City of San José

San José/Santa Clara Water Pollution Control Plant Master Plan

TASK NO. 3
PROJECT MEMORANDUM NO. 5
CAPACITY RATING OF EXISTING FACILITIES

FINAL DRAFT
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in association with

2700 YGNACIO VALLEY ROAD • SUITE 300 • WALNUT CREEK, CALIFORNIA 94598 • (925) 932-1710 • FAX (925) 930-0208

CITY OF SAN JOSÉ

SAN JOSÉ/SANTA CLARA WATER POLLUTION CONTROL PLANT MASTER PLAN

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CAPACITY RATING OF EXISTING FACILITIES

1.0 INTRODUCTION

The purpose of this project memorandum (PM) is to summarize the capacity rating of the existing facilities at the San José/Santa Clara Water Pollution Control Plant (WPCP) for the San José/Santa Clara Water Pollution Control Plant Master Plan (Master Plan). This PM describes full capacity (all units in service) and reliable capacity (standby units out of service) for treatment process and hydraulic conveyance for each of the major treatment processes based upon the reliability and design criteria developed in PM 3.4.

The significance of the capacity rating is that the rated capacities of existing facilities and future flow and loading projections are taken into account to determine future capacity needs. Required future capacities and the reliability and design criteria are utilized to size, cost, and evaluate treatment process alternatives identified in the Master Plan. Therefore, the capacity rating of existing facilities is a key component of this Master Plan.

The capacity rating analyses include developing two distinct design capacities:

1. **Hydraulic Capacity** - the maximum flow capacity of a unit process that does not result in flooding or overflowing.
2. **Treatment Process Capacity** - the maximum flow capacity of a unit process that meets required National Pollutant Discharge Elimination System (NPDES) permit effluent limitations.

2.0 BACKGROUND

The treatment plant was originally designed for a capacity of 167 million gallons per day (mgd) average dry weather influent flow (ADWIF). ADWIF is defined in the current NPDES permit as the maximum of the average daily flow over any five-weekday period between the months of June and October. The design peak hour wet weather flow (PHWWF), according to the NPDES permit, is 271 mgd.

2.1 Influent Characteristics

The treatment process capacity of unit processes for this analysis is based on current influent wastewater characteristics. Current wastewater flows are represented by the 2010 flow projections without additional water conservation (refer to PM 3.8). Current loadings are represented by the medium loading scenario in PM 3.8 for 2010.

The flow projections, summarized in PM 3.8, predict PHWWF values much higher than the original design, and the peaking factor (ratio of peak to average flows) is also much higher.

At the end of the planning period (2040), the flow projections without any additional water conservation result in an ADWIF of 182 mgd and a PHWWF of 449 mgd. This PM will address both PHWWF capacity and ADWIF capacity.

The flow and loading projections in PM 3.8 represent the influent flow from the interceptors and do not include contributions from recycle streams returned to the headworks. Recycle streams have averaged approximately three percent of plant influent flow during the last five years. Since very limited data were available about the concentrations in these streams, they are assumed to be three percent of the influent flow and have the same concentrations as the influent flow.

The capacities presented in this PM are adjusted to reflect only the flow from the interceptors (not including recycle flows). For flows less than average day max month flow (ADMMF), a 3 percent adjustment for in-plant recycle flows will be made. For flows greater than ADMMF, a constant 6 mgd will be made. Therefore, capacities less than the 2040 projected ADMMF of 195 mgd are reduced by 3 percent, and capacities greater than 195 mgd are reduced by a constant 6 mgd. For example, while a process might be able to convey a total of 400 mgd, the capacity is only 394 mgd to account for recycle streams.

2.2 Effluent Requirements

Treatment capacity is based on meeting the current NPDES permit requirements, as described in PM 4.1.

2.3 Plant Mass Balance

A key step in the plant's treatment capacity evaluation was the calculation of plant mass balances based on plant data and process calculations. Two significant discrepancies were observed during the analysis. Consequently, simplifying assumptions were made to allow the process evaluation to proceed. These assumptions have a significant impact on the rated capacity of plant processes. The discrepancies are described below.

A mass balance around primary treatment showed that the recorded primary sludge mass was approximately 35 percent less than the mass based on primary influent and the weighted BNR influent. Based on an agreement with City staff (January 7, 2009 discussion with D. Ihrke, B. Yerrapotu, and A. Ekster), the primary sludge mass for the master planning evaluation is calculated based on primary influent and the weighted BNR influent. (See PM 3.3 for additional detail regarding the primary sludge discrepancy.) It is recommended that this discrepancy in primary sludge mass balance be resolved in the immediate future.

Recorded waste activated sludge measurements were 20 to 30 percent higher than the BioWin process model predictions based on typical secondary influent characteristics. Conservatively, City staff agreed to use the BioWin model predictions of waste activated sludge production, based on a finding by City staff that the existing waste activated sludge flow meters are inaccurate (April 20, 2009 personal communication with A. Ekster).

3.0 CAPACITY RATING ANALYSIS

A treatment process and hydraulic capacity evaluation (where applicable) for each existing major unit process at the WPCP is presented in the following sections.

3.1 Approach

Capacities are based on current influent wastewater characteristics, as described previously. Full capacity assumes all treatment units in service. Reliable capacity is based on the reliability criteria in PM 3.4. The number of units out of service (OOS) is shown for each process.

3.1.1 <u>Hydraulic Capacity Rating</u>

The hydraulic capacity identifies the PHWWF that liquid process facilities can handle without overtopping structures or submerging critical weirs. Although a facility may have sufficient hydraulic capacity for a given PHWWF, there may not be sufficient treatment process capacity for the same flow. Treatment process capacity at PHWWF for liquid stream facilities was determined as part of the treatment process capacity rating.

The PHWWF hydraulic capacity is based on the reliable capacity as defined in the Hydraulic and Bottleneck Summary Report (Malcolm Pirnie, 2001). In general, those definitions for reliable capacity are similar to the definitions for this Master Plan as those summarized in PM 3.4. The Malcolm Pirnie report did not show full capacities, i.e., with all units in service. For the purposes of this PM, all hydraulic capacities will be reported as reliable capacities.

3.1.2 <u>Treatment Capacity Rating</u>

The treatment capacities for preliminary treatment, primary treatment, filtration, disinfection, and solids handling facilities are based upon the design criteria in PM 3.4. The treatment capacity for secondary treatment is based on the criteria described in Section 3.5 of this PM. While these design criteria reflect acceptable industry standards, they do not take into account plant-specific characteristics that can impact capacity. The capacity ratings presented in this PM should be viewed as estimates suitable for master planning, rather than as precise predictions of process capacity.

Treatment process capacities are presented for PHWWF and ADWIF conditions for liquid stream facilities. Because the treatment process capacities for solids stream facilities are not impacted by the PHWWF, their capacities are presented only for ADWIF conditions. Since treatment process capacity criteria are not typically based on ADWIF conditions, but rather on ADMMF conditions, ADMMF capacities are converted to an equivalent ADWIF capacity. This was calculated by dividing the ADMMF by 1.06, which represents the plant’s historical ADMMF/ADWIF peaking factor (see PM 3.8).

3.2 Preliminary Treatment

Table 1 summarizes the preliminary treatment criteria and reliable treatment capacities for both Headworks 1 and 2. An equivalent ADWIF process capacity is not presented for the preliminary treatment facilities because sizing criteria for these facilities are based on PHWWF conditions, and not ADMMF or ADWIF conditions.

Table 1 Preliminary Treatment Capacity
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José

	Headworks 1	Headworks 2	Total
Criteria			
Units out of service			
Bar Screens	1 unit OOS	All in service	
Grit Removal(1)	All in service	All in service	
Raw Sewage Pump Station	1 unit OOS	1 unit OOS	
Capacity Criteria			
Bar Screens	3 fps at PHWWF	3 fps at PHWWF	
Grit Removal(1)	33,900 gpd/sf at PHWWF	148,000 gpd/sf at PHWWF	
Hydraulic and Treatment Process Capacity, PHWWF, mgd(2)			
Bar Screens	282	237	
Grit Removal	237(3)	198	
Raw Sewage Pump Station	335	157(3)	
Headworks capacity			394

Note:
(1) Aerator and detritor in Headworks 1. Vortex grit removal in Headworks 2.
(2) 6 mgd recycle stream divided equally between Headworks 1 and Headworks 2.
(3) Limits capacity.

3.3 Primary Treatment

Table 2 summarizes the primary treatment criteria and reliable and full capacities. Note that while the PHWWF treatment process capacity ranges from 399 to 436 mgd, the overall PHWWF capacity is limited to 374 mgd due to hydraulic limitations. The equivalent ADWIF full and reliable treatment process capacities are 244 and 223 mgd, respectively.

3.4 Flow Equalization

The plant has two flow equalization basins: a raw sewage equalization basin with a volume of 8 million gallons (MG), and a primary equalization basin with a volume of 16 MG. The raw sewage equalization basin is unlined and designed for emergency use only. It will likely need to be lined before it can be used on a more regular basis. The primary effluent equalization basin is lined and is in regular use to dampen diurnal fluctuations.

Table 2	Primary Treatment Capacity San José/Santa Clara Water Pollution Control Plant Master Plan City of San José	
	Full Capacity	**Reliable Capacity**
Criteria		
Units out of service	All in service	2 units OOS (1 east and 1 west)
Capacity Criteria	2,500 gpd/sf at PHWWF 1,500 gpd/sf at ADMMF	2,500 gpd/sf at PHWWF 1,500 gpd/sf at ADMMF
Hydraulic Capacity, PHWWF, mgd		374
Treatment Process Capacity, mgd		
PHWWF	436	399
ADMMF	259	237
Equivalent ADWIF	244	223

Diverting flow to the two equalization basins during peak flow events has a direct impact on whether the capacities of the various unit processes are sufficient to meet future projected flows. While this will be further analyzed as part of the treatment alternatives assessment in PMs 5.1 and 5.2, it has a direct bearing on the capacity of the secondary treatment process, which forms part of the current evaluation. For this analysis, it is assumed that all 24 MG of storage is available for flow equalization.

Since the planning period (2040) PHWWF is projected to be 449 mgd, a flow equalization analysis was conducted to estimate the equalized PHWWF possible with the existing 24 MG. A PHWWF hydrograph was generated for 2040 from plant influent records, and a residual PHWWF was calculated by subtracting a volume of 24 MG.

The approach followed was to first isolate the rainfall dependent flow from the February 3, 1998 flow hydrograph. Plant staff and the project team agreed that this storm event represented the worst-case wet weather scenario for the plant. To isolate the rainfall dependent flow, an average ADWF unit flow hydrograph was developed for 1998 using hourly flow data from 10 days between May 1 and October 31 (the period over which the ADWF is defined) for which daily average flows were closest to the ADWF in 1998.

Figure A-1 in Appendix A shows the unit hydrographs for each of the 10 selected days, and the average unit hydrograph. Developing an average unit hydrograph from 10 unit hydrographs aims to minimize possible abnormal peaks or flow patterns that could be inherent to a particular day.

This average ADWF unit hydrograph was then multiplied by the 1998 ADWF to obtain the 1998 ADWF hydrograph. The rainfall dependent flow was isolated by subtracting the 1998 ADWF hydrograph from the February 3, 1998 hydrograph.

The 2040 ADWF projected hydrograph was developed by multiplying the 1998 average ADWF unit flow hydrograph by the projected 2040 ADWF. The new curve now represented the ADWF hydrograph for 2040. The rainfall dependant flow hydrograph was superimposed on this 2040 ADWF hydrograph, and shifted as necessary, to generate the 2040 PHWWF hydrograph with a PHWWF of 449 mgd. This information is summarized in Table A-1, Appendix A. The 2040 PHWWF hydrograph is shown in Figure A-2 in Appendix A.

With the 2040 PHWWF hydrograph defined, the first step was to deduct the 8 MG of storage capacity of the raw equalization basin (See Table A-1). The new hydrograph shows the peak reduced from 449 mgd to 400 mgd, which would be the peak entering the headworks. Since the plant recycle flows are added at the headworks, approximately 6 mgd was added to this hydrograph (which is 3 percent of the ADMMF). This is the hydrograph to preliminary and primary treatment before equalization at the primary effluent equalization basin. After this second equalization step, the peak was reduced to 356 mgd, which is the maximum flow to the secondary treatment and other downstream processes.

3.5 Secondary Treatment

A detailed process model, BioWin, was used to determine secondary treatment capacity and predict waste activated sludge production for use in the solids treatment capacity evaluation. Some of the limitations of the BioWin model are discussed below, while a more detailed description of the modeling effort is provided in Appendix B.

A Level 2 BioWin calibration based on historical data was used (WERF, 2003). A typical level 2 calibration only provides a rough calibration for the model. The accuracy of the results is reduced because of several discrepancies between the model and data.

For the calibration months, the recorded BOD removal in the primary clarifiers was much higher than predicted by BioWin for typical wastewater characteristics and the measured TSS removal. To resolve this discrepancy, standard BioWin primary effluent characteristics were assumed, and the primary clarifiers were not modeled. Typical primary clarifier removals for BOD (42 percent) and TSS (61 percent) based on historical removals at ADWF (see PM 3.3) were assumed for the capacity evaluation.

In addition, simulated waste activated sludge production was 20 to 30 percent lower than the recorded values. As discussed previously, the decision was made to use the BioWin projections.

If incorrect, these assumptions could have an impact on treatment process capacities. Additional data collection to improve the BioWin calibration could be used to verify the modeling assumptions and is recommended before detailed design.

A 5-day aerobic solids retention time was assumed for secondary treatment to ensure sufficient nitrification. The capacity was determined from multiple BioWin runs for a range of influent ADMMF (and load) conditions. Linear interpolation established the ADMMF capacity, which was the flow condition that resulted in the limiting mixed liquor solids concentration determined from the state point analysis for peak hour conditions. The peak hour flow was assumed to occur during the maximum month influent loading. State point analysis on a poor settling sludge (90th percentile SVI of 114 milliliters per gram [mL/g]) at peak hour flow was used to determine the maximum mixed liquor suspended solids concentration allowable without causing clarifier overload.

Combining these results gives the secondary treatment capacity. The capacity is conservative, since peak hour flow is assumed to occur during the maximum month loading with a poor settling sludge.

Capacity of the aeration systems was not evaluated. It was assumed that improvements to the diffusers and blowers are likely during the planning period, so capacity was based on the amount of available basins.

3.5.1 BNR Mode

The plant currently operates in BNR (Biological Nutrient Removal) mode. The first and third quads of each aeration basin are unaerated (50 percent of the tank volume). Return activated sludge (RAS) is routed to the first quad, while primary effluent is split 60 percent to the first quad and 40 percent to the third quad. In this mode, the plant removes phosphorus biologically, nitrifies, and partially denitrifies. Further optimization of the process to maintain the treatment performance and increase capacity will be evaluated with future alternatives.

The plant currently operates with equalization ahead of secondary treatment. The Malcolm Pirnie report recommended that flow equalization be used to limit the PHWWF to secondary treatment to 300 mgd. Because the total clarifier areas for BNRs 1 and 2 are similar, it was assumed that during PHWWF periods, flow would be split evenly between BNRs 1 and 2.

Table 3 shows the capacity for BNR mode in the current configuration with all units in service, including all RAS pumps in BNR 2. With one BNR 2 RAS pump out of service, clarifier capacity is significantly less. Although the combined hydraulic capacity of BNR 1 and 2 is 358 mgd, when operating in BNR mode with all process units in service, the PHWWF capacity is limited by the process to 300 mgd. The equivalent ADWIF treatment capacity is 173 mgd.

It is important to note that this capacity will be lower if the PHWWF is larger than 300 mgd. As shown in Section 3.4 of this PM, the current combined equalization capacity of 24 MG will likely reduce the projected 2040 PHWWF to 356 mgd, i.e., significantly more equalization capacity will be required by 2040 to keep the PHWWF at 300 mgd.

Table 3	**Secondary Treatment Capacity in BNR Mode (Full) San José/Santa Clara Water Pollution Control Plant Master Plan City of San José**				
	Settled Sewage Pump Station	**BNR 1**	**Primary Effluent Pump Station**	**BNR 2**	**Total**
Criteria					
Units out of service					
Pumps	1 unit OOS		1 unit OOS		
Aeration Basins		All in service		All in service	
Secondary Clarifiers		All in service		All in service	
Hydraulic Capacity, PHWWF, mgd					
Treatment Process Capacity, mgd					
PHWWF(1)		150		150	300
ADMMF(2)		118		68	186
Equivalent ADWIF(2)		110		63	173

Notes:
(1) PHWWF is the equalized flow to secondary treatment including recycle streams.
(2) ADMMF (and equivalent ADWIF) capacities are reduced to account for recycle streams.

Table 4 shows the reliable capacity in BNR mode. PM 3.4 showed reliability criteria of one aeration basin out of service and one clarifier each in BNR 1 and BNR 2. Based on discussions with plant staff, these criteria were revised to reflect their experience with number of units out of service, which is more conservative. Table 4 assumes one clarifier out of service in BNR 2. In BNR 1, two large clarifiers were assumed to be out of service. Based on the treatment area, two large clarifiers out of service is equivalent to four small clarifiers out of service. The reliable capacity in BNR mode is 300 mgd at PHWWF and an equivalent ADWIF treatment capacity of 147 mgd. As mentioned above, additional equalization capacity will be required before 2040 to keep the PHWWF at 300 mgd, otherwise the ADWIF treatment capacity should be reduced.

3.5.2 Nitrification Mode

The plant has the capability to operate in nitrification mode. Since the plant is not required to denitrify or remove phosphorus, operating in nitrification mode is an acceptable method of meeting permit requirements and results in an increased capacity rating. In nitrification mode, the first quad of each aeration basin is unaerated to improve sludge settlability (25 percent of the tank volume). RAS and primary effluent are routed to the first quad.

Table 4	**Secondary Treatment Capacity in BNR Mode (Reliable) San José/Santa Clara Water Pollution Control Plant Master Plan City of San José**				
	Settled Sewage Pump Station	**BNR 1**	**Primary Effluent Pump Station**	**BNR 2**	**Total**
Criteria					
Units out of service					
Pumps	1 OOS		1 OOS		
Aeration Basins		1 OOS		All in service	
Secondary Clarifiers		2 large (or 4 small) OOS		1 OOS	
Hydraulic Capacity, PHWWF, mgd(2)	204(1)	213	154(1)	198	358
Treatment Process Capacity, mgd					
PHWWF(2)		150		150	300
ADMMF(3)		103		55	158
Equivalent ADWIF(3)		96		51	147

Notes:
(1) Limits hydraulic capacity.
(2) PHWWF is the equalized flow to secondary treatment including recycle streams.
(3) ADMMF (and equivalent ADWIF) capacities are reduced to account for recycle streams.

The plant currently operates with equalization ahead of secondary treatment. As discussed in Section 3.4, analyses show that the existing equalization volume will limit the projected 2040 PHWWF of 449 mgd to 356 mgd, including recycle streams.

During PHWWF periods, flow would be split between BNRs 1 and 2 according to the SSPS and PEPS pumping capacities. Table 5 shows the capacity for nitrification mode in the current configuration with all units in service, including all RAS pumps in BNR 2. In nitrification mode with all process units in service, the PHWWF capacity is 356 mgd and the equivalent ADWIF treatment capacity is 204 mgd.

Table 6 shows the reliable capacity in nitrification mode. The reliability criteria used are the same as for BNR mode, namely one clarifier out of service in BNR 2, and two large clarifiers out of service in BNR 1 (equivalent to four small clarifiers out of service). The reliable capacity in nitrification mode is 356 mgd at PHWWF and an equivalent ADWIF treatment capacity of 169 mgd.

The ADMMF reliable capacity (shown in Table 6) is lower than the ADMMF full capacity (shown in Table 5) because the MLSS level that can be sustained at peak hour during max month flow and load conditions is less, due to the lower aeration volume and clarifier surface area available under reliable conditions.

**Table 5 Secondary Treatment Capacity in Nitrification Mode (Full)
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José**

	Settled Sewage Pump Station	BNR 1	Primary Effluent Pump Station	BNR 2	Total
Criteria					
Units out of service					
Pumps	1 OOS		1 OOS		
Aeration Basins		All in service		All in service	
Secondary Clarifiers		All in service		All in service	
Hydraulic Capacity, PHWWF, mgd					
Treatment Process Capacity, mgd					
PHWWF(1)		202		154	356
ADMMF(2)		131		87	218
Equivalent ADWIF(2)		122		81	204

Notes:
(1) PHWWF is the equalized flow to secondary treatment including recycle streams.
(2) ADMMF (and equivalent ADWIF) capacities are reduced to account for recycle streams.

**Table 6 Secondary Treatment Capacity in Nitrification Mode (Reliable)
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José**

	Settled Sewage Pump Station	BNR 1	Primary Effluent Pump Station	BNR 2	Total
Criteria					
Units out of service					
Pumps	1 OOS		1 OOS		
Aeration Basins		1 OOS		All in service	
Secondary Clarifiers		2 large (or 4 small) OOS		1 OOS	
Hydraulic Capacity, PHWWF, mgd(2)	204(1)	213	154(1)	198	358
Treatment Process Capacity, mgd					
PHWWF(2)		202		154	356
ADMMF(3)		113		69	182
Equivalent ADWIF(3)		105		64	169

Notes:
(1) Limits hydraulic capacity.
(2) PHWWF is the equalized flow to secondary treatment including recycle streams.
(3) ADMMF (and equivalent ADWIF) capacities are reduced to account for recycle streams.

3.5.3 Secondary Treatment Summary

Table 7 summarizes the secondary treatment capacity for both the BNR and nitrification modes of operation. In addition, the loading capacities are shown. Loading is the critical parameter for determining the maximum month mixed liquor concentration. If water conservation increases beyond current levels, the loadings will increase faster than the flows. Capacity with additional water conservation should be based on the loadings shown in Table 7.

Table 7 Secondary Treatment Summary
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José

	BNR Mode		Nitrification Mode	
	Full Capacity	Reliable Capacity	Full Capacity	Reliable Capacity
PHWWF Capacity, mgd[1]		300		356
Treatment Process Capacity, mgd				
Equivalent ADWIF Capacity, mgd	173	147	204	169
BOD ADWL, lb/day	415,000	353,000	488,000	406,000
Ammonia-N ADWL, lb/day	33,000	28,000	39,000	32,000

Note:
(1) PHWWF is the equalized flow to secondary treatment including recycle streams. Reported value is lower of hydraulic capacity or PHWWF process capacity.

3.5.4 Comparison With Previous Capacity Rating

As shown in Section 2 of this PM, the original design was rated at a capacity of 167 mgd ADWIF at a PHWWF of 271 mgd. Under that capacity rating, the secondary treatment process was operating as a single plant system, i.e., BNR1 and BNR2 were operated in series, and were named Secondary and Nitrification respectively, based on their treatment functions. Plant operation has since been changed to a two-plant system, i.e., Secondary and Nitrification both receive primary effluent and are operated in parallel. The names of these two biological treatment systems were changed to BNR1 and BNR2 to reflect this change.

This represents an increase of approximately 22 percent over the original capacity rating, somewhat low considering the switch from series to parallel operation. The explanation of this apparent discrepancy lies in the significant increase in the PHWWF/ADWIF ratio over time. The PHWWF/ADWIF ratio for the original design was 1.62 (271 mgd/167 mgd), while the currently projected ratio is 2.20 (449 mgd/204 mgd).

The secondary treatment process is sized to accommodate the PHWWF. In the parallel mode of operation, the PHWWF capacity of the plant is 449 mgd, which represents a significant increase over the 271 mgd PHWWF rating of the original design in series operation. However, because of the higher PHWWF/ADWIF ratio, when converted to an equivalent ADWIF rating of 204 mgd, the increase does not appear as significant.

3.6 Filtration

The hydraulic capacity of the filtration system is 300 mgd based on having one unit out of service for backwashing. Theoretical treatment process capacities are typically based on ADMMF loading rates. Wastewater treatment plants typically operate at a filter loading rate of between 5.0 and 7.5 gallons per minute per square foot (gpm/sf). A loading rate of 5.0 gpm/sf is the current upper limit set by the Department of Public Health (DPH) for reuse. The DPH has allowed higher filtration loading rates for Title 22 reuse water, e.g., 7.5 gpm/sf for the Monterey Regional Water Pollution Control Agency (MRWPCA), but this is handled on a case-by-case basis.

Filtration performance can vary greatly from installation to installation, however, due to differences in filter media, suspended solids characteristics and TSS concentrations in the secondary effluent to the filters, etc. Therefore, to allow for these site-specific considerations, it is appropriate to have plant operating data form the basis of the filter capacity rating instead.

Filter operating data for 1998 through 2007, presented in Figure C-1 in Appendix C, show flow rates typically between 120 and 140 mgd. Over this period, the average ADMMF with sixteen filters in operation was 135 mgd, and 129 mgd with fifteen filters in operation. Historically, filter run times range from 16 hours to 20 hours (July 30, 2009 personal communication with A. Ekster).

Higher filtration flow rates can be accommodated if the run times were shortened. However, since it takes 30 minutes to backwash a filter (consisting of two cells), it will take at least 7.5 hours to backwash fifteen filters. Therefore, the minimum filter run time that will ensure continuous rotation of all sixteen filters is 7.5 hours. The ratio of the historical 16-hour run times to the minimum 7.5-hour run times is applied to the observed average flow rates to yield the ADMMF filter capacities of 288 mgd (full) and 275 mgd (reliable). These capacities translate to filter loading rates of approximately 10.5 gpm/sf for bay discharge filtration, and 7.5 gpm/sf for Title 22 reuse.

The associated full and reliable ADWIF treatment process capacities are 271 mgd and 259 mgd. These capacities are summarized in Tables 8 and 9.

It is important to note that the operating capacities of the filters are likely to fluctuate as the secondary effluent characteristics fluctuate. During a storm event, for instance, the TSS concentrations are likely to increase. In addition, the particle distribution is likely to change, both of which could adversely affect the filter capacity.

An additional evaluation was conducted to determine whether the backwash system, which includes the backwash pumps, equalization tank, and flocculation/sedimentation basin, could be capacity limiting. That analysis showed that even under the extreme backwashing condition of 18 minutes backwashing per filter (June 10, 2009 personal communication with

Table 8	Filtration Capacity (Full) San José/Santa Clara Water Pollution Control Plant Master Plan City of San José		
	Filter Influent Pump Station	**Supplemental Filter Influent Pump Station**	**Filters**
Criteria			
Units out of service	1 unit OOS	1 unit OOS	1 unit OOS (backwash)
Capacity Criteria			Operational Data
Hydraulic Capacity, mgd			
Treatment Process Capacity, mgd			
ADMMF			288
Equivalent ADWIF			271

Table 9	Filtration Capacity (Reliable) San José/Santa Clara Water Pollution Control Plant Master Plan City of San José		
	Filter Influent Pump Station	**Supplemental Filter Influent Pump Station**	**Filters**
Criteria			
Units out of service	1 unit OOS	1 unit OOS	1 unit OOS (backwash) + 1 unit OOS
Capacity Criteria			Operational Data
Hydraulic Capacity, mgd(1)	280	50	300
Treatment Process Capacity, mgd			
ADMMF			275
Equivalent ADWIF			259

Note:
(1) PHWWF is equalized flow, including recycle.

R. Liu and filter operating staff) the backwash system would have sufficient capacity. A detailed explanation is provided in Appendix C.

3.7 Disinfection

Tables 10 and 11 summarize the disinfection criteria and capacities. The PHWWF capacity is 288 mgd and the equivalent ADWIF full capacity is 186 mgd. The reuse capacity includes the detention time in the discharge pipe to the recycled water pump station. The reliable ADWIF capacity with one tank out of service is 137 mgd.

Table 10	**Disinfection Capacity (Full) San José/Santa Clara Water Pollution Control Plant Master Plan City of San José**		
	Discharge (75 percent), Tanks 1-3	**Reuse (25 percent), Tank 4**	**Total**
Criteria			
Units out of service	All in service	All in service	
Capacity Criteria	30 minutes (theoretical) at PHWWF 40 minutes at ADMMF	30 minutes (theoretical) at PHWWF 120 minutes at ADMMF	
Hydraulic Capacity, PHWWF, mgd			
Treatment Process Capacity, mgd			
PHWWF Process capacity, mgd(2)	216(1)	72(1)	288(1)
ADMMF	157	41	198
Equivalent ADWIF	148	38	186

Notes:
(1) Limits PHWWF capacity.
(2) PHWWF is equalized flow.

Table 11	**Disinfection Capacity (Reliable) San José/Santa Clara Water Pollution Control Plant Master Plan City of San José**		
	Discharge (75 percent), Tanks 1-3	**Reuse (25 percent), Tank 4**	**Total**
Criteria			
Units out of service	All in service at PHWWF, One unit out of service at ADWF	All in service	
Capacity Criteria	30 minutes (theoretical) at PHWWF 40 minutes at ADMMF	30 minutes (theoretical) at PHWWF 120 minutes at ADMMF	
Hydraulic Capacity, PHWWF, mgd(2)	231	77	308
Treatment Process Capacity (reliable), mgd			
PHWWF Process capacity, mgd(2)	216(1)	72(1)	288(1)
ADMMF	105	41	145
Equivalent ADWIF	99	38	137

Notes:
(1) Limits PHWWF capacity.
(2) PHWWF is equalized flow.

3.8 Solids Handling

The capacity of the existing SJ/SC WPCP solids handling facilities was determined using projected peak month primary sludge and the waste activated sludge production determined from the process modeling for BNR mode. Process modeling is described in Appendix B, and the projected solids loadings are shown in Appendix D.

The reliable capacity of each unit process was determined by comparing projected solids and hydraulic loadings against corresponding design criteria, assuming one or more process units were out of service (in accordance with reliability criteria in PM 3.4). Process capacity is defined as the plant influent flow rate at which any design criterion is exceeded. The capacity of any unit process is the point at which the projected solids or hydraulic loading exceeds any given capacity criterion. For those processes with multiple criteria, the capacity is based on the point at which any of the loadings exceeds the capacity criteria.

3.8.1 Solids Thickening

Waste activated sludge (WAS) from the BNR 1 and BNR 2 systems is thickened using dissolved air flotation thickeners (DAFTs). Primary sludge is thickened separately in the primary clarifiers.

Capacity of the existing DAFTs was determined assuming 3 tanks were out of service, as discussed in PM 3.4. This corresponds to approximately 80 percent of the tanks in service. PM 3.4 cites solids loading and hydraulic loading capacity criteria of 9.6 lb/sf-day and 0.5 gpm/sf at ADAL conditions. Corresponding capacity criteria for ADMML conditions are 16.8 lb/sf-day and 0.8 gpm/sf.

Table 12 shows the capacity of the existing DAFTs. The DAFT hydraulic load depends on the WAS concentration in addition to the projected WAS production. Hydraulic loading rates correspond to a WAS concentration of 7,310 mg/L, the average performance described in PM 3.3. Appendix B shows results for a range of WAS concentrations.

The existing DAFTs, with some upgrades, could be used for co-thickening primary and waste activated sludge. This would allow for continuous primary sludge pumping. Design criteria for this alternate configuration were not presented in PM 3.4. Typically, the maximum solids loading rate with co-thickening is approximately double that for WAS thickening only. Accordingly, DAFT solids loading and hydraulic loading capacity criteria of 33.6 lb/sf-day and 0.8 gpm/sf at ADMML conditions were used for co-thickening evaluation. The hydraulic loading rate was calculated assuming a primary sludge flow rate approximately four times current flow rates to represent more frequent pumping.

Subordinate systems, such as the DAFT dissolution system, were not included in this capacity analysis. DAFT performance depends on the ratio of dissolved air to feed solids, in addition to solids and hydraulic loading rates considered above. The capacity of the dissolution system should be verified, especially if co-thickening is considered for future DAFT operation.

Table 12 DAFT Capacity
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José

	WAS Only	**Co-thickening**
Criteria		
Units out of service	3 units OOS	3 units OOS
Solids Loading Criteria	16.8 lb/sf/day solids loading at ADMML	33.6 lb/sf/day solids loading at ADMML
	9.6 lb/sf/day solids loading at ADAL	
Hydraulic Loading Criteria	0.8 gpm/sf at ADMML	0.8 gpm/sf at ADMML
	0.5 gpm/sf/day at ADAL	
Treatment Process Capacity, mgd		
Equivalent ADWIF	276(1)	225(1)

Note:
(1) DAFT capacity for WAS only or for co-thickening is limited by ADMML solids loading conditions.

3.8.2 Solids Digestion

The thickened primary sludge and thickened WAS are stabilized using anaerobic digestion. Capacity of the existing digesters was determined assuming 3 digesters (one of the smaller digesters and two of the larger digesters) were out of service, as discussed in PM 3.4. This corresponds to approximately 80 percent of the digesters in service. PM 3.4 cites solids loading and hydraulic loading capacity criteria of 0.15 lb VS/cf-day and a hydraulic residence time of 15 days for ADMML conditions (see Table 13).

Table 13 Digester Capacity
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José

	Without FOG	**With FOG**
Criteria		
Units out of service	1 small units OOS and 2 large units OOS	1 small units OOS and 2 large units OOS
Solids Loading Criteria	0.15 lb/cf-day volatile solids loading at ADMML	0.15 lb/cf-day volatile solids loading at ADMML
Hydraulic Loading Criteria	15 days hydraulic residence time at ADMML	15 days hydraulic residence time at ADMML
Treatment Process Capacity, mgd		
Equivalent ADWIF	221(1)	219(1)

Note:
(1) Digester capacity is limited by ADMML hydraulic residence time. Solids loading criteria are not exceeded during the planning period.

Two scenarios were evaluated - one with FOG production and one without. Initial FOG production is based on projected scum production within the plant (as presented in TM 3.3 from the FOG Evaluation, Digester Rehabilitation, and Gas Line Replacement Project). FOG production is assumed to increase linearly to the projected design amount presented in TM 3.3 of the Digester Rehabilitation Project as increasing amounts of FOG are trucked to the plant.

The hydraulic loading rates correspond to a primary sludge concentration of 3.9 percent TS, DAFT solids capture of 88.3 percent, and thickened WAS concentrations of 4.0 percent - typical performance described in PM 3.3. Appendix D shows results for a range of WAS concentrations and captures.

3.8.3 Sludge Storage and Solids Drying

The residual solids management (RSM) facilities include 29 active sludge lagoons and 20 drying beds. The lagoons and drying beds are operated on a four-year cycle to provide additional pathogen inactivation and produce a Class A air-dried sludge. The lagoons are divided into four blocks. Within any 12-month period, one block of lagoons receives anaerobically-digested sludge, two blocks of lagoons are inactive, and one block is dredged and prepared for loading the following year. The dredged sludge is air dried before reuse/disposal.

The capacity criterion for the sludge storage lagoons was determined based on the lowest total volume of the four blocks of lagoons, 158.4 MG, and an average sidewater depth of 10 feet. The maximum quantity of digested sludge that could be stored was calculated assuming a sludge depth of eight feet (i.e., two feet of water over the sludge) and a solids concentration varying from 4 percent at the top of the sludge layer to 8 percent at the bottom. The corresponding maximum digested sludge storage capacity is 71.4 million lb/year.

The sludge loading rates correspond to digester volatile solids reduction of 55 percent. (see Table 14).

4.0 SUMMARY & CONCLUSIONS

Table 15 shows capacities with standby components both in and out of service, as well as for different flow and load conditions. Figure 1 shows the PHWWF capacity for the liquid treatment processes. The lower value establishes the overall PHWWF capacity.

The current design PHWWF of 271 mgd, as well as the projected 2040 PHWWF of 449 mgd and 2040 Equalized PHWWF (with recycle) of 356 mgd, are shown to provide comparison.

Table 14	Storage Lagoon Capacity San José/Santa Clara Water Pollution Control Plant Master Plan City of San José	
	Without FOG	**With FOG**
Capacity Criteria	71.4 million lb/yr	71.4 million lb/yr
Treatment Process Capacity, mgd		
Equivalent ADWIF	157	155

Table 15	Capacity Summary San José/Santa Clara Water Pollution Control Plant Master Plan City of San José		
	Hydraulic or Process Capacity, PHWWF, mgd	**Treatment Process Capacity (Full), Equivalent ADWIF, mgd**	**Treatment Process Capacity (Reliable), Equivalent ADWIF, mgd**
Headworks	394(1)		
Primary Treatment	374(1)	244	223
Secondary Treatment			
BNR Mode	300(2)	173(1)	147(1)
Nitrification Mode	356(2)	204	169(1)
Filtration	300(2)	271	259
Disinfection	288(1,2)	186	137(1)
Solids			
Thickening			
WAS only			276
Co-thickening			225
Digestion			221(1)
Digestion with Scum/Grease and FOG			219(1)
Lagoons			157(1)
Lagoons with Scum/Grease and FOG			155(1)

Notes:

(1) Based on flow and loading projections, current capacity is exceeded before the end of the planning period (2040).

(2) Maximum flow to secondary, filtration and disinfection system limited to 300 mgd if additional equalization provided. Existing equalization volume will limit maximum flow to 356 mgd.

Figure 2 shows the full and reliable ADWIF capacity for liquid treatment processes. Figure 3 shows the full and reliable ADWIF capacity for the solids treatment processes. On both these figures, the capacities can be compared to the current design ADWIF of 167 mgd, and 2040 projected ADWIF of 182 mgd.

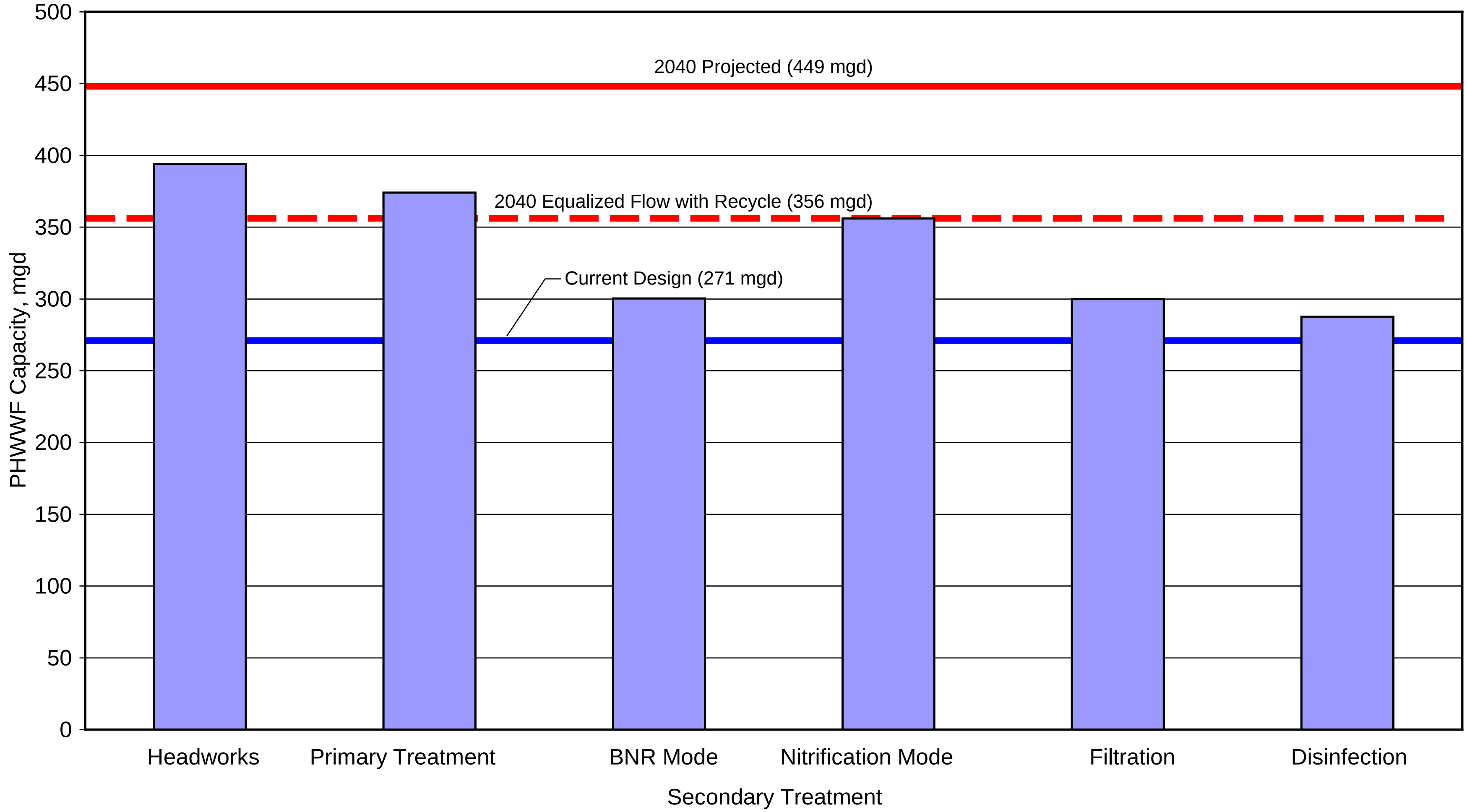

Figure 1
PHWWF CAPACITY RATING SUMMARY FOR LIQUID PROCESSES
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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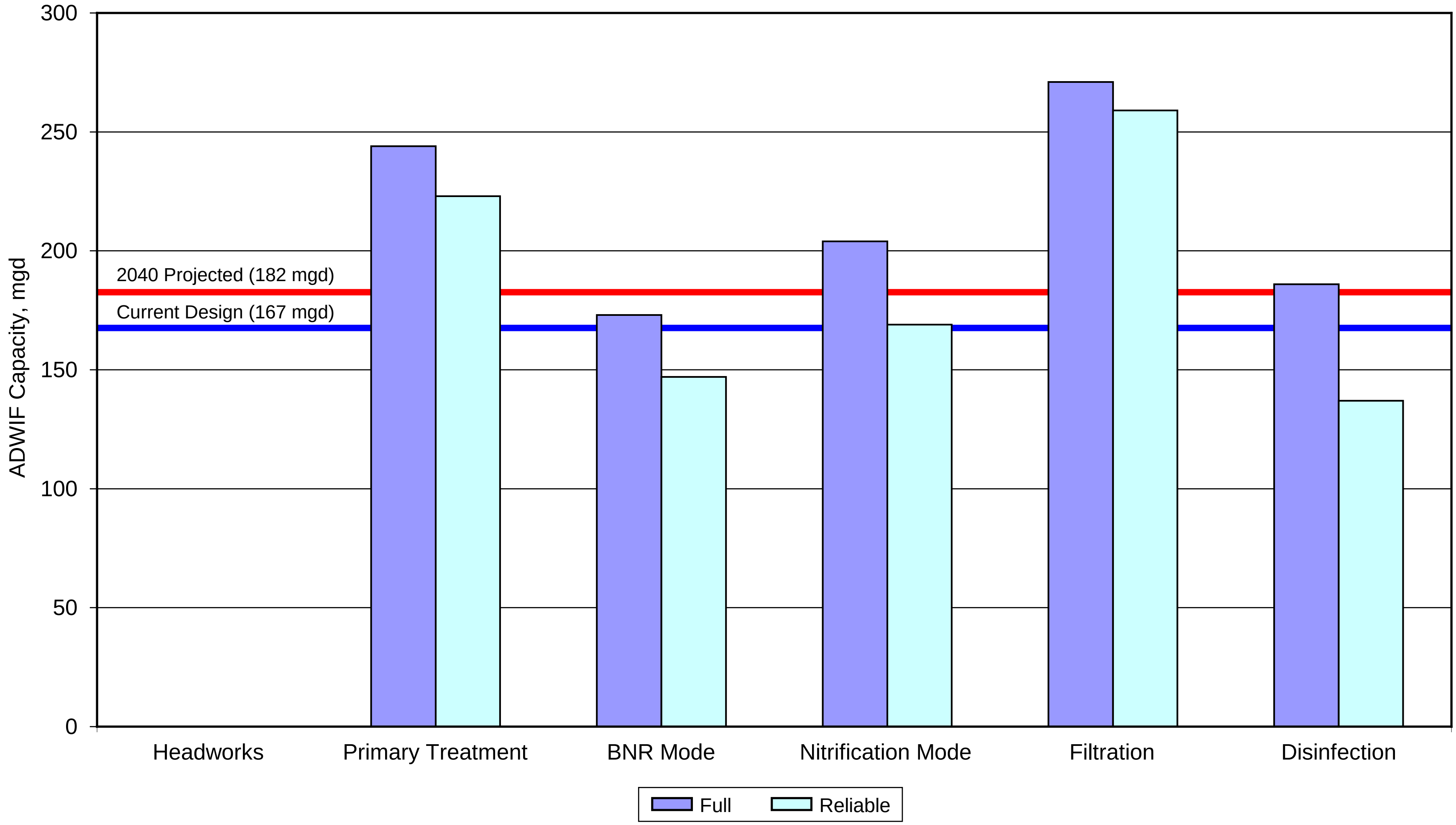

Figure 2
EQUIVALENT ADWIF CAPACITY RATING SUMMARY FOR LIQUID PROCESSES
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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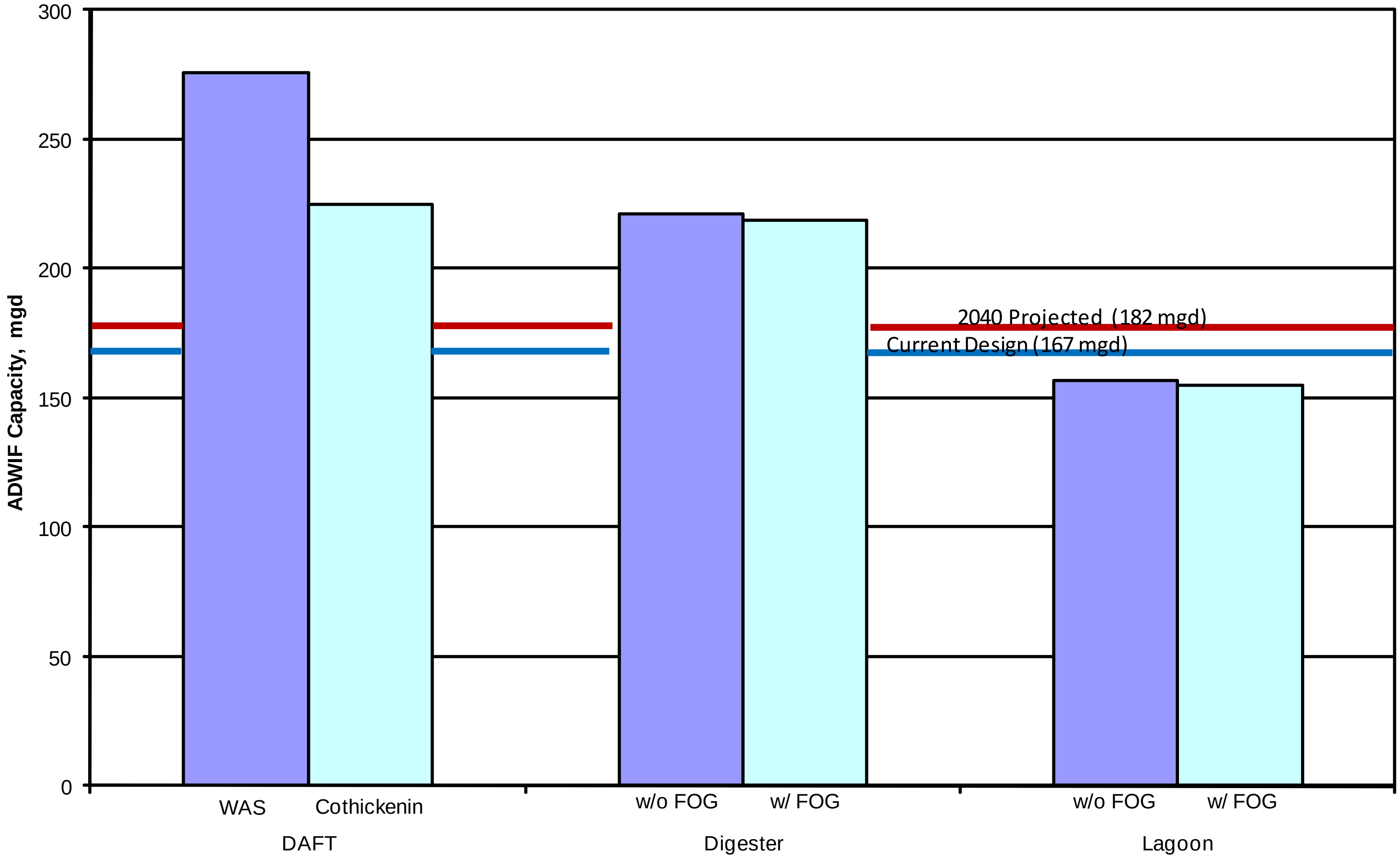

Figure 3
EQUIVALENT ADWIF CAPACITY RATING SUMMARY FOR SOLIDS PROCESSES
SAN JOSE/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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REFERENCES

REFERENCES

1. January 7, 2009 personal communication with D. Ihrke, B. Yerrapotu, and A. Ekster.
2. April 20, 2009 personal communication with A. Ekster.
3. Malcom Pirnie, 2001. Hydraulic and Bottleneck Summary Report.
4. WERF, 2003. Methods for Wastewater Characterization in Activated Sludge Modeling.
5. July 30, 2009 personal communication with A. Ekster.
6. June 10, 2009 personal communication with R. Liu and O. Madrigal.

APPENDIX A - FLOW EQUALIZATION DETAILS

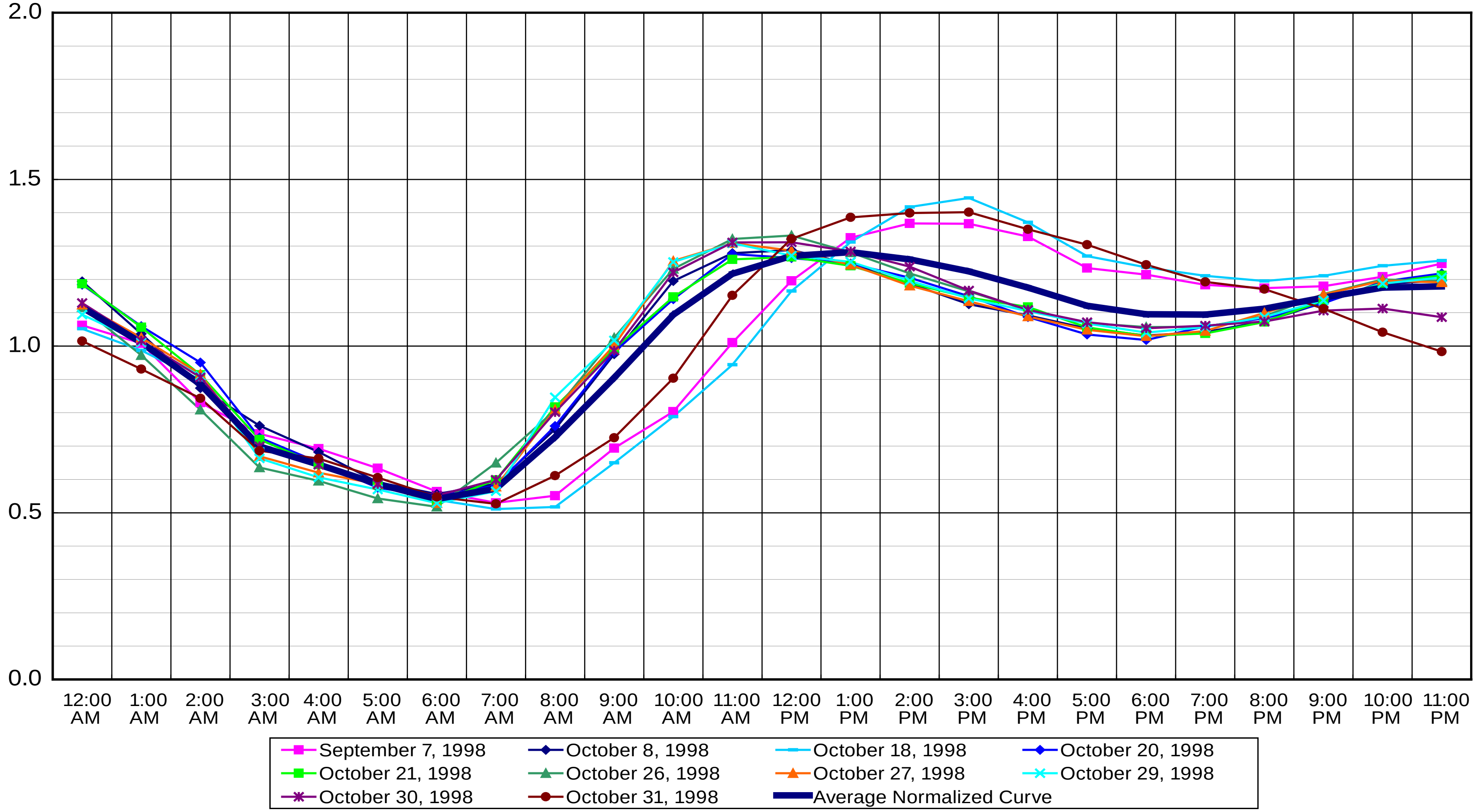

Figure A-1
1998 ADWF UNIT HYDROGRAPHS
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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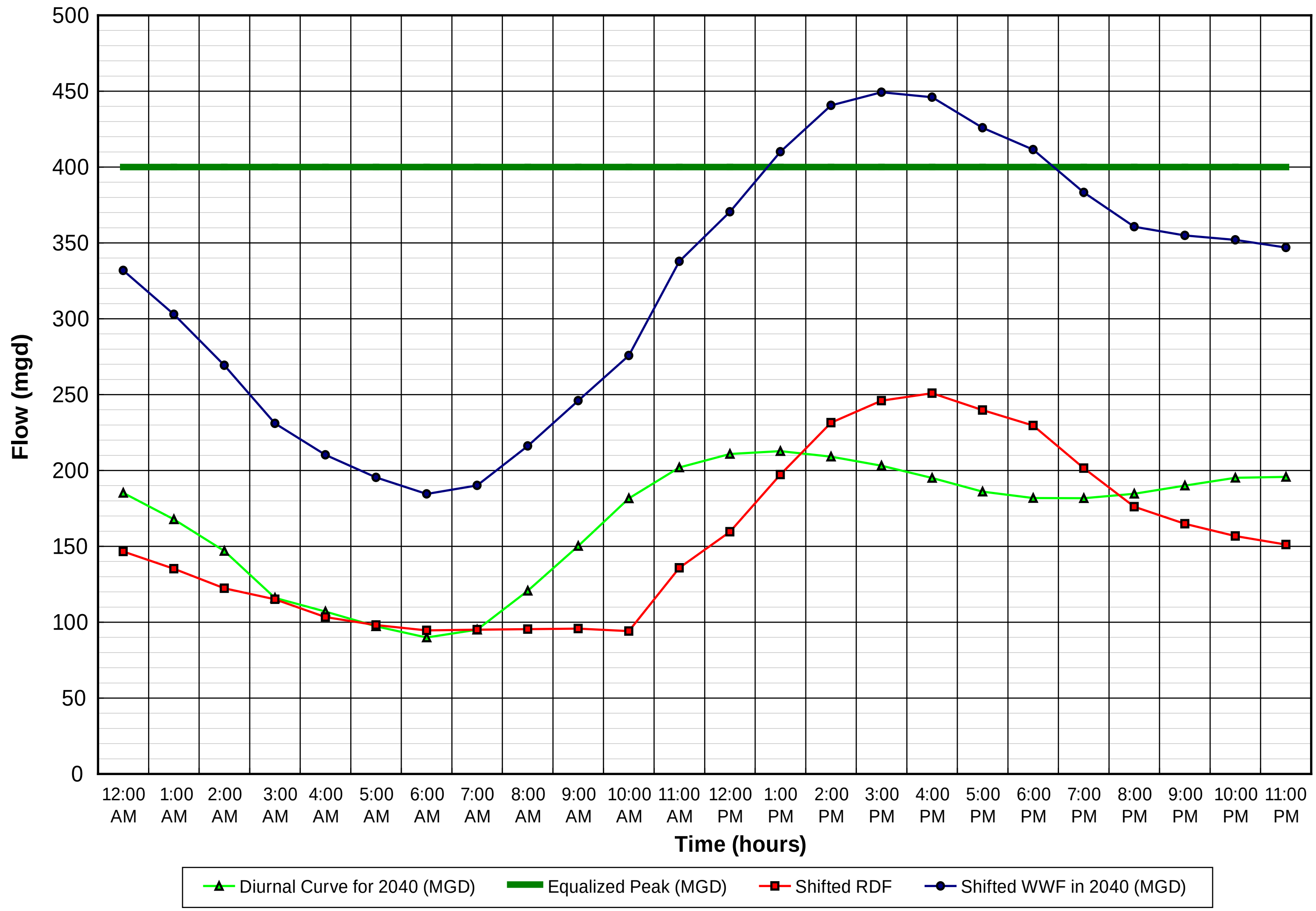

Figure A-2
PROJECTED WET WEATHER HYDROGRAPH FOR 2040
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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Table A-1 Flow Equalization Summary Table
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José

Time	2040 PHWWF (MGD)	Peak After 8-MG Equalization (mgd)	Raw Storage Required Every hour (MG)	PHWWF Hydrograph After 8-MG Equalization (mgd)	PHWWF Hydrograph After 8-MG Equalization + Recycle (mgd)	Peak After 16-MG Equalization (mgd)	PE Storage Required Every Hour (MG)	PHWWF Hydrograph After 16 MG Additional Equalization (mgd)
12:00 AM	331.87	**400**	0.00	331.87	338.15	**356**	0.00	338.15
1:00 AM	302.98	400	0.00	302.98	309.27	356	0.00	309.27
2:00 AM	269.27	400	0.00	269.27	275.56	356	0.00	275.56
3:00 AM	231.09	400	0.00	231.09	237.37	356	0.00	237.37
4:00 AM	210.32	400	0.00	210.32	216.61	356	0.00	216.61
5:00 AM	195.40	400	0.00	195.40	201.69	356	0.00	201.69
6:00 AM	184.56	400	0.00	184.56	190.84	356	0.00	190.84
7:00 AM	190.13	400	0.00	190.13	196.41	356	0.00	196.41
8:00 AM	216.14	400	0.00	216.14	222.42	356	0.00	222.42
9:00 AM	246.01	400	0.00	246.01	252.29	356	0.00	252.29
10:00 AM	275.74	400	0.00	275.74	282.03	356	0.00	282.03
11:00 AM	*337.86*	400	0.00	337.86	344.15	356	0.00	344.15
12:00 PM	370.45	400	0.00	370.45	376.74	356	0.86	356.00
1:00 PM	410.08	400	0.42	400.00	406.29	356	2.10	356.00
2:00 PM	440.64	400	1.69	400.00	406.29	356	2.10	356.00
3:00 PM	**449.26**	400	2.05	400.00	406.29	356	2.10	356.00
4:00 PM	446.07	400	1.92	400.00	406.29	356	2.10	356.00
5:00 PM	425.89	400	1.08	400.00	406.29	356	2.10	356.00
6:00 PM	411.49	400	0.48	400.00	406.29	356	2.10	356.00
7:00 PM	383.28	400	0.00	383.28	389.56	356	1.40	356.00
8:00 PM	360.69	400	0.00	360.69	366.98	356	0.46	356.00
9:00 PM	354.97	400	0.00	354.97	361.26	356	0.22	356.00
10:00 PM	351.97	400	0.00	351.97	358.26	356	0.09	356.00
11:00 PM	346.91	400	0.00	346.91	353.20	356	0.00	353.20
Total			**7.64**				**15.60**	

APPENDIX B - PROCESS MODELING

PROCESS MODEL CALIBRATION

A level 2 calibration (WERF, 2003) was used. A level 2 calibration is based on historical data only, and typically only provides a rough calibration for the model.

The calibration was done as a steady state based on one month of data. Data for August 2007 is shown, but similar results were obtained for January 2007 and May 2007. No kinetic or stoichiometric parameters were changed in any run.

Model Setup

The BioWin configuration is shown in Figure B-1. BioWin setup assumptions (tank volumes, flow splits, etc) are shown in Table B-1. Flow split percentages between trains, TWAS flow, and temperature was based on measured data. Quad 1 of each train was assumed to receive 60 percent of the flow, although no data was available. Dissolved oxygen (DO) values were assumed to be 0 in quads 1 and 3, 2.25 mg/L in quad 2, and 4.25 mg/L in quad 4. Based on the grab samples conducted by the plant in their modeling effort, bio-P removal is occurring, so using unaerated zones is reasonable. Measured TWAS mass was 108 percent of measured WAS mass. A DAFT capture rate of 95 percent was assumed.

Attempts were made to include the primary clarifiers in the model, assuming standard wastewater characteristics and the measured TSS removal between influent and the weighted BNR influent. The modeled primary effluent BOD (226 mg/L) was much higher than the measured weighted BNR influent BOD (173 mg/L). Similar results were found for other months in 2007 (modeled primary effluent BOD 19 to 41 percent higher than measured). Wastewater fractions were modified within typical municipal wastewater ranges, but the discrepancy persisted. With the historical data available, this discrepancy could not be resolved. Possible explanations might include sludge held long enough in the primary clarifiers so COD is lost due to methane formation, sampling or laboratory issues, or unusual wastewater characteristics. City staff agreed to assume the weighted BNR influent BOD and TSS numbers are correct (April 20, 2009 discussion with A. Ekster), so the model setup does not include primary clarifiers.

Primary Effluent Characteristics

The measured influent flow, weighted BNR influent BOD, and weighted BNR influent TSS were used as inputs to the model. BioWin default settled sewage wastewater fractions were used. Primary effluent VSS percent was assumed to equal the measured primary sludge VS percent. Primary effluent TKN was calculated to match the primary effluent ammonia based on a standard PE NH_3/TKN fraction of 0.75. Primary effluent TP was calculated to

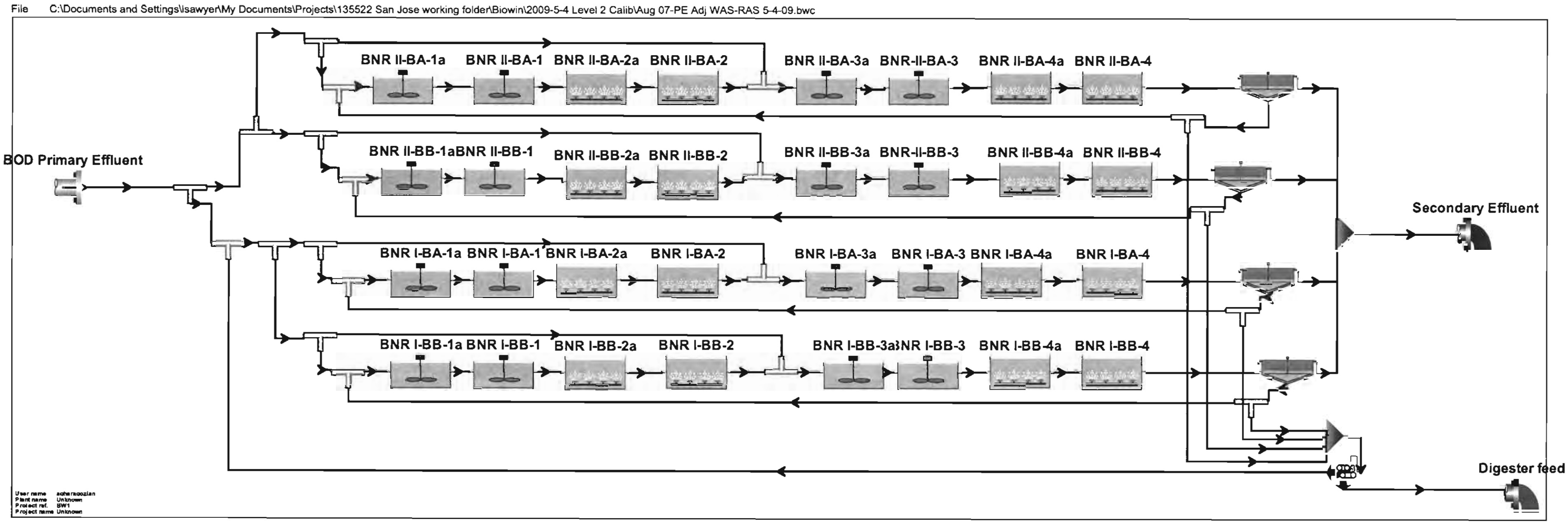


Figure B-1. Biowin Configuration

yield a PO4 of 4.5 mg/L, based on phosphate data collected during special struvite sampling in March 2009. BioWin default settled sewage pH and alkalinity values were used. These values were similar to values measured during struvite sampling.

Calibration Results

Results are shown in Table B-2. Clarifier mass balances for each train did not show good agreement. The train influent flow, MLSS, and RAS concentrations were assumed to be correct, and the RAS flow was adjusted. WAS flow to each train was adjusted to match MLSS and MLVSS within 10 percent. Modeled WAS flow was 77 percent of measured WAS flow. Modeled WAS mass was 80 percent of measured WAS mass. Modeled SRT was higher than measured SRT. City staff agreed to use the BioWin model predictions of waste activated sludge production, based on a finding by City staff that the existing waste activated sludge flow meters are inaccurate (April 20, 2009 discussion with A. Ekster).

CAPACITY EVALUATION

Secondary treatment capacity was determined by using the BioWin model to determine the mixed liquor suspended solids concentration under maximum month loading conditions. A 5-day aerobic solids retention time was assumed for secondary treatment to ensure sufficient nitrification. The peak hour flow was assumed to occur during the maximum month influent loading. State point analysis on a poor settling sludge (90^{th} percentile SVI of 114 mL/g) at peak hour flow was used to determine the maximum mixed liquor suspended solids concentration allowable without causing clarifier overload. Combining these results gives the capacity. The capacity is conservative, since peak hour flow is assumed to occur during the maximum month loading with a poor settling sludge.

Capacity of the aeration systems was not evaluated. It was assumed that improvements to the diffusers and blowers were likely during the planning period, so that as long as the tank volume was sufficient the capacity rating was valid.

BioWin

Capacities are based on existing wastewater characteristics, as represented by the flows with existing water conservation and the medium loading condition in the flow and loading projections. Maximum month loading conditions were used with BioWin to determine the MLSS concentration at steady state. The loading was split between the basins based on aeration volume in service (60 to 65 percent to BNR I). The primary effluent flows modeled include plant recycles streams that enter before the influent flow metering; therefore, to match the projected influent flows without recycle streams, flows must be reduced by 3 percent.

As discussed in the calibration section, the primary clarifiers were not modeled. Standard BioWin primary effluent characteristics were assumed. Typical primary clarifier removals for

BOD (42 percent) and TSS (61 percent) based on historical removals at ADWF (most conservative monthly removals from PM 3.3) were assumed for the capacity evaluation. Based on these removals, the primary effluent concentrations were calculated.

For each configuration (full treatment and reliable treatment in both operating modes), the model was run at two to three different influent flows. For the existing water conservation scenario, influent concentrations are constant. The mixed liquor concentrations are linear with flow.

BNR Mode

The plant currently operates in BNR mode. The first and third quads of each aeration basin are unaerated (50 percent of the tank volume). Return activated sludge (RAS) is fed to the first quad, while primary effluent is split 60 percent to the first quad and 40 percent to the third quad. In this mode, the plant removes phosphorus biologically, nitrifies, and partially denitrifies. Further optimization of the process to maintain the treatment performance and increase capacity will be evaluated with future alternatives.

Nitrification Mode

The plant has the capability to operate in nitrification mode. Since the plant is not required to denitrify or remove phosphorus, operating in nitrification mode is an acceptable method to increase capacity. In nitrification mode, the first quad of each aeration basin is unaerated to improve sludge settlability (25 percent of the tank volume). RAS and primary effluent are fed to the first quad.

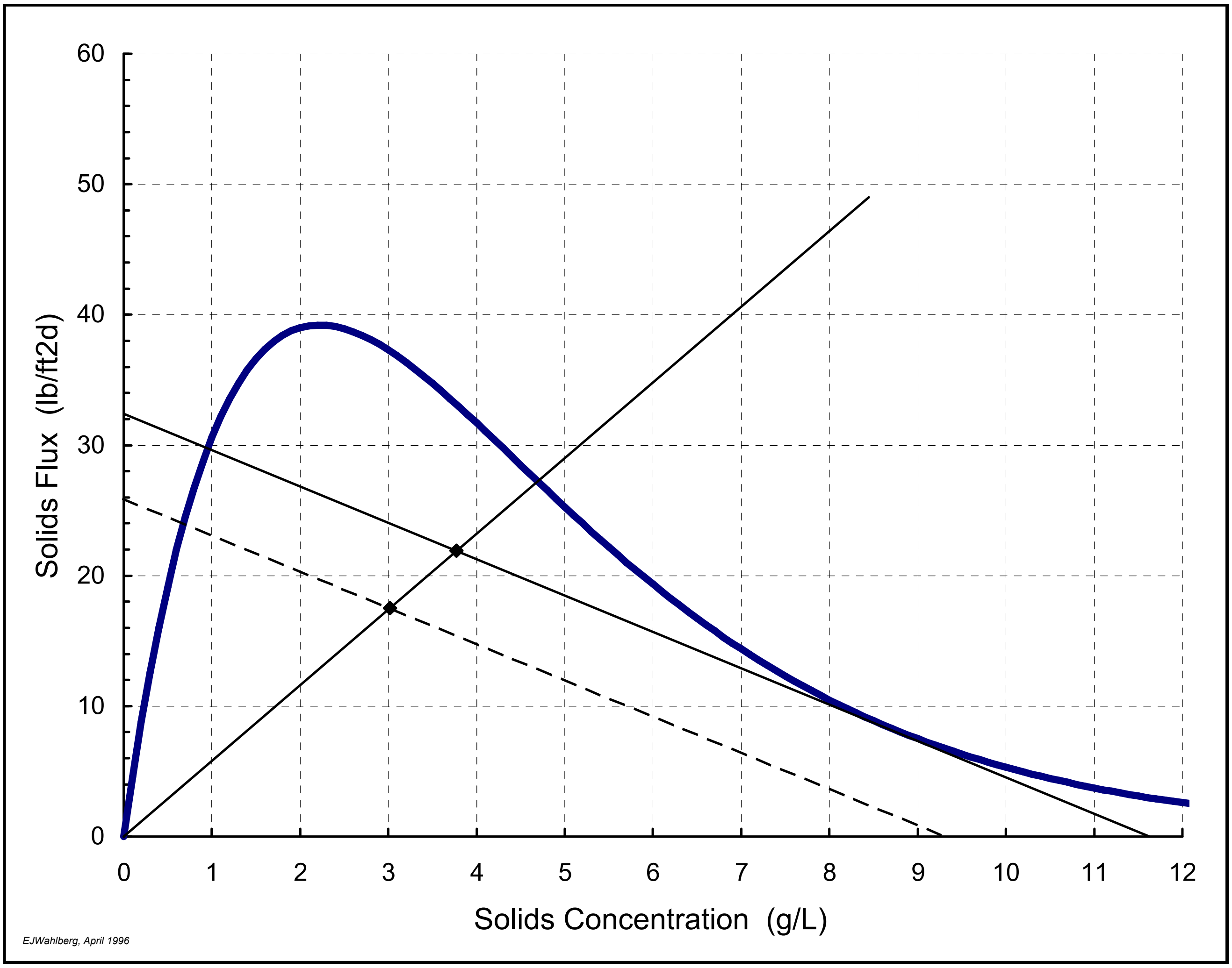
State Point Analysis

Peak hour flows were used with state point to determine the maximum MLSS to the clarifiers. Equalized peak hour flows (including recycle flows) were assumed to be 300 mgd for BNR mode and 356 mgd for nitrification mode. The Wahlberg (1995) state point correlation was used. The solids loading rate was derated by 20 percent, since state point analysis overestimates clarifier performance.

The 90th percentile SVI (114 mL/g) was used. SVI was assumed to be the same for the nitrification with 25 percent anaerobic selector.

Figure B-2 shows an example state point result for BNR 2 with one clarifier out of service and reliable RAS flows. The design MLSS concentration is 3,016 mg/L. Table B-3 summarizes the state point results.

Figure B-2. BNR 2A, 1 Clarifier Out of Service, Reliable RAS



Summary Information		
Operating Point Shown		
SVISN	114	mL/g
Total Clarifier Surface Area	107,702	ft^2
MLSS Concentration	3,770	mg/L
Influent Flow	75	mgd
Surface Overflow Rate	696.3659	gal/ft^2d
RAS Flow	36	mgd
Applied Solids Loading*	32.40	lb/ft2d
RAS SS Concentration*	11,624	mg/L
**Assumes underloaded conditions;check flux curve*		
Derated (Design Point)		
Derate SLR by	20%	
Design RAS Concentration	9,297	mg/L
Design Solids Loading	25.92	lb/ft2d
Design MLSS Concentration	3,016	mg/L

Capacity Determination

The results of BioWin and state point were combined to determine capacity. Since peak hour flows to secondary treatment are assumed to be constant regardless of the ADWIF, the maximum allowable mixed liquor concentration (based on state point) is constant. Assuming a linear relationship, the BioWin results were used to determine the ADMML for each train. Results for each train were combined to yield the overall capacity.

Tables B-4 and B-5 summarize BNR capacity and nitrification capacity.

REFERENCES

Wahlberg, E.J. and T.M. Keinath (1995). "Development of settling flux curves using SVI: An addendum." Water Environment Research, 67, 872.

Table B-1.
Biowin Calibration Setup Assumptions - August 2007

Parameter	Units	Value
Temperature	°C	23.4
Primary Clarifiers		
TSS removal		65%
BOD removal		48%
Flow Splits		
BNR I / primary effluent flow		56.7%
BNR II battery A / BNR II influent flow		50.0%
BNR I battery B / BNR I influent flow (including DAFTO)		69.9%
Zone 1 flow / total battery influent flow (same for all batteries)		60.0%
Aeration Basins		
Number in service		
BNR I-BA		2
BNR I-BB		5
BNR II-BA		6
BNR II-BB		6
Total Volume		
BNR I-BA	million gallons	5.5
BNR I-BB	million gallons	13.75
BNR II-BA	million gallons	9
BNR II-BB	million gallons	9
DO setpoint (same for each battery)		
Zone 1	mg/L	0.00
Zone 2	mg/L	2.25
Zone 3	mg/L	0.00
Zone 4	mg/L	4.25
Secondary Clarifiers		
Number in service		
BNR I-BA		4
BNR I-BB		10
BNR II-BA		6
BNR II-BB		4
Area		
BNR I-BA	sf	29,962
BNR I-BB	sf	74,362
BNR II-BA	sf	92,316
BNR II-BB	sf	61,544
TSS Removal (for all batteries)		99.81%
RAS flow split		
BNR I-BA		70.8%
BNR I-BB		66.2%
BNR II-BA		112.6%
BNR II-BB		63.1%
Solids Handling		
DAFT		
Capture		95%
Concentrated solids flow / Influent flow		28.1%

Table B-2.
Biowin Calibration Results - August 2007

Parameter	**Units**	**Value**	
		Measured	**Biowin**
Influent for Reference			
Flow	mgd	113	
BOD	mg/L	332	
TSS	mg/L	293	
NH3	mg/L	25	
ISS	mg/L		
Primary Effluent			
BOD	mg/L	173	173
TSS	mg/L	103	103
NH3	mg/L	28	28
Primary Effluent Fractions			
Fbs - Readily biodegradable			0.27
Fac - Acetate			0.15
Fxsp - Non-colloidal slowly biodegradable			0.60918
Fus - Unbiodegradable soluble			0.08
Fup - Unbiodegradable particulate			0.08
Fna - Ammonia			0.75
ISS/TSS			0.16
BNR II A (Nit A)			
Flow	mgd	24.9	24.4
MLSS	mg/L	3,311	3,508
MLVSS	mg/L	2,471	2,369
VSS:TSS		0.75	0.68
RAS flow	mgd	18.8	27.0
RAS concentration	mg/L	6,272	6,617
WAS flow	mgd	0.43	0.34
WAS mass	lb/day	22,278	18,762
Effluent mass	lb/day		1,494
Aerobic Inventory	lb		145,836
Total Inventory	lb		291,061
BOD removed	lb/day		34,487
Aerobic SRT	days	6.2	7.2
Total SRT	days	12.3	14.4
Yield	lb TSS/lb BOD	0.68	0.59

Table B-2.
Biowin Calibration Results - August 2007

Parameter	Units	Value	
		Measured	**Biowin**
BNR II B (Nit B)			
Flow	mgd	24.9	24.4
MLSS	mg/L	3,250	3,408
MLVSS	mg/L	2,425	2,300
VSS:TSS		0.75	0.67
RAS flow	mgd	17.0	15.2
RAS concentration	mg/L	8,398	8,801
WAS flow	mgd	0.52	0.26
WAS mass	lb/day	36,287	19,084
Effluent mass	lb/day		1,117
Aerobic Inventory	lb		147,426
Total Inventory	lb		293,615
BOD removed	lb/day		34,607
Aerobic SRT	days	3.8	7.3
Total SRT	days	7.5	14.5
Yield	lb TSS/lb BOD	1.11	0.58
BNR I A (Sec A)			
Flow	mgd	19.6	19.6
MLSS	mg/L	3,126	3,280
MLVSS	mg/L	2,333	2,275
VSS:TSS		0.75	0.69
RAS flow	mgd	12.3	13.7
RAS concentration	mg/L	7,566	7,905
WAS flow	mgd	0.35	0.27
WAS mass	lb/day	22,167	17,799
Effluent mass	lb/day		900
Aerobic Inventory	lb		86,667
Total Inventory	lb		172,775
BOD removed	lb/day		27,669
Aerobic SRT	days	3.7	4.6
Total SRT	days	7.4	9.2
Yield	lb TSS/lb BOD	0.87	0.68

Table B-2.
Biowin Calibration Results - August 2007

Parameter	Units	Value	
		Measured	**Biowin**
BNR I B (Sec B)			
Flow	mgd	45.6	45.4
MLSS	mg/L	3,276	3,388
MLVSS	mg/L	2,445	2,327
VSS:TSS		0.75	0.69
RAS flow	mgd	29.6	29.7
RAS concentration	mg/L	8,258	8,497
WAS flow	mgd	0.59	0.57
WAS mass	lb/day	40,901	40,393
Effluent mass	lb/day		2,105
Aerobic Inventory	lb		224,233
Total Inventory	lb		446,892
BOD removed	lb/day		64,300
Aerobic SRT	days	5.1	5.3
Total SRT	days	10.1	10.5
Yield	lb TSS/lb BOD	0.69	0.66
BNR Overall			
Aerobic SRT	days	4.6	5.9
Total SRT	days	9.2	11.8
Yield	lb TSS/lb BOD		0.63
Was flow	mgd	1.89	1.44
WAS mass	lb/day	121,632	96,038
Secondary Effluent			
NH3-N	mg/L	0.10	0.07
NO3-N	mg/L		8.7
NO2-N	mg/L		0.02
BOD	mg/L		3.0
TSS	mg/L	6.2	6.0
Tertiary Effluent			
BOD	mg/L	3.3	
TSS	mg/L	1.6	

Table B-3. State Point Results

BNR I A, Reliable (Largest out of service or 2 small out of service)							
PWWF	Area	RAS Capacity	Actual RAS	RAS %	SVI	Design SLR	Design MLSS
75	98,317	100.6	73	97%	114	44.88	3,576
87.5	98,317	100.6	75	86%	114	45.53	3,304
101	98,317	100.6	75	74%	114	45.49	3,048

BNR II A, Reliable (Largest out of service)							
PWWF	Area	RAS Capacity	Actual RAS	RAS %	SVI	Design SLR	Design MLSS
75	107,702	36	36	48%	114	25.92	3,016
87.5	107,702	36	36	41%	114	25.93	2,712
77	107,702	36	36	47%	114	25.89	2,960

BNR I A, All Clarifiers, Reliable RAS							
PWWF	Area	RAS Capacity	Actual RAS	RAS %	SVI	Design SLR	Design MLSS
75	113,703	100.6	84	112%	114	44.87	3,848
87.5	113,703	100.6	87	99%	114	45.55	3,560
101	113,703	100.6	87	86%	114	45.55	3,304

BNR II A, All Clarifiers, Reliable RAS							
PWWF	Area	RAS Capacity	Actual RAS	RAS %	SVI	Design SLR	Design MLSS
75	123,088	36	36	48%	114	23.40	3,112
87.5	123,088	36	36	41%	114	23.56	2,816
77	123,088	36	36	47%	114	23.39	3,056

BNR I A, All in Service, Max RAS							
PWWF	Area	RAS Capacity	Actual RAS	RAS %	SVI	Design SLR	Design MLSS
75	113,703	126.6	84	112%	114	44.87	3,848
87.5	113,703	126.6	87	99%	114	45.55	3,560
101	113,703	126.6	87	86%	114	45.55	3,304

BNR II A, All in Service, Max RAS							
PWWF	Area	RAS Capacity	Actual RAS	RAS %	SVI	Design SLR	Design MLSS
75	123,088	72	72	96%	114	38.48	3,864
87.5	123,088	72	72	82%	114	38.55	3,568
77	123,088	72	72	94%	114	38.52	3,816

BNR II A, Reliable Clarifiers, Increase RAS							
PWWF	Area	RAS Capacity	Actual RAS	RAS %	SVI	Design SLR	Design MLSS
77	107,702	36	72	94%	114	41.99	3,640

Table B-4. Capacity Summary - BNR Mode

	All in Service All Aeration Basins, All Clarifiers, Max RAS	**Reliable Operation** AB Out in BNR IA, One large or two small clarifiers out in BNR IA, One large or two small clarifiers out in BNR IB, One clarifier out in BNR IIB, Reliable RAS	**Reliable Operation, Increase RAS** AB Out in BNR IA, One large or two small clarifiers out in BNR IA, One large or two small clarifiers out in BNR IB, One clarifier out in BNR IIB, FULL RAS
Plant Influent (without recycles)			
ADWIF	173	147	158
ADMMF	186	158	169
ADWL BOD	415,211	353,216	378,323
ADMML BOD	649,728	552,717	592,005
ADWL NH3	32,975	28,052	30,046
ADMML NH3	43,083	36,650	39,255
Including Recycles and PHWWF equalization (24 MG)			
ADWIF to secondary treatment	179	152	163
ADMMF to secondary treatment	191	163	174
PHWWF to secondary treatment	300	300	300
ADMML BOD to primary treatment	669,822	569,812	610,315
ADMML BOD to secondary treatment	388,497	330,491	353,982
Year Capacity Reached	2035	2019	2026
Assumptions			
SVI, mL/g	114	114	114
Temperature, deg C	16	16	16
Aerobic SRT, days	5	5	5
Primary TSS Removal	61	61	61
Primary BOD Removal	42	42	42
BNR I			
ADWIF (without recycles)	110	96	96
ADWIF (with recycles)	113.6	99.3	99.3
ADMMF (without recycles)	118	103	103
ADMMF (with recycles)	121.7	106.3	106.3
BNR II			
ADWIF (without recycles)	63	51	62
ADWIF (with recycles)	65.1	52.8	63.6
ADMMF (without recycles)	68	55	66
ADMMF (with recycles)	69.7	56.5	68.1

Table B-4. Capacity Summary - BNR Mode

		All in Service All Aeration Basins, All Clarifiers, Max RAS	**Reliable Operation** AB Out in BNR IA, One large or two small clarifiers out in BNR IA, One large or two small clarifiers out in BNR IB, One clarifier out in BNR IIB, Reliable RAS	**Reliable Operation, Increase RAS** AB Out in BNR IA, One large or two small clarifiers out in BNR IA, One large or two small clarifiers out in BNR IB, One clarifier out in BNR IIB, FULL RAS
BNR I A				
	Number Aeration Basins	8	7	7
	Area Clarifiers	113,703	98,317	98,317
	ADWIF to secondary	56.8	46.0	46.0
	ADMMF to secondary	60.9	49.3	49.3
	ADMML BOD to secondary, lb/day	123,513	100,032	100,032
	PWWF to secondary, mgd	75.0	75.0	75.0
	RAS Flow, mgd	84	73	73
	MLSS, mg/L	3,848	3,576	3,576
	SLR at PHWWF, lb/sf/day	44.87	44.88	44.88
BNR I B				
	Number Aeration Basins	8	8	8
	Area Clarifiers	113,703	98,317	98,317
	ADWIF to secondary	56.8	53.2	53.2
	ADMMF to secondary	60.9	57.0	57.0
	ADMML BOD to secondary, lb/day	123,513	115,751	115,751
	PWWF to secondary, mgd	75.0	75.0	75.0
	RAS Flow, mgd	84	73	73
	MLSS, mg/L	3,848	3,576	3,576
	SLR at PHWWF, lb/sf/day	44.87	44.88	44.88
BNR II A				
	Number Aeration Basins	8	8	8
	Area Clarifiers	123,088	123,088	123,088
	ADWIF to secondary	32.5	26.8	32.5
	ADMMF to secondary	34.9	28.7	34.9
	ADMML BOD to secondary, lb/day	70,736	58,289	70,736
	PWWF to secondary, mgd	75.0	75.0	75.0
	RAS Flow, mgd	72	36	72
	MLSS, mg/L	3,864	3,112	3,864
	SLR at PHWWF, lb/sf/day	38.48	23.40	38.48
BNR II B				
	Number Aeration Basins	8	8	8
	Area Clarifiers	123,088	107,702	107,702
	ADWIF to secondary	32.5	26.0	31.0
	ADMMF to secondary	34.9	27.8	33.2
	ADMML BOD to secondary, lb/day	70,736	56,419	67,464
	PWWF to secondary, mgd	75.0	75.0	75.0
	RAS Flow, mgd	72	36	72
	MLSS, mg/L	3,864	3,016	3,688
	SLR at PHWWF, lb/sf/day	38.48	25.92	41.97

Table B-5. Capacity Summary - Nitrification with Anaerobic Selector

	All in Service All Aeration Basins, All Clarifiers, Max RAS	**Reliable Operation** AB Out in BNR IA, One large or two small clarifiers out in BNR IA, One large or two small clarifiers out in BNR IB, One clarifier out in BNR IIB, Reliable RAS	**Reliable Operation** AB Out in BNR IA, One large or two small clarifiers out in BNR IA, One large or two small clarifiers out in BNR IB, One clarifier out in BNR IIB, FULL RAS
Plant Influent (without recycles)			
ADWIF	204	169	185
ADMMF	218	182	198
ADWL BOD	487,546	405,986	443,165
ADMML BOD	762,918	635,292	693,469
ADWL NH3	38,720	32,243	35,195
ADMML NH3	50,588	42,125	45,983
Including Recycles and PHWWF equalization (24 MG)			
ADWIF to secondary treatmen	210	175	191
ADMMF to secondary treatme	225	187	204
PHWWF to secondary treatme	356	356	356
ADMML BOD to primary treatr	786,514	654,941	714,917
ADMML BOD to secondary tre	456,178	379,866	414,652
Year Capacity Reached	>2040		
Assumptions			
SVI, mL/g	114	114	114
ASSUME SVI STAY SAME, SINCE STILL HAVE ANAEROBIC SELECTOR IN FIRST 25%			
Temperature, deg C	16	16	16
Aerobic SRT, days	5	5	5
Primary TSS Removal	61	61	61
Primary BOD Removal	42	42	42
BNR I			
ADWIF (without recycles)	122	105	105
ADWIF (with recycles)	125.8	108.6	108.6
ADMMF (without recycles)	131	113	113
ADMMF (with recycles)	134.8	116.4	116.4
BNR II			
ADWIF (without recycles)	81	64	80
ADWIF (with recycles)	84.0	66.1	82.1
ADMMF (without recycles)	87	69	85
ADMMF (with recycles)	90.0	70.8	88.0

Table B-5. Capacity Summary - Nitrification with Anaerobic Selector

		All in Service All Aeration Basins, All Clarifiers, Max RAS	**Reliable Operation** AB Out in BNR IA, One large or two small clarifiers out in BNR IA, One large or two small clarifiers out in BNR IB, One clarifier out in BNR IIB, Reliable RAS	**Reliable Operation** AB Out in BNR IA, One large or two small clarifiers out in BNR IA, One large or two small clarifiers out in BNR IB, One clarifier out in BNR IIB, FULL RAS
BNR I A				
	Number Aeration Basins	8	7	7
	Area Clarifiers	113,703	98,317	98,317
	ADWIF	62.9	50.5	50.5
	ADMMF	67.4	54.1	54.1
	ADMML Influent BOD, lb/day	136,753	109,859	109,859
	PWWF	101.0	101.0	101.0
	RAS Flow	87	75	75
	MLSS	3,304	3,048	3,048
	SLR at PHWWF	45.55	45.49	45.49
BNR I B				
	Number Aeration Basins	8	8	8
	Area Clarifiers	113,703	98,317	98,317
	ADWIF	62.9	58.1	58.1
	ADMMF	67.4	62.2	62.2
	ADMML Influent BOD, lb/day	136,753	126,317	126,317
	PWWF	101.0	101.0	101.0
	RAS Flow	87	75	75
	MLSS	3,304	3,048	3,048
	SLR at PHWWF	45.55	45.49	45.49
BNR II A				
	Number Aeration Basins	8	8	8
	Area Clarifiers	123,088	123,088	123,088
	ADWIF	42.0	33.6	42.0
	ADMMF	45.0	36.0	45.0
	ADMML Influent BOD, lb/day	91,336	72,986	91,336
	PWWF	77.0	77.0	77.0
	RAS Flow	72	36	72
	MLSS	3,816	3,056	3,816
	SLR at PHWWF	38.52	23.39	38.52
BNR II B				
	Number Aeration Basins	8	8	8
	Number Clarifiers	123,088	107,702	107,702
	ADWIF	42.0	32.5	40.1
	ADMMF	45.0	34.8	42.9
	ADMML Influent BOD, lb/day	91,336	70,703	87,139
	PWWF	77.0	77.0	77.0
	RAS Flow	72	36	72
	MLSS	3,816	2,960	3,640
	SLR at PHWWF	38.52	25.89	41.99

APPENDIX C – FILTER BACKWASH DETAILS

APPENDIX C – FILTER BACKWASH DETAILS

Based on information from operations staff, the most extreme backwashing scenario possible is continuous backwashing progressing from one filter to the next. This would entail starting the draining phase of a second filter while the first is in the active backwashing stage. Once the first filter backwashing phase is complete, the second filter is drained and ready for backwashing to commence immediately.

Active backwashing is an 18-minute process, and commences once the entire filter has been drained. The two adjacent cells that comprise the filter are backwashed sequentially. The active backwash sequence is made up of set flow rates, namely 7,000 gpm initially, followed by 15,000 gpm, and back to 7,000 gpm, and repeated in the adjacent cell.

The backwash water generated during active backwash flows by gravity to the equalization basin. From the equalization basin, flow goes to the backwash treatment unit, which consists of flocculation and sedimentation. Flow to and from the equalization basin is by gravity. Flow from the equalization basin is designed to be 8,100 gpm, but can reach a maximum of 10,000 gpm[1].

During normal operations, the whole backwash sequence, including draining, active backwashing, and refilling takes 45 minutes in automatic mode. This duration can be reduced to 30 minutes in manual mode. Simulating a typical 30-minute backwash cycle, and maintaining a flow of 8,100 gpm from the equalization basin results in a zero net increase of equalization volume every cycle. Thus, normal plant operations are not limited by equalization volume, and could backwash every 30 minutes indefinitely if needed. If all sixteen filters are in operation, a sustained 30-minute backwash cycle results in a 7.5-hour runtime. However, as indicated in the main body of text, appropriate filter run times are more in the order of 16 hours.

Simulating extreme backwashing conditions, i.e. continuous backwashing transitioning from filter to filter every 18 minutes, the volume of the equalization basin could be limiting if the flow rate leaving the equalization basin was limited to 8,100 gpm. Under these conditions, the working volume of the equalization basin is filled after only 9 backwashes. However, if the flow rate leaving the equalization basin could be maintained at 10,000 gpm, then the equalization basin working volume never fills up, and backwashing in this extreme mode could continue indefinitely.

A flow rate of 8,100 gpm leaving the equalization basin results in the backwash treatment sedimentation tanks being loaded at 927 gal/sf/day. A flow rate of 10,000 gpm results in a

[1] San Jose O&M manual.

loading rate of 1,145 gal/sf/day, which is still considered feasible. Based on these analyses, the filtration process is not backwash limited.

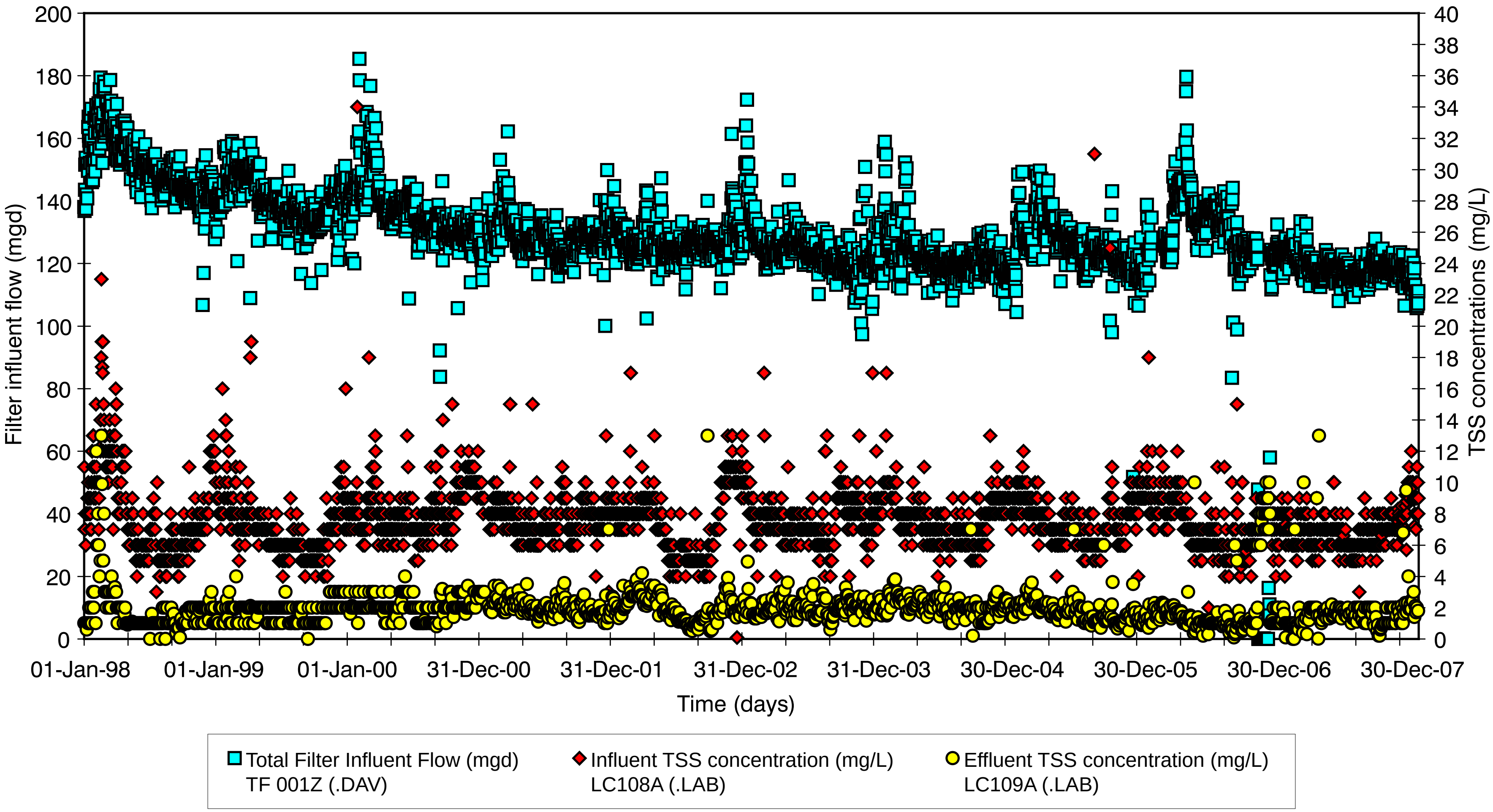


Figure C-1
FILTER INFLUENT FLOW AND TSS REMOVAL
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

sj809f6-7897.ai

APPENDIX D – PROJECTED SOLIDS LOADINGS

APPENDIX D – PROJECTED SOLIDS LOADINGS

SOLIDS HANDLING

The capacity of the existing SJ/SC WPCP solids handling facilities was determined using projected peak month primary and waste activated sludge production presented in Appendix B of PM 3.5 and the design/standby criteria presented in PM 3.4. Projected sludge production was estimated for 2010, 2040, and buildout conditions, as shown on Figure D-1. A linear increase in sludge production between 2010 and 2040 was assumed for this analysis.

The reliable capacity of each unit process was determined by comparing projected solids and hydraulic loadings against corresponding design criteria, assuming one or more process units were out of service. Process capacity is defined as the plant influent flow rate at which any design criterion is exceeded.

Solids Thickening

Waste activated sludge (WAS) from the BNR I and BNR II systems is thickened using dissolved air flotation thickeners (DAFTs). Primary sludge is thickened separately in the primary clarifiers.

Capacity of the existing DAFTs was determined assuming 3 tanks were out of service, as discussed in PM 3.4. This corresponds to approximately 80 percent of the tanks in service. PM 3.4 cites solids loading and hydraulic loading capacity criteria of 9.6 lb/sf-day and 0.5 gpm/sf at ADAL conditions. Corresponding capacity criteria for ADMML conditions are 16.8 lb/sf-day and 0.8 gpm/sf.

Figures D-2a and D-2b show the projected DAFT solids loading rate for ADAL and ADMML conditions. The shaded area on each figure represents solids loading rates greater than the capacity criteria. In either case, the projected solids loading will not exceed the limiting solids loading rate during the planning period.

Figures D-3a and D-3b show the projected DAFT hydraulic loading rate for ADAL and ADMML conditions. The shaded area on each figure represents hydraulic loading rates greater than the capacity criteria. The DAFT hydraulic load depends on the WAS concentration in addition to the projected WAS production. The high and low hydraulic loading rates correspond to WAS concentrations of 6,750 and 7,860 mg/L, the typical performance range described in PM 3.3. In either case, the projected hydraulic loading will not exceed the limiting hydraulic loading rate during the planning period.

The existing DAFTs could be used for co-thickening primary and waste activated sludge, enabling continuous primary sludge pumping. Design criteria for this alternate configuration were not presented in PM 3.4; but, experience has shown that the maximum solids loading rate with co-thickening is approximately double that for WAS thickening only. Accordingly, DAFT solids loading and hydraulic loading capacity criteria of 33.6 lb/sf-day and 0.8 gpm/sf at ADMML conditions were used for co-thickening evaluation.

Figures D-4 and D-5 show the projected DAFT solids and hydraulic loading rates for ADMML conditions. The hydraulic loading rate was calculated assuming a primary sludge flow rate approximately four times current flow rates to represent more frequent pumping. The shaded area on each figure represents conditions exceeding the capacity criteria. The figures show that neither the projected solids or hydraulic loadings will exceed the limiting solids loading rate during the planning period

Subordinate systems, such as DAFT dissolution system, were not included in this capacity analysis. DAFT performance depends on the ratio of dissolved air to feed solids, in addition to solids and hydraulic loading rates considered above. The capacity of the dissolution system should be verified, especially if co-thickening is considered for future DAFT operation.

Solids Digestion

The thickened primary sludge and thickened WAS are stabilized using anaerobic digestion. Capacity of the existing digesters was determined assuming 3 digesters (one of the smaller digesters and two of the larger digesters) were out of service, as discussed in PM 3.4. This corresponds to approximately 80 percent of the digesters in service. PM 3.4 cites solids loading and hydraulic loading capacity criteria of 0.15 lb VS/cf-day and a hydraulic residence time of 20 days for ADMML conditions.

Figure D-6 shows the projected digester volatile solids loading rate for ADMML conditions. The shaded area on the figure represents solids loading rates greater than the capacity criteria. Two scenarios are shown on the figure – one with FOG production and one without. Initial FOG production is based on projected scum production within the plant, as presented in TM 3.3 from the FOG evaluation, digester rehabilitation, and gas line replacement project. FOG production is assumed to increase linearly to the projected design amount presented in TM 3.3 as increasing amounts of FOG are trucked to the plant.

The high and low hydraulic loading rates correspond to primary sludge concentrations of 3.4 and 4.3 percent TS, DAFT solids captures of 84.9 and 91.7 percent, and thickened WAS concentrations of 3.0 to 5.0 percent – typical performance ranges described in PM 3.3. The projected volatile solids loading will not exceed the limiting volatile solids loading rate during the planning period.

Figure D-7 shows the projected digester hydraulic residence time for ADMML conditions. The shaded area on the figure represents hydraulic loading rates resulting in a hydraulic residence time less than 20 days. The projected average and high hydraulic loading rates (*i.e.*, low primary sludge concentration, high DAFT solids capture, and low thickened WAS concentration) will push the hydraulic residence time below 20 days during the planning period.

Sludge Storage and Solids Drying

The residual solids management (RSM) facilities include 29 active sludge lagoons and 20 drying beds. The lagoons and drying beds are operated on a four-year cycle to provide additional pathogen inactivation and produce a Class A air-dried sludge. The lagoons are divided into four blocks. Within any 12-month period, one block of lagoons receives anaerobically-digested sludge, two blocks of lagoons are inactive, and one block is dredged and prepared for loading the following year. The dredged sludge is air dried before reuse/disposal.

The capacity criterion for the sludge storage lagoons was determined based on the lowest total volume of the four blocks of lagoons, 158.4 MG, and an average sidewater depth of 10 feet. The maximum quantity of digested sludge that could be stored was calculated assuming a sludge depth of eight feet (*i.e.*, two feet of water over the sludge) and a solids concentration varying from 4 percent at the top of the sludge layer to 8 percent at the bottom. The corresponding maximum digested sludge storage capacity is 71.4 million lb/year.

Figure D-8 shows the projected annual digested sludge production for ADAL conditions. The shaded area on the figure represents sludge production greater than the capacity criterion. Two scenarios are shown on the figure – one with FOG production and one without. Initial FOG production is based on projected scum production within the plant, as presented in TM 3.3 from the FOG evaluation, digester rehabilitation, and gas line replacement project. FOG production is assumed to increase linearly to the projected design amount presented in TM 3.3 as increasing amounts of FOG are trucked to the plant.

The high and low sludge loading rates correspond to digester volatile solids reduction of 50 and 60 percent, as described in TM 3.3. The projected digested sludge production will exceed the maximum capacity during the planning period.

Overall Capacity Rating

The capacity of any unit process is the point at which the projected solids or hydraulic loading exceeds any given capacity criterion. For those processes with multiple criteria, the capacity is based on the point at which any of the loadings exceeds the capacity criteria. Figure D-1 provides a basis for determining process capacity based on ADWIF or year, assuming a linear increase in sludge production between 2010 and 2040.

Projected DAFT loadings for WAS thickening only will exceed the solids loading rate capacity criterion at ADMML conditions before the hydraulic loading criterion or corresponding ADAL criteria. Extrapolating the projected solids loading linearly beyond 2040, the existing DAFTs have a reliable ADWIF capacity of 276 mgd. The DAFT capacity would be reduced to 225 mgd ADWIF even with a higher solids loading rate capacity criterion because of the higher proportion of primary sludge.

Projected anaerobic digester loadings will exceed the hydraulic loading rate criterion before the volatile solids loading rate criterion. The existing anaerobic digesters have a reliable ADWIF capacity of 166 mgd without plant scum, grease, and FOG and 164 mgd with plant scum, grease, and FOG.

The sludge lagoons have a reliable ADWIF capacity of 157 mgd based on projected digested sludge production. The addition of plant scum, grease, and FOG to the anaerobic digesters would reduce the ADWIF capacity to 155 mgd.

Figure D-9 summarizes the reliable unit process capacities for the existing solids handling facilities. The overall capacity of the solids handling facilities is limited by the sludge lagoons. The overall ADWIF capacity without plant scum, grease, and FOG added to the anaerobic digesters is 157 mgd; with plant scum, grease, and FOG, the overall ADWIF capacity would decrease to 155 mgd.

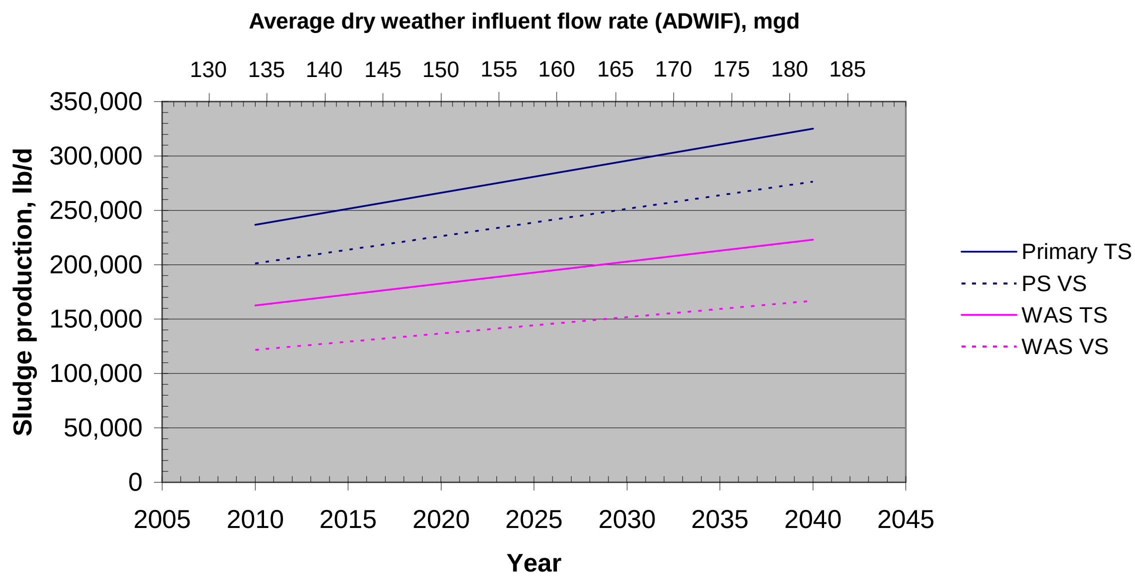


Figure D-1. Projected sludge production

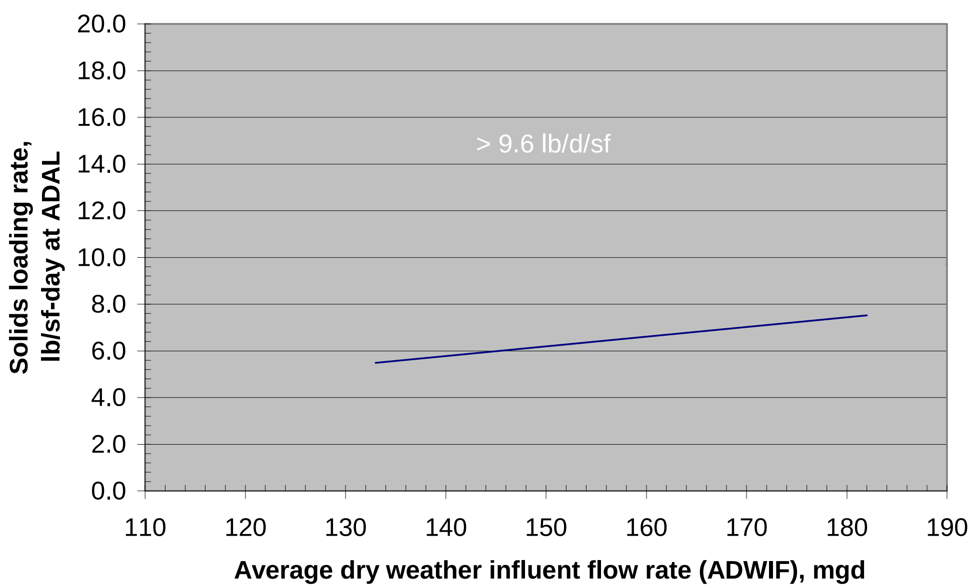


Figure D-2a. DAFT solids loading, ADAL conditions

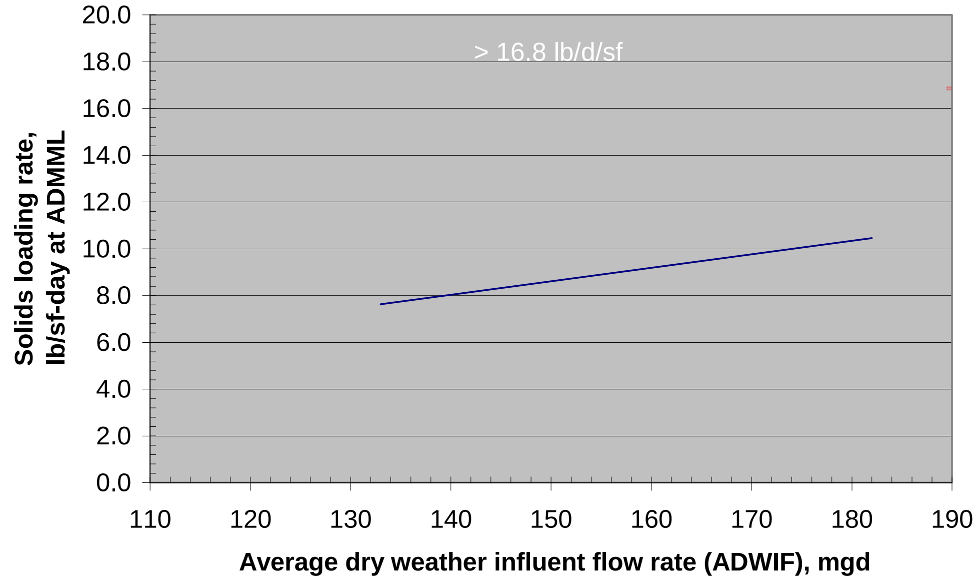


Figure D-2b. DAFT solids loading, ADMML conditions

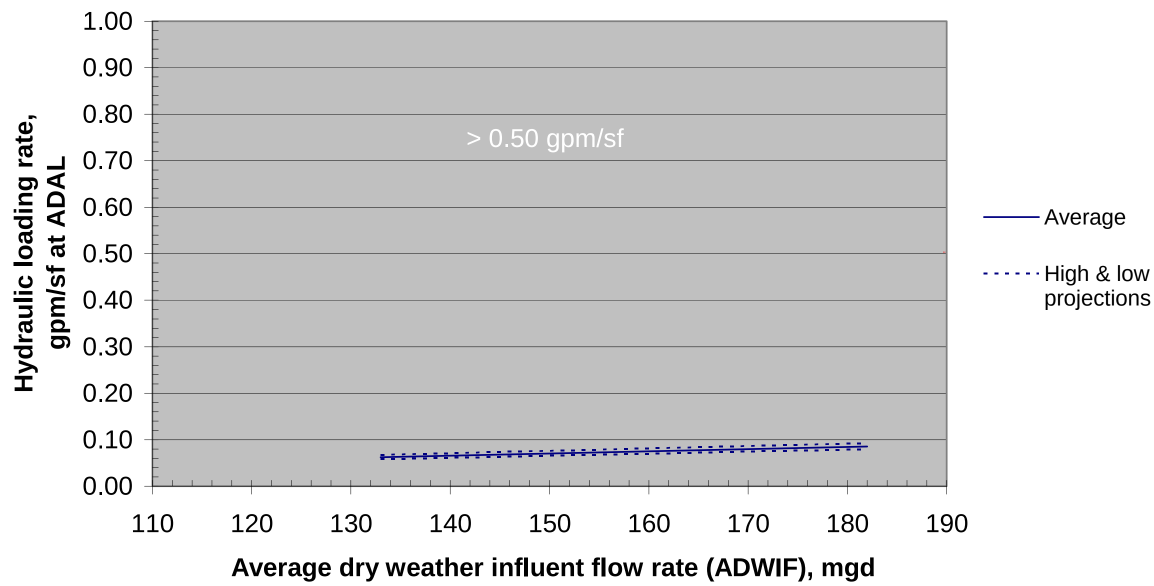


Figure D-3a DAFT hydraulic loading, ADAL conditions

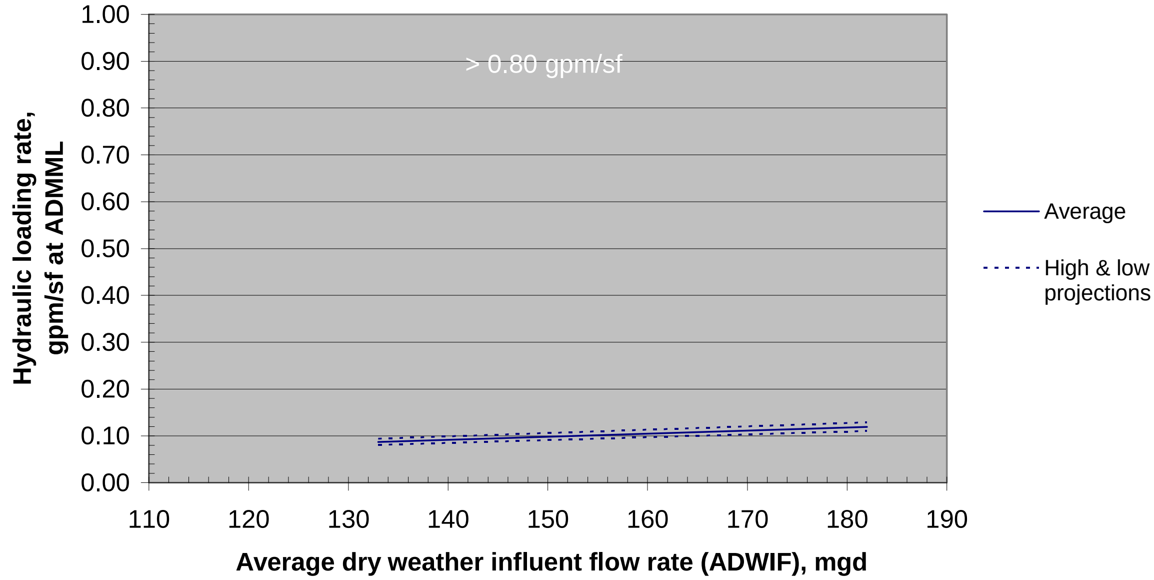


Figure D-3b. DAFT hydraulic loading, ADMML conditions

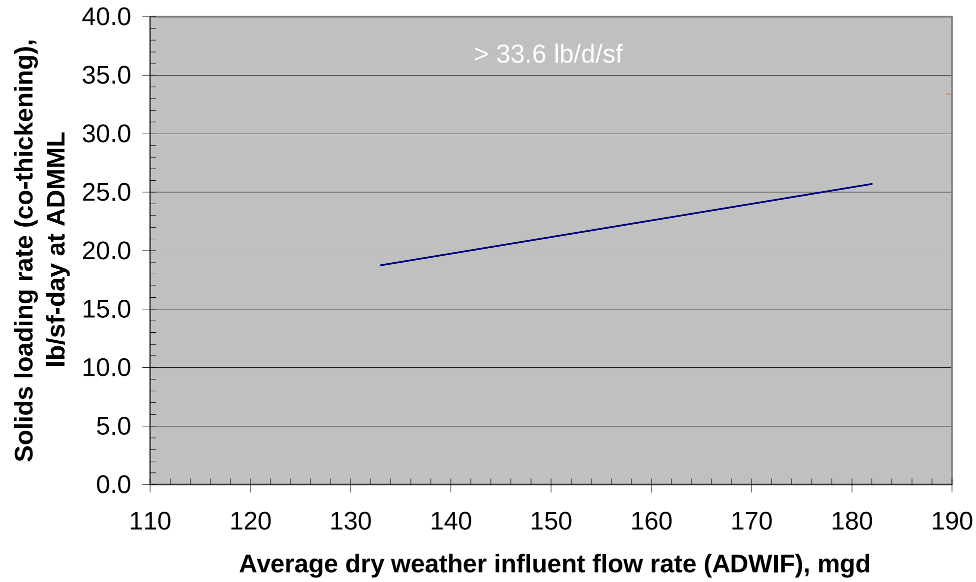


Figure D-4. DAFT solids loading with co-thickening, ADMML conditions

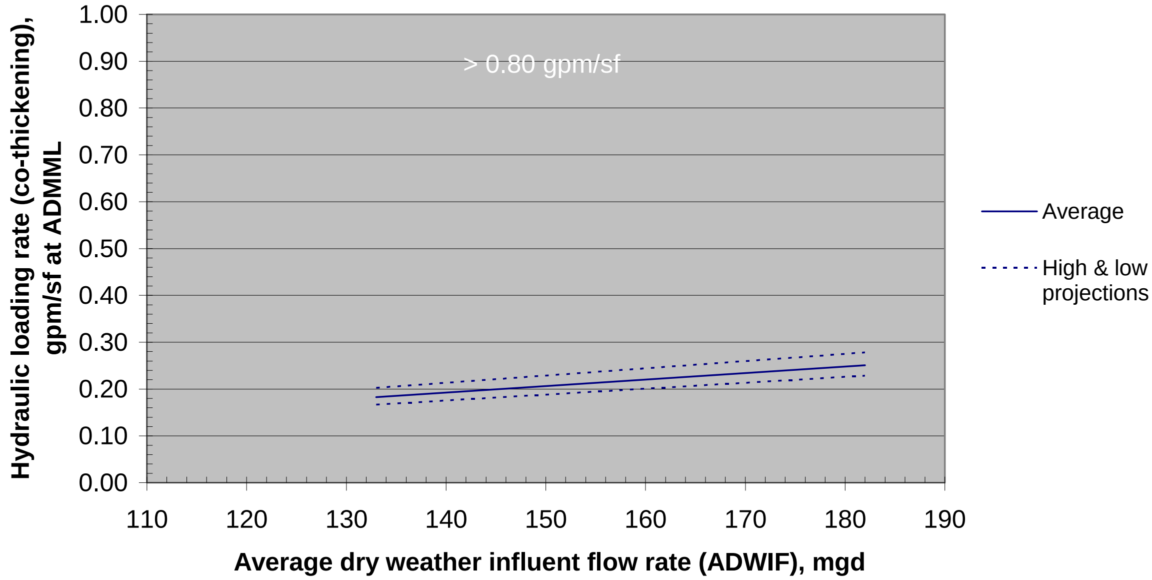


Figure D-5. DAFT hydraulic loading with co-thickening, ADMML conditions

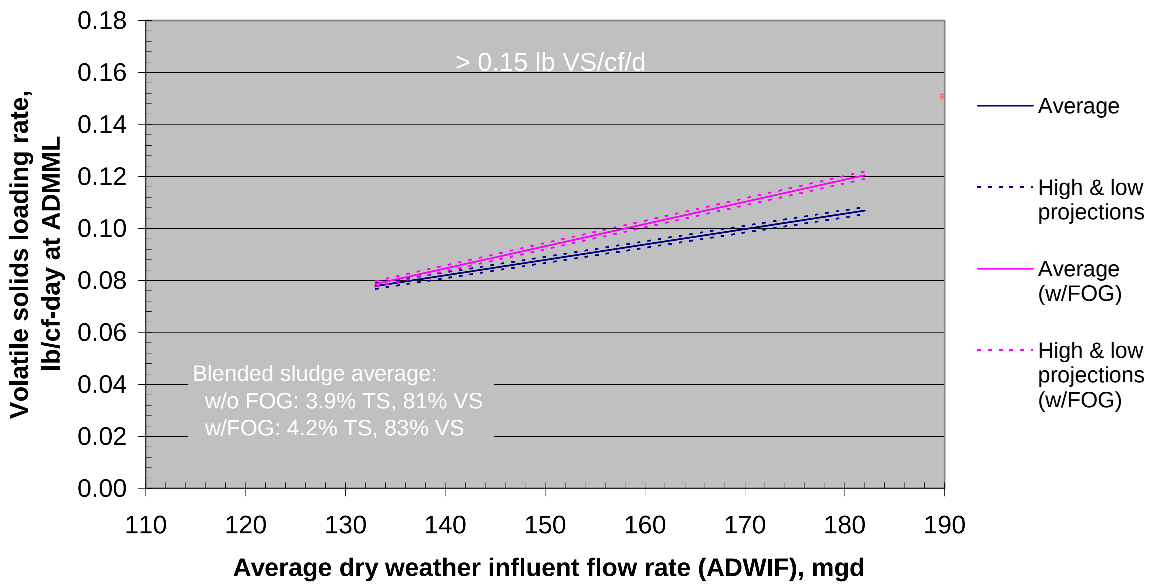


Figure D-6. Digester volatile solids loading, ADMML conditions

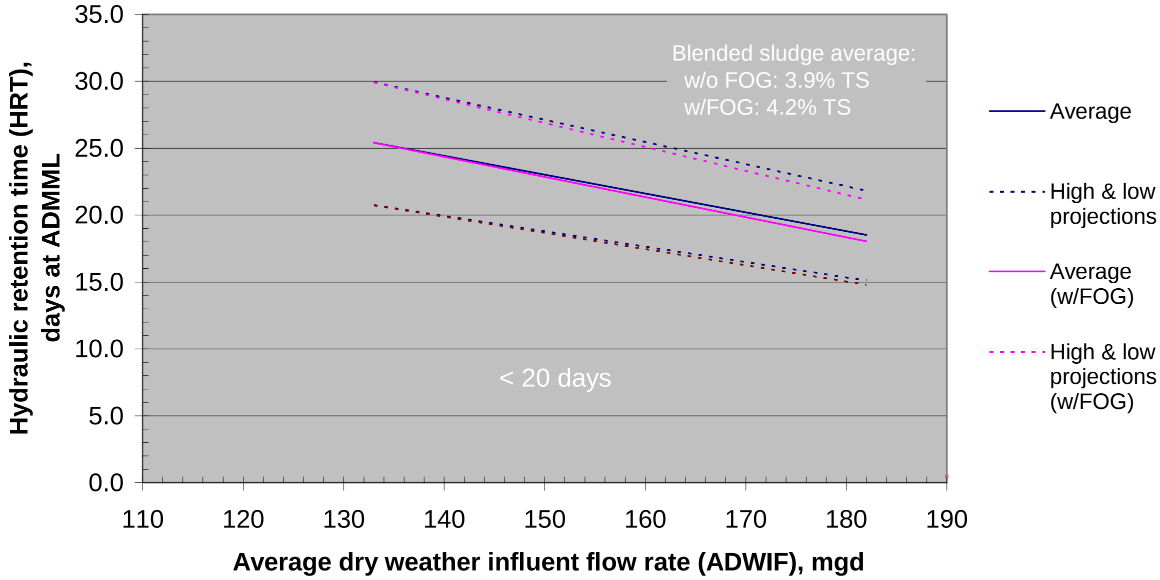


Figure D-7. Digester hydraulic loading, ADMML conditions

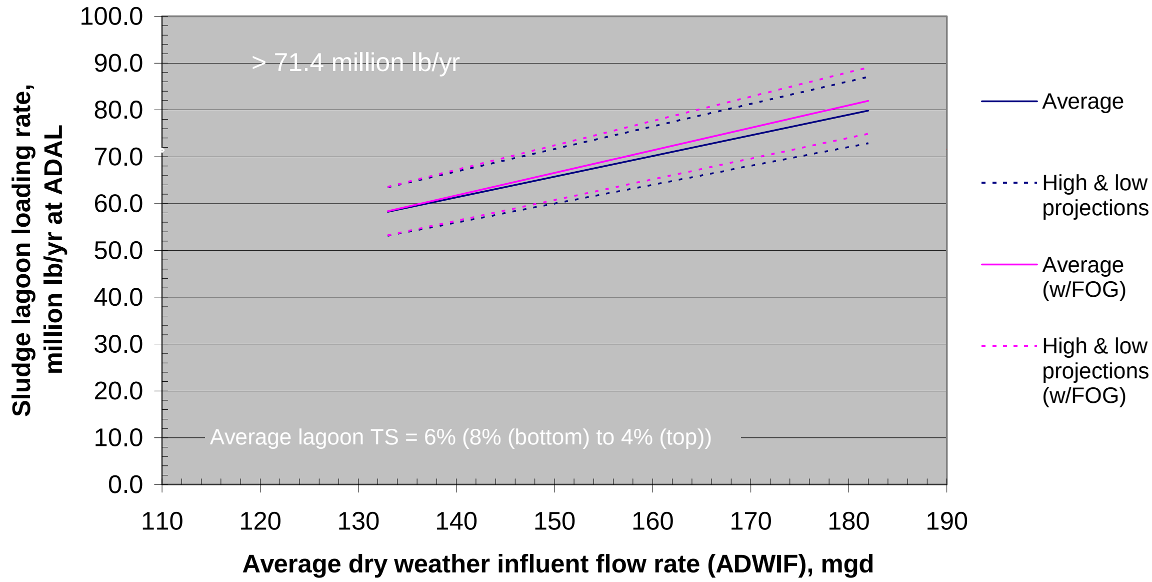


Figure D-8. Sludge lagoon solids loading, ADAL conditions

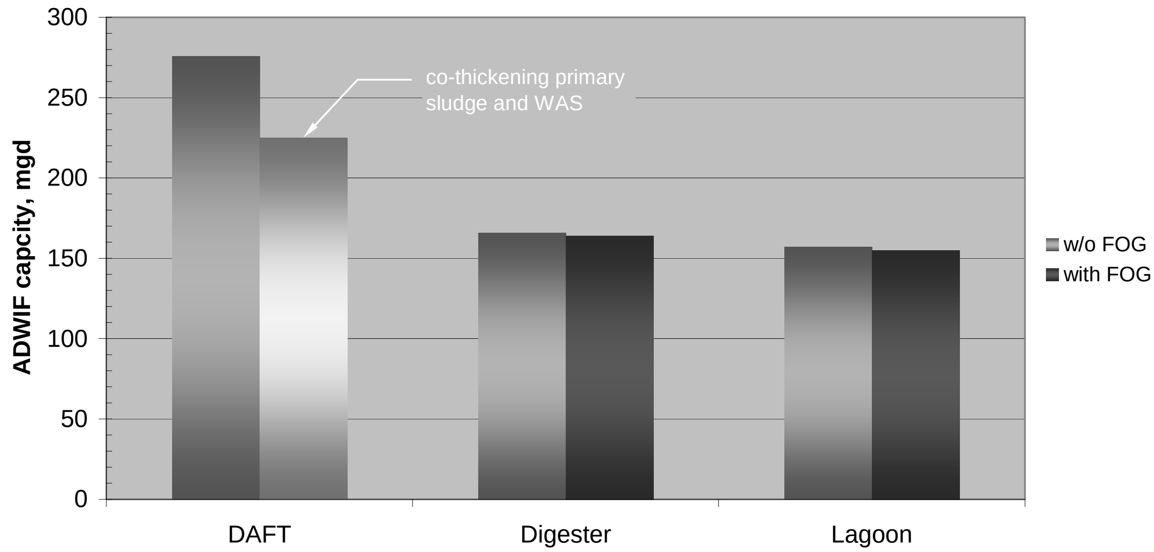


Figure D-9. Solids handling unit processes capacity summary