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City of Oxnard

Public Works Integrated Master Plan

WASTEWATER

PROJECT MEMORANDUM 3.4
TREATMENT PLANT PERFORMANCE AND CAPACITY

FINAL DRAFT
December 2015

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Public Works Integrated Master Plan

WASTEWATER

PROJECT MEMORANDUM 3.4
TREATMENT PLANT PERFORMANCE AND CAPACITY

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TREATMENT PLANT PERFORMANCE AND CAPACITY

1.0 INTRODUCTION

This Project Memorandum (PM) summarizes the existing Oxnard Wastewater Treatment Plant (OWTP) performance and determines a capacity rating for each unit process at the plant. This analysis is integral to determining required future capital improvement projects.

1.1 PMs Used for Reference

The findings outlined in this PM are made in concert with recommendations and analyses from other related PMs:

- PM 3.1 - Wastewater System - Background Summary.
- PM 3.2 - Wastewater System - Flow and Load Projections.
- PM 3.3 - Wastewater System - Infrastructure Modeling and Alternatives.
- PM 3.11 - Wastewater System - Flow Monitoring.

1.2 Other Reports Used for Reference

In analyzing the OWTP's performance and capacity in this PWIMP, findings from other reports were incorporated to ensure a well-rounded and holistic look at the wastewater system. The following reports are used in this PWIMP analysis:

- Oxnard Wastewater Treatment Plant National Pollutant Discharge Elimination System (NPDES) Permit, Order No. R4-2013-0094, NPDES No. CA0054097. (NPDES Permit, 2013).
- Oxnard Wastewater Treatment Plant Operations and Maintenance Manual Volume 1-6, April 1980 (Brown and Caldwell, 1980).
- Oxnard Wastewater Treatment Plant Operations and Maintenance Manual Phase 1 Expansion Volumes 1-4, September 1991 (Camp Dresser McKee Inc., 1991).
- Design of Municipal Wastewater Treatment Plants Fifth Edition, Water Environment Federation/America Society of Civil Engineers, (WEF/ASCE, 2010).
- Wastewater Engineering Treatment and Resource Recovery, Fifth Edition, (Metcalf and Eddy, 2014).

2.0 PLANT PERFORMANCE AND CRITERIA REVIEW

This section summarizes the performance of the OWTP treatment processes. The existing performance provided a benchmark for the planning of new facilities. The plant

performance review was used to calibrate a process model and establish sizing criteria for use in the capacity analysis. The review period over which performance has been evaluated is from January 2010 through December 2013. Historical process loadings and criteria presented are based on reported data provided by the OWTP staff.

The performance assessment discussed in the sections below is comprised of two main sections:

- Overall treatment performance of the OWTP, with respect to meeting discharge limits and other effluent requirements.
- Historical loading and performance of each of the unit processes.

An understanding of the OWTP's current treatment performance is critical in determining the treatment capacity of the OWTP. Based on historical loading and performance, recommended criteria for assessing capacity were developed for each major treatment process. The recommended criteria serve as the basis for the process capacity assessment.

2.1 Overall Treatment Plant Performance

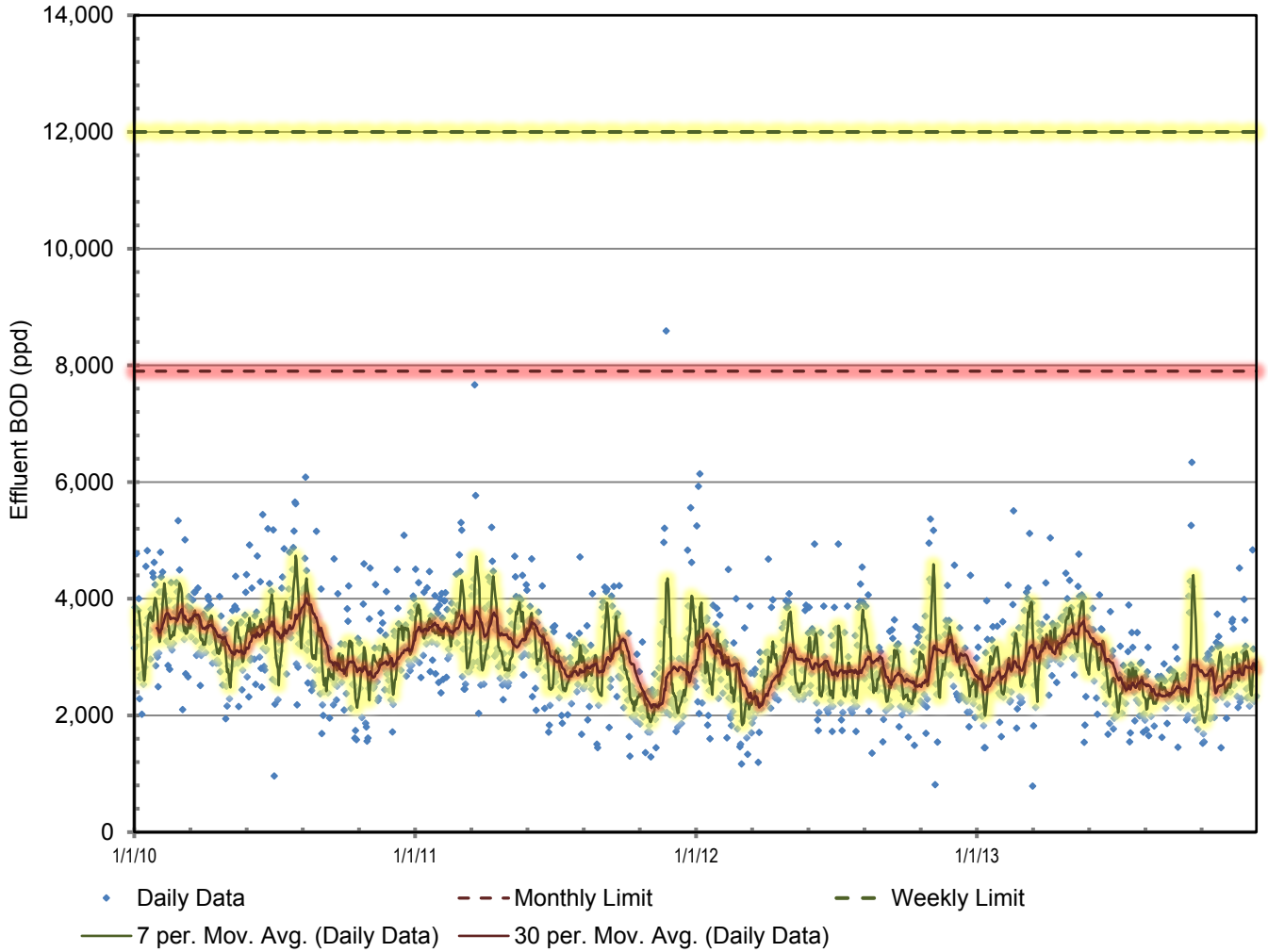
This section summarizes the overall treatment plant performance of the OWTP. The overall treatment performance is based on historical compliance with conventional pollutant requirements in the OWTP's NPDES permit.

2.1.1 NPDES Conventional Pollutants

Conventional pollutants regulated in the NPDES permit include biochemical oxygen demand (BOD_5), total suspended solids (TSS), pH, oil and grease, settleable solids, and turbidity. During the review period, the OWTP achieved compliance with all of the regulated conventional pollutants.

The OWTP met all the limits for conventional pollutants. There were some instances where performance goals were exceeded. The instances were minor and usually associated with reported detection limits for some of the priority pollutants being above the effluent limit. It is not known if the effluent concentration would be less than the effluent limit if the analysis method had a lower detection limit.

Figures 1 and 2 show the daily effluent BOD_5 and TSS concentrations, respectively, along with the 7-day and 30-day running averages. The 7-day and 30-day running averages represent the weekly and monthly averages of the data, and correspond to the effluent weekly and monthly NPDES limits. As shown in the figures, the running averages are well below the weekly and monthly effluent limits for both of these constituents.



HISTORICAL FINAL EFFLUENT BOD_5 LOADING

FIGURE 1

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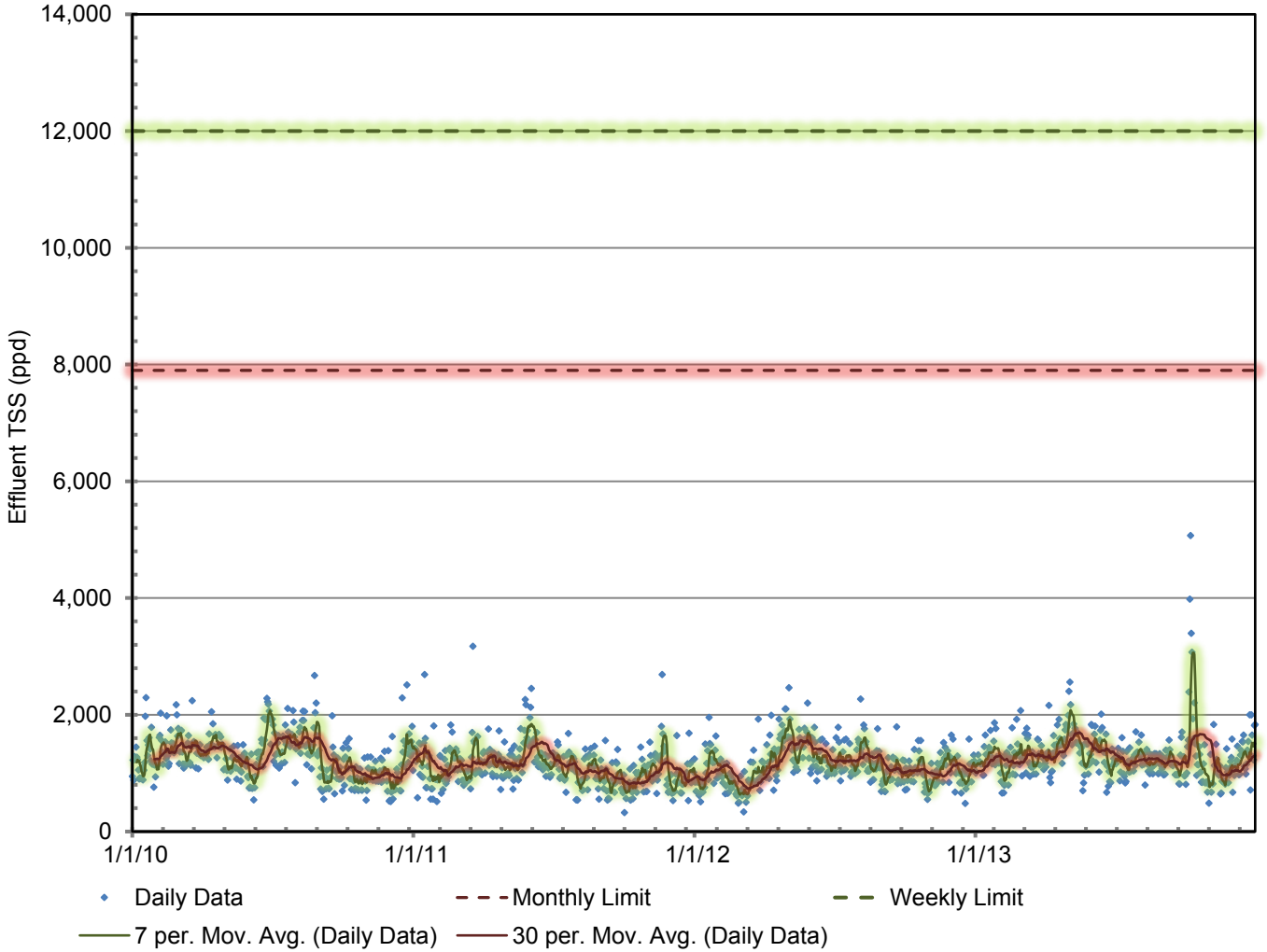

HISTORICAL FINAL EFFLUENT TSS LOADING

FIGURE 2

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Table 1 summarizes the overall performance of the OWTP with respect to conventional pollutants in the NPDES permit.

Table 1 Overall OWTP Performance for Conventional Pollutants
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Effluent Water Quality Parameter	Units	Limit[1]	2010 - 2013 Performance	Number of Exceedances
BOD_5	mg/L	Average Monthly = 30	13 - 22	0
		Average Weekly = 45	11 - 28	0
	ppd	Average Monthly = 7,960	2126 - 4009	0
		Average Weekly = 11,900	1834 - 4737	0
TSS	mg/L	Average Monthly = 30	4 - 10	0
		Average Weekly = 45	4 - 19	0
	ppd	Average Monthly = 7,960	731 - 1696	0
		Average Weekly = 11,900	633 - 3063	0
pH	Standard Units	6.0 - 9.0	7 - 8	0
Oil and Grease	mg/L	Average Monthly = 25	5 - 7	0
		Average Weekly = 40	5 - 9	0
	ppd	Average Monthly = 6,630	754 - 1393	0
		Average Weekly = 10,600	693 - 1694	0
Settleable Solids	ml/L	Average Monthly = 1.0	0.01 - 0.016	0
		Average Weekly = 1.5	0.01 - 0.036	0
Turbidity	NTU	Average Monthly = 75	3 - 7	0
		Average Weekly = 100	2 - 13	0

Note:
(1) Per NPDES Waste Discharge Requirements Order No. R4-2013-0094, NPDES No. CA0054097.

2.2 Unit Process Loading and Performance

This section summarizes the assessment of the OWTP performance and unit process performance. This is important as it provides a benchmark for the planning of new facilities and assessing capacity. In some cases, historical performance confirms that original design criteria are appropriate for assessing unit process capacity. In others, above or below average performance warrants using criteria different from the original design for assessing capacity. For each unit process, recommended criteria should be developed for use in the capacity assessment. Table 2 summarizes the key load and performance data as well as the recommended criteria for the OWTP processes. Approximately 1 to 3 years of daily operating data were reviewed to characterize the historical performance.

Table 2 OWTP Process Performance and Criteria Summary
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Process/Design Parameter	Design Parameter	Units	Original Design[1]	Historical Performance (2010 – 2013)	MOP-8[2] or Typical Values[3]	Recommended Criteria for Capacity Analysis
Grit Chambers	Overflow Rate at PWWF	gpd/sf	42,315	23,056	20,000 - 50,000	42,315
	Detention Time at PWWF	min	2.8	5.1	2 to 5[4]	2.8
Primary Sedimentation Tanks	Overflow Rate:	gpd/sf				
	ADWF		1,270	809[5]	800 - 1,200[2]	1,270
	PWWF		2,200	1,598[5]	2,000 - 3,000[2]	2,200
	% BOD Removal	%	35	46	25 - 40[2]	35
	% TSS Removal	%	65	70	50 - 70[2]	65
Biofiltration Units	Hydraulic Load:					
	Average	gpm/sf	0.50	--	0.9[2]	1.00
	Peak		1.50	--	2.9[2]	1.50
	Volumetric Load at ADMML	lb BOD_5/ 1,000 ft^3/d	47[6]	55	100-220[2]	100
	% BOD Removal	%	--	23	40-70[2]	24
	% Soluble BOD Removal	%	--	63	40-70[2]	69
Aeration Basins	Solids Retention Time (SRT)	days	--	2.0 [7]	Variable	2.5
	Hydraulic Detention Time (HRT)	hrs	--	4.3 [7]	Variable	Variable
	MLSS	mg/L	--	1002	2,000 - 4,000[2]	Depends on Peak Week Load, SVI, and Sec Sed Basin Capacity
	Sludge Volume Index (SVI)	mL/g	--			
	90 Percentile			177	150[3]	150
	Temperature	°C	--	19 - 27	Variable	20 - 27

Table 2 OWTP Process Performance and Criteria Summary
Public Works Integrated Master Plan
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Process/Design Parameter	Design Parameter	Units	Original Design[1]	Historical Performance (2010 – 2013)	MOP-8[2] or Typical Values[3]	Recommended Criteria for Capacity Analysis
Secondary Sedimentation Tanks	Peak Solids Loading	lb/sf/day	--	28.7[8]	40 - 50[2]	28.7[9]
	Overflow Rate at ADWF	gpd/sf	600	341[10]	400 - 700[2]	Depends on SVI and MLSS concentration
	Overflow Rate at PWWF	gpd/sf	1,100	699[10]	1,000 - 1,600[3]	Depends on SVI and selected MLSS concentration
Chlorine Contact Basins	Detention Time:					
	ADWF	min	20	46	30 - 60[2]	30
	PWWF		--	23	15 - 30[2]	15
Dissolved Air Floatation Thickeners (DAFTs)	Solids Load (Peak 14-day Average)	lb/sf/hr	--	1.78[11]	0.4 - 1[2]	1.6
	Hydraulic Load (Peak 14-day Average)	gpm/sf	--	1.06[11]	0.5 - 2[2]	1.0
	TWAS Concentration	% TS	--	5.5	3.5 - 4[2]	--
Gravity Thickeners	Solids Load (Peak 14-day Average)	lb/sf/hr	1.0	1.5 [11]	1.2	1.2
	Hydraulic Load (Peak 14-day Average)	gpd/sf	700	842 [11]	700	700
	Percent Solids Capture	%	--	--	85 - 90	--
	Thickened Sludge Concentration	% TS	--	--	3.5 - 4.0	--

Table 2 OWTP Process Performance and Criteria Summary
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Process/Design Parameter	Design Parameter	Units	Original Design(1)	Historical Performance (2010 – 2013)	MOP-8(2) or Typical Values(3)	Recommended Criteria for Capacity Analysis
Anaerobic Digesters	Volatile Solids Load at ADMML	lbs VS/ CF/ day	0.1	0.10 (12)	0.1 - 0.4(2)	0.15
	HRT	days	25	25.4(12)	10 - 20(2)	15
	VS Reduction	%	55	55	50 - 65%(2)	55
	Volatile Acids	mg/L	50 - 500	194	< 300	< 300
	Alkalinity	mg/L as $CaCO_3$	2,000 - 4,000	3,378	> 1,000	> 1,000
	Volatile Acids / Alkalinity	--	0.03 - 0.13	0.06	< 0.10	< 0.10
	pH	-	6.8 - 7.4	--	6.8 - 7.4	6.8 - 7.4
Belt Filter Press	Solids Feed Rate per unit	lb/hr	820	984(13)	700 - 900	820
	Dewatered Sludge % Solids	%	18 - 22	19.6	15 - 25	20

Notes:
(1) From OWTP O&M Manuals (Brown and Caldwell, 1980) (Camp Dresser McKee Inc., 1991).
(2) (WEF/ASCE, 2010).
(3) Typical values based on Carollo experience.
(4) (Metcalf and Eddy, 2014).
(5) Calculated assuming 3 of 4 in service.
(6) Based on 1.73 lb BOD_5/d/sf media. 604 kcf of media at 27 sf/cf results in max BOD5 load of 28,213 lb/d.
(7) Based on 1 of 2 in service.
(8) Peak flow rate of 74.5 mgd, RAS flow rate of 29.0 mgd, all secondary clarifiers in service, and an SVI of 150 mL/g.
(9) Given the shallow surface water depth of the OWTP primary clarifiers, a higher solids loading rate is not recommended.
(10) Assume all in service.
(11) Based on 1 of 2 in service.
(12) Digester 1 and 3 in service only.
(13) Based on all four in service for 16 hours per day.

In general, the unit processes at the OWTP have been operating at loading rates that are well within their original design values or typical operating ranges. In addition, performance has been adequate and some of the unit processes are not even operating with all units in service, which means there is capacity for additional flow or load. The following sections review key findings for each unit process.

2.2.1 Aerated Grit Chambers

Key design parameters for grit removal include surface overflow rate and hydraulic detention time. During both dry and wet weather periods, the grit chambers are typically operated well within their design capacity with both units in service. During the review period, the average overflow rate at peak wet weather flow was around 23,000 gallons per day per square foot (gpd/sf) and the average detention time was 5.1 minutes. Given that the grit chambers have been performing satisfactorily, it is recommended the original design criteria be used for the capacity analysis.

2.2.2 Primary Clarifiers

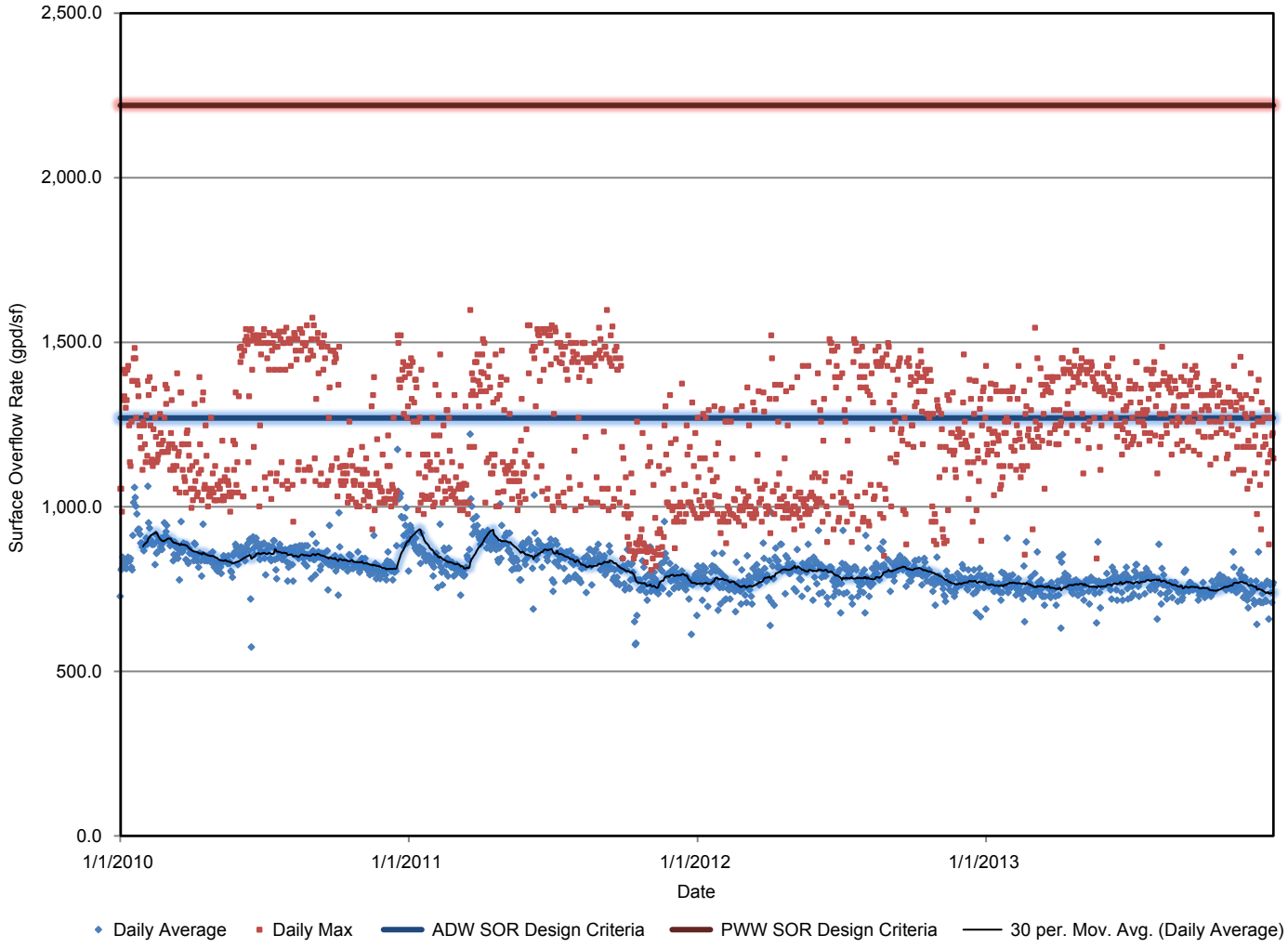
Surface overflow rate is the key parameter used to design primary clarifiers. Over the review period, the primary clarifiers were generally operated below the original design overflow rate and within the typical range for primary clarifiers. Figure 3 presents the daily and 30-day average overflow rates for the review period and shows that the design wet weather overflow rate and the design average dry weather (ADW) overflow rate was never exceeded during the review period.

During the review period, the plant operated with only three of the four primary clarifiers in service. Even with only three of four in service, the primary clarifiers have performed well within the range for typical primary clarifiers. Their performance with respect to BOD and TSS removal has been quite good, with an average BOD removal of 46 percent and TSS removal of 70 percent. Both of these removal rates are better than design. The likely reason for the better performance is that the facility operates with chemical addition to enhance performance. The recommended criteria for capacity analysis are shown in Table 2.

2.2.3 Biotowers

Key parameters used to design biotowers include hydraulic load rate and BOD_5 load rate. Over the review period, the volumetric BOD_5 load to the biotowers has been well below typical biotower design criteria, but slightly higher than the original design criteria.

The biotowers are designed to reduce the organic load to the downstream secondary system. Over the review period, the biotowers achieved approximately 23 percent BOD_5 removal and 63 percent soluble BOD removal. Over this period, the maximum month BOD_5 load to the biotowers was 55 lbs BOD_5/ 1000 CF of media/ day. The BOD_5 removal rate is quite low especially given the relatively low loading rate. It is likely that a portion of the flow



PRIMARY CLARIFIER OVERFLOW RATE

FIGURE 3

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is short-circuiting the biotowers by flowing down the central column, and thus is short-circuiting treatment.

2.2.4 Activated Sludge Tanks

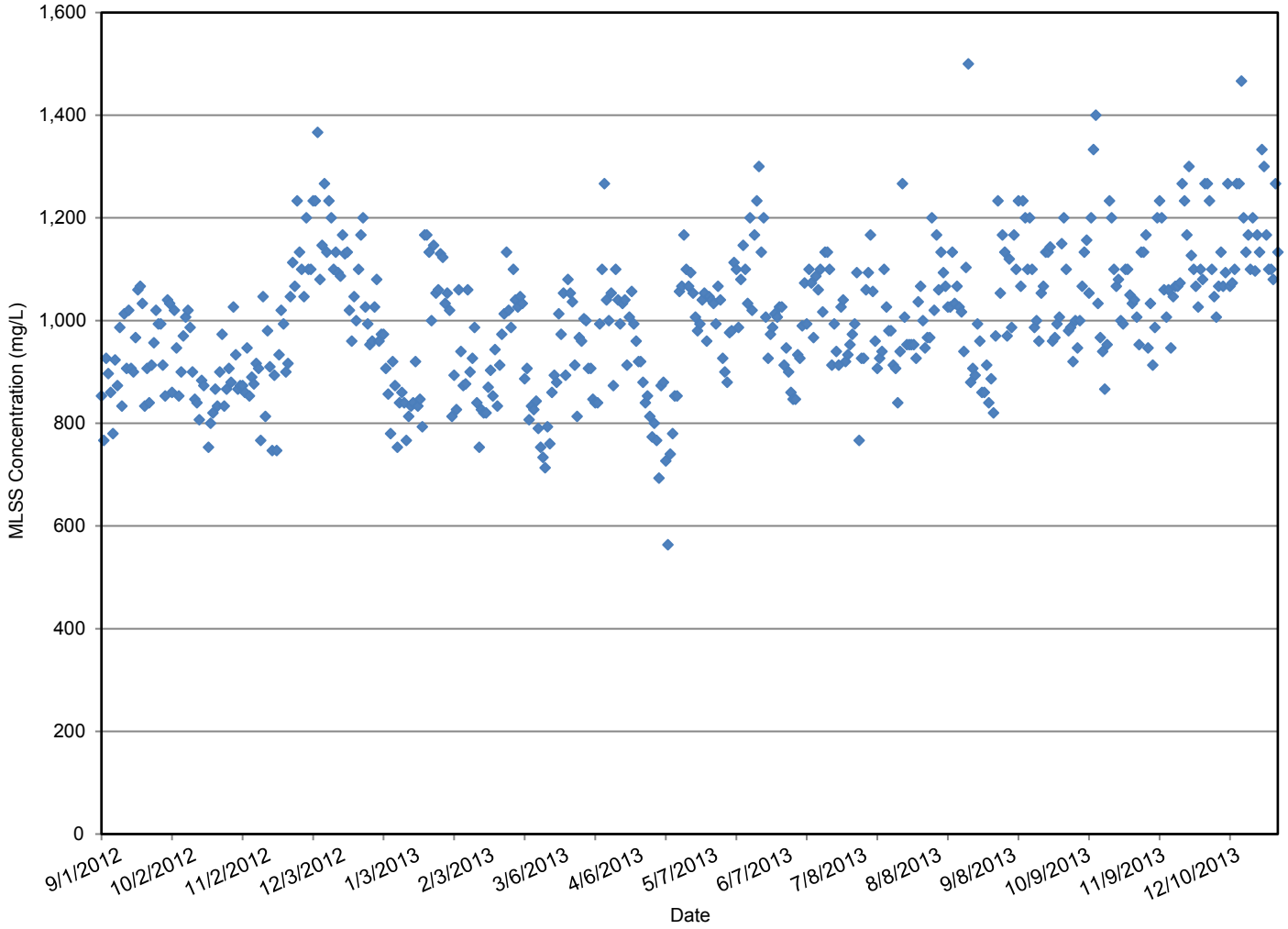
The aeration tanks can be configured as 6 parallel basins or as 2 three-pass basins with a serpentine flow pattern. During the period of operations and performance data reviewed, a single three-pass basin was used.

The aeration basins remove BOD_5 by converting soluble organics into settleable biomass (floc). The aeration basins were designed for BOD_5 removal only. Because the current NPDES permit does not have effluent ammonia requirements, they have never been operated to fully oxidize ammonia (nitrify). The key parameters used in the design and operation of an activated sludge process include: Mixed Liquor Suspended Solids (MLSS) concentration, Solids Retention Time (SRT), and Sludge Volume Index (SVI).

Figure 4 shows that the aeration basins have typically been operated at an MLSS concentration of around 1,000 milligrams per liter (mg/L), which is lower than typical design values. The MLSS concentration is important as it directly affects the mass of solids in the aeration tanks, which affects the operating SRT and treatment capacity. The MLSS concentration calculated in assessing capacity will depend on the peak flow through the activated sludge process. Peak flow to the activated sludge process is critical because it is desirable to use the maximum MLSS concentration that does not cause failure of the downstream secondary clarifiers from solids overload during peak flows. Based on historic operation, a MLSS concentration of 1,530 mg/L at ADMM was used for assessing activated sludge system capacity.

The SRT is one of the most important operating parameters for an activated sludge system and is defined as the total mass of solids in the aeration tanks divided by the total mass of the solids leaving the system in the Waste Activated Sludge (WAS) and secondary effluent. The SRT needed to achieve good performance depends on the treatment objectives (e.g., BOD_5 removal only, nitrification, denitrification, biological phosphorus removal) and the wastewater temperature. Because there are currently no controlling effluent ammonia limits, the treatment objective of the aeration basins is for BOD_5 removal only. Figure 5 shows the SRT over the study period. As shown in the graph, the SRT has stayed relatively constant at 2 days. An SRT of 2.5 days at ADMM will be used for assessing aeration basin capacity.

In addition to removing BOD_5 and other desired constituents, the aeration basin should generate well-settling sludge, which is measured by the SVI. The SVI represents the volume the solids in a mixed liquor sample with a given concentration will compress to after 30 minutes. In general, the lower the SVI, the faster the solids settle.



MIXED LIQUOR SUSPENDED SOLIDS CONCENTRATION

FIGURE 4

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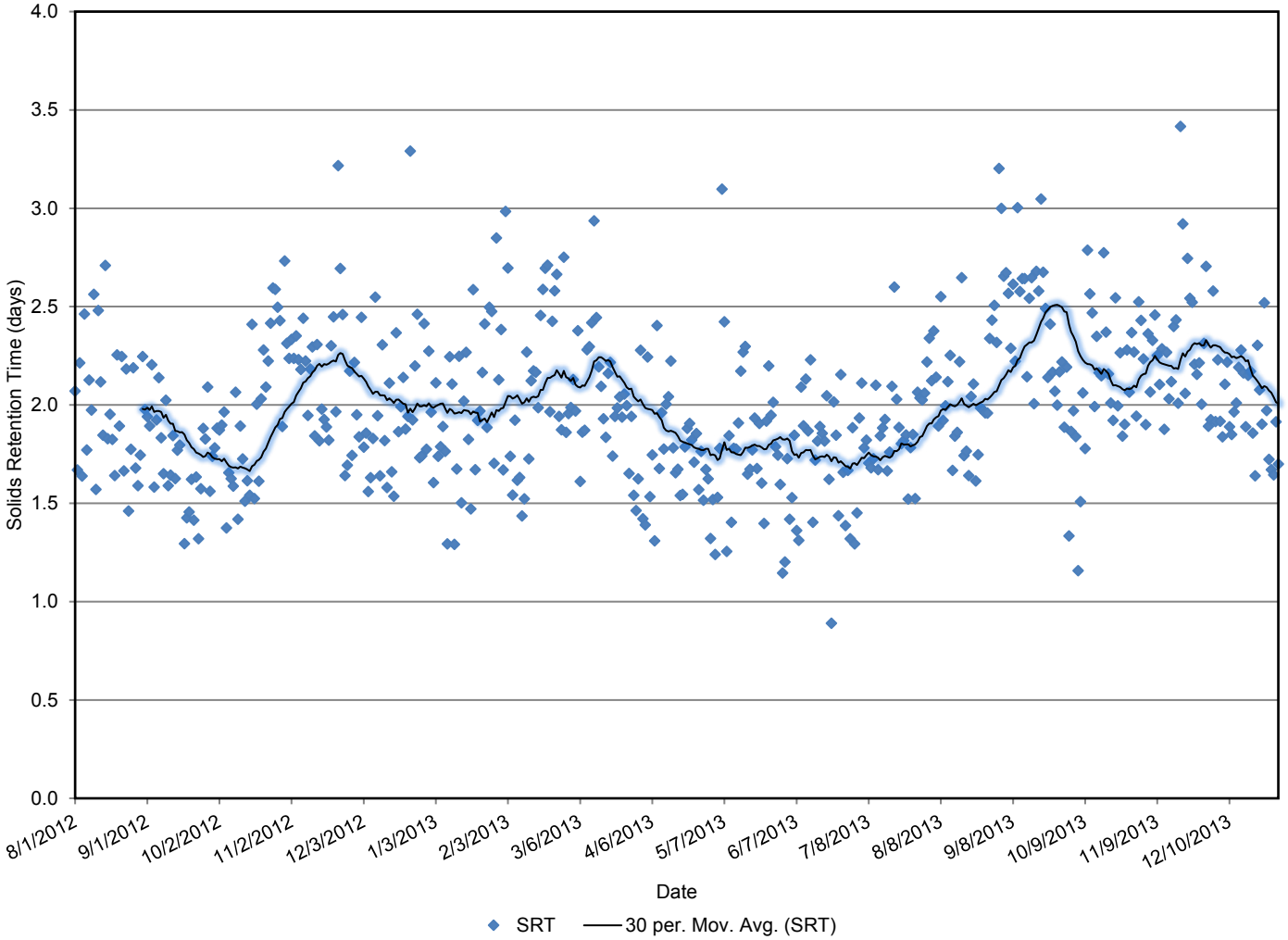

SOLIDS RETENTION TIME

FIGURE 5

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The SVI is important as it directly affects the capacity of the downstream clarifiers and overall secondary process. Figure 6 shows how the SVI has varied historically. Over the past four years, the 90th percentile SVI value was about 177 mL/g. The 90th percentile SVI for a typical, properly functioning activated sludge process is generally closer to 150 mL/g. A SVI less than 150 mL/g represents a well-settling sludge and an SVI greater than 150 represents a poor-settling sludge. Since the observed 90th percentile SVI is higher than design, the City should continue to monitor this and consider modifications to improve settleability, such as a biological selector, if this becomes an issue in the future. Additionally, the City should have an alternate means of improving settleability, such as polymer addition or RAS chlorination, in the event that a peak flow event occurs during the approximately 30 days per year that the SVI is greater than 150 mL/g.

For planning purposes, a 90th percentile SVI of 150 mL/g was used for assessing the PWWF capacity.

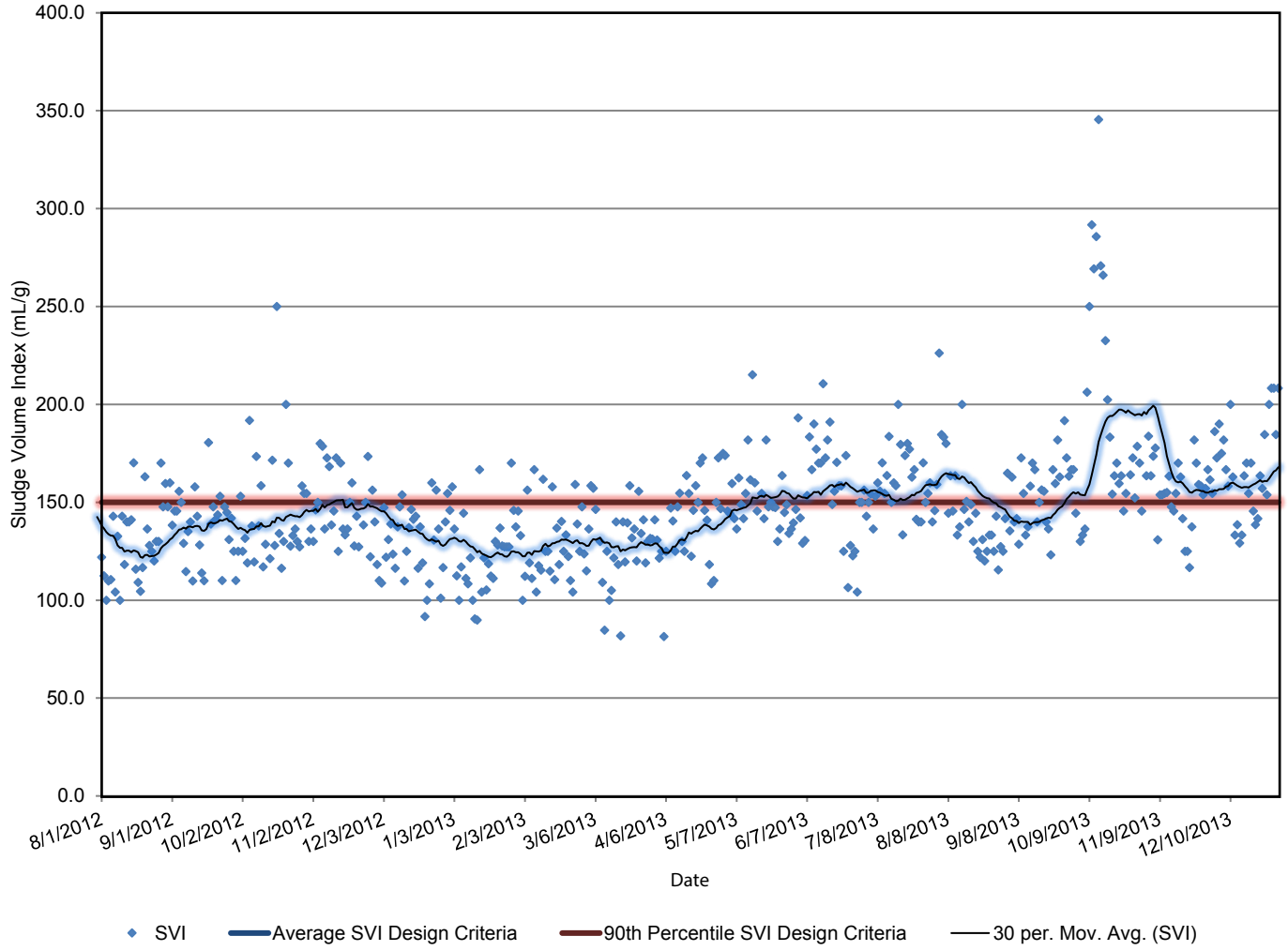
2.2.5 Secondary Sedimentation Tanks

The OWTP has 18 rectangular secondary sedimentation tanks (SSTs), each with a surface water depth of 9.9 feet. Typically, 12 of 18 are in service.

The secondary sedimentation basins separate the settleable biomass and floc (activated sludge) generated in the aeration basins from the effluent. In general, the sedimentation basins have performed well given the OWTP met the BOD_5 and TSS effluent requirements during the entire review period. Figure 7 shows the secondary sedimentation basin overflow rate over the review period. The figure shows that the sedimentation basins were generally operated at well below their design overflow rates, with all units in service. As part of the capacity assessment, a process model was developed to identify the maximum capacity for the sedimentation basins. The 90th percentile SVI of 150 mL/g was used to assess the capacity of the secondary sedimentation basins for a range of MLSS concentrations. As discussed in further detail in the capacity assessment, modeling results indicate that the sedimentation basins can operate at a surface overflow rate of 1,200 gallons per day per square foot (gpd/sf) during the projected 2040 peak flow of 50.5 mgd.

2.2.6 Chlorine Contact Tanks

The OWTP has two 3-pass chlorine contact tanks. In 2013, the 30-day geometric mean total coliform in OWTP effluent was around 80,800 MPN/L. While this is quite high, given their allowable dilution of 98:1, the OWTP was able to meet the recommended Ocean Plan receiving water total coliform limit of 1,000 MPN/L.



SLUDGE VOLUME INDEX

FIGURE 6

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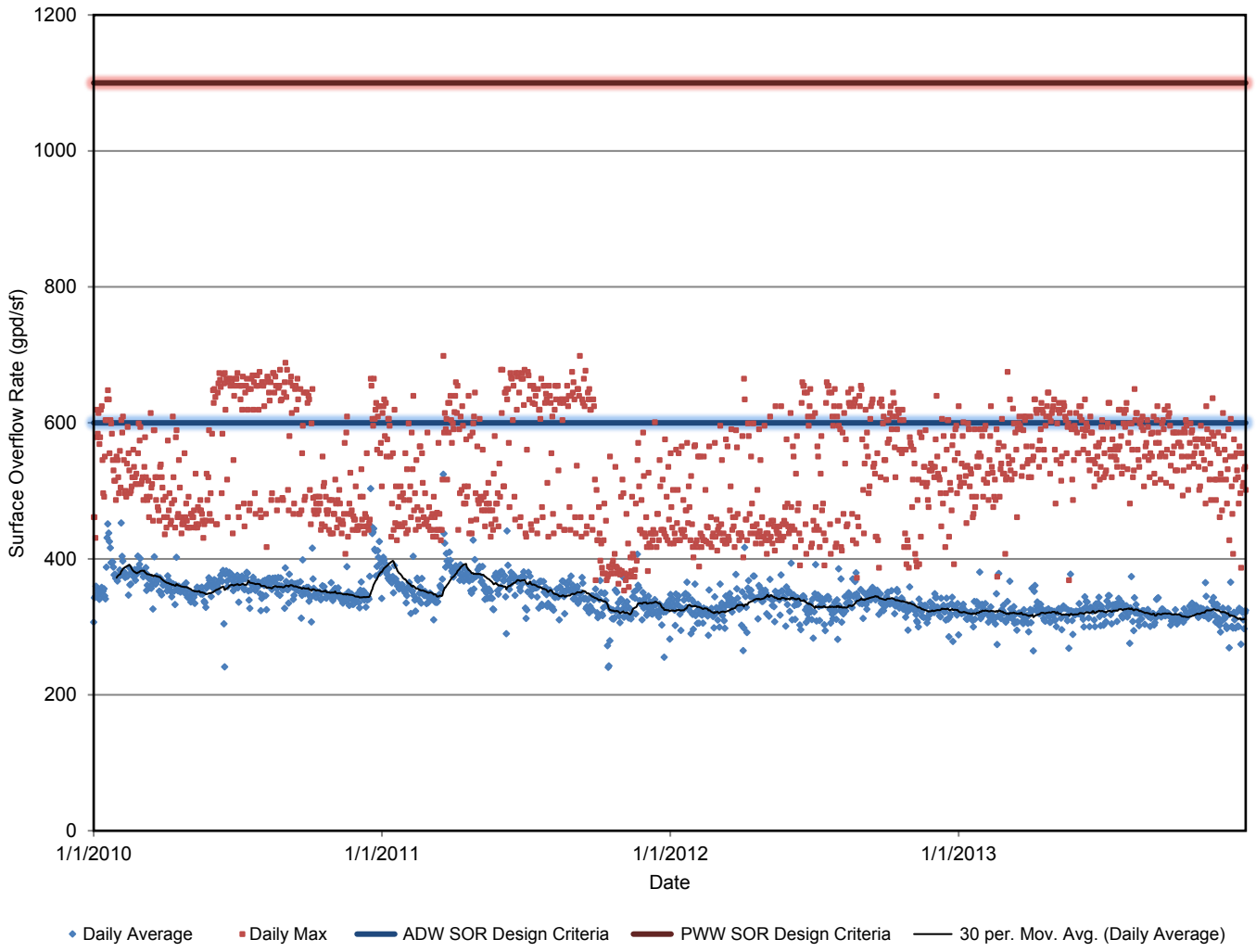

SECONDARY CLARIFIER OVERFLOW RATE

FIGURE 7

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Key parameters used to design and operate chlorine disinfection processes include chlorine dose and contact time. Over the review period, the contact time was about 46 minutes and 23 minutes at average dry weather flow (ADWF) and peak wet weather flow (PWWF), respectively. The contact time at ADWF was well above the original design criteria of 20 minutes. In addition, chlorine contact basins are routinely operated at 15 to 30 minute contact times during peak flows. Given this, it is recommended that a revised contact time of 30 minutes be used to assess the ADWF capacity of the disinfection process and a revised contact time of 15 minutes be used to assess the PWWF capacity.

2.2.7 Gravity Thickeners

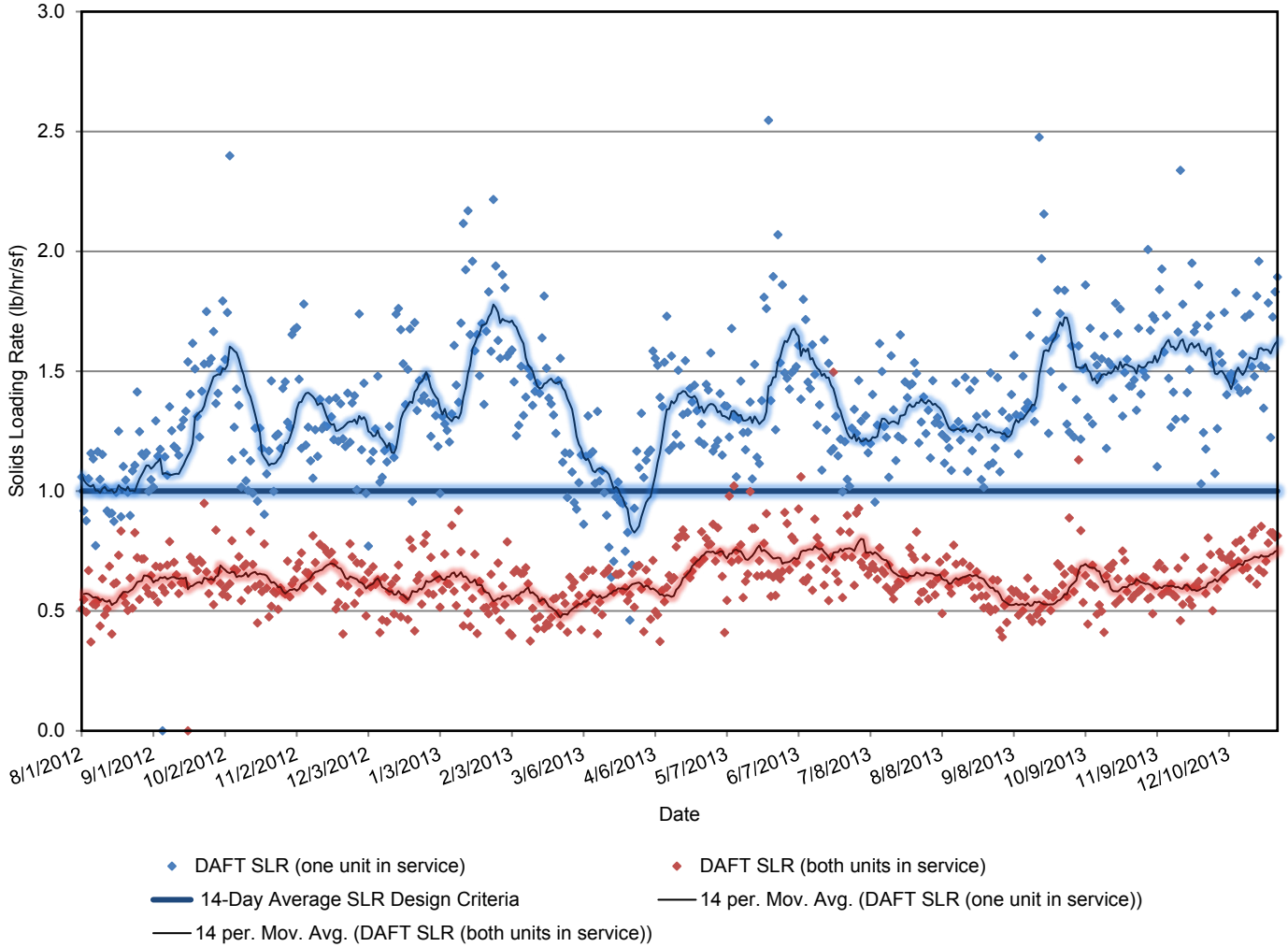
Historically, the gravity thickeners thicken primary sludge from the primary clarifiers before the primary sludge is mixed with thickened waste activated sludge (TWAS) and sent to the digesters. Key parameters used to design and operate the gravity thickeners include solids loading and hydraulic loading. During the review period, the gravity thickeners have been over-loaded both on a hydraulic and solids basis when one unit is out of service. The 14-day average solids loading to the gravity thickeners was 1.5 pounds per hour per square foot (lb/sf/hr) and the 14-day average hydraulic loading was 842 gallons per day per square foot (gpd/sf). Both of these loading rates assume one gravity thickener is out of service. A solids loading rate of 1.2 lb/sf/hr and a hydraulic loading rate of 700 gpd/sf are recommended for the capacity analysis.

2.2.8 DAFTs

Solids loading rate is the primary parameter used for DAFT design and operation. Figure 8 shows the DAFT solids loading rates based on operating one and two DAFTs for 24 hours per day. As shown in the figure, when only one unit is in operation, the DAFT is overloaded. Hydraulic loading rate is often also considered. Figure 9 shows the DAFT hydraulic loading rate based on operating one and two DAFTs for 24 hours per day.

OWTP typically operates with only one DAFT in service. Under this operating condition, typical peak 14-day solids and hydraulic loading are 1.78 pounds per square foot per hour (lb/sf/hr) and 1.06 gallons per minute per square foot (gpm/sf), respectively. Under this operating condition, the DAFTs are overloaded. However, with both units in service the loading rates are within recommended values. Even with hydraulic and solids loading rates exceeding original design criteria, the DAF thickeners have performed well, achieving an average percent total solids (TS) concentration of 5.5 percent.

While typical design criteria for peak 14-day solids and hydraulic loading is 1.0 lb/sf/hr and 1.0 gpm/sf respectively, based on successful operating experience, a solids load criterion of 1.6 lb/sf/hr and a hydraulic load rate criterion of 1.0 gpm/sf will be used for peak 14-day to conduct the capacity assessment. This peak 14-day solids loading rate corresponds to 40 pounds per day per square foot (ppd/sf).



DAFT SOLIDS LOADING RATE

FIGURE 8

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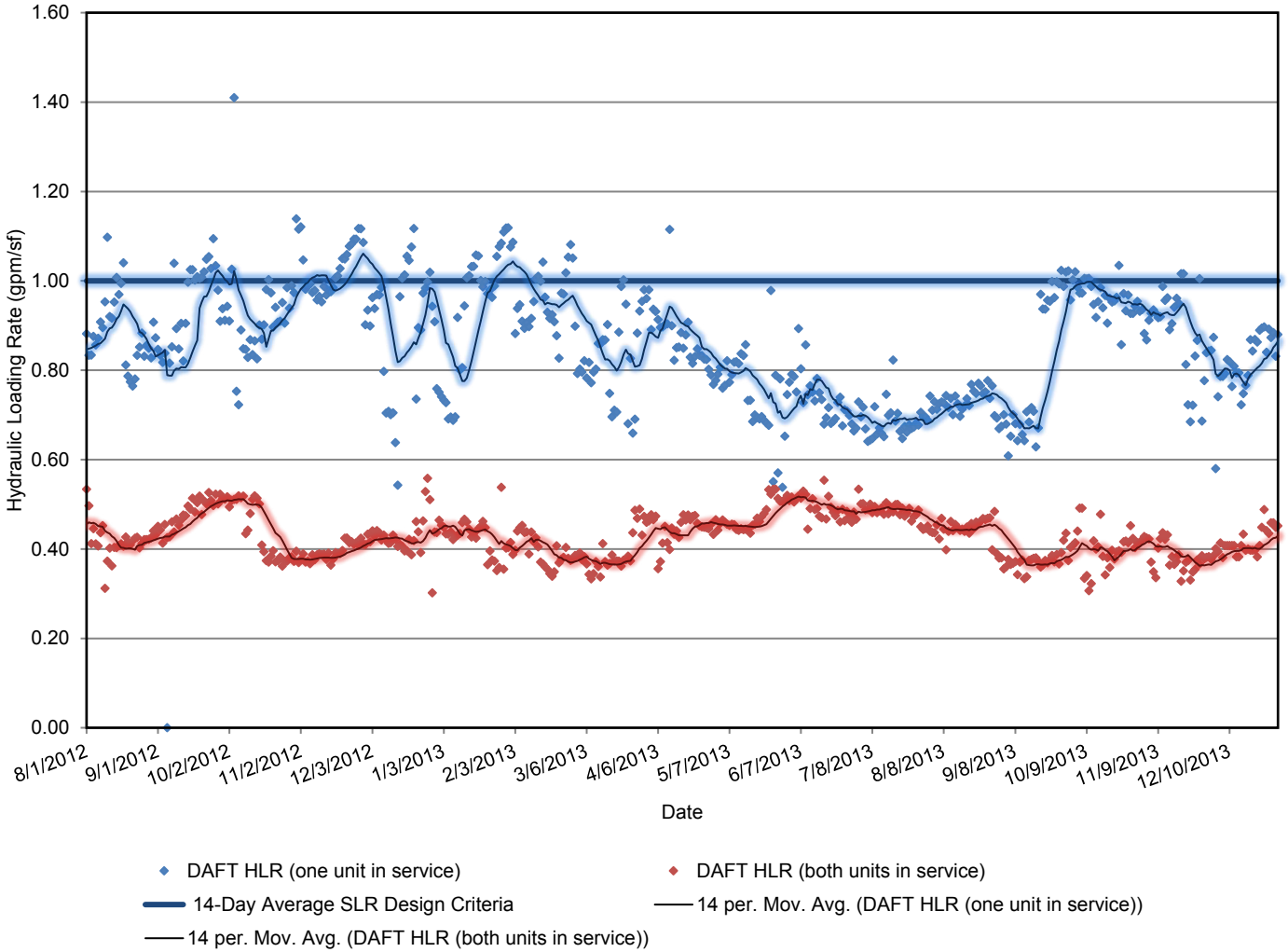

DAFT HYDRAULIC LOADING RATE

FIGURE 9

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2.2.9 Digesters

The anaerobic digesters have performed adequately with both Digesters 1 and 3 in service, achieving an average volatile solids reduction (VSR) of 55 percent, which is equal to the original design VSR.

Volatile solids loading rate (VSLR) and the hydraulic residence time (HRT) are key parameters used for digester design and operation. The VSLR has been right around the original design criteria, which is on the low end of typical design values. In addition, as shown in Figure 10 the average HRT has almost always been higher than the original design criteria. It is recommended that a minimum HRT of 15 days and a maximum VSLR of 0.15 lb/cf/d be used to conduct the capacity assessment.

While the digester performance has been adequate with both Digesters 1 and 3 in service, neither Digester 1 nor Digester 3 can be taken offline for cleaning without putting Digester 2 back in service. Currently, Digester 2 is not operational due to the condition of its roof.

2.2.10 Dewatering

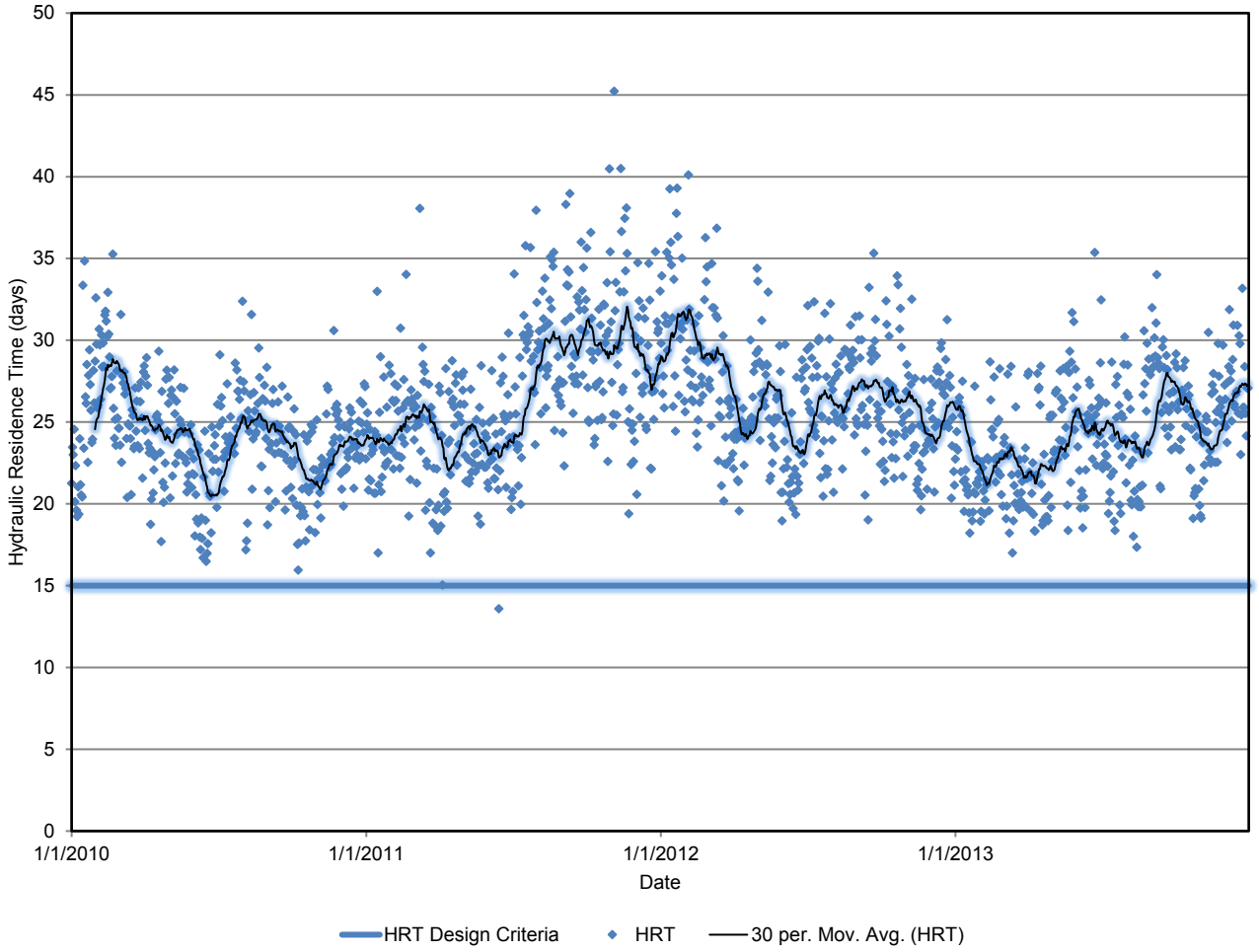
Typically, all four BFP units are in operation for 16 hours each day, Monday through Saturday. On Sunday, typically only two BFP units are in operation for 16 hours. The average dried sludge percent solids are 19.6, which is within the original design value range. However, the historical solids feed rate, assuming all four units are in service for 16 hours each day, is higher than the original design criteria, indicating that the BFPs are likely overloaded. The original design solids loading rate of 820 pounds per hour (pph) was used for the capacity analysis.

3.0 CAPACITY ANALYSIS

This section summarizes the results of the capacity analysis. Process capacities were estimated for each unit process and are dependent on a range of parameters, including: flow, influent wastewater characteristics, treatment objectives, process configurations and limitations, and desired redundancy. Capacities were estimated for each of these processes based on the recommended criteria in Table 2.

3.1 Peak Hour Wet Weather Flow Capacity

The Peak Hour Wet Weather Flow (PHWWF) capacity was estimated for facilities where sizing is established by the peak flow. These facilities include the headworks, influent pumping, primary clarifiers, biotowers, and interstage pumping. Peak capacities for process units are based on all units being in service, while pumping capacities are based on the large unit being out of service. Table 3 summarizes the PHWWF capacity for each of these processes. Figure 11 illustrates this same information.



DIGESTER HYDRAULIC RESIDENCE TIME ASSUMING DIGESTER 2 IS OUT OF SERVICE

FIGURE 10

CITY OF OXNARD

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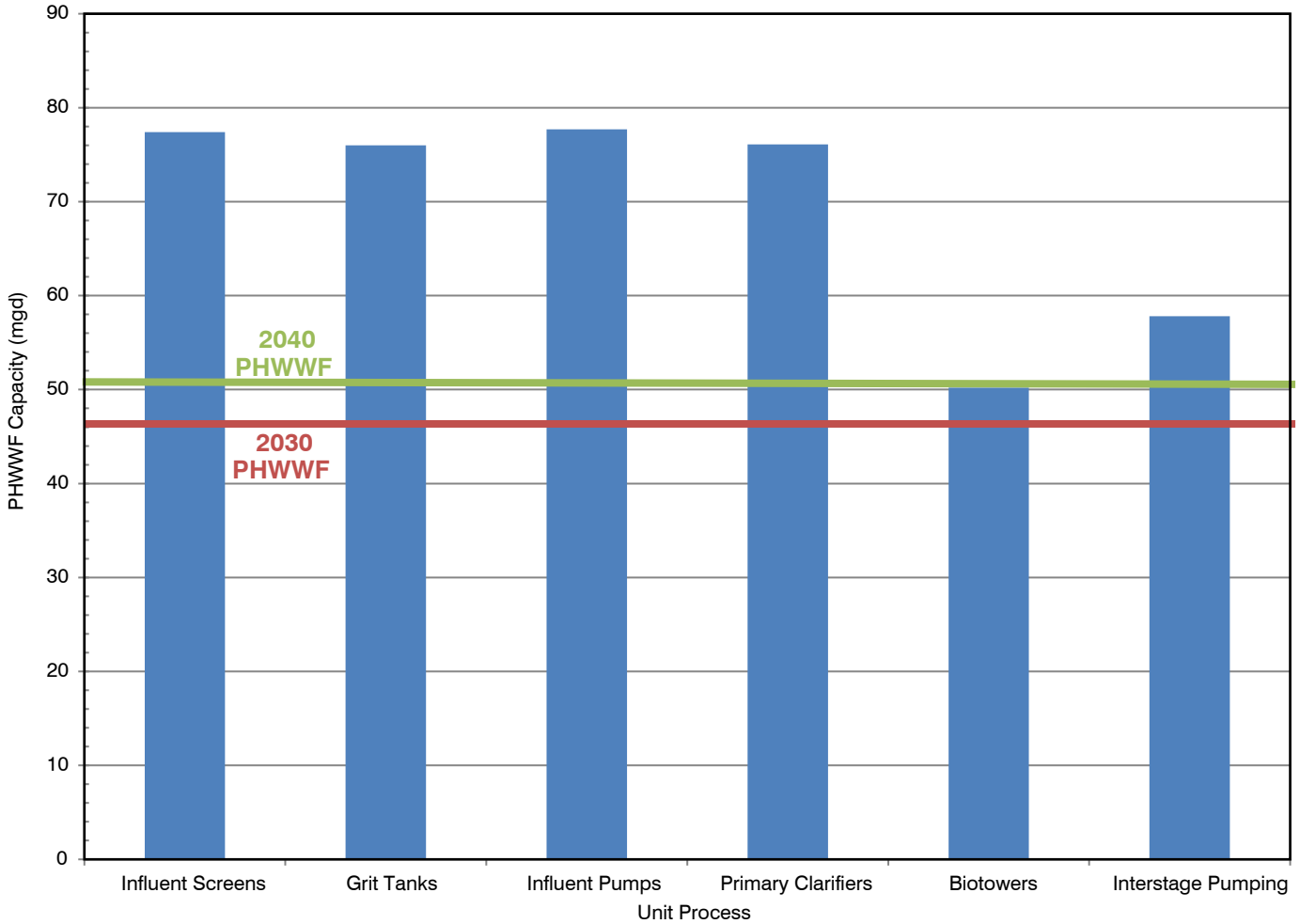
Table 3 Peak Hour Wet Weather Flow Capacity Public Works Integrated Master Plan City of Oxnard	
Process	**PHWWF Capacity (mgd)**
Influent Screens	77.4(1)
Grit Tanks	76(2)
Influent Pumps	77.7(3)
Primary Clarifiers	76.1(4)
Biotowers	50.2(5)
Interstage Pumping	57.8(6)

Notes:
(1) Based on 2 of 4 automatic screens in service or 1 of 2 manual bar screens in service.
(2) Based on both units in service and a peak overflow rate of 42,315 gpd/sf, as originally designed.
(3) Based on 3 of 6 pumps being out of service, as originally designed.
(4) Assumes all 4 units are in service and the peak overflow rate is 2,200 gpd/sf, as originally designed.
(5) Based on both units in service and a peak overflow rate of 1.5 gpm/sf, as originally designed.
(6) Assumes 2 of 3 units are in service.

3.2 Wet Weather Flow Equalization Capacity

Design influent flow hydrographs were developed for the current 10-year and future 10-year design storms to determine if the existing headworks and equalization facilities have sufficient capacity to accommodate wet weather flows. The hydrographs, which are shown in Figure 12, were developed as part of PM 3.3 - *Wastewater System - Infrastructure Modeling and Alternatives*. The 10-year design storm was selected to be consistent with the collection system analysis and because it is believed to be a sufficiently conservative basis for evaluating the OWTP headworks and equalization (EQ) basin capacity. The rated maximum capacity of the OWTP outfall is 50 mgd, so flow equalization is necessary when the plant flow rate exceeds this value.

The hydrographs summarize the peak wet weather flow expected at the OWTP for each hour of each design storm. The current 10-year design storm hydrograph approximates expected OWTP influent flows given current collection system flows. The design storm hydrographs approximate what OWTP influent flows are expected to be when flows increase in the future. The peak flow of the current 10-year storm is about 38.5 mgd and occurs around the 13th hour of the storm; and the peak flow of the future 10-year storm is about 49.6 mgd and also occurs around the 13th hour of the storm.



OWTP PEAK HOUR WET WEATHER FLOW CAPACITY BAR GRAPH

FIGURE 11

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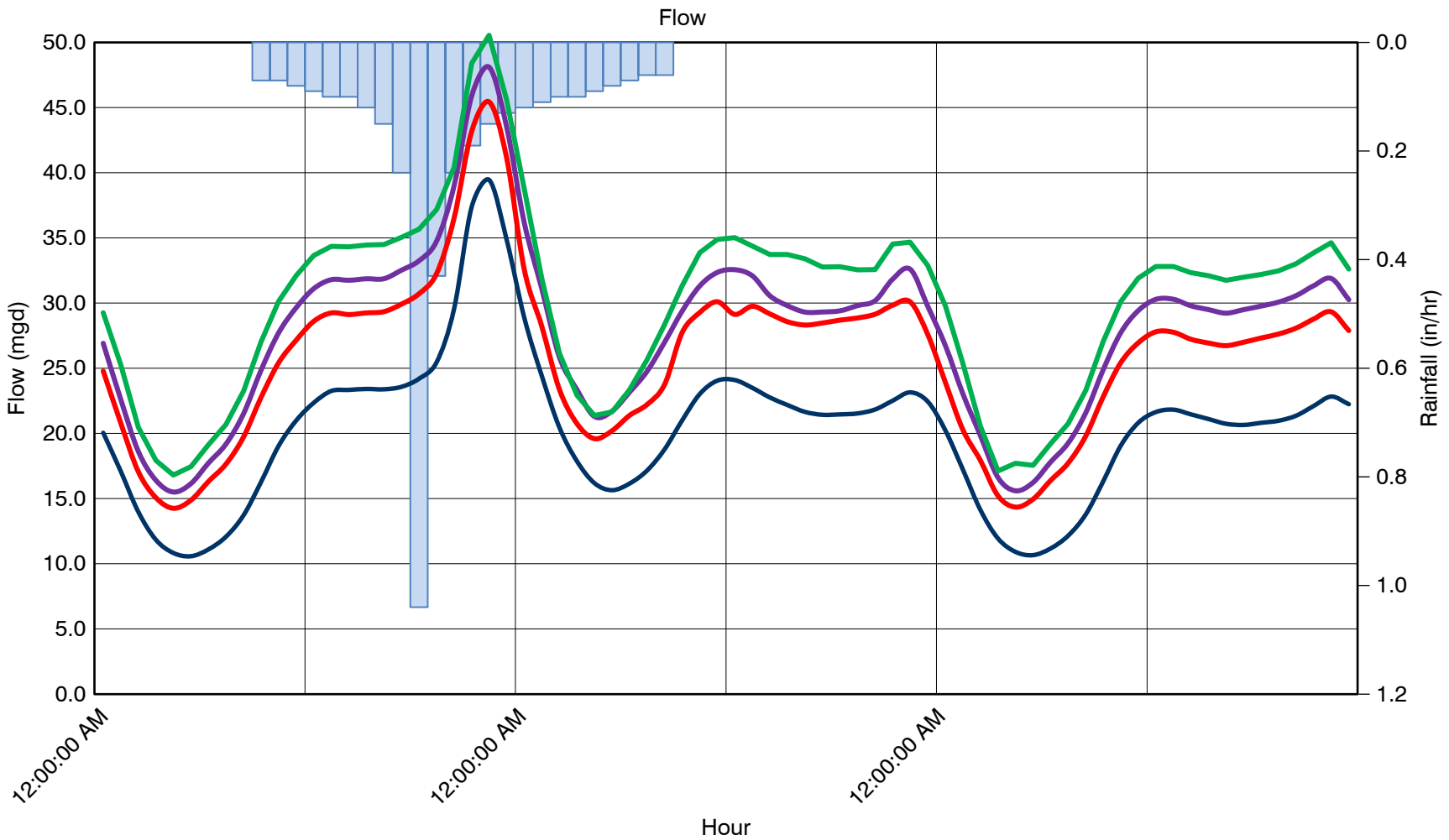

LEGEND

Rainfall | Existing | 2020 | 2030 | 2040

OWTP EXISTING AND PROJECTED 10-YEAR 24-HOUR STORM HYDROGRAPH

FIGURE 12

CITY OF OXNARD

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ox1115f3-9587(PM3-4FIG12).ai

In comparing the hydrographs to the capacity of the existing headworks and equalization facilities, it was determined the OWTP has sufficient capacity to accommodate peak wet weather flows over the planning horizon. As shown in Figure 11, the capacity of the headworks facilities are greater than the peak wet weather flows expected at the OWTP during the design storm. Figure 13 illustrates the required EQ basin volume needed for the design storm as a function of flow rate being treated at the OWTP. At the permitted capacity of 31.7 mgd, approximately 4.95 million gallons of storage is needed in 2040, which is just under the available storage capacity. Historically, the EQ basins have never been filled to capacity. While in 2040, EQ basin capacity will be nearing its limit, determining if additional capacity is needed will depend on how the EQ basins are operated. Both the Advanced Water Purification Facility (AWPF) and outfall needs should be considered to see if there is additional EQ basin capacity needed.

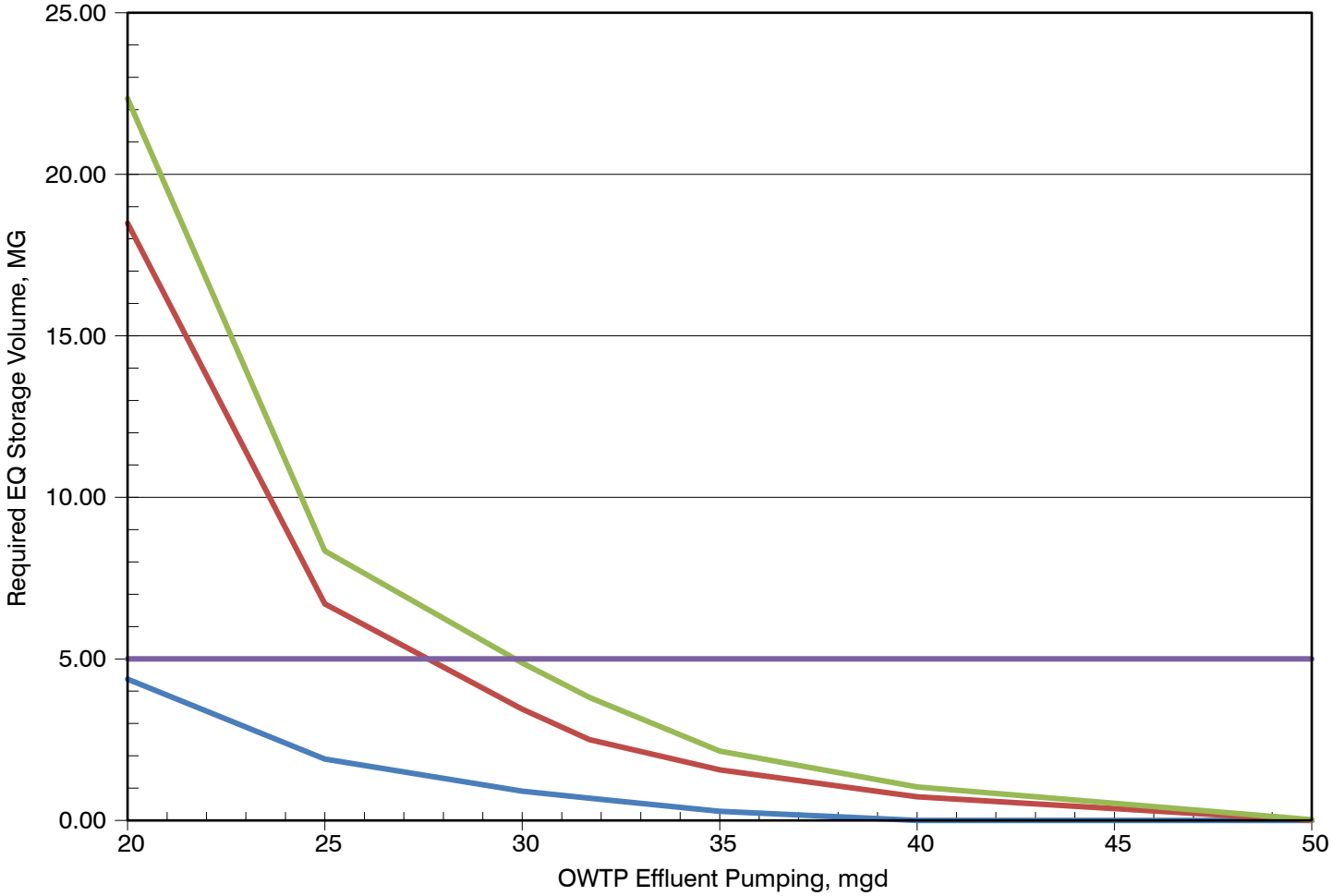
3.3 ADWF Capacity

The ADWF capacity was estimated for facilities where sizing is established by average flows, or influent BOD and TSS loading to the plant. These facilities include the primary clarifiers, aeration basins, secondary clarifiers, gravity thickeners, DAF thickeners, anaerobic digesters, and dewatering. To determine the capacity for these facilities, a plant process model was developed and calibrated to historical operating data from 2013. This process model was used to simulate maximum month, peak 14-day, and peak day conditions for the plant. Each unit process was evaluated using one of these flow conditions. Using the process model to simulate the flow condition of interest for each unit process, the influent flow was increased until the operating limits (as established in Table 2) were exceeded for each particular unit. This influent flow was taken as the capacity limit for that particular unit. The capacity limit was converted to an equivalent ADWF based on the historical peaking factors observed (see flow and load analysis). Table 4 summarizes the capacity for each process. Figure 14 shows the ADWF capacities of each process. Appendix A includes a summary of the model outputs and operational data for the calibration period.

3.3.1 Liquid Treatment Process Capacity

As shown in Table 4, all of the liquid treatment processes have sufficient capacity for projected flows through 2040. The limiting liquid treatment process is the secondary capacity.

The average dry weather capacity rating of the aeration basins is dependent on their ability to remove organic material at the anticipated peak flow and load conditions associated with a given ADW flow rate. The aeration basin performance is dependent on several factors, including but not limited to treatment goals, solids retention time (SRT), MLSS concentration, influent alkalinity, and temperature. To determine the ADWF capacity of the aeration basins, dynamic and steady state process models were used to simulate process



LEGEND			
Current	2030	2040	Current EQ Basin Volume (5 MG)

REQUIRED EQUALIZATION (EQ) STORAGE FOR PEAK WET WEATHER FLOWS

FIGURE 13

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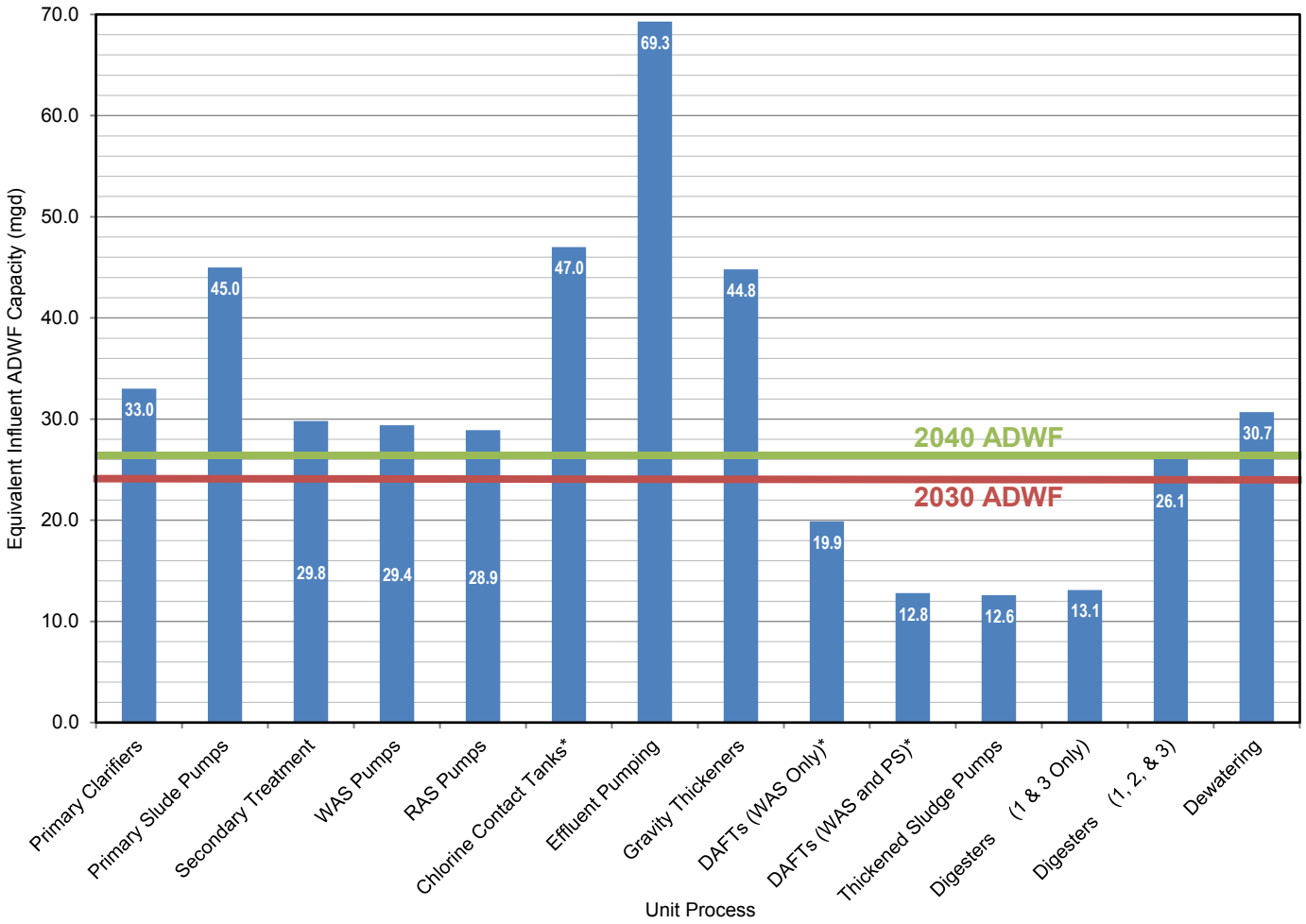

* *All unit processes assume the largest unit is out of service except for those starred.*

OWTP AVERAGE DRY WEATHER FLOW CAPACITY BAR GRAPH

FIGURE 14

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Table 4 ADWF Capacity
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City of Oxnard

Process	Averaging Period	Design Criteria	Equivalent Influent ADWF Capacity (mgd)(1)
Primary Clarifiers	Average Annual	1270 gpd/sf	**33.0(2)**
	Peak Day	2200 gpd/sf	56.4(3)
Primary Sludge Pumps	Average Annual	2 mgd	45.5(2)
	Peak Day	3 mgd	**45.0(3)**
Secondary Treatment	Average Annual	--(4)	--
	Maximum Month	--(4)	**29.8**
WAS Pumps	Average Annual	1.4 mgd	**29.4(2)**
	Peak 14-day	2.1 mgd	44.1(3)
RAS Pumps	Average Annual	--(5)	**28.9(2)**
Chlorine Contact Tanks	Average Annual	20 min	47.6(3)
	Peak Day	15 min	**47.0(3)**
Effluent Pumping	Average Annual	69.2 mgd	**69.3(2)**
	Peak Day	94.2 mgd	69.9(3)
Gravity Thickeners	Average Annual	29 ppd/sf	**44.8(2)**
	Peak 14-day	29 ppd/sf	59.7(3)
DAFTs - WAS Only	Average Annual	30 ppd/sf	21.7(3)
	Peak 14-day	40 ppd/sf	**19.9(3)**
DAFTs - WAS and Primary Sludge	Average Annual	60 ppd/sf	18.9(3)
	Peak 14-day	60 ppd/sf	**12.8(3)**
Thickened Sludge Pumps	Average Annual	0.1 mgd	**12.6(2)**
	Peak 14-day	0.2 mgd	17.0(3)
Digesters - Digester 1 and 3	Average Annual	15 days	15.0(2) (6)
		0.15 lb VSS/d/cuft	**13.1(2) (7)**
	Maximum Month	15 days	27.9(3)
		0.15 lb VSS/d/cuft	25.8(3)
Digesters - Digester 1, 2, & 3	Average Annual	15 days	30(2)
		0.15 lb VSS/d/cuft	**26.1(2)**
	Maximum Month	15 days	39.1(3)
		0.15 lb VSS/d/cuft	36.1(3)
Digested Sludge Pumps	Average Annual	0.7 mgd	**101(2)**
	Peak 14-day	1.1 mgd	103(3)
Dewatering	Average Annual	820 lb/hr	31.7(2) (8)
	Maximum Month	820 lb/hr	**30.7(3) (8)**

Notes:
(1) The limiting ADWF capacity is shown in bold and underlined.
(2) Assumes largest unit is out of service.
(3) Assumes all units are in service.
(4) Depends on SVI and selected MLSS concentration.
(5) RAS pumps' capacity is rated to handle average influent dry weather flow.
(6) If both Digesters 1 and 3 were in service the equivalent ADWF capacity would be 37.4 mgd.
(7) If both Digesters 1 and 3 were in service the equivalent ADWF capacity would be 25.8 mgd. This would then be the limiting capacity.
(8) Assumes continuous operation.

conditions at the facility's operating limits. Secondary treatment capacity was evaluated for two scenarios:

- BOD Removal Only. The City's existing NPDES permit is based on meeting a monthly limit of 30 mg/L for BOD and TSS. For this scenario, the recommended operating limit is a 2.5-day SRT and a 150 mL/g 90th percentile SVI under maximum month load conditions.

- Nitrification / Denitrification. While it is not anticipated that the City's existing NPDES permit will change in the near future, increased recycled water production by the AWPF will increase constituent concentrations, particularly ammonia, above those in the secondary effluent. A detailed discussion of these effects can be found in PM 4.3. One way potentially to address this concern is to nitrify and denitrify in the secondary treatment process. For this scenario, an operating SRT limit of 5 days and a 90th percentile SVI of 150 mL/g were used under maximum month load conditions. Recirculation within the aeration basins and the creation of an initial anoxic zone was modeled as part of this denitrification scenario.

While the existing secondary treatment process has sufficient treatment capacity to meet the City's NPDES BOD limits through the planning horizon, the secondary treatment process does not have sufficient capacity to nitrify and denitrify. Thus, it is recommended that the OWTP consider a secondary treatment capacity expansion or switch to an alternative process configuration, such as membrane bioreactors, in order to handle the higher MLSS concentrations associated with the higher SRT needed for nitrification/denitrification should this be necessary with the expansion of the AWPF.

3.3.2 Solids Handling Process Capacity

The simulated primary sludge, thickened primary sludge, WAS, TWAS, and digested sludge production were used to determine the capacity of the gravity thickeners, DAFTs, anaerobic digesters, and centrifuges from the rating criteria presented in Table 4. Based on the BioWin Model's projected sludge production through 2030, the DAFTs, thickened sludge pumps, digesters, and dewatering units need additional capacity.

While the influent solids load and organic load are expected to increase by around 30 percent, the modeled sludge production is expected to increase by more than 30 percent. This increase in sludge production is in part due to the removal of the biotowers and addition of an anaerobic selector in the ASTs. This change will increase the amount of WAS produced which will affect the capacity of the DAFTs, digesters, and dewatering equipment. An increase in modeled sludge production is also likely due to the efficiency chosen in the primaries. As a conservative approach, a BOD and TSS percent removal of 35 and 65, respectively, was used in the modeling effort. However, historically the OWTP has operated with a 46 percent BOD removal efficiency and a 70 percent TSS removal efficiency. This change in efficiency will also affect the amount of WAS produced

downstream. Because of these anticipated changes to sludge production, additional DAFT units, digesters, and dewatering units are needed.

Two scenarios were considered for loading of the DAFTs. The first scenario assumed that primary sludge would be thickened separately in either the existing gravity thickeners or, if the primary clarifiers are rebuilt, in new primary clarifiers. Results of this capacity analysis can be found in Table 4 under 'DAFTs – WAS Only'. The second scenario assumed that the DAFTs would be used to thicken both primary sludge and WAS. The results of this capacity analysis can also be found in Table 4 under 'DAFTs – WAS and Primary Sludge'. Based on our process model, in both instances, the DAFTs need additional units. The associated thickened sludge pumps will also need to be upsized.

Two scenarios were also considered for the digesters. The first scenario is consistent with current operation, which assumes that Digester 2 is out of service. Under this configuration, neither Digester 3 nor Digester 1 can be taken offline for maintenance given current digester loading. The second scenario assumes that Digester 2 is repaired and put back online. Under this scenario, a digester can be taken offline during average annual flows and loadings for maintenance and repair through 2030. However, the three digesters will need additional capacity by 2040, given the projected changes to sludge production at the plant and projected flows and loads in this PWIMP.

Dewatering capacity was also considered as part of this capacity analysis. If continuous operation is assumed, then the dewatering units have sufficient capacity through 2040. However, additional capacity would allow the units to come offline at night and make operation logistically easier.

APPENDIX A – BIOWIN CALIBRATION REPORT

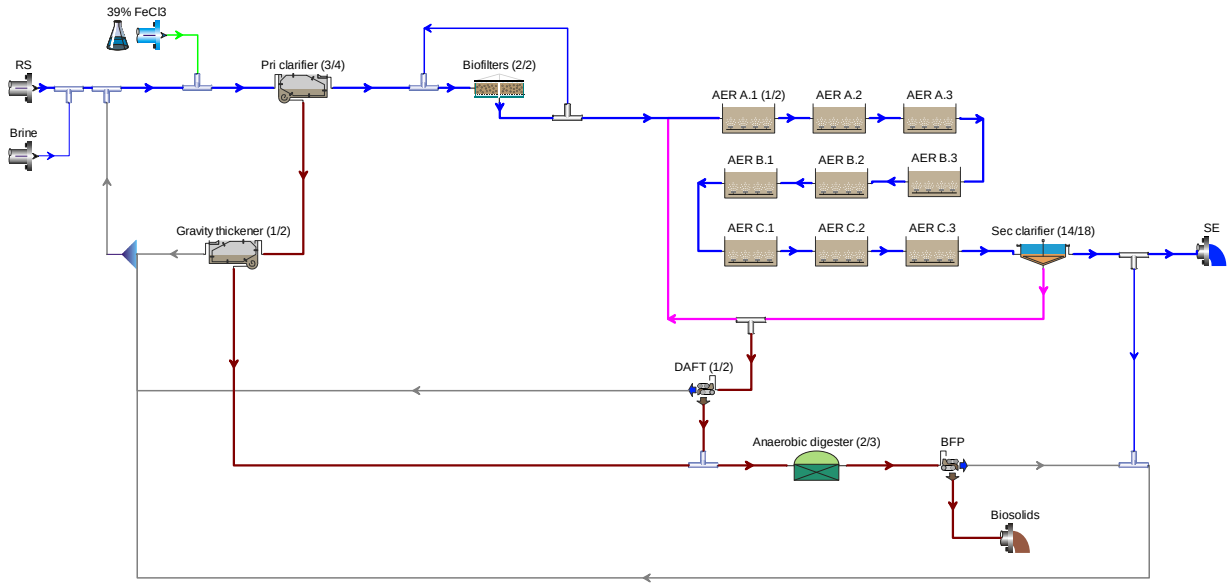
BioWin user and configuration data

Project details
Project name: Oxnard Master PlanProject ref.: 9587A.00
Plant name: Oxnard WWTPUser name: Ron Appleton

Created: 5/22/2014Saved: 5/29/2015

Steady state solution
SRT (total): 2.21112 days
Temperature: 26.0°C

Flowsheet



Configuration information for all Ideal primary settling tank units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]
Gravity thickener (1/2)	0.3272	2734.0000	16.000

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Gravity thickener (1/2)	Fraction	0.09

Element name	Percent removal	Blanket fraction

Gravity thickener (1/2)	95.00000	0.50000

Configuration information for all Anaerobic Digester units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	Head space volume
Anaerobic digester (2/3)	3.9750	1.586E+4	33.500	1.0

Operating data Average (flow/time weighted as required)

Element name	Pressure [psi]	pH
Anaerobic digester (2/3)	14.9	7.0

Element name	Average Temperature
Anaerobic digester (2/3)	35.0

Configuration information for all Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
AER A.1 (1/2)	0.4960	3900.0000	17.000	2626
AER A.2	0.4960	3900.0000	17.000	2626
AER A.3	0.4960	3900.0000	17.000	2626
AER B.3	0.4960	3900.0000	17.000	2626
AER B.2	0.4960	3900.0000	17.000	2626
AER B.1	0.4960	3900.0000	17.000	2626
AER C.3	0.4960	3900.0000	17.000	2626
AER C.2	0.4960	3900.0000	17.000	2626
AER C.1	0.4960	3900.0000	17.000	2626

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
AER B.3	0.3
AER B.2	0.4
AER B.1	0.5
AER C.3	1.0
AER C.2	0.8
AER C.1	0.7

Element name	Average Air flow rate [ft3/min (20C, 1 atm)]
AER A.1 (1/2)	325.0
AER A.2	325.0
AER A.3	325.0

Aeration equipment parameters

Element name	k1 in C = k1(PC)^0.25 + k2	k2 in C = k1(PC)^0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	% of tank area covered by diffusers [%]
AER A.1 (1/2)	2.5656	0.0432	0.8200	0.2673	18.0000
AER A.2	2.5656	0.0432	0.8200	0.2673	18.0000
AER A.3	2.5656	0.0432	0.8200	0.2673	18.0000
AER B.3	2.5656	0.0432	0.8200	0.2673	18.0000
AER B.2	2.5656	0.0432	0.8200	0.2673	18.0000
AER B.1	2.5656	0.0432	0.8200	0.2673	18.0000
AER C.3	2.5656	0.0432	0.8200	0.2673	18.0000
AER C.2	2.5656	0.0432	0.8200	0.2673	18.0000
AER C.1	2.5656	0.0432	0.8200	0.2673	18.0000

Configuration information for all Effluent units

Configuration information for all Ideal clarifier units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]
Sec clarifier (14/18)	3.3972	4.620E+4	9.830

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Sec clarifier (14/18)	Ratio	0.54

Element name	Average Temperature	Reactive	Percent removal	Blanket fraction
Sec clarifier (14/18)	Uses global setting	No	99.55000	0.05000

Configuration information for all COD Influent units

Operating data Average (flow/time weighted as required)

Element name	RS	Brine
Time	0	0
Flow	17.9998901044325	1.65
TCOD mgCOD/L	685.00000	0
TKN mgN/L	53.00000	0
TP mgP/L	10.00000	0
NO3-N mgN/L	0	0
pH	7.60000	7.30000
Alk mmol/L	6.00000	6.00000
ISSinf mgISS/L	45.00000	0
SCa mg/L	80.00000	80.00000
SMg mg/L	15.00000	15.00000
DO mg/L	0	0

Element name	RS	Brine
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.1600	0.1600
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.1500	0.1500

Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	0.8500	0.7500
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.0500	0.0500
Fup - Unbiodegradable particulate [gCOD/g of total COD]	0.1300	0.1300
Fna - Ammonia [gNH3-N/gTKN]	0.6600	0.6600
Fnox - Particulate organic nitrogen [gN/g Organic N]	0.5000	0.5000
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0.0200	0.0200
FupN - N:COD ratio for unbiodegradable part. COD [gN/gCOD]	0.0350	0.0350
Fpo4 - Phosphate [gPO4-P/gTP]	0.5000	0.5000
FupP - P:COD ratio for unbiodegradable part. COD [gP/gCOD]	0.0110	0.0110
FZbh - OHO COD fraction [gCOD/g of total COD]	0.0200	0.0200
FZbm - Methylotroph COD fraction [gCOD/g of total COD]	1.000E-4	1.000E-4
FZaob - AOB COD fraction [gCOD/g of total COD]	1.000E-4	1.000E-4
FZnob - NOB COD fraction [gCOD/g of total COD]	1.000E-4	1.000E-4
FZaao - AAO COD fraction [gCOD/g of total COD]	1.000E-4	1.000E-4
FZbp - PAO COD fraction [gCOD/g of total COD]	1.000E-4	1.000E-4
FZbpa - Propionic acetogens COD fraction [gCOD/g of total COD]	1.000E-4	1.000E-4
FZbam - Acetoclastic methanogens COD fraction [gCOD/g of total COD]	1.000E-4	1.000E-4
FZbhm - H2-utilizing methanogens COD fraction [gCOD/g of total COD]	1.000E-4	1.000E-4
FZe - Endogenous products COD fraction [gCOD/g of total COD]	0	0

Configuration information for all Metal addition units

Operating data Average (flow/time weighted as required)

Element name	39% FeCl3
Zbh mgCOD/L	0
Zbmeth mgCOD/L	0
Zaob mgCOD/L	0
Znob mgCOD/L	0
Zaao mgCOD/L	0
Zbp mgCOD/L	0
Zbpa mgCOD/L	0
Zbam mgCOD/L	0
Zbhm mgCOD/L	0
Ze mgCOD/L	0
Xsp mgCOD/L	0
Xsc mgCOD/L	0
Xi mgCOD/L	0
Xon mgN/L	0
Xop mgP/L	0
Xin mgN/L	0
Xip mgP/L	0
Spha mgCOD/L	0
PP-lo mgP/L	0
PP-hi mgP/L	0
Sbsc mgCOD/L	0
Sbsa mgCOD/L	0
Sbsp mgCOD/L	0
Sbmeth mgCOD/L	0
SbH2 mgCOD/L	0
CH4 mg/L	0
NH3-N mgN/L	0
Nos mgN/L	0
N2O-N mgN/L	0
NO2-N mgN/L	0
NO3-N mgN/L	0
N2 mgN/L	0
PO4-P (incl. MeP) mgP/L	0
Sus mgCOD/L	0
Nus mgN/L	0
ISSinf mgISS/L	0
XStru mgISS/L	0
XHDP mgISS/L	0
XHAP mgISS/L	0
SMg mg/L	0

SCa mg/L	0
Me mg/L	190500.00000
SCat meq/L	5.00000
SAn meq/L	10252.71160
SCO2 mmol/L	7.00000
UD1 mg/L	0
UD2 mg/L	0
UD3 mgVSS/L	0
UD4 mgISS/L	0
DO mg/L	0
Flow	0.0009

Configuration information for all Ideal primary settling tank (old) units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]
Pri clarifier (3/4)	1.9434	2.598E+4	10.000

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Pri clarifier (3/4)	Fraction	0.05

Element name	Percent removal	Blanket fraction
Pri clarifier (3/4)	74.00000	0.10000

Configuration information for all Dewatering unit units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
DAFT (1/2)	Fraction	0.05
BFP	Fraction	0.14

Element name	Percent removal
DAFT (1/2)	95.00000
BFP	95.00000

Configuration information for all Sludge units

Configuration information for all Splitter units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification

TFE recycle splitter	Flowrate [Side]	11.6
WAS splitter	Flowrate [Side]	0.7188
BFP spray water splitter	Flowrate [Side]	1.5

Configuration information for all Trickling filter units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	Media area [ft2]
Biofilters (2/2)	3.0089	2.325E+4	17.300	1.086E+7

Element name	Specific area [ft2/ft3]	Specific volume [ft3/ft3]
Biofilters (2/2)	27	0.05

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint
Biofilters (2/2)	2.0

Aeration equipment parameters

Element name	Alpha (surf) OR Alpha F (diff) [-]	Beta [-]	Surface pressure [kPa]	Fractional effective saturation depth (Fed) [-]
Biofilters (2/2)	0.8500	0.9500	101.3250	0.3250

Element name	Supply gas CO2 content [vol. %]	Supply gas O2 [vol. %]	Off-gas CO2 [vol. %]	Off-gas O2 [vol. %]	Off-gas H2 [vol. %]	Off-gas NH3 [vol. %]	Off-gas CH4 [vol. %]	Surface turbulence factor [-]
Biofilters (2/2)	0.0350	20.9500	2.0000	18.8000	0	0	0	2.0000

BioWin Album

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Elements	Flow [mgd]	TSS [mgTSS/L]	VSS [mgVSS/L]	TCBOD [mg/L]	SCBOD [mg/L]	TKN [mgN/L]	NH3-N [mgN/L]	NOx [mgN/L]	TP [mgP/L]	PO4-P (incl. MeP) [mgP/L]	pH []	Alk [mmol/L]	Temp. [deg. C]
RS	17.99989	344.19243	298.29893	328.96570	124.28132	53.00000	34.98000	0	10.00000	5.00000	7.59997	6.00006	26.00000
RS mixer	19.64989	315.29061	273.25079	301.34247	113.84543	48.54959	32.04273	0	9.16030	4.58015	7.56228	5.99938	26.00000
Plant influent	22.93119	296.02930	253.44681	273.72505	102.21638	53.17057	37.43361	0.00195	11.19908	6.85819	7.39185	6.28903	26.00000
Pri clarifi	21.84969	86.50419	69.15784	149.01181	102.21237	46.32965	37.43214	0.00195	5.95599	4.77149	7.20048	6.03163	26.00000

er (3/4)													
TFE recycle splitter	21.84969	118.90456	100.25312	117.04596	45.81488	46.19281	38.89614	0.01560	5.95599	4.26925	7.00186	6.14256	26.00000
SE	19.63089	7.54448	5.95360	4.71338	1.14003	38.60772	35.86977	0.02050	2.90267	2.72969	7.05231	5.93529	26.00000

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Elements	TSS [lb TSS/d]	VSS [lb VSS/d]	ISSinf [lb ISS/d]	ISScell [lb ISS/d]	ISSprec [lb ISS/d]	ISStot [lb ISS/d]
RS	51703.33419	44809.37962	6759.73627	134.21830	0	6893.95457
	-	-	-	-	-	-
Pri clarifier (3/4) (U)	44895.04120	35891.57137	5539.77610	171.04538	3292.64836	9003.46983
Gravity thickener (1/2) (U)	41728.91977	33375.14665	5262.78729	147.18903	2943.79680	8353.77311
	-	-	-	-	-	-
WAS splitter (U)	18550.40367	14630.87884	1816.08766	1025.61475	1077.82241	3919.52483
DAFT (1/2) (U)	17622.90668	13899.33490	1725.28328	974.33402	1023.95449	3723.57178
	-	-	-	-	-	-
Digester feed mixer	59350.71592	47274.48155	6988.07057	1121.52304	3966.64076	12076.23437
Anaerobic digester (2/3)	33032.74056	21300.86550	6988.07057	592.60031	4151.20418	11731.87506
	-	-	-	-	-	-
Biosolids	31381.32400	20235.82222	6638.66704	562.97030	3943.86444	11145.50178

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Elements	TSS [lb TSS/d]	VSS [lb VSS/d]	TCBOD [lb /d]	TKN [lb N/d]	NH3-N [lb N/d]	TP [lb P/d]	SPO4 [lb P/d]
DAFT (1/2)	927.52140	731.54394	445.53848	282.79684	203.44435	43.08102	15.17513
BFP filtrate mixer	1745.64554	1139.57113	492.98051	1506.23788	1396.50586	514.22803	461.11340
	-	-	-	-	-	-	-
Total	2673.16695	1871.11507	938.51899	1789.03472	1599.95020	557.30905	476.28853
	-	-	-	-	-	-	-
RS	51703.33419	44809.37962	49416.03002	7961.46717	5254.56833	1502.16362	751.08181

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Elements	DO [mg/L]	OUR - Total [mgO/L/hr]	OUR - Nitrification [mgO/L/hr]	OTR [lb/hr]	Air flow rate [ft3/min (20C, 1 atm)]
AER A.1 (1/2)	0.02699	20.51424	0.01763	66.30016	325.00000
AER A.2	0.02850	16.01141	0.01860	66.28792	325.00000
AER A.3	0.07364	15.80373	0.04604	65.92197	325.00000
AER B.1	0.50000	17.47218	0.22661	73.44844	395.97710
AER B.2	0.40000	17.67317	0.19321	74.28032	395.18891
AER B.3	0.30000	18.03627	0.15542	77.21305	407.91526
AER C.1	0.70000	17.33566	0.28225	74.01496	412.73377
AER C.2	0.80000	16.75587	0.30737	70.48364	395.26051
AER C.3	1.00000	16.18817	0.34991	69.26551	400.08558
	-	-	-	-	-
Total	3.82914	155.79070	1.59704	637.21598	3382.16112

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Elements	Flow [mgd]	Flow [mgd]	TSS [mgTSS/L]	TSS [lb TSS/d]
RS	17.99989	-----	344.19243	51703.33419
SE	19.63089	-----	7.54448	1235.99490
	-	-	-	
Pri clarifier (3/4) (U)	1.08239	-----	4970.10329	44895.04120
Gravity thickener (1/2) (U)	0.10175	-----	49144.65935	41728.91977
	-	-	-	
WAS splitter (U)	0.71880	-----	3092.41600	18550.40367
DAFT (1/2) (U)	0.03917	-----	53904.56995	17622.90668
	-	-	-	
Digester feed mixer	0.14092	-----	50466.93399	59350.71592
	-	-	-	
Anaerobic digester (2/3)	0.14092	-----	28088.30714	33032.74056
	-	-	-	
Biosolids	0.01990	-----	188980.73122	31381.32400

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Elements	MeP (s) [mol/d]	MeOH3 (s) [mol/d]	MeH2PO4++ [mol/d]	Me+++ [mol/d]	PO4-P (incl. MeP) [lb P/d]
	-	-	-	-	-
Pri clarifier (3/4) (U)	5950.98887	0	0.27429	0.00000	442.39626
	-	-	-	-	-
WAS splitter (U)	1948.00917	0	0.37788	0.00000	149.07354
DAFT (1/2) (U)	1850.65063	0	0.01675	0.00000	127.24722
	-	-	-	-	-
Anaerobic digester (2/3)	7502.70517	0	2.30446	0.00000	1010.21248
	-	-	-	-	-
Biosolids	7127.96838	0	0.26730	0.00000	557.03566

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Elements	TSS [mgTSS/L]	VSS [mgVSS/L]
AER A.1 (1/2)	1105.77111	877.97160
AER A.2	1109.56961	881.38781
AER A.3	1109.07340	880.57377
AER B.1	1099.24707	869.81333
AER B.2	1102.69046	873.54688
AER B.3	1106.08177	877.24784
AER C.1	1095.82738	866.12342
AER C.2	1092.49317	862.55102
AER C.3	1089.25267	859.10597

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Elements	VSS destruction [%]	Off gas flow rate (dry) [ft3/min]	Off gas Methane [%]	Off gas Carbon dioxide [%]
Anaerobic digester (2/3)	54.94215	279.90329	64.03812	35.85033

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Elements	TSS [mgTSS/L]	VSS [mgVSS/L]	TCBOD [mg/L]	TKN [mgN/L]	NH3-N [mgN/L]	SPO4 [mgP/L]	VFA [mg/L]	pH []	Alk [mmol/L]
Pri clarifier (3/4) (U)	4970.10329	3973.37462	2791.01389	191.22031	37.43214	3.98874	15.87836	7.20048	9.22581
Gravity thickener (1/2) (U)	49144.65935	39306.31854	27078.96010	1534.02206	55.10152	42.86919	914.90795	5.09621	21.58204
	-	-	-	-	-	-	-	-	-
WAS splitter (U)	3092.41600	2439.01775	1465.03802	261.15282	35.86977	2.67607	0.03363	7.05231	7.61875
DAFT (1/2) (U)	53904.56995	42514.98823	25518.62797	3926.78191	35.86977	2.67556	0.03363	7.09029	19.01306
	-	-	-	-	-	-	-	-	-
Anaerobic digester (2/3)	28088.30714	18112.49210	6122.36273	2199.19101	938.12542	423.36179	105.70785	6.81758	110.36574
BFP (U)	188980.82091	121861.66780	40746.06119	9414.77042	938.12542	423.33579	105.70785	6.88711	205.39913
	-	-	-	-	-	-	-	-	-
Gravity thickener (1/2)	277.83045	222.58645	247.83011	51.90087	37.77552	3.89970	56.43157	6.95332	6.15795
DAFT (1/2)	163.53358	128.98031	78.55399	49.86061	35.86977	2.67556	0.03363	7.09029	6.07234
BFP	1635.33522	1054.52329	429.69130	1012.83818	938.12542	423.33579	105.70785	6.88711	60.11605
	-	-	-	-	-	-	-	-	-
Recycle stream mixer	180.64488	134.85166	108.33944	80.84310	69.71660	18.55936	20.78625	6.98744	8.02279

Global Parameters

Common

Name	Default	Value	
Hydrolysis rate [1/d]	2.1000	2.1000	1.0290
Hydrolysis half sat. [-]	0.0600	0.0600	1.0000
Anoxic hydrolysis factor [-]	0.2800	0.2800	1.0000
Anaerobic hydrolysis factor (AS) [-]	0.0400	0.0400	1.0000
Anaerobic hydrolysis factor (AD) [-]	0.5000	0.1800	1.0000
Adsorption rate of colloids [L/(mgCOD d)]	0.1500	0.1500	1.0290
Ammonification rate [L/(mgN d)]	0.0400	0.0400	1.0290
Assimilative nitrate/nitrite reduction rate [1/d]	0.5000	0.5000	1.0000
Endogenous products decay rate [1/d]	0	0	1.0000

AOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.9000	0.9000	1.0720
Substrate (NH4) half sat. [mgN/L]	0.7000	0.7000	1.0000
Byproduct NH4 logistic slope [-]	50.0000	50.0000	1.0000
Byproduct NH4 inflection point [mgN/L]	1.4000	1.4000	1.0000
AOB denite DO half sat. [mg/L]	0.1000	0.1000	1.0000
AOB denite HNO2 half sat. [mgN/L]	5.000E-6	5.000E-6	1.0000
Aerobic decay rate [1/d]	0.1700	0.1700	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0800	0.0800	1.0290
KiHNO2 [mmol/L]	0.0050	0.0050	1.0000

NOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.7000	0.7000	1.0600
Substrate (NO2) half sat. [mgN/L]	0.1000	0.1000	1.0000
Aerobic decay rate [1/d]	0.1700	0.1700	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0800	0.0800	1.0290
KiNH3 [mmol/L]	0.0750	0.0750	1.0000

AAO

Name	Default	Value	
Max. spec. growth rate [1/d]	0.2000	0.1000	1.1000
Substrate (NH4) half sat. [mgN/L]	2.0000	2.0000	1.0000
Substrate (NO2) half sat. [mgN/L]	1.0000	1.0000	1.0000
Aerobic decay rate [1/d]	0.0190	0.0190	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0095	0.0095	1.0290
Ki Nitrite [mgN/L]	1000.0000	1000.0000	1.0000
Nitrite sensitivity constant [L / (d mgN)]	0.0160	0.0160	1.0000

OHO

Name	Default	Value	
Max. spec. growth rate [1/d]	3.2000	3.2000	1.0290
Substrate half sat. [mgCOD/L]	5.0000	5.0000	1.0000
Anoxic growth factor [-]	0.5000	0.5000	1.0000
Denite N2 producers (NO3 or NO2) [-]	0.5000	0.5000	1.0000
Aerobic decay rate [1/d]	0.6200	0.6200	1.0290
Anoxic decay rate [1/d]	0.2330	0.2330	1.0290
Anaerobic decay rate [1/d]	0.1310	0.1310	1.0290
Fermentation rate [1/d]	1.6000	1.6000	1.0290
Fermentation half sat. [mgCOD/L]	5.0000	5.0000	1.0000
Fermentation growth factor (AS) [-]	0.2500	0.2500	1.0000
Free nitrous acid inhibition [mmol/L]	1.000E-7	1.000E-7	1.0000

Methylotrophs

Name	Default	Value	
Max. spec. growth rate [1/d]	1.3000	1.3000	1.0720
Methanol half sat. [mgCOD/L]	0.5000	0.5000	1.0000
Denite N2 producers (NO3 or NO2) [-]	0.5000	0.5000	1.0000
Aerobic decay rate [1/d]	0.0400	0.0400	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0300	0.0300	1.0000
Free nitrous acid inhibition [mmol/L]	1.000E-7	1.000E-7	1.0000

PAO

Name	Default	Value	
Max. spec. growth rate [1/d]	0.9500	0.9500	1.0000
Max. spec. growth rate, P-limited [1/d]	0.4200	0.4200	1.0000
Substrate half sat. [mgCOD(PHB)/mgCOD(Zbp)]	0.1000	0.1000	1.0000
Substrate half sat., P-limited [mgCOD(PHB)/mgCOD(Zbp)]	0.0500	0.0500	1.0000
Magnesium half sat. [mgMg/L]	0.1000	0.1000	1.0000
Cation half sat. [mmol/L]	0.1000	0.1000	1.0000
Calcium half sat. [mgCa/L]	0.1000	0.1000	1.0000

Aerobic/anoxic decay rate [1/d]	0.1000	0.1000	1.0000
Aerobic/anoxic maintenance rate [1/d]	0	0	1.0000
Anaerobic decay rate [1/d]	0.0400	0.0400	1.0000
Anaerobic maintenance rate [1/d]	0	0	1.0000
Sequestration rate [1/d]	4.5000	4.5000	1.0000
Anoxic growth factor [-]	0.3300	0.3300	1.0000

Acetogens

Name	Default	Value	
Max. spec. growth rate [1/d]	0.2500	0.2500	1.0290
Substrate half sat. [mgCOD/L]	10.0000	10.0000	1.0000
Acetate inhibition [mgCOD/L]	10000.0000	10000.0000	1.0000
Anaerobic decay rate [1/d]	0.0500	0.0500	1.0290
Aerobic/anoxic decay rate [1/d]	0.5200	0.5200	1.0290

Methanogens

Name	Default	Value	
Acetoclastic max. spec. growth rate [1/d]	0.3000	0.3000	1.0290
H2-utilizing max. spec. growth rate [1/d]	1.4000	1.4000	1.0290
Acetoclastic substrate half sat. [mgCOD/L]	100.0000	100.0000	1.0000
Acetoclastic methanol half sat. [mgCOD/L]	0.5000	0.5000	1.0000
H2-utilizing CO2 half sat. [mmol/L]	0.1000	0.1000	1.0000
H2-utilizing substrate half sat. [mgCOD/L]	0.1000	0.1000	1.0000
H2-utilizing methanol half sat. [mgCOD/L]	0.5000	0.5000	1.0000
Acetoclastic propionic inhibition [mgCOD/L]	10000.0000	10000.0000	1.0000
Acetoclastic anaerobic decay rate [1/d]	0.1300	0.1300	1.0290
Acetoclastic aerobic/anoxic decay rate [1/d]	0.6000	0.6000	1.0290
H2-utilizing anaerobic decay rate [1/d]	0.1300	0.1300	1.0290
H2-utilizing aerobic/anoxic decay rate [1/d]	2.8000	2.8000	1.0290

pH

Name	Default	Value
OHO low pH limit [-]	4.0000	4.0000
OHO high pH limit [-]	10.0000	10.0000
Methylotrophs low pH limit [-]	4.0000	4.0000
Methylotrophs high pH limit [-]	10.0000	10.0000
Autotrophs low pH limit [-]	5.5000	5.5000
Autotrophs high pH limit [-]	9.5000	9.5000
PAO low pH limit [-]	4.0000	4.0000
PAO high pH limit [-]	10.0000	10.0000
OHO low pH limit (anaerobic) [-]	5.5000	5.5000
OHO high pH limit (anaerobic) [-]	8.5000	8.5000
Propionic acetogens low pH limit [-]	4.0000	4.0000
Propionic acetogens high pH limit [-]	10.0000	10.0000
Acetoclastic methanogens low pH limit [-]	5.0000	5.0000
Acetoclastic methanogens high pH limit [-]	9.0000	9.0000
H2-utilizing methanogens low pH limit [-]	5.0000	5.0000
H2-utilizing methanogens high pH limit [-]	9.0000	9.0000

Switches

Name	Default	Value
Aerobic/anoxic DO half sat. [mgO2/L]	0.0500	0.0500
Anoxic/anaerobic NOx half sat. [mgN/L]	0.1500	0.1500

AOB DO half sat. [mgO2/L]	0.2500	1.0000
NOB DO half sat. [mgO2/L]	0.5000	0.5000
AAO DO half sat. [mgO2/L]	0.0100	0.0100
Anoxic NO3(->NO2) half sat. [mgN/L]	0.1000	0.1000
Anoxic NO3(->N2) half sat. [mgN/L]	0.0500	0.0500
Anoxic NO2(->N2) half sat. (mgN/L)	0.0100	0.0100
NH3 nutrient half sat. [mgN/L]	0.0050	0.0050
PolyP half sat. [mgP/mgCOD]	0.0100	0.0100
VFA sequestration half sat. [mgCOD/L]	5.0000	5.0000
P uptake half sat. [mgP/L]	0.1500	0.1500
P nutrient half sat. [mgP/L]	0.0010	0.0010
Autotroph CO2 half sat. [mmol/L]	0.1000	0.1000
H2 low/high half sat. [mgCOD/L]	1.0000	1.0000
Propionic acetogens H2 inhibition [mgCOD/L]	5.0000	5.0000
Synthesis anion/cation half sat. [meq/L]	0.0100	0.0100

Common

Name	Default	Value
Biomass volatile fraction (VSS/TSS)	0.9200	0.9200
Endogenous residue volatile fraction (VSS/TSS)	0.9200	0.9200
N in endogenous residue [mgN/mgCOD]	0.0700	0.0700
P in endogenous residue [mgP/mgCOD]	0.0220	0.0220
Endogenous residue COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Particulate substrate COD:VSS ratio [mgCOD/mgVSS]	1.6000	1.6000
Particulate inert COD:VSS ratio [mgCOD/mgVSS]	1.6000	1.6000

AOB

Name	Default	Value
Yield [mgCOD/mgN]	0.1500	0.1500
AOB denite NO2 fraction as TEA [-]	0.5000	0.5000
Byproduct NH4 fraction to N2O [-]	0.0025	0.0025
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

NOB

Name	Default	Value
Yield [mgCOD/mgN]	0.0900	0.0900
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

AAO

Name	Default	Value
Yield [mgCOD/mgN]	0.1140	0.1140
Nitrate production [mgN/mgBiomassCOD]	2.2800	2.2800
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

OHO

Name	Default	Value
Yield (aerobic) [-]	0.6660	0.6660
Yield (fermentation, low H2) [-]	0.1000	0.1000
Yield (fermentation, high H2) [-]	0.1000	0.1000
H2 yield (fermentation low H2) [-]	0.3500	0.3500
H2 yield (fermentation high H2) [-]	0	0
Propionate yield (fermentation, low H2) [-]	0	0
Propionate yield (fermentation, high H2) [-]	0.7000	0.7000
CO2 yield (fermentation, low H2) [-]	0.7000	0.7000
CO2 yield (fermentation, high H2) [-]	0	0
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Endogenous fraction - aerobic [-]	0.0800	0.0800
Endogenous fraction - anoxic [-]	0.1030	0.1030
Endogenous fraction - anaerobic [-]	0.1840	0.1840
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Yield (anoxic) [-]	0.5400	0.5400
Yield propionic (aerobic) [-]	0.6400	0.6400
Yield propionic (anoxic) [-]	0.4600	0.4600
Yield acetic (aerobic) [-]	0.6000	0.6000
Yield acetic (anoxic) [-]	0.4300	0.4300
Yield methanol (aerobic) [-]	0.5000	0.5000
Adsorp. max. [-]	1.0000	1.0000
Max fraction to N2O at high FNA over nitrate [-]	0.0500	0.0500
Max fraction to N2O at high FNA over nitrite [-]	0.1000	0.1000

Methylotrophs

Name	Default	Value
Yield (anoxic) [-]	0.4000	0.4000
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Max fraction to N2O at high FNA over nitrate [-]	0.1000	0.1000
Max fraction to N2O at high FNA over nitrite [-]	0.1500	0.1500

PAO

Name	Default	Value
Yield (aerobic) [-]	0.6390	0.6390
Yield (anoxic) [-]	0.5200	0.5200
Aerobic P/PHA uptake [mgP/mgCOD]	0.9300	0.9300
Anoxic P/PHA uptake [mgP/mgCOD]	0.3500	0.3500
Yield of PHA on sequestration [-]	0.8890	0.8890
N in biomass [mgN/mgCOD]	0.0700	0.0700
N in sol. inert [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous part. [-]	0.2500	0.2500
Inert fraction of endogenous sol. [-]	0.2000	0.2000
P/Ac release ratio [mgP/mgCOD]	0.5100	0.5100
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Yield of low PP [-]	0.9400	0.9400

Acetogens

Name	Default	Value
Yield [-]	0.1000	0.1000
H2 yield [-]	0.4000	0.4000
CO2 yield [-]	1.0000	1.0000
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Methanogens

Name	Default	Value
Acetoclastic yield [-]	0.1000	0.1000
Methanol acetoclastic yield [-]	0.1000	0.1000
H2-utilizing yield [-]	0.1000	0.1000
Methanol H2-utilizing yield [-]	0.1000	0.1000
N in acetoclastic biomass [mgN/mgCOD]	0.0700	0.0700
N in H2-utilizing biomass [mgN/mgCOD]	0.0700	0.0700
P in acetoclastic biomass [mgP/mgCOD]	0.0220	0.0220
P in H2-utilizing biomass [mgP/mgCOD]	0.0220	0.0220
Acetoclastic fraction to endog. residue [-]	0.0800	0.0800
H2-utilizing fraction to endog. residue [-]	0.0800	0.0800
Acetoclastic COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
H2-utilizing COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

General

Name	Default	Value
Molecular weight of other anions [mg/mmol]	35.5000	35.5000
Molecular weight of other cations [mg/mmol]	39.1000	39.1000
Mg to P mole ratio in polyphosphate [mmolMg/mmolP]	0.3000	0.3000
Cation to P mole ratio in polyphosphate [meq/mmolP]	0.1500	0.1500
Ca to P mole ratio in polyphosphate [mmolCa/mmolP]	0.0500	0.0500
Cation to P mole ratio in organic phosphate [meq/mmolP]	0.0100	0.0100
Bubble rise velocity (anaerobic digester) [cm/s]	23.9000	23.9000
Bubble Sauter mean diameter (anaerobic digester) [cm]	0.3500	0.3500
Anaerobic digester gas hold-up factor []	1.0000	1.0000
Tank head loss per metre of length (from flow) [m/m]	0.0025	0.0025

Mass transfer

Name	Default	Value	
Kl for H2 [m/d]	17.0000	17.0000	1.0240
Kl for CO2 [m/d]	10.0000	10.0000	1.0240
Kl for NH3 [m/d]	1.0000	1.0000	1.0240
Kl for CH4 [m/d]	8.0000	8.0000	1.0240
Kl for N2 [m/d]	15.0000	15.0000	1.0240
Kl for N2O [m/d]	8.0000	8.0000	1.0240
Kl for O2 [m/d]	13.0000	13.0000	1.0240

Henry's law constants

Name	Default	Value	
CO2 [M/atm]	3.4000E-2	3.4000E-2	2400.0000
O2 [M/atm]	1.3000E-3	1.3000E-3	1500.0000
N2 [M/atm]	6.5000E-4	6.5000E-4	1300.0000
N2O [M/atm]	2.5000E-2	2.5000E-2	2600.0000

NH3 [M/atm]	5.8000E+1	5.8000E+1	4100.0000
CH4 [M/atm]	1.4000E-3	1.4000E-3	1600.0000
H2 [M/atm]	7.8000E-4	7.8000E-4	500.0000

Physico-chemical rates

Name	Default	Value	
Struvite precipitation rate [1/d]	3.000E+10	3.000E+10	1.0240
Struvite redissolution rate [1/d]	3.000E+11	3.000E+11	1.0240
Struvite half sat. [mgTSS/L]	1.0000	1.0000	1.0000
HDP precipitation rate [L/(molP d)]	1.000E+8	1.000E+8	1.0000
HDP redissolution rate [L/(mol P d)]	1.000E+8	1.000E+8	1.0000
HAP precipitation rate [molHDP/(L d)]	5.000E-4	5.000E-4	1.0000

Physico-chemical constants

Name	Default	Value
Struvite solubility constant [mol/L]	6.918E-14	6.918E-14
HDP solubility product [mol/L]	2.750E-22	2.750E-22
HDP half sat. [mgTSS/L]	1.0000	1.0000
Equilibrium soluble PO4 with Al dosing at pH 7 [mgP/L]	0.0100	0.0100
Al to P ratio [molAl/molP]	0.8000	0.8000
Al(OH)3 solubility product [mol/L]	1.259E+9	1.259E+9
AlHPO4+ dissociation constant [mol/L]	7.943E-13	7.943E-13
Equilibrium soluble PO4 with Fe dosing at pH 7 [mgP/L]	0.0100	0.0100
Fe to P ratio [molFe/molP]	1.6000	1.6000
Fe(OH)3 solubility product [mol/L]	0.0500	0.0500
FeH2PO4++ dissociation constant [mol/L]	5.012E-22	5.012E-22

Aeration

Name	Default	Value
Alpha (surf) OR Alpha F (diff) [-]	0.5000	0.4000
Beta [-]	0.9500	0.9500
Surface pressure [kPa]	101.3250	101.3250
Fractional effective saturation depth (Fed) [-]	0.3250	0.3250
Supply gas CO2 content [vol. %]	0.0350	0.0350
Supply gas O2 [vol. %]	20.9500	20.9500
Off-gas CO2 [vol. %]	2.0000	2.0000
Off-gas O2 [vol. %]	18.8000	18.8000
Off-gas H2 [vol. %]	0	0
Off-gas NH3 [vol. %]	0	0
Off-gas CH4 [vol. %]	0	0
Surface turbulence factor [-]	2.0000	2.0000
Set point controller gain []	1.0000	1.0000

Modified Vesilind

Name	Default	Value
Maximum Vesilind settling velocity (Vo) [ft/min]	0.387	0.387
Vesilind hindered zone settling parameter (K) [L/g]	0.370	0.370
Clarification switching function [mg/L]	100.000	100.000
Specified TSS conc.for height calc. [mg/L]	2500.000	2500.000
Maximum compactability constant [mg/L]	15000.000	15000.000

Double exponential

Name	Default	Value
Maximum Vesilind settling velocity (Vo) [ft/min]	0.934	0.934
Maximum (practical) settling velocity (Vo') [ft/min]	0.615	0.615
Hindered zone settling parameter (Kh) [L/g]	0.400	0.400
Flocculent zone settling parameter (Kf) [L/g]	2.500	2.500
Maximum non-settleable TSS [mg/L]	20.0000	20.0000
Non-settleable fraction [-]	0.0010	0.0010
Specified TSS conc. for height calc. [mg/L]	2500.0000	2500.0000

Emission factors

Name	Default	Value
Carbon dioxide equivalence of nitrous oxide	296.0000	296.0000
Carbon dioxide equivalence of methane	23.0000	23.0000

Biofilm general

Name	Default	Value	
Attachment rate [g / (m2 d)]	80.0000	80.0000	1.0000
Attachment TSS half sat. [mg/L]	100.0000	100.0000	1.0000
Detachment rate [g/(m3 d)]	8.000E+4	8.000E+4	1.0000
Solids movement factor []	10.0000	10.0000	1.0000
Diffusion neta []	0.8000	0.8000	1.0000
Thin film limit [mm]	0.5000	0.5000	1.0000
Thick film limit [mm]	3.0000	3.0000	1.0000
Assumed Film thickness for tank volume correction (temp independent) [mm]	0.7500	0.7500	1.0000
Film surface area to media area ratio - Max.[ ]	1.0000	1.0000	1.0000
Minimum biofilm conc. for streamer formation [gTSS/m2]	4.0000	4.0000	1.0000

Maximum biofilm concentrations [mg/L]

Name	Default	Value	
Zbh	5.000E+4	5.000E+4	1.0000
Zbmeth	5.000E+4	5.000E+4	1.0000
Zaob	1.000E+5	1.000E+5	1.0000
Znob	1.000E+5	1.000E+5	1.0000
Zaao	5.000E+4	5.000E+4	1.0000
Zbp	5.000E+4	5.000E+4	1.0000
Zbpa	5.000E+4	5.000E+4	1.0000
Zbam	5.000E+4	5.000E+4	1.0000
Zbhm	5.000E+4	5.000E+4	1.0000
Ze	3.000E+4	3.000E+4	1.0000
Xsp	5000.0000	5000.0000	1.0000
Xsc	4000.0000	4000.0000	1.0000
Xi	5000.0000	5000.0000	1.0000
Xon	0	0	1.0000
Xop	0	0	1.0000
Xin	0	0	1.0000
Xip	0	0	1.0000
Spha	5000.0000	5000.0000	1.0000
PP-lo	1.150E+6	1.150E+6	1.0000
PP-hi	1.150E+6	1.150E+6	1.0000
Sbsc	0	0	1.0000
Sbsa	0	0	1.0000
Sbsp	0	0	1.0000
Sbmeth	0	0	1.0000
SbH2	0	0	1.0000
CH4	0	0	1.0000

NH3-N	0	0	1.0000
Nos	0	0	1.0000
N2O-N	0	0	1.0000
NO2-N	0	0	1.0000
NO3-N	0	0	1.0000
N2	0	0	1.0000
PO4-P (incl. MeP)	1.000E+10	1.000E+10	1.0000
Sus	0	0	1.0000
Nus	0	0	1.0000
ISSinf	1.300E+6	1.300E+6	1.0000
XStru	8.500E+5	8.500E+5	1.0000
XHDP	1.150E+6	1.150E+6	1.0000
XHAP	1.600E+6	1.600E+6	1.0000
SMg	0	0	1.0000
SCa	0	0	1.0000
Me	1.000E+10	1.000E+10	1.0000
SCat	0	0	1.0000
SAn	0	0	1.0000
SCO2	0	0	1.0000
UD1	0	0	1.0000
UD2	0	0	1.0000
UD3	5.000E+4	5.000E+4	1.0000
UD4	5.000E+4	5.000E+4	1.0000
DO	0	0	1.0000

Effective diffusivities [m2/s]

Name	Default	Value	
Zbh	5.000E-14	5.000E-14	1.0290
Zbmeth	5.000E-14	5.000E-14	1.0290
Zaob	5.000E-14	5.000E-14	1.0290
Znob	5.000E-14	5.000E-14	1.0290
Zaao	5.000E-14	5.000E-14	1.0290
Zbp	5.000E-14	5.000E-14	1.0290
Zbpa	5.000E-14	5.000E-14	1.0290
Zbam	5.000E-14	5.000E-14	1.0290
Zbhm	5.000E-14	5.000E-14	1.0290
Ze	5.000E-14	5.000E-14	1.0290
Xsp	5.000E-14	5.000E-14	1.0290
Xsc	5.000E-12	5.000E-12	1.0290
Xi	5.000E-14	5.000E-14	1.0290
Xon	5.000E-14	5.000E-14	1.0290
Xop	5.000E-14	5.000E-14	1.0290
Xin	5.000E-14	5.000E-14	1.0290
Xip	5.000E-14	5.000E-14	1.0290
Spha	5.000E-14	5.000E-14	1.0290
PP-lo	5.000E-14	5.000E-14	1.0290
PP-hi	5.000E-14	5.000E-14	1.0290
Sbsc	6.900E-10	6.900E-10	1.0290
Sbsa	1.240E-9	1.240E-9	1.0290
Sbsp	8.300E-10	8.300E-10	1.0290
Sbmeth	1.600E-9	1.600E-9	1.0290
SbH2	5.850E-9	5.850E-9	1.0290
CH4	1.963E-9	1.963E-9	1.0290
NH3-N	2.000E-9	2.000E-9	1.0290
Nos	1.370E-9	1.370E-9	1.0290
N2O-N	1.607E-9	1.607E-9	1.0290
NO2-N	2.980E-9	2.980E-9	1.0290
NO3-N	2.980E-9	2.980E-9	1.0290
N2	1.900E-9	1.900E-9	1.0290
PO4-P (incl. MeP)	2.000E-9	2.000E-9	1.0290
Sus	6.900E-10	6.900E-10	1.0290
Nus	6.850E-10	6.850E-10	1.0290
ISSinf	5.000E-14	5.000E-14	1.0290
XStru	5.000E-14	5.000E-14	1.0290
XHDP	5.000E-14	5.000E-14	1.0290
XHAP	5.000E-14	5.000E-14	1.0290

SMg	7.200E-10	7.200E-10	1.0290
SCa	7.200E-10	7.200E-10	1.0290
Me	4.800E-10	4.800E-10	1.0290
SCat	1.440E-9	1.440E-9	1.0290
SAn	1.440E-9	1.440E-9	1.0290
SCO2	1.960E-9	1.960E-9	1.0290
UD1	6.900E-10	6.900E-10	1.0290
UD2	6.900E-10	6.900E-10	1.0290
UD3	5.000E-14	5.000E-14	1.0290
UD4	5.000E-14	5.000E-14	1.0290
DO	2.500E-9	2.500E-9	1.0290

EPS Strength coefficients [ ]

Name	Default	Value	
Zbh	1.0000	1.0000	1.0000
Zbmeth	1.0000	1.0000	1.0000
Zaob	5.0000	5.0000	1.0000
Znob	25.0000	25.0000	1.0000
Zaao	10.0000	10.0000	1.0000
Zbp	1.0000	1.0000	1.0000
Zbpa	1.0000	1.0000	1.0000
Zbam	1.0000	1.0000	1.0000
Zbhm	1.0000	1.0000	1.0000
Ze	1.0000	1.0000	1.0000
Xsp	1.0000	1.0000	1.0000
Xsc	1.0000	1.0000	1.0000
Xi	1.0000	1.0000	1.0000
Xon	1.0000	1.0000	1.0000
Xop	1.0000	1.0000	1.0000
Xin	1.0000	1.0000	1.0000
Xip	1.0000	1.0000	1.0000
Spha	1.0000	1.0000	1.0000
PP-lo	1.0000	1.0000	1.0000
PP-hi	1.0000	1.0000	1.0000
Sbsc	0	0	1.0000
Sbsa	0	0	1.0000
Sbsp	0	0	1.0000
Sbmeth	0	0	1.0000
SbH2	0	0	1.0000
CH4	0	0	1.0000
NH3-N	0	0	1.0000
Nos	0	0	1.0000
N2O-N	0	0	1.0000
NO2-N	0	0	1.0000
NO3-N	0	0	1.0000
N2	0	0	1.0000
PO4-P (incl. MeP)	1.0000	1.0000	1.0000
Sus	0	0	1.0000
Nus	0	0	1.0000
ISSinf	0.3300	0.3300	1.0000
XStru	1.0000	1.0000	1.0000
XHDP	1.0000	1.0000	1.0000
XHAP	1.0000	1.0000	1.0000
SMg	0	0	1.0000
SCa	0	0	1.0000
Me	1.0000	1.0000	1.0000
SCat	0	0	1.0000
SAn	0	0	1.0000
SCO2	0	0	1.0000
UD1	0	0	1.0000
UD2	0	0	1.0000
UD3	1.0000	1.0000	1.0000
UD4	1.0000	1.0000	1.0000
DO	0	0	1.0000