BROWN AND CALDWELL

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Technical Memorandum

Prepared for: City of Sunnyvale, Sunnyvale, CA

Project Title: Sunnyvale Strategic Infrastructure Plan for the WPCP

Project No: 135083

Technical Memorandum

Subject: Influent Flows and Loads

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1. EXECUTIVE SUMMARY

Historical plant influent data (2004 – 2007) to the City of Sunnyvale (City) Water Pollution Control Plant (WPCP) were provided by the City for the flows and loads analysis. The objective of the analysis was to determine future flows and loads that will be used for planning efforts. Historical influent data that were analyzed included: daily influent flows, 5-day carbonaceous biochemical oxygen demand (CBOD), total suspended solids (TSS), and ammonia. The daily CBOD, TSS and ammonia values were converted to daily influent loadings by multiplying concentration by influent flow. Flow peaking factors were determined using historical data to make predictions for peak wet weather, peak day, peak week and peak month flows. The peak hour peaking factor was determined using data from a recent wet-weather related peak flow event. Peaking factors were also developed for CBOD, TSS and ammonia. Historical census data provided by the City were used with the results of the historical data analysis to generate flows and load projections to 2035. The results of the flow and load analysis are summarized in Table ES-1.

Table ES-1. Projected Influent Flows and Loads								
Parameter	2005/2006*	2010	2015	2020	2025	2030	2035	Ultimate Planning Allowance
Influent Flows								
ADWF, mgd	14.2	15.7	15.9	16.0	16.2	16.2	16.7	29.5
AAF, mgd	15.1	16.9	17.2	17.3	17.5	17.5	18.0	31.9
AWWF, mgd	15.4	17.4	17.6	17.7	17.9	17.9	18.5	32.7
Peak Month Flow, mgd	17.6	21.0	21.3	21.5	21.7	21.7	22.4	39.6
Peak Week Flow, mgd	19.5	22.8	23.1	23.3	23.5	23.5	24.3	42.9
Peak Day Flow, mgd	23.3	30.1	30.6	30.7	31.1	31.1	32.0	56.7
Peak Hour Flow, mgd	---	47.0	47.7	48.0	48.5	48.5	50.0	88.5
Minimum Daily Flow, mgd	9.95	9.81	9.96	10.0	10.1	10.1	10.4	18.5
Minimum Hourly Flow, mgd	5.37	5.30	5.38	5.41	5.46	5.47	5.63	9.98
CBOD Loading								
ADWL, lb/d	22,061	22,739	23,509	24,360	25,211	25,948	26,734	47,332
Peak Month Loading, lb/d	29,185	32,516	33,616	34,834	36,051	37,104	38,228	67,682
Peak Week Loading, lb/d	36,268	39,706	41,050	42,536	44,023	45,309	46,681	82,649
Peak Day Loading, lb/d	44,994	54,191	56,024	58,053	60,082	61,837	63,710	112,798
TSS Loading								
ADWL, lb/d	17,934	18,485	19,110	19,802	20,494	21,093	21,732	38,476
Peak Month Loading, lb/d	27,276	33,467	34,599	35,852	37,105	38,189	39,346	69,662
Peak Week Loading, lb/d	47,100	52,293	54,062	56,020	57,977	59,672	61,479	108,848
Peak Day Loading, lb/d	69,672	85,107	87,987	91,173	94,359	97,116	100,057	177,151
Ammonia Loading								
ADWL, lb/d	2,750	2,834	2,930	3,036	3,143	3,234	3,332	5,900
Peak Month Loading, lb-N/d	3,600	4,151	4,291	4,446	4,602	4,736	4,880	8,640
Peak Day Loading, lb-N/d	4,463	5,327	5,507	5,707	5,906	6,079	6,263	11,088

** The 2005/2006 data was determined by taking the average of the annual values (2004-2007) for each parameter.*
AAF – annual average flow
ADWF – average dry weather flow
AWWF – average wet weather flow
ADWL – average dry weather load

2. INTRODUCTION

This Technical Memorandum (TM) describes the development of the influent flows and loads to the WPCP. The influent flows and loads developed in this TM will be used for subsequent tasks as a part of the Strategic Infrastructure Plan for the WPCP.

2.1 Background

Four years of historical influent data (January 1, 2004 to December 31, 2007) to the WPCP were provided by the City for the development of influent flows and loads. Influent data included daily measurements of: flow, CBOD, TSS, and ammonia. Influent temperature data is not collected and was therefore not analyzed. In addition, influent total Kjeldahl nitrogen (TKN) is not measured. The TKN provides a measurement of ammonia and organic nitrogen and is used to estimate the amount of nitrogen available for nitrification. For subsequent analyses of treatment processes, it is recommended that the influent TKN is measured to estimate the ratio of influent TKN to ammonia.

The TSS, CBOD and ammonia samples are 24-h flow-weighted composite samples and represent influent concentrations (i.e. no return streams are included). Similarly, influent flows represent influent only and do not include contributions from return streams. Plant recycles from a well operated facility can contribute up to 20 to 30 percent of the influent flows and loads. For subsequent analyses of treatment equipment, the influent flows and loads will be increased by 20 percent to account for return streams.

Average influent flow is recorded once per day. Influent CBOD and TSS composite samples are collected approximately 3 times per week. Influent ammonia composite sample collection frequency has varied over the years, but is collected approximately once per week. Table 1 presents the frequency of CBOD, TSS and ammonia sample collection on specific days of the week. Table 1 shows that most CBOD and TSS samples are collected Monday through Thursday with Tuesdays and Wednesdays being the most common; samples are rarely collected on Fridays, Saturdays or Sundays. The majority of ammonia samples are collected Sunday through Wednesday with most collected Monday through Wednesday.

Table 1. Frequency of TSS, CBOD and Ammonia Influent Sample Collection by Day of the Week (2004 – 2007)

Day of Week	TSS	CBOD	Ammonia
Sunday	6%	6%	15%
Monday	17%	17%	29%
Tuesday	26%	27%	27%
Wednesday	27%	27%	22%
Thursday	16%	16%	6%
Friday	7%	7%	1%
Saturday	0%	0%	0%

The frequency of sample collection presented in Table 1 will result in some bias to the influent data. In addition, it is more difficult to accurately determine peak week and peak day loadings for CBOD and TSS because samples are not collected every day. The same is true for ammonia, and because samples are collected once per week, peak week loadings were not determined.

3. ANALYSIS OF HISTORICAL DATA

3.1 Influent Flows

Daily flows for the period January 1, 2004 to December 31, 2007 are shown in Figure 1. The vertical lines on the figure indicate wet and dry weather seasons. The dry weather season is defined as the lowest average flow for three consecutive dry weather months as defined by the existing NPDES permit.

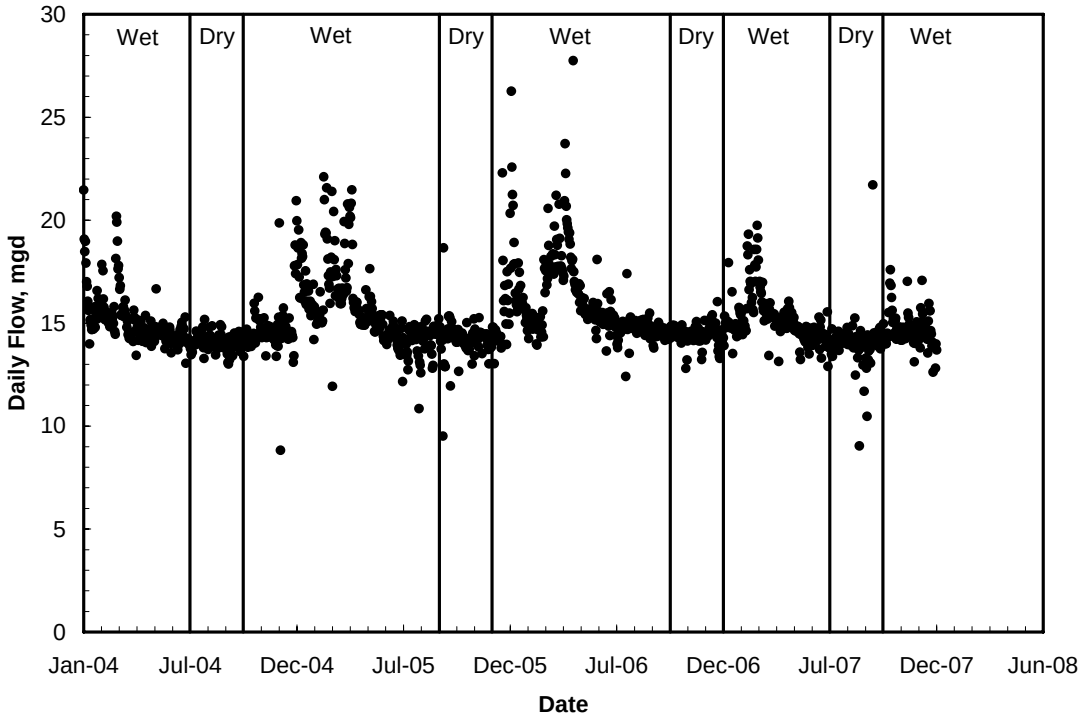

Figure 1. Daily Influent Flows for January 1, 2004 to December 31, 2007 with Wet and Dry Weather Seasons.

For each of the four years of record, the following daily flows were determined: annual average flow (AAF), average dry weather flow (ADWF), average wet weather flow (AWWF), peak average day flow, peak average week flow, and peak average month flow. The ADWF was determined from the lowest flow from three consecutive months as defined by the NPDES permit. These flows are given in Table 2. The results in Table 2 show that there has not been a significant increase in flows over the past four years. In addition, analysis of the historic record showed that peak day flow event and peak week flow event occurred during peak month flow event in 2006.

Table 2. Different Daily Flows for January 1, 2004 through December 31, 2007

Parameter	Flow, mgd			
	2004	2005	2006	2007
ADWF	14.1	14.2	14.4	14.0
AAF	14.8	15.3	15.6	14.8
AWWF	15.0	15.6	16.0	15.0
Peak Month Flow	16.2	17.9	19.4	17.1
Peak Week Flow	18.5	20.3	21.0	18.4
Peak Day Flow	21.5	22.3	27.8	21.7
Minimum Day Flow	8.82	9.51	12.41	9.04

Peaking factors were calculated by taking the ratio of the various flows in Table 2 and dividing them by ADWF. These peaking factors are given in Table 3.

Table 3. Observed Flow Peaking Factors for January 1, 2004 through December 31, 2007

Ratio	Peaking Factor			
	2004	2005	2006	2007
AAF:ADWF	1.05	1.08	1.08	1.05
AWWF:ADWF	1.06	1.10	1.11	1.07
Peak Month:ADWF	1.15	1.26	1.34	1.22
Peak Week:ADWF	1.32	1.43	1.46	1.31
Peak Day:ADWF	1.52	1.57	1.92	1.55
Minimum Day Flow:ADWF	0.63	0.67	0.86	0.64

The peaking factors observed over the four-year period were identified, all of which occurred in 2006. Table 4 presents the peaking factors determined from the historical record that are recommended for subsequent analysis. The peak hour peaking factor presented in Table 4 was determined from historical flow data from the Sunnyvale influent pumping station. Figure 2 presents hourly flows from January 2, 2008 to January 7, 2008, which represents the largest wet-weather related flow event in recent history. The peak hour flow was 40.4 mgd which corresponds to a peaking factor of 2.89 (assuming an ADWF of 14.0 mgd). A peak hour:ADWF of 3.00 was assumed for the flows and loads analysis. The minimum hourly flow factor (0.54) was determined using the data from Figure 2 (using flows from January 2 and January 3, 2008). This factor is applied to the minimum daily flow to determine the minimum hour flow. These values can be verified in the future if the City does a hydraulic analysis of the collection system.

Table 4. Recommended Flow Peaking Factors

Ratio	Recommended Peaking Factor
AAF:ADWF	1.08
AWWF:ADWF	1.11
Peak Month:ADWF	1.34
Peak Week:ADWF	1.46
Peak Day:ADWF	1.92
Peak Hour:ADWF	3.00
Minimum Day: ADWF	0.63
Minimum Hourly Flow:Average Daily Flow	0.54

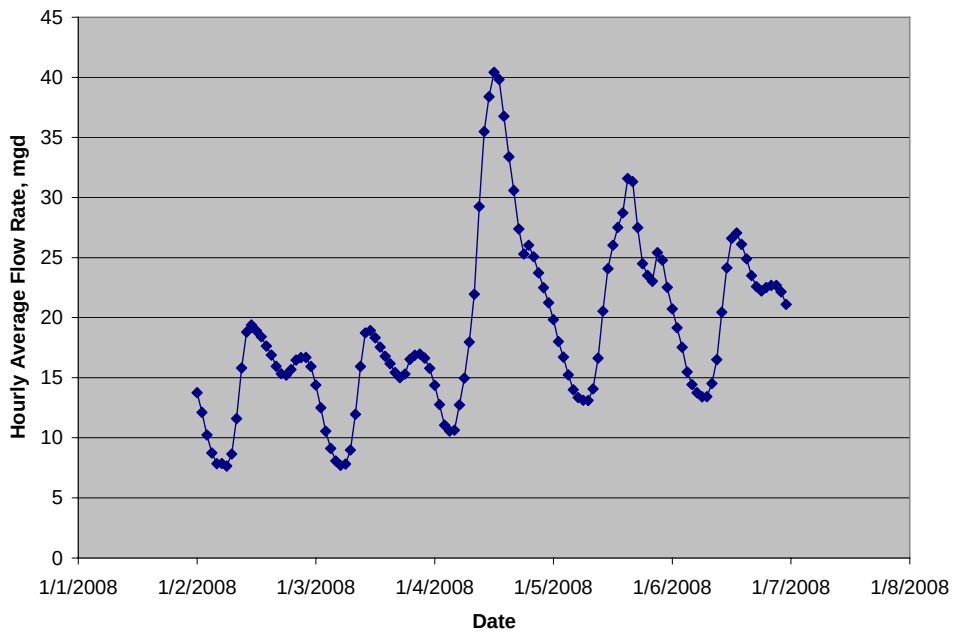

Figure 2. Sunnyvale Influent Pumping Station Hourly Flows (1/2/08 – 1/7/08).

3.2 Influent CBOD Loading

For each of the four years of record, the following daily CBOD loadings were determined: annual average loading, average dry weather loading (ADWL), peak average day load, peak average week load, and peak average month load. Table 5 presents the influent CBOD loadings. Similar to influent flows, the influent CBOD loadings have not increased over the past 4 years. In fact, CBOD loadings have slightly reduced. For 2004, 2005, and 2007, the peak day and peak week loadings occurred during the peak month.

Table 5. Different Daily CBOD Loads for January 1, 2004 through December 31, 2007

Parameter	Loading, lb/d			
	2004	2005	2006	2007
Annual Average	23,317	23,495	21,881	22,317
ADWL	23,781	22,146	20,836	21,482
Peak Month	34,006	29,634	26,487	26,614
Peak Week	41,525	33,139	35,496	34,912
Peak Day	56,673	44,279	38,376	40,648

The peaking factors for each year are presented in Table 6. Table 7 presents the recommended peaking factors for subsequent analysis. With the exception of the annual average loading:ADWL, the maximum peaking factors occurred in 2004. The recommended peaking factors are typical of wastewater plants of this size.

Table 6. Observed CBOD Loading Peaking Factors for January 1, 2004 through December 31, 2007

Ratio	Peaking Factor			
	2004	2005	2006	2007
Annual Average:ADWL	0.98	1.06	1.05	1.04
Peak Month:ADWL	1.43	1.34	1.27	1.24
Peak Week:ADWL	1.75	1.50	1.70	1.63
Peak Day:ADWL	2.38	2.00	1.84	1.89

Table 7. Recommended CBOD Loading Peaking Factors

Ratio	Recommended Peaking Factor
Annual Average:ADWL	1.06
Peak Month:ADWL	1.43
Peak Week:ADWL	1.75
Peak Day:ADWL	2.38

3.3 Influent TSS Loading

For each of the four years of record, the following daily TSS loadings were determined: annual average loading, ADWL, peak average day load, peak average week load, and peak average month load. Table 8 presents the influent TSS loadings. From 2004 to 2007, there was not an increase in annual average loading. However, there was an increase in ADWL of 16 percent from 2004 to 2007. For 2004, 2006, and 2007, the peak day and peak week loadings occurred during the peak month.

Table 8. Different Daily TSS Loads for January 1, 2004 through December 31, 2007

Parameter	Loading, lb/d			
	2004	2005	2006	2007
Annual Average	19,484	17,276	20,675	19,495
ADWL	16,317	16,665	19,772	18,980
Peak Month	32,469	20,354	28,892	27,389
Peak Week	44,124	42,641	47,941	53,695
Peak Day	75,128	42,641	73,812	87,109

The peaking factors for each year are presented in Table 9. With the exception of the peak week:ADWL, all peaking factors occurred in 2004. Table 10 presents the recommended peaking factors for subsequent analysis. With the exception of peak month, the largest values for each parameter were used. The peak month peaking factor for 2004 was much higher than any other peak month peaking factor (values ranged from 1.22 to 1.46). If the peak month peaking factor for 2004 were used, unusually high peak month TSS loadings would be predicted for the load projection. Instead, a peaking factor of 1.81 was selected which was determined by taking the peak loading that occurred in the historical record (32,469 lb/d in 2004) and dividing it by the average of each ADWL value (17,934 lb/d). The peaking factors presented in Table 10 are considered high for a wastewater plant of this size and could be attributed to solids becoming resuspended in the collection system due to increased flows during a storm event.

Table 9. Observed TSS Loading Peaking Factors for January 1, 2004 through December 31, 2007

Ratio	Peaking Factor			
	2004	2005	2006	2007
Annual Average:ADWL	1.19	1.04	1.05	1.03
Peak Month:ADWL	1.99	1.22	1.46	1.44
Peak Week:ADWL	2.70	2.56	2.42	2.83
Peak Day:ADWL	4.60	2.56	3.73	4.59

Table 10. Recommended TSS Loading Peaking Factors

Ratio	Recommended Peaking Factor
Annual Average:ADWL	1.19
Peak Month:ADWL	1.81
Peak Week:ADWL	2.83
Peak Day:ADWL	4.60

3.4 Influent Ammonia Loading

For each of the four years of record, the following daily ammonia loadings were determined: annual average loading, ADWL, peak average day load, peak average week load, and peak average month load. Table 11 presents the influent ammonia loadings. From 2004 to 2007, there was a 19 percent increase in annual average loading; ADWL followed a similar pattern of increase. The increase in ammonia is not expected to

continue, and future ammonia loadings are expected to rise linearly with population increase. For 2004, 2005 and 2006, the peak loading occurred during the peak month.

Table 11. Different Daily Ammonia Loads for January 1, 2004 through December 31, 2007

Parameter	Loading, lb-N/d			
	2004	2005	2006	2007
Annual Average	2,728	2,875	3,126	3,247
ADWL	2,215	2,821	2,899	3,065
Peak Month	3,243	3,488	3,623	4,047
Peak Day	4,087	4,080	3,923	5,761

The peaking factors for each year are presented in Table 12. Table 12 presents the recommended peaking factors for subsequent analysis. With the exception of the peak week:ADWL, all peaking factors occurred in 2004. The peaking factors presented in Table 13 are typical of wastewater plants of this size.

Table 12. Observed Ammonia Loading Peaking Factors for January 1, 2004 through December 31, 2007

Ratio	Peaking Factor			
	2004	2005	2006	2007
Annual Average:ADWL	1.23	1.02	1.08	1.06
Peak Month:ADWL	1.46	1.24	1.25	1.32
Peak Day:ADWL	1.85	1.45	1.35	1.88

Table 13. Ammonia Loading Peaking Factors Recommended for Design

Ratio	Recommended Peaking Factor
Annual Average:ADWL	1.23
Peak Month:ADWL	1.46
Peak Day:ADWL	1.88

4. PROJECTED FLOWS AND LOADS

4.1 Critical Design Condition

For the design of treatment processes, it is important to know the occurrence of peak events. It would be overly conservative to assume that peak flows are coincident with peak loads. The historical data were analyzed to determine the occurrence of these events. Table 14 summarizes the results of this analysis. The most conservative occurrence was used for the critical design condition. If two events were coincident in the historic data, it is assumed that they can be coincident in the future. The parameters and coincident events summarized in Table 14 will be used to determine treatment capacity in subsequent analyses.

Table 14. Critical Design Condition for Each Parameter

Parameter	Coincident Event
CBOD Loading	
Peak Day	peak week flow
Peak Week	peak week flow
Peak Month	peak month flow
TSS Loading	
Peak Day	AWWF
Peak Week	peak month flow
Peak Month	AAF
Ammonia Loading	
Peak Day	peak month flow
Peak Month	AWWF

4.2 Population Projections

The historical flow and load analysis has shown that there has been little change over the past four years. For the future projections, Sunnyvale population data from the Association of Bay Area Governments (ABAG) (Projections 2007: Forecasts for the San Francisco Bay Area to Year 2035, December, 2006) show a population increase from 133,086 people in 2000 to 163,300 people by 2035 (Figure 3). Population results also show that the persons per household should remain the same at 2.5 people per household (data not shown). It is important to note that the Sunnyvale population data does not include Rancho Rinconada in Cupertino which is a tributary to the plant. Presumably, the Rancho Rinconada population is small compared to the Sunnyvale population. In addition, it is assumed that increases in Rancho Rinconada population will be similar to Sunnyvale in the future. Figure 4 shows the expected percent increase in population from 2007 to 2035 is 20 percent.

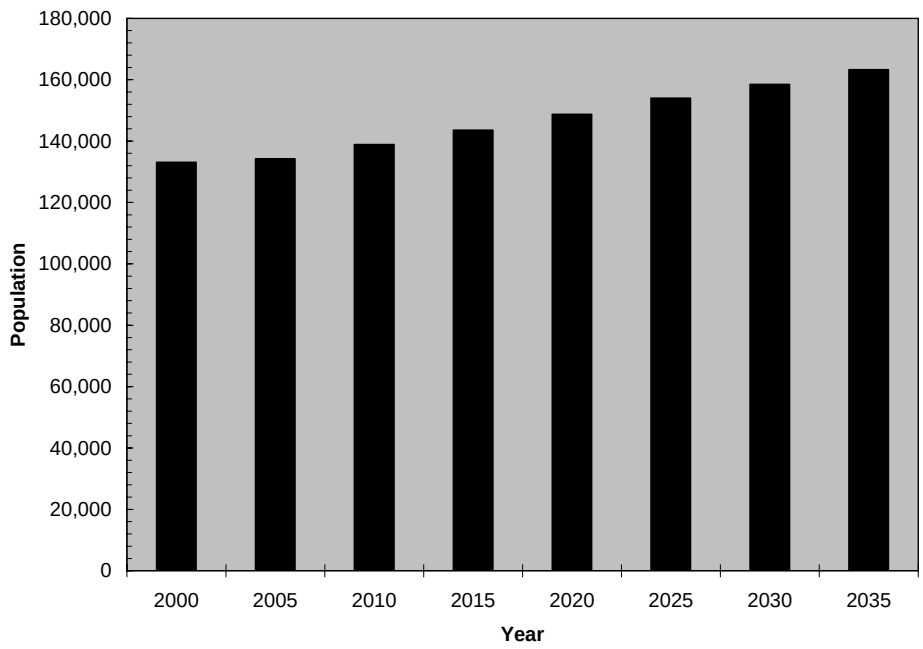

Figure 3. Population Predictions for Sunnyvale (numbers do not include Rancho Rinconada).

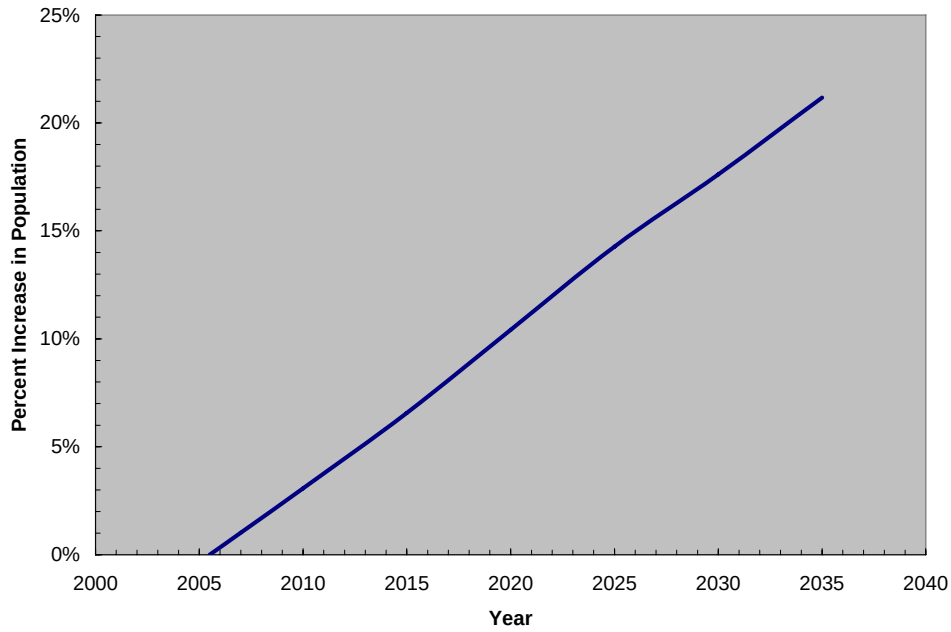

Figure 4. Relative Increase in Population Used for Flow and Loading Projections.

4.3 Flow and Load Projections

The City has seen much higher flows in the past than currently. Planning documents from the early eighties anticipated ADWFs of 29.5 mgd for the plant, but in recent years, the ADWF has been 14.0 to 14.4 mgd

(Table 2). The older planning numbers from the past reflected much higher industrial usage of the wastewater treatment plant than occurs currently. In the early eighties, canneries were centered in Sunnyvale, which are very high water using industries. Indeed the plant design was configured to serve their high summer flows and organic loadings. Originally, the raw product for these operations largely was produced either within the county or nearby. Urbanization (conversion of farms to subdivisions) and other economic drivers caused the canneries to relocate to farming areas (principally the Central Valley) where both transportation and the costs for water and wastewater services were lower. The relatively low cost of land there allowed the use of less costly land disposal systems.

What happened to Sunnyvale was not unique and happened in other urban areas, including San Jose, Oakland and Sacramento. Replacement with high tech industry, with their lower water use, fueled the continued growth of the city. At the same time, efforts at water conservation from all sectors have been successful, and per capita water use has declined. Figure 5 shows that Sunnyvale flows from 1990 to 2005 have not increased at a rate consistent with the population growth. So these various trends have had two opposing influences at the wastewater treatment plant; today it serves more people but receives less flow.

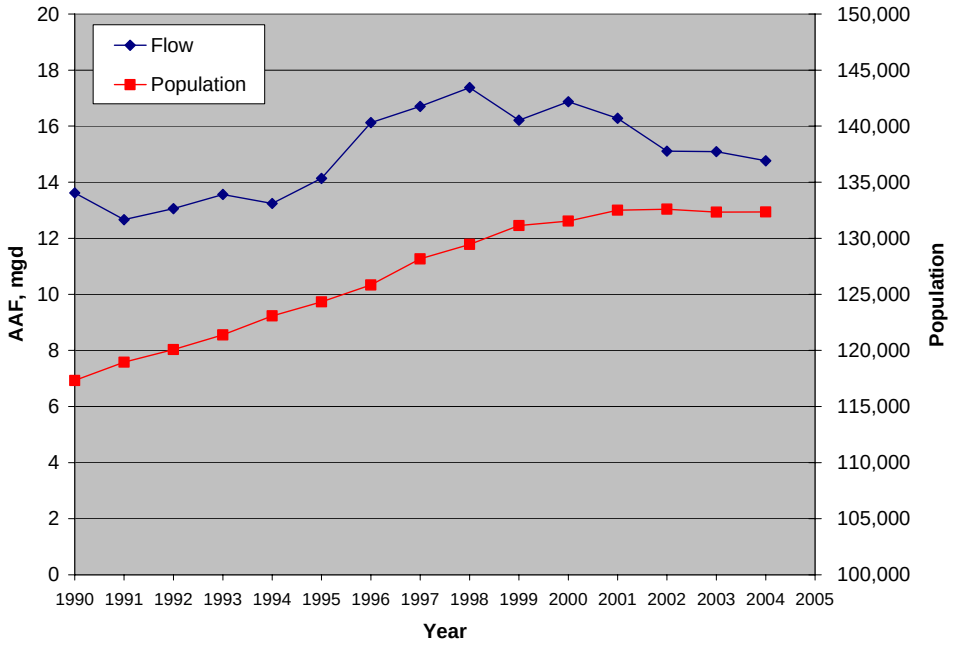

Figure 5. Historical (1990-2005) AAF and Population for the City of Sunnyvale. (Population numbers are adapted from the California Department of Finance).

In our judgment, we see no change in the development patterns that would cause either heavy water using industries to return to Sunnyvale nor to reverse the gains already made or projected to occur with respect to water conservation. Therefore, we have limited our analysis to waste flows and loads that have occurred in the recent past and projected ahead based on current population projections and estimated increases in water demand in the City

The City of Sunnyvale Wastewater Collection Master Plan (CH2MHill, 2002) provided information on projected build out wastewater flows for the City of Sunnyvale. However, there were several issues identified in the report by EOA, Inc. (Appendix C of the Collection System Master Plan). EOA noted that although the overall wastewater flow estimate was consistent with current wastewater flows, the breakdown by category (i.e., residential, industrial and commercial) was not consistent with estimates presented in the Bartle Wells

Rate study, and a previous analysis performed by EOA. CH2MHill used acreage to determine build out wastewater flows; EOA used winter water use flows (the Bartle Wells analysis used a similar methodology to EOA). For the future flow analysis, CH2MHill did not project a net increase in the flow through 2030, and EOA stated that these predictions should be accurate. However, these flow projections do not reflect recent population projections, commercial water use projections and future changes in residential flows (i.e., multi-family dwelling units versus single family dwelling units).

Rather than using information from the Collection System Master Plan, the City's Urban Water Management Plan (UWMP) (December 2005, Revision August, 2006) and the SFPUC Wholesale Customer Water Demand Projections Technical Report (URS, November 2004) were considered for wastewater flow projections. It is assumed that wastewater flow will increase in proportion to the increase in residential and commercial water use. Table 15 presents the water use projections from each report. Both reports predict an increase in water use from 2000 to 2030. On average, the SFPUC predictions are 2.0 mgd higher than the UWMP predictions. This difference could be due to differences in service areas. Regardless, the UWMP is a more recent document and will more accurately reflect expected changes for the City of Sunnyvale. Therefore, the UWMP was used as the basis for future wastewater flow projections for this project.

Table 15. Water Use Projections for City of Sunnyvale
(adapted from City's UWMP and SFPUC Wholesale Customer Water Demand Projections Technical Report,)

	UWMP Predictions (including residential, irrigation, commercial and system losses)		SFPUC Predictions	
Year	UWMP Water Use (MGD)	Percent Change	SFPUC Water Use (MGD)	Percent Change
2005	22.1		24.8	
2010	21.0	-4.9%	25.0	0.8%
2015	23.3	10.6%	25.3	1.2%
2020	23.6	1.4%	25.6	1.2%
2025	23.9	1.3%	25.9	1.2%
2030	24.2	1.3%	26.3	1.5%
2035	24.6	1.7%	26.8	1.9%

Figure 6 shows that the UWMP projects a net increase in residential and commercial water use through 2030; landscape irrigation water use not associated with dwelling units (e.g., golf course, park and median irrigation) is not included. Single family water use is not expected to increase significantly (8.01 mgd in 2000 to 8.10 in 2030). Multi-family water use will increase from 5.77 mgd in 2000 to 6.87 mgd in 2030. Commercial water use is not expected to change significantly from 2000 (5.53 mgd) to 2030 (5.85 mgd). However, there was a drop in commercial water use in 2005 that is expected to increase in the subsequent years.

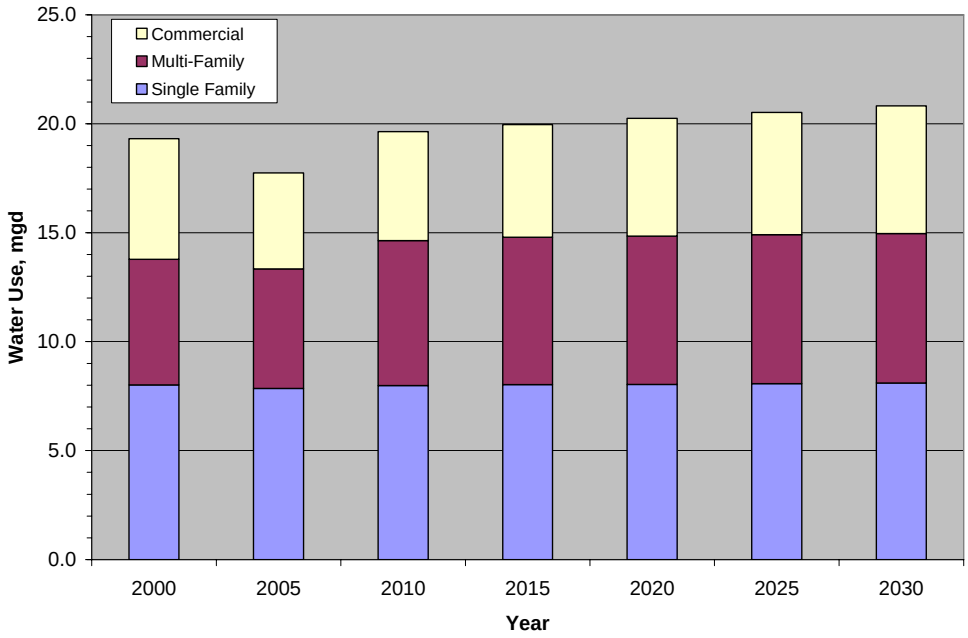

Figure 6. Water Use for Multi-Family, Single Family and Commercial Sectors; Landscape Irrigation Water Use not Shown. Data adapted from City's UWMP.

Table 16 presents the residential and commercial water flows (landscape irrigation not included) from the UWMP normalized by population. The reduction in normalized water use is attributed to an increase in multi-family dwelling unit water use. Table 16 also presents the calculated normalized wastewater production values. The average value for AAF for 2004-2007 (15.10 mgd) was normalized to the population for 2005 (134,300) and a normalized wastewater flow of 112 gallons/capita-day was determined. Projected normalized wastewater values were estimated from the 2005 value, assuming that the same trend predicted for water use would apply to wastewater flows. Normalizing the flows to population accounts for the differences in population numbers (UWMP used 2005 projections; wastewater projections will be based on 2007 projections). The difference between the normalized water and wastewater values is expected, and is attributed to residential irrigation and other minor losses. Using the ABAG population projections in Figure 3 and the normalized wastewater flow values presented in Table 16, the influent flows were projected out to 2035. Figure 7 shows that the AAF is predicted to increase from 15.1 mgd in 2005 to 18.0 mgd by 2035.

Table 16. Normalized Water Use and Wastewater Production

Year	Normalized Water Use* (gal/capita-day)	Normalized Wastewater Production (gal/capita-day)
2005	133	112
2010	145	122
2015	142	120
2020	138	116
2025	135	113
2030	131	110
2035	131**	110

** Adapted from City's UWMP*
*** No data available for 2035; the 2030 value was assumed.*

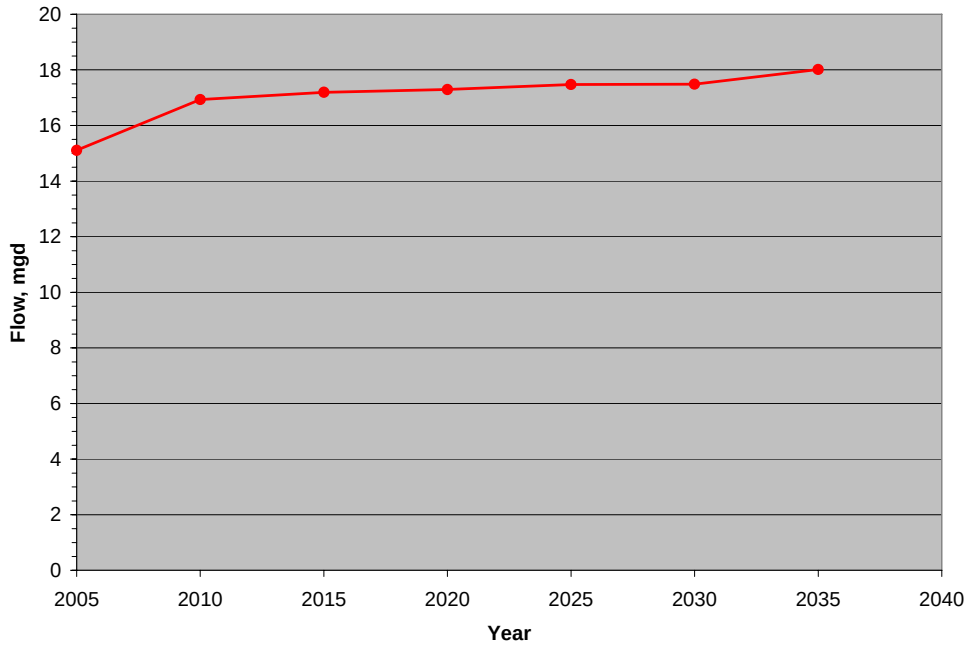

Figure 7. Projected AAF based on water use trends from the UWMP and the 2007 ABAG predictions.

Table 17 presents the projected flow and loads for the Sunnyvale WPCP. The flows and loads associated with the ultimate planning allowance of 29.5 mgd ADWF are also included. Influent BOD, TSS and ammonia projections were determined using the normalized loadings (i.e. mass of constituent divided by population). The normalized loadings (0.13 lb/capita-day for TSS; 0.16 lb/capita-day for BOD; 0.02 lb-N/capita-day for ammonia) were multiplied by the population projection to make a loading projection. The peaking factors determined for flow, CBOD, TSS and ammonia were used to estimate peak loadings and results are presented in Table 17.

Table 17. Projected Influent Flows and Loads

Parameter	2005/2006*	2010	2015	2020	2025	2030	2035	Ultimate Planning Allowance
Influent Flows								
ADWF, mgd	14.2	15.7	15.9	16.0	16.2	16.2	16.7	29.5
AAF, mgd	15.1	16.9	17.2	17.3	17.5	17.5	18.0	31.9
AWWF, mgd	15.4	17.4	17.6	17.7	17.9	17.9	18.5	32.7
Peak Month Flow, mgd	17.6	21.0	21.3	21.5	21.7	21.7	22.4	39.6
Peak Week Flow, mgd	19.5	22.8	23.1	23.3	23.5	23.5	24.3	42.9
Peak Day Flow, mgd	23.3	30.1	30.6	30.7	31.1	31.1	32.0	56.7
Peak Hour Flow, mgd	---	47.0	47.7	48.0	48.5	48.5	50.0	88.5
Minimum Daily Flow, mgd	9.95	9.81	9.96	10.0	10.1	10.1	10.4	18.5
Minimum Hourly Flow, mgd	5.37	5.30	5.38	5.41	5.46	5.47	5.63	9.98
CBOD Loading								
ADWL, lb/d	22,061	22,739	23,509	24,360	25,211	25,948	26,734	47,332
Peak Month Loading, lb/d	29,185	32,516	33,616	34,834	36,051	37,104	38,228	67,682
Peak Week Loading, lb/d	36,268	39,706	41,050	42,536	44,023	45,309	46,681	82,649
Peak Day Loading, lb/d	44,994	54,191	56,024	58,053	60,082	61,837	63,710	112,798
TSS Loading								
ADWL, lb/d	17,934	18,485	19,110	19,802	20,494	21,093	21,732	38,476
Peak Month Loading, lb/d	27,276	33,467	34,599	35,852	37,105	38,189	39,346	69,662
Peak Week Loading, lb/d	47,100	52,293	54,062	56,020	57,977	59,672	61,479	108,848
Peak Day Loading, lb/d	69,672	85,107	87,987	91,173	94,359	97,116	100,057	177,151
Ammonia Loading								
ADWL, lb/d	2,750	2,834	2,930	3,036	3,143	3,234	3,332	5,900
Peak Month Loading, lb-N/d	3,600	4,151	4,291	4,446	4,602	4,736	4,880	8,640
Peak Day Loading, lb-N/d	4,463	5,327	5,507	5,707	5,906	6,079	6,263	11,088

** The 2005/2006 data was determined by taking the average of the annual values (2004-2007) for each parameter.*

5. CONCLUSIONS

The following conclusions can be made from the flow and load analysis for the Sunnyvale WPCP:

- Influent CBOD and TSS samples are collected approximately three times per week and influent ammonia samples are collected approximately once per week. In addition, samples are typically not collected on weekends.
- It is recommended that the influent TKN is measured to make some estimate of the ratio of influent TKN to ammonia for sizing treatment processes.
- Analysis of historical data (2004 – 2007) was performed to determined peaking factors. Selected peaking factors represent the maximum value of the four years of data. In general, the peak flows occurred in 2006 and the peak loadings occurred in 2004.

- Peak day wet weather flow can be approximately twice the ADWF.
- The peaking factor for peak hour flow was assumed to be 3.0 based on the largest wet-weather related flow event in recent history. This value can be verified in the future if the City does a hydraulic analysis of the collection system.
- Peak influent CBOD and ammonia loading peaking factors were typical for a wastewater plant of this size. The influent TSS loading peaking factors were higher than typical and could be due to the resuspension of solids in the collection system during peak flow events.
- Annual average influent flows, CBOD loadings and TSS loadings have not significantly increased in the past four years. There was an increase in ammonia loadings but this trend is not expected to continue.
- Flow projections (Table 17) were made using 2007 ABAG population projections (Figure 3) and water use projections from the City's UWMP. Load projections were determined assuming historical loadings per capita, and accounting for population increase. Peak flows and loads were determined using the peaking factors determined from historical data (Tables 4, 7, 10 and 13).
- Critical design conditions for influent flows and loads (Table 14) were determined from analysis of the historical data.