per month or 18 dry-tons per month. Normalizing for average monthly flowrate during these 11 months (0.825 mgd), the average solids generation was approximately 260 dry-tons per year per mgd. The maximum monthly solids generation was 31 dry-tons per month per mgd, equating to a maximum month factor of 1.44. Sludge process parameters are given in **Table 7**.

It is noted that a simple mass balance using 182 mg/L average influent BOD and the derived sludge disposal mass would result in a mass Yield of 0.94 which is higher than anticipated. It is suggested that the District monitor mass loading and verify the influent sampling protocol to ensure that influent organic loading is properly characterized.

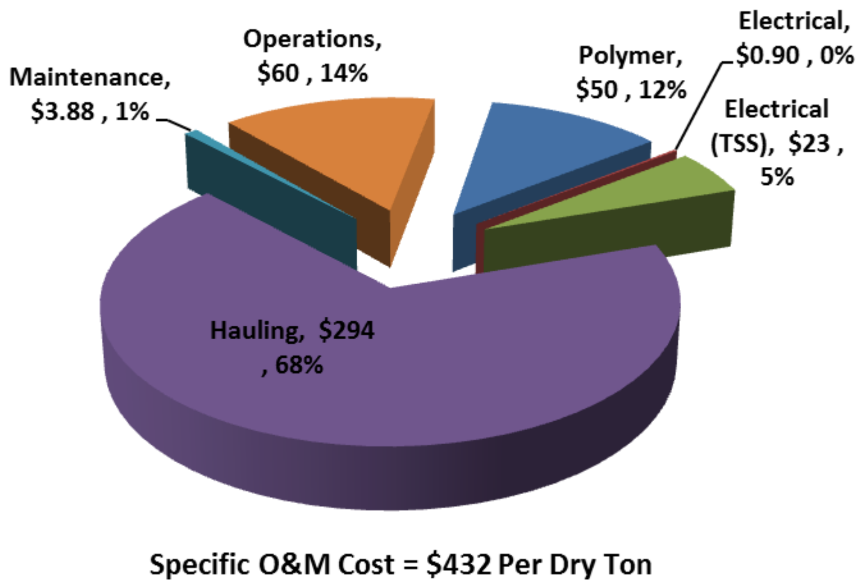
Table 7: 4S Ranch WRF Sludge Process Values

Parameter	Unit	Value
Plant Flow Rate		
Current Flowrate (annual average)	mgd	0.825
Current Capacity	mgd	2.0
Percent Capacity	%	41.5
Influent Loading		
BOD_5 (average)	mg/l	182
Aeration Basin Operating Criteria		
Solids Retention Time (SRT)	days	26
Thickening Process		
Process Type	type	Gravity Belt Thickener (Gravity Section of 1M BFP)
Thickened WAS Concentration	%DS	4.7
Dewatering Process		
Process Type	type	Belt Filter Press, 1 meter
Feed Sludge Concentration	%DS	4 to 6
Cake Concentration	%DS	17
Solids Loading Rate	lbs/hr	600
Solids Generation		
Sept. 2013 to July 2014 (Ave. Q = 0.825 mgd)	dry-tons	197
Unit Generation Factor	dry-tons per mgd per year	260
Polymer Usage	lbs-active per dry-ton	25

At 40% active polymer and solids generation rate of 18 dry-tons per month, polymer usage equates to 25 active-lbs of polymer per dry ton of solids. This is within the range of industry-standard usage for polymer, indicating good polymer control.

The belt filter press is achieving approximately 17% dry solids cake on average, which is reasonable performance for a belt filter press dewatering aerobically digested sludge. In order to achieve higher sludge cake dryness, more energy-intensive equipment would be required. For example, screw presses commonly achieve cake dryness slightly higher than belt filter presses and centrifuges can generally be expected to achieve 2% to 3% drier cake than screw presses. Other important parameters influencing the total dewatering performance include: polymer usage, electrical power consumption, and cake hauling/disposal costs. Using cost data derived from operating data for the current operation (17% cake, 85% solids capture, 18 dry-tons/month, 25 active-lbs of polymer per dry-ton, power at $0.12/kWh, annualized routine O&M, and a cake hauling/disposal cost of $50/wet ton), the specific unit cost is calculated to be approximately $430/dry ton produced. The unit cost breakdown in **Figure 11** illustrates that with the current dewatering operation, nearly 70% of the solids handling cost is attributed to hauling and disposal. To optimize the dewatering process, consideration should be given to alternative dewatering technologies that can improve cake dryness. For example, if the dewatering belt press was replaced with a centrifuge, power consumption would increase, but if a 3% solids increase could be achieved, the specific unit cost would be reduced by over 10% to $380/dry ton. It is recommended that alternative dewatering technologies (screw presses and centrifuges) be evaluated prior to replacing the dewatering belt presses in order to minimize life cycle cost of this unit process operation.

Figure 11 – Sludge Unit Cost Breakdown, Cost per Dry-Ton



3 SUMMARY OF RECOMMENDATIONS

This Technical Memorandum #3 provides a high-level audit of the current operating profile at the 4S Ranch WRF. The 4S Ranch WRF consistently meets permit requirements, however, plant optimization is recommended to reduce operating costs, improve process reliability, and ensure satisfactory performance as plant flows increase in the future. **Table 8** summarizes the major recommendations identified in this TM #3.

Table 8 – Summary of Process Evaluation Recommendations

No.	Process Area	Recommendation
1	Headworks	Evaluate influent sampling configuration and consider revising sampling location or physical configuration to ensure accurate sampling regimen. With updated sampling data, confirm influent organic loading characterization.
2	Hydraulics	Review flow monitoring/recording data and validate influent, filtration, and disinfection flowrates to confirm internal plant return percentage. Review unit process water usage and identify opportunities to reduce internal plant water usage including: • Reduce secondary clarifier foam sprayer usage; • Control foam through revised biological process control (reduced sludge age, lower MLSS); • With new filtration project, optimize filter backwash waste; • Eliminate pump seal water usage by replacing mechanical seals with self-flushing seals.
3	Plant B Oxidation Ditch & Clarifiers	Conduct process evaluation study to: • confirm energy use profile and evaluate alternative aeration/mixing systems; • identify preferred operating parameters (SRT, F:M) in order to optimize nitrification and denitrification and floc settling characteristics; • perform solids flux analysis to optimize return sludge pumping;
4	Plant B Oxidation Ditch & Clarifiers	Lower SRT (range of 10-15 days) to reduce oxygen demand on the oxidation ditch, improve floc settleability (reduce SVI), and transfer volatile solids reduction work to the aerobic digester.
5	Secondary Effluent EQ Basin	Consider covering secondary effluent EQ basins to alleviate the chlorine demand (reduce chemical usage) and to protect pre-filtration water quality.
6	Aerobic Digesters	Conduct comprehensive evaluation of facultative sludge treatment as alternative to aerobic digestion.

No.	Process Area	Recommendation
7	Aerobic Digesters	As assets reach the end of useful life, optimize aeration system including replacement of blowers to improve reliability and efficiency.
8	Dewatering	Conduct study of dewatering technology alternatives to: • identify preferred, lowest life-cycle equipment/system for replacement of belt presses when they reach the end of their useful life; • evaluate biosolids treatment options including lime stabilization and heat treatment to produce Class A product suitable for reuse.
9	Tertiary Filtration	Replace existing tertiary filters. See TM #3A for analysis.
10	Ultraviolet Disinfection	Replace existing UV system with updated UV system. See TM#3B for analysis.

4 REFERENCES

Metcalf & Eddy, Wastewater Engineering, Treatment and Reuse, 4th Edition, 2003.

Montgomery Watson, Kelwood Development Company 4S Ranch Sanitation District, 4S Ranch WWTP Expansion and Related Projects, Wastewater Treatment Plant Expansion to 2.0 MGD, April 2002.

Water Environment Federation (WEF), Manual of Practice No. 8, Design of Municipal Wastewater Treatment Plants, Volume 1, 1992.

5 ATTACHMENTS

ATTACHMENT 1 – OVIVO Ringstrip System Preliminary Proposal

ATTACHMENT 2 – Ennix Facultative Digestion Information

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ATTACHMENT 1 – OVIVO Ringstrip System Preliminary Proposal (Oxidation Ditch Conversion)

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Ringstrip System Preliminary Proposal

Design Type:

AEROSTRIP® Ditch System

For

Olivenhain, 4S Ranch, CA

Provided on **April 29, 2015**

By
Ovivo USA, LLC
4255 Lake Park Blvd., Suite 100
Salt Lake City, Utah
84120-8201
USA
www.ovivowater.com

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Bringing water to life

With pleasure we announce
effective September 13, 2010
Eimco Water Technologies, LLC
changed its name to
Ovivo USA, LLC

www.ovivowater.com

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4255 Lake Park Blvd., Suite 100
Salt Lake City, Utah
84120-8201
USA

Telephone: 801.931.3000
Facsimile: 801.931.3080

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Project Summary Letter

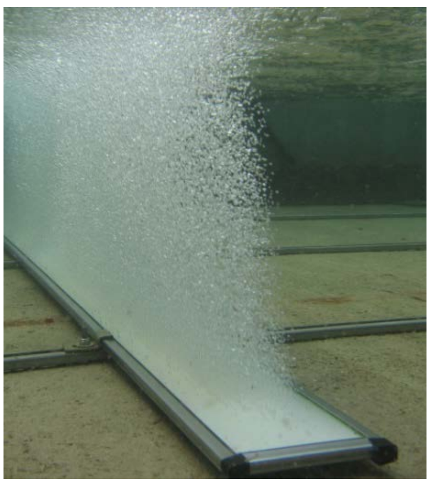
April 29, 2015

Tom C. Falk, PE
Dudeck
c/o Tom Roberson
Misco
27101 Burbank Suite B
Foothill Ranch, Ca 92610

Subject: Olivenhaim 4S Ranch, CA AEROSTRIP® Ringstrip System Proposal

Dear Tom,

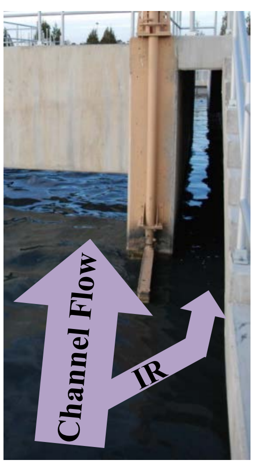
We are pleased to provide you with this proposal for the 4S Ranch, CA Carrousel® retrofit. The proposal provides the basics of



<u>AEROSTRIP® Diffusers</u>

AEROSTRIP® diffusers are floor-mounted for **maximum oxygen transfer** and **minimum impedance of channel velocity** (floor mounting)in a ditch configuration. Diffusers are 316 stainless steel construction with a high strength polyurethane membrane. The polyurethane membrane allows for "check-valve" perforation technology that minimizes fouling and results in high energy efficiency.

Airflow and pressure drop calculations are included in this proposal. The AEROSTRIP brochure is also included for your reference. We also recommend watching the following video link: http://youtu.be/ScnfkhCOjlk



<u>Internal Recycle (IR) Channel/ Eliminat*IR*® Gate (Already Installed)</u>

The Ovivo design takes advantage of the propulsion inherent to the System. A slip stream of the main channel flow is conveyed to the anoxic zone. This allows very high internal recycle (up to 10-15Q) for maximum nitrate removal. No separate recycle pumps are required.

The IR flow is controlled by the Eliminat***IR*** gate, which adjusts to control the actual internal recycle at any given time. Our Oculus™ Control System uses an oxidation-reduction (ORP) probe located in the anoxic basin for Eliminat***IR*** gate adjustment.

Ovivo USA, LLC
4255 Lake Park Blvd., Suite 100
Salt Lake City, Utah
84120-8201
USA

Telephone: 801.931.3000
Facsimile: 801.931.3080

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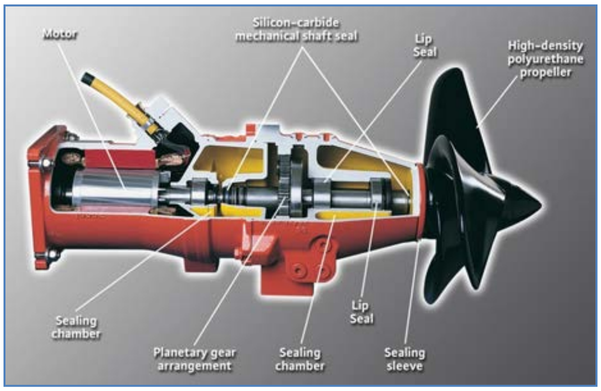
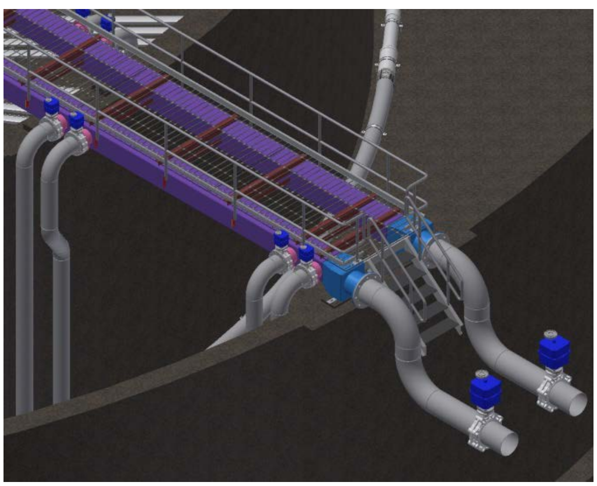
Olivenhaim 4S Ranch, CA
AEROSTRIP® Proposal
April 29, 2015



<u>Efficient Propulsion Mixers®</u>

Ovivo Submersible Mixers use a high-efficiency, molded, chemical resistant, polyurethane (PUR) propeller. Unlike steel, PUR can be molded into the most efficient shape. This shape creates a completely horizontal flow pattern. By eliminating radial flow energy, mixing efficiency is improved resulting in a lower HP per unit volume requirement. Additionally, there is no need for impeller shroud rings, which pose a threat of ragging.



<u>Ovivo AirBridge (Not Included But Available)</u>

Ovivo provides an AirBridge spanning each basin. The structural members of the AirBridge are used to convey the air to the System. The Contractor supplies and connects headers and the drop piping to the Ovivo AirBridge. The Airbridge is also used to mount the propulsion mixers.

Ovivo provides automated valves at the bridge at each drop and provides all in-basin process instrumentation (e.g., dissolved oxygen, ammonia, nitrate). The Ovivo Oculus™ System controls the position of each valve and sends a signal to the blower control panel.

Ovivo USA, LLC
4255 Lake Park Blvd., Suite 100
Salt Lake City, Utah
84120-8201
USA

Telephone: 801.931.3000
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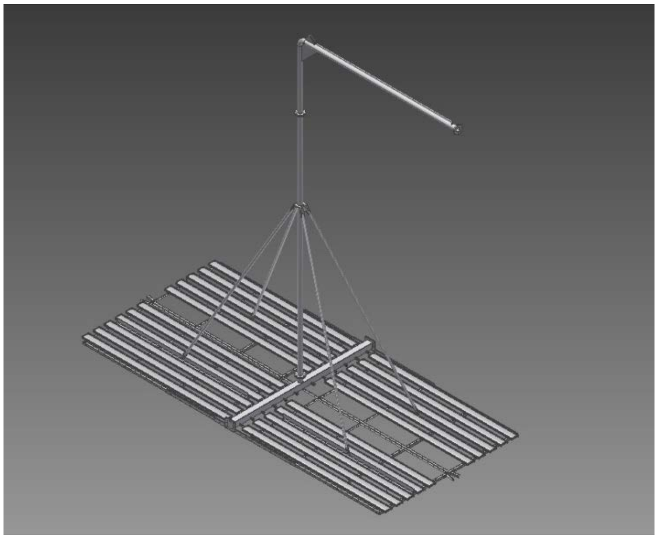

Retrievable Racks

Ovivo provides retrievable racks to facilitate removing diffusers for maintenance activites in one train systems. The racks are fabricated from 304 stainless steel and are designed with guide rails and feet to ensure an easy and level installation.

The AEROSTRIP system requires little maintenance, so it may be possible to use a conventional installation without retrievable racks. The system is usually only nonspected and cleaned every few years, and membrane replacement is typically every 12-15 years.

Budgetary Scope of Supply (Total For One Train):

Quantity	Item Description
4	Grids AEROSTRIP diffusers (16-18 diffusers per grid, total 68 ea T-4.0), anchors, mounting hardware, and fittings
4	Retrievable 304 SS Racks With Integral drop pipe and manifolds for each grid
2	6 HP Propulsion Mixers, including dedicated hoist
1	Freight and Service

Please feel free to contact me at (801) 931-3242 (Mountain Time) if you have any questions.

Very truly yours,

Tom Leland, P.E.
Group Manager
Aeration Processes

Attached: aeration calculations, layout drawing, brochures

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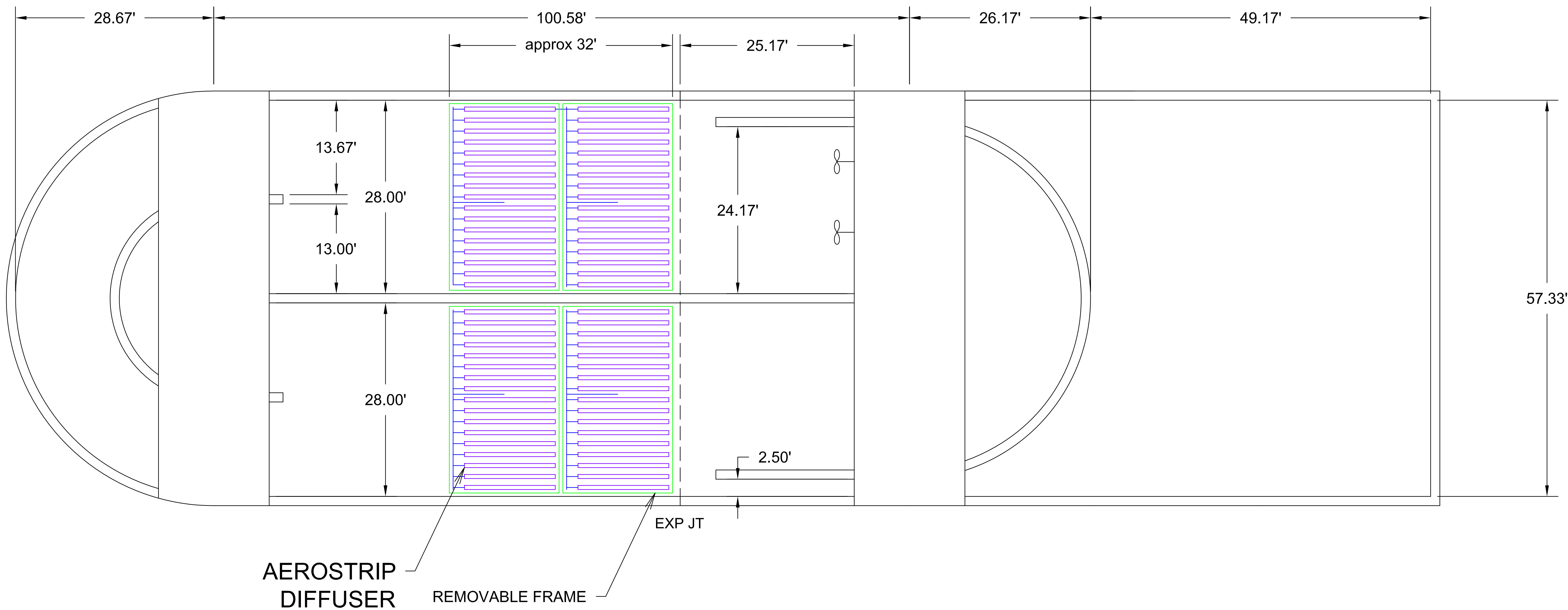
AERATION CALCULATIONS

Operating Conditions	Units	Average Train total	Average Each pass	Peak Train total	Peak Each pass
Total Wastewater Flow To All Operating Trains	MGD	1.50	1.50	1.50	1.50
BOD	mg/L	180	180	250	250
TN	mg/L	50	50	50	50
Design Plant AOR (All Trains)	lb O_2/day	---	---	---	---
Design Plant SOR (All Trains)	lb O_2/day	---	---	---	---
Percentage of Plant AOR	%	100%	50%	100%	50%
AOR	lb O_2/day	5,329	2,665	6,380	3,190
alpha	fraction	0.55	0.55	0.55	0.55
beta	fraction	0.95	0.95	0.95	0.95
Temperature	°C	28	28	28	28
DO Concentration	mg/L	2.0	2.0	2.0	2.0
Elevation	ft	600	600	600	600
AOR/SOR	%	40.9%	40.9%	40.9%	40.9%
Percent of Plant SOR	%	---	---	---	---
Design SOR	lb O_2/day	13,040	6,520	15,611	7,806
Hours per day aerating	hr	24	24	24	24
Design SOR	**lb O_2/hr**	543	272	650	325
Number of Trains/Cells		1	2	1	2
Length	ft	---	31.00	---	31.00
Width	ft	---	28.00	---	28.00
Side Water Depth	ft	---	14.16	---	14.16
Volume	MG	0.18	0.09	0.18	0.09
Air Flow Required For Process	scfm	---	923	---	1,130
Tank Flux Required For Mixing	scfm/ft2	---	0.10	---	0.10
Air Flow Required For Mixing	scfm	---	87	---	87
Design Air Flow	**scfm**	1,846	923	2,261	1,130
Membrane Area	sq ft	---	255	---	255
Bottom Coverage	%	---	29.3%	---	29.3%
Operating Flux (Membrane Area)	scfm/ft2	---	3.62	---	4.44
Operating Tank Flux (Floor Area)	scfm/ft2	---	1.06	---	1.30
SOTE @ Operating Membrane Flux	**%**	---	28.4%	---	27.7%
Immersion Depth	ft	---	13.83	---	13.83
SOTE/ft of immersion	**%/ft**	---	2.1%	---	2.0%
ΔP Static	psig	---	6.00	---	6.00
ΔP Membrane	psig	---	0.88	---	0.93
ΔP Lateral Piping	psig	---	0.02	---	0.02
ΔP @ Top of Drop	psig	---	6.89	---	6.95
ΔP Fouling Allowance (engineer determined)	psig	---	0.00	---	0.00
ΔP @ at Top of Drop For Design	**psig**	---	6.89	---	6.95

1.2 used for carbonaceous oxygen coefficient and 4.2 used for nitrogenous oxygen coefficient



OVIVO AEROSTRIP DIFFUSERS	
Diffuser type	T 4.0
Number of diff per drop	17 #
Total per train	68 #

Note:
·Side water depth: 14.16'
·Diffuser immersion depth: 13.83'

4S RANCH WWTP

California
Train B oxidation ditch
Diffuser layout

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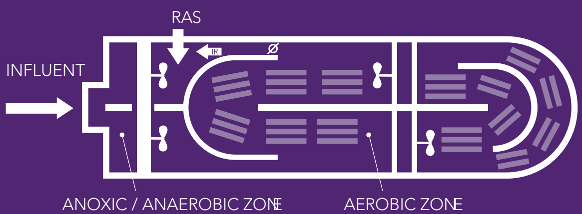
A TRULY **EFFICIENT DITCH**



Floor-Mounted Stainless Steel Diffusers

Highest Energy Efficiency

No Internal Recycle Pumping

Total Nitrogen ≤ 3 mg/L

Total Phosphorus ≤ 0.1 mg/L

INTERESTED?
Call 1.800.GO.OVIVO to find out how you could lower your energy costs by up to 70%

RINGSTRIP™ SYTEMS

FINALLY... A TRUE PROCESS SOLUTION

LOW-MAINTENANCE, HIGHLY EFFICIENT OXIDATION DITCH

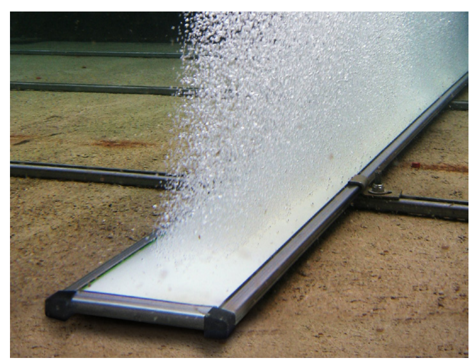
While many have cobbled together their generic products in an attempt to enter the market, Ovivo has developed a true process solution for a low-maintenance, highly efficient oxidation ditch based on ultra-fine diffuser technology. Several brands of flow-boosting mixers and highly efficient blowers may be used based on your preference. Two Ovivo design components are the key to our robust, high-performing solution:

Stainless steel AEROSTRIP® diffusers are mounted right on the floor and are uniquely designed to withstand high ditch velocities and resist vibration and ragging. AEROSTRIP diffusers operate at a very wide flux (air flow) range of 24:1, and have no restrictions on intermittent operations, maximizing dissolved oxygen control, denitrification, and total nitrogen removal. The Ovivo AirBridge delivers the air to several grids allowing for maximum flexibility in operation.

A slip stream from the main flow becomes the internal recycle (IR) stream using fiberglass or concrete formed channels. The IR rate is simply controlled by an electrically-actuated pivoting gate (the EliminatIR™ gate) tied to an oxidation-reduction potential (ORP) probe. IR rates of 10Q are easily possible with no pumps, allowing for very high nitrogen removal in a two stage modified Lutzack-Ettinger (MLE) system.

OVIVO OCULUS™ CONTROL SYSTEM

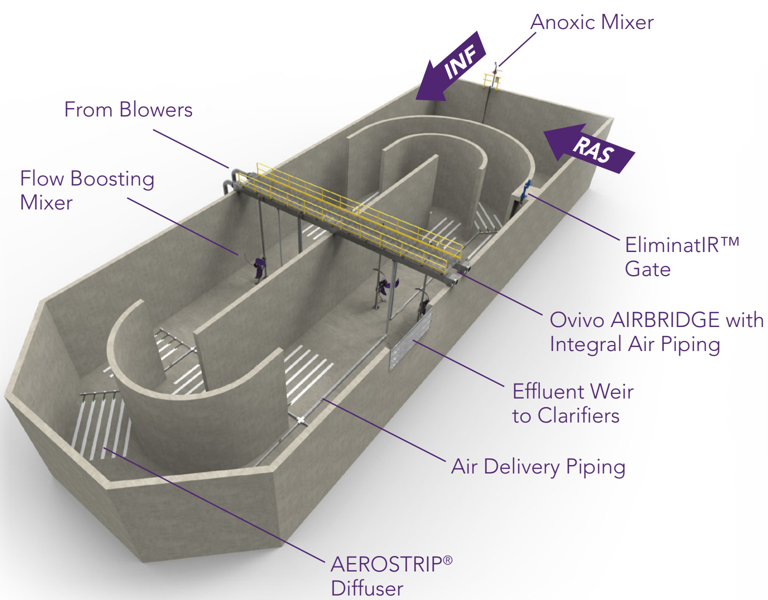
Ring Strip Systems are fully-automated to meet the strictest nutrient criteria in North America. The wide operational range of the AEROSTRIP system combined with the ability to operate intermittently and the high capacity, pumpless IR channel allow for tight dissolved oxygen and ORP control. The Oculus Controller operates blowers, the EliminatIR gate, flow boosting mixers, and the AirBridge air control valves based on on-line monitoring systems.
The entire system comes right in a fabricated building ready to run and may be controlled remotely on smartphones and tablets.

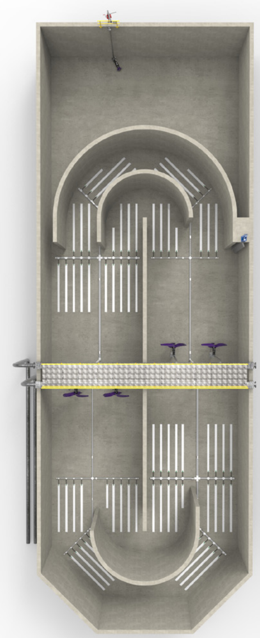


AEROSTRIP® AERATORS

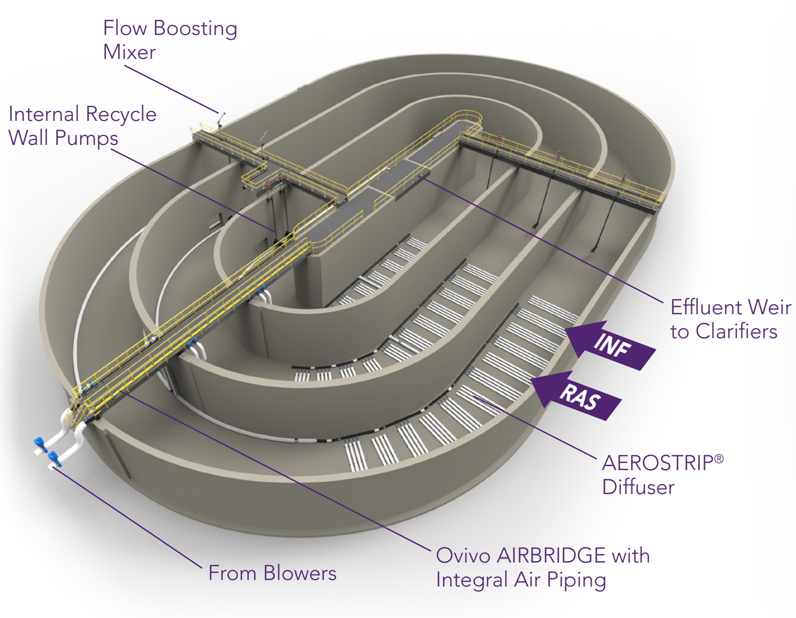
Rather than using slits, AEROSTRIP® diffusers are needle-punched using check valve perforation technology. Pores remain tightly closed when the air is turned off. Pores open evenly throughout the entire system when the air is turned on creating evenly distributed fine bubbles for the highest energy efficiency on the market.

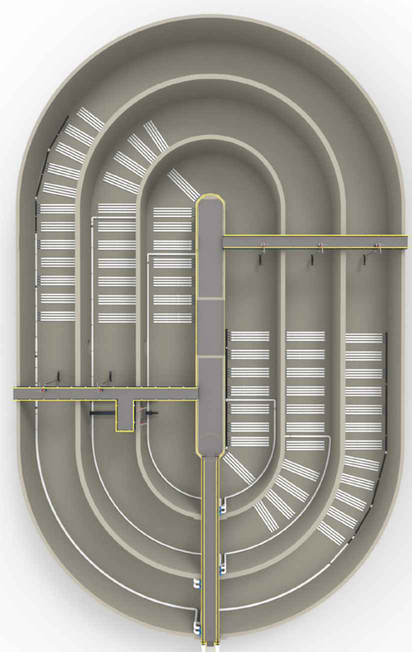
SINGLE TRAIN **TRACK** DESIGN





SINGLE TRAIN **CONCENTRIC** DESIGN





THE **OVIVO** DIFFERENCE

200+ YEARS OF HERITAGE • 100% FOCUSED ON WATER

PROCESS OPTIMIZATION CONTROL

Ovivo can provide your Ring Strip installation fully equipped with the latest and most effective control system available. Whether your goal is basic aerobic treatment or full-scale biological nutrient removal, Ovivo can provide it.

OVIVO: AN ENGINEERING PROCESS POWERHOUSE

The Ovivo Aeration Process Team, which consists of decades of biological wastewater treatment plant design and innovation, has provided expertise and design assistance for wastewater treatment plants consisting of all shapes, sizes, and effluent permits.

CAPABILITIES

- Detailed Design Support
- Process Calculations
- Equipment Sizing
- Process Guarantees
- Extended Warranties
- Retrofit Expertise
- Process Training
- Equipment Startup
- Ovivo®Connect℠

OVIVO® AIRBRIDGE

ovivo®connect℠

Ovivo® Connect℠ portal is an innovative and intuitive application that allows our customers to use 'SmartTags' installed on our equipment (or a web URL) to access a personalized customer zone. Access your equipment documentation, find contract references, track service logs, manage spare parts, and plan your next maintenance to get the most out of your equipment.

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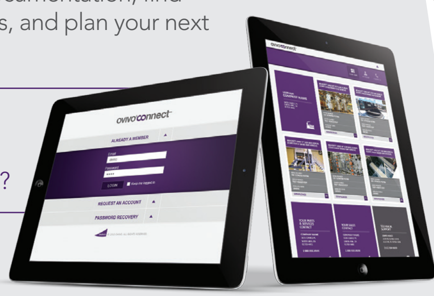

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LOWEST HIGHEST LONGEST... BEST.

FOR NEW CONSTRUCTION OR AEROBIC RETROFIT TREATMENT SYSTEMS

- LOWEST cost of ownership
- HIGHEST oxygen transfer efficiency
- LONGEST lasting membrane diffuser – Proven
- Your BEST Option for Process Aeration

AEROSTRIP® SYSTEMS:

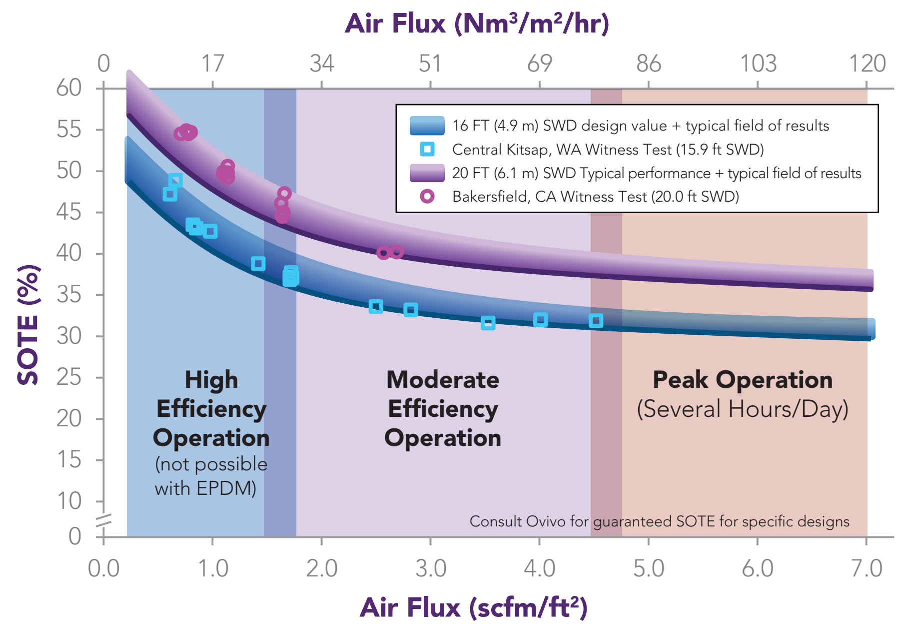
DITCH THE DISC

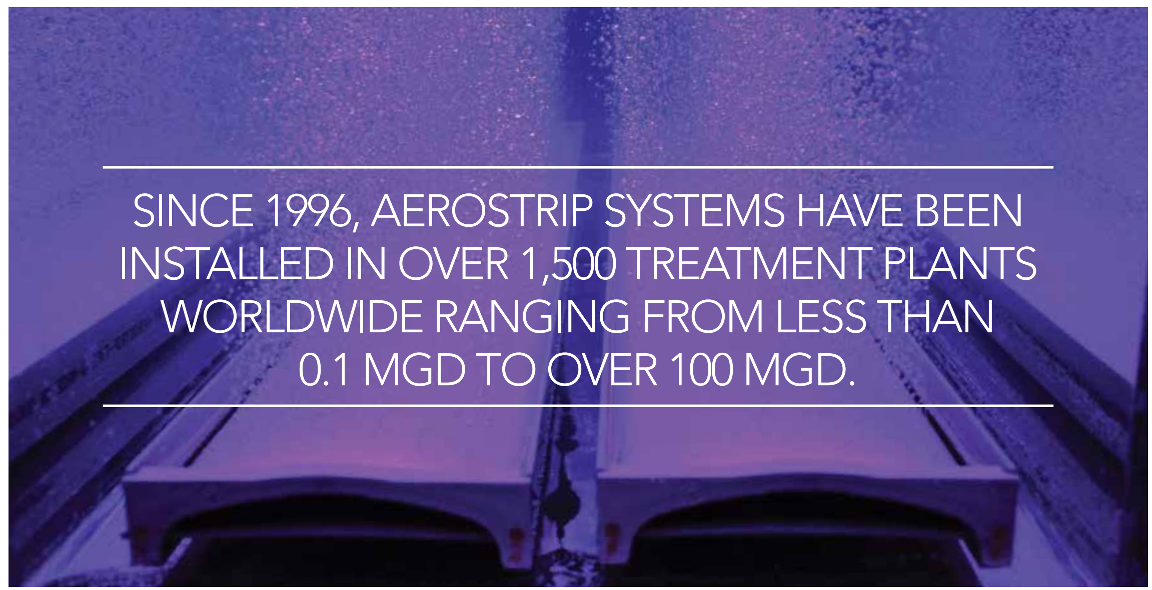
The AEROSTRIP® fine pore diffuser system provides the highest oxygen transfer and lowest energy demand possible for aeration of wastewater. Since 1996 with over 1,500 AEROSTRIP installations, this efficiency comes with proven reliability, low maintenance, and long-term performance.

AEROSTRIP diffusers are manufactured with a proprietary polyurethane membrane using a check valve perforation technique. When air is turned off (for example, in SBRs and in swing zones) pores close, and no air is released and no backflow of mixed liquor occurs. As air is turned on, pores open simultaneously along the length of the diffuser, allowing for small bubble formation at very low air flux rates under conditions that all other diffusers would clog.

At the factory, each individual AEROSTRIP diffuser—yes, each one —is tested for trans-membrane pressure and is inspected under air flow in a submerged condition. This quality program remains unparalleled in our industry today.

Membrane Expected Life	12-20 years
Flux Range:	0.3 – 7.0 scfm/ft² (5 - 120 Nm³/m²/hr)
Standard Oxygen Transfer Efficiency (SOTE):	Up to 60% for 20 ft (6 m) Sidewater Depth (SWD)
Standard Aeration Efficiency (SAE):	>8 lbs O_2/HP-hr (>5 kg O_2/kW-hr)
High Efficiency Dynamic Wet Pressure (DWP)	10 – 20 in H_2O (250 -500 mm H_2O) 0.36 – 0.72 psi (25 – 50 mbar)





CONSTRUCTION & RESULTS

PIPING

Conventional stainless steel drops to Schedule 40 PVC or stainless steel manifolds may be used for installation. Alternatively, high temperature-rated HDPE drops may be connected from the main air header down to a group of 4-6 diffusers. This latter option allows flexibility to operate (or not operate) small groups of individual diffusers by adjusting valves at the top of the tank. With either method, the floor-mounted AEROSTRIP diffuser is the lowest point of the system, and no condensate purge is required.

FLOOR MOUNTING

Floor mounting substantially improves mixing, eliminates grit accumulation dead zones, and provides additional contact time for each bubble. Sloped floors are no problem – the diffusers are mounted higher on the anchors at the lower points of the floor.

BEYOND THE CLEAN WATER TEST

AEROSTRIP polyurethane membranes have no additives: such additives leach into the wastewater over time causing EPDM membranes to become brittle. The AEROSTRIP polyurethane membrane remains elastic, and the perforations remain true to their original form over time.

LOWEST COST OF OWNERSHIP

With easy installation, long-term low energy usage, and unparalleled service life, AEROSTRIP systems are the lowest cost of ownership aeration system for wastewater. AEROSTRIP systems have been installed in numerous energy reduction projects throughout the United States.

ON LINE MAINTENANCE

Our check valve perforation technique allows us to perform a relax/flex cycle of the membrane which keeps the pores clean, allowing high efficiency to be maintained for many years.

TYPE T - TIMELESS

Body	AISI 316 Ti Stainless
Membrane	Polyurethane
Connection	Threaded
Height	0.8 in (2 cm)
Width	6 - 7 in (15 - 18 cm)
Length	1.6 -13.1 ft (0.5-4.0 m)

TYPE Q - QUALITY

Body	PVC
Membrane	Polyurethane
Connection	Compression, PVC
Height	1.8 in (4.5 cm)
Width	7 in (18 cm)
Length	1.6 -14.8 ft (0.5 - 4.5 m)

Bremerton, WA

The first US AEROSTRIP installation started up in 2001 at the Bremerton, WA WWTP. In 2012 and 2013, the diffusers with the original membranes were independently tested using both the ASCE clean water test and the off gas process water method. The diffusers were found to be operating at 90% of their original efficiency after 12 years of continuous use.

"For conventional short sludge retention time treatment plants (SRT 1 to 6 days) this [12-year old AEROSTRIP] system performed better than all previously tested fine pore diffuser systems installed, and even better than most new ones"

- Dr. M.K. Stenstrom, Distinguished Professor, U.C.L.A.
December 2012

Rome, NY

In 2009, AEROSTRIP diffusers were installed in the Rome, NY plant as part of a nutrient removal and energy conservation project. The total suspended solids distribution was measured at various air flux rates. Due to the even distribution of air resulting from the check valve perforation technology and the floor mounting arrangement, good mixing occurred at flux rates half that of other fine pore diffusers.

"With AEROSTRIP Diffusers, we are able to adequately mix our Aeration Basins at 0.05 scfm per square foot of tank floor area. That gives us a lot of operational flexibility and also helps lower the electric bill."

- Richard Kenealy, Chief Operator, City of Rome New York WPCP
September 2012

PROCESS OPTIMIZATION & CONTROL

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APPLICATIONS:

- Conventional Activated Sludge
- Oxidation Ditches
- Membrane Bioreactors (MBR's)
- Sequencing Batch Reactors (SBR's)
- Integrated Fixed-film Activated Sludge (IFAS)
- Municipal applications
- Industrial applications
- Retrofits

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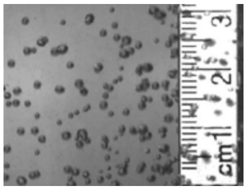

AEROSTRIP® Diffusers

FAQs - Frequently asked questions

1. What is the size and the weight of an AEROSTRIP diffuser?

   The diffuser width is 15 cm (5.9”) or 18 cm (7.1”). The length varies in 0.5 m (19.7”) increments between 0.5 m (1.6 ft) and 4.0 m (13.1 ft), special lengths by request. The largest AEROSTRIP diffuser (model T4-18) weight is approximately 12 kg (27 lbs), and each diffuser has an aeration surface area of 0.70 m^2 (7.5 ft^2).

2. What are the diffusers made of?

   The base plate, peripheral strips and air connection are made from 316 Stainless Steel for the “T” type and are made from PVC for the “Q” type. The membrane is made from a proprietary thermoplastic polyurethane material selected to provide longevity as well as superior properties for fine bubble formation and backflow prevention.

3. What is the range of the airflow capability of the Aerostrip diffuser?

   In general, AEROSTRIP diffusers have an operational range from 5 $Nm^3/m^2/hr$ (0.3 $scfm/ft^2$) to 150 $Nm^3/m^2/hr$ (9 $scfm/ft^2$) with a turndown range from 12:1 to 24:1, unparalleled in the industry. Diffuser is also designed for regular intermittent operation. Consult plant O&M manual for specific limits of any individual system.

4. How are the diffusers mounted inside the tank? What are the mounting or floor tolerances?

   The diffusers can be installed directly on the tank bottom (grit removal, if required, is actually easier when the diffusers are installed very close to the bottom.) They can also be elevated if required. All diffusers attached to the same air header should be leveled within ±2.5 cm (±1“) of each other. The diffuser should be level to ±0.6 cm (0.25“) along its length to ensure peak performance.

5. Why is floor mounting important?

   Floor mounting eliminates the effects of vibration and ragging that cause elevated diffuser systems (basically all other systems) to prematurely fail. Also, floor mounting eliminates grit accumulation zones, reducing maintenance requirements and maximizing available process volume. Mixing requirements are 20-40% lower with floor mounted systems, saving energy and allowing more flexibility in dissolved oxygen control when DO setpoints need to be low. Studies have shown adequate mixing for floor mounted AEROSTRIP systems of 1.3 – 1.8 $Nm^2/hr/m^2$ floor area (0.07 – 0.10 $scfm/ft^2$ floor area).

6. How do we connect the diffusers to the main air supply distribution?

   In large plants the air headers often run across the bottom of the tank feeding two rows of diffusers. Each diffuser is then connected to the air header by standard plastic tubing and fittings. Other possible configurations are available to meet your unique site constraints, including HDPE drops directly from the main header at the top of the tank.

7. Do we have to schedule the cleaning of the diffusers on a regular basis? How are they cleaned?

   A large number of our references have the diffusers running in an on-off mode (e.g. for denitrification) and do not require any cleaning. For plants that are running at a constant air flow we recommend the use of a daily relaxing cycle, (i.e., turning the air flow off and releasing the air from the system for a few minutes per day and then restarting). This relaxing cycle squeezes deposits out of the pores before they have a chance to accumulate. For some industrial plants where chemical deposits build up even with the relax cycle, we have successfully dosed an organic acid feed into the air supply for a day or two every one to two years while the basin is on-line.

8. How long is the life expectancy for a membrane?

   The membrane has a life expectancy of 15-20 years for municipal wastewater applications. We have installations with AEROSTRIP diffusers running for longer than 18 years without membrane replacement.

9. Why is this system more efficient than other systems? Is it prone to clogging?

   Our diffusers produce very fine bubbles that rarely coalesce. The bubble release is very uniform across the surface. This is a result of superior membrane and perforation expertise that leads to increased efficiency. The strip shape adds to the efficiency when compared to other configurations. It is not prone to clogging as particles are squeezed out when the pores are closed, which occurs when the air is shut off. Our diffusers are preferred for on-off operation. The following video link illustrates the advantages of the unique AEROSTRIP check valve needle perforation technique https://youtu.be/FP0fuKN-fQg

10. Have you performed any oxygen transfer efficiency tests with a third party independent institute?

    Yes, many independent consultants have performed field testing on existing AEROSTRIP installations. In addition, we use clean water testing as a production quality control measure. For this purpose we have installed a test tank inside our production facility. Test reports are available upon request.

11. How high are the costs of your system, compared with other systems?

    The AEROSTRIP diffusers are energy efficient both for low and high-density systems. We are cost competitive when life cycle costs are considered, even at relatively low power rates.

12. Can we use the AEROSTRIP diffusers to upgrade an existing plant? Does this limit the existing mixing capability of the plant?

    The AEROSTRIP diffusers can be laid out in a very efficient manner and can be designed to avoid all existing obstacles. Existing old piping for old coarse bubble and old tubular diffusers can be utilized for substantial savings, as the ¾" fittings can be used to connect the new strip diffusers. The smaller the bubble size, the better the mixing for a given air flow. Mixing typically requires 1.3 – 1.8 $Nm^2/hr/m^2$ floor area (0.07 – 0.10 $scfm/ft^2$ floor area) with floor-mounted AERSOTRIP diffusers.

13. What is the safe-operating temperature range for the AEROSTRIP diffusers?

    The maximum operating temperature of the waste water is 35 °C (95 °F), which is acceptable for all US municipal applications (We have AEROSTRIP installations in FL, AZ, and CA). The water surrounding the diffuser must never be allowed to freeze. Temperature limits for storage are -5 °C to 40 °C (23°F to 104°F). If the diffusers are to be stored outside at or below freezing temperatures frost damage must be avoided. UV inhibitors are added to the AEROSTRIP membranes. However, as with all thermoplastic materials, the membrane can be damaged from long-term exposure to UV light. The diffusers should be kept in their shipping crate until they are ready to be installed. Once installed, it is recommended to maintain 1 m (3.3 feet) of water over the diffusers during prolonged idle periods.

14. Can we use the AEROSTRIP diffusers at a water temperature higher than 35°C (95° F)?

    We use our silicone membrane for higher water temperatures (theoretically up to 200°C = 392°F) and/or aggressive chemical environment. This membrane has the similar high efficiency as the polyurethane membrane. The life expectancy of such a membrane is estimated to be 7-10 years. We have installed plants with these silicone membranes, installation list available upon request.

15. How much does the pressure drop increase during 15 years of operation?

    AEROSTRIP membranes use no fillers or plasticizers. Reduction of flexibility or other deterioration of membrane performance with time will be minimal. Using the relaxing cycle described in #6 is typically sufficient to prevent significant clogging of pores over the life of the membrane. If required, the occasional dosing of organic acid in to the air supply line, also described in #6, will clear deposits such that the pressure drop will not increase by more than 0.2 psi even after 15 years of operation.

16. How many installations to you have?

    There are approximately 1,800 AEROSTRIP installations worldwide with over 75 installations in the USA.

17. Technical data of the membrane:

    Thickness of membrane: 0.6 mm (0.024 inch)
    Size of perforations: 0.2 mm (0.0079 inch)
    Number of perforations: ~40/cm2 (~260/ $inch^2$)

ATTACHMENT 2 – Ennix Facultative Digestion Information

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Ennix Incorporated

Sustainability Through Biotechnology TM

HOME
FAST-RATE DIGESTION
DIGESTER SERVICE
DIGESTER OPTIMIZATION
DIGESTER STUDY
STUDY RESULTS
OPERATIONS STUDY
VIDEO
Contact Us

Ennix Incorporated has been bringing "Sustainability through Biotechnology"$_{TM}$ to the wastewater industry since 1997. Ennix brings a non-capital approach to residual solids processing and handling that maximizes existing capacity and reduces the use of non-renewable resources such as electrical energy, dewatering chemicals and fuel used in hauling and disposal of solids.

The cornerstone of our business is the Ennix "Fast-Rate" Facultative Digestion$_{TM}$ Process. Our "Fast-Rate" process is provided as a service program and is implemented by converting existing assets such as aerobic or anaerobic digesters into facultative reactors.

CO_2 gas bubbles from Ennix *"Fast-Rate" Facultative Digestion$_{TM}$*

Our "Fast-Rate" Digestion process is proven to be a low-cost/low-tech solution to residual solids management in wastewater treatment facilities. During the last seventeen years, our clients have amassed millions of dollars in operational savings and have further benefited by conserving over 10MW of electrical energy with little to no capital investment.

Ennix is the first company to combine proprietary bio-chemical innovations with a service staff of wastewater professionals that will integrate our improved digestion process with plant process and existing assets.

We look forward to helping you optimize your residual operations and extend the life cycles of your biosolids processing assets.

Ted Mullennix
President
Ennix Incorporated

Ennix Incorporated
1426 Spring Street, Ste #C
Paso Robles, CA 93446

(800) 496-0362 * Fax: (805) 239-8996
e-mail us at: KK@ennix.com

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- HOME
- FAST-RATE DIGESTION
- DIGESTER SERVICE
- DIGESTER OPTIMIZATION
- DIGESTER STUDY
- STUDY RESULTS
- OPERATIONS STUDY
- VIDEO
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Ennix "Fast-Rate" Facultative DigestionTM Process

The aerobic digestion process is a popular method for vector attraction reduction and disinfection of municipal wastewater treatment plant sludges. The process is inherently stable, easy to operate, and meets EPA 503 Class B standards under ambient conditions provided that sufficient solids residence time is maintained. A major disadvantage of the process is the large amount of energy needed to provide oxygen for bacteria, which grow on hydrolysis products of the sludge mass. Energy is also needed for mixing, which is essential for efficient transfer of oxygen to the liquid and for keeping sludge flocs in suspension.

The Ennix "Fast-Rate" Facultative DigestionTM Process provides an alternative means of digester operation without aeration or mixing while achieving or exceeding the same performance goals as those of conventional aerobic digestion.

Ennix Service Tech visiting a plant

Establishing the facultative microbiology requires an initial inoculation of the digester system with a select consortia of specialized bacteria and bio-chemicals necessary to initiate a favorable environment for facultative digestion. The digester feed continues to be inoculated periodically to maintain the facultative environment. Since oxygen transfer and mixing is not required for facultative digestion, aeration and mixing is discontinued. Digestion is carried out at ambient temperature.

Two clearly defined zones are formed and maintained in the facultative digester cell- a sludge blanket and supernatant layer. Without aeration or mixing, the digester is operated in a full-time decant mode with available supernatant returned to the plant to accommodate daily digester feed. Given a normal range of solids concentration in WAS digester feed, 80% or more of WAS gallons wasted to the digester are returned to the plant as decanted supernate. Solids are retained in the digester until dewatering is needed to accommodate digester feed. Decanting of available supernate substaintially increases Sludge Retention Time (SRT) and leads to additional volatile solids reduction. Increased SRT and our consortia of specialized bacteria enhance biodegradation of biomolecules and complete the "Fast-Rate" digestion methodology.

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APPENDIX F

TM3A – Tertiary Filtration Alternatives

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TECHNICAL MEMORANDUM #3A

4S Ranch Water Reclamation Facility Tertiary Filter Assessment

for the Olivenhain Municipal Water District

Draft Date: March 19, 2015
Revised Date: July 2, 2015
Final Date:

Authors: Shane Trussell, Ph.D., P.E., BCEE
Brett Faulkner

Reviewers: Tom Falk, P.E.

Subject: Tertiary Filter Assessment and CIP Alternative Evaluation

1 EXECUTIVE SUMMARY

Although the existing filters at the 4S Ranch Water Reclamation Facility (4S Ranch WRF) appear to be performing reasonably well, visual inspections reveal that the existing filters are nearing the end of their useful life and need to be replaced. This TM provides an evaluation of the existing filter performance as benchmark for anticipated alternative filter selection and considers five commercially available products as replacement alternatives at a nominal capacity of 2 MGD. Both cloth filtration and a granular media filtration are viable options although granular media filtration is preferred due to its robustness and reliability, which will provide a long-term solution (i.e., 30+ years). Cloth filtration offers significant project cost savings at $1,461,000 compared to $2,966,000 for concrete granular media filters. However, cloth filters have an operational risk that could increase maintenance and impact performance reliability if Bryozoan sponges were to become established or if secondary effluent quality were to diminish in the future. Additionally the proposed package cloth filters only have an expected life of 15 years. Considering these risks, cost, and the expected life of these options, granular media filters are the preferred filtration technology. If OMWD decides to proceed with cloth filters, it will be important to engage the Division of Drinking Water to confirm that the redundancy strategies assumed to develop the capital costs in this analysis will be permitted.

2 INTRODUCTION

Olivenhain Municipal Water District (OMWD) has retained Dudek and Trussell Technologies to assist with determining and prioritizing capital improvements for the 4S Ranch Water Reclamation Facility. Through this effort the existing Hydro-Clear® sand filters have been identified as one of the major process components that needs evaluation. The purpose of this TM is to:

- Document the condition and performance of the existing filters
- Describe and evaluate potential alternative filter technologies
- Explore the feasibility of repurposing used GE/Zenon membrane modules from the drinking water plant for tertiary filtration at the reclamation plant
- Recommend the most appropriate filtration technology
- Provide budgetary cost estimates for the tertiary filter upgrade

3 CONDITION AND PERFORMANCE OF EXISTING FILTERS

The existing filters are a standard Hydro-Clear® design, which is designed to operate using the principals of surface filtration. Surface filtration, as opposed to depth filtration, occurs when the floc size is too large to penetrate into the media bed and is removed by straining at the media surface. As a result, the media depth is less important for surface filtration as the majority of solids removal will occur in the top few inches of media. Surface filtration also produces a more rapid build up of headloss than depth filtration, as pore blocking occurs (see Figure 1). In an effort to manage the rapid headloss buildup, the Hydro-Clear® design concept employs an intermittent air "pulse mix" to extend filter runs between backwashes.

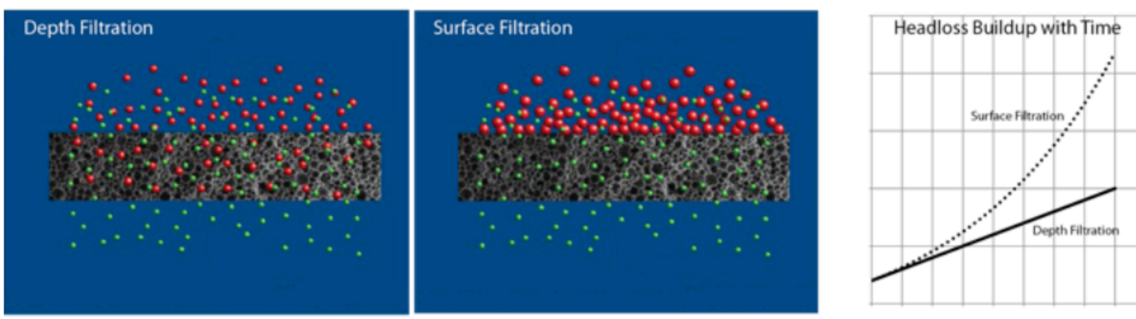

Figure 1. Hydro-Clear® filters design concept is based on surface filtration

In surface filtration, particles must be agglomerated above a certain critical size before reaching the filter media surface for removal, such that the formation of large flocs is targeted. A surface filtration system will normally be operated using significantly higher coagulant doses and flocculation times than depth filtration to promote the formation of large floc. Algae are a concern with surface filtration as it can cause rapid clogging and headloss. Currently chlorine is needed in the secondary flow equalization basins to prevent algae from rapidly fouling the filters.

Figure 2 presents filter turbidity data as a probability plot of daily average tertiary influent and effluent turbidity data from September 2013 through September 2014.

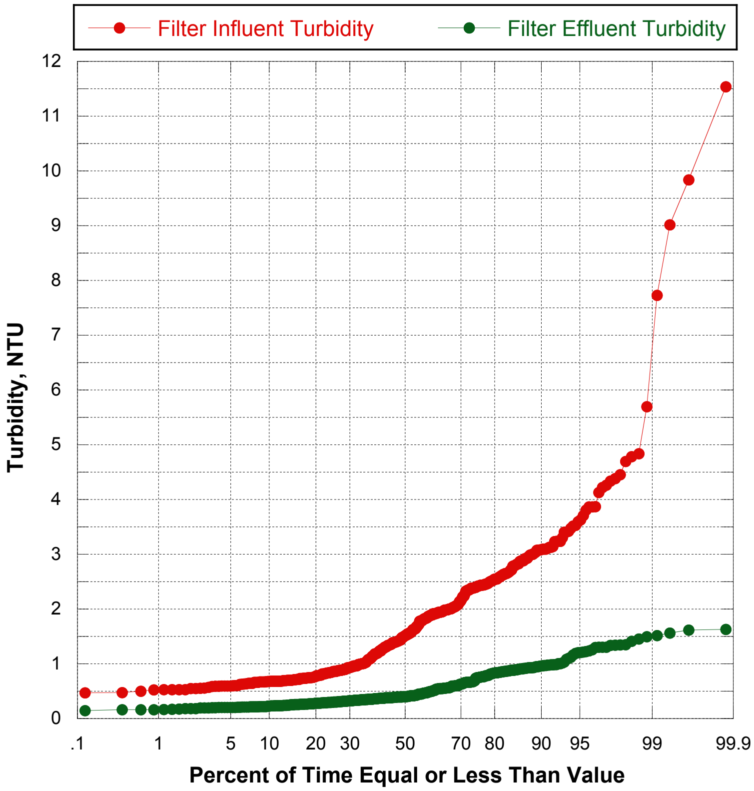

Figure 2. Daily Average Turbidity Data

The turbidity data in Figure 2 shows that the filters effectively remove turbidity and reliably meet the Title 22 requirement of 2 NTU. It is also worth noting that the secondary effluent turbidity that feeds into the Hydro-Clear filters is < 3 NTU 90% of the time, illustrating the relatively low solids loading and consistently high quality feed water.

Wastewater flows to the 4S Ranch WRF are projected to remain steady for the foreseeable future due to limited future development in the service area. Figure 3 presents the daily tertiary flow through the filters over the past year.

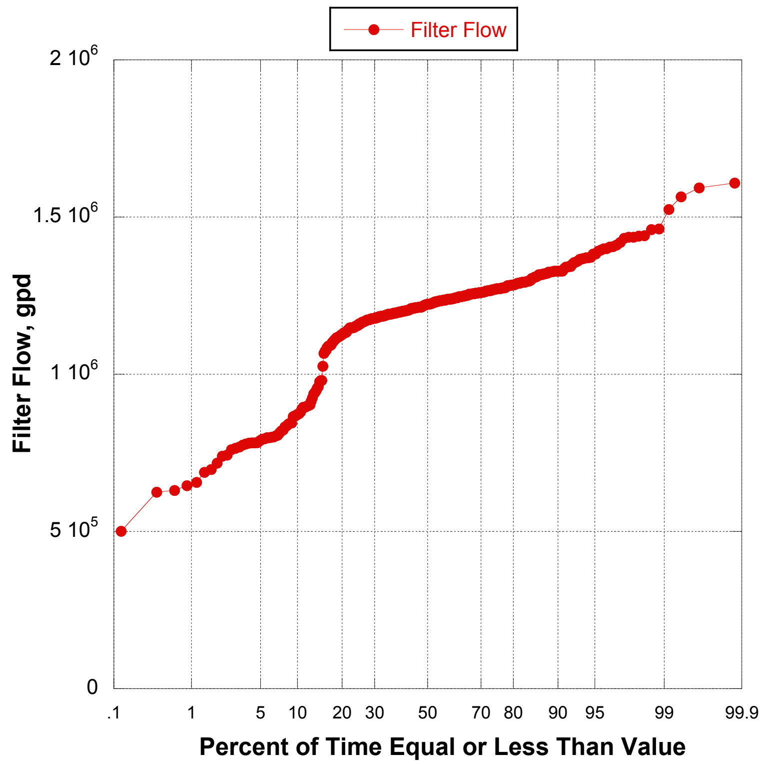

Figure 3. Tertiary Average Daily Flows

The filters were designed for a nominal capacity of 2 MGD so current and expected flow is within their capacity. Table 1 presents the filtration rates based on the average and max flow rates from Figure 3 with all four filters in service and with one filter out of service for backwashing or maintenance. It is observed that the filtration rate is low and ranges between ~2 and ~3 gallons per minute per square foot (gpm/ft^2), which is likely a factor in the demonstrated performance observed in Figure 2. Title 22 regulations require that the filtration rate not exceed 5 gpm/ft^2, which is a typical design basis. The filter loading rate, a major factor in filter performance, does not appear to be an issue with secondary flow equalization at the current flows providing low filtration rates. It is noted, however, that the 4S Ranch WRF experiences significant internal recycle flows (current average recycle rate is up to 350,000 gpd) and if or when the facility reaches its nominal rated capacity of 2 mgd, the current filters would potentially be hydraulically limited.

Table 1: Current Filtration Rates

Parameter	Units	Average	Max
Flow	MGD	1.2	1.6
Filtration Rate	gpm/sf	2.1	2.8
Filtration Rate with 1 Filter Out of Service	gpm/sf	2.8	3.7

Headloss is a critical parameter for the operation and performance of granular media filters. As the filter media removes particles, headloss increases, requiring more driving pressure to force the water through the media. Once headloss reaches a defined level, the filter media must be cleaned with a backwash. Table 2 presents the number of times each filter was backwashed each day for the month of December, 2014.

Table 2: Filter Backwash Frequency

Date	# of backwashes per cell (daily)			
	Cell #1	**Cell #2**	**Cell #3**	**Cell #4**
12/1/14	2	4	2	3
12/2/14	2	2	1	1
12/3/14	1	2	1	1
12/4/14	1	1	1	1
12/5/14	0	1	1	1
12/6/14	1	1	1	1
12/7/14	1	1	0	1
12/8/14	0	1	1	1
12/9/14	1	1	1	1
12/10/14	1	1	1	1
12/11/14	1	2	0	1
12/12/14	1	3	0	2
12/13/14	1	2	1	2
12/14/14	1	2	0	1
12/15/14	2	2	1	2
12/16/14	1	2	0	1
12/17/14	1	2	0	2
12/18/14	1	2	0	1
12/19/14	1	2	0	1
12/20/14	1	1	1	1
12/21/14	0	1	1	1
12/22/14	1	1	1	1
12/23/14	1	1	1	1
12/24/14	0	1	0	1
12/25/14	1	1	1	1
12/26/14	1	1	0	1
12/27/14	1	2	1	1
12/28/14	1	3	1	2
12/29/14	1	1	1	1
12/30/14	1	2	1	2
12/31/14	1	2	1	1
Average:	**0.97**	**1.65**	**0.71**	**1.26**

On average, the filters backwash roughly once a day, although Cell 2 often requires more frequent backwashing than the other filters. A typical granular media filter is designed to backwash every 24-48 hours and based on the December 2014 performance data, headloss does not appear to be an issue for these filters even with surface filtration. The reasonable headloss accumulation and backwashing interval is attributed to the high quality secondary effluent, low filtration rate, and flow equalization providing a relatively even load.

Although the existing filters effectively remove turbidity, operate at reasonable filtration rates, and do not require excessive backwashing, they are nearing the end of their useful life due to physical degradation. The carbon steel filters show significant corrosion damage, and need to be replaced (see Figure 4).

Figure 4: Filter Corrosion Damage

Corrosion is common in wastewater treatment with carbon steel tanks; especially when the paint or coating is not maintained. Because all of the flow through the plant is treated and used as recycled water, maintenance that requires the filters to be offline for extended periods of time is not practical.

Overall, the granular media filters are performing adequately but have been delivered with a package system design that should be replaced due to their physical condition.

4 OVERVIEW OF FILTRATION TECHNOLOGIES

There are a variety of filtration technologies utilized by the industry to produce recycled water. Some of the most common filter technologies are:

- Granular media filter
- Membrane filter
- Cloth filter
- Fuzzy filter
- Disc filter

Granular media filters exist as pressure filters, gravity filters, and continuous backwash filters and they are the most widespread technology used in recycled water facilities today. Granular media filters can utilize depth or surface filtration although depth filtration is much more commonly applied. Depth filtration removes turbidity and particulate matter by passing the water through the media, creating tortuous pathways in which particulates and suspended materials are trapped and retained in the media bed. Depth filtration is accomplished with a combination of various particle transport mechanisms (e.g. interception, diffusion, and sedimentation) that are impacted by both media depth and media size. Granular media filters can utilize mono-media, dual-media, or multi-media designs consisting of layers of uniform granular activated carbon, anthracite coal, silica sand, garnet, and gravel. The media design ultimately dictates filter performance and an effective media design will balance treatment efficiency with headloss accumulation to provide both effective turbidity removal and prolonged filter runs (>24 hours). The media is typically cleaned using an air scour in combination with backwashing every 24-48 hours. Some filters use a surface wash in lieu of or in addition to the air scour system.

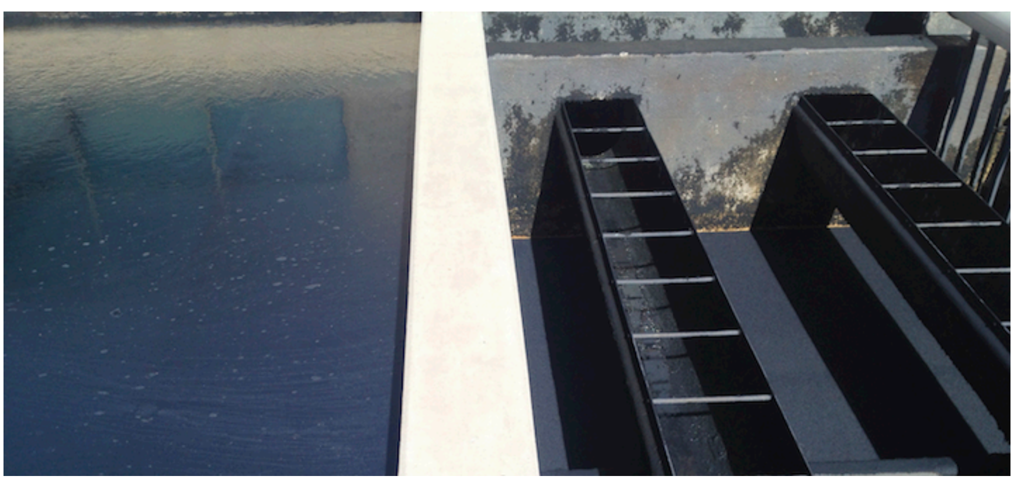

Figure 5. Gravity Granular Media Filters

Membrane filtration has seen more recycled water installations as market factors and innovation have reduced capital and operating costs and as specific applications requiring high turbidity removal have emerged (e.g., pre-treatment for potable reuse). At this scale, most commonly membrane filtration utilizes hollow fiber membranes that have pores 0.01 – 0.2 µm in diameter. Water is forced through these pores not allowing particles or impurities larger than the pore to penetrate the surface of the membrane, resulting in effective surface filtration (i.e., straining). Flow through hollow fiber membranes can either be an outside-in our inside-out configuration and membranes can either be submerged or in pressure vessels depending on the product and application. Membrane filtration requires frequent backwashes (e.g., every 20-30 minutes) and chemical cleans (e.g., every 30 days). The effluent is very consistent and high quality, but the capacity of membranes and required chemical cleaning frequency depends on the feed water quality. While membrane filtration is a powerful separation technology, the cost is typically higher than that of a granular media filter and thus the proper design drivers must exist (e.g., high turbidity feedwater, footprint constraints or TDS reduction needs).

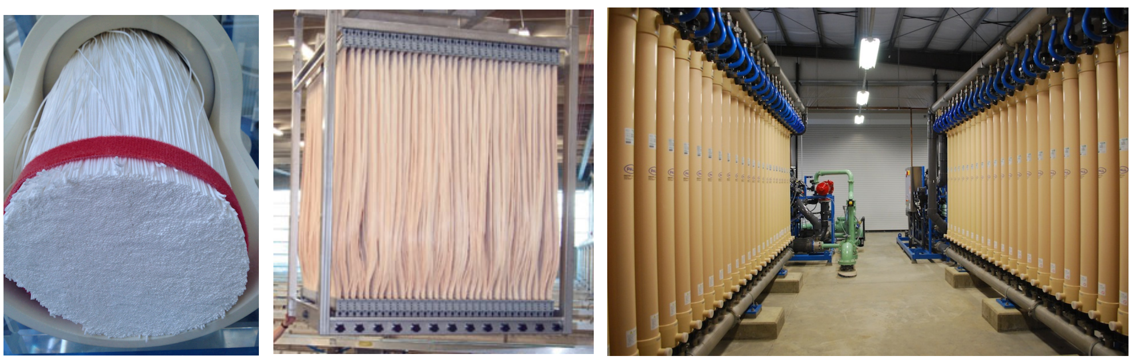

Figure 6: Cross Section of Hollow Fibers (left) Submerged Hollow Fiber Membranes (middle) and Pressure Vessels (right)

Cloth filters are the least expensive of the major filtration technologies because they are package and require little civil infrastructure. Cloth filters utilize woven cloth or fiber material to strain suspended particles and impurities from the water (i.e., surface filtration). Cloth filters typically have ~10 µm openings so particles much larger are removed. As a cloth filter operates, a layer of solids accumulates on the cloth surface, which can increase solids removal, but also increases headloss. Periodically this solids layer is backwashed or scrapped off to restore the headloss. The most common configuration for cloth filtration in recycled water applications is rotating cloth disc filters. In this configuration (see Figure 7) multiple discs are in each unit, and only 2-4 discs backwash at a time while the other discs remain in operation. Cloth filters can be challenging to operate when a significant turbidity reduction is required (i.e. >2-3 NTU removal) and may require infrequent chemical cleans (6 months – year) to remove biogrowth and foulants. Some Southern California installations have recently experienced Bryozoan growth in Southern California, which are raising new concerns.

Figure 7: Cloth Disc Filters (left) and Bryozoan Sponges in a Cloth Media Filter Panel (right)

Bryozoans are sponge like aquatic invertebrates that are known to be as small as 0.5-mm in size. With this size range, the bryozoans are likely to pass through imperfections in the cloth media and grow inside the cloth media filter. As the sponges grow, they create significant headloss that eventually reduces the rated filtration capacity and result in effluent turbidity spikes. Several Southern California facilities have recently encountered significant infestations (e.g., Eastern Municipal Water District) and the primary strategy utilized to combat the sponge has been frequent removal of the cloth media and manually cleaning of the devices in a regular rotation. Evidently, chlorination and potassium permanganate have been fairly ineffective at preventing their growth. Granular media filters operated at some of these same facilities with cloth filter infestations have not experienced similar sponge growth in the media or under drain systems and it is believed that the spores are effectively filtered out with a granular media filter.

Disc and fuzzy filters are other, less common, filtration alternatives for recycled water filtration. Fuzzy filters utilize depth filtration similar to granular media filtration, but use a compressible pink synthetic fiber media filter instead of granular media. Disc filters utilize a stack of discs in a cartridge that act similarly to a screen filter and primarily utilize surface filtration and are more commonly used in irrigation systems. Both disc and fuzzy filters are applicable for recycled water production, but have not seen as many installations in recycled water facilities.

Figure 7: Fuzzy Filter Media Sample (left) and Uncompressed Disc Filter (right)

Table 3 provides a qualitative comparison of key characteristics for the three main filtration technologies for recycled water.

Table 3: Filter Technology Comparison

Characteristic	Granular Media	Cloth	Membrane
Capital Cost	Moderate	Low	High
O&M Cost	Low	Low	Moderate
Turbidity Removal	Moderate	Low	High
Impacted by Feed WQ	Moderate	High	Low
Chemical Cleaning Needs	Low	Low	High
Decrease Downstream UV Disinfection Cost	Low	Low	Moderate
Pathogen Removal	Moderate	Low	High
Virus Removal	Variable, depends on coagulation	Low	Variable, depends on membrane
Compatibility with Downstream TDS Removal (RO)	Low	Low	High
Reduced Downstream UV Requirements	Low	Low	Moderate

5 REPURPOSING MEMBRANES FOR RECYCLED WATER

OMWD's David C. McCollom Water Treatment Plant filters up to 34 MGD with GE/Xenon ZeeWeed 500D membranes that could potentially be used for filtration at 4S Ranch WRF. The concept is to take used membranes that are at the end of their useful life for drinking water treatment at David C. McCollom Water Treatment Plant, and reuse them for recycled water filtration at 4S Ranch WRF. Recycled water standards are more lenient so the membranes that are no longer suitable for drinking water could have additional life treating recycled water, however the repurposed membranes may require additional maintenance and their effective reusable life is unknown.

In October 2013 GE Water and Process Technologies provided OMWD with a budgetary proposal for the equipment needed to utilize the used ZeeWeed® membranes. The quote assumed an average day flow of 1.0 MGD at a cost of roughly $1,000,000 (see Appendix). This budgetary quote did not include the civil, structural, site work, and installation cost associated the membrane tanks, yard piping, and process integration. Upon review, the membrane sizing was found to contain multiple errors. The GE proposal reports the 1.0 MGD the system will operate at an instantaneous flux of 10.9 gfd, however based on the 340 ft^2 membrane area per module and a total of 702 modules the flux is 4.2 gfd:

$$\frac{340\ ft^2}{module} \times 702\ modules = \ 238{,}680\ ft^2$$

$$\frac{1{,}000{,}000\ gpd}{238{,}680\ ft^2} = 4.2\ gfd$$

Membranes filtering nitrified secondary effluent with turbidity consistently less than 5 NTU can operate at flux rates between 10 and 30 gfd, although with used membranes it is advisable to operate toward the lower end (10-15 gfd). Table 4 shows that the proposed system of 3 trains containing 4 cassettes per train can treat the current tertiary capacity of 2.0 MGD and maintain reasonable flux rates with one train out of service for backwashing/maintenance.

Table 4: Flux Rates

Flow (MGD)	Flux (gfd) N Trains	Flux (gfd) N-1 Trains
1.0	4.2	6.3
2.0	8.4	12.6

N = 3 Trains

GE provided reference dimensions that show that the proposed 3 trains with 4 cassettes per train would require a footprint of roughly 60' x 47' (see Appendix). While typically membrane filtration provides the benefit of a compact footprint, this area is larger than what is currently utilized by the granular media filtration (50'x28'). Total cost could be reduced if existing tankage is utilized for the submerged membrane tanks, however the only available infrastructure on site is the Plant 1 oxidation ditch or anoxic basin. Although Plant 1 is not currently utilized, converting its tanks would reduce the plant's design treatment capacity by 0.5 mgd.

While reusing membranes from the drinking water plant would save on membrane replacement cost and maximize the membrane investments from the drinking water plant, the capital and operational cost are still substantially higher than both cloth and granular media filtration. Additionally, it would require larger footprint, additional maintenance, and there is no major driver such as downstream TDS removal or effluent water quality limits to justify this approach.

6 IDENTIFY BEST-FIT FILTRATION TECHNOLOGY

Table 5 summarizes the key advantages and disadvantages of granular media, cloth, and membrane filtration.

Table 5: Advantages and Disadvantages of Filter Technologies

Technology	Advantages	Disadvantages
Granular Media	• Reliable • Industry Standard	• Footprint
Cloth	• Lowest Cost	• Requires high quality feed water • Risk of Bryozoan Issues
Membrane	• Effluent Quality • Pathogen Removal	• High Cost • Requires chemical cleans • Footprint

Based on the associated cost and current filtration needs at 4S Ranch WRF granular media or cloth filtration is recommended over membrane filtration. Cloth filtration, while the most economical, will rely on the upstream process to provide low turbidity water continuously, and has the risk of bryozoan sponges forming. Granular media filtration is more conservative and robust as it can handle higher turbidity secondary effluent if the biological process experiences any upsets. Granular media filtration has historically worked well at 4S Ranch WRF and is proven to be reliable. Based on this information both cloth filtration and granular media filtration provide viable filtration options at 4S Ranch. The subsequent section provides budgetary cost comparisons to compare capital cost.

7 BUDGETARY COST ESTIMATE

Budgetary construction cost estimates were developed for three alternatives: cloth filtration, granular media filtration with concrete tanks, and granular media filtration with steel tanks. Table 6 summarizes the total construction and total project cost for these three options and Figures 8 through 10 provide the cost breakdown for each alternative.

Table 6: Alternative Cost Summary

	Cloth Filter	Granular Media Filter Concrete Tanks	Granular Media Filter Steel Tanks
Total Construction Cost	$1,229,000	$2,487,000	$3,233,000
Total Project Cost	**$1,461,000**	**$2,966,000**	**$3,857,000**

For the granular media filters options a well-designed depth filter is recommended over surface filtration because of its ability to hold more solids, builds head at a lower rate, and its overall robustness. Other granular media filter designs such as continuous backwashing filters offer cost savings due to less automation, piping, valves, and lower backwash rates/volumes; however these types of filters tend to accumulate solids in the filter bed, compromising performance and can lead to coliform issues downstream due to particle shielding (e.g., Western Municipal Water District, San Elijo Water Reclamation Facility). As a result the granular media filter alternatives assume a robust granular media filter design that utilizes depth filtration and full air scour and backwashing capabilities. The current granular media filters provide capacity for current and projected flow so the newly proposed granular media filters assume similar sizing (4 filter cells, each 100 square feet). The concrete filters are lower in cost than the steel tank filters and offer a longer life expectancy, and are less susceptible to corrosion. To promote depth filtration the new granular media filters include 72 inches of silica sand but the media design should be carefully considered as part of the filter design. It is possible to locate the new filters to the southeast of the existing filters and to utilize some of the existing piping, pumps, blowers, and backwash water mudwell.

The cloth filters are to be enclosed in a single steel tank that is placed on a concrete slab. The cloth filter utilizes multiple discs within the filter cell and in order to achieve redundancy requirements required by the Division of Drinking Water (DDW) regulations, it is recommended that additional discs be provided along with a spare drive and chain unit should a failure occur. An additional unit for complete redundancy could be considered, but it would double the cost making it roughly the same as the concrete granular media filtration option. DDW should be engaged if the District proceeds with cloth filters to confirm that these redundancy measures would be adequate.

Additional assumptions for developing the cost estimates include:

- The existing mudwell is adequately sized for wash water generated from the cloth or granular media filters
- Existing filter feed pump station would remain unchanged.
- The washwater pumps would need to be upsized to provide higher backwash rate and the blowers would be replaced
- New filters would be located immediately to the south of the existing tertiary area, constructed independent of the existing facilities such that the HydroClear filters can remain in operation until the new filters are commissioned.

Figure 8: Cloth Filter Construction Cost Estimate Breakdown

Olivenhain Municipal Water District
4S Ranch
Cloth Filter Retrofit

PRELIMINARY DESIGN OPCC - CLASS 5 - COST ESTIMATE
June 2015

GENERAL REQUIREMENTS

CSI	DESCRIPTION			TOTAL COST
01010	GENERAL & SUPPLEMENTAL CONDITIONS	10%	%	$ 77,500
01020	MOBILIZATION & DEMOBILIZATION % OF CONSTRUCTION	8%	%	$ 62,000
01030	PROTECTION OF EXISTING FACILITIES	1	ls	$ 5,000
01040	TESTING AND COMMISSIONING	1	ls	$ 25,000
			Subtotal Cost	$ 169,500

4S Ranch

	AREA	DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST	COST BY AREA
1	SITE WORK						
2		Excavation, Backfill & Recompaction	100	cu ft	$ 50	$ 5,000	
3		Concrete Pad with Drain	310	sf	$ 55	$ 17,050	
4		Metal Roof on Pole-Barn Structure	310	sf	$ 25	$ 7,750	
5							$ 29,800
6	ELECTRICAL AND INSTRUMENTATION						
7		Conduit and electrical for HMI, mechanical components	1	ls	$ 30,000	$ 30,000	
8		SCADA & Distributive Control System Tie-in	1	ls	$ 30,000	$ 30,000	
9		Programming and Testing	1	ls	$ 20,000	$ 20,000	
10							$ 80,000
11	PACKAGE FILTER AND INSTALLATION						
12		Package Cloth Disk Filter System	1	ea	$ 298,000	$ 298,000	
13		Spare Parts and Equipment for Reliability	1	ea	$ 75,000	$ 75,000	
14		Recommended upgrade to SS304 Tank	1	ea	$ 35,000	$ 35,000	
15		Piping and Connections	1	ea	$ 50,000	$ 50,000	
16		Disassembly/Modifications to Existing Piping and Connections	1	ea	$ 25,000	$ 25,000	
17		Anchor bolts, fittings, pipe supports, bolts, nuts gaskets, wiring	1	ea	$ 10,000	$ 10,000	
18		Installation of the above Equipment	35%	%	$ 493,000	$ 172,550	
							$ 665,550
				Subtotal Construction Cost			$ 775,000
				Subtotal General Requirements Cost			$ 170,000
				Allowance for contingencies		30%	$ 284,000
				Total Construction Cost			$ 1,229,000

PRELIMINARY DESIGN OPCC - CLASS 5 - COST ESTIMATE

Construction Costs	Percent	Cost
Subtotal Construction Cost		$775,000
Subtotal General Requirements Cost		$170,000
Contingencies	30%	$284,000
Total Construction Cost		$1,229,000
Soft Costs		
Engineering Design and Design During Construction	15%	$116,000
Construction Inspection and Management	12%	$93,000
Administration and Legal	3%	$23,000
Total Soft Cost		$232,000
TOTAL PROJECT COSTS		$1,461,000

Figure 9: Granular Media Filters with Concrete Tanks Construction Cost Estimate Breakdown

Olivenhain Municipal Water District
4S Ranch
Granular Media Filters: Concrete Tanks

PRELIMINARY DESIGN OPCC - CLASS 5 - COST ESTIMATE
June 2015

GENERAL REQUIREMENTS

CSI	DESCRIPTION			TOTAL COST
01010	GENERAL & SUPPLEMENTAL CONDITIONS	10%	%	$ 159,600
01020	MOBILIZATION & DEMOBILIZATION % OF CONSTRUCTION	8%	%	$ 127,680
01030	PROTECTION OF EXISTING FACILITIES	1	ls	$ 5,000
01040	TESTING AND COMMISSIONING	1	ls	$ 25,000
			Subtotal Cost	$ 317,280

4S Ranch

	AREA	DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST	COST BY AREA
1	SITE WORK						
2		Excavation, Backfill & Recompaction	800	cu ft	$ 50	$ 40,000	
3		Reinforced Concrete Structures	200	cu yd	$ 1,050	$ 210,000	
4							$ 250,000
5	ELECTRICAL AND INSTRUMENTATION						
6		Conduit and electrical for HMI, mechanical components	1	ls	$ 30,000	$ 30,000	
7		SCADA & Distributive Control System Tie-in	1	ls	$ 30,000	$ 30,000	
8		Programming and Testing	1	ls	$ 20,000	$ 20,000	
9							$ 80,000
10	PACKAGE FILTER AND INSTALLATION						
12		Filter Equipment (Troughs, Valves, Underdrain, Media, Air Header, Control System, etc)	1	ea	$ 477,000	$ 477,000	
13		Air Scour Blowers	2	ea	$ 20,000	$ 40,000	
14		Filter Backwash Pumps	2	ea	$ 20,000	$ 40,000	
15		Backwash Flow Meter and Flow Control Valve	1	ea	$ 15,000	$ 15,000	
16		Piping and Connections	1	ea	$ 100,000	$ 100,000	
17		Disassembly/Modifications to Existing Piping and Connections	1	ea	$ 25,000	$ 25,000	
18		Anchor bolts, fittings, pipe supports, bolts, nuts gaskets, wiring	1	ea	$ 20,000	$ 20,000	
19		Stairs, Railing, and Walkways to Access top of Filters	1	ea	$ 50,000	$ 50,000	
20		Installation of the above Equipment	65%	%	$ 767,000	$ 498,550	
							$ 1,265,550
				Subtotal Construction Cost			$ 1,596,000
				Subtotal General Requirements Cost			$ 317,000
				Allowance for contingencies	30%		$ 574,000
				Total Construction Cost			$ 2,487,000

PRELIMINARY DESIGN OPCC - CLASS 5 - COST ESTIMATE

Construction Costs	Percent	Cost
Subtotal Construction Cost		$1,596,000
Subtotal General Requirements Cost		$317,000
Contingencies	30%	$574,000
Total Construction Cost		$2,487,000
Soft Costs		
Engineering Design and Design During Construction	15%	$239,000
Construction Inspection and Management	12%	$192,000
Administration and Legal	3%	$48,000
Total Soft Cost		$479,000
TOTAL PROJECT COSTS		**$2,966,000**

Figure 10: Granular Media Filters with Steel Tanks Construction Cost Estimate Breakdown

Olivenhain Municipal Water District
4S Ranch
Granular Media Filter: Steel Tanks

PRELIMINARY DESIGN OPCC - CLASS 5 - COST ESTIMATE
June 2015

GENERAL REQUIREMENTS

CSI	DESCRIPTION			TOTAL COST
01010	GENERAL & SUPPLEMENTAL CONDITIONS	10%	%	$ 208,200
01020	MOBILIZATION & DEMOBILIZATION % OF CONSTRUCTION	8%	%	$ 166,560
01030	PROTECTION OF EXISTING FACILITIES	1	ls	$ 5,000
01040	TESTING AND COMMISSIONING	1	ls	$ 25,000
			Subtotal Cost	$ 404,760

4S Ranch

	AREA	DESCRIPTION	QUANTITY	UNITS	UNIT COST	TOTAL COST	COST BY AREA
1	SITE WORK						
2		Excavation, Backfill & Recompaction	400	cu ft	$ 50	$ 20,000	
3		Concrete Pad with Drain (50'x30')	1500	sf	$ 55	$ 82,500	
4							$ 102,500
5	ELECTRICAL AND INSTRUMENTATION						
6		Conduit and electrical for HMI, mechanical components	1	ls	$ 30,000	$ 30,000	
7		SCADA & Distributive Control System Tie-in	1	ls	$ 30,000	$ 30,000	
8		Programming and Testing	1	ls	$ 20,000	$ 20,000	
9							$ 80,000
10	PACKAGE FILTER AND INSTALLATION						
11		Steel Filters (8'x12'x16')	4	ea	$ 160,000	$ 640,000	
12		Filter Equipment (Troughs, Valves, Underdrain, Media, Air Header, Control System, etc)	1	ea	$ 477,000	$ 477,000	
13		Air Scour Blowers	2	ea	$ 20,000	$ 40,000	
14		Filter Backwash Pumps	2	ea	$ 20,000	$ 40,000	
15		Backwash Flow Meter and Flow Control Valve	1	ea	$ 15,000	$ 15,000	
16		Piping and Connections	1	ea	$ 100,000	$ 100,000	
17		Disassembly/Modifications to Existing Piping and Connections	1	ea	$ 25,000	$ 25,000	
18		Anchor bolts, fittings, pipe supports, bolts, nuts gaskets, wiring	1	ea	$ 20,000	$ 20,000	
19		Stairs, Railing, and Walkways to Access top of Filters	1	ea	$ 50,000	$ 50,000	
20		Installation of the above Equipment	35%	%	$ 1,407,000	$ 492,450	
							$ 1,899,450
				Subtotal Construction Cost			$ 2,082,000
				Subtotal General Requirements Cost			$ 405,000
				Allowance for contingencies		30%	$ 746,000
				Total Construction Cost			$ 3,233,000

PRELIMINARY DESIGN OPCC - CLASS 5 - COST ESTIMATE

Construction Costs	Percent	Cost
Subtotal Construction Cost		$2,082,000
Subtotal General Requirements Cost		$405,000
Contingencies	30%	$746,000
Total Construction Cost		$3,233,000
Soft Costs		
Engineering Design and Design During Construction	15%	$312,000
Construction Inspection and Management	12%	$250,000
Administration and Legal	3%	$62,000
Total Soft Cost		$624,000
TOTAL PROJECT COSTS		**$3,857,000**

Conclusions and Recommendation:

Although the existing filters at the 4S Ranch WRF appear to be performing reasonably well, visual inspections reveal that the existing filters are nearing the end of their useful life and need to be replaced. This TM considered five commercially available products as replacement alternatives at a nominal capacity of 2 MGD and both cloth filtration and a granular media filtration were determined to be the most viable options. Granular media filtration is preferred due to its robustness and reliability, which should provide a long-term solution (30 years). Cloth filtration offers significant project cost savings at $1,461,000 compared to $2,966,000 for granular media filters. However, cloth filters have an operational risk that could increase maintenance and impact performance reliability if Bryozoan sponges were to become established or if secondary effluent quality were to diminish in the future. Additionally the package cloth filter system's life expectancy is only 10-15 years. Considering these risks, cost, and expected life of these options, granular media filters are the preferred filtration technology. If OMWD decides to proceed with cloth filters, it will be important to engage the Division of Drinking Water to confirm that the redundancy strategies assumed to develop the capital costs in this analysis will be permitted.

Appendix:

Contents:

- GE Water & Process Technologies Budget Proposal for OMWS 4S Ranch Tertiary 500D Transfer
- GE Water & Process Technolgies ZENON Membrane Reference Layout Dimensions
- Leopold Filter Equipment Quote
- Leopold Filter Drawings
- Five Star Filtration Equipment Quote
- Five Star Filtration CDPH Redundancy Requirements Acceptance Letter

Appendix A:
GE Water & Process Technologies Budget Proposal for OMWS 4S Ranch Tertiary 500D Transfer
&
Email Correspondences

GE
Water & Process Technologies

Budget Proposal for

OMWS 4S Ranch Tertiary 500D Transfer

ZeeWeed® Membrane Filtration System

Submitted to:

Olivenhain Municipal Water District
1966 Olivenhain Road
Encinitas, CA 92024

Attention: Tom Kennedy

October 18, 2013

Proposal Number : 861101

ZENON Environmental Corporation
d/b/a GE Water & Process Technologies
Jodi Smart, Regional Manager
Tel: (619) 990-7987
Email: jodi.smart@ge.com

Local Representation By:
The Coombs-Hopkins Company
Jeremy Neill, P.E.
Tel: (760)931-0555
Email: Jeremy@coombshopkins.com

GE Water & Process Technologies
Confidential and Proprietary Information

GE Water and Process Technologies ("Seller") submits the information contained in this document for evaluation by Olivenhain Municipal Water District ("Buyer") only. Buyer agrees not to reveal its contents except to those in Buyer's organization necessary for evaluation. Copies of this document may not be made without the prior written consent of Seller's Management. If the preceding is not acceptable to Buyer, this document shall be returned to Seller.

This proposal is for budgetary purposes only and does not constitute an offer of sale.

Table of Contents

1 Basis of Design

This proposal for 4S Ranch WWTP retrofit is offered based on GE supplying a ZeeWeed® Ultrafiltration Membrane System to filter secondary effluent from an existing biological treatment system.

This system is based on the existing ZW500D membranes and cassettes from the Olivenhain Water Treatment Plant being reused in this application.

1.1 Design Capacity

The design treatment flow rates are summarized in the table below. The flows refer to the influent wastewater flow. The permeate production capacity of the ZeeWeed® Ultrafiltration Membrane System is determined by the system recovery.

Average Day Flow	1.0	mgd
Maximum Day Flow	1.0	mgd
Peak Hour Flow (for 2 hours)	1.2	mgd
Maximum Flow with one train offline for maintenance or cleaning (less than 24 hrs)	1.0	mgd

- Average Day Flow (ADF) – The average flow rate occurring over a 24-hour period based on annual flow rate data.
- Maximum Day Flow (MDF) – The maximum flow rate averaged over a 24-hour period occurring within annual flow rate data.

1.2 Feed Water Quality

The proposed design solution is based on the feed water to the membrane tank detailed below.

Minimum Wastewater Temperature	15	°C
Average BOD_5	<2	mg/L
Average TSS	<5	mg/L

Note: Recovery of 90% is assumed.

1.3 Filtered Water Quality

The following performance parameters are expected based on the design parameters above.

TSS	< 5	mg/L
Turbidity	< 1	NTU

1.4 Influent Variability

Flows or loads in excess of the design criteria defined above must be equalized prior to the membrane filtration system. In the event that the influent exceeds the specifications used in engineering this proposal, or the source of influent changes, the ability of the treatment system to produce the designed treated water quality and/or quantity may be impaired. Buyer may continue to operate the system, but assumes the risk of damage to the system and/or additional costs due to increased membrane cleanings, potential for biological upset and/or increased consumable usage.

2 System Design and Scope

2.1 Process Flow

The mixed liquor would flow through the existing secondary treatment system to the filter pump station. The existing piping would be rerouted and the filter pump would pump the water to the existing anoxic tank rather than the existing filters.

The new tertiary filtration system would consist of two trains with each train populated with four (3) of the 64 module ZW500d cassettes. Eleven cassettes will be reused from the Olivenhain plant and one additional cassette should be purchased. Concrete walls should be poured to separate the trains and to provide the appropriate tank dimension.

Operating liquid level in the membrane tank is between 8.25 – 9.25 feet with 1-1/2 ft of freeboard.

Tertiary applications require the membrane tank to fully drain. The membrane tanks should be sloped to a drain sump and the drain pipe sized such that the tank can drain completely within 20-30 minutes.

The permeate pumps will pump the filtrate to the existing ultra violet disinfection tanks. One duty pump per train is supplied. The permeate pumps are reversible rotary lobe pumps which will both permeate and backpulse.

Membrane blowers are provided for membrane air scour. One duty blower and one standby is included.

Maintenance cleaning is required with this system. The trains are sized such that when one train is in cleaning mode, the other train will treat the full flow. A clean in place (CIP) system is provided complete with recirculation pumps and a CIP tank. The CIP recirculation pumps allow the cleaning chemicals to be pumped into the membrane tank. Once the cleaning is complete, the solution from the membrane tank is pumped into the CIP tank, neutralized and then sent back to the plant headworks.

2.2 Ultrafiltration Flux

Design Condition	N Trains		N-1 Train	
	Flow	Flux	Flow	Flux
	Partially Populated Cassettes – 234 module/train (3x64 + 1x42)			
Average Day Flow	1.0	10.9	1.0	22.52
Peak Hour Flow (for 2 hours)	1.2	13.15	1.2	21.05

- Flux = maximum instantaneous flux in gfd.
- Flow = listed as MGD
- N = 3 trains

Ultrafiltration System Design

Type of Membrane	ZeeWeed® 500D (340 ft^2)
Type of Cassette	64M
Number of Membrane Trains	3
Number of Cassettes Per Train	4
Number of Cassette Spaces Per Train	4
Number of Modules per Cassette	3x64 + 1x42
Total Number of Installed Cassettes	12
Total Number of Installed Modules	702
Membrane Tank Dimensions per train (ft L x W x H)	18 x 8.86 x 10.25*
Design Recovery	90%

Note 1: It is assumed that eleven cassettes with modules will be reused from the Olivenhain WTP. One new cassette and 42 new modules and all the hangers and brackets are included in this proposal

Note 2: Tank dimensions and volumes are preliminary only and may change slightly once final detail design commences.

Note 3: The ultrafiltration system is designed for installation within the existing anoxic concrete tank onsite at the 4S Ranch WWTP. The dimension of the anoxic tank is 34 ft L x 34 ft W x 10.25 ft D*.

3 Scope of Supply by GE

Membranes and Tankage Equipment

- One (1) ZW500D 64M cassette
- Forty-two (42) ZW500D modules
- Membrane cassette support beams, hangers and brackets for a total of twelve cassettes
- Permeate collection header pipes
- Air scour distribution header pipes
- Tank feed and drain control valves

Permeate System Equipment

- Reversible rotary lobe permeate/backpulse pumps, supplied loose, complete with required isolation valves, pressure gauges and flow meters
- Trans-membrane pressure transmitters
- Vacuum ejectors
- Turbidimeters

Membrane Air Scour Blower Equipment

- Membrane air scour blowers, supplied loose, complete with required isolation valves, and flow switches

Backpulse System Equipment

- Backpulse tank complete with level transmitter and isolation valves

Membrane Cleaning/Neutralization System

- CIP tank complete with level transmitter and isolation valves
- CIP tank heater
- Recirculation/neutralization pumps, with flowmeter, pressure gauges and isolation valves
- Sodium hypochlorite chemical feed system
- Citric acid chemical feed system
- $NaHSO_3$ and NaOH chemical feed systems

Electrical and Control Equipment

- PLC with Touchscreen HMI

Miscellaneous

- Air compressors and dryers for pneumatic valve, ejector and air diaphragm pump operation

General

- Equipment general arrangement and layout drawings
- Operating & Maintenance manuals
- Field service and start-up assistance[1] - 40 days support over 2 site visits from GE Water field-service personnel for commissioning, plant start-up and operator training
- Equipment mechanical warranty – 1 year or 18 months from shipment of equipment
- Insight Process Monitoring and 24/7 Emergency Technical Support – 1 year

Notes:

1 Additional man-hours will be billed separately from the proposed system capital cost at a rate of $1,300 per day plus living and traveling expenses. Detailed GE Water service rates are available upon request.

2 All GE supplied equipment is designed for installation in an unclassified area.

3 A further customized package of post-commissioning Field Service support can be provided upon request. The package may include additional years of GE's ZenoTrac process monitoring or 24/7 services or site visits by GE Field Service personnel,.

4 Buyer Scope of Supply

The following items are for supply by Buyer and will include but are not limited to:

- ❑ Overall plant design responsibility
- ❑ Review and approval of design parameters related to the membrane separation system
- ❑ Review and approval of GE supplied equipment drawings and specifications
- ❑ Detail drawings of all termination points where GE equipment or materials tie into equipment or materials supplied by Buyer
- ❑ Design, supply and installation of an Overhead Traveling Beam Crane and monorail beam, conductor bar system, interlocks, etc.
- ❑ Civil works, provision of main plant tank structures, buildings, equipment foundation pads etc. including but not limited to:
    - Common channels, Housekeeping pads, Equipment access platforms, walkways, stairs etc.
    - Membrane tanks c/w tank coating to be suitable for appropriate chemical contact, Covers, grating, and their support over membrane tanks. Note: cassette beams provided by GE have structural strength for the grating
    - Treated water storage tank, as required
- ❑ HVAC equipment design, specifications and installation (where applicable)
- ❑ UPS, power conditioner, emergency power supply and specification (where applicable)
- ❑ Membrane modules (ZW500D 340 ft^2)
- ❑ Membrane cassettes (64M)
- ❑ VFDs and MCC for all GE supplied equipment
- ❑ Plant SCADA system
- ❑ Acoustical enclosures for membrane blowers
- ❑ Process and utilities piping, pipe supports, hangers, valves, etc. including but not limited to:
    - Piping, pipe supports and valves between GE-supplied equipment and other plant process equipment
    - Piping between any loose-supplied GE equipment
- ❑ Electrical wiring, conduit and other appurtenances required to provide power connections as required from the electrical power source to the GE control panel and from the control panel to any electrical equipment, pump motors and instruments external to the GE-supplied enclosure

- Design, supply and installation of equipment anchor bolts, brackets, and fasteners for GE supplied equipment. Seismic structural analysis and anchor bolt sizing.
- Receiving, unloading and safe storage of GE supplied equipment at site until ready for installation
- Installation on site of all GE supplied loose-shipped equipment
- Alignment of rotating equipment
- Raw materials, chemicals, and utilities during equipment start-up and operation
- Disposal of initial start-up wastewater and associated chemicals
- Laboratory services, operating and maintenance personnel during equipment checkout, start-up and operation
- Touch up primer and finish paint surfaces on equipment as required at the completion of the project
- Weather protection as required for all GE supplied equipment. Skids and electrical panels are designed for indoor operation and will need shelter from the elements.

5 Commercial

5.1 Pricing Table

Pricing for the proposed equipment and services, as outlined in Section 3, is summarized in the table below. All pricing is based on the operating conditions and influent analysis that are detailed in Section 1 of the proposal. The pricing herein is for budgetary purposes only and does not constitute an offer of sale. No sales, consumer use or other similar taxes or duties are included in the pricing below.

Price: All Equipment & Service	
ZeeWeed® Membrane Filtration System, as outlined in Section 3	$ 1,055,000 USD

5.2 Equipment Shipment and Delivery

Equipment Shipment is estimated at 26 to 35 weeks after order acceptance. The Buyer and Seller will arrange a kick off meeting after contract acceptance to develop a firm shipment schedule.

Typical Drawing Submission and Equipment Shipment Schedule

		8-12 weeks	2-3 weeks	16-20 weeks		2 weeks
Acceptance of PO						
Submission of Drawings						
Drawings Approval						
Equipment Manufacturing						
Equipment Shipment						
Plant Operations Manuals						

The delivery schedule is presented based on current workload backlogs and production capacity. This estimated delivery schedule assumes no more than 2 weeks for Buyer review of submittal drawings. Any delays in Buyer approvals or requested changes may result in additional charges and/or a delay to the schedule.

5.3 Terms and Conditions of Sale

This proposal has been prepared and is submitted based on Seller's Standard Terms and Conditions of Sale.

From: **Jeremy Neill** jeremy@coombshopkins.com
Subject: FW: OMWD reuse for 4S Ranch WWTP ZW500 Oct 2013 Retrofit Budget Proposal (coag info)
Date: February 19, 2015 at 9:37 AM
To: Brett Faulkner (brett.faulkner@trusselltech.com) brett.faulkner@trusselltech.com

JN

Brett,

Per discussions the original proposal was quite confusing and frankly incorrect in the flows vs. flux specified. GE and I have reviewed the design and, as you suspected, there is plenty of room in the design presented in this 10/18/2013 proposal. The concern with three trains is the flux / capacity with two of the trains offline. I can confirm that we could do 2 MGD with used membranes with three trains online and with two trains online. (N and N-1 design). At a N-2 condition, so two trains offline, we are likely to be hydraulically limited in the feed / drain lines. Regardless, I would say that we could still do the 2MGD flow but we would probably put a cap on the maximum amount of time you could run at this condition and still maintain a 30 day CIP interval as the flux is quite high, especially given the age of the membranes.

Attached is a layout for a 4 train system that has 4 cassettes per train. It is a layout for an MBR system yet is still quite applicable. The items that will be different is elimination of the RAS lines / WAS lines and the number and size of blowers. For this design there would be at least two blowers in a duty/standby configuration.

You can proceed with the same price and scope from the 2013 budget proposal. In general this is an interesting concept as it gives you membrane quality water at a budget price.

Regards,
Jeremy

Jeremy Neill, P.E.
WE HAVE A NEW ADDRESS EFFECTIVE NOVEMBER 1, 2014 - PLEASE CHANGE YOUR RECORDS
2011 Palomar Airport Road, Suite 303
Carlsbad, CA 92011

The Coombs-Hopkins Company
www.coombshopkins.com
(760) 931-0555 main office line
(714) 337-1570 mobile
jeremy@coombshopkins.com

From: Jeremy Neill
Sent: Tuesday, January 27, 2015 3:01 PM
To: Brett Faulkner (brett.faulkner@trusselltech.com)
Subject: FW: OMWD reuse for 4S Ranch WWTP ZW500 Oct 2013 Retrofit Budget Proposal (coag info)

Brett,

Here is the most recent proposal from GE for re-using ZeeWeed 500D membranes from their WTP over at 4S Ranch WRF. See you tomorrow at 10am!

Jeremy Neill, P.E.
WE HAVE A NEW ADDRESS EFFECTIVE NOVEMBER 1, 2014 - PLEASE CHANGE YOUR RECORDS
2011 Palomar Airport Road, Suite 303
Carlsbad, CA 92011

The Coombs-Hopkins Company
www.coombshopkins.com
(760) 931-0555 main office line
(714) 337-1570 mobile
jeremy@coombshopkins.com

From: Smart, Jodi (GE Power & Water) [mailto:Jodi.Smart@ge.com]
Sent: Monday, April 28, 2014 1:25 PM
To: Jeremy Neill
Subject: OMWD reuse for 4S Ranch WWTP ZW500 Oct 2013 Retrofit Budget Proposal (coag info)

Jeremy,

Attached is the revised proposal we prepared following our last meeting with Tom. If we hear back from Tom that the project is progressing we could discuss the current scope.
You don't need to forward anything until we hear from Tom. I wanted you to have a copy of the latest design, scope, budget price.

I saw Kim Thorner with OMWD at the YMCA dance recital this weekend. We were chatting as the kids were getting ready to perform. If Bella wants to see a video of her hip hop class I will forward you the file.

Jodi

From: Sams, Michele (GE Power & Water)
Sent: Friday, October 18, 2013 1:28 PM
To: Smart, Jodi (GE Power & Water)
Subject: CA - OMWD reuse for 4S Ranch WWTP _ Budget Proposal

Hi Jodi
Please find attached the budgetary proposal for the 4S Ranch tertiary plant.
If you have questions we can discuss on Monday.
Thanks
Michele Sams, P.Eng.
GE
Water & Process Technologies
Commercial Engineer

T 905-465-3030 x3472
F 905-465-3050
E michele.sams@ge.com

3239 Dundas Street West
Oakville, Ontario L6M 4B2

From: Tom Kennedy [mailto:tkennedy@olivenhain.com]
Sent: Tuesday, September 17, 2013 3:41 PM
To: Jeremy Neill
Cc: Smart, Jodi (GE Power & Water)
Subject: RE: 4S Ranch WWTP & GE membrane design

Here is a link to the manufacturer's page for the coagulant we are using. It is #908 and is an aluminum based product.

http://ntutechnologies.com/indexsp.php

Tom Kennedy | Operations Manager | Olivenhain Municipal Water District
1966 Olivenhain Road, Encinitas, CA 92024 | Cell: 760.445.0000 | www.omwd.com

From: Jeremy Neill [mailto:jeremy@coombshopkins.com]
Sent: Monday, September 16, 2013 4:26 PM
To: Tom Kennedy
Cc: jodi.smart@ge.com
Subject: RE: 4S Ranch WWTP & GE membrane design

Tom,

How about 1:30pm at your office tomorrow?

Jeremy Neill, P.E.
The Coombs-Hopkins Company
www.coombshopkins.com
(760) 931-0555 main office line
(714) 337-1570 mobile
(760) 931-9115 fax
jeremy@coombshopkins.com

CA - 4S Ranch Tertiary Budget Pro… Oct 18.pdf

Appendix B:
GE Water & Process Technologies Tertiary 500D Drawings

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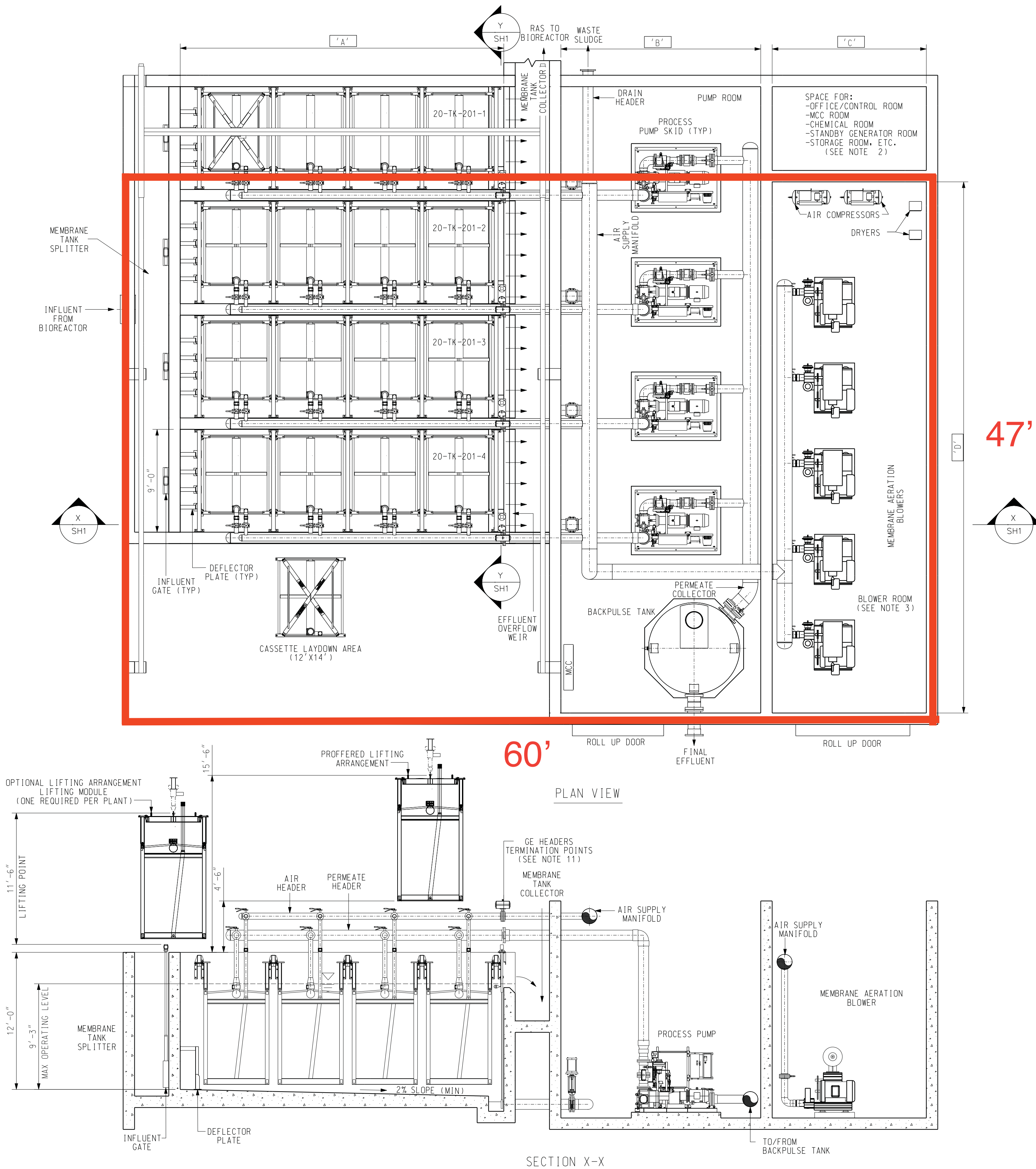

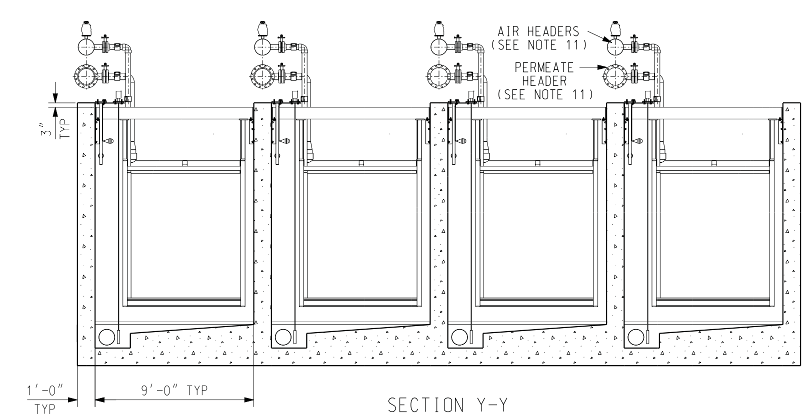

MAJOR TANK & BUILDING DIMENSIONS

CASSETTES 'N' PER TRAIN	'A'	'B'	'C'	'D'
1	8'-6"	17'-6"	13'-6"	25'-0"
2	15'-0"	17'-6"	13'-6"	32'-0"
3	21'-8"	17'-6"	13'-6"	40'-0"
4	28'-4"	17'-6"	13'-6"	46'-6"

NOTES

1. FOR SCOPE OF GE-SUPPLIED EQUIPMENT AND TECHNICAL DATA REFER TO THE PROPOSAL AND P&IDs.
2. SIZE AND LOCATION OF LISTED ROOMS ARE PRESENTED FOR REFERENCE ONLY. SYSTEM INTEGRATOR TO DETERMINE SIZE AND LOCATION OF ALL AMENITIES.
3. BIOLOGICAL PROCESS AERATION BLOWERS ARE NOT INCLUDED IN THE BLOWER ROOM. BOTH GROUPS OF BLOWERS CAN BE PLACED IN THE SAME ROOM.
4. SYSTEM INTEGRATOR IS RESPONSIBLE FOR DESIGN OF CONCRETE TANKS, GRAVITY MEMBRANE TANK SPLITTER (GRAVITY CHANNEL OR PIPE MANIFOLD), INFLUENT GATES, EMERGENCY OVERFLOW, WALKWAYS/HANDRAILS ON TOP OF WALLS (IF REQUIRED). THESE ARE NOT SHOWN IN THIS DRAWING FOR CLARITY.
5. TANK BOTTOM AND DRAIN SUMP DESIGNS ARE NOT BY GE. HOWEVER IT IS RECOMMENDED THAT MEMBRANE TANK BOTTOM IS TO BE CONFIGURED AS A ONE WAY SLOPE TOWARDS DRAIN TRENCH CROSSING THE ENTIRE TANK WIDTH. DRAIN SUMP CAN BE LOCATED ANYWHERE INSIDE THE TRENCH, WITH A TRENCH SLOPE TAPERING INTO THE SUMP ON ONE OR BOTH SIDES OF IT, DEPENDING ON THE LOCATION OF THE DRAIN PUMP.
6. BOTTOM OF VERTICAL DRAIN SUCTION SPOOL HAS TO BE AT LEAST 6" BELOW ELEVATION OF A TOP OF A DRAIN SUMP.
7. TANKS TO BE COVERED FOR ACCESS TO CASSETTES AND EQUIPMENT. DESIGN, SUPPLY AND INSTALLATION OF MEMBRANE TANK COVERS ARE BY OTHERS (TANKS MUST BE VENTED). GE SUPPLIED CASSETTE SUPPORT BEAMS INCLUDE A 3" ALLOWANCE FOR TANK COVERS THAT HAVE TO BE FLUSH WITH TOP OF TANKS. SPECIFIC DESIGN HAVE TO BE COORDINATED WITH GE. FOR ADDITIONAL INFORMATION REFER TO THE GE DESIGN GUIDELINE LISTED BELOW (NOTE 16a).
8. CONCRETE MEMBRANE TANK MUST BE LINED APPROPRIATELY FOR CONTACT WITH MEMBRANE CLEANING CHEMICALS. FOR ADDITIONAL INFORMATION REFER TO THE GE DESIGN GUIDELINE LISTED BELOW (NOTE 16b).
9. ALL INTERNAL DIMENSIONS ARE GIVEN TO THE FINISHED CONCRETE AND COATING SURFACE; CONTRACTOR TO CALCULATE THE THICKNESS OF THE COATING BEFORE POURING THE CONCRETE (NOTE 16c).
10. BAFFLE PLATE DESIGN AND SUPPLY ARE BY OTHERS. FOR ADDITIONAL INFORMATION REFER TO THE GE DESIGN GUIDELINE LISTED BELOW (NOTE 16d).
11. DESIGN AND SUPPLY OF SUPPORTS FOR PERMEATE AND AIR HEADERS ARE BY OTHERS. OVERALL SYSTEM ENGINEER TO DETERMINE DESIGN, NUMBER AND LOCATION OF SUPPORTS. GE TIE POINTS MUST NOT BE USED TO SUPPORT INTERCONNECTING PIPING.
12. SYSTEM INTEGRATOR TO CONSIDER PROVISION FOR FOAM/SLUDGE SURFACE WASTING AT THE DETAILED ENGINEERING STAGE.
13. MINIMUM OPERATING LEVEL IN THE BACKPULSE TANK (IF APPLICABLE) TO ALWAYS STAY ABOVE TOP OF CASING OF THE PROCESS PUMP.
14. THE BACKPULSE TANK IS OF IN-LINE (FLOW-THROUGH) CONFIGURATION IF PD PROCESS PUMPS ARE USED; IT IS OF OFF-LINE CONFIGURATION IF CENTRIFUGAL PROCESS PUMPS ARE USED.
15. ESTIMATED CASSETTE SHIPPING WEIGHT 4,500 LBS [2,040 KG]. ESTIMATED CASSETTE MAX WEIGHT(SLUDGED) 10,000 LBS [4,535 KG]. MEMBRANE LIFTING DEVICE (TRAVELING BRIDGE-CRANE) TO BE SIZED FOR 5,000 KG (NOTE 16e).
16. THE FOLLOWING DESIGN GUIDELINES ARE AVAILABLE FROM GE UPON REQUEST:

a. TANK COVER GUIDELINES FOR ZEEWEED 500 SYSTEMS.
b. MG-09012-C CONCRETE TANK COATING GUIDELINES FOR ZEEWEED SYSTEMS.
c. MG-09011-A MEMBRANE TANK TOLERANCES.
d. BEP #2007-04 BAFFLE DESIGN.
e. ZEEWEED 500 SERIES MEMBRANE LIFTING EQUIPMENT GUIDELINE.

GE Water & Process Technologies
ZENON Membrane Solutions

REFERENCE ONLY
DO NOT USE FOR CONSTRUCTION

REV	DESCRIPTION	ECO	DWN	APVD	DATE	CHKD
A	INITIAL RELEASE/SAP IMPLEMENTATION	15311	RI	JM	26NOV12	RB

TOLERANCES UNLESS NOTED: DECIMALS .X .030, .XX .015, .XXX .010; ANGLES .5; FRAC 1/8
DIMENSIONS IN INCHES. DO NOT SCALE. THIRD ANGLE

DRAWN BY SR, DATE 29JUN12
CHECKED BY MJ, DATE 29JUN12
APPROVED BY CB, DATE 29JUN12
APPROVED BY

GE Water & Process Technologies
GLOBAL HEADQUARTERS : TREVOSE, PA USA +1-215-355-3300 WWW.GEWATER.COM

CLIENT/JOB: PUMP TO ZW500D 48M LEAPMBR - FLOW THROUGH SYS
TITLE: PLOT PLAN FOR 4 TANKS/- 4 CASSETTES MAX
FILE: MICROSTATION
MATERIAL
SIZE: D DRAWING NO. 2801000B-AG-01 REV A
PROJECT 2801000
SCALE 1:64 SHEET 1OF2

P/N 1161662-RHP01

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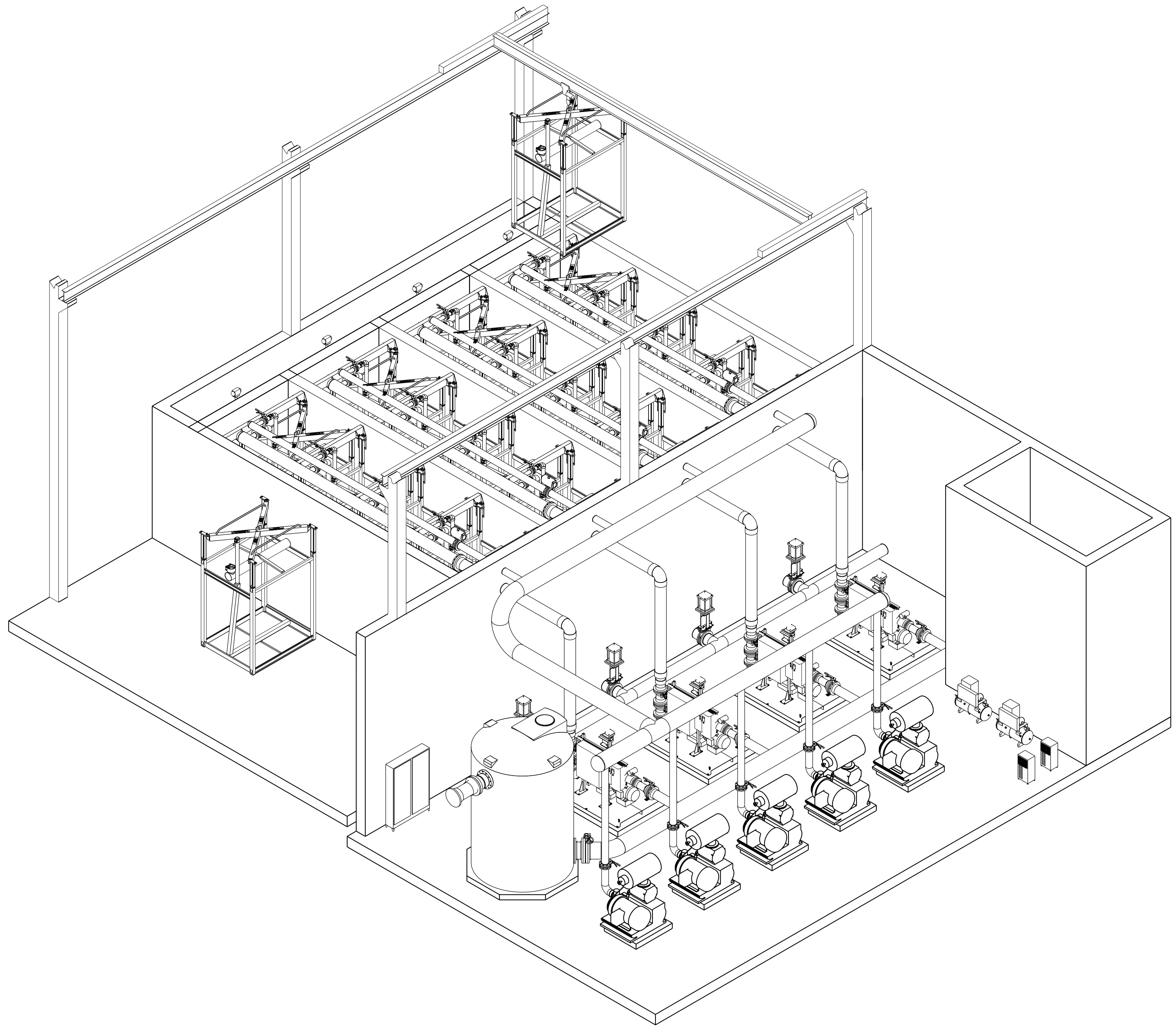

RIGHT ISO VIEW
(WALL REMOVED FOR CLARITY)

REV	DESCRIPTION	ECO	DWN	APVD	DATE	CHKD
A	INITIAL RELEASE/SAP IMPLEMENTATION	15311	RI	JM	26NOV12	RB

TOLERANCES UNLESS NOTED
DECIMALS .X .030 .XX .015 .XXX .010
ANGLES .5
FRAC 1/8
DIMENSIONS IN INCHES
DO NOT SCALE
THIRD ANGLE

DRAWN BY SR	DATE 25JUL12
CHECKED BY MZ	DATE 25JUL12
APPROVED BY CB	DATE 25JUL12
APPROVED BY	DATE

GE
Water & Process Technologies
GLOBAL HEADQUARTERS : TREVOSE, PA USA +1-215-355-3300 WWW.GEWATER.COM

CLIENT/JOB: PUMP TO ZW500D 48M LEAPMBR – FLOW THROUGH SYS
FILE: MICROSTATION

TITLE: PLOT PLAN FOR 4 TANKS/– 4 CASSETTES MAX
MATERIAL:

SIZE: D
DRAWING NO.: 2801000B-AG-01
REV: A
PROJECT: 2801000
SCALE: 1:64
SHEET: 2 OF 2

P/N 1161662-RHP01

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Appendix C:
Leopold Granular Media Filtration Budgetary Equipment Quote and Drawings

From: **Jeremy Neill** jeremy@coombshopkins.com
Subject: Fwd: Olivenhain, CA title 22 reuse
Date: February 11, 2015 at 10:13 AM
To: Brett Faulkner brett.faulkner@trusselltech.com

JN

Brett,

See below and attached. Let me know if you have any questions. Budget price is $477,000.00.

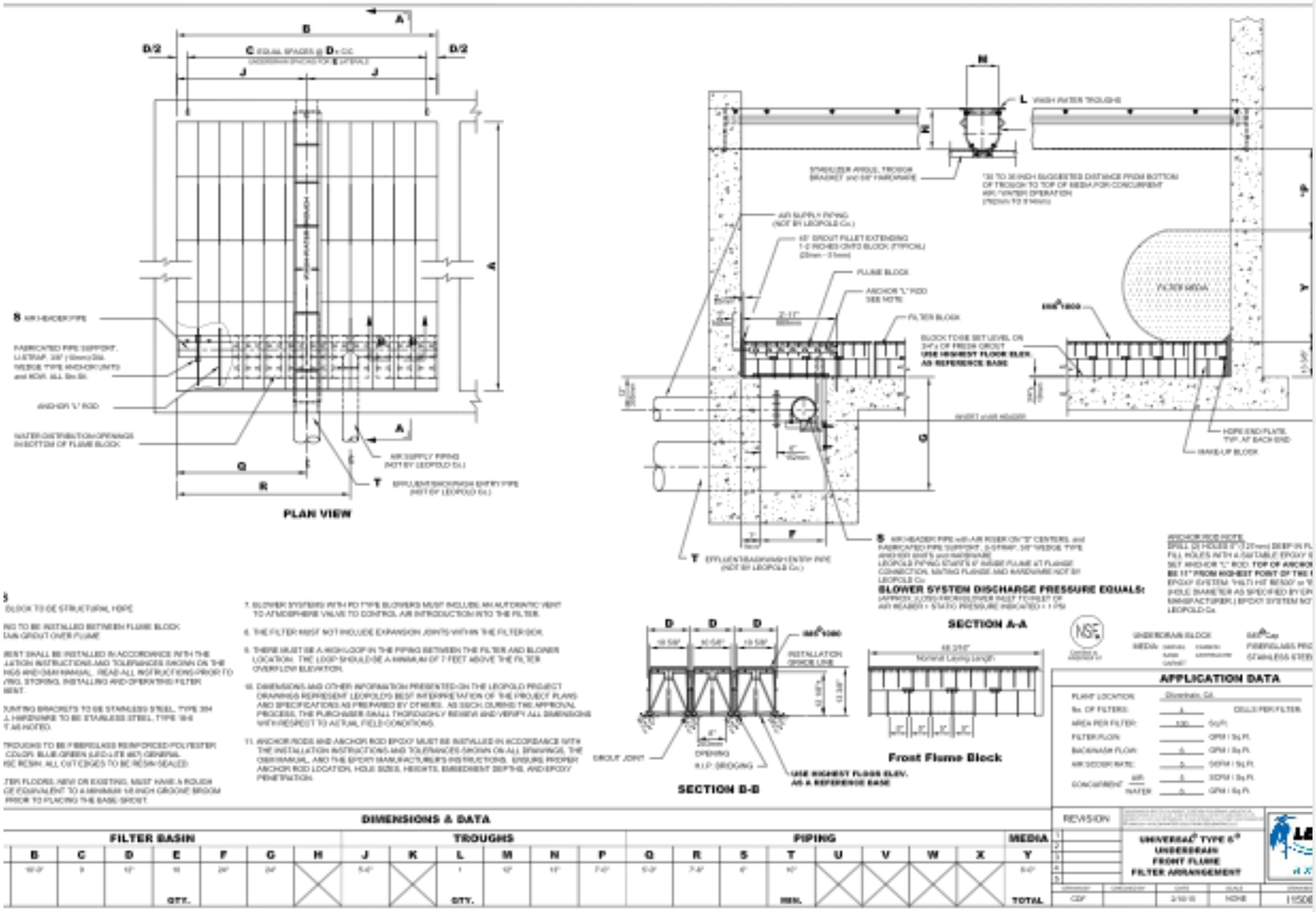
Jeremy

Sent from my iPhone

Begin forwarded message:

> **From:** "Steen, Wayne - Xylem" <Wayne.Steen@Xyleminc.com>
> **To:** "Jeremy Neill" <jeremy@coombshopkins.com>
> **Subject: FW: Olivenhain, CA title 22 reuse**
>
> Wayne Steen
> Sr. Sales Engineer
> 227 South Division Street
> Zelienople, PA 16063
> (O) 724-453-2111
> (M) 724-272-2905
> wayne.steen@xyleminc.com
>
> ---
>
> **From:** Falbo, Chris - Xylem
> **Sent:** Tuesday, February 10, 2015 4:39 PM
> **To:** Steen, Wayne - Xylem
> **Subject:** Olivenhain, CA title 22 reuse
>
> Wayne,
>
> I have attached the proposal and drawing for the title 22 reuse filters. Use a target budget sell price 477k for the system.
>
> Regards,
>
> Christopher D. Falbo
> Sales Engineer, Leopold, USA
> Water Solutions
> 227 South Division Street
> Zelienople, PA 16063
> Office: 724-453-2051
> Fax: 724-453-2122
>
> Linked to http://www.xylem.com/treatment/us/

CONFIDENTIALITY NOTICE: This e-mail, including any attachments and/or linked documents, is intended for the sole use of the intende addressee and may contain information that is privileged, confidential, proprietary, or otherwise protected by law. Any unauthorized reviev dissemination, distribution, or copying is prohibited. If you have received this communication in error, please contact the original sender immediately by reply email and destroy all copies of the original message and any attachments. Please note that any views or opinions presented in this e-mail are solely those of the author and do not necessarily represent those of Xylem Inc.



Xylem Water Solutions USA, Inc.

227 S. Division St.
Zelienople, PA 16063
tel 724-452-6300
fax 724-453-2122
email wayne.steen@xyleminc.com

February 10, 2015

PROPOSAL NO.: I15069

TO: To Whom It May Concern

SUBJECT: Olivenhain, CA

We are pleased to offer the following materials and services by Xylem Water Solutions USA, Inc.

This quotation has been prepared using Leopold's standard specifications.

FILTER UNDERDRAIN SYSTEM:

LEOPOLD UNIVERSAL® TYPE S® UNDERDRAIN:

Under this section, we propose to furnish Leopold Universal® Type S® Underdrain of the Dual/Parallel Lateral type, manufactured from corrosion resistant, high density polyethylene for installation in four (4) filter cells. Each filter cell measures 10'-0" lateral run x 10'-0". The total filter area is 400 square feet.

The blocks shall be arranged end-to-end and mechanically joined with an O-ring to form continuous underdrain laterals approximately equivalent to the length of the filter cell. The joints shall be gasketed, bell and spigot type with internal alignment tabs for proper alignment, and be air and water tight. Joints shall be snap-lock type so that the blocks are joined with integral interlocking snap lugs and lug receptors for ease of assembly and installation of the laterals, and supplied with carbon steel "L" anchor rods.

I.M.S® 1000 MEDIA RETAINER:

Under this section, we propose to furnish 400 square feet of I.M.S® 1000 media retainer. The scope includes molded thermoplastic I.M.S® 1000 media retainer factory installed onto the proposed Leopold Universal® Type S® Underdrain block prior to shipment.

AIR HEADER PIPING:

Under this section, we propose to furnish four (4) Leopold Air Header Assemblies, manufactured from schedule 5, type 304 stainless steel pipe. The air header pipe shall measure 6" in diameter and will run the width of the filter. The air header shall commence with a flange approximately 6" inside the filter cell. Mating flange and hardware is to be supplied by others.

The air header pipe will have J-risers to provide air to each of the individual filter laterals.

Included with the air header pipe are the required type 304 stainless steel supports with securement hardware.

WASH TROUGHS:

Under this section, we propose to furnish four (4) Leopold Reinforced Fiberglass Troughs, Leo-Lite No. 87, measuring 12" wide x 13" deep x 10'-0" long, round bottom construction.

Also included is the standard end hanger assembly fabricated from type 316 stainless steel and type 18-8 stainless steel hardware.

Wash troughs shall have one closed end and one open discharge end with waterstop.

FILTER MEDIA:

Four (4) filter cells, 100 square feet each
TOTAL FILTER AREA: 400 square feet

2,400 cubic feet SILICA SAND 72” Depth plus
Effective size: 1.75 to 1.85mm
Uniformity coefficient: 1.40
116.4 Tons

SUBMITTAL:

Materials meet and/or exceed American Water Works Association Standard B100 (latest revision) for Filtering Material. Samples and/or test reports detailing the physical and chemical characteristics of the filtering material will be provided for review and approval prior to release for shipment.

PACKAGING AND PLACEMENT EQUIPMENT:

Material will be packaged in semi-bulk containers, “Super Bags,” with lifting sleeves and bottom discharge spout, containing approximately 2,000 to 4,000 pounds per sack.

QUANTITIES:

Quantities indicated above are Xylem Water Solutions USA, Inc. best calculations of the quantity requirements. Loss of material due to storage or handling is not covered by this proposal.

FilterWorx™ Control System:

One (1) **Leopold model AFC-5000 Quad Filter Control Panel.** The panel shall be housed in a NEMA 4X rated, 304 stainless steel, wall-mounted enclosure. The panel shall include provisions for the automatic, semi-automatic, and manual control of the filtration and backwashing operations of four (4) filters. Logic functions shall be performed by an Allen Bradley Compact

Logix Series PLC. Manual operation shall be independent of the PLC. Operator interface shall be via a Magelis 2-line LCD touchpad and Square D type ZB4 selector switches, pushbuttons and pilot lights.

Four (4) **Ultrasonic filter level probes.**

One (1) Lot **Spare Equipment** consisting of:
- One (1) PLC DI module
- One (1) PLC DO module
- One (1) PLC AI module
- One (1) PLC AO module
- Two (2) of each type of relay, selector switch, pushbutton, and pilot light used.

AUTOMATIC VALVES:

Under this section we propose to furnish the following 150 lb. Class flanged butterfly valves conforming to AWWA C-504. The valves shall be flanged with EDPM seats, 316 stainless steel shafts and cast iron bodies per ASTM A126. Shaft seals should be self compensating split V-type or O-ring packing made of BUNA-N per AWWA C-504 Class B. The valves shall be supplied with the listed electric operators. Actuators shall be NEMA 4 rated with local visual position indicators, local controls, 2 limit switches, and manual hand wheel override.

Quantity	Function	Size	Service
Four (4)	Effluent	10-inch	open/close
Four (4)	Influent	10-inch	open/close
Four (4)	Backwash Control	8-inch	open/close
Four (4)	Backwash Waste	8-inch	open/close
Four (4)	Air Inlet	6-inch	open/close
One (1)	Air Vent	3-inch	open/close

MANUFACTURER'S SERVICES:

The services of a qualified Leopold technical representative to instruct the Contractor's personnel about the proper installation technique of the equipment will be provided for a period of six (6) days (8 hr/day) on site plus four (4) days travel time to and from the job-site in two (2) trips.

The services of a qualified Leopold technical representative to instruct the Contractor's personnel about the proper installation technique of the Controls Equipment will be provided for a period of six (6) days (8 hr/day) on site plus four (4) days travel time to and from the job-site in two (2) trips.

Additional services may be obtained at the current prevailing rate plus living and travel expenses.

PRICING:

Pricing is for shipments on or before August 10, 2015. We do not include any applicable taxes.

MANUFACTURING LEADTIME:

Please consult our factory for manufacturing lead-times.

BASIS of PRICING:

Any items and/or accessories not specifically called out in this quotation must be construed as being furnished by others.

This quotation is considered firm for 90 days. Orders received more than 90 days after the date of this quotation is reviewed by Xylem Water Solutions USA, Inc. before acceptance and is subject to changes in prices or delivery depending on conditions existing at the time of entry. Quoted prices are firm for delivery within 12 months from the delivery date stipulated in the plans & specifications or mutually agreed upon by Xylem Water Solutions USA, Inc. and Purchase Order issuer at time of order placement.

We do not include any applicable taxes.

Orders resulting from this quotation should be addresses to Xylem Water Solutions USA, Inc. 227 S. Division St., Zelienople, PA, 16063, USA.

We propose to furnish the material described in this document for **a total budget selling price of $477,000,** FCA factory with full freight allowed to the job site.

For final pricing and further information pertaining to the equipment contained in this proposal, please contact our area representative, who is:

Coombs-Hopkins Company
5411 Avenida Encinas
Suite 250
Carlsbad, CA 92008
Phone: (760) 931-0555
Fax: (760) 931-9115

Attention: Jeremy Neill

Payment terms:

10% net 30 days upon initial submittal of mechanical, electrical and I/C drawings for approval
80% net 30 days from the date of the respective shipments of the product
5% installation of the Leopold equipment, NTE 150 days after shipment
5% start-up / training on the Leopold equipment, NTE 180 days after shipment

FILTER MEDIA WARRANTY (if applicable): SELLER warrants that its filter media products will meet the standards established by the latest edition of AWWA (American Water Works Association) B100. SELLER shall be responsible for verifying that the filter media meets or exceeds the AWWA B100 Standard at the point of sale. Testing shall be by an independent laboratory, which regularly performs testing of filter media. BUYER shall notify Xylem Water Solutions USA, Inc. immediately upon discovery of any defective product. The SELLER shall have the right to inspect said product and BUYER shall, if requested, return the defective product to the SELLER with transportation prepaid. NO LIABILITY IS ASSUMED BY THE SELLER UNDER ANY CIRCUMSTANCES FOR LABOR, MATERIAL OR

OTHER COSTS ASSOCIATED WITH THE REMOVAL OR REPLACEMENT OF MEDIA UNLESS PREVIOUSLY APPROVED IN WRITING BY AN AUTHORIZED EMPLOYEE OF THE SELLER.

Respectfully,

Xylem Water Solutions USA, Inc.

Wayne Steen
Sr. Sales Engineer, Leopold

Attachment: Terms of Quotation

Olivenhain, CA I15069

Xylem Water Solutions USA, Inc.
TERMS and CONDITIONS

1. Agreement, Integration and Conflict of Terms. These terms and conditions, together with any special conditions expressly incorporated thereto in the quotation or sales form, are to govern any sale between the Seller and Buyer. The Seller shall mean the applicable affiliate of Xylem Inc. that is party to the Agreement ("Seller"). The Buyer shall mean the entity that is party to the Agreement with Seller. This writing is an offer or counteroffer by Seller to sell the goods and/or services set forth on the quotation or sales form subject to these terms and conditions and is expressly made conditional on Buyer's assent to these terms and conditions. Acceptance by Buyer is expressly limited to these terms and conditions. Any additional or different terms and conditions contained in Buyer's purchase order or other communication shall not be effective or binding upon Seller unless specifically agreed to in writing by Seller; Seller hereby objects to any such conditions, and the failure of Seller to object to specific provisions contained in any purchase order or other communication from Buyer shall not be construed as a waiver of these terms and conditions nor an acceptance of any such provisions. Neither Seller's commencement of performance nor delivery shall be deemed or construed as acceptance of Buyer's additional or different terms and conditions. Buyer agrees that these terms and conditions, together with any accompanying quotation and any special conditions or limited process guarantees or documents referred to or included within the quotation and expressly made a part of this agreement, (e.g., drawings, illustrations, specifications, or diagrams), is the complete and final agreement between Buyer and the Seller ("Agreement"). This Agreement supersedes all prior negotiations, representations, or agreements, either written or oral, between the parties and, further, can only be altered, modified or amended with the express written consent of Seller.

2. Quotation, Withdrawal, Expiration. Quotes are valid for thirty (30) calendar days from the date of issuance unless otherwise provided therein. Seller reserves the right to cancel or withdraw the quotation at any time with or without notice or cause prior to acceptance by Buyer. There is no Agreement if any conditions specified within the quotation ***or*** sales form are not completed by Buyer to Seller's satisfaction within thirty (30) calendar days of Seller's acknowledgement in writing of an order. Seller nevertheless reserves its right to accept any contractual documents received from Buyer after this 30-day period.

3. Prices. Prices apply to the specific quantities stated on the quotation or sales form. Unless otherwise agreed to in writing by Seller, all prices are FCA; Origin (as defined in accordance with the latest version of Incoterms), and do not include transportation costs or charges relating to transportation unless otherwise specified. Prices include standard packing according to Seller's specifications for delivery. All costs and taxes for special packing requested by Buyer, including packing for exports, shall be paid by Buyer as an additional charge. Prices are subject to change without notice.

4. Taxes. The price for the goods does not include any applicable sales, use, excise, GST, VAT, or similar tax, duties or levies. Buyer shall have the responsibility for the payment of such taxes if applicable.

5. Payment Terms. Seller reserves the right to require payment in advance or C.O.D. and otherwise modify credit terms should Buyer's credit standing not meet Seller's acceptance. Unless different payment terms are expressly set forth in the quotation or sales form or order acknowledgment or Sales Policy Manual, goods will be invoiced upon shipment. Payment shall be made in U.S. Dollars. Payment in full is due within thirty (30) days from the invoice date. In the event payment is not made when due, Buyer agrees to pay Seller a service or finance charge of the lesser of (i) one and one-half percent (1.5%) per month (18% per annum), or (ii) the highest rate permitted by applicable law, on the unpaid balance of the invoice from and after the invoice due date. Buyer is responsible for all costs and expenses associated with any checks returned due to insufficient funds. All credit sales are subject to prior approval of Seller's credit department. Export shipments will require payment prior to shipment or an appropriate Letter of Credit. If, during the performance of the contract with Buyer, the financial responsibility or condition of Buyer is such that Seller in good faith deems itself insecure, or if Buyer becomes insolvent, or if a material change in the ownership of Buyer occurs, or if Buyer fails to make any payments in accordance with the terms of its contract with Seller, then, in any such event, Seller is not obligated to continue performance under the contract and may stop goods in transit and defer or decline to make delivery of goods, except upon receipt of satisfactory security or cash payments in advance, or Seller may terminate the order upon written notice to Buyer without further obligation to Buyer whatsoever. If Buyer fails to make payments or fails to furnish security satisfactory to Seller, then Seller shall also have the right to enforce payment to the full contract price of the work completed and in process. Upon default by Buyer in payment when due, Buyer shall immediately pay to Seller the entire unpaid amounts for any and all shipments made to Buyer irrespective of the terms of said shipment and whether said shipments are made pursuant to this Agreement or any other contract of sale between Seller and Buyer, and Seller may withhold all subsequent shipments until the full amount is settled. Acceptance by Seller of less than full payment shall not be a waiver of any of its rights hereunder. Buyer shall not assign or transfer this Agreement or any interest in it, or monies payable under it, without the written consent of Seller and any assignment made without such consent shall be null and void.

6. Delivery, Risk of Loss. Delivery dates are estimates, and time is not of the essence. All shipments will be made FCA; Origin, unless otherwise specified. Seller shall not be responsible to Buyer for any loss, whether direct, indirect, incidental or consequential in nature, including without limitation loss of profits, arising out of or relating to any failure of the goods to be delivered by the specified delivery date. In the absence of specific instructions, Seller will select the carrier. Upon delivery to the common carrier, title and the risk of loss for the material shall pass to Buyer. Buyer shall reimburse Seller for the additional cost of its performance resulting from inaccurate or lack of delivery instructions, or by any act or omission on Buyer’s part. Any such additional cost may include, but is not limited to, storage, insurance, protection, re-inspection and delivery expenses. Buyer further agrees that any payment due on delivery shall be made on delivery into storage as though goods had been delivered in accordance with the order.

Buyer grants to Seller a continuing security interest in and a lien upon the products and the proceeds thereof (including insurance proceeds), as security for the payment of all such amounts and the performance by Buyer of all of its obligations to Seller pursuant to the order and all such other sales, and Buyer shall have no right to sell, encumber or dispose of the products. Buyer shall execute any and all financing statements and other documents and instruments and do and perform any and all other acts and things which Seller may consider necessary, desirable or appropriate to establish, perfect or protect Seller's title, security interest and lien. In addition, Buyer authorizes Seller and its agents and employees to execute any and all such documents and instruments and do and perform any and all such acts and things, at Buyer's expense, in Buyer's name and on its behalf. Such documents and instruments may also be filed without the signature of Buyer to the extent permitted by law.

7. Warranty. For goods sold by Seller to Buyer that are used by Buyer for personal, family or household purposes, Seller warrants the goods to Buyer on the terms of Seller’s limited warranty available on Seller’s website. For goods sold by Seller to Buyer for any other purpose, Seller warrants that the goods sold to Buyer hereunder (with the exception of membranes, seals, gaskets, elastomer materials, coatings and other "wear parts" or consumables all of which are not warranted except as otherwise provided in the quotation or sales form) will be (i) be built in accordance with the specifications referred to in the quotation or sales form, if such specifications are expressly made a part of this Agreement, and (ii) free from defects in material and workmanship for a period of one (1) year from the date of installation or eighteen (18) months from the date of shipment (which date of shipment shall not be greater than thirty (30) days after receipt of notice that the goods are ready to ship), whichever shall occur first, unless an alternate period of time is provided by law or is specified in the product documentation from Xylem (the “Warranty”).

Except as otherwise provided by law, Seller shall, at its option and at no cost to Buyer, either repair or replace any product which fails to conform with the Warranty; provided, however, that under either option, Seller shall not be obligated to remove the defective product or install the replaced or repaired product and Buyer shall be responsible for all other costs, including, but not limited to, service costs, shipping fees and expenses. Seller shall have complete discretion as to the method or means of repair or replacement. Buyer's failure to comply with Seller's repair or replacement directions shall constitute a waiver of its rights and render all warranties void. Any parts repaired or replaced under the Warranty are warranted only for the balance of the warranty period on the parts that were repaired or replaced. The Warranty is conditioned on Buyer giving written notice to Seller of any defects in material or workmanship of warranted goods within ten (10) days of the date when any defects are first manifest. Seller shall have no warranty obligations to Buyer with respect to any product or parts of a product that: (a) have been repaired by third parties other than Seller or without Seller's written approval; (b) have been subject to misuse, misapplication, neglect, alteration, accident, or physical damage; (c) have been used in a manner contrary to Seller's instructions for installation, operation and maintenance; (d) have been damaged from ordinary wear and tear, corrosion, or chemical attack; (e) have been damaged due to abnormal conditions, vibration, failure to properly prime, or operation without flow; (f) have been damaged due to a defective power supply or improper electrical protection; or (g) have been damaged resulting from the use of accessory equipment not sold by Seller or not approved by Seller in connection with products supplied by Seller hereunder. In any case of products not manufactured by Seller, there is no warranty from Seller; however, Seller will extend to Buyer any warranty received from Seller's supplier of such products.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ANY AND ALL OTHER EXPRESS OR IMPLIED WARRANTIES, GUARANTEES, CONDITIONS OR TERMS OF WHATEVER NATURE RELATING TO THE GOODS PROVIDED HEREUNDER, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WHICH ARE HEREBY EXPRESSLY DISCLAIMED AND EXCLUDED. EXCEPT AS OTHERWISE PROVIDED BY LAW, BUYER'S EXCLUSIVE REMEDY AND SELLER'S AGGREGATE LIABILITY FOR BREACH OF ANY OF THE FOREGOING WARRANTIES ARE LIMITED TO REPAIRING OR REPLACING THE PRODUCT AND SHALL IN ALL CASES BE LIMITED TO THE AMOUNT PAID BY THE BUYER HEREUNDER. IN NO EVENT IS SELLER LIABLE FOR ANY OTHER FORM OF DAMAGES, WHETHER DIRECT, INDIRECT, LIQUIDATED, INCIDENTAL, CONSEQUENTIAL, PUNITIVE, EXEMPLARY OR SPECIAL DAMAGES, INCLUDING BUT NOT LIMITED TO LOSS OF PROFIT, LOSS OF ANTICIPATED SAVINGS OR REVENUE, LOSS OF INCOME, LOSS OF BUSINESS, LOSS OF PRODUCTION, LOSS OF OPPORTUNITY OR LOSS OF REPUTATION.

8. Inspection. Buyer shall have the right to inspect the goods upon their receipt. When delivery is to Buyer's site or to a project site ("Site"), Buyer shall notify Seller in writing of any nonconformity of the goods with this Agreement within three (3) days from receipt by Buyer. For all other deliveries, Buyer shall notify Seller in writing of any nonconformity with this Agreement within fourteen (14) days from receipt by Buyer. Failure to give such applicable notice shall constitute a waiver of Buyer's right to inspect and/or reject the goods for nonconformity and shall be equivalent to an irrevocable acceptance of the goods by Buyer. Claims for loss of or damage to goods in transit must be made to the carrier, and not to Seller.

9. Seller's Limitation of Liability. EXCEPT AS OTHERWISE PROVIDED BY LAW, IN NO EVENT SHALL SELLER'S LIABILITY UNDER THIS AGREEMENT EXCEED THE AMOUNT PAID BY BUYER UNDER THIS AGREEMENT. SELLER SHALL HAVE NO LIABILITY FOR LOSS OF PROFIT, LOSS OF ANTICIPATED SAVINGS OR REVENUE, LOSS OF INCOME, LOSS OF BUSINESS, LOSS OF PRODUCTION, LOSS OF OPPORTUNITY, LOSS OF REPUTATION, INDIRECT, CONSEQUENTIAL, INCIDENTAL, PUNITIVE OR EXEMPLARY DAMAGES.

10. Force Majeure. Seller may cancel or suspend this Agreement and Seller shall have no liability for any failure to deliver or perform, or for any delay in delivering or performing any obligations, due to acts or omissions of Buyer and/or its contractors, or due to circumstances beyond Seller's reasonable control, including but not limited to acts of God, fire, flood or other natural disasters, war and civil disturbance, riot, acts of governments, terrorism, disease, currency restrictions, labor shortages or disputes, unavailability of materials, fuel, power, energy or transportation facilities, failures of suppliers or subcontractors to effect deliveries, in which case the time for performance shall be extended in an amount equal to the excused period, provided that Seller shall have, as soon as reasonably practicable after it has actual knowledge of the beginning of any excusable delay, notified Buyer of such delay, of the reason therefor and of the probable duration and consequence thereof. Seller shall use its best efforts to eliminate the cause of the delay, interruption or cessation and to resume performance of its obligations hereunder with the least possible delay.

11. Cancellation. Except as otherwise provided in this Agreement, no order may be cancelled on special or made-to-order goods or unless otherwise requested in writing by either party and accepted in writing by the other. In the event of a cancellation by Buyer, Buyer shall, within thirty (30) days of such cancellation, pay Seller a cancellation fee, which shall include all costs and expenses incurred by Seller prior to the receipt of the request for cancellation including, but not limited to, all commitments to its suppliers, subcontractors and others, all fully burdened labor and overhead expended by Seller, plus a reasonable profit charge." Return of goods shall be in accordance with Seller's most current Return Materials Authorization and subject to a minimum fifteen percent (15%) restocking fee.

Notwithstanding anything to the contrary herein, in the event of the commencement by or against Buyer of any voluntary or involuntary proceedings in bankruptcy or insolvency, or in the event Buyer shall be adjusted bankrupt, make a general assignment for the benefit of its creditors, or if a receiver shall be appointed on account of Buyer's insolvency, or if Buyer fails to make payment when due under this Agreement, or in the event Buyer does not correct or, if immediate correction is not possible, commence and diligently continue action to correct any default of Buyer to comply with any of the provisions or requirements of this Agreement within ten (10) calendar days after being notified in writing of such default by Seller, Seller may, by written notice to Buyer, without prejudice to any other rights or remedies which Seller may have, terminate its further performance of this Agreement. In the event of such termination, Seller shall be entitled to receive payment as if Buyer has cancelled the Agreement as per the preceding paragraph. Seller may nevertheless elect to complete its performance of this Agreement by any means it chooses. Buyer agrees to be responsible for any additional costs incurred by Seller in so doing. Upon termination of this Agreement, the rights, obligations and liabilities of the parties which shall have arisen or been incurred under this Agreement prior to its termination shall survive such termination.

12. Drawings. All drawings are the property of Seller. Seller does not supply detailed or shop working drawings of the goods; however, Seller will supply necessary installation drawings. The drawings and bulletin illustrations submitted with Seller's quotation show general type, arrangement and approximate dimensions of the goods to be furnished for Buyer's information only and Seller makes no representation or warranty regarding their accuracy. Unless expressly stated to the contrary within the quotation or sales form, all drawings, illustrations, specifications or diagrams form no part of this Agreement. Seller reserves the right to alter such details in design or arrangement of its goods which, in its judgment, constitute an improvement in construction, application or operation. All engineering information necessary for installation of the goods shall be forwarded by Seller to Buyer to upon Buyer's acceptance of this Agreement. After Buyer's acceptance of this Agreement, any changes in the type of goods, the arrangement of the goods, or application of the goods requested by Buyer will be made at Buyer's expense. Instructions necessary for installation, operating and maintenance will be supplied when the goods are shipped.

13. Proprietary Information, Injunction. Seller's designs, illustrations, drawings, specifications, technical data, catalogues, "know-how", economic or other business or manufacturing information (collectively "Proprietary Information") disclosed to Buyer shall be deemed proprietary and confidential to Seller. Buyer agrees not to disclose, use, or reproduce any Proprietary Information without first having obtained Seller's express written consent. Buyer's agreement to refrain from disclosing, using or reproducing Proprietary Information shall survive completion of the work under this Agreement. Buyer acknowledges that its improper disclosure of Proprietary Information to any third party will result in Seller's suffering irreparable harm. Seller may seek injunctive or equitable relief to prevent Buyer's unauthorized disclosure.

14. Installation and Start-up. Unless otherwise agreed to in writing by Seller, installation shall be the sole responsibility of Buyer. Where start-up service is required with respect to the goods purchased hereunder, it must be performed by Seller's authorized personnel or agents; otherwise, the Warranty is void. In the event Buyer has engaged Seller to provide an engineer for start-up supervision, such engineer will function in a supervisory capacity only and Seller shall have no responsibility for the quality of workmanship of the installation. In any event, Buyer understands and agrees that it shall furnish, at Buyer's expense, all necessary foundations, supplies, labor and facilities that might be required to install and operate the goods.

15. Specifications. Changes in specifications requested by Buyer are subject to approval in writing by Seller. In the event such changes are approved, the price for the goods and the delivery schedule shall be changed to reflect such changes.

16. Buyer Warranty. Buyer warrants the accuracy of any and all information relating to the details of its operating conditions, including temperatures, pressures, and where applicable, the nature of all hazardous materials. Seller can justifiably rely upon the accuracy of Buyer's information in its performance. Should Buyer's information prove inaccurate, Buyer agrees to reimburse Seller for any losses, liabilities, damages and expenses that Seller may have incurred as a result of any inaccurate information provided by Buyer to Seller.

17. Minimum Order. Seller reserves the right to refuse to process any order that does not meet quantity requirements that Seller may establish for any given product or group of products.

18. Quality Levels. Prices are based on quality levels commensurate with normal processing. If a different quality level is required, Buyer must specify its requirements, as approved in writing by Seller, and pay any additional costs that may be applicable.

19. Product Recalls. In cases where Buyer purchases for resale, Buyer shall take all reasonable steps (including, without limitation, those measures prescribed by the seller): (a) to ensure that all customers of the Buyer and authorised repairers who own or use affected products are advised of every applicable recall campaign of which the Buyer is notified by the Seller; (b) to ensure that modifications notified to Buyer by Seller by means of service campaigns, recall campaigns, service programmes or otherwise are made with respect to any products sold or serviced by Buyer to its customers or authorized repairers. The reimbursement of Buyer for parts and labor used in making those modifications shall be as set forth in the campaign or program instructions. Without the prior consent of the Seller, the Buyer shall not disclose to any third party the information contained in service campaign, recall campaign or service programme literature. Should Buyer fail to perform any of the actions required under this section, Seller shall have the right to obtain names and address of the Buyer's customers and shall be entitled to get into direct contact which such customers.

19. GOVERNING LAW. THE TERMS OF THIS AGREEMENT AND ALL RIGHTS AND OBLIGATIONS HEREUNDER SHALL BE GOVERNED BY THE LAWS OF THE STATE OF SELLER'S OFFICE TO WHICH THIS ORDER HAS BEEN SUBMITTED (WITHOUT REFERENCE TO PRINCIPLES OF CONFLICTS OF LAWS). THE RIGHTS AND OBLIGATIONS OF THE PARTIES HEREUNDER SHALL NOT BE GOVERNED BY THE 1980 U.N. CONVENTION ON CONTRACTS FOR THE INTERNATIONAL SALE OF GOODS.

20. Titles. The section titles are for reference only, and shall not limit or restrict the interpretation or construction of this Agreement.

21. Waiver. Seller's failure to insist, in any one or more instances, upon Buyer's performance of this Agreement, or to exercise any rights conferred, shall not constitute a waiver or relinquishment of any such right or right to insist upon Buyer's performance in any other regard.

22. Severability. The partial or complete invalidity of any one or more provisions of this Agreement shall not affect the validity or continuing force and effect of any other provision.

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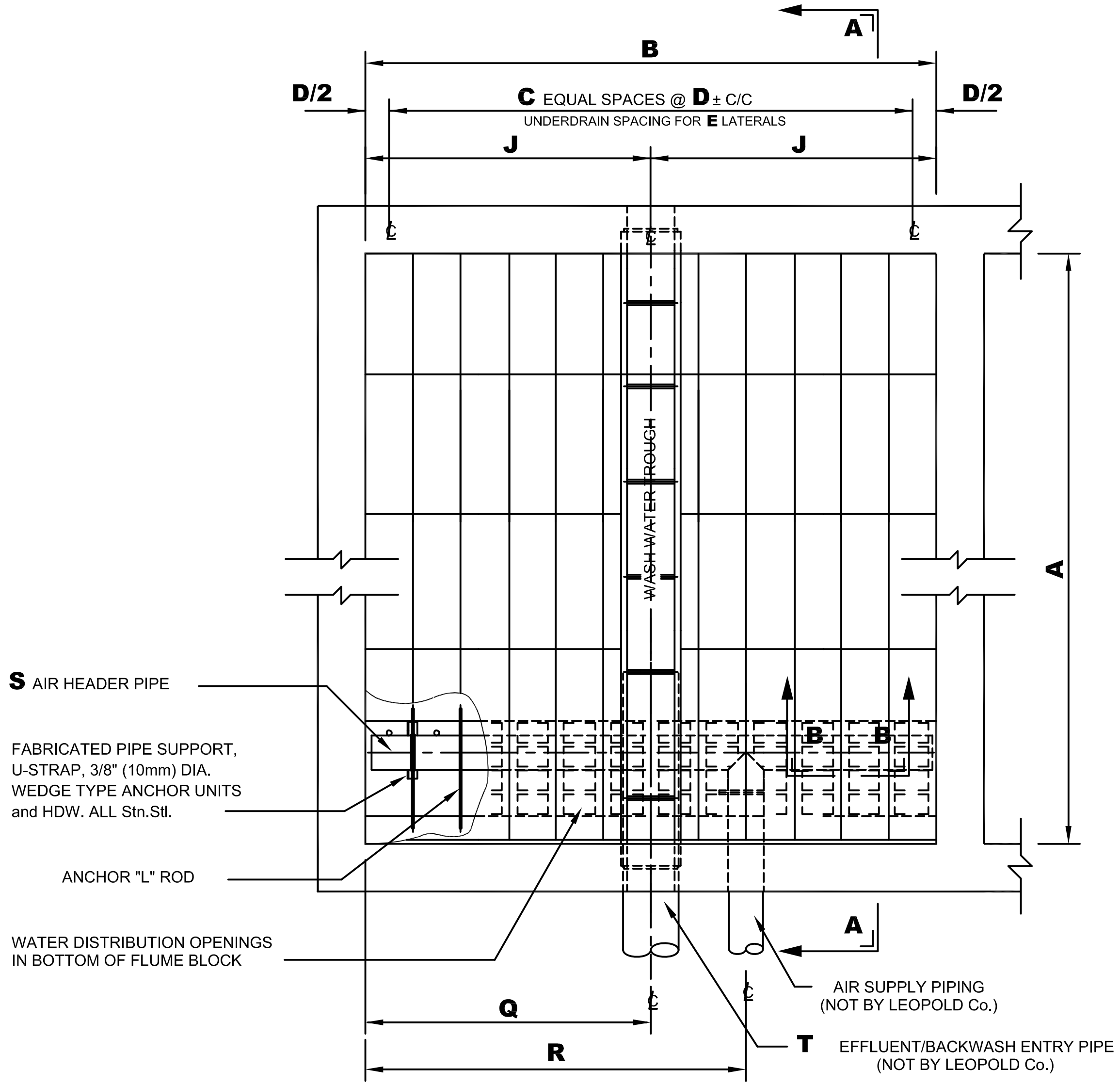
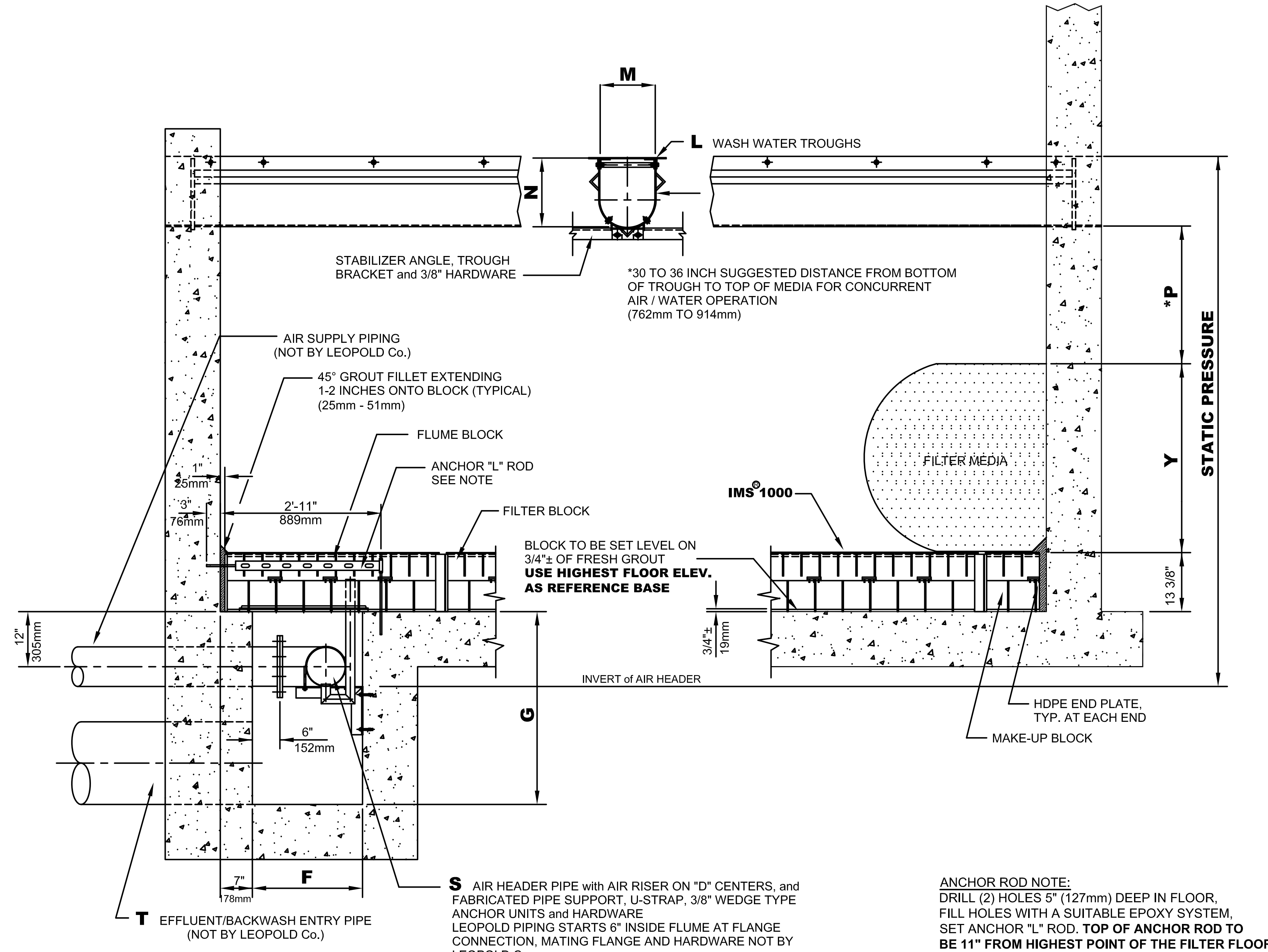


PLAN VIEW



S AIR HEADER PIPE with AIR RISER ON "D" CENTERS, and FABRICATED PIPE SUPPORT, U-STRAP, 3/8" WEDGE TYPE ANCHOR UNITS and HARDWARE
LEOPOLD PIPING STARTS 6" INSIDE FLUME AT FLANGE CONNECTION, MATING FLANGE AND HARDWARE NOT BY LEOPOLD Co.

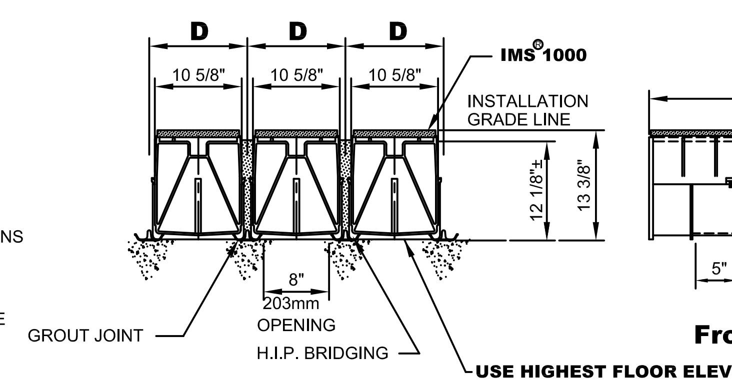
BLOWER SYSTEM DISCHARGE PRESSURE EQUALS:
(APPROX.) LOSS FROM BLOWER INLET TO INLET OF AIR HEADER + STATIC PRESSURE INDICATED + 1 PSI

SECTION A-A

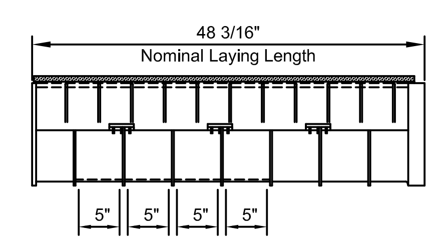
ANCHOR ROD NOTE:
DRILL (2) HOLES 5" (127mm) DEEP IN FLOOR, FILL HOLES WITH A SUITABLE EPOXY SYSTEM, SET ANCHOR "L" ROD. **TOP OF ANCHOR ROD TO BE 11" FROM HIGHEST POINT OF THE FILTER FLOOR** EPOXY SYSTEM: "HILTI HIT RE500" or "EPCON C6". (HOLE DIAMETER AS SPECIFIED BY EPOXY MANUFACTURER.) EPOXY SYSTEM NOT BY LEOPOLD Co.

NOTES

1. FILTER BLOCK TO BE STRUCTURAL HDPE
2. BRIDGING TO BE INSTALLED BETWEEN FLUME BLOCK TO RETAIN GROUT OVER FLUME
3. EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH THE INSTALLATION INSTRUCTIONS AND TOLERANCES SHOWN ON THE DRAWINGS AND O&M MANUAL. READ ALL INSTRUCTIONS PRIOR TO RECEIVING, STORING, INSTALLING AND OPERATING FILTER EQUIPMENT.
4. ALL MOUNTING BRACKETS TO BE STAINLESS STEEL, TYPE 304 AND ALL HARDWARE TO BE STAINLESS STEEL, TYPE 18-8 EXCEPT AS NOTED.
5. WASH TROUGHS TO BE FIBERGLASS REINFORCED POLYESTER RESIN, COLOR: BLUE-GREEN (LEO-LITE #87) GENERAL PURPOSE RESIN. ALL CUT EDGES TO BE RESIN SEALED.
6. ALL FILTER FLOORS, NEW OR EXISTING, MUST HAVE A ROUGH SURFACE EQUIVALENT TO A MINIMUM 1/8 INCH GROOVE BROOM FINISH PRIOR TO PLACING THE BASE GROUT.
7. BLOWER SYSTEMS WITH PD TYPE BLOWERS MUST INCLUDE AN AUTOMATIC VENT TO ATMOSPHERE VALVE TO CONTROL AIR INTRODUCTION INTO THE FILTER.
8. THE FILTER MUST NOT INCLUDE EXPANSION JOINTS WITHIN THE FILTER BOX.
9. THERE MUST BE A HIGH LOOP IN THE PIPING BETWEEN THE FILTER AND BLOWER LOCATION. THE LOOP SHOULD BE A MINIMUM OF 7 FEET ABOVE THE FILTER OVERFLOW ELEVATION.
10. DIMENSIONS AND OTHER INFORMATION PRESENTED ON THE LEOPOLD PROJECT DRAWINGS REPRESENT LEOPOLD'S BEST INTERPRETATION OF THE PROJECT PLANS AND SPECIFICATIONS AS PREPARED BY OTHERS. AS SUCH, DURING THE APPROVAL PROCESS, THE PURCHASER SHALL THOROUGHLY REVIEW AND VERIFY ALL DIMENSIONS WITH RESPECT TO ACTUAL FIELD CONDITIONS.
11. ANCHOR RODS AND ANCHOR ROD EPOXY MUST BE INSTALLED IN ACCORDANCE WITH THE INSTALLATION INSTRUCTIONS AND TOLERANCES SHOWN ON ALL DRAWINGS, THE O&M MANUAL, AND THE EPOXY MANUFACTURER'S INSTRUCTIONS. ENSURE PROPER ANCHOR ROD LOCATION, HOLE SIZES, HEIGHTS, EMBEDMENT DEPTHS, AND EPOXY PENETRATION.



SECTION B-B



Front Flume Block

NSF Certified to ANSI/NSF 61

UNDERDRAIN BLOCK MEDIA: GRAVEL, SAND, GARNET, CARBON, ANTHRACITE
IMS® Cap
FIBERGLASS PRODUCTS
STAINLESS STEEL PRODUCTS

APPLICATION DATA

PLANT LOCATION:	Olivenhain, CA		
No. OF FILTERS:	4	CELLS PER FILTER:	1
AREA PER FILTER:	100 Sq.Ft.		
FILTER FLOW:	GPM / Sq.Ft.		
BACKWASH FLOW:	6 GPM / Sq.Ft.		
AIR SCOUR RATE:	5 SCFM / Sq.Ft.		
CONCURRENT AIR	5 SCFM / Sq.Ft.		
CONCURRENT WATER	6 GPM / Sq.Ft.		

DIMENSIONS & DATA

FILTER BASIN								TROUGHS						PIPING								MEDIA
A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	U	V	W	X	Y
10'-0"	10'-0"	9	12"	10	24"	24"		5'-0"		1	12"	13"	7'-0"	5'-0"	7'-6"	6"	10"					6'-0"
				QTY.						QTY.							MIN.					TOTAL

REVISION	
1	
2	
3	
4	
5	

UNIVERSAL® TYPE S® UNDERDRAIN FRONT FLUME FILTER ARRANGEMENT

LEOPOLD a xylem brand

DRAWN BY	CHECKED BY	DATE	SCALE	DRAWING NUMBER	REV
CDF		2/10/15	NONE	I15069.90.1	00

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Appendix D:
Cloth Filter Budgetary Quote and
CDPH Redundancy Correspondence Letter

Five Star Filtration LLC
12621 Highway 105 West, Suite 205 • Conroe, Texas 77304 - 1315 USA • 936.588.5033 • 936.588. 4110 fax
e-mail: jay@5starfiltration.com Website: http://www. 5starfiltration.com

May 8, 2015

Mr. Brett Faulkner
Trussell Technologies, Inc.
360 Stevens Avenue, Suite 308
Solana Beach, CA 92075

Reference: **4S Ranch WWTP**
Cloth Media Filter – BUDGET Cost
Five Star Proposal No 2384-055

Gentlemen,

We appreciate the opportunity to provide this proposal for the project referenced above.

The Five Star Disk Filter is a CA Department of Health Services Certified Title 22 product utilizing the latest developments in the continuous cloth media filtration market. The benefits from this design are numerous and easily realized.

Five Star Filtration is pleased to offer one (1) Five Star Disk Filter Model FSDF-4D84D-CS. The equipment will be furnished assembled ready to be mounted on a concrete foundation. The filter design provides redundancy (allowed by CaDPH) by providing one additional disk more than is required to handle 100% of Design Flow with one disk removed from service. No field welding will be required.

Description of Operation

The Five Star Disk Filter Model FSDF-4D84D-CS utilizes an outside-in flow pattern, and a stationary disk to minimize mechanical requirements of the system. The disk modules are designed for easy removal without the need to dewater the tank or take the system offline. All components of the system are constructed from corrosion resistant materials that have been designed for continuous operation.

The flow enters the tank through the influent nozzle and distribution trough. As the water passes through the cloth material, it enters into the core of each disk module. The water exits each disk through one filtrate line located on the top of the disk. This line passes the filtrate to the filtrate collection trough. During the normal filtration process, the entire filter is in a static mode. As the filter cloth collects solids on the outer surface, headloss across the media gradually increases to a set point elevation in the tank. At this point, the backwash cleaning system energizes in a set sequence of cleaning operations. Influent will continue to be processed during the backwash cleaning cycle, allowing for continuous filtration, 24 hours per day.

The units backwash cleaning system is controlled by a Allen-Bradley PLC based operation system furnished with the filter equipment. The cleaning mechanism will not be in contact with the filter cloth. This eliminates any possibility of solids being forced into and through the cloth or unnecessary wear to the cloth. Each filter cloth is removable from the tank and replaceable in the field while the filter remains in operation.

Based on the requirements, the two filter system will be designed as follows:

Average Daily Flow:		1,390 USgpm (2.0 MGD)
Total filter area available:		288 ft^2
Filter Area flow rate (Design Flow):		4.82 gpm/ ft^2
Influent to Filters	TSS Average	20 mg/L

Filtration will be accomplished within one (1) unit, mounted on a concrete foundation (by others) with four (4) disks installed. The structural dimensions are 12'-0” W x 11'-6" L x 10'-6" H. These dimensions are subject to minor adjustments.

Items Furnished by Five Star Filtration

The proposed Five Star Disc Filter System will be complete and will include the following:

(1)	carbon steel filter tank with epoxy coating
(4)	filter disk modules (304 stainless steel) with filter grid and cloth media
(1)	center vacuum tube assembly complete with eight (8) vacuum shoes
(1)	0.33 HP drive unit with 480 volt, 60 Hz, 3 phase motor, polyethylene drive sprocket, nylon chain with stainless steel link pins and guards
(4)	disk isolation valves
(2)	vacuum pump for backwash system consisting of and externally mounted centrifugal pump on base plate with a 5 HP 480 volt, 60 Hz., 3 phase motor; two (2) electric actuated valves for backwash and one (1) electric actuated valve for sludge withdrawal
(1)	UL Listed PLC control panel with NEMA 4X, 304 stainless steel enclosure to include but not limited to main disconnect circuit breaker, GFI receptacle, terminal blocks, motor starters for pumps and drives, pilot lights. Submersible level transmitter and support brackets

Spare Parts are included in the proposal and include:

(2) swivel joint seal & repair kits

(2) swivel joint ball bearing kits

(4) shear pins

(4) filter cloth (one complete set)

Items Furnished by Others

Equipment unloading and installation, including plumbing and electrical from components to control panel enclosure

Purchase Price

The TOTAL PRICE for one (1) Model FSDF-4D84D-CS with four (4) disks installed and as described herein is: **$** 298,000 ***US Dollars***

This price includes freight and service to the jobsite.

Startup Supervision and Operator Training

The price of this proposal INCLUDES installation inspection, filter startup supervision and operator training consisting of one (1) trip and three (3) days onsite. These and additional services may be provided in accordance with the attached form labeled "SERVICE TERMS".

Equipment Delivery

Submittal of drawings for customer approval can be forwarded one (1) week after receipt of a notice of selection. Shipment of equipment is estimated at 10 to 12 weeks after receipt of approved drawings and a release to manufacture.

Terms of Payment

25% upon approval of submittals

70% upon shipment to jobsite

5% retainage, not to exceed 90 days from shipment

ALL payments shall be direct to Five Star Filtration by wire transfer.

General Information

Five Star Filtration Service Terms, and Warranty Statements are attached and apply.

Five Star Filtration prices do not include sales, use, excise, or other similar taxes, and all such taxes will be paid by the purchaser at the commencement of the contract, if applicable.

Time of Acceptance

This proposal is valid for a period of sixty (60) days from the date of this proposal unless extended in writing by Five Star Filtration, LLC.

Sincerely,

FIVE STAR FILTRATION, LLC

Jay S. Stevens

Jay S. Stevens
President

Attachments: Service Terms, Warranty Statement
FSDF-4D84D-CS-100 General Arrangement Drawing

Cc: Jeremy Neill - Coombs Hopkins Company
Jason Stevens - FSF
Brad Kocian - FSF
file

STANDARD TERMS AND CONDITIONS

Standard Terms and Conditions shall apply and form part of the within quotation except as expressly otherwise agreed by an officer of FIVE STAR FILTRATION, LLC (“Five Star”).

ACCEPTANCE: Unless otherwise expressly stated herein, this quotation shall expire thirty (30) days after its date.

DELIVERY: Except as otherwise specified in this quotation, delivery will be Ex-Works, Conroe, Texas. Time of Delivery is an estimate only and is based upon the receipt of all information and necessary approvals. The company shall in no event be liable for delays caused by fires, acts of God, strikes, labor difficulties, and acts of governmental or military authorities, delays in transportation or procuring materials, or causes of any kind beyond the company’s control.

WARRANTIES: The equipment offered is warranted in accordance with the terms of Five Star's standard warranty which is hereby made part of this proposal.

PRICES: All prices exclude sales, use, occupation, license, excise and other taxes in respect to manufacture, sale or delivery, all of which shall be paid by the buyer unless a proper exemption certificate is furnished.

TERMS: If not otherwise specified in the quotation, the terms of payment shall be balance net within **thirty (30**) days after invoice date. In all cases payment, other than initial payments, shall be made pro rata as principal items are shipped. In the event delay in making shipment is caused by buyer, payment for such shipment shall be due thirty (30) days from date Five Star notifies buyer that Five Star is prepared to make such shipment. If buyer delays completion of manufacture, Five Star may elect to require payment according to percentage of completion. Machinery held for buyer shall be at buyer’s risk and expense.

CANCELLATION CHARGES: In the event the buyer elects to cancel the order or if any proceeding be instituted by or against buyer under any bankruptcy or insolvency law, or if in Five Star 's judgment, buyer’s financial situation justifies such action, Five Star may, at its election exercisable at any time prior to delivery require payment in advance or cancel the order as to any unshipped items and require payment of its reasonable cancellation charges.

Schedule of Cancellation Charges

Attained Milestone	% of P.O Contract Value
Prior to Submittal	5%
Subsequent to Submittal Approval	15%
Subsequent to Release to Production	50%
Subsequent to Initiation of Equipment Assembly	100%

BACKCHARGE(S)/CHANGE ORDER(S): Five Star shall not accept any backcharges unless written approval has been furnished by an authorized Five Star employee prior to work/task commencement. An authorized Five Star employee prior to commencement must execute all change orders.

TITLE AND LIEN RIGHTS: The equipment shall remain personal property, regardless of how affixed to any realty or structure until the price (including any notes given therefore) of the equipment has been fully paid in cash. The company shall, in the event of customer’s default, have the right to repossess such equipment.

THIS QUOTATION MAY BE CHANGED OR BE REVOKED AND WITHDRAWN BY THE COMPANY AT ANY TIME UPON WRITTEN NOTICE TO THE BUYER.

SERVICE TERMS

1. **Rates**

Service rates are as follows per 8-hour man-day during normal working hours:

	Monday-Friday	Saturday	Sunday & Holidays
Service Technicians	$1,000/day	$1,250/day	$1,500/day

Overtime service rates on an hourly basis in excess of 8 hours worked are as follows:

	Monday-Friday	Saturday	Sunday & Holidays
Service Technicians	$125.00/hr	$156.25/hr	$187.50/hr

All above rates are in U.S. dollars. Travel time is included as working time. Parts and expenses are additional. Terms - payable upon receipt of invoice.

2. **Minimum Billing**

A minimum charge of 1/2 day's time will be made. Billing will be made in 1/2 day increments for time each day at job and/or traveling during normal working hours. Thus, five hours spent on job and/or traveling is billed as one full day.

3. **Normal Working Time**

Eight hours per day with one hour for lunch, Monday - Friday, except observed holidays.

4. **Travel**

Travel arrangements are made with 14-day advance purchase. Should the agreed travel dates change due to no fault of Five Star and additional costs be levied, such costs shall be chargeable.

These Include:

- Plane, Train and/or Automobile rental cost from Five Star, Conroe, Texas, to the customer's plant or construction site and return.
- Private Automobile travel at the current IRS published rate.
- Expenses also include all local travel.
- Living expenses for lodging, meals and incidental costs.
- Telephone calls and wires, as required in connection with the details of the job.
- When our service representative goes from job to job rather than returning to his headquarters, an equitable distribution or travel charge will be made.

A 20% charge will be added to cover administration costs on all travel and living expenses.

5. **Parts**

All parts supplied will be billed at selling prices. Service work by others under our authorization will be billed at our cost plus 20% overhead.

6. **Limits of Liability**

As our representatives are authorized to work on Five Star equipment, all responsibility for operation rests with the customer. Five Star shall not be liable for any claims, losses, labor, expenses, or damages, direct or consequential, resulting directly or indirectly from the service performed hereunder or for other consequential loss or damage of any nature arising from any cause.

7. **Authorization**

Five Star will not commence any service work until an official Purchase Order for the work has been received.

WARRANTY

FIVE STAR FILTRATION, LLC warrants for a period of twelve (12) months from start up, not to exceed eighteen (18) months from date of shipment, the new equipment of its own manufacture to be free from defects in material and workmanship under normal use and service when used and maintained in accordance with Operation and Maintenance Instruction Manual supplied by Five Star. Five Star's obligation under this warranty being limited to repairing or replacing, at its option, any part found to its satisfaction to be defective, providing that such part is, upon request, returned to Five Star's factory, freight prepaid. This warranty does not cover parts damaged by decomposition from chemical action or wear caused by abrasive materials, nor does it cover damage resulting from misuse, accident, neglect or from improper operation, maintenance, installation, modification, or adjustment. This warranty also excludes the coating when the equipment is constructed from a corrosive material such as carbon steel. Five Star will warrant the coating for one year and will not cover any corrosion due to damaged coating or misuse during the warranty period.

Filter cloth bags are warranted for 3 years from initial startup of the equipment. Five Star offers the 3-year prorated warranty on the filter cloths based on a pre-determined number of backwash cycles per year (8,000 backwash cycles per year for this project as recorded by the PLC control system). Feed pumps, backwash pumps and drive motors/gearboxes are warranted by the original manufacturer, not by Five Star.

Five Star shall not be liable for indirect or consequential damages, whether or not caused by seller's neglect. Consequential damages for the purposes of this agreement shall include, but not be limited to, loss of use, income or profit, or loss of or damage to property occasioned by or arising out of the operation, use, installation, repair or replacement of the equipment or otherwise.

"Start up" for the purpose of this agreement shall be the date when the equipment is first placed into operation regardless of the status of other items, i.e. chemical feed systems, and polymer feed systems, piping, etc., at that time.

All parts repaired or replaced under this warranty will continue coverage on a prorated basis of the original warranty.

The company shall in no event be liable for damage caused by acts of force majeure, including but not limited to acts of war, fires, acts of God, strikes, and labor difficulties, acts of governmental or military authorities, civil unrest, or causes of any kind beyond the company’s control.

Service may be refused to any area designated as High Risk by the company. This refusal will take precedence over any other agreed terms.

January 22, 2009

Mr. Jay Stevens, President
Five Star Filtration, LLC
35 Wellington Lane
Conroe, Texas 77304-1315

Subject: Redundancy Requirements
California Water Recycling Criteria

Dear Mr. Stevens:

First, concerning "the system shall be provided such that 100% of the flow shall be accommodated with one unit out of service", you're likely referring to Article 10 (Reliability Requirements for Full Treatment), Section 60351 (Filtration), which cites five options for meeting reliability criteria for filtration. It's important to note that only one of these must be met.

Subsection (a) states "Alarm and multiple filter units capable of treating the entire flow with one unit not in operation". If this were the option selected, you would need multiple units, since as you note, there are ancillary equipment components (e.g. backwash pumps/backwash drive). If option (b) were selected and, in addition to short term retention, you have standby replacement parts for these ancillary components, in addition to a sufficient number of disks in the unit to treat the entire flow (or replacement disks if a disk failed), this would also meet the intent of Section 60351.

I hope this gives you the clarifications you're looking for…if not…please give me a call.

Sincerely,

Original Signed by;

Jeffrey L. Stone, Chief
Recycled Water Unit
Division of Drinking Water
and Environmental Management

CDPH-Recycled Water Unit
1180 Eugenia Place, Ste. 200
Carpinteria, CA 93013
Phone (805) 566-9767
FAX (805) 745-8196

APPENDIX G

TM3B – Disinfection Alternatives

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TECHNICAL MEMORANDUM #3B

To: George Briest, Olivenhain Municipal Water District

Author(s): Greg Guillen, Ph.D., P.E.; Phil Giori

Reviewer(s): Tom Falk, P.E.

Date: June 2015

Subject: 4S Ranch Water Reclamation Facility, Disinfection Alternatives

1. INTRODUCTION

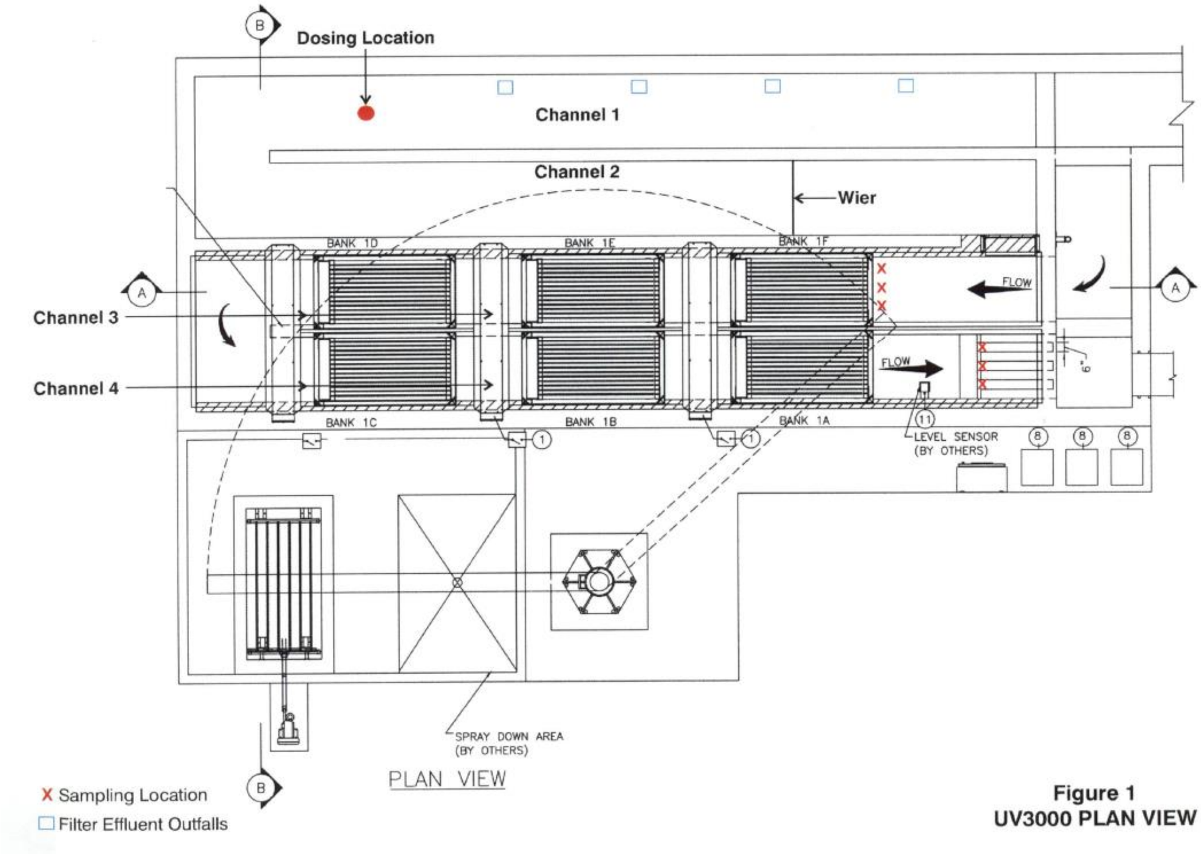
The Olivenhain Municipal Water District (District) contracted Dudek to prepare an Operations and Condition Assessment and Capital Improvement Plan for the 4S Ranch and Rancho Cielo Sanitation Districts that will guide strategic planning and investments for the District's collection, treatment, and reuse programs.

This Technical Memorandum #3B (TM3B) presents the evaluation of disinfection alternatives for the 4S Ranch Water Reclamation Facility.

2. CURRENT 4S RANCH WRF DISINFECTION SYSTEM

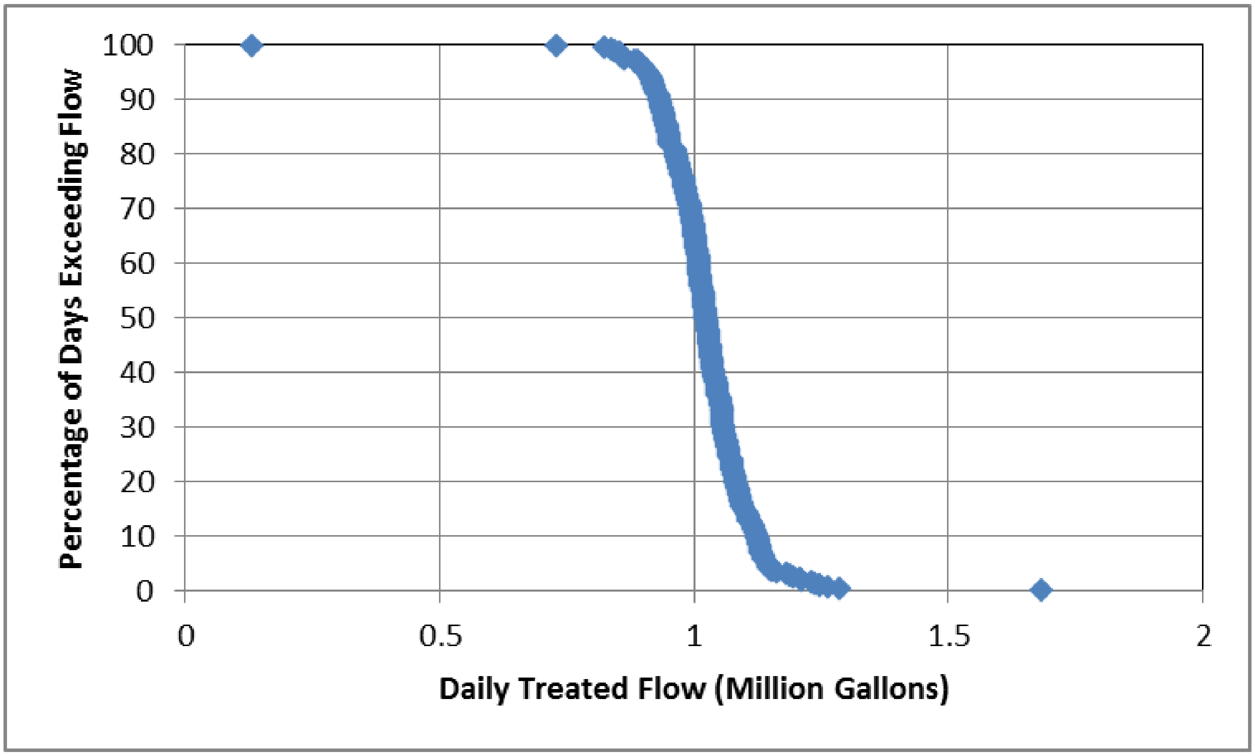
Olivenhain Municipal Water District (OMWD, District) currently utilizes ultraviolet (UV) disinfection at its 4S Ranch Water Reclamation Facility (WRF). Originally commissioned in 2002, the Trojan UV3000 system was designed to treat 2.0 mgd of tertiary effluent using six duty UV banks with a UV transmittance (UVT) of 55%. The current system contains six UV banks in series. Each bank houses 14 modules. Each module has its own ballast and holds 8 low pressure, low output 87.5 W UV lamps. There are a total of 672 lamps in the existing UV disinfection system. The UV banks are located in a serpentine concrete channel formerly used for chlorine disinfection. The channel measures 42 inches wide with four passes each 46 feet long. Channel water depth ranges from 23.5 inches to 25.25 inches based on flow and location within the channel. Lamps are oriented parallel to the direction of water flow. The UV system is gravity fed with filtered water from existing packaged sand filters (Hydro-Clear). UV dose is determined by tertiary effluent flow rate and UVT. Individual banks may be turned on or off to deliver the required UV dose. Modules are periodically removed from the channel for manual cleaning using phosphoric acid to remove scale. A schematic of the UV3000 system at 4S Ranch WRF is shown in Figure 1 [Carollo].

Figure 1: Plan view of existing UV3000 system at 4S Ranch WRF



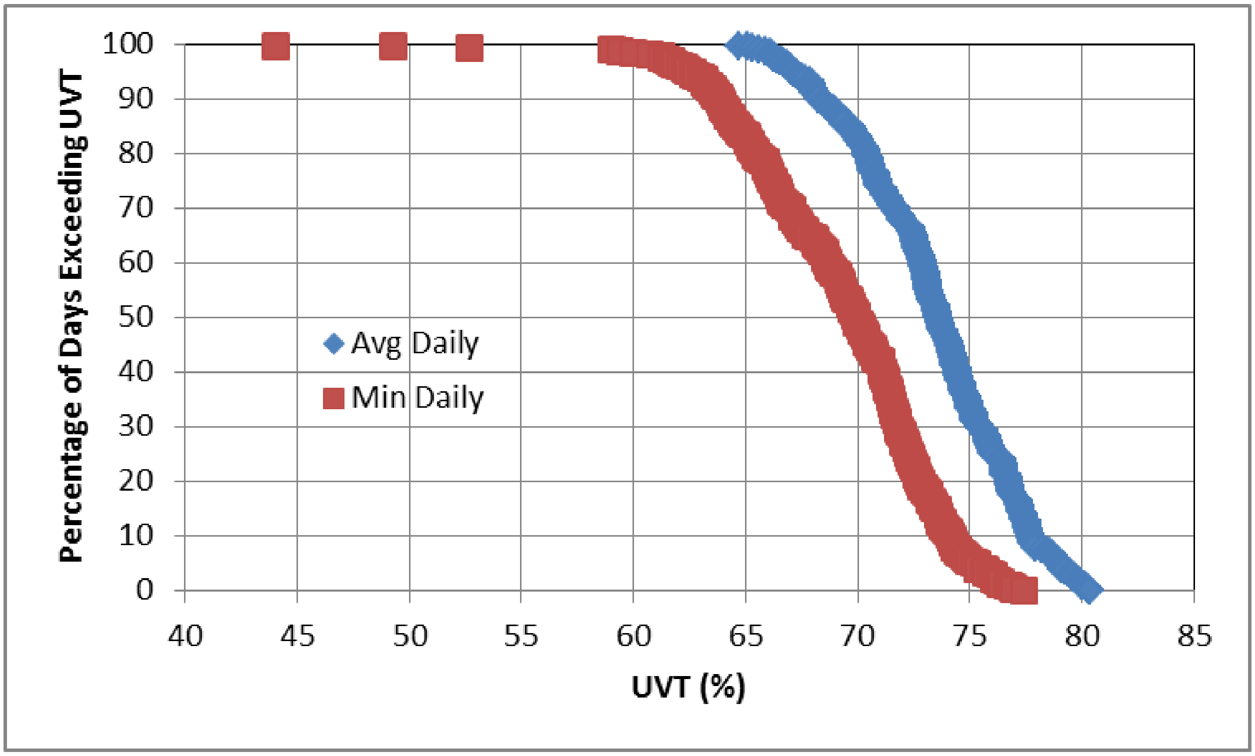
UV system flow rates for September 2013 through August 2014 are plotted in Figure 2. Daily UV-treated flow exceeded 930,000 gallons for 90% of the days during the analyzed time period, 1,000,000 gallons for 50% of the days, 1,120,000 gallons for 10% of the days, and treated a total of approximately 374 million gallons of tertiary effluent. These flows are approximately 20% greater than the plant influent flows provided in Technical Memorandum #3. The additional UV-treated flow is likely due to wash water (belt filter press) and chemical make down water. Treated UV flow is approximately 20% lower than the tertiary filter feed flow rates given in Technical Memorandum #3A potentially due to the additional re-filtering of backwash water. See Technical Memorandum 3 for further discussion of plant internal recycle rates.

Figure 2: Probability plot for 4S Ranch WRF daily treated tertiary flow



System feed water UVT data for September 2013 through August 2014 are plotted in Figure 3. Average daily and the minimum measured daily UVT values are shown. The minimum measured UVT exceeded 63% on 90% of the days on which it was measured. The average daily UVT exceeded 68% on 90% of the days on which it was measured.

Figure 3: Probability plot for 4S Ranch WRF UV system feed UV transmittance



The National Water Research Institute (NWRI) in collaboration with the Water Research Foundation (WRF) has published UV disinfection guidelines for water reuse [National Water Research Institute]. In these guidelines it is stated that UV systems may be designed for the 10th percentile UVT value if UVT data have been collected for a minimum of 6 months. The data must include wet weather flows and a minimum of 3 samples per day spaced equally over the operating period. UVT data presented in Figure 3 demonstrate that 4S Ranch WRF 10th percentile UVT is approximately 68%. However, these are reported herein as average daily values. Per the 4S Ranch WRF waste discharge requirements (WDR), the District should be able to demonstrate "3 samples per day spaced equally over the operating period" using existing data. The District should consider collecting the required data to demonstrate a higher acceptable design UVT. This would allow for more efficient operation of the current UV disinfection system, and it would enable the design of a smaller future UV disinfection system with fewer lamps and less O&M costs.

The waste discharge requirements (WDR) for the UV disinfection system at 4S Ranch WRF (R9-2003-0007, Addendum No. 2, 2005) require the following:

- Average daily flow rate from the UV disinfection system shall not exceed 2.0 mgd
- Continuous recording of flow rate, UVT, and turbidity
- Tertiary effluent UVT shall be 55% or greater at all times
- The minimum UV dose shall be 100 mJ/cm^2 at all times
- Lamp age shall not exceed 18,500 hours

- Lamp quartz sleeves shall be cleaned a minimum of every 4 months
- Lamp loading shall be within the range of 3.75 – 12.5 gallons per minute per lamp

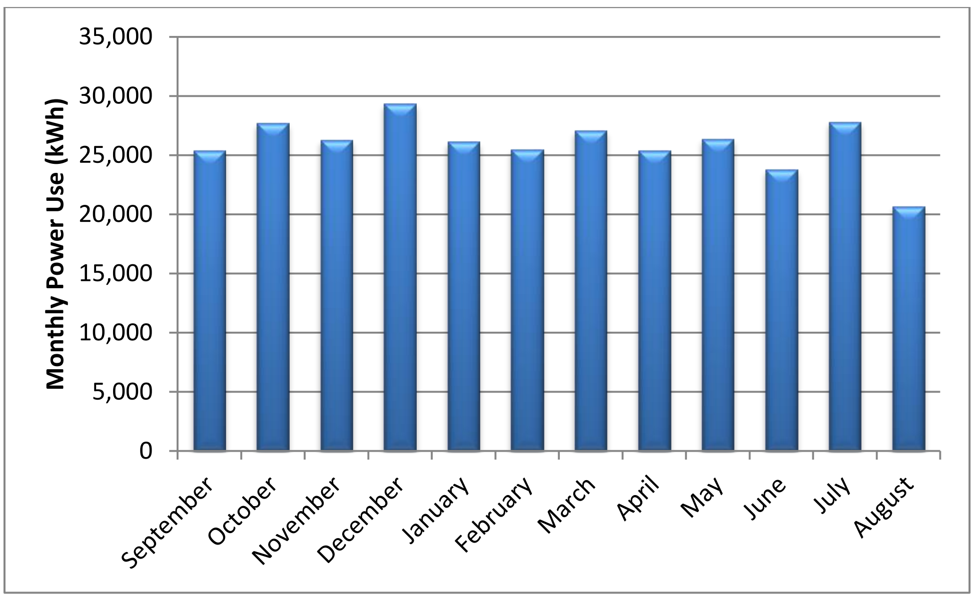
The delivered UV dose (mJ/cm^2) for the 4S Ranch WRF UV system is calculated using Equation 1

$$\text{UV Dose} = 0.728 * N * 10^{[1.59+0.42\log(UVT)-0.78\log(F)]}, \tag{1}$$

where *N* is the number of banks in operation, *UVT* is the percent UV transmittance at 254 nm, and *F* is the UV system flow rate divided by the number of lamps in operation (gpm/lamp). The 0.728 multiplier is a product of the end of lamp life factor (0.91) and the quartz fouling factor (0.80) (WDR). This equation is only valid for the current UV system at 4S Ranch WRF utilizing Phillips lamps model number G64T5L within a UVT range of 53% - 66% [Carollo]. Additional validation testing would be required if the District wished to use different UV lamps.

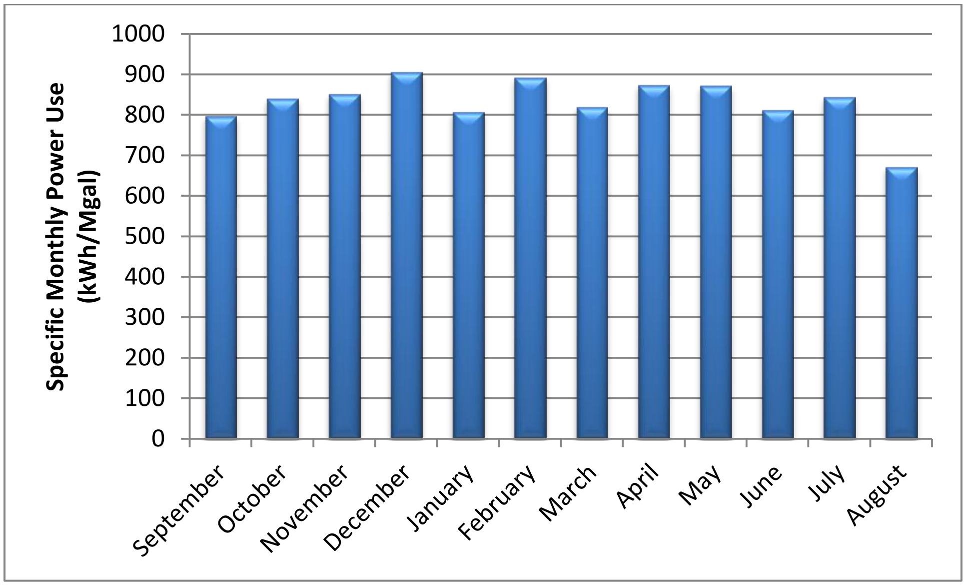
Monthly power use was determined from UV3000 system operations data. Power use is plotted in Figure 4 for September 2013 through August 2014. During this time period the UV system consumed approximately 312,000 kWh of electricity, with monthly power use ranging from 20,000 kWh-30,000 kWh.

Figure 4: Monthly power use for 4S Ranch WRF UV system



A more useful way to analyze the power use data is to normalize by the amount of tertiary effluent treated. This gives a more accurate picture of the current energy requirements for UV disinfection. Monthly power use normalized by the monthly treated flow is plotted in Figure 5 for September 2013 through August 2014. Specific monthly power use ranged from 670 kWh per million gallons treated to 900 kWh/Mgal. Annual specific power use for the same time range was 830 kWh/Mgal.

Figure 5: Specific monthly power use for 4S Ranch WRF UV system



UV lamps, per the 4S Ranch WRF WDR, are cleaned every 4 months using a phosphoric acid solution and are replaced at least every 18,500 hours at a cost of $33 per lamp. For the purposes of this analysis, it is assumed that 8 hours of labor are required to clean a single UV bank at a labor rate of $50/hr. Banks are cleaned 3 times per year for a total of 18 bank cleanings per year resulting in an estimated annual labor cost of $7,200. Approximately 3,560,000 lamp-hours were accumulated from September 2013 through August 2014, which results in a minimum (10,000 hr average lamp life) annual lamp replacement cost of $13,200.

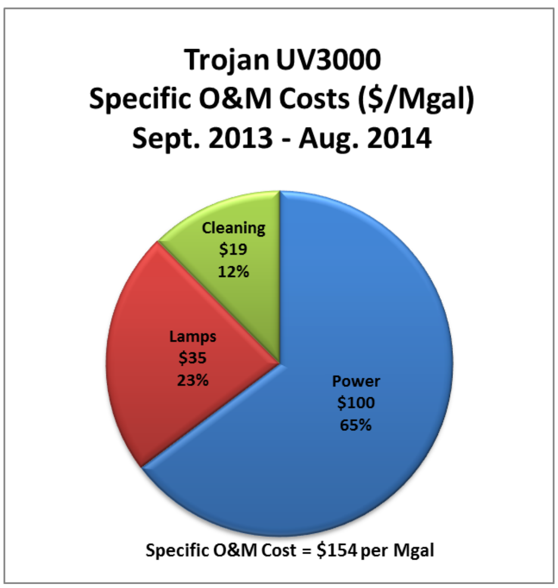
Power, lamp replacement, and cleaning costs for the 4S Ranch WRF Trojan UV3000 system for September 2013 through August 2014 are summarized in Table 1. It is estimated that the existing UV system O&M cost for this time period was $58,000, or $154/Mgal.

Table 1: Estimated annual O&M costs for existing 4S Ranch WRF UV disinfection system

Trojan UV3000	Sept. 2013 - Aug. 2014
Treated Volume Treated (Mgal)	374
Power Use (kWh)	312,000
Electricity Cost ($/kWh)	$0.12
Power Cost ($)	$37,440
Specific Power Cost ($/Mgal)	$100
Lamp Replacements (No.)	400
Lamp Cost ($/lamp)	$33
Lamp Replacement ($)	$13,200
Specific Lamp Replacement ($/Mgal)	$35
UV Bank Cleaning (hrs)	144
Labor Rate ($/hr)	$50
Cleaning Labor ($)	$7,200
Specific Cleaning Labor ($/Mgal)	$19
Total ($)	$57,840
Total ($/Mgal)	$154

Relative O&M costs are presented in the Figure 6. Power consumption makes up the majority of O&M costs of the existing UV system followed by cleaning and lamp replacement.

Figure 6: O&M costs for existing 4S Ranch WRF UV disinfection system.



3. DISINFECTION ALTERNATIVES

3.1 Disinfection Alternative 1 – UV rehab/controls upgrade

The District may continue to operate the UV3000 disinfection system. However, the existing UV3000 system controls are obsolete, are no longer supported by Trojan, and will not be serviced by Trojan. If the control system fails, the District would need to quickly find another entity for repairs or make repairs in-house. This raises reliability and regulatory compliance concerns for the disinfection system. In addition, the existing system does not have the ability to turn off individual modules or lamps; it can only turn on/off individual banks in an attempt to match UV dose with flow and UVT, which in turn leads to inefficient energy use.

Trojan has indicated that the existing control system may be upgraded to more current, supported Trojan control technology. Upgrading the PLC would not require any changes to the existing UV channel and mechanical equipment and has the added benefit that should the District decide to upgrade the UV system in the future to another Trojan system, the upgraded controls could be used on the new UV system. Upgrading the PLC, however, would not enable control of individual modules or ballasts, but would enable monitoring. Individual modules can be enabled or disabled, for example, to conduct maintenance on a single module while the system is still operating. No alarms are generated on a disabled module, which in turn allows the bank to remain healthy. As for control of single modules, if a module is enabled, all available healthy lamps/ballasts will be requested to turn on. No additional validation testing would be required for this alternative. An upgraded control system for the UV3000 is estimated to cost $60,000-$70,000. Annual O&M costs would hold at approximately $140/Mgal treated. This alternative represents an increase in system reliability and an investment in a potential future UV system upgrade.

3.2 Disinfection Alternative 2 - Total UV system upgrade (Trojan UV3000Plus)

Under this alternative, the entire UV system (controls, lamps, modules) would be replaced with Trojan's UV3000Plus disinfection system and the existing UV channel could be used without major alteration. The UV3000Plus system has several benefits over the existing UV3000 system including: low pressure, high output UV lamps, variable-output electronic ballasts (lamp dimming capability), and automated chemical/mechanical cleaning system. Upgrading to the UV3000Plus system would allow the District to discontinue use and storage of phosphoric acid for lamp cleaning. The self-cleaning system utilizes a safer, food-grade gel rather than a strong, corrosive acid. As with the existing UV3000 system, UV dosing is based on flow rate and UVT. The lamp dimming feature of the UV3000Plus, however, allows for more precise control of UV dose, making this system more energy efficient than the existing UV3000 system.

Average UV system power consumption at 0.85 mgd is expected to range from 13-27 kW, depending on UVT. Peak UV system power consumption at 2.0 mgd is expected to range from 30-54 kW [TROJAN]. The low pressure, high output (250 W) amalgam lamps require fewer lamps to deliver the same UV dose as low output lamps, thus the number of lamps that need to be cleaned and replaced is decreased. The number of lamps required to treat 2.0 mgd is estimated to be 150-270 (vs. 672 lamps in the existing system) and are anticipated to have a minimum life of 9,000 hours [TROJAN]. For the purpose of this analysis, it is approximated that annual lamp-hour accumulation for the UV3000Plus system will decrease relative to the lamp-hour accumulation of the existing UV3000 system due to the increase in lamp wattage (87.5 W vs. 250 W). The estimated annual lamp-hour accumulation treating 1.0 mgd is 525,000-1,419,000 lamp-hr/yr for a feed UVT of 65% and 55%, respectively [TROJAN]. Replacing lamps every 9,000 hours at a replacement cost of $250 per lamp results in an annual lamp replacement cost of $15,000-$40,000. The automated cleaning system reduces O&M costs and frees up staff for other plant maintenance needs. Power, lamp replacement, and cleaning costs for a hypothetical 4S Ranch WRF UV3000Plus system treating flows from September 2013 through August 2014 are summarized in Table 2. The low and high estimates represent feed UVT of 65% and 55%, respectively. It is estimated that the UV3000Plus system O&M cost for this time period would be $29,000-$68,000, or $83-$188 per million gallons treated, which spans the $154/MGal O&M cost for the existing UV system (Table 1). Validation testing would be required as part of this new UV system installation, which would cost $50,000-$60,000

[TROJAN]. A new UV3000Plus system would cost between $410,000-$650,000 plus an estimated $200,000-$300,000 installation cost. Amortizing capital expenditures (equipment, installation, testing) assuming a 20-yr loan with a 3% interest rate results in an annual payment of $45,000-$60,000.

Table 2: Estimated annual O&M costs for UV3000Plus UV disinfection system

Trojan UV3000Plus	Sept. 2013 - Aug. 2014	
Design UVT	65%	55%
Treated Volume Treated (Mgal)	374	374
Power Use (kWh)	114,000	237,000
Electricity Cost ($/kWh)	$0.12	$0.12
Power Cost ($)	$13,700	$28,500
Specific Power Cost ($/Mgal)	$37	$76
Lamp Replacements (No.)	59	158
Lamp Cost ($/lamp)	$250	$250
Lamp Replacement ($)	$14,800	$39,500
Specific Lamp Replacement ($/Mgal)	$39	$105
UV Bank Cleaning (hrs)	50	100
Labor Rate ($/hr)	$50	$50
Cleaning Labor ($)	$2,500	$5,000
Specific Cleaning Labor ($/Mgal)	$7	$13
Total ($)	$28,500	$68,000
Total ($/Mgal)	$83	$188

3.3 Disinfection by chlorination

3.3.1 Chlorine demand

Chlorine disinfection was previously employed at 4S Ranch WRF and is a common disinfection process in wastewater treatment and reuse. Typical chlorine demand for filtered activated sludge effluent ranges from 8-30 mg/l [Metcalf & Eddy]. The chlorine demand for the 4S Ranch WRF is assumed to range between 10-15 mg/l. This equates to a chlorine mass demand at 1.0 mgd (374 Mgal/yr) of 90-130 lb/d. Chlorine can be delivered by many methods. Two common methods for consideration in this study include: liquid sodium hypochlorite (NaOCl) and the on-site electrochemical generation of hypochlorite using sodium chloride (NaCl).

3.3.2 Chlorination using liquid sodium hypochlorite

Liquid NaOCl is typically supplied as solutions containing 12-15% available chlorine. Assuming a NaOCl solution with 12.5% available chlorine and specific gravity of 1.17, the required delivered volume to meet the 90-130 lb/d chlorine demand is 74-107 gal/d. Using a unit cost for NaOCl of $1.00/gal results in an annual NaOCl (12.5% strength) cost of $27,000-$39,000 per year or $74-$107 per million gallons treated. The District currently doses NaOCl in its chemical scrubbers and to the secondary effluent equalization basins, so it is well-equipped to receive liquid NaOCl deliveries. Additional one-time costs for storage tanks, dosing equipment, and civil work are estimated at $175,000-$225,000 (installed). Chlorine contact tracer testing is estimated to cost $50,000.

3.3.3. Chlorination using on-site sodium hypochlorite generation

The on-site generation (OSG) of NaOCl via the electrochemical oxidation of NaCl represents a safer alternative to chlorine gas or NaOCl due to the reduction in potential gas leaks and the transport and storage of large volumes of hazardous chemicals. An example of a skid-mounted electrochemically-generated chlorine system is shown in Figure 7. Approximately 3 lbs of NaCl and 2 kWh of electricity are required to produce 1 lb of chlorine [EVOQUA; White]. Chlorine mass demand at 1.0 mgd (90-130 lb/d) requires a NaCl supply of 270-390 lb/d and an energy consumption of 180-260 kWh/d. Using unit costs of $0.08/lb NaCl and $0.12/kWh results in an annual cost of $16,000-$23,000 per year or $65-$94 per million gallons treated. The one-time installed cost of a chlorine generation system with 2.0 mgd treatment capacity is in the range of $225,000-$390,000 plus an estimated $150,000-$200,000 installed cost for storage tanks, dosing equipment, and civil work. Chlorine contact tracer testing is estimated to cost $50,000.

Figure 7: Skid mounted electrochemically-generated chlorination system [EVOQUA].

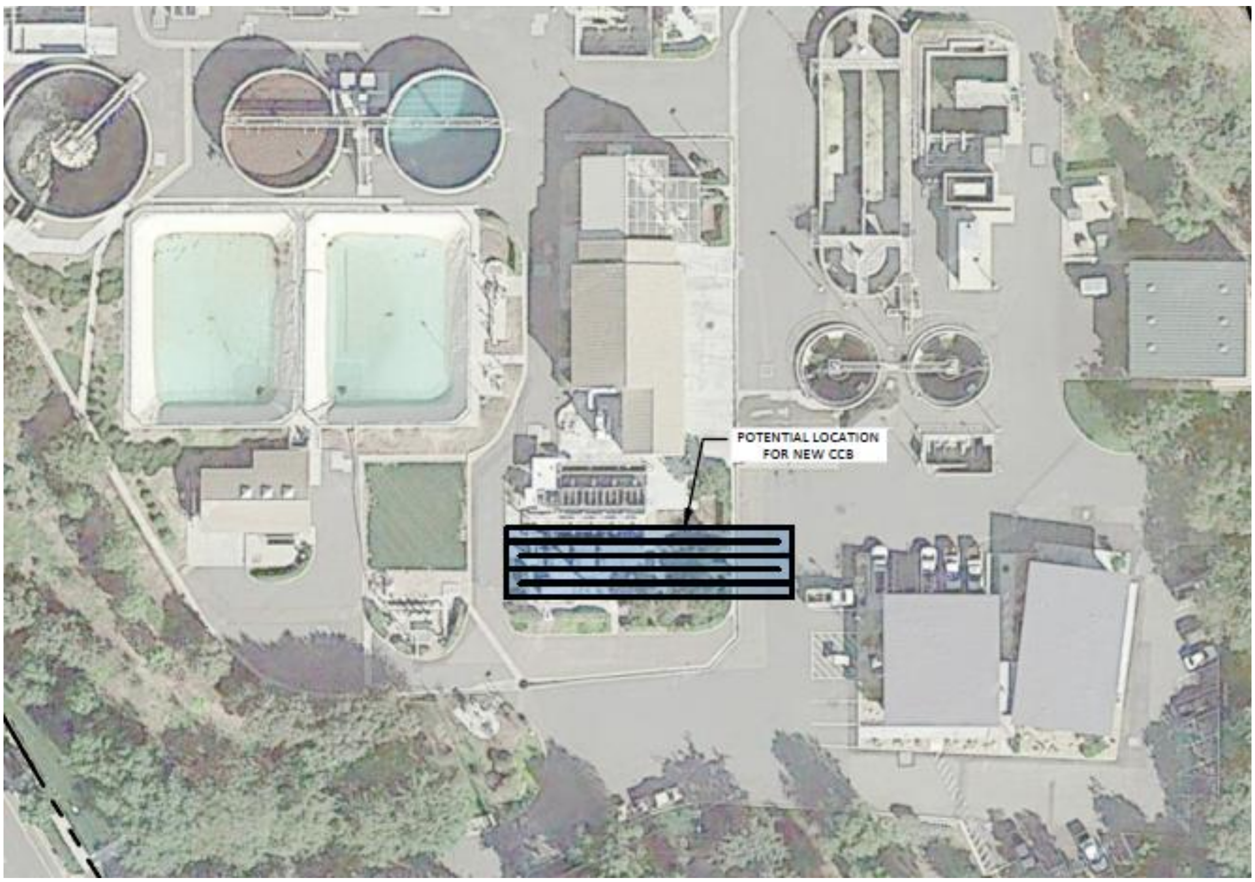
3.3.4. Chlorine contact basin options

The existing UV channels (formerly the chlorine contact basins for the original WRF at capacity of 0.5 mgd) measure 42 in wide by 46 ft long with four passes and have an approximate footprint of 644 ft^2. Channel depth is approximately 7 ft. Assuming a water depth of 6 ft and a flow of 2.0 mgd, the resulting theoretical hydraulic residence time (HRT) in the existing UV channel is approximately 20 minutes. This residence time is far too low for adequate chlorine disinfection. Title 22 disinfection requirements state that chlorine contact time must achieve a minimum 90 minute modal contact time, and the product of chlorine residual and contact time must be at least 450 mg-min/l. In practice, new chlorine contact basins are commonly designed for 120 minute HRT, assuming that with proper reactor configuration, a 0.75 baffling factor can be achieved to provide the 90 minute modal contact time. In order to comply with current disinfection requirements, the current chlorine contact basins would need to be replaced. Two options for redesigned chlorine contact basins are given in the following sections.

3.3.4.1. Disinfection Alternative 3 - New chlorine contact basin

Chlorine contact basins are typically designed to provide a theoretical hydraulic residence time of 120 minutes. The added contact time (120 min vs. the required 90 min) provides a margin of safety for the non-ideal flow patterns inherent to all contact basins (e.g. short-circuiting and mixing). A chlorine contact basin having a cross section of 6 ft by 6 ft treating 2.0 mgd would require an effective length of 620 ft, or five passes each 124 ft in length, to achieve a theoretical 120 minute hydraulic residence time. The resulting channels would have a footprint of 3,720 ft^2, which is six times greater than the existing UV disinfection channel footprint. This larger footprint would likely mean siting a new contact basin in a location, if available, that could require pumping rather than the gravity feed and discharge that are currently employed. The size and a potential location of a new chlorine contact basin within 4S Ranch WRF are depicted in Figure 8.

Figure 8: 4S Ranch WRF site plan with potential new chlorine contact basin

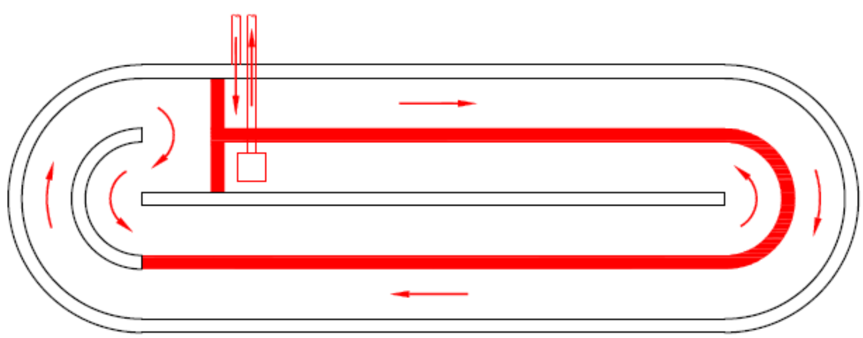


The basin would likely need to be below grade to fit in the proposed location and to maintain access to other parts of the facility. Additional channels and footprint would be needed if redundancy is desired. It is estimated that the constructed cost of a new five pass concrete chlorine contact basin with 2.0 mgd treatment capacity would be on the order of $1,000,000. The space requirements for a new chlorine contact basin within the existing 4S Ranch WRF layout render this alternative infeasible.

3.3.4.2. Disinfection Alternative 4 – Plant A oxidation ditch retrofit

A second alternative to new chlorine contact basins is the repurposing of the existing Plant A oxidation ditch as a chlorine contact basin. The 242,500 gallon oxidation ditch would have a theoretical hydraulic residence time of 174 minutes at a flow rate of 2.0 mgd. Internal baffles would be added to the oxidation ditch to approach the plug flow required for efficient chlorine disinfection. Baffled tanks typically have a baffling factor of 0.5–0.7 [EPA]. Applying a 0.5–0.7 baffling factor would result in an 87-122 minute mean contact time at 2.0 mgd. Baffle placement and the resulting flow profile would need careful consideration to ensure that the minimum 90 minute contact time required by Title 22 is achieved. Filtered effluent would need to be piped and pumped over to the oxidation ditch, and the disinfected effluent would need to be piped to the recycled water pump station. The District would need to re-rate the Plant B oxidation ditch to ensure adequate plant capacity for ultimate plant flow rate and internal recycle flows would need to be confirmed to ensure adequate capacity in the chlorine contact basin. Technical Memorandum #3 discusses options for retrofit of Plant B oxidation ditch with a more efficient oxygen transfer system like blowers and air diffusers along with modifications to operating parameters that could allow a plant rerate to replace capacity sacrificed by retrofitting the Plant A oxidation ditch. It is estimated that the constructed cost of a retrofitted chlorine contact basin with 2.0 mgd treatment capacity would be on the order of $500,000-$750,000. The nominal disinfection capacity of 2.0 mgd was chosen in order to maintain the permitted 4S Ranch WRF treatment capacity and to achieve adequate disinfection at ultimate peak flows. The potential retrofit of the Plant A oxidation ditch to a chlorine contact basin is illustrated in Figure 9.

Figure 9: Potential retrofit of Plant A oxidation ditch to chlorine contact basin



4. DISINFECTION ALTERNATIVE COMPARISON

Alternative 1, UV rehab/controls upgrade, represents status quo for the District. This alternative is likely only viable for the next couple of years because the existing UV system controls are no longer supported by Trojan and the lamps are no longer available for purchase. Aging, unsupported equipment represents a significant risk to 4S Ranch WRF's disinfection capabilities and regulatory compliance.

Upgrades to the disinfection system should be made and Alternatives 2-4 should be evaluated. A comparison of Alternatives 2-4 is provided in the Table 3. The capital costs for each alternative consider equipment, installation, and any required testing for systems that are sized to treat a maximum of 2.0 mgd. Capital costs assume an annual payment on a 20-yr, 3% interest loan. Annual O&M costs assume a daily average treated flow of 1.0 mgd. The low and high capital and O&M values for the UV system represent high (65%) and low (55%) design UVT, respectively. The low and high values for the chlorine disinfection alternatives represent ranges of chlorine demand and construction cost. Annual O&M values do not account for temporal changes in treated flow or prices of chemicals or electricity.

Table 3: Estimated annual costs for 4S Ranch WRF disinfection alternatives.

	Alt. 2 - UV System Upgrade	Alt. 3 - New Chlorine Contact Basin		Alt. 4 - Retrofitted Plant A Ox Ditch as CCB	
	UV3000Plus	NaOCl	OSG	NaOCl	OSG
Capital (2.0 mgd)					
Equipment	$ 410,000 - $ 650,000	$ 175,000 - $ 225,000	$ 375,000 - $ 590,000	$ 175,000 - $ 225,000	$ 375,000 - $ 590,000
Installation/Construction	$ 205,000 - $ 325,000	$ 800,000 - $ 1,200,000	$ 800,000 - $ 1,200,000	$ 500,000 - $ 750,000	$ 500,000 - $ 750,000
Testing	$ 50,000 - $ 60,000	$ 50,000 - $ 60,000	$ 50,000 - $ 60,000	$ 50,000 - $ 60,000	$ 50,000 - $ 60,000
Total	$ 665,000 - $ 1,035,000	$ 1,025,000 - $ 1,485,000	$ 1,225,000 - $ 1,850,000	$ 725,000 - $ 1,035,000	$ 925,000 - $ 1,400,000
Annual (3%, 20-yr)	$ 45,000 - $ 70,000	$ 69,000 - $ 100,000	$ 83,000 - $ 125,000	$ 49,000 - $ 70,000	$ 63,000 - $ 95,000
O&M (1.0 mgd)					
Labor	$ 3,000 - $ 5,000	$ 6,000 - $ 11,000	$ 6,000 - $ 11,000	$ 6,000 - $ 11,000	$ 6,000 - $ 11,000
Chemical/Lamps	$ 15,000 - $ 40,000	$ 27,000 - $ 39,000	$ 8,000 - $ 12,000	$ 27,000 - $ 39,000	$ 8,000 - $ 12,000
Power	$ 14,000 - $ 29,000	$ 2,000 - $ 4,000	$ 10,000 - $ 16,000	$ 2,000 - $ 4,000	$ 10,000 - $ 16,000
Total O&M	$ 32,000 - $ 74,000	$ 35,000 - $ 54,000	$ 24,000 - $ 39,000	$ 35,000 - $ 54,000	$ 24,000 - $ 39,000
Total Annual	$ 77,000 - $ 144,000	$ 104,000 - $ 154,000	$ 107,000 - $ 164,000	$ 84,000 - $ 124,000	$ 87,000 - $ 134,000

Alternative 2, UV system upgrade, spans the largest range of estimated annual costs due to the assumed 55%-65% feed UVT range. Examination of Fig. 3 indicates that 4S Ranch WRF UVT is closer to 65%, which would put the estimated annual cost for Alternative 2 closer to $77,000. Future 4S Ranch WRF UVT should remain similar to the values given in Fig. 3 assuming significant changes are not made to the biological treatment, secondary equalization and chlorination, and media filtration systems. Compromised treatment in any of these systems could lead to decreased UVT and increased UV system capital and O&M costs. Of particular importance is the current practice of chlorinating secondary effluent in the secondary equalization basins as this may help increase UVT by oxidizing dissolved organic matter that passes through media filtration. Discontinuing chlorination of secondary effluent may lead to decreased UVT. Upgrading to the UV3000Plus system does not require storage of hazardous chemicals as is the case with the existing system (phosphoric acid) and Alternatives 3 and 4 (sodium hypochlorite). Alternative 2 requires relatively less footprint and construction and site alterations compared to Alternative 3. Alternative 4 requires a potential loss of overall plant capacity or an upgraded aeration delivery system in the Plant B oxidation ditch.

Alternative 3 requires more capital expense than Alternative 2 due to the construction of a new and much larger contact basin. Current 4S Ranch WRF site constraints may preclude the placement of an estimated 3,700 ft^2 basin (no redundancy) within the property. For reference, the existing area containing the tertiary filters and UV system is approximately 6,300 ft^2. The on-site generation of chlorine options are more costly than NaOCl due to the increased capital expense of the electrochemical generation system. The range of estimated capital costs for Alternatives 3 and 4 are due to ranges of construction and equipment costs. O&M costs for Alternatives 3 and 4 are lower than Alternative 2 due to the relatively inexpensive cost of NaOCl and NaCl and the higher energy demand of UV disinfection compared to on-site hypochlorite generation. The range of O&M costs for Alternatives 3 and 4 are due to the range of estimated 4S Ranch WRF tertiary effluent chlorine demand.

5. RECOMMENDATIONS

Each disinfection alternative's 20-yr capital and annual O&M cost is highly dependent on UVT or chlorine demand. 4S Ranch WRF chlorine demand is currently unknown but is likely 10-15 mg/l. 4S Ranch WRF

UVT data that fulfill NWRI UV system design guidelines are likely to exist as part of 4S Ranch WRF's WDR. The District should compile UVT measurements taken at a minimum of 3 times per day spaced equally over the UV system daily operating time. The data should span a minimum 6 month operating window and include wet weather flows. This UVT data will likely demonstrate a 10th percentile design UVT greater than 65%, which would shift the estimated annual cost of Alternative 2, total UV system upgrade, toward the lower end of the range given in Table 3. The low range of Alternative 2 annual cost is the lowest of the examined alternatives. It should again be noted that feed UVT is a product of the preceding treatment processes. Future alterations to upstream treatment could impact UVT.

Dudek recommends that the District pursue Alternative 2, total UV system upgrade, within the next 2 years.

6. REFERENCES

Carollo Engineers, "Capacity Evaluation for the 4S Ranch Trojan UV3000 Disinfection System", Feb. 2005.

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APPENDIX H

TM4 – Failure Modes and Consequences Analysis

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TECHNICAL MEMORANDUM #4

To:	**George Briest, Olivenhain Municipal Water District**
Author(s):	**Phil Giori, Tom Klein (RCS), Jim Hudson (RCS)**
Reviewer(s):	**Tom Falk, P.E., Michael Hill, P.E.**
Date:	**May, 2015**
Subject:	**Failure Mode and Effects Analysis**

1 INTRODUCTION

The Olivenhain Municipal Water District (District) contracted Dudek to prepare an Operations and Condition Assessment and Capital Improvement Plan for the 4S Ranch and Rancho Cielo Sanitation Districts that will guide strategic planning and investments for the District's collection, treatment, and reuse programs.

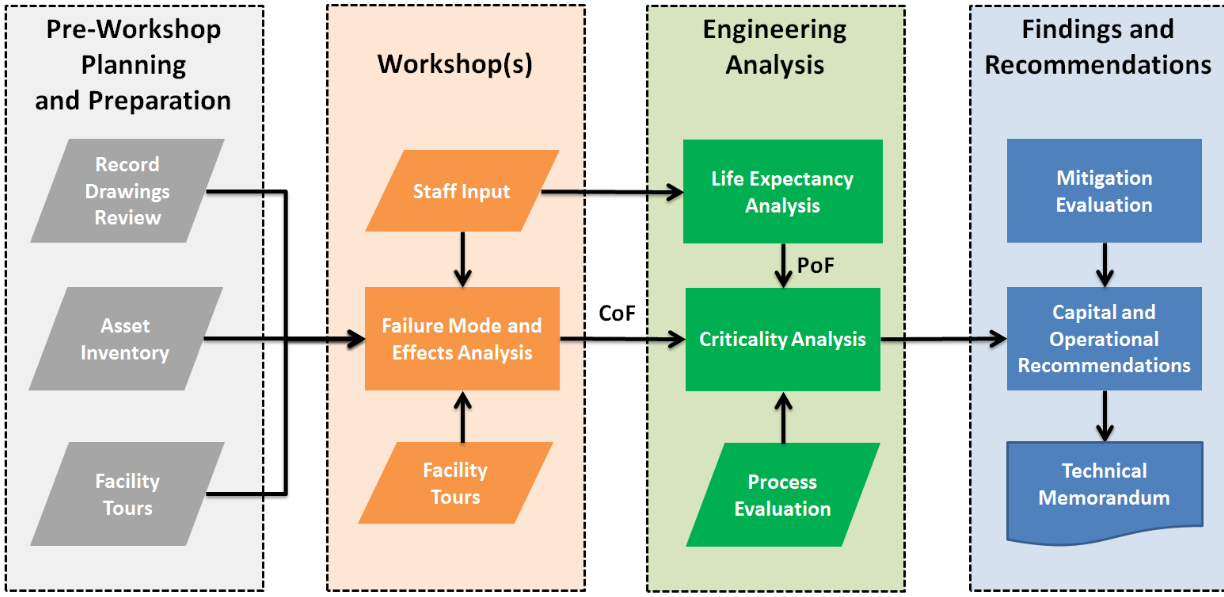
This Technical Memorandum #4 (TM4) presents the Failure Modes and Effects Analysis (FMEA) methodology, recommended capital improvement projects, and non-CIP recommendations for the 4S Ranch WRF and the pump stations within the 4S Ranch and Rancho Cielo collections systems.

2 METHODOLOGY

The Failure Modes and Effects Analysis (FMEA) is a process that facilitates deliberate discussion and analysis of the criticality of process systems, drilling down to the component-level. Through a workshop format, critical District input is captured to expeditiously define a consequence of failure score. **Figure 1** presents the FMEA flowchart. The outcome from the FMEA process is identification of operating and maintenance (O&M) adjustments (i.e. non-CIP Recommendations) and/or capital improvement projects (CIP) that improve the reliability and efficient operation of the 4S Ranch WRF. Separate methodologies were used for the 4S Ranch WRF and the collection system pump stations which are described in the following sections.

The Consequence of Failure (CoF) and Probability of Failure (PoF) are used to calculate a criticality score that allows for the prioritization of risk-based strategic planning. Depending on the criticality score and the nature of the defined failure mode, operational-based and/or capital-based recommendations are made in order to mitigate the risk by either reducing the defined consequence and/or probability of failure.

Figure 1 – Failure Mode and Effects Analysis Flow Chart



2.1 4S Ranch Water Reclamation Facility FMEA Methodology

For the 4S Ranch WRF, the FMEA utilized information obtained from review of the record drawings for the 4S Ranch WRF, tours of 4S Ranch WRF, and three workshop meetings with District staff to develop and populate a scoring matrix to determine the criticality of each asset. The workshop discussions identified process areas with major equipment and components fundamental to the successful operation of the WRF. The intent of the workshop was to evaluate plant systems by examining specific major equipment items within the system and drilling down into major sub-components as applicable to define failure modes. Failure is defined as the system or component losing its ability to perform its function. With failure modes defined, the effects or consequences of system failure were discussed with operations and maintenance personnel. Through this collaborative process, the effects were defined within the system under evaluation, but also with attention to impacts to downstream and peripheral systems. District staff was also asked to provide anecdotal information about historical system and/or component issues in order to support assumptions for the occurrence or probability of system failure. The District staff and Dudek worked together to evaluate each process area by breaking down each major process equipment and component within the study area. **Figure 2** graphically depicts the hierarchy of system, equipment, and component for the purposes of evaluating each process area. Specific process areas with associated equipment and components evaluated in the workshop pertaining to the 4S Ranch WRF are summarized in **Table 1**, which also served as the outline for the workshop.

Figure 2 – Process Area Equipment and Component Representation

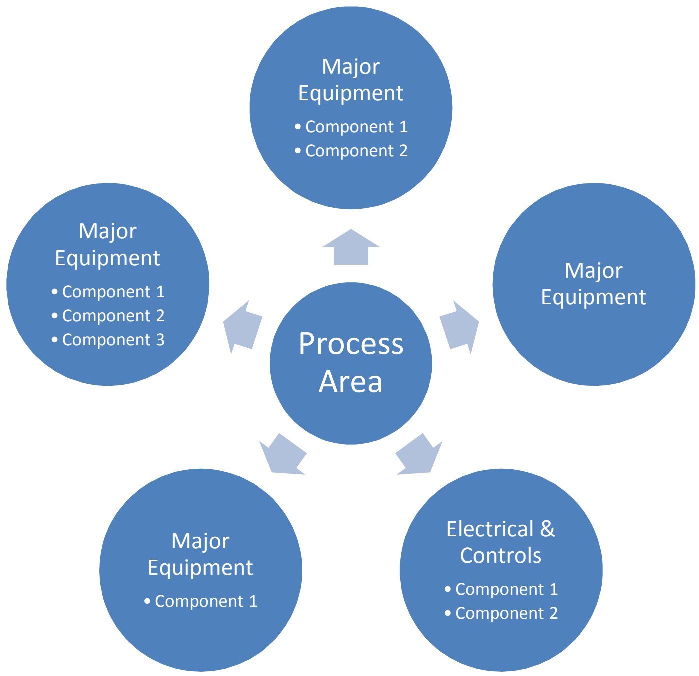


Table 1 – FMEA Workshop Process Areas and major equipment/components

Process Area	Equipment → Component
Headworks Functional Description: Remove rags, grit, and other large materials before entering downstream processes. Reference: P&ID 1I-1	Screen → Bandscreen → Grinder → Wash/Press → Level Switch Grit → Grit Chamber → Grit Pumps → Grit Classifier Control Panels and Electrical Switchgear Structure
Oxidation Ditch/Anoxic Tank Functional Description: Remove BOD and TSS, nitrification and denitrification. Reference: P&ID 2I-1	Oxidation Ditch → Aerators → VFDs → DO Probes → Weir Gate Anoxic Tank → Anoxic Mixer → Inlet control (denitrification control) Control Panels & Electrical Switchgear Biological Process Structure

Process Area	Equipment → Component
RAS Pump Station Functional Description: Supply Return Activated Sludge to the Oxidation Ditch to sustain biology. Reference: P&ID 4I-6	RAS Pumps → Motor/Pump → VFD → Flow Meter Control Panels & Electrical Switchgear Structure
WAS Pump Station Functional Description: Controls MLSS, MCRT, and F/M by controlling solids in the process. Reference: P&ID 4I-7	WAS Pumps → Motor/Pump/Stator → Pipeline (plugging) → VFD → Flow Meter Control Panels & Electrical Switchgear Structure
Secondary Clarifiers Functional Description: Separates solids and liquid prior to tertiary filtration and disinfection. Reference: P&ID 3I-1, 3I-2	Secondary Clarifiers → Skimmer/Scraper/Sludge Rake/Drive → Weir and Launder Scum Pumps Turbidimeter Control Panels & Electrical Switchgear Structure
Equalization Basins Functional Description: Equalizes secondary effluent flow to maintain consistent load on downstream tertiary filters and disinfection processes. Reference: N/A	EQ Basins → Liner → Level Transmitter Control Panels & Electrical Switchgear Structure
Tertiary Filters Functional Description: Removes residual suspended solids from the water prior to disinfection Reference: P&ID 8I-1, 8I-2	Filter Influent Pumps → Motors/Pumps → VFD Structure (Steel Tanks) Flash Mix Pump Filters → Backwash Pumps → Mudwell Pumps → Air Scour Blowers Turbidimeters Control Panels & Electrical Switchgear
UV Disinfection Functional Description: Disinfects filtered water for Title 22 compliance. Reference: P&ID 9I-1	UV Banks → Bulbs/Sleeves/Sensors (UVT/UVI) → Level Switch Turbidimeter Control Panels & Electrical Switchgear Structure
Non-Potable Water Pump Station Functional Description: Backup plant water source for headworks screen washing, landscaping, and other plant water demands. Reference: P&ID 4I-1	Non-Potable Water Pumps → Motors/Pumps → Level Switch → MOV Control Panels & Electrical Switchgear Structure

Process Area	Equipment → Component
Aerobic Digestion Functional Description: Reduction of thickened waste activated sludge mass and volatile suspended solids content to decrease loading to the dewatering system and vector attraction. Reference: P&ID 5I-1, 5I-2	Digesters → Air Diffusers → MOVs → Blowers/Motors/Belt Drive Digested Sludge Pumps → VFD Control Panels & Electrical Switchgear Biological Process Loss Structure
Sludge Dewatering Functional Description: Removal of water from digested sludge to decrease hauling costs. Reference: P&ID 6I-1, 6I-2, 6I-3	Belt Presses → Rollers/Belts → MOV → VFD → Level Switch Conveyor Booster Pumps TWAS Hopper → TWAS Pumps Control Panels & Electrical Switchgear Structure
Chemical Handling Functional Description: Systems and equipment for the storage, transmission, and dosing of chemicals within the plant Reference: P&ID 6I-4	Chemical Feed Pumps Chemical Feed Tanks → Level Transmitter Control Panels & Electrical Switchgear Structure
Plant Support Systems Functional Description: Emergency backup power and odor control for system reliability and neighborhood nuisance, respectively. Reference: P&ID GI-3, 13E-1	Backup Power Automatic Transfer Switch Odor Control Scrubbers Stormwater Pump Station Structure

The major equipment and major sub-components of each process area are documented in a spreadsheet database. The workshop goal was to collaboratively discuss and ultimately document failure modes and consequence scores in the spreadsheet.

Each process area, equipment, or component line item in the spreadsheet model was introduced with a functional description, key design parameters, and current operating condition to provide background information. In some cases, predicted failure modes were defined prior to the workshop to facilitate discussion; however, the workshop team was expected to validate those failure modes and identify additional effects, where appropriate. The District staff primarily provided input based on institutional knowledge and operational expertise to score the consequences of a potential unmitigated failure of the system.

2.1.1 Consequence of Failure

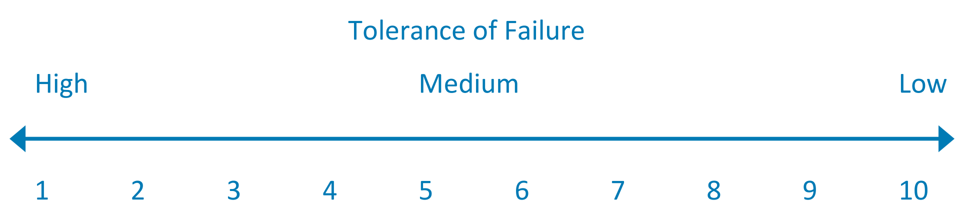
Conventionally, failure consequences focus on capacity, level of service, and mortality. With the understanding that the ultimate flowrate will likely not exceed the plant's current rated capacity and because asset remaining useful life is assessed as part of the parallel condition assessment task, capacity and mortality consequences were considered in the context of level of service for this FMEA process. Failure effects focused on level of service under four distinct categories: Health & Safety, Treatment Performance, Maintenance Resources, and Organizational Impact, as explained in **Table 2**.

Table 2 – Description of Consequences

Consequence	Description
Health & Safety	Failure results in potential impacts on Health & Safety of District staff or the public.
Treatment Loss	Failure results in a loss of treatment (e.g. BOD removal, nutrient removal, etc.) and potential regulatory violations and fines.
Maintenance Resources	Failure results in extensive maintenance resource consumption (e.g. financial cost to fix).
Organizational Impact	Failure results in negative public perception of the District (e.g. odor issues create public nuisance).

Each consequence category received a numerical score, 1 to 10, for each item based on the tolerance of failure of the process or equipment as shown in **Figure 3**. The average of individual consequence of failure scores determines an overall consequence of failure score. The baseline (existing conditions) consequence scores were defined given the assumption that no activity is performed to mitigate the risk of failure to the process or equipment. The baseline consequence score is important for prioritizing recommendations and subsequent analysis has considered mitigation or activities that reduce the risk potential of a given failure mode.

Figure 3 – Consequence of Failure Scoring



2.1.2 Probability of Failure

Items with a high consequence of failure are naturally the first to be analyzed for risk mitigation, however, equally important is the unmitigated probability of failure (PoF) of the process or equipment. For example, the minute probability of a catastrophic failure may not warrant a large CIP project for mitigation, but a medium consequence of failure item with a high probability of failure may justify capital investment to reduce that probability and/or consequence of failure. Therefore, each item was assigned an unmitigated PoF score. The baseline PoF score has been calculated from the following equation:

$$PoF = \frac{Useful\ Life - (Remaining\ Life \times Cond.Assessment)}{Useful\ Life} \times (1 - Redundancy\ Factor) \times 10$$

The probability of failure is a value between 0 (low probability) and 10 (high probability). The PoF scores incorporate condition assessment opinions to adjust the likelihood of occurrence to reflect the anticipated serviceability or reliability of an asset. The condition assessment factor ranges from 0 (failed condition) and 1 (new condition). The redundancy factor also ranges from 0 to 1, with the factor representative of percent redundancy as explained in **Table 3**.

Table 3 – Redundancy Factors

Redundancy	Redundancy Factor
25% (1 standby unit to 4 duty units)	0.25
33% (1 standby unit to 3 duty units)	0.33
50% (1 standby unit to 2 duty units)	0.5
100% (1 standby unit to 1 duty unit)	0.9
200% (2 standby units to 1 duty unit)	0.98

Furthermore, the level of redundancy in a system reduces the probability of failure. The asset age PoF scores have been calculated separately from the workshop; however, District experience with failure modes and frequency of occurrence did influence the PoF score ultimately used in the criticality ranking.

2.1.3 Criticality Analysis

Following the workshop, the average of the consequence of failure (CoF) score for each system was multiplied by the PoF score to define the criticality (i.e., process, equipment, or component) being evaluated in accordance with the following criticality equation.

Criticality = CoF x PoF

Recommendations for risk mitigation are prioritized based on the resulting criticality scores. Mitigation measures are categorized as O&M procedural adjustments or as defined CIP projects. Depending on the criticality score and benefit/cost analyses, the recommendations are prioritized over the 10-year and 20-year planning horizons. Items with significant calculated criticality that cannot be adequately mitigated by non-capital recommendations are evaluated for potential CIP projects which will supersede programmed replacement scheduling such that the upgrade or betterment project is implemented appropriately in the CIP timeframe.

2.1.4 Analysis and Recommendations

The Consequence of Failure and Probability of Failure scores calculated for each piece of equipment and component item are plotted on a graph to illustrate relative criticality scores. **Figure 4** presents the generic criticality chart. The CoF and PoF scores generate a spread of scores located within the graph, populating the area within the three different “zones” of criticality. Each criticality “zone” warrants a different strategy for risk mitigation. These strategies are described in **Table 4**.

Figure 4 – Criticality Chart

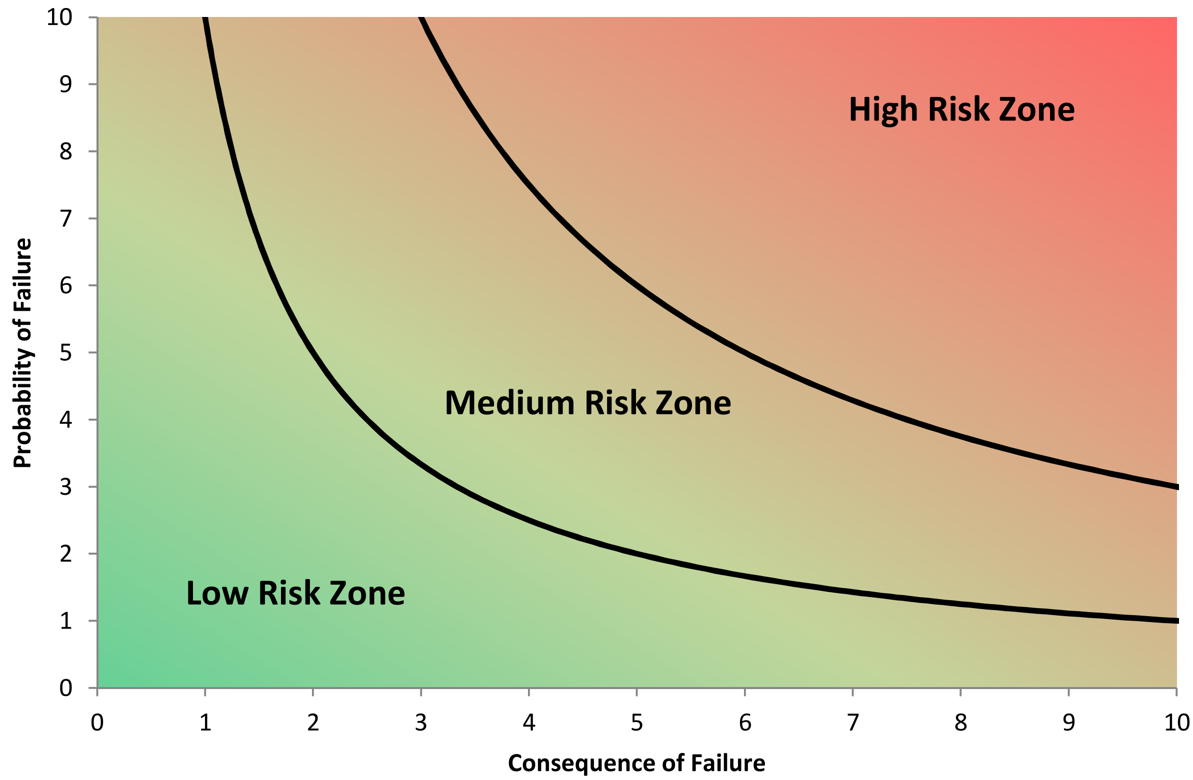


Table 4 – Strategies for Risk Mitigation

Criticality Zone	Range of Criticality Scores	Strategy for Risk Mitigation
Low Risk Zone	0-10	Reactive strategy is acceptable. The criticality does not suggest proactive monitoring strategies or capital improvement projects are necessary.
Medium Risk Zone	10-30	Proactive strategy for monitoring performance and condition may be recommended. Mix of proactive and reactive strategies may also apply. Capital Improvement projects may be recommended to mitigate risk where applicable.
High Risk Zone	30-100	Proactive planning and risk mitigation strategy is required. Capital Improvement projects will be recommended if operations and maintenance strategies are insufficient to mitigate risk to an acceptable level.

The results of the workshop, subsequent CoF and PoF analysis, mitigation evaluation, and recommendations are documented in the "Results" section below in this Technical Memorandum. Where capital projects are recommended to mitigate high criticality scenarios, project costs are compared to a derived consequence cost in order to confirm a positive benefit/cost ratio. The recommended improvements will ultimately be incorporated into the Capital Improvement Plan report.

Following the workshop, process areas, equipment and components were consolidated in order to prioritize critical unit processes. Process areas, equipment, and components not specifically depicted in the complete results presented in Attachment 4 were not considered to be potentially critical elements and were not further evaluated.

The results of the FMEA process are organized such that each evaluated asset contains a two-letter abbreviation for the asset's facility location. The abbreviation corresponding to each facility is presented in **Table 5**.

Table 5 – FMEA Location Abbreviation List

Abbreviation	Facility
HW	Headworks
OX	Oxidation Ditch and Anoxic Tank
SC	Secondary Clarifiers
TF	Tertiary Filters
UV	Ultraviolet Disinfection
AS	Activated Sludge (Waste and Return pump stations)
AD	Aerobic Digestion
SD	Sludge Dewatering
SS	Support Systems

2.1.5 Workshop Discussion Results and Input

FMEA workshops were performed on February 11, February 18, and April 29, 2015 to define the District's consequence of failure tolerances and establish scoring guidelines that match FMEA scoring implications with the District's level of tolerance. Detailed meeting notes are presented in Attachment 1, 2 and 3, respectively. Once consequence of failure guidelines had been established, the workshop team examined each treatment plant process to create hypothetical failure scenarios and establish a consequence of failure score for specific asset failures. Workshop discussion included response strategies and mitigation opportunities for treatment plant processes perceived to have a high consequence of failure.

The consequence of failure scoring guidelines defined by the District during workshop discussion is presented in **Table 6**.

Table 6 – Consequence of Failure Scoring Guidelines

Health and Safety		
Tolerance	Score	Description
Low	10	Loss of life
	9	
	8	FMLA/reportable injury
	7	
	6	1-day loss time/reportable injury
Medium	5	
	4	Visit to US Healthworks (hospital)
	3	
	2	
High	1	Minor 1st aid/no lost time
Treatment Performance		
Tolerance	Score	Description
Low	10	Catastrophic plant failure; plant offline for 1+ weeks
	9	
	8	Permit violation (chronic)
	7	
	6	Permit violation (one-time)
Medium	5	
	4	
	3	
	2	
High	1	Process control

Maintenance Resources		
Tolerance	Score	Description
Low	10	Key personnel; lead time > acceptable downtime
	9	
	8	Board action required; $50k equipment (PO); $35k construction project
	7	
Medium	6	
	5	
	4	
	3	> $2,500 PO required
	2	<$1,500
High	1	Minor equipment/shelf spares

Organizational Impact		
Tolerance	Score	Description
Low	10	Spill/odor; visual impact, public impact, noise
	9	
	8	
	7	Temporary public impacts; trucking noise
Medium	6	
	5	
	4	
	3	Unscheduled attention; nuisance failures
	2	
High	1	

2.2 Sewer Pump Station FMEA Methodology

Risk mitigation measures were generated for the sewer pump stations through Dudek's independent analysis and using a slightly modified methodology better suited to evaluate the District's pump stations. The primary failure scenario of a sewer pump station or forcemain is considered a sewer overflow, and the District has low tolerance of an overflow in the collection system which could occur at any one of their pump stations, upstream of a pump station due to pump station failure, or through a break in a forcemain. In order to better evaluate each pump station, failure modes were evaluated and existing mitigation measures accounted for to determine a current FMEA score. Additional mitigation measures are recommended to mitigate risk associated with failure modes determined to be in the high-risk zone.

Failure modes of a sewer pump station that could result in a sewer overflow are:

- Mechanical/pump failure
- Power failure (primary/utility)
- Electrical gear failure
- Piping/valve failure
- Forcemain failure/break
- Instrumentation failure
- Control failure

These failure modes were evaluated through the FMEA for each sewer pump station.

2.2.1 Probability of Failure

The probability of each of these failure modes is calculated using the same equation described in Section 2.1.2, where the probability of failure is a function of the expected useful life, current age, current condition, and redundancy.

2.2.2 Consequence of Failure

The consequence of failure of a sewer overflow is high for any sewer pump station; however, the size of the pump station adjusts the relative consequence of a sewer overflow at the pump station. For example, a sewer overflow at a smaller pump station with a low average daily flow would result in less overflow sewage and therefore presumably lesser regulatory penalties. A sewer overflow at a large pump station with high average daily flow would result in more overflow sewage and presumably higher regulatory penalties. The Consequence of Failure score representative of each pump station ranges from a minimum score of 7 and a maximum score of 10. The scores are identified for each pump station in **Table 7**.

Table 7 – Sewer Pump Station Consequence of Failure Scores

Sewer Pump Station	Current Average Daily Flow	Consequence of Failure Score
Avenida Apice	1-3 gpm	7
Avenida Orilla	0 gpm	N/A[1]
Camino Sin Puente #1	1-3 gpm	7
Camino Sin Puente #2	1-3 gpm	7
Camino Sin Puente #3	1-3 gpm	7
Camino Sin Puente #4	1-3 gpm	7
Cerro Del Sol #1	1-3 gpm	7
Cerro Del Sol #2	1-3 gpm	7
Del Dios	35,000-45,000 gpm	8
Fire House	160,000-190,000 gpm	9
Midpoint	35,000-45,000 gpm	8
Neighborhood #1	230,000-400,000 gpm	9
Neighborhood #3	380,000-450,000 gpm	10
Santaluz	20,000-30,000 gpm	8

2.2.3 Criticality Analysis

The criticality of the equipment related to each failure mode is calculated using the same equation described in Section 2.1.3. Failure mode scenarios are prioritized based on the resulting criticality score, and mitigation measures are recommended based on their ability to effectively mitigate risk to an acceptable level of service.

2.2.4 Analysis and Recommendations

Recommendations are made to reduce the criticality score associated with a particular failure mode at a sewer pump station. The criticality score associated with each failure mode for a sewer pump station can be mitigated by reducing either the probability of failure (PoF) or consequence of failure (CoF) score. Performing the FMEA for existing facilities commonly disregards most, if not all, consequence of failure mitigation measures because the CoF score is dependent on existing conditions, such as the flow rate

[1] The Avenida Orilla sewer pump station is not yet operational; therefore, no failure scenario applies.

and location of the pump station, and projects involving changes to design criteria are most often cost prohibitive. This leaves the PoF score as the viable option to reduce criticality of a failure mode. The PoF score, as described in Section 2.2.1, is the function of the expected useful life, current age, current condition, and redundancy. Therefore, criticality can be mitigated by a project that extends the expected useful life, reduces the current age, and improves the current condition of the asset(s) (i.e. replacing the asset(s) with new asset(s)). Alternatively, and often preferably, criticality can be mitigated by adding redundancy to a system in order to maximize the useful life of installed assets while maintaining a level of safety in the redundancy provided by backup equipment.

Redundancy factors for mechanical equipment were introduced in Section 2.1.2, Table 3. These same redundancy factors will apply to the Sewer Pump Station criticality analysis. The mitigation measures identified to provide specific levels of redundancy are described in **Table 8**.

Table 8 – Mitigation Measures with Corresponding Redundancy

Mitigation Measure	Redundancy Factor	Applicable Failure Modes	Description
VFD bypass starters/contactors	0.9	Electrical gear failure (VFD)	As applicable, a VFD bypass starter/contactor would provide full redundancy by allowing the pumps to operate on constant speed instead of the variable frequency drive.
Pump redundancy	0.5-0.9	Mechanical/pump failure	Redundant pumps allow for the pump station to stay operational in the event that a duty pump goes down.
Backup Generator	0.9	Power failure (primary/utility)	Backup generator allows for the pump station to stay operational in the event that a primary/utility power failure occurs.
Bypass pumping	0.9	Mechanical/pump failure Power failure (primary/utility) Electrical gear failure Piping/Valve failure Instrumentation failure Control failure	Bypass pumping connections or an installed engine-driven bypass pump allows for the entire pump station to be bypassed for repairs. Bypass pumping provides full redundancy to every aspect of a sewer pump station, and therefore is a very valuable mitigation measure.
Level control redundancy	0.9-0.98	Instrumentation failure	Level control redundancy allows for the pump station to stay operational in the event that a failure occurs to the primary level control system. This mitigation measure is widely used because it is inexpensive and effective.
Parallel forcemain	0.9	Forcemain failure/break	A parallel forcemain is the most effective mitigation measure for a forcemain failure by providing full redundancy. This mitigation measure is commonly expensive and only preferred if the criticality of the forcemain is exceptionally high.

Mitigation measures not specifically adding redundancy are assigned an "equivalent redundancy factor" selected to represent the benefit of the mitigation measure as a level of redundancy, even if the benefit is not specifically a level of redundancy. For example, emergency storage is a widespread mitigation measure to a sewer pump station failure. Although emergency storage does not provide redundancy to any specific function of the sewer pump station, the storage volume provided allows for a longer response time available in case of any pump station failure mode. In other words, the District has a better opportunity to fix the failure of the sewer pump station before an overflow, regardless of which failure mode occurs, because the emergency storage provides a time buffer between the failure occurrence and the consequence of failure (sewer overflow). The hours of emergency storage during average and peak flow conditions were calculated for each sewer pump station, and an equivalent redundancy factor was applied according to **Table 9**.

Table 9 – Equivalent Redundancy Factors for Emergency Storage

Emergency Storage (Peak Flow)	Equivalent Redundancy Factor
1 Hour	0.05
2 Hours	0.1
3 Hours	0.15
4 Hours	0.2
5 Hours	0.3
6+ Hours	0.4

Similarly, an Emergency Response Plan (ERP) is commonly developed for sewer pump stations to document necessary information, actions, procedures, and directions for response to a pump station failure. Like emergency storage, the emergency response plan does not act as a redundant unit to any specific function of the sewer pump station, but it does in theory reduce the response time to a failure of the pump station thereby mitigating the risk of a sewer system overflow. Therefore, an equivalent redundancy factor of 0.05 was applied for the ERP mitigation measure.

3 RESULTS

3.1 4S Ranch Water Reclamation Facility FMEA Results

The FMEA workshop and post-workshop analysis established ten critical assets (assets in the “high-risk zone”) and presents non-CIP recommendations for all process areas. Capital improvement projects are recommended to mitigate risk associated with critical assets where applicable. The assets calculated to be critical and established in the “high-risk zone” are summarized in **Table 10.**

Table 10 – Summary of Critical Assets

ID	Asset	CoF	PoF	Risk	Initial Workshop Comments
HW-1	Bandscreen & Wash/Press	3.3	9.7	31.4	Consider redundant screen: economic evaluation required for potential capital expenditure
OX-1	Oxidation Ditch Aerators	7.8	5.7	44.0	Consider alternative aeration technology
OX-4	Anoxic Tank Mixer	6.0	5.7	34.1	Consider alternative mixing technology
SC-1	Skimmer/Scraper/Sludge Rake/Drive	6.8	5.5	36.9	Consider constructing bypass piping to Plant A clarifiers as emergency redundancy
TF-11	Tertiary Filters Structure	6.5	6.3	40.6	Replace existing Tertiary Filters Structure
UV-1	UV Banks	7.5	6.3	47.3	Upgrade existing disinfection system
UV-5	UV Control Panel	6.3	8.4	52.5	Upgrade existing disinfection system
SS-4	Switchboards, Breakers, and Feeders	9.0	5.3	47.9	Main breakers have not been NETA tested since original construction
SS-6	Motor Control Centers (MCCs)	8.3	5.3	43.9	Electrical room is undersized. No redundancy. MCC failure would be catastrophic. Consider distributed MCC’s
SS-8	PLC’s and Communications	7.8	5.2	40.3	Existing PLC’s will be obsolete within 10 years

3.1.1 Capital Improvement Recommendations

For critical assets, non-CIP operations and maintenance recommendations for a process area, equipment, or component may not be satisfactory to mitigate the risk associated with a failure to an acceptable level of service. These items require capital improvement projects to lower the risk to an acceptable level of service. **Table 11** represents the capital improvement projects recommended following the FMEA.

Table 11 – Capital Improvement Project Recommendations

ID	Asset	Project Recommendation
HW-1	Bandscreen & Wash/Press	Replace existing bandscreen and wash/press. Consider redundant equipment.
OX-1	Oxidation Ditch Aerators	Develop a contingency plan for emergency or planned, prolonged aerator downtime. Consider procuring shelf-spares for major or long-lead-time components. Engineering Study to evaluate changing Oxidation Ditch aeration to fine bubble diffused aeration, and installation of separate mixers to de-couple aeration and mixing needs in the ditch.
OX-4	Anoxic Tank Mixer	Engineering Study to evaluate change from single vertical turbine mixer to multiple smaller mixers for redundancy.
SC-1	Skimmer/Scraper/Sludge Rank/Drive	Construct bypass piping to Plant A clarifiers to act as emergency redundancy.[2]
TF-4	Tertiary Filters Structure	Replace the existing tertiary filters structure. See Technical Memorandum #3A for detailed analysis and recommendation.
UV-1	UV Banks	Upgrade existing disinfection system. See Technical Memorandum #3B for detailed analysis and recommendation.
UV-5	UV Control Panel	Upgrade existing disinfection system. See Technical Memorandum #3B for detailed analysis and recommendation.
SS-4	Switchboards, Breakers, and Feeders	Purchase new main breaker and test old breaker. Maintain old breaker as a spare. Replace switchboard with new switchboard with ATS bypass. Test critical feeders between Switchboard "S" and Switchboard "6". See Attachment 3 for detailed analysis and recommendation.
SS-6	Motor Control Centers (MCCs)	Distribute MCCs around the plant in the long-term for distributed backup power. See Attachment 3 for detailed analysis and recommendation.
SS-8	PLC's and Communications	Replace current PLC system in the mid-term before system becomes obsolete. Recommend phased approach to replacements in coordination with other plant modifications for maximum benefit. See Attachment 3 for detailed analysis and recommendation.

[2] Secondary Clarifiers were evaluated under perceived current operating conditions of no redundancy. See Technical Memorandum #3 for operational improvement recommendations resulting in potential for operation through one clarifier, therefore mitigating the potential of failure with redundancy and removing asset from the high-risk zone. If the plant can be operated through one clarifier, no bypass piping to Plant A clarifiers would be needed.

The workshop discussion produced interest in pursuing the capital project concept of installing a redundant screen and wash/press in the existing manual bar screen by-pass channel. This alternative will be evaluated in the Capital Improvement Plan Report.

3.1.2 Non-CIP Recommendations

During and after workshop discussion, the Dudek team identified several observations resulting in potential operational or minor upgrades that aim to resolve issues that are not addressed through the District's current preventative maintenance program and operating scheme. These non-CIP recommendations should be further evaluated by the District to confirm applicability and consideration for implementation. The non-CIP recommendations generated through workshop discussion are summarized in **Table 12** below.

Table 12 – Non-CIP Recommendations

Recommendations	Risk Mitigation Benefit
Headworks	
1. Reconfigure PLC to run headworks bandscreen continuously if level sensors fail.	1. Mitigates consequence of failure by allowing the system to continue operating in instance that support system fails.
2. Reconfigure PLC control logic to automatically shut off bandscreen if the wash water system fails.	2. Mitigates consequence of failure by shutting system down before wash/press cleaning becomes maintenance intensive.
3. Switch grit pump mechanical seals to self-contained non-flushing type seals.	3. Mitigates probability of a seal failure on the grit pump by not relying on plant water system.
4. Purchase shelf spare vortex drive for grit chamber.	4. Mitigates consequence of failure by shortening response and fix time.
5. Annually clean grit chamber.	5. Mitigates probability of failure by clogging grit chamber, hopper and inlet piping.
6. Add redundant level switch to the headworks channel.	6. Mitigates probability of failure by having redundancy in alarm in case of bandscreen failure.
7. Consider an emergency response plan in case of headworks structural failure.	7. Mitigates consequence of failure and reduces response time in case of an emergency.

Recommendations	Risk Mitigation Benefit
Oxidation Ditch/Anoxic Tank	
1. Measure pH in the splitter box.	1. Mitigates probability of failure by indicating if pH is too low or high and has potential to upset biology.
2. Add pH, nitrate, ammonia, and ORP probes strategically within the Oxidation Ditch and Anoxic Tank.	2. Mitigates probability of failure by improving ability to control and monitor biology and facilitate efficient treatment.
3. Add redundant DO probes to Oxidation Ditch and Anoxic Tank.	3. Mitigates probability of failure of DO process control through redundancy.
4. Consider adding ammeter to the Anoxic Tank mixer gear box to monitor when ragging causes over-torque on the drive.	4. Mitigates probability of failure by monitoring mixer. If ragging occurs, ammeter will indicate over-torque and allow for operations to respond before a failure of the gear box.
5. Purchase shelf spare gear box for Anoxic Tank mixer.	5. Mitigates consequence of failure and reduces response time in case of a failure.
6. Replace existing gate with submersible pump to better control flow through the anoxic zone.	6. Mitigates probability of failure of biological process by upgrading to a more controllable system. Existing gate does not control flow effectively, submersible pump would regulate flow.
7. Establish an emergency response plan in case of a catastrophic Oxidation Ditch/Anoxic Tank failure.	7. Mitigates consequence of failure and reduces response time in case of an emergency.
Secondary Clarifiers	
1. Establish an emergency response plan in case of a catastrophic Secondary Clarifier failure.	1. Mitigates consequence of failure and reduces response time in case of an emergency.
2. Evaluate feasibility of constructing emergency bypass piping to Plant A clarifiers.	2. Mitigates consequence of failure by shortening response time to bypass in case of a secondary clarifier failure.
Tertiary Filters	
1. Replace tertiary filters within 5 years.	1. Mitigates probability of failure by replacing aging asset with new asset.
2. Establish an emergency response plan in case of a catastrophic failure.	2. Mitigates consequence of failure and response time in case of an emergency.

Recommendations	Risk Mitigation Benefit
UV Disinfection	
1. Upgrade UV or establish a new disinfection process within 5 years. 2. Consider stocking parts anticipated to become obsolete within a few years. 3. Consider pursuing disinfection flexibility in WDR permit (e.g. permitted to use chlorine tanks as emergency backup). 4. Establish an emergency response plan in case of a catastrophic failure.	1. Mitigates probability of failure by replacing aging asset with new asset. 2. Mitigates consequence of failure by having replacement parts for failure response even if part is not commercially available. 3. Mitigates consequence of failure by allowing for temporary chlorine contact disinfection during a failure response to keep plant operational. 4. Mitigates consequence of failure and response time in case of an emergency.
Aerobic Digestion	
1. Evaluate feasibility of converting to facultative digestion.	1. Mitigates probability of failure with a new technology not reliant on aging blowers.
Sludge Dewatering	
1. Consider adding booster pump to potable make-up water to improve polymer mixing. 2. Evaluate feasibility of joining a North San Diego County regional Class A biosolids project (e.g., Encina Water Pollution Control Facility, San Elijo WRF, Escondido HARRF).	1. Mitigates probability of failure with a system improvement. 2. Reduce uncertainty of long-term Class B Biosolids disposal to Arizona; potential for reuse to offset increased operating costs.
Support Systems	
1. Establish self-contained seal water for all applicable seals.	1. Mitigates consequence of widespread seal water system failure.

Many of the non-CIP recommendations require capital investments; however, the cost of implementation is not expected to exceed the $50,000 project cost threshold for a CIP project.

3.2 4S Ranch Collection System FMEA Results

The FMEA for the 4S Ranch Collection System was evaluated for sewer pump stations and forcemains according to the methodology presented in Section 2.2. The 4S Ranch Collection System contains four sewer pump stations:

- Fire House
- Neighborhood #1
- Neighborhood #3
- Santaluz

A summary of the FMEA criticality score results is presented in **Table 13**. Failure scenarios for each sewer pump station are color-coded to represent whether the criticality score occupies the "low-risk zone" (scores from zero to ten), "medium-risk zone" (scores from ten to thirty), or "high-risk zone" (scores from thirty to one-hundred). Low-risk criticality scores are shaded green, medium-risk criticality scores are shaded yellow, and high-risk criticality scores are shaded red.

Table 13 – 4S Ranch Collection System FMEA Results

Pump Station	Mechanical/ Pump Failure	Power Failure (primary/utility)	Electrical Gear Failure	Piping/Valve Failure	Forcemain Failure/Break	Instrumentation Failure	Control Failure
Fire House	0.2	0.5	2.0	1.7	11.2	0.2	2.5
Neighborhood #1	0.4	0.5	4.6	3.3	19.0	0.5	5.1
Neighborhood #3	4.4	8.0	**44.0**	**36.8**	22.4	5.6	**56.0**
Santaluz	2.9	4.8	28.6	23.8	14.3	3.6	**36.5**

The FMEA results show that current mitigation measures are effective in keeping the majority of failure scenarios in the low-risk and medium-risk criticality zones; however, there are opportunities for improvements to help mitigate risk.

Of the four sewer pump stations, the Neighborhood #3 sewer pump station and the Santaluz sewer pump station scored in the "High-Risk Zone" in one or more failure mode scenarios. A summary of high-risk failure mode scenarios and recommended mitigation measures for each pump station is presented in **Table 14**.

Table 14 – 4S Ranch "High-Risk Zone" Failure Scenarios

Sewer Pump Station	High-Risk Failure Mode	Criticality Score	Recommended Mitigation
Fire House	None	N/A	Prepare an emergency response plan.
Neighborhood #1	None	N/A	Prepare an emergency response plan.
Neighborhood #3	Electrical Gear Failure Piping/Valve Failure Control Failure	44.0 36.8 56.0	Install bypass pumping connection and prepare an emergency response plan.
Santaluz	Control Failure	36.5	Install bypass pumping connection and prepare an emergency response plan.

The recommended mitigation measures to reduce criticality associated with the high-risk failure scenarios are effective, and significantly reduce the criticality score of high-risk failure scenarios. The results of the FMEA analysis including recommended mitigation measures are presented in **Table 15**.

Table 15 – 4S Ranch Collection System FMEA Results with Recommended Mitigation Measures

Pump Station	Mechanical/ Pump Failure	Power Failure (primary/utility)	Electrical Gear Failure	Piping/Valve Failure	Forcemain Failure/Break	Instrumentation Failure	Control Failure
Fire House	0.2	0.5	1.9	1.6	10.7	0.2	2.4
Neighborhood #1	0.4	0.5	4.4	3.1	18.1	0.5	4.8
Neighborhood #3	0.4	0.8	4.2	3.5	21.3	0.5	5.3
Santaluz	0.3	0.5	2.7	2.3	13.6	0.3	3.5

The FMEA results including recommended mitigation measures are effective in reducing the majority of failure mode scenarios into the low-risk zone of criticality scores. Only forcemain failure scenarios remain in the lower to middle range of the medium-risk zone for criticality scores. Complete analysis and calculation results for each sewer pump station are presented in Attachment 5.

3.3 Rancho Cielo Collection System FMEA Results

The FMEA for the Rancho Cielo Collection System was evaluated for sewer pump stations and forcemains according to the methodology presented in Section 2.2. The Rancho Cielo Collection System contains ten sewer pump stations:

- Avenida Apice
- Avenida Orilla
- Cerro Del Sol #1
- Cerro Del Sol #2
- Camino Sin Puente #1
- Camino Sin Puente #2
- Camino Sin Puente #3
- Camino Sin Puente #4
- Del Dios
- Midpoint

A summary of the FMEA criticality score results is presented in **Table 16**. Failure scenarios for each sewer pump station are color-coded to represent whether the criticality score occupies the “low-risk zone” (scores from zero to ten), “medium-risk zone” (scores from ten to thirty), or “high-risk zone” (scores from thirty to one-hundred). Low-risk criticality scores are shaded green, medium-risk criticality scores are shaded yellow, and high-risk criticality scores are shaded red.

Table 16 – 4S Ranch Collection System FMEA Results

Pump Station	Mechanical/ Pump Failure	Power Failure (primary/utility)	Electrical Gear Failure	Piping/Valve Failure	Forcemain Failure/Break	Instrumentation Failure	Control Failure
Avenida Apice	1.7	4.2	17.4	14.8	9.5	2.2	21.8
Avenida Orilla	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cerro Del Sol #1	1.7	4.2	17.4	14.8	9.5	2.2	21.8
Cerro Del Sol #2	1.7	4.2	17.4	14.8	9.5	2.2	21.8
Camino Sin Puente #1	2.9	4.9	29.2	24.3	14.6	3.7	**37.2**
Camino Sin Puente #2	2.9	4.9	29.2	24.3	14.6	3.7	**37.2**
Camino Sin Puente #3	2.9	4.9	29.2	24.3	14.6	3.7	**37.2**
Camino Sin Puente #4	2.5	4.2	25.0	20.8	12.5	3.2	**31.9**
Del Dios	2.6	4.8	26.4	22.1	13.4	3.4	**33.6**
Midpoint	2.6	4.8	26.4	22.1	13.4	3.4	**33.6**

The FMEA results show that current mitigation measures are effective in keeping the majority of failure scenarios in the low-risk and medium-risk criticality zones; however, there are opportunities for improvements to help mitigate risk.

Of the four sewer pump stations, the Camino Sin Puente sewer pump stations (1 through 4) Del Dios, and the Midpoint sewer pump stations scored in the high-risk zone in one or more failure mode scenarios. A summary of high-risk failure mode scenarios and recommended mitigation measures for each pump station is presented in **Table 17**.

Table 17 – 4S Ranch "High-Risk Zone" Failure Scenarios

Sewer Pump Station	High-Risk Failure Mode	Criticality Score	Recommended Mitigation
Avenida Apice	None	N/A	Install bypass pumping connection and prepare an emergency response plan.
Avenida Orilla	N/A	N/A	Install bypass pumping connection and prepare an emergency response plan.
Cerro Del Sol #1	None		Install bypass pumping connection and prepare an emergency response plan.
Cerro Del Sol #2	None	N/A	Install bypass pumping connection and prepare an emergency response plan.
Camino Sin Puente #1	Control Failure	37.2	Install bypass pumping connection and prepare an emergency response plan.
Camino Sin Puente #2	Control Failure	37.2	Install bypass pumping connection and prepare an emergency response plan.
Camino Sin Puente #3	Control Failure	37.2	Install bypass pumping connection and prepare an emergency response plan.
Camino Sin Puente #4	Control Failure	31.9	Install bypass pumping connection and prepare an emergency response plan.
Del Dios	Control Failure	33.6	Install bypass pumping connection and prepare an emergency response plan.
Midpoint	Control Failure	33.6	Install bypass pumping connection and prepare an emergency response plan.

The recommended mitigation measures to reduce criticality associated with the high-risk failure scenarios are effective, and significantly reduce the criticality score of high-risk failure scenarios. The results of the FMEA analysis including recommended mitigation measures are presented in **Table 18**.

Table 18 – 4S Ranch Collection System FMEA Results with Recommended Mitigation Measures

Pump Station	Mechanical/ Pump Failure	Power Failure (primary/utility)	Electrical Gear Failure	Piping/Valve Failure	Forcemain Failure/Break	Instrumentation Failure	Control Failure
Avenida Apice	0.2	0.4	1.7	1.4	9.0	0.2	2.1
Avenida Orilla	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cerro Del Sol #1	0.2	0.4	1.7	1.4	9.0	0.2	2.1
Cerro Del Sol #2	0.2	0.4	1.7	1.4	9.0	0.2	2.1
Camino Sin Puente #1	0.3	0.5	2.8	2.3	13.9	0.4	3.5
Camino Sin Puente #2	0.3	0.5	2.8	2.3	13.9	0.4	3.5
Camino Sin Puente #3	0.3	0.5	2.8	2.3	13.9	0.4	3.5
Camino Sin Puente #4	0.2	0.4	2.4	2.0	11.9	0.3	3.0
Del Dios	0.3	0.5	2.5	2.1	12.8	0.3	3.2
Midpoint	0.3	0.5	2.5	2.1	12.8	0.3	3.2

The FMEA results including recommended mitigation measures are effective in reducing the majority of failure mode scenarios into the low-risk zone of criticality scores. Only forcemain failure scenarios remain in the lower range of the medium-risk zone for criticality scores. Complete analysis and calculation results for each sewer pump station are presented in Attachment 5.

4 ATTACHMENTS

The following pages contain the documented results and plotted risk scores for each process area evaluated following the FMEA workshop.

Attachment 1: February 11, 2015 FMEA Workshop Notes.

Attachment 2: February 18, 2015 FMEA Workshop Notes.

Attachment 3: April 29, 2015 FMEA and Conditions Assessment Discussion Meeting Summary

Attachment 4: 4S Ranch WRF FMEA Results and Plotted Criticality Scores

Attachment 5: Sewer Pump Station FMEA Results and Calculated Criticality Scores

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ATTACHMENT I

February 11, 2015 FMEA Workshop Notes

MEETING NOTES

Date: February 11, 2015

Time: 8:00 AM to 10:00 AM

Location: 1966 Olivenhain Road, Encinitas, CA 92024

Subject: **Olivenhain Municipal Water District**
Failure Mode and Effects Analysis Workshop
Workshop #1

Project Team Members in Attendance:

OMWD		Dudek Team
☒ George Briest	☒ Raymond Motas	☒ Tom Falk
☒ Cari Dale	☒ Jason Emerick	☒ Steve Deering
☒ John Onkka	☒ Bill Forquer	☒ Wyatt Troxel
☒ Gabe Hernandez	☒ Rudy Petrovski	☒ Greg Guillen
☒ Bruno	☒ Erik Harp	☒ Phil Giori
☐	☐	
☐	☐	

Legend: ☒ Attended the meeting in person. ☑ Attended the meeting via telephone. ☐ Unable to attend.

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1. Objectives

a. Establish ranking criteria

b. Discuss unit ops at 4S Ranch WRF

c. Example: look at headworks as a system; what is the purpose of the headworks? What are sub-processes? What are consequences of sub-process failures?

2. Failures and consequences categories

a. Organizational Impacts

b. Health and Safety

c. Treatment Performance

d. Maintenance Resources

e. Score ranges from 1-10

i. 1 = low consequence/high tolerance of failure

ii. 10 = high consequence/low tolerance of failure

3. Probability of Failure

a. Probability of failure defined by the following formula:

$$PoF = \frac{Useful\ Life - (Remaining\ Life \times Cond.\ Assessment)}{Useful\ Life} \times (1 - Redundancy) \times 10$$

b. Scores will be adjusted based on District input of historical failures and experiences

4. Consequence of Failure

a. Unmitigated failure: what would happen if equipment/process was left unattended

b. Mitigated failure: changes to O&M procedures

c. If risk is still high after mitigation, then consider making capital improvements

5. Health and Safety

Health and Safety		
Tolerance	Score	Description
Low	10	Loss of life
	9	
	8	FMLA/reportable injury
	7	
Med	6	1-day loss time/reportable injury
	5	
	4	Visity to US Healthworks (hospital)
	3	
	2	
High	1	Minor 1st aid/no loss time

6. Treatment Performance

Treatment Performance		
Tolerance	Score	Description
Low	10	Catastrophic plant failure; plant offline for 1 wk +
	9	
	8	Permit violation (chronic)
	7	
Med	6	Permit violation (1 time)
	5	
	4	
	3	
	2	
High	1	Process control

7. Maintenance Resources

Maintenance Resources		
Tolerance	Score	Description
Low	10	Key personnel; leadtime > acceptable downtime
	9	
	8	Board action required; $50k equipment (PO); $35k construction project
	7	
Med	6	
	5	
	4	
	3	> $2,500 PO required
	2	< $1,500
High	1	Minor equipment/shelf spares
		*identify obsolete equipment

8. Organizational Impact

Organizational Impact		
Tolerance	Score	Description
Low	10	Spill/odor; visual impact; public impact; noise
	9	
	8	
	7	Temporary public impacts; trucking noise
Med	6	
	5	
	4	
	3	unscheduled attention; nuisance failures
	2	
High	1	

9. 4SRWRF Unit Operations

a. Headworks screens

i. Band screen failure requires use of manual bar screen which leads to ragging of RAS pumps

ii. Level sensor failure leads to shut down of band screen and bypass to bar screen

1. Level sensors were ultrasonic but are now submersible

2. Single system

iii. PLC could be adjusted to run continuously if level sensors fail

iv. Can remotely bypass to bar screen

1. Have to rake bar screen 3 times daily when bypassing

v. Encounter problems when communications are lost at headworks

vi. Band screen will continue to run without wash water, which leads to bad screenings

1. Loss of wash water happens frequently and is a critical problem

vii. District Staff estimates Band Screen unit fails 5 times per year.

Headworks Band Screen	
Category	Score
Health and Safety	1-3
Treatment Performance	5
Maintenance Resources	5
Organizational Impacts	3-4

b. Grit pumps

i. 1 pump has seal water; 1 pump does not use seal water

ii. Belts fail on belt drives on pumps

iii. Overhaul on 2 grit pumps completed and should allow for another 8 years operation

c. Grit chamber

i. Vortex drive shaft rags which causes over-torque on bearings

ii. Have a shelf spare for vortex drive

iii. Have had electrical failures (corroded wires)

iv. Have only bypassed chamber once

v. Can still flow through chamber if vortex is not running

vi. Currently no way to measure instantaneous grit removal efficiency

Grit Chamber	
Category	Score
Health and Safety	1
Treatment Performance	3-4
Maintenance Resources	3
Organizational Impacts	3

d. Grit classifier

i. Had to replace auger shaft 2-3 years ago

ii. Grit system is down if classifier fails

iii. Wear shoes on screw require 1-2 days to replace; has happened once in 5 years

iv. Rubber boot in cyclone section is a wear item

Grit Classifier	
Category	Score
Health and Safety	3-4
Treatment Performance	-
Maintenance Resources	-
Organizational Impacts	-

e. Parshall flume/splitter box

i. Odor issues

ii. Added exhaust fan

iii. Splitter box is unlined

iv. Splitter box has temporary cover to mitigate odors

v. Recommended to measure surface pH

vi. Level indicators need to be replaced on splitter box

vii. Parshall flume is influent + recycle

1. Ultrasonic level indicator

2. Has a failure alarm

3. Plant influent flow rate dictates RAS flow rate

Parshall Flume/Splitter Box	
Category	Score
Health and Safety	-
Treatment Performance	5
Maintenance Resources	-
Organizational Impacts	-

f. Oxidation ditch (Plant B)

i. 2 DO probes; 1 in oxidation ditch, 1 in anoxic zone

ii. No nitrogen discharge limit; TDS limit is 1,200 mg/l

iii. Recommended to add pH, nitrate, ammonia, and ORP probes

iv. 2 aerators and a mixer

v. Gate that controls flow to anoxic zone is almost completely corroded

vi. Gear box failure on mixer

1. Has ragged in past (with old headworks screen)

2. Could add ampmeter

vii. Very difficult to remove mixer blade (2 cranes required)

viii. Loss of anoxic mixer leads to foam, sludge settling, and possible septic condition.

ix. Loss of aerators (gear boxes are not available off shelf from Ovivo; District has spare motor)

1. Gear boxes are 10 yrs old

Oxidation Ditch	
Category	Score
Health and Safety	2
Treatment Performance	8-10
Maintenance Resources	9
Organizational Impacts	9

ATTACHMENT 2

February 18, 2015 FMEA Workshop Notes

OLIVENHAIN Municipal Water District

DUDEK

MEETING NOTES

Date: February 18, 2015

Time: 8:00 AM to 11:00 AM

Location: 1966 Olivenhain Road, Encinitas, CA 92024

Subject: **Olivenhain Municipal Water District**
Failure Mode and Effects Analysis Workshop
Workshop #2

Project Team Members in Attendance:

OMWD		**Dudek Team**
☒ George Briest	☒ Raymond Motas	☒ Tom Falk
☒ Cari Dale	☒ Jason Emerick	☐ Steve Deering
☒ John Onkka	☒ Bill Forquer	☒ Wyatt Troxel
☒ Gabe Hernandez	☒ Rudy Petrovski	☐ Greg Guillen
☒ Bruno	☒ Erik Harp	☒ Phil Giori
☐	☐	
☐	☐	

Legend: ☒ Attended the meeting in person. ☑ Attended the meeting via telephone. ☐ Unable to attend.

Unit Process Area Notes and Recommendations:

1. Oxidation Ditch/Anoxic Tank

    a. Mechanical weir gate is no longer operated or moved. The District relies on aerator VFD to control aeration input instead.

    b. ONE TIME RECOMMENDATION: (Wyatt) De-couple oxygen vs. mixing. Aerators provide both oxygen input into the ditch and mixing to keep everything in suspension. Separate mixers would allow for the aerators to turn off at times at night and cut energy costs.

    c. The District runs Aerator #2 at 75%, and runs Aerator #1 on VFD controlled by DO.

    d. Velocity in Ox ditch controls flow through anoxic zone, alkalinity recovery, and pH control, manages health of bacteria, want to control the system better, regardless of aerator performance.

e. ONE TIME RECOMMENDATION: Submersible pump instead of gate to control flow through the anoxic zone.

f. Wall mounted mixers could provide mixing solution

g. Energy efficiency can be improved

h. Aeration change to diffused air may be able to increase capacity and performance

2. Secondary Clarifiers

   a. SVI controls clarifier effectiveness, clarifiers have been bottleneck of the plant according to operations

   b. One failure mode is SVI, but the failure is occurring in the ditch

   c. SVI is high at the plant

   d. Array of factors affect the SVI

   e. Scum pumps return to headworks, has ability to go to digesters

   f. Scum pumps are self-priming Wemco, new, 2 years old

   g. Clarifier arm, anodes, and squigee’s were replaced on both clarifiers 1 year ago

   h. Failure of clarifiers requires high-line bypass to Plant A clarifiers

   i. Clarifiers were spot-treated last time they went offline (for repairs) and had minimal corrosion

   j. Should we add a clarifier rehab program?

   k. District has brushes for skimmers, launders

   l. Control of algae growth on weirs has impact of “chunkies” going to the filters

   m. Cover would not necessarily help

   n. Continuously cleaning weirs interrupt algae growth on the weirs

   o. Failure of Clarifier gearbox would take 4 months to replace, would have to bypass to Plant A clarifiers

   p. Failure at night would have effect in the morning. District would be able to bypass to Plant A clarifiers in about 2 days, maybe faster

q. Sludge floats would be a failure

r. The district manually treats the clarifiers with chlorine, although there is a tie-in

s. With looming buildout, the district should have an emergency response plan and a long-term ditch control plan

t. Ideally, clarifiers would remove as many solids as it is receiving (not necessarily flow)

u. High SVI indicates high sludge blanket depth, control sludge blanket

v. Stanford Baffles don't address sludge settling ability, only address hydraulics & control effect of high SVI

w. Overflow to pond if clarifiers fail

x. Solids loading rate is driving the issue with clarifiers, higher percentage of solids incoming over time

y. ONE TIME RECOMMENDATION: Evaluate the feasibility of constructing piping to Plant A clarifiers in case of a failure.

z. Solids loading may require 3rd clarifier in the future, current MLSS already at 4000 to 4200 mg/L

3. EQ Basins

    a. Flow EQ basins will be concrete lined, structural change, currently at 50% design. 40% capacity increase

    b. EQ basins turned over daily, cleaned weekly, looking into covering basins

    c. 1 HP mixer in each

4. Filter Influent Pump Station

    a. VFDs upgraded within past 3 years

    b. Controlled from gpm set point, 700 gpm during the day, 1200 gpm at night

    c. Submersible level sensor with float backup

    d. Floats don't indicate self-failure

    e. CoF scores: 1, 5, 9, 7

f. District using 908 polymer, no longer alum. Flash mix pump runs but polymer not added there.

5. Filters
   a. Can operate with 3
   b. Typically backwash 1 time per day per filter cell
   c. Can load at about 500 gpm per cell
   d. Pneumatic valves, all replaced within past 4 years
   e. No failures associated with air compressor to date
   f. No clogging in the underdrain and no mudballs
   g. Rust is biggest problem
   h. 7 or 8 years ago replaced all media, no full overhaul since then
   i. Ops doesn't think they have another 5 years from the filters
   j. Polymer dose effects number of backwashes per day
   k. Air runs thorugh the structure from scour blowers, leak there would affect all cells
   l. ONE TIME RECOMMENDATION: Replace filters within 5 years
   m. Hydroclear can be adjusted to concrete cells
   n. Filter PLC, failure would be catastrophic, filter process will shut down
   o. Control Panel is older

6. UV Disinfection
   a. Control System is outdated, complicated, becoming obsolete, need a new control system
   b. Control panel only says bulb has failed, no specifics
   c. 2 different PLCs managing information, cumbersome
   d. UV flow meter measures height over weir
   e. UVT measured before entering channel

f. No local dose read currently

g. Bulbs are limited, poor performance, acid wash every 60 days

h. Bulbs have 8000 hour warranty, most don't last that long

i. Clean 2 banks at a time 2 weeks apart

j. 45 minutes in acid

k. Ballast – control board for bank goes out, replaced all, rubber receptacles have tendency to blow out, 5 to 6 modual rubber receptacles replaced per year

l. High maintenance UV system

m. Mitigation in place

n. UV cons: maintenance & energy

o. Chlorine Pros: RW residual, low maintenance, energy

p. Sodium limits in permit may effect feasibility for switch to chlorine disinfection

q. UV parts are obsolete, bulbs are no longer manufactured, control boards will not be available for long (5 years tops)

r. UV upgrade needs to happen in next 5 years

s. Potential mitigation: stock up on obsolete parts

t. Control system failure – goes to overflow pond

u. Testing has been done, RWQCB needs to validate (new lamps?)

v. UV CoF: 7,8,8,7

w. Filter pumps shut down if UV system fails

x. Permit does not accept chlorine as backup to UV for disinfection

y. 4 or 5 Baker tanks in a row has been used in the past for chlorine disinfection

7. Non-potable water pumps

   a. All pumps have been overhauled

   b. Now using Thelma head to supply NPW to plant

c. 3 pumps available if issue with Thelma

d. Criticality of NPW pumps is low

e. Supplies Seal Water

f. ONE TIME RECOMMENDATION: Self-contained seal water for all seals

g. Loss of utility water would result in multiple pump failures (including RAS pumps)

h. Failure modes: mechanical

i. NPW pumps doesn't supply desired pressure (90 psi) (bandscreen requires 70-80 psi)

j. Thelma head pressure is about 120 psi (preferred)

8. RAS Pumps

   a. 2 duty, 1 standby

   b. Loss is significant treatment impact

   c. SCADA controls RAS

   d. 1 pump per clarifier is sufficient

9. WAS Pumps

   a. Batch waste daily

   b. RAS shuts down when WAS system starts up

   c. Waste cycle happens daily, about 6 or 7 am

   d. WAS started manually

   e. Waste for 4 to 5 hours on average

   f. Single duty/standby, same sump, separate pipes, pulls from both clarifiers

   g. WAS on seal water

   h. ONE TIME RECOMMENDATION: self-contain seal water for WAS system

   i. WAS CoF: 2,5,5,3

   j. Lead-time for WAS pump: 8-10 weeks

10. Aerobic Digesters
    a. 3-4% solids
    b. Thickener – could be worked around if failure
    c. Failure modes: loss of digestion, odor, electro-mechanical
    d. 2 different blowers
    e. 2 digesters, but takes long time to transfer
    f. Mag-hydroxide added
    g. Kaeser blower has had multitude of problems, enclosure overheating
    h. Failure modes: blower failure, biological failure
    i. pH tried to maintain at 7 to 7.5
    j. ONE TIME RECOMMENDATION: Evaluate feasibility of facultative digestion
    k. 220000 gal capacity for each digester
    l. Meeting class B standard for sludge
    m. Digester CoF: 2,5,8,8
11. Belt Presses
    a. Could run thickening, dewatering on one Belt Press
    b. Dewater about 4 times a week for 4-5 hours
    c. Nearing end of life
    d. New roller coming
    e. Belts: replaced 1 to 2 times per year (each belt) (4 total per year)
    f. Low make-up water pressure creates problems for mixing, may need booster for potable water system
    g. Filtrate pumped to headworks
    h. Almost same scores as digester (CoF: 2,5,7,8)

i. 20 hours per week for dewatering, hauling 2 times per week

j. Class A: can achieve through heating, chemical, drying

k. Could go to Encina/San Diego for Class A

l. ONE TIME RECOMMENDATION: Evaluate lyso with Ozone

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ATTACHMENT 3

April 29, 2015 FMEA and Conditions Assessment Discussion Meeting Summary

Date: June 3, 2015

Project: Olivenhain Municipal Water District
4S Ranch WRF and Lift Stations

Subject: **FMEA and Conditions Assessment Discussion Meeting Summary**

Following is a discussion summary for the FMEA and Conditions Assessment Discussion Meeting held at 4S Ranch WRF on April 29, 2015.

A. Discussion Overview

1. The meeting was held with key members of the OMWD operations, Electrical, I&C, and SCADA personnel. The purpose of the meeting was to discuss various failure modes and effects as related to the Electrical, I&C, and SCADA functions of the 4S Ranch WRF and remote lift stations. Meeting discussions also included input from the District related to the Conditions Assessment Technical Memorandum. The two functions discussed were the Power Process Equipment and Control Process & SCADA Equipment.

B. Power Process Equipment

1. Service Switchboard "S"

    a. Service Switchboard "S" includes the Main SDG&E Utility Disconnect Breaker and an Automatic Transfer Switch (ATS).

        i. Main Breaker[1]

            (a) There is major concern that the Main Breaker has not been serviced or NETA maintenance tested since the initial commissioning date about 14 years ago. Failure of the main breaker would produce unacceptable failure mode results since the plant would not be able to run on utility power until the breaker is repaired and re-commissioned, or a new breaker is installed and commissioned. There is concern that if the breaker is turned off and cannot be turned back on during testing or maintenance, the plant would not be able to run on utility power until the breaker was repaired or replaced.

            (b) To assist in mitigating this problem, a short-term plan was discussed to purchase a new breaker and then replace the existing breaker with the new breaker. The new breaker would be NETA tested. Once removed, the existing breaker would be sent out to be refurbished & then put on the shelf as a spare. The plan for replacing the breaker would include disconnecting

[1] There is an existing Main Breaker within Existing Main Switchboard "6" with same concerns as the existing Main Breaker within Switchboard "S". Recommend similar plan for the Switchboard "6" Main Breaker. Refer to Attachment #2 for a single line diagram showing additional detail regarding the existing Switchboard "S" Main Breaker and the existing Switchboard "6" Main Breaker.

SDG&E utility power and running on the existing standby generator during breaker replacement. This would allow the plant to continue to run during the breaker replacement.

ii. ATS

(a) There is concern that the ATS has not been serviced or NETA maintenance tested since the initial commissioning date about 14 years ago. The ATS cannot be serviced since it is continuously required to furnish utility power or emergency generator power to the plant. There is currently no way to bypass the ATS for periodic maintenance.

(b) A long-term plan was discussed to replace the existing Switchboard “S” with a new Switchboard “S”. The new Switchboard “S” would include ATS bypass functions for utility power and emergency generator power. The recommendation would be a two-source transfer switch with bypass isolation for both sources. Source 1 would be SDG&E power and Source 2 would be Generator power. Drawout power case switches/breakers would allow for maintenance, inspection, and testing to be performed while maintaining continuous power to the load. This configuration will provide safe system maintenance without any power disruptions to the plant.

(i) Refer to Attachment #2 for a single line diagram showing a new ATS with bypass isolation for both sources. The single line diagram was configured with an EATON Magnum ATS utilized as a guideline.

(ii) Refer to Attachment #3 for an EATON Magnum ATS manual.

iii. Surge Protection and Spare Main Breaker

(a) It is recommended that the new Switchboard “S” include a spare Main Utility Breaker and surge protection.

2. Main Switchboard “6”

a. Existing Main Switchboard “6” is the main switchboard for 480VAC power distribution throughout the plant. There is an existing Main Breaker within Main Switchboard “6” with same concerns as the existing Main Breaker within Service Switchboard “S”. Recommend similar plan for the Switchboard “6” Main Breaker. Refer to Attachment #2 for a single line diagram showing additional detail regarding the existing Switchboard “6” Main Breaker.

i. Main Breaker

(a) There is major concern that the Main Breaker has not been serviced or NETA maintenance tested since the initial commissioning date about 14 years ago. Failure of the main breaker would produce unacceptable failure mode results since the plant would not be able to run on utility power until the breaker is repaired and re-commissioned, or a new breaker is installed and commissioned. There is concern that if the breaker is turned off and cannot be turned back on during testing or maintenance, the plant would not be able to run on utility power until the breaker was repaired or replaced.

(b) To assist in mitigating this problem, a short-term plan would be to purchase a new breaker and then replace the existing breaker with the new breaker. The new breaker would be NETA tested. Once removed, the existing breaker would be sent out to be refurbished & then put on the shelf as a spare. The plan for replacing the breaker should include disconnecting the Main Switchboard "6" feeder, fed from the ATS, and running on a temporary generator during breaker replacement. The temporary generator would be wired downstream of the Switchboard "6" Main Breaker. This would allow the plant to continue to run during the breaker replacement.

3. Plant Power Feeders

   a. There is concern that a failure of the plant power feeders would produce long power down time which would result in the plant not being able to run for a long period of time.

   b. Power Feeders between Switchboard "S" and Switchboard 6.

      i. The condition of the power feeders between Switchboard "S" and Switchboard 6 are of the utmost importance since Switchboard 6 is utilized to distribute all plant power. It is recommended that these feeders are tested to assess their condition.

      ii. To test these feeders, utility power would have to be turned off via the Main Breaker located in Switchboard "S". Since the condition of the existing Main Breaker is unknown, the testing of these feeders should not be completed until a new Main Breaker is purchased, installed and commissioned.

   c. Power Feeders between Switchboard 6 and MCC 6M, Switchboard 6 and MCC 7M, and Switchboard 6 and MCC 11M.

      i. The condition of the power feeders between Switchboard 6 and MCC 6M (Electrical Room), MCC 7M (RWPS), and MCC 11M (Overflow Pond) are unknown. It would be prudent to test these power feeders to assess their condition.

      ii. The testing of these power feeders is not as important, since there is discussion to distribute the functions of MCC 6 in the long term.

4. Manual Transfer Switches (MTSs) for Distributed Portable Generator Power

   a. It was determined that the critical plant equipment necessary to maintain a healthy plant are the Oxidation Ditch Aerators, Secondary Clarifiers, and RAS/WAS Pump Stations. Two concepts were discussed to keep this and other equipment operational during power distribution problems. Both concepts include addition of MTSs to allow for powering MCCs and/or equipment with portable generators during power problems.

b. MTSs for Incoming MCC Feeders.

   i. MTSs could be added for the incoming MCC Feeders at MCC 6M (Electrical Room), MCC 7M (RWPS) and MCC 11M (Overflow Pond). Addition of MTSs at the three MCC locations would allow for a temporary portable generator power connection to feed each MCC. There would have to be manual load shedding at each MCC to run critical equipment only. This option would be costly and the District's initial input is that they would rather invest in distributed MCCs than this option.

c. MTSs at Critical Equipment

   i. MTSs and other required equipment could be placed at each critical piece of equipment so that critical equipment could be run with portable generators. This idea would have to be further discussed to identify an exact list of critical equipment and appropriate locations for MTSs & other required equipment to allow for a complete distributed portable generator backup power plan.

5. Distributed MCCs

   a. The electrical room is currently packed. A long-term upgrade to consider would be to distribute MCCs so that the MCC 6M functions would be distributed to various local areas. This would allow for better planning of distributed emergency power for critical equipment and would pair well with distributed PLCs with redundant communications. This would also allow for a clean-up of the packed electrical room.

   b. New distributed MCCs are to include surge protection.

C. Control Process & SCADA Equipment

1. Level Control

   a. The current level control at the 14 remote lift stations consists of one (1) reactive air primary level (analog) monitoring system and a float-based backup control system. The District mentioned that one primary level measurement device is all that is needed and they do not think that a redundant primary level measurement system is necessary. Also, the float backup system includes start and stop backup floats held in place with a PVC coated anchor. The backup float system works independent of the primary PLC Level Control. The District does not think that a stilling well is needed since their maintenance routine includes cleaning and testing the backup float system on a monthly basis.

2. PLCs

a. PLC Overview

i. 4S Ranch WRF PLCs – PLCs within the plant are Allen-Bradley SLC 5/05 PLCs and Micrologix 1400 PLCs, with integral Ethernet communications and Ethernet/IP protocol.

Refer to Attachment #1 Existing PLC Block Diagram for additional information regarding Existing PLCs and plant control network connectivity details.

Following is a list of PLCs currently in operation at the plant.

(a) PLC-2A, Electric Room, A/B SLC 5/05
(b) PLC-2B, Electric Room, A/B SLC 5/05
(c) PLC-3, Reclaimed Water PS, A/B SLC 5/05 (level control signal required from Thelma Reservoir)
(d) PLC-4, Overflow Pond PS, A/B SLC 5/05
(e) PLC Filters, A/B SLC 5/05 (permissive interlocks required from PLC-2)
(f) PLC Blowers, A/B SLC 5/05
(g) PLC Headworks Bandscreen, A/B MicroLogix 1400
(h) PLC Headworks Scrubber, A/B MicroLogix 1400
(i) PLC Sludge Dewatering Scrubber, A/B MicroLogix 1400

ii. Remote Lift Station PLCs – All of the PLCs at the 14 remote lift stations are Allen-Bradley SLC 5/05 PLCs with integral Ethernet communications and Ethernet/IP protocol.

b. Short Term Mitigation

i. It is recommended that the following spares are on hand for quick repair of any existing PLC component malfunction that may occur prior to the mid-to-long term modifications are performed.

(a) One SLC 5/05 Controller with memory size to accommodate replacement of any SLC 5/05 PLC in the plant or at the remote lift stations.
(b) One of each type of SLC 5/05 I/O Module.
(c) One of each type of SLC 5/05 PLC Power Supply.
(d) One of each type of SLC 5/05 Communications Module.
(e) One of each size of SLC 5/05 PLC Rack.
(f) One MicroLogix 1400 Controller with memory size to accommodate replacement of any MicroLogix 1400 PLC in the plant.
(g) One of each type of MicroLogix 1400 I/O Module.
(h) One of largest Ethernet Switch to accommodate replacement of any switch in the plant.

c. Mid-to-Long Term Modifications

i. Overview

(a) The current PLC system is in good condition. In the mid-to-long term, it is recommended that the existing PLCs are replaced and transitioned to PLC products that will have longevity and Allen-Bradley's long term support. Also, a more robust PLC system is preferred that would provide redundant hot backup PLCs, Distributed I/O over redundant media, and a redundant SCADA communications network. This would be more in line with the OMWD McCollom WTP, and would assist in establishing a standard for OMWDs plants.

ii. PLC Product Longevity and Support

(a) Allen-Bradley SLC 500 Family – The Allen-Bradley SLC 500 PLC line has a limited life span. Allen-Bradley is anticipating discontinuing the production of the SLC 500 PLC line in about 5 years, with support and repair concluding about 5 years after discontinuation. The product costs are also expected to increase 5-8% annually. It is recommended that the SLC 500 PLCs at the 4S Ranch WRF are replaced with ControlLogix PLC products. The ControlLogix PLCs will have production longevity and Allen-Bradley's long term support. The ControlLogix PLCs have PLC redundancy capabilities and communications redundancy capabilities. The migration to ControlLogix PLCs should take place within 10 years or less.

(b) Allen-Bradley MicroLogix 1400 – Allen-Bradley is not currently anticipating discontinuing production on the MicroLogix 1400 & the MicroLogix 1400 product line should be in production for more than 5 years. Although this is true, the CompactLogix products are expected to have production longevity and Allen-Bradley's long term support. It is recommended that the MicroLogix 1400 PLCs at the 4S Ranch WRF are replaced with CompactLogix PLC products.

iii. Phased Approach

(a) The requirements/configuration of the replacement system has to take into consideration other plant modifications that may take place, such as distributed MCCs, which would affect location of distributed I/O and communications topology. It is also required that the plant runs continuously through the PLC transition. A phased approach would allow for integration of ControlLogix PLC systems for phased distribution of new MCC(s) and PLC(s). The phased approach would also provide PLC redundancy and SCADA network redundancy for new PLC systems.

Refer to Attachment #1 Phased PLC Block Diagram for additional information regarding new phased PLC systems.

iv. Fully Transitioned PLC Plant Control System

(a) It is recommended that the fully transitioned PLC Plant Control System consists of a redundant ControlLogix PLC system with redundant Ethernet connectivity to the SCADA network and redundant Ethernet media connectivity to ControlLogix Remote I/O racks. The McCollom plant utilizes Remote (distributed) I/O connected via ControlNet. Allen-Bradley recommends a redundant Ethernet Remote I/O for a new system in lieu of ControlNet, since ContolNet support is expected to be reduced in the long term.

Refer to Attachment #1 Fully Transitioned PLC Block Diagram for additional information.

(b) It is recommended that MicroLogix 1400 PLCs are transitioned to CompactLogix PLCs. The CompactLogix PLCs would not provide redundant PLCs or communications, but the three systems to be transitioned are not critical & can be run in hand mode during repairs. We feel that putting these three systems on the redundant ControlLogix network would be excessive.

Refer to Attachment #1 Fully Transitioned PLC Block Diagram for additional information.

v. Transitioned Remote Lift Stations – It is recommended that the SLC 500 PLCs at the Lift Stations are replaced with CompactLogix PLC products and possibly non-redundant ControlLogix for the larger lift stations. The migration to CompactLogix/ControlLogix PLCs should take place within 10 years or less.

3. Communications

a. The existing communications system in the plant is not redundant. When there is a communications failure, SCADA connectivity for monitoring, alarm and historical functions are affected, along with possible interlocks between PLCs that are necessary to keep the process operational. The upgrade to redundant ControlLogix PLCs would allow for redundant communications capabilities via redundant Ethernet media for Remote I/O and redundant ring SCADA communications.

b. Possible short term mitigation for loss of necessary interlocks that may be lost due to a communications failure would be to hardwire required interlocks between PLCs as a backup to interlocks messaged between PLCs via the communications network. Further investigation would be necessary to identify required hardwired interlocks.

c. Modifications for communications between the plant and larger remote lift stations may be required to allow for proper bandwidth to support SCADA client workstations at the larger lift stations. The client IndustrialPCs (iPC) workstations would replace the door-mounted Operator Interface Terminals (OIT) at the larger lift stations.

4. SCADA

    a. SCADA hardware and software products are in the process of being upgraded and are expected to be in excellent condition when complete.

    b. The District would like to install iPC based SCADA clients at the larger remote lift stations, which are Firehouse, Neighborhood #1, Neighborhood #3, Midpoint, and Del Dios. The SCADA client iPCs would replace the door-mounted Operator Interface Terminals (OIT) at each of the stations mentioned. This modification would allow operations to monitor and control the entire SCADA system at each of the stations, which would produce greater operational flexibility and efficiency.

Attachments:

Attachment #1 – Plant Control System, PLC Block Diagrams

- Existing PLC Block Diagram
- Phased PLC Block Diagram
- Fully Transitioned PLC Block Diagram

Attachment #2 – Single Line Diagram, New ATS with Bypass Isolation

Attachment #3 – EATON Magnum ATS Manual

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Attachment # 1:

Plant Control System
PLC Block Diagrams

- **Existing PLC Block Diagram**
- **Phased PLC Block Diagram**
- **Fully Transitioned PLC Block Diagram**

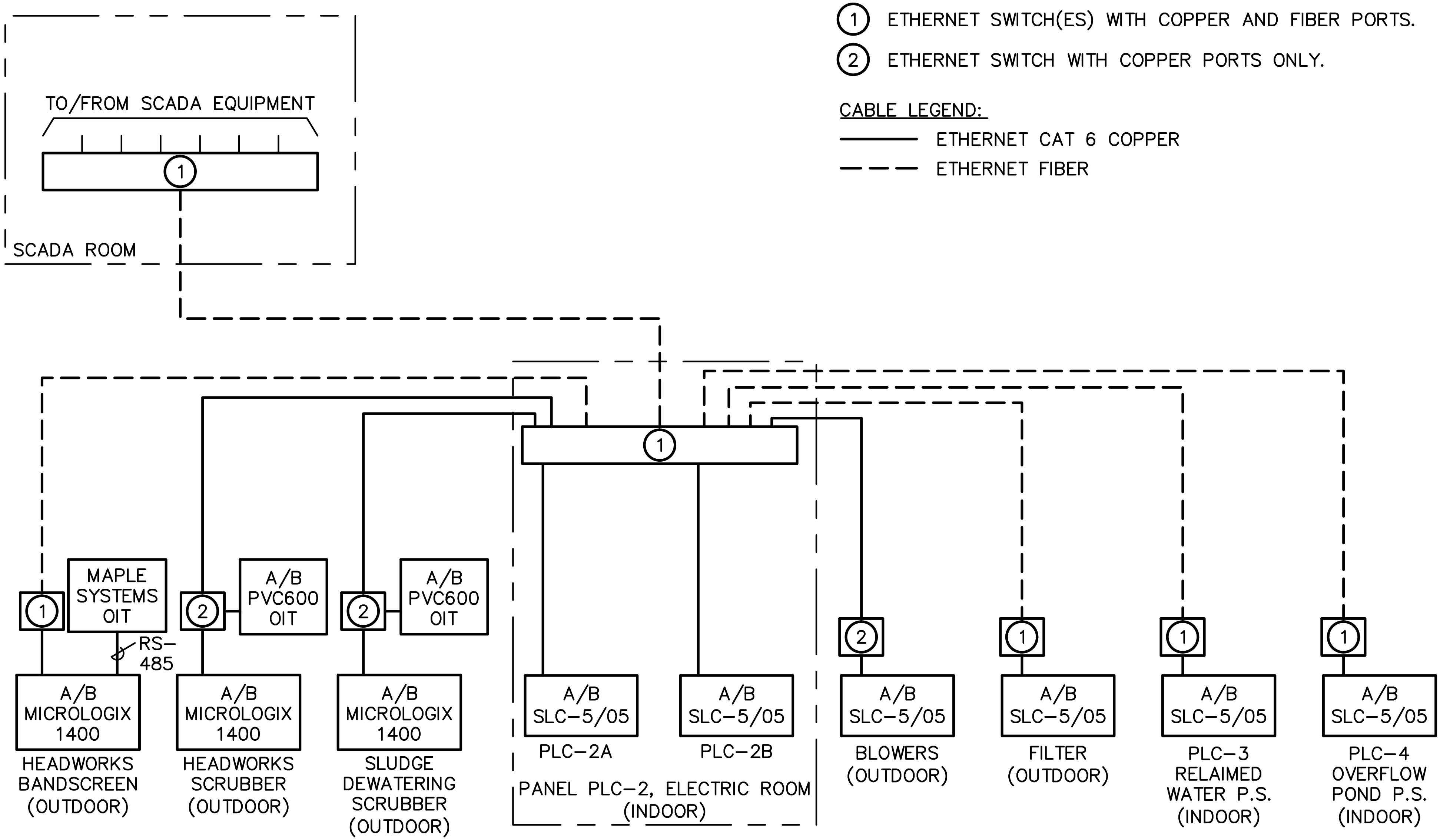
NOTES:

1. ETHERNET SWITCH(ES) WITH COPPER AND FIBER PORTS.
2. ETHERNET SWITCH WITH COPPER PORTS ONLY.

CABLE LEGEND:

——— ETHERNET CAT 6 COPPER

– – – ETHERNET FIBER



PLANT CONTROL SYSTEM
EXISTING PLC BLOCK DIAGRAM

4S RANCH WASTEWATER TREATMENT PLANT

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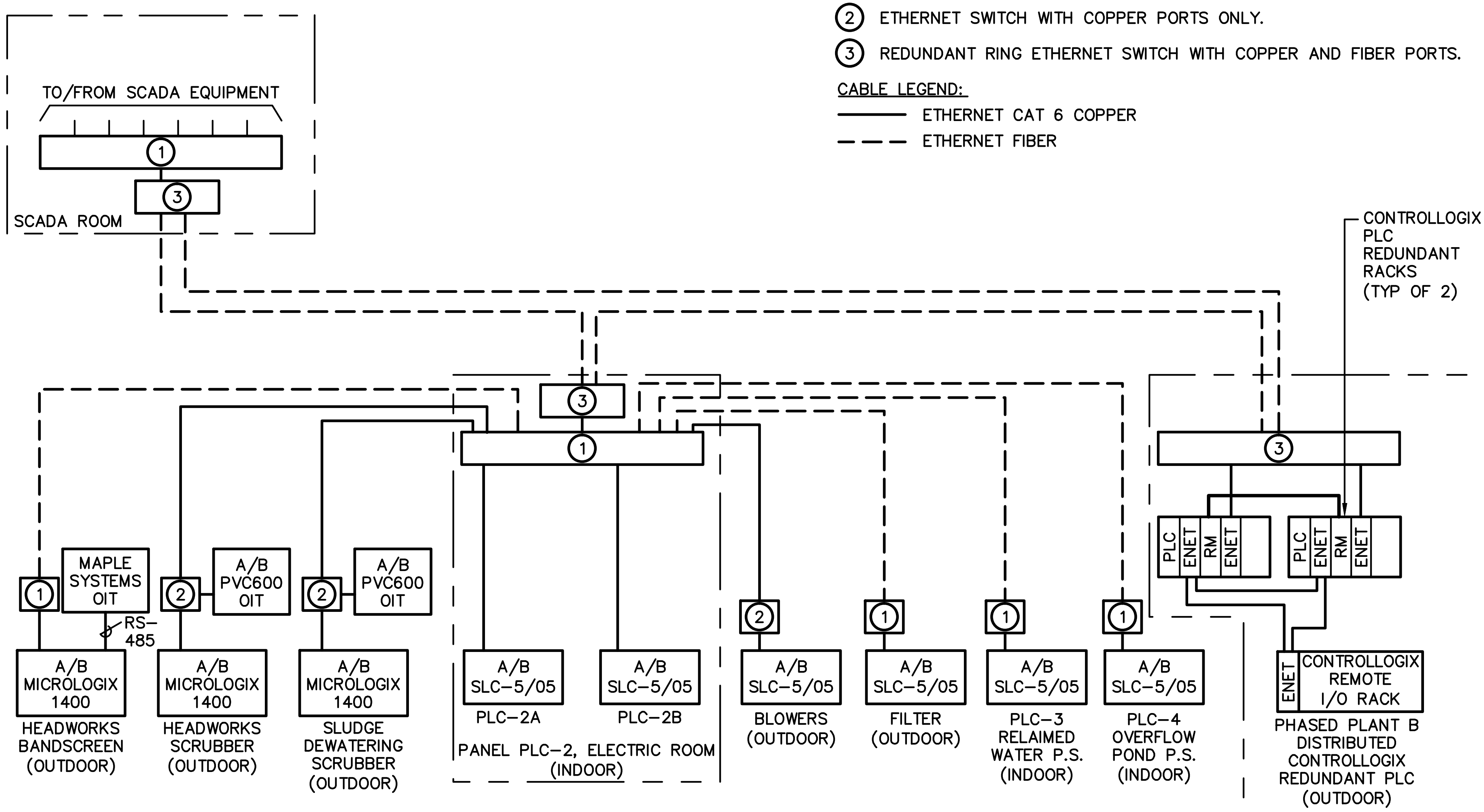
NOTES:

1. ETHERNET SWITCH(ES) WITH COPPER AND FIBER PORTS.
2. ETHERNET SWITCH WITH COPPER PORTS ONLY.
3. REDUNDANT RING ETHERNET SWITCH WITH COPPER AND FIBER PORTS.

CABLE LEGEND:

- solid line: ETHERNET CAT 6 COPPER
- dashed line: ETHERNET FIBER



PLANT CONTROL SYSTEM
PHASED PLC BLOCK DIAGRAM

4S RANCH WASTEWATER TREATMENT PLANT

DUDEK

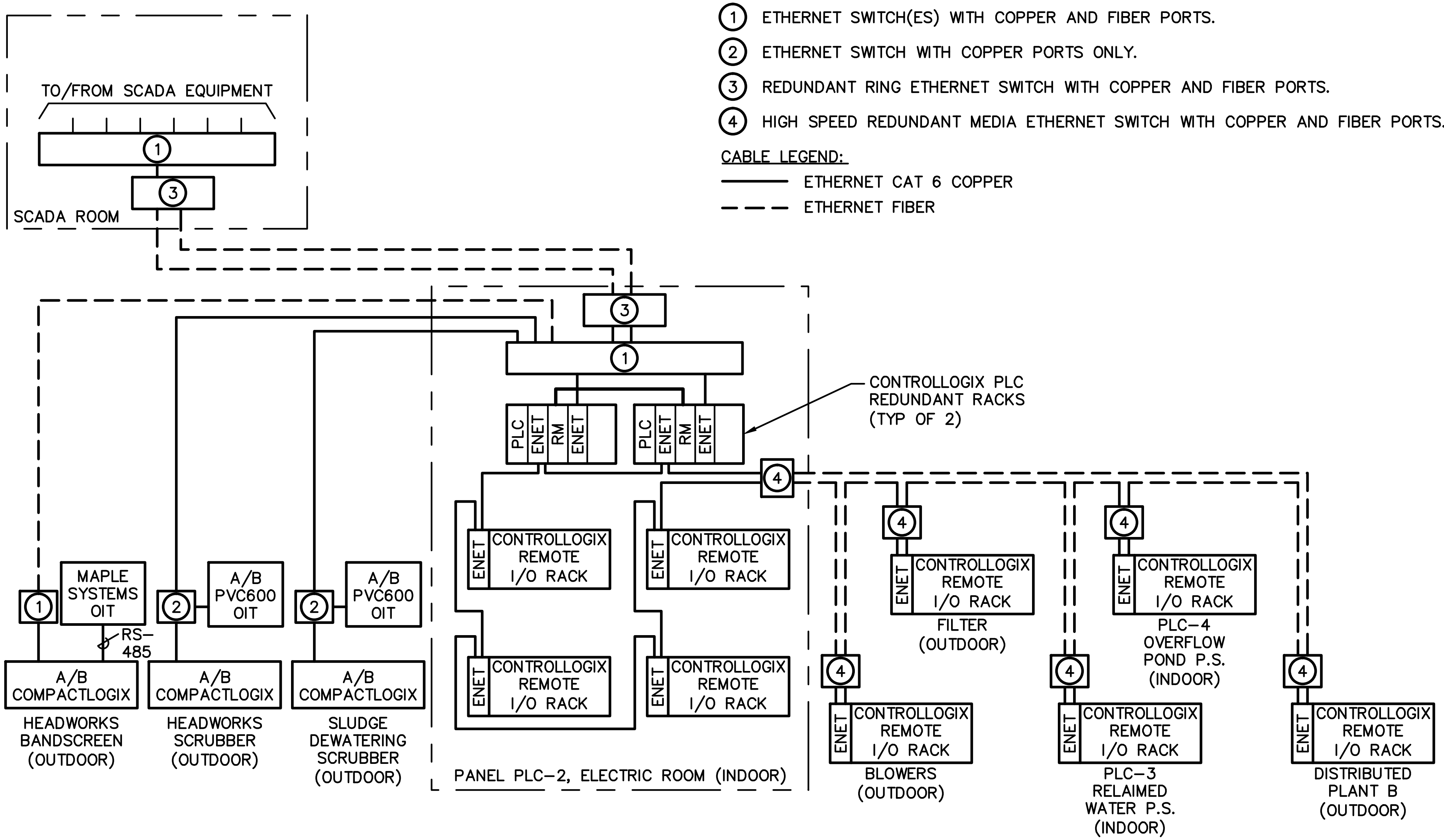
NOTES:

1. ETHERNET SWITCH(ES) WITH COPPER AND FIBER PORTS.
2. ETHERNET SWITCH WITH COPPER PORTS ONLY.
3. REDUNDANT RING ETHERNET SWITCH WITH COPPER AND FIBER PORTS.
4. HIGH SPEED REDUNDANT MEDIA ETHERNET SWITCH WITH COPPER AND FIBER PORTS.

CABLE LEGEND:

——— ETHERNET CAT 6 COPPER

— — — ETHERNET FIBER



PLANT CONTROL SYSTEM
FULLY TRANSITIONED PLC BLOCK DIAGRAM

4S RANCH WASTEWATER TREATMENT PLANT

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Attachment # 2:

Single Line Diagram
New ATS with Bypass Isolation

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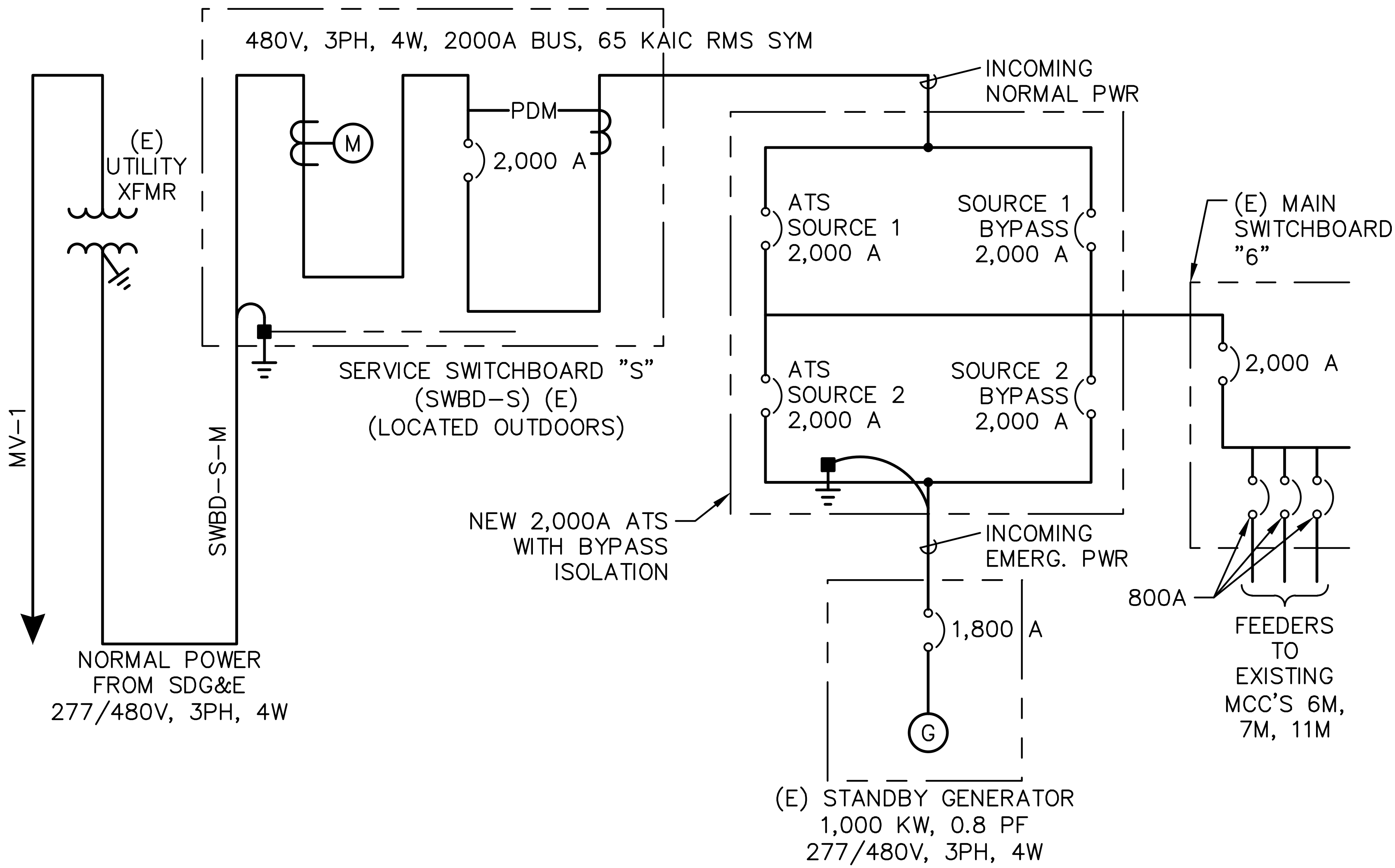

REVISED SINGLE LINE DIAGRAM SHOWING NEW AUTOMATIC TRANSFER SWITCH W/ BYPASS ISOLATION

4S RANCH WASTEWATER TREATMENT PLANT

DUDEK

Attachment # 3:

EATON Magnum ATS Manual

Powering Business Worldwide

O & M Manual for the Fixed and Drawout Magnum Transfer Switches

Instruction Booklet

4000A Magnum

2000A Magnum

⚠ WARNING

READ AND UNDERSTAND THE INSTRUCTIONS CONTAINED HEREINAFTER BEFORE ATTEMPTING TO UNPACK, ASSEMBLE, OPERATE, OR MAINTAIN THIS EQUIPMENT.

HAZARDOUS VOLTAGES ARE PRESENT INSIDE TRANSFER SWITCH ENCLOSURES THAT CAN CAUSE DEATH OR SEVERE PERSONAL INJURY. FOLLOW PROPER INSTALLATION, OPERATION, AND MAINTENANCE PROCEDURES TO AVOID THESE VOLTAGES.

TRANSFER SWITCH EQUIPMENT COVERED BY THIS INSTRUCTION BOOK IS DESIGNED AND TESTED TO OPERATE WITHIN ITS NAMEPLATE RATINGS. OPERATION OUTSIDE OF THESE RATINGS MAY CAUSE THE EQUIPMENT TO FAIL RESULTING IN DEATH, SERIOUS BODILY INJURY, AND/OR PROPERTY DAMAGE. ALL RESPONSIBLE PERSONNEL SHOULD LOCATE THE DOOR MOUNTED EQUIPMENT NAMEPLATE AND BE FAMILIAR WITH THE INFORMATION PROVIDED ON THE NAMEPLATE. A TYPICAL EQUIPMENT NAMEPLATE IS SHOWN IN FIGURE 1.

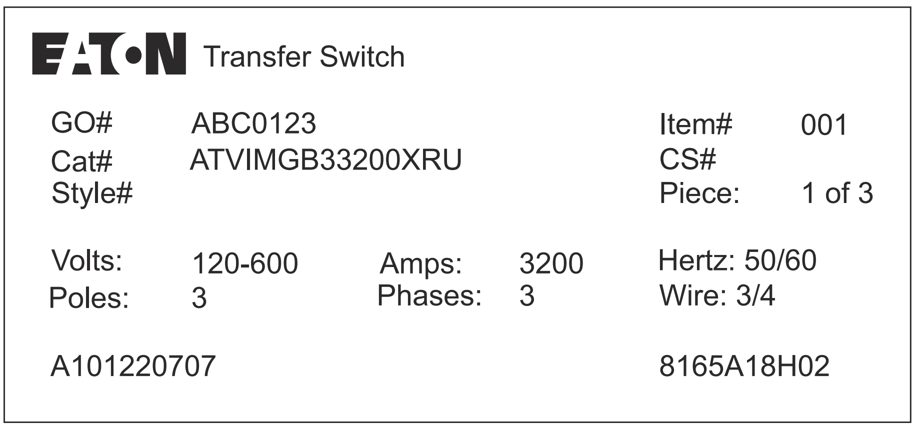

Figure 1. Typical Automatic Transfer Switch Equipment Nameplate.

NOTICE

A FINAL INSPECTION OF THE EQUIPMENT SHOULD BE PERFORMED PRIOR TO ENERGIZING THE TRANSFER SWITCH.

Step 1: Remove any dirt or debris that may have collected during shipment or installation. NEVER use high pressure blowing air. This could drive dirt or other foreign objects into electrical or mechanical components which could cause damage. Use an industrial quality vacuum cleaner to remove any dirt or foreign objects.

Step 2: Be certain all cable connections are correct and that the phase rotation of both sources match.

Step 3: Inspect the engine start connections and verify the correct connection of all control wires.

Step 4: Check all programmable setpoints and adjust as necessary. In addition, adjust any optional accessories as required.

Step 5: Be certain that the actual lug torque values are in keeping with the requirements outlined in the instruction book to insure the integrity of power connections.

Step 6: Check to be sure that all covers and barriers are properly installed and fastened.

ALL POSSIBLE CONTINGENCIES WHICH MAY ARISE DURING INSTALLATION, OPERATION, OR MAINTENANCE, AND ALL DETAILS AND VARIATIONS OF THIS EQUIPMENT DO NOT PURPORT TO BE COVERED BY THESE INSTRUCTIONS. IF FURTHER INFORMATION IS DESIRED BY THE PURCHASER REGARDING HIS PARTICULAR INSTALLATION, OPERATION, OR MAINTENANCE OF PARTICULAR EQUIPMENT, CONTACT AN EATON REPRESENTATIVE.

Section 1: Introduction

1.1 Preliminary Comments and Safety Precautions

This technical document is intended to cover most aspects associated with the installation, application, operation, and maintenance of transfer switch equipment with ratings from 800 through 5000 amperes (A), except for the specific logic used to control the equipment. It is provided as a guide for authorized and qualified personnel only. Please refer to the specific WARNING and CAUTION in Section 1.1.2 before proceeding. If further information is required by the purchaser regarding a particular installation, application, or maintenance activity, contact an Eaton representative. For information associated with the control, refer to the separate instruction book pertaining to the logic package installed in the switch.

1.1.1 Warranty and Liability Information

No warranties, expressed or implied, including warranties of fitness for a particular purpose of merchant-ability, or warranties arising from course of dealing or usage of trade, are made regarding the information, recommendations and descriptions contained herein. In no event will Eaton be responsible to the purchaser or user in contract, in tort (including negligence), strict liability or otherwise for any special, indirect, incidental or consequential damage or loss whatsoever, including but not limited to damage or loss of use of equipment, plant or power system, cost of capital, loss of power, additional expenses in the use of existing power facilities, or claims against the purchaser or user by its customers resulting from the use of the information and descriptions contained herein.

1.1.2 Safety Precautions

All safety codes, safety standards, and/or regulations must be strictly observed in the installation, operation, and maintenance of this device.

⚠ WARNING

THE WARNINGS AND CAUTIONS INCLUDED AS PART OF THE PROCEDURAL STEPS IN THIS DOCUMENT ARE FOR PERSONNEL SAFETY AND PROTECTION OF EQUIPMENT FROM DAMAGE. AN EXAMPLE OF A TYPICAL WARNING LABEL HEADING IS SHOWN ABOVE TO FAMILIARIZE PERSONNEL WITH THE STYLE OF PRESENTATION. THIS WILL HELP TO INSURE THAT PERSONNEL ARE ALERT TO WARNINGS, WHICH APPEAR THROUGHOUT THE DOCUMENT. IN ADDITION, CAUTIONS ARE ALL UPPER CASE AND BOLDFACE.

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⚠ CAUTION

COMPLETELY READ AND UNDERSTAND THE MATERIAL PRESENTED IN THIS DOCUMENT BEFORE ATTEMPTING INSTALLATION, OPERATION, OR APPLICATION OF THE EQUIPMENT. IN ADDITION, ONLY QUALIFIED PERSONS SHOULD BE PERMITTED TO PERFORM ANY WORK ASSOCIATED WITH THE EQUIPMENT. ANY WIRING INSTRUCTIONS PRESENTED IN THIS DOCUMENT MUST BE FOLLOWED PRECISELY. FAILURE TO DO SO COULD CAUSE PERMANENT EQUIPMENT DAMAGE.

⚠ WARNING

THE CLOSED TRANSITION PRODUCT CONTAINS A SPECIAL CONTACT ARRANGEMENT (OVERLAPPING CONTACTS). MISUSE CAN RESULT IN DEATH, SEVERE PERSONAL INJURY, AND/OR PROPERTY DAMAGE.

1.2 General Information

Transfer switches are used to protect critical electrical loads against loss of power. The Source 1 power source of the load is backed-up by a Source 2 power source. A transfer switch is connected to both the Source 1 and Source 2 power sources and supplies the load with power from one of these two sources. In the event that power is lost from the Source 1 power source, the transfer switch transfers the load to the Source 2 power source. This transfer can be automatic or manual, depending upon the type of transfer switch equipment being used. Once Source 1 power is restored, the load is automatically or manually transferred back to the Source 1 power source, again depending upon the type of transfer equipment being used (Figure **2**).

In addition, the Eaton closed transition transfer switch may be applied where it is desirable to avoid any momentary power interruptions. Although the closed transition switch is not a substitute for an uninteruptable power source (UPS), it does eliminate power interruptions to loads except to those caused by power sources or equipment external to the transfer switch. If both sources are acceptable as determined by the IQ Transfer logic, a make-before-break transfer is performed during a transfer test or retransfer operation.

1.2.1 Transfer Switch Types

There are four types of transfer switch equipment.

Automatic Transfer Switch

Automatic transfer switches (ATSs) automatically perform the transfer function. They consist of three basic elements:

1. Main contacts to connect and disconnect the load to and from the source of power.
2. Intelligence/supervisory circuits to constantly monitor the condition of the power sources and thus provide the intelligence necessary for the switch and related circuit operation.
3. A transfer mechanism to effect the transfer of the main contacts from source to source.

Basic Transfer Switch (Power Panel)

The basic transfer switch is designed for use with customer furnished logic. It is similar in design to the automatic version, except the intelligence circuit (logic panel) and voltage selection panel are omitted. All control devices are the customer's responsibility.

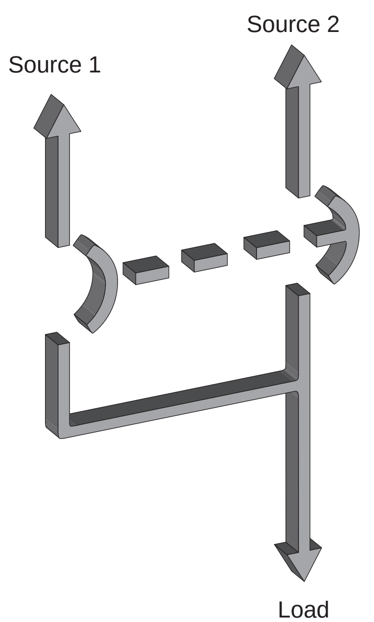


Figure 2. Typical Load Transfer Switch (Switching Device Type) Schematic.

Non-Automatic Transfer Switch (Electrically Operated)

Non-automatic transfer switches are manually initiated, electrically operated devices for applications where automatic load transfer is not required.

Bypass Isolation Transfer Switch

The bypass isolation switch is designed for applications where maintenance, inspection, and testing must be performed while maintaining continuous power to the load (Figures 3 and 4). This is typically required in critical life support systems and standby power situations calling for safe system maintenance with no power disruptions. Such a design allows for the quick removal of the different switching devices for inspection, maintenance, or replacement.

The ATS, non-automatic transfer switch (electrically operated), and bypass isolation transfer switch are the available types for the configuration described in this manual.

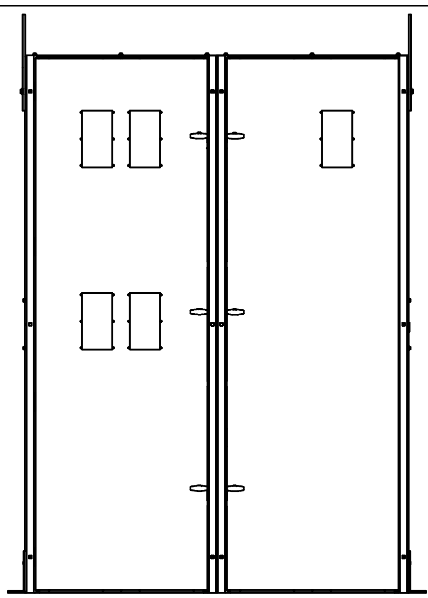
Operation of the ATS and the bypass isolation switch only are discussed in this manual (Sections 5 and 7 respectively).

1.2.2 Design Configuration

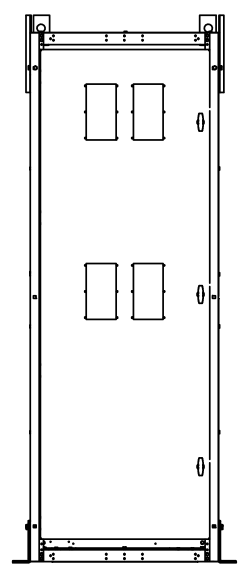
The Eaton transfer switch is a rugged, compact design utilizing power case switches or power case circuit breakers to transfer essential loads from one power source to another. Open transition switching devices are interlocked to prevent both switching devices from being closed at the same time. The versatile design, in addition to standard transfer functions, offers an optional integral thermal and short circuit protection in either or both switching devices.

The switching devices are in a compact vertical arrangement. The logic can be easily disconnected from the switching device without disturbing critical connections. The enclosure is free standing, and, by using the specially supplied cleats, the switch is (Option 42) OSHPD Seismic Certified (3200 A and below). The terminals are mounted in the rear of the switch, permitting rear, top, bottom, or side cable or bus bar entrance.

The switching devices have a high withstand rating (Table **1**). The high-speed, stored-energy switching mechanism guarantees a transfer time of less than 5 cycles.



Typical Bypass Isolation Switch



Typical Non-Bypass Isolation Switch

Figure 3.Typical Bypass Isolation Switch.

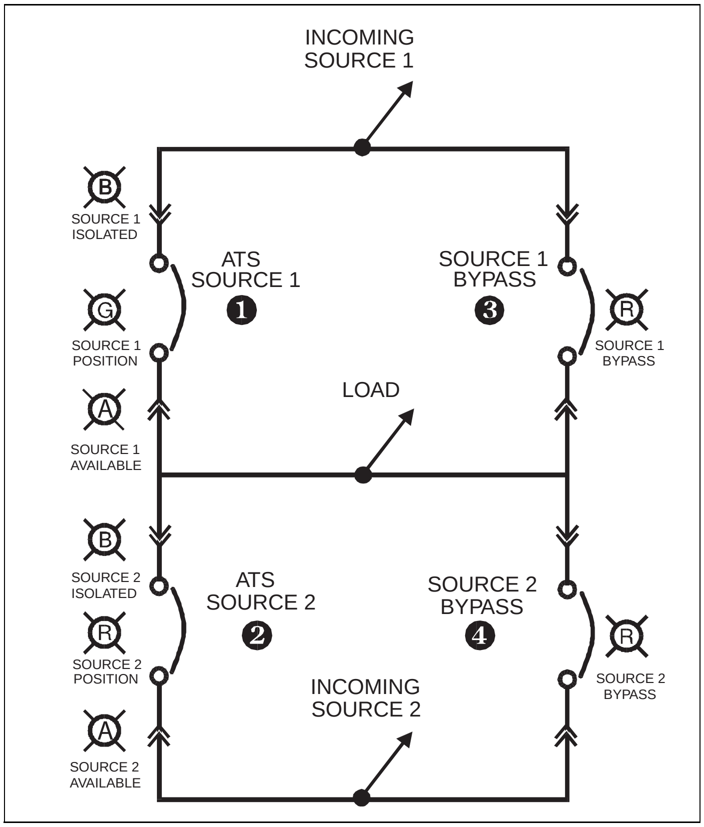


Figure 4.Typical Bypass Isolation Switch Schematic.

Table 1. System Coordination Information—Withstand, Closing and Interrupting Ratings

TRANSFER SWITCH AMPERE RATING	3-CYCLE SHORT-CIRCUIT 600V (kA)	30-CYCLE ❶ SHORT-TIME 600V (kA)
UL 1008		
800	100	85
1000	100	85
1200	100	85
1600	100	85
2000	100	85
2500	100	85
3000	100	85
3200	100	85
4000	100	---
UL 891		
4000	---	85 ❷
5000	---	85 ❷

❶ A Ratings used for coordination with upstream breakers with short-time ratings.
❷ UL 1066 short-time withstand rating.

1.3 Magnum Fixed and Drawout Switching Devices

1.3.1 General Magnum Switching Device

In a typical Magnum automatic transfer switch, the switching device is a Magnum power case switch. The magnum power case switch does not include an overcurrent trip. For specific applications like an integrated service entrance rated automatic transfer switch or an application where it is desirable to include overcurrent trips to the magnum device, a magnum breaker can be provided on either or both Source 1 and/or Source 2 device. In those cases the magnum device includes an overcurrent trip. The standard trip unit is a Digitrip 520. Optionally a digitrip 520M, 520MC, or 1150 can be provided.

Figure 5. The Magnum Fixed Switching Device.

The magnum power case switch can be provided in a standard fixed mounted design or an optional drawout design. Bypass isolation automatic transfer switches are provided with all drawout type designs. In addition the 4000A and 5000A designs come standard with drawout magnum power devices.

Figure 6. The Magnum Drawout Switching Device.

The Magnum transfer switches are available in the following configurations:

Table 2. Magnum Transfer Switch Configurations

NUMBER OF SWITCHING DEVICES	SWITCHING DEVICE TYPE
2	Fixed
2	Drawouts
4 (Bypass Isolation)	Drawouts

All Magnum switching devices are 100% rated, Underwriters Laboratories (UL) listed, and are built and tested in an ISO 9002 certified facility to applicable NEMA, ANSI, IEEE, and UL standards. For more information on Magnum switching devices, consult the Magnum switching device manual supplied with the transfer switch.

The main difference between the fixed and drawout versions of the Magnum switching devices used in the Magnum transfer switch is the mounting method. Fixed switching devices are bolted directly into the transfer switch frame while drawout switching devices are mounted in an extendable carriage within the transfer switch, allowing the switching device to be "drawn out" for service, maintenance, and/or replacement.

Figure 7. Fixed Switching Device for the Magnum Transfer Switch.

Figure 8. Drawout Switching Device Installed in the Magnum Transfer Switch.

1.3.2 Magnum Drawout Switching Devices

The Magnum drawout switching device is a design having three positions with the compartment door closed (CONNECT, TEST, DISCONNECT) and one position out of its compartment on the extendable carriage rails (REMOVE). The Magnum drawout switching device is equipped with both primary and secondary disconnects to provide for the drawout functioning. The operating mechanism is a two-step, stored energy mechanism, either manually or electrically operated. When withdrawn on the extendable carriage rails, Magnum switching devices can be inspected, accessory items added, and minor maintenance performed. The inside of the compartment can also be inspected with the switching device withdrawn on the extendable carriage rails.

Figure 9. Drawout Switching Device Fully Extended from the Magnum Transfer Switch.

1.3.3 Magnum Fixed Switching Devices

The Magnum fixed type switching device differs from the drawout version in that it has no levering device, primary disconnects, and secondary disconnects.

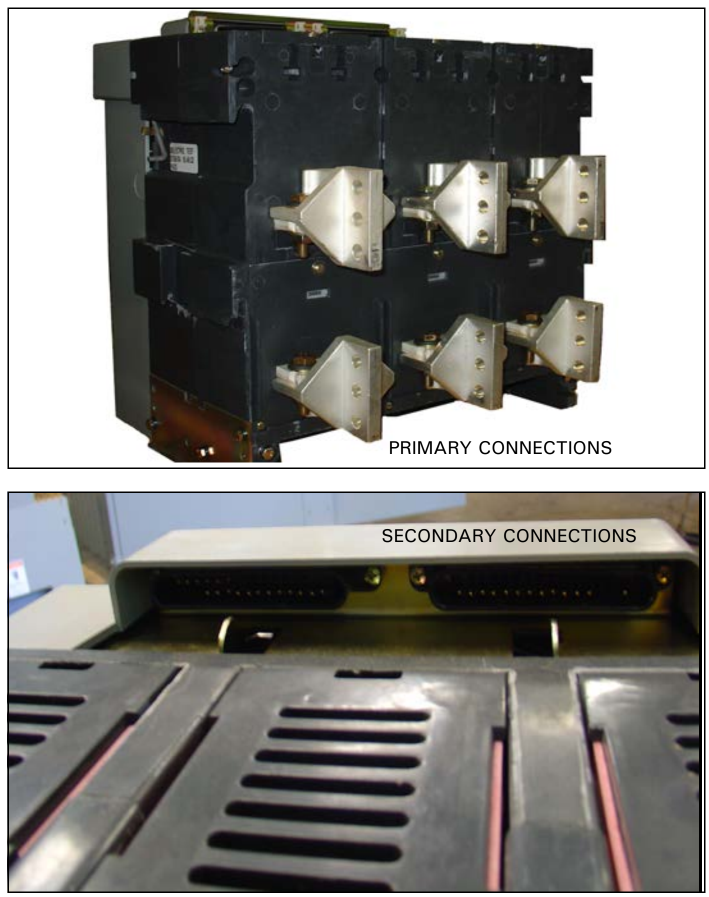


Figure 10. Primary and Secondary Connections on a Magnum Fixed Switching Device.

In addition, a fixed switching device does not have a standard feature to hold the switching device in a “trip-free” position.

Magnum fixed switching device terminals have holes for making bolted horizontal primary bus connections. Adapters are available for making vertical primary bus connections. Secondary connections can be made through standard terminal blocks or a special connector compatible with the drawout switching device’s type secondary connector. Both secondary connection devices are mounted at the top front of the switching device.

The Magnum fixed switching devices have two mounting feet, one on each side, to permit the switching device to be securely mounted to the transfer switch frame. Each mounting foot has two slotted mounting holes to facilitate mounting.

1.4 Transfer Switch Catalog Number Identification

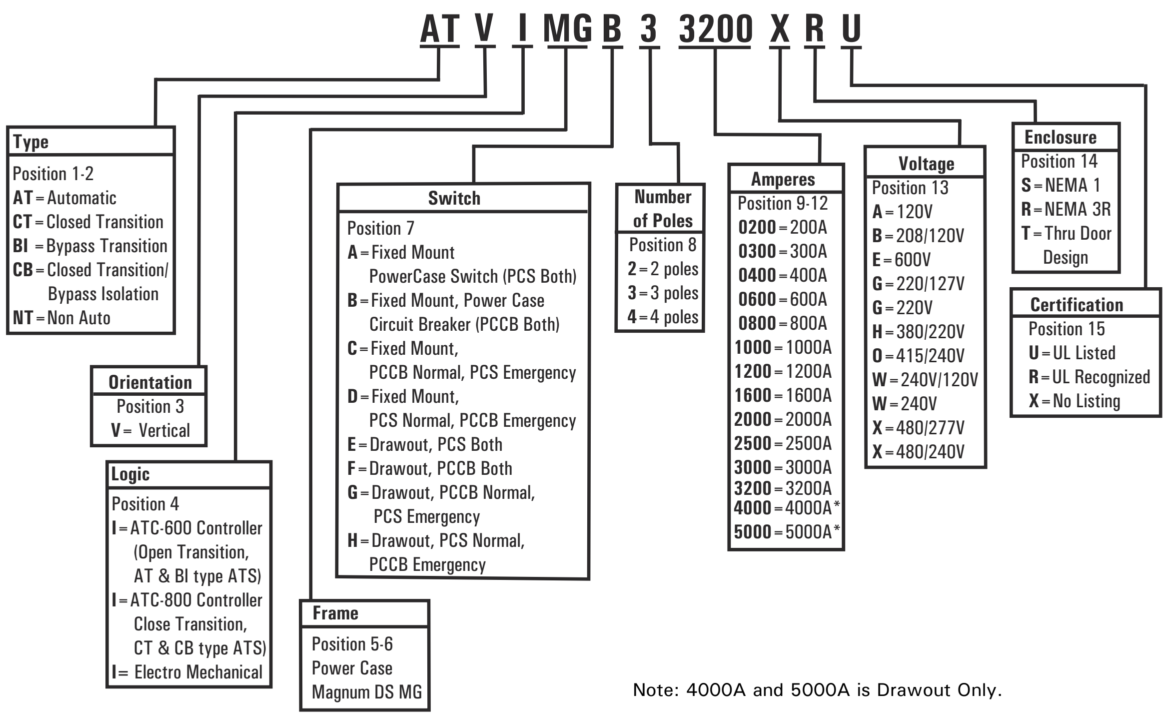
Transfer switch equipment catalog numbers provide a significant amount of relevant information that pertains to a particular piece of equipment. The catalog number identification table (Table 3) provides the required interpretation information. An example for an open transition switch is offered to initially simplify the process.

Example: Catalog Number (circled numbers correspond to position headings in Table 3).

①to②	③	④	⑤ to ⑥	⑦	⑧	⑨to⑫	⑬	⑭	⑮
AT	V	I	MG	B	3	3200	X	R	U

The catalog number ATVIMGB33200XRU describes an ATS with the switching devices mounted vertically in the enclosure. The intelligence, represented by the ATC-600/ATC-800, is a microprocessor-based logic package. The Magnum Breaker is used as the switching device and is a 3-pole power case breaker for each source. The continuous current rating of this equipment is 3200 A and is applicable at 480/277 Vac, 60 Hz. The transfer switch equipment is enclosed in a NEMA 3R enclosure and is listed for Underwriters Laboratories (UL) and Canadian Standards Association (CSA) applications.

Table 3. Transfer Switch Catalog Number Explanation.



Note: 4000A and 5000A is Drawout Only.

Section 2: Receiving, Handling, and Storage

2.1 Receiving

Every effort is made to ensure that the transfer switch equipment arrives at its destination undamaged and ready for installation. Crating and packing is designed to protect internal components as well as the enclosure. Transfer switch enclosures are skid mounted and suited for fork lift movement. Care should be exercised, however, to protect the equipment from impact at all times. Do not remove the protective packaging until the equipment is at the installation location and ready for installation.

When the transfer switch equipment reaches its destination, the customer should inspect the shipping container for any obvious signs of rough handling and/or external damage incurred during transportation. Record any external and internal damage observed for reporting to the transportation carrier and Eaton, once a thorough inspection is completed. All claims should be as specific as possible and include the General Order numbers.

A shipping label is affixed to the top of the shipping container which includes a variety of equipment and customer information, such as General Order Number (GO #) and Catalog Number (Cat #). Make certain that this information matches other shipping paper information.

Each transfer switch enclosure is bolted to a rigid wooden pallet. The pallet is open at two ends for movement by a fork lift. The shipment is secured and further protected with shrink wrap. Do not discard the packing material until the equipment is ready for installation.

A plastic bag of documents will be found within the enclosure, usually attached to the inside of the door. Important documents, such as test reports, wiring diagrams, and appropriate instruction leaflets, are enclosed within the bag and should be filed in a safe place.

2.2 Handling

As previously mentioned, the transfer switch equipment is packaged for fork lift movement. Protect the equipment from impact at all times and DO NOT double stack. Once the equipment is at the installation location and ready for installation, the packaging material can be removed. Once the enclosure is unbolted from the wooden pallet, it can be installed using the lifting provision located on the top of the structure. Be careful not to damage the top or bottom enclosure mounting flanges. Refer to Section 4 of this manual for specific installation instructions.

2.3 Storage

Although well packaged, this equipment is not suitable for storage outdoors. The equipment warranty will not be applicable if there is evidence of outdoor storage. If the equipment is to be stored indoors for any period of time, it should be stored with its protective packaging material in place. Protect the equipment at all times from excessive moisture, construction dirt, corrosive conditions, and other contaminants.

It is strongly suggested that the package-protected equipment be stored in a climate controlled environment of -20° to 85°C (-4° to 185°F) with a relative humidity of 80% or less. DO NOT, under any circumstances, stack other equipment on top of a transfer switch equipment enclosure, whether packaged or not.

Section 3: Equipment Description

3.1 General

This Eaton transfer switch equipment is available in three different configurations:

- ATS (Closed and Open transition);
- Non-Automatic (Electrically Operated) (Open Transition Only);
- Bypass Isolation Transfer Switch (Open and Closed Transition); and

Refer to Section 1 for a discussion of all three types. Each transfer switch is usually supplied in an enclosure, although unmounted sub-assemblies can be supplied for mounting by the customer. The enclosed ATS is the only specific type that will be discussed in this section.

Figure 11. Typical Power Compartments (Open Transition Shown).

The enclosed ATS consists of three basic panels interconnected through connector plugs and mounted in an enclosure:

- Power Compartments;
- Voltage Selection Panel; and
- Logic Panel
  - ATC-600 (open transition only)
  - ATC-800 (closed transition only).

The components comprising the three panels are installed in accordance with the specific requirements of the circuit being controlled. Each transfer switch is, therefore, tailor-made to a specific application.

3.2 Power Compartments

The power compartment consists of a means for making load, power, and neutral connections. The main contacts and the transfer mechanism are all on one steel frame (Figure 12). The actual power connections are shown in Figure 13.

Figure 12. Power Case Switching Device.

3.2.1 Main Contacts

The main contacts connect and disconnect the load to and from the different power sources. High withstand power case switches are the main contacts for the Source 1 and Source 2 power sources in standard, unmodified ATSs. Optional integral thermal and short circuit protection in either or both switching devices is available (Section 3.6). These continuous duty devices are rated for all classes of loads. In addition, they have high dielectric strength, heavy-duty switching and withstand capabilities, and high interrupting capacity.

3.2.2 Switch Interlocks (Open Transition Only)

Eaton transfer switches are mechanically and electrically interlocked to prevent the two sets of main contacts from being closed simultaneously.

3.2.3 Drawout Interlocks

The standard **closed transition** ATS is not provided with a mechanical interlock. All bypass switching devices are mechanically interlocked to the drawout mechanism to ensure that the switching device is always open when connecting or disconnecting it from the line and load stabs when in the bypass mode.

All **open transition** switching devices are mechanically interlocked to the drawout mechanism to ensure that the switching device is always open when connecting or disconnecting it from the line and load stabs.

The switching device will close only in the DISCONNECT, TEST, and CONNECT positions.

3.2.4 TRANSFER MECHANISM

The transfer switch uses Eaton Magnum power case switching devices and power case switches with a stored-energy mechanism. An electrical operator automatically recharges the mechanism after the switching device has been closed, and an indicator on the switch shows whether it is in the OPEN or CLOSED position and the status of the stored energy mechanism.

The switching device is closed by energizing a solenoid that releases the spring mechanism. A shunt trip will open the switching device if energized.

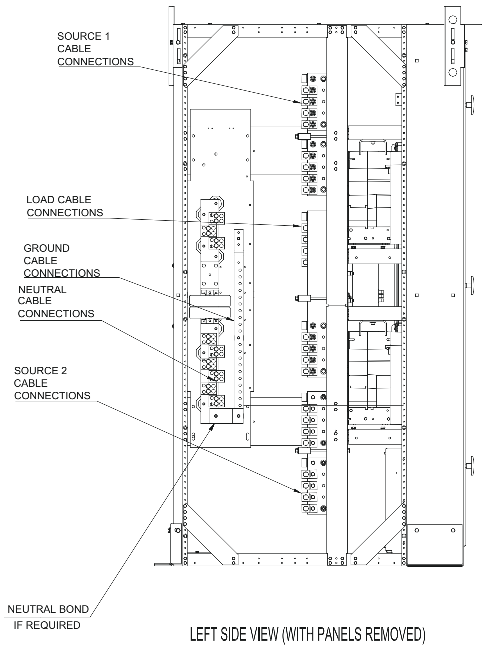


Figure 13. Terminal Connections for a Typical Drawout Transfer Switch (800-3200A Closed Transition Shown).

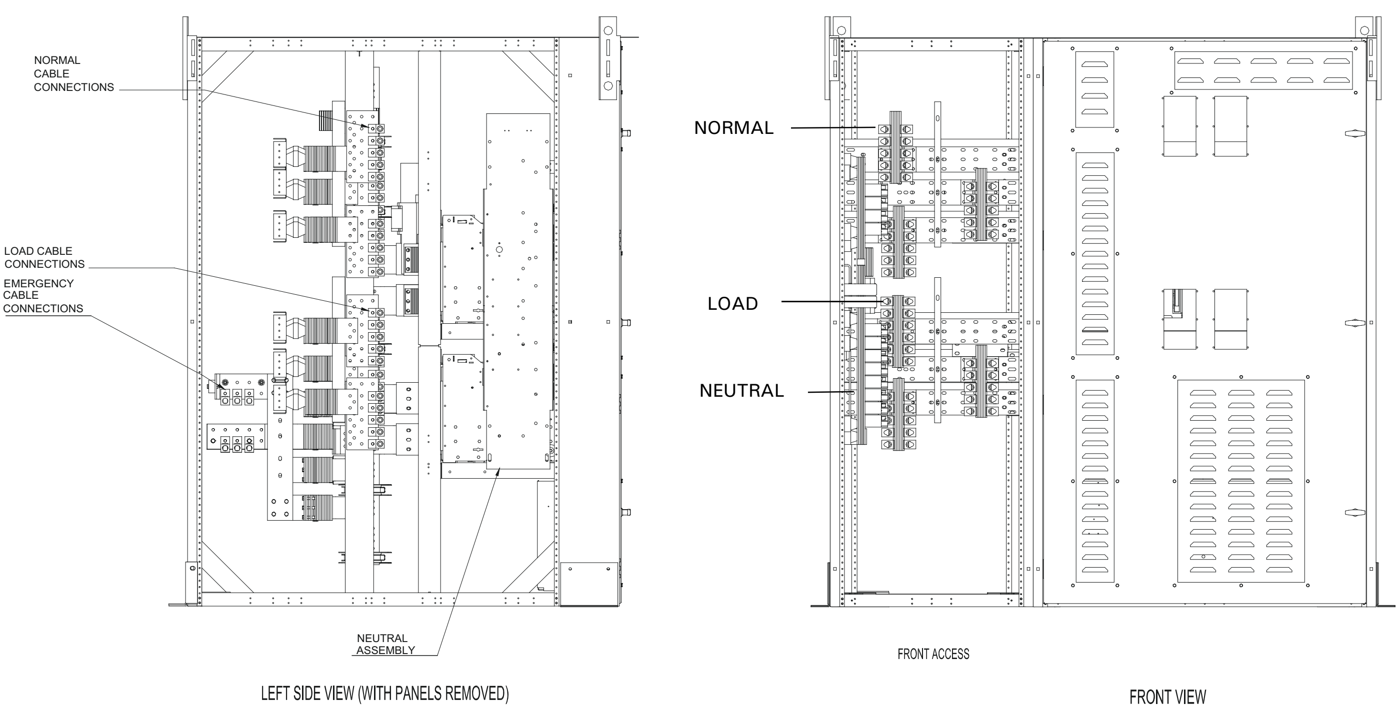


Figure 13a. Terminal Connections for a Typical Drawout Transfer Switch (4000A Shown).

3.2.5 Drawout Mechanism

The drawout mechanism is described in detail in Section 6 (Figure 14).

Figure 14. Drawout Mechanism (Closed Transition Shown)

3.3 Voltage Selection Panel

3.3.1 Voltage Selection (208, 220, 240, 380, 415, 480, and 600 Vac, 50/60 Hz)

The market voltage selection panel consists of multi-tap transformers, contained in a steel case mounted in the transfer switch enclosure (Figure 15). The cover has "teardrop" holes for the screws to allow easy access to the transformers. The voltage is selected by simply removing the wires from the default primary taps of both transformers and installing them on the primary taps for the desired voltage. Taps are provided for 208 to 600 Vac to satisfy any required North American market application voltage. The factory default position is the voltage tap based on customer voltage specification.

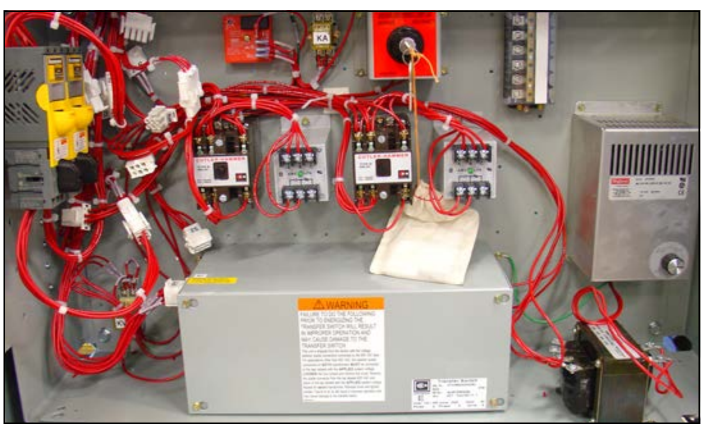


Figure 15. Voltage Selection Panel

⚠ WARNING

WHEN CHANGING THE SELECTED VOLTAGE, THE POWER MUST BE REMOVED FROM THE TRANSFER SWITCH AND THE WIRES MUST BE MOVED ON THE TAPS OF BOTH TRANSFORMERS.

Figure 16. North American Market Voltage Selection Terminals (Shown Connected to the 120 Vac Taps).

3.4 Logic Panel

The logic panel provides the intelligence and supervisory circuits which constantly monitor the condition of both the Source 1 and Source 2 power sources, thus providing the required intelligence for transfer operations (Figure 17). Detailed information is presented in a separate document:

- ATC-600 Instruction Book (IB ATS-I005 - open transition only)
- ATC-800 Instruction Book (IB ATS-CI03 - closed transition only)

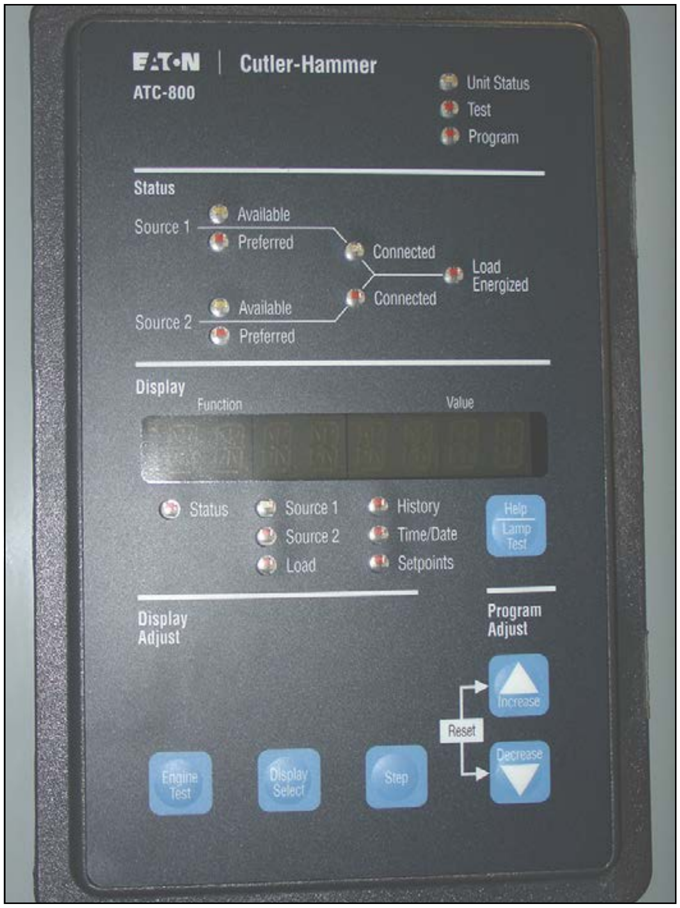


Figure 17. ATC-800.

3.5 Neutrals

All 2-pole and 3-pole transfer switches are equipped with 100% rated neutral connections (Figures 18 and 19). Different lug configurations are available (See Option 21A).

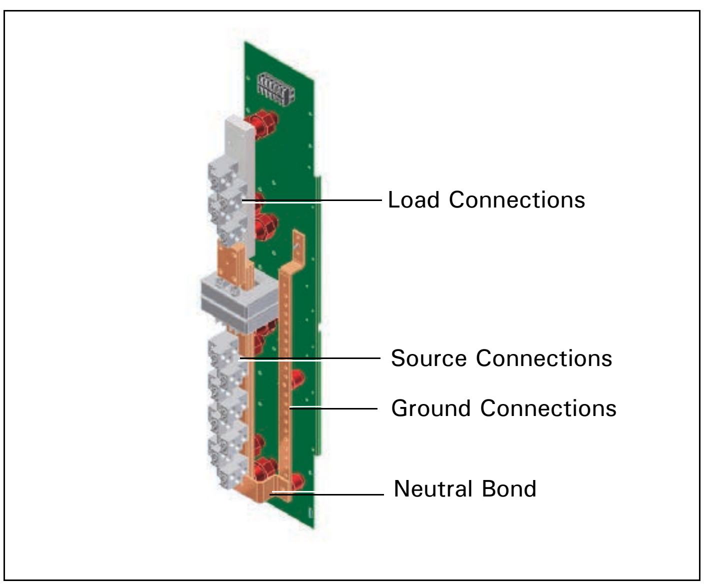


Figure 18. Neutral SE with Ground Fault.

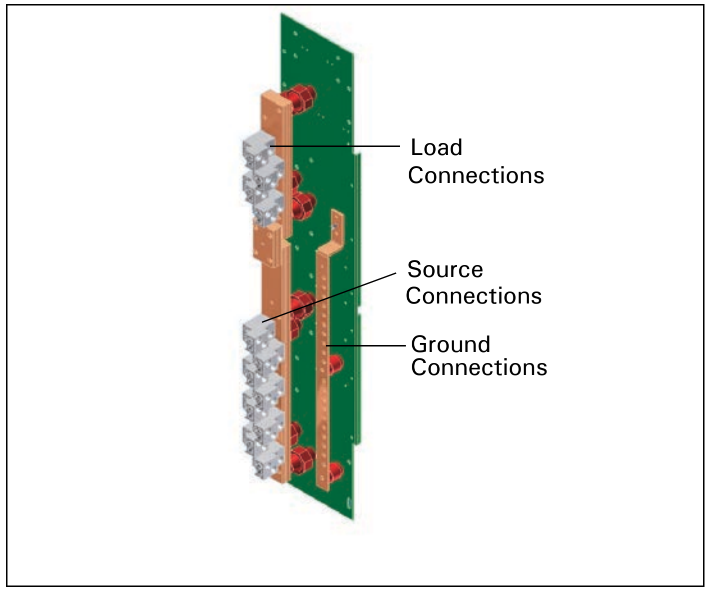


Figure 19. Solid Neutral.

3.6 Features

Switch options, which are not part of the logic scheme, are available to meet a variety of other application requirements. Options are numbered with an associated description. More detailed selections, which must be made within a specific option number, are identified by letters. For available options associated with the logic scheme, refer to the specific logic document associated with the type of logic selected.

NOTICE

OPTIONS ARE UL LISTED, EXCEPT AS NOTED, WHEN SUPPLIED ON UL LISTED SWITCHES. IF AN OPTION IS SELECTED WHICH IS NOT UL LISTED, THE SWITCH WILL NOT HAVE A UL LABEL.

NOTICE

NOT ALL OPTIONS ARE AVAILABLE FOR ALL TRANSFER SWITCH CONFIGURATIONS. IF IN DOUBT, CHECK PRICE LIST 29-920 FOR THE AVAILABILITY OF OPTIONS FOR A SPECIFIC TRANSFER SWITCH DESIGN. THE OPTION NUMBERS USED HERE CORRESPOND TO THE NUMBERS USED IN THE PRICE LIST.

Section 3.6 covers a whole series of features in all of the other IB's, but in the magnum only a few features were included.

3.6.1.1 Standard Features

The following is a list of the standard features of the ATC-600/800 controller.

Feature Description
Timers

1. Time Delay Normal to Emergency (TDNE)

Provides a time delay to allow for the generator to warm up before transferring the load to the emergency source. Timing begins only after the Emergency Source becomes available and is deemed good based on the programmable voltage and frequency set points in the controller.

2. Time Delay Engine Start (TDES)

Provides a time delay before initiating the generator start cycle. This is to account for momentary power outages or voltage fluctuations of the normal source. Provides a Form C contact to the generator starter circuit.

3. Time Delay Emergency to Normal (TDEN)

Provides a time delay of the retransfer operation to permit stabilization of the normal source. Timing begins only after the normal source becomes available and is deemed good based on the programmable voltage and frequency set points in the controller. This function is fail-safe protected.

4. Time Delay Engine Cooldown (TDEC)

Provides a time delay before initiating the generator stop cycle after the retransfer operation. This allows the generator to cool down by running unloaded. Timing begins on completion of the retransfer cycle.

Source 2 Sensing

5. Source 2-Monitoring and Protection

Provides monitoring and protection based on the Source 2 voltage and/or frequency set points. All Feature 5 monitoring and protection functions are fail-safe operations.

5J. All-Phase Undervoltage/

Underfrequency Protection Provides undervoltage/underfrequency monitoring and protection based on programmable set points in the controller.

5K. All-Phase Overvoltage/

Overfrequency Protection Provides overvoltage/overfrequency monitoring and protection based on programmable set points in the controller.

6B. Test Operators

Automatic transfer switches are provided with a controller faceplate test pushbutton that simulates a loss of the Source 1 as standard. All programmed time delays (TDNE, TDEN, etc.) will be performed as part of the test. Engine run time of the test is equal to the plant exerciser programmed set point. All tests are fail-safe protected.

7. Time Delay Emergency Fail (TDEF)

Provides a time delay that prevents a connected emergency source from being declared "unavailable" based on the customer's set points. This is to account for momentary generator fluctuations. If the Source 2 remains in a failed state, then 0.5 second after the TDEF timer expires the transfer switch will proceed with the programmed sequence for retransfer if Source 1 is available. This time delay is only implemented when Source 2 is a generator.

Note: This feature is also enabled when large loads cause generator output to drop below customer set points.

8. Time Delay Bypass Pushbutton

Provides a momentary contact pushbutton to bypass the TDNE (Feature 1) and/or TDEN (Feature 3) time delays. The Time Delay Bypass Pushbutton contact, when closed, will reduce any or all of the programmed time delay to zero. Must be executed when TDNE or TDEN timer is displayed on the controller.

8C. Bypass Time Delay Emergency to Normal (TDEN)

8D. Bypass Time Delay Normal to Emergency (TDNE)

10. Preferred Source Selector

Provides a means to designate either Source 1 or Source 2 as the "Preferred" source. The "Preferred" source is the source that the transfer switch will connect the load to if it is available.

Note: This is a programmable software feature not an actual switch.

10B. Preferred Source Selector

Provides a programmable source selector for use on systems comprised of dual utility or utility and engine/ generator power sources.

10D. Preferred Source Selector

Provides a programmable source selector for use on systems comprised of dual engine/generator power sources. (Dual engine starting circuits are provided.)

12C. Source 1-Load Connected

Provides a green indication that indicates the load is connected to Source 1 when lit. 12D. Source 2-Load Connected Provides a red indication that indicates the load is connected to Source 2 when lit.

12G. Source 1-Present

Provides a white or amber indication "Depending on the Controller" that Source 1 has power; however, this does not indicate whether Source 1 is acceptable.

12H. Source 2-Present

Provides an amber indication that Source 2 has power; however, this does not indicate whether Source 2 is acceptable.

14. Relay Auxiliary Contacts

14E. Source 1 Available

Provides 1 Form C relay auxiliary contact. The relay is energized when Source 1 is available and within the controller's programmable set points.

14F. Source 2 Available

Provides 1 Form C relay auxiliary contact. The relay is energized when Source 2 is available and within the controller's programmable set points.

15. Switch Position Indication Contact

Provides a contact that indicates if the power switching device is in the "open" or "closed" position.

15E. Source 1 Position Indication Contact

Provides 1 Form C contact that indicates the position of the Source 1 power switching device.

15F. Source 2 Position Indication Contact

Provides 1 Form C contact that indicates the position of the Source 2 power switching device.

Plant Exerciser

23J. Plant Exerciser (PE) With Fail-Safe

Provides a means for automatic testing of the engine generator set or standby power system. All programmed time delays in the controller will be performed during the plant exerciser operation. Programmable set points for test interval are start time, either disabled or 7 days, and engine test time. Test may be performed with or without a load transfer. Test may be manually cancelled during the operation. This is a fail-safe operation.

26D. Go to Emergency (Source 2)

Provides the capability for an external contact closure to initiate a transfer to the Source 2 power source. This includes starting the generator, performing the programmed time delays and the transfer operation. Retransfer will occur when the external contact is opened. This is a fail-safe function.

Source 1 Sensing

26. Source 1-Monitoring and Protection

Provides Source 1 monitoring and protection functions. If Source 1 fails, then the automatic transfer controller will begin the sequence of operations necessary to transfer the load to Source 2. All Feature 26 monitoring and protection functions are fail-safe operations.

26J. All-Phase Undervoltage/ Underfrequency Protection

Provides all-phase undervoltage/ underfrequency monitoring and protection based on programmable set points in the controller.

26K. All-Phase Overvoltage/ Overfrequency Protection

Provides all-phase overvoltage/ overfrequency monitoring and protection based on programmable set points in the controller.

32. Delayed Transition Transfer Modes for Open Transition Transfer Switches

Provides delayed transition transfer modes for an open transition transfer switch. Often used in systems with inductive loads, a delayed transition transfer switch may prevent or reduce inrush currents due to out-of-phase switching of inductive loads.

32A. Time Delay Neutral

Provides a time delay in the neutral position during the transfer and retransfer operations during which both Source 1 and Source 2 are disconnected from the load circuit. This allows inductive loads time to reach a safe voltage and eliminate back EMF. The time delay is programmable and is the same for both transfer and retransfer operations This is a passive feature that requires the consulting engineer/installer to determine the settings based on how the user will operate the facility. Adjustable 0-120 seconds.

42. Seismic Qualification

59a. Silver-Plated Bus

Silver-plated bus is a standard feature for all Magnum-based designs.

3.6.1.2 Optional Features

The following is a list of the optional features of the ATC-600/800 controller.

5H. Three-Phase Rotation Protection

Provides three-phase reversal sensing in order to protect against transferring to an out-of-phase source. The controller will treat the opposite source as unavailable if the sources are out of phase, based on programmable set points in the controller.

6H. 4-Position Test Selector Switch (FPSS)

Provides a door-mounted 4-position, maintained contact selector switch marked "Auto," "Test," "Engine Start," and "Off." The FPSS is fail-safe protected, except for the "Off Position." Transfer switch operation is determined by the switch position. Transfer switch operations are as follows: "Auto"-Automatic operation mode. "Test"-A load test is performed until the switch is moved to another position. "Engine Start"-A no-load test is performed until the switch is moved to another position. "Off"-The automatic transfer controller and engine start contact are disabled. A white pilot light is provided to indicate that the FPSS is in the "Off" position.

9B. Maintenance Selector Switch (MSS)

Provides a 2-position, maintained contact selector switch marked "Operate" and "Disable." When the MSS is placed in the "Disable" position, the controller logic will be disconnected from the transfer motor circuit. The MSS is placed in the "Operate" position for normal automatic operation.

Overcurrent Trip Indication

Available only with integral overcurrent protection (**Feature 16**) (shown on automatic transfer controller display).

12L. Source 1 Trip Indication

The automatic transfer controller display will read "Lockout" if the Source 1 circuit breaker is in the "tripped" position.

12M. Source 2 Trip Indication

The automatic transfer controller display will read "Lockout" if the Source 2 circuit breaker is in the "tripped" position.

14C. Source 1 Present

Provides 4 Form C relay auxiliary contacts. The relay is energized when Source 1 is present.

14D. Source 2 Present

Provides 4 Form C relay auxiliary contacts. The relay is energized when Source 2 is present.

16B. Integral Overcurrent Protection on Both Power Source Switching Devices

Provides integral overcurrent protection on both Source 1 and Source 2 power switching devices.

16E. Integral Overcurrent Protection on the Source 2 Power Switching Device

Provides integral overcurrent protection on the Source 2 power switching device.

18. Metering

The ATS controller provides voltage and frequency readings. If additional metering functions are required, Eaton offers a series of digital meters that may be added to the ATS. The meter type can provide simple current and voltage readings or more capable meters providing Power, Demand and energy readings. Available with an optional communications interface. (See **Feature 48**- Communications for available communication modules.) **Feature 18** metering options include all required external devices (CTs, etc.) for a fully functioning metering system.

IQ 130/140/150

IQ 130

This digital meter provides basic current and voltage per phase (L-L, L-N) and min./max. readings (I, V). Optional communication RS-485, Modbus RTU.

IQ 140

In addition to basic current and voltage, will provide frequency, power measurements real, reactive and apparent power, total (W, VAR, VA). Optional communication RS-485, Modbus RTU.

IQ 150

In addition to basic current/voltage/ frequency and power readings, will provide Energy Real reactive and apparent (Wh, VAR, Vah). Optional communication RS-485, Modbus RTU.

IQ 250/260

IQ 250

This digital meter provides current per phase and current demand, voltage (L-L, L-N) and frequency. Power, energy and demand readings. Real, reactive and apparent power and energy, power factor. RS-485 communications, Modbus RTU or ASCII. Optional I/O slots available.

IQ 260

In addition to all of the features of the IQ 250, power quality analysis is available with THD voltage and current per phase.

Power Xpert 2000

Provides either a Power Xpert PXM 2250, PXM 2260 or PXM 2270 meter. Power Xpert 4000, 6000, 8000 Provides one of the Power Xpert Meters with or without graphic displays.

18W. Ammeter Side Metering

Provides an ammeter for monitoring the load side circuit. 20A. Rear Bus Provisions Provides Source 1, Source 2 and Load Circuit rear accessible bus stabs with provision for bus bar connection. Eaton transfer switches are provided with either front or rear (dependant on switch type) connected solderless screw-type terminals for power cable connection as standard.

21A. Optional Power Cable

Connection Terminals Eaton transfer switches are provided as standard with Source 1, Source 2 and load circuit solderless screw-type terminals for power cable connection. Alternate terminal wire sizes, and compression lug provisions may be available dependant on transfer switch type and ampere rating.

26H. Three-Phase Rotation Protection

Provides three-phase reversal sensing in order to protect against transferring to an out-of-phase source. The controller will treat the opposite source as unavailable if the sources are out of phase, based on programmable set points in the controller.

26L. Three-Phase Voltage Unbalance/ Phase Loss

Provides phase loss detection from blown fuses on the Source 1.

29J. Automatic Transfer or Automatic

Transfer With Non-Automatic Retransfer Operation Provides a field-selectable programmable set point that permits the transfer switch to operate in one of the following two transfer modes (A or B): A. Fully automatic operation. B. Automatic engine/generator startup and automatic transfer operation from Source 1 to Source 2. Manual pushbutton operation is required to initiate the retransfer operation and engine/generator shutdown. The pushbutton for manual retransfer operation is included. This is fail-safe protected.

29G. Automatic/Manual Operation With Selector Switch

Provides 2-position selector switch (labeled Auto/manual) that permits selection of the automatic or manual transfer. When in the "Auto" position, the transfer switch operates with fully automatic transfer, retransfer and generator startup and shutdown operations. When in the "Manual" position, manual operation is required to initiate the generator startup or retransfer with generator shutdown operations.

Note: Transfer switches with **Feature 29** must be labeled as non-automatic transfer switch equipment.

32B. Load Voltage Decay

Provides load voltage measurement to sense back EMF that is generated when the transfer switch is the neutral position. It provides a delay in transfer in either direction if an unacceptable level is sensed as established by a programmed set point. This is an active feature that adapts to how the facility is operating in order to minimize neutral position wait time, but ensure safety. Adjustable 2-30% of nominal voltage.

32C. In-Phase Transition With Default to Load Voltage Decay

Provides in-phase transition, which is a feature that will permit a transfer or retransfer between two available sources that have a phase angle difference near zero. The in-phase transition feature includes permissible frequency difference and synchronization time set points. In the event Source 1 and Source 2 fail to synchronize within the permitted frequency difference and time, then the controller defaults to the load voltage decay operation as described in **Feature 32B**. Adjustable frequency difference 0.0-3.0 Hz. Adjustable synchronization time allowance 1-60 minutes.

32D. In-Phase Transition With Default to Time Delay Neutral

Provides in-phase transition, which is a feature that will permit a transfer or retransfer only between two available sources that have a phase angle difference near zero. The in-phase transition feature includes permissible frequency difference and synchronization time set points. In the event Source 1 and Source 2 fail to synchronize within the permitted frequency difference and time, then the controller defaults to the time delay neutral operation as described in **Feature 32A**. Adjustable frequency difference 0.0-3.0 Hz. Adjustable synchronization time allowance 1-60 minutes.

35A. Pretransfer Signal With 1 Form C Contact

Provides a signal prior to the transferring of the load. Will not transfer until the programmable delay set point in the controller is reached. If both sources are not available, this option will ignore the time delay set in the controller.

36. Load Shed From Emergency Provides the capability for an external

NC contact to initiate a load circuit disconnection from the Source 2 power source. If the load circuit is connected to Source 2 and the contact is opened, then a retransfer to Source 1 is completed if Source 1 is available. If Source 1 is not available, then the transfer switch will transfer to neutral. If the load circuit is connected to Source 1 and the contact is open, then a transfer Source 2 is prohibited.

37. Service Equipment Rated Transfer Switch

Provides the label "suitable for use as service equipment" and the features necessary to meet the requirements for the label. Includes service disconnect with visible indication and neutral assembly with removable |link. **Feature 16B or 16N** must be selected separately.

37A. Service Equipment Rated

Transfer Switch Without Ground Fault Protection Provides service equipment rating for an application that does not require ground fault protection.

37B. Service Equipment Rated Transfer Switch With Ground Fault Protection

Provides service equipment rating for an application that requires ground fault protection.

38. Steel Cover

Provides protection for a device panel as option 38a and protection for the controller as option 38b.

41. Space Heater With Thermostat

Provides a space heater and adjustable thermostat. External control power is not required. Availability is dependent on transfer switch type.

41E. Space Heater With Thermostat- 375 Watt

Provides 375-watt space heater

45. Load Sequencing Capability

Provides the capability for sequential closure of up to 10 addressable relays after a transfer. Each addressable relay provides (1) Form C contact. A single adjustable time delay between each of the relay closures is provided. Operates via a sub-network. Adjustable 1-120 seconds.

45A. Load Sequencing Contact

Provides (1) addressable relay.

45B. Load Sequencing Contact

Provides (2) addressable relays.

45C. Load Sequencing Contact

Provides (3) addressable relays.

45D. Load Sequencing Contact

Provides (4) addressable relays.

45E. Load Sequencing Contact

Provides (5) addressable relays.

45F. Load Sequencing Contact

Provides (6) addressable relays.

45G. Load Sequencing Contact

Provides (7) addressable relays.

45H. Load Sequencing Contact

Provides (8) addressable relays.

45I. Load Sequencing Contact

Provides (9) addressable relays.

45J. Load Sequencing Contact

Provides (10) addressable relays.

47. Transfer Modes for Closed Transition Transfer Switches

Provides available transition transfer modes for a closed transition transfer switch. Closed transition is a "make before break" transfer and retransfer scheme that will parallel (a maximum of 100 ms) Source 1 and Source 2 providing a seamless transfer when both sources are available. The closed transition feature includes permissible voltage difference frequency difference and synchronization time allowance set points. The phase angle difference between the two sources must be near zero for a permitted transfer. These are all programmable set points in the controller.

47C. Closed Transition With Default to In-Phase Transition With Default to Load Voltage Decay

Provides a closed transition transfer as the primary transfer mode. In the event Source 1 and Source 2 fail to synchronize within the permitted voltage difference, frequency difference, phase angle difference and time, then the controller defaults to the in-phase transition with default to load voltage decay operations as described in **Feature 32C and 32B.** Adjustable frequency difference 0.0-0.3 Hz. Adjustable voltage difference 1-5% volts. Adjustable synchronization time allowance 1-60 minutes.

47D. Closed Transition

Provides a closed transition transfer as the primary transfer mode. Only under a fail-safe condition (i.e., loss of the connected source) will the controller transfer to the alternate source using the load voltage decay operation as described in **Feature 32B32B.** Adjustable frequency difference 0.0-0.3 Hz. Adjustable voltage difference 1-5% V.

47E. Closed Transition With Default to In-Phase Transition With Default to Time Delay Neutral

Provides a closed transition transfer

as the primary transfer mode. In the event Source 1 and Source 2 fail to synchronize within the permitted voltage difference, frequency difference, phase angle difference and time, then the controller defaults to the in-phase transition with default to time delay neutral operation as described in **Features 32D** and **32A32B32A**. Adjustable frequency difference 0.0-0.3 Hz. Adjustable voltage difference 1-5 percent volts. Adjustable synchronization time allowance 1-60 minutes.

48. Communication Modules

Provides communications modules for the ATC-600 and ATC-800 transfer switch controllers.

48A. INCOM

Communication (IPONI) Provides Eaton's proprietary INCOM protocol communications modules.

48D. Ethernet

Communication (PXG400 Gateway) Translates Modbus RTU, QCPort or INCOM to Modbus TCP. The PXG400 Gateway includes embedded Web server monitoring of up to 64 connected devices. (Includes the IPONI with the ATC-600 and ATC-800 controllers.)

48F. Modbus

Communication (MPONI) Provides Modbus RTU protocol via communications module. 48R. Remote Annunciator Provides remote monitoring of source availability, source position and test status for the ATC-600 and ATC-800 controllers. Operates via the controller sub-network.

48RAC. Remote Annunciator with Control

Provides remote monitoring and control via a color touch screen display for the ATC-600 and ATC-800 controllers. Operates using Modbus protocol (MPONI required for the ATC-600 and 800).

Option 51. Surge Protection Device

Two types of surge protection devices are used in Eaton automatic transfer switches. Both types meet the requirements for UL 1449 3rd Edition for surge suppression devices and are CE marked. The type CVX is used on Eaton wallmount ATS designs and the Eaton type SPD are used on floor-standing designs.

CVX

The CVX device features a Thermally Protected Metal Oxide Varistor technology and comes with high intensity LED phase status indicators.

SPD

The SPD features a Thermally Protected Metal Oxide Varistor technology. It comes with dual-colored protection status indicators for each phase and for neutral-ground protection mode. It comes with an audible alarm with silence button and a Form C contact. An optional SPD with surge counter feature package is available. This provides six-digit surge counter with reset button.

51S1B. 50 kA-SPD standard source 1

51S2B. 80 kA-SPD standard source 1

51S3B. 100 kA-SPD standard source 1

51S4B. 120 kA-SPD standard source 1

51S5B. 160 kA-SPD standard source 1

51S6B. 200 kA-SPD standard source 1

51S7B. 250 kA-SPD standard source 1

51S8B. 300 kA-SPD standard source 1

51S9B. 400 kA-SPD standard source 1

51S1C. 50 kA-SPD standard with surge counter source 1

51S2C. 80 kA-SPD standard with surge counter source 1

51S3C. 100 kA-SPD standard with surge counter source 1

51S4C. 120 kA-SPD standard with surge counter source 1

51S5C. 160 kA-SPD standard with surge counter source 1

51S6C. 200 kA-SPD standard with surge counter source 1

51S7C. 250 kA-SPD standard with surge counter source 1

51S8C. 300 kA-SPD standard with surge counter source 1

51S9C. 400 kA-SPD standard with surge counter source 1

54. Front Access

54A. Front access cabinet available for all Magnum products. This option will add an additional pull section mounted on the side of the switch.

59b. Tin-Plated Bus

Tin-plated bus is available as an option for Magnum-based designs.

3.7 Enclosure

The rugged steel switch enclosure is supplied with four door hinges, regardless of enclosure size, to insure proper support of the door and door mounted devices. The hinges have removable hinge pins to facilitate door removal. The doors are supplied as standard with thumbscrew and padlock latches. Cable entry holes are the customer's responsibility.

The door is used to mount a variety of lights, switches, and push buttons, depending upon the options required for a particular switch. All switch doors are supplied with a heavy duty plastic accessory panel in place, whether or not external devices are required. When lights, pushbuttons, or switches are required, they are normally mounted in the plastic door mounted panel.

Transfer switch enclosures and some internal steel mounting plates, such as the transformer panel mounting plate, go through a pre-treatment cleaning system prior to painting to insure a durable finish. Should the enclosure become scratched and in need of touch up paint, use ANSI 61. All remaining steel is galvanized.

The standard switch enclosure is NEMA Type 1 for general indoor use (Table 4).

Table 4. Transfer Switch Equipment Enclosures.

NEMA TYPE	DESIGN	PROTECTION
1	Indoor	Enclosed Equipment
3R	Outdoor	Rain, Ice Formation

3.8 Standards

Eaton transfer switch equipment is listed for application by UL and CSA. In addition, Eaton ATSs are listed in File E38116 by UL, Inc., under Standard UL 1008. This standard covers requirements for ATSs intended for use in ordinary locations to provide for lighting and power as follows:

a. In emergency systems, in accordance with articles 517 and 700 in the National Electrical Code (NEC), American National Standards Institute/National Fire Protection Association (ANSI/NFPA) 70 and the NFPA No. 76A and/or

b. In stand-by systems, in accordance with article 702 of the NEC and/or

c. In legally required stand-by systems in accordance with article 701 of the NEC.

d. In critical operations power systems (COPS article 708) in accordance with article 708 of the NEC

Eaton ATSs are available to meet NFPA 110 for emergency and stand-by power systems, and NFPA 99 for health care facilities when ordered with the appropriate options.

Since Eaton ATSs utilize specially designed switches and/or switching devices as the main power switching contacts, these devices must also be listed under the additional UL Standard 1066. UL utilizes two basic types of listing programs: a) Label Service and b) Re-examination. UL1066 employs a label service listing program which requires an extensive follow-up testing program for listed devices. Standard UL1008 for ATSs lists devices under the re-examination program which only requires a continual physical re-examination of the components used in the product to insure consistency with the originally submitted device. Follow-up testing IS NOT required by UL1008.

Representative production samples of switches and switching devices used in Eaton ATSs are subjected to a complete test program identical to the originally submitted devices on an ongoing periodic basis per UL1066. The frequency of such a re-submittal can be as often as every quarter for a low ampere device.

Section 4: Installation and Wiring

4.1 General

Eaton transfer switches are factory wired and tested. Installation requires solidly mounting the enclosed unit and connecting the power cables and auxiliary pilot circuits. Physical mounting procedures and power cable connections are covered in this section. All other required wiring or electrical connection references are covered in a separate **Customer Wiring Diagram** packaged with the transfer switch.

Locate the wiring booklet, review it, and keep it readily available for reference purposes during installation and testing. Once a transfer switch is properly installed and wired, it should be mechanically and electrically checked for proper installation and operation. The procedures for these initial mechanical and electrical checks are outlined in Section 8.1 of this instruction manual.

WARNING

BE CERTAIN THAT THE SOLID STEEL DEAD FRONT SHIELDS ARE PROPERLY INSTALLED BEFORE THE TRANSFER SWITCH EQUIPMENT IS PUT INTO SERVICE. THE SHIELD PROVIDES PROTECTION FROM DANGEROUS VOLTAGES AT THE LINE AND LOAD TERMINALS WHEN THE EQUIPMENT IS IN OPERATION. FAILURE TO DO SO COULD RESULT IN PERSONAL INJURY OR DEATH.

4.2 Mounting Location

Choose a location that offers a flat, rigid mounting surface capable of supporting the weight of the enclosed transfer switch equipment. Avoid locations that are moist, hot, or dusty. However, Eaton offers enclosure designs that can be used in special environments. If there are any doubts as to the suitability of the location, discuss it with your Eaton representative.

Check to make certain that there are no pipes, wires, or other hazards in the immediate area that could create a problem. The panels provide ample room for rear cable entry from top, bottom, and sides. At no time should cable be routed to retard the action of relays or cover the logic in a way that restricts adjustments. Maintain proper electrical clearances between live metal parts and grounded metal.

For installation and maintenance purposes, the Source 1 and Source 2 power sources must have an overcurrent protective device upstream of the transfer switch, unless overcurrent protection is integral to the switch.

The dimensions of the transfer switch are an important consideration in determining proper location selection.

4.3 Unpackaging and Inspection

CAUTION

SINCE THE ENCLOSED TRANSFER SWITCH MUST BE LIFTED INTO PLACE FOR MOUNTING, BE CERTAIN THAT ADEQUATE RESOURCES ARE AVAILABLE FOR LISTING TO AVOID PERSONNEL INJURIES OR EQUIPMENT DAMAGE.

Proceed with the following four steps:

Step 1: Carefully uncrate the transfer switch. If damage is visible, please contact your local Eaton sales representative or the factory.

Step 2: Open the door and visually verify that there are no broken or damaged components or evidence of distorted metal or loose wires as a result of rough handling.

Step 3: A label on the door provides specifications for your transfer switch. Verify that these specifications comply with your requirements.

Step 4: Remove any braces or packing used to protect the transfer switch or internal components during shipping.

CAUTION

EXTREME CARE SHOULD BE TAKEN TO PROTECT THE TRANSFER SWITCH FROM DRILL CHIPS, FILLINGS, AND OTHER CONTAMINANTS WHEN MAKING THE CABLE ENTRY HOLES AND MOUNTING THE ENCLOSURE TO PREVENT COMPONENT DAMAGE OR A FUTURE MALFUNCTION.

4.4 Mounting Procedure

NOTICE

CABLE ENTRY HOLES ARE NOT PART OF THE ENCLOSURE WHEN SHIPPED FROM THE FACTORY AND MUST BE PROVIDED IN THE FIELD, EITHER BEFORE OR AFTER MOUNTING THE ENCLOSURE.

With the enclosed transfer switch equipment unpacked and ready for mounting, proceed with the following steps:

Step 1: Mounting and cabling access is best provided by removing side and rear covers (when applicable). See Section 9.3 for cover removal instructions.

Step 2: Gently maneuver the switch into its location using all of the supplied lift brackets.

Step 3: Bolt the enclosure to the base. Use separate cleats (Option 42 only) if Seismic Uniform Building Code (UBC) Zone 4 certification is desired (Figure 20), and secure with 1/2-13 UNC Grade 5 hex bolts. Seismic per IBC 2009, CBC2010, OSHPD OSP-0014-10 (3200 A and below)

Step 4: Tighten bolts to 50 ft-lbs (68 Nm).

Step 5: Double check to ensure that all packing and shipping material has been removed

.

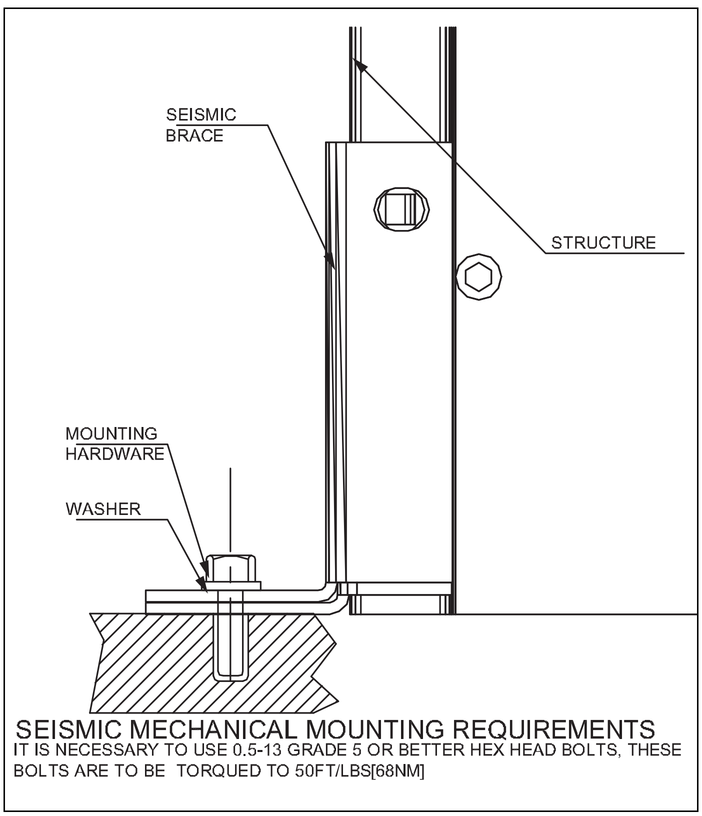


Figure 20. Seismic Tested and Approved Product Mounting Instructions.

4.5 Power Cable Connections

WARNING

POWER CONDUCTORS MAY HAVE VOLTAGE PRESENT THAT CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. DE-ENERGIZE ALL POWER OR CONTROL CIRCUIT CONDUCTORS TO BE CONNECTED TO THE TRANSFER SWITCH EQUIPMENT BEFORE BEGINNING TO WORK WITH THE CONDUCTORS AND/OR TERMINATING THEM TO THE EQUIPMENT.

CAUTION

USE OF CABLE LUGS NOT DESIGNED FOR THE TRANSFER SWITCH APPLICATIONS MAY CAUSE HEATING PROBLEMS. BREAKER LUGS ONLY MOUNT TO THE BREAKER, WHILE TRANSFER SWITCH LUGS MOUNT TO BOTH THE BREAKER AND THE BUS BAR BEHIND THE BREAKER. FOR INSTALLATION INSTRUCTIONS, REFER TO THE INSTRUCTION LEAFLET SUPPLIED FOR THE SPECIFIC LUGS.

CAUTION

TO HELP PREVENT COMPONENT DAMAGE OR FUTURE MALFUNCTIONS, USE EXTREME CARE TO KEEP CONTAMINANTS OUT OF THE TRANSFER SWITCH EQUIPMENT WHEN MAKING POWER CABLE CONNECTIONS.

CAUTION

RUN THE POWER CABLE THROUGH THE GUTTER SPACE PROVIDED IN THE REAR OF POWER COMPARTMENTS.

Test all power cables prior to connection to the unit to ensure that the conductors or cable insulation have not been damaged while being pulled into position.

Power cables are to be connected to solderless screw type lugs located on the ATS switching devices. Refer to the separate customer wiring diagram supplied with the ATS equipment for power termination. Verify that the lugs supplied will accommodate the power cables being used. Also verify that the cables comply with local electrical codes. Standard ATS equipment, as supplied from the factory, will accommodate the wire sizes shown in Table 5.

Carefully strip the insulation from the power cables to avoid nicking or ringing of the conductor strands. Prepare the stripped conductor termination end by cleaning it with a wire brush. If aluminum conductors are used, apply an appropriate joint compound to the clean conductor surface area.

Wrap line cables together with nominal 3/8 inch nylon rope or rope having tensile strength of 2,000 pounds.

Wrap at 4 inches and 15 inches from the line terminals with 8 and 18 wraps respectively or every 1 inch with 1 wrap.

Repeat the above for the load cables.

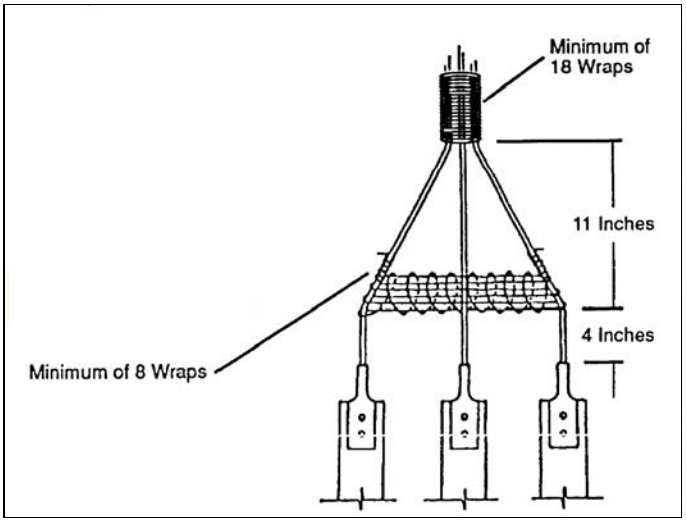


Figure 21. Cable Bracing Instructions.

⚠ CAUTION

IMPROPER POWER CABLE CONNECTIONS CAN CAUSE EXCESSIVE HEAT AND SUBSEQUENT EQUIPMENT FAILURE.

Tighten the cable lugs to the torque identified on the label affixed to the door.

Proceed with the following steps:

Step 1: Verify that the line and load cables comply with applicable electrical codes.

Step 2: Verify that the transfer switch rated current and voltage (see identification plate on the door of the transfer switch) agree with system current and voltage.

Step 3: After the transfer switch is mounted, provide the conduit or cable openings as required. Ensure that no metal filings contaminate the transfer switch components.

Step 4: Test all power cables before connecting them to the unit to insure that the conductors or the cable insulation have not been damaged while being pulled into position.

Step 5: Carefully strip the insulation from the power cables. Avoid nicking or ringing of the conductor strands. Prepare the stripped conductor termination end by cleaning it with a wire brush. If aluminum conductors are used, apply an appropriate joint compound to the clean conductor surface area. Refer to Figure 13 for the approximate locations of the power connections.

Table 5. Wire Size for Available Power Cable Connections.

DEVICE	SWITCH RATING (AMPS)	CABLES PER PHASE	RANGE WIRING SIZE
Switch	800-2000	6	3/0-750 MCM
Switch	2500-3200	9	3/0-750 MCM
Switch	4000	10	3/0-750 MCM
Switch	5000	12	3/0-750 MCM
Neutral	800-2000	24	4/0-500 MCM
Neutral	2500-3200	36	4/0-500 MCM
Neutral	4000	48	4/0-500 MCM
Neutral	5000	48	4/0-500 MCM

Step 6: Make the necessary connections of any options using the wiring diagrams supplied with the unit.

Step 7: Connect the engine start wires to the logic connector J5-1 & J5-2 on the ATC-600/ATC-800 Controller.

4.6 Voltage Selection Adjustment

Certain devices, such as the voltage selection panel, sensing relays, and timers need to be set and/or calibrated prior to placing the transfer switch equipment into service. Adjustments for logic devices are described in the separate instructional document dedicated to the specific logic being used. Voltage selection adjustments are described here

Voltage selection is made at the multi-tap transformer subassembly (see figure 22.A) mounted in the lower compartment of the transfer switch. This subassembly includes two identical control power transformers with one connected to Source 1(NT1) and the other connected to Source 2 (ET1). The control power transformers are mounted behind a removable panel (See Figure 22.B)

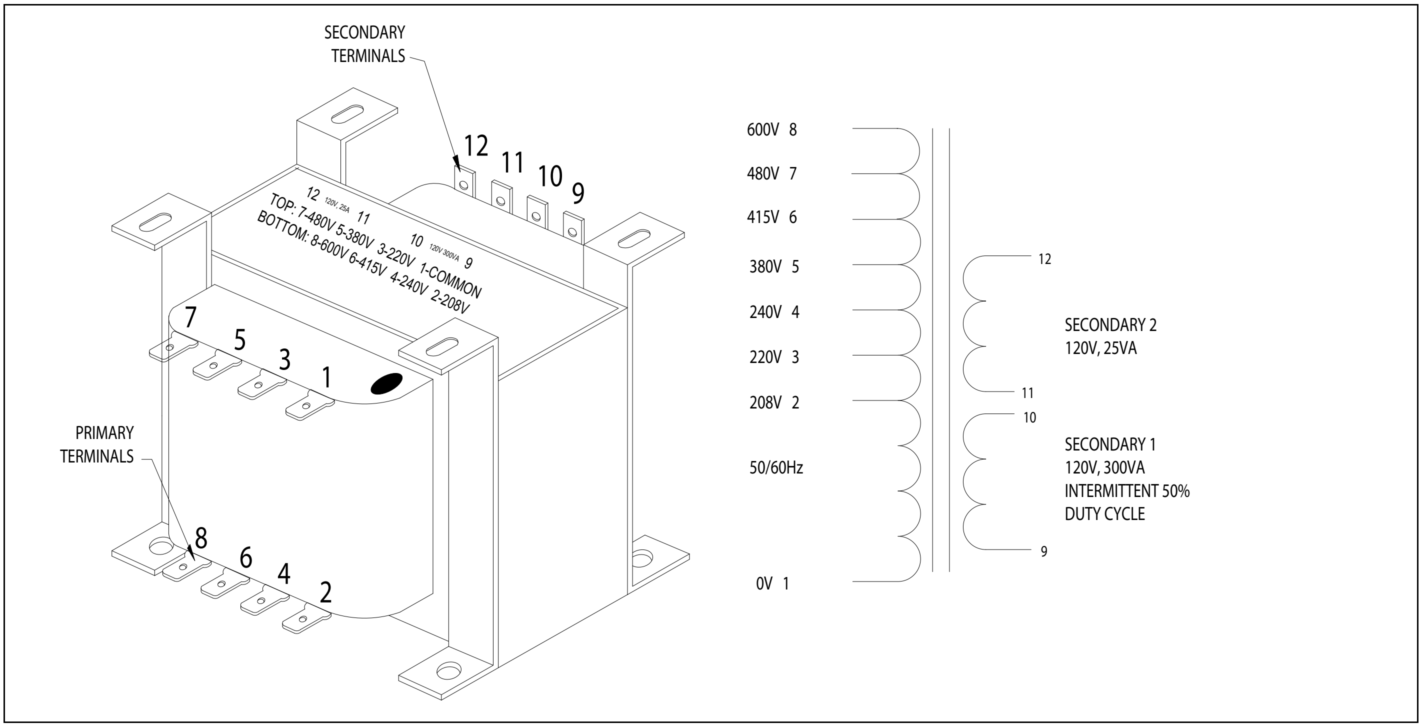


Figure 22. Voltage Selection Adjustment.

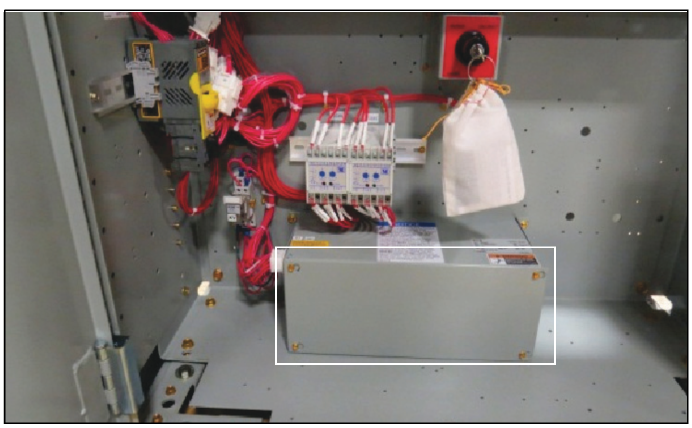
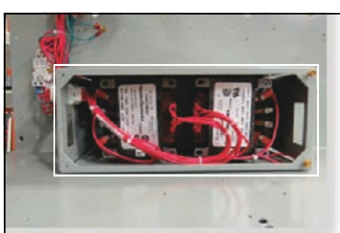


Figure 22A.



Primary Side Connections:

Connection 1 - Tap on #1 Common

Connection 2 - Tap on the nominal system voltage

Figure 22B.

⚠ WARNING

DISCONNECT ALL SOURCES OF POWER OR DISCONNECT P7/S7 PRIOR TO PERFORMING THE FOLLOWING. FAILURE TO DO SO MAY CAUSE SERIOUS INJURY OR DEATH.

- Remove the transformer pack cover by loosening the 4 screws located at each corner of the transformer pack assembly.
- The transformers are factory set on the voltage tap specified by the customer. (See illustration above for location of various taps and voltages)
- Detach the spade connector from the existing voltage tap and place on the tap that is suitable for your application.

.

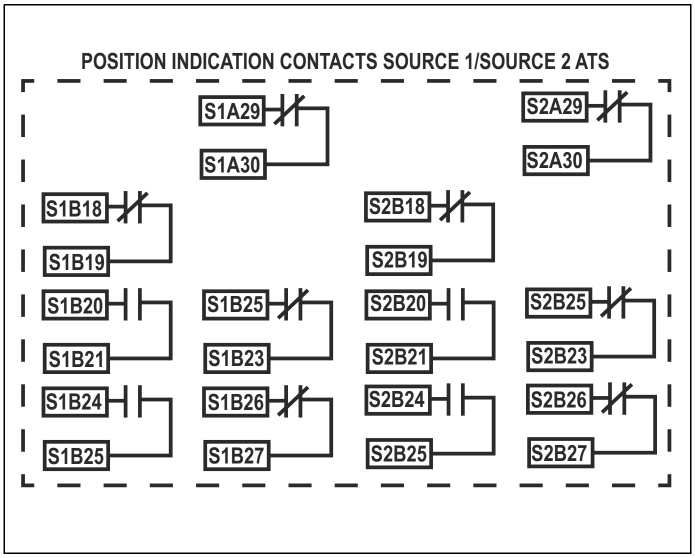
⚠ CAUTION

BE SURE THAT THE CORRECT VOLTAGE IS SELECTED TO MATCH THE SYSTEM VOLTAGE. AN IMPROPER SELECTION AND/OR CONNECTION COULD RESULT IN EQUIPMENT DAMAGE.

- After changing the taps on both transformers, replace the transformer pack cover and tighten all four screws.

4.7 Control Wiring to Magnum Power Case Switch/ Breaker

Control connections to the magnum power case switch can be made to the terminal blocks mounted above each device. The dead front needs to be removed first to gain access to the terminal locations. Typically the Source 1 (Normal) is the upper power device and Source 2 (Emergency) is the lower power device. The terminals are numbered the same for each one and also the same for fixed mounted or drawout designs. An example of the auxiliary contacts is shown in typical drawing below.



4.8 Wiring

CAUTION

POWER CONDUCTORS AND CONTROL WIRING MAY HAVE VOLTAGE PRESENT THAT CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. DE-ENERGIZE ALL POWER OR CONTROL CIRCUIT CONDUCTORS BEFORE BEGINNING TO PERFORM ANY WIRING ACTIVITY TO OR WITHIN THE TRANSFER SWITCH EQUIPMENT.

Power sources, load conductors, and control wiring should be connected to locations as indicated in the **Customer Wiring Diagrams** supplied with the transfer switch equipment.

4.8.1 Engine Start Connection

The engine control contact connections are located on the ATC-600/ATC 800 Controller. The engine control contact connections of bypass isolation units are located in the door of the enclosure.

Note: Prior to making the engine start connection to the switch on bypass isolation units, set the engine generator controls selector switch in the OFF position to prevent an unwanted engine start. A contact closes between these terminal blocks when an engine start signal is provided by the ATS logic.

4.8.2 ALARM CONTACTS (CLOSED TRANSITION ONLY)

Closed transition only ATSs are provided with an extra shunt trip on the Source 1 device. This shunt trip is energized when the Time Delay Utility Parallel (TDUP) times out (preset by user), thus opening the source device. The TDUP timer starts timing when both sources are paralleled. Refer to the IQ Transfer instruction book for additional alarms.

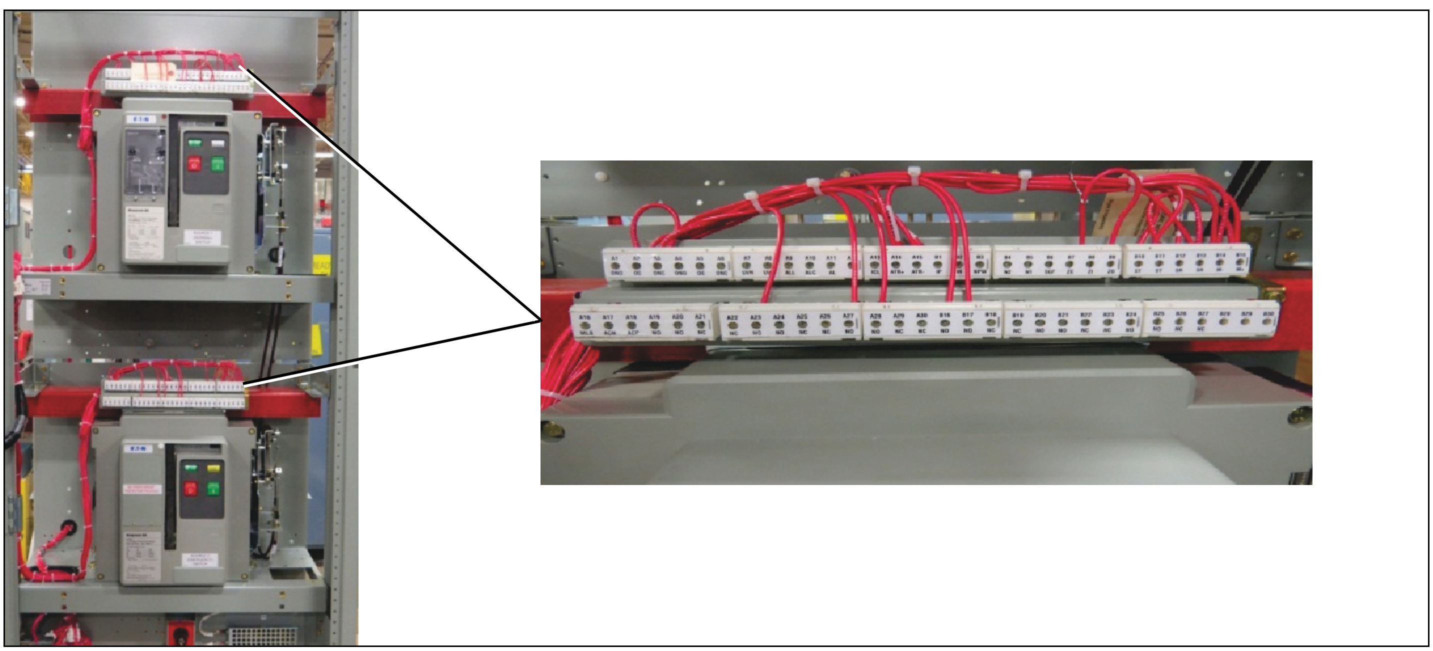


Figure 23. Terminal Blocks Mounted Above Each Device.

Section 5: Operation

5.1 General

⚠ WARNING

THE CLOSED TRANSITION PRODUCT CONTAINS A SPECIAL CONTACT ARRANGEMENT (OVERLAPPING CONTACTS). MISUSE CAN RESULT IN DEATH, SEVERE PERSONAL INJURY, AND/OR PROPERTY DAMAGE.

A transfer switch provides main contacts to connect and disconnect the load to and from the Source 1 and Source 2 power sources. A stored-energy type transfer mechanism provides the mechanical motion required to open and close the main contacts (Paragraph 3.2.1).

Each switch can be manually operated. Before a switching device can be closed, the stored energy mechanism must be charged by pumping the handle (Figure 24).

Figure 24. Pumping Handle Charges Stored Energy Mechanism (Closed Transition Shown).

In the **closed transition product**, a single switching device can be manually closed by following the instructions detailed in Figure 26. An indicator window shows whether the switch is open or closed.

The open transition switching device can be closed by pushing the close button (Figure 25). The other switching device is prevented from closing through a rigid mechanical interlock (Paragraph 3.2.2). An indicator window shows whether the switch is open or closed.

Figure 25. Close Switch by Pushing Close Button.

NOTICE

IF A TRANSFER SWITCH WITH ANY TYPE OF ELECTRICAL OPERATING CAPABILITIES IS TO BE OPERATED MANUALLY UTILIZING THE MANUAL OPERATING HANDLE, IT IS STRONGLY RECOMMENDED THAT THE TRANSFER CONTROL CIRCUIT FIRST BE ISOLATED. THIS IS ACCOMPLISHED BY DISCONNECTING THE S7/P7 PLUG ON THE TRANSFORMER PANEL. AN AUTOMATIC ENGINE START WILL OCCUR UNLESS THE GENERATOR RUN SWITCH SET TO "OFF." IF, HOWEVER, A TRANSFER SWITCH IS SUPPLIED WITH A FOUR-POSITION SELECTOR SWITCH (OPTION 6H), IT CAN BE TURNED TO THE OFF POSITION, MAKING IT UNNECESSARY TO UNPLUG THE LOGIC. IN THE CASE OF THE ATS DESIGN, ANY ATTEMPT TO OPERATE THE MANUAL HANDLE WITHOUT FIRST ISOLATING THE CONTROL CIRCUIT CAUSES AN AUTOMATIC TRANSFER.

5.2 Automatic Transfer Switch

The operating sequence of an ATS is dictated by the switch's standard features and selected options. Operation of an ATS during Source 1 power source failure, Source 1 power source restoration, and testing is described in the associated Controller Instruction Booklet.

⚠WARNING

OVERLAPPING CONTACTS
SOURCE 1 AND SOURCE 2
must be Synchronized

7805C60H04

THIS PRODUCT CONTAINS A SPECIAL CONTACT ARRANGEMENT (OVERLAPPING CONTACTS). MISUSE CAN RESULT IN DEATH SEVERE PERSONAL INJURY OR PROPERTY DAMAGE.

(THIS LABEL IS APPLIED TO THE DOOR)

Do Not Use Without
Reading Manual
Operating Instructions

MANUAL CLOSE BUTTON

FOLLOW THE INSTRUCTIONS OUTLINED IN THE NEXT WARNING LABEL.

(THIS LABEL IS APPLIED TO THE COVER OF THE MANUAL CLOSE BUTTON ON EACH

⚠WARNING

Attempting to close both switching devices simultaneously can cause severe injury or death.

Follow Manual Operation Instructions Below

Manual Operation Instructions

1. **Disconnect Logic Connectors**
2. **Open both switching devices**
3. **Verify "OPEN" flags**
4. **Verify source availability**
5. **Close switching device on available source**

7805C60H05

THESE INSTRUCTIONS ONLY PERTAIN TO MANUALLY CLOSING A SINGLE SWITCHING DEVICE. ATTEMPTING TO CLOSE BOTH SWITCHING DEVICES CAN CAUSE SEVERE INJURY OR DEATH.

THIS LABEL IS APPLIED TO THE DOOR.

Figure 26. Switching Device Closing Precautions (Closed Transition Only).

Section 6: Drawout and Fixed Switching Devices

6.1 Installing a Drawout Switching Device

In transfer switches equipped with drawout switching devices, bolted-in carriages with extendable rails support the switching devices.

Figure 27. Switching Device Drawn Out from the Transfer Switch.

To install a drawout switching device, the extendable rails must first be pulled all the way out. Once the rails are fully extended, the switching device can be carefully placed on the rails.

⚠ CAUTION

IT IS IMPORTANT TO TAKE GREAT CARE WHEN PLACING A DRAWOUT SWITCHING DEVICE ON ITS EXTENDED RAILS. IF THE SWITCHING DEVICE IS NOT PROPERLY SEATED ON THE EXTENDABLE RAILS, IT COULD FALL FROM THE RAILS CAUSING EQUIPMENT DAMAGE AND/OR BODILY INJURY.

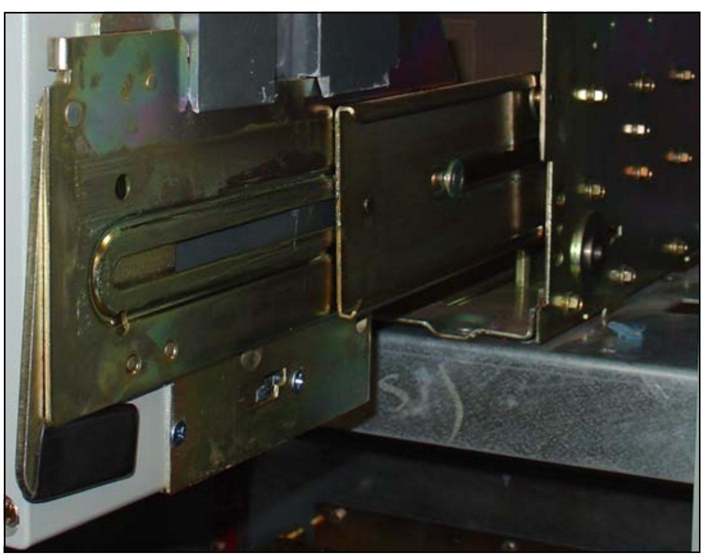


Figure 28. Drawout Rail Supports Fully Seated in the Rail Cutouts.

Carefully lower the switching device onto the extended rails. Be certain that the switching device's four molded drawout rail supports are fully seated in the extendable rail cutouts on both sides (Figure 29). **Do not remove the lifting yoke from the switching device until it is properly seated on the rails.**

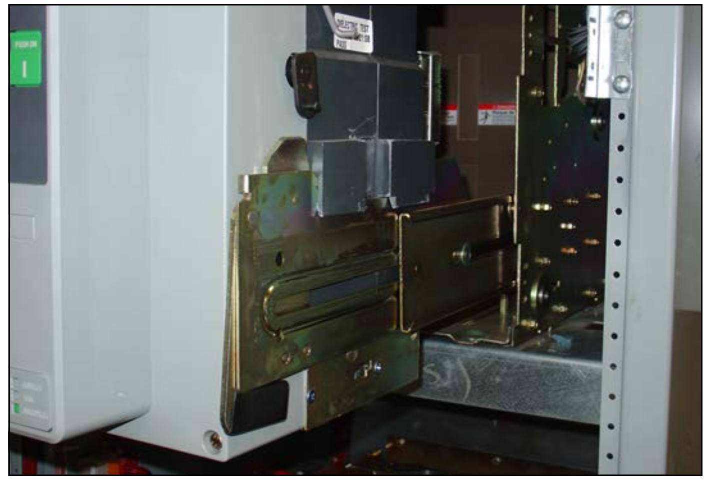


Figure 29. Switching Device in the REMOVE Position.

Once the switching device is properly seated on the extended rails, the lifting yoke can be removed and the rest of the switching device installation procedure can be completed.

6.1.1 Switching Device Positioning

The Magnum drawout switching device has four normal positions:

- REMOVE (Withdrawn) (Figure 29)
- DISCONNECT (Figure 32)
- TEST (Figure 31)
- CONNECT (Figure 30)

The REMOVE position is a position outside the compartment on the carriages drawout rails where the switching device is not engaged with the levering mechanism. The DISCONNECT, TEST, and CONNECT, positions are reached by means of the levering mechanism.

With the switching device solidly positioned on the carriage's extendable rails and the levering-in mechanism in the DISCONNECT position, carefully and firmly push the switching device into the compartment as far as it will go. The outer (recessed) portion of the switching device face plate should align with the GREEN target line (labeled DISC) on the inside top left wall of the carriage (Figure 33).

⚠ CAUTION

MAKE CERTAIN THAT THE SWITCHING DEVICE IS FULLY INSERTED INTO ITS COMPARTMENT BEFORE ANY ATTEMPT IS MADE TO LEVER THE SWITCHING DEVICE. ATTEMPTING TO LEVER THE SWITCHING DEVICE IN BEFORE IT IS FULLY POSITIONED INSIDE ITS COMPARTMENT CAN RESULT IN DAMAGE TO BOTH THE SWITCHING DEVICE AND THE COMPARTMENT.

Figure 30. Switching Device in the CONNECT Position.

Figure 31. Switching Device in the TEST Position.

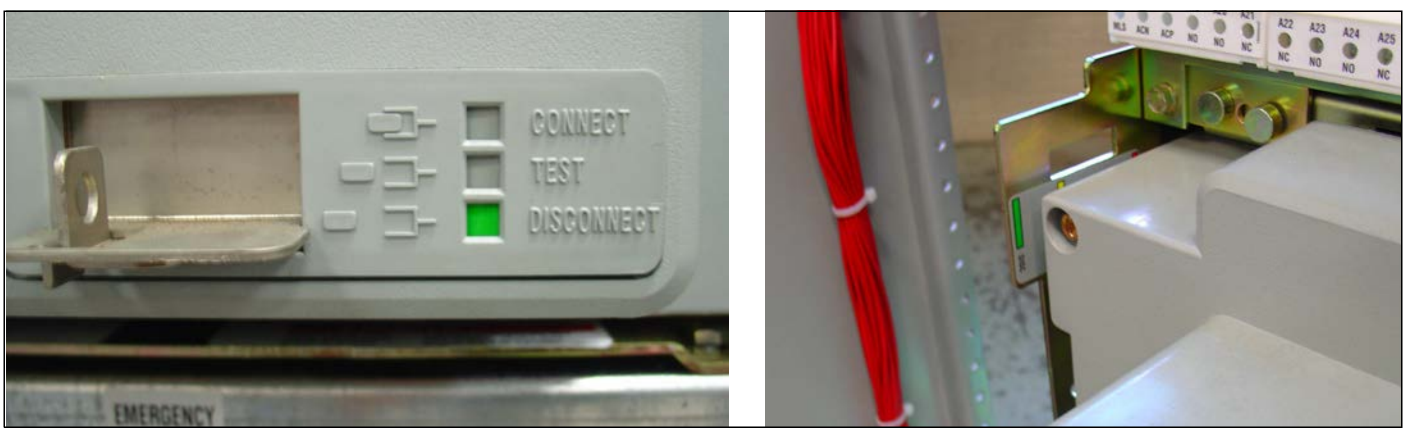


Figure 32. Switching Device in the DISCONNECT Position.

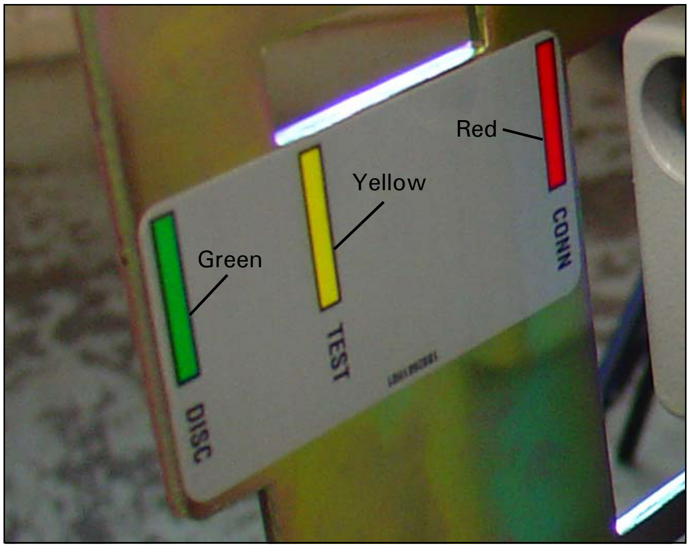


Figure 33.Carriage Label Showing DISCONNECT, TEST, and CONNECT Positions of the Recessed Cover.

6.1.2 Levering the Switching Device

The switching device is now ready to be levered. With the switching device OPEN, the levering device access door can be raised. The levering device is hand operated using a standard 3/8" square drive and ratchet, which is not provided (Figure 34). As long as the access door is raised, the switching device is held in the "trip free" condition. Begin by rotating the levering-in screw to the full counter clockwise (DISCONNECT) position.

Figure 34.Levering and Position Indication.

Close the compartment door and begin levering the switching device into its different positions using a clockwise ratcheting motion. When the switching device is levered fully to the DISCONNECT or CONNECT position, the levering shaft hits a hard stop. Do NOT exceed 25 ft lb (33.9 Nm) of torque or the levering mechanism may be damaged.

NOTICE

THE SWITCHING DEVICE CAN BE LEVERED WITH THE COMPARTMENT DOOR OPEN OR CLOSED, BUT IT IS ADVISABLE TO CLOSE THE DOOR PRIOR TO LEVERING.

The position of the switching device within its compartment is indicated by color coded position indicators (See Figure 30 through 33):

- Red = Connect;
- Yellow = Test; and
- Green = Disconnect.

To remove the switching device from its compartment, follow the procedure just described using a counter clockwise ratcheting motion.

NOTICE

THE SWITCHING DEVICE MECHANISM IS INTERLOCKED SUCH THAT CHARGED CLOSING SPRINGS ARE AUTOMATICALLY DISCHARGED IF THE SWITCHING DEVICE IS LEVERED INTO OR OUT OF THE CELL. DISCHARGE TAKES PLACE BETWEEN THE DISCONNECT AND TEST POSITION.

6.2. Fixed Switching Device

The Magnum fixed type switching device differs from the drawout version in that it has no levering device, primary disconnects, and secondary disconnects (Figure 35). In addition, a fixed switching device does not have a standard feature to hold the switching device in a "trip free" position

Figure 35. Typical Magnum Fixed Switching Device.

Fixed switching device terminals have holes for making bolted horizontal primary bus connections. Adapters are available for making vertical primary bus connections. Secondary connections can be made through standard terminal blocks or a special connector compatible with the drawout switching device's type secondary connector. Both secondary connection devices are mounted at the top front of the switching device.

The fixed switching device frame has two mounting feet, one on each side, to permit the fixed switching device to be securely mounted. Each mounting foot has two slotted mounting holes which are used to bolt the switching device securely in place. Use either 3/8" or M 10 bolts for this purpose. Refer to the dimensional drawings supplied with the transfer switch for switching device and bus stab dimensions.

6.3 Switching Device Operation

Switching devices should be operated manually and/or electrically before they are put into service. This can be done during the installation process or some later date prior to start-up. To check the switching device operation, follow the operational procedures outlined in switching device manual supplied with the transfer switch for both manually operated and electrically operated switching devices.

Section 7: Operation of the Bypass Isolation Transfer Switch

7.1 Operator Panel

The design of this transfer switch allows quick removal of the different switching devices for inspection or maintenance or, if required, quick replacement.

Depending on the optional features selected by the customer the bypass isolation switch will have two operator panels with switches and lights (Figure **36 and 37**).

Figure 36.Typical Bypass Isolation Transfer Switch Device Panel.

The left door control panel will have following standard features:

1. AMBER LED on the ATC-600/800 Controller to indicate if the Source 1 power source is available.
2. AMBER LED on the ATC-600/800 Controller to indicate if the Source 2 power source is available.
3. GREEN LED on the ATC-600/800 Controller to indicate if the Source 1position is energized, that is, the Source 1 switching device in the automatic transfer switch is closed.
4. RED LED on the ATC-600/800 Controller to indicate if the Source 2 position is energized, that is, the Source 2 switching device in the automatic transfer switch is closed.
5. The Engine Test Pushbutton can be pressed twice and released with the ATC-600/800 controller in the status state to initiate a self test. This test can be initiated and accomplished while in the Run or Program Modes. Pressing the Engine Test Pushbutton again while in the engine run condition aborts the test.

   Upon test initiation, a generator start of the non-preferred source is engaged after TDES timeout. If a full test is programmed, a transfer with all programmed timers occurs. The test engine run timer will hold the load for the required timeout and the test is concluded with a re-transfer cycle. For an engine run only test, no transfer will occur and the engine will run for the programmed run time.
6. Three-position selector switch to control the generator:
   - AUTO - The intelligence circuit of the transfer switch will start the generator if the Source 1 power source is not available.
   - OFF - The intelligence circuit of the transfer switch will not be able to start the generator, which eliminates nuisance starts during maintenance.
   - RUN - The generator will run regardless of the availability of the Source 1 power source.

Figure 37. Magnum Bypass Lights.

The right door control panel has following standard features:

1. BLUE light to indicate if the Source 1 switching device is isolated (only if the Source 1 switching device is racked out).
2. BLUE light to indicate if the Source 2 switching device is isolated (only if the Source 2 switching device is racked out).
3. RED light to indicate if the Source 1 bypass switching device is closed.
4. RED light to indicate if the Source 2 bypass switching device is closed.

7.2 Automatic Operation

The intelligence/supervisory circuits on Eaton transfer switches constantly monitor the condition of both the Source 1 and Source 2 power sources. These circuits automatically initiate an immediate transfer of power from the Source 1 to the Source 2 power source when the power source fails or the voltage level drops below a preset value. Transfer back to the Source 1 power source is automatic upon return of the Source 1 power source.

Monitoring the power source is always performed on the line side of the power source to which the switch is connected. The Source 1 power source is the preferred source and the transfer switch will always seek this source when it is available.

7.3 Bypassing the Transfer Switch

⚠ WARNING

THE CLOSED TRANSITION PRODUCT CONTAINS A SPECIAL CONTACT ARRANGEMENT (OVERLAPPING CONTACTS). MISUSE CAN RESULT IN DEATH, SEVERE PERSONAL INJURY, AND/OR PROPERTY DAMAGE.

7.3.1 Source 1 to Source 1 Bypass

The Source 1 switching device can be bypassed and isolated by the following sequence (Figures 36, 37, 38, and 39):

1. Move the generator selector switch to the OFF position to avoid nuisance starts.
2. Close the Source 1 bypass switch manually. The Source 1 bypass RED light will illuminate.
3. Remove J7 Plug from ATC-600/800 controller.
4. Open and rack out the Source 1 switching device (see Section 6). The Source 1 isolated BLUE light will illuminate and the Source 1 position energized GREEN LED on the ATC-600/800 controller will no longer be illuminated.
5. Inspect and/or perform the needed maintenance on the Source 1 switching device.
6. Rack in the Source 1 switching device (see Section 6). The Source 1 switching device will automatically recharge when it is in the CONNECT position.
7. Reconnect J7 plug back onto the ATC-600/800 controller.
8. ATC-600/800 controller will automatically sense the availability of the preferred Source 1 and will connect the Source 1 switching device. Source 1 isolated BLUE light will no longer be illuminated and the Source 1 position energized GREEN LED will be illuminated.
9. Open the Source 1 bypass switch. The Source 1 bypass RED light will no longer be illuminated.
10. Move the generator selector switch to the AUTO position
11. The Source 1 switching device is now back in automatic operation.

7.3.2 Source 2 to Source 2 Bypass

The Source 2 switching device can be bypassed and isolated by the following sequence (considering Source 2 is the only source available):

1. Move the generator selector switch to the RUN position to avoid losing power to source 2.
2. Close the Source 2 bypass switch manually. The Source 2 bypass RED light will illuminate.
3. Remove J7 Plug from ATC-600/800 controller.
4. Open and rack out the Source 2 switching device (see Section 6). The Source 2 isolated BLUE light will illuminate and the Source 2 position energized RED LED on the ACT-600/800 controller will no longer be illuminated.
5. Inspect and/or perform the needed maintenance on the Source 2 switching device.
6. Rack in the Source 2 switching device (see Section 6). The Source 2 switching device will automatically recharge when in the CONNECT position.
7. Reconnect J7 plug back onto the ATC-600/800 controller.
8. ATC-600/800 controller will automatically sense the availability of the Source 2 and will connect the Source 2 switching device. Source 2 isolated BLUE light will no longer be illuminated and the Source 2 position energized RED LED will be illuminated.

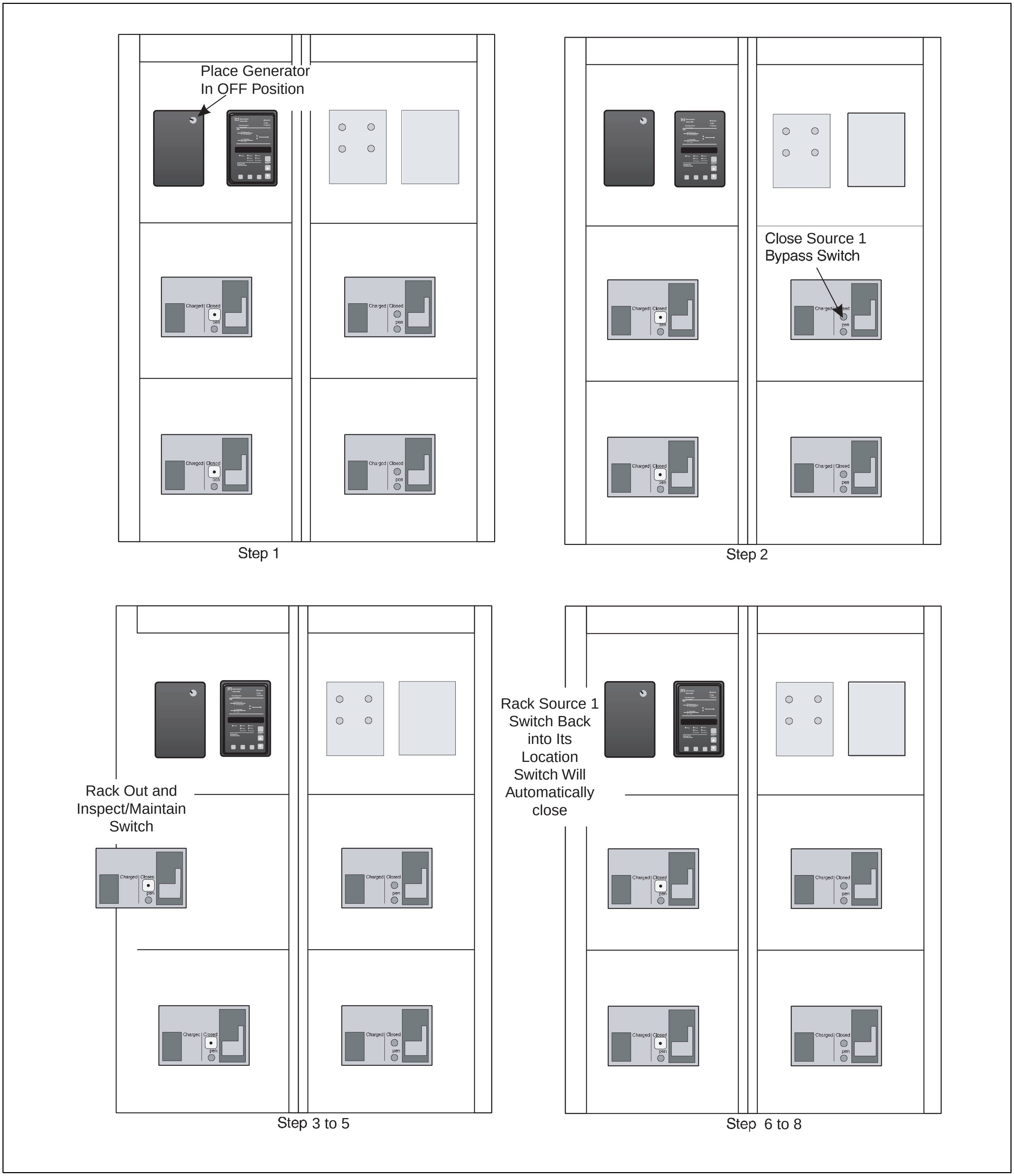


Figure 38. Transfer from Normal Switching Device to Normal Bypass Switching Device, Steps 1-8.

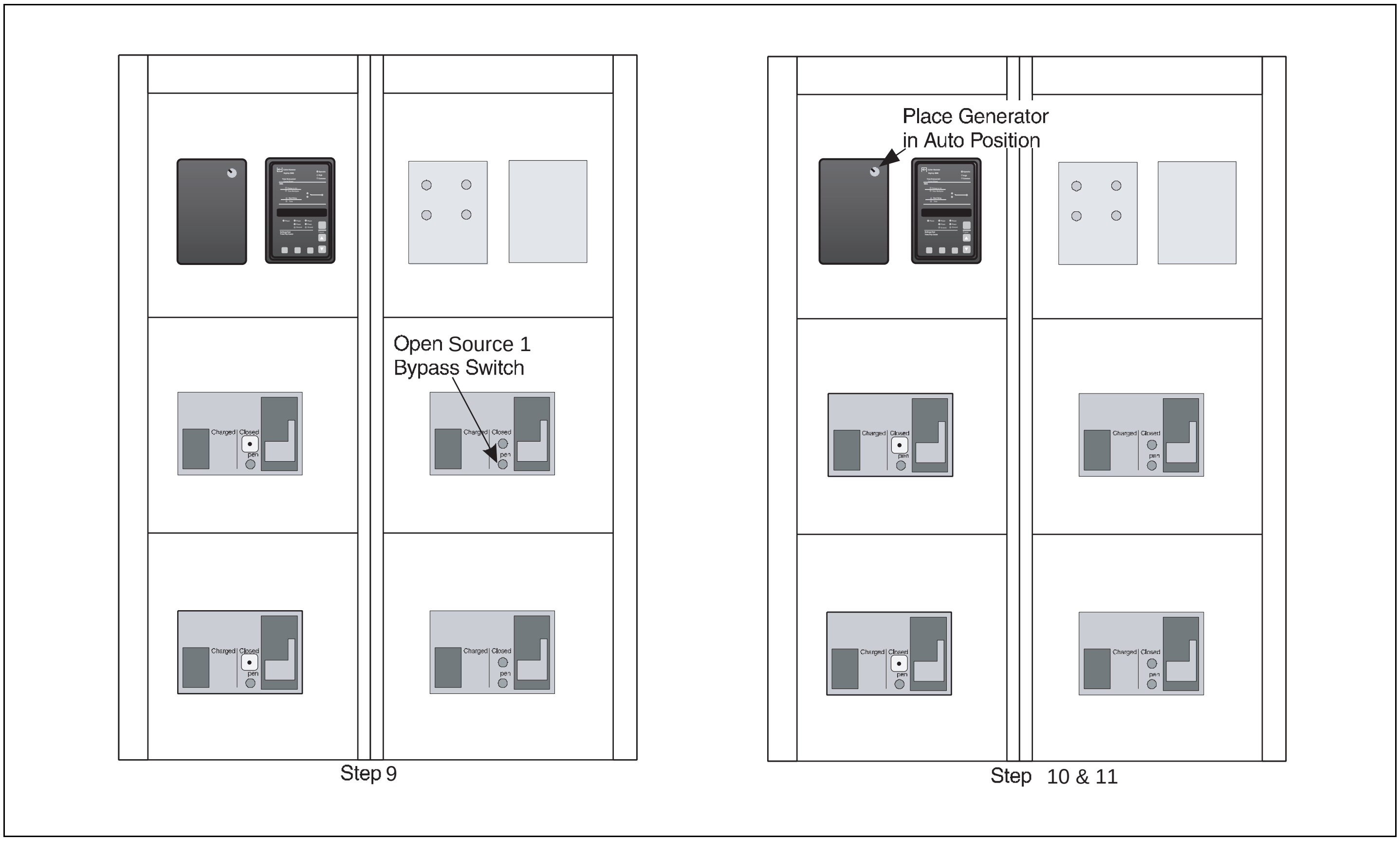


Figure 39. Transfer from Normal Switching Device to Normal Bypass Switching Device, Steps 9-11.

9. Open the Source 2 Bypass switch. The source 2 Bypass RED light will no longer be illuminated.
10. Move the generator selector switch to the AUTO position.
11. The Source 2 Switching device is now back in automatic operation.

7.3.3 Source 1 to Source 2 Bypass (Open Transition Only)

The Source 1 switching device can be isolated and bypassed to source 2 by the following sequence:

1. Move the generator selector switch to the RUN position because the load needs to be energized from the Source 2 power source.
2. Make sure that the Source 2 power source is available.
3. Remove J7 Plug from ATC-600/800 controller.
4. Open and rack out the Source 1 switching device manually (see Section 6). The Source 1 isolated BLUE light will illuminate and Source 1 position energized GREEN LED will no longer be illuminated.
5. Close the Source 2 bypass switching device manually. The Source 2 bypass RED light will be illuminated.
6. Inspect and/or perform the needed maintenance on the Source 1 switching device.
7. Rack in the Source 1 switching device (see Section 6). The Source 1 switching device will automatically recharge when it is in the CONNECT position. The Source 1 isolated BLUE light will no longer be illuminated.

Note: Source 1 switching device will not be closed with Source 2 bypass switching device closed due to mechanical interlock.

8. Reconnect J7 plug back onto the ATC-600/800 controller.
9. Open the Source 2 bypass switching device. The Source 2 bypass RED light will no longer be illuminated.
10. The Source 1 switching device should now automatically close and Source 1 position energized GREEN LED will be illuminated.
11. Move the generator selector switch to the AUTO position.
12. The Source 1 switching device is now back in automatic operation.

7.3.4 Source 2 to Source 1 Bypass (Open Transition Only)

The Source 2 switching device can be bypassed to source 1 by the following sequence:

Note: This operation can be performed by programming Preferred Source = Source 2 inside the ATC-600/800 controller

1. Ensure that the Source 1 power is available since the load will be energized from the Source 1 power source.
2. Move the generator selector switch to the OFF position to avoid nuisance starting of the generator while work is being performed on the Source 2 switching device.
3. Remove J7 PLug from ATC-600/800 controller.
4. Open and rack out the Source 2 switching device manually (see Section 6). The source 2 isolated BLUE light will illuminate and Source 2 position energized RED LED will no longer be illuminated.

5. Close the Source 1 bypass switching device manually. The Source 1 bypass BLUE light will illuminate.
6. Inspect and/or perform the needed maintenance on the Source 2 switching device.
7. Rack in the Source 2 switching device (see Section 6). The Source 2 Switching device will automatically recharge when it is in the Connect position. The source 2 isolated BLUE light will no longer be illuminated.

Note: Source 2 switching device will not be closed with Source 1 bypass switching device closed due to mechanical interlock.

8. Reconnect J7 plug back onto the ATC-600/800 controller.
9. Open the Source 1 bypass switching device. The Source 1 bypass BLUE light will no longer be illuminated.
10. The Source 2 switching device should now automatically close and Source 2 position energized RED LED will be illuminated.
11. Move the generator selector switch to the AUTO position.
12. The Source 2 switching device is now back in automatic operation.
13. Now re-program Preferred Source = Source 1 inside the ATC controller.
14. With Source 1 available as a preferred source, Source 2 switching device should now open automatically close and Source 1 switching device should close automatically. Source 2 position energized RED LED will no longer be illuminated and Source 1 position energized GREEN LED will be illuminated.

7.4 Manual Operation When in Bypass Mode

7.4.1 Source 1 Bypass to Source 2 Bypass

When the transfer switch is set to Source 1 bypass, it can be transferred to Source 2 bypass by the following sequence:

1. Move the generator selector switch to the RUN position.
2. Open the Source 1 bypass switching device. The Source 1 bypass RED light will no longer be illuminated.
3. Close the Source 2 bypass switching device manually and the Source 2 bypass RED light will illuminate.

7.4.2 Source 2 Bypass to Source 1 Bypass

When the transfer switch is set to Source 2 bypass, it can be transferred to the Source 1 bypass switching device by the following sequence:

1. Open the Source 2 bypass switching device and the Source 2 bypass RED light will no longer be illuminated.
2. Close the Source 1 bypass switching device manually and the Source 1 bypass RED light will illuminate.
3. Move the generator selector switch to the OFF or AUTO position.

Section 8: Testing and Problem Solving

8.1 Testing

After transfer switch equipment is initially installed or during planned outages, the installation should be tested to ensure that all equipment operates properly. This attention to detail will help to avoid unexpected malfunctions. Mechanical and/or electrical tests should be performed.

The frequency of subsequent testing should be based on recommendations of the generator set manufacturer. Use the test pushbutton to check the electrical operation of the switch. **IF A TEST SWITCH IS PROVIDED, ALWAYS RETURN THE SWITCH TO THE AUTO POSITION AFTER THE TEST IS COMPLETE.**

WARNING

HIGH VOLTAGES ASSOCIATED WITH OPERATIONAL TRANSFER SWITCH EQUIPMENT PRESENT A SHOCK HAZARD THAT CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. USE EXTREME CAUTION TO AVOID TOUCHING ELECTRICAL CONNECTIONS WHENEVER INSPECTING OR TESTING THE EQUIPMENT.

IN ADDITION, IMPROPER OPERATION OF THE GENERATOR SET PRESENTS A HAZARD THAT CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. OBSERVE ALL SAFETY PRECAUTIONS IN YOUR GENERATOR SET OPERATIONS AND INSTALLATION MANUALS

WARNING

FOR MECHANICAL OPERATIONS, REFER TO SECTION 5. IN THIS INSTRUCTION BOOK. REFER TO THE APPLICABLE LOGIC INSTRUCTION BOOK FOR ELECTRICAL TESTING

8.2 Problem Solving

WARNING

HAZARDOUS VOLTAGES IN AND AROUND TRANSFER SWITCH EQUIPMENT DURING THE PROBLEM SOLVING PROCESS CAN CAUSE PERSONAL INJURY AND/OR DEATH. AVOID CONTACT WITH ANY VOLTAGE SOURCE WHILE PROBLEM SOLVING.

WARNING

ONLY PROPERLY TRAINED PERSONNEL FAMILIAR WITH THE TRANSFER SWITCH EQUIPMENT AND ITS ASSOCIATED EQUIPMENT SHOULD BE PERMITTED TO PERFORM THE PROBLEM SOLVING FUNCTION. IF AN INDIVIDUAL DOES NOT FEEL QUALIFIED TO PERFORM THE PROBLEM SOLVING FUNCTION, THE INDIVIDUAL SHOULD NOT ATTEMPT TO PERFORM ANY OF THESE PROCEDURES.

A basic problem solving effort is the first step to take prior to calling for assistance. Frequently, the effort will successfully address most problems encountered. Most problem solving procedures are outlined in the instruction manual unique to the type of logic being used. In addition, several problem solving procedures are presented here which are specific to the type of switches or switching devices used in this equipment.

If a problem persists after having completed the problem solving procedure, contact an Eaton representative for further assistance. When calling for assistance, the following is the MINIMUM information required to properly address the need:

1. General Order Number (GO #) of the transfer switch, plus related Item Number;
2. Catalog and/or Style Number of the transfer switch;
3. Actual location of transfer switch (type of facility, address, etc.);
4. Company name;
5. Name and position of individual representing company;
6. Basic description of situation as it exists; and
7. Any results of problem solving steps taken and/or readings taken.

WARNING

THIS CLOSED TRANSITION PRODUCT CONTAINS A SPECIAL CONTACT ARRANGEMENT (OVERLAPPING CONTACTS). MISUSE CAN RESULT IN DEATH, SEVERE PERSONAL INJURY, AND/OR PROPERTY DAMAGE.

8.2.1 Transfer Switch Appears Inoperative

Step 1: Verify that all plugs and sockets are properly interconnected.

Step 2: Verify that the correct system voltage appears at Source 1 switch. Measure the voltage at the breaker lugs.

Step 3: Verify that the voltage selection plug is in the proper position to match the system voltage.

Step 4: Look for any obviously burned components. Determine the cause and rectify, if possible. Replace any defective components after the cause is determined.

Step 5: For **closed transition,** refer to Figure 25 for manual operating instructions. Verify whether or not the system voltage now appears on the load terminals.

If YES: Check the logic for problems in the respective logic instruction book.

If NO: Check all power connections and the switching mechanism.

Step 5: For **open transition,** press the Push-To-Close button on the Source 1 switching device. Verify whether or not the system voltage now appears on the load terminals.

If YES: Check the logic for problems in the respective logic instruction book.

If NO: Check all power connections and the switching mechanism.

8.2.2 Transfer Switch Will Not Automatically Transfer to Source 1

Step 1: Check for the proper line voltage on N1, N2, and N3.

Step 2: Is the Source 1 switching device charged?

If YES: Continue with the other procedures.

If NO: Go through section 8.2.4 first before continuing.

Step 3: Is the Source 2 switch OPEN?

If YES: Proceed to Step 5.

If NO: Proceed to Step 4.

Step 4: Measure the voltage between terminals S2B1O and S2B11 on the Source 2 switching device (shunt trip). Does the voltage measure 120 Vac ±10 volts? Record the reading.

If YES: Check the shunt trip in the Source 2 switch.

If NO: Check the wiring to S2B10 and S2B11.

Step 5: Measure the voltage between terminals S1B12 and S1B13 on the Source 1 switching device (spring release coil). Does the voltage measure 120 Vac ± 10 volts? Record the reading.

If YES: Check the spring release coil in Source 1 switching device.

If NO: Check the wiring to S1B12 and S1B13.

8.2.3 Transfer Switch Will Not Automatically Transfer to Source 2

Step 1: Check for the proper line voltage on E1, E2, and E3.

Step 2: Is the Source 2 switching device charged?

If YES: Continue with the other procedures.

If NO: Go through Section 8.2.4 first before continuing.

Step 3: Is the Source 1 switching device OPEN?

If YES: Proceed to Step 5.

If NO: Proceed to Step 4.

Step 4: Measure the voltage between terminals S1B10 and S1B11 on the Source 1 switching device (shunt trip). Does the voltage measure 120 Vac ± 10 volts? Record the reading.

If YES: Check the shunt trip in the Source 1 switch.

If NO: Check the wiring to S1B10 and S1B11.

Step 5: Measure the voltage between terminals S2B12 and S2B13 on the Source 2 switching device (spring release coil). Does the voltage measure 120 Vac$\underline{+}$ 10 volts? Record the reading.

If YES: Check the spring release coil in Source 2 switch.

If NO: Check the wiring to S2B12 and S2B13.

8.2.4 Transfer Switch Will Not Automatically Recharge Switches

Step 1: Measure the voltage between terminals B15 and B14 on the switching device that does not automatically recharge. Does the voltage read 120 Vac $\underline{+}$ 10 volts? Record the reading.

If YES: Check the electrical operator inside the switching device.

If NO: Verify the wiring to B15 and B14.

Step 2: If problem persists, contact Eaton.

Section 9: Maintenance

9.1 Introduction

WARNING

HIGH VOLTAGES ARE PRESENT IN AND AROUND TRANSFER SWITCH EQUIPMENT. BEFORE INSPECTING OR MAINTAINING THIS EQUIPMENT, DISCONNECT THE LINE POWER FROM THE EQUIPMENT BEING SERVICED BY OPENING AND LOCKING OUT, IF POSSIBLE, THE NEXT HIGHEST DISCONNECT DEVICE. FAILURE TO FOLLOW THIS PROCEDURE COULD CAUSE PERSONAL INJURY AND/OR DEATH.

WARNING

THE CLOSED TRANSITION PRODUCT CONTAINS A SPECIAL CONTACT ARRANGEMENT (OVERLAPPING CONTACTS). MISUSE CAN RESULT IN DEATH, SEVERE PERSONAL INJURY, AND/OR PROPERTY DAMAGE.

In general, transfer switch equipment is designed to be relatively maintenance free under normal usage. How-ever, because of the variability of application conditions and the importance placed on dependable operation by this type of equipment, inspection and maintenance checks should be made on a regularly scheduled basis. Since equipment maintenance will consist mainly of keeping the equipment clean, the frequency of maintenance will depend, to a large extent, on the cleanliness of the surroundings. If a significant amount of dust or foreign matter is present, a more frequent maintenance schedule should be followed.

It is suggested that visual inspections of the equipment be made on a regular basis, not just during regularly scheduled periods. Always be alert for an accumulation of dirt in and around the structure, loose parts and/or hardware, cracks and/or discoloration to insulation, and damaged or discolored components.

9.2 Maintenance Procedures

A suggested maintenance procedure to follow is outlined in Table 6.

Table 6. Periodic Maintenance Procedures.

	STEP	ACTION
a.	Make the transfer switch equipment safe for inspection and/or maintenance.	Disconnect the line power from the equipment being serviced by opening next highest disconnect device. Make certain that any accessory control power is switched off and the logic plugs are disconnected
b.	Inspect the structure area for any safety hazards or potential maintenance problems.	Inspect the area, especially where switching devices are installed, for any safety hazards, including personnel safety and fire hazards. Exposure to certain chemical vapors can cause deterioration of electrical connections. Inspect for accumulated dirt, loose hardware, or physical damage. Examine the primary insulation for evidence of cracking or overheating. Overheating will show as discoloration, melting or blistering of conductor insulation, or as pitting or melting of conductor surfaces due to arcing. Inspect the secondary control connections for damage and the control wiring for insulation integrity
c.	Inspect the switching devices for dust, dirt, soot, grease, moisture, or corrosion.	Remove the dust, dirt, soot, grease, moisture, and corrosion contamination from the surface of the switching device using a dry, soft lint-free cloth, dry, soft bristle brush, and vacuum cleaner. Do not blow debris into the switching device or nearby breaker structure. If contamination is found, look for the source and fix the problem.
d.	Check for material integrity, uneven wear, discoloration, or loose hardware.	Severe material cracking will require replacement and loose hardware will need to be tightened.
e.	Check all terminals and connectors for looseness or signs of overheating.	Overheating will show as discoloration, melting, or blistering of conductor insulation. Connections that do not have signs of looseness or overheating should not be disturbed.
f.	Contact Inspection Procedure	Loosen the arc chute retaining screws on the top rear of the breaker, then slide the molded cover toward the back of the breaker. The arc chute can then be lifted out of the molded case and the contacts can be inspected. Contact Eaton Care (1-877-ETN-CARE, Option-2, Option-4, Option-3) if the contacts have excessive wear. Reinstall the arc chute, slide the cover forward and tighten the retaining screw.
g.	Exercise the switching devices if they are not often exercised while in operation. This will permit a wiping action by the contacts.	If a switching device is used for frequent switching during normal operation, this step can be disregarded.
h.	Inspect NEMA 3R filters for blockage or contamination.	For NEMA 3R enclosed transfer switches with venting, check that the air filters are clean and uncompromised. Replace the filters as necessary.
i.	Return the transfer switch equipment to service.	Make certain that all barriers are in place and the doors are closed. Reapply the Source 1 and Source 2 power.

9.3 Cover Removal and Replacement

Many of the maintenance procedures outlined in Table 6 require the removal and replacement of side and rear covers. For all NEMA 1 and NEMA 3R enclosed transfer switches, see Section 9.3.1 for cover removal and replacement instructions.

9.3.1 Cover Removal and Replacement

A 3/8″ wrench or socket and ratchet is required to perform this procedure.

Cover Removal

Step 1: Locate the bolts used to secure the cover to the frame and remove them with the 3/8″ wrench. Remove the top screws last while holding the cover in place (Figure 40).

Step 2: Allow the top of the cover to slowly tilt away from the enclosure frame (Figure 41).

Step 3: Move your hands around to the sides and lift the cover free (Figure 42).

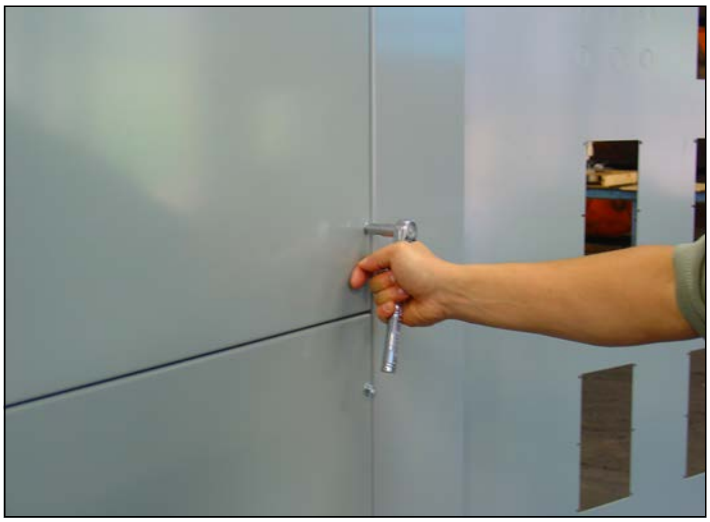


Figure 40. Removing the Bolts.

Figure 41.Tilting the Cover Away from the Frame.

Figure 42. Lifting the Cover Free.

Section 10: Renewal Parts Guide

10.1 General

Refer to Figure 43 through 45 for assistance with selecting and ordering selected ATS renewal parts.

Example: To order Logic Harness for an ATVIMGB33200XRU transfer switch, order Catalog Number 68C8190G01 as shown in Figure 43.

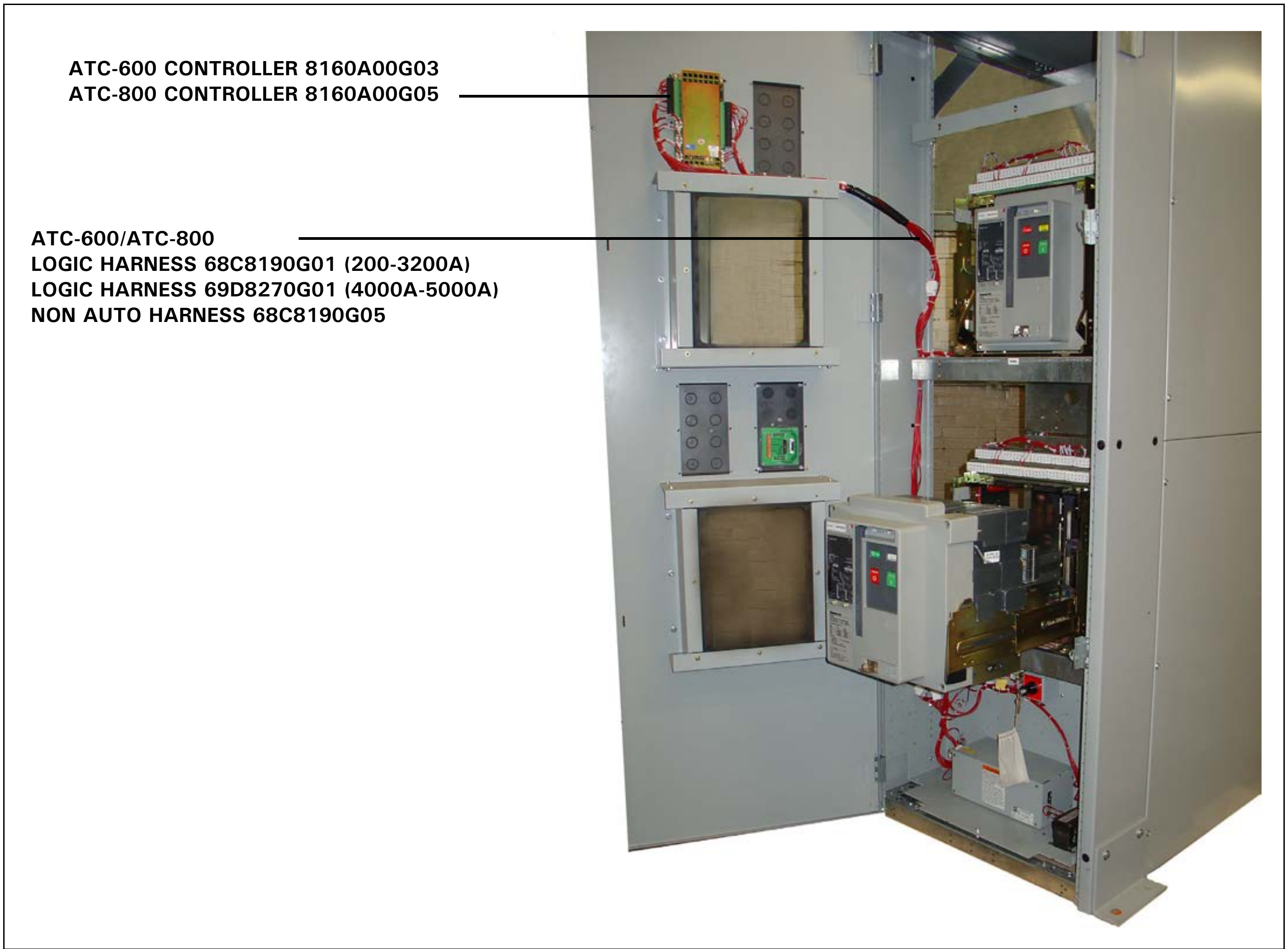


Figure 43.

Note: The ATC600 or ATC800 controller replacement kit is ordered by the table below. The replacement kit style number does include the 2D7850G50 or 2D7850G60 printed circuit board.

SWITCH TYPE	CONTROLLER	REPLACEMENT STYLE
Magnum Based Design		
Magnum Open Transition	ATC-600	8160A00G03
Magnum Closed Transition	ATC-800	8160A00G05

Feature List

The replacement controller needs to match the originally supplied features. The easiest way to supply this list is to provide the **original order number** on the original shipment. The ATS product line has a data base that is maintained with the original feature list. The general order number or GO # is on the nameplate of the ATS located on the inside of the door. In addition it is very helpful to also supply the **15 digit catalog number** of the ATS. This number is also available on the nameplate of the ATS.

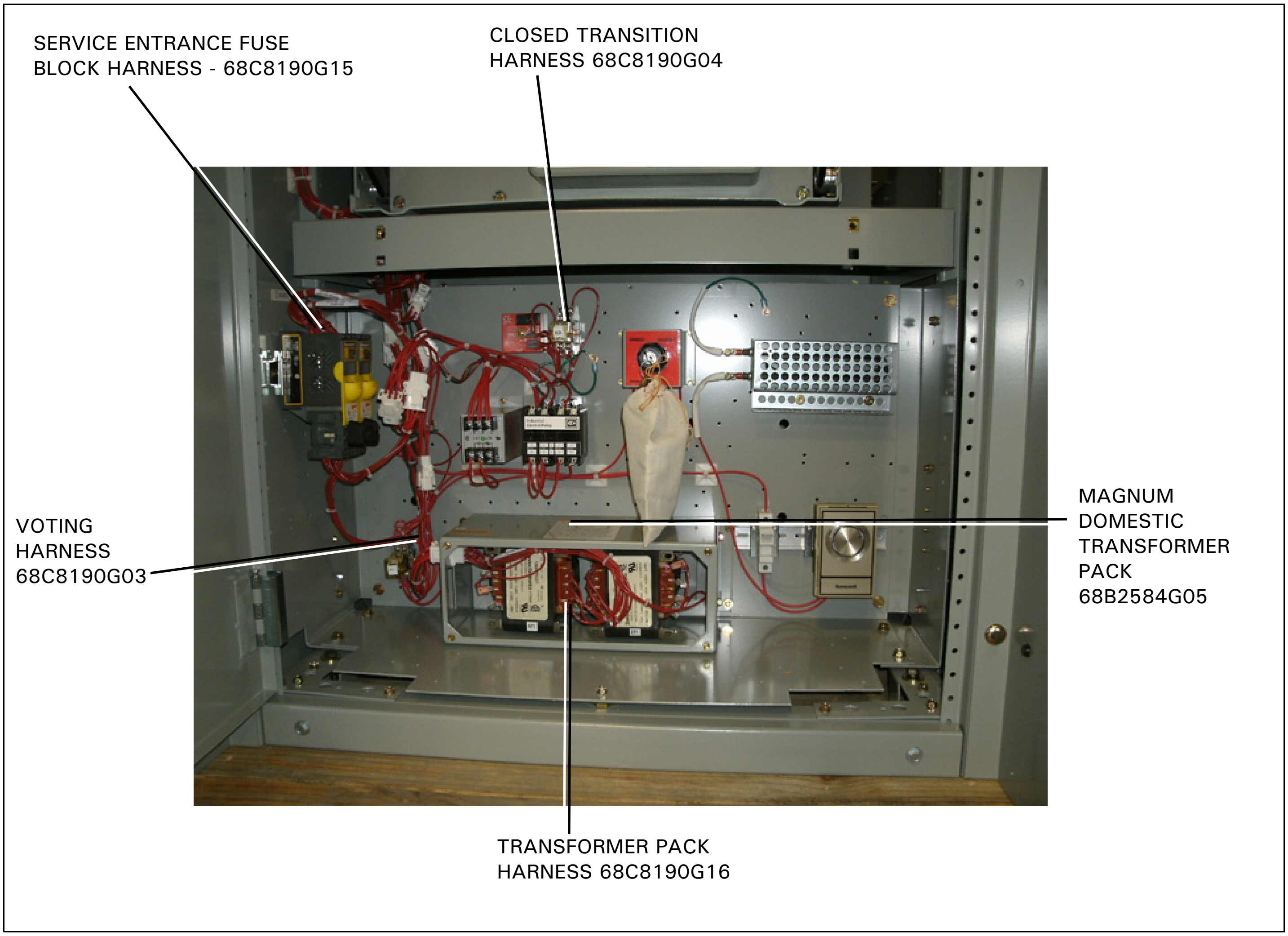

SERVICE ENTRANCE FUSE
BLOCK HARNESS - 68C8190G15
CLOSED TRANSITION
HARNESS 68C8190G04
VOTING
HARNESS
68C8190G03
MAGNUM
DOMESTIC
TRANSFORMER
PACK
68B2584G05
TRANSFORMER PACK
HARNESS 68C8190G16

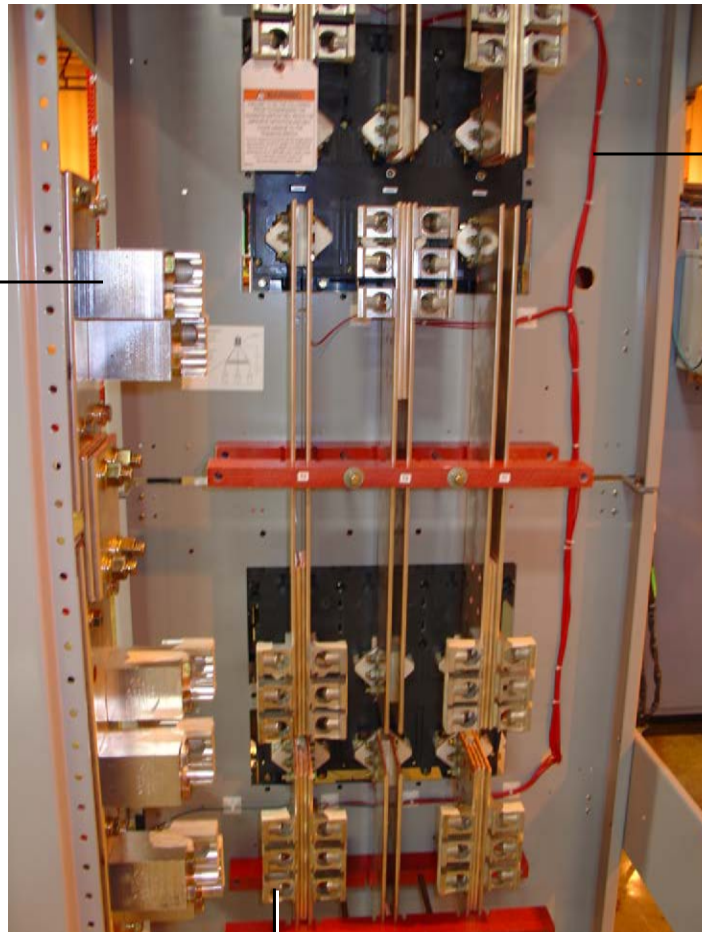
Figure 44.

SENSING HARNESS
68C8190G02

4/0 to 500 KCMIL
NEUTRAL
TERMINAL (AL)
D2247A22T

OR

500 to 750 KCMIL
NEUTRAL (AL)
D2246A22T



3/0 to 750 KCMIL LUGS (AL)
5081A01H01

Figure 45.

Notes:

Notes:

Notes

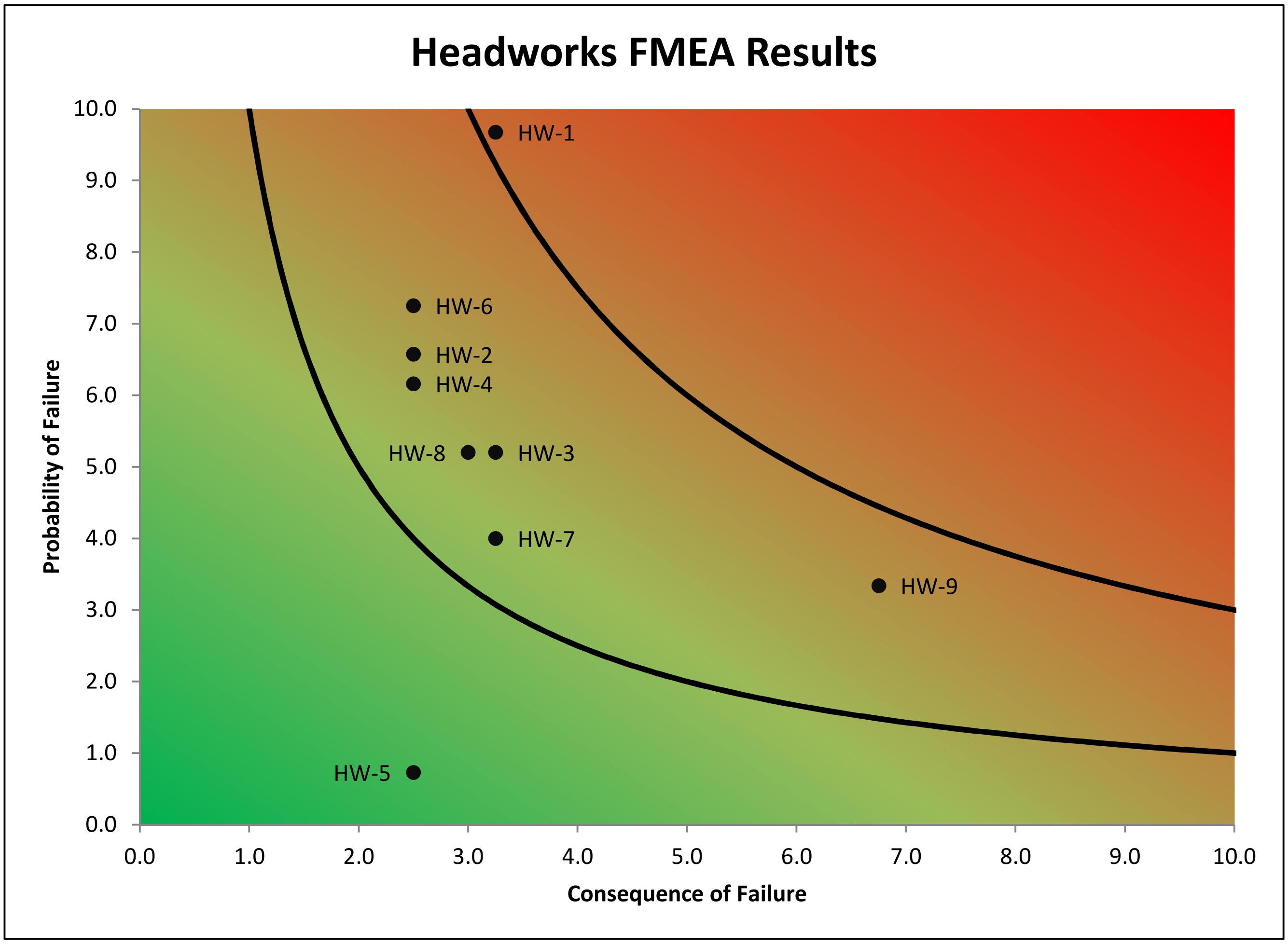
Eaton
Electrical Sector
1000 Eaton Boulevard
Cleveland, Ohio 44122
United States
877-ETN CARE (877-386-2273)
Eaton.com

Powering Business Worldwide

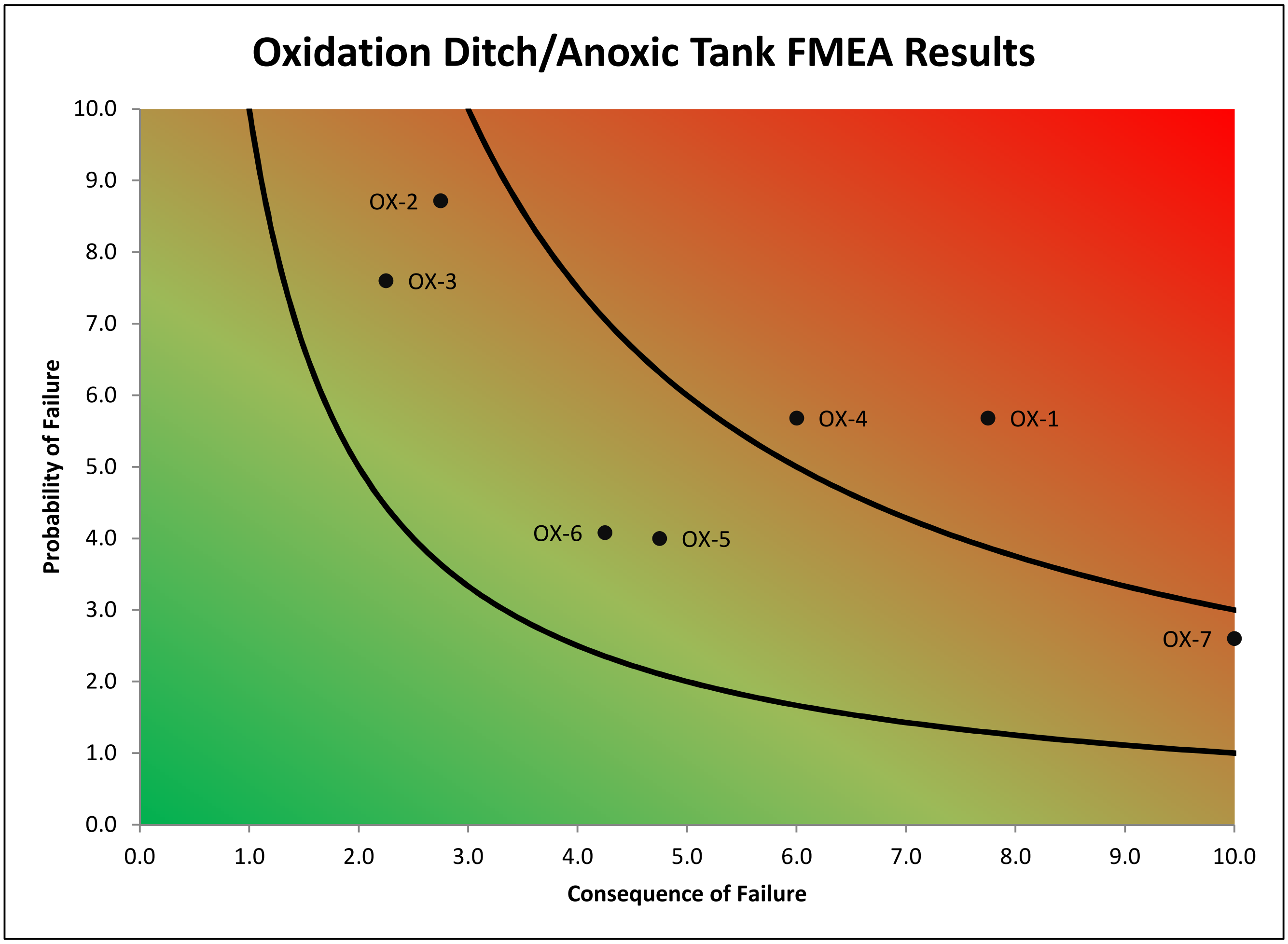
Printed in USA
Publication No. IB01602011E / TBG00256
March 2014

ATTACHMENT 4

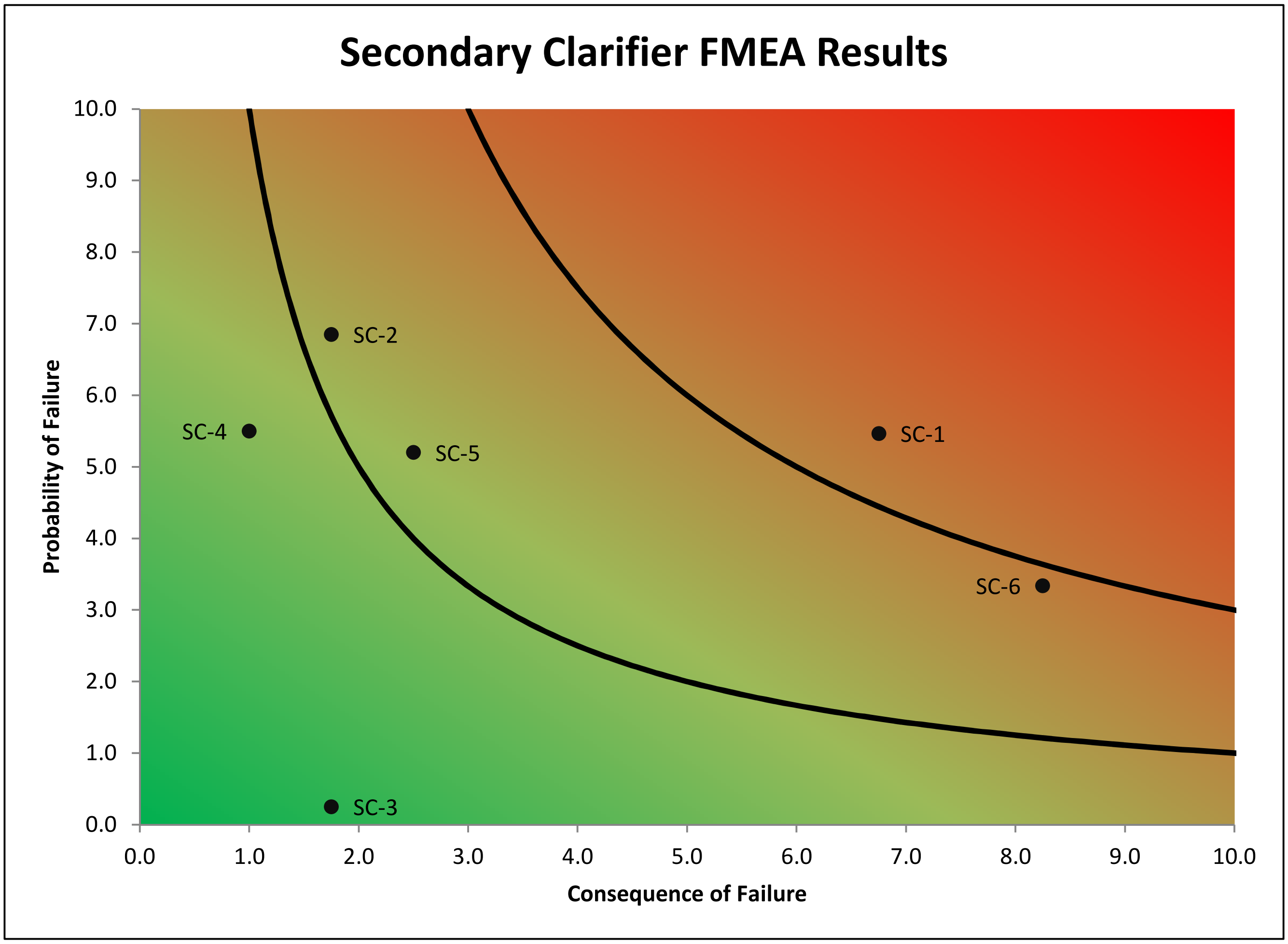
4S Ranch WRF FMEA Results and Plotted Criticality Scores



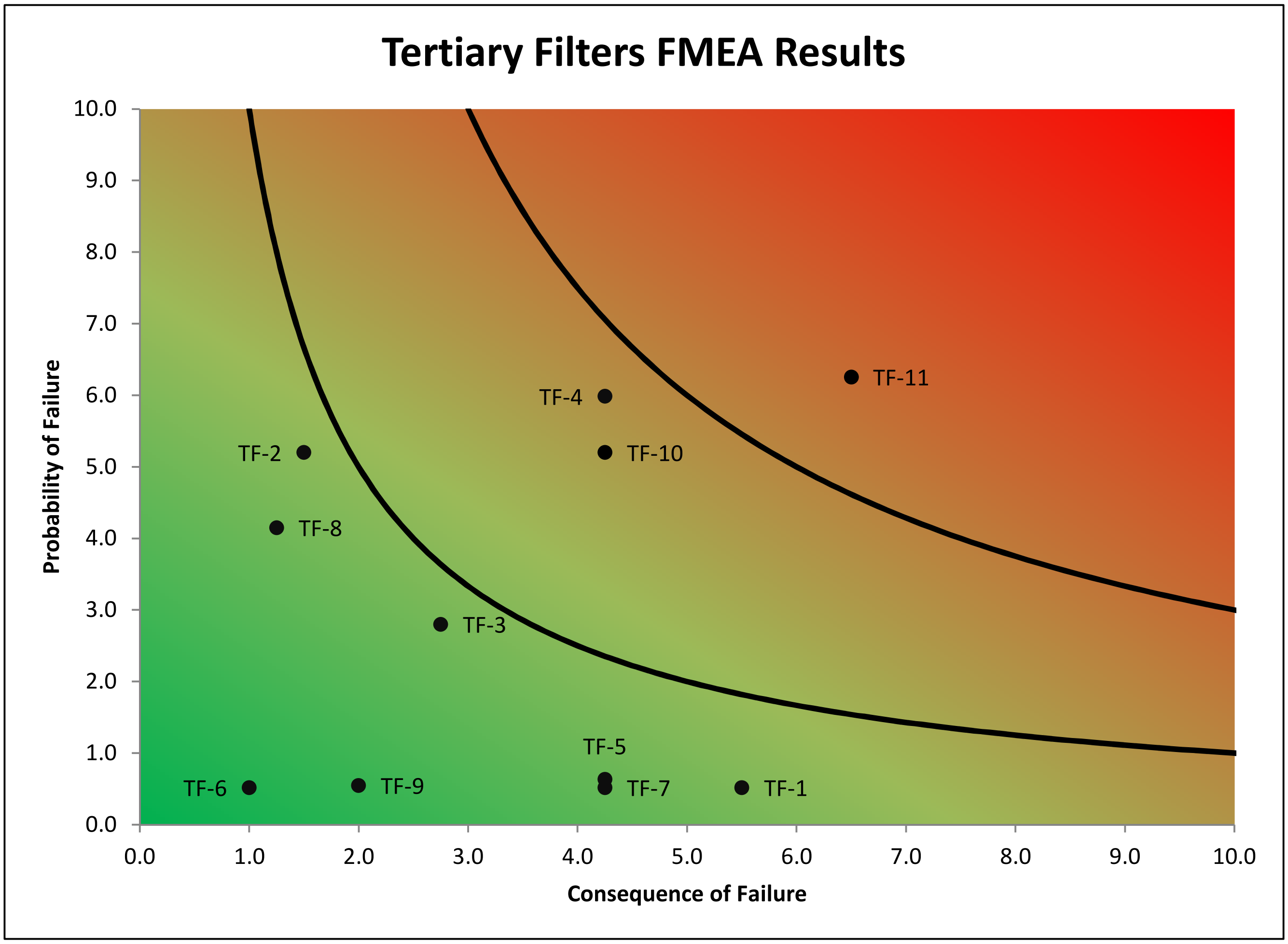
ID	Asset	CoF	PoF	Risk	Comments
HW-1	Bandscreen & Wash/Press	3.3	9.7	31.4	Consider redundant screen: economic evaluation required for potential capital expenditure
HW-2	Level Switch	2.5	6.6	16.4	Add redundant level switch to mitigate PoF
HW-3	Screen Control Panel	3.3	5.2	16.9	
HW-4	Grit Chamber	2.5	6.2	15.4	Annual cleaning to mitigate PoF
HW-5	Grit Pumps	2.5	0.7	1.8	Redundant unit mitigates PoF
HW-6	Grit Classifier	2.5	7.3	18.1	No redundancy
HW-7	Parshall Flume	3.3	4.0	13.0	
HW-8	Grit Control Panel	3.0	5.2	15.6	
HW-9	Structure	6.8	3.3	22.5	Consider by-pass pumping emergency response plan



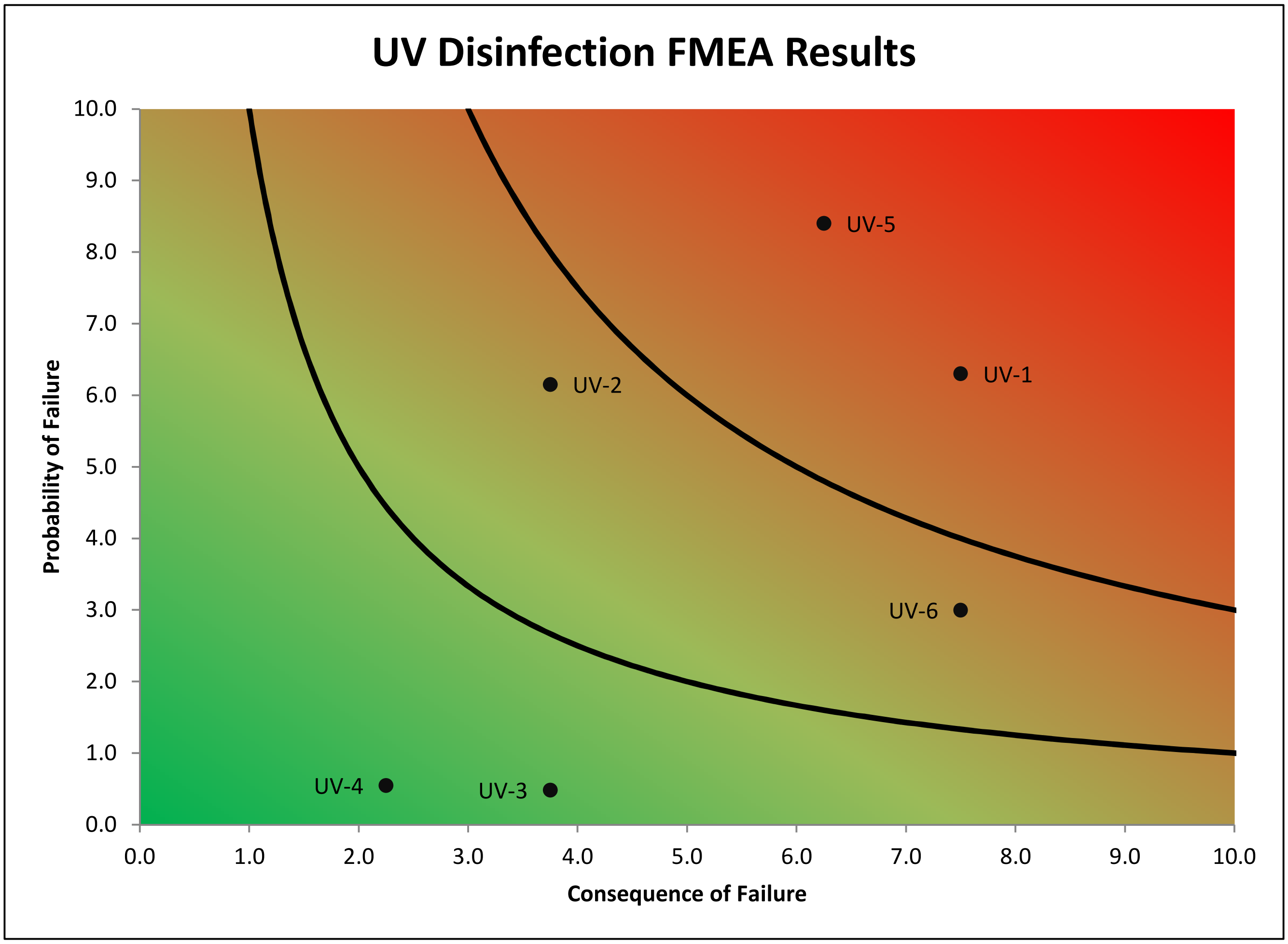
ID	Asset	CoF	PoF	Risk	Comments
OX-1	Oxidation Ditch Aerators	7.8	5.7	44.0	Consider alternative aeration technology
OX-2	DO Probes	2.8	8.7	24.0	Add redundant DO Probes to mitigate PoF
OX-3	Mechanical Weir Gate	2.3	7.6	17.1	Poor Condition, no redundancy
OX-4	Anoxic Tank Mixer	6.0	5.7	34.1	Consider alternative mixing technology
OX-5	Control Panel	4.8	4.0	19.0	
OX-6	Splitter Box	4.3	4.1	17.3	Consider measuring surface pH
OX-7	Structure	10.0	2.6	26.0	Consider emergency response plan



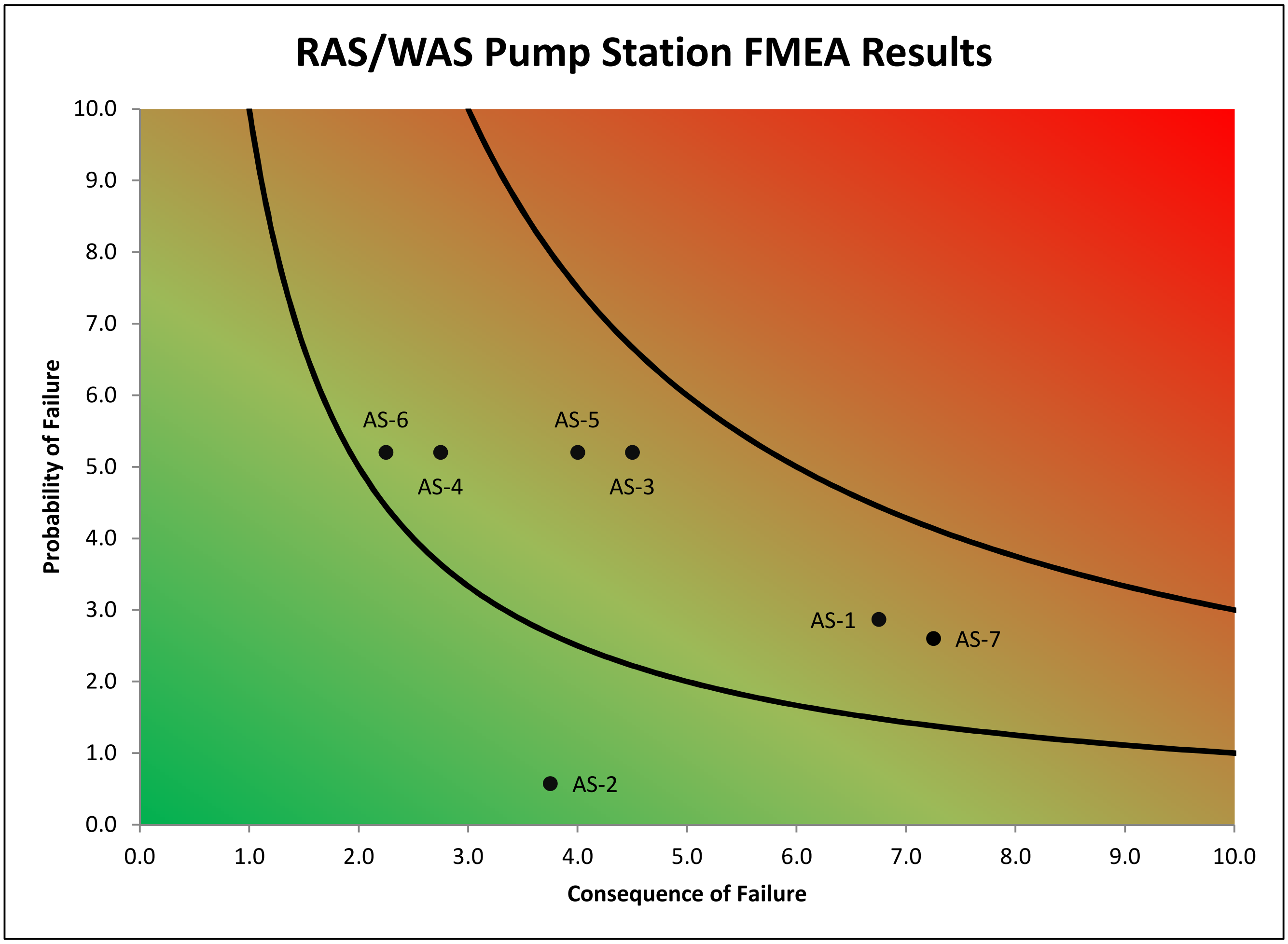
ID	Asset	CoF	PoF	Risk	Comments
SC-1	Skimmer/Scraper/Sludge Rake/Drive	6.8	5.5	36.9	Clarifier arm and anodes were recently replaced.
SC-2	Launder Screen	1.8	6.9	12.0	
SC-3	Scum Pumps	1.8	0.3	0.4	Scum pumps replaced 2 years ago.
SC-4	Turbidimeter	1.0	5.5	5.5	
SC-5	Control Panel	2.5	5.2	13.0	
SC-6	Structure	8.3	3.3	27.6	Consider a clarifier rehab program.



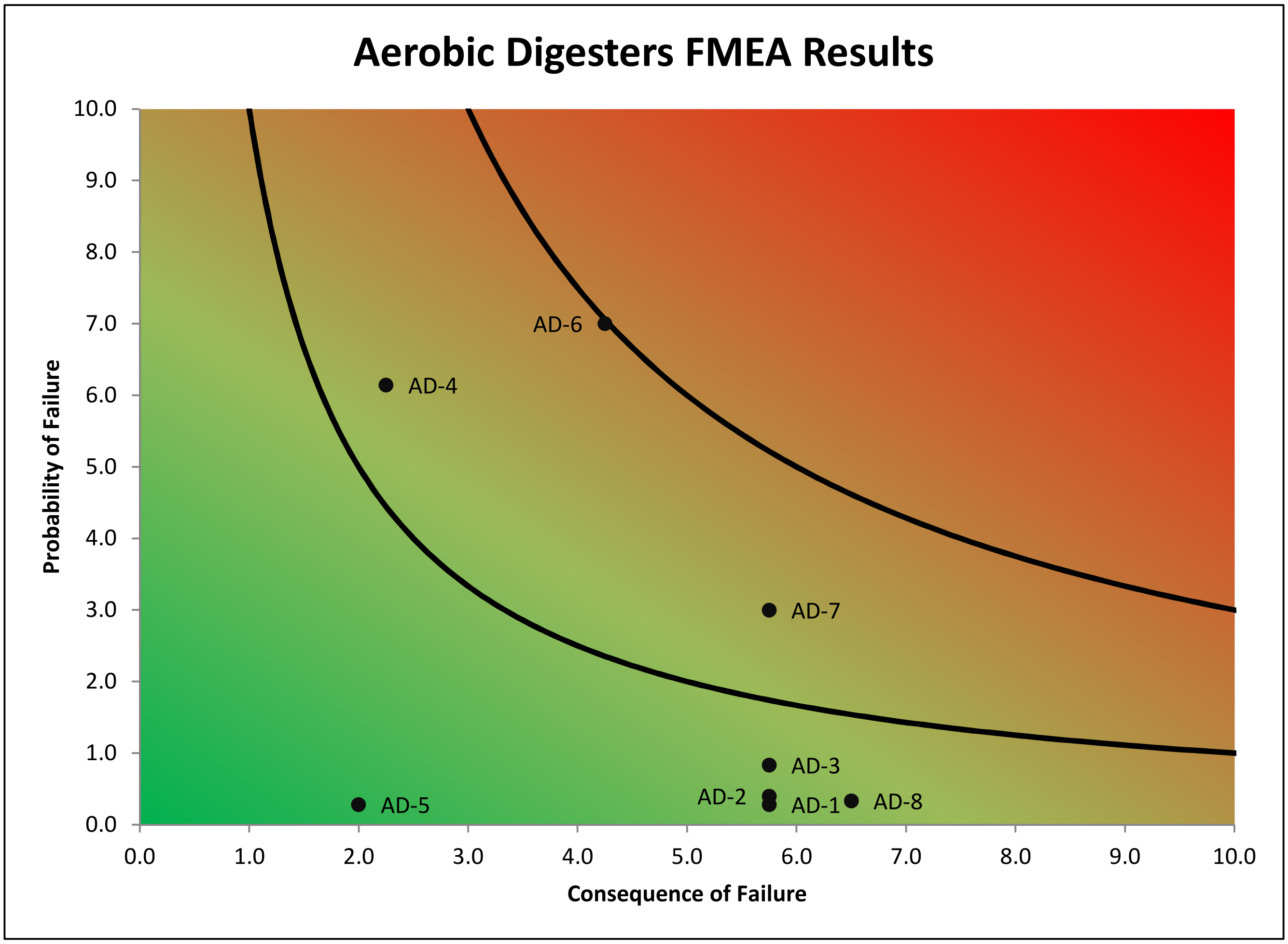
ID	Asset	CoF	PoF	Risk	Comments
TF-1	Filter Feed Pump/Motor	5.5	0.5	2.9	
TF-2	Secondary Effluent Flow Meter	1.5	5.2	7.8	
TF-3	Filter Feed VFD	2.8	2.8	7.7	
TF-4	Filters (incl. Mechanical Systems)	4.3	6.0	25.4	33% redundancy
TF-5	Backwash Pumps	4.3	0.6	2.7	Backwash pumps observed to be in poor condition. 100% redundancy.
TF-6	Mudwell Pumps	1.0	0.5	0.5	
TF-7	Air Scour Blowers	4.3	0.5	2.2	
TF-8	Flash Mix Pump	1.3	4.2	5.2	
TF-9	Turbidimeter	2.0	0.6	1.1	
TF-10	Control Panel	4.3	5.2	22.1	



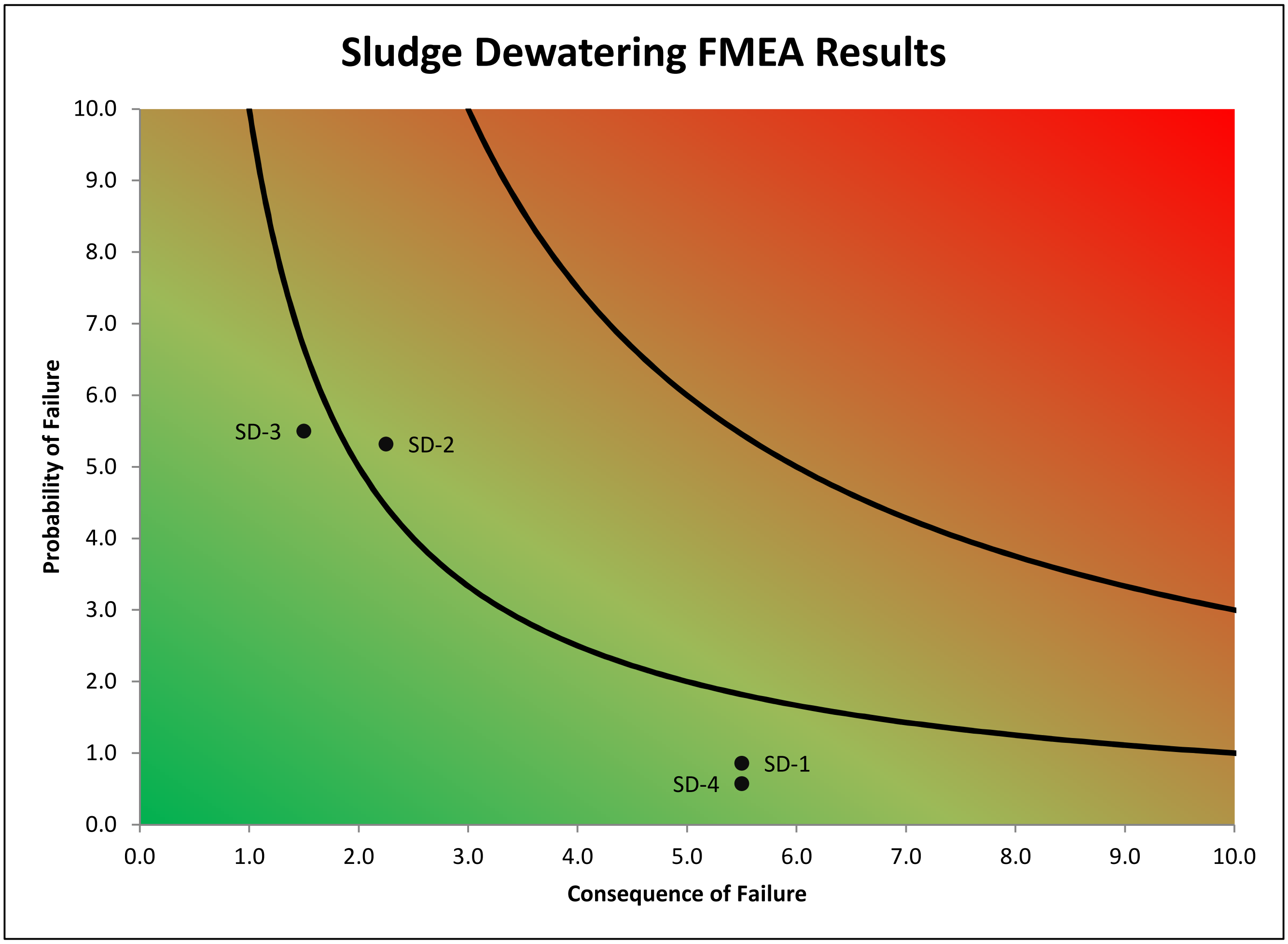
ID	Asset	CoF	PoF	Risk	Comments
UV-1	UV Banks	7.5	6.3	47.3	UV system is going obsolete. System must be upgraded or new system must be installed.
UV-2	UV bulbs/sleeves/sensors (UVT/UVI)	3.8	6.2	23.1	
UV-3	Level Switch	3.8	0.5	1.8	
UV-4	Turbidimeter	2.3	0.6	1.2	
UV-5	Control Panel	6.3	8.4	52.5	UV control system is going obsoltete. Controls must be upgraded or new system must be installed.
UV-6	Structure	7.5	3.0	22.5	Structure is older, but in good condition.



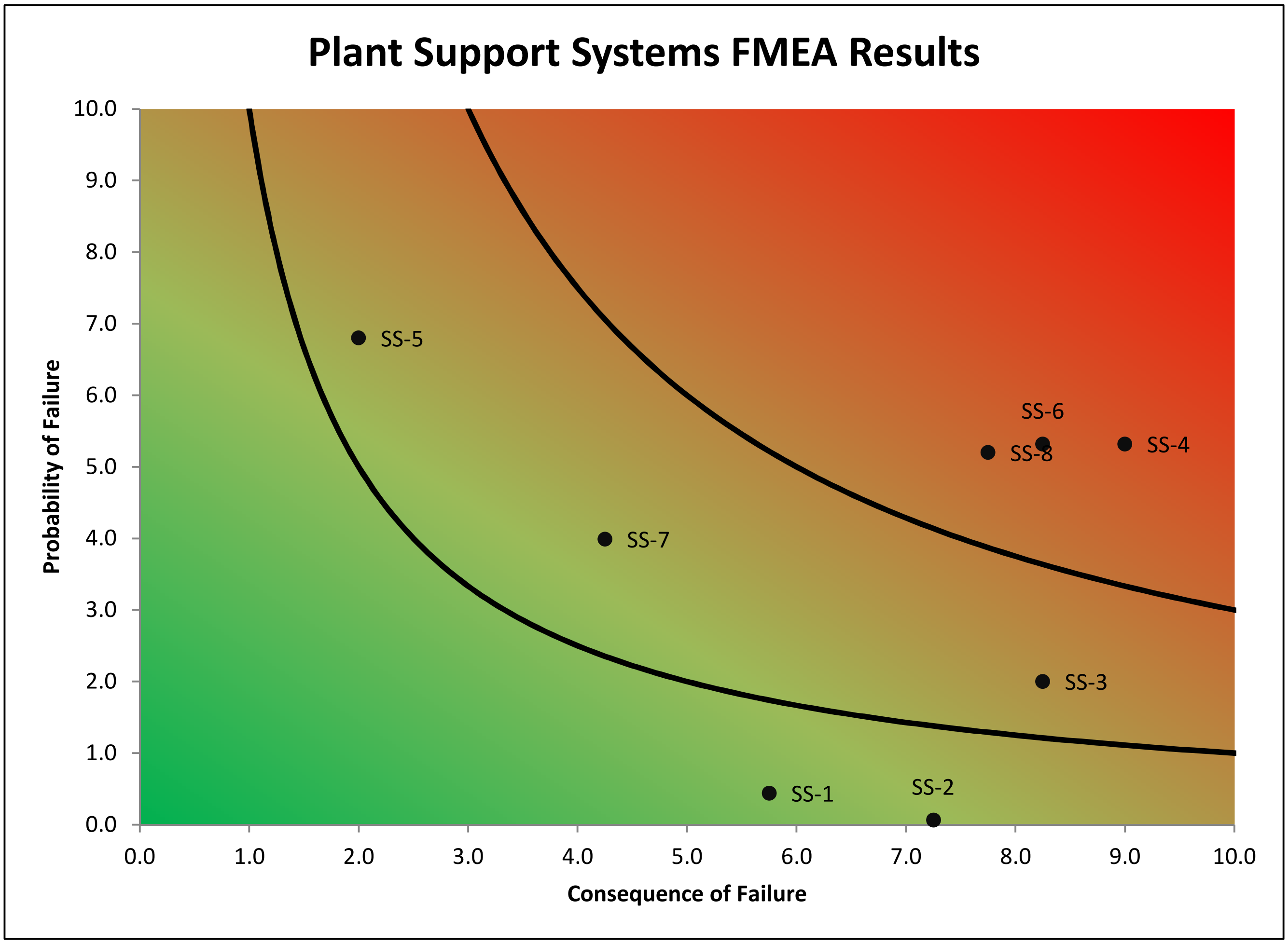
ID	Asset	CoF	PoF	Risk	Comments
AS-1	RAS Pumps/Motors	6.8	2.9	19.4	50% redundancy with 2 clarifiers running.
AS-2	WAS Pumps/Motors	3.8	0.6	2.2	100% redundancy
AS-3	RAS Control Panel	4.5	5.2	23.4	
AS-4	WAS Control Panel	2.8	5.2	14.3	
AS-5	RAS Flow Meter	4.0	5.2	20.8	Consider SCADA algorithm to improve solids return rate to match solids input rate.
AS-6	WAS Flow Meter	2.3	5.2	11.7	Consider SCADA algorithm to improve solids wasting rate to match solids input rate.
AS-7	Structure	7.3	2.6	18.9	



ID	Asset	CoF	PoF	Risk	Comments
AD-1	Aerobic Digesters	5.8	0.3	1.6	Full redundant digester.
AD-2	Air Diffusers	5.8	0.4	2.3	
AD-3	Blowers/Motor/Belt Drive	5.8	0.8	4.8	Consider housing blowers to reduce noise. Blowers have had history of failure.
AD-4	DO Probe	2.3	6.1	13.8	Consider adding redundant DO Probe.
AD-5	Digested Sludge Pumps/VFDs	2.0	0.3	0.6	
AD-6	Control Panel	4.3	7.0	29.8	Consider replacing control panel in next 5 years.
AD-7	Biological Process	5.8	3.0	17.3	Consider facultative digestion as alternative.
AD-8	Structure	6.5	0.3	2.2	



ID	Asset	CoF	PoF	Risk	Comments
SD-1	Belt Presses (incl. Belts, Rollers)	5.5	0.9	4.7	Belts replaced 1 to 2 times per year, new roller coming soon
SD-2	Conveyor	2.3	5.3	12.0	
SD-3	Standby Generator	1.5	5.5	8.3	
SD-4	TWAS Pumps & VFD	5.5	0.6	3.2	



ID	Asset	CoF	PoF	Risk	Comments
SS-1	Non-Potable Water Pumps/Motors	5.8	0.4	2.5	Only used if Thelma Miller Reservoir supply system fails.
SS-2	SCADA	7.3	0.1	0.5	New SCADA system and redundant server mitigate probability of failure.
SS-3	Backup Power (Emergency Generator)	8.3	2.0	16.5	District maintains and operates generator on regular basis.
SS-4	Switchboards, Breakers, and Feeders	9.0	5.3	47.9	Main Breakers have not been NETA tested since original construction.
SS-5	Odor Control Scrubber	2.0	6.8	13.6	Scrubber failure response time should be less than 24 hours, no odor issues occur during maintenance shut-downs.
SS-6	Motor Control Centers (MCCs)	8.3	5.3	43.9	All gear in undersized Electrical Room. No redundancy. MCC failure would be catastrophic.
SS-7	Chemical Handling	4.3	4.0	17.0	Redundant chemical feed pumps.
SS-8	PLC's and Communications	7.8	5.2	40.3	Existing PLC's will be obsolete within 10 years.

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ATTACHMENT 5

Sewer Pump Station FMEA Results and Calculated Criticality Scores

Avenida Apice Sewer Pump Station Existing Conditions							
Failure Modes	**Mechanical/ pump failure**	**Power failure (primary/utility)**	**Electrical Gear failure**	**Piping/ Valve failure**	**Forcemain failure/break**	**Instrumentation Failure**	**Control Failure**
CoF	7	7	7	7	7	7	7
Assets	Pumps & Motors	Utility Power	Switchgear, MCCs, VFDs	Mechanical Piping, Valves	Forcemain	Level Control/ Monitoring Instrumentation	PLC/SCADA
Expected Useful Life	20	N/A	20	25	50	15	15
Age	7	N/A	7	7	7	7	7
Condition	0.9	N/A	0.9	0.9	0.9	0.9	0.9
Unmitigated PoF	4.15	10	4.15	3.52	2.26	5.2	5.2
Unmitigated Criticality	**29**	**70**	**29**	**25**	**16**	**36**	**36**
Mitigation Measures	**Equivalent Redundancy Factors**						
VFD bypass starters/contactors							
Pump redundancy	0.9						
Emergency storage	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Backup Generator		0.9					
Bypass pumping							
Emergency Response Plan							
Level control redundancy						0.9	
Parallel Forcemain							
Protocol for monitoring electrical gear							
shelf-spare pump & motor							
FMEA Results							
Mitigated PoF	0.25	0.60	2.49	2.11	1.36	0.31	3.12
Mitigated Criticality	**1.7**	**4.2**	**17.4**	**14.8**	**9.5**	**2.2**	**21.8**
Recommendations for Risk Mitigation							
Mitigation Measures	**Equivalent Redundancy Factors**						
VFD bypass starters/contactors							
Pump redundancy	0.9						
Emergency storage	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Backup Generator		0.9					
Bypass pumping	***0.9***	***0.9***	***0.9***	***0.9***		***0.9***	***0.9***
Emergency Response Plan	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***
Level control redundancy						0.9	
Parallel Forcemain							
Protocol for monitoring electrical gear							
shelf-spare pump & motor							
FMEA Results							
Mitigated PoF	0.02	0.06	0.24	0.20	1.29	0.03	0.30
Mitigated Criticality	**0.2**	**0.4**	**1.7**	**1.4**	**9.0**	**0.2**	**2.1**

Cerro Del Sol (#1 & #2) Sewer Pump Station Existing Conditions							
Failure Modes	**Mechanical/ pump failure**	**Power failure (primary/utility)**	**Electrical Gear failure**	**Piping/ Valve failure**	**Forcemain failure/break**	**Instrumentation Failure**	**Control Failure**
CoF	7	7	7	7	7	7	7
Assets	Pumps & Motors	Utility Power	Switchgear, MCCs, VFDs	Mechanical Piping, Valves	Forcemain	Level Control/ Monitoring Instrumentation	PLC/SCADA
Expected Useful Life	20	N/A	20	25	50	15	15
Age	7	N/A	7	7	7	7	7
Condition	0.9	N/A	0.9	0.9	0.9	0.9	0.9
Unmitigated PoF	4.15	10	4.15	3.52	2.26	5.2	5.2
Unmitigated Criticality	**29**	**70**	**29**	**25**	**16**	**36**	**36**
Mitigation Measures	**Equivalent Redundancy Factors**						
VFD bypass starters/contactors							
Pump redundancy	0.9						
Emergency storage	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Backup Generator		0.9					
Bypass pumping							
Emergency Response Plan							
Level control redundancy						0.9	
Parallel Forcemain							
Protocol for monitoring electrical gear							
shelf-spare pump & motor							
FMEA Results							
Mitigated PoF	0.25	0.60	2.49	2.11	1.36	0.31	3.12
Mitigated Criticality	**1.7**	**4.2**	**17.4**	**14.8**	**9.5**	**2.2**	**21.8**
Recommendations for Risk Mitigation							
Mitigation Measures	**Equivalent Redundancy Factors**						
VFD bypass starters/contactors							
Pump redundancy	0.9						
Emergency storage	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Backup Generator		0.9					
Bypass pumping	***0.9***	***0.9***	***0.9***	***0.9***		***0.9***	***0.9***
Emergency Response Plan	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***
Level control redundancy						0.9	
Parallel Forcemain							
Protocol for monitoring electrical gear							
shelf-spare pump & motor							
FMEA Results							
Mitigated PoF	0.02	0.06	0.24	0.20	1.29	0.03	0.30
Mitigated Criticality	**0.2**	**0.4**	**1.7**	**1.4**	**9.0**	**0.2**	**2.1**

OMWD Failure Modes and Effects Analysis Results

Camino Sin Puente #1, #2, & #3 Sewer Pump Station Existing Conditions							
Failure Modes	**Mechanical/ pump failure**	**Power failure (primary/utility)**	**Electrical Gear failure**	**Piping/ Valve failure**	**Forcemain failure/break**	**Instrumentation Failure**	**Control Failure**
CoF	7	7	7	7	7	7	7
Assets	Pumps & Motors	Utility Power	Switchgear, MCCs, VFDs	Mechanical Piping, Valves	Forcemain	Level Control/ Monitoring Instrumentation	PLC/SCADA
Expected Useful Life	20	N/A	20	25	50	15	15
Age	11	N/A	11	11	11	11	11
Condition	0.9	N/A	0.9	0.9	0.9	0.9	0.9
Unmitigated PoF	5.95	10	5.95	4.96	2.98	7.6	7.6
Unmitigated Criticality	**42**	**70**	**42**	**35**	**21**	**53**	**53**
Mitigation Measures	**Equivalent Redundancy Factors**						
VFD bypass starters/contactors							
Pump redundancy	0.9						
Emergency storage	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Backup Generator		0.9					
Bypass pumping							
Emergency Response Plan							
Level control redundancy						0.9	
Parallel Forcemain							
Protocol for monitoring electrical gear							
shelf-spare pump & motor							
FMEA Results							
Mitigated PoF	0.42	0.70	4.17	3.47	2.09	0.53	5.32
Mitigated Criticality	**2.9**	**4.9**	**29.2**	**24.3**	**14.6**	**3.7**	**37.2**
Recommendations for Risk Mitigation							
Mitigation Measures	**Equivalent Redundancy Factors**						
VFD bypass starters/contactors							
Pump redundancy	0.9						
Emergency storage	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Backup Generator		0.9					
Bypass pumping	***0.9***	***0.9***	***0.9***	***0.9***		***0.9***	***0.9***
Emergency Response Plan	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***
Level control redundancy						0.9	
Parallel Forcemain							
Protocol for monitoring electrical gear							
shelf-spare pump & motor							
FMEA Results							
Mitigated PoF	0.04	0.07	0.40	0.33	1.98	0.05	0.51
Mitigated Criticality	**0.3**	**0.5**	**2.8**	**2.3**	**13.9**	**0.4**	**3.5**

Camino Sin Puente #4 Sewer Pump Station Existing Conditions							
Failure Modes	**Mechanical/ pump failure**	**Power failure (primary/utility)**	**Electrical Gear failure**	**Piping/ Valve failure**	**Forcemain failure/break**	**Instrumentation Failure**	**Control Failure**
CoF	7	7	7	7	7	7	7
Assets	Pumps & Motors	Utility Power	Switchgear, MCCs, VFDs	Mechanical Piping, Valves	Forcemain	Level Control/ Monitoring Instrumentation	PLC/SCADA
Expected Useful Life	20	N/A	20	25	50	15	15
Age	11	N/A	11	11	11	11	11
Condition	0.9	N/A	0.9	0.9	0.9	0.9	0.9
Unmitigated PoF	5.95	10	5.95	4.96	2.98	7.6	7.6
Unmitigated Criticality	**42**	**70**	**42**	**35**	**21**	**53**	**53**
Mitigation Measures	**Equivalent Redundancy Factors**						
VFD bypass starters/contactors							
Pump redundancy	0.9						
Emergency storage	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Backup Generator		0.9					
Bypass pumping							
Emergency Response Plan							
Level control redundancy						0.9	
Parallel Forcemain							
Protocol for monitoring electrical gear							
shelf-spare pump & motor							
FMEA Results							
Mitigated PoF	0.36	0.60	3.57	2.98	1.79	0.46	4.56
Mitigated Criticality	**2.5**	**4.2**	**25.0**	**20.8**	**12.5**	**3.2**	**31.9**
Recommendations for Risk Mitigation							
Mitigation Measures	**Equivalent Redundancy Factors**						
VFD bypass starters/contactors							
Pump redundancy	0.9						
Emergency storage	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Backup Generator		0.9					
Bypass pumping	***0.9***	***0.9***	***0.9***	***0.9***		***0.9***	***0.9***
Emergency Response Plan	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***
Level control redundancy						0.9	
Parallel Forcemain							
Protocol for monitoring electrical gear							
shelf-spare pump & motor							
FMEA Results							
Mitigated PoF	0.03	0.06	0.34	0.28	1.70	0.04	0.43
Mitigated Criticality	**0.2**	**0.4**	**2.4**	**2.0**	**11.9**	**0.3**	**3.0**

Del Dios Sewer Pump Station Existing Conditions							
Failure Modes	**Mechanical/ pump failure**	**Power failure (primary/utility)**	**Electrical Gear failure**	**Piping/ Valve failure**	**Forcemain failure/break**	**Instrumentation Failure**	**Control Failure**
CoF	8	8	8	8	8	8	8
Assets	Pumps & Motors	Utility Power	Switchgear, MCCs, VFDs	Mechanical Piping, Valves	Forcemain	Level Control/ Monitoring Instrumentation	PLC/SCADA
Expected Useful Life	20	N/A	20	25	50	15	15
Age	10	N/A	10	10	10	10	10
Condition	0.9	N/A	0.9	0.9	0.9	0.9	0.9
Unmitigated PoF	5.5	10	5.5	4.6	2.8	7	7
Unmitigated Criticality	**44**	**80**	**44**	**37**	**22**	**56**	**56**
Mitigation Measures	**Equivalent Redundancy Factors**						
VFD bypass starters/contactors							
Pump redundancy	0.9						
Emergency storage	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Backup Generator		0.9					
Bypass pumping							
Emergency Response Plan							
Level control redundancy						0.9	
Parallel Forcemain							
Protocol for monitoring electrical gear							
shelf-spare pump & motor							
FMEA Results							
Mitigated PoF	0.33	0.60	3.30	2.76	1.68	0.42	4.20
Mitigated Criticality	**2.6**	**4.8**	**26.4**	**22.1**	**13.4**	**3.4**	**33.6**
Recommendations for Risk Mitigation							
Mitigation Measures	**Equivalent Redundancy Factors**						
VFD bypass starters/contactors							
Pump redundancy	0.9						
Emergency storage	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Backup Generator		0.9					
Bypass pumping	***0.9***	***0.9***	***0.9***	***0.9***		***0.9***	***0.9***
Emergency Response Plan	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***
Level control redundancy						0.9	
Parallel Forcemain							
Protocol for monitoring electrical gear							
shelf-spare pump & motor							
FMEA Results							
Mitigated PoF	0.03	0.06	0.31	0.26	1.60	0.04	0.40
Mitigated Criticality	**0.3**	**0.5**	**2.5**	**2.1**	**12.8**	**0.3**	**3.2**

Fire House Sewer Pump Station Existing Conditions							
Failure Modes	**Mechanical/ pump failure**	**Power failure (primary/utility)**	**Electrical Gear failure**	**Piping/ Valve failure**	**Forcemain failure/break**	**Instrumentation Failure**	**Control Failure**
CoF	9	9	9	9	9	9	9
Assets	Pumps & Motors	Utility Power	Switchgear, MCCs, VFDs	Mechanical Piping, Valves	Forcemain	Level Control/ Monitoring Instrumentation	PLC/SCADA
Expected Useful Life	20	N/A	20	25	50	15	15
Age	6	N/A	6	6	6	6	6
Condition	0.9	N/A	0.9	0.9	0.9	0.9	0.9
Unmitigated PoF	3.7	10	3.7	3.16	2.08	4.6	4.6
Unmitigated Criticality	**33**	**90**	**33**	**28**	**19**	**41**	**41**
Mitigation Measures	**Equivalent Redundancy Factors**						
VFD bypass starters/contactors							
Pump redundancy	0.9						
Emergency storage	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Backup Generator		0.9					
Bypass pumping	0.9	0.9	0.9	0.9		0.9	0.9
Emergency Response Plan							
Level control redundancy						0.9	
Parallel Forcemain							
Protocol for monitoring electrical gear							
shelf-spare pump & motor							
FMEA Results							
Mitigated PoF	0.02	0.06	0.22	0.19	1.25	0.03	0.28
Mitigated Criticality	**0.2**	**0.5**	**2.0**	**1.7**	**11.2**	**0.2**	**2.5**
Recommendations for Risk Mitigation							
Mitigation Measures	**Equivalent Redundancy Factors**						
VFD bypass starters/contactors							
Pump redundancy	0.9						
Emergency storage	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Backup Generator		0.9					
Bypass pumping	0.9	0.9	0.9	0.9		0.9	0.9
Emergency Response Plan	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***
Level control redundancy						0.9	
Parallel Forcemain							
Protocol for monitoring electrical gear							
shelf-spare pump & motor							
FMEA Results							
Mitigated PoF	0.02	0.06	0.21	0.18	1.19	0.03	0.26
Mitigated Criticality	**0.2**	**0.5**	**1.9**	**1.6**	**10.7**	**0.2**	**2.4**

Midpoint Sewer Pump Station Existing Conditions							
Failure Modes	**Mechanical/ pump failure**	**Power failure (primary/utility)**	**Electrical Gear failure**	**Piping/ Valve failure**	**Forcemain failure/break**	**Instrumentation Failure**	**Control Failure**
CoF	8	8	8	8	8	8	8
Assets	Pumps & Motors	Utility Power	Switchgear, MCCs, VFDs	Mechanical Piping, Valves	Forcemain	Level Control/ Monitoring Instrumentation	PLC/SCADA
Expected Useful Life	20	N/A	20	25	50	15	15
Age	10	N/A	10	10	10	10	10
Condition	0.9	N/A	0.9	0.9	0.9	0.9	0.9
Unmitigated PoF	5.5	10	5.5	4.6	2.8	7	7
Unmitigated Criticality	**44**	**80**	**44**	**37**	**22**	**56**	**56**
Mitigation Measures	**Equivalent Redundancy Factors**						
VFD bypass starters/contactors							
Pump redundancy	0.9						
Emergency storage	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Backup Generator		0.9					
Bypass pumping							
Emergency Response Plan							
Level control redundancy						0.9	
Parallel Forcemain							
Protocol for monitoring electrical gear							
shelf-spare pump & motor							
FMEA Results							
Mitigated PoF	0.33	0.60	3.30	2.76	1.68	0.42	4.20
Mitigated Criticality	**2.6**	**4.8**	**26.4**	**22.1**	**13.4**	**3.4**	**33.6**
Recommendations for Risk Mitigation							
Mitigation Measures	**Equivalent Redundancy Factors**						
VFD bypass starters/contactors							
Pump redundancy	0.9						
Emergency storage	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Backup Generator		0.9					
Bypass pumping	***0.9***	***0.9***	***0.9***	***0.9***		***0.9***	***0.9***
Emergency Response Plan	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***
Level control redundancy						0.9	
Parallel Forcemain							
Protocol for monitoring electrical gear							
shelf-spare pump & motor							
FMEA Results							
Mitigated PoF	0.03	0.06	0.31	0.26	1.60	0.04	0.40
Mitigated Criticality	**0.3**	**0.5**	**2.5**	**2.1**	**12.8**	**0.3**	**3.2**

Neighborhood #1 Sewer Pump Station Existing Conditions							
Failure Modes	**Mechanical/ pump failure**	**Power failure (primary/utility)**	**Electrical Gear failure**	**Piping/ Valve failure**	**Forcemain failure/break**	**Instrumentation Failure**	**Control Failure**
CoF	9	9	9	9	9	9	9
Assets	Pumps & Motors	Utility Power	Switchgear, MCCs, VFDs	Mechanical Piping, Valves	Forcemain	Level Control/ Monitoring Instrumentation	PLC/SCADA
Expected Useful Life	20	N/A	20	25	50	15	15
Age	14	N/A	14	14	14	14	14
Condition	0.9	N/A	0.5	0.9	0.9	0.9	0.9
Unmitigated PoF	7.3	10	8.5	6.04	3.52	9.4	9.4
Unmitigated Criticality	**66**	**90**	**77**	**54**	**32**	**85**	**85**
Mitigation Measures	**Equivalent Redundancy Factors**						
VFD bypass starters/contactors							
Pump redundancy	0.9						
Emergency storage	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Backup Generator		0.9					
Bypass pumping	0.9	0.9	0.9	0.9		0.9	0.9
Emergency Response Plan							
Level control redundancy						0.9	
Parallel Forcemain							
Protocol for monitoring electrical gear							
shelf-spare pump & motor							
FMEA Results							
Mitigated PoF	0.04	0.06	0.51	0.36	2.11	0.06	0.56
Mitigated Criticality	**0.4**	**0.5**	**4.6**	**3.3**	**19.0**	**0.5**	**5.1**
Recommendations for Risk Mitigation							
Mitigation Measures	**Equivalent Redundancy Factors**						
VFD bypass starters/contactors							
Pump redundancy	0.9						
Emergency storage	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Backup Generator		0.9					
Bypass pumping	0.9	0.9	0.9	0.9		0.9	0.9
Emergency Response Plan	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***
Level control redundancy						0.9	
Parallel Forcemain							
Protocol for monitoring electrical gear							
shelf-spare pump & motor							
FMEA Results							
Mitigated PoF	0.04	0.06	0.48	0.34	2.01	0.05	0.54
Mitigated Criticality	**0.4**	**0.5**	**4.4**	**3.1**	**18.1**	**0.5**	**4.8**

Neighborhood #3 Sewer Pump Station Existing Conditions							
Failure Modes	**Mechanical/ pump failure**	**Power failure (primary/utility)**	**Electrical Gear failure**	**Piping/ Valve failure**	**Forcemain failure/break**	**Instrumentation Failure**	**Control Failure**
CoF	10	10	10	10	10	10	10
Assets	Pumps & Motors	Utility Power	Switchgear, MCCs, VFDs	Mechanical Piping, Valves	Forcemain	Level Control/ Monitoring Instrumentation	PLC/SCADA
Expected Useful Life	20	N/A	20	25	50	15	15
Age	10	N/A	10	10	10	10	10
Condition	0.9	N/A	0.9	0.9	0.9	0.9	0.9
Unmitigated PoF	5.5	10	5.5	4.6	2.8	7	7
Unmitigated Criticality	**55**	**100**	**55**	**46**	**28**	**70**	**70**
Mitigation Measures	**Equivalent Redundancy Factors**						
VFD bypass starters/contactors							
Pump redundancy	0.9						
Emergency storage	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Backup Generator		0.9					
Bypass pumping							
Emergency Response Plan							
Level control redundancy						0.9	
Parallel Forcemain							
Protocol for monitoring electrical gear							
shelf-spare pump & motor							
FMEA Results							
Mitigated PoF	0.44	0.80	4.40	3.68	2.24	0.56	5.60
Mitigated Criticality	**4.4**	**8.0**	**44.0**	**36.8**	**22.4**	**5.6**	**56.0**
Recommendations for Risk Mitigation							
Mitigation Measures	**Equivalent Redundancy Factors**						
VFD bypass starters/contactors							
Pump redundancy	0.9						
Emergency storage	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Backup Generator		0.9					
Bypass pumping	***0.9***	***0.9***	***0.9***	***0.9***		***0.9***	***0.9***
Emergency Response Plan	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***
Level control redundancy						0.9	
Parallel Forcemain							
Protocol for monitoring electrical gear							
shelf-spare pump & motor							
FMEA Results with Additional Mitigation Measures							
Mitigated PoF	0.04	0.08	0.42	0.35	2.13	0.05	0.53
Mitigated Criticality	**0.4**	**0.8**	**4.2**	**3.5**	**21.3**	**0.5**	**5.3**

OMWD Failure Modes and Effects Analysis Results

Santaluz Sewer Pump Station Existing Conditions							
Failure Modes	**Mechanical/ pump failure**	**Power failure (primary/utility)**	**Electrical Gear failure**	**Piping/ Valve failure**	**Forcemain failure/break**	**Instrumentation Failure**	**Control Failure**
CoF	8	8	8	8	8	8	8
Assets	Pumps & Motors	Utility Power	Switchgear, MCCs, VFDs	Mechanical Piping, Valves	Forcemain	Level Control/ Monitoring Instrumentation	PLC/SCADA
Expected Useful Life	20	N/A	20	25	50	15	15
Age	11	N/A	11	11	11	11	11
Condition	0.9	N/A	0.9	0.9	0.9	0.9	0.9
Unmitigated PoF	5.95	10	5.95	4.96	2.98	7.6	7.6
Unmitigated Criticality	**48**	**80**	**48**	**40**	**24**	**61**	**61**
Mitigation Measures	**Equivalent Redundancy Factors**						
VFD bypass starters/contactors							
Pump redundancy	0.9						
Emergency storage	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Backup Generator		0.9					
Bypass pumping							
Emergency Response Plan							
Level control redundancy						0.9	
Parallel Forcemain							
Protocol for monitoring electrical gear							
shelf-spare pump & motor							
FMEA Results							
Mitigated PoF	0.36	0.60	3.57	2.98	1.79	0.46	4.56
Mitigated Criticality	**2.9**	**4.8**	**28.6**	**23.8**	**14.3**	**3.6**	**36.5**
Recommendations for Risk Mitigation							
Mitigation Measures	**Equivalent Redundancy Factors**						
VFD bypass starters/contactors							
Pump redundancy	0.9						
Emergency storage	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Backup Generator		0.9					
Bypass pumping	***0.9***	***0.9***	***0.9***	***0.9***		***0.9***	***0.9***
Emergency Response Plan	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***	***0.05***
Level control redundancy						0.9	
Parallel Forcemain							
Protocol for monitoring electrical gear							
shelf-spare pump & motor							
FMEA Results							
Mitigated PoF	0.03	0.06	0.34	0.28	1.70	0.04	0.43
Mitigated Criticality	**0.3**	**0.5**	**2.7**	**2.3**	**13.6**	**0.3**	**3.5**

APPENDIX I

District-Approved 10 Year Capital Spending Plan

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Olivenhain Municipal Water District
10 Year Capital Spending Plan
Capital Improvement Fund - Wastewater (4S and Rancho Cielo)

	Project Description	FY 15-16	FY 16-17	FY 17-18	FY 18-19	FY 19-20	FY 20-21	FY 21-22	FY 22-23	FY 23-24	FY 24-25
(1)	Replace Neighborhood #1 Pump Station	-	-	-	787,000	2,691,000	-	-	-	-	-
	Complete Campus - Building D	110,000	21,000	941,000	-	-	-	-	-	-	-
	Replacement Program - Pumps and Motors	50,000	52,000	54,000	56,000	58,000	61,000	63,000	66,000	68,000	71,000
	SCADA System Upgrades	15,000	-	-	-	-	-	-	-	-	-
(1)	Replace Wet Weather Storage Pond Liner	2,928,000	-	-	-	-	-	-	-	-	-
	Rehab Ultra-Violet System	250,000	-	-	-	-	-	-	-	-	-
	Replace Ultra-Violet System	-	-	-	-	-	-	-	-	1,213,000	2,519,000
(1)	4S Ranch Piping Improvements	32,000	-	-	-	-	-	-	-	-	-
	Pump Station Flow Meters	50,000	-	-	-	-	-	-	-	-	-
(1)	Equalization Basin Improvements	40,000	135,000	-	-	-	-	633,000	-	-	-
(1)	Digester Enhancement Project	129,000	-	-	-	-	-	-	-	-	-
(1)	Covered Storage Area	-	-	-	-	-	134,000	-	-	-	-
(1)	Wet Well Access Hatches	30,000	73,000	32,000	-	-	-	-	-	-	-
(1)	Mid-Point Pump Station Odor Control Modifications	250,000	-	-	-	-	-	-	-	-	-
	Wide Area Network (WAN) Upgrade	15,000	-	-	-	-	-	-	-	-	-
	Replace Headworks	124,000	504,000	-	-	-	-	-	-	-	-
(1)	Sewer Pump Station - Cielo to DCM WTP	85,000	260,000	-	-	-	-	-	-	-	-
	Replace Belt Press Belts	-	-	-	112,000	-	-	-	-	-	-
	Replace Tertiary Filters	-	780,000	811,000	-	-	-	-	-	-	-
	Replace Smart Cover Batteries	-	-	-	56,000	-	-	-	-	68,000	71,000
	Neighborhood #3 Pump Station Improvements	-	-	-	56,000	-	-	-	-	-	-
	Plant Odor Control Modifications	-	-	-	-	585,000	608,000	-	-	-	-
	Recoat Pumps and Piping	-	-	-	-	-	67,000	70,000	-	-	-
	Odor Control - Various	-	-	-	-	-	-	-	132,000	-	-
	Biosolids Process and Handling Upgrades	-	-	-	-	-	-	-	-	274,000	1,139,000
	Finance Utility Billing	15,000	-	-	-	-	-	-	-	-	-
	Total	**$ 4,123,000**	**$ 1,825,000**	**$ 1,838,000**	**$ 1,067,000**	**$ 3,334,000**	**$ 870,000**	**$ 766,000**	**$ 198,000**	**$ 1,623,000**	**$ 3,800,000**

Source: Capital Projects Budget for Fiscal Year Ended June 30, 2016

(1) *These projects are carried over from the prior year and have incurred costs prior to FY 15-16*

Olivenhain Municipal Water District
Summary of Ten Year Planned Capital Improvement Program
Fund: Wastewater - Capital Improvement Fund

Project Name	Appropriation	Budget (Current Dollars)	Fiscal Year Begin	Fiscal Year Complete	Project Description
Replace Neighborhood 1 Pump Station	$ 40,000	$ 3,000,000	18/19	19/20	Rehab to include new and upsized pumps, electrical systems, instrumentation and vault.
Complete Campus - Building D	$ 110,000	$ 1,000,000	15/16	16/17	These facilities are planned as part of the master development of District headquarters.
Replacement Program - Pumps and Motors	$ 50,000	$ 500,000	15/16	24/25	This is a planned upgrade, needed due to the aging of the pump and motor drives, as well as to enhance operational efficiencies.
Replace Wet Weather Storage Pond Liner	$ 3,410,000	$ 3,410,000	14/15	15/16	This is a planned replacement which will be necessary due to the liner having a limited useful life.
Replace Ultra-Violet System	$ -	$ 2,656,000	23/24	24./25	This project will involve replacing the UV disinfection process with a chlorine disinfection system, which is being undertaken prior to the current system needing major refurbishing. Chlorine provides a simpler, extremely effective system, with less labor required for UV lamp maintenance.
4S Ranch Piping Improvements	$ 32,000	$ 32,000	15/16	15/16	Includes pipe upgrades to the chlorine system and potable feed to the forebay.
Pump Station Flow Meters	$ 50,000	$ 50,000	15/16	15/16	Several pump stations do not have flow meters, which are needed as they provide inflow and infiltration data and assist operators in gauging pump efficiency.
Equalization (EQ) Basin Improvements	$ 50,000	$ 700,000	13/14	21/22	This project will explore replacing the EQ liners, or upgrading to concrete basins.
Digester Enhancement Project	$ 40,000	$ 79,000	12/13	15/16	Several improvements are being made to the digesters, including modifications for a safe entry system and upgrading the chemical feed system.
Mid-Point Pump Station Odor Control Improvements	$ 300,000	$ 300,000	14/15	15/16	Install carbon scrubbers and collection system air vent to prevent nuisance odors in the community.
Covered Storage Area	$ -	$ 110,000	13/14	20/21	Certain equipment has been housed outside, having covered storage will protect assets from the elements.

Olivenhain Municipal Water District
Summary of Ten Year Planned Capital Improvement Program
Fund: Wastewater - Capital Improvement Fund

Project Name	Appropriation	Budget (Current Dollars)	Fiscal Year Begin	Fiscal Year Complete	Project Description
Rehab Ultra-Violet System	$ 250,000	$ 250,000	15/16	15/16	Replacement parts for the existing system are no longer available, so modification of the process is necessary.
Finance Utility Billing System	$ 15,000	$ 15,000	15/16	15/16	As part of the potable project, there are certain billing processes which must be specifically designed for wastewater.
Wet Well Access Hatches	$ 25,000	$ 150,000	13/14	16/17	The hatches will replace manhole covers and allow increased access for wet well cleaning and provide better visual inspection of wet wells.
Replace Headworks	$ 124,000	$ 609,000	15/16	16/17	Replace existing bandscreen, wash/press and grit classifier, which have corroded, experienced increased maintenance and inhibited optimal downstream process performance.
Replace Tertiary Filters	$ -	$ 1,500,000	.16/17	17/18	Replace existing tertiary filter due to physical degradation and end of useful life.
Wide Area Network (WAN) Upgrades	$ 15,000	$ 15,000	15/16	15/16	Replace and upgrade critical radio equipment.
SCADA System Upgrades	$ 15,000	$ 15,000	15/16	15/16	These upgrades improve the reliability of communications between off-site facilities.
Sewer Pump Station- Cielo to DCM WTP	$ 5,000	$ 340,000	13/14	16/17	A permanent pump station will be built so that the District will no longer have to truck sewage from the DCM WTP to the 4S Ranch wastewater plant.
Replace Belt Press Belts	$ -	$ 100,000	16/17	16/17	This is a planned replacement which will be necessary due to the belt press belt having a limited useful life.
Replace Sand Filters	$ -	$ 250,000	17/18	17/18	Projected replacement of equipment which is nearing the end of it's useful life
Replace Smart Cover Batteries	$ -	$ 50,000	17/18	17/18	This is a planned replacement which will be necessary due to the batteries having a limited useful life.

Olivenhain Municipal Water District
Summary of Ten Year Planned Capital Improvement Program
Fund: Wastewater - Capital Improvement Fund

Project Name	Appropriation	Budget (Current Dollars)	Fiscal Year Begin	Fiscal Year Complete	Project Description
Neighborhood 3 SPS Improvements	$ -	$ 50,000	17/18	17/18	This project will improve the lighting system as the current ceiling lights are difficult to access for maintenance.
Plant Odor Control Modifications	$ -	$ 1,000,000	18/19	19/20	As plant capacity increases, and with housing built in close proximity to the facility, additional odor control will be needed.
Recoat Pumps and Piping	$ -	$ 110,000	19/20	20/21	Approximately every five years recoating these appurtenances is required to maintain the coating against the elements.
Odor Control - Various	$ -	$ 100,000	21/22	21/22	This will involve a study of current odor systems at several pump stations.
Biosolids Process and Handling Upgrades	$ -	$ 1,000,000	22/23	23/24	Project will upgrade the District biosolids process from producing Grade B class solids to Grade A. This will allow the District to explore more local uses of biosolids, as opposed to hauling it to Yuma, AZ., for disposal.