

EXHIBIT B

2022 PERDUE WATER TREATMENT PLANT

MASTER PLAN



Sweetwater Authority
Perdue Water Treatment Plant

SITE FACILITIES MASTER PLAN UPDATE

FINAL | December 2023





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Chapter 1

INTRODUCTION AND BACKGROUND

1.1 Background

The Sweetwater Authority (Authority) owns and operates Robert A. Perdue Water Treatment Plant (Perdue WTP) serving a population of approximately 200,000. Service areas include the City of National City, unincorporated area of Bonita and Lincoln Acres, and the western portion of the City of Chula Vista, covering approximately 36 square miles. The Authority completed the Site Facilities Master Plan for the Perdue WTP in 2016 by Carollo Engineers, Inc. (Carollo). The analysis developed layouts and process treatment scenarios for possible addition to the facility. Since the completion of the 2016 master plan, the facility has undergone minor upgrades however areas of the facility may still require attention to ensure the facility's reliability.

The Perdue WTP is a conventional treatment plant rated for a production capacity of 30 million gallons per day (mgd). The Perdue WTP's raw water supply is Sweetwater Reservoir adjacent to the facility. The Authority has two raw water reservoirs to capture surface water in the surrounding 182 square-mile watershed, including the Authority's Loveland Reservoir and Sweetwater Reservoir. In the instance when both Loveland and Sweetwater Reservoirs are low, the Authority has a connection to receive raw or treated water from the San Diego County Water Authority (SDCWA). Figure 1.1 below provides an overview of the Perdue WTP.



Figure 1.1 Overview of Perdue WTP Existing Facilities

1.2 Purpose

The objective of this Site Facilities Master Plan Update is to determine what future infrastructure may be required at the Perdue WTP such that it fits within the existing plant boundaries and will be capable of meeting anticipated future regulatory requirements. In addition, this master plan includes a condition assessment and specific project evaluations to develop project grouping and prioritization for future planning.

1.3 Existing Facilities

The Perdue WTP is a conventional treatment plant with treatment facilities including:

- Raw Water System.
- Chemical Coagulation and Flocculation.
- Dissolved Air Flotation (DAF).
- Media Filtration.
- Chemical Disinfection.

Figure 1.2 displays the hydraulic profile and treatment processes at the Perdue WTP. A general description of the Perdue WTP facilities follows with specific design criteria of the facilities provided later on in Section 1.5.

1.3.1 Raw Water System

The treatment facility has the flexibility to treat local water from Sweetwater Reservoir or import via the intertie with the SDCWA. The supply of local water is from snowmelt and rainfall, which is collected in either the Sweetwater Reservoir or Loveland Reservoir. Water from the Sweetwater Reservoir is pumped to the plant from the Sweetwater Perdue WTP intake pump station, which includes five vertical turbine pumps with varying flow capacities. The Loveland Reservoir supplies the Sweetwater Reservoir and has no pumps sending flow to the treatment facility. The facility can treat 100 percent from Sweetwater Reservoir or the SDCWA connection or has the limited ability to blend the water sources to overcome water quality issues. During the period between 2019-2021, 76 percent of the water treated was from the Sweetwater Reservoir.

1.3.2 Process Treatment

The Perdue WTP is a conventional water treatment plant using treatment processes such as coagulation, flocculation, DAF, and filtration. Raw water is sent to a flash mix system where coagulant is introduced prior to the flow splitting into four flocculation/DAF trains. Each treatment train is comprised of two flocculators equipped with variable frequency drives (VFDs) for a total of eight mixers. Following flocculation, the water enters the DAF system where solids are floated to the water surface via air bubbles and captured over a weir, while the water continues flowing below. From the DAF system, an effluent channel collects water from each train and distributes the clarified water among four dual-media filters. Following filtration, water flows to a 10-million-gallon (MG) clear well. DAF solids are pumped back to Sweetwater reservoir, and filter backwash waste flows by gravity and discharges into Sweetwater reservoir.

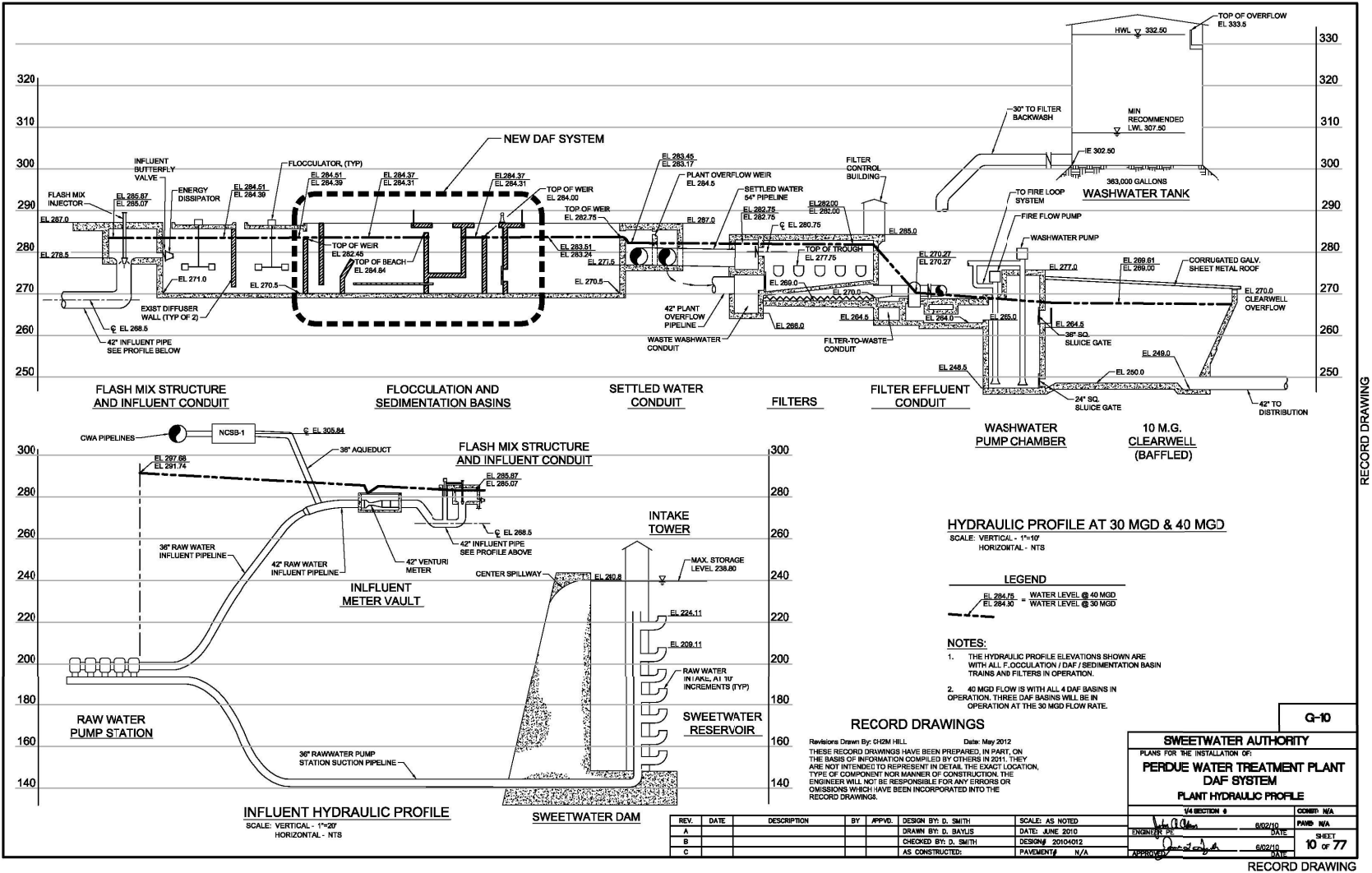


Figure 1.2 Existing Facility Hydraulic Profile



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1.3.3 Chemical Systems

Chemical systems located at the facility include:

1. Chlorine Gas.
2. Aqueous Ammonia.
3. Chlorine Dioxide.
 - a. Sodium Chlorite.
4. Ferric Chloride.
5. Cationic Polymer.
6. Ferrous Chloride.
7. Caustic Soda.
8. Fluorosilicic Acid.

Operators at the Perdue WTP have options available in how they achieve the required disinfection. Free chlorine in the form of chlorine gas dissolved in a carrier water can be added at the raw water pump station (RWPS), flash mix, upstream/downstream of filters, and downstream of the clear well. Chlorine dioxide, generated onsite using chlorine gas and sodium chlorite, can be added at the RWPS. And finally, ammonia can be added at the flash mix and downstream of the filters prior to the clear well or SDCWA supply to form chloramines. The overall disinfection strategy to meet the disinfection requirements is discussed in more detail in the following section.

Ferric chloride is used as the primary coagulant with cationic polymer used to aid coagulation. Coagulants can be injected at the RWPS or the flash mix locations. In the event Sweetwater Reservoir water is being treated and chlorine dioxide doses greater than 1.0 part per million (ppm) are required for treatment, ferrous chloride is added at the flash mix to reduce chlorite levels below the maximum contaminant level (MCL).

Caustic soda is used for pH adjustment and only added downstream of the filters. Fluorosilicic acid is used to provide fluoride to the finished water and injected at the inlet to the clear well before the distribution system.

Chemical injection locations can be found on Figure 1.3.

1.3.4 Chemical Disinfection

The Authority has the flexibility to use three different disinfectants at the Perdue WTP.

Disinfectants include:

- Free Chlorine.
- Chloramines.
- Chlorine Dioxide.

Free chlorine and chlorine dioxide can be added per the locations described in Section 1.3.3. Operations has the flexibility to dose ammonia at the flash mix upstream of the DAF system or downstream of the filters to generate chloramines. A chloramine residual is carried through the clear well and the distribution system.

Based on the Surface Water Treatment Rule (SWTR), the Perdue WTP needs to achieve a minimum of 3-log removal/inactivation of *Giardia* and 4-log removal/inactivation of viruses. A removal of 2-log *Cryptosporidium* is also required based on the Long Term 2 Enhanced Water Treatment Rule (LT2ESWTR).

The guidance manuals allow for process treatment credits as shown in Table 1.1.

Table 1.1 Remaining Log Reduction Required

Total Required	Log Credit-Filtration	Log Remaining (inactivation)
3.0-log <i>Giardia</i>	2.5-log ⁽¹⁾	0.5-log
4.0-log Virus	2.0-log ⁽¹⁾	2.0-log
2.0-log <i>Cryptosporidium</i>	2.0-log ⁽²⁾	0-log

Notes:

(1) From SWTR Guidance Manual.

(2) From LT2ESWTR Manual.

As discussed in Chapter 2, the Division of Drinking Water (DDW) staff have established additional treatment requirements for the required level of *Giardia* and virus inactivation depending on the source water and quality. Total log inactivation required can range up to 2.5-log for *Giardia* and 4.0-log for Virus depending on total coliform and *Escherichia coli* (*E. coli*). Refer to Appendix E for DDW permit detailing source water and inactivation requirements.

Disinfection requirements are determined by the required “CT” which is a combination of the disinfection concentration (C) and the contact time (T) expressed in milligrams-minutes per liter (mg-min/L) published by the United States Environmental Protection Agency (EPA). Tables are dependent on temperature and disinfectant type. For free chlorine, pH is also a factor. A baffle factor (T10/T) is also applied to account for short circuiting within the facility where disinfection is taking place.

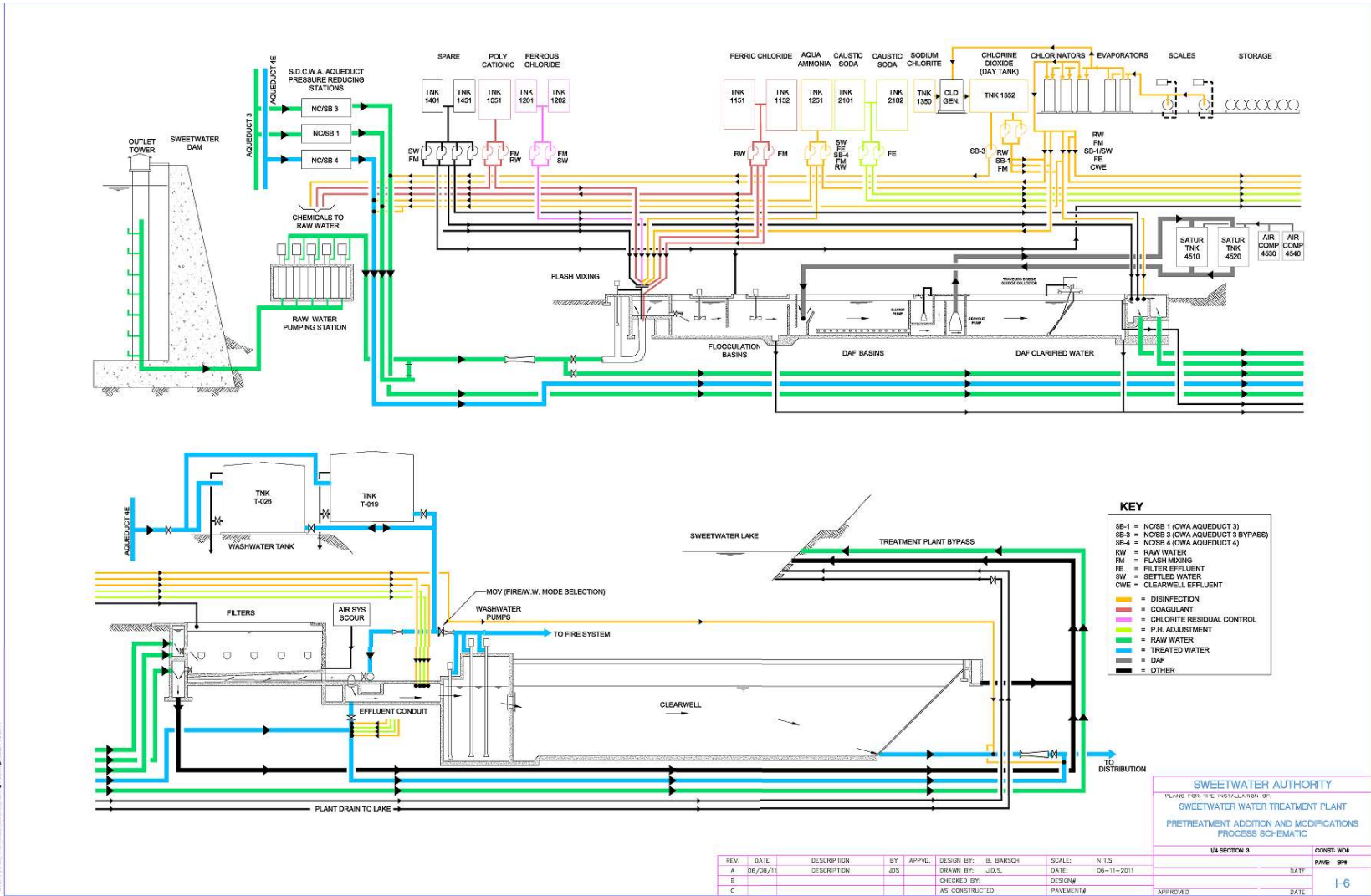


Figure 1.3 Chemical Feed System Schematic

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The Authority tracks disinfection residuals, disinfectant type, and baffle factor through their daily disinfection monitoring report as seen on Figure 1.4.

ROBERT A. PERDUE WATER TREATMENT PLANT DAILY DISINFECTION MONITORING REPORT						
CT Ratios---->		7.89 (Giardia)	5.31 (Virus)	Report Date		6/20/16
Enter Desig. Period Date		6/9/2013		Critical (Hour) Period Number		0
Hour Ending:		1300		Of: (No. of Critical Periods For the Day)		0
Sweetwater Peak Flow (mgd) in Hr=		25.0		FOR THIS CRITICAL (HOUR) PERIOD		
Aqdt Raw Peak Flow (mgd) in Hr=		0.0		Min. No. of Units Used:		Floc./Sed. 3
Aqdt Trtd Peak Flow (mgd) in Hr=		0.0		Min. No. of Units Used:		Filters 4
Clrwl Eff. Peak Flow (mgd) in Hr=		21.0				
Min Clrwl depth (Ft) in Hr=		6.0				
Cond Raw Temp (°F)=		76		Prior to Cl ₂ , App.		Disinfectant Res.
SW Raw Temp (°F)=		76		Conditioned Raw		----
SW Raw Water pH=		8.3		Floculator Effluent		0.00
Conditioned Raw pH=		7.9		Sedimentation Effluent		0.00
Filter Effluent pH=		8.3		Filter Effluent		0.00
Lower Temp SW Raw/Cond Raw (°F)=		76		Clearwell Effluent		0.00
						3.40
Unit	Volume per Unit (Mil-gal)	Number of Units in Service	"Plug Flow" Detention Time, (T, Min)	T10/T	Disinfectant Residual, (C) (mg/l)	CT (Actual)
NCSB#1(AQ RAW) to Spool	0.0244	1	0.0	1.000	0.29	0.0
Pre Pmp Sta	0.0522	1	3.0	1.000	0.29	0.9
PS to Spool	0.0375	1	2.2	1.000	0.29	0.6
Spool to Flash Mix	0.0187	1	1.1	1.000	0.29	0.3
Flocculation	0.1031	3	19.0	0.580	0.00	0.0
Sedimentation	0.2670	3	47.9	0.580	0.00	0.0
Filters	0.0905	4	20.8	0.580	0.00	0.0
Clearwell	6.0000	1	411.4	0.660	3.40	923.2
Post Clearwell	0.1475	0	0.0	1.000	0.00	0.0
			Giardia		Virus	
Unit	pH (For CT _{req} Free Only)	Disinfectant (Free Cl ₂ , ClO ₂ or Chloramine)	CT _(Required)	CT _{act} / CT _{req}	CT _(Required)	CT _{act} / CT _{req}
NCSB#1(AQ RAW) to Spool	7.9	None	----	0.00	----	0.00
Pre Pmp Sta	8.3	Chlorine Dioxide	2.1	0.42	1.5	0.59
PS to Spool	7.9	Chlorine Dioxide	2.1	0.31	1.5	0.42
Spool to Flash Mix	7.9	Chlorine Dioxide	2.1	0.15	1.5	0.21
Flocculation.....	7.9	None	----	0.00	----	0.00
Sedimentation.....	7.9	None	----	0.00	----	0.00
Filters.....	7.9	None	----	0.00	----	0.00
Clearwell.....	8.3	Chloramine	131.7	7.01	225.9	4.09
Post Clearwell.....	8.3	None	----	0.00	----	0.00
			TOTAL	7.89	TOTAL	5.31
			Free Tot.	0.00	Free Tot.	0.00
			Comb. Tot.	0.00	Comb. Tot.	0.00

Figure 1.4 Blank Sample CT Calculation Worksheet

1.4 Historic Flows and Water Quality

Historic plant filter production from October 2015 through April 2022 is shown on Figure 1.5.

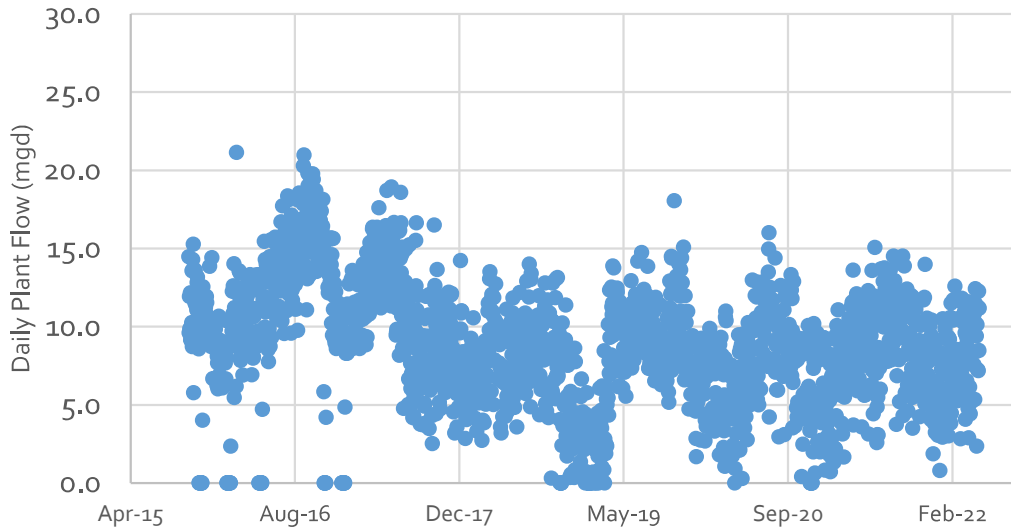


Figure 1.5 Historical Filter Effluent Production Flow

Production flows from the facility have decreased from 2016. Average flow from May 2015 to April 2022 was 8.7 mgd with a maximum flow of 21.1 mgd.

Water quality data from Sweetwater Reservoir and from the SDCWA aqueduct is provided in Table 1.2.

Table 1.2 Sweetwater Reservoir Raw Water Quality

Parameter	Sweetwater Reservoir			SDCWA Aqueduct		
	Minimum	Maximum	Average	Minimum	Maximum	Average
pH	7.6	8.8	8.2	7.9	8.2	8.0
Conductivity (µS)	866	2,248	538	510	1,000	839
Alkalinity (mg/L as CaCO ₃)	143	238	193	90	130	120
Total Hardness (mg/L as CaCO ₃)	241	482	338	140	290	241
Calcium Hardness (mg/L as CaCO ₃)	119	208	156	87	192	152
Chloride (mg/L)	140	430	73	60	99	87
Bromide (µg/L)	300	1,000	590	ND	130	60
Sulfate (mg/L)	84	224	143	74	234	175
Color (units)	20	150	57	1	5	2.9
Turbidity (NTU)	1.27	16	8.1	0.28	1.49	0.64
TOC (mg/L)	6.9	20.3	10.4	1.0	7.1	2.6

Notes:

Abbreviations: µg/L - micrograms per liter; µS - microseconds; CaCO₃ - calcium carbonate; mg/L - milligrams per liter; ND - non-detect; NTU - nephelometric turbidity unit; TOC - total organic carbon.

Due to the higher values such as TOC, the Sweetwater Reservoir water quality is more challenging to treat compared to the SDCWA aqueduct raw water. To allow for smoother operations, the plant can blend both water supplies to make treatment more manageable.

However, there are instances when they are required to treat 100 percent of each supply due to external factors.

1.5 Design Criteria

Design criteria for the existing Perdue WTP are summarized in Table 1.3. Design criteria is based on available record information and discussions with plant staff.

Table 1.3 Perdue WTP Design Criteria

Description	Units	Capacity
Plant Capacity		
Permitted	mgd	30
Average	mgd	8.7
RWPS		
Type: Can-Style Vertical Turbine		
Number of Pumps	No.	5
<i>Capacity of Pumps</i>		
Pump Nos. 1 and 2	mgd	6
Motor Size	hp	150
VFD	(Y/N)	N
Pump Nos. 3 and 4	mgd	18
Motor Size	hp	400
VFD	(Y/N)	Y
Pump No. 5	mgd	10
Motor Size	hp	200
VFD	(Y/N)	Y
Flash Mixing		
Flash Mix Pump		
Capacity	gpm	800
Motor Size	hp	7.5
Mixing Energy (G)	seconds ⁻¹	750
Mixing Time	seconds	1
Flocculation		
Type: Vertical Shaft, VFD Equipped		
Number of Basins	No.	4
Stages per Basin	No.	2
Stage Inside Dimension	feet x feet	22 x 22.5
Average Side Water Depth	feet	14
Stage Volume (each)	gallons	51,800
Basin Volume	gallons	103,600
Total Flocculation Time at Permitted Flow	minutes	20

Description	Units	Capacity
Clarification		
Type: DAF		
Number of Basins	No	4
Basin Dimensions (length x width)	feet x feet	39 x 21.5
Average Side Water Depth	feet	14
Basin Volume (each)	gallons	87,500
Total Volume	gallons	350,000
Detention Time at Permitted Flow	minutes	16.8
Surface Loading Rate	gpm/ft ²	8.3
Compressors		
Type: Rotary Screw		
Number of Compressors	No.	1+1
Capacity	scfm	83
Saturation Tanks		
Number of Saturation Tanks	No.	1+1
Capacity (each)	gallons	5,550
Recycle Pumps		
Type: Submersible		
Number of Pumps	No.	4
Capacity (each)	mgd	1
Motor Size	hp	105
Sludge Pumps		
Type: Submersible		
Number of Pumps	No.	4
Capacity (each)	gpm	548
Motor Size	hp	3
Filters		
Type: Gravity, Dual Media		
Number of Filters	No.	4
Cells per Filter	No.	2
Cell Length	feet	35.5
Cell Width	feet	16.5
Filter Bed Area (each)	ft ²	1,170
Filter Area (total)	ft ²	4,680

Description	Units	Capacity
Filter Media		
Type: Sand		
Depth	inches	12
Effective Size	mm	0.6
Uniformity Coefficient	Unitless	<1.4
Sand L/d Ratio	Unitless	510
Type: Anthracite		
Depth	inches	18
Effective Size	mm	1.03
Uniformity Coefficient	Unitless	<1.4
Anthracite L/d Ratio	Unitless	440
Total Media L/d Ratio	Unitless	950
Type: Filter Backwash		
Type: Tank/Gravity		
Maximum Backwash Rate	gpm/ft ² gpm	22.5 26,111
Number of Backwash Supply Pumps	No.	2
Pump Capacity (each)	gpm	2,100
Motor Size (each)	hp	50
Tank Volume	gallons	363,000
Fire Flow Pump (Located Adjacent to Backwash Supply Pumps)		
Number of Pumps	No.	1
Pump Capacity (each)	gpm	870
Motor Size (each)	hp	100
Filter Air Scour		
Type: Centrifugal Blower		
Maximum Air Scour Rate	scfm/ft ²	3.42
Air Scour Flow Rate	scfm	4,000
Number of Blowers	No.	1
Filter Backwash Sequence and Waste Washwater Volume		
Air Scour (4 minutes at 4,000 scfm)		
Filter Washwater Bump	gallons	10,000
Low Rate Backwash (3.5 minutes at 4 gpm/ft ²)	gallons	16,400
High Rate Backwash (3.5 minutes at 22 gpm/ft ²)	gallons	90,180
Total Volume per Wash	gallons	116,580

Description	Units	Capacity
Treated Water Reservoir		
Type: Hopper Bottom with Gunite Floor and Sides, Metal Roof		
Number of Reservoirs	No.	1
Capacity	MG	10
Floor		
Length	feet	276
Width	feet	216
Top of Slope		
Length	feet	316
Width	feet	256
Sidewall Water Depth	feet	19
Estimated Baffle Factor	T10/T	0.66
Chemicals		
Chlorine Gas		
One-Ton Cylinders	No.	16
Total Weight	pounds	32,000
Aqueous Ammonia		
Tanks	No.	1
Volume per Tank	gallons	6,000
Cationic Polymer		
Tanks	No.	1
Volume per Tank	gallons	6,000
Ferric Chloride		
Tanks	No.	2
Volume per Tank	gallons	10,000
Ferrous Chloride		
Tanks	No.	2
Volume per Tank	gallons	4,000
Sodium Hydroxide (Caustic Soda)		
Tanks	No.	2
Volume per Tank	gallons	6,000
Fluoride		
Tanks	No.	1
Volume per Tank	gallons	6,000
Chlorite Solution		
Tanks	No.	1
Volume per Tank	gallons	6,500

Description	Units	Capacity
Ancillary		
Plant Water Pumps		
Type: Horizontal Centrifugal		
Number of Pumps	No.	2
Capacity (each)	gpm	80
TDH	feet	145
Motor Size	hp	7.5

Notes:

Abbreviations: ft² - square feet; gpm - gallons per minute; gpm/ft² - gallons per minute per square foot; hp - horsepower; mm - millimeters; scfm - standard cubic feet per minute; TDH - total dynamic head.

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Chapter 2

REGULATORY REVIEW

2.1 Introduction

In 2016 Carollo prepared a Site Facilities Master Plan for the Perdue WTP. This chapter presents an evaluation of regulatory compliance for the Sweetwater Reservoir and Perdue WTP with existing drinking water regulations and anticipated near-term regulations. To prepare this evaluation, a written data request (water quality data, permits, reports, correspondence) was submitted to Authority staff. In addition, Title 22 regulatory compliance data was downloaded from the DDW's online water quality database.

2.2 Existing Regulations

This section presents a brief overview of existing regulations that are important for the Perdue WTP.

2.2.1 Surface Water Treatment Rule

The SWTR was promulgated in 1989 to control the levels of turbidity, *Giardia lamblia*, viruses, *Legionella*, and heterotrophic plate count bacteria. Compliance with the SWTR is demonstrated by meeting specific turbidity and disinfection performance requirements. Surface water treatment plants are required to achieve 3-log (99.9 percent) reduction of *Giardia* and 4-log (99.99 percent) reduction of viruses. A conventional filtration plant in compliance with the turbidity performance standards is given credit for physical removal of 2.5-log *Giardia* and 2.0-log virus. The additional 0.5-log *Giardia* reduction and 2-log virus reduction must be achieved through disinfection. Compliance with the disinfection requirements is demonstrated by monitoring contact time (disinfection concentration X contact time, CT) where C is the concentration of disinfectant and T is the contact time for the disinfectant, with units of mg-min/L. Beyond the minimum SWTR requirements described above, DDW staff have established additional treatment requirements for the required level of inactivation depending on the source water being used at the Perdue WTP. When the Perdue WTP raw water supply is 100 percent from Sweetwater Reservoir, Table 2.1 presents the increased treatment requirements based on total coliform levels. Table 2.1 also presents the log credit for *Giardia* and virus reduction received for filtration. The increased level of *Giardia* and virus reduction, therefore, must be achieved through inactivation/disinfection.

Table 2.1 Raw Water Coliform Triggers for Increased *Giardia* and Virus Reduction Requirements at the Perdue WTP When Using Only Sweetwater Reservoir

Raw Water Coliform (MPN/100 mL)	<i>Giardia</i>			Virus		
	Log Treatment Required	Log Credit for Filtration	Remaining Log Reduction Required	Log Treatment Required	Log Credit for Filtration	Remaining Log Reduction Required
<1,000	3	2.5	0.5	4	2.0	2.0
>1,000-10,000	4	2.5	1.5	5	2.0	3.0
>10,000-100,000	5	2.5	2.5	6	2.0	4.0

Notes:

Abbreviation: MPN/100 mL - most probable number per 100 milliliters.

If the raw water supply to the Perdue WTP is 100 percent raw SDCWA aqueduct water, Table 2.2 presents the increased *Giardia* and virus reduction that is required based on *E. coli* levels.

Table 2.2 also presents the log credit for *Giardia* and virus reduction for filtration. The increased level of *Giardia* and virus reduction, therefore, must be achieved through inactivation/disinfection.

Table 2.2 Raw Water *E. coli* Triggers for Increased *Giardia* and Virus Reduction Requirements at the Perdue WTP When Using Only SDCWA Aqueduct Supply

Raw Water <i>E. coli</i> (MPN/100 mL)	<i>Giardia</i>			Virus		
	Log Reduction Required	Log Credit for Filtration	Remaining Log Reduction Required	Log Treatment Required	Log Credit for Filtration	Remaining Log Reduction Required
<20	3	2.5	0.5	4	2.0	2.0
>20-39	3.5	2.5	1.0	4.5	2.0	2.5
>40-99	4	2.5	1.5	5	2.0	3.0
>100-199	4.5	2.5	2.0	5.5	2.0	3.5
>200	5	2.5	2.5	6	2.0	4.0

When the raw water supply is a blend of Sweetwater Reservoir and the SDCWA Aqueduct, it is not possible to collect a sample that represents the raw water blend. As required by the DDW, when Perdue WTP is treating a blend of the two sources (no matter what the ratio is between the two sources), Authority staff sample each source and test for total coliforms in the Sweetwater Reservoir supply and *E. coli* in the SDCWA Aqueduct supply. Whichever sample has a higher total coliform and/or *E. coli* dictates the required treatment inactivation goal.¹

2.2.2 Interim Enhanced Surface Water Treatment Rule

The EPA promulgated the Interim Enhanced Surface Water Treatment Rule (IESWTR) in 1998 (effective in California in January 2008). The IESWTR lowered the turbidity performance requirement in the 1989 SWTR for the combined filter effluent from 0.5 NTU to 0.3 NTU for

¹ This requirement is described in a letter from SWRCB DDW to Mr. Scott McClelland, Sweetwater Authority. September 2, 2014.

conventional and direct filtration plants and required that utilities monitor and record the turbidity for individual filters. In addition, the IESWTR added 1) a requirement that utilities achieve 2-log removal of *Cryptosporidium*, with compliance demonstrated by meeting the turbidity performance requirement, 2) requirements for disinfection profiling and benchmarking, and 3) a requirement that all new finished water storage facilities be covered.

2.2.3 Long-Term Enhanced Surface Water Treatment Rule

The LT2ESWTR was promulgated in 2006 and was effective in California in July 2013. The LT2ESWTR required two years of monthly source water monitoring for *Cryptosporidium*. Depending upon the concentration of *Cryptosporidium*, utilities were placed into one of four levels of risk (referred to as bins). Public water systems were required to conduct a second round of source water monitoring for *Cryptosporidium* beginning six years after the initial round of monitoring. For public water systems serving over 100,000 residents, the second round of source water monitoring began in April 2015. Table 2.3 presents the various bin classifications adopted in the LT2ESWTR. If the monitoring results indicated placement in Bin 1, no additional treatment for *Cryptosporidium* was required beyond a 2-log removal credit given to plants that meet the turbidity removal requirements. Placement in Bins 2 through 4 required increasing levels of *Cryptosporidium* reduction. The EPA developed a microbial toolbox that assigned credit for *Cryptosporidium* reduction for various treatment options. For public water systems serving over 100,000 residents, the second round of source water monitoring began in April 2015.

Table 2.3 LT2ESWTR Bin Classification

<i>Cryptosporidium</i> Concentration (oocysts/L)	Bin Classification	Additional Treatment Required for Conventional Filtration Plant ⁽¹⁾
<0.075	1	No Additional Treatment
>0.075 and <1.0	2	1-log Treatment
>1.0 and <3.0	3	2-log Treatment ⁽²⁾
>3.0	4	2.5-log Treatment ⁽²⁾

Notes:

(1) Using any technology or combination of technologies from microbial toolbox.

(2) At least 1-log must be achieved using ozone, chlorine dioxide, ultraviolet light, membranes, bag/cartridge filters, or bank filtration.

2.2.4 Disinfection Byproducts

Disinfection byproducts (DBPs) have been regulated since the adoption of the 1979 total trihalomethane (TTHM) standard. In 1998, the EPA promulgated the Stage 1 Disinfectants and Disinfection byproducts (D/DBP) Rule that lowered the MCL for TTHMs from 0.10 mg/L to 0.080 mg/L and established new MCLs for HAA5 at 0.060 mg/L, bromate at 0.010 mg/L (for systems using ozone), and chlorite at 1.0 mg/L (for systems using chlorine dioxide). The Stage 1 D/DBP Rule also established distribution system maximum residual disinfectant levels for disinfectants including chlorine, chloramines, and chlorine dioxide, and included requirements for “enhanced coagulation” for the removal of natural organic matter in surface water filtration plants that use conventional treatment. Compliance with the enhanced coagulation requirement is met by achieving specific levels of TOC removal for a given raw water quality.

To determine compliance with the enhanced coagulation requirements, each monthly set of paired TOC samples (raw water and combined filter effluent) is used to determine the removal percentage achieved, as follows:

$$\text{TOC Removal Achieved} = \left[\frac{\text{Raw Water TOC} - \text{Treated Water TOC}}{\text{Raw Water TOC}} \right] \times 100$$

The required TOC removal varies with the quality of the source water, as shown in Table 2.4. After determining the TOC removal achieved and finding the Step 1 TOC removal required from Table 2.4, the compliance ratio is calculated as follows:

$$\text{Compliance Ratio} = \frac{\text{TOC Removal Achieved}}{\text{TOC Removal Required}}$$

Each month, a compliance ratio is determined. Each month’s compliance ratio is averaged with the compliance ratios for the previous 11 months to calculate a rolling 12-month average. If the rolling 12-month average of compliance ratios is 1.0 or greater, the requirement is met. This calculation must be done each quarter.

Table 2.4 Step 1 TOC Removal Requirements

Source Water TOC (mg/L)	Source Water Alkalinity (mg/L as CaCO ₃)		
	0 to 60	>60 to 120	>120
>2.0 to 4.0	35 percent	25 percent	15 percent
>4.0 to 8.0	45 percent	35 percent	25 percent
>8.0	50 percent	40 percent	30 percent

There are “alternative compliance criteria,” which can be used to exempt a system from the DBP precursor treatment technique requirements. In any month that one or more of the following six conditions are met, a monthly compliance ratio value of 1.0 can be assigned (in lieu of the value calculated above) when determining compliance.

1. The source water TOC is <2.0 mg/L.
2. The treated water TOC is <2.0 mg/L.
3. The source water specific ultraviolet absorbance (SUVA), prior to any treatment, is ≤2.0 liters per milligrams-meter (L/mg-m).
4. The treated SUVA is ≤2.0 L/mg-m.
5. The raw water TOC is <4.0 mg/L, the raw water alkalinity is >60 mg/L (as CaCO₃), the TTHMs are <40 µg/L, and the HAA5 is <30 µg/L.
6. The TTHMs are <40 µg/L and the HAA5 is <30 µg/L with only chlorine for disinfection.

Both source water and treated water SUVA must be measured upstream of any oxidant addition, including chlorine. Further, both UV254 and dissolved organic carbon used in the SUVA calculation are measured after the water has been filtered through 0.45-micrometer filter paper.

If the system cannot meet the Step 1 TOC removal levels, the system can apply to the DDW for a “Step 2” alternative TOC removal requirement. The Step 2 application must be made within three months of determining that Step 1 removals cannot be achieved.

In its application for the “Step 2” alternate TOC removal, the system must provide data from bench or pilot testing. The Step 2 removal requirements are determined as follows:

1. Bench- or pilot-scale testing of enhanced coagulation is conducted using representative water samples and adding 10 mg/L increments of alum (or 5.4 mg/L of ferric chloride) until the pH is reduced to a level less than or equal to the Step 2 target pH values in Table 2.5.

Table 2.5 Step 2 Enhanced Coagulation Target pH Values

Raw Water Alkalinity (mg/L as CaCO ₃)	Target pH
0 to 60	5.5
>60 to 120	6.3
>120 to 240	7.0
>240	7.5

2. The “Step 2” dose is the least of the following two doses:
 - a. The dose resulting in the Step 2 target pH value shown in Table 2.5, or
 - b. The dose above which the next higher dose results in less than 0.3 mg/L of additional TOC removal (this is called the point of diminishing returns [PODR]).
3. The percent TOC removal achieved with the “Step 2” dose is then defined as the minimum TOC removal required by the plant.
4. Once approved by the DDW, this Step 2 TOC removal requirement supersedes the minimum TOC removal requirement (Step 1) shown in Table 2.4. If no incremental increase of 10 mg/L alum (or 5.4 mg/L ferric chloride) results in greater than 0.3 mg/L incremental TOC removal, then the water is deemed to contain TOC not amenable to enhanced coagulation. Under those conditions, the system may apply to the DDW for a waiver of enhanced coagulation requirements.

On January 4, 2006, the EPA promulgated the Stage 2 D/DBP Rule (effective in California in June 2012). The Stage 2 D/DBP Rule changed the manner in which compliance with the MCLs for trihalomethanes (THMs) and HAA5 is determined, requiring compliance at each sampling location rather than across the entire distribution system (referred to as a locational running annual average [LRAA]).

2.2.5 Additional Drinking Water Regulations

In addition to the regulations described above, the EPA and DDW have established health-based regulations for a number of microbiological constituents (total coliform, *E. coli*), inorganic chemicals (metals, minerals), organic chemicals (volatile organic compounds [VOCs] and synthetic organic chemicals [SOCs]), radionuclide contaminants (RADs) (man-made and naturally occurring), and non-health based secondary standards for constituents that can impact the taste, odor, and/or color of drinking water.

2.3 Future Regulations

This section presents a review of upcoming regulations within the next five years.

2.3.1 Revised Microbial/Disinfection Byproduct Rules

Under the DDW Safe Drinking Water Act as amended in 1996, the EPA is required to conduct a review of drinking water regulations every six years and, if appropriate, revise specific regulations. Previous six-year reviews were concluded in 2003 and in 2010.

In December 2016, the EPA announced the completion of its third review of existing drinking water regulations. The EPA determined that eight regulations are candidates for regulatory revision. The eight are chlorite, *Cryptosporidium*, *Giardia lamblia*, HAA5, heterotrophic bacteria, *Legionella*, THMs, and viruses. These constituents are currently regulated under the LT2ESWTR and the Stage 2 D/DBP Rule and are referred to as Microbial/Disinfection Byproduct (M/DBP) rules.

On October 14 and 15, 2020, the EPA held a public meeting to obtain input on possible revisions to the eight M/DBP rules. Additional public meetings were held during 2021 to the present to discuss information on specific topics. In April 2022, an M/DBP Working Group was established under the National Drinking Water Advisory Council (NDWAC). The goal of the Working Group will be to develop recommendations for eight M/DBP rules. The Working Group held its first meeting on May 23, 2022. The second meeting of the M/DBP Working Group occurred August 17, 2022. The M/DBP Working Group is scheduled to continue meeting until mid-2023. The EPA currently plans to propose revised regulations by July 2024 and publish final regulations by September 2027.

2.3.2 Cyanobacteria

Cyanobacteria (also known as blue-green algae) occur throughout the world. Some species of cyanobacteria can produce toxins. Factors that affect cyanobacteria blooms include light intensity, sunlight duration, nutrient availability, water temperature, pH, and water stability. Many cyanobacteria produce trace chemicals that are toxic at low concentrations. These chemicals are commonly referred to as cyanotoxins, or algal toxins.

Neither the EPA nor the State of California currently has drinking water limits for cyanotoxins, and water utilities are not required to monitor for them in their water supplies. However, in 2015, the EPA established health advisories (HAs) for two cyanotoxins: microcystin and cylindrospermopsin.

Table 2.6 presents the EPA's 10-day HAs for microcystin and cylindrospermopsin.

Table 2.6 EPA 10-Day Cyanotoxin HA Values

Algal Toxin	10-Day HA <6 Years of Age (µg/L)	10-Day HA >6 Years of Age (µg/L)
Microcystin	0.3	1.6
Cylindrospermopsin	0.7	3

The EPA describes 10-day HAs as follows:

"HAs serve as the informal technical guidance for unregulated drinking water contaminants to assist Federal, State, and local officials, and managers of public or community water systems in protecting public health as needed. They are not to be construed as legally enforceable Federal standards."²

On February 4, 2021, the DDW submitted a formal request to the Office of Environmental Health Hazard Assessment (OEHHA) to develop recommended notification levels (NLs) for microcystins, cylindrospermopsin, anatoxin-a, and saxitoxin. On May 3, 2021, the OEHHA submitted recommended NLs (presented in Table 2.7). As of the preparation of this review (October 2022), the DDW has not yet indicated whether it will implement OEHHA's recommended NLs, and the DDW has not yet signed off on the recommended NLs.

Table 2.7 OEHHA Recommended Cyanotoxin NLs

Algal Toxin	Recommended NL ⁽¹⁾	Recommended Safe Exposure Duration
Anatoxin-a	4 µg/L	One Month
Saxitoxins	Interim: 0.6 µg/L	One Day
Microcystins	Interim: 0.03 µg/L	Up to Three Months
Cylindrospermopsin	Interim: 0.3 µg/L	Up to Three Months

Notes:

(1) OEHHA recommended that three of the NLs be used on an interim basis while they complete a review of available toxicity studies.

2.3.3 Per- and Polyfluoroalkyl Substances

Per- and polyfluoroalkyl substances (PFAS) are a group of several thousands of organofluorine chemicals used in products to resist heat, oils, stains, and water. They are found in a wide range of household and commercial products, from non-stick cookware to stain-resistant furniture to firefighting foam. Over the past several years there has been a significant increase in regulatory activity regarding PFAS at both the state and federal levels. California adopted NLs and response levels (RLs) for several individual PFAS. The OEHHA has proposed Public Health Goals (PHGs) for perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS). In addition, the DDW has issued several monitoring orders to collect occurrence data throughout the state. At the federal level, the EPA recently released interim updated HAs for PFOA and PFOS and final HAs for perfluorobutane sulfonic acid (PFBS) and GenX chemicals. The EPA intends to propose MCLs for PFOA and PFOS by the end of 2023. Monitoring for 30 constituents under the federal fifth Unregulated Contaminants Monitoring Rule (UCMR 5) is planned to occur during 2023 through 2025. Twenty-nine of the 30 constituents to be monitored are PFAS.

² EPA, 2018 Edition of the Drinking Water Standards and Health Advisories Tables. EPA 822-F-18-001.

2.3.4 Microplastics

California Senate Bill 1422 was signed into law in 2018 (which added Section 116376 to California’s Health and Safety Code). This law required the following DDW activities regarding microplastics:

1. On or before July 1, 2020: Adopt a definition of microplastics in drinking water.
2. On or before July 1, 2021:
 - a. Adopt a standard methodology for testing of microplastics in drinking water.
 - b. Adopt requirements for four years of testing and reporting of microplastics in drinking water, including public disclosure of those results.
 - c. Consider issuing quantitative guidelines (e.g., NL) to aid consumer interpretations of the testing results, if appropriate.
 - d. Accredit qualified laboratories in California to analyze for microplastics in drinking water.

The following present descriptions of the current State of California’s efforts regarding microplastics in drinking water.

2.3.4.1 Definition of Microplastics

On June 16, 2020, the California State Water Resources Control Board (SWRCB) voted to adopt the DDW’s proposed definition of microplastics. The adopted definition of microplastics is below.

“Solid polymeric materials to which chemical additives or other substances may have been added, which are particles which have at least three dimensions that are greater than 1 nm and less than 5,000 micrometers. Polymers that are derived in nature that have not been chemically modified (other than by hydrolysis) are excluded.”

Microplastics Policy Handbook: On September 7, 2022, the SWRCB voted to adopt the DDW’s Policy Handbook “Establishing a Standard Method of Testing and Reporting of Microplastics in Drinking Water.” The following presents highlights of the DDW’s microplastics monitoring program:

1. *Analytical Methods and Sample Collection:* The DDW has identified two methods for monitoring microplastics: 1) infrared spectroscopy and 2) Raman spectroscopy. California’s Environmental Laboratory Accreditation Program will offer accreditation to qualified laboratories to monitor for microplastics.
2. *Pilot Phase (Summer 2022 through Summer 2023):* The DDW is continuing to conduct research on analytical methods and sample collection. The DDW intends to provide training for sample collection, prepare guidance for reducing sample interferences, and provide tools for communicating risks of microplastics.
3. *Phase 1 Monitoring (Fall 2023 through Fall 2025):* The DDW will issue monitoring orders for the Phase 3 monitoring program to a “small number” of public water systems (goal is to include sources serving the greatest number of consumers). Monitoring will be conducted for raw water only. Monitoring will cover a period of two years. Two samples are anticipated to be collected October through April, and May through September of each year (a total of eight samples). Prior to issuing monitoring orders, the DDW plans to hold a public workshop. As of the preparation of this regulatory review, the schedule for the workshop has not yet been announced.

4. *Systems Required to Conduct Phase 1 Monitoring:* The Policy Handbook includes a list of public water systems anticipated to receive monitoring orders for the Phase I monitoring program (it is possible there will be changes to the list of systems before monitoring orders are issued). The Authority and Sweetwater Reservoir are not included in the list. At the present time, the City of San Diego and the City of Escondido are included on the list.
5. *DDW Six-Month Review of Results:* At the conclusion of the Phase I monitoring, the DDW plans to spend six months reviewing the results, before moving to the Phase 2 monitoring.
6. *Phase 2 Monitoring (Fall 2026 through Fall 2028):* The DDW will issue monitoring orders for the Phase 2 monitoring program. During the Phase 2 monitoring, samples will be collected in finished water. Sampling will last two years (the DDW currently anticipates the same number of samples and the same schedule as described above for the Phase 1 monitoring).
7. *Consumer Confidence Reports (CCRs):* any detections of microplastics, during either the Phase 1 or Phase 2 monitoring will need to be reported in the utility’s CCR.

NL: State law required that the DDW consider adopting guidelines (e.g., an NL) to aid interpretation of testing results. The DDW indicated that there is not sufficient information to establish an NL. However, the DDW adopted the following qualitative language regarding potential health effects:

"Studies of rodents exposed to some types of microplastics through drinking water indicate potentially adverse effects, including on the reproductive system. However, more research is needed to understand potential impacts on human health, including determining concentrations at which effects may occur. California is monitoring microplastics in drinking water to understand its occurrence and is supporting ongoing research."

Figure 2.1 presents the DDW’s current schedule for the microplastics monitoring program.

Microplastics Regulation and Monitoring Plan	2022				2023				2024				2025				2026				2027				2028			
	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
Pilot Phase																												
Lab Accreditation Program																												
DDW Public Workshop			★		★																							
Phase I Monitoring Orders																												
Phase I Monitoring																												
DDW Review Phase I Results																												
Phase II Monitoring Orders																												
Phase II Monitoring																												

Figure 2.1 Anticipated Schedule for Phase 1 and Phase 2 Microplastics Monitoring

2.3.5 N-Nitrosodimethylamine

The main source of N-Nitrosodimethylamine (NDMA) in drinking water is disinfection with chloramines. There is currently no state or federal MCL for NDMA. California has an NL for NDMA of 10 nanograms per liter (ng/L) and an RL of 300 ng/L³. In 2006, OEHHA set a PHG at 3 ng/L (based on carcinogenicity). For several years, DDW staff have included setting an MCL for

³ DDW has adopted an NL and RL for two other nitrosamines: N-nitrosodiethylamine (NDEA) and N-nitroso-di-n-propylamine (NDPA). The RL and NL for NDEA are 10 ng/L and 100 ng/L, respectively. The NL and RL for NDPA are 10 ng/L and 500 ng/L, respectively.

NDMA in their annual list of regulatory priorities. To date, nothing has been proposed and no information has been released with regard to setting an MCL. Monitoring for six nitrosamines was included in the federal second Unregulated Contaminant Monitoring Rule (UCMR 2) monitoring program. The Authority conducted quarterly UCMR 2 monitoring in 2009 and 2010. For the six nitrosamines included in UCMR 2, NDMA was the only compound detected. The range of results was ND to 5.8 ng/L, with an average of 1.1 ng/L.

2.4 Summary and Conclusions

The Perdue WTP is in compliance with all existing regulations. The use and, at times, blending of two raw water sources in the influent to Perdue WTP poses operational challenges adjusting to influent water quality, such as turbidity, taste and odor, or manganese, and requires constant vigilance in monitoring and evaluating conditions and communications to operations. However, Authority staff have developed and implemented plans to meet these challenges, specifically with regard to meeting the enhanced coagulation requirements and to meet required CT inactivation requirements.

The most likely future regulations to impact the Perdue WTP are modifications to the M/DBP rules as described in this section. Depending on monitoring results from Sweetwater Reservoir, PFAS regulations may also pose a future impact. While it is very early in the process, and it is not possible to predict the final outcome since the EPA plans to proposed revised regulations in 2024 and publish final revised regulations in 2027, it is highly likely efforts will focus on the following: *Legionella*, HAAs, and enhanced coagulation.

Chapter 3

REVIEW OF RAW AND TREATED WATER QUALITY

3.1 Introduction

This chapter presents a review of raw and treated water quality for the Perdue WTP.

3.2 Production Data

Figure 3.1 presents monthly production data for the Perdue WTP from January 2016 through December 2021. During the 72 months of data presented, the SDCWA raw water aqueduct was 100 percent of the supply for the Perdue WTP during the 15 months of January 2016 through March 2017. The same data set shows, the Sweetwater Reservoir was essentially 100 percent of the supply for 24 months (either 100 percent of the supply was from the Sweetwater Reservoir or the SDCWA aqueduct supply was less than 5 MG for the month). During 33 of the 72 months the raw water influent was a blend of both sources.

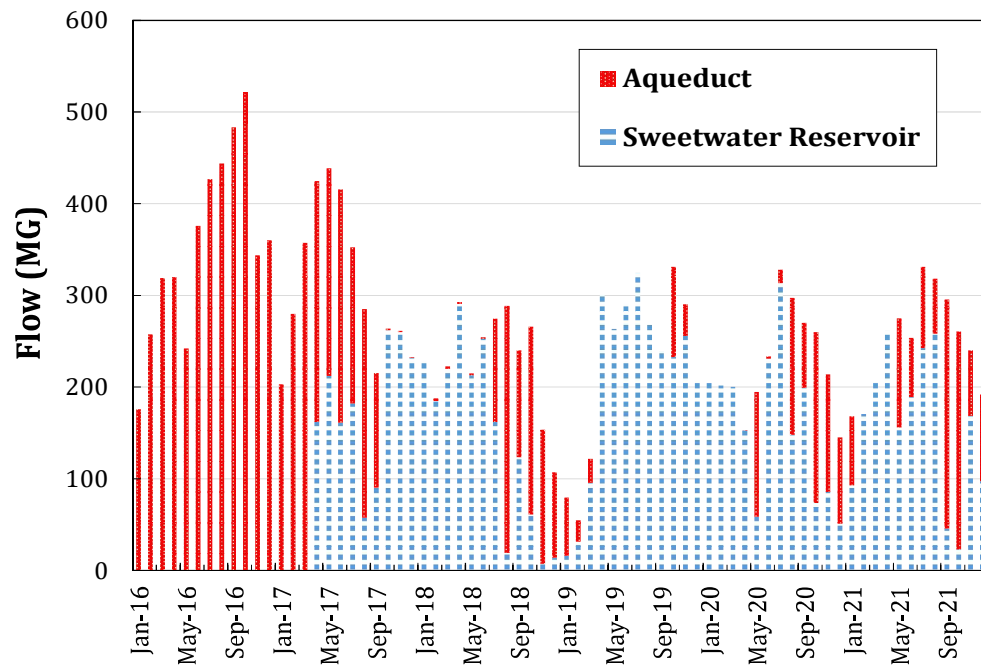


Figure 3.1 Monthly Raw Water Supply to the Perdue WTP (2016 to 2021)

Future requirements for flow demand were also reviewed. San Diego Association of Governments (SANDAG) was contacted to understand population growth projections in the service area Perdue WTP serves. Table 3.1 displays the population growth projections.

Table 3.1 SANDAG Population Projects and Water Demand

Year	Population
2020	197,058
2030	211,296
2040	226,700
2050	228,414

In addition to the Perdue WTP, the service area also receives water from the National City wells and the Reynolds Groundwater Desalination Facility. Table 3.2 displays the breakdown of production from October 2015 through April 2022 from the three different sources.

Table 3.2 Authority Water Production by Source October 2015-April 2022

Metric	Perdue WTP (mgd)	National City Wells (mgd) ⁽¹⁾	Reynolds Desalination Facility (mgd)	Total Production (mgd)
Average	8.72	1.59	5.56	15.19
Maximum	21.13	2.21	9.16	24.81
99th Percentile	17.89	2.15	8.74	21.72
90th Percentile	13.59	2.02	7.91	19.06
50th Percentile	8.82	1.81	5.65	15.50
5th Percentile	2.11	0.00	2.43	9.98

Notes:

(1) Includes periods non-use.

Based on the overall production numbers between 2015 and 2022, the Perdue WTP's 30 mgd capacity should be sufficient to meet population demands through 2050 as well as cover demands from the National City wells and Reynolds Groundwater Desalination Facility in the event they cannot produce water. This is evidenced by the projected population increase of 16 percent between 2020 and 2050, which would result in a linear maximum system demand of 28.8 mgd.

3.3 General Water Quality Parameters

Table 3.3 presents a summary of general water quality parameters for Sweetwater Reservoir, the SDCWA Aqueduct raw water supply, and the Perdue WTP clear well effluent from 2016 through 2021. Sweetwater Reservoir has higher average levels of alkalinity, total hardness (both supplies would be considered a hard water), color, and turbidity, and a much higher level of bromide and TOC, which contribute to TTHM formation, as compared to the SDCWA Aqueduct supply.

Table 3.3 General Water Quality Parameters Raw Water (2016 to 2021)

Parameter	Sweetwater Reservoir			SDCWA Aqueduct		
	Minimum	Maximum	Average	Minimum	Maximum	Average
pH	7.6	8.8	8.2	7.9	8.2	8.0
Conductivity (μ S)	866	2,248	1538	510	1,000	839
Alkalinity (mg/L as CaCO ₃)	143	238	193	90	130	120
Total Hardness (mg/L as CaCO ₃)	241	482	338	140	290	241
Calcium Hardness (mg/L as CaCO ₃)	119	208	156	87	192	152
Chloride (mg/L)	140	430	233	60	99	87
Bromide (μ g/L)	300	1,000	590	ND	130	60
Sulfate (mg/L)	84	224	143	74	234	175
Color (units)	20	150	57	1	5	2.9
Turbidity (NTU)	1.27	16	8.1	0.28	1.49	0.64
TOC (mg/L)	6.9	20.3	10.4	1.0	7.1	2.6

3.4 Title 22 Review

To prepare this assessment, 10 years of Title 22 compliance data (inorganic chemicals), VOCs, SOCs, RADs, and secondary MCLs for Sweetwater Reservoir and the Perdue WTP were downloaded from the State of California’s online water quality database¹. The data was then organized and presented in tables. Appendix A presents the tables with Title 22 compliance monitoring results for Sweetwater Reservoir and the Perdue WTP. Low levels of a few inorganic chemicals were detected in Sweetwater Reservoir, and, at the Perdue WTP, all results were well below their respective MCLs. No VOCs or SOCs were detected in Sweetwater Reservoir.

3.5 Taste and Odor Compounds

Geosmin and 2-methylisoborneol (MIB) are products of algal activity in surface water sources and are very common in surface waters throughout California. These chemicals can impart objectionable taste-and-odor into the water at ng/L levels. Table 3.4 presents general guidelines for consumer responses (Table 3.4 presents suggested guidelines for MIB only as it is more difficult than geosmin to remove).

Table 3.4 General Guidelines for MIB in Drinking Water

MIB (ng/L)	Response
<5	Most customers unlikely to detect.
5 to <10	Small portion of population can detect an “earthy” smell.
10 to <20	Most customers can detect smell, may contact utility.
>20	Virtually all customers can detect the “earthy” smell and taste.

¹ <https://sdwis.waterboards.ca.gov/PDWW/>

Figures 3.2 and 3.3 presents available results for geosmin and MIB, respectively, for Sweetwater Reservoir from February 2015 to August 2021. During this period, geosmin ranged from ND to >100 ng/L, with an average of 6.8 ng/L. MIB results ranged from ND to 23.5 ng/L with an average of 0.4 ng/L.

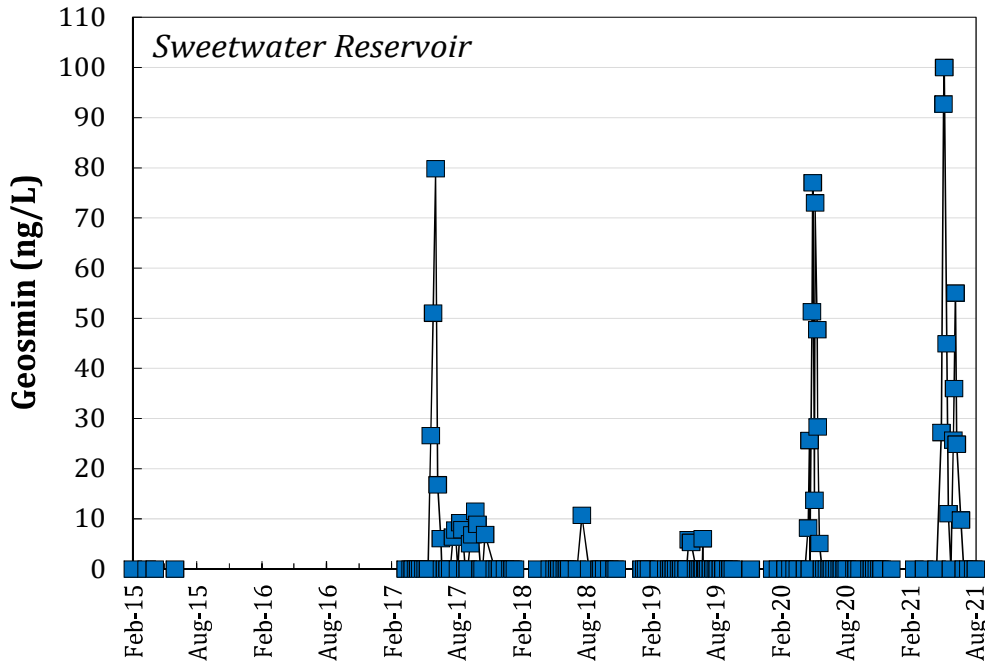


Figure 3.2 Geosmin in Sweetwater Reservoir (ng/L)

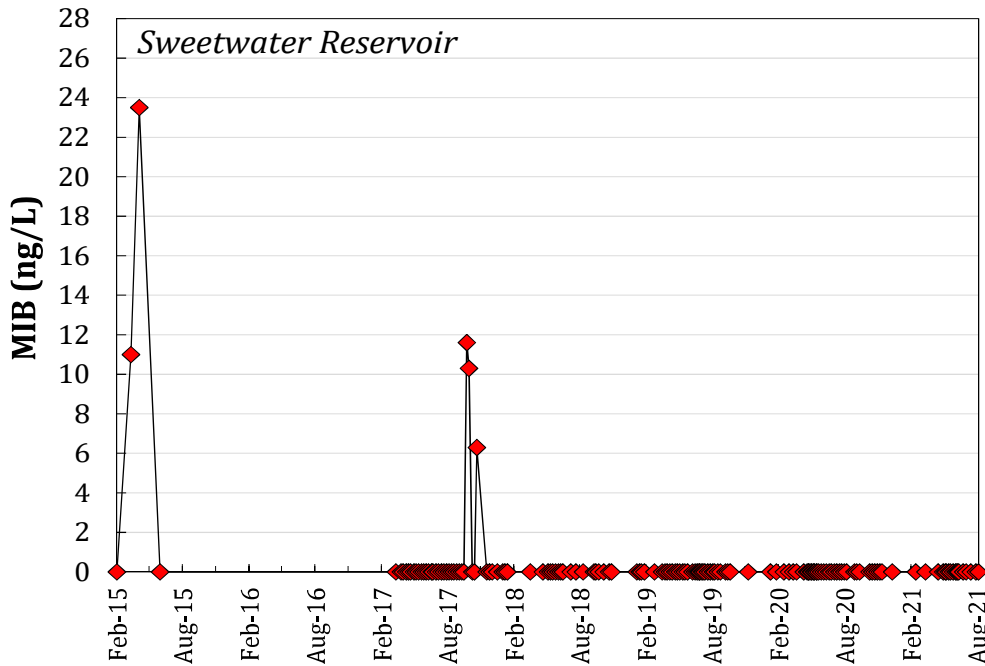


Figure 3.3 MIB in Sweetwater Reservoir (ng/L)

The Authority has authorization to apply aquatic pesticides to Sweetwater Reservoir under the SWRCB's National Pollutant Discharge Elimination System (NPDES) General Permit CAG990005, Water Quality Order No. 2013-0002-DWQ. The Authority prepared an Aquatic Pesticide Application Plan and, each year, prepares an annual report indicating whether or not pesticides were applied to Sweetwater Reservoir (if pesticides were applied during the year, the Authority reports the amount of algaecide applied and conducts the required monitoring).

During 2016 through 2019, no algaecides were applied to Sweetwater Reservoir. Due to an increase in cyanobacteria and levels of geosmin, during May 2020, 500 pounds of copper sulfate and 240 pounds of citric acid as a chelating agent were applied. Similarly, due to an increase in cyanobacteria and levels of geosmin during 2021, 542 pounds of copper sulfate were applied in May 2021, and 517 pounds of copper sulfate were applied in June 2021. Water quality monitoring indicated compliance with all terms and conditions of NPDES Permit No. 2013-0002-DWQ, and no negative water quality impacts were observed.

Figure 3.4 and Figure 3.5 present the application of copper sulfate during 2020 and 2021, respectively. Also presented in Figure 3.4 and Figure 3.5 are levels of a primary cyanobacteria of concern (*Anabaena circinalis*) before and after application of copper sulfate. As indicated, the application of copper sulfate was effective in reducing the levels of cyanobacteria.

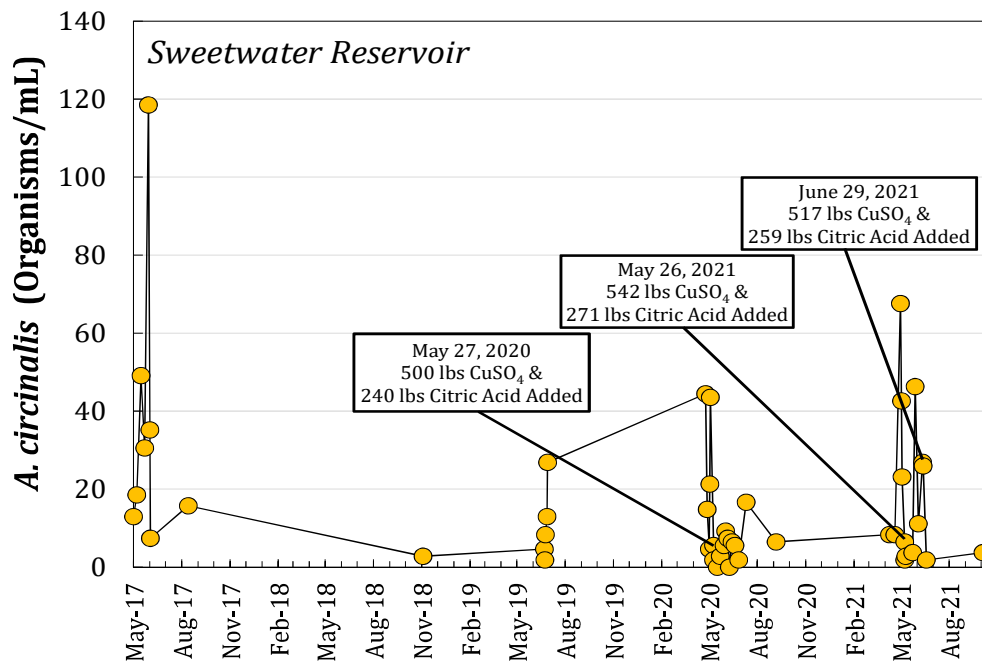


Figure 3.4 Application of Copper Sulfate to Sweetwater Reservoir (2020)

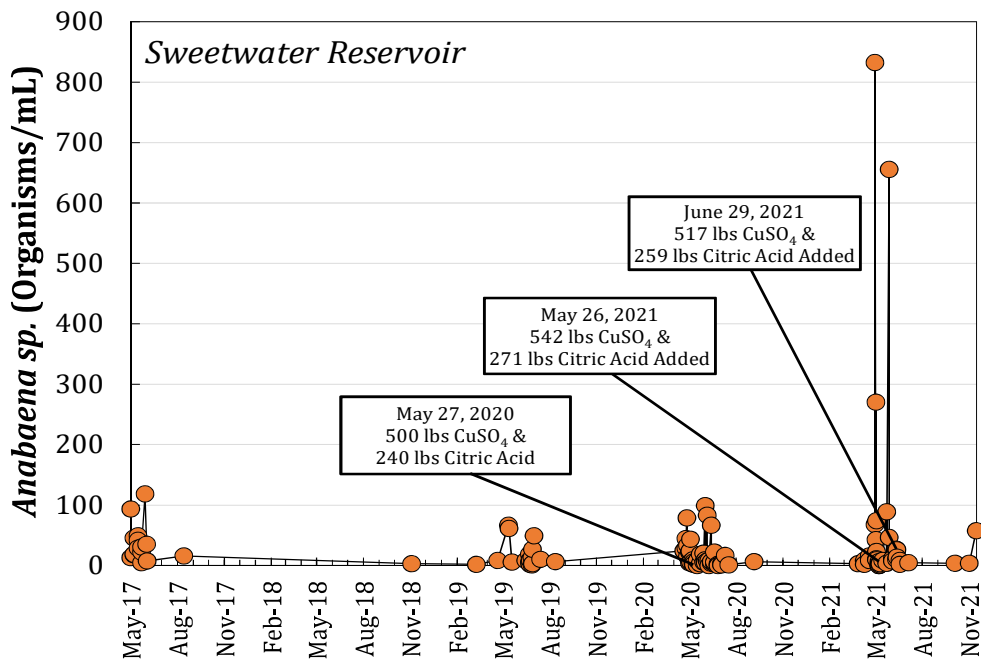


Figure 3.5 Application of Copper Sulfate to Sweetwater Reservoir (2021)

3.6 Raw Water Total Coliforms and *E. coli*

Table 3.5 presents a summary of the total coliforms and *E. coli* results for Sweetwater Reservoir and the SDCWA Aqueduct during 2016 through 2021. The average levels of total coliforms and *E. coli* in the SDCWA Aqueduct are lower than the average values for Sweetwater Reservoir.

Table 3.5 Total Coliform and *E. coli* in Sweetwater Reservoir and SDCWA Aqueduct Raw Water (2016 to 2021)

Sample Point	Total Coliforms (cfu/100 mL)			<i>E. coli</i> (cfu/100 mL)		
	Minimum	Maximum	Average	Minimum	Maximum	Average
Sweetwater Reservoir	ND	29,833	627	ND	350	23
SDCWA Aqueduct	ND	13,010	126	ND	2	0.04

Notes:
Abbreviation: cfu/100 mL - colony forming units per 100 milliliters.

Figure 3.6 and Figure 3.7 present the monitoring results for total coliforms for Sweetwater Reservoir and the SDCWA Aqueduct, respectively. During this period of time, there were 22 weekly samples where the total coliforms in Sweetwater Reservoir were greater than 1,000 cfu/100 mL and less than 10,000 cfu/100 mL (and would thus trigger a requirement to achieve one additional log inactivation of *Giardia* and virus, if Sweetwater Reservoir were being used as a source. During the same period of time there were six weekly samples with total coliform results greater than 10,000 cfu/100 mL. Those results would trigger a requirement for two additional logs of reduction for both *Giardia* and virus if Sweetwater Reservoir were being used as a source.

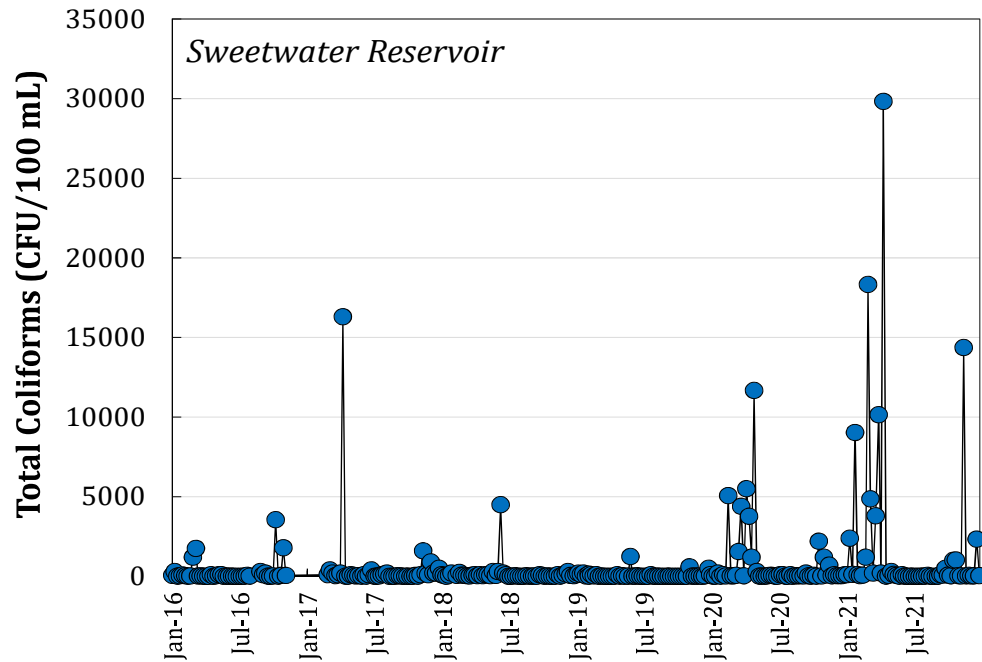


Figure 3.6 Total Coliforms in Sweetwater Reservoir (2016 to 2021)

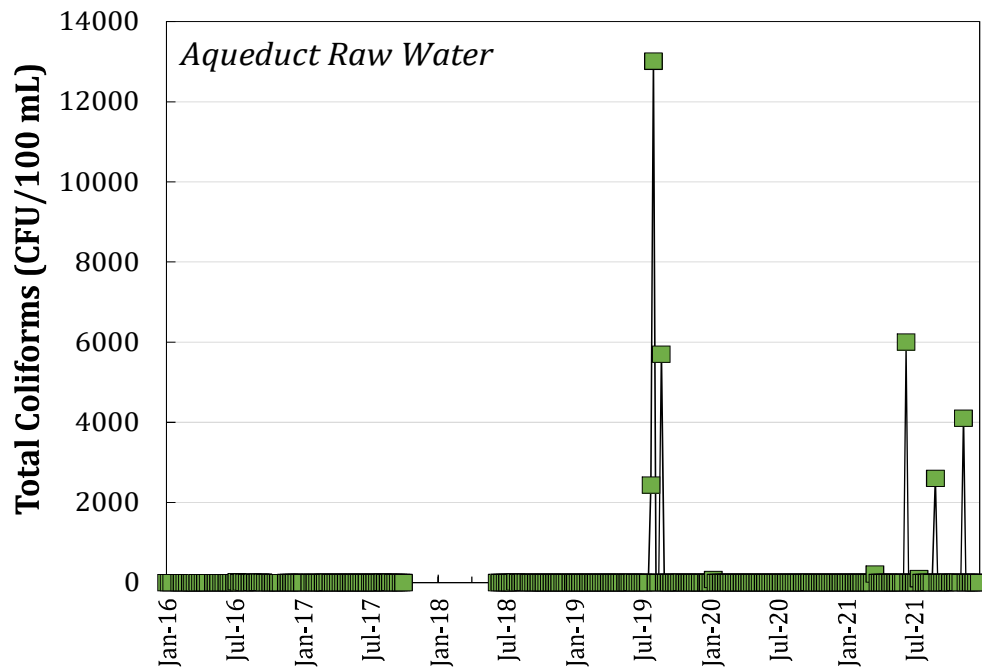


Figure 3.7 Total Coliforms in Aqueduct Raw Water (2016 to 2021)

Figure 3.8 and Figure 3.9 present the monitoring results for *E. coli* for Sweetwater Reservoir and the SDCWA Aqueduct, respectively. There were no periods when the *E. coli* concentrations in the SDCWA Aqueduct supply were greater than 20 cfu/100 mL. Thus, there were no weekly samples that would have triggered a requirement for additional log reductions of *Giardia* and viruses.

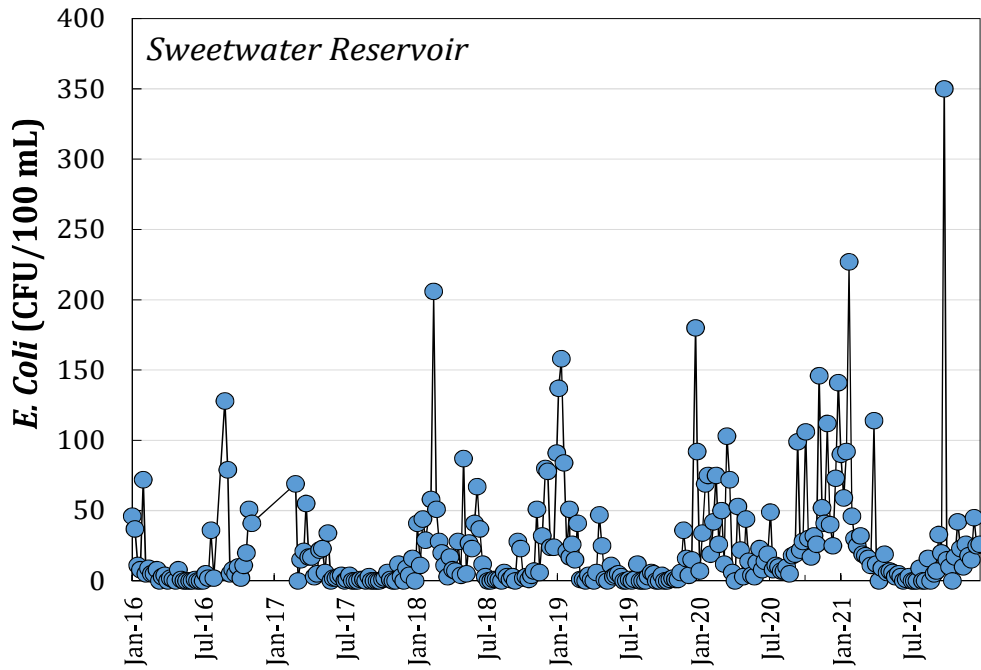


Figure 3.8 *E. coli* Sweetwater Reservoir (2016 to 2021)

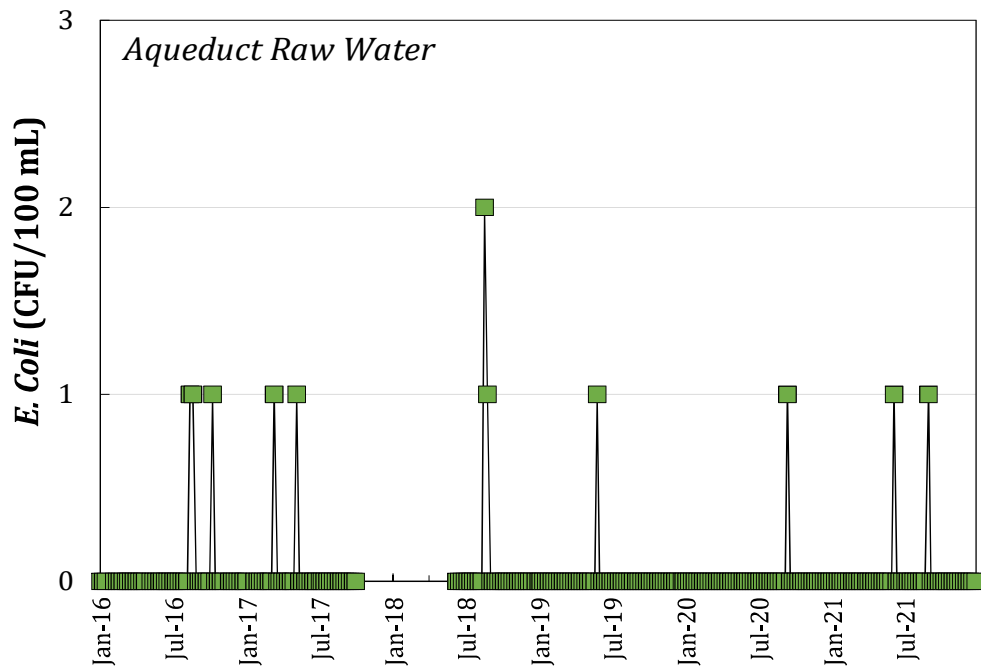


Figure 3.9 *E. coli* Aqueduct Raw Water (2016 to 2021)

As described earlier in this review, the DDW has established required levels of treatment for *Giardia* and viruses for the Perdue WTP based on the levels of total coliforms and *E. coli*, and whether the source water is from Sweetwater Reservoir, the SDCWA Aqueduct, or a blend of the two sources. The Authority has procedures in place to comply with the DDW's requirements.

3.7 *Cryptosporidium*

Authority staff provided a database with 20 years of monitoring results for *Giardia* and *Cryptosporidium* in Sweetwater Reservoir and the raw SDCWA Aqueduct supply. No *Giardia* cysts have been detected in the SDCWA Aqueduct supply, and a single *Giardia* cyst was detected in Sweetwater Reservoir (in 2004). During the first and second rounds of source water *Cryptosporidium* monitoring required under the LT2ESWTR, the Perdue WTP was placed in Bin 1, and no additional treatment for *Cryptosporidium* is required. Twenty years of historical monitoring does not indicate any needed additional treatment due to *Cryptosporidium*.

3.8 Cyanotoxins

The Authority conducted monitoring for cyanotoxins during 2019 (samples were collected from the Perdue WTP clear well effluent during April, May, June, and July of 2019 as part of the fourth Unregulated Contaminant Monitoring Rule (UCMR 4) monitoring. Samples were tested for total microcystin, cylindrospermopsin, and anatoxin-a. All results were ND.

3.9 Enhanced Coagulation

Authority staff employ all of the steps described in the enhanced coagulation requirement in order to maintain continued compliance. Each month staff collect monthly paired samples to determine if the needed percent reduction of TOC (as presented in Table 2.4) has been achieved. Authority staff also employ alternative compliance criteria (i.e., SUVA) and conduct quarterly jar testing to determine a PODR.

3.10 Disinfection Byproducts

The Authority collects quarterly samples for THMs and HAA5 at the Perdue WTP clear well effluent and at 10 locations throughout the distribution system. The Authority identified 8 of the 10 distribution system locations as representing 100 percent treated water from the Perdue WTP.

Figure 3.10 and Figure 3.11 present the quarterly results for THMs and HAA5, respectively, for the Perdue WTP clear well effluent. Beginning in May 2019, there was an increase in the quarterly THMs up to a maximum value of approximately 65 µg/L in November 2019.

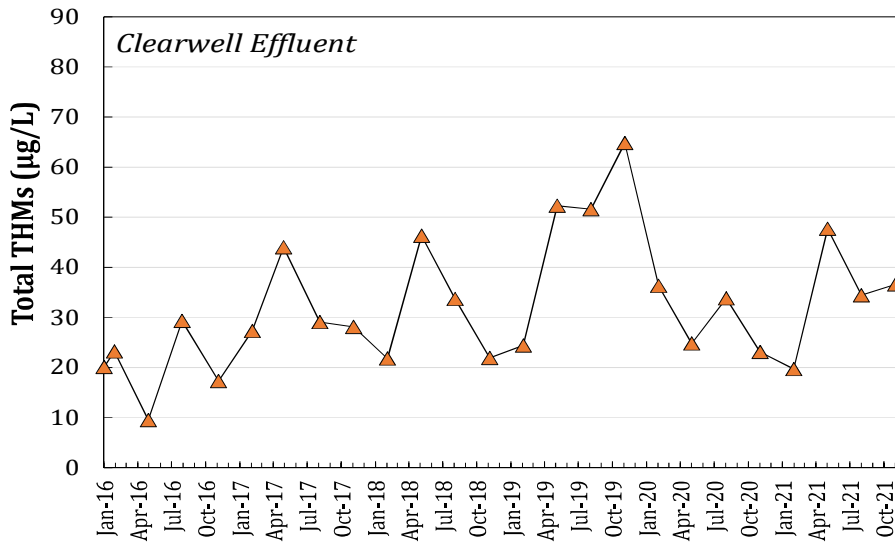


Figure 3.10 Perdue WTP Clear Well Effluent Quarterly THMs (2016 to 2021)

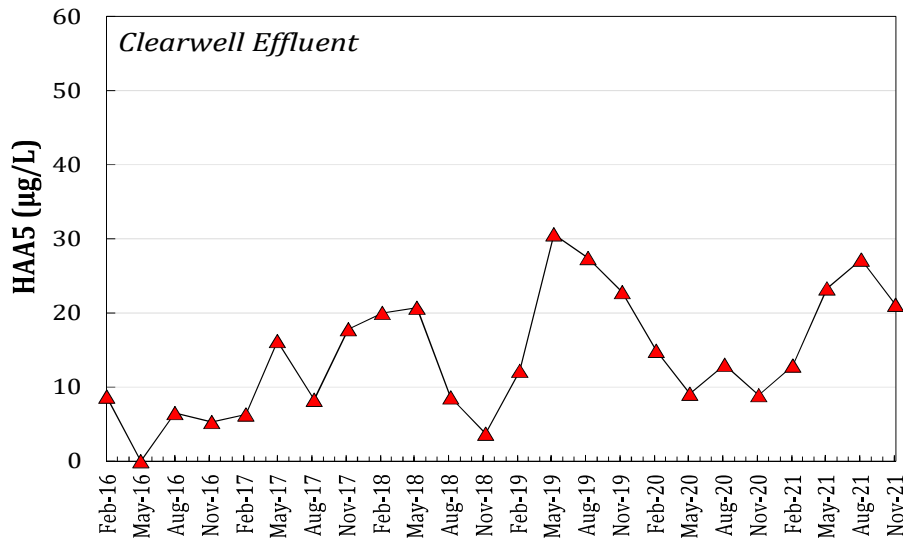


Figure 3.11 Perdue WTP Clear Well Effluent Quarterly HAA5 (2016 to 2021)

Compliance with the MCLs for THMs and HAA5 is based on a quarterly LRAA at each distribution system location.

Figure 3.12 presents the THM LRAA results for the eight distribution system compliance locations that are 100 percent treated water from the Perdue WTP. Each figure includes a red horizontal line highlighting the THM MCL of 80 µg/L. All of the calculated THM LRAAs are well below the MCL. The maximum individual quarterly result was 63.5 µg/L, and the maximum LRAA during the six-year period was 55 µg/L.

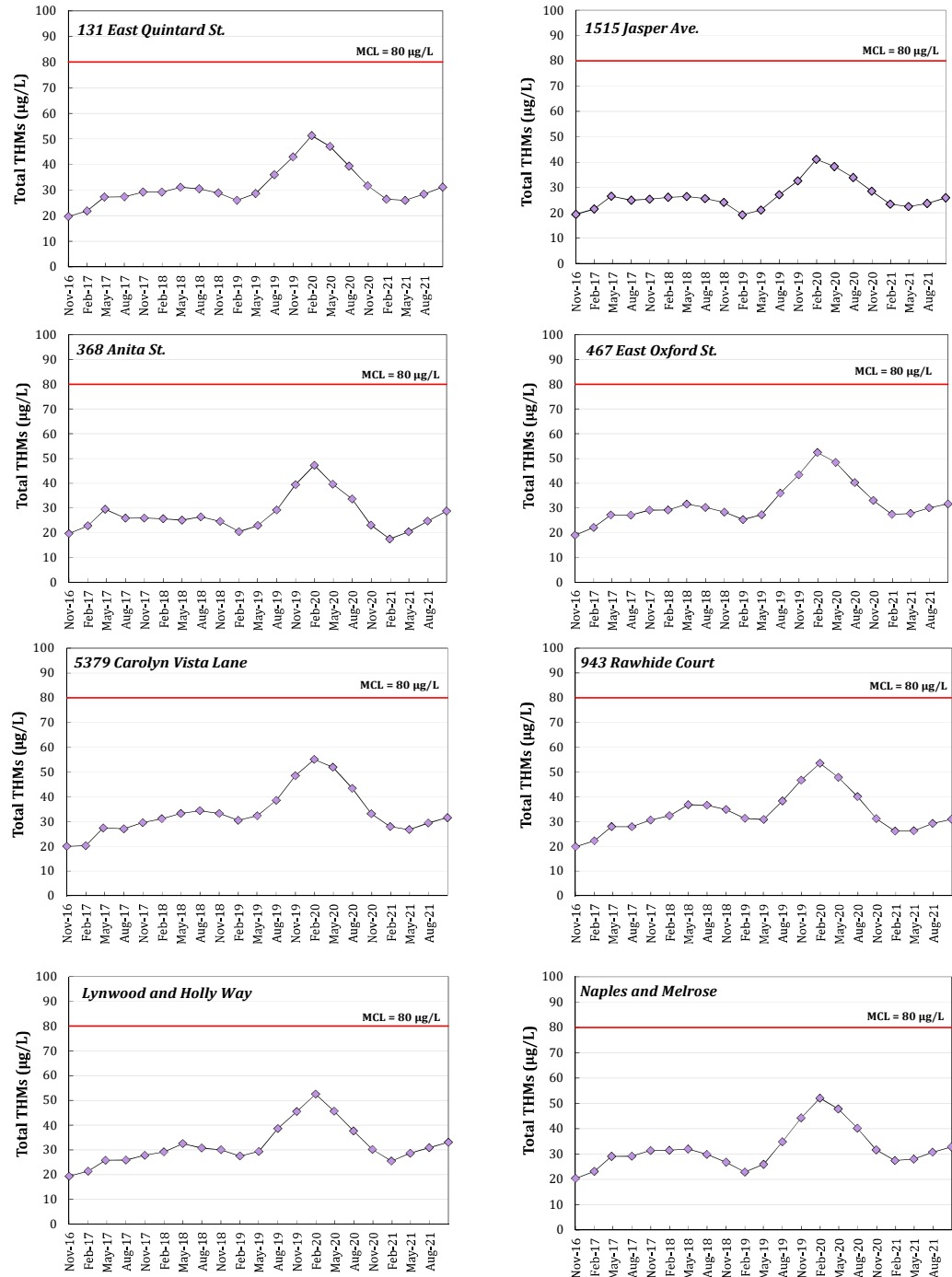


Figure 3.12 THM LRAA Results at Eight Distribution System Locations (2016 to 2021)

Figure 3.13 presents the HAA5 LRAA results for the eight distribution system compliance locations that are 100 percent treated water from the Perdue WTP. Each figure includes a red horizontal line highlighting the HAA5 MCL of 60 µg/L. All of the calculated HAA5 LRAAs are well below the MCL. The maximum individual quarterly result was 40 µg/L, and the maximum LRAA during the six-year period was 30 µg/L.

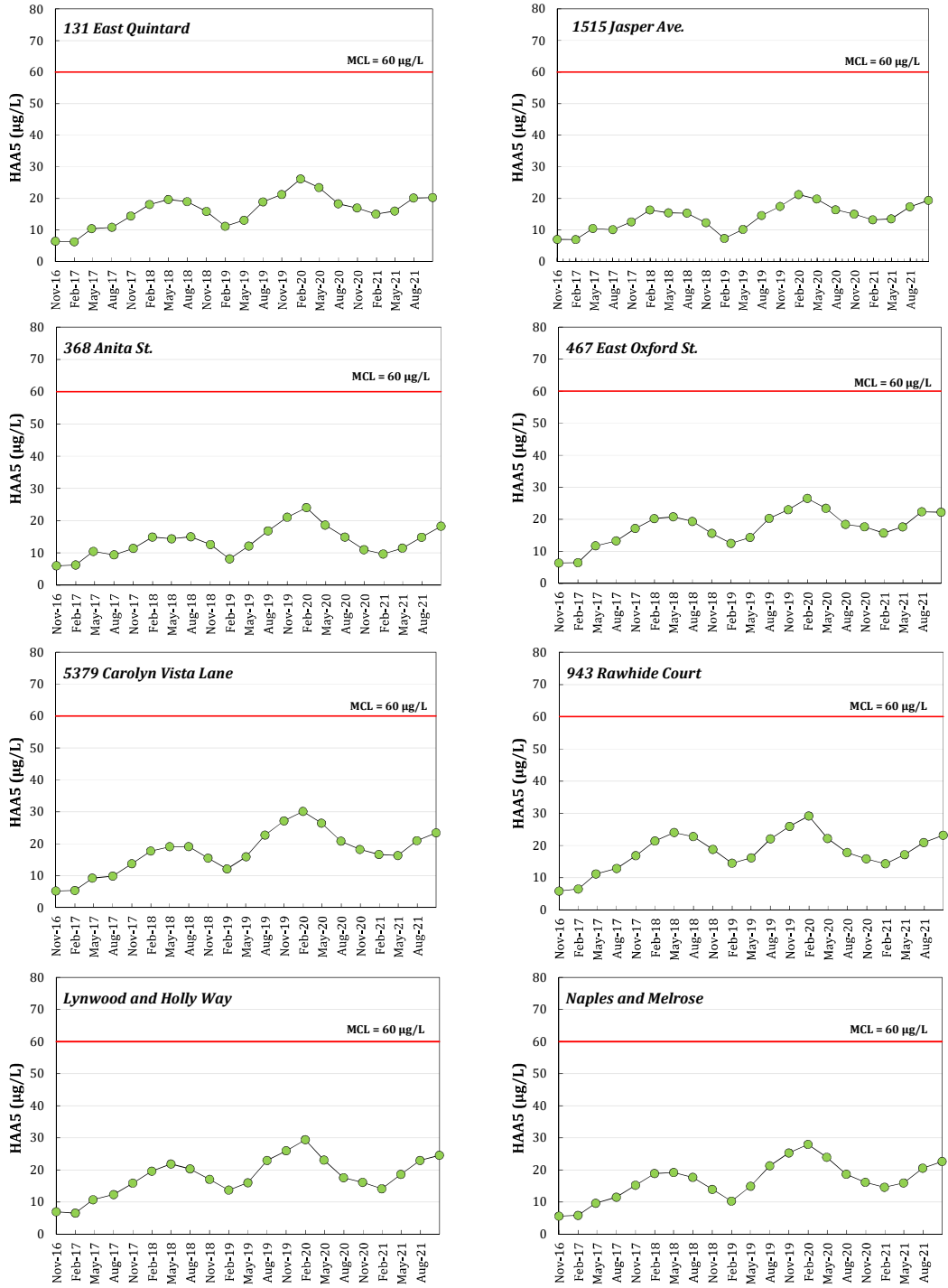


Figure 3.13 HAA5 LRAA Results at Eight Distribution System Locations (2016 to 2021)

3.11 Per- and Polyfluoroalkyl Substances

Currently the Authority does not have any sampling data on PFAS compounds in Sweetwater Reservoir. Common treatment techniques for PFAS include adsorption through granular activated carbon (GAC) or ion exchange systems. Based on an assumed concentration range of 0 to 50 ng/L of PFAS and the 30-mgd capacity flow, a treatment system is projected to cost between \$35,000,000 and \$40,000,000. Sampling and piloting for future removal is recommended to determine the best technologies and refine design criteria for the facility if required to move forward with removal. The Authority will be required to conduct monitoring for PFAS in Sweetwater Reservoir during the UCMR 5 monitoring program.

3.12 UCMR 4 Monitoring Results for HAA6 and HAA9

The Authority completed four quarters of distribution system monitoring for HAA6 and HAA9 under the UCMR 4 program. The results are presented in Table 3.6. As the NDWAC M/DBP Working Group begins the process to review and evaluate recommendations for revising the M/DBP rules, there is a good chance there will be interest in modifying the current HAA5 MCL with a recommendation that the EPA adopt an MCL for HAA6 or HAA9. Based on the results presented in Table 3.6, if the EPA does establish an HAA6 or HAA9 MCL in the future, and if compliance continues to be based on a running annual average of quarterly results at each location (and not on individual quarterly results), the Perdue WTP will likely not be impacted.

Table 3.6 Authority UCMR 4 HAA6 and HAA9 Monitoring Results

Location	HAA6 (µg/L)			HAA9 (µg/L)		
	Minimum	Maximum	Average	Minimum	Maximum	Average
131 East Quintard Street	5.2	34.5	18.7	7.5	57.1	33.3
1515 Jasper Avenue	3.3	32.1	16.5	4.3	51.1	28.8
368 Anita Street	4.5	29.5	15.9	5.9	51.2	28.4
467 East Oxford Street	6.4	36.3	19.9	9.3	59.0	35.4
5379 Carolyn Vista Lane	7.8	39.5	21.6	13.3	66.4	38.6
943 Rawhide Court	8.2	36.5	20.6	14.1	59.4	36.7
Lynwood Drive and Holly Way	8.9	39.6	21.8	13.7	64.6	38.4
East Naples Street and Melrose Avenue	6.6	36.1	19.4	9.4	59.8	34.7

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Chapter 4

FACILITY CONDITION ASSESSMENT

4.1 Introduction

This chapter provides a summary of the condition assessment performed at Perdue WTP. Asset condition is reviewed by process area and asset risk assessment is provided with discussion on assessment basis and a review of critical assets.

4.2 Methodology

Before visiting the Perdue WTP and performing the condition assessment, project engineers were provided with record drawings and previous studies to review and understand the facility. Forms were developed prior to the assessment by discipline to focus on different aspects of the assessment. The forms included common questions specific to each engineering discipline and were used to identify potential condition issues for each asset.

An initial trip to the facility was made to walk the site, discuss operations, and understand any issues that may require a closer look prior to the assessment. The Perdue WTP condition assessment took place April 20, 2022, by project engineers with assistance from Authority staff. Staff was available to answer questions and provide insight for asset replacement and maintenance. Table 4.1 represents the project engineers and staff involved with the condition assessment.

Table 4.1 Carollo and Sweetwater Staff Members

Project Personnel	Affiliation	Role
Justin Brazil	Authority	Director of Water Quality
Mark Hatcher	Authority	Water Treatment Superintendent
Davis Doane	Authority	Plant Maintenance Supervisor
Jim Meyerhofer	Carollo	Project Manager
Jeff Weishaar	Carollo	Electrical/Instrumentation
Brian Owen	Carollo	Process Mechanical

During the assessment, notes and photographs were used for documentation, and asset conditions were scored from 1 to 5 with a score of “1” indicating “Very Good” equating to a brand new condition and a “5” indicating “Very Poor” equating to replacement is recommended. Table 4.2 provides each possible score with the description.

Table 4.2 Asset Condition Ranking Scale

Ranking	Description	Percent Requiring Rehabilitation ^(1,2)
1-Very Good	Brand new condition	0 percent
2-Good	Performing well, routine maintenance only	0-10 percent
3-Fair	Requires increased maintenance	11-20 percent
4-Poor	Rehabilitation or replacement needed	21-50 percent
5-Very Poor	Unserviceable (replacement needed)	>50 percent

Notes:

(1) Adapted from the International Infrastructure Management Manual.

(2) Percent of the value of the asset needed to return the asset to a condition 1.

4.3 Condition Assessment Findings

The following section provides a summary of findings by process area. Condition assessment forms can be found in Appendix B, and recommendations for potential projects to address some of the items identified here are discussed in more detail in Chapter 5.

4.3.1 Intake Pump Station

The intake pump station consists of the intake tower located in the reservoir, five vertical turbine intake pumps, two surge tanks, and an air compressor. The intake tower is original to the dam's construction going back to 1888 with modification in 1910. Due to solids deposition in the reservoir, two lower elevations are buried at elevations 30 foot and 20 foot. There is little resolution between the intake cups spaced at 10-foot elevation intervals. To target an elevation between cups, Operations staff require divers and operational personnel on boats to bring spool pieces to target a specific water surface elevation. To withdraw from between cups, Operations staff installs spools on the intake cups that provide 2.5-foot resolution. Cups below the active intake require sealing by specialized divers to prevent seepage into the plant intake from lower levels of the reservoir.

The pumps are well maintained and operate as intended. Minor rusting was seen on supports, and it was noted that the impellers were not inspected. The pumps are limited on turndown and there is a desire to install a VFD on pumps 1 and 2 to increase the ability to dial in blends with the raw aqueduct supply, lower the intake flow, and keep the plant operational rather than shutting down the plant during low flow or blending. The surge system showed no issues as the compressor was replaced in 2013, and no issues were identified with either surge tank. It was noted that cobble-sized rocks were sliding toward the intake surge tank.

4.3.2 Dissolved Air Flotation

The DAF system includes four trains each equipped with two VFD-driven flocculators, a sludge pump, and a recycle pump. The DAF system also incorporates common equipment including two saturators, two air compressors, and one air receiver. The DAF system was installed in 2011, and the entirety of the system is in good condition. The flocculators, which were part of the previously existing flocculation system prior to the DAF system addition, had motors and shafts replaced when the DAF system was constructed. No significant issues were identified with this equipment. Minor issues were noted such as a historic oil leak from the saturation compressor and actuator issues with the saturator tanks. All pumps and piping were in good shape and worked well according to Authority staff.

4.3.3 Filtration

The facility has four identical filters that typically all operate regardless of flow rate. Operations staff noted filter block underdrains are inspected every five years, and the filters operate well. Media consists of anthracite and sand, and current filter run times range between 75 and 300 hours, depending on treatment source and water quality, indicating efficient pretreatment. Filter media beds are inspected annually. Improvements were made to the pipe gallery during 2011 upgrades. All piping and valves function properly and look to be in good condition.

The filter washwater system is comprised of two washwater supply pumps located at the clear well, a washwater tank, a master control valve, and air scour blower. There were no reported issues with the system. The washwater pumps that fill the washwater tank were originally sized for six washes per day. With filter run times between 75 and 300 hours, the requirement for washes per day has decreased, leaving the pumps to be oversized. The Authority would like to evaluate a VFD to fill the washwater tank over a longer period of time for energy efficiency as identified by the DHK Engineering Inc.'s energy management audit. The air scour blower was in pristine condition with no issues.

4.3.4 Chemical Systems

There are a number of chemicals present at the facility, including chlorine gas, aqueous ammonia, chlorine dioxide, cationic polymer, ferric chloride, ferrous chloride, fluorosilicic acid, and caustic soda. The chlorine gas building housing equipment, such as 1-ton chlorine cylinders, evaporators, and chlorinators, were all in good condition. It was noted that there was no emergency gas scrubber in the event chlorine gas was to be inadvertently released. Operations staff also noted that the existing chlorinators are unable to turndown sufficiently during low-flow events, limiting dosing flexibility.

The chlorine dioxide generation system is also located in the chemical building. The system utilizes chlorine gas in combination with sodium chlorite for chlorine dioxide generation. The generation system is under a service contract and in good condition. Day tank and metering pumps located in the basement level were also found to be in good condition.

The remaining chemicals are located at the chemical tank farm. Evidence of previous ferric/ferrous leaks was noted in the containment areas, but no current leaking issues were identified. The fluorosilicic acid containment area was noted to have signs of previous chemical deposits on the hanging partitions, but there were no other signs of chemical leaking. The aqueous ammonia system did not have any odors associated with the chemical, indicating the scrubber tank was working effectively. Remaining gear pumps used for chemical metering in the chemical building basement level were all in good condition. It was noted that the Authority has two spare 6,000-gallon fiber-reinforced tanks in the tank farm and spare pumps and piping setup in the basement for potential future use. Caustic tanks located next to the clear well structure were observed to be in good condition with insulation intact. Pumps were noted to be rebuilt annually by Operations staff.

4.3.5 Ancillary Systems

4.3.5.1 Plant Water and Air

The plant water and air system were observed to be aged but in good condition with no apparent operational issues. Operations staff noted the plant water pump heads were recently replaced; however, the system piping has had no inspections, and the system hasn't been upgraded since

the original installation, leading to flow and pressure limitations. The associated systems surge tank was also noted to exhibit rust at the foot supports. The plant air compressor and receiver tank were noted to be in good condition.

4.3.5.2 Hydroelectric station

The hydroelectric station accepts water from the aqueduct to produce electricity. The station contains two hydroelectric turbines, valving, piping and associated electrical equipment. The system is in good condition and is well maintained. Operations staff noted that parts for the system can be long lead.

4.3.6 Electrical Distribution

The electrical distribution system at the facility is comprised of four motor control centers (MCCs) and two standby generators. The most recent project in 2011 installed the latest MCC and a new standby generator that are in good condition. The other three MCCs and standby generator are original but still in good condition. Associated fuel storage with the generators were not noted to have any issues.

4.4 Risk Assessment

4.4.1 Original Useful Life

The original useful life (OUL) of an asset represents the amount of time it is estimated to function properly under standard maintenance before becoming unserviceable. The estimated lives of each asset were based upon both technical experience and industry trends. The OULs used in the risk assessment are shown in Table 4.3. The OULs were used in conjunction with the condition scores to produce an evaluated remaining useful life (EvRUL) for each component, resulting in a vulnerability rating for each component.

Table 4.3 OUL

Category	OUL
Chemical Equipment	15
Civil/Sitework	50
Electrical	30
Heating, Ventilation, and Air Conditioning	15
Instrumentation	15
Mechanical	20
Pump/Compressor	15
Structural - Concrete	50
Structural - Fiberglass	25
Structural - Plastic	10
Structural - Steel	25
Valve	35

4.4.2 Remaining and Evaluated Remaining Useful Life Estimates

The remaining useful life (RUL) estimate is a straight line calculation of the years remaining based on the installation date, OUL, and the current year. A separate estimate, called the EvRUL is calculated for each component based on the OUL and the condition scores. The EvRUL ignores the original installation date of the asset and is calculated according to the following:

$$\text{EvRUL} = \text{Condition Fraction} \times \text{Original Useful Life}$$

The Condition Fraction is based on the condition score, as shown in Table 4.4. The EvRUL is typically a more representative estimate of the true RUL of an asset, as it is based on the current observed condition of the asset and recognizes that most assets will outlive their OUL with proper maintenance.

Table 4.4 Condition Fractions

Condition Rating	Condition Fraction
1	1
2	0.9
3	0.8
4	0.6
5	0.1

4.4.3 Criticality Assessment

The criticality of each asset is an essential element to evaluate the consequence of asset failure throughout the facility. Four criticality categories were selected for the Authority’s assets. Table 4.5 presents the criticality matrix used to rate each asset.

Table 4.5 Criticality Matrix

Criticality Category	Weight	Description	Rating
Health and Safety of Public and Employees	15%	No injuries or adverse health effects	1
		No lost-time injuries or medical attention	4
		Lost-time injury or medical attention	7
		Potential for loss of life	10
Financial Impact	35%	Informal purchase (\$1 to \$1000)	1
		Informational bid required for materials, supplies, maintenance, and non-professional services (\$10,000 to \$50,000)	4
		Requires General Manager approval (\$50,000 to \$75,000)	7
		Requires Board approval, new borrowing, or impacts rates (> \$75,000)	10

Criticality Category	Weight	Description	Rating
Impact on Environment or Regulatory Compliance	25%	100% compliance with permits and no impact on environment	1
		Violation but no enforcement action and/or minor impact on environment	4
		Violation with minor enforcement action and/or moderate impact on environment	7
		Enforcement action with fines and/or major impact on environment	10
Effect on Service to Customers	25%	No impacts on service delivery; redundant asset available or service restored in <2 hours	1
		Minor disruption; service restored in 2 to 8 hours	4
		Short-term impact and/or substantial disruption; Service restored in 8 to 24 hours	7
		Long-term impact and/or area-wide disruption; not able to restore service for >24 hours	10

Assets of most critical importance, based on the criticality assessment include the clear well, chlorine gas system, and power distribution at the top of the list.

4.4.4 Vulnerability Assessment

The vulnerability of an asset is defined as 10 times the inverse of the EvRUL. The inverse is multiplied by 10 to bring the vulnerability rating to a 10-point scale to match the same 10-point scale used in the criticality assessment.

4.4.5 Risk Assessment

The risk of asset failure considers the criticality, condition, and remaining life of each asset, and was used to help prioritize the need for asset rehabilitation or replacement. Risk is calculated as:

$$\text{Risk} = \text{Vulnerability} \times \text{Criticality}$$

The resulting risk assessment has produced a list of priority assets that should be rehabilitated, replaced, or monitored. These assets are used as the basis of creating capital improvement projects. Assets are grouped together according to process area or functionality to form larger projects that can then be compared to other capital improvement projects to determine budgeting and implementation needs. These assets are shown in Table 4.6 and listed according to risk ranking. Due to the overall good condition of the facility, the list has been trimmed to show the top 20 assets and recommendations.

Table 4.6 Priority Assets

No.	Process	Component	Condition	Risk	Project Recommendation
1	Clear Well	Clear Well	5	19.10	Replace
2	Chlorine Gas System	Chlorinator No. 1	2	5.52	Monitor Condition
3	Chlorine Gas System	Chlorinator No. 2	2	5.52	Monitor Condition
4	Chlorine Gas System	Chlorinator No. 3	2	5.52	Monitor Condition
5	Aqua Ammonia	Storage Tank	2	5.19	Monitor Condition
6	Chlorine Gas System	Evaporator No. 1	2	4.96	Monitor Condition
7	Chlorine Gas System	Evaporator No. 2	2	4.96	Monitor Condition
8	Fluoride	Storage Tank	2	4.63	Monitor Condition
9	Intake Pump Station	Raw Water Pump No. 3	2	4.19	Monitor Condition
10	Intake Pump Station	Raw Water Pump No. 4	2	4.19	Monitor Condition
11	Intake Pump Station	Raw Water Pump No. 1	3	3.83	Monitor Condition
12	Intake Pump Station	Raw Water Pump No. 2	3	3.83	Monitor Condition
13	Filter No. 1	Filter No. 1 Underdrain	2	3.81	Monitor Condition
14	Filter No. 2	Filter No. 2 Underdrain	2	3.81	Monitor Condition
15	Filter No. 3	Filter No. 3 Underdrain	2	3.81	Monitor Condition
16	Filter No. 4	Filter No. 4 Underdrain	2	3.81	Monitor Condition
17	Caustic Soda	Storage Tank No. 1	2	3.74	Monitor Condition
18	Caustic Soda	Storage Tank No. 2	2	3.74	Monitor Condition
19	Ferric Chloride	Storage Tank No. 1	2	3.74	Monitor Condition
20	Ferric Chloride	Storage Tank No. 2	2	3.74	Monitor Condition

A comprehensive list of all assets can be found in Appendix C.

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Chapter 5

PROJECT EVALUATIONS

5.1 Introduction

The Authority has identified a number of potential new projects with interest in future implementation. This section discusses the design criteria, spatial impacts, and opinion of cost.

5.2 Sodium Hypochlorite Alternatives

The Perdue WTP currently uses a gaseous chlorine system as a part of the disinfection system. The existing chlorine system is comprised of a storage room housing 1-ton cylinders, two evaporators, a pressure reducing/vacuum system, and chlorinators to deliver the targeted chlorine dose for chloramine generation. Additionally, the Perdue WTP uses the chlorine gas system to generate a chlorine dioxide solution from a mixture of chlorine, water, and sodium chlorite for pre-oxidation at the head of the treatment process.

Gaseous chlorine systems have additional safety considerations and requirements when compared to sodium hypochlorite. As part of this evaluation, the Perdue WTP was evaluated for the use of bulk 12.5 percent sodium hypochlorite and 0.8 percent sodium hypochlorite using onsite generation.

The use of 12.5 percent sodium hypochlorite is common for chlorine disinfection at water treatment facilities. Unlike chlorine gas, sodium hypochlorite only requires storage and metering pump equipment and the typical safety considerations that accompany them like secondary containment. The chemical strength can degrade and off gas if stored for extended periods, but there is no additional safety equipment required.

Onsite generation of 0.8 percent sodium hypochlorite uses the combination of a brine solution and electrolyzers to create a liquid-gas mixture of 0.8 percent sodium hypochlorite and hydrogen gas. Sodium hypochlorite is stored in bulk tanks and the hydrogen gas is diluted and vented to the atmosphere. Figure 5.1 demonstrates this process.

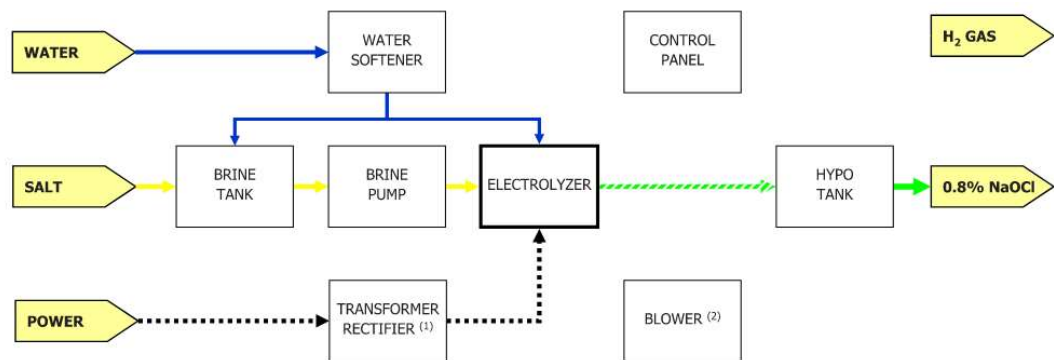


Figure 5.1 Onsite Sodium Hypochlorite Generation Diagram

Both systems, bulk and onsite generated sodium hypochlorite, were evaluated for design criteria and spatial impacts.

5.2.1 Design Criteria

The existing chlorine dose range and process flows were reviewed to determine design criteria for chlorine dosing requirements. Table 5.1 represents the chemical dose range and process flows.

Table 5.1 Chlorine Design Flows and Doses

Description	Unit	Minimum	Average	Maximum
Process Flow	mgd	6	8.8	30
Chlorine Dose	mg/L	0.5	6.5 ⁽²⁾	10.5 ⁽¹⁾

Notes:

- (1) Not used continuously.
- (2) Includes chlorine dioxide generation.

Chemical feed requirements were determined from the flow and chemical dose information. Table 5.2 displays the total requirement of chlorine in pounds per day (lb/day).

Table 5.2 Chlorine Chemical Requirements

Chemical	Unit	Minimum Dose, Minimum Flow	Average Dose, Average Flow	Maximum Dose, Maximum Flow	Average Dose, Maximum Flow
Total Chlorine	lb/day	25	478	2,629	1,628

The Perdue WTP uses chlorine for chloramines and generates chlorine dioxide onsite using the existing chlorine gas system. The total chlorine requirement is made up of these two applications. To determine the size of the chlorine dioxide system and chlorine demand, the applications were separated. Dose setpoint data provided by operations was used to size the chlorine dioxide generation system sizing requirement.

Table 5.3 represents chemical dose range and process flows for the chlorine dioxide system design.

Table 5.3 Chlorine Dioxide Design Flows and Doses

Description	Unit	Minimum	Average	Maximum
Process Flow	mgd	6	8.8	30.0
Chlorine Dioxide Dose	mg/L	0.6	1.6	2.0

Chlorine dioxide feed requirements were developed based on the flow and chemical doses.

Table 5.4 provides the usage for chlorine dioxide.

Table 5.4 Chlorine Dioxide lb/day Equivalent

Description	Unit	Minimum Dose, Minimum Flow	Average Dose, Average Flow	Maximum Dose, Maximum Flow	Average Dose, Maximum Flow
Chlorine Dioxide	lb/day	30	118	500	400
Chlorine Dioxide ⁽¹⁾	gpd	3	12	50	40

Notes:

Abbreviations: gpd - gallons per day.

(1) Based on 10 pounds per gallon.

The existing chlorine dioxide generation currently uses chlorine gas combined with sodium chlorite to generate chlorine dioxide onsite. If sodium hypochlorite is to be used, a new generation system will be required. The new system would require a mixture of sodium hypochlorite, sodium chlorite, and hydrochloric acid. Information from one of the leading manufacturers of chlorine dioxide generation equipment was used to estimate the quantities of chemicals required for the various chemical system options. Table 5.5 provides the precursor requirement for each component per pound of chlorine dioxide generated. Chlorine gas is included to represent the current operation.

Table 5.5 Precursor Requirements for 1 lb/day of Chlorine Dioxide Generated

Precursor	lb/day ⁽¹⁾	gpd ⁽¹⁾
12.5% Sodium Hypochlorite	5.7	0.56
0.8% Sodium Hypochlorite	85.4	10.23
Chlorine Gas ⁽²⁾	0.5	-
Hydrochloric Acid	3.6	0.42
Sodium Chlorite	5.6	0.55

Notes:

(1) Values shown reflect bulk solution.

(2) Reflects current operation.

Based on the required chemical ratios for chlorine dioxide and feed requirements, chemical usage for the Perdue WTP was determined and provided in Table 5.6.

Table 5.6 Precursor Requirements for Chlorine Dioxide at Perdue WTP

Precursor	lb/day ⁽¹⁾				gpd ⁽¹⁾			
	Minimum Dose, Minimum Flow	Average Dose, Average Flow	Maximum Dose, Maximum Flow	Average Dose, Maximum Flow	Minimum Dose, Minimum Flow	Average Dose, Average Flow	Maximum Dose, Maximum Flow	Average Dose, Maximum Flow
12.5% Sodium Hypochlorite	170	665	2,832	2,266	17	66	280	224
0.8% Sodium Hypochlorite	2,566	10,037	42,772	34,218	307	1,202	5,122	4,098
Chlorine Gas ⁽²⁾	16	63	265	212	-	-	-	-

Precursor	lb/day ⁽¹⁾				gpd ⁽¹⁾			
	Minimum Dose, Minimum Flow	Average Dose, Average Flow	Maximum Dose, Maximum Flow	Average Dose, Maximum Flow	Minimum Dose, Minimum Flow	Average Dose, Average Flow	Maximum Dose, Maximum Flow	Average Dose, Maximum Flow
Hydrochloric Acid	107	419	1,788	1,430	13	49	210	168
Sodium Chlorite	167	653	2,782	2,225	17	65	275	220

Notes:

- (1) Bulk solution.
- (2) Reflects current operation.

Based on the overall total requirements displayed in Table 5.2 and chlorine dioxide demand, the remaining chlorine demand was determined.

Table 5.7 provides the remaining chlorine requirement and total daily consumption between the two alternatives. The salt requirement for the 0.8 percent sodium hypochlorite generation was also provided.

Table 5.7 Chlorine Requirement Breakdown

Chemical	Unit	Minimum Dose, Minimum Flow	Average Dose, Average Flow	Maximum Dose, Maximum Flow	Average Dose, Maximum Flow
Total Chlorine Requirement	lb/day	25	477	2,629	1,627
Chlorine Dioxide Chlorine Requirement	lb/day	16	63	265	212
Remaining Chlorine Requirement	lb/day	9	414	2,364	1,415
Total Chlorine Requirement as 12.5% Sodium Hypochlorite	gpd	24	395	2,152	1,345
Total Chlorine Requirement as 0.8% Sodium Hypochlorite	gpd	444	7,415	40,500	25,280
Total Salt Requirement	lb/day	75	2,862	7,887	4,881

The requirements for recommended storage volumes differ between 12.5 percent and 0.8 percent sodium hypochlorite.

5.2.1.1 12.5 Percent Sodium Hypochlorite Design Criteria

For the use of 12.5 percent sodium hypochlorite, it is recommended to size the bulk storage system for 30 days at maximum flow, average dose conditions. The resulting storage requirement equates to 40,350 gallons.

Table 5.8 represents the storage volume and durations under different flow and doses.

Table 5.8 12.5% Sodium Hypochlorite Storage and Durations

Description	Unit	Value
12.5% Sodium Hypochlorite Total Stored Volume	gallons	40,350
Average Flow, Average Dose	days	102
Maximum Flow, Average Dose	days	30
Maximum Flow, Maximum Dose	days	18

Using 12.5 percent sodium hypochlorite with the chlorine dioxide system requires sodium chlorite storage and hydrochloric acid storage. Both are recommended to have 30 days of storage at maximum flow, average dose conditions. Based on the 220 gpd at the maximum flow, average dose, for sodium chlorite the storage requirement is 6,600 gallons. The existing chlorine dioxide system has a 6,500-gallon storage tank that could potentially be reused.

Table 5.9 represents the chlorite storage and demand using the existing chlorite tank.

Table 5.9 Sodium Chlorite Storage and Durations

Description	Unit	Value
Sodium Chlorite Storage	gallons	6,500
Average Flow, Average Dose	days	102
Maximum Flow, Average Dose	days	30
Maximum Flow, Maximum Dose	days	24

Hydrochloric acid requires a new bulk storage tank. Based on the 168 gpd consumption at maximum flow average dose, the total storage requirement is approximately 5,000 gallons. The acid system requires all plastic components due to the high chloride levels in the chemical. Additionally, all fumes from the storage tank need to be addressed to prevent escape into the air around the system. A wet scrubber and glycerin filled overflow are recommended to prevent vapors from leaving the tank. Table 5.10 below represents the storage requirement and durations.

Table 5.10 Hydrochloric Acid Storage and Durations

Description	Unit	Value
Hydrochloric Acid Storage	gallons	5,000
Average Flow, Average Dose	days	102
Maximum Flow, Average Dose	days	30
Maximum Flow, Maximum Dose	days	24

All flow and dose conditions were reviewed to determine the required metering pump dose ranges. Table 5.11 below provides the pumping requirement for each chemical.

Table 5.11 Hydrochloric Acid Storage and Durations

Chemical	Unit	Range
12.5% Sodium Hypochlorite	gpm	0.02-1.49
Sodium Chlorite	gph	0.07-11.47
Hydrochloric Acid	gph	0.53-8.76

Notes:
Abbreviations: gph - gallons per hour.

5.2.1.2 0.8 Percent Sodium Hypochlorite Design Criteria

Due to the 0.8 percent sodium hypochlorite system being an onsite system, it is recommended to have storage for one day at maximum dose, maximum flow, which equates to 40,500 gallons of storage.

Table 5.12 provides the storage capacity and duration for the onsite system.

Table 5.12 0.8% Sodium Hypochlorite Storage and Durations

Description	Unit	Value
0.8% Sodium Hypochlorite Total Stored Volume	gallons	40,500
Average Flow, Average Dose	days	5.5
Maximum Flow, Average Dose	days	1.6
Maximum Flow, Maximum Dose	days	1.0

To generate the amount of 0.8 percent sodium hypochlorite required two electrolyzer skids are required. With two 1,500 lb/day electrolyzer skids, the total production is 3,000 lb/day to meet the 2,629 lb/day of chlorine requirement per Table 5.7.

The onsite system will also require storage for salt to create the brine needed for the sodium hypochlorite generation. Based on the sodium hypochlorite generation requirements, the manufacturer recommends a total brine storage capacity of 34,000 gallons. Additional equipment is required for the generation system including brine pumps, a transformer, water softeners and blowers. Table 5.13 summarizes all the equipment and capacities required.

Table 5.13 0.8% Sodium Hypochlorite Equipment Design Criteria

Description	Quantity	Unit	Value
Electrolyzer Skid	2	lb/day	1,500
Water Softener ⁽¹⁾	2	gpd	22,500
Brine Pump	2	gph	102
Brine Tank	2	gallons	17,000
Blower	2	hp	3
Metering Pumps	2	gpm	0.31-28.13
Transformer	2	-	-

Notes:
(1) Based on 15 gallons per pound of chlorine

The previously discussed hydrochloric acid and sodium chlorite consumption are the same for the 0.8 percent sodium hypochlorite alternative, only the sodium hypochlorite requirement increases.

5.2.1.3 Hybrid System Design Criteria

Rather than having an onsite system for the entirety of the flow and dose demands, the Authority requested the evaluation of a hybrid system to decrease the overall storage requirements. A configuration with an onsite system dedicated to more common conditions and a 12.5 percent sodium hypochlorite backup supply was evaluated to decrease idle equipment and lower the total storage requirements for the system. The 12.5 percent sodium hypochlorite can be used during times of high flows, and can be used for chlorine dioxide generation so that it is regularly consumed prior to degrading or serve as an emergency backup to the onsite system.

Reviewing the peak historic flows, the Perdue WTP’s highest flow in the last seven years is approximately 20 mgd. At the average chemical dose of 6.5 mg/L, the chemical consumption is 1,080 lb/day. Based on these flow and dose conditions, the onsite generation system was sized for 1,000 lb/day of demand equating to 15,000 gallons of 0.8 percent sodium hypochlorite. The onsite system could cover all flows up to the 20-mgd threshold at the average dose and is still well above the average flow and average dose projection of 477 lb/day. In the event that the flow is higher, 12.5 percent can be used to make up the difference in demand.

To meet the maximum flow, average dose total chemical usage of 1,627 pounds under a hybrid configuration, the 12.5 percent system was sized for 627 lb/day, which equates to approximately 500 gpd.

Table 5.14 summarizes the criteria used to size the 0.8 percent sodium hypochlorite onsite generation system and 12.5 percent sodium hypochlorite bulk storage.

Table 5.14 Hybrid Configuration Design Criteria

Description	Unit	Value
Total Chlorine Requirement at Maximum Flow, Maximum Dose	lb/day	2,629
Flow	mgd	20
Target Dose	mg/L	6.5
Target 0.8% Sodium Hypochlorite Chemical Consumption	lb/day	1,080
0.8% Sodium Hypochlorite Onsite Generation System Criteria		
Electrolyzer Capacity	lb/day	1,000
0.8% Sodium Hypochlorite Chemical Storage	gallons	15,000
Brine Storage	gallons	17,000
Brine Pump	gph	102
Water Softener ⁽¹⁾	gpd	15,000
Blower	hp	1
0.8% Sodium Hypochlorite Metering Pumps	gpm	0.31-28.13

Description	Unit	Value
12.5% Sodium Hypochlorite System Criteria		
Remaining Chlorine Requirement at Maximum Flow, Average Dose	lb/day	627
12.5% Sodium Hypochlorite Required	gpd	500
30 day 12.5% Sodium Hypochlorite Storage	gallons	15,000
12.5% Sodium Hypochlorite Emergency Storage Duration ⁽²⁾	days	11
12.5% Sodium Hypochlorite Metering Pumps	gph	0.89-20.58

Notes:

(1) Based on 15 gallons per pound of chlorine.

(2) Based on if on 12.5% sodium hypochlorite usage for permitted flow of 30 mgd and average dose.

A summary of the hybrid configuration storage is provided in Table 5.15.

Table 5.15 Hybrid Sodium Hypochlorite Storage and Durations

Concentration	Description	Unit	Value
0.8%	Sodium Hypochlorite Total Stored Volume	gallons	15,000
	20 mgd, Average Dose	days	1
12.5%	Sodium Hypochlorite Total Stored Volume	gallons	15,000
	Remainder of Total Chlorine usage Under Maximum Flow, Average Dose	day	30
	Maximum Flow, Average Dose ⁽¹⁾	days	11
	Maximum Flow, Maximum Dose ⁽¹⁾	days	7
	Chlorine Dioxide Generation Only, Maximum Demand	days	53

Notes:

(1) Refers to conditions identified in Table 5.1.

5.2.2 Spatial Impacts

Because a new sodium hypochlorite system would be constructed, the chlorine gas system would be demolished providing space in the chemical building. It was evaluated to see if the existing cylinder storage room could house new bulk storage tanks. Without modification, the existing doors are 8-feet wide, limiting tankage size. Existing overhead monorails are approximately 13.3 feet from the finished floor and can be removed for a total of 14 feet from the finished floor. Based on the 40,000-gallon capacity requirement, the existing chlorine building is not a good candidate to be reused for bulk storage of 12.5 percent sodium hypochlorite. Storage outside the existing chemical building was assessed.

The use of double-wall high-density polyethylene (HDPE) containment tanks with no containment area was evaluated to minimize the structural and civil work required. The use of double-wall tanks meets the containment requirements for chemical storage without large concrete containment areas. Only a 6-inch containment curb was considered for incidental leaking.

Double-wall tank supplier standard options were reviewed to best meet the storage capacities required. Bulk storage tanks were evaluated for nearby placement to the existing chemical building and along the chemical truck delivery route in the facility. Table 5.16 displays the storage tank criteria used for the footprint available and durations. Standard HDPE tank sizes available were used for spatial impacts.

Table 5.16 12.5% Sodium Hypochlorite Only - Storage Tank Design

Description	Unit	Value
Type	-	Double-Walled HDPE
Quantity ⁽²⁾	number	5
Diameter	feet	11'11"
Usable Storage Height	feet	14'10"
Capacity per Tank	gallons	8,700
Total Capacity	gallons	43,500
Average Flow, Average Dose ⁽¹⁾	days	116
Maximum Flow, Average Dose ⁽¹⁾	days	34
Maximum Flow, Maximum Dose ⁽¹⁾	days	21

Notes:

(1) Refers to conditions identified in Table 5.1.

(2) Tank sizes based on standard HDPE availability.

Due to the size of the bulk storage tanks, and the chemical building being located adjacent to a hillside, a potential location along the road was identified. The current area would require the existing roll off dumpsters to be relocated.

The hydrochloric acid was located across from the chemical building to keep it separate from the other chemical due to the fuming and incompatibility.

Table 5.17 Hydrochloric Acid Storage Tank Design

Description	Unit	Value
Type	-	Double-Walled HDPE
Quantity	number	1
Diameter	feet	11'11"
Usable Storage Height	feet	10'0"
Capacity per Tank	gallons	5,400
Average Flow, Average Dose ⁽¹⁾	days	109
Maximum Flow, Average Dose ⁽¹⁾	days	32
Maximum Flow, Maximum Dose ⁽¹⁾	days	26

Notes:

(1) Refers to conditions identified in Table 5.3.

The removal of the chlorinators from the existing chemical building allows for the chlorinator room to be converted to a metering pump room. The resulting existing area is represented on Figure 5.2.

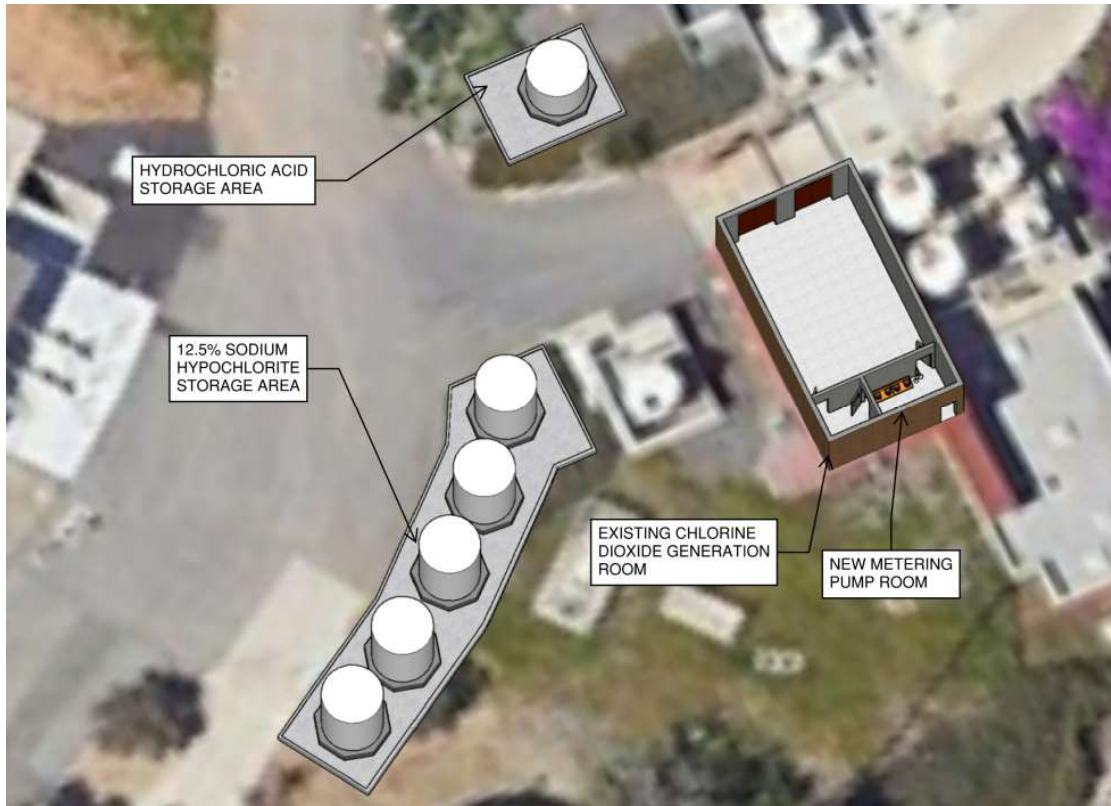


Figure 5.2 12.5% Sodium Hypochlorite Layout

The evaluation was based on the total chlorine consumption. For multiple injection points, the existing building footprint is available for day tank storage and metering pumps based on desired injection points being used simultaneously with the main injection location at the clear well. Final injection points are anticipated to be confirmed during detailed design.

The existing building was also evaluated to determine the required footprint for the hybrid system. The 12.5 percent bulk storage portion of the system would be required to be installed outside the footprint of the chemical building similar to the previous alternative. The existing facility would be used to house the sodium hypochlorite generation equipment, including the brine tank, brine pumps, blowers, and electrolyzer skid. The existing chlorinator room is also shown as the new metering pump room.

The onsite generation system equipment has ample space to be installed in the existing cylinder storage room, equipment layout was discussed with the manufacturer to keep compact. The additional tankage required for the 12.5 percent and 0.8 percent sodium hypochlorite were too large to house in the existing building. Double-wall HDPE tanks were assessed for the hybrid storage requirements. Bulk storage locations for the hybrid configuration were similar to the 12.5 percent sodium hypochlorite alternative due to the limited space near the chemical facility. Table 5.18 and Table 5.19 display the storage tank criteria used for the footprint available and durations.

Table 5.18 0.8% Sodium Hypochlorite Hybrid Configuration Storage Tank Design

Description	Unit	Value
Type	-	Double-Walled HDPE
Quantity	number	2
Diameter	feet	11' 11"
Usable Storage Height	feet	14'10"
Capacity per Tank	gallons	8,700
Total Capacity	gallons	17,400
20 mgd, Average Dose	days	1

Table 5.19 12.5% Sodium Hypochlorite Hybrid Configuration Storage Tank Design

Description	Unit	Value
Type	-	Double Walled HDPE
Quantity	number	2
Diameter	feet	11' 11"
Usable Storage Height	feet	14'10"
Capacity per Tank	gallons	8,700
Total Capacity	gallons	17,400
Remainder of Chlorine Demand Maximum Flow, Average Dose ⁽¹⁾	days	35
Chlorine Dioxide Generation Only, Maximum Demand	days	62
Emergency Backup at Maximum Dose, Maximum Flow ⁽²⁾	days	8

Notes:

(1) Refers to condition identified in Table 5.14 of 500 gpd.

(2) Refers to condition identified in Table 5.1 of 30 mgd and average dose of 6.5 mg/L.

Figure 5.3 illustrates the hybrid layout.



Figure 5.3 Hybrid Sodium Hypochlorite Layout

5.2.3 Opinion of Cost

The opinion of cost for each alternative is provided in Table 5.20.

Table 5.20 Opinion of Cost - Sodium Hypochlorite Alternatives

Discipline	12.5% Sodium Hypochlorite	Onsite Generation Sodium Hypochlorite with 12.5% Backup Hybrid
Major Equipment	\$285,000	1,113,600
Additional Mechanical	\$60,000	300,000
Civil/Structural	\$120,000	500,000
Electrical and Instrumentation	\$232,500	\$950,000
Total Project ⁽¹⁾	1,610,000	6,330,000
Estimate Range ⁽²⁾	\$1,370,000-2,250,000	\$5,380,000-8,860,000

Notes:

(1) Includes sales tax= 8.75%, overhead and profit= 15%, Contingency=30%, engineering= 15%.

(2) Class IV estimate with range of -15% to +40%.

Projected operations and maintenance (O&M) costs based on chemical consumption and electrical power needs are listed in Table 5.21.

Table 5.21 O&M Estimates - Sodium Hypochlorite Alternatives

Alternative	12.5% Sodium Hypochlorite	Onsite Generation Sodium Hypochlorite
Annual O&M	\$1,990,000	\$1,950,000
5-Year Projected O&M ⁽¹⁾	\$2,420,000	\$2,375,000
10-Year Projected O&M ⁽¹⁾	\$2,945,000	\$2,890,000

Notes:

(1) Assumes 4% interest rate.

Based on the Class IV estimate, the range for the opinion of cost was projected for 5- and 10-year intervals. Projected opinion of cost is provided in Table 5.22.

Table 5.22 Present Worth Analysis - Sodium Hypochlorite Alternatives

Alternative	-15%		Project Estimate		+40%	
	5 Year	10 Year	5 Year	10 Year	5 Year	10 Year
12.5% Sodium Hypochlorite ⁽¹⁾	\$1,670,000	\$2,030,000	\$1,960,000	\$2,380,000	\$2,740,000	\$3,330,000
Onsite Generation Sodium Hypochlorite ⁽¹⁾	\$6,550,000	\$7,960,000	\$7,700,000	\$9,370,000	\$10,780,000	\$13,110,000

Notes:

(1) Assumes 4% interest rate.

5.3 Liquid Ammonium Sulfate Conversion

Currently the Perdue WTP utilizes chloramines for disinfection in the distribution system. Chloramines are generated when ammonia is added to free chlorine. The reaction can be seen in Equation 1.



The Authority generates chloramines by dosing 19 percent aqueous ammonia and free chlorine to mix in the process stream. The facility currently has three different injection locations available, but typically only one point is used at a time. The injection point options include:

- Mixing bowl upstream of the DAF process.
- Upstream of clear well influent (main injection point).
- SDCWA finished water.
- Settled water.

The Authority is interested in moving away from aqueous ammonia due to potentially hazardous vapor conditions but do not have any issues currently. The current system is comprised of a pressurized bulk storage tank, ammonia scrubber and ammonia feed pumps. As a non-toxic alternative to aqueous ammonia, liquid ammonium sulfate (LAS) was evaluated as a safer alternative that does not have off-gassing issues or require any risk management plan.

5.3.1 Design Criteria

The existing ammonia dose range and process flows were reviewed to determine design criteria for 40 percent LAS solution dosing requirements. Table 5.23 represents the chemical dose range and process flows.

Table 5.23 LAS Design Flows and Doses

Description	Unit	Minimum	Average	Maximum
Process Flow	mgd	6	8.8	30
Chemical Dose	mg/L	0.7	1	1.4

Chemical feed quantities were calculated from the flow and chemical dose information. Table 5.24 presents the required feed rates of LAS and provides a comparison to 19 percent aqueous ammonia.

Table 5.24 LAS Chemical Feed Rates

Chemical	Unit	Minimum Dose, Minimum Flow	Average Dose, Average Flow	Maximum Dose, Maximum Flow	Average Dose, Maximum Flow
Aqueous Ammonia and LAS	lb/day	35.1	73.4	350.5	250.4
40% LAS ⁽¹⁾	gpd	34.2	71.6	341.7	244.0
19% Aqueous Ammonia	gpd	25.9	54.4	259.4	185.3

Notes:

(1) 40% LAS Equivalent to 10% Active Ammonia.

Although chemical storage facilities are typically designed to store sufficient chemicals for 30 days at maximum dose, maximum flow, there is flexibility based on the Authority’s level of comfort with less storage. Using average dose, maximum flow, the required storage would equal 7,320 gallons. However, the Authority has an existing spare tank with 5,945-gallon capacity that could be considered for this purpose. This is discussed later in the spatial impacts section, but this tank would provide 24 days of storage at average dose, maximum flow conditions.

The required chemical pump rates between the two options were also compared and are provided in Table 5.25.

Table 5.25 LAS Metering Pump Flow Ranges

Consumption	Unit	Minimum Flow	Average Flow	Maximum Flow
40% LAS	gph	1.42	2.98	14.24
18% Aqueous Ammonia	gph	1.08	2.26	10.81

Due to the similar flow rates and the existing facility gear pumps being in good condition, the existing pumps could be used for LAS. While it is assumed the wetted materials should be compatible with LAS, a detailed analysis should be performed prior to switching, as not all materials are compatible with LAS just because they are acceptable for use with aqueous ammonia (steel is one example where it is an acceptable option for aqueous ammonia but is not compatible with LAS).

5.3.2 Spatial Impacts

Located in the existing chemical tank farm on the north end of the facility, the Authority has a spare fiber reinforced plastic bulk tank with a capacity of 5,945 gallons that is currently not being used. To minimize impact to the existing facility and operations, the spare chemical tank could potentially be used for LAS. Specific design parameters of the tank should be confirmed with the tank manufacturer, if possible, such as the design specific gravity of the contents and the suitability of the fiberglass design with LAS. Piping from the existing tank could be modified to feed the existing pumps from the new bulk tank. Once the changeover to LAS is completed the existing pressure vessel for aqueous ammonia could be demolished.

If there is a desire to maintain the spare chemical bulk tank, a new tank could be provided. Double-wall HDPE tanks were assessed to minimize the required structural modifications for a chemical containment area. Table 5.26 represents the storage tank criteria used for the footprint available and chemical storage durations.

Table 5.26 LAS Storage Tank Design

Description	Unit	Value
Type	-	Double-Walled HDPE
Quantity	number	1
Diameter	feet	10'2"
Usable Storage Height	feet	14'9"
Capacity per Tank	gallons	6,650
Total Capacity	gallons	6,650
Average Flow, Average Dose	days	93
Maximum Flow, Average Dose	days	27
Maximum Flow, Maximum Dose	days	19

The additional location has been identified along the chemical access road per Figure 5.4.

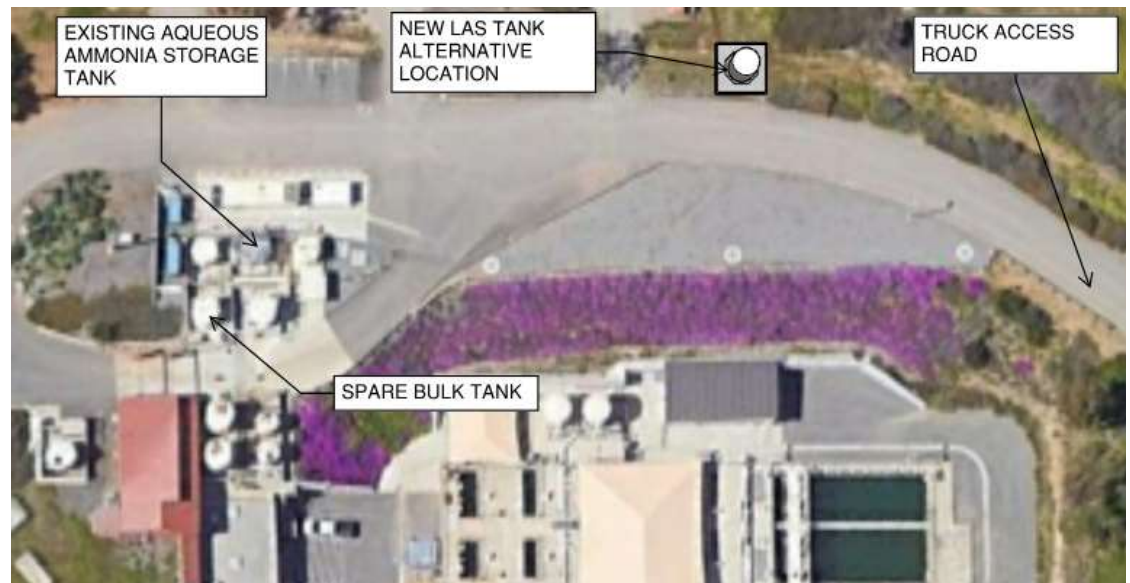


Figure 5.4 LAS Bulk Tank Location Alternatives

The proposed newly constructed location requires a new slab on grade with a 6-inch containment curb for incidental leaking, new piping to connect to metering pumps, and new instrumentation.

5.3.3 Opinion of Cost

The opinion of cost was developed for the most conservative option of a new tank. The opinion of cost for the evaluation is provided in Table 5.27.

Table 5.27 Opinion of Cost - LAS

Discipline	Cost
Major Equipment	\$50,000
Additional Mechanical	\$80,000
Civil/Structural	\$35,000
Electrical and Instrumentation	\$60,000
Total Project ⁽¹⁾	\$500,000
Estimate Range ⁽²⁾	\$430,000-\$700,000

Notes:

- (1) Includes sales tax= 8.75%, overhead and profit= 15%, contingency=30%, engineering=15%.
- (2) Class IV estimate with range of -15% to +40%.

Projected O&M costs based on chemical consumption and electrical power needs are listed in Table 5.28.

Table 5.28 O&M Estimates - LAS

Description	Cost ⁽¹⁾
Annual O&M-Aqueous Ammonia ⁽²⁾	\$205,000
Annual O&M-LAS ⁽²⁾	\$265,000
5-Year Projected O&M ⁽³⁾	\$320,000
10-Year Projected O&M ⁽³⁾	\$390,000

Notes:

- (1) Based on maximum flow, maximum dose chemical consumption.
- (2) Based on \$1.95 per gallon for aqueous ammonia and \$1.95 per gallon for LAS.
- (3) Assumes 4% interest rate.

Based on the Class IV estimate, the range for the opinion of cost was projected for 5- and 10-year intervals. Projected opinion of cost is provided in Table 5.29.

Table 5.29 Present Worth Analysis - LAS

Description	-15% Cost		Project Estimate		+40% Cost	
	5 Year	10 Year	5 Year	10 Year	5 Year	10 Year
Liquid Ammonium ⁽¹⁾	\$520,000	\$640,000	\$610,000	\$740,000	\$850,000	\$1,050,000

Notes:

- (1) Assumes 4% interest rate.

5.4 Intake Tower Refurbishment

The existing intake tower is a multilevel intake structure with eight inlets at various elevations – seven of which are on the tower, and one which is downstream of the tower on the outlet line. Drawings and photographs of the intake suggest that the structure is unreinforced masonry with

a cementitious exterior coating. The multilevel inlets use a novel design that is referred to as “cups and saucers.” The cups are elbows embedded in the tower walls with the elbow pointed upward. The saucers are plates that can be moved up and down to cover the open end of the elbow to either allow or prevent water from entering at a particular level. The saucers are raised and lowered by a cable system. Both the cable system and saucers are understood to be in poor condition and not capable of effectively closing the inlets without some leaking. Current operations require divers and a crew on rafts to adjust the saucers. The divers are employed to ensure the lower cups, that are not in service, are properly sealed and caulked. Divers are not required for a cup change to take place, as Maintenance staff can routinely perform this task independently.

5.4.1 Design Criteria

Since the dam was completed in 1888, there has been significant accumulation of sediments in the area of the intake and across the lower portion of the reservoir. Between 1931 and 2008, bathymetry in the area of the intake shows roughly 20 feet of sediment accumulation. This suggests that the lower inlets at 20 feet and 30 feet are buried in sediment and are not useful. The Authority is currently exploring dredging options for the reservoir to restore use of the lower inlets, increase storage capacity, and improve water quality.

Modern intakes at surface water treatment plants are characterized by fine intake screens with an automated cleaning system and isolation valving. If the Perdue intake is modernized, this would involve the addition of intake screens upstream of the existing eight inlets and valving downstream of the intake screens. The intake screens should be fine, generally 1/8-inch opening or smaller and constructed of stainless steel or other corrosion-resistant materials. The isolation valves can be located on the exterior of the intake or within the structure. If the valves are on the interior of the structure, a slide gate with an above water actuator is typically used. The most common screen type for a still water intake is a wedge wire tee screen with an internal airburst cleaning system. The Hefner Water Treatment Plant (Hefner WTP) intake for Oklahoma City was rehabilitated with such a system. The Hefner WTP intake has a capacity of 100 mgd and uses six, 66-inch diameter tee screens with airburst cleaning and internal fabricated sluice gates for isolation. Each tee screen has a capacity of 50 mgd. This project has been in operation for approximately four years and was engineered by Schnabel Engineering for Carollo.

While refitting the Perdue WTP intake with tee screens is possible, it is likely not the best alternative. The tee screens and associated piping are heavy and will place significant loads on the existing elbows and structure. Further, the modifications to the interior of the structure to accommodate isolation valves or gates would be extensive. Another alternative, which is likely more attractive and less costly, is to continue with the concept of the cups and saucers and add a few modern enhancements.

Figure 5.5 shows a modified cup and saucer concept for rehabilitating the Perdue WTP intake multilevel inlets. Refer to Appendix F for original intake tower drawings and details.

The area around the intake would be dredged to provide access to all eight inlets. The existing saucers would be removed from the inlets and the two lower inlets would be abandoned in-place. The remaining inlets would be fitted with a cylindrical wedge wire screen that has an internal mud valve constructed of 1-inch plate. The mud valve could be opened and closed (and therefore the inlet opened or closed) by rotating the non-rising shaft with an electric actuator located on the upper deck of the intake. When the mud valve is operated, an airburst backwash

can be used to clean the screen from the inside. The Acme threads within the screen assembly can be cleaned with an air knife that operates off the compressed air system. The load of the screen/valve assembly concept can be primarily supported off the wall of the structure as shown on Figure 5.5.

To maintain the ability to fine tune intake depth with 5-foot and 2.5-foot spools, the screen and mud valve assembly can be installed higher above the cup with the spools installed. If desired to lower the elevation, a temporary screen can be clamped in place.

The capacity of the screens is limited by the screen area and the approach velocity to the screens. In the case of the 48 inch diameter inlets, a screen area of approximately 63 square feet (ft²) can be provided. At 30 mgd, this produces an approach velocity of 0.74 feet per second; this is considered a reasonable maximum velocity for tee screens in still water applications when fish protection is not a controlling consideration. It follows that the smaller diameter inlets would have a lower inlet capacity.

While we have not inspected or analyzed the capacity of the upper deck, we believe some modifications may be necessary to accommodate the loads imposed by pedestal mounted valve actuators and a compressor/receiver skid. Like any modern mechanical equipment, the inlet operation can be remotely operated and differential head loss across the intake screens can be monitored by differential level sensors.

It is possible to accomplish both the dredging and intake modifications without dewatering the reservoir. This comes at a cost premium, but one that is likely less than the value of water. The Oklahoma City project mentioned earlier was accomplished completely by dive crews, without dewatering the reservoir.

5.4.2 Opinion of Cost

The opinion of cost for the evaluation is provided in Table 5.30.

Table 5.30 Opinion of Cost - Intake Tower Refurbishment

Discipline	Cost
Major Equipment	\$1,010,000
Additional Mechanical	-
Civil/Structural	\$250,000
Electrical and Instrumentation	\$200,000
Total Project ⁽¹⁾	\$3,300,000
Estimate Range ⁽²⁾	\$2,810,000-\$4,620,000

Notes:

(1) Includes sales tax= 8.75%, overhead and profit= 15%, contingency=30%, engineering=15%.

(2) Class IV estimate with range of -15% to +40%.

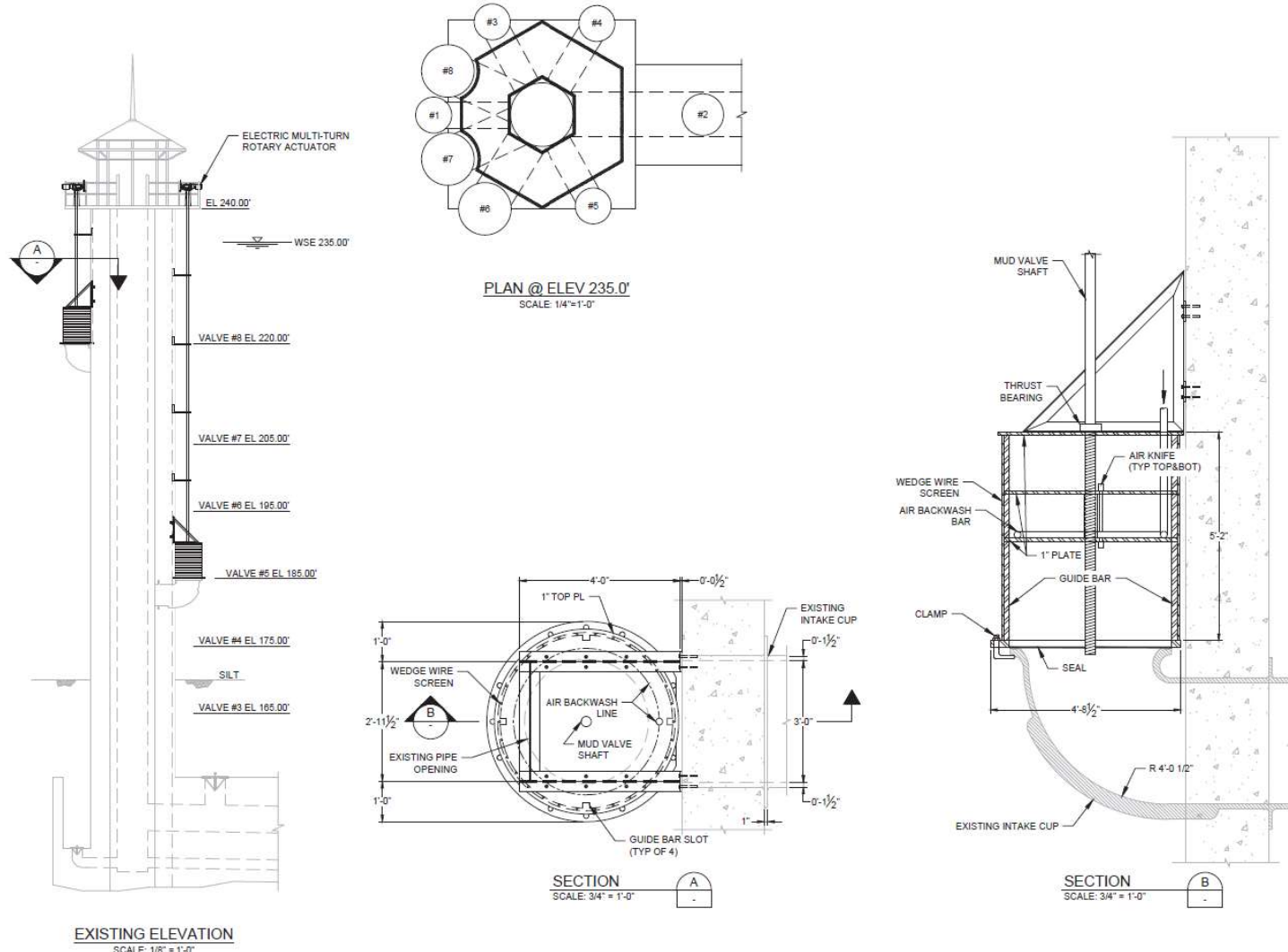


Figure 5.5 Intake Tower Saucer Modifications

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Projected O&M costs based on electrical power needs are listed in Table 5.31.

Table 5.31 O&M Estimates - Intake Tower Refurbishment

Description	Cost
Annual O&M	\$60,000
5-Year Projected O&M ⁽¹⁾	\$71,000
10-Year Projected O&M ⁽¹⁾	\$86,000

Notes:

(1) Assumes 4% interest rate.

Based on the Class IV estimate, the range for the opinion of cost was projected for 5- and 10-year intervals. Projected opinion of cost is provided in Table 5.32.

Table 5.32 Present Worth Analysis - Intake Tower Refurbishment

Description	-15%		Project Estimate		+40%	
	5 Year	10 Year	5 Year	10 Year	5 Year	10 Year
Intake Tower Refurbishment ⁽¹⁾	\$3,420,000	\$4,160,000	\$4,010,000	\$4,880,000	\$5,620,000	\$6,840,000

Notes:

(1) Assumes 4% interest rate.

For the purposes of this estimate, it was assumed that all six tower inlets would be rehabilitated and that the cost of both the larger and smaller inlets would be the same. Dredging costs were not considered.

5.5 Dechlorination System

Currently, the facility does not include any automation for dechlorination of discharges to Sweetwater Reservoir. All processes requiring dechlorination are carried out manually by operations staff when required. The two main processes currently operated at the facility requiring dechlorination are clear-well draining and filter to waste, both of which flow back to Sweetwater Reservoir.

Typically, within the industry, a chlorine quenching agent such as sodium bisulfite would be used for dechlorination. However, because the Perdue WTP uses chloramines for disinfection the use of a sodium bisulfite would produce ammonia chloride as a byproduct per Equation 2.

For Chloramines:



In this case, it is not recommended to use a quenching agent that would release ammonia back into the source water due to potential issues such as algae growth in the raw water. Two alternatives were reviewed for complete removal of chloramines from the water without an ammonia byproduct, GAC and breakpoint chlorination coupled with a quenching agent.

5.5.1 Design Criteria

Before evaluating the alternatives, the facility’s operations data for filter to waste flows was analyzed to understand historical flow requirements. Filter to waste data provided by the Authority is summarized in Table 5.33.

Table 5.33 Filter to Waste Flows

Source Water	Backwash Frequency (hours)	Filter to Waste Time (minutes)	Maximum Filter to Waste Flow ⁽¹⁾ (mgd)
100% Sweetwater Reservoir	155	190	7.5
100% Raw Aqueduct Water	300	70	7.5
50% Sweetwater Reservoir/ 50% Raw Aqueduct	280	140	7.5

Notes:

(1) Assumes all four filters in service and plant operating at permitted capacity of 30 mgd.

The worst-case volume of treatment would be based on the source water being 100 percent Sweetwater Reservoir water. The resulting volume to treat is approximately 990,000 gallons per event. The use of either alternative requires that the water be captured and treated prior to discharge back to the reservoir. There is also a time constraint to treat the water prior to the next backwash and filter to waste event. Based on the volume and backwash frequency the minimum treatment flow is 106.5 gpm. However, increasing the treatment flow rate capacity will reduce the required storage amount from the previously stated 990,000 gallons.

GAC is typically used as an adsorbent to remove dissolved constituents from the water. However, chloramines are removed through a reaction with the carbon rather than being adsorbed. Equation 3 represents the reaction that occurs during the removal process, where CO* represents a surface oxidant on the GAC.



The reaction results in nitrogen gas, chloride and water that can be readily discharged back to the reservoir. GAC vessels were evaluated for use and the storage volume was assessed to determine a balance between number of GAC vessels and storage volume. Design criteria for GAC vessels is provided in Table 5.34.

Table 5.34 GAC Vessel Design Criteria

Description	Unit	Value
Quantity	number	12 (6+6)
Diameter	feet	10
Media Area	ft ²	78.5
Media Depth	feet	6
Design Flow per Vessel	gpm	450
Total System Flow	mgd	3.88
Loading Rate	gpm/ft ²	5.73
Empty Bed Contact Time	minutes	7.8

With an overall flow capacity of 3.88 mgd, the resulting volume to capture decreases to approximately 480,000 gallons. The storage tank would need to be below grade to intercept existing filter to waste piping and divert to the new tank without pumping. Proposed tank dimensions are provided in Table 5.35.

Table 5.35 Capture Tank Design Criteria - GAC

Description	Unit	Value
Length	feet	325
Width	feet	20
Depth	feet	10
Capacity	gallons	486,000

The tank was sized to fit south of the existing clear well.

The second alternative evaluated was breakpoint chlorination. Breakpoint chlorination is the chemical reaction of adding free chlorine into a solution to push all the chlorine present, to almost entirely free chlorine. Breakpoint chlorination can be broken out into four phases.

Initially chlorine added is consumed by organics or other reducing compounds. In phase two monochloramines are generated through the reaction of ammonia with chlorine. During phase three monochloramine reacts with chlorine to create dichloramines and trichloramines lowering the overall chlorine residual. Finally in phase four all that remains is a small fraction of trichloramines and the remainder of the chlorine residual is almost entirely free chlorine. Equations 4 through 6 and Figure 5.6 represent the reaction of creating monochloramine, dichloramine, trichloramine and ultimately free chlorine.

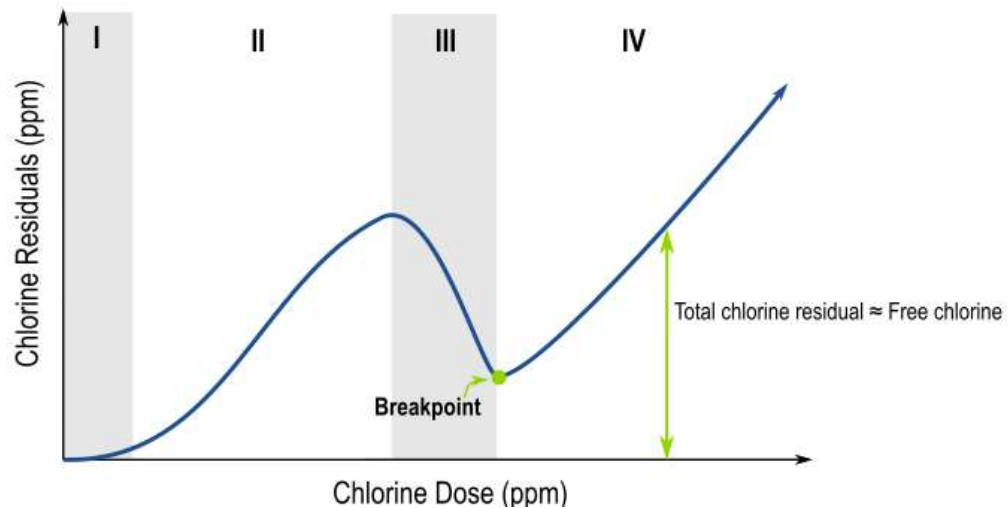


Figure 5.6 Breakpoint Chlorination

The reaction requires a minimum of 30 minutes to ensure breakpoint has been reached. Once the chlorine residual becomes all free chlorine, quenching agents such as sodium bisulfite can be used. The breakpoint analysis assumes the same size capture basin to be used for a balance between storage and equipment requirements, which is feasible since the total filter to waste time is 190 minutes and the minimum reaction time is 30 minutes so water can begin being discharged after reaction prior to completion of the filter to waste cycle. Therefore, the design flow rate for the breakpoint alternative is the same with a flow of 3.88 mgd. Chemical dosing criteria for the system is provided in Table 5.36.

Table 5.36 Process Flow and Chemical Dose Criteria

Description	Unit	Value
Process Flow	mgd	3.88
Chlorine Dose ⁽¹⁾	mg/L	10
Sodium Bisulfite Dose ⁽²⁾	mg/L	27

Notes:

- (1) Based on 2:1 ratio of free chlorine to chloramine and maximum chloramine value of 5 mg/L.
- (2) Based on 1.78:1 ratio of Sodium Bisulfite to chlorine and assume 15 mg/L of chlorine.

Based on the chemical dose and process flow requirements, the chemical feed requirements are provided in Table 5.37.

Table 5.37 Chemical Consumption

Description	Unit	Value
Chlorine ⁽¹⁾	pounds/event	83
Sodium Bisulfite	pounds/event	223
Sodium Bisulfite	gallons/event	52.5
Sodium Bisulfite ⁽²⁾	gph	15.3

Notes:

- (1) Assumes existing chlorine gas system to be used.
- (2) Required pump flow rate.

A total of 16 to 20 filter-to-waste operations occur per month, with the shortest backwash frequency being 155 hours per filter. Therefore, the storage target was a month’s supply for the quenching agent. Free chlorine use was assumed to be based on the current chlorine gas system with new piping. Table 5.38 represents the storage criteria.

Table 5.38 Sodium Bisulfite Storage Criteria

Description	Unit	Value
Type	-	Bulk Storage Tank
Target Capacity	gallons	1,050
Number of Tanks	number	1
Tank Capacity	gallons	1,015

To achieve a required breakpoint reaction time of 30 minutes, a pipe contactor was evaluated to determine the size and length needed. Pipe diameter and length were evaluated with the space available onsite for location and feasibility. Criteria is provided in Table 5.39.

Table 5.39 Pipe Contactor Design Criteria

Description	Unit	Value
Process Flow	mgd	3.88
Target Retention Time	minutes	30
Volume Required	cubic feet	10,828
Pipe Diameter	inch	60
Pipe Length	feet	575
Pipe Volume	cubic feet	11,290
Pipe Retention Time	minutes	31.2

5.5.2 Spatial Impacts

Both alternatives include a storage tank to capture the intermittent flow for treatment. The treatment flow rates were developed based on the available storage feasible on site. To minimize impacts on current operations, provide a location to intercept the existing pipe, allow discharge to Sweetwater Reservoir and to be in the vicinity of the clear well for multi-functional use, the storage tank was situated to the south of the existing clear well and north of the existing reservoir access road. When not in use, flow could be bypassed with the existing pipe route. Figure 5.7 illustrates the proposed location and configuration.

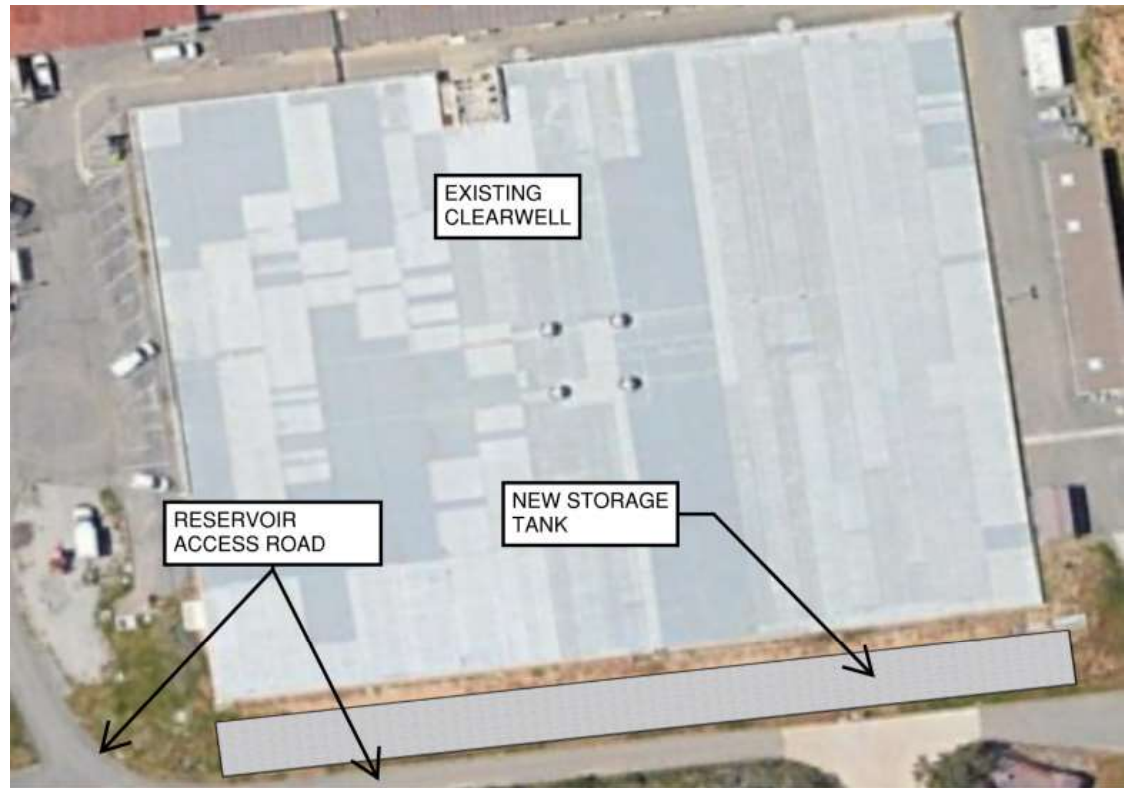


Figure 5.7 New Storage Tank Site Location

The tank construction is assumed to be able to carry load on top providing a location for either the GAC pressure vessels or the breakpoint piping. Figure 5.8 displays the GAC alternative.

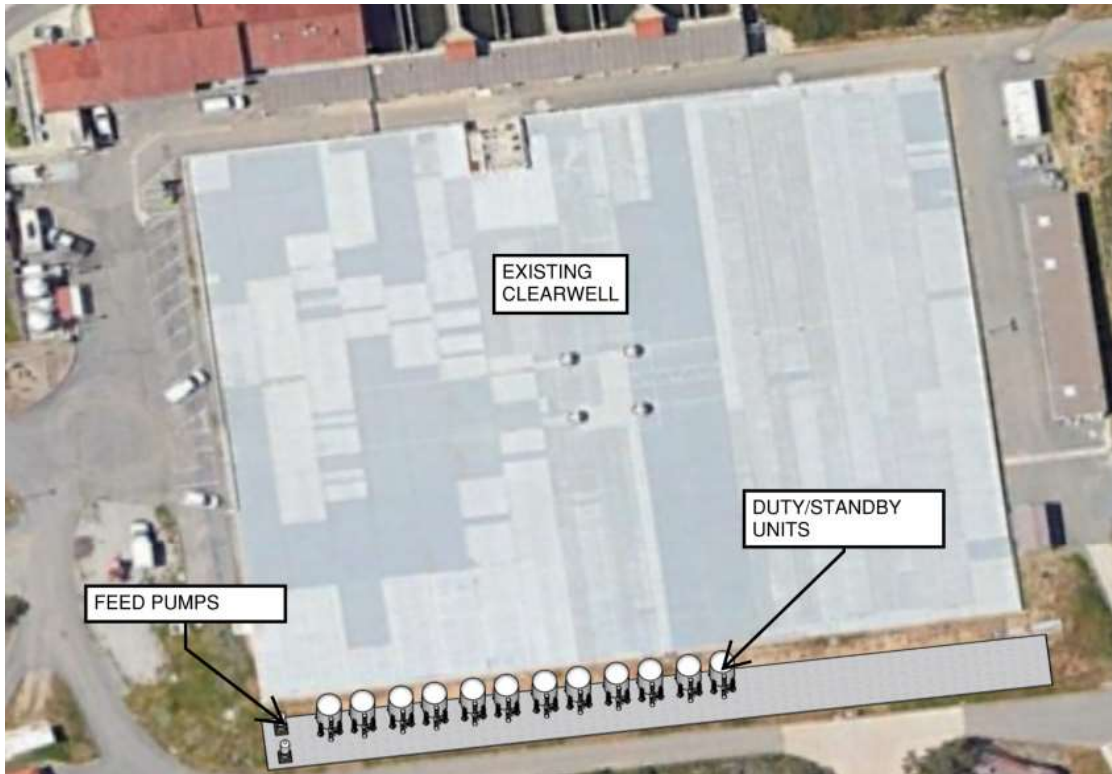


Figure 5.8 GAC Alternative Layout

The vessels are situated with space for future vessels if required. The system would be fed from the west side where the existing piping would be modified to feed the tank. The pumps could be operated as lead/lag or duty/standby depending on flow requirements.

Similarly, the breakthrough chlorination alternative has equipment situated on top of the new storage tank. In addition, a small sodium bisulfite storage tank was located off to the west of the system but nearby to minimize mechanical additions. Table 5.40 provides the storage criteria used for the footprint available and sodium bisulfite storage durations.

Table 5.40 Sodium Bisulfite Storage Tank Design

Description	Unit	Value
Type	-	Bulk Storage Tank
Quantity	number	1
Capacity per Tank	gallons	1,015
Total Capacity	gallons	1,015
Storage	number of backwashes	19

Figure 5.9 displays the breakpoint chlorination alternative.

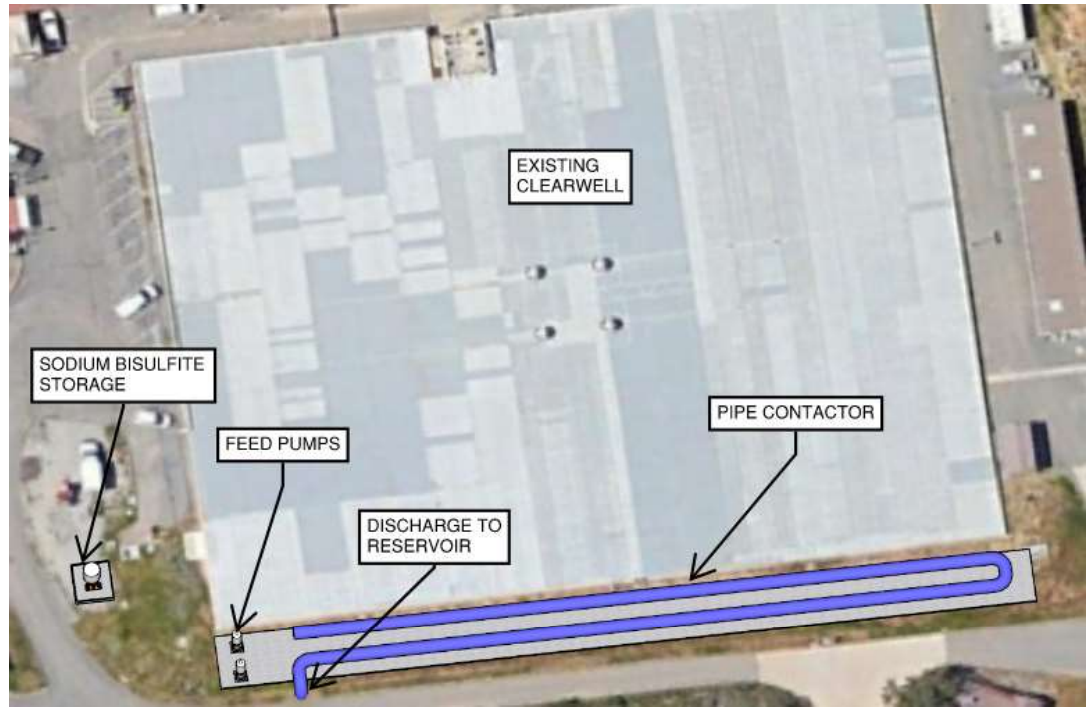


Figure 5.9 Breakpoint Chlorination Alternative Layout

5.5.3 Opinion of Cost

The opinion of cost for each alternative is provided in Table 5.41.

Table 5.41 Opinion of Cost - Dechlorination Alternatives

Discipline	GAC	Breakpoint Chlorination
Major Equipment	\$3,000,000	\$1,310,000
Additional Mechanical	\$600,000	\$300,000
Civil/Structural	\$4,000,000	\$4,300,000
Electrical and Instrumentation	\$200,000	\$300,000
Total Project ⁽¹⁾	\$18,600,000	\$14,750,000
Estimate Range ⁽²⁾	\$15,810,000-\$26,000,000	\$12,535,000-\$20,650,000

Notes:

(1) Includes sales tax= 8.75%, overhead and profit= 15%, contingency=30%, engineering=15%.

(2) Class IV estimate with range of -15% to +40%.

Projected O&M costs based on chemical consumption and electrical power needs are listed in Table 5.42.

Table 5.42 O&M Estimates - Dechlorination Alternatives

Alternative	GAC	Breakpoint Chlorination
Annual O&M	\$330,000	\$472,000
5-Year Projected O&M ⁽¹⁾	\$400,000	\$575,000
10-Year Projected O&M ⁽¹⁾	\$490,000	\$700,000

Notes:

(1) Assumes 4% interest rate.

Based on the Class IV estimate, the range for the opinion of cost was projected for 5- and 10-year intervals. Projected opinion of cost is provided in Table 5.43.

Table 5.43 Present Worth Analysis - Dechlorination Alternatives

Alternative	-15%		Project Estimate		+40%	
	5 Year	10 Year	5 Year	10 Year	5 Year	10 Year
GAC ⁽¹⁾	\$19,240,000	\$23,400,000	\$22,630,000	\$27,530,000	\$31,680,000	\$38,550,000
Breakpoint Chlorination ⁽¹⁾	\$15,210,000	\$18,500,000	\$17,880,000	\$21,760,000	\$25,040,000	\$30,460,000

Notes:

(1) Assumes 4% interest rate.

5.6 Sewage Lift Station Improvements

The existing sewage lift station is located to the northwest of the existing clear well, and collects all sewage flows from the administrative building. The wet well is approximately 45 feet from the corner of the clear well. Based on the site grading, there is a concern that any overflows will flow towards the storm drain system by the caustic system and ultimately into the environment, causing contamination. Figure 5.10 illustrates the location of the lift station in relation to the caustic area.



Figure 5.10 Sewage Lift Station and Clear Well Relative Locations

5.6.1 Design Criteria

The lift station utilizes the facility grade difference to collect all sewage flows via gravity. Similarly, the process hydraulics situate the clear well at the lowest relative elevation, taking up a large portion of the available lower elevation area.

Relocation of the lift station would likely lead to additional pumping requirements, therefore, providing preference to leaving it in the location where it is now. Rather than relocate the lift station, it was evaluated to provide increased safety measures, redundancy, and additional monitoring of the lift station to provide additional warning and protection from a potential overflow event.

The existing system has a high level alarm that is visual and audible locally and on SCADA. An additional level probe for high level can be installed to provide an advanced warning to operations that the lift station could potentially overflow with enough time to react and adjust any pumping as necessary. With the new sensor acting as a warning, the existing alarm would be used to indicate a close-to-spill condition. A containment wall could also be added to provide additional storage volume in the event that the warning does not provide adequate time to react. The addition of a 2-foot wall would provide additional time for reaction if there were an overflow event.

Figure 5.11 illustrates what the existing lift station currently looks like with the additional containment.

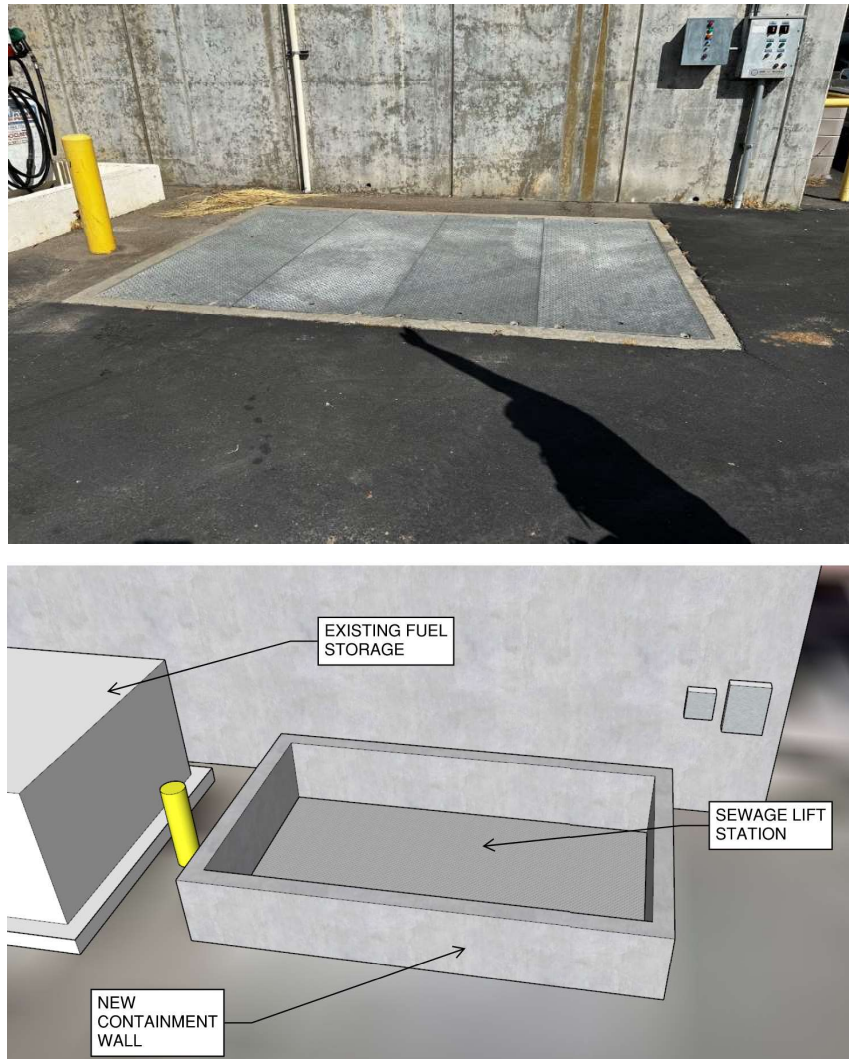


Figure 5.11 Existing Lift Station Location and Modifications

These upgrades will necessitate further modifications for fuel tank access connections. Piping can be installed on the adjacent wall to make the area more operator-friendly.

5.6.2 Opinion of Cost

Opinion of cost of the increased monitoring and additional containment is provided in Table 5.44.

Table 5.44 Opinion of Cost - Sewage Lift Station Improvements

Discipline	Cost
Major Equipment	\$30,000
Additional Mechanical	-
Civil/Structural	\$20,000
Electrical and Instrumentation	\$40,000
Total Project ⁽¹⁾	\$190,000
Estimate Range ⁽²⁾	\$160,000-\$270,000

Notes:

- (1) Includes sales tax= 8.75%, overhead and profit= 15%, contingency=30%, engineering=15%.
- (2) Class IV estimate with range of -15% to +40%.

5.7 Clear Well Improvements

The existing 10-MG clear well is from the original 1960 construction. It is trapezoidal in shape with a corrugated metal roof and sloped gunite side walls and floor. The operations staff have indicated there have been historic floor leakage issues that were previously repaired, and portions of the roof have been replaced and others in need of replacement. The Authority also desires the ability to take half the clear well offline for inspection and cleaning, while leaving the other half operational. The 1960 construction does not meet current building codes, and the clear well was identified under the condition assessment as a high-risk asset to be replaced. Figure 5.12 displays the existing clear well section.

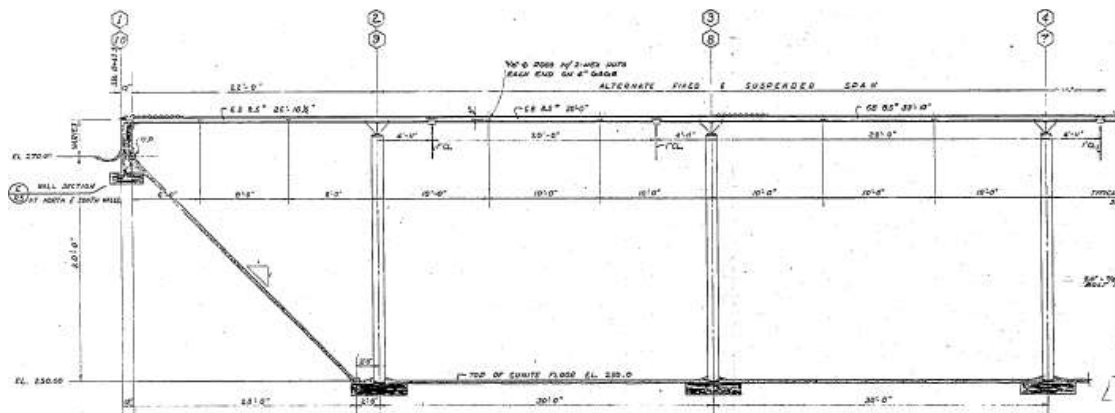


Figure 5.12 Existing Clear Well Section

5.7.1 Design Criteria

Replacement of the existing clear well requires evaluation of:

1. Storage requirements for disinfection.
2. Impact to operations during construction.
3. Location of washwater supply pumps and fire flow pumps.

The Authority would like to maintain 10 MG of clear well storage for operations and disinfection so options which provided less than 10MG were discarded early in the evaluation process.

Figure 5.13 provides a plan view of the existing clear well with the pertinent features identified.

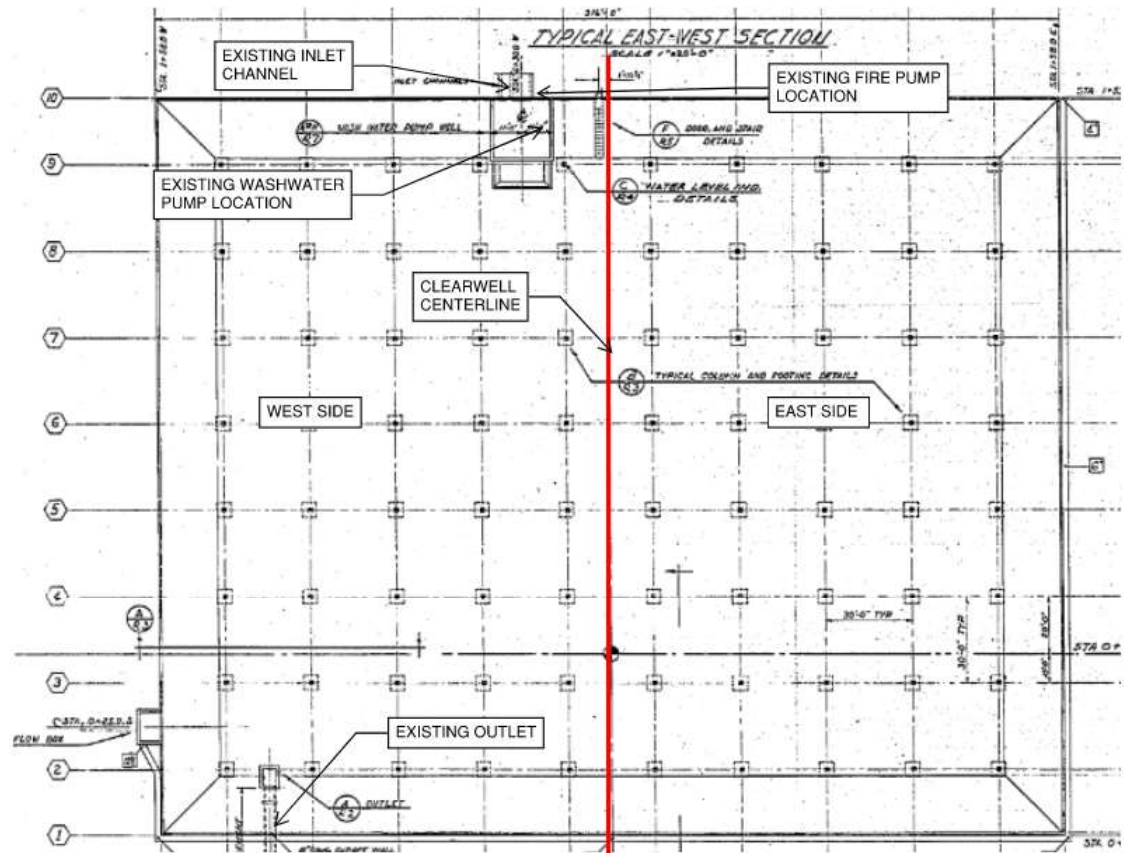


Figure 5.13 Existing Clear Well Centerline

While other alternative locations were considered for a replacement clear well, the existing location of the clear well is actually the best location based on land requirements and hydraulic constraints. The greatest challenge related to constructing a new clear well in the same location as the existing, is the construction sequencing required to provide disinfection for the treated water during the project. The following outlines considerations reviewed related to this sequencing.

Construction of a divider wall in the clear well at the beginning of the project would be required to maintain use of the west side while the east side is demolished for the new construction, thereby shortening the time the clear well would be out of service. Table 5.45 presents the required CT values in mg-min/L to obtain both a 0.5 log inactivation of *Giardia* and a 2-log inactivation of viruses using chloramine disinfection, which is the primary need for the clear well.

Table 5.45 Chloramine CT Requirements for 0.5-Log Inactivation of *Giardia* and 2-log Inactivation of Viruses

Target Organism	Temperature (degrees Celsius)				
	5	10	15	20	25
	CT Values (mg-min/L)				
<i>Giardia</i> ⁽¹⁾	365	310	250	185	125
Virus	857	643	428	321	214

Notes:
 (1) For pH 6.0-9.0.

Based on Table 5.45, the 2-log virus requirement is the governing requirement. A review of historical operations data was used to determine the worst case disinfection scenario. Table 5.46 represents the parameters used to determine the maximum CT achievable.

Table 5.46 Operational Parameters June 2021-May 2022

Minimum Temperature (degrees Celsius)	pH Range	Clear Well Volume (MG)	Flow (mgd)	Theoretical Detention Time (minutes)	Baffle Factor (T ₁₀ /T)	T ₁₀ (minutes)	Maximum Chloramine Residual (mg/L)
13.3	7.8-8.5	5	21.1	342	0.66	226	4

Notes:
 (1) Based on highest flow seen in historical flow analysis.

Based on the parameters above the maximum achievable CT value is 905 mg-min/L. From the requirements, a CT value of 643 mg-min/L is required for 2-log inactivation indicating the clear well has ample volume during construction to meet CT requirements if no additional log credits are required.

Additional log credit inactivation requirements driven by the coliform count or *E. coli* count discussed in Section 2.2 could potentially require further disinfection. If the coliform count is between 10,000 and 100,000, which occurred six times between 2016 and 2021 an additional 2.5-log inactivation and 4-log inactivation of virus is required. Table 5.47 provides the CT requirements under the scenario the raw water coliform count is between 10,000 and 100,000.

Table 5.47 Chloramine CT Requirements for 2.5-Log Inactivation of *Giardia* and 4-Log Inactivation of Viruses

Target Organism	Temperature (degrees Celsius)				
	5	10	15	20	25
	CT Values (mg-min/L)				
<i>Giardia</i> ⁽¹⁾	1,830	1,540	1,250	915	625
Virus	1,988	1,491	994	746	497

Notes:

(1) For pH 6.0-9.0.

Table 5.48 represents the worst case parameters used to determine CT.

Table 5.48 Worst Case Operational Parameters

Minimum Temperature (degrees Celsius)	pH Range	Clear Well Volume (MG)	Flow (mgd)	Theoretical Detention Time (minutes)	Baffle Factor (T ₁₀ /T)	T ₁₀ (minutes)	Maximum Chloramine Residual (mg/L)
13.3	7.8-8.5	5	30 ⁽¹⁾	240	0.66	158	4

Notes:

(1) Permitted flow.

Based on the worst case temperature and flow the achievable CT is 632 mg-min/L. Compared to the required CT values in Table 5.47 the clear well would not have enough volume to meet the higher CT requirements, and CT credit from additional areas of the facility would be needed. Alternately, the plant water source could be changed over (i.e., imported raw water) to meet CT requirements if the total coliform and/or *e. Coli* counts do not trigger increased inactivation.

As previously mentioned, a divider wall would be required to divide the clear well, providing half for disinfection during construction. The divider wall would serve as a support structure for the roof during construction and could act as a permanent structure to divide the clear well. It is estimated a shutdown of 12 weeks is needed for the wall to be installed, requiring a plant shutdown and the importation of treated water from SDCWA. Once the east side of the new clear well is completed, influent modifications can be made to direct flow there while the west side is under construction. Figure 5.14 presents the concept for the new divider wall.

A new washwater supply pump station can be constructed on the east side of the new clear well while the west side is still in operation. The new pump station would be connected to both sides of the clear well with gates allowing both sides of the clear well to operate independently. The fire flow pump can be hydraulically connected using piping, so the existing pump location does not need to be changed. With the new clear well located in the same location as the existing, the footprint would remain unchanged.

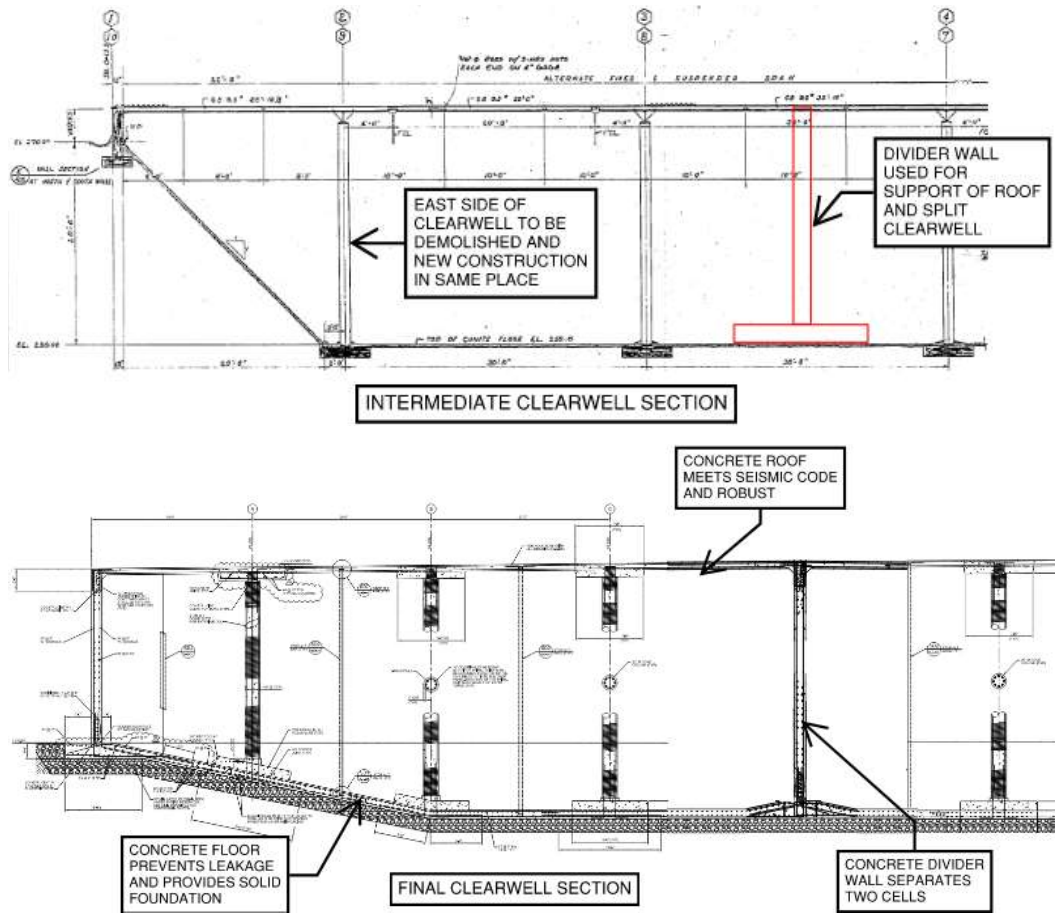


Figure 5.14 Section Views of Clear Well Replacement Concept

5.7.2 Opinion of Cost

The opinion of cost for the evaluation is provided in Table 5.49.

Table 5.49 Opinion of Cost - Clear Well Improvements

Discipline	Cost
Major Equipment	-
Additional Mechanical	-
Civil/Structural	\$17,460,000
Electrical and Instrumentation	-
Total Project ⁽¹⁾	\$41,700,000
Estimate Range ⁽²⁾	\$35,450,000-58,380,000

Notes:

- (1) Includes sales tax= 8.75%, overhead and profit= 15%, contingency=30%, engineering=15%.
- (2) Class IV estimate with range of -15% to +40%.

5.8 Filter Washwater Chlorine Addition

Typically, the Authority doses free chlorine and ammonia for chloramine generation downstream of the filters to meet disinfection requirements, however certain times of the year the water quality requires short term oxidation to remove material built up in the filters.

Providing the ability to apply free chlorine across the filter during a filter backwash will allow operational flexibility and improve filter performance. Due to the limited equipment requirements, including a chemical metering pump, discharge piping, and diffuser, this project may be considered to be coupled with the previously mentioned chlorine conversion project.

5.8.1 Design Criteria

The facility operates four filters with extended filter run times ranging from 200 to 300 hours. Backwashes are performed by gravity feed from the washwater supply tank that is filled from the clear well washwater supply pumps.

The design flow and target chemical dose are provided in Table 5.50.

Table 5.50 Chlorinated Backwash Design Flows and Doses

Description	Unit	Minimum	Average	Maximum
Washwater Flow	mgd	37.6	37.6	37.6
Chemical Dose	mg/L	0.5	6	15

BW frequency was also reviewed to understand the frequency of the chemical system operating. Figure 5.15 below represents the number of backwashes per month. Table 5.51 displays backwash data on a per month basis from 2021.



Figure 5.15 Number of Monthly Backwashes

Table 5.51 Backwash Frequency for 2021

Total Number of Backwashes	Annual Average Backwashes/Day	Minimum Backwashes/Day	Average Backwashes/Day	Maximum Backwashes/Day
243	0.66	0.29	0.59	0.87

Based on the maximum number of backwashes per day, and the seven-minute duration of each backwash, the chemical feed system will be required to be active 0.4 percent of the day. Chemical usage was estimated based on the percent daily activity, backwash flow, and chemical dose range. Usage rates for chlorine gas, 0.8 percent sodium hypochlorite, and 12.5 percent sodium hypochlorite are provided in Table 5.52.

Table 5.52 Chlorine Chemical Consumption

Consumption	Unit	Minimum Dose, Minimum Flow	Average Dose, Average Flow	Maximum Dose, Maximum Flow
Chlorine Gas	lb/day	0.7	8.0	19.9
12.5 Sodium Hypochlorite	gpd	0.5	6.3	15.7
0.8% Sodium Hypochlorite	gpd	9.2	110.7	276.6

5.8.2 Spatial Impacts

The low quantity of chemical used for this application will not result in a significant impact on the chlorine storage and feed system whether it be the existing gaseous chlorine system or a future sodium hypochlorite system. A new chlorinator or additional hypochlorite feed pump can easily be added with a new feed line to carry the solution to the washwater header where the solution would be injected into the washwater supply. The washwater supply tank is located to the west of the filters and the supply piping is buried until it is first exposed in a vault in the filter gallery area, which provides access for a new chemical injector. Figure 5.16 identifies the location of the vault.

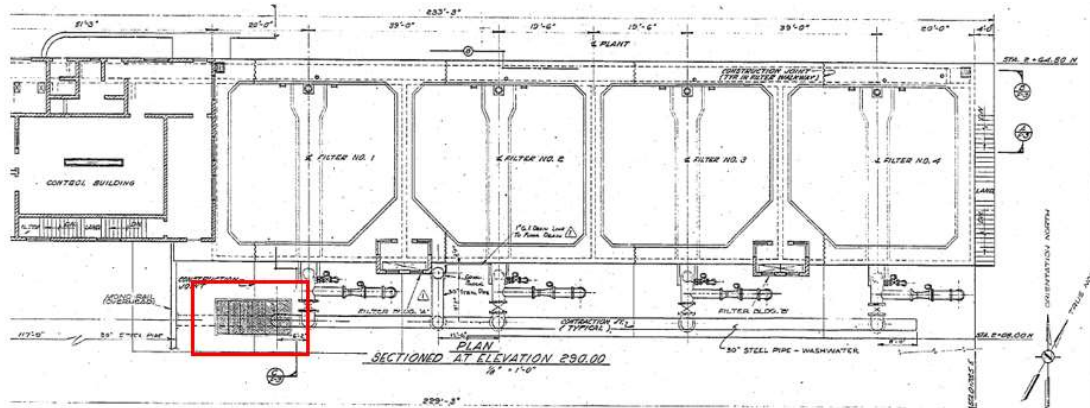
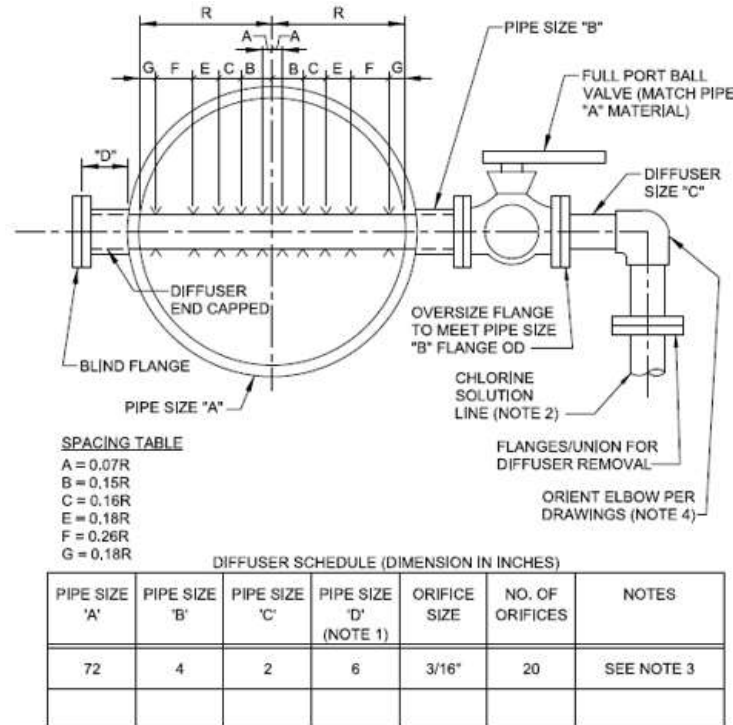


Figure 5.16 Chlorine Injection Location

To provide good dispersion throughout the washwater pipe, a diffuser similar to the one depicted on Figure 5.17 is recommended.



NOTES:

1. WELDED OUTLET FOR STEEL PIPE, TWO AT 180° AT OPPOSITE, DIMENSION PER AWWA C206.
2. ISOLATION VALVE SHALL BE LOCATED IN CHLORINE SOLUTION, LINE UPSTREAM OF DIFFUSER REMOVAL FLANGES.
3. ORIFICES SHALL BE PERPENDICULAR TO FLOW.
4. SEE DRAWINGS FOR PIPING ORIENTATION.
5. COAT INSIDE OF TAPS WITH POTAPOX PER SPECIFICATION 09960.

Figure 5.17 Chlorine Diffuser Detail

A static mixer could also be installed to ensure the chemical is thoroughly mixed, however, our initial evaluation indicated the system should function appropriately without that addition. A small-diameter chemical line would be required to deliver the chlorine solution to the injection point. Similar to the existing chemical piping, new piping would leave the chemical building and following the same pathway to the filter gallery as shown on Figure 5.18.

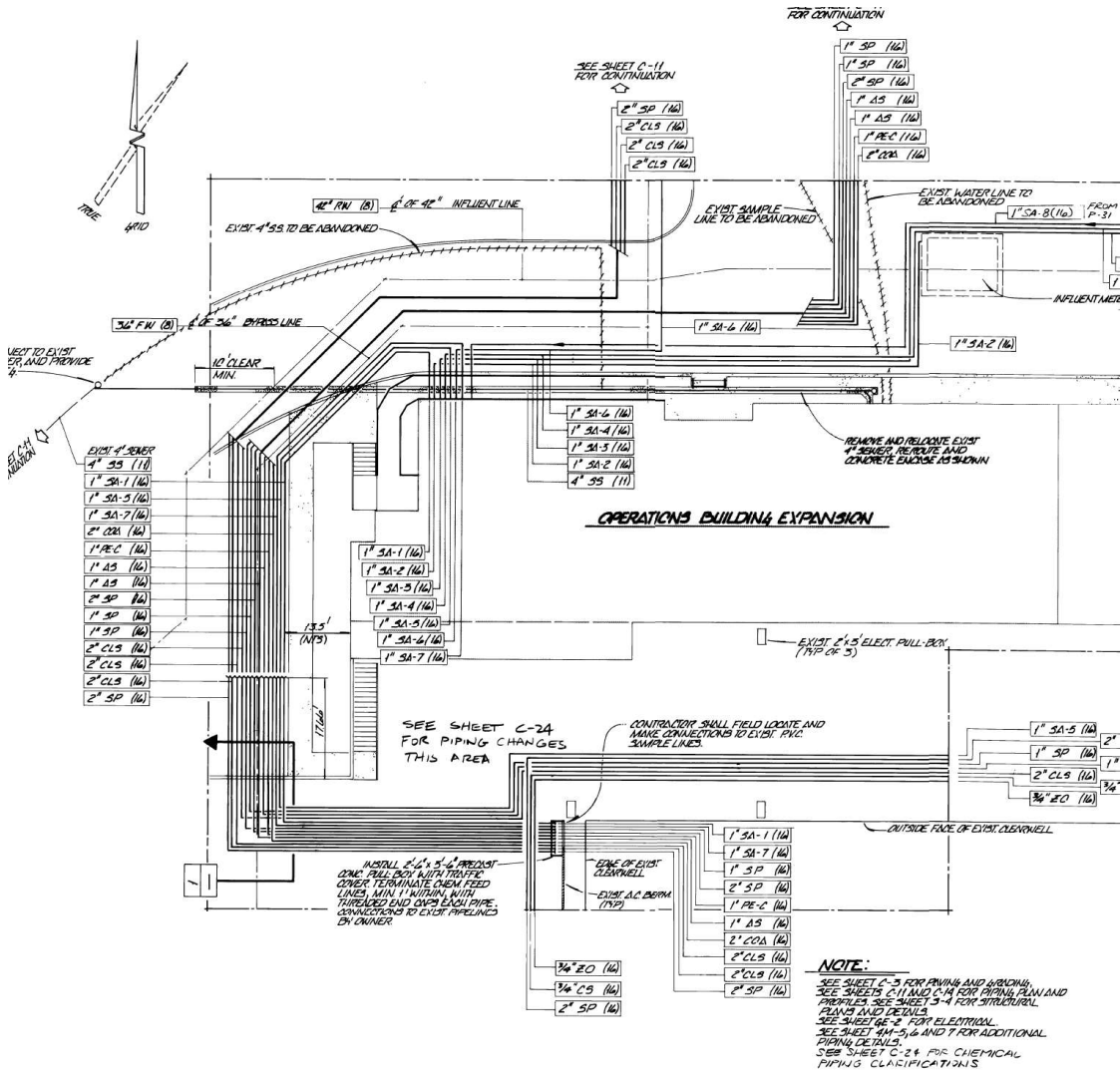


Figure 5.18 Existing Chemical Routing

5.8.3 Opinion of Cost

The opinion of cost for the evaluation is provided in Table 5.53.

Table 5.53 Opinion of Cost - Filter Washwater Chlorine Addition

Discipline	Cost
Major Equipment	\$20,000
Additional Mechanical	\$90,000
Civil/Structural	\$30,000
Electrical and Instrumentation	\$60,000
Total Project ⁽¹⁾	\$460,000
Estimate Range ⁽²⁾	\$390,000-\$640,000

Notes:

(1) Includes sales tax= 8.75%, overhead and profit= 15%, contingency=30%, engineering= 15%.

(2) Class IV estimate with range of -15% to +40%.

Projected O&M costs based on chemical usage and electrical requirements are listed in Table 5.54.

Table 5.54 O&M Estimates - Filter Washwater Chlorine Addition

Description	Cost
Annual O&M	\$17,500
5-Year Projected O&M ⁽¹⁾	\$21,000
10-Year Projected O&M ⁽¹⁾	\$25,800

Notes:

(1) Assumes 4% interest rate.

5.9 Power Supply Evaluation

An analysis was done on the existing electrical supply system to determine if modifications are required for any of the evaluations considered at Perdue WTP. The last large scale project at the facility was the DAF upgrades project in 2012. The service load conditions provided in the record drawings show the existing service size is 173 amps at 12 kilovolts (kV). Figure 5.19 shows the current power distribution schematic at the facility.

Based on the record drawings of the existing loads there are 26.1 amps still available at 12 kV. Apparent power or kilovolt-amperes (kVA) can be determined based on Equation 7.

$$\text{Power (kVA)} = 3 \times \text{Current (Amps)} \times \text{Voltage (V)} / 1,000 \tag{7}$$

The resulting apparent power from the equation above is 542 kVA. Assuming a power factor of 0.9, the resulting power available would be 488 kilowatts (kW). Based on 480-volt supply that is commonly used for process equipment, there is a load capacity of 652 amps available at the facility.

The location of the electrical distribution equipment was also reviewed to evaluate capacity and vicinity to existing or new equipment. There are four MCCs onsite, MCC-A, MCC-B, MCC-C, and MCC-D. Based on a review of the existing loads from the record documentation, Table 5.55 was generated for the remaining capacity of each MCC.

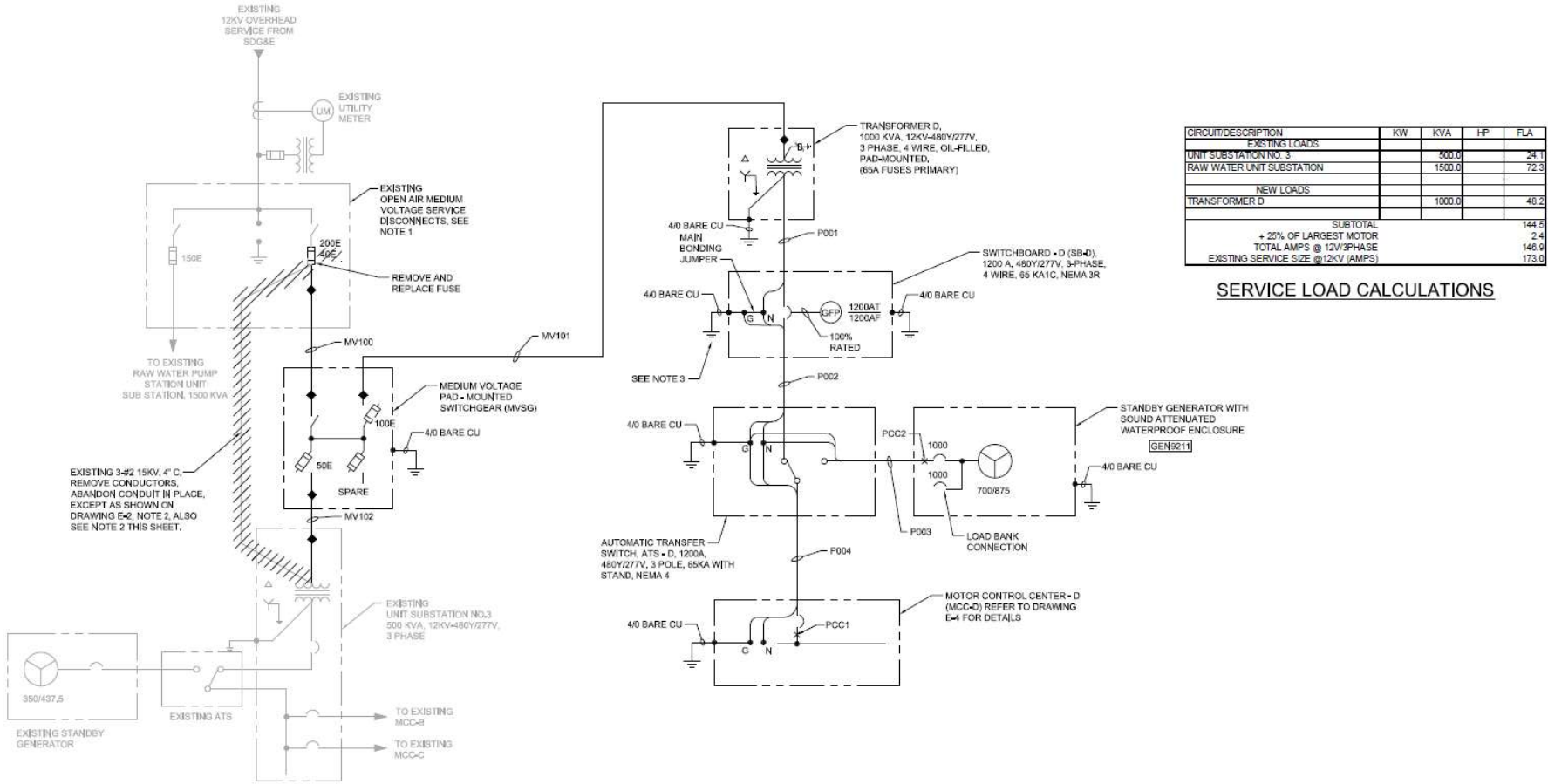
Table 5.55 Existing MCC Remaining Capacity

MCC	Capacity Remaining (%)	Capacity Remaining (kVA)	Capacity Remaining ⁽¹⁾ (Amps)
A	0	0	0
B	20	50.9	106
C	20	32.2	67
D	13	76.8	160

Notes:

(1) Assumes 480-volt power supply.

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CIRCUIT DESCRIPTION	KW	KVA	HP	FLA
EXISTING LOADS				
UNIT SUBSTATION NO. 3		500.0		24.1
RAW WATER UNIT SUBSTATION		1500.0		72.3
NEW LOADS				
TRANSFORMER D		1000.0		48.2
SUBTOTAL				
+ 25% OF LARGEST MOTOR				
TOTAL AMPS @ 12V/3PHASE				
EXISTING SERVICE SIZE @ 12KV (AMPS)				
				144.5
				2.4
				146.9
				173.0

SERVICE LOAD CALCULATIONS

Figure 5.19 Perdue WTP Electrical Distribution

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Locations for each MCC are shown on Figure 5.20.

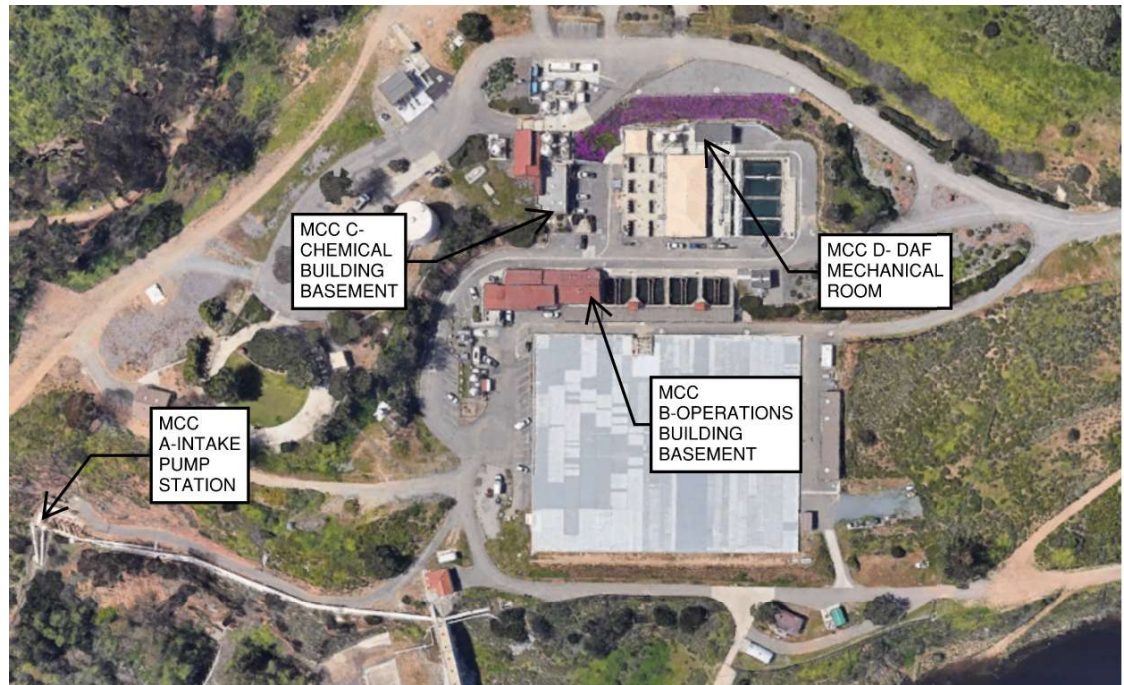


Figure 5.20 Existing MCC Locations

Any evaluations with a load higher than the remaining MCC loads will require a new distribution system to be installed onsite. It is recommended to collect existing MCC load data to ensure the loads reflected in record drawings equate to actual loads seen during operations.

5.10 Additional Project Evaluations Identified

As a part of the condition assessment, the facility was also assessed for opportunities for chemical/electrical efficiency and safety improvements. Additional project evaluations identified from the condition assessment are below.

5.10.1 Solar

Based on the DHK Engineers, Inc., recommendations from the Energy Audit performed in 2021, a solar evaluation was conducted to determine the feasibility of constructing a solar array at the Perdue WTP. Two different configurations were considered, a ground mounted array and a floating array.

Due to the sensitive habitat surrounding the existing facility, the ground mounted solar array was positioned adjacent to the existing clear well structure. This area has been previously considered for future projects and the mitigation of the sensitive habitat is understood. The analysis also assumes the existing clear well is in place, which cannot support structural loads due to the corrugated metal roof design. If a new clear well is constructed, a solar array could potentially be mounted to the roof with proper structural support. Figure 5.21 displays the ground-mounted array location adjacent to the existing clear well.



Figure 5.21 Ground Mounted Solar Array

The system is comprised of 236 frames with each frame housing 4 modules for a total of 944 modules. The system footprint is approximately 40,000 ft² with an alternating current (AC) power generation nameplate of 264 kW. The annual production is estimated to be 592.4 megawatt-hours (MWh).

The second configuration was a larger array, which would float on top of Sweetwater Reservoir, as shown on Figure 5.22.



Figure 5.22 Floating Solar Array

The system is comprised of 903 frames with each frame housing 4 modules for a total of 3,612 modules. The system footprint is approximately 105,000 ft² with an AC power generation nameplate of 1.0 megawatts. The footprint is similar to the area presently occupied by the clear well. The alternative also serves as an evaluation for the installation of a solar structure on top of a new clear well, assuming the structural capacity is adequate. The annual production is estimated to be 2.262 gigawatt-hours.

An opinion of cost was developed for a self-constructed system and with a purchase power agreement (PPA) approach. Under a PPA approach, the system capital and O&M are paid for by a third party, and electricity is sold to the third party at a cheaper rate than the electrical utility supplier. Table 5.56 provides the opinion of capital cost.

Table 5.56 Opinion of Cost - Solar

Discipline	Ground Mounted	Floating Array
Major Equipment	\$1,320,000	\$4,135,000
Additional Mechanical	-	-
Civil/Structural	\$264,000	\$1,000,000
Electrical and Instrumentation	790,000	2,568,000
Total Project ⁽¹⁾	\$5,190,000	\$16,820,000
Estimate Range ⁽²⁾	\$4,410,000-7,270,000	\$14,300,000-\$23,550,000

Notes:

(1) Includes sales tax= 8.75%, overhead and profit= 15%, contingency=30%, engineering=15%.

(2) Class IV estimate with range of -15% to +40%.

O&M costs for a self-constructed system is provided in Table 5.57.

Table 5.57 O&M Estimates - Solar

Description	Ground Mounted	Floating
Annual Maintenance	\$45,000	\$150,000
5-Year Projected O&M ⁽¹⁾	\$55,000	\$178,000
10-Year Projected O&M ⁽¹⁾	\$67,000	\$217,000

Notes:

(1) Assumes 4% interest rate.

The current rate at the facility for power is \$0.18 per kilowatt-hour. Based on the current pricing and a demand and non-bypassable charges of 60 percent, a self-constructed system was assessed. A net present value evaluation was done for years 5 and 10, and is presented in Table 5.58. An interest rate of 4 percent was assumed.

Table 5.58 Opinion of Savings

Alternative	Annual Generation	Annual Power Savings	20 Year Net Present Value Savings
Ground Mounted	593 MWh	\$31,700	\$280,000
Floating	2,262 MWh	\$113,300	\$870,000
PPA Agreement	593 MWh	\$28,500	\$387,000

Based on the savings for solar power generated and the annual savings, it is not financially attractive to self-construct a solar power system at the Perdue WTP. If desired, the route of a PPA loan would provide some cost savings without the investment capital.

5.10.2 Washwater Supply Pump Variable Frequency Drive

Another recommendation from the DHK Engineering Energy Audit was to install VFDs on the washwater supply pumps. With the installation of the DAF pretreatment system, the facility's existing filters have extended filter runs ranging from 200 to 300 hours. The original system was sized for six washes a day, and, based on a review of the previous operating year, the facility is averaging 0.6 washes per day. Therefore, there is a lower demand for the washwater supply tank to be filled than when the pumps were originally installed.

Installation of a VFD will allow the pumps to operate at a lower flow setpoint consuming less energy to supply the same amount of water. To install two VFDs for the washwater pumps, there is room available adjacent to MCC-B. A planning-level estimate is shown in Table 5.59.

Table 5.59 Opinion of Cost - Washwater Supply Pump VFD

Discipline	Cost
Major Equipment	\$25,000
Additional Mechanical	\$14,000
Civil/Structural	-
Electrical and Instrumentation	\$13,000
Total Project ⁽¹⁾	\$130,000
Estimate Range ⁽²⁾	\$110,000-\$180,000

Notes:

(1) Includes sales tax= 8.75%, overhead and profit= 15%, contingency=30%, engineering=15%.

(2) Class IV estimate with range of -15% to +40%.

Projected O&M costs based on electrical power needs are listed in Table 5.60.

Table 5.60 O&M Estimates - Washwater Supply Pump VFD

Description	Cost
Annual O&M	\$3,500
5-Year Projected O&M ⁽¹⁾	\$4,300
10-Year Projected O&M ⁽¹⁾	\$5,250

Notes:

(1) Assumes 4% interest rate.

5.10.3 Chemical Mixing Improvements

Based on conversations with operations staff, chemical dosing prior to the clear well has poor mixing. Historically chemicals have precipitated out of solution and formed a large mass, which required being chipped out. The existing chemical diffuser arrangement is shown on Figure 5.23.

Three different chemicals are injected upstream of the clear well including chlorine solution, caustic soda, and aqueous ammonia solution. Based on feedback from operations and the precipitation occurrence, the channel has inadequate mixing. This was reinforced by the mention of the facility experiencing lag times in their chemical adjustments with their instrumentation.

The use of softened carrier water for the system was considered. Increased flow rate and dilution of the chemical prevents scaling at the diffuser due to an increase in the velocity through the diffuser ports. The increased velocity can provide additional mixing energy, however, this solution was not regarded as impactful due to the scale buildup occurring in the process stream and not at the diffuser ports.

An alternative to address the mixing is to install a flash mixing system similar to what is employed upstream of the DAF system. The system would be comprised of a recirculation pump and a cone nozzle spraying counter to the flow. The configuration will disperse the chemical, add additional energy, and allow for better mixing. Once the mixing is improved the existing analyzers should see changes in chemical concentrations more rapidly.

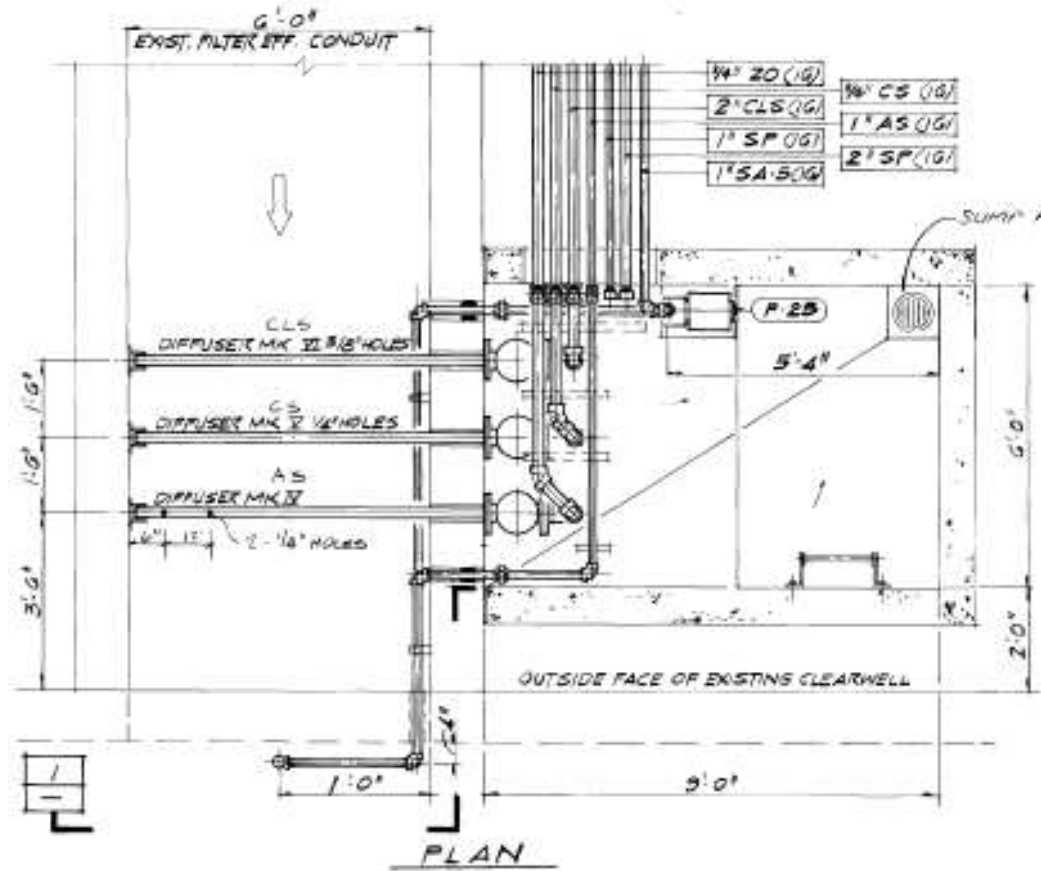


Figure 5.23 Existing Chemical Diffuser Configuration

The recirculation rate of 1 mgd requires a motor rating of 5 hp. The recirculation pump can be installed adjacent to the existing washwater supply pumps, where room for a designated future pump was provided. Figure 5.24 and Figure 5.25 represent the identified location plan and sections.

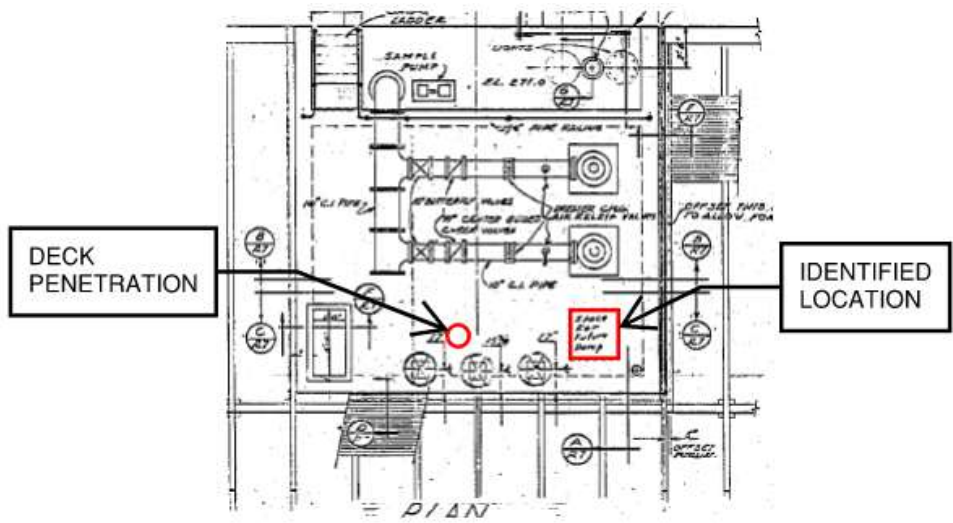


Figure 5.24 Recirculation Pump Location-Plan

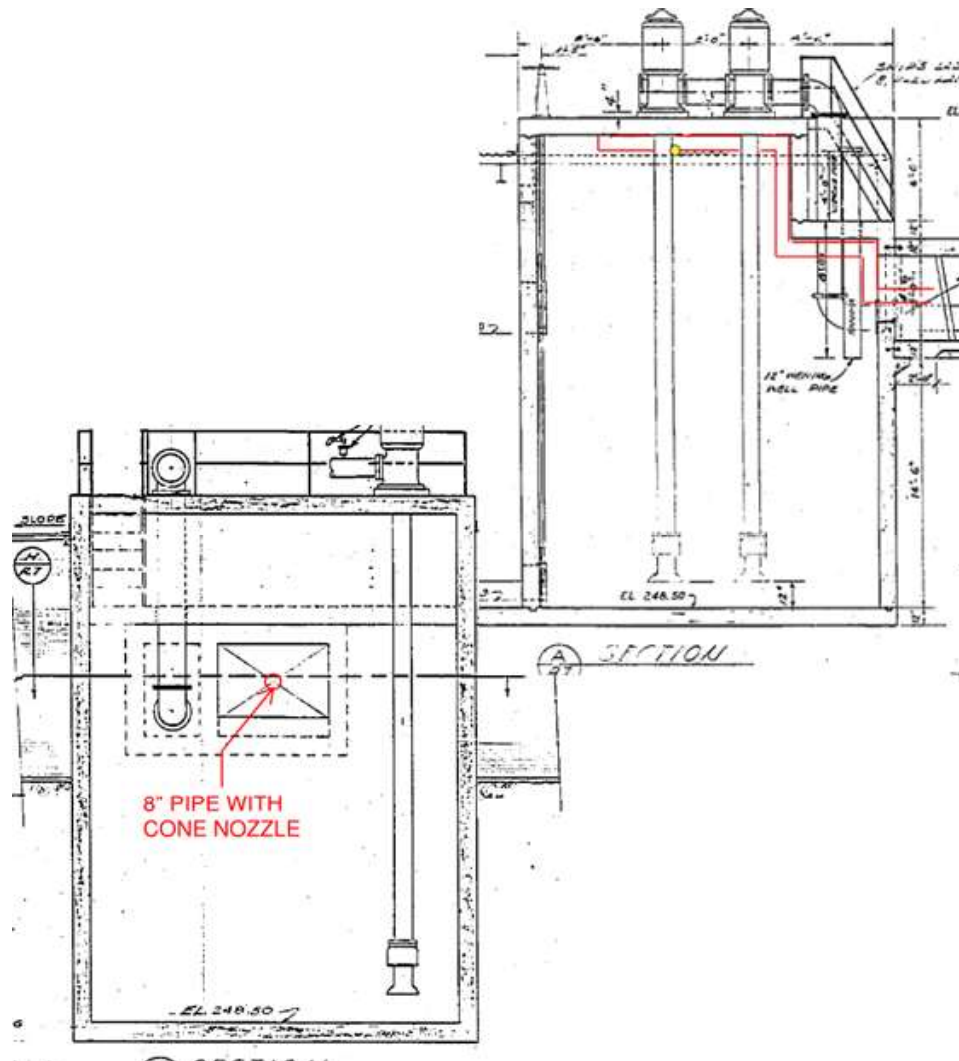


Figure 5.25 Recirculation Pump Location-Sections

The cone nozzle on the end of the pipe includes a solid cone shape spray pattern with a round impact area. Nozzle sizes are available up to 8 inches for threaded connections with spray angles ranging from 50 to 95 degrees. The cone spray pattern flow would be counter to the process flow to create the turbulence required for mixing. Figure 5.26 is an example of mixing nozzles available.

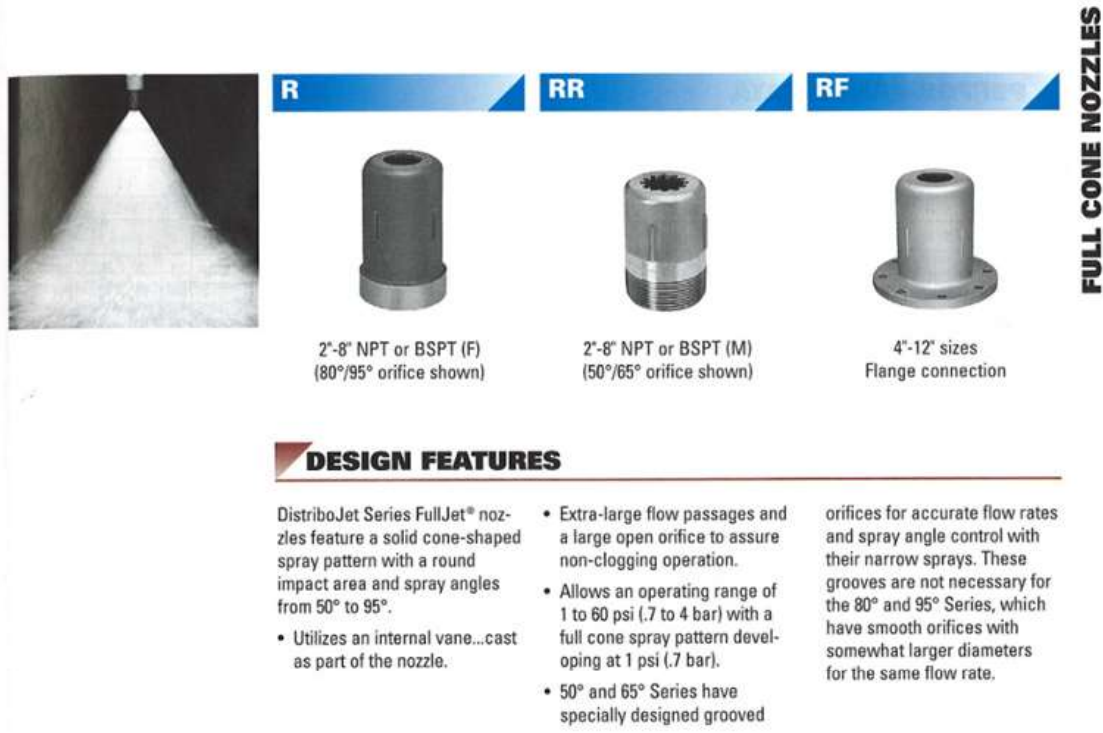


Figure 5.26 Recirculation Pump Location-Sections

An opinion of cost for the system can be seen in Table 5.61.

Table 5.61 Opinion of Cost - Chemical Mixing Improvements

Discipline	Cost
Major Equipment	\$50,000
Additional Mechanical	\$80,000
Civil/Structural	\$20,000
Electrical and Instrumentation	\$75,000
Total Project ⁽¹⁾	\$490,000
Estimate Range ⁽²⁾	\$420,000-\$690,000

Notes:

- (1) Includes sales tax= 8.75%, overhead and profit= 15%, contingency=30%, engineering=15%.
- (2) Class IV estimate with range of -15% to +40%.

Projected O&M costs based on electrical power needs are listed in Table 5.62.

Table 5.62 O&M Estimates - Chemical Mixing Improvements

Description	Cost
Annual O&M	\$28,000
5-Year Projected O&M ⁽¹⁾	\$33,000
10-Year Projected O&M ⁽¹⁾	\$40,300

Notes:

- (1) Assumes 4% interest rate.

5.10.4 Low Capacity Chlorinator

A part of the condition assessment looked at efficiencies of chemical use. Due to the plant operating at lower flows than the rated 30 mgd, the existing chlorine gas system does not have the desired operational range to operate efficiently at the lower flow rate. Based on conversations with operations staff the lowest dose the chlorinators can get down to is 1.9 mg/L. Overdosing of free chlorine can lead to the formation of DBPs and adds unnecessary additional operating cost.

Currently there are three existing chlorinators located on the upper level of the chemical building. Chlorinator capacities include two 2,000-pound chlorinators and one 500-pound chlorinator. It is recommended to include a 250-pound chlorinator to provide flexibility for operational staff. The existing chlorinator room has space available for an additional chlorinator to be installed. Opinion of cost for a new 250-pound chlorinator is provided in Table 5.63.

Table 5.63 Opinion of Cost - Low Capacity Chlorinator

Discipline	Cost
Major Equipment	\$10,000
Additional Mechanical	\$80,000
Civil/Structural	-
Electrical and Instrumentation	\$45,000
Total Capital ⁽¹⁾	\$290,000
Estimate Range ⁽²⁾	\$250,000-\$410,000

Notes:

(1) Includes sales tax= 8.75%, overhead and profit= 15%, contingency=30%, engineering=15%.

(2) Class IV estimate with range of -15% to +40%.

Projected O&M costs based on chemical consumption needs are listed in Table 5.64.

Table 5.64 O&M Estimates - Low Capacity Chlorinator

Description	Cost
Annual O&M	\$12,800
5-Year Projected O&M ⁽¹⁾	\$15,500
10-Year Projected O&M ⁽¹⁾	\$19,000

Notes:

(1) Assumes 4% interest rate.

5.10.5 Raw Water Pump Variable Frequency Drive

From the analysis of historical flows at the facility, the demand for water from Perdue WTP has decreased. The facility is rated for 30 mgd, however it has operated at an average daily flow of 8.7 mgd over the last seven years. The facility has been turned off intermittently due to lower demand and an increase in available water supply from the desalination facility, which was expanded in 2017. To avoid the lengthy shutdown and start-up process, it was proposed to install a VFD on Intake Pumps 1 and 2 to provide operational flexibility and to avoid potential facility shutdowns.

Typically, the influent water to the facility is made up of 50 percent Sweetwater Reservoir water and 50 percent raw aqueduct water. Since Intake Pumps 1 and 2 are rated for 6 mgd, a 50/50 split

would result in a 12-mgd flow rate. A VFD would allow for the pump speed to be lower by roughly 50 percent and produce a lower flow rate to keep the plant running, which would allow for easier, more efficient operations. There is adequate space at the intake pump station for a new VFD installation for Intake Pumps 1 and 2 adjacent to the existing VFD installed for Intake Pumps 3 and 4. Figure 5.27 identifies space for a new VFD.



Figure 5.27 Intake Pumps 1 and 2 Potential VFD Location

The evaluation found that the original manufacturer for Intake Pumps 1 and 2 is no longer in business. Therefore, it was also evaluated to replace Intake Pumps 1 and 2 with new vertical turbine pumps with similar flow capacities and VFD compatibility. The new pump VFD would be located adjacent to the VFD for Intake Pumps 3 and 4.

The opinion of cost is compared for both options in Table 5.65.

Table 5.65 Opinion of Cost - Raw Water Pump Modifications

Discipline	VFD Only	Replacement Intake Pumps 1 and 2
Major Equipment	\$20,000	\$180,000
Additional Mechanical	-	\$20,000
Civil/Structural	-	-
Electrical and Instrumentation	\$10,000	\$100,000
Total Project ⁽¹⁾	\$70,000	\$660,000
Estimate Range ⁽²⁾	\$60,000-100,000	\$560,000-920,000

Notes:

(1) Includes sales tax= 8.75%, overhead and profit= 15%,contingency=30%, engineering=15%.

(2) Class IV estimate with range of -15% to +40%.

Based on the Class IV estimate, the range for the opinion of cost was projected for 5- and 10-year intervals. Projected opinion of cost is provided in Table 5.66.

Table 5.66 Present Worth Analysis - Raw Water Pump Modifications

Description	-15%		Project Estimate		+40%	
	5 Year	10 Year	5 Year	10 Year	5 Year	10 Year
VFD Only ⁽¹⁾	\$60,000	\$70,000	\$70,000	\$80,000	\$100,000	\$120,000
Replacement Intake Pumps 1 and 2 ⁽¹⁾	\$600,000	\$730,000	\$690,000	\$840,000	\$970,000	\$1,180,000

Notes:

(1) Assumes 4% interest rate.

5.10.6 Filter Backwash Realignment

Based on discussions with the Authority, the reservoir has been accumulating solids and dredging of the lake is being evaluated. Accumulated solids have buried lower cups on the intake tower resulting in the cups being unusable. In further discussion, it was noted that the filter backwash waste is discharged back into the reservoir similarly to the operation during the last master plan update. During a backwash event it was seen that the backwash solids being wasted into the reservoir flow in the direction of the intake tower as seen on Figure 5.28.



Figure 5.28 Filter Backwash Water Discharge Approaching Intake Tower

Since the Authority reinforced the inability to access intake tower cups, the recommendation from the previous master plan update to realign the backwash waste away from the intake tower could prevent the issue from getting worse.

Three different alternative alignments were previously reviewed as seen on Figure 5.29.



Figure 5.29 Backwash Realignment Alternatives

Each alternative was reviewed for hydraulics, pipe material, surrounding sensitive habitat, and required civil modifications. Alternative details can be found in Appendix D. Opinion of cost for each alternative has been updated to reflect current costs, which are provided in Table 5.67.

Table 5.67 Opinion of Cost - Filter Backwash Realignment

Discipline	Alternative 1	Alternative 2	Alternative 3
Major Equipment	\$91,500	\$326,000	\$521,000
Additional Mechanical			-
Civil/Structural	\$75,000	\$80,000	\$258,000
Electrical and Instrumentation	-	-	-
Total Project ⁽¹⁾	\$400,000	\$970,000	\$1,860,000
Estimate Range ⁽²⁾	\$340,000-\$560,000	\$820,000-\$1,360,000	\$1,580,000-\$2,600,000

Notes:

- (1) Includes sales tax= 8.75%, overhead and profit= 15%, contingency=30%, engineering=15%.
- (2) Class IV estimate with range of -15% to +40%.

Based on the Class IV estimate, the range for the opinion of cost was projected for 5- and 10-year intervals. Projected opinion of cost is provided in Table 5.68.

Table 5.68 Present Worth Analysis - Filter Backwash Realignment

Alternative ⁽¹⁾	-15%		Project Estimate		+40%	
	5 Year	10 Year	5 Year	10 Year	5 Year	10 Year
Alternative 1	\$410,000	\$500,000	\$490,000	\$590,000	\$680,000	\$830,000
Alternative 2	\$1,000,000	\$1,210,000	\$1,180,000	\$1,440,000	\$1,650,000	\$2,010,000
Alternative 3	\$1,920,000	\$2,340,000	\$2,260,000	\$2,750,000	\$3,160,000	\$3,850,000

Notes:

(1) Assumes 4% interest rate.

5.10.7 Structural Assessment

After a review of the record drawings for the various facilities, five existing structures were selected for inclusion in this seismic evaluation. The list of existing structures evaluated in this study are shown in Table 5.69.

Table 5.69 List of Structures Evaluated

Structure Name	Type	Approximate Date Built
Control Building	Building	1959
Operations Building Expansion	Building	1985
Chemical Feed Building	Building	1985
Filters 1-4	Water-bearing Basins	1959
Clear Well	Water-bearing Basin	1959

The purpose of the evaluation was to identify seismic vulnerabilities and deficiencies to be considered for plant resiliency enhancement. The seismic evaluation for facilities identified as buildings was performed using the procedures established by American Society of Civil Engineers (ASCE) Standard: Seismic Evaluation and Retrofit of Existing Buildings 41-17 (ASCE 41-17). The standard prescribes a three-tiered approach for the seismic evaluation: Tier 1 - Screening, Tier 2 - Deficiency-based evaluation and retrofit and Tier 3 - Systematic evaluation and retrofit. For this evaluation, analysis procedures were limited to the Tier 1 level. For facilities identified as water-bearing basins, the evaluation was performed using American Concrete Institute (ACI) 350-20 and ACI 350.3-20 but using the seismic hazards set forth in ASCE 7-16 and with adjustments made below to adapt the use of ACI 350-20 and ACI 350.3-20 for seismic evaluation, rather than design:

- Importance factor = 1.25 for Risk Category III structures.
- Importance factor = 1.50 for Risk Category IV structures.
- Load factors were limited to 1.0 for load combinations.
- Capacity-reduction factors were set equal to 1.0.

As part of ASCE 41-17 procedures, a site visit is required to verify as-built conditions. At this time, no site visit has been conducted to confirm the as-built conditions. Once a site visit is performed, any findings should be updated to reflect current conditions in field rather than what was assumed from as-built drawings.

The evaluation findings from review of the record drawings and structural calculations are presented in the sections below pertaining to each building or basin. The structural members were checked against the demands imposed by the prescribed seismic loads as described in the code standards previously mentioned to obtain corresponding demand-capacity ratios (DCRs). DCR values exceeding 1.0 indicate a deficiency with respect to the evaluated performance level. The members and connections that were found to be deficient for each structure are listed in tables corresponding to each building or basin. There are also recommendations pertaining to the deficiencies for further evaluation or mitigation strategies.

5.10.7.1 Control Building

The Control building is a one-story building with a basement constructed in 1959. It is made of brick masonry and concrete walls with a wood roof framing system. As part of the 1985 plant expansion, the Operations building was added next to the Control building. Refer to Table 5.70 for a list of deficiencies noted and recommendations.

Table 5.70 List of Deficiencies - Control Building

No.	Deficiency	Description	Recommendation
1	Torsional Response	The second-floor diaphragm has a high level of torsional eccentricity to the center of rigidity. This configuration can cause twisting in addition to horizontal displacement, potentially resulting in increased damage levels.	Perform a Tier 2 evaluation of the building to determine if this deficiency requires any mitigation.
2	Ties Between Foundation Elements	The concrete slab on grade at the first floor is not tied to the walls or footings of the building. The slab interface at the walls is comprised of an expansion joint. This renders the slab unable to contribute to maintaining building stability during an earthquake. Differential movement of the slab and building is a possibility.	Tie the concrete slab on grade to the walls and footings.
3	Openings at Shear Walls	The second-floor diaphragm has a 21'-10" opening alongside the southern shear wall. Large openings limit the diaphragm's ability to transfer loads to the shear walls and provide out-of-plane support to shear walls. This can result in large deflections and increased damages.	Perform a Tier 2 evaluation of the building to determine if this deficiency requires any mitigation. Diaphragm and shear wall stresses and deflections should be checked. Additionally, out-of-plane stability and stresses should be checked.
4	Reinforcing Steel	The reinforced masonry walls above the ground floor do not appear to have any specified horizontal reinforcing steel. The wall capacity to resist both in-plane and out-of-plane seismic forces will be minimal.	Replace existing wall segments as required with reinforced concrete shear walls.

No.	Deficiency	Description	Recommendation
5	Wall Anchorage	The connections at the tops of all masonry walls, both interior partition walls and exterior bearing walls, lack adequate lateral bracing (wall anchorage) to the roof diaphragm.	Add wall bracing connections between the tops of masonry walls and the roof diaphragm.
6	Diagonally Sheathed and Unblocked Diaphragms	The roof diaphragm consists of diagonal sheathing, which may have insufficient capacity.	Perform a Tier 2 evaluation of the building to determine if this deficiency requires any mitigation.
7	Transfer to Shear Walls	Portions of the roof connection are unclear, such as the roof to shear wall connection for the walls spanning perpendicular to roof members.	Add diaphragm ties along collectors and at re-entrant corners to develop the necessary shear transfer from the roof diaphragm to the shear walls.
8	Stiffness of Wall Anchors	The brick masonry walls are anchored to trusses with 2x10 blocking and embedded bolts. The truss bottom chord deflection will be 1.5 inches, which is far greater than the 1/8-inch maximum deflection.	Add wall bracing connections between the tops of masonry walls and the roof diaphragm.

5.10.7.2 Operations Building Expansion

The Operations building expansion is a one-story building with basement constructed in 1985 to expand off the existing Control building. The building was built using wood framed and concrete walls with a wood roof framing system. Refer to Table 5.71 for list of deficiencies noted and recommendations.

Table 5.71 List of Deficiencies - Operations Building Expansion

No.	Deficiency	Description	Recommendation
1	Transfer to Shear Walls	The roof framing has no drag connections at the re-entrant corners (two locations).	Add diaphragm ties along collectors and at re-entrant corners to develop the necessary shear transfer from the roof diaphragm to the shear walls.
2	Vertical Irregularities	The wood-framed shear walls at the second floor are discontinuous down to the foundation.	Perform a Tier 2 evaluation of the building to determine if this deficiency requires any mitigation.
3	Torsional Response	The second-floor diaphragm has a torsional eccentricity in its potential response to ground shaking. This configuration may cause twisting in addition to horizontal displacement during an earthquake.	Perform a Tier 2 evaluation of the building to determine if this deficiency requires any mitigation.

No.	Deficiency	Description	Recommendation
4	Shear Wall Stress	Numerous wood-framed shear walls at the second floor have shear demands that exceed the in-plane shear capacities. The north-south direction shear wall DCRs range from 1.72 to 10.72, and the east-west direction walls range from 1.8 to 3.6.	Add new shear walls and add sheathing to existing shear walls.
5	Narrow Wood Shear Walls	The building relies on narrow wood shear wall segments that have limited shear capacity. This may result in excessive diaphragm drift.	Extend the length of the existing shear walls.
6	Shear Walls Connected Through Floors	Some shear walls lack hold-downs to resist overturning forces. The lack of hold-downs can result in excessive building drift and localized damage.	Add hold-downs at the ends of existing shear walls.
7	Roof Chord Continuity	The roof diaphragm is interrupted by clear story windows. Lateral bracing is provided for the upper diaphragm; however, the lower diaphragm is unsupported at one end.	Add panel blocking to provide a shear connection between the two separate diaphragms.
8	Load Path/ Transfer to Shear Walls	The steel braces intended to connect the roof framing elements at the discontinuous diaphragm, lack the tensile capacity to transfer seismic loading from the roof diaphragm to the suspended floor slab.	Provide additional shear walls, shear connections, and drag connections.
9	Load Path/ Transfer to Shear Walls	The strap provided in the roof beam splice detail lacks the shear capacity to transfer the required drag loads.	Provide two additional CMST12 straps at each face of the shape beams.
10	Tops of Partition Walls	Some wood stud partition walls are braced at a spacing larger than the acceptable limit of 6 feet.	Verify the as-built condition and provide wall bracing that complies with the current building code.
11	Masonry Veneer Ties	The masonry veneer does not have ties specified.	Perform an as-built survey as required to determine the existing construction and replace the veneer with a new veneer system with adequate bracing or an alternative finish that complies with the current building code.

No.	Deficiency	Description	Recommendation
12	Weep Holes	The masonry veneer does not have weep holes detailed. Weep holes in the veneer allow for trapped moisture to escape from between the wood walls and the masonry layer. The trapped moisture can lead to poor attachment of the veneer layer to the wall framing, which will increase the potential for damages and injury.	Retrofit weep holes according to the current building code.

5.10.7.3 Chemical Feed Building

The Chemical Feed building is a one-story building with a basement constructed in 1985 as part of the plant expansion using reinforced masonry and concrete walls with the roof framing system being a combination of wood and concrete framing. Refer to Table 5.72 for list of deficiencies noted and recommendations.

Table 5.72 List of Deficiencies - Chemical Feed Building

No.	Deficiency	Description	Recommendation
1	Load Path/ Transfer to Shear Walls	The roof diaphragm is interrupted by clear story windows creating a discontinuity in the shear resistance and breaking the roof into two smaller diaphragms with high aspect ratios.	Combine the diaphragms together with plywood panel blocking to infill window openings. The exterior aesthetics can be maintained by changing the windows for opaque glass.
2	Ties Between Foundation Elements	Some of the concrete slabs on grade at the upper and lower building are not tied to the walls and/or footings of the building. These slab segments are unable to contribute to maintaining building stability during an earthquake. Differential movement between the slab and building is an additional possibility.	Tie the concrete slab on grade to the walls and footings.
3	Wall Anchorage	Connections for bracing the reinforced masonry walls to the roof diaphragm at the upper building are not detailed. This condition applies to both the interior partition walls and perimeter bearing walls.	Add wall bracing connections between the tops of masonry walls and the roof diaphragm.
4	Wood Ledgers	The sheathing plate atop the masonry wall in detail G/1S-8 is loaded in cross grain tension.	By adding wall bracing connections between the masonry wall and the roof diaphragm, this deficiency can be mitigated.

No.	Deficiency	Description	Recommendation
5	Crossties	Crossties are lacking at the clear story window due to the diaphragm discontinuity. Crossties are used to develop out of plane forces imposed on the walls into the main roof diaphragm. The lack of crossties renders the roof diaphragm unable to transfer seismic forces to the supporting shear walls. This will result in increased damages.	Refer to recommendation for Deficiency No. 1.
6	Openings at Shear Walls	The clear story window opening is longer than 25 percent of the masonry shear walls.	Perform a Tier 2 evaluation of the building to determine if this deficiency requires any mitigation.
7	Tops of Partition Walls	The masonry partition walls are not braced to the roof or ceiling.	Add wall bracing connections between the tops of masonry walls and the roof diaphragm.
8	Masonry Veneer Ties	The masonry veneer does not have any ties specified.	Perform an as-built survey as required to determine the existing construction and replace the veneer with a new veneer system with adequate bracing or an alternative finish that complies with the current building code.
9	Weakened Planes	No ties are specified at the weakened plane created by flashing at the south wall.	Refer to recommendation for Deficiency No. 8.

5.10.7.4 Filters 1-4

Filters 1-4 were constructed in 1959 with concrete walls and slab, with modifications to the filters during the 1985 plant expansion construction. Refer to Table 5.73 for a list of deficiencies noted and recommendations.

Table 5.73 List of Deficiencies - Filters 1-4

No.	Deficiency	Description	Recommendation
1	Filter Inlet Channel Wall	The 8-inch filter inlet wall cannot develop the horizontal bending demands due to seismic loading (DCR = 2.11).	Replace the existing wall with a wall having adequate strength.
2	Filter Slab	The filter slabs below the dividing walls, west filter wall, east filter wall, and south filter walls lack capacity to develop the wall flexural bending stress (worst DCR = 1.28).	Mitigation is not recommended at this time as the nature of the deficiency does not present a significant risk to the structural performance.

5.10.7.5 Clear Well

As indicated in Section 4.7, the existing 10-MG clear well was built during the original 1960 construction. It is trapezoidal in shape with a corrugated metal roof, concrete stem walls, and sloped gunite side walls and floor. Modifications were made to the existing structure during the 1985 plant expansion project. Refer to Table 5.74 for list of deficiencies noted and recommendations.

Table 5.74 List of Deficiencies - Clear Well

No.	Deficiency	Description	Recommendation
1	Compacted Fill around Perimeter	The interior lining of the reservoir is comprised of a 2.5-inch-thick layer of gunite that is reinforced with a wire mesh and sloped at a 45 degree angle. If under seismic loading, the gunite layer fractures, water can penetrate the compacted fill berm under hydrostatic pressure from the liquid level in the reservoir. Depending on the size of a leak, the berm can become destabilized in a short period of time, which can result in a complete containment failure of the reservoir.	As this current study is limited to the performance of the existing structures, it is our recommendation that a geo-seismic evaluation of the berm be performed to assess the risk of a failure.
2	Roof Beam Connection to Wall	The W12x19 roof beam anchorage lacks the strength to develop the tributary seismic roof loads in both directions (worst DCR = 2.31).	Provide a seismic retrofit of the roof framing system.
3	Interior Column Reinforcing	The interior column reinforcing bars lack the capacity to develop the bending moment due to the tributary seismic loads (DCR = 3.52).	Provide a seismic retrofit of the roof framing system.
4	Interior Column Baseplate Connection	The interior column baseplate anchorage, thickness, and welded bar reinforcing to the baseplate lack sufficient strength to develop the tributary seismic loads from basin (DCR = 2.96).	Provide a seismic retrofit of the roof framing system.
5	Interior Column Footing Overturning	The interior column footing becomes unstable when the water level within the reservoir is less than 11.66 feet above the top of the footing.	Assuming that it is not practical to operate the reservoir at a strictly controlled level or range of levels, our recommendation is to provide a seismic retrofit of the roof framing system.
6	Interior Column Footing Bearing Pressure	The interior column footing bearing pressure due to seismic loads exceeds the allowable soil bearing pressure (DCR = 1.48).	Provide a seismic retrofit of the roof framing system.

No.	Deficiency	Description	Recommendation
7	Inlet Walls Horizontal Reinforcing	The inlet structure horizontal wall reinforcing bars aren't sufficient to develop the bending moments due to hydrostatic and hydrodynamic loads (worst DCR = 2.13).	Thicken existing walls with high strength shotcrete and epoxy dowels.
8	North Elevation Inlet Wall Vertical Reinforcing	The inlet structure north elevation vertical wall reinforcing bars aren't sufficient to develop the bending moments due to hydrostatic and hydrodynamic loads (DCR = 1.61).	Thicken existing wall with high strength shotcrete and epoxy dowels.

5.10.7.6 Opinion of Cost

Opinion of cost for each building is summarized in Table 5.75 with a total project cost.

Table 5.75 Opinion of Cost - Structural Repairs

Structure	Cost
Control Building	\$385,000
Operations Building Expansion	\$340,000
Chemical Feed Building	\$370,000
Filters 1-4	\$490,000
Clear Well	\$9,540,000
Total Project ⁽¹⁾	\$12,820,000
Estimate Range ⁽²⁾	\$10,900,000-\$17,950,000

Notes:

- (1) Includes sales tax= 8.75%, overhead and profit= 15%, contingency=30%, engineering=15%.
- (2) Class IV estimate with range of -15% to +40%.

5.10.8 Dam Relief Valve Actuators

The Sweetwater Dam is not directly related to treatment process; however, the dam blocks the Sweetwater River providing the intake source for the facility. In the event of a dam failure, there are emergency release valves to send flow into the valley to prevent catastrophic damage to the dam. There are a total of four gate valves used for this application.

There are two existing 18-inch valves and two 20-inch valves, with Limitorque L120-10 actuators. Under normal circumstances, the valves do not open and close and, therefore, sit idle until exercised. Per the Authority staff, the valves are exercised annually to ensure proper functionality. However, it was discovered this past year that the existing actuators failed with the electrical motors burning out.

Due to the valves being used for emergency safety events, the actuators need to be reliable. It was evaluated to replace the existing Limitorque actuators with Beck actuators. Beck actuators are unique and take advantage of a magnetically driven motor. Since there is no electrical motor, there is no failure point for motor burnout and the actuator would be available 100 percent of the time. Opinion of cost for the new actuators is provided in Table 5.76.

Table 5.76 Opinion of Cost - Dam Relief Valve Actuators

Discipline	Beck Actuators
Major Equipment	\$66,000
Additional Mechanical	-
Civil/Structural	-
Electrical and Instrumentation	\$33,000
Total Project ⁽¹⁾	\$220,000
Estimate Range ⁽²⁾	\$190,000-\$310,000

Notes:

(1) Includes sales tax= 8.75%, overhead and profit= 15%, contingency=30%, engineering=15%.

(2) Class IV estimate with range of -15% to +40%.

5.10.9 Chlorine Gas Scrubber

During the condition assessment of the chlorine gas system, it was found that the existing system and building did not have any emergency safety measures for a chlorine gas release event. Exposure to chlorine gas can cause blurred vision, burning sensations on skin and blistering. Extended exposure can cause pulmonary issues or loss of life. For safety reasons, a dry scrubber system was evaluated for installation.

An EST™ Type DES 3000 emergency dry scrubber system by Denora was looked at to address any chlorine gas release. Components of the system include an exhaust blower, exhaust stack, media, media reaction tank, and control panel. Design criteria for the scrubber system is provided in Table 5.77.

Table 5.77 Emergency Scrubber Design Criteria

Design Characteristic	Unit	Value
Diameter	feet	8
Height	feet	18
Scrubber Rate	cfm	4,000 (air)/3,000 (chlorine)
Draft Across Scrubber	water column	1-1/2 inches
Maximum/Minimum Temperature for Tank	degrees Fahrenheit	200/-40
Maximum Exhaust Concentration	ppm	5
Power Supply	voltage/phase/Hertz	480/3/60
Electrical Load	amps	40

A system shop drawing is shown on Figure 5.30 as an example.

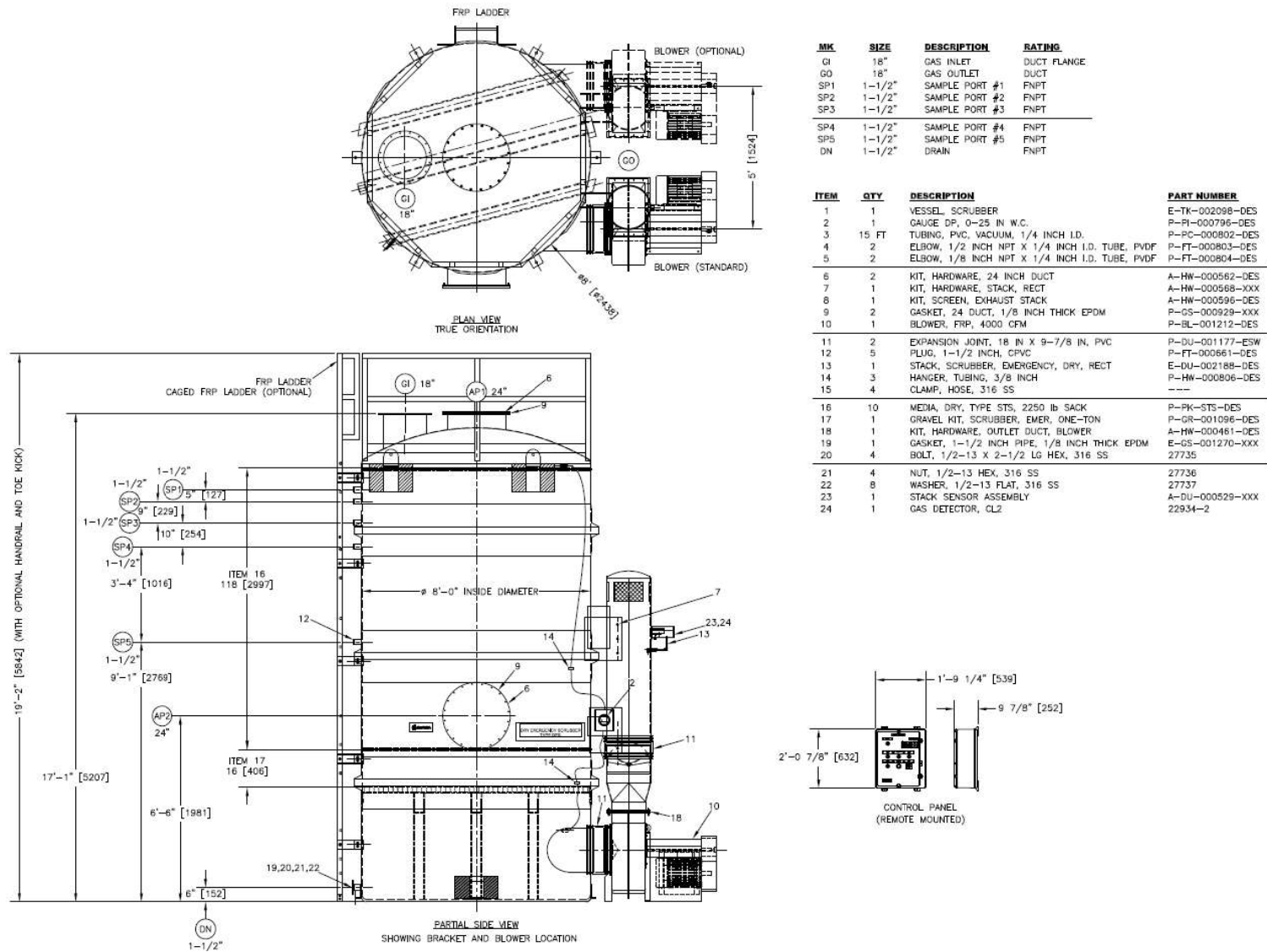


Figure 5.30 Chlorine Air Scrubber Shop Drawing Example

The system only includes the treatment vessel and ancillary equipment such as ducting, sensor, and electrical work are required to be done by the installing contractor. To be most effective, the chlorine scrubber system must be located adjacent to the existing chlorine cylinder storage room for quick activation. There is space available next to the sodium chlorite bulk storage tank as shown on Figure 5.31.



Figure 5.31 Available Space Next to Existing Cylinder Room

Opinion of cost for the new system is provided in Table 5.78.

Table 5.78 Opinion of Cost - Chlorine Gas Scrubber

Discipline	Cost
Major Equipment	\$260,000
Additional Mechanical	\$120,000
Civil/Structural	\$30,000
Electrical and Instrumentation	\$205,000
Total Project ⁽¹⁾	\$1,340,000
Estimate Range ⁽²⁾	\$1,140,000-\$1,880,000

Notes:

(1) Includes sales tax= 8.75%, overhead and profit= 15%, contingency=30%, engineering=15%.

(2) Class IV estimate with range of -15% to +40%.

5.10.10 Plant Water Upgrades

The plant water system is used for the chemical system carrier water. During the condition assessment, the pumps heads were noted to be recently replaced and the system has not undergone any upgrades or inspections since the original construction. There is also a desire to provide additional flow and pressure capacity. Currently, the facility requires booster pumps at applications such as the chlorine dioxide injection system to calibrate and maintain equipment. Replacing the existing plant water pumping system would eliminate the need for additional booster pumps and additional O&M expense. Table 5.79 represents the old pump setpoints with new pump operating points.

Table 5.79 Existing Pump Comparison to New

Description	Unit	Old	New
Flow	gpm	80	120
TDH	feet	145	280 ⁽¹⁾
Motor Size	hp	7.5	10

Notes:

(1) Based on requirements for chlorine dioxide.

The opinion of cost to replace the existing pumps and system is provided in Table 5.80.

Table 5.80 Opinion of Cost - Plant Water Upgrades

Discipline	Cost
Major Equipment	\$87,000
Additional Mechanical	\$60,000
Civil/Structural	\$20,000
Electrical and Instrumentation	\$83,500
Total Project ⁽¹⁾	\$600,000
Estimate Range ⁽²⁾	\$510,000-\$840,000

Notes:

(1) Includes sales tax= 8.75%, overhead and profit= 15%, contingency=30%, engineering=15%.

(2) Class IV estimate with range of -15% to +40%.

Projected O&M costs based on electrical power needs are listed in Table 5.81.

Table 5.81 O&M Estimates - Plant Water Upgrades

Description	Cost
Annual O&M	\$38,000
5-Year Projected O&M ⁽¹⁾	\$46,000
10-Year Projected O&M ⁽¹⁾	\$56,000

Notes:

(1) Assumes 4% interest rate.

Chapter 6

CAPITAL IMPROVEMENT PROJECT GROUPING AND PRIORITIZATION

6.1 Identified Projects and Groupings

Through the condition assessment of the facility, speaking with operations and evaluating specific projects, 21 specific potential projects were identified. Descriptions and evaluations for the projects are discussed in Chapter 5. Table 6.1 displays the identified projects alphabetically.

Table 6.1 Identified Projects

Project No.	Project Name	Opinion of Project Cost
1	12.5% Sodium Hypochlorite	\$1,610,000
2	Chlorine Gas Scrubber	\$1,340,000
3	Clear Well Improvements	\$41,700,000
4	Dam Release Valve Actuators	\$220,000
5	Dechlorination - GAC	\$18,600,000
6	Dechlorination - Breakpoint	\$14,700,000
7	Filter Backwash Realignment	\$970,000
8	Filter Washwater Chlorine Addition	\$460,000
9	Improved Chemical Mixing	\$490,000
10	Intake Tower Upgrades	\$3,300,000
11	LAS Conversion	\$500,000
12	Low Capacity Chlorinator	\$290,000
13	Onsite Hypochlorite Generation	\$6,330,000
14	PFAS Treatment ⁽¹⁾	\$40,250,000
15	Plant Water Upgrades	\$600,000
16	Raw Water Pump Replacement	\$660,000
17	Raw Water Pump VFD	\$70,000
18	Seismic Upgrades	\$12,820,000
19	Sewage Lift Station Improvements	\$190,000
20	Solar Upgrades	\$5,190,000
21	Washwater Supply Pump VFD	\$130,000

Notes:

(1) If required by future regulations.

Identified projects were sorted into different groupings based on fiscal impact, plant operability, and Authority input. Table 6.2 breaks the project groupings into three categories:

- Low-Cost/High-Value Projects.
- Medium-Cost/Medium-Term Projects.
- High-Cost/Long-Term Financial Planning.

Table 6.2 Financial Groupings

Grouping	Project Name	Opinion of Project Cost
Low-Cost/High-Value Projects	Dam Release Valve Actuators	\$220,000
	Filter Backwash Realignment	\$970,000
	Filter Washwater Chlorine Addition	\$460,000
	Improved Chemical Mixing	\$490,000
	LAS Conversion	\$500,000
	Low Capacity Chlorinator	\$290,000
	Plant Water Upgrades	\$600,000
	Raw Water Pump Replacement	\$660,000
	Raw Water Pump VFD	\$70,000
	Sewage Lift Station Improvements	\$190,000
Washwater Supply Pump VFD	\$130,000	
Medium-Cost/Medium-Term Projects	12.5% Sodium Hypochlorite	\$1,610,000
	Chlorine Gas Scrubber	\$1,340,000
High-Cost/Long-Term Financial Planning	Clear Well Improvements	\$41,700,000
	Dechlorination - GAC	\$18,600,000
	Dechlorination - Breakpoint	\$14,700,000
	Intake Tower Upgrades	\$3,300,000
	Onsite Hypochlorite Generation	\$6,330,000
	PFAS Treatment	\$40,250,000
	Seismic Upgrades	\$12,820,000
Solar Upgrades	\$5,190,000	

Once the projects in Table 6.2 were separated into the three financial categories, they were prioritized.

6.2 Prioritization Methodology

To determine project priority, each project was scored and ranked against the other. Three categories were considered, including impacts on water quality, environmental impacts, and social impacts. Project scoring was done in matrices to compare each project against the other. If the project was deemed more attractive, it was awarded one point; if not, it was given a zero. Scoring was then summed for the individual project, and a weighting was applied for each category. Weighting for each category was developed with input from the Authority. Table 6.3 provides a description of each category and weighting.

Table 6.3 Prioritization Category Description and Weighting

Category	Weighting	Description
Water Quality	40%	Point awarded for greater impact on water quality
Environmental Impact	20%	Point awarded for lower environmental impact
Social	40%	Point awarded for increased operator safety or improved operations

6.3 Final Groupings and Prioritization

Final financial groupings and prioritization ranking is shown in Table 6.4.

Table 6.4 Final Groupings and Prioritization

Grouping	Project Name	Opinion of Project Cost	Priority Ranking
Low-Cost/High-Value Projects	Improved Chemical Mixing	\$490,000	2
	Low Capacity Chlorinator	\$290,000	4
	LAS Conversion	\$500,000	6
	Filter Backwash Realignment	\$970,000	8
	Filter Washwater Chlorine Addition	\$460,000	9
	Raw Water Pump Replacement	\$660,000	13
	Plant Water Upgrades	\$600,000	14
	Raw Water Pump VFD	\$70,000	17
	Washwater Supply Pump VFD	\$130,000	18
	Dam Release Valve Actuators	\$220,000	19
Medium-Cost/Medium-Term Projects	Sewage Lift Station Improvements	\$190,000	20
	12.5% Sodium Hypochlorite	\$1,610,000	3
High-Cost/Long-Term Financial Planning	Chlorine Gas Scrubber	\$1,340,000	12
	Intake Tower Upgrades	\$3,300,000	1
	Clear Well Improvements	\$41,700,000	5
	Onsite Hypochlorite Generation	\$6,330,000	7
	PFAS Treatment	\$40,250,000	10
	Seismic Upgrades	\$12,820,000	11
	Dechlorination - GAC	\$18,600,000	15
	Dechlorination - Breakpoint	\$14,700,000	16
Solar Upgrades	\$5,190,000	21	

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Appendix A
TITLE 22 TABLES

Table A.1 Title 22 Analysis of Perdue WTP

Constituent	MCL	Units	Samples	Average	Minimum	Maximum
Inorganics						
Aluminum	1,000	µg/L	21	ND	ND	ND
Antimony	6	µg/L	21	ND	ND	ND
Arsenic	10	µg/L	21	0.03	ND	0.67
Asbestos	7	MFL	1	ND	ND	ND
Barium	1,000	µg/L	21	67	ND	130
Beryllium	4	µg/L	21	ND	ND	ND
Cadmium	5	µg/L	21	ND	ND	ND
Chromium, Total	50	µg/L	21	0.01	ND	0.20
Cyanide	150	µg/L	21	ND	ND	ND
Fluoride	2	mg/L	22	0.43	0.19	0.70
Mercury	2	µg/L	21	ND	ND	ND
Nickel	100	µg/L	21	0.2	ND	2.4
Nitrate (As N)	10	mg/L	13	0.03	ND	0.17
Nitrate + Nitrite (As N)	10	mg/L	20	0.02	ND	0.17
Nitrite (As N)	1	mg/L	20	ND	ND	ND
Perchlorate	6	µg/L	45	ND	ND	ND
Selenium	50	µg/L	21	ND	ND	ND
Thallium	2	µg/L	21	ND	ND	ND

Constituent	MCL	Units	Samples	Average	Minimum	Maximum
Secondary Standards						
Aluminum	200	µg/L	21	ND	ND	ND
Chloride	250; 500; 600	mg/L	21	149	73	210
Color	15	Units	20	2	1	8
Copper	1,000	µg/L	23	24	ND	2
Foaming Agents (MBAS)	0.5	mg/L	21	0.05	ND	0.13
Iron	300	µg/L	23	ND	ND	ND
Manganese	50	µg/L	23	14	ND	43
MTBE	5	µg/L	0	0		
Odor - Threshold	3	Ton	20	0.6	ND	1.0
Silver	100	µg/L	21	ND	ND	ND
Specific Conductance	900; 1,600; 2,200	µS/cm	0	0		
Sulfate	250; 500; 600	mg/L	22	153	82	239
Thiobencarb	1	µg/L	0	0		
TDS	500; 1,000; 1,500	mg/L	21	614	310	760
Turbidity	5	NTU	20	0.22	ND	0.57
Zinc	5,000	µg/L	23	ND	ND	ND

Notes:

Abbreviations: µg/L - micrograms per liter; µS/cm - microsiemens per centimeter; MBAS - methylene blue active substances; MCL - maximum contaminant level; MFL - million fibers per liter; mg/L - milligrams per liter; MTBE - Methyl-tert-butyl ether; N - nitrogen; ND - non-detect; NTU - nephelometric turbidity unit; TDS - total dissolved solids.

Table A.2 Title 22 Analysis of the Sweetwater Reservoir

Constituent	MCL	Units	Samples	Average	Minimum	Maximum
Inorganics						
Aluminum	1,000	µg/L	21	161	ND	420
Antimony	6	µg/L	21	ND	ND	ND
Arsenic	10	µg/L	21	2.3	ND	4.6
Asbestos	7	MFL	0			
Barium	1,000	µg/L	21	68	ND	140
Beryllium	4	µg/L	21	ND	ND	ND
Cadmium	5	µg/L	21	ND	ND	ND
Chromium, Total	50	µg/L	21	0.02	ND	0.39
Cyanide	150	µg/L	21	ND	ND	ND
Fluoride	2	mg/L	22	0.31	0.22	0.45
Mercury	2	µg/L	21	ND	ND	ND
Nickel	100	µg/L	21	ND	ND	ND
Nitrate (As N)	10	mg/L	13	0.20	ND	0.41
Nitrate + Nitrite (As N)	10	mg/L	20	0.20	ND	0.41
Nitrite (As N)	1	mg/L	20	ND	ND	ND
Perchlorate	6	µg/L	45	ND	ND	ND
Selenium	50	µg/L	21	0.1	ND	1.1
Thallium	2	µg/L	21	ND	ND	ND
Radionuclides						
Combined radium-226 and radium-228	5	pCi/L	1	ND	ND	ND
Radium 226		pCi/L	0			
Radium 228		pCi/L	1	ND	ND	ND
Gross Alpha particle activity (excluding radon and uranium)	15	pCi/L	6	3	ND	7
Uranium	20	pCi/L	5	2.6	1.3	5.1

Constituent	MCL	Units	Samples	Average	Minimum	Maximum
VOCs						
Benzene	1	µg/L	14	ND	ND	ND
Carbon Tetrachloride	0.5	µg/L	14	ND	ND	ND
Dichlorobenzene, 1,2-	600	µg/L	14	ND	ND	ND
Dichlorobenzene, 1,4-	5	µg/L	14	ND	ND	ND
Dichloroethane, 1, 1-	5	µg/L	14	ND	ND	ND
Dichloroethane, 1,2-	0	µg/L	14	ND	ND	ND
Dichloroethylene, 1,1-	6	µg/L	14	ND	ND	ND
Dichloroethylene, cis-1,2-	6	µg/L	14	ND	ND	ND
Dichloroethylene, trans-1,2-	10	µg/L	14	ND	ND	ND
Dichloromethane	5	µg/L	14	ND	ND	ND
Dichloropropane, 1,2-	5	µg/L	14	ND	ND	ND
Dichloropropene, 1,3-	0.5	µg/L	13	ND	ND	ND
Ethylbenzene	300	µg/L	14	ND	ND	ND
MTBE	13	µg/L	14	ND	ND	ND
Monochlorobenzene	70	µg/L	14	ND	ND	ND
Styrene	100	µg/L	14	ND	ND	ND
Tetrachloroethane, 1,1,1,2-	1	µg/L	14	ND	ND	ND
Tetrachloroethylene	5	µg/L	14	ND	ND	ND
Toluene	150	µg/L	14	ND	ND	ND
Trichlorobenzene, 1,2,4-	5	µg/L	14	ND	ND	ND
Trichloroethane, 1, 1, 1-	200	µg/L	14	ND	ND	ND
Trichloroethane, 1, 1, 2-	5	µg/L	14	ND	ND	ND
Trichloroethylene	5	µg/L	14	ND	ND	ND
Trichlorofluoromethane	150	µg/L	14	ND	ND	ND
Trichloro-1,2,2-Trifluoroethane, 1, 1, 2	1,200	µg/L	14	ND	ND	ND

Constituent	MCL	Units	Samples	Average	Minimum	Maximum
Vinyl Chloride	0.5	µg/L	14	ND	ND	ND
Xylenes	1,750	µg/L	28	ND	ND	ND
SOCs						
Alachlor	2	µg/L	0			
Atrazine	1	µg/L	13	ND	ND	ND
Bentazon	18	µg/L	7	ND	ND	ND
Benzo(a)pyrene	0.2	µg/L	14	ND	ND	ND
Carbofuran	18	µg/L	7	ND	ND	ND
Chlordane	0.1	µg/L	7	ND	ND	ND
D, 2,4-	70	µg/L	7	ND	ND	ND
Dalapon	200	µg/L	7	ND	ND	ND
Dibromochloropropane	0.2	µg/L	8	ND	ND	ND
Di(2-ethylhexyl)adipate	400	µg/L	14	ND	ND	ND
Di(2-ethylhexyl)phthalate	4	µg/L	14	ND	ND	ND
Dinoseb	7	µg/L	7	ND	ND	ND
Diquat	20	µg/L	8	ND	ND	ND
Endothall	100	µg/L	7	ND	ND	ND
Endrin	2	µg/L	7	ND	ND	ND
Ethylene Dibromide	0.05	µg/L	8	ND	ND	ND
Glyphosate	700	µg/L	51	ND	ND	ND
Heptachlor	0.01	µg/L	7	ND	ND	ND
Heptachlor Epoxide	0.01	µg/L	7	ND	ND	ND
Hexachlorobenzene	1	µg/L	7	ND	ND	ND
Hexachlorocyclopentadiene	50	µg/L	9	ND	ND	ND
Lindane	0.2	µg/L	0			

Constituent	MCL	Units	Samples	Average	Minimum	Maximum
Methoxychlor	30	µg/L	9	ND	ND	ND
Molinate	20	µg/L	14	ND	ND	ND
Oxamyl	50	µg/L	7	ND	ND	ND
Pentachlorophenol	1	µg/L	7	ND	ND	ND
Picloram	500	µg/L	7	ND	ND	ND
Polychlorinated Biphenyls	0.5	µg/L	7	ND	ND	ND
Simazine	4	µg/L	55	ND	ND	ND
Thiobencarb	70	µg/L	14	ND	ND	ND
Toxaphene	3	µg/L	7	ND	ND	ND
Trichloropropane, 1,2,3-	0.005	µg/L	12	ND	ND	ND
TCDD, 2,3,7,8- (Dioxin)	30	PG/L	7	ND	ND	ND
TP, 2,4,5- (Silvex)	50	µg/L	7	ND	ND	ND
Secondary Standards						
Aluminum	200	µg/L	21	161	ND	420
Chloride	250; 500; 600	mg/L	21	242	140	430
Color	15	Units	20	53	13	150
Copper	1,000	µg/L	23	29	ND	86
Foaming Agents (MBAS)	0.5	mg/L	21	0.02	ND	0.30
Iron	300	µg/L	23	248	ND	760
Manganese	50	µg/L	23	141	ND	370
MTBE	5	µg/L	14	ND	ND	ND
Odor - Threshold	3	Ton	20	3	1	8
Silver	100	µg/L	21	ND	ND	ND
Specific Conductance	900; 1,600; 2,200	µS/cm	0			
Sulfate	250; 500; 600	mg/L	22	140	84	224

Constituent	MCL	Units	Samples	Average	Minimum	Maximum
Thiobencarb	1	µg/L	14	ND	ND	ND
TDS	500; 1,000; 1,500	mg/L	21	780	510	1,100
Turbidity	5	NTU	20	8	1	16
Zinc	5,000	µg/L	23	ND	ND	ND

Notes:

Abbreviations: pCi/L - picoCurie per liter; PG/L - picogram per liter; SOC - synthetic organic chemical; SOC - synthetic organic chemical; VOC - volatile organic compound.

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Appendix B

CONDITION ASSESSMENT FIELD FORMS



Facility / System Condition Assessment Form

Facility: Sweetwater Authority Perdue WTP page1
 Process: Filter
 Component: Gallery Piping
 Discipline: Mechanical

Main Tab

Level of Service* 1 2 3 4 **5** 0 Date of Inspection 4/20/2022
 Criticality
 Public Health & Safety Multiple /Single Seasonal **No Effect**
 Environmental Major Minor **No Effect** Assessed By Brian Owen
 Cost of Repair **Major** Minor No Effect
 Effect on Customers **Major** Minor No Effect Photo # _____

Condition* 1 **2** 3 4 5 0

Component Information Tab

Comments	Mechanical		
EIM Actuators VAC controls long lead time	Excessive vibration?	Yes	No N/A
	Excessive noise?	Yes	No N/A
2011 upgrades	Excessive corrosion?	Yes	No N/A
	Excessive leaks?	Yes	No N/A
200-300 hour run time	Running hot?	Yes	No N/A
	Capable of running when inspected?	Yes	No N/A
Backwash supply from tank	Support equipment functional?	Yes	No N/A
	Equipment or parts missing?	Yes	No N/A
	Parts for maintenance available?	Yes	No N/A
	Adequate for intended purpose?	Yes	No N/A
	Motor amps within rating?	Yes	No N/A
	Piping		
* Condition / Level of Service	Excessive corrosion?	Yes	No N/A
1 - Very Good/ Low Impact	Excessive leaks?	Yes	No N/A
2 - Minor Defects/ Med Low Impact	Paint in good condition?	Yes	No N/A
3 - Requires Significant Maintenance/ Medium Impact	Supports in good condition?	Yes	No N/A
4 - Requires Rehabilitation/ Med High Impact			
5 - Requires Replacement (> 50%)/ High Impact			
0 - Non-Existent			



Facility / System Condition Assessment Form

Facility: Sweetwater Authority Perdue WTP page 2
 Process: Plant Water
 Component: Surge Tank
 Discipline: Mechanical

Main Tab

Level of Service*	1	2	3	4	5	0	Date of Inspection	<u>4/20/2022</u>
Criticality								
Public Health & Safety	Multiple /Single	Seasonal		No Effect			Assessed By	<u>Brian Owen</u>
Environmental	Major	Minor		No Effect				
Cost of Repair	Major	Minor		No Effect				
Effect on Customers	Major	Minor		No Effect			Photo #	<u></u>
Condition*	1	2	3	4	5	0		

Component Information Tab

Comments	Mechanical		
<u>Pump backup</u>	Excessive vibration?	Yes	No N/A
<u></u>	Excessive noise?	Yes	No N/A
<u>Due for inspection, concrete corroding under support</u>	Excessive corrosion?	Yes	No N/A
<u></u>	Excessive leaks?	Yes	No N/A
<u>Motor old/pump serviced regularly</u>	Running hot?	Yes	No N/A
<u></u>	Capable of running when inspected?	Yes	No N/A
<u>Pump wasn't outputting correct volume and replaced</u>	Support equipment functional?	Yes	No N/A
<u></u>	Equipment or parts missing?	Yes	No N/A
<u>Piping anchor missing/temp support</u>	Parts for maintenance available?	Yes	No N/A
<u></u>	Adequate for intended purpose?	Yes	No N/A
<u>Murphy Switch failed</u>	Motor amps within rating?	Yes	No N/A
<u></u>	Piping		
<u>* Condition / Level of Service</u>	Excessive corrosion?	Yes	No N/A
1 - Very Good/ Low Impact	Excessive leaks?	Yes	No N/A
2 - Minor Defects/ Med Low Impact	Paint in good condition?	Yes	No N/A
3 - Requires Significant Maintenance/ Medium Impact	Supports in good condition?	Yes	No N/A
4 - Requires Rehabilitation/ Med High Impact			
5 - Requires Replacement (> 50%)/ High Impact			
0 - Non-Existent			



Facility / System Condition Assessment Form

Facility: Sweetwater Authority Perdue WTP page 3
 Process: Plant Water/Plant Air
 Component: Pumps/Compressors
 Discipline: Mechanical

Main Tab

Level of Service*	1	2	3	4	5	0	Date of Inspection	<u>4/20/2022</u>
Criticality								
Public Health & Safety	Multiple /Single	Seasonal		No Effect			Assessed By	<u>Brian Owen</u>
Environmental	Major	Minor		No Effect				
Cost of Repair	Major	Minor		No Effect				
Effect on Customers	Major	Minor		No Effect			Photo #	<u></u>
Condition*	1	2	3	4	5	0		

Component Information Tab

Comments	Mechanical				
<u>Replaced both heads recently</u>	Excessive vibration?	Yes	No	N/A	
<u></u>	Excessive noise?	Yes	No	N/A	
<u>For chem system and carrier water</u>	Excessive corrosion?	Some evidence of ol	Yes	No	N/A
<u>Barrertt pumps</u>	Excessive leaks?	Yes	No	N/A	
<u></u>	Running hot?	Yes	No	N/A	
<u>Some evidence of old leaks</u>	Capable of running when inspected?	Yes	No	N/A	
<u></u>	Support equipment functional?	Yes	No	N/A	
<u>Plant water system noted to be on older side and not</u>	Equipment or parts missing?	Yes	No	N/A	
<u>inspected. Additional capacity and pressure desired.</u>	Parts for maintenance available?	Yes	No	N/A	
<u></u>	Adequate for intended purpose?	Yes	No	N/A	
<u></u>	Motor amps within rating?	Yes	No	N/A	

	Piping			
* Condition / Level of Service	Excessive corrosion?	Yes	No	N/A
1 - Very Good/ Low Impact	Excessive leaks?	Yes	No	N/A
2 - Minor Defects/ Med Low Impact	Paint in good condition?	Yes	No	N/A
3 - Requires Significant Maintenance/ Medium Impact	Supports in good condition?	Yes	No	N/A
4 - Requires Rehabilitation/ Med High Impact				
5 - Requires Replacement (> 50%)/ High Impact				
0 - Non-Existent				



Facility / System Condition Assessment Form

Facility: Sweetwater Authority Perdue WTP page 5
 Process: Chemical
 Component: Caustic (50%) Pumps & Tanks
 Discipline: Mechanical

Main Tab

Level of Service*	1	2	3	4	5	0	Date of Inspection	<u>4/20/2022</u>
Criticality								
Public Health & Safety		Multiple	Single	Seasonal	No Effect		Assessed By	<u>Brian Owen</u>
Environmental		Major	Minor	No Effect				
Cost of Repair		Major	Minor	No Effect				
Effect on Customers		Major	Minor	No Effect			Photo #	<u></u>
Condition*	1	2	3	4	5	0		

Component Information Tab

Comments	Mechanical		
<u>2017 Updates</u>	Excessive vibration?	Yes	No N/A
<u>Leaking at pump head</u>	Excessive noise?	Yes	No N/A
<u>Pulsa feeder Magnetic coupled pumps</u>	Excessive corrosion?	Yes	No N/A
<u>Maintenance for o'rings bearings and gears every 6 months</u>	Excessive leaks?	Yes	No N/A
<u>Annual rebuild</u>	Running hot?	Yes	No N/A
<u>Insulation in good condition</u>	Capable of running when inspected?	Yes	No N/A
<u>Drains to chemical vault</u>	Support equipment functional?	Yes	No N/A
<u>Parts expensive for replacement</u>	Equipment or parts missing?	Yes	No N/A
	Parts for maintenance available?	Yes	No N/A
	Adequate for intended purpose?	Yes	No N/A
	Motor amps within rating?	Yes	No N/A
	Piping		
* Condition / Level of Service	Excessive corrosion?	Yes	No N/A
1 - Very Good/ Low Impact	Excessive leaks?	Yes	No N/A
2 - Minor Defects/ Med Low Impact	Paint in good condition?	Yes	No N/A
3 - Requires Significant Maintenance/ Medium Impact	Supports in good condition?	Yes	No N/A
4 - Requires Rehabilitation/ Med High Impact			
5 - Requires Replacement (> 50%)/ High Impact			
0 - Non-Existent			



Facility / System Condition Assessment Form

Facility: Sweetwater Authority Perdue WTP page 6
 Process: Intake
 Component: Surge Tank Compressor
 Discipline: Mechanical

Main Tab

Level of Service*	1	2	3	4	5	0	Date of Inspection	<u>4/20/2022</u>
Criticality								
Public Health & Safety	Multiple /Single		Seasonal				No Effect	
Environmental	Major		Minor				No Effect	Assessed By <u>Brian Owen</u>
Cost of Repair	Major		Minor				No Effect	
Effect on Customers	Major		Minor				No Effect	Photo # _____
Condition*	1	2	3	4	5	0		

Component Information Tab

Comments	<u>Mechanical</u>		
<u>Sight gage on water separator not working</u>	Excessive vibration?	Yes	No N/A
<u>Replaced in 2013</u>	Excessive noise?	Yes	No N/A
_____	Excessive corrosion?	Yes	No N/A
<u>Facility has not looked for spare parts recently</u>	Excessive leaks?	Yes	No N/A
_____	Running hot?	Yes	No N/A
_____	Capable of running when inspected?	Yes	No N/A
_____	Support equipment functional?	Yes	No N/A
_____	Equipment or parts missing?	Yes	No N/A
_____	Parts for maintenance available?	Yes	No N/A
_____	Adequate for intended purpose?	Yes	No N/A
_____	Motor amps within rating?	Yes	No N/A

* Condition / Level of Service	<u>Piping</u>		
1 - Very Good/ Low Impact	Excessive corrosion?	Yes	No N/A
2 - Minor Defects/ Med Low Impact	Excessive leaks?	Yes	No N/A
3 - Requires Significant Maintenance/ Medium Impact	Paint in good condition?	Yes	No N/A
4 - Requires Rehabilitation/ Med High Impact	Supports in good condition?	Yes	No N/A
5 - Requires Replacement (> 50%)/ High Impact			
0 - Non-Existent			



Facility / System Condition Assessment Form

Facility: Sweetwater Authority Perdue WTP page 7
 Process: Intake
 Component: Surge Tank- Pump Suction
 Discipline: Mechanical

Main Tab

Level of Service*	1	2	3	4	5	0	Date of Inspection	<u>4/20/2022</u>
Criticality								
Public Health & Safety	Multiple /Single	Seasonal					Assessed By	<u>Brian Owen</u>
Environmental	Major	Minor						
Cost of Repair	Major	Minor					Photo #	<u></u>
Effect on Customers	Major	Minor						
Condition*	1	2	3	4	5	0		

Component Information Tab

Comments	<u>Mechanical</u>		
<u>Soil/rocks sliding toward tank</u>	Excessive vibration?	Yes	No N/A
<u></u>	Excessive noise?	Yes	No N/A
<u></u>	Excessive corrosion?	Yes	No N/A
<u></u>	Excessive leaks?	Yes	No N/A
<u></u>	Running hot?	Yes	No N/A
<u></u>	Capable of running when inspected?	Yes	No N/A
<u></u>	Support equipment functional?	Yes	No N/A
<u></u>	Equipment or parts missing?	Yes	No N/A
<u></u>	Parts for maintenance available?	Yes	No N/A
<u></u>	Adequate for intended purpose?	Yes	No N/A
<u></u>	Motor amps within rating?	Yes	No N/A
	<u>Piping</u>		
* Condition / Level of Service	Excessive corrosion?	Yes	No N/A
1 - Very Good/ Low Impact	Excessive leaks?	Yes	No N/A
2 - Minor Defects/ Med Low Impact	Paint in good condition?	Yes	No N/A
3 - Requires Significant Maintenance/ Medium Impact	Supports in good condition?	Yes	No N/A
4 - Requires Rehabilitation/ Med High Impact			
5 - Requires Replacement (> 50%)/ High Impact			
0 - Non-Existent			



Facility / System Condition Assessment Form

Facility: Sweetwater Authority Perdue WTP page 8
 Process: Effluent
 Component: Surge Tank- Pump Discharge
 Discipline: Mechanical

Main Tab

Level of Service*	1	2	3	4	5	0	Date of Inspection	<u>4/20/2022</u>
Criticality								
Public Health & Safety	Multiple /Single		Seasonal		No Effect		Assessed By	<u>Brian Owen</u>
Environmental	Major		Minor		No Effect			
Cost of Repair	Major		Minor		No Effect		Photo #	<u></u>
Effect on Customers	Major		Minor		No Effect			
Condition*	1	2	3	4	5	0		

Component Information Tab

Comments	<u>Mechanical</u>		
<u>Inspected every 5 years</u>	Excessive vibration?	Yes	No N/A
<u></u>	Excessive noise?	Yes	No N/A
<u></u>	Excessive corrosion?	Yes	No N/A
<u></u>	Excessive leaks?	Yes	No N/A
<u></u>	Running hot?	Yes	No N/A
<u></u>	Capable of running when inspected?	Yes	No N/A
<u></u>	Support equipment functional?	Yes	No N/A
<u></u>	Equipment or parts missing?	Yes	No N/A
<u></u>	Parts for maintenance available?	Yes	No N/A
<u></u>	Adequate for intended purpose?	Yes	No N/A
<u></u>	Motor amps within rating?	Yes	No N/A

<u>* Condition / Level of Service</u>	<u>Piping</u>		
1 - Very Good/ Low Impact	Excessive corrosion?	Yes	No N/A
2 - Minor Defects/ Med Low Impact	Excessive leaks?	Yes	No N/A
3 - Requires Significant Maintenance/ Medium Impact	Paint in good condition?	Yes	No N/A
4 - Requires Rehabilitation/ Med High Impact	Supports in good condition?	Yes	No N/A
5 - Requires Replacement (> 50%)/ High Impact			
0 - Non-Existent			



Facility / System Condition Assessment Form

Facility: Sweetwater Authority Perdue WTP page 9
 Process: Intake
 Component: Pump 5 VFD (200 HP/10 MGD)
 Discipline: Mechanical

Main Tab

Level of Service*	1	2	3	4	5	0	Date of Inspection	<u>4/20/2022</u>
Criticality								
Public Health & Safety		Multiple /Single	Seasonal		No Effect		Assessed By	<u>Brian Owen</u>
Environmental		Major	Minor		No Effect			
Cost of Repair		Major	Minor		No Effect			
Effect on Customers		Major	Minor		No Effect		Photo #	<u></u>
Condition*	1	2	3	4	5	0		

Component Information Tab

Comments	<u>Mechanical</u>		
<u>Excessive vibration?</u>	Yes	No	N/A
<u>Excessive noise?</u>	Yes	No	N/A
<u>Excessive corrosion?</u>	Yes	No	N/A
<u>Excessive leaks?</u>	Yes	No	N/A
<u>Running hot?</u>	Yes	No	N/A
<u>Capable of running when inspected?</u>	Yes	No	N/A
<u>Leaky air lines on actuator</u>	Yes	No	N/A
<u>Support equipment functional?</u>	Yes	No	N/A
<u>Equipment or parts missing?</u>	Yes	No	N/A
<u>Parts for maintenance available?</u>	Yes	No	N/A
<u>Adequate for intended purpose?</u>	Yes	No	N/A
<u>Motor amps within rating?</u>	Yes	No	N/A

* Condition / Level of Service	<u>Piping</u>		
<u>1 - Very Good/ Low Impact</u>	Excessive corrosion?	Yes	No N/A
<u>2 - Minor Defects/ Med Low Impact</u>	Excessive leaks?	Yes	No N/A
<u>3 - Requires Significant Maintenance/ Medium Impact</u>	Paint in good condition?	Yes	No N/A
<u>4 - Requires Rehabilitation/ Med High Impact</u>	Supports in good condition?	Yes	No N/A
<u>5 - Requires Replacement (> 50%)/ High Impact</u>			
<u>0 - Non-Existent</u>			



Facility / System Condition Assessment Form

Facility: Sweetwater Authority Perdue WTP page 10
 Process: Intake
 Component: Pump 3 & 4 VFD (400 HP/ 18 MGD)
 Discipline: Mechanical

Main Tab

Level of Service*	1	2	3	4	5	0	Date of Inspection	<u>4/20/2022</u>
Criticality								
Public Health & Safety		Multiple /Single	Seasonal		No Effect		Assessed By	<u>Brian Owen</u>
Environmental		Major	Minor		No Effect			
Cost of Repair		Major	Minor		No Effect		Photo #	<u></u>
Effect on Customers		Major	Minor		No Effect			
Condition*	1	2	3	4	5	0		

Component Information Tab

Comments	Mechanical		
<u></u>	Excessive vibration?	Yes	No N/A
<u></u>	Excessive noise?	Yes	No N/A
<u></u>	Excessive corrosion?	Yes	No N/A
<u></u>	Excessive leaks?	Yes	No N/A
<u></u>	Running hot?	Yes	No N/A
<u></u>	Capable of running when inspected?	Yes	No N/A
<u></u>	Support equipment functional?	Yes	No N/A
<u></u>	Equipment or parts missing?	Yes	No N/A
<u></u>	Parts for maintenance available?	Yes	No N/A
<u></u>	Adequate for intended purpose?	Yes	No N/A
<u></u>	Motor amps within rating?	Yes	No N/A
	Piping		
* Condition / Level of Service	Excessive corrosion?	Yes	No N/A
1 - Very Good/ Low Impact	Excessive leaks?	Yes	No N/A
2 - Minor Defects/ Med Low Impact	Paint in good condition?	Yes	No N/A
3 - Requires Significant Maintenance/ Medium Impact	Supports in good condition?	Yes	No N/A
4 - Requires Rehabilitation/ Med High Impact			
5 - Requires Replacement (> 50%)/ High Impact			
0 - Non-Existent			



Facility / System Condition Assessment Form

Facility: Sweetwater Authority Perdue WTP page 11
 Process: Intake
 Component: Intake Pump 1&2 (150 HP/6 MGD)
 Discipline: Mechanical

Main Tab

Level of Service*	1	2	3	4	5	0	Date of Inspection	<u>4/20/2022</u>
Criticality								
Public Health & Safety		Multiple /Single	Seasonal		No Effect		Assessed By	<u>Brian Owen</u>
Environmental		Major	Minor		No Effect			
Cost of Repair		Major	Minor		No Effect			
Effect on Customers		Major	Minor		No Effect		Photo #	<u></u>
Condition*	1	2	3	4	5	0		

Component Information Tab

Comments	Mechanical			
<u>VFD desired</u>	Excessive vibration?	Yes	No	N/A
<u>6 month PM interval</u>	Excessive noise?	Yes	No	N/A
<u>Don't inspect bowl/impellers</u>	Excessive corrosion?	Yes	No	N/A
<u></u>	Excessive leaks?	Yes	No	N/A
<u>Some rusting on supports</u>	Running hot?	Yes	No	N/A
<u></u>	Capable of running when inspected?	Yes	No	N/A
<u>Condition score derated following lack of parts from original manufacturer</u>	Support equipment functional?	Yes	No	N/A
<u></u>	Equipment or parts missing?	Yes	No	N/A
<u></u>	Parts for maintenance available?	Yes	No	N/A
<u></u>	Adequate for intended purpose?	Yes	No	N/A
<u></u>	Motor amps within rating?	Yes	No	N/A
<u></u>	Piping			
<u>* Condition / Level of Service</u>	Excessive corrosion?	Yes	No	N/A
1 - Very Good/ Low Impact	Excessive leaks?	Yes	No	N/A
2 - Minor Defects/ Med Low Impact	Paint in good condition?	Yes	No	N/A
3 - Requires Significant Maintenance/ Medium Impact	Supports in good condition?	Yes	No	N/A
4 - Requires Rehabilitation/ Med High Impact				
5 - Requires Replacement (> 50%)/ High Impact				
0 - Non-Existent				



Facility / System Condition Assessment Form

Facility: Sweetwater Authority Perdue WTP page 13
 Process: Sedimentation Basin
 Component: Traveling Bridge
 Discipline: Mechanical

Main Tab

Level of Service*	1	2	3	4	5	0	Date of Inspection	<u>4/20/2022</u>
Criticality								
Public Health & Safety	Multiple /Single	Seasonal	No Effect				Assessed By	<u>Brian Owen</u>
Environmental	Major	Minor	No Effect					
Cost of Repair	Major	Minor	No Effect					
Effect on Customers	Major	Minor	No Effect				Photo #	<u></u>
Condition*	1	2	3	4	5	0		

Component Information Tab

Comments	Mechanical		
<u>1/3 days run if no desludge</u>	Excessive vibration?	Yes	No N/A
<u></u>	Excessive noise?	Yes	No N/A
<u>Frequently Breaksdown</u>	Excessive corrosion?	Yes	No N/A
<u></u>	Excessive leaks?	Yes	No N/A
<u></u>	Running hot?	Yes	No N/A
<u></u>	Capable of running when inspected?	Yes	No N/A
<u></u>	Support equipment functional?	Yes	No N/A
<u></u>	Equipment or parts missing?	Yes	No N/A
<u></u>	Parts for maintenance available?	Yes	No N/A
<u></u>	Adequate for intended purpose?	Yes	No N/A
<u></u>	Motor amps within rating?	Yes	No N/A

	Piping		
<u>* Condition / Level of Service</u>	Excessive corrosion?	Yes	No N/A
1 - Very Good/ Low Impact	Excessive leaks?	Yes	No N/A
2 - Minor Defects/ Med Low Impact	Paint in good condition?	Yes	No N/A
3 - Requires Significant Maintenance/ Medium Impact	Supports in good condition?	Yes	No N/A
4 - Requires Rehabilitation/ Med High Impact			
5 - Requires Replacement (> 50%)/ High Impact			
0 - Non-Existent			



Facility / System Condition Assessment Form

Facility: Sweetwater Authority Perdue WTP page 14
 Process: Dissolved Air Flotation (DAF)
 Component: DAF Valves before bridge
 Discipline: Mechanical

Main Tab

Level of Service*	1	2	3	4	5	0	Date of Inspection	<u>4/20/2022</u>
Criticality								
Public Health & Safety		Multiple /Single	Seasonal		No Effect		Assessed By	<u>Brian Owen</u>
Environmental		Major	Minor		No Effect			
Cost of Repair		Major	Minor		No Effect			
Effect on Customers		Major	Minor		No Effect		Photo #	<u></u>
Condition*	1	2	3	4	5	0		

Component Information Tab

Comments	Mechanical		
<u>Each Failed (4) at gear coupler</u>	Excessive vibration?	Yes	No N/A
<u></u>	Excessive noise?	Yes	No N/A
<u></u>	Excessive corrosion?	Yes	No N/A
<u></u>	Excessive leaks?	Yes	No N/A
<u></u>	Running hot?	Yes	No N/A
<u></u>	Capable of running when inspected?	Yes	No N/A
<u></u>	Support equipment functional?	Yes	No N/A
<u></u>	Equipment or parts missing?	Yes	No N/A
<u></u>	Parts for maintenance available?	Yes	No N/A
<u></u>	Adequate for intended purpose?	Yes	No N/A
<u></u>	Motor amps within rating?	Yes	No N/A
	Piping		
<u>* Condition / Level of Service</u>	Excessive corrosion?	Yes	No N/A
1 - Very Good/ Low Impact	Excessive leaks?	Yes	No N/A
2 - Minor Defects/ Med Low Impact	Paint in good condition?	Yes	No N/A
3 - Requires Significant Maintenance/ Medium Impact	Supports in good condition?	Yes	No N/A
4 - Requires Rehabilitation/ Med High Impact			
5 - Requires Replacement (> 50%)/ High Impact			
0 - Non-Existent			



Facility / System Condition Assessment Form

Facility: Sweetwater Authority Perdue WTP page 15
 Process: Dissolved Air Flotation (DAF)
 Component: Saturation Compressors & Air Receiver
 Discipline: Mechanical

Main Tab

Level of Service*	1	2	3	4	5	0	Date of Inspection	<u>4/20/2022</u>
Criticality								
Public Health & Safety	Multiple /Single	Seasonal		No Effect			Assessed By	<u>Brian Owen</u>
Environmental	Major	Minor		No Effect				
Cost of Repair	Major	Minor		No Effect			Photo #	<u></u>
Effect on Customers	Major	Minor		No Effect				
Condition*	1	2	3	4	5	0		

Component Information Tab

Comments	<u>Mechanical</u>		
<u>2013</u>	Excessive vibration?	Yes	No N/A
<u>Oil Leak from Filter</u>	Excessive noise?	Yes	No N/A
<u></u>	Excessive corrosion?	Yes	No N/A
<u></u>	Excessive leaks?	Yes	No N/A
<u></u>	Running hot?	Yes	No N/A
<u></u>	Capable of running when inspected?	Yes	No N/A
<u></u>	Support equipment functional?	Yes	No N/A
<u></u>	Equipment or parts missing?	Yes	No N/A
<u></u>	Parts for maintenance available?	Yes	No N/A
<u></u>	Adequate for intended purpose?	Yes	No N/A
<u></u>	Motor amps within rating?	Yes	No N/A
	<u>Piping</u>		
<u>* Condition / Level of Service</u>	Excessive corrosion?	Yes	No N/A
1 - Very Good/ Low Impact	Excessive leaks?	Yes	No N/A
2 - Minor Defects/ Med Low Impact	Paint in good condition?	Yes	No N/A
3 - Requires Significant Maintenance/ Medium Impact	Supports in good condition?	Yes	No N/A
4 - Requires Rehabilitation/ Med High Impact			
5 - Requires Replacement (> 50%)/ High Impact			
0 - Non-Existent			



Facility / System Condition Assessment Form

Facility: Sweetwater Authority Perdue WTP page 16
 Process: Dissolved Air Flotation (DAF)
 Component: Saturation Tanks
 Discipline: Mechanical

Main Tab

Level of Service*	1	2	3	4	5	0	Date of Inspection	<u>4/20/2022</u>
Criticality								
Public Health & Safety		Multiple /Single	Seasonal		No Effect		Assessed By	<u>Brian Owen</u>
Environmental		Major	Minor		No Effect			
Cost of Repair		Major	Minor		No Effect			
Effect on Customers		Major	Minor		No Effect		Photo #	<u></u>
Condition*	1	2	3	4	5	0		

Component Information Tab

Comments	<u>Mechanical</u>		
<u>EIM parts long lead</u>	Excessive vibration?	Yes	No N/A
<u>Potentiometer issue</u>	Excessive noise?	Yes	No N/A
<u></u>	Excessive corrosion?	Yes	No N/A
<u>Beck Valves</u>	Excessive leaks?	Yes	No N/A
<u></u>	Running hot?	Yes	No N/A
<u>Return piping good shape & recycle</u>	Capable of running when inspected?	Yes	No N/A
<u></u>	Support equipment functional?	Yes	No N/A
<u></u>	Equipment or parts missing?	Yes	No N/A
<u></u>	Parts for maintenance available?	Yes	No N/A
<u></u>	Adequate for intended purpose?	Yes	No N/A
<u></u>	Motor amps within rating?	Yes	No N/A
	<u>Piping</u>		
<u>* Condition / Level of Service</u>	Excessive corrosion?	Yes	No N/A
1 - Very Good/ Low Impact	Excessive leaks?	Yes	No N/A
2 - Minor Defects/ Med Low Impact	Paint in good condition?	Yes	No N/A
3 - Requires Significant Maintenance/ Medium Impact	Supports in good condition?	Yes	No N/A
4 - Requires Rehabilitation/ Med High Impact			
5 - Requires Replacement (> 50%)/ High Impact			
0 - Non-Existent			



Facility / System Condition Assessment Form

Facility: Sweetwater Authority Perdue WTP page 17
 Process: Dissolved Air Flotation (DAF)
 Component: Ancillary Equipment (mixing pump, mixers, sludge pumps)
 Discipline: Mechanical

Main Tab

Level of Service*	1	2	3	4	5	0	Date of Inspection	<u>4/20/2022</u>
Criticality								
Public Health & Safety	Multiple /Single		Seasonal		No Effect		Assessed By	<u>Brian Owen</u>
Environmental	Major		Minor		No Effect			
Cost of Repair	Major		Minor		No Effect			
Effect on Customers	Major		Minor		No Effect		Photo #	<u></u>
Condition*	1	2	3	4	5	0		

Component Information Tab

Comments	<u>Mechanical</u>			
<u>PMs every 6 months of pump/mixers</u>	Excessive vibration?	Yes	No	N/A
<u>Values EIM controls-> standard</u>	Excessive noise?	Yes	No	N/A
<u>All mixers/valves new</u>	Excessive corrosion?	Yes	No	N/A
<u></u>	Excessive leaks?	Yes	No	N/A
<u>Mixers on VFD, 1 mixer is rapid, 2 mixer flocculation</u>	Running hot?	Yes	No	N/A
<u></u>	Capable of running when inspected?	Yes	No	N/A
<u>Sludge pumps work well, work off level and send to</u>	Support equipment functional?	Yes	No	N/A
<u>sludge to reservoir</u>	Equipment or parts missing?	Yes	No	N/A
<u></u>	Parts for maintenance available?	Yes	No	N/A
<u>Flash mix pump little older but running well</u>	Adequate for intended purpose?	Yes	No	N/A
<u></u>	Motor amps within rating?	Yes	No	N/A
<u></u>	<u>Piping</u>			
<u>* Condition / Level of Service</u>	Excessive corrosion?	Yes	No	N/A
1 - Very Good/ Low Impact	Excessive leaks?	Yes	No	N/A
2 - Minor Defects/ Med Low Impact	Paint in good condition?	Yes	No	N/A
3 - Requires Significant Maintenance/ Medium Impact	Supports in good condition?	Yes	No	N/A
4 - Requires Rehabilitation/ Med High Impact				
5 - Requires Replacement (> 50%)/ High Impact				
0 - Non-Existent				



Facility / System Condition Assessment Form

Facility: Sweetwater Authority Perdue WTP page 18
 Process: Raw Water
 Component: Aqueduct Turbines
 Discipline: Mechanical

Main Tab

Level of Service*	1	2	3	4	5	0	Date of Inspection	<u>4/20/2022</u>
Criticality								
Public Health & Safety	Multiple /Single	Seasonal		No Effect			Assessed By	<u>Brian Owen</u>
Environmental	Major	Minor		No Effect				
Cost of Repair	Major	Minor		No Effect			Photo #	<u></u>
Effect on Customers	Major	Minor		No Effect				
Condition*	1	2	3	4	5	0		

Component Information Tab

Comments	<u>Mechanical</u>		
<u>Hydraulic turbines long lead ~ 4 months</u>	Excessive vibration?	Yes	No N/A
<u></u>	Excessive noise?	Yes	No N/A
<u></u>	Excessive corrosion?	Yes	No N/A
<u></u>	Excessive leaks?	Yes	No N/A
<u></u>	Running hot?	Yes	No N/A
<u></u>	Capable of running when inspected?	Yes	No N/A
<u></u>	Support equipment functional?	Yes	No N/A
<u></u>	Equipment or parts missing?	Yes	No N/A
<u></u>	Parts for maintenance available?	Yes	No N/A
<u></u>	Adequate for intended purpose?	Yes	No N/A
<u></u>	Motor amps within rating?	Yes	No N/A
	<u>Piping</u>		
<u>* Condition / Level of Service</u>	Excessive corrosion?	Yes	No N/A
1 - Very Good/ Low Impact	Excessive leaks?	Yes	No N/A
2 - Minor Defects/ Med Low Impact	Paint in good condition?	Yes	No N/A
3 - Requires Significant Maintenance/ Medium Impact	Supports in good condition?	Yes	No N/A
4 - Requires Rehabilitation/ Med High Impact			
5 - Requires Replacement (> 50%)/ High Impact			
0 - Non-Existent			



Facility / System Condition Assessment Form

Facility: Sweetwater Authority Perdue WTP page 19
 Process: Chemical
 Component: Tank Farm
 Discipline: Mechanical

Main Tab

Level of Service*	1	2	3	4	5	0	Date of Inspection	<u>4/20/2022</u>
Criticality								
Public Health & Safety			Multiple /Single	Seasonal	No Effect		Assessed By	<u>Brian Owen</u>
Environmental			Major	Minor	No Effect			
Cost of Repair			Major	Minor	No Effect			
Effect on Customers			Major	Minor	No Effect		Photo #	<u></u>
Condition*	1	2	3	4	5	0		

Component Information Tab

Comments	Mechanical			
<u>FRP</u>	Excessive vibration?	Yes	No	N/A
<u>Ferrous Tank recently replace ~3 years</u>	Excessive noise?	Yes	No	N/A
<u>Level Transmitter issues with ultrasonic, radar desired</u>	Excessive corrosion?	Yes	No	N/A
<u></u>	Excessive leaks?	Yes	No	N/A
<u>Evidence of past spills for ferric and ferrous storage area</u>	Running hot?	Yes	No	N/A
<u></u>	Capable of running when inspected?	Yes	No	N/A
<u></u>	Support equipment functional?	Yes	No	N/A
<u></u>	Equipment or parts missing?	Yes	No	N/A
<u></u>	Parts for maintenance available?	Yes	No	N/A
<u></u>	Adequate for intended purpose?	Yes	No	N/A
<u></u>	Motor amps within rating?	Yes	No	N/A
	Piping			
<u>* Condition / Level of Service</u>	Excessive corrosion?	Yes	No	N/A
1 - Very Good/ Low Impact	Excessive leaks?	Yes	No	N/A
2 - Minor Defects/ Med Low Impact	Paint in good condition?	Yes	No	N/A
3 - Requires Significant Maintenance/ Medium Impact	Supports in good condition?	Yes	No	N/A
4 - Requires Rehabilitation/ Med High Impact				
5 - Requires Replacement (> 50%)/ High Impact				
0 - Non-Existent				



Facility / System Condition Assessment Form

Facility: Sweetwater Authority Perdue WTP page 21
 Process: Chemical
 Component: Chlorine Gas System
 Discipline: Mechanical

Main Tab

Level of Service*	1	2	3	4	5	0	Date of Inspection	<u>4/20/2022</u>
Criticality								
Public Health & Safety		Multiple /Single	Seasonal		No Effect		Assessed By	<u>Brian Owen</u>
Environmental		Major	Minor		No Effect			
Cost of Repair		Major	Minor		No Effect			
Effect on Customers		Major	Minor		No Effect		Photo #	<u></u>
Condition*	1	2	3	4	5	0		

Component Information Tab

Comments	<u>Mechanical</u>		
<u>RMP issue for plant</u>	Excessive vibration?	Yes	No N/A
<u>Dose limited to 1.9 mg/l</u>	Excessive noise?	Yes	No N/A
<u>Cranes OK, inspect every 5 years</u>	Excessive corrosion?	Yes	No N/A
<u>D& H water supply all chlorine related items</u>	Excessive leaks?	Yes	No N/A
<u>Separate carrier water pump to boost pressure</u>	Running hot?	Yes	No N/A
<u>Plant water system hasn't had upgrade in a while</u>	Capable of running when inspected?	Yes	No N/A
<u>Feeders include 2,000/2,000/500 lb</u>	Support equipment functional?	Yes	No N/A
<u>Thermal sensing flow meters</u>	Equipment or parts missing?	Yes	No N/A
<u></u>	Parts for maintenance available?	Yes	No N/A
<u></u>	Adequate for intended purpose?	Yes	No N/A
<u></u>	Motor amps within rating?	Yes	No N/A
	<u>Piping</u>		
<u>* Condition / Level of Service</u>	Excessive corrosion?	Yes	No N/A
1 - Very Good/ Low Impact	Excessive leaks?	Yes	No N/A
2 - Minor Defects/ Med Low Impact	Paint in good condition?	Yes	No N/A
3 - Requires Significant Maintenance/ Medium Impact	Supports in good condition?	Yes	No N/A
4 - Requires Rehabilitation/ Med High Impact			
5 - Requires Replacement (> 50%)/ High Impact			
0 - Non-Existent			



Facility / System Condition Assessment Form

Facility: Sweetwater Authority Perdue WTP page 22
 Process: Chemical
 Component: Chemical Feed Pumps
 Discipline: Mechanical

Main Tab

Level of Service*	1	2	3	4	5	0	Date of Inspection	<u>4/20/2022</u>
Criticality								
Public Health & Safety		Multiple /Single	Seasonal		No Effect		Assessed By	<u>Brian Owen</u>
Environmental		Major	Minor		No Effect			
Cost of Repair		Major	Minor		No Effect			
Effect on Customers		Major	Minor		No Effect		Photo #	<u></u>
Condition*	1	2	3	4	5	0		

Component Information Tab

Comments	Mechanical		
<u>Hours tracked on SCADA</u>	Excessive vibration?	Yes	No N/A
<u>All gear feeders</u>	Excessive noise?	Yes	No N/A
<u>2017 chemical upgrades</u>	Excessive corrosion?	Yes	No N/A
<u>2017 Ferrous leak</u>	Excessive leaks?	Yes	No N/A
<u>All PVC pipe</u>	Running hot?	Yes	No N/A
<u>Spare chem area not being used</u>	Capable of running when inspected?	Yes	No N/A
<u></u>	Support equipment functional?	Yes	No N/A
<u></u>	Equipment or parts missing?	Yes	No N/A
<u></u>	Parts for maintenance available?	Yes	No N/A
<u></u>	Adequate for intended purpose?	Yes	No N/A
<u></u>	Motor amps within rating?	Yes	No N/A
	Piping		
<u>* Condition / Level of Service</u>	Excessive corrosion?	Yes	No N/A
1 - Very Good/ Low Impact	Excessive leaks?	Yes	No N/A
2 - Minor Defects/ Med Low Impact	Paint in good condition?	Yes	No N/A
3 - Requires Significant Maintenance/ Medium Impact	Supports in good condition?	Yes	No N/A
4 - Requires Rehabilitation/ Med High Impact			
5 - Requires Replacement (> 50%)/ High Impact			
0 - Non-Existent			



Facility / System Condition Assessment Form

Facility: Sweetwater Authority Perdue WTP page 23
 Process: Filters
 Component: Air Scour Blowers
 Discipline: Mechanical

Main Tab

Level of Service*	1	2	3	4	5	0	Date of Inspection	<u>4/20/2022</u>
Criticality								
Public Health & Safety	Multiple /Single	Seasonal				No Effect	Assessed By	<u>Brian Owen</u>
Environmental	Major	Minor				No Effect		
Cost of Repair	Major	Minor				No Effect	Photo #	<u></u>
Effect on Customers	Major	Minor				No Effect		
Condition*	1	2	3	4	5	0		

Component Information Tab

Comments	<u>Mechanical</u>		
<u>Replaced 2011</u>	Excessive vibration?	Yes	No N/A
<u>HSI Blower</u>	Excessive noise?	Yes	No N/A
<u>Not bolted down</u>	Excessive corrosion?	Yes	No N/A
<u></u>	Excessive leaks?	Yes	No N/A
<u></u>	Running hot?	Yes	No N/A
<u></u>	Capable of running when inspected?	Yes	No N/A
<u></u>	Support equipment functional?	Yes	No N/A
<u></u>	Equipment or parts missing?	Yes	No N/A
<u></u>	Parts for maintenance available?	Yes	No N/A
<u></u>	Adequate for intended purpose?	Yes	No N/A
<u></u>	Motor amps within rating?	Yes	No N/A
	<u>Piping</u>		
<u>* Condition / Level of Service</u>	Excessive corrosion?	Yes	No N/A
1 - Very Good/ Low Impact	Excessive leaks?	Yes	No N/A
2 - Minor Defects/ Med Low Impact	Paint in good condition?	Yes	No N/A
3 - Requires Significant Maintenance/ Medium Impact	Supports in good condition?	Yes	No N/A
4 - Requires Rehabilitation/ Med High Impact			
5 - Requires Replacement (> 50%)/ High Impact			
0 - Non-Existent			



Facility / System Condition Assessment Form

Facility: Sweetwater Authority Perdue WTP page 24
 Process: Storage/Disinfection
 Component: Clearwell
 Discipline: Mechanical

Main Tab

Level of Service*	1	2	3	4	5	0	Date of Inspection	<u>4/20/2022</u>
Criticality								
Public Health & Safety		Multiple /Single	Seasonal		No Effect			
Environmental		Major	Minor		No Effect		Assessed By	<u>Brian Owen</u>
Cost of Repair		Major	Minor		No Effect			
Effect on Customers		Major	Minor		No Effect		Photo #	<u></u>
Condition*	1	2	3	4	5	0		

Component Information Tab

Comments	<u>Mechanical</u>		
<u>All 4 gates stuck</u>	Excessive vibration?	Yes	No N/A
<u>Curtain Wall for baffling, unsure if working properly due to lack of access</u>	Excessive noise?	Yes	No N/A
<u>Pinhole leaks in roof, cannot hold any weight</u>	Excessive corrosion?	Yes	No N/A
<u>Gunite, sloped sidewalls</u>	Excessive leaks?	Yes	No N/A
<u>Substantial leaking</u>	Running hot?	Yes	No N/A
<u>Chemical mixing issues upstream causing precipitation</u>	Capable of running when inspected?	Yes	No N/A
<u>Poor chemical feedback</u>	Support equipment functional?	Yes	No N/A
<u></u>	Equipment or parts missing?	Yes	No N/A
<u></u>	Parts for maintenance available?	Yes	No N/A
<u></u>	Adequate for intended purpose?	Yes	No N/A
<u></u>	Motor amps within rating?	Yes	No N/A
	<u>Piping</u>		
* Condition / Level of Service	Excessive corrosion?	Yes	No N/A
1 - Very Good/ Low Impact	Excessive leaks?	Yes	No N/A
2 - Minor Defects/ Med Low Impact	Paint in good condition?	Yes	No N/A
3 - Requires Significant Maintenance/ Medium Impact	Supports in good condition?	Yes	No N/A
4 - Requires Rehabilitation/ Med High Impact			
5 - Requires Replacement (> 50%)/ High Impact			
0 - Non-Existent			



Facility / System Condition Assessment Form

Facility: Sweetwater Authority Perdue WTP page 25
 Process: Filter
 Component: Backwash Pumps
 Discipline: Mechanical

Main Tab

Level of Service*	1	2	3	4	5	0	Date of Inspection	<u>4/20/2022</u>
Criticality								
Public Health & Safety	Multiple /Single	Seasonal	No Effect				Assessed By	<u>Brian Owen</u>
Environmental	Multiple /Single	Seasonal	No Effect					
Cost of Repair	Major	Minor	No Effect				Photo #	<u></u>
Effect on Customers	Major	Minor	No Effect					
Condition*	1	2	3	4	5	0		

Component Information Tab

Comments	Mechanical			
<u>Lead/lag configuration</u>	Excessive vibration?	Yes	No	N/A
<u>Level based control</u>	Excessive noise?	Yes	No	N/A
<u>Temporary support being used</u>	Excessive corrosion?	Yes	No	N/A
<u>Apart of energy recommendation for longer fill times</u>	Excessive leaks?	Yes	No	N/A
<u></u>	Running hot?	Yes	No	N/A
<u></u>	Capable of running when inspected?	Yes	No	N/A
<u></u>	Support equipment functional?	Yes	No	N/A
<u></u>	Equipment or parts missing?	Yes	No	N/A
<u></u>	Parts for maintenance available?	Yes	No	N/A
<u></u>	Adequate for intended purpose?	Yes	No	N/A
<u></u>	Motor amps within rating?	Yes	No	N/A
	Piping			
* Condition / Level of Service	Excessive corrosion?	Yes	No	N/A
1 - Very Good/ Low Impact	Excessive leaks?	Yes	No	N/A
2 - Minor Defects/ Med Low Impact	Paint in good condition?	Yes	No	N/A
3 - Requires Significant Maintenance/ Medium Impact	Supports in good condition?	Yes	No	N/A
4 - Requires Rehabilitation/ Med High Impact				
5 - Requires Replacement (> 50%)/ High Impact				
0 - Non-Existent				



Facility / System Condition Assessment Form

Facility: Sweetwater Authority Perdue WTP page 1
 Process: Electrical Distribution
 Component: MCC-C & IOC-1000
 Discipline: Electrical & Instrumentation

Main Tab

Level of Service*	1	2	3	4	5	0	Date of Inspection	<u>4/20/2022</u>
Criticality								
Public Health & Safety	Multiple /Single		Seasonal	No Effect			Assessed By	<u>Jeff Weishaar</u>
Environmental	Major	Minor	No Effect					
Cost of Repair	Major	Minor	No Effect					
Effect on Customers	Major	Minor	No Effect			Photo #	<u></u>	
Condition*	1	2	3	4	5	0		

Component Information Tab

Comments	Electrical			
	Excessive corrosion?	Yes	No	N/A
	Clean, well maintained contacts?	Yes	No	N/A
	Parts available for maintenance?	Yes	No	N/A
	Supports in good condition?	Yes	No	N/A
	Instrumentation			
All critical indications functioning?	Yes	No	N/A	
Alarms functional?	Yes	No	N/A	
Equipment or missing parts?	Yes	No	N/A	
Parts available for maintenance?	Yes	No	N/A	

*** Condition / Level of Service**

- 1 - Very Good/ Low Impact
- 2 - Minor Defects/ Med Low Impact
- 3 - Requires Significant Maintenance/ Medium Impact
- 4 - Requires Rehabilitation/ Med High Impact
- 5 - Requires Replacement (> 50%)/ High Impact
- 0 - Non-Existent



Facility / System Condition Assessment Form

Facility: Sweetwater Authority Perdue WTP
 Process: Electrical Distribution
 Component: MCC-A
 Discipline: Electrical & Instrumentation

page 3

Main Tab

Level of Service*	1	2	3	4	5	0	Date of Inspection	<u>4/20/2022</u>
Criticality								
Public Health & Safety	Multiple	Single	Seasonal	No Effect			Assessed By	<u>Jeff Weishaar</u>
Environmental	Major		Minor	No Effect				
Cost of Repair	Major		Minor	No Effect				
Effect on Customers	Major		Minor	No Effect			Photo #	<u></u>
Condition*	1	2	3	4	5	0		

Component Information Tab

Comments	Electrical		
<u>Analog meter has issues standby power from portable generator up top of hill</u>	Excessive corrosion?	Yes	No N/A
<u>Surficial rust on base</u>	Clean, well maintained contacts?	Yes	No N/A
<u>AC units are problematic. AC for pump 5 shut down pump on high temp yesterday</u>	Parts available for maintenance?	Yes	No N/A
<u>Pump 1 & 2 RVSS recently replaced 10 yrs ago</u>	Supports in good condition?	Yes	No N/A
<u>Pump 3, 4, 5 VFD's installed 2013</u>	Instrumentation		
<u>Regular PM to keep buckets clean, rodents out etc.</u>	All critical indications functioning?	Yes	No N/A
	Alarms functional?	Yes	No N/A
	Equipment or missing parts?	Yes	No N/A
	Parts available for maintenance?	Yes	No N/A

* Condition / Level of Service

- 1 - Very Good/ Low Impact
- 2 - Minor Defects/ Med Low Impact
- 3 - Requires Significant Maintenance/ Medium Impact
- 4 - Requires Rehabilitation/ Med High Impact
- 5 - Requires Replacement (> 50%)/ High Impact
- 0 - Non-Existent



Facility / System Condition Assessment Form

Facility: Sweetwater Authority Perdue WTP page 8
 Process: DAFT
 Component: Actuators, VFDs
 Discipline: Electrical & Instrumentation

Main Tab

Level of Service*	1	2	3	4	5	0	Date of Inspection	<u>4/20/2022</u>
Criticality								
Public Health & Safety	Multiple	Single	Seasonal	No Effect			Assessed By	<u>Jeff Weishaar</u>
Environmental	Major	Minor	No Effect					
Cost of Repair	Major	Minor	No Effect					
Effect on Customers	Major	Minor	No Effect			Photo #		
Condition*	1	2	3	4	5	0		

Component Information Tab

Comments	Electrical			
<u>DAFT implemented 2012/2013</u>	Excessive corrosion?	Yes	No	N/A
<u>Actuators, pump,s mixers all installed w/DAFT</u>	Clean, well maintained contacts?	Yes	No	N/A
<u></u>	Parts available for maintenance?	Yes	No	N/A
<u></u>	Supports in good condition?	Yes	No	N/A
<u>Saturation tanks inspected every 5 years</u>				
<u>All in good condition</u>				
<u>ATS good condition</u>				
<u>All EIM actuators</u>				
	Instrumentation			
<u></u>	All critical indications functioning?	Yes	No	N/A
<u></u>	Alarms functional?	Yes	No	N/A
<u></u>	Equipment or missing parts?	Yes	No	N/A
<u></u>	Parts available for maintenance?	Yes	No	N/A

* Condition / Level of Service

- 1 - Very Good/ Low Impact
- 2 - Minor Defects/ Med Low Impact
- 3 - Requires Significant Maintenance/ Medium Impact
- 4 - Requires Rehabilitation/ Med High Impact
- 5 - Requires Replacement (> 50%)/ High Impact
- 0 - Non-Existent



Facility / System Condition Assessment Form

Facility: Sweetwater Authority Perdue WTP page 12
 Process: Electrical Distribution & Communication
 Component: IOC 9500
 Discipline: Electrical & Instrumentation

Main Tab

Level of Service*	1	2	3	4	5	0	Date of Inspection	<u>4/20/2022</u>
Criticality								
Public Health & Safety	Multiple	Single	Seasonal	No Effect			Assessed By	<u>Jeff Weishaar</u>
Environmental	Major		Minor	No Effect				
Cost of Repair	Major		Minor	No Effect				
Effect on Customers	Major		Minor	No Effect			Photo #	<u></u>
Condition*	1	2	3	4	5	0		

Component Information Tab

Comments	Electrical		
<u>Installed 2019</u>	Excessive corrosion?	Yes	No N/A
<u></u>	Clean, well maintained contacts?	Yes	No N/A
<u>Good condition</u>	Parts available for maintenance?	Yes	No N/A
<u></u>	Supports in good condition?	Yes	No N/A
<u>MCC overheating was found to be due to limit switch settings.</u>			
<u>Adjusted switch and no more issues</u>			
<u></u>			
Instrumentation			
<u></u>	All critical indications functioning?	Yes	No N/A
<u></u>	Alarms functional?	Yes	No N/A
<u></u>	Equipment or missing parts?	Yes	No N/A
<u></u>	Parts available for maintenance?	Yes	No N/A

* Condition / Level of Service

- 1 - Very Good/ Low Impact
- 2 - Minor Defects/ Med Low Impact
- 3 - Requires Significant Maintenance/ Medium Impact
- 4 - Requires Rehabilitation/ Med High Impact
- 5 - Requires Replacement (> 50%)/ High Impact
- 0 - Non-Existent

Appendix C

RISK ASSESSMENT EVALUATION

Discipline	Process	Component	Tag	Condition	Criticality Weighted	Criticality-Public Health and Safety	Criticality - Financial	Criticality - Environmental	Criticality - Effect on Service	Original Life	Evaluated RUL	Vulnerability	Risk
Mech	Clearwell	Clearwell	ME4	5	9.55	7	10	10	10	50	5	2.00	19.10
Mech	Chlorine Gas System	Chlorinator No.1	ME5	2	7.45	10	7	10	4	15	13.5	0.74	5.72
Mech	Chlorine Gas System	Chlorinator No.2	ME6	2	7.45	10	7	10	4	15	13.5	0.74	5.72
Mech	Chlorine Gas System	Storage Tank	TKN1251	2	7.45	7	7	7	7	15	13.5	0.74	5.19
Mech	Chlorine Gas System	Exaporator No.1	ME9	2	6.7	10	7	10	1	15	13.5	0.74	4.96
Mech	Chlorine Gas System	Storage Tank	ME10	2	6.7	10	7	10	1	15	13.5	0.74	4.96
Mech	Intake PS	Raw Water Pump No.3	PMP3123	2	6.25	7	10	7	4	15	13.5	0.74	4.63
Mech	Intake PS	Raw Water Pump No.4	PMP3124	2	5.65	1	10	1	7	15	13.5	0.74	4.19
Mech	Intake PS	Raw Water Pump No.1	PMP3121	3	4.8	1	10	1	7	15	13.5	0.83	3.83
Mech	Intake PS	Raw Water Pump No.2	PMP3122	2	6.85	4	10	10	1	15	13.5	0.56	3.81
Mech	Filter No.2	Filter No.2 Underdrain	-	2	6.85	4	10	10	1	20	18	0.56	3.81
Mech	Filter No.3	Filter No.3 Underdrain	-	2	6.85	4	10	10	1	20	18	0.56	3.81
Mech	Filter No.4	Filter No.4 Underdrain	-	2	6.85	4	10	10	1	20	18	0.56	3.81
Mech	Caustic Soda	Storage Tank No.1	TKN2101	2	5.05	4	7	7	1	15	13.5	0.74	3.74
Mech	Caustic Soda	Storage Tank No.2	TKN2102	2	5.05	4	7	7	1	15	13.5	0.74	3.74
Mech	Ferric Chloride	Storage Tank No.1	TKN1151	2	5.05	4	7	7	1	15	13.5	0.74	3.74
Mech	Ferric Chloride	Storage Tank No.2	TKN1152	2	5.05	4	7	7	1	15	13.5	0.74	3.74
Mech	Ferric Chloride	Storage Tank No.3	TKN1201	2	5.05	4	7	7	1	15	13.5	0.74	3.74
Mech	Filter No.1	Filter No.1 Media	-	2	6.4	1	10	10	1	20	18	0.56	3.56
Mech	Filter No.2	Filter No.2 Media	-	2	6.4	1	10	10	1	20	18	0.56	3.56
Mech	Filter No.3	Filter No.3 Media	-	2	6.4	1	10	10	1	20	18	0.56	3.56
Mech	Filter No.4	Filter No.4 Media	-	2	6.4	1	10	10	1	20	18	0.56	3.56
Mech	Wastewater System	Sump Pump No.1	-	2	4.75	4	4	4	1	15	13.5	0.74	3.52
Mech	Wastewater System	Sump Pump No.2	-	2	4.75	4	4	4	1	15	13.5	0.74	3.52
Mech	Chlorine Dioxide	TKN1451	TKN1451	2	4.6	1	7	7	4	15	13.5	0.74	3.41
Mech	Chlorine Dioxide	Sodium Chloride Storage Tank	TKN1350	2	4.6	1	7	7	4	15	13.5	0.74	3.41
Mech	Chlorine Dioxide	Raw Water Pump No.5	PMP3125	2	4.6	1	7	7	7	15	13.5	0.74	3.41
Mech	Chlorine Dioxide	Day Tank	TKN1352	1	5.05	4	7	7	7	15	15	0.67	3.37
E/I &C	Emergency Power	Standby Generator	GEN921	1	5.05	10	10	1	1	15	15	0.67	3.37
Mech	Fire System	Emergency Fire Pump	PMP7119	2	4.45	10	7	1	1	15	15	0.74	3.30
E/I &C	Power Distribution	MCC A	-	2	8.5	10	10	10	10	30	27	0.37	3.15
Mech	DNF	Flash Mixer Pump	PMP4601	2	4	4	4	4	4	15	13.5	0.74	2.96
Mech	Chlorine Dioxide	Fesder No.1	-	1	4.3	1	4	4	1	15	15	0.67	2.87
Mech	Chlorine Dioxide	Fesder No.2	-	1	4.3	1	4	4	1	15	15	0.67	2.87
Mech	Chlorine Dioxide	Fesder No.3	-	1	4.3	1	4	4	1	15	15	0.67	2.87
E/I &C	Power Distribution	MCC B	-	1	8.5	10	10	4	10	30	30	0.33	2.83
E/I &C	Power Distribution	MCC C	-	1	8.5	10	10	4	10	30	30	0.33	2.83
E/I &C	Power Distribution	MCC D	-	1	8.5	10	10	4	10	30	30	0.33	2.83
Mech	Aqua Ammonia	Scrubber Tank	-	2	3.7	4	4	4	1	15	13.5	0.74	2.74
E/I &C	DNF	ICCC0000	-	1	5.35	4	4	4	4	20	20	0.50	2.68
Mech	Filter	AW-SC02/Blower	BLW5601	1	7.85	1	10	10	4	15	15	0.57	2.52
E/I &C	Filter	IOC0010	-	1	7.6	10	10	10	4	30	30	0.33	2.52
Mech	Plant Water	Emergency Water Pump	PMP7230	2	3.4	10	4	1	1	15	13.5	0.74	2.52
Mech	Chlorine Dioxide	Generation Pump	-	1	3.55	4	4	1	1	15	15	0.67	2.37
Mech	Spare Chemical	Storage Tank No.1	TKN1401	2	3.1	1	7	1	1	15	13.5	0.74	2.30
Mech	Spare Chemical	Storage Tank No.2	TKN1451	2	3.1	1	7	1	1	15	13.5	0.74	2.30
E/I &C	Emergency Power	Fuel Storage Tank	TKN9212	1	4.45	10	7	1	1	20	20	0.50	2.23
E/I &C	DNF	Transformer D	ZMTRD	1	6.55	7	10	10	7	30	30	0.33	2.18
Mech	Caustic Soda	Reservoir No.1	FD-10	2	2.8	4	4	4	1	15	13.5	0.74	2.07
Mech	Caustic Soda	Reservoir No.2	FD-11	2	2.8	4	4	4	1	15	13.5	0.74	2.07
E/I &C	DNF	XFMK-D1	-	1	6.1	4	10	1	7	30	30	0.33	2.03
E/I &C	DNF	XFMK-D2	-	1	6.1	4	10	1	7	30	30	0.33	2.03
E/I &C	Hydro Facility	IOC 9500	-	1	6.1	4	10	1	7	30	30	0.33	2.03
E/I &C	Intake PS	IOC 0000	-	1	5.8	7	7	1	10	30	30	0.33	1.93
E/I &C	Caustic Soda	IOC 2000	-	1	5.65	1	10	1	7	30	30	0.33	1.88
E/I &C	Chlorine Dioxide	Chlorine Dioxide Blg	-	1	5.65	1	10	1	7	30	30	0.33	1.88
E/I &C	Aqua Ammonia	IOC 3000	-	1	5.65	10	10	1	7	30	30	0.33	1.88
Mech	Aqua Ammonia	Fesder No.1	FD-1	2	2.5	4	4	1	1	15	13.5	0.74	1.82

Discipline	Process	Component	Tag	Condition	Criticality Weighted	Criticality- Public Health and Safety	Criticality- Financial	Criticality- Environmental	Criticality- Effect on Service	Original Life	Evaluated RUL	Vulnerability	Risk
Mech	Aqua Ammonia	Feeder No.2	FD-2	2	2.5	4	4	1	1	15	13.5	0.74	1.85
Mech	Plant Air	Air Compressor No.1	ME16	2	2.5	4	4	1	1	15	13.5	0.74	1.85
Mech	Plant Air	Air Compressor No.2	ME17	2	2.5	4	4	1	1	15	13.5	0.74	1.85
Mech	Plant Water	Plant Water Pump No.1	MPW2116	2	2.5	4	4	1	1	15	13.5	0.74	1.85
Mech	Plant Water	Plant Water Pump No.2	MPW2117	2	2.5	4	4	1	1	15	13.5	0.74	1.85
Mech	Washwater System	Washwater Pump No.1	PMP1118	2	2.5	4	4	1	1	15	13.5	0.74	1.85
Mech	Washwater System	Washwater Pump No.2	PMP1119	2	2.5	4	4	1	1	15	13.5	0.74	1.85
E/I &C	DAF	IOC001		1	5.35	10	10	1	4	30	30	0.33	1.78
Mech	DAF	Saturation Tank No.1	TNK4510	1	3.55	7	7	1	1	20	20	0.50	1.78
Mech	DAF	Saturation Tank No.2	TNK4520	1	3.55	7	7	1	1	20	20	0.50	1.78
Mech	Intake PS	Discharge Surge Tank	TNK3131	2	3.1	7	7	1	1	20	20	0.56	1.72
Mech	Intake PS	Suction Surge Tank	TNK3111	2	3.1	7	7	1	1	20	20	0.56	1.72
Mech	DAF	Air Compressor No.1	FC-1	2	2.5	4	4	1	1	15	13.5	0.74	1.85
Mech	DAF	Air Compressor No.2	FC-2	2	2.5	4	4	1	1	15	13.5	0.74	1.85
Mech	DAF	Air Receiver	TNK4535	1	3.25	4	4	1	4	20	20	0.67	1.67
Mech	Washwater System	Master Washwater Valve	FCV5623	2	5.05	7	7	4	4	35	31.5	0.32	1.60
Mech	Carbonic Polymer	Feeder No.1	FD-3	2	2.05	4	4	1	1	15	13.5	0.74	1.52
Mech	Carbonic Polymer	Feeder No.2	FD-4	2	2.05	4	4	1	1	15	13.5	0.74	1.52
Mech	Chlorine Gas System	Scale No.1	ME12	2	2.05	4	4	1	1	15	13.5	0.74	1.52
Mech	Chlorine Gas System	Scale No.2	ME13	2	2.05	4	4	1	1	15	13.5	0.74	1.52
Mech	Ferrous Chloride	Feeder No.1	FD-5	2	2.05	4	4	1	1	15	13.5	0.74	1.52
Mech	Ferrous Chloride	Feeder No.2	FD-6	2	2.05	4	4	1	1	15	13.5	0.74	1.52
Mech	Ferrous Chloride	Feeder No.1	FD-7	2	2.05	4	4	1	1	15	13.5	0.74	1.52
Mech	Ferrous Chloride	Feeder No.2	FD-8	2	2.05	4	4	1	1	15	13.5	0.74	1.52
Mech	Fluoride	Feeder No.1	FD-9	2	2.05	4	4	1	1	15	13.5	0.74	1.52
Mech	Fluoride	Feeder No.2	FD-10	2	2.05	4	4	1	1	15	13.5	0.74	1.52
Mech	Plant Water	Plant Water Pump No.1	PMP7214	2	2.05	4	4	1	1	15	13.5	0.74	1.52
Mech	Plant Water	Plant Water Pump No.2	PMP7215	2	2.05	4	4	1	1	15	13.5	0.74	1.52
Mech	Spare Chemical	Feeder No.1	FD-11	2	2.05	4	4	1	1	15	13.5	0.74	1.52
Mech	Spare Chemical	Feeder No.2	FD-12	2	2.05	4	4	1	1	15	13.5	0.74	1.52
Mech	Spare Chemical	Feeder No.3	FD-13	2	2.05	4	4	1	1	15	13.5	0.74	1.52
Mech	Spare Chemical	Feeder No.4	FD-14	2	2.05	4	4	1	1	15	13.5	0.74	1.52
Mech	Washwater System	Washwater Tank No.2	TNK7026	2	6.55	10	10	1	1	50	45	0.22	1.46
E/I &C	Washwater System	Washwater Used Flow	FTS604	2	3.85	7	7	4	4	30	27	0.37	1.43
Mech	Plant Air	Air Receiver No.1	ME19	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Air	Air Receiver No.2	ME20	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7213	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7214	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7215	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7216	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7217	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7218	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7219	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7220	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7221	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7222	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7223	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7224	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7225	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7226	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7227	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7228	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7229	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7230	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7231	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7232	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7233	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7234	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7235	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7236	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7237	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7238	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7239	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7240	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7241	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7242	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7243	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7244	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7245	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7246	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7247	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7248	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7249	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7250	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7251	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7252	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7253	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7254	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7255	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7256	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7257	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7258	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7259	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7260	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7261	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7262	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7263	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7264	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7265	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7266	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7267	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7268	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7269	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7270	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7271	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7272	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7273	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK7274	2	2.5	4	4	1	1	20	18	0.56	1.39
Mech	Plant Water	Hydrate Tank	TNK										

Discipline	Process	Component	Tag	Condition	Criticality Weighted	Criticality - Public Health and Safety	Criticality - Financial	Criticality - Environmental	Criticality - Effect on Service	Original Life	Evaluated RUL	Vulnerability	Risk
E/I &C	Filter No.2	Filter No.2 Flow Meter	HT223	2	3.1	1	7	1	1	30	27	0.37	1.15
E/I &C	Filter No.3	Filter No.3 Flow Meter	HT233	2	3.1	1	7	1	1	30	27	0.37	1.15
E/I &C	Filter No.4	Filter No.4 Flow Meter	HT243	2	3.1	1	7	1	1	30	27	0.37	1.15
Mech	Washwater System	Washwater Tank No.1	HW205	2	2.05	7	10	1	1	30	27	0.22	1.15
Mech	DAF	Train No.1 Flocculator No.1	MX401	1	2.05	4	4	1	1	20	20	0.50	1.03
Mech	DAF	Train No.3 Flocculator No.1	MX4301	1	2.05	4	4	1	1	20	20	0.50	1.03
Mech	DAF	Train No.4 Flocculator No.1	MX4401	1	2.05	4	4	1	1	20	20	0.50	1.03
Mech	DAF	Train No.1 Flocculator No.2	MX4102	1	2.05	4	4	1	1	20	20	0.50	1.03
Mech	DAF	Train No.2 Flocculator No.2	MX4202	1	2.05	4	4	1	1	20	20	0.50	1.03
Mech	DAF	Train No.3 Flocculator No.2	MX4302	1	2.05	4	4	1	1	20	20	0.50	1.03
Mech	DAF	Train No.4 Flocculator No.2	MX4402	1	2.05	4	4	1	1	20	20	0.50	1.03
Mech	Filter No.1	Filter No.1 Air Scour No.1 (West)	MOV5101	2	2.05	4	4	1	1	35	31.5	0.32	0.89
Mech	Filter No.2	Filter No.2 Effluent Modulating	FCV302	2	2.8	4	4	1	1	35	31.5	0.32	0.89
Mech	Filter No.3	Filter No.3 Effluent Modulating	FCV303	2	2.8	4	4	1	1	35	31.5	0.32	0.89
Mech	Filter No.4	Filter No.4 Effluent Modulating	FCV304	2	2.8	4	4	1	1	35	31.5	0.32	0.89
Mech	NC/SB Turnouts	Aqueduct 3 Raw Water Valve to NCSB No.1	MOV3310	1	2.8	4	4	1	1	35	31.5	0.32	0.89
Mech	NC/SB Turnouts	Aqueduct 4 Raw Water Valve to NCSB No.4	MOV3511	1	2.8	4	4	1	1	35	35	0.29	0.80
Mech	Filter No.1	Filter No.1 Washwater Supply	MOV5103	2	2.5	4	4	1	1	35	35	0.32	0.79
Mech	Filter No.2	Filter No.2 Washwater Supply	MOV5203	2	2.5	4	4	1	1	35	31.5	0.32	0.79
Mech	Filter No.3	Filter No.3 Washwater Supply	MOV5303	2	2.5	4	4	1	1	35	31.5	0.32	0.79
Mech	Filter No.4	Filter No.4 Washwater Supply	MOV5403	2	2.5	4	4	1	1	35	31.5	0.32	0.79
Mech	Washwater System	Washwater Pumped Flow Flowmeter	HT106	2	2.05	4	4	1	1	30	27	0.32	0.76
Mech	Filter No.1	Filter No.1 Influent Valve	MOV9101	2	2.05	4	4	1	1	35	31.5	0.32	0.65
Mech	Filter No.1	Filter No.1 Washwater to Waste Valve	MOV9105	2	2.05	4	4	1	1	35	31.5	0.32	0.65
Mech	Filter No.1	Filter No.1 Filter to Waste	MOV9106	2	2.05	4	4	1	1	35	31.5	0.32	0.65
Mech	Filter No.1	Filter No.1 Effluent Isolation	MOV9107	2	2.05	4	4	1	1	35	31.5	0.32	0.65
Mech	Filter No.1	Filter No.1 Air Scour No.1 (West)	MOV9111	2	2.05	4	4	1	1	35	31.5	0.32	0.65
Mech	Filter No.1	Filter No.1 Air Scour No.2 (East)	MOV9112	2	2.05	4	4	1	1	35	31.5	0.32	0.65
Mech	Filter No.1	Filter No.1 Air Scour No.3 (East)	MOV9113	2	2.05	4	4	1	1	35	31.5	0.32	0.65
Mech	Filter No.2	Filter No.2 Washwater to Waste Valve	MOV9205	2	2.05	4	4	1	1	35	31.5	0.32	0.65
Mech	Filter No.2	Filter No.2 Filter to Waste	MOV9206	2	2.05	4	4	1	1	35	31.5	0.32	0.65
Mech	Filter No.2	Filter No.2 Effluent Isolation	MOV9207	2	2.05	4	4	1	1	35	31.5	0.32	0.65
Mech	Filter No.2	Filter No.2 Air Scour No.1 (West)	MOV9211	2	2.05	4	4	1	1	35	31.5	0.32	0.65
Mech	Filter No.2	Filter No.2 Air Scour No.2 (East)	MOV9212	2	2.05	4	4	1	1	35	31.5	0.32	0.65
Mech	Filter No.3	Filter No.3 Influent Valve	MOV9301	2	2.05	4	4	1	1	35	31.5	0.32	0.65
Mech	Filter No.3	Filter No.3 Washwater to Waste Valve	MOV9305	2	2.05	4	4	1	1	35	31.5	0.32	0.65
Mech	Filter No.3	Filter No.3 Filter to Waste	MOV9306	2	2.05	4	4	1	1	35	31.5	0.32	0.65
Mech	Filter No.3	Filter No.3 Effluent Isolation	MOV9307	2	2.05	4	4	1	1	35	31.5	0.32	0.65
Mech	Filter No.3	Filter No.3 Air Scour No.1 (West)	MOV9311	2	2.05	4	4	1	1	35	31.5	0.32	0.65
Mech	Filter No.3	Filter No.3 Air Scour No.2 (East)	MOV9312	2	2.05	4	4	1	1	35	31.5	0.32	0.65
Mech	Filter No.4	Filter No.4 Influent Valve	MOV9401	2	2.05	4	4	1	1	35	31.5	0.32	0.65
Mech	Filter No.4	Filter No.4 Washwater to Waste Valve	MOV9405	2	2.05	4	4	1	1	35	31.5	0.32	0.65
Mech	Filter No.4	Filter No.4 Filter to Waste	MOV9406	2	2.05	4	4	1	1	35	31.5	0.32	0.65
Mech	Filter No.4	Filter No.4 Effluent Isolation	MOV9407	2	2.05	4	4	1	1	35	31.5	0.32	0.65
Mech	Filter No.4	Filter No.4 Air Scour No.1 (West)	MOV9411	2	2.05	4	4	1	1	35	31.5	0.32	0.65
Mech	Filter No.4	Filter No.4 Air Scour No.2 (East)	MOV9412	2	2.05	4	4	1	1	35	31.5	0.32	0.65
Mech	NC/SB Turnouts	Aqueduct 3 Raw Water Valve No.1 to NCSB No.3	MOV9321	1	2.05	4	4	1	1	35	35	0.29	0.59
Mech	NC/SB Turnouts	Aqueduct 3 Raw Water Valve No.2 to NCSB No.3	MOV9322	1	2.05	4	4	1	1	35	35	0.29	0.59
Mech	Washwater System	Washwater Pumped Flow Valve	MOV7101	2	1.75	1	1	1	4	35	31.5	0.32	0.36
E/I &C	Plant Water	Plant Utility Water System Flowmeter	HT201	2	1	1	1	1	1	30	27	0.37	0.37
Mech	DAF	Train No.4 Influent Valve No.1	MOV4431	1	1	1	1	1	1	35	35	0.29	0.29
Mech	DAF	Train No.4 Influent Valve No.2	MOV4432	1	1	1	1	1	1	35	35	0.29	0.29
Mech	DAF	Train No.3 Influent Valve No.1	MOV4331	1	1	1	1	1	1	35	35	0.29	0.29
Mech	DAF	Train No.3 Influent Valve No.2	MOV4332	1	1	1	1	1	1	35	35	0.29	0.29
Mech	DAF	Train No.2 Influent Valve No.1	MOV4231	1	1	1	1	1	1	35	35	0.29	0.29
Mech	DAF	Train No.2 Influent Valve No.2	MOV4232	1	1	1	1	1	1	35	35	0.29	0.29
Mech	DAF	Train No.1 Influent Valve No.1	MOV4131	1	1	1	1	1	1	35	35	0.29	0.29
Mech	DAF	Train No.1 Influent Valve No.2	MOV4132	1	1	1	1	1	1	35	35	0.29	0.29

Appendix D

BACKWASH PIPE RE-ALIGNMENT DETAIL

Chapter 3

RESERVOIR MANAGEMENT

Raw water entering the Perdue WTP primarily comes from the Sweetwater Reservoir and an intertie with CWA for imported raw water. Historically, approximately 70 percent of the customer demands are served from the local water supply. However, the year long drought has diminished water levels in both the Loveland and Sweetwater Reservoirs. The Authority has been relying on raw water from CWA since late 2012/early 2013. For planning purposes, it is assumed that reservoir levels will be replenished and local water supply from Sweetwater Reservoir will again be the primary source for treatment at Perdue WTP. As part of this Site Facilities Master Plan, existing practices for disposal of filter wash water (FWW) and reservoir management were evaluated.

3.1 Replacement Options for the Filter Wash Water Pipeline

This section provides recommendations to the Authority for replacement of the Perdue WTP FWW pipeline. The goals of the FWW retention project is to reduce the potential for recirculation of waste wash water back to the plant intake and minimize the chance for such overflows of the transition box. The Authority wishes to relocate the FWW discharge outlet further to the east away from the existing Dam Intake Structure and closer to the high water elevation of 239 feet. Placing the discharge pipe near the reservoir high water level will also make the line more accessible for maintenance or repairs. Another issue that has occurred several times has been overflow of the Transition Box where the concrete channel connects to the 48-inch line. This box has a grated top and during a surcharge waste wash water can flow up and out into the parking area and adjacent building. These overflow events are atypical and occur when the filters are operated manually, outside of the standard operating procedures.

Objectives of this analysis are the following:

1. Develop hydraulic model for the existing and proposed FWW lines.
2. Develop FWW pipeline options that meet the following criteria:
 - a. Relocate the discharge point of FWW further away from the intake structure.
 - b. Reduce nuisance overflows at Transition Box.
3. Develop construction costs estimates and pros/cons for each option.

3.1.1 Existing Conditions

The process flow schematic of the current FWW system is shown in Figure 3.1. A hydraulic model was developed to determine the hydraulic grade line along the FWW pipeline. The model was initially tested at the standard backwash flow of 38 mgd and then at a higher flow to simulate overflow conditions at the Transition Box. A summary of flows that could occur at the WTP are listed in Table 3.1.

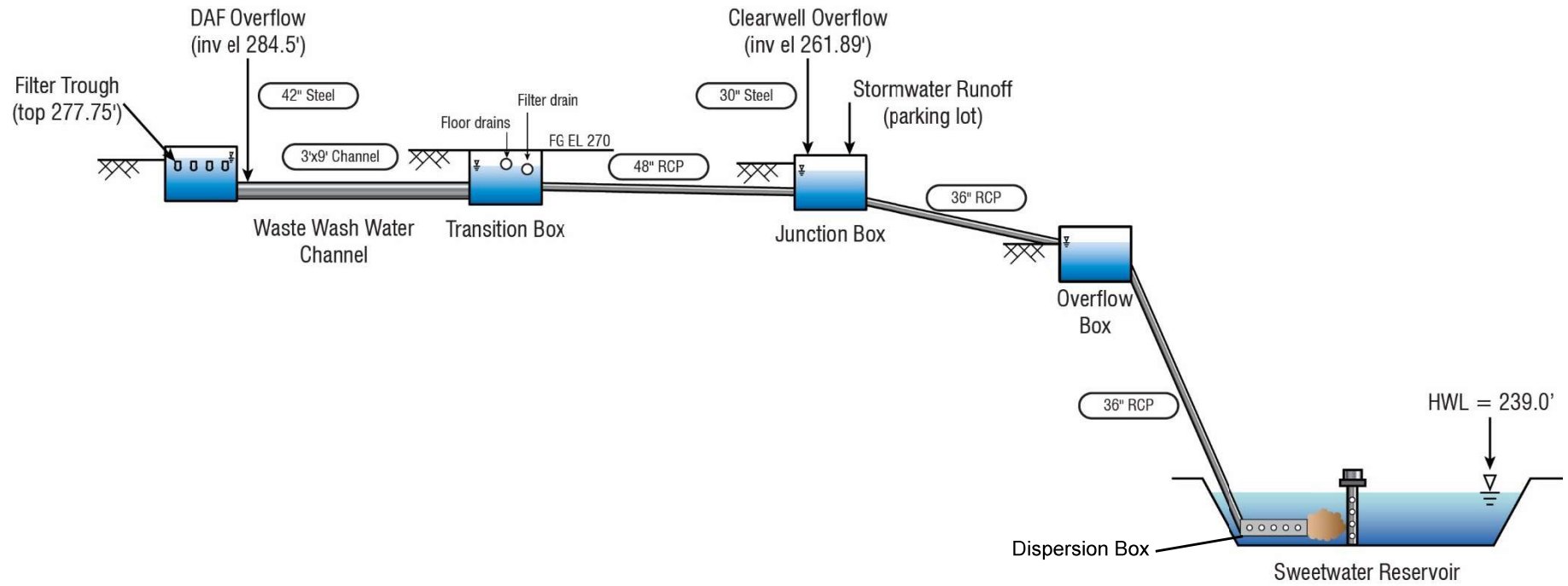


Figure 3.1 Existing FWW Process Flow Diagram

Table 3.1 Summary of Flow Conditions Used in this Analysis

Process Stream	Flow (mgd)	Notes
WTP Capacity		
Nominal	30	All 4 filters in service at 4.5 gpm/ft ² .
Maximum	40	All 4 filters in service at 6.0 gpm/ft ² .
Filter Backwash	38	Backwash rate at 22.5 gpm/ft ² for one filter (1,172 ft ²).
Overflow		
Dissolved Air Flotation Tanks	40	All 4 DAF trains in operation.
"Filter Dump"	115	Water surface elevation of 4.25 ft above waste washwater troughs and all 4 filters dumping simultaneously.

The model was calibrated against field measurements during a single backwash event (i.e., 38 mgd). Minor losses and roughness coefficients in the model were adjusted so that the model's calculated hydraulic grade line in the Transition Box matched what was measured in the field. Once calibrated, the model predicted that at high flow rates (e.g., "Filter Dumping"), the Transition Box would overflow. Based on the model results, it appears that there is approximately a safety factor of two for the FWW line. That is, this line can safely convey up two filter backwashes simultaneously.

This model was later used to develop hydraulic grade line for the FWW pipeline options. Pipe sizing and slopes for each pipeline option were adjusted until open channel flow resulted.

3.1.2 Filter Wash Water Pipeline Options

The basis for design of the relocation of the FWW pipeline will be established and will include necessary site work, piping, and plan profiles of potential FWW pipe realignments. Hydraulic grade line, construction cost estimates, and a list of bid plans/specifications will also be presented. Planning of potential pipe alignments will take into consideration and accommodate future plant modifications and existing sensitive structures, such as the south face of the Clearwell, "Commissary" building, and the "Quonset" hut. The report will also provide a detailed listing of potential permitting issues that may need to be addressed during the final design stage.

Three possible FWW pipeline realignment options were investigated and are outlined below in Table 3.2. Figure 3.2 shows a general overview of the three options as well as the existing FWW system. Table 3.3 summarizes the advantages/disadvantages for each option. Subsequent discussion contains the details for each option.

Table 3.2 FWW Pipeline Replacement Options

Option No.	Description
1	Extend existing 36-inch pipe approximately 370 feet to the east and construct new discharge headwall. Convert existing Overflow Box into a junction box and abandon Dispersion Box and line to it.
2	Install new 36-inch pipe from existing Junction box, along south side of clearwell, approximately 560 feet to new discharge headwall.
3	Install new FWW channel outlet on east side of filters and install new 48-inch pipe along east side of clearwell, approximately 590 feet to new discharge headwall.

Table 3.3 Advantages and Disadvantages of Each FWW Pipeline Options

Option No.	Advantages	Disadvantages
1	<ul style="list-style-type: none"> Least Expensive Option. No Excavation Adjacent to Clearwell. Avoids Work Areas. 	<ul style="list-style-type: none"> May require DSOD⁽¹⁾ approval. Does not Address Transition Box Overflow⁽²⁾. Potential environmental protection/mitigation⁽³⁾.
2	<ul style="list-style-type: none"> May be Combined with and Reduce Proposed Drain Line Work. 	<ul style="list-style-type: none"> Trenching through Clearwell Embankment. May Require DSOD⁽¹⁾ Approval. Does Not Address Transition Box Overflow⁽²⁾. Requires Coordination with Work.
3	<ul style="list-style-type: none"> Solves Overflow of Transition Box. May be Combined with and Reduce Proposed Drain Line Work. 	<ul style="list-style-type: none"> Most expensive option. Difficult Excavation between Filters and Blower Building. Trenching Adjacent to Clearwell. Requires Coordination with Work. Potential environmental protection/mitigation⁽³⁾.

Notes:

- (1) Division of Safety of Dams.
- (2) Assumes grating cover remains in place and is not replaced with a sealed, water tight cover.
- (3) Part of work occurs in area containing Coastal Sage Scrub.

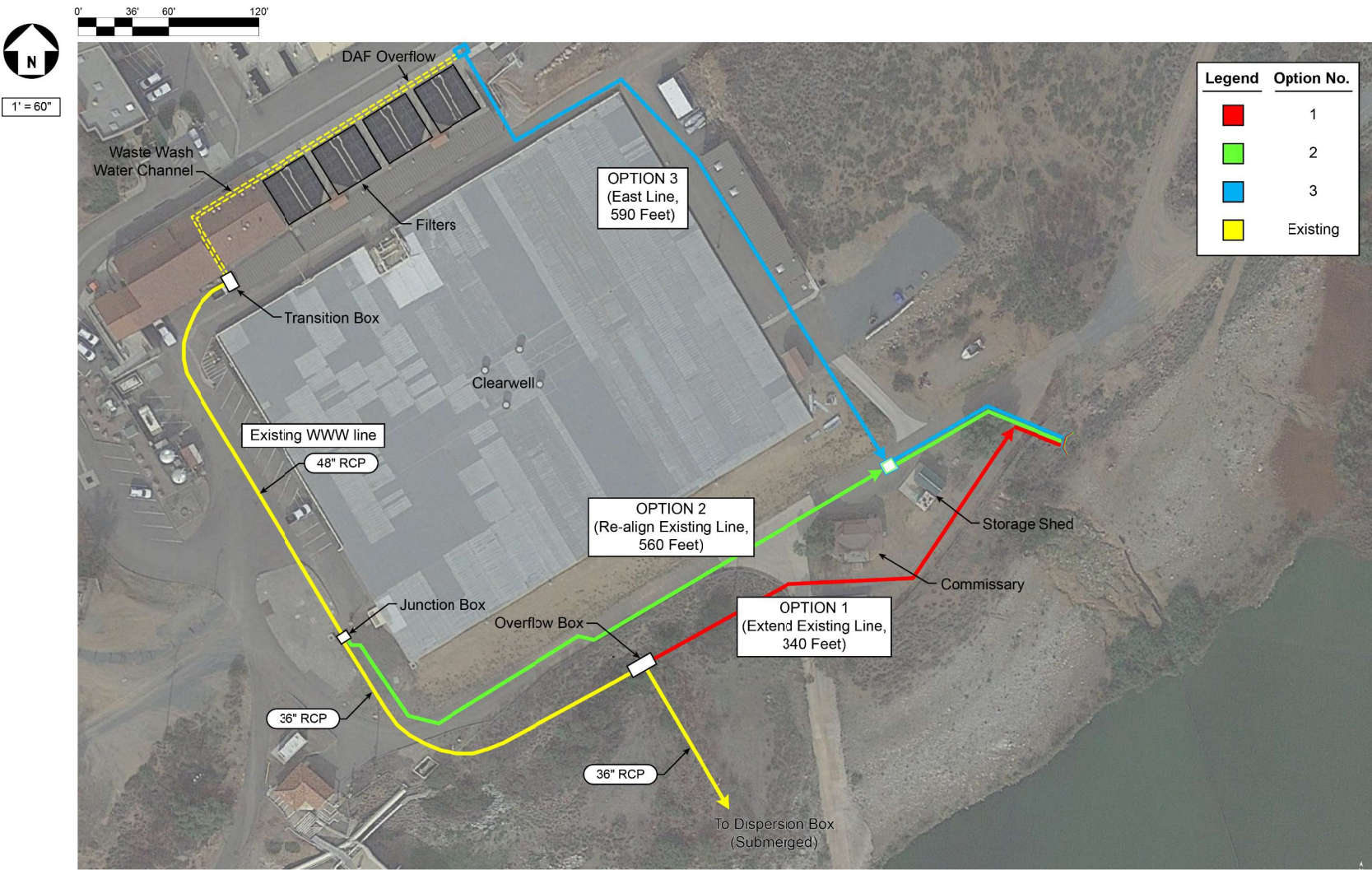


Figure 3.2 Filter Wash Water Options Overview

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3.1.2.1 Pipeline Plans and Profiles

All three options developed utilize a common discharge point located approximately 330 feet further away from the dam/intake structure. This point was selected as it provides easy access along the existing maintenance roads and is at a location already receiving discharge from other drain lines at the Perdue WTP. This area of the reservoir contains banks that are clear and uncrowded with vegetation minimizing concerns for additional environmental protection or mitigation measures.

The hydraulic model was used to plot the hydraulic grade line (or water surface profile) for each option. Figure 3.3 shows the pipe plan, profile, and hydraulic grade line for the existing FWW pipeline during a filter backwash event. Note that the 48-inch pipe at Station 1+00 is slightly submerged and flowing under submerged/pressure conditions. Under submerged conditions, there is more headloss generated (i.e., higher water surface) as compared to open-channel flow. Thus, when flows are even higher (e.g., "Filter Dump"), the headlosses increase to the point that the water surface goes above the Transition Box, resulting in an overflow. Details of the hydraulic calculations are provided in Appendix A.

Figures 3.4, 3.5, and 3.6 show the pipe plan, profile and hydraulic grade line for Options 1, 2, and 3, respectively. Because Options 1 and 2 reused the 48-inch pipe between the Transition and Junction Boxes, there still is the potential issue of overflowing. If the Transition Box is covered, there will be a slight over pressurization of several feet. Option 3 replaces all the existing FWW pipeline by connecting to the existing FWW channel on the east side of the filters. As such, the line has been sized and sloped to accommodate higher flows and remain as open-channel flow.

3.1.3 Coordination with Future Plant Expansion

The different pipeline alignments must take into consideration both existing yard piping and utilities as well as future planned work. Pipe alignments for each option depict horizontal bends to accommodate either significant changes in direction to stay within the roadway or to facilitate crossing other large diameter pipelines in the yard. Options 1 and 2 use much of the existing FWW pipeline and keep the alignment along the west and south side of the existing Clearwell. Option 3 uses all new piping.

3.1.3.1 Pipe Material Options

The existing FWW piping is reinforced concrete pipe (RCP) and is in very good condition. A list of possible piping alternates for the new FWW piping is provided in Table 3.4. The table compares pipe materials, availability of diameters and fittings, and material cost. Option 1 has been shown with RCP as the alignment has few utility crossings and the future tie-in can easily be accomplished at the existing Overflow Box. Options 2 and 3 are shown with steel pipe (AWWA C200) as there are more turns/fittings due to either subsurface utilities or surface features that need to be accommodated.

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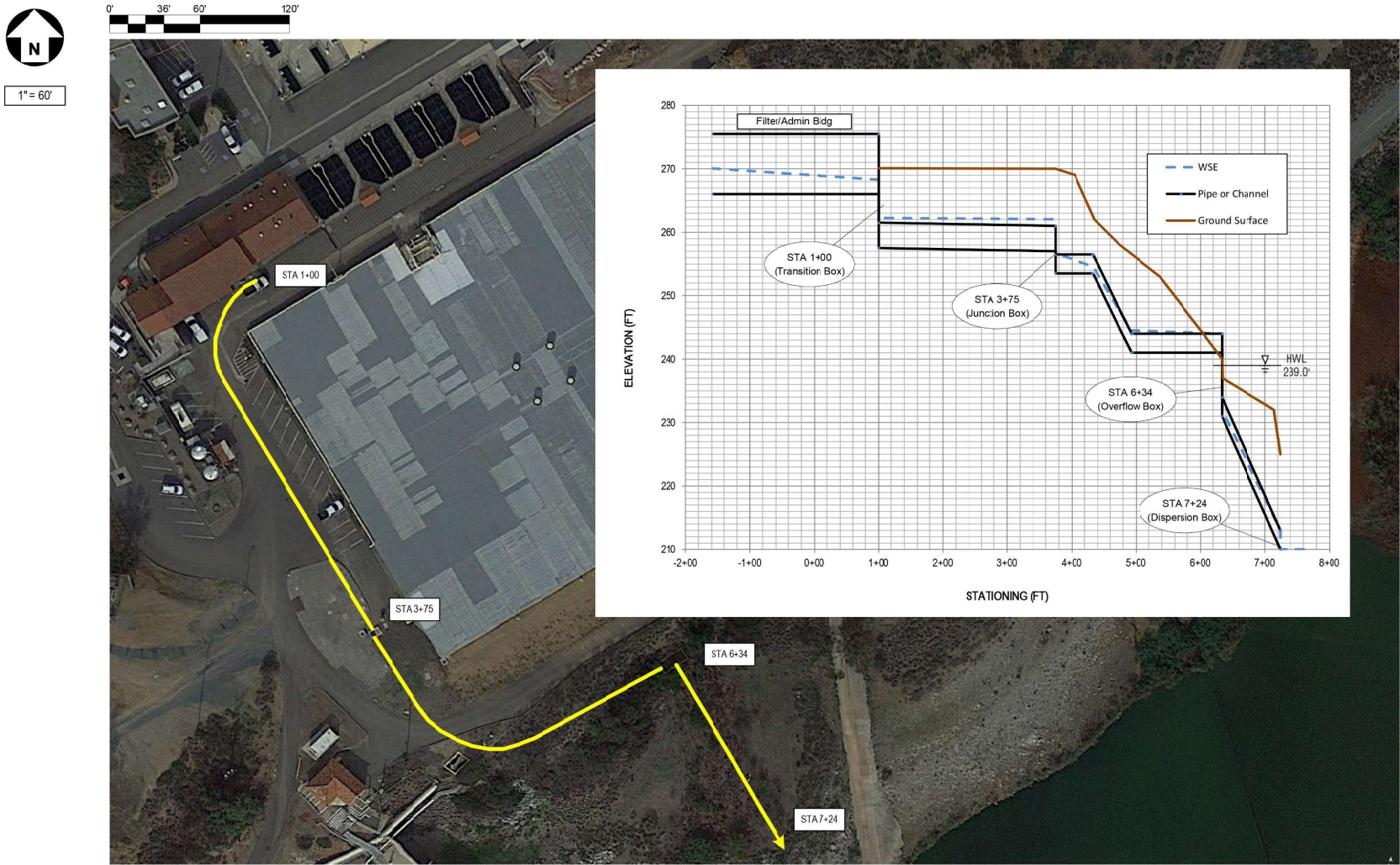


Figure 3.3 Existing FWW Plan and Profile at 38 mgd of Backwash Flow

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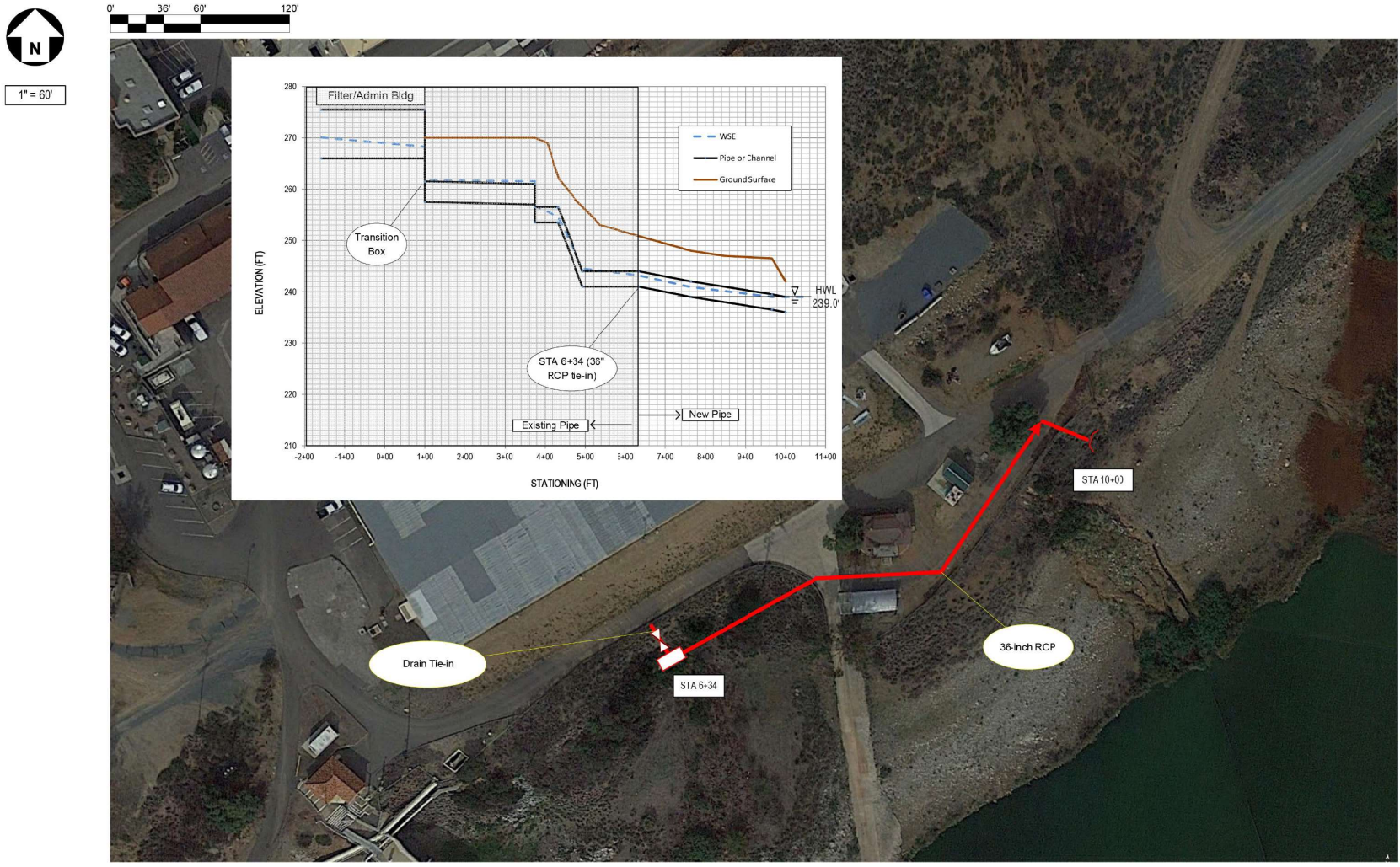


Figure 3.4 FWW Option 1 Plan and Profile

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Figure 3.5 FWW Option 2 Plan and Profile

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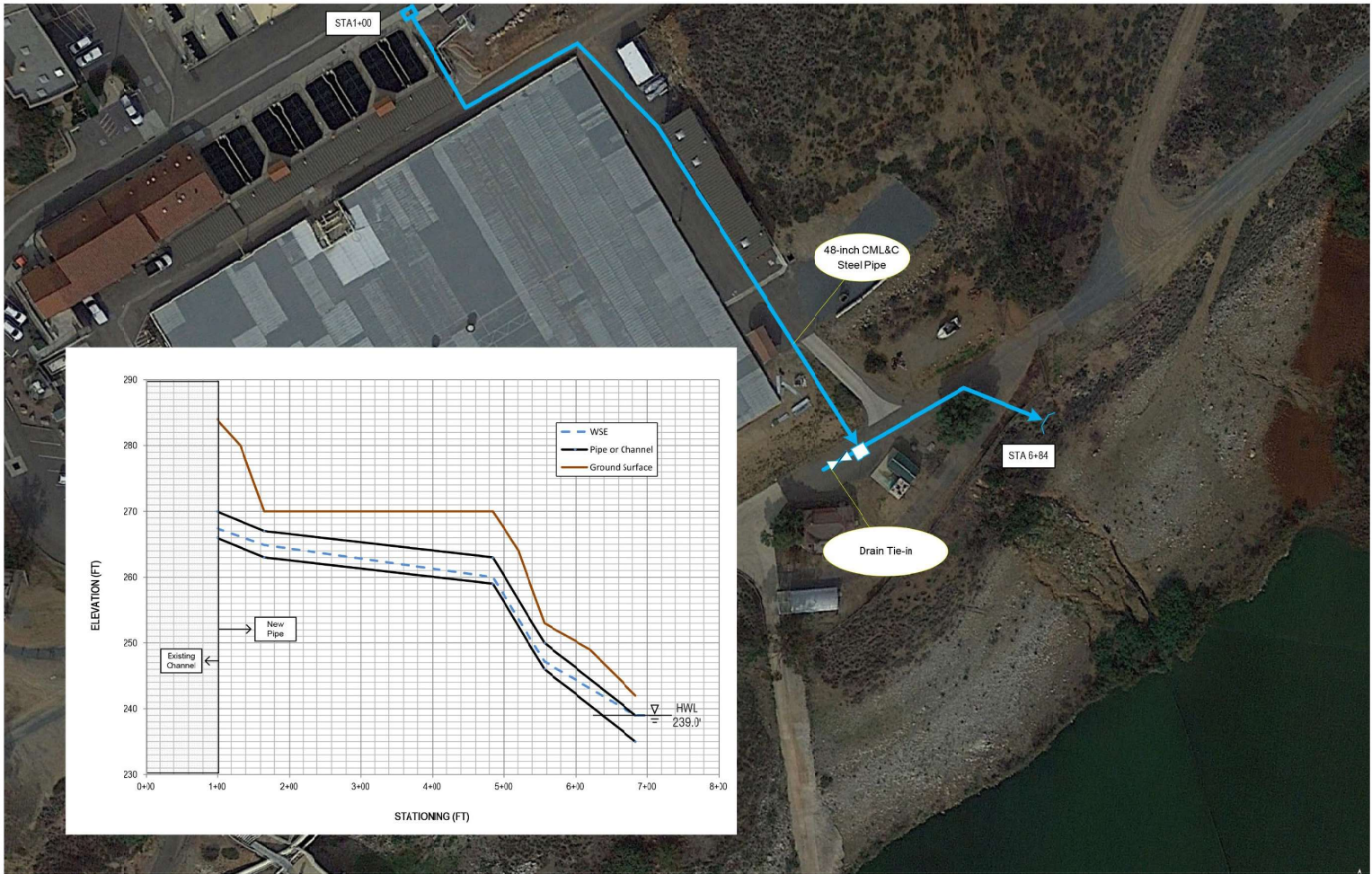


Figure 3.6 FWW Option 3 Plan and Profile

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Table 3.4 Pipe Material Alternatives

Pipe Material	Standard	Diameter Range	Bends Available	Material Cost (\$/ft for 36" Dia.)
Reinforced Concrete Pipe	ASTM C76	12" - 144"	Any angle can be fabricated.	\$80
Fiberglass Pipe	ASTM D3262	8" - 144"	Any angle can be fabricated.	\$180
PVC Solid Wall Pipe	ASTM F679	18" - 48"	11 ¹ / ₄ , 22 ¹ / ₂ , 45, 90 standard. Any angle can be fabricated.	\$110
PVC Profile Pipe	ASTM F794	4" - 48"	11 ¹ / ₄ , 22 ¹ / ₂ , 45, 90 standard. Any angle can be fabricated.	\$100
PVC Closed Profile Pipe	ASTM F1803	18" - 60"	Issues with large diameter fittings.	\$100
HDPE Corrugated Pipe (smooth wall)	ASTM F2306	12" - 60"	11 ¹ / ₄ , 22 ¹ / ₂ , 30, 45, 90 standard. Any angle can be fabricated.	\$30
Polypropylene Triple Wall Pipe	ASTM F2764	30" - 60"	11 ¹ / ₄ , 22 ¹ / ₂ , 30, 45, 90 standard. Any angle can be fabricated.	\$40
Steel Pipe	AWWA C200	6" and greater	Any angle can be fabricated.	\$380

3.1.3.2 Civil Site Work Requirements

The discharge headwall or outlet will be the same for all options. It will consist of a cast-in-place concrete headwall with riprap for erosion protection. The pipe invert elevation at the discharge point will be 236 feet. High water level of Sweetwater Reservoir is at 239 feet. This will allow the Authority accessibility during most times of the year for maintenance or repair. From the outlet headwall down to low water level a grouted riprap drainage channel would be constructed to prevent erosion of the reservoir slope. Figure 3.7 shows a compilation typical for outlet headwalls, straight and winged, and grouted riprap channel.

Options 1 and 2 consists of pipe trenching along the west and/or southside of the clearwell. This would be similar to NCSB-3 outlet structure to Sweetwater Reservoir. Option 3 also includes significant excavation (i.e., 25 ft deep) and shoring on the east side of the filters. There is approximately 16 feet between the Filters and Blower Building further restricting construction in this area. This area also consists of rock which could further slowdown work productivity. Note that this portion of work with deep excavation and shoring represents about 60 feet of the total 590-ft long pipeline.



Figure 3.7 Typical Outlet Headwalls and Grouted Riprap Channel

Appendix E
SWRCB-DDW WS PERMIT



EDMUND G. BROWN JR.
GOVERNOR



MATTHEW RODRIGUEZ
SECRETARY FOR
ENVIRONMENTAL PROTECTION

State Water Resources Control Board
Division of Drinking Water

September 2, 2014

Scott McClelland
Director of Water Quality
Sweetwater Authority
P.O. Box 2328
Chula Vista, CA 91912

Dear Mr. McClelland:

**SWEETWATER AUTHORITY, SYSTEM NO. 3710025,
PERDUE OPERATING REQUIREMENTS FOR INCREASED INACTIVATION**

On July 6, 2011, the Division issued a letter to Sweetwater Authority with operating requirements for the Perdue Water Treatment Plant. The letter included the following requirement:

28. Sweetwater Authority shall submit a monthly report, signed by a person directly responsible for plant operation, on the operation of the Perdue Water Treatment Plant by the tenth day of the following month that includes the following:

[...]

c. Disinfection monitoring results including:

i. Contact time calculations to show that a minimum of 0.5 log of Giardia lamblia cysts and 2-log virus inactivation has been achieved through disinfection for each day that the plant was operated. The lowest disinfectant residual, lowest water temperature, lowest clearwell level, highest pH and highest flow rate shall be used for these calculations. Alternatively the system may calculate CT continuously through its SCADA system and report the lowest CT per day.

When the coliform levels at the plant influent exceed the levels in the table below, Sweetwater Authority shall provide the corresponding additional disinfection inactivation credit. As Sweetwater Authority collects coliform samples on a weekly basis from the plant intake and analyzes them using the membrane filtration method, the system shall use the most current sample result to determine the

FELICIA MARCUS, CHAIR | THOMAS HOWARD, EXECUTIVE DIRECTOR

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level of additional disinfection required (if any). Daily samples collected and analyzed with Colilert shall not be used to determine increased inactivation requirements.

Coliform (MPN/100 mL)	Required Log Removal through Disinfection	
	Giardia cysts	Viruses
<1000	0.5	2
>1000 – 10,000	1.5	3
>10,000 – 100,000	2.5	4

As an alternative to total coliforms, Sweetwater Authority may submit a proposal to use fecal or E. Coli as a trigger for increased inactivation. Any changes to increased inactivation triggers shall receive CDPH approval prior to implementation.

In October 2013, Sweetwater Authority and the Division came to an agreement that due to the changes in San Diego County Water Authority (SDCWA) raw source water by the addition of Lake Hodges water, Sweetwater Authority would use E. Coli as a trigger instead of total coliform whenever using 100% SDCWA raw water. On August 25, 2014, the Division and Sweetwater agreed to change the requirements for increased inactivation when using a blend of the two sources, as the system is not able to collect a combined blend sample. Sweetwater agreed to use whichever log inactivation is greater when using both sources. For example, if a total coliform sample result from Sweetwater Reservoir triggered one additional log of inactivation but no increased inactivation were required for SDCWA water, the system would operate using one log of additional inactivation. Therefore, **effective November 1, 2014**, Provision #28c is revised to:

28. Sweetwater Authority shall submit a monthly report, signed by a person directly responsible for plant operation, on the operation of the Perdue Water Treatment Plant by the tenth day of the following month that includes the following:

[...]

c. Disinfection monitoring results including:

- i. Contact time calculations to show that a minimum of 0.5 log of Giardia lamblia cysts and 2-log virus inactivation has been achieved through disinfection for each day that the plant was operated. The lowest disinfectant residual, lowest water temperature, lowest clearwell level, highest pH and highest flow rate shall be used for these calculations. Alternatively the system may calculate CT continuously through its SCADA system and report the lowest CT per day.

When the coliform levels at the plant influent when using Sweetwater Reservoir water only exceed the levels in the table below, Sweetwater Authority shall provide the corresponding additional disinfection inactivation credit.

Coliform (MPN/100 mL)	Required Log Removal through Disinfection	
	Giardia cysts	Viruses
<1000	0.5	2
>1000 – 10,000	1.5	3
>10,000 – 100,000	2.5	4

When the E Coli levels at the plant influent when using SDCWA water only exceed the levels in the table below, Sweetwater Authority shall provide the corresponding additional disinfection inactivation credit.

E. Coli (MPN/100 mL)	Required Log Removal through Disinfection	
	Giardia cysts	Viruses
<20	0.5	2
>20-39	1	2.5
>40-99	1.5	3
>100-199	2	3.5
>200	2.5	4

If Sweetwater Authority is using a blend of Sweetwater Reservoir and SDCWA water, the increased inactivation shall be determined for each source based on the separate raw weekly samples and the higher additional log inactivation shall be provided.

As Sweetwater Authority collects coliform samples on a weekly basis from the plant intake and analyzes them using the membrane filtration method, the system shall use the most current sample result to determine the level of additional disinfection required (if any). Daily samples collected and analyzed with Colilert shall not be used to determine increased inactivation requirements.

The revision to requirement 28c for E. Coli based increased inactivation is based on the following calculations:

Giardia Inactivation Requirements

Source E. Coli Levels (MPN/100 mL)	Increased Log Reduction Required	Total Log Reduction Required	Filtration: Log Removal Credit	Disinfection: Log Inactivation Required
<20	0	3	2.5 (conventional)	0.5
>20-39	0.5	3.5		1
>40-99	1	4		1.5
>100-199	1.5	4.5		2
>200	2	5		2.5

Virus Inactivation Requirements

Source E. Coli Levels (MPN/100 mL)	Increased Log Reduction Required	Total Log Reduction Required	Filtration: Log Removal Credit	Disinfection: Log Inactivation Required
<20	0	4	2 (conventional)	2
>20-39	0.5	4.5		2.5
>40-99	1	5		3
>100-199	1.5	5.5		3.5
>200	2	6		4


Sweetwater is currently certified for the use of membrane filtration for total coliform and fecal coliform, but is in the process of changing their approval to total coliform and E. Coli by the Environmental Lab Accreditation Program. In the interim, the use of fecal coliform in lieu of E. Coli for triggering increased inactivation using SDCWA water is acceptable as fecal coliform results are theoretically equal to or greater than E. Coli results and thus more conservative.

A review of Sweetwater's raw bacteriological data from January 2013 through July 2014 shows that if the E. Coli trigger had been in effect instead of the total coliform trigger for the SDCWA raw water source, the use of SDCWA raw water would have never resulted in increased inactivation. During this same time period, the use of total coliform as a trigger resulted in increased inactivation in 1% of samples from the SDCWA Aqueduct. Sweetwater must revise its CT monthly reporting form in accordance with this letter.

Please submit a revised Operations Plan to include the use of E. Coli as a trigger for increased inactivation by **October 31, 2014**.

If you have any questions regarding this letter, please contact myself or Erica Wolski (619) 525-4772.

Sincerely,



Sean Sterchi, P.E.
District Engineer

cc: Mark McPherson, Chief, Land and Water Quality Division, County of San Diego, Department of Environmental Health

Appendix F
INTAKE TOWER DRAWINGS

Detail of Sweetwater Dam Plate 3

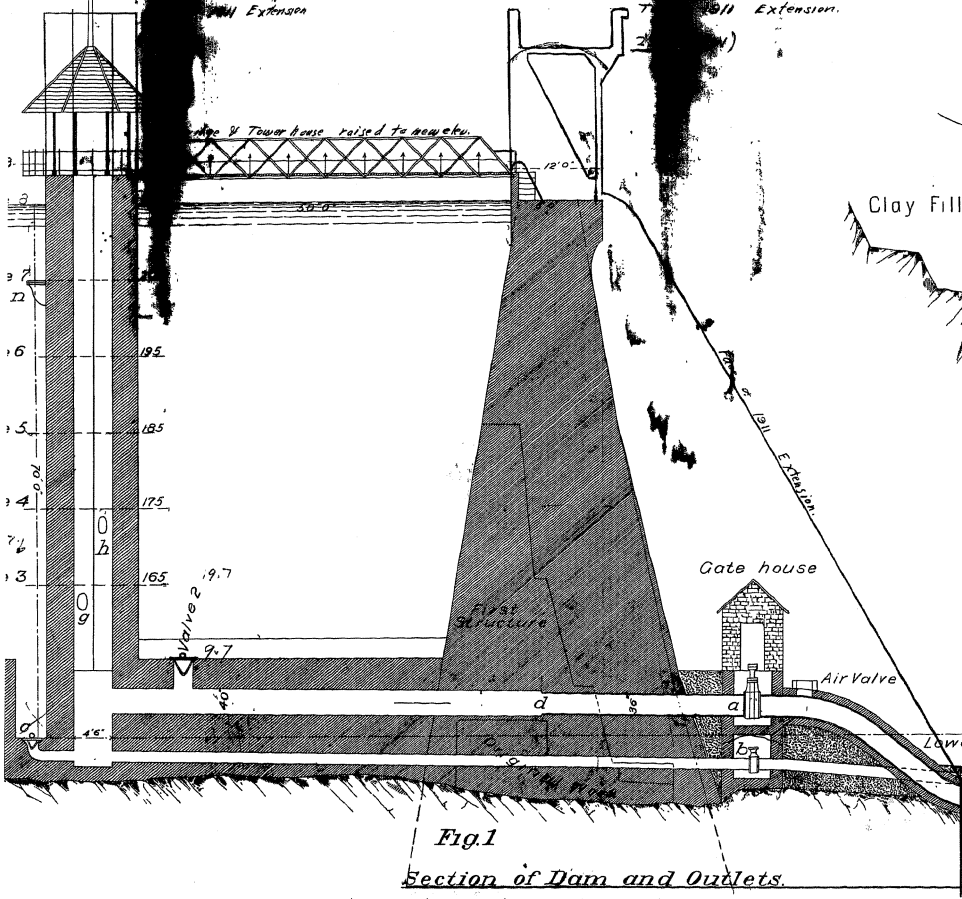
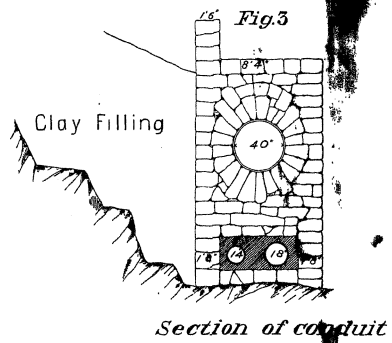
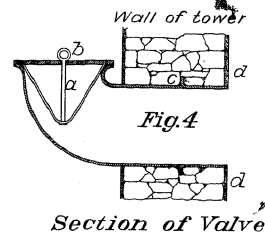


Fig. 1
Section of Dam and Outlets.



Section of conduit



Section of Valve

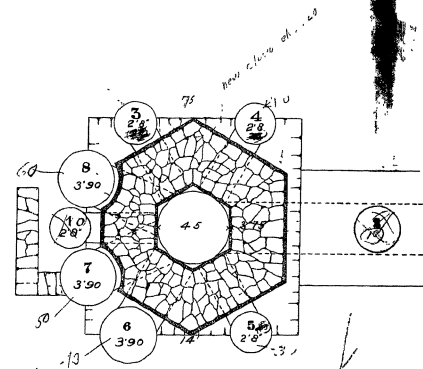
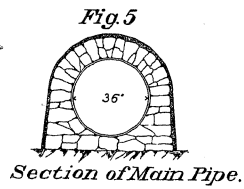
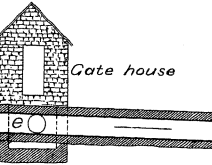


Fig. 2
Plan of Valves



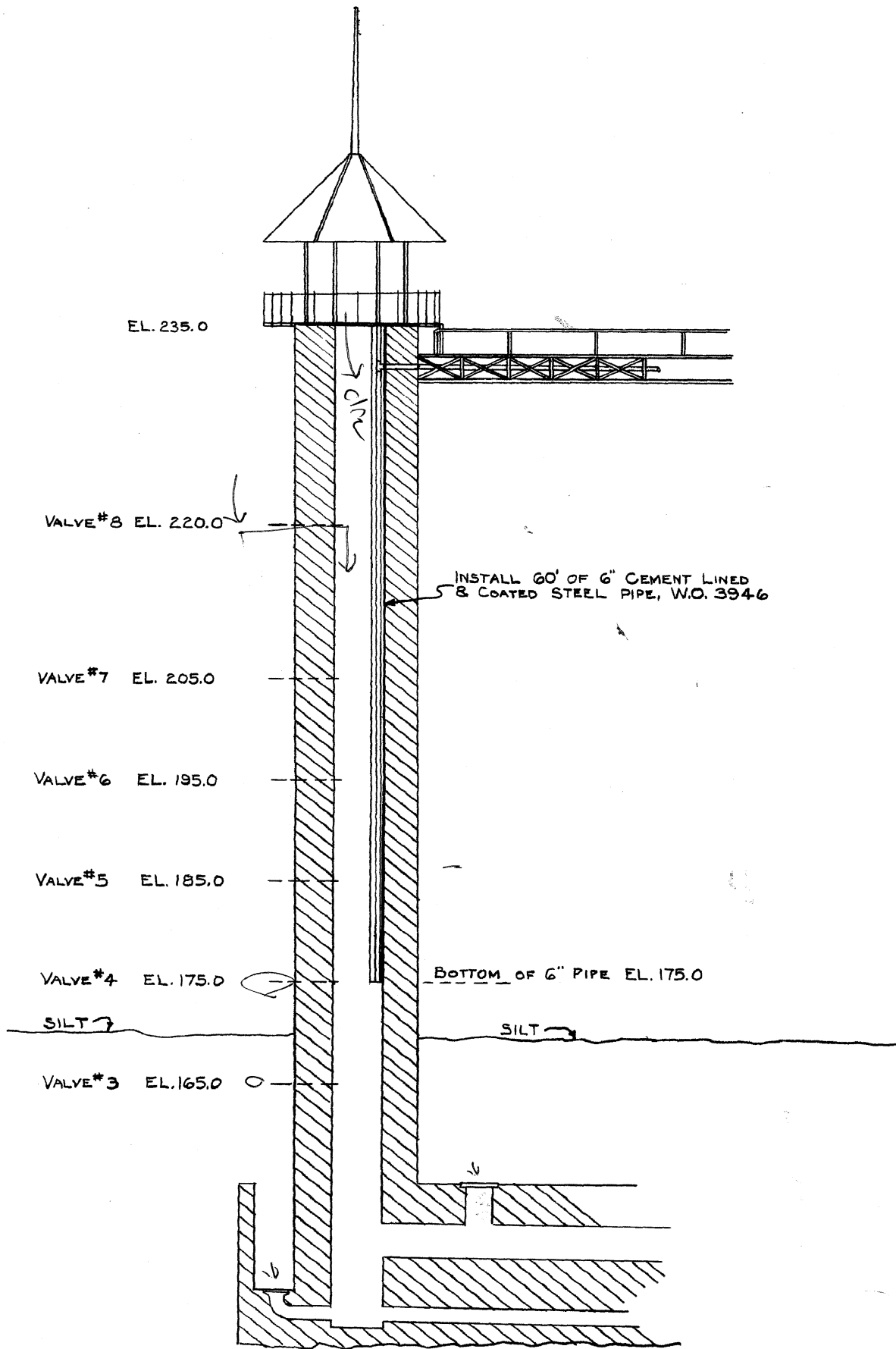
Section of Main Pipe.



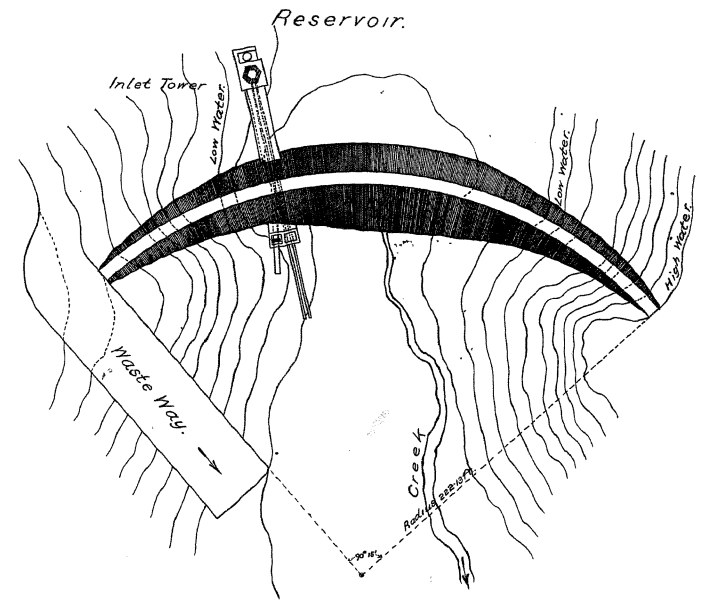
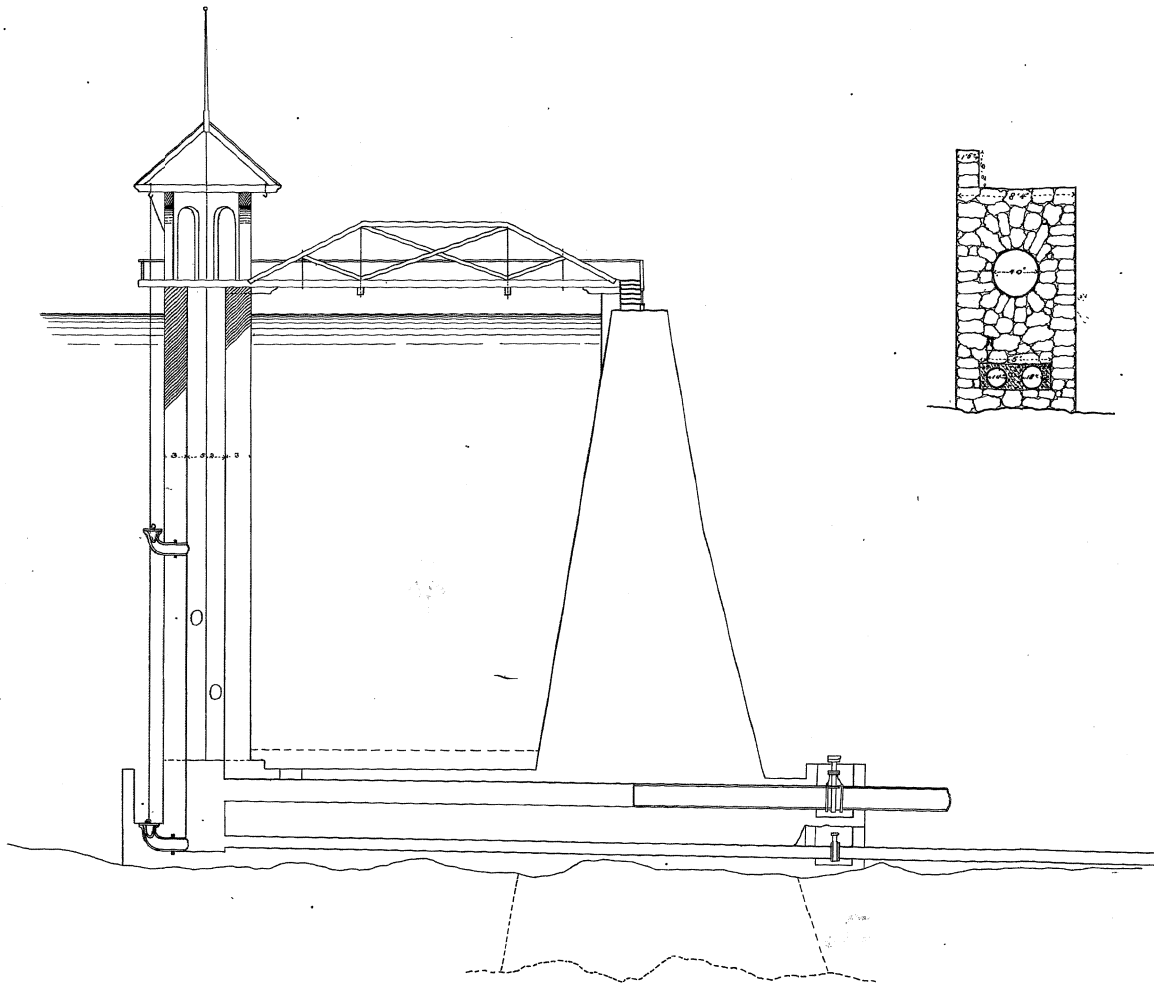
Drawn by R.H. Stretch, June, 1888
242.22

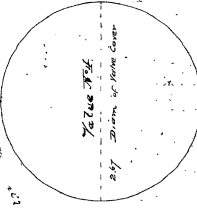
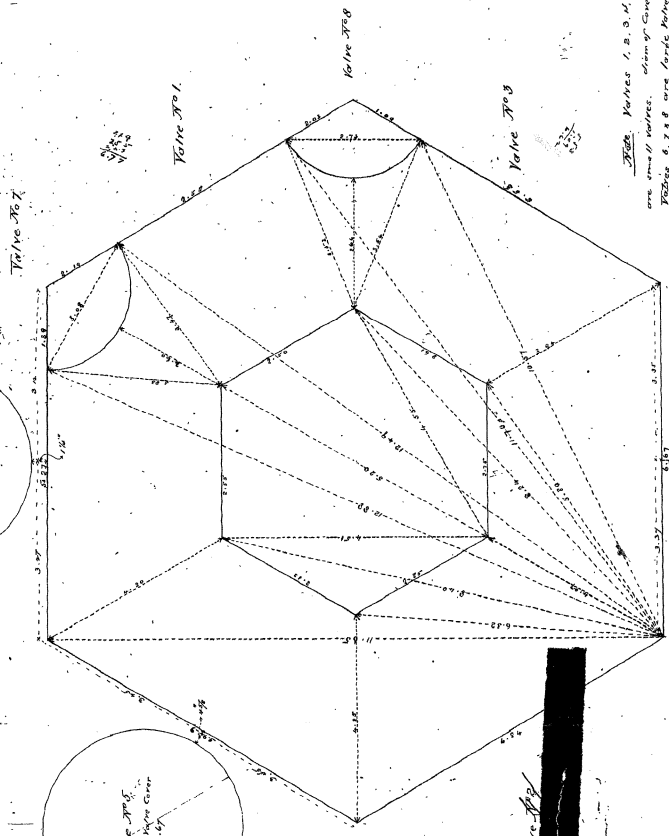
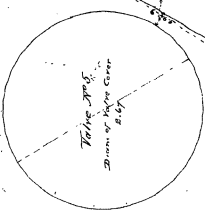
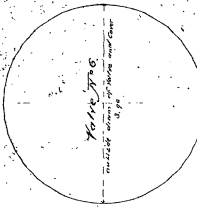
B-19

ROCKET 3 - FIVEK 1



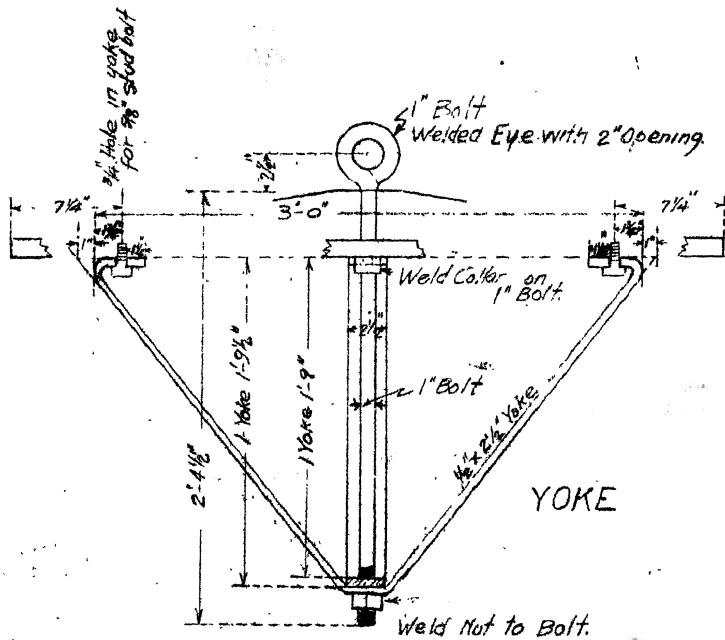
SECTION THROUGH OUTLET TOWER
SCALE: 1"=10'



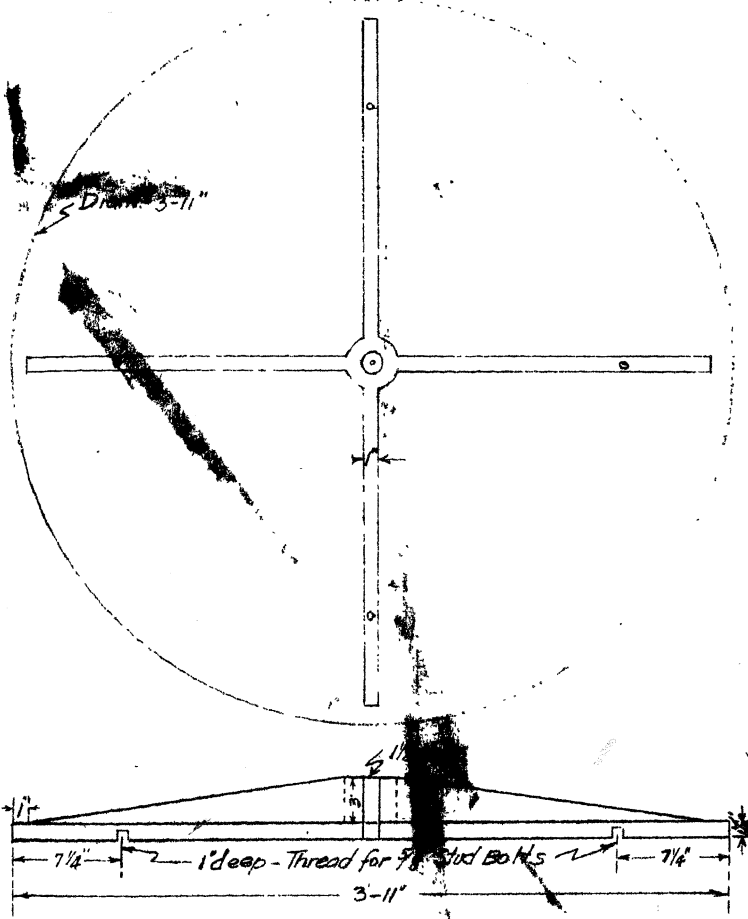


Valve No. 2
Diam. of Valve Cover 1.57
Diam. of Valve 1.25

Ball Valves 1, 2, 3, 4, 5
are small valves. diam. of cover 2 1/2
diam. of ball 1 3/8 diam. of valve stem
of cover 3/8.



YOKE



CASTING

CALIFORNIA WATER & TELEPHONE CO.
SAN DIEGO BAY DIVISION

SAUCER VALVE

Drawn by E.R.R.	Date Dec. 18, 1946
Checked " - - - -"	Scale $1\frac{1}{2}'' = 1'$

MAP. No. B-156