Water Reclamation Plant Facilities Assessment and Master Plan

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Hazen

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1. BACKGROUND AND APPROACH SUMMARY

1.1 Facilities Master Plan Goals

As good stewards of the City of San Bernardino's Water Reclamation Plant (SBWRP), the San Bernardino Municipal Water Department (Department) completed a Facilities Assessment and Master Plan that serves as a roadmap for implementation of short-term and long-term projects over the 2020 to 2040 planning horizon. The Master Plan used an analytical approach for optimizing operations, performance, and needed improvements at the SBWRP to develop a schedule for capital improvement projects to inform rate payer studies.

The SBWRP is a regional secondary wastewater treatment facility that was constructed in 1958 at what is now 399 Chandler Place, San Bernardino, California. Originally constructed as an activated sludge system to handle 13 million gallons per day (mgd), the SBWRP has gone through several expansions and modifications for its current permitted capacity of 33 mgd. Like many treatment plants, the SBWRP is facing challenges from aging infrastructure, lower flows due to conservation, higher pollutant concentrations, increased energy costs, and more stringent water and air regulatory requirements. Challenges will be amplified due to the East Valley Water District's (EVWD) Sterling Natural Resource Center (SNRC) project that will reduce flow to the SBWRP by up to 6 mgd in a few years, which will both impact the SBWRP treatment processes and constrain the Department financially.

The Facilities Master Plan is a roadmap that guides the Department to financial sustainability by navigating near-term challenges while maximizing flexibility for the future to adapt to changes, including the anticipated reduction in flows and loads. The Facilities Master Plan identifies ways to:

- Increase the level of confidence in decision making by developing a complete and functional asset inventory and determining the remaining useful life and replacement cost associated with each asset.
- Maximize the value of existing assets through understanding the condition and remaining useful life and timing of life cycle investments to maintain reliable wastewater treatment capacity and quality while optimizing operational efforts and capital investments.
- Improve the quality of asset data, data collection, analytical practices and decision-making tools.
- Provide the appropriate asset data and hierarchy to serve as a foundation for the existing or new Computerized Maintenance Management System (CMMS).
- Provide condition-based planning that focuses the rehabilitation and replacement projects on the highest risk assets that allows for gradual renewal of assets.

1.2 Facilities Master Plan Approach

The traditional approach to master planning provides a static "snapshot" in time focused on a single path forward which can lack a precise, systematic, and analytical approach. The Department chose to mitigate these common issues and move towards a more defensible, reliable, and dynamic process by integrating a data-driven approach including:

- Complete asset inventory
- Risk assessment
- Focused condition assessment

- Remaining useful life assessment
- Asset valuation
- Interactive asset management dashboards

The master planning process used the analytical data to identify projects that increase reliability and optimize plant performance. The Facilities Master Plan synthesizes the results of the condition assessments with future impacts from projects, planning assumptions, and proposed changes in regulatory compliance to identify opportunities to optimize and increase efficiency and reduce operational costs. By combining analytical data with planning assumptions and goals, capital improvement projects were developed for the short-term within the next 5 years and the long-term over the 2020 to 2040 planning horizon. The resultant recommended capital improvement projects will be used to inform future rate studies.

Specifically, the Facilities Master Plan addresses the following projects which are expected to have major impacts on SBWRP operations over the short-term:

- Digester Gas Beneficial Use (DGBU) program and resultant projects (see Section 7.3)
- Clean Water Factory (CWF) recycled water project (see Section 5.1.3)
- Southern California Edison (SCE) Primary Metering Project
- EVWD SNRC, resulting in a 6 mgd reduction of influent flow and $8 million reduction in revenue

The analyses that provide the foundation of the Facilities Master Plan are illustrated in Figure 1-1.

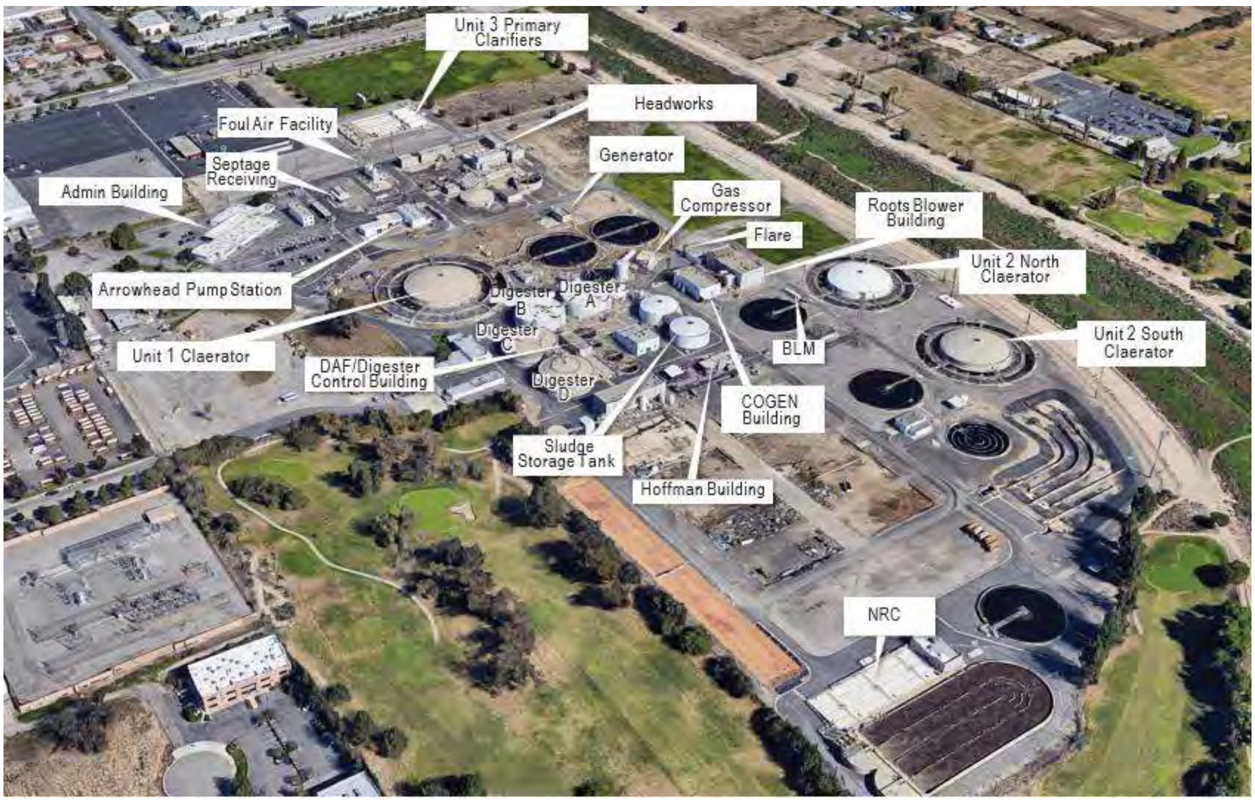
Figure 1-1: Facilities Master Plan Development Approach

The Facilities Master Plan also includes an assessment of two important water quality parameters: total dissolved solids (TDS) and total inorganic nitrogen (TIN). TDS and TIN levels are increasing at the SBWRP primarily from changes in source water quality and decreasing per capita water usage as a result of water conservation. TDS and TIN concentrations are important to evaluate because elevated concentrations have the potential to impact wastewater treatment processes, infrastructure integrity, the use of recycled water, and the ability to practice environmental discharge. TDS and TIN concentrations are projected for the 2020 to 2040 planning horizon to support the Department's planning and response to changing wastewater quality. The TDS and TIN Assessment Technical Memorandum (Hazen and Sawyer, 2020) is attached as Appendix A.

1.3 Facility Description

The SBWRP is located at 399 Chandler Place northeast of Interstate 215 (I-215) and I-10 at the confluence of East Twin Creek and the Santa Ana River. The SBWRP is situated on a site of approximately 60 acres that is bordered by Orange Show Road to the north; East Twin Creek to the east; the former San Bernardino Golf Club to the south/southwest; and developed industrial parcels to the west/northwest. Neighboring businesses include Durham School Bus Services and San Bernardino Animal Control. An aerial view of the existing facilities is shown on Figure 1-2 (below) and Exhibit 1 (attached).

Figure 1-2: SBWRP Facilities Aerial View Looking Northeast



1.4 Plant Overview and Upgrade History

The SBWRP was originally constructed in 1958 to provide secondary treatment of wastewater prior to discharge to the Santa Ana River. The original plant consisted of a single primary clarifier surrounded by aeration basins divided into 10 cells, and a secondary clarifier. This system, called "Unit 1 Claerator," had a capacity of 13 mgd. The original 1958 plant had two anaerobic digesters (Digester A and Digester B). To address hydraulic capacity issues, a second secondary clarifier was added to Unit 1 in 1987.

In 1968, the SBWRP was expanded by an additional 15 mgd for a total rated secondary treatment capacity of 28 mgd by constructing two more units, designated Units 2 North and South, and a 3 mgd tertiary treatment facility. Unit 2 North and Unit 2 South are like Unit 1, but smaller, each adding 7.5 mgd of treatment capacity.

Several solids handling projects in the 1980s added dissolved air floatation (DAF) thickeners, two more digesters and belt filter presses. Odor handling facilities and headworks facilities were also added in the 1980s.

The Primary Hydraulic Reliability Project was completed in the 1990s and included the Unit 3 Primary Clarifier. Two centrifuges were installed in 1997 and later replaced in 2013. To provide better treatment of the high ammonia recycle from the centrifuges, the Nitrogen Removal Carousel (NRC) was added, which consisted of a pre-anoxic tank followed by an oxidation ditch. Unit 1 was rehabilitated in 2014/2015.

The permitted treatment capacity of the SBWRP is currently 33 mgd; however, nutrient removal constraints are limiting capacity (see Section 8.5).

1.5 Existing Facilities

The SBWRP consists of five major systems: 1) preliminary processes; 2) primary treatment; 3) secondary treatment; 4) solids treatment; and 5) discharge. Raw influent wastewater passes through the headworks/preliminary processes, and then is split between Unit 1, Unit 2N, and Unit 2S primary clarifiers and aeration basin units as well as the NRC. The secondary treatment process includes concentric ring step-feed aeration basins, followed by secondary clarifiers.

The solid treatment stream includes managing both primary sludge and waste activated sludge (WAS). WAS is thickened through DAF thickeners and then pumped along with primary sludge to the anaerobic digesters. Digested sludge flows by gravity to storage tanks prior to dewatering by centrifuge units or belt presses, and then hauled off-site for composting.

The SBWRP does not disinfect secondary effluent. The secondary effluent is filtered and disinfected at the offsite Rapid Infiltration and Extraction (RIX) facility in Colton (see Section 5.2.1) which is jointly owned with the City of Colton and exclusively operated by the Department.

The SBWRP produces digester gas (DG) from the anaerobic digestion process and currently uses the gas beneficially as a fuel source for internal combustion engines, boilers, and cogeneration.

The major systems and components are summarized in Table 1-1 and a process flow diagram of the major systems is shown on Exhibit 2 attached.

Table 1-1: Major Systems and Components

System	Sub-system	Component
Preliminary Processes	Influent Lift Stations	Arrowhead Lift Station
		E Street Lift Station
		East Influent Lift Station
	Septage and Brine Receiving	Static Grinder Room
	Preliminary Treatment	Bar Screen
		Grit Chambers
		Screening Compaction / Grit Classifiers
Primary Treatment	Primary Clarifiers	Clarifier Tanks
		Primary Sludge Pump
		Scum Pump
Secondary Treatment	Secondary Aeration Basins	Basins
	Secondary Aeration System	Blower System
	Nitrogen Carousel	Aeration Basins
		Clarifiers
		RAS/WAS Pumping

System	Sub-system	Component
	Secondary Pumping	RAS Pumps
		WAS Pumps
	Secondary Clarifiers	Clarifier Tanks
Solids Treatment	Dissolved Air Flotation Thickener	Thickened Sludge Pumps
		DAFT Tanks
	Anaerobic Digesters	Digester Recirculation Pumps
		Digester Mixing Pumps
		Digester Heating System
		Digester Gas Collection System
	Digested Sludge Storage	Storage Tanks
		Mixing Pumps
	Dewatering	Belt Press Feed Pumps
		Belt Press
		Recycle Pumps
		Centrifuge Feed Pump
		Centrifuge
		Polymer System
	Truck Loading, Conveyors and Storage Silos	Silo
		Truck Loading Bin
		Conveyor and Belt
Discharge	Gravity Conveyance to RIX	Flow Metering and Sampling Station
	Chlorine Contact Basin	Basins

1.5.1 Preliminary Processes

The sources of wastewater for the SBMWD are as follows:

- SBMWD service area comprising most of the City of San Bernardino and some unincorporated areas in San Bernardino County, served by the three terminal lift stations (current average dry weather flow (ADWF) is approximately 13.4 mgd)
- EVWD service area comprising the City of Highland and the remaining portions of the City of San Bernardino, served by the East Influent Lift Station (current ADWF is approximately 6.0 mgd)
- City of Loma Linda, served by the E Street Lift Station (current ADWF is approximately 2.1 mgd)
- Former headworks near the historic Valley Truck Farm east of Twin Creek (relatively low flow).

Raw wastewater is conveyed to the SBWRP via two force mains and one gravity sewer that are metered independently. A fourth gravity sewer from the historic Valley Truck Farm area is not metered but is relatively low flow and is counted as part of the SBWRP drain flow. Wastewater that enters by gravity flow must be pumped via the East Influent Lift Station screw pumps to an influent channel where it combines with the other two influent lines. The combined influent is sampled, screened and de-gritted.

1.5.1.1 Influent Lift Stations

Wastewater from the west side of the service area is pumped by the Arrowhead Lift Station, which receives raw sewage via a 54-inch interceptor from the west side of the service area, recycled-plant drain flows, gravity line from the historic headworks/Valley Truck Farm area, and septage from the receiving station. The Arrowhead Lift Station consists of five variable speed pumps, one electric and four engine-driven pumps (two fueled by digester gas and two fueled by natural gas). The gas-driven engines are subject to South Coast Air Quality Management District (SCAQMD) Rule 1110.2 (see Section 7.3).

The electrically driven pump was installed in 2015 and has a 200 horsepower (hp) motor controlled with a variable frequency drive (VFD). The speed of each engine is controlled by a miltronics level sensor that allows the pumps to run at a maximum speed of 900 rpm. Under normal operation and headloss conditions, the approximate output capacity for each pump running alone is 13,500 gpm at 40 feet of head. The average daily flow through this lift station when its hydraulic capacity is reached is 31 mgd (based on a 2.0 peaking factor).

The E Street Lift Station pumps wastewater from the south side of the service area and from the Satellite Service Area of the City of Loma Linda. The E Street Lift Station houses three non-clog centrifugal pumps and the lift station control system determines the number of on-line pumps based on the liquid level in the wet well. Pumping capacity is adjusted using VFDs to accommodate the varying influent wastewater flow.

Both lift stations convey wastewater to the combined influent channel where it mixes with flows from the East Influent Lift Station, which conveys flow from the East Trunk Sewer. Influent lift station design information is summarized in Table 1-2.

Table 1-2: Influent Lift Station Design Information

Component	Equipment Description	Design Flow
Arrowhead Lift Station	Quantity: 5 Type: Variable Speed: 2 digester gas-driven, 2 natural gas-driven, 1 electric	Capacity: 13,500 gpm (ea.)
E Street Lift Station	Quantity: 3 (2 Duty) Type: Non-clog Centrifugal with VFDs	Capacity: 4,500 gpm (ea.)
East Influent Lift Station	Quantity: 3 screw pumps 2 + 1 standby (2 Future) Size: 66-inch	Each at 12,500 gpm 18 mgd (Average) 24 mgd (Peak Day) 36 mgd (Peak Hour)

1.5.1.2 East Hydraulic Structure

Wastewater collected by gravity from the eastern service area (eastern part of SBMWD Service Area and all of EVWD Service Area) flows through the East Hydraulic Structure via two 36-inch pipes where it combines to a 54-inch interceptor and flows to the East Influent Junction Box. The water surface elevation (WSE) in the East Influent Junction Box is controlled by WSE in the downstream influent screw pump influent channel. The East Influent Lift Station screw pumps lift the wastewater to the combined influent channel and headworks.

1.5.1.3 Influent Metering Station

The influent metering structure measures all influent wastewater entering the SBWRP from the Arrowhead Lift Station, E Street Lift Station, and East Hydraulic Structure except for the drain line from the historic Valley Truck Farm area mentioned in Section 1.5.1. Influent flow monitoring is required by the SWRCB. Flow measurements are used to determine chemical feeds and plant process pumping rates and are recorded for statistical and historical plant data.

1.5.1.4 Septage Receiving

Septage is hauled by permitted private waste haulers in trucks to the SBWRP and unloaded at the septage receiving station. Under normal conditions, septage flows through a motorized plug valve, a grinder, and another plug valve to a meter. After metering, the septage flows to the Arrowhead Lift Station influent pit where it intermixes with raw wastewater and is pumped to preliminary processes. The receiving station samples and monitors the septage to determine whether there are excessive amounts of grease or other harmful substances which may upset plant operations.

1.5.1.5 Bar Screens

Screening prevents large solids from entering the treatment process. The SBWRP utilizes three "climber-type" mechanically cleaned bar screens to provide influent screening and one manually cleaned bar screen, which is used for emergency bypass flow. The bar screens consist of vertically inclined stainless steel bars spaced at equal intervals across a channel through which raw influent wastewater flows. To prevent solids deposition, low pressure air is diffused into the influent wastewater in the bar screen inlet channel. The air lines are no longer in use. The bar screens are designed to meet design peak hour flow conditions with one unit out of service. Table 1-3 summarizes the bar screen design criteria.

Table 1-3: Bar Screen Design Information

Component	Equipment Description	Design Flow
Bar Screens	Quantity: 3 Mechanically Cleaned Climber-type Channel Width: 6 feet Clear Screen Velocity: 2.1 feet/sec. (Peak Day) 2.5 feet/sec. (Peak Hour)	90 mgd (Peak Hour flow with one unit out of service)
Emergency Bypass	Quantity: 1 Manually Cleaned Bar Screen Channel Width: 8 feet	N/A

1.5.1.6 Grit Removal

The grit removal system consists of aerated grit chambers with grit hoppers and grit slurry pumps to convey to the grit classifier and auger system, diffusers, and other ancillary system components located above the hopper. Screened wastewater enters each grit chamber through 48-inch by 60-inch openings equipped with a sluice gate for isolation. Four structurally identical grit chambers are available for removing grit from the wastewater. The degritted wastewater exits each grit chamber into the grit chamber collection channel through 84-inch by 48-inch bottom-opening sluice gates. Each grit chamber is dewatered through the grit slurry piping. Table 1-4 summarizes the grit removal system design criteria.

Table 1-4: Grit Removal Design Information

Component	Equipment Description	Design Flow
Grit Chambers	Quantity: 4 (3 + 1 Future) <u>Overflow Rate</u> Average: 17,900 gpd/sf	<u>Each Chamber</u> Average: 15 mgd Peak Day: 20 mgd

	Peak Day: 23,800 gpd/sf Peak Hour: 35,700 gpd/sf Air Supply (only Chambers 1 – 3) Maximum Air Flow: 5 cfm/LF of basin length	Peak Hour: 30 mgd
Grit Slurry Pumps	Number: 5 (3 + 2 standby) Type: Recessed Impeller	Hydraulic Capacity (ea.): 600 gpm Fixed Capacity: 1,800 gpm
Grit Wash/Bin Loading	Number of Bays: 2 (1 for grit bin + 1 for screenings compactor and bin) Overflow Rate: 12,000 gpd/sf Weir Overflow Rate: 200,000 gpd/ft Peak Hourly Grit Loading: 80 cf/hour Number: 2 (1 + 1 standby) Diameter: 16 inches Screenings Conveyors Number: 2 Type: 1 inclined sidewall, 1 flat Screenings Loading: 0.06 cy/mgd	Hydraulic Capacity (ea.): 3,600 gpm

1.5.2 Primary and Secondary Treatment

Primary and secondary treatment is accomplished by the four parallel treatment units: Unit 1, Units 2N and 2S, and NRC. Each of these units has its own independent return activated sludge (RAS) system, so from the point of view of process biology, the four units function as individual treatment trains.

1.5.2.1 Primary Clarifiers

In the circular clarifiers, Unit 1 and Unit 2, the wastewater generally enters in the middle and flows towards the outside edge. Settled sludge is pushed to a hopper that is in the middle of the tank bottom. Floating material is removed by a surface skimmer connected to the sludge collector. The flow enters Unit 1 primary clarifier through a 42-inch gravity line from the headworks splitter box and Unit 2 through a 48-inch line from the headworks splitter box via a diversion box which splits the flow to the north or south clarifier. Flow passes through the clarifier over weirs in radial troughs and is collected in a circular effluent trough. The original dual inboard discharge weirs were replaced at Unit 1 with single outboard discharge weirs. A circular baffle wall extending a few inches above the water surface forces the entering wastewater to go down before it continues towards the peripheral discharge weir to reduce the possibility of "short-circuiting." Back-up for the Unit 1 clarifier is provided by four rectangular clarifiers (Unit 3). Unit 3 primary effluent is directed to Unit 1 aeration system via PIPL. The Unit 3 clarifiers have not been used under normal operating conditions since 2015 but are currently being put back online so they can be rotated in and out of service with the Unit 1 primary clarifiers.

The estimated capacity is based on the surface overflow rate (SOR) as the critical hydraulic condition for treatment. Typical design SOR ranges from 600 to 1,000 gpd/ft^2 of surface area. The clarifier depth is determined by providing between 90 to 150 minutes of detention time for the total flow (including recycle streams) through the tank. Design criteria for the primary clarifiers is shown in Table 1-5.

Table 1-5: Primary Clarifier Design Information

Component	Equipment Description	Design Flow
Unit 1 Primary Clarifier	Quantity: 1 Diameter: 140 ft Side Water Depth: 10 ft Area: 15,400 ft^2 Volume: 183,000 ft^3 (1,370,000 gal) Overflow: 1,000 gals/day-ft^2 Detention time: 2.1 hours	Clarifier: 15.4 mgd Total Unit 1 Clarifiers: 15.4 mgd
Unit 2 Primary Clarifiers	Quantity: 2 Diameter: 120 ft Side Water Depth: 9 ft Area (each) 11,300 ft^2 Volume (each): 120,700 ft^3 (902,650 gallons) Overflow: 660 gal/day-ft^2 Detention Time: 2.9 hours	Each Clarifier: 7.5 mgd Total Unit 2 Clarifiers: 15 mgd
Unit 3 Primary Clarifiers (Back-up for Unit 1 Clarifier)	Quantity: 4 Type: Rectangular Side Water Depth: 10 ft Width: 26 ft Length: 162 ft Area (each): 4,413 ft^2 Volume (each): 297,000 gal Overflow Rate 850 gal/day-ft^2 Detention Time: 1.9 hours	Each Clarifier: 3.75 mgd Total Unit 3 Clarifiers: 15 mgd

1.5.2.2 Primary Sludge Pumping

Primary sludge pumping is operated to maintain thin underflow and short sludge blanket retention times (i.e. “thin-sludge pumping mode”) to prevent fermentation of settled solids and to increase clarifier efficiency. The primary sludge is normally withdrawn automatically by the primary sludge pumps on a timed cycle to allow for sludge thickening to approximately 5% solids. In addition, the pumps operate in conjunction with the sludge grinder, which runs with the pump. There is a bypass for the grinder system in case of failure.

The primary sludge pumps at Unit 1 and Unit 2 Sludge Pump Station are currently duplex, piston-type positive displacement pumps each driven by a 15 hp electric motor. Some have been switched to Seepex progressive cavity pumps (Unit 1 #2 and Unit 2 #1) and replacement of the remaining pumps has been budgeted for this fiscal year. Floatable materials, such as shredded plastic and trash from the bar screen and other light material such as fats and grease, are usually called scum. Two pumps recirculate and convey the contents of the primary scum wet well directly to the digesters via the primary sludge pump discharge line. Table 1-6 summarizes primary sludge and scum pump design criteria.

Table 1-6: Primary Sludge and Scum Pumping Design Information

Component	Equipment Description	Design Flow
Primary Sludge Pumps and Scum Pumps – Unit 1	Primary Sludge Pumps Quantity: 2 Type: Duplex Plunger (#1); Seepex Progressive Cavity (#2) Capacity (ea.): 90-250 gpm at 60 TDH Motor (ea.): 15 hp Scum Pumps Quantity: 2 Type: Duplex Plunger Capacity (ea.): 90 gpm at 60 TDH Motor (ea.): 5 hp	Total Capacity: 500 gpm Total Capacity: 180 gpm
Primary Sludge Pumps and Scum Pumps – Unit 2	Primary Sludge Pumps Quantity: 2 Type: Seepex Progressive Cavity (#1) and Duplex Plunger (#2) Capacity (ea.): 90-250 gpm at 60 TDH Motor (ea.): 15 hp, 50 rpm Scum Pumps Quantity: 1 Type: Simplex Piston-type Positive Displacement Capacity (ea.): 75-130 gpm at 60 TDH Motor (ea.): 15 hp, 50 rpm Scum Grinder Quantity: 1 Capacity (ea.): 3-160 gpm Motor (ea.): 2 hp	Total Capacity: 500 gpm Total Capacity: 130 gpm Total Capacity: 320 gpm
Primary Sludge Pumps – Unit 3	Primary Sludge Pumps Quantity: 3 Type: Plunger duplex Motor (ea.): 15 hp, 50 rpm Scum Pumps Quantity: 2 Type: Komline-Sanderson Capacity (ea.): 130 gpm Motor (ea.): 15 hp	Capacity (ea.): 250 gpm

1.5.2.3 Secondary Treatment

Secondary treatment uses an activated sludge process to stabilize the soluble and dissolved organic matter by biological oxidation. The system produces a settleable floc that is separated from the secondary effluent through settling. The secondary process includes activated sludge bioreactors, secondary clarifiers, and the NRC. The activated sludge system consists of one large Claerator (Unit 1) and two smaller Claerators (Unit 2N and 2S). The Unit 1 Claerator includes two concentric-rings of 18 step-feed aeration basins and two secondary clarifiers (East and West). Unit 2 consists of two Claerators (Units 2N and 2S) each including a circular primary clarifier and two concentric-rings of ten step-feed aeration basins followed by one circular secondary clarifier each. The rated design flow of the Unit 1 Claerator is 15 mgd and the design flow for each Unit 2 Claerator is 7.5 mgd. Table 1-7 summarizes the aeration basin design criteria.

Table 1-7: Aeration Basin Design Information

Component	Equipment Description	Design Flow
Unit 1 Aeration Basins	Quantity: 1 Type: Circular HRT (@125% flow): 5 hours Side Water Depth: 14 ft Inside Bays: 334,300 gallons Outside Bays: 447,500 gallons Total Volume: 3,910,000 gallons	15 mgd
Unit 2 Aeration Basins -Unit 2 North -Unit 2 South	Quantity: 2 Type: Circular HRT (@125% flow): 6 hours Side Water Depth: 14 ft Inside Bays: 200,000 gallons Outside Bays: 268,000 gallons Total Volume (ea.): 2,340,000 gallons	7.5 mgd (each)

Secondary clarifiers are very similar in structure to primary clarifiers and are equipped with similar mechanical equipment. Loading and sludge settling characteristics are the most important factors affecting their operation. The settling characteristics of the solids are developed in the aeration tank and are affected by mixed liquor suspended solids (MLSS) concentration. The settling properties of the solids are measured by the sludge volume index (SVI) or by settleometer. The capacity presented uses the surface overflow rate (SOR) and weir overflow rate as the critical hydraulic condition for treatment. Table 1-8 summarizes the secondary clarifier design criteria.

Table 1-8: Secondary Clarifier Design Information

Component	Equipment Description	Design Flow
Unit 1 Secondary Clarifiers -Unit 1 East -Unit 1 West	Quantity: 2 Diameter: 140 ft Side Water Depth: 10 ft Area: 15,394 ft^2 Volume (each): 1,151,471 gallons <u>Surface Overloading Rate (each)</u> 440 gpd/sf (average) 705 gpd/sf (peak) <u>Solids Loading (each):</u> 36.7 lbs./day/sf (average) 58.7 lbs./day/sf (peak) <u>Weir loading</u> 5,045 gpd/sf Detention Time at Average: 4.2 hours RAS Recycle: 25% - 80%	15 mgd

Component	Equipment Description	Design Flow
Unit 2 Secondary Clarifiers Unit 2 North and Unit 2 South	Quantity: 2 Diameter: 125 ft Side Water Depth: 12 ft Area: 12,250 ft^2 Volume (each): 1,260,350 gallons Surface Overloading Rate (each): 610 gpd/sq. ft. (average) 978 gpd/sq. ft. (peak) Solids Loading (each): 51.0 lbs./day/sq. ft. (average) 81.6 lbs./day/sq. ft. (peak) Detention Time at Average: 4.0 hours RAS Recycle: 25%-80%	Each 11.9 mgd *(based on SOR Peak)* Total Capacity for Unit 2: 23.8 mgd

The secondary aeration system consists of fine-bubble membrane diffusers and four blowers currently located in the Roots Blower Building (north side of secondary clarifier 2N). Each aerated zone air piping header has a flow meter and butterfly valve. Some of the installed diffusers and headers have been blanked to allow for additional diffusers to be installed in the future as required. Secondary aeration system capacities are summarized in Table 1-9.

Table 1-9: Secondary Aeration System Design Information

Component	Equipment Description	Design Flow
Blower System	Internal Combustion Engine (ICE) Quantity: 2 Type: Rotary Lobe Displacement, Engine-driven Horsepower: 750 hp Electric Powered Blowers Quantity: 2 Type: Rotary Lobe Displacement Capacity:16,400 scfm (each) Horsepower: 750 hp	Capacity:16,400 scfm (each) 32,800 scfm (total) Capacity:16,400 scfm (each) 32,800 scfm (total)
Aeration System	Unit 1 Type: Fine-bubble Membrane Disc No. of Diffusers in Bays 1 to 5: 7,087 No. of Diffusers in Bays 6 to 10: 8,527 Unit 2 Type: Fine-bubble Membrane Disc No. of Diffusers in Bays 1 to 5: 4,143 No. of Diffusers in Bays 6 to 10: 4,410	 N/A

Of the four existing blowers, two are electric-powered and two are engine-driven using digester gas. The Department plans to cease operation of the engine-driven blowers by September 1, 2021 as part of a larger Digester Gas Beneficial Use (DGBU) Program. Under the new program, five electric turbo blowers (4 + 1) at 6,000 scfm each will be installed in a new Unit 1 blower building that is currently under design, and the two existing electric blowers at the Roots Blower

Building will supply air to Unit 2. These projects are being performed in response to SCAQMD Amended Rule 1110.2 (see Section 7.3).

1.5.2.4 RAS Pumping Systems

The mixed liquor solids concentration in the aeration basins is controlled by return activated sludge (RAS) pumps to assure proper operations of the activated sludge process. Excess solids not needed for treatment and settled out in the secondary clarifiers are wasted to the DAF thickeners by the waste activated sludge (WAS) pumps. The Unit 1 RAS/WAS Pump Station has three (3) RAS pumps, two (2) WAS pumps, and one (1) scum pump. Separate return sludge lines from each of the two secondary clarifiers enter the pump station and then merge into a common header. The suction piping is arranged in such a way that sludge can be drawn by any one RAS pump.

The RAS pumps at Unit 1 and Unit 2 pump station are mixed-flow type pumps and non-clog centrifugal pump, respectively. Each is provided with VFD and driven by a 100 hp (Unit 1) and 60 hp (Unit 2) electric motors. Pump operation can be controlled automatically via SCADA. RAS pumping capacity information is summarized in Table 1-10.

Table 1-10: RAS Pumping Design Information

Component	Equipment Description	Design Flow
Unit 1 RAS Pumps	Quantity: 3 (2+1 standby) Type: Mixed-flow TDH: 18 ft Motor (ea.): 100 hp, 1200 rpm	Each: 2,700 gpm
Unit 2 RAS Pumps	Quantity: 3 (2+1 standby) Type: Non-clog Centrifugal TDH: 40 ft Motor (ea.): 60 hp	Each: 3,150 gpm

1.5.2.5 WAS Pumping Systems

From the WAS withdrawal system, waste sludge is transported to the DAF thickener by non-clog, centrifugal pumps. Each pump is provided with VFD drives and is driven by a 7.5 hp (Unit 1) and 10 hp (Unit 2) electric motor. A 4-inch magnetic flowmeter is mounted on the WAS discharge line from Unit 1, Unit 2N and Unit 2S secondary clarifiers, inside the Sludge Pump Building. The flowmeter provides flow control and it also indicates, records, and totalizes the waste sludge flow in the Operation Building. Design criteria for secondary sludge and scum pumping is summarized in Table 1-11.

Table 1-11: WAS Pumping Design Information

Component	Equipment Description	Design Flow
Unit 1 WAS Pumps	Quantity: 2 (1+1 standby) Capacity (total): 5 - 385 gpm TDH: –12.6 feet Motor (ea.): 7.5 hp, 1200 rpm	Combined: Up to 400 gpm (per SBMWD)
Unit 2 WAS Pumps	Quantity: 3 (2+1 standby) Capacity (ea.): 400 gpm TDH: 14 ft Motor (ea.): 5 hp	Each: 400 gpm

1.5.3 Nitrogen Removal Carousel

The NRC consists of an influent junction structure, equalization basin for belt press filtrate, anoxic basins, oxidation ditch for nitrification and denitrification, secondary clarification and auxiliary systems. The purpose of the NRC with pre-anoxic stages is to treat 3 mgd of raw wastewater and 0.2 to 0.6 mgd of belt press filtrate and centrate from the centrifuges, which has a high ammonia content. Nitrogen removal is accomplished through the stepwise process of decomposition of organic material to ammonia, nitrification of ammonia to nitrate, and denitrification of nitrate to nitrogen gas. The carousel oxidation ditch with pre-anoxic stages uses the influent wastewater as an organic carbon source for denitrification and alternating aerobic/anoxic stages for a complete nitrogen removal. Mixed influent is conveyed to the NRC with 3 screw lift pumps and enters the oxidation ditch where it is aerated to raise the dissolved oxygen (DO) level to 2 mg/L. To increase detention time for efficient nitrogen removal, the flow is recycled internally at a rate of 2:1 to 4:1 (recycle:NRC influent). RAS is used to maintain a high microorganism concentration. The rated design capacity of the NRC is approximately 3 mgd. The NRC design criteria is summarized in Table 1-12.

Table 1-12: NRC Design Information

Component	Equipment Description	Design Flow
Nitrogen Removal Carousel	SRT (Overall/Nitrification): 20/10 MLSS: 4,000 Temperature 15 deg C to 25 deg C	3.6 mgd (3 mgd raw WW + 0.6 mgd filtrate/centrate)
NRC Secondary Clarifier	Diameter: 110 ft Side Water Depth: 15.3 ft Maximum Overflow Rate: 400 gpd/sf	3.8 mgd *(based on SOR)*
NRC RAS Pumping	Quantity: 3 Motor (variable speed): 25 hp	Capacity (ea.): 1,250 gpm
NRC WAS Pumping	Quantity: 2 Motor (variable speed): 5 hp	Capacity (ea.): 250 gpm

1.5.4 Solids Handling

1.5.4.1 Solids Thickening

The solids thickening process consists of a thickener basin and mechanisms, pressurization systems, air supply systems, thickened sludge pumping system and polymer feed system. The DAF thickeners use recycle pressurization for dissolving air into the recycle stream. Recycle ratio ranges from two to four times the WAS influent. Design criteria for the DAF thickening system is summarized in Table 1-13.

Table 1-13: Solids Thickening Design Information

Component	Equipment Description	Design Flow
DAF Tanks	Quantity: 4 (3 in service) Diameter: DAF 1, 2 and 4: 35 ft DAF 3 (*not operational*): 25 ft Effective Surface Area: 25-ft. Diameter: 440 sf. 35-ft. Diameter: 880 sf. Side Water Depth: 8.125 ft Loading Rate: Solid: 1.0 lb./sf/hr. Hydraulic: 1.0 gpm/sf. Solids Capture Rate: With Chemical: 95% Without Chemical: 90%	3.80 mgd *(based on Hydraulic Loading rate)*
TWAS Pumps	Quantity: 2 (1+1 standby) Capacity (each): 400 gpm TDH: 14 ft Motor (each): 5 hp	100 gpm

1.5.4.2 Anaerobic Digestion

There are four anaerobic digester tanks (Digesters A - D) that are fed continuously and overflow to digested sludge storage tanks. The digesters are mixed with pumps and nozzles to recirculate flows within the tanks. The digester feed solids are heated by spiral heat exchangers before entering the digester tanks.

Digesters A and B were constructed in 1958 and were upgraded in 1983-84 and 1989-90. The dimensions of these are 90-foot diameter and approximately 33.5-foot sidewall with 10-foot deep cone section. Digesters A and B are concrete tanks with insulated metal lids with approximately 1.7 million gallons (MG) of liquid storage and an estimated 30,000 standard cubic feet (SCF) of DG storage in each digester. Digester B is currently out of service because the concrete is damaged which prevents pressurized operation and anaerobic conditions. At the time of this Master Plan, the Department was in the process of preparing an RFP to replace Digester B.

Digesters C and D are the newer tanks built in the late 1980s with 90-foot diameter and approximately 36.5-foot sidewall and 10-foot deep cone section. These are concrete tanks with concrete lids. Digesters C and D have approximately 1.8 MG of liquid storage and 35,000 SCF of DG storage in each digester. Design criteria for anaerobic digestion is summarized in Table 1-14.

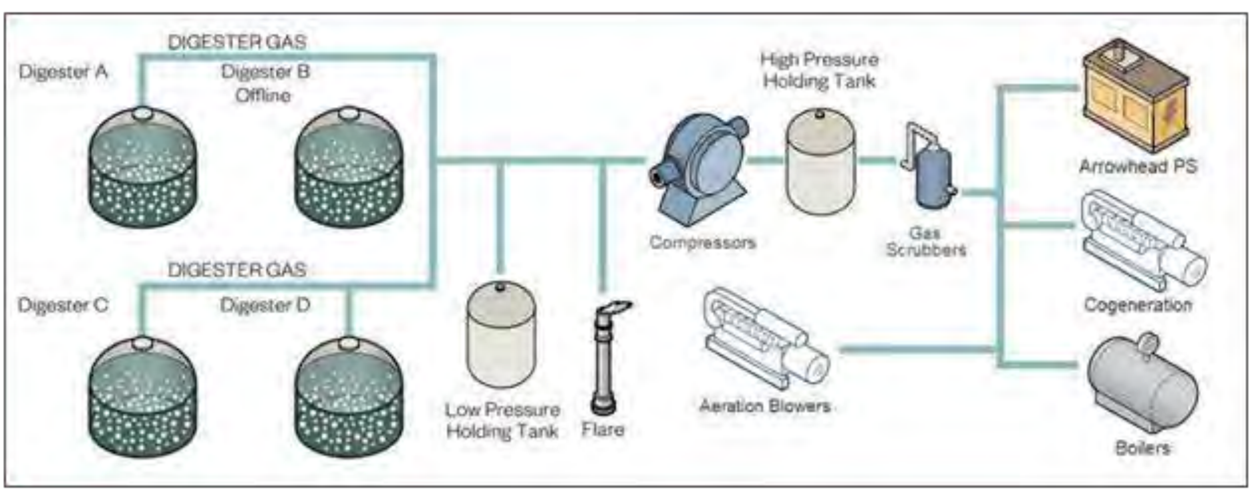
Table 1-14: Anaerobic Digestion Design Information

Major Component	Description	Design Flow
Anaerobic Digesters	Quantity: 4 (3 in service) Diameter: 90 ft <u>Effective Digester Volume</u>: Digester A: 156,000 ft^3 Digester C: 169,000 ft^3 Digester D: 169,000 ft^3 Total: 494,000 ft^3 <u>Solids Loading</u>: 0.07 lb.-VSS/cu ft/day (average) 0.09 lb.-VSS/cu ft/day (peak) <u>Hydraulic Retention Time</u>: 24.4 days (Average) 19.0 days (Peak) Digester B: 169,000 ft^3 (*Abandoned in Place; RFP for replacement in progress*)	246,340 gpd sludge flow (*based on HRT of 15 days*)
Digester Mixing Pumps	Quantity: 1 per digester Capacity (each): 8,000 gpm Motor (each): 60 hp	Each: 8,000 gpm

1.5.4.3 Digester Gas Management

The existing DG management system includes four anaerobic digester tanks, a low-pressure holding tank, a high-pressure holding tank, gas compressors, gas cleaning units, and a flare. DG is currently used to power digester gas-driven engines for pumps at the Arrowhead Pump Station, blowers, cogeneration, and boiler heating as shown in Figure 1-3. In the future, DG will be used to the fullest extent under the DGBU program, which is currently in design. Under the DGBU, DG will be used in a Fuel Cell system and excess not used by the boilers will be flared by an Ultra-Low Emissions (ULE) flare (see Section 7.3).

Figure 1-3: Digester Gas Management



1.5.4.4 Sludge Dewatering

The sludge to be dewatered at SBWRP normally consists of a combination of anaerobically digested primary sludge, WAS from activated sludge tanks, and WAS from the NRC at a ratio of 60% primary to 40% TWAS. In 2014, two centrifuges were installed in the dewatering building and are the primary dewatering method, with belt presses as back-ups. The belt press system consists of a continuous belt filter press, belt wash system, sludge feed pump, and filtrate pump system. Each press operates identically and is designed to treat digested sludge with an average inlet solids concentration of approximately 2.5%. Design criteria for the dewatering system is summarized in Table 1-15.

Table 1-15: Dewatering Design Information

Major Component	Description	Design Flow
Digested Sludge Storage Tanks (North and South)	Quantity: 2 Diameter: 70 feet Side Water Depth:12 feet Active Volume: 350,000 gallons	N/A
Centrifuge (Primary)	Quantity: 2	The feed solids range from 1.6-2.2 TS% the average cake solids range from 22-24%. The Centrifuges are designed for aa feed flow of 20 gpm, but we typically do not go over 180 gpm.
Belt Press (Back-up)	Quantity: 3 Belt Width (each): 2 meters (approx. 6 feet) Feed Solids: 2-3 % Cake Solids: 22% Solids Capture: 90% Belt Wash Pressure: 90 psig Belt Wash Flow Rate: 125 gpm Belt Material: Monofilament, Polyester	135 gpm (ea.)

1.5.4.5 Solids Storage

The solids storage and handling include solids storage bin, truck loading bin and belt conveyors which convey the dewatered sludge to these facilities. The purpose of these facilities is to minimize truck loading times, maximize truck payload, and allow flexibility for dewatering and transportation. Design criteria for the solids storage facility is summarized in Table 1-16.

Table 1-16: Solids Storage Design Information

Major Component	Description	Design Flow
Solids Storage Facility	Quantity: 1 Solids Loading Rate: 36,850 lbs. dry solids/day Retention Time: 3 days	350 cubic yards
Truck Loading Storage	Storage in Bins	40 cubic yards

1.5.5 Disinfection

The chlorine contact basins and lagoon are designed for disinfection purposes. Currently, these units are not in operation. Disinfection through chlorination is only required if secondary effluent is discharged to the Santa Ana River, only as permitted during a 20:1 dilution, which is not how SBWRP is currently operated. SBWRP effluent currently passes through the chlorine contact basin to the Rapid Infiltration Extraction (RIX) facility for groundwater infiltration.

Original design criteria for the chlorine disinfection units is summarized in Table 1-17.

Table 1-17: Chlorine Disinfection Design Information

Major Component	Description	Design Flow
Chlorine Contact Basin Unit 1	Diameter: 60 ft Volume: 159,000 gallons Side Water Depth: 7.5 ft Contact Time (13 mgd): 29 minutes	13 mgd (average flow)
Chlorine Contact Basin Unit 2	Diameter: 100 ft Volume: 543,000 gallons Side Water Depth: 10 ft Contact Time (15 mgd): 52 minutes	15 mgd (average flow)
Chlorine Contact Lagoon	Volume: 1,260,000 gallons Contact Time (28 mgd): 65 minutes	28 mgd (average flow)

1.5.6 Odor Control

The SBWRP currently operates 5 foul air scrubbers with 2 packed bed scrubbers, each with 25,000 cfm capacity, dedicated to the Headworks Building; 2 caustic scrubbers, each with 25,000 cfm capacity, dedicated to the belt filter presses; and one dedicated to the digested sludge storage tanks.

2. ASSET INVENTORY

2.1 Introduction

SBMWD elected to incorporate elements of asset management into the development of the SBWRP Facilities Assessment and Master Plan. Some of the benefits being:

- Asset inventory that can serve as a data source for the new Enterprise Asset Management (EAM) System, which will include as one component a Computerized Maintenance Management System (CMMS) to be used Department wide.
- Rehabilitation and Replacement decisions based on condition versus age.
- Better able to manage SBMWD's business risk exposure
- Minimize life-cycle costs
- Better project long range funding requirements

Determination of the current state of the SBWRP's assets requires knowledge of the assets owned and managed by SBMWD, so the first phase consisted of populating the asset register for the SBWRP. Figure 2-1 provides an aerial view of the SBWRP. While this project only populated the asset register with SBWRP assets, the asset register framework was developed so that it could also be expanded and applied to other Departments in the future.

Figure 2-1: SBMWD Water Reclamation Facility (Scope Area)

2.2 Data Collection

The first step of the WRP Facilities Assessment was the identification of all assets associated with the WRP into a consolidated database referred to as an asset register. Using data from SBMWD's existing sources such as Record Drawings, electronic O&M manuals (EOM) and institutional knowledge of staff, a preliminary asset register of SBWRP above-ground and yard piping assets was developed.

2.2.1 Above-Ground Assets

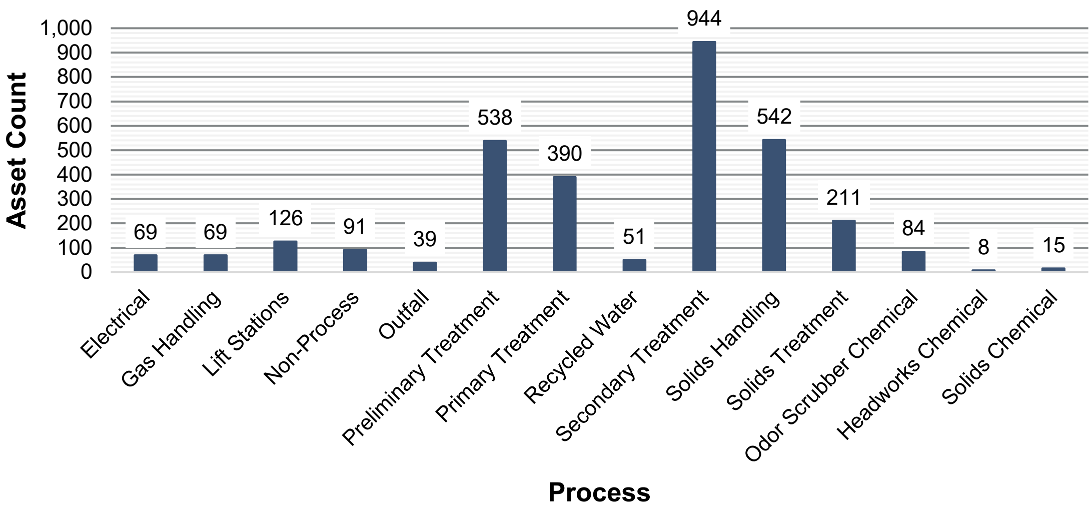
The preliminary asset register of above-ground assets was further developed during the field inventory, condition assessment and further gap closure activities after the field inventory as shown in Table 2-1.

Table 2-1: Sources of Information

Data Collection Methods	Percentage of Total Asset Count	Count of Assets
Record Drawings, Electronic O&M Manuals, Staff	57%	1,804
Added Onsite	42%	1,335
After Onsite	1%	40
TOTALS	100%	3,179

Figure 2-2 lists the count of above-ground assets by process.

Figure 2-2: SBWRP Count of Above-Ground Assets by Process



2.2.2 Yard Piping

The preliminary asset register for WRP yard piping was developed using a combination of AutoCAD, ArcGIS and Excel. The source files consisted of pipe layers in AutoCAD, a grid shapefile in ArcGIS and record plant drawings. The source CAD file was processed for geolocation and cleaned for transfer into GIS. ArcGIS was used to parse and compile pertinent data from the processed CAD file and to geo- process layers for information such as pipe length and grid location. All layers were then compiled into one layer and attribute table, which served as the basis of the asset register. This table was transferred into Excel for final cleaning and processing. Using record drawings, approximate pipe ages were added to the spreadsheet based on the year of construction for each function. Approximate available useful life, derived by function, was also added to the yard piping asset register. Figure 2-3 illustrates the resultant yard pipes captured in the asset register, colored by function.

Figure 2-3: SBWRP Yard Piping

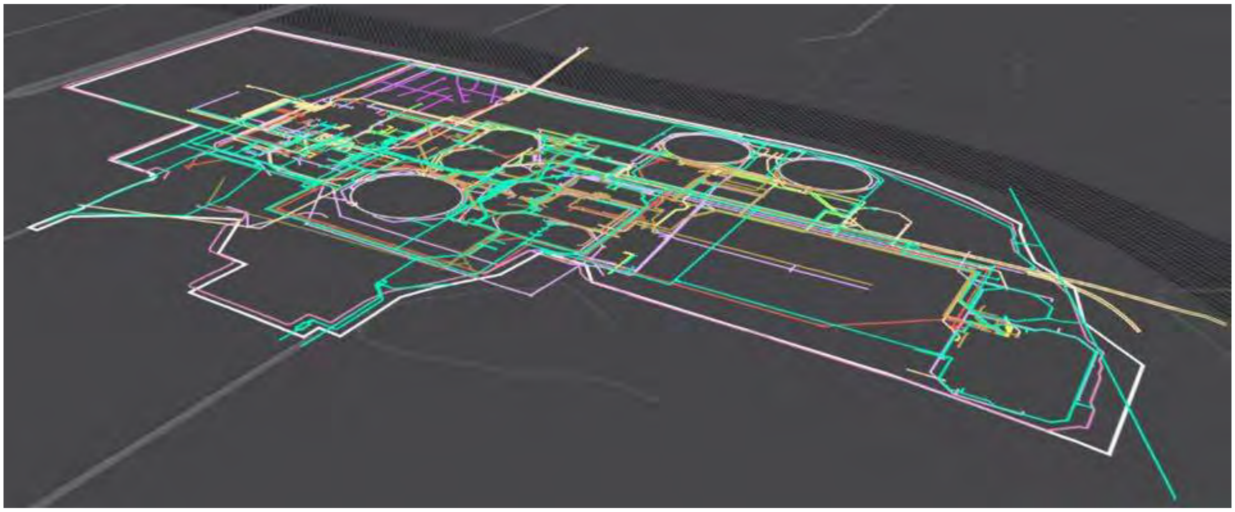
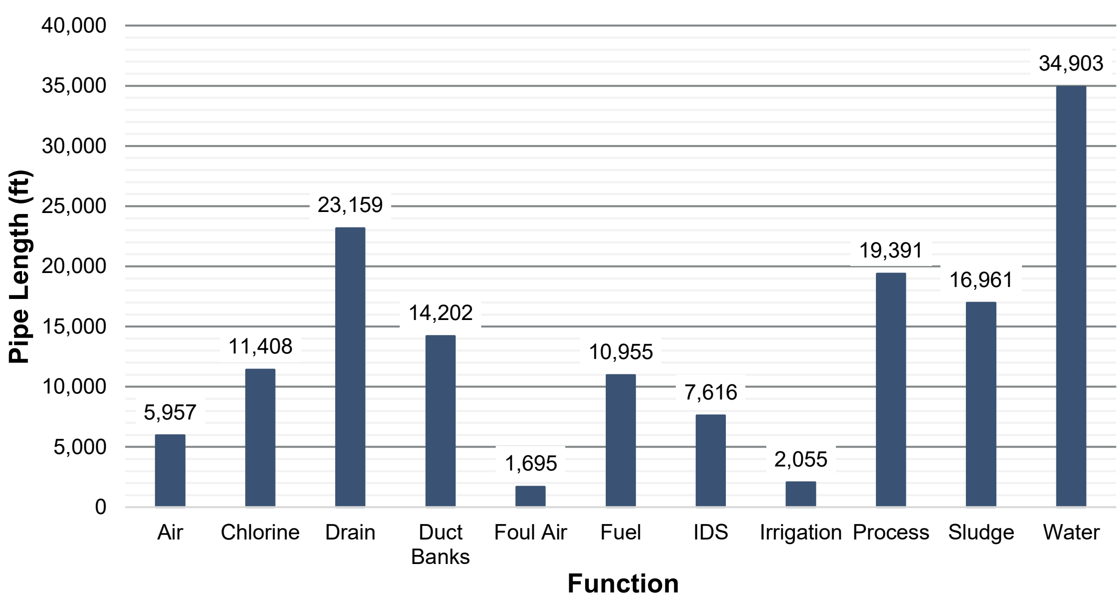


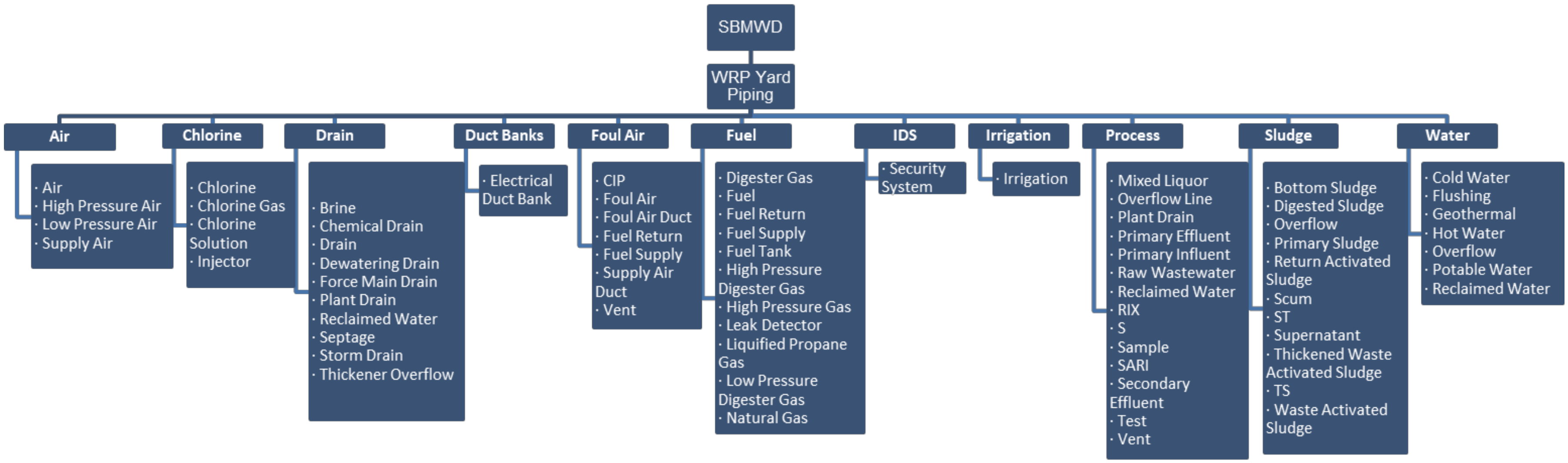
Figure 2-4 illustrates the resultant yard piping lengths by function and Figure 2-5 presents the yard piping function hierarchy.

Figure 2-4: SBWRP Yard Piping Length by Function



*IDS lines represent the SBMWD WRP Security System

Figure 2-5: SBWRP Yard Piping Function-Based Hierarchy



2.2.3 Data Attributes

A data attribute is a characteristic that sets it apart from other data and is key to performing condition and risk assessment. Table 2-2 shows the typical relevant asset attributes associated with each above-ground and yard pipe asset within the SBWRP asset register.

Table 2-2: Typical Asset Attributes for Water and Wastewater Treatment Facilities

Physical/Attributes	Groupings	Remaining Useful Life	Valuation	Risk
Size	Class	Condition Score	Unit Cost	Probability of Failure
Size Unit	Type	Useful Life	Replacement Cost	Consequence of Failure
Material	Discipline	Remaining Useful Life		Risk Score
Manufacturer		Rehab Year		
Serial Number		Rehab Description		
Tag ID				
Model				
Asset Description				

Prior to the field inventory of above-ground assets at WRP, gaps in attributes such as install year and major rehabilitation history were closed during the gap closure workshops with the Department. This allowed for derivation of remaining useful life, probability of failure (PoF) and consequence of failure (CoF) to develop a list of assets for a focused condition assessment. Any remaining gaps in physical attributes such as Manufacturer, Model, Serial Number and Size were closed during the field inventory. Furthermore, about 1,300 additional assets, not identified during the development of the preliminary asset register, were added to the asset register during the field inventory while attribute information for the existing assets were verified and updated as needed.

Fields such as Material, Condition and Status are currently gaps in the yard piping asset register. Other minor gaps in the asset register are length (ft) at 6% of the dataset and diameter (in) at 18% of the dataset.

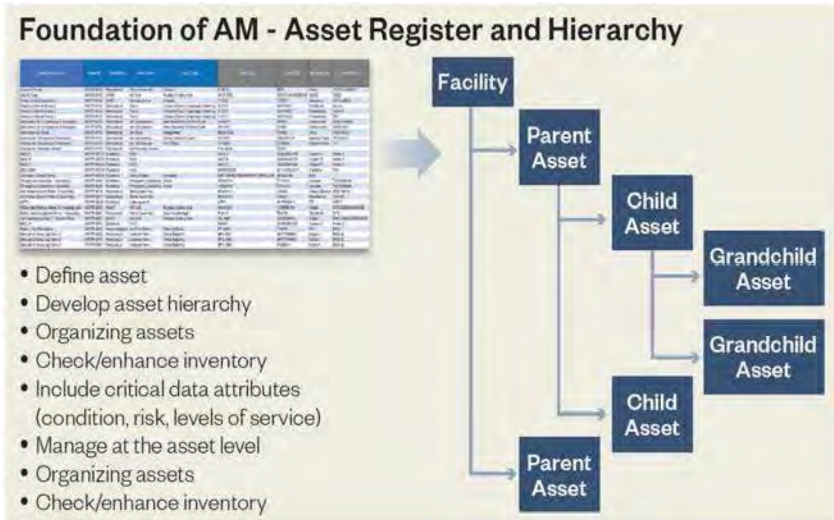
2.3 Asset Register Framework

An asset register is the systematic recording of all assets within the WRP that SBMWD owns or is responsible for their operations and maintenance. An asset hierarchy provides a structured framework for organizing assets in the asset register. A hierarchy enables SBMWD staff to easily locate an asset and obtain data (e.g., valuation, risk, remaining useful life) required to support asset management decisions.

An asset register forms links between all asset-related applications or information systems and enables the assessment of the assets as individual components, composite assets, or groups of assets. Along with establishing the asset register hierarchy as shown in Figure 2-6, developing an asset register includes the following components:

- Asset Definition. Developing a definition for an asset that can be used across SBMWD by the Finance and Water Reclamations Divisions, and Engineering Section.
- Asset Classification. An asset class can be defined as a group of assets with similar type, function, useful life, and pricing attributes (e.g., size, material, power).
- Data Standards. Data standards identify data attributes required to support asset management decisions. There are common attributes (e.g., year of install, replacement cost, asset naming/numbering) and specific attributes (e.g., type, power, size, length, and material) for each asset class.

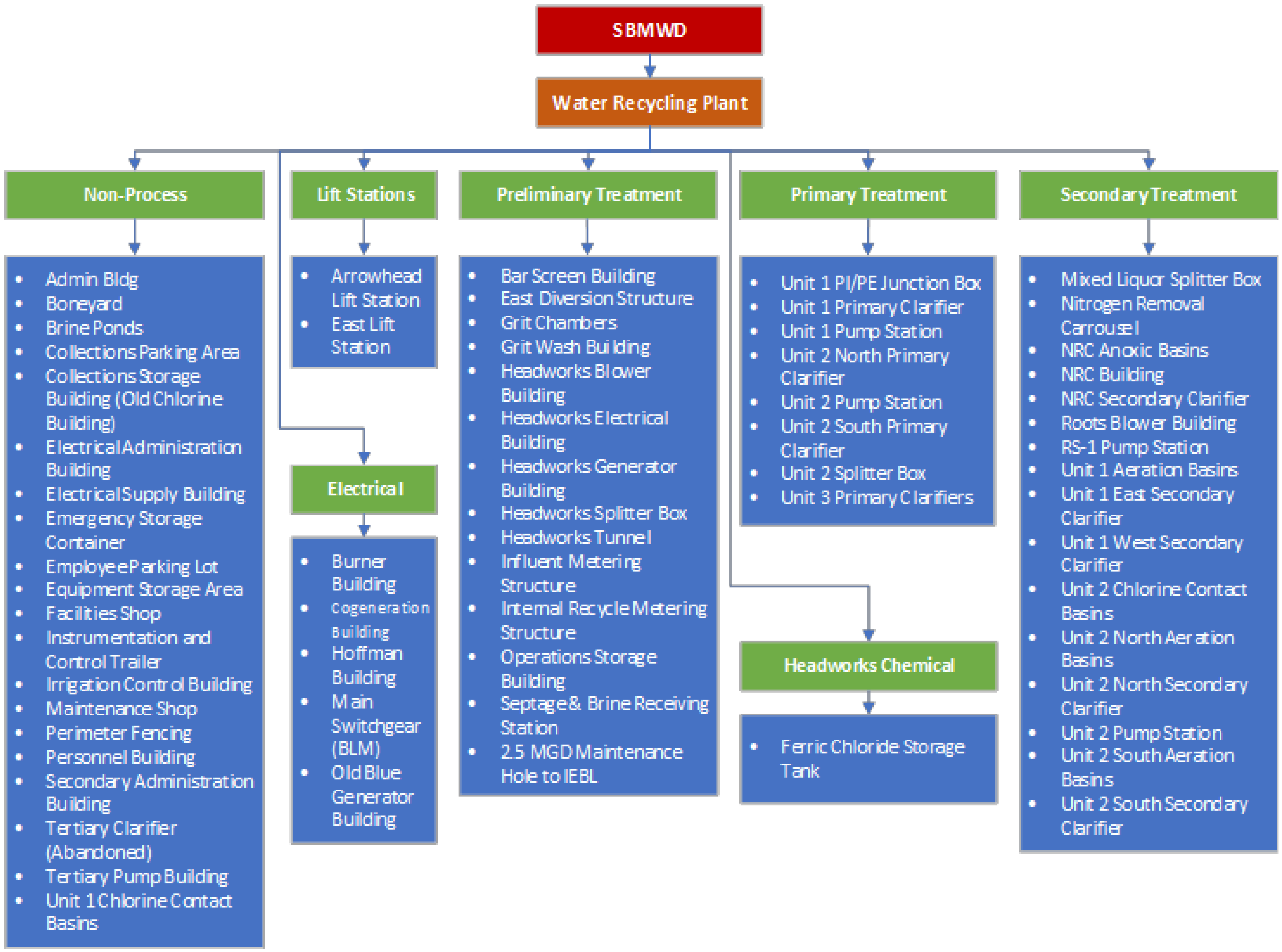
Figure 2-6: Asset Register Hierarchy Parent-Child Relationship



The asset register for SBMWD was set up using a “process-based” hierarchy as shown in Figure 2-7 and Figure 2-8. There are five levels of hierarchy captured for the SBWRP in the asset register. The hierarchy divides into facility and major process first and then location, which is further broken down into assembly/systems.

Figure 2-7: Five Levels of Hierarchy for Drilling Down and Rolling Up

Figure 2-8: Process-Based Hierarchy



2.3.1 Asset Identification and Asset Tagging System

Each asset in the asset register was assigned a unique "Asset ID" starting with the number 1 and continuing sequentially as assets are added to the asset register.

Along with assigning an Asset ID, Hazen collaborated with SBMWD staff to refine their Tagging ID System which consists of:

Owner / Site / Location / Process / Type / Number

An example is:

Arrowhead Influent Flow Meter Tube SBMWD.WRP.B223.81.FE.010

Table 2-3 provides the Tag ID System elements and a description of the example above.

Table 2-3: Typical Asset Attributes for Water and Wastewater Treatment Facilities

Tag ID System Elements	Example Description
Owner	SBMWD (San Bernardino Municipal Water Department)
Site	WRP (Water Reclamation Plant)
Location	B223 (Grid B2, Influent Area 23)
Process	81 (Process Instrument)
Type	FE (Flow Element)
Number	010 (Number assigned to flow element. There are three flow elements with the flow metering structure and numbers would be assigned accordingly: 010, 020, 030)

A Tag ID was assigned to each asset and incorporated into the asset register.

2.4 Summary

Once populated, the asset register is used to identify the assets for the risk assessment that identified the assets for the focused condition assessment. During the field condition assessment, data in the SBWRP asset register was verified and information, such as asset photos, asset performance, nameplate data, manufacturer, model, and asset condition for assets ranked high risk were added to the asset register.

The asset register serves as the foundation of a future asset management program for SBMWD and as a data source for a new computerized maintenance management system.

3. CONDITION ASSESSMENT

3.1 Condition Assessment

3.1.1 Introduction

Each organization is unique, and no condition assessment framework will work universally. However, each organization's condition assessment framework should be built on the same basic framework or foundation and should incorporate the same fundamental concepts. This section describes the basics of a focused condition assessment that was developed for SBMWD's SBWRP to meet the short-term needs of SBMWD and provide a framework for continuing with the facility condition assessment over the next several years.

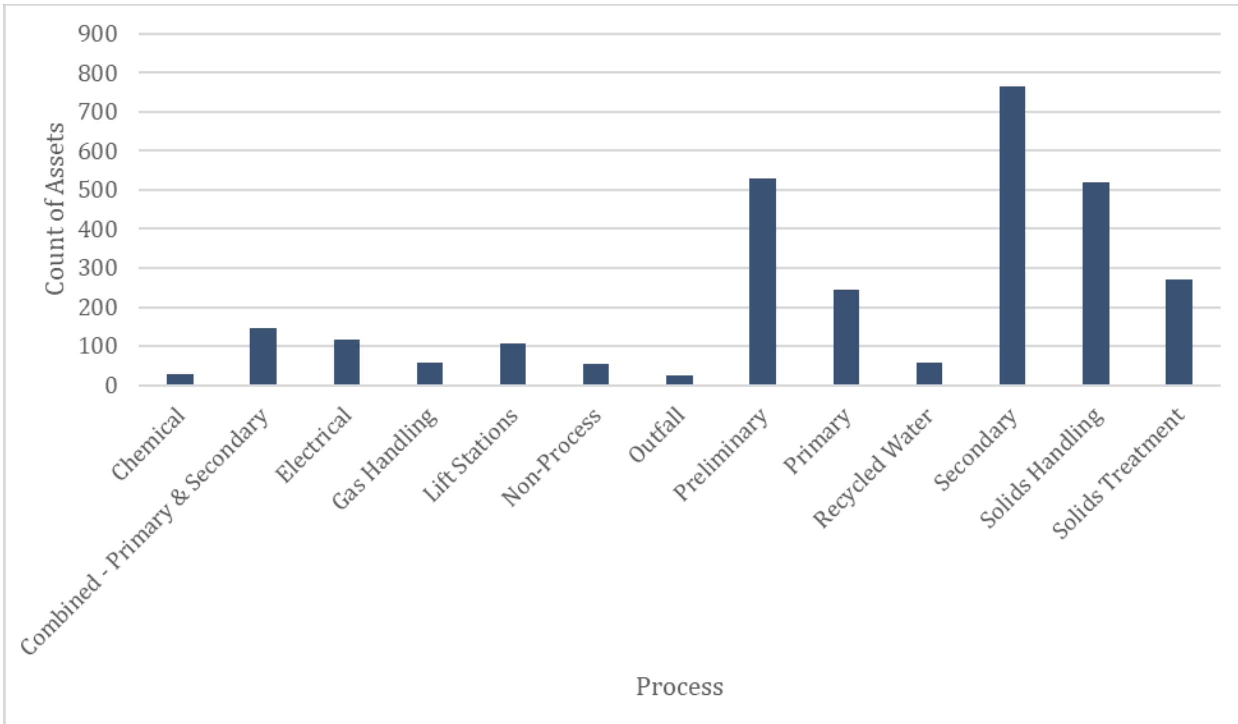
The objective of condition assessment is to estimate asset failure or the rate of deterioration of an asset and adjust asset management plans accordingly. This includes adjusting remaining useful life, revising maintenance schedules, and updating total asset management costs and funding needs. The probability of an asset failing is most dependent upon the condition of the asset. As the condition of an asset deteriorates, the probability of failure increases. Ultimately, the goal of any condition assessment protocol is to acquire a more accurate knowledge of the timing to asset failure. Having more confidence in asset failures and renewal needs will lead to more efficient and effective use of SBMWD's staff, resources, and funds.

The condition assessment for this project included three components: 1) desktop evaluation of each asset; 2) desktop evaluation of underground assets; and 3) a focused field condition assessment of assets identified as high risk.

3.2 Focused Condition Assessment

A desktop assessment of the 3,184 above-ground assets in the preliminary asset register and a ranking of the criticality of processes was determined in workshops with SBMWD staff to identify assets for the Level 1 visual condition assessment. Figure 3-1 shows a breakdown of assets by process.

Figure 3-1: Assets in the Preliminary Register by Process



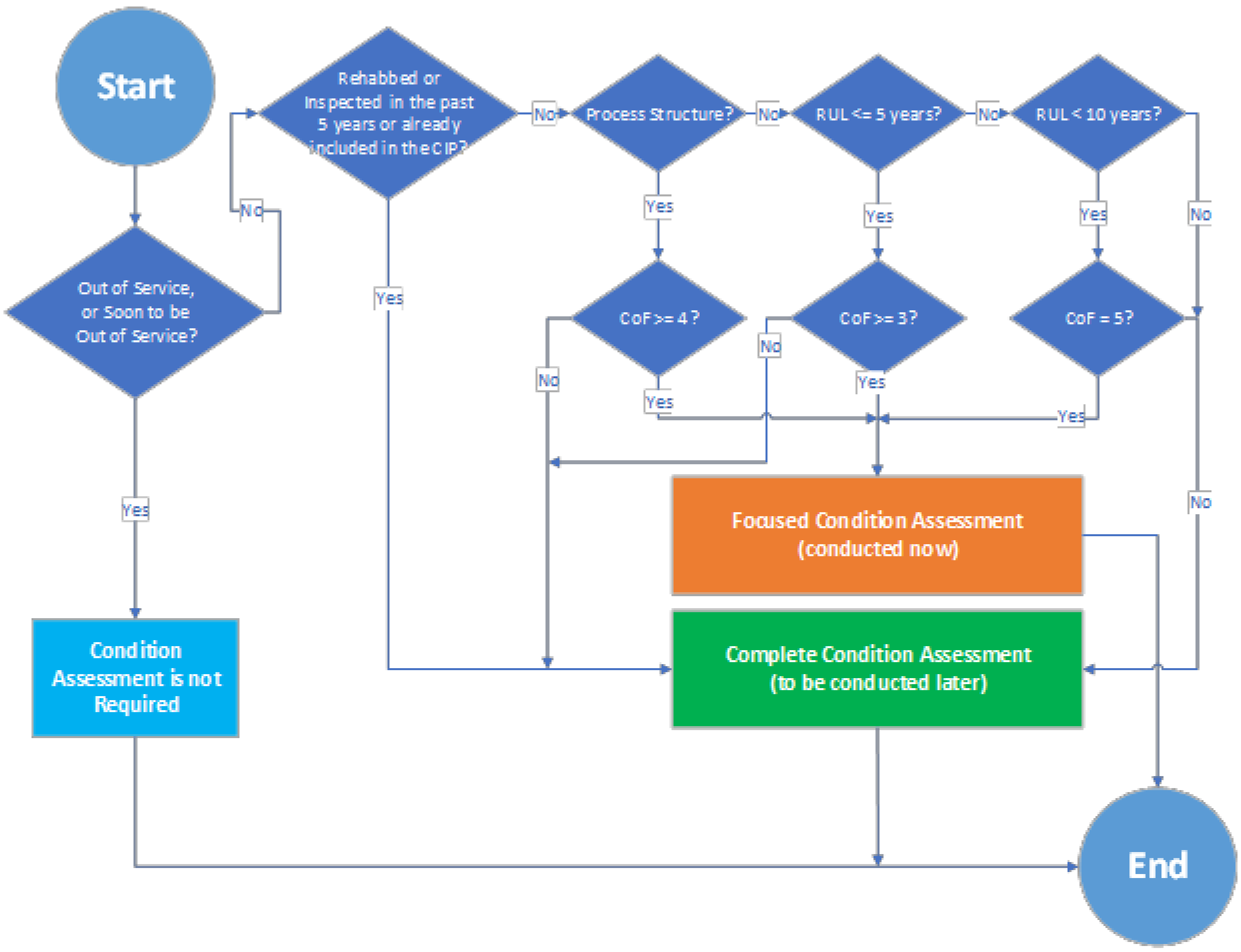
Hazen developed a risk-based approach for the level 1 focused field condition assessment by prioritizing the assets with the highest risk based on determining the remaining useful life (RUL) and consequence of failure (CoF).

RUL was used as an indicator of likelihood of failure within the next 5 years or less or the next 6 to 10 years. Assets in the preliminary asset register were assessed to determine the RUL based on the age of each asset and the expected useful life for each asset class.

The CoF evaluates the direct and indirect impacts of a failure. The CoF was determined for each process within the SBWRP through collaborative workshops with SBMWD staff.

Using the methodology shown in Figure 3-2, a combination of remaining useful life and CoF scores were used to determine the assets on which to conduct the Focused Condition Assessment and the assets on which to conduct Complete Condition Assessment later. Assets that had been identified by SBMWD to be abandoned or planned to be rehabilitated or replaced within the next 5 years were not considered for the field condition assessment.

Figure 3-2: Focused Condition Assessment Methodology



3.2.1 Remaining Useful Life

The expected useful life of an asset is a key factor in assessing a replacement timeframe. A predetermined useful life for each type of asset class was assigned and the year of installation of each asset was used to determine the current age of the asset. The expected useful lives are based on industry best practices and knowledge from local and similar projects. The estimated useful life table developed for SBMWD can be found in Appendix B.

The expected useful life for each asset along with the determined age were used to assess remaining useful life (RUL) of each of SBMWD's assets in the preliminary asset register using the equation as follows:

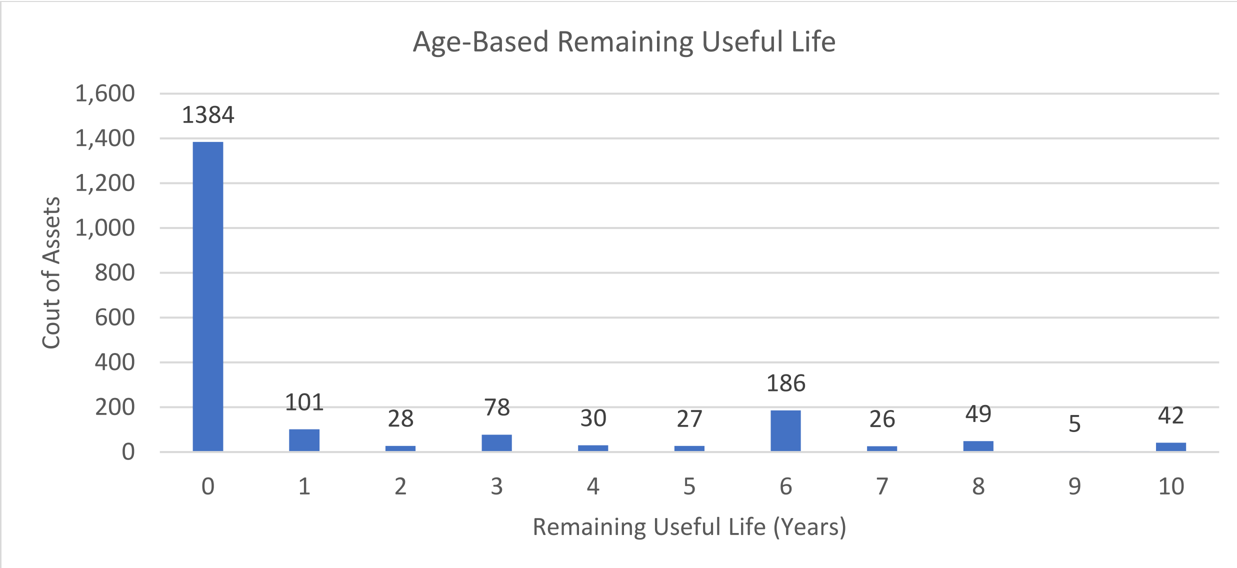
RUL=Expected Useful Life (years)-Age (years)

Where: RUL = Remaining Useful Life (years)

Age (years) = Current Year – Year Installed

As shown in Figure 3-3, 1,956 (approximately 60%) of assets in the preliminary asset register were determined to be reaching the end of their useful life within the next 10 years.

Figure 3-3: RUL – Asset Count by Year (Age-Based)



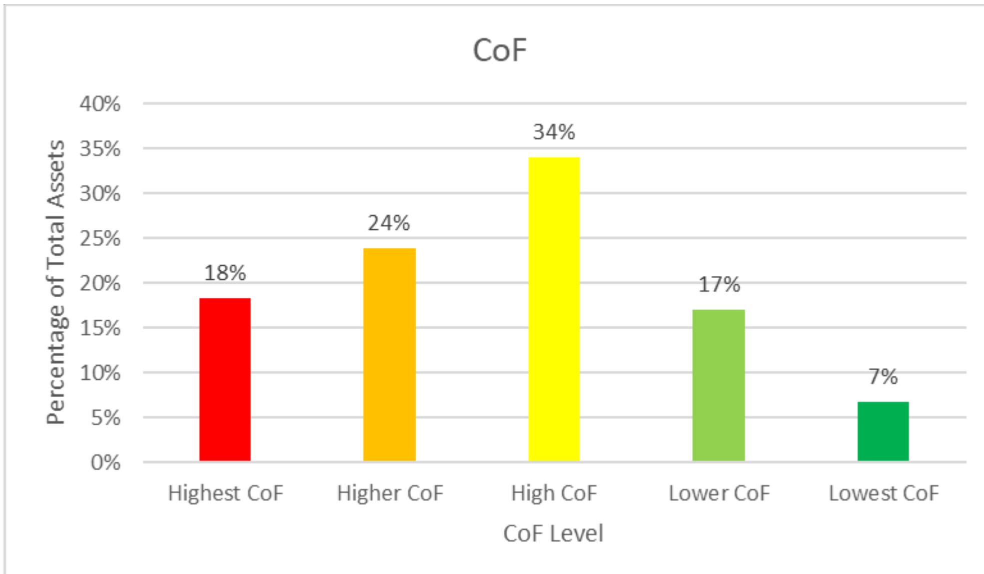
3.2.2 Consequence of Failure

To determine the CoF of each asset, a multi-parameter weighted consequence of failure (CoF) score (ranging from 1 to 5) was determined for each asset at the process level as presented in Table 3-1. The Hazen team utilized SBMWD operations staff's knowledge of processes in critical condition and workshops were conducted with a broader range of SBMWD staff to gain further input. The results of the preliminary CoF analysis are shown in Figure 3-4.

Table 3-1: CoF Description and Related Score

CoF Range	Description	CoF Score
Lowest	Lowest impact on the main functionality of the process/facility	1
Lower	Lower impact on the main functionality of the process/facility	2
High	High impact on the main functionality of the process/facility	3
Higher	Higher impact on the main functionality of the process/facility	4
Highest	Highest impact on the main functionality of the process/facility	5

Figure 3-4: Preliminary CoF Results



3.2.3 Assets Identified for Field Condition Assessment

The results of remaining useful life analysis and consequence of failure were combined to identify the critical assets that are reaching the end of their useful life (Figure 3-5). Following the decision tree presented in Figure 3-2, 850 assets (approximately 30%) were identified for the focused condition assessment. Figure 3-6 presents the count of those assets at each process.

Figure 3-5: Remaining Useful Life Combined with CoF Results

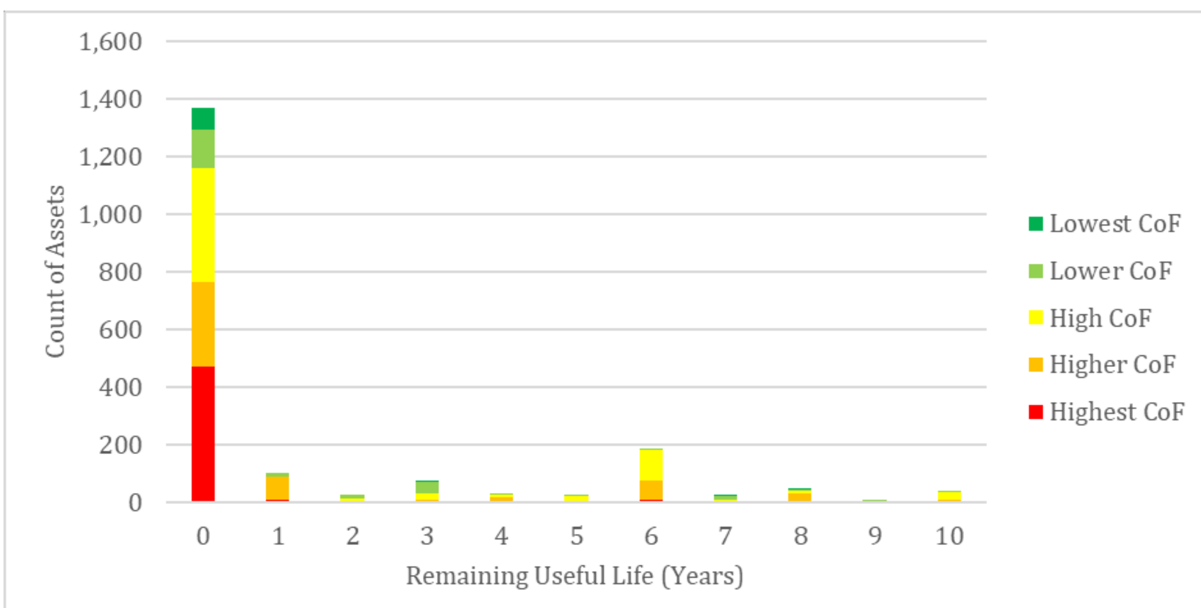
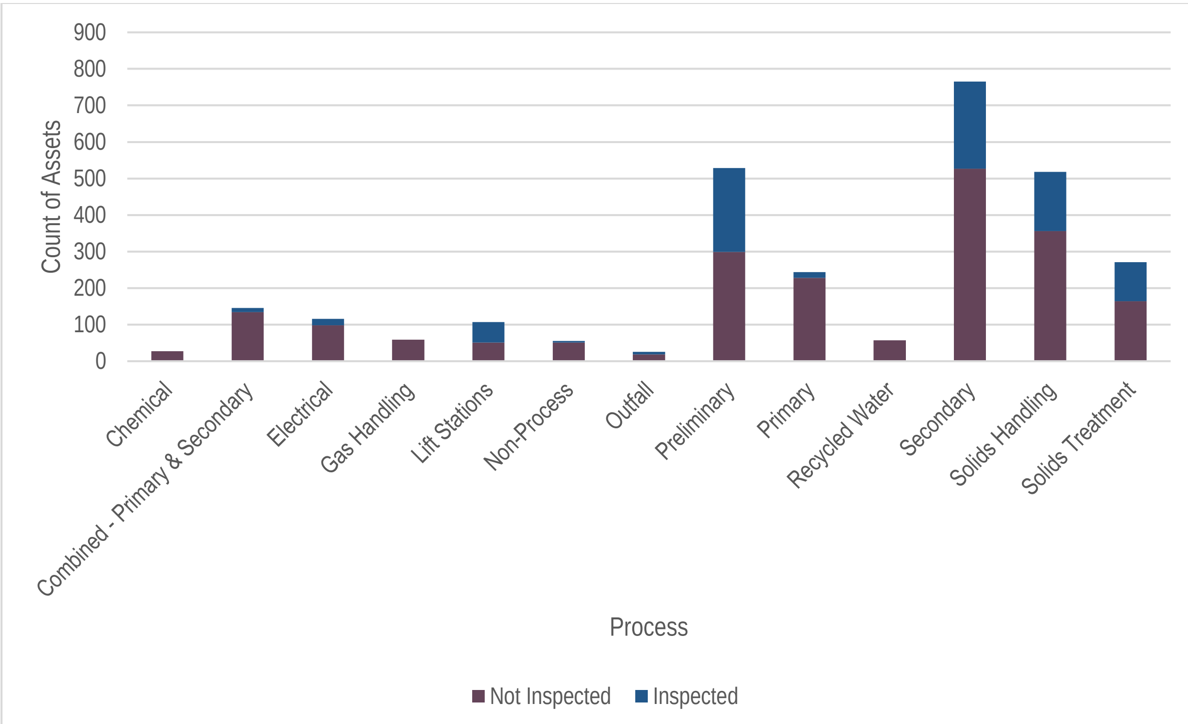


Figure 3-6: Assets Selected for the Focused Condition Assessment



3.3 Field Condition Assessment Approach

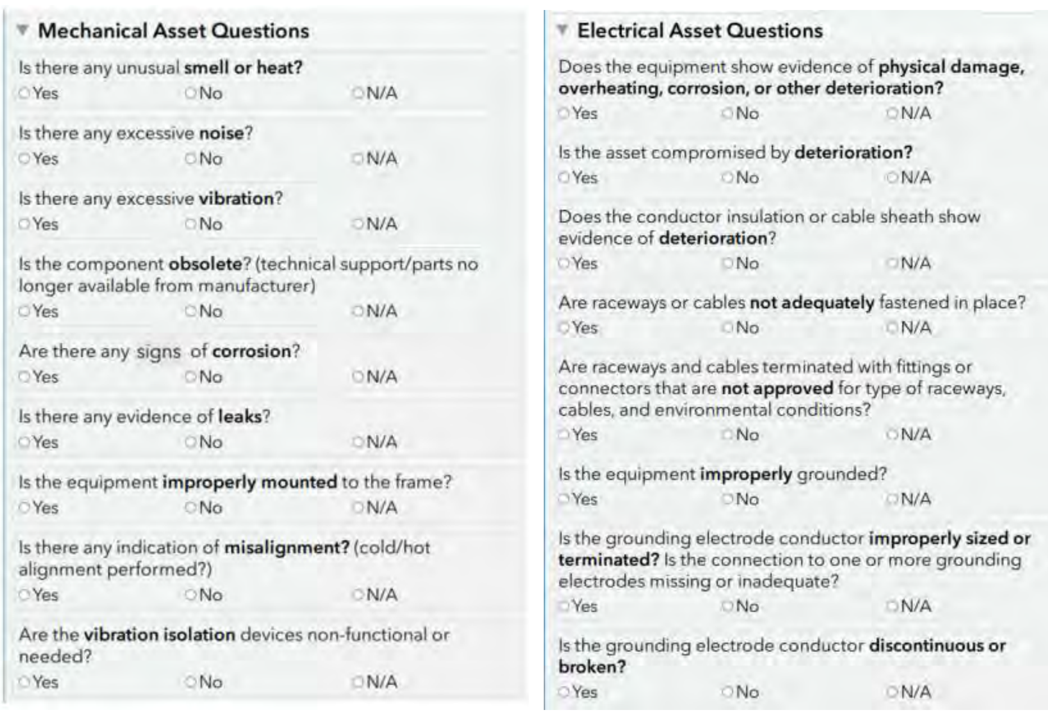
A field inventory to close data gaps in the preliminary asset register and a Level 1 visual condition assessment of approximately 30% of the WRP assets was conducted. Condition assessment is a combination of field performance and design assessments of assets followed by implementation of the condition scoring process to assign a condition grade to each asset.

Hazen performed an inventory of all assets and a focused condition assessment of about 30% of the assets within the SBWRP. A Level 1 (visual) condition assessment was conducted to assess the mechanical, electrical and structural conditions of assets at WRP. The condition of assets, system redundancies, installation years, quantities, and O&M assessment/needs were identified during the on-site focused facility condition assessment. Additionally, inputs from SBMWD staff as to when the asset was last serviced were used to complete the focused condition assessment.

Asset condition was determined via visual inspection. Field observations were recorded by analysts on mobile devices utilizing customized condition assessment forms. The condition scoring system and mobile devices with electronic forms are presented in Figure 3-7. This system uses a rating range from 1 (Excellent condition) to 5 (Poor condition). Descriptions for each rating enable analysts to assign ratings consistently to assets. The data collected for each asset, including photographs of the assets, notes taken during the condition assessment, condition scores for specific attributes, inspection checklists, etc., were stored digitally. Figure 3-8 shows a portion of the inspection checklists for Mechanical, Electrical, Instrumentation and Structural assets. The complete checklist for each discipline can be found in Appendix B.

Figure 3-7: Mobile Data Collection Tools and Scoring Guide

Figure 3-8: Inspection Checklists for Mechanical, Electrical, Instrumentation and Structural Assets



Mechanical Asset Questions

Is there any unusual **smell or heat?**
○Yes ○No ○N/A

Is there any excessive **noise**?
○Yes ○No ○N/A

Is there any excessive **vibration**?
○Yes ○No ○N/A

Is the component **obsolete**? (technical support/parts no longer available from manufacturer)
○Yes ○No ○N/A

Are there any signs of **corrosion**?
○Yes ○No ○N/A

Is there any evidence of **leaks**?
○Yes ○No ○N/A

Is the equipment **improperly mounted** to the frame?
○Yes ○No ○N/A

Is there any indication of **misalignment?** (cold/hot alignment performed?)
○Yes ○No ○N/A

Are the **vibration isolation** devices non-functional or needed?
○Yes ○No ○N/A

Electrical Asset Questions

Does the equipment show evidence of **physical damage, overheating, corrosion, or other deterioration?**
○Yes ○No ○N/A

Is the asset compromised by **deterioration?**
○Yes ○No ○N/A

Does the conductor insulation or cable sheath show evidence of **deterioration**?
○Yes ○No ○N/A

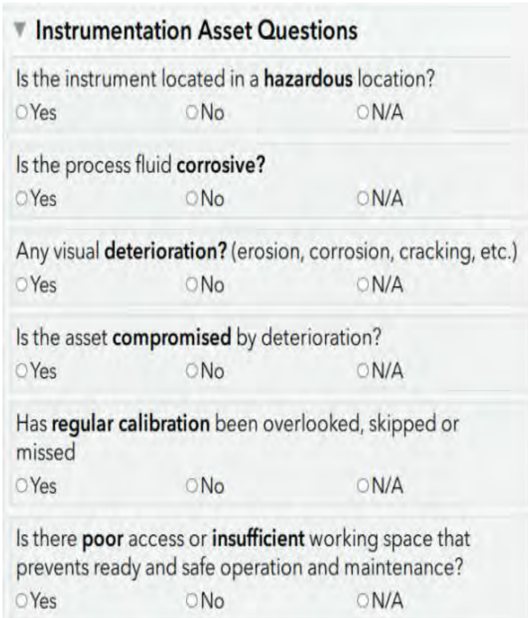
Are raceways or cables **not adequately** fastened in place?
○Yes ○No ○N/A

Are raceways and cables terminated with fittings or connectors that are **not approved** for type of raceways, cables, and environmental conditions?
○Yes ○No ○N/A

Is the equipment **improperly** grounded?
○Yes ○No ○N/A

Is the grounding electrode conductor **improperly sized or terminated?** Is the connection to one or more grounding electrodes missing or inadequate?
○Yes ○No ○N/A

Is the grounding electrode conductor **discontinuous or broken?**
○Yes ○No ○N/A



Instrumentation Asset Questions

Is the instrument located in a **hazardous** location?
○Yes ○No ○N/A

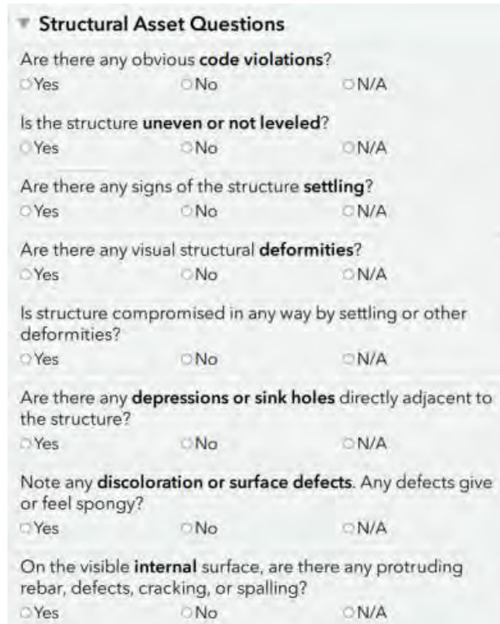
Is the process fluid **corrosive?**
○Yes ○No ○N/A

Any visual **deterioration?** (erosion, corrosion, cracking, etc.)
○Yes ○No ○N/A

Is the asset **compromised** by deterioration?
○Yes ○No ○N/A

Has **regular calibration** been overlooked, skipped or missed
○Yes ○No ○N/A

Is there **poor** access or **insufficient** working space that prevents ready and safe operation and maintenance?
○Yes ○No ○N/A



Structural Asset Questions

Are there any obvious **code violations**?
○Yes ○No ○N/A

Is the structure **uneven or not leveled**?
○Yes ○No ○N/A

Are there any signs of the structure **settling**?
○Yes ○No ○N/A

Are there any visual structural **deformities**?
○Yes ○No ○N/A

Is structure compromised in any way by settling or other deformities?
○Yes ○No ○N/A

Are there any **depressions or sink holes** directly adjacent to the structure?
○Yes ○No ○N/A

Note any **discoloration or surface defects**. Any defects give or feel spongy?
○Yes ○No ○N/A

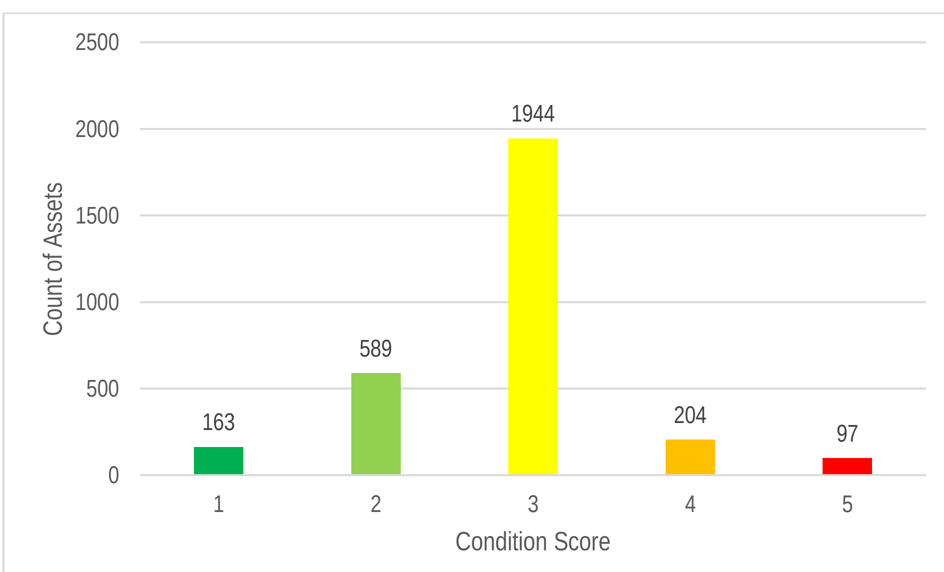
On the visible **internal** surface, are there any protruding rebar, defects, cracking, or spalling?
○Yes ○No ○N/A

All data collected for each asset, including photographs of facility assets, the inspectors' notes, condition scores, inspection checklists, etc., were stored digitally and can be exported in a variety of formats. The Hazen Facilities Inspection forms were provided as a deliverable to SBMWD enabling staff to easily continue to periodically collect condition information and update the asset inventory.

3.4 Field Condition Assessment Results

A total of 2,995 assets were inspected and assigned a condition score. This included 850 assets identified during the desktop and workshop analysis and another 2,145 identified in the field for inspection based on the criteria described in Figure 3-2. Figure 3-9 provides a summary of the condition assessment results.

Figure 3-9: Summary of Condition Assessment Results



As shown in Figure 3-9, the majority of assets inspected were found to be in “Average”, “Good” or “Excellent” condition.

A total of 204 assets were found to be in “Fair” condition. Table 3-2 and Figure 3-10 and Table 3-34 provide the count of assets in Fair condition by location.

As shown in Table 3-23 and Figure 3-11, a total of 97 assets were found to be in need of rehabilitation or replacement (condition score 5).

Table 3-2: Location of Assets with Condition Score 4

Location of Assets with Condition Score 4	Count of Assets
Dewatering & Thickening (D&T) Building	30
Unit 3 Primary Clarifiers	25
Unit 2 Pump Station	23
Arrowhead Lift Station	19
Boiler Building	12
Dewatering Building & Conveyors 1 & 2	11
Unit 1 Aeration Basins	8
NRC Anoxic Basins	6
RS-1 Pump Station	5
Nitrogen Removal Carousel	5
North Outfall Structure	4
Headworks Splitter Box	4
Digester D	3
Dissolved Air Flotation Thickener (DAFT) 1	3
Secondary Administration Building	3
Sludge Storage Odor Scrubber	3
Burner Building	3
Grit Chambers	3
Bar Screen Building	3
Digester A	2
East Influent Lift Station	2
Headworks Tunnel	2
NRC Building	2
South Outfall Structure	2
Old Blue Generator Building	2
Digester C	2
Dissolved Air Flotation Thickener (DAFT) 2	2
Admin Bldg	2
Ferric Chloride Storage Tank	1
Unit 2 South Primary Clarifier	1
Unit 2 North Aeration Basins	1
Bio-Solids Storage Beds	1

Location of Assets with Condition Score 4	Count of Assets
Manual Biosolids Loading Bed	1
Century Well	1
Unit 2 Chlorine Contact Basins	1
Existing 0.06 Flare	1
Chlorine Contact Lagoon	1
Internal Recycle Metering Structure	1
Irrigation Control Building	1
Headworks Electrical Building	1
Headworks Odor Scrubber	1

Figure 3-10: Count of Assets with Condition Score of 4 (based on level 4 of hierarchy)

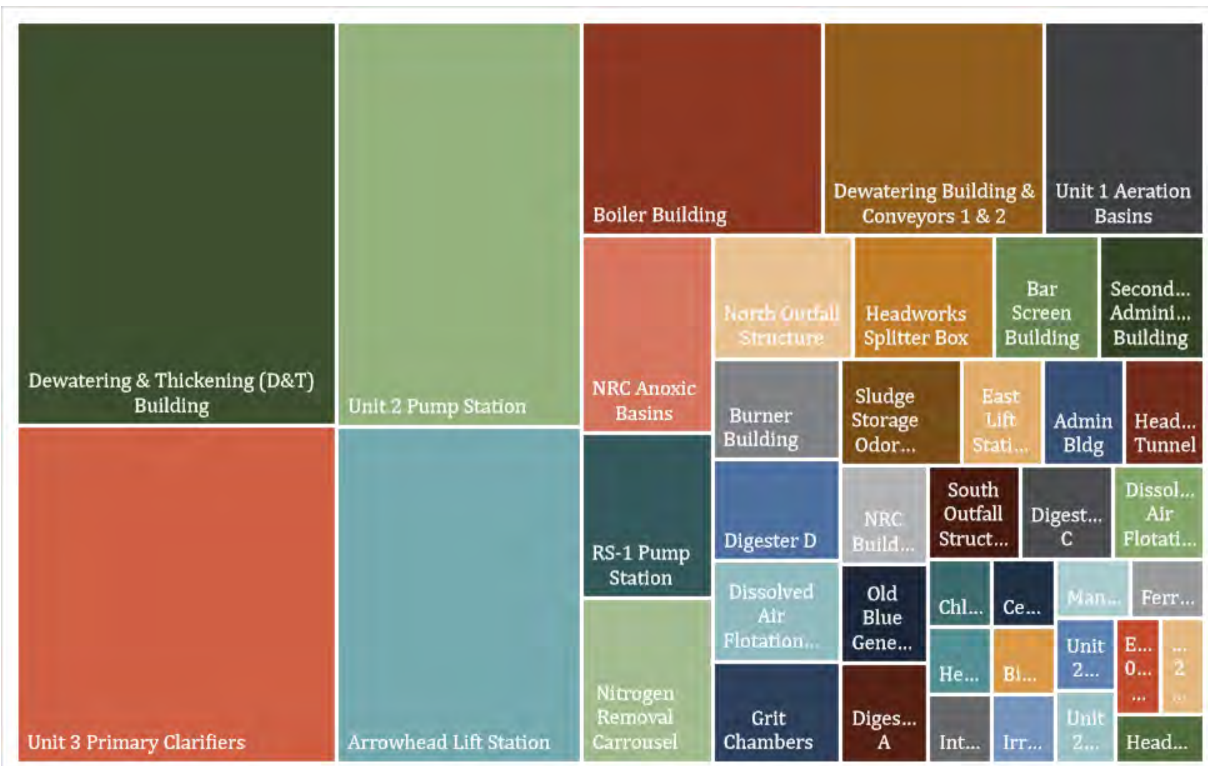


Table 3-3: Location of Assets with Condition Score 5

Location of Assets with Condition Score 5	Count of Assets
Boiler Building	16
Unit 2 Pump Station	11
Digester C	8
RS-1 Pump Station	7
NRC Anoxic Basins	5
Gas Compression Area	5

Location of Assets with Condition Score 5	Count of Assets
Nitrogen Removal Carousel	4
Digester A	3
Sludge Storage Odor Scrubber	3
Unit 1 Pump Station	3
Grit Chambers	3
Arrowhead Lift Station	3
Unit 1 Chlorine Contact Basins	2
Bar Screen Building	2
Old Blue Generator Building	2
Unit 2 South Primary Clarifier	2
Unit 3 Primary Clarifiers	1
Headworks Blower Building	1
Digester B	1
Internal Recycle Metering Structure	1
Unit 2 North Primary Clarifier	1
Low Pressure Holding Tank (LPHT)	1
Hazardous Materials Storage Area	1
Collections Storage Building (Old Chlorine Building)	1
South Digested Sludge Storage Tank	1
North Outfall Structure	1
Burner Building	1
Century Well	1
Unit 2 North Secondary Clarifier	1
Cogeneration Building	1
Grit Dewatering Bed	1
Combination Truck Unloading Bed	1
NRC Secondary Clarifier	1
Influent Metering Structure	1

Figure 3-11: Count of Assets with Condition Score of 5 (based on level 4 of hierarchy)

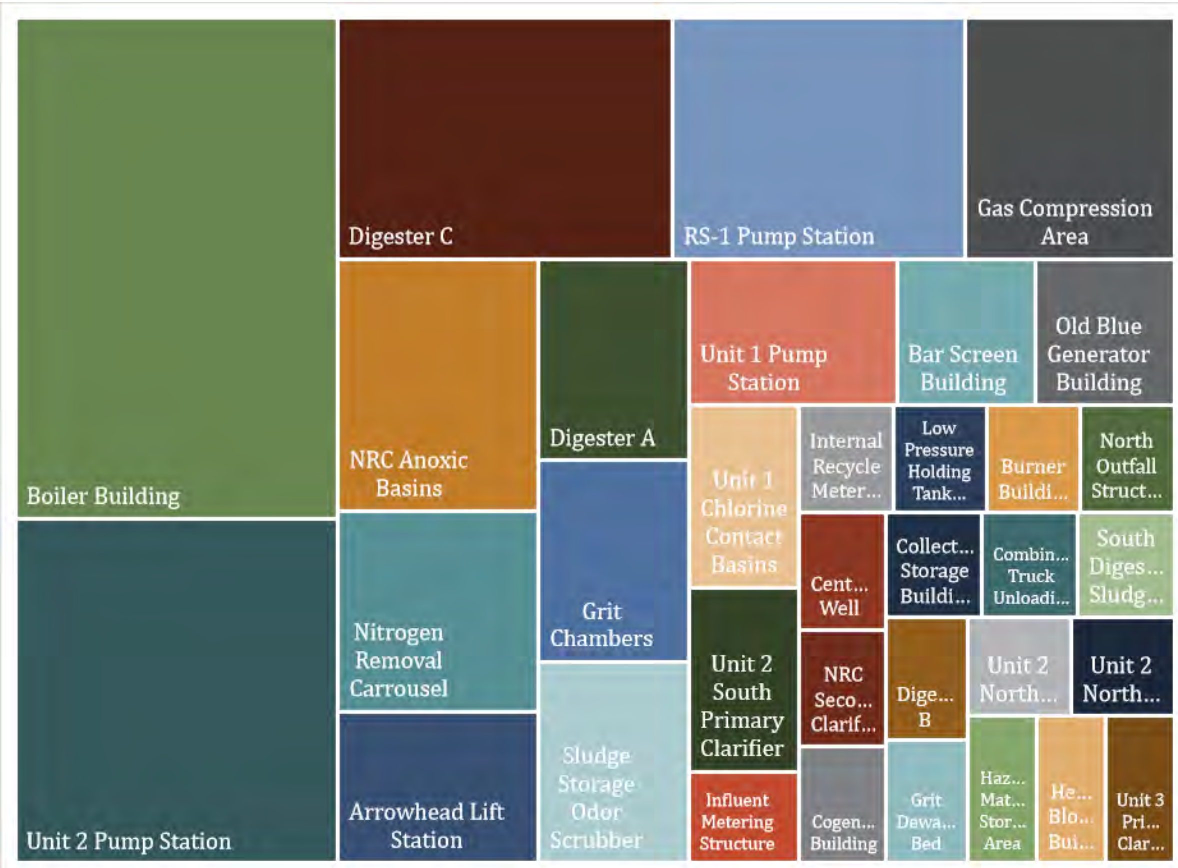


Figure 3-12 presents photos of a sample of assets with condition score 5.

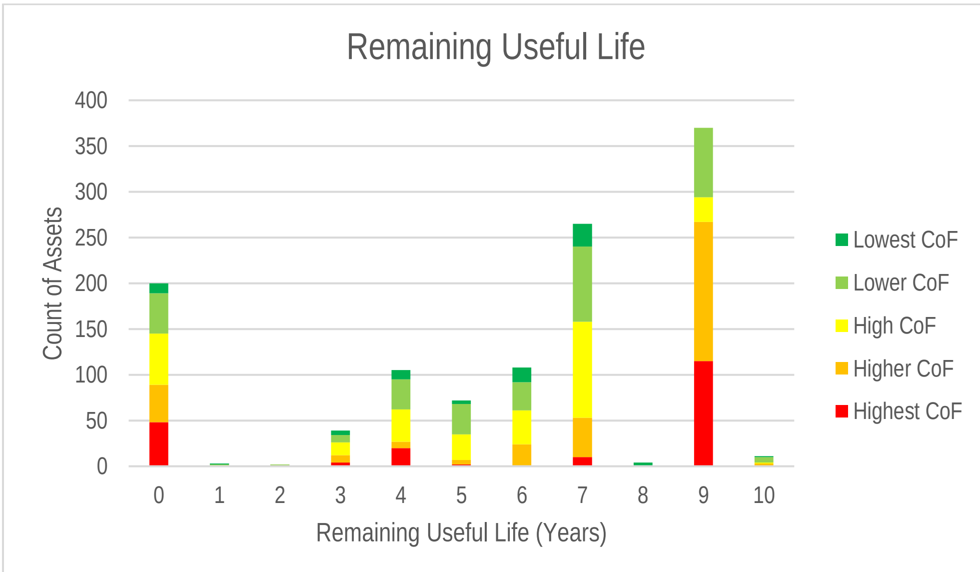
Figure 3-12: Sample of Assets in Need of Rehabilitation or Replacement

Boiler Building – MCC BB | Unit 2 PS Suction Isolation Valve | Grit Chamber No. 1 Structure | Arrowhead LS Control Cabinet

3.5 Updated Remaining Useful Life

The preliminary asset register was updated with new assets identified in the field (1,335 assets) and condition scores and remaining useful life were updated for those assets for which a visual condition assessment was performed. Figure 3-13 shows the updated remaining useful lives based on the results of the condition assessment. A total of 1,179 assets (approximately 37%) were identified as reaching the end of their useful lives within the next 10 years. The results of the remaining useful life analysis are utilized to identify assets for rehabilitation or replacement within the next 10 years.

Figure 3-13: Condition-Based RUL by Asset Count



3.6 Summary of Findings

The focused condition assessment consisted of Hazen engineers conducting visual inspections of approximately 30% of the most critical assets on the SBWRP. Assets that had been inspected or rehabilitated within the past five years were not included.

Of the 2,995 assets with condition scores, the results indicated that the majority of assets (2,694) inspected were found to be in “Average”, “Good” or “Excellent” condition.

A total of 204 assets were found to be in “Fair” condition and total of 97 assets were found to have reached the end of their useful life and be in need of rehabilitation or replacement.

Based on condition and age, a total of 1,179 assets (approximately 37%) were identified as reaching the end of their useful lives within the next 10 years. The results of the remaining useful life analysis were utilized to identify assets for rehabilitation or replacement within the next 10 years.

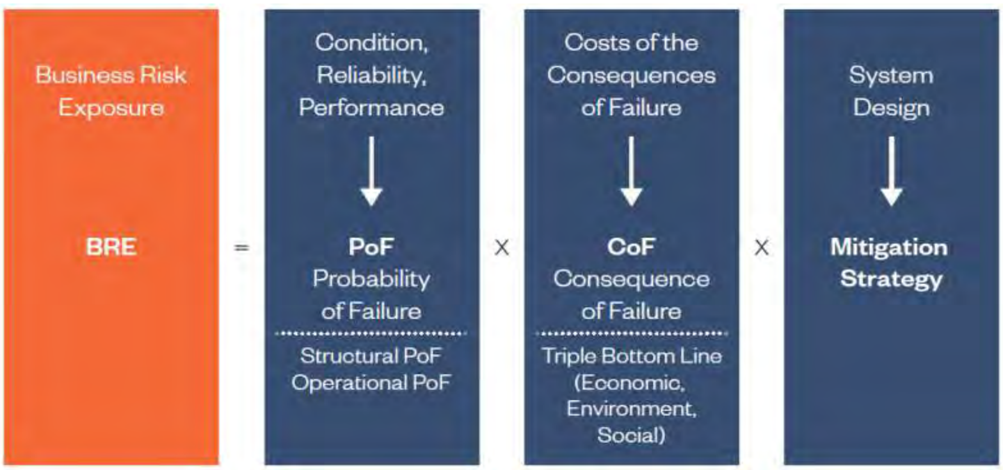
4. RISK ASSESSMENT

4.1 Business Risk Exposure Methodology

A business risk is the threat that an event, action or inaction will adversely affect an organization's ability to achieve its business objectives and execute its strategies successfully. An analysis of risk commonly identifies the risk of an event, analyzes the probability of failure and the consequence of failure, calculates a risk score, ranks assets based on their risk scores, and develops risk mitigation strategies if required.

Business Risk Exposure (BRE) is the term used to describe and quantify the risks associated with the management of assets. It can be assessed at an asset level and/or at the system level. Business risk exposure is comprised of three major components: probability of failure, consequence of failure, and redundancy. The probability of failure measures an asset's likelihood of or timing to failure. The consequence of failure evaluates the direct and indirect impacts of a failure. Redundancy, the presence of backup equipment, helps to decrease the overall risks of a failure. A BRE score is assigned to each asset in the asset register to help prioritize the needs under limited resources. BRE scoring results are used to help prioritize investments in inspection, maintenance, rehabilitation, and replacement activities, informing the prioritization of near-term actions needed to mitigate asset risk and/or help meet level of service goals.

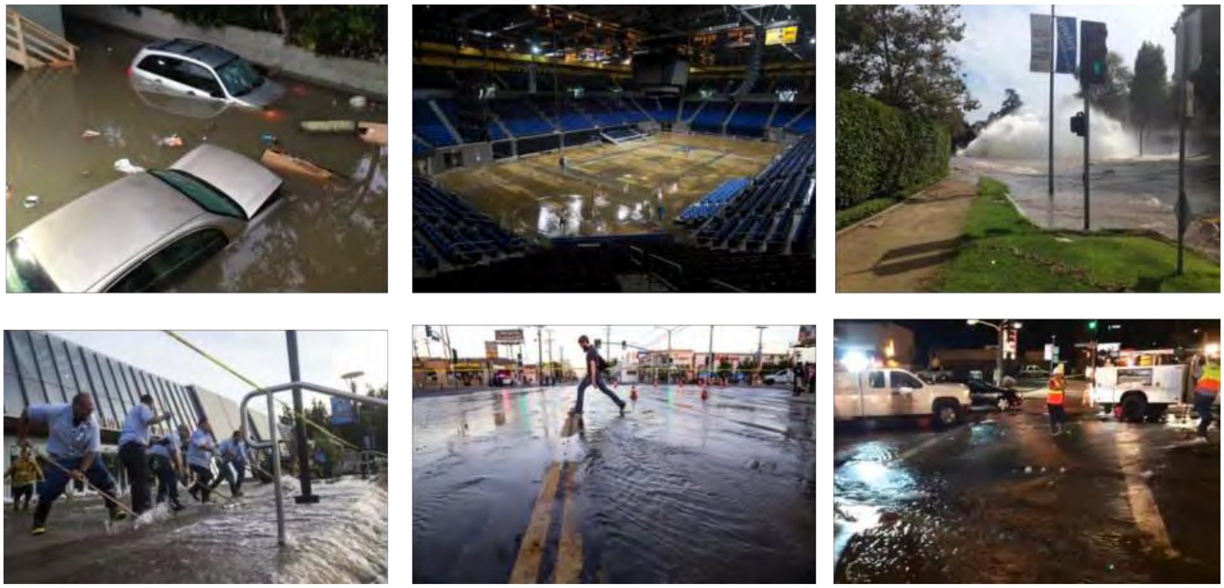
Figure 4-1: Business Risk Exposure Methodology



One of the fundamental questions that must be answered in prioritizing assets for maintenance, renewal, and replacement is: "Which assets pose high risk to sustained performance?"

Not all assets are equally important to the system's operation (see Figure 4-2). Some assets are highly critical to operations (e.g., failure of a chlorine container resulting in potential injury or death of onsite personnel) and others are less critical. Furthermore, critical assets are system specific. Certain assets or types of assets may be critical in one location but not critical in another. For example, within one system, a sludge dewatering press may be a critical asset due to the lack of redundancy and poor condition. In another system, the sludge dewatering press may not be a critical asset because redundant equipment is available that is in good condition. So, an asset-level and process level assessment of probability of failure and consequence of failure is key to evaluate the risk associated with each asset.

Figure 4-2: Consequences of Failure Are Not All the Same



4.1.1 Probability of Failure

Probability of Failure (PoF) measures an asset's likelihood of failure. A condition-based approach has been followed to calculate the PoF. Condition is the most important factor in determining the probability of an asset failing. As the condition of an asset deteriorates, it will become more likely to fail. Condition of the SBWRP assets was determined via visual inspection of the equipment, along with interviews with Department operations and maintenance staff to determine a condition score as described in the following sections.

Based upon the findings of the field observations (level 1 visual assessment) and interviews, an overall condition score was assigned to each asset. Condition assessment is a combination of field and design assessments of assets followed by implementation of the condition scoring process to assign a condition grade to each asset. The scoring system was developed by Hazen in conjunction with SBMWD staff. The condition scoring system utilized is presented in Table 4-1. This system uses a rating range from 1 (Excellent condition) to 5 (Poor condition). Descriptions for each rating enable analysts to assign ratings to assets. The results of the field investigation were also used to determine the estimated remaining useful life.

Table 4-1: Asset Condition Rating Guidelines

Condition/ Scale	Asset Condition	Definition
1	Excellent	The physical condition of the asset is as new, e.g., new equipment.
2	Good	Asset has minor integrity issues. Not new but in very good condition
3	Average	Asset does not operate efficiently but does not significantly hamper normal operations. Corroded parts on an asset that do not affect operation.
4	Fair	Asset has significant structure or integrity issues that have the potential to develop into major operational problems. Significant leaks, damaged electrical cables

Condition/ Scale	Asset Condition	Definition
5	Poor	Asset incapable of performing to a satisfactory standard under normal operational conditions Corroded electrical cabinet which is not sealed

4.1.2 Consequence of Failure

When assets fail, the consequences depend on the failure mode and level of redundancy. Consequences of failure can range from a minor inconvenience to a major disruption of customer service, inability to comply with operating permit, and possible endangerment of public health.

The consequence of failure measures the direct and indirect impacts of an asset failure from triple bottom line perspectives of economic, environment and social factors. The consequence of failure was assessed at both the process-location-level and asset-level as show in Figure 4-3.

Figure 4-3: Consequence of Failure: Multiple Levels

To objectively measure the criticality of each process, an assessment was conducted at a WRP-wide level, considering all processes managed by the SBMWD. Four parameters were identified by the SBMWD to measure the consequence of failure at the process-level:

- Fatalities/Serious Injuries or Sickness
- Cost to Remediate/Economic Loss
- Environmental Damage
- Public Perception

Each process was assigned a score of 1 to 5 under each consequence of failure parameter to describe the impact of failure from no impact to high impact. Table 4-2 presents the process-level guideline for scoring each consequence of failure parameter from 1 to 5.

Table 4-2: Process/Location-Level Scoring Guide

CoF Range	Description	CoF Score
Lowest	Lowest impact on the main functionality of the process/facility	1

CoF Range	Description	CoF Score
Lower	Lower impact on the main functionality of the process/facility	2
High	High impact on the main functionality of the process/facility	3
Higher	Higher impact on the main functionality of the process/facility	4
Highest	Highest impact on the main functionality of the process/facility	5

Additionally, each parameter was assigned a weighting factor that defines the relative importance of each parameter. The weight for each factor is shown in Table 4-3.

Table 4-3: Process/Location Level Weighting Factors

Process Level CoF Criteria	Weighting Factor (%)
Fatalities/Serious Injury or Sickness	35
Cost to Remediation/Economic Loss	25
Environmental Damage	20
Public Perception	20

At the asset-level, the impact was measured by the impact of the asset failure on the process. Table 4-4 presents the Asset-level scoring guideline for scoring each consequence of failure parameter from Catastrophic (score of 5) to No impact (score of 1).

Table 4-4: Asset Level CoF Scoring Guide

CoF Level	Description	Examples
5 - Highest	Highest impact on the main functionality of the process/facility	Automatic Transfer Switch, Blowers, Flame Arrester, Gas Detector, Emergency Generator, MCC, Eyewash Station
4 - Higher	Higher impact on the main functionality of the process/facility	Flow Meter, Pumps, Mixer, Belt Press, Gas Meters, Grinder, Motor, Conveyors, Valves
3 - High	High impact on the main functionality of the process/facility	Air Compressor, Air Dryer, Boiler, Crane Assembly, Fuel Tank, Sampler, Skimmer, Process Structure, Ventilation Fan, Weir Structure
2 - Lower	Lower impact on the main functionality of the process/facility	Access Cover, Louver, Spray System, Air Receiver, Water Softener
1 - Lowest	Lowest impact on the main functionality of the process/facility	Concrete Pad, Exhauster, Paving, Fence, Roof, Trailer, Walkway

4.2 Risk Results

4.2.1 Probability of Failure Summary Results

- The Probability of Failure (PoF) was generated for each WRP asset based on one of two following approaches.
- Condition score for approximately 30% of the WRP's assets generated during the focused field condition assessment.
- Desktop assessment of approximately 70% of the WRP's assets based on:
  - Age

- Institutional knowledge
- Desktop review of the WRP performance data

Table 4-5 shows an example of how assets with a condition score had the Percentage (%) Consumed used to calculate PoF and for assets without a condition score Remaining Useful Life was used to determine PoF. For example, the age of Motor No. 2 is beyond its expected useful life, however the percent consumed based on the condition score of 4 shows that the asset is in Fair condition and therefore has a percent consumed of 84% which results in a remaining useful life of 3 years.

Table 4-5: Calculation of PoF Example

Asset	Age	Condition	% Consumed	Expected Useful Life	Remaining Useful Life	PoF (%)
Concrete Vault	65	-	-	100	35	65
Motor No. 1	12	-	-	20	8	60
Motor No. 2	34	4	84	20	3	84
Ball Valve	36	5	100	30	0	100
MCC Cabinet	27	3	65	20	7	65
VFD	2	1	0	15	15	0

PoF thresholds for high, medium, low, and negligible categories were established as shown in Table 4-6 and the PoF was calculated for each category.

Table 4-6: PoF Thresholds

PoF	Threshold Values
High	Greater than 75%
Medium	Between 50% and 75% (including 75%)
Low	25% to 50% (including 25% and 50%)
Negligible	Less than 25%

Location-based results of the PoF assessment are shown on a map of the WRP in Figure 4-4 and Figure 4-5. The results indicated a majority of the WRP assets with "Medium" or "High" PoF scores are scattered throughout the WRP versus being concentrated in one area.

Figure 4-4: Summary of PoF Results (Colored Map)

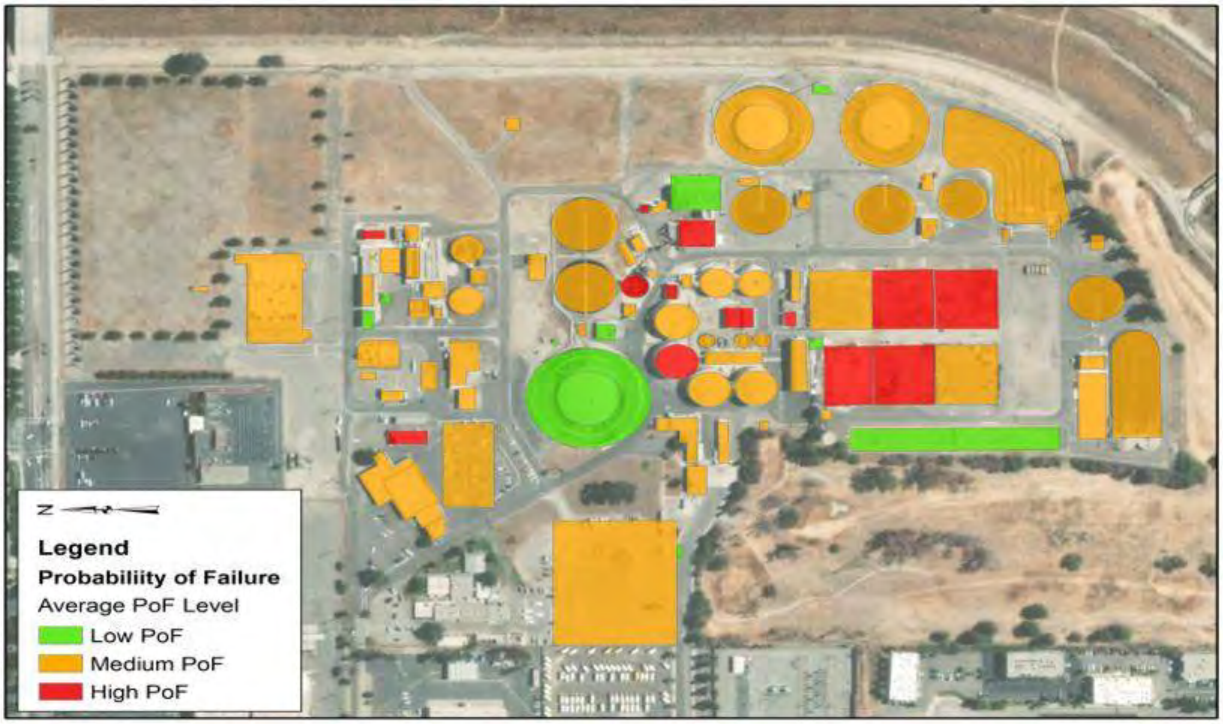


Figure 4-5: Summary of PoF Results (Grayscale Map)

Figure 4-6 presents examples of assets that are reaching the end of their useful life and have the highest PoF score.

Figure 4-6: Examples of Assets with Highest PoF

Scum Pump No. 1 (Unit 1 PS)

North Primary Clarifiers Platforms (Unit 2)

Foul Air Piping Assembly (South Digested Sludge Storage Area)

Equalization Pumps Control Panel (NRC Building)

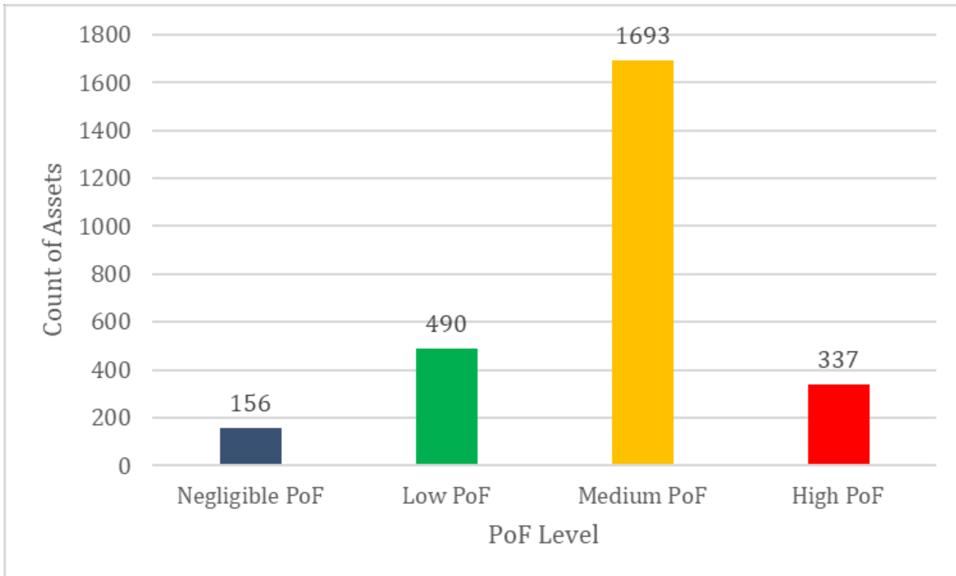
Table 4-7 presents the number of assets with high PoF at each of the different plant processes. A list of high PoF assets can be found in Appendix C.

Table 4-7: High PoF Assets per Process

Process	No. of Assets with High PoF	Percentage of Assets with High PoF
Headworks Chemical	1	13
Solids Chemical	1	7
Recycled Water	3	6
Electrical	7	14
Odor Scrubber Chemical	7	9
Outfall	8	21
Lift Stations	10	9
Non-Process	13	14
Preliminary	28	7
Solids Treatment	46	24
Solids Handling	48	11
Primary	50	17
Secondary	104	12
Total	326	12

Figure 4-7 summarizes the findings of PoF risk scores by showing the probability of failure and number of assets.

Figure 4-7: Summary of PoF Results



4.2.2 Consequence of Failure Summary Results

The process level and asset level CoF scores were combined using the formula presented in Figure 4-8 to come up with an overall CoF score. The product of Process-Level CoF and Asset-Level CoF were divided by 2.5 to adjust the final CoF score from 1-25 to 1-10. Table 4-8 presents the process/location level CoF results.

Figure 4-8: Final CoF Formula

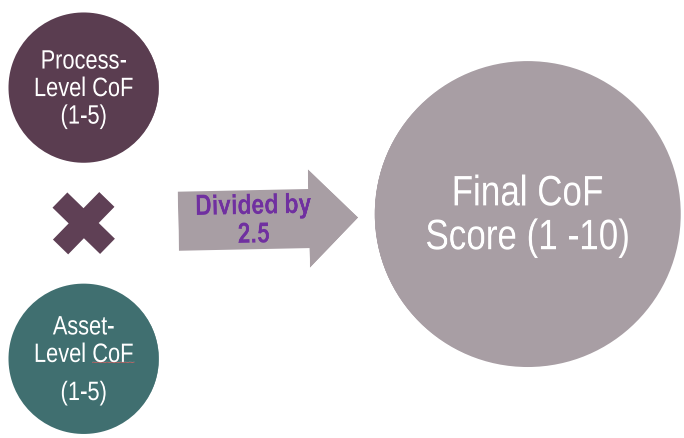


Table 4-8: Process/Location Level CoF

Process	Location	CoF
Electrical	Burner Building	5
Electrical	Cogeneration Building	5
Electrical	Hoffman Building	5
Electrical	Main Switchgear (BLM)	5

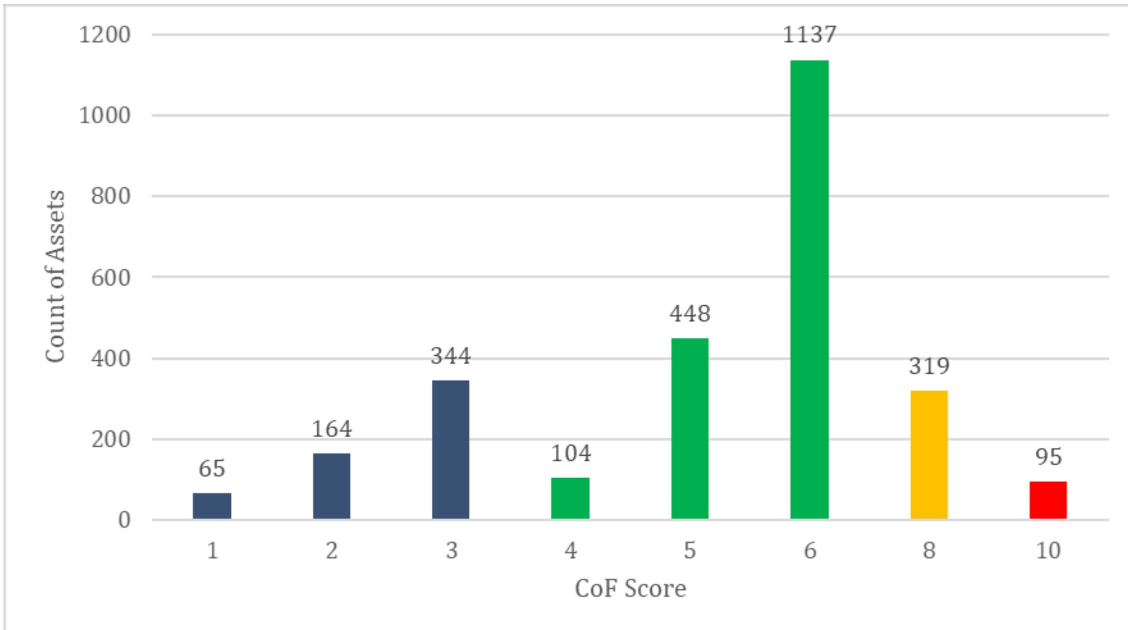
Process	Location	CoF
Electrical	Old Blue Generator Building	5
Gas Handling	Existing 0.06 Flare	5
Gas Handling	Gas Compression Area	5
Gas Handling	High Pressure Storage Tank (HPST)	5
Gas Handling	Low Pressure Holding Tank (LPHT)	3
Headworks Chemical	Ferric Chloride Storage Tank	2
Lift Stations	Arrowhead Lift Station	5
Lift Stations	East Influent Lift Station	5
Non-Process	Emergency Storage Container	5
Non-Process	Unit 1 Chlorine Contact Basins	5
Non-Process	Unit 2 Chlorine Contact Basins	5
Non-Process	Admin Bldg	2
Non-Process	Boneyard	1
Non-Process	Brine Ponds	1
Non-Process	Collections Parking Area	1
Non-Process	Collections Storage Building (Old Chlorine Building)	1
Non-Process	Electrical Administration Building	1
Non-Process	Electrical Supply Building	1
Non-Process	Employee Parking Lot	1
Non-Process	Equipment Storage Area	1
Non-Process	Facilities Shop	1
Non-Process	Instrumentation and Control Trailer	1
Non-Process	Irrigation Control Building	1
Non-Process	Maintenance Shop	1
Non-Process	Perimeter Fencing	1
Non-Process	Personnel Building	1
Non-Process	Secondary Administration Building	1
Non-Process	Tertiary Clarifier (Abandoned)	1
Non-Process	Tertiary Pump Building	1
Odor Scrubber Chemical	Sludge Storage Odor Scrubber	4
Odor Scrubber Chemical	Headworks Odor Scrubber	3
Outfall	North Outfall Structure	5
Outfall	Outfall Sampling Station	5
Outfall	South Outfall Structure	5
Outfall	Chlorine Contact Lagoon	1
Outfall	Outfall Bleach Tank	1
Preliminary	Bar Screen Building	5
Preliminary	Headworks Electrical Building	5
Preliminary	Headworks Generator Building	5

Process	Location	CoF
Preliminary	Influent Metering Structure	5
Preliminary	Internal Recycle Metering Structure	5
Preliminary	East Diversion Structure	4
Preliminary	Grit Chambers	4
Preliminary	Headworks Blower Building	3
Preliminary	Headworks Tunnel	3
Preliminary	2.5 MGD Maintenance Hole to IEBL	2
Preliminary	Grit Wash Building	2
Preliminary	Headworks Splitter Box	2
Preliminary	Septage & Brine Receiving Station	2
Preliminary	Operations Storage Building	1
Primary	Unit 2 North Primary Clarifier	4
Primary	Unit 2 Pump Station	4
Primary	Unit 2 South Primary Clarifier	4
Primary	Headworks Tunnel	3
Primary	Unit 1 PI/PE Junction Box	2
Primary	Unit 1 Primary Clarifier	2
Primary	Unit 1 Pump Station	2
Primary	Unit 2 Splitter Box	2
Primary	Unit 3 Primary Clarifiers	2
Recycled Water	Alternate 6-inch Potable Water Connection	2
Recycled Water	Century Well	2
Recycled Water	Chandler Well	2
Recycled Water	Golf Course and Caltrans Irrigation Meters	2
Recycled Water	Main Potable Water Feed Source	2
Recycled Water	Orange Show Well	2
Recycled Water	Tertiary Reservoir	2
Solids Chemical	Polymer Storage Area	3
Solids Chemical	Hazardous Materials Storage Area	2
Solids Handling	Dewatering & Thickening (D&T) Building	4
Solids Handling	Dewatering Building & Conveyors 1 & 2	4
Solids Handling	Truck Loading, Conveyors 3-5, & Storage Silo	2
Solids Handling	Bio-Solids Storage Beds	1
Solids Handling	Combination Truck Unloading Bed	1
Solids Handling	Grit Dewatering Bed	1
Solids Handling	Manual Biosolids Loading Bed	1
Solids Treatment	Boiler Building	5
Solids Treatment	Digester A	4
Solids Treatment	Digester C	4

Process	Location	CoF
Solids Treatment	Digester C&D Common Valve Vault	4
Solids Treatment	Digester D	4
Solids Treatment	Dissolved Air Flotation Thickener (DAFT) 1	3
Solids Treatment	Dissolved Air Flotation Thickener (DAFT) 2	3
Solids Treatment	Dissolved Air Flotation Thickener (DAFT) 4	3
Solids Treatment	North Digested Sludge Storage Tank	2
Solids Treatment	South Digested Sludge Storage Tank	2
Solids Treatment	Digester B	1
Secondary	Roots Blower Building	5
Secondary	Unit 2 Chlorine Contact Basins	5
Secondary	RS-1 Pump Station	4
Secondary	Unit 1 Aeration Basins	4
Secondary	Unit 1 East Secondary Clarifier	4
Secondary	Unit 1 West Secondary Clarifier	4
Secondary	Unit 2 North Aeration Basins	4
Secondary	Unit 2 North Secondary Clarifier	4
Secondary	Unit 2 Pump Station	4
Secondary	Unit 2 South Aeration Basins	4
Secondary	Unit 2 South Secondary Clarifier	4
Secondary	Nitrogen Removal Carousel	3
Secondary	NRC Anoxic Basins	3
Secondary	NRC Building	3
Secondary	NRC Secondary Clarifier	3
Secondary	Mixed Liquor Splitter Box	2

Figure 4-9 summarizes the findings of CoF risk scores by showing the consequence of failure and number of assets.

Figure 4-9: Summary of Final CoF Scores



Process level results of the CoF assessment are shown on a map of the WRP in Figure 4-10 and Figure 4-11. The results indicated the assets judged to have a higher consequence of failure are primarily associated with the primary, secondary and gas handling processes.

Figure 4-10: Process Level CoF Results (Colored Map)

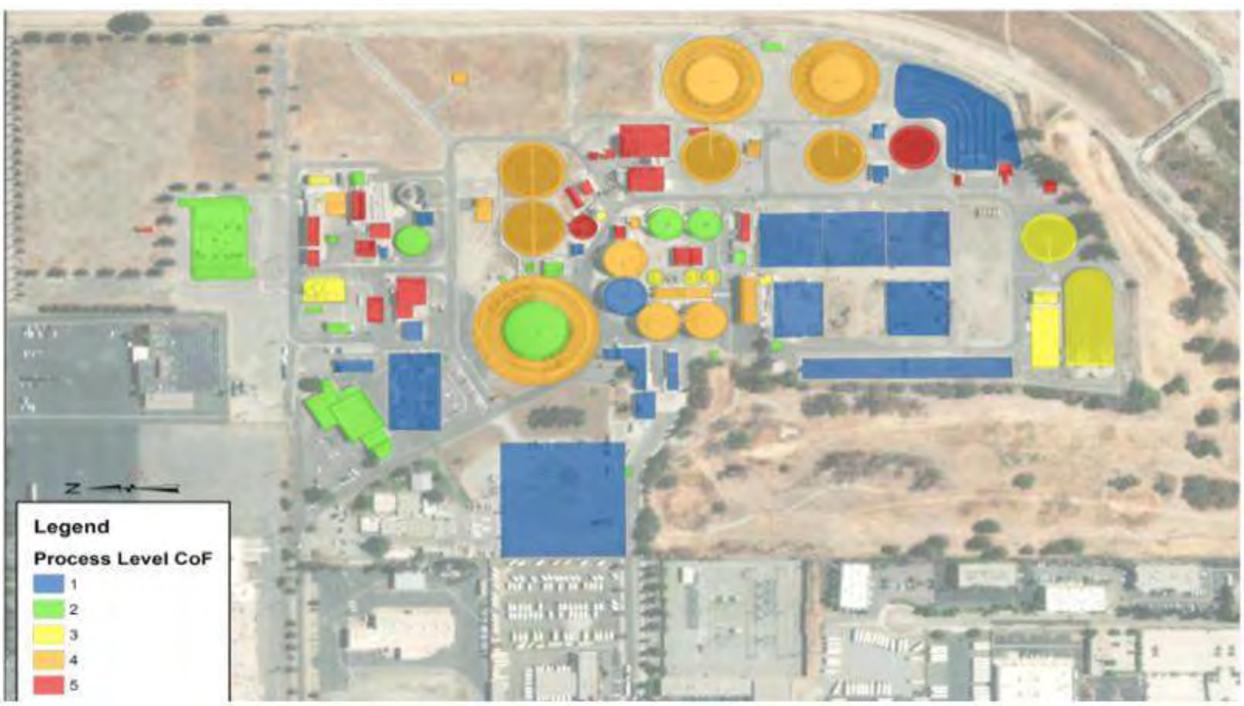


Figure 4-11: Process Level CoF Results (Grayscale Map)

Figure 4-12 presents examples of assets with a high level CoF.

Figure 4-12: Examples of Assets with High CoF


MCC 2 (Arrowhead Lift Station)


Gas Compression Area Flame Arrestors 1&2


Gas Sensor Assembly (Bar Screen Building)


Generator (Headworks Electrical Building)

Table 4-9 presents the number of assets with high CoF at each of the different plant processes. A list of high CoF assets is presented in Appendix C.

Table 4-9: High CoF Assets

Process	No. of Assets with High CoF	Percentage of Assets with High CoF
Solids Treatment	1	<1
Outfall	2	5
Primary	2	<1

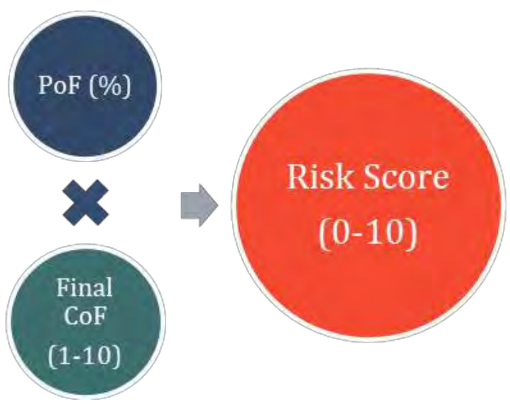
Process	No. of Assets with High CoF	Percentage of Assets with High CoF
Solids Handling	2	<1
Lift Stations	7	6
Gas Handling	2	3
Secondary	13	2
Preliminary	22	6
Electrical	30	58
Total	81	3

4.3 Business Risk Exposure Summary Results

Through a workshop, the Hazen team worked with SBMWD staff to determine the appropriate risk assessment methodology to calculate the risk score for each asset.

Business Risk Exposure (BRE) is a component of both the probability of failure and consequence of failure based on the formula presented in Figure 4-13.

Figure 4-13: Business Risk Exposure Formula



Mapping the risk results on a matrix is a powerful tool to visualize how each asset is scored against the main constituents of the risk (PoF and CoF). The risk matrix, presented in Figure 4-14, demonstrates the probability of failure on the vertical axis and consequence of failure on the horizontal axis. The numbers inside the individual cells denote the number of assets identified in that risk level.

Figure 4-14: Risk Matrix

PoF	100%	5	6	11	5	28	57	-	16	-	5
	90%	-	1	1	-	2	3	-	-	-	-
	80%	10	11	30	3	33	79	-	25	-	6
	70%	37	119	219	76	283	701	-	188	-	62
	60%	-	1	-	-	3	1	-	-	-	-
	50%	-	-	-	5	-	2	-	-	-	1
	40%	10	23	45	14	76	233	-	64	-	15
	30%	1	1	-	-	2	-	-	1	-	-
	20%	-	-	1	-	7	-	-	-	-	-
	10%	-	-	-	-	4	1	-	-	-	-
	0%	2	2	37	1	10	60	-	25	-	6
	Count of Assets	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
		CoF									

Assets within the WRP were mapped on the risk matrix based on their categories (i.e., High, Medium, and Low). The risk matrix was categorized and color-coded into high, medium, and low risk zones (red, orange, and green respectively). Assets located on the top-right corner of the risk matrix are considered high risk and assets located on the bottom-left of the risk matrix are considered low risk assets. Here is a summary of the logics set up to categorize assets into high, medium, and low risk zones:

- For assets with High PoF:
  - If the CoF is Medium or High, the asset is considered High Risk
  - If the CoF is Low or Negligible, the asset is considered Medium Risk
- For assets with Medium PoF:
  - If the CoF is High, the asset is considered High Risk
  - If the CoF is Low or Medium, the asset is considered Medium Risk
  - If the CoF is Negligible, the asset is considered Low Risk
- For assets with Low PoF:
  - If the CoF is Medium or High, the asset is considered Medium Risk
  - If the CoF is Negligible or Low, the asset is considered Low Risk
- For assets with Negligible PoF:
  - Regardless of the CoF score, the asset is considered Low Risk

Table 4-10 presents the number of assets with high risk BRE scores at each of the different plant processes. A list of high risk BRE assets is shown in Appendix C.

Table 4-10: High Risk Assets

Process	No. of Assets with High CoF	Percentage of Assets with High CoF
Solids Handling	2	<1
Primary	3	1
Outfall	7	18
Lift Stations	9	8
Secondary	10	1
Solids Treatment	14	8
Electrical	29	29
Preliminary	29	7
Total	103	4

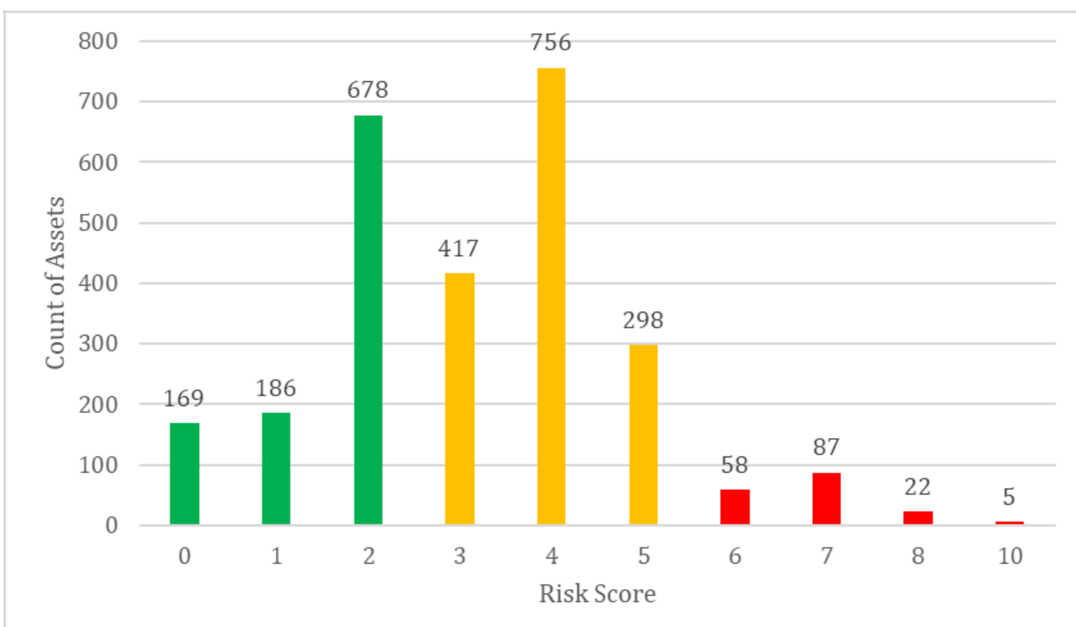
Figure 4-15 and Figure 4-16 show location-based BRE results.

Figure 4-15: Location-Based BRE Results (Colored Map)

Figure 4-16: Location-Based BRE Results (Grayscale Map)

Figure 4-17 presents the count of assets for each BRE score of 0 through 10.

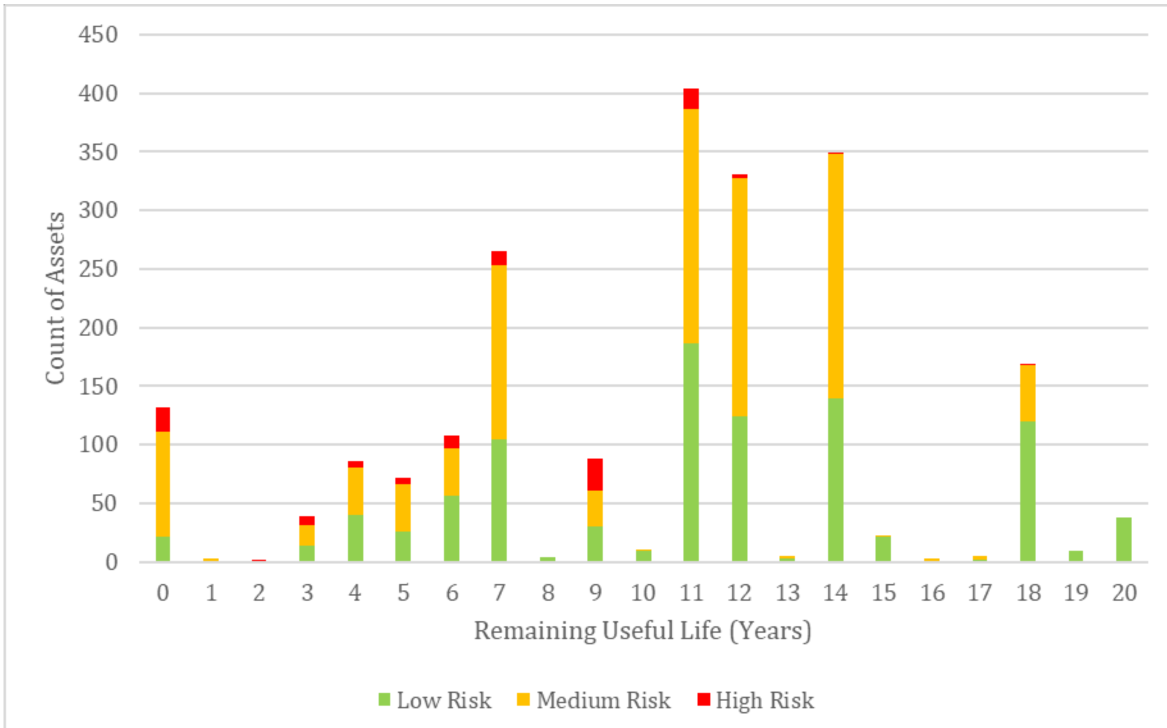
Figure 4-17: Asset Count by BRE Score



The results of the risk assessment are combined with the results of the remaining useful life analysis in order to prioritize the replacement of the assets. Figure 4-18 exhibits a risk-based prioritization of assets by categorizing the assets that are reaching the end of their useful lives in the next 20 years into high risk, medium risk, and low risk. This will help

SBMWD to prioritize the rehabilitation and replacement investments by focusing on assets with higher business risk exposure.

Figure 4-18: Risk-Based Prioritization of Assets



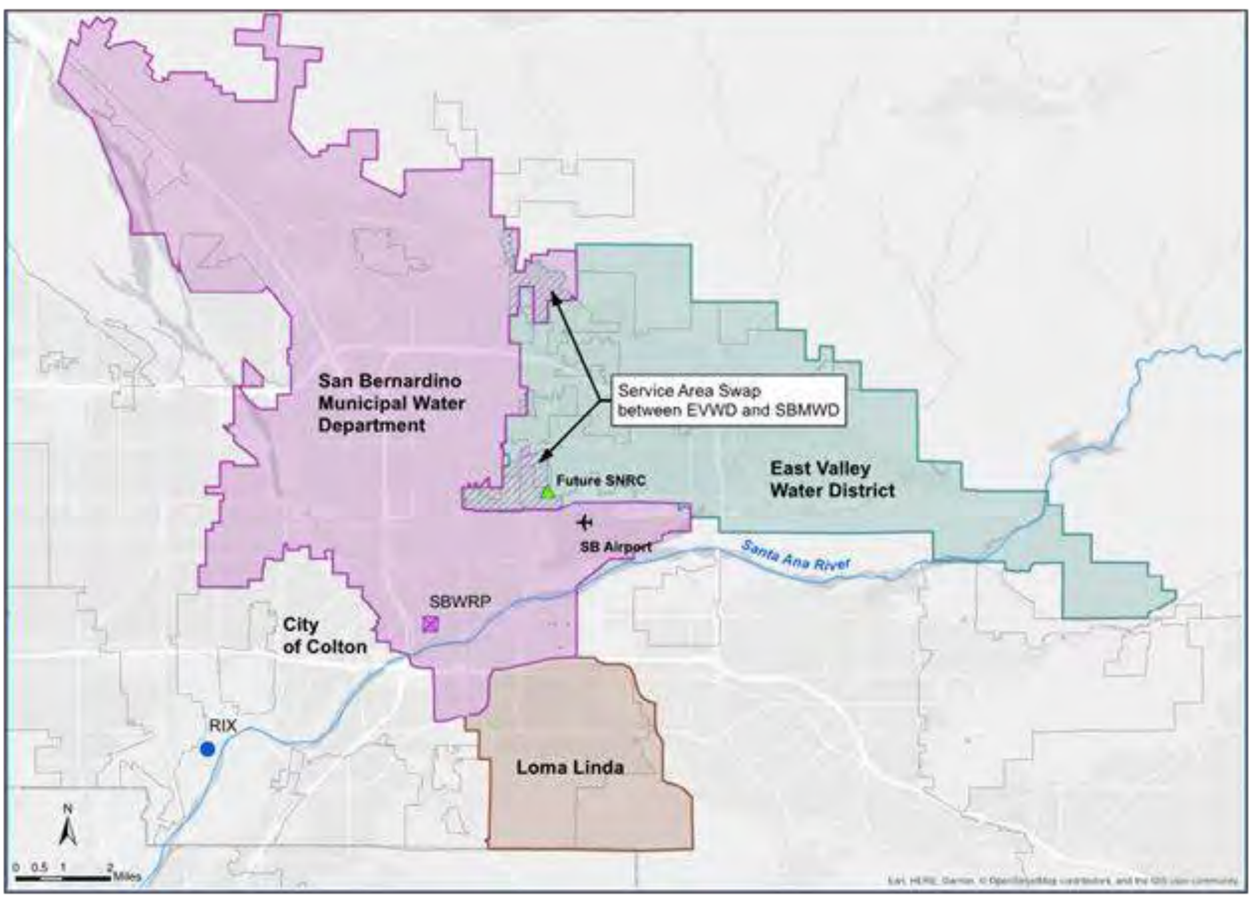
The results show approximately 132 assets have reached the end of their useful life. The list of assets at the end of their useful life that are high and medium risk can be found in Appendix C.

5. FACILITY PLANNING ASSUMPTIONS

Facilities master planning for the SBWRP addresses numerous water resource considerations such as stormwater management, liquefaction and flooding potential, and planned water recycling projects at the site. In addition to these site-specific concerns, there are offsite projects with impacts to the SBWRP: the future East Valley Water District (EVWD) Sterling Natural Resource Center (SNRC) in the City of Highland that will reduce wastewater flow to the SBWRP; and the Santa Ana River discharge requirements from the Rapid Infiltration Extraction (RIX) facility that may impact the volume of water that can be recycled at the SBWRP. This Section discusses how these water resource considerations impact facility planning for the SBWRP.

Figure 5-1 presents the setting for many of the planning assumptions. The shaded areas represent the current service areas for the SBWRP, including the City of San Bernardino Municipal Water Department, the East Valley Water District, and the City of Loma Linda. At the RIX facility in the City of Colton, secondary treated wastewater from SBWRP's service area combines with flows from outside its service area, including the City of Colton and the satellite collection system of the City of Grand Terrace. The secondary-treated wastewater is further combined with extracted groundwater and undergoes tertiary treatment at RIX before it is discharged to the Santa Ana River.

Figure 5-1: Planning Assumption Setting



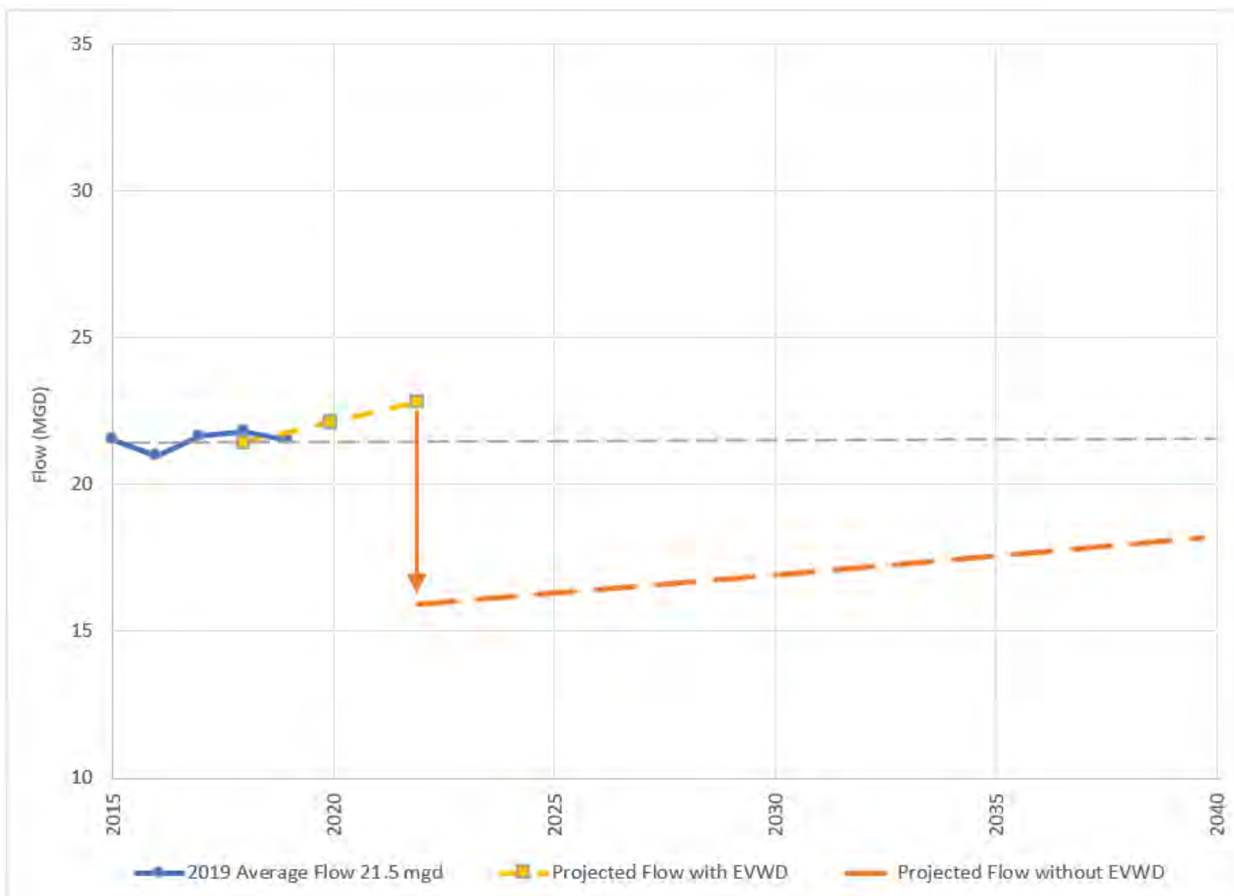
5.1 Current Projects with Potential Impacts to the Facilities Master Plan

5.1.1 East Valley Water District Sterling Natural Resource Center

Wastewater produced in East Valley Water District (EVWD) is currently treated at the SBWRP. GIS analysis shows that approximately 13% of San Bernardino's land area is contained within EVWD's service area. Flow from the EVWD combines with flow from the SBWRP service area and enters the plant through the East Trunk Sewer. The flow contribution from EVWD is approximately 6 mgd or 28% of the current SBWRP flow.

EVWD is building a new water recycling plant called the Sterling Natural Resources Center (SNRC) that, when complete, will divert EVWD's wastewater flow from the SBWRP to a new reclamation facility in Highland (Figure 5-1). The SNRC will produce Title 22 disinfected tertiary recycled water to recharge the Bunker Hill Groundwater Basin and meet environmental commitments to the Santa Ana River. The SNRC is under construction and anticipated to be completed in October/November 2021. When the SNRC starts up, an estimated 6 mgd of flow will cease to flow to the SBWRP. As shown on Figure 5-2, anticipated growth in the SBWRP service area from 2023 to 2040 will make up a portion of the loss of flow from EVWD; however, growth will not likely fully recover the loss of 6 mgd of EVWD flow by the year 2040.

Figure 5-2: Projected Wastewater Flow



The net flow decrease from the EVWD will have multiple impacts to operation of the SBWRP, including a loss of approximately 28% of the total flow into the plant. Because the cost structure for the SBWRP is a combination of costs that are fixed (not flow-dependent) and variable (flow-dependent), the corresponding operational savings from the future flow reduction is estimated at less than 10% (Section 10.2.2). Without options to divert wastewater from other sources, the Department must make changes to minimize the impact to rates within the SBWRP service areas.

5.1.2 East Valley Water District Sewer Exchange Flow Agreement

A small portion of flow from EVWD will be diverted to SBWRP as part of a sewer exchange flow Agreement. The sewer exchange flow Agreement between EVWD and SBMWD stipulates that 398,500 gpd from EVWD service area will be diverted to the SBWRP and 355,746 gpd from SBWRP will be directed to the SNRC. The sewer exchange areas are shown on Figure 5-1.

5.1.3 Clean Water Factory

The SBMWD is planning a recycled water project called the Clean Water Factory (CWF) which will be a Title 22-compliant tertiary treatment facility that will supply recycled water for:

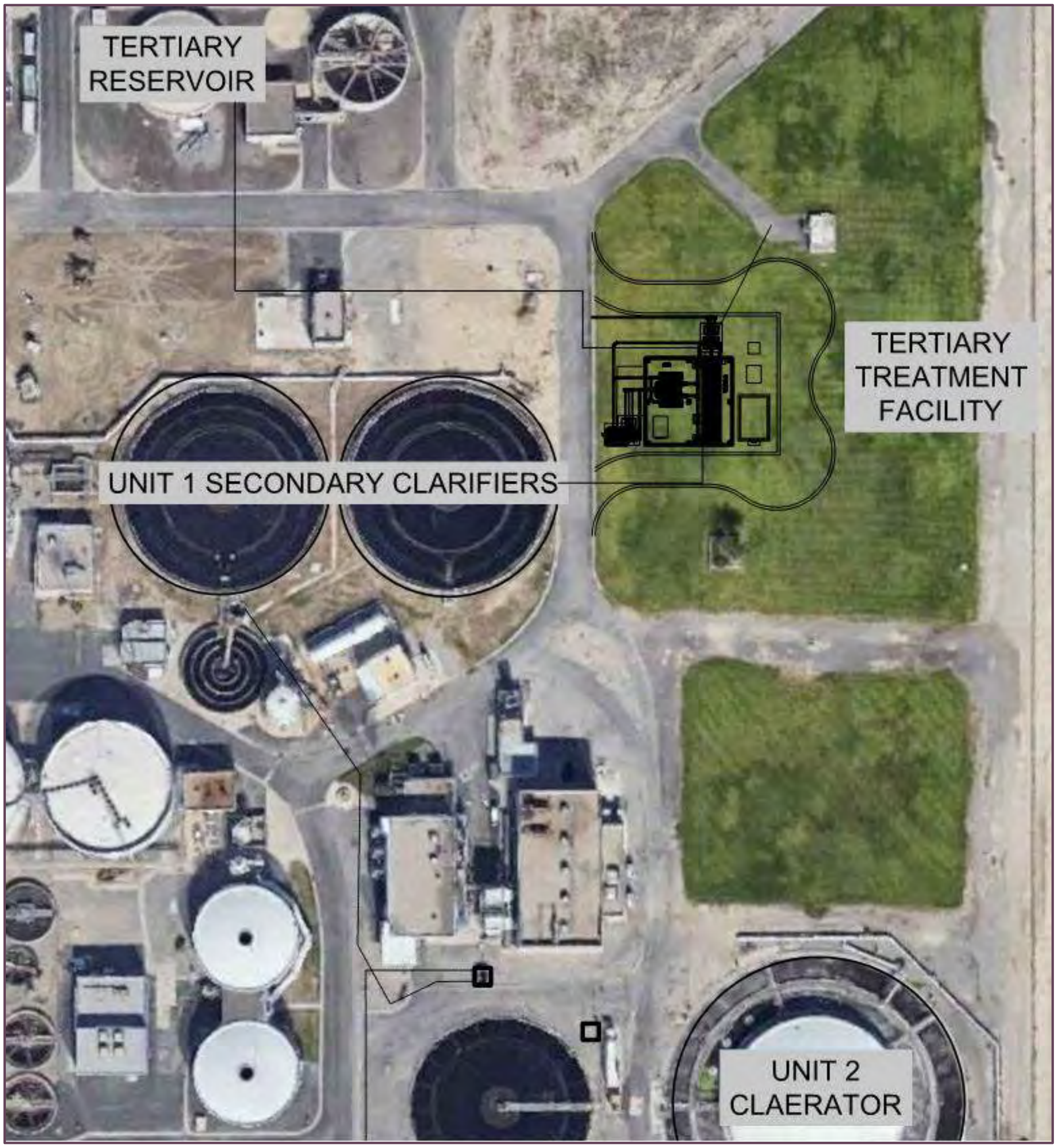
- Operational needs within the plant, eliminating in-plant use of groundwater and onsite groundwater storage
- Groundwater recharge of the Bunker Hill Groundwater Basin, which is SBMWD's sole source of water supply
- Supplying potential future recycled water customers.

The CWF is currently in the preliminary design phase and is expected to be operational in 2021. Based on the preliminary design, the CWF is sited on the former site of the pre-aerator structure, a currently unused area, east of the Unit 1 secondary clarifiers as shown in Figure 5-3. The design includes a new pump station and pipelines to convey secondary effluent to new filtration and disinfection processes. After treatment, the tertiary recycled water will be stored in an existing reservoir that will be rehabilitated and modified to store tertiary effluent (existing reservoir currently stores groundwater). Production of tertiary disinfected recycled water from the CWF will be phased with provisions to allow future expansion of up to 5 mgd (AECOM, 2019) and will only occur in the volume that exceeds discharge commitments to the SAR from the RIX.

The CWF has been approved for funding through the San Bernardino Valley Municipal Water District (Valley District) Local Resource Investment Program (LRIP). The LRIP has a target of investing in 15,000 acre-feet of locally supplied water in the region. The Valley District Board of Directors approved the Clean Water Factory for funding of approximately $970,000 per year for 20 years once the project comes online in 2021 (based on a production rate of 5,600 AF (5 mgd) of recycled water).

The CWF presents implications to the Facilities Master Plan and future operation of the SBWRP. Space needs to be reserved and power requirements and other interfacing issues need to be considered. The CWF will require consistent influent water quality from the SBWRP. There are also minimum discharge requirements to the Santa Ana River through the RIX facility that may limit recycled water production (Section 5.2).

Figure 5-3: Proposed Clean Water Factory Tertiary Treatment Facility



Source: AECOM, 2019, Tertiary Treatment System Design Plans (Progress Set)

5.2 Santa Ana River Discharge Considerations

Discharges to the Santa Ana River are one of the considerations for the SBWRP Facilities Master Plan. Some of the wastewater treatment and water reclamation plants that discharge to the Santa Ana River are obligated to provide certain volumes of water into the river to satisfy legal and environmental requirements downstream. Further, management of groundwater levels below the Rapid Infiltration Extraction (RIX) facility requires the extraction of additional volumes of groundwater, which are discharged to the Santa Ana River. The following sections briefly describe the Santa Ana River discharge considerations for the SBWRP.

5.2.1 Rapid Infiltration Extraction Facility

Effluent from the SBWRP is currently conveyed to the RIX facility located at 1990 Agua Mansa Road in Colton for additional treatment prior to discharge to the Santa Ana River. RIX was established in 1994 as a method to effectively meet the filtration and disinfection requirements for discharge to the Santa Ana River. RIX is jointly owned by the City of San Bernardino and the City of Colton through a Joint Powers Authority (JPA), which created the "Colton/San Bernardino Regional Tertiary Treatment and Reclamation Authority."

RIX infiltrates secondary treated wastewater from the SBWRP and the City of Colton's wastewater treatment plant. The secondary effluent plus a small volume of native groundwater is extracted prior to discharge. The soil beneath the percolation ponds provides additional filtration, which is then followed by ultraviolet (UV) disinfection before discharge to the Santa Ana River. RIX is permitted to treat an influent flow rate of up to 40 mgd, with the subsequent UV disinfection system designed to treat 64 mgd to account for the extracted groundwater.

As shown in Table 5-1, from August 2018 through July 2019, the influent flow to RIX was approximately 26.5 mgd, with 80% from the SBWRP (21.5 mgd) and 20% from the City of Colton (5.0 mgd). The monthly discharge from RIX to the Santa Ana River averaged 29.3 mgd for this 12-month period, including 2.8 mgd of extracted groundwater (Colton/San Bernardino Tertiary Treatment and Reclamation Authority, August 2018 - July 2019). The volume of native groundwater that is over extracted has been approximately 10% of the secondary influent volume in recent years, but historically has been as high as 40%.

Table 5-1: RIX Flows August 2018 – July 2019

Month		Influent from SBWRP	Influent from Colton	Extracted Groundwater	Discharge to Santa Ana River
Aug 2018		22.3	5.0	2.4	29.6
Sep 2018		22.1	4.8	2.8	29.8
Oct 2018		21.9	4.8	2.9	29.6
Nov 2018		21.6	4.9	2.5	28.9
Dec 2018		20.9	5.2	2.8	28.9
Jan 2019		21.7	5.2	2.6	29.5
Feb 2019		22.1	5.4	3.1	30.6
Mar 2019		20.7	5.1	3.1	28.9
Apr 2019		20.7	5.0	2.5	28.2
May 2019		21.0	4.9	3.1	29.0
Jun 2019		21.4	5.0	3.3	29.7
Jul 2019		22.0	5.1	2.7	29.8
12-month average	mgd	21.5	5.0	2.8	29.3
	AFY	24,100	5,600	3,100	32,800

Source: Colton/San Bernardino Tertiary Treatment and Reclamation Authority Daily Monitoring Report

5.2.2 1969 Judgement Water Discharge Obligations to the Santa Ana River

The "1969 Judgement" requires the City of San Bernardino, through the Valley District, be responsible for a baseflow volume in the Santa Ana River at Riverside Narrows, adjusted annually (Superior Court of the State of California for the County of Orange, 1969). The volume requirement is adjusted for quality based on the weighted annual average of total dissolved solids (TDS) in baseflow and storm flow at Prado Dam. To accomplish the legal flow obligation, the SBWRP must discharge 16,000 AFY (14.28 mgd or 22.10 cubic feet per second (cfs)) to the Santa Ana River, which is accomplished through the RIX facility.

An agreement made in 1972 between the Valley District and the City of Colton requires the City of Colton to continue discharging from its sewage works to the Santa Ana River. In the 1972 Agreement, the City of Colton agreed to discharge at least 2,450 AFY (2.19 mgd or 3.38 cfs) to the Santa Ana River (San Bernardino Valley Municipal Water District and City of Colton, 1972). The City of Colton's discharge for the 12-month period from August 2018 through July 2019 was approximately 5,600 AFY (5 mgd or 7.74 cfs) through the RIX facility.

5.2.3 Upper Santa Ana River Habitat Conservation Plan

The Upper Santa Ana River Habitat Conservation Plan (HCP) is a collaborative effort among the water resource agencies of the Santa Ana River Watershed, in partnership with the United States Fish and Wildlife Service (USFWS), California Department of Fish and Wildlife (CDFW), and several other government agencies and stakeholder organizations. The purpose of the HCP is to enable the water resource agencies to continue to provide and maintain a secure source of water for the residents and businesses in the watershed, and to conserve and maintain natural rivers and streams that provide habitat for a diversity of unique and rare species in the watershed. The HCP allows water resource agencies to maintain, operate, and improve their water resource infrastructure while adhering to federal and State endangered species acts (Upper Santa Ana Habitat Conservation Plan, n.d.).

In April 2014, the SBMWD and the Valley District, together with nine other public agencies, began joint development of the HCP in order to obtain incidental take authorization under the Federal Endangered Species Act and California Endangered Species Act for various proposed water supply projects and maintenance activities in the Santa Ana River watershed. Formation of a JPA and joint funding agreements are underway. Agreements will lay out the financial and resource obligations of each agency and memorialize the minimum discharge requirements for each agency.

The HCP has preliminarily identified the need to maintain 35 cfs (22.6 mgd) of flow resulting from treated wastewater discharge to the Santa Ana River as measured in the Santa Ana River reach immediately below the RIX Facility. The 35 cfs treated wastewater discharge will be provided by RIX and other upstream dischargers.

5.2.4 Center for Biological Diversity Agreement

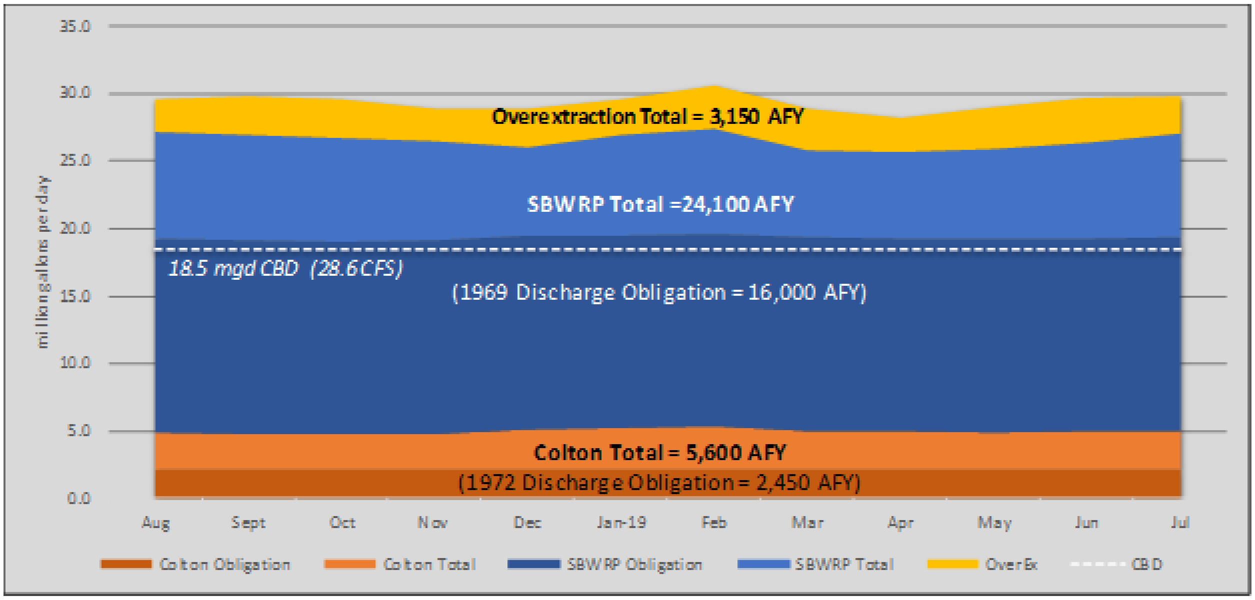
On October 2, 2018, the SBMWD entered into an agreement to settle litigation filed by the Center for Biological Diversity (CBD) and San Bernardino Valley Audubon Society. Regarding SBWRP flows to the Santa Ana River and the Clean Water Factory Project, the Agreement requires the SBMWD to:

- Maintain a minimum discharge of 28.6 cfs (18.5 mgd) to the Santa Ana River from the RIX facility from June 1 to October 15 of each year, in perpetuity, subject to certain terms and conditions.
- Coordinate the operation of the Retrofit Project with operation of the "Rialto Tank Project" to aid in temperature management of water in the Rialto Channel for Santa Ana sucker benefit, clear sand off beds and address needs for hydrologic continuity below RIX during times of RIX shutdown.
- Prepare a pumping analysis of the effects of over-extraction associated with the Clean Water Factory Project and the Retrofit Project and implement certain pumping limits that may be identified as a result of that analysis.

In January 2019, the SBMWD and the Valley District signed an agreement to work together to carry out obligations under the 2018 agreement and develop groundwater recharge projects (San Bernardino Valley Municipal Water District, 2019).

During the 12-month period analyzed, combined flows from the SBMWD, City of Colton, and groundwater over-extractions resulted in discharges to the Santa Ana River from RIX that averaged 29.3 mgd and exceeded the CBD agreement flow by 9 to 12 mgd. The discharge obligations from the 1969 and 1972 agreements were also both exceeded. Recent flows that make up the total discharge to the Santa Ana River from RIX are presented graphically in Figure 5-4. The CBD Agreement flow requirement and the discharge obligations from the 1969 Western Judgement and 1972 Agreement are also indicated.

Figure 5-4: RIX Flows and Discharge Obligations to the Santa Ana River: August 2018 – July 2019



5.2.5 Impacts to the Facilities Master Plan

The flow of secondary effluent from the SBWRP to the RIX facility is expected to be lower in the year 2040 due to loss of wastewater flows from the East Valley Water District (EVWD) (see Section 6.1.2). Future growth will likely make up some of the lost flow; however, even with assumed future growth, 2040 flows are projected to be lower than current flows (see Section 6.1.3).

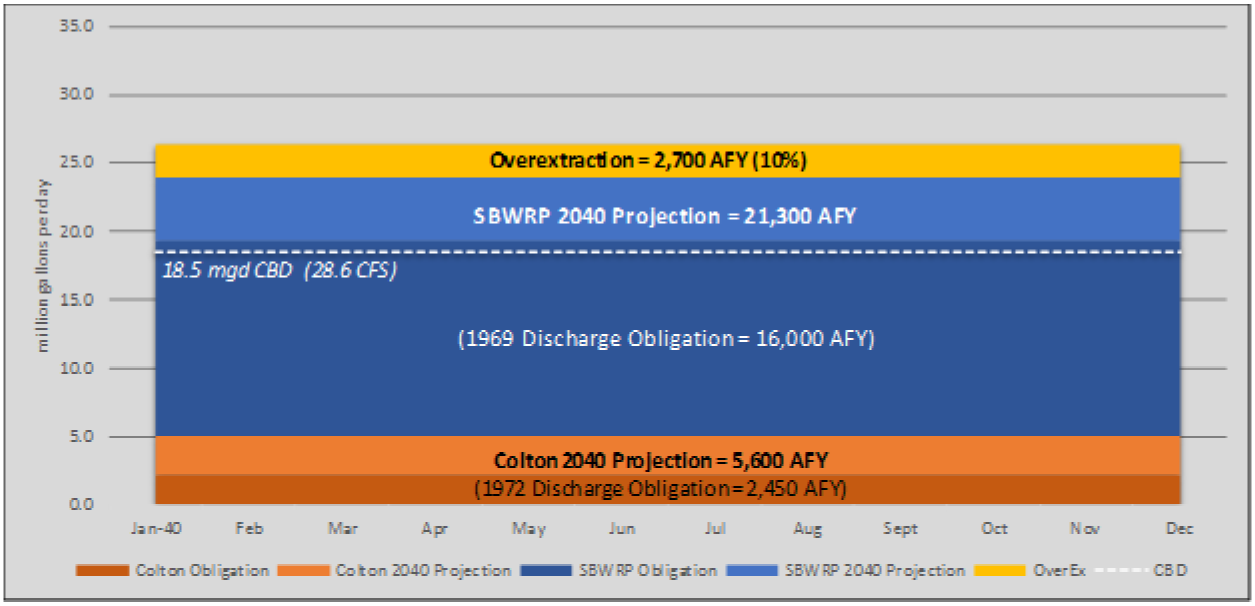
Projected 2040 discharge from the RIX facility is summarized in Table 5-2 and Figure 5-5 assuming the contribution from SBWRP is reduced to approximately 19 mgd (21,300 AFY) due to the EVWD SNRC Project. Flow from Colton was not analyzed and therefore is shown at the current rate of 5 mgd (5,600 AFY) with no adjustment for future growth. The over-extracted groundwater is assumed to remain at approximately 10% of the RIX influent. Based on these assumptions, the RIX facility is projected to discharge a maximum of approximately 26.4 mgd (29,600 AFY) to the Santa Ana River in the year 2040.

Table 5-2: Projected RIX Flows to the Santa Ana River 2040

Units	Influent from Colton	Influent from SBWRP	Over-Extracted Groundwater	Discharge to Santa Ana River
AFY	5,600	21,300	2,700	29,600
mgd	5.0	19.0	2.4	26.4

SBMWD intends to meet all discharge obligations at the RIX facility and plans to utilize remaining water for beneficial use in the Bunker Hill Groundwater Basin, which is SBMWD's sole source of water supply. In the future, if the City of Colton decides to implement a recycled water project that results in a reduction of its discharge, the impact to the Santa Ana River will have to be considered.

Figure 5-5: RIX Flows to the Santa Ana River: 2040 with Projected Flows from SBWRP and Colton



5.3 Flood Hazard

The SBWRP site is adjacent to East Twin Creek, which is a south flowing tributary to the Santa Ana River. Twin Creek is channelized by earthen levees along the eastern boundary of the SBWRP, which protects much of the site from flooding. The potential for flooding on the SBWRP site is generally higher on the southern portion of the site where Twin Creek turns southwest before merging with the Santa Ana River. In this area, offsite stormwater can flow from the adjacent former golf course under a fence located at the southern end of the plant. Stormwater either percolates into the permeable soil onsite or flows into the chlorine contact lagoon (San Bernardino Municipal Water Department, 2018).

The northern portion of the site along Orange Show Road is not mapped within a flood hazard area (Exhibit 3, attached). The remainder of the site south of Chandler Place/East Dumas Street is mapped within areas of flood hazard. Most of the site is within Zone X with a 0.2% annual chance of flood hazard, which would constitute the 500-year event. In the southeast portion near the chlorination lagoon where the creek bends to the southwest is an area mapped within Zone A with a 1% annual chance of flood hazard (100-year event). Impacts to the chlorination lagoon from flooding are minimal because the lagoon is not currently in use and is not anticipated to be used in the future. Permanently abandoning the chlorination lagoon could be considered.

Per the Waste Discharge Requirements, the SBWRP shall be designed, constructed, operated and maintained to prevent inundation or washout due to a 100-year storm event (California Regional Water Quality Control Board, Santa Ana Region, 2017).

Per the City of San Bernardino Municipal Code, a Flood Control Development Permit shall be obtained before construction begins within any area of special flood hazards. To be granted a permit, the application would be required to show that the site is reasonably safe from flooding and that the proposed improvements do not adversely affect the carrying capacity of areas where base flood elevations have been determined but the floodway has not been designated. “Adversely affects" means that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water surface elevation of the base flood more than one (1) foot at any point (City of San Bernardino, 2019).

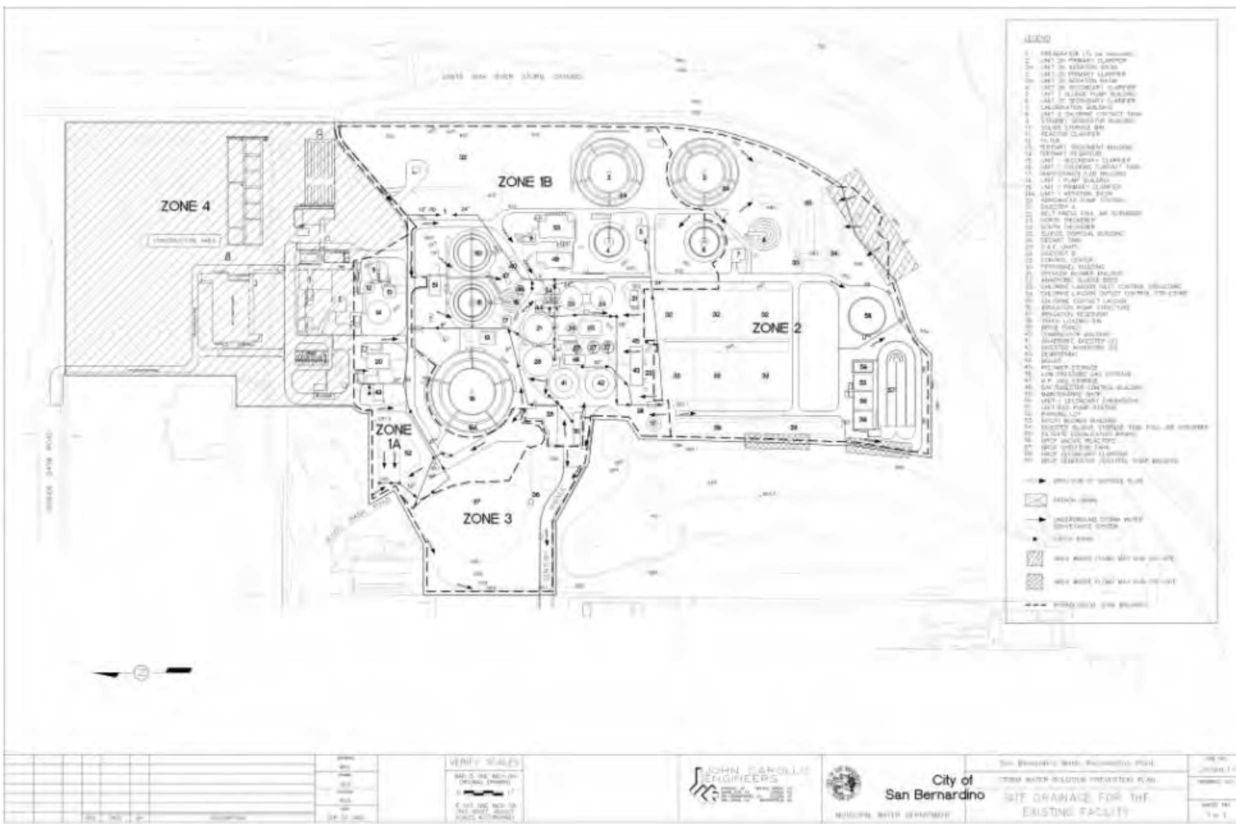
5.4 Stormwater Management

There are 16 cities as permittees under the San Bernardino County Municipal Separate Storm Sewer System (MS4) NPDES permit. The MS4 stormwater discharge permit is issued by the State of California through the Santa Ana Regional Water Quality Control Board. The San Bernardino County Flood Control District has been designated "Principal Permittee" and administers and coordinates many of the permit requirements on behalf of the other permittees (San Bernardino County Stormwater Program, 2019). As a permittee, the City of San Bernardino is required to comply with permit requirements for stormwater discharges.

In accordance with the Waste Discharge Requirements, a Stormwater Pollution Prevention Program (SWPPP) is maintained for the SBWRP. All significant spills and leaks that have occurred in the past five years were confined to the facility boundaries. No spills or leaks were discharged offsite or into the stormwater conveyance system (San Bernardino Municipal Water Department, 2018). Process areas are contained and drain to the headworks, and the facilities have performed as designed.

The Site Drainage Plan divides the SBWRP site into five zones, as illustrated on Figure 5-6 and described in the following sections.

Figure 5-6: Site Drainage Areas



5.4.1 Zones 1A and 1B

Zones 1A and 1B include primary and secondary clarification, aeration, anaerobic digestion, and sludge treatment. The SBWRP boundary for Zone 1A extends to the front of the Administration Building. The boundary for Zone 1B is adjacent to East Twin Creek, a tributary to the Santa Ana River. All stormwater and non-stormwater discharges in Zones 1A and 1B are conveyed to the facility headworks for treatment.

5.4.2 Zone 2

Zone 2 is at the southern end of the SBWRP and includes the Unit 2 South Primary Clarifier, sludge drying beds, biosolids storage bed, heavy equipment storage, chlorine contact area, and nitrogen-removal carousel equalization and oxidation processes (NRCP).The facility boundary for Zone 2 runs adjacent to East Twin Creek and the property that is former San Bernardino Golf Club. Stormwater which enters the process areas in Zone 2 is mixed and treated with the process water in each area. An earthen berm which extends between the eastern border of the property and the primary clarifiers prevents discharge from the property. Stormwater runoff from non-process areas typically percolates onsite, although during extreme events, a small portion may drain to the chlorine contact lagoon. The first flush will typically percolate onsite, while larger storms may run off-site to the adjacent former golf course and percolate.

5.4.3 Zone 3

This zone is located at the western end of the SBWRP. The gravel covered area serves as parking space for heavy equipment and vehicles. There are no industrial processes located in this area. Stormwater runoff from this area drains to street gutters that flow to the off-site Municipal Separate Storm Sewer System (MS4). Stormwater samples are taken at the facility boundary (Discharge Point S-001) prior to the stormwater discharging off-site into the MS4 drain located on Century Avenue.

5.4.4 Zone 4

This zone is located at the northeast area of the SBWRP and includes the odor control facilities, bar screen, and grit removal processes; Administration Building and parking lot; and an undeveloped vegetated area. The drainage system of Zone 4 consists of two separate drainage systems. The first system conveys process equipment drainage areas to a series of catch basins which transfer the stormwater to the plant headworks for treatment.

The second system conveys non-process drainage areas including streets, building roofs, vegetated areas, and parking lots to a collection structure. Discharge from the collection structure is typically pumped to the plant headworks for treatment. Discharge to the Santa Ana River storm channel via East Twin Creek will occur only during extreme wet weather events which generate excess stormwater runoff. The stormwater in the collection structure (Discharge Point S-002) is sampled before being released to East Twin Creek.

5.4.5 Offsite Stormwater Flows

In addition to stormwater drainage from the facility area, some stormwater generated off-site occasionally flows onto the facility from the adjacent former golf course to the southwest. At this location, stormwater flows under a fence at the southern end of the plant and either percolates into the soil or flows into the chlorine contact lagoon.

5.5 Groundwater

Three SBWRP wells were originally installed in the 1990s as dewatering wells to lower the high groundwater level and protect structures at the SBWRP from liquefaction. There are three SBWRP wells located onsite:

- Orange Show Well
- Chandler Well
- Century Well

In addition, a well owned by the Valley District is located at the south end of the SBWRP that is not currently used due to lack of water.

The Orange Show Well originally fed a pipeline to the City of Riverside. After the groundwater table declined, groundwater from these wells was used for non-potable purposes. Prior to the closure of the adjacent golf course to the southwest, the groundwater was used for golf course irrigation. Currently the groundwater is used for in-plant use and Caltrans irrigation. The Orange Show and Chandler wells pump to the groundwater storage tank. The Century Well pumps straight into the plant system (not into the storage tank).

Groundwater was observed as shallow as 21 feet below ground surface (bgs) in 1999 and as deep as 121.5 feet bgs in 2017. Observed groundwater levels for each of the wells recorded during their completion in the 1990s and during recent observations in 2017 are documented in Table 5-3.

Table 5-3: Observed Groundwater Levels

	Well Completion Report Data		Recent Soundings
Well	09/07/1993	03/05/1999	04/18/2017
Orange Show	--	21' bgs	121.5' bgs
Chandler	50' bgs	--	116.0' bgs
Century	52' bgs	--	116.7' bgs

Source: San Bernardino Municipal Water Department

The Department of Water Resources Water Data Library maintains data from the 1930s through 2010 from multiple wells on and near the SBWRP site. For the 80 years measured, the data show an overall declining trend in groundwater levels with the steepest declines occurring in the 1960s. Data for three wells on the SBWRP site for the 6-year period from the beginning of 2005 to the end of 2010 show the groundwater level continuing to decline. Figure 5-7 shows the groundwater level data from one onsite well declining from a depth of approximately 50 feet in 2005 to 100 feet in 2010.

Groundwater depths are approximately 50 to 100 feet below ground surface at the site. Thus, dewatering during construction of subsurface facilities is not anticipated; however, groundwater levels vary and should be re-evaluated prior to design and construction. Groundwater levels could recover in the future. Groundwater pumping for the onsite will be reduced after the Clean Water Factory is online and the groundwater storage tank is converted to recycled water storage. There was historically a risk of liquefaction as a result of high groundwater. If the groundwater table rises to similar historic levels, re-evaluation of liquefaction potential would also be needed.

Figure 5-7: Water Data Library Wells at SBWRP

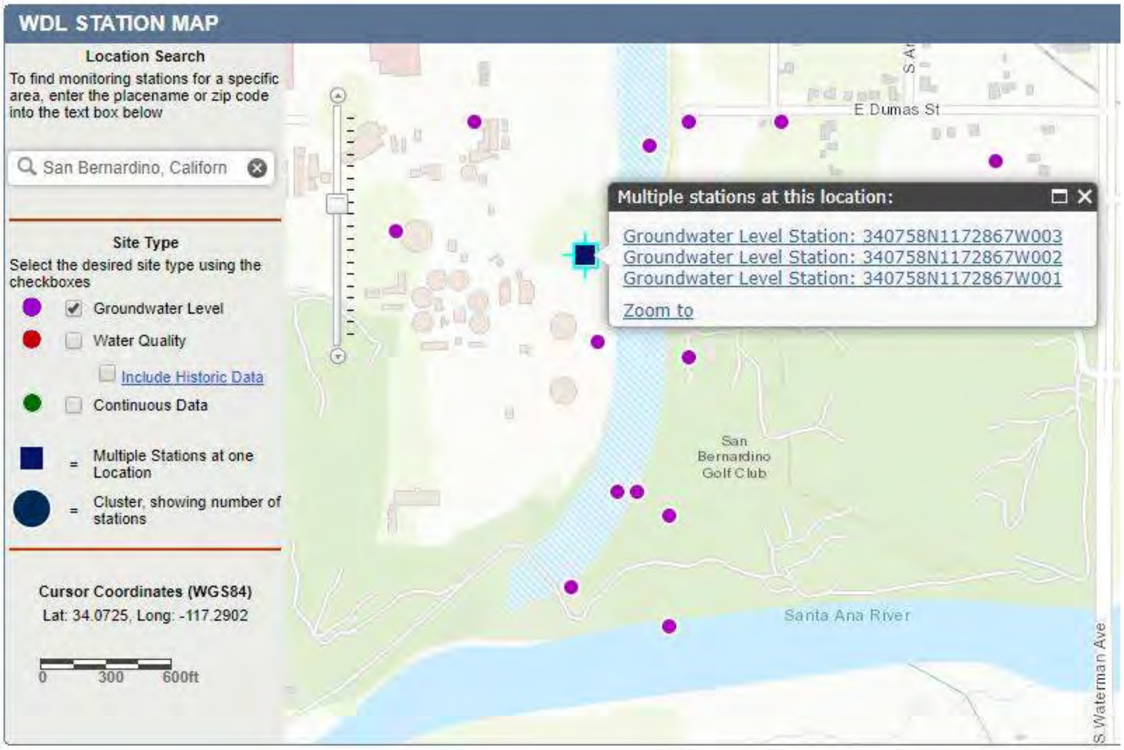


Figure 5-8: Water Data Library Wells at SBWRP

Source: http://wdl.water.ca.gov/waterdatalibrary/

5.6 Seismicity

The SBWRP is in an active seismic area and located about a mile northeast of the mapped San Jacinto fault and in an area with high potential for ground failure due to liquefaction (United States Geological Survey, 1991). The following seismic design factors were obtained from www.seismicmaps.org.

- Mapped Spectral Response Acceleration for Short Period (Ss) = 2.518
- Mapped Spectral Response Acceleration for 1-second Period (S1) = 1.154
- Design Spectral Response Acceleration for Short Period (SDS) = 1.678
- Design Spectral Response Acceleration for 1-second Period (SD1) = 1.154
- Risk Category: III
- Site: Class D (to be verified by geotechnical engineer)
- Seismic Design: Category D
- Seismic Importance Factor (IP) = 1.5

Seismic design factors shall be verified by the geotechnical engineer and considered during pre-design/design of any recommended projects. New structural facilities will be required to be designed in accordance with the California Building Code to withstand the appropriate seismic load and liquefaction potential, as applicable.

6. WASTEWATER CHARACTERISTICS

6.1 Flows and Loads Analysis

This Section analyzes historic and current flows and biological loading to the SBWRP and presents the methodology used to estimate the future flows and loads within the planning period. Flows and loads are projected to the year 2040; however, the accuracy of the future estimates declines the farther the projection into the future.

6.1.1 SBMWD, EVWD, and Loma Linda Service Areas Population Projections

The SBWRP currently treats wastewater from the City of San Bernardino, City of Loma Linda, the service area of the EVWD and some areas of unincorporated San Bernardino County. Flow to SBWRP comes from three collection system service areas: SBMWD, City of Loma Linda and EVWD. Due to the imminent cessation of EVWD wastewater flow to SBWRP, the three services areas were analyzed separately in order to accurately assess the remaining flow that the plant would receive in the medium term and at buildout.

Multiple sources were collected on the three service areas regarding population growth projections, including the City of San Bernardino Environmental Impact Report, Loma Linda General Plan, Southern California Association of Governments (SCAG) 2016 Growth Forecast, and the 2015 San Bernardino Valley Municipal Water District Urban Water Management Plan (UWMP). The SCAG growth population model projects growth within the confines of city limits, while the UWMP utilizes the Department of Drinking Water (DWR) population tool to estimate current population and project growth within the service area boundaries. Due to the consistency with SBMWD, City of Loma Linda, and EVWD service area boundaries, and consistency with the Draft SBMWD Sewer Master Plan, the UWMP population projections were selected as the basis for this Master Plan. The growth percentages are presented in Table 6-1.

Table 6-1: Projected Population Growth for SBMWD, Loma Linda and EVWD

	SBMWD	Loma Linda	EVWD
Current - 2020	0.7%	1.3%	3.8%
2020 - 2025	0.7%	1.3%	1.0%
2025 - 2030	0.7%	1.3%	0.8%
2030 - 2035	0.7%	1.3%	0.8%
2035 - 2040	0.7%	1.3%	0.8%

The population growth percentages were applied to current population estimates per the response letter dated February 21, 2018 from SBMWD to the Local Agency Formation Commission (LAFCO) for San Bernardino County. Current population estimates by service area are shown in Table 6-2, with projected population through 2040 in 5-year increments. Figure 6-1 depicts the projected populations for the same time period using both the San Bernardino Valley Municipal Water District UWMP figures and SCAG 2016 figures.

Figure 6-1: SBWRP Population Projections

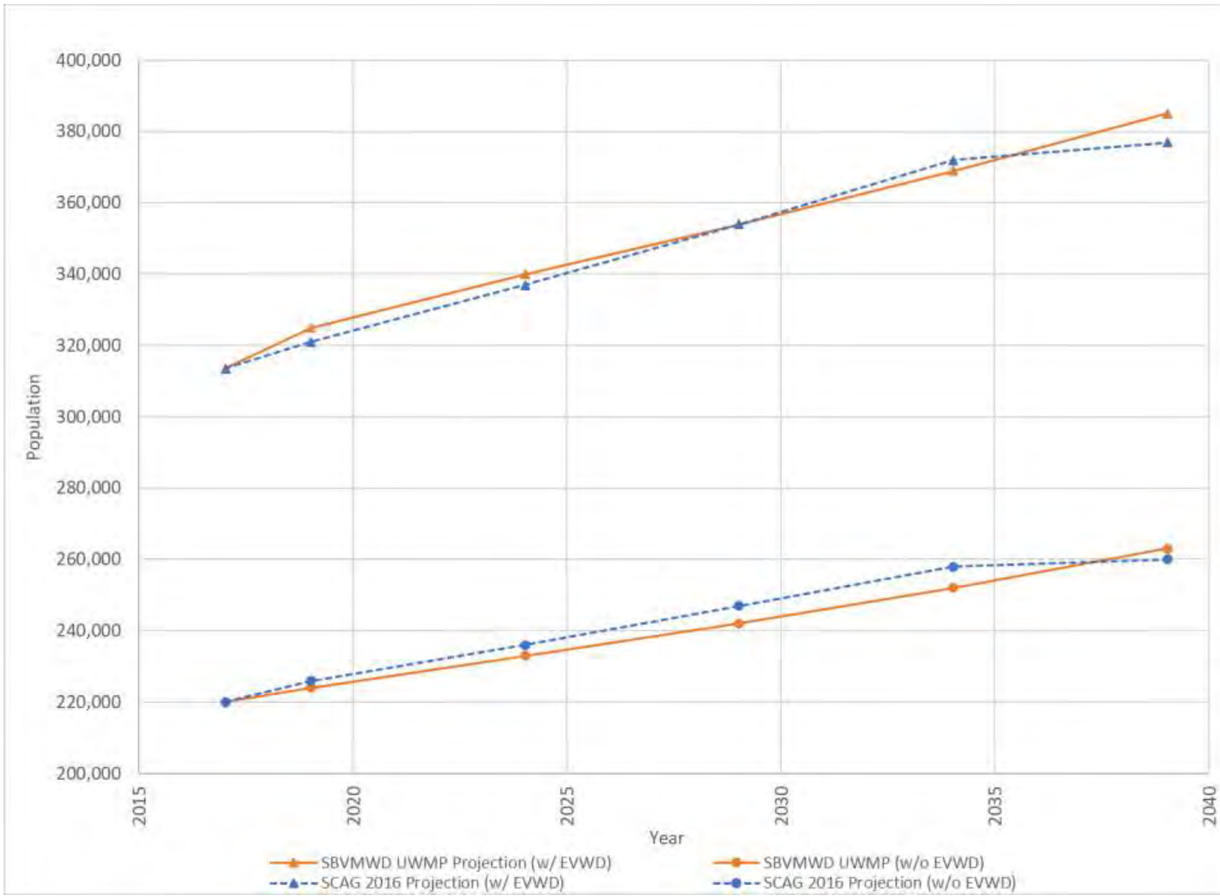


Table 6-2: Current and Projected Population of SBWRP Service Area

	SBMWD	Loma Linda	EVWD	Total not Including EVWD	Total Including EVWD
Current	195,000	25,000	93,500	220,000	313,500
2020	198,000	26,000	101,000	224,000	325,000
2025	205,000	28,000	107,000	233,000	340,000
2030	212,000	30,000	112,000	242,000	354,000
2035	220,000	32,000	117,000	252,000	369,000
2040	228,000	35,000	122,000	263,000	385,000

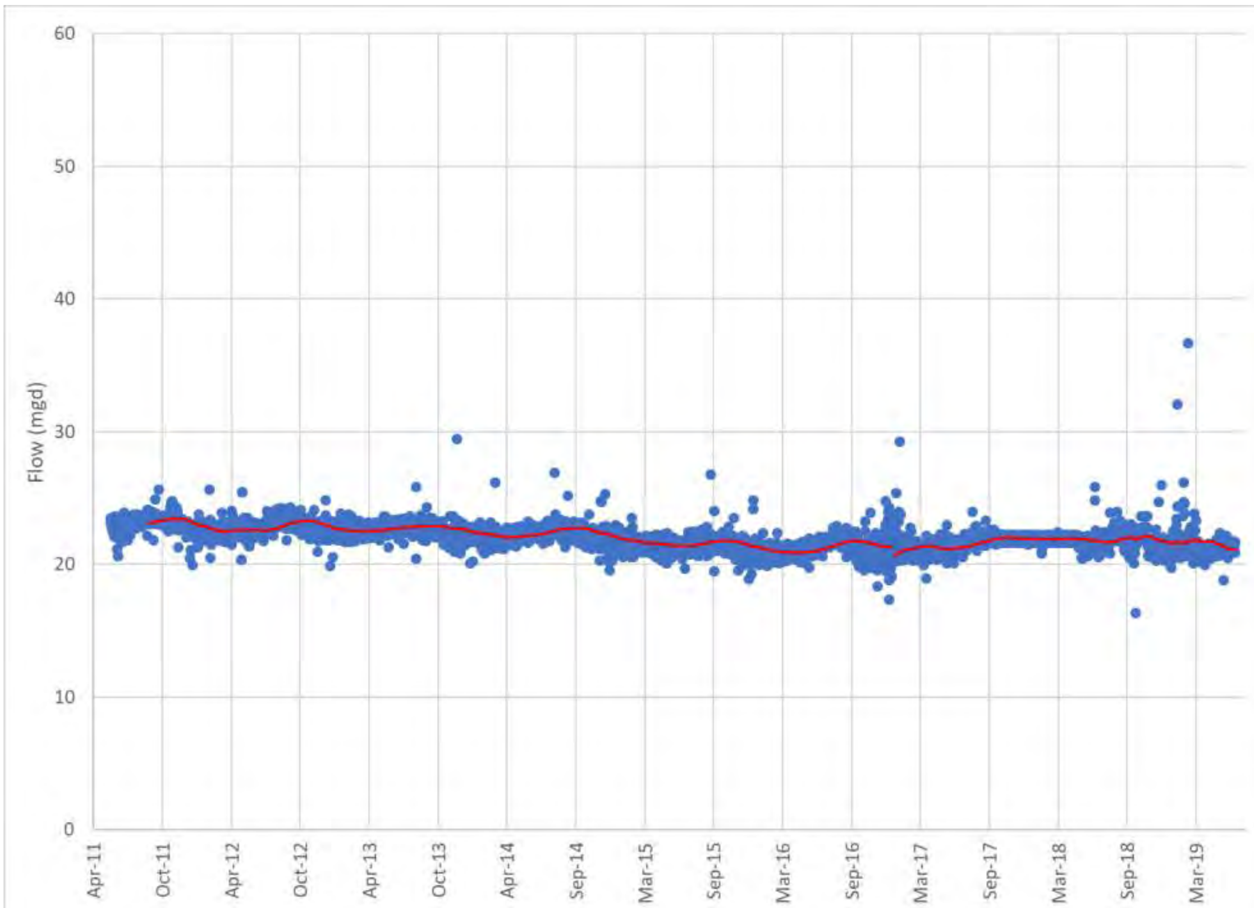
The population projections were used to project influent flow to the SBWRP as described in the next Section.

6.1.2 SBWRP Current and Projected Flows

There are three lift stations that pump influent to the SBWRP Headworks including the E Street Lift Station, which conveys flow from Loma Linda and SBMWD, Arrowhead Lift Station, which conveys flow from SBMWD, and East Influent Lift Station, which conveys from EVWD and SBMWD. Flow data was provided by SBMWD staff for SBWRP influent and effluent flow in 30-minute increments. The total influent flow data was the summation of the three lift station flow meters, E Street, Arrowhead and East. Additionally, a fourth gravity sewer from the historic Valley Truck Farm area is not metered but is relatively low flow and is counted as part of the SBWRP drain flow. There are no other flow meters within the plant that measure total plant flow prior to splitting of primary influent downstream of the headworks.

Analysis of influent flow data revealed that data associated with the East Influent Lift Station flow meter was erroneous for significant portions of the period analyzed. SBMWD staff acknowledged the past issues with East Influent Lift Station meter data and confirmed that the meter was subsequently replaced in summer of 2019. SBWRP effluent data was therefore analyzed in lieu of influent flow for projections. Effluent data is assumed to be an accurate alternative to influent data since SBWRP has not utilized flow equalization. Figure 6-2 shows representative influent flow from 2011 to 2019, utilizing plant effluent flow starting in January 2017 due to erroneous influent data from 2017 to 2019.

Figure 6-2: SBWRP Historic Flow



Notes:

1. Flow data shown from 6/1/2014 to 12/31/2016 is average daily influent. Flow data from 1/1/2017 to 7/1/2019 is average daily effluent data.

In order to separate influent flow provided by the three service areas, Loma Linda and EVWD flows were subtracted from the total SBWRP flow. EVWD was estimated as 6.0 mgd based on the sum of the ADWF from the 6th Street and 3rd Street flow meters in the Draft EVWD Sewer Master Plan. Loma Linda influent flow was available in the form of 30-minute flow data from the North and South meters, which feed directly to the SBWRP.

The SBWRP plant effluent data was analyzed to determine plant peaking factors in relation to ADWF, the results are presented in Table 6-3.

Table 6-3: SBWRP Historic Influent Flow Peaking Factors and Flow

Scenario	Peaking Factor (xADWF)	Historic Flows (mgd)
Average Dry Weather	1.00	21.5
Maximum Month	1.07	22.9
Maximum Week	1.12	24.1
Peak Day Dry Weather	1.25	26.8
Peak Hour Dry Weather	1.89	40.3
Peak Hour Wet Weather	2.97	63.8

Notes:

1. Historic peaking factors were calculated based on flow data from January 1, 2015 to July 1, 2019.

Using the populations projections derived in Section 6.1.1, gallon per capita-day (gpcd) usage was calculated by dividing each service area flow by the corresponding population total. The gpcd usage for each service area was assumed to remain constant and was multiplied by the projected population through 2040 in 5-year increments. Although conservation efforts in recent years have generally caused wastewater flows to decrease in Southern California, there was not a notable decrease for the SBWRP service area. Table 6-4 presents the results of the total current flow, and gpcd usage by service area. Table 6-5 presents the results of the flow projection exercise.

Table 6-4: Current Influent Flow and Per Capita Usage

	SBMWD	Loma Linda	EVWD	Total WRP Including EVWD	Total WRP not Including EVWD
Current ADWF (mgd)	13.4	2.1	6.0	21.5	15.5
Current ADWF (gpcd)	69	85	64	69	71

Table 6-5: Current and Projected Average Dry Weather Flow (mgd)

	SBMWD	Loma Linda	EVWD	Total SBWRP Including EVWD	Total SBWRP not Including EVWD
Current	13.4	2.1	6.0	21.5	15.5
2020	13.6	2.1	6.5	22.2	15.8
2025	14.1	2.3	6.9	23.3	16.4
2030	14.6	2.5	7.2	24.2	17.1
2035	15.1	2.6	7.5	25.3	17.8
2040	15.7	2.9	7.8	26.4	18.6

Notes:

1. Current ADWF flows estimated from available data from January 1, 2015 to July 1, 2019.

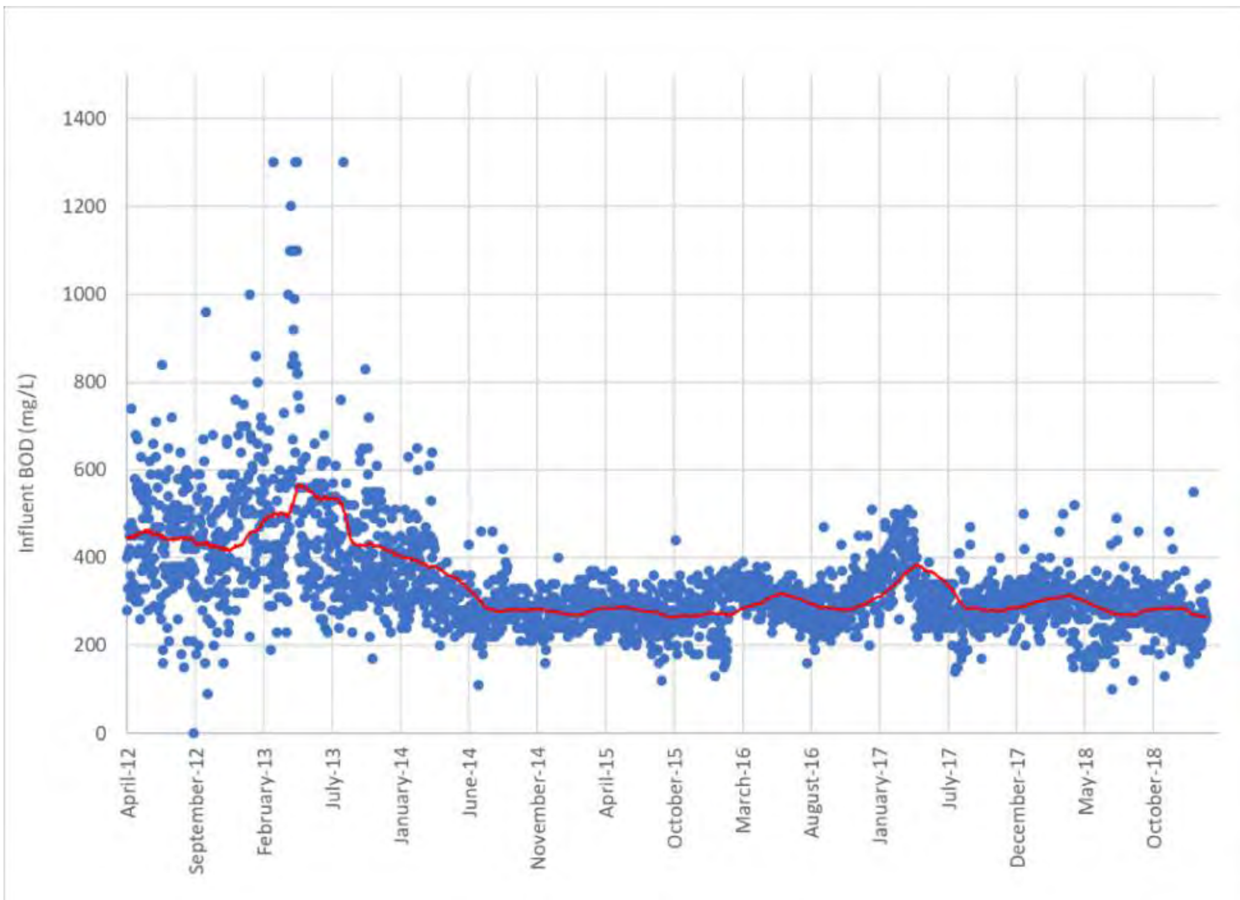
With EVWD flows remaining within the service area of SBWRP, flow would be expected to rise to 26.4 mgd by 2040; however, when factoring out EVWD's contribution to influent flow, the 2040 projected influent flow is expected to be 18.6 mgd. To factor in a buffer for potential growth exceeding projections (about a 2% buffer), this Master Plan will assume a projected influent flow of 19 mgd by 2040.

6.1.3 SBWRP Current and Projected Loads

SBWRP loads were calculated using daily concentration measurements and flow data collected by SBMWD. Concentrations of biological oxygen demand (BOD), total suspended solids (TSS), ammonia, nitrate and nitrite are measured using 24-hour composite samples collected downstream of the three influent flow meters and upstream of the headworks facility.

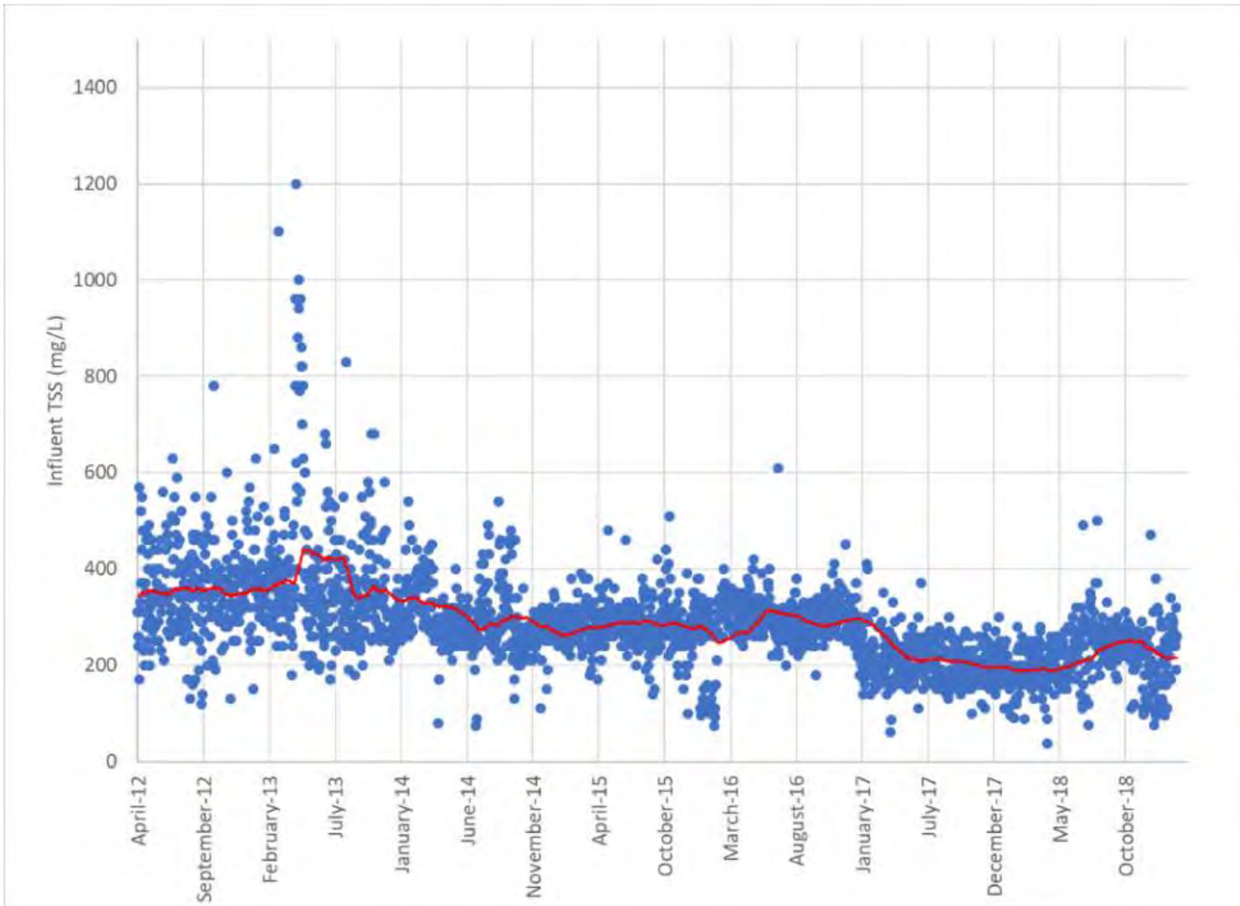
Figure 6-3 and Figure 6-4 portray the influent concentrations of BOD and TSS to SBWRP. Prior to 2015, the SBMWD service area produced higher BOD and TSS concentrations with a wider range of scatter. This can be attributed to illegal discharges, which were eliminated in 2014. The analysis of BOD and TSS for projection purposes utilized data starting January 1, 2015 (in order to avoid using data that would influence higher loads than currently experienced at the SBWRP) and ending December 31, 2018 to provide three full years of data.

Figure 6-3: SBWRP Influent BOD Concentration



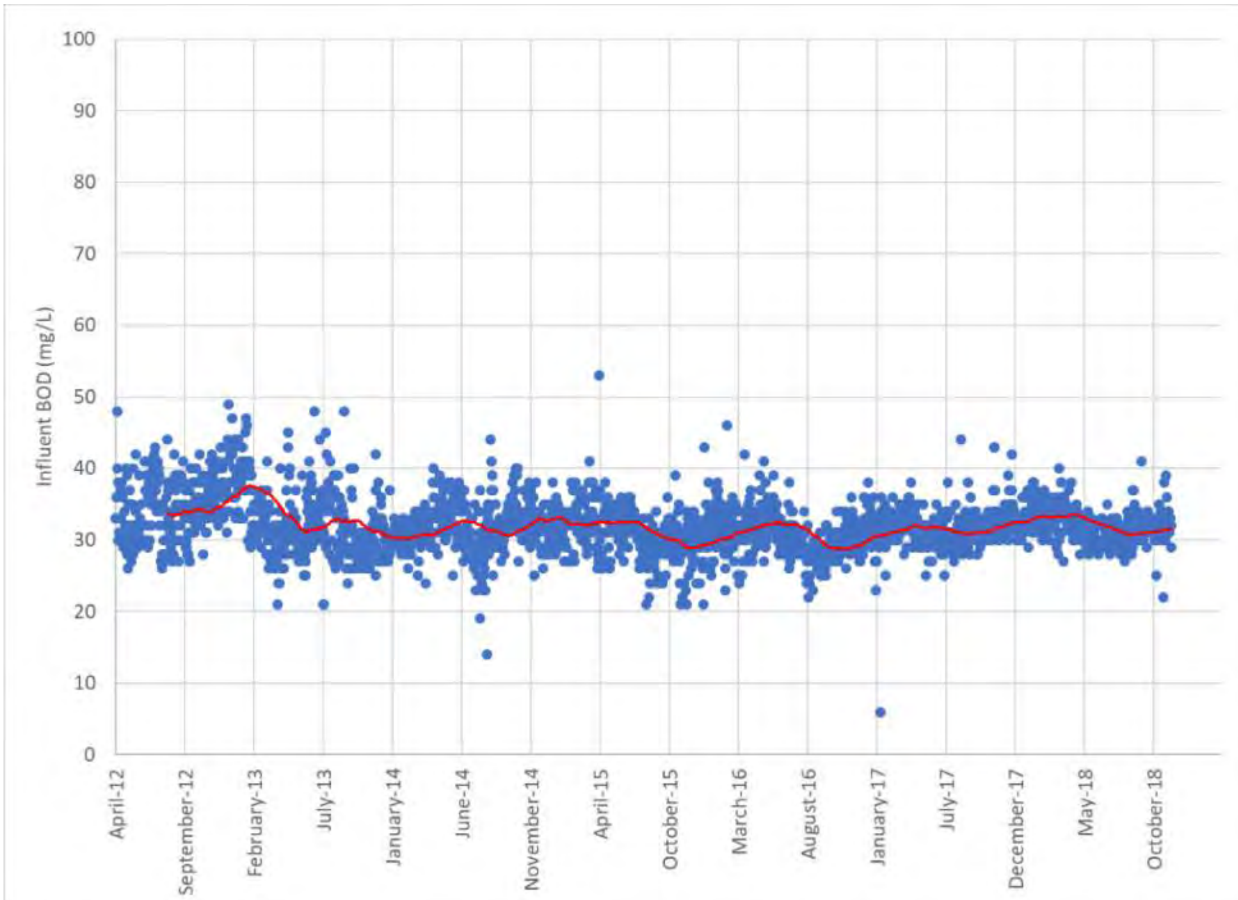
Following the reduction of high concentration discharges, the level of BOD concentrations has remained relatively flat. The peak in BOD concentration observed in the Spring of 2017 was not observed in TSS or ammonia during the same time, as can be observed in Figure 6-4 and Figure 6-5. Therefore, the peak was not factored into peaking and projection calculations.

Figure 6-4: SBWRP Influent TSS Concentration



Daily composite samples for ammonia are collected at the SBWRP. Other nitrogen species such as nitrate, nitrite, and Total Kjeldahl Nitrogen (TKN) are collected on a weekly basis. TKN is ammonia plus organic nitrogen, most of which is converted to ammonia within the treatment process. Thus, this Master Plan uses ammonia to evaluate nitrogen removal throughout the plant. The average ammonia-to-TKN ratio observed in the plant is 0.63, which is within the typical range of 0.6 to 0.8.

Figure 6-5: SBWRP Influent Ammonia Concentration



A summary on influent concentrations for BOD, TSS and ammonia is provided in Table 6-6. Due to the relatively stable levels of concentrations from 2015 to the present, these values were utilized for future loading projections.

Table 6-6: SBWRP Influent Wastewater Concentrations

Criteria	BOD (mg/L)	TSS (mg/L)	Ammonia (mg/L)
Average	293	248	31
Max Month	429	429	34
Max Week	466	325	38
Max Day	550	363	53

Notes:

1. Influent concentration data spans 1/1/2015 to 12/31/2018.

Table 6-7: SBWRP Current Influent Loading and Peaking Factors

Criteria	BOD Load (lb./day)	BOD Peaking Factor (xADWF)	TSS Load (lb./day)	TSS Peaking Factor (xADWF)	Ammonia Load (lb./day)	Ammonia Peaking Factor (xADWF)
Average	52,700	1.00	44,100	1.00	5,700	1.00
Max Month	59,900	1.14	57,100	1.29	6,900	1.21
Max Week	82,300	1.56	65,200	1.48	6,300	1.11
Max Day	98,200	1.86	104,100	2.36	9,100	1.60

Notes:

1. Data utilized for loading and peaking factors spans 1/1/2015 to 12/31/2018.

BOD, TSS and Ammonia average dry weather loading were compared with maximum month, week and day values to produce their corresponding peaking factors, which are presented in Table 6-7. These peaking factors will be utilized for future capacity determinations.

Table 6-8: SBWRP Projected Influent Loading

Criteria	Service Areas Included	BOD Load (lb./day)	TSS Load (lb./day)	Ammonia Load (lb./day)
Current	SBMWD, Loma Linda, EVWD	52,700	44,300	5,700
2020	SBMWD, Loma Linda, EVWD	52,400	44,400	5,600
2025	SBMWD, Loma Linda	38,300	32,500	4,100
2030	SBMWD, Loma Linda	39,700	33,700	4,300
2035	SBMWD, Loma Linda	41,200	34,900	4,400
2040	SBMWD, Loma Linda	42,800	36,200	4,600

Final projected loading values are provided in Table 6-8, which assumes EVWD wastewater flow will cease in between years 2020 and 2025.

6.2 Summary of Projected Flows and Loads

The resulting flow and load projections under average and peak scenarios are provided in Table 6-9 and Table 6-10 for the years 2025 and 2040, respectively. The year 2022 was selected to represent the cessation of EVWD flows and the year 2040 was selected as the planning horizon.

Table 6-9: 2025 Projected SBWRP Flows and Loads

	Flow (mgd)	BOD (lb./day)	TSS (lb./day)	TKN (lb./day)
Annual Average	16.4	38,500	32,600	6,500
Max Month	17.5	43,800	42,200	8,500
Max Week	18.4	60,100	48,200	9,700
Max Day	20.5	71,700	77,000	15,400
Peak Hour	31.1	NA	NA	NA

Notes:

1. TKN is derived from the historical ammonia to TKN ratio (0.63) of influent to the SBWRP.

Table 6-10: 2040 Projected SBWRP Flows and Loads

	Flow (mgd)	BOD (lb./day)	TSS (lb./day)	TKN (lb./day)
Annual Average	18.6	43,400	36,800	7,500
Max Month	19.8	49,300	47,600	9,700
Max Week	20.8	67,800	54,400	11,100
Max Day	23.2	80,900	86,900	17,700
Peak Hour	35.2	NA	NA	NA

Notes:

1. TKN is derived from the historical ammonia to TKN ratio (0.63) of influent to the SBWRP.

Following the departure of EVWD influent flows, SBWRP is not expected to reach current flow and loading levels through 2040. Table 6-9 and Table 6-10 present the flow and load values that will be utilized for capacity evaluation and project feasibility in the latter portions of this Master Plan.

7. EXISTING AND FUTURE REGULATORY CONSIDERATIONS

This Section summarizes existing regulations for effluent discharge, biosolids, air quality, and safety that apply to the SBWRP. It also examines regulations that may potentially apply to the SBWRP or indirectly affect its operation in the future. The anticipated regulatory changes relate to air emissions, biosolids disposal, habitat conservation in the Santa Ana River, and potential changes in discharge requirements for total dissolved solids (TDS) and total inorganic nitrogen (TIN).

7.1 Discharge Requirements

Discharge from the SBWRP is regulated by several agencies including the Regional Water Quality Control Board (RWQCB), the Upper Santa Ana Habitat Conservation Plan (HCP), the Santa Ana Watershed Project Authority (SAWPA) and the Orange County Sanitation District (OCSD). The RWQCB regulates wastewater discharge from the SBWRP and RIX facility, as described in the following sections.

7.1.1 Rapid Infiltration/Extraction (RIX) Facility

Secondary effluent from the SBWRP is conveyed to the Rapid Infiltration Extraction (RIX) facility located at 1990 Agua Mansa Road in Colton. RIX is jointly owned by the City of San Bernardino (80%) and the City of Colton (20%) and is operated by the SBMWD. The treatment train includes infiltration of secondary treated wastewater into a series of ponds under conditions of wet and dry cycles. Infiltrated wastewater plus native groundwater are extracted, disinfected with UV, and discharged to Reach 4 of the Santa Ana River. Groundwater over-extraction is required to lower groundwater levels in the vicinity of the ponds to maintain percolation rates.

The RIX facility is permitted to treat an influent flow rate of up to 40 mgd and discharge at its UV disinfection's design capacity of 64 mgd. Effluent discharge volume is higher than influent volume because the effluent discharge includes over-extracted groundwater. During 2016, average monthly discharges from the RIX facility to the Santa Ana River ranged from 28 to 30 mgd (California Regional Water Quality Control Board, Santa Ana Region, 2016).

Due to a decline in percolation rates, the hydraulic capacity of the basins decreased, and tertiary filtration equipment was added to cover the gap in capacity. Dyna-Sand filters were first added and then eventually the Aqua-Disc Filters. When used, the tertiary filters are used in parallel with the basins, not in series. As discussed in Section 5.2.1, RIX influent flow now averages 26.5 mgd, and the basins have enough capacity to treat this flow without using the add-on filter systems. The tertiary filtration equipment is now used only during very high flow periods to maintain the 3-basin rotation (wet / dry cycles) to minimize algae growth.

Discharge to the Santa Ana River from RIX is regulated under Order No. R8-2013-0032, NPDES No. CA8000304 which expired on July 31, 2018 and has been administratively extended since the receipt of the application prior to expiration. There are two sets of discharge requirements when dilution from the river is:

1) Below 20:1, or
2) 20:1 or more.

The discharge requirements are more stringent when dilution from the river is below 20:1 as shown in Table 7-1. For the purposes of this Facilities Master Plan, the target secondary effluent limits will be based on the discharge requirements for the lower dilution requirement (Table 7-1). Table 7-2 summarizes discharge limits when dilution is 20:1 or more.

While the RIX permit allows for discharge at less than 20:1, there is no infrastructure in place to do this at the RIX.

Table 7-1: Summary of RIX Discharge Requirements Below 20:1 Dilution

Parameter	Units	Average Monthly	Average Weekly
BOD_5	mg/L	20	30
TSS	mg/L	20	30
Ammonia - Nitrogen	mg/L	4.5	--
TDS	mg/L	550 (12-month flow-weighted running average)	
TIN	mg/L	10 (12-month flow-weighted running average)	
Turbidity	NTU	2 (within any 24-hour period) 5 (more than 5% in any 24-hour period) 10 (at any time)	
Coliform	MPN	--	2.2 per 100 ml
pH	-	6.5 - 8.5	

Table 7-2: Summary of RIX Discharge Requirements at 20:1 Dilution or More

Parameter	Units	Average Monthly	Average Weekly
BOD_5	mg/L	30	45
TSS	mg/L	30	45
Coliform	MPN	--	23 per 100 ml
pH	-	6.5 - 8.5	

7.1.2 SBWRP Direct Discharge to the Santa Ana River

During hydrological periods when 20:1 dilution can be achieved, the SBWRP may discharge directly to the Santa Ana River at its confluence with Twin Creek adjacent to the site of the SBWRP without going to the RIX. This discharge is regulated under Order No. R8-2017-0049, NPDES No. CA0105392 which went into effect on January 1, 2018 and will expire on December 31, 2022. This method of discharge was used in the past during heavy rainfall, but the revised discharge permit is too restrictive for compliance testing and this method of discharge is no longer used. Although not used, the infrastructure still exists at the SBWRP to accommodate discharge directly to the SAR. Discharge limits are summarized in Table 7-3. For permit renewal, the SBMWD is required to file a Report of Waste Discharge and application for renewal of its Waste Discharge Requirements and NPDES permit no later than July 5, 2022. Future renewals will likely include a requirement for a Climate Change Action Plan.

Table 7-3: Summary of SBWRP Discharge Requirements with 20:1 Dilution

Parameter	Units	Average Monthly	Average Weekly	Daily Max
BOD_5	mg/L	30	45	--
TSS	mg/L	30	45	
Aldrin	μg/L	0.00014		0.00028
pH	-	6.5 - 8.5		
Facility Design Flow	mgd	33		

7.1.3 Capacity Trigger in NPDES Permit

Per the SBWRP NPDES Permit No. CA0105392 Order No. R8-2017-0049, certain actions are triggered if the average dry weather discharge for any month equals or exceeds 75% of the treatment design or discharge capacity of the SBWRP (75% of 33 mgd = 24.75 mgd). If the treatment or discharge capacity trigger is exceeded, the SBMWD would have to adequately inform the RWQCB of the plant's capacity status by submitting a report containing the following information:

- Average daily flow for the month, the date on which the instantaneous peak flow occurred, the rate of that peak flow, and the total flow for the day.
- Best estimate of when the average daily dry-weather flow rate will equal or exceed the design capacity of the treatment facilities.
- An intended schedule for studies, design, and other steps needed to provide additional capacity for the waste treatment and/or disposal facilities before the waste flow rate equals the capacity of present units.

Under the current permit, the projected flow of 19 mgd in the year 2040 would not exceed the capacity reporting trigger; however, this capacity trigger should be considered if de-rating SBWRP's treatment capacity is contemplated due to the future decrease in flow.

7.1.4 Potential Future Changes to Discharge Requirements

The Santa Ana Watershed Project Authority (SAWPA) is a Joint Powers Authority (JPA) of five member agencies: Eastern Municipal Water District, Inland Empire Utilities Agency, Orange County Water District, San Bernardino Valley Municipal Water District, and Western Municipal Water District. The Santa Ana River is a significant source of recharge to groundwater management zones underlying the River and to the Orange County groundwater basin downstream. The quality of the River influences the region's groundwater, which is used by more than 5 million people.

SAWPA serves as an administrator for several task forces within the watershed. In 1995, a task force comprising approximately 20 water, wastewater, and groundwater agencies was formed to evaluate the impact of total inorganic nitrogen (TIN) and total dissolved solids (TDS) on water resources in the Santa Ana River Watershed.

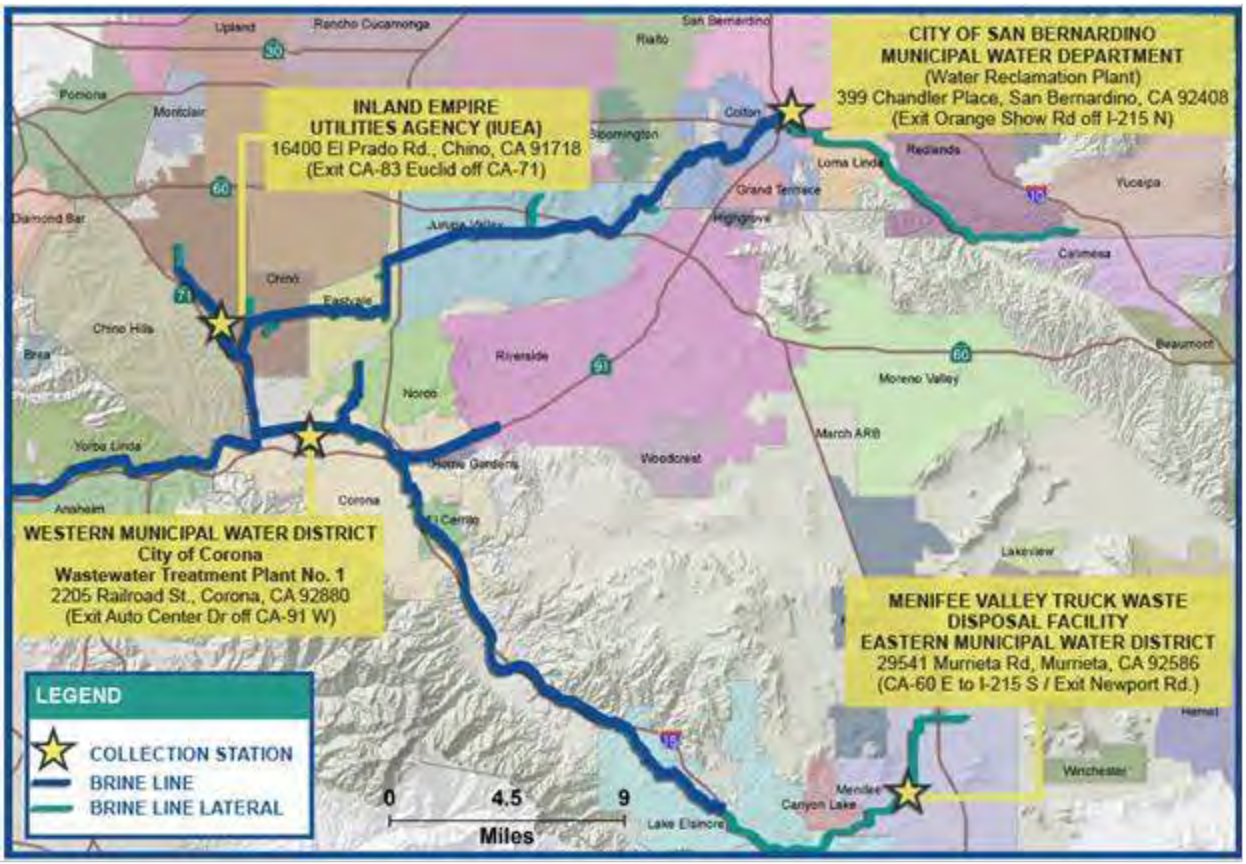
Wasteload allocations for regulating discharges of TDS and TIN to the Santa Ana River are implemented primarily through TDS and nitrogen limits in waste discharge requirements issued to municipal wastewater treatment facilities that directly or indirectly discharge to the River. SAWPA's task force is using the Wasteload Allocation Model (WLAM) to simulate the future groundwater quality to determine whether any changes are necessary in TDS and TIN regulation (Wildermuth Environmental, Inc., 2015). The TIN/TDS task force work was divided into a series of phases and work on the TIN/TDS Task Force Study is nearing completion (Santa Ana Watershed Project Authority, n.d.).

Preliminary WLAM results indicate the potential for degradation/exceedance of water quality objectives for TDS and TIN in the groundwater management zone where RIX is located. Future regulations may come out of the WLAM that could impact the RIX discharge to the Santa Ana River.

7.1.5 Inland Empire Brine Line Collection Station

The SBMWD has an agreement with Valley District, who in turn has an agreement with the Santa Ana Watershed Project Authority (SAWPA) for 2.5 mgd capacity in the Inland Empire Brine Line (IEBL) formerly known as the Santa Ana Regional Interceptor (SARI). SAWPA was created to help resolve interagency conflicts and address regional water issues in the Santa Ana River Watershed. The IEBL was developed by SAWPA for the purpose of transporting high strength brine wastewater from the Inland Empire to the Orange County Sanitation District (OCSD) for treatment and disposal to the Pacific Ocean. The SBWRP has an authorized collection station onsite for the direct discharge of hauled brine waste to the IEBL (Figure 7-1). Permits are issued by the Department to indirect dischargers to dispose at the Brine Receiving Station.

Figure 7-1: Inland Empire Brine Line Collection Stations



Source: https://sawpa.org/inland-empire-brine-line/

Use of the SBWRP Inland Empire Brine Line collection station is regulated by Ordinance No. 73-SARI, which includes general prohibitions and limitations on discharges, wastewater discharge permits, and monitoring, reporting, inspection, and facilities requirements (San Bernardino Valley Municipal Water District, 2011).

7.1.5.1 Hydrolysate of Human Remains

Valley District does not currently regulate the discharge of hydrolysate of human remains to the Inland Empire Brine Line collection station; however, it could potentially be a source of future revenue for the SBMWD if hydrolysate businesses develop within the service area.

Effective July 1, 2019, OCSD Ordinance No. OCSD-53 prohibits the discharge of hydrolysate wastes and wastewater resulting from hydrolysis to the Orange County Sanitation District. Per Assembly Bill No. 967 (2017-2018), the SBMWD and the OCSD would both have to authorize the disposal of hydrolysate into the SBMWD's Inland Empire Brine Line collection station for it to be allowed.

Per Assembly Bill No. 967 (2017-2018) Section 7639.10 (a), a licensed hydrolysis facility may dispose of hydrolysate using a sewer collection system only if all the following conditions are met:

1. The city, county, special district, joint powers authority, or other public agency that provides wastewater treatment and disposal services to the licensed hydrolysis facility expressly authorizes the disposal of hydrolysate into the sewer collection system. If issuance of a permit is required by another city, county, special

district, joint powers authority, or other public agency that provides sewer collection services where the licensee is located, authorization from both agencies must be obtained.

2. If the licensee receives the appropriate permissions required by subparagraph (A), the licensee shall comply with all local ordinances, pretreatment requirements, permitting requirements, waste discharge requirements, and all other applicable federal, state, and local laws, ordinances, and regulations governing the protection of water quality and public health, promotion of water recycling, and discharge into the sewer system.
3. The licensee shall demonstrate compliance as deemed appropriate by the public agency or agencies authorizing the disposal of hydrolysate into the sewer collection system. At a minimum this should include annual water quality testing as prescribed by the public agency or agencies authorizing the disposal of hydrolysate into the sewer collection system.
4. Authorization for disposal of hydrolysate using a sewer collection system shall be voluntary and at the discretion of each public agency described in subparagraph (A). Each public agency described in subparagraph (A) has the discretion to authorize or to prohibit the discharge of hydrolysate into a sewer collection system for any reason, including for purposes of promoting advanced water recycling systems (California Legislative Information, 2017-2018).

7.2 Biosolids Disposal

The regulation of biosolids involves multiple agencies at the federal, state, and local levels. The United States Environmental Protection Agency (US EPA) Region IX regulates biosolids disposal in California by the Part 503 Rule, which sets national minimum requirements for biosolids quality. The following sections describe the federal rules governing biosolids.

7.2.1 US EPA Part 503 Rule

The Part 503 Rule has four groups of requirements to protect the environment and public health:

- Management Practices
- Pollutant Limits
- Pathogen Reduction Requirements
- Vector Attraction Reduction Requirements

7.2.1.1 Management Practices

Bulk biosolids shall:

- Not be applied to land when it is likely to adversely affect a threatened or endangered species.
- Not be applied to a site that is flooded, frozen, or snow-covered so that the biosolids enters a wetland or other waters of the United States.
- Not be applied to a site that is 10 meters or less from waters of the United States.
- Be applied to a site at an application rate that is equal to or less than the agronomic rate for nutrient uptake.
- Be provided with a label or information sheet with the following information:
  - Name and address of the person who prepared the biosolids.

- Statement that application of the biosolids to the land is prohibited except in accordance with the instructions on the label or information sheet.
- Statement of the annual whole sludge application rate for the biosolids that does not cause annual pollutant loading rates to be exceeded.

7.2.1.2 Pollutant Limits

Table 7-4 summarizes the Part 503 pollutant limits for biosolids applied to land. For biosolids meeting the pollutant concentration limits in Table 7-4, land application is limited to the agronomic rate.

Table 7-4: Part 503 Pollutant Limits for Biosolids Applied to Land

Pollutant	Ceiling Limits (mg/kg)	Cumulative Pollutant Loading Rate (kg/hectare)	Pollutant Concentration Limits (mg/kg)	Annual Pollutant Loading Rate (kg/ha-year)
Arsenic	75	41	41	2.0
Cadmium	85	39	39	1.9
Copper	4,300	1,500	1,500	75
Lead	840	300	300	15
Mercury	57	17	17	0.85
Molybdenum	75	--	--	--
Nickel	420	420	420	21
Selenium	100	100	100	5.0
Zinc	7,500	2,800	2,800	140
Applies to:	*Biosolids that are land-applied*	*Bulk biosolids*	*Bulk and bagged biosolids regulated under Exceptional Quality (EQ) or Pollutant Concentration (PC) options*	*Bagged biosolids*

7.2.1.3 Pathogen Reduction Requirements

The 503 Rule defines two classes of biosolids: Class A, in which the pathogens are reduced below detectable levels and are available for use; and Class B, where the presence of reduced levels of pathogens requires site restrictions and management practices to protect against pathogen exposure. Class B site restrictions include limits on public access, crop harvesting, and animal grazing.

To produce Class A or B biosolids, one of the six alternatives for pathogen reduction listed in Table 7-5 must be met in addition to meeting the requirements for fecal coliform or Salmonella bacteria levels.

Table 7-5: Alternatives for Pathogen Reduction

Alternative	Class A Biosolids	Class B Biosolids
1	Thermally-treated biosolids with a time/temperature-based treatment process	Monitoring of indicator organisms: Fecal coliform geometric mean of 7 sample (min) over 2 week period < 2x 10^6 MPN/g or CFU /g
2	High pH (alkali) – High-temperature air drying process	Process to significantly reduce pathogens (PSRP)
3	For biosolids treated in other processes, must demonstrate reduction of enteric viruses and helminth ova	Process deemed equivalent to a PSRP by the permitting authority
4	For biosolids treated in unknown processes, must test for pathogens – fecal coliform bacteria or Salmonella, enteric viruses, and helminth ova at the time biosolids are used or disposed	--
5	Biosolids treatment in a process to further reduce pathogens (PFRP)	--
6	Process deemed equivalent to a PFRP by the permitting authority	--

7.2.1.4 Vector Reduction Requirements

Vector attraction reduction at the land application sites can reduce the potential for vectors to potentially transport pathogens. Typically, anaerobic digestion facilities will use Option 1, whereby solids are reduced by 38% during the solids treatment process. All ten options are listed in Table 7-6.

Table 7-6: Vector Attraction Reduction Options for Class A Biosolids

Option	Class A Biosolids
1	Reduction of volatile solids by at least 38%
2	If 38% reduction of volatile solids cannot be achieved, digestion of anaerobically digested biosolids for additional 40 days (bench-scale demonstration)
3	If 38% reduction of volatile solids cannot be achieved, digestion of anaerobically digested biosolids for additional 30 days (bench-scale demonstration)
4	Specific oxygen uptake rate for anaerobically digested biosolids below a threshold
5	Aerobic process for 14 days or longer at specified temperature
6	Addition of alkali to raise the pH above a threshold
7	Moisture reduction of biosolids (no unstabilized solids) to > 75% solids
8	Moisture reduction of biosolids with unstabilized solids to > 90% solids
9	Injecting biosolids below the ground
10	Incorporating biosolids into the soil within 6 hours after land application

7.2.2 Synagro Composting Biosolids Requirements

The SBWRP currently produces Class B biosolids which are dewatered and transported offsite by a Contractor (Synagro) and composted offsite, resulting in a Class A final product. Synagro provides composting of biosolids and green waste at its Hawes facility in Helendale in San Bernardino County. The Contract with Synagro requires the dewatered biosolids from the SBWRP to be 15% solids or greater and meet Class B or better.

The biosolids Contract was initiated with Nursery Products, LLC and the Contract term began on October 1, 2007 and continues for 20-years. Nursery Products was purchased by Synagro in 2016. The agreement may be extended for two successive periods of three years each by mutual consent. The Contract may be terminated by Nursery Products/Synagro with 24-hours written notice or by the SBMWD with 30 days' written notice (Nursery Products, 2007). There are no additional agreements in place for biosolids disposal.

7.3 Air Quality

This section summarizes existing and anticipated regulations that affect the SBWRP related to air quality. Applicable regulations from the South Coast Air Quality Management District (SCAQMD), the California Air Resources Board (CARB), and recent legislation regarding climate pollutants are discussed.

7.3.1 South Coast Air Quality Management District

The SCAQMD adopts policies and regulations that promote clean air within Los Angeles, Orange, Riverside, and San Bernardino Counties. The Federal and California Clean Air Act regulations require that SCAQMD meet clean air standards to protect public health. Ambient Air Quality Standards (AAQS) have been established for the "criteria" pollutants which include ozone, oxides of nitrogen (NOx), particulate matter less than 10 microns (PM_{10}), particulate matter less than 2.5 microns ($PM_{2.5}$), carbon monoxide (CO), sulfur dioxide (SO_2) and lead. California has also established its own standards for several additional pollutants including hydrogen sulfide (H_2S) and sulfate.

The SCAQMD rules and regulations establish permit requirements (Rules 201-223), prohibitions (Rules 401-481), source-specific standards (Rules 1100-1196), air toxics requirements (Rules 1401-1472), New Source Review (Rules 1300-1325), Prevention of Significant Deterioration (Rules 1701-1714), New Source Performance Standards (Regulation IX), National Emission Standards for Hazardous Air Pollutants (Regulation X), climate change requirements (Rules 2700-2702), Title V requirements (Rules 3000-3008), and others. Under Rule 201 and Rule 203, a permit is required for any equipment or process that has the potential to emit air contaminants or which may eliminate, reduce or control the issuance of air contaminants, unless specifically exempted.

The City of San Bernardino is in the SCAQMD's South Coast Air Basin, which is designated as an "extreme non-attainment" area for ozone standards. Facilities located in extreme non-attainment areas have the lowest major source emission thresholds (i.e. 10 tons/year NOx and VOC) and some of the most stringent emission limits in the nation. In 2011, the SBWRP was granted a conditional exemption from the Title V permitting requirements after the SBWRP's potential to emit (PTE) was permanently reduced through enforceable permit conditions to limit the PTE levels less than the emission limitations in Rule 3001(b). However, if the SBWRP's PTE or actual annual emissions exceed the major source emission thresholds, the SBWRP is required to obtain a Title V permit.

The SBWRP operates under a Permit to Operate and 20 other permits for individual pieces of equipment including digester gas-fired engines, natural gas-fired engines, diesel engines for generators, a flare, boilers, odor control systems, and a steam washer. The source-specific rules establish emission limits, monitoring, testing, recordkeeping and reporting requirements for each category of equipment and these requirements are summarized in the individual permits. See Table 7-9 for a permit summary.

The SBWRP produces digester gas from the anaerobic digestion process and beneficially uses the gas as a fuel source for five internal combustion engines and two boilers. Thus, Rule 1110.2 (Emissions from Gaseous and Liquid-Fueled Engines) and Rule 1118.1 (Control of Emissions from Non-Refinery Flares) currently have the most significant impact on the SBWRP. Once the DGBU Project is implemented, the facility will no longer operate digester gas-fueled engines under Rule 1110.2 and the two new flares will be designed to waste digester gas that is not beneficially used without exceeding the 70% capacity threshold in Rule 1118.1. Brief summaries of the key SCAQMD rules are provided below.

Rule 1179 POTW Operations and Proposed Rule 1179.01 NOx Emission Reductions from Combustion Equipment at POTWs

Rule 1179 was adopted by the SCAQMD Governing Board on June 7, 1991, and it requires POTWs with design capacities greater than or equal to 10 MGD to develop and submit an Emissions Inventory Plan (EIP) outlining the methods to be used to quantify emissions of volatile organic compounds (VOCs) and to characterize odorous emissions. SBWRP submitted EIP and inventories were submitted in 1993.

Proposed Rule 1179.1 is being designed to address NOx emissions from combustion equipment at POTWs and will be applicable to boilers, turbines, microturbines and other biogas combustion equipment. Engines might also be covered under this rule, but flares will remain under 1118.1 (described below).

Rule 1110.2 Emissions from Gaseous and Liquid-Fueled Engines

Rule 1110.2 applies to all stationary and portable engines rated over 50 brake horsepower (bhp) burning gaseous or liquid fuels. The rule was amended in September 2012 to establish biogas ICE emission limits equivalent to those for natural gas and established an effective date of January 1, 2015. SBWRP operates five digester gas-fueled engines pursuant to District permits to operate G37211, G12477, G12476, G12499 and G12498. The engines do not meet the applicable 2015 emission limits for digester gas-fired engines. The previous and new limits are summarized in Table 7-7.

Table 7-7: Rule 1110.2 Emission Limits for Digester Gas-fired Engines

	NOx (ppm)	VOC (ppm)	CO (ppm)
Previous Limits	36 (bhp>=500) 45 (bhp < 500)	250	2,000
New Limits (2015)	11	30	250

Source: http://www.aqmd.gov/docs/default-source/rule-book/Proposed-Rules/1110.2/par1110-2_wgm6_final.pdf?sfvrsn=6

SBWRP participated in a demonstration project evaluating the feasibility of using a proprietary Partial Oxidation Gas Turbine (POGT) technology to meet the lower emission limits, but this technology was not found to be a commercially viable option at the time. SCAQMD amended in the rule December 2015 extending the compliance date until January 1, 2018 for facilities that implemented technology demonstration projects. SBMWD chose to defer compliance from the emission limits, in quarterly increments, for one year until January 1, 2019 by submitting an alternate compliance plan as allowed in Rule 1110.2(h) Alternate Compliance Option.

SBWRP plans to cease operation of these engines by September 1, 2021 as part of a larger Digester Gas Beneficial Use (DGBU) Program which includes a new fuel cell system, flares, digester gas storage system, newly converted pumps and new blowers. Specifically, the DGBU Program includes:

- Fuel cell project (digester gas will be used to generate the hydrogen required for the fuel cell)
- Blower decentralization project
- Ultra-Low Emissions (ULE) duty flare project (0.025 lb/MMBtu NOx)

- Backup flare project (0.06 lb/MMBtu NOx)
- Digester gas storage project
- Electrical Infrastructure Improvements Project (Arrowhead Lift Station pump conversion and SCE primary metering)

Since the DGBU Program was not going to be completed by the January 1, 2019 compliance deadline, SBMWD sought a Variance from 203(b), 1110.2(d)(1)(B(ii), 1110.2(f)(1)(C)(ii), 1110.2(f)(1)(D)(iii) and 1110.2(f)(1)(H)(i) from SCAQMD. On January 28, 2019, SCAQMD granted the Variance for the period commencing January 1, 2019 and continuing through September 1, 2020, the final compliance date.

Rule 1118.1 Control of Emissions from Non-Refinery Flares

The existing flare combusts excess digester gas that is not beneficially used. The flare was constructed in 1988 and can meet an emissions limit of 0.06 lbs/MMBTU NOx. SCAQMD Non-refinery Flares Rule 1118.1 was adopted in January 2019. Rule 1118.1 provides different emission limits for minor and major facilities as shown in Table 7-8.

Table 7-8: Emission Limits

Flare Gas	NO_x	CO	VOC
	pounds/MMBtu		
Digester Gas			
Major facility	0.025	0.06	0.038
Minor facility	0.06	N/A	N/A
Landfill gas	0.025	0.06	0.038

Source: SCAQMD Non-refinery Flares Rule 1118.1

The total quantity of NOx emissions from the SBWRP must be less than 10 tons in any 12-month period to be classified as a minor facility. Permit No. G40829 permits a “Sewage Treatment System” to operate at emissions levels that would allow SBWRP to remain exempt from being considered a major source. The SBWRP currently meets the requirements of a minor facility; however, in the past, there were incidences when SBWRP emitted higher amounts of NOx and classified as a major facility (2008-2011). It is expected that during the service life of the 0.06 UL flare that SBWRP will be required to meet more restrictive emissions limits; therefore, the Department decided that there be at least one flare that can satisfy the tighter limits Proposed in Rule 1118.1 for major facilities.

As part of the larger Digester Gas Beneficial Use Program, the Department will construct one 0.025 lbs/MMBtu Ultra-low Emissions (ULE) flare (0.025 Duty Flare) to be used as a duty flare and replace the existing flare with a new Low-Emissions (LE) 0.06 lbs NOx/MMBtu flare that will be utilized as a standby flare (0.06 Backup Flare). The ULE flare is designed to handle current and anticipated future gas flow conditions in coordination with the DG storage project. The future DG storage system will minimize the wasting of gas to the flare system. Coordination between the DG storage and ULE flare project (i.e. flow, operating pressure, etc.) is essential to ensure efficient and effective operation.

SCAQMD Permits

SBWRP operates the treatment plant under Permit to Operate G40829 and 20 other individual permits for five digester gas fired engines (including one cogeneration engine), two natural gas-fired engines, one digester gas-fired cogeneration engine, one natural gas generator engine, four diesel generator engines, one digester gas flare, two boilers, three odor control systems, and a steam washer. The applicable requirements for each piece of equipment are identified in the individual permits. Each permit must be renewed annually unless there are changes to the process. Table 7-9 lists a summary of existing permits and anticipated permit changes due to the DGBU Program.

Table 7-9: SCAQMD Permits to Operate

Permit Number	Equipment	Fuel	Notes
G12466*	Digester Gas Flare	Digester Gas	Will be replaced with 0.06 lb NOx/MMBtu flare with DGBU Program
G12467	Old Blue Emergency Electrical Generator	Diesel	
G12468	Emergency Standby Electrical Generator (Admin Building)	Diesel	
G12471	Boiler # 2 (West Boiler)	Digester Gas or Natural Gas	
G12472	PHR Emergency Electrical Generator (Headworks)	Diesel	
G12476*	Roots #2 - Waukesha	Digester Gas	Will be eliminated with DGBU Program
G12477*	Roots #1 - Waukesha	Digester Gas	Will be eliminated with DGBU Program
G12478	RS-1 Emergency Standby Electrical Generator	Diesel	
G12496	NRC Emergency Electrical Generator	Diesel	
G12497	CAT #4	Natural Gas	
G12498*	CAT #3	Digester Gas	Will be converted to propane and permit modified accordingly
G12499*	CAT #2	Digester Gas	Will be eliminated as part of DGBU Program and permit terminated
G12500	CAT #1	Natural Gas	
G19402	Boiler # 1 – East Unit	Digester Gas with Flue Gas Recirculation	
G33083	Partial Oxidation Gas Turbine (Experimental Research Operations)		Demonstration project; not a commercially viable option
G33167	Landa Steam Washer	Diesel	
G37211*	Cogen System #1	Digester Gas	Will be eliminated with DGBU Program

Permit Number	Equipment	Fuel	Notes
G40829*	Sewage Treatment		Will be amended to include tertiary treatment system and possibly DGBU **Program's DG Storage** project
R-F99434	Odor Scrubber (Thickeners)		
R-F99435	Odor Scrubber (Headworks)		
R-F99436	Odor Scrubber (Belt Press)		

**Will be eliminated or amended as part of the DGBU Program.*

7.3.2 California Air Resources Board

The project to decentralize the blowers for Unit 1 and Unit 2 will add provisions for connection of a new (Owner-provided) stationary diesel generator, which will require a Permit to Operate from the SCAQMD.

7.3.3 Senate Bill 1383 (Short-lived Climate Pollutants)

Short-lived climate pollutants have relatively short atmospheric lifetimes yet have a dramatic and detrimental effect on air quality, public health, and climate change. Senate Bill (SB) 1383, which was passed in September 2016, established reduction targets for short-lived climate pollutants, including methane, hydrofluorocarbons, and anthropogenic black carbon. The bill established reduction targets for the disposal of organic wastes in landfills and requires state agencies to increase the sustainable production and use of renewable gas. SB 1383 established a target of a 50% reduction in the statewide disposal of organic waste by 2020 and a 75% reduction by 2025 (based on the 2014 levels). Table 7-10 summarizes SB 1383 implementation dates and thresholds.

Table 7-10: Senate Bill 1383 Implementation Dates

Date	Implementation Thresholds
2017 - 2019	CalRecycle will initiate formal rulemaking and adopt the regulations
January 1, 2020	50% statewide reduction of the disposal of organic waste (based on 2014 level)
July 1, 2020	CalRecycle and Air Resources Board analyzes progress. If significant progress has not been made, CalRecycle may include incentives or additional requirements. Revisions to targets may also be recommended.
January 1, 2022	CalRecycle's regulations to meet the organic waste reduction targets for 2020 and 2025 take effect and are enforceable.
January 1, 2024	Regulations may require local jurisdictions to impose penalties for noncompliance on generators within their jurisdiction.

Date	Implementation Thresholds
January 1, 2025	The state must achieve a 75% reduction in the level of the statewide disposal of organic waste (based on 2014 level). Not less than 20% of currently disposed of edible food must be recovered for human consumption.

Sources: https://www.calrecycle.ca.gov/climate/slcp
https://ww3.arb.ca.gov/cc/shortlived/meetings/03142017/final_slcp_report.pdf
https://www2.calrecycle.ca.gov/PublicNotices/Details/2462

Decomposition of organic matter in landfills is a significant source of methane emissions in the state. SB 1838 may limit biosolids disposal options to landfills and drive up the cost for composting biosolids. The legislation could also result in organics being diverted from landfills to WRPs that have capacity to beneficially use fat, oil, and grease (FOG) and other anaerobically digestible material (ADM) as sources of energy for wastewater treatment.

SB 1383 could result in significant impacts to biosolids disposal and digester gas facilities at the SBWRP. The existing biosolids contract expires in 2027 (see Section 7.2.2) and no backup contract is in place. Costs for composting Class B biosolids produced at the SBWRP could potentially increase significantly upon expiration of the current contract. Further, the potential for additional FOG/ADM diversion to the SBWRP should be considered when planning digester replacement and maintenance. There are currently four digesters at the SBWRP, one of which is currently inoperable (Digester B). See further discussion in Section 10.5.

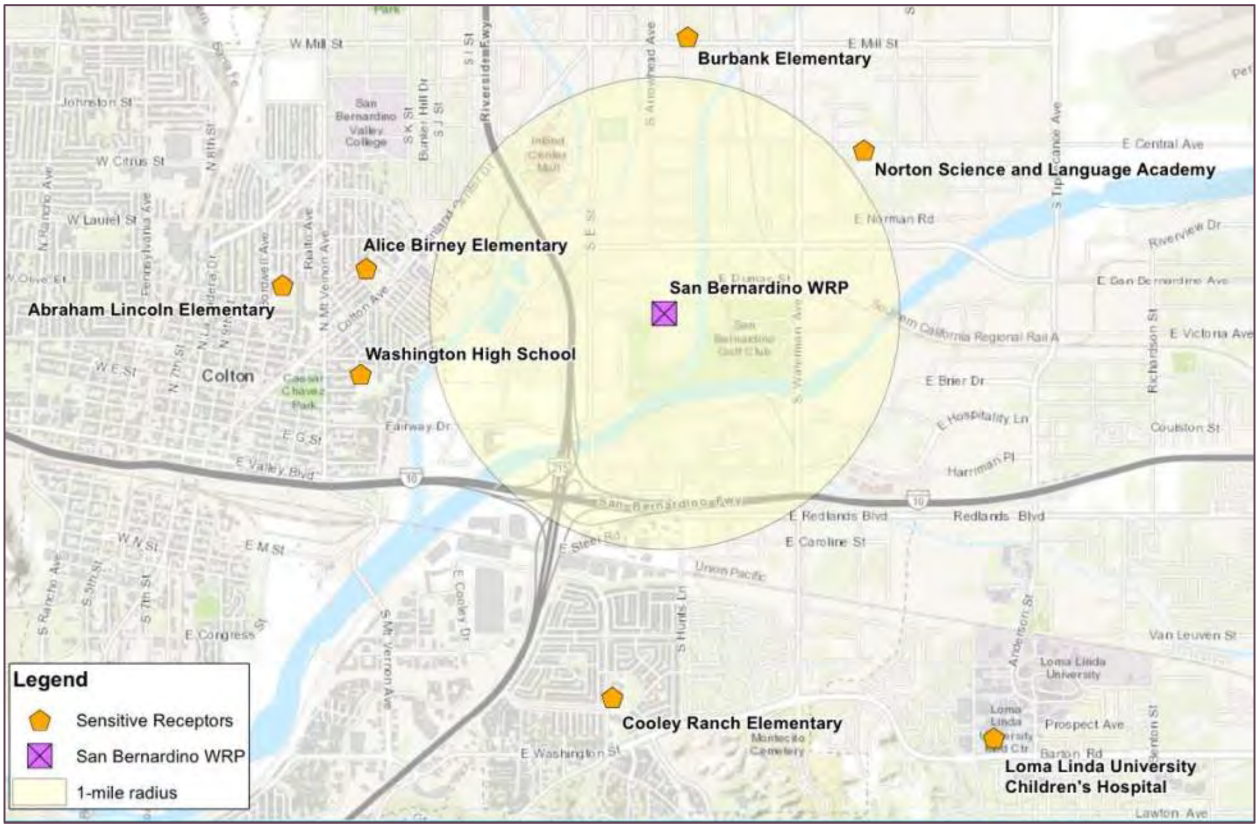
The adoption of R1118.1 also included a resolution that directs SCAQMD staff to "*work with the California Air Pollution Control Officers Association, California Department of Resources Recycling and Recovery, California Association of Sanitation Agencies and Southern California Alliance of Publicly Owned Treatment Works in an effort to balance air quality requirements with the state-wide effort to divert organics from landfills as required under Senate Bill 1383, and shall report back to the Stationary Source Committee within 12 months of rule adoption to present findings and potential recommendations*;" and to "*conduct a BACT technical assessment for flares receiving biogas derived from advanced digestion and/or organic waste digestion or codigestion that considers costs, review the current scientific literature, existing measurement methods, technology achieved in practice, reliability issues, and if necessary, field testing*"

7.3.4 Odor Control

Controlling odor emissions is an important consideration in the operation of the SBWRP and the design of new facilities. Sensitive receptors include hospitals, schools, residences and daycare centers. Nearby sensitive receptors shown on Figure 7-2 include the Burbank Elementary School and Norton Science and Language Academy, located approximately 1 mile north of the SBWRP; the Alice Birney Elementary School, Washington High School, the Abraham Lincoln Elementary School located approximately 1-1/4 miles west of the SBWRP, and the Cooley Ranch Elementary School and Loma Linda University Children's Hospital located less than 2 miles south of the SBWRP. The nearest residence is located on East Dumas Street east of the SBWRP.

Odorous emissions are regulated by the SCAQMD and the NPDES Permit. SCAQMD Rule No. 402 stipulates that no odorous discharge shall create a public nuisance. The SCAQMD permit limits hydrogen sulfide exhaust from scrubbers to 1 ppm. The SBWRP's SCAQMD sewage treatment permit limits the facility's cumulative total sulfur compounds as H_2S from all sources to less than 5 pounds per day. To comply with Rule 1179, the Department submitted an Odor Evaluation Report to SCAQMD in 1993. At that time, SCAQMD and the Department determined that the reported odors were not excessive or a nuisance. NPDES Permit No. CA0105392 for the SBWRP states that neither the treatment nor the discharge of wastes shall create a nuisance or pollution as defined by Section 13050 of the California Water Code. Odor control systems can minimize odor complaints from the surrounding communities and create a good working environment for treatment plant staff.

Figure 7-2: Sensitive Receptors



7.4 Federal Aviation Administration

The San Bernardino International Airport Authority oversees the development and reuse of the aviation portions of the former Norton Air Force Base, now known as the San Bernardino International Airport. The San Bernardino International Airport Authority is a regional Joint Powers Authority comprised of local member agencies: City of Colton, City of Highland, City of San Bernardino, City of Loma Linda, and County of San Bernardino.

The northeast corner of the SBWRP property is approximately 11,000 feet from the southwest edge of the runway at the San Bernardino International Airport. If any construction or alteration between 10,000 and 20,000 feet from the nearest point of the nearest runway exceeds an imaginary surface extending outward and upward at a 100 to 1 slope, a notice shall be filed with the FAA. Based on the approximately elevations of the SBWRP at 995 feet and the runway a 1070 ft, a new structure of approximately 185 feet in height at the SBWRP would require a notice to be filed with the FAA. A notice for construction or alteration does not need to be filed for any antenna structure of 20 feet or less in height, except one that would increase the height of another antenna structure (US Department of Transportation, Federal Aviation Administration, 2012).

For airports serving turbine-powered aircraft, the FAA recommends a separation of 10,000 feet between the farthest edge of the airport's air operations area and an area that could potentially attract hazardous wildlife. At 11,000 feet, the SBWRP is just outside this separation; however, the FAA recommends that airport operators be notified of any potential changes to land use within 5 miles of the airport, including expansion of wastewater treatment facilities. If future facilities could potentially attract wildlife that are hazardous to aircraft, the SBWRP should notify the airport operator to provide an opportunity for plan review. Table 7-11 lists ten wildlife species groups that are most hazardous to aircraft (U.S. Department of Transportation, Federal Aviation Administration, 2007).

Table 7-11: Most Hazardous Wildlife Species to Aircraft

Species Group	Relative Hazard Score (100 = greatest potential hazard)
Deer	100
Vultures	64
Geese	55
Cormorants/Pelicans	54
Cranes	47
Eagles	41
Ducks	39
Osprey	39
Turkey/Pheasants	33
Herons	27

The FAA strongly recommends that airport operators immediately correct any wildlife hazards arising from existing wastewater treatment facilities near airports (U.S. Department of Transportation, Federal Aviation Administration, 2007). Accordingly, the SBWRP should incorporate reasonable measures to minimize hazardous wildlife attractants in consultation with a wildlife damage management biologist if deemed necessary by the airport operator.

7.5 Safety

New facilities and projects recommended as part of the Master Plan shall comply with all safety and health and environmental standards as outlined in the City of San Bernardino Municipal Water Department Safety Manual and required by relevant agencies including Cal/OSHA, the National Electrical Code and the San Bernardino County Fire Protection District. The SBMWD is currently working with a consultant that is preparing a Hazard Mitigation Plan that covers, among many other areas, the SBWRP. This document should be reviewed for conformance with safety regulations/codes.

7.5.1 Cal/OSHA

Detailed review of Cal/OSHA requirements and identification of specific safety requirements shall occur as part of the preliminary design of all recommended projects. Applicable safety considerations shall include but not be limited to providing handrails and appropriate fall protection measures, identifying and marking confined spaces, providing emergency equipment such as eye washes required for chemical storage and handling, implementing lockout/tagout procedures, attenuating occupational noise exposure and providing means of egress in buildings and structures.

7.5.2 San Bernardino County Fire Protection District

Coordination with the San Bernardino County Fire Protection District (SBCFPD) shall occur during the preliminary design stages of recommended facility improvement projects as needed. Specific fire and life safety requirements shall be identified at that time. Considerations shall include but not be limited to providing hydrants, sprinkler systems, sufficient water pressure for hydrants and sprinkler systems, fire alarms, and access for emergency vehicles.

7.5.3 National Electrical Code

The National Electrical Code (NEC) or National Fire Protection Agency (NFPA) 70 is a regionally adopted standard for the safe installation of wiring and electrical equipment in the United States. The California Electrical Code (CEC) has adopted the NEC 2017 version. As of November 2019, the NEC 2020 is available; typically, the NEC is updated every three years.

The NEC is used as a basis for all electrical design including master planning to determine the equipment and installation required to maintain safety and a reliable system. Additionally, NFPA 70E, Standard for Electrical Safety in the Workplace, is referred to as it pertains to arc flash hazards and engineering controls to provide safety when maintaining and working with electrical equipment.

7.6 Utility Considerations

Utility providers include So Cal Gas, Verizon, and Southern California Edison (SCE). SCE currently provides six electrical services for the SBWRP. There is one 4160V service at BLM, and five 480V services at Hoffman, Administration Building, Century Well, Chandler Well, and the Orange Show Well. Century Well is tapped off the transformer that feeds Hoffman. SBMWD is currently working with SCE to get one combined 4.16kV service at the existing BLM Switchgear such that Hoffman and Century Well will be fed from BLM for one combined service, which will reduce the number of utility services from six to four.

Currently, the largest transformer that SCE can provide is rated at 3750 kVA (3.75 MW). Future load estimates are currently calculated at 3.8 MW. Onsite generation is expected to increase by 1.4 MW with the addition of a fuel cell system to offset possible overloading of the substation transformer. Presently, SCE has approved allowing the projected overload on the utility transformer assuming the fuel cell system will supplement plant power needs.

8. EXISTING PROCESS PERFORMANCE AND CAPACITY

This Section evaluates performance of the major treatment processes. Plant data from the 3-year period of March 2016 through February 2019 is compared against SBMWD goals, discharge requirements and industry standards.

8.1 Hydraulic Capacity

According to the SBWRP Operations and Maintenance (O&M) Manual (Carollo, 2000), the peak hydraulic capacity of the plant was intended to be 90 mgd with Unit 3 fully operational. The headworks and grit removal systems were constructed with 90 mgd of capacity with provisions for future expansion. Unit 3 was intended to have a capacity of 30 mgd when fully constructed, but the secondary treatment portion was never built. It currently serves to back up the Unit 1 primary clarifier if necessary, and therefore does not add to the overall plant peak hydraulic capacity.

The 1995 O&M manual listed the hydraulic capacity of Unit 1 as 38 mgd. Recent hydraulic modeling suggests that its capacity may be much less. In 2011, Carollo modeled the hydraulic capacity of Units 1 and 3 as part of their planning for Unit 1 upgrades (Carollo, 2011). They found that using either the Unit 1 or the Unit 3 primary clarifier, flow was limited to 20 mgd of forward flow, assuming mixed liquor recycle (MLR) and 6 mgd of RAS. Higher flows would submerge the primary clarifier weirs. At this flow the Unit 1 secondary clarifier flow split weirs would be submerged but this was not expected to significantly impact the flow split. Carollo recommended increasing the size of the mixed liquor pipe from the Unit 1 aeration basin to the flow splitter to help improve capacity. Black & Veatch performed a similar analysis in their 2012 Preliminary Design Report, “Overhaul of Unit 1 Primary and Aeration System Project.” They concluded that the Unit 1 hydraulic capacity would be 20 mgd with a parallel mixed liquor pipe. They also found that RAS could be increased to 12 mgd with MLR turned off.

Capacities of the major treatment units are summarized in Table 8-1. The total plant hydraulic capacity (Unit 1, 2 and NRC) based on the 1995 O&M manual is 67 mgd. With the lower capacity of 20 mgd for Unit 1, the total plant capacity is 48 mgd.

The Nitrogen Removal Carousel is designed for a consistent influent flow of 3 mgd to provide a carbon source for denitrifying recycle from dewatering. It is not designed to accept higher flows during wet weather.

Table 8-1: Peak Hydraulic Capacity of Treatment Units

Treatment Unit	Peak Hydraulic Capacity
Headworks & Grit (existing)	90 mgd
Unit 1	38 mgd / 20 mgd (1)
Unit 2	25 mgd
Unit 3 (only the primaries were constructed)	30 mgd
Nitrogen Removal Carousel (NRC)	3 mgd
Total Current Plant	66 mgd / 48 mgd

Notes:

1. Capacities are from O&M Manual Design Criteria (Carollo, 2000), except (1) is from 2011 and 2012 studies mentioned above.

During three significant storms in January and February of 2019, instantaneous plant flows reached between 47 to 64 mgd as measured by the two effluent flow meters. Operators observed that there were no overflows or significant hydraulic issues during this event. This is not necessarily inconsistent with the 48 mgd total capacity reported above, as the primary clarifier weirs could have been submerged during the higher flow events without causing any other significant hydraulic issues.

8.2 Influent Distribution Performance

Table 8-2 shows influent flow statistics for each of the major treatment units. The headworks flow splitter and Unit 2 flow splitter work together and divide flows among the four treatment trains. NRC is designed for a stable raw wastewater influent flow of 3.0 to 3.6 to provide a carbon source for denitrification of centrate. The recorded average flow of 2.4 mgd is less than the design flow. The remainder of the flow is intended to be split 50 percent to Unit 1, and 25 percent to each of the Unit 2 trains, in accordance with the ratio of their design capacities. The data shows that on average, the flow split works well: Unit 1 receives 48 percent of the non-NRC flow, with Units 2N and 2S each receiving 27 and 25 percent respectively.

Table 8-2: WRP Flow Distribution

	Units	Unit 1	Unit 2 North	Unit 2 South	Nitrogen Removal Carousel
Average Flow	mgd	9.22	5.08	4.75	2.35
Maximum Flow	mgd	16.13	9.50	9.28	3.19
Minimum Flow	mgd	7.35	3.87	3.30	0.64

Notes:

1. NRC influent flow does not include centrate, which adds an average of 0.2- to 0.6 mgd of flow.

8.3 Primary Process Performance

Primary clarifier performance is summarized in Table 8-3. Average performance of the Unit 1 and 2 primary clarifiers is similar, with COD removal ranging from 40 to 46 percent, and TSS removal between 61 and 65 percent. These removals are at the high end of typical ranges and indicate that the primary clarifiers are working well. TSS removal in primary clarifiers commonly ranges from 40 to 70 percent, with 60 percent being typical. BOD removals are typically 25 to 40-percent, it is assumed that COD removal would typically be higher.

The high observed removals are most likely a result of the low overflow rates. Average overflow rates of 400 to 600 gpd/sf are low compared with the typical design range of 800 to 1200 gpd/sf (Metcalf & Eddy, p.394). The addition of ferric chloride at the headworks may also play a roll. Ferric chloride is added to precipitate sulfur and minimize hydrogen sulfide formation in the digesters but may also help with coagulation and settling of fine particles.

It is desirable for the SBWRP to remove as much of the organic load as possible in the primary sludge for a couple of reasons. Primary sludge is sent directly to the digester where it is converted to biogas and used as an energy source in the existing reciprocal engines and in the fuel cells which are planned to replace them. Load removed in primary treatment also does not require secondary treatment, reducing the energy used for aeration and freeing up capacity in Units 1 and 2.

Table 8-3: Primary Treatment Average Performance

	Units	Unit 1	Unit 2N	Unit 2S
Overflow Rate	*gpd/sf*	599	449	420
COD Removal	*%*	40%	43%	46%
TSS Removal	*%*	61%	63%	65%
Primary Sludge % Total Solids	*%*	4.0%	4.3%	4.2%

8.4 Secondary Process Overall Performance

As discussed in Section 7.1.1, the main goals of secondary treatment are to remove BOD and TSS to less than 20 mg/L each on a monthly average basis, and TIN to 10 mg/L on a 12-month average. Table 8-4 shows on average the plant is below the limit for BOD and TSS, and at the limit for TIN. For all these parameters, 95th percentile values are above the limits.

Table 8-4: SBWRP Effluent Data

	Unit	Average	95 Percentile
Effluent BOD	*mg/L*	13.3	28.3
Effluent TSS	*mg/L*	10.5	22.1
Effluent TIN	*mg/L*	9.4	16.4

Notes:

1. Effluent Data is sourced from the SBWRP lab spanning April 2012 to August 2018. Non-detect values are not included the values presented above.

8.5 Secondary Process Nitrogen Removal Performance

For plants designed to remove nitrogen, solids residence times are usually long enough that BOD removal is easily achieved. Nitrogen removal requires a longer SRT and is therefore the limiting process. It is accomplished by first converting ammonia to nitrate in the aerated zones (nitrification), then using the energy available in a carbon source such as the influent BOD to convert the nitrate to nitrogen gas (denitrification). This section explores nitrogen removal performance of the four treatment units in more detail.

Average TIN removal performance for each of the four treatment units is shown in Table 8-5. Only Unit 1 appears to be meeting its average effluent TIN goal of 10 mg/L. Most of the effluent TIN at Unit 2 appears to be nitrate, which suggests that while Unit 2N and 2S are both achieving consistent nitrification, denitrification is limited. This is likely due to the lack of internal nitrogen recycle in these units. The last halves of Unit 2N and 2S consist of aerobic bays, which is likely where most of the nitrification takes place. For the nitrate produced in these bays, only the fraction that is returned in the RAS can be denitrified.

By contrast, Unit 1 does have mixed liquor recycle. This allows more nitrate to be returned to the anoxic zones, and as a result Unit 1 effluent nitrate concentration is half of what is observed at Unit 2, resulting in a lower effluent TIN.

Unit 1 shows signs of incomplete nitrification, as indicated by its higher effluent ammonia and nitrite concentrations. Common causes of incomplete nitrification include insufficient solids residence time and insufficient dissolved oxygen. Nitrifying bacteria are relatively slow to grow. Stable nitrification requires a minimum SRT to insure a sufficient population. Metcalf and Eddy (2014, p.719) cites a wide range of 3 to 18 days of SRT as being required for complete nitrification. The longer times are required at cooler wastewater temperatures. Given the relatively warm influent temperatures at SBWRP, the retention times shown in Table 8-5 should be sufficient and do not alone explain partial nitrification.

Nitrifying bacteria grow best within a DO range of 1.5 to 2.0 mg/L (Metcalf and Eddy, 2014, p.729). While plant data shows that DO concentrations in the aerobic bays of Unit 1 are on average greater than 2.0, the levels are inconsistent. During a site visit on August 12, 2019, DO levels in bays 1 through 8 were observed to all be less than 0.7 mg/L. The blower project currently under design is intended to improve oxygen delivery and control to Units 1 and 2 and should help promote complete nitrification.

Table 8-5: Average Secondary Treatment Nitrogen Removal Performance

	Units	Unit 1	Unit 2N	Unit 2S	NRC
Aerobic SRT [1]	*days*	6.3	8.7	6.5	12.3
Effluent Ammonia	*mg/L*	1.5	0.7	0.5	10.9
Effluent Nitrite	*mg/L*	1.4	0.0	0.0	1.5
Effluent Nitrate	*mg/L*	5.1	10.5	11.5	2.7
Total TIN	*mg/L*	8.0	11.2	12.0	15.1
Influent Alkalinity	*mg/L*	290	297	296	227

Notes:

1. Aerobic SRT was calculated from total SRT using current aeration bay configurations: Unit 1 70% aerobic, Unit 2N 80% aerobic, Unit 2S 63% aerobic.

8.6 Secondary Clarifier Performance

Table 8-6 summarizes parameters for each unit related to secondary clarifier performance. All four treatment units have settleability issues as indicated by high 95th percentile SVI values ranging from 280 to 390 mL/g. For comparison, a 95th percentile SVI of 200 mL/g is a typical design value for plants without selectors. It is possible that the process configuration contributes to high SVI, but a filament analysis would be required to confirm. In Units 1 and 2N, the small pre-anoxic zone (10% of the reactor volume) is likely insufficient to provide a beneficial selector effect. Subsequent alternating small aerobic/anoxic zones may result in marginal DO concentrations that promote filament growth in addition to limiting nitrification.

Table 8-6: Secondary Clarifier Performance

	Units	Unit 1	Unit 2N	Unit 2S	NRC
Avg. Overflow Rate	*gpd/sf*	300	414	387	268
Avg. MLSS	*mg/L*	2501	2139	2306	2791
Avg. SVI	*mL/g*	182	107	92	202
95^{th} Percentile SVI	*mL/g*	389	282	290	345
Avg. Effluent TSS	*mg/L*	7.5	8.5	8.1	9.4
95^{th} Percentile Effluent TSS	*mg/L*	18.0	17.6	16.8	20.0

8.7 Secondary Treatment Capacity

Capacity of the secondary treatment system is defined by two measures:

1. The reactor tanks and blower system must have enough capacity to meet effluent BOD and TIN requirements under typical high (max month or week) loading conditions.
2. The secondary clarifiers must have enough capacity to handle peak hour flows without losing solids.

The capacity of the Unit 1 reactor tanks was evaluated in separate modeling studies by Carollo (2011) and Black & Veatch (2012). These studies both examined the ability of Unit 1 to remove TIN to 10 mg/L at max month loading with the addition of mixed liquor recycle (MLR). While Unit 1 has a rated capacity of 15 mgd, both studies concluded that in order to meet the TIN requirement, the average flow could not exceed 12 mgd. The Black & Veatch study determined that capacity would be limited by ability to transfer sufficient dissolved oxygen to meet the high demand in the first bays. The Carollo study found that capacity was limited by the ability to achieve complete nitrification.

Although modeling was not performed for the Unit 2 trains, these have the same configuration as Unit 1: ten reactor bays in series. Assuming the same primary effluent concentrations, a rough estimate of the capacity of Units 2N and 2S can be made based on the ratio of their volume to that of Unit 1. The Unit 1 reactor volume is reported as 485,000 in the 2016 Hazen and Sawyer PDR. The volume for each of the Unit 2 trains is reported as 321,000 cubic feet by the same source. If the capacity of Unit 1 is 12 mgd based on nutrient removal objectives, then the capacity of each Unit 2 train would be 7.2 mgd based on a volume ratio. This value is slightly less than the original average dry weather flow capacity of 7.5 for these units. This analysis presumes that mixed-liquor recycle pumps have been added to Unit 2N and 2S.

The peak forward flow capacity of the secondary clarifier was estimated using state point analysis (SPA). State point analysis is a graphical technique for comparing the rate at which solids are introduced and removed from the clarifier with an empirical settling rate curve. Results are summarized in Table 8-7. These capacities are based on the current 95th percentile SVI and average mixed liquor concentrations presented above.

Table 8-7: Current Secondary Clarifier Capacity

	Units	Unit 1	Unit 2N	Unit 2S	NRC
Firm RAS Capacity (1)	*mgd*	12	4.4	4.2	3.6
Peak Forward Flow Capacity (2)	*mgd*	15	11	9	4.5 (3)

Notes:

1. RAS capacity with one pump out of service, from Carollo 2016 Capacity Update.
2. Based on state point analysis using average mixed-liquor concentrations and 95th percentile SVI from the previous table. Unit 1 assumes both clarifiers are online.
3. NRC is not intended to handle more than 3 mgd of raw influent.

State point analysis estimates that the peak flow capacity of Unit 1 is at its average design capacity of 15 mgd. The peak capacities of Units 2N and 2S are only slightly higher than their design average capacity of 7.5 mgd. This is an issue because at their design flows, these units will have little additional capacity to handle wet weather flows without losing solids. The discrepancy in peak capacities between Units 2N and 2S are due to the difference in MLSS concentration as shown in Table 8-6. The high SVI values limit capacities for both Unit 1 and 2. The peak capacity of the NRC's secondary clarifier is less of a concern because it is not intended to handle flows above 3 mgd.

Table 8-8 shows how the capacity of the SBWRP's secondary clarifiers could be increased by improving settleability and reducing the 95th-percentile SVI to a more typical value of 200 mL/g. This analysis assumes that the MLSS concentration has also been increased to a design concentration of 3000 mg/L for all units based on what the Black & Veatch modeling study predicted would be necessary to treat an average flow of 12 mgd in Unit 1.

For Unit 1, the improvement is considerable: state point analysis estimates the peak flow capacity would be increased to 25 mgd. For Unit 2, which currently has a lower SVI, improving the SVI to 200 is canceled out by the increase in MLSS concentration, resulting in no net increase in capacity.

This analysis assumes that the Unit 2 RAS capacity has been restored to its original design value of 4.5 mgd (3150 gpm) per train. Though it is common to size RAS pumps in nutrient removal systems for 100% of the average flow, state point analysis suggests that increasing the capacity of the Unit 2 RAS pumps beyond 4.5 mgd does not increase secondary clarifier capacity in any scenario.

Table 8-8: Design Secondary Clarifier Capacity with Improved SVI

	Units	Unit 1	Units 2N & 2S (each)	Units 2N & 2S (each), Contact Stabilization
Design SVI	*mL/g*	200	200	200
Design MLSS Concentration	*mg/L*	3000	3000	1500
Firm RAS Capacity Required	*mgd*	12	4.5	4.5
Peak Forward Flow Capacity	*mgd*	25	9	20

An additional strategy for increasing wet weather capacity of Unit 2 above 9 mgd would be to temporarily reduce the MLSS concentration during wet weather by implementing contact stabilization. To achieve this, operators would direct most or all the primary effluent to bay(s) downstream of where the RAS is introduced. This reduces the mixed liquor concentration entering the secondary clarifiers and effectively increases their capacity. The last column of Table 8-8 shows that reducing the MLSS concentration to 1,500 mg/L by this method would double the peak flow capacity of Unit 2 to 20 mgd. This could increase the SBWRP's total peak secondary clarifier capacity to 68 mgd, including 3 mgd of treatment at NRC. Additional detailed modeling is required to confirm.

8.8 Solids Handling Capacity and Performance

This section discussed capacity and performance of the major processes in the solids handling system:

- Dissolved Air Floatation Thickeners (DAFTs)
- Anaerobic Digesters
- Centrifuge and Belt Filter Press (BFP) Dewatering

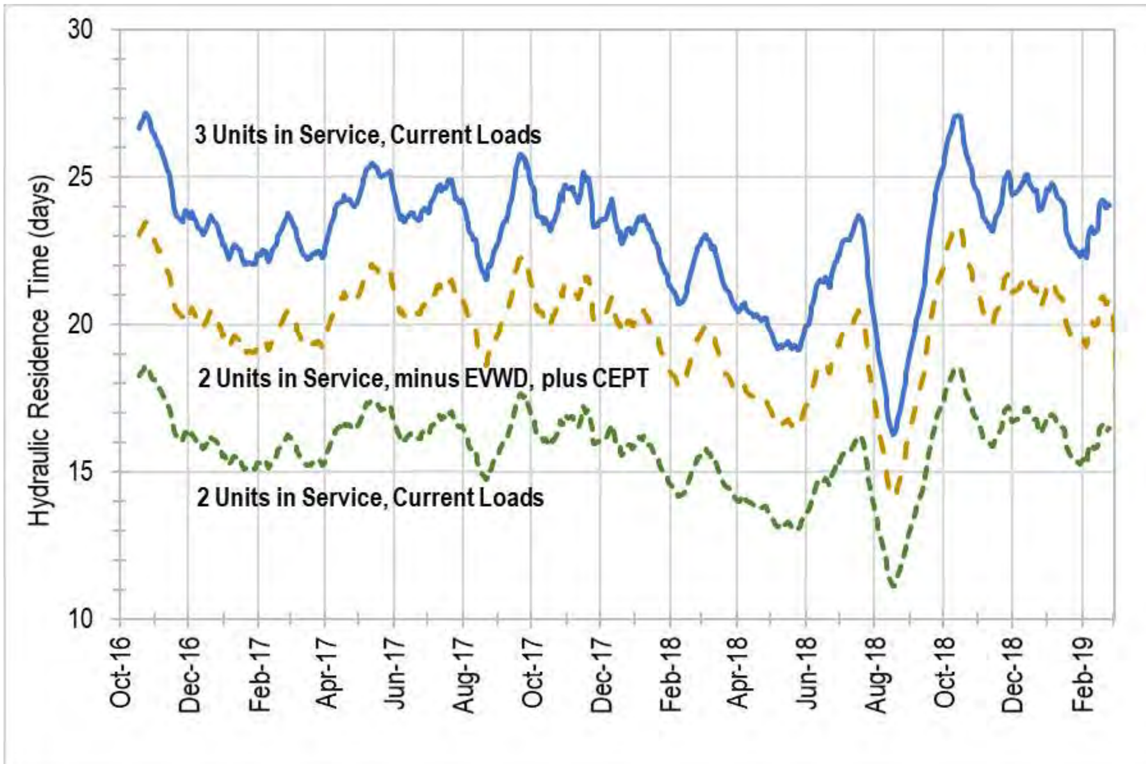
The DAFT are used to remove water from the secondary solids to reduce the hydraulic loading to digesters. There are four DAFT units, three of which are functional. Typically, only one DAFT is in operation. Occasionally, two DAFT units are in service for transitioning from one to another. DAFT 4 is the primary unit in service, and DAF 1 and DAF 2 are rotated into service. Table 8-9 presents a summary of DAFT performance. The average loading rate is slightly higher than the 1995 design of 24 lbs./day/sf, but less than the industry-standard loading rate of 48 lbs./day/sf. Performance of the DAFT is good, with an average solids-capture of 99.7% and an average thickened concentration of 6.4%.

Table 8-9: DAFT Performance

	Units	Value
Average Solids Loading	*pounds per day*	27,360
Average Float TS	*percent*	6.4%
Average Float Solids Capture	*pounds per day*	27,300
Average Solids Capture Rate	*percent*	99.7%
Average Surface Loading Rate	*pounds per day per square foot*	28

Primary and thickened secondary solids are conditioned in three anaerobic digesters (a fourth digester is currently out of service). A key measure of digester capacity is hydraulic residence time (HRT), which is summarized in Figure 8-1, below. In order to meet the pathogen reduction requirements of the Part 503 Biosolids Rule, a 15-day residence time is required. 15 days is also a practical minimum residence time to maintain stable operations. The top line in Figure 8-1 shows that three digesters were required to stay above the 15-day minimum HRT based on loadings over the last several years. The bottom line shows the HRT with just two digesters, which would have dipped below 15-days for an extended period.

Figure 8-1: Digester Hydraulic Retention Time (30-day average)



The middle line in Figure 8-1 shows the projected HRT with two digesters when EVWD departs. The solids load has been decreased proportionally to EVWD's flow. An additional 10-percent load has been added back to account for the potential additional solids load from chemically-enhanced primary treatment, which is discussed as a possible upgrade option in Section 10. Under this scenario, two digesters are sufficient to maintain a 15-day HRT, which would provide an opportunity for the SBMWD to perform rehabilitation and upgrade work on the digesters. This is discussed further in Section 10.

A pair of centrifuges are available for dewatering. Under normal operations, one centrifuge is run 24 hours per day, 7 days per week. The second centrifuge serves as a backup. This provides sufficient capacity for current and future conditions.

9. RECOMMENDED REHABILITATION AND REPLACEMENT PROJECTS

To organize the rehabilitation and replacement (R&R) of assets for the Capital Improvement Plan (CIP), the assets were grouped by process location or type of work and organized into the time periods that correlate with SBMWD's CIP format. R&R projects included in this CIP are limited to a 20-year planning period.

The time periods used for this CIP are as follows:

- Near-Term: 1 to 5 years (FY 2020/2021 through FY 2024/2025)
  - Projects in this time period were selected based on assets with 5-years or less of estimated remaining useful life with additional considerations for assets that SBMWD staff saw as a priority for replacement.
- Medium-Term: 6 to 10 years (FY 2025/2016 through FY 2029/2030)
  - Projects in this period were selected based on assets with less than 10 years of estimated remaining useful life that were not addressed under the near-term projects.
- Long-Term: 11 to 20 years (FY 2030/2031 through FY 2039/2040)
  - Projects in this period were selected based on assets with less than 20 years of estimated remaining useful life that were not addressed under the near- or medium-term projects.

The reference for R&R projects and their costs is the Asset Register Version 90. As a part of the development of the Asset Registry, a Business Risk Exposure (BRE) analysis was used to describe and quantify the risks associated with failure of SBWRP's assets (see Section 4: Risk Assessment). The BRE score that was assigned to each asset was used to prioritize near-term actions needed to mitigate asset risk and/or help meet level of service goals. BRE scores have three major components: Probability of failure (PoF); Consequence of failure (CoF); and redundancy. The BRE scores were used to prioritize asset R&R by process location.

The near-term R&R projects were further prioritized using the scoring system described in Section 9.1.

R&R project costs include construction markups for general conditions, electrical and I&C, contractor overhead and profit, and bonds and insurance. R&R project costs also include allowances for design and construction management (see Table 10-3). A 30% project contingency is included in all project cost estimates.

9.1 Near-Term R&R Projects (1 to 5 Years)

This section describes projects that are recommended in the Near-Term (FY 2020/2021 through FY 2024/2025). A summary of cost estimates for each project is provided in Table 9-1 with more detailed cost sheets included at the end of this section.

Table 9-1: Near-Term R&R Projects (1 to 5 Years)

R&R Project	Project Description	Project Cost
HVAC and Misc. Mechanical Asset R&R	R&R of aging and critical HVAC and miscellaneous mechanical assets. Assets to be replaced include HVAC and various valves located in the Administration and Secondary Admin Buildings, and Arrowhead Lift Station.	$500,000
Instrumentation R&R	R&R of aging and critical instrumentation assets. Instrumentation to be replaced include meters, sensors and probes located at the onsite wells, headworks buildings and outfall sample stations.	$450,000
Liner and Containment Structure R&R	R&R of aging and critical liner and containment structure assets. Assets to be replaced include liners and containment structures located at the truck unloading bed, grit dewatering bed, and ferric chloride and hazardous material storage areas.	$240,000
Solids Handling and Digester A R&R	R&R of aging and critical dewatering and digester assets. Assets to be replaced include various sludge handling, dewatering and odor control equipment located at the dewatering building, DAFTs, Digester A and sludge storage. Digester A rehabilitation should take place after the completion of the Digester B replacement.	$4,690,000
Digester C & D R&R	R&R of aging and critical assets associated with Digesters C and D. Assets to be replaced include various process mechanical equipment. R&R of Digesters C and D should not occur until Digester B is replaced (see Section 10).	$220,000
Pavement R&R	R&R of pavement throughout the treatment plant site. This cost has been spread over a 10-year period.	$3,640,000
Grit Removal System R&R	R&R of aging and critical assets associated with grit removal. Assets to be replaced include grit chamber assemblies and meters, aerator blowers, motors and VFDs.	$2,520,000
Nitrogen Removal Carrousel R&R	R&R of aging and critical assets associated with the Nitrogen Removal Carrousel and North Outlet structure. Assets to be replaced include various process equipment.	$3,830,000
Pump and VFD Replacement Project	R&R of aging and critical Pumps and Variable Frequency Drives. Assets to be replaced include pumps, VFDs and instrumentation located at the Roots Blower Building, RS-1 Pump Station and Tertiary Reservoir.	$4,940,000

R&R Project	Project Description	Project Cost
Units 1 and 2 R&R	R&R of aging and critical assets associated with the Unit 1 and Unit 2 process. Assets to be replaced include diffusers, mixers, motors, VFDs, platforms, and miscellaneous mechanical equipment and instrumentation.	$3,510,000
Unit 3 R&R	R&R of aging and critical assets associated with the Unit 3 primary process. The assets under Unit 3 R&R include valves and flow meters at Low Pressure Supply Air Assembly, Flight Scraper Mechanism at Primary Clarifier No. 3D, Grinders and Gas meter at Scum Pump Station and Pumps and Motors at Primary Sludge Pump Station.	$1,720,000
Total Near-Term R&R Project Cost		$26,260,000

The near-term R&R projects were further prioritized using the scoring system described in the following section. The scoring system relied on four evaluation categories:

- Reducing consequence of failure (COF)
- Improving energy efficiency (Energy)
- Renewing or replacing aging assets (Life)
- Reducing operational cost and/or simplifying operations (Ops)

Each evaluation category was assigned a weight of 1 to 3, with three being the most significant and one being the least. Weights are shown in the table below. Each project was given a score of 0 to 3 in each evaluation category based its relevance to the project. A score of three indicates that the category is highly relevant to a project; zero indicates no relevance. A total score was then calculated for each project by multiplying the score for each category by its weight, then summing the weighted scores. Projects with the highest total score offer the greatest benefit to SBMWD. Note that these scores are independent of the capital costs presented previously.

Scores were only developed for the near-term R&R projects since a specific year for implementation needed to be identified. The scores for each near-term R&R project by evaluation category and total are presented in Table 9-2. The projects have been sorted in descending order based on their total score.

Table 9-2: Near-Term R&R Project Scoring and Ranking

Project	Total Score	Evaluation Category			
		COF	Energy	Life	Ops
		Category Weight			
		3	1	2	1
		Category Score			
VFD Replacement Project	16	3	1	3	0
Solids Handling and Digester A	16	3	1	3	0
Nitrogen Removal Carrousel	15	3	0	3	0
Units 1 and 2	15	3	0	3	0
Unit 3	15	3	0	3	0
Digester C & D	14	3	1	2	0
HVAC and Misc. Mechanical Assets	14	2	1	3	1
Instrumentation	13	2	0	3	1
Liner and Containment Structures	12	2	0	3	0
Grit Removal System	12	2	0	3	0
Pavement	10	1	0	3	1

9.2 Medium-Term R&R Projects (6 to 10 Years)

This section describes projects that are recommended in the Medium-Term (FY 2025/2026 through FY 2029/2030). A summary of cost estimates for each project is provided in Table 9-3 with more detailed cost sheets included at the end of this section.

Table 9-3: Medium-Term R&R Projects (6 to 10 Years)

CIP Project	Project Description	Project Cost
HVAC and Misc. Mechanical Asset R&R	R&R of aging HVAC and miscellaneous mechanical assets. Assets to replaced include HVAC and various valves located in Electrical Administration Building, Boiler Building, and Headworks Tunnel and Splitter box.	$1,671,000
Instrumentation R&R	R&R of aging instrumentation assets. Instrumentation to be replaced include meters, sensors and probes located at the onsite wells, bar screen building and outfall sample stations.	$5,552,000
General Site Civil	R&R of aging assets at the Septage and Brine Receiving Station, Irrigation Control Building and Brine Ponds.	$340,000
Solids Handling R&R	R&R of aging dewatering and digester assets. Assets to be replaced include various sludge handling, dewatering and odor control equipment located at the dewatering building, DAFTs, Digester A and sludge storage.	$11,274,000

CIP Project	Project Description	Project Cost
Lift Station R&R	R&R of aging assets associated with Arrowhead and East Influent Lift Stations. Assets to be replaced include pumps, motors, and sensors.	$2,846,000
Pavement R&R	R&R of pavement throughout the treatment plant site. This cost has been spread over a 10-year period.	$3,640,000
Headworks R&R	R&R of aging assets associated with the headworks including grit removal and odor control systems.	$3,853,000
Nitrogen Removal Carousel R&R	R&R of aging assets associated with the Nitrogen Removal Carousel. Assets to be replaced include RAS/WAS pumps and motors, and various mechanical equipment.	$1,900,000
VFD R&R	R&R of aging assets associated with Variable Frequency Drives. Assets to be replaced include VFD and instrumentation located at the Roots Blower Building and Tertiary Reservoir. Consideration should be given to replacing the Roots blowers in addition to the VFDs for this project.	$3,263,000
Units 1 and 2 R&R	R&R of aging assets associated with the Unit 1 and Unit 2 process. Assets to be replaced include diffusers, mixers, motors and miscellaneous mechanical equipment and instrumentation.	$6,296,000
Unit 3 R&R	R&R of aging assets associated with the Unit 3 primary process. Assets to be replaced include scum pumps, motors, grinders, and miscellaneous mechanical equipment and instrumentation.	$3,791,000
Total Medium-Term R&R Project Costs		$40,786,000

9.3 Long-Term R&R Projects (11 to 20 Years)

This section summarizes projects that are recommended in the Long-Term (FY 2030/2031 through FY 2039/2040). A summary of cost estimates for each project is provided in Table 9-4 with more detailed cost sheets included at the end of this section.

Table 9-4: Long-Term R&R Projects (11 to 20 Years)

CIP Project	Project Cost
HVAC and Misc. Mechanical Asset R&R	$8,886,000
Instrumentation R&R	$19,128,000
General Site Civil	$956,000
Solids Handling R&R	$36,745,000
Lift Station R&R	$7,701,000
Digester C & D R&R	$1,931,000

CIP Project	Project Cost
Paving R&R	$1,107,000
Headworks R&R	$10,100,000
VFD R&R	$6,232,000
Unit 3 R&R	$2,639,000
Total Long-Term R&R Project Costs	$95,425,000

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Project Name: 1 HVAC AND MISC. MECHANICAL ASSET R&R
Asset Classification: REHABILITATION AND ASSET REPLACEMENT
Asset Category: WRP FACILITIES ASSESSMENT AND MASTER PLAN

Budget ID No. **CO No.**

Project Description: Rehabilitation and Replacement of aging and critical HVAC and miscellaneous mechanical assets. Assets to replaced include HVAC and various valves located in Administration, Secondary Admin, Boiler, and Burner Buildings, and Arrowhead Lift Station.

Construction Cost Breakdown	Quantity	Unit	Unit Cost	Total
Admin Bldg HVAC	1	LS	$18,000	$18,000
Arrowhead Lift Station	1	LS	$193,000	$193,000
Secondary Administration Building HVAC	1	LS	$90,000	$90,000
			Installation Subtotal:	**$301,000**
General Conditions	0%			$0
Electrical and I&C	0%			$0
Contractor Overhead	0%			$0
Contractor Profit	0%			$0
Bonds & Insurance	0%			$0
Construction Contingency	0%	N/A		$0
			Construction Subtotal:	**$301,000**

Budgetary Requirements:

Cost Category	Estimated Cost
CEQA Compliance:	$0
Design:	$36,120
Const. Mgmnt:	$45,150
Construction:	$301,000
SBMWD Labor & Ovhd:	$0
SBMWD Stock Issues	$0
Equipment Rental:	$0
Purchased Material:	$0
Contract Services	$0
Subtotal:	**$382,270**
Contingency (30%)	**$114,681**
TOTAL COSTS (ROUNDED)	**$500,000**

Project Funding Sources:	Funding Amount
Water Capital:	$0
Chartis Escrow:	$0
Water Conservation:	$0
Other (Debt):	$0
FUNDING (ROUNDED)	**$0**

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Project Name: 2 INSTRUMENTATION R&R
Asset Classification: REHABILITATION AND ASSET REPLACEMENT
Asset Category: WRP FACILITIES ASSESSMENT AND MASTER PLAN

Budget ID No. **CO No.**

Project Description: Rehabilitation and Replacement of aging and critical instrumentation assets. Instrumentation to be replaced include meters, sensors and probes located at the onsite wells, headworks buildings and outfall sample stations.

Construction Cost Breakdown	Quantity	Unit	Unit Cost	Total
Bar Screen Building Instrumentation	1	LS	$56,000	$56,000
Century Well Instrumentation	1	LS	$5,000	$5,000
Chandler Well Instrumentation	1	LS	$10,000	$10,000
East Lift Station Instrumentation	1	LS	$35,000	$35,000
Headworks Splitter Box	1	LS	$10,000	$10,000
Headworks Tunnel Instrumentation	1	LS	$35,000	$35,000
Influent Metering Structure	1	LS	$29,000	$29,000
Internal Recycle Metering Structure	1	LS	$45,000	$45,000
Orange Show Well Instrumentation	1	LS	$42,000	$42,000
Outfall Sampling Station	1	LS	$3,000	$3,000
			Installation Subtotal:	**$270,000**
General Conditions	0%			$0
Electrical and I&C	0%			$0
Contractor Overhead	0%			$0
Contractor Profit	0%			$0
Bonds & Insurance	0%			$0
Construction Contingency	0%	N/A		$0
			Construction Subtotal:	**$270,000**

Budgetary Requirements:

Cost Category	**Estimated Cost**
CEQA Compliance:	$0
Design:	$32,400
Const. Mgmnt:	$40,500
Construction:	$270,000
SBMWD Labor & Ovhd:	$0
SBMWD Stock Issues	$0
Equipment Rental:	$0
Purchased Material:	$0
Contract Services	$0
Subtotal:	**$342,900**
Contingency (30%)	**$102,870**
TOTAL COSTS (ROUNDED)	**$450,000**

Project Funding Sources:	**Funding Amount**
Water Capital:	$0
Chartis Escrow:	$0
Water Conservation:	$0
Other (Debt):	$0
FUNDING (ROUNDED)	**$0**

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Project Name: 3 LINER AND CONTAINMENT STRUCTURE R&R
Asset Classification: REHABILITATION AND ASSET REPLACMENT
Asset Category: WRP FACILITIES ASSESSMENT AND MASTER PLAN

Budget ID No. **CO No.**

Project Description: Rehabilitation and Replacement of aging and critical liner and containment structure assets. Assets to be replaced include liners and containements structures located at the brine pond, truck unloading bed, grit dewatering bed, and ferric chloride and hazardous material storage areas.

Construction Cost Breakdown	Quantity	Unit	Unit Cost	Total
Combination Truck Unloading Bed	1	LS	$23,000	$23,000
Ferric Chloride Storage Tank	1	LS	$74,000	$74,000
Grit Dewatering Bed	1	LS	$23,000	$23,000
Hazardous Materials Storage Area	1	LS	$27,000	$27,000
			Installation Subtotal:	**$147,000**
General Conditions	0%			$0
Electrical and I&C	0%			$0
Contractor Overhead	0%			$0
Contractor Profit	0%			$0
Bonds & Insurance	0%			$0
Construction Contingency	0%	N/A		$0
			Construction Subtotal:	**$147,000**

Budgetary Requirements:

Cost Category	Estimated Cost
CEQA Compliance:	$0
Design:	$17,640
Const. Mgmnt:	$22,050
Construction:	$147,000
SBMWD Labor & Ovhd:	$0
SBMWD Stock Issues	$0
Equipment Rental:	$0
Purchased Material:	$0
Contract Services	$0
Subtotal:	**$186,690**
Contingency (30%)	**$56,007**
TOTAL COSTS (ROUNDED)	**$240,000**

Project Funding Sources:	Funding Amount
Water Capital:	$0
Chartis Escrow:	$0
Water Conservation:	$0
Other (Debt):	$0
FUNDING (ROUNDED)	**$0**

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Project Name: 4 SOLIDS HANDLING AND DIGESTER A R&R
Asset Classification: REHABILITATION AND ASSET REPLACEMENT
Asset Category: WRP FACILITIES ASSESSMENT AND MASTER PLAN

Budget ID No. **CO No.**

Project Description: Rehabilitation and Replacement of aging and critical dewatering and digester assets. Assets to be replaced include various sludge handling, dewatering and odor control equipment located at the dewatering building, DAFTs, Digester A and sludge storage.

Construction Cost Breakdown	Quantity	Unit	Unit Cost	Total
Dewatering & Thickening (D&T) Assets	1	LS	$483,000	$483,000
Dewatering Building & Conveyors 1 & 2	1	LS	$1,653,000	$1,653,000
Digester A Assets	1	LS	$41,000	$41,000
Dissolved Air Flotation Thickener 1 Assets	1	LS	$28,000	$28,000
Dissolved Air Flotation Thickener 2 Assets	1	LS	$28,000	$28,000
Sludge Storage Odor Scrubber Assets	1	LS	$603,000	$603,000
South Digested Sludge Storage Tank Assets	1	LS	$5,000	$5,000
			Installation Subtotal:	**$2,841,000**
General Conditions	0%			$0
Electrical and I&C	0%			$0
Contractor Overhead	0%			$0
Contractor Profit	0%			$0
Bonds & Insurance	0%			$0
Construction Contingency	0%	N/A		$0
			Construction Subtotal:	**$2,841,000**

Budgetary Requirements:

Cost Category	Estimated Cost
CEQA Compliance:	$0
Design:	$340,920
Const. Mgmnt:	$426,150
Construction:	$2,841,000
SBMWD Labor & Ovhd:	$0
SBMWD Stock Issues	$0
Equipment Rental:	$0
Purchased Material:	$0
Contract Services	$0
Subtotal:	**$3,608,070**
Contingency (30%)	**$1,082,421**
TOTAL COSTS (ROUNDED)	**$4,690,000**

Project Funding Sources:	Funding Amount
Water Capital:	$0
Chartis Escrow:	$0
Water Conservation:	$0
Other (Debt):	$0
FUNDING (ROUNDED)	**$0**

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Project Name: 5 DIGESTER C & D R&R
Asset Classification: REHABILITATION AND ASSET REPLACEMENT
Asset Category: WRP FACILITIES ASSESSMENT AND MASTER PLAN

Budget ID No. **CO No.**

Project Description: Rehabilitation and Replacement of aging and critical assets associated with Digesters C and D. Assets to be replaced include various process mechanical equipment.

Construction Cost Breakdown	Quantity	Unit	Unit Cost	Total
Digester C Assets	1	LS	$130,000	$130,000
Digester D Assets	1	LS	$5,000	$5,000
			Installation Subtotal:	**$135,000**
General Conditions	0%			$0
Electrical and I&C	0%			$0
Contractor Overhead	0%			$0
Contractor Profit	0%			$0
Bonds & Insurance	0%			$0
Construction Contingency	0%	N/A		$0
			Construction Subtotal:	**$135,000**

Budgetary Requirements:

Cost Category	Estimated Cost
CEQA Compliance:	$0
Design:	$16,200
Const. Mgmnt:	$20,250
Construction:	$135,000
SBMWD Labor & Ovhd:	$0
SBMWD Stock Issues	$0
Equipment Rental:	$0
Purchased Material:	$0
Contract Services	$0
Subtotal:	**$171,450**
Contingency (30%)	**$51,435**
TOTAL COSTS (ROUNDED)	**$220,000**

Project Funding Sources:	Funding Amount
Water Capital:	$0
Chartis Escrow:	$0
Water Conservation:	$0
Other (Debt):	$0
FUNDING (ROUNDED)	**$0**

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Project Name: 6 PAVEMENT R&R
Asset Classification: REHABILITATION AND ASSET REPLACMENT
Asset Category: WRP FACILITIES ASSESSMENT AND MASTER PLAN

Budget ID No. **CO No.**

Project Description: Rehabilitation and Replacement of employee parking lot at the WRP.

Construction Cost Breakdown	Quantity	Unit	Unit Cost	Total
Pavement R&R	1	LS	$5,728,000	$5,728,000
			Installation Subtotal:	**$5,728,000**
General Conditions	0%			$0
Electrical and I&C	0%			$0
Contractor Overhead	0%			$0
Contractor Profit	0%			$0
Bonds & Insurance	0%			$0
Construction Contingency	0%	N/A		$0
			Construction Subtotal:	**$5,728,000**

Budgetary Requirements:

Cost Category	Estimated Cost
CEQA Compliance:	$0
Design:	$687,360
Const. Mgmnt:	$859,200
Construction:	$5,728,000
SBMWD Labor & Ovhd:	$0
SBMWD Stock Issues	$0
Equipment Rental:	$0
Purchased Material:	$0
Contract Services	$0
Subtotal:	**$7,274,560**
Contingency (30%)	**$2,182,368**
TOTAL COSTS (ROUNDED)	**$9,460,000**

Project Funding Sources:	Funding Amount
Water Capital:	$0
Chartis Escrow:	$0
Water Conservation:	$0
Other (Debt):	$0
FUNDING (ROUNDED)	**$0**

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Project Name: 7 GRIT REMOVAL SYSTEM R&R
Asset Classification: REHABILITATION AND ASSET REPLACMENT
Asset Category: WRP FACILITIES ASSESSMENT AND MASTER PLAN

Budget ID No. **CO No.**

Project Description: Rehabilitation and Replacement of aging and critical assets associated with grit removal. Assets to be replaced include grit chamber assemblies and meters, aerator blowers, motors and VFDs.

Construction Cost Breakdown	Quantity	Unit	Unit Cost	Total
Grit Chamber Assets	1	LS	$1,105,000	$1,105,000
Headworks Blower Assets	1	LS	$203,000	$203,000
Headworks Electrical Assets	1	LS	$206,000	$206,000
Headworks Odor Scrubber Analyzers	1	LS	$10,000	$10,000
			Installation Subtotal:	**$1,524,000**
General Conditions	0%			$0
Electrical and I&C	0%			$0
Contractor Overhead	0%			$0
Contractor Profit	0%			$0
Bonds & Insurance	0%			$0
Construction Contingency	0%	N/A		$0
			Construction Subtotal:	**$1,524,000**

Budgetary Requirements:

Cost Category	**Estimated Cost**
CEQA Compliance:	$0
Design:	$182,880
Const. Mgmnt:	$228,600
Construction:	$1,524,000
SBMWD Labor & Ovhd:	$0
SBMWD Stock Issues	$0
Equipment Rental:	$0
Purchased Material:	$0
Contract Services	$0
Subtotal:	**$1,935,480**
Contingency (30%)	**$580,644**
TOTAL COSTS (ROUNDED)	**$2,520,000**

Project Funding Sources:	**Funding Amount**
Water Capital:	$0
Chartis Escrow:	$0
Water Conservation:	$0
Other (Debt):	$0
FUNDING (ROUNDED)	**$0**

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Project Name: 8 NITROGEN REMOVAL CARROUSEL R&R
Asset Classification: REHABILITATION AND ASSET REPLACEMENT
Asset Category: WRP FACILITIES ASSESSMENT AND MASTER PLAN

Budget ID No. **CO No.**

Project Description: Rehabilitation and Replacement of aging and critical assets associated with the Nitrogen Removal Carrousel and North Outlet structure. Assets to be replaced include various process equipment.

Construction Cost Breakdown	Quantity	Unit	Unit Cost	Total
Nitrogen Removal Carrousel Assets	1	LS	$1,589,000	$1,589,000
NRC Anoxic Basins	1	LS	$380,000	$380,000
NRC Building	1	LS	$204,000	$204,000
NRC Secondary Clarifier	1	LS	$8,000	$8,000
North Outfall Structure	1	LS	$139,000	$139,000
			Installation Subtotal:	**$2,320,000**
General Conditions	0%			$0
Electrical and I&C	0%			$0
Contractor Overhead	0%			$0
Contractor Profit	0%			$0
Bonds & Insurance	0%			$0
Construction Contingency	0%	N/A		$0
			Construction Subtotal:	**$2,320,000**

Budgetary Requirements:

Cost Category	**Estimated Cost**
CEQA Compliance:	$0
Design:	$278,400
Const. Mgmnt:	$348,000
Construction:	$2,320,000
SBMWD Labor & Ovhd:	$0
SBMWD Stock Issues	$0
Equipment Rental:	$0
Purchased Material:	$0
Contract Services	$0
Subtotal:	**$2,946,400**
Contingency (30%)	**$883,920**
TOTAL COSTS (ROUNDED)	**$3,830,000**

Project Funding Sources:	**Funding Amount**
Water Capital:	$0
Chartis Escrow:	$0
Water Conservation:	$0
Other (Debt):	$0
FUNDING (ROUNDED)	**$0**

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Project Name: 9 VFD REPLACEMENT PROJECT
Asset Classification: REHABILITATION AND ASSET REPLACMENT
Asset Category: WRP FACILITIES ASSESSMENT AND MASTER PLAN

Budget ID No. **CO No.**

Project Description: Rehabilitation and Replacement of aging and critical assets Variable Frequency Drives. Assets to be replaced include VFD and instrumentation located at the Roots Blower Building, RS-1 Pump Station and Tertiary Reservoir.

Construction Cost Breakdown	Quantity	Unit	Unit Cost	Total
Roots Blower Building VFDs and Assets	1	LS	$1,959,000	$1,959,000
RS-1 Pump Station VFDs and Pumps	1	LS	$853,000	$853,000
Tertiary Reservoir VFDs and Assets	1	LS	$182,000	$182,000
			Installation Subtotal:	**$2,994,000**
General Conditions	0%			$0
Electrical and I&C	0%			$0
Contractor Overhead	0%			$0
Contractor Profit	0%			$0
Bonds & Insurance	0%			$0
Construction Contingency	0%	N/A		$0
			Construction Subtotal:	**$2,994,000**

Budgetary Requirements:

Cost Category	**Estimated Cost**
CEQA Compliance:	$0
Design:	$359,280
Const. Mgmnt:	$449,100
Construction:	$2,994,000
SBMWD Labor & Ovhd:	$0
SBMWD Stock Issues	$0
Equipment Rental:	$0
Purchased Material:	$0
Contract Services	$0
Subtotal:	**$3,802,380**
Contingency (30%)	**$1,140,714**
TOTAL COSTS (ROUNDED)	**$4,940,000**

Project Funding Sources:	**Funding Amount**
Water Capital:	$0
Chartis Escrow:	$0
Water Conservation:	$0
Other (Debt):	$0
FUNDING (ROUNDED)	**$0**

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Project Name: 10 UNITS 1 AND 2 R&R
Asset Classification: REHABILITATION AND ASSET REPLACEMENT
Asset Category: WRP FACILITIES ASSESSMENT AND MASTER PLAN

Budget ID No. **CO No.**

Project Description: Rehabilitation and Replacement of aging and critical assets associated with the Unit 1 and Unit 2 process. Assets to be replaced include diffusers, mixers, motors, VFDs, platforms, and miscellaneous mechanical equipment and instrumentation.

Construction Cost Breakdown	Quantity	Unit	Unit Cost	Total
Unit 1 Aeration Basins	1	LS	$153,000	$153,000
Unit 2 North Primary Clarifier	1	LS	$184,000	$184,000
Unit 2 North Secondary Clarifier	1	LS	$42,000	$42,000
Unit 2 Pump Station	1	LS	$1,362,000	$1,362,000
Unit 2 South Aeration Basins	1	LS	$158,000	$158,000
Unit 2 South Primary Clarifier	1	LS	$226,000	$226,000
			Installation Subtotal:	**$2,125,000**
General Conditions	0%			$0
Electrical and I&C	0%			$0
Contractor Overhead	0%			$0
Contractor Profit	0%			$0
Bonds & Insurance	0%			$0
Construction Contingency	0%	N/A		$0
			Construction Subtotal:	**$2,125,000**

Budgetary Requirements:

Cost Category	**Estimated Cost**
CEQA Compliance:	$0
Design:	$255,000
Const. Mgmnt:	$318,750
Construction:	$2,125,000
SBMWD Labor & Ovhd:	$0
SBMWD Stock Issues	$0
Equipment Rental:	$0
Purchased Material:	$0
Contract Services	$0
Subtotal:	**$2,698,750**
Contingency (30%)	**$809,625**
TOTAL COSTS (ROUNDED)	**$3,510,000**

Project Funding Sources:	**Funding Amount**
Water Capital:	$0
Chartis Escrow:	$0
Water Conservation:	$0
Other (Debt):	$0
FUNDING (ROUNDED)	**$0**

San Bernardino Municipal Water Department
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Project Name: 11 UNIT 3 R&R
Asset Classification: REHABILITATION AND ASSET REPLACEMENT
Asset Category: WRP FACILITIES ASSESSMENT AND MASTER PLAN

Budget ID No. **CO No.**

Project Description: Rehabilitation and Replacement of aging and critical assets associated with the Unit 3 primary process. Assets to be replaced include sump pumps, motors, grinders, and miscellaneous mechanical equipment and instrumentation.

Construction Cost Breakdown	Quantity	Unit	Unit Cost	Total
Unit 3 Primary Clarifiers	1	LS	$1,040,000	$1,040,000
			Installation Subtotal:	**$1,040,000**
General Conditions	0%			$0
Electrical and I&C	0%			$0
Contractor Overhead	0%			$0
Contractor Profit	0%			$0
Bonds & Insurance	0%			$0
Construction Contingency	0%	N/A		$0
			Construction Subtotal:	**$1,040,000**

Budgetary Requirements:

Cost Category	**Estimated Cost**
CEQA Compliance:	$0
Design:	$124,800
Const. Mgmnt:	$156,000
Construction:	$1,040,000
SBMWD Labor & Ovhd:	$0
SBMWD Stock Issues	$0
Equipment Rental:	$0
Purchased Material:	$0
Contract Services	$0
Subtotal:	**$1,320,800**
Contingency (30%)	**$396,240**
TOTAL COSTS (ROUNDED)	**$1,717,000**

Project Funding Sources:	**Funding Amount**
Water Capital:	$0
Chartis Escrow:	$0
Water Conservation:	$0
Other (Debt):	$0
FUNDING (ROUNDED)	**$0**

Annual/In-house Projected Budgetary Requirement:	$0

10. OPERATIONAL EFFICIENCY AND OPTIMIZATION PROJECTS

This Section considers ten capital improvement projects and four special studies to analyze opportunities for increased efficiency and address needs identified in this Master Plan including peak-flow management, reduction of flow from EVWD, energy conservation, and process reliability. The projects described in this Section are in addition to projects currently in the Capital Improvement Plan (which are discussed in Section 0).

The following list is a summary of the projects and studies that were developed and evaluated. The rest of this Section discusses each of these projects in detail:

<u>Capital Projects</u>

1. Primary Treatment
   - 1.1. Primary Flow Equalization: Increase wet-weather storage capacity by adding primary flow equalization (EQ). Project is discussed in further detail in Section 10.1.1.
   - 1.2. Chemically Enhanced Primary Treatment: Improve solids removal in the primary clarifiers through chemically enhanced primary treatment (CEPT). Project is discussed in further detail in Section 10.1.2.
2. Secondary Treatment
   - 2.1. Liquid Process Optimization: Improve nitrogen removal and sludge settleability by studying and pilot testing different operational modes for Units 1 and 2 and the addition of Mixed Liquor Return (MLR) pumps to Unit 2. Project is discussed in further detail in Section 10.2.1.
   - 2.2. Secondary Capacity Reduction: Reduce operational costs and complexity by taking one of the Unit 2 trains off-line after the reduction of flow from EVWD. Project is discussed in further detail in Section 10.2.2.
   - 2.3. NRC Conversion to Diffused Air: Improve NRC process control and increase energy savings by converting mechanical aerators to diffused air and installing DO control. Project is discussed in further detail in Section 10.2.3.
   - 2.4. Unit 3 Expansion and Completion: Improve overall plant efficiency and performance by replacing multiple liquid processes with a unified conventional activated sludge process designed for nitrogen removal. Project is discussed in further detail in Section .
3. Solids Handling
   - 3.1. Digester B Replacement: Provide digester redundancy by replacing Digester B, which is currently offline due to leakage. Project is discussed in further detail in Section 10.3.1.
   - 3.2. Digester Cleaning: Maintain digester performance and reliability by cleaning the existing digesters. Project is discussed in further detail in Section 10.3.2.
   - 3.3. Digester Mixing Optimization: Save energy by optimizing digester mixing. Project is discussed in further detail in Section 10.3.3.
4. Brine Line Improvements
   - 4.1. Increase efficiency by installing manholes in the brine line connecting the septage/brine receiving station to the Inland Empire Brine Line to reduce cleaning time and cost. Project is discussed in further detail in Section 0.
5. Influent Lift Stations

5.1. Downsizing of the East Influent Lift Station

6. Special Studies

6.1. Electrical Master Plan: Electrical master plan to provide a comprehensive, strategic approach to guide future projects and improve reliability. Project is discussed in further detail in Section 10.6.1.

6.2. SCADA Master Plan: SCADA master plan to achieve a secure, flexible, reliable, and comprehensive SCADA environment. Project is discussed in further detail in Section 10.6.2.

6.3. Biosolids Strategic Plan: Strategic plan for biosolids management to identify multiple options and ensure reliable disposal and/or reuse of biosolids. Project is discussed in further detail in Section 0.

6.4. RIX Facility Plan: RIX master plan to evaluate the performance and current efficacy of the RIX facility, which filters and disinfects secondary effluent from SBWRP and the City of Colton for discharge to the Santa Ana River. Project is discussed in further detail in Section 10.6.4.

Basis of Cost

For each project, a conceptual/feasibility-level cost estimate was prepared, with a simple payback approach used to evaluate projects to determine whether economically viable. Projects were also evaluated based on their operational benefits. When estimates have been based on costs of recent past projects, costs have been escalated using a construction cost index (CCI) to the present day (Sept 2019) CCI of 12021.45 for Los Angeles.

The International Association for the Advancement of Cost Engineering (AACE International) suggests five levels of accuracy for cost estimates. Table 10-1 shows the five classes and their respective accuracy ranges. As this study is for preliminary planning, the provided estimates are considered Class 4 or Class 5. Some, such as the estimate for flow equalization, were based on similar projects adjusted for capacity (Class 5). Others, such as CEPT and the Unit 3 Expansion and Completion Project, were based on factored equipment costs (Class 4).

Table 10-1: Classes of Cost Estimates

Estimate Class	Level of Project Definition	Typical Purpose	Methodology	Expected Accuracy Range	Preparation Effort Relative to Least Cost Index of 1
5	0% to 2%	Concept Screening	Capacity factored, parametric models, judgement or analogy	Low: -20% to -50% High: +30% to +100%	1
4	1% to 15%	Study or Feasibility	Equipment factored or parametric models	Low: -15% to -30% High: +20% to +50%	2 to 4
3	10% to 40%	Budget, Authorization, or Control	Semi-detailed unit costs with assembly level line items	Low: -10% to -20% High: +10% to +30%	3 to 10
2	30% to 70%	Control or Bid/Tender	Detailed unit cost with forced detailed take-off	Low: -5% to -15% High: +5% to +20%	4 to 20
1	50% to 100%	Check Estimate or Bid/Tender	Detailed unit cost with forced detailed take-off	Low: -3% to -10% High: +3% to +15%	5 to 100

Notes:

1. Content comes from the AACE International Recommended Practices, No. 18R-97.

2. The +/- value represents typical percentage variation of actual costs from the cost estimate after applying contingency.

Project costs include direct construction costs plus the indirect costs required to implement the project. Indirect costs include site civil engineering, environmental documentation, permits, administrative costs, construction management, and engineering services during construction. Indirect costs have been estimated as a percentage of the construction cost as shown in Table 10-3.

In addition, construction costs vary with changing conditions. For example, the bidding climate may change related to the supply and demand of construction work, the availability of qualified contractors, etc. or the project scope may change during design, or site conditions may not be known. To account for uncertainties, an estimating contingency of 30% was applied to arrive at the project cost.

Annual Costs

Annual operation and maintenance (O&M) costs are the ongoing costs to run and maintain a facility, including power, labor, chemicals, and equipment replacement. O&M costs vary by treatment process according to the flow and/or load treated. O&M costs are based on estimates of labor, energy, and material use and are used to compare the life-cycle costs of alternatives. O&M costs were based on current SBWRP rates as summarized in Table 10-2.

Table 10-2: O&M Unit Costs

Item	2019 Cost
Labor (average)	$150 / hour
Electricity	$0.12 / kilowatt-hour
CEPT Polymer	$1.40 / active pound
Natural Gas	$ 1.05 / therm (100,000 btu)

Table 10-3 summarizes the guidelines used to estimate total project costs for the SBWRP. The 15% allowance for electrical and instrumentation is intended to capture installation and material costs for ancillary electrical equipment including cable, wire, auxiliary terminals, consumables, conduit (not including large duct banks), fittings, pull boxes, lighting, switches, support structures (not including cable trays) and grounding equipment. The allowance for planning studies and CEQA compliance varies by project. As most projects are R&R, they are not expected to require significant CEQA documentation. A project contingency of 30% was applied to all projects.

Table 10-3 Summary of Cost Estimating Markups

Item	Markup
Construction Markups	
General Conditions	15%
Electrical and Instrumentation Allowance	15%
Contractor Overhead	10%
Contractor Profit	10%
Bonds & Insurance	3%
Indirect Costs	
Planning Studies / CEQA Compliance, where applicable	0 – 1%
Engineering Design	12%
Construction Administration	15%

Item	Markup
Contingency	
Project Contingency	30%

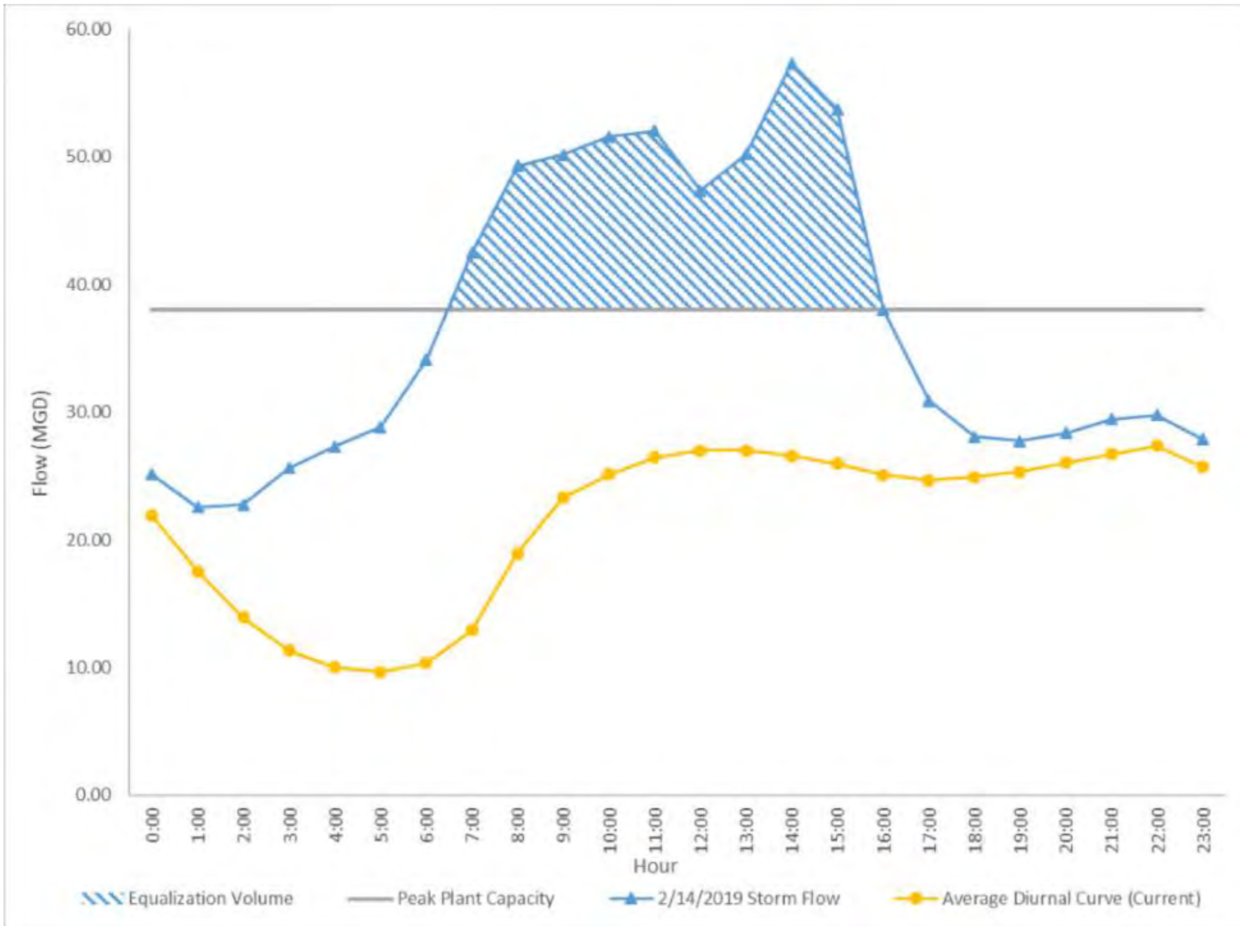
10.1 Primary Treatment

10.1.1 Primary Flow Equalization

The main objective of providing primary flow equalization would be to relieve downstream treatment processes during wet weather to provide onsite storage of primary flow during a large storm event. Due to the relatively even influent diurnal flow to the SBWRP, daily peak flow equalization is not considered a worthwhile investment for the plant.

The primary flow equalization basin was sized based on the influent flow experienced by the SBWRP during a large storm event on February 14, 2019. This storm was selected due to its recency and the high flow it generated. SBMWD staff confirmed that the SBWRP was able to handle the high flow throughout the processes without over-topping. Since it is not practical to design a flow equalization basin to detain the full storm flow volume generated over a 24-hour period, the primary equalization basin was designed to hold the flow above the current estimated capacity of the plant. The capacity of 38 mgd estimated in Section 10.2.2 represents the peak flow that can pass through the secondary clarifiers with all units online. The volume required to store flows above this, based on the peak flow event in February of 2019, is 4.7 million gallons (MG), and is represented by the shaded area under the curve in Figure 10-1. This sizing is based on current flows and is conservative for future peak flows when influent flow will be reduced; however, additional hydraulic capacity may be needed if one train of Unit 2 is taken offline (see project detailed in Section 10.2.2).

Figure 10-1: Peak Wet Weather Flow Event (2/14/2019)



The cost estimate for the equalization basin is based on below-grade, geomembrane-lined basin, with an additional allowance for bird deterrents per FAA requirements. It is assumed that influent will flow by gravity from the existing blind flanged 42-inch primary influent line at the headworks splitter box. This same line could conceptually be utilized to pump primary equalization volume back into the splitter box when SBWRP influent flow reduces to normal levels. The pump station is assumed to be dry pit with submersible non-clog pumps. Further details of the primary equalization project would be determined during the design phase of the project.

The estimated cost of constructing a storage basin of this size, including a pump station, is $9.3 million. This cost is based on Carollo's 2015 estimate for a 5 MG facility, and a similar 1.3 MG storage basin constructed in 2005 for the Yucaipa Valley Water District. Costs were adjusted based on volume and escalated to present day. Allowances for contractor markups, design, and construction management are included, along with a 30% project contingency.

10.1.2 Chemically Enhanced Primary Treatment

The primary treatment process can be optimized through the addition of chemical coagulants such as metal salts and organic polymers. This technique, known as chemically enhanced primary treatment (CEPT), improves settling, thereby increasing primary sludge volume and decreasing the load to the secondary system.

Benefits of enhancing primary clarifier removal through chemical addition include:

- Increasing diversion of organic matter directly to the digester, with a corresponding increase in biogas production and energy generation.
- Reducing organic loading to secondary treatment, with a corresponding reduction in the energy required for aeration and the creation of additional capacity to accommodate growth or optimize process performance.
- Potential for lowering the MLSS concentration, which in turn would increase the peak-flow capacity of the secondary clarifiers.

Potential drawback of enhancing primary clarifier removal through chemical addition include:

- Impact on TIN removal performance

CEPT is reported to increase TSS removal by 20 to 30 percent, and BOD removal by 25 to 40 percent (Metcalf & Eddy, 2014, p.477). Experience at the Encina Water Pollution Control Facility (EWPCF) shows a more modest increase of 10% in TSS removal and gas production, with minimal improvement in BOD removal (Carollo, 2016). Nevertheless, an economic analysis showed the practice to be worth continuing at EWPCF largely due to the 10% increase in biogas production. The SBWRP is already adding ferric chloride at the headworks to reduce hydrogen sulfide buildup in the digesters, so there may already be some enhancement of primary clarifier removal. Adding polymer downstream of the ferric chloride addition may further increase primary removals.

It is assumed that the CEPT project would consist of two new polymer skids to feed polymer ahead of Units 1 and 2 primary clarifiers. For this analysis, it is assumed that polymer would be fed into the Unit 2 influent splitter box, and into the Unit 1 above-ground influent pipe or, when the Unit 3 primary clarifier is on-line, the Unit 1 splitter box. The polymer skids would be located near the feed points in simple sheds or under roofs for weather protection. Polymer would be delivered and stored in totes. Preliminary design would investigate other locations for the skids including inside existing structures such as the Unit 1 and 2 pump stations. Preliminary design would also consider the optimum point for feeding to the process including bench scaling testing, considering available mixing energy and flocculation time. A budget cost estimate for this alternative, including design and contingency, is $390,000.

Table 10-4: Simple Payback Analysis for CEPT

	Units	Value
Polymer Dose	mg/L	0.5
Dry Feed Rate	ppd	10
Annual Polymer Cost	$/year	5,000
Operations	hour/week	2
Annual Labor Cost	$/year	15,600
Additional Biogas Volume	scf/day	40,000
Additional Biogas Energy	therm/year	83,220
Annual Value of Biogas	$/year	87,000
Net Annual Cost	$/year	(66,400)
Capital Cost	$	390,000
Simple Payback	Years	6

A simple payback analysis, presented in Table 10-4, estimates a payback time of 6 years on the capital investment, assuming a polymer dose of 0.5 mg/L results in a 10% increase in biogas production (similar performance to EWPCF). It is also assumed that the system will require an average of 2 hours per week of operations and maintenance time. Ferric addition has not been included in the payback analysis, since it is assumed that the current dosage of ferric for odor control purposes is adequate for CEPT. The estimated payback period for CEPT is relatively short, so this project is recommended. It is also recommended that SBMWD perform jar testing to help validate chemical doses and expected performance.

10.2 Secondary Treatment

10.2.1 Liquid Process Optimization

Several performance issues with secondary treatment in Units 1 and 2 were identified:

- Insufficient oxygen delivery and/or control may limit nitrification and process control, especially in Unit 1
- Limited TIN removal due to lack of mixed liquor recycle in Units 2N and 2S
- Inconsistent sludge settleability, indicated by high 95th-percentile SVI values, especially in Unit 1.

The first issue will be addressed, at least in part, by the aeration upgrades which are currently being designed and implemented in the 1110.2 Resultant Projects. The aeration components of the project will include new high-efficiency blowers and automatic DO control.

This liquid process optimization project is intended to address the other issues identified. It would include adding one MLR pump to both Units 2N and 2S. Redundant locations for MLR pumps are not considered necessary as the plant could operate for a limited time without MLR pumping in either Units 2N or 2S if required for maintenance.

This project also includes an optimization study to investigate and pilot test different basin configurations to improve sludge settleability. Options to evaluate include:

- Consolidating anoxic zones to the start of the treatment train to run in a Modified Ludzak-Ettinger (MLE) configuration. An MLE configuration consists of a pre-anoxic zone followed by an aerated zone, with mixed liquor return to bring nitrate back to the anoxic zone for denitrification. Each zone may consist of multiple bays. Converting to an MLE process may improve TIN removal, stabilize SVI and simplify operations.
- Switching to contact stabilization during wet weather to increase peak secondary clarifier capacity. Contact stabilization involves sending all the RAS to the first zone, with most or all the primary effluent introduced downstream. Running in this mode during wet weather concentrates the mixed liquor in the first zone, and reduces the solids loading to the secondary clarifier, temporarily increasing secondary clarifier capacity.

Any operational strategy that is considered will need to include provisions for taking pairs of bays offline, as this is critical for redundancy. An allowance of $200,000 is included for pilot testing to cover additional sampling and minor modifications to gates, mixer locations, etc. It is assumed that SBMWD staff would be available to assist with operational changes. The estimated cost for this liquid process optimization project, including the MLR pumps and the process optimization study, is $1,520,000.

10.2.2 Secondary Capacity Reduction

Table 10-5 summarizes current and future flows in 5-year planning increments showing the impact of the reduction of flow from EVWD on future flows to the SBWRP. The diversion of flows from EVWD is anticipated to begin at the end of 2021. As a result, the 2025 SBWRP flows are anticipated to be about 73% of current flows. With population growth (discussed in Section 6.1.3), flows are projected to return to about 90% of current flows by 2040.

Table 10-5: Summary of Current and Future SBWRP Flows

Scenario	Current (2020)	Reduction due to EVWD (2025)	Future (2040)
Average Dry Weather (mgd)	22	16	19
Peak Wet Weather (mgd)	64	47	54

The reduction of SBWRP influent flow resulting from the departure of EVWD will result in an estimated reduction in overall annual operating expense of approximately $1 million per year or 9%. The assumed components of this savings are summarized in Table 10-6. Operational cost reduction will be primarily from the decrease in aeration and corresponding electrical use, decreased polymer and ferric chloride use, and decreased biosolids volume. Chemical use was assumed to be proportional to flow. No reduction in personnel was assumed since the same treatment processes will be utilized and the same facilities will need to be maintained.

Table 10-6: Estimated Operational Savings Due to Reduction in Flow (2025)

Operational Budget Item	Current (FY 2019-2020)	After SNRC Startup (2025)	Estimated Savings ($)	Estimated Savings (%)
Personnel	$ 6,037,328	$6,037,328	N/A	0%
Utilities - Electric	$ 2,125,000	$1,769,186	$356,000	17%
Materials & Supplies	$ 265,000	$228,023	$37,000	14%
Ferric chloride	$ 412,720	$297,542	$115,000	28%
Brine line O&M	$ 205,170	$205,170	N/A	0%
Contract serv. (biosolids)	$ 1,043,410	$825,022	$218,000	21%
Polymer	$ 839,000	$604,860	$234,000	28%
Inspection services	$ 54,000	$54,000	N/A	0%
Equip. parts & supplies	$ 120,000	$120,000	N/A	0%
Equip. repairs	$ 129,500	$129,500	N/A	0%
Street repairs	$ 120,000	$120,000	N/A	0%
Other	$ 783,993	$674,599	$109,000	14%
Total	$12,135,121	$11,065,231	$1,069,000	9%

The reduction of SBWRP influent due to the reduction from EVWD will present an opportunity to take treatment processes off-line to reduce capital, operating, and maintenance costs. Unit 1 was upgraded most recently and is therefore not a candidate for removal from service. The NRC is needed to treat the high ammonia recycle flow from dewatering. This leaves Unit 2 as the most viable option for capacity reduction.

Table 10-7 shows how the overall capacity of the SBWRP could be managed to match capacity with flows by removing one or both Unit 2 trains. These scenarios are based on the capacity analysis in Section 8.7, assuming 3 mgd of treatment at NRC.

Table 10-7: SBWRP Capacity (mgd)

Capacity Measure	All Units On-Line	One Unit 2 Train Off-Line	Both Unit 2 Trains Off-Line
Average Dry Weather (ADW)	30	22.5	15
Peak Hydraulic (1)	48	36	23
Peak Secondary Clarifier, Current	38	28	18
Peak Secondary Clarifier, Improved (2)	68	48	28

Notes:

1. Based on 20 mgd hydraulic capacity for Unit 1 to prevent submergence of primary clarifier weirs
2. Assumes SVI reduced to 200 g/mL in Unit 1 and Unit 2, and Unit 2 run in contact-stabilization mode during peak flows

Removing all of Unit 2 (both trains) does not provide enough ADW capacity even for the lowest average flow of 16 mgd in 2025. Removing one Unit 2 train, on the other hand, would provide enough ADW capacity for the full range of future flows. Under this scenario, the plant would be at 78% capacity in 2040, exceeding the 75% threshold which typically triggers facilities upgrade planning (Section 7.1.3). Although the plant would have enough capacity for current ADW without one Unit 2 train, it is recommended to keep all of Unit 2 on-line in the near term to provide a measure of contingency and redundancy.

The current peak flow is above hydraulic capacity as modeled, but it is known that the plant can pass peak flows without overflowing based on recent wet-weather performance experience. Hydraulic capacity is therefore not considered to be an issue currently. It should also not be an issue if half of Unit 2 is taken off-line when flows decrease due to the SNRC project: the 25% drop in hydraulic capacity essentially matches the 27% drop in flows. As flows increase toward the 2040 projection, however, additional hydraulic capacity may be needed for peak flows. This could be addressed either by building equalization (refer to Project 10.1.1), or possibly by identifying and removing process bottlenecks. The latter would require creating a calibrated, full-plant hydraulic model. The expansion and completion of Unit 3 (refer to Project) would also address capacity issues.

Peak secondary clarifier capacity also needs to be considered. Results from the state-point analyses performed previously are summarized in Table 10-7. With improved SVI, secondary clarifier capacity with one Unit 2 train off-line (three clarifiers on-line) matches the projected peak flow projected in 2025. As flows increase, additional capacity will be needed. Either both Unit 2 secondary clarifiers will need to remain online, or flow equalization will need to be constructed. Note that flow equalization would remove flows above 38 mgd, so that SVI improvements and contact stabilization would not be necessary. For this evaluation, it will be assumed that both Unit 2 secondary clarifiers remain in continuous service.

The ability to take Unit 2S off-line assumes that Primary Flow Equalization is in place and the following redundancy is available on a temporary basis:

- Unit 3 is available as a backup to the Unit 1 primary clarifier if needed.
- Flow to the remaining Unit 2 train can bypass the primary clarifier and be sent directly to the reactor bays as required on a temporary basis for maintenance of the primary clarifier, or Unit 2S can be brought back online as needed.
- Any pair of reactor bays can be taken off-line for maintenance without significantly impacting treatment ability.
- Unit 1 can operate temporarily with a single secondary clarifier.
- The cross-connection between the Unit 2 secondary clarifiers has been restored so both can remain on-line.

Taking one of the Unit 2 trains offline will result in a reduction in both annual operational cost and the capital upgrades need to keep the unit running in the long term. Operational savings are estimated to be approximately $173,000 per year (based on the current budget) and result primarily from a reduction in electrical use from taking the aeration system offline. There are also modest reductions in equipment repairs, materials, and supplies. No reduction in personnel is assumed in this analysis as the overall number of operations tasks would not be significantly reduced. Estimated operational savings due to removing Unit 2S from service are summarized in Table 10-8.

Table 10-8: Estimated Operational Savings due to Taking One Unit 2 Train Offline

Operational Budget Item	Current (FY 2019-2020)	Estimated Savings ($)	Estimated Savings (%)
Personnel	$ 6,037,328	N/A	N/A
Utilities Electric	$ 2,125,000	$101,000	5%
Materials & Supplies	$ 265,000	$13,000	5%
Ferric Chloride	$ 412,720	N/A	N/A
Brineline O&M	$ 205,170	N/A	N/A
Contract Serv (biosolids)	$ 1,043,410	N/A	N/A
Polymer	$ 839,000	N/A	N/A
Inspection Services	$ 54,000	N/A	N/A
Equip. parts & supplies	$ 120,000	$10,000	8%
Equip. repairs	$ 129,500	$11,000	8%
Street repairs	$ 120,000	N/A	N/A
Other	$ 783,993	$38,000	5%
Total	$12,135,121	$173,000	1%

For capital upgrades, it is assumed that all the near-term (5-year) capital improvements identified in the condition assessment will need to occur to keep both trains of Unit 2 operational until the projected reduction in flow when the SNRC begins operations.

The savings will come in years 6 through 20, where projects for either Unit 2N or 2S could be deferred until past the 20-year planning timeframe. During this period the off-line unit will likely become sufficiently deteriorated and obsolete that it is not worth returning to service. If its capacity is needed in the future it would most likely be replaced by a new unit.

The total costs in years 6 through 20 for Unit 2N and 2S are $1.2 and $1.1 million, respectively. These costs are indistinguishable at the conceptual level of the analysis, so more detailed analysis would be required to determine which train is more cost-effective to take offline.

Additional upgrades (such as restoring the interconnect between the Unit 2 secondary clarifiers) will also need to be completed before half of Unit 2 can be taken offline. The conceptual cost estimate for this alternative includes an allowance of $200,000 for these upgrades. A more detailed preliminary design effort should be performed to refine this cost.

Cost impacts for this option are summarized in the Table 10-9.

Table 10-9: Summary of Cost Impacts of Secondary Capacity Reduction

Operational Impact	Annual Savings
Operational Savings from Flow Reduction	$1,100,000
Operational Savings from Off-Lining One Unit 2 Train	$200,000
Estimated Total Annual Savings	$1,300,000
Capital Impact	**Savings**
Capital Savings from Off-Lining One Unit 2 Train (long-term)	$1,200,000
Capital Projects for Off-Lining One Unit 2 Train (near-term)	Cost of $500,000
Estimated Total Capital Savings	$700,000

10.2.3 NRC Conversion to Diffused Air

This option considers replacing the mechanical aerators in the Nitrogen Removal Carousel (NRC) with diffused aeration to save energy. Diffused air would also provide more precise control of DO levels, with the potential to improve process performance. The depth of the existing tanks (13 to 14.5 feet) is reasonable for efficient oxygen transfer with fine bubble diffusers.

The two existing mechanical aerators are powered by two-speed electric motors rated for a maximum of 125 hp each. The aerators are run continuously at high speed to provide oxygen to the process, keep solids in suspension, and move the mixed liquor around the carousel. Assuming average power consumption is 80% of the motor rating, the mechanical aerators consume approximately $160,000 worth of electricity each year. Replacing the existing system with blowers and fine bubble diffusers could reduce the power demand and cost considerably. It would also improve operator safety and the work environment by reducing aerosolization of the wastewater.

Conceptually, the diffused air option would consist of packaged blowers mounted on pads outside near the carousel. Stainless steel pipe would distribute air to diffuser grids located in the carousel. Automatic control would be provided by a system of electrically actuated valves, air flow meters, and dissolved oxygen probes. It is assumed that without the surface aerators, submersible axial-flow pumps will be needed to keep the liquid circulating in the carousel.

With a conceptual-level cost estimate of approximately $1.8 million, and assuming a 40% reduction in electrical cost, the simple payback for this project would be on the order of 18 years. If the SBMWD wishes to pursue this option further, it is recommended that a more detailed analysis be performed to refine the payback estimate. The scope of work for this analysis should include:

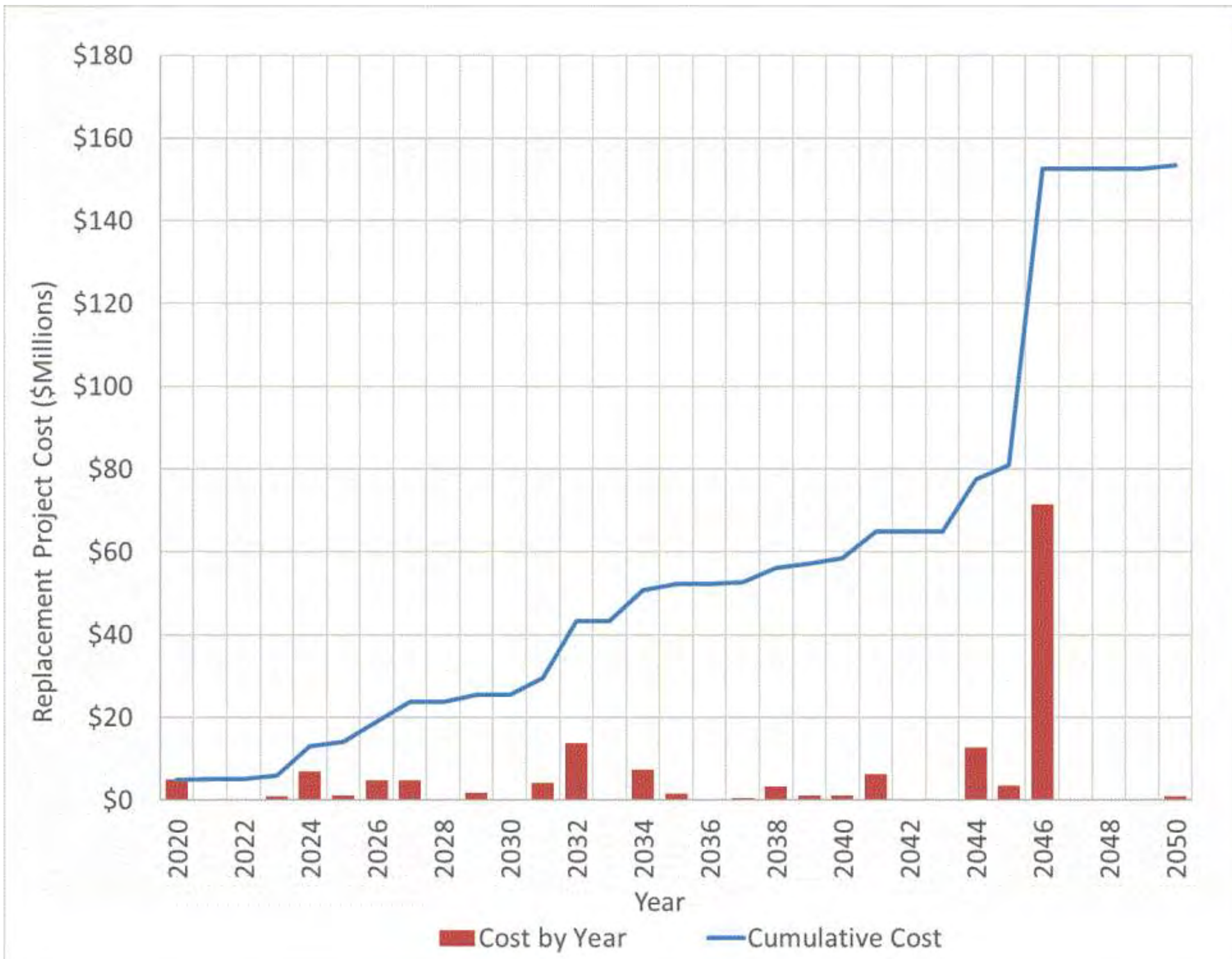
- Evaluating the current mechanical aerator performance based on operating practices, SCADA information, and/or power monitoring.
- Evaluating the current DO profile in the carousel.
- Developing a spreadsheet model to estimate aeration demand.
- Evaluation of up to three blower technology options.
- Evaluation of up to three diffuser technology options.
- Preliminary design and cost estimate for a diffused aeration system.

10.2.4 Unit 3 Expansion and Completion

The liquid treatment processes currently in operation at SBWRP consists of Unit 1, Unit 2 North, Unit 2 South, and the NRC. Figure 10-2 depicts the estimated annual R&R and cumulative R&R costs for assets associated with Unit 1, Unit 2 North, Unit 2 South, and the NRC that have been identified over the next 30 years. By the year 2046, the cumulative

R&R cost for these processes are over $150 million. In particular there is a large spike in predicted R&R costs in 2046 as significant structural assets reach their design life. The magnitude of the cumulative R&R costs presents an opportunity to replace the older multiple liquid treatment processes with a single unified process by expanding and completing Unit 3. The expanded facility would be designed to treat the anticipated future with the flow reduction by EVWD, handle the ammonia load from the centrate and meet water quality requirements for tertiary treatment at RIX or CWF. Space and connection points would be included for future additional treatment systems for any known emerging constituents.

Figure 10-2: Unit 1, Unit 2N, Unit 2S and NRC Asset R&R Costs

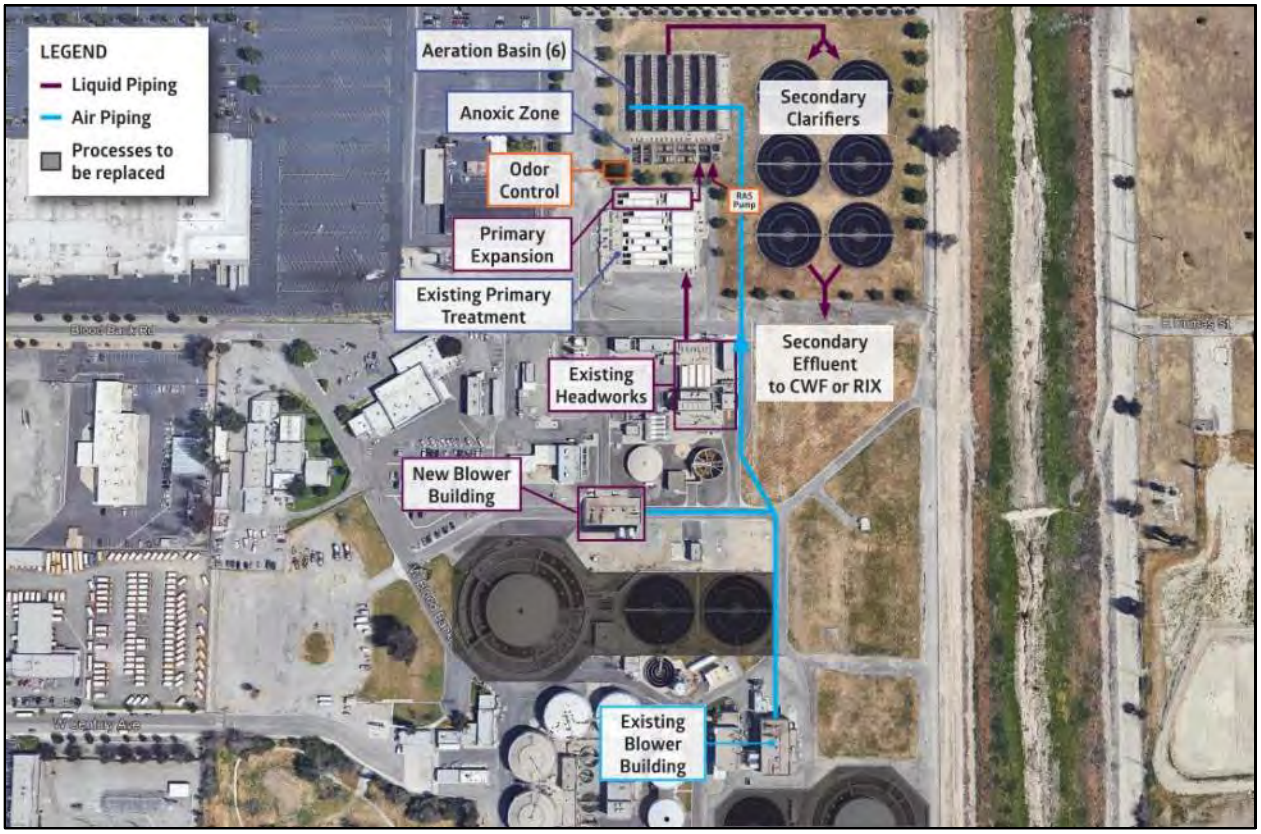


Source: Asset Register V90

The Unit 3 Expansion and Completion project would replace Unit 1, Unit 2 North, Unit 2 South, and the NRC with an activated sludge process with secondary clarification. This project would utilize the existing headworks, Unit 3 primary treatment, and solids handling facilities. Further, it is assumed that aeration is provided by the existing Roots blowers and/or new turbo blowers, which will be installed as part of a current project as described in Section 11.1.2. The project would require expansion of Unit 3 primary treatment and the R&R projects associated with Unit 3.

Figure 10-3 shows a conceptual layout for the proposed Unit 3 Expansion and Completion project in the northeast corner of the site adjacent to the existing Unit 3 primary clarifiers, south of Orange Show Road and West of East Twin Creek.

Figure 10-3: Unit 3 Expansion and Completion Project



To meet the RIX effluent TIN limit of 10 mg/L for discharge to the Santa Ana River, the aeration tanks are assumed to be configured for the Modified Ludzac-Ettinger (MLE) process, including pre-anoxic zones and internal mixed-liquor return. This is similar to the flow arrangement currently in use at Unit 1 and recommended for Unit 2. The secondary system could be sized to accept the ammonia load from the centrate so that the NRC process could be taken off-line. This approach would be evaluated against sidestream deammonification to determine the best path forward. Assumptions for the conceptual cost estimate are as follows:

- Average daily flow of 20 mgd.
- Maximum month design load of 49,300 pounds BOD per day.
- Maximum month design load of 9,700 pounds TKN per day.

- Expansion of existing Unit 3 primary clarifiers by 50% to provide capacity for 54 mgd peak flow.
- Aeration basins. Covers with odor control facilities will be considered for all or part of the tanks due to the proximity to surrounding development.
- Addition 10% loading to account for centrate return to headworks.

- 30% BOD removal
- Six parallel reactor tanks, each with an anoxic zone, swing zone, aerobic zone, and mixed liquor return with mixers in the anoxic and swing zones.
- New aeration piping from an above-ground pipe from blower project currently being designed (no additional blower cost included).
- Six 100-foot diameter secondary clarifiers sized for peak flow of 54 mgd with an SVI of 150 mL/g and MLSS of 3,000 mg/L.
- Underground RAS/WAS pumping gallery with above-ground electrical/control building.

The engineer's estimate of probable cost for the Unit 3 Expansion and Completion is based on the stated assumptions and is on the order of $100 million, within a range of $80 million to $140 million based on -20% to +40% range for Class 4 estimates. This estimate is inclusive of planning, design, and construction with a 30% project contingency applied.

Table 10-10: Unit 3 Expansion and Completion Cost Estimate (Class 4)

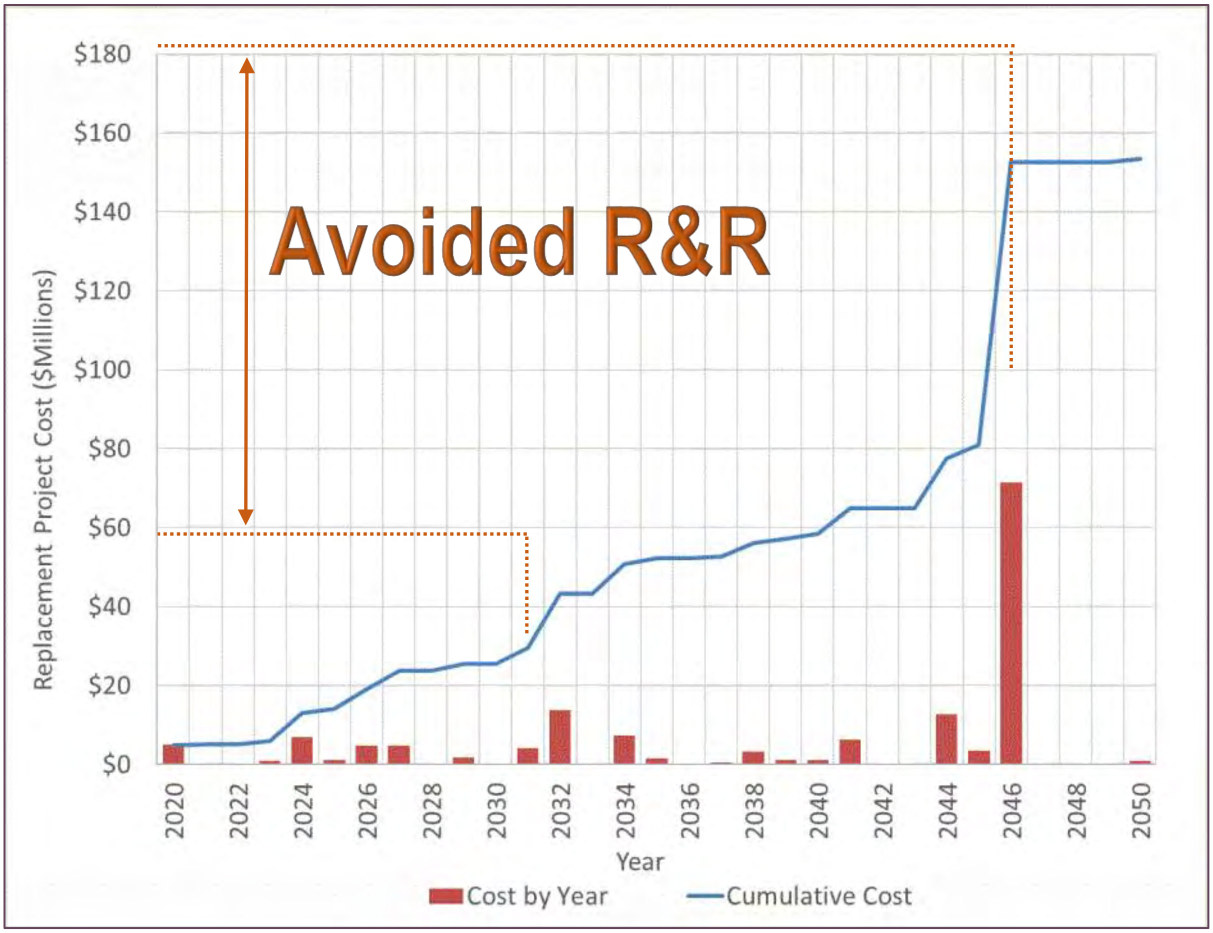
Project Component	Estimated Cost
Project Subtotal	$ 78,000,000
Project Contingency (+30%)	$ 23,500,000
Total Project Cost (2019$ rounded) [1]	$ 101,500,000

Notes:

1. Sequencing of the Unit 3 Expansion and Completion Project is detailed in Section 11.3.

As shown in Figure 10-4, in 2032 an expenditure over $15 million has been identified for R&R associated with the existing liquid treatment facilities. Ideally, the new unified treatment process would be installed prior to 2032 to avoid this expenditure. Timing the Unit 3 Expansion and Completion Project must consider the time needed for financing, facility planning, design, and construction. The flow reduction by EVWD is scheduled for late 2021. A facility planning level analysis of the Unit 3 Expansions and Completion can logically begin after the EVWD flow reduction occurs and resultant reduction in loads can be verified. Once more detailed planning and initial studies are complete, preliminary design can reasonably begin with sufficient time to allow construction to be complete by 2031.

Figure 10-4: Unit 3 Expansion and Completion Project Timing and Avoided R&R



Source: Asset Register V90

Table 10-11 presents a summary of avoided R&R costs by area that could result from the construction of the Unit 3 Expansion and Completion if completed by 2031.

Table 10-11: Avoided R&R Costs with Unit 3 Expansion and Completion (2031 – 2046)

Project	Estimated Cost
Unit 1	$ 36,000,000
Unit 2	$ 45,000,000
NRC	$ 23,000,000
Shared Facilities	$ 23,000,000
Total R&R Avoided	$ 127,000,000

Over two-thirds of the avoided R&R costs listed above can be attributed to structural assets that reach the end of their useful lives between 2031 and 2046. The year 2046 in particular has a number of structures reaching the end of their remaining useful lives of 60-75 years, explaining the peak shown in Figure 10-4. Significant structures included in the R&R costs in Table 10-11 include:

- Mixed Liquor Splitter Box Structure
- NRC Anoxic Basin Fiber Glass Mounting
- NRC Building Structure
- NRC Secondary Clarifier Structure and Rake Arm Assembly
- Root Blower Building Structure
- RS-1 Pump Station Vault Structure
- Unit 1 Aeration Bay Structure (1 total) and Walkway Structures
- Unit 1 East Secondary Clarifier Structure and Rake Arm Assembly
- Unit 1 West Secondary Clarifier Structure and Rake Arm Assembly
- Unit 1 Pump Station Building
- Unit 2 Chlorine Contact Basin Structure
- Unit 2 North Aeration Basins Structure (6 total) and Walkway Structures
- Unit 2 North Primary Clarifier Structure
- Unit 2 North Secondary Clarifier Rake Arm Assembly
- Unit 2 South Aeration Basins Structure (4 total) and Walkway Structures
- Unit 2 South Primary Clarifier Structure
- Unit 2 South Secondary Clarifier Tank and Rake Arm Assembly

An additional 20% of the R&R listed in Table 10-11 is attributed to rehab and replacement of mechanical assets. This includes assets such as valves and gates, aerators, diffusers, mixers, screw pumps, RAS and WAS pumps, scum pumps, pump motors, and Roots Building Blowers 4 and 5. The remainder of the costs are associated with piping, electrical and I&C R&R costs.

10.3 Solids Handling

10.3.1 Digester B Replacement

Digester B is a concrete tank with an insulated metal lid that was originally built in 1958. It is 90-feet in diameter with a 33.5-foot sidewall and a 10-foot deep cone section.

Three digesters (Digester A, C and D) are fed continuously for the current solids loading to produce Class B biosolids. The biosolids composting contract requires Class B biosolids or better (Section 7.2). As discussed in Section 8.7, taking an existing digester offline for service or cleaning would result in shortened retention time below the requirement for Class B. There is also particular risk associated with Digester A, which is the same age as Digester B and has a heightened likelihood of failure. Restoring Digester B to operation would improve redundancy and reliability of the digestion process.

The budget estimate for replacing Digester B is $8 million based on the summation of relevant assets in the Asset Register. Costs for replacing the structure and cover were derived from Digester B assets listed in the Asset Register. Costs for ancillary equipment were derived from Digester A assets. In February 2020, the Department was provided a final “Digester B Evaluation Study” from Carollo Engineers. The Department is moving forward with an immediate project to replace Digester B due to its high criticality.

10.3.2 Digester Cleaning

Digesters C and D are concrete tanks with concrete lids that were built in the late 1980s. Digesters C and D have a 90-foot diameter and 36.5-foot sidewall with a 10-foot deep cone section. Digesters C and D have approximately 1.8 MG of liquid storage and 35,000 SCF of DG storage in each digester.

Anaerobic digestion occurs in a highly corrosive environment. Regular maintenance including digester cover coating is required to maximize service life and is recommended to be performed every 10 years. Digester cleaning has been identified as an area of concern as there is no record of digester cleaning since the late 1980s. The digester cleaning project is anticipated to include the following:

- Drain, remove debris, and clean tank interiors.
- Replace lid seals.
- Evaluate and address pipe penetrations and replace modular wall seals/sleeves on interior and exterior.
- Minor metal repair.
- Concrete repair.

It is anticipated that cleaning of Digesters C and D would occur sequentially after a new Digester B had been returned to service and EVWD has removed its flows and loads from the system. The budget cost estimate for cleaning Digesters C and D is approximately $3.2 million.

10.3.3 Digester Mixing Optimization

Replacing the existing mixing system could enhance reliability, improve dewatering performance, reduce trash and hair accumulation in the digester tanks, and optimize digester gas production. The digester mixing optimization project is anticipated to include the following:

- Evaluate mixing technology alternatives and replace existing mixing system with an alternative system.
- Develop a recommended approach to rehab the mixing systems including intermittent mixing.

If the evaluation determines that capital upgrades are recommended, they would be constructed while each digester is off-line for cleaning. The budget cost estimate for mixer replacement is approximately $1.2 million per digester and would have a payback period of over 60 years. This project is not recommended due to the long payback period. The existing mixers were all replaced or rehabilitated in the past four years and have a RUL of 15 years. Revisiting digester mixing should be done when the existing mixing pumps approach the end of their RUL.

10.4 Brine Line Improvements

A pipe connecting the SBWRP septage/brine receiving station to the Inland Empire Brine Line (IEBL) runs through the WRP site. This pipe has clogged and is difficult and costly to clean because the existing clean outs are inadequate. This project installs seven 60-inch diameter manholes in several locations along the existing pipe to allow for proper cleaning of the line.

The budget cost estimate for installing seven manholes in the pipeline within the SBWRP that connects to the IEBL is $200,000.

10.5 Influent Lift Stations

10.5.1 Downsizing of the East Influent Lift Station

With the departure of EVWD flows from the SBWRP influent once the SNRC is completed, the East Influent Lift Station (EILS) will receive significantly less flow than it currently does. The EILS currently receives flows from the eastern portion of the City of San Bernardino and all the EVWD flow. The total ADWF at EILS is approximately 12 mgd currently. With EWVD providing approximately 6 mgd influent flow, the lift station flow will be reduced by about half. This option explores the potential cost savings from downsizing the capacity of the EILS due to the reduced flow.

The EILS station is currently comprised of three 66-inch diameter screw pumps, two in operation and one standby. Each screw pump has a capacity of 18 mgd with a 60hp motor. The downsized lift station would consist of the same pump configuration with new 66-inch diameter single flight open screw pumps but would be equipped with a smaller horsepower motor, reduced from 60hp to 30hp. No changes to the existing trough would need to occur to accommodate the new screw pumps other than some slight changes to the lower bearing mount. Table 10-12 below presents a summary of the assumptions made for a simple payback calculation.

Table 10-12: Summary of EILS Downsizing Assumptions

Criteria	Units	Design Scenarios	
		Current	Downsized
Average Influent Flow	mgd	12	6
Configuration	-	2+1 Standby	2+1 Standby
Capacity of pump (each)	mgd	18	10.5
Average number of units in operation	-	1	1
Daily Operation	hr	24	24
Rated power, each	hp	60	30
Average power draw, percent of rated	%	80%	80%
Average power draw	kW	36	18
Annual electricity cost	$/year	40,000	20,000

One pump in operation would be adequate with the reduced capacity of 10.5 mgd during dry weather but would require that two pumps be in operation to meet peak flows estimated at 21 mgd for the EILS. For simplicity, it is assumed that one pump is in operation on average in both scenarios. Table 10-13 below presents the result of a simple payback analysis based on the assumed conditions described above.

Table 10-13: EILS Downsizing Simple Payback Results

Simple Payback	Result
Electrical savings, assumed	50%
Capital Costs	
Pumps (each)	$92,000
Pumps (total)	$276,000
Mounting and Installation	$200,000
Design and soft costs	$124,000
Total Capital cost	$600,000
Simple Payback	30 years

The 50% electrical savings provided is a based on the annual cost difference presented in Table 10-12. This estimated savings is considered conservative, as there would likely be less electrical savings when considering details such as pump efficiencies, amount of flow being conveyed, and times of operation. Given the assumptions above, it is not recommended that SBMWD pursue the downsizing of the EILS due to the long payback period. Additional analysis could be done to provide a refined payback estimate, however additional savings are not likely to reduce the payback period significantly.

10.6 Special Studies

This section describes four special studies that have been identified to respond to results of the asset inventory, enhance safety, optimize plant performance, and plan for future changes in the regulatory landscape and electrical codes. Cost placeholders have been included for potential resultant projects from the Electrical and SCADA Master Plans since these projects are anticipated to be required in the near-term (5-year) period. Costs for resultant projects from the Biosolids Strategic Plan and RIX Facilities Plan are not included since the analysis results and timing of resultant projects are unknown at this time.

10.6.1 Electrical Master Plan

Most of the electrical distribution panels at the plant have exceeded their useful life of 30 years, which is a typical industry standard for replacing most electrical equipment. These panels include the BLM Switchgear (5kV), Hoffman Switchgear (480V) and majority of the motor control centers (MCC) located throughout the plant. Some of the electrical panels date back to 1971 (Burner Building), other such panels were installed in the early to late 1980s. Furthermore, modifications to these panels over the years has created a lack of vendor continuity and spare parts.

The condition assessment revealed that 12% of all inspected electrical assets in use have zero remaining useful life (RUL), 20% of electrical assets have RUL of less than 5 years, and 72% less than 10 years. Many changes over the life of the plant have resulted in electrical cables, circuit breakers, and MCC buckets being abandoned in place and simply tagged as out of service. Many of the MCCs are underutilized with only a handful of actively used buckets.

Currently, the plant is undergoing CIP projects that require additional power capacity and interim solutions to handle additional load requirements (kW) and distribution. Projects such as the Blower Rehabilitation Project, Fuel Cell Project and Clean Water Factory are impacting the existing electrical distribution system. The SBMWD is presently working with Southern California Edison (SCE) to combine the two of the six services at the plant to one metered service at the existing BLM Switchgear as part of the Electrical Infrastructure Improvement Project. This work is expected to be done in 2021. Based on current load information and proposed additional loads, the existing (12kV/4160V) SCE transformer will be 109% of rated capacity when the fuel cell is not operational.

An Electrical Master Plan is recommended to provide a holistic approach to upgrading the plant's existing electrical distribution system to improve reliability, redundancy and create equipment standards with features to enhance electrical work safety practices as defined by NFPA 70E. The Electrical Master Plan should be completed by a professional electrical engineer with municipal experience and familiarity of the NEC and CEC codes. The Electrical Master Plan should include the following tasks:

- Condition assessment of electrical distribution equipment, including evaluation and identification of current electrical code violations and recommendations for correction.
- Review of as-built documentation.
- Develop as-built single line diagram (to help confirm what is existing).
- Load calculations and capacity requirements, including future work.
- Investigate existing MCC's and approach to consolidation. Consolidation methods should consider the RUL of the MCCs and compare to complete replacement. Replacement of the MCCs should be coordinated with process improvement projects.
- Alternative configurations including cost analysis.
- Review of arc resistant enclosure types including arc flash reduction controls such as protection relays and maintenance switches.
- Sequence of work and implementation, grouping electrical work with process improvement projects.
- Coordinate with the SCADA Master Plan.
- Report with recommendations.
- Workshops with SBMWD to review the results of the Electrical Master Plan.

The budget cost estimate for the Electrical Master Plan is approximately $130,000.

It is expected that the projects listed in Table 10-14 would be identified during the master planning process as required projects in the near-term 5-year timeframe.

Table 10-14: Potential Electrical CIP Projects

Potential Projects	Estimated Project Cost
BLM Switchgear (5kV) Replacement	$ 2,000,000
Hoffman Building Main Switchgear (480V) Replacement	$ 1,150,000
MCC Consolidation	$ 3,400,000
Burner Building - New Power Distribution	$ 250,000
Plant-wide Arc Flash Hazards Analysis and Labeling	$ 120,000
Construction Subtotal	$ 6,920,000
Design (12%)	$ 830,400
Construction Management (15%)	$ 1,038,000
Project Subtotal	$ 8,788,400
Project Contingency (30%)	$ 2,636,520
Total Estimated Cost (rounded)	$ 11,400,000

10.6.2 SCADA Master Plan

The existing control system at the SBWRP consists of a mix of PLCs from manufacturers including Modicon (Schneider) and Allen Bradley. The following models are in use:

- Quantum 113 02
- Compact A984-145
- Compact E984-275
- 800 Series E685
- CompactLogix

The SCADA headend is built on Wonderware InTouch. Approximately fifty graphic screens, alarm screens, and pop-up windows have been developed on the system over the course of several years. The implementation is relatively consistent and incorporates isometric representation of the plant equipment. Color is used to indicate the status of the equipment; red indicates a run, open, or energized state, while green represents a stopped, closed, or deenergized state. Utilizing colors to indicate status without the additional aid of text may be difficult for a colorblind person to recognize the change in state. The features and characteristics found on high-performance graphics have not been implemented. While color is used to alert operators to deteriorating conditions, it is typically only a single color meant only to change the contrast and draw the operator’s attention rather than indicate a specific status.

Like the electrical system, Instrumentation and Controls (I&C) assets were assessed for remaining useful life (RUL) and criticality to operations. The assessment revealed that 10% of I&C assets inspected have no remaining useful life and more than 60% have a RUL of 10 years or less; however, RUL does not consider supportability or maintainability. Many manufacturers drop product support after 10 years and replacement parts become scarce in the years that follow.

A SCADA Master Plan is recommended to provide a framework to achieve a secure, flexible, reliable, and comprehensive SCADA environment. The SCADA Master Plan should evaluate all instrumentation 10 years old and older in order to develop a replacement plan. In addition to the replacement plan, standards should also be developed that identify minimum specifications and preferred manufacturers for each type of process measurement taking into consideration the properties of the process fluid, solid, or gas being measured. The Master Plan shall include specific recommendations with budgetary cost estimates and schedule for the next five to ten years generated from a gap analysis.

The following major tasks should be included in a SCADA Master Plan:

- Existing Documentation Review
- Site Investigation and Staff Interviews
- Current-state Technical Memorandum
- Strategic Visioning Session Workshop
- SCADA Requirements Workshop and Technical Memorandum
- Draft Master Plan Report – Future Projects Scope and Budget
- Final Master Plan Report and Presentation

The budget cost estimate for the SCADA Master Plan for the SBWRP is approximately $260,000. Additional facilities such as RIX and the collection system should also be evaluated and included in the SCADA Master Plan. Ideally, a citywide SCADA Master Plan would be undertaken, which would also include the Water Utility Division. However, the RIX, collection system, and water utilities were not part of this evaluation and have not been included in the cost estimate.

SCADA systems of this vintage require common projects to upgrade, replace, and otherwise enhance the system's operational effectiveness. It is expected that the projects listed in Table 10-15 would be identified during the master planning process as required projects. The list of projects and estimated cost is intended to provide guidance for CIP planning.

Table 10-15: Potential SCADA CIP Projects at SBWRP

Potential Projects	Estimated Project Cost
Control System Standards	$ 228,000
SCADA HMI Evaluation	$ 91,000
Standard HMI and PLC Templates	$ 248,000
SCADA Software Development Lab	$ 286,000
HMI Upgrade Project	$ 514,000
Control System Upgrade Project	$ 2,820,000
SCADA Cybersecurity Vulnerability Assessment	$ 174,000
Developing Process Control Narratives (PCN's)	$ 568,000
Instrument Specifications and Calibration Procedures	$ 205,000
SCADA Historian and Reporting	$ 242,000
Remote Data Collection	$ 150,000
Instrumentation Study	$ 224,000
Operational Efficiency Evaluation (KPI's)	$ 131,000
Project Subtotal	$ 4,523,000
Project Contingency (30%)	$ 1,357,000
Total Estimated Cost (rounded)	$ 5,900,000

While the Evaluation and Upgrade projects in the above table are specific to the SBWRP, additional benefit could be gained if the projects were applied throughout the DepartmentDepartment-wide:

- Control System Standards
- Standard HMI and PLC Templates
- SCADA Software Development Lab

- Instrument Specifications and Calibration Procedures
- Remote Data Collection
- The results and policy recommendations from the SCADA Cybersecurity Vulnerability Assessment could be applied across the Department.
- The template produced as part of the Developing Process Control Narratives could also be applied across the Department.

10.6.3 Biosolids Strategic Plan

Regulations have been enacted at the State level directed towards management of organic waste that can impact options for biosolids management in California. SB 1383 requires a reduction of landfill disposal of organics of 50-percent from the 2014 levels by 2020, and a reduction of 75-percent statewide disposal from the 2014 levels by 2025. The Southern California Association of Publicly Owned Treatment Works (SCAP) 2016 Biannual Biosolids Trends Survey Report concluded that 16% of biosolids generated in California are disposed of in landfills. The diversion of biosolids and other organics from landfills to the compost market may greatly strain the demand for compost in the already limited compost end-use market. This could impact both the cost and availability of outlets for biosolids.

The goal of the Biosolids Strategic Plan is to develop a long term, reliable, cost effective and diversified approach for the management of SBMWD's biosolids that is compliant with State, local, Federal and environmental regulations. A Biosolids Strategic Plan would identify multiple options for biosolids management and provide information needed to make informed decisions regarding potential improvements to the SBWRP.

The scope of work for a Biosolids Strategic Plan should include the following:

- Review the existing SBMWD biosolids management program. Review previous relevant studies. Meet with SBMWD staff to discuss its biosolids management views in order to refine the analysis to a reasonable number of alternatives.

- Provide a brief assessment of the current regulatory, political and public environment associated with biosolids reuse and disposal options in California. Survey other agencies and provide a brief status report on current activities, available options and future planning to resolve any identified biosolids issues. Obtain Biosolids information from neighboring agencies to assess the benefits of a regional biosolids management strategy.

- Identify potential alternative disposal strategies and marketplace opportunities for disposal of Class B biosolids for SBMWD. The goal of this element of the scope is to provide SBMWD with greater diversity and eliminate any risk associated with the long-range viability of their existing Class B disposal contract. Develop criteria for initial screening of identified alternatives. Criteria should include items such as reliability, maturity of the identified alternative, facility requirements (if any), potential impacts to operations (if any), capital cost (if any) and related O&M cost. Perform the analysis for both a regional and stand-alone approach.

- Identify potential alternative and emerging treatment technologies that could produce a Class A biosolids product to create more disposal options for SBMWD. These technologies should include but not be limited to improved digestion (thermophilic, TPAD, etc.), thermal hydrolysis (Cambi, Lystek, etc.), heat drying, pyrolysis, and alkaline stabilization. Develop criteria for initial screening of identified alternatives. Criteria should include items such as reliability, maturity of the technology, siting constraints, compatibility with existing process, marketability of final end-product, capital cost and O&M cost. Provide additional analysis of the alternatives that are preferred following the initial screening process. Perform the analysis for both a regional and stand-alone approach.

- Develop a Biosolids Strategic Plan with primary focus on long term reliability, diversification and cost. Assess the feasibility of using land currently owned by the Department for future biosolids facilities. Develop a short list of feasible alternatives for both Class B and Class A disposal/beneficial use. Develop concept level design and implementation plan that will identify regulatory, institutional, technical, schedule and monetary requirements for implementing top Class A and Class B alternatives in the Strategic Plan. Include any pilot testing and/or full-scale demonstration studies required.

The budget cost estimate for the Biosolids Strategic Plan is approximately $390,000.

10.6.4 RIX Facility Plan

RIX was constructed in the mid-1990s to filter and disinfect 40 mgd of secondary effluent from SBWRP and the City of Colton using percolation basins to meet discharge requirements to the Santa Ana River. Tertiary filter equipment was added to bridge the gap in treatment capacity when infiltration rate in the percolation basin was less than anticipated. With flows currently at 26.5 mgd, the tertiary filtration equipment that was added on is used only during periods of high flow. With flow rates expected to be further reduced due to recycling projects (and within the confines of multiple agreements, commitments, and obligations), the RIX facility is due for an evaluation of its treatment processes and facilities at the anticipated future flowrates.

The RIX Facilities Plan should include the following tasks:

- Evaluate existing treatment technology to meet both flow capacity and quality objections for the projected discharge requirements to the Santa Ana River.
- Flow considerations include the environmental flows determined in the HCP and other discharge obligations, and the potential for the City of Colton to recycle a portion of its secondary effluent contribution to RIX.
- Water quality considerations should include potential changes to TDS and TIN discharge limitations resulting from the SAWPA study to be finalized and impacts of emerging contaminants such as PFAS/PFOA.
- Evaluation of Electrical Infrastructure

The budget cost estimate for the RIX Facility Plan is approximately $130,000.

10.7 Project Ranking and Recommendations

This section presents scoring and ranking of capital projects based on how beneficial they would be to the SBMWD. High scoring projects are most beneficial, while lower scoring projects offer limited benefits. This ranking approach is the same as the one used for the near-term R&R projects. Based on the ranking and additional considerations, primarily capital cost and return on investment, certain projects are recommended to be carried forward into the Capital Improvement Plan presented in Section 11.

The scoring system relies on four evaluation categories, same as described in Section 9.1:

- Reducing consequence of failure,
- Improving energy efficiency,
- Renewing or replacing aging assets and
- Reducing operational cost and/or simplifying operations.

Each evaluation category was assigned a weight of 1 to 3, with three being the most significant and one being the least. Weights are shown in Table 10-16. Each project was given a score of 0 to 3 in each evaluation category based on its relevance to the project. A score of three indicates that the category is highly relevant to a project; zero indicates no relevance. A total score was then calculated for each project by multiplying the score for each category by its weight, then summing the weighted scores. Table 10-16 presents scores for each project. The projects have been sorted based on their total score in descending order. Note that the SCADA and Electrical plans are included in the scoring table below because these will result in capital projects which are well defined enough to assign scores. The RIX and Biosolids Plans will be higher level and the scope of any resulting capital projects is undefined at this point. These two plans were not included in the table but are discussed later in this section.

Table 10-16: Operational Efficiency and Optimization Project Scoring and Ranking

Project	Total Score	Evaluation Category			
		COF	Energy	Life	Ops
		Category Weight			
		3	1	2	1
		Category Score			
Recommended Projects					
Unit 3 Expansion and Completion	18	3	1	3	2
Electrical Master Plan	16	3	0	3	1
SCADA Plan & Upgrades	15	2	1	3	2
Digester B Replacement	14	2	1	3	1
Digester Cleaning	14	3	1	2	0
Liquid Process Optimization	8	2	1	0	1
CEPT	8	1	3	0	2
Brine Line MH	6	0	0	2	2
Not-Recommended Projects					
NRC Diffused Air	5	0	2	1	1
Secondary Capacity Reduction	5	-1	2	2	2
Primary Flow EQ	4	1	0	0	1
Digester Mixing Optimization	3	0	1	1	0

The highest scoring project is the Unit 3 Expansion and Completion. SCADA and electrical plans and digester improvements were also high scoring. These projects all score high because they upgrade aging processes and assets with significant consequences of failure. They also offer energy savings and/or operational benefits. These projects are all recommended.

The first three of the lower scoring projects are also recommended. CEPT is recommended because its low cost and reasonable payback (6 years) make it worth pursuing. Liquid process optimization is recommended because it is a low-cost way to improve reliability of the existing secondary process. Adding brine-line manholes is considered a priory project from a maintenance perspective.

The remaining low-scoring projects are not recommended. While NRC Diffused Air offers some benefit, the high capital cost and long payback (18 years) do not justify the project. Secondary Capacity Reduction would offer considerable operations savings, as discussed above, but it reduces secondary capacity too much. For this reason, it is assigned a negative score in the COF category. It would also be superseded by the Unit 3 Expansion and Completion. Primary Flow Equalization and Digester Mixing Optimization have limited benefits and high capital costs.

The most significant recommended project is the expansion and completion of Unit 3. As discussed in Section 10.2.4, $127 million in R&R costs on Unit 1, Unit 2N, Unit 2S, and NRC would be avoided by building Unit 3. In addition, approximately $10 million in optimization project costs would also be avoided. Since the Unit 3 expansion would be sized to treat flows projected through 2040, including wet weather flow, there would not be a need to implement primary flow equalization or reduce the capacity of Unit 2. The estimated savings from avoided capital improvement project is approximately $35 million as shown in Table 10-17.

Table 10-17: Avoided Costs with Unit 3 Expansion and Completion

Project	Estimated Savings
R&R Projects Avoided	
R&R Avoided on Unit 1, Unit 2N, Unit 2S, and NRC	$ 127,000,000
Capital Improvement Projects Avoided	
Primary Flow Equalization	$ 9,000,000
Secondary Capacity Reduction	$ 500,000
Total Cost Savings	$ 136,500,000
Capital Improvement Projects Implemented	
Unit 3 Expansion and Completion	Cost of $ 101,500,000
Net Cost Savings	$ 35,000,000

In addition to being competitive on a capital cost-basis with maintaining the existing treatment units, expanding Unit 3 would provide significant operational and maintenance advantages including:

- Operators would only need to manage one biological system, rather than the current four
- Flow split and hydraulic issues with existing plant would be corrected
- The new plant would be designed to reliably meet effluent TIN requirements
- The physical size and complexity of the plant would be reduced.

Other recommended projects relate to maximizing performance of the liquid system in the near term and maintaining long-term reliability of the solids handling system. SCADA and electrical studies are also recommended to develop strategies for upgrading and modernizing these aging systems. Evaluating current treatment facilities at RIX and developing biosolids reuse/disposal options are also recommended. Table 10-18 summarizes all project alternatives considered and identifies the projects and studies recommended to address the needs of the SBWRP for the next 20 years.

Table 10-18: Recommended Capital Improvement Projects and Studies

Project Summary	Project Description	Project Cost	Recommended?
Primary Treatment Projects			
Primary Flow Equalization	Construct a primary equalization basin to capture wet-weather peak flows and reduce impacts on downstream processes.	$9,320,000	No
Chemically Enhanced Primary Treatment	Equipment to add chemical coagulants downstream of ferric chloride addition and upstream of primary clarifiers.	$390,000	Yes
Secondary Treatment Projects			
Liquid Process Optimization	Study and pilot testing of alternate operating modes to reduce SVI and improve process performance. Addition of MLR pumps to Unit 2.	$1,520,000	Yes

Project Summary	Project Description	Project Cost	Recommended?
Secondary Capacity Reduction	Modifications necessary to take one train of Unit 2 offline.	$500,000	No
NRC Conversion to Diffused Air	Replacing the mechanical aerators with fine bubble diffuser system including blower and automatic dissolved oxygen control.	$1,800,000	No
Unit 3 Expansion and Completion	Expansion of Unit 3 primary clarifiers and addition of reactor tanks configured for biological nitrogen removal, new secondary clarifiers, a RAS gallery and electrical and control building, and associated work. This new facility would allow for decommissioning Unit 1, Unit 2 North, Unit 2 South, and NRC.	$101,500,000	Yes
Solids Handling Projects			
Digester B Replacement	Replace Digester B to provide digester redundancy. Digester B is currently offline due to leakage.	$8,000,000	Yes
Digester Cleaning	Clean out and repair Digesters C & D. Digesters C & D are concrete tanks w/concrete lids built in late 1980s.	$3,200,000	Yes
Digester Mixing Optimization	Replace existing digester pump mixers with high efficiency linear motion mixers; Cost is per digester.	$1,200,000	No
Brine Line Improvements			
Brine Line Improvements	Install seven manholes in the pipe connecting the septage/brine receiving station to the IEBL to allow for proper cleaning of the line. Existing cleanouts are inadequate, and cleaning is difficult and costly.	$200,000	Yes
Influent Lift Stations			
Downsizing of East Influent Lift Station	Replace the existing screw pumps with ones requiring lower energy demand to account for the reduced influent flow without EVWD flow.	$600,000	No
Studies and Resultant Projects			
Electrical Master Plan	Study to upgrade electrical distribution system to improve safety, reliability, redundancy, and create equipment standards as defined by NFPA 70E through: Condition assessment; As-built single line diagrams; Load calculations and capacity requirements; Consolidation approach for existing MCCs; Sequence of work and implementation; Arc flash hazard mitigation; Alternative configuration design.	$130,000	Yes
Electrical Master Plan Resultant Projects	Resulting projects from the Electrical Master Plan potentially including: Switchgear replacement; MCC consolidation; New power distribution; Plant-wide hazard analysis and labeling.	$11,400,000	Yes

Project Summary	Project Description	Project Cost	Recommended?
SCADA Master Plan	Study to provide a framework to achieve a secure, flexible, reliable, and comprehensive SCADA environment. The SCADA Master Plan shall include specific recommendations with budgetary cost estimates and schedule for the next 5 to 10 years generated from a gap analysis.	$260,000	Yes
SCADA Master Plan Resultant Projects	Resulting projects from the SCADA Master Plan potentially including: Control system standards and upgrades; Software Development; HMI upgrades; Process control narrative development; SCADA cybersecurity.	$5,900,000	Yes
Biosolids Strategic Plan	Study to identify a long-term approach for biosolids management compliant with State, local, Federal and environmental regulations. SB 1383 requires 50% reduction of landfill disposal of organics by 2020 and 75% reduction by 2025. Cost increase for current biosolids end use option may occur. No backup biosolids contract in place.	$390,000	Yes
RIX Facilities Plan	Study to evaluate the efficacy of existing treatment process facilities (percolation basins, filtration equipment, disinfection method) at projected lower flowrates considering planned water recycling projects and HCP flow obligations to the Santa Ana River.	$130,000	Yes
Total Recommended Project Cost			$133,020,000

11. CAPITAL IMPROVEMENT PLAN

This section presents the recommended Capital Improvement Plan (CIP) based on the discussion, analysis and recommendations presented in Sections 9 and 10. The plan schedules the recommended projects over the planning period based on priority, funding, sequencing considerations (such as maintaining a minimum number of processes on-line) and external events (such as the reduction of influent flow). The following section provides a summary of the ongoing projects funded under previous CIPs.

11.1 Ongoing Projects

The following projects are currently in design or under construction. Descriptions are from the *Sewer Treatment Capital Improvement Budget Summary for Fiscal Year 2019-2020* (San Bernardino Municipal Water Department, 2019). Ongoing projects are not listed in the CIP implementation Plan presented in Section 11.4 through 11.7 since they are accounted for in SBMWD's current CIP.

11.1.1 Digester Gas Beneficial Use Program / Fuel Cell Project

SBWRP beneficially uses digester gas which is produced as a byproduct of the wastewater treatment process. Most of the digester gas is currently used to fuel internal combustion engines (ICEs) to drive process equipment including blowers, pumps, and the generator that is part of the Cogen system. A portion of the digester gas is also used in boilers to heat the anaerobic digesters. The remaining digester gas is flared.

Emission limits for digester gas-fueled ICEs are governed by Rule 1110.2 of the South Coast Air Quality Management District (SCAQMD). Rule 1110.2 was amended to reduce the overall emissions from digester-gas fueled engines. To meet the emission limits and continue using digester gas-fueled ICEs, extensive retrofitting of the existing engines would be required. To comply with Rule 1110.2, SBMWD conducted a *Digester Gas Beneficial Use Study* (Carollo, 2018), which recommended conversion from digester gas-fueled ICEs to a fuel cell system.

SBMWD executed a power purchase agreement with FuelCell Energy (FCE) on April 29, 2019. FCE will convert digester gas produced by the SBWRP to electricity and heat through a gas pretreatment and fuel cell system. All digester gas produced at the SBWRP will be made available, free of charge, to FCE, and the electricity will be sold to the SBMWD at a rate lower than that which could be purchased from the electric utility provider (SCE). In 2021 to 2022, 2.2 MW (2,200 kW) of power is projected to be needed at the SBWRP. The vendor will provide a fuel cell system below 2.2 MW so that the SBWRP will not be a net generator of electricity.

11.1.2 Blower Electrification Project

The secondary treatment processes at Units 1 and 2 have an aeration system consisting of two digester gas-fueled ICE blowers and two electric-driven blowers. As part of the fuel cell conversion project, two blowers that are driven by digester gas-fueled ICEs will be replaced by more efficient electric turbo-style blowers. The blowers will be decentralized and dedicated to aeration basins Units 1 and 2.

Five high-speed electric turbo blowers will be installed in the new Unit 1 blower building to supply air to Unit 1 in a dedicated pressure zone. Air for Unit 2 will be supplied from the existing two electric rotary blowers. Control upgrades to Unit 1 will include automated dissolved oxygen (DO) control and ammonium-based aeration control (ABAC). The blower electrification project will also include installation of a generator to supply limited power to Unit 1 during an outage.

11.1.3 Duty Flare and Backup Flare Replacement

To meet SCAQMD Rule 1118.1 emission requirements for flares, a new 0.025 lbs/MMBtu ULE flare (0.025 Duty Flare) will be constructed and used as a duty flare. The existing duty flare will be replaced with a Low-Emissions (LE) 0.06 lbs NOx/MMBtu flare and used as a standby flare (0.06 Backup Flare). The ULE flare is designed to handle current and anticipated future gas flow conditions in coordination with the DG storage project as part of the larger Digester Gas Beneficial Use Program.

11.1.4 Arrowhead Lift Station Electrical Supply and Pump Conversion Project

As a direct result of the SCAQMD's revision to Rule 1110.2, the two existing ICEs fueled by digester gas to drive the pumps at the Arrowhead Lift Station will be converted to alternative power supplies. One ICE will be converted to electricity and the other will be converted to propane.

11.1.5 Digester Gas Holder Project

This project will design and construct a new low-pressure digester gas (DG) holder to equalize the flow of DG to the Fuel Cell Project. The new DG storage system aims to minimize the wasting of gas to the flare system. Coordination between the DG storage and ULE flare project (i.e. flow, operating pressure, etc.) is essential to ensure efficient and effective operation.

11.1.6 Primary Metering Project

This project will expand the BLM to accommodate switches to power the Hoffman switchgear, Unit 1 Blower Building, Clean Water Factory, and to receive power from the Fuel Cell.

11.1.7 Clean Water Factory Tertiary Treatment System Design

As described in Section 5.1.3, the SBMWD is planning a recycled water project called the Clean Water Factory, which will be a Title-22 compliant tertiary treatment system that will supply recycled water for:

- Operational needs within the plant, eliminating in-plant use of groundwater from wells.
- Groundwater recharge of the Bunker Hill Groundwater Basin, which is SBMWD's sole source of water supply.
- Recycled water customers.

The Clean Water Factory is sited east of the Unit 1 secondary clarifiers, adjacent to East Twin Creek. The design includes a new pump station and pipelines to convey secondary effluent to new filtration and disinfection processes. After treatment, the tertiary recycled water will be stored in a rehabilitated existing reservoir that currently stores groundwater. Production of tertiary disinfected recycled water from the Clean Water Factory will be phased with provisions to allow future expansion of up to 5 mgd (AECOM, 2019) using water in excess of the discharge commitments to the Santa Ana River. The Clean Water Factory is in the final design phase and is expected to be operational in 2021.

11.1.8 Receiving Station for Fats, Oils, Grease and Other Anaerobically Digestible Materials

Co-digestion of fats, oils and greases (FOG) and anaerobically digestible materials (ADM) can be beneficially reused to generate energy. SBMWD is evaluating installing a FOG receiving station to generate more DG to compensate for the loss of load from the SNRC. There may also be a potential economic benefit to the SBMWD from tipping fees charged to FOG haulers. ADM is defined as any waste material containing organic matter that is digestible and may include food waste, FOG, source separated organics and waste from industrial sources such as whey, glycerin, de-icing fluids, brewery waste, etc.

A preliminary review of FOG/ADM addition to the SBWRP indicated that it is feasible from a treatment standpoint (Hazen and Sawyer, 2019). Given the available digestion capacity at SBWRP, DG production could potentially increase approximately 25% to 30% over the current daily average, which could compensate for the loss of load from the SNRC.

Constructing a FOG/ADM receiving station supports the statewide goal to reduce short-lived climate pollutants. Short-lived climate pollutants, including methane, hydrofluorocarbons, and anthropogenic black carbon, have relatively short atmospheric lifetimes yet have a dramatic and detrimental effect on air quality, public health, and climate change. Senate Bill (SB) 1383, which was passed in September 2016 and will become enforceable in 2022, established reduction targets for short-lived climate pollutants and established reduction targets for the disposal of organic wastes in landfills and requires state agencies to increase the sustainable production and use of renewable gas (Section 7.3.3). The legislation could result in more organics being diverted to the SBWRP (i.e. food waste), incentivize methane production at the SBWRP, and potentially impact future biosolids disposal costs due to higher demand for composting over disposal in landfills.

Based on Hazen's high-level FOG/ADM study, it was realized that food waste and other ADM within the specified area are not readily available for SBWRP since there are a number of facilities around the San Bernardino area that currently processes this feedstock in anaerobic digestion. Hazen identified one FOG hauler who is interested in options of disposal facility around San Bernardino at a competitive tipping fee. The market survey indicated that the availability of FOG in this area is higher than other sources and the availability of FOG ranges between 15,000 to 25,000 gpd. The existing three digesters currently have available capacity to accept FOG/ADM for codigestion. However, the SBWRP does not have firm capacity to accept FOG/ADM at the time of this study. When the EVWD flow of 6 mgd is diverted to the new facility (Around year 2022), the existing anaerobic digesters can accept higher amounts of FOG. Even with 2 digesters online (firm capacity), the SBWRP can accept over 25,000 gpd of FOG. If SBMWD implements a codigestion program after the departure of 6 MGD flow to EVWD, and accepts 25,000 gpd of FOG, digester gas production is estimated to increase over 35%. The estimated construction costs of a FOG receiving station is approximately $2.0 million and estimated annual O&M cost is $141,000. Hazen recommends conducting a more thorough analysis of the impact of FOG to the overall solids handling operation and digester gas handling and beneficial use and a more thorough market assessment to identify local or regional sources of FOG. This research may include negotiation with haulers and contract agreement.

11.2 Current Capital Improvement Projects

Capital improvement projects for sewer treatment in Fiscal Year (FY) 2018-2019 and FY 2019-2020 are listed in Table 11-1. These projects are in various stages of implementation between planning, design, and construction. All are fully-funded and are not included in the CIP for FY 2020-2021.

Table 11-1: Capital Improvements in FY 2018 – 2020 CIPs for Sewer Treatment

Item	CIP Budget FY 18-19	CIP Budget FY 19-20
WRP Facilities Assessment	$ 750,000	$ 72,830
Conveyor No. 5 Modifications	$ 80,000	$ 67,000
Unit 1 Secondary Effluent Modifications	--	$ 250,000
E Street Lift Station Controls Upgrades	--	$ 120,000
Annual R/R - Solids Handling System	--	$ 60,000
Annual R/R – WRP Operational (Ferric chloride backup tank)	--	$ 30,000

Item	CIP Budget FY 18-19	CIP Budget FY 19-20
Annual R/R - WRP Structural	--	$ 15,000
Annual R/R - WRP Mechanical	--	$ 245,000
Annual R/R - WRP Electrical, Instrumentation and SCADA	--	$ 45,000
Annual R/R - WRP Facilities	--	$ 40,000
Flare Replacement Project (0.06 Backup)	$ 1,400,000	$ 1,218,000
Flare Replacement Project (0.025 Duty)	$ 100,000	$ 1,652,760
Blower Decentralization Project	$ 10,700,000	$ 12,785,000
ALS Reliability Project	$ 3,000,000	$ 2,905,673
Digester Gas Holder Project	$ 2,500,000	$ 2,650,000
WRP Primary Metering Project	--	$ 250,000
SBMWD Administration Building	$ 1,125,000	$ 1,125,000
Phase 2 - Tertiary Treatment System (Design)	$ 3,585,313	$ 2,543,554
Phase 2 - Tertiary Treatment System (Design) - Grant	$ 472,113	-
Phase 4 - Tertiary Treatment System (Construction)	$ 13,500,000	$ 13,500,000
Total	$ 37,212,426	$ 39,574,817

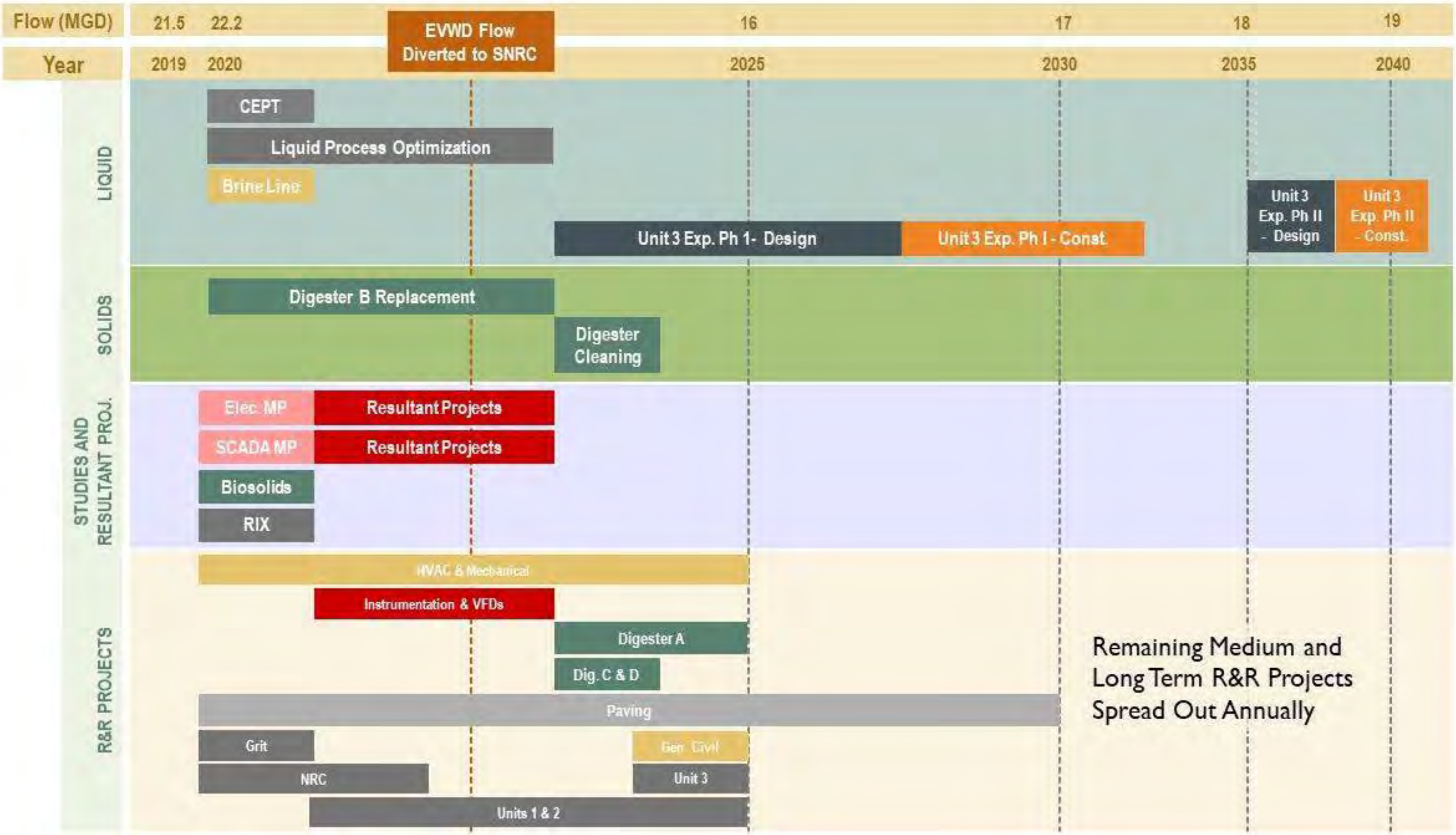
Source: SBMWD Sewer Treatment CIP Budget Summary, 2019

11.3 2020 – 2040 CIP Implementation Road Map

The CIP plan schedules the recommended projects over the 2020-2040 planning period based on priority, funding, sequencing considerations (such as maintaining a minimum number of processes on-line) and external events (such as the reduction of influent flow). Implementation of recommended projects presented in a visual format in Figure 11-1 and described in the sections that follow. The timeline is presented on a log scale to enhance clarity on the project schedule from 2020-2025. The rows separate project categories into Liquid, Solid, Studies/Resultant Projects, and R&R projects. Only near-term R&R projects are shown on the figure. An implementation schedule was not developed for medium- and long-term R&R projects due to uncertainty.

Individual projects are color-coded: gray represent liquid process projects, green represents solids-related projects, red represents electrical and SCADA projects (with pink to represent associated plans), and tan represents general projects. The Unit 3 Expansion and completion project is split into two phases, which are described in Section 11.4.1. The design and construction phases are separated in slate and orange colors, respectively.

Figure 11-1: CIP Implementation Road Map



11.4 Unit 3 Expansion and Completion Project

Due to the magnitude of project cost for the Unit 3 Expansion and Completion Project, a comparison is made between:

- Maintaining existing WRP facilities without undertaking expansion of Unit 3, and
- Maintaining existing facilities while the Unit 3 Expansion and Completion Project is constructed.

Phasing of the Unit 3 Expansion and Completion Project and financing discussion are included in the following sections.

11.4.1 Phasing

Phasing the Unit 3 Expansion and Completion Project is recommended for two main reasons. First, the cost of implementation will be spread over a longer duration, which will make the project more financially feasible. Second, phasing of the project allows for Unit 1 to be utilized longer, taking advantage of the recent improvements performed on it.

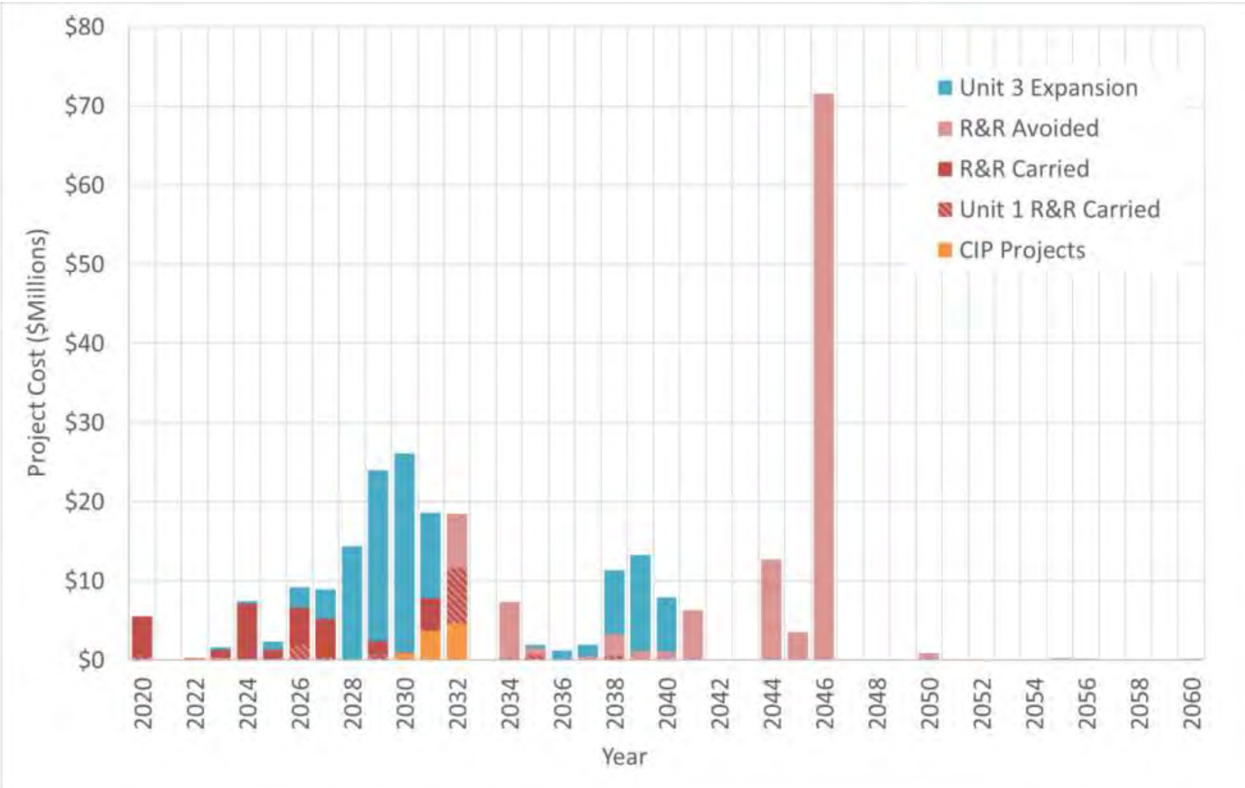
Conceptually, the first expansion phase of Unit 3 would operate in tandem with Unit 1 to treat all of the flow that SBWRP receives, allowing Unit 2N and Unit 2S to be put out of service. The firm capacity of Unit 1 and Unit 3 combined would be 20 mgd, with a peak capacity of 54 mgd. Firm capacity is with the largest tank of each treatment process offline. For primary clarifiers, this is Unit 1. For Secondary Clarifiers it is also one of the Unit 1 tanks. For aeration, it is Unit 3 since the Unit 1 aeration has internal redundancy where just a pair of cells can be taken offline.

By keeping Unit 1 online, the firm capacity can be reached by building two thirds of Unit 3. This would consist of four new aeration trains, and four new secondary clarifiers, and no additional primary clarifiers. Additionally, certain parts of the project such as yard piping, odor control, splitter box, RAS gallery and electrical infrastructure would be built out to completion. The cost for Phase I of the Unit 3 Expansion Project would be about $80M.

Phase I of the Unit 3 Expansion would need to be completed by FY 2031/32 to avoid R&R costs associated with Unit 2N and Unit 2S. In Figure 11-2, R&R costs associated with Units 1, 2N and 2S are carried through the CIP until the completion of Phase I of the Unit 3 Expansion. After FY 2031/32, only Unit 1 R&R costs are carried through since it will continue to be in operation. Additionally, two CIP projects, Primary Flow Equalization (Section 10.1.1) and Secondary Capacity reduction (Section 10.2.2), would no longer needed with the implementation of the Unit 3 Expansion.

Phase II of the Unit 3 Expansion builds out the remainder of Unit 3 to allow for Unit 1 to go offline. Phase II would consist of new primary clarifiers, two additional new aeration trains, and two additional new secondary clarifiers. The cost for the second phase of the Unit 3 Expansion and Completion would be about $30M. This total cost of the phase approach is approximately $9M more costly than the estimate cost in Section 10.2.4 to account for inefficiencies in a phased approached from multiple design efforts and additional mobilization. Phase II of the expansion would be completed by FY 2040/41 in order to avoid R&R costs that are attributed to Unit 1. Completion of Unit 3 would also avoid the largest R&R cost in FY 2046/47, which is attributed to numerous Unit 1, 2N and 2S structures reaching their estimated end of life.

Figure 11-2: Unit 3 Expansion and Completion (Phased) with R&R avoided

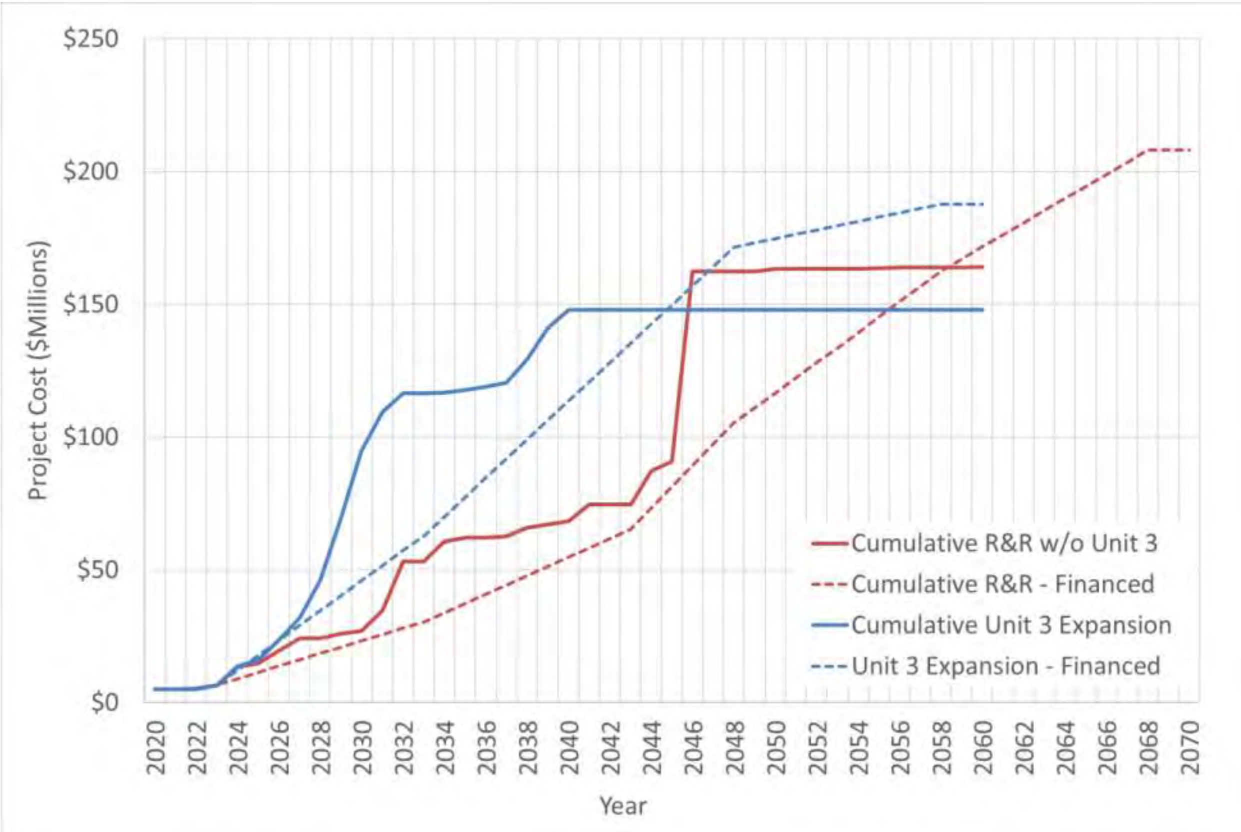


11.4.2 Cost Comparison and Financing

The graph below compares estimated cumulative costs with and without the Unit 3 Expansion. The blue lines represent annual costs including the Unit 3 Expansion and Completion Project and R&R on the existing facilities. The red lines represent annual R&R costs for maintaining the existing facility without the expansion project.

The solid lines represent the annual cost if SBMWD pays for the improvements "out-of-pocket" or pay as you go (PayGo). The dashed lines represent the annual cost if SBMWD pays for the improvements with bond financing. The bond financing option is based on a 2.06% interest rate that made the financing option equal to the PayGo option on a Net Present Value basis. With State/Federal loan programs, it is reasonable to assume that SBMWD will be able to get rates in that range or lower.

Figure 11-3: Cost Comparison with and without Phased Unit 3 Expansion



11.5 Project Implementation

This Section combines the R&R projects described in Section 9 with the optimization and efficiency projects and studies recommended in Section 10.7 to develop a CIP implementation plan.

The Phased Unit 3 Expansion and Completion Project is included in the CIP across the near-, medium- and long-term timeframes as presented in Section 11.4.1; however, costs are presented in the PayGo option rather than the financing option (described in Section 11.4.2).

Projects anticipated after July 2040 are not considered in this CIP prioritization.

11.5.1 Near-Term Projects (1 to 5 Years)

This section describes projects that are recommended within the next 5 years (FY 2020/2021 through FY 2024/2025). Cost estimates for each project are provided. Project cost estimates include construction markups and allowances for design, construction management, and CEQA compliance, as listed in Table 10-3, where applicable. A 30% project contingency is included in all project cost estimates, with exception to the Pavement R&R project.

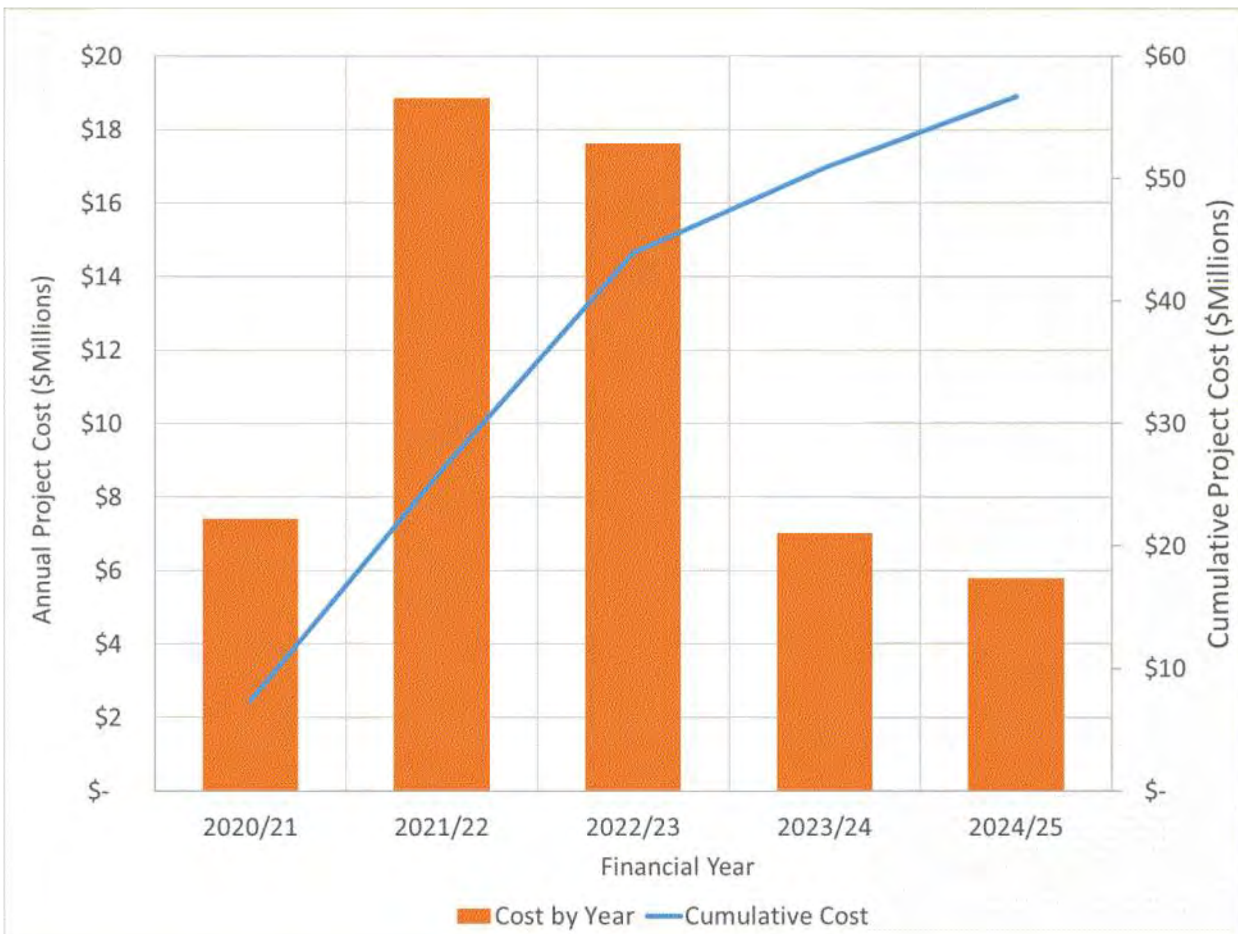
Table 11-2: Near-Term Capital Improvements Project Costs

CIP Project	2020/21	2021/22	2022/23	2023/24	2024/25	TOTAL
Recommended Improvement Projects						
Chemically Enhanced Primary Treatment (CEPT)	$360,000					$360,000
Liquid Process Optimization	$200,000	$660,000	$660,000			$1,520,000
Digester B Replacement	$800,000	$3,600,000	$3,600,000			$8,000,000
Digester Cleaning				$3,200,000		$3,200,000
Brine Line Manholes	$200,000					$200,000
Unit 3 Expansion and Completion Phase I – Design				$475,000	$476,000	$951,000
Studies and Resultant Projects						
Electrical Master Plan	$130,000					$130,000
Electrical Master Plan Resultant Projects		$5,700,000	$5,700,000			$11,400,000
SCADA Master Plan	$260,000					$260,000
SCADA Master Plan Resultant Projects		$2,950,000	$2,950,000			$5,900,000
Biosolids Strategic Plan	$390,000					$390,000
RIX Facility Plan	$130,000					$130,000
R&R Projects						
HVAC and Misc. Mechanical Asset R&R	$100,000	$100,000	$100,000	$100,000	$100,000	$500,000
Instrumentation R&R		$225,000	$225,000			$450,000
Liner and Containment Structure R&R					$240,000	$240,000
Solids Handling and Digester A R&R			$469,000	$2,110,500	$2,110,500	$4,690,000
Digester C & D R&R			$220,000			$220,000

CIP Project	2020/21	2021/22	2022/23	2023/24	2024/25	TOTAL
Pavement R&R	$364,000	$364,000	$364,000	$364,000	$364,000	$3,640,000
Grit Removal System R&R	$2,520,000					$2,520,000
Nitrogen Removal Carousel R&R	$1,915,000	$1,915,000				$3,830,000
VFD Replacement Project		$2,470,000	$2,470,000			$4,940,000
Units 1 and 2 R&R		$877,500	$877,500	$877,500	$877,500	$3,510,000
Unit 3 R&R					$1,720,000	$1,720,000
Total	$7,399,000	$18,861,500	$17,635,500	$7,027,000	$5,787,000	56,710,000

Figure 11-4 provides a graphical visualization of the 5-year annual and cumulative costs as recommended in this Master Plan.

Figure 11-4: Total Near-Term Recommended Project and R&R Costs – 5 Year



11.5.2 Recommended Medium-Term Projects (6 to 10 Years)

This section describes projects that are recommended within the 6- to 10-year period (FY 2025/2026 through FY 2029/2030). Table 11-3 provides project descriptions, along with construction and implementation costs for the projects over the 6- to 10-year time period. R&R projects and costs were determined by compiling assets from the asset registry with less than 10 years of remaining useful life remaining that were not addressed in the short-term projects.

Table 11-3: Recommended Medium-Term Capital Improvement Projects

CIP Project	Project Description	Construction Cost	Project Cost
Recommended Improvement Projects			
Unit 3 Expansion and Completion Phase I – Design and CEQA	Design of the expanded Unit 3 treatment process to replace aging Unit 1, Unit 2 North and Unit 2 South primary and secondary process trains while keeping Unit 3 primaries in service. Evaluation would utilize multiple years of influent flow and load data following the departure of EVWD source flow to SBWRP, with design process beginning after the evaluation phase. The CEQA process would also take place during this phase.	$ -	$9,354,000
Unit 3 Expansion and Completion Phase I – Construction[1]	Construction of the expanded Unit 3 treatment process to replace aging Unit 1, Unit 2 North and Unit 2 South primary and secondary process trains while keeping Unit 3 primaries in service. Construction of a new process train would begin in the 2028/29 financial year and continue until 2031/32.	$31,250,000	$35,937,000
R&R Projects			
HVAC and Misc. Mechanical Asset R&R	R&R of aging HVAC and miscellaneous mechanical assets. Assets to be replaced include HVAC and various valves located in Electrical Administration Building, Boiler Building, and Headworks Tunnel and Splitter box.	$998,000	$1,671,000
Instrumentation R&R	R&R of aging instrumentation assets. Instrumentation to be replaced include meters, sensors and probes located at the onsite wells, bar screen building and outfall sample stations.	$3,316,000	$5,552,000
General Site Civil	R&R of aging assets at the Septage and Brine Receiving Station, Irrigation Control Building and Brine Ponds	$203,000	$340,000

CIP Project	Project Description	Construction Cost	Project Cost
Solids Handling R&R	R&R of aging dewatering and digester assets. Assets to be replaced include various sludge handling, dewatering and odor control equipment located at the dewatering building, DAFTs, Digester A and sludge storage.	$6,733,000	$11,274,000
Pavement R&R	R&R of pavement throughout the treatment plant site. This cost has been spread over a 10-year period.	$2,864,000	$3,640,000
Lift Station R&R	R&R of aging assets associated with Arrowhead and East Influent Lift Stations. Assets to be replaced include pumps, motors, and sensors.	$1,700,000	$2,846,000
Headworks R&R	R&R of aging assets associated with the headworks including grit removal and odor control systems.	$2,301,000	$3,853,000
Nitrogen Removal Carousel R&R	R&R of aging assets associated with the Nitrogen Removal Carousel. Assets to be replaced include RAS/WAS pumps and motors, and various mechanical equipment.	$1,135,000	$1,900,000
VFD R&R	R&R of aging assets associated with Variable Frequency Drives. Assets to be replaced include VFD and instrumentation located at the Roots Blower Building and Tertiary Reservoir.	$1,949,000	$3,263,000
Units 1 and 2 R&R	R&R of aging assets associated with the Unit 1 and Unit 2 process. Assets to be replaced include diffusers, mixers, motors and miscellaneous mechanical equipment and instrumentation.	$3,760,000	$6,296,000
Unit 3 R&R	R&R of aging assets associated with the Unit 3 primary process. Assets to be replaced include scum pumps, motors, grinders, and miscellaneous mechanical equipment and instrumentation.	$2,264,000	$3,791,000
Total Medium-Term Project Cost			$85,919,000

Notes:

1. The Unit 3 Expansion and Completion Phase I Construction spans the medium- and long-term ranges. The values in the table only present the costs from FY 2025/26 to 2029/30.

11.5.3 Recommended Long-Term Projects (11 to 20 Years)

This section lists projects that are recommended within the 11- to 20-year period (2030 through 2039). The cost for the Unit 3 Expansion and Completion project cost is discussed in Section and outlined in CIP Sheet 2.4.

Table 11-4 provides construction and implementation costs for the projects over the 11- to 20-year time period. R&R projects and costs were determined by compiling assets from the asset registry with less than 20 years of remaining useful life remaining that were not addressed in the short-term or medium-term projects. R&R costs for Unit 1, Unit 2 North, Unit 2 South, and the NRC have been excluded from the long-term CIP recommended projects, since they are recommended to be abandoned after completion of the Unit 3 Expansion and Completion project.

Table 11-4: Recommended Long-Term Capital Improvement Projects

CIP Project	Construction Cost	Project Cost
Recommended Improvement Projects		
Unit 3 Expansion and Completion Phase I – Construction[1]	$31,250,000	$35,937,000
Unit 3 Expansion and Completion Phase II – Design	$ -	$3,047,000
Unit 3 Expansion and Completion Phase II – Construction	$23,437,500	$26,953,000
R&R Projects		
HVAC and Misc. Mechanical Asset R&R	$5,307,000	$8,886,000
Instrumentation R&R	$11,424,000	$19,128,000
General Site Civil	$571,000	$956,000
Solids Handling R&R	$21,945,000	$36,745,000
Lift Station R&R	$4,599,000	$7,701,000
Digester C & D R&R	$1,153,000	$1,931,000
Paving R&R	$661,000	$1,107,000
Headworks R&R	$6,032,000	$10,100,000
VFD R&R	$3,722,000	$6,232,000
Unit 3 R&R	$1,576,000	$2,639,000
Total Long-Term Project Cost		$161,362,000

Notes:

1. The Unit 3 Expansion and Completion Phase I Construction spans the medium- and long-term ranges. The values in the table only present the costs from FY 2030/31 to 2031/32.

11.6 CIP Summary

Figure 11-5 depicts the next 20 years of CIP project costs summarized in annual costs and cumulative costs. The increase in capital spending from 2028 to 2031 is from the Unit 3 Expansion and Completion project. R&R costs after FY 2031/2032 are assumed to be spread out evenly across each year due to unknown scheduling more than 10 years in the future.

Approximately $305 million in project costs and R&R is expected for the SBWRP over the next 20 years.

Figure 11-5: Total Recommended Project and R&R Costs – 20 Year

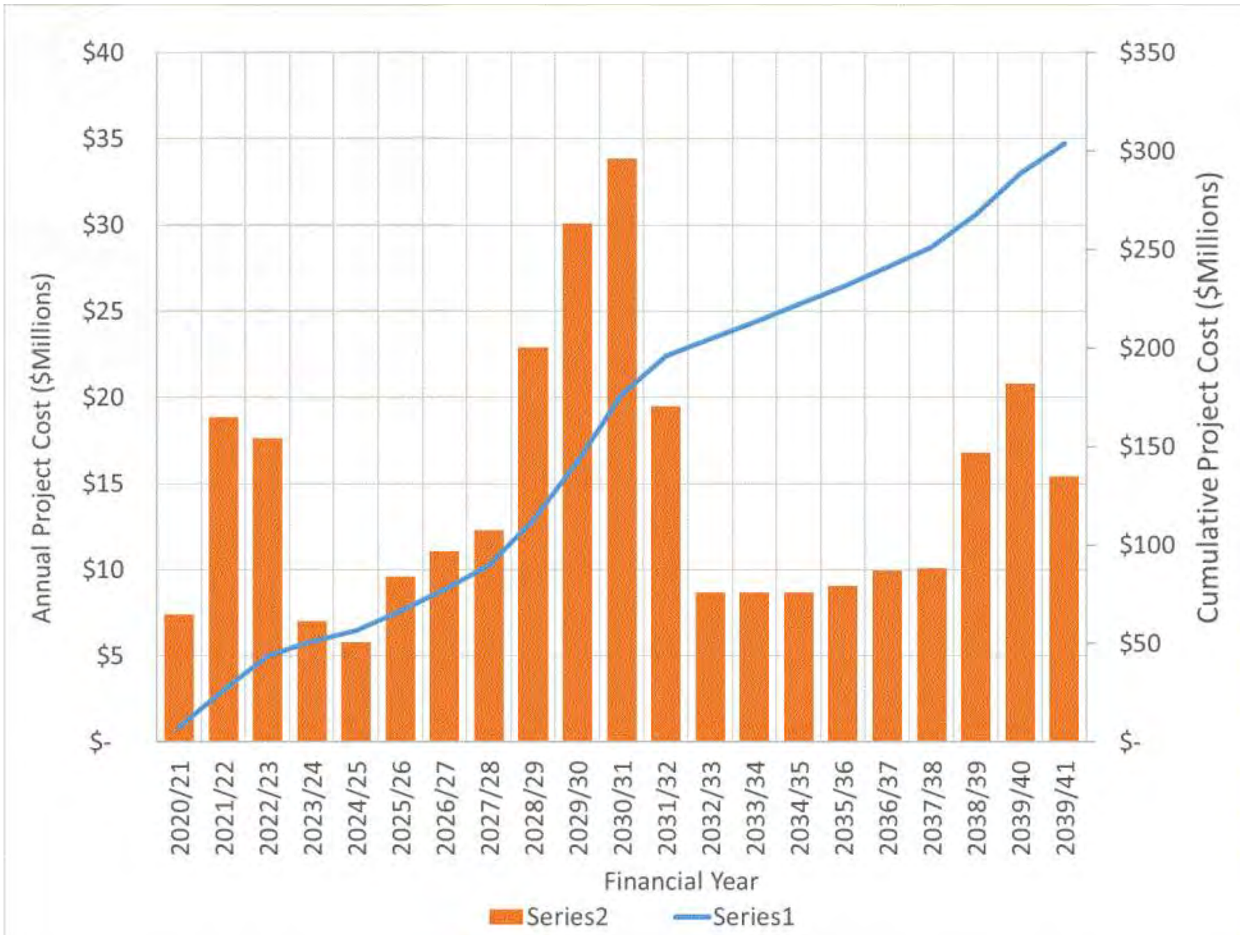


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Exhibit 1: Site Plan

SAN BERNARDINO WATER RECLAMATION PLANT

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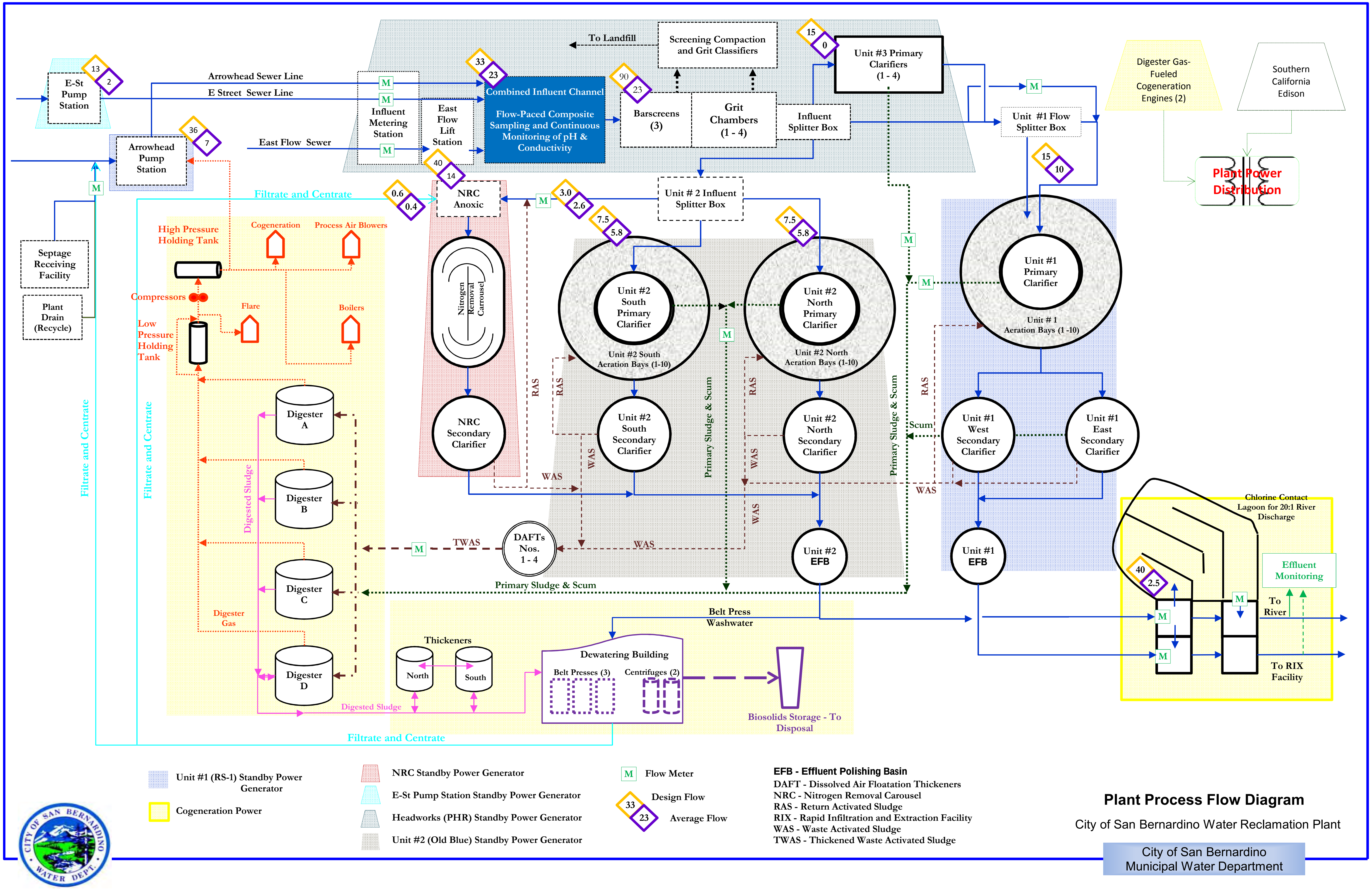
Created: Thursday, February 14, 2019

Exhibit 2: Process Flow Diagram



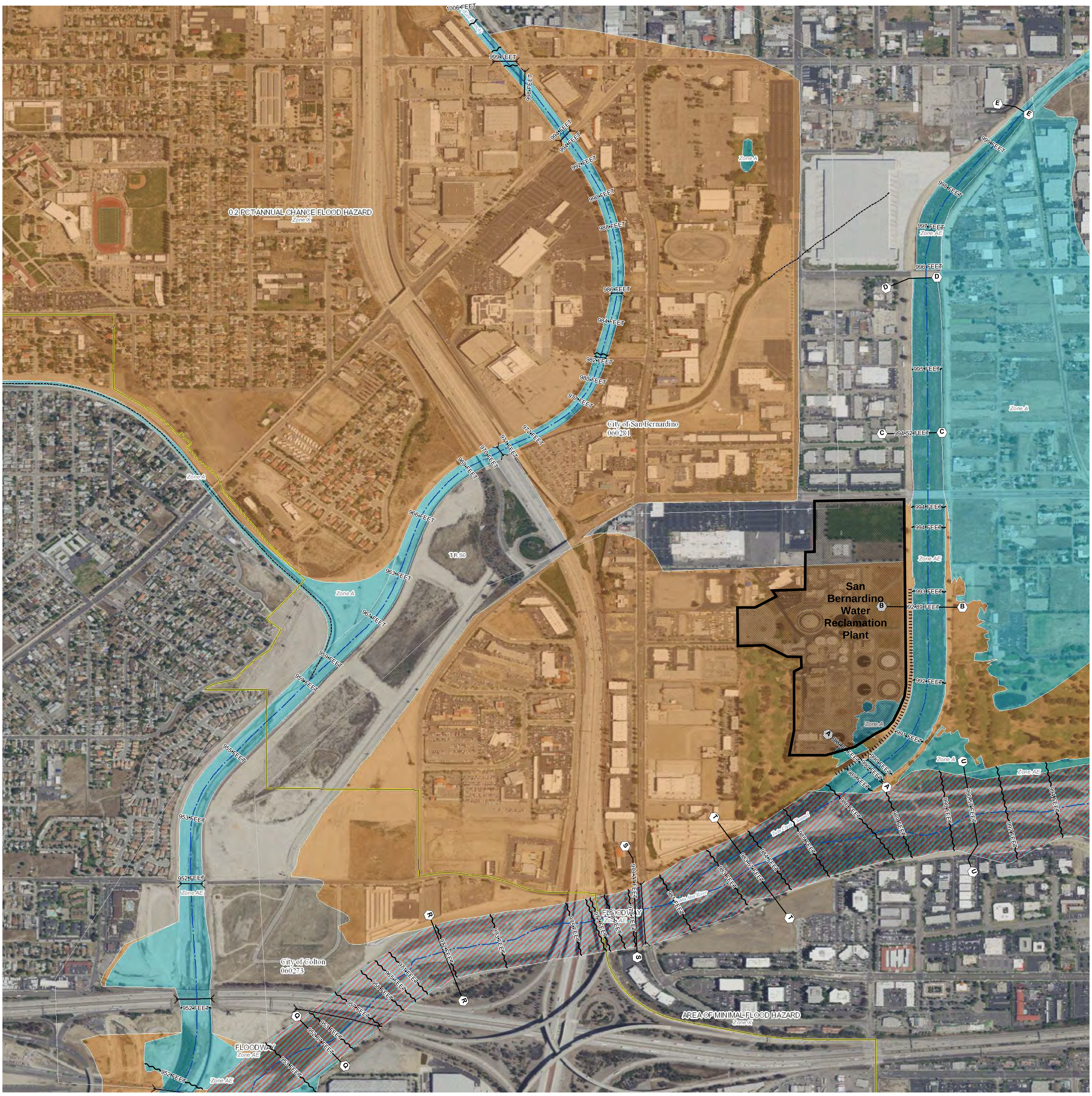
Plant Process Flow Diagram

City of San Bernardino Water Reclamation Plant

City of San Bernardino Municipal Water Department

Exhibit 3: FEMA Flood Insurance Rate Map, Panel 8683 of 9375

34°5'44.18"N
117°18'45.54"W



117°16'52.05"W
USGS The National Map: Orthoimagery. Data refreshed April, 2019.
34°3'38.36"N

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) *Zone A, V, A99* With BFE or Depth *Zone AE, AO, AH, VE, AR*
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
		Future Conditions 1% Annual Chance Flood Hazard *Zone X*
		Area with Reduced Flood Risk due to Levee See Notes. *Zone X*
		Area with Flood Risk due to Levee *Zone D*
OTHER AREAS	NO SCREEN	Area of Minimal Flood Hazard *Zone X*
		Effective LOMRs
		Area of Undetermined Flood Hazard *Zone D*
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES	B 20.2	Cross Sections with 1% Annual Chance
	17.5	Water Surface Elevation
	8	Coastal Transect
		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
	513	Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary

NOTES TO USERS

For information and questions about this Flood Insurance Rate Map (FIRM), available products associated with this FIRM, including historic versions, the current map date for each FIRM panel, how to order products, or the National Flood Insurance Program (NFIP) in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can beordered or obtained directly from the website.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study Report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Basemap information shown on this FIRM was provided in digital format by USDA, Farm Service Agency (FSA). This information was derived from NAIP, dated April 11, 2018.

This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **7/9/2019 7:54:47 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date.

SCALE

N

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: NAVD88
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map please see the Flood Insurance Study(FIS) Report for your community at https://msc.fema.gov

1 inch = 500 feet 1:6,000

0 250 500 1,000 1,500 2,000 Feet

0 50 100 200 300 400 Meters

FEMA
National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

SAN BERNARDINO COUNTY CALIFORNIA AND INCORPORATED AREAS

PANEL **8683** OF **9375**

Panel Contains:

COMMUNITY	NUMBER	PANEL
CITY OF SAN BERNARDINO CALIFORNIA	060281	8683
CITY OF COLTON CALIFORNIA	060273	8683

MAP NUMBER
06071C8683J
EFFECTIVE DATE
09/02/2016

APPENDIX A: TOTAL DISSOLVED SOLIDS AND TOTAL INORGANIC NITROGEN ASSESSMENT TECHNICAL MEMORANDUM

Hazen *Technical Memorandum*

San Bernardino Municipal Water Department WRP Facilities Assessment

Total Dissolved Solids and Total Inorganic Nitrogen Assessment Technical Memorandum
May 29, 2020

Hazen and Sawyer • 7700 Irvine Center Drive, Suite 200 • Irvine, CA 92618 • 949.557.8549

Table of Contents

List of Acronyms

Acronym	Description
CWF	Clean Water Factory
EVWD	East Valley Water District
GRRP	Groundwater replenishment reuse project
MGD	Million gallons per day
mg/L	Milligrams per liter
NPDES	National Pollutant Discharge Elimination System
RIX	Rapid Infiltration / Extraction Facility
SAR	Sodium adsorption ratio
SAWPA	Santa Ana Watershed Project Authority
SBMWD	San Bernardino Municipal Water Department
TDS	Total dissolved solids
TIN	Total inorganic nitrogen
TKN	Total Kjeldahl nitrogen
TM	Technical memorandum
TN	Total nitrogen
TU	Toxicity unit (equal to 1 divided by the no observable effect concentration)
WLAM	Wasteload Allocation Model
WRP	Water Reclamation Plant

1. Purpose of Technical Memorandum

An unintended consequence of water conservation is the more concentrated nature of wastewater, as exemplified by increasing concentrations of influent total dissolved solids (TDS) and total inorganic nitrogen (TIN) at water reclamation facilities. Wastewater quality is also impacted by source water selection, particularly as municipalities increasingly rely on alternative water supplies that may have high initial TDS and/or TIN concentrations or result in drinking water with high concentrations due to the need for chemical inputs during treatment. Elevated TDS and TIN concentrations in wastewater are important because they have the potential to impact wastewater treatment processes, infrastructure integrity, the use of recycled water, and the ability to practice environmental discharge. This technical memorandum (TM) evaluates current and potential future TDS and TIN concentrations at the San Bernardino Municipal Water Department (SBMWD) Water Reclamation Plant (WRP) and Rapid Infiltration / Extraction (RIX) Facility to support SBMWD's planning and response to changing wastewater quality.

The approach to this evaluation involved summarizing acceptable TDS and TIN ranges for the WRP and RIX facilities based on infrastructure and treatment process tolerances, permit requirements for discharge, and recycled water requirements. These acceptable TDS and TIN ranges were compared to current and projected TDS and TIN concentrations at the WRP and RIX facilities for the 2019 WRP Master Plan planning horizon (2020 to 2040). Projections considered many factors, including source water concentrations, customer water usage and activities, pretreatment, and treatment at the WRP. The analysis resulted in two primary variables for TDS and TIN increases: 1) source water quality, and 2) per capita water use rates. TDS and TIN projections may be used to inform monitoring activities at the WRP and RIX, as well as planning for potential capital and operational modifications that may be required as a response.

This TM is organized to first present an overview of TDS and TIN (Section 2), followed by an exploration of site-specific acceptable ranges for TDS and TIN considering discharge requirements, treatment processes at the WRP and RIX facilities, and recycled water use (Section 3). Section 4 includes a characterization of current TDS and TIN contributions from SBMWD source waters, drinking water treatment, customer use of drinking water, and wastewater treatment using historical and newly collected water quality data. The TDS and TIN characterization results are coupled with potential changes in source water selections and per capita water use rates to project TDS and TIN concentrations in future scenarios in Section 5. Finally, recommendations are provided in Section 6 considering projected TDS and TIN concentrations relative to site-specific acceptable ranges.

2. Introduction

SBMWD owns and operates a 33 million gallon per day (mgd) WRP. The WRP uses screening, primary clarification, aeration, secondary clarification and solids treatment processes to treat wastewater from the City of San Bernardino, City of Loma Linda, East Valley Water District, and some areas of unincorporated San Bernardino County (Figure 2-1). WRP effluent is typically directed to the RIX Facility for further treatment and discharge to Reach 4 of the Santa Ana River. WRP effluent is also permitted to be directly discharged to Reach 5 of the Santa Ana River at the confluence with East Twin

Creek when there is sufficient flow in the river to provide 20:1 dilution; however, SBMWD has not directly discharged from the WRP to the Santa Ana River since 2017 and intends to direct all effluent to the RIX Facility in the future.

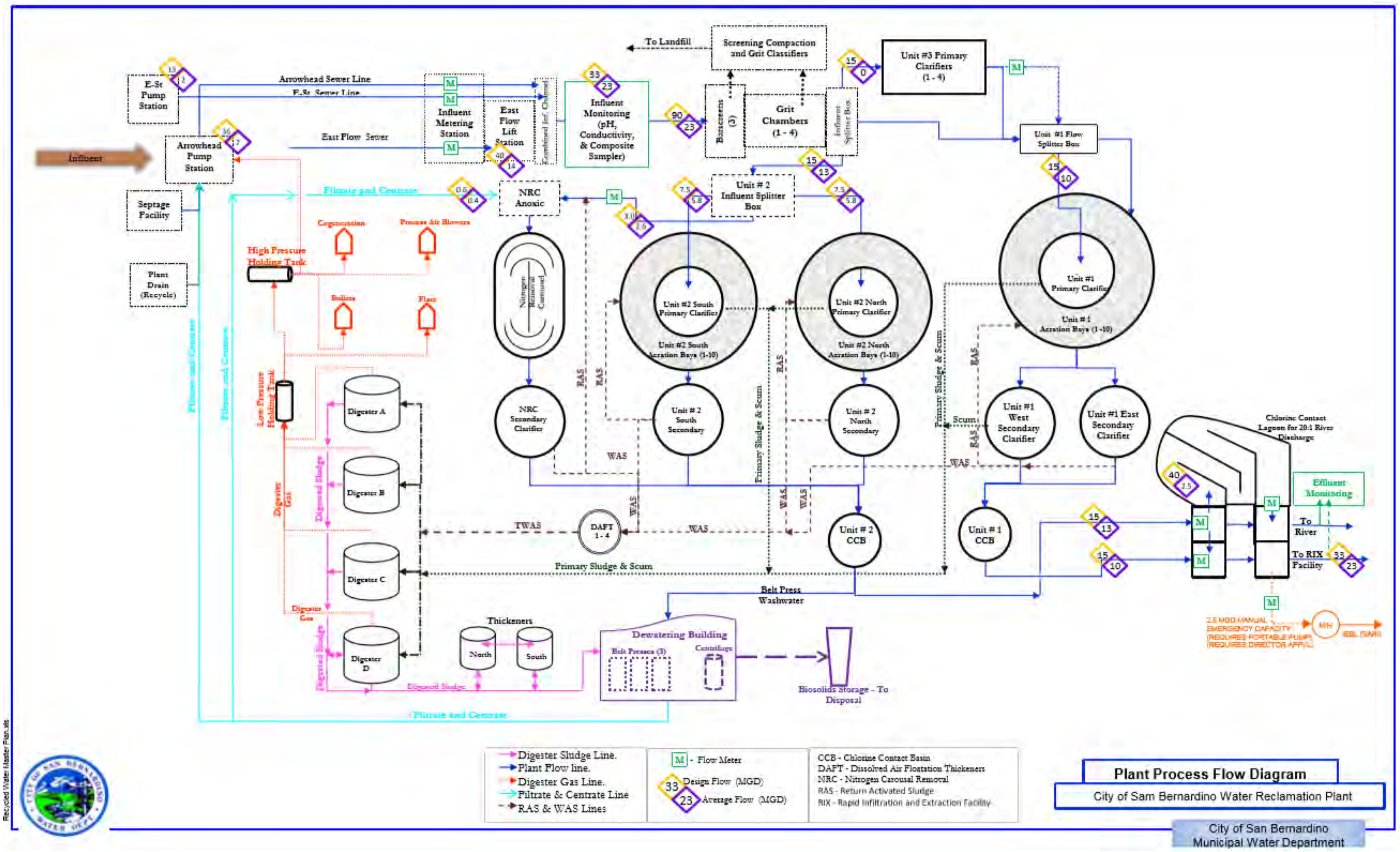


Figure 2-1: San Bernardino Municipal Water Department Water Reclamation Plant Process Flow Diagram

In recognition of the value of water, SBMWD supports a wide range of water conservation measures and programs that educate homeowners, business owners, students, and community members on a variety of ways to conserve water; however, these conservation measures do not affect the pollutant load to the WRP (e.g., pounds of a given constituent per day). When reduced per capita wastewater flows are coupled with maintained pollutant loads, the result is an increase in the concentration of influent wastewater (e.g., mg/L of a given constituent). Two important water quality parameters that may increase in response to widespread water conservation are the concentrations of TDS and TIN. TDS and TIN concentrations may also increase as a result of changes in source water quality because conventional drinking water treatment does not reduce TDS and/or TIN. TDS and/or TIN may be added to drinking water during treatment (e.g., coagulant addition, chloramine disinfection) and use by customers.

Influent TDS concentrations at the WRP are important because elevated TDS concentrations can impact in-plant performance, as well as the acceptability of effluent for various endpoints including Santa Ana River discharge. For example, TDS has the potential to impact corrosion in the collection and treatment systems, inhibit nitrification, negatively impact aeration efficiency, and negatively impact activated sludge settling and digested sludge dewatering. As discussed in Section 3.1, there is not currently a numerical limit for TDS in the WRP's discharge requirements (National Pollutant Discharge Elimination System (NPDES) permit No. CA0105392); however, TDS is of concern to the Regional Water Quality Control Board and Basin Plan Objectives for Reach 4 must be met. Accordingly, TDS is included as a RIX discharge requirement (NPDES permit No. CA800030). The RIX permit does have a provision that the TDS limit may be waived when the ratio of flows in Reach 4 of the Santa Ana River to discharge exceed a dilution factor of 20 to 1; however, this condition is rarely observed and the TDS limit is considered a constant requirement. Potential future recycled water users may also object to TDS concentrations above a given threshold depending on the specific reuse application.

Similarly, influent TIN concentrations are also important. Elevated TIN concentrations may exceed the nutrient removal capabilities of the existing treatment processes and compromise effluent quality. The WRP is not subject to a nitrogen-related discharge requirement for direct discharge to Reach 5 of the Santa Ana River; however, the RIX Facility is subject to TIN and ammonia discharge requirements. Similar to TDS, the RIX permit includes a provision for waiving the TIN and ammonia discharge limits when receiving water to discharge flow ratios exceed 20 to 1, but considering the rarity of this condition, the TIN and ammonia limits are considered constantly applicable. Furthermore, elevated TIN concentrations may impact the acceptability of effluent for potential future recycled water applications due to nutrient sensitivities.

Future regulations for TDS and TIN are being considered that could impact the RIX discharge to the Santa Ana River. In 1995, the Santa Ana Watershed Project Authority (SAWPA) formed a taskforce of approximately 20 water, wastewater, and groundwater agencies to evaluate the impact of TDS and TIN on water resources in the watershed. SAWPA's task force is using the Wasteload Allocation Model (WLAM) to simulate future groundwater quality to determine whether any changes are necessary in TDS and TIN regulation (Wildermuth Environmental, Inc., 2015). The WLAM is currently undergoing updates and preliminary WLAM results indicate the potential for degradation/exceedance of water quality objectives for TDS and TIN in the groundwater management zone where RIX is located. SAWPA's task force may recommend more stringent TDS and TIN limits for wastewater treatment facilities that discharge to the Santa Ana River and/or request the allocation of assimilative capacity in groundwater basins, as needed.

SBMWD embarked on this assessment to project influent wastewater TDS and TIN concentrations and loads over the 2019 WRP Master Plan planning horizon spanning the next 20 years. These projections are compared against site-specific acceptable ranges of TDS and TIN with respect to treatment and effluent management to inform the timing and type of required actions to manage TDS and TIN concentrations.

2.1 Definitions of Total Dissolved Solids and Total Inorganic Nitrogen

2.1.1 Total Dissolved Solids

TDS is a bulk water quality parameter that reflects the total concentration of organic and inorganic solids dissolved in water passing through a 2 micron (μm) filter. TDS is the summation of positively and negatively charged ions in water. In municipal water and wastewater, the primary components of TDS are bicarbonate, calcium, chloride, magnesium, potassium, sodium, and sulfate.

In wastewater, sources of TDS include source water and drinking water treatment-related contributions, domestic inputs, and industrial and commercial discharges. The drinking water contribution to TDS will vary, as raw water TDS levels are dependent on the geographical area, source water type, season, and treatment requirements. Domestic contributions to TDS include urine, feces, cleaning products, and other inputs. Some industrial discharges, such as those coming from industrial cooling operations, may have exceptionally high levels of TDS due to evaporative losses and/or chemical additions throughout operations.

Conventional wastewater treatment plants are not designed to remove TDS, thus meaning that influent TDS concentrations are generally approximately equal to effluent TDS concentrations. Effluent TDS can be higher at some water reclamation facilities if significant chemical inputs are needed for solids and phosphorus management and/or disinfection. A substantial reduction in constituents that contribute to TDS generally requires membrane filtration (nanofiltration, reverse osmosis) or softening. The SBMWD WRP and RIX facilities do not currently have treatment processes that aim to remove TDS; however, a portion of influent TDS may be removed via sorption and/or biological consumption of alkalinity. Certain components of TDS will also increase throughout treatment due to chemical additions (e.g., ferric chloride).

2.1.2 Total Inorganic Nitrogen

TIN is a bulk water quality parameter that represents the total concentration of nitrogen in the nitrate, nitrite, and/or ammonia form in a wastewater sample. The difference between total nitrogen (TN) and TIN is the organic nitrogen fraction (e.g., urea, amino acids). TIN tends to be the dominant contributor to

TN in influent wastewater because the majority of nitrogen in wastewater is attributed to urine, in which nitrogen is originally present in the form urea (organic nitrogen), but quickly transformed to ammonia (inorganic nitrogen). TIN in wastewater may also originate from source water and drinking water treatment-related inputs (e.g., chloramines), domestic inputs, and industrial/commercial inputs.

If nitrogen removal is required, conventional wastewater treatment processes are designed for the conversion of TIN to nitrogen gas via nitrification and denitrification processes. In the two-step nitrification process, nitrogen in the ammonia form is generally converted to nitrate in a highly aerobic environment. First, ammonia oxidizing autotrophic bacteria convert ammonia to nitrite, then nitrite oxidizing bacteria convert nitrite to nitrate. Nitrate is subsequently reduced to nitrogen gas via denitrification under anoxic conditions, which results in the liberation of nitrogen into the atmosphere. If TIN concentrations in influent wastewater increase, the conversion rates of biological treatment may be taxed, thus challenging compliance with nitrogen-related effluent limits. The SBMWD WRP has nitrification and denitrification facilities to remove TIN.

3. Site-Specific Acceptable Ranges for Total Dissolved Solids and Total Inorganic Nitrogen

A discussion of TDS- and TIN-related guidelines for WRP treatment and effluent endpoints is provided in Sections 3.1 through 3.4. These acceptable TDS and TIN ranges were determined using existing permits, historical performance data, literature review, and experiences at other water reclamation facilities. Section 3.5 provides a summary of acceptable TDS and TIN ranges through the WRP and RIX Facility, with discussion provided as to how effluent limits may be coupled with treatment information to determine acceptable influent concentrations.

3.1 Surface Water Discharge

The WRP and RIX Facility are permitted to discharge treated effluent to Reach 5 and Reach 4, respectively, of the Santa Ana River if various water quality limits are achieved. Table 3-1 provides a summary of the TDS and TIN related surface water discharge limits included in the existing WRP and RIX Facility NPDES permits. In addition to permit requirements, SBMWD must also take into considering any downstream water quality requirements that may limit their ability to discharge, such as the Prado Basin TDS limit of 700 mg/L for grab samples taken annually in August. Permit requirements and discharge limits related to downstream water quality objectives may be achieved by one of two ways:

1) Influent load management: Targeted effluent quality may be achieved by managing the quality of influent wastewater, e.g., via industrial pretreatment, the extent of which is dependent on the characteristics of dischargers.

2) Treatment: Targeted effluent quality may be achieved by treatment at the WRP and/or RIX if influent wastewater quality is within the capabilities and tolerances of treatment processes.

Table 3-1: Summary of TDS- and TIN-Related Surface Water Discharge Limits at the WRP and RIX Facility

Parameter	Dilution Factor [1]	WRP Discharge Limit	RIX Facility Discharge Limit
TDS, mg/L	Less than 20:1	Discharge prohibited	550 (12-month flow-weighted running average)
	20:1 or greater	No limit	No limit
TIN, mg/L	Less than 20:1	Discharge prohibited	10 (12-month flow-weighted running average)
	20:1 or greater	No limit	No limit
Ammonia, mg/L as N	Less than 20:1	Discharge prohibited	4.5 (monthly average)
	20:1 or greater	No limit	No limit
Toxicity	Less than 20:1	Discharge prohibited	Accelerated chronic toxicity monitoring required if the result of any single chronic toxicity test of the effluent exceeds 1.0 chronic toxicity unit (TUc) [3]
	20:1 or greater	Accelerated acute toxicity monitoring required if < 70% survival for any one bioassay, or < 90% median survival for any three consecutive bioassays [2]	No limit

[1] Ratio of receiving water flow to wastewater flow
[2] Acute toxicity monitoring required at least twice during the five year permit term; no numeric limitation for toxicity, but SBMWD must conduct accelerated toxicity monitoring when the result of any acute toxicity test does not meet the specified survival limits; elevated TDS and ammonia may impart toxicity to effluent, the extent of which may be determined via whole effluent toxicity testing
[3] Chronic toxicity monitoring required; there is no numeric limitation for toxicity at this time, but that may change if the Whole Effluent Toxicity Plan is adopted and included in the renewed RIX permit; SBMWD must conduct accelerated toxicity monitoring when the result of any chronic toxicity test exceeds 1.0 TUc; elevated TDS and ammonia may impart toxicity to effluent, the extent of which may be determined via whole effluent toxicity testing

3.2 Water Reclamation Plant Treatment

Elevated TDS and TIN concentrations may interfere with the effectiveness, efficiency, and/or structural integrity of treatment processes at the WRP. Potential TDS-related challenges include structural and corrosion concerns, reduced aeration efficiency and/or maintenance requirements, nitrification inhibition, and settling/dewatering issues. The challenge with elevated TIN is that influent concentrations and/or loads may surpass the biological treatment capacity of the WRP, thus negatively impacting effluent quality.

Table 3-2 provides a summary of acceptable TDS and TIN ranges for treatment processes at the WRP. The TDS-related thresholds were determined using literature review and experience at other wastewater treatment facilities. Acceptable TIN ranges pertain to secondary treatment and chlorination because elevated concentrations and/or loads may exceed biological treatment capacity and/or increase chlorine demand beyond equipment capabilities. It should be noted, however, that the chlorine contact basins and lagoon are not currently in operation. Disinfection through chlorination is only required if secondary effluent is discharged to the Santa Ana River, as permitted when the ratio of receiving water to discharge exceeds 20 to 1 dilution, which is not how the WRP operations. WRP effluent currently passes through the chlorine contact basin to the RIX facility. Site-specific TIN ranges can be determined for the WRP using process modeling, which was not included in this evaluation. The TIN removal capacity is important because it is one of the WRP treatment objectives, whereas the TDS removal capacity does not need to be quantified because it is not a WRP treatment objective and negligible TDS removal is assumed.

Table 3-2: Summary of Acceptable TDS and TIN Concentrations for Treatment Processes at the WRP

Treatment Category	Treatment Process	Acceptable TDS Range	Acceptable TIN Range
Overall	Structural integrity / corrosion	Sulfate (SO_4^{2-}) < 150 mg/L [1]	No limit
Primary treatment	Clarification	Low monovalent to divalent cation equivalent ratio; approximate target of < 2:1 [2]	No limit
Secondary treatment	Aeration	Site-specific; elevated TDS may increase diffuser fouling and/or hinder oxygen transfer efficiency [3]	Unknown; acceptable range depends on treatment capacity [5]
	Nitrification	TDS < 2,000 mg/L [4]	
	Clarification	Monovalent to divalent cation equivalent ratio < 2:1 [2]	
	Chlorination	No limit	Unknown; acceptable range depends on the WRP's ability to convert ammonia if chlorination is practiced in the future [6]
Biosolids	Thickening and dewatering	Monovalent to divalent cation equivalent ratio < 2:1 [2]	No limit
	Anaerobic digestion	Unknown	No limit

[1] American Concrete Institute guideline for negligible corrosion

[2] Monovalent to divalent cation ratios > 2:1 on an equivalent basis may negatively impact settling and dewatering, but the acceptable maximum value is site-specific (Higgins and Novak, 1997; *The Effect of Cations on the settling and Dewatering of Activated Sludges: Laboratory Results*)

[3] Aeration is generally less sensitive to elevated TDS than nitrification; however, increasing TDS concentrations may impede the process due to adverse impacts to diffusers via precipitation or to the oxygen transfer efficiency by reducing the beta factor (ratio of oxygen saturation in the wastewater relative to water with no TDS); membrane diffusers are less susceptible to TDS-related fouling than ceramic diffusers; nitrification performance, diffuser pressure/air flow, and off gas should be monitored to determine if aeration efficacy is impacted over time

[4] Nitrification tends to be the most sensitive biological wastewater treatment process to TDS

[5] The acceptable TIN range for secondary treatment is dependent on the site-specific treatment capacity and the associated ability to meet discharge limits for TIN and ammonia; the treatment capacity may be determined via process modeling; historical treatment performance data at the WRP shows that 20 to 30 mg/L of TIN is removed during secondary treatment under current conditions (influent TN ~32 mg/L) and that the majority of effluent TIN is in the form of nitrate

[6] Chlorination is not currently practiced at the WRP because effluent goes to the RIX facility instead of being discharged to the Santa Ana River; if disinfection with a free chlorine residual in the presence of ammonia is

Treatment Category	Treatment Process	Acceptable TDS Range	Acceptable TIN Range
practiced in the future, breakpoint chlorination must be practiced; if influent TIN concentrations hinder the WRP's ability to convert ammonia to other forms of nitrogen, chlorine inputs will have to be increased during disinfection to overcome the ammonia			

3.3 Rapid Infiltration / Extraction Facility Treatment

WRP effluent is primarily discharged to the RIX Facility. The RIX Facility receives and infiltrates secondary treated wastewater from the WRP and the City of Colton's wastewater treatment plant into percolation ponds and underlying soil. The secondary effluent is mixed with a small volume of native groundwater, extracted, and then subject to UV disinfection prior to discharge to Reach 4 of the Santa Ana River. Treatment processes at the RIX Facility may also be impacted by elevated TDS and TIN, as summarized in Table 3-3; however, treatment objectives at the RIX Facility are limited to filtration and disinfection, thus negating the need to quantify a TDS and/or TIN removal capacity. It should be noted that native groundwater with which secondary effluent is mixed and extracted may also serve as a source of TDS and TIN, thus impacting the final discharge water quality from the RIX Facility.

Table 3-3: Summary of Acceptable TDS and TIN Ranges at the RIX Facility

Treatment Category	Treatment Process	Acceptable TDS Range	Acceptable TIN Range
Overall	Structural integrity / corrosion	Sulfate (SO_4^{2-}) < 150 mg/L [1]	No limit
Tertiary treatment	Percolation basins	No limit	No limit
	Tertiary filtration	No limit	No limit
	UV disinfection	Elevated TDS may cause scaling in UV reactors; monitoring of cleaning frequency relative to influent TDS is recommended	No limit

[1] American Concrete Institute guideline for negligible corrosion

3.4 Potential Future Recycled Water Users

The WRP and RIX do not currently serve any recycled water customers. However, SBMWD is planning a recycled water project called the Clean Water Factory (CWF) which will be a Title 22-compliant tertiary treatment facility that will supply recycled water for the following recycled water applications:

- Operational needs within the plant, eliminating in-plant use of groundwater and onsite groundwater storage,
- Landscape irrigation,

- Groundwater recharge of the Bunker Hill Groundwater Basin, which is SBMWD's sole source of water supply, and
- Supplying potential future recycled water customers.

California's Title 22 regulations for recycled water do not designate any specific TDS limits, but water quality objectives in the Santa Ana River Basin Plan limit both TDS and TIN for groundwater replenishment reuse projects (GRRPs), and Recycled Water Policy restrictions also apply. A GRRP is a project involving the planned use of recycled municipal wastewater that is operated for the purpose of replenishing a groundwater basin designated for use as a source of municipal and domestic water supply.

In addition to Title 22 regulations and Basin Plan water quality objectives for GRRPs, recycled water users may have specific TDS- and TIN-related water quality requirements for their intended reuse applications. Potential water quality requirements for irrigation, industrial cooling, groundwater replenishment, and potable reuse are noted in Table 3-4.

Table 3-4: Summary of TDS- and TIN-Related Recycled Water Limits

Recycled Water Application	Acceptable TDS Range	Acceptable TIN Range
Irrigation	Crop dependent; generally TDS < 800 mg/L; sodium adsorption ratio (SAR) < 3 [1]	Dependent on nutrient uptake capacity of irrigated vegetation, particularly if close to nutrient-sensitive surface water bodies [4]
Industrial cooling	Dependent on equipment tolerances and user preferences; TDS comparable to potable water is typically preferred in order to achieve similar cycles of concentration [2]	Ammonia < 2 mg/L [5]
Groundwater replenishment	Bunker Hill B Subbasin < 330 mg/L [6]	Bunker Hill B Subbasin < 7.3 mg/L Total nitrogen < 10 mg/L [6]
Potable reuse	TDS < 500 mg/L [3]	Nitrate < 10 mg/L; nitrite < 1 mg/L [7]

[1] SAR is the ratio of the sodium concentration to the square root of one half of the combined calcium and magnesium concentration, with all concentrations in units of equivalents; SAR = [Na] / (0.5 x [Ca + Mg])$^{0.5}$
[2] The cycle of concentration is determined by calculating the ratio of TDS in blowdown water compared to the make-up water; the higher the cycles of concentration, the more efficient the water use
[3] USEPA secondary maximum contaminant level
[4] Nutrient concentrations in recycled water may be limited based on the assimilative capacity of the irrigated vegetation if the irrigated vegetation is in close proximity to nutrient-sensitive surface water bodies; the concern is that excess nutrient loading will be conveyed to the surrounding environment
[5] Ammonia can encourage biological growth and is also a corrosion agent with copper bearing alloys; the guideline of 2 mg/L only applies if any of the metallurgy of the cooling water system contains certain copper-bearing alloys; PEIR Final Project Report – Cooling Tower Water Quality Parameters for Degraded Water, April 2006. Available: https://ww2.energy.ca.gov/2005publications/CEC-500-2005-170/CEC-500-2005-170.PDF
[6] California Title 22 regulations for groundwater replenishment reuse projects; Santa Ana Region Basin Plan, Updated July 2014. Available: http://www.swrcb.ca.gov/santaana/water_issues/programs/basin_plan/index.shtml
[7] USEPA primary maximum contaminant levels; recycled water concentrations may be higher if downstream removal barriers are in place

3.5 Summary of Acceptable Total Dissolved Solids and Total Inorganic Nitrogen Ranges

Table 3-5 provides a summary of the acceptable TDS and TIN ranges for the WRP and RIX Facility, spanning surface water discharge limits, treatment tolerances, and recycle water usage. The acceptable ranges in the "treatment" category can be interpreted as acceptable ranges for influent wastewater to the WRP. The acceptable ranges in the "surface water discharge" and "recycled water usage" categories, however, must be coupled with TDS and TIN changes at the WRP and RIX Facility (i.e., TDS additions from chemical inputs, TIN removal by biological treatment, contributions from native groundwater at the RIX Facility) in order to make these limits applicable to influent wastewater.

Table 3-5: Summary of Acceptable TDS and TIN Ranges for the WRP and RIX Facility

Impact Category	Impact Area	Acceptable TDS Range	Acceptable TIN Range
Surface Water Discharge	WRP Discharge	Elevated TDS may impact acute toxicity results and RIX effluent water quality	Elevated TIN may impact RIX effluent water quality
	RIX Discharge	TDS < 550 mg/L if dilution factor is less than 20:1 Elevated TDS may impact chronic toxicity results	TIN < 10 mg/L if dilution factor is less than 20:1. Accounting for the 25% nitrogen-loss coefficient applied due to nitrate loss in percolation and streambed movement, the acceptable TIN is less than 13.3 mg/L. Ammonia < 4.5 mg/L if dilution factor is less than 20:1
Treatment	Structural Integrity / Corrosion at WRP and RIX	Sulfate (SO_4^{2-}) < 150 mg/L	No limit
	Clarification, Thickening, and Dewatering at WRP	Low monovalent to divalent cation equivalent ratio; approximate target of < 2:1	No limit
	Aeration at WRP	Site-specific; elevated TDS may increase diffuser fouling and/or hinder oxygen transfer efficiency	Unknown; acceptable range depends on treatment capacity as determined via process modeling and/or stress testing
	Nitrification at WRP	TDS < 2,000 mg/L	
	Chlorination at WRP	No limit	Unknown; acceptable range depends on the WRP's ability to convert ammonia because ammonia contributes to chlorine demand
	UV Disinfection at RIX	Elevated TDS may cause scaling in UV reactors Monitoring of cleaning frequency relative to influent TDS is recommended	No limit

Impact Category	Impact Area	Acceptable TDS Range	Acceptable TIN Range
Recycled Water Usage	Irrigation	Crop dependent Generally TDS < 800 mg/L and SAR < 3	Dependent on nutrient uptake capacity of irrigated vegetation, particularly if close to nutrient-sensitive surface water bodies [4]
	Industrial cooling	Dependent on equipment tolerances and user preferences TDS comparable to potable water is typically preferred in order to achieve similar cycles of concentration	Ammonia < 2 mg/L
	Groundwater replenishment	TDS < 330 mg/L	TIN < 7.3 mg/L Total nitrogen < 10 mg/L
	Potable reuse	TDS < 500 mg/L	Nitrate < 10 mg/L Nitrite < 1 mg/L

4. Total Dissolved Solids and Total Inorganic Nitrogen Characterization

Historical and newly collected water quality data were evaluated to quantify contributions of TDS and TIN to influent wastewater at the WRP. The following sections begin by characterizing the various source waters that ultimately contribute to wastewater, followed by contributions associated with drinking water treatment, customer use of the water prior to its discharge to the collection system, and wastewater treatment.

4.1 Source Water Quality

4.1.1 Historical Data

To better understand how various blends of source waters (i.e., drinking water supplies) may impact influent TDS and TIN at the WRP, historical source water grab sample data for SBMWD, Loma Linda, and East Valley Water District (EVWD) were provided by SBMWD. These historical source water quality data are provided in Appendix A. Taken together, the source waters in SBMWD, Loma Linda, and EVWD have average TDS concentrations that range from 160 to 570 mg/L, and average nitrate concentrations that range from less than 1 to 13 mg/L. The nitrate concentrations can be equated with TIN concentrations because TIN tends to exist as nitrate in native groundwater supplies, as confirmed by newly collected source water quality data. These historical source water TDS and TIN data demonstrate that the increased use of certain source waters relative to others has the potential to substantially influence TDS and TIN concentrations at the WRP, particularly with respect to TDS.

4.1.2 2019 Special Sampling Data

Additional source water grab samples were collected in October and November of 2019 as part of this assessment to more specifically quantify the speciation of TDS and TIN in drinking water supplies. The newly collected TDS data for various source waters are provided in Appendix A. Specific source waters in each service area were selected because they were representative of typically used source waters (i.e., used regularly, large withdrawals). The special sampling data shows that TDS concentrations in the selected source waters ranged from 300 to 485 mg/L, which is consistent with historical source water TDS data. The dominant contributor to TDS in all source waters is bicarbonate, followed by calcium, sulfate, chloride, and sodium.

The newly collected source water TIN data is also provided in Appendix A. Special sampling data confirm that nitrate is the dominant TIN species, as contributions from nitrite and ammonia were non-detect. TIN concentration ranges shown in Figures A-7 and A-8 show the newly collected TIN data, in which it was confirmed that nitrate is the dominant species with non-detected contributions from nitrite and ammonia. TIN concentrations range from less than 1 to almost 5 mg/L, which is consistent with the majority of the historical source water TIN data.

4.2 Distributed Drinking Water Quality

4.2.1 Historical Data

Historical water quality data for treated/distributed drinking water supplies were not able to be provided for TDS and TIN; however, treated/distributed drinking water is expected to have similar TDS and TIN compositions as source waters due to the fact that treatment throughout SBMWD, Loma Linda, and EVWD contributes minimally to TDS and TIN concentrations. Treated / distributed drinking water samples were newly collected to confirm this hypothesis.

4.2.2 2019 Special Sampling Data

To confirm the comparability of source water TDS and TIN with treated drinking water TDS and TIN, distributed drinking water grab samples were collected and analyzed in October and November of 2019. Locations in the SBMWD, Loma Linda, and EVWD distribution systems were selected to have known contributions from the previously selected source water sampling locations and to be representative of distributed drinking water throughout the system. The TDS results for distributed drinking water in the SBMWD service area are provided in Appendix B. Relative to the SBMWD source water TDS data, the changes in TDS that result from treatment are relatively minor. At most, the SBMWD distributed water TDS was 38 mg/L higher than raw source water supplies. Similarly, Loma Linda distributed water TDS was a maximum of 57 mg/L higher than raw source waters. EVWD distributed water TDS was actually less than individual sampled source waters. The reduced TDS of EVWD distributed drinking water can be attributed to the fact that, although chemical inputs during drinking water treatment increase TDS, various source waters are also being blended together in the distribution system, which may result in reduced TDS relative to a given source water.

A comparison of TIN concentrations in distributed SBMWD, Loma Linda, and EVWD drinking water relative to raw source waters shows that drinking water treatment does not have a significant contribution to TIN (Appendix B). The maximum increase in distributed drinking water TIN relative to raw source waters was 5 mg/L.

4.3 Influent Wastewater Quality

4.3.1 Historical Data

SBMWD provided historical influent wastewater quality data, which is presented in Appendix C. Influent TDS concentrations have ranged from 450 to 660 mg/L with an average of 570 mg/L. Influent TIN concentrations, which were calculated as total nitrogen (TN) minus total Kjeldahl nitrogen (TKN) plus ammonia, have ranged from 29 to 40 mg/L with an average of 33 mg/L.

4.3.2 2019 Special Sampling Data

Additional composite samples of WRP influent wastewater were collected in October and November of 2019 to directly compare influent wastewater quality to distributed drinking water quality, thus enabling the quantification of domestic inputs to TDS and TIN. The first graph in Figure 4-1 shows influent wastewater TDS concentrations, as determined by direct measurement (i.e., sample drying and weighing). TDS concentrations range from 520 to 610 mg/L, which is consistent with historical influent wastewater TDS concentrations. The second graph in Figure 4-1 shows influent wastewater TDS concentrations, as determined by the measurement and summation of individual anions and cations. The summed TDS concentrations of influent wastewater range from 738 to 769 mg/L, which is notably higher than the directly measured TDS concentrations. The summed TDS concentrations are expected to be higher than reality due to an artificially high measurement of an anion or cation as a result of raw wastewater analytical interferences. Bicarbonate was the major contributor to influent wastewater TDS, followed by chloride, calcium, sulfate, and sodium, as would be expected in municipal wastewater.

The newly collected TIN data for influent wastewater to the WRP are presented in Figure 4-2. TIN concentrations ranged from 39 to 44 mg/L, comprised entirely of ammonia. These TIN concentrations are consistent with historical influent wastewater quality data.

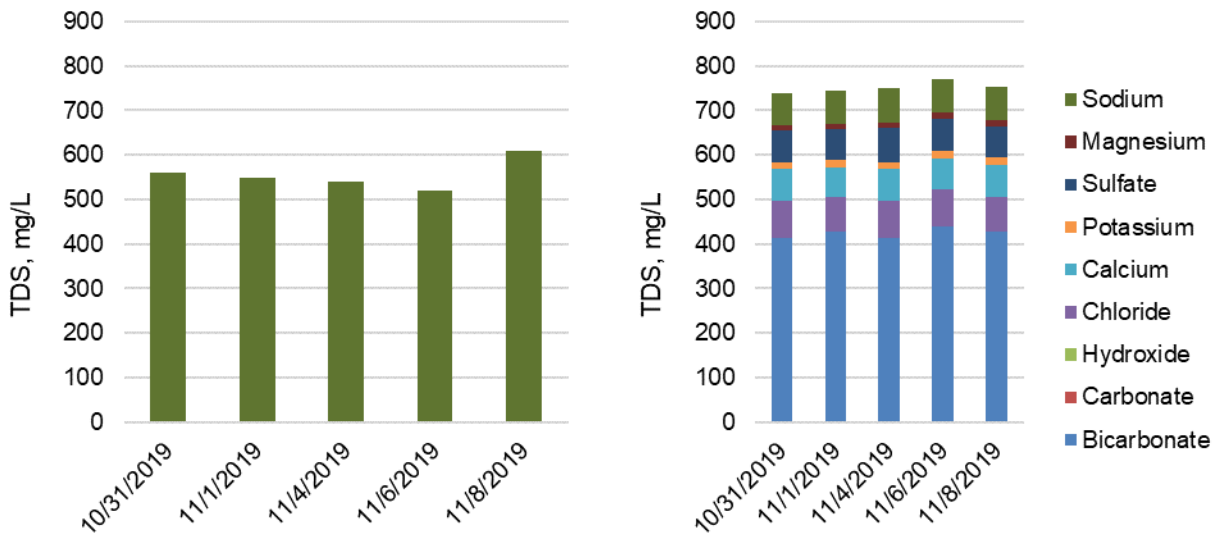


Figure 4-1: 2019 Special Sampling TDS Data for WRP Influent Wastewater [1]

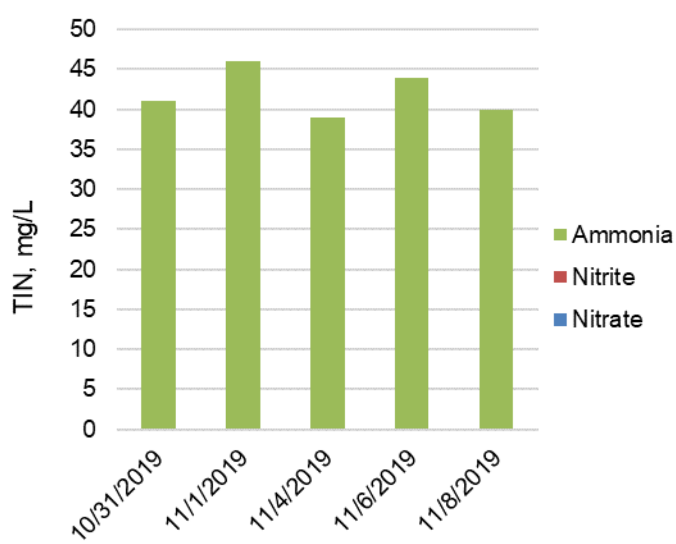


Figure 4-2: 2019 Special Sampling TIN Data for WRP Influent Wastewater

In order to differentiate the influent wastewater TDS and TIN content into drinking water-related and domestic use-related contributions, one must consider the flows from SBMWD, Loma Linda, and EVWD. The SBMWD *Water Reclamation Plant Facilities Assessment and Master Plan* states that 62%, 10%, and 28% of the influent WRP flow can be attributed to SBWMD, Loma Linda, and EVWD, respectively. One can determine the TDS and TIN contributions to influent wastewater that stem from

[1] TDS data on the left were determined via direct measurement; TDS data on the right were determined by summing the contributions from individual anions and cations

customer activities by coupling these percent flow contributions to WRP with distributed drinking water and influent wastewater quality data. The distributed drinking water data in Table 4-1 show that influent TDS and TIN concentrations at the WRP would be expected to be 361 mg/L and 3.1 mg/L, respectively, if contributions were from drinking water alone. Thus, assuming an average influent wastewater TDS concentration of 556 mg/L and TIN concentration of 42 mg/L, approximately 195 mg/L (35% of influent TDS) of TDS and 39 mg/L (93% of influent TIN) of TIN are expected to stem from domestic contributions. Furthermore, the majority of the added TDS from domestic activities is bicarbonate, chloride, and sodium.

Table 4-1

Agency	Volumetric Contribution to Influent WRP Flow	Average Distributed Drinking Water Concentration, mg/L [1]	
		TDS	TIN
SBMWD	62%	370	3.6
Loma Linda	10%	280	3.8
EVWD	28%	370 [2]	1.7 [2]
Combined Influent Source Water at the WRP	100%	361	3.1

[1] Average distributed drinking water concentrations are based on the five days of 2019 special sampling conducted as part of this evaluation

[2] EVWD average distributed drinking water concentrations assume a 90% contribution from treated groundwater and 10% contribution from treated surface water

4.4 Effluent Wastewater Quality

4.4.1 Historical Data

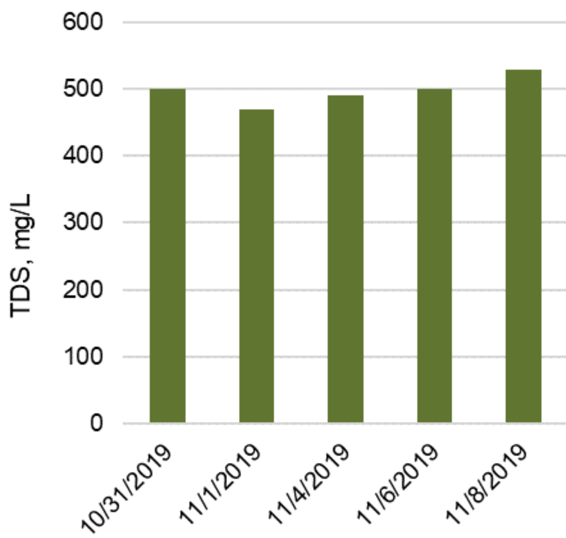
SBMWD provided historical effluent wastewater quality data, which are summarized in Appendix D. Effluent TDS concentrations have ranged from 210 to 640 mg/L, with an average of 506 mg/L. Effluent TIN concentrations, which were calculated as TN minus TKN plus ammonia, have ranged from 3 to 25 mg/L with an average of 9 mg/L. Relative to the historical influent wastewater quality data, wastewater treatment at the WRP appears to reduce TDS by approximately 70 mg/L (10 to 15% of influent TDS) and TIN by 24 mg/L (73% of influent TIN). The specific TDS and TIN fractions that are being removed via wastewater treatment can be further explored by comparing the speciation of effluent and influent TDS and TIN using the special sampling data in Section 4.4.2.

4.4.2 2019 Special Sampling Data

Additional effluent wastewater composite samples were collected to directly compare effluent and influent wastewater quality. The first graph in Figure 4-3 shows influent wastewater TDS concentrations, as determined by direct measurement (i.e., sample drying and weighing). TDS concentrations range from

470 to 530 mg/L, which is consistent with historical effluent wastewater TDS concentrations. The second graph in Figure 4-3 shows effluent wastewater TDS concentrations, as determined by the measurement and summation of individual anions and cations. The summed TDS concentrations of effluent wastewater range from 541 to 556 mg/L. Contrary to special sampling results for influent wastewater, the summed TDS concentrations are consistent with the directly measured TDS concentrations, likely due to reduced analytical interferences in effluent wastewater relative to influent wastewater. Bicarbonate was the major contributor to overall TDS, although to a lesser extent than in influent wastewater.

The newly collected TIN data for effluent wastewater from the WRP are presented in Figure 4-4. TIN concentrations in effluent wastewater ranged from 6 to 10 mg/L, largely comprised of nitrate (Figure 4-4). These TIN concentrations are consistent with historical effluent wastewater quality data.



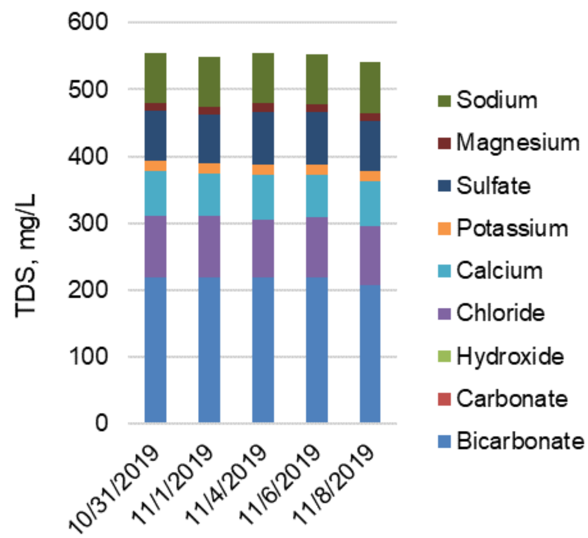


Figure 4-3: 2019 Special Sampling TDS Data for WRP Effluent Wastewater [2]

[2] TDS data on the left were determined via direct measurement; TDS data on the right were determined by summing the contributions from individual anions and cations

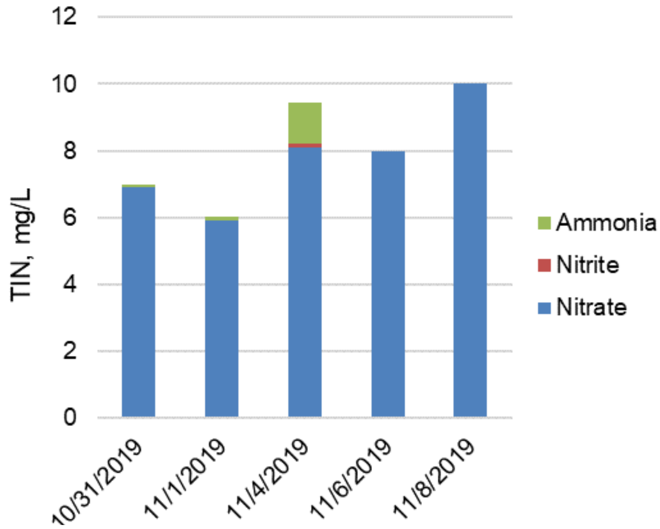


Figure 4-4: 2019 Special Sampling TIN Data for WRP Effluent Wastewater

When comparing influent and effluent wastewater quality data, wastewater treatment appears to reduce TDS by approximately 50 mg/L (10% of influent TDS). The entirety of this wastewater treatment-induced TDS removal is due to a reduction in bicarbonate; the other TDS components (e.g., calcium, chloride, sulfate, sodium, etc.) are conserved through treatment. The loss of bicarbonate throughout the WRP can be attributed to the consumption of alkalinity, of which bicarbonate is a component, during the nitrification process. TIN is largely converted from ammonia to nitrate as a result of wastewater treatment, and TIN is reduced by approximately 30 mg/L (approximately 70% of influent TIN).

5. Total Dissolved Solids and Total Inorganic Nitrogen Projections

Figure 5-1 and Figure 5-2 summarize the evolution of TDS and TIN concentrations from source water to WRP effluent under current conditions (e.g., current drinking water treatment strategy, customer per capita use rates, and wastewater treatment strategy). For TDS, the starting point is the TDS concentration of the source water(s) in use; from there, up to approximately 50 mg/L is added due to drinking water treatment, approximately 200 mg/L is added due to customer inputs, and approximately 50 mg/L is removed due to wastewater treatment. Similarly for TIN, the starting point is the TIN concentration of the source water(s) in use and then up to 5 mg/L is added due to drinking water treatment, 30 to 40 mg/L is added due to customer inputs, and 20 to 30 mg/L is removed due to wastewater treatment. It is important to recall that this assumed TIN removal due to wastewater treatment is based on historical performance operations, as opposed to a capacity determination for the WRP. The maximum TIN removal capacity of the WRP may be greater than what has historically been observed; similarly, the extent to which WRP treatment can reduce TIN concentrations may be adversely impacted by influent TIN concentrations and/or loads beyond a given threshold.

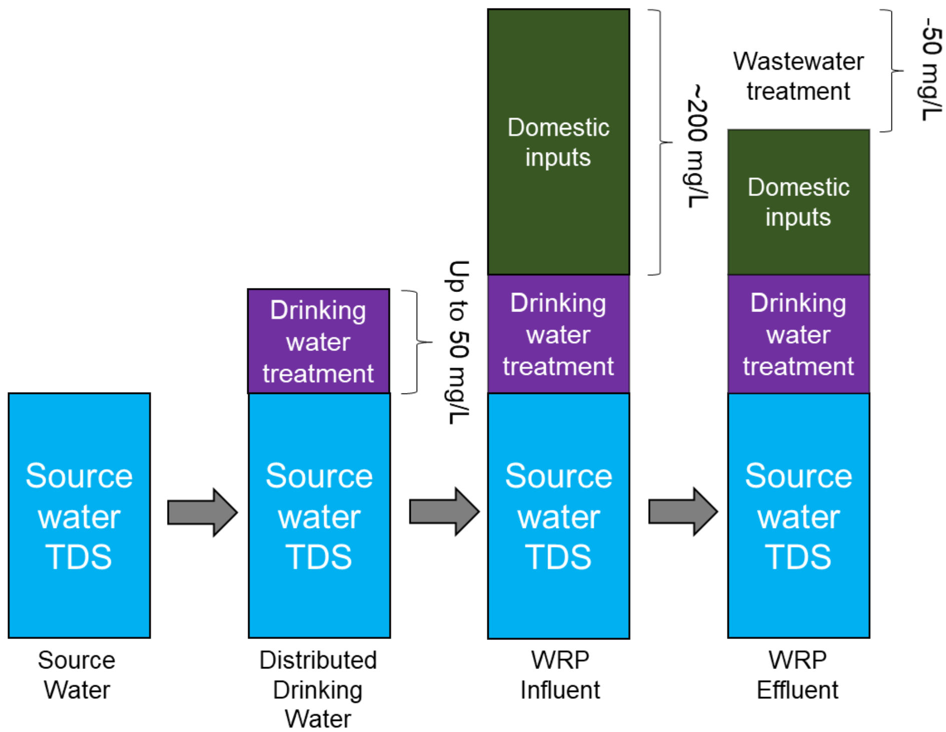


Figure 5-1: Evolution of TDS Concentrations from Source Water to WRP Effluent under Current Conditions [3]

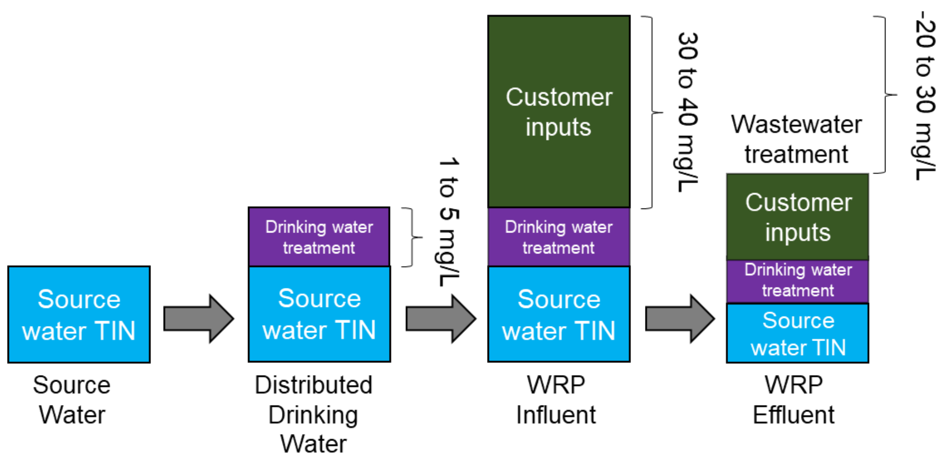


Figure 5-2: Evolution of TIN Concentrations from Source Water to WRP Effluent under Current Conditions

The two main conditions that may change TDS and TIN at the WRP in the future are the selected source water blends and per capita water use rates. The cessation of flow from EVWD may also impact influent

[3] Boxes are not drawn to scale

conditions at the WRP; however, the TDS and TIN-related changes are expected to be minimal due to comparable service area characteristics across the different agency service areas (e.g., primarily domestic discharges; similar per capita water use rates). New industrial discharges also have the potential to influence wastewater quality, but SBMWD is not aware of any new significant industrial users on the planning horizon.

Due to the relevance of source water selection and per capita water use rates, these two conditions were varied in order to project potential future TDS and TIN concentrations at the WRP. Table 5-1 characterizes the various scenarios for which TDS and TIN were projected. For all scenarios, per capita load contributions (e.g., pounds TDS to wastewater per person per day) were assumed to be constant. Scenarios 1, 2, 3, and 4 evaluate the impact of decreasing per capita water use rates (i.e., conservation) assuming the current source water blend is continually used (i.e., the source water blend in October and November 2019). Scenarios 5, 6, 7, and 8 evaluate the compounding impact of decreasing per capita water use rates in combination with the use of existing source waters with high TDS and/or TIN concentrations.

Table 5-1: Scenarios for TDS and TIN Projections

Condition	Scenario Number							
	1	2	3	4	5	6	7	8
Source water	Current source water blend				Worst case source waters [1]			
Customer TDS contribution, lbs/person/year	43.7 [2]							
Customer TIN contribution, lbs/person/year	8.0 [3]							
Per capita water use rates[4]	2010 Rates	Current Rates	2025 Target Rates	2030 Target Rates	2010 Rates	Current Rates	2025 Target Rates	2030 Target Rates
SBMWD, gpcd	126	69	55	50	126	69	55	50
Loma Linda, gpcd	126.5	85	55	50	126.5	85	55	50
EVWD, gpcd	167	64	55	50	167	64	55	50
Volumetric contribution to influent WRP flow								
SBMWD	62%							
Loma Linda	10%							
EVWD	28%							

[1] Based on review of historical source water data; "worst case" = highest recorded concentrations

[2] Based on the calculated difference between influent wastewater TDS and distributed drinking water TDS (2019 special sampling results), combined with current per capita water use rates

[3] Based on the calculated difference between influent wastewater TIN and distributed drinking water TIN (2019 special sampling results), combined with current per capita water use rates

[4] 2010 water use rates were estimated based on total per capita water use rates in the 2010 Urban Watershed Management Plan and an assumption that 50% of per capita water use was for indoor applications; current per capita water use rates were taken from the SBMWD *Water Reclamation Plant Facilities Assessment and Master Plan*; the 2025 and 2030 target rates of 55 and 50 gpcd, respectively, are the current and future California standards for indoor water use

The projected WRP influent TDS, SAR, and monovalent to divalent cation ratio concentrations are shown in Figure 5-3, Figure 5-4, and Figure 5-5, respectively. All projections are sensitive to the assumed per capita water use rate and source water quality. The projected WRP influent TDS figure shows TDS concentrations approaching 900 to 1,000 mg/L with low per capita water use rates and high TDS source waters, as compared with current influent TDS concentrations of approximately 600 mg/L. If influent TDS concentrations at the WRP approach 900 to 1,000 mg/L, the most relevant areas of concern are anticipated to be surface water discharge from the RIX Facility and water recycling. The environmental discharge implications of increasing TDS are being addressed in another study at the watershed scale. TDS-related issues with water recycling can be avoided with early communication between SBMWD and potential recycled water customers; customers should be asked to provide recycled water quality requirements and SBMWD should share current and potential future recycled water quality. Projected TDS concentrations and SAR values suggest that SBMWD recycled water is anticipated to be suitable for irrigation, but may not be appropriate for some types of vegetation that are more sensitive to salts. Furthermore, TDS removal may be required in order to practice groundwater replenishment or any other potable reuse configuration due to state and federal TDS limits in drinking water. The monovalent to divalent cation ratios in Figure 5-5 are projected to remain within the acceptable range of less than two, thus supporting maintained clarification, thickening, and dewatering performance.

The projected WRP influent TIN concentrations and loads are shown in Figure 5-6 and Figure 5-7. Figure 5-6 shows that WRP influent TIN concentrations (mg/L) are projected to increase as per capita water use rates decrease due to reduced dilution of customer TIN inputs to the collection system; however, Figure 5-7 shows that WRP influent TIN loads (lbs/day) are projected to decrease with decreasing per capita water use rates due to reduced TIN load contributions from drinking water. The extent to which influent TIN concentrations and loads will impact SBMWD's ability to comply with environmental discharge and recycled water limits related to TIN is dependent on the WRP treatment capacity. As previously discussed, historical performance data shows that 20 to 30 mg/L of TIN can be removed by existing treatment processes at the WRP; however, the treatment capacity has yet to be quantified via process modeling and/or stress testing. Similar to TDS, SBMWD should engage in early discussions with potential recycled water users regarding preferred and projected water quality to avoid issues with customer dissatisfaction.

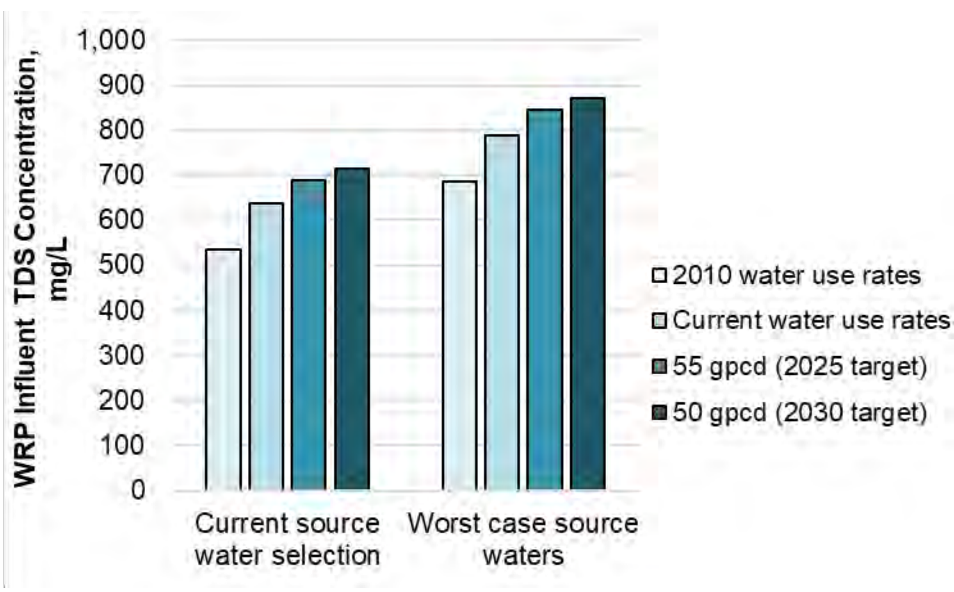


Figure 5-3: Projected WRP Influent TDS Concentrations Based on Source Water Selection and Per Capita Water Use Rates

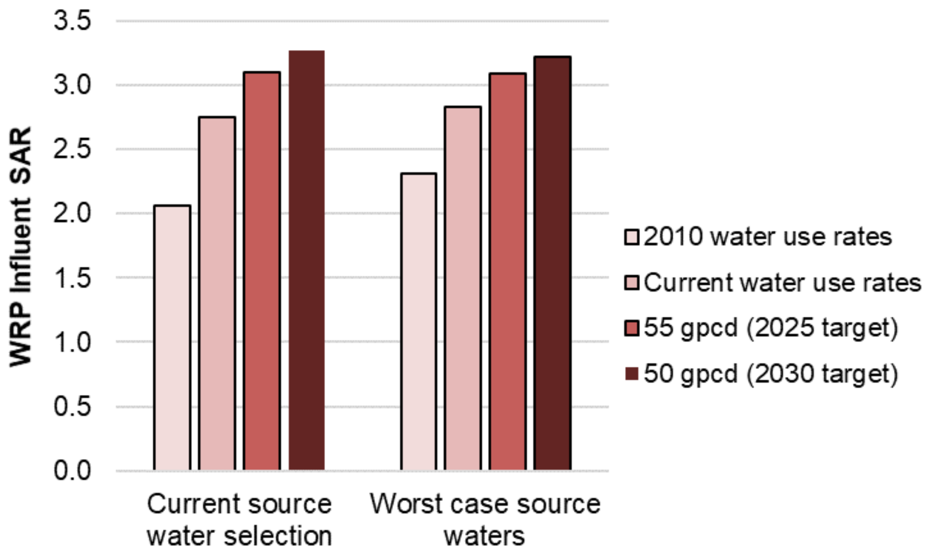


Figure 5-4: Projected WRP Influent Sodium Adsorption Ratio Based on Source Water Selection and Per Capita Water Use Rates

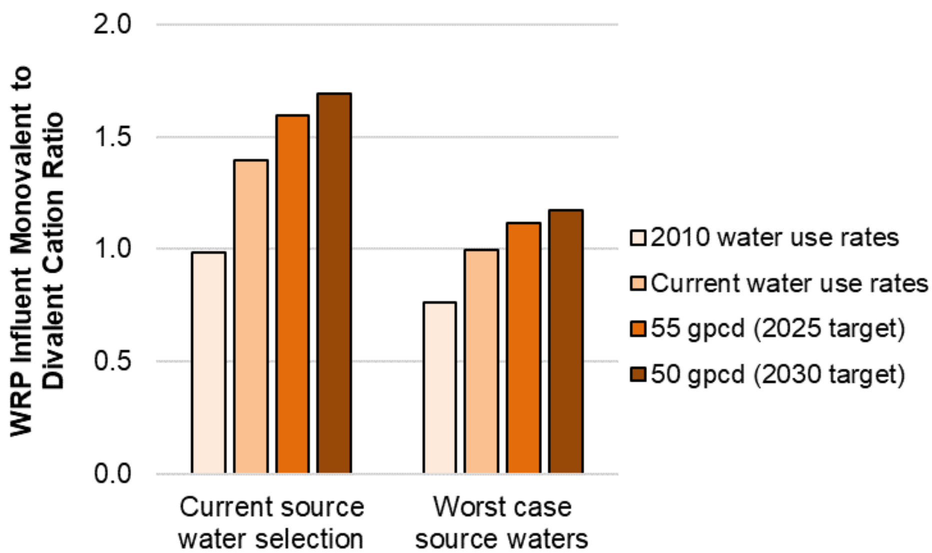


Figure 5-5: Projected WRP Influent Monovalent to Divalent Cation Ratio Based on Source Water Selection and Per Capita Water Use Rates

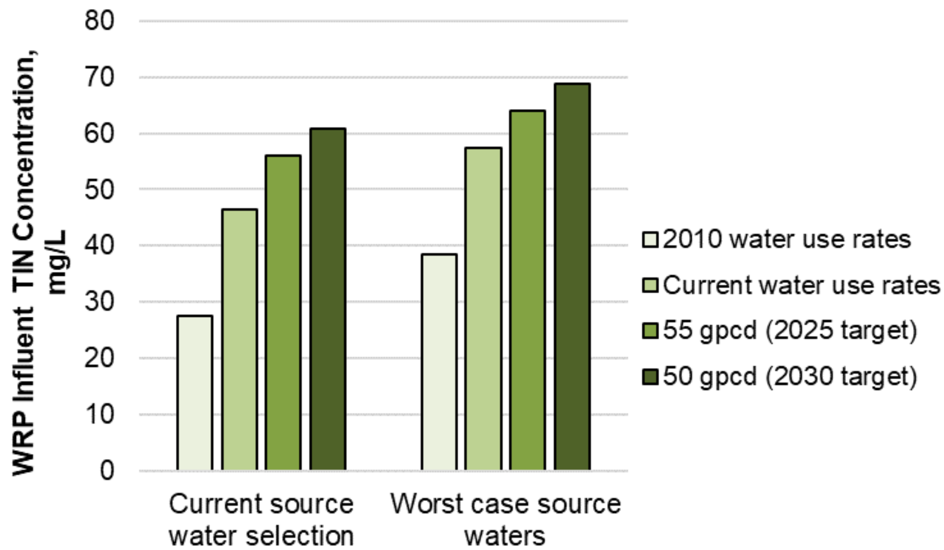


Figure 5-6: Projected WRP Influent TIN Concentrations Based on Source Water Selection and Per Capita Water Use Rates

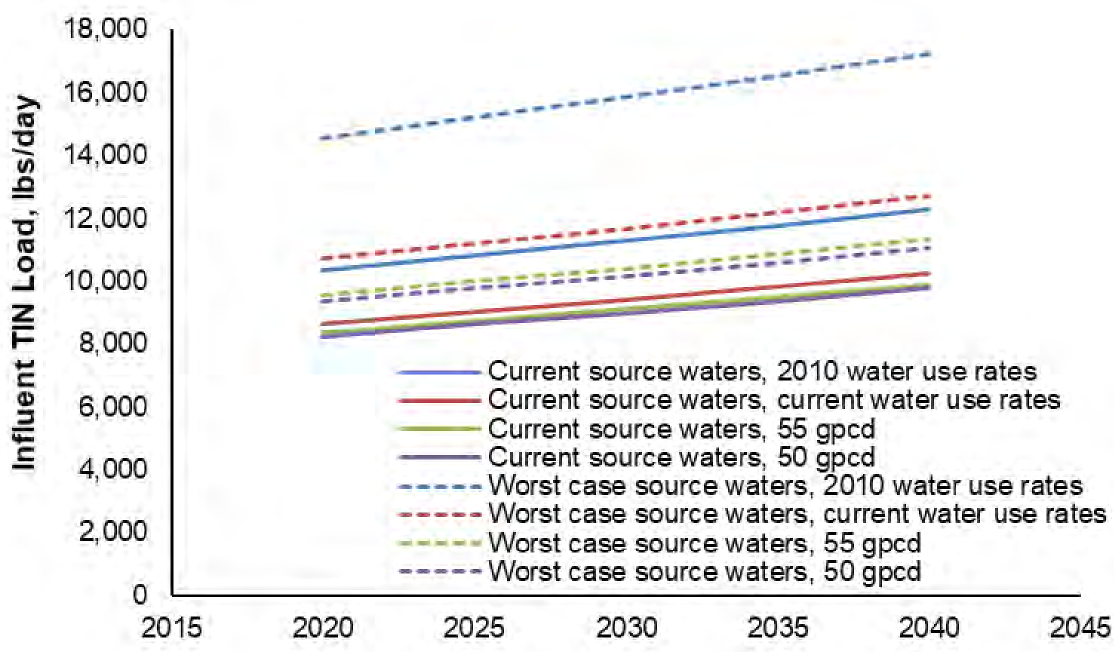


Figure 5-7: Projected WRP Influent TIN Loads Based on Source Water Selection, Per Capita Water Use Rates, and 2019 WRP Master Plan Flow Projections

6. Recommendations

The information presented herein includes acceptable TDS and TIN ranges for maintenance of existing treatment process performance, discharge capabilities, and potential recycled water usage at the WRP and RIX Facility. Historical and special sampling data from 2019 were used to characterize TDS and TIN contributions to WRP influent from existing source waters, drinking water treatment, customer use of drinking water, and wastewater treatment. Source water quality and per capita water use rates were identified as two major factors that drive influent TDS and TIN concentrations/loads at the WRP. The following recommendations are provided to help anticipate, prepare for, and address increasing TDS and TIN at the WRP:

- Implement regular TIN and TDS or conductivity monitoring of WRP influent with quarterly detailed TIN and TDS analysis to monitor total concentrations and speciation over time. Calculate and track related indices (e.g., SAR and monovalent to divalent cation ratio) over time.

- Confirm recycled water TDS- and TIN-related water quality requirements and compatibility with WRP projections for each individual recycled water customer that is considered.

- Benchmark current clarification, aeration, and nitrification efficiencies to provide a baseline against which to compare future performance. If efficiencies worsen over time and TDS is determined to be the causative agent, capital and operational improvements can be made to address TDS-related issues (e.g., a liquid acid-cleaning system for in-situ diffuser cleaning if inorganic fouling is significant).

- Assess the WRP treatment capacity using process modeling and/or stress testing to quantify acceptable influent TIN concentrations and loads considering environmental discharge and recycled water limits.

Appendix A – Source Water Quality Data

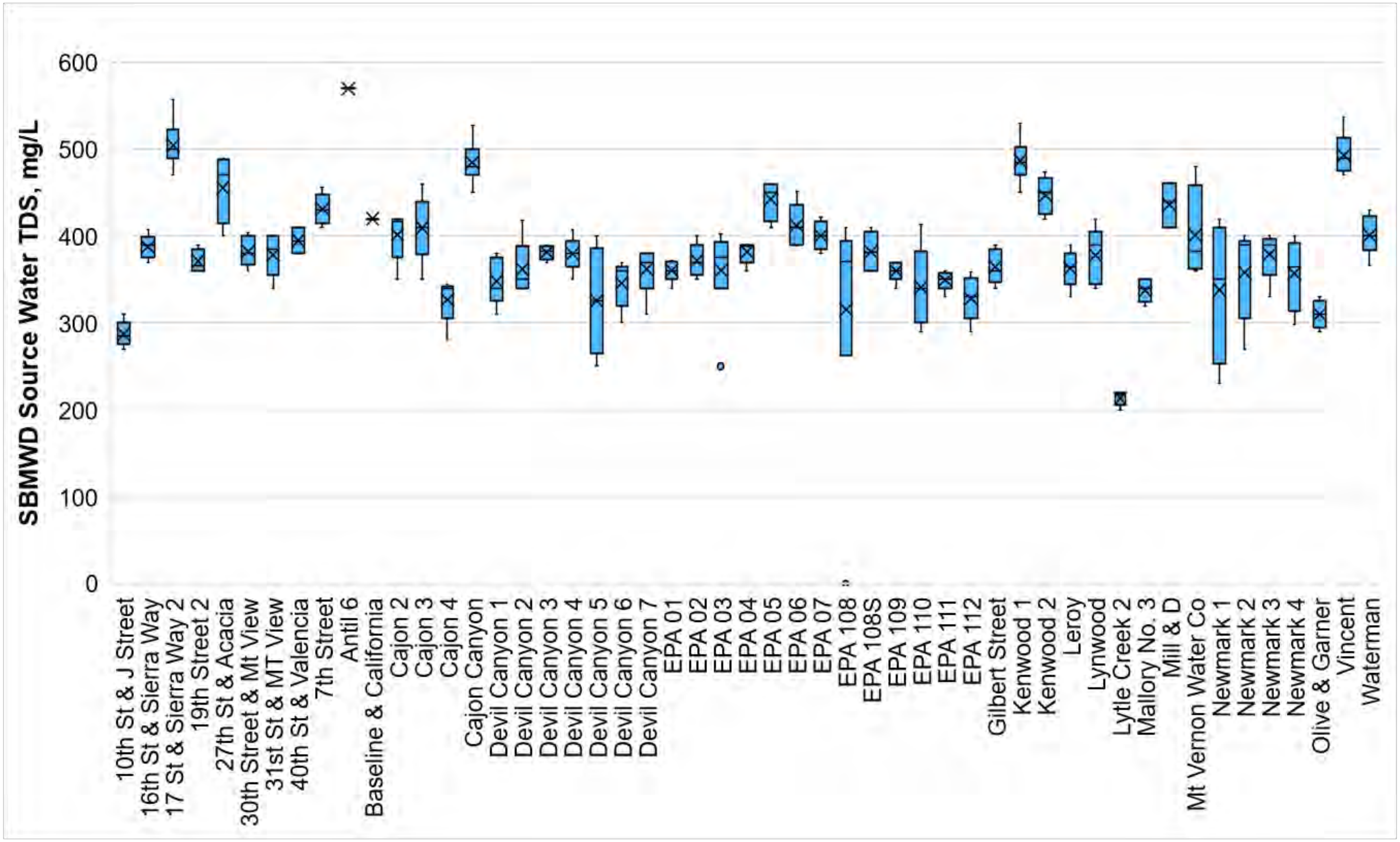


Figure A-1: Distribution of Historical SBMWD Source Water TDS Concentrations (2015 – 2019)

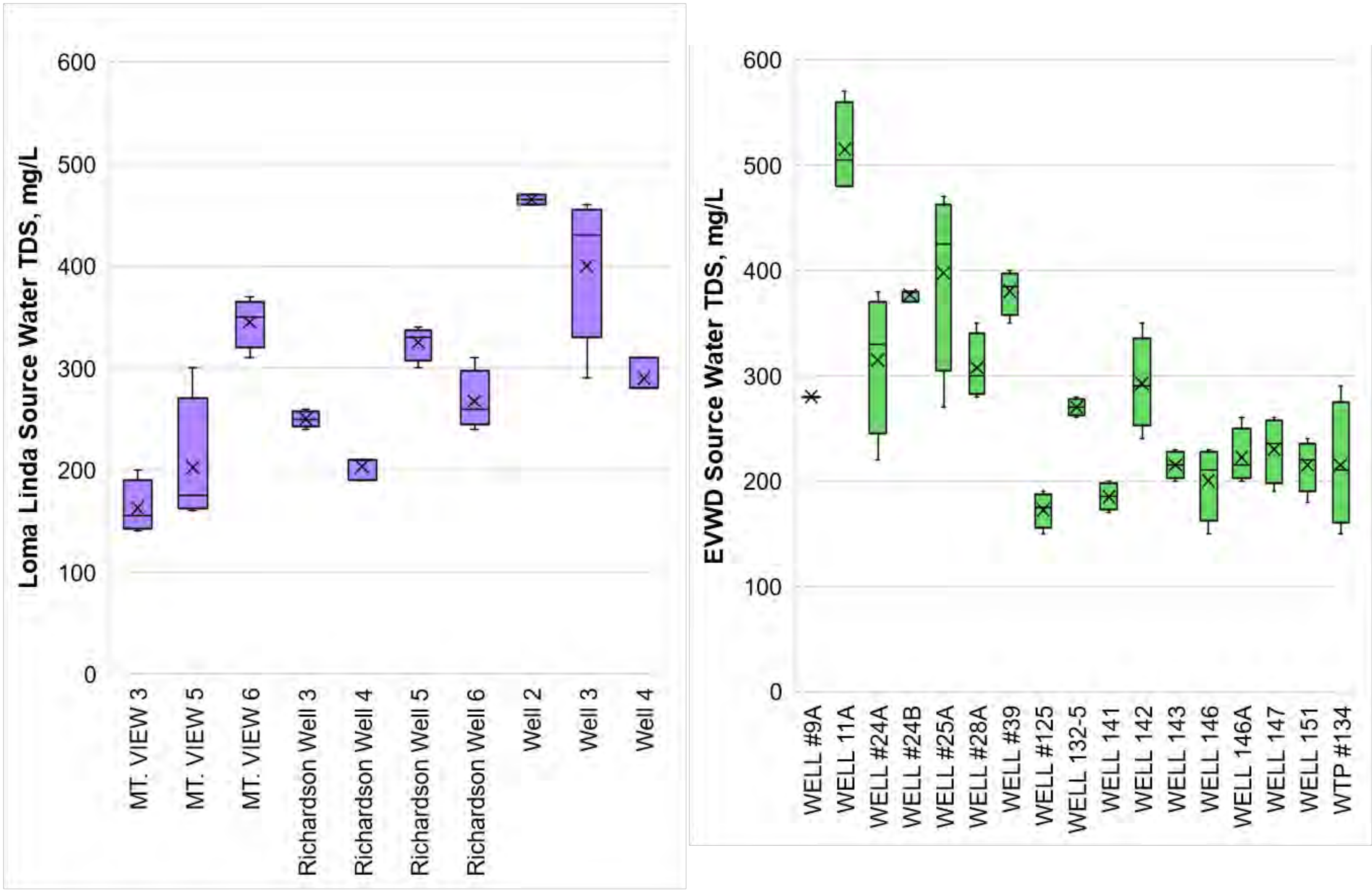


Figure A-2: Distribution of Historical Loma Linda Source Water (left) and EVWD Source Water (right) TDS Concentrations (2016 - 2019)

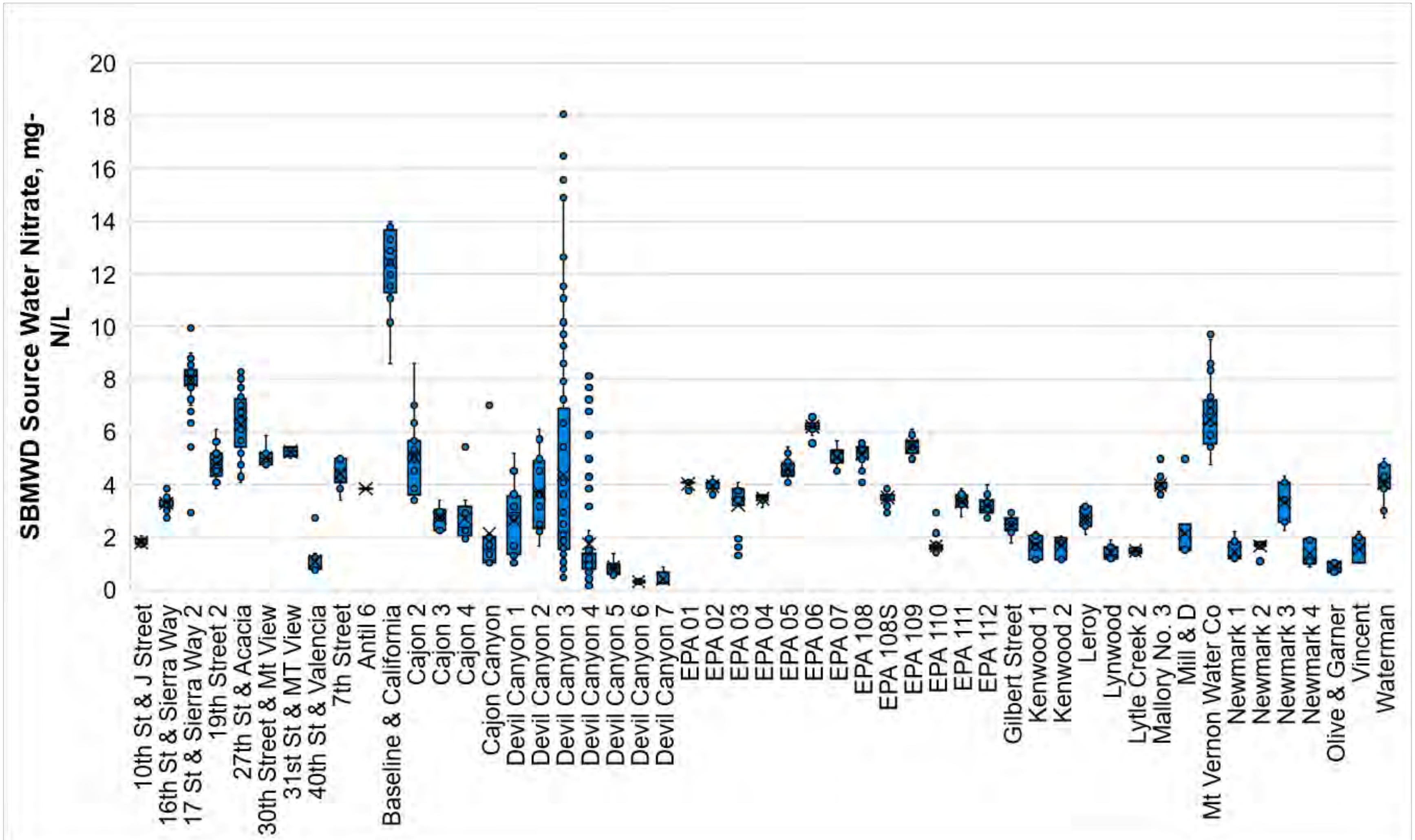


Figure A-3: Distribution of Historical SBMWD Source Water Nitrate Concentrations (2015 – 2019)

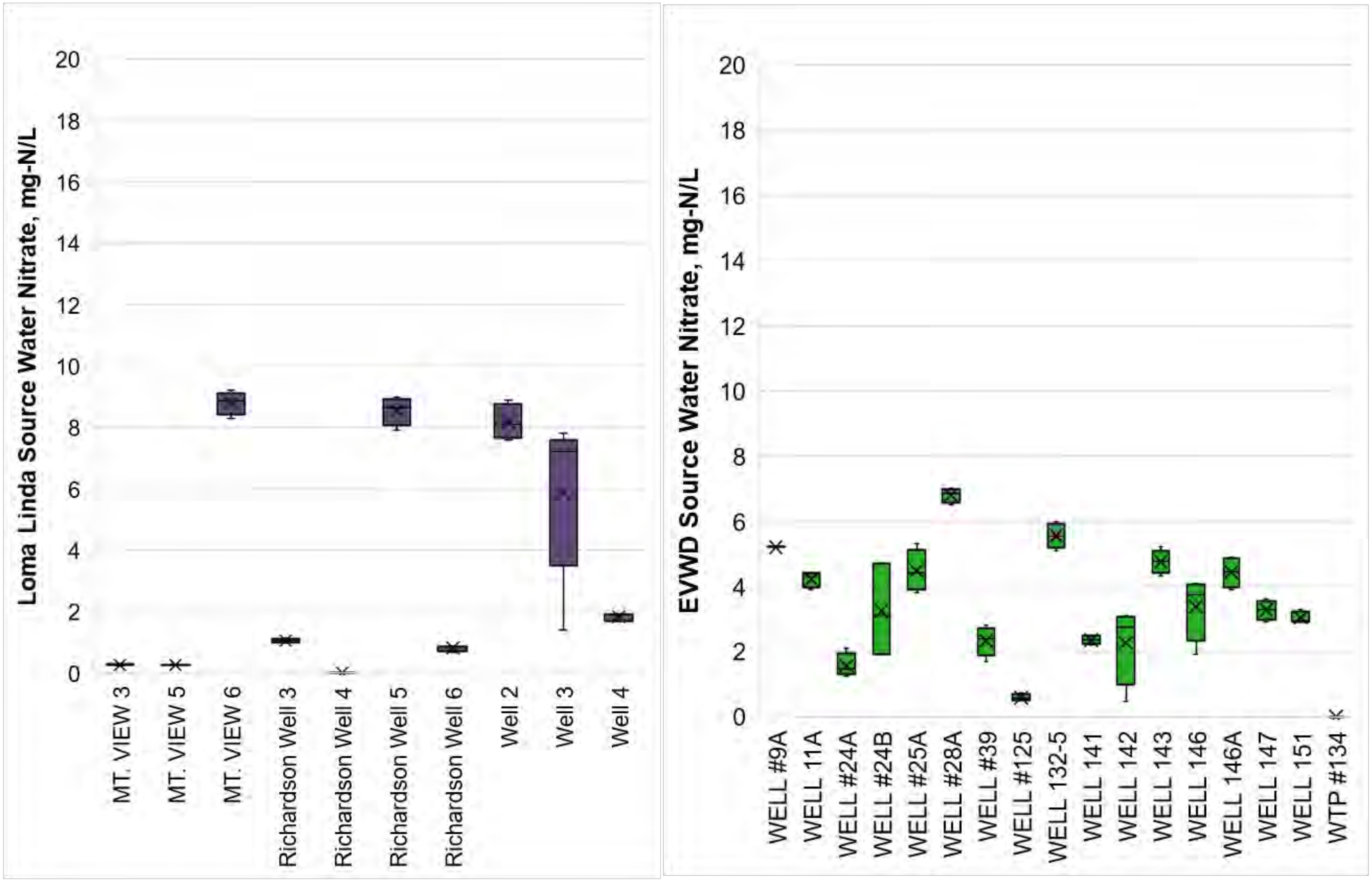


Figure A-4: Distribution of Historical Loma Linda Source Water (left) and EVWD Source Water (right) Nitrate Concentrations (2015 – 2019)

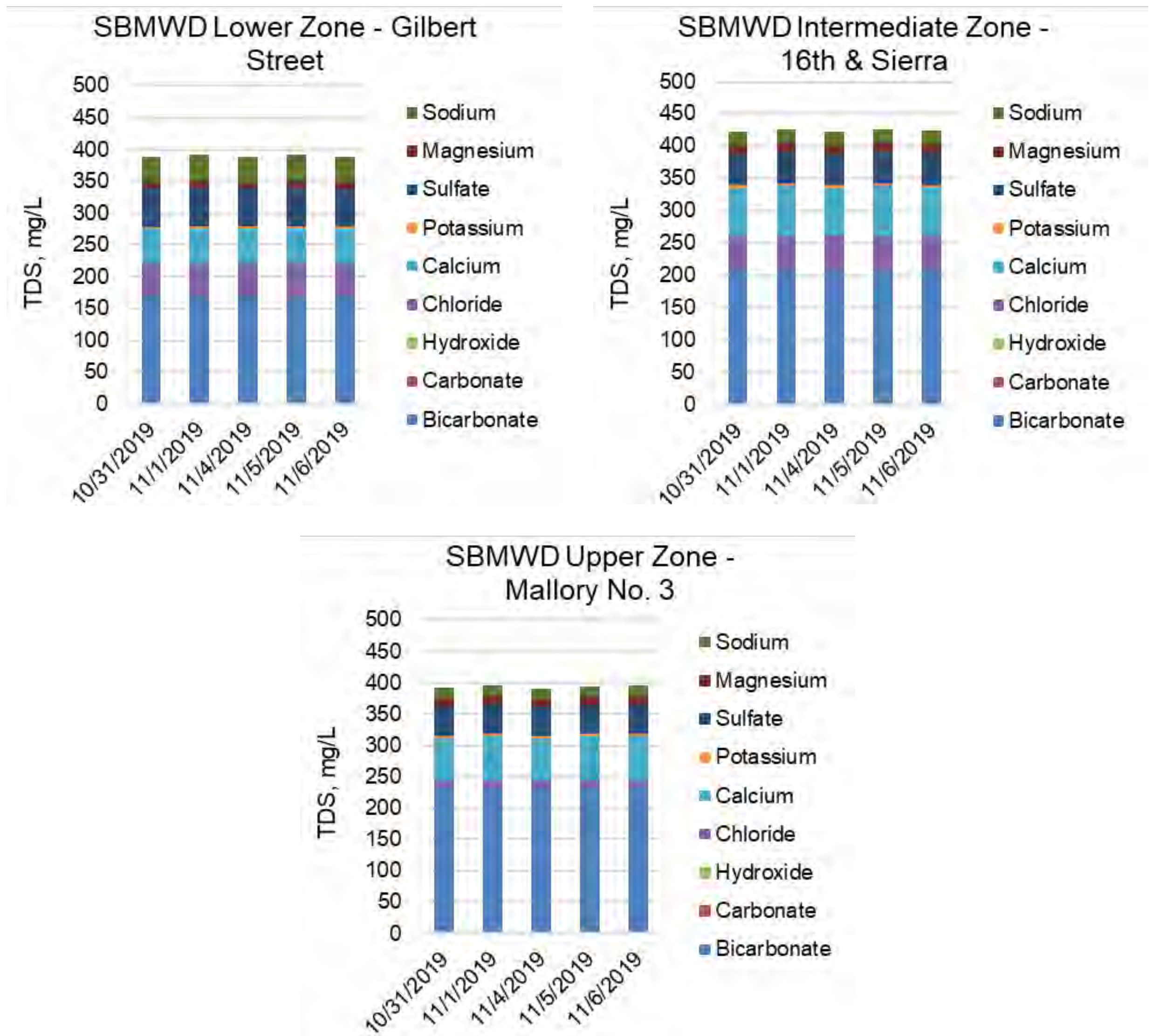


Figure A-5: 2019 Special Sampling TDS Data for Three Representative SBMWD Source Waters

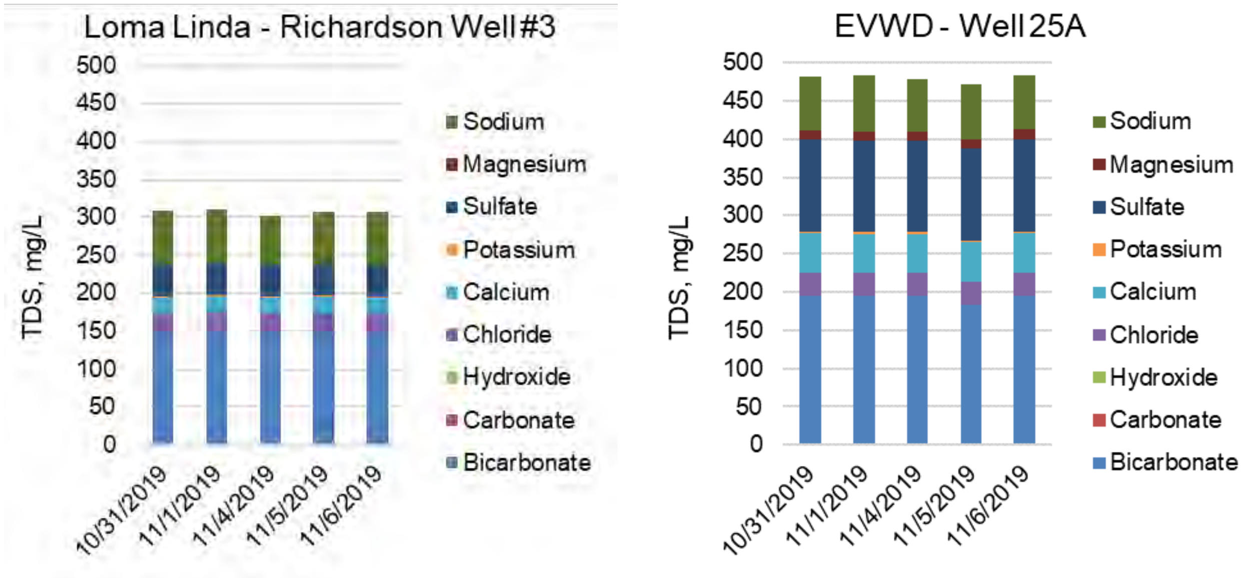


Figure A-6: 2019 Special Sampling TDS Data for Representative Loma Linda (left) and EVWD (right) Source Waters

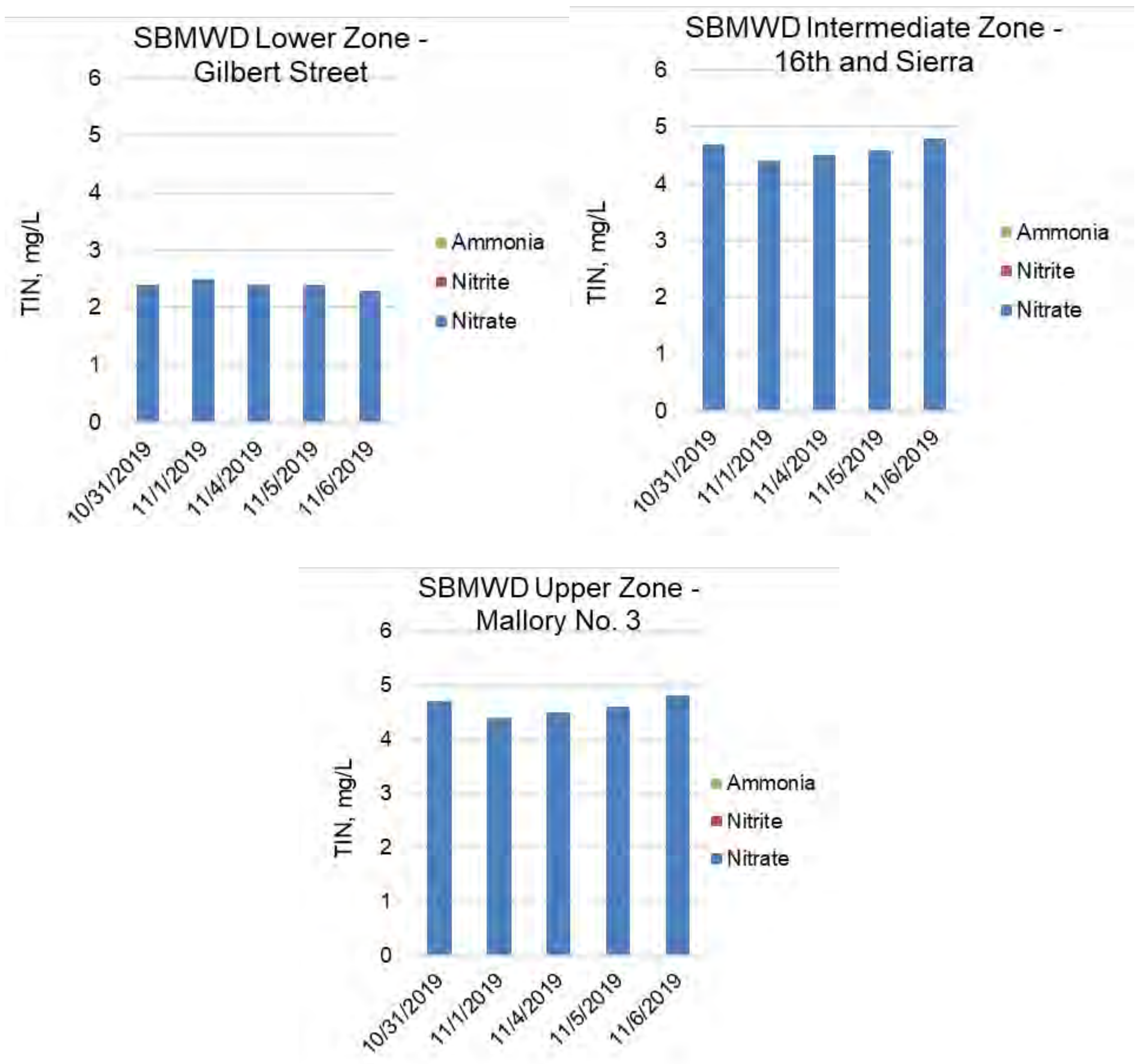


Figure A-7: 2019 Special Sampling TIN Data for Representative SBMWD Source Waters

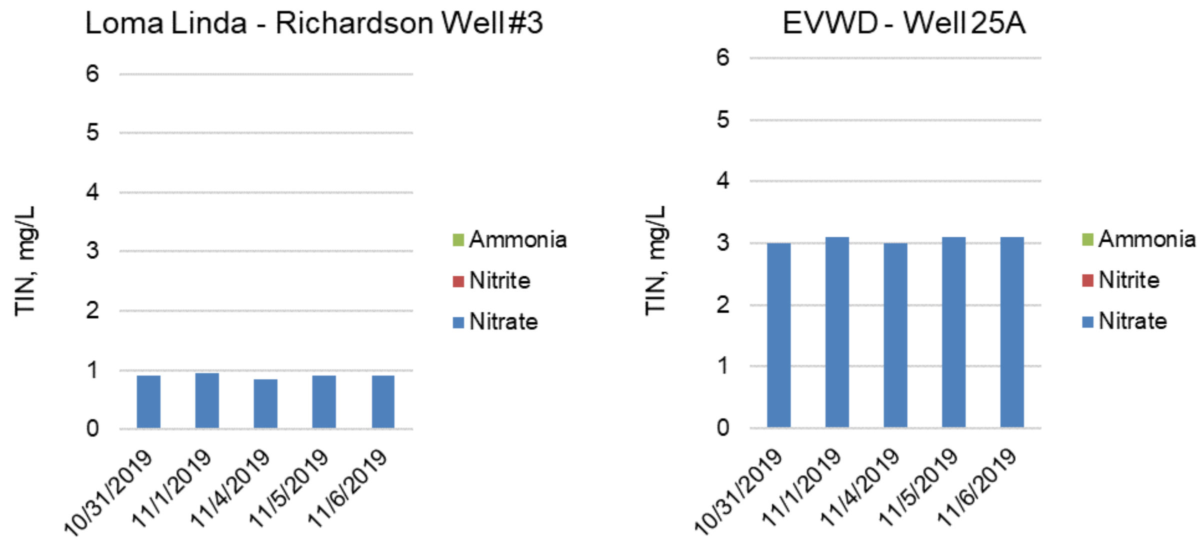


Figure A-8: 2019 Special Sampling TIN Data for Representative Loma Linda (left) and EVWD (right) Source Waters

Appendix B – Distributed Drinking Water Quality Data

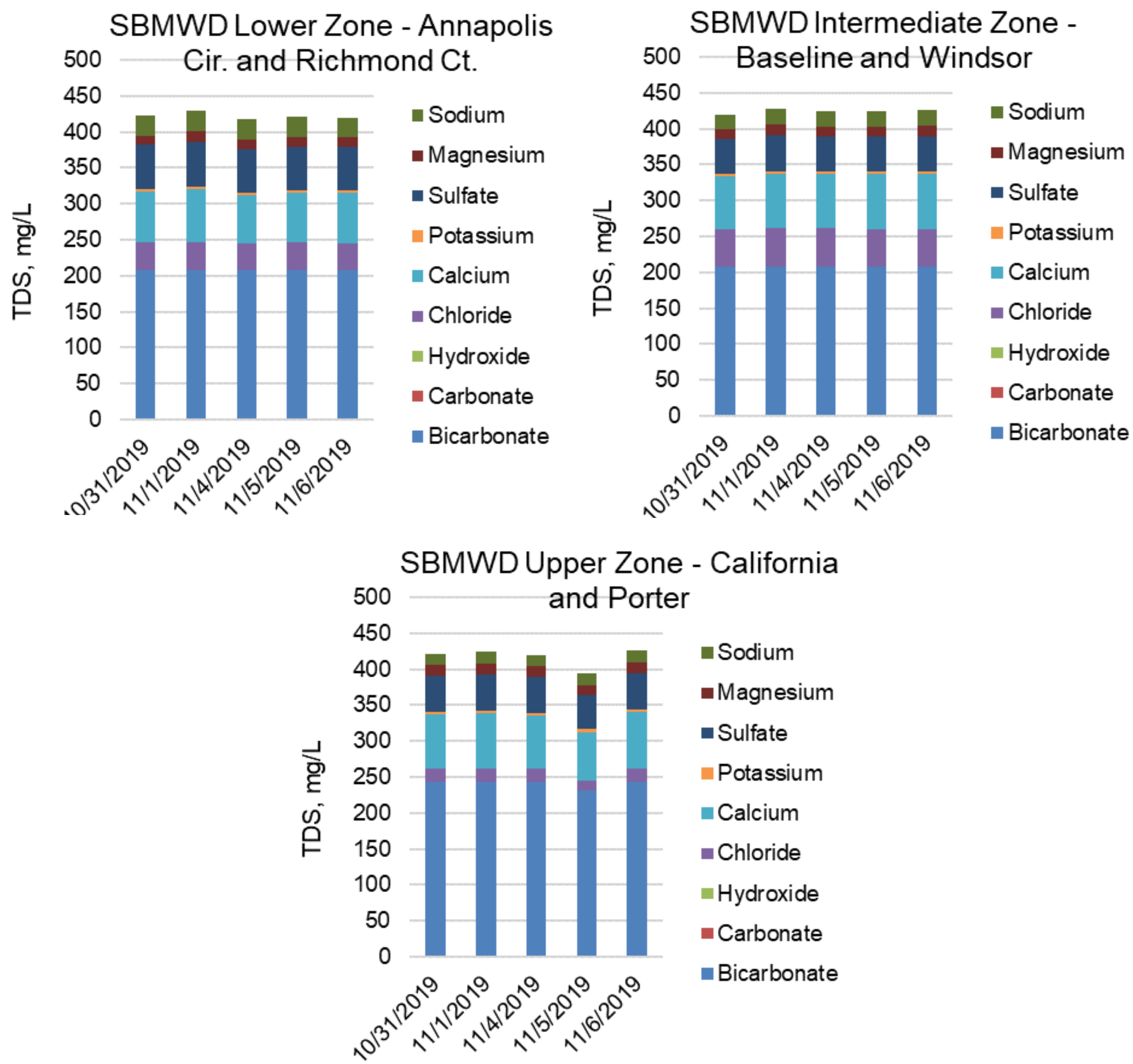


Figure B-1: 2019 Special Sampling TDS Data for Three Representative SBMWD Distributed Drinking Water Locations

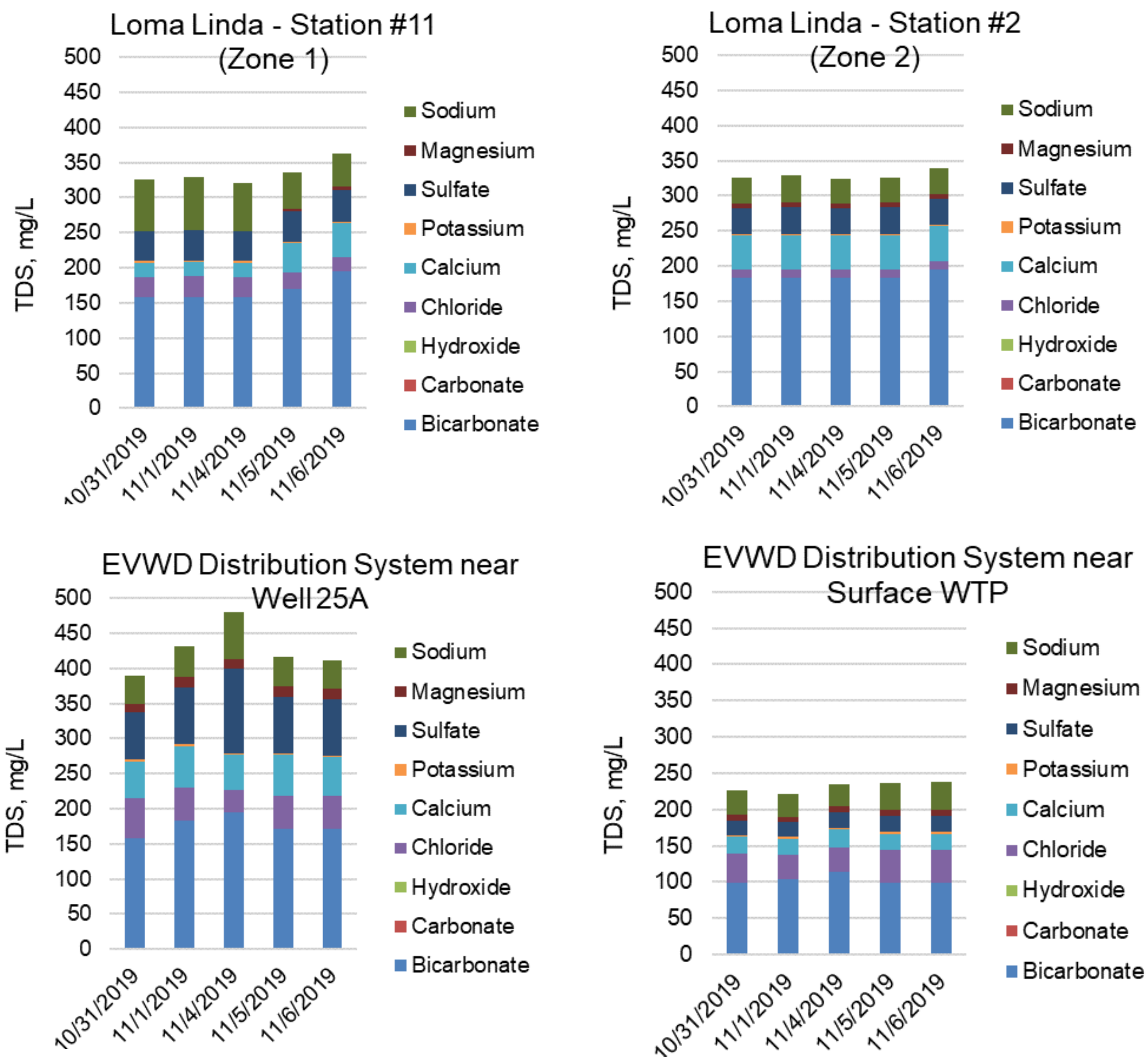
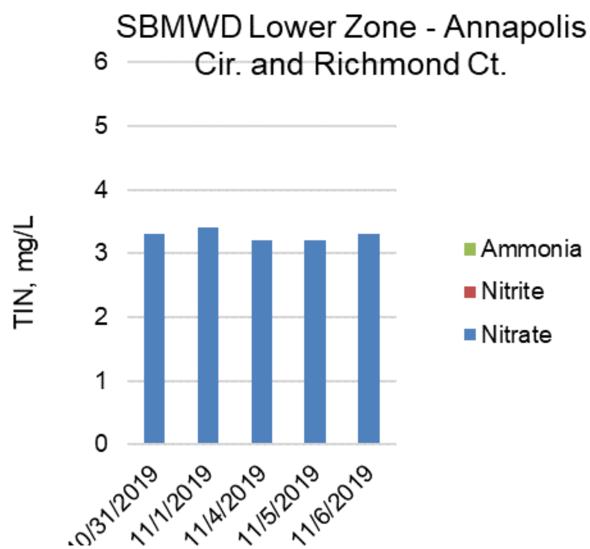
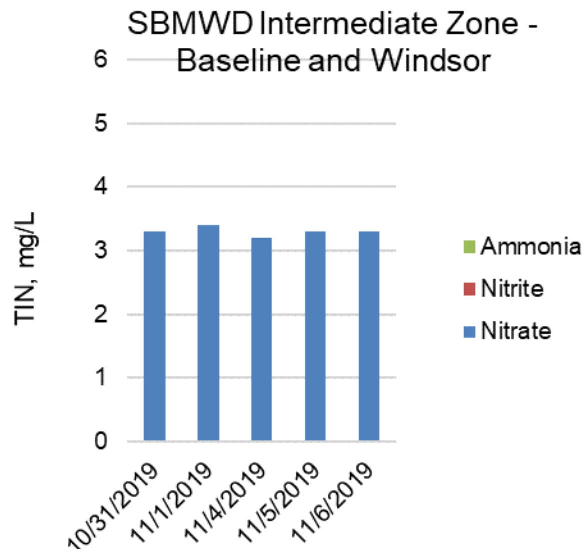


Figure B-2: 2019 Special Sampling TDS Data for Two Representative Loma Linda (top) and EVWD (bottom) Distributed Drinking Water Locations





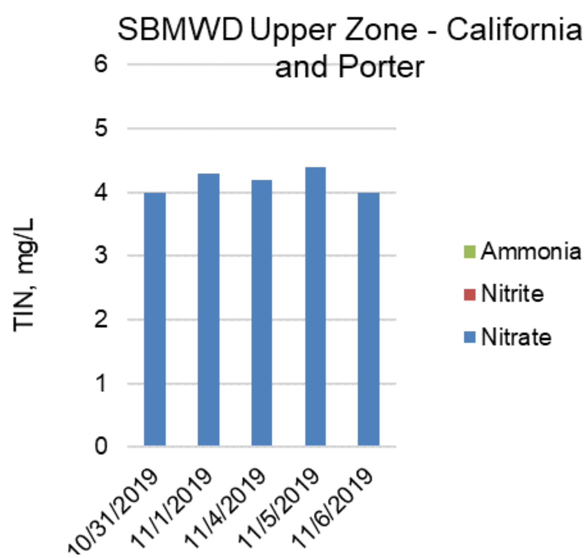


Figure B-3: 2019 Special Sampling TIN Data for Three Representative SBMWD Distributed Drinking Water Locations

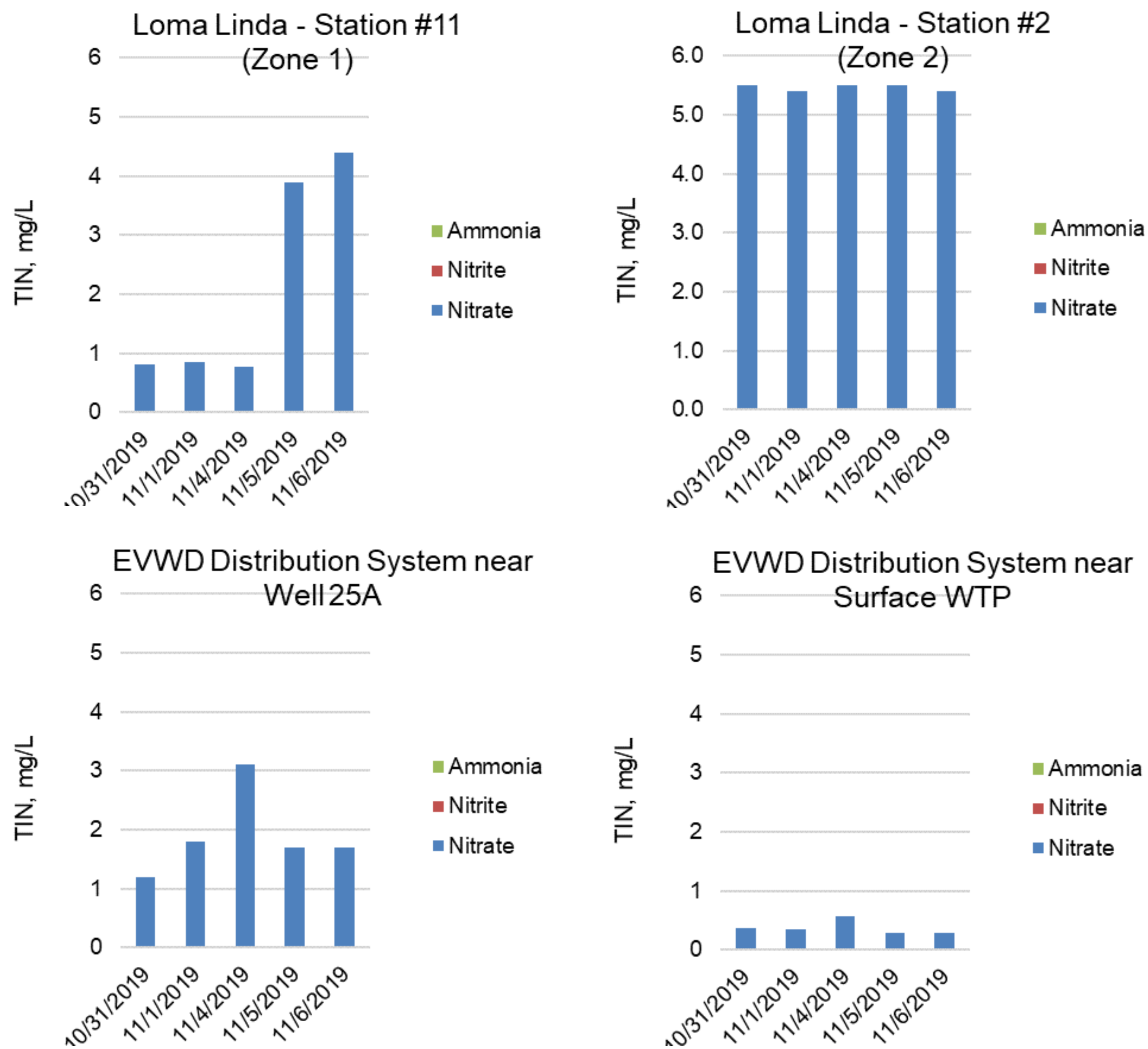


Figure B-4: 2019 Special Sampling TIN Data for Two Representative Loma Linda (top) and EVWD (bottom) Distributed Drinking Water Locations

Appendix C – WRP Influent Wastewater Quality Data

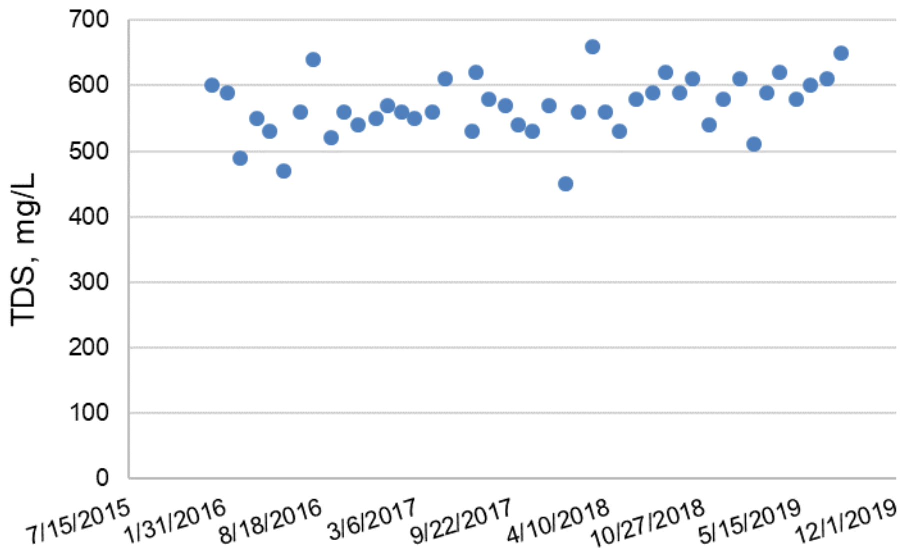


Figure C-1: Historical Influent Wastewater TDS Concentrations at the WRP

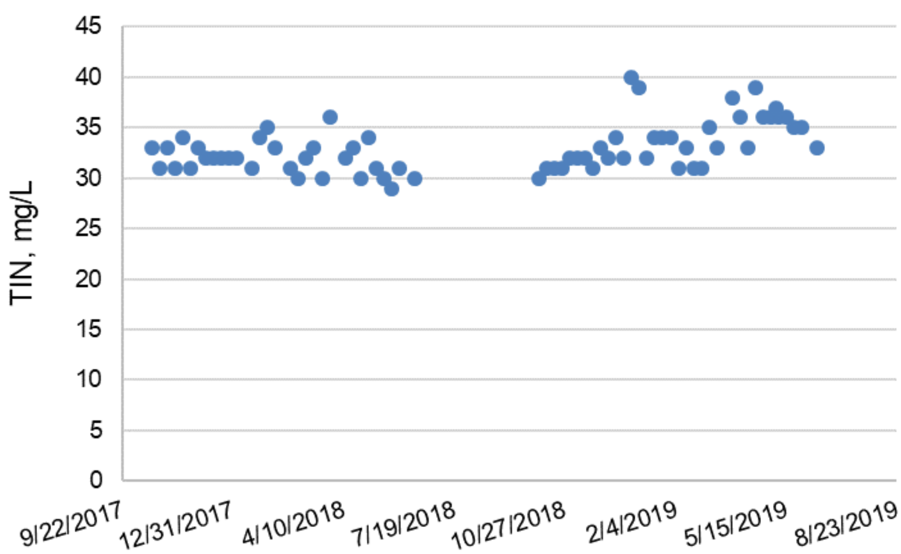


Figure C-2: Historical Influent Wastewater TIN Concentrations at the WRP

Appendix D – WRP Effluent Wastewater Quality Data

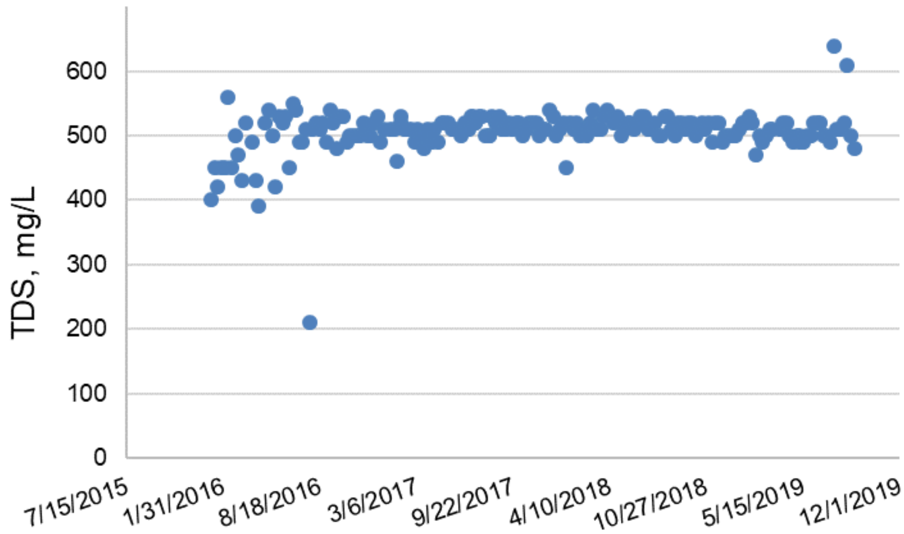


Figure D-1: Historical Effluent Wastewater TDS Concentrations at the WRP

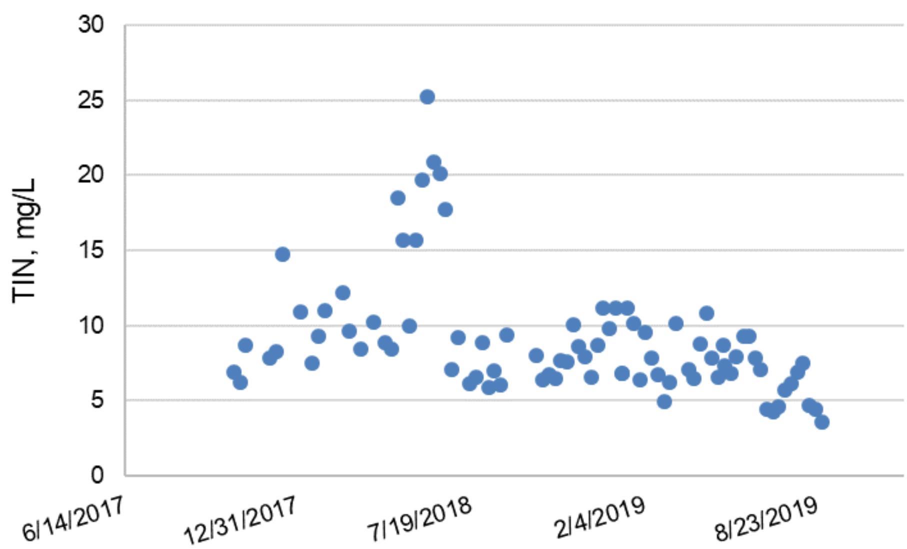


Figure D-2: Historical Effluent Wastewater TIN Concentrations at the WRP

APPENDIX B: CONDITION ASSESSMENT APPENDICES (2 COMBINED)

Appendix A

Class	Type	Updated Useful Life
Access Cover		75
Access Gate		50
Actuator		17
Aerator		25
Air Compressor	Screw Drive	30
Air Conditioning Unit		20
Air Damper	Butterfly	35
Air Dryer		20
Air Handling Unit		20
Alarm System Assembly		20
Analyzer	Level	10
Analyzer	pH & Conductivity Probe	10
Analyzer	pH Probe	10
Analyzer	Temperature Sensor	10
Analyzer	TSS Sensor	10
Analyzer	Turbidity Sensor	10
Analyzer		10
Automatic Transfer Switch		30
Bar Screen		45
Basin Liner		40
Battery Charger		15
Belt Filter Press		25
Blower	Aeration	40
Blower	Foul Air	30
Blower	Rotary Positive Blower	40
Blower Filter		30
Boiler		40
Bypass Contactor		20
Bypass Isolation Switch		20
Catalytic Converter		25
Centrifuge		30
Chlorine Injection Assembly		15
Clay Treater		50
Concrete Pad		75
Condensate Separator		30

Class	Type	Updated Useful Life
Conveyor Assembly	Belt	10
Conveyor Assembly	Plow	30
Conveyor Assembly		30
Crane Assembly		50
Diffusers Assembly		10
Disconnect Switch		30
Drive Assembly		60
Drive Shaft		60
Electrical Cabinet	Bubbler	20
Electrical Cabinet	Control	20
Electrical Cabinet	Level Control	20
Electrical Cabinet	Lighting	20
Electrical Cabinet	MPC	20
Electrical Cabinet	SCR Controller	20
Engine		50
Eyewash Station		50
Fence	Perimeter Fencing	75
Flame Arrester		35
Flow Meter	Air	25
Flow Meter	Air - Differential Pressure	25
Flow Meter	Gas	25
Flow Meter	Magnetic	20
Flow Meter	Magnetic	20
Flow Meter	Mass	8
Flow Meter	Propeller	8
Flow Meter	Rotameter	8
Flow Meter	Ultrasonic Level Control	25
Fuel Monitoring System		10
Gas Compressor		20
Gas Detection System		10
Gate	Sluice	40
Gate	Stop Plate	40
Gate	Swing	40
Generator	Diesel	30
Generator	Gas	30
Grinder		15
Heat Exchanger		45

Class	Type	Updated Useful Life
Load Bank		30
Load Reactor		30
MCC	Bucket	20
MCC	Cabinet	20
Metering Pump		10
Mixer		20
Motor		20
Non-Process Structure	Building	75
Non-Process Structure	Trailer	75
Non-Process Structure	Walkway	75
Non-Process Structure		75
Odor Scrubber		50
Paving		30
Piping		40
PLC		30
Pneumatic Cylinder		40
Pressure Transmitter		20
Process Structure	Grit Hopper	30
Process Structure	Rake Arm	60
Process Structure	Scraper Assembly	60
Process Structure	Scum Collection Box	75
Process Structure	Scum Trough	75
Process Structure	Skimmer	60
Process Structure	Solids Bin	75
Process Structure	Vault	100
Process Structure	Well Casing	100
Process Structure	Wet Well	75
Process Structure		75
Pump	Centrifugal	25
Pump	Centrifugal - Chopper	25
Pump	Fuel	30
Pump	Gas Compression	25
Pump	Lube	5
Pump	Plunger	25
Pump	Polymer Mixing	25
Pump	RAS	25
Pump	Recessed Impeller	25

Hazen

Class	Type	Updated Useful Life
Pump	Rotary Pump	20
Pump	Screw	40
Pump	Scum	25
Pump	Scum - Centrifugal	25
Pump	Scum - Piston	25
Pump	Sludge	25
Pump	Sludge - Piston	25
Pump	Sludge - Piston-type Positive Displacement	25
Pump	Sludge - Progressive Cavity	25
Pump	Submersible	15
Pump	WAS	25
Pump	WAS - Centrifugal	25
Pump	Well	20
Pump		20
Radio Frequency System		20
Sampler		10
SCADA		20
Screw Conveyor		25
Screw Feeder		35
Silencer	Blower	40
Silencer	Engine	35
Sump Pump Assembly		15
Switchgear	Fuse	25
Switchgear	General	25
Switchgear	Main	40
Switchgear		25
Tank	Air Dryer	20
Tank	Chemical	30
Tank	Expansion	40
Tank	Fuel	50
Tank	Gas Holding	50
Tank	Hydropneumatic	50
Tank	Oil Tank	50
Tank	Retention	50
Tank	Surge Tank	50
Tank	Waste Oil	50
Transformer		30

Class	Type	Updated Useful Life
Truck Scale		50
Valve	3-way, Pneumatic	40
Valve	Air Release	20
Valve	Ball	30
Valve	Butterfly	30
Valve	Check	30
Valve	Combination Air	20
Valve	Control	30
Valve	Diaphragm	30
Valve	Flow Control	30
Valve	Gate	35
Valve	Isolation	30
Valve	Knife Gate	35
Valve	Motorized	35
Valve	Pinch	20
Valve	Plug	35
Valve	Pressure Control	30
Valve	Swing Check	30
Valve	Telescopic	30
Ventilation Fan	Clarifier	20
Ventilation Fan	Exhaust	50
Ventilation Fan	Foul Air	50
Ventilation Fan	Mushroom Style	20
Ventilation Fan	Supply	50
Ventilation Fan	Supply Fan	50
VFD		10
VSD		10
Waste Gas Flare		30

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Appendix B

Mechanical Assets – Generic

Is the equipment in use during the inspection? [Yes, No]
Is there any evidence of excessive heat, noise or vibration? [Yes, No]
Does the operator indicate component obsolete? (technical support/parts no longer available from manufacturer) [Yes, No]
Are there any singes of corrosion or deterioration? [Yes, No]
Is the asset compromised by corrosion or deterioration? [Yes, No]
Is there any evidence of leaks? [Yes, No]
Does the operator indicate that the valve leaks internally? [Yes, No]
Is the equipment improperly mounted to the frame? [Yes, No]
Is there any indication of misalignment? (cold/hot alignment performed?) [Yes, No]
Are the vibration isolation devices non-functional or needed? [Yes, No]
Is there an indication of over-greasing? [Yes, No]
Start and stop equipment. Are there any known issues of loose drive shafts, belts, and/or guards? [Yes, No, N/A]
Are there any missing or unlabeled power disconnects? [Yes, No]
Does the operator indicate any hydraulic capacity inadequacies? [Yes, No]
Is there a history of maintenance problems and/or failures? [Yes, No]
Are there any obvious design issues? [Yes, No, N/A]
Condition Rating: [1-5]
Notes if answered yes to anything above:

Electrical Assets - Generic

Does the equipment show evidence of physical damage, overheating, corrosion, or other deterioration? [Yes, No]
Is the asset compromised by deterioration? [Yes, No]
Are raceways or cables not adequately fastened in place? [Yes, No]
Did you observe any issues with grounding? [Yes, No]
Is the equipment exposed to excessive heat? (missing proper shading or air conditioning) [Yes, No]
Does it appear that the equipment has the appropriate enclosure rating given the environment? [Yes, No]
Is there any excessive heat? [Yes, No]
Are there any obvious code issues? [Yes, No]
Was the equipment opened? [Yes, No]
Are the arc flash labels for the equipment missing or outdated (greater than 5 years)? [Yes, No]
Is there poor access or insufficient working space that prevents ready and safe operation and maintenance? [Yes, No]
Does the equipment show signs of accumulated dust? [Yes, No]
Did the operator indicate any issues with the operation or finding parts to maintain the equipment? [Yes, No]
Condition Rating: [1-5]
Notes if answered yes to anything above:

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Instrumentation/Control Assets - Generic
Any visual deterioration? (erosion, corrosion, cracking, etc.) [Yes, No]
Is the asset compromised by deterioration? [Yes, No]
Does it appear that calibration has been overlooked, skipped or missed? [Yes, No]
Is there poor access or insufficient working space that prevents ready and safe operation and maintenance? [Yes, No]
Did the operator indicate any issues with the operation or finding parts to maintain the equipment? [Yes, No]
Condition Rating: [1-5]
Notes if answered yes to anything above:

Structural Assets - Generic
Are there any obvious code issues? [Yes, No]
Are there any signs of the structure **settling or depression in adjacent grade**? [Yes, No]
Is there **exposed rebar** in the foundation? [Yes, No]
On the visible **internal and external** surface, are there any protruding rebar, defects, cracking, spalling, delamination, deterioration or protective coating failures? [Yes, No]
Note any **deformities**, **discoloration** or **surface defects**? [Yes, No]
Are **stairs, handrails, ladders, gratings, access hatches** or other miscellaneous attachments to the main structure show signs of corrosion, deterioration or other surface defects? [Yes, No]
Any **metal building or tank** structures show signs of corrosion, deterioration, coating failures or other surface defects? [Yes, No]
Any **non-metallic and non-cementitious** structures show signs of deterioration or other surface defects? [Yes, No]
Any improperly sealed piping or conduit **penetrations** through the structure? [Yes, No]
Any historical **failures or maintenance problems** indicated by the operator? [Yes, No]
Are there any obvious **health and safety** issues? [Yes, No]
Is the **space too small/inadequate** or the access limited for personnel or equipment to properly operate? [Yes, No]
Is the level of **housekeeping** inadequate? (excess debris, dirt, ponding of water, chemical etc.) [Yes, No]
Condition Rating: [1-5]
Notes if answered yes to anything above:

APPENDIX C: RISK ASSESSMENT APPENDICES (4 COMBINED)

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Appendix A – List of High PoF Assets

#	Location	Asset Description	PoF
1	Admin Bldg	Exhaust Fan	84%
2	Admin Bldg	HVAC Unit	84%
3	Arrowhead Lift Station	Common Discharge Header Isolation Valve	100%
4	Arrowhead Lift Station	MCC 2 Cabinet	84%
5	Arrowhead Lift Station	MCC 2E Cabinet	84%
6	Arrowhead Lift Station	Compressor Room Compressed Air Dryer	100%
7	Arrowhead Lift Station	Control Cabinet for Pumps 1-4	100%
8	Arrowhead Lift Station	Gas Engine 1&2 Swamp Coolers	100%
9	Arrowhead Lift Station	Gas Engine 3&4 Swamp Coolers	100%
10	Arrowhead Lift Station	Rooftop AC for Offices	84%
11	Bar Screen Building	Bar Screen No. 1 Assembly	84%
12	Bar Screen Building	Bar Screen No. 2 Assembly	84%
13	Bar Screen Building	Air Flow Meter	100%
14	Bar Screen Building	Bar Screen Inlet Channel - Air Flow Meter	100%
15	Bar Screen Building	Bar Screen Outlet Channel - Flow Meter	84%
16	Bio-Solids Storage Beds	Bio-Solids Storage Beds Containment Structure	84%
17	Boiler Building	Boiler No. 1 Hot Water Return Control Valve	100%
18	Boiler Building	Boiler No. 1 Hot Water Return Isolation Valve	100%
19	Boiler Building	Boiler No. 1 Hot Water Supply Isolation Valve	100%
20	Boiler Building	Boiler No. 2 Hot Water Return Control Valve	100%
21	Boiler Building	East Boiler Hot Water Supply Check Valve	84%
22	Boiler Building	East Boiler Hot Water Supply Isolation Valve	84%
23	Boiler Building	Expansion Tanks No. 1	85%
24	Boiler Building	Hot Water Return Piping	84%
25	Boiler Building	Hot Water Supply Piping	84%
26	Boiler Building	West Boiler Hot Water Supply Check Valve	84%
27	Boiler Building	West Boiler Hot Water Supply Isolation Valve	84%
28	Boiler Building	Hot Water Return Inlet Isolation Valve from Roots Bldg.	84%
29	Boiler Building	Hot Water Supply - Inlet Piping Assembly	84%
30	Boiler Building	Hot Water Supply - Outlet Piping Assembly	84%
31	Boiler Building	Hot Water Supply Isolation Valve to D&T Heat Exchangers	84%
32	Boiler Building	North Inlet Isolation Valve from Roots Bldg.	84%
33	Boiler Building	South Inlet Isolation Valve from Roots Bldg.	84%
34	Boiler Building	MCC BB Cabinet	100%

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#	Location	Asset Description	PoF
35	Boiler Building	Exhaust Fans No. 1	100%
36	Boiler Building	Exhaust Fans No. 2	100%
37	Burner Building	MCC-4 Cabinet	84%
38	Burner Building	MCC-4E Cabinet	84%
39	Burner Building	Electrical Room Air Conditioning Unit	100%
40	Century Well	Casing No. 1 (0-50 ft)	100%
41	Century Well	Discharge Piping	84%
42	Chlorine Contact Lagoon	Chlorine Contact Lagoon Lining	84%
43	Cogeneration Building	Cogeneration Building	100%
44	Collections Storage Building (Old Chlorine Building)	Chlorine Building (Storage)	80%
45	Collections Storage Building (Old Chlorine Building)	MCC-5E	100%
46	Combination Truck Unloading Bed	Combination Truck Unloading Bed Containment Structure	100%
47	Dewatering & Thickening (D&T) Building	Recycle Pressurization Pump No. 2 - Check Valve	84%
48	Dewatering & Thickening (D&T) Building	Recycle Pressurization Pump No. 2 - Plant Water Suction - Isolation Valve	84%
49	Dewatering & Thickening (D&T) Building	Thickened Sludge Pump No. 1 - Common Suction Drain Isolation Valve	84%
50	Dewatering & Thickening (D&T) Building	Thickened Sludge Pump No. 2B - Check Valve	84%
51	Dewatering & Thickening (D&T) Building	Thickened Sludge Pump No. 4 - Common Suction Left Isolation Valve	84%
52	Dewatering & Thickening (D&T) Building	Digester TWAS Feed A Pneumatic Valve	84%
53	Dewatering & Thickening (D&T) Building	Heat Exchanger A	84%
54	Dewatering & Thickening (D&T) Building	Heat Exchanger C	84%
55	Dewatering & Thickening (D&T) Building	Heat Exchanger D	84%
56	Dewatering & Thickening (D&T) Building	Hot Water Loop A Piping	84%
57	Dewatering & Thickening (D&T) Building	Hot Water Loop C Piping	84%
58	Dewatering & Thickening (D&T) Building	Hot Water Loop D Piping	84%
59	Dewatering & Thickening (D&T) Building	Hot Water Loop Supply A - Inlet - Isolation Valve	84%
60	Dewatering & Thickening (D&T) Building	Hot Water Loop Supply A - Outlet - Isolation Valve	84%
61	Dewatering & Thickening (D&T) Building	Hot Water Loop Supply A Check Valve	84%

#	Location	Asset Description	PoF
62	Dewatering & Thickening (D&T) Building	Hot Water Loop Supply A Valve and Actuator	84%
63	Dewatering & Thickening (D&T) Building	Hot Water Loop Supply C - Inlet - Isolation Valve	84%
64	Dewatering & Thickening (D&T) Building	Hot Water Loop Supply C - Outlet - Isolation Valve	84%
65	Dewatering & Thickening (D&T) Building	Hot Water Loop Supply C - Pump Discharge - Isolation Valve	84%
66	Dewatering & Thickening (D&T) Building	Hot Water Loop Supply C Valve and Actuator	84%
67	Dewatering & Thickening (D&T) Building	Hot Water Loop Supply C Check Valve	84%
68	Dewatering & Thickening (D&T) Building	Hot Water Loop Supply D - Inlet - Isolation Valve	84%
69	Dewatering & Thickening (D&T) Building	Hot Water Loop Supply D - Outlet - Isolation Valve	84%
70	Dewatering & Thickening (D&T) Building	Hot Water Loop Supply D - Pump Discharge - Isolation Valve	84%
71	Dewatering & Thickening (D&T) Building	Hot Water Loop Supply D Valve and Actuator	84%
72	Dewatering & Thickening (D&T) Building	Hot Water Loop Supply D Check Valve	84%
73	Dewatering & Thickening (D&T) Building	Recirculated Sludge Discharge Check Valve A	100%
74	Dewatering & Thickening (D&T) Building	Recirculated Sludge Discharge Check Valve C	100%
75	Dewatering & Thickening (D&T) Building	Recirculated Sludge Discharge Check Valve D	100%
76	Dewatering & Thickening (D&T) Building	Recirculation Sludge Pump A	84%
77	Dewatering & Thickening (D&T) Building	Recirculation Sludge Pump C	84%
78	Dewatering & Thickening (D&T) Building	Recirculation Sludge Pump D	84%
79	Dewatering & Thickening (D&T) Building	DAF No. 1 Check Valve	84%
80	Dewatering Building & Conveyors 1 & 2	Belt Press 3	84%
81	Dewatering Building & Conveyors 1 & 2	Belt Press Sludge Feed Pump 1	84%
82	Dewatering Building & Conveyors 1 & 2	Scrubber 1 Foul Air Blower	84%
83	Dewatering Building & Conveyors 1 & 2	Scrubber 1 Recirculating Pump 1	84%
84	Dewatering Building & Conveyors 1 & 2	Scrubber 1 Recirculating Pump 2	84%

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#	Location	Asset Description	PoF
85	Dewatering Building & Conveyors 1 & 2	Scrubber 2 Foul Air Blower	84%
86	Dewatering Building & Conveyors 1 & 2	Scrubber 2 Recirculating Pump 1	84%
87	Dewatering Building & Conveyors 1 & 2	Scrubber 2 Recirculating Pump 1 Motor	84%
88	Dewatering Building & Conveyors 1 & 2	Scrubber 2 Recirculating Pump 2	84%
89	Dewatering Building & Conveyors 1 & 2	Scrubber 2 Recirculating Pump 2 Motor	84%
90	Dewatering Building & Conveyors 1 & 2	Filtrate Pump 3	84%
91	Digester A	Flame Arrestor Downstream Isolation Valve	84%
92	Digester A	Flame Arrestor Upstream Isolation Valve	84%
93	Digester A	Sludge Overflow Isolation Valve to Draw Out	100%
94	Digester A	Tank Draw Out Isolation Valve No. 1	100%
95	Digester A	Tank Draw Out Isolation Valve No. 2 (to Dewatering)	100%
96	Digester B	Digester Tank B	100%
97	Digester C	Sludge Mixing Motor	84%
98	Digester C	Bottom Sludge Draw Common Isolation Valve	100%
99	Digester C	Bottom Sludge Draw Isolation Valve	84%
100	Digester C	Bottom Sludge Draw Isolation Valve No. 1	100%
101	Digester C	Bottom Sludge Draw Isolation Valve No. 2	100%
102	Digester C	Bottom Sludge Draw Isolation Valve No. 3	100%
103	Digester C	Bottom Sludge Draw Isolation Valve No. 4	100%
104	Digester C	Heated Sludge Return Bypass Isolation Valve	100%
105	Digester C	Heated Sludge Return Inlet Isolation Valve	100%
106	Digester C	Heated Sludge Return Isolation Valve	100%
107	Digester D	Heated Sludge Return Common Isolation Valve	84%
108	Digester D	Heated Sludge Return Inlet Isolation Valve	84%
109	Digester D	Heated Sludge Return Isolation Valve	84%
110	Dissolved Air Flotation Thickener (DAFT) 1	Back Pressure Control Valve	84%
111	Dissolved Air Flotation Thickener (DAFT) 1	DAF Drive Unit Assembly	84%
112	Dissolved Air Flotation Thickener (DAFT) 1	Propeller Meter	84%
113	Dissolved Air Flotation Thickener (DAFT) 2	Back Pressure Control Valve	84%
114	Dissolved Air Flotation Thickener (DAFT) 2	DAF Drive Unit Assembly	84%
115	Dissolved Air Flotation Thickener (DAFT) 2	Propeller Meter	100%

#	Location	Asset Description	PoF
116	East Lift Station	Screw Pumps Inlet Channel - Air Flow Meter	84%
117	East Lift Station	Screw Pumps Outlet Channel - Air Flow Meter	84%
118	Electrical Administration Building	Electrical Administration Building	81%
119	Electrical Administration Building	Overhead Crane Assembly	100%
120	Ferric Chloride Storage Tank	Ferric Chloride Storage Tank	84%
121	Grit Chambers	Grit Slurry Pump No. 2 Motor	100%
122	Grit Chambers	Grit Chamber No. 1 - Flow Meter	84%
123	Grit Chambers	Grit Chamber No. 2 - Flow Meter	84%
124	Grit Chambers	Grit Chamber No. 3 - Flow Meter	84%
125	Grit Chambers	Grit Chamber No. 1 Assembly	100%
126	Grit Chambers	Grit Chamber No. 2 Assembly	100%
127	Grit Chambers	Grit Chamber No. 3 Assembly	100%
128	Grit Dewatering Bed	Grit Dewatering Bed Containment Structure	100%
129	Grit Wash Building	Grit Hopper No. 1 Assembly	90%
130	Hazardous Materials Storage Area	Hazardous Materials Storage Structure	100%
131	Headworks Blower Building	Air Discharge Flow Meter	100%
132	Headworks Blower Building	Blower No. 1 Control Cabinet	100%
133	Headworks Blower Building	Blower No. 2 Control Cabinet	100%
134	Headworks Blower Building	Headworks Blower Motor No. 1	100%
135	Headworks Blower Building	Headworks Blower Motor No. 2	100%
136	Headworks Electrical Building	Aeration Blowers VFD No. 1	84%
137	Headworks Electrical Building	Blower No. 1 Soft Starter	100%
138	Headworks Odor Scrubber	Odor Scrubber Recirculation Pump No. 2B Check Valve	84%
139	Headworks Splitter Box	Foul Air Fan IF-2	84%
140	Headworks Splitter Box	Influent Channel - North - Flow Meter	84%
141	Headworks Splitter Box	Influent Channel - South - Flow Meter	84%
142	Headworks Splitter Box	Headworks Splitter Box Building	84%
143	Headworks Tunnel	Supply Fan SUF-04	84%
144	Headworks Tunnel	Reclaimed Water Piping Assembly	84%
145	Instrumentation and Control Trailer	Instrumentation and Control Trailer	81%
146	Internal Recycle Metering Structure	Duplex Sump Pump Assembly	100%
147	Internal Recycle Metering Structure	Recycle Flow Meter Bypass Isolation Valve	84%
148	Irrigation Control Building	Hydropneumatic Tank No. 2	84%
149	Manual Biosolids Loading Bed	Manual Biosolids Loading Bed Containment Structure	84%
150	Nitrogen Removal Carrousel	Aerator No. 1 (North)	84%
151	Nitrogen Removal Carrousel	Aerator No. 2 (South)	84%
152	Nitrogen Removal Carrousel	Effluent Sluice Gate No. 1 (West)	84%
153	Nitrogen Removal Carrousel	Effluent Sluice Gate No. 2 (East)	84%

#	Location	Asset Description	PoF
154	Nitrogen Removal Carrousel	Sluice Gate No. 5 (Internal Recycle)	100%
155	Nitrogen Removal Carrousel	Sluice Gate No. 6 (Internal Recycle)	100%
156	Nitrogen Removal Carrousel	Sluice Gate No. 7 (Plant Drain)	84%
157	Nitrogen Removal Carrousel	Screw Pump No. 3	100%
158	Nitrogen Removal Carrousel	Slide Gate No. 3	100%
159	North Outfall Structure	Lagoon Sluice Gate	84%
160	North Outfall Structure	North Outfall - Drain Valve	84%
161	North Outfall Structure	Sluice Gate No. 1	84%
162	North Outfall Structure	Unit 2 Sluice Gate	100%
163	North Outfall Structure	North Outfall Structure	84%
164	NRC Anoxic Basins	Anoxic Basin No. 1 Mixer Assembly	100%
165	NRC Anoxic Basins	Sluice Gate No. 1 (Internal Recycle)	84%
166	NRC Anoxic Basins	Sluice Gate No. 2 (Internal Recycle)	84%
167	NRC Anoxic Basins	Sluice Gate No. 3 (Plant Drain)	84%
168	NRC Anoxic Basins	Anoxic Basin No. 2 Mixer Assembly	100%
169	NRC Anoxic Basins	Sluice Gate No. 4 (Plant Drain)	84%
170	NRC Anoxic Basins	Raw Wastewater By-Pass Isolation Valve	84%
171	NRC Anoxic Basins	Raw Wastewater Meter Upstream Isolation Valve	86%
172	NRC Anoxic Basins	Raw Wastewater Motorized Control Valve	86%
173	NRC Anoxic Basins	Sump Pump Assembly	100%
174	NRC Anoxic Basins	Influent Mixer No. 1	100%
175	NRC Anoxic Basins	Influent Mixer No. 2	100%
176	NRC Anoxic Basins	Internal Recycle Flow Meter No. 1	84%
177	NRC Anoxic Basins	Internal Recycle Flow Meter No. 2	100%
178	NRC Building	Equalization Pumps Control Panel	100%
179	NRC Building	Control Room Air Conditioning Unit - HP-1 - NRE-139	84%
180	NRC Building	Exhaust Fan	100%
181	NRC Building	RAS Pump No. 2	84%
182	NRC Secondary Clarifier	Submersible Scum Pump No. 2	100%
183	Old Blue Generator Building	MCC 6E Cabinet	100%
184	Old Blue Generator Building	400 A Auto Transfer Switch	84%
185	Old Blue Generator Building	Emergency Main Panel 1	100%
186	Orange Show Well	Pump Control Cabinet	100%
187	Roots Blower Building	Waste Oil Tank Level Sensor	100%
188	RS-1 Pump Station	UST Monitoring System	100%
189	RS-1 Pump Station	RS-1 Pump Station MCC9 - Cabinet	84%
190	RS-1 Pump Station	RS-1 Pump Station MCC 9E - Cabinet	84%
191	RS-1 Pump Station	RS-1 Pump Station Bucket RAS-3 Switchgear	100%

#	Location	Asset Description	PoF
192	RS-1 Pump Station	Generator Bldg. Exhaust Fan	100%
193	RS-1 Pump Station	Plant Flow Control Cabinet	100%
194	RS-1 Pump Station	Pump Vault Exhaust Fan 1	100%
195	RS-1 Pump Station	Pump Vault Exhaust Fan 2	100%
196	RS-1 Pump Station	RS-1 PLC-26	100%
197	RS-1 Pump Station	RAS Pump No. 1 Discharge Bypass Line	83%
198	RS-1 Pump Station	RAS Pump No. 1 VFD	100%
199	RS-1 Pump Station	RAS Pump No. 2 VFD	100%
200	RS-1 Pump Station	RAS Pump No. 3	84%
201	RS-1 Pump Station	RAS Pump No. 3 VFD	100%
202	RS-1 Pump Station	WAS Common Suction Header Isolation Valve 2	84%
203	RS-1 Pump Station	WAS Pump No. 1	100%
204	RS-1 Pump Station	WAS Pump No. 1 South Waste VFD	100%
205	RS-1 Pump Station	WAS Pump No. 2	100%
206	RS-1 Pump Station	WAS Pump No. 2 North Waste VFD	100%
207	Secondary Administration Building	Air Conditioning Unit 1	84%
208	Secondary Administration Building	Air Conditioning Unit 2	84%
209	Secondary Administration Building	Air Conditioning Unit 3	84%
210	Sludge Storage Odor Scrubber	Air Injection System Control Panel	84%
211	Sludge Storage Odor Scrubber	Combined Flow meter	100%
212	Sludge Storage Odor Scrubber	Combined Foul Air Piping	84%
213	Sludge Storage Odor Scrubber	Flow Meter from North SST	100%
214	Sludge Storage Odor Scrubber	Flow Meter from South SST	100%
215	Sludge Storage Odor Scrubber	Foul Air Blower	84%
216	South Digested Sludge Storage Tank	Foul Air Piping Assembly	100%
217	South Outfall Structure	South Lagoon Sluice Gate	84%
218	South Outfall Structure	South Outfall Structures	84%
219	Unit 1 Aeration Basins	Bay 9 Structure	84%
220	Unit 1 Aeration Basins	LPA Main Line Isolation Valve	84%
221	Unit 1 Aeration Basins	Sampler	90%
222	Unit 1 Aeration Basins	Unit 1 Air Flow Meter	84%
223	Unit 1 Aeration Basins	Walkway Structure No. 1	84%
224	Unit 1 Aeration Basins	Walkway Structure No. 2	84%
225	Unit 1 Aeration Basins	Walkway Structure No. 3	84%
226	Unit 1 Aeration Basins	Walkway Structure No. 4	84%
227	Unit 1 Aeration Basins	Walkway Structure No. 5	84%
228	Unit 1 Chlorine Contact Basins	Influent Isolation Valve	100%
229	Unit 1 Chlorine Contact Basins	Unit 1 Chlorine Contact Basin Structure	100%

#	Location	Asset Description	PoF
230	Unit 1 East Secondary Clarifier	Sampler	100%
231	Unit 1 East Secondary Clarifier	Unit 1 East Secondary Clarifier Drain Valve	100%
232	Unit 1 East Secondary Clarifier	Unit 1 East Secondary Clarifier Scum Box	81%
233	Unit 1 Primary Clarifier	Unit 1 Primary Clarifier Drain Valve	100%
234	Unit 1 Primary Clarifier	Unit 1 Primary PC Drive and Motor	83%
235	Unit 1 Pump Station	Unit 1 MCC 8 Feed Switchgear	100%
236	Unit 1 Pump Station	Scum Pump No. 1	100%
237	Unit 1 Pump Station	Scum Pump No. 2	100%
238	Unit 1 West Secondary Clarifier	Sampler	100%
239	Unit 1 West Secondary Clarifier	Unit 1 West Secondary Clarifier Drain Valve	100%
240	Unit 2 Chlorine Contact Basins	Unit 2 Chlorine Contact Basin Structure	84%
241	Unit 2 North Aeration Basins	Bay 6 Gate Valve	83%
242	Unit 2 North Aeration Basins	Low pressure air supply manual isolation Valve	97%
243	Unit 2 North Aeration Basins	Outer Catwalk Structure	84%
244	Unit 2 North Primary Clarifier	Unit 2 North Primary Clarifier - Platforms	100%
245	Unit 2 North Primary Clarifier	Unit 2 North Primary Clarifier Drain Valve	100%
246	Unit 2 North Secondary Clarifier	Unit 2 North Secondary Clarifier Drain Valve	100%
247	Unit 2 North Secondary Clarifier	Unit 2 North Secondary Clarifier Scum Skimmer	100%
248	Unit 2 North Secondary Clarifier	Unit 2 North Secondary Clarifier Scum Box	81%
249	Unit 2 Pump Station	MCC 3 Cabinet	84%
250	Unit 2 Pump Station	MCC 3E	84%
251	Unit 2 Pump Station	Air Compressor	100%
252	Unit 2 Pump Station	Mini Power Center RS-200	100%
253	Unit 2 Pump Station	Mini Power Center RT	100%
254	Unit 2 Pump Station	Primary Sludge Pump No. 1	100%
255	Unit 2 Pump Station	Primary Sludge Pumps Flow Meter Isolation Valve No. 1	84%
256	Unit 2 Pump Station	Primary Sludge Pumps Flow Meter Isolation Valve No. 2	84%
257	Unit 2 Pump Station	Primary Sludge Pumps Flow Meter Bypass Isolation Valve	84%
258	Unit 2 Pump Station	RAS Pump No. 1 Suction Isolation Valve	100%
259	Unit 2 Pump Station	RAS Pump No. 1 Suction Pipe	84%
260	Unit 2 Pump Station	RAS Pump No. 1-3 Discharge Isolation Valve	100%
261	Unit 2 Pump Station	RAS Pump No. 1-3 Suction Isolation Valve	100%
262	Unit 2 Pump Station	RAS Pump No. 2 Discharge Isolation Valve	100%
263	Unit 2 Pump Station	RAS Pump No. 2 Discharge Pipe	84%
264	Unit 2 Pump Station	RAS Pump No. 2 Suction Isolation Valve	100%
265	Unit 2 Pump Station	RAS Pump No. 2 Suction Pipe	84%
266	Unit 2 Pump Station	RAS Pump No. 2-3 Discharge Isolation Valve	100%

#	Location	Asset Description	PoF
267	Unit 2 Pump Station	RAS Pump No. 2-3 Suction Isolation Valve	100%
268	Unit 2 Pump Station	RAS Pump No. 3 Discharge Isolation Valve	100%
269	Unit 2 Pump Station	RAS Pumps Discharge Isolation Valve (to Unit 1)	84%
270	Unit 2 Pump Station	RAS Pumps Unit 2 North Flow Meter	84%
271	Unit 2 Pump Station	RAS Pumps Unit 2 North Flow Meter - Bypass Isolation Valve	84%
272	Unit 2 Pump Station	RAS Pumps Unit 2 North Flow Meter - Downstream Isolation Valve	84%
273	Unit 2 Pump Station	RAS Pumps Unit 2 North Flow Meter - Upstream Isolation Valve	84%
274	Unit 2 Pump Station	RAS Pumps Unit 2 South Flow Meter	84%
275	Unit 2 Pump Station	RAS Pumps Unit 2 South Flow Meter - Bypass Isolation Valve	84%
276	Unit 2 Pump Station	RAS Pumps Unit 2 South Flow Meter - Downstream Isolation Valve	84%
277	Unit 2 Pump Station	RAS Pumps Unit 2 South Flow Meter - Upstream Isolation Valve	84%
278	Unit 2 Pump Station	North Scum Isolation Valve	84%
279	Unit 2 Pump Station	Scum Pump Inlet Check Valve	84%
280	Unit 2 Pump Station	Scum Pump Inlet Isolation Valve	84%
281	Unit 2 Pump Station	Scum Pump Inlet Isolation Valve 2	84%
282	Unit 2 Pump Station	Scum Pump Motor	84%
283	Unit 2 Pump Station	Scum Pump No. 1	100%
284	Unit 2 Pump Station	South Scum Isolation Valve	84%
285	Unit 2 Pump Station	WAS Pump No. 1 Suction Isolation Valve	100%
286	Unit 2 Pump Station	WAS Pump No. 1 VFD	100%
287	Unit 2 Pump Station	WAS Pumps Common Suction Piping	90%
288	Unit 2 South Aeration Basins	2S Bay 2 Mixer No. 3	80%
289	Unit 2 South Aeration Basins	2S Bay 5 Mixer No. 3	80%
290	Unit 2 South Primary Clarifier	Unit 2 South Primary Clarifier - Platforms	100%
291	Unit 2 South Primary Clarifier	Unit 2 South PC Skimmer Assembly 2	84%
292	Unit 2 South Primary Clarifier	Unit 2 South Primary Clarifier Drain Valve	100%
293	Unit 2 South Secondary Clarifier	Unit 2 South Secondary Clarifier Drain Valve	100%
294	Unit 2 South Secondary Clarifier	Unit 2 South Secondary Clarifier Scum Skimmer	100%
295	Unit 2 South Secondary Clarifier	Unit 2 South Secondary Clarifier Scum Box	81%
296	Unit 3 Primary Clarifiers	Flow Meter	84%
297	Unit 3 Primary Clarifiers	Flow Meter Bypass Isolation Valve	84%
298	Unit 3 Primary Clarifiers	Flow Meter Inlet Isolation Valve	84%
299	Unit 3 Primary Clarifiers	Flow Meter Outlet Isolation Valve	84%
300	Unit 3 Primary Clarifiers	Low Pressure Air - 3A Isolation Valve	84%

#	Location	Asset Description	PoF
301	Unit 3 Primary Clarifiers	Low Pressure Air - 3B Isolation Valve	84%
302	Unit 3 Primary Clarifiers	Low Pressure Air - 3C Isolation Valve	84%
303	Unit 3 Primary Clarifiers	Low Pressure Air - 3D Isolation Valve	84%
304	Unit 3 Primary Clarifiers	Clarifier No. 3A Flight Mechanism	84%
305	Unit 3 Primary Clarifiers	Clarifier No. 3B Flight Mechanism	84%
306	Unit 3 Primary Clarifiers	Clarifier No. 3C Flight Mechanism	84%
307	Unit 3 Primary Clarifiers	Clarifier No. 3D Flight Scraper Mechanism	100%
308	Unit 3 Primary Clarifiers	Common Discharge No. 1 Flow Meter	100%
309	Unit 3 Primary Clarifiers	Common Discharge No. 2 Flow Meter	100%
310	Unit 3 Primary Clarifiers	Common Suction - Drain Isolation Valve	84%
311	Unit 3 Primary Clarifiers	Common Suction - Drain Piping Assembly	84%
312	Unit 3 Primary Clarifiers	Inlet Motor Operated Isolation Valve From Clarifier No. 3D	84%
313	Unit 3 Primary Clarifiers	Sludge Pump Motor No. 3-1	100%
314	Unit 3 Primary Clarifiers	Sludge Pump Motor No. 3-2	100%
315	Unit 3 Primary Clarifiers	Sludge Pump Motor No. 3-3	100%
316	Unit 3 Primary Clarifiers	Sludge Pump No. 3-1	84%
317	Unit 3 Primary Clarifiers	Sludge Pump No. 3-1 Suction - Grinder Inlet Isolation Valve	84%
318	Unit 3 Primary Clarifiers	Sludge Pump No. 3-1 Suction - Grinder Outlet Isolation Valve	84%
319	Unit 3 Primary Clarifiers	Sludge Pump No. 3-2	84%
320	Unit 3 Primary Clarifiers	Sludge Pump No. 3-2 Suction - Grinder Inlet Isolation Valve	84%
321	Unit 3 Primary Clarifiers	Sludge Pump No. 3-2 Suction - Grinder Outlet Isolation Valve	84%
322	Unit 3 Primary Clarifiers	Sludge Pump No. 3-3	84%
323	Unit 3 Primary Clarifiers	Sludge Pump No. 3-3 Suction - Grinder Inlet Isolation Valve	84%
324	Unit 3 Primary Clarifiers	Sludge Pump No. 3-3 Suction - Grinder Outlet Isolation Valve	84%
325	Unit 3 Primary Clarifiers	Sludge Pumps Common Suction Piping Isolation Valve No. 1	84%
326	Unit 3 Primary Clarifiers	Sludge Pumps Common Suction Piping Isolation Valve No. 2	84%

Location	Asset Description
Burner Building	MCC-4 Cabinet
Burner Building	MCC-4E Cabinet
Burner Building	Electrical Room Air Conditioning Unit

Location	Asset Description
Cogeneration Building	Cogeneration Building
Old Blue Generator Building	MCC 6E Cabinet
Old Blue Generator Building	400 A Auto Transfer Switch
Old Blue Generator Building	Emergency Main Panel 1
Existing 0.06 Flare	Burner Assembly
Gas Compression Area	Gas Compression Pump No. 1
Gas Compression Area	Gas Compression Pump No. 2
Gas Compression Area	Compressor Master Control Panel
Gas Compression Area	Control Panel
Gas Compression Area	Gas Compressor PLC-20
High Pressure Storage Tank (HPST)	High Pressure Gas Condensate Assembly
Low Pressure Holding Tank (LPHT)	Low Pressure Holding Tank
Ferric Chloride Storage Tank	Ferric Chloride Storage Tank
Arrowhead Lift Station	Common Discharge Header Isolation Valve
Arrowhead Lift Station	MCC 2 Cabinet
Arrowhead Lift Station	MCC 2E Cabinet
Arrowhead Lift Station	Compressor Room Compressed Air Dryer
Arrowhead Lift Station	Control Cabinet for Pump 2 & 3
Arrowhead Lift Station	Gas Engine 1&2 Swamp Coolers
Arrowhead Lift Station	Gas Engine 3&4 Swamp Coolers
Arrowhead Lift Station	Rooftop AC for Offices
East Lift Station	Screw Pumps Inlet Channel - Air Flow Meter
East Lift Station	Screw Pumps Outlet Channel - Air Flow Meter
Admin Bldg	Exhaust Fan
Admin Bldg	HVAC Unit
Collections Storage Building (Old Chlorine Building)	Chlorine Building (Storage)
Collections Storage Building (Old Chlorine Building)	MCC-5E
Electrical Administration Building	Electrical Administration Building
Electrical Administration Building	Overhead Crane Assembly
Instrumentation and Control Trailer	Instrumentation and Control Trailer
Irrigation Control Building	Hydropneumatic Tank No. 2
Secondary Administration Building	Air Conditioning Unit 1
Secondary Administration Building	Air Conditioning Unit 2
Secondary Administration Building	Air Conditioning Unit 3
Unit 1 Chlorine Contact Basins	Influent Isolation Valve
Unit 1 Chlorine Contact Basins	Unit 1 Chlorine Contact Basin Structure
Headworks Odor Scrubber	Odor Scrubber Recirculation Pump No. 2B Check Valve
Sludge Storage Odor Scrubber	Air Injection System Control Panel
Sludge Storage Odor Scrubber	Combined Flow meter

Location	Asset Description
Sludge Storage Odor Scrubber	Combined Foul Air Piping
Sludge Storage Odor Scrubber	Flow Meter from North SST
Sludge Storage Odor Scrubber	Flow Meter from South SST
Sludge Storage Odor Scrubber	Foul Air Blower
Chlorine Contact Lagoon	Chlorine Contact Lagoon Lining
North Outfall Structure	Lagoon Sluice Gate
North Outfall Structure	North Outfall - Drain Valve
North Outfall Structure	North Outfall Structure
North Outfall Structure	Sluice Gate No. 1
North Outfall Structure	Unit 2 Sluice Gate
South Outfall Structure	South Lagoon Sluice Gate
South Outfall Structure	South Outfall Structures
Bar Screen Building	Bar Screen No. 1 Assembly
Bar Screen Building	Bar Screen No. 2 Assembly
Bar Screen Building	Air Flow Meter
Bar Screen Building	Bar Screen Inlet Channel - Air Flow Meter
Bar Screen Building	Bar Screen Outlet Channel - Flow Meter
Grit Chambers	Grit Chamber No. 1 Assembly
Grit Chambers	Grit Chamber No. 2 Assembly
Grit Chambers	Grit Chamber No. 3 Assembly
Grit Chambers	Grit Slurry Pump No. 2 Motor
Grit Chambers	Grit Chamber No. 1 - Flow Meter
Grit Chambers	Grit Chamber No. 2 - Flow Meter
Grit Chambers	Grit Chamber No. 3 - Flow Meter
Grit Wash Building	Grit Hopper No. 1 Assembly
Headworks Blower Building	Air Discharge Flow Meter
Headworks Blower Building	Blower No. 1 Control Cabinet
Headworks Blower Building	Blower No. 2 Control Cabinet
Headworks Blower Building	Headworks Blower Motor No. 1
Headworks Blower Building	Headworks Blower Motor No. 2
Headworks Electrical Building	Aeration Blowers VFD No. 1
Headworks Electrical Building	Blower No. 1 Soft Starter
Headworks Splitter Box	Foul Air Fan IF-2
Headworks Splitter Box	Influent Channel - North - Flow Meter
Headworks Splitter Box	Influent Channel - South - Flow Meter
Headworks Splitter Box	Headworks Splitter Box Building
Headworks Tunnel	Supply Fan SUF-04
Headworks Tunnel	Reclaimed Water Piping Assembly
Influent Metering Structure	East Sewer Influent Flow Meter

Location	Asset Description
Internal Recycle Metering Structure	Duplex Sump Pump Assembly
Internal Recycle Metering Structure	Recycle Flow Meter Bypass Isolation Valve
Unit 1 Primary Clarifier	Unit 1 Primary Clarifier Drain Valve
Unit 1 Primary Clarifier	Unit 1 Primary PC Drive and Motor
Unit 1 Pump Station	Unit 1 MCC 8 Feed Switchgear
Unit 1 Pump Station	Scum Pump No. 1
Unit 1 Pump Station	Scum Pump No. 2
Unit 2 North Primary Clarifier	Unit 2 North Primary Clarifier - Platforms
Unit 2 North Primary Clarifier	Unit 2 North Primary Clarifier Drain Valve
Unit 2 Pump Station	MCC 3 Cabinet
Unit 2 Pump Station	MCC 3E
Unit 2 Pump Station	Air Compressor
Unit 2 Pump Station	Mini Power Center RS-200
Unit 2 Pump Station	Mini Power Center RT
Unit 2 Pump Station	Primary Sludge Pump No. 1
Unit 2 Pump Station	Primary Sludge Pumps Common Discharge Isolation Valve No. 1
Unit 2 Pump Station	Primary Sludge Pumps Common Discharge Isolation Valve No. 2
Unit 2 Pump Station	Primary Sludge Pumps Flow Meter Bypass Isolation Valve
Unit 2 South Primary Clarifier	Unit 2 South Primary Clarifier - Platforms
Unit 2 South Primary Clarifier	Unit 2 South PC Skimmer Assembly 2
Unit 2 South Primary Clarifier	Unit 2 South Primary Clarifier Drain Valve
Unit 3 Primary Clarifiers	Flow Meter
Unit 3 Primary Clarifiers	Flow Meter Bypass Isolation Valve
Unit 3 Primary Clarifiers	Flow Meter Inlet Isolation Valve
Unit 3 Primary Clarifiers	Flow Meter Outlet Isolation Valve
Unit 3 Primary Clarifiers	Low Pressure Air - 3A Isolation Valve
Unit 3 Primary Clarifiers	Low Pressure Air - 3B Isolation Valve
Unit 3 Primary Clarifiers	Low Pressure Air - 3C Isolation Valve
Unit 3 Primary Clarifiers	Low Pressure Air - 3D Isolation Valve
Unit 3 Primary Clarifiers	Clarifier No. 3A Flight Mechanism
Unit 3 Primary Clarifiers	Clarifier No. 3B Flight Mechanism
Unit 3 Primary Clarifiers	Clarifier No. 3C Flight Mechanism
Unit 3 Primary Clarifiers	Clarifier No. 3D Flight Scraper Mechanism
Unit 3 Primary Clarifiers	Common Discharge No. 1 Flow Meter
Unit 3 Primary Clarifiers	Common Discharge No. 2 Flow Meter
Unit 3 Primary Clarifiers	Common Suction - Drain Isolation Valve
Unit 3 Primary Clarifiers	Common Suction - Drain Piping Assembly

Location	Asset Description
Unit 3 Primary Clarifiers	Inlet Motor Operated Isolation Valve From Clarifier No. 3D
Unit 3 Primary Clarifiers	Sludge Pump Motor No. 3-1
Unit 3 Primary Clarifiers	Sludge Pump Motor No. 3-2
Unit 3 Primary Clarifiers	Sludge Pump Motor No. 3-3
Unit 3 Primary Clarifiers	Sludge Pump No. 3-1
Unit 3 Primary Clarifiers	Sludge Pump No. 3-1 Suction - Grinder Inlet Isolation Valve
Unit 3 Primary Clarifiers	Sludge Pump No. 3-1 Suction - Grinder Outlet Isolation Valve
Unit 3 Primary Clarifiers	Sludge Pump No. 3-2
Unit 3 Primary Clarifiers	Sludge Pump No. 3-2 Suction - Grinder Inlet Isolation Valve
Unit 3 Primary Clarifiers	Sludge Pump No. 3-2 Suction - Grinder Outlet Isolation Valve
Unit 3 Primary Clarifiers	Sludge Pump No. 3-3
Unit 3 Primary Clarifiers	Sludge Pump No. 3-3 Suction - Grinder Inlet Isolation Valve
Unit 3 Primary Clarifiers	Sludge Pump No. 3-3 Suction - Grinder Outlet Isolation Valve
Unit 3 Primary Clarifiers	Sludge Pumps Common Suction Piping Isolation Valve No. 1
Unit 3 Primary Clarifiers	Sludge Pumps Common Suction Piping Isolation Valve No. 2
Century Well	Casing No. 1 (0-50 ft)
Century Well	Discharge Piping
Orange Show Well	Pump Control Cabinet
Nitrogen Removal Carrousel	Aerator No. 1 (North)
Nitrogen Removal Carrousel	Aerator No. 2 (South)
Nitrogen Removal Carrousel	Effluent Sluice Gate No. 1 (West)
Nitrogen Removal Carrousel	Effluent Sluice Gate No. 2 (East)
Nitrogen Removal Carrousel	Sluice Gate No. 5 (Internal Recycle)
Nitrogen Removal Carrousel	Sluice Gate No. 6 (Internal Recycle)
Nitrogen Removal Carrousel	Sluice Gate No. 7 (Plant Drain)
Nitrogen Removal Carrousel	Screw Pump No. 3
Nitrogen Removal Carrousel	Slide Gate No. 3
NRC Anoxic Basins	Anoxic Basin No. 1 Mixer Assembly
NRC Anoxic Basins	Sluice Gate No. 1 (Internal Recycle)
NRC Anoxic Basins	Sluice Gate No. 2 (Internal Recycle)
NRC Anoxic Basins	Sluice Gate No. 3 (Plant Drain)
NRC Anoxic Basins	Anoxic Basin No. 2 Mixer Assembly
NRC Anoxic Basins	Sluice Gate No. 4 (Plant Drain)

Location	Asset Description
NRC Anoxic Basins	Raw Wastewater By-Pass Isolation Valve
NRC Anoxic Basins	Raw Wastewater Meter Upstream Isolation Valve
NRC Anoxic Basins	Raw Wastewater Motorized Control Valve
NRC Anoxic Basins	Sump Pump Assembly
NRC Anoxic Basins	Influent Mixer No. 1
NRC Anoxic Basins	Influent Mixer No. 2
NRC Anoxic Basins	Internal Recycle Flow Meter No. 1
NRC Anoxic Basins	Internal Recycle Flow Meter No. 2
NRC Building	Equalization Pumps Control Panel
NRC Building	Control Room Air Conditioning Unit - HP-1 - NRE-139
NRC Building	Exhaust Fan
NRC Building	RAS Pump No. 2
NRC Secondary Clarifier	Submersible Scum Pump No. 2
Roots Blower Building	Waste Oil Tank Level Sensor
RS-1 Pump Station	UST Monitoring System
RS-1 Pump Station	RS-1 Pump Station MCC9 - Cabinet
RS-1 Pump Station	RS-1 Pump Station MCC 9E - Cabinet
RS-1 Pump Station	RS-1 Pump Station Bucket RAS-3 Switchgear
RS-1 Pump Station	Generator Bldg. Exhaust Fan
RS-1 Pump Station	Plant Flow Control Cabinet
RS-1 Pump Station	Pump Vault Exhaust Fan 1
RS-1 Pump Station	Pump Vault Exhaust Fan 2
RS-1 Pump Station	RS-1 PLC-26
RS-1 Pump Station	RAS Pump No. 1 Discharge Bypass Line
RS-1 Pump Station	RAS Pump No. 1 VFD
RS-1 Pump Station	RAS Pump No. 2 VFD
RS-1 Pump Station	RAS Pump No. 3
RS-1 Pump Station	RAS Pump No. 3 VFD
RS-1 Pump Station	WAS Common Suction Header Isolation Valve 2
RS-1 Pump Station	WAS Pump No. 1
RS-1 Pump Station	WAS Pump No. 1 South Waste VFD
RS-1 Pump Station	WAS Pump No. 2
RS-1 Pump Station	WAS Pump No. 2 North Waste VFD
Unit 1 Aeration Basins	Bay 9 Structure
Unit 1 Aeration Basins	LPA Main Line Isolation Valve
Unit 1 Aeration Basins	Sampler
Unit 1 Aeration Basins	Unit 1 Air Flow Meter
Unit 1 Aeration Basins	Walkway Structure No. 1
Unit 1 Aeration Basins	Walkway Structure No. 2

Location	Asset Description
Unit 1 Aeration Basins	Walkway Structure No. 3
Unit 1 Aeration Basins	Walkway Structure No. 4
Unit 1 Aeration Basins	Walkway Structure No. 5
Unit 1 East Secondary Clarifier	Sampler
Unit 1 East Secondary Clarifier	Unit 1 East Secondary Clarifier Drain Valve
Unit 1 East Secondary Clarifier	Unit 1 East Secondary Clarifier Scum Box
Unit 1 West Secondary Clarifier	Sampler
Unit 1 West Secondary Clarifier	Unit 1 West Secondary Clarifier Drain Valve
Unit 2 Chlorine Contact Basins	Unit 2 Chlorine Contact Basin Structure
Unit 2 North Aeration Basins	Bay 6 Gate Valve
Unit 2 North Aeration Basins	Low pressure air supply manual isolation Valve
Unit 2 North Aeration Basins	Outer Catwalk Structure
Unit 2 North Secondary Clarifier	Unit 2 North Secondary Clarifier Drain Valve
Unit 2 North Secondary Clarifier	Unit 2 North Secondary Clarifier Scum Box
Unit 2 North Secondary Clarifier	Unit 2 North Secondary Clarifier Scum Skimmer
Unit 2 Pump Station	RAS Pump No. 1 Suction Isolation Valve
Unit 2 Pump Station	RAS Pump No. 1 Suction Pipe
Unit 2 Pump Station	RAS Pump No. 1-3 Discharge Isolation Valve
Unit 2 Pump Station	RAS Pump No. 1-3 Suction Isolation Valve
Unit 2 Pump Station	RAS Pump No. 2 Discharge Isolation Valve
Unit 2 Pump Station	RAS Pump No. 2 Discharge Pipe
Unit 2 Pump Station	RAS Pump No. 2 Suction Isolation Valve
Unit 2 Pump Station	RAS Pump No. 2 Suction Pipe
Unit 2 Pump Station	RAS Pump No. 2-3 Discharge Isolation Valve
Unit 2 Pump Station	RAS Pump No. 2-3 Suction Isolation Valve
Unit 2 Pump Station	RAS Pump No. 3 Discharge Isolation Valve
Unit 2 Pump Station	RAS Pumps Discharge Isolation Valve (to Unit 1)
Unit 2 Pump Station	RAS Pumps Unit 2 North Flow Meter
Unit 2 Pump Station	RAS Pumps Unit 2 North Flow Meter - Bypass Isolation Valve
Unit 2 Pump Station	RAS Pumps Unit 2 North Flow Meter - Downstream Isolation Valve
Unit 2 Pump Station	RAS Pumps Unit 2 North Flow Meter - Upstream Isolation Valve
Unit 2 Pump Station	RAS Pumps Unit 2 South Flow Meter
Unit 2 Pump Station	RAS Pumps Unit 2 South Flow Meter - Bypass Isolation Valve
Unit 2 Pump Station	RAS Pumps Unit 2 South Flow Meter - Downstream Isolation Valve
Unit 2 Pump Station	RAS Pumps Unit 2 South Flow Meter - Upstream Isolation Valve

Location	Asset Description
Unit 2 Pump Station	North Scum Isolation Valve
Unit 2 Pump Station	Primary Sludge Inlet Check Valve
Unit 2 Pump Station	Primary Sludge Inlet Isolation Valve
Unit 2 Pump Station	Primary Sludge Inlet Isolation Valve 2
Unit 2 Pump Station	Scum Pump Motor
Unit 2 Pump Station	Scum Pump No. 1
Unit 2 Pump Station	South Scum Isolation Valve
Unit 2 Pump Station	WAS Pump No. 1 Suction Isolation Valve
Unit 2 Pump Station	WAS Pump No. 1 VFD
Unit 2 Pump Station	WAS Pumps Common Suction Piping
Unit 2 South Aeration Basins	2S Bay 2 Mixer No. 3
Unit 2 South Aeration Basins	2S Bay 5 Mixer No. 3
Unit 2 South Secondary Clarifier	Unit 2 South Secondary Clarifier Drain Valve
Unit 2 South Secondary Clarifier	Unit 2 South Secondary Clarifier Scum Box
Unit 2 South Secondary Clarifier	Unit 2 South Secondary Clarifier Scum Skimmer
Hazardous Materials Storage Area	Hazardous Materials Storage Structure
Bio-Solids Storage Beds	Bio-Solids Storage Beds Containment Structure
Combination Truck Unloading Bed	Combination Truck Unloading Bed Containment Structure
Dewatering & Thickening (D&T) Building	Recycle Pressurization Pump No. 2 - Check Valve
Dewatering & Thickening (D&T) Building	Recycle Pressurization Pump No. 2 - Plant Water Suction - Isolation Valve
Dewatering & Thickening (D&T) Building	Thickened Sludge Pump No. 1 - Common Suction Drain Isolation Valve
Dewatering & Thickening (D&T) Building	Thickened Sludge Pump No. 2B - Check Valve
Dewatering & Thickening (D&T) Building	Thickened Sludge Pump No. 4 - Common Suction Left Isolation Valve
Dewatering & Thickening (D&T) Building	Digester TWAS Feed A Pneumatic Valve
Dewatering & Thickening (D&T) Building	Heat Exchanger A
Dewatering & Thickening (D&T) Building	Heat Exchanger C
Dewatering & Thickening (D&T) Building	Heat Exchanger D
Dewatering & Thickening (D&T) Building	Hot Water Loop A Piping
Dewatering & Thickening (D&T) Building	Hot Water Loop C Piping
Dewatering & Thickening (D&T) Building	Hot Water Loop D Piping
Dewatering & Thickening (D&T) Building	Hot Water Loop Supply A - Inlet - Isolation Valve
Dewatering & Thickening (D&T) Building	Hot Water Loop Supply A - Outlet - Isolation Valve
Dewatering & Thickening (D&T) Building	Hot Water Loop Supply A Check Valve
Dewatering & Thickening (D&T) Building	Hot Water Loop Supply A Valve and Actuator
Dewatering & Thickening (D&T) Building	Hot Water Loop Supply C - Inlet - Isolation Valve
Dewatering & Thickening (D&T) Building	Hot Water Loop Supply C - Outlet - Isolation Valve

Location	Asset Description
Dewatering & Thickening (D&T) Building	Hot Water Loop Supply C - Pump Discharge - Isolation Valve
Dewatering & Thickening (D&T) Building	Hot Water Loop Supply C Valve and Actuator
Dewatering & Thickening (D&T) Building	Hot Water Loop Supply C Check Valve
Dewatering & Thickening (D&T) Building	Hot Water Loop Supply D - Inlet - Isolation Valve
Dewatering & Thickening (D&T) Building	Hot Water Loop Supply D - Outlet - Isolation Valve
Dewatering & Thickening (D&T) Building	Hot Water Loop Supply D - Pump Discharge - Isolation Valve
Dewatering & Thickening (D&T) Building	Hot Water Loop Supply D Valve and Actuator
Dewatering & Thickening (D&T) Building	Hot Water Loop Supply D Check Valve
Dewatering & Thickening (D&T) Building	Recirculated Sludge Discharge Check Valve A
Dewatering & Thickening (D&T) Building	Recirculated Sludge Discharge Check Valve C
Dewatering & Thickening (D&T) Building	Recirculated Sludge Discharge Check Valve D
Dewatering & Thickening (D&T) Building	Recirculation Sludge Pump A
Dewatering & Thickening (D&T) Building	Recirculation Sludge Pump C
Dewatering & Thickening (D&T) Building	Recirculation Sludge Pump D
Dewatering & Thickening (D&T) Building	DAF No. 1 Check Valve
Dewatering Building & Conveyors 1 & 2	Belt Press 3
Dewatering Building & Conveyors 1 & 2	Pump 1
Dewatering Building & Conveyors 1 & 2	Scrubber 1 Foul Air Blower
Dewatering Building & Conveyors 1 & 2	Scrubber 1 Recirculating Pump 1
Dewatering Building & Conveyors 1 & 2	Scrubber 1 Recirculating Pump 2
Dewatering Building & Conveyors 1 & 2	Scrubber 2 Foul Air Blower
Dewatering Building & Conveyors 1 & 2	Scrubber 2 Recirculating Pump 1
Dewatering Building & Conveyors 1 & 2	Scrubber 2 Recirculating Pump 1 Motor
Dewatering Building & Conveyors 1 & 2	Scrubber 2 Recirculating Pump 2
Dewatering Building & Conveyors 1 & 2	Scrubber 2 Recirculating Pump 2 Motor
Dewatering Building & Conveyors 1 & 2	Filtrate Pump 3
Grit Dewatering Bed	Grit Dewatering Bed Containment Structure
Manual Biosolids Loading Bed	Manual Biosolids Loading Bed Containment Structure
Boiler Building	Boiler No. 1 Hot Water Return Control Valve
Boiler Building	Boiler No. 1 Hot Water Return Isolation Valve
Boiler Building	Boiler No. 1 Hot Water Supply Isolation Valve
Boiler Building	Boiler No. 2 Hot Water Return Control Valve
Boiler Building	East Boiler Hot Water Supply Check Valve
Boiler Building	East Boiler Hot Water Supply Isolation Valve
Boiler Building	Expansion Tanks No. 1
Boiler Building	Expansion Tanks No. 2
Boiler Building	Hot Water Return Piping

Location	Asset Description
Boiler Building	Hot Water Supply Piping
Boiler Building	West Boiler Hot Water Supply Check Valve
Boiler Building	West Boiler Hot Water Supply Isolation Valve
Boiler Building	Hot Water Return Inlet Isolation Valve from Roots Bldg.
Boiler Building	Hot Water Supply - Inlet Piping Assembly
Boiler Building	Hot Water Supply - Outlet Piping Assembly
Boiler Building	Hot Water Supply Isolation Valve to D&T Heat Exchangers
Boiler Building	North Inlet Isolation Valve from Roots Bldg.
Boiler Building	South Inlet Isolation Valve from Roots Bldg.
Boiler Building	MCC BB Cabinet
Boiler Building	Exhaust Fans No. 1
Boiler Building	Exhaust Fans No. 2
Digester A	Flame Arrestor Downstream Isolation Valve
Digester A	Flame Arrestor Upstream Isolation Valve
Digester A	Sludge Overflow Isolation Valve to Draw Out
Digester A	Tank Draw Out Isolation Valve No. 1
Digester A	Tank Draw Out Isolation Valve No. 2 (to Dewatering)
Digester B	Digester Tank B
Digester C	Sludge Mixing Motor
Digester C	Bottom Sludge Draw Common Isolation Valve
Digester C	Bottom Sludge Draw Isolation Valve
Digester C	Bottom Sludge Draw Isolation Valve No. 1
Digester C	Bottom Sludge Draw Isolation Valve No. 2
Digester C	Bottom Sludge Draw Isolation Valve No. 3
Digester C	Bottom Sludge Draw Isolation Valve No. 4
Digester C	Heated Sludge Return Bypass Isolation Valve
Digester C	Heated Sludge Return Inlet Isolation Valve
Digester C	Heated Sludge Return Isolation Valve
Digester D	Heated Sludge Return Common Isolation Valve
Digester D	Heated Sludge Return Inlet Isolation Valve
Digester D	Heated Sludge Return Isolation Valve
Dissolved Air Flotation Thickener (DAFT) 1	Back Pressure Control Valve
Dissolved Air Flotation Thickener (DAFT) 1	DAF Drive Unit Assembly
Dissolved Air Flotation Thickener (DAFT) 1	Propeller Meter
Dissolved Air Flotation Thickener (DAFT) 2	Back Pressure Control Valve
Dissolved Air Flotation Thickener (DAFT) 2	DAF Drive Unit Assembly
Dissolved Air Flotation Thickener (DAFT) 2	Propeller Meter
South Digested Sludge Storage Tank	Foul Air Piping Assembly

Hazen

Appendix B – List of High CoF Assets

#	Location	Asset Description	CoF
1	Arrowhead Lift Station	Main Switchgear Panel A	10
2	Arrowhead Lift Station	MCC 2 Cabinet	10
3	Arrowhead Lift Station	MCC 2E Cabinet	10
4	Arrowhead Lift Station	Arrowhead Allen-Bradley PLC	10
5	Arrowhead Lift Station	Arrowhead PLC-16	10
6	Arrowhead Lift Station	Compressor Room AC to DC Transformer	10
7	Bar Screen Building	Gas Sensor Assembly	10
8	Boiler Building	MCC BB Cabinet	10
9	Burner Building	MCC-4 Cabinet	10
10	Burner Building	MCC-4E Cabinet	10
11	Burner Building	Burner Building Panel PLC-12	10
12	Burner Building	Main Service and Distribution Panel	10
13	Cogeneration Building	MCC-7E	10
14	Dewatering & Thickening (D&T) Building	Digester Control Panel PLC-11	10
15	Dewatering Building & Conveyors 1 & 2	Belt Press PLC-14	10
16	East Lift Station	Gas Detection System	10
17	Gas Compression Area	MCC CO	10
18	Gas Compression Area	MCC COE	10
19	Headworks Electrical Building	Uninterruptible Power Supply (UPS) for PLC	10
20	Headworks Electrical Building	MCC H1E Cabinet - Northside	10
21	Headworks Electrical Building	MCC H1E Cabinet - SouthSide	10
22	Headworks Electrical Building	MCC H2E Cabinet	10
23	Headworks Electrical Building	H3E-401 Caustic Scrubber No.1 Foul Air Blower Combination Starter	10
24	Headworks Electrical Building	MCC H3E Cabinet	10
25	Headworks Electrical Building	MCC H4E Cabinet	10
26	Headworks Electrical Building	Emergency Switchboard	10
27	Headworks Electrical Building	H1E Automatic Transfer Switch	10
28	Headworks Electrical Building	H2E Automatic Transfer Switch	10
29	Headworks Electrical Building	Load Bank, Edison	10
30	Headworks Electrical Building	Load Bank, Generator	10
31	Headworks Electrical Building	Main Breaker, Edison H401	10
32	Headworks Electrical Building	Main Breaker, Edison H402	10
33	Headworks Electrical Building	Main Breaker, Generator HE401	10
34	Headworks Electrical Building	Main Breaker, Generator HE402	10

Hazen

#	Location	Asset Description	CoF
35	Headworks Electrical Building	Main Swichboard	10
36	Headworks Electrical Building	Headworks Electrical Building Main Switchgear	10
37	Headworks Electrical Building	Headworks Electrical Transformer	10
38	Hoffman Building	Alarm Reset	10
39	Hoffman Building	Main Breaker	10
40	Hoffman Building	Main Swichboard MS to COGEN	10
41	Hoffman Building	Main Switchboard MS	10
42	Hoffman Building	MS No. 5 2 MCC DAF	10
43	Hoffman Building	MS No.6 - 2 MCC Sludge Disposal Building	10
44	Hoffman Building	MS-1 Spare	10
45	Hoffman Building	MS-2 LTS/Power LC	10
46	Hoffman Building	Switchgear - Pumphouse 2 MCC RS	10
47	Hoffman Building	Hoffman MCC	10
48	Hoffman Building	MS-10 Switchgear - Feeding RAS MCC (RS-1 Building) and Switchgear	10
49	Hoffman Building	Switchboard (Century Well 400 A)	10
50	Hoffman Building	Switchboard STB	10
51	Influent Metering Structure	Safety Shower and Eyewash Station	10
52	Internal Recycle Metering Structure	Gas Detector/Transmitter Panel	10
53	Main Switchgear (BLM)	Blower No. 4 Fuse	10
54	Main Switchgear (BLM)	Blower No. 5 Fuse	10
55	Main Switchgear (BLM)	Cogen Fuse	10
56	Main Switchgear (BLM)	Headworks Fuse	10
57	Main Switchgear (BLM)	Main Circuit Breaker	10
58	Main Switchgear (BLM)	NRC Fuse	10
59	Main Switchgear (BLM)	Roots Circuit Breakers	10
60	Main Switchgear (BLM)	Roots Transformer	10
61	NRC Building	NRC PLC-23	10
62	Old Blue Generator Building	MCC 6E Cabinet	10
63	Old Blue Generator Building	400 A Auto Transfer Switch	10
64	Old Blue Generator Building	Automatic Two Way Charger	10
65	Old Blue Generator Building	Emergency Main Panel 1	10
66	Outfall Sampling Station	Outfall PLC-19	10
67	Outfall Sampling Station	Outfall Transformer	10
68	Roots Blower Building	Blower No. 4 Bypass Contactor	10
69	Roots Blower Building	Blower No. 4 Bypass Isolation switch	10
70	Roots Blower Building	Blower No. 4 I/O Cabinet	10
71	Roots Blower Building	Blower No. 5 Bypass Contactor	10

#	Location	Asset Description	CoF
72	Roots Blower Building	Blower No. 5 Bypass Isolation Switch	10
73	Roots Blower Building	Blower No. 5 I/O Cabinet	10
74	Roots Blower Building	MCC B Cabinet	10
75	Roots Blower Building	Lighting Panel (LP-B)	10
76	Roots Blower Building	North Transformer	10
77	Roots Blower Building	Roots PLC 18	10
78	Roots Blower Building	South Transformer	10
79	RS-1 Pump Station	RS-1 PLC-26	10
80	Unit 1 Pump Station	Unit 1 PLC-13	10
81	Unit 2 Pump Station	Unit 2 PLC-17	10

Location	Asset Description
Burner Building	MCC-4 Cabinet
Burner Building	MCC-4E Cabinet
Burner Building	Burner Building Panel PLC-12
Burner Building	Main Service and Distribution Panel
Cogeneration Building	MCC-7E
Hoffman Building	Alarm Reset
Hoffman Building	Main Breaker
Hoffman Building	Main Swichboard MS to COGEN
Hoffman Building	Main Switchboard MS
Hoffman Building	MS No. 5 2 MCC DAF
Hoffman Building	MS No.6 - 2 MCC Sludge Disposal Building
Hoffman Building	MS-1 Spare
Hoffman Building	MS-2 LTS/Power LC
Hoffman Building	Switchgear - Pumphouse 2 MCC RS
Hoffman Building	Hoffman MCC
Hoffman Building	MS-10 Switchgear - Feeding RAS MCC (RS-1 Building) and Switchgear
Hoffman Building	Switchboard (Century Well 400 A)
Hoffman Building	Switchboard STB
Main Switchgear (BLM)	Blower No. 4 Fuse
Main Switchgear (BLM)	Blower No. 5 Fuse
Main Switchgear (BLM)	Cogen Fuse
Main Switchgear (BLM)	Headworks Fuse
Main Switchgear (BLM)	Main Circuit Breaker
Main Switchgear (BLM)	Main Switchgear (BLM)
Main Switchgear (BLM)	NRC Fuse

Location	Asset Description
Main Switchgear (BLM)	Roots Building Fuse
Main Switchgear (BLM)	Roots Circuit Breakers
Main Switchgear (BLM)	Roots Transformer
Old Blue Generator Building	MCC 6E Cabinet
Old Blue Generator Building	400 A Auto Transfer Switch
Old Blue Generator Building	Automatic Two Way Charger
Old Blue Generator Building	Emergency Generator
Old Blue Generator Building	Emergency Main Panel 1
Existing 0.06 Flare	Burner Assembly
Gas Compression Area	Inlet Flame Arrestor No. 1
Gas Compression Area	Inlet Flame Arrestor No. 2
Gas Compression Area	Outlet Flame Arrestor No. 1
Gas Compression Area	Outlet Flame Arrestor No. 2
Gas Compression Area	MCC CO
Gas Compression Area	MCC COE
Gas Compression Area	Gas Compressor PLC-20
Arrowhead Lift Station	Main Switchgear Panel A
Arrowhead Lift Station	MCC 2 Cabinet
Arrowhead Lift Station	MCC 2E Cabinet
Arrowhead Lift Station	Arrowhead Allen-Bradley PLC
Arrowhead Lift Station	Arrowhead PLC-16
Arrowhead Lift Station	Compressor Room AC to DC Transformer
East Lift Station	Gas Detection System
Outfall Sampling Station	Outfall PLC-19
Outfall Sampling Station	Outfall Transformer
Bar Screen Building	Gas Sensor Assembly
Headworks Electrical Building	Uninterruptible Power Supply (UPS) for PLC
Headworks Electrical Building	MCC H1E Cabinet - Northside
Headworks Electrical Building	MCC H1E Cabinet - SouthSide
Headworks Electrical Building	MCC H2E Cabinet
Headworks Electrical Building	H3E-401 Caustic Scrubber No.1 Foul Air Blower Combination Starter
Headworks Electrical Building	MCC H3E Cabinet
Headworks Electrical Building	MCC H4E Cabinet
Headworks Electrical Building	Emergency Switchboard
Headworks Electrical Building	H1E Automatic Transfer Switch
Headworks Electrical Building	H2E Automatic Transfer Switch
Headworks Electrical Building	Load Bank, Edison
Headworks Electrical Building	Load Bank, Generator
Headworks Electrical Building	Main Breaker, Edison H401

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Location	Asset Description
Headworks Electrical Building	Main Breaker, Edison H402
Headworks Electrical Building	Main Breaker, Generator HE401
Headworks Electrical Building	Main Breaker, Generator HE402
Headworks Electrical Building	Main Swichboard
Headworks Electrical Building	Headworks Electrical Building Main Switchgear
Headworks Electrical Building	Headworks Electrical Transformer
Headworks Generator Building	Day Tank Assembly
Headworks Generator Building	Generator Fuel Tank (Underground)
Headworks Generator Building	Standby Generator Assembly
Influent Metering Structure	Safety Shower and Eyewash Station
Internal Recycle Metering Structure	Gas Detector/Transmitter Panel
Unit 1 Pump Station	Unit 1 PLC-13
Unit 2 Pump Station	Unit 2 PLC-17
NRC Building	NRC PLC-23
Roots Blower Building	Blower No. 4 Bypass Contactor
Roots Blower Building	Blower No. 4 Bypass Isolation switch
Roots Blower Building	Blower No. 4 I/O Cabinet
Roots Blower Building	Blower No. 5 Bypass Contactor
Roots Blower Building	Blower No. 5 Bypass Isolation Switch
Roots Blower Building	Blower No. 5 I/O Cabinet
Roots Blower Building	Blower No.4
Roots Blower Building	Blower No.5
Roots Blower Building	MCC B Cabinet
Roots Blower Building	Lighting Panel (LP-B)
Roots Blower Building	North Transformer
Roots Blower Building	Roots PLC 18
Roots Blower Building	South Transformer
RS-1 Pump Station	RS-1 PLC-26
Dewatering & Thickening (D&T) Building	Digester Control Panel PLC-11
Dewatering Building & Conveyors 1 & 2	Belt Press PLC-14
Boiler Building	MCC BB Cabinet

Appendix C – List of High Risk Assets

#	Location	Asset Description	PoF	CoF	Risk
1	Boiler Building	MCC BB Cabinet	100%	10	10.0
2	Old Blue Generator Building	MCC 6E Cabinet	100%	10	10.0
3	Old Blue Generator Building	Emergency Main Panel 1	100%	10	10.0
4	RS-1 Pump Station	RS-1 PLC-26	100%	10	10.0
5	Arrowhead Lift Station	Common Discharge Header Isolation Valve	100%	8	8.0
6	Arrowhead Lift Station	MCC 2 Cabinet	84%	10	8.0
7	Arrowhead Lift Station	MCC 2E Cabinet	84%	10	8.0
8	Arrowhead Lift Station	Control Cabinet for Pumps 1-4	100%	8	8.0
9	Bar Screen Building	Air Flow Meter	100%	8	8.0
10	Bar Screen Building	Bar Screen Inlet Channel - Air Flow Meter	100%	8	8.0
11	Boiler Building	Boiler No. 1 Hot Water Return Control Valve	100%	8	8.0
12	Boiler Building	Boiler No. 1 Hot Water Return Isolation Valve	100%	8	8.0
13	Boiler Building	Boiler No. 1 Hot Water Supply Isolation Valve	100%	8	8.0
14	Boiler Building	Boiler No. 2 Hot Water Return Control Valve	100%	8	8.0
15	Burner Building	MCC-4 Cabinet	84%	10	8.0
16	Burner Building	MCC-4E Cabinet	84%	10	8.0
17	Headworks Electrical Building	Blower No. 1 Soft Starter	100%	8	8.0
18	North Outfall Structure	Unit 2 Sluice Gate	100%	8	8.0
19	Old Blue Generator Building	400 A Auto Transfer Switch	84%	10	8.0
20	RS-1 Pump Station	UST Monitoring System	100%	8	8.0
21	Arrowhead Lift Station	Arrowhead PLC-16	65%	10	7.0
22	Arrowhead Lift Station	Compressor Room AC to DC Transformer	65%	10	7.0
23	Bar Screen Building	Bar Screen No. 1 Assembly	84%	8	7.0
24	Bar Screen Building	Bar Screen No. 2 Assembly	84%	8	7.0
25	Bar Screen Building	Bar Screen Outlet Channel - Flow Meter	84%	8	7.0
26	Boiler Building	East Boiler Hot Water Supply Isolation Valve	84%	8	7.0
27	Boiler Building	Hot Water Return Piping	84%	8	7.0
28	Boiler Building	Hot Water Supply Piping	84%	8	7.0
29	Boiler Building	West Boiler Hot Water Supply Isolation Valve	84%	8	7.0
30	Boiler Building	Hot Water Return Inlet Isolation Valve from Roots Bldg.	84%	8	7.0
31	Boiler Building	Hot Water Supply - Inlet Piping Assembly	84%	8	7.0
32	Boiler Building	Hot Water Supply - Outlet Piping Assembly	84%	8	7.0
33	Boiler Building	Hot Water Supply Isolation Valve to D&T Heat Exchangers	84%	8	7.0
34	Boiler Building	North Inlet Isolation Valve from Roots Bldg.	84%	8	7.0

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#	Location	Asset Description	PoF	CoF	Risk
35	Boiler Building	South Inlet Isolation Valve from Roots Bldg.	84%	8	7.0
36	Cogeneration Building	MCC-7E	65%	10	7.0
37	Dewatering & Thickening (D&T) Building	Digester Control Panel PLC-11	65%	10	7.0
38	Dewatering Building & Conveyors 1 & 2	Belt Press PLC-14	65%	10	7.0
39	East Lift Station	Screw Pumps Inlet Channel - Air Flow Meter	84%	8	7.0
40	East Lift Station	Screw Pumps Outlet Channel - Air Flow Meter	84%	8	7.0
41	East Lift Station	Gas Detection System	65%	10	7.0
42	Headworks Electrical Building	MCC H1E Cabinet - Northside	65%	10	7.0
43	Headworks Electrical Building	MCC H1E Cabinet - SouthSide	65%	10	7.0
44	Headworks Electrical Building	MCC H2E Cabinet	65%	10	7.0
45	Headworks Electrical Building	H3E-401 Caustic Scrubber No.1 Foul Air Blower Combination Starter	65%	10	7.0
46	Headworks Electrical Building	MCC H3E Cabinet	65%	10	7.0
47	Headworks Electrical Building	MCC H4E Cabinet	65%	10	7.0
48	Headworks Electrical Building	Emergency Switchboard	65%	10	7.0
49	Headworks Electrical Building	H1E Automatic Transfer Switch	65%	10	7.0
50	Headworks Electrical Building	H2E Automatic Transfer Switch	65%	10	7.0
51	Headworks Electrical Building	Load Bank, Edison	65%	10	7.0
52	Headworks Electrical Building	Load Bank, Generator	65%	10	7.0
53	Headworks Electrical Building	Main Breaker, Edison H401	65%	10	7.0
54	Headworks Electrical Building	Main Breaker, Edison H402	65%	10	7.0
55	Headworks Electrical Building	Main Breaker, Generator HE401	65%	10	7.0
56	Headworks Electrical Building	Main Breaker, Generator HE402	65%	10	7.0
57	Headworks Electrical Building	Main Swichboard	65%	10	7.0
58	Headworks Electrical Building	Headworks Electrical Building Main Switchgear	65%	10	7.0
59	Headworks Electrical Building	Headworks Electrical Transformer	65%	10	7.0
60	Headworks Electrical Building	Aeration Blowers VFD No. 1	84%	8	7.0
61	Hoffman Building	Alarm Reset	65%	10	7.0
62	Hoffman Building	Main Breaker	65%	10	7.0
63	Hoffman Building	Main Swichboard MS to COGEN	65%	10	7.0
64	Hoffman Building	Main Switchboard MS	65%	10	7.0
65	Hoffman Building	MS No. 5 2 MCC DAF	65%	10	7.0
66	Hoffman Building	MS No.6 - 2 MCC Sludge Disposal Building	65%	10	7.0
67	Hoffman Building	MS-1 Spare	65%	10	7.0
68	Hoffman Building	MS-2 LTS/Power LC	65%	10	7.0
69	Hoffman Building	Switchgear - Pumphouse 2 MCC RS	65%	10	7.0
70	Hoffman Building	Hoffman MCC	65%	10	7.0

#	Location	Asset Description	PoF	CoF	Risk
71	Hoffman Building	MS-10 Switchgear - Feeding RAS MCC (RS-1 Building) and Switchgear	65%	10	7.0
72	Hoffman Building	Switchboard (Century Well 400 A)	65%	10	7.0
73	Hoffman Building	Switchboard STB	65%	10	7.0
74	Influent Metering Structure	Safety Shower and Eyewash Station	65%	10	7.0
75	Internal Recycle Metering Structure	Gas Detector/Transmitter Panel	65%	10	7.0
76	Internal Recycle Metering Structure	Recycle Flow Meter Bypass Isolation Valve	84%	8	7.0
77	Main Switchgear (BLM)	Blower No. 4 Fuse	65%	10	7.0
78	Main Switchgear (BLM)	Blower No. 5 Fuse	65%	10	7.0
79	Main Switchgear (BLM)	Cogen Fuse	65%	10	7.0
80	Main Switchgear (BLM)	Headworks Fuse	65%	10	7.0
81	Main Switchgear (BLM)	Main Circuit Breaker	65%	10	7.0
82	Main Switchgear (BLM)	NRC Fuse	65%	10	7.0
83	Main Switchgear (BLM)	Roots Building Fuse	65%	10	7.0
84	Main Switchgear (BLM)	Roots Circuit Breakers	65%	10	7.0
85	Main Switchgear (BLM)	Roots Transformer	65%	10	7.0
86	North Outfall Structure	Lagoon Sluice Gate	84%	8	7.0
87	North Outfall Structure	North Outfall - Drain Valve	84%	8	7.0
88	North Outfall Structure	Sluice Gate No. 1	84%	8	7.0
89	Old Blue Generator Building	Emergency Generator	65%	10	7.0
90	Outfall Sampling Station	Outfall PLC-19	65%	10	7.0
91	Outfall Sampling Station	Outfall Transformer	65%	10	7.0
92	Roots Blower Building	Blower No. 4 Bypass Contactor	65%	10	7.0
93	Roots Blower Building	Blower No. 4 Bypass Isolation switch	65%	10	7.0
94	Roots Blower Building	Blower No.5	65%	10	7.0
95	Roots Blower Building	North Transformer	65%	10	7.0
96	Roots Blower Building	Roots PLC 18	65%	10	7.0
97	Roots Blower Building	South Transformer	65%	10	7.0
98	RS-1 Pump Station	RS-1 Pump Station MCC9 - Cabinet	84%	8	7.0
99	RS-1 Pump Station	RS-1 Pump Station MCC 9E - Cabinet	84%	8	7.0
100	South Outfall Structure	South Lagoon Sluice Gate	84%	8	7.0
101	Unit 2 Pump Station	MCC 3 Cabinet	84%	8	7.0
102	Unit 2 Pump Station	MCC 3E	84%	8	7.0
103	Unit 2 Pump Station	Unit 2 PLC-17	65%	10	7.0

Location	Asset Description
Burner Building	MCC-4 Cabinet
Burner Building	MCC-4E Cabinet
Cogeneration Building	MCC-7E
Hoffman Building	Alarm Reset
Hoffman Building	Main Breaker
Hoffman Building	Main Swichboard MS to COGEN
Hoffman Building	Main Switchboard MS
Hoffman Building	MS No. 5 2 MCC DAF
Hoffman Building	MS No.6 - 2 MCC Sludge Disposal Building
Hoffman Building	MS-1 Spare
Hoffman Building	MS-2 LTS/Power LC
Hoffman Building	Switchgear - Pumphouse 2 MCC RS
Hoffman Building	Hoffman MCC
Hoffman Building	MS-10 Switchgear - Feeding RAS MCC (RS-1 Building) and Switchgear
Hoffman Building	Switchboard (Century Well 400 A)
Hoffman Building	Switchboard STB
Main Switchgear (BLM)	Blower No. 4 Fuse
Main Switchgear (BLM)	Blower No. 5 Fuse
Main Switchgear (BLM)	Cogen Fuse
Main Switchgear (BLM)	Headworks Fuse
Main Switchgear (BLM)	Main Circuit Breaker
Main Switchgear (BLM)	NRC Fuse
Main Switchgear (BLM)	Roots Building Fuse
Main Switchgear (BLM)	Roots Circuit Breakers
Main Switchgear (BLM)	Roots Transformer
Old Blue Generator Building	MCC 6E Cabinet
Old Blue Generator Building	400 A Auto Transfer Switch
Old Blue Generator Building	Emergency Generator

Location	Asset Description
Old Blue Generator Building	Emergency Main Panel 1
Existing 0.06 Flare	Burner Assembly
Gas Compression Area	Gas Compression Pump No. 1
Gas Compression Area	Gas Compression Pump No. 2
Gas Compression Area	Inlet Flame Arrestor No. 1
Gas Compression Area	Inlet Flame Arrestor No. 2
Gas Compression Area	Outlet Flame Arrestor No. 1
Gas Compression Area	Outlet Flame Arrestor No. 2
Gas Compression Area	Compressor Master Control Panel
Gas Compression Area	Control Panel
Gas Compression Area	Gas Compressor PLC-20
Arrowhead Lift Station	Common Discharge Header Isolation Valve
Arrowhead Lift Station	MCC 2 Cabinet
Arrowhead Lift Station	MCC 2E Cabinet
Arrowhead Lift Station	Arrowhead PLC-16
Arrowhead Lift Station	Compressor Room AC to DC Transformer
Arrowhead Lift Station	Control Cabinet for Pump 2 & 3
East Lift Station	Screw Pumps Inlet Channel - Air Flow Meter
East Lift Station	Screw Pumps Outlet Channel - Air Flow Meter
East Lift Station	Gas Detection System
North Outfall Structure	Lagoon Sluice Gate
North Outfall Structure	North Outfall - Drain Valve
North Outfall Structure	Sluice Gate No. 1
North Outfall Structure	Unit 2 Sluice Gate
Outfall Sampling Station	Outfall PLC-19

Location	Asset Description
Outfall Sampling Station	Outfall Transformer
South Outfall Structure	South Lagoon Sluice Gate
Bar Screen Building	Bar Screen No. 1 Assembly
Bar Screen Building	Bar Screen No. 2 Assembly
Bar Screen Building	Air Flow Meter
Bar Screen Building	Bar Screen Inlet Channel - Air Flow Meter
Bar Screen Building	Bar Screen Outlet Channel - Flow Meter
Headworks Electrical Building	MCC H1E Cabinet - Northside
Headworks Electrical Building	MCC H1E Cabinet - SouthSide
Headworks Electrical Building	MCC H2E Cabinet
Headworks Electrical Building	H3E-401 Caustic Scrubber No.1 Foul Air Blower Combination Starter
Headworks Electrical Building	MCC H3E Cabinet
Headworks Electrical Building	MCC H4E Cabinet
Headworks Electrical Building	Emergency Switchboard
Headworks Electrical Building	H1E Automatic Transfer Switch
Headworks Electrical Building	H2E Automatic Transfer Switch
Headworks Electrical Building	Load Bank, Edison
Headworks Electrical Building	Load Bank, Generator
Headworks Electrical Building	Main Breaker, Edison H401
Headworks Electrical Building	Main Breaker, Edison H402
Headworks Electrical Building	Main Breaker, Generator HE401
Headworks Electrical Building	Main Breaker, Generator HE402
Headworks Electrical Building	Main Swichboard
Headworks Electrical Building	Headworks Electrical Building Main Switchgear

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Location	Asset Description
Headworks Electrical Building	Headworks Electrical Transformer
Headworks Electrical Building	Aeration Blowers VFD No. 1
Headworks Electrical Building	Blower No. 1 Soft Starter
Influent Metering Structure	East Sewer Influent Flow Meter
Influent Metering Structure	Safety Shower and Eyewash Station
Internal Recycle Metering Structure	Gas Detector/Transmitter Panel
Internal Recycle Metering Structure	Recycle Flow Meter Bypass Isolation Valve
Unit 2 Pump Station	MCC 3 Cabinet
Unit 2 Pump Station	MCC 3E
Unit 2 Pump Station	Unit 2 PLC-17
Roots Blower Building	Blower No. 4 Bypass Contactor
Roots Blower Building	Blower No. 4 Bypass Isolation switch
Roots Blower Building	Blower No.5
Roots Blower Building	North Transformer
Roots Blower Building	Roots PLC 18
Roots Blower Building	South Transformer
RS-1 Pump Station	UST Monitoring System
RS-1 Pump Station	RS-1 Pump Station MCC9 - Cabinet
RS-1 Pump Station	RS-1 Pump Station MCC 9E - Cabinet
RS-1 Pump Station	RS-1 PLC-26
Dewatering & Thickening (D&T) Building	Digester Control Panel PLC-11
Dewatering Building & Conveyors 1 & 2	Belt Press PLC-14
Boiler Building	Boiler No. 1 Hot Water Return Control Valve
Boiler Building	Boiler No. 1 Hot Water Return Isolation Valve
Boiler Building	Boiler No. 1 Hot Water Supply Isolation Valve

Location	Asset Description
Boiler Building	Boiler No. 2 Hot Water Return Control Valve
Boiler Building	East Boiler Hot Water Supply Isolation Valve
Boiler Building	Hot Water Return Piping
Boiler Building	Hot Water Supply Piping
Boiler Building	West Boiler Hot Water Supply Isolation Valve
Boiler Building	Hot Water Return Inlet Isolation Valve from Roots Bldg.
Boiler Building	Hot Water Supply - Inlet Piping Assembly
Boiler Building	Hot Water Supply - Outlet Piping Assembly
Boiler Building	Hot Water Supply Isolation Valve to D&T Heat Exchangers
Boiler Building	North Inlet Isolation Valve from Roots Bldg.
Boiler Building	South Inlet Isolation Valve from Roots Bldg.
Boiler Building	MCC BB Cabinet

Appendix D – List of High and Medium Risk Assets at End of Useful Life

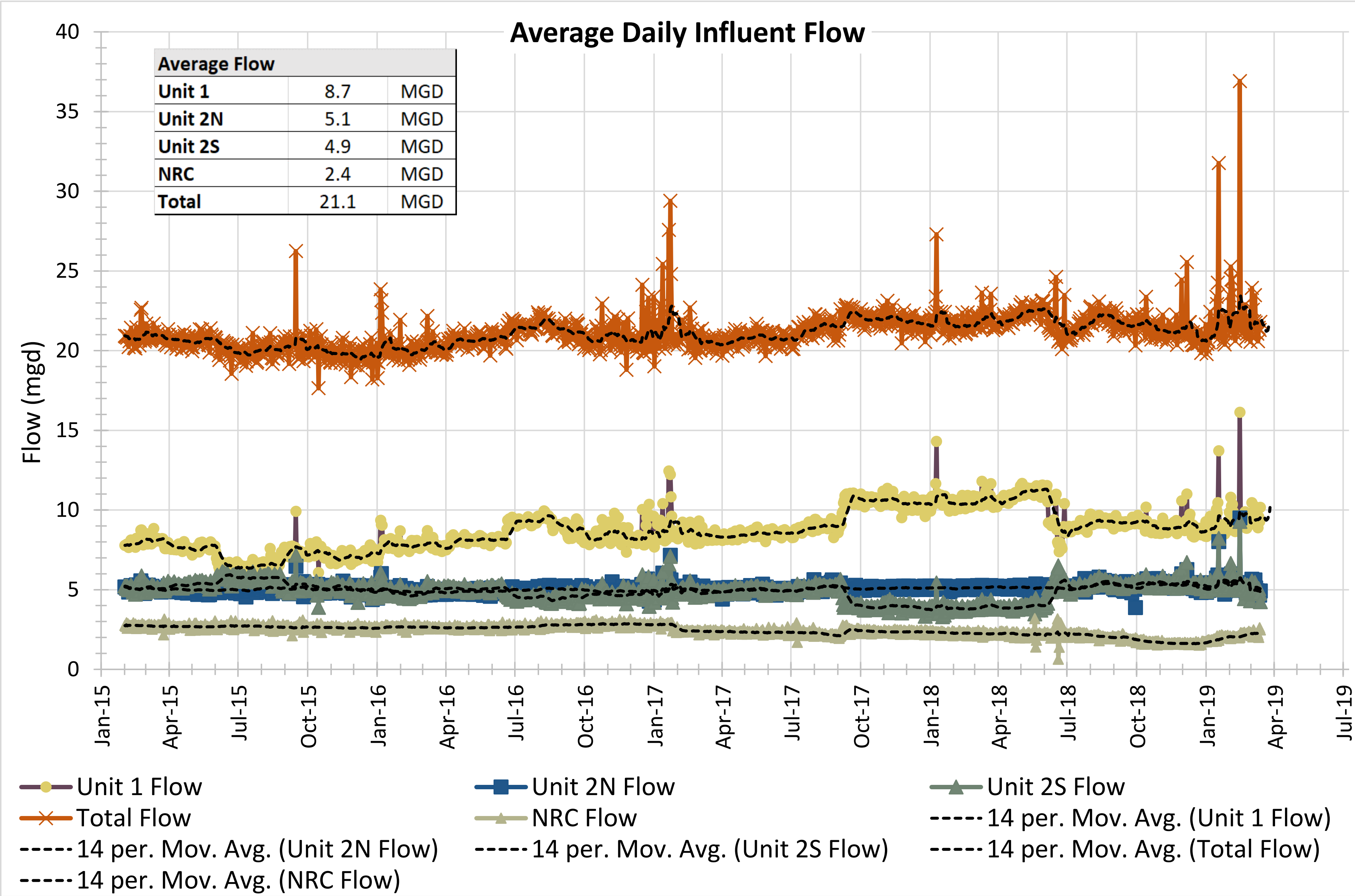
#	Location	Asset Description	Risk Level
1	Burner Building	Electrical Room Air Conditioning Unit	Medium Risk
2	Cogeneration Building	Cogeneration Building	Medium Risk
3	Old Blue Generator Building	MCC 6E Cabinet	High Risk
4	Old Blue Generator Building	Emergency Main Panel 1	High Risk
5	Arrowhead Lift Station	Common Discharge Header Isolation Valve	High Risk
6	Arrowhead Lift Station	Compressor Room Compressed Air Dryer	Medium Risk
7	Arrowhead Lift Station	Control Cabinet for Pump 1-4	High Risk
8	Arrowhead Lift Station	Gas Engine 1&2 Swamp Coolers	Medium Risk
9	Arrowhead Lift Station	Gas Engine 3&4 Swamp Coolers	Medium Risk
10	Unit 1 Chlorine Contact Basins	Influent Isolation Valve	Medium Risk
11	Unit 1 Chlorine Contact Basins	Unit 1 Chlorine Contact Basin Structure	Medium Risk
12	Sludge Storage Odor Scrubber	Combined Flow meter	Medium Risk
13	Sludge Storage Odor Scrubber	Flow Meter from North SST	Medium Risk
14	Sludge Storage Odor Scrubber	Flow Meter from South SST	Medium Risk
15	North Outfall Structure	Unit 2 Sluice Gate	High Risk
16	Bar Screen Building	Air Flow Meter	High Risk
17	Bar Screen Building	Bar Screen Inlet Channel - Air Flow Meter	High Risk
18	Grit Chambers	Grit Chamber No. 1 Assembly	Medium Risk
19	Grit Chambers	Grit Chamber No. 2 Assembly	Medium Risk
20	Grit Chambers	Grit Chamber No. 3 Assembly	Medium Risk
21	Grit Chambers	Grit Slurry Pump No. 2 Motor	Medium Risk
22	Headworks Blower Building	Air Discharge Flow Meter	Medium Risk
23	Headworks Blower Building	Blower No. 1 Control Cabinet	Medium Risk
24	Headworks Blower Building	Blower No. 2 Control Cabinet	Medium Risk
25	Headworks Blower Building	Headworks Blower Motor No. 1	Medium Risk
26	Headworks Blower Building	Headworks Blower Motor No. 2	Medium Risk
27	Headworks Electrical Building	Blower No. 1 Soft Starter	High Risk
28	Internal Recycle Metering Structure	Duplex Sump Pump Assembly	Medium Risk
29	Unit 1 Pump Station	Unit 1 MCC 8 Feed Switchgear	Medium Risk
30	Unit 2 North Primary Clarifier	Unit 2 North Primary Clarifier Drain Valve	Medium Risk

#	Location	Asset Description	Risk Level
31	Unit 2 Pump Station	Air Compressor	Medium Risk
32	Unit 2 Pump Station	Mini Power Center RS-200	Medium Risk
33	Unit 2 Pump Station	Mini Power Center RT	Medium Risk
34	Unit 2 Pump Station	Primary Sludge Pump No. 1	Medium Risk
35	Unit 2 South Primary Clarifier	Unit 2 South Primary Clarifier Drain Valve	Medium Risk
36	Nitrogen Removal Carrousel	Sluice Gate No. 5 (Internal Recycle)	Medium Risk
37	Nitrogen Removal Carrousel	Sluice Gate No. 6 (Internal Recycle)	Medium Risk
38	Nitrogen Removal Carrousel	Screw Pump No. 3	Medium Risk
39	Nitrogen Removal Carrousel	Slide Gate No. 3	Medium Risk
40	NRC Anoxic Basins	Anoxic Basin No. 1 Mixer Assembly	Medium Risk
41	NRC Anoxic Basins	Anoxic Basin No. 2 Mixer Assembly	Medium Risk
42	NRC Anoxic Basins	Sump Pump Assembly	Medium Risk
43	NRC Anoxic Basins	Influent Mixer No. 1	Medium Risk
44	NRC Anoxic Basins	Influent Mixer No. 2	Medium Risk
45	NRC Anoxic Basins	Internal Recycle Flow Meter No. 2	Medium Risk
46	NRC Building	Equalization Pumps Control Panel	Medium Risk
47	NRC Building	Exhaust Fan	Medium Risk
48	NRC Secondary Clarifier	Submersible Scum Pump No. 2	Medium Risk
49	Roots Blower Building	Waste Oil Tank Level Sensor	Medium Risk
50	RS-1 Pump Station	UST Monitoring System	High Risk
51	RS-1 Pump Station	RS-1 Pump Station Bucket RAS-3 Switchgear	Medium Risk
52	RS-1 Pump Station	Generator Bldg. Exhaust Fan	Medium Risk
53	RS-1 Pump Station	Plant Flow Control Cabinet	Medium Risk
54	RS-1 Pump Station	Pump Vault Exhaust Fan 1	Medium Risk
55	RS-1 Pump Station	Pump Vault Exhaust Fan 2	Medium Risk
56	RS-1 Pump Station	RS-1 PLC-26	High Risk
57	RS-1 Pump Station	RAS Pump No. 1 VFD	Medium Risk
58	RS-1 Pump Station	RAS Pump No. 2 VFD	Medium Risk
59	RS-1 Pump Station	RAS Pump No. 3 VFD	Medium Risk
60	RS-1 Pump Station	WAS Pump No. 1	Medium Risk
61	RS-1 Pump Station	WAS Pump No. 1 South Waste VFD	Medium Risk
62	RS-1 Pump Station	WAS Pump No. 2	Medium Risk
63	RS-1 Pump Station	WAS Pump No. 2 North Waste VFD	Medium Risk

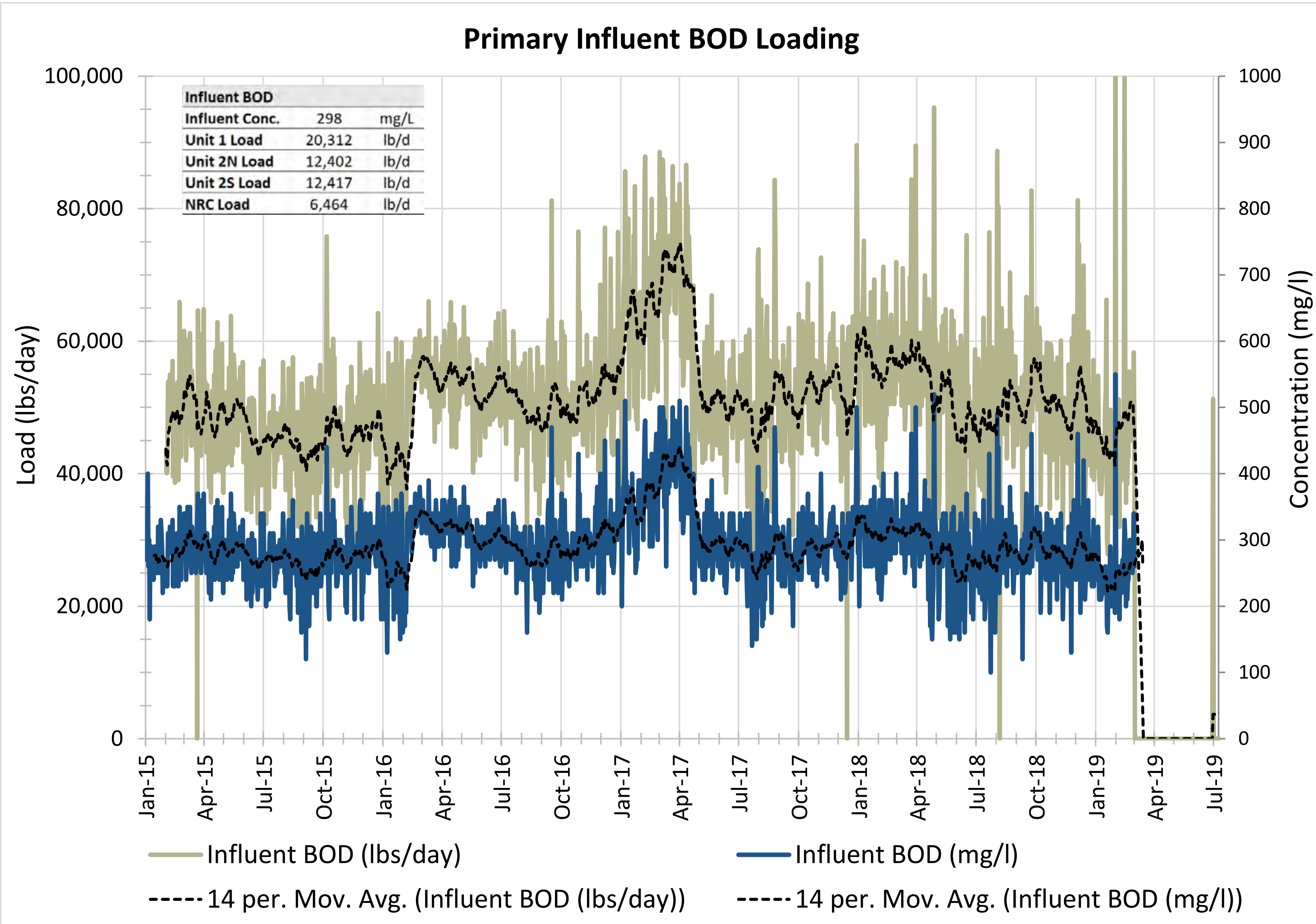
#	Location	Asset Description	Risk Level
64	Unit 1 East Secondary Clarifier	Unit 1 East Secondary Clarifier Drain Valve	Medium Risk
65	Unit 1 West Secondary Clarifier	Unit 1 West Secondary Clarifier Drain Valve	Medium Risk
66	Unit 2 North Secondary Clarifier	Unit 2 North Secondary Clarifier Drain Valve	Medium Risk
67	Unit 2 North Secondary Clarifier	Unit 2 North Secondary Clarifier Scum Skimmer	Medium Risk
68	Unit 2 Pump Station	RAS Pump No. 1 Suction Isolation Valve	Medium Risk
69	Unit 2 Pump Station	RAS Pump No. 1-3 Discharge Isolation Valve	Medium Risk
70	Unit 2 Pump Station	RAS Pump No. 1-3 Suction Isolation Valve	Medium Risk
71	Unit 2 Pump Station	RAS Pump No. 2 Discharge Isolation Valve	Medium Risk
72	Unit 2 Pump Station	RAS Pump No. 2 Suction Isolation Valve	Medium Risk
73	Unit 2 Pump Station	RAS Pump No. 2-3 Discharge Isolation Valve	Medium Risk
74	Unit 2 Pump Station	RAS Pump No. 2-3 Suction Isolation Valve	Medium Risk
75	Unit 2 Pump Station	RAS Pump No. 3 Discharge Isolation Valve	Medium Risk
76	Unit 2 Pump Station	Scum Pump No. 1	Medium Risk
77	Unit 2 Pump Station	WAS Pump No. 1 Suction Isolation Valve	Medium Risk
78	Unit 2 Pump Station	WAS Pump No. 1 VFD	Medium Risk
79	Unit 2 South Secondary Clarifier	Unit 2 South Secondary Clarifier Drain Valve	Medium Risk
80	Unit 2 South Secondary Clarifier	Unit 2 South Secondary Clarifier Scum Skimmer	Medium Risk
81	Dewatering & Thickening (D&T) Building	Recirculated Sludge Discharge Check Valve A	Medium Risk
82	Dewatering & Thickening (D&T) Building	Recirculated Sludge Discharge Check Valve C	Medium Risk
83	Dewatering & Thickening (D&T) Building	Recirculated Sludge Discharge Check Valve D	Medium Risk
84	Boiler Building	Boiler No. 1 Hot Water Return Control Valve	High Risk
85	Boiler Building	Boiler No. 1 Hot Water Return Isolation Valve	High Risk
86	Boiler Building	Boiler No. 1 Hot Water Supply Isolation Valve	High Risk
87	Boiler Building	Boiler No. 2 Hot Water Return Control Valve	High Risk
88	Boiler Building	MCC BB Cabinet	High Risk

#	Location	Asset Description	Risk Level
89	Boiler Building	Exhaust Fans No. 1	Medium Risk
90	Boiler Building	Exhaust Fans No. 2	Medium Risk
91	Digester A	Sludge Overflow Isolation Valve to Draw Out	Medium Risk
92	Digester A	Tank Draw Out Isolation Valve No. 1	Medium Risk
93	Digester A	Tank Draw Out Isolation Valve No. 2 (to Dewatering)	Medium Risk
94	Digester C	Bottom Sludge Draw Common Isolation Valve	Medium Risk
95	Digester C	Bottom Sludge Draw Isolation Valve No. 1	Medium Risk
96	Digester C	Bottom Sludge Draw Isolation Valve No. 2	Medium Risk
97	Digester C	Bottom Sludge Draw Isolation Valve No. 3	Medium Risk
98	Digester C	Bottom Sludge Draw Isolation Valve No. 4	Medium Risk
99	Digester C	Heated Sludge Return Bypass Isolation Valve	Medium Risk
100	Digester C	Heated Sludge Return Inlet Isolation Valve	Medium Risk
101	Digester C	Heated Sludge Return Isolation Valve	Medium Risk
102	Dissolved Air Flotation Thickener (DAFT) 2	Propeller Meter	Medium Risk

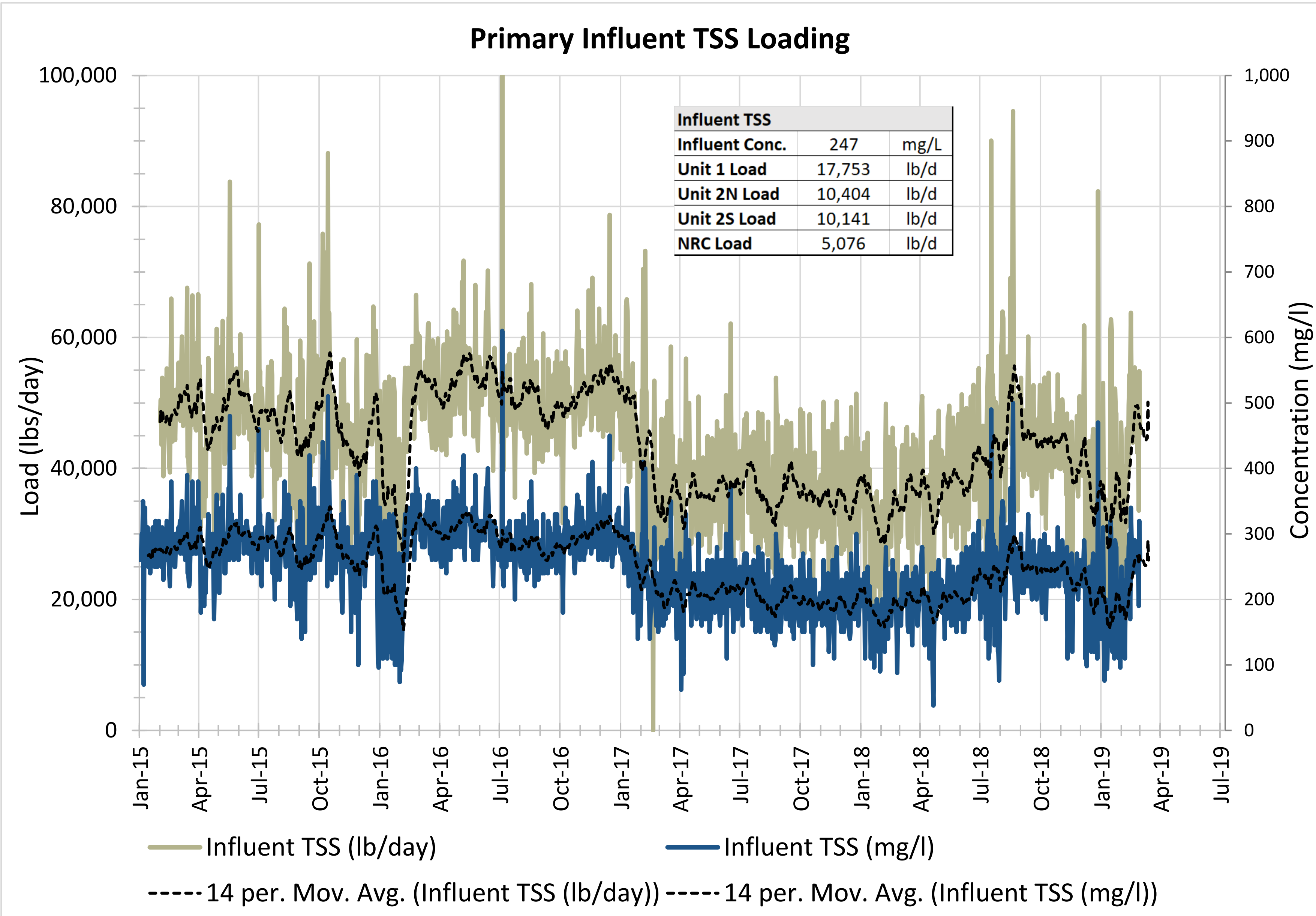
APPENDIX D: INFLUENT FLOWS AND LOADS

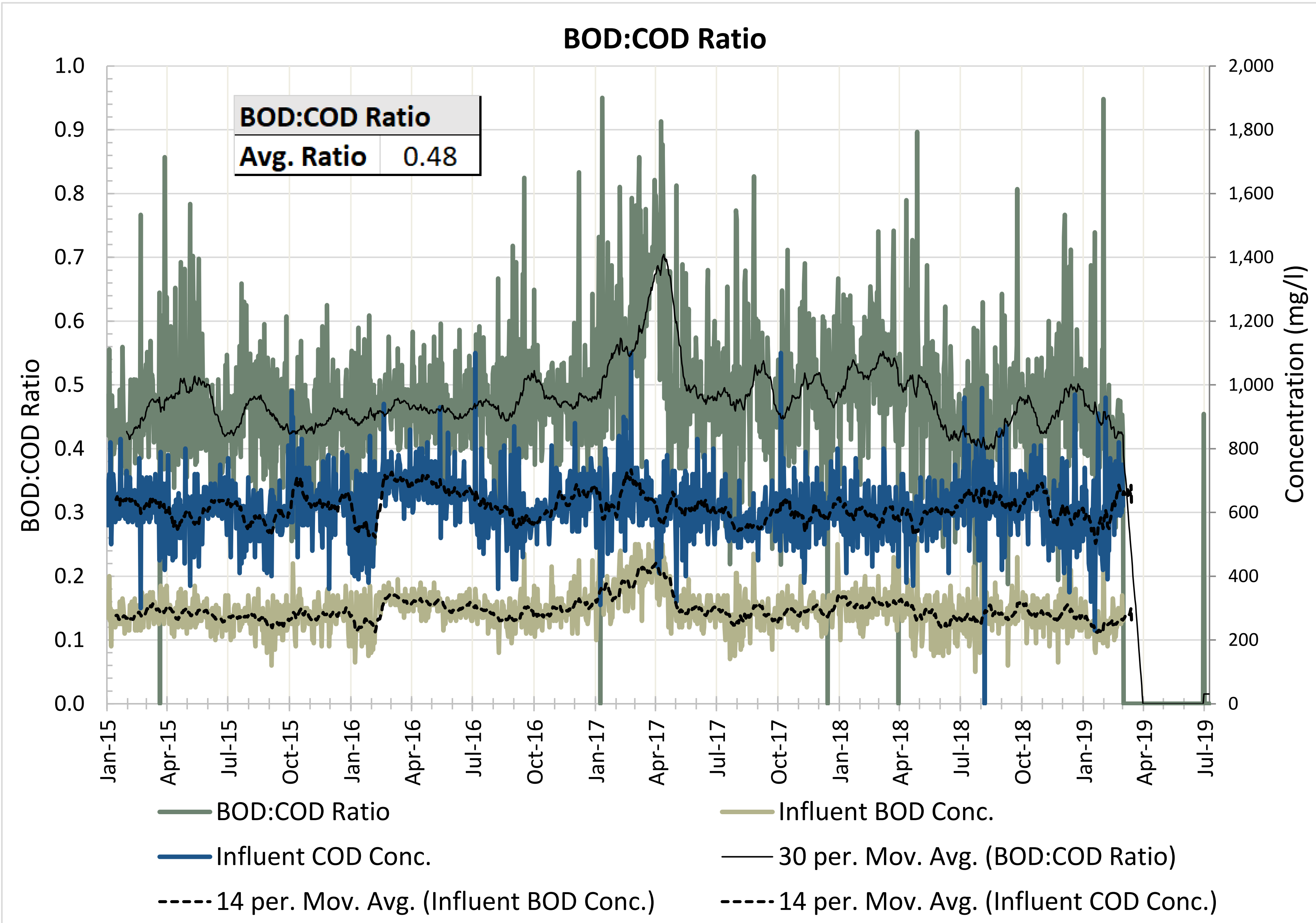


Average Flow		
Unit 1	8.7	MGD
Unit 2N	5.1	MGD
Unit 2S	4.9	MGD
NRC	2.4	MGD
Total	21.1	MGD



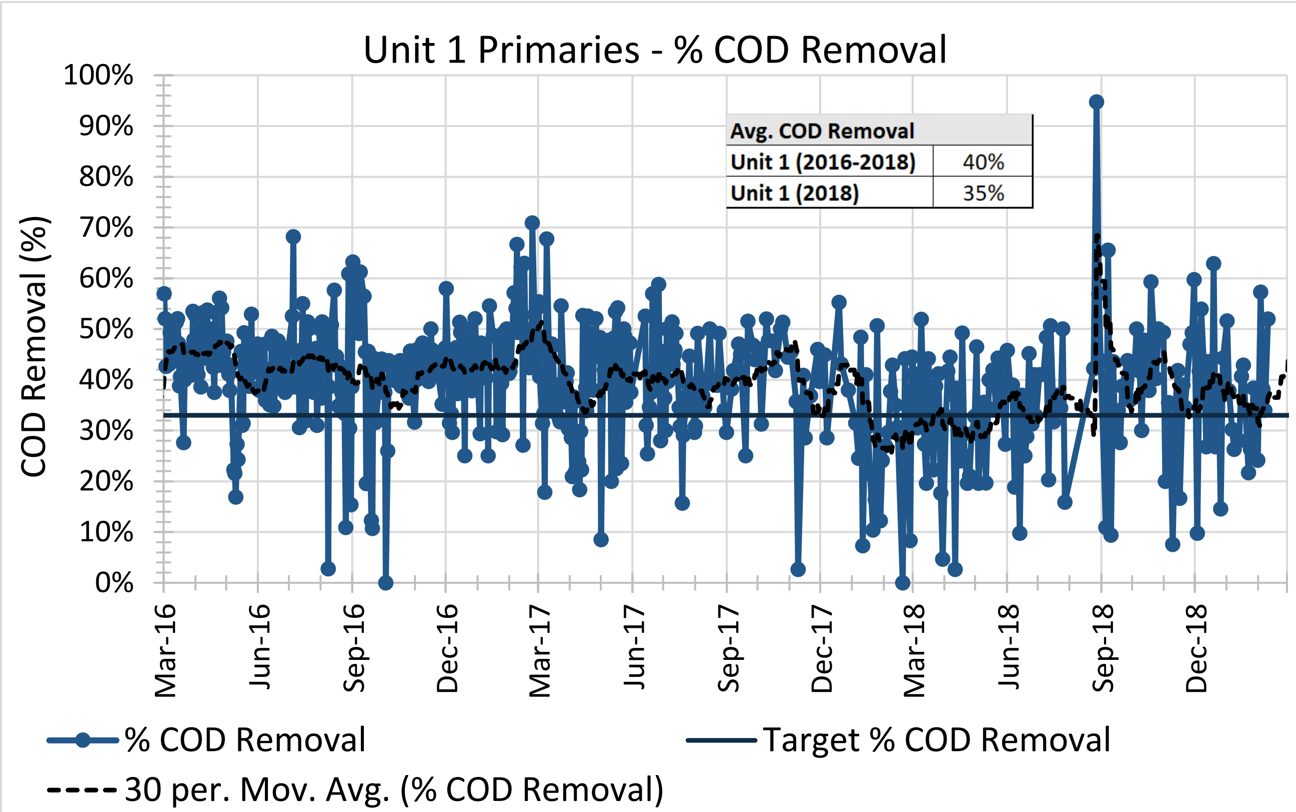
Primary Influent BOD Loading
Influent BOD
Influent Conc. 298 mg/L
Unit 1 Load 20,312 lb/d
Unit 2N Load 12,402 lb/d
Unit 2S Load 12,417 lb/d
NRC Load 6,464 lb/d
Load (lbs/day)
Concentration (mg/l)
100,000
80,000
60,000
40,000
20,000
0
1000
900
800
700
600
500
400
300
200
100
0
Jan-15
Apr-15
Jul-15
Oct-15
Jan-16
Apr-16
Jul-16
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
Influent BOD (lbs/day)
Influent BOD (mg/l)
14 per. Mov. Avg. (Influent BOD (lbs/day))
14 per. Mov. Avg. (Influent BOD (mg/l))


Primary Influent TSS Loading
Influent TSS
Influent Conc. 247 mg/L
Unit 1 Load 17,753 lb/d
Unit 2N Load 10,404 lb/d
Unit 2S Load 10,141 lb/d
NRC Load 5,076 lb/d
Load (lbs/day)
Concentration (mg/l)
100,000
80,000
60,000
40,000
20,000
0
1,000
900
800
700
600
500
400
300
200
100
0
Jan-15
Apr-15
Jul-15
Oct-15
Jan-16
Apr-16
Jul-16
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
Influent TSS (lb/day)
Influent TSS (mg/l)
14 per. Mov. Avg. (Influent TSS (lb/day))
14 per. Mov. Avg. (Influent TSS (mg/l))

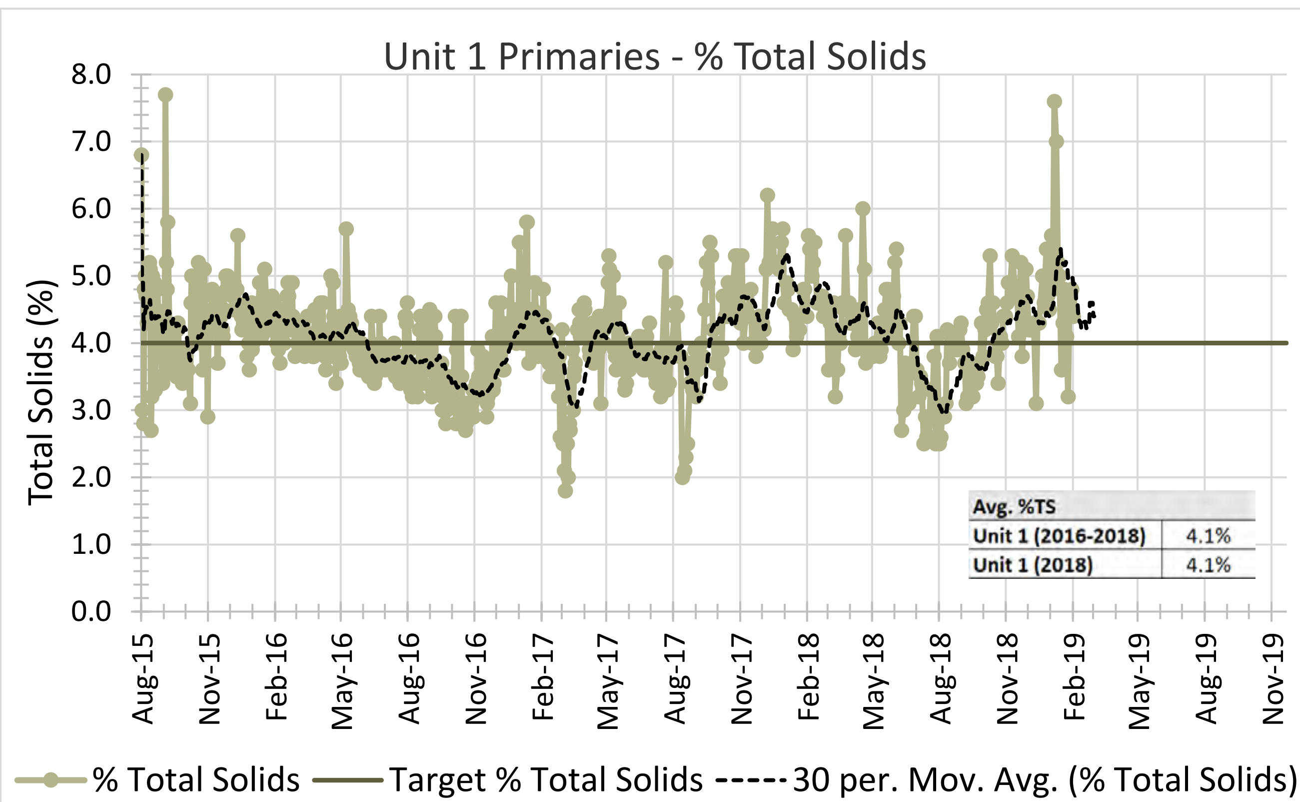


BOD:COD Ratio
BOD:COD Ratio
Avg. Ratio 0.48
BOD:COD Ratio
Concentration (mg/l)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
Jan-15
Apr-15
Jul-15
Oct-15
Jan-16
Apr-16
Jul-16
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
BOD:COD Ratio
Influent BOD Conc.
Influent COD Conc.
30 per. Mov. Avg. (BOD:COD Ratio)
14 per. Mov. Avg. (Influent BOD Conc.)
14 per. Mov. Avg. (Influent COD Conc.)

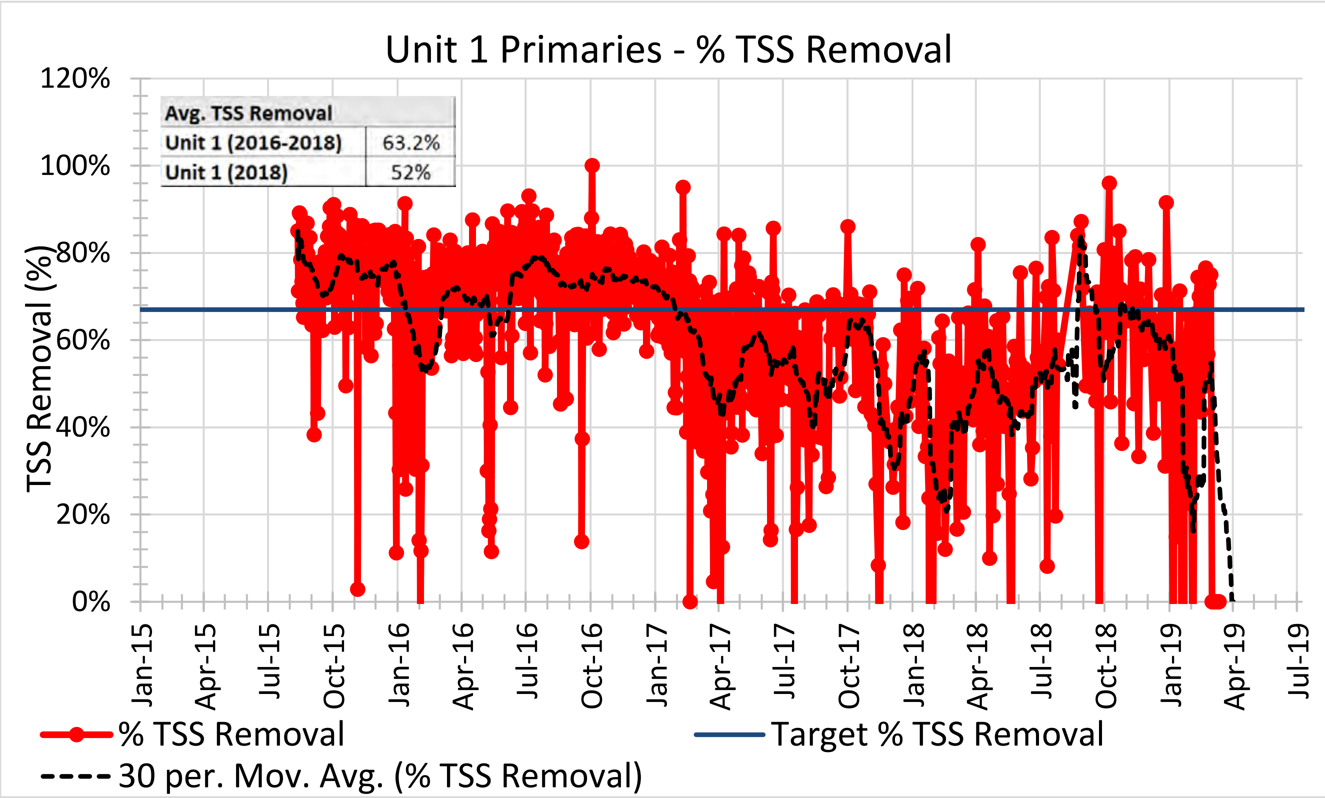
APPENDIX E: PROCESS DATA ANALYSIS



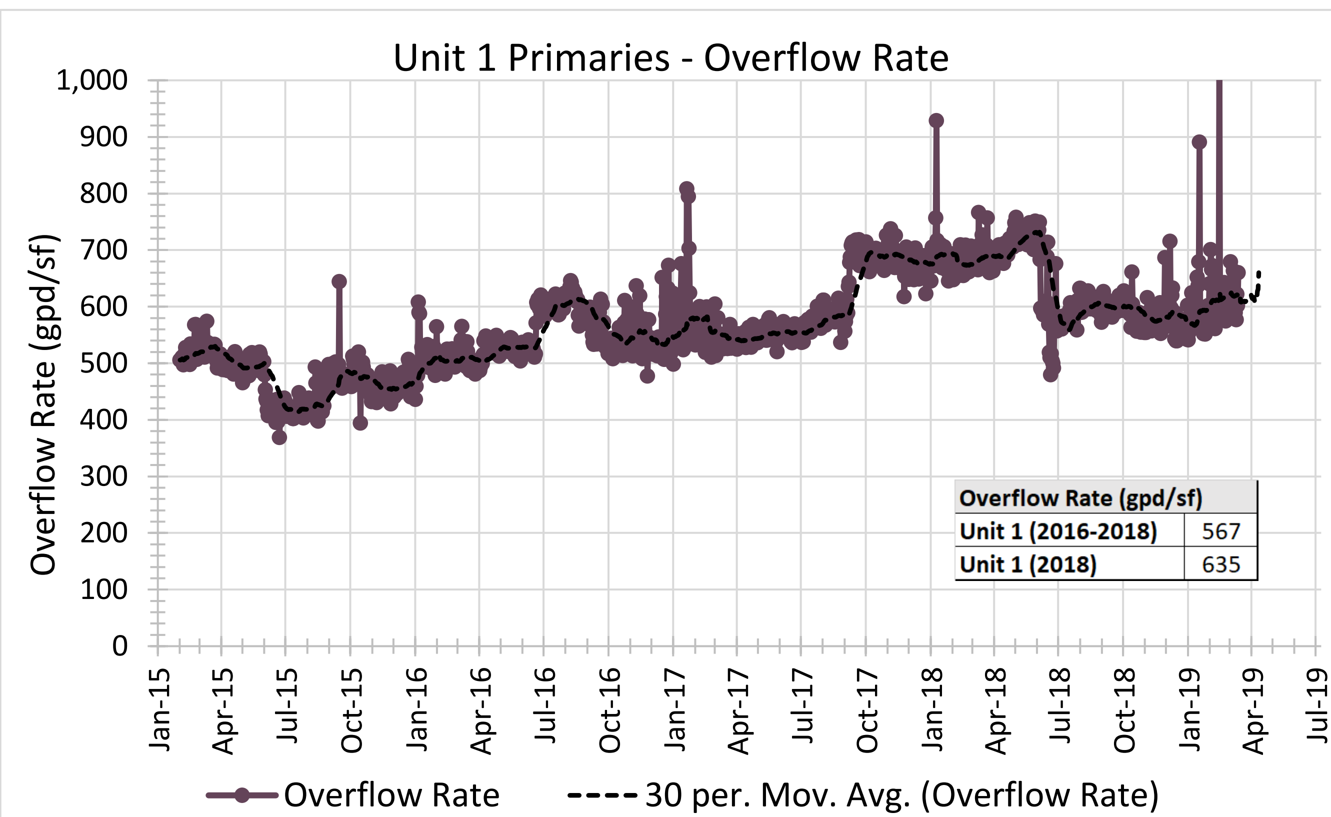
Unit 1 Primaries - % COD Removal
Avg. COD Removal
Unit 1 (2016-2018) 40%
Unit 1 (2018) 35%
COD Removal (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Mar-16
Jun-16
Sep-16
Dec-16
Mar-17
Jun-17
Sep-17
Dec-17
Mar-18
Jun-18
Sep-18
Dec-18
% COD Removal
Target % COD Removal
30 per. Mov. Avg. (% COD Removal)



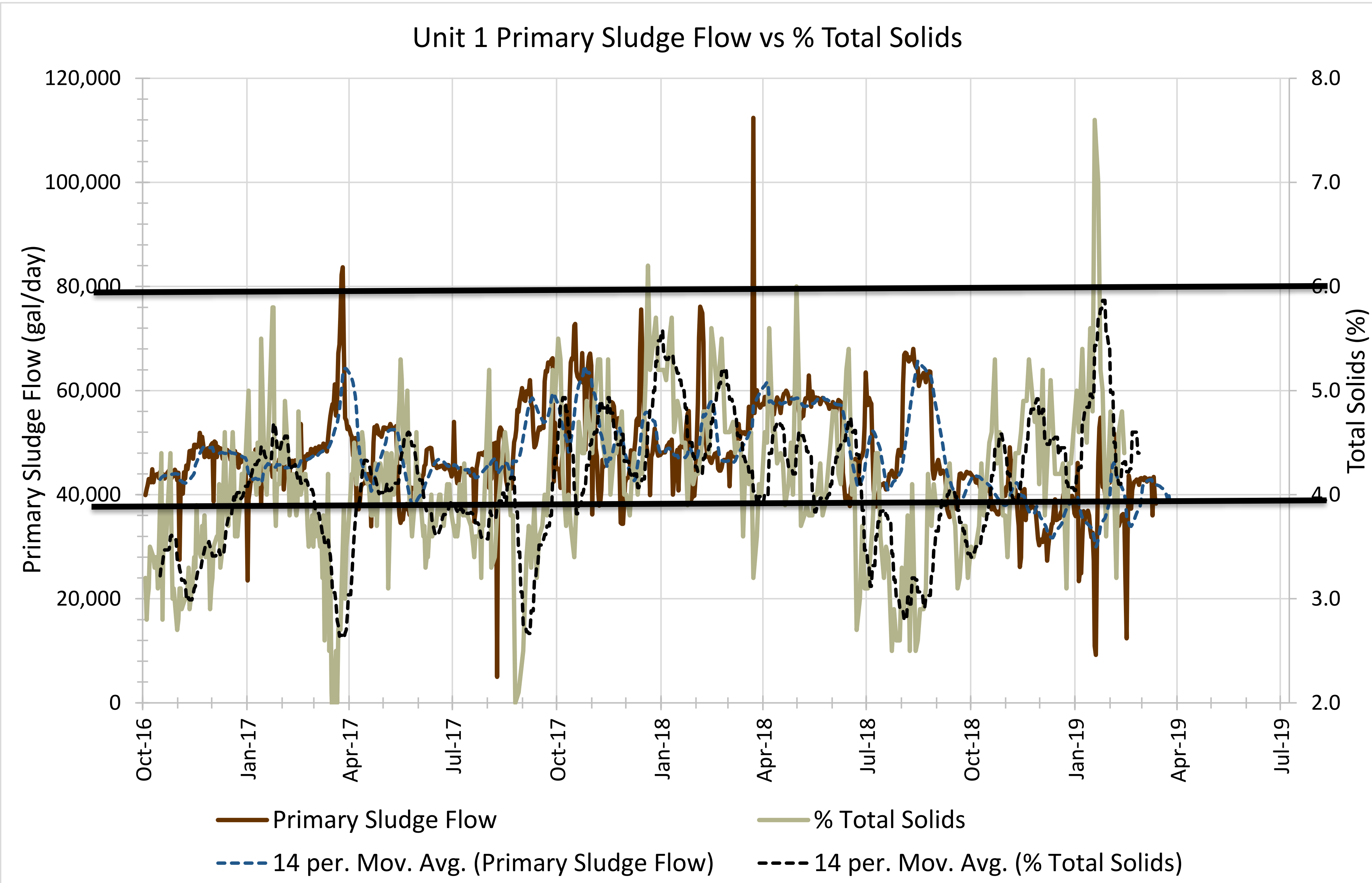
Unit 1 Primaries - % Total Solids
Total Solids (%)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Avg. %TS
Unit 1 (2016-2018) 4.1%
Unit 1 (2018) 4.1%
Aug-15
Nov-15
Feb-16
May-16
Aug-16
Nov-16
Feb-17
May-17
Aug-17
Nov-17
Feb-18
May-18
Aug-18
Nov-18
Feb-19
May-19
Aug-19
Nov-19
% Total Solids
Target % Total Solids
30 per. Mov. Avg. (% Total Solids)



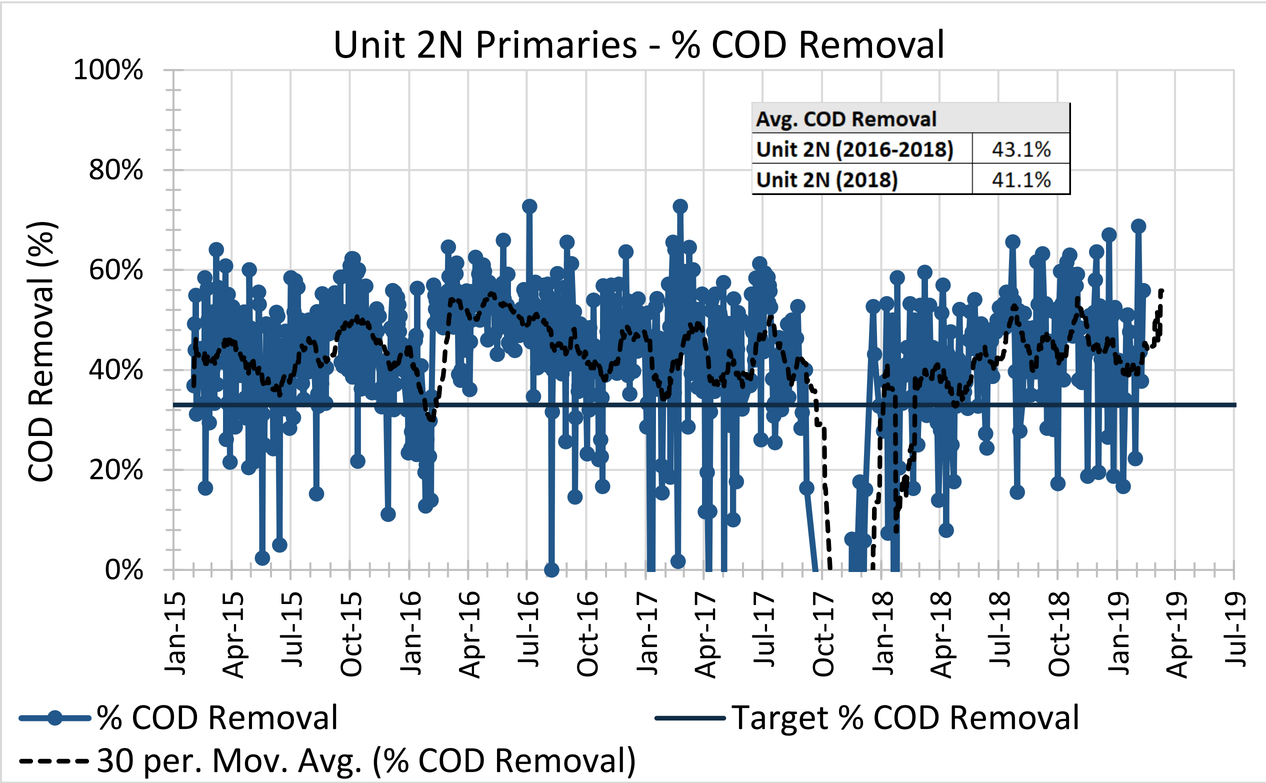
Unit 1 Primaries - % TSS Removal
Avg. TSS Removal
Unit 1 (2016-2018) 63.2%
Unit 1 (2018) 52%
TSS Removal (%)
120%
100%
80%
60%
40%
20%
0%
Jan-15
Apr-15
Jul-15
Oct-15
Jan-16
Apr-16
Jul-16
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
% TSS Removal
Target % TSS Removal
30 per. Mov. Avg. (% TSS Removal)

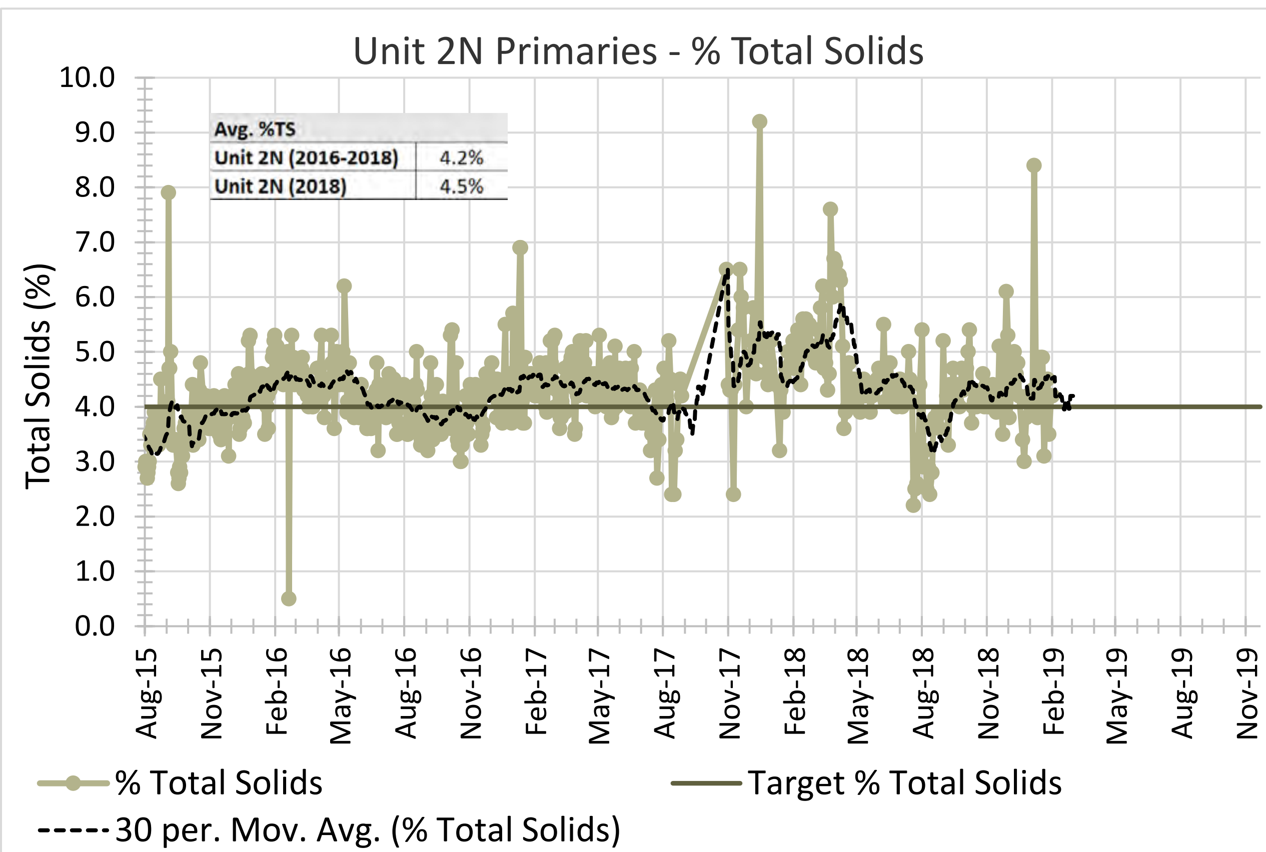


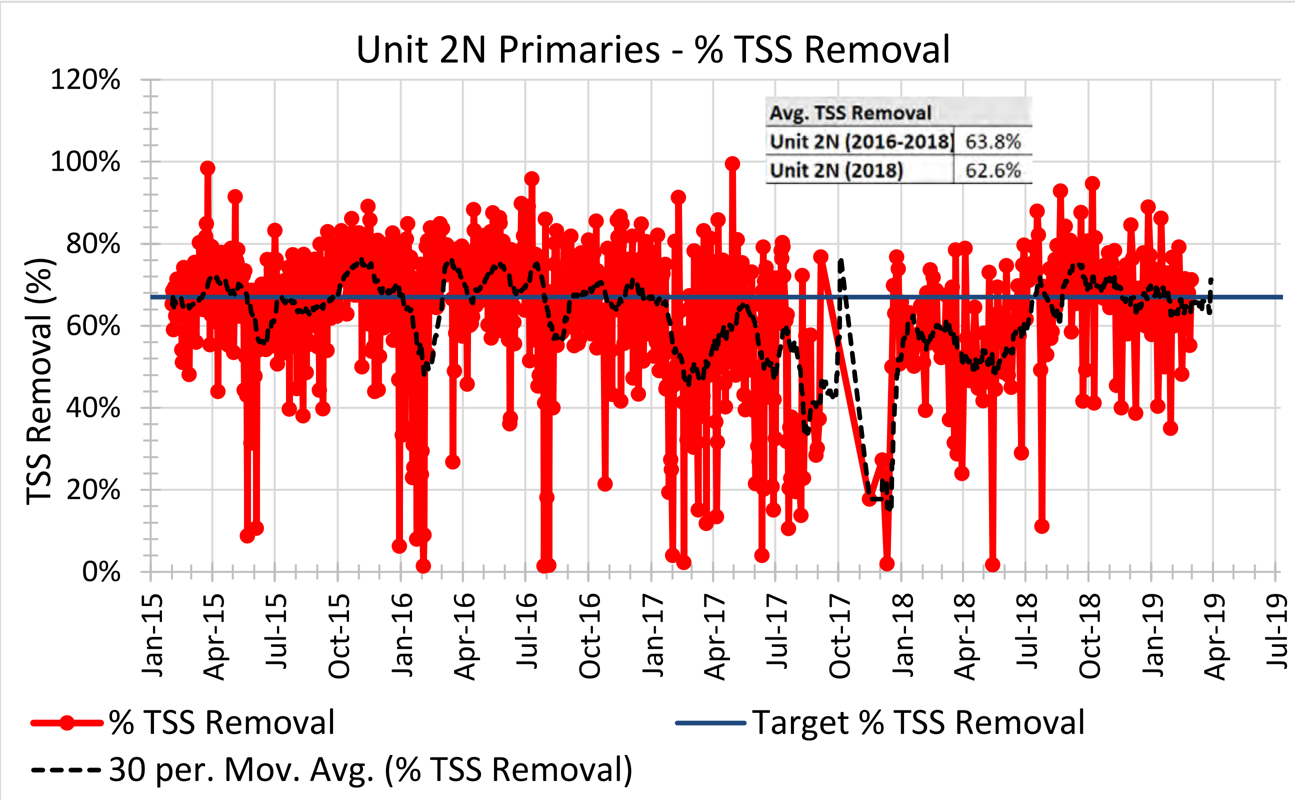
Unit 1 Primaries - Overflow Rate
Overflow Rate (gpd/sf)
1,000
900
800
700
600
500
400
300
200
100
0
Overflow Rate (gpd/sf)
Unit 1 (2016-2018) 567
Unit 1 (2018) 635
Jan-15
Apr-15
Jul-15
Oct-15
Jan-16
Apr-16
Jul-16
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
Overflow Rate
30 per. Mov. Avg. (Overflow Rate)



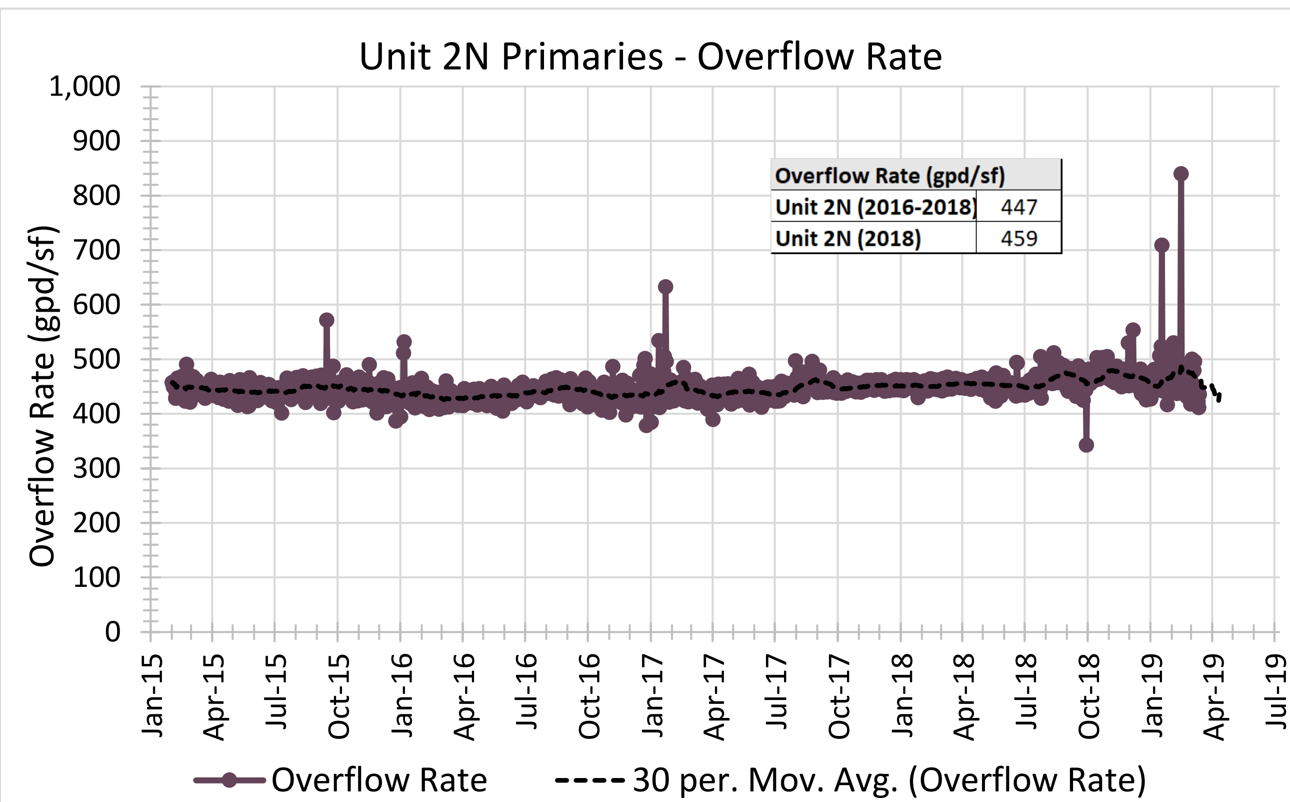
Unit 1 Primary Sludge Flow vs % Total Solids
Primary Sludge Flow (gal/day)
Total Solids (%)
120,000
100,000
80,000
60,000
40,000
20,000
0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
Primary Sludge Flow
% Total Solids
14 per. Mov. Avg. (Primary Sludge Flow)
14 per. Mov. Avg. (% Total Solids)


Unit 2N Primaries - % COD Removal
Avg. COD Removal
Unit 2N (2016-2018) 43.1%
Unit 2N (2018) 41.1%
100%
80%
60%
40%
20%
0%
COD Removal (%)
Jan-15
Apr-15
Jul-15
Oct-15
Jan-16
Apr-16
Jul-16
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
% COD Removal
Target % COD Removal
30 per. Mov. Avg. (% COD Removal)

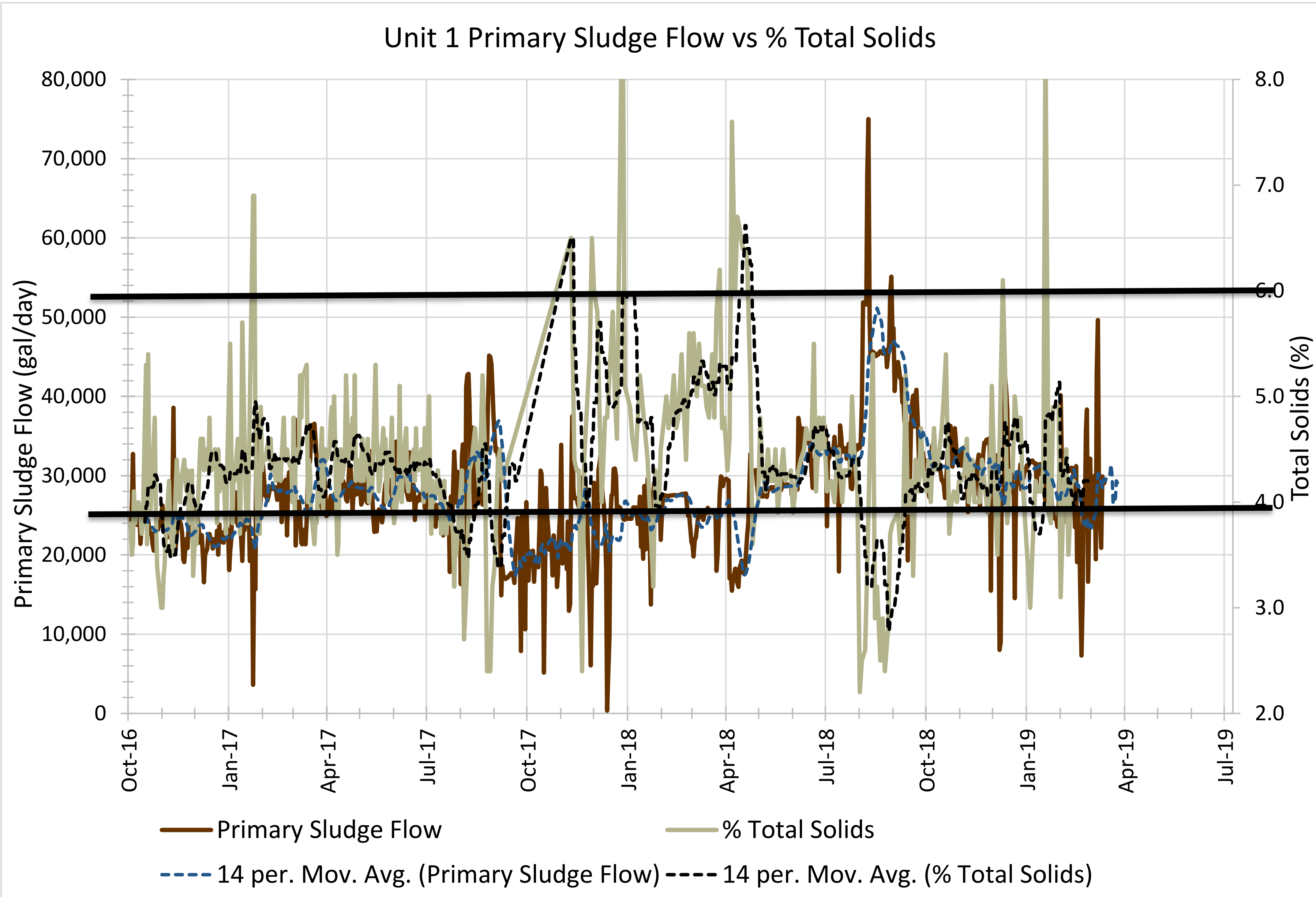

Unit 2N Primaries - % Total Solids
Avg. %TS
Unit 2N (2016-2018) 4.2%
Unit 2N (2018) 4.5%
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Total Solids (%)
Aug-15
Nov-15
Feb-16
May-16
Aug-16
Nov-16
Feb-17
May-17
Aug-17
Nov-17
Feb-18
May-18
Aug-18
Nov-18
Feb-19
May-19
Aug-19
Nov-19
% Total Solids
Target % Total Solids
30 per. Mov. Avg. (% Total Solids)

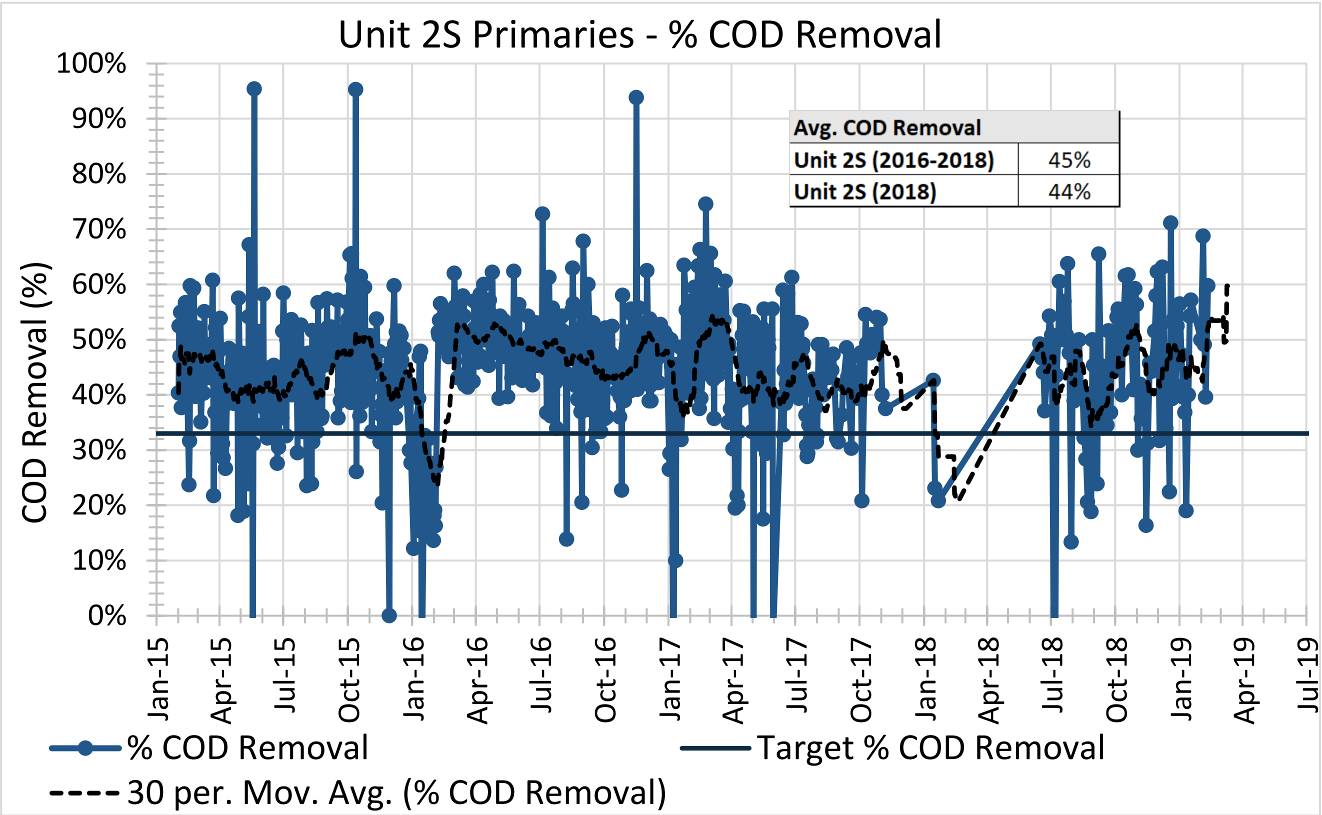


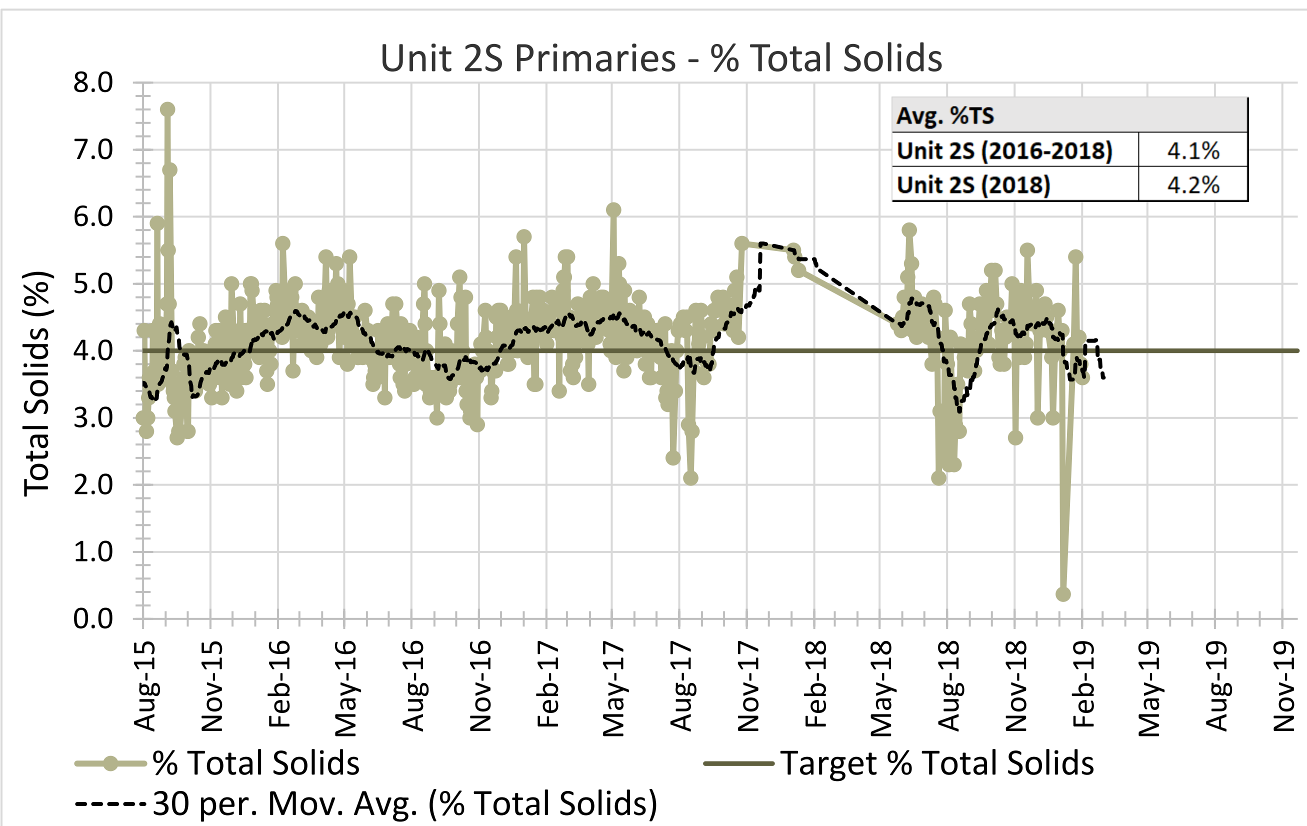
Unit 2N Primaries - % TSS Removal
Avg. TSS Removal
Unit 2N (2016-2018) 63.8%
Unit 2N (2018) 62.6%
TSS Removal (%)
120%
100%
80%
60%
40%
20%
0%
Jan-15
Apr-15
Jul-15
Oct-15
Jan-16
Apr-16
Jul-16
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
% TSS Removal
Target % TSS Removal
30 per. Mov. Avg. (% TSS Removal)

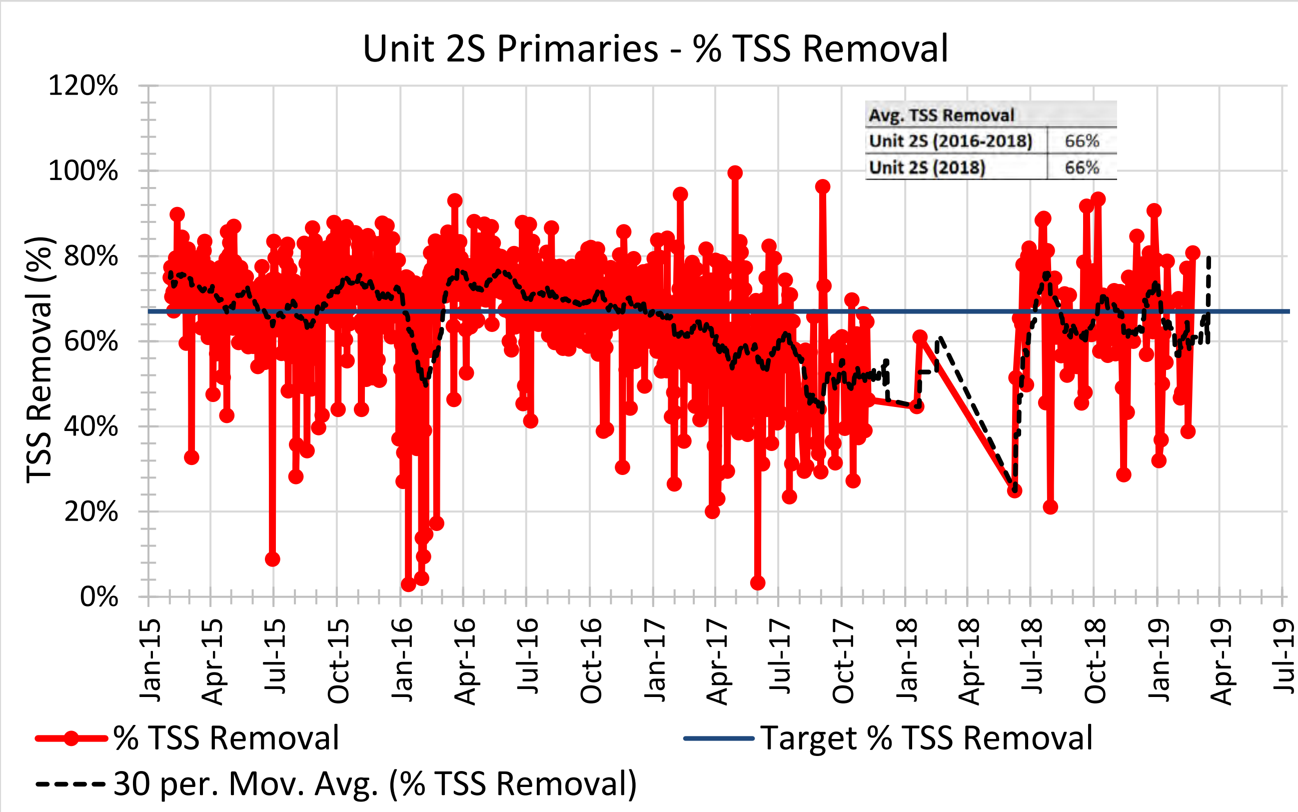


Unit 2N Primaries - Overflow Rate
Overflow Rate (gpd/sf)
Unit 2N (2016-2018) 447
Unit 2N (2018) 459
Overflow Rate (gpd/sf)
1,000
900
800
700
600
500
400
300
200
100
0
Jan-15
Apr-15
Jul-15
Oct-15
Jan-16
Apr-16
Jul-16
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
Overflow Rate
30 per. Mov. Avg. (Overflow Rate)

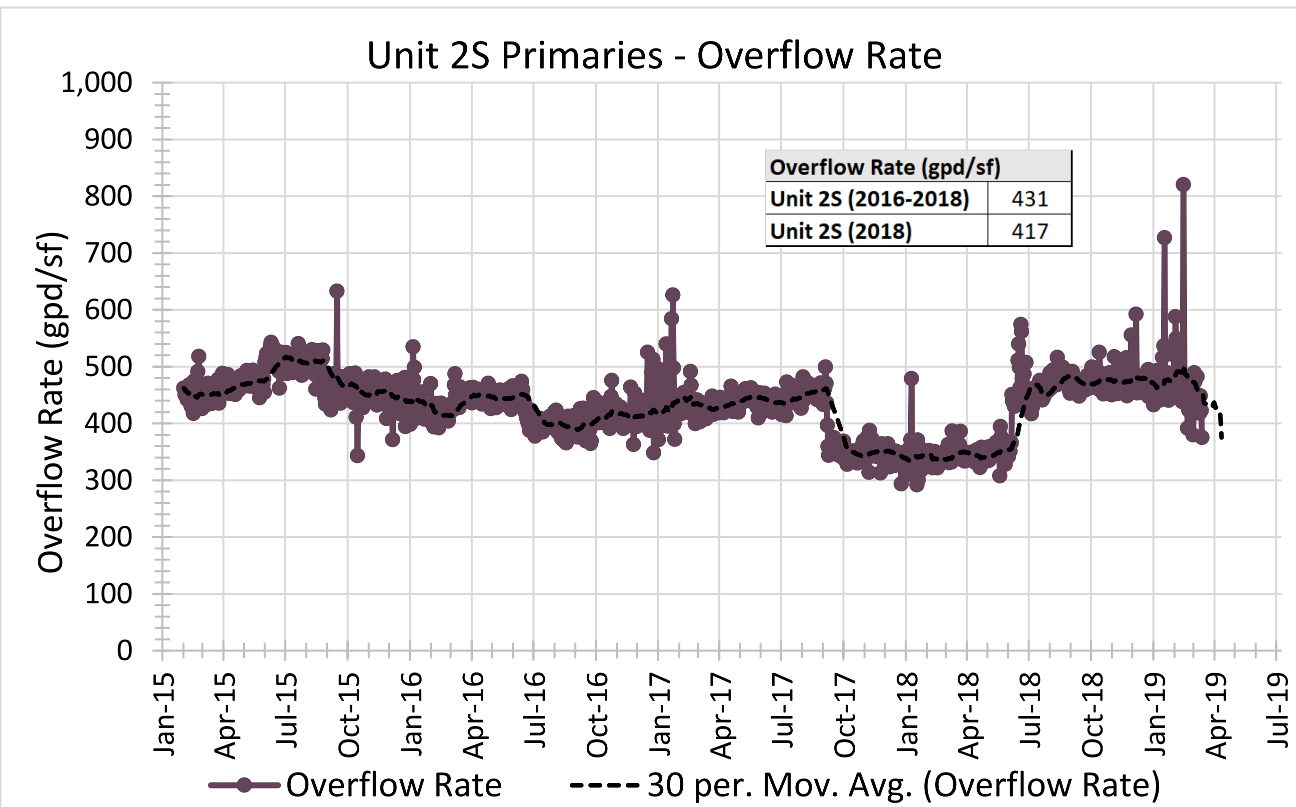

Unit 1 Primary Sludge Flow vs % Total Solids
Primary Sludge Flow (gal/day)
Total Solids (%)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
Primary Sludge Flow
% Total Solids
14 per. Mov. Avg. (Primary Sludge Flow)
14 per. Mov. Avg. (% Total Solids)


Unit 2S Primaries - % COD Removal
COD Removal (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Jan-15
Apr-15
Jul-15
Oct-15
Jan-16
Apr-16
Jul-16
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
% COD Removal
Target % COD Removal
30 per. Mov. Avg. (% COD Removal)
Avg. COD Removal
Unit 2S (2016-2018) 45%
Unit 2S (2018) 44%

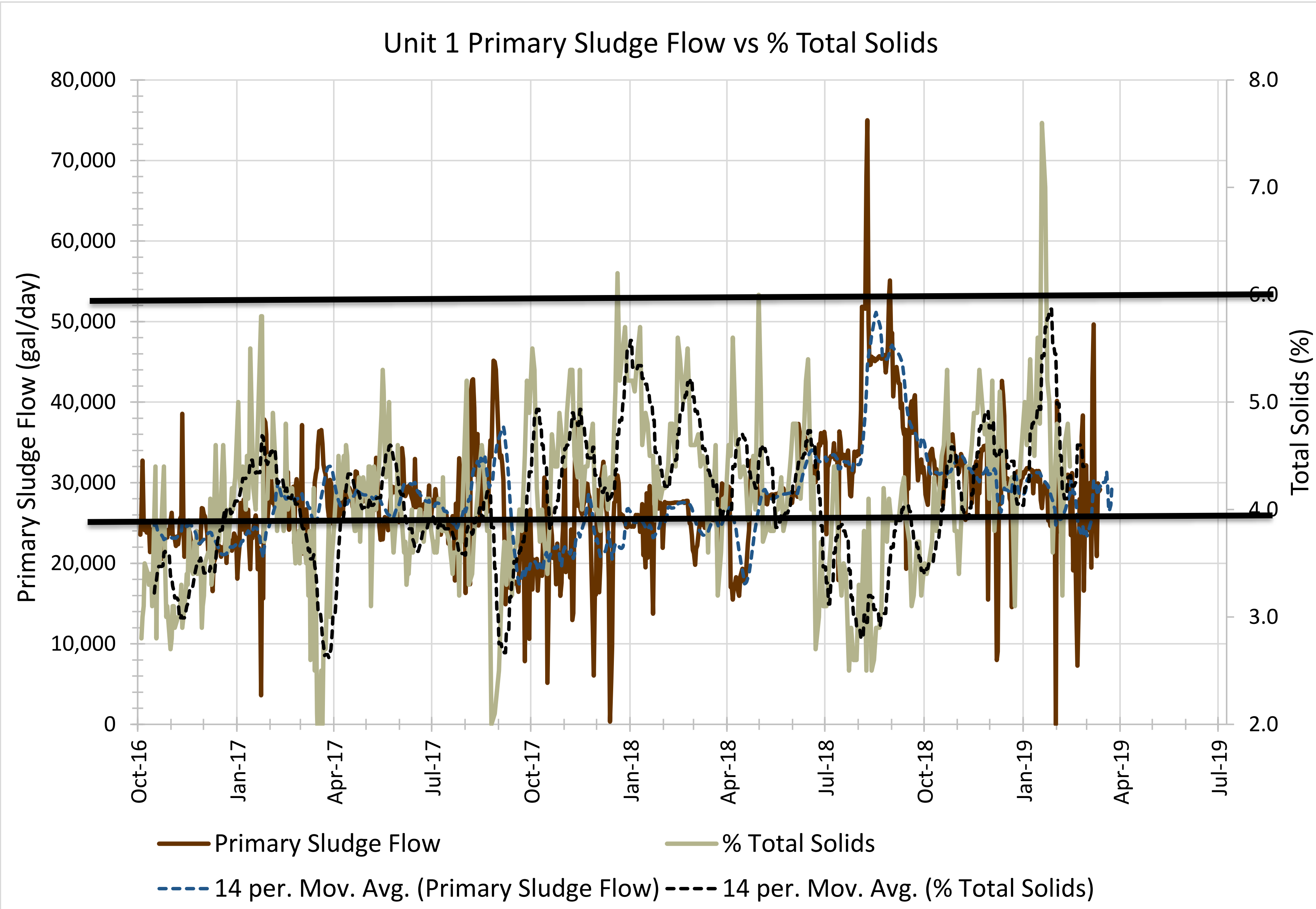

Unit 2S Primaries - % Total Solids
Total Solids (%)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Aug-15
Nov-15
Feb-16
May-16
Aug-16
Nov-16
Feb-17
May-17
Aug-17
Nov-17
Feb-18
May-18
Aug-18
Nov-18
Feb-19
May-19
Aug-19
Nov-19
% Total Solids
Target % Total Solids
30 per. Mov. Avg. (% Total Solids)
Avg. %TS
Unit 2S (2016-2018) 4.1%
Unit 2S (2018) 4.2%



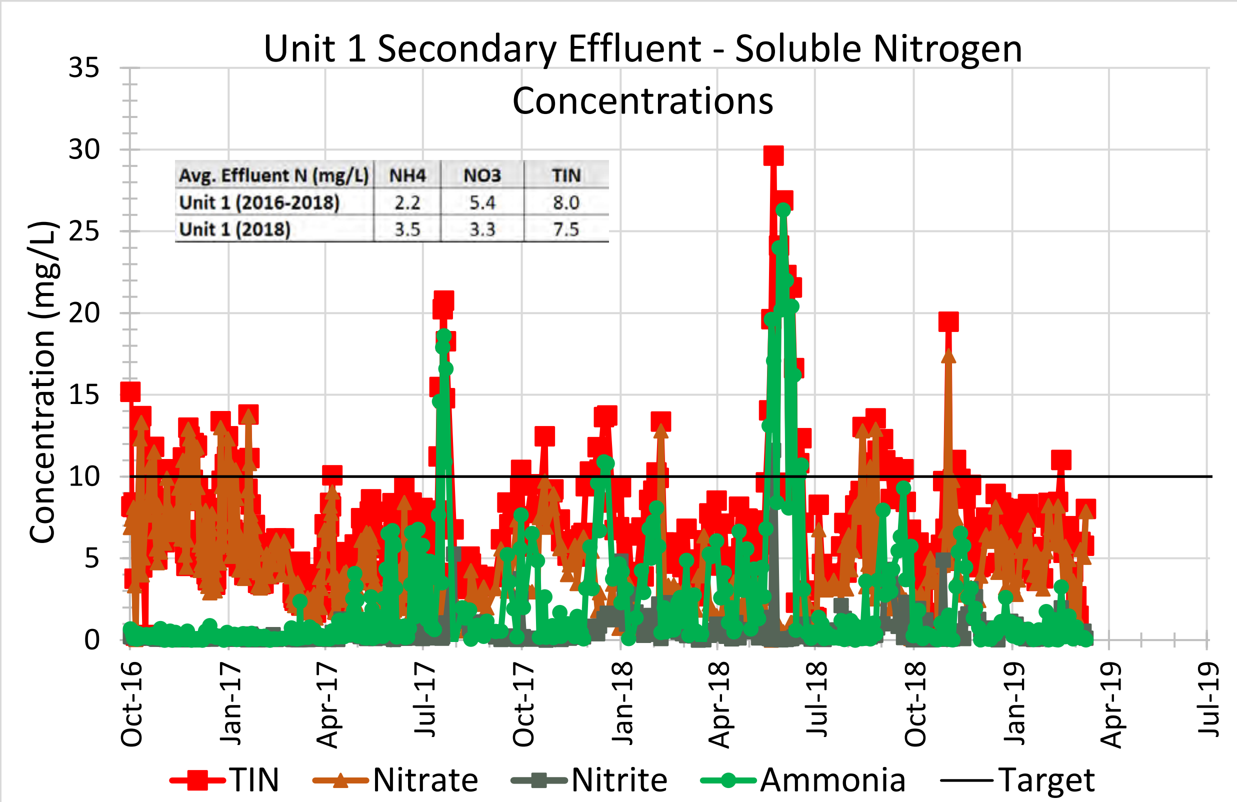
Unit 2S Primaries - % TSS Removal
120%
100%
80%
60%
40%
20%
0%
TSS Removal (%)
Avg. TSS Removal
Unit 2S (2016-2018) 66%
Unit 2S (2018) 66%
Jan-15
Apr-15
Jul-15
Oct-15
Jan-16
Apr-16
Jul-16
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
% TSS Removal
Target % TSS Removal
30 per. Mov. Avg. (% TSS Removal)



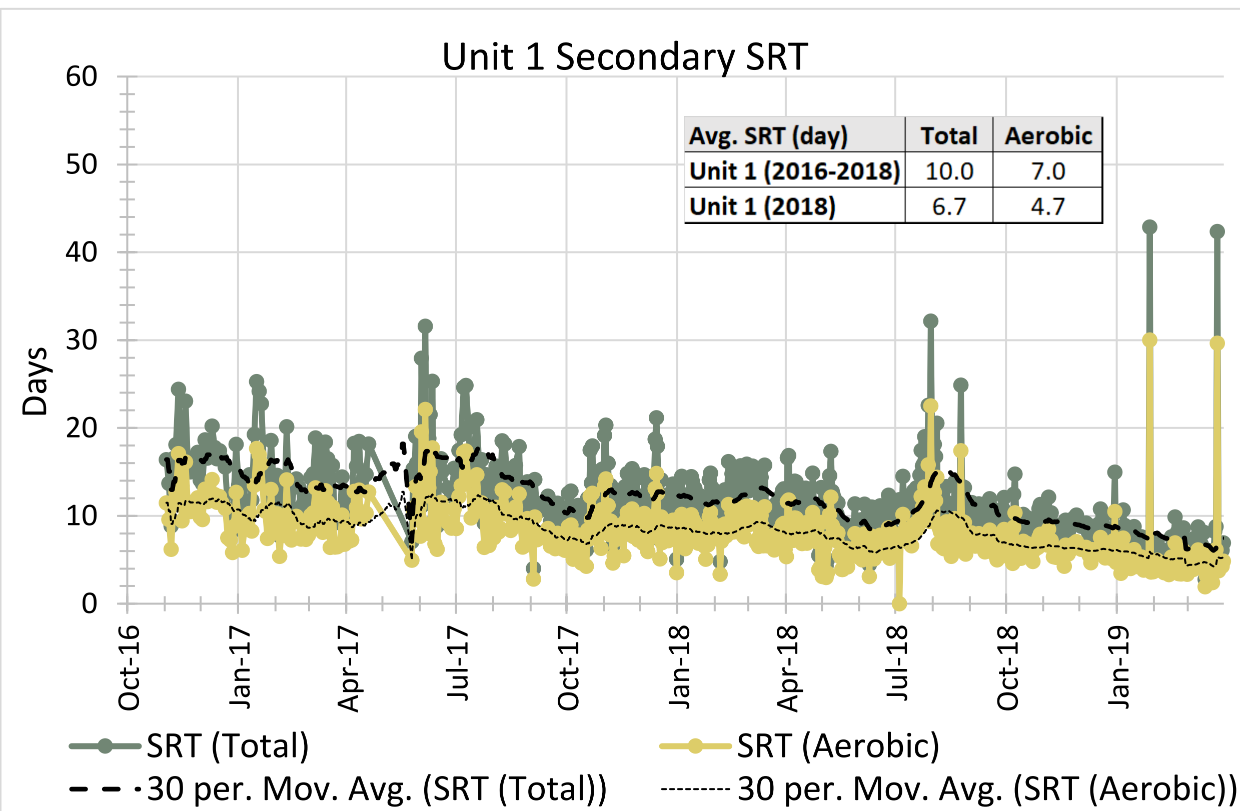
Unit 2S Primaries - Overflow Rate
1,000
900
800
700
600
500
400
300
200
100
0
Overflow Rate (gpd/sf)
Overflow Rate (gpd/sf)
Unit 2S (2016-2018) 431
Unit 2S (2018) 417
Jan-15
Apr-15
Jul-15
Oct-15
Jan-16
Apr-16
Jul-16
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
Overflow Rate
30 per. Mov. Avg. (Overflow Rate)



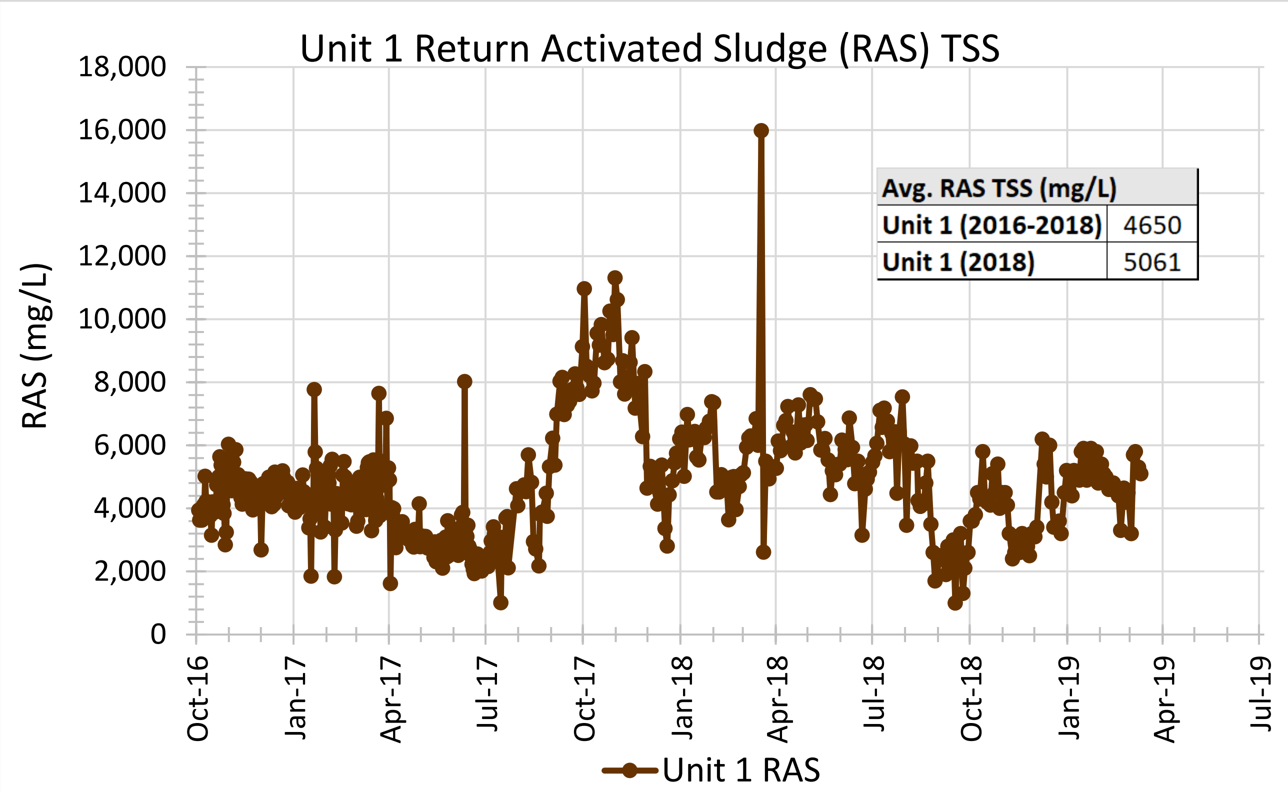
Unit 1 Primary Sludge Flow vs % Total Solids
Primary Sludge Flow (gal/day)
Total Solids (%)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
Primary Sludge Flow
% Total Solids
14 per. Mov. Avg. (Primary Sludge Flow)
14 per. Mov. Avg. (% Total Solids)



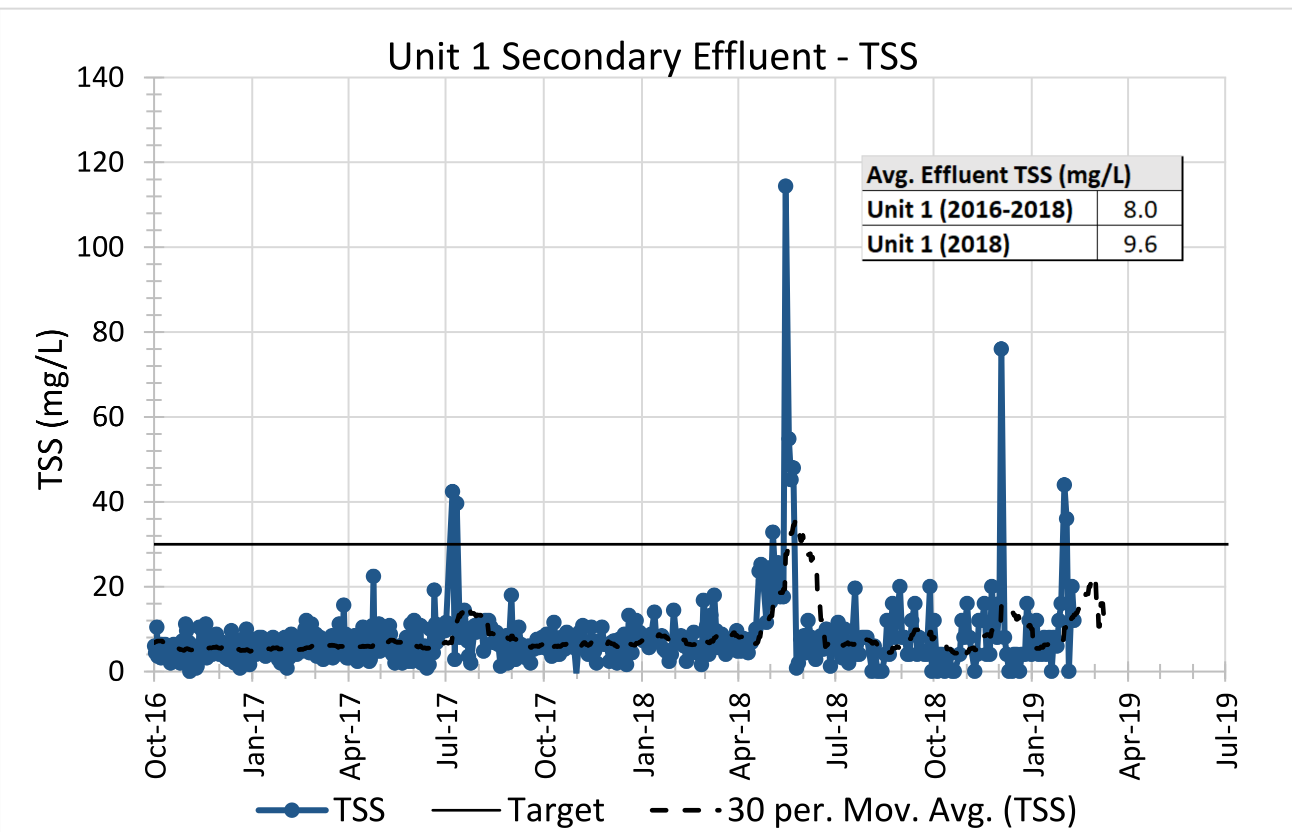
Avg. Effluent N (mg/L)	NH4	NO3	TIN
Unit 1 (2016-2018)	2.2	5.4	8.0
Unit 1 (2018)	3.5	3.3	7.5



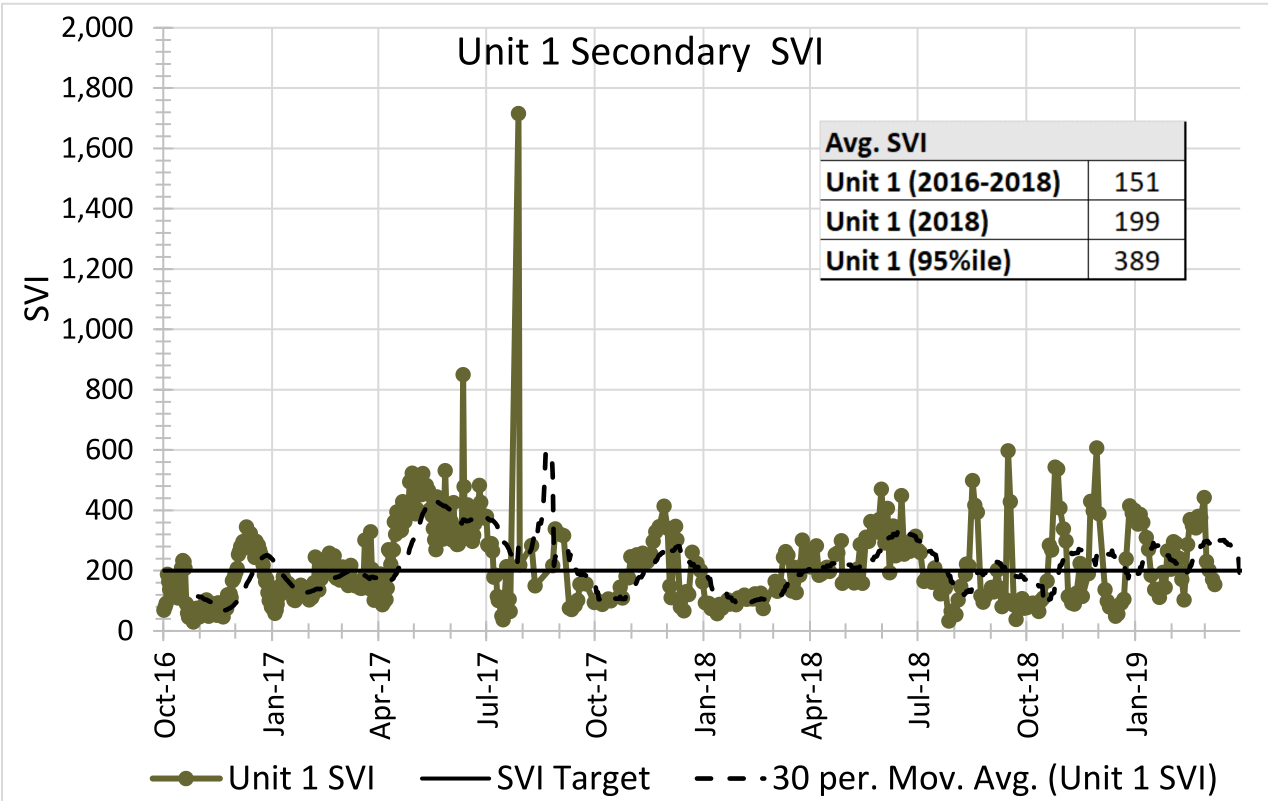
Avg. SRT (day)	Total	Aerobic
Unit 1 (2016-2018)	10.0	7.0
Unit 1 (2018)	6.7	4.7

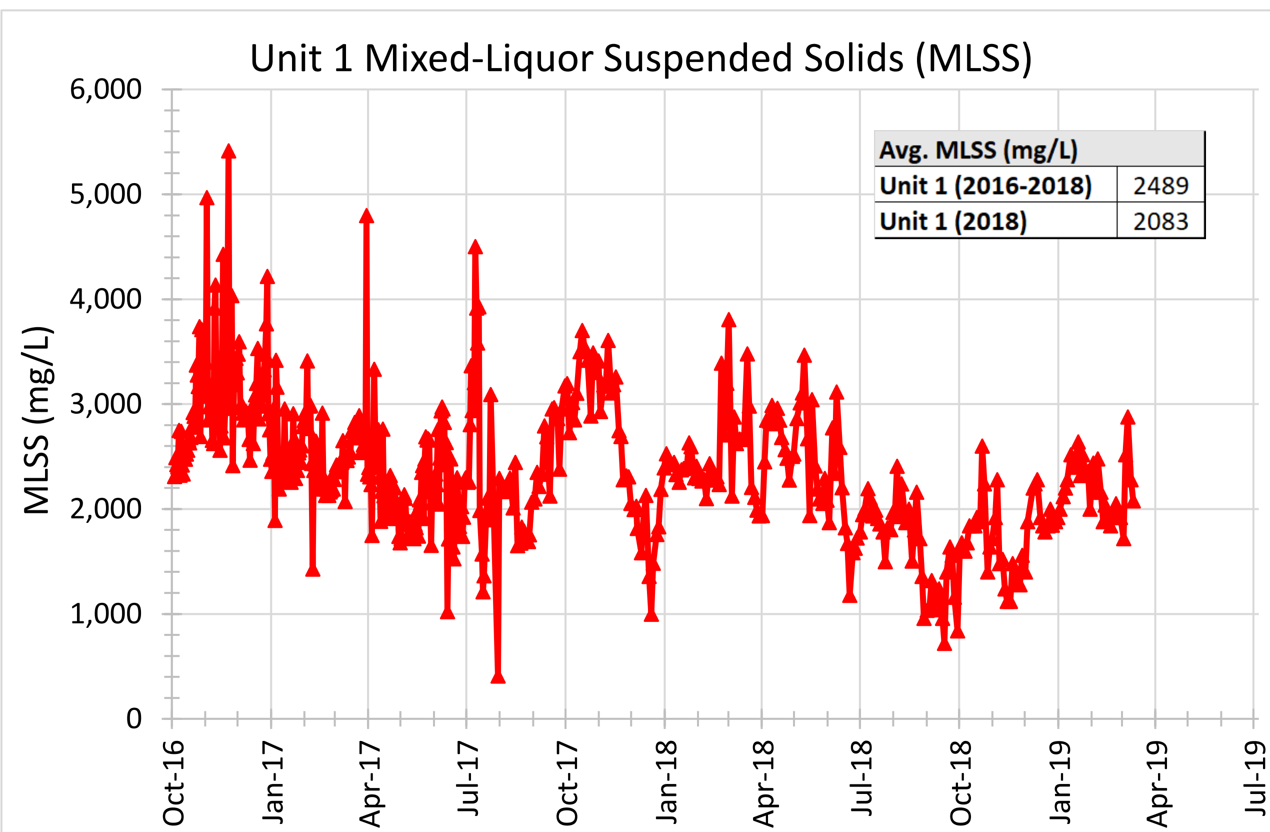


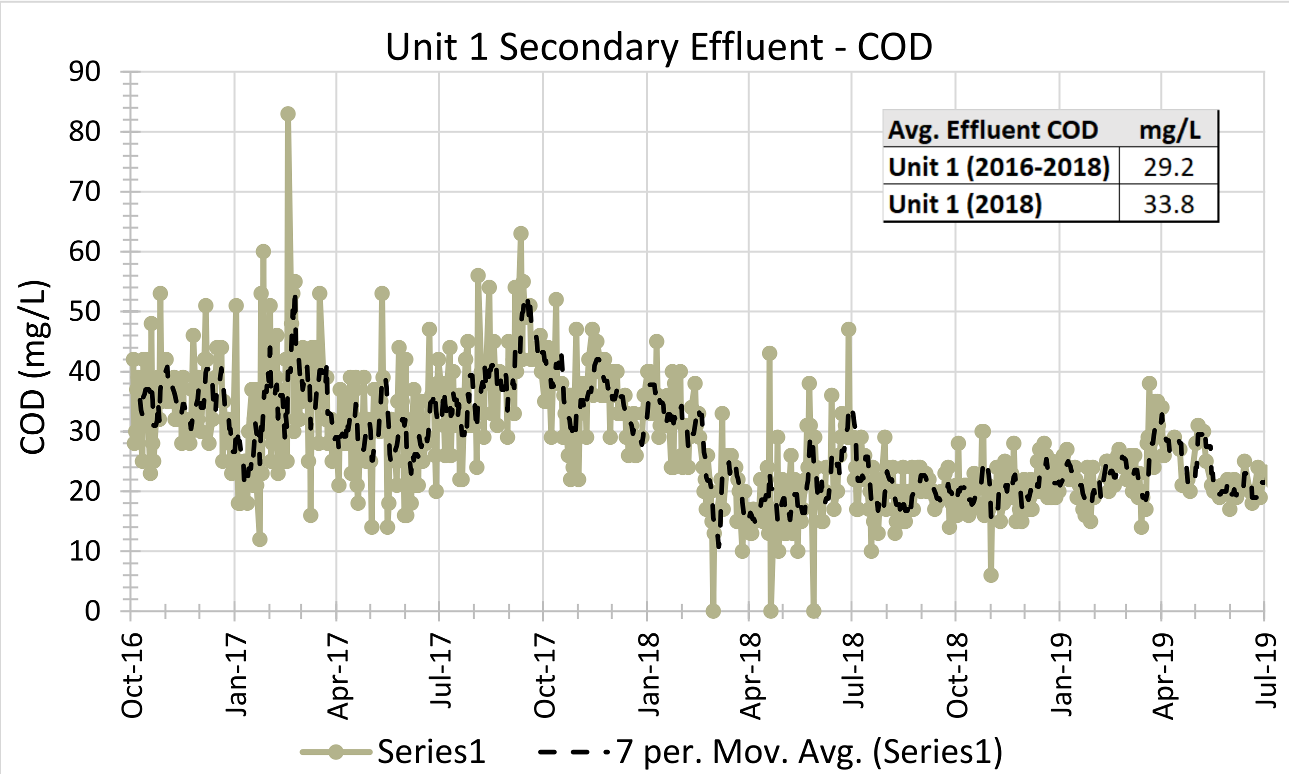
Avg. RAS TSS (mg/L)	
Unit 1 (2016-2018)	4650
Unit 1 (2018)	5061

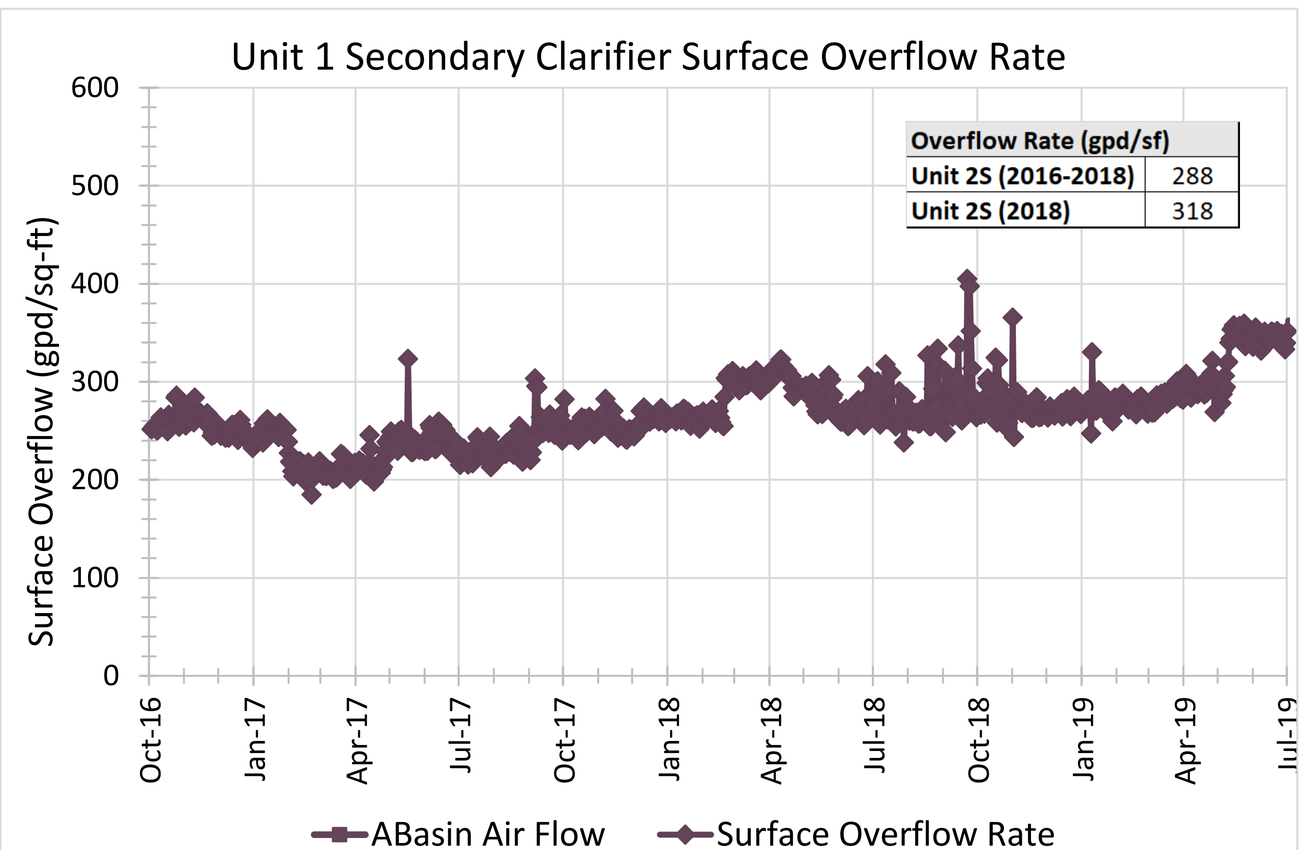


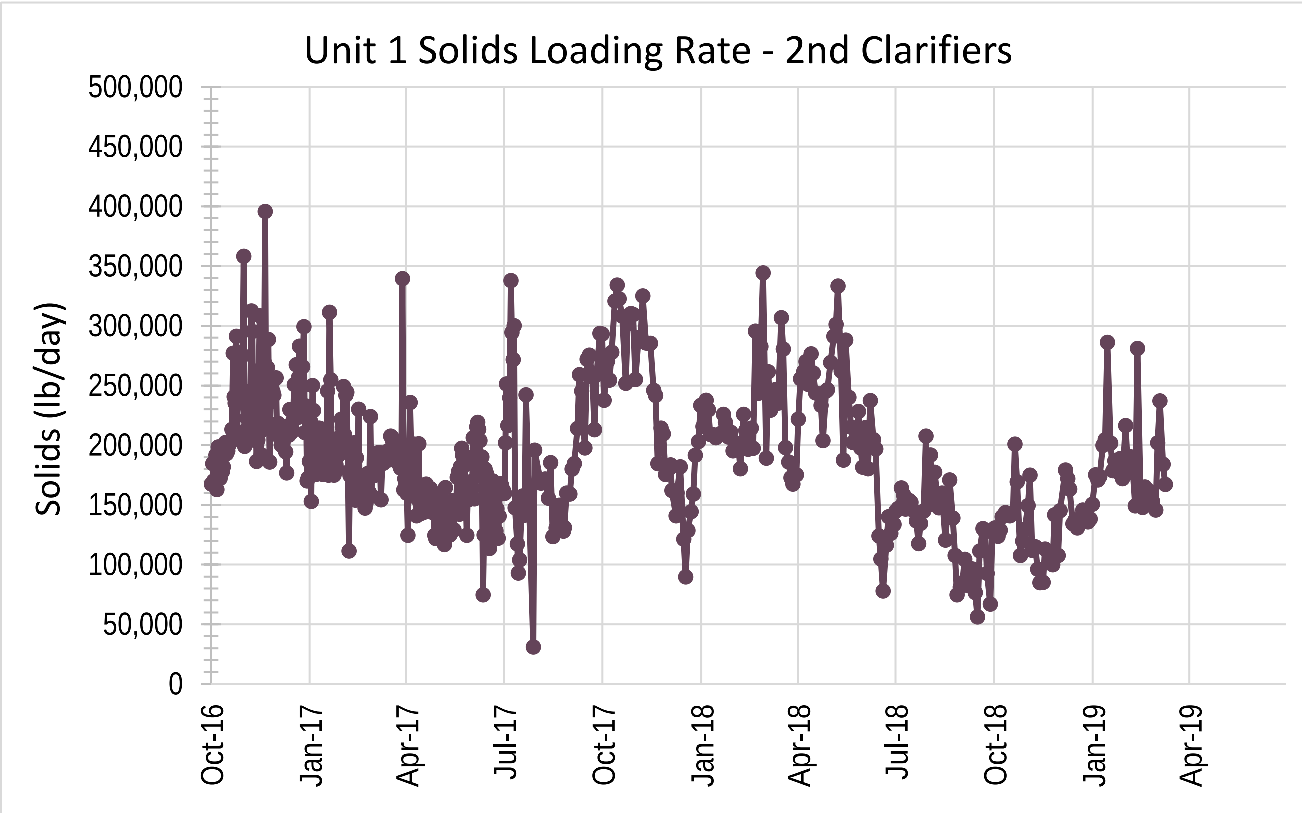
Avg. Effluent TSS (mg/L)	
Unit 1 (2016-2018)	8.0
Unit 1 (2018)	9.6


Unit 1 Secondary SVI
SVI
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
Avg. SVI
Unit 1 (2016-2018) 151
Unit 1 (2018) 199
Unit 1 (95%ile) 389
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Unit 1 SVI
SVI Target
30 per. Mov. Avg. (Unit 1 SVI)

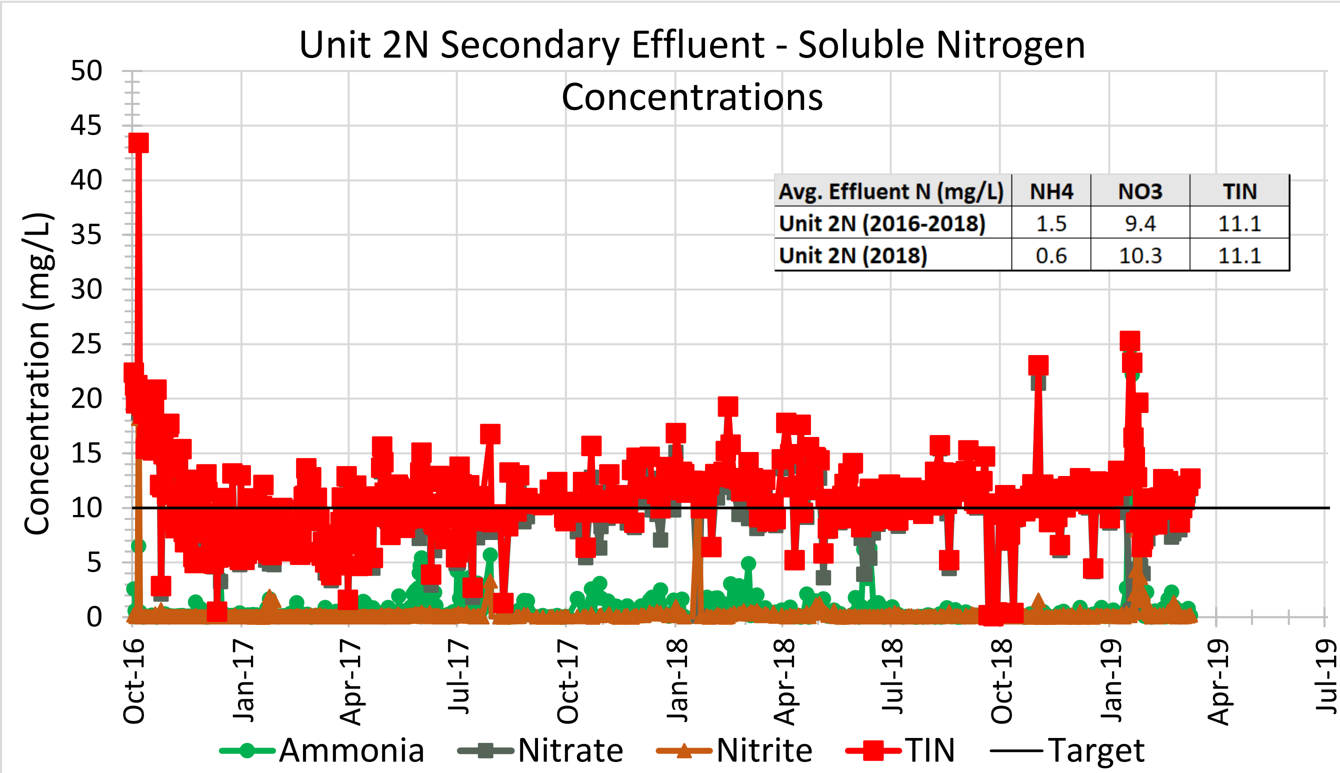

Unit 1 Mixed-Liquor Suspended Solids (MLSS)
MLSS (mg/L)
6,000
5,000
4,000
3,000
2,000
1,000
0
Avg. MLSS (mg/L)
Unit 1 (2016-2018) 2489
Unit 1 (2018) 2083
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19


Unit 1 Secondary Effluent - COD
Avg. Effluent COD mg/L
Unit 1 (2016-2018) 29.2
Unit 1 (2018) 33.8
COD (mg/L)
90
80
70
60
50
40
30
20
10
0
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
Series1
7 per. Mov. Avg. (Series1)

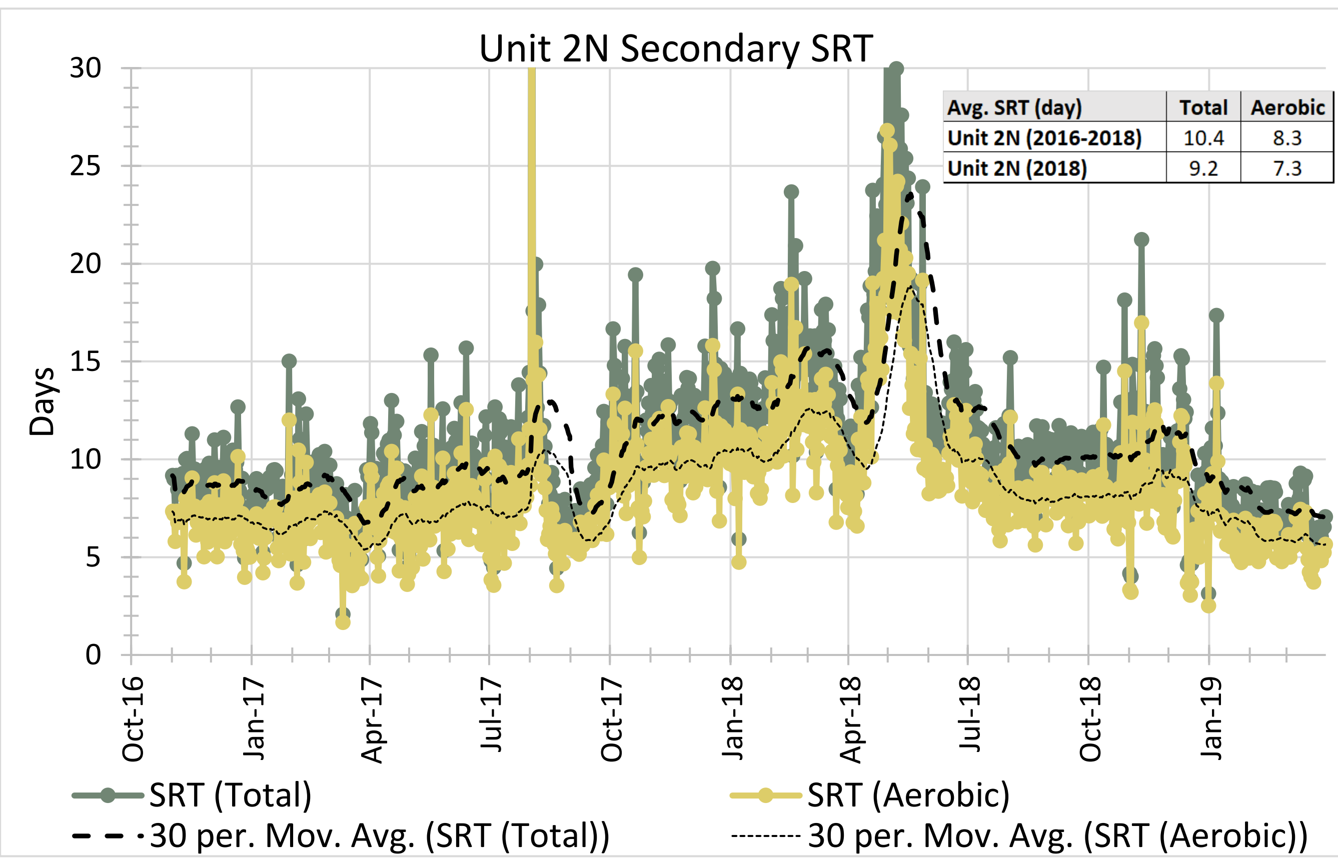

Unit 1 Secondary Clarifier Surface Overflow Rate
Overflow Rate (gpd/sf)
Unit 2S (2016-2018) 288
Unit 2S (2018) 318
Surface Overflow (gpd/sq-ft)
600
500
400
300
200
100
0
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
ABasin Air Flow
Surface Overflow Rate



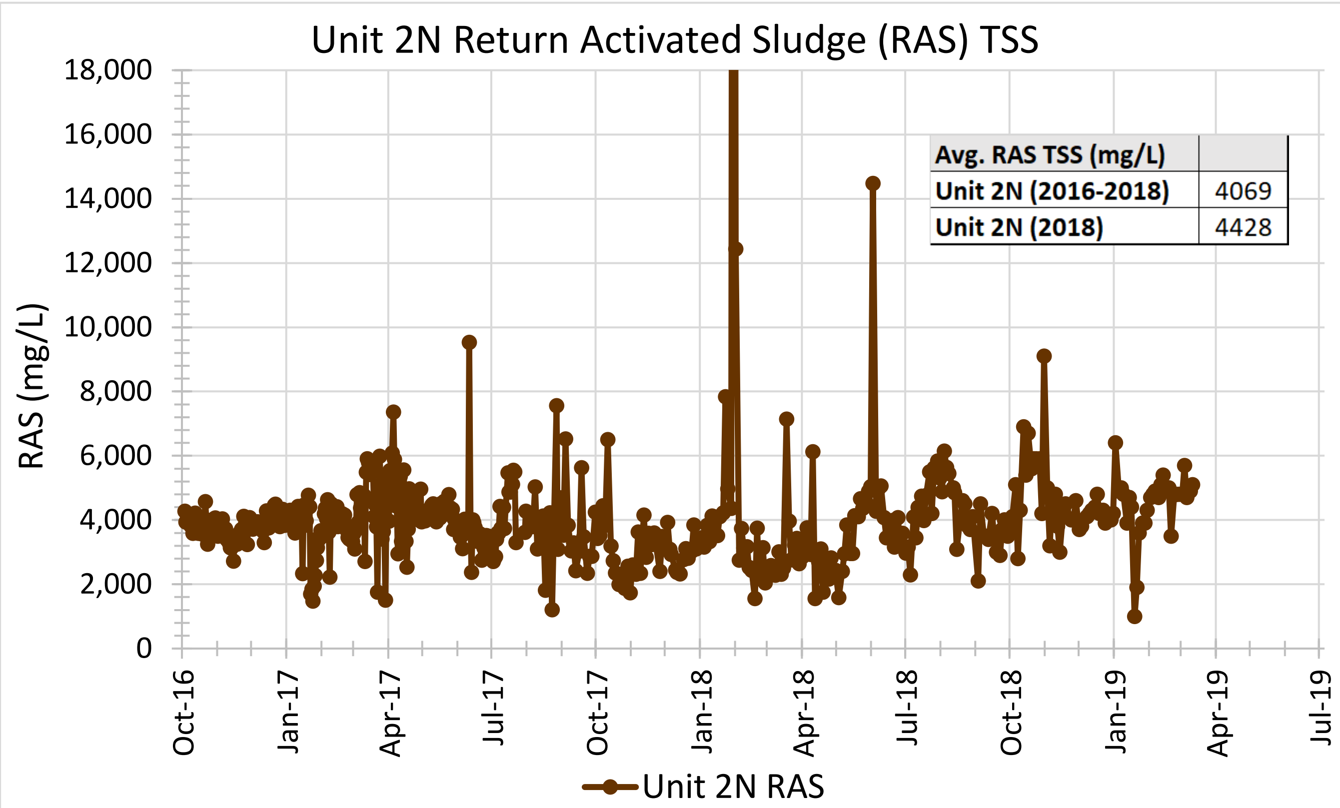
Unit 1 Solids Loading Rate - 2nd Clarifiers
Solids (lb/day)
500,000
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19

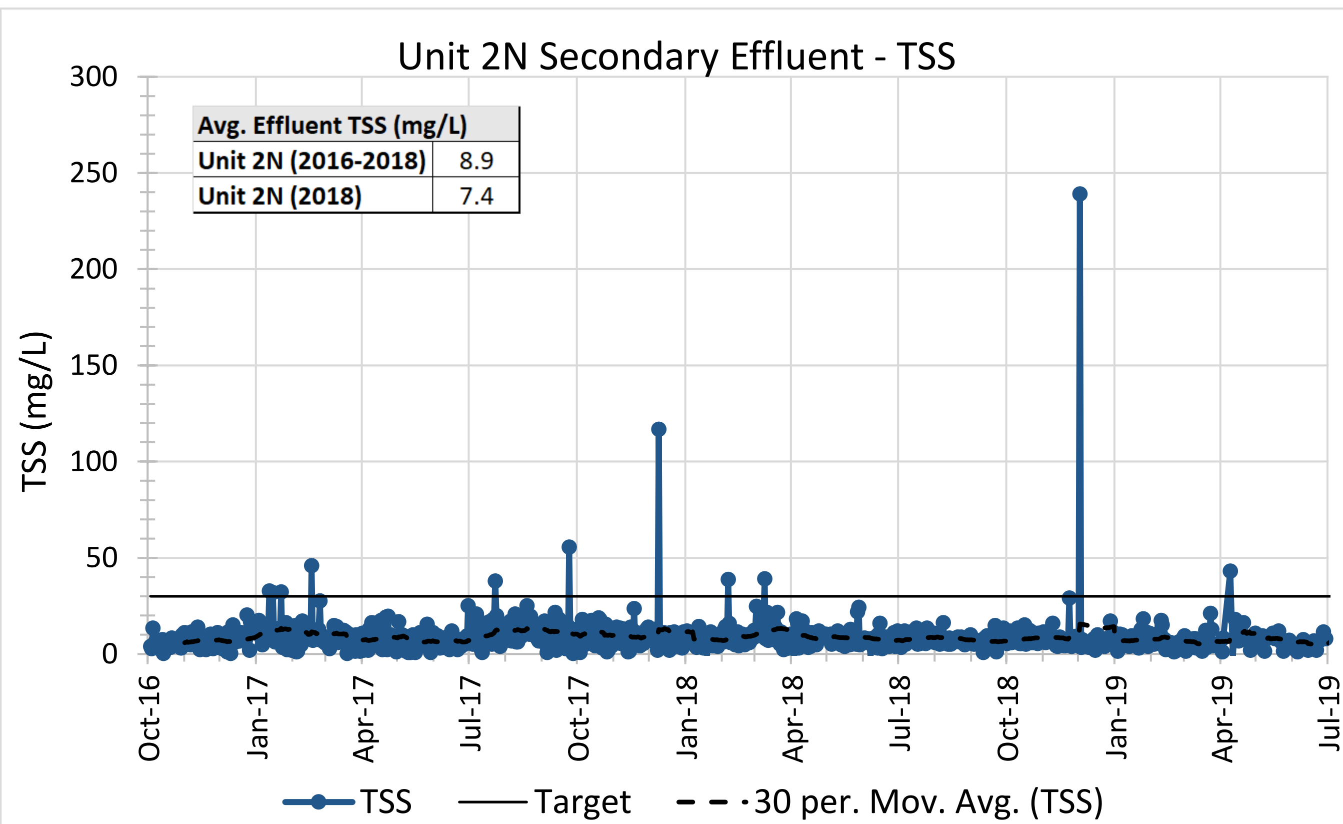


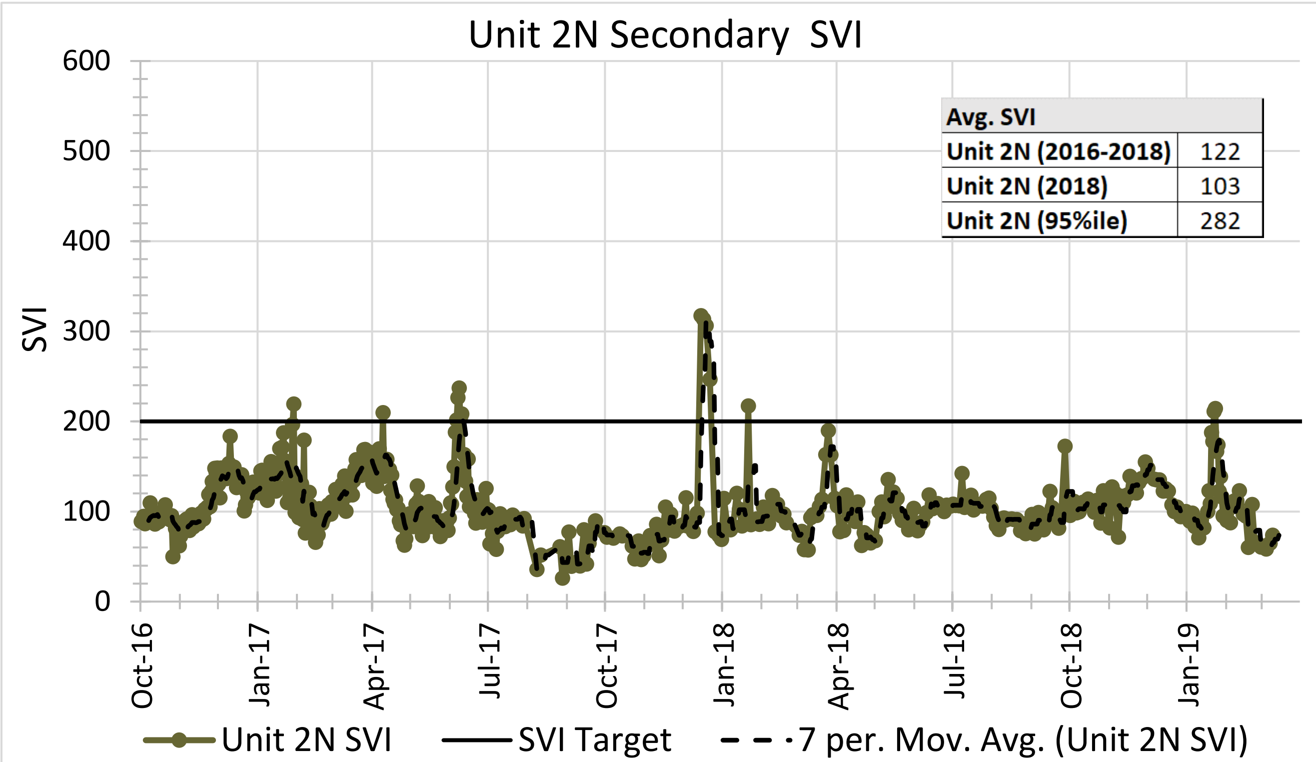
Avg. Effluent N (mg/L)	NH4	NO3	TIN
Unit 2N (2016-2018)	1.5	9.4	11.1
Unit 2N (2018)	0.6	10.3	11.1

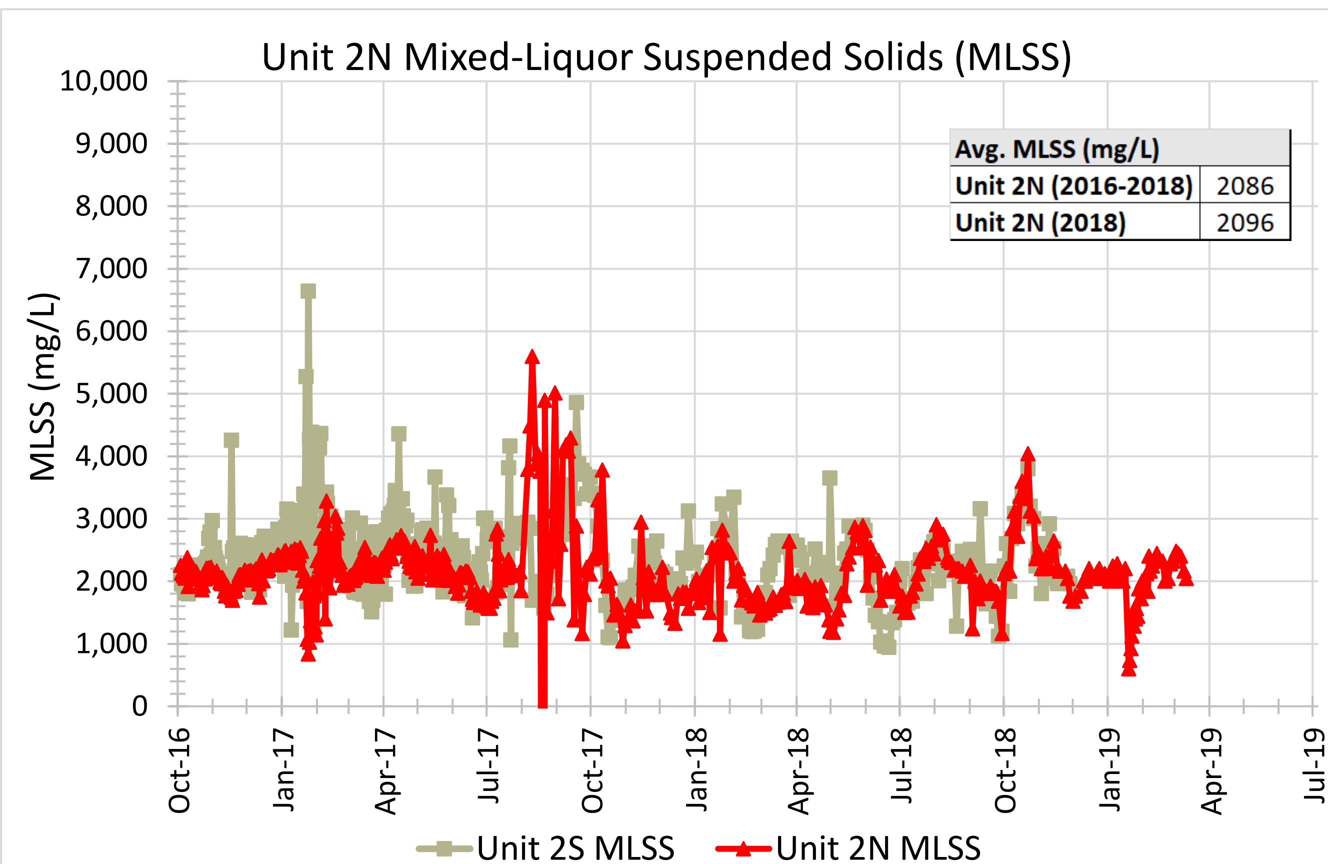


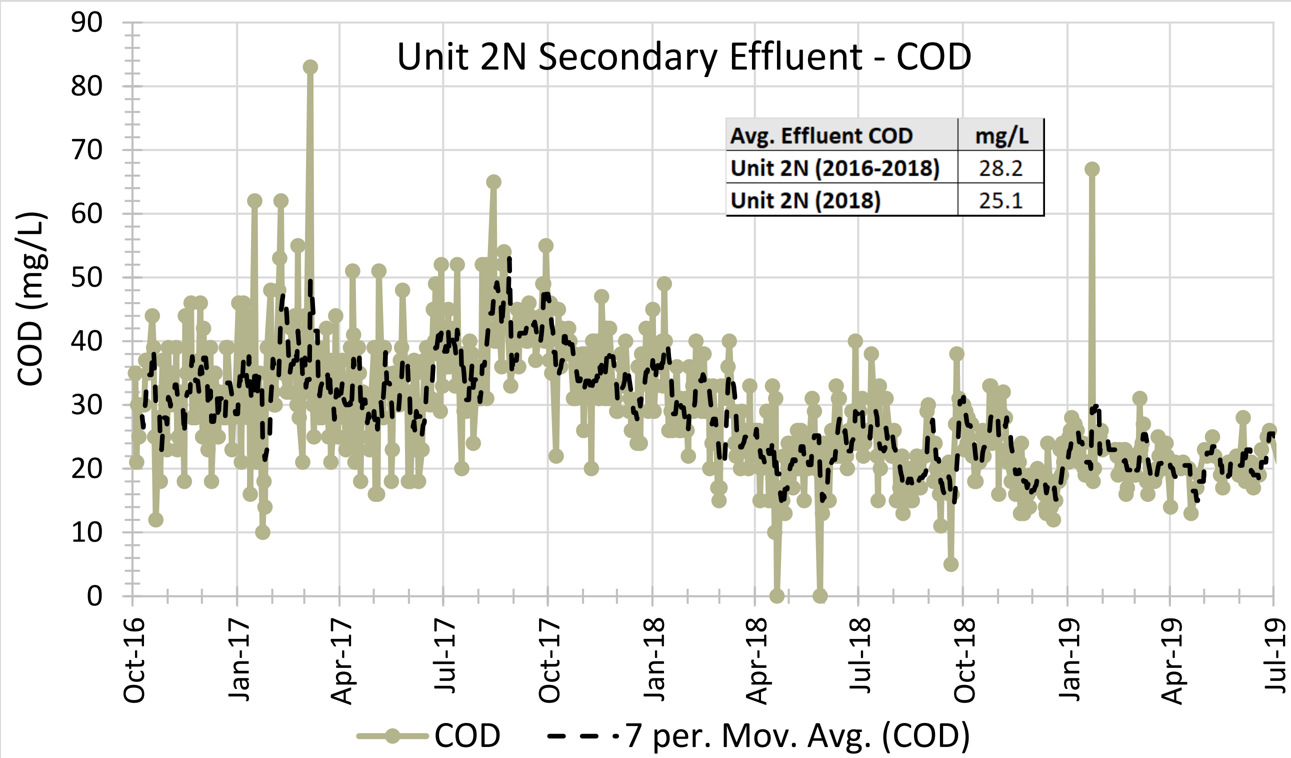
Avg. SRT (day)	Total	Aerobic
Unit 2N (2016-2018)	10.4	8.3
Unit 2N (2018)	9.2	7.3


Unit 2N Return Activated Sludge (RAS) TSS
RAS (mg/L)
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
Unit 2N RAS
Avg. RAS TSS (mg/L)
Unit 2N (2016-2018) 4069
Unit 2N (2018) 4428

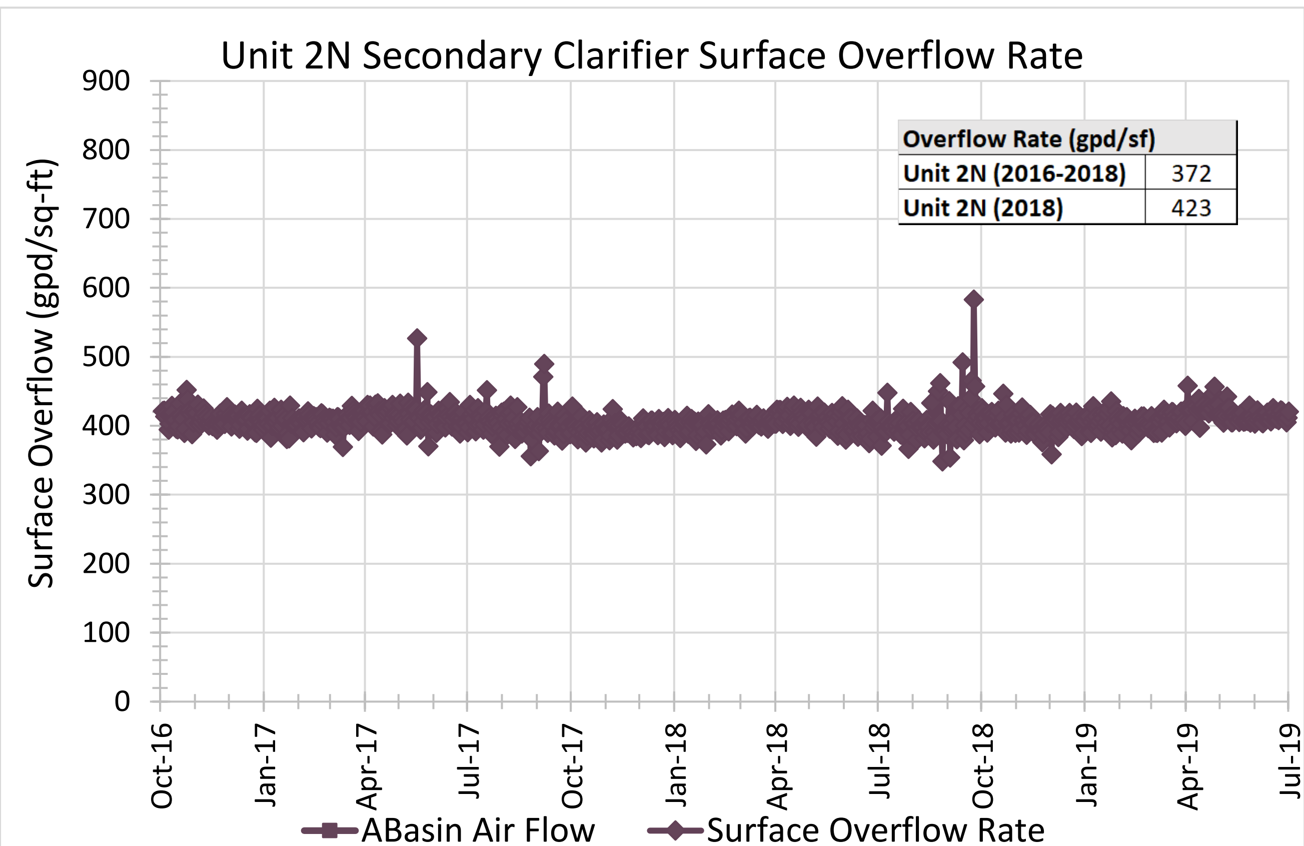

Unit 2N Secondary Effluent - TSS
TSS (mg/L)
300
250
200
150
100
50
0
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
TSS
Target
30 per. Mov. Avg. (TSS)
Avg. Effluent TSS (mg/L)
Unit 2N (2016-2018) 8.9
Unit 2N (2018) 7.4


Unit 2N Secondary SVI
SVI
600
500
400
300
200
100
0
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Avg. SVI
Unit 2N (2016-2018) 122
Unit 2N (2018) 103
Unit 2N (95%ile) 282
Unit 2N SVI
SVI Target
7 per. Mov. Avg. (Unit 2N SVI)

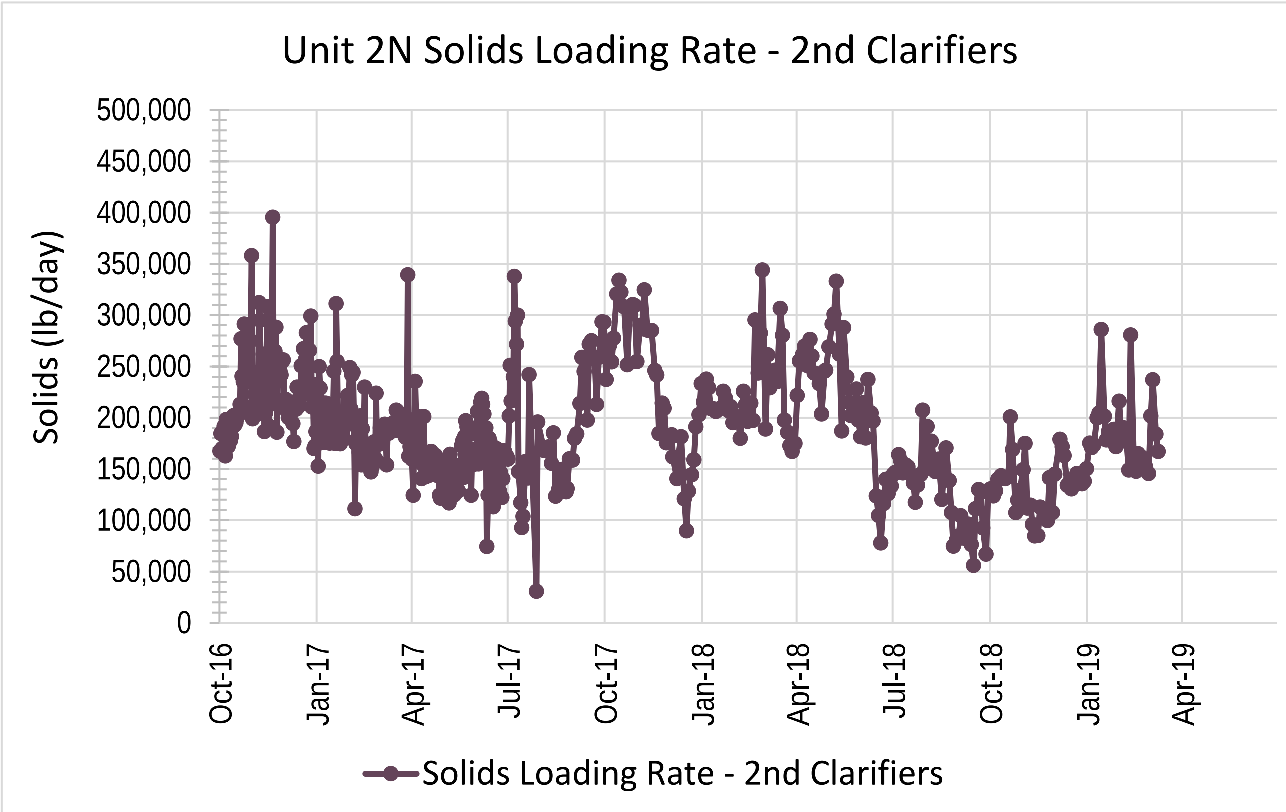

Unit 2N Mixed-Liquor Suspended Solids (MLSS)
MLSS (mg/L)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
Avg. MLSS (mg/L)
Unit 2N (2016-2018) 2086
Unit 2N (2018) 2096
Unit 2S MLSS
Unit 2N MLSS



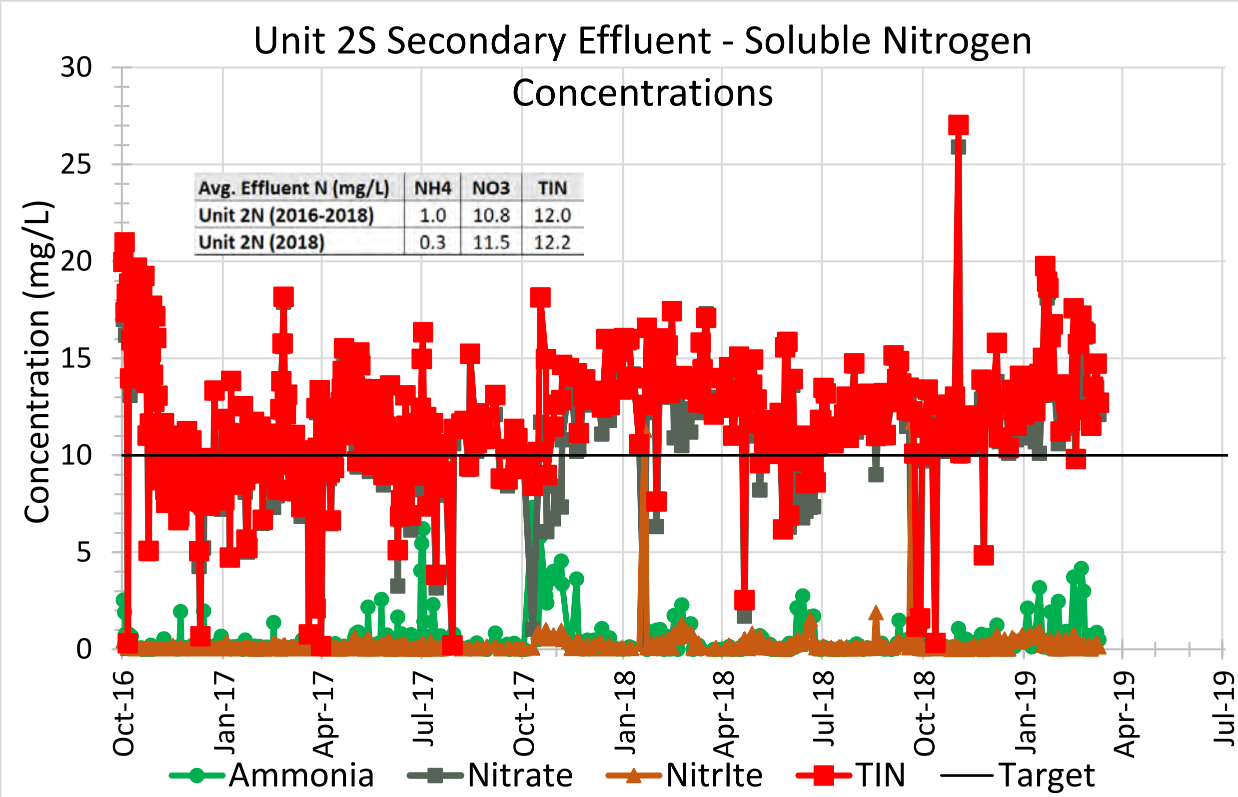
Avg. Effluent COD	mg/L
Unit 2N (2016-2018)	28.2
Unit 2N (2018)	25.1

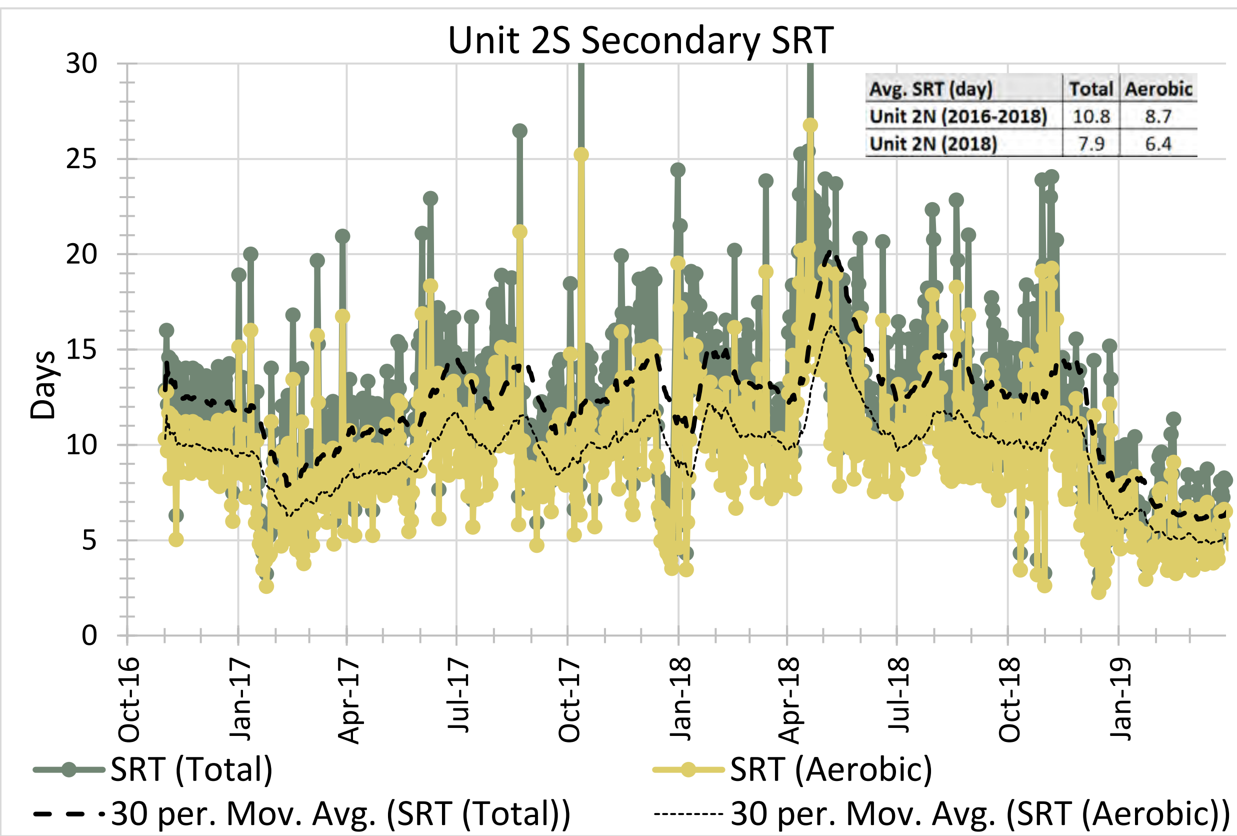


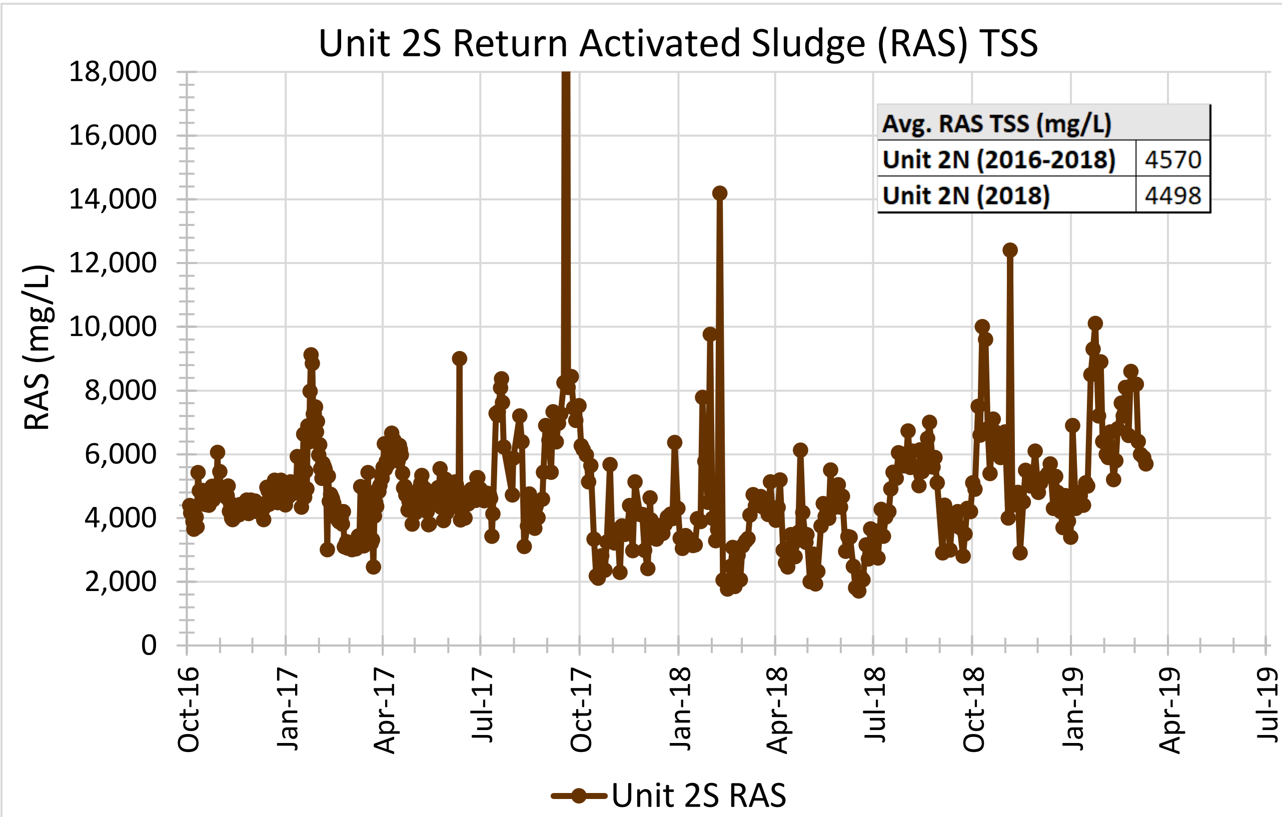
Overflow Rate (gpd/sf)	
Unit 2N (2016-2018)	372
Unit 2N (2018)	423

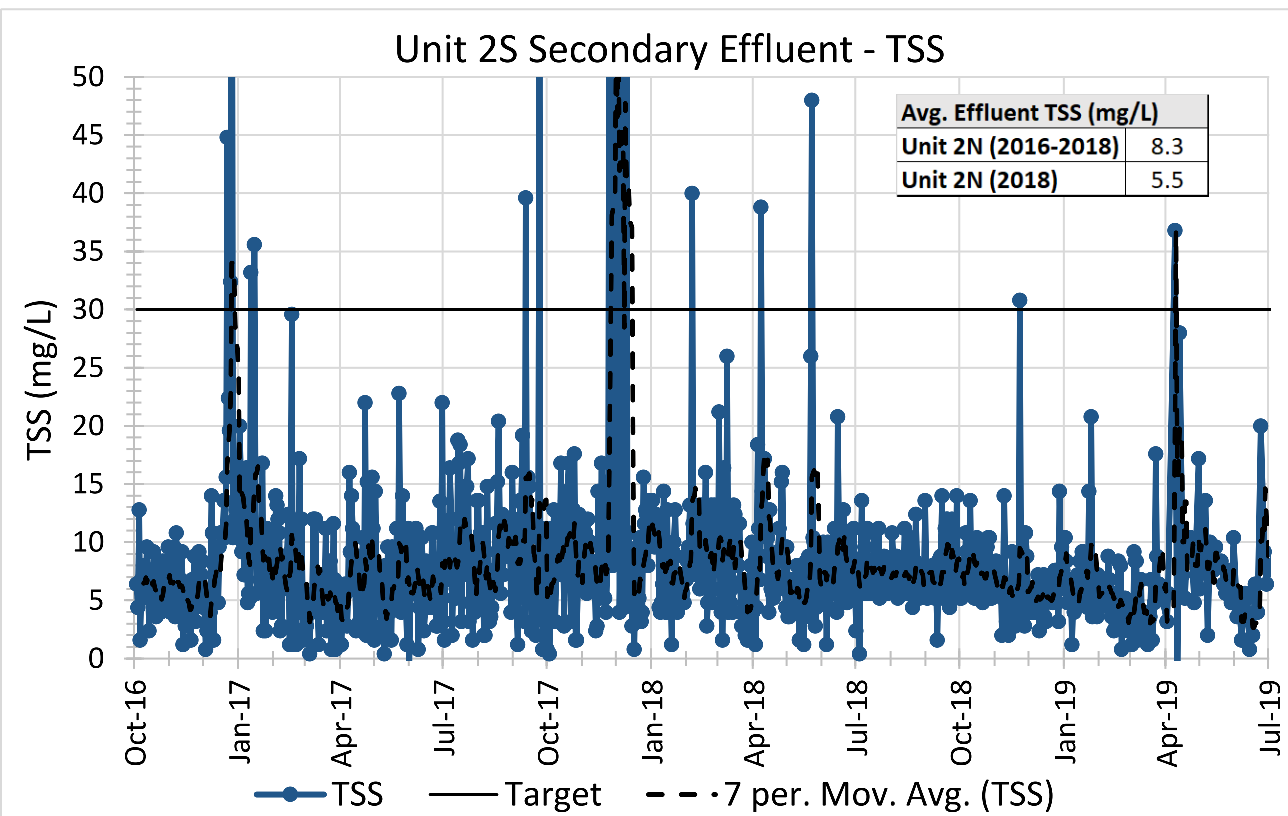


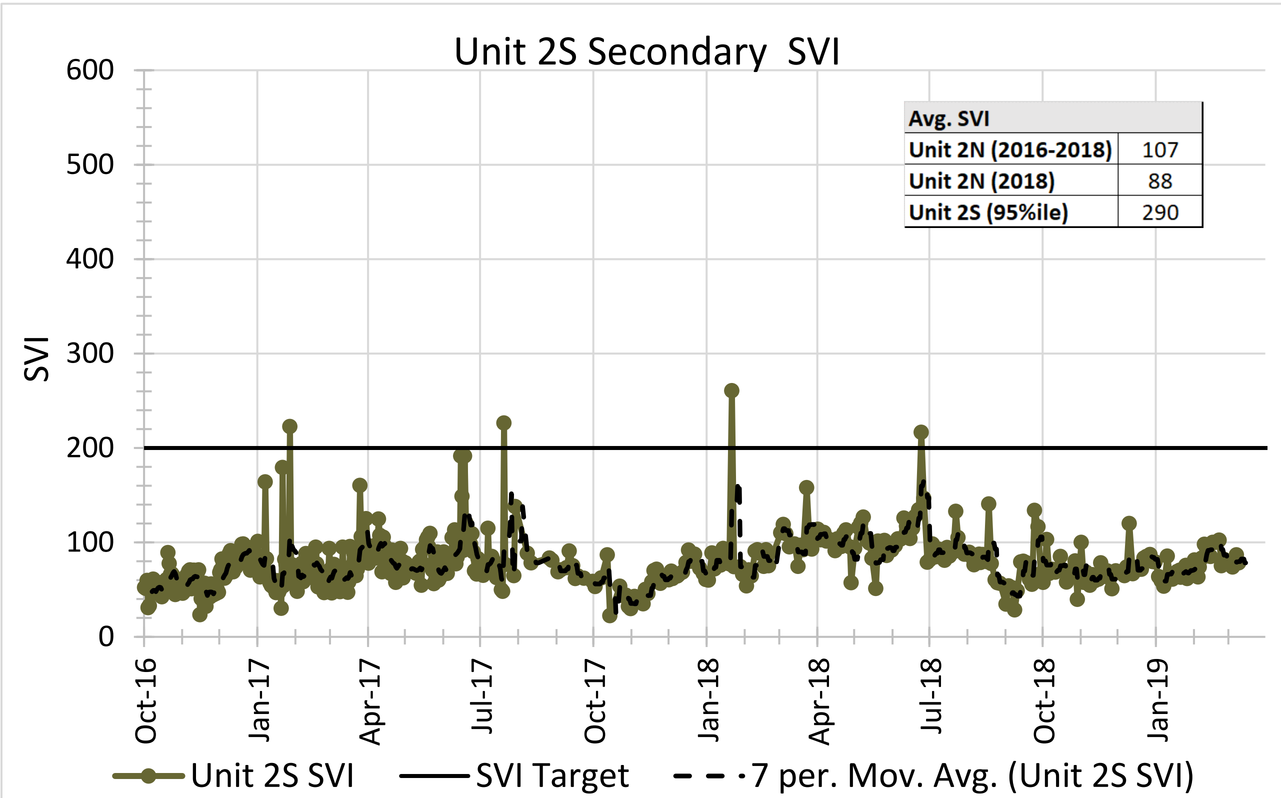
Unit 2N Solids Loading Rate - 2nd Clarifiers
Solids (lb/day)
500,000
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Solids Loading Rate - 2nd Clarifiers

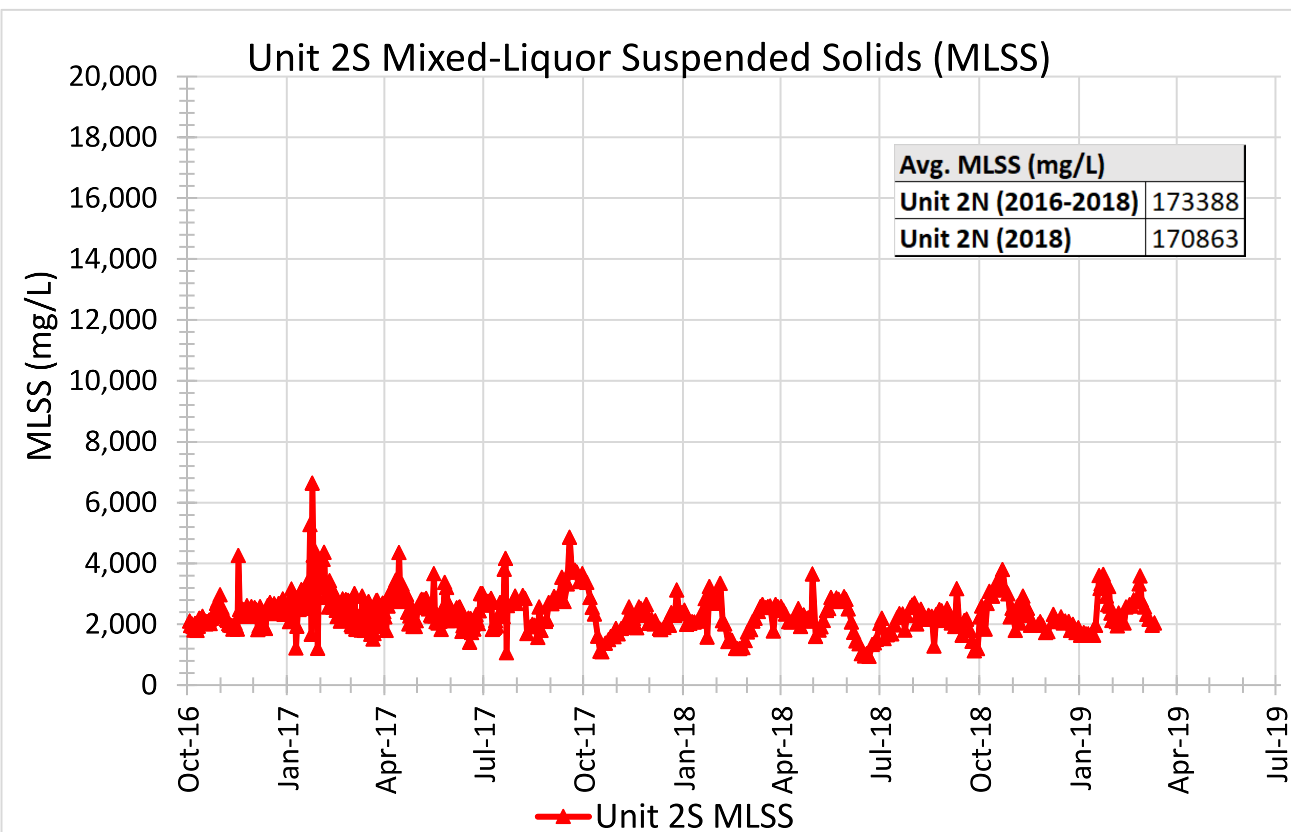

Unit 2S Secondary Effluent - Soluble Nitrogen Concentrations
Avg. Effluent N (mg/L) | NH4 | NO3 | TIN
Unit 2N (2016-2018) | 1.0 | 10.8 | 12.0
Unit 2N (2018) | 0.3 | 11.5 | 12.2
Concentration (mg/L)
30
25
20
15
10
5
0
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
Ammonia
Nitrate
NitrIte
TIN
Target

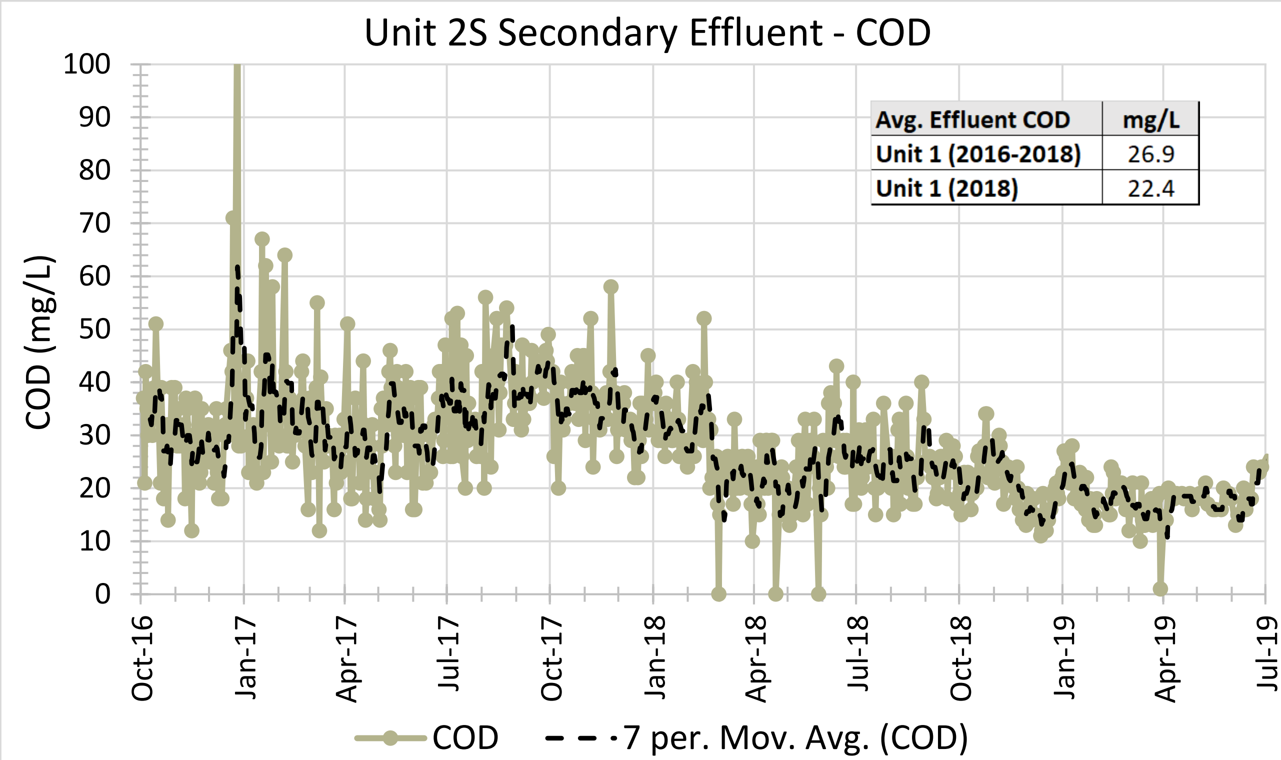

Unit 2S Secondary SRT
Avg. SRT (day) | Total | Aerobic
Unit 2N (2016-2018) | 10.8 | 8.7
Unit 2N (2018) | 7.9 | 6.4
Days
30
25
20
15
10
5
0
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
SRT (Total)
SRT (Aerobic)
30 per. Mov. Avg. (SRT (Total))
30 per. Mov. Avg. (SRT (Aerobic))


Unit 2S Return Activated Sludge (RAS) TSS
Avg. RAS TSS (mg/L)
Unit 2N (2016-2018) 4570
Unit 2N (2018) 4498
RAS (mg/L)
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
Unit 2S RAS

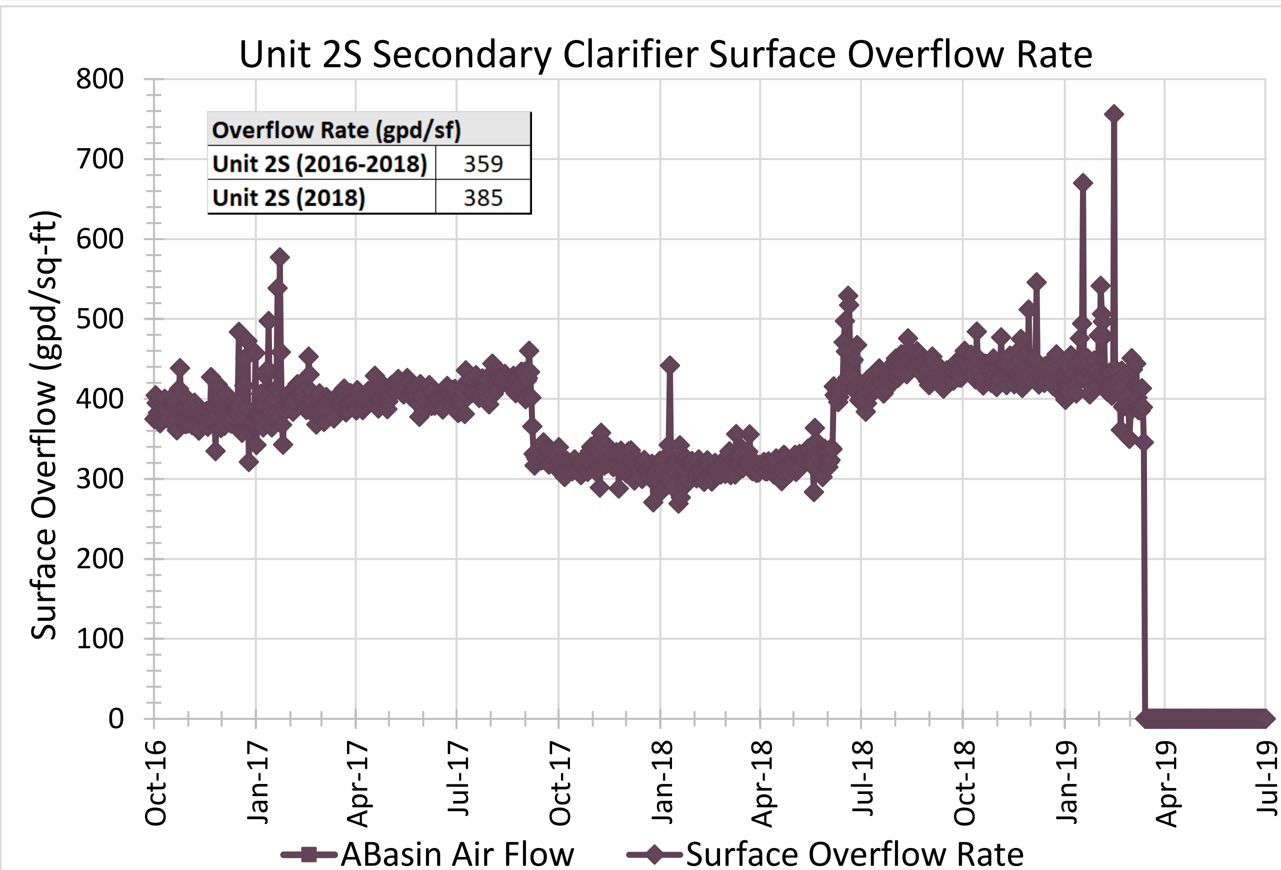

Unit 2S Secondary Effluent - TSS
Avg. Effluent TSS (mg/L)
Unit 2N (2016-2018) 8.3
Unit 2N (2018) 5.5
TSS (mg/L)
50
45
40
35
30
25
20
15
10
5
0
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
TSS
Target
7 per. Mov. Avg. (TSS)


Unit 2S Secondary SVI
Avg. SVI
Unit 2N (2016-2018) 107
Unit 2N (2018) 88
Unit 2S (95%ile) 290
SVI
Unit 2S SVI
SVI Target
7 per. Mov. Avg. (Unit 2S SVI)

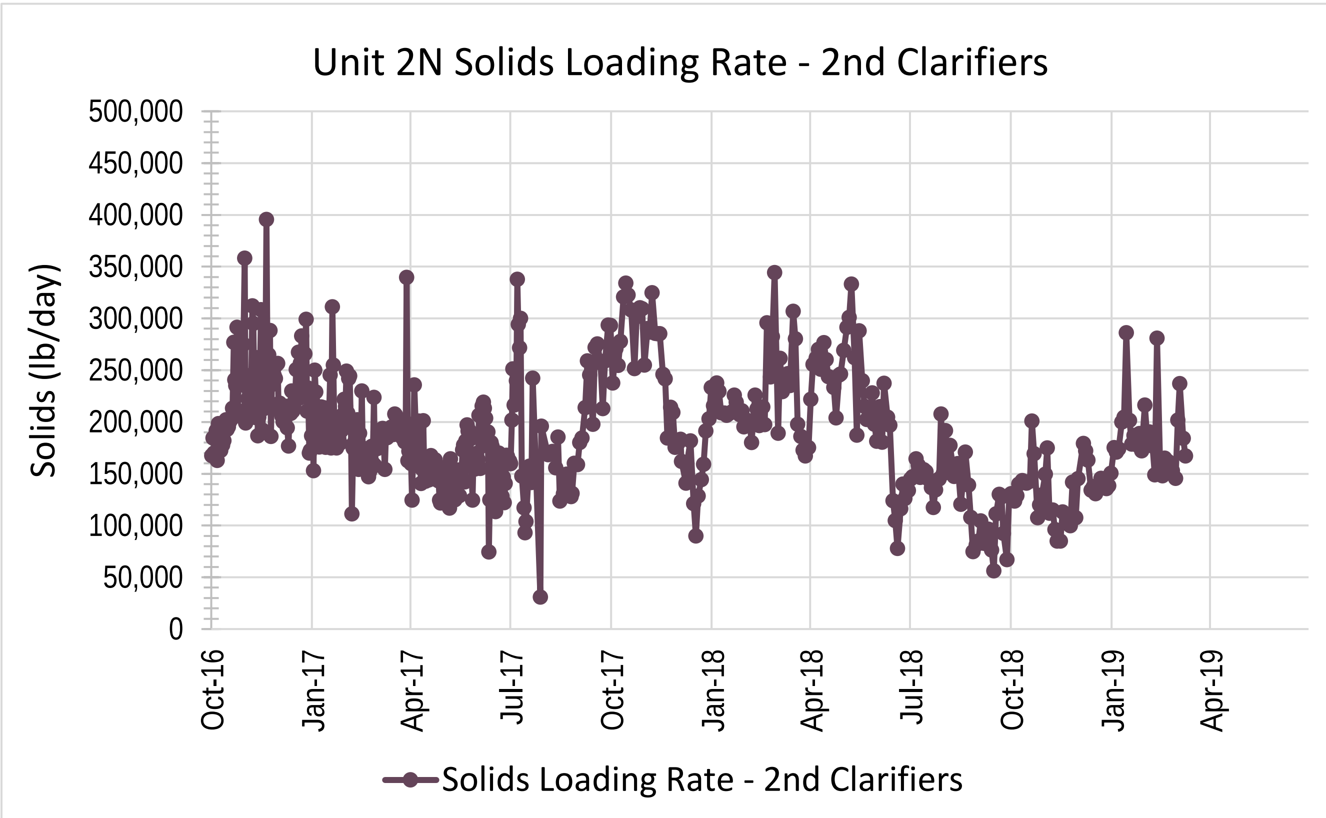

Unit 2S Mixed-Liquor Suspended Solids (MLSS)
Avg. MLSS (mg/L)
Unit 2N (2016-2018) 173388
Unit 2N (2018) 170863
MLSS (mg/L)
Unit 2S MLSS

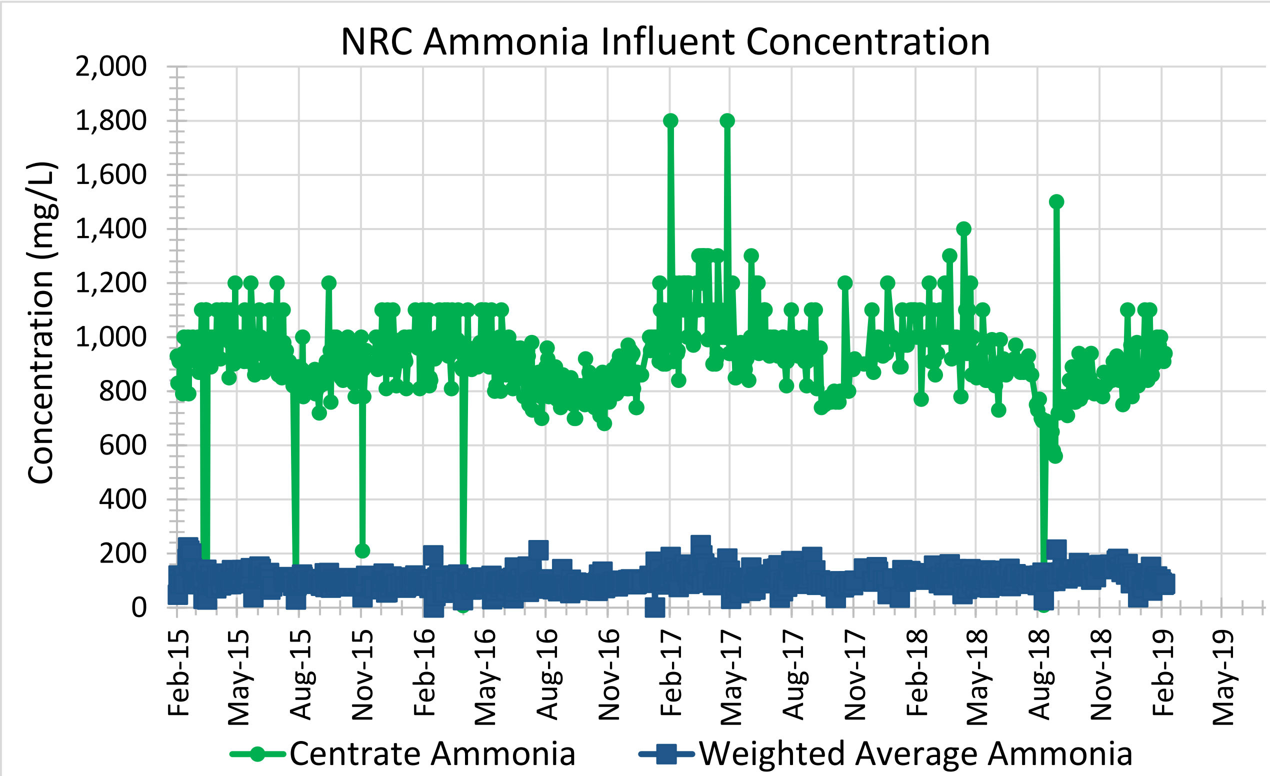


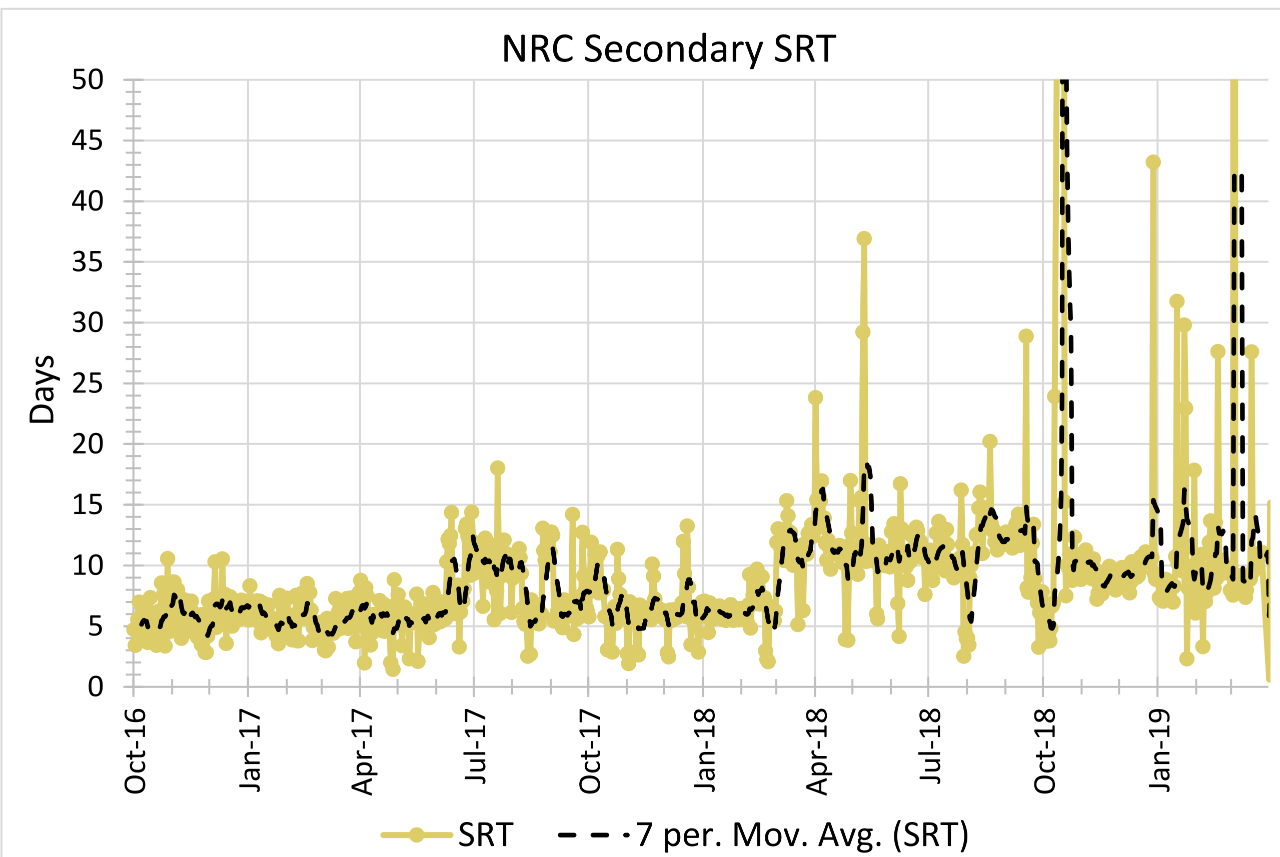
Avg. Effluent COD	mg/L
Unit 1 (2016-2018)	26.9
Unit 1 (2018)	22.4

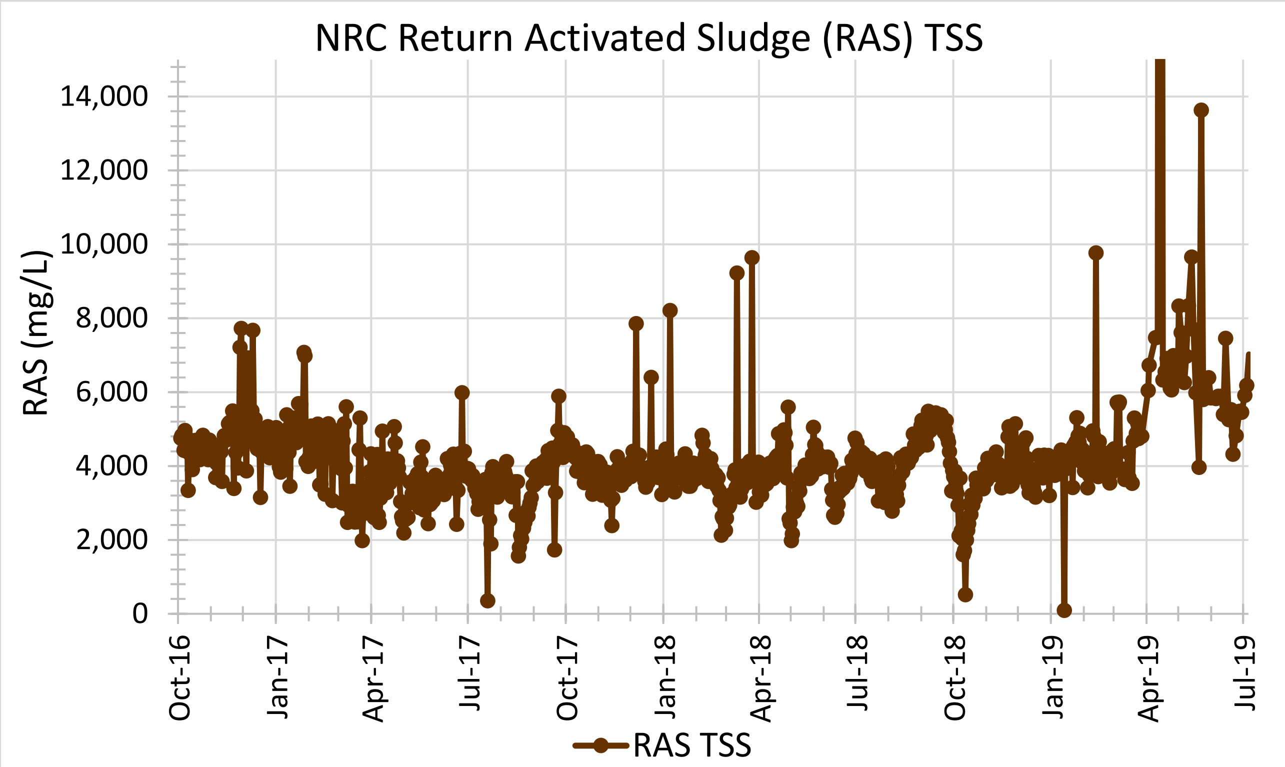


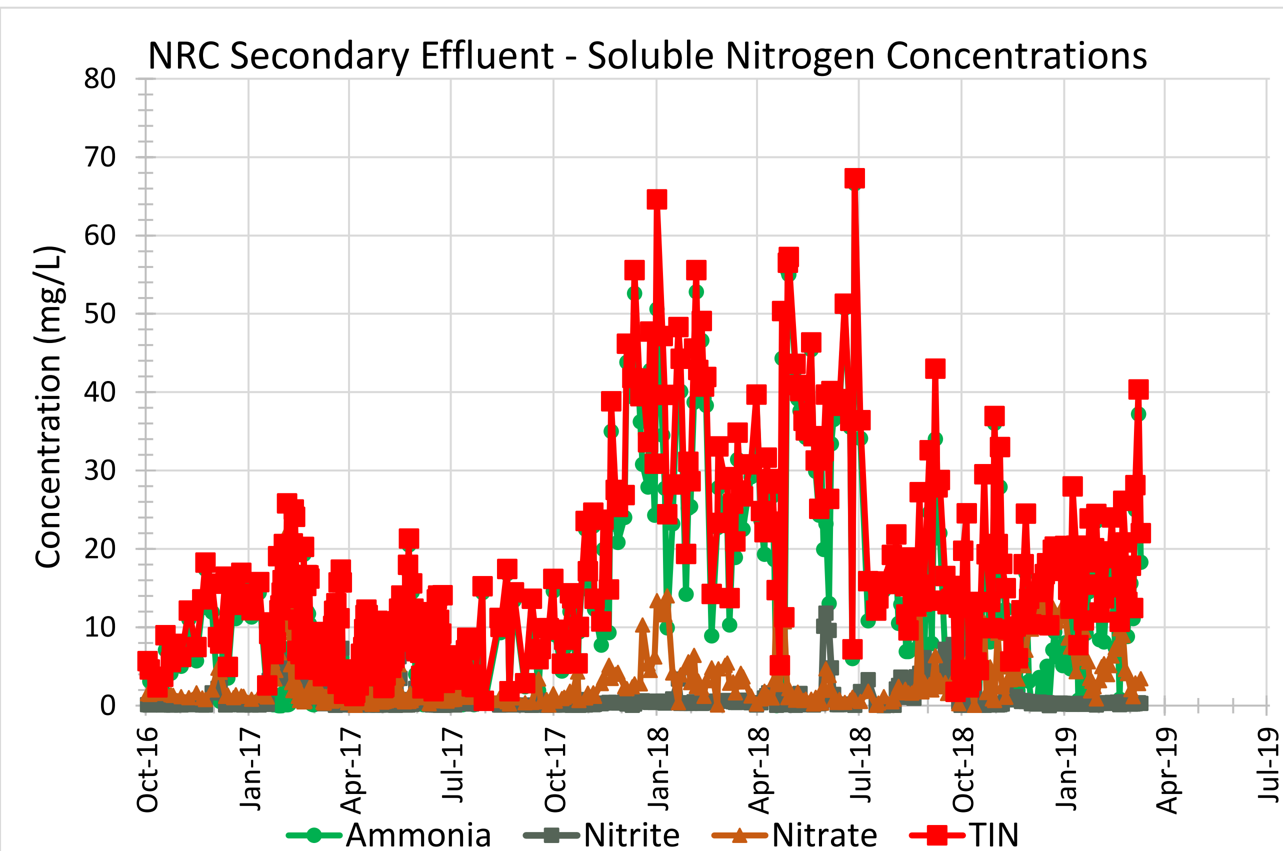
Overflow Rate (gpd/sf)	
Unit 2S (2016-2018)	359
Unit 2S (2018)	385


Unit 2N Solids Loading Rate - 2nd Clarifiers
Solids (lb/day)
500,000
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Solids Loading Rate - 2nd Clarifiers


NRC Ammonia Influent Concentration
Concentration (mg/L)
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
Feb-15
May-15
Aug-15
Nov-15
Feb-16
May-16
Aug-16
Nov-16
Feb-17
May-17
Aug-17
Nov-17
Feb-18
May-18
Aug-18
Nov-18
Feb-19
May-19
Centrate Ammonia
Weighted Average Ammonia

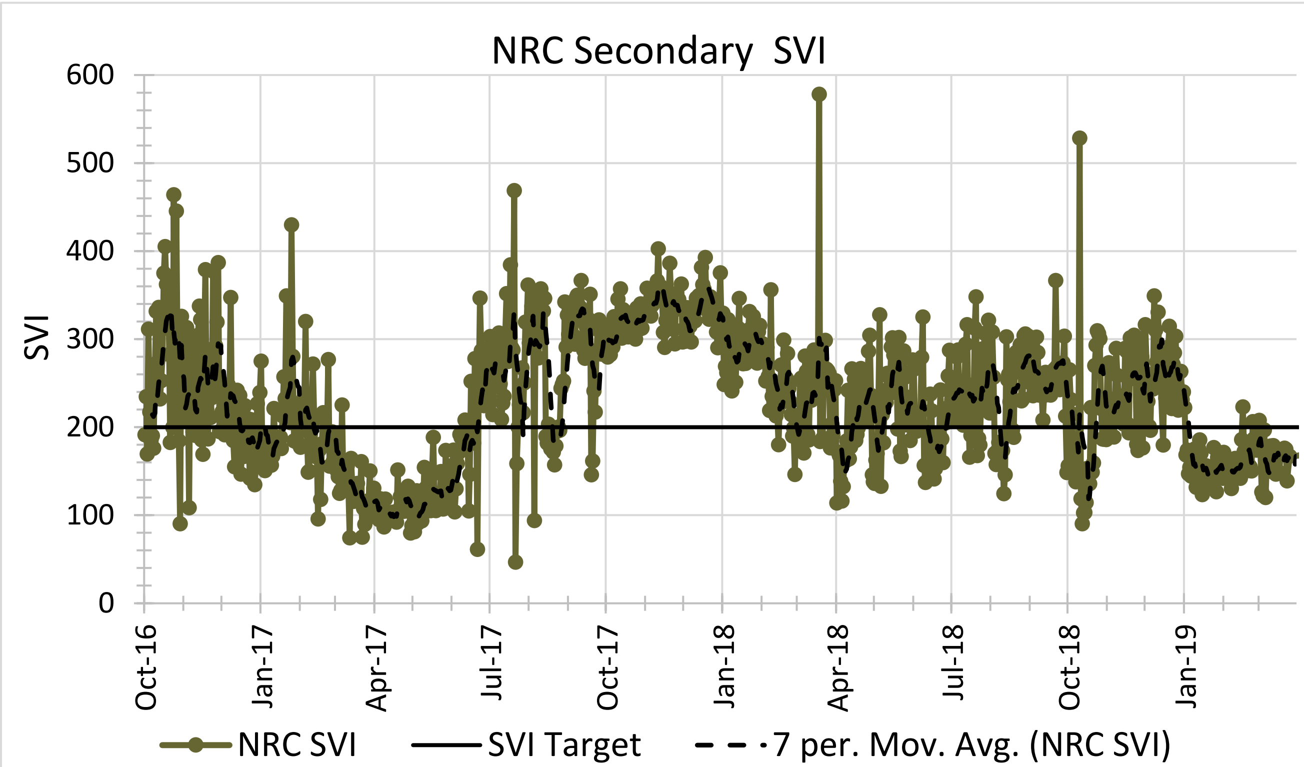

NRC Secondary SRT
Days
50
45
40
35
30
25
20
15
10
5
0
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
SRT
7 per. Mov. Avg. (SRT)

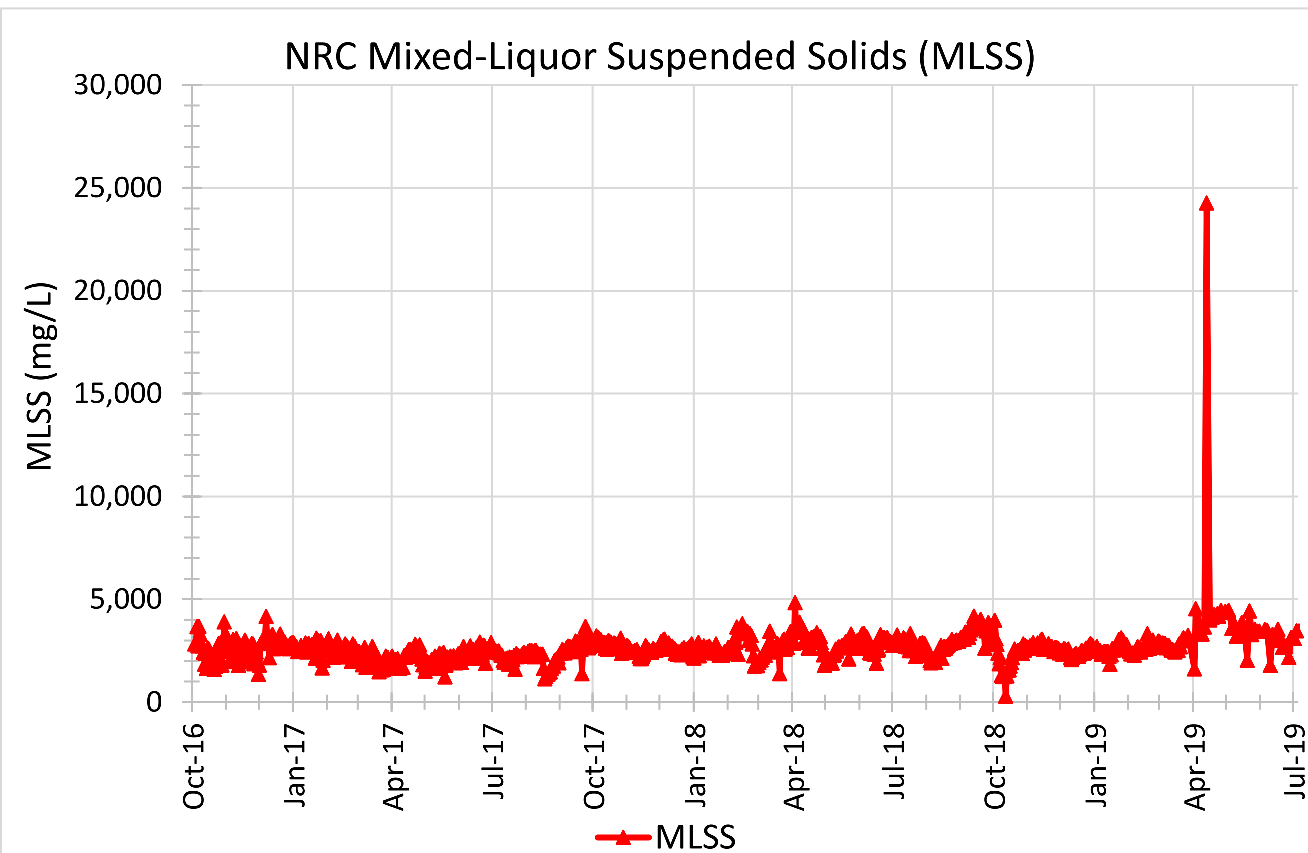

NRC Return Activated Sludge (RAS) TSS
RAS (mg/L)
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
RAS TSS

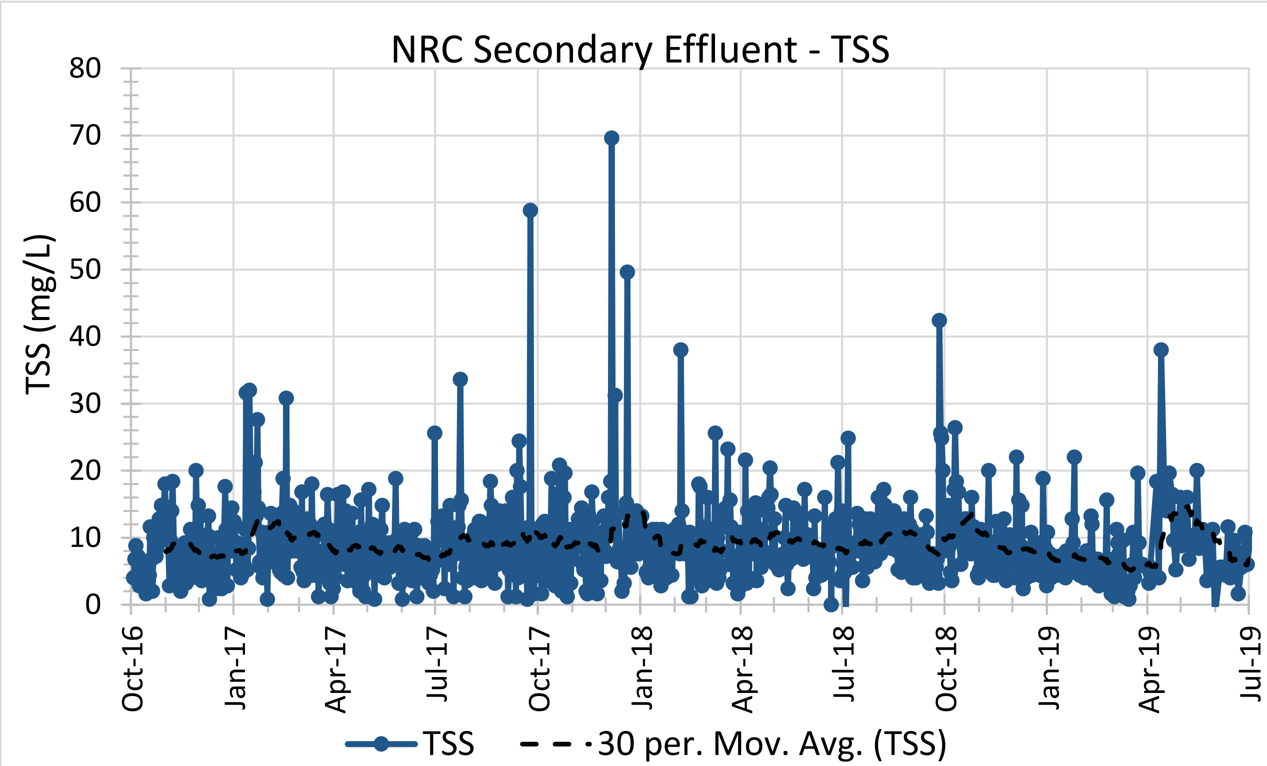

NRC Secondary Effluent - Soluble Nitrogen Concentrations
Concentration (mg/L)
80
70
60
50
40
30
20
10
0
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
Ammonia
Nitrite
Nitrate
TIN

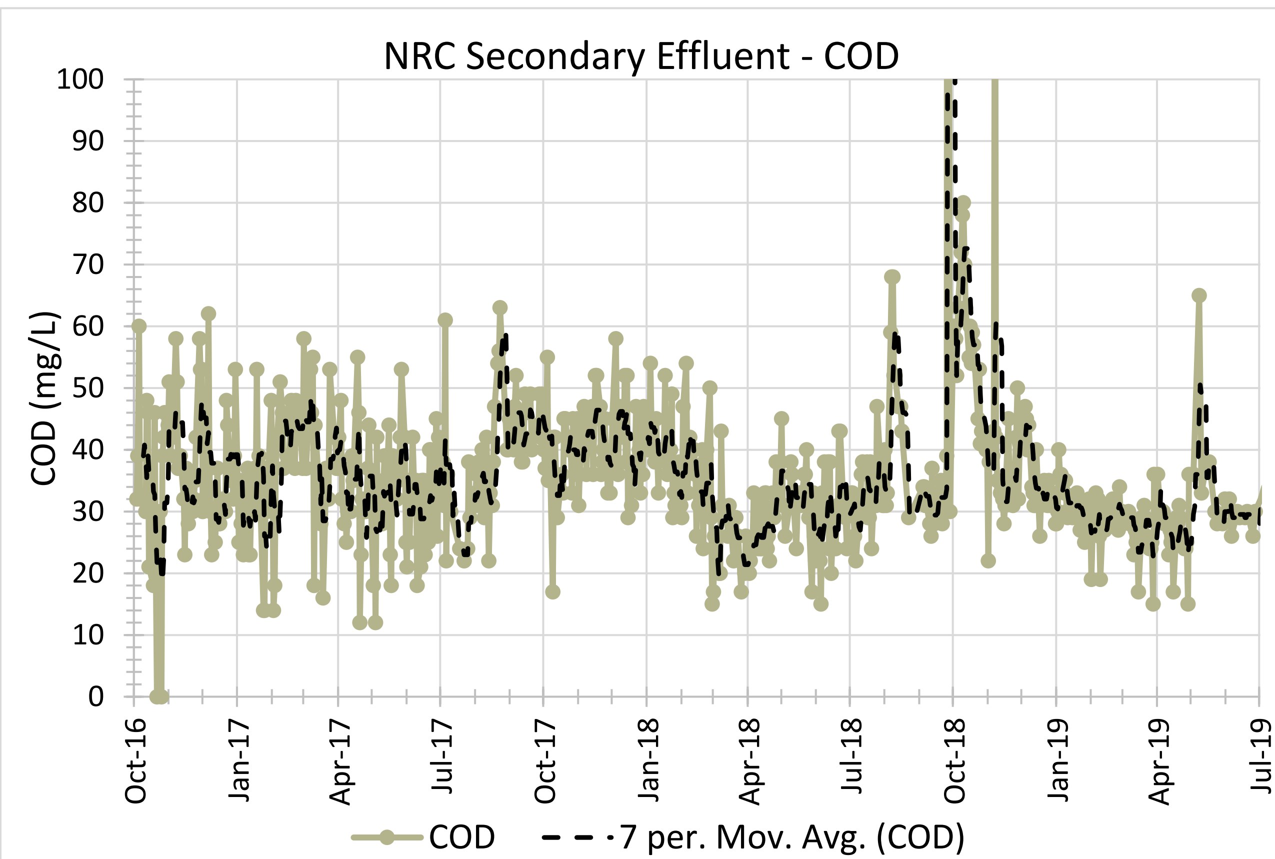
Hazen

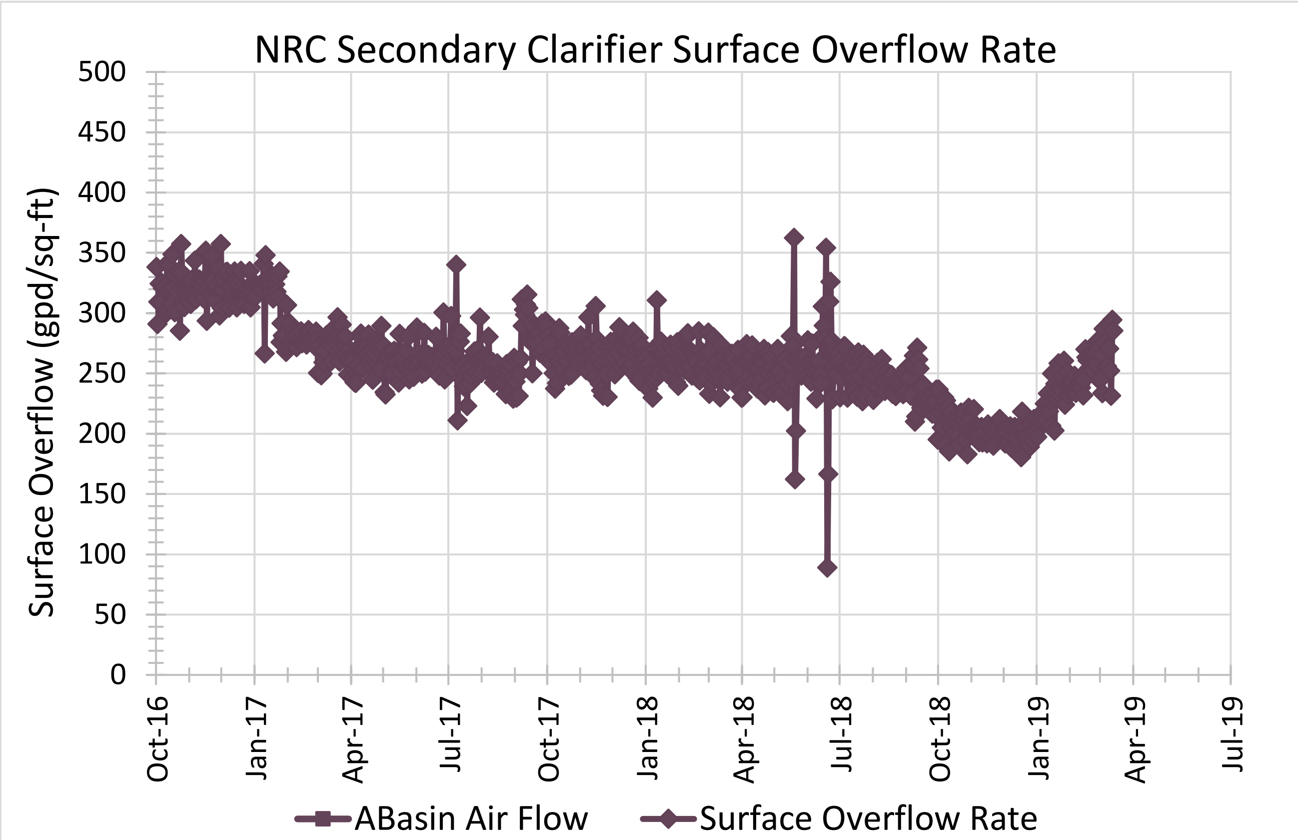
WOODARD & CURRAN

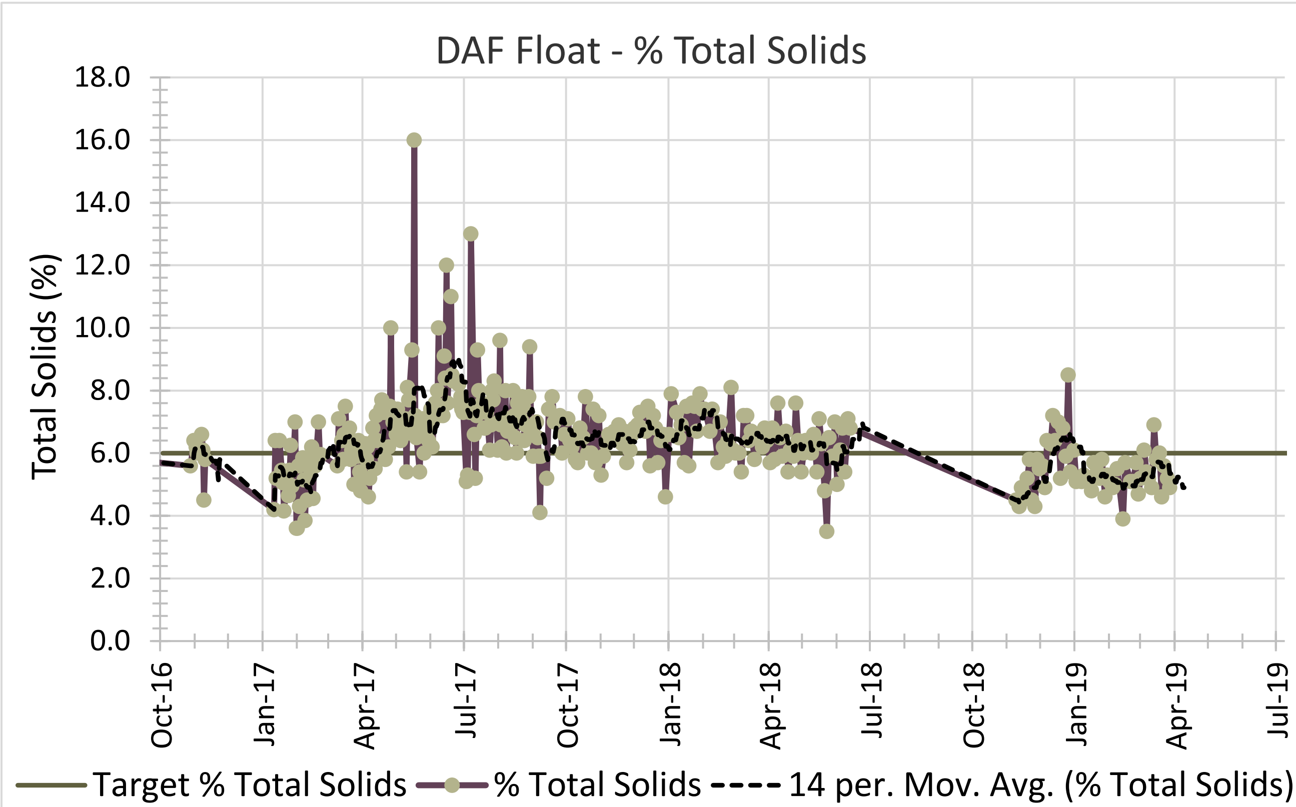


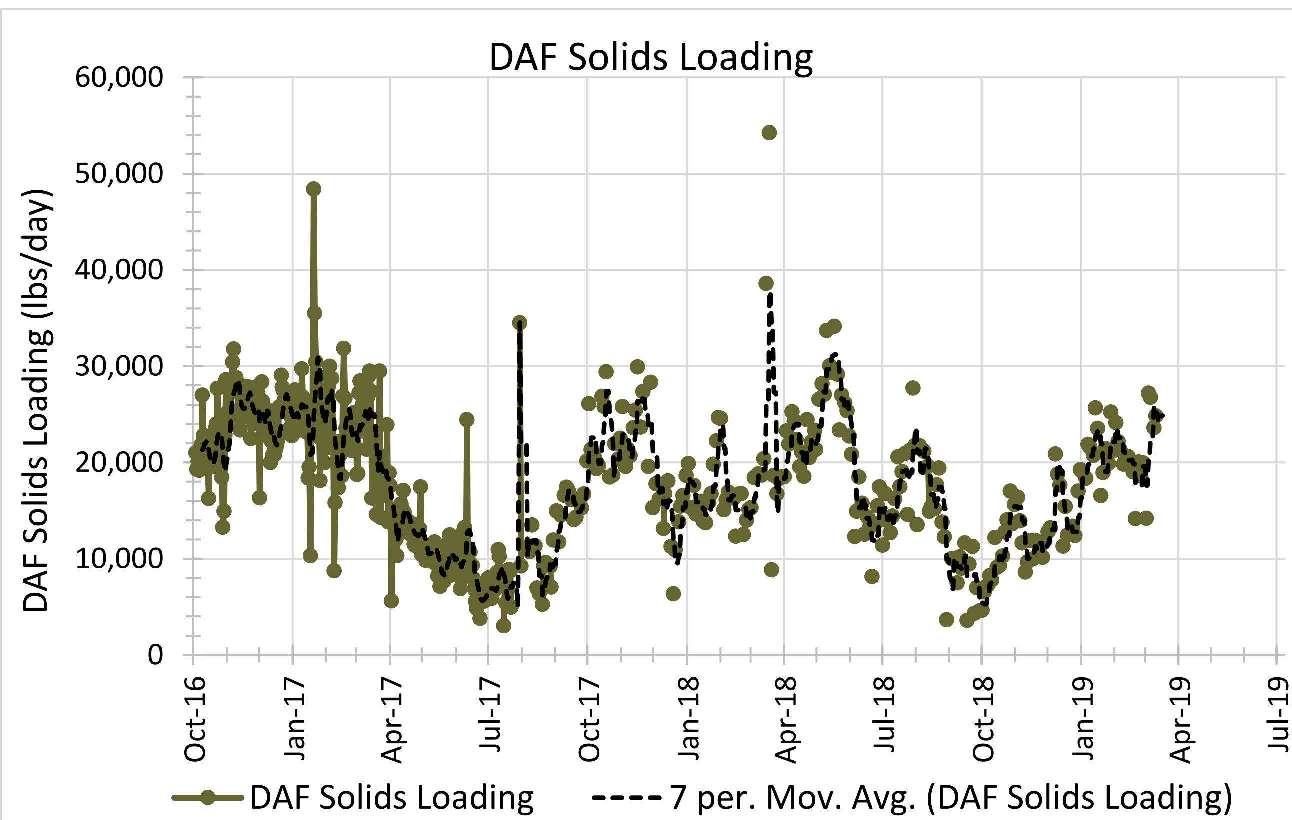


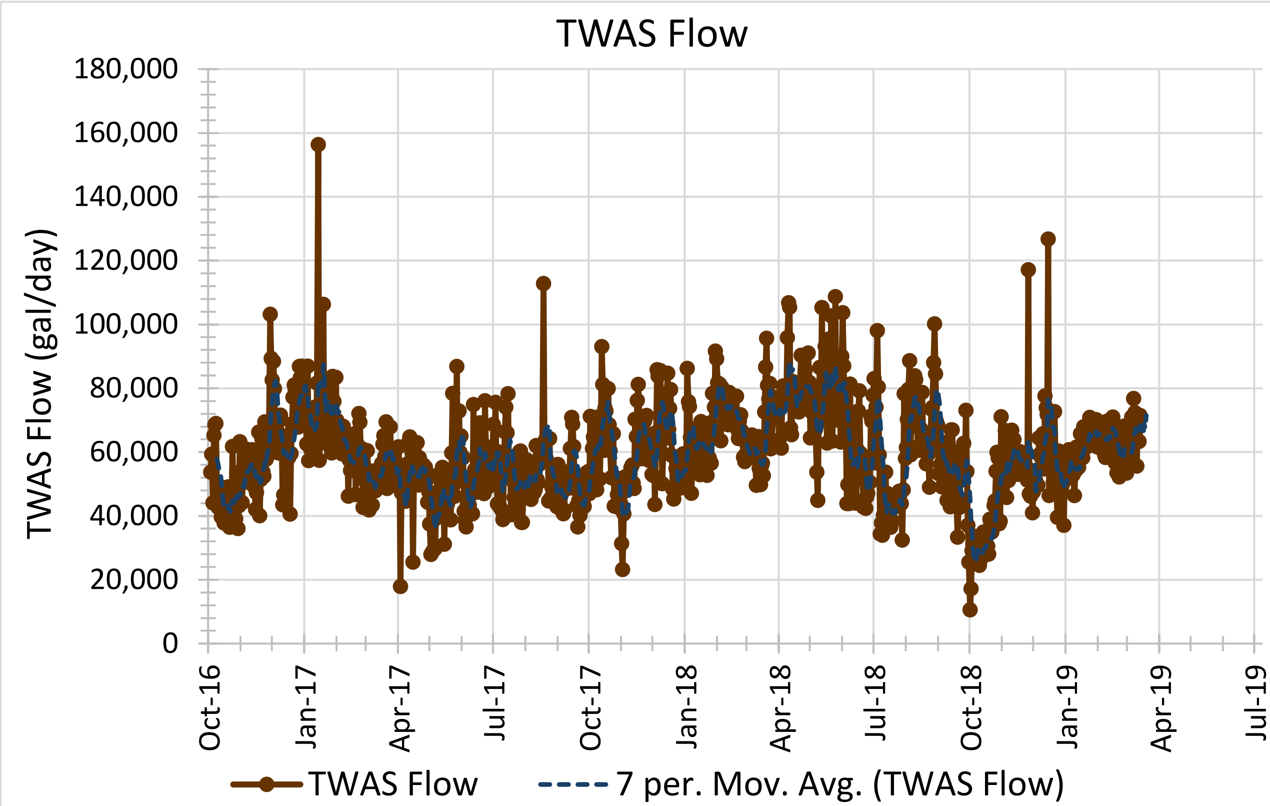

NRC Secondary Effluent - TSS
TSS (mg/L)
80
70
60
50
40
30
20
10
0
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
TSS
30 per. Mov. Avg. (TSS)

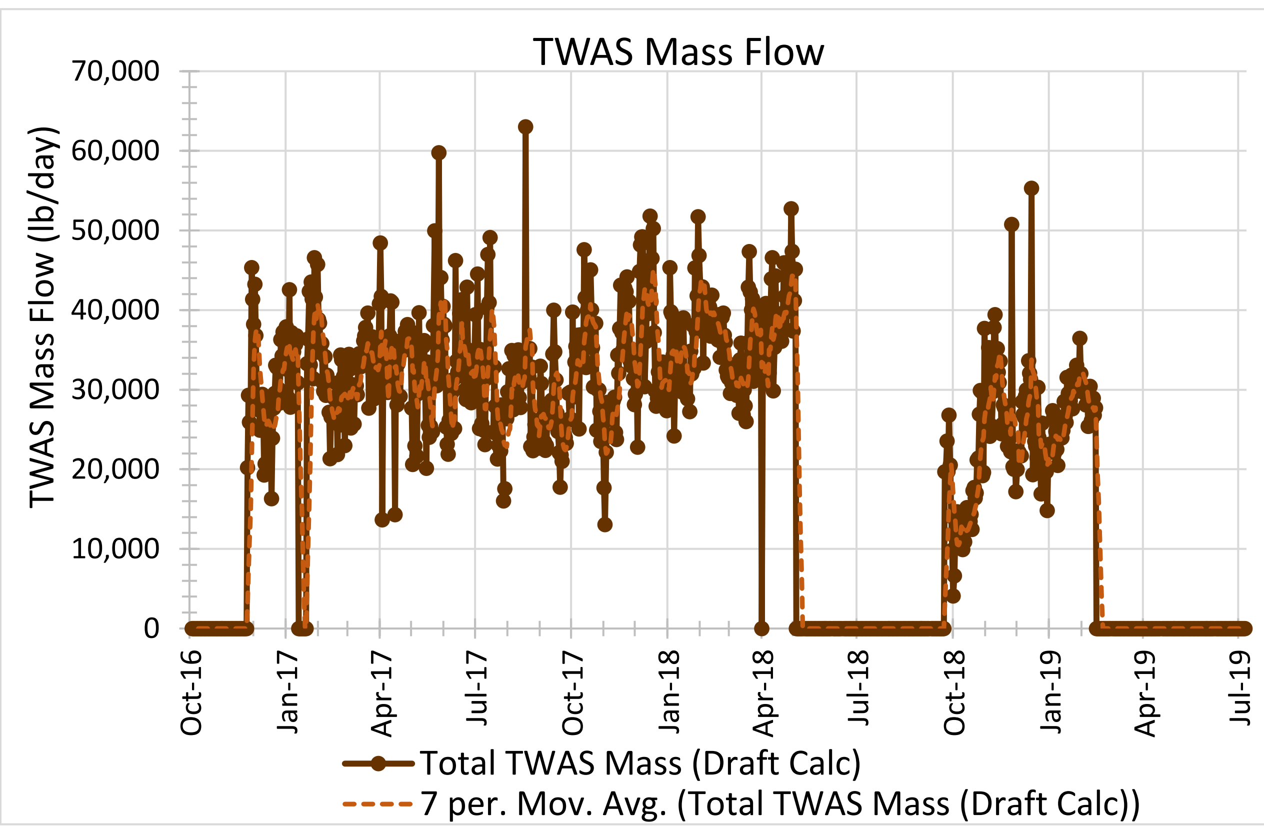

NRC Secondary Effluent - COD
COD (mg/L)
100
90
80
70
60
50
40
30
20
10
0
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
COD
7 per. Mov. Avg. (COD)

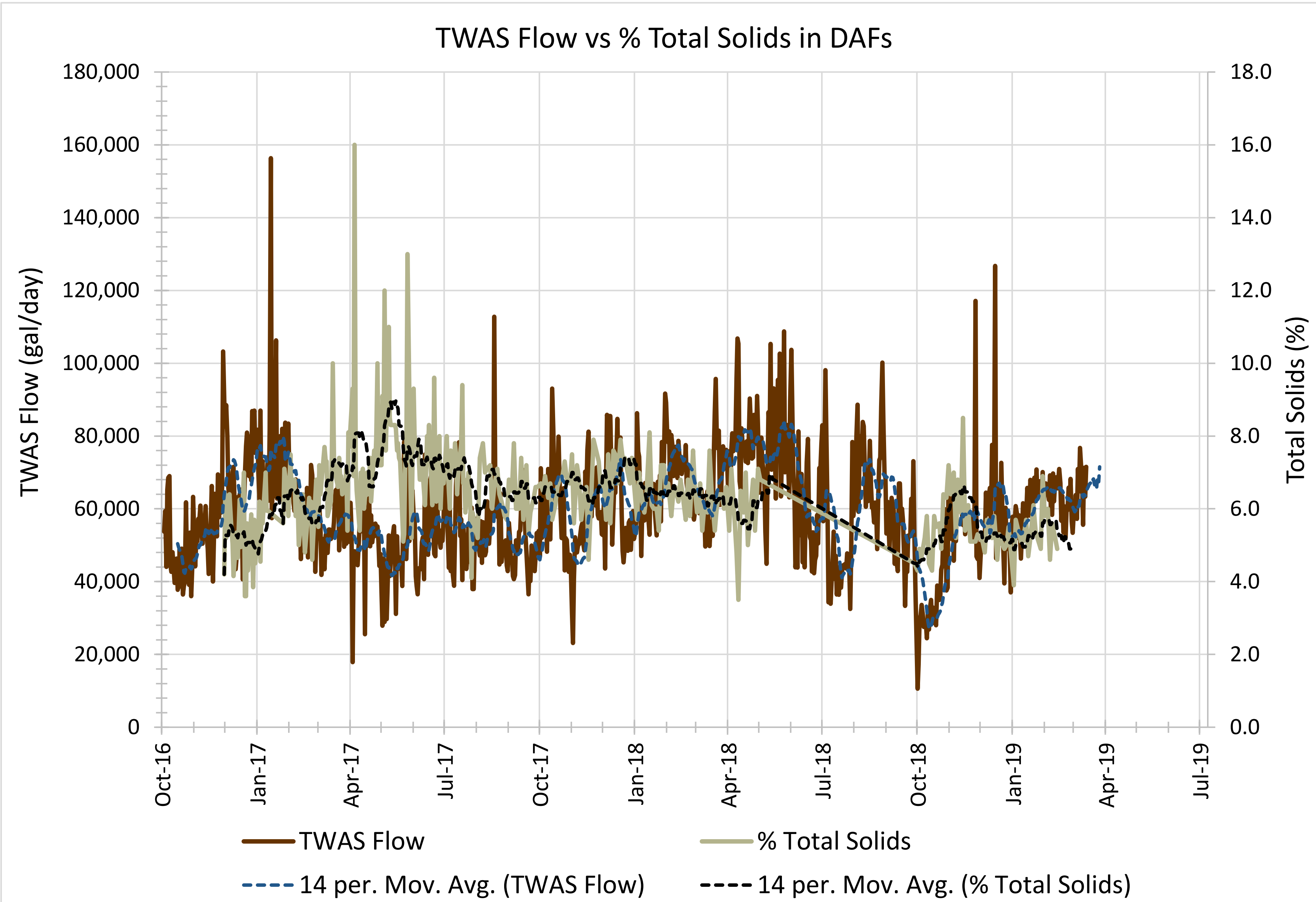

NRC Secondary Clarifier Surface Overflow Rate
Surface Overflow (gpd/sq-ft)
500
450
400
350
300
250
200
150
100
50
0
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
ABasin Air Flow
Surface Overflow Rate


DAF Float - % Total Solids
Total Solids (%)
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
Target % Total Solids
% Total Solids
14 per. Mov. Avg. (% Total Solids)

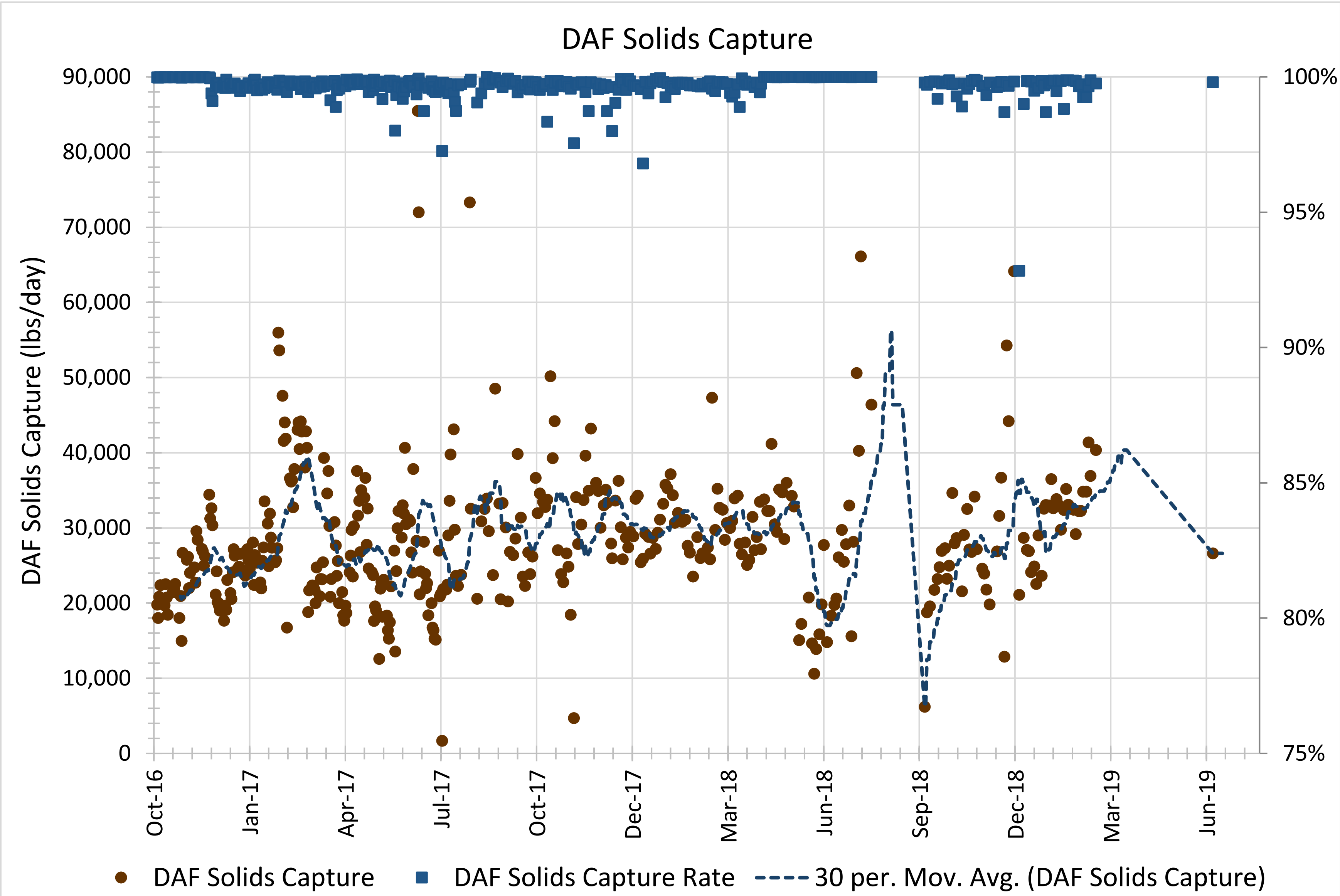

DAF Solids Loading
DAF Solids Loading (lbs/day)
60,000
50,000
40,000
30,000
20,000
10,000
0
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
DAF Solids Loading
7 per. Mov. Avg. (DAF Solids Loading)

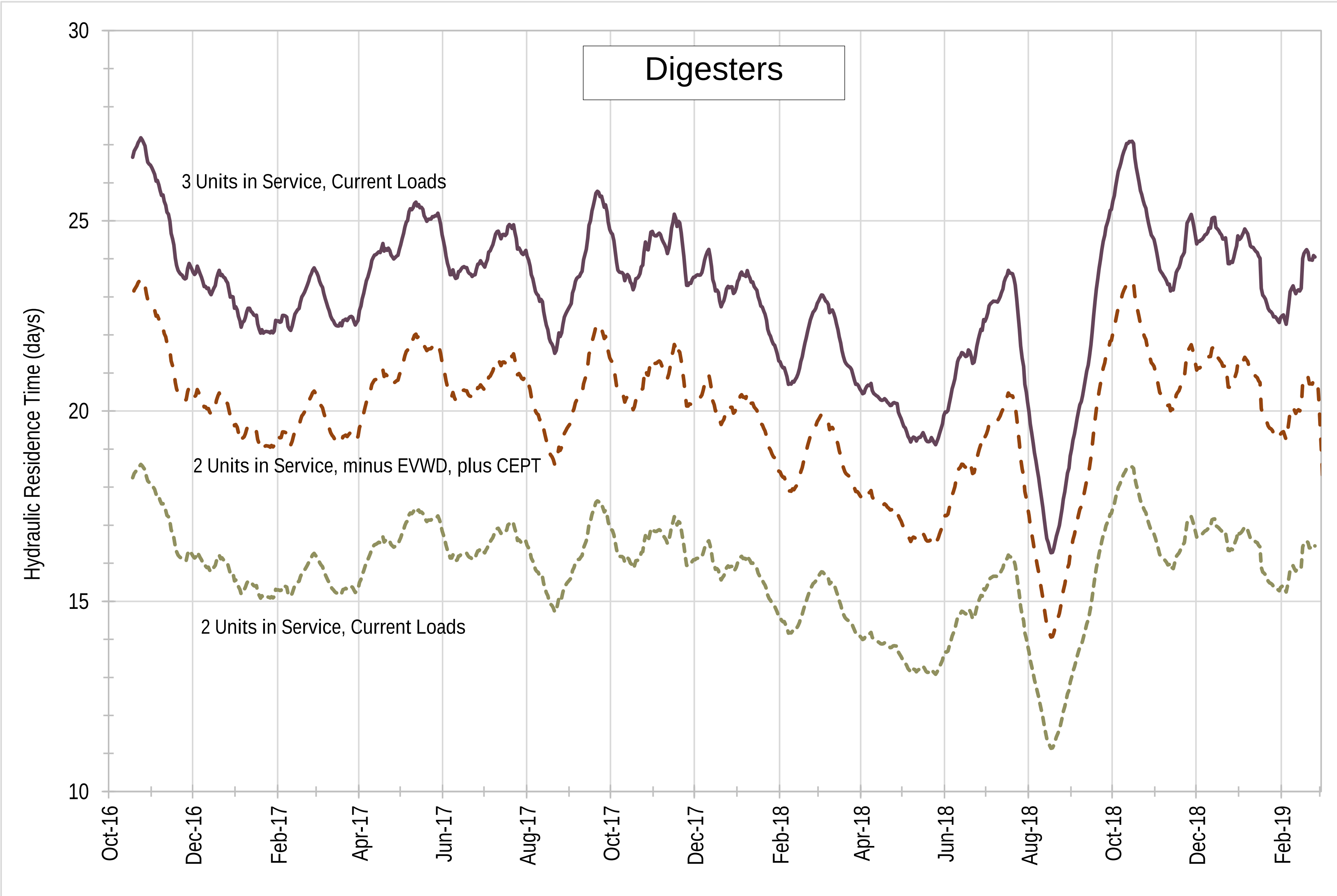

TWAS Flow
TWAS Flow (gal/day)
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
TWAS Flow
7 per. Mov. Avg. (TWAS Flow)


TWAS Mass Flow
TWAS Mass Flow (lb/day)
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
Total TWAS Mass (Draft Calc)
7 per. Mov. Avg. (Total TWAS Mass (Draft Calc))



TWAS Flow vs % Total Solids in DAFs
TWAS Flow (gal/day)
Total Solids (%)
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Jan-18
Apr-18
Jul-18
Oct-18
Jan-19
Apr-19
Jul-19
TWAS Flow
% Total Solids
14 per. Mov. Avg. (TWAS Flow)
14 per. Mov. Avg. (% Total Solids)


DAF Solids Capture
DAF Solids Capture (lbs/day)
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
100%
95%
90%
85%
80%
75%
Oct-16
Jan-17
Apr-17
Jul-17
Oct-17
Dec-17
Mar-18
Jun-18
Sep-18
Dec-18
Mar-19
Jun-19
DAF Solids Capture
DAF Solids Capture Rate
30 per. Mov. Avg. (DAF Solids Capture)



Digesters
Hydraulic Residence Time (days)
30
25
20
15
10
3 Units in Service, Current Loads
2 Units in Service, minus EVWD, plus CEPT
2 Units in Service, Current Loads
Oct-16
Dec-16
Feb-17
Apr-17
Jun-17
Aug-17
Oct-17
Dec-17
Feb-18
Apr-18
Jun-18
Aug-18
Oct-18
Dec-18
Feb-19

APPENDIX F: OPERATIONAL EFFICIENCY & OPTIMIZATION PROJECTS – CIP SHEETS

San Bernardino Municipal Water Department
Water Fund Capital Projects Budget
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Project Name: 1.2 CHEMICALLY ENCHANCED PRIMARY TREATMENT (CEPT)
Asset Classification: NEW FACILITY
Asset Category: WRP FACILITIES ASSESSMENT AND MASTER PLAN

Budget ID No. **CO No.**

Project Description: New equipment to add chemical coagulants downstream of ferric chloride addition and upstream of primary clarifiers.

Construction Cost Breakdown	Quantity	Unit	Unit Cost	Total
Polymer Feed Systems using totes	2	EA	$22,000	$44,000
Installation	2	LS	$15,000	$30,000
Shed or Roof	2	LS	$20,000	$40,000
Polymer Piping Allowance	200	LF	$100	$20,000
Allowance for Additional Optimization (such as moving ferric feed point, adding static mixing)	1	LS	$20,000	$20,000
			Installation Subtotal:	**$154,000**
General Conditions	15%			$23,100
Electrical and I&C	15%			$23,100
Contractor Overhead	10%			$15,400
Contractor Profit	10%			$15,400
Bonds & Insurance	3%			$4,620
			Construction Subtotal:	**$235,620**

Budgetary Requirements:

Cost Category	**Estimated Cost**
CEQA Compliance:	$0
Design:	$28,274
Const. Mgmnt:	$35,343
Construction:	$235,620
SBMWD Labor & Ovhd:	$0
SBMWD Stock Issues	$0
Equipment Rental:	$0
Purchased Material:	$0
Contract Services	$0
Subtotal:	**$299,237**
Contingency (30%)	**$89,771**
TOTAL COSTS (ROUNDED)	**$390,000**

Project Funding Sources:	**Funding Amount**
Water Capital:	$0
Chartis Escrow:	$0
Water Conservation:	$0
Other (Debt):	$0
FUNDING (ROUNDED)	**$0**

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Project Name: 2.1 LIQUID PROCESS OPTIMIZATION
Asset Classification: REHABILITATION
Asset Category: WRP FACILITIES ASSESSMENT AND MASTER PLAN

Budget ID No. **CO No.**

Project Description: Study and pilot testing of alternate operating modes to reduce SVI and improve process performance. Addition of MLR pumps to Unit 2.

Construction Cost Breakdown	Quantity	Unit	Unit Cost	Total
New MLR Pumps or other improvements (equipment to be based on results of study)	1	LS	$500,000	$500,000
			Installation Subtotal:	**$500,000**
General Conditions	15%			$75,000
Electrical and I&C	15%			$75,000
Contractor Overhead	10%			$50,000
Contractor Profit	10%			$50,000
Bonds & Insurance	3%			$15,000
			Construction Subtotal:	**$765,000**

Budgetary Requirements:

Cost Category	Estimated Cost
CEQA Compliance:	$0
Design:	$91,800
Const. Mgmnt:	$114,750
Construction:	$765,000
Process Optimization Study:	$200,000
SBMWD Labor & Ovhd:	$0
SBMWD Stock Issues	$0
Equipment Rental:	$0
Purchased Material:	$0
Contract Services	$0
Subtotal:	**$1,171,550**
Contingency (30%)	**$351,465**
TOTAL COSTS (ROUNDED)	**$1,520,000**

Project Funding Sources:	Funding Amount
Water Capital:	$0
Chartis Escrow:	$0
Water Conservation:	$0
Other (Debt):	$0
FUNDING (ROUNDED)	**$0**

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Project Name: 2.4 UNIT 3 EXPANSION AND COMPLETION
Asset Classification: NEW FACILITY
Asset Category: WRP FACILITIES ASSESSMENT AND MASTER PLAN

Budget ID No. **CO No.**

Project Description: R&R Cost for Units 1, 2, & NRC over next 15 years provides a business case for replacement with a new liquid secondary treatment process. This project expands Unit 3 primary clarifiers, adds reactor tanks configured for biological nitrogen removal (MLE), adds new secondary clarifiers, a RAS gallery, electrical and control building, and associated work. Assumes process air would be piped from existing blower building.

Construction Cost Breakdown	Quantity	Unit	Unit Cost	Total
Primary Clarifier, Aeration Basin and Secondary Clarifier Construction			$23,420,000	
Excavation	136,000	CY	$10	$1,360,000
Sheeting	110,000	SF	$31	$3,410,000
Structural Fill	6,000	CY	$50	$300,000
Native Fill	15,000	CY	$10	$150,000
Concrete Floor	12,000	CY	$400	$4,800,000
Concrete Walls	9,000	CY	$1,000	$9,000,000
Misc. Concrete (Launders,	1	LS	$1,000,000	$1,000,000
Covers, AB & PC	7	EA	$200,000	$1,400,000
Misc. Metals (Grating, Handrails,	1	LS	$1,000,000	$1,000,000
Misc Mechanical (Valves, Gates,	1	LS	$1,000,000	$1,000,000
Other Structures Construction			$1,100,000	
Elec & Control Room (above RAS	2,000	SF	$300	$600,000
Secondary Effluent Structure	1	LS	$500,000	$500,000
Process Equipment (Installed Costs)			$9,636,000	
PC Mechanism	4	EA	$200,000	$800,000
Anoxic Mixers	12	EA	$50,000	$600,000
Diffusers	73,000	SF	$12	$876,000
Aeration Valves & Flow Meters,	18	EA	$30,000	$540,000
MLR Pumps	6	EA	$100,000	$600,000
Fiberglass Baffle Walls	10	EA	$50,000	$500,000
SC Mechanisism	6	EA	$420,000	$2,520,000
RAS Pumps	6	EA	$120,000	$720,000
RAS Flow Meters	6	EA	$20,000	$120,000
Other Pumps (PS, WAS, Scum)	6	EA	$60,000	$360,000
RAS Gallery Piping	1	LS	$1,000,000	$1,000,000
Odor Treatment System	1	LS	$1,000,000	$1,000,000
Process piping (Installed Costs)			$5,700,000	
Buried Yard Piping (24"-48")	6,000	LF	$500	$3,000,000
Above-GradePipe (Air, Odor,	3,400	LF	$500	$1,700,000
RAS Gallery Piping & Valves	1	LS	$1,000,000	$1,000,000
			Installation Subtotal:	**$39,856,000**
General Conditions	15%			$5,978,400
Electrical and I&C	15%			$5,978,400
Contractor Overhead	10%			$3,985,600
Contractor Profit	10%			$3,985,600
Bonds & Insurance	3%			$1,195,680
			Construction Subtotal:	**$60,979,680**

Budgetary Requirements:

Cost Category	Estimated Cost
CEQA Compliance:	$609,797
Design:	$7,317,562
Const. Mgmnt:	$9,146,952
Construction:	$60,979,680
SBMWD Labor & Ovhd:	$0
SBMWD Stock Issues	$0
Equipment Rental:	$0
Purchased Material:	$0
Contract Services	$0
Subtotal:	**$78,053,991**
Contingency (30%)	**$23,416,197**
TOTAL COSTS (ROUNDED)	**$101,500,000**

Project Funding Sources:	Funding Amount
Water Capital:	$0
Chartis Escrow:	$0
Water Conservation:	$0
Other (Debt):	$0
FUNDING (ROUNDED)	**$0**

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Project Name: 3.1 DIGESTER B REPLACEMENT
Asset Classification: ASSET REPLACEMENT
Asset Category: WRP FACILITIES ASSESSMENT AND MASTER PLAN

Budget ID No. **CO No.**

Project Description: Justification and Description: Replace Digester B to improve digester reliability and provide redundancy. Digester B is currently offline due to leakage. Digester B is 90' diam. concrete tank w/insulated metal lid, 33.5' sidewall, and 10' cone, and was built in 1958 along with Digester A, which is still in operation.

Construction Cost Breakdown	Quantity	Unit	Unit Cost	Total
Tank	1	LS	$3,505,000	$3,505,000
Steel Cover Dome	1	LS	$1,041,000	$1,041,000
Sludge Mixing Pump	1	LS	$191,000	$191,000
Condensate Separator and Drip Trap	1	LS	$30,000	$30,000
Digester Gas Flow Meter	1	LS	$25,000	$25,000
Digester Gas Piping	1	LS	$35,000	$35,000
Digester Mixing Piping	1	LS	$27,000	$27,000
Discharge Bypass Isolation Valve	1	LS	$20,000	$20,000
East Discharge Isolation Valve	1	LS	$20,000	$20,000
Flame Arrestor Downstream Isolation Valve	1	LS	$10,000	$10,000
Flame Arrestor Upstream Isolation Valve	1	LS	$10,000	$10,000
Heated Sludge Return Bottom Isolation Valve	1	LS	$8,000	$8,000
Heated Sludge Return Main Isolation Valve	1	LS	$8,000	$8,000
Heated Sludge Return Top Isolation Valve	1	LS	$8,000	$8,000
Inlet Isolation Valve	1	LS	$20,000	$20,000
Level Transmitter	1	LS	$13,000	$13,000
Pressure Relief and Vacuum Breaker	1	LS	$23,000	$23,000
Sludge Overflow Isolation Valve to Draw Out	1	LS	$8,000	$8,000
Tank Draw Out Isolation Valve No. 1	1	LS	$10,000	$10,000
Tank Draw Out Isolation Valve No. 2 (to Dewatering)	1	LS	$10,000	$10,000
TWAS Inlet Isolation Valve	1	LS	$10,000	$10,000
Walkway Structure	1	LS	$25,000	$25,000
			Installation Subtotal:	**$5,057,000**
General Conditions	0%	incl.		$0
Electrical and I&C	0%	incl.		$0
Contractor Overhead	0%	incl.		$0
Contractor Profit	0%	incl.		$0
Bonds & Insurance	0%	incl.		$0
			Construction Subtotal:	**$5,057,000**

Budgetary Requirements:

Cost Category	**Estimated Cost**
CEQA Compliance:	$0
Design:	$606,840
Const. Mgmnt:	$758,550
Construction:	$5,057,000
SBMWD Labor & Ovhd:	$0
SBMWD Stock Issues	$0
Equipment Rental:	$0
Purchased Material:	$0
Contract Services	$0
Subtotal:	**$6,422,390**
Contingency (30%)	**$1,926,717**
TOTAL COSTS (ROUNDED)	**$8,000,000**

Project Funding Sources:	**Funding Amount**
Water Capital:	$0
Chartis Escrow:	$0
Water Conservation:	$0
Other (Debt):	$0
FUNDING (ROUNDED)	**$0**

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Project Name: 3.2 DIGESTER CLEANING
Asset Classification: MAJOR MAINTENANCE
Asset Category: WRP FACILITIES ASSESSMENT AND MASTER PLAN

Budget ID No. **CO No.**

Project Description: Justification and Description: Clean out and repair Digesters C & D. Digesters C & D are concrete tanks w/concrete lids built in late 1980s, 90' diam., 36.5' sidewall, 10' cone. No record of last cleaning.

Construction Cost Breakdown	Quantity	Unit	Unit Cost	Total
Bonds, Insurance	1	LS	$120,000	$120,000
Mob/Demob	1	LS	$125,000	$125,000
Safety measures	1	LS	$5,000	$5,000
Remove liquid	2	EA	$100,000	$200,000
Remove settled material	2	EA	$175,000	$350,000
Hauling of dewatered material	2	EA	$100,000	$200,000
Metal repair consolidated	2	EA	$30,000	$60,000
Concrete repair consolidated	2	EA	$30,000	$60,000
Unforeseen conditions	2	EA	$100,000	$200,000
All other work	2	EA	$300,000	$600,000
			Installation Subtotal:	**$1,920,000**
General Conditions	0%	incl.		$0
Electrical and I&C	0%	N/A		$0
Contractor Overhead	0%	incl.		$0
Contractor Profit	0%	incl.		$0
Bonds & Insurance	0%	incl.		$0
			Construction Subtotal:	**$1,920,000**

Budgetary Requirements:

Cost Category	Estimated Cost
CEQA Compliance:	$0
Design:	$230,400
Const. Mgmnt:	$288,000
Construction:	$1,920,000
SBMWD Labor & Ovhd:	$0
SBMWD Stock Issues	$0
Equipment Rental:	$0
Purchased Material:	$0
Contract Services	$0
Subtotal:	**$2,438,400**
Contingency (30%)	**$731,520**
TOTAL COSTS (ROUNDED)	**$3,200,000**

Project Funding Sources:	Funding Amount
Water Capital:	$0
Chartis Escrow:	$0
Water Conservation:	$0
Other (Debt):	$0
FUNDING (ROUNDED)	**$0**

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Project Name: 3.4 BRINE LINE IMPROVEMENTS
Asset Classification: NEW FACILITY
Asset Category: WRP FACILITIES ASSESSMENT AND MASTER PLAN

Budget ID No. **CO No.**

Project Description: Septage/brine receiving station line runs through the WRP and exits near the outfall. The line within the WRP clogs and is difficult and costly to clean because existing cleanouts are inadequate. This project installs manholes in several locations along the pipe to allow proper cleaning.

Construction Cost Breakdown	Quantity	Unit	Unit Cost	Total
Install New MH 25 - 60" MH	7	EA	$12,488	$87,416
MH 25 Shoring Adder	1	LS	$375	$375
			Installation Subtotal:	**$88,000**
General Conditions	15%			$13,200
Electrical and I&C	0%	N/A		$0
Contractor Overhead	10%			$8,800
Contractor Profit	10%			$8,800
Bonds & Insurance	3%			$2,640
			Construction Subtotal:	**$121,440**

Budgetary Requirements:

Cost Category	**Estimated Cost**
CEQA Compliance:	$0
Design:	$14,573
Const. Mgmnt:	$18,216
Construction:	$121,440
SBMWD Labor & Ovhd:	$0
SBMWD Stock Issues	$0
Equipment Rental:	$0
Purchased Material:	$0
Contract Services	$0
Subtotal:	**$154,229**
Contingency (30%)	**$46,000**
TOTAL COSTS (ROUNDED)	**$200,000**

Project Funding Sources:	**Funding Amount**
Water Capital:	$0
Chartis Escrow:	$0
Water Conservation:	$0
Other (Debt):	$0
FUNDING (ROUNDED)	**$0**

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Project Name: 1 ELECTRICAL MASTER PLAN
Asset Classification: SPECIAL STUDY
Asset Category: WRP FACILITIES ASSESSMENT AND MASTER PLAN

Budget ID No. **CO No.**

Project Description: Study to upgrade electrical distribution system to improve safety, reliability, redundancy, and create equipment standards as defined by NFPA 70E. Inlcudes: condition assessment; as-built single line diagrams; load calculations and capacity requirements; MCC consolidation approach; arc flash hazard mitigation; sequencing implementation with process improvement projects; report.

Construction Cost Breakdown	Quantity	Unit	Unit Cost	Total
General Conditions	0%	N/A		$0
Electrical and I&C	0%	N/A		$0
Contractor Overhead	0%	N/A		$0
Contractor Profit	0%	N/A		$0
Bonds & Insurance	0%	N/A		$0
			Construction Subtotal:	**$0.00**

Budgetary Requirements:

Cost Category	**Estimated Cost**
CEQA Compliance:	$0
Design:	$0
Const. Mgmnt:	$0
Construction:	$0
Electrical Master Plan - Special Study	$100,000
SBMWD Labor & Ovhd:	$0
SBMWD Stock Issues	$0
Equipment Rental:	$0
Purchased Material:	$0
Contract Services	$0
Subtotal:	**$100,000**
Contingency (30%)	**$30,000**
TOTAL COSTS (ROUNDED)	**$130,000**

Project Funding Sources:	**Funding Amount**
Water Capital:	$0
Chartis Escrow:	$0
Water Conservation:	$0
Other (Debt):	$0
FUNDING (ROUNDED)	**$0**

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Project Name: 1A POTENTIAL ELECTRICAL CIP PROJECTS TO BE IDENTIFIED DURING MASTER PLANNING
Asset Classification: ASSET REPLACEMENT
Asset Category: WRP FACILITIES ASSESSMENT AND MASTER PLAN

Budget ID No. **CO No.**

Project Description: Replacement and safety enhancement projects anticipated to be identified in the Electrical Master Plan.

Construction Cost Breakdown	Quantity	Unit	Unit Cost	Total
BLM Switchgear (5kV) Replacement				$2,000,000
Hoffman Bldg Main Switchgear (480V) Replacement				$1,150,000
MCC Consolidation				$3,400,000
Burner Building - New Power Distribution				$250,000
Plant-wide Arc Flash Hazards Analysis and Labeling				$120,000
			Installation Subtotal:	**$6,920,000**
General Conditions	0%	N/A		$0
Electrical and I&C	0%	N/A		$0
Contractor Overhead	0%	N/A		$0
Contractor Profit	0%	N/A		$0
Bonds & Insurance	0%	N/A		$0
			Construction Subtotal:	**$6,920,000**

Budgetary Requirements:

Cost Category	**Estimated Cost**
CEQA Compliance:	$0
Design:	$830,400
Const. Mgmnt:	$1,038,000
Construction:	$6,920,000
SBMWD Labor & Ovhd:	$0
SBMWD Stock Issues	$0
Equipment Rental:	$0
Purchased Material:	$0
Contract Services	$0
Subtotal:	**$8,788,400**
Contingency (30%)	**$2,636,520**
TOTAL COSTS (ROUNDED)	**$11,400,000**

Project Funding Sources:	**Funding Amount**
Water Capital:	$0
Chartis Escrow:	$0
Water Conservation:	$0
Other (Debt):	$0
FUNDING (ROUNDED)	**$0**

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Project Name: 2 SCADA MASTER PLAN
Asset Classification: SPECIAL STUDY
Asset Category: WRP FACILITIES ASSESSMENT AND MASTER PLAN

Budget ID No. **CO No.**

Project Description: Study to provide a framework to achieve a secure, flexible, reliable, and comprehensive SCADA environment. The SCADA Master Plan shall include specific recommendations with budgetary cost estimates and schedule for the next 5 to 10 years generated from a gap analysis.

Construction Cost Breakdown	Quantity	Unit	Unit Cost	Total
General Conditions	0%	N/A		$0
Electrical and I&C	0%	N/A		$0
Contractor Overhead	0%	N/A		$0
Contractor Profit	0%	N/A		$0
Bonds & Insurance	0%	N/A		$0
			Construction Subtotal:	**$0.00**

Budgetary Requirements:

Cost Category	**Estimated Cost**
CEQA Compliance:	$0
Design:	$0
Const. Mgmnt:	$0
Construction:	$0
SCADA Master Plan - Special Study	$200,000
SBMWD Labor & Ovhd:	$0
SBMWD Stock Issues	$0
Equipment Rental:	$0
Purchased Material:	$0
Contract Services	$0
Subtotal:	**$200,000**
Contingency (30%)	**$60,000**
TOTAL COSTS (ROUNDED)	**$260,000**

Project Funding Sources:	**Funding Amount**
Water Capital:	$0
Chartis Escrow:	$0
Water Conservation:	$0
Other (Debt):	$0
FUNDING (ROUNDED)	**$0**

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Project Name: 2A POTENTIAL SCADA CIP PROJECTS TO BE IDENTIFIED DURING MASTER PLANNING
Asset Classification: ASSET REPLACEMENT
Asset Category: WRP FACILITIES ASSESSMENT AND MASTER PLAN

Budget ID No. **CO No.**

Project Description: Various projects anticipated to be identified in the SCADA Master Plan to achieve a secure, flexible, reliable, and comprehensive SCADA environment

Construction Cost Breakdown	Quantity	Unit	Unit Cost	Total
Control System Standards				$175,000
SCADA HMI Evaluation				$70,000
Standard HMI and PLC Templates				$191,000
SCADA Software Development Lab				$220,000
HMI Upgrade Project				$395,000
Control System Upgrade Project				$2,169,000
SCADA Cybersecurity Vulnerability Assessment				$134,000
Developing Process Control Narratives (PCN's)				$437,000
Instrument Specifications and Calibration Procedures				$158,000
SCADA Historian and Reporting				$186,000
Remote Data Collection				$115,000
Instrumentation Study				$172,000
Operational Efficiency Evaluation (KPI's)				$101,000
			Installation Subtotal:	**$4,523,000**
General Conditions	0%	N/A		$0
Electrical and I&C	0%	N/A		$0
Contractor Overhead	0%	N/A		$0
Contractor Profit	0%	N/A		$0
Bonds & Insurance	0%	N/A		$0
			Construction Subtotal:	**$4,523,000**

Budgetary Requirements:

Cost Category	**Estimated Cost**
CEQA Compliance:	$0
Design:	$0
Const. Mgmnt:	$0
Construction:	$4,523,000
SBMWD Labor & Ovhd:	$0
SBMWD Stock Issues	$0
Equipment Rental:	$0
Purchased Material:	$0
Contract Services	$0
Subtotal:	**$4,523,000**
Contingency (30%)	**$1,357,000**
TOTAL COSTS (ROUNDED)	**$5,900,000**

Project Funding Sources:	**Funding Amount**
Water Capital:	$0
Chartis Escrow:	$0
Water Conservation:	$0
Other (Debt):	$0
FUNDING (ROUNDED)	**$0**

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Project Name: 3 BIOSOLIDS STRATEGIC PLAN
Asset Classification: SPECIAL STUDY
Asset Category: WRP FACILITIES ASSESSMENT AND MASTER PLAN

Budget ID No. **CO No.**

Project Description: Study to to identify a long-term approach for biosoids management compliant with State, local, Federal and environmental regulations. SB 1383 requires 50% reduction of landfill disposal of organics by 2020 and 75% reduction by 2025. Cost increase for biosolids composting may occur. No backup biosolids contract in place.

Construction Cost Breakdown	Quantity	Unit	Unit Cost	Total
General Conditions	0%	N/A		$0
Electrical and I&C	0%	N/A		$0
Contractor Overhead	0%	N/A		$0
Contractor Profit	0%	N/A		$0
Bonds & Insurance	0%	N/A		$0
			Construction Subtotal:	**$0**

Budgetary Requirements:

Cost Category	**Estimated Cost**
CEQA Compliance:	$0
Design:	$0
Const. Mgmnt:	$0
Construction:	$0
Biosolids Strategic Plan - Special Study	$300,000
SBMWD Labor & Ovhd:	$0
SBMWD Stock Issues	$0
Equipment Rental:	$0
Purchased Material:	$0
Contract Services	$0
Subtotal:	**$300,000**
Contingency (30%)	**$90,000**
TOTAL COSTS (ROUNDED)	**$390,000**

Project Funding Sources:	**Funding Amount**
Water Capital:	$0
Chartis Escrow:	$0
Water Conservation:	$0
Other (Debt):	$0
FUNDING (ROUNDED)	**$0**

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Project Name: 4 RIX FACILITY PLAN
Asset Classification: SPECIAL STUDY
Asset Category: WRP FACILITIES ASSESSMENT AND MASTER PLAN

Budget ID No. **CO No.**

Project Description: Study to evaluate the performance and efficacy of RIX facilities under projected reduced flow. RIX started in 1994 to meet filtration and disinfection requirements for discharge to the Santa Ana River. It typically uses percolations basins and UV, but filtration equipment is used during high flow.

Construction Cost Breakdown	Quantity	Unit	Unit Cost	Total
General Conditions	0%	N/A		$0
Electrical and I&C	0%	N/A		$0
Contractor Overhead	0%	N/A		$0
Contractor Profit	0%	N/A		$0
Bonds & Insurance	0%	N/A		$0
			Construction Subtotal:	**$0**

Budgetary Requirements:

Cost Category	**Estimated Cost**
CEQA Compliance:	$0
Design:	$0
Const. Mgmnt:	$0
Construction:	$0
Special Study	$100,000
SBMWD Labor & Ovhd:	$0
SBMWD Stock Issues	$0
Equipment Rental:	$0
Purchased Material:	$0
Contract Services	$0
Subtotal:	**$100,000**
Contingency (30%)	**$30,000**
TOTAL COSTS (ROUNDED)	**$130,000**

Project Funding Sources:	**Funding Amount**
Water Capital:	$0
Chartis Escrow:	$0
Water Conservation:	$0
Other (Debt):	$0
FUNDING (ROUNDED)	**$0**

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