Bay Area Clean Water Agencies
Nutrient Reduction Study

Group Annual Report

Nutrient Watershed Permit Annual Report

2018

October 1, 2018

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1 Introduction

On April 9, 2014 the San Francisco Bay Regional Water Quality Control Board (Regional Water Board) adopted the Nutrient Watershed Permit, also known as National Pollutant Discharge Elimination System (NPDES) Permit No. CA0038873, Regional Water Board Order No. R2-2014-0014. The Nutrient Watershed Permit became effective on July 1, 2014 and covers each municipal Publicly Owned Treatment Works (POTW) that discharges to the San Francisco Bay and its tributaries. The purpose of this Nutrient Watershed Permit is to track and evaluate treatment plant performance, fund nutrient research and monitoring programs, support load response modeling, and conduct treatment plant optimization and upgrade studies for nutrient removal.

One of the requirements of the Nutrient Watershed Permit is the reporting and analysis of effluent nutrient monitoring data, and concentration and loading trends. Each agency's nutrient loads must also be compared to total POTW loads in their respective subembayment, as defined in the permit. An annual report is required to provide an ongoing record of these data and analyses.

The purpose of this Group Annual Report is to fulfill the reporting and analysis requirement of the Nutrient Watershed Permit for the participating agencies for the period between July 1, 2012 and June 30, 2018. This report includes the following sections:

- **Section 2 – Background.** This section includes relevant background information on the requirements of the Nutrient Watershed Permit.
- **Section 3 – Approach.** This section presents the approach to obtain data, the constituents of interest, data confirmation, seasonality analysis, and statistical trending.
- **Section 4 – Results.** This section presents the data for each discharger as well as the annual and seasonal averages for the Discharge Flow, Ammonia, Total Kjeldahl Nitrogen, Nitrite plus Nitrate, Total Nitrogen, Orthophosphate, and Total Phosphorus. In addition, the contributing flows and loads for each discharger are presented in comparison to the other dischargers in its respective subembayment.
- **Section 5 – Discussion.** This section includes a discussion of the data presented in Section 4.
- **Section 6 – Summary.** This section provides a brief summary of the findings, discussion, and recommendations that will improve the data collection and analysis in future years.
- **Appendix.** A separate section is provided in the appendix to present the data and analysis for each of the thirty-four dischargers.

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2 Background

The Nutrient Watershed Permit applies to the municipal wastewater dischargers and specific facilities identified in Table 2-1. In addition, the location of each discharger is shown in Figure 2-1.

Table 2-1. Municipal Wastewater Dischargers Included in the Nutrient Watershed Permit

Discharger Name (Abbreviation)	POTW Facility Name	Minor / Major[(a)]
American Canyon, City of (American Canyon)	Wastewater Treatment and Reclamation Facility	Major
Benicia, City of (Benicia)	Benicia Wastewater Treatment Plant	Major
Burlingame, City of (Burlingame)	Burlingame Wastewater Treatment Plant	Major
Central Contra Costa Sanitary District (CCCSD)	Central Contra Costa Sanitary District Wastewater Treatment Plant	Major
Central Marin Sanitation Agency (CMSA)	Central Marin Sanitation Agency Wastewater Treatment Plant	Major
Crockett Community Services District (Port Costa)	Port Costa Wastewater Treatment Plant	Minor
Delta Diablo (Delta Diablo)	Wastewater Treatment Plant	Major
East Bay Dischargers Authority (EBDA) (City of Hayward, City of San Leandro, Oro Loma Sanitary District, Castro Valley Sanitary District, Union Sanitary District, Livermore-Amador Valley Water Management Agency, Dublin San Ramon Services District, and City of Livermore)	EBDA Common Outfall	Major
	Hayward Water Pollution Control Facility	
	San Leandro Water Pollution Control Plant	
	Oro Loma/Castro Valley Sanitary Districts Water Pollution Control Plant	
	Raymond A. Boege Alvarado Wastewater Treatment Plant	
	Livermore-Amador Valley Water Management Agency Export and Storage Facilities	
	Dublin San Ramon Services District Wastewater Treatment Plant	
	City of Livermore Water Reclamation Plant	
East Bay Municipal Utility District (EBMUD)	East Bay Municipal Utility District, Special District No. 1 Wastewater Treatment Plant	Major
Fairfield-Suisun Sewer District (FSSD)	Fairfield-Suisun Wastewater Treatment Plant	Major
Las Gallinas Valley Sanitary District (Las Gallinas)	Las Gallinas Valley Sanitary District Sewage Treatment Plant	Major
Marin County (Paradise Cove), Sanitary District No. 5 of	Paradise Cove Treatment Plant	Minor
Marin County (Tiburon), Sanitary District No. 5 of	Wastewater Treatment Plant	Minor
Millbrae, City of (Millbrae)	Water Pollution Control Plant	Major
Mt. View Sanitary District (Mt View)	Mt View Sanitary District Wastewater Treatment Plant	Major
Napa Sanitation District (Napa)	Soscol Water Recycling Facility	Major
Novato Sanitary District (Novato)	Novato Sanitary District Wastewater Treatment Plant	Major
Palo Alto, City of (Palo Alto)	Palo Alto Regional Water Quality Control Plant	Major
Petaluma, City of (Petaluma)	Ellis Creek Water Recycling Facility	Major

Discharger Name (Abbreviation)	POTW Facility Name	Minor / Major[a]
Pinole, City of (Pinole)	Pinole-Hercules Water Pollution Control Plant	Major
Rodeo Sanitary District (Rodeo)	Rodeo Sanitary District Water Pollution Control Facility	Major
San Francisco (San Francisco International Airport), City and County of (SFO Airport)	Mel Leong Treatment Plant, Sanitary Plant	Major
San Francisco (Southeast Plant), City and County of (SFPUC Southeast)	Southeast Water Pollution Control Plant	Major
San Jose/Santa Clara Water Pollution Control Plant and Cities of San Jose and Santa Clara (San Jose)	San Jose/Santa Clara Water Pollution Control Plant	Major
San Mateo, City of (San Mateo)	City of San Mateo Wastewater Treatment Plant	Major
Sausalito-Marin City Sanitary District (SMCSD)	Sausalito-Marin City Sanitary District Wastewater Treatment Plant	Major
Sewerage Agency of Southern Marin (SASM)	Sewerage Agency of Southern Marin Wastewater Treatment Plant	Major
Sonoma Valley County Sanitary District (Sonoma Valley)	Municipal Wastewater Treatment Plant	Major
Silicon Valley Clean Water (SVCW)	SVCW Wastewater Treatment Plant	Major
South San Francisco and San Bruno, Cities of (South SF)	South San Francisco and San Bruno Water Quality Control Plant	Major
Sunnyvale, City of (Sunnyvale)	Sunnyvale Water Pollution Control Plant	Major
U.S. Department of Navy (Treasure Island)	Wastewater Treatment Plant	Major
Vallejo Flood and Wastewater District (Vallejo) [b]	Vallejo Wastewater Treatment Plant	Major
West County Agency (West County) (West County Wastewater District and City of Richmond Municipal Sewer District)	West County Agency Combined Outfall	Major

(a) As defined in the Nutrient Watershed Permit.
(b) Formerly known as the Vallejo Sanitation and Flood Control District

The Nutrient Watershed Permit has specific effluent monitoring requirements. Each agency covered by the Permit is required to monitor and report the following constituents in their effluent:

1. Ammonia as Nitrogen
2. Total Kjeldahl Nitrogen
3. Nitrate/Nitrite as Nitrogen
4. Total Nitrogen as Nitrogen
5. Soluble Reactive Phosphorus as Phosphorus
6. Total Phosphorus

Figure 2-1. Location of Dischargers

Major municipal dischargers having a permitted or design flow greater than 10 million gallons per day (mgd), are required to sample twice per month. Major municipal dischargers having a flow less than 10 mgd, are required to sample once per month. Minor municipal discharges, which are those with a flow less than 1 mgd, are required to monitor twice per year. In addition, dischargers are required to sample only during the portion of the year when they are discharging. The data collected must be submitted monthly on the Regional Water Board’s California Integrated Water Quality System (CIWQS) online data reporting tool.

Prior to the sampling required under the Nutrient Watershed Permit, the dischargers were required to perform similar sampling and data collection. This early data collection was required under the Regional Water Board's Section 13267 Letter, dated March 2, 2012.[1]

Together, the Nutrient Watershed Permit data and the Section 13267 Letter data, form the dataset for the analysis and reporting in this Group Annual Report. Additional information regarding the data sources and data confirmation is included in Section 3.

Per Attachment E, Section IV.B.1.b., of the Nutrient Watershed Permit the Group Annual Report must include the following:

ii. Summary tables depicting the Discharger's annual and monthly flows, nutrient concentrations, and nutrient mass loads, calculated as described in Section VIII.1 Arithmetic Calculations of Standard Provisions (Attachment G of individual permits) covering July 1 through June 30 of the preceding year. Each individual Discharger shall document its nutrient loads relative to other facilities covered by this Order that discharge to the same subembayment, i.e., Suisun Bay, San Pablo Bay, Central Bay, South Bay, and Lower South Bay.

iii. An analysis of nutrient trends, load variability, and an assessment as to whether or not nutrient mass discharges are increasing or decreasing.

iv. If trend analysis shows a significant change in load, the Discharger shall investigate the cause and shall report its results, or status, or plans for investigation, in the annual report or in subsequent annual reports. This investigation shall include, at a minimum, whether treatment process changes have reduced or increased nutrient discharges, changes in nutrient loads related to water reclamation (increasing or decreasing), and changes in total influent flow resulted to water conservation, population growth, transient work community, new industry, and/or changes in wet weather flows.

[1] Wolfe, Bruce. (2012) Letter: Water Code Section 13267 Technical Report Order Requiring Submittal of Information on Nutrients in Wastewater Discharges. March 2, 2012. http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/planningtmdls/amendments/estuarineNNE/Nutrients%2013267%20Order%20-%203-12.pdf

3 Approach

The sources of effluent data, as well as the approach for data confirmation, analysis of seasonality, and statistical trending are presented in the subsections below.

3.1 Data Sources

Data from July 2012 to June 2018 was collected from two different sources, including that compiled for the Section 13267 Letter requirements and the subsequent Nutrient Watershed Permit data. The Section 13267 Letter data includes the initial two years (July 2012 through June 2014) and the Nutrient Watershed Permit data includes the subsequent years (July 2014 through June 2018).

The sampling requirements and frequency differ between the two data sets. The requirements for each are summarized in Table 3-1.

Table 3-1. Comparison of Section 13267 Letter and Nutrient Watershed Permit Requirements

Parameter	Section 13267 Letter Data	Nutrient Watershed Permit Data
Major Dischargers and Sampling Frequency	1) Flows ≥5 mgd permitted capacity a. Year round dischargers: Sample twice per month and two additional samples each wet season during peak wet weather flow conditions b. Seasonal dischargers: Sample twice per month during discharge (wet) season; sample once during non-discharge (dry) season 2) Flows between 1 and 5 mgd permitted capacity a. Year round dischargers: Sample twice per month and two additional samples each wet season during peak wet weather flow conditions b. Seasonal dischargers: Sample twice per month during discharge (wet) season; sample once during non-discharge (dry) season	1) Flows >10 mgd permitted capacity must sample twice per month 2) Flows between 1 and 10 mgd permitted capacity must sample once per month
Minor Dischargers and Sampling Frequency	1) Flows <1 mgd permitted capacity a. Year round dischargers: Sample once per month b. Seasonal dischargers: Sample once per month during discharge (wet) season; sample once during non-discharge (dry) season	1) Flows <1 mgd permitted capacity must sample twice per year
Non-Nutrient Sampling Parameters	Flow pH Temperature	Flow
Nitrogen Species and Sample Type	1) Total Ammonia (NH3 plus NH4+, reported as N) – Composite Sample 2) Total Dissolved Nitrogen (TDN, reported as N) – Composite Sample 3) Total Kjeldahl Nitrogen (TKN, reported as N) – Composite Sample 4) Soluble Kjeldahl Nitrogen (SKN, reported as N) – Composite Sample	1) Total Ammonia (NH3 plus NH4+, reported as N) – Composite Sample 2) Total Kjeldahl Nitrogen (TKN) – Composite Sample 3) Nitrate (NO3-) plus Nitrite (NO2-) (NOx, reported as N) – Composite Sample 4) Total Nitrogen (TN, calculated) – Composite Sample

Parameter	Section 13267 Letter Data	Nutrient Watershed Permit Data
	5) Nitrate (NO_3^-, reported as N) – Composite Sample 6) Nitrite (NO_2^-, reported as N) – Composite Sample 7) Urea (limited to 5 largest dischargers, reported as N) – Composite Sample	
Phosphorus Species and Sample Type	1) Total Phosphorus (TP) – Composite Sample 2) Soluble Total Phosphorus (STP; reported as P) – Composite Sample 3) Dissolved Orthophosphate (reported as P) – Composite or Grab Sample 4) Total Orthophosphate (reported as P) – Composite Sample	1) Soluble Reactive Phosphorus (SRP, reported as P) – Grab Sample 2) Total Phosphorus (TP) – Composite Sample

3.2 Parameters of Interest

A list of the parameters required by both the Section 13267 Letter and the Nutrient Watershed Permit and their respective measurement methodology is presented in Table 3-2. With the exception of orthophosphate (measured as soluble reactive phosphorus, SRP), the samples for all other parameters were 24 hour composites. The orthophosphate sample type was a composite or grab for the Section 13267 Letter data and a grab sample for the Nutrient Watershed Permit data.

Table 3-2. List of Parameters, Methodology, and Sample Type Required for both Datasets

Parameter	Measured or Calculated	Sample Type	Method[a,b]	Calculation
Flow	Both (plant specific)	Continuous		$Flow\ (mgd) = \frac{Load\ (\frac{kg}{d})}{Conc\ \left(\frac{mg}{L}\right) * 3.78}$
Total Ammonia	Measured[c]	24-hr Composite	4500-NH3	
TKN	Both (plant specific)[c]	24-hr Composite	4500-N(org)	
NOx	Measured[c]	24-hr Composite	4500-N	
TN	Calculated[c]	24-hr Composite	Calculated	$TN = TKN + NOx$
SRP (referred to as Ortho-P[d] from herein)	Measured[c]	24-hr Composite or Grab for Section 13267 Letter data; Grab for Nutrient Watershed Permit	4500-P	
TP	Measured[c]	24-hr Composite	4500-P	

a. Standard Methods for the Examination of Water and Wastewater 2017-23rd Edition, American Public Health Association/American Water Works Association/Water Environment Federation, Washington, D.C.
b. Dischargers may propose other U.S. EPA-approved analytical methods, if available, with detection limits low enough to quantify concentrations in wastewater.
c. For plants with only flow and concentration values available, loads were manually calculated for daily values and/or using average monthly flow and concentration values.
d. Dissolved orthophosphate if available and total orthophosphate if dissolved not available.

The phosphorus species are different for the Section 13267 Letter data and the Nutrient Watershed Permit data. The Section 13267 Letter data requires sampling for a suite of phosphorus species (total phosphorus, soluble total phosphorus, dissolved orthophosphate and total orthophosphate). In contrast, the Watershed Permit requires soluble reactive phosphorus which is unclear, as a specific method of analysis was not defined. As a result, the phosphorus species reported under the Watershed Permit varies by discharger. The species listed in CIWQS, available for reporting, includes: total phosphate, dissolved orthophosphate, total orthophosphate, and dissolved phosphorus. The majority of agencies reported as dissolved orthophosphate (28 out of the 33 discharging agencies). The remaining dischargers reported total orthophosphate.

In order to provide consistency, the analysis presented in this Group Annual Report is based on:

- Dissolved orthophosphate from the Section 13267 Letter dataset;
- FY14/15: Dissolved orthophosphate, if available, and total orthophosphate otherwise; and
- FY15/16: Orthophosphate is reported as soluble reactive phosphorus.

In this Group Annual Report, SRP is referred to as orthophosphate (ortho-P).

3.3 Data Confirmation

Once the datasets were collected and compiled, the data for each plant was summarized and provided to each participating discharger for review and confirmation. The data presented in this Group Annual Report reflects additions and corrections provided by the participating agencies.

3.4 Seasonality

The seasonal variations in the data were examined by dividing the data into a dry and wet season. Understanding seasonality is critical for the analysis of nutrient discharges because of the following factors:

- The dry season is reflective of the base sanitary flows and loads from residential population and industrial contributions to wastewater. In contrast, the increased flows during wet weather events is attributed to inflow and infiltration (I&I) during such events which can bias the discharge results, especially for small datasets such as this.
- Wastewater treatment facilities are better able to remove nutrient loads (if deemed necessary) during the warmer, dry season when the kinetics of biological treatment are more favorable and there are fewer (if any) peak flow events.
- A Nutrient Management Study led by the San Francisco Estuary Institute (SFEI) is currently underway to evaluate San Francisco Bay’s resilience to nutrients. It is expected to be less sensitive to nutrients during the wet season because the water is cooler, light irradiance in the Bay is reduced, turbidity in the Bay is elevated, and the hydraulic residence time in the Bay is reduced.

Seasonality is defined in the participating agencies’ NPDES permits in different ways; furthermore, not all the permits have a seasonal definition. In order to provide a consistent basis for the purposes of this Group Annual Report, the seasonal definition presented in the approved Scoping and Evaluation Plan[2] was used. The wet and dry seasons are defined as follows:

- Dry season: May 1 through September 30
- Wet season: October 1 through April 30

3.5 Trend Analysis

The effluent data was evaluated to identify evidence of trends over the past six years. Due to the change in sampling frequency between the Section 13267 Letter and Watershed Permit requirements, there is an inconsistency in the reporting of flows and loads during the wet season. Specifically, the Section 13267 Letter data required that in addition to normal monthly sampling, two additional samples be taken in the wet season during peak wet weather events. This requirement is not included in the Watershed Permit. As a result, an artificial bias has been introduced which was expected to overestimate the wet season load. A sensitivity analysis was performed for each Subembayment to confirm this bias. Based on that analysis, it was confirmed that the peak wet weather events do impact the trend analysis because the dataset is not large enough to offset such a load. For example, there are a few instances (e.g., Lower South Bay ammonia loading) with the Section 13267 Letter data that are several times greater than the average annual values and can skew the trending analysis. As a result, the trend analysis was limited to the dry season, which best represents the actual base sanitary wastewater flows and loads for each plant.

The approach used to evaluate trend significance was the slope of a regression line. The slope was determined using the method of least squares.[3] The sample set size was 5 samples per year (n = 30 in total for the six years of effluent data; limited to the last four years of dry season discharge data (n = 20) for orthophosphate due to sampling biases which is further discussed in Section 5.8). An alpha of 0.05 was assumed which denotes that a 5 percent risk of concluding that a difference exists when there is no actual difference. A trend was denoted significant if the p-value was less than alpha. Furthermore, the percent change with respect to the initial three years of data was included to serve as a reference or baseline for the extent of change over time.

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[2] Bay Area Clean Water Agencies (2015) Scoping and Evaluation Plan for Potential Nutrient Reduction by Treatment Optimization and Treatment Upgrades. Order No. R2-2014-0014, NPDES Permit No. CA0038873.

[3] Montgomery, D.C.; Peck, E.A.; Vining, G.G. (2012) Introduction to Linear Regression Analysis. Published by John Wiley and Sons, Inc. Hoboken, NJ. Pages 12-66.

4 Results

This section presents a discussion of the dataset limitations as well as the data results for the following effluent parameters:

1. Flow
2. Total Ammonia (reported as N)
3. Total Kjeldahl Nitrogen
4. Nitrate plus Nitrite (NOx, reported as N))
5. Total Nitrogen (reported as N)
6. Orthophosphate (reported as P)
7. Total Phosphorus

Data are summarized for each discharger, as well as for each of the five subembayments. The data are also presented for both the annual average and dry season average. Data are presented based on the period of collection; for example, 2012/2013 represents the period between July 1, 2012 and June 30, 2013.

In addition, the relative contribution of flow and loads for each discharger is provided for each subembayment.

4.1 Dataset Limitations

There are some limitations in the overall dataset for the period between July 2012 and June 2018. The sampling frequency requirements vary by size of discharger, ranging from once per dry season for minor plants to twice per month for plants larger than 10 mgd. It is further complicated by the earlier Section 13267 Letter requirement to sample twice per wet season during peak wet weather events. This variation in data collection creates inconsistencies in the datasets and presents limitations on statistical analysis for the purposes of trending. Given the relatively small dataset (n = 72 for most dischargers), a few additional samples from wet weather events can artificially exaggerate the average monthly load values during the wet period as previously discussed in Section 3.5..

As previously described, the trend analysis presented in the following subsections is based on the Dry Season (n = 30 for most dischargers).

Since the first Group Annual Report submitted in 2015, there have been several data changes as follows:

- Data from the City of Palo Alto, the City of San Mateo, and Napa Sanitation District submitted under the 2015 Group Annual Report Submittal was initially updated in the 2016 Report with updated data that is reflected in this report.
- Total Nitrogen data from the Las Gallinas 2015-2016 dataset was updated with values that are reflected in this report.
- Data from the Rodeo Sanitary District 2014-2016 datasets were updated with values that are reflected in this report.

- Ammonia data for June 2017 from Sausalito Marin City Sanitation District were updated with values that are reflected in this report.
- TKN data for June 2015 from Sewerage Agency of Southern Marin was updated from 0 to 0.6 kg N/d. This report reflects the updated data.
- Flow data from Tiburon for the 2014/2015 and 2015/2016 were inaccurately reported in the 2017 Group Annual Report. This report reflects the accurate data from CIWQS.

4.2 Flows

The annual average and dry season average monthly effluent flows are presented in Table 4-1 and Table 4-2, respectively. The annual average and dry season effluent flows discharged to each subembayment are presented in Table 4-3 and Table 4-4, respectively.

Table 4-1. Annual Average Daily Effluent Flows by Discharger (mgd)

Discharger	Sub-embayment (a)	Permitted Capacity (b)	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
American Canyon	SPB	2.5	1.5	1.4	1.5	1.5	1.7	1.4
Benicia	SPB	4.5	2.2	2.1	2.0	2.0	2.4	2.0
Burlingame	SB	5.5	3.0	3.0	3.0	2.8	3.6	2.8
CCCSD	SUB	53.8	37.4	36.2	33.7	33.2	42.8	35.4
CMSA	CB	10	7.7	6.1	7.0	7.8	13.0	9.3
Port Costa	SPB	0.033	0.01	0.01	0.01	0.02	0.03	0.02
Delta Diablo	SUB	19.5	6.9	6.1	7.3	7.1	9.3	9.6
EBDA	SB	107.8	62.2	59.6	59.4	60.5	68.5	59.7
EBMUD	CB	120	58.8	57.2	52.2	52.9	65.6	52.5
FSSD	SUB	23.7	13.6	12.6	12.3	12.8	15.0	13.4
Las Gallinas[c]	SPB	2.92	1.4	1.2	1.3	1.7	2.9	1.4
Millbrae	SB	3	1.5	1.7	1.4	1.4	1.9	1.5
Mt. View	SUB	3.2	1.4	1.3	1.3	1.2	1.5	1.3
Napa[c]	SPB	15.4	5.0	4.6	5.3	6.0	8.9	4.6
Novato[c]	SPB	7	3.2	2.9	3.3	2.9	4.8	3.0
Palo Alto	LSB	39	21.7	19.5	19.4	21.6	24.3	18.4
Paradise Cove	CB	0.04	0.01	0.01	0.01	0.01	0.01	0.01
Petaluma[c]	SPB	6.7	3.7	4.3	3.2	2.8	4.6	3.2
Pinole	SPB	4.06	2.6	2.6	2.5	2.4	2.9	2.5
Rodeo	SPB	1.14	0.6	0.6	0.6	0.6	0.7	0.6
San Jose	LSB	167	92.5	85.6	83.0	79.3	89.2	87.0
San Mateo	SB	15.7	10.8	10.0	10.4	10.1	12.2	10.4
SASM	CB	3.6	2.2	2.7	2.4	2.5	3.0	2.3
SFO Airport	SB	2.2	1.1	1.2	1.1	1.1	1.2	1.2
SFPUC Southeast	SB	84.5	56.8	58.6	56.0	56.3	62.3	57.4
SMCSD	CB	1.8	1.5	1.3	1.2	1.3	1.5	1.2
Sonoma Valley[c]	SPB	3	1.6	1.3	0.3	0.6	2.2	0.0
South SF	SB	13	9.0	8.7	8.6	8.3	9.1	7.6
Sunnyvale	LSB	29.5	10.3	11.0	10.4	10.1	11.7	10.6
SVCW	SB	29	13.2	12.4	12.4	14.1	15.9	14.0
Tiburon	CB	0.98	0.58	0.59	0.64	0.55	0.79	0.62
Treasure Island	CB	2	0.3	0.3	0.3	0.3	0.4	0.3
Vallejo	SPB	15.5	10.4	9.1	10.2	9.7	12.5	9.2
West County	CB	28.5	8.5	8.3	7.5	9.3	13.2	9.8
Total [d]		**826**	**453**	**434**	**421**	**425**	**510**	**434**

a. SB = Suisun Bay; SPB = San Pablo Bay; CB = Central Bay; SB = South Bay; LSB = Lower South Bay

b. Based on ADWF permitted capacity. Data is presented in detail and summarized for each plant in the Appendix.

c. No discharge during a portion or all of the dry season months, except with authorization under emergency conditions.

d. The total values might vary from the sum of the listed values by plant due to rounding.

Table 4-2. Dry Season Average Daily Flows by Discharger (mgd)

Discharger	Sub-embayment (a)	Permitted Capacity (b)	2012/13 (c)	2013/14 (c)	2014/15 (c)	2015/16 (c)	2016/17 (c)	2017/18 (c)
American Canyon	SPB	2.5	1.2	1.2	1.2	1.1	1.1	1.1
Benicia	SPB	4.5	1.9	2.0	1.8	1.8	1.9	1.9
Burlingame	SB	5.5	2.7	2.7	2.7	2.4	2.7	2.7
CCCSD	SUB	53.8	33.8	34.2	30.2	29.0	32.1	32.4
CMSA	CB	10	5.7	5.5	4.8	5.1	6.5	7.3
Port Costa	SPB	0.03	0.01	0.01	0.01	0.01	0.01	0.01
Delta Diablo	SUB	19.5	6.4	5.7	5.8	6.0	7.3	8.7
EBDA	SB	107.8	55.6	53.4	51.9	52.1	54.1	53.0
EBMUD	CB	120	51.4	49.3	45.4	44.2	47.0	46.9
FSSD	SUB	23.7	11.1	10.6	9.7	9.6	11.1	11.8
Las Gallinas(d)	SPB	2.92	0.0	0.0	0.0	0.0	0.4	0.0
Millbrae	SB	3	1.4	1.5	1.2	1.3	1.4	1.4
Mt. View	SUB	3.2	1.3	1.2	1.2	1.2	1.2	1.2
Napa(d)	SPB	15.4	0.0	1.2	0.0	0.0	0.0	0.0
Novato(d)	SPB	7	0.8	0.7	0.7	0.8	1.6	0.9
Palo Alto	LSB	39	23.1	20.3	19.9	19.7	21.6	17.8
Paradise Cove	CB	0.04	0.01	0.01	0.01	0.01	0.01	0.01
Petaluma(d)	SPB	6.7	0.0	0.0	0.0	0.0	0.0	0.0
Pinole	SPB	4.06	2.7	2.4	2.2	2.1	2.3	2.3
Rodeo	SPB	1.14	0.6	0.6	0.5	0.5	0.5	0.5
San Jose	LSB	167	86.0	80.2	76.3	72.2	77.2	80.7
San Mateo	SB	15.7	10.2	9.8	8.9	8.7	9.4	9.7
SASM	CB	3.6	2.0	1.9	1.8	1.8	1.8	1.9
SFO Airport	SB	2.2	1.0	1.1	1.1	0.9	1.1	1.2
SFPUC Southeast	SB	84.5	52.9	55.2	54.4	53.9	55.4	55.2
SMCSD	CB	1.8	1.2	1.1	1.1	1.1	1.2	1.1
Sonoma Valley(d)	SPB	3	0.0	0.0	0.0	0.0	0.1	0.0
South SF	SB	13	8.6	8.5	7.9	7.5	7.3	7.2
Sunnyvale	LSB	29.5	7.9	9.5	8.2	7.7	8.9	8.8
SVCW	SB	29	12.5	11.6	11.0	12.6	12.8	12.8
Tiburon	CB	0.98	0.51	0.55	0.54	0.55	0.56	0.55
Treasure Island	CB	2	0.3	0.3	0.3	0.3	0.3	0.3
Vallejo	SPB	15.5	8.9	8.7	8.6	8.3	8.6	8.4
West County	CB	28.5	7.0	6.3	5.8	6.9	9.0	8.3
Total (e)		**826**	**399**	**387**	**365**	**359**	**387**	**386**

a. SB = Suisun Bay; SPB = San Pablo Bay; CB = Central Bay; SB = South Bay; LSB = Lower South Bay

b. Based on ADWF permitted capacity.

c. Data is presented in detail and summarized for each plant in the Appendix. A "-" indicates data was not available, whereas a "0" indicates a value of zero.

d. No discharge during a portion or all of the dry season months, except with authorization under emergency conditions.

e. The total values might vary from the sum of the listed values by plant due to rounding.

Table 4-3. Annual Average Daily Discharges by Subembayment, Flow (mgd)

Subembayment	Permitted Capacity[(a)]	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
Suisun Bay	100.2	59.3	56.1	54.6	54.3	68.5	59.7
San Pablo Bay	62.8	32.2	30.2	30.1	30.1	43.9	27.9
Central Bay	166.9	79.7	76.5	71.3	74.7	97.6	76.0
South Bay	261.6	157.6	155.1	152.2	154.6	174.6	154.6
Lower South Bay	235.5	124.6	116.0	112.9	111.0	125.1	116.0
Total	**826**	**453**	**434**	**421**	**425**	**510**	**434**

a. Based on ADWF permitted capacity.

Table 4-4. Dry Season Average Daily Discharges by Subembayment, Flow (mgd)

Subembayment	Permitted Capacity[(a)]	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	Trend[(b,c)]
Suisun Bay	100.2	52.6	51.7	46.8	45.8	51.8	54.1	None
San Pablo Bay	62.8	16.1	16.9	15.1	14.6	16.4	15.2	None
Central Bay	166.9	68.1	65.0	59.7	59.9	66.4	66.4	None
South Bay	261.6	144.9	143.7	139.0	139.3	144.3	143.1	None
Lower South Bay	235.5	116.9	110.0	104.4	99.6	107.7	107.3	None
Total	**826**	**399**	**387**	**365**	**359**	**387**	**386**	**None**

a. Based on ADWF permitted capacity.

b. Trend analysis is based on average monthly values. Discernible trends were identified based on the slope of a regression line determined using the method of least squares to fit the data (alpha = 0.05). Sample size is 30. Where “None” is stated, the limited dataset does not indicate a statistically relevant trend.

c. The percent change represents the 2017/18 value in comparison to the average of the initial three years of data (2012/2013 through 2014/2015).

The total average annual discharge flows (Table 4-3) were decreasing in the initial 3 years of data, but gradually increased in 2015/2016 and subsequently significantly increased during the 2016/2017 season due to a relatively wet year in terms of precipitation. The total average annual discharge flows returned to pre-2016/2017 levels for the 2017/2018 dataset.

The 2017/2018 total dry season discharge flows (Table 4-4) were similar with the previous year’s data and near the average for the six-year period. The total dry season discharge flows were decreasing in the initial 4 years of data, but increased during the 2016/2017 season and maintained the 2016/2017 values for the 2017/2018 season.. No Subembayments or total flows showed any statistically significant trending for the discharge dry season flows. This trending is based on the least squares correlation test selected as the basis for trends analysis (see Section 3.5).

The historical average monthly daily discharge flows are presented in Figure 4-1. The South Bay and Lower South Bay Subembayments account for over half of the flow discharged to the San Francisco Bay (see Table 4-3). The dry season discharge flows show an overall decrease compared to the wet season for all subembayments.

A discussion of the results is provided in Section 5.2.

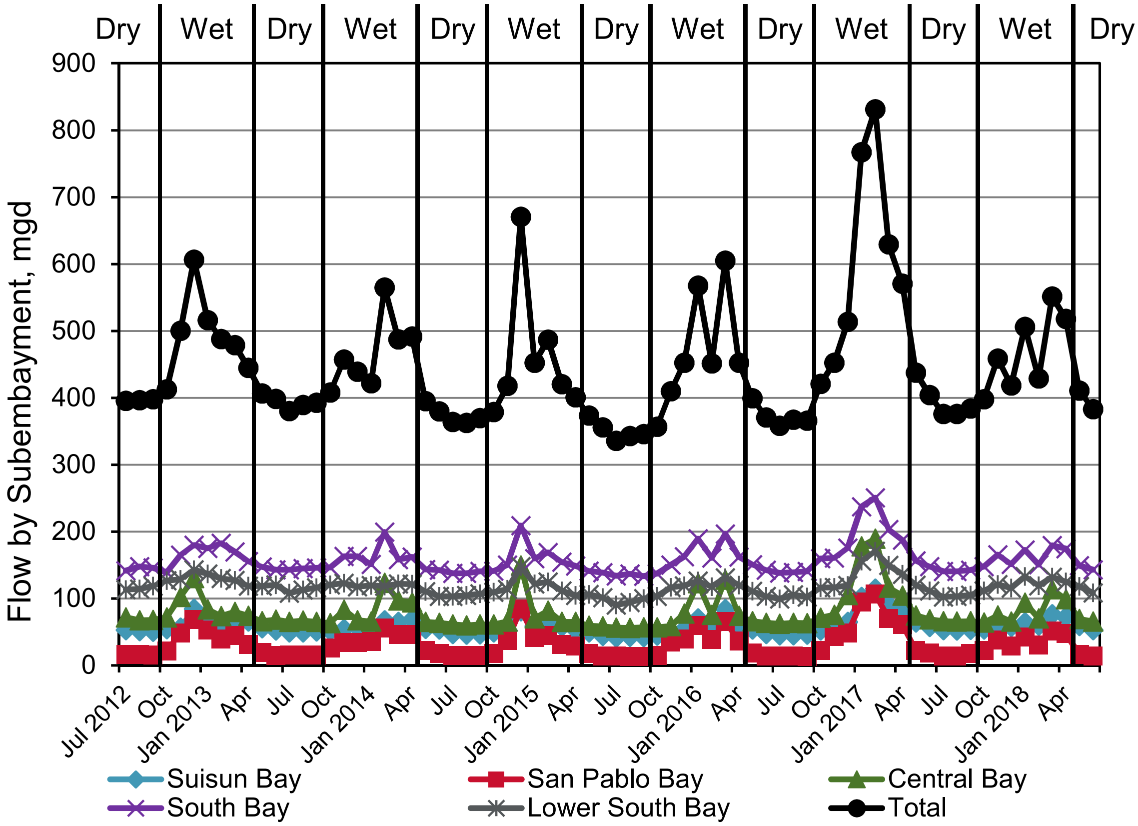

Figure 4-1. Historical Average Monthly Daily Discharge Flow Values

4.3 Ammonia

The annual average and dry season average monthly effluent ammonia loads are presented in Table 4-5 and Table 4-6, respectively. The annual average and dry season loadings to each subembayment are presented in Table 4-7 and Table 4-8, respectively.

Table 4-5. Annual Average Daily Discharges by Discharger, Ammonia (kg N/d)

Discharger	Subembayment	2012/13 (a)	2013/14 (a)	2014/15 (a)	2015/16 (a)	2016/17 (a)	2017/18 (a)
American Canyon	San Pablo Bay	1.7	6.3	3.5	1.5	2.4	4.2
Benicia	San Pablo Bay	182	175	199	180	164	232
Burlingame	South Bay	284	274	254	273	341	269
CCCSD	Suisun Bay	3,544	3,545	3,341	3,370	3,671	3,564
CMSA	Central Bay	750	778	623	682	1,005	899
Port Costa	San Pablo Bay	0.2	0.4	0.3	0.4	0.9	0.8
Delta Diablo	Suisun Bay	769	746	925	788	1,303	1,541
EBDA	South Bay	6,714	6,942	7,158	7,454	7,499	7,539
EBMUD	Central Bay	7,890	8,359	8,606	8,952	9,207	9,925
FSSD	Suisun Bay	1.5	1.6	1.6	1.8	2.2	6.3
Las Gallinas[(b)]	San Pablo Bay	11	15	12	23	35	35
Millbrae	South Bay	226	250	225	256	287	272
Mt. View	Suisun Bay	3.1	0.8	1.6	4.2	2.6	2.0
Napa[(b)]	San Pablo Bay	44	17	6	16	103	38
Novato[(b)]	San Pablo Bay	7	10	17	7	40	17
Palo Alto	Lower South Bay	12	13	17	19	12	16
Paradise Cove	Central Bay	0.4	-	0.3	0.7	0.0	0.0
Petaluma[(b)]	San Pablo Bay	3.2	7.2	2.8	5.4	2.6	3.1
Pinole	San Pablo Bay	218	196	235	233	270	262
Rodeo	San Pablo Bay	5.3	4.7	4.0	6.3	8.3	5.2
San Jose	Lower South Bay	280	201	197	233	176	206
San Mateo	South Bay	1,233	1,331	1,315	1,031	1,291	1,229
SASM	Central Bay	44	48	45	56	31	38
SFO Airport	South Bay	215	223	167	117	181	189
SFPUC Southeast	South Bay	7,194	9,313	8,822	8,115	9,915	8,511
SMCSD	Central Bay	54	42	49	42	60	96
Sonoma Valley[(b)]	San Pablo Bay	1.5	2.5	0.2	0.1	0.8	0.0
South SF	South Bay	822	818	884	743	1,009	989
Sunnyvale	Lower South Bay	307	86	165	28	98	177
SVCW	South Bay	1,858	2,001	2,073	2,558	2,412	2,719
Tiburon	Central Bay	41	-	54	50	34	55
Treasure Island	Central Bay	0.6	1.6	7.1	10	4.9	3.7
Vallejo	San Pablo Bay	401	567	842	755	774	843
West County	Central Bay	652	653	606	789	721	721
Total [(c)]		**33,770**	**36,628**	**36,858**	**36,801**	**40,664**	**40,407**

a. Data is presented in detail and summarized for each plant in the Appendix. A "-" indicates data was not available, whereas a "0" indicates a value of zero.

b. No discharge during a portion or all of the dry season months, except with authorization under emergency conditions.

c. The total values might vary from the sum of the listed values by plant due to rounding.

Table 4-6. Dry Season Average Daily Discharges by Discharger, Ammonia (kg N/d)

Discharger	Subembayment	2012/13 (a)	2013/14 (a)	2014/15 (a)	2015/16 (a)	2016/17 (a)	2017/18 (a)
American Canyon	San Pablo Bay	1.2	1.6	2.7	0.9	1.9	1.4
Benicia	San Pablo Bay	171	187	173	158	168	234
Burlingame	South Bay	261	264	229	244	263	245
CCCSD	Suisun Bay	3,366	3,467	3,265	3,222	3,402	3,259
CMSA	Central Bay	813	778	666	743	1,014	907
Port Costa	San Pablo Bay	0.3	0.1	0.1	-	-	0.3
Delta Diablo	Suisun Bay	739	690	700	654	1,043	1,449
EBDA	South Bay	6,028	6,338	6,816	6,923	6,683	6,619
EBMUD	Central Bay	7,592	8,517	8,714	8,343	8,896	9,337
FSSD	Suisun Bay	1.2	1.2	1.2	1.1	1.5	3.7
Las Gallinas[b]	San Pablo Bay	0.0	0.0	0.0	0.0	2.3	0
Millbrae	South Bay	215	246	205	272	277	277
Mt. View	Suisun Bay	1.3	0.8	1.1	4.6	1.2	2.2
Napa[b]	San Pablo Bay	0.0	0.4	0.0	0.0	0.0	0
Novato[b]	San Pablo Bay	0.3	2.4	1.2	0.9	15	4.6
Palo Alto	Lower South Bay	11	14	14	30	13	26
Paradise Cove	Central Bay	0.2	0.0	0.4	0.7	0.0	0.0
Petaluma[b]	San Pablo Bay	0.0	0.0	0.0	0.0	0.0	0.0
Pinole	San Pablo Bay	283	188	234	271	258	239
Rodeo	San Pablo Bay	5.1	2.8	2.7	3.8	3.7	4.5
San Jose	Lower South Bay	229	153	182	165	179	210
San Mateo	South Bay	1,323	1,550	1,447	1,110	1,294	1,202
SASM	Central Bay	41	38	40	34	33	32
SFO Airport	South Bay	206	216	227	134	262	227
SFPUC Southeast	South Bay	7,716	8,924	9,388	8,610	10,441	8,782
SMCSD	Central Bay	57	50	43	53	71	134
Sonoma Valley[b]	San Pablo Bay	0.0	0.0	0.0	0.0	0.0	0.0
South SF	South Bay	900	801	826	710	813	851
Sunnyvale	Lower South Bay	22	10	16	10	54	25
SVCW	South Bay	1,666	1,942	1,909	2,510	2,430	2,428
Tiburon	Central Bay	38	0.0	48	50	29	57
Treasure Island	Central Bay	0.6	2.0	7.5	8.3	3.6	4.1
Vallejo	San Pablo Bay	373	513	767	719	728	761
West County	Central Bay	658	644	634	759	727	719
Total [c]		**32,719**	**35,541**	**36,560**	**35,745**	**39,108**	**38,041**

a. Data is presented in detail and summarized for each plant in the Appendix. A "-" indicates data was not available, whereas a "0" indicates a value of zero.

b. No discharge during a portion or all of the dry season months, except with authorization under emergency conditions.

c. The total values might vary from the sum of the listed values by plant due to rounding.

Table 4-7. Annual Average Daily Discharges by Subembayment, Ammonia (kg N/d)

Subembayment	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
Suisun Bay	4,318	4,293	4,269	4,164	4,979	5,113
San Pablo Bay	875	1,001	1,322	1,228	1,401	1,441
Central Bay	9,432	9,882	9,990	10,582	11,063	11,738
South Bay	18,546	21,152	20,898	20,547	22,935	21,717
Lower South Bay	599	300	379	280	286	399
Total	**33,770**	**36,628**	**36,858**	**36,801**	**40,664**	**40,407**

Table 4-8. Dry Season Average Daily Discharges by Subembayment, Ammonia (kg N/d)

Subembayment	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	Trend[a,b]
Suisun Bay	4,108	4,159	3,967	3,882	4,448	4,714	Increasing (16% Change)
San Pablo Bay	834	895	1,181	1,154	1,177	1,245	Increasing (28% Change)
Central Bay	9,200	10,029	10,153	9,991	10,774	11,190	Increasing (14% Change)
South Bay	18,315	20,281	21,047	20,513	22,463	20,632	Increasing (4% Change)
Lower South Bay	262	177	212	205	246	261	None
Total	**32,719**	**35,541**	**36,560**	**35,745**	**39,108**	**38,041**	**Increasing (9% Change)**

a. Trend analysis is based on average monthly values. Discernible trends were identified based on the slope of a regression line determined using the method of least squares to fit the data (alpha = 0.05). Sample size is 30. Where "None" is stated, the limited dataset does not indicate a statistically relevant trend.

b. The percent change represents the 2017/18 value in comparison to the average of the initial three years of data (2012/2013 through 2014/2015).

The average monthly 2016/2017 dry season and average annual total loads were the highest since nutrient sampling began in July 2012. The average monthly 2017/2018 data for both average annual and dry season total loads shows a decrease in ammonia discharge compared to the previous year, but is still higher than any other year of data since sampling began in 2012. On a dry season basis, ammonia loads appear to be trending upwards for Suisun Bay, San Pablo Bay, Central Bay, and South Bay Subembayments based on the least squares correlation analysis. Further, the Baywide dry season loads suggest an upwards trending (see Section 3.5).

The historical average monthly daily discharge ammonia loads are presented in Figure 4-2. The South Bay Subembayment accounts for over half of the load discharged to the San Francisco Bay (see Table 4-7).

A discussion of the results is provided in Section 5.3.

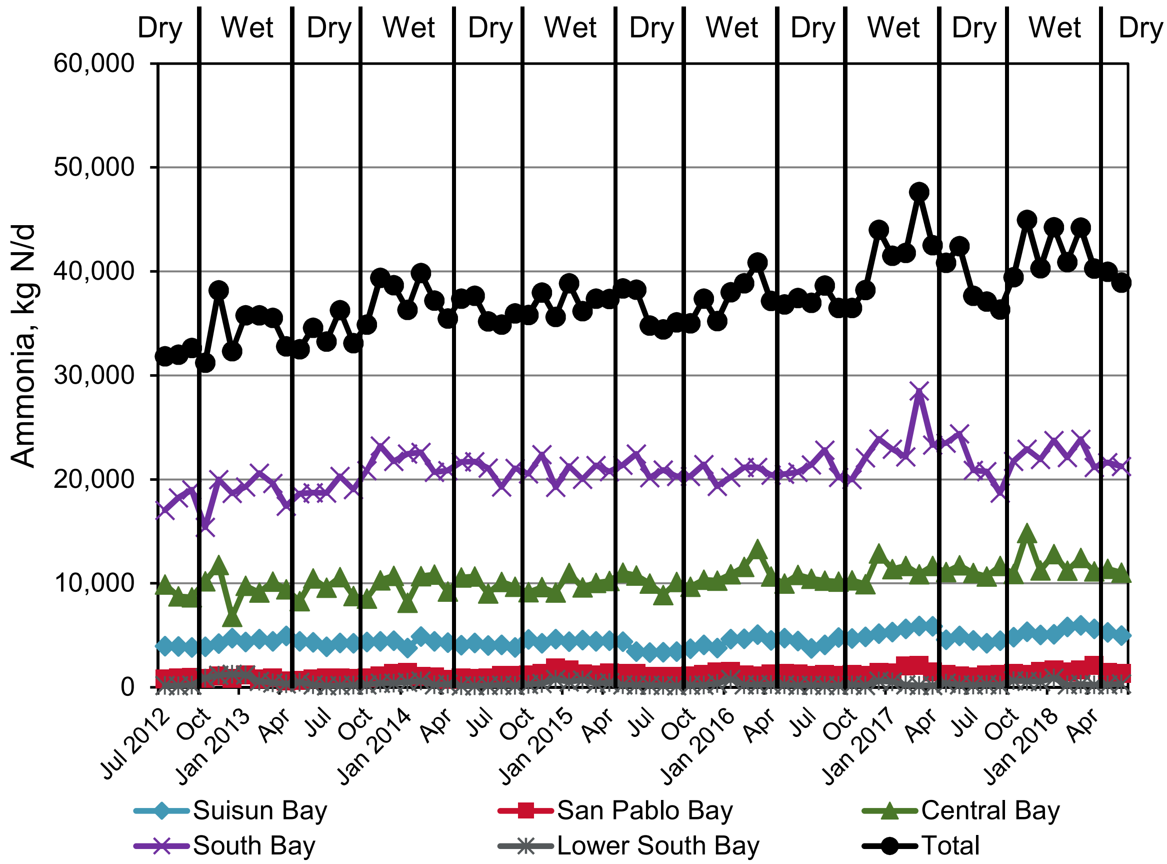

Figure 4-2. Historical Average Monthly Daily Discharge Ammonia Load Values

4.4 Total Kjeldahl Nitrogen (TKN)

The annual average and dry season average monthly effluent TKN loads are presented in Table 4-9 and Table 4-10, respectively. The annual average and dry season effluent loads to each subembayment are presented in Table 4-11 and Table 4-12, respectively.

Table 4-9. Annual Average Daily Discharges by Discharger, TKN (kg N/d)

Discharger	Subembayment	2012/13 (a)	2013/14 (a)	2014/15 (a)	2015/16 (a)	2016/17 (a)	2017/18 (a)
American Canyon	San Pablo Bay	7.5	4.3	10.9	10.1	11.1	10.5
Benicia	San Pablo Bay	179	177	202	180	169	221
Burlingame	South Bay	394	328	310	368	461	300
CCCSD	Suisun Bay	3,910	3,858	3,597	3,676	3,935	3,883
CMSA	Central Bay	793	884	839	830	1,082	1,015
Port Costa	San Pablo Bay	-	-	-	0.3	1.0	1.7
Delta Diablo	Suisun Bay	805	695	1,024	860	1,436	1,656
EBDA	South Bay	7,476	7,816	7,765	8,406	8,563	8,539
EBMUD	Central Bay	9,113	9,717	9,579	9,820	10,374	10,747
FSSD	Suisun Bay	31	18	15	24	53	87
Las Gallinas[b]	San Pablo Bay	16	18	17	37	46	27
Millbrae	South Bay	244	286	264	301	329	289
Mt. View	Suisun Bay	6.4	1.7	2.0	4.7	7.4	5.2
Napa[b]	San Pablo Bay	89	51	47	76	172	75
Novato[b]	San Pablo Bay	25	18	30	23	84	35
Palo Alto	Lower South Bay	76	19	151	33	46	20
Paradise Cove	Central Bay	0.5	-	0.3	0.8	0.1	0.0
Petaluma[b]	San Pablo Bay	18	31	29	20	20	19
Pinole	San Pablo Bay	243	215	268	273	317	292
Rodeo	San Pablo Bay	8.4	7.8	9.2	8.0	12.3	5.8
San Jose	Lower South Bay	683	529	504	480	388	418
San Mateo	South Bay	1,363	1,509	1,554	1,235	1,492	1,341
SASM	Central Bay	68	83	70	93	62	76
SFO Airport	South Bay	213	207	146	103	143	154
SFPUC Southeast	South Bay	7,705	9,161	9,860	9,402	9,463	8,766
SMCSD	Central Bay	71	58	66	66	78	123
Sonoma Valley[b]	San Pablo Bay	6.3	6.5	1.3	0.9	5.9	0.0
South SF	South Bay	977	1,013	1,063	971	1,205	1,341
Sunnyvale	Lower South Bay	380	170	246	107	180	272
SVCW	South Bay	2,042	2,158	2,066	2,532	2,633	3,043
Tiburon	Central Bay	45	-	66	62	42	60
Treasure Island	Central Bay	3.7	4.9	6.1	12.3	9.5	4.4
Vallejo	San Pablo Bay	492	674	1,019	988	1,112	998
West County	Central Bay	730	800	755	1,014	872	834
Total [c]		**38,213**	**40,519**	**41,582**	**42,017**	**44,804**	**44,660**

a. Data is presented in detail and summarized for each plant in the Appendix. A "-" indicates data was not available, whereas a "0" indicates a value of zero.
b. No discharge during a portion or all of the dry season months, except with authorization under emergency conditions.
c. The total values might vary from the sum of the listed values by plant due to rounding.

Table 4-10. Dry Season Average Daily Discharges by Discharger, TKN (kg N/d)

Discharger	Subembayment	2012/13 (a)	2013/14 (a)	2014/15 (a)	2015/16 (a)	2016/17 (a)	2017/18 (a)
American Canyon	San Pablo Bay	5.8	2.1	9.1	7.4	7.2	6.5
Benicia	San Pablo Bay	157	191	173	182	159	221
Burlingame	South Bay	313	263	272	328	329	274
CCCSD	Suisun Bay	3,683	3,770	3,546	3,535	3,694	3,510
CMSA	Central Bay	853	891	796	918	1,198	1,000
Port Costa	San Pablo Bay	-	-	-	-	-	-
Delta Diablo	Suisun Bay	794	636	692	776	1,196	1,545
EBDA	South Bay	6,795	7,040	7,327	7,669	7,409	7,545
EBMUD	Central Bay	8,678	9,791	9,601	9,323	10,049	10,258
FSSD	Suisun Bay	23	16	13	19	22	174
Las Gallinas[b]	San Pablo Bay	0.0	0.0	0.0	0.0	0.7	0.0
Millbrae	South Bay	240	271	241	329	310	296
Mt. View	Suisun Bay	4.8	2.1	0.9	6.0	5.6	2.9
Napa[b]	San Pablo Bay	0.0	7.6	0.0	0.0	0.0	0.0
Novato[b]	San Pablo Bay	6.7	2.1	6.5	2.7	25	11
Palo Alto	Lower South Bay	73	18	17	35	36	13
Paradise Cove	Central Bay	0.3	-	0.4	0.8	0.0	0.0
Petaluma[b]	San Pablo Bay	0.0	0.0	0.0	0.0	0.0	0.0
Pinole	San Pablo Bay	312	205	267	316	297	267
Rodeo	San Pablo Bay	8.0	6.8	7.1	5.2	4.1	3.8
San Jose	Lower South Bay	529	436	444	424	376	442
San Mateo	South Bay	1,521	1,735	1,662	1,364	1,429	1,323
SASM	Central Bay	66	65	52	61	68	60
SFO Airport	South Bay	234	182	180	93	170	130
SFPUC Southeast	South Bay	8,031	8,959	9,954	9,391	10,248	9,240
SMCSD	Central Bay	75	63	61	80	95	154
Sonoma Valley[b]	San Pablo Bay	0.0	0.0	0.0	0.0	0.2	0.0
South SF	South Bay	990	1,064	972	867	1,095	1,164
Sunnyvale	Lower South Bay	104	122	119	87	125	132
SVCW	South Bay	1,922	2,046	1,884	2,414	2,490	2,825
Tiburon	Central Bay	44	-	57	62	34	64
Treasure Island	Central Bay	3.9	3.6	6.7	14	9.9	5.2
Vallejo	San Pablo Bay	483	624	946	944	989	852
West County	Central Bay	742	739	737	955	872	819
Total [c]		**36,692**	**39,152**	**40,044**	**40,208**	**42,743**	**42,340**

a. Data is presented in detail and summarized for each plant in the Appendix. A "-" indicates data was not available, whereas a "0" indicates a value of zero.
b. No discharge during a portion or all of the dry season months, except with authorization under emergency conditions.
c. The total values might vary from the sum of the listed values by plant due to rounding.

Table 4-11. Annual Average Daily Discharges by Subembayment, TKN (kg N/d)

Subembayment	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
Suisun Bay	4,752	4,573	4,638	4,565	5,431	5,631
San Pablo Bay	1,084	1,203	1,634	1,616	1,950	1,686
Central Bay	10,824	11,547	11,381	11,898	12,520	12,861
South Bay	20,414	22,478	23,028	23,318	24,289	23,772
Lower South Bay	1,139	718	901	620	614	709
Total	**38,213**	**40,519**	**41,582**	**42,017**	**44,804**	**44,660**

Table 4-12. Dry Season Average Daily Discharges by Subembayment, TKN (kg N/d)

Subembayment	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	Trend [a,b]
Suisun Bay	4,505	4,424	4,252	4,336	4,918	5,232	Increasing (19% Change)
San Pablo Bay	973	1,039	1,409	1,457	1,482	1,363	Increasing (20% Change)
Central Bay	10,462	11,553	11,311	11,414	12,326	12,360	Increasing (11% Change)
South Bay	20,046	21,560	22,492	22,455	23,480	22,799	Increasing (7% Change)
Lower South Bay	706	576	580	546	537	586	None
Total	**36,692**	**39,152**	**40,044**	**40,208**	**42,743**	**42,340**	**Increasing (10% Change)**

a. Trend analysis is based on average monthly values. Discernible trends were identified based on the slope of a regression line determined using the method of least squares to fit the data (alpha = 0.05). Sample size is 30. Where "None" is stated, the limited dataset does not indicate a statistically relevant trend.

b. The percent change represents the 2017/18 value in comparison to the average of the initial three years of data (2012/2013 through 2014/2015).

The average monthly 2016/2017 dry season and average annual total loads were the highest since nutrient sampling began in July 2012. The 2017/2018 data for both average annual and dry season total loads shows a decrease in TKN discharge compared to the previous year, but is still higher than any other year of data since sampling began in 2012. On a dry season basis, TKN loads appear to be trending upwards for Suisun Bay, San Pablo Bay, Central Bay, and South Bay Subembayments based on the least squares correlation analysis (see Section 3.5).

The average monthly daily discharge TKN loads since the 2012/13 season are presented in Figure 4-3. Similar to Ammonia, the South Bay Subembayment accounts for over half of the TKN load discharged to the San Francisco Bay (see Table 4-7).

A discussion of the results is provided in Section 5.5.

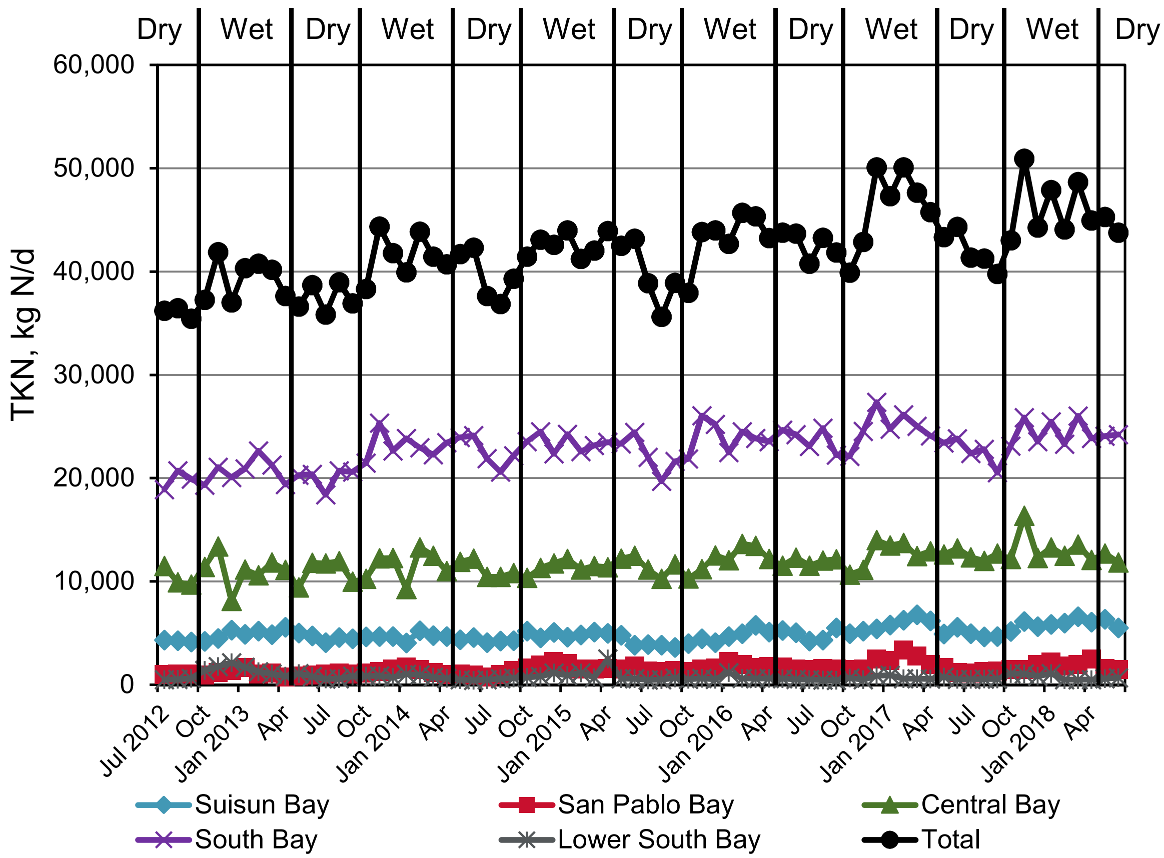

Figure 4-3. Historical Average Monthly Daily Discharge TKN Load Values

4.5 Nitrite plus Nitrate (NOx)

The annual average and dry season average monthly effluent NOx loads are presented in Table 4-13 and Table 4-14, respectively. The annual average and dry season effluent loads to each subembayment are presented in Table 4-15 and Table 4-16, respectively.

Table 4-13. Annual Average Daily Discharges by Discharger, NOx (kg N/d)

Discharger	Subembayment	2012/13 (a)	2013/14 (a)	2014/15 (a)	2015/16 (a)	2016/17 (a)	2017/18 (a)
American Canyon	San Pablo Bay	59	79	53	32	41	30
Benicia	San Pablo Bay	37	40	45	43	70	34
Burlingame	South Bay	64	215	29	23	29	50
CCCSD	Suisun Bay	265	277	421	355	358	296
CMSA	Central Bay	110	80	148	131	131	145
Port Costa	San Pablo Bay	-	-	-	1.3	1.1	0.7
Delta Diablo	Suisun Bay	907	736	554	502	46	25
EBDA	South Bay	1,044	866	1,011	1,025	1,036	840
EBMUD	Central Bay	1,245	1,114	779	565	524	571
FSSD	Suisun Bay	1,278	1,467	1050	935	789	1,212
Las Gallinas[(b)]	San Pablo Bay	118	104	86	98	104	101
Millbrae	South Bay	2.4	2.2	2.2	2.4	2.3	0.7
Mt. View	Suisun Bay	121	131	116	117	138	124
Napa[(b)]	San Pablo Bay	129	158	165	154	156	123
Novato[(b)]	San Pablo Bay	137	126	150	132	150	112
Palo Alto	Lower South Bay	2,326	2,201	2116	2,517	2,744	2,056
Paradise Cove	Central Bay	1.6	-	1.6	1.5	2.1	2.3
Petaluma[(b)]	San Pablo Bay	22	4.6	20	10	14	1.7
Pinole	San Pablo Bay	104	104	44	65	70	38
Rodeo	San Pablo Bay	33	26	29	23	36	27
San Jose	Lower South Bay	4,501	4,475	5,248	4,944	5,545	4,798
San Mateo	South Bay	138	102	64	203	94	130
SASM	Central Bay	162	154	133	172	142	130
SFO Airport	South Bay	23	15	20	25	16	16
SFPUC Southeast	South Bay	554	783	873	764	475	437
SMCSD	Central Bay	72	80	73	88	78	41
Sonoma Valley[(b)]	San Pablo Bay	28	6.8	23	10	84	0.0
South SF	South Bay	199	120	66	146	65	36
Sunnyvale	Lower South Bay	681	584	586	563	763	769
SVCW	South Bay	62	78	57	58	71	29
Tiburon	Central Bay	16	-	4.4	8.4	12	0.4
Treasure Island	Central Bay	9.3	11	10	10	11	7.7
Vallejo	San Pablo Bay	343	251	127	154	118	107
West County	Central Bay	120	148	54	122	412	198
Total [(c)]		**14,911**	**14,538**	**14,158**	**13,999**	**14,327**	**12,489**

a. Data is presented in detail and summarized for each plant in the Appendix. A "-" indicates data was not available, whereas a "0" indicates a value of zero.
b. No discharge during a portion or all of the dry season months, except with authorization under emergency conditions.
c. The total values might vary from the sum of the listed values by plant due to rounding.

Table 4-14. Dry Season Average Daily Discharges by Discharger, NOx (kg N/d)

Discharger	Subembayment	2012/13 (a)	2013/14 (a)	2014/15 (a)	2015/16 (a)	2016/17 (a)	2017/18 (a)
American Canyon	San Pablo Bay	41	109	57	23	26	25
Benicia	San Pablo Bay	40	38	48	48	51	37
Burlingame	South Bay	57	159	23	40	18	48
CCCSD	Suisun Bay	168	205	321	305	286	331
CMSA	Central Bay	70	91	79	86	100	185
Port Costa	San Pablo Bay	-	-	-	-	-	-
Delta Diablo	Suisun Bay	855	716	631	195	61	25
EBDA	South Bay	858	800	698	712	762	684
EBMUD	Central Bay	1,183	636	652	585	435	468
FSSD	Suisun Bay	1,293	1,296	861	776	870	1,036
Las Gallinas[(b)]	San Pablo Bay	0.0	0.0	0.0	0.0	6.7	0.0
Millbrae	South Bay	1.9	3.5	1.6	1.2	0.9	0.9
Mt. View	Suisun Bay	108	119	97	114	110	112
Napa[(b)]	San Pablo Bay	0.0	50	0.0	0.0	0.0	0
Novato[(b)]	San Pablo Bay	40	40	36	37	64	35
Palo Alto	Lower South Bay	2,494	2,262	2,225	2,337	2,578	1,931
Paradise Cove	Central Bay	1.8	-	1.2	1.5	2.7	2.3
Petaluma[(b)]	San Pablo Bay	0.0	0.0	0.0	0.0	0.0	0.0
Pinole	San Pablo Bay	109	126	32	43	25	42
Rodeo	San Pablo Bay	26	24	25	22	28	23
San Jose	Lower South Bay	3,944	3,946	4,753	4,681	4,377	4,486
San Mateo	South Bay	28	5.9	4.9	110	69	103
SASM	Central Bay	134	120	125	140	142	127
SFO Airport	South Bay	21	20	19	24	13	21
SFPUC Southeast	South Bay	519	750	881	859	434	467
SMCSD	Central Bay	71	81	80	83	79	15
Sonoma Valley[(b)]	San Pablo Bay	0.0	0.0	0.0	0.0	4.8	0.0
South SF	South Bay	105	118	78	187	117	54
Sunnyvale	Lower South Bay	565	295	366	328	357	531
SVCW	South Bay	88	67	61	58	60	31
Tiburon	Central Bay	10	-	6.3	8.4	16	0.3
Treasure Island	Central Bay	7.2	9.1	10	13	9.0	8.2
Vallejo	San Pablo Bay	322	270	152	135	108	114
West County	Central Bay	24	19	12	50	260	199
Total [(c)]		**13,184**	**12,375**	**12,337**	**12,002**	**11,471**	**11,142**

a. Data is presented in detail and summarized for each plant in the Appendix. A "-" indicates data was not available, whereas a "0" indicates a value of zero.
b. No discharge during a portion or all of the dry season months, except with authorization under emergency conditions.
c. The total values might vary from the sum of the listed values by plant due to rounding.

Table 4-15. Annual Average Daily Discharges by Subembayment, NOx (kg N/d)

Subembayment	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
Suisun Bay	2,571	2,611	2,141	1,909	1,331	1,658
San Pablo Bay	1,010	899	742	722	843	574
Central Bay	1,736	1,587	1,203	1,098	1,311	1,095
South Bay	2,086	2,181	2,122	2,246	1,790	1,538
Lower South Bay	7,508	7,260	7,950	8,024	9,052	7,623
Total	**14,911**	**14,538**	**14,158**	**13,999**	**14,327**	**12,487**

Table 4-16. Dry Season Average Daily Discharges by Subembayment, NOx (kg N/d)

Subembayment	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	Trend [a,b]
Suisun Bay	2,424	2,336	1,910	1,390	1,327	1,503	Decreasing (-32% Change)
San Pablo Bay	578	657	350	308	314	277	Decreasing (-48% Change)
Central Bay	1,501	956	966	967	1,044	1,004	Decreasing (-12% Change)
South Bay	1,678	1,923	1,767	1,991	1,474	1,409	None
Lower South Bay	7,003	6,503	7,344	7,346	7,312	6,949	None
Total	**13,184**	**12,375**	**12,337**	**12,002**	**11,471**	**11,142**	**Decreasing (-3% Change)**

a. Trend analysis is based on average monthly values. Discernible trends were identified based on the slope of a regression line determined using the method of least squares to fit the data (alpha = 0.05). Sample size is 30. Where "None" is stated, the limited dataset does not indicate a statistically relevant trend.

b. The percent change represents the 2017/18 value in comparison to the average of the initial three years of data (2012/2013 through 2014/2015).

The average monthly 2017/2018 average annual and dry season total loads were the lowest since nutrient sampling began in in 2012. With the exception of the annual average 2016/2017 dataset, the NOx total loads are decreasing overtime. On a dry season basis, NOx loads appear to be trending downwards for Suisun Bay, San Pablo Bay, Central Bay, and across the Bay based on the least squares correlation trend analysis (see Section 3.5). The South Bay and Lower South Bay Subembayments do not show any significant trending.

The average monthly daily discharge NOx loads since the 2012/13 season are presented in Figure 4-4. The Lower South Bay Subembayment accounts for over half of the load discharged to the San Francisco Bay (see Table 4-15). The reason for this is all the dischargers in the Lower South Bay fully nitrify (i.e., convert ammonia to NOx) year-round.

A discussion of the results is provided in Section 5.6.

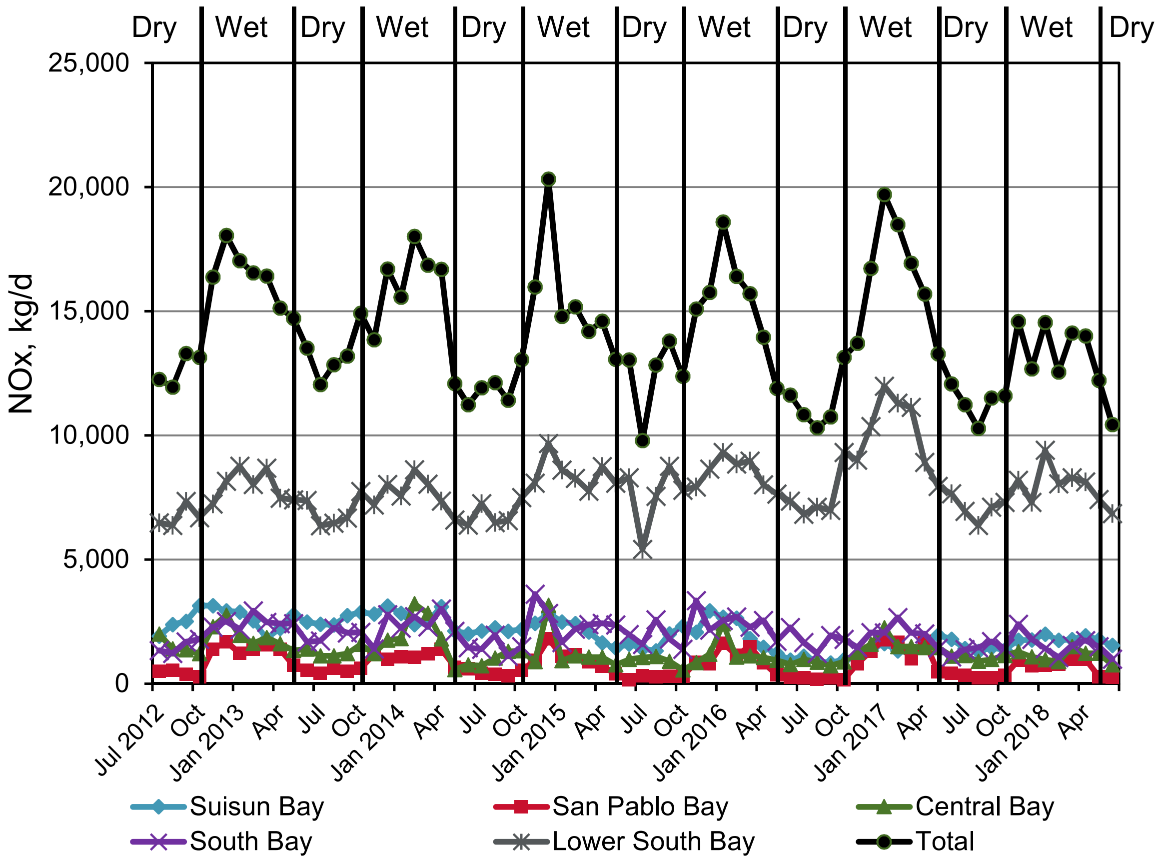

Figure 4-4. Historical Average Monthly Daily Discharge NOx Load Values

4.6 Total Nitrogen (TN)

The annual average and dry season average monthly effluent TN loads are presented in Table 4-17 and Table 4-18, respectively. The annual average and dry season effluent TN loads by subembayment are presented in Table 4-19 and Table 4-20, respectively.

Table 4-17. Annual Average Daily Discharges by Discharger, TN (kg N/d)

Discharger	Subembayment	2012/13 (a)	2013/14 (a)	2014/15 (a)	2015/16 (a)	2016/17 (a)	2017/18 (a)
American Canyon	San Pablo Bay	66	83	64	42	52	41
Benicia	San Pablo Bay	215	218	245	222	230	255
Burlingame	South Bay	458	544	337	391	465	350
CCCSD	Suisun Bay	4,175	4,135	4,002	4,044	4,293	4,191
CMSA	Central Bay	903	964	992	961	1,214	1,160
Port Costa	San Pablo Bay	-	-	-	1.6	2.1	2.4
Delta Diablo	Suisun Bay	1,712	1,431	1,571	1,362	1,477	1,681
EBDA	South Bay	8,483	8,664	8,777	8,996	9,599	9,369
EBMUD	Central Bay	10,356	10,831	10,361	10,382	10,898	11,304
FSSD	Suisun Bay	1,308	1,442	1,083	959	819	1,299
Las Gallinas[(b)]	San Pablo Bay	135	122	103	135	150	128
Millbrae	South Bay	246	288	266	303	331	290
Mt. View	Suisun Bay	128	133	118	122	145	129
Napa[(b)]	San Pablo Bay	218	209	212	230	328	200
Novato[(b)]	San Pablo Bay	162	144	180	155	234	146
Palo Alto	Lower South Bay	2,402	2,220	2,268	2,549	2,790	2,075
Paradise Cove	Central Bay	2.1	-	1.9	2.4	2.1	2.3
Petaluma[(b)]	San Pablo Bay	40	35	51	30	34	21
Pinole	San Pablo Bay	347	319	315	338	387	331
Rodeo	San Pablo Bay	41	33	39	31	49	33
San Jose	Lower South Bay	5,185	5,004	5,752	5,280	5,934	5,224
San Mateo	South Bay	1,501	1,611	1,619	1,438	1,586	1,470
SASM	Central Bay	230	237	203	266	204	206
SFO Airport	South Bay	236	222	166	128	160	169
SFPUC Southeast	South Bay	8,258	9,944	10,733	10,166	9,939	9,203
SMCSD	Central Bay	143	138	140	154	156	165
Sonoma Valley[(b)]	San Pablo Bay	34	13	25	11	90	0
South SF	South Bay	1,176	1,134	1,129	1,117	1,270	1,377
Sunnyvale	Lower South Bay	1,060	754	868	670	911	1,041
SVCW	South Bay	2,113	2,237	2,123	2,591	2,577	3,072
Tiburon	Central Bay	61	-	70	71	53	61
Treasure Island	Central Bay	13	16	17	22	20	12
Vallejo	San Pablo Bay	836	925	1,145	1,142	1,230	1,105
West County	Central Bay	850	948	808	1,136	1,284	1,032
Total [(c)]		**53,093**	**54,998**	**55,784**	**55,448**	**58,913**	**57,144**

a. Data is presented in detail and summarized for each plant in the Appendix. A "-" indicates data was not available, whereas a "0" indicates a value of zero.
b. No discharge during a portion or all of the dry season months, except with authorization under emergency conditions.
c. The total values might vary from the sum of the listed values by plant due to rounding.

Table 4-18. Dry Season Average Daily Discharges by Discharger, TN (kg N/d)

Discharger	Subembayment	2012/13 (a)	2013/14 (a)	2014/15 (a)	2015/16 (a)	2016/17 (a)	2017/18 (a)
American Canyon	San Pablo Bay	47	111	67	30	34	32
Benicia	San Pablo Bay	196	229	222	228	188	255
Burlingame	South Bay	370	422	295	368	285	323
CCCSD	Suisun Bay	3,851	3,975	3,852	3,843	3,980	3,866
CMSA	Central Bay	922	982	875	1,004	1,298	1,185
Port Costa	San Pablo Bay	-	-	-	-	-	-
Delta Diablo	Suisun Bay	1,649	1,352	1,308	971	1,255	1,570
EBDA	South Bay	7,611	7,796	8,024	8,381	8,171	8,229
EBMUD	Central Bay	9,862	10,428	10,263	9,908	10,484	10,725
FSSD	Suisun Bay	1,315	1,312	919	795	837	1,209
Las Gallinas(b)	San Pablo Bay	0.0	0.0	0.0	0.0	7.3	0.0
Millbrae	South Bay	242	274	243	330	311	297
Mt. View	Suisun Bay	113	121	98	120	116	114
Napa(b)	San Pablo Bay	0.0	57	0.0	0.0	0.0	0.0
Novato(b)	San Pablo Bay	46	42	43	40	89	46
Palo Alto	Lower South Bay	2,567	2,281	2,242	2,371	2,614	1,944
Paradise Cove	Central Bay	2.2	-	1.6	2.4	2.8	2.3
Petaluma(b)	San Pablo Bay	0.0	0.0	0.0	0.0	0.0	0.0
Pinole	San Pablo Bay	421	331	304	359	322	309
Rodeo	San Pablo Bay	34	31	32	27	32	27
San Jose	Lower South Bay	4,473	4,382	5,196	5,105	4,753	4,928
San Mateo	South Bay	1,549	1,741	1,667	1,475	1,498	1,426
SASM	Central Bay	200	185	176	201	210	187
SFO Airport	South Bay	255	202	199	117	183	151
SFPUC Southeast	South Bay	8,550	9,709	10,835	10,250	10,682	9,708
SMCSD	Central Bay	146	144	143	163	174	169
Sonoma Valley(b)	San Pablo Bay	0.0	0.0	0.0	0.0	5.5	0.0
South SF	South Bay	1,096	1,182	1,050	1,054	1,212	1,218
Sunnyvale	Lower South Bay	669	417	566	415	407	663
SVCW	South Bay	2,033	2,113	1,946	2,471	2,252	2,856
Tiburon	Central Bay	54	-	64	71	49	64
Treasure Island	Central Bay	11	13	17	27	19	13
Vallejo	San Pablo Bay	805	895	1,098	1,079	1,097	967
West County	Central Bay	766	758	749	1,004	1,132	1,018
Total (c)		**49,855**	**51,485**	**52,495**	**52,209**	**53,700**	**53,504**

a. Data is presented in detail and summarized for each plant in the Appendix. A "-" indicates data was not available, whereas a "0" indicates a value of zero.

b. No discharge during a portion or all of the dry season months, except with authorization under emergency conditions.

c. The total values might vary from the sum of the listed values by plant due to rounding.

Table 4-19. Annual Average Daily Discharges by Subembayment, TN (kg N/d)

Subembayment	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
Suisun Bay	7,323	7,141	6,774	6,487	6,734	7,300
San Pablo Bay	2,094	2,101	2,379	2,338	2,786	2,261
Central Bay	12,558	13,134	12,593	12,994	13,831	13,942
South Bay	22,471	24,644	25,150	25,130	25,927	25,300
Lower South Bay	8,647	7,978	8,888	8,499	9,635	8,340
Total	**53,093**	**54,998**	**55,784**	**55,448**	**58,913**	**57,144**

Table 4-20. Dry Season Average Daily Discharges by Subembayment, TN (kg N/d)

Subembayment	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	Trend [a,b]
Suisun Bay	6,928	6,760	6,177	5,729	6,188	6,760	None
San Pablo Bay	1,549	1,696	1,766	1,763	1,775	1,636	Increasing (-2% Change)[c]
Central Bay	11,963	12,510	12,289	12,380	13,369	13,364	Increasing (9% Change)
South Bay	21,706	23,439	24,259	24,446	24,594	24,208	Increasing (5% Change)
Lower South Bay	7,709	7,080	8,004	7,891	7,774	7,535	None
Total	**49,855**	**51,485**	**52,495**	**52,209**	**53,700**	**53,504**	**Increasing (4% Change)**

a. Trend analysis is based on average monthly values. Discernible trends were identified based on the slope of a regression line determined using the method of least squares to fit the data (alpha = 0.05). Sample size is 30. Where "None" is stated, the limited dataset does not indicate a statistically relevant trend.
b. The percent change represents the 2017/18 value in comparison to the average of the initial three years of data (2012/2013 through 2014/2015).
c. The San Pablo Bay upward trend is based on all six years of data, whereas the negative percent change reflects the 2017/2018 dataset against the average of the initial three years of data (2012/2013 through 2014/2015).

The 2016/2017 dry season and average annual total loads were the highest since nutrient sampling began in July 2012. The 2017/2018 data for both average annual and dry season total loads shows a decrease in TN discharge compared to the previous year, but is still higher than any other year of data since sampling began in 2012. On a dry season basis, TN loads appear to be trending upwards for San Pablo Bay, Central Bay, and South Bay Subembayments based on the least squares correlation trend analysis (see Section 3.5). The overall Bay is showing an increase in TN discharge loads.

The average monthly daily discharge TN loads since the 2012/13 season are presented in Figure 4-5. The South Bay Subembayment accounts for nearly half of the load discharged to the San Francisco Bay (see Table 4-19).

A discussion of the results is provided in Section 5.7.

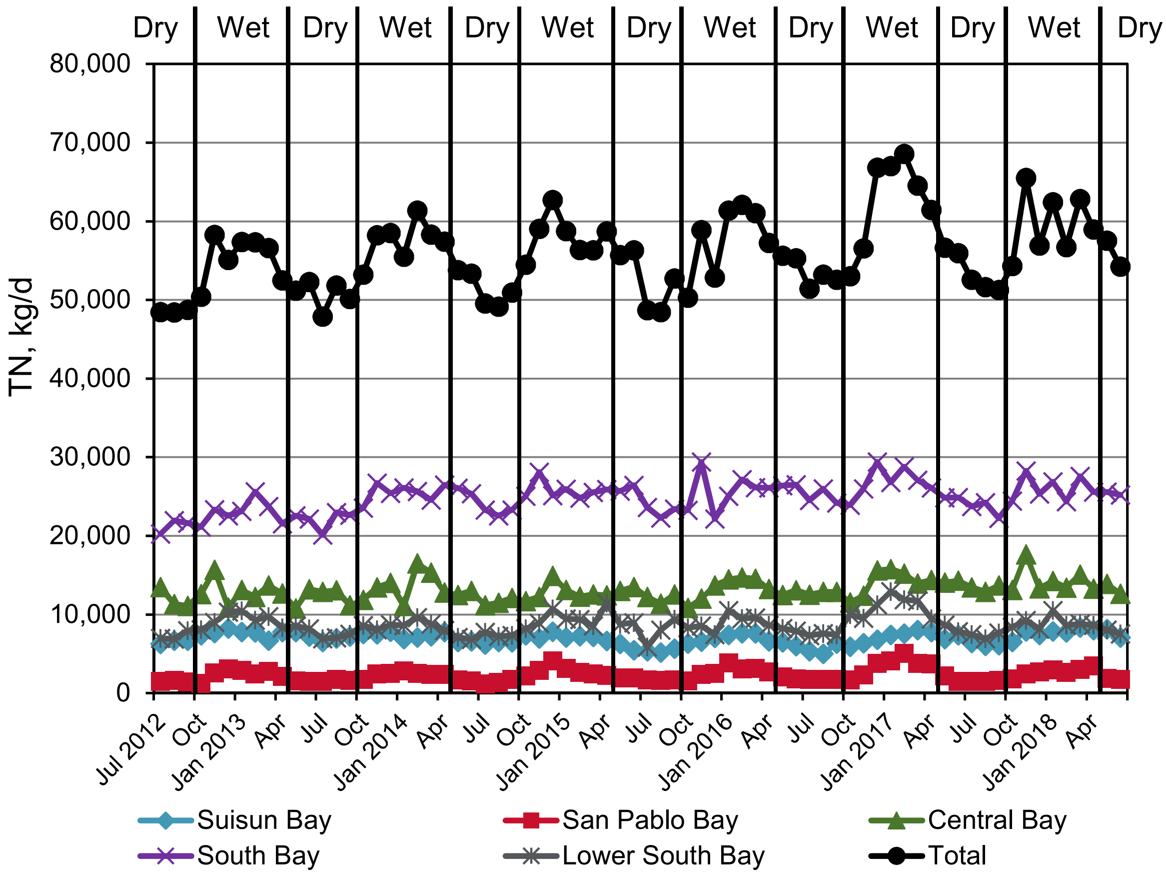

Figure 4-5. Historical Average Monthly Daily Discharge TN Load Values

4.7 Orthophosphate (Ortho-P)

The annual average and dry season average monthly effluent ortho-P loads are presented in Table 4-21 and Table 4-22, respectively. The annual average and dry season effluent ortho-P loads discharge to each subembayment are presented in Table 4-23 and Table 4-24, respectively.

Table 4-21. Annual Average Daily Discharges by Discharger, Ortho-P (kg P/d)

Discharger	Subembayment	2012/13 (a)	2013/14 (a)	2014/15 (a)	2015/16 (a)	2016/17 (a)	2017/18 (a)
American Canyon	San Pablo Bay	23	34	25	27	23	26
Benicia	San Pablo Bay	22	25	21	13	18	8
Burlingame	South Bay	162	110	18	24	18	30
CCCSD	Suisun Bay	80	47	58	52	65	62
CMSA	Central Bay	138	109	84	76	86	97
Port Costa	San Pablo Bay	-	-	-	0.2	0.3	0.3
Delta Diablo	Suisun Bay	32	27	18	12	31	42
EBDA	South Bay	597	629	422	417	448	433
EBMUD	Central Bay	944	805	501	501	342	821
FSSD	Suisun Bay	224	321	185	194	184	219
Las Gallinas[b]	San Pablo Bay	18	26	15	21	18	15
Millbrae	South Bay	21	18	6.0	6.8	4.6	4.0
Mt. View	Suisun Bay	17	15	15	14	15	12
Napa[b]	San Pablo Bay	24	7.6	8.2	19	47	16
Novato[b]	San Pablo Bay	26	14	18	6.8	6.0	0.5
Palo Alto	Lower South Bay	342	333	342	403	413	326
Paradise Cove	Central Bay	0.3	-	0.3	0.3	0.2	0.5
Petaluma[b]	San Pablo Bay	28	31	24	19	25	14
Pinole	San Pablo Bay	48	30	12	17	18	22
Rodeo	San Pablo Bay	15	9.6	7.5	8.0	10	7.4
San Jose	Lower South Bay	374	276	280	289	376	111
San Mateo	South Bay	159	219	134	119	102	101
SASM	Central Bay	72	92	36	35	34	32
SFO Airport	South Bay	14	21	5.7	9.3	7.2	28
SFPUC Southeast	South Bay	340	313	197	233	299	185
SMCSD	Central Bay	38	37	15	15	16	17
Sonoma Valley[b]	San Pablo Bay	16	10	3.0	2.4	20	0.0
South SF	South Bay	189	219	110	115	84	97
Sunnyvale	Lower South Bay	200	172	215	177	201	237
SVCW	South Bay	259	316	164	238	200	213
Tiburon	Central Bay	8.8	-	7.1	7.2	10	5.2
Treasure Island	Central Bay	3.6	3.7	4.1	4.1	4.3	3.4
Vallejo	San Pablo Bay	106	108	87	90	84	89
West County	Central Bay	82	86	32	47	77	84
Total [c]		**4,623**	**4,464**	**3,071**	**3,212**	**3,287**	**3,363**

a. Data is presented in detail and summarized for each plant in the Appendix. A "-" indicates data was not available, whereas a "0" indicates a value of zero.

b. No discharge during a portion or all of the dry season months, except with authorization under emergency conditions.

c. The total values might vary from the sum of the listed values by plant due to rounding.

Table 4-22. Dry Season Average Daily Discharges by Discharger, Ortho-P (kg P/d)

Discharger	Subembayment	2012/13 (a)	2013/14 (a)	2014/15 (a)	2015/16 (a)	2016/17 (a)	2017/18 (a)
American Canyon	San Pablo Bay	24	62	23	23	13	29
Benicia	San Pablo Bay	20	24	18	16	12	3
Burlingame	South Bay	160	96	20	25	14	17
CCCSD	Suisun Bay	90	61	49	57	57	57
CMSA	Central Bay	126	111	85	80	101	116
Port Costa	San Pablo Bay	-	-	-	-	-	-
Delta Diablo	Suisun Bay	30	33	12	8.1	26	45
EBDA	South Bay	503	559	450	415	424	439
EBMUD	Central Bay	692	601	435	370	481	674
FSSD	Suisun Bay	246	335	163	165	186	200
Las Gallinas[(b)]	San Pablo Bay	0.0	0.0	0.0	0.0	0.8	0.0
Millbrae	South Bay	23	21	7.9	8.3	7.8	5.7
Mt. View	Suisun Bay	17	16	18	16	14	11
Napa[(b)]	San Pablo Bay	0.0	0.9	0.0	0.0	0.0	0.0
Novato[(b)]	San Pablo Bay	1.9	1.4	0.1	0.4	0.3	0.6
Palo Alto	Lower South Bay	383	350	378	396	422	319
Paradise Cove	Central Bay	0.4	-	0.2	0.3	0.2	0.5
Petaluma[(b)]	San Pablo Bay	0.0	0.0	0.0	0.0	0.0	0.0
Pinole	San Pablo Bay	52	38	12	22	20	19
Rodeo	San Pablo Bay	16	6.6	9.3	8.3	6.8	6.7
San Jose	Lower South Bay	121	215	214	315	286	82
San Mateo	South Bay	130	230	122	128	112	113
SASM	Central Bay	73	89	37	34	35	36
SFO Airport	South Bay	15	27	8.0	7.0	4.0	36
SFPUC Southeast	South Bay	387	400	212	250	315	242
SMCSD	Central Bay	48	50	18	17	17	19
Sonoma Valley[(b)]	San Pablo Bay	0.0	0.0	0.0	0.0	0.8	0.0
South SF	South Bay	218	217	112	122	106	88
Sunnyvale	Lower South Bay	202	133	208	164	162	243
SVCW	South Bay	323	381	168	274	224	243
Tiburon	Central Bay	7.3	-	7.3	7.2	13	4.5
Treasure Island	Central Bay	3.7	3.6	4.5	4.1	4.2	3.8
Vallejo	San Pablo Bay	108	104	104	99	87	80
West County	Central Bay	83	61	29	49	69	82
Total [(c)]		**4,104**	**4,227**	**2,923**	**3,081**	**3,220**	**3,218**

a. Data is presented in detail and summarized for each plant in the Appendix. A "-" indicates data was not available, whereas a "0" indicates a value of zero.

b. No discharge during a portion or all of the dry season months, except with authorization under emergency conditions.

c. The total values might vary from the sum of the listed values by plant due to rounding.

Table 4-23. Annual Average Daily Discharges by Subembayment, Ortho-P (kg P/d)

Subembayment	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
Suisun Bay	353	410	276	272	295	335
San Pablo Bay	326	295	221	223	269	200
Central Bay	1,287	1,133	680	686	570	1,061
South Bay	1,741	1,845	1,057	1,162	1,163	1,092
Lower South Bay	916	781	837	869	990	675
Total	**4,623**	**4,464**	**3,071**	**3,212**	**3,287**	**3,363**

Table 4-24. Dry Season Average Daily Discharges by Subembayment, Ortho-P (kg P/d)

Subembayment	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	Trend (a,b)
Suisun Bay	384	445	242	246	283	314	Increasing (22% Change)
San Pablo Bay	222	237	166	169	141	140	None
Central Bay	1,033	916	616	562	720	936	Increasing (48% Change)
South Bay	1,759	1,931	1,099	1,229	1,206	1,185	None
Lower South Bay	706	698	800	875	870	644	None
Total	**4,104**	**4,227**	**2,923**	**3,081**	**3,220**	**3,218**	**None**

a. Trend analysis is based on average monthly values from July 2014 through June 2018 (excludes the initial two years of data due to sampling related issues as previously discussed in Section 3.2). Discernible trends were identified based on the slope of a regression line determined using the method of least squares to fit the data (alpha = 0.05). Sample size is 20. Where “None” is stated, the limited dataset does not indicate a statistically relevant trend.

b. The percent change represents the 2017/18 value in comparison to the average of three years of data (2014/2015 through 2016/2017).

The average monthly daily discharge Ortho-P loads since the 2012/13 season are presented in Figure 4-6. The dry season ortho-P loads discharged to the Bay generally appear to exhibit a decreasing trend which may be attributed to different two different sampling requirements under the Section 13267 Letter and the Nutrient Watershed Permit (see Section 3.2). Due to this difference in sampling requirements, the statistical trending (see Section 3.5) was limited to the last four years of data (i.e., limited to Nutrient Watershed Permit dataset). The Bay-wide ortho-P loads did not suggest any significant dry season trends. Both Suisun Bay and Central Bay dry season data suggests a significant upward trend. Historically, the predominant Subembayment has varied. The most recent year of data suggests that the Central and South Bays have the largest discharge contributions to the Bay.

A discussion of the results is provided in Section 5.8.

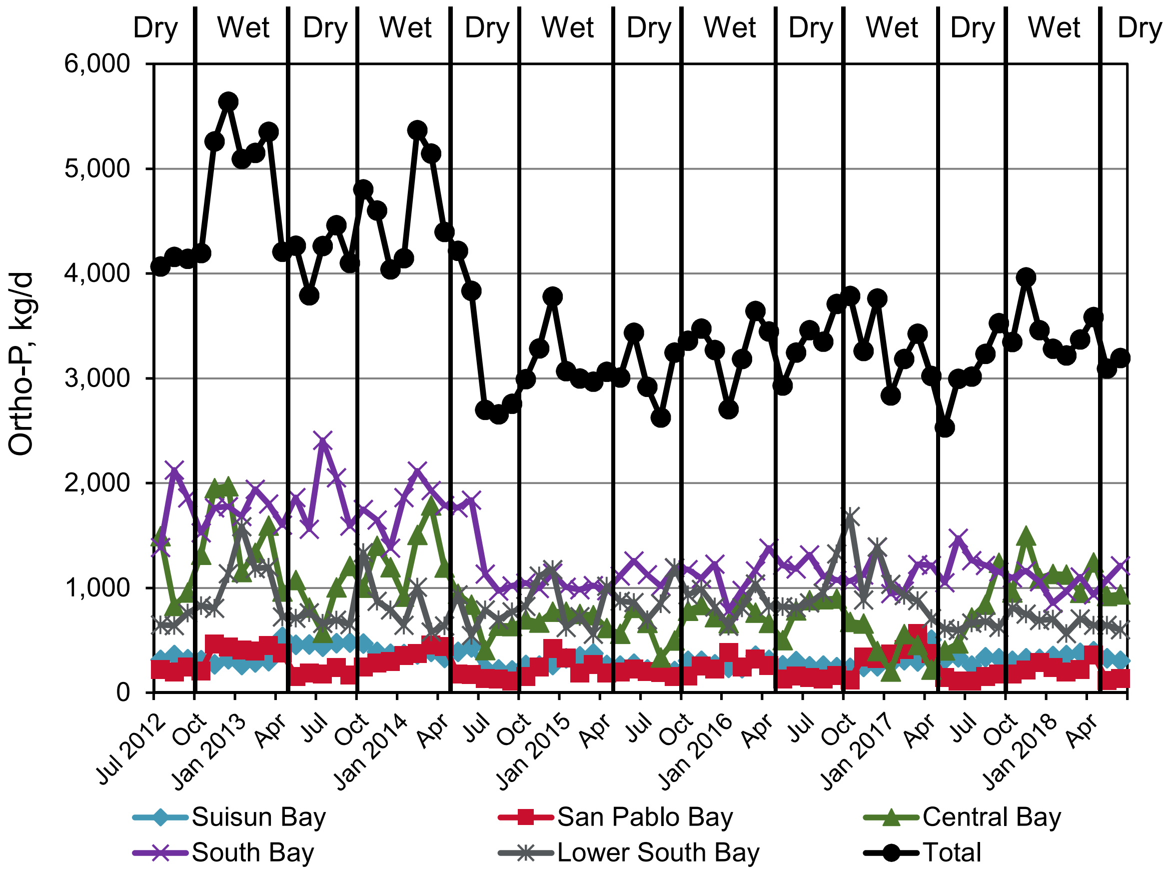

Figure 4-6. Historical Average Monthly Daily Discharge Ortho-P Load Values

4.8 Total Phosphorus (TP)

The annual average and dry season average monthly effluent TP loads are presented in Table 4-25 and Table 4-26, respectively. The annual average and dry season effluent TP load discharged by subembayment is presented in Table 4-27 and Table 4-28, respectively.

Table 4-25. Annual Average Daily Discharges by Discharger, TP (kg P/d)

Discharger	Subembayment	2012/13 (a)	2013/14 (a)	2014/15 (a)	2015/16 (a)	2016/17 (a)	2017/18 (a)
American Canyon	San Pablo Bay	26	26	24	31	23	25
Benicia	San Pablo Bay	26	26	28	14	20	14
Burlingame	South Bay	81	140	22	26	29	28
CCCSD	Suisun Bay	139	96	125	107	124	121
CMSA	Central Bay	89	88	93	83	95	104
Port Costa	San Pablo Bay	-	-	-	0.6	0.5	0.4
Delta Diablo	Suisun Bay	33	28	36	29	45	66
EBDA	South Bay	539	539	517	524	644	537
EBMUD	Central Bay	933	800	769	735	564	987
FSSD	Suisun Bay	195	203	197	198	179	226
Las Gallinas[(b)]	San Pablo Bay	20	17	15	23	22	16
Millbrae	South Bay	16	16	12	13	11	8
Mt. View	Suisun Bay	18	17	17	15	15	14
Napa[(b)]	San Pablo Bay	23	14	25	35	59	22
Novato[(b)]	San Pablo Bay	16	11	21	9.6	13	2.9
Palo Alto	Lower South Bay	349	346	357	429	429	345
Paradise Cove	Central Bay	0.3	-	0.3	0.3	0.4	0.8
Petaluma[(b)]	San Pablo Bay	28	31	25	19	25	16
Pinole	San Pablo Bay	34	19	14	17	23	26
Rodeo	San Pablo Bay	9.3	7.1	7.7	8.5	9.3	7.4
San Jose	Lower South Bay	326	261	306	351	412	159
San Mateo	South Bay	124	128	122	139	126	129
SASM	Central Bay	41	49	42	51	39	40
SFO Airport	South Bay	15	17	8.6	11	10	28
SFPUC Southeast	South Bay	100	134	172	257	329	291
SMCSD	Central Bay	23	20	17	17	16	20
Sonoma Valley[(b)]	San Pablo Bay	16	10	2.8	2.5	22	0
South SF	South Bay	154	155	169	150	140	141
Sunnyvale	Lower South Bay	214	202	225	191	223	254
SVCW	South Bay	172	177	176	249	218	226
Tiburon	Central Bay	8.2	-	8.3	8.7	8.6	7.8
Treasure Island	Central Bay	1.9	2.6	3.3	4.0	4.3	3.7
Vallejo	San Pablo Bay	128	130	121	129	138	108
West County	Central Bay	57	62	41	62	91	98
Total [(c)]		**3,954**	**3,772**	**3,720**	**3,939**	**4,107**	**4,076**

a. Data is presented in detail and summarized for each plant in the Appendix.

b. No discharge during a portion or all of the dry season months, except with authorization under emergency conditions.

c. The total values might vary from the sum of the listed values by plant due to rounding.

Table 4-26. Dry Season Average Daily Discharges by Discharger, TP (kg P/d)

Discharger	Subembayment	2012/13 (a)	2013/14 (a)	2014/15 (a)	2015/16 (a)	2016/17 (a)	2017/18 (a)
American Canyon	San Pablo Bay	26	47	17	25	11	23
Benicia	San Pablo Bay	27	25	24	15	18	6
Burlingame	South Bay	76	103	23	24	18	15
CCCSD	Suisun Bay	141	110	107	103	100	113
CMSA	Central Bay	92	94	86	85	102	122
Port Costa	San Pablo Bay	-	-	-	-	-	
Delta Diablo	Suisun Bay	32	28	27	27	36	65
EBDA	South Bay	477	505	519	482	539	513
EBMUD	Central Bay	885	610	698	590	704	763
FSSD	Suisun Bay	202	204	169	172	186	211
Las Gallinas[b]	San Pablo Bay	0.0	0.0	0.0	0.0	0.8	0.0
Millbrae	South Bay	17	19	12	15	13	10
Mt. View	Suisun Bay	18	18	19	17	15	12
Napa[b]	San Pablo Bay	0.0	3.8	0.0	0.0	0.0	0
Novato[b]	San Pablo Bay	1.1	1.6	0.8	1.2	1.7	0.8
Palo Alto	Lower South Bay	393	366	392	410	432	342
Paradise Cove	Central Bay	0.3	-	0.2	0.3	0.4	0.8
Petaluma[b]	San Pablo Bay	0.0	0.0	0.0	0.0	0.0	0.0
Pinole	San Pablo Bay	40	23	17	18	18	26
Rodeo	San Pablo Bay	9.2	5.6	8.6	9.0	7.6	6.6
San Jose	Lower South Bay	119	233	229	357	326	123
San Mateo	South Bay	117	137	130	132	131	128
SASM	Central Bay	40	51	44	40	43	40
SFO Airport	South Bay	19	18	7.8	8.4	7.7	34
SFPUC Southeast	South Bay	103	112	183	289	388	329
SMCSD	Central Bay	24	23	19	18	19	22
Sonoma Valley[b]	San Pablo Bay	0.0	0.0	0.0	0.0	0.8	0.0
South SF	South Bay	156	158	158	162	157	135
Sunnyvale	Lower South Bay	214	155	207	167	173	259
SVCW	South Bay	181	173	181	276	212	219
Tiburon	Central Bay	7.8	-	8.1	8.7	8.2	8.9
Treasure Island	Central Bay	2.0	1.9	3.1	4.3	4.3	4.5
Vallejo	San Pablo Bay	130	126	127	134	118	105
West County	Central Bay	54	45	32	61	78	86
Total [c]		**3,603**	**3,396**	**3,448**	**3,650**	**3,869**	**3,723**

a. Data is presented in detail and summarized for each plant in the Appendix. A "-" indicates data was not available, whereas a "0" indicates a value of zero.

b. No discharge during a portion or all of the dry season months, except with authorization under emergency conditions.

c. The total values might vary from the sum of the listed values by plant due to rounding.

Table 4-27. Annual Average Daily Discharges by Subembayment, TP (kg P/d)

Subembayment	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
Suisun Bay	385	344	375	349	363	428
San Pablo Bay	326	291	284	289	355	239
Central Bay	1,153	1,022	974	961	818	1,262
South Bay	1,201	1,306	1,199	1,369	1,507	1,389
Lower South Bay	889	809	888	971	1,064	758
Total	**3,954**	**3,772**	**3,720**	**3,939**	**4,107**	**4,076**

Table 4-28. Dry Season Average Daily Discharges by Subembayment, TP (kg P/d)

Subembayment	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	Trend (a,b)
Suisun Bay	393	360	322	319	337	402	None
San Pablo Bay	233	232	194	202	176	168	Decreasing (-24% Change)
Central Bay	1,105	825	890	807	959	1,048	None
South Bay	1,146	1,225	1,214	1,388	1,466	1,382	Increasing (16% Change)
Lower South Bay	726	754	828	934	931	724	None
Total	**3,603**	**3,396**	**3,448**	**3,650**	**3,869**	**3,723**	**None**

c. Trend analysis is based on average monthly values. Discernible trends were identified based on the slope of a regression line determined using the method of least squares to fit the data (alpha = 0.05). Sample size is 30. Where “None” is stated, the limited dataset does not indicate a statistically relevant trend.
d. The percent change represents the 2017/18 value in comparison to the average of the initial three years of data (2012/2013 through 2014/2015).

The 2016/2017 average annual and dry season total loads were the highest since nutrient sampling began in July 2012. The 2017/2018 data for both average annual and dry season shows a decrease in TP discharge compared to the previous year, but is still higher than any other year of data since sampling began in 2012. The dry season TP loads discharged to the Bay exhibit a decreasing trend for San Pablo Bay and an increasing trend for the South Bay based on the least squares correlation test selected as the basis for trends analysis (see Section 3.5). There is no statistically significant baywide trend.

The reported ortho-P values were greater than TP values in several cases (compare values in Table 4-21 and Table 4-25 for specific plants.). It is especially pronounced for certain plants, such as the SFPUC Southeast Plant, who communicated this issue with the Regional Water Board in the summer of 2015. This issue is attributed to a combination of sampling methodology (composite versus grab) and the analytical methodology for measuring phosphorus, which suffers from matrix issues.[4] The issue has since been resolved by using a different analytical technique (Inductively Coupled Plasma – Atomic Emission Spectroscopy) and is not expected to be an issue in the future.

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[4] Neal, C.; Neal, M; and Wickham, H. (2000) Phosphate measurement in natural waters: two examples of analytical problems associated with silica interference using phosphomolybdic acid methodologies. Science of the Total Environment, 251-252:511-522. Also Eleuterio, L. and Neethling, J.B., “Low Phosphorus Analytical Measurement Study” WERF Nutrient Removal Challenge Report NUTR1R06F, 2009.

The average monthly daily discharge TP loads since the 2012/13 season are presented in Figure 4-7. The South Bay Subembayment received the largest TP load and accounts for approximately one-third of the TP load discharged to the San Francisco Bay (see Table 4-27).

A discussion of the results is provided in Section 5.9.

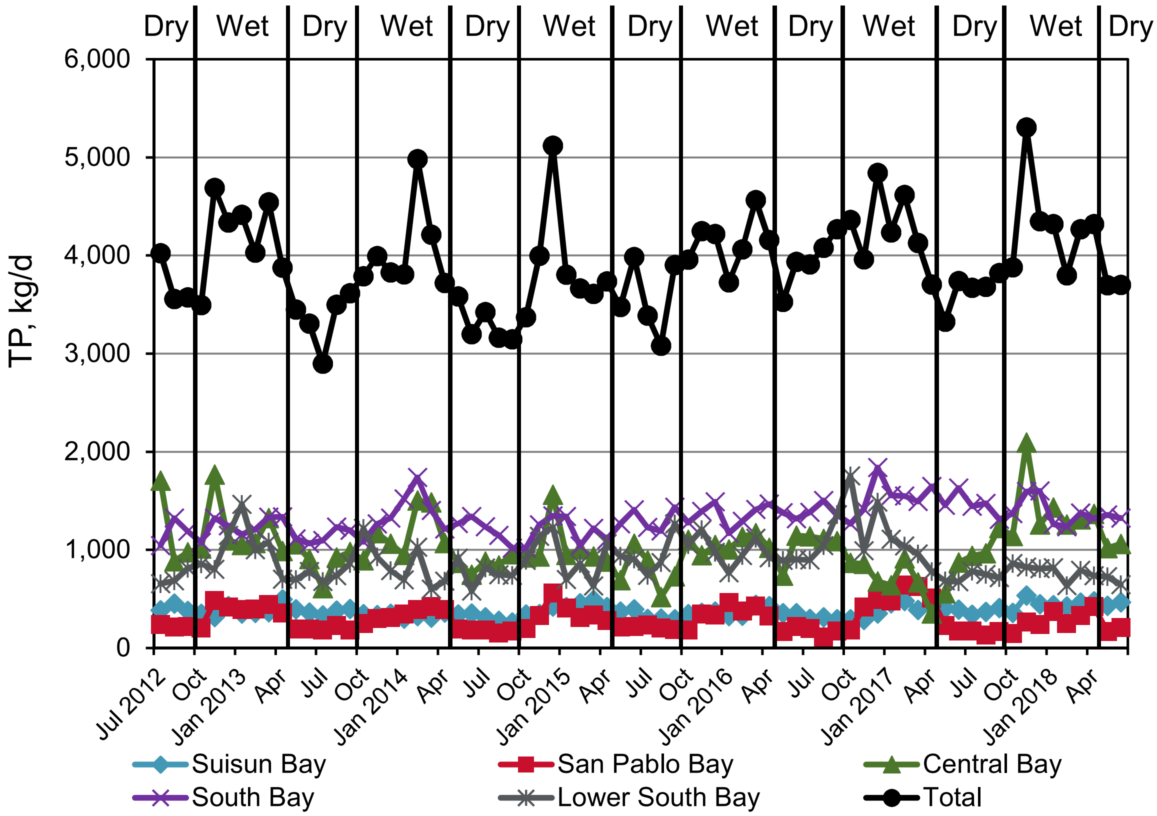

Figure 4-7. Historical Average Monthly Daily Discharge TP Load Values

4.9 Subembayment Nutrient Loading

Nutrient effluent loading for select nitrogen and phosphorus species has been analyzed by subembayment to demonstrate the relative contributions for each discharger. In this section, loading diagrams illustrate the discharge loads over time for the past six years (July 2012 through June 2018).

The cumulative figures in the following subsections are organized by subembayment and present the relative contribution of each discharger within its respective subembayment, for flow, ammonia, total nitrogen and total phosphorus.

4.9.1 Suisun Bay

The average monthly discharge to Suisun Bay by discharger for flow, ammonia, TN and TP is provided in Figure 4-8, Figure 4-9, Figure 4-10, and Figure 4-11, respectively. Flows to Suisun Bay are dominated by the CCCSD discharge and followed, in terms of magnitude, by FSSD and Delta Diablo. CCCSD also discharges the largest loads of ammonia and total nitrogen. FSSD discharges the largest phosphorus load to Suisun Bay, followed by CCCSD.

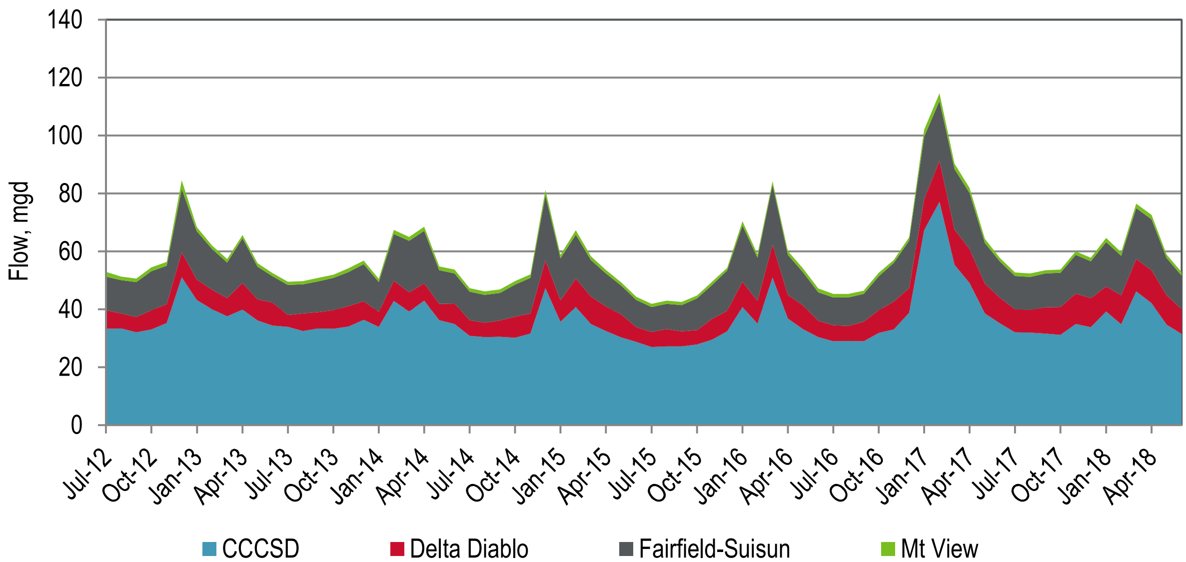

Figure 4-8. Flow Contribution by Discharger to Suisun Bay

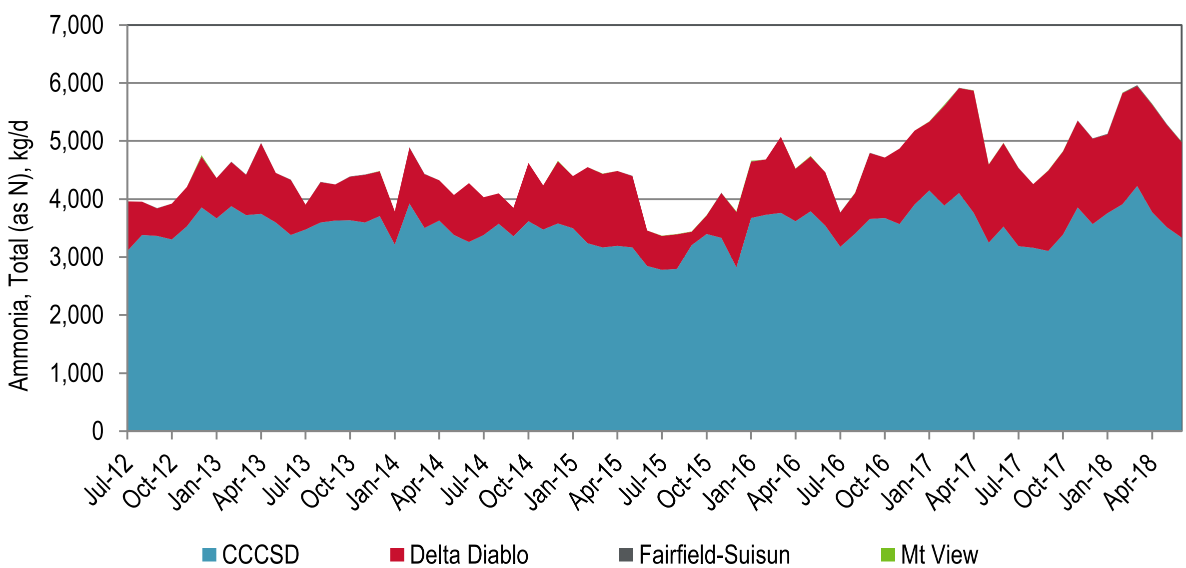

Figure 4-9. Ammonia Load Contribution by Discharger to Suisun Bay

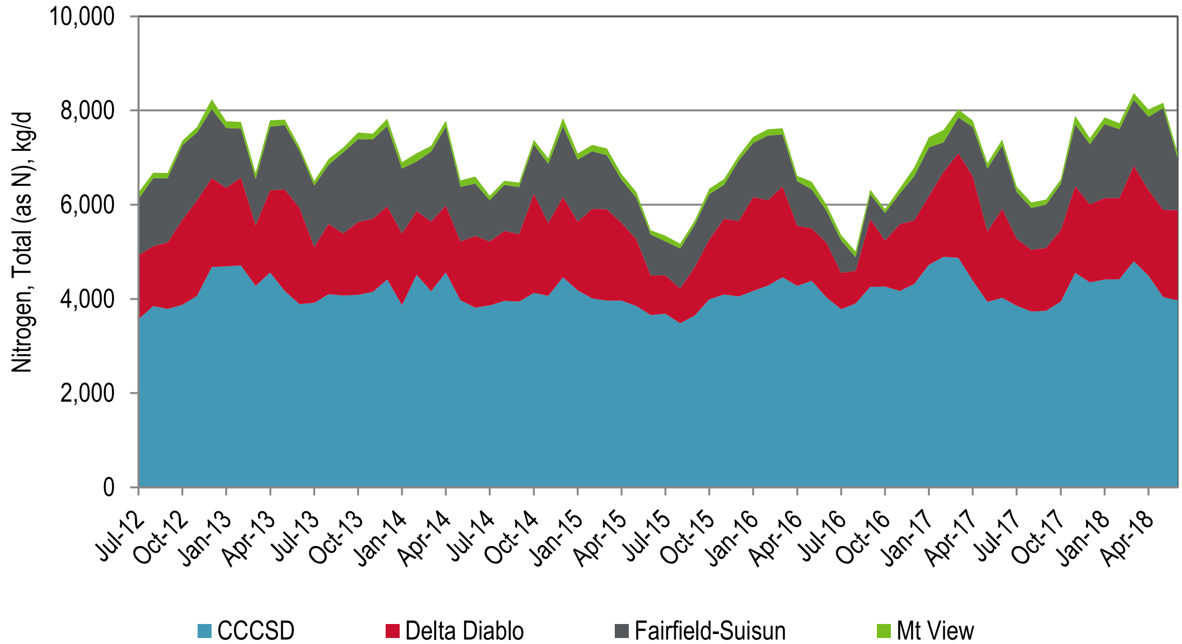

Figure 4-10. Total Nitrogen Load Contribution by Discharger to Suisun Bay

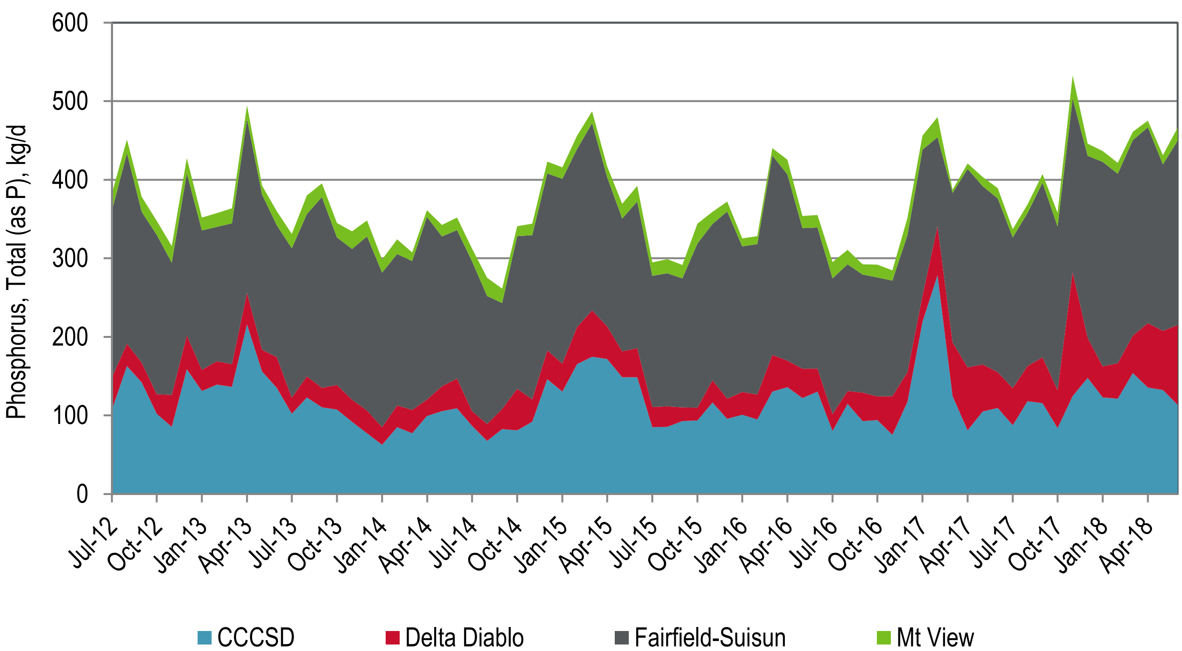

Figure 4-11. Total Phosphorus Load Contribution by Discharger to Suisun Bay

4.9.2 San Pablo Bay

The average monthly discharge to San Pablo Bay by discharger for flow, ammonia, TN and TP is provided in Figure 4-12, Figure 4-13, Figure 4-14, and Figure 4-15, respectively. Figure 4-12 clearly demonstrates the seasonal discharges at Sonoma Valley, Napa, Las Gallinas, and Petaluma. The relative ammonia load contribution from Vallejo increased over the past few years. Similar to flow, total nitrogen and total phosphorus loads to San Pablo Bay appear to exhibit a significant seasonal pattern with higher wintertime loads.

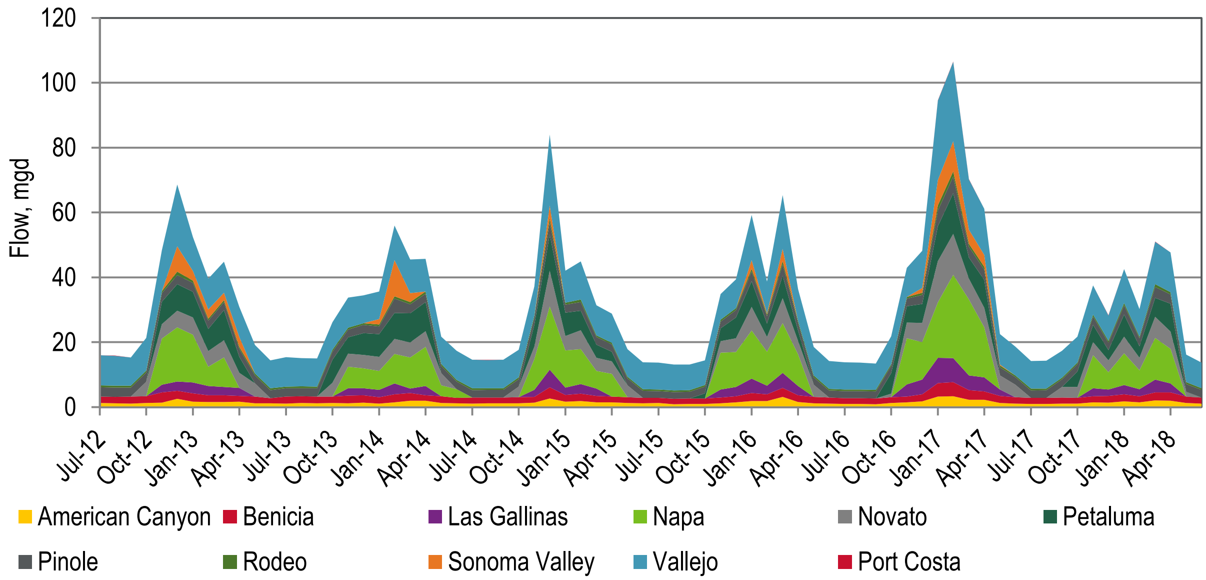

Figure 4-12. Flow Contribution by Discharger to San Pablo Bay

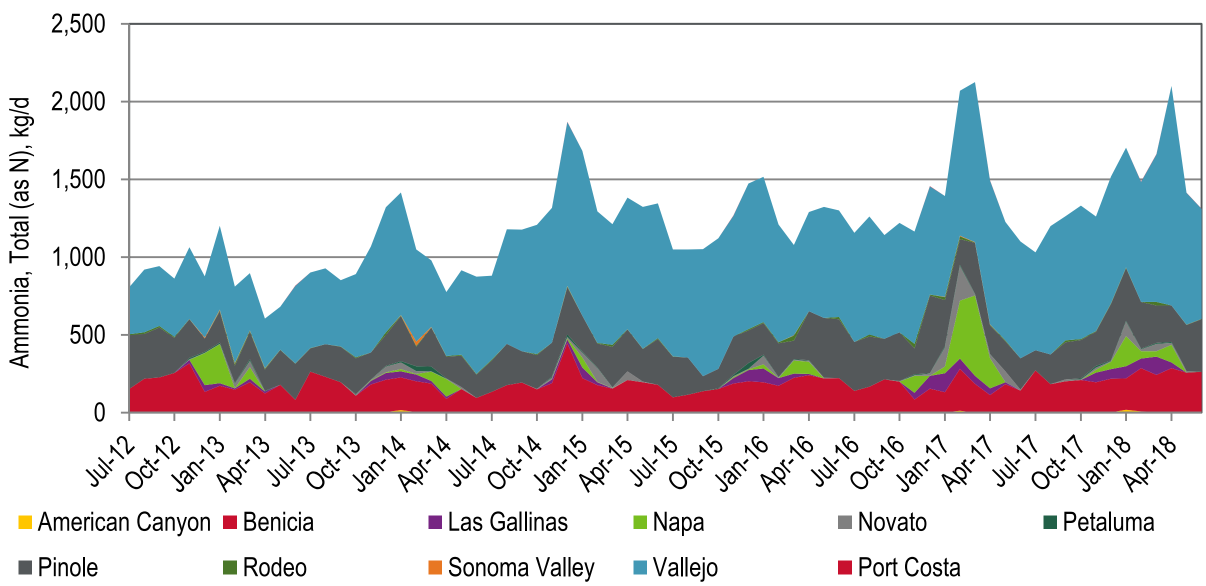

Figure 4-13. Ammonia Load Contribution by Discharger to San Pablo Bay

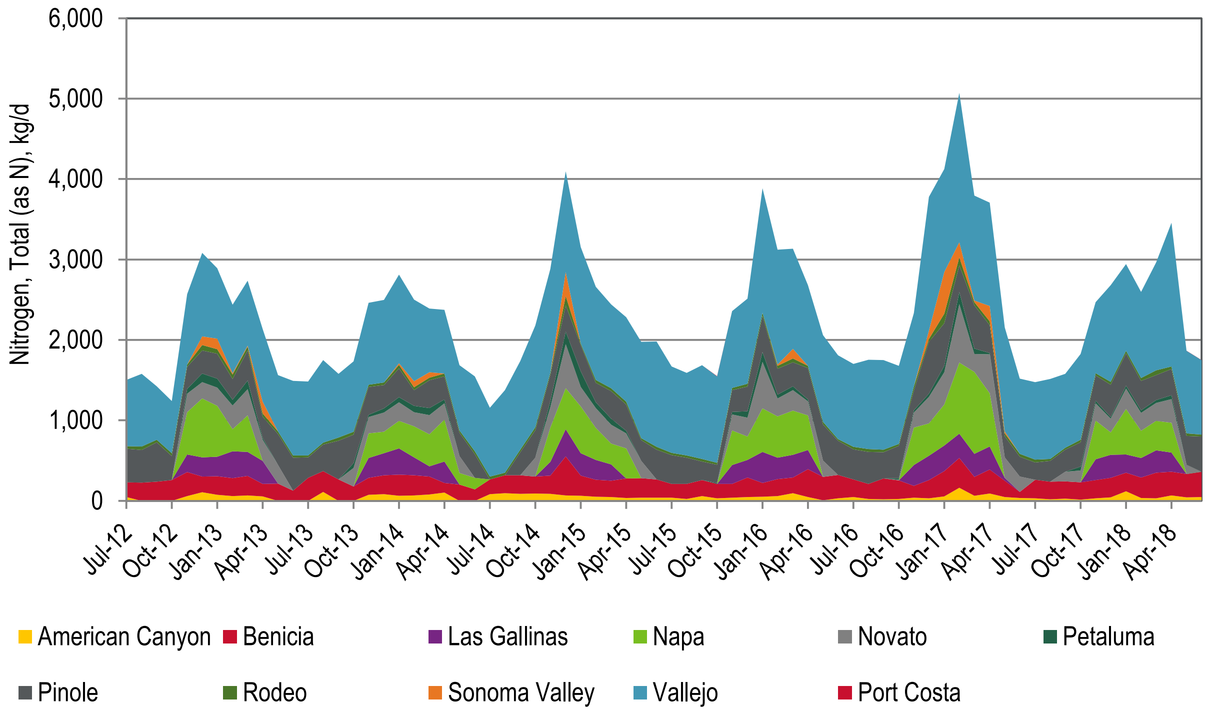

Figure 4-14. Total Nitrogen Load Contribution by Discharger to San Pablo Bay

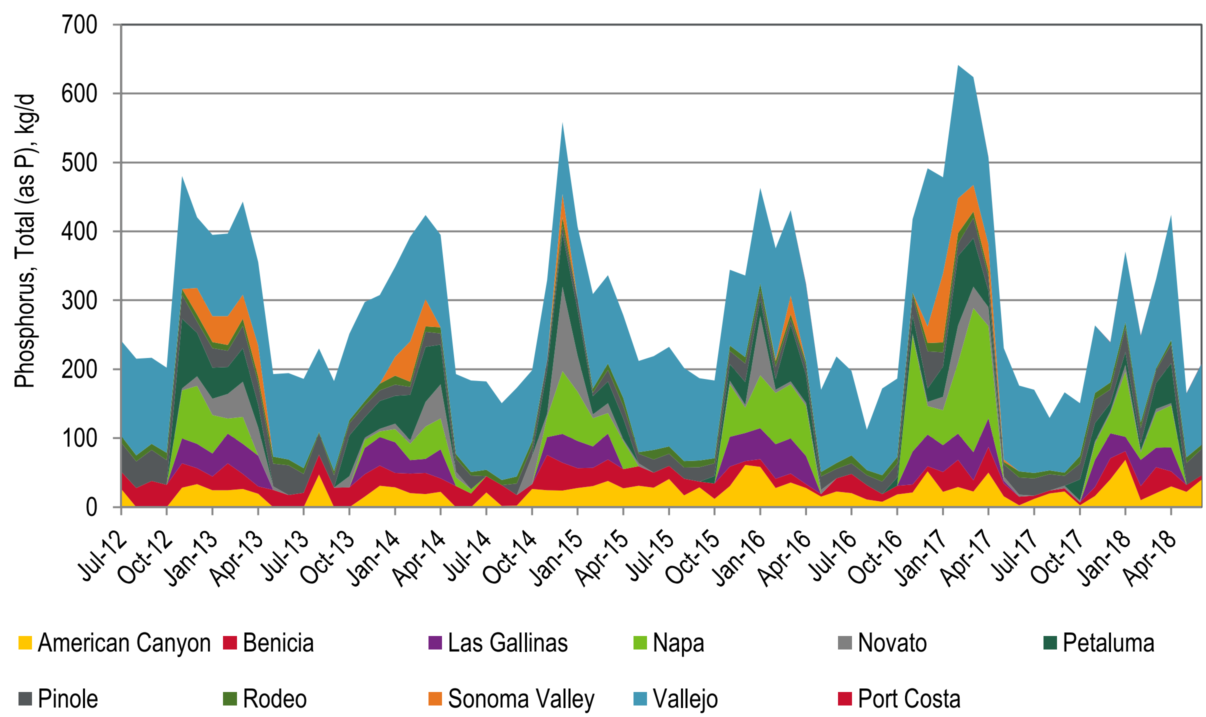

Figure 4-15. Total Phosphorus Load Contribution by Discharger to San Pablo Bay

4.9.3 Central Bay

The average monthly discharge to Central Bay by discharger for flow, ammonia, TN and TP is provided in Figure 4-16, Figure 4-17, Figure 4-18, and Figure 4-19, respectively. Discharge flows and loads to the Central Bay are dominated by EBMUD.

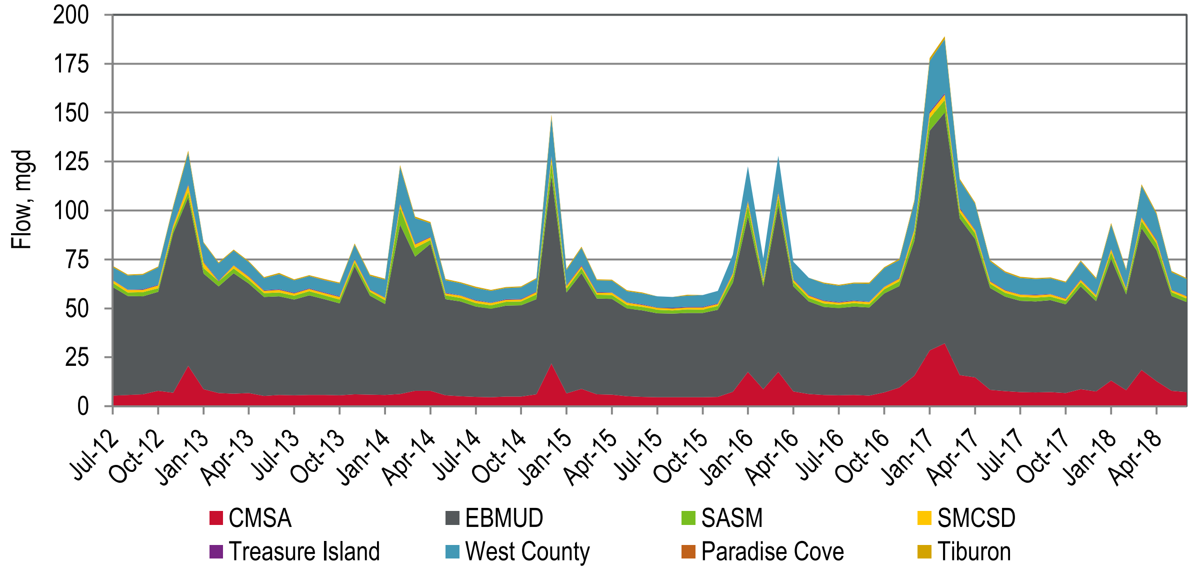

Figure 4-16. Flow Contribution by Discharger to Central Bay

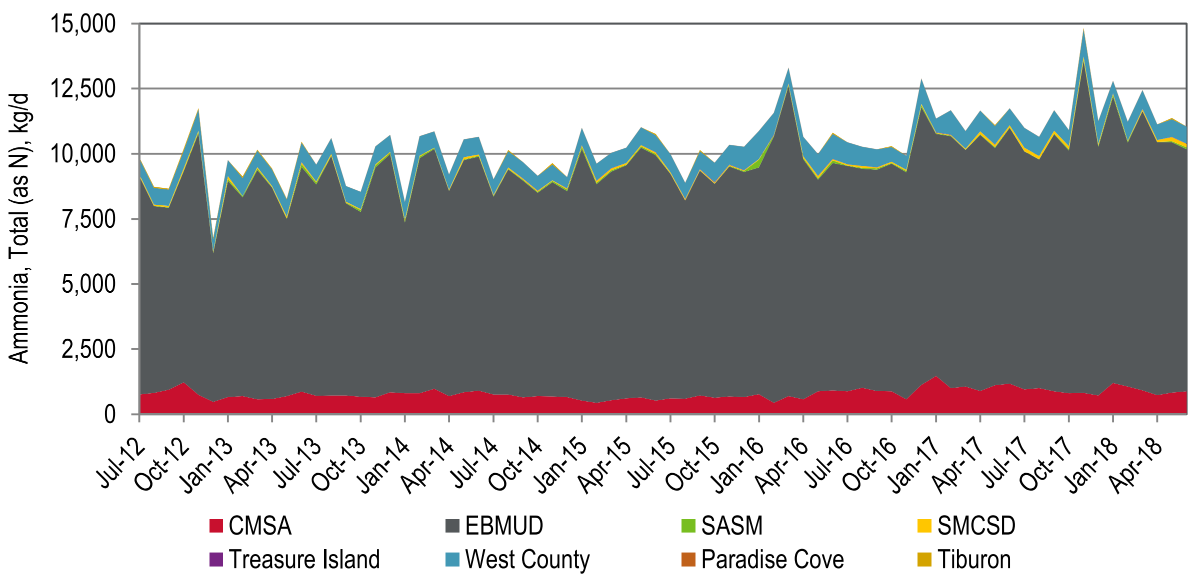

Figure 4-17. Ammonia Load Contribution by Discharger to Central Bay

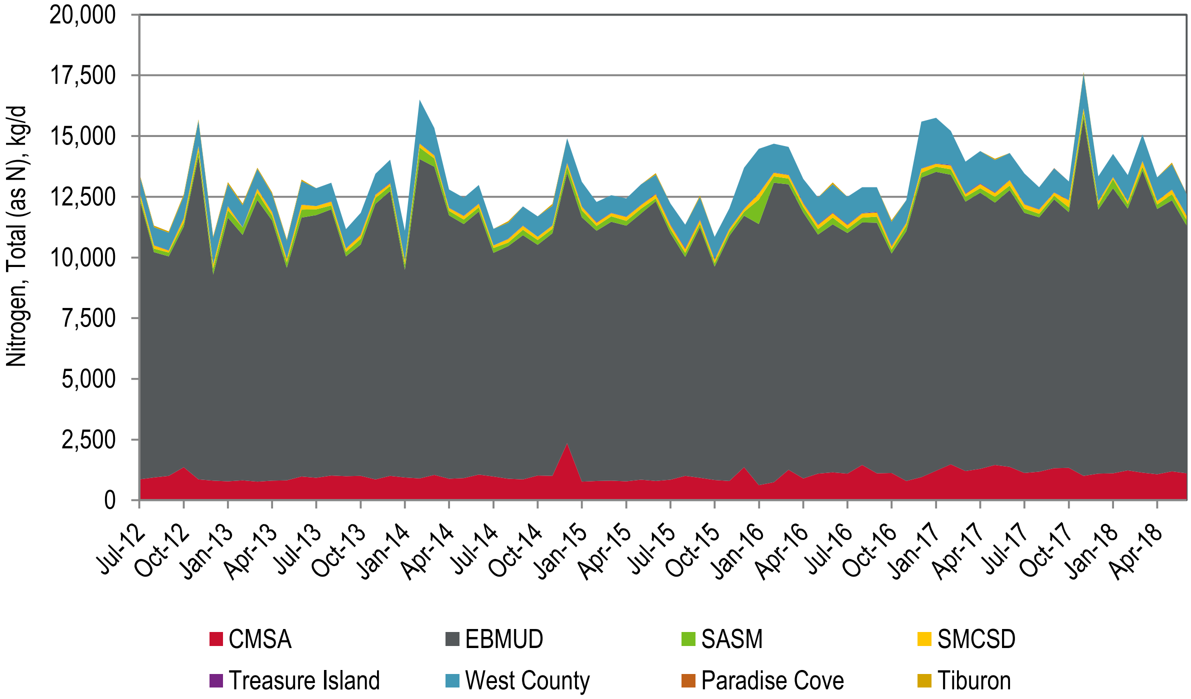

Figure 4-18. Total Nitrogen Load Contribution by Discharger to Central Bay

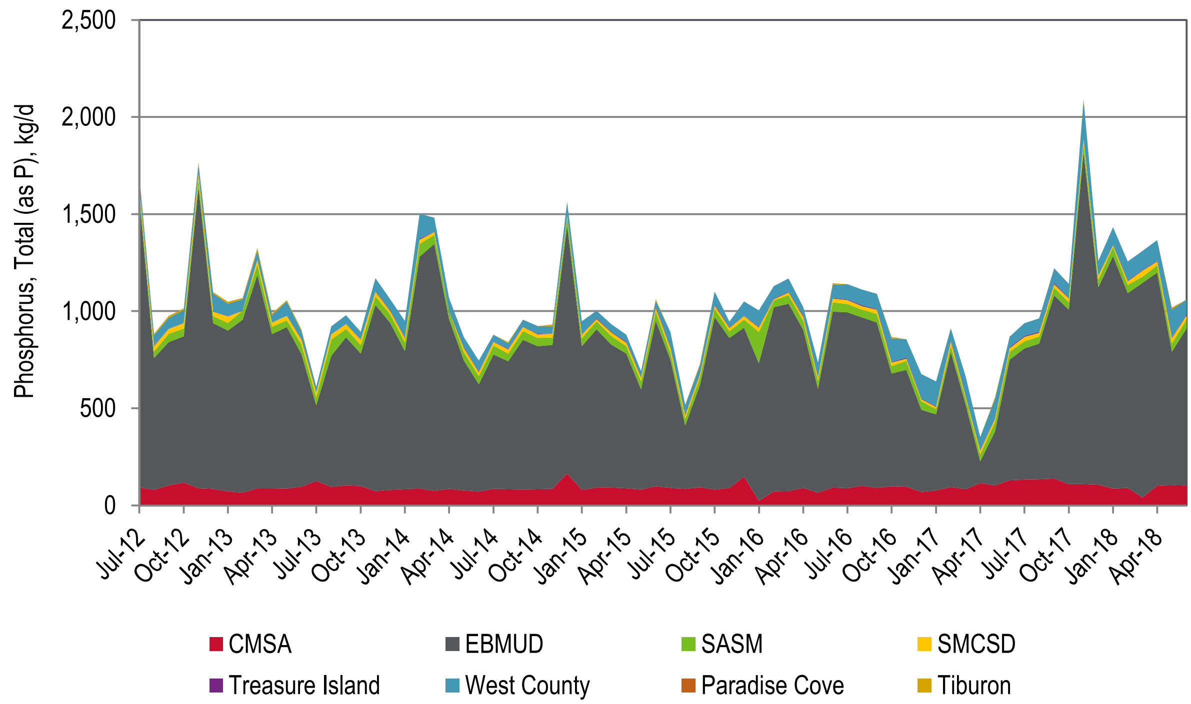

Figure 4-19. Total Phosphorus Load Contribution by Discharger to Central Bay

4.9.4 South Bay

The average monthly discharge to the South Bay by discharger for flow, ammonia, TN and TP is provided in Figure 4-20, Figure 4-21, Figure 4-22, and Figure 4-23, respectively. In the South Bay, the largest wastewater discharges are from the SFPUC Southeast Plant and EBDA. Ammonia and total nitrogen loads to the South Bay are also largest from the SFPUC Southeast Plant and EBDA. The total phosphorus discharges to the South Bay are more evenly distributed between EBDA, SFPUC Southeast Plant, San Mateo, and SVCW. SFPUC's total phosphorus loads are a lower proportion of the total compared to flow, ammonia, and total nitrogen.

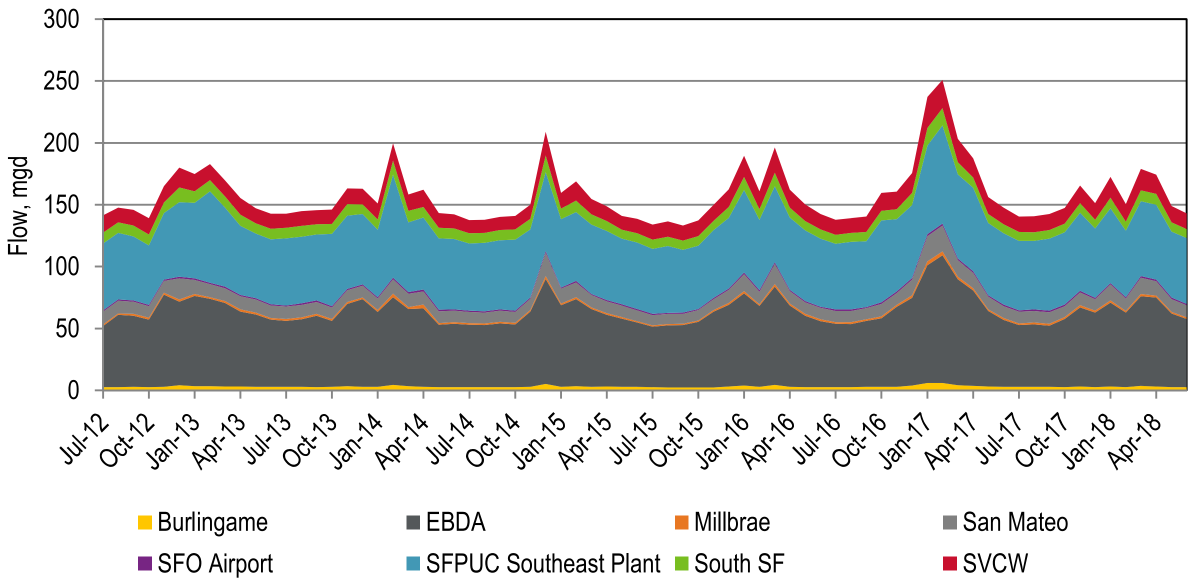

Figure 4-20. Flow Contribution by Discharger to South Bay

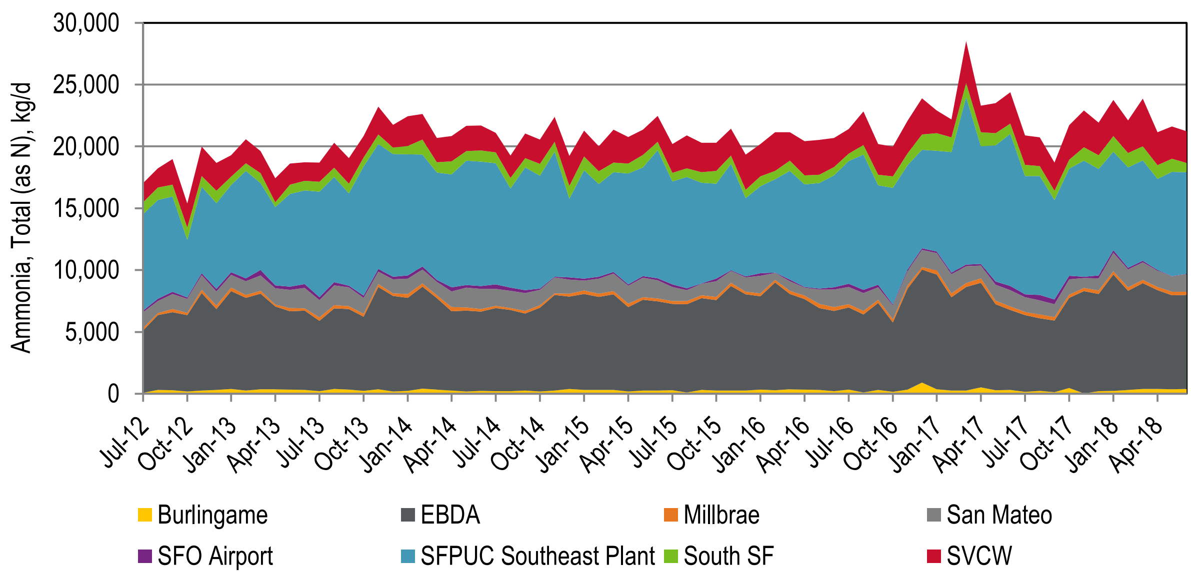

Figure 4-21. Ammonia Load Contribution by Discharger to South Bay

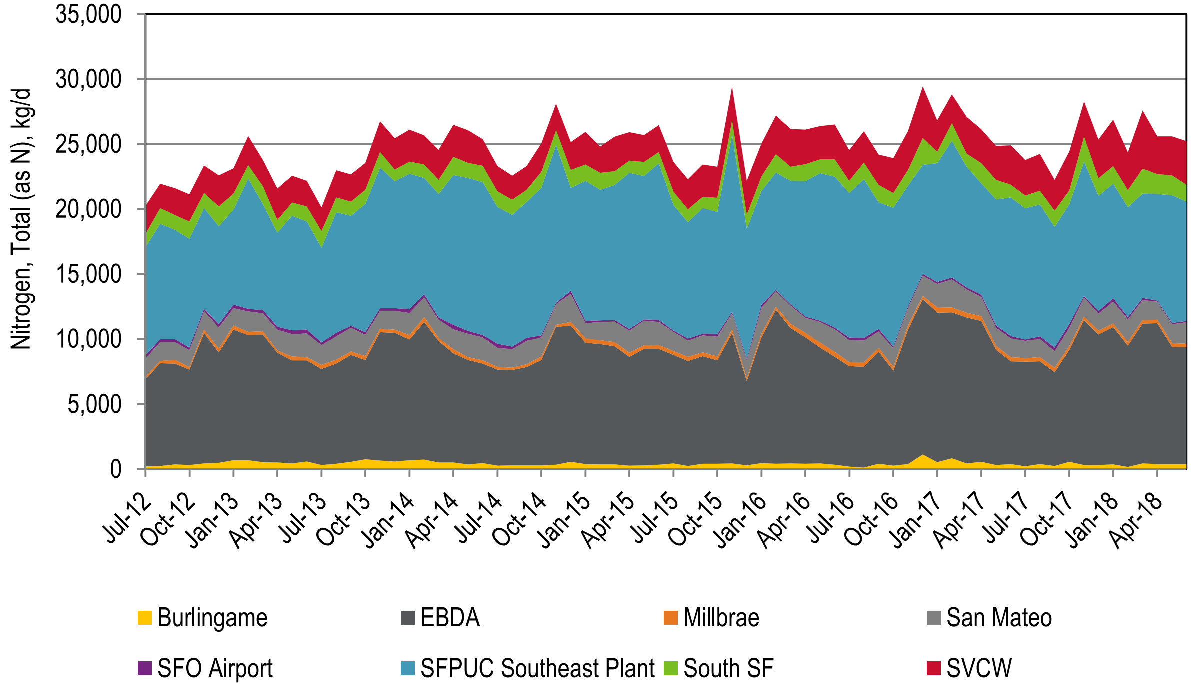

Figure 4-22. Total Nitrogen Load Contribution by Discharger to South Bay

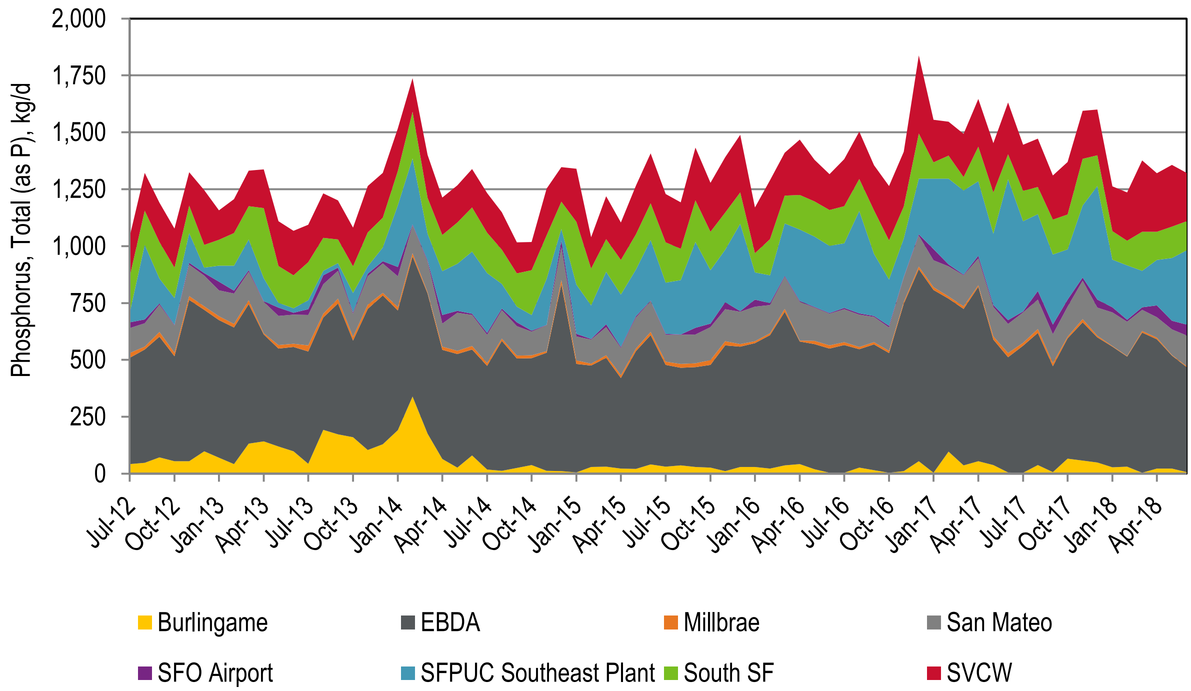

Figure 4-23. Total Phosphorus Load Contribution by Discharger to South Bay

4.9.5 Lower South Bay

The average monthly discharge to Lower South Bay by discharger for flow, ammonia, TN and TP is provided in Figure 4-24, Figure 4-25, Figure 4-26, and Figure 4-27, respectively. Lower South Bay wastewater flows are dominated by San Jose. San Jose also discharges the largest total nitrogen load. Sunnyvale and San Jose's ammonia loads exhibit a significant seasonal pattern. San Jose's total nitrogen loads are sporadic (e.g., July 2015), which is likely attributed to the biological nitrogen removal step feed process.

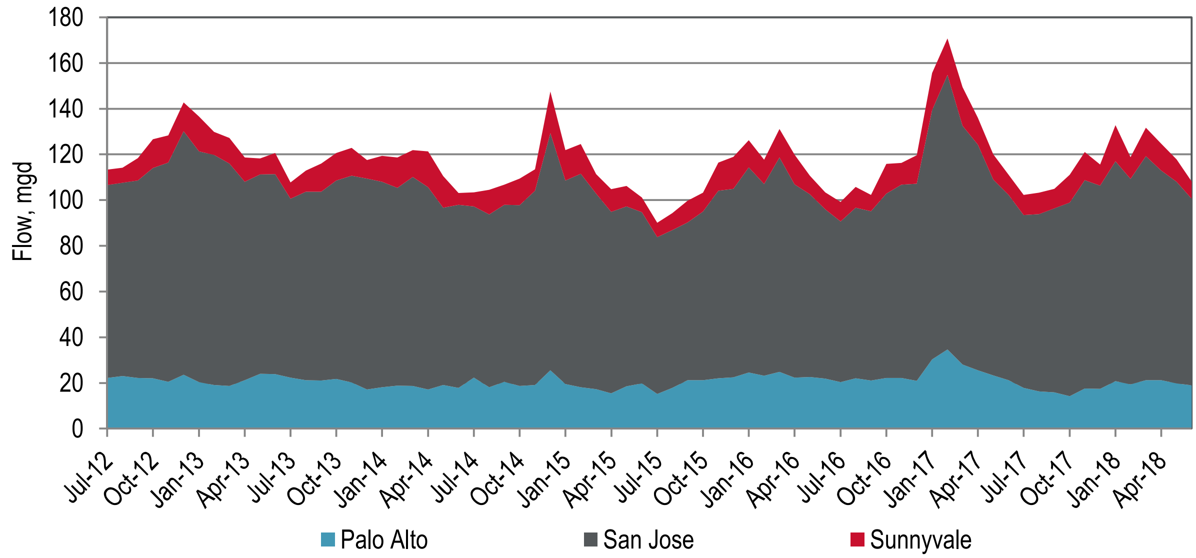

Figure 4-24. Flow Contribution by Discharger to Lower South Bay

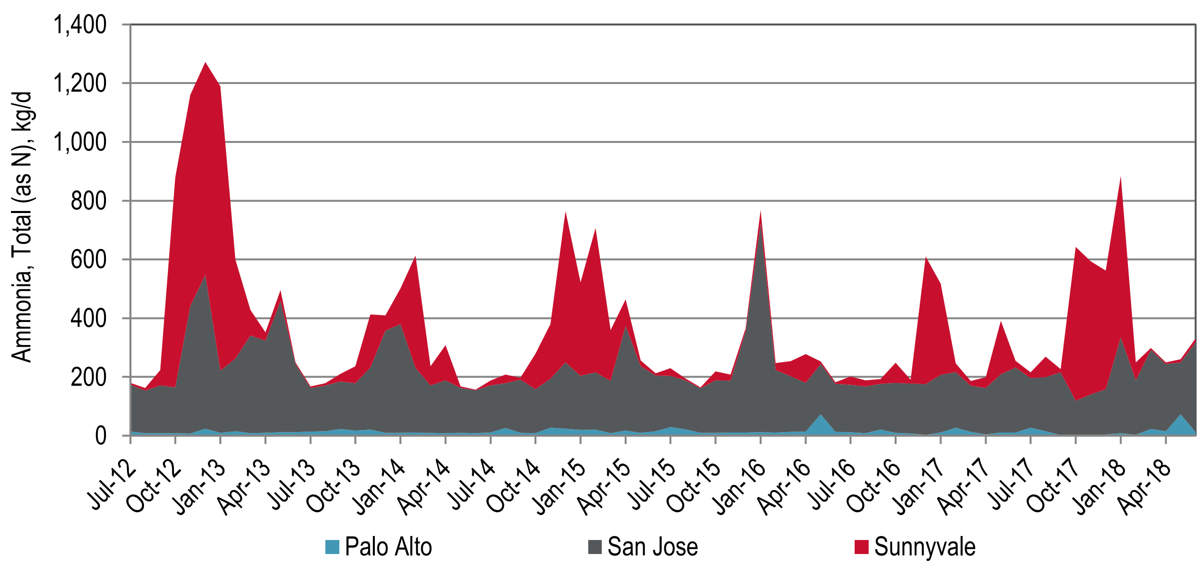

Figure 4-25. Ammonia Load Contribution by Discharger to Lower South Bay

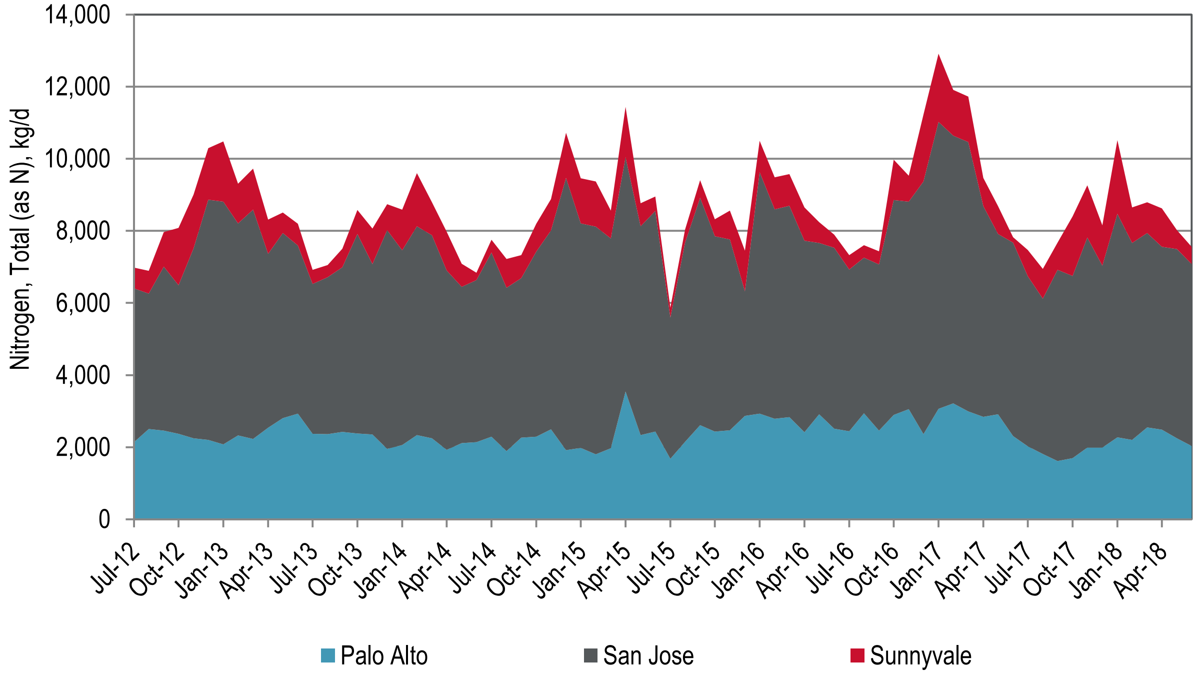

Figure 4-26. Total Nitrogen Load Contribution by Discharger to Lower South Bay

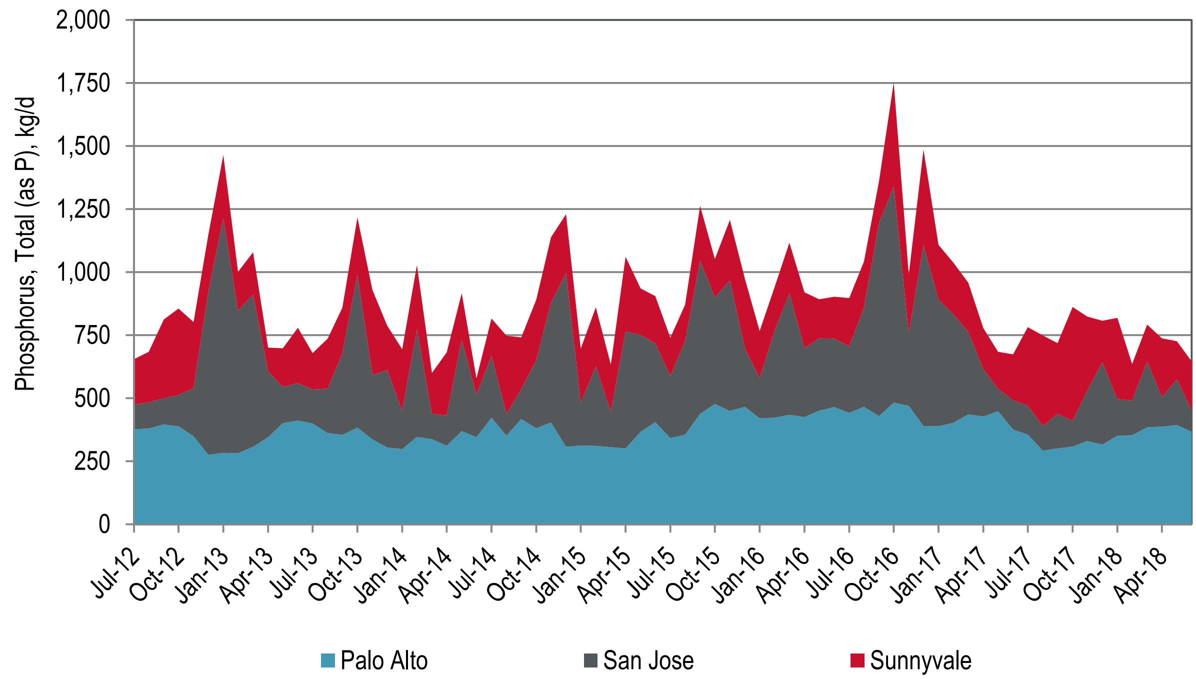

Figure 4-27. Total Phosphorus Load Contribution by Discharger to Lower South Bay

5 Discussion

The 2016/2017 dataset was one of the wettest years on record for Northern California. As a result, the average annual total flows during the 2016/2017 wet season were the highest since sampling began in July 2012. Both average annual and dry season 2016/2017 loads for all parameters (except NOx and Ortho-P) were also the highest since sampling began in July 2012. Average annual total flows from the 2017/2018 dataset returned to pre-2016/2017 values. In contrast, the dry season 2017/2018 total discharge flows were similar to 2016/2017. Loads from the 2017/2018 dataset were reduced from 2016/2017, but not as pronounced as flows. The average annual total loads from the 2017/2018 dataset were the second-highest since sampling began in July 2012, (except NOx and Ortho-P).

A plot of the historical average monthly daily discharge flow, ammonia, and TN loads are presented in Figure 5-1. In general, both ammonia and total nitrogen loads tend to track with the flows. For example, during peak wet weather events, both the flow and total nitrogen loads typically increase. However, the limited dataset restricts confidence in the strength of this relationship. In other words, it is unknown whether the trend would be as evident with increased sampling frequency where the impacts from an initial scouring event in the collection system due to wet weather would be reduced and dilution increased (similar to the "first flush" in stormwater collection systems). Additional data is needed to further understand the correlation between flow and loads during peak wet weather events.

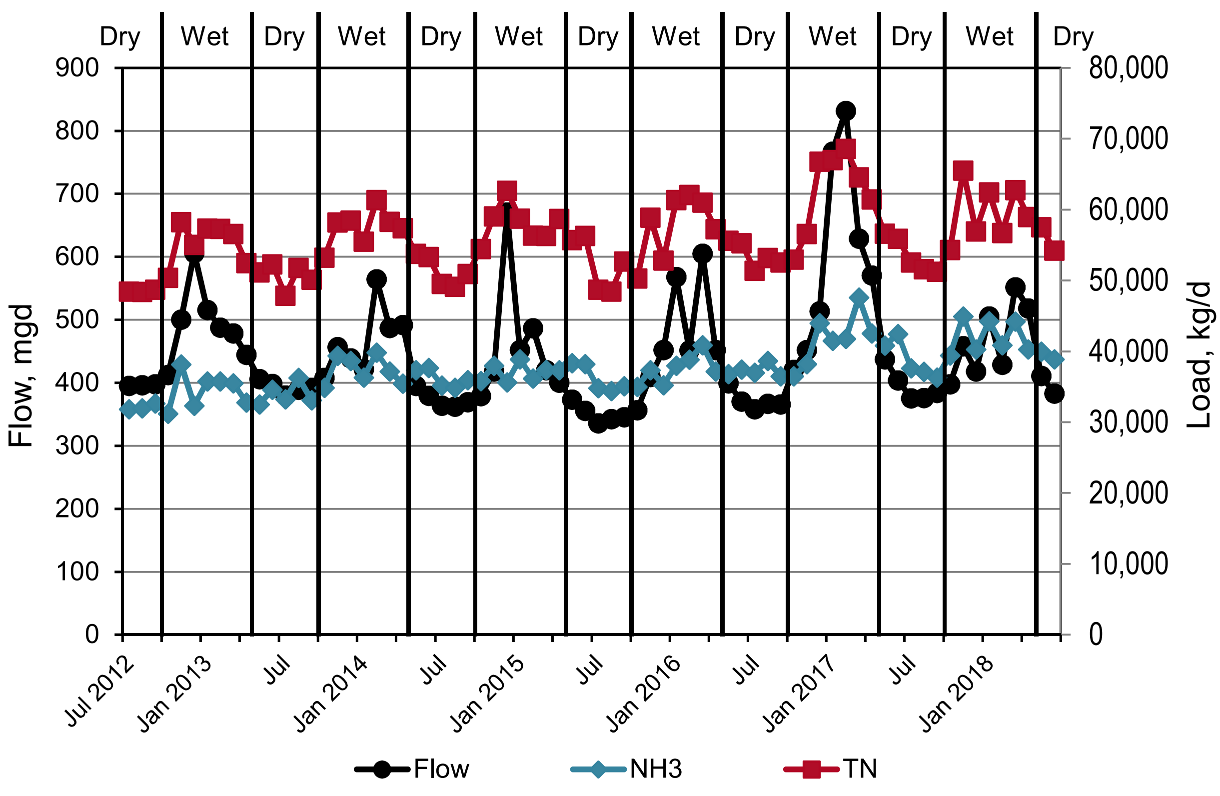

Figure 5-1. Historical Average Monthly Daily Discharge Flows and Loads

The 2017/18 dry season total flows and loads had similar trends as the average annual total values. The 2016/17 and 2017/2018 dry season flows returned to pre-drought levels as evidenced by flows comparable to 2013/2014 flows. Additionally, all the 2016/2017 and 2017/2018 dry season loads (except NOX and ortho-P) are the highest and second-highest, respectively, since sampling began in July 2012.

This trending analysis increase in ammonia, TKN, and TN total loads for both the average annual and dry season is likely due to a combination of the following:

- Population increase in the Bay Area as well as a robust labor market drawing more outside the Bay Area commuters.
- Improvement in general economic conditions in the Bay Area,
- Industrial impacts as more treatment plants across the Bay import organics for energy production.
- Infrequent sampling frequency (twice per month for Major Dischargers) can result in biased results. For example, if a plant's two sampling events were during peak flow events it could result in values that do not necessarily reflect day to day values for that particular month.
- Sampling requirements between Section 13267 Letter data and Watershed Permit as discussed in Section 3.

The following subsections present observations of each parameter considered, including outliers, seasonality, and the role of the largest dischargers.

5.1 Trending Statistics

The method of least squares trend analysis is intended to identify potential significant trends. Verifying the trends would require a more rigorous statistical approach than applied for this report. While effective as a first step for identifying potential significant trends, the method of least squares does not verify whether regression assumptions of normality and independence of errors have been satisfied. The recommended next steps if trend verification is required are as follows:

1) Verify the correlation of errors (e.g., Durbin-Watson correlation of errors).
2) Evaluate whether the data needs to be transformed (e.g., natural log) to provide context on whether data is conforming to the distributional assumptions of the modeling errors. A probability plot of errors will provide context on whether data is conforming to the errors.
3) Use the Cochrane–Orkut regression model to adjust the data for a time series correlation in the error term.

5.2 Flow Analysis

Although the total Average Dry Weather Flow (ADWF) permitted capacity of the POTW dischargers in the San Francisco Bay is 826 mgd, the total average annual discharge ranged from 421 mgd to 510 mgd for the six year period. The ADWF total flows declined from 2012/2013 to 2014/2015, increased in 2015/2016 and 2016/2017, and decreased again in 2017/2018. The 2016/2017 dry season and average annual total flows exhibited the largest increase in flow from one year to the next, while the largest decrease in average annual total flows occurred in 2017/2018. The basis for this rapid increase and decrease in the following year is captured at the beginning of Section 5 with the wet 2016/2017 season being the main contributor to this flow increase.

The South Bay and Lower South Bay Subembayments received the highest flows, making up approximately 60 percent of the total flow discharged to the Bay. The largest discharger is San Jose, followed by SFPUC Southeast, EBDA, and EBMUD. San Pablo Bay has the largest portion of recycled water diversion during the dry season; several plants divert all flow and have a zero dry season discharge.

The dry season flow trends for all Subembayments are not statistically significant. While several subembayments had been previously identified as having a significant downward dry season trend (e.g., Suisun and Lower South Bay), dry season flows in the 2016/2017 and 2017/2018 season have rebounded such that there is no longer a significant dry season trend.

5.3 Ammonia:TKN Ratio

There are several instances where the dischargers average monthly ammonia values for both average annual and dry season are greater than TKN. The frequency of instances is on the order of 10 percent of the samples. Such instances defy anticipated values as ammonia makes up a portion of TKN values according to the following equation:

$$TKN = Ammonia\ as\ N + \ Organic\ Nitrogen \quad (1)$$

There are instances where the discrepancy could be attributed to differing monthly sampling frequency, but others where the sampling occurs on the same days. This issue has a ripple effect as it impacts the total nitrogen values as well. TKN makes up a portion of TN values, as shown in the following equation:

$$Total\ Nitrogen = TKN + \ NOx \quad (2)$$

For instances where ammonia is greater than TKN, the strategy for calculating TN (Equation 2) should be evaluated and could consider using the larger of the ammonia and TKN values. The results reported herein have not been adjusted.

5.4 Ammonia Analysis

The total average annual ammonia discharge ranged from approximately 33,770 kg N/d to 40,660 kg N/d for the six year period. The Central Bay and South Bay Subembayments receive the highest ammonia loads, making up over 80 percent of the total ammonia discharged to the Bay. The largest overall ammonia discharger is the SFPUC Southeast Plant, followed by EBMUD and EBDA.

The dry season ammonia loads appear to be statistically increasing Bay-wide, and for all subembayments other than the Lower South Bay. Despite receiving the second highest flows, the Lower South Bay ammonia loads are about an order of magnitude lower than any other Subembayment, making up less than one percent of the total ammonia load to the Bay. This is because the three dischargers that make up the Lower South Bay are required to fully nitrify at their plants due to their shallow water discharges. Ammonia removal addresses ammonia related toxicity; however, a portion of the nitrogen is still present as nitrate in the effluent.

The seasonal variation of discharged ammonia load from the wet to the dry season (based on the percent difference) are most pronounced for the Lower South Bay and San Pablo Bay. The Lower South Bay has the most significant seasonal load reduction as evidenced by about a 50 percent reduction from the wet to the dry season. Similar to the seasonal variation in flow, these seasonal load variations are attributed to a combination of seasonal diversion of recycled water, pond dredging, colder temperatures, and seasonal nitrification. Nitrification is less effective at the cooler wet season temperatures; as a result, a few of the dischargers appear to experience increased ammonia concentrations during the wet season. Additionally, recycling water has the potential to divert loads from the Bay when used for consumptive purposes (e.g., irrigation).

Agencies with nitrifying trickling filters (e.g., Sunnyvale), have variable wet weather ammonia concentrations which are attributed to temperature variations that impact the nitrification process. As a result, these plants appear to have difficulty maintaining a consistent effluent ammonia load during winter months.

5.5 TKN Analysis

The total average annual TKN discharge ranged from approximately 38,210 kg N/d to just under 44,800 kg N/d for the six year period. TKN loads exhibit similar patterns to ammonia, except the seasonal difference in the Lower South Bay Subembayment is not as pronounced.

5.6 NOx Analysis

The total average annual NOx discharge ranged from approximately 12,490 kg N/d to nearly 14,910 kg N/d for the six year period and illustrates an overall downward dry season trend, with the exception of the 2016/2017 dataset, in which there was a slight increase compared to the previous year. The 2017/2018 dataset had a 13 percent decrease in NOx discharge compared to the previous year, the largest year-to-year decrease since sampling began in July 2012.The basis for this reduction is unclear and should be further evaluated in future nutrient trending reports. Possible reasons could include a reduction in nitrification for plants with intermittent nitrification or enhanced denitrification for plants that are denitrifying.

The Lower South Bay receives the highest NOx load, making up approximately 63 percent of the total NOx load discharged to the Bay. The largest overall discharger of NOx is San Jose, averaging 4,919 kg N/d for the six year period, which is about 35 percent of the total NOx load to the Bay. As previously stated, this is attributed to nitrification of ammonia at all three plants in the Lower South bay. A portion of the ammonia converted to NOx is discharged as NOx. The overwhelming majority of NOx discharged is nitrate.

The seasonal variation of discharged NOx load from the wet to the dry season (based on the percent difference) is most pronounced on a percentile load basis for San Pablo Bay, Central Bay, and South Bay, in that order. San Pablo Bay has the largest variation due to the lack of dry season dischargers coupled with several of the plants in San Pablo Bay performing nitrification. There are also occasional spikes of NOx in the dry season from agencies that have intermittent nitrification, specifically for under-loaded trickling filter plants.

5.7 Total Nitrogen Analysis

The total average annual TN discharge ranged from 53,090 kg N/d to 58,910 kg N/d for the six year period. The Central Bay and South Bay Subembayments receive the highest total nitrogen loads, making up over 65 percent of the total nitrogen discharged to the Bay. The largest overall discharger of TN on an average annual basis is EBMUD, followed by SFPUC Southeast and EBDA.

There appears to be a Baywide upward dry and wet season trend in total nitrogen loads, which is largely attributed to increasing loads for all Subembayments (except Suisun Bay and the Lower

South Bay Subembayments). SFPUC and EBDA are the primary contributors to the load increase in the South Bay. Suisun Bay and the Lower South Bay load values suggest no statistical significance trend in dry season total nitrogen loads.

The seasonal difference in TN discharges from the wet to the dry season (based on the percent difference) are most pronounced in San Pablo Bay and the Central Bay. San Pablo Bay has the most significant seasonal load reduction as evidenced by an approximately 39 percent reduction from the wet to the dry season. Similar to TKN and ammonia, this is attributed to a combination of more effective nitrification/denitrification during the dry season and seasonal use of recycled water, which diverts loads.

5.8 Orthophosphate Analysis

The total average annual ortho-P discharge ranged from approximately 3,070 kg P/d to 4,620 kg P/d for the six year period and demonstrated an overall downward trend. There appears to be a distinct reduction in load values from the two different sampling requirements under the Section 13267 Letter (2012/13 through 2013/14 data) and the subsequent Nutrient Watershed Permit (2014/15 through 2017/18 data). The basis for this load reduction might be due to the sampling requirements under the two different sampling requirements as previously stated in Section 3.2. Composite or grab samples were required for the Section 13267 Letter and grab samples under the Nutrient Watershed Permit. Ortho-P is time sensitive for analysis, especially for non-filtered samples. Due to this difference in sampling requirements, it is difficult to draw any conclusions from the overall dataset.

While limiting the trending analysis to the Nutrient Watershed Permit dataset (7/2015-6/2018), there is a significant upward dry season trend in ortho-P as values increased from 2,920 kg P/d to 3,360 kg P/d.

The South Bay received the highest ortho-P load. The largest overall discharger of ortho-P is EBMUD, followed by EBDA and Palo Alto.

5.9 Total Phosphorus Analysis

The total average annual TP discharge ranged from approximately 3,720 kg P/d to 4,110 kg P/d for the six year period. Unlike the ortho-P sampling, the TP sampling are composite for both the Section 13267 Letter data and the Nutrient Watershed Permit. However, the Section 13267 Letter data required sampling during peak flows as previously discussed.

The dry season trending varies by Subembayment. The South Bay received the largest TP load of all Subembayments and its dry season TP loads are trending upwards. San Pablo Bay TP loads are trending downwards for the dry season. The largest overall discharger of TP based on average annual loads is EBMUD, followed by EBDA and Palo Alto.

The seasonal variation of TP discharge loads from the wet to dry season (based on the percent difference) are most pronounced for San Pablo Bay, Central Bay, and Lower South Bay Subembayments. In contrast, the South Bay and Suisun Subembayments do not appear to have a significant variation in TP loading between the wet and dry season.

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6 Summary

Table 6-1 and Table 6-2 present an overall summary of the average annual and dry season flows and nutrient loads discharged to the San Francisco Bay, respectively, between July 2012 and June 2018. Similarly, Table 6-3 and Table 6-4 present a summary of the corresponding dry season and average annual constituent concentrations, respectively, for the same period. The concentrations were calculated by dividing the loads by the flows for the appropriate averaging period.

The 2016/2017 dataset was one of the wettest years on record for Northern California. In most cases, the flows and loads for the most recent year of data was lower than the 2016/2017 year, but higher than all previous years (with the exception of NOx loads and Ortho-P loads). This overall increase is attributed to the wet year in the 2016/2017 dataset, increasing population in the Bay Area and a robust work force, as well as the other items discussed in Section 5.

Ammonia, TKN, TN, and TP total loads discharged to the San Francisco Bay have generally increased from year to year for both dry season and average annual conditions, with the exception of the most recent year (2017/2018) compared to the prior year (2016/2017). The nutrient concentrations all decreased in 2016/2017 with respect to the prior year's dataset (2015/2016) except for dry season ammonia. This reduction in concentration was likely due to dilution as the flows increased with respect to the previous year. The concentrations returned to pre-2016/2017 levels for the 2017/2018 dataset.

The analysis did not evaluate influent flows and loadings to the dischargers over the six-year period. Plant influent flows and loadings were collected since the 2015/2016 data request but not all plants provided influent information.

Changes in the data collection procedures during the six year period created some uncertainty about the resulting trends. The data collection requirements were different in the initial two years, under the Section 13267 Letter data requirements, which disproportionately emphasized the importance of wet weather loading and potentially skewed the resulting trends. As a result, trends for each discharge were limited to the Dry Season, which limited the number of data points for use in the trend analysis (most agencies had 30). Future data will increase the size of the sample set and improve the level of confidence in the trends.

In addition to the wet weather sampling, there were observed issues with the reporting of soluble reactive phosphorus (SRP) as addressed in the previous Group Annual Report Submittals (2015, 2016, and 2017). This sampling issue was addressed in the previous Group Annual Report Submittals (2016 and 2017) as all the dischargers are collecting grab samples.

As expected, the largest dischargers dominate the nutrient loading. Generally, three to four large dischargers contribute more than 70 percent of the nutrient loads. The loading of ammonia and NOx is impacted by plants that nitrify. Those plants that nitrify have the lowest ammonia discharge concentrations and the highest NOx concentrations.

Seasonal variations are pronounced. Dry season loads are generally lower than wet season loads. This is attributed to two factors. First, the higher flows and sampling procedures amplify the wet season discharges. Secondly, during the dry season, water reuse diverts much of the nutrient load away from the Bay. In some instances, agencies have achieved zero discharge during the summer months. It is recommended that in future years, agencies report the flow diverted for recycled water use as well as any return streams (e.g., cooling tower blow down, advanced purification concentrate, etc.) such that the total quantity of recycled water can be clearly quantified, as well as the associated nutrient loads being diverted from the San Francisco Bay.

Table 6-1. Summary of Average Annual Flow and Load Discharges to the Bay

Constituent	2012/13 (a)	2013/14 (a)	2014/15 (a)	2015/16 (a)	2016/17 (a)	2017/18 (a)	Trend (b,c)	6 Year Average
Flow, mgd	453	434	421	425	510	434	None	446
Ammonia, kg N/d	33,770	36,628	36,858	36,801	40,664	40,407	Increasing (13% Change)	37,521
TKN, kg N/d	38,213	40,519	41,582	42,017	44,804	44,660	Increasing (11% Change)	41,967
NOx, kg N/d	14,911	14,538	14,158	13,999	14,327	12,489	None	14,070
TN, kg N/d	53,093	54,998	55,784	55,448	58,913	57,144	Increasing (5% Change)	55,896
Ortho-P, kg P/d	4,623	4,464	3,071	3,212	3,287	3,363	Increasing (5% Change)	3,670
TP, kg P/d	3,954	3,772	3,720	3,939	4,107	4,076	None	3,928

a. 2012/13 represents the period between July 1, 2012 and June 30, 2013; 2013/14 represents the period between July 1, 2013, June 30, 2014; 2014/15 represents the period between July 1, 2014 and June 30, 2015; 2015/16 represents the period between July 1, 2015 and June 30, 2016; 2016/17 represents the period between July 1, 2016 and June 30, 2017; and 2017/18 represents the period between July 1, 2017 and June 30, 2018.

b. Trend analysis is based on average monthly values. Discernible trends were identified based on the slope of a regression line determined using the method of least squares to fit the data (alpha = 0.05). Sample size is 72 (48 for Ortho-P as it excludes the initial two years of data). Where “None” is stated, the limited dataset does not indicate a statistically relevant trend.

c. The percent change represents the 2017/18 value in comparison to the average of the initial three years of data (2012/2013 through 2016/2017).

Table 6-2. Summary of Dry Season Flow and Load Discharges to the Bay

Constituent	2012/13 (a)	2013/14 (a)	2014/15 (a)	2015/16 (a)	2016/17 (a)	2017/18 (a)	Trend (b,c)	6 Year Average
Flow, mgd	399	387	365	359	387	386	None	381
Ammonia, kg N/d	32,719	35,541	36,560	35,745	39,108	38,041	Increasing (11% Change)	36,286
TKN, kg N/d	36,692	39,152	40,044	40,208	42,743	42,340	Increasing (10% Change)	40,197
NOx, kg N/d	13,184	12,375	12,337	12,002	11,471	11,142	None	12,085
TN, kg N/d	49,855	51,485	52,495	52,209	53,700	53,504	Increasing (5% Change)	52,208
Ortho-P, kg P/d	4,104	4,227	2,923	3,081	3,220	3,218	None	3,462
TP, kg P/d	3,603	3,396	3,448	3,650	3,869	3,723	None	3,615

a. 2012/13 represents the period between July 1, 2012 and June 30, 2013; 2013/14 represents the period between July 1, 2013, June 30, 2014; 2014/15 represents the period between July 1, 2014 and June 30, 2015; 2015/16 represents the period between July 1, 2015 and June 30, 2016; 2016/17 represents the period between July 1, 2016 and June 30, 2017; and 2017/18 represents the period between July 1, 2017 and June 30, 2018.

b. Trend analysis is based on average monthly values. Discernible trends were identified based on the slope of a regression line determined using the method of least squares to fit the data (alpha = 0.05). Sample size is 30 (20 for Ortho-P as it excludes the initial two years of data). Where “None” is stated, the limited dataset does not indicate a statistically relevant trend.

c. The percent change represents the 2017/18 value in comparison to the average of the initial three years of data (2012/2013 through 2014/2015).

Table 6-3. Summary of Average Annual Flow and Constituent Concentrations Discharged to the Bay

Constituent	2012/13 (a)	2013/14 (a)	2014/15 (a)	2015/16 (a)	2016/17 (a)	2017/18 (a)	Trend (b,c)	6 Year Average
Flow, mgd	453	434	421	425	510	434	None	446
Ammonia, mg N/L	20	22	23	23	21	25	Increasing (13% Change)	22
TKN, mg N/L	22	25	26	26	23	27	Increasing (12% Change)	25
NOx, mg N/L	8.7	8.8	8.8	8.7	7.4	8.0	Decreasing (-14% Change)	8.0
TN, mg N/L	31	33	35	34	31	35	None	33
Ortho-P, mg P/L	2.7	2.7	1.9	2.0	1.7	2.0	None	2.2
TP, mg P/L	2.3	2.3	2.3	2.4	2.1	2.5	None	2.3

a. 2012/13 represents the period between July 1, 2012 and June 30, 2013; 2013/14 represents the period between July 1, 2013, June 30, 2014; 2014/15 represents the period between July 1, 2014 and June 30, 2015; 2015/16 represents the period between July 1, 2015 and June 30, 2016; 2016/17 represents the period between July 1, 2016 and June 30, 2017; and 2017/18 represents the period between July 1, 2017 and June 30, 2018.

b. Trend analysis is based on average monthly values. Discernible trends were identified based on the slope of a regression line determined using the method of least squares to fit the data (alpha = 0.05). Sample size is 30. Where "None" is stated, the limited dataset does not indicate a statistically relevant trend.

c. The percent change represents the 2017/18 value in comparison to the average of the initial three years of data (2012/2013 through 2014/2015) (2014/2015 through 2016/2017 for Ortho-P).

Table 6-4. Summary of Dry Season Flow and Constituent Concentrations Discharged to the Bay

Constituent	2012/13 (a)	2013/14 (a)	2014/15 (a)	2015/16 (a)	2016/17 (a)	2017/18 (a)	Trend (b,c)	6 Year Average
Flow, mgd	399	387	365	359	387	386	None	381
Ammonia, mg N/L	22	24	26	26	27	26	Increasing (8% Change)	25
TKN, mg N/L	24	27	29	30	29	29	Increasing (9% Change)	28
NOx, mg N/L	8.7	8.4	8.9	8.8	7.8	8.0	Decreasing (12% Change)	8
TN, mg N/L	33	35	38	38	37	37	Increasing (3% Change)	36
Ortho-P, mg P/L	2.7	2.9	2.1	2.3	2.2	2.2	None	2.4
TP, mg P/L	2.4	2.3	2.5	2.7	2.6	2.5	None	2.5

a. 2012/13 represents the period between July 1, 2012 and June 30, 2013; 2013/14 represents the period between July 1, 2013 and June 30, 2014; 2014/15 represents the period between July 1, 2014 and June 30, 2015; 2015/16 represents the period between July 1, 2015 and June 30, 2016; 2016/17 represents the period between July 1, 2016 and June 30, 2017; and 2017/18 represents the period between July 1, 2017 and June 30, 2018.

b. Trend analysis is based on average monthly values. Discernible trends were identified based on the slope of a regression line determined using the method of least squares to fit the data (alpha = 0.05). Sample size is 30. Where "None" is stated, the limited dataset does not indicate a statistically relevant trend.

c. The percent change with respect to the average of the initial three years of data (2012/2013 through 2014/2015, and 2014/2015 through 2016/2017 for Ortho-P).

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Appendix

Discharge Evaluation for Individual Dischargers

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Contents

Tables

Figures

1 City of American Canyon

American Canyon discharges to San Pablo Bay, and serves approximately 5,562 connections. The plant is rated for an ADWF capacity of 2.5 mgd and a peak permitted wet weather flow of 5 mgd. It has a current ADWF flow of approximately 1.1 mgd. The plant is a nitrifying and denitrifying MBR plant.

The following observations are made based upon the figures and table in the subsequent pages:

- There are 10 missing monthly average nutrient load samples per nutrient up to June 2014, which may be attributed to seasonal discharge restrictions.
- Based on the table and figures with the average monthly values, there does not appear to be any emerging dry season trends for flow, ammonia or phosphorus loads. NOx and total nitrogen dry season loads show a decreasing trend.
- NOx is the majority of the nitrogen species discharged, regardless of season. This would be expected since this plant nitrifies.
- Total phosphorus concentrations are wide ranging with values from less than 1 mg P/L to over 11 mg P/L.
- The distribution of phosphorus species is predominantly ortho-P.

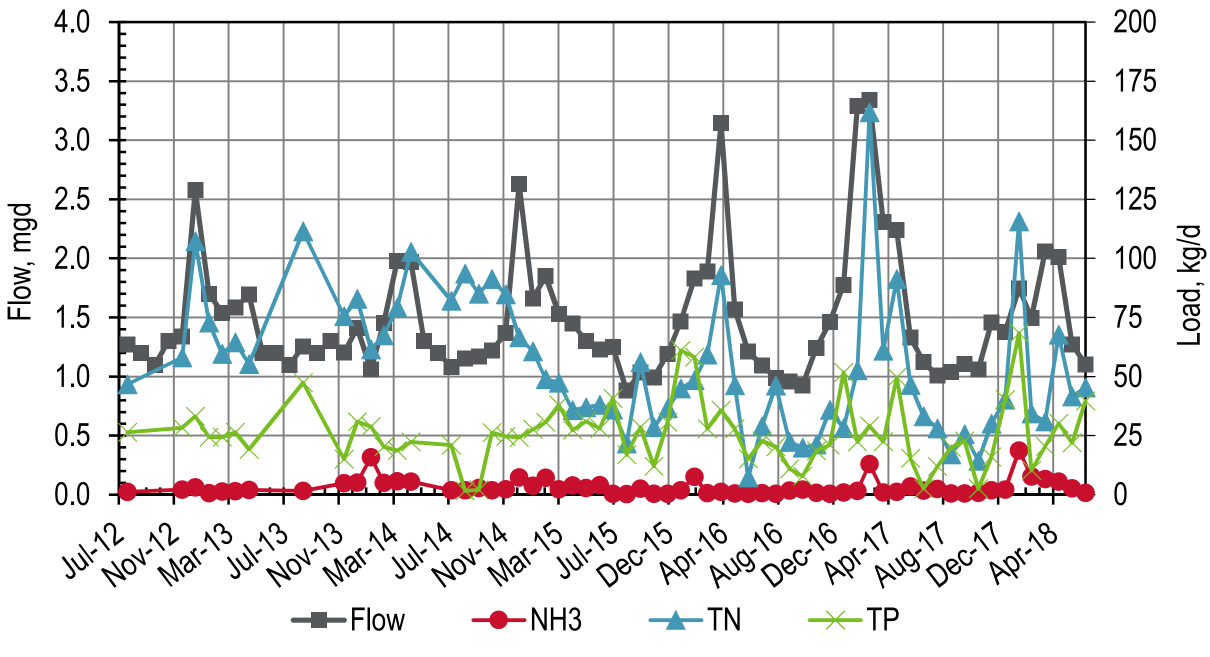

Figure 1-1. American Canyon Monthly Flows and Loads

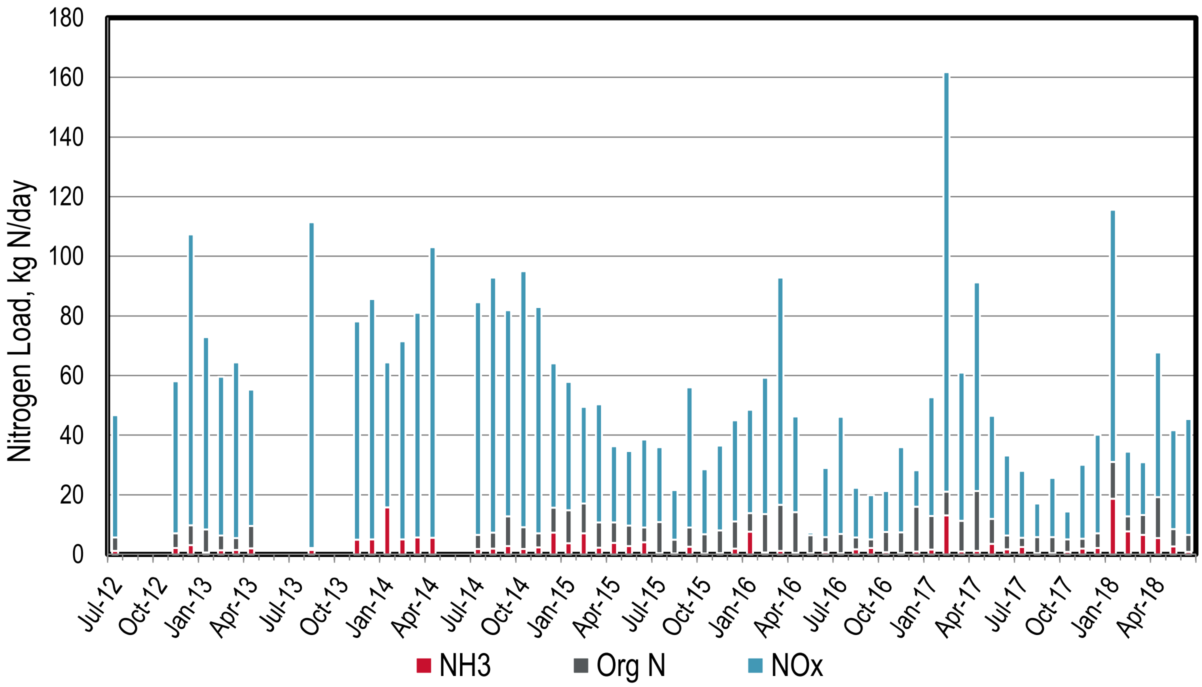

Figure 1-2. American Canyon Monthly Nitrogen Loads

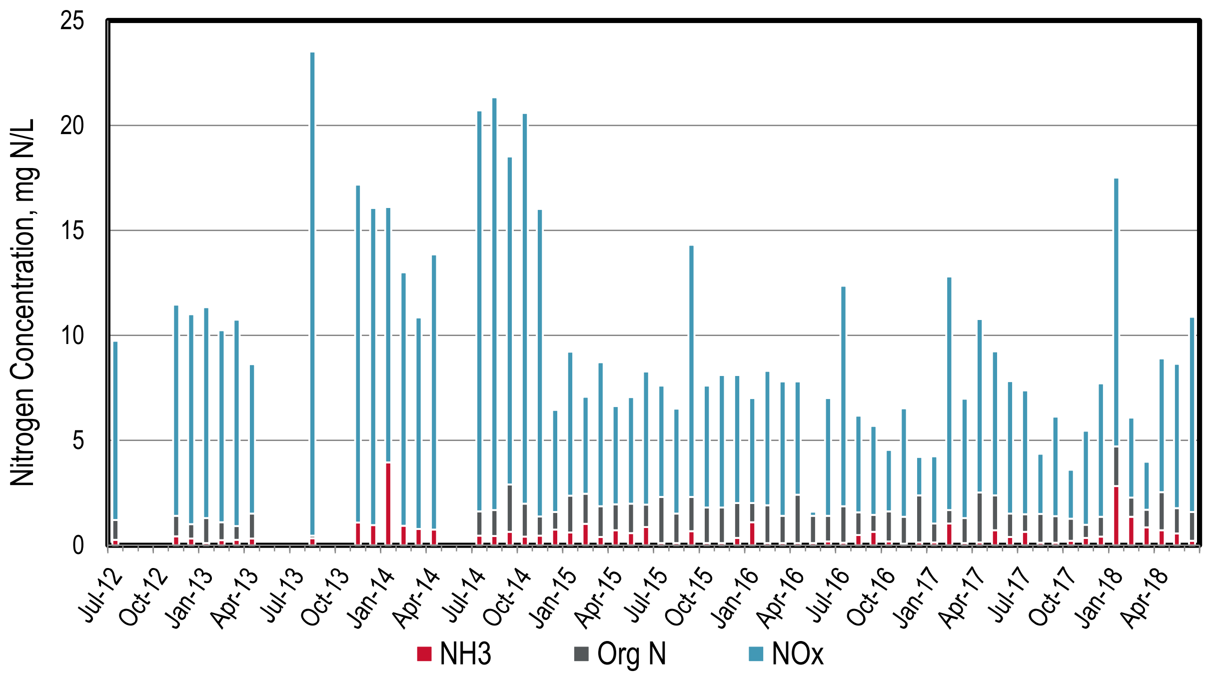

Figure 1-3. American Canyon Monthly Nitrogen Concentrations

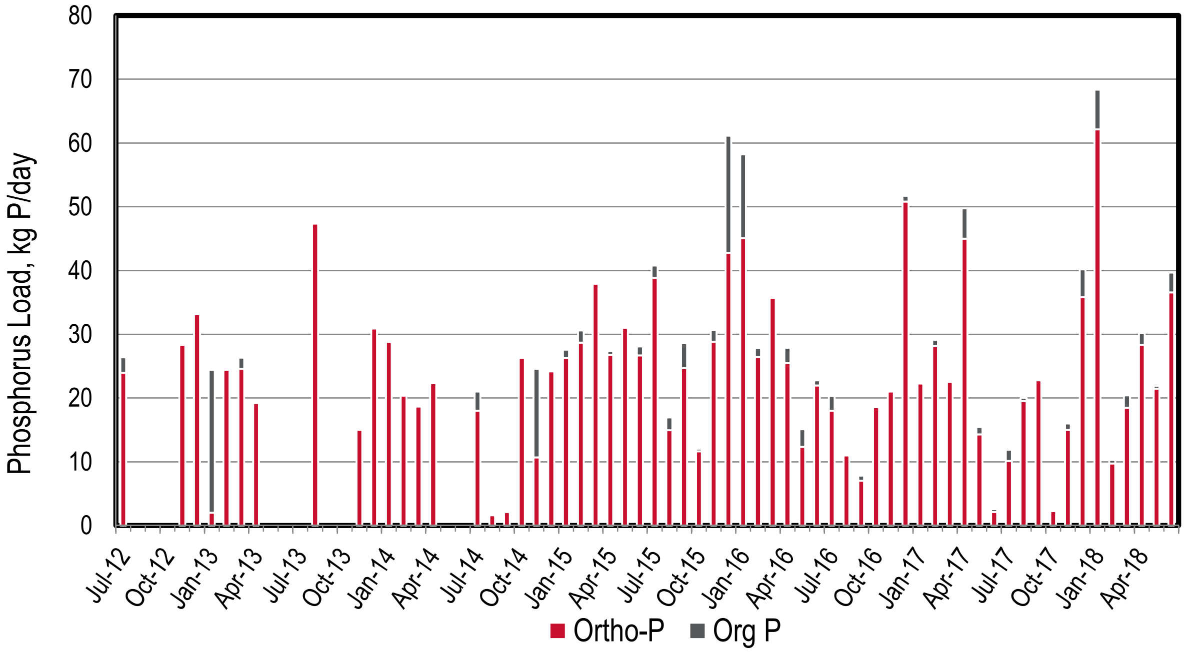

Figure 1-4. American Canyon Monthly Phosphorus Loads

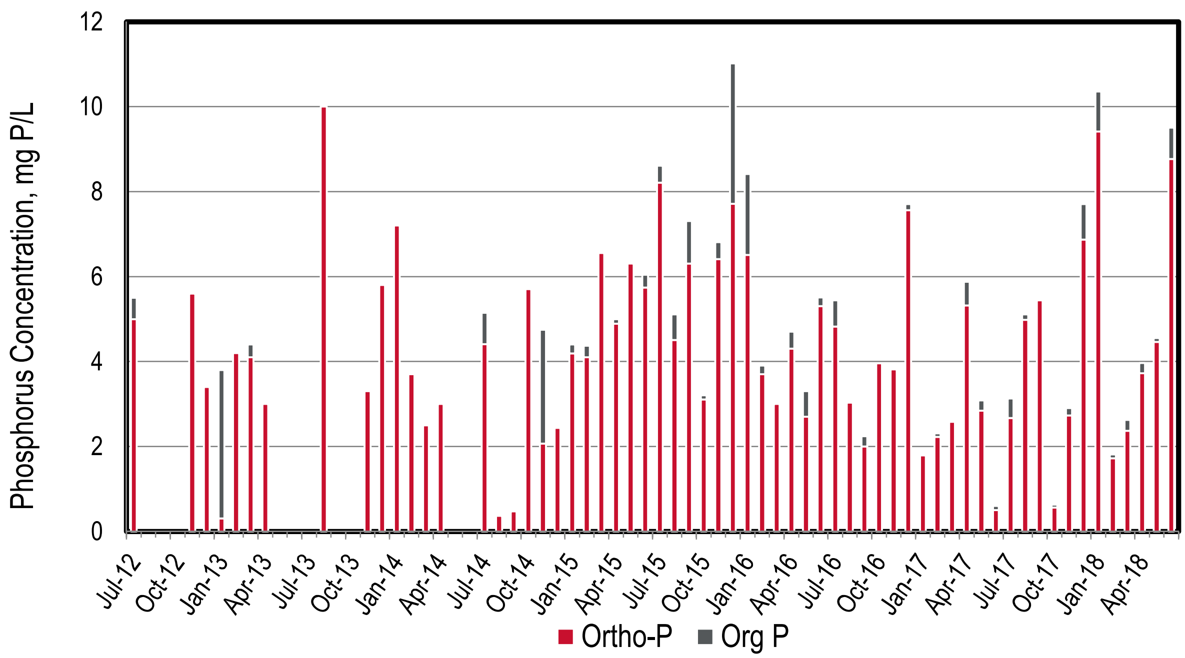

Figure 1-5. American Canyon Monthly Phosphorus Concentrations

Table 1-1. American Canyon Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jul-12	1.3	1	6	41	47	24	26
Aug-12	1.2						
Sep-12	1.1						
Oct-12	1.3						
Nov-12	1.3	2	7	51	58	31	28
Dec-12	2.6	3	10	98	107	37	33
Jan-13	1.7	1	8	65	73	2	24
Feb-13	1.5	1	6	53	60	24	24
Mar-13	1.6	1	5	59	64	25	26
Apr-13	1.7	2	10	46	55	20	19
May-13	1.2						
Jun-13	1.2						
Jul-13	1.1						
Aug-13	1.3	2	2	109	111	62	47
Sep-13	1.2						
Oct-13	1.3						
Nov-13	1.2	5	2	73	76	18	15
Dec-13	1.4	5	2	81	83	33	31
Jan-14	1.1	16	13	49	61	42	29
Feb-14	1.5	5	1	66	67	35	20
Mar-14	2.0	6	4	75	79	24	19
Apr-14	2.0	6	5	98	103	28	22
May-14	1.3						
Jun-14	1.2						
Jul-14	1.1	2	7	78	82	18	21
Aug-14	1.2	2	7	86	94	24	2
Sep-14	1.2	3	13	69	85	18	2
Oct-14	1.2	2	9	86	91	27	26
Nov-14	1.4	2	7	76	85	11	25

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Dec-14	2.6	7	16	48	67	27	24
Jan-15	1.7	4	15	43	61	26	28
Feb-15	1.9	7	17	32	49	29	31
Mar-15	1.5	2	11	40	47	38	38
Apr-15	1.5	4	11	26	36	27	27
May-15	1.3	3	10	25	37	31	31
Jun-15	1.2	4	9	30	38	27	28
Jul-15	1.3	0	11	25	36	39	41
Aug-15	0.9	0	5	17	22	15	17
Sep-15	1.0	3	9	47	56	25	29
Oct-15	1.0	0	7	22	29	12	12
Nov-15	1.2	0	8	28	37	29	31
Dec-15	1.5	2	11	34	45	43	61
Jan-16	1.8	8	14	35	49	45	58
Feb-16	1.9	1	14	46	59	26	28
Mar-16	3.1	1	17	76	93	36	36
Apr-16	1.6	1	14	32	46	26	28
May-16	1.2	0	6	1	7	12	15
Jun-16	1.1	1	6	23	29	22	23
Jul-16	1.2	0	7	39	46	18	20
Aug-16	1.0	2	6	17	22	22	11
Sep-16	0.7	2	5	15	20	7	8
Oct-16	0.9	1	8	14	21	19	19
Nov-16	1.2	0	7	28	36	21	21
Dec-16	2.5	1	16	12	28	51	52
Jan-17	4.2	2	13	40	53	22	22
Feb-17	2.7	13	21	141	162	28	29
Mar-17	2.5	1	11	50	61	23	23
Apr-17	3.1	1	21	70	91	45	50
May-17	1.6	4	12	35	46	14	15

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jun-17	1.1	2	6	27	33	2	3
Jul-17	1.0	2	6	22	28	10	12
Aug-17	1.0	0	6	11	17	20	20
Sep-17	1.1	0	6	20	26	58	23
Oct-17	1.1	1	5	9	14	2	3
Nov-17	1.5	2	5	25	30	15	16
Dec-17	1.4	2	7	33	40	36	40
Jan-18	1.7	19	31	85	116	62	68
Feb-18	1.5	8	13	22	34	10	10
Mar-18	2.1	7	13	18	31	18	20
Apr-18	2.0	5	19	48	68	28	30
May-18	1.3	3	9	33	42	21	22
Jun-18	1.1	1	7	39	45	37	40
Dry Season Average	**1.1**	**2**	**7**	**37**	**44**	**24**	**21**
Dry Season Trend **	**None**	**None**	**None**	**Down**	**Down**	**-**	**None**
Wet Season Average	**1.7**	**4**	**11**	**51**	**62**	**27**	**29**
Average Annual	**1.5**	**3**	**10**	**46**	**55**	**26**	**26**

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

2 City of Benicia

Benicia discharges to San Pablo Bay, and serves approximately 9,569 service connections. The plant has a permitted ADWF capacity of 4.5 mgd and 18 mgd one-hour peak wet weather design flow capacity. It has a current ADWF flow of approximately 1.9 mgd. The plant performs secondary treatment using a combination of activated sludge and rotating biological contractors.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the table and figures with the average monthly values, there appears to be an emerging dry season downward trend for total phosphorus loads.
- Ammonia loads are routinely greater than TKN loads. For such instances, the TKN values were used as is while calculating the TN loads.
- Nitrogen loads increase with flow during wet weather events.
- Wet season loads are greater and more variable year to year than the dry season loads.
- Ammonia is the majority of the nitrogen species discharged, regardless of season. This would be expected since this plant does not nitrify.
- Ammonia concentrations vary in the range of 8 to 39 mg/L throughout the year.
- Total phosphorus concentrations range from less than 1 mg P/L to over 7 mg P/L.
- The distribution of phosphorus species is predominantly ortho-P. Since the Regional Watershed Permit sampling began in July 2014, the ortho-P values are occasionally greater than total phosphorus. This discrepancy is likely due to ortho-P being measured on grab samples, while total phosphorus is measured for 24-hour composite samples.

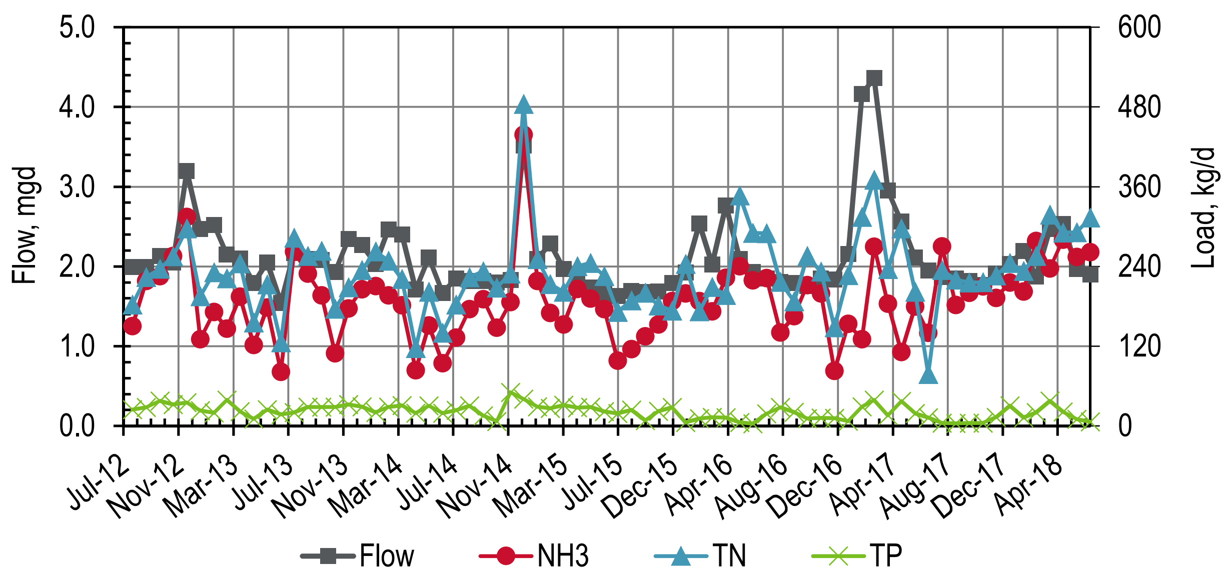

Figure 2-1. Benicia Monthly Flows and Loads

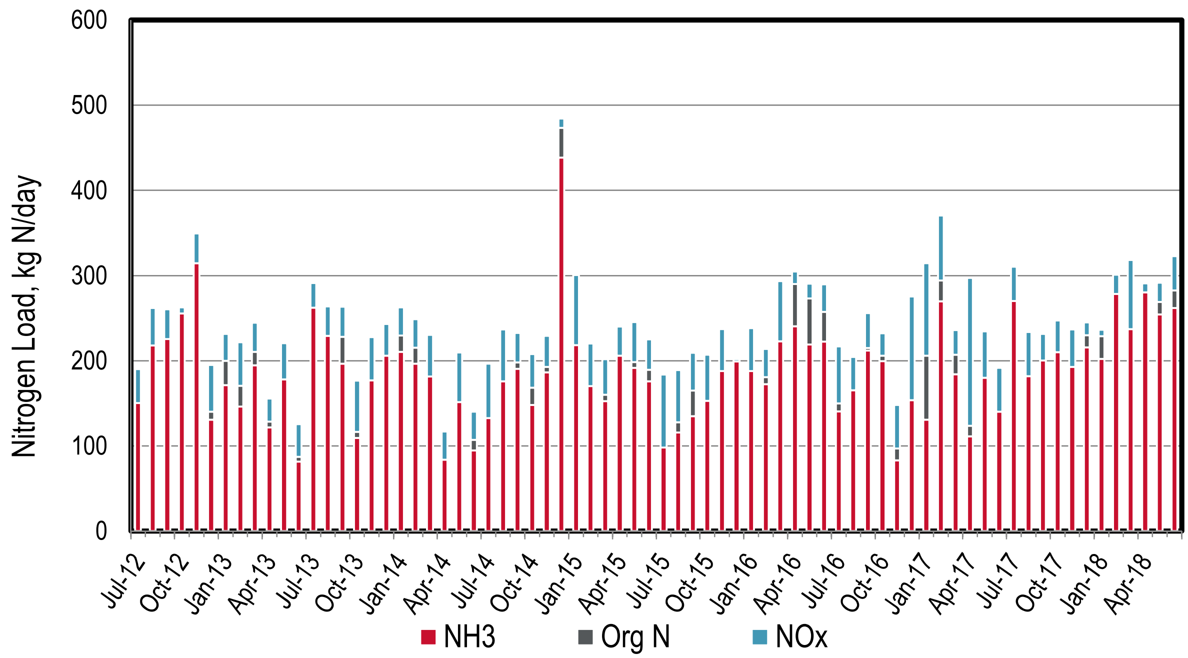

Figure 2-2. Benicia Monthly Nitrogen Loads

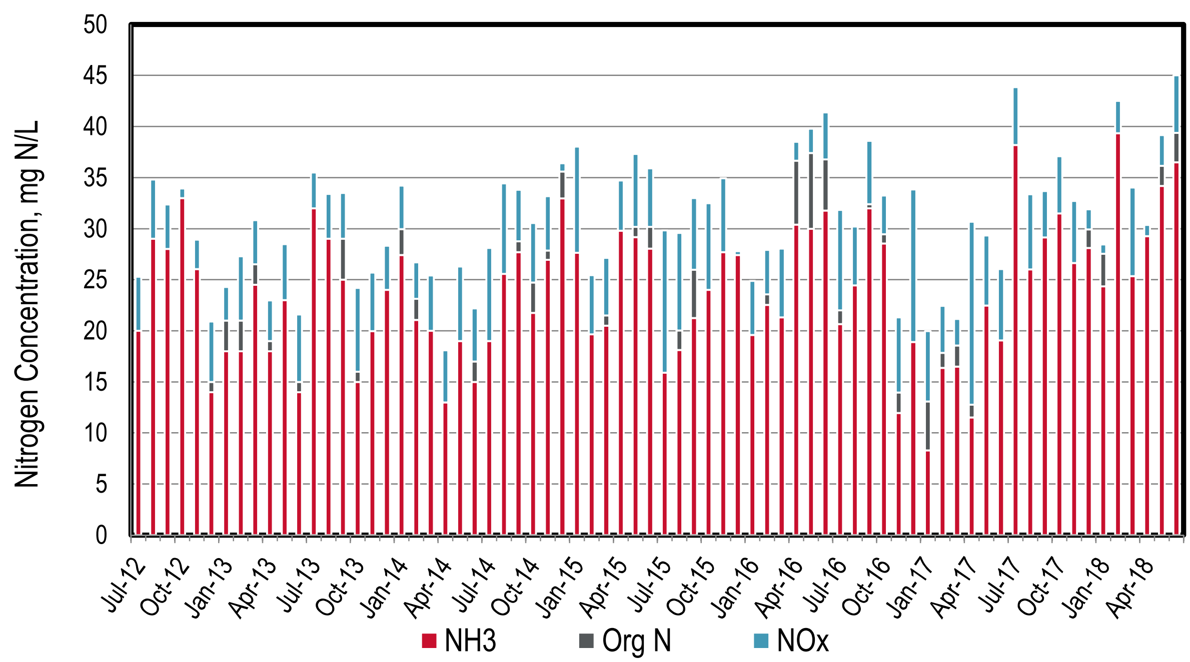

Figure 2-3. Benicia Monthly Nitrogen Concentrations

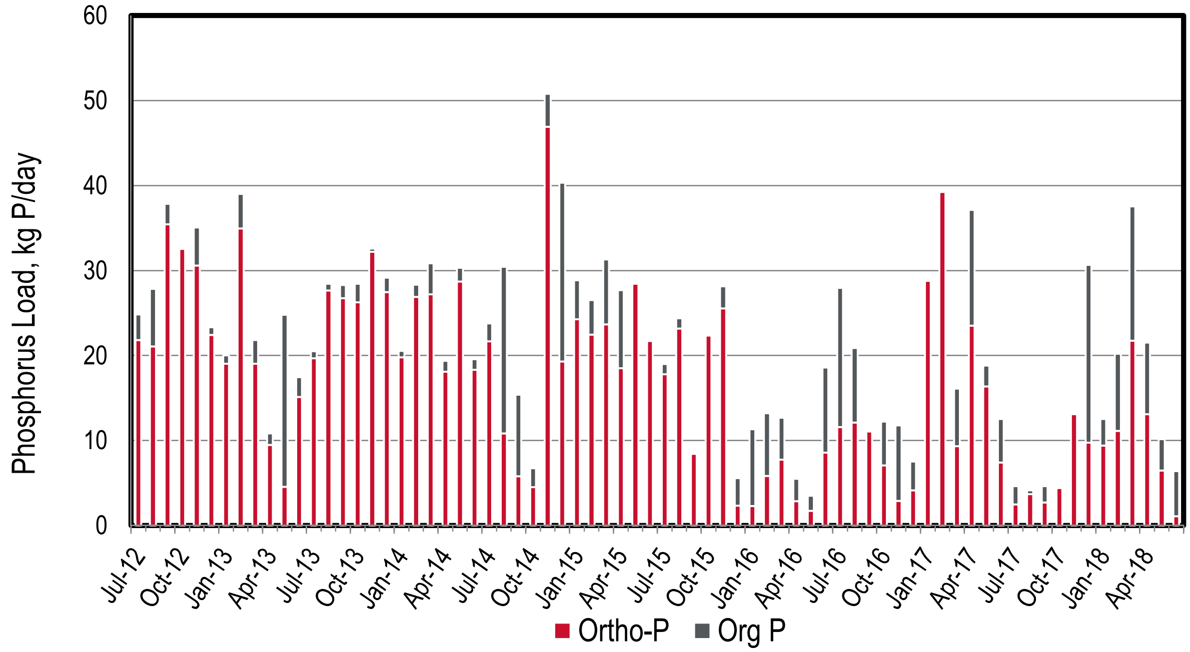

Figure 2-4. Benicia Monthly Phosphorus Loads

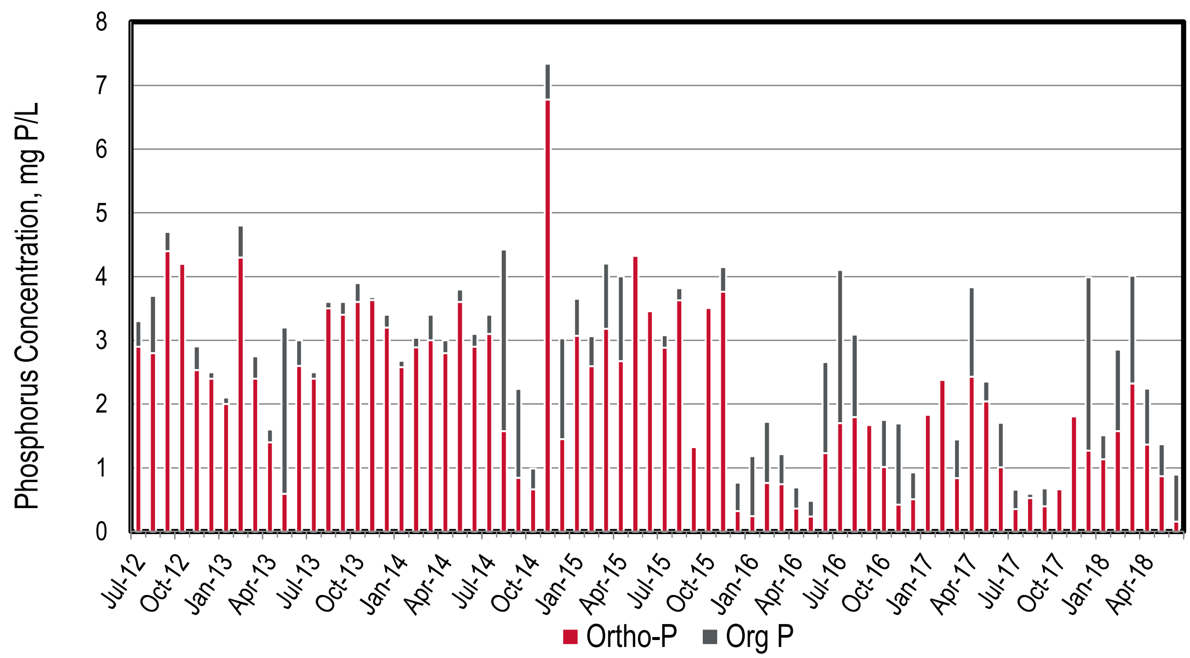

Figure 2-5. Benicia Monthly Phosphorus Concentrations

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

Table 2-1. Benicia Monthly Flows and Loads*

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day**	Ortho-P kg P/day	Total P kg P/day
Jul-12	2.0	150	143	40	183	22	25
Aug-12	2.0	218	181	44	224	21	28
Sep-12	2.1	225	201	35	236	35	38
Oct-12	2.1	256	248	7	255	33	33
Nov-12	3.2	314	262	35	297	31	35
Dec-12	2.5	131	140	55	195	22	23
Jan-13	2.5	171	200	31	231	19	20
Feb-13	2.2	146	171	51	222	35	39
Mar-13	2.1	195	210	34	245	19	22
Apr-13	1.8	122	129	27	155	9	11
May-13	2.1	178	170	43	213	5	25
Jun-13	1.5	81	87	38	126	15	17
Jul-13	2.2	262	254	29	283	20	21
Aug-13	2.1	229	221	35	256	28	28
Sep-13	2.1	197	228	35	263	27	28
Oct-13	1.9	109	117	60	177	26	28
Nov-13	2.3	177	158	51	209	32	33
Dec-13	2.3	206	197	37	235	27	29
Jan-14	2.0	210	230	33	263	20	21
Feb-14	2.5	196	215	33	249	27	28
Mar-14	2.4	181	172	49	221	27	31
Apr-14	1.7	84	84	33	117	18	19
May-14	2.1	152	144	58	202	29	30
Jun-14	1.7	95	107	33	140	18	20
Jul-14	1.9	133	119	64	183	22	24
Aug-14	1.8	176	162	61	223	11	30
Sep-14	1.8	191	198	34	232	6	15
Oct-14	1.8	148	168	40	208	5	7
Nov-14	1.8	186	193	37	229	47	51

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day**	Ortho-P kg P/day	Total P kg P/day
Dec-14	3.5	438	474	11	484	19	40
Jan-15	2.1	218	194	82	251	24	29
Feb-15	2.3	170	163	50	214	22	27
Mar-15	2.0	153	160	42	202	24	31
Apr-15	1.8	206	206	34	240	19	28
May-15	1.7	192	198	47	245	29	28
Jun-15	1.7	176	189	36	225	22	22
Jul-15	1.6	98	86	86	172	18	19
Aug-15	1.7	116	128	61	189	23	24
Sep-15	1.7	135	165	44	201	27	8
Oct-15	1.7	153	151	54	181	34	22
Nov-15	1.8	188	153	49	174	26	28
Dec-15	1.9	199	177	3	244	2	6
Jan-16	2.5	188	144	50	172	2	11
Feb-16	2.0	173	181	33	209	6	13
Mar-16	2.8	223	155	70	197	8	13
Apr-16	2.1	241	290	15	347	3	5
May-16	1.9	219	273	17	291	2	4
Jun-16	1.9	223	258	32	290	9	19
Jul-16	1.8	141	150	67	217	12	28
Aug-16	1.8	165	148	39	187	12	21
Sep-16	1.8	212	215	41	256	14	11
Oct-16	1.8	199	206	26	232	7	12
Nov-16	1.8	83	97	51	148	3	12
Dec-16	2.2	154	105	122	227	4	8
Jan-17	4.2	131	206	109	314	58	29
Feb-17	4.4	270	294	76	370	52	39
Mar-17	3.0	184	207	29	236	9	16
Apr-17	2.6	111	124	173	297	24	37
May-17	2.1	180	147	55	202	16	19

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day**	Ortho-P kg P/day	Total P kg P/day
Jun-17	1.9	140	133	51	78	7	13
Jul-17	1.9	270	215	40	235	2	5
Aug-17	1.9	182	154	52	220	4	4
Sep-17	1.8	200	186	31	216	3	5
Oct-17	1.8	210	176	37	216	4	4
Nov-17	1.9	193	165	44	226	14	13
Dec-17	2.0	216	230	15	245	10	31
Jan-18	2.2	202	229	8	233	9	13
Feb-18	1.9	279	230	22	256	11	20
Mar-18	2.5	237	237	81	318	22	38
Apr-18	2.5	280	280	10	291	13	22
May-18	2.0	254	269	23	291	6	10
Jun-18	1.9	262	282	40	314	1	6
Dry Season Average	**1.9**	**182**	**180**	**44**	**220**	**16**	**19**
Dry Season Trend *	**None**	**None**	**None**	**None**	**None**	**-**	**Down**
Wet Season Average	**2.3**	**194**	**194**	**45**	**239**	**20**	**23**
Average Annual	**2.1**	**189**	**188**	**45**	**231**	**18**	**22**

* The City of Benicia has sampled more intensively since September 2015 than required under the Nutrient Watershed Permit. This data represents the average monthly loads during this intensive sampling period.

** The Total Nitrogen value is calculated by adding the TKN and the NOx values.

*** Refer to the Section 3.5 in the main report for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main body for a detailed discussion on this issue.

3 City of Burlingame

Burlingame discharges to South Bay, and serves approximately 16,000 service connections. The plant has a permitted ADWF capacity of 5.5 mgd and a peak permitted wet weather flow of 16 mgd. It has a current ADWF flow of approximately 2.6 mgd. The plant performs secondary treatment using activated sludge.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the table and figures with the average monthly values, there appears to be a dry season downward trend for TP loads, with a stark drop beginning in spring 2014.
- Both nitrogen and phosphorus loads increase with flow during wet weather events.
- Wet season loads are greater and more variable year to year than the dry season loads.
- Ammonia is typically the majority of the nitrogen species discharged, regardless of season. However, from about August 2013 through June 2014, the NOx load and concentration was significantly higher than in the preceding or subsequent year, indicating the potential occurrence of nitrification.
- Ammonia concentrations are relatively consistent throughout the year (with the exception of January 2017 and October 2017).
- Total phosphorus concentrations were typically above 10 mg P/L in the first two reporting years and then dropped to less than 5 mg P/L in the most recent three years. This decrease in concentration is largely attributed to the change in sampling methodology between the Section 13267 Letter data and the Nutrient Watershed Permit dataset.
- The distribution of phosphorus species is predominantly ortho-P.

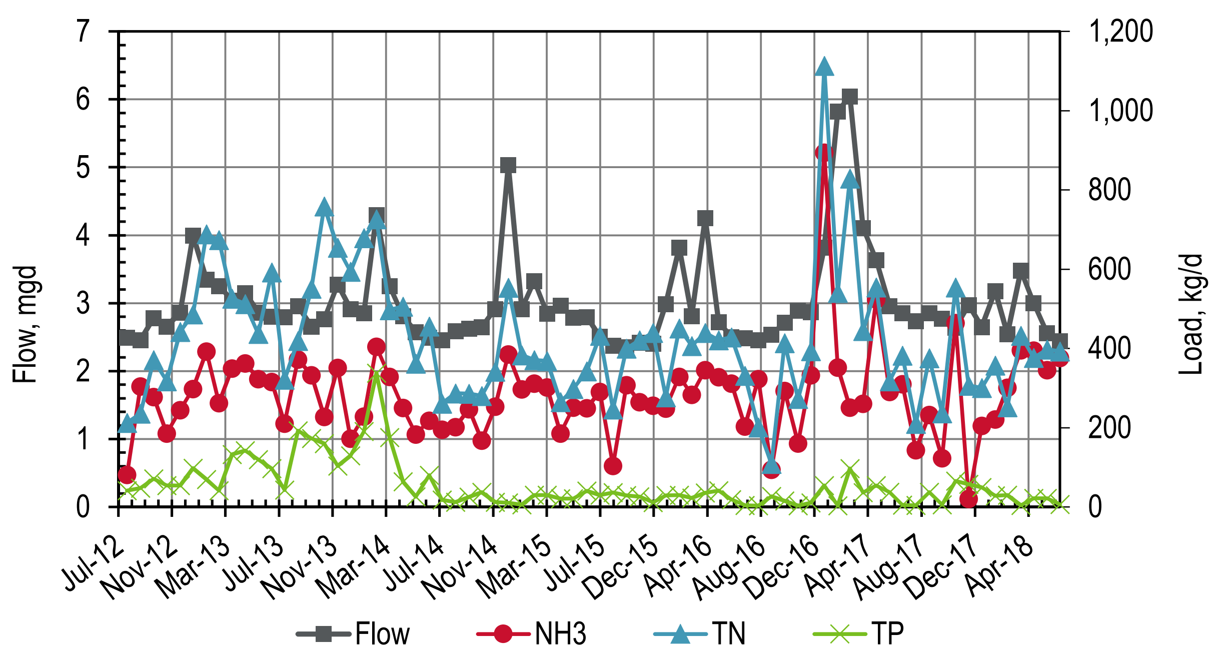

Figure 3-1. Burlingame Monthly Flows and Loads

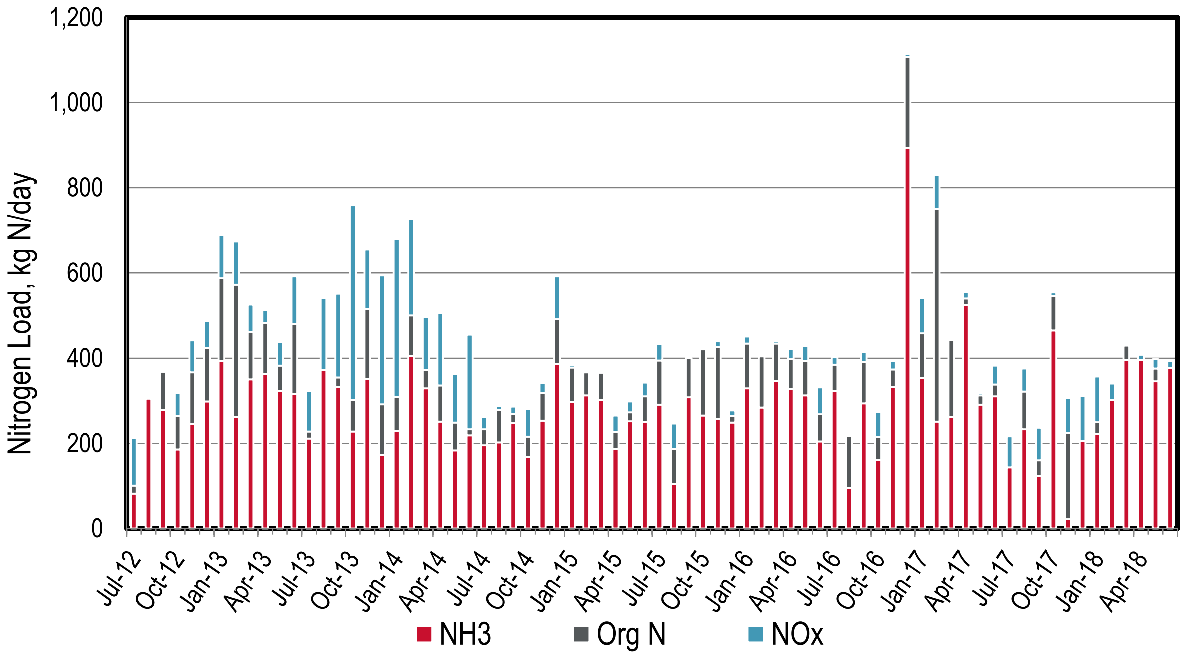

Figure 3-2. Burlingame Monthly Nitrogen Loads

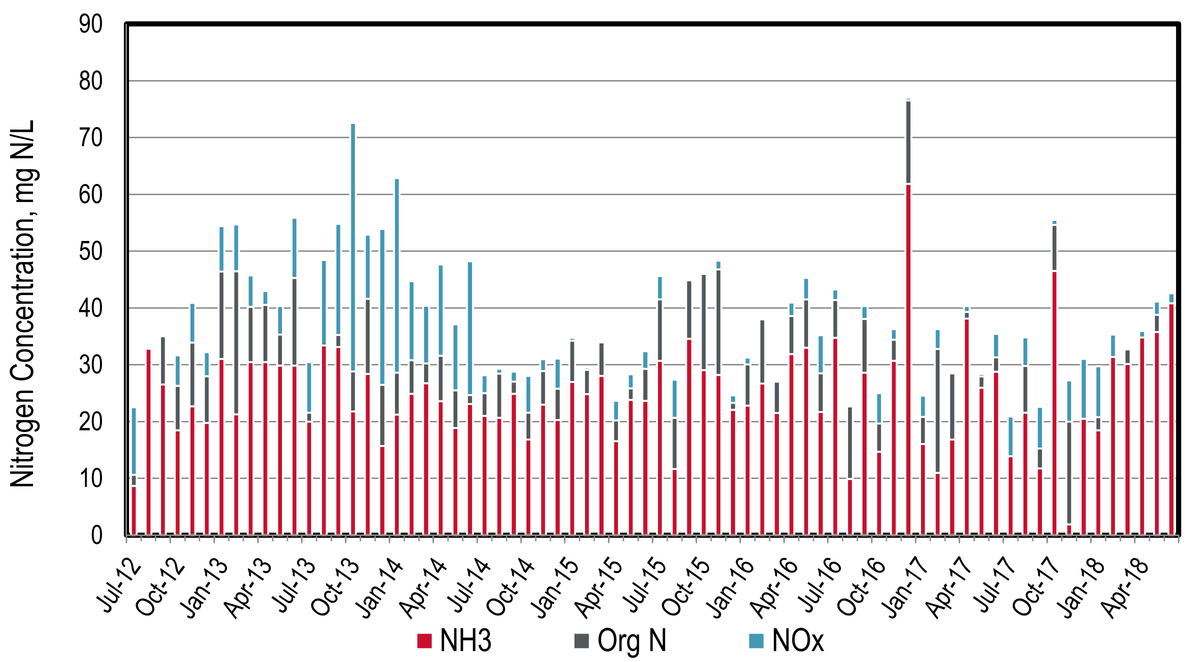

Figure 3-3. Burlingame Monthly Nitrogen Concentrations

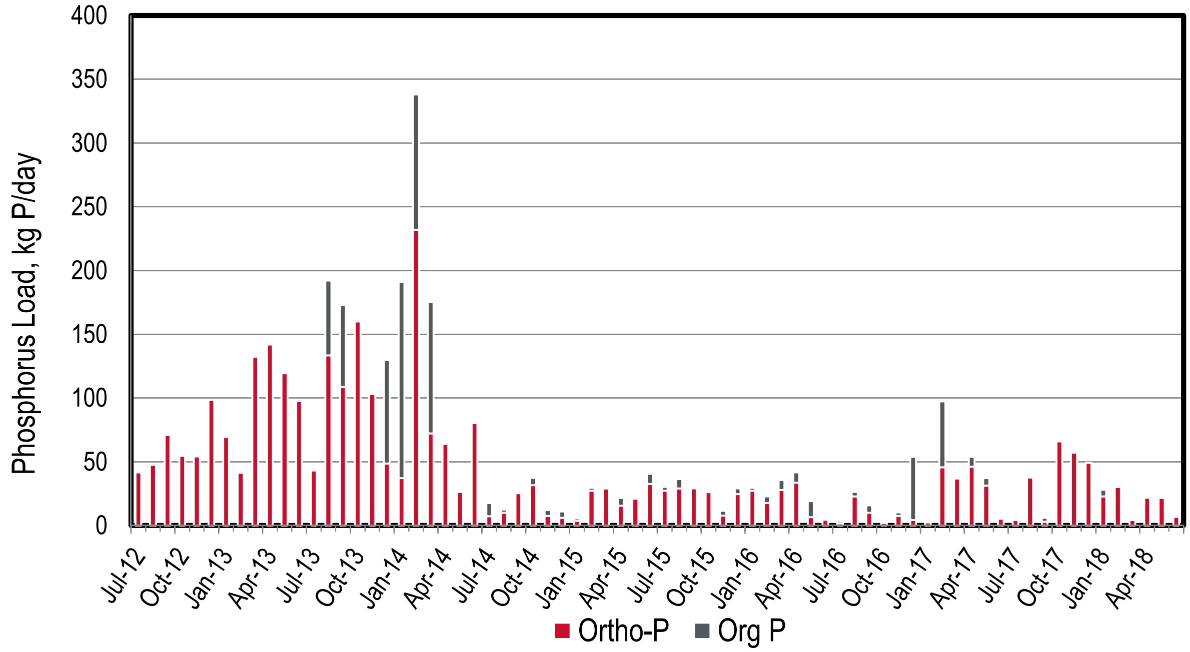

Figure 3-4. Burlingame Monthly Phosphorus Loads

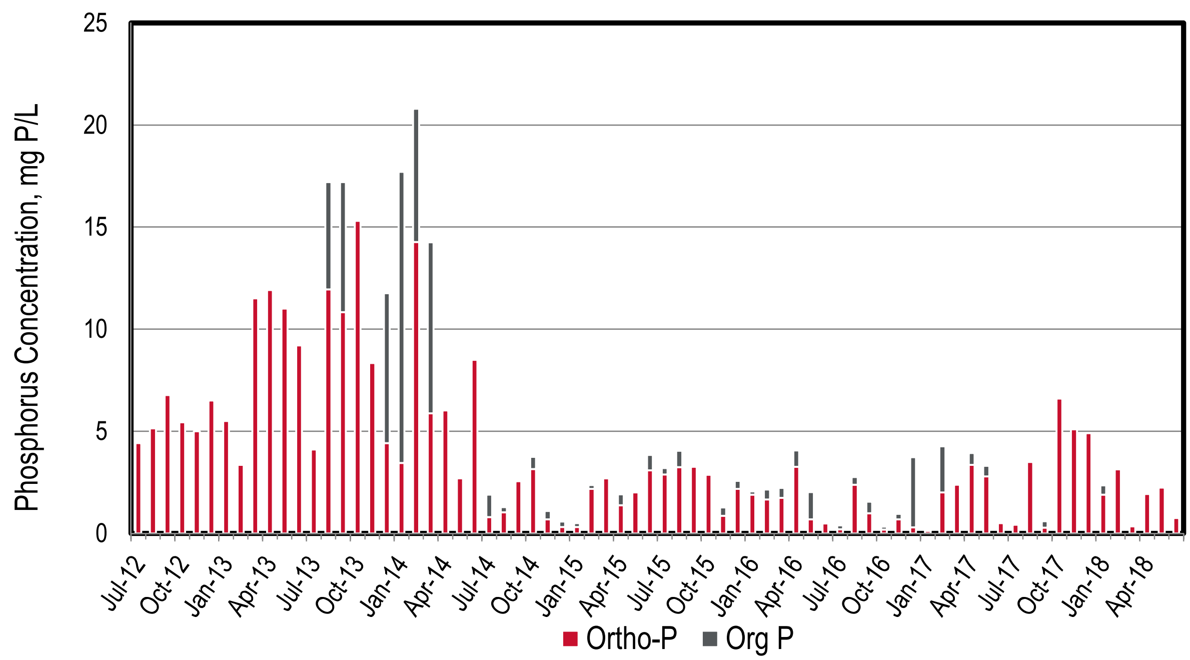

Figure 3-5. Burlingame Monthly Phosphorus Concentrations

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

Table 3-1. Burlingame Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jul-12	2.5	82	101	112	213	127	42
Aug-12	2.5	305	235	1	236	158	48
Sep-12	2.8	279	368	3	371	111	71
Oct-12	2.7	186	265	54	318	122	55
Nov-12	2.9	245	366	76	442	122	54
Dec-12	4.0	299	423	64	487	238	98
Jan-13	3.4	393	588	101	689	185	70
Feb-13	3.3	263	573	101	674	167	41
Mar-13	3.0	350	462	64	526	142	132
Apr-13	3.2	363	483	29	513	170	142
May-13	2.9	323	383	55	437	222	119
Jun-13	2.8	316	480	112	593	185	98
Jul-13	2.8	211	228	94	322	60	43
Aug-13	3.0	373	251	168	419	133	192
Sep-13	2.7	333	355	197	551	109	173
Oct-13	2.8	228	302	457	759	212	160
Nov-13	3.3	351	516	139	655	111	103
Dec-13	2.9	173	292	303	594	49	130
Jan-14	2.9	229	309	370	679	37	191
Feb-14	4.3	405	501	226	727	232	338
Mar-14	3.3	329	372	125	497	72	175
Apr-14	2.8	251	336	171	506	125	64
May-14	2.6	184	249	114	362	46	26
Jun-14	2.5	218	233	223	456	131	80
Jul-14	2.5	195	233	29	262	7	18
Aug-14	2.6	202	278	9	287	10	13
Sep-14	2.6	248	269	17	286	27	25
Oct-14	2.7	169	216	65	281	32	37
Nov-14	2.9	254	319	23	342	8	12

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Dec-14	5.0	386	491	101	554	6	11
Jan-15	2.9	298	378	5	383	3	6
Feb-15	3.3	312	366	5	371	27	30
Mar-15	2.9	302	366	3	368	29	30
Apr-15	3.0	186	227	39	266	15	22
May-15	2.8	251	273	26	298	22	21
Jun-15	2.8	250	310	32	342	33	41
Jul-15	2.5	291	394	39	433	27	30
Aug-15	2.4	105	186	60	246	29	36
Sep-15	2.4	308	400	1	400	32	29
Oct-15	2.4	266	421	1	421	27	26
Nov-15	2.4	257	426	14	439	8	12
Dec-15	3.0	249	263	14	278	25	29
Jan-16	3.8	329	434	17	451	27	30
Feb-16	2.8	284	405	2	406	18	23
Mar-16	4.3	346	435	5	440	28	36
Apr-16	2.7	328	397	24	421	34	42
May-16	2.5	312	393	36	428	7	19
Jun-16	2.5	204	268	63	331	28	5
Jul-16	2.5	323	385	17	201	2	4
Aug-16	2.5	95	218	0	109	23	26
Sep-16	2.7	294	391	23	414	10	16
Oct-16	2.9	161	215	58	273	2	4
Nov-16	2.9	333	373	20	394	7	10
Dec-16	3.8	894	1,107	6	1,113	4	54
Jan-17	5.8	353	459	82	541	3	3
Feb-17	6.0	251	750	80	829	46	97
Mar-17	4.1	261	443	2	445	37	37
Apr-17	3.6	525	541	14	555	46	54
May-17	3.0	291	313	5	318	31	37

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jun-17	2.9	311	338	44	382	6	5
Jul-17	2.7	144	138	73	211	5	4
Aug-17	2.9	233	322	54	376	43	38
Sep-17	2.8	123	160	77	237	3	6
Oct-17	2.6	465	546	9	555	80	66
Nov-17	3.0	21	225	81	306	63	57
Dec-17	2.7	205	195	106	301	51	49
Jan-18	3.2	222	249	108	357	23	28
Feb-18	2.5	302	214	38	252	30	30
Mar-18	3.5	396	430	2	432	5	4
Apr-18	3.0	396	364	13	377	22	22
May-18	2.6	346	375	22	398	29	22
Jun-18	2.4	377	377	16	393	7	7
Dry Season Average	**2.6**	**251**	**297**	**57**	**344**	**55**	**43**
Dry Season Trend **	**None**	**None**	**None**	**None**	**None**	**-**	**Down**
Wet Season Average	**3.3**	**305**	**406**	**77**	**481**	**64**	**62**
Average Annual	**3.0**	**282**	**360**	**69**	**424**	**60**	**54**

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

4 Central Contra Costa Sanitary District (CCCSD)

CCCSD discharges to Suisun Bay, and serves approximately 115,100 service connections. The plant has a permitted ADWF capacity of 53.8 mgd and a peak wet weather influent design flow of 250 mgd. It has a current ADWF flow of approximately 32 mgd. The plant performs secondary treatment using activated sludge.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the table and figures with the average monthly values, there appears to be an upward trend for NOx loads.
- Ammonia, TKN and TN loads increase with flow during wet weather events.
- Wet season loads are typically greater than the dry season loads.
- Ammonia is the majority of the nitrogen species discharged, regardless of season. This would be expected since this plant does not fully nitrify.
- Ammonia concentrations are greatest during the dry season and it becomes more pronounced towards the end of the dry season.
- Total phosphorus concentrations are generally less than 1.5 mg P/L, which is lower than typical effluent concentrations of 4 to 6 mg P/L. This indicates the plant is reliably removing phosphorus.

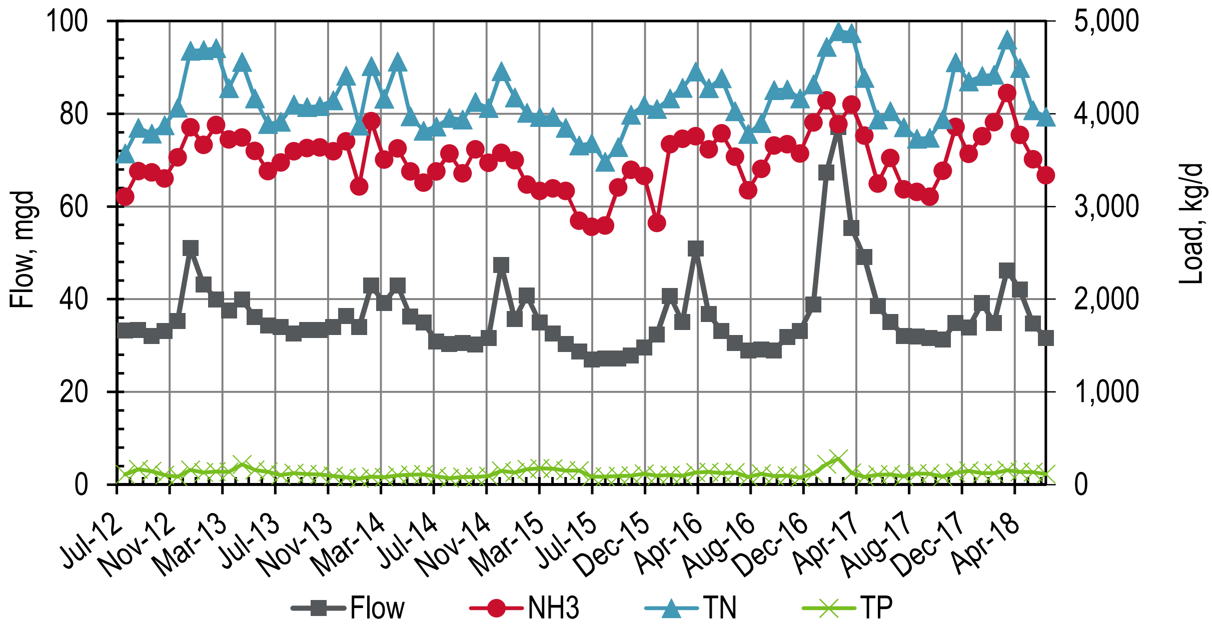

Figure 4-1. CCCSD Monthly Flows and Loads

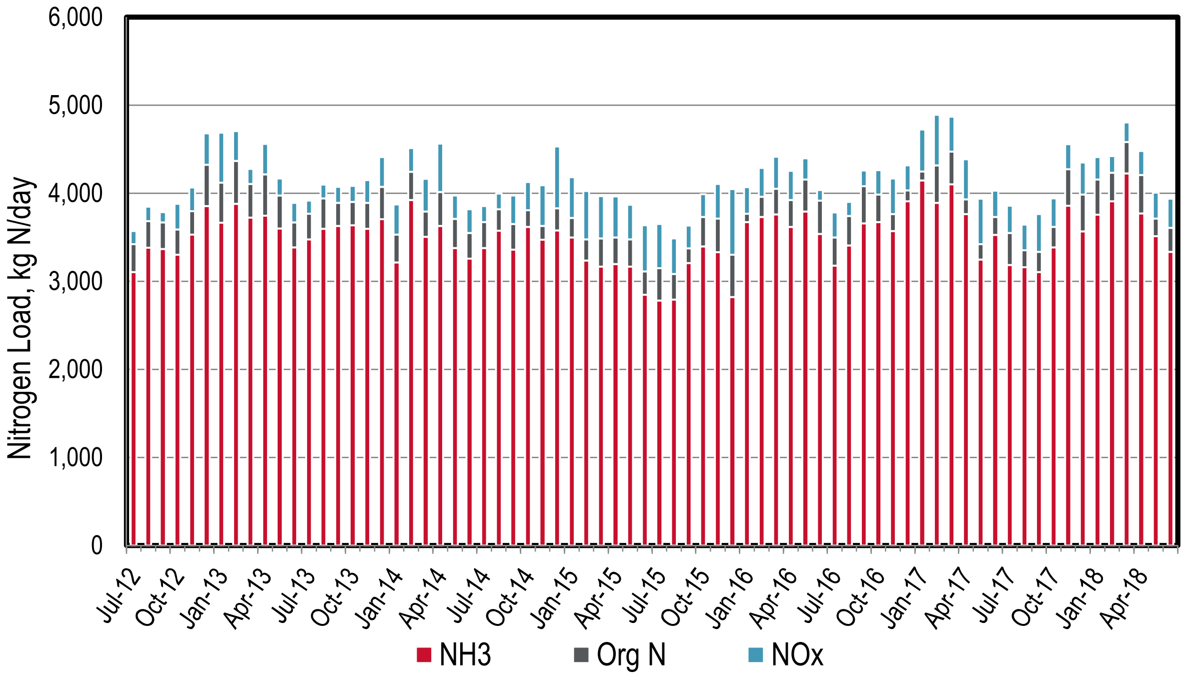

Figure 4-2. CCCSD Monthly Nitrogen Loads

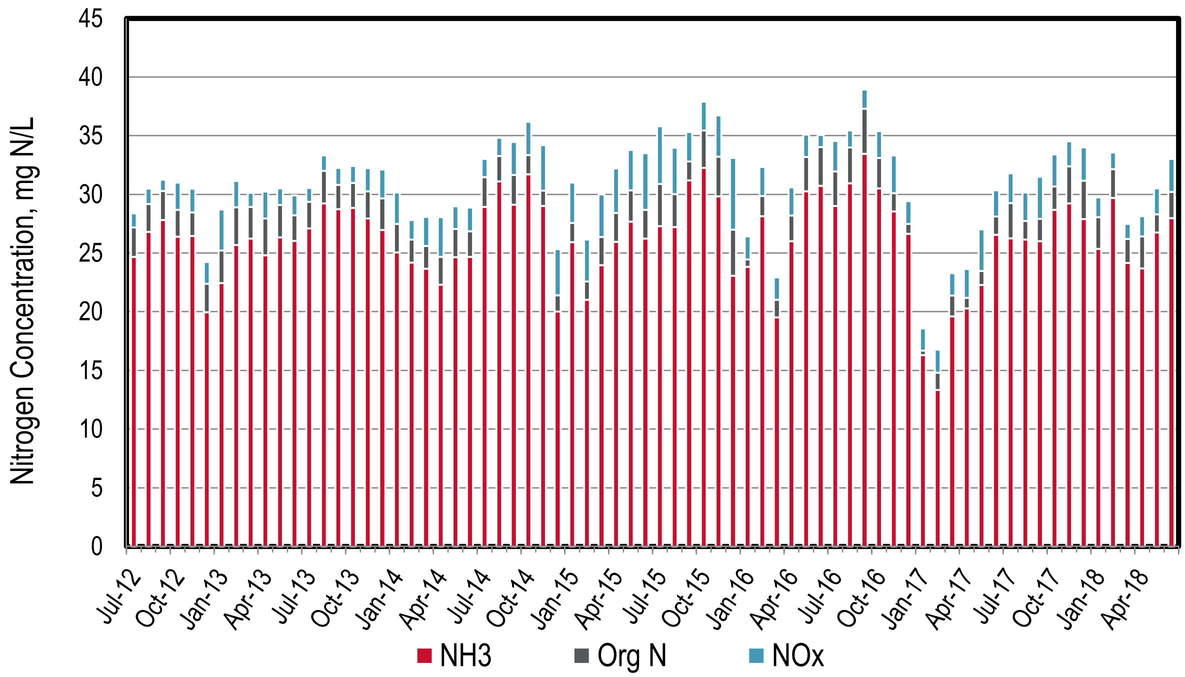

Figure 4-3. CCCSD Monthly Nitrogen Concentrations

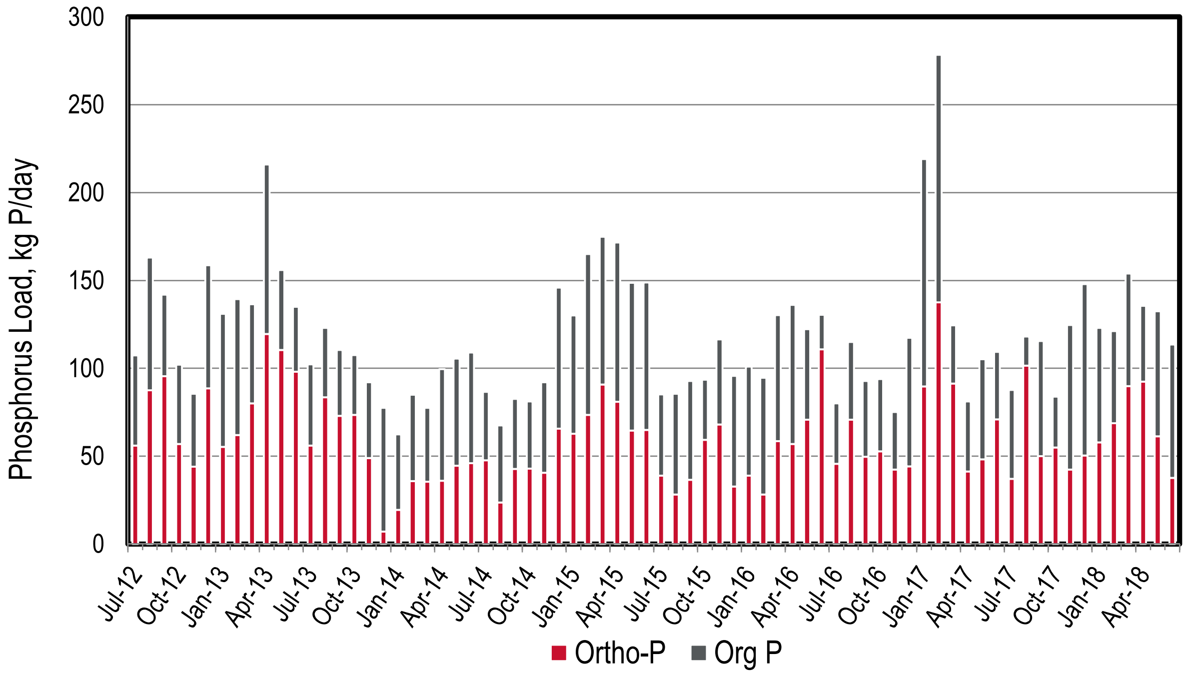

Figure 4-4. CCCSD Monthly Phosphorus Loads

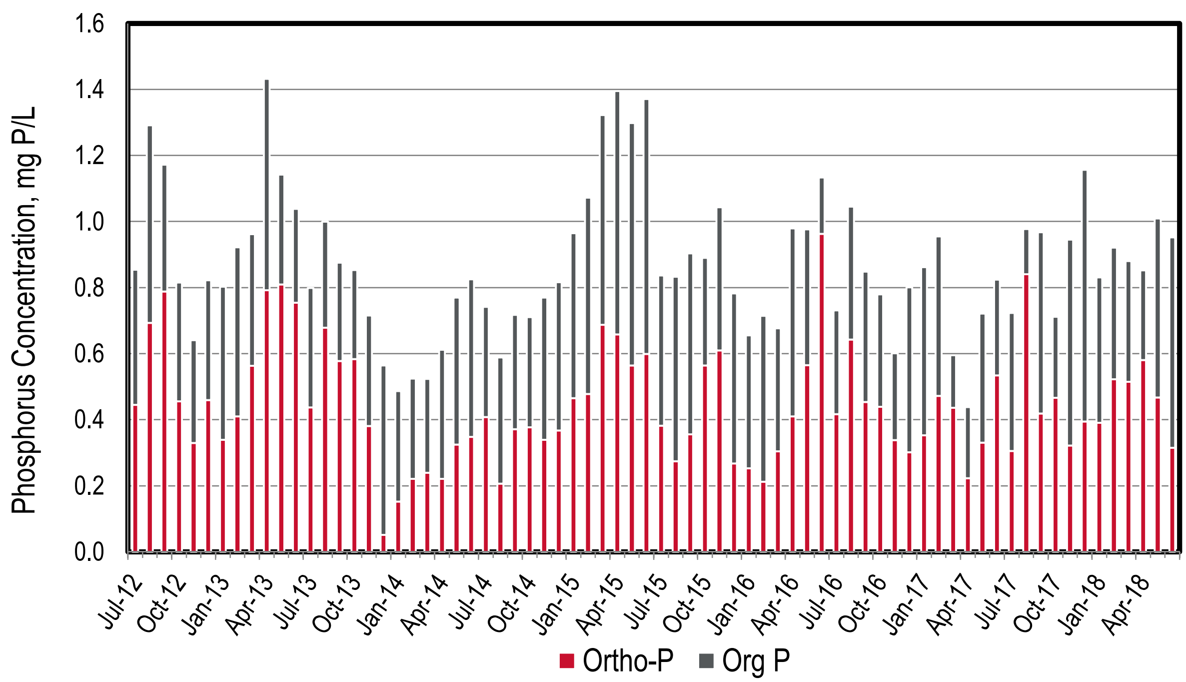

Figure 4-5. CCCSD Monthly Phosphorus Concentrations

Table 4-1. CCCSD Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jul-12	33.3	3,104	3,420	150	3,570	56	107
Aug-12	33.4	3,381	3,683	165	3,847	88	163
Sep-12	32.0	3,367	3,669	116	3,784	96	142
Oct-12	33.1	3,301	3,588	290	3,877	57	102
Nov-12	35.3	3,530	3,797	269	4,065	44	86
Dec-12	51.1	3,855	4,322	357	4,678	89	159
Jan-13	43.2	3,666	4,117	569	4,686	55	131
Feb-13	40.0	3,879	4,366	340	4,706	62	139
Mar-13	37.6	3,723	4,106	170	4,276	80	137
Apr-13	39.9	3,744	4,214	344	4,558	120	216
May-13	36.1	3,598	3,975	191	4,165	111	156
Jun-13	34.4	3,383	3,669	220	3,888	98	135
Jul-13	33.9	3,474	3,765	149	3,914	56	102
Aug-13	32.6	3,596	3,940	160	4,099	84	123
Sep-13	33.4	3,630	3,890	184	4,073	73	111
Oct-13	33.3	3,636	3,902	182	4,083	74	108
Nov-13	34.0	3,596	3,892	255	4,146	49	92
Dec-13	36.3	3,704	4,074	336	4,410	7	78
Jan-14	34.0	3,216	3,529	342	3,871	20	63
Feb-14	42.9	3,922	4,243	270	4,513	36	85
Mar-14	39.2	3,505	3,793	370	4,163	36	78
Apr-14	43.0	3,628	4,013	550	4,563	36	100
May-14	36.3	3,379	3,709	264	3,972	45	106
Jun-14	35.0	3,259	3,548	268	3,816	46	109
Jul-14	30.9	3,378	3,673	182	3,861	48	87
Aug-14	30.4	3,572	3,818	178	3,954	24	68
Sep-14	30.5	3,358	3,650	325	3,939	43	83
Oct-14	30.2	3,618	3,805	323	4,129	43	81
Nov-14	31.7	3,472	3,627	465	4,061	41	92

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Dec-14	47.3	3,578	3,827	705	4,458	66	146
Jan-15	35.7	3,499	3,719	463	4,177	63	130
Feb-15	40.7	3,236	3,476	550	4,009	74	165
Mar-15	35.0	3,168	3,486	479	3,964	91	175
Apr-15	32.6	3,195	3,497	467	3,965	81	172
May-15	30.3	3,168	3,474	395	3,847	65	149
Jun-15	28.7	2,848	3,113	524	3,659	65	149
Jul-15	27.0	2,782	3,148	501	3,682	39	85
Aug-15	27.2	2,794	3,081	406	3,481	28	86
Sep-15	27.2	3,206	3,373	260	3,642	37	93
Oct-15	27.8	3,395	3,729	260	3,989	59	94
Nov-15	29.6	3,331	3,710	393	4,092	68	116
Dec-15	32.4	2,823	3,301	747	4,053	33	96
Jan-16	40.7	3,671	3,766	302	4,166	39	101
Feb-16	35.1	3,730	3,959	327	4,280	28	95
Mar-16	50.9	3,758	4,050	365	4,456	59	130
Apr-16	36.8	3,617	3,922	333	4,276	57	136
May-16	33.1	3,790	4,156	239	4,384	71	122
Jun-16	30.5	3,538	3,916	120	4,028	111	130
Jul-16	29.0	3,176	3,498	283	3,781	46	80
Aug-16	29.1	3,405	3,741	159	3,900	71	115
Sep-16	28.9	3,656	4,078	178	4,257	50	93
Oct-16	31.8	3,671	3,984	277	4,261	53	94
Nov-16	33.1	3,570	3,764	402	4,167	42	75
Dec-16	38.8	3,907	4,031	284	4,316	44	117
Jan-17	67.3	4,144	4,247	475	4,722	90	219
Feb-17	77.1	3,889	4,317	574	4,891	137	278
Mar-17	55.4	4,100	4,472	397	4,870	91	124
Apr-17	49.1	3,764	3,931	454	4,385	41	81
May-17	38.6	3,248	3,422	515	3,937	48	105

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jun-17	35.1	3,525	3,731	296	4,027	71	109
Jul-17	32.1	3,186	3,549	309	3,853	37	88
Aug-17	32.0	3,159	3,350	293	3,729	101	118
Sep-17	31.6	3,105	3,333	428	3,742	50	116
Oct-17	31.2	3,385	3,618	323	3,941	55	84
Nov-17	34.9	3,857	4,272	282	4,554	42	125
Dec-17	33.8	3,567	3,985	363	4,348	50	148
Jan-18	39.2	3,757	4,156	252	4,408	58	123
Feb-18	34.8	3,909	4,231	188	4,419	69	121
Mar-18	46.2	4,223	4,580	221	4,801	90	154
Apr-18	42.1	3,772	4,205	274	4,492	92	136
May-18	34.7	3,510	3,714	292	4,038	61	132
Jun-18	31.6	3,335	3,605	333	3,969	38	114
Average Monthly Values over Dry Season Months	**32.0**	**3,330**	**3,623**	**269**	**3,895**	**62**	**112**
Dry Season Trend using all Dry Season Average Monthly Values**	**None**	**None**	**None**	**Up**	**None**	**-**	**None**
Average Monthly Values over Wet Season Months	**39.6**	**3,631**	**3,943**	**371**	**4,315**	**60**	**123**
Average Annual	**36.4**	**3,506**	**3,810**	**329**	**4,140**	**61**	**119**

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

5 Central Marin Sanitation Agency (CMSA)

CMSA discharges to the Central Bay Subembayment, and serves approximately 52,200 service connections. The plant has a permitted ADWF capacity of 10.0 mgd. It has a current ADWF flow of approximately 5.8 mgd. The plant performs secondary treatment using a trickling filter and activated sludge process.

The following observations are made based upon the figures and table in the subsequent pages:

- Both nitrogen and phosphorus loads increase with flow during wet weather events.
- Based on the table and figures with the average monthly values, there appears to be an upward dry season trend for flow and the nutrient species analyzed.
- Ammonia is the majority of the nitrogen species discharged, regardless of season. This would be expected since the plant was not designed to nitrify (some nitrification does occur in the secondary process, most likely in the biotowers).
- Ammonia, TKN, and total nitrogen concentrations increase during the dry weather season as flows decrease and temperatures increase.
- Total phosphorus concentrations range from less than 1 mg P/L to 6 mg P/L.
- The distribution of phosphorus species is predominantly ortho-P.

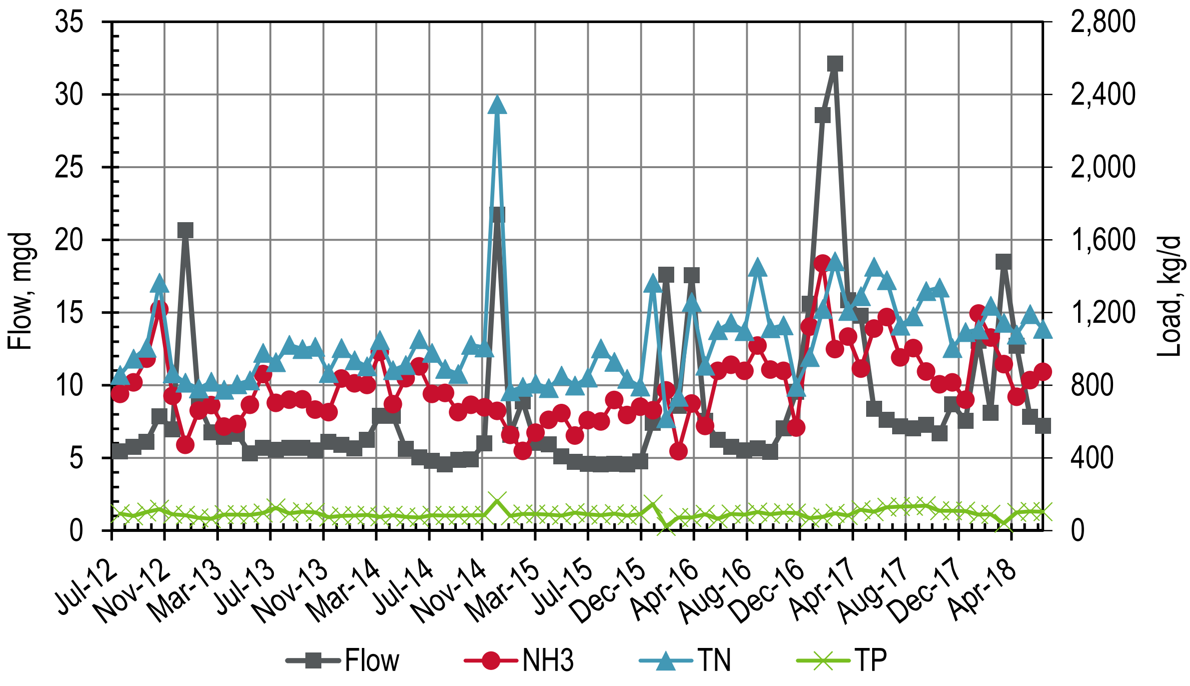

Figure 5-1. CMSA Monthly Flows and Loads

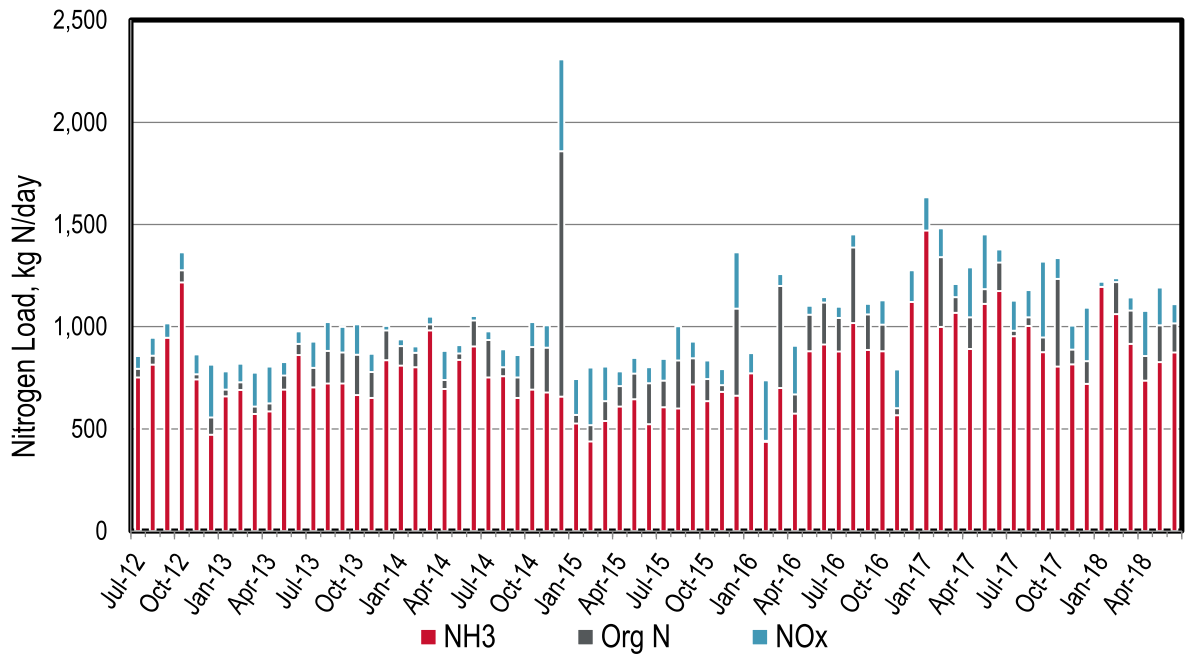

Figure 5-2. CMSA Monthly Nitrogen Loads

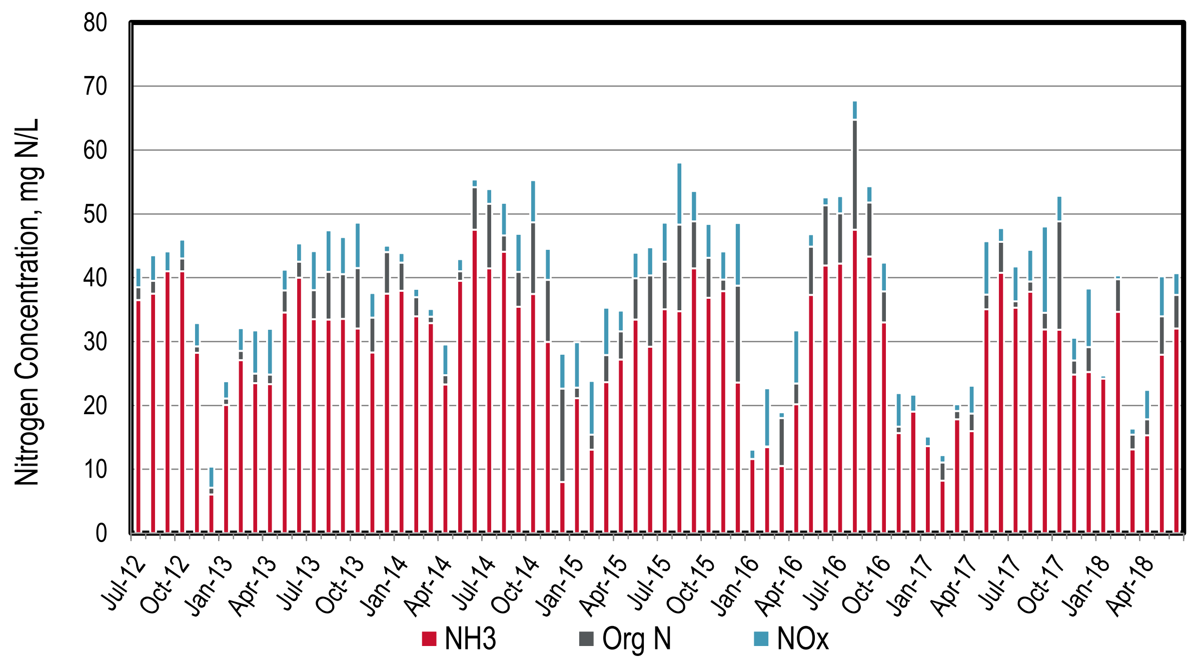

Figure 5-3. CMSA Monthly Nitrogen Concentrations

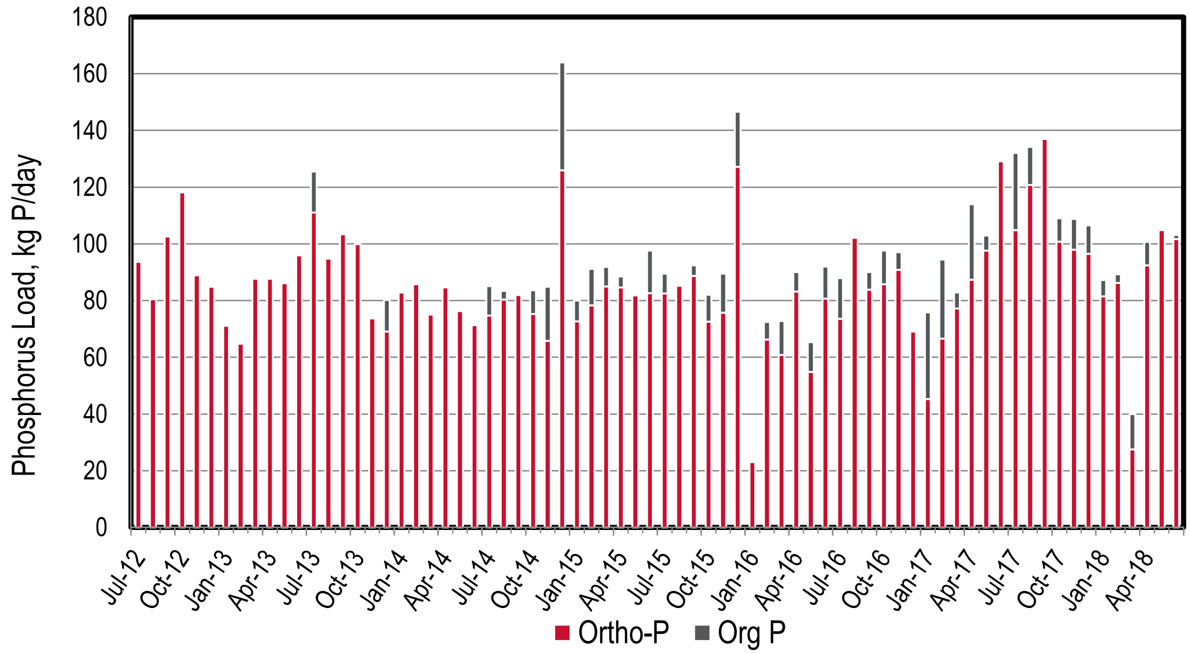

Figure 5-4. CMSA Monthly Phosphorus Loads

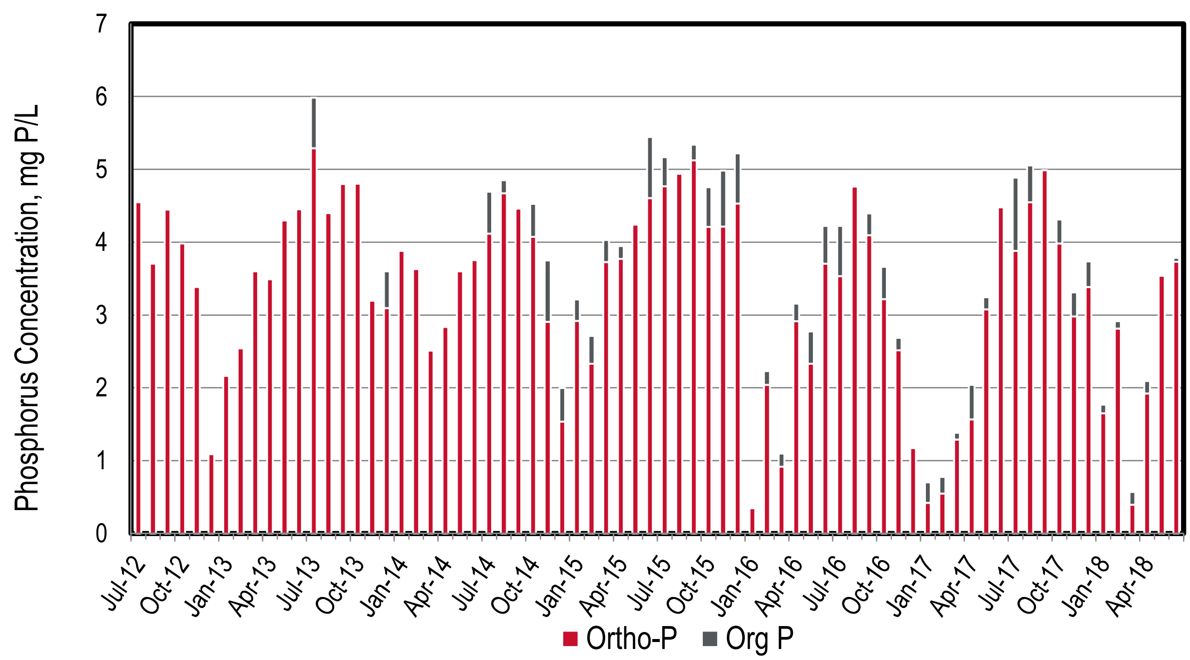

Figure 5-5. CMSA Monthly Phosphorus Concentrations

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

Table 5-1. CMSA Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jul-12	5.5	752	793	63	857	125	94
Aug-12	5.8	815	858	87	946	103	81
Sep-12	6.1	945	934	72	1,006	142	103
Oct-12	7.9	1,217	1,276	88	1,363	178	118
Nov-12	7.0	742	768	96	864	102	89
Dec-12	20.7	471	556	258	814	322	85
Jan-13	8.7	660	692	89	782	86	71
Feb-13	6.8	691	729	90	819	89	65
Mar-13	6.5	573	610	165	775	128	88
Apr-13	6.7	586	624	180	805	128	88
May-13	5.3	692	762	65	827	125	86
Jun-13	5.7	862	916	62	977	132	96
Jul-13	5.6	703	798	128	926	111	126
Aug-13	5.7	721	882	140	1,022	125	95
Sep-13	5.7	722	874	125	999	137	103
Oct-13	5.5	666	863	148	1,011	148	100
Nov-13	6.1	652	778	89	867	116	74
Dec-13	5.9	836	981	22	1,004	69	80
Jan-14	5.7	810	905	33	937	105	83
Feb-14	6.3	802	873	31	904	99	86
Mar-14	7.9	982	1,012	36	1,049	99	75
Apr-14	7.9	695	739	143	882	113	85
May-14	5.6	838	869	41	910	108	76
Jun-14	5.0	903	1,030	23	1,053	72	71
Jul-14	4.8	752	935	42	977	75	85
Aug-14	4.5	757	802	88	889	80	83
Sep-14	4.9	651	751	110	861	82	82
Oct-14	4.9	692	900	122	1,022	75	84
Nov-14	6.0	678	898	110	1,008	66	85

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Dec-14	21.7	658	1,859	449	2,347	126	164
Jan-15	6.6	527	568	176	766	73	80
Feb-15	8.9	439	518	283	792	78	91
Mar-15	6.0	539	636	169	809	85	92
Apr-15	5.9	610	709	72	783	85	89
May-15	5.1	645	771	77	852	106	82
Jun-15	4.7	524	723	80	798	83	98
Jul-15	4.6	607	736	106	842	83	89
Aug-15	4.6	600	834	168	1,002	94	85
Sep-15	4.6	718	845	83	928	89	92
Oct-15	4.6	636	744	91	835	73	82
Nov-15	4.8	681	713	80	793	76	90
Dec-15	7.4	663	1,088	277	1,364	127	147
Jan-16	17.6	772	521	98	619	25	23
Feb-16	8.6	438	441	296	737	66	72
Mar-16	17.6	700	1,199	59	1,257	61	73
Apr-16	7.5	575	668	238	906	83	90
May-16	6.2	880	1,058	45	1,103	55	65
Jun-16	5.8	913	1,118	27	1,145	81	92
Jul-16	5.5	879	1,042	56	1,098	74	88
Aug-16	5.7	1,018	1,388	64	1,452	110	102
Sep-16	5.4	887	1,060	53	1,112	84	90
Oct-16	7.1	880	1,010	120	1,130	86	98
Nov-16	9.6	567	602	189	791	91	97
Dec-16	15.6	1,122	800	154	954	73	69
Jan-17	28.6	1,470	1,055	163	1,219	45	76
Feb-17	32.1	999	1,340	141	1,481	67	94
Mar-17	15.8	1,067	1,145	64	1,209	77	83
Apr-17	14.8	892	1,047	243	1,290	87	114
May-17	8.4	1,111	1,184	267	1,451	98	103

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jun-17	7.6	1,175	1,314	63	1,378	139	129
Jul-17	7.1	953	981	147	1,128	105	132
Aug-17	7.0	1,004	1,047	132	1,178	121	134
Sep-17	7.3	875	947	371	1,318	141	137
Oct-17	6.7	805	1,234	102	1,336	101	109
Nov-17	8.7	816	888	117	1,005	98	109
Dec-17	7.5	720	831	261	1,093	96	107
Jan-18	13.1	1,194	1,080	26	1,105	82	87
Feb-18	8.1	1,062	1,218	19	1,236	86	89
Mar-18	18.5	916	1,079	64	1,143	28	40
Apr-18	12.7	736	856	222	1,078	92	101
May-18	7.8	828	1,007	184	1,191	110	105
Jun-18	7.2	874	1,017	93	1,110	102	103
Dry Season Average	**5.8**	**820**	**943**	**102**	**1,045**	**103**	**97**
Dry Season Trend **	**Up**	**Up**	**Up**	**Up**	**Up**	**-**	**Up**
Wet Season Average	**10.4**	**768**	**882**	**140**	**1,023**	**95**	**89**
Average Annual	**8.5**	**789**	**907**	**124**	**1,032**	**98**	**92**

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

6 Crockett Community Services District - Port Costa

The Crockett Community Services District serves two distinct separate communities, the town of Crockett and the town of Port Costa, each with their own treatment plant facilities. The Crockett Sanitary Department is excluded from the requirements of the Nutrient NPDES Order No. R2-2014-0014 as it shares use of an industrial wastewater treatment plant with C&H Sugar which has submitted its own sampling plan. The town of Port Costa has its own municipal wastewater treatment plant which is covered under the Nutrient NPDES Order. This analysis focuses on Port Costa.

The Community of Port Costa uses the Port Costa Wastewater Treatment Plant to discharge to the Carquinez Straight, which is connected to San Pablo Bay. The service area population is approximately 250 people. The plant has a permitted ADWF capacity of 0.033 mgd. It has a current ADWF flow of approximately 0.010 mgd. The plant performs secondary treatment using a septic tank for solids separation, followed by filtration and disinfection.

Port Costa was exempt from the Section 13267 Letter sampling requirements due to their permitted capacity flow (<1 mgd). The following observations are made based upon the available data presented in figures and table in the subsequent pages:

- The dataset is limited to flow, ammonia a few times per year, and most recently a few TN and TP samples. Based on the average monthly values in the table and figures below, there appears to be an emerging upward dry season trend for flow. There is insufficient dry season nutrient data to perform trend analysis.
- Ammonia loads typically increase with flow during wet weather events. There is insufficient TN and TP data to comment on trends.

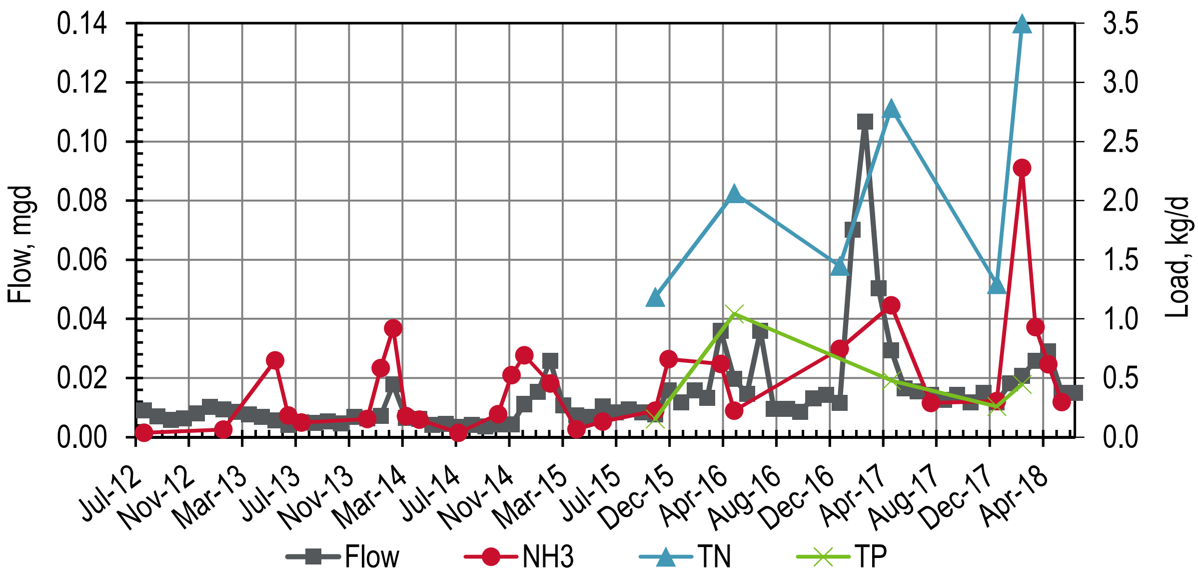

Figure 6-1. Port Costa Monthly Flows and Loads

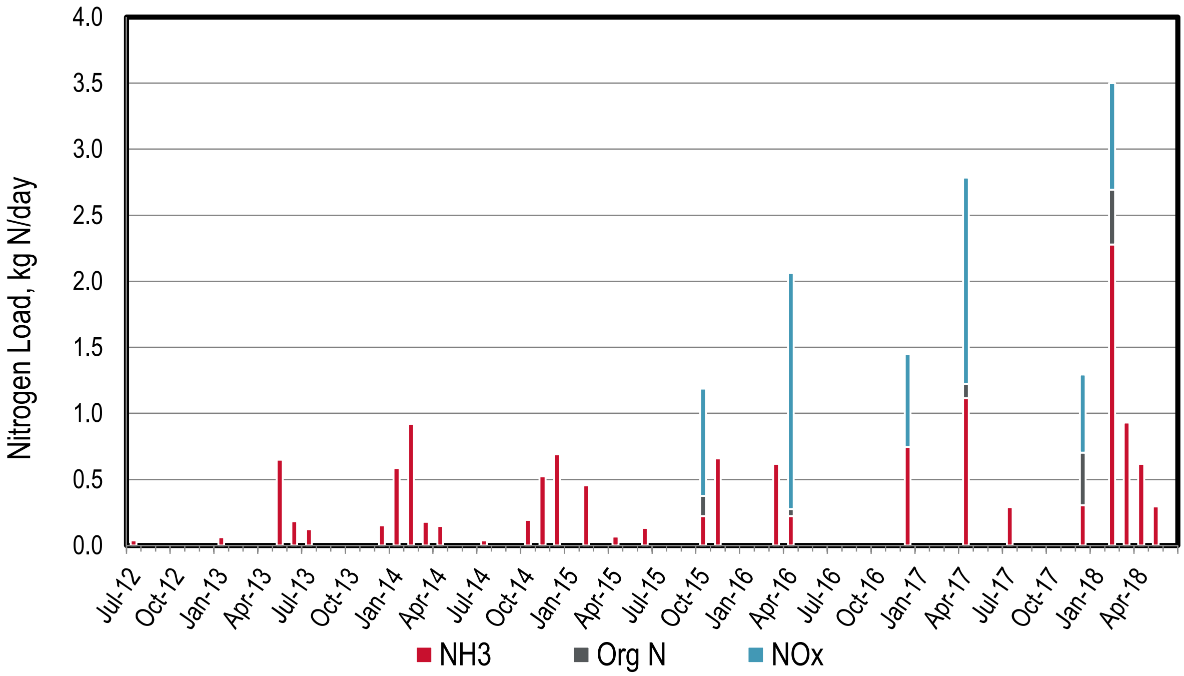

Figure 6-2. Port Costa Monthly Ammonia Loads

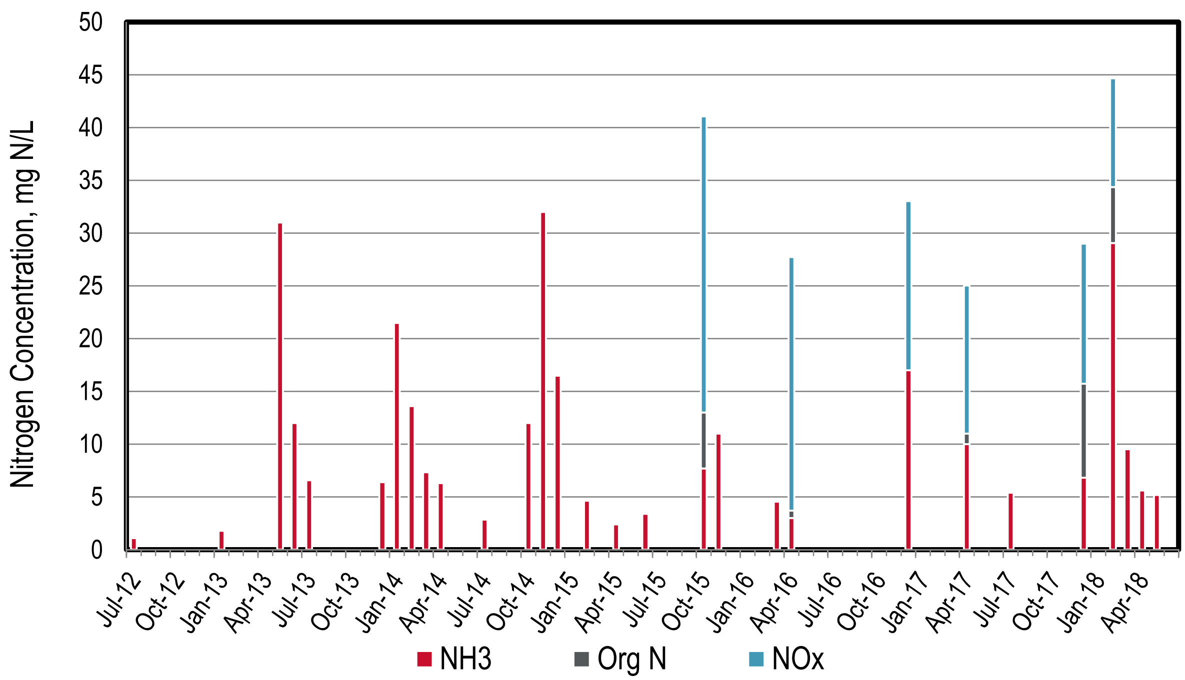

Figure 6-3. Port Costa Monthly Ammonia Concentrations

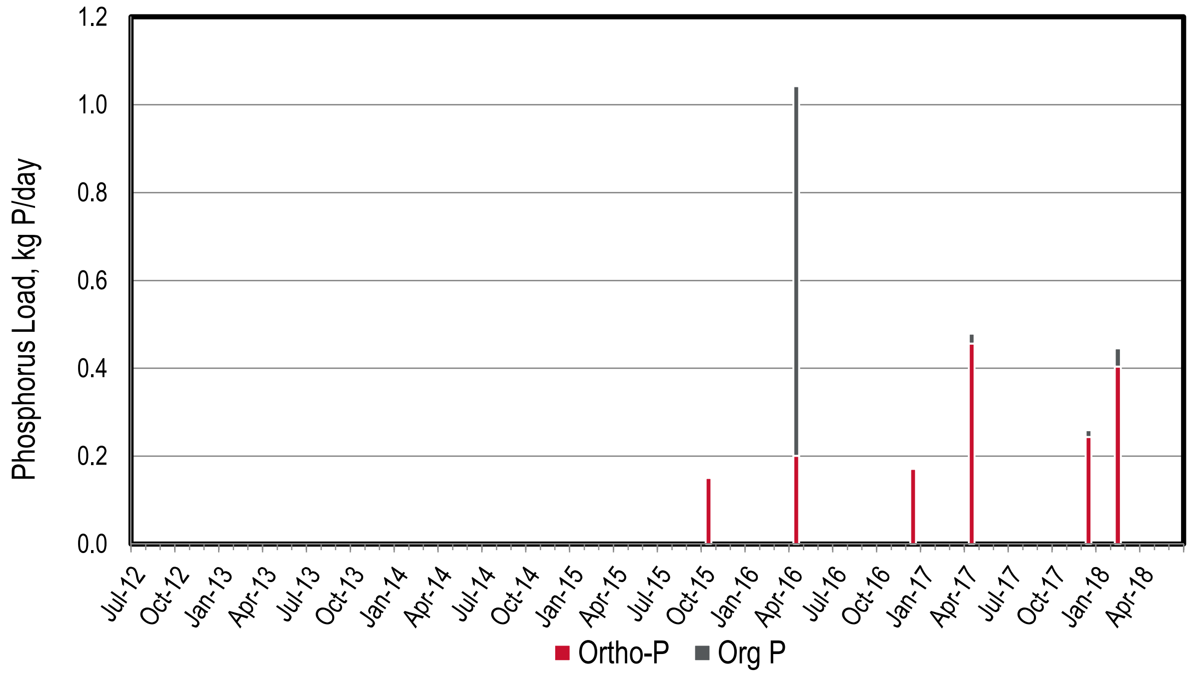

Figure 6-4. Port Costa Monthly Phosphorus Loads

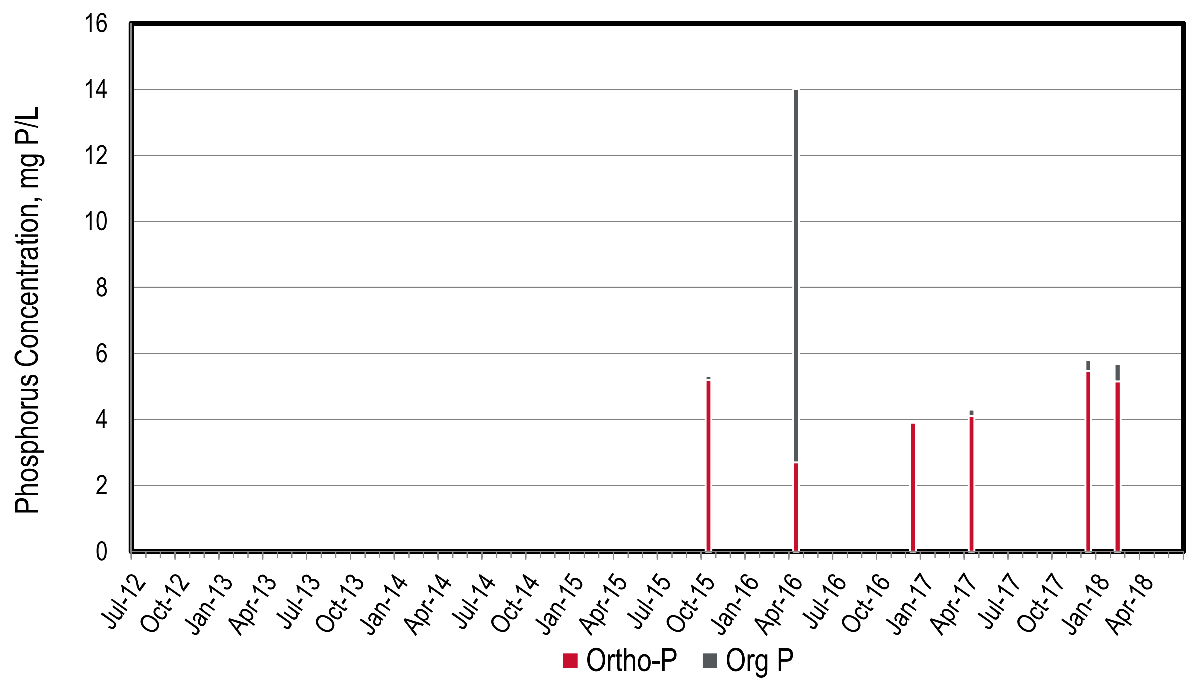

Figure 6-5. Port Costa Monthly Phosphorus Concentrations

Table 6-1. Port Costa Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jul-12	0.009	0.0					
Aug-12	0.007						
Sep-12	0.006						
Oct-12	0.006						
Nov-12	0.008						
Dec-12	0.010						
Jan-13	0.009	0.1					
Feb-13	0.009						
Mar-13	0.008						
Apr-13	0.007						
May-13	0.006	0.7					
Jun-13	0.004	0.2					
Jul-13	0.005	0.1					
Aug-13	0.005						
Sep-13	0.005						
Oct-13	0.005						
Nov-13	0.007						
Dec-13	0.006	0.2					
Jan-14	0.007	0.6					
Feb-14	0.018	0.9					
Mar-14	0.006	0.2					
Apr-14	0.006	0.1					
May-14	0.004						
Jun-14	0.005						
Jul-14	0.004	0.0					
Aug-14	0.004						
Sep-14	0.004						
Oct-14	0.004	0.2					
Nov-14	0.004	0.5					

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Dec-14	0.011	0.7					
Jan-15	0.015						
Feb-15	0.026	0.5					
Mar-15	0.011						
Apr-15	0.007	0.1					
May-15	0.007						
Jun-15	0.010	0.1					
Jul-15	0.008						
Aug-15	0.009						
Sep-15	0.008						
Oct-15	0.008	0.2	0.4	0.8	1.2	0.2	0.2
Nov-15	0.016	0.7					
Dec-15	0.012						
Jan-16	0.016						
Feb-16	0.013						
Mar-16	0.036	0.6					
Apr-16	0.020	0.2	0.3	1.8	2.1	0.2	1.0
May-16	0.015						
Jun-16	0.036						
Jul-16	0.010						
Aug-16	0.010						
Sep-16	0.009						
Oct-16	0.013						
Nov-16	0.014						
Dec-16	0.012	0.7	0.7	0.7	1.4	0.2	--
Jan-17	0.070						
Feb-17	0.107						
Mar-17	0.050						
Apr-17	0.029	1.1	1.2	1.6	2.8	0.5	0.5
May-17	0.017						

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jun-17	0.016						
Jul-17	0.014	0.3					
Aug-17	0.013						
Sep-17	0.014						
Oct-17	0.012						
Nov-17	0.015						
Dec-17	0.012	0.3	0.7	0.6	1.3	0.2	0.3
Jan-18	0.018						
Feb-18	0.021	2.3	2.7	0.8	3.5	0.4	0.4
Mar-18	0.026	0.9					
Apr-18	0.029	0.6					
May-18	0.015	0.3					
Jun-18	0.015						
Dry Season Average	**0.010**	**0.2**					
Dry Season Trend **	**Up**	**None**	**-**	**-**	**-**	**-**	**-**
Wet Season Average	**0.018**	**0.6**	**1.0**	**1.0**	**2.0**	**0.3**	**0.5**
Average Annual	**0.014**	**0.5**	**1.0**	**1.0**	**2.0**	**0.3**	**0.5**

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

7 Delta Diablo

Delta Diablo discharges to New York Slough (part of the Suisun Bay) and serves approximately 57,700 service connections throughout Antioch, Pittsburg and Bay Point. The plant has a permitted ADWF capacity of 19.5 mgd. It has a current ADWF discharge of approximately 6.7 mgd. The plant performs secondary treatment using trickling filters, followed by activated sludge. Secondary effluent (up to 12.8 mgd) is diverted upstream of the disinfection process and sent for tertiary treatment prior to distribution to recycled water users. Approximately 90% of the recycled water is sent to two power plants for use in their cooling towers. The blowdown from the cooling towers is returned to the secondary treatment plant, blended with secondary effluent, and disinfected prior to discharge.

The following observations are made based upon the figures and table in the subsequent pages:

- NOx dry weather loads appear to trend downwards (see cooling tower explanation below). In contrast, flow, ammonia, TKN and TP dry season loads appear to trend upwards. The increase since 2016/2017 period is due to increased discharge flows associated with the power plants demanding less water and going offline for significant periods of time, as well as decreased recycled water demand from irrigation customers because of non-drought conditions
- The variability of the distribution of the nitrogen species in the effluent is due to the power plant cooling towers going in and out of nitrification and possible denitrification occurring sporadically. Since the summer of 2016, NOx loads have decreased and the predominant form of nitrogen has become the ammonia species due to the cessation of nitrification in the power plant cooling towers.
- TN concentrations are variable, ranging from 32 to 80 mg N/L and are largely influenced by the operations of the power plants and the blowdown flows that are returned to the treatment plant
- Ortho-P values are occasionally greater than TP values for the Section 13257 Letter based on the composite sampling issue discussed in the main report body. Since the Regional Watershed Permit sampling began (July, 2014), the ortho-P values has only exceeded the TP value twice. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- TP concentrations are generally less than 2 mg P/L, which is lower than typical effluent concentrations of 4 to 6 mg P/L. The phosphorus removal is a result of ferrous chloride added in the collection system coupled with alum in the recycled water facility clarifier sludge that is returned to the headworks of the treatment plant. As such, phosphorus concentrations in the effluent are inversely proportional to the amount of recycled water production.

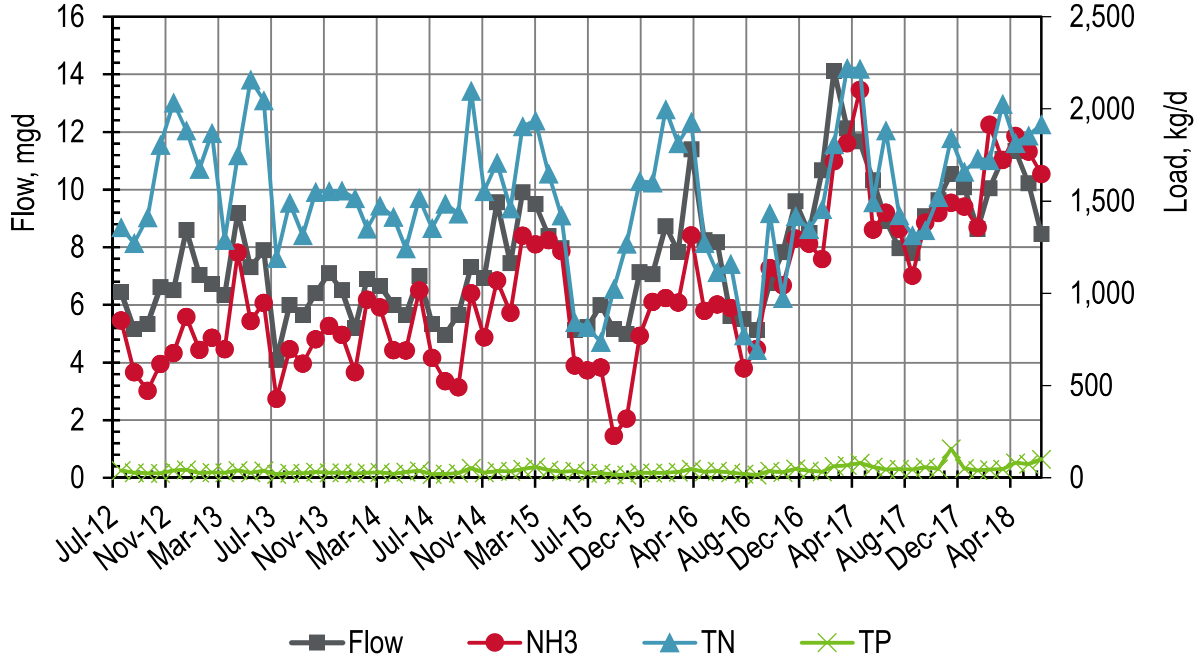

Figure 7-1. Delta Diablo Monthly Flows and Loads

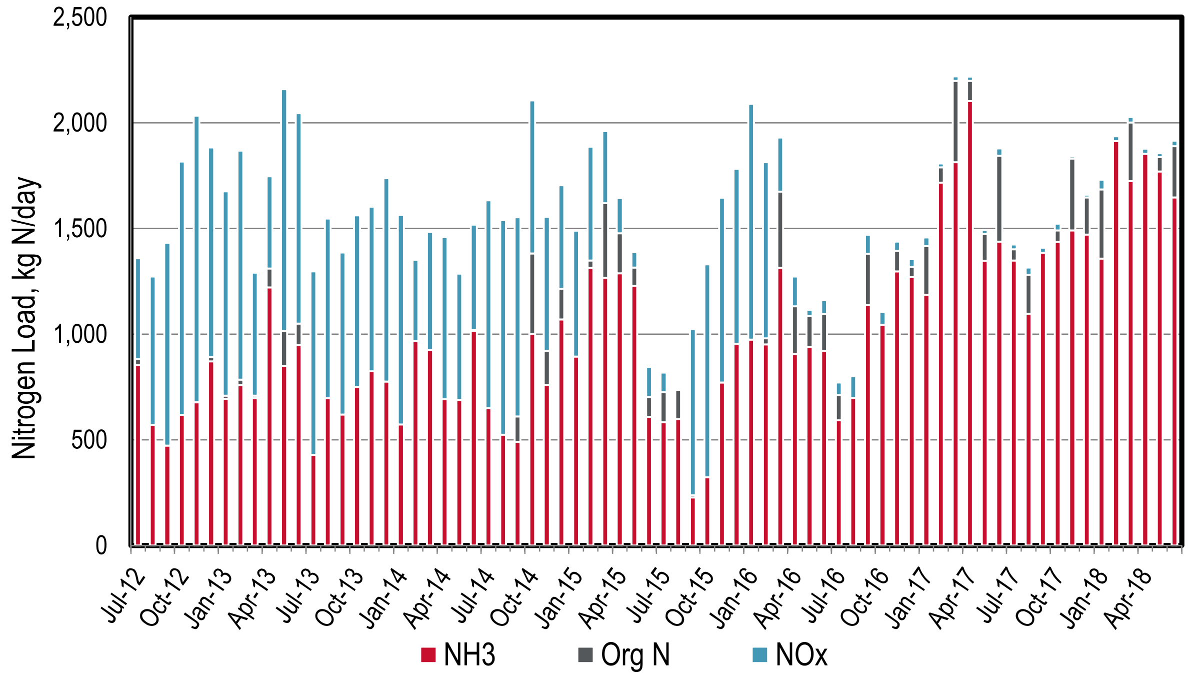

Figure 7-2. Delta Diablo Monthly Nitrogen Loads

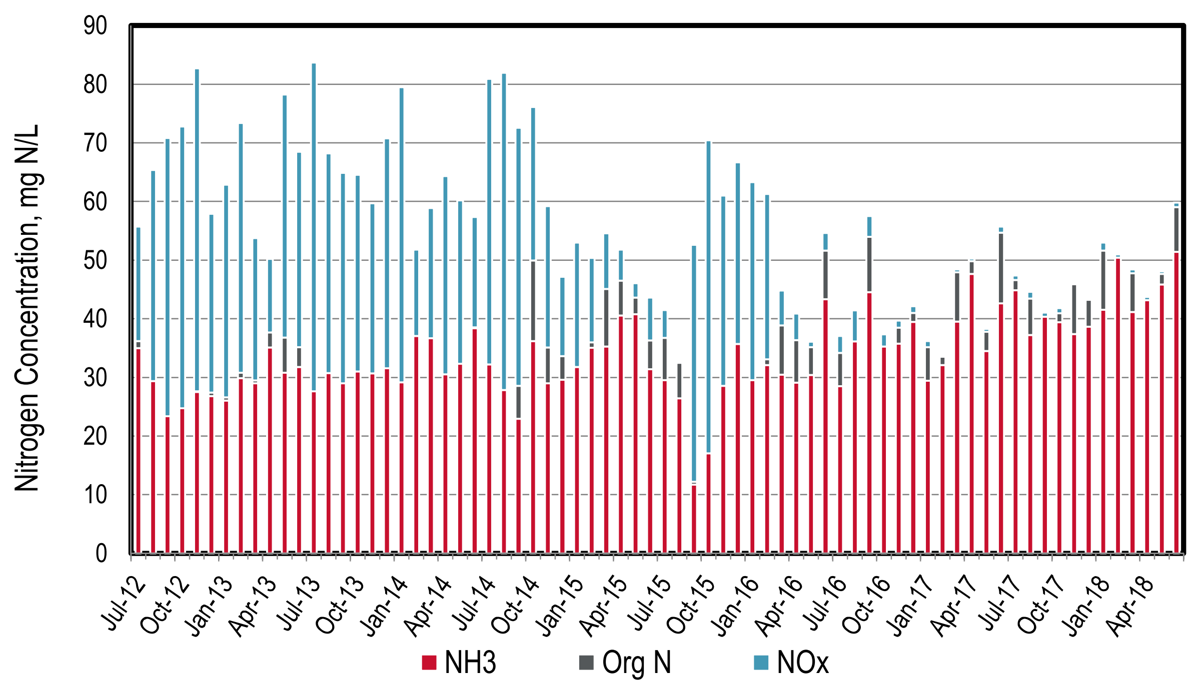

Figure 7-3. Delta Diablo Monthly Nitrogen Concentrations

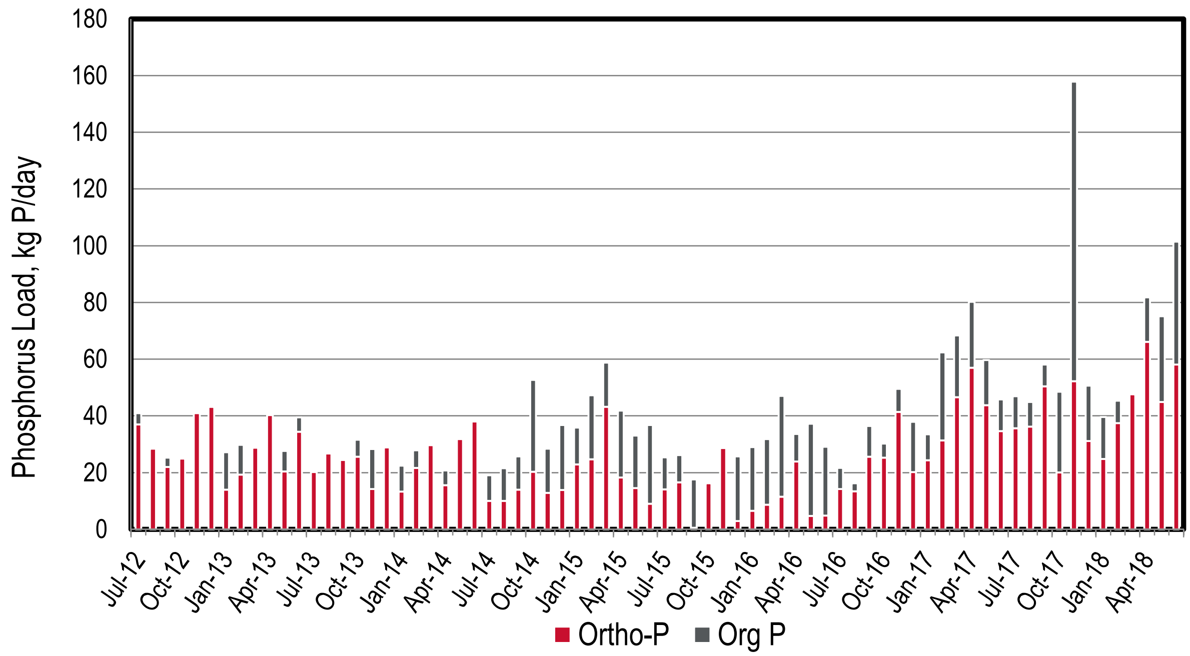

Figure 7-4. Delta Diablo Monthly Phosphorus Loads

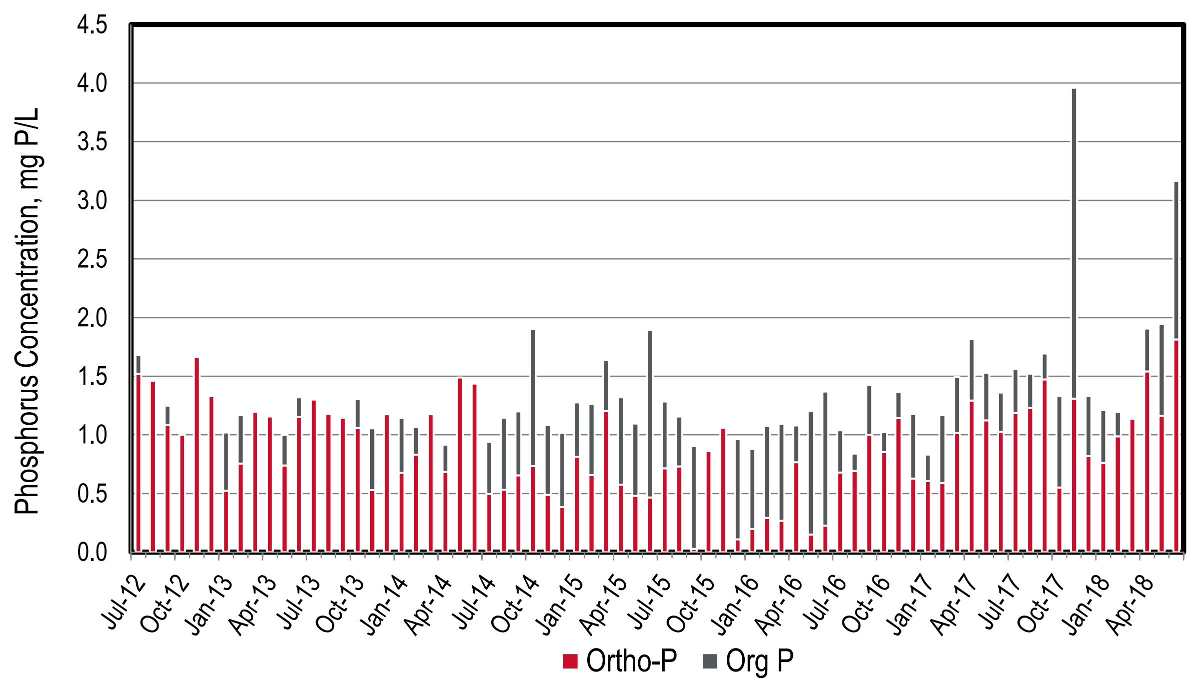

Figure 7-5. Delta Diablo Monthly Phosphorus Concentrations

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

Table 7-1. Delta Diablo Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day*	TKN kg N/day	NOx kg N/day	Total N kg N/day **	Ortho-P kg P/day	Total P kg P/day
Jul-12	6.5	853	882	476	1,358	37	41
Aug-12	5.2	572	572	701	1,273	43	28
Sep-12	5.4	473	452	959	1,412	22	25
Oct-12	6.6	618	607	1,199	1,805	29	25
Nov-12	6.5	677	679	1,354	2,033	44	41
Dec-12	8.6	872	891	991	1,882	43	43
Jan-13	7.1	694	708	967	1,675	14	27
Feb-13	6.7	760	784	1,084	1,868	19	30
Mar-13	6.4	697	708	582	1,290	36	29
Apr-13	9.2	1,221	1,310	437	1,747	43	40
May-13	7.3	850	1,015	1,143	2,159	20	28
Jun-13	7.9	948	1,050	995	2,045	34	39
Jul-13	4.1	429	323	868	1,191	22	20
Aug-13	6.0	697	641	850	1,491	31	27
Sep-13	5.7	619	548	767	1,315	24	25
Oct-13	6.4	750	739	812	1,550	26	32
Nov-13	7.1	824	775	778	1,553	14	28
Dec-13	6.5	776	594	963	1,557	30	29
Jan-14	5.2	573	525	990	1,515	13	22
Feb-14	6.9	966	966	385	1,351	22	28
Mar-14	6.7	925	916	559	1,475	39	30
Apr-14	6.0	693	647	767	1,414	16	21
May-14	5.7	690	648	596	1,244	40	32
Jun-14	7.0	1,015	1,019	498	1,517	48	38
Jul-14	5.3	651	414	982	1,355	10	19
Aug-14	5.0	524	418	1,016	1,487	10	22
Sep-14	5.7	490	611	942	1,433	14	26
Oct-14	7.3	1,001	1,381	725	2,098	20	53
Nov-14	6.9	761	921	633	1,554	13	28

Month, Year	Flow mgd	Ammonia kg N/day*	TKN kg N/day	NOx kg N/day	Total N kg N/day **	Ortho-P kg P/day	Total P kg P/day
Dec-14	9.6	1,070	1,215	488	1,707	14	37
Jan-15	7.4	894	865	595	1,461	23	36
Feb-15	9.9	1,313	1,348	538	1,905	25	47
Mar-15	9.5	1,266	1,619	341	1,937	43	59
Apr-15	8.4	1,288	1,477	167	1,649	18	42
May-15	8.0	1,229	1,314	74	1,422	14	33
Jun-15	5.1	609	704	142	842	9	37
Jul-15	5.2	583	725	93	818	14	25
Aug-15	6.0	599	736	1	738	17	26
Sep-15	5.2	228	237	787	1,024	1	18
Oct-15	5.0	322	262	1,008	1,270	19	16
Nov-15	7.1	771	734	875	1,608	31	29
Dec-15	7.1	954	772	828	1,600	3	26
Jan-16	8.7	975	884	1,114	1,998	6	29
Feb-16	7.8	951	980	834	1,814	9	32
Mar-16	11.4	1,314	1,673	256	1,930	12	47
Apr-16	8.2	905	1,131	141	1,272	24	34
May-16	8.2	940	1,086	28	1,115	5	37
Jun-16	5.6	921	1,096	64	1,160	5	29
Jul-16	5.5	593	712	60	772	14	22
Aug-16	5.1	699	569	102	692	13	16
Sep-16	6.8	1,138	1,380	90	1,434	26	36
Oct-16	7.8	1,044	943	60	975	25	30
Nov-16	9.6	1,296	1,394	44	1,419	41	50
Dec-16	8.5	1,269	1,318	37	1,349	20	38
Jan-17	10.7	1,186	1,416	41	1,457	24	34
Feb-17	14.1	1,716	1,789	19	1,808	31	62
Mar-17	12.1	1,813	2,197	23	2,221	47	68
Apr-17	11.7	2,102	2,199	20	2,218	57	80
May-17	10.3	1,346	1,473	20	1,493	44	60

Month, Year	Flow mgd	Ammonia kg N/day*	TKN kg N/day	NOx kg N/day	Total N kg N/day **	Ortho-P kg P/day	Total P kg P/day
Jun-17	8.9	1,438	1,844	35	1,882	35	46
Jul-17	8.0	1,348	1,402	22	1,424	36	47
Aug-17	7.8	1,096	1,280	35	1,314	36	45
Sep-17	9.1	1,384	1,318	24	1,342	50	58
Oct-17	9.6	1,435	1,491	32	1,523	20	49
Nov-17	10.6	1,491	1,830	11	1,841	52	158
Dec-17	10.1	1,471	1,646	13	1,659	31	51
Jan-18	8.6	1,357	1,685	46	1,730	25	40
Feb-18	10.0	1,914	1,701	22	1,722	37	45
Mar-18	11.1	1,724	2,001	26	2,027	48	48
Apr-18	11.4	1,853	1,792	24	1,816	66	82
May-18	10.2	1,769	1,838	18	1,855	45	75
Jun-18	8.5	1,647	1,890	26	1,915	58	101
Dry Season Average	**6.7**	**879**	**940**	**414**	**1,351**	**26**	**36**
Dry Season Trend * **	**Up**	**Up**	**Up**	**Down**	**None**	**-**	**Up**
Wet Season Average	**8.5**	**1,107**	**1,179**	**496**	**1,673**	**28**	**42**
Average Annual	**7.7**	**1,012**	**1,079**	**462**	**1,539**	**27**	**40**

* Delta Diablo typically samples each month more than the required frequency for ammonia. This dataset includes this additional sampling. On days when both ammonia and TKN are sampled, the ammonia loads are always less than TKN loads. The occasional average monthly values when ammonia loads are greater than TKN is attributed to this additional ammonia sampling.

** The Total Nitrogen value is calculated by adding the TKN and the NOx values.

*** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

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8 East Bay Dischargers Authority (EBDA)

EBDA discharges to the South Bay. EBDA has a permitted ADWF capacity of 107.8 mgd and a peak wet weather capacity of 189.1 mgd. It has a current ADWF flow of approximately 53 mgd. The EBDA plants have various types of secondary treatment.

The following observations are made based upon the figures and table in the subsequent pages:

- The flows reduce 10 to 20 mgd from the wet to the dry season due to a combination of recycled water demand during the dry season and a lack of inflow and infiltration.
- Peak flows in the 2017-18 wet season were significantly lower than those in the 2016-17 wet season. This decrease is primarily due to 2017-18 being a much drier season. A portion of the decrease can also be attributed to Oro Loma Sanitary District initiating use of their equalization basin in the 2017-18 season, which has an instantaneous diversion capacity of 20 MG.
- Based on the average monthly values table, there appears to be a slight upward dry season trend for ammonia, TKN, and total nitrogen loads.
- Ammonia, total nitrogen, and phosphorus loads typically increase with flow during wet weather events. The increase in loads during a wet weather event is less pronounced with months where there are back to back months with storms, such as December 2014 and January 2015. This is attributed to a lack of scouring in the collection system during the latter month.
- Wet season loads are greater and more variable than the dry season loads.
- Ammonia is the majority of the nitrogen species discharged, regardless of season. This would be expected since the EBDA plants were not designed to nitrify.
- Total phosphorus concentrations are relatively flat and range from approximately 2 mg P/L to 3 mg P/L. Such values are lower than typical effluent concentrations of 4 to 6 mg P/L. This was expected as a portion of the EBDA plants perform either biological P removal using an anaerobic selector or chemical removal at the headworks, primaries, or filters.

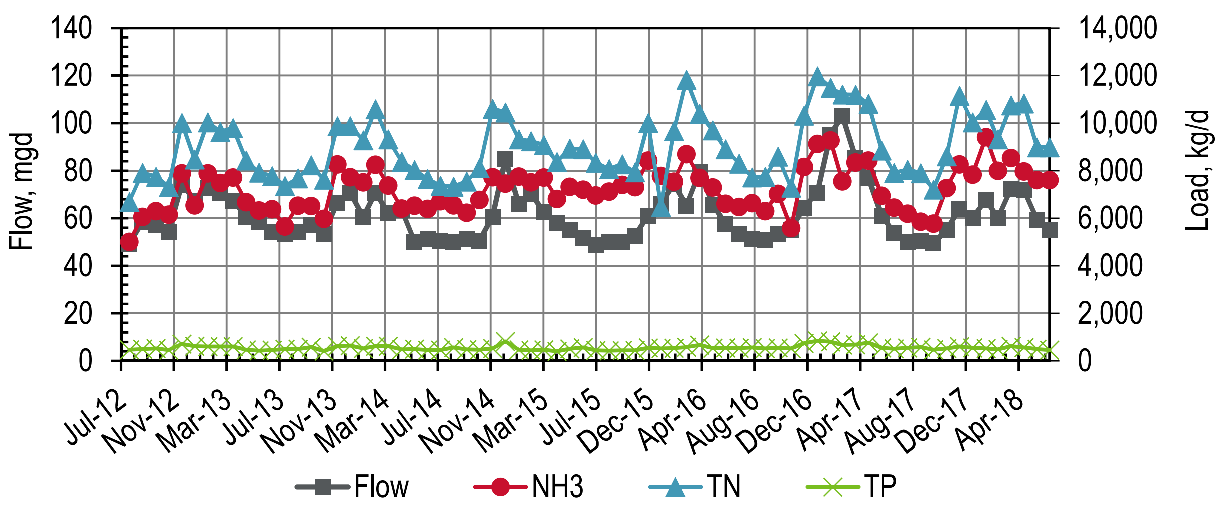

Figure 8-1. EBDA Monthly Flows and Loads

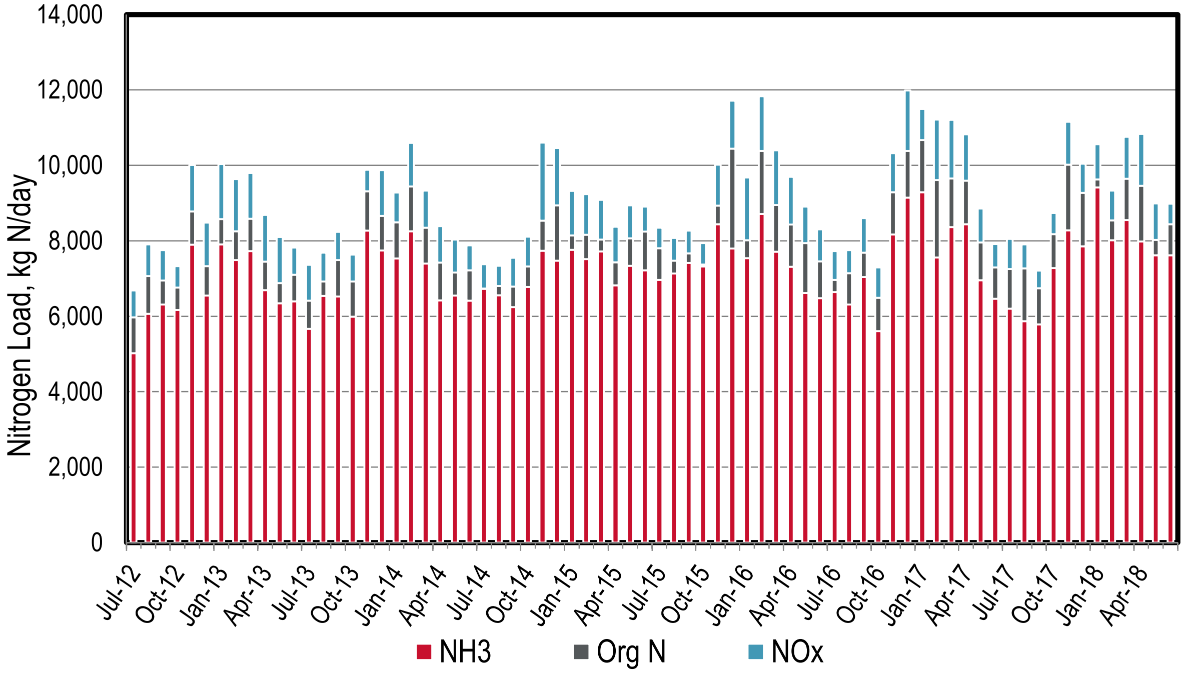

Figure 8-2. EBDA Monthly Nitrogen Loads

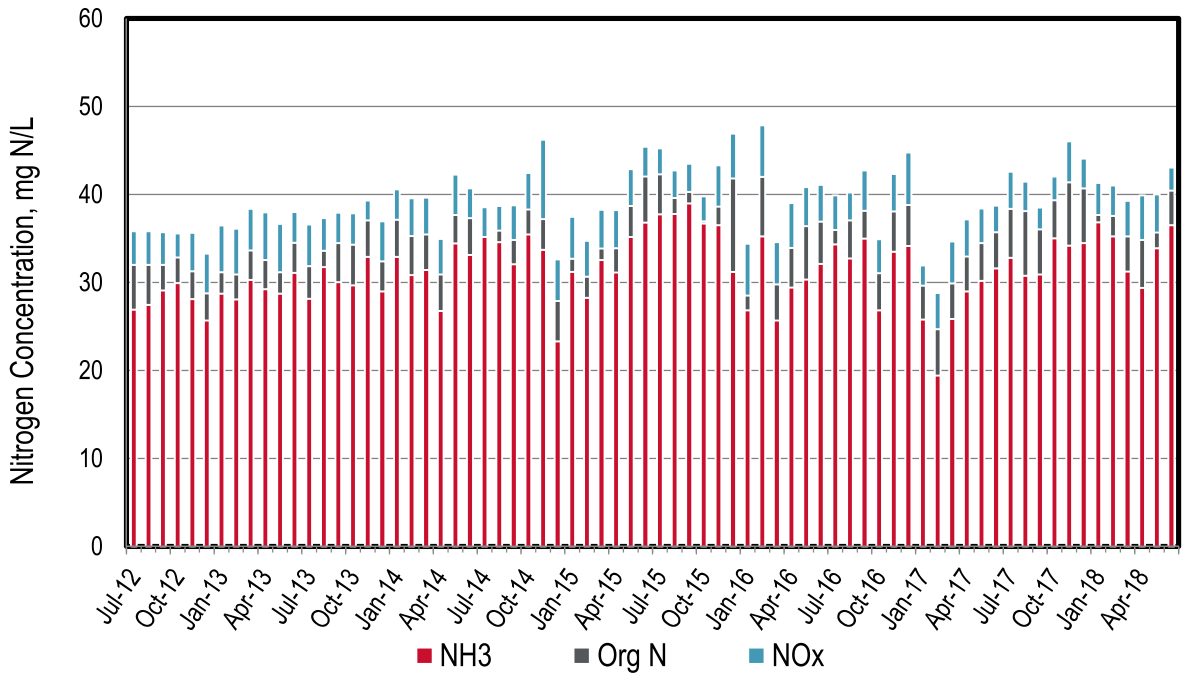

Figure 8-3. EBDA Monthly Nitrogen Concentrations

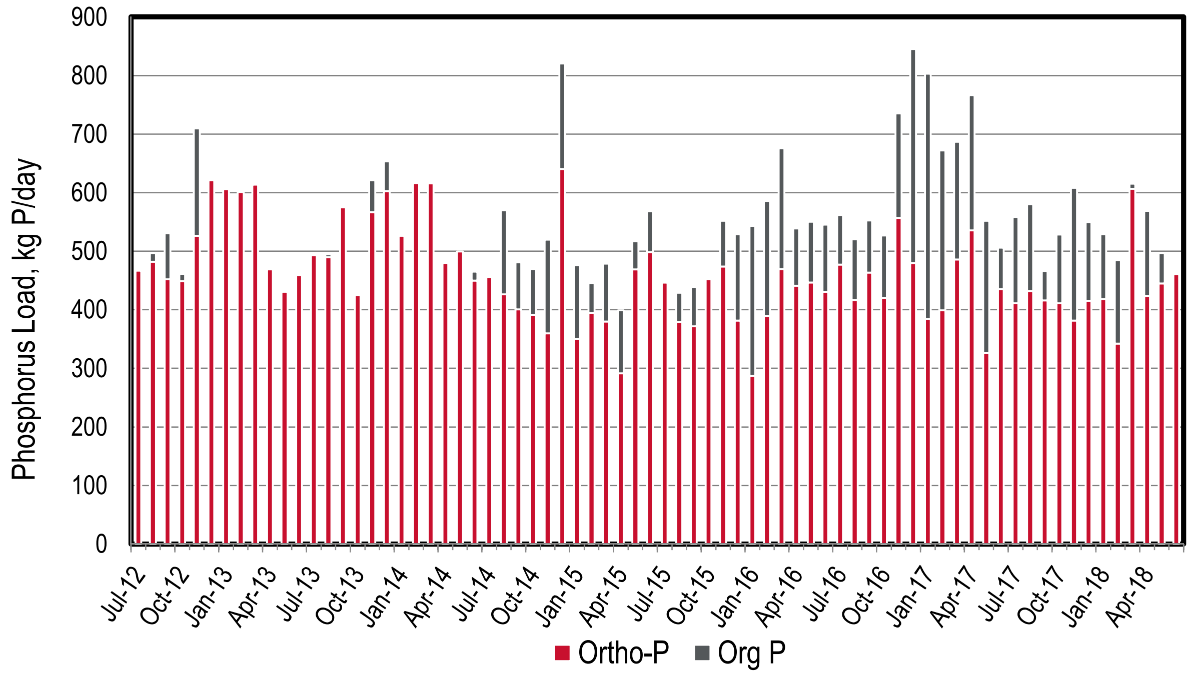

Figure 8-4. EBDA Monthly Phosphorus Loads

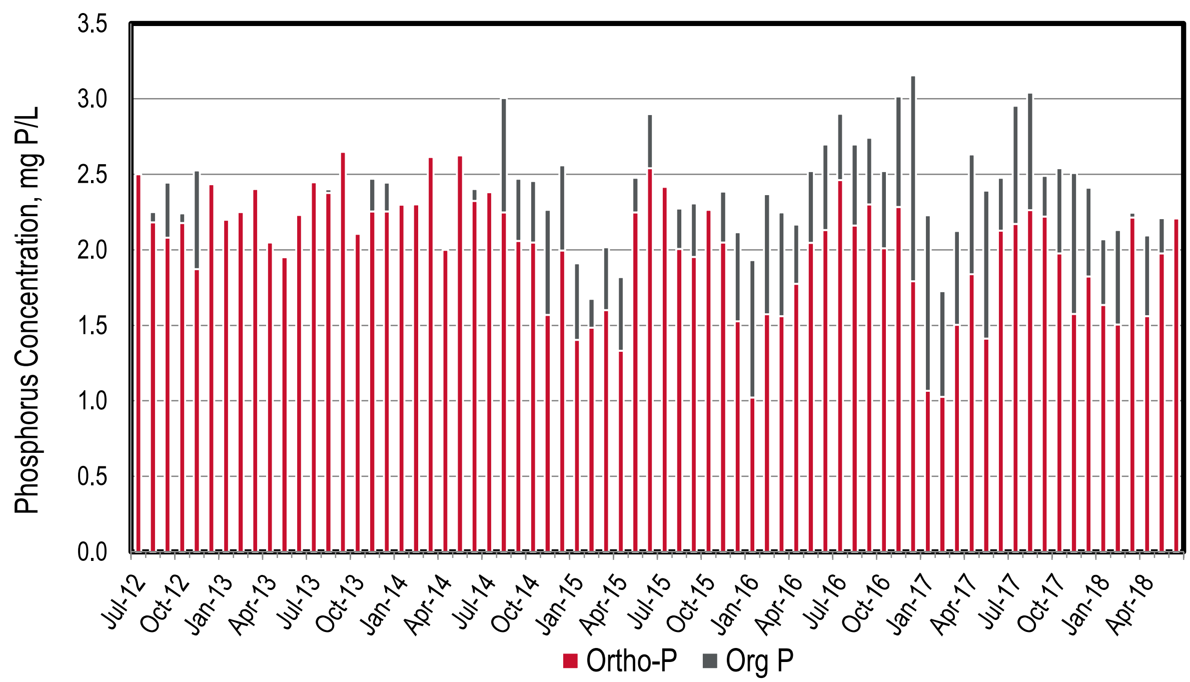

Figure 8-5. EBDA Monthly Phosphorus Concentrations

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

Table 8-1. EBDA Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jul-12	49.4	5,023	5,975	710	6,685	476	467
Aug-12	58.5	6,065	7,070	840	7,910	482	497
Sep-12	57.5	6,311	6,949	804	7,754	452	531
Oct-12	54.5	6,164	6,759	568	7,327	448	462
Nov-12	74.3	7,898	8,781	1,228	10,009	526	710
Dec-12	67.5	6,550	7,333	1,152	8,485	813	621
Jan-13	72.9	7,904	8,577	1,459	10,036	778	606
Feb-13	70.7	7,491	8,252	1,388	9,640	802	601
Mar-13	67.6	7,727	8,583	1,212	9,795	714	613
Apr-13	60.6	6,691	7,446	1,237	8,442	568	469
May-13	58.5	6,341	6,882	1,215	7,932	530	431
Jun-13	54.5	6,399	7,099	719	7,777	573	459
Jul-13	53.3	5,670	6,413	953	7,366	627	493
Aug-13	54.5	6,538	6,922	763	7,685	490	494
Sep-13	57.5	6,523	7,487	750	8,236	677	575
Oct-13	53.4	5,990	6,920	715	7,635	686	425
Nov-13	66.5	8,272	9,313	567	9,880	567	621
Dec-13	70.7	7,745	8,661	1,217	9,878	603	654
Jan-14	60.6	7,530	8,492	789	9,282	644	526
Feb-14	70.9	8,258	9,446	1,148	10,593	751	616
Mar-14	62.3	7,395	8,344	986	9,329	883	616
Apr-14	63.5	6,425	7,420	966	8,387	624	480
May-14	50.3	6,546	7,158	873	8,031	550	499
Jun-14	51.2	6,413	7,221	660	7,661	450	465
Jul-14	50.7	6,731	6,733	649	7,382	456	456
Aug-14	50.2	6,560	6,806	534	7,340	427	570
Sep-14	51.5	6,239	6,783	765	7,547	401	481
Oct-14	50.6	6,780	7,318	795	8,113	392	470
Nov-14	60.7	7,736	8,531	2,074	10,605	360	520

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Dec-14	84.9	7,472	8,939	1,519	10,458	640	821
Jan-15	65.9	7,766	8,143	1,184	9,327	350	476
Feb-15	70.4	7,520	8,158	1,083	9,241	395	446
Mar-15	62.8	7,723	8,036	1,046	9,082	380	479
Apr-15	58.0	6,824	7,427	948	8,375	292	399
May-15	55.2	7,335	8,068	874	8,942	469	517
Jun-15	51.9	7,215	8,245	667	8,911	499	569
Jul-15	48.8	6,966	7,806	540	8,346	446	448
Aug-15	50.0	7,134	7,478	594	8,072	379	429
Sep-15	50.3	7,414	7,666	609	8,275	372	439
Oct-15	52.8	7,319	7,374	564	7,938	481	452
Nov-15	61.2	8,445	8,933	1,082	10,015	474	552
Dec-15	66.1	7,795	10,441	1,271	6,491	381	529
Jan-16	74.4	7,545	8,017	1,660	9,677	287	543
Feb-16	65.4	8,708	10,381	1,451	11,831	389	586
Mar-16	79.6	7,715	8,949	1,453	10,402	469	676
Apr-16	65.8	7,313	8,434	1,264	9,699	441	539
May-16	57.7	6,619	7,938	972	8,910	446	550
Jun-16	53.5	6,482	7,456	845	8,301	431	545
Jul-16	51.2	6,646	6,966	763	7,728	477	562
Aug-16	51.0	6,307	7,145	608	7,754	417	520
Sep-16	53.3	7,043	7,685	916	8,601	463	552
Oct-16	55.3	5,605	6,493	802	7,295	420	527
Nov-16	64.5	8,167	9,287	1,037	10,324	557	736
Dec-16	70.9	9,143	10,385	1,597	11,982	480	845
Jan-17	95.3	9,288	10,674	819	11,494	384	803
Feb-17	103.0	7,561	9,614	1,601	11,216	399	672
Mar-17	85.5	8,362	9,657	1,545	11,202	486	687
Apr-17	77.1	8,443	9,596	1,224	10,820	536	767
May-17	61.0	6,958	7,954	905	8,859	326	552

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jun-17	54.1	6,460	7,297	617	7,915	435	506
Jul-17	50.0	6,202	7,254	797	8,052	411	559
Aug-17	50.5	5,867	7,266	638	7,904	432	580
Sep-17	49.6	5,788	6,747	467	7,215	416	466
Oct-17	55.0	7,276	8,175	559	8,613	411	528
Nov-17	64.1	8,276	10,023	1,131	11,153	382	608
Dec-17	60.3	7,853	9,274	767	10,041	415	550
Jan-18	67.7	9,419	9,626	937	10,563	418	529
Feb-18	60.2	8,015	8,544	785	9,329	342	485
Mar-18	72.4	8,549	9,644	1,112	10,756	607	615
Apr-18	71.9	7,983	9,457	1,372	10,830	424	569
May-18	59.5	7,622	8,021	972	8,993	445	497
Jun-18	55.2	7,619	8,438	545	8,984	493	461
Dry Season Average	**53.3**	**6,568**	**7,298**	**752**	**8,036**	**465**	**506**
Dry Season Trend **	**None**	**Up**	**Up**	**None**	**Up**	**-**	**None**
Wet Season Average	**67.6**	**7,682**	**8,663**	**1,127**	**9,657**	**510**	**582**
Average Annual	**61.6**	**7,218**	**8,094**	**971**	**8,981**	**491**	**550**

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

9 East Bay Municipal Utility District (EBMUD)

EBMUD discharges to the Central Bay. They have an ADWF permitted capacity of 120 mgd and a peak wet weather capacity of 320 mgd. It has a current ADWF flow of approximately 47 mgd. The plant performs secondary treatment using a high purity oxygen system. This plant accepts high-strength (organic) trucked wastes to its anaerobic digesters for renewable energy production. These wastes contribute to the plant discharge nutrient loads.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the average monthly values table and figures below, there appears to be a slight downward dry season trend for NOx loads.
- There appears to be an upward dry season trend for ammonia and TKN loads. However, there is no trend for total nitrogen loads due to the falling NOx loads.
- July 2012 (i.e., first nutrient sampling event) has the largest dry season flow and dry season nutrient loads for NOx, TN, ortho-P, and TP.
- Wet season loads are typically greater and more variable than the dry season loads.
- Nitrogen loads typically increase with flow during wet weather events.
- The effluent TN concentrations are relatively strong with occasional exceedence of 60 mg N/L.
- Ammonia is the majority of the nitrogen species discharged, regardless of season since EBMUD does not nitrify.
- Ortho-P is the predominant phosphorus species.

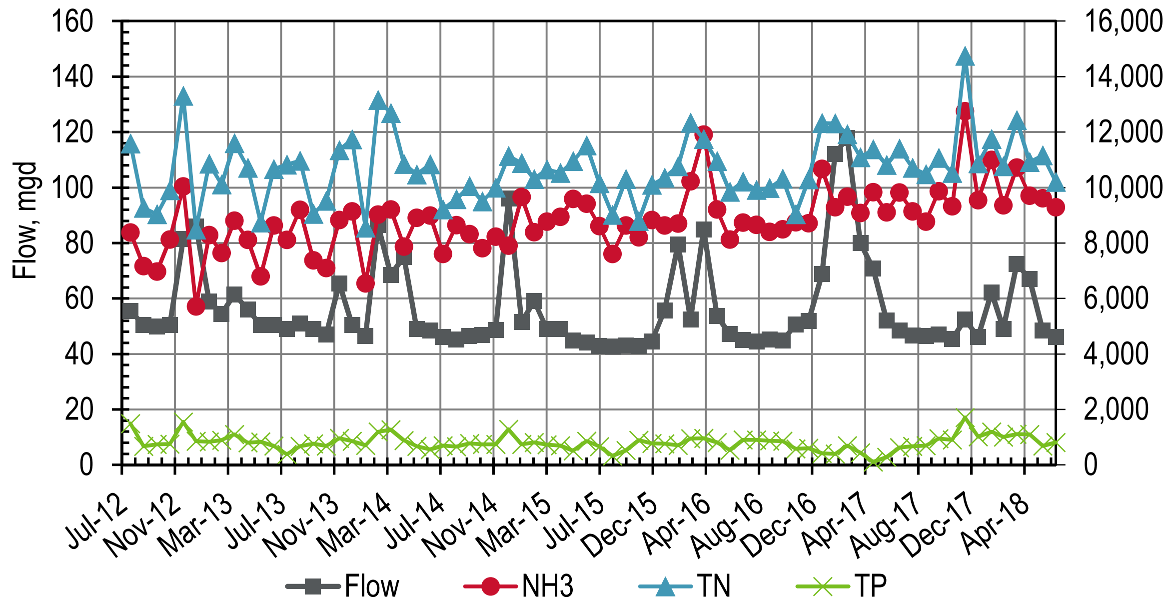

Figure 9-1. EBMUD Monthly Flows and Loads

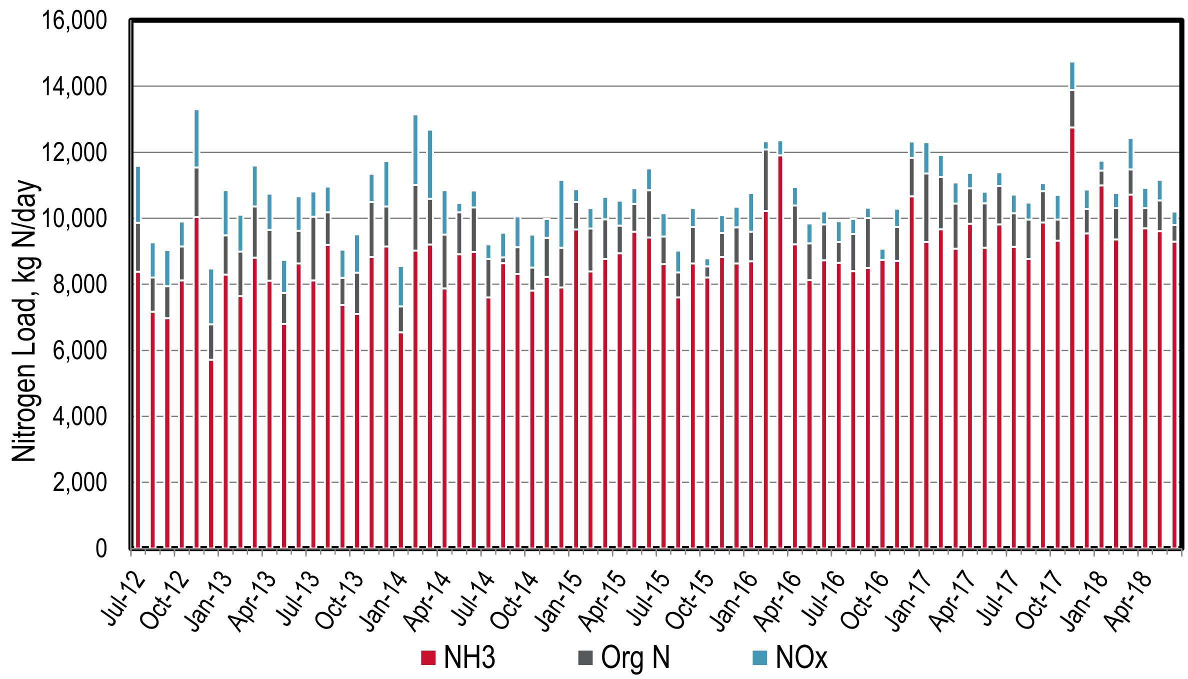

Figure 9-2. EBMUD Monthly Nitrogen Loads

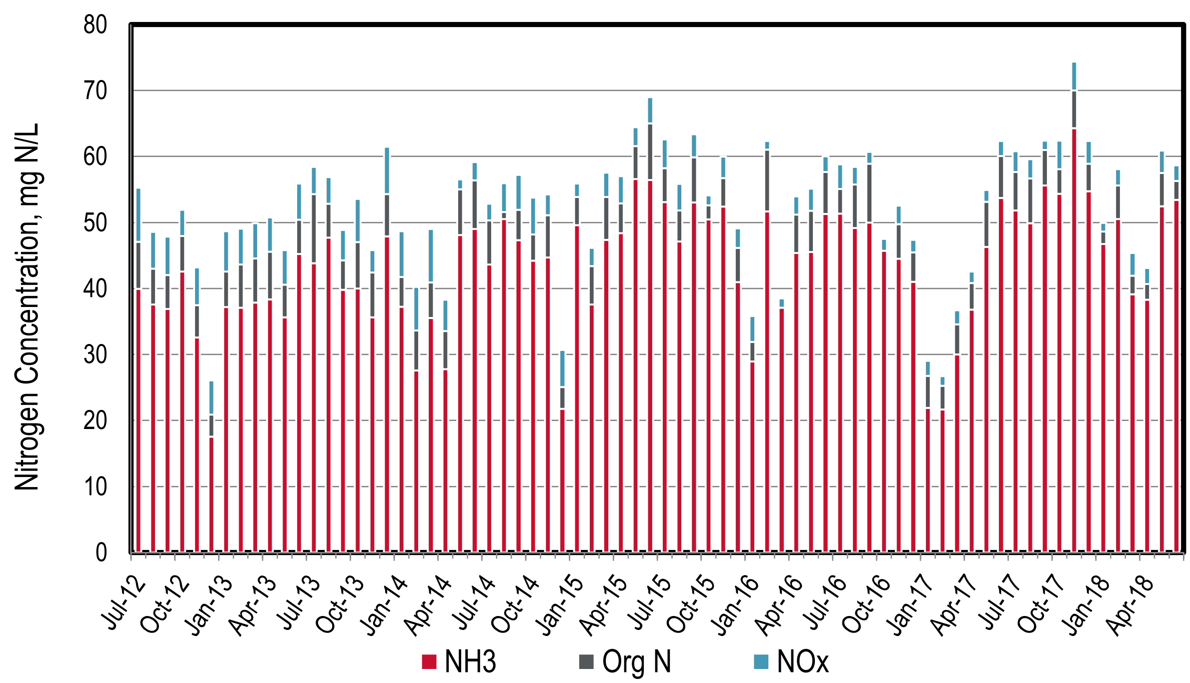

Figure 9-3. EBMUD Monthly Nitrogen Concentrations

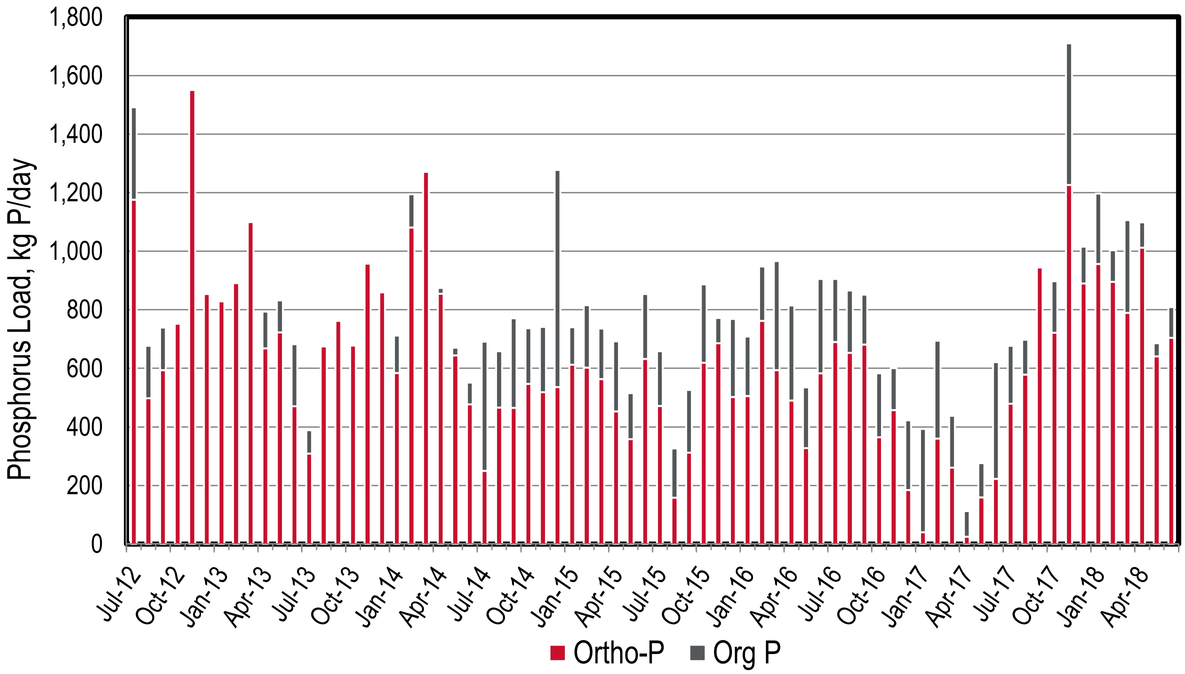

Figure 9-4. EBMUD Monthly Phosphorus Loads*** (Refer to the Table 9-1 Footnote)

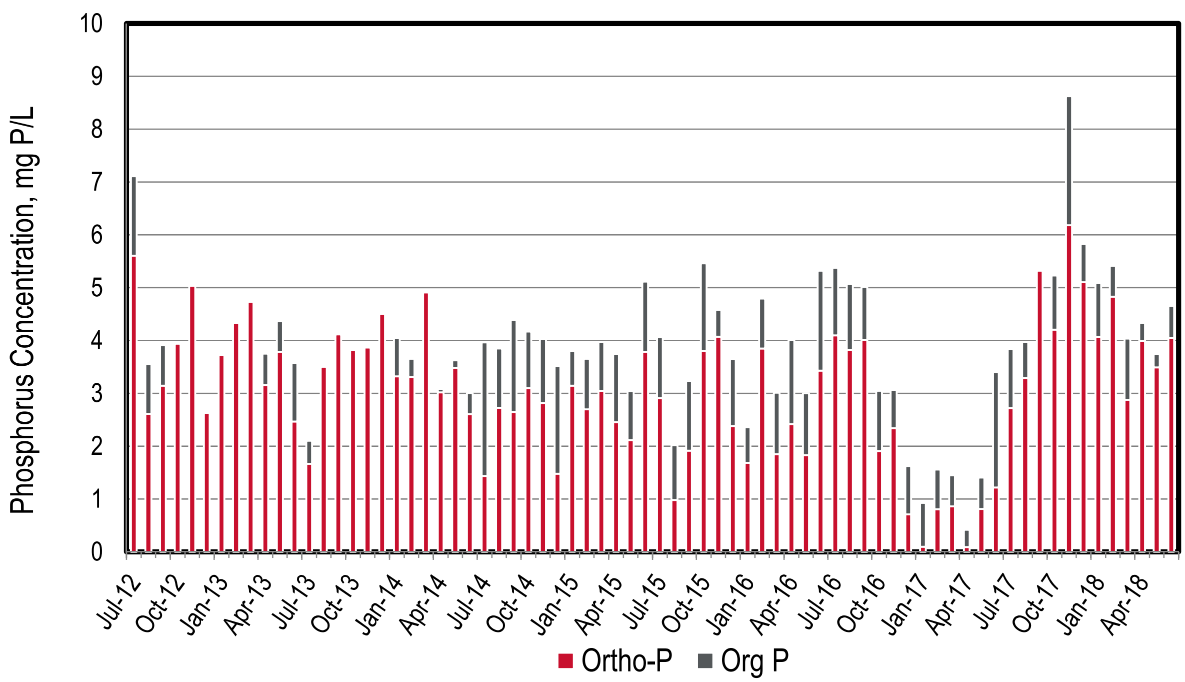

Figure 9-5. EBMUD Monthly Phosphorus Concentrations

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

Table 9-1. EBMUD Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day ***	Total P kg P/day
Jul-12	55.5	8,383	9,870	1,719	11,589	1,176	1,491
Aug-12	50.5	7,168	8,210	1,060	9,270	498	677
Sep-12	50.0	6,975	7,946	1,095	9,041	594	739
Oct-12	50.5	8,121	9,151	756	9,907	903	752
Nov-12	81.5	10,037	11,540	1,767	13,307	1,631	1,551
Dec-12	86.0	5,711	6,791	1,690	8,480	1,435	854
Jan-13	59.0	8,291	9,487	1,367	10,855	908	829
Feb-13	54.5	7,641	8,991	1,115	10,107	1,048	891
Mar-13	61.5	8,803	10,359	1,238	11,597	1,277	1,100
Apr-13	56.0	8,115	9,649	1,094	10,711	668	794
May-13	50.5	6,801	7,746	996	8,743	723	832
Jun-13	50.5	8,635	9,621	1,045	10,666	471	683
Jul-13	49.0	8,116	10,052	767	10,819	309	389
Aug-13	51.0	9,196	10,188	771	10,960	695	675
Sep-13	49.0	7,375	8,194	858	9,051	878	762
Oct-13	47.0	7,103	8,351	1,167	9,518	679	681
Nov-13	65.5	8,824	10,497	847	11,344	1,075	958
Dec-13	50.5	9,146	10,359	1,375	11,734	931	859
Jan-14	46.5	6,545	7,332	1,220	8,552	584	711
Feb-14	86.5	9,024	11,005	2,150	13,155	1,081	1,195
Mar-14	68.5	9,205	10,595	2,090	12,685	1,458	1,271
Apr-14	75.0	7,876	9,510	1,341	10,850	854	874
May-14	49.0	8,910	10,190	277	10,467	645	671
Jun-14	48.5	8,986	10,333	509	10,842	477	551
Jul-14	46.1	7,605	8,771	444	9,215	251	691
Aug-14	45.2	8,639	8,818	749	9,575	466	658
Sep-14	46.5	8,316	9,128	927	10,055	466	771
Oct-14	46.7	7,810	8,511	992	9,502	547	737

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day ***	Total P kg P/day
Nov-14	48.7	8,227	9,408	574	9,992	519	742
Dec-14	96.2	7,907	9,104	2,061	11,140	537	1,278
Jan-15	51.5	9,659	10,491	392	10,883	613	740
Feb-15	59.1	8,392	9,687	623	10,310	603	816
Mar-15	49.0	8,770	9,968	679	10,656	564	736
Apr-15	48.9	8,941	9,774	765	10,530	453	693
May-15	44.8	9,591	10,437	479	10,956	358	516
Jun-15	44.2	9,419	10,853	664	11,516	633	854
Jul-15	42.9	8,616	9,446	708	10,154	472	658
Aug-15	42.7	7,605	8,365	652	9,017	158	326
Sep-15	43.1	8,633	9,742	570	10,312	312	526
Oct-15	43.0	8,204	8,546	247	8,793	619	887
Nov-15	44.6	8,824	9,555	543	10,098	686	772
Dec-15	55.8	8,634	9,726	624	10,350	502	769
Jan-16	79.5	8,702	9,591	1,174	10,765	506	709
Feb-16	52.4	10,227	12,083	259	12,342	762	948
Mar-16	85.0	11,907	11,330	457	11,750	594	966
Apr-16	53.7	9,214	10,392	557	10,949	491	814
May-16	47.3	8,131	9,248	595	9,843	327	535
Jun-16	45.0	8,733	9,812	400	10,213	583	905
Jul-16	44.6	8,653	9,282	629	9,911	690	906
Aug-16	45.2	8,399	9,527	458	9,985	653	866
Sep-16	45.0	8,496	10,007	309	10,316	681	852
Oct-16	50.6	8,744	8,693	340	9,032	365	583
Nov-16	51.8	8,716	9,737	554	10,291	458	600
Dec-16	68.8	10,670	11,834	494	12,328	185	422
Jan-17	112.2	9,285	11,356	953	12,310	41	393
Feb-17	118.0	9,672	11,255	669	11,924	360	695
Mar-17	80.0	9,081	10,450	640	11,089	260	438
Apr-17	70.7	9,837	10,914	463	11,377	25	112

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day ***	Total P kg P/day
May-17	52.1	9,110	10,452	357	10,810	160	277
Jun-17	48.4	9,821	10,977	423	11,400	223	622
Jul-17	46.6	9,135	10,160	555	10,714	479	677
Aug-17	46.5	8,768	9,964	511	10,475	578	698
Sep-17	47.0	9,873	10,829	243	11,072	966	945
Oct-17	45.4	9,322	9,962	742	10,528	721	898
Nov-17	52.5	12,751	13,884	867	14,751	1,226	1,710
Dec-17	46.2	9,546	10,280	593	10,874	890	1,015
Jan-18	62.3	11,002	11,443	303	11,746	956	1,197
Feb-18	49.0	9,365	10,310	458	10,768	895	1,003
Mar-18	72.5	10,718	11,486	945	12,431	789	1,106
Apr-18	67.1	9,704	10,314	606	10,920	1,013	1,098
May-18	48.5	9,618	10,541	622	11,163	640	686
Jun-18	46.0	9,292	9,795	409	10,204	704	809
Dry Season Monthly Ave. for all Years	**47.4**	**8,567**	**9,617**	**660**	**10,278**	**542**	**708**
Dry Season Monthly Ave for All Years Trend **	**Down**	**Up**	**Up**	**Down**	**None**	**-**	**None**
Wet Season Monthly Ave. for all Years	**63.1**	**9,007**	**10,088**	**900**	**10,982**	**731**	**862**
Ave. Annual for All Years	**56.5**	**8,823**	**9,892**	**800**	**10,689**	**652**	**798**

- * The Total Nitrogen value is calculated by adding the TKN and the NOx values.
- ** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.
- *** The mass loading for ortho-P was calculated by using the peak flow during the day when a grab sample was taken under the Section 13267 Letter data (July 2012 through June 2014). The sampling protocol changed under the Nutrient Watershed Permit (July 2014 through June 2016) where the flowrate that occurred during the grab sample was used for calculating the load. There was also a change in field filtering for ortho-P samples when EBMUD transitioned from the 13267 study to the Nutrients Permit study. The ortho-P samples were filtered in the lab outside of the 15-minute time required for filtration during 2012-2014 (Section 13267 Letter Data), but in the field within 15 minutes of collection during 2014-2016 (Watershed Permit).
- Numbers in this table are slightly different compared to those reported in the CIWQS, due to rounding of conversion factors used.

10 Fairfield-Suisun Sewer District (FSSD)

FSSD discharges to waterways in the Suisun Marsh that flow more than 13 miles before reaching Suisun Bay. FSSD serves approximately 40,300 service connections. The plant has a permitted ADWF capacity of 23.7 mgd and a peak wet weather capacity of 52.9 mgd. The current ADWF flow is approximately 11 mgd. The plant fully nitrifies and partially denitrifies using a combination of trickling filters and activated sludge.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the table with the average monthly values, there appears to be an emerging dry season downward trend for NOx loads.
- Nitrogen loads typically increase with flow during wet weather events, whereas the phosphorus loads are relatively flat year round.
- Nitrogen wet season loads are typically greater and more variable than the dry season loads (with the exception of TN spikes in September 2013, May 2017, June 2017, and May 2018).
- NOx is the majority of the nitrogen species discharged, regardless of season. This would be expected since this plant reliably nitrifies year round.
- Ortho-P values are routinely greater than TP values. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations are wide ranging from approximately 1.5 to 6 mg P/L. Typical effluent TP concentrations are 3 to 6 mg P/L

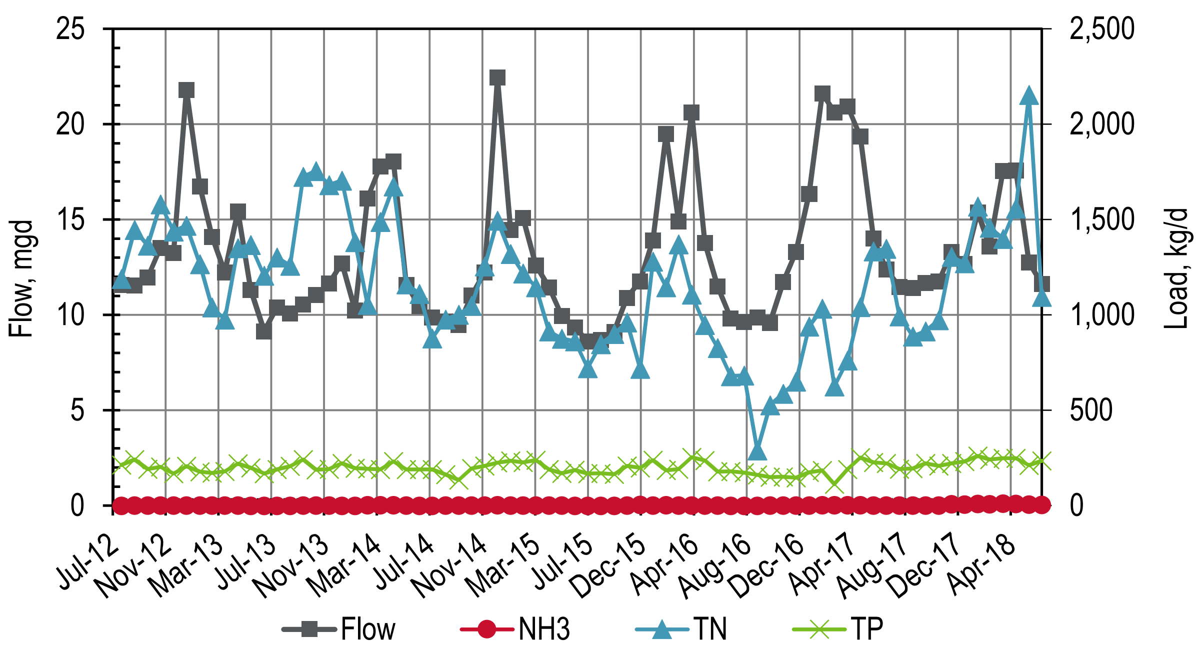

Figure 10-1. Fairfield-Suisun Sewer District Monthly Flows and Loads

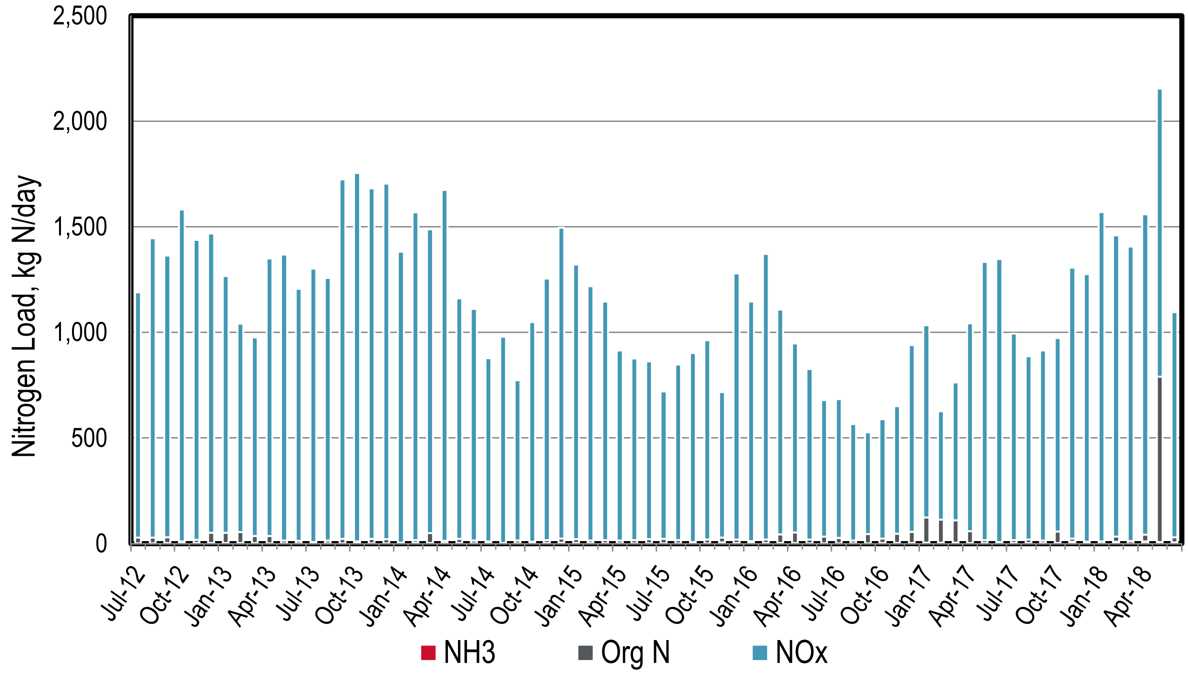

Figure 10-2. Fairfield-Suisun Sewer District Monthly Nitrogen Loads

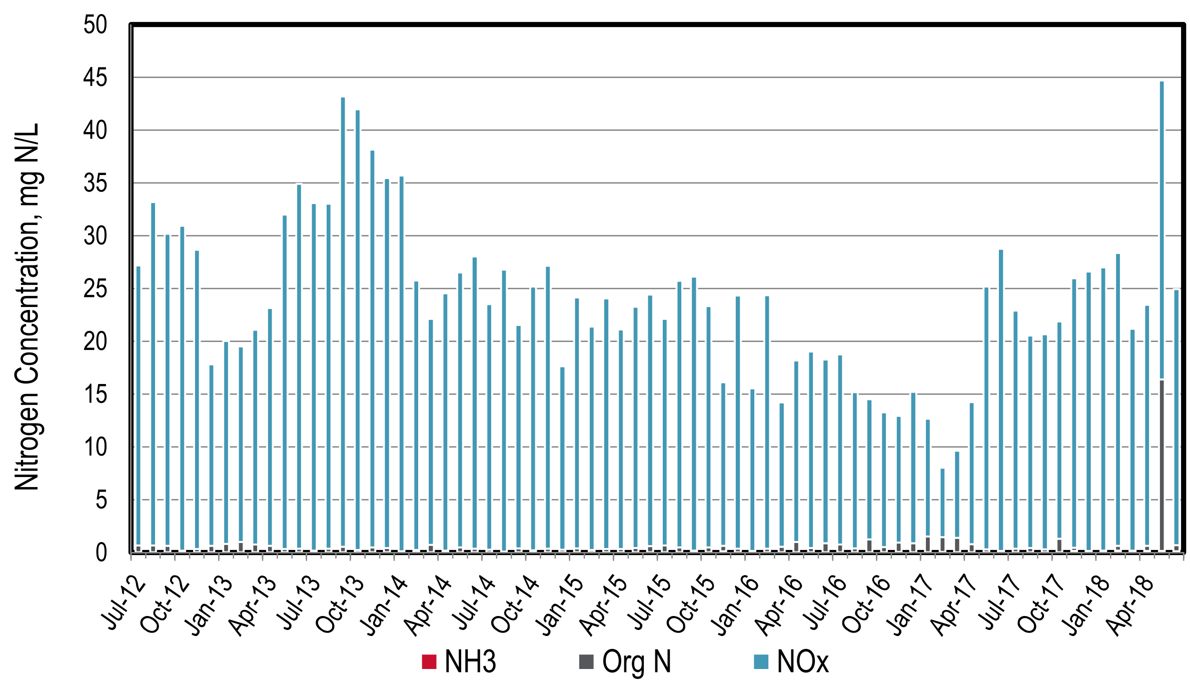

Figure 10-3. Fairfield-Suisun Sewer District Monthly Nitrogen Concentrations

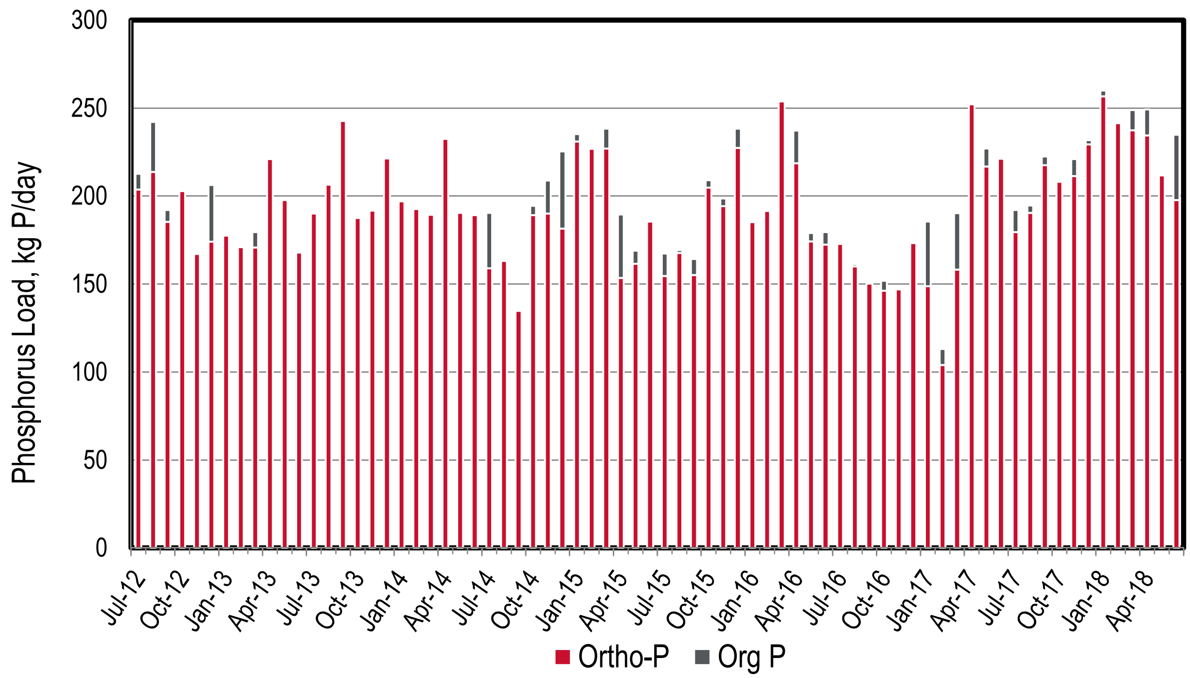

Figure 10-4. Fairfield-Suisun Sewer District Monthly Phosphorus Loads

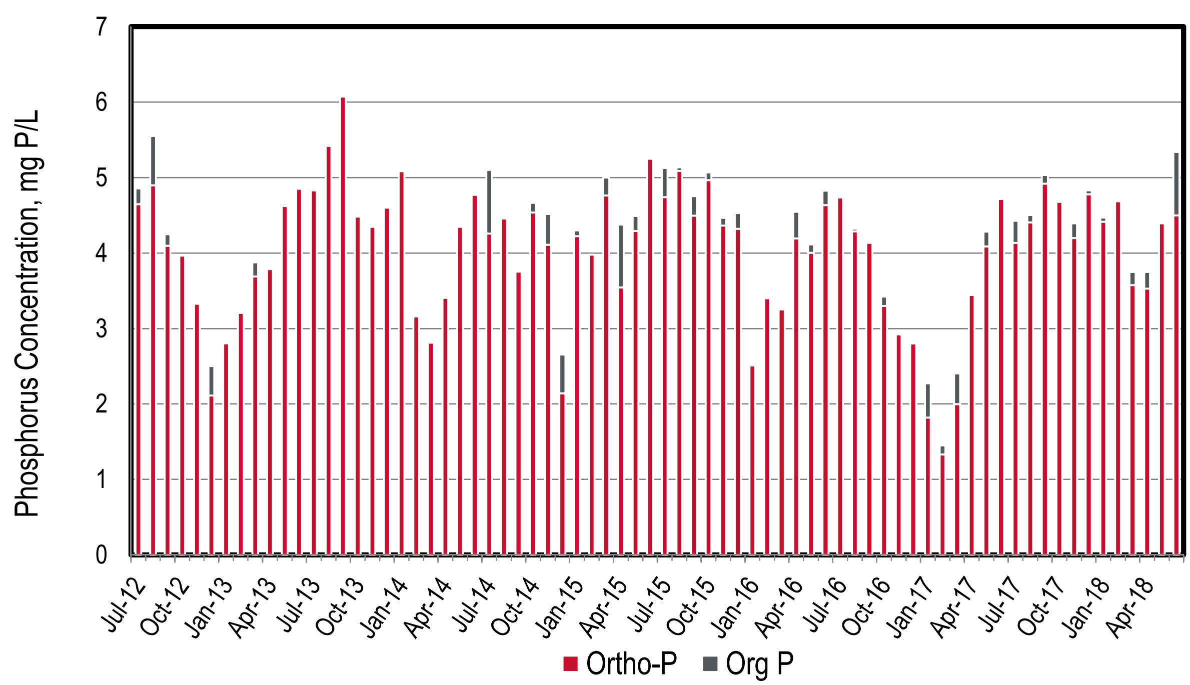

Figure 10-5. Fairfield-Suisun Sewer District Monthly Phosphorus Concentrations

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

Table 10-1. Fairfield-Suisun Sewer District Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jul-12	11.6	1	29	1,162	1,190	204	213
Aug-12	11.5	1	28	1,418	1,447	214	242
Sep-12	12.0	2	29	1,336	1,365	185	192
Oct-12	13.5	1	10	1,572	1,582	213	203
Nov-12	13.3	2	17	1,422	1,439	167	168
Dec-12	21.8	3	51	1,417	1,468	174	206
Jan-13	16.7	2	51	1,216	1,267	179	177
Feb-13	14.1	2	53	987	1,041	192	171
Mar-13	12.2	2	35	941	977	171	179
Apr-13	15.4	1	36	1,314	1,350	356	221
May-13	11.3	1	15	1,354	1,368	315	198
Jun-13	9.1	1	12	1,194	1,206	313	168
Jul-13	10.4	1	7	1,296	1,302	349	190
Aug-13	10.1	1	14	1,245	1,259	340	206
Sep-13	10.6	1	22	1,703	1,724	366	243
Oct-13	11.1	1	10	1,745	1,755	355	187
Nov-13	11.7	1	22	1,661	1,682	309	192
Dec-13	12.7	1	21	1,684	1,705	318	221
Jan-14	10.3	1	5	1,378	1,383	323	197
Feb-14	16.1	4	15	1,554	1,053	292	193
Mar-14	17.8	3	50	1,439	1,489	307	189
Apr-14	18.1	3	12	1,662	1,675	275	232
May-14	11.6	2	21	1,139	1,161	292	191
Jun-14	10.5	1	14	1,097	1,111	325	189
Jul-14	9.9	1	10	868	878	159	190
Aug-14	9.7	1	3	977	977	168	163
Sep-14	9.5	1	14	759	1,002	142	135

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Oct-14	11.0	2	8	1,041	1,050	189	195
Nov-14	12.2	2	16	1,239	1,255	190	209
Dec-14	22.4	3	24	1,472	1,496	182	225
Jan-15	14.5	2	21	1,300	1,321	231	235
Feb-15	15.1	2	14	1,205	1,219	235	227
Mar-15	12.6	1	16	1,131	1,147	227	238
Apr-15	11.5	1	14	901	915	154	190
May-15	10.0	1	16	860	876	162	169
Jun-15	9.3	1	21	842	863	186	187
Jul-15	8.6	1	22	699	721	155	167
Aug-15	8.7	1	16	831	848	168	169
Sep-15	9.1	1	7	895	902	155	164
Oct-15	10.9	1	20	943	962	205	209
Nov-15	11.8	5	28	690	718	194	199
Dec-15	13.9	2	19	1,261	1,280	227	238
Jan-16	19.5	3	12	1,134	1,146	188	185
Feb-16	14.9	2	20	1,351	1,371	191	191
Mar-16	20.6	2	43	1,065	1,108	276	254
Apr-16	13.8	2	52	896	948	219	237
May-16	11.5	1	19	809	827	174	179
Jun-16	9.8	1	33	646	679	172	180
Jul-16	9.6	1	27	657	684	173	173
Aug-16	9.9	1	15	552	291	160	161
Sep-16	9.6	1	45	482	527	158	150
Oct-16	11.7	2	23	565	588	146	152
Nov-16	13.3	3	47	604	651	152	147
Dec-16	16.4	2	55	885	940	173	174
Jan-17	21.6	3	123	910	1,033	149	186
Feb-17	20.6	4	112	514	627	104	113
Mar-17	20.9	3	110	653	762	158	190

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Apr-17	19.4	3	58	984	1,043	401	252
May-17	14.0	2	17	1,318	1,335	217	227
Jun-17	12.4	2	7	1,341	1,348	221	221
Jul-17	11.5	2	16	979	994	179	192
Aug-17	11.4	2	19	868	887	190	195
Sep-17	11.7	2	14	900	914	218	223
Oct-17	11.8	2	57	916	973	214	208
Nov-17	13.3	8	23	1,283	1,306	211	221
Dec-17	12.7	8	5	1,268	1,273	229	232
Jan-18	15.4	10	8	1,561	1,569	257	260
Feb-18	13.6	9	32	1,427	1,459	244	241
Mar-18	17.6	12	6	1,394	1,400	237	249
Apr-18	17.6	10	42	1,517	1,559	235	249
May-18	12.8	7	790	1,366	2,155	214	212
Jun-18	11.6	6	30	1,065	1,096	198	235
Dry Season Average	**10.6**	**2**	**44**	**1,022**	**1,065**	**216**	**191**
Dry Season Trend **	**None**	*******	**None**	**Down**	**None**	**-**	**None**
Wet Season Average	**15.1**	**3**	**33**	**1,193**	**1,214**	**225**	**206**
Average Annual	**13.3**	**3**	**38**	**1,122**	**1,152**	**221**	**200**

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

*** Ammonia was not considered in the trending as the plant reliably nitrifies and the majority of samples are non-detects

11 Las Gallinas Valley Sanitary District

Las Gallinas discharges to Miller Creek that is connected to San Pablo Bay. The plant has approximately 15,800 service connections; it has a permitted capacity of 2.92 mgd ADWF and a peak wet weather secondary treatment capacity of 8.0 mgd. The plant performs secondary treatment using two rock trickling filters and nitrification using a third trickling filter equipped with plastic media. Discharge to Miller Creek is prohibited June 1 through October 31.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the average monthly values table, there are no emerging dry season trends as Las Gallinas does not typically discharge during the dry season.
- Wet season trends analyzed (statistical data not shown) and there is an emerging upward trend for ammonia and TKN loads. This trend is likely attributed to the 2016 winter that had relatively high levels of precipitation. However, TN loads are relatively consistent over the years shown.
- NOx is the majority of the nitrogen species discharged as would be expected since this plant nitrifies. A portion of ammonia bleeds through during the colder months. This increases the ammonia contribution during such months.
- Ortho-P values are routinely greater than TP values. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations range from 0.5 to 5.3 mg P/L, This suggests occasional P removal as typical effluent TP concentrations are 4 to 6 mg P/L.

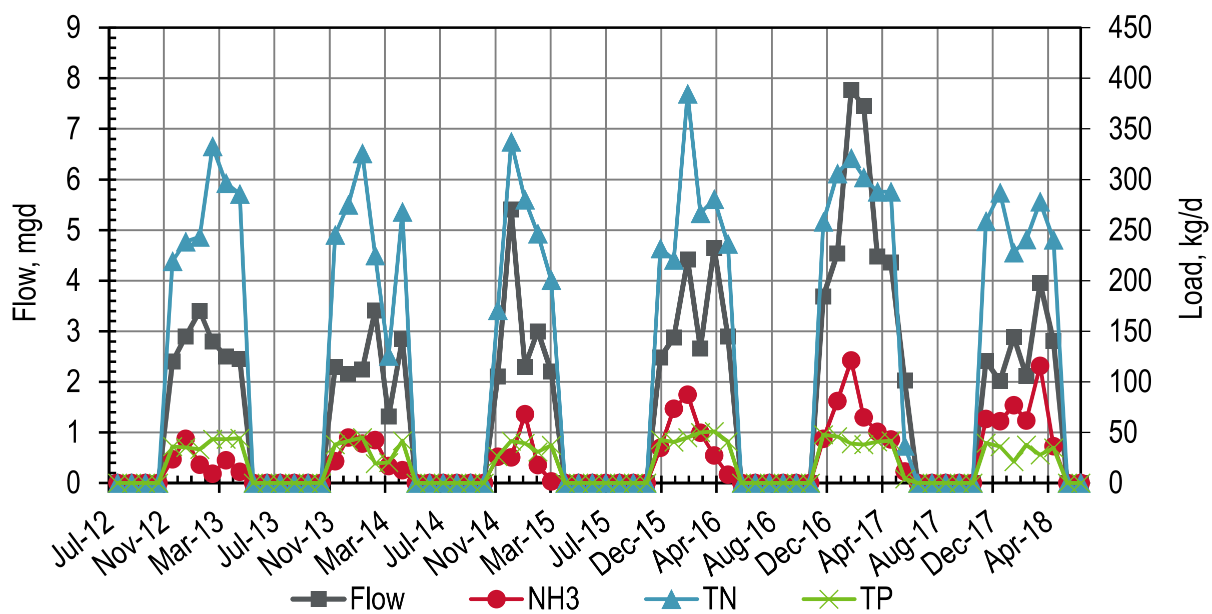

Figure 11-1. Las Gallinas Monthly Flows and Loads

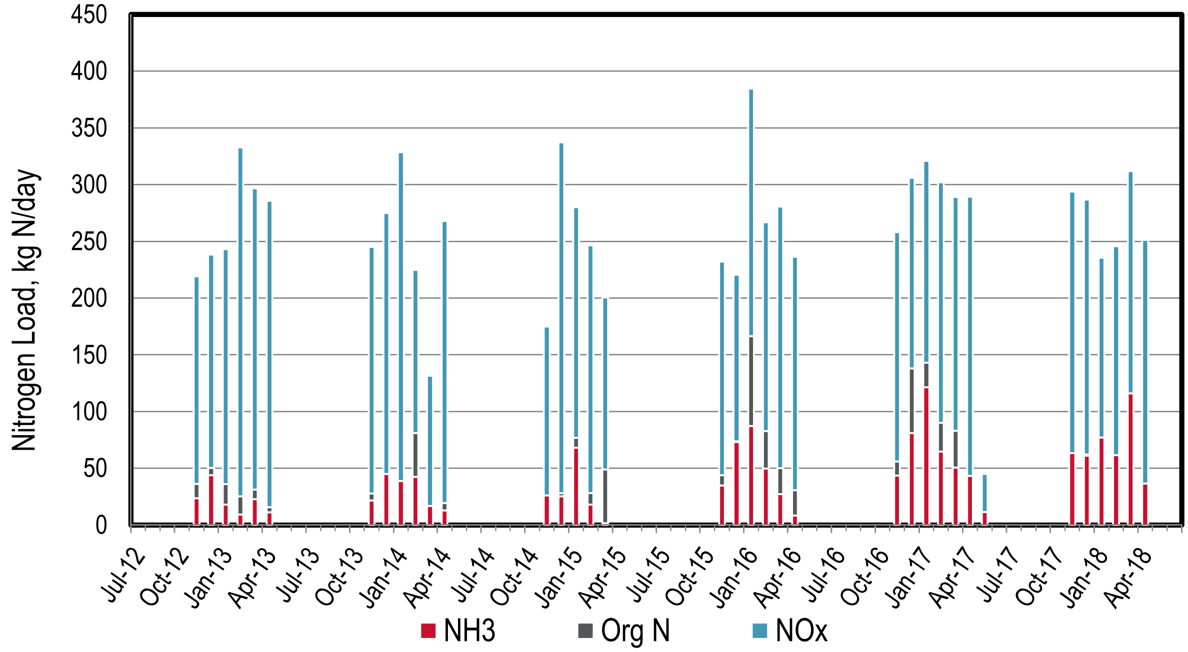

Figure 11-2. Las Gallinas Monthly Nitrogen Loads

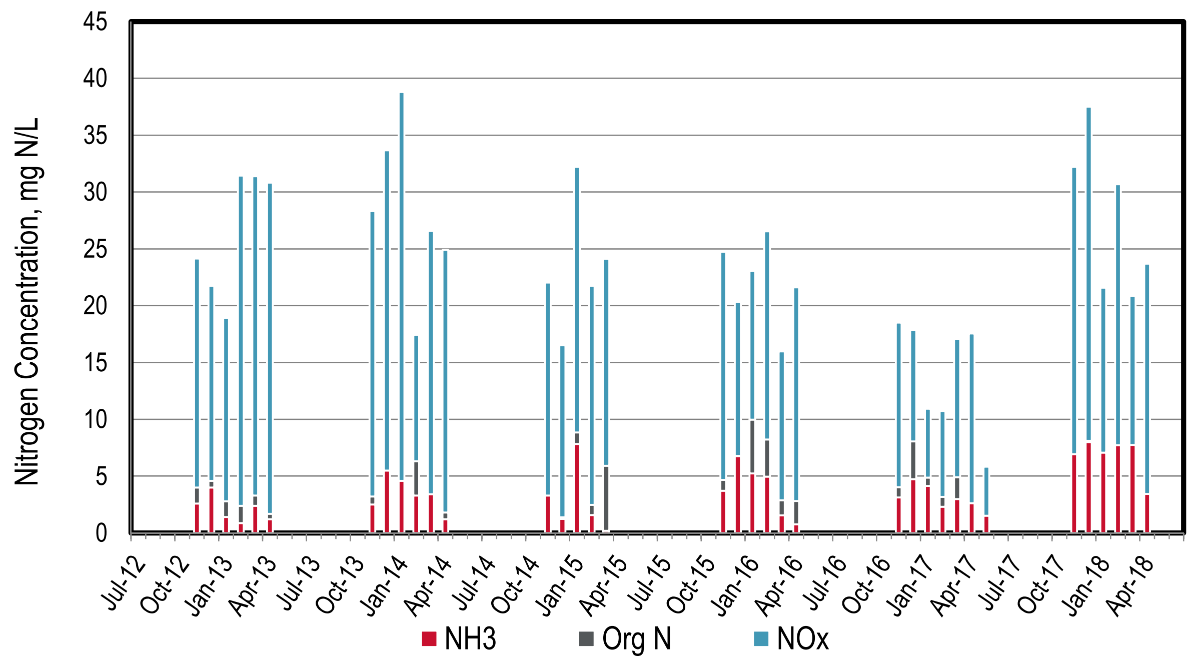

Figure 11-3. Las Gallinas Monthly Nitrogen Concentrations

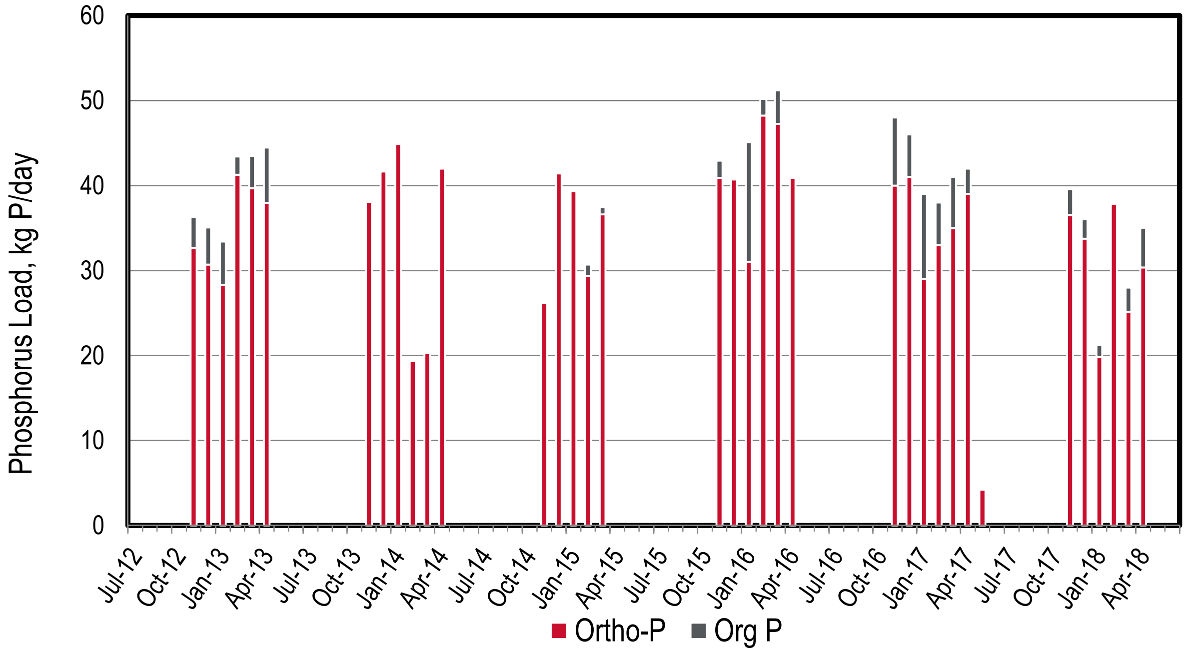

Figure 11-4. Las Gallinas Monthly Phosphorus Loads

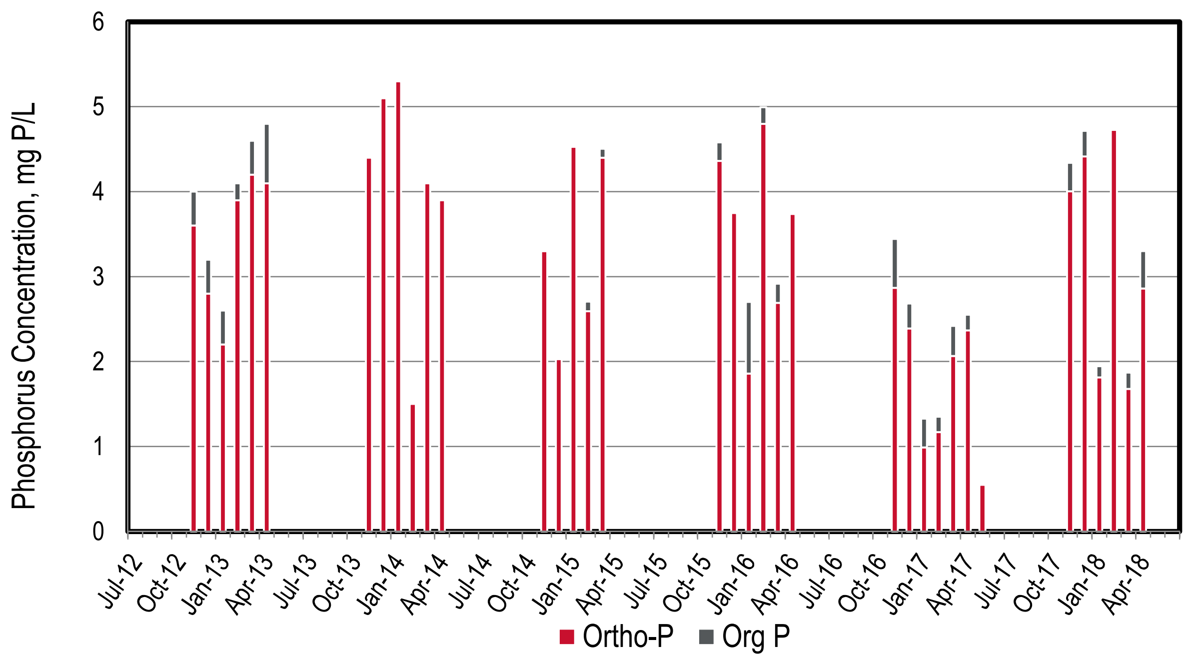

Figure 11-5. Las Gallinas Monthly Phosphorus Concentrations

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

Table 11-1. Las Gallinas Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jul-12	0.0	0	0	0	0	0	0
Aug-12	0.0	0	0	0	0	0	0
Sep-12	0.0	0	0	0	0	0	0
Oct-12	0.0	0	0	0	0	0	0
Nov-12	2.4	24	36	183	219	33	36
Dec-12	2.9	44	50	188	238	31	35
Jan-13	3.4	18	36	207	243	28	33
Feb-13	2.8	9	25	307	333	41	43
Mar-13	2.5	23	31	265	296	40	43
Apr-13	2.5	11	16	270	286	38	44
May-13	0.0	0	0	0	0	0	0
Jun-13	0.0	0	0	0	0	0	0
Jul-13	0.0	0	0	0	0	0	0
Aug-13	0.0	0	0	0	0	0	0
Sep-13	0.0	0	0	0	0	0	0
Oct-13	0.0	0	0	0	0	0	0
Nov-13	2.3	22	28	217	245	57	38
Dec-13	2.2	45	45	230	275	52	42
Jan-14	2.2	39	36	289	326	71	45
Feb-14	3.4	43	81	144	225	27	19
Mar-14	1.3	17	11	115	126	49	20
Apr-14	2.8	13	19	249	268	62	42
May-14	0.0	0	0	0	0	0	0
Jun-14	0.0	0	0	0	0	0	0
Jul-14	0.0	0	0	0	0	0	0
Aug-14	0.0	0	0	0	0	0	0
Sep-14	0.0	0	0	0	0	0	0
Oct-14	0.0	0	0	0	0	0	0
Nov-14	2.1	26	22	149	171	26	26

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Dec-14	5.4	25	28	309	337	43	41
Jan-15	2.3	68	77	203	280	40	39
Feb-15	3.0	18	28	218	247	29	31
Mar-15	2.2	2	49	152	201	37	37
Apr-15	0.0	0	0	0	0	0	0
May-15	0.0	0	0	0	0	0	0
Jun-15	0.0	0	0	0	0	0	0
Jul-15	0.0	0	0	0	0	0	0
Aug-15	0.0	0	0	0	0	0	0
Sep-15	0.0	0	0	0	0	0	0
Oct-15	0.0	0	0	0	0	0	0
Nov-15	2.5	35	44	188	232	41	43
Dec-15	2.9	73	74	147	220	42	41
Jan-16	4.4	87	167	218	385	31	45
Feb-16	2.7	50	83	184	267	48	50
Mar-16	4.6	27	50	230	280	47	51
Apr-16	2.9	8	31	206	236	41	41
May-16	0.0	0	0	0	0	0	0
Jun-16	0.0	0	0	0	0	0	0
Jul-16	0.0	0	0	0	0	0	0
Aug-16	0.0	0	0	0	0	0	0
Sep-16	0.0	0	0	0	0	0	0
Oct-16	0.0	0	0	0	0	0	0
Nov-16	3.7	44	56	202	258	40	48
Dec-16	4.5	81	138	168	306	41	46
Jan-17	7.8	121	143	178	321	29	39
Feb-17	7.5	65	90	212	302	33	38
Mar-17	4.5	51	83	206	288	35	41
Apr-17	4.4	43	42	246	288	39	42
May-17	2.0	12	3	33	37	4	4

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jun-17	0.0	0	0	0	0	0	0
Jul-17	0.0	0	0	0	0	0	0
Aug-17	0.0	0	0	0	0	0	0
Sep-17	0.0	0	0	0	0	0	0
Oct-17	0.0	0	0	0	0	0	0
Nov-17	2.4	63	28	231	259	37	40
Dec-17	2.0	61	62	225	287	34	36
Jan-18	2.9	77	69	159	228	20	21
Feb-18	2.1	62	57	184	241	39	38
Mar-18	4.0	116	82	196	278	25	28
Apr-18	2.8	36	26	215	240	30	35
May-18	0.0	0	0	0	0	0	0
Jun-18	0.0	0	0	0	0	0	0
Dry Season Average **	**0.1**	**0**	**0**	**1**	**1**	**0**	**0**
Dry Season Trend ***	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Wet Season Average	**2.7**	**37**	**46**	**174**	**220**	**32**	**32**
Average Annual	**1.6**	**22**	**27**	**102**	**129**	**19**	**19**

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** The dry season average is so much lower than the wet season due to only having one month with a dry season discharge (May 2017).

*** No dry season trending analysis was performed on Las Gallinas as there is only a single month of dry season discharge (May 2017) since sampling began in July 2012.

12 City of Millbrae

Millbrae discharges to the South Bay. The plant has approximately 6,500 service connections and it has a permitted capacity of 3.0 mgd ADWF. The current average plant flows are 1.3 mgd ADWF. The plant performs secondary treatment using an activated sludge process.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the table with the average monthly values, there appears to be an emerging dry season downward trend for phosphorus loads. This is likely attributed to improved solids residence time control since plant upgrades in 2012.
- Based on the table with the average monthly values, there appears to be an emerging dry season upward trend for ammonia, TKN, and total nitrogen loads.
- Both nitrogen and phosphorus loads typically increase with flow during wet weather events. However, the loads typically stay elevated after the flows decline back to typical values.
- Ammonia is the majority of the nitrogen species discharged, regardless of season. This would be expected since this plant does not nitrify.
- Ortho-P values are occasionally greater than TP values for the Section 13267 Letter data (pre-July 2014) based on the composite sampling issue and use of dissolved reactive phosphorus as discussed in the main report body. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table. Since the Regional Watershed Permit sampling began (July, 2014), the ortho-P values has not exceeded the TP value.
- Total phosphorus concentrations range from 0.5 to 4.7 mg P/L, This suggests occasional P removal as typical effluent TP concentrations are 4 to 6 mg P/L. The removal mechanism is thought to be the anaerobic selector in the activated sludge process.

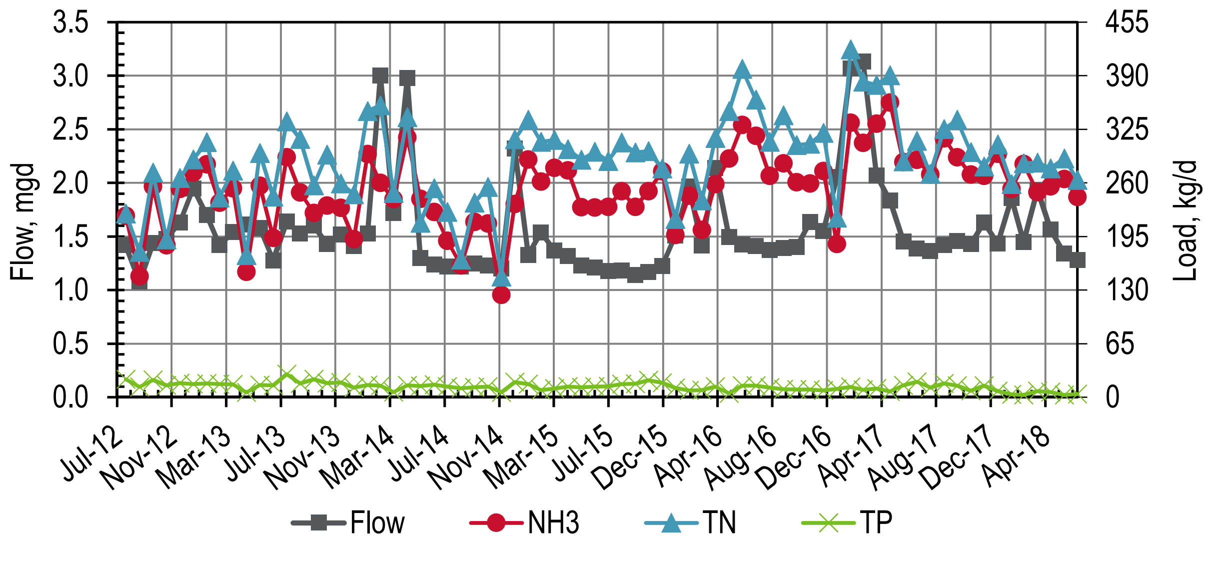

Figure 12-1. Millbrae Monthly Flows and Loads

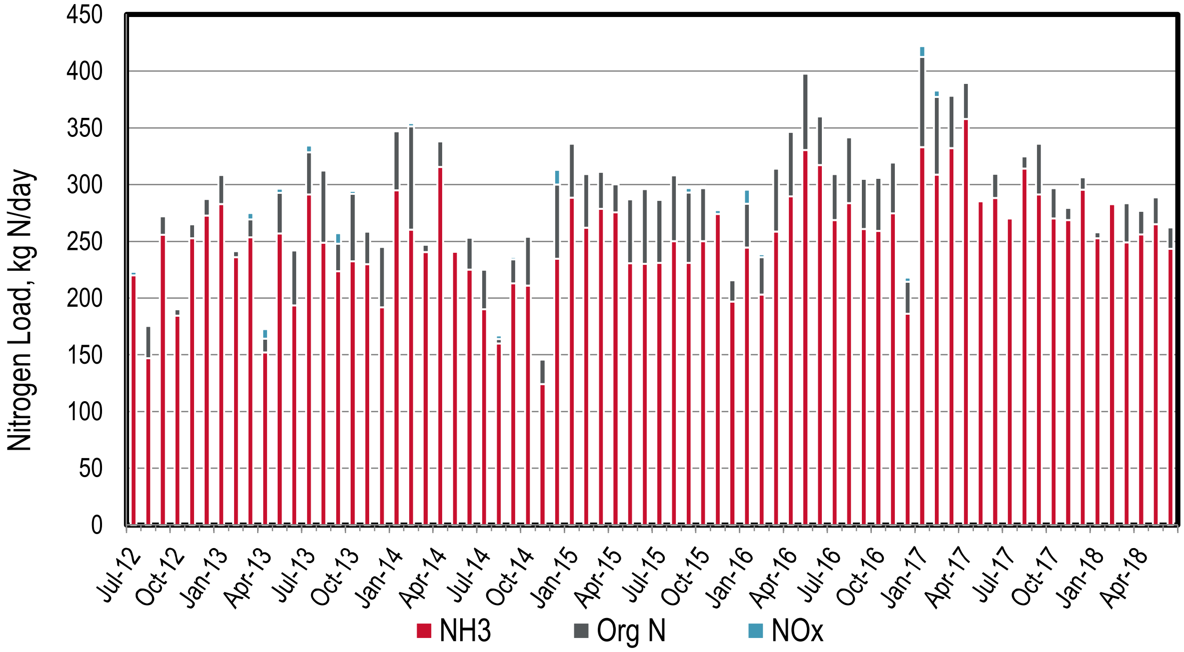

Figure 12-2. Millbrae Monthly Nitrogen Loads

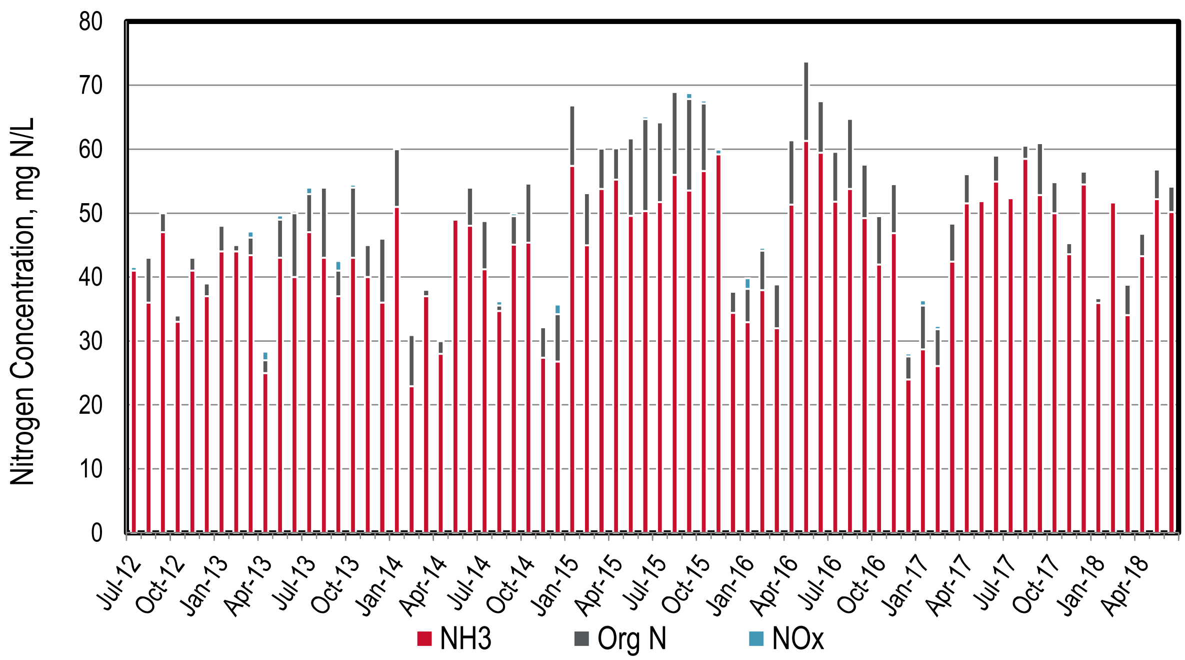

Figure 12-3. Millbrae Monthly Nitrogen Concentrations

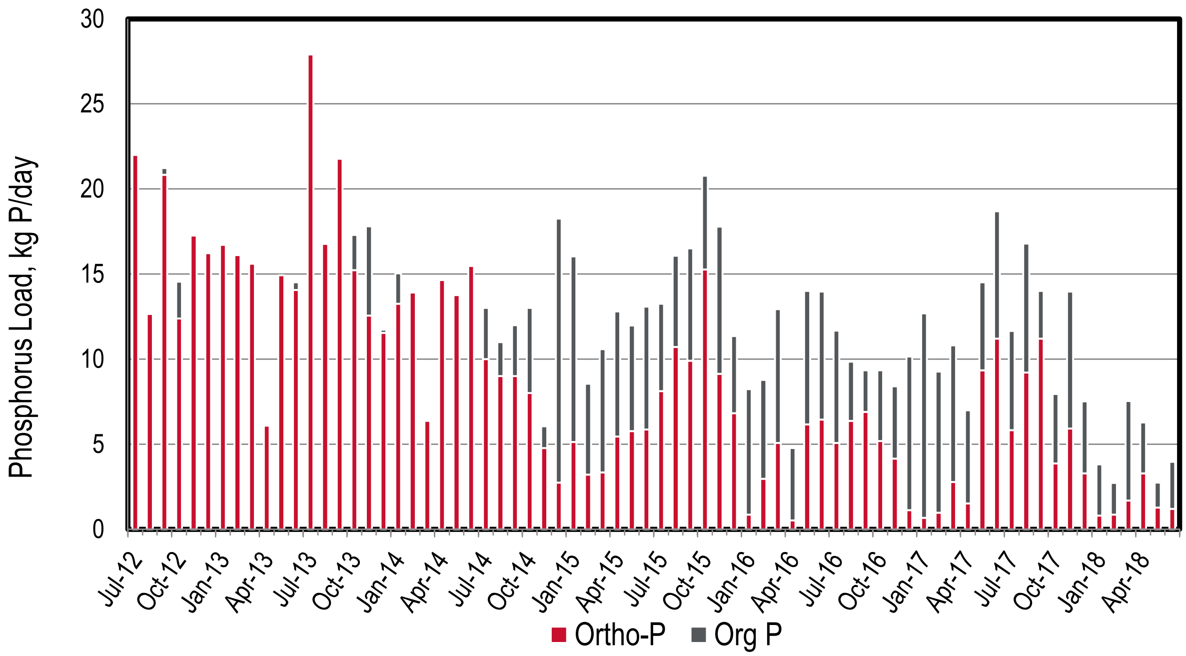

Figure 12-4. Millbrae Monthly Phosphorus Loads

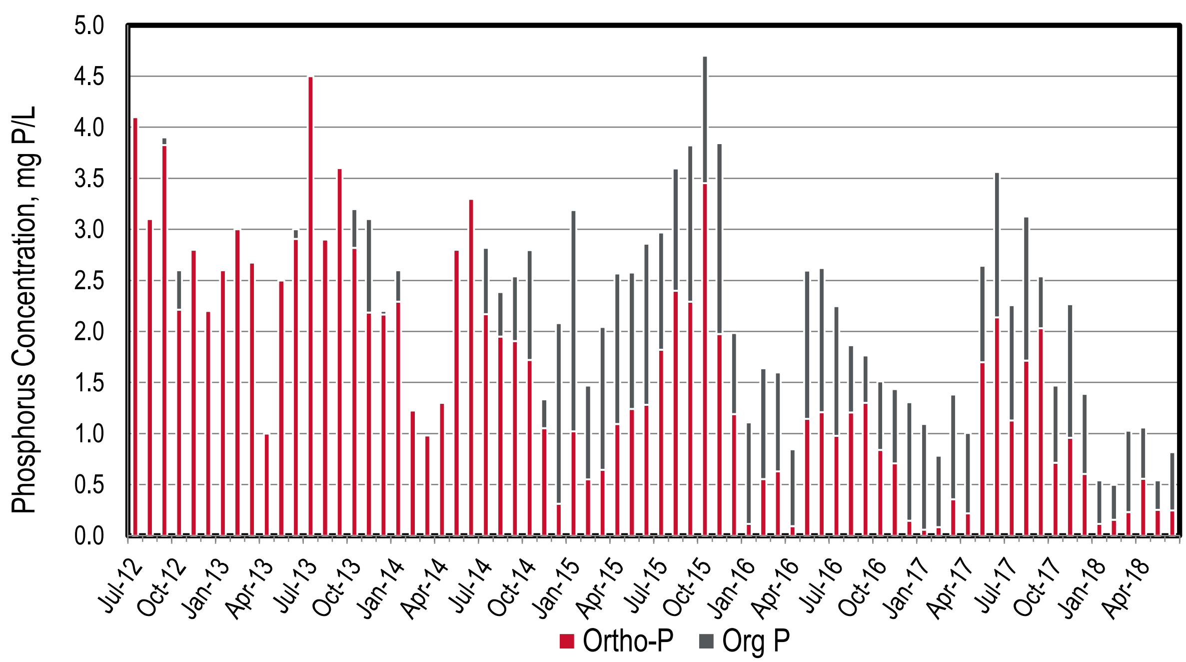

Figure 12-5. Millbrae Monthly Phosphorus Concentrations

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

Table 12-1. Millbrae Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jul-12	1.4	220	220	3	223	23	22
Aug-12	1.1	147	176	1	176	38	13
Sep-12	1.4	256	272	0	273	21	21
Oct-12	1.5	185	190	1	192	12	15
Nov-12	1.6	253	265	1	266	39	17
Dec-12	2.0	273	287	1	288	24	16
Jan-13	1.7	283	308	1	309	17	17
Feb-13	1.4	236	242	1	242	20	16
Mar-13	1.5	253	269	5	275	22	16
Apr-13	1.6	152	164	8	173	8	6
May-13	1.6	257	293	4	296	20	15
Jun-13	1.3	194	242	2	243	14	15
Jul-13	1.6	291	329	6	335	32	28
Aug-13	1.5	249	312	1	313	18	17
Sep-13	1.6	224	248	9	257	22	22
Oct-13	1.4	232	292	2	294	15	17
Nov-13	1.5	230	259	1	259	13	18
Dec-13	1.4	192	245	1	246	12	12
Jan-14	1.5	295	347	0	347	13	15
Feb-14	3.0	260	351	3	354	17	14
Mar-14	1.7	241	247	1	248	8	6
Apr-14	3.0	315	338	2	340	36	15
May-14	1.3	241	211	0	212	18	14
Jun-14	1.2	225	253	1	254	16	15
Jul-14	1.2	190	225	0	225	10	13
Aug-14	1.2	160	164	3	167	9	11
Sep-14	1.3	213	234	2	236	9	12
Oct-14	1.2	211	254	1	255	8	13
Nov-14	1.2	124	146	1	146	5	6

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Dec-14	2.3	235	300	13	313	3	18
Jan-15	1.3	289	336	1	337	5	16
Feb-15	1.5	262	309	1	310	3	9
Mar-15	1.4	279	311	1	312	3	11
Apr-15	1.3	276	300	1	301	5	13
May-15	1.2	231	287	1	288	6	12
Jun-15	1.2	230	296	2	298	6	13
Jul-15	1.2	231	287	0	287	8	13
Aug-15	1.2	250	308	1	309	11	16
Sep-15	1.1	231	293	4	297	10	17
Oct-15	1.2	250	297	2	299	15	21
Nov-15	1.2	274	274	3	277	9	18
Dec-15	1.5	197	216	1	216	7	11
Jan-16	2.0	245	283	12	296	1	8
Feb-16	1.4	203	236	3	239	3	9
Mar-16	2.1	259	314	1	315	5	13
Apr-16	1.5	290	346	1	347	1	5
May-16	1.4	331	398	1	398	6	14
Jun-16	1.4	317	360	1	361	6	14
Jul-16	1.4	269	309	0	310	5	12
Aug-16	1.4	284	342	1	342	6	10
Sep-16	1.4	261	305	1	306	7	9
Oct-16	1.6	259	306	1	307	5	9
Nov-16	1.5	275	319	1	321	4	8
Dec-16	2.1	186	214	4	218	1	10
Jan-17	3.1	333	412	10	422	1	13
Feb-17	3.1	309	377	6	383	1	9
Mar-17	2.1	332	378	0	379	3	11
Apr-17	1.8	358	390	1	390	2	7
May-17	1.5	285	285	1	286	9	15

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jun-17	1.4	288	310	2	311	11	19
Jul-17	1.4	270	270	1	271	6	12
Aug-17	1.4	314	325	1	325	9	17
Sep-17	1.5	291	336	1	337	11	14
Oct-17	1.4	270	297	0	297	4	8
Nov-17	1.6	269	280	0	280	6	14
Dec-17	1.4	296	306	0	307	3	8
Jan-18	1.9	253	258	1	259	1	4
Feb-18	1.4	283	283	1	284	1	3
Mar-18	1.9	249	284	1	285	2	8
Apr-18	1.6	256	277	1	278	3	6
May-18	1.3	265	289	1	290	1	3
Jun-18	1.3	243	262	1	264	1	4
Dry Season Average	**1.3**	**249**	**281**	**2**	**283**	**12**	**14**
Dry Season Trend **	**None**	**Up**	**Up**	**None**	**Up**	**-**	**Down**
Wet Season Average	**1.7**	**255**	**288**	**2**	**291**	**9**	**12**
Average Annual	**1.6**	**252**	**285**	**2**	**287**	**10**	**13**

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

13 Mt. View Sanitary District

Mt. View Sanitary District discharges to Suisun Bay. The plant has approximately 10,500 service connections; it has a permitted capacity of 3.2 mgd ADWF and a peak wet weather capacity of 8.5 mgd. The current flow is 1.2 mgd ADWF. The plant performs nitrification using a series of trickling filters.

The following observations are made based upon the figures and table in the subsequent pages:

- Both nitrogen and phosphorus loads typically increase with flow during wet weather events.
- Wet season nitrogen loads are greater and more variable than the dry season loads.
- NOx is the majority of the nitrogen species discharged as would be expected since this plant nitrifies. A portion of ammonia bleeds through during the colder months. This increases the ammonia contribution during such months.
- Based on average monthly values, there appears to be a downward dry season trend for Total Phosphorus loads.
- Ortho-P values are occasionally greater than TP values. For such instances, ortho-P values were set equal to TP for the plots.
- Total phosphorus concentrations range from 0.6 to 6.2 mg P/L, which suggests occasional P removal as typical effluent TP concentrations are 4 to 6 mg P/L.

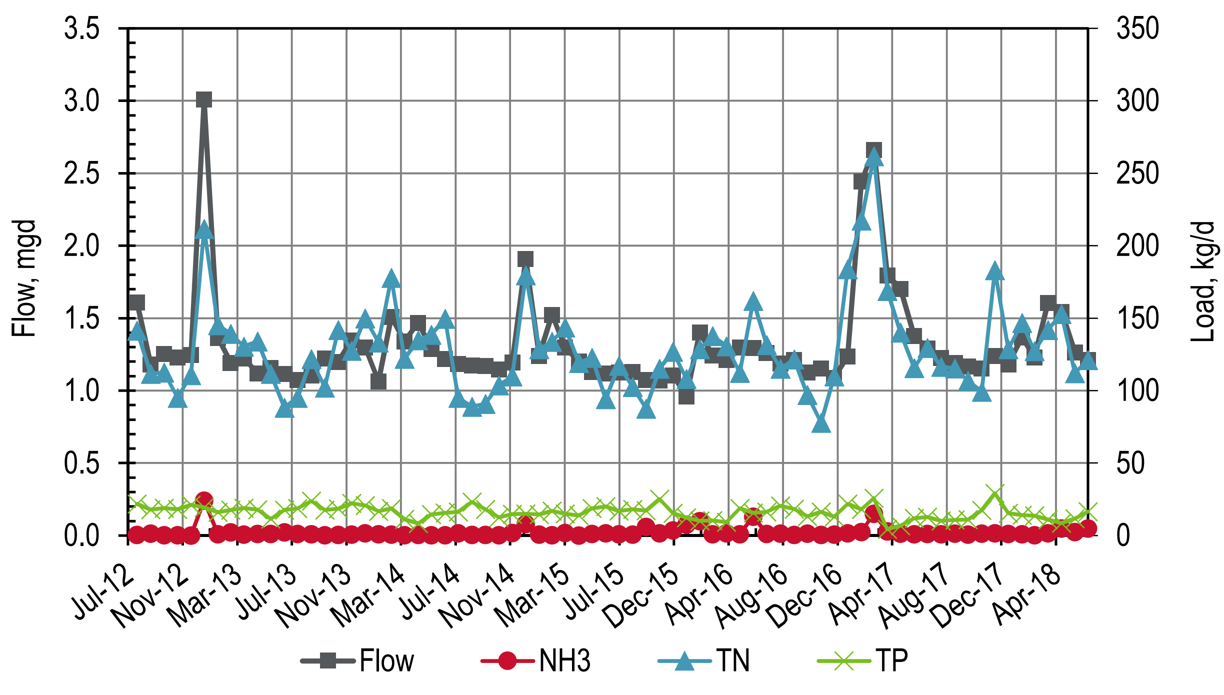

Figure 13-1. Mt. View Sanitary District Monthly Flows and Loads

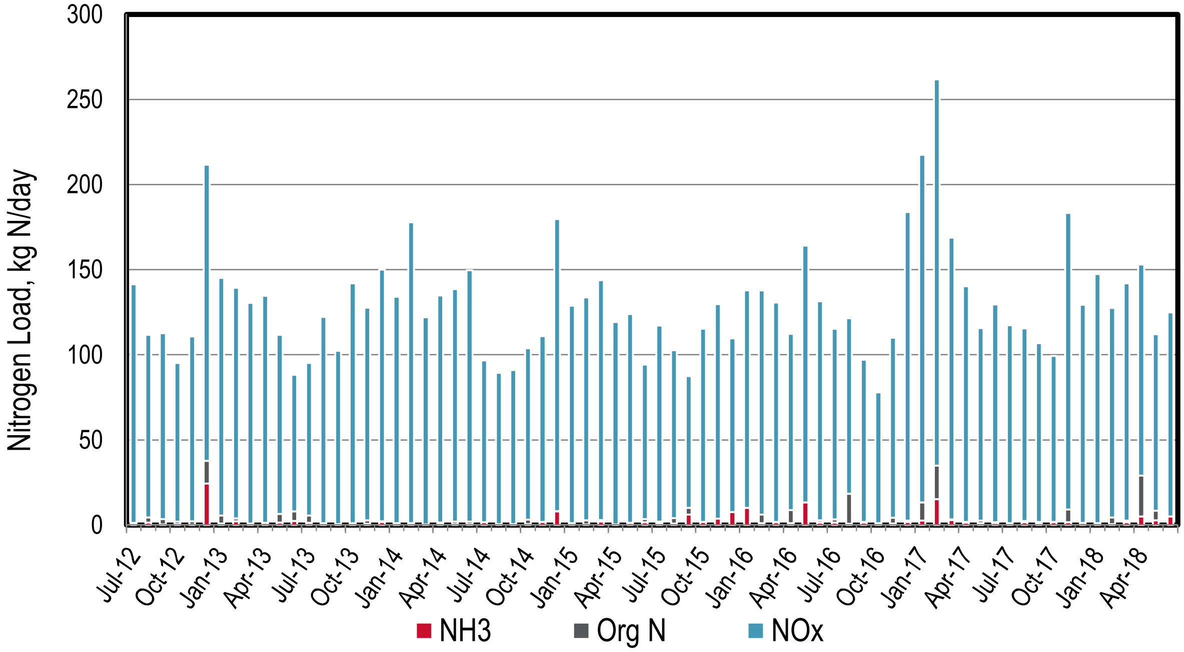

Figure 13-2. Mt. View Sanitary District Monthly Nitrogen Loads

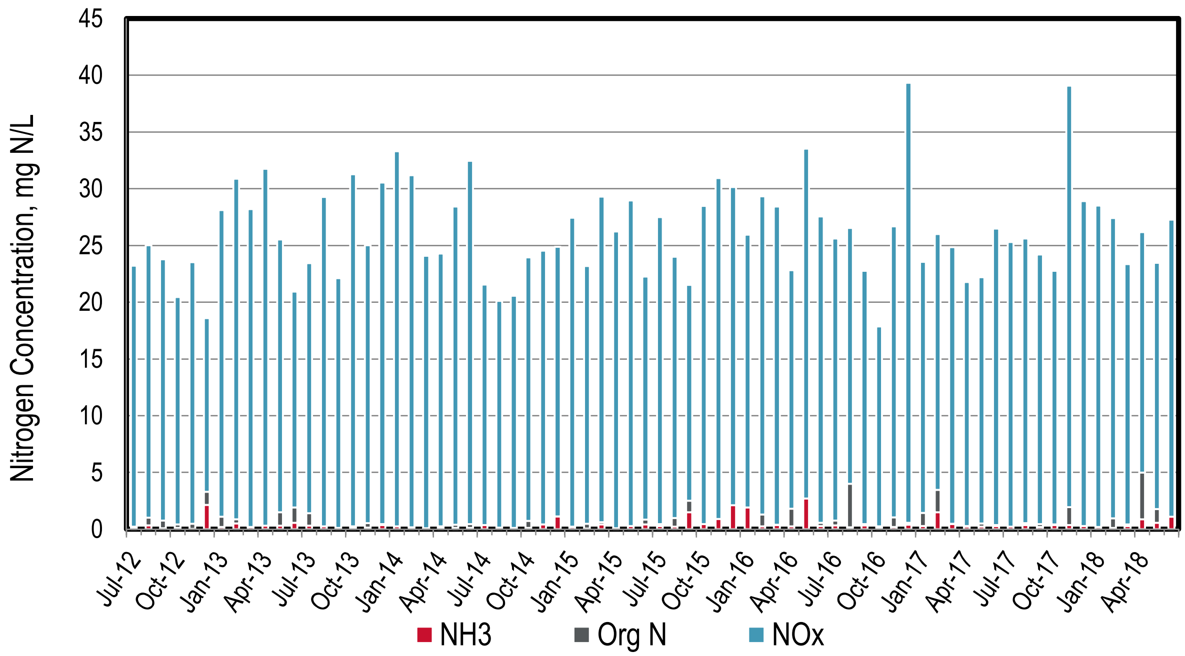

Figure 13-3. Mt. View Sanitary District Monthly Nitrogen Concentrations

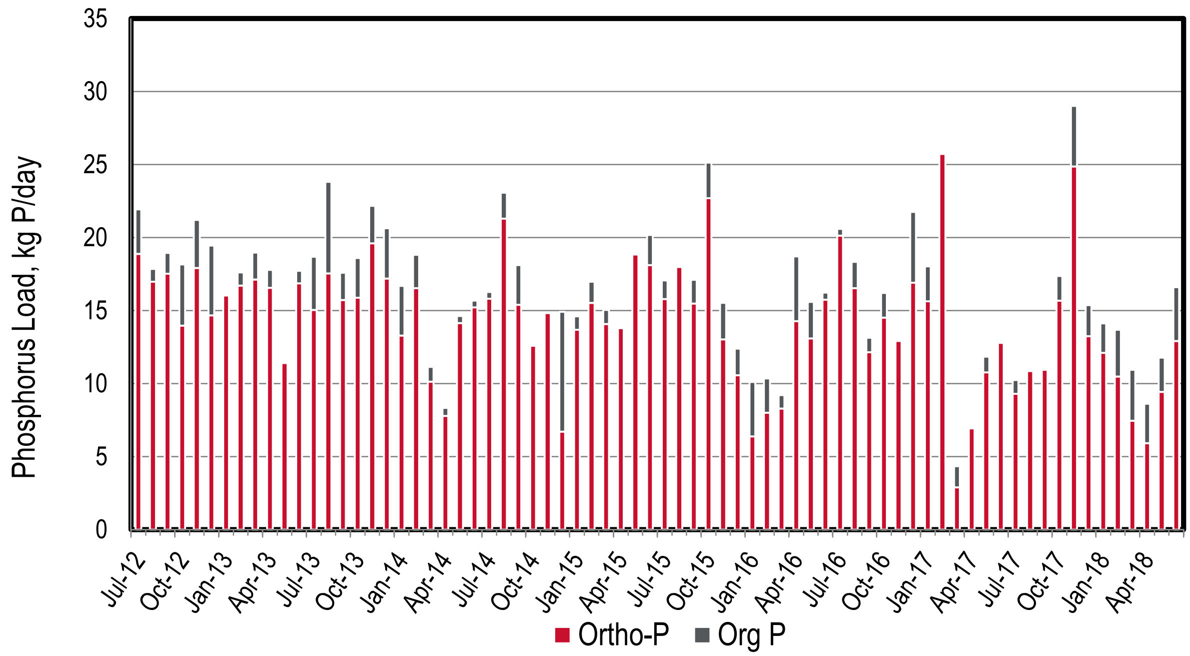

Figure 13-4. Mt. View Sanitary District Monthly Phosphorus Loads

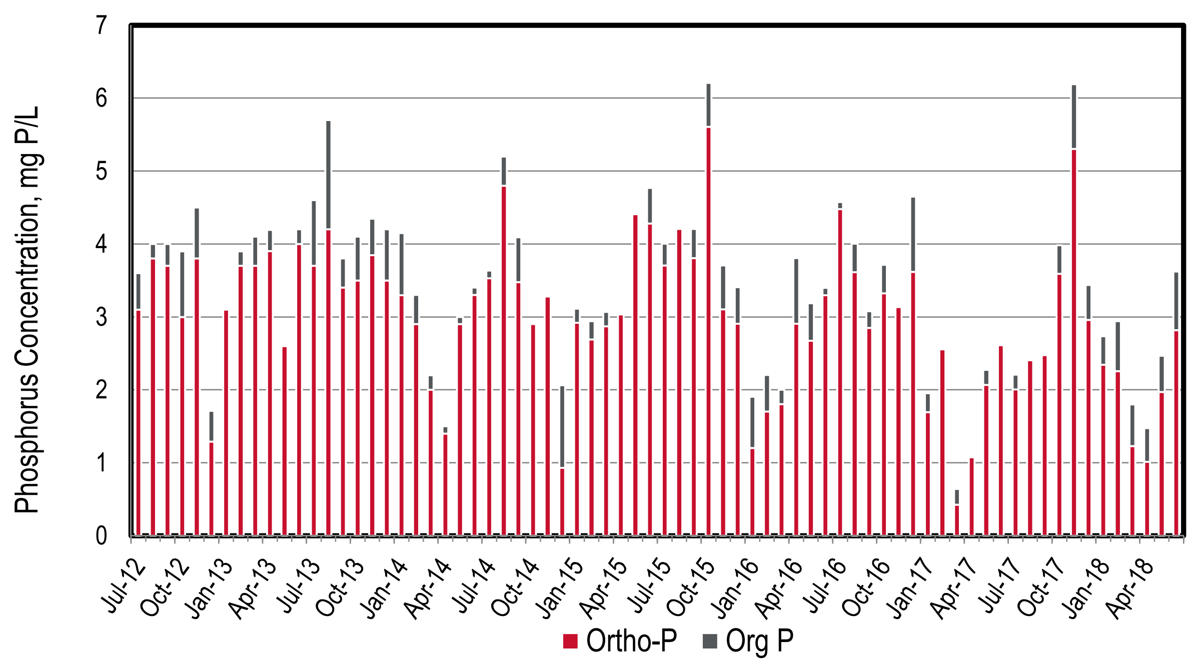

Figure 13-5. Mt. View Sanitary District Monthly Phosphorus Concentrations

Table 13-1. Mt. View Sanitary District Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jul-12	1.6	1	1	140	141	19	22
Aug-12	1.2	2	4	107	112	17	18
Sep-12	1.3	0	4	109	113	18	19
Oct-12	1.2	0	2	93	95	14	18
Nov-12	1.2	0	2	109	111	18	21
Dec-12	3.0	24	38	174	212	15	19
Jan-13	1.4	1	6	140	145	19	16
Feb-13	1.2	2	4	135	139	17	18
Mar-13	1.2	1	1	130	131	17	19
Apr-13	1.1	1	1	133	134	17	18
May-13	1.2	1	7	105	112	12	11
Jun-13	1.1	2	8	80	88	17	18
Jul-13	1.1	1	6	90	95	15	19
Aug-13	1.1	1	1	121	122	18	24
Sep-13	1.2	1	0	102	102	16	18
Oct-13	1.2	1	1	141	142	16	19
Nov-13	1.4	1	3	125	128	20	22
Dec-13	1.3	2	2	148	150	17	21
Jan-14	1.1	1	0	133	133	13	17
Feb-14	1.5	1	1	177	178	17	19
Mar-14	1.3	0	0	122	122	10	11
Apr-14	1.5	1	1	133	135	8	8
May-14	1.3	0	2	137	139	14	15
Jun-14	1.2	0	2	148	150	15	16
Jul-14	1.2	2	0	95	95	16	16
Aug-14	1.2	1	0	89	89	21	23
Sep-14	1.2	1	0	91	91	15	18
Oct-14	1.1	0	3	101	104	13	13

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Nov-14	1.2	2	1	109	110	17	15
Dec-14	1.9	8	8	171	180	7	15
Jan-15	1.2	1	1	128	129	14	15
Feb-15	1.5	0	3	131	134	16	17
Mar-15	1.3	2	3	141	144	14	15
Apr-15	1.2	0	0	119	119	14	14
May-15	1.1	1	0	123	123	20	19
Jun-15	1.1	2	4	91	94	18	20
Jul-15	1.1	1	2	115	117	16	17
Aug-15	1.1	1	4	98	103	19	18
Sep-15	1.1	6	10	77	88	15	17
Oct-15	1.1	2	2	114	115	23	25
Nov-15	1.1	4	1	126	127	13	16
Dec-15	1.0	8	6	102	108	11	12
Jan-16	1.4	10	1	128	129	6	10
Feb-16	1.2	1	6	132	138	8	10
Mar-16	1.2	2	2	129	131	8	9
Apr-16	1.3	1	9	103	112	14	19
May-16	1.3	13	11	151	162	13	16
Jun-16	1.3	1	3	129	131	16	16
Jul-16	1.2	2	3	112	115	20	21
Aug-16	1.2	1	18	103	122	17	18
Sep-16	1.1	1	2	95	97	12	13
Oct-16	1.2	1	1	77	78	15	16
Nov-16	1.1	1	4	106	110	13	13
Dec-16	1.2	2	3	181	184	17	22
Jan-17	2.4	3	13	204	218	16	18
Feb-17	2.7	15	35	227	262	39	26
Mar-17	1.8	3	3	166	169	3	4
Apr-17	1.7	1	2	138	140	7	7

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
May-17	1.4	1	3	113	116	11	12
Jun-17	1.3	1	2	128	130	13	13
Jul-17	1.2	1	0	116	117	9	10
Aug-17	1.2	2	2	113	115	12	11
Sep-17	1.2	1	2	105	107	12	11
Oct-17	1.2	2	2	97	99	16	17
Nov-17	1.2	2	9	174	183	25	29
Dec-17	1.2	1	1	128	129	13	15
Jan-18	1.4	1	0	146	147	12	14
Feb-18	1.2	1	4	123	127	10	14
Mar-18	1.6	2	3	139	142	7	11
Apr-18	1.5	5	29	124	153	6	9
May-18	1.3	3	8	104	112	9	12
a	1.2	5	1	120	121	13	17
Dry Season Average	**1.2**	**2**	**4**	**110**	**114**	**15**	**17**
Dry Season Trend **	**None**	**None**	**None**	**None**	**None**	**-**	**Down**
Wet Season Average	**1.4**	**3**	**5**	**135**	**140**	**14**	**16**
Average Annual	**1.3**	**2**	**5**	**124**	**129**	**15**	**16**

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

14 Napa Sanitation District

Napa Sanitation District discharges to the Napa River that is connected to San Pablo Bay. The plant has a permitted capacity of 15.4 mgd ADWF. The plant performs nitrogen removal using a step-feed activated sludge process with anoxic zones coupled with oxidation ponds which also serves as equalization during peak flow. Discharge is prohibited July 1 through September 30.

The following observations are made based upon the figures and table in the subsequent pages:

- There are no emerging dry season trends as Napa has only discharged for a portion of two dry season months (May and June 2014) since sampling began in July 2012.
- Both nitrogen and phosphorus loads generally increase with flow during wet weather events.
- NOx is the majority of the nitrogen discharged as the Activated Sludge system is operated to nitrify. During the wet season months partially nitrified pond effluent may be clarified then comingled with nitrified Activated Sludge effluent prior to discharge which may increase the ammonia levels during such months.
- Based on average monthly values, the plant discharge currently meets Level 2 total nitrogen concentration limits (i.e., 15 mg N/L) developed under the Scoping and Evaluation Plan for all but four months.
- The plant discharge average monthly total phosphorus concentrations ranging from 0.3 to 3.3 mg P/L, This suggests a portion of P is removed as typical influent TP concentrations are 4 to 6 mg P/L. The removal mechanism is most likely from ferric chloride addition.

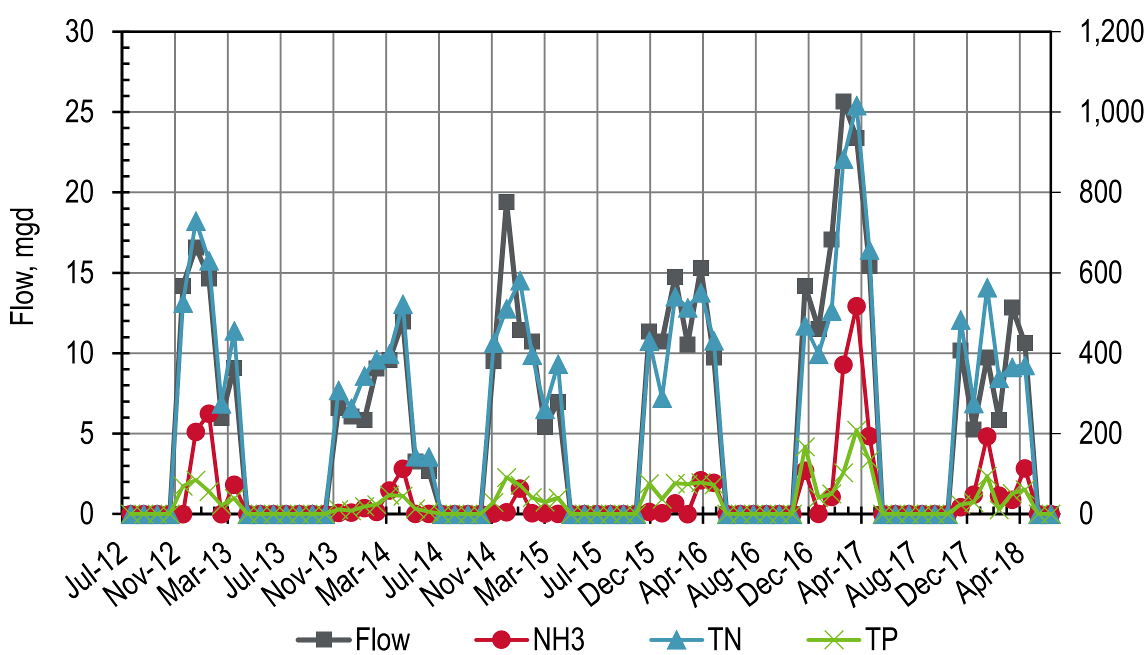

Figure 14-1. Napa Sanitation District Monthly Flows and Loads

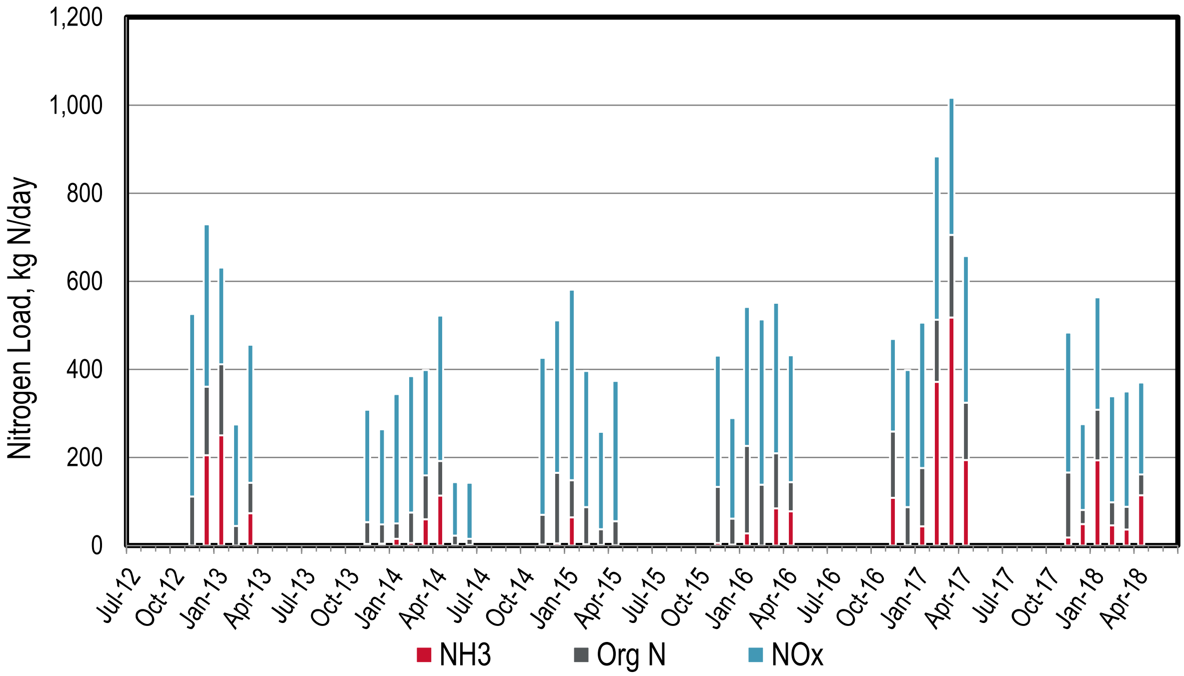

Figure 14-2. Napa Sanitation District Monthly Nitrogen Loads

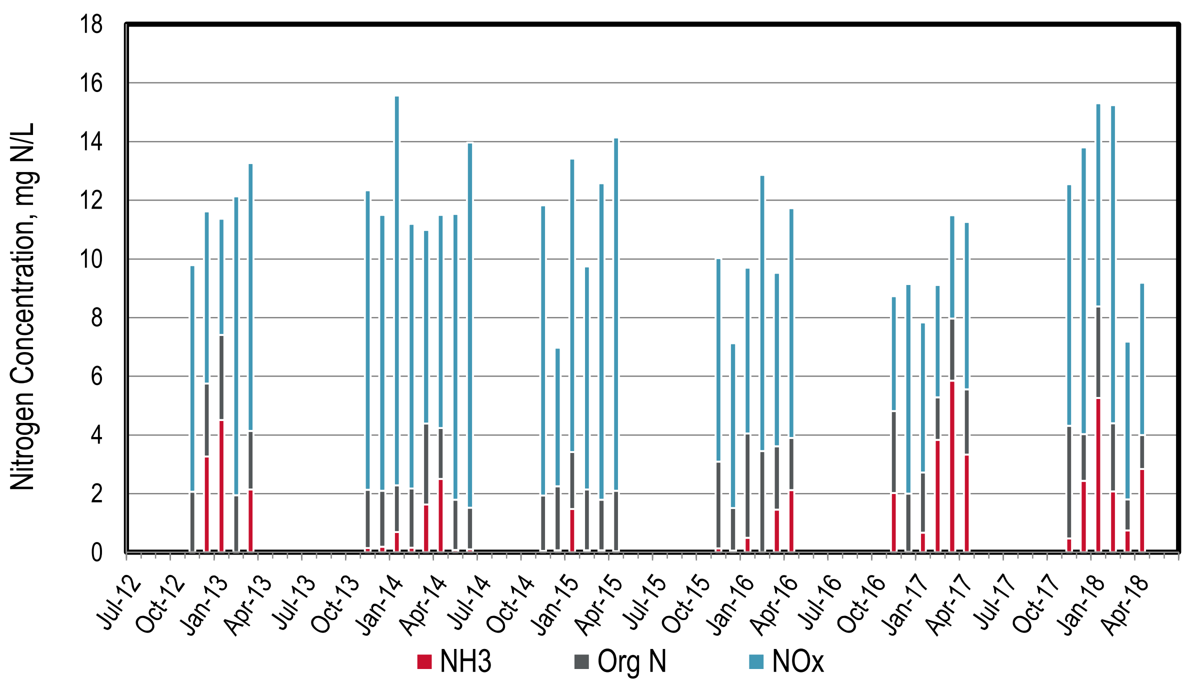

Figure 14-3. Napa Sanitation District Monthly Nitrogen Concentrations

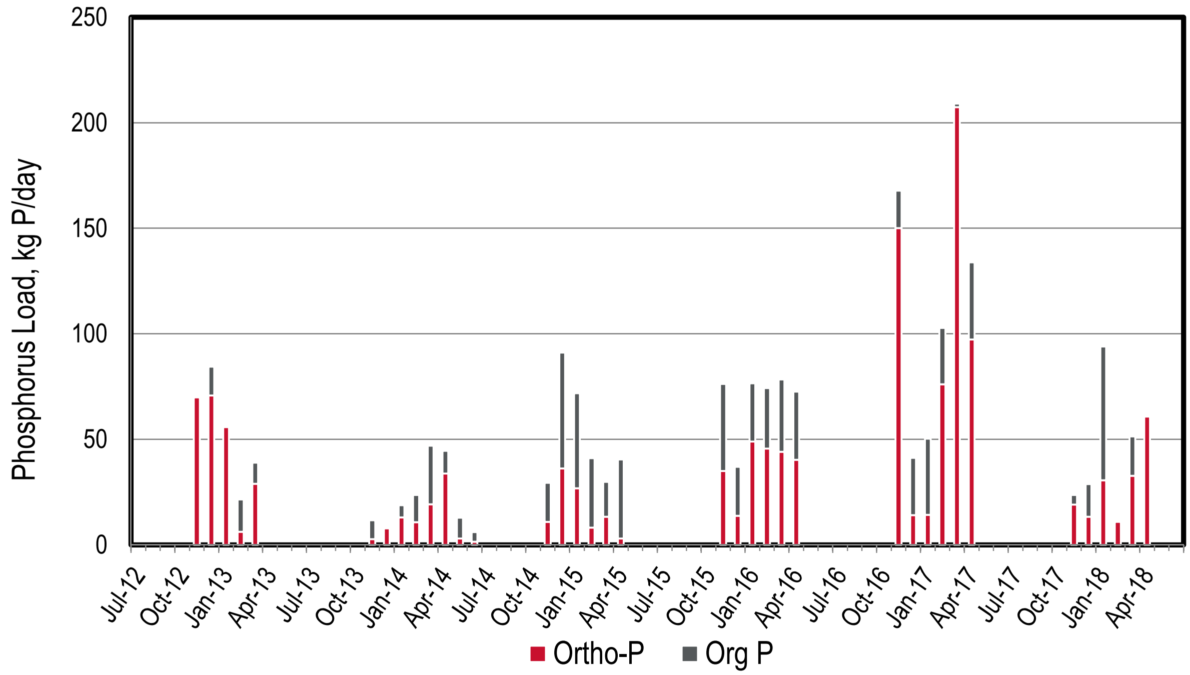

Figure 14-4. Napa Sanitation District Monthly Phosphorus Loads

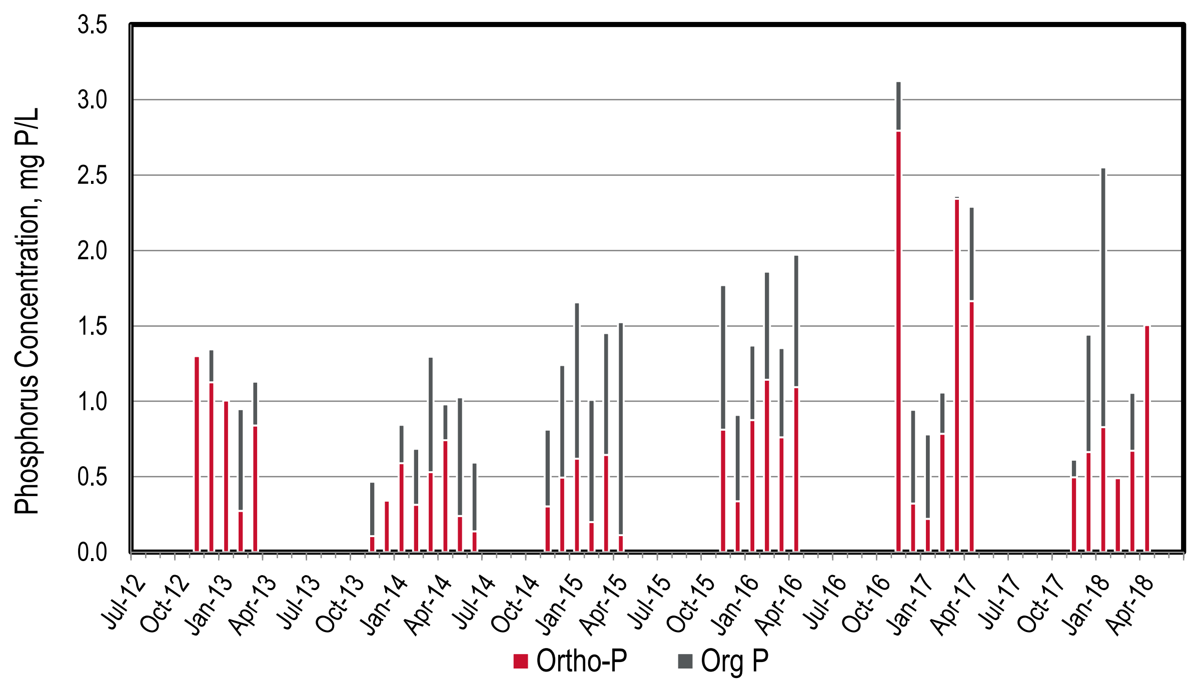

Figure 14-5. Napa Sanitation District Monthly Phosphorus Concentrations

Table 14-1. Napa Sanitation District Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jul-12	0.0	0	0	0	0	0	0
Aug-12	0.0	0	0	0	0	0	0
Sep-12	0.0	0	0	0	0	0	0
Oct-12	0.0	0	0	0	0	0	0
Nov-12	14.2	0	111	414	525	72	70
Dec-12	16.6	205	361	369	729	71	84
Jan-13	14.7	250	411	220	631	111	56
Feb-13	6.0	0	44	231	275	6	21
Mar-13	9.1	74	142	314	456	29	39
Apr-13	0.0	0	0	0	0	0	0
May-13	0.0	0	0	0	0	0	0
Jun-13	0.0	0	0	0	0	0	0
Jul-13	0.0	0	0	0	0	0	0
Aug-13	0.0	0	0	0	0	0	0
Sep-13	0.0	0	0	0	0	0	0
Oct-13	0.0	0	0	0	0	0	0
Nov-13	6.6	4	53	255	308	3	12
Dec-13	6.1	4	48	216	264	8	8
Jan-14	5.9	15	50	294	344	13	19
Feb-14	9.1	5	75	310	385	11	24
Mar-14	9.6	59	159	239	399	19	47
Apr-14	12.0	113	192	330	522	34	45
May-14	3.3	1	22	122	144	3	13
Jun-14	2.7	1	15	127	142	1	6
Jul-14	0.0	0	0	0	0	0	0
Aug-14	0.0	0	0	0	0	0	0
Sep-14	0.0	0	0	0	0	0	0
Oct-14	0.0	0	0	0	0	0	0
Nov-14	9.5	2	70	356	426	11	29

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Dec-14	19.4	5	165	347	511	36	91
Jan-15	11.5	64	148	433	581	27	72
Feb-15	10.8	3	87	309	396	8	41
Mar-15	5.4	2	37	221	261	13	30
Apr-15	7.0	1	56	319	374	3	40
May-15	0.0	0	0	0	0	0	0
Jun-15	0.0	0	0	0	0	0	0
Jul-15	0.0	0	0	0	0	0	0
Aug-15	0.0	0	0	0	0	0	0
Sep-15	0.0	0	0	0	0	0	0
Oct-15	0.0	0	0	0	0	0	0
Nov-15	11.4	6	133	298	431	35	76
Dec-15	10.7	2	61	228	289	14	37
Jan-16	14.8	28	226	315	542	49	77
Feb-16	10.6	0	138	376	514	46	74
Mar-16	15.3	84	209	342	551	44	78
Apr-16	9.7	78	144	288	432	40	73
May-16	0.0	0	0	0	0	0	0
Jun-16	0.0	0	0	0	0	0	0
Jul-16	0.0	0	0	0	0	0	0
Aug-16	0.0	0	0	0	0	0	0
Sep-16	0.0	0	0	0	0	0	0
Oct-16	0.0	0	0	0	0	0	0
Nov-16	14.2	109	259	210	469	150	168
Dec-16	11.5	1	87	311	399	14	41
Jan-17	17.1	43	176	330	506	14	50
Feb-17	25.7	372	513	371	884	76	103
Mar-17	23.4	517	705	311	1,017	207	209
Apr-17	15.4	194	324	333	657	97	134
May-17	0.0	0	0	0	0	0	0

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jun-17	0.0	0	0	0	0	0	0
Jul-17	0.0	0	0	0	0	0	0
Aug-17	0.0	0	0	0	0	0	0
Sep-17	0.0	0	0	0	0	0	0
Oct-17	0.0	0	0	0	0	0	0
Nov-17	10.2	18	166	317	484	19	24
Dec-17	5.3	49	80	195	276	13	29
Jan-18	9.7	194	309	255	564	31	94
Feb-18	5.9	46	98	241	339	26	11
Mar-18	12.9	36	88	262	366	33	51
Apr-18	10.7	114	161	209	370	66	61
May-18	0.0	0	0	0	0	0	0
Jun-18	0.0	0	0	0	0	0	0
Dry Season Average	**0.2**	**0**	**1**	**8**	**10**	**0**	**1**
Dry Season Trend **	**	**	**	**	**	**	**
Wet Season Average	**9.7**	**64**	**145**	**247**	**392**	**34**	**50**
Average Annual	**5.7**	**38**	**85**	**147**	**233**	**20**	**30**

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** No dry season trending analysis was performed on Napa as there are only two months (May and June 2014) that discharged since sampling began in July 2012.

15 Novato Sanitary District

Novato discharges to San Pablo Bay. The plant has approximately 28,500 service connections; it has a permitted capacity of 7.0 mgd ADWF and a peak wet weather capacity of 47 mgd. The plant performs nitrogen removal using activated sludge. Discharge is prohibited June 1 through August 31, unless (1) facility inflow will exceed the capacity of influent storage (after factoring in anticipated wet weather storage needs), and facility effluent flow will exceed the capacity of the reclamation water distribution and storage system to meet reclaimed water demand (e.g., June 2017); and (2) the discharge meets the advanced treatment limits specified in the permit. The discharge will increase to year-round if Novato begins discharging to a new wetland adjacent to San Pablo Bay as noted in their current permit.

The following observations are made based upon the figures and table in the subsequent pages:

- There are no emerging dry season trends as Novato does not typically discharge during the dry season.
- Wet season trends were analyzed (data not shown) and there are no emerging trends.
- Both nitrogen and phosphorus loads typically increase with flow during wet weather events.
- NOx is the majority of the nitrogen species discharged as would be expected since this plant nitrifies. A portion of ammonia bleeds through during the colder months. This increases the ammonia contribution during such months.
- The plant nearly meets Level 2 total nitrogen concentration limits (i.e., 15 mg N/L) developed under the Scoping and Evaluation Plan with values reliably less than 22 mg N/L.
- Ortho-P values are occasionally greater than TP values for the Section 13267 Letter based on the composite sampling issue discussed in the main report body. Since the Regional Watershed Permit sampling began (July, 2014), the ortho-P values has only exceeded the TP value twice. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations range from 0.1 to 3.2 mg P/L, This suggests a portion of P is removed as typical effluent TP concentrations for similar treatment plants are 4 to 6 mg P/L. The removal mechanism might be attributed to a combination of ferric chloride addition to the digester influent and/or biological P removal.

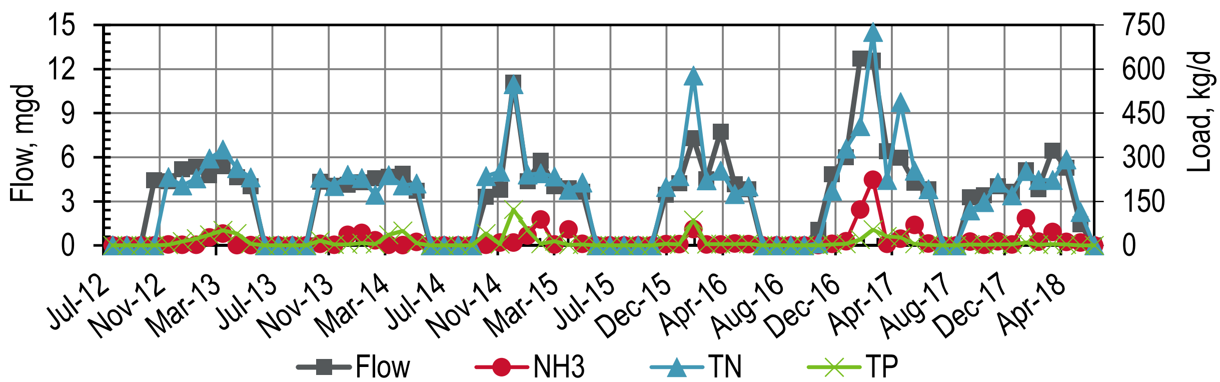

Figure 15-1. Novato Monthly Flows and Loads

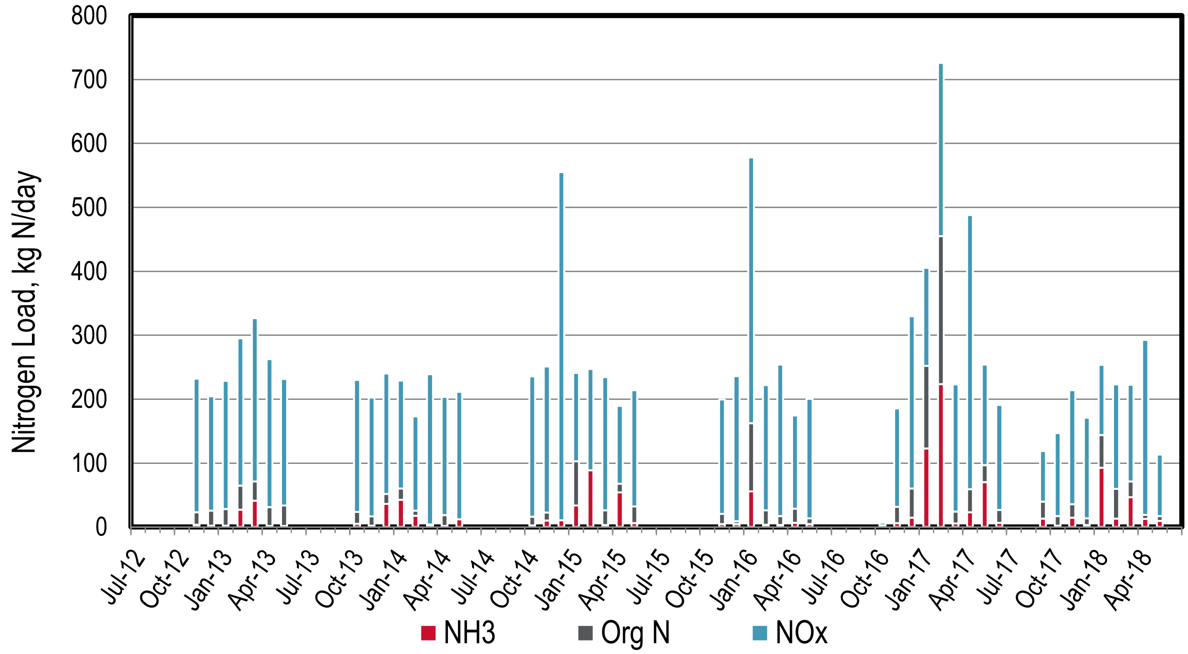

Figure 15-2. Novato Monthly Nitrogen Loads

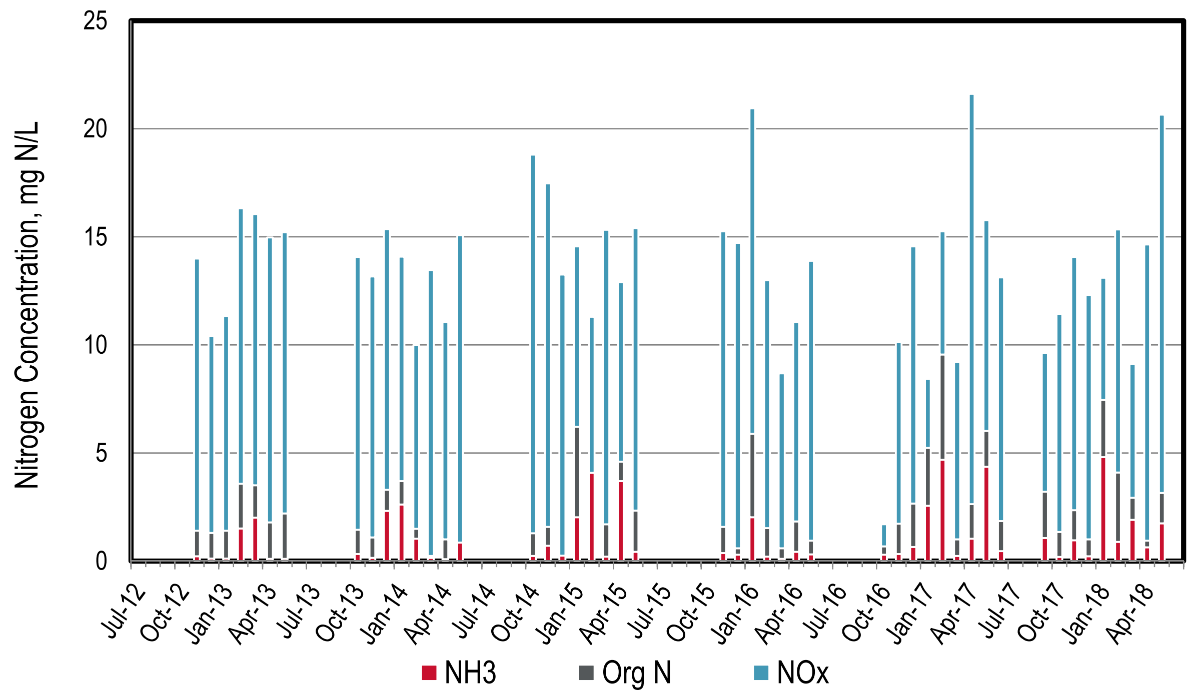

Figure 15-3. Novato Monthly Nitrogen Concentrations

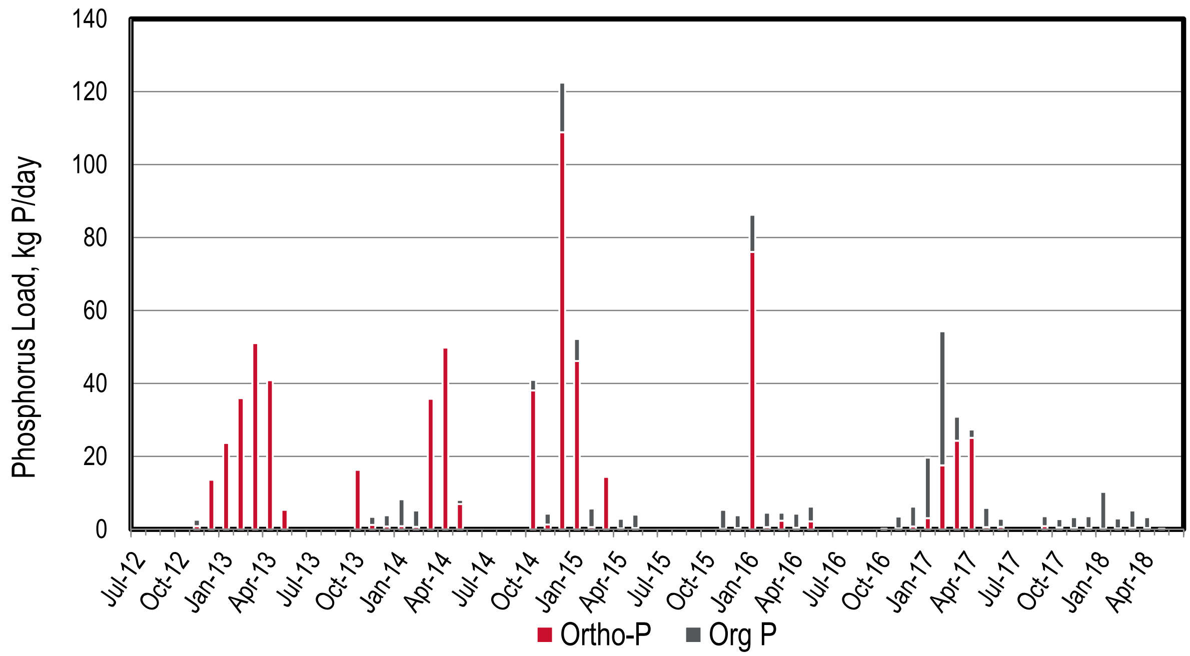

Figure 15-4. Novato Monthly Phosphorus Loads

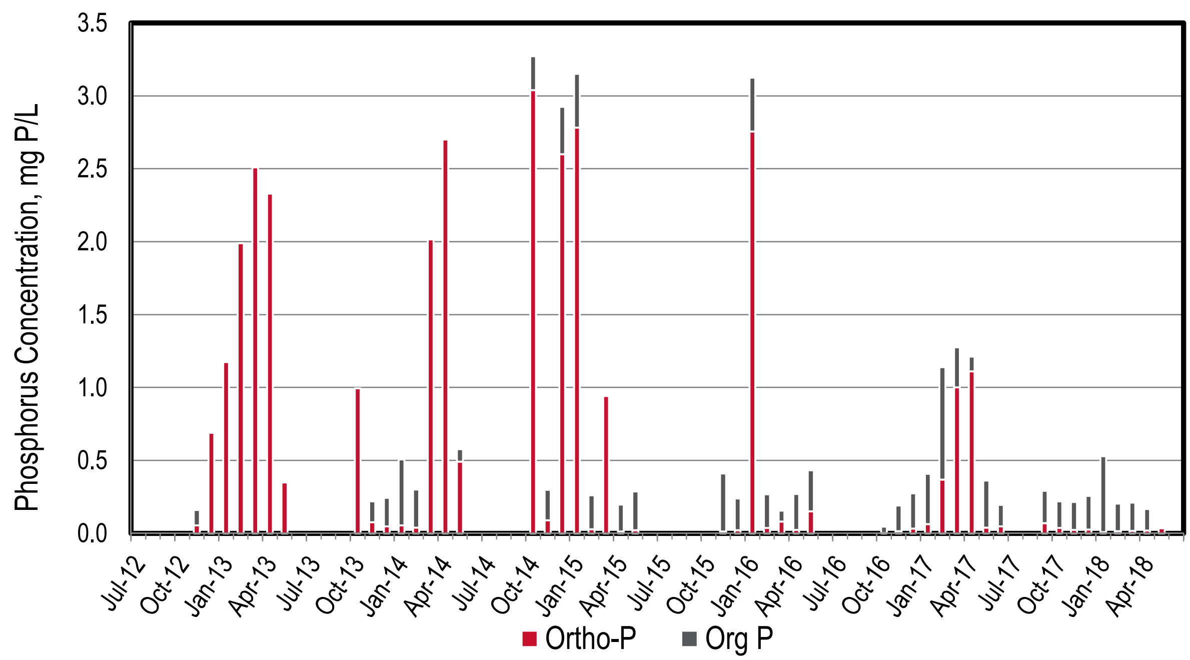

Figure 15-5. Novato Monthly Phosphorus Concentrations

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

Table 15-1. Novato Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jul-12	0.0	0	0	0	0	0	0
Aug-12	0.0	0	0	0	0	0	0
Sep-12	0.0	0	0	0	0	0	0
Oct-12	4.4	--	--	--	--	--	--
Nov-12	4.4	4	23	209	232	1	3
Dec-12	5.2	2	26	179	205	35	14
Jan-13	5.3	2	28	200	229	35	24
Feb-13	4.8	27	65	231	295	58	36
Mar-13	5.4	41	71	255	327	86	51
Apr-13	4.6	2	31	231	263	64	41
May-13	4.0	2	34	198	232	9	5
Jun-13	0.0	0	0	0	0	0	0
Jul-13	0.0	0	0	0	0	0	0
Aug-13	0.0	0	0	0	0	0	0
Sep-13	0.0	0	0	0	0	0	0
Oct-13	4.3	5	24	207	230	22	16
Nov-13	4.1	2	17	186	202	1	3
Dec-13	4.1	36	52	189	240	1	4
Jan-14	4.3	43	60	169	229	1	8
Feb-14	4.6	18	26	147	173	1	5
Mar-14	4.7	3	4	235	239	58	36
Apr-14	4.9	2	18	185	204	82	50
May-14	3.7	12	10	200	210	7	8
Jun-14	0.0	0	0	0	0	0	0
Jul-14	0.0	0	0	0	0	0	0
Aug-14	0.0	0	0	0	0	0	0
Sep-14	0.0	0	0	0	0	0	0
Oct-14	3.3	3	16	220	236	38	41
Nov-14	3.8	10	23	228	251	1	4

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Dec-14	11.1	11	4	544	548	109	123
Jan-15	4.4	34	103	138	241	46	52
Feb-15	5.8	89	88	158	246	1	6
Mar-15	4.0	3	26	208	234	19	14
Apr-15	3.9	54	68	122	189	0	3
May-15	3.7	6	32	182	214	0	4
Jun-15	0.0	0	0	0	0	0	0
Jul-15	0.0	0	0	0	0	0	0
Aug-15	0.0	0	0	0	0	0	0
Sep-15	0.0	0	0	0	0	0	0
Oct-15	0.0	0	0	0	0	0	0
Nov-15	3.5	5	21	179	199	0	5
Dec-15	4.2	5	9	227	236	0	4
Jan-16	7.3	56	162	416	578	76	86
Feb-16	4.5	3	26	196	222	1	5
Mar-16	7.7	3	17	237	254	2	5
Apr-16	4.2	7	29	146	175	0	4
May-16	3.8	5	14	187	200	2	6
Jun-16	0.0	0	0	0	0	0	0
Jul-16	0.0	0	0	0	0	0	0
Aug-16	0.0	0	0	0	0	0	0
Sep-16	0.0	0	0	0	0	0	0
Oct-16	1.0	1	3	4	7	0	0
Nov-16	4.8	6	32	154	185	0	4
Dec-16	6.0	15	60	270	330	1	6
Jan-17	12.7	123	252	154	405	3	20
Feb-17	12.6	223	455	271	726	18	54
Mar-17	6.4	6	24	199	223	24	31
Apr-17	6.0	23	59	429	488	25	27
May-17	4.3	70	97	157	254	1	6

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jun-17	3.9	7	27	164	191	1	3
Jul-17	0.0	0	0	0	0	0	0
Aug-17	0.0	0	0	0	0	0	0
Sep-17	3.3	13	40	79	119	1	4
Oct-17	3.4	2	17	130	147	0	3
Nov-17	4.0	15	36	179	214	0	3
Dec-17	3.7	3	14	157	171	0	4
Jan-18	5.1	93	144	109	253	0	10
Feb-18	3.8	13	60	164	223	0	3
Mar-18	6.5	47	71	151	223	0	5
Apr-18	5.3	13	19	273	292	0	3
May-18	1.5	10	17	96	113	2	0
Jun-18	0.0	0	0	0	0	0	0
Dry Season Average	**0.9**	**4**	**9**	**42**	**51**	**1**	**1**
**Dry Season Trend ** **	**	**	**	**	**	**	**
Wet Season Average	**5.1**	**25**	**54**	**197**	**252**	**19**	**19**
Average Annual	**3.4**	**17**	**36**	**134**	**170**	**12**	**12**

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** No dry season trending analysis was performed on Novato as the facility does not discharge during most dry season months.

16 City of Palo Alto

Palo Alto discharges to the Lower South Bay. The plant serves an estimated population of 217,000 and it has a permitted ADWF capacity of 39 mgd and a peak wet weather capacity of 80 mgd. The current ADWF flow is approximately 20 mgd. The plant performs ammonia and limited nitrogen removal using a combination of trickling filters and activated sludge.

The following observations are made based upon the figures and table in the subsequent pages:

- There appears to be a downward dry season trend for flows and TKN loads.
- There is a dry season upwards trend in TP loads in the plant influent (data not shown) that might continue as population and economy grows and shifts away from industrial and towards business office growth.
- NOx is the majority of the nitrogen species discharged, regardless of season. This would be expected since this plant reliably nitrifies year round.
- TN loads in general increase with flows.
- TKN and TN have a sudden spike in April 2015, which was validated by contract laboratory. The basis for this is unclear.
- TP discharge concentrations range from 3.1 to 5.9 mg P/L. This is within the range of typical effluent TP concentrations (4 to 6 mg P/L).

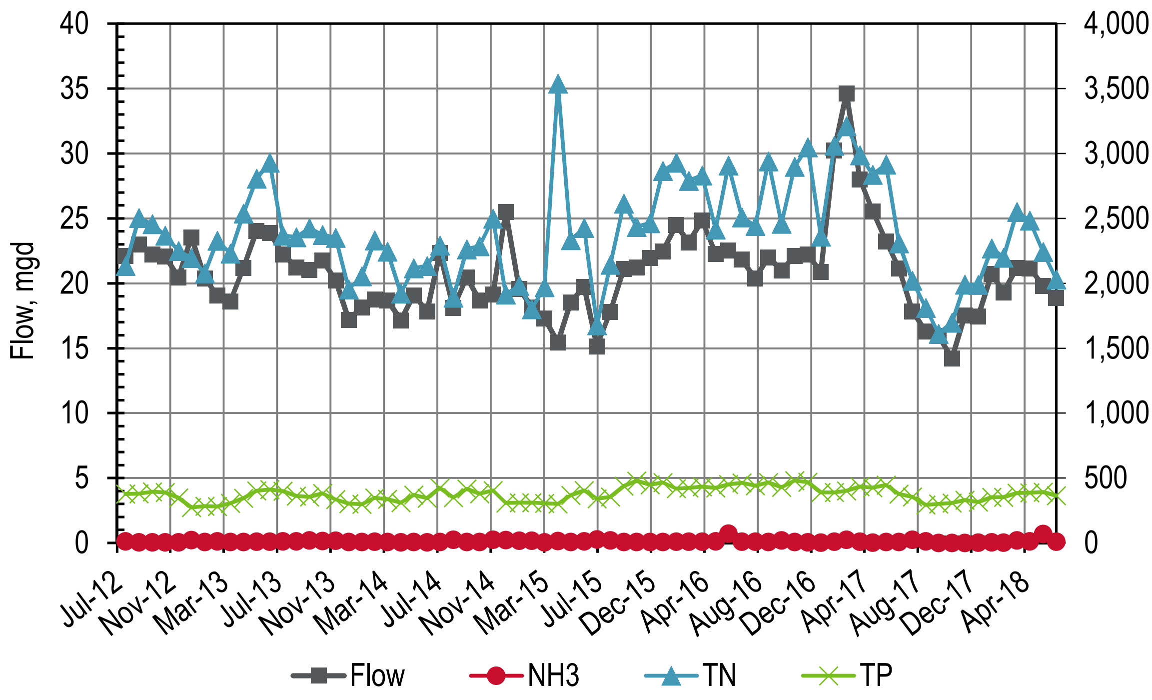

Figure 16-1. Palo Alto Monthly Flows and Loads

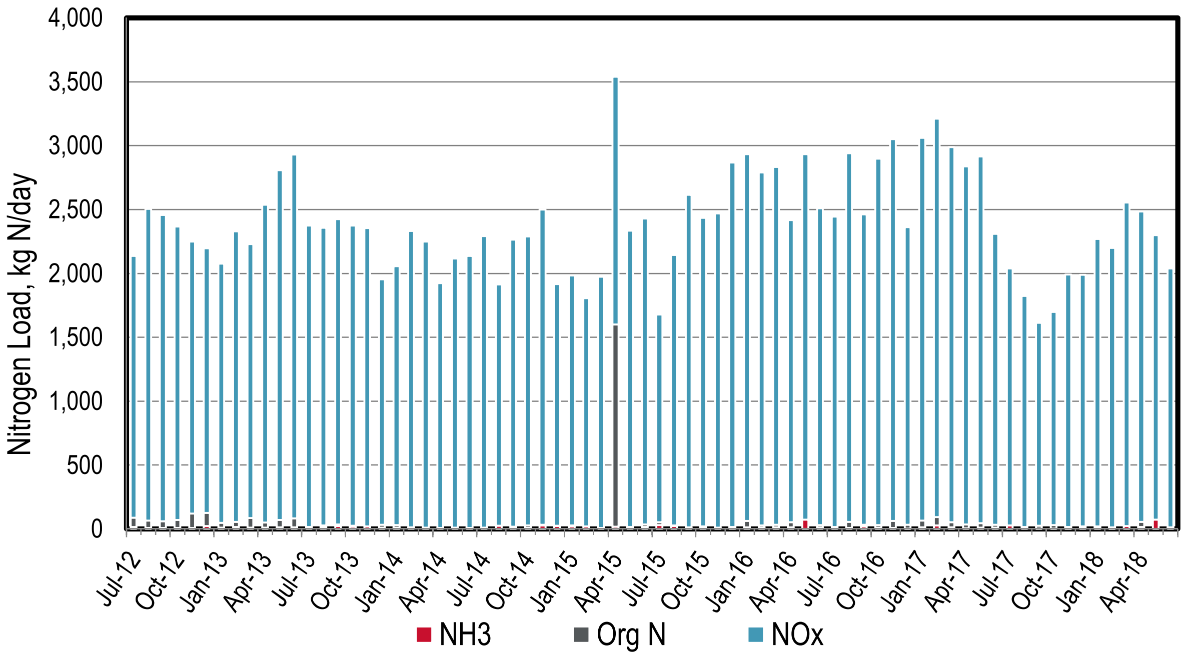

Figure 16-2. Palo Alto Monthly Nitrogen Loads

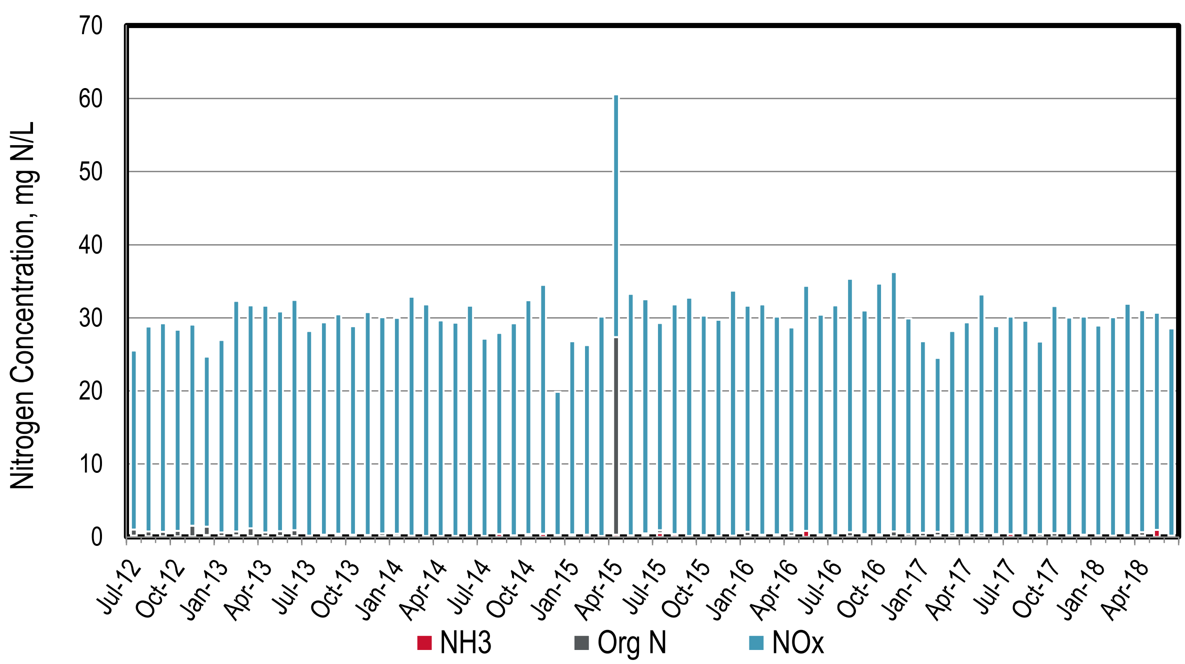

Figure 16-3. Palo Alto Monthly Nitrogen Concentrations

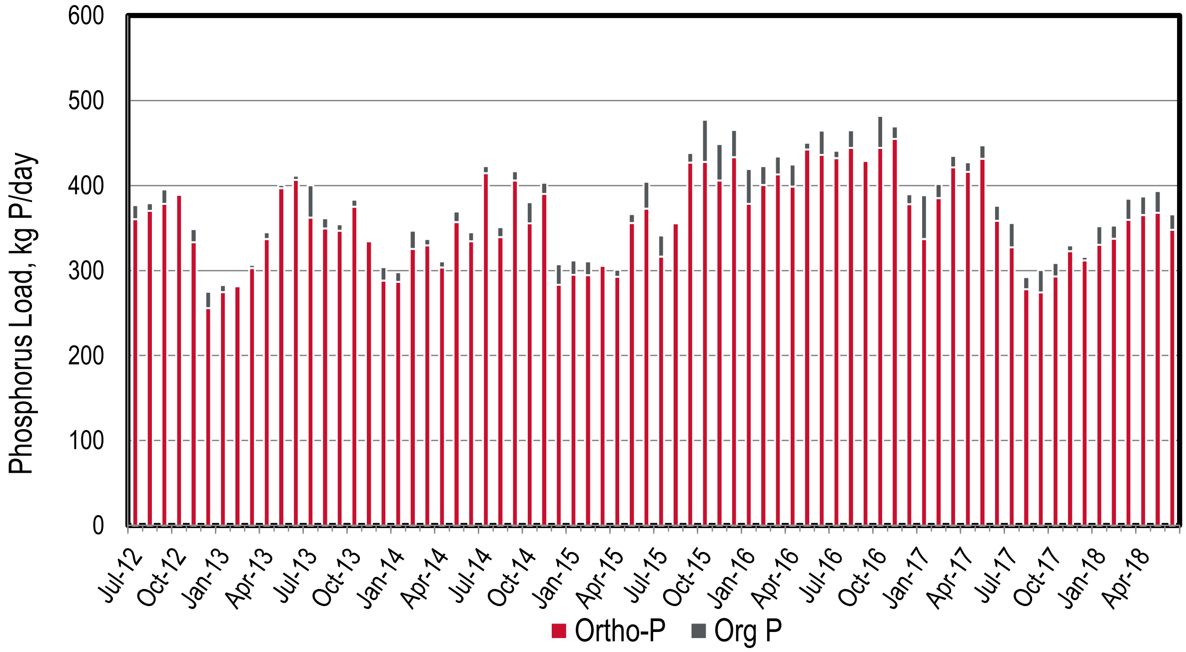

Figure 16-4. Palo Alto Monthly Phosphorus Loads

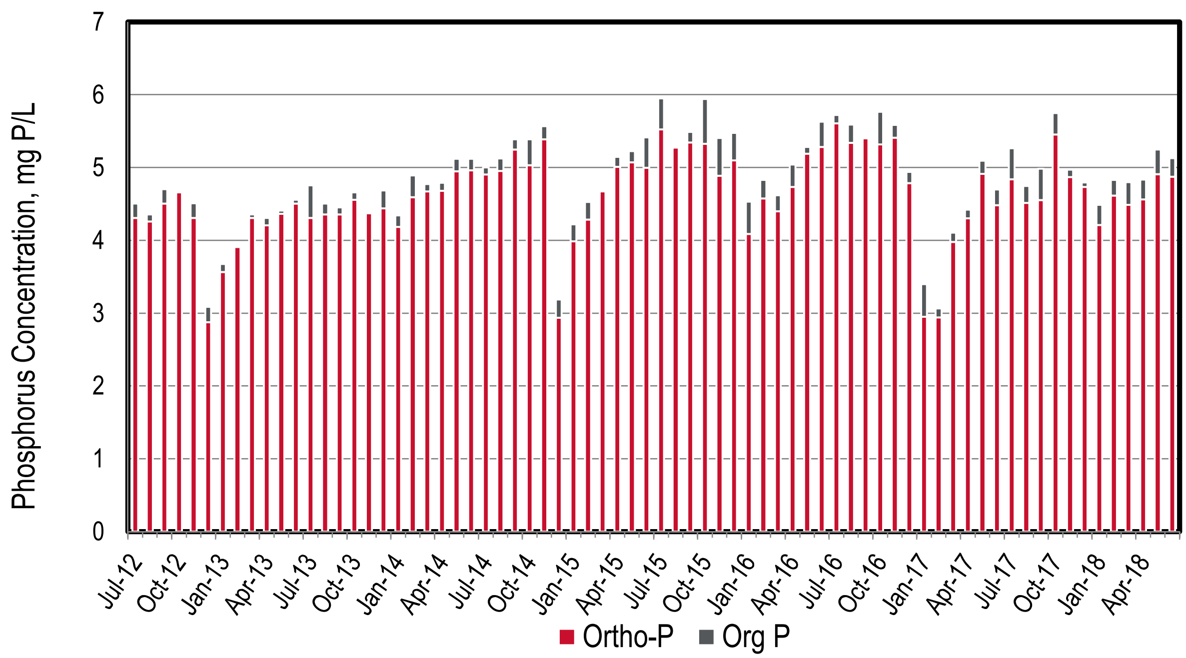

Figure 16-5. Palo Alto Monthly Phosphorus Concentrations

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

Table 16-1. Palo Alto Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day*	TKN kg N/day*	NOx kg N/day	Total N kg N/day**	Ortho-P kg P/day	Total P kg P/day
Jul-12	22.1	14	87	2,049	2,136	360	377
Aug-12	23.0	9	66	2,439	2,504	370	379
Sep-12	22.2	8	60	2,398	2,457	379	395
Oct-12	22.1	8	69	2,298	2,368	389	389
Nov-12	20.5	8	120	2,130	2,250	333	349
Dec-12	23.6	24	125	2,072	2,197	256	275
Jan-13	20.4	10	48	2,029	2,077	275	283
Feb-13	19.1	15	55	2,275	2,330	298	282
Mar-13	18.6	9	84	2,146	2,230	303	306
Apr-13	21.2	10	51	2,487	2,538	337	345
May-13	24.1	12	71	2,737	2,808	397	401
Jun-13	23.9	12	82	2,848	2,931	407	411
Jul-13	22.3	14	10	2,359	2,370	362	400
Aug-13	21.2	15	27	2,330	2,357	350	362
Sep-13	21.1	23	35	2,390	2,425	347	355
Oct-13	21.8	18	26	2,349	2,375	375	383
Nov-13	20.2	21	18	2,333	2,352	334	336
Dec-13	17.2	10	33	1,921	1,954	288	304
Jan-14	18.1	10	30	2,025	2,055	287	298
Feb-14	18.8	11	12	2,319	2,331	326	347
Mar-14	18.7	9	9	2,239	2,247	330	337
Apr-14	17.2	8	8	1,916	1,924	304	311
May-14	19.1	9	10	2,106	2,117	357	370
Jun-14	17.8	9	8	2,127	2,136	335	345
Jul-14	22.4	11	11	2,282	2,292	415	423
Aug-14	18.1	26	5	1,887	1,892	339	351
Sep-14	20.5	10	18	2,246	2,264	406	417
Oct-14	18.7	9	27	2,261	2,288	355	380
Nov-14	19.2	28	33	2,466	2,499	390	403

Month, Year	Flow mgd	Ammonia kg N/day*	TKN kg N/day*	NOx kg N/day	Total N kg N/day**	Ortho-P kg P/day	Total P kg P/day
Dec-14	25.5	24	24	1,891	1,916	283	307
Jan-15	19.6	19	27	1,956	1,983	295	312
Feb-15	18.2	20	16	1,785	1,802	294	311
Mar-15	17.3	9	5	1,966	1,971	306	306
Apr-15	15.5	17	1,600	1,940	3,540	293	301
May-15	18.6	9	15	2,320	2,334	356	367
Jun-15	19.8	16	37	2,392	2,429	373	404
Jul-15	15.2	30	52	1,627	1,679	317	341
Aug-15	17.8	22	28	2,116	2,144	360	355
Sep-15	21.1	10	12	2,602	2,614	427	438
Oct-15	21.3	10	21	2,413	2,434	428	477
Nov-15	22.0	11	6	2,459	2,465	406	449
Dec-15	22.5	11	15	2,852	2,867	433	465
Jan-16	24.5	12	64	2,868	2,932	378	419
Feb-16	23.2	11	27	2,763	2,790	401	423
Mar-16	24.9	13	33	2,801	2,834	413	434
Apr-16	22.3	14	53	2,363	2,416	399	425
May-16	22.6	73	49	2,859	2,908	442	450
Jun-16	21.8	14	31	2,480	2,511	436	465
Jul-16	20.4	12	16	2,428	2,444	432	441
Aug-16	22.0	9	55	2,885	2,941	444	465
Sep-16	21.0	21	33	2,429	2,461	443	429
Oct-16	22.1	10	31	2,868	2,898	444	482
Nov-16	22.2	8	63	2,987	3,050	455	470
Dec-16	20.9	4	33	2,329	2,362	378	390
Jan-17	30.2	12	65	2,996	3,062	337	388
Feb-17	34.7	27	94	3,118	3,212	385	402
Mar-17	28.0	14	54	2,935	2,989	421	435
Apr-17	25.6	4	35	2,803	2,838	416	427

Month, Year	Flow mgd	Ammonia kg N/day*	TKN kg N/day*	NOx kg N/day	Total N kg N/day**	Ortho-P kg P/day	Total P kg P/day
May-17	23.2	11	45	2,871	2,916	432	447
Jun-17	21.2	11	34	2,276	2,310	359	376
Jul-17	17.9	28	12	2,011	2,023	327	356
Aug-17	16.3	15	4	1,807	1,811	278	292
Sep-17	15.9	2	25	1,588	1,612	274	300
Oct-17	14.2	2	29	1,670	1,699	293	309
Nov-17	17.5	2	16	1,976	1,992	323	329
Dec-17	17.4	4	21	1,969	1,990	312	316
Jan-18	20.8	8	19	2,251	2,270	330	352
Feb-18	19.3	4	13	2,185	2,199	337	353
Mar-18	21.2	23	18	2,533	2,551	359	384
Apr-18	21.2	16	55	2,429	2,484	365	387
May-18	19.8	73	16	2,226	2,243	368	393
Jun-18	18.9	12	6	2,026	2,031	348	366
Dry Season Average	**20.4**	**18**	**32**	**2,305**	**2,337**	**375**	**389**
Dry Season Trend * **	**Down**	**None**	**Down**	**None**	**None**		**None**
Wet Season Average	**21.1**	**12**	**76**	**2,342**	**2,418**	**349**	**366**
Average Annual	**20.8**	**15**	**58**	**2,327**	**2,384**	**360**	**376**

* For instances when ammonia is greater than TKN values, this is attributed to TKN having a lower method detection limit than ammonia.

** The Total Nitrogen value is calculated by adding the TKN and the NOx values.

*** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

17 Sanitary District No. 5 of Marin County - Paradise Cove Treatment Plant

The Paradise Cove Treatment Plant discharges to the Central Bay. The service area has approximately 65 service connections. The plant has a permitted ADWF capacity of 0.040 mgd and it has currents flows of approximately 0.013 mgd ADWF. The plant performs secondary treatment using an activated sludge treatment process.

The plant is classified as a minor discharger (<1 mgd permitted capacity) and thus not required to sample as frequently as the major dischargers (>1 mgd permitted capacity). The minor dischargers are required to sample twice per year under the Nutrient Watershed Permit. As a result, there are several months of nutrient data gaps, in particular from July 2013 through July 2017.

The following observations are made based upon the figures and table in the subsequent pages:

- Flow values are provided over the entire study period. The remaining nutrient species only have monthly sampling for the first year of sampling, followed by occasional sampling thereafter.
- The plant occasionally nitrifies as evidenced by ammonia values of less than 0.2 mg N/L.
- During months of nitrification, NOx is the majority of the nitrogen species discharged. During months of no nitrification, ammonia is the majority of the nitrogen species discharged.
- Ortho-P values are routinely greater than TP values. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations are wide ranging from approximately 2.2 to 16 mg P/L. Typical effluent TP concentrations range from 4 to 6 mg P/L.

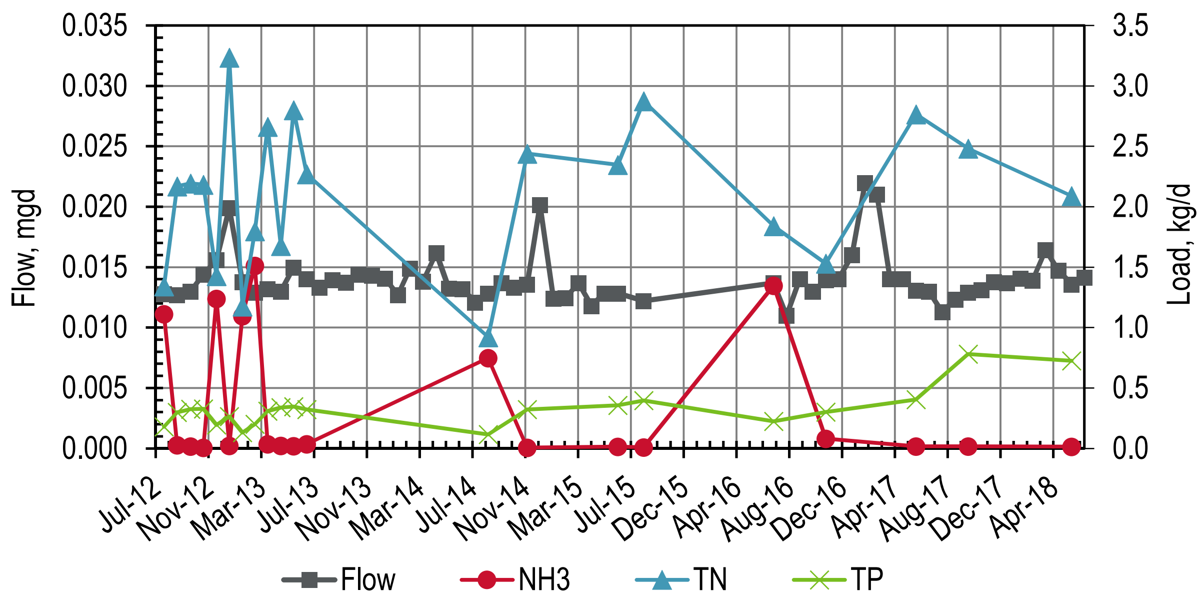

Figure 17-1. Paradise Cove Monthly Flows and Loads

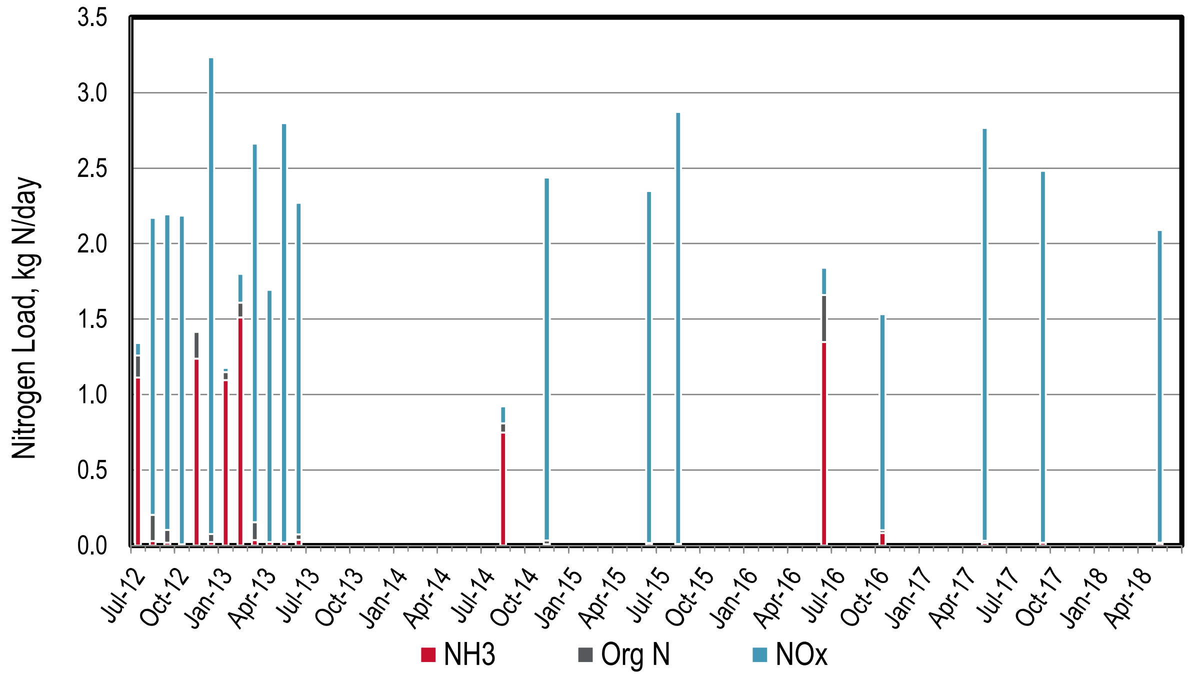

Figure 17-2. Paradise Cove Monthly Nitrogen Loads

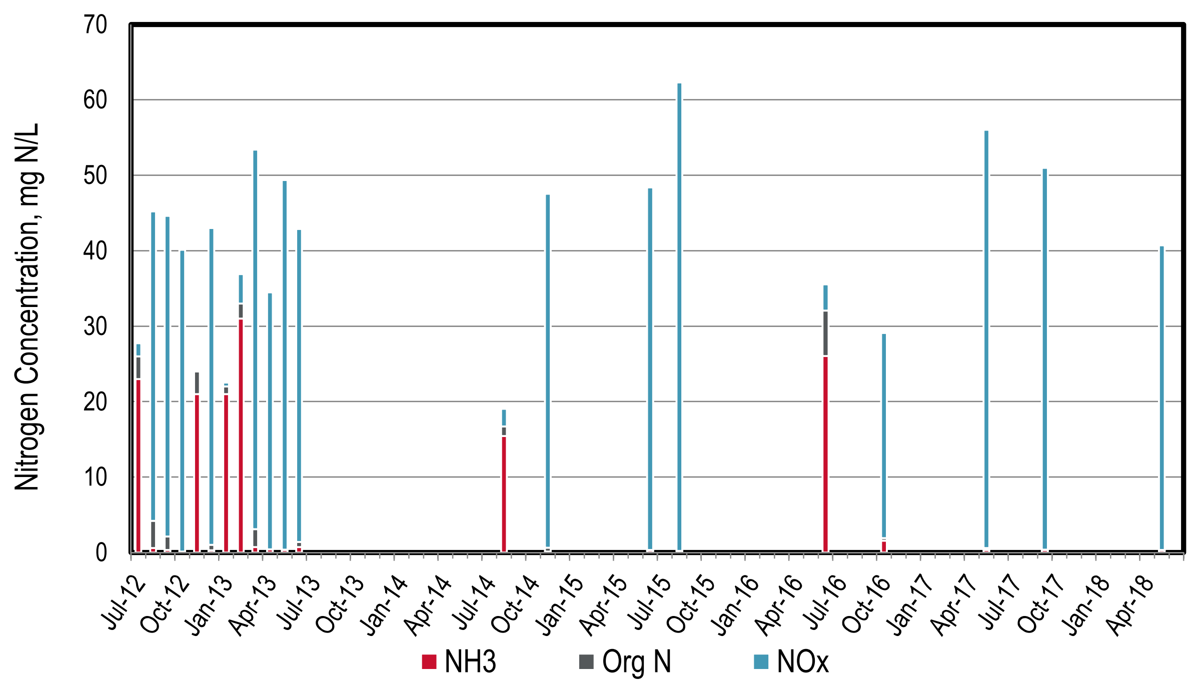

Figure 17-3. Paradise Cove Monthly Nitrogen Concentrations

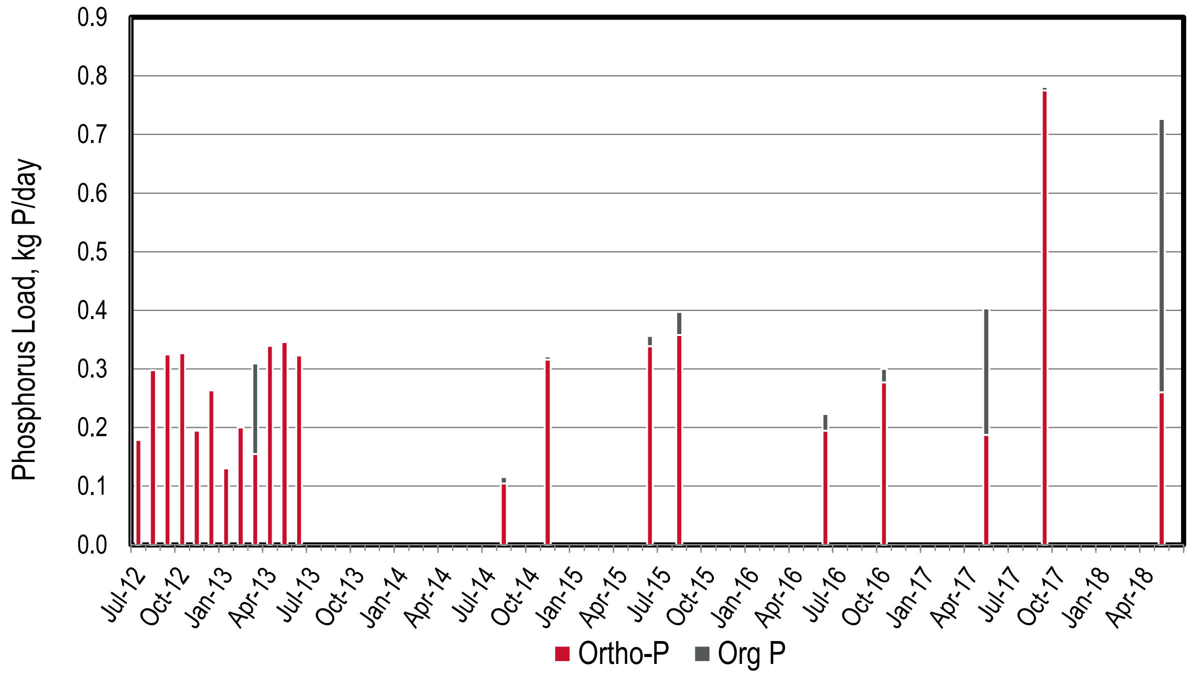

Figure 17-4. Paradise Cove Monthly Phosphorus Loads

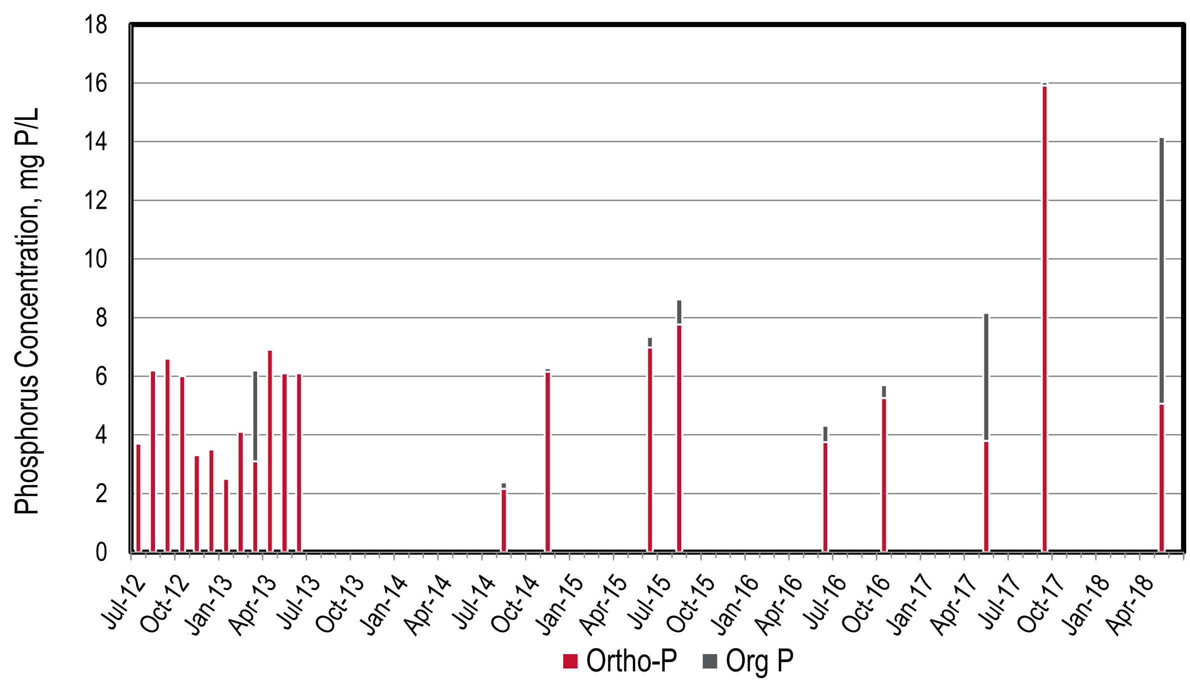

Figure 17-5. Paradise Cove Monthly Phosphorus Concentrations

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

Table 17-1. Paradise Cove Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jul-12	0.013	1.1	1.3	0.1	1.3	0.2	0.2
Aug-12	0.013	0.0	0.2	2.0	2.2	0.4	0.3
Sep-12	0.013	0.0	0.1	2.1	2.2	0.4	0.3
Oct-12	0.014	0.0	0.0	2.2	2.2	0.4	0.3
Nov-12	0.016	1.2	1.4	0.0	1.4	0.2	0.2
Dec-12	0.020	0.0	0.1	3.2	3.2	0.5	0.3
Jan-13	0.014	1.1	1.1	0.0	1.2	0.2	0.1
Feb-13	0.013	1.5	1.6	0.2	1.8	0.2	0.2
Mar-13	0.013	0.0	0.2	2.5	2.7	0.2	0.3
Apr-13	0.013	0.0	0.0	1.7	1.7	0.5	0.3
May-13	0.015	0.0	0.0	2.8	2.8	0.5	0.3
Jun-13	0.014	0.0	0.1	2.2	2.3	0.4	0.3
Jul-13	0.013						
Aug-13	0.014						
Sep-13	0.014						
Oct-13	0.014						
Nov-13	0.014						
Dec-13	0.014						
Jan-14	0.013						
Feb-14	0.015						
Mar-14	0.014						
Apr-14	0.016						
May-14	0.013						
Jun-14	0.013						
Jul-14	0.012						
Aug-14	0.013	0.7	0.8	0.1	0.9	0.1	0.1
Sep-14	0.014						
Oct-14	0.013						
Nov-14	0.014	0.0	0.0	2.4	2.4	0.3	0.3

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Dec-14	0.020						
Jan-15	0.012						
Feb-15	0.012						
Mar-15	0.014						
Apr-15	0.012						
May-15	0.013						
Jun-15	0.013	0.0	0.0	2.3	2.3	0.3	0.4
Jul-15	0.012						
Aug-15	0.012	0.0	0.0	2.9	2.9	0.4	0.4
Sep-15	0.012						
Oct-15	0.013						
Nov-15	0.013						
Dec-15	0.014						
Jan-16	0.018						
Feb-16	0.012						
Mar-16	0.017						
Apr-16	0.012						
May-16	0.012						
Jun-16	0.012	1.3	1.7	0.2	1.8	0.2	0.2
Jul-16	0.011						
Aug-16	0.014						
Sep-16	0.013						
Oct-16	0.014	0.1	0.1	1.4	1.5	0.3	0.3
Nov-16	0.014						
Dec-16	0.016						
Jan-17	0.022						
Feb-17	0.021						
Mar-17	0.014						
Apr-17	0.014						
May-17	0.013	0.0	0.0	2.7	2.8	0.2	0.4

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jun-17	0.013						
Jul-17	0.011						
Aug-17	0.012						
Sep-17	0.013	0.0	0.0	2.5	2.5	0.8	0.8
Oct-17	0.013						
Nov-17	0.014						
Dec-17	0.014						
Jan-18	0.014						
Feb-18	0.014						
Mar-18	0.016						
Apr-18	0.015						
May-18	0.014	0.0	0.0	2.1	2.1	0.3	0.7
Jun-18	0.014						
Dry Season Average	**0.013**	**0.3**	**0.4**	**1.8**	**2.2**	**0.3**	**0.4**
**Dry Season Trend ** **	**None**	***	***	***	***	***	***
Wet Season Average	**0.015**	**0.4**	**0.5**	**1.5**	**2.0**	**0.3**	**0.3**
Average Annual	**0.014**	**0.4**	**0.4**	**1.7**	**2.1**	**0.3**	**0.3**

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis.

*** No statistical dry season trending analysis was performed on nutrient species due to the limited number of samples required for minor dischargers.

18 City of Petaluma

Petaluma discharges to Petaluma River that is connected to San Pablo Bay. The plant has approximately 25,300 service connections and it has a permitted capacity of 6.7 mgd ADWF. The plant performs nitrogen and phosphorus removal using oxidation ditches coupled with treatment wetlands and oxidation ponds. The oxidation ponds also serve as equalization during peak wet weather flow. Effluent flow that is not discharged to the Petaluma River is diverted to recycled water whenever possible. Discharge to Petaluma River is prohibited May 1 through October 20, except when the Facility inflow exceeds the recycled water distribution and storage system capacity.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the average monthly values table, there are no emerging dry season trends as Petaluma does not discharge during the dry season.
- Wet season trends analyzed (data not shown) and there are no emerging trends.
- Both nitrogen and phosphorus loads typically increase with flow during wet weather events.
- NOx and organic nitrogen are the majority of the nitrogen species discharged as would be expected since this plant nitrifies. The plant has reduced their total nitrogen and NOx discharge loads in 2017/2018 likely due to fewer wet weather events.
- The plant meets Level 3 total nitrogen concentration limits (i.e., 6 mg N/L) developed under the Bay Area Clean Water Agencies Scoping and Evaluation Plan for all but two months.
- Ortho-P values are routinely greater than TP values. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations range from 0.5 to 3.8 mg P/L, which suggests P removal. The removal mechanism is attributed to biological P removal in the oxidation ditch.

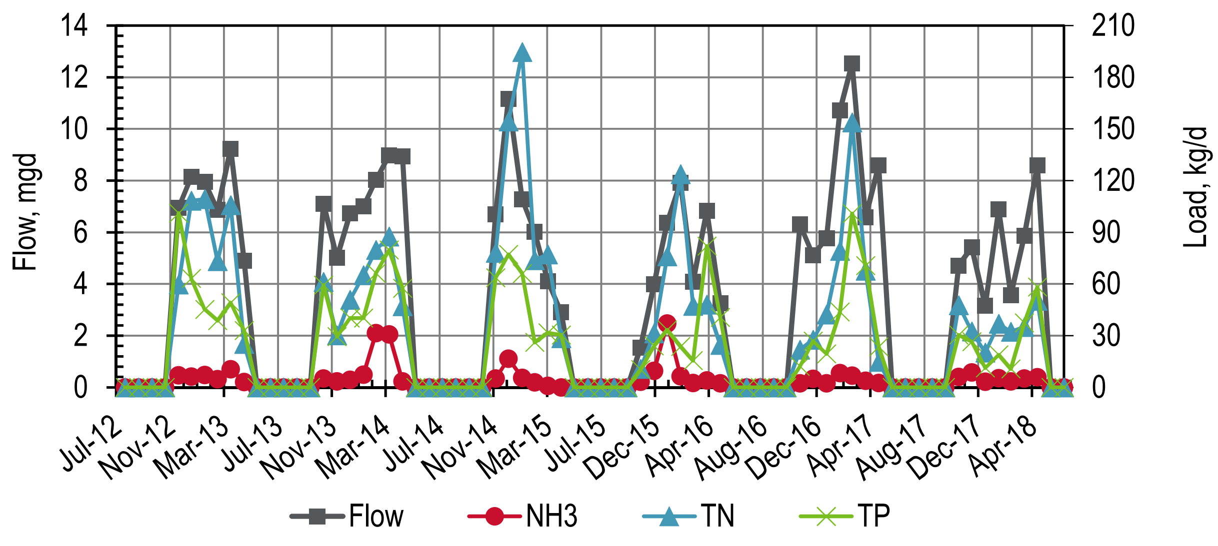

Figure 18-1. Petaluma Monthly Flows and Loads

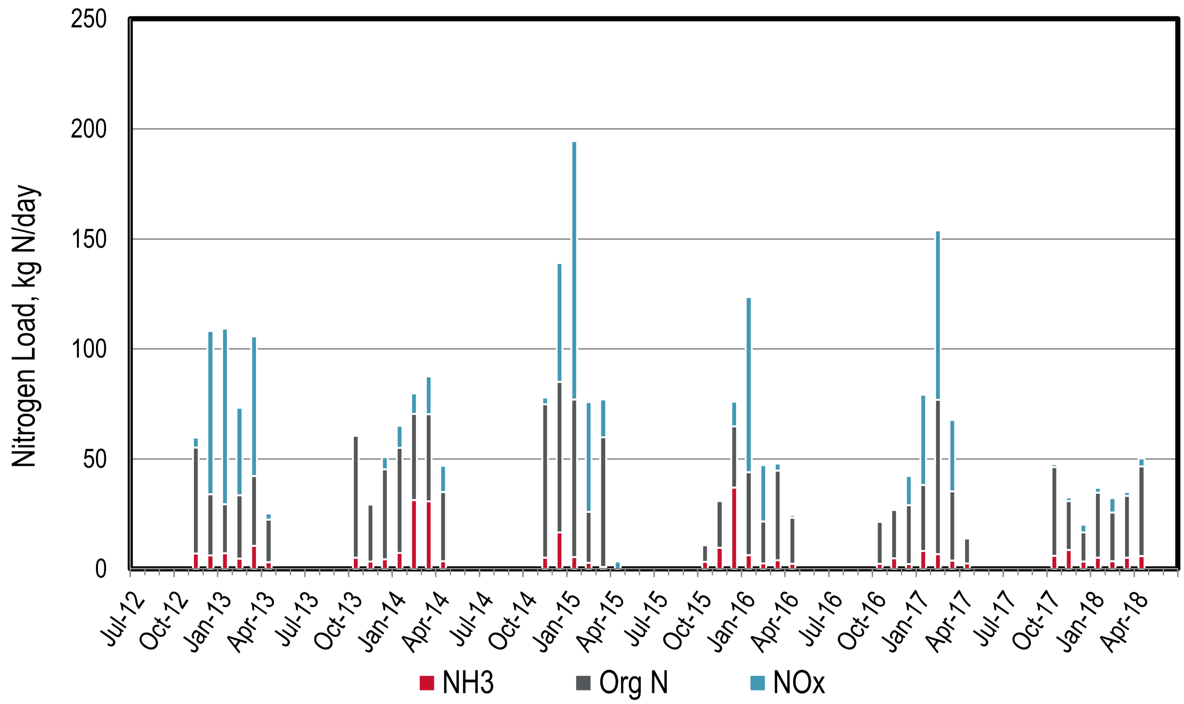

Figure 18-2. Petaluma Monthly Nitrogen Loads

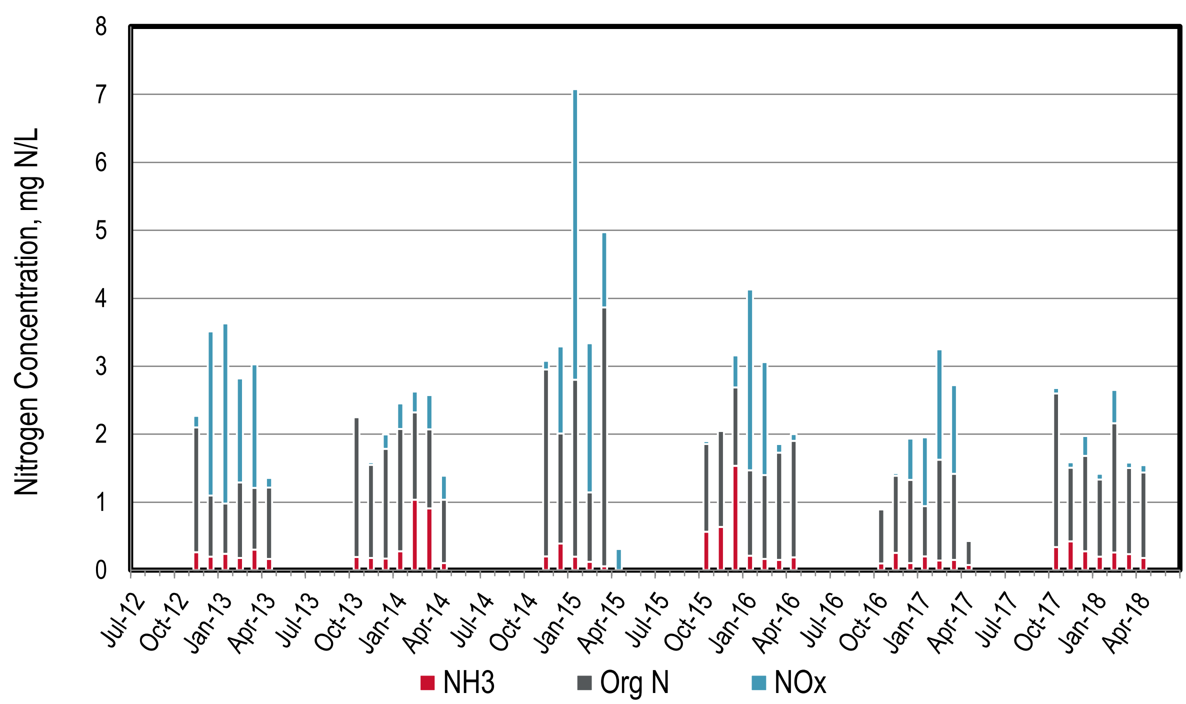

Figure 18-3. Petaluma Monthly Nitrogen Concentrations

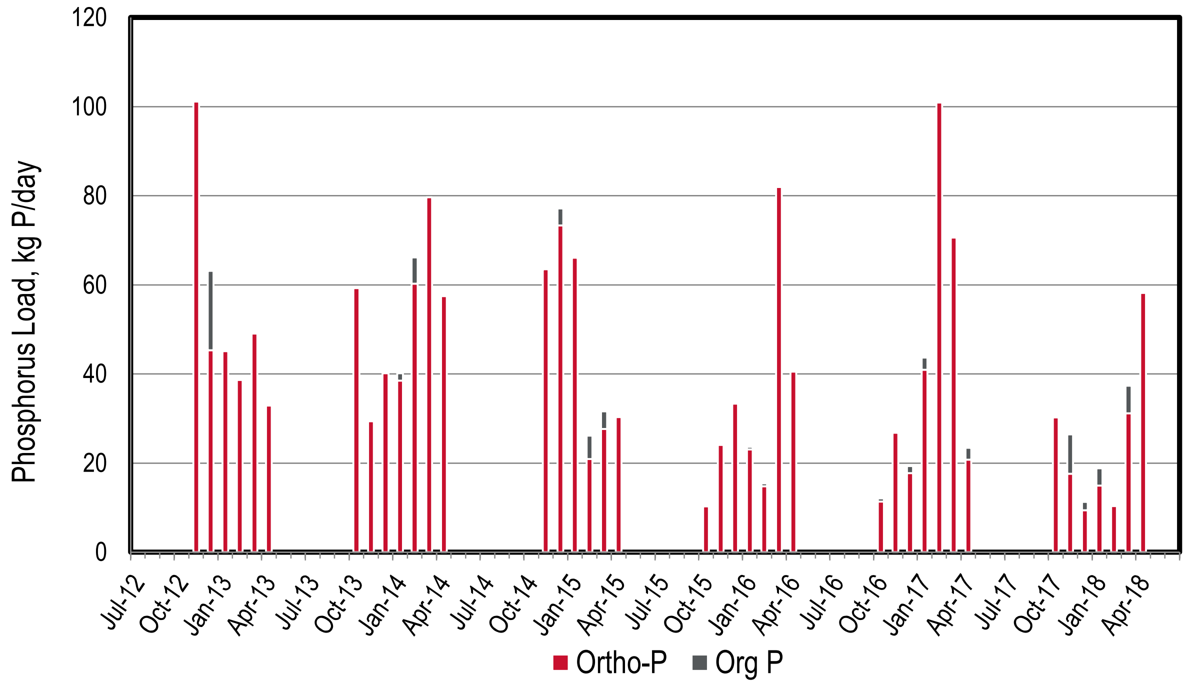

Figure 18-4. Petaluma Monthly Phosphorus Loads

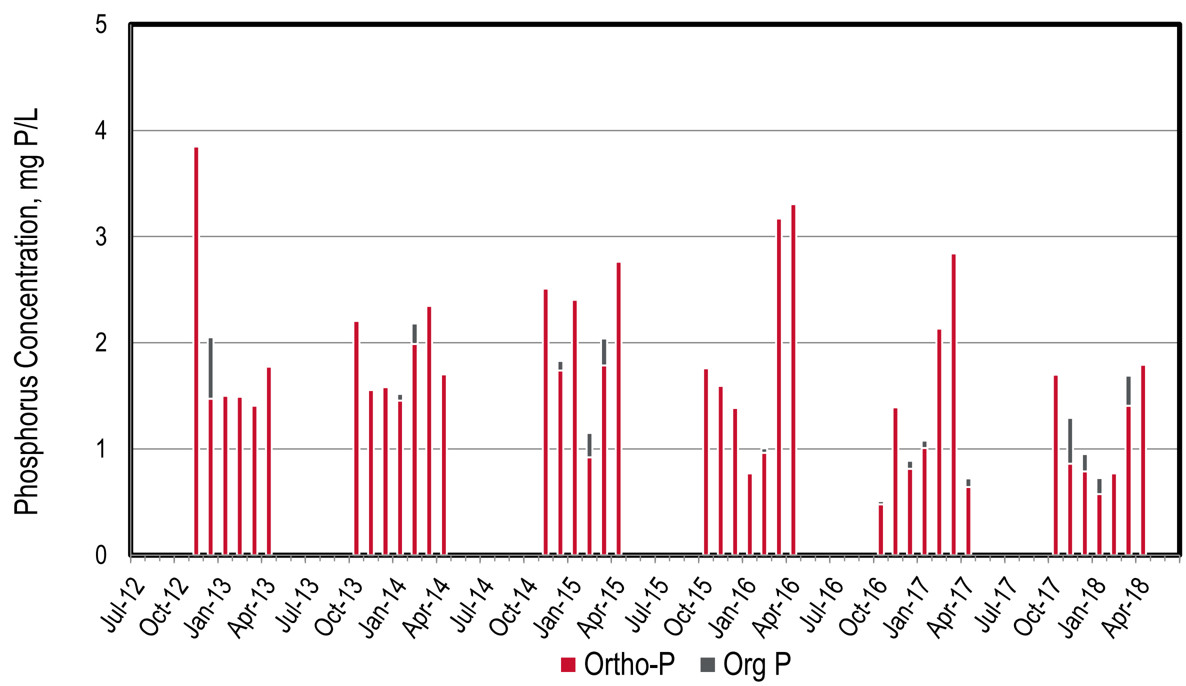

Figure 18-5. Petaluma Monthly Phosphorus Concentrations

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

Table 18-1. Petaluma Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jul-12	0.0	0	0	0	0	0	0
Aug-12	0.0	0	0	0	0	0	0
Sep-12	0.0	0	0	0	0	0	0
Oct-12	0.0	0	0	0	0	0	0
Nov-12	7.0	7	55	4	60	106	101
Dec-12	8.2	6	34	74	108	45	63
Jan-13	8.0	7	29	80	109	45	45
Feb-13	6.9	5	33	40	73	45	39
Mar-13	9.2	11	42	63	106	51	49
Apr-13	4.9	3	23	3	25	38	33
May-13	0.0	0	0	0	0	0	0
Jun-13	0.0	0	0	0	0	0	0
Jul-13	0.0	0	0	0	0	0	0
Aug-13	0.0	0	0	0	0	0	0
Sep-13	0.0	0	0	0	0	0	0
Oct-13	7.1	5	61	1	61	61	59
Nov-13	5.0	3	29	1	30	30	29
Dec-13	6.7	4	45	5	51	45	40
Jan-14	7.0	7	55	10	65	39	40
Feb-14	8.0	31	70	9	80	60	66
Mar-14	9.0	31	70	17	87	81	80
Apr-14	8.9	4	35	12	47	63	57
May-14	0.0	0	0	0	0	0	0
Jun-14	0.0	0	0	0	0	0	0
Jul-14	0.0	0	0	0	0	0	0
Aug-14	0.0	0	0	0	0	0	0
Sep-14	0.0	0	0	0	0	0	0
Oct-14	0.0	0	0	0	0	0	0
Nov-14	6.7	5	75	3	78	66	64

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Dec-14	11.2	17	85	54	154	73	77
Jan-15	7.3	6	77	117	195	66	66
Feb-15	6.0	3	26	50	74	21	26
Mar-15	4.1	1	60	17	77	28	32
Apr-15	2.9		25	3	28	30	30
May-15	0.0	0	0	0	0	0	0
Jun-15	0.0	0	0	0	0	0	0
Jul-15	0.0	0	0	0	0	0	0
Aug-15	0.0	0	0	0	0	0	0
Sep-15	0.0	0	0	0	0	0	0
Oct-15	1.5	1	2	0	2	1	1
Nov-15	4.0	10	31	0	31	24	24
Dec-15	6.4	37	65	11	76	33	33
Jan-16	7.9	6	44	80	124	23	24
Feb-16	4.1	3	22	26	47	15	15
Mar-16	6.8	4	45	3	48	87	82
Apr-16	3.2	0	2	0	2	0	0
May-16	0.0	0	0	0	0	0	0
Jun-16	0.0	0	0	0	0	0	0
Jul-16	0.0	0	0	0	0	0	0
Aug-16	0.0	0	0	0	0	0	0
Sep-16	0.0	0	0	0	0	0	0
Oct-16	6.3	2	21	0	22	11	12
Nov-16	5.1	5	27	1	28	30	27
Dec-16	5.8	2	29	13	42	18	19
Jan-17	10.7	8	38	41	79	41	44
Feb-17	12.5	7	77	77	154	101	101
Mar-17	6.6	4	35	32	68	82	71
Apr-17	8.6	3	14	1	15	21	23
May-17	0.0	0	0	0	0	0	0

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jun-17	0.0	0	0	0	0	0	0
Jul-17	0.0	0	0	0	0	0	0
Aug-17	0.0	0	0	0	0	0	0
Sep-17	0.0	0	0	0	0	0	0
Oct-17	4.7	6	46	1	48	30	30
Nov-17	5.4	9	31	2	32	18	26
Dec-17	3.1	3	17	3	20	9	11
Jan-18	6.9	5	35	2	37	15	19
Feb-18	3.6	4	26	7	32	10	11
Mar-18	5.9	5	33	2	35	31	37
Apr-18	8.6	6	47	4	50	58	58
May-18	0.0	0	0	0	0	0	0
Jun-18	0.0	0	0	0	0	0	0
Dry Season Average	**0.0**	**0**	**0**	**0**	**0**	**0**	**0**
Dry Season Trend **	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Wet Season Average	**6.2**	**7**	**39**	**21**	**60**	**41**	**41**
Average Annual	**3.6**	**4**	**23**	**12**	**35**	**24**	**24**

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

19 City of Pinole

The Pinole-Hercules Water Pollution Control Plant discharges to San Pablo Bay. The plant has approximately 11,215 service connections; it has a permitted capacity of 4.06 mgd ADWF and a peak wet weather capacity of 20.0 mgd. The current flow averages about 2.4 mgd ADWF.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the table with the average monthly values, there appears to be an emerging dry season downward trend for flow, NOx, and TP loads.
- Nitrogen and phosphorus loads do not track with the flows as seen at the majority of the other plants.
- With the exception of ammonia, nutrient species were not sampled in July and August 2014.
- Ammonia is the majority of the nitrogen species discharged, regardless of season. This would be expected since this plant does not fully nitrify. A portion of the ammonia load is partially nitrified to NOx. The ammonia loads increased in the 2016 dry season due to operational changes at the plant (decrease in MCRT and low dissolved oxygen levels to remedy floating solids in the secondary clarifiers).
- Ortho-P values are routinely greater than TP values. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations from 0.5 to 5.1 mg P/L.

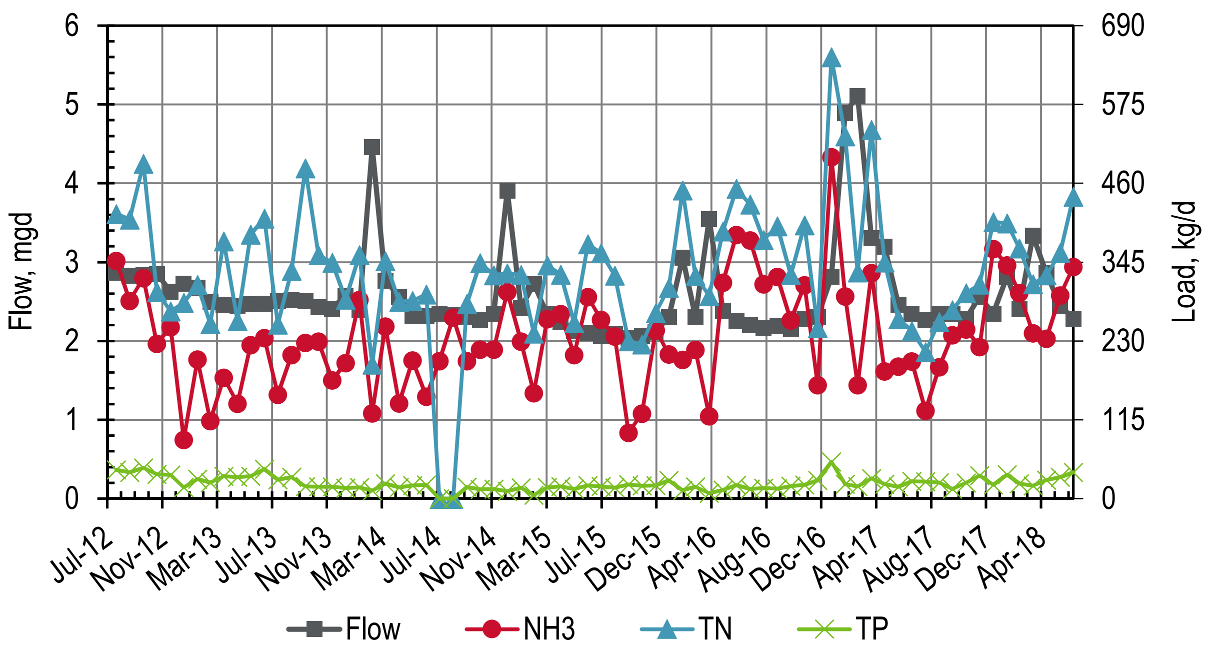

Figure 19-1. Pinole Monthly Flows and Loads

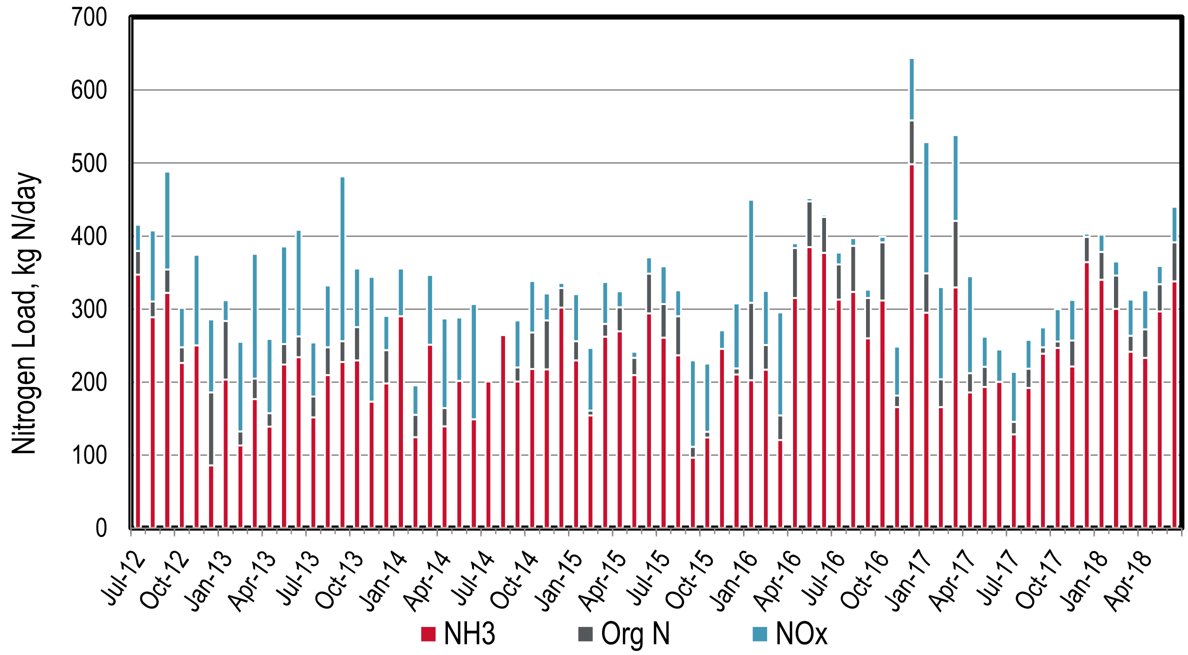

Figure 19-2. Pinole Monthly Nitrogen Loads

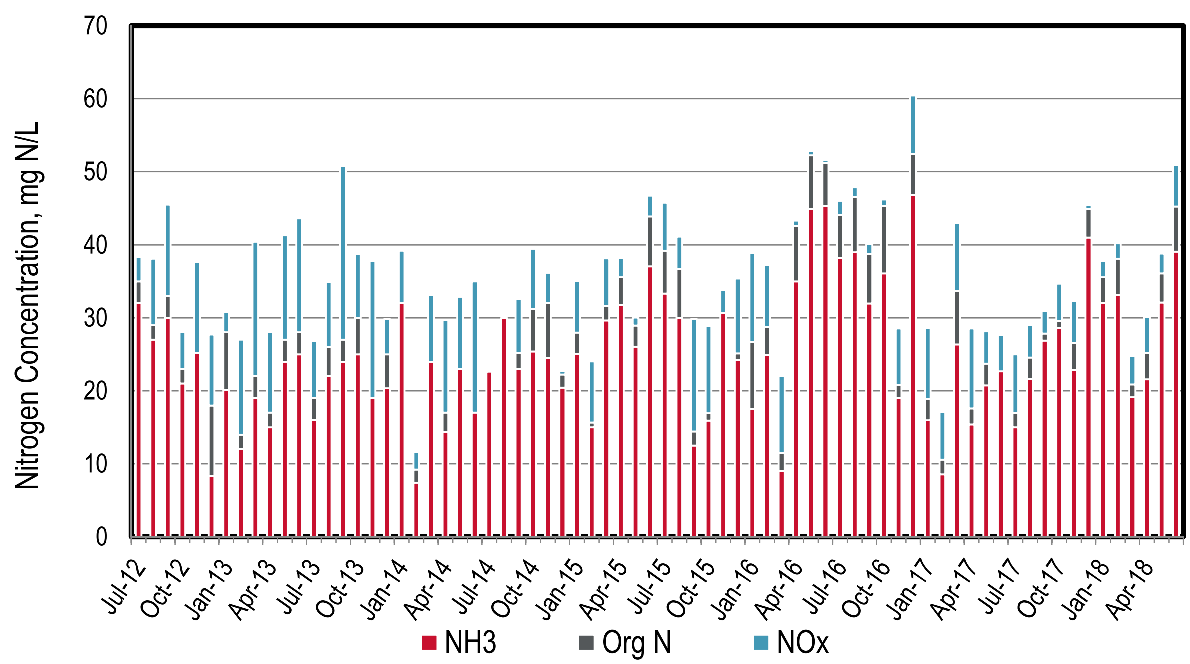

Figure 19-3. Pinole Monthly Nitrogen Concentrations

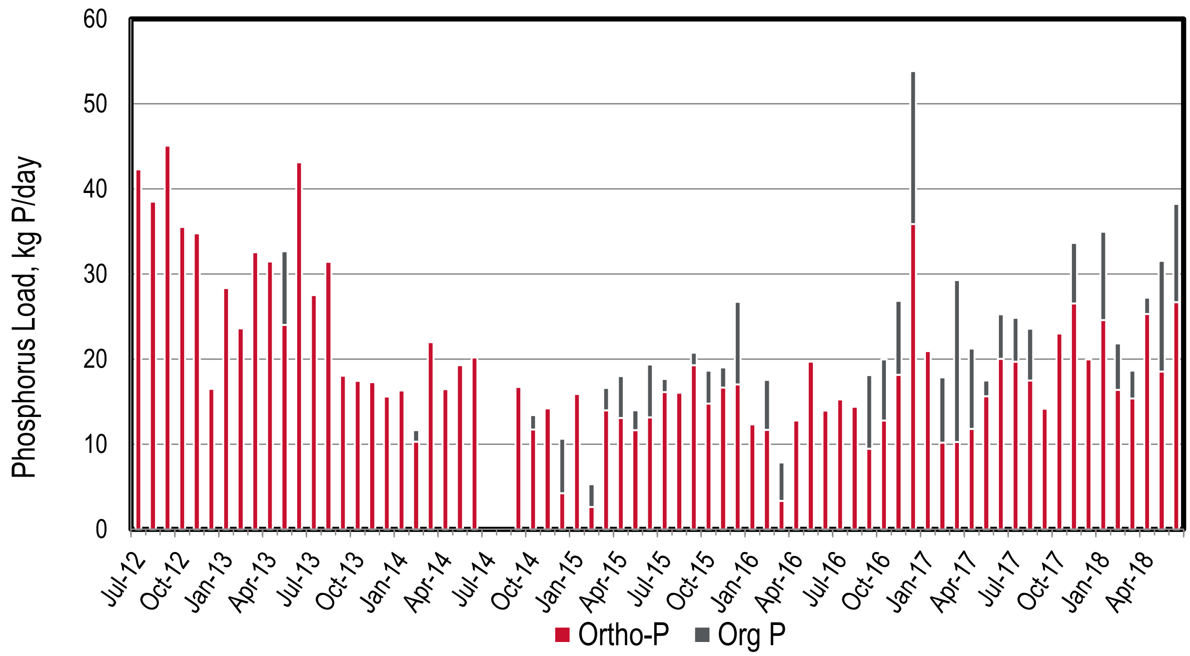

Figure 19-4. Pinole Monthly Phosphorus Loads

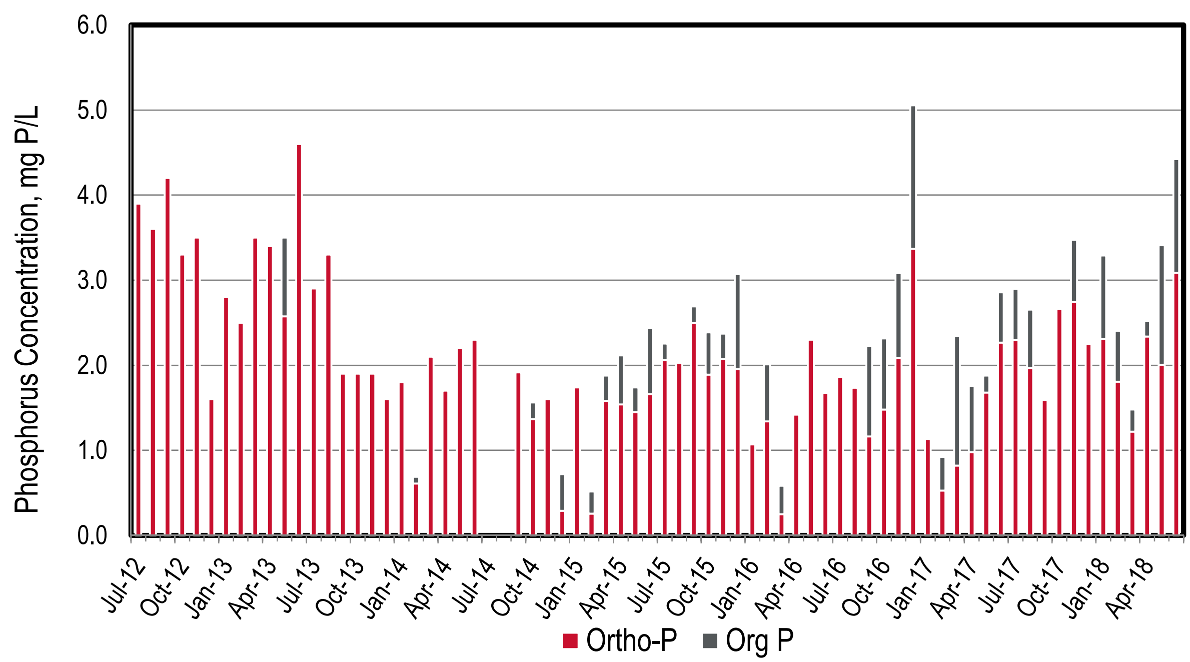

Figure 19-5. Pinole Monthly Phosphorus Concentrations

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

Table 19-1. Pinole Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jul-12	2.9	347	380	36	416	62	42
Aug-12	2.8	289	310	97	408	49	39
Sep-12	2.8	322	354	134	488	66	45
Oct-12	2.9	226	248	54	302	50	36
Nov-12	2.6	250	149	124	273	52	35
Dec-12	2.7	86	186	100	286	37	17
Jan-13	2.7	203	284	28	312	32	28
Feb-13	2.5	113	132	123	255	34	24
Mar-13	2.5	177	205	171	376	50	33
Apr-13	2.5	139	157	102	259	60	31
May-13	2.5	224	252	134	386	24	33
Jun-13	2.5	234	262	146	409	59	43
Jul-13	2.5	152	180	74	254	40	28
Aug-13	2.5	210	248	85	332	45	31
Sep-13	2.5	228	256	226	482	40	18
Oct-13	2.4	230	276	80	355	29	17
Nov-13	2.4	173	173	171	344	32	17
Dec-13	2.6	198	244	47	291	25	16
Jan-14	2.4	290	290	65	356	25	16
Feb-14	4.5	125	155	40	196	10	12
Mar-14	2.8	251	251	95	347	31	22
Apr-14	2.6	139	165	123	287	21	16
May-14	2.3	202	202	87	289	31	19
Jun-14	2.3	149	140	158	298	35	20
Jul-14	2.4	201	--	--	--	--	--
Aug-14	2.3	264	--	--	--	--	--
Sep-14	2.3	201	220	64	285	--	17
Oct-14	2.3	218	268	70	344	12	13
Nov-14	2.4	218	284	37	326	18	14

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Dec-14	3.9	302	329	7	329	4	11
Jan-15	2.4	230	256	64	327	16	16
Feb-15	2.7	154	161	86	241	3	5
Mar-15	2.3	262	280	58	341	14	17
Apr-15	2.3	270	303	22	327	13	18
May-15	2.1	210	233	9	256	12	14
Jun-15	2.1	294	348	22	372	13	19
Jul-15	2.1	261	307	51	359	16	18
Aug-15	2.1	237	290	35	326	16	16
Sep-15	2.0	96	111	119	230	19	21
Oct-15	2.1	124	132	93	225	15	19
Nov-15	2.1	246	246	25	271	17	19
Dec-15	2.3	211	219	89	308	17	27
Jan-16	3.1	203	309	141	450	13	12
Feb-16	2.3	217	251	74	325	12	18
Mar-16	3.6	121	154	141	296	3	8
Apr-16	2.4	315	383	7	390	14	13
May-16	2.3	385	447	5	452	40	20
Jun-16	2.2	377	426	3	429	16	14
Jul-16	2.2	313	361	16	377	29	15
Aug-16	2.2	324	387	11	397	24	14
Sep-16	2.2	260	315	11	326	9	18
Oct-16	2.3	312	392	8	399	13	20
Nov-16	2.3	166	182	67	249	18	27
Dec-16	2.8	498	558	86	644	36	54
Jan-17	4.9	295	349	180	529	22	21
Feb-17	5.1	166	204	126	330	10	18
Mar-17	3.3	330	421	117	538	10	29
Apr-17	3.2	186	212	133	345	12	21
May-17	2.5	193	221	41	262	16	17

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jun-17	2.3	200	200	44	245	20	25
Jul-17	2.3	128	146	69	214	20	25
Aug-17	2.4	192	218	39	258	17	24
Sep-17	2.4	239	248	27	275	15	14
Oct-17	2.3	247	256	44	300	23	23
Nov-17	2.6	221	257	56	313	27	34
Dec-17	2.4	364	399	5	403	41	20
Jan-18	2.8	340	378	24	402	25	35
Feb-18	2.4	301	346	19	365	16	22
Mar-18	3.3	242	263	49	313	15	19
Apr-18	2.9	233	272	54	326	25	27
May-18	2.4	297	334	25	359	19	32
Jun-18	2.3	338	391	49	440	27	38
Dry Season Average	**2.4**	**246**	**260**	**61**	**321**	**26**	**23**
Dry Season Trend **	**Down**	**None**	**None**	**Down**	**None**	**-**	**Down**
Wet Season Average	**2.8**	**228**	**261**	**76**	**338**	**23**	**21**
Average Annual	**2.6**	**236**	**268**	**72**	**340**	**25**	**23**

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

20 Rodeo Sanitary District

Rodeo discharges to San Pablo Bay. The plant services approximately 8,900 people and it has a permitted capacity of 1.14 mgd ADWF. The current plant flows are approximately 0.5 mgd. The plant performs nitrification and phosphorus removal using an activated sludge process.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the table with the average monthly values, no emerging dry season trends emerge.
- Total nitrogen loads generally increase with flow during wet weather events.
- NOx is the majority of the nitrogen species discharged as would be expected since this plant nitrifies. A portion of ammonia occasionally bleeds through year round.
- Ortho-P values are routinely greater than TP values. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations range from 0.3 to 7.5 mg P/L, This suggests occasional P removal as typical effluent TP concentrations are 4 to 6 mg P/L. The removal mechanism is thought to be the anaerobic selector in the activated sludge process.

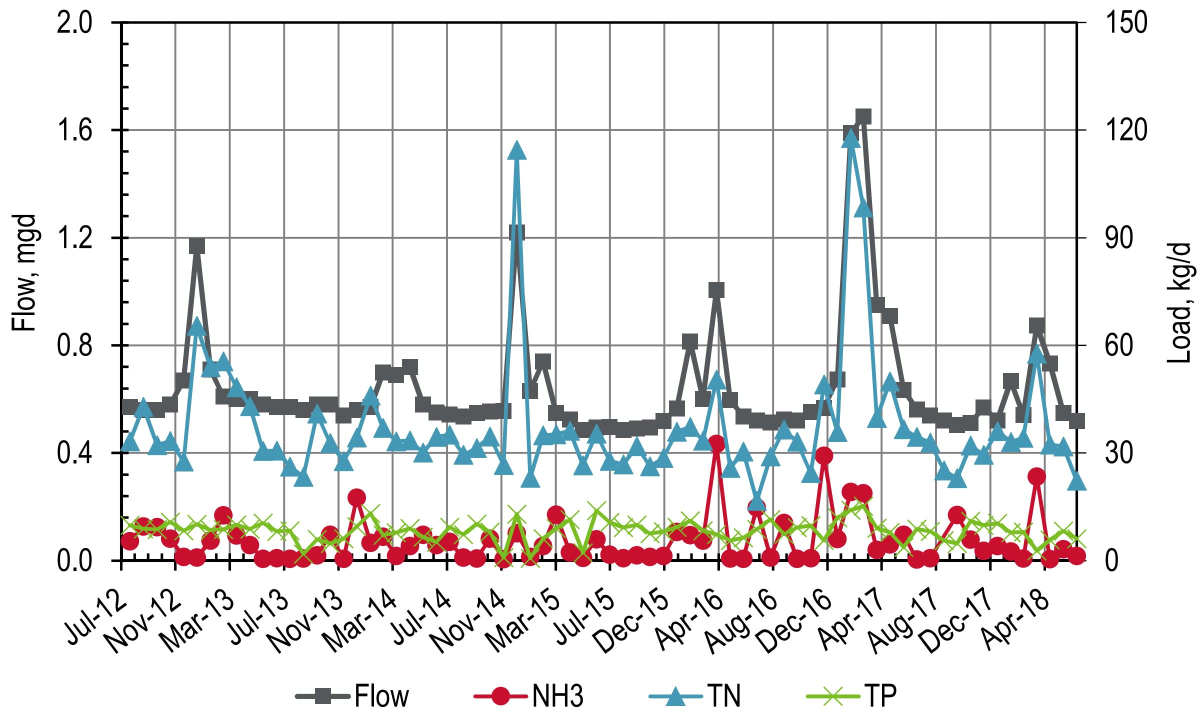

Figure 20-1. Rodeo Monthly Flows and Loads

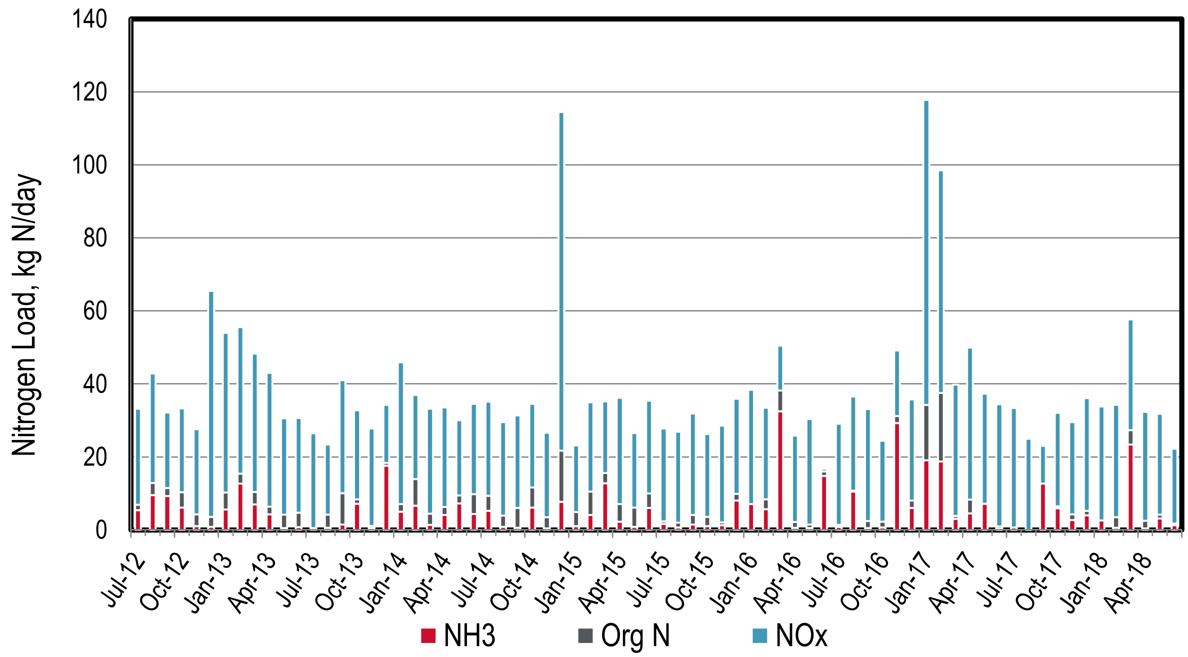

Figure 20-2. Rodeo Monthly Nitrogen Loads

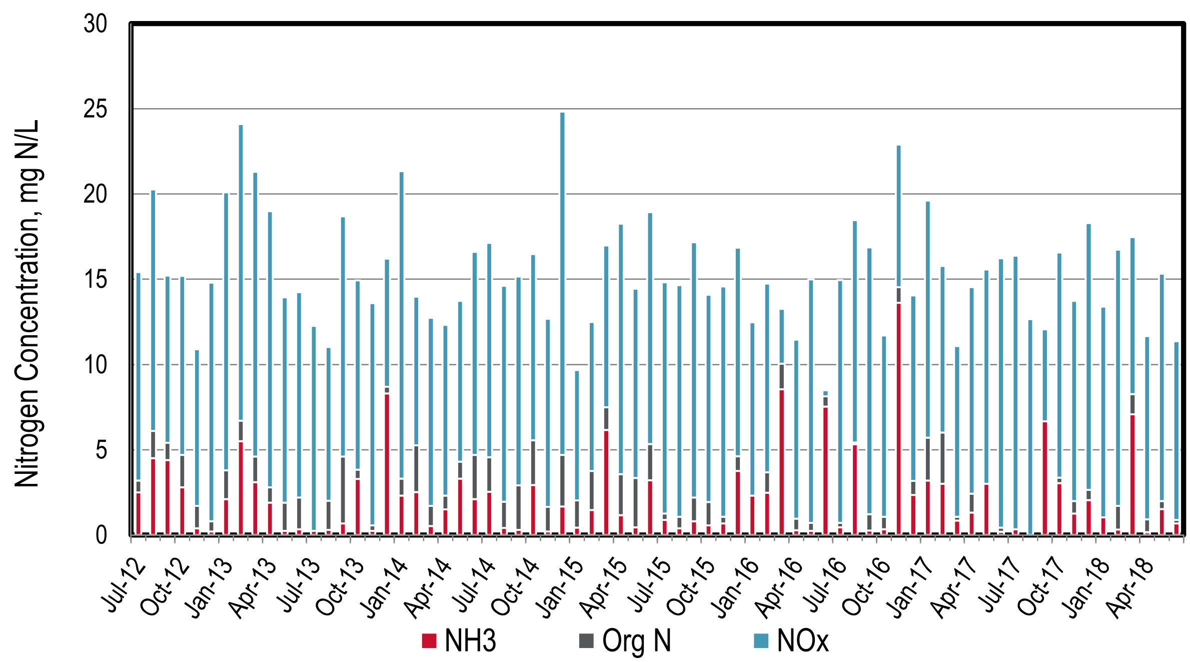

Figure 20-3. Rodeo Monthly Nitrogen Concentrations

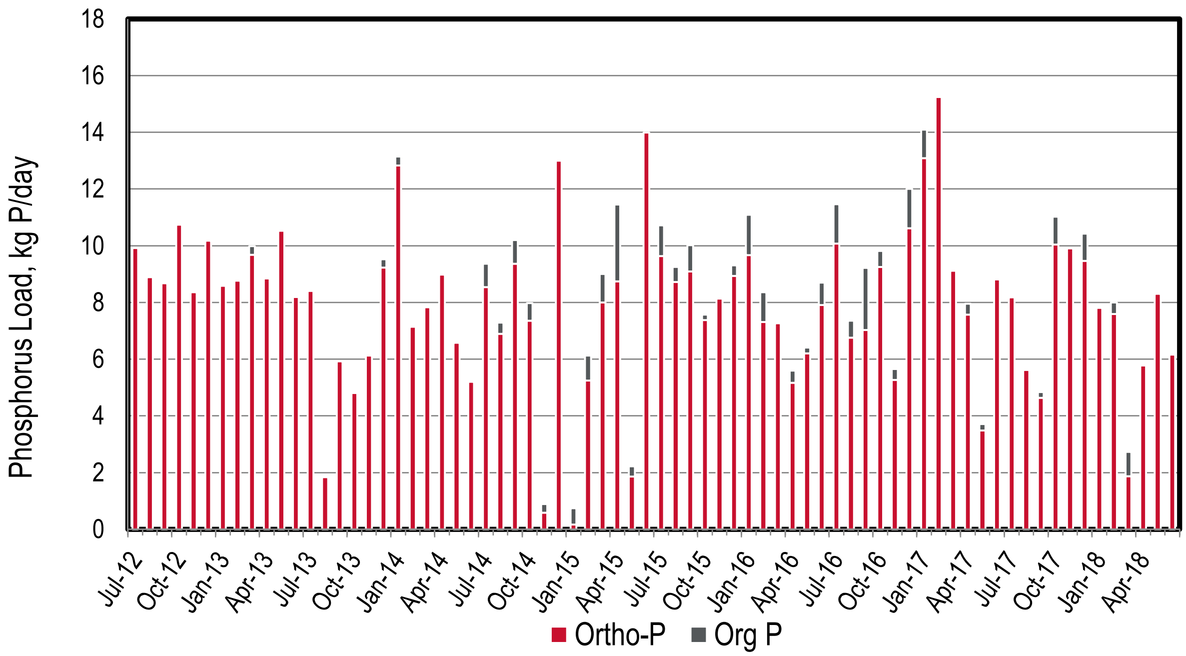

Figure 20-4. Rodeo Monthly Phosphorus Loads

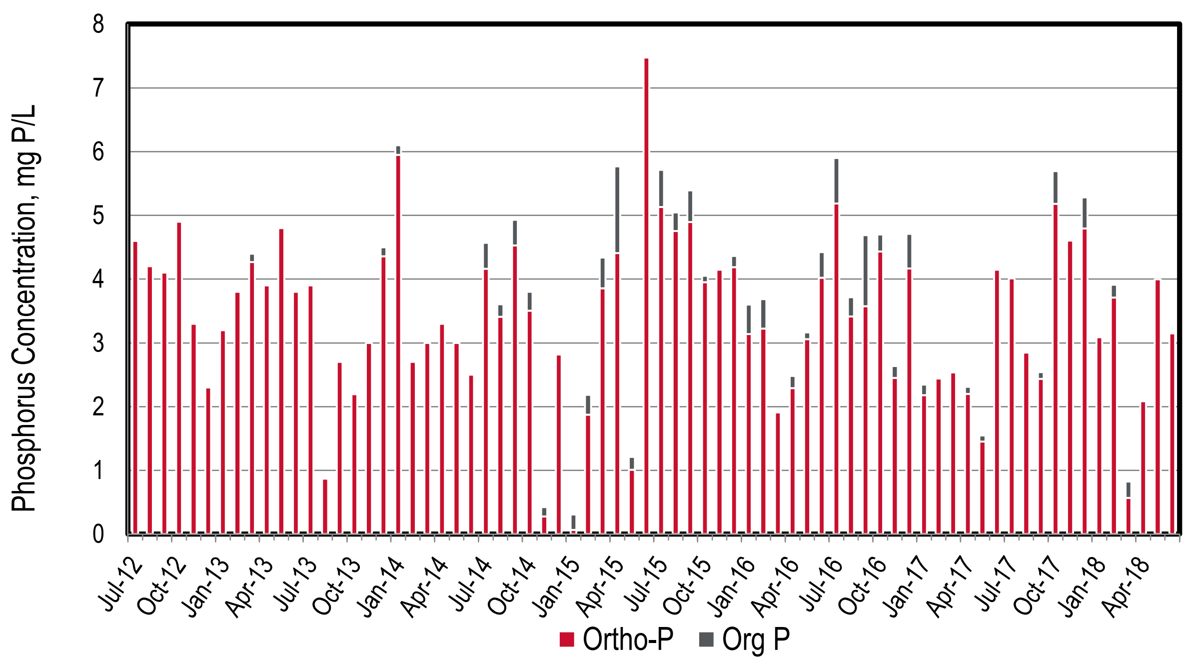

Figure 20-5. Rodeo Monthly Phosphorus Concentrations

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

Table 20-1. Rodeo Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jul-12	0.6	5	7	26	33	19	10
Aug-12	0.6	10	13	30	43	20	9
Sep-12	0.6	9	11	21	32	22	9
Oct-12	0.6	6	10	23	33	14	11
Nov-12	0.7	1	4	23	28	13	8
Dec-12	1.2	1	4	62	65	32	10
Jan-13	0.7	6	10	44	54	10	9
Feb-13	0.6	13	15	40	56	9	9
Mar-13	0.6	7	10	38	48	10	10
Apr-13	0.6	4	6	37	43	10	9
May-13	0.6	1	4	26	31	13	11
Jun-13	0.6	1	5	26	31	9	8
Jul-13	0.6	1	0	26	26	10	8
Aug-13	0.6	1	4	19	23	2	2
Sep-13	0.6	1	10	31	41	8	6
Oct-13	0.6	7	8	24	33	5	5
Nov-13	0.5	1	1	27	28	7	6
Dec-13	0.6	18	18	16	34	9	10
Jan-14	0.6	5	7	39	46	13	13
Feb-14	0.7	7	14	23	37	16	7
Mar-14	0.7	1	4	29	33	14	8
Apr-14	0.7	4	6	27	34	18	9
May-14	0.6	7	9	21	30	8	7
Jun-14	0.6	4	10	25	35	5	5
Jul-14	0.5	5	9	26	35	9	9
Aug-14	0.5	1	4	26	30	7	7
Sep-14	0.5	1	6	25	31	9	10
Oct-14	0.6	6	12	23	35	7	8
Nov-14	0.6	0	3	23	27	1	1

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Dec-14	1.2	8	22	93	115	13	13
Jan-15	0.6	1	5	18	23	0	1
Feb-15	0.7	4	10	24	35	5	6
Mar-15	0.5	13	16	20	35	8	9
Apr-15	0.5	2	7	29	36	9	11
May-15	0.5	1	6	20	27	2	2
Jun-15	0.5	6	10	25	35	20	14
Jul-15	0.5	2	2	25	28	10	11
Aug-15	0.5	1	2	25	27	9	9
Sep-15	0.5	1	4	28	32	9	10
Oct-15	0.5	1	4	23	26	7	8
Nov-15	0.5	1	2	26	29	9	8
Dec-15	0.6	8	10	26	36	9	9
Jan-16	0.8	7	6	31	37	10	11
Feb-16	0.6	6	8	25	33	7	8
Mar-16	1.0	32	38	12	50	7	7
Apr-16	0.6	1	2	24	26	5	6
May-16	0.5	0	1	29	30	6	6
Jun-16	0.5	15	16	1	17	8	9
Jul-16	0.5	1	1	28	29	10	11
Aug-16	0.5	11	11	26	37	7	7
Sep-16	0.5	1	2	31	33	7	9
Oct-16	0.5	1	2	22	24	9	10
Nov-16	0.6	29	31	18	49	5	6
Dec-16	0.7	6	8	28	36	11	12
Jan-17	1.6	19	34	84	118	13	14
Feb-17	1.7	19	38	61	98	33	15
Mar-17	1.0	3	4	36	40	11	9
Apr-17	0.9	5	8	42	50	8	8
May-17	0.6	7	6	30	37	3	4

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jun-17	0.6	0	1	34	34	9	9
Jul-17	0.5	1	0***	33	33***	8	8
Aug-17	0.5	--****	0***	25	25***	6	6
Sep-17	0.5	13	13	10	23	5	5
Oct-17	0.5	6	6	26	32	10	11
Nov-17	0.6	3	4	25	30	12	10
Dec-17	0.5	4	5	31	36	9	10
Jan-18	0.7	3	2	31	33	8	8
Feb-18	0.5	1	3	31	34	8	8
Mar-18	0.9	23	27	30	58	2	3
Apr-18	0.7	0	3	30	32	6	6
May-18	0.5	3	4	28	32	8	8
Jun-18	0.5	1	2	21	22	6	6
Dry Season Average	**0.5**	**4**	**6**	**25**	**31**	**9**	**8**
Dry Season Trend **	**None**	**None**	**None**	**None**	**None**	**-**	**None**
Wet Season Average	**0.7**	**7**	**11**	**32**	**43**	**10**	**9**
Average Annual	**0.6**	**6**	**9**	**29**	**38**	**10**	**8**

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

*** TKN samples were non-detects. TKN values used to calculate TN loads (TN = TKN + NOx)

**** Missing data due to Caltest missing request for ammonia analysis. (See letter below).

NELAP/ORELAP Certification 4036

Caltest ANALYTICAL LABORATORY
ENVIRONMENTAL ANALYSES

ELAP Certification 1664

September 29, 2017

Andrew Alva
Rodeo Sanitary District
800 San Pablo Ave
Rodeo, CA 94572

RECEIVED
OCT 03 2017
BY: SSB

RE: Missed Ammonia Analysis

Dear Andrew Alva,

On August 14, 2017, Caltest received two water samples from Rodeo Sanitary District. One of the samples had TKN, NH3, Total Phosphate, and Nitrate/Nitrite analyses clearly requested on the accompanying Chain of Custody form. Unfortunately, the request for NH3 analysis was missed by Caltest and was not performed on the sample received. This request was not noticed until the client brought it to my attention on September 27, 2017, by then the sample was beyond the method prescribed 28 day holding time.

I apologize for this error; missed analysis requests are quite an anomaly here at Caltest and are something we take very seriously. I've alerted our staff of this unfortunate event to decrease the likelihood of this error occurring again.

Please feel free to contact me if you have any questions or need any further assistance.

Thank you,

Sincerely,
Caltest Analytical Laboratory

Sandralyn Luna
Project Manager
Caltest Analytical Laboratory

1885 North Kelly Road • Napa, California 94558
(707) 258-4000 • Fax: (707) 226-1001 • e-mail: info@caltestlabs.com

Figure 20-6. Caltest Letter to Rodeo about Missing Ammonia Data

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21 San Jose-Santa Clara Regional Wastewater Facility

The San Jose-Santa Clara Regional Wastewater Facility discharges to the Lower South Bay, and serves an estimated population of 1.4 million with approximately 17,000 commercial and industrial connections. The plant has a permitted ADWF capacity of 167 mgd and a peak wet weather capacity of 261 mgd. The current flows are approximately 79 mgd ADWF. The process includes advanced treatment with a Biological Nutrient Removal (BNR) activated sludge system for N and P removal.

The following observations are made based upon the figures and table in the subsequent pages:

- The flows reduce 10 to 20 mgd from the wet to the dry season due to a combination of recycled water demand and a lack of inflow and infiltration during the dry season.
- There appears to be an upward dry season trend for NOx loads. The increase in concentration over time supports this trend as the dry season flows are relatively flat.
- Both total nitrogen and total phosphorus loads generally increase with flow during wet weather events.
- Wet season loads are greater and more variable than the dry season loads.
- NOx is the majority of the nitrogen species discharged, regardless of season. This would be expected since the plant fully nitrifies year-round.
- Ortho-P values are routinely greater than TP values, in particular for the Section 13267 Letter Day (July 2012 through June 2014). For such instances, ortho-P values were set equal to TP for the plots. This has only occurred for three monthly average values since the Regional Watershed Permit nutrient sampling went into effect (July 2014).
- Since April 2017, the facility has enhanced the total phosphorus load reduction capabilities as evidenced by total phosphorus concentrations below 1 mg P/L.

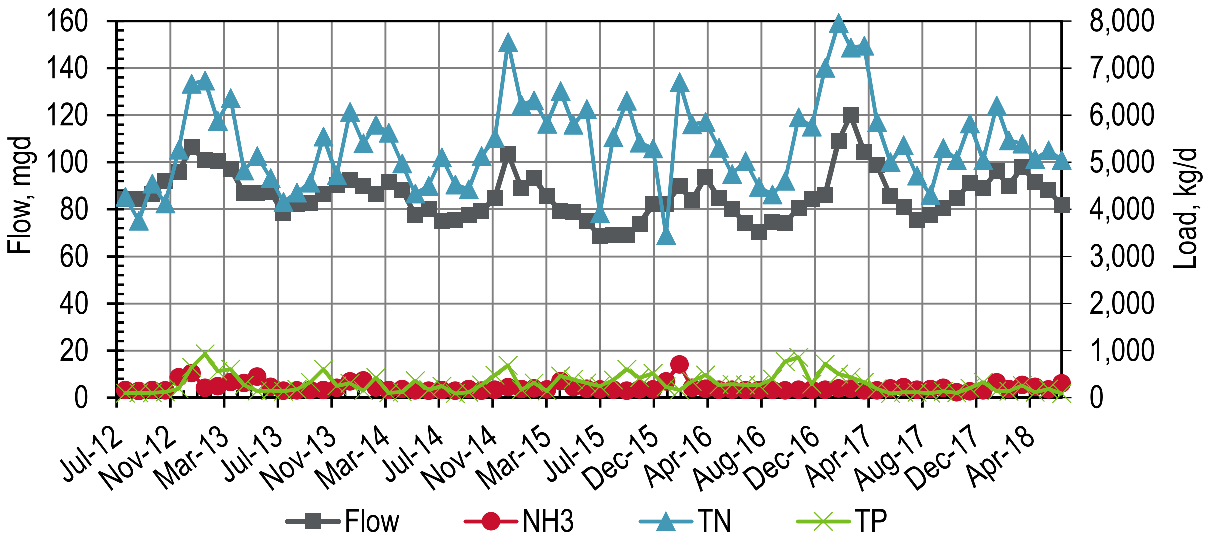

Figure 21-1. San Jose Monthly Flows and Loads

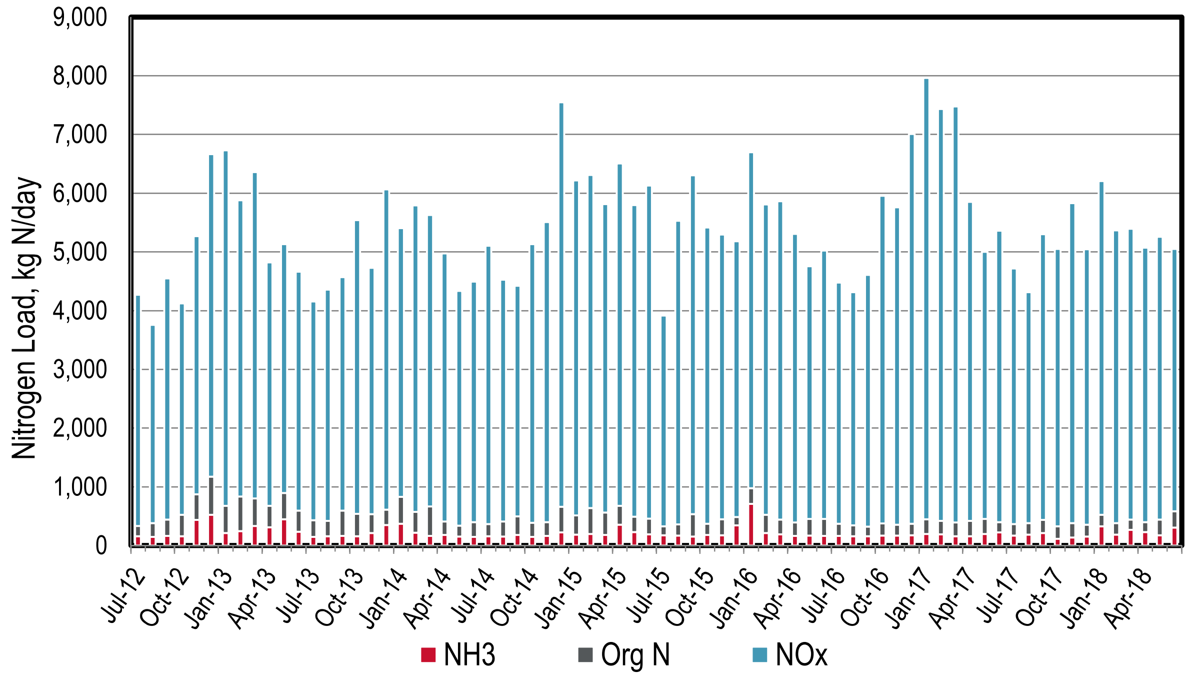

Figure 21-2. San Jose Monthly Nitrogen Loads

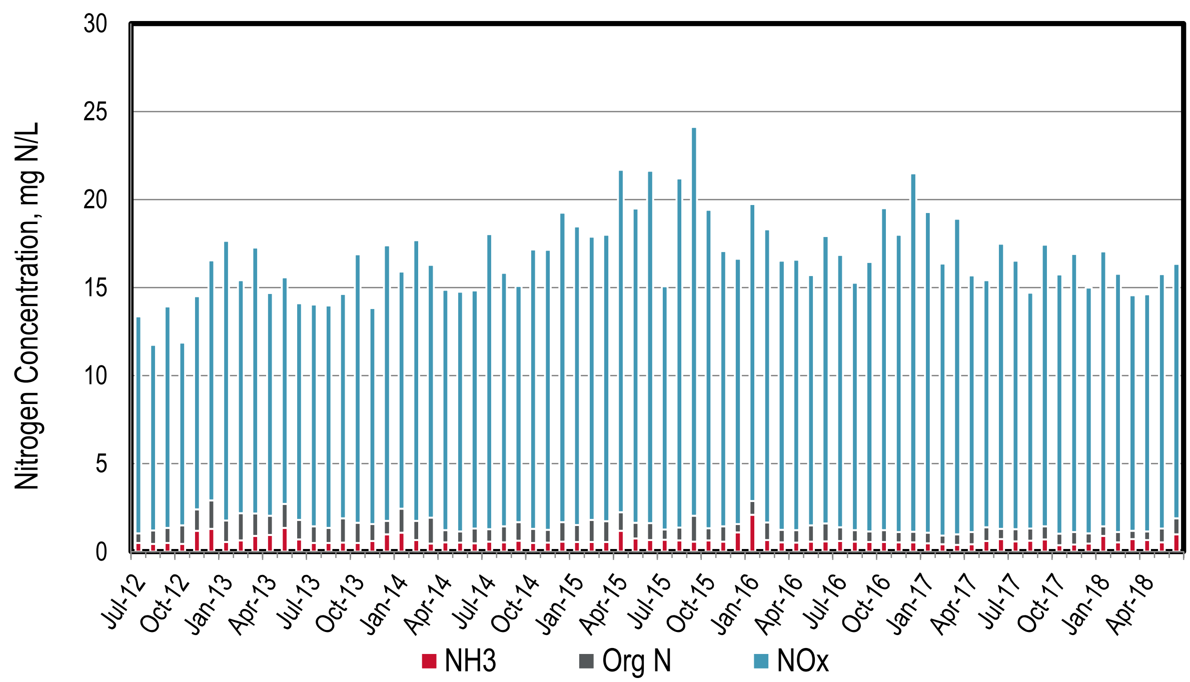

Figure 21-3. San Jose Monthly Nitrogen Concentrations

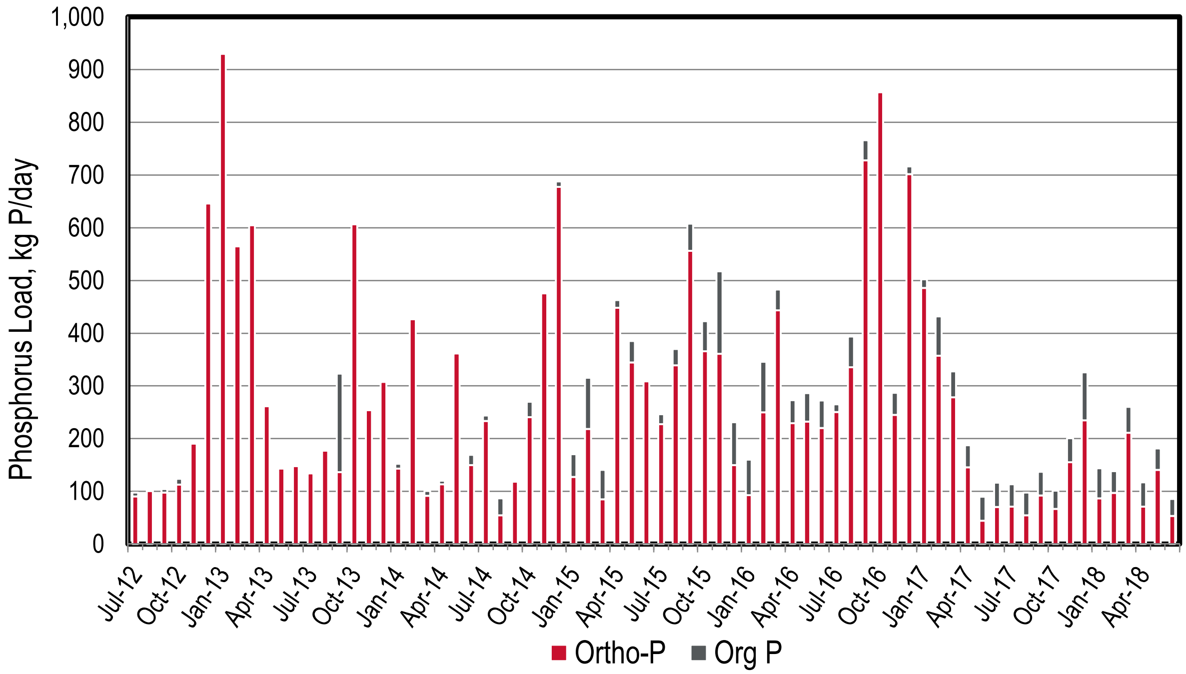

Figure 21-4. San Jose Monthly Phosphorus Loads

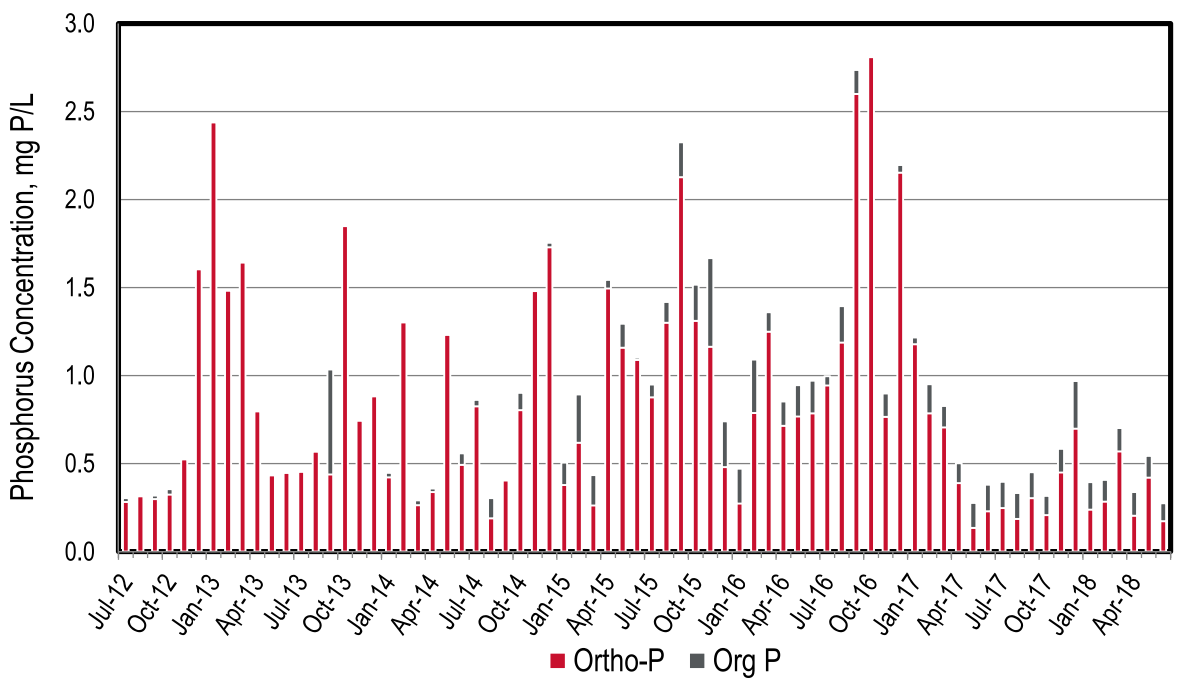

Figure 21-5. San Jose Monthly Phosphorus Concentrations

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

Table 21-1. San Jose Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jul-12	84.5	160	335	3,932	4,267	90	97
Aug-12	84.6	144	384	3,372	3,755	101	104
Sep-12	86.3	163	439	4,107	4,546	98	104
Oct-12	91.9	157	521	3,604	4,125	113	124
Nov-12	96.0	433	874	4,393	5,267	203	190
Dec-12	106.5	523	1,171	5,494	6,665	672	646
Jan-13	100.9	211	674	6,059	6,732	1,102	930
Feb-13	100.8	247	836	5,040	5,876	746	565
Mar-13	97.3	332	802	5,557	6,359	746	605
Apr-13	86.9	313	674	4,148	4,822	304	261
May-13	87.2	446	892	4,242	5,134	167	143
Jun-13	87.5	232	596	4,068	4,665	148	149
Jul-13	78.3	148	429	3,726	4,156	159	134
Aug-13	82.4	156	421	3,936	4,357	217	177
Sep-13	82.6	161	594	3,975	4,569	137	323
Oct-13	86.8	161	541	5,002	5,543	766	606
Nov-13	90.4	211	534	4,195	4,729	254	254
Dec-13	92.3	347	612	5,455	6,067	349	307
Jan-14	89.9	370	829	4,576	5,405	143	152
Feb-14	86.7	220	575	5,219	5,794	521	426
Mar-14	91.5	162	667	4,963	5,630	91	101
Apr-14	88.4	180	411	4,562	4,973	113	120
May-14	77.6	153	338	3,997	4,334	411	361
Jun-14	80.2	146	399	4,098	4,496	150	169
Jul-14	74.9	160	363	4,743	5,107	234	244
Aug-14	75.6	152	412	4,115	4,526	54	87
Sep-14	77.5	181	494	3,929	4,424	129	118
Oct-14	79.1	149	387	4,746	5,133	241	270
Nov-14	84.9	166	401	5,108	5,508	496	475

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Dec-14	103.7	226	658	6,890	7,549	678	688
Jan-15	89.0	184	512	5,708	6,219	127	171
Feb-15	93.3	195	636	5,675	6,312	218	315
Mar-15	85.5	178	563	5,253	5,816	85	141
Apr-15	79.4	356	675	5,832	6,508	448	463
May-15	78.7	227	491	5,306	5,797	344	385
Jun-15	74.9	190	458	5,670	6,128	309	312
Jul-15	68.6	175	328	3,584	3,913	227	246
Aug-15	69.0	167	357	5,172	5,530	339	370
Sep-15	69.2	151	532	5,774	6,306	556	608
Oct-15	73.8	178	371	5,046	5,417	365	423
Nov-15	82.1	177	446	4,849	5,295	361	518
Dec-15	82.4	343	488	4,691	3,453	150	231
Jan-16	89.8	710	978	5,721	6,698	93	160
Feb-16	83.8	212	525	5,281	5,806	250	346
Mar-16	93.8	190	444	5,417	5,861	443	483
Apr-16	84.7	166	392	4,915	5,307	229	273
May-16	80.1	170	452	4,301	4,753	232	287
Jun-16	74.1	163	450	4,574	5,024	220	272
Jul-16	70.3	161	369	4,110	4,479	251	265
Aug-16	74.7	159	344	3,971	4,315	335	394
Sep-16	74.1	156	321	4,289	4,610	728	766
Oct-16	80.7	171	375	5,581	5,956	869	857
Nov-16	84.6	169	356	5,401	5,756	245	287
Dec-16	86.2	172	371	6,635	7,007	702	716
Jan-17	109.1	196	448	7,512	7,960	486	502
Feb-17	120.1	190	417	7,015	7,433	357	432
Mar-17	104.5	157	392	7,083	7,475	279	327
Apr-17	98.7	159	419	5,432	5,852	145	187
May-17	85.7	198	450	4,549	4,999	44	90

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jun-17	81.1	222	397	4,964	5,361	70	117
Jul-17	75.5	168	363	4,356	4,719	71	114
Aug-17	77.6	185	384	3,928	4,312	54	98
Sep-17	80.5	214	437	4,866	5,303	92	137
Oct-17	84.8	117	330	4,718	5,048	66	101
Nov-17	91.1	138	382	5,445	5,827	155	201
Dec-17	88.9	154	353	4,692	5,045	235	326
Jan-18	96.2	327	522	5,682	6,204	87	144
Feb-18	90.0	185	381	4,986	5,462	97	139
Mar-18	98.0	269	440	4,953	5,393	211	260
Apr-18	91.7	229	398	4,673	5,071	71	117
May-18	88.2	177	442	4,814	5,256	140	182
Jun-18	81.7	305	584	4,466	5,050	54	85
Dry Season Average	**78.8**	**186**	**442**	**4,364**	**4,806**	**205**	**231**
Dry Season Trend **	**None**	**None**	**None**	**Up**	**None**	**-**	**None**
Wet Season Average	**91.3**	**236**	**542**	**5,314**	**5,818**	**341**	**353**
Average Annual	**86.1**	**216**	**501**	**4,919**	**5,396**	**284**	**303**

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

22 City of San Mateo

San Mateo discharges to the South Bay and it has approximately 37,823 service connections. The plant has a permitted ADWF capacity of 15.7 mgd and a peak wet weather capacity of 60 mgd, with blending allowable above 40 mgd. The current flows are approximately 9.4 mgd ADWF. The plant performs secondary treatment using activated sludge.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the average monthly values table below, there appears to be an emerging upward dry season trend for NOx loads.
- Nitrogen species concentrations are typically highest during the dry season.
- Ammonia is the majority of the nitrogen species discharged, regardless of season. This would be expected since this plant does not nitrify.
- The Section 13267 Letter data (up to June 2014) routinely had Ortho-P values greater than TP values due to sampling reasons as stated in the main report. This issue is not evident anymore. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations range from 1.5 to 4.6 mg P/L, This suggests a portion of P is removed as typical effluent TP concentrations are 4 to 6 mg P/L. The removal mechanism is most likely from ferrous chloride addition to solids thickening.

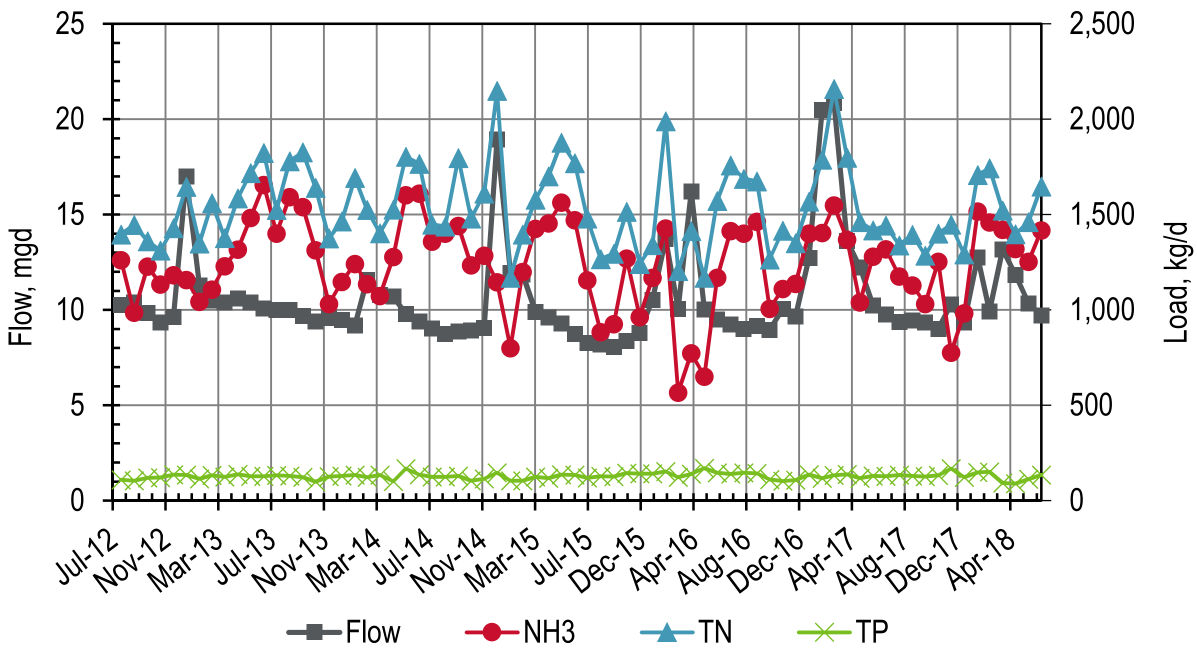

Figure 22-1. San Mateo Monthly Flows and Loads

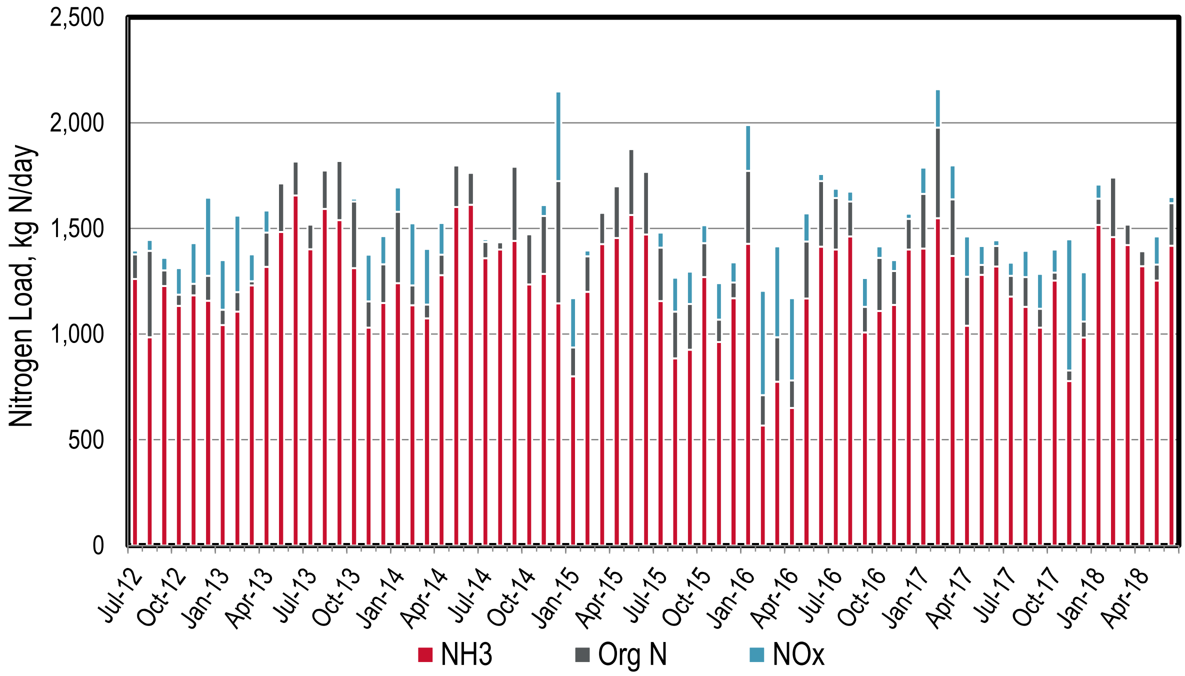

Figure 22-2. San Mateo Monthly Nitrogen Loads

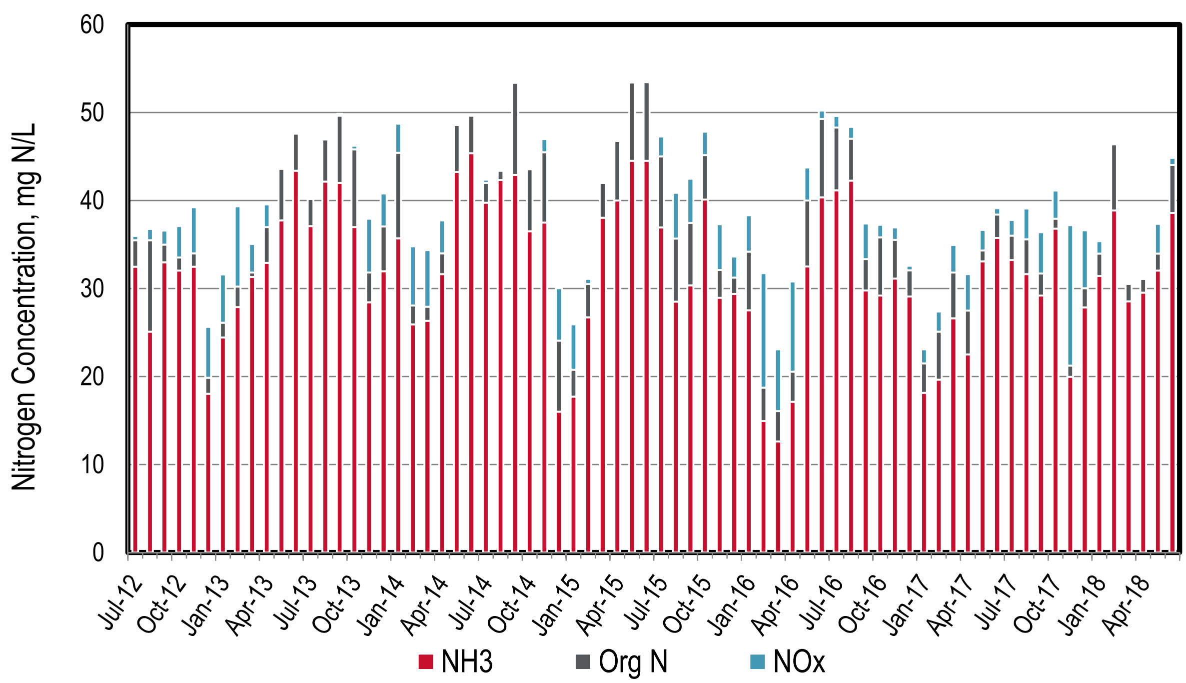

Figure 22-3. San Mateo Monthly Nitrogen Concentrations

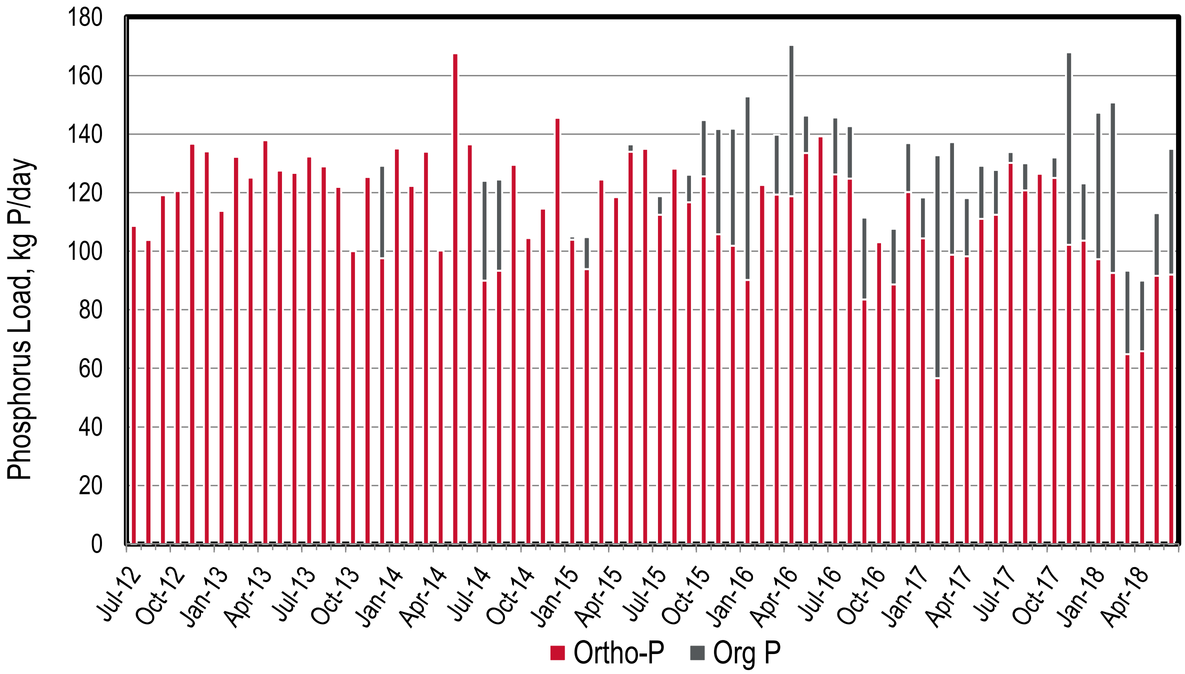

Figure 22-4. San Mateo Monthly Phosphorus Loads

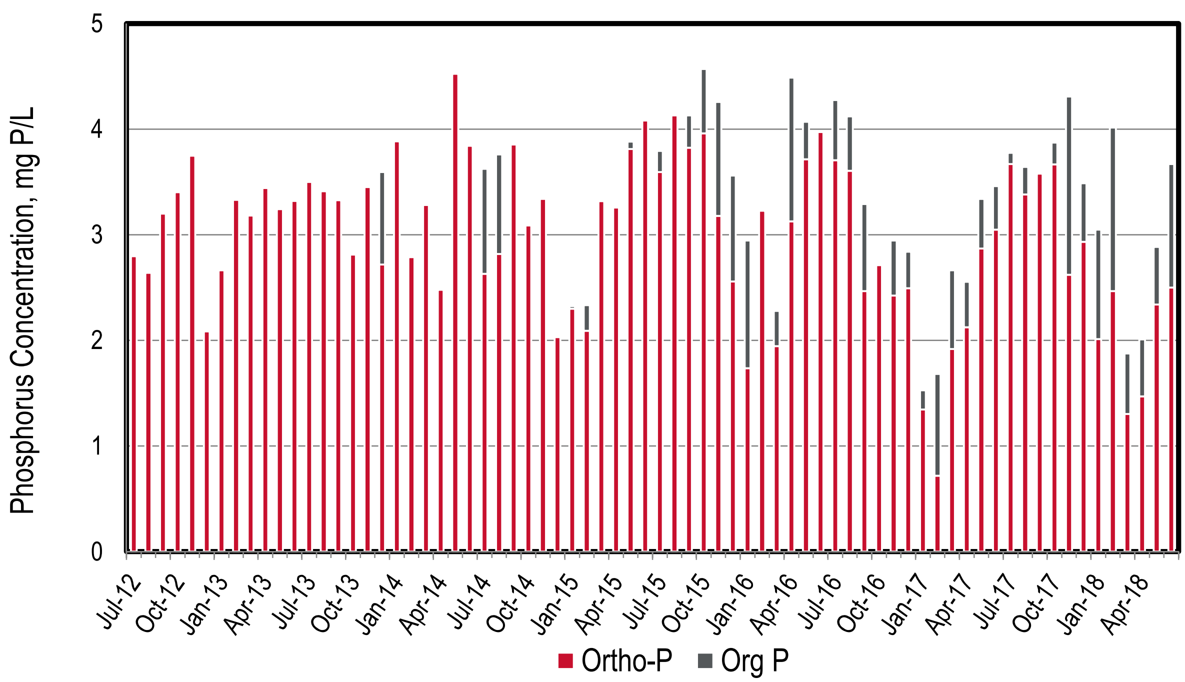

Figure 22-5. San Mateo Monthly Phosphorus Concentrations

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

Table 22-1. San Mateo Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jul-12	10.3	1,262	1,378	18	1,396	113	109
Aug-12	10.4	986	1,395	51	1,446	127	104
Sep-12	9.8	1,228	1,303	59	1,362	140	119
Oct-12	9.4	1,134	1,187	126	1,313	207	121
Nov-12	9.6	1,184	1,239	192	1,430	158	137
Dec-12	17.0	1,158	1,276	371	1,646	141	134
Jan-13	11.3	1,044	1,115	235	1,350	149	114
Feb-13	10.5	1,107	1,199	362	1,561	220	132
Mar-13	10.4	1,230	1,251	127	1,378	245	125
Apr-13	10.6	1,318	1,481	104	1,585	140	138
May-13	10.4	1,484	1,714	4	1,718	142	128
Jun-13	10.1	1,656	1,818	7	1,824	127	127
Jul-13	10.0	1,402	1,518	6	1,525	221	132
Aug-13	10.0	1,593	1,774	6	1,780	193	129
Sep-13	9.7	1,540	1,820	8	1,828	205	122
Oct-13	9.4	1,313	1,627	14	1,641	219	100
Nov-13	9.6	1,032	1,155	221	1,376	250	125
Dec-13	9.5	1,148	1,330	135	1,465	98	129
Jan-14	9.2	1,241	1,579	115	1,694	263	135
Feb-14	11.6	1,136	1,231	294	1,525	131	122
Mar-14	10.8	1,074	1,140	263	1,403	203	134
Apr-14	10.7	1,279	1,376	151	1,527	319	100
May-14	9.8	1,602	1,799	6	1,805	273	168
Jun-14	9.4	1,612	1,764	4	1,767	257	137
Jul-14	9.1	1,359	1,437	12	1,449	90	124
Aug-14	8.8	1,401	1,436	3	1,439	93	125
Sep-14	8.9	1,441	1,793	5	1,798	150	130
Oct-14	8.9	1,235	1,473	7	1,480	177	105
Nov-14	9.1	1,286	1,560	51	1,611	143	115

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Dec-14	18.9	1,145	1,725	425	2,150	156	146
Jan-15	12.0	983	938	233	1,171	104	105
Feb-15	11.9	1,370	1,369	27	1,396	94	105
Mar-15	9.9	1,426	1,575	4	1,579	136	125
Apr-15	9.6	1,455	1,700	2	1,702	183	119
May-15	9.3	1,564	1,877	2	1,879	134	137
Jun-15	8.8	1,472	1,768	3	1,771	146	135
Jul-15	8.3	1,156	1,409	71	1,480	113	119
Aug-15	8.2	885	1,107	161	1,267	135	128
Sep-15	8.1	927	1,143	153	1,296	117	126
Oct-15	8.4	1,270	1,431	84	1,515	126	145
Nov-15	8.8	963	1,068	173	1,242	106	142
Dec-15	10.5	1,170	1,244	96	1,340	102	142
Jan-16	13.7	1,428	1,773	217	1,990	90	153
Feb-16	10.1	567	711	495	1,205	129	123
Mar-16	16.2	775	986	430	1,415	119	140
Apr-16	10.0	651	780	389	1,170	119	170
May-16	9.5	1,169	1,438	134	1,572	134	146
Jun-16	9.3	1,414	1,725	33	1,759	145	139
Jul-16	9.0	1,401	1,644	44	1,689	126	146
Aug-16	9.2	1,463	1,628	47	1,674	125	143
Sep-16	9.0	1,008	1,129	136	1,265	83	111
Oct-16	10.1	1,110	1,362	54	1,416	103	103
Nov-16	9.7	1,138	1,299	52	1,351	89	108
Dec-16	12.7	1,401	1,545	24	1,570	120	137
Jan-17	20.5	1,405	1,664	124	1,788	104	118
Feb-17	20.9	1,549	1,978	182	2,159	57	133
Mar-17	13.6	1,370	1,638	162	1,799	99	137
Apr-17	12.2	1,040	1,272	190	1,462	98	118
May-17	10.2	1,280	1,328	90	1,418	111	129

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jun-17	9.8	1,320	1,417	27	1,444	113	128
Jul-17	9.4	1,177	1,276	63	1,339	130	134
Aug-17	9.4	1,129	1,271	124	1,395	121	130
Sep-17	9.3	1,032	1,120	166	1,285	129	126
Oct-17	9.0	1,253	1,292	109	1,401	125	132
Nov-17	10.3	778	827	621	1,449	102	168
Dec-17	9.3	983	1,060	233	1,293	104	123
Jan-18	12.8	1,517	1,641	68	1,708	97	147
Feb-18	9.9	1,459	1,741	3	1,744	93	151
Mar-18	13.2	1,421	1,518	4	1,522	65	93
Apr-18	11.8	1,321	1,392	5	1,397	66	90
May-18	10.4	1,254	1,330	132	1,462	92	113
Jun-18	9.7	1,419	1,619	29	1,649	92	135
Dry Season Average	**9.4**	**1,321**	**1,506**	**53**	**1,559**	**139**	**129**
Dry Season Trend **	**None**	**None**	**None**	**Up**	**None**	**-**	**None**
Wet Season Average	**11.5**	**1,179**	**1,351**	**171**	**1,522**	**139**	**127**
Average Annual	**10.7**	**1,238**	**1,416**	**122**	**1,537**	**139**	**128**

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

23 Sewerage Agency of Southern Marin (SASM)

SASM discharges to the Central Bay. The plant has approximately 14,800 service connections and it has a permitted capacity of 3.6 mgd ADWF. The current plant flow is approximately 1.9 mgd ADWF. The plant currently performs nitrification using under-loaded trickling filters.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the table with the average monthly values, there are no emerging dry season trends.
- NOx is the majority of the nitrogen species discharged as would be expected since this plant nitrifies. However, a portion of ammonia occasionally bleeds through year round. The ammonia bleed through is attributed to cold weather and over loading the trickling filters for nitrification.
- Ortho-P values are occasionally greater than TP values for the Section 13257 Letter based on the composite sampling issue discussed in the main report body. Since the Regional Watershed Permit sampling began (July, 2014), the ortho-P values has only exceeded the TP value once. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations range from 1.1 to 11 mg P/L, This suggests occasional P removal as typical effluent TP concentrations are 4 to 6 mg P/L. The removal mechanism is thought to be metal salt addition in the collection system.

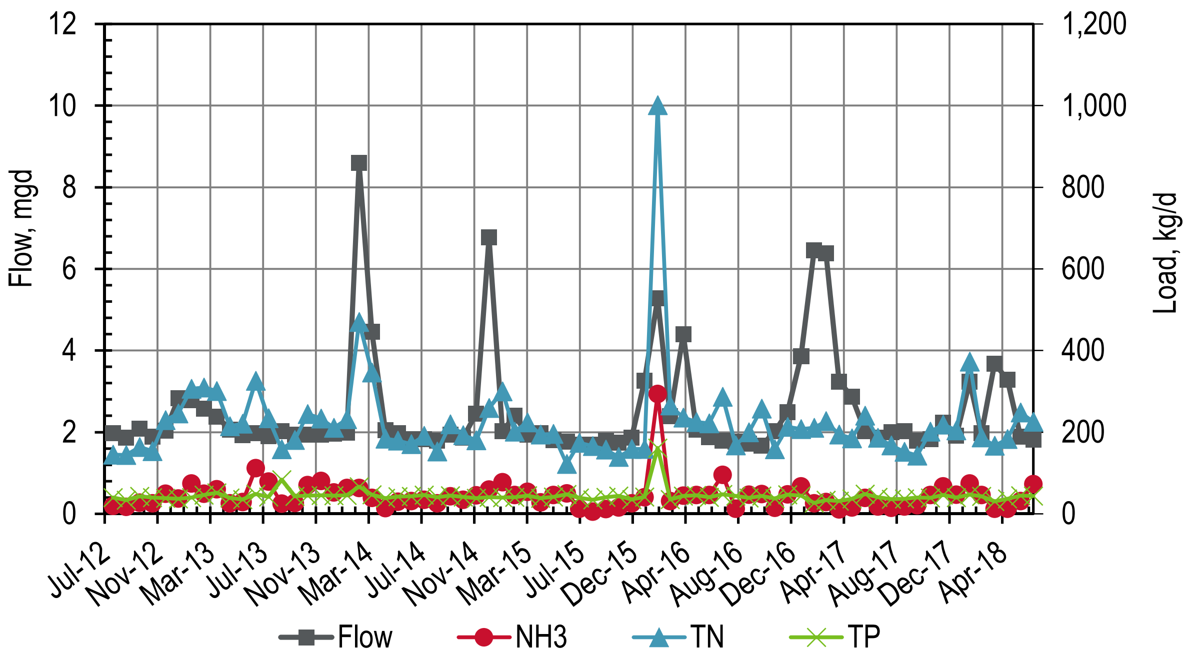

Figure 23-1. SASM Monthly Flows and Loads

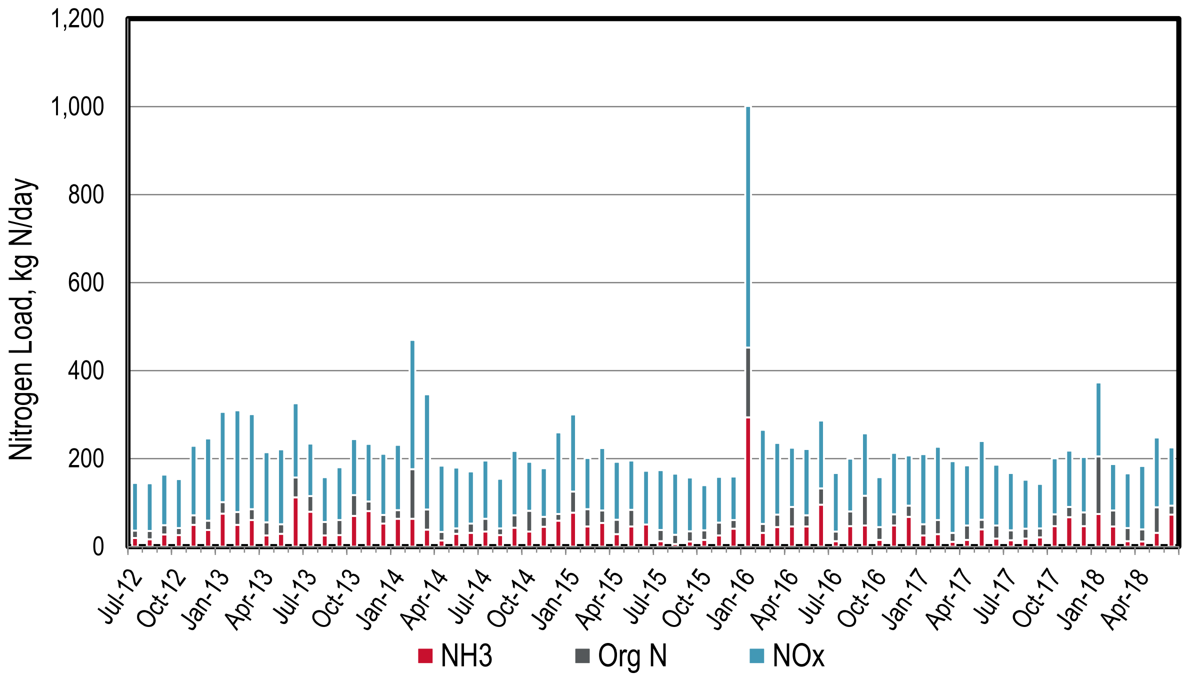

Figure 23-2. SASM Monthly Nitrogen Loads

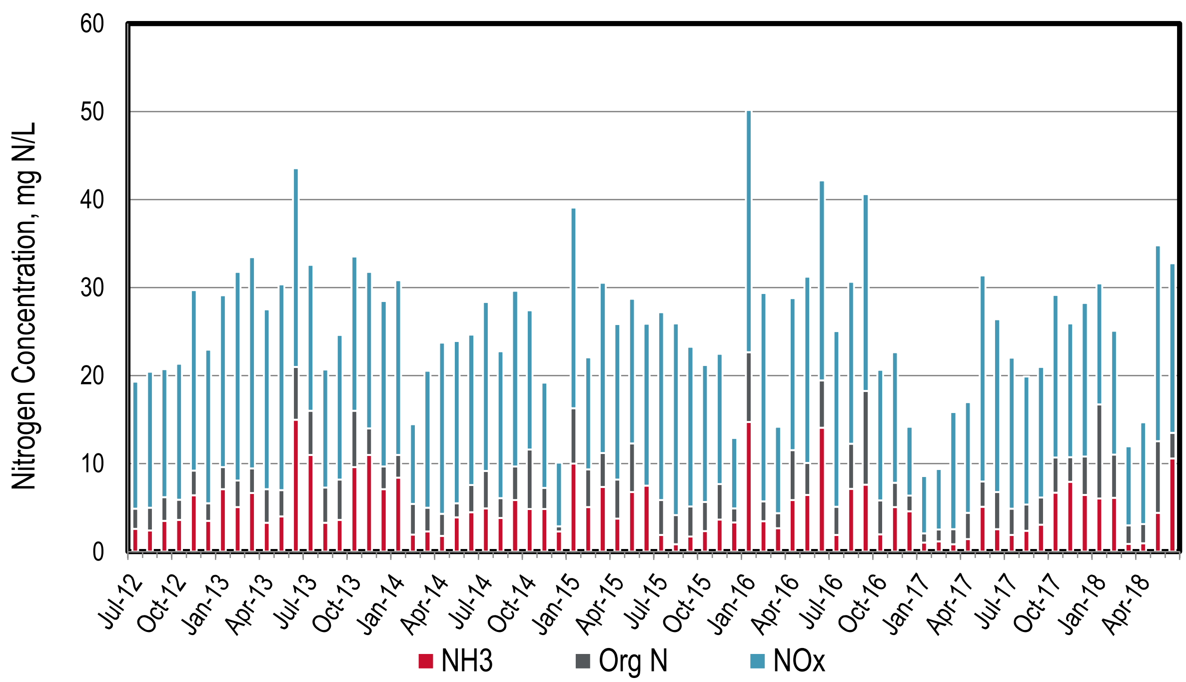

Figure 23-3. SASM Monthly Nitrogen Concentrations

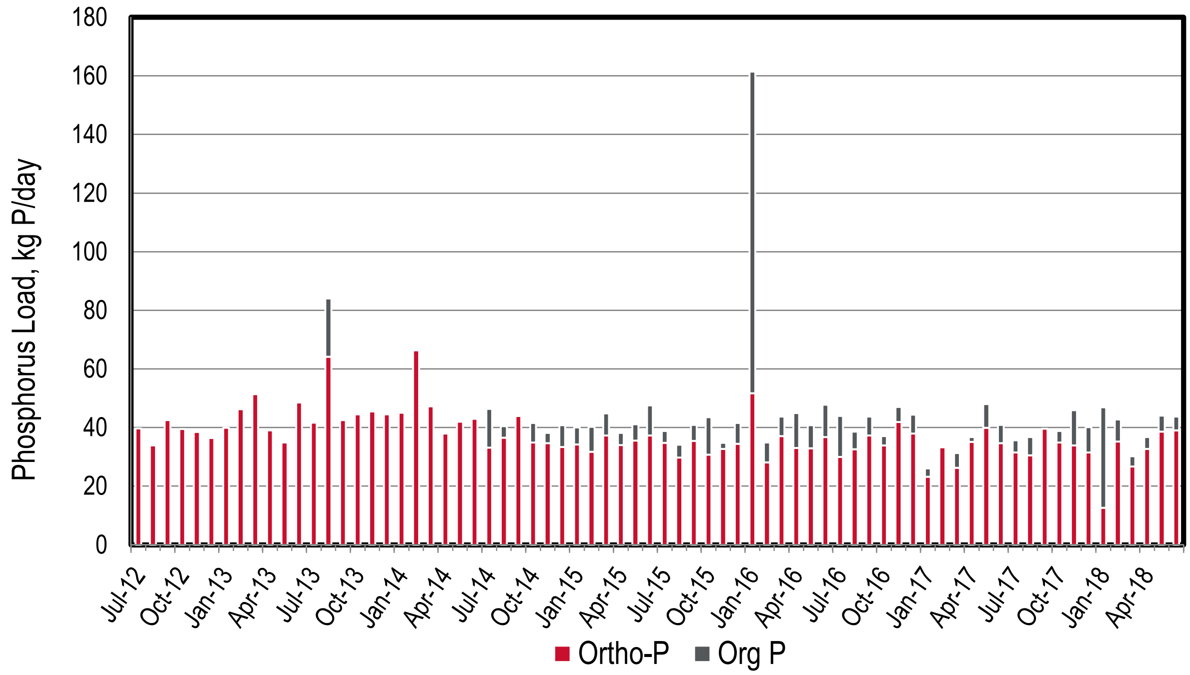

Figure 23-4. SASM Monthly Phosphorus Loads

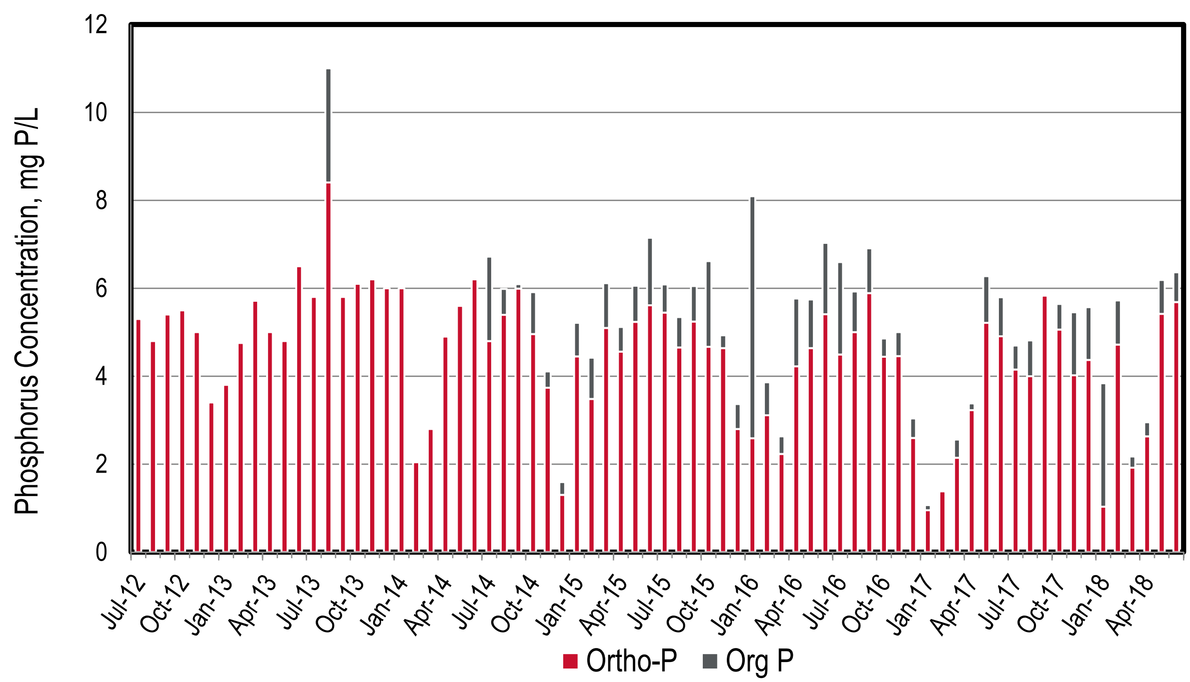

Figure 23-5. SASM Monthly Phosphorus Concentrations

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

Table 23-1. SASM Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jul-12	2.0	19	37	108	145	56	40
Aug-12	1.9	17	35	109	144	69	34
Sep-12	2.1	28	49	115	164	70	43
Oct-12	1.9	26	42	111	153	80	39
Nov-12	2.0	49	71	158	229	67	39
Dec-12	2.8	37	59	187	246	55	36
Jan-13	2.8	75	101	205	306	58	40
Feb-13	2.6	49	79	231	310	91	46
Mar-13	2.4	60	85	216	301	78	51
Apr-13	2.1	26	55	159	215	71	39
May-13	1.9	29	51	170	221	80	35
Jun-13	2.0	112	157	169	326	90	49
Jul-13	1.9	79	115	119	234	66	42
Aug-13	2.0	25	56	102	158	64	84
Sep-13	1.9	26	60	120	181	74	43
Oct-13	1.9	70	117	128	245	78	45
Nov-13	1.9	81	103	130	233	79	45
Dec-13	2.0	53	72	139	211	79	44
Jan-14	2.0	63	83	149	232	98	45
Feb-14	8.6	63	176	294	470	128	66
Mar-14	4.5	39	84	262	346	120	47
Apr-14	2.1	14	33	151	184	72	38
May-14	2.0	29	41	138	179	78	42
Jun-14	1.8	31	53	118	171	164	43
Jul-14	1.8	34	63	132	191	33	46
Aug-14	1.8	26	41	113	153	36	40
Sep-14	1.9	43	71	146	219	44	45
Oct-14	1.9	34	82	111	193	35	42
Nov-14	2.5	45	67	111	180	35	38

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Dec-14	6.8	59	74	185	260	33	41
Jan-15	2.0	77	125	175	300	34	40
Feb-15	2.4	46	85	116	201	32	40
Mar-15	1.9	54	82	142	224	37	45
Apr-15	2.0	28	61	132	194	34	38
May-15	1.8	46	84	112	195	36	41
Jun-15	1.8	50	1	122	122	37	48
Jul-15	1.7	12	37	136	174	35	39
Aug-15	1.7	5	27	139	166	30	34
Sep-15	1.8	12	35	123	157	35	41
Oct-15	1.7	15	37	102	139	31	44
Nov-15	1.9	26	54	104	159	33	35
Dec-15	3.3	41	61	99	159	35	42
Jan-16	5.3	294	452	549	1,001	52	161
Feb-16	2.4	31	52	214	265	28	35
Mar-16	4.4	45	73	163	236	37	44
Apr-16	2.1	46	90	135	225	33	45
May-16	1.9	46	72	150	222	33	41
Jun-16	1.8	95	132	154	286	37	48
Jul-16	1.8	13	34	133	167	30	44
Aug-16	1.7	47	80	120	200	33	39
Sep-16	1.7	48	116	142	257	37	44
Oct-16	2.0	15	45	113	158	34	37
Nov-16	2.5	48	73	140	213	42	47
Dec-16	3.9	67	93	114	207	38	44
Jan-17	6.5	26	51	159	210	23	26
Feb-17	6.4	29	61	166	227	37	33
Mar-17	3.2	11	31	163	194	26	31
Apr-17	2.9	15	48	137	185	35	37
May-17	2.0	39	61	179	240	40	48

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jun-17	1.9	18	48	139	186	35	41
Jul-17	2.0	14	37	130	167	32	36
Aug-17	2.0	18	41	111	152	30	37
Sep-17	1.8	21	42	101	142	42	40
Oct-17	1.8	46	74	127	201	35	39
Nov-17	2.2	67	90	128	218	34	46
Dec-17	1.9	46	78	126	204	31	40
Jan-18	3.2	74	205	168	373	13	47
Feb-18	2.0	46	82	105	187	35	43
Mar-18	3.7	12	42	125	166	27	30
Apr-18	3.3	12	39	144	183	33	37
May-18	1.9	32	90	158	248	39	44
Jun-18	1.8	73	93	132	225	39	44
Dry Season Average	**1.9**	**36**	**62**	**131**	**193**	**51**	**43**
Dry Season Trend **	**None**	**None**	**None**	**None**	**None**	**-**	**None**
Wet Season Average	**3.0**	**49**	**85**	**161**	**246**	**50**	**44**
Average Annual	**2.5**	**44**	**75**	**149**	**224**	**50**	**44**

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

24 San Francisco International Airport – MLTP (SFO)

SFO discharges to the South Bay. The plant has a permitted capacity of 3.4 mgd ADWF. The current flow is approximately 1.1 mgd ADWF. The process includes two separate treatment processes. Domestic water from the airport facilities are collected through the sanitary sewer collection system and treated with a sequential batch reactors (SBRs). Industrial wastewater and storm run-off is treated in the Industrial plant, which includes a trickling filter.

The following observations are made based upon the figures and table in the subsequent pages:

- The facility made numerous process changes over the last few months (completed in 2018) to accomplish ammonia/total nitrogen load reduction (limited to the dry season).
- Based on the average monthly values table below, there appears to be an emerging dry season downward trend for TKN and TN loads.
- Phosphorus loads generally increase with flow during wet weather events.
- Ammonia is the majority of the nitrogen species discharged, regardless of season. This would be expected since this plant does not nitrify. There are instances where average monthly ammonia loads exceed TKN loads. This is attributed to sampling protocol as the ammonia samples are grabs and TKN are composite samples.
- Total nitrogen concentrations occasionally reach upwards of 100 mg N/L, which is higher than most of the other plants. The plant receives concentrated waste from landed planes which most likely increases the concentrations.
- Ortho-P values are occasionally greater than TP values. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations range from <1 to 11.6 mg P/L. This wide range is attributed to a combination of highly variable industrial waste and/or occasional P removal (typical municipal discharge TP concentrations are 4 to 6 mg P/L).

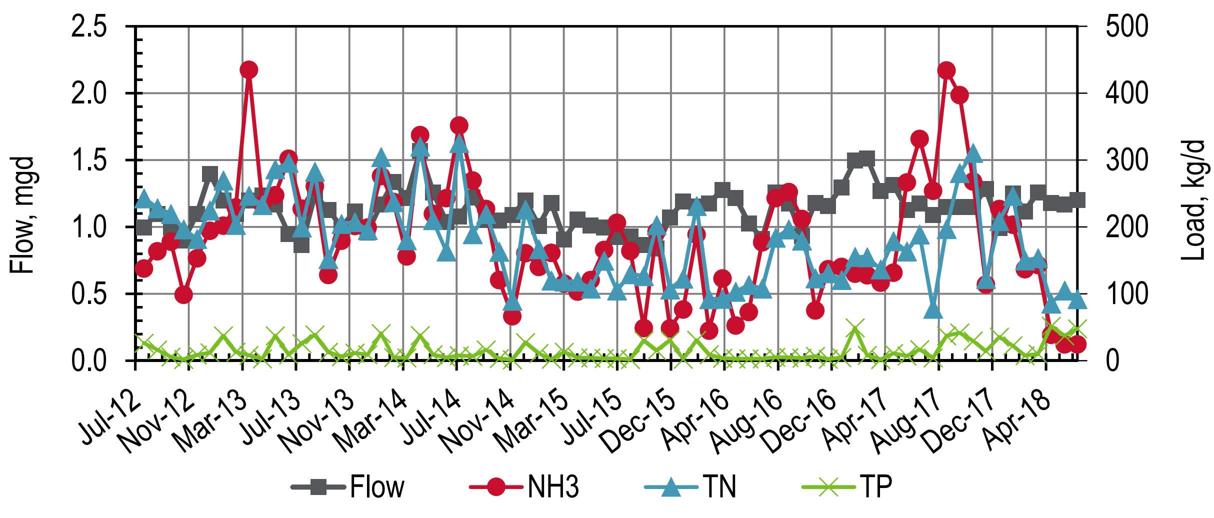

Figure 24-1. SFO Airport Monthly Flows and Loads

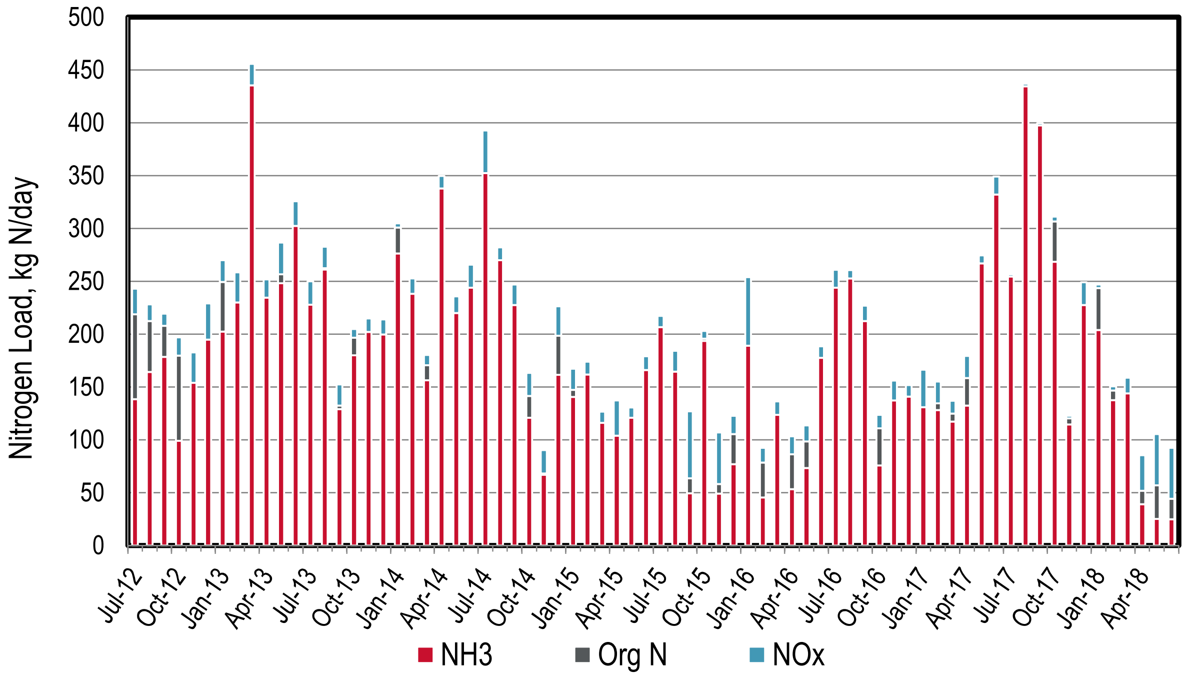

Figure 24-2. SFO Airport Monthly Nitrogen Loads

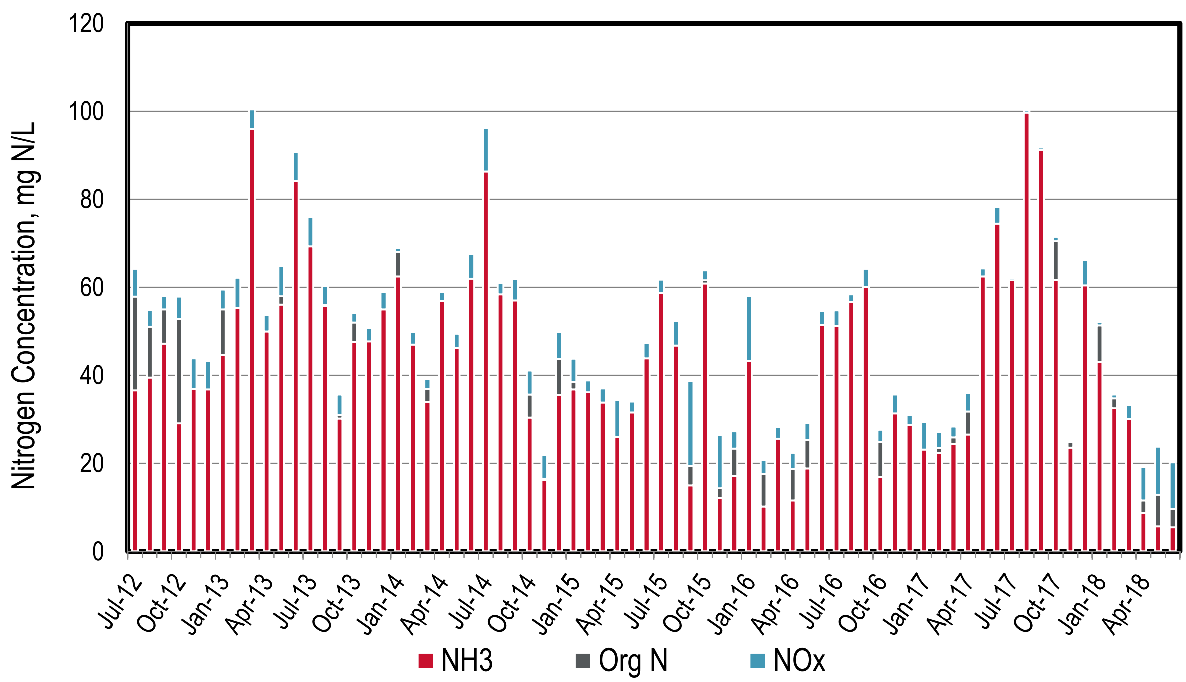

Figure 24-3. SFO Airport Monthly Nitrogen Concentrations

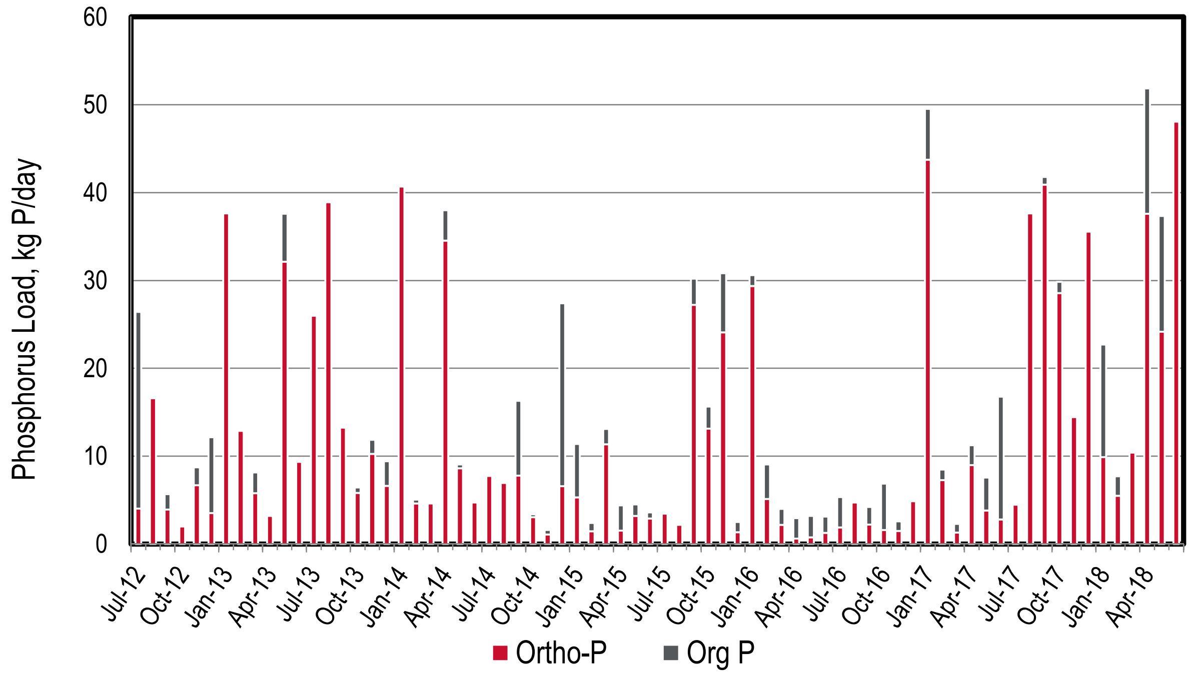

Figure 24-4. SFO Airport Monthly Phosphorus Loads

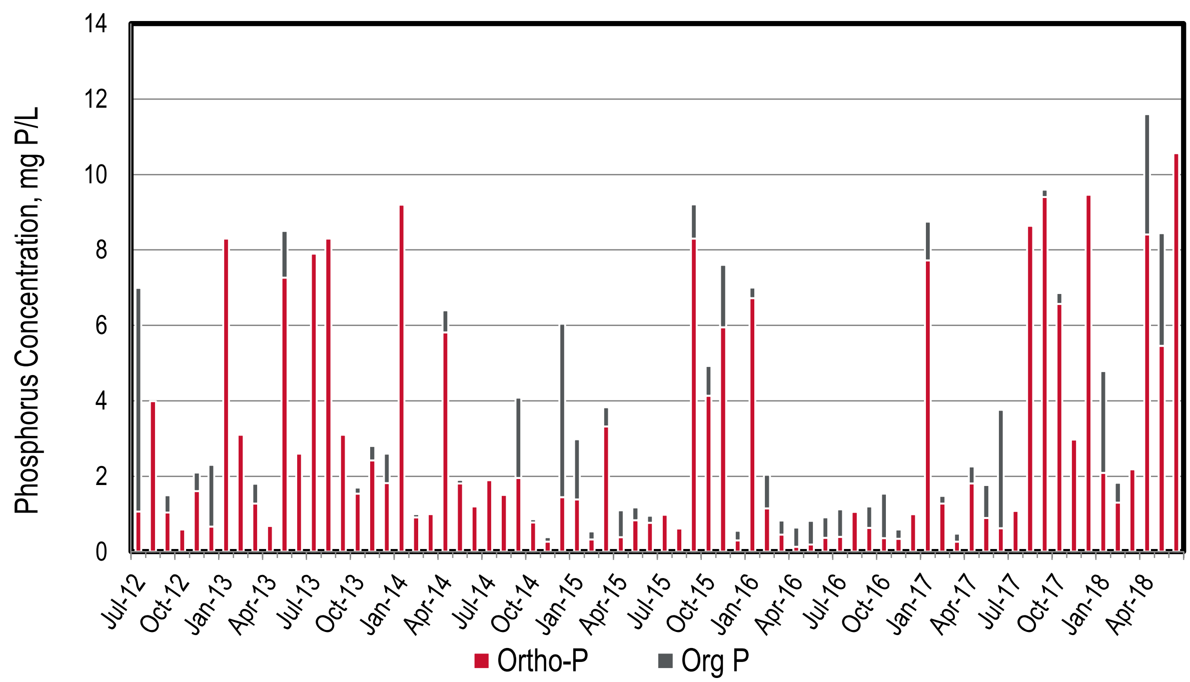

Figure 24-5. SFO Airport Monthly Phosphorus Concentrations

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

Table 24-1. SFO Airport Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day *	TKN kg N/day *	NOx kg N/day	Total N kg N/day **	Ortho-P kg P/day	Total P kg P/day
Jul-12	1.0	138	219	24	243	4	26
Aug-12	1.1	164	212	16	228	25	17
Sep-12	1.0	178	208	12	219	4	6
Oct-12	0.9	99	180	17	197	8	2
Nov-12	1.1	154	154	29	183	7	9
Dec-12	1.4	195	191	34	225	4	12
Jan-13	1.2	202	249	20	270	43	38
Feb-13	1.1	230	175	29	203	25	13
Mar-13	1.2	435	227	20	247	6	8
Apr-13	1.2	234	216	18	233	4	3
May-13	1.2	248	257	30	287	32	38
Jun-13	1.0	302	273	23	296	12	9
Jul-13	0.9	228	178	22	200	48	26
Aug-13	1.2	261	262	20	283	57	39
Sep-13	1.1	129	132	20	152	17	13
Oct-13	1.0	180	197	8	205	6	6
Nov-13	1.1	202	195	13	208	10	12
Dec-13	1.0	200	181	14	196	7	9
Jan-14	1.2	276	301	4	305	41	41
Feb-14	1.3	238	223	15	238	5	5
Mar-14	1.2	156	171	10	180	6	5
Apr-14	1.6	338	309	12	321	35	38
May-14	1.3	220	195	16	211	9	9
Jun-14	1.0	244	142	22	163	6	5
Jul-14	1.1	352	285	40	326	13	8
Aug-14	1.2	270	177	12	189	11	7
Sep-14	1.1	228	200	19	220	8	16
Oct-14	1.1	121	141	22	163	3	3
Nov-14	1.1	67	68	22	90	1	2

Month, Year	Flow mgd	Ammonia kg N/day *	TKN kg N/day *	NOx kg N/day	Total N kg N/day **	Ortho-P kg P/day	Total P kg P/day
Dec-14	1.2	162	198	28	226	7	27
Jan-15	1.0	141	147	20	167	5	11
Feb-15	1.2	162	108	12	120	1	2
Mar-15	0.9	116	108	11	119	11	13
Apr-15	1.1	104	85	33	119	2	4
May-15	1.0	121	99	10	108	3	5
Jun-15	1.0	166	137	13	150	3	4
Jul-15	0.9	207	95	10	106	3	3
Aug-15	0.9	165	110	20	130	3	2
Sep-15	0.9	49	64	63	127	27	30
Oct-15	0.8	194	196	7	203	13	16
Nov-15	1.1	49	58	49	107	24	31
Dec-15	1.2	77	105	18	123	1	3
Jan-16	1.2	189	167	65	232	29	31
Feb-16	1.2	45	78	14	92	5	9
Mar-16	1.3	124	80	13	93	2	4
Apr-16	1.2	53	86	17	103	1	3
May-16	1.0	73	99	15	114	1	3
Jun-16	0.9	178	97	11	108	1	3
Jul-16	1.3	244	167	17	184	2	5
Aug-16	1.2	253	189	8	197	7	5
Sep-16	0.9	212	165	15	180	2	4
Oct-16	1.2	76	111	13	124	2	7
Nov-16	1.2	137	113	19	131	1	3
Dec-16	1.3	141	110	11	121	5	5
Jan-17	1.5	131	120	35	156	44	50
Feb-17	1.5	128	134	21	155	7	8
Mar-17	1.3	117	125	12	137	1	2
Apr-17	1.3	132	158	21	179	9	11
May-17	1.1	267	156	8	164	4	8

Month, Year	Flow mgd	Ammonia kg N/day *	TKN kg N/day *	NOx kg N/day	Total N kg N/day **	Ortho-P kg P/day	Total P kg P/day
Jun-17	1.2	332	172	17	189	3	17
Jul-17	1.1	255	76	2	78	9	4
Aug-17	1.2	434	195	2	197	52	38
Sep-17	1.2	397	279	2	281	41	42
Oct-17	1.2	268	307	4	311	29	30
Nov-17	1.3	115	120	2	123	17	14
Dec-17	1.0	227	187	22	209	47	36
Jan-18	1.3	204	243	3	247	10	23
Feb-18	1.1	137	147	4	151	5	8
Mar-18	1.3	144	139	15	154	15	10
Apr-18	1.2	39	52	34	86	38	52
May-18	1.2	25	57	48	105	24	37
Jun-18	1.2	25	44	48	92	54	48
Dry Season Average	**1.1**	**212**	**169**	**20**	**184**	**16**	**16**
Dry Season Trend ***	**None**	**None**	**Down**	**None**	**Down**	**-**	**None**
Wet Season Average	**1.2**	**160**	**159**	**19**	**177**	**13**	**15**
Average Annual	**1.1**	**182**	**161**	**19**	**180**	**14**	**15**

* Average monthly ammonia loads occasionally exceed TKN loads due to sampling protocol. The ammonia loads are grabs, whereas the TKN samples are composite.

** The Total Nitrogen value is calculated by adding the TKN and the NOx values.

*** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

25 SFPUC Southeast Plant

SFPUC has a combined collection system, discharges to the South Bay, and serves approximately 450,000 service connections. The plant has a permitted ADWF capacity of 85.4 mgd and a peak wet weather capacity of 250 mgd (150 mgd secondary, 100 mgd primary). The plant currently flows at approximately 55 mgd ADWF and performs secondary treatment using a high purity oxygen system.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the average monthly loads since 2012, there appears to be a dry season upward trend for nitrogen species (except NOx).
- Ammonia and Total Nitrogen loads do not always increase with elevated flows typically associated with rain events during the wet season.
- Ammonia is the majority of the nitrogen species discharged, regardless of season. This is expected because this plant does not nitrify.
- Reported Ortho-P values were frequently greater than TP values prior to January 2015. This is attributed to a combination of the sampling methodology as discussed in the main report body. Starting in July 2015, the SFPUC began using Inductively Coupled Plasma – Atomic Emission Spectroscopy (ICP-AES) for TP detection. For such instances in Figure 25-4 and Figure 25-5, ortho-P values were set equal to TP. In Table 25-1, the reported ortho-P values were used for the data table.

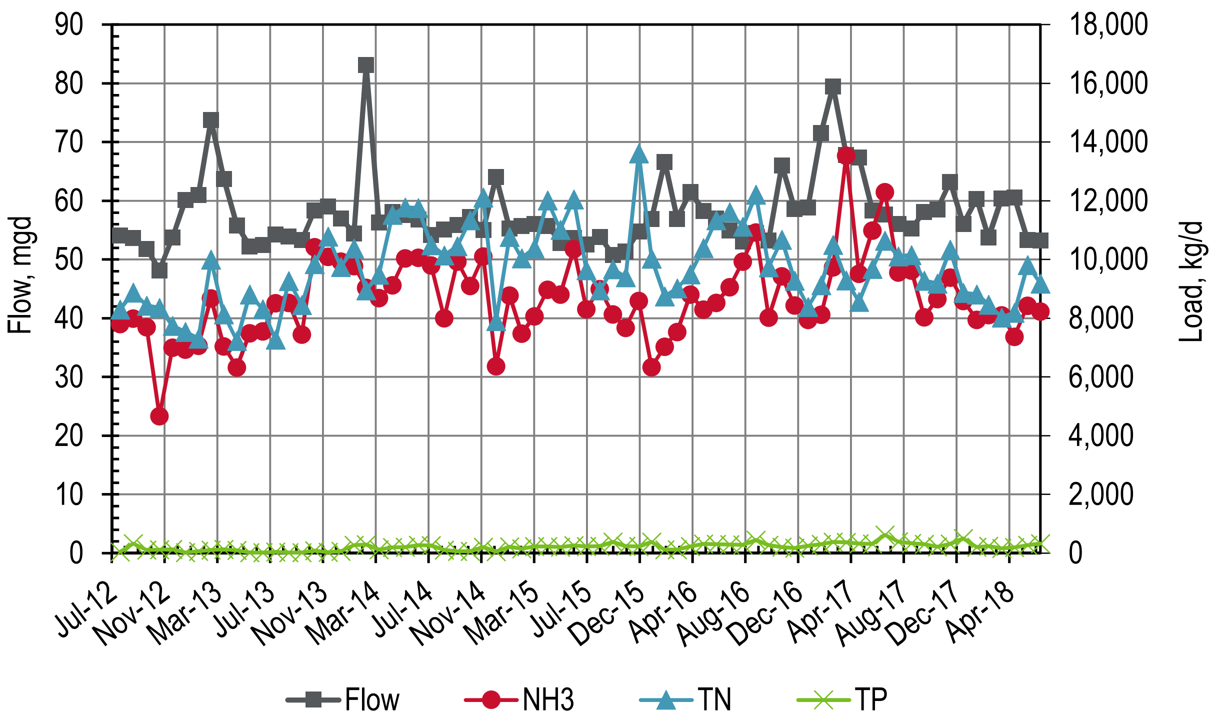

Figure 25-1. SFPUC Southeast Monthly Flows and Loads

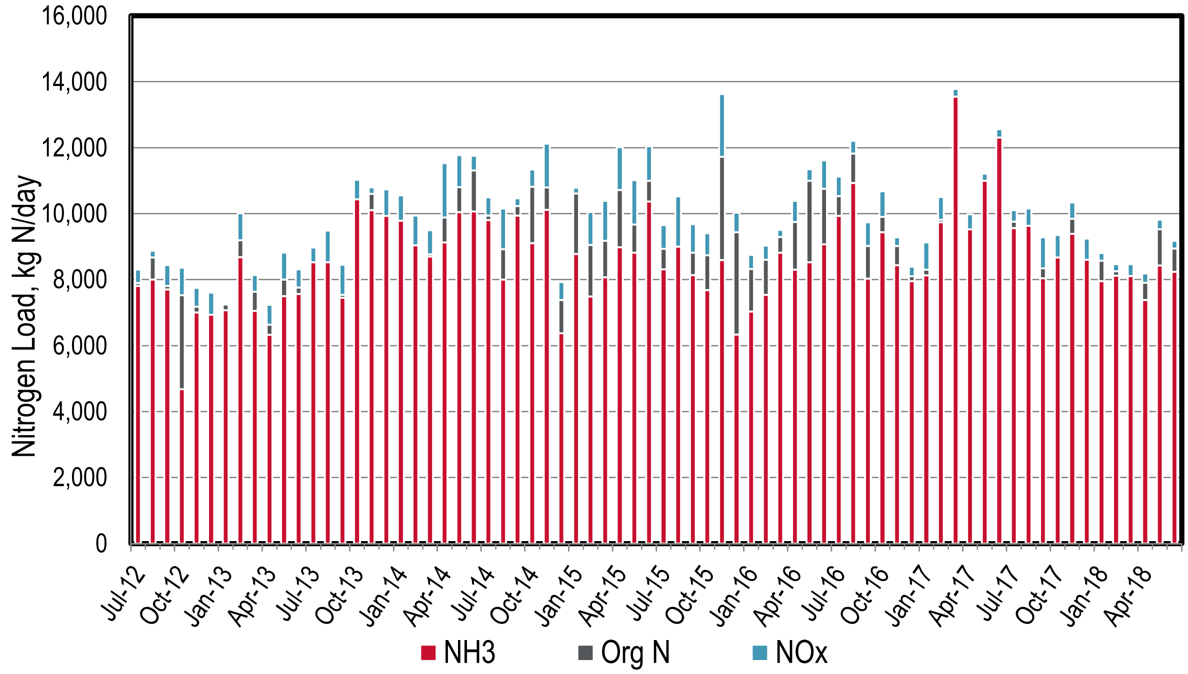

Figure 25-2. SFPUC Southeast Monthly Nitrogen Loads

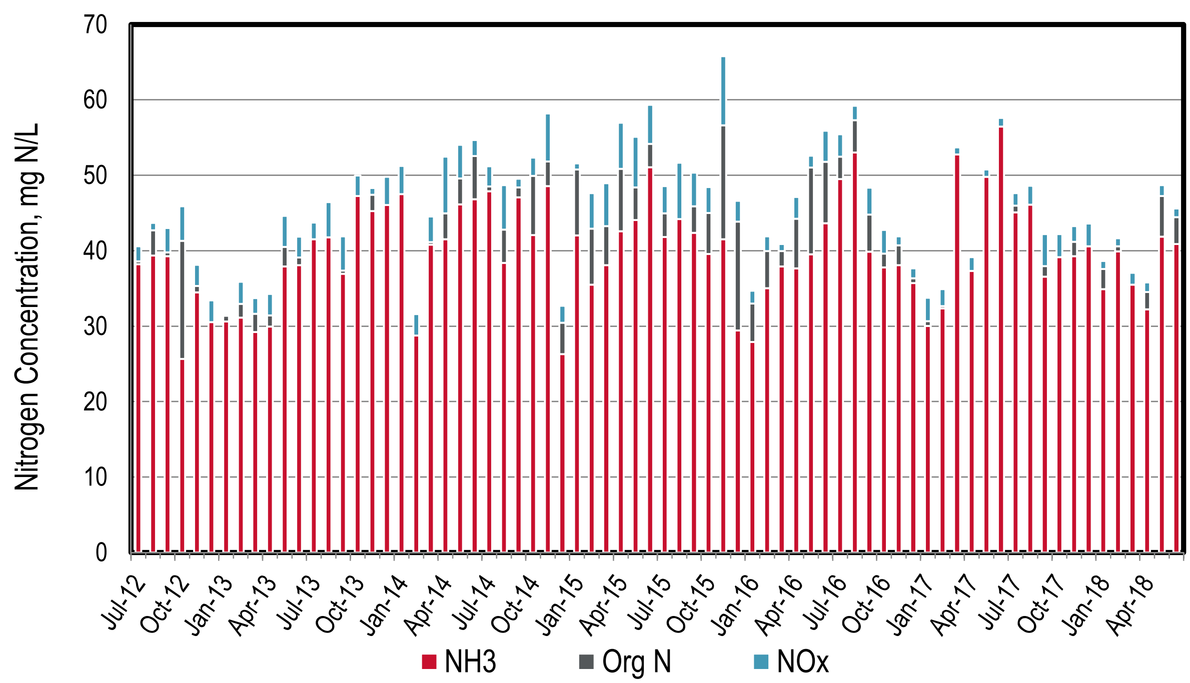

Figure 25-3. SFPUC Southeast Monthly Nitrogen Concentrations

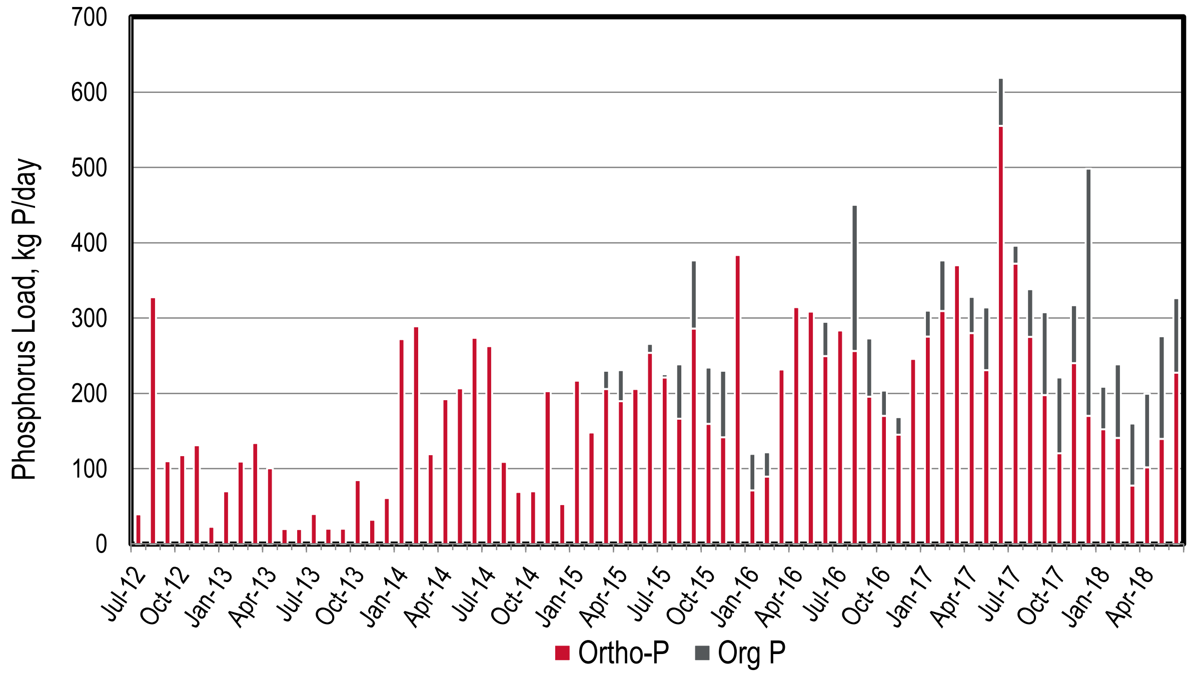

Figure 25-4. SFPUC Southeast Monthly Phosphorus Loads

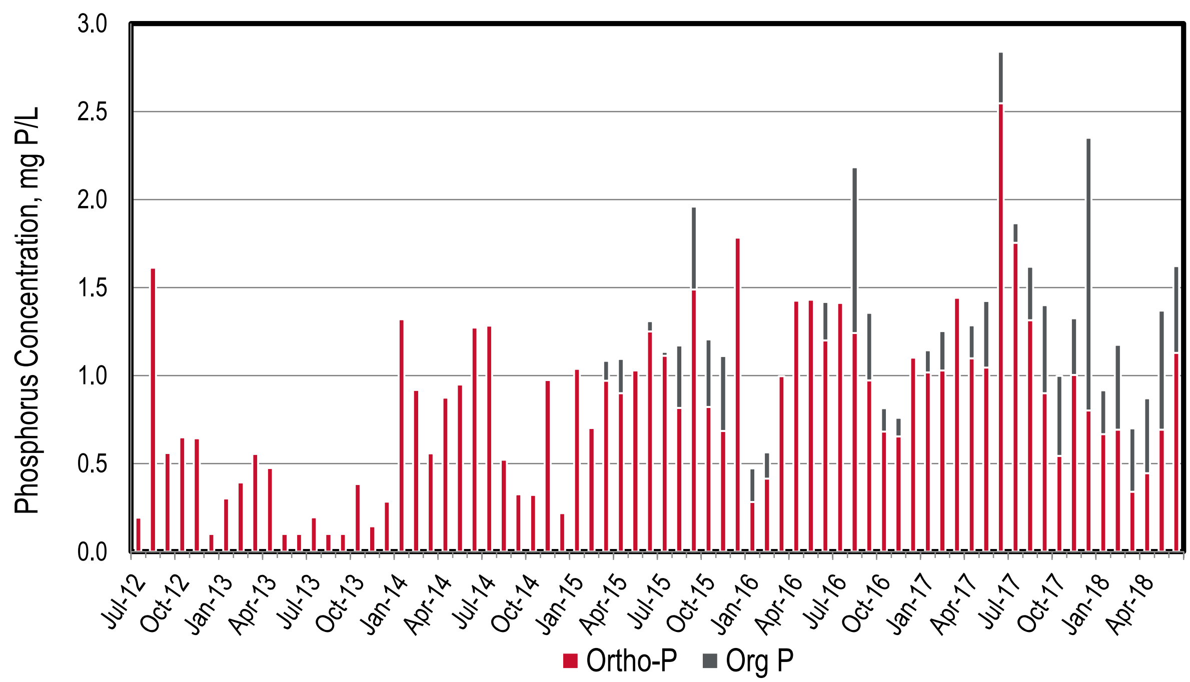

Figure 25-5. SFPUC Southeast Monthly Phosphorus Concentrations

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

Table 25-1. SFPUC Southeast Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jul-12	54.1	7,812	7,897	406	8,302	231	40
Aug-12	53.8	7,999	8,677	201	8,878	831	328
Sep-12	51.9	7,707	7,808	627	8,436	304	110
Oct-12	48.2	4,674	7,529	832	8,362	295	118
Nov-12	53.8	7,009	7,182	570	7,752	560	131
Dec-12	60.2	6,939	6,882	663	7,545	173	23
Jan-13	61.1	7,070	7,244	65	7,309	244	70
Feb-13	73.8	8,683	9,196	810	10,006	324	110
Mar-13	63.8	7,050	7,633	506	8,139	308	134
Apr-13	55.9	6,327	6,635	600	7,235	234	100
May-13	52.3	7,498	8,008	813	8,820	356	20
Jun-13	52.6	7,563	7,764	550	8,314	215	20
Jul-13	54.3	8,526	6,828	451	7,279	688	40
Aug-13	54.0	8,528	8,321	956	9,277	288	20
Sep-13	53.4	7,449	7,534	920	8,453	200	20
Oct-13	58.4	10,433	9,255	600	9,855	131	85
Nov-13	59.1	10,107	10,598	194	10,793	132	32
Dec-13	57.1	9,935	8,947	804	9,752	147	61
Jan-14	54.5	9,785	9,622	769	10,391	359	272
Feb-14	83.2	9,043	8,064	895	8,959	446	289
Mar-14	56.4	8,698	8,769	726	9,494	228	119
Apr-14	58.2	9,129	9,882	1,653	11,535	307	192
May-14	57.7	10,053	10,806	973	11,779	349	207
Jun-14	56.9	10,067	11,306	452	11,758	478	274
Jul-14	54.2	9,809	9,943	549	10,496	287	263
Aug-14	55.2	8,006	8,926	1,230	10,149	161	109
Sep-14	55.9	9,944	10,229	235	10,462	152	69
Oct-14	57.3	9,109	10,811	528	11,343	159	70
Nov-14	55.1	10,118	10,796	1,328	12,121	203	203

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Dec-14	64.1	6,373	7,381	544	7,915	119	53
Jan-15	55.3	8,784	10,614	168	10,782	222	217
Feb-15	55.8	7,491	9,052	997	10,044	205	148
Mar-15	56.1	8,073	9,177	1,207	10,388	206	230
Apr-15	55.8	8,980	10,723	1,295	12,022	190	231
May-15	52.9	8,814	9,675	1,339	11,017	206	206
Jun-15	53.7	10,365	10,995	1,052	12,052	254	266
Jul-15	52.6	8,313	8,933	714	9,647	221	226
Aug-15	53.9	9,002	7,437	1,525	8,961	166	239
Sep-15	50.8	8,138	8,821	856	9,678	286	377
Oct-15	51.4	7,687	8,738	668	9,406	160	234
Nov-15	54.8	8,599	11,727	1,900	13,627	142	230
Dec-15	56.9	6,337	9,441	591	10,031	405	384
Jan-16	66.7	7,036	8,323	425	8,748	71	120
Feb-16	57.0	7,542	8,602	427	9,029	90	122
Mar-16	61.5	8,815	9,290	217	9,507	271	232
Apr-16	58.3	8,309	9,750	643	10,393	401	315
May-16	57.1	8,529	11,004	344	11,348	327	309
Jun-16	55.0	9,070	10,760	856	11,616	250	295
Jul-16	53.1	9,934	10,534	591	11,126	339	284
Aug-16	54.6	10,935	11,824	388	12,212	256	450
Sep-16	53.3	8,029	9,017	723	9,740	196	273
Oct-16	66.1	9,442	9,902	777	10,679	170	204
Nov-16	58.6	8,443	9,022	263	9,285	145	169
Dec-16	58.9	7,952	8,101	287	8,388	400	246
Jan-17	71.6	8,129	8,304	828	9,132	276	310
Feb-17	79.6	9,740	9,819	686	10,505	310	377
Mar-17	67.9	13,545	9,063	236	9,299	435	370
Apr-17	67.5	9,522	8,105	458	8,564	280	328
May-17	58.4	10,997	9,471	213	9,684	231	314

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jun-17	57.7	12,308	10,395	253	10,648	555	619
Jul-17	56.1	9,567	9,759	349	10,108	372	396
Aug-17	55.3	9,633	9,630	524	10,153	275	338
Sep-17	58.2	8,040	8,342	938	9,280	198	308
Oct-17	58.6	8,668	8,510	680	9,191	120	221
Nov-17	63.3	9,393	9,846	495	10,341	240	317
Dec-17	56.1	8,601	8,231	641	8,872	170	498
Jan-18	60.4	7,959	8,572	239	8,811	152	209
Feb-18	53.8	8,118	8,256	211	8,468	141	239
Mar-18	60.4	8,107	7,669	359	8,028	78	160
Apr-18	60.6	7,379	7,908	284	8,192	102	200
May-18	53.3	8,435	9,524	291	9,815	140	276
Jun-18	53.3	8,237	8,946	235	9,181	227	327
Dry Season Average	**54.5**	**8,9877**	**9,304**	**652**	**9,956**	**301**	**234**
Dry Season Trend **	**None**	**Up**	**Up**	**None**	**Up**	**-**	**-**
Wet Season Average	**60.3**	**8,408**	**8,885**	**645**	**9,529**	**232**	**199**
Average Annual	**57.9**	**8,645**	**9,060**	**648**	**9,707**	**261**	**214**

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue. Statistical trending was not performed on TP due to the analytical methodology issue discussed in the bullet points.

26 Sausalito-Marin City Sanitary District (SMCSD)

SMCSD discharges to the Central Bay. The plant has approximately 6,500 service connections and permitted capacity of 1.8 mgd ADWF. The current flows are approximately 1.1 mgd ADWF. The plant performs partial nitrification using a trickling filter.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the table with the average monthly values, there appears to be an emerging downward trend for flows.
- The plant has been under construction since May 2017 with upgrades to improve treatment capacity and performance. During this period, the plant has been using one of two sedimentation tanks and fixed film reactors which has compromised the overall treatment performance. As a result, no statistical trending analysis on discharge loads was performed as the May and June 2017 data is not reflective of plant treatment capacity and performance.
- Nitrogen and phosphorus loads do not appear to track with flows during wet weather events.
- NOx is the majority of the nitrogen species discharged as would be expected since this plant nitrifies. A portion of ammonia bleeds through year round due to the trickling filters inability to reliably remove all the ammonia.
- Ortho-P values are routinely greater than TP values due to the different nature of samples (grab vs. composite as discussed in the main report body). For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations range from 0.8 to 6.3 mg P/L, This suggests occasional P removal as typical effluent TP concentrations are 4 to 6 mg P/L. The removal mechanism is most likely from metal salt addition at the front of the plant with removal in the primary clarifiers.

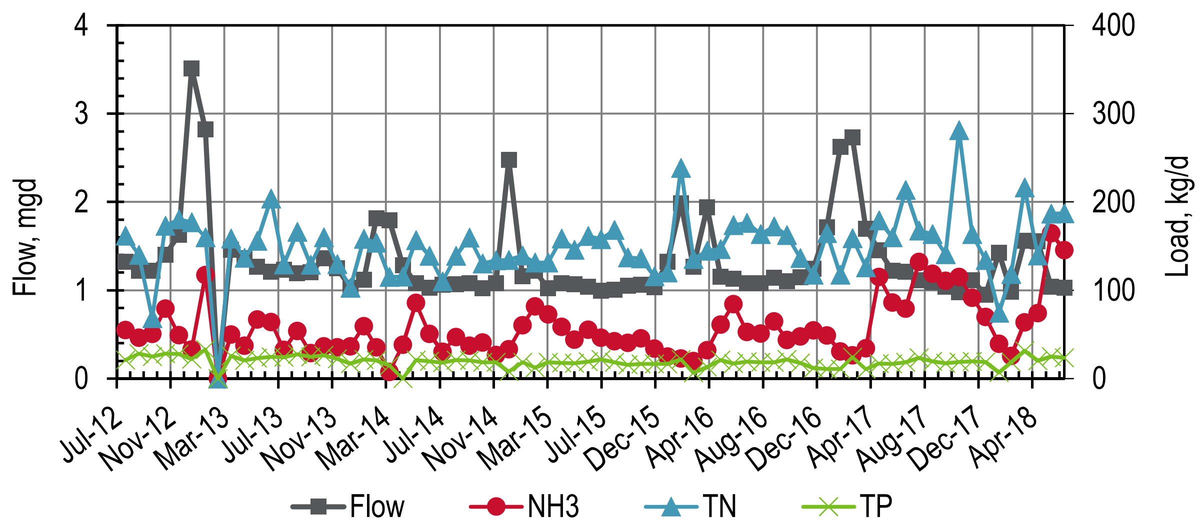

Figure 26-1. SMCSD Monthly Flows and Loads

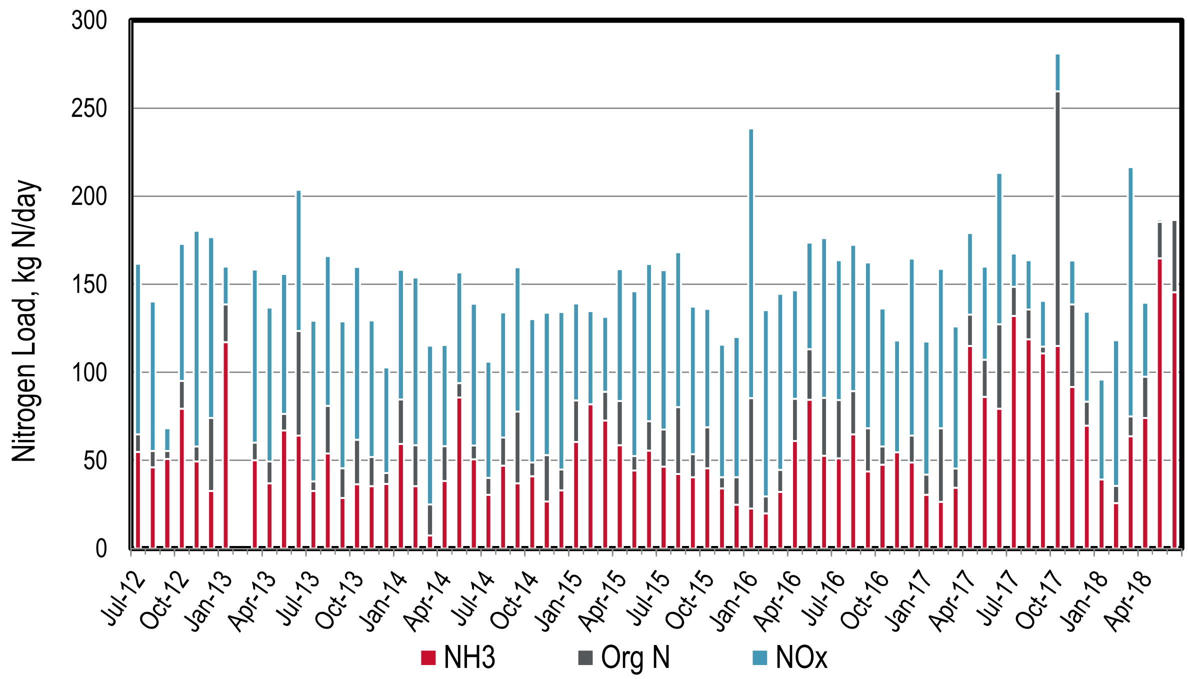

Figure 26-2. SMCSD Monthly Nitrogen Loads

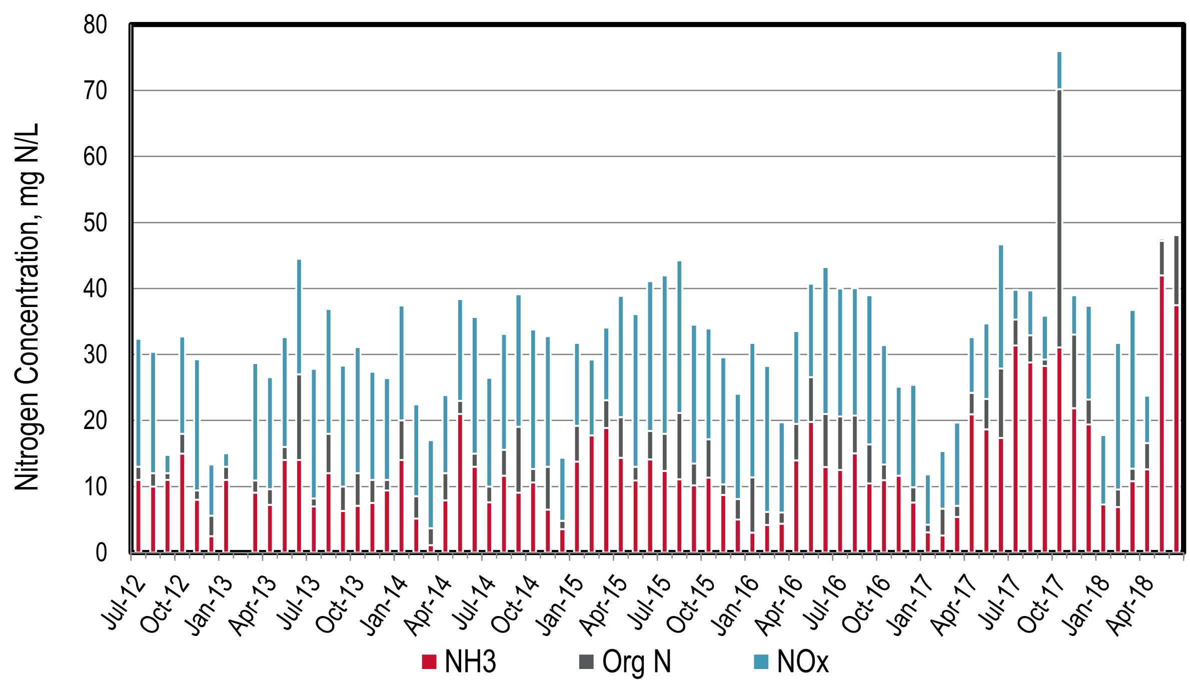

Figure 26-3. SMCSD Monthly Nitrogen Concentrations

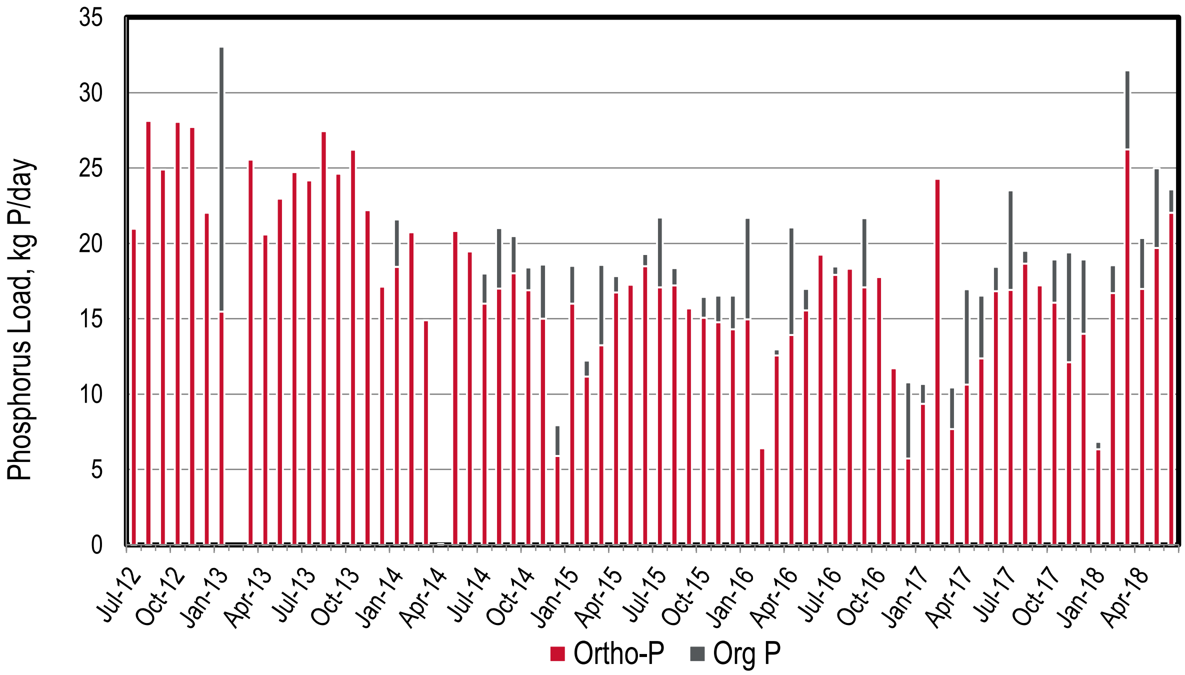

Figure 26-4. SMCSD Monthly Phosphorus Loads

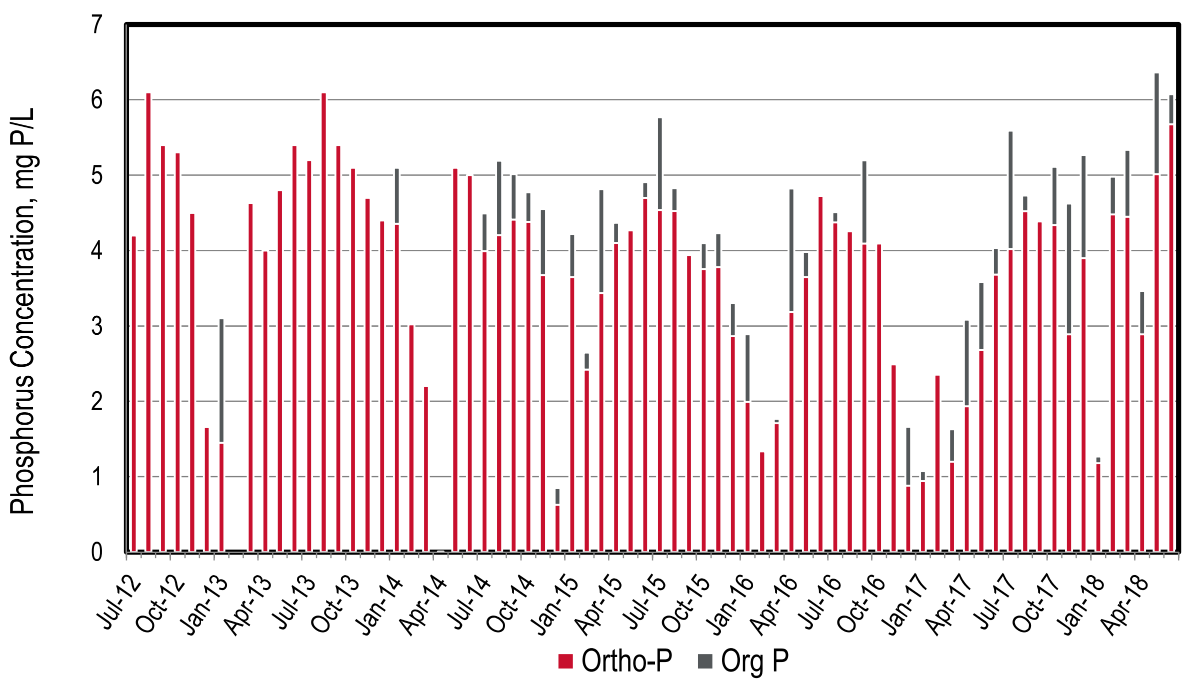

Figure 26-5. SMCSD Monthly Phosphorus Concentrations

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

Table 26-1. SMCSD Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jul-12	1.3	55	65	97	162	36	21
Aug-12	1.2	46	55	85	140	63	28
Sep-12	1.2	51	55	13	68	40	25
Oct-12	1.4	79	95	78	173	42	28
Nov-12	1.6	49	58	122	180	63	28
Dec-12	3.5	33	74	103	177	30	22
Jan-13	2.8	117	139	22	160	15	33
Feb-13	0.0	0	0	0	0	0	0
Mar-13	1.5	50	60	98	158	39	26
Apr-13	1.4	37	49	87	137	29	21
May-13	1.3	67	77	79	156	36	23
Jun-13	1.2	64	124	80	204	67	25
Jul-13	1.2	33	38	91	129	55	24
Aug-13	1.2	54	81	85	166	56	27
Sep-13	1.2	29	46	83	129	69	25
Oct-13	1.4	36	62	98	160	35	26
Nov-13	1.3	35	52	77	129	35	22
Dec-13	1.0	37	43	60	103	32	17
Jan-14	1.1	59	85	74	158	18	22
Feb-14	1.8	35	59	95	154	29	21
Mar-14	1.8	7	25	90	115	16	15
Apr-14	1.3	38	58	57	115	25	0
May-14	1.1	86	94	63	157	37	21
Jun-14	1.0	51	58	81	139	33	19
Jul-14	1.1	31	40	66	110	16	18
Aug-14	1.1	47	63	71	139	17	21
Sep-14	1.1	37	78	82	160	18	20
Oct-14	1.0	41	49	81	130	17	18
Nov-14	1.1	27	53	81	134	15	19

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Dec-14	2.5	33	45	89	134	6	8
Jan-15	1.2	60	84	55	139	16	19
Feb-15	1.2	82	78	53	132	11	12
Mar-15	1.0	73	89	43	131	13	19
Apr-15	1.1	59	84	75	159	17	18
May-15	1.1	44	53	93	146	19	17
Jun-15	1.0	55	72	89	162	18	19
Jul-15	1.0	46	68	90	158	17	22
Aug-15	1.0	42	80	88	168	17	18
Sep-15	1.1	40	54	84	137	17	16
Oct-15	1.1	45	69	67	136	15	16
Nov-15	1.0	34	40	75	116	15	17
Dec-15	1.3	25	40	80	120	14	17
Jan-16	2.0	23	85	153	239	15	22
Feb-16	1.3	20	30	106	135	7	6
Mar-16	1.9	32	45	100	145	13	13
Apr-16	1.2	61	85	62	147	14	21
May-16	1.1	84	113	61	174	16	17
Jun-16	1.1	53	86	91	176	19	19
Jul-16	1.1	51	84	79	164	18	18
Aug-16	1.1	65	89	83	172	18	18
Sep-16	1.1	44	68	94	163	17	22
Oct-16	1.1	48	58	78	136	19	18
Nov-16	1.2	55	54	64	118	14	12
Dec-16	1.7	49	64	101	165	6	11
Jan-17	2.6	31	42	75	117	9	11
Feb-17	2.7	27	68	90	159	40	24
Mar-17	1.7	34	45	81	126	8	10
Apr-17	1.5	115	133	46	179	11	17
May-17 ***	1.2 ***	86 ***	107 ***	53 ***	160 ***	12 ***	17 ***

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jun-17 ***	1.2 ***	79 ***	127 ***	86 ***	213 ***	17***	18 ***
Jul-17 ***	1.1 ***	132 ***	149 ***	19 ***	168 ***	17 ***	24 ***
Aug-17 ***	1.1 ***	119 ***	136 ***	28 ***	164 ***	19 ***	20 ***
Sep-17 ***	1.0 ***	111 ***	115 ***	26 ***	141 ***	17 ***	17 ***
Oct-17 ***	1.0 ***	115 ***	260 ***	22 ***	281 ***	16 ***	19 ***
Nov-17 ***	1.1 ***	92 ***	139 ***	25 ***	163 ***	12 ***	19 ***
Dec-17 ***	1.0 ***	70 ***	83 ***	51 ***	134 ***	14 ***	19 ***
Jan-18 ***	1.4 ***	39 ***	18 ***	57 ***	75 ***	6 ***	7 ***
Feb-18 ***	1.0 ***	26 ***	36 ***	83 ***	118 ***	17 ***	19 ***
Mar-18 ***	1.6 ***	64 ***	75 ***	142 ***	217 ***	26 ***	31 ***
Apr-18 ***	1.6 ***	74 ***	98 ***	42 ***	139 ***	17 ***	20 ***
May-18 ***	1.0 ***	165 ***	185 ***	1 ***	187 ***	20 ***	25 ***
Jun-18 ***	1.0 ***	146 ***	187 ***	1 ***	187 ***	22 ***	24 ***
Dry Season Average	**1.1**	**67**	**88**	**68**	**157**	**28**	**21**
Dry Season Trend **	**Down**	**--*****	**--*****	**--*****	**--*****	**--*****	**--*****
Wet Season Average	**1.5**	**49**	**69**	**75**	**144**	**19**	**18**
Average Annual	**1.3**	**57**	**77**	**72**	**149**	**23**	**19**

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

*** The plant has been under construction since May 2017 with upgrades to improve treatment capacity and performance. During this period, the plant has been using one of two sedimentation tanks and fixed film reactors which has compromised the overall treatment performance. As a result, no statistical trending analysis on discharge loads was performed as data collected after May 2017 is not reflective of plant treatment capacity and performance.

27 Sonoma Valley County Sanitation District

Sonoma Valley discharges to Schell Slough which is connected to San Pablo Bay. The plant has approximately 17,200 service connections and a permitted capacity of 3.0 mgd ADWF. The plant has a wet weather discharge to Schell Slough at a capacity of 11 mgd. Discharge to Schell Slough is prohibited May 1 through October 31. The plant performs nitrogen removal using an activated sludge process.

The following observations are made based upon the figures and table in the subsequent pages:

- There are no emerging dry season trends as Sonoma Valley is prohibited from discharging to Schell Slough during the dry season. There is one exception in May 2017, where discharge was for 3 days due to the relatively wet month. Sonoma Valley is only allowed to discharge if flows entering the plant exceed 6 mgd or storage is 50 % or more full.
- Wet season trends analyzed (data not shown) and there are no emerging trends.
- There are only 17 out of 72 months in which they discharged to Schell Slough. The water was all recycled or used for environmental enhancement during the other months.
- Both nitrogen and phosphorus loads increase with flow during wet weather events.
- NOx is the majority of the nitrogen species discharged as would be expected since this plant fully nitrifies. The highest average monthly effluent ammonia concentration was 0.6 mg N/L.
- The plant meets Level 2 total nitrogen concentration limits (i.e., 15 mg N/L) developed under the Scoping and Evaluation Plan for all but four months. Three of these months are in the July 2016 through June 2017 dataset due to the relatively high levels of precipitation during that wet season.
- Ortho-P values are occasionally greater than TP values for the Section 13257 Letter based on the composite sampling issue discussed in the main report body. Since the Regional Watershed Permit sampling began (July, 2014), the ortho-P values has only exceeded the TP value once. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations range from 1.3 to 4.5 mg P/L, which suggests a portion of P is removed as typical effluent TP concentrations are 4 to 6 mg P/L. The removal mechanism is unclear at this stage.

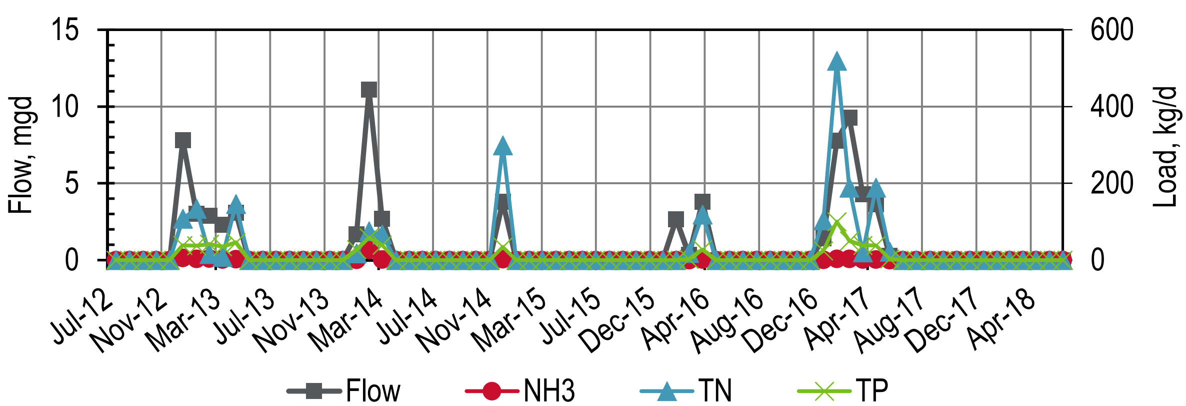

Figure 27-1. Sonoma Valley Monthly Flows and Loads

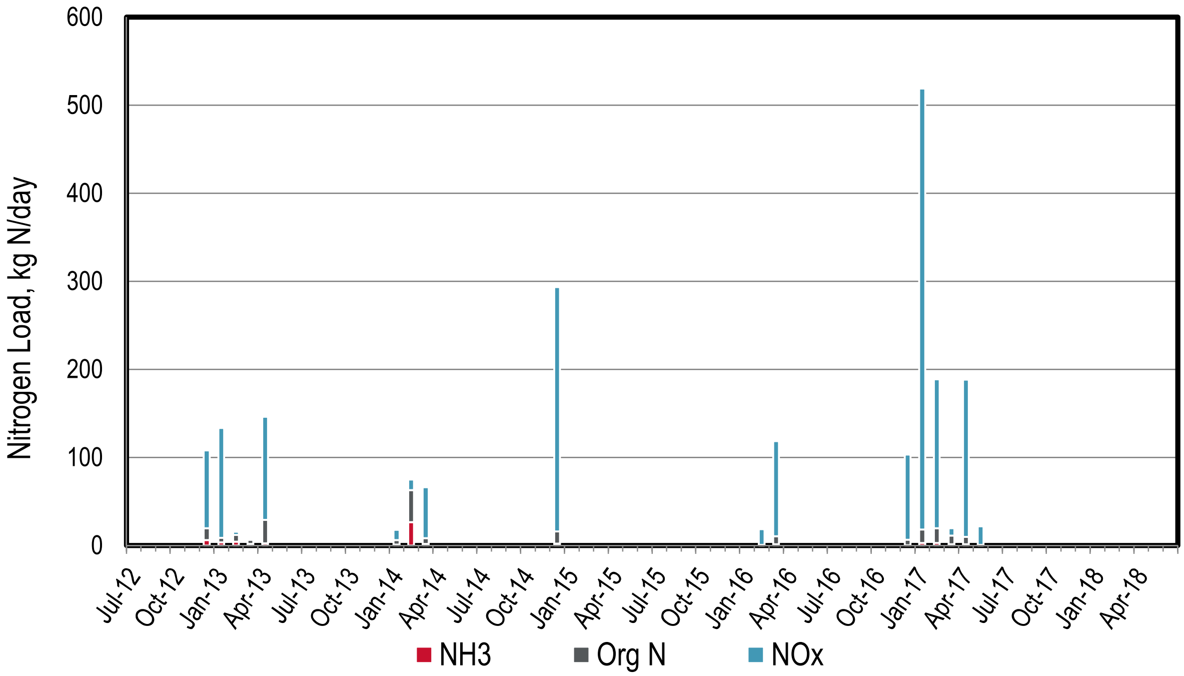

Figure 27-2. Sonoma Valley Monthly Nitrogen Loads

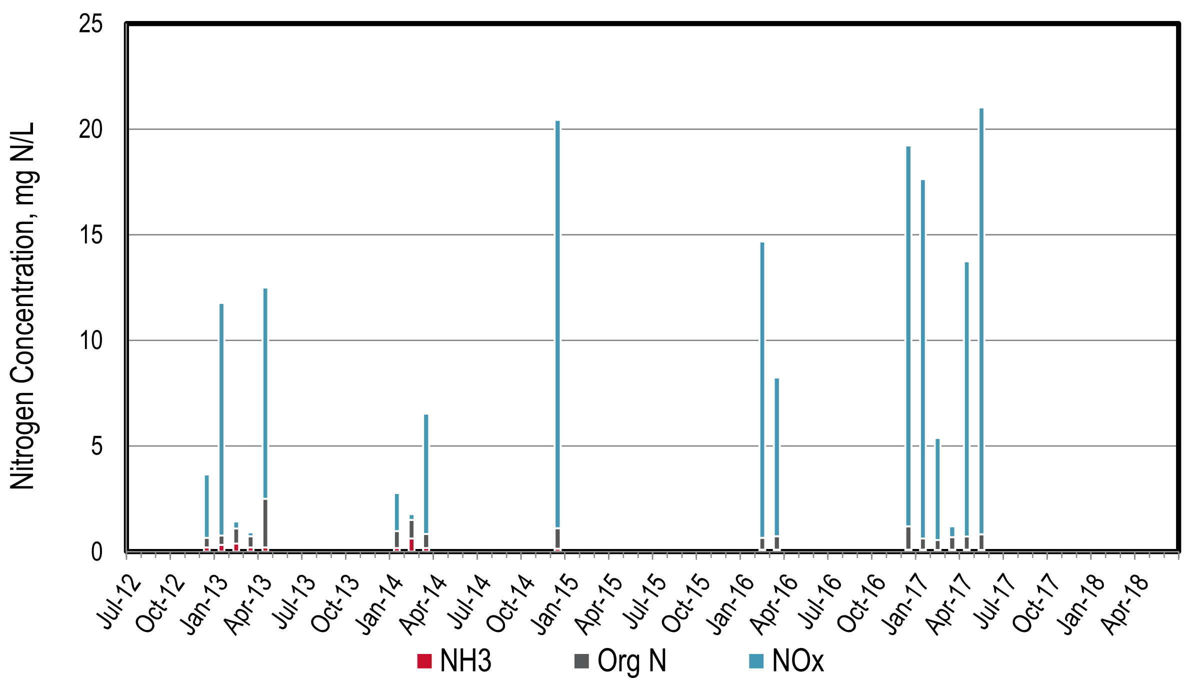

Figure 27-3. Sonoma Valley Monthly Nitrogen Concentrations

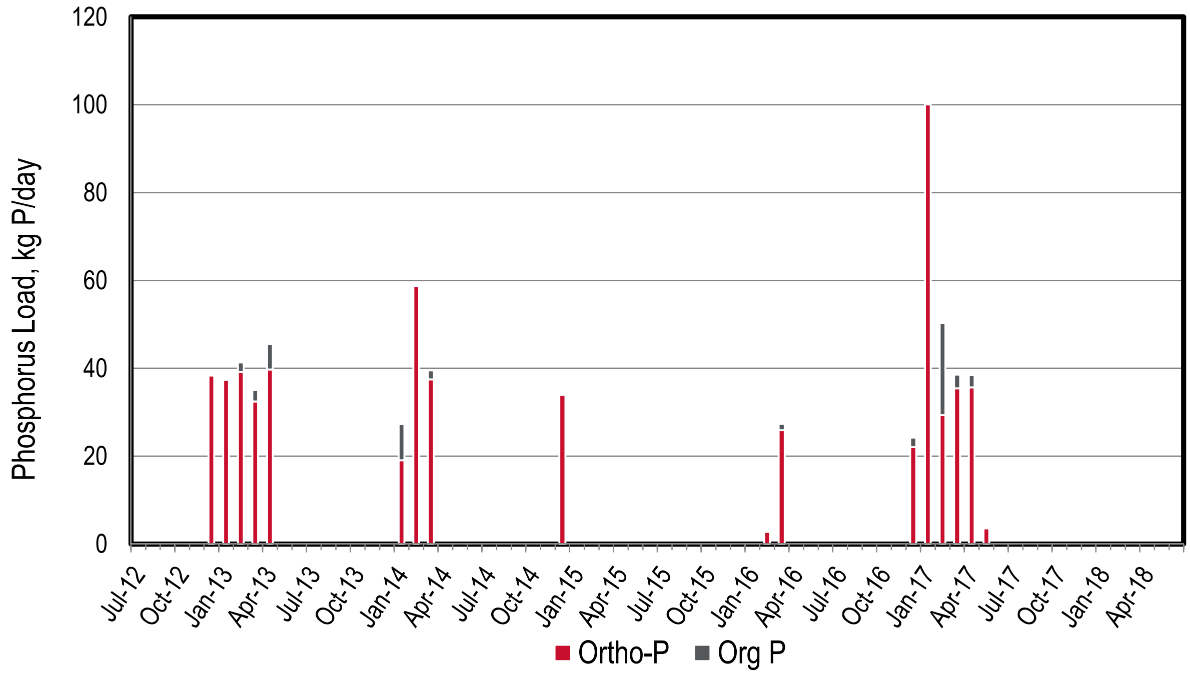

Figure 27-4. Sonoma Valley Monthly Phosphorus Loads

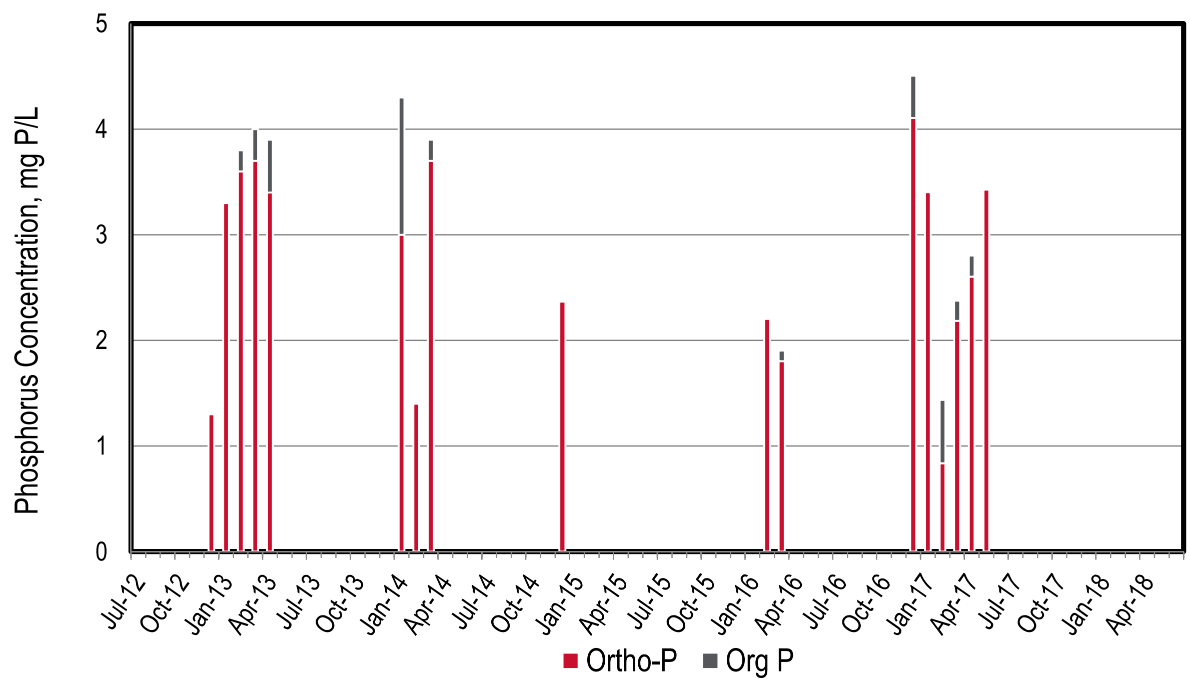

Figure 27-5. Sonoma Valley Monthly Phosphorus Concentrations

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

Table 27-1. Sonoma Valley Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jul-12	0.0	0	0	0	0	0	0
Aug-12	0.0	0	0	0	0	0	0
Sep-12	0.0	0	0	0	0	0	0
Oct-12	0.0	0	0	0	0	0	0
Nov-12	0.0	0	0	0	0	0	0
Dec-12	7.8	6	19	88	108	41	38
Jan-13	3.0	4	9	125	133	39	37
Feb-13	2.9	4	12	4	16	39	41
Mar-13	2.3	2	6	2	8	32	35
Apr-13	3.1	2	29	117	146	40	46
May-13	0.0	0	0	0	0	0	0
Jun-13	0.0	0	0	0	0	0	0
Jul-13	0.0	0	0	0	0	0	0
Aug-13	0.0	0	0	0	0	0	0
Sep-13	0.0	0	0	0	0	0	0
Oct-13	0.0	0	0	0	0	0	0
Nov-13	0.0	0	0	0	0	0	0
Dec-13	0.0	0	0	0	0	0	0
Jan-14	1.7	1	6	11	18	19	27
Feb-14	11.1	26	63	12	75	63	59
Mar-14	2.7	2	9	58	66	37	40
Apr-14	0.0	0	0	0	0	0	0
May-14	0.0	0	0	0	0	0	0
Jun-14	0.0	0	0	0	0	0	0
Jul-14	0.0	0	0	0	0	0	0
Aug-14	0.0	0	0	0	0	0	0
Sep-14	0.0	0	0	0	0	0	0
Oct-14	0.0	0	0	0	0	0	0
Nov-14	0.0	0	0	0	0	0	0

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Dec-14	3.8	2	16	278	299	36	34
Jan-15	0.0	0	0	0	0	0	0
Feb-15	0.0	0	0	0	0	0	0
Mar-15	0.0	0	0	0	0	0	0
Apr-15	0.0	0	0	0	0	0	0
May-15	0.0	0	0	0	0	0	0
Jun-15	0.0	0	0	0	0	0	0
Jul-15	0.0	0	0	0	0	0	0
Aug-15	0.0	0	0	0	0	0	0
Sep-15	0.0	0	0	0	0	0	0
Oct-15	0.0	0	0	0	0	0	0
Nov-15	0.0	0	0	0	0	0	0
Dec-15	0.0	0	0	0	0	0	0
Jan-16	2.7	0	0	0	0	0	0
Feb-16	0.3	0	1	18	19	3	3
Mar-16	3.8	1	11	108	118	26	27
Apr-16	0.0	0	0	0	0	0	0
May-16	0.0	0	0	0	0	0	0
Jun-16	0.0	0	0	0	0	0	0
Jul-16	0.0	0	0	0	0	0	0
Aug-16	0.0	0	0	0	0	0	0
Sep-16	0.0	0	0	0	0	0	0
Oct-16	0.0	0	0	0	0	0	0
Nov-16	0.0	0	0	0	0	0	0
Dec-16	1.4	1	6	97	103	22	24
Jan-17	7.8	3	18	500	519	100	100
Feb-17	9.3	3	20	169	189	29	50
Mar-17	4.3	2	11	8	20	35	39
Apr-17	3.6	1	10	178	188	36	38
May-17	0.3	0	1	21	22	4	4

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jun-17	0.0	0	0	0	0	0	0
Jul-17	0.0	0	0	0	0	0	0
Aug-17	0.0	0	0	0	0	0	0
Sep-17	0.0	0	0	0	0	0	0
Oct-17	0.0	0	0	0	0	0	0
Nov-17	0.0	0	0	0	0	0	0
Dec-17	0.0	0	0	0	0	0	0
Jan-18	0.0	0	0	0	0	0	0
Feb-18	0.0	0	0	0	0	0	0
Mar-18	0.0	0	0	0	0	0	0
Apr-18	0.0	0	0	0	0	0	0
May-18	0.0	0	0	0	0	0	0
Jun-18	0.0	0	0	0	0	0	0
Dry Season Average	**0.0**	**0**	**0**	**1**	**1**	**0**	**0**
Dry Season Trend **	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Wet Season Average	**1.7**	**1**	**6**	**42**	**48**	**14**	**15**
Average Annual	**1.0**	**1**	**3**	**25**	**28**	**8**	**9**

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

28 South San Francisco-San Bruno

South SF-San Bruno discharges to Lower San Francisco Bay (referred to as South Bay in the Group Annual Report). The plant has a permitted capacity of 13 mgd ADWF and a peak wet weather capacity of 30 mgd, with blending above 30 mgd allowable. The current flow is approximately 7.8 mgd ADWF. The process includes a conventional activated sludge system.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the average monthly values table below, there appears to be a downward dry season trend for flows. The decrease in flows is attributed to a combination of recycled water and water conservation.
- Nitrogen loads generally increase with flow during wet weather events.
- Ammonia is the majority of the nitrogen species discharged, regardless of season. This would be expected since they do not nitrify.
- Ammonia loads are occasionally greater than TN loads. This is attributed to sampling frequency, whereby ammonia is sampled daily and other nitrogen species bimonthly. During nitrogen species sampling days, ammonia values are less than TKN and TN values.
- Ortho-P values are routinely greater than TP values. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table. This is not an issue in the most recent three reporting years.
- Total phosphorus concentrations range from 1.3 to 9 mg P/L, which suggests a portion of P might be removed as typical effluent TP concentrations are 4 to 6 mg P/L. The majority of the samples fall within the typical effluent TP concentrations though so the occasional lower concentrations might be sampling artifacts.

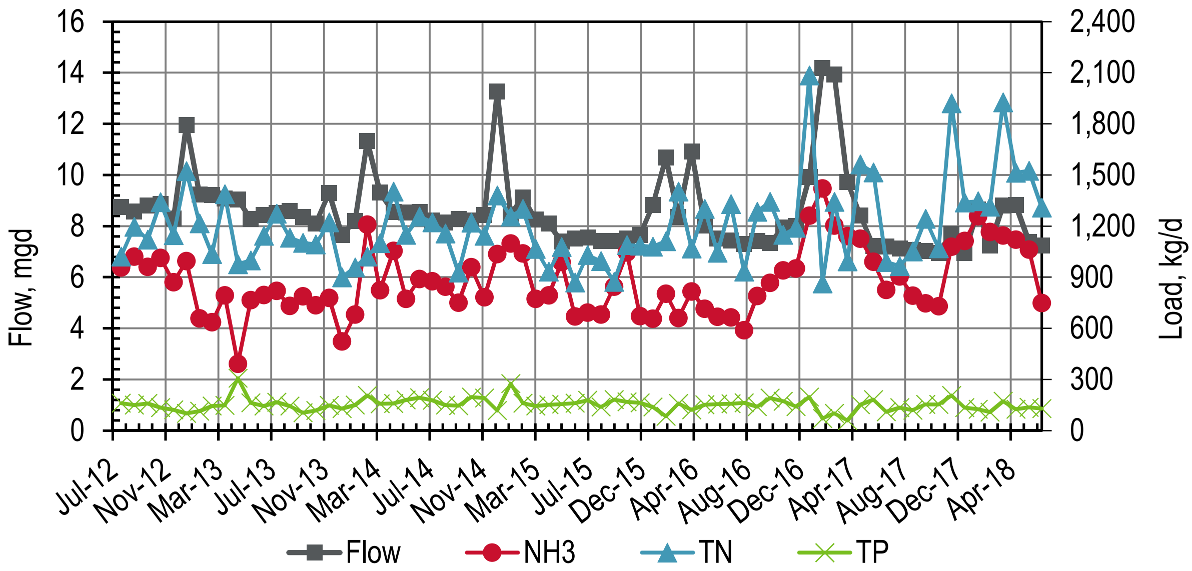

Figure 28-1. South SF-San Bruno Monthly Flows and Loads

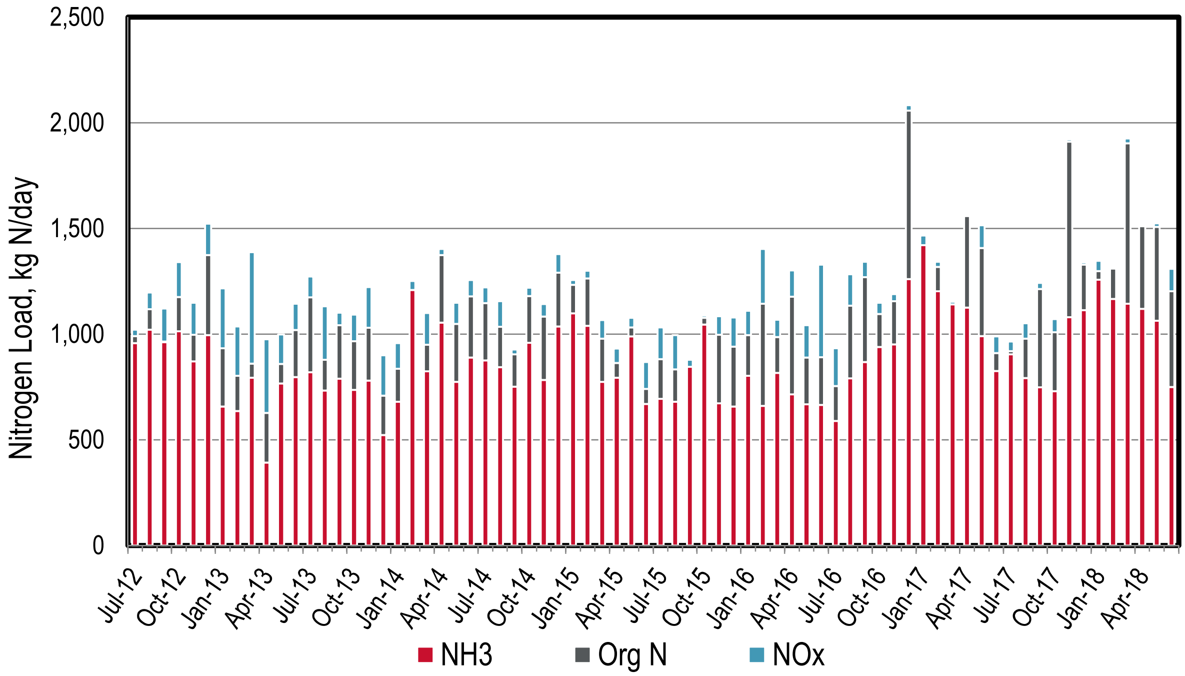

Figure 28-2. South SF-San Bruno Monthly Nitrogen Loads

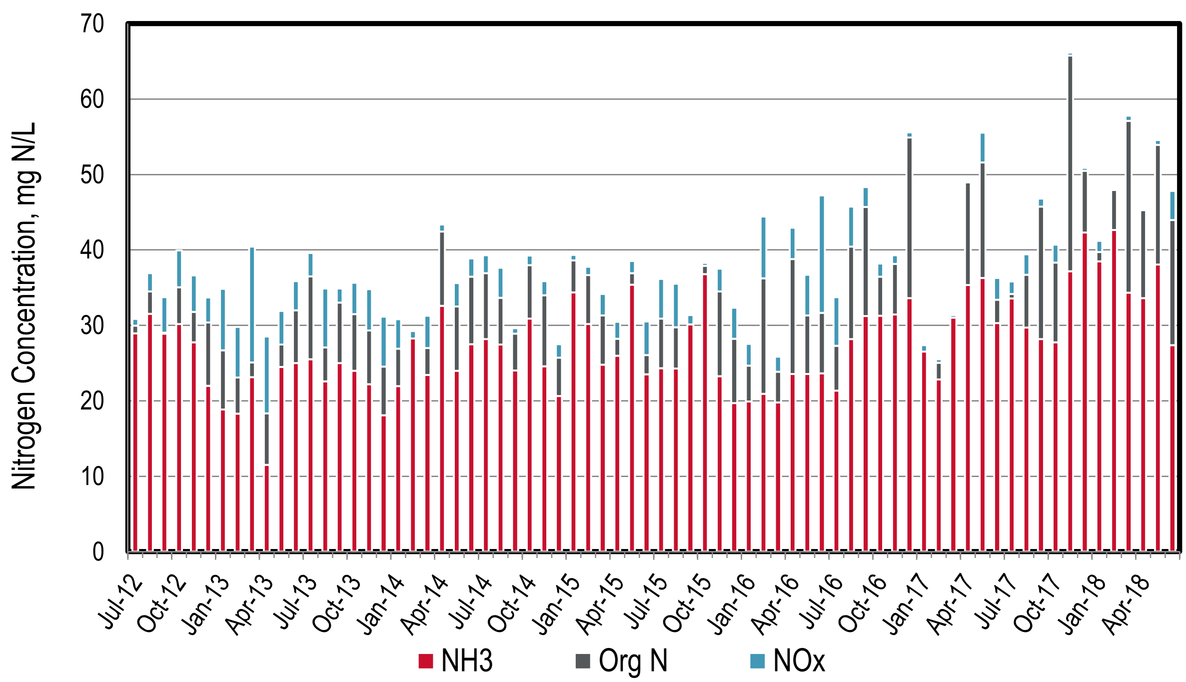

Figure 28-3. South SF-San Bruno Monthly Nitrogen Concentrations

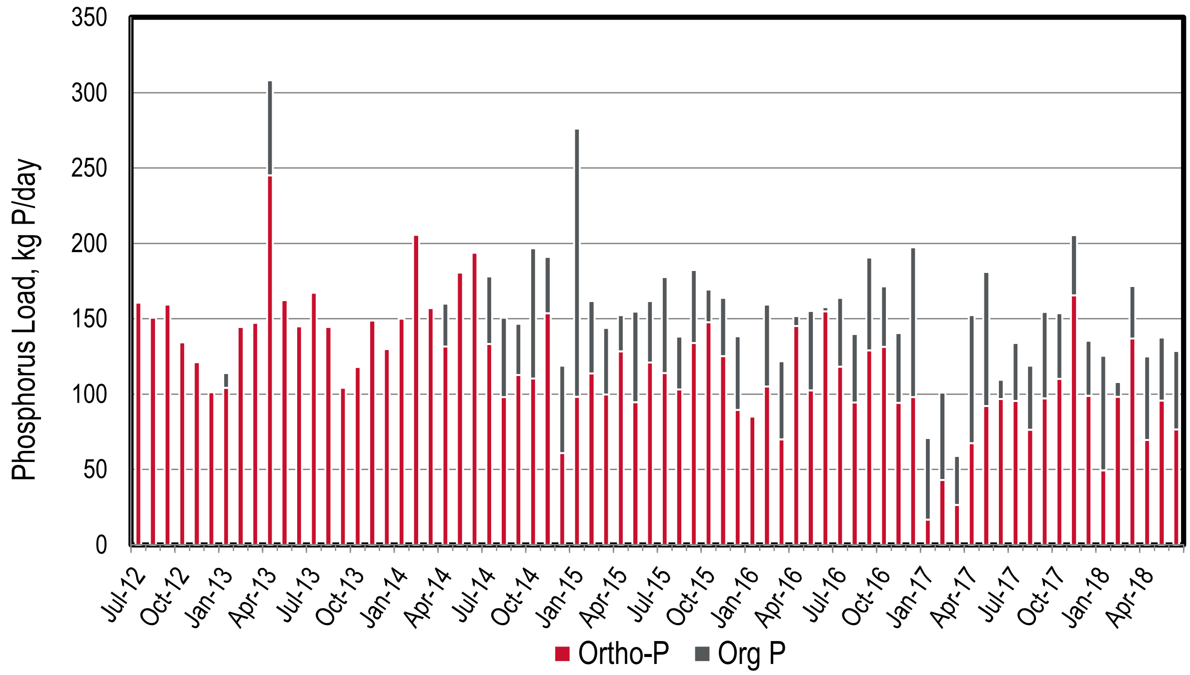

Figure 28-4. South SF-San Bruno Monthly Phosphorus Loads

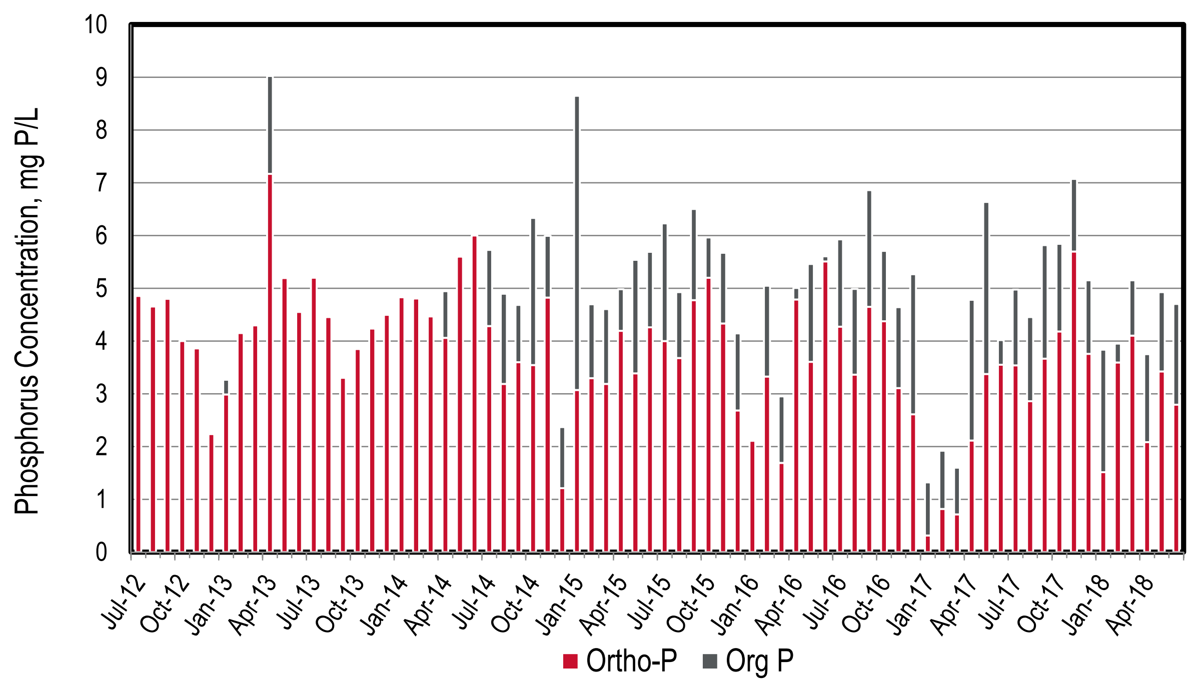

Figure 28-5. South SF-San Bruno Monthly Phosphorus Concentrations

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

Table 28-1. South SF-San Bruno Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jul-12	8.7	957	990	30	1,020	182	161
Aug-12	8.6	1,021	1,118	78	1,196	161	151
Sep-12	8.8	962	965	156	1,121	264	159
Oct-12	8.9	1,013	1,176	164	1,340	148	134
Nov-12	8.3	870	997	151	1,148	161	121
Dec-12	12.0	995	1,373	149	1,523	128	101
Jan-13	9.2	658	933	284	1,217	104	114
Feb-13	9.2	637	804	233	1,037	205	144
Mar-13	9.1	793	860	527	1,387	183	147
Apr-13	9.0	393	626	349	975	245	308
May-13	8.3	766	859	139	998	297	162
Jun-13	8.4	797	1,020	124	1,143	188	145
Jul-13	8.5	820	1,173	100	1,273	194	167
Aug-13	8.6	733	878	254	1,132	163	144
Sep-13	8.4	789	1,042	60	1,101	150	104
Oct-13	8.1	736	966	127	1,092	196	118
Nov-13	9.3	779	1,030	193	1,223	255	149
Dec-13	7.6	523	709	191	900	211	130
Jan-14	8.2	681	836	121	957	226	150
Feb-14	11.3	1,209	978	43	1,021	273	206
Mar-14	9.3	824	950	150	1,100	254	157
Apr-14	8.6	1,054	1,374	29	1,403	131	160
May-14	8.5	774	1,048	100	1,148	275	181
Jun-14	8.6	889	1,179	77	1,256	304	194
Jul-14	8.2	876	1,147	74	1,222	133	178
Aug-14	8.1	844	1,034	122	1,156	98	151
Sep-14	8.3	752	904	23	927	113	147
Oct-14	8.2	960	1,180	39	1,220	110	197
Nov-14	8.4	783	1,083	60	1,143	154	191

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Dec-14	13.3	1,036	1,291	88	1,379	61	119
Jan-15	8.5	1,098	1,233	23	1,257	98	276
Feb-15	9.1	1,040	1,263	37	1,300	114	162
Mar-15	8.3	774	979	88	1,067	100	144
Apr-15	8.1	794	863	69	932	128	152
May-15	7.4	989	1,031	45	1,077	95	155
Jun-15	7.5	669	741	127	868	121	162
Jul-15	7.5	693	881	150	1,031	114	178
Aug-15	7.4	680	834	161	995	103	138
Sep-15	7.4	845	839	34	874	134	182
Oct-15	7.5	1,045	1,077	11	1,088	148	169
Nov-15	7.6	673	997	87	1,084	125	164
Dec-15	8.8	657	941	137	1,078	89	138
Jan-16	10.7	803	996	115	1,111	91	85
Feb-16	8.3	661	1,144	258	1,402	105	159
Mar-16	10.9	817	986	83	1,068	70	122
Apr-16	8.0	714	1,176	125	1,301	145	152
May-16	7.5	668	890	153	1,043	102	155
Jun-16	7.4	665	890	438	1,329	155	158
Jul-16	7.3	590	755	178	933	118	164
Aug-16	7.4	791	1,134	149	1,283	94	140
Sep-16	7.3	868	1,269	73	1,342	129	191
Oct-16	7.9	940	1,095	53	1,148	131	171
Nov-16	8.0	951	1,155	34	1,189	94	140
Dec-16	9.9	1,260	2,058	26	2,083	98	197
Jan-17	14.2	1,421	818	45	863	17	71
Feb-17	13.9	1,203	1,318	25	1,342	43	101
Mar-17	9.7	1,141	981	12	993	26	59
Apr-17	8.4	1,126	1,559	3	1,562	67	152
May-17	7.2	990	1,407	108	1,515	92	181

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jun-17	7.2	826	910	79	989	97	110
Jul-17	7.1	904	920	45	965	95	134
Aug-17	7.1	793	979	72	1,051	76	119
Sep-17	7.0	748	1,214	28	1,242	97	154
Oct-17	7.0	730	1,008	62	1,071	110	154
Nov-17	7.7	1,080	1,910	11	1,920	165	205
Dec-17	7.0	1,113	1,328	10	1,338	99	135
Jan-18	8.6	1,257	1,298	48	1,346	49	125
Feb-18	7.2	1,166	1,310	4	1,314	98	108
Mar-18	8.8	1,144	1,902	24	1,926	137	172
Apr-18	8.8	1,120	1,510	3	1,513	70	125
May-18	7.4	1,063	1,507	18	1,524	96	138
Jun-18	7.2	749	1,203	105	1,308	76	129
Dry Season Average	**7.8**	**817**	**1,025**	**110**	**1,135**	**144**	**154**
Dry Season Trend **	**Down**	**None**	**None**	**None**	**None**	**-**	**None**
Wet Season Average	**9.1**	**921**	**1,145**	**102**	**1,247**	**130**	**150**
Average Annual	**8.6**	**877**	**1,095**	**105**	**1,200**	**136**	**152**

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

29 City of Sunnyvale

Sunnyvale discharges to a tributary of the Lower South Bay. It has approximately 28,300 service connections with a permitted ADWF capacity of 29.5 mgd and a peak wet weather flow capacity of 40 mgd. The permitted ADWF capacity will be reduced to 19.5 mgd as part of the ongoing plant upgrades design. The current flows are approximately 8.5 mgd ADWF. This value excludes effluent that is diverted to Sunnyvale's recycling water network. The plant currently nitrifies using oxidation ponds followed by nitrifying trickling filters and has filtration.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the average monthly values table below, there do not appear to be any emerging dry season trends for any of the parameters considered. Seasonal flow variation is attributed to rainfall and evaporation from the oxidation ponds and recycled water in the summer.
- Nitrogen and phosphorus loads typically increase with flow during wet weather events.
- The trickling filters struggle to reliably nitrify during colder months as evidenced by occasional ammonia spikes. This is a common phenomenon for nitrifying trickling filters exacerbated by occasional cold temperatures from the oxidation ponds.
- In 2012, the City began a dredging project in the Oxidation Ponds to remove accumulated sediment and restore treatment capacity. Disturbance of the sediment resulted in the release of bound ammonia and the increase in loading rates during that period.
- Nitrogen wet season loads are typically greater and more variable than the dry season loads (with the exception of a TN spike in September 2013).
- The plant has seasonal denitrification as evidenced by ADWF TN values that typically range from 10 to 20 mg N/L. Denitrification occurs in the oxidation ponds during the summer months.
- NOx is the majority of the nitrogen species discharged, regardless of season. This would be expected since this plant nitrifies year round (except for colder months, when partial nitrification occurs occasionally).
- Total phosphorus concentrations are wide ranging from approximately 2.3 to 10.2 mg P/L.

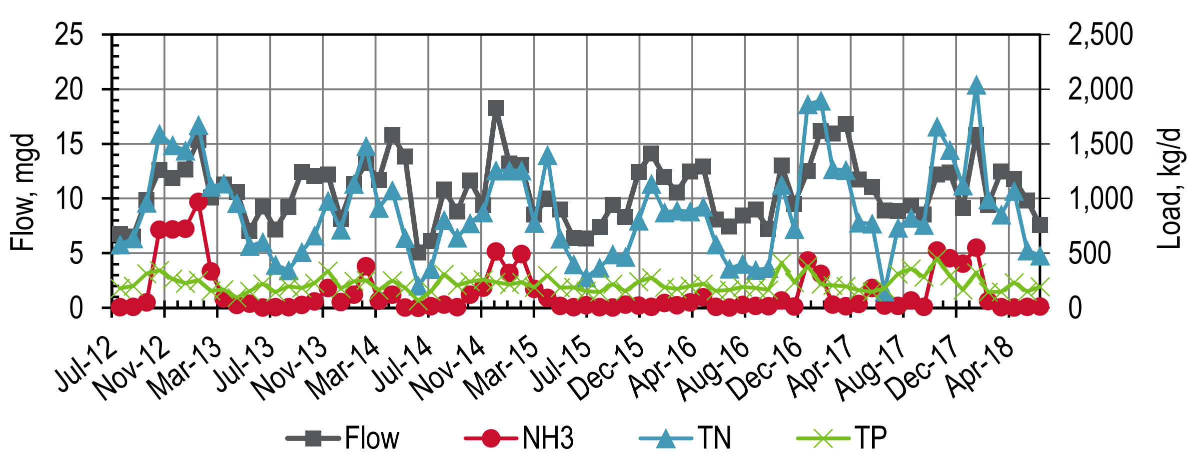

Figure 29-1. Sunnyvale Monthly Flows and Loads

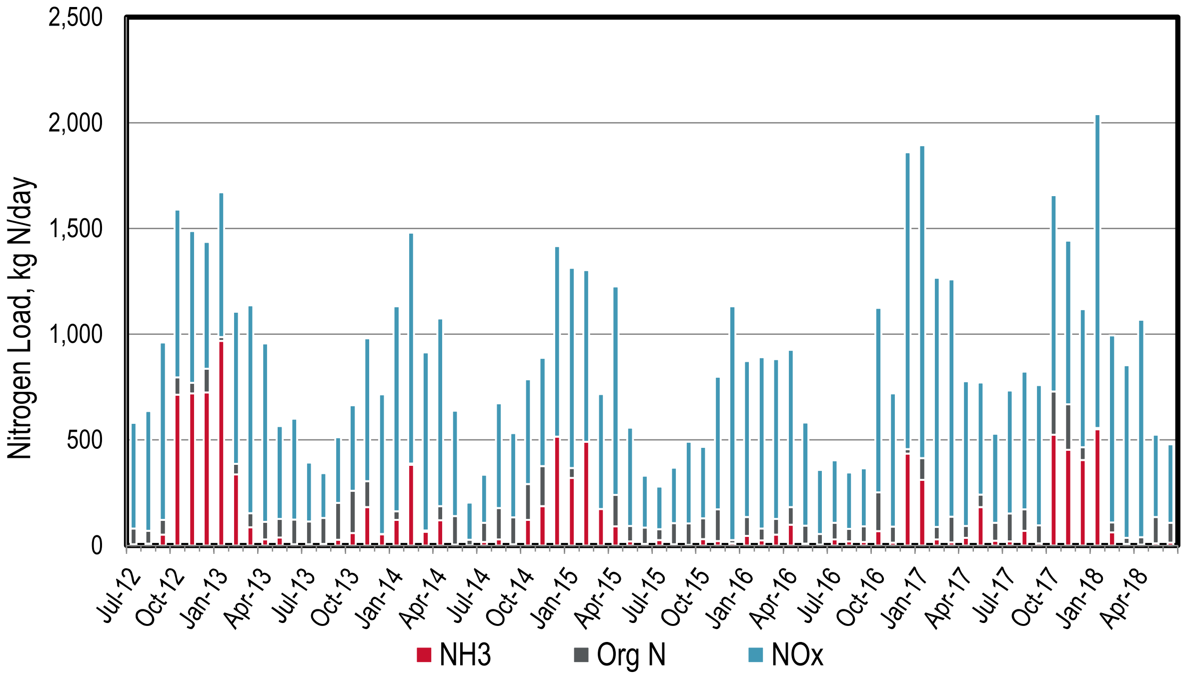

Figure 29-2. Sunnyvale Monthly Nitrogen Loads

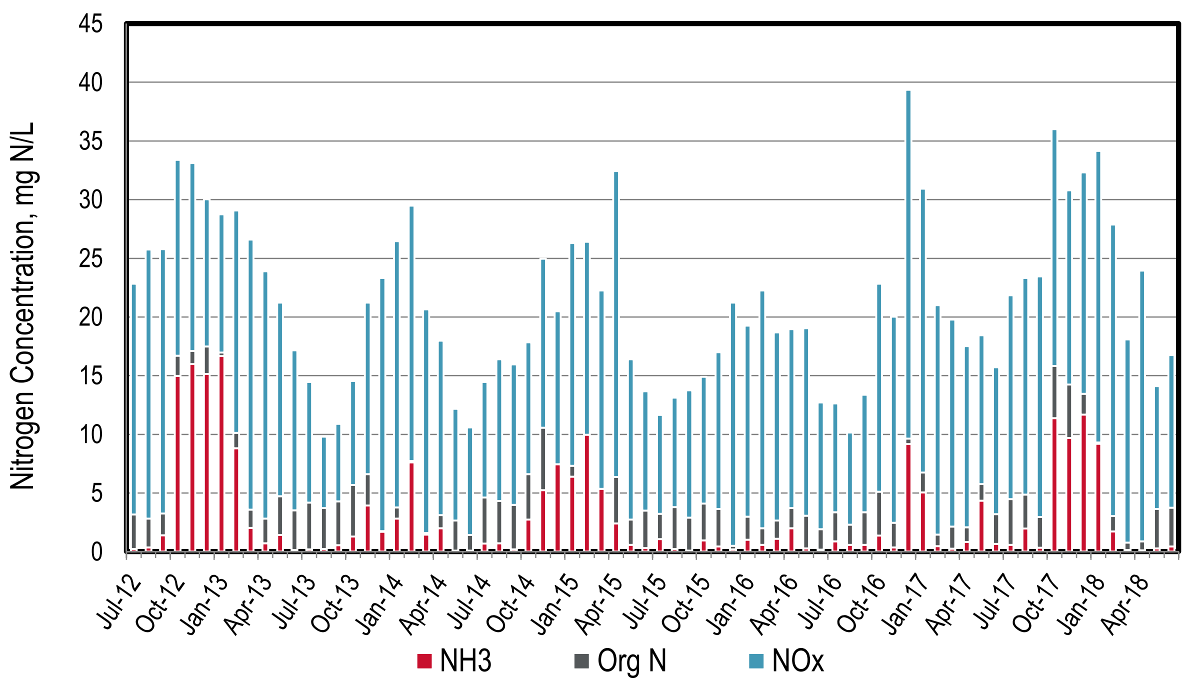

Figure 29-3. Sunnyvale Monthly Nitrogen Concentrations

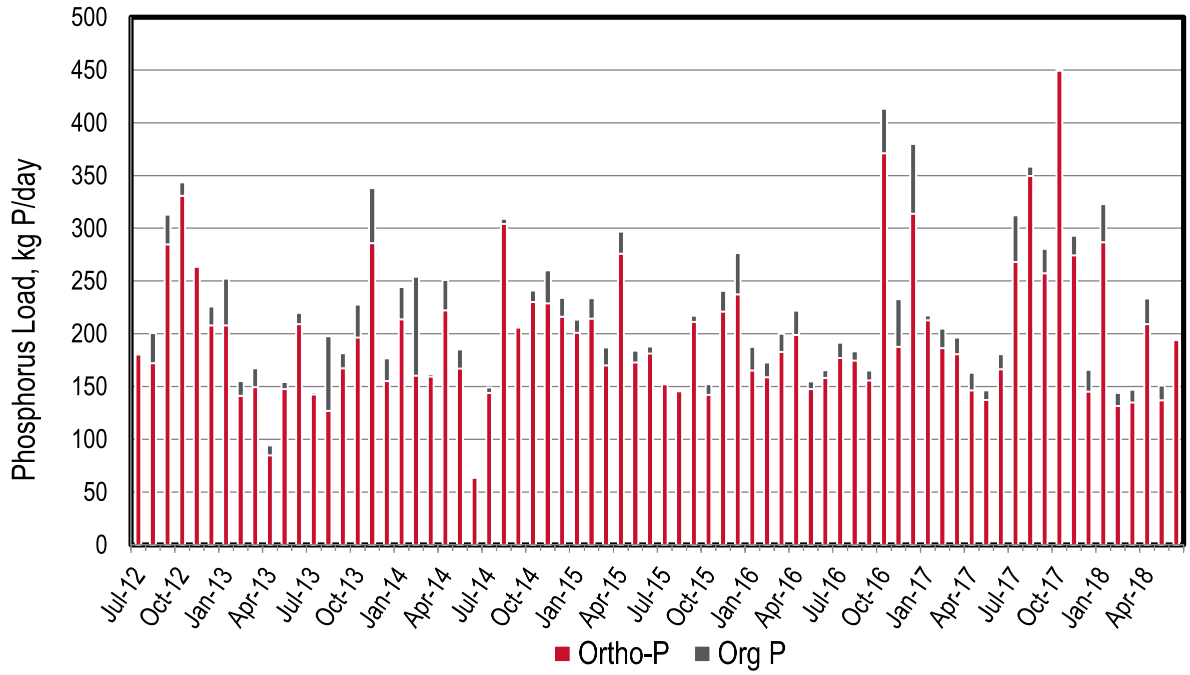

Figure 29-4. Sunnyvale Monthly Phosphorus Loads

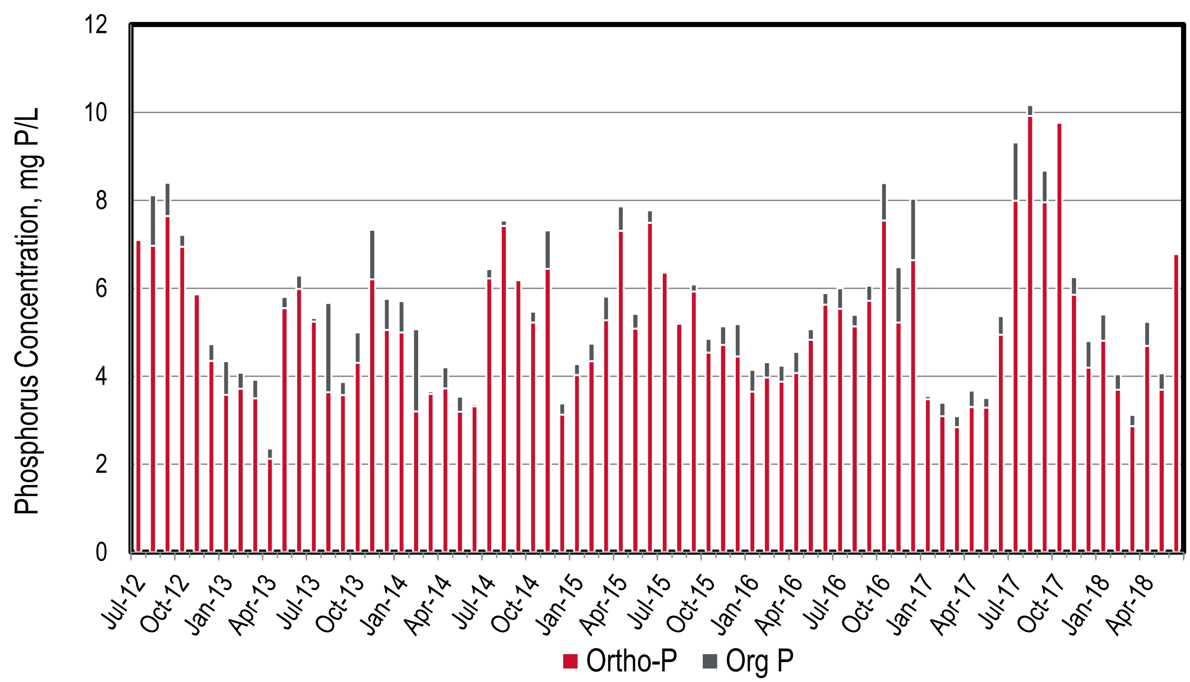

Figure 29-5. Sunnyvale Monthly Phosphorus Concentrations

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

Table 29-1. Sunnyvale Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jul-12	6.7	6	81	500	581	197	180
Aug-12	6.5	9	70	567	637	172	201
Sep-12	9.9	52	121	840	961	285	313
Oct-12	12.6	714	795	795	1,590	331	343
Nov-12	11.9	719	769	718	1,488	269	263
Dec-12	12.6	724	835	600	1,436	208	226
Jan-13	15.4	968	986	685	1,671	208	252
Feb-13	10.1	336	386	720	1,106	141	155
Mar-13	11.3	86	153	983	1,136	149	167
Apr-13	10.6	29	113	844	956	85	94
May-13	7.0	38	125	439	565	148	154
Jun-13	9.2	6	123	477	600	209	220
Jul-13	7.2	6	113	279	393	142	145
Aug-13	9.2	8	130	212	342	127	198
Sep-13	12.4	27	201	310	511	167	181
Oct-13	12.1	58	259	404	663	196	228
Nov-13	12.2	181	304	675	979	286	338
Dec-13	8.1	52	54	661	715	155	177
Jan-14	11.3	121	161	971	1,132	214	244
Feb-14	13.3	382	388	1,092	1,479	160	254
Mar-14	11.7	65	71	843	914	159	162
Apr-14	15.8	120	187	887	1,074	222	251
May-14	13.9	5	139	498	638	167	185
Jun-14	5.1	2	28	175	202	63	64
Jul-14	6.1	16	107	228	356	144	149
Aug-14	10.8	29	177	495	803	304	309
Sep-14	8.8	6	133	399	641	239	206
Oct-14	11.7	120	291	495	774	230	241
Nov-14	9.4	186	375	512	873	229	260

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Dec-14	18.3	515	477	901	1,255	216	234
Jan-15	13.2	319	366	948	1,257	201	214
Feb-15	13.1	491	481	811	1,255	214	234
Mar-15	8.5	173	127	544	776	170	187
Apr-15	10.0	91	240	985	1,397	276	297
May-15	9.0	20	93	465	632	173	184
Jun-15	6.4	8	85	246	399	181	188
Jul-15	6.3	26	77	201	279	153	152
Aug-15	7.4	6	106	262	368	150	145
Sep-15	9.4	3	104	386	490	211	217
Oct-15	8.3	30	129	338	467	142	152
Nov-15	12.4	21	171	627	798	221	241
Dec-15	14.1	11	26	1,105	1,132	237	276
Jan-16	12.0	46	135	737	872	165	188
Feb-16	10.6	24	80	810	890	159	173
Mar-16	12.5	51	126	756	882	183	200
Apr-16	12.9	98	182	744	925	199	222
May-16	8.1	9	94	488	582	147	155
Jun-16	7.4	5	54	303	357	158	166
Jul-16	8.5	28	107	296	403	177	192
Aug-16	9.0	20	79	267	345	174	183
Sep-16	7.2	16	91	273	365	156	165
Oct-16	13.0	68	252	872	1,124	371	413
Nov-16	9.5	13	89	631	720	188	233
Dec-16	12.5	434	456	1,404	1,861	314	380
Jan-17	16.2	310	414	1,479	1,893	213	217
Feb-17	16.0	29	89	1,178	1,267	187	205
Mar-17	16.8	16	136	1,123	1,258	181	196
Apr-17	11.7	36	93	685	778	146	163
May-17	11.1	182	241	530	770	137	146

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jun-17	8.9	22	108	421	151	166	181
Jul-17	8.9	20	151	582	733	268	312
Aug-17	9.3	70	171	651	822	350	359
Sep-17	8.6	11	96	663	758	257	281
Oct-17	12.2	524	728	928	1,657	449	451
Nov-17	12.4	453	667	774	1,442	274	293
Dec-17	9.1	404	465	652	1,117	145	166
Jan-18	15.8	550	556	1,484	2,040	287	323
Feb-18	9.4	61	109	885	994	132	144
Mar-18	12.5	7	37	816	852	135	147
Apr-18	11.8	5	40	1,028	1,068	209	233
May-18	9.8	11	136	388	524	137	151
Jun-18	7.6	13	107	372	479	202	194
Dry Season Average	**8.5**	**23**	**115**	**407**	**523**	**185**	**196**
**Dry Season Trend ** **	**None**	**None**	**None**	**None**	**None**	**-**	**None**
Wet Season Average	**12.3**	**230**	**305**	**836**	**1,142**	**211**	**234**
Average Annual	**10.7**	**143**	**226**	**658**	**884**	**200**	**218**

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

30 Silicon Valley Clean Water (SVCW)

SVCW discharges to the South Bay. The plant services a population of approximately 200,000 and has a permitted ADWF capacity of 29 mgd. The current flows are approximately 12.2 mgd ADWF. The plant performs tertiary treatment using a trickling filter complemented with an activated sludge system followed by mono-media or dual-media filtration.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the table with the average monthly values, there is an emerging slight upward dry season trend for flow and nutrient species loads (except NOx). NOx has an emerging slight downward dry season trend.
- Nitrogen loads typically increases with flow during wet weather events.
- Nitrogen wet season loads are typically greater and more variable than the dry season loads. The plant is subjected to lower loads in the dry season and the warmer temperature lends itself to nitrifying a portion of the ammonia load.
- Ammonia is the majority of the nitrogen species discharged, regardless of season. This would be expected since this plant does not nitrify.
- There was an analytical sampling issue for the July 2015 phosphorus species samples (data not shown)
- Ortho-P values are routinely greater than TP values for the sampling issues discussed in the main report body. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations are wide ranging, from approximately 1.7 to 5.7 mg P/L. Typical effluent TP concentrations range from 4 to 6 mg P/L.

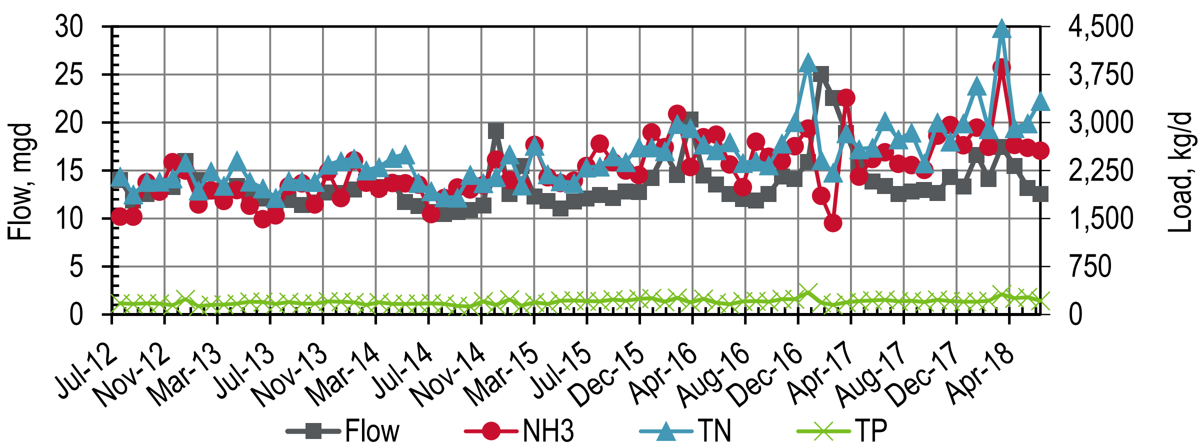

Figure 30-1. SVCW Monthly Flows and Loads

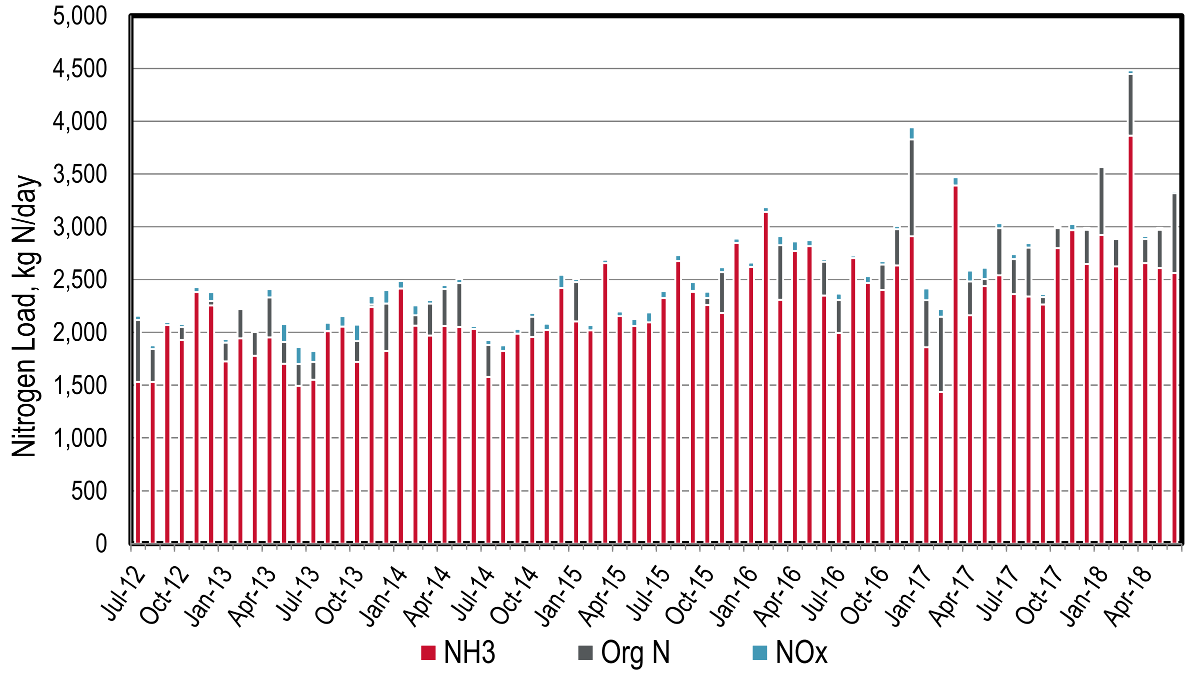

Figure 30-2. SVCW Monthly Nitrogen Loads

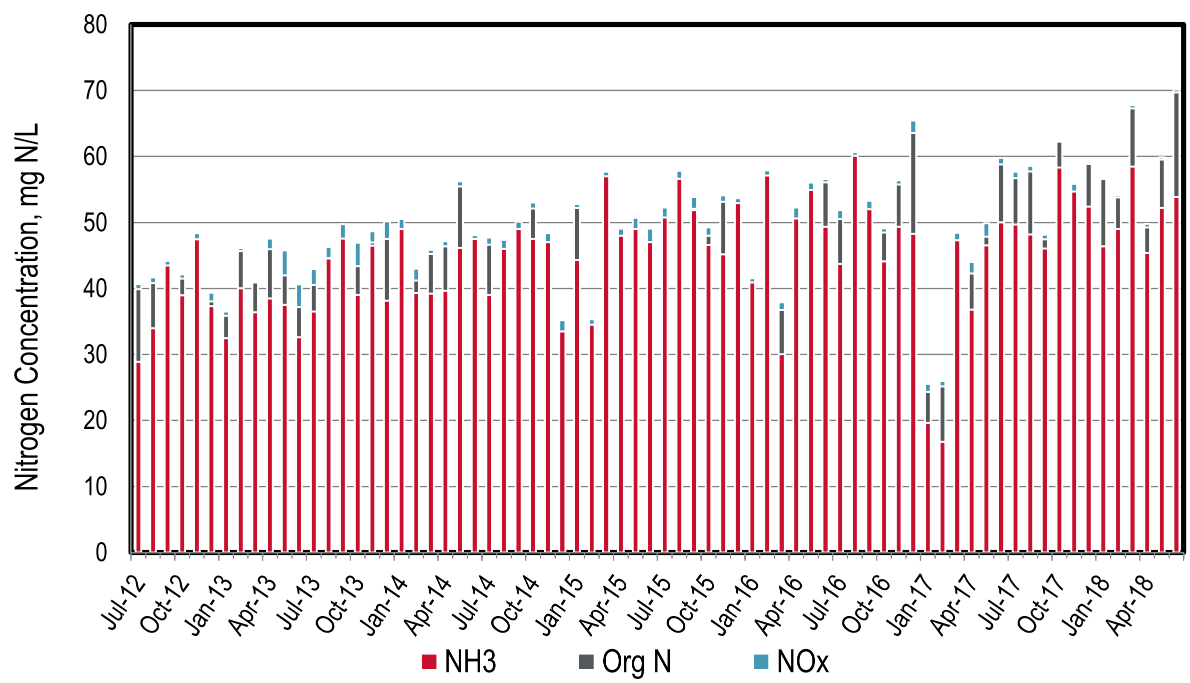

Figure 30-3. SVCW Monthly Nitrogen Concentrations

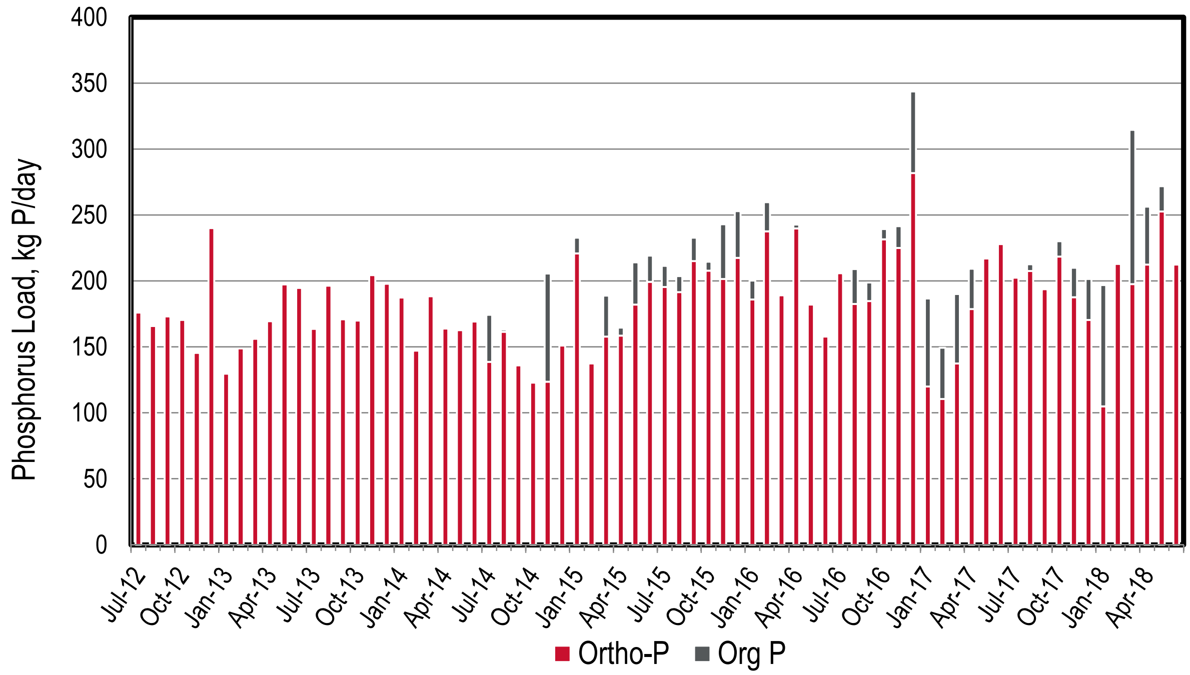

Figure 30-4. SVCW Monthly Phosphorus Loads

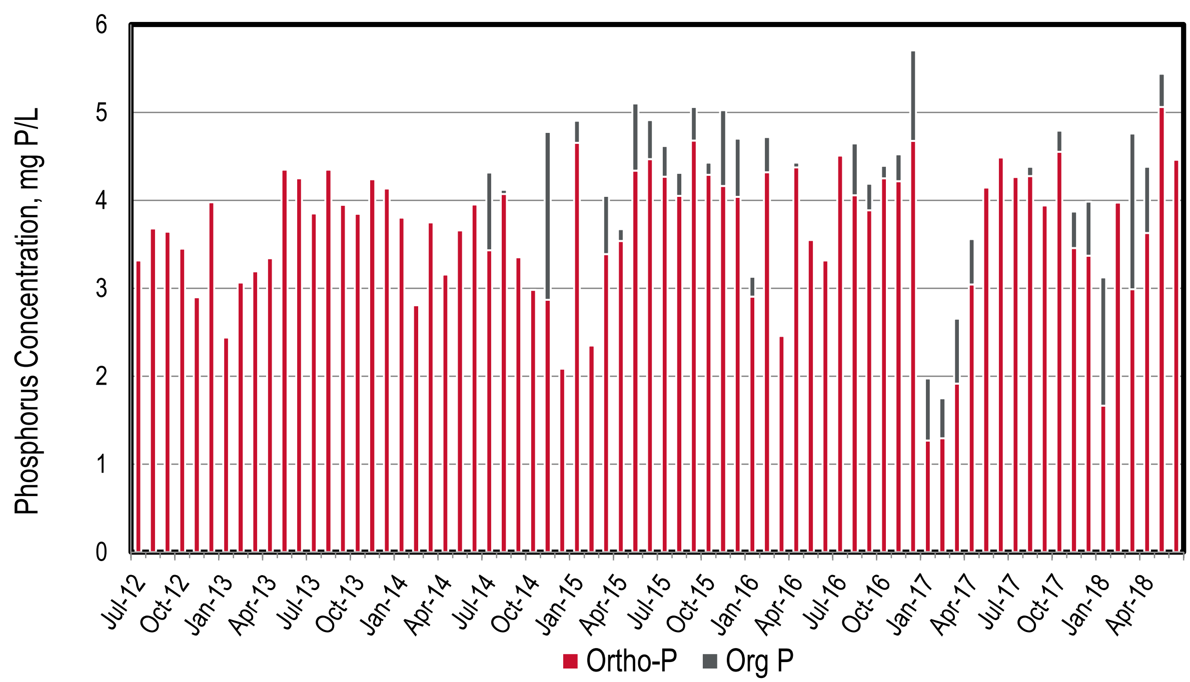

Figure 30-5. SVCW Monthly Phosphorus Concentrations

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

Table 30-1. SVCW Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jul-12	14.0	c1,533	2,118	41	2,159	233	176
Aug-12	11.9	1,533	1,839	39	1,878	305	166
Sep-12	12.6	2,068	2,045	31	2,076	564	173
Oct-12	13.1	1,927	2,051	30	2,081	288	171
Nov-12	13.3	2,384	2,083	44	2,128	193	146
Dec-12	16.0	2,256	2,299	80	2,379	257	240
Jan-13	14.1	1,724	1,905	33	1,939	161	130
Feb-13	12.9	1,945	2,219	19	2,238	181	149
Mar-13	13.0	1,782	2,003	15	2,017	181	156
Apr-13	13.4	1,952	2,330	81	2,411	233	170
May-13	12.0	1,703	1,907	171	2,078	263	197
Jun-13	12.1	1,494	1,702	159	1,976	250	195
Jul-13	11.3	1,553	1,723	103	1,826	541	164
Aug-13	12.0	2,012	2,014	78	2,092	709	196
Sep-13	11.5	2,057	1,991	95	2,086	212	171
Oct-13	11.7	1,723	1,916	157	2,073	286	170
Nov-13	12.8	2,241	2,264	82	2,346	312	204
Dec-13	12.7	1,825	2,274	127	2,401	256	198
Jan-14	13.0	2,415	2,366	74	2,440	280	187
Feb-14	13.9	2,063	2,162	94	2,256	261	147
Mar-14	13.3	1,971	2,273	32	2,305	274	188
Apr-14	13.8	2,060	2,412	39	2,451	212	164
May-14	11.8	2,053	2,468	35	2,504	248	163
Jun-14	11.3	2,034	2,034	24	2,059	196	169
Jul-14	10.7	1,576	1,884	43	1,928	139	174
Aug-14	10.5	1,824	1,778	54	1,833	161	163
Sep-14	10.7	1,989	1,783	45	1,829	161	136
Oct-14	10.9	1,959	2,149	39	2,188	168	123
Nov-14	11.4	2,024	1,994	59	2,053	124	206

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Dec-14	19.1	2,424	2,026	122	2,148	151	152
Jan-15	12.6	2,103	2,478	28	2,506	221	233
Feb-15	15.5	2,020	1,969	49	2,018	144	138
Mar-15	12.3	2,657	2,608	33	2,641	158	189
Apr-15	11.9	2,152	2,148	48	2,196	159	165
May-15	11.1	2,058	2,014	72	2,086	182	214
Jun-15	11.8	2,096	1,962	92	2,054	199	219
Jul-15	12.1	2,324	2,231	68	2,299	195	211
Aug-15	12.5	2,676	2,258	57	2,316	191	204
Sep-15	12.2	2,385	2,395	82	2,477	215	233
Oct-15	12.8	2,257	2,325	63	2,387	208	215
Nov-15	12.8	2,187	2,571	47	2,618	201	243
Dec-15	14.2	2,849	2,576	40	2,616	217	253
Jan-16	16.9	2,621	2,513	40	2,553	186	200
Feb-16	14.6	3,143	2,939	43	2,982	238	260
Mar-16	20.3	2,310	2,825	88	2,913	199	189
Apr-16	14.5	2,774	2,572	89	2,661	240	243
May-16	13.6	2,816	2,512	58	2,570	191	182
Jun-16	12.6	2,351	2,672	24	2,695	167	158
Jul-16	12.1	1,996	2,307	61	2,368	248	206
Aug-16	11.9	2,705	2,377	23	2,400	183	209
Sep-16	12.6	2,471	2,274	61	2,335	185	199
Oct-16	14.4	2,404	2,642	33	2,675	232	239
Nov-16	14.1	2,635	2,978	32	3,010	225	242
Dec-16	15.9	2,909	3,829	115	3,944	282	344
Jan-17	25.1	1,858	2,303	115	2,417	120	187
Feb-17	22.6	1,434	2,148	72	2,221	111	149
Mar-17	19.0	3,391	2,757	81	2,833	137	190
Apr-17	15.5	2,162	2,484	103	2,586	179	209
May-17	13.9	2,436	2,506	106	2,612	248	217

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jun-17	13.4	2,540	2,986	50	3,027	256	228
Jul-17	12.6	2,361	2,694	47	2,741	233	203
Aug-17	12.8	2,340	2,803	42	2,845	208	213
Sep-17	13.0	2,264	2,334	32	2,365	259	194
Oct-17	12.7	2,799	2,988	16	3,003	218	230
Nov-17	14.4	2,967	2,645	62	2,707	188	210
Dec-17	13.4	2,649	2,975	16	2,991	170	202
Jan-18	16.7	2,925	3,568	14	3,582	105	197
Feb-18	14.2	2,626	2,885	17	2,901	255	213
Mar-18**	17.5	3,866	4,449	34	4,483	198	315
Apr-18	15.5	2,656	2,885	29	2,914	212	256
May-18	13.2	2,609	2,975	17	2,991	253	272
Jun-18	12.6	2,565	3,320	20	3,340	262	212
Dry Season Average	**12.2**	**2,147**	**2,264**	**61**	**2,328**	**255**	**194**
Dry Season Trend * **	**Up**	**Up**	**Up**	**Down**	**Up**	**-**	**Up**
Wet Season Average	**14.7**	**2,358**	**2,519**	**58**	**2,576**	**205**	**200**
Average Annual	**13.7**	**2,270**	**2,412**	**59**	**2,473**	**226**	**198**

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** One of the monthly nutrient sampling events (n=2) occurred during the maximum daily flow for that month. The loads are atypically high for this particular day due to a likely flushing phenomenon in the collection system.

*** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

31 Sanitary District No. 5 of Marin County – Tiburon Treatment Plant

The Tiburon Treatment Plant discharges to the Central Bay. The service area has a population of approximately 8,400. The plant has a permitted ADWF capacity of 0.98 mgd and a peak wet weather capacity of 2.3 mgd. It has currents flows of approximately 0.54 mgd ADWF. The plant performs secondary treatment using an activated sludge treatment process.

The plant is classified as a minor discharger (<1 mgd permitted capacity) and thus not required to sample as frequently as the major dischargers (>1 mgd permitted capacity). The minor dischargers are required to sample twice per year under the Nutrient Watershed Permit. As a result, there are several months of nutrient data gaps, in particular from July 2013 through July 2014.

The following observations are made based upon the figures and table in the subsequent pages:

- Flow values are provided over the entire study period. The remaining nutrient species only have monthly sampling for the first year of sampling, followed by occasional sampling thereafter.
- Based on the table with the average monthly values, there appears to be an emerging upward trend for flows in the dry season. There is insufficient data to evaluate nutrient species trending.
- With the exception of January 2013, ammonia is the majority of the nitrogen species discharged, regardless of season. This would be expected since this plant does not nitrify.
- Ortho-P values are routinely greater than TP values. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations are wide ranging from approximately 1.4 to 6.5 mg P/L. Typical effluent TP concentrations range from 4 to 6 mg P/L.

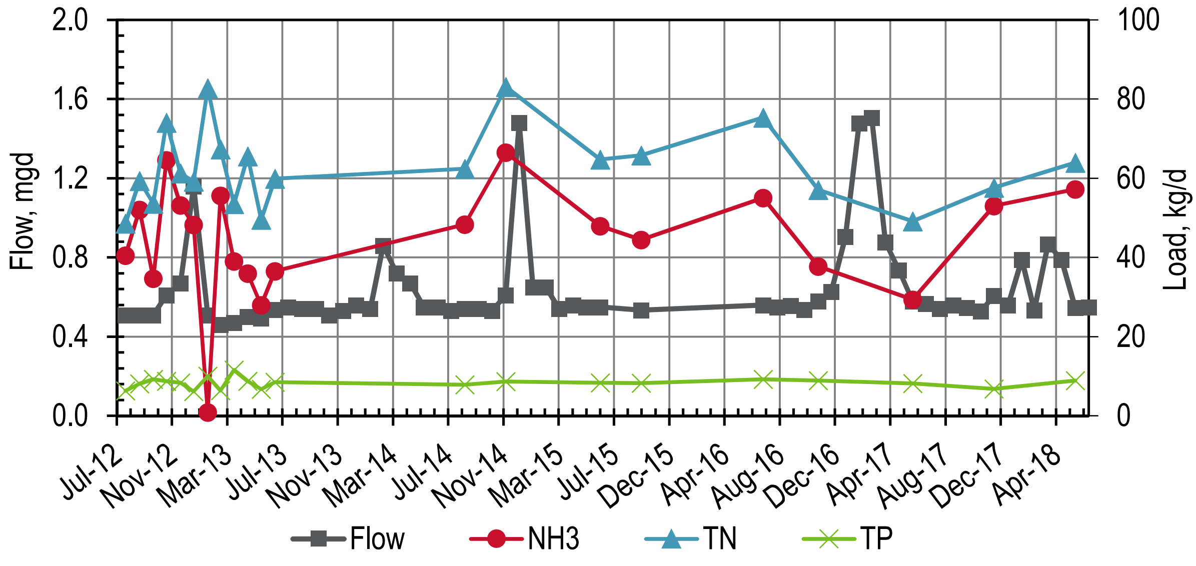

Figure 31-1. Tiburon Monthly Flows and Loads

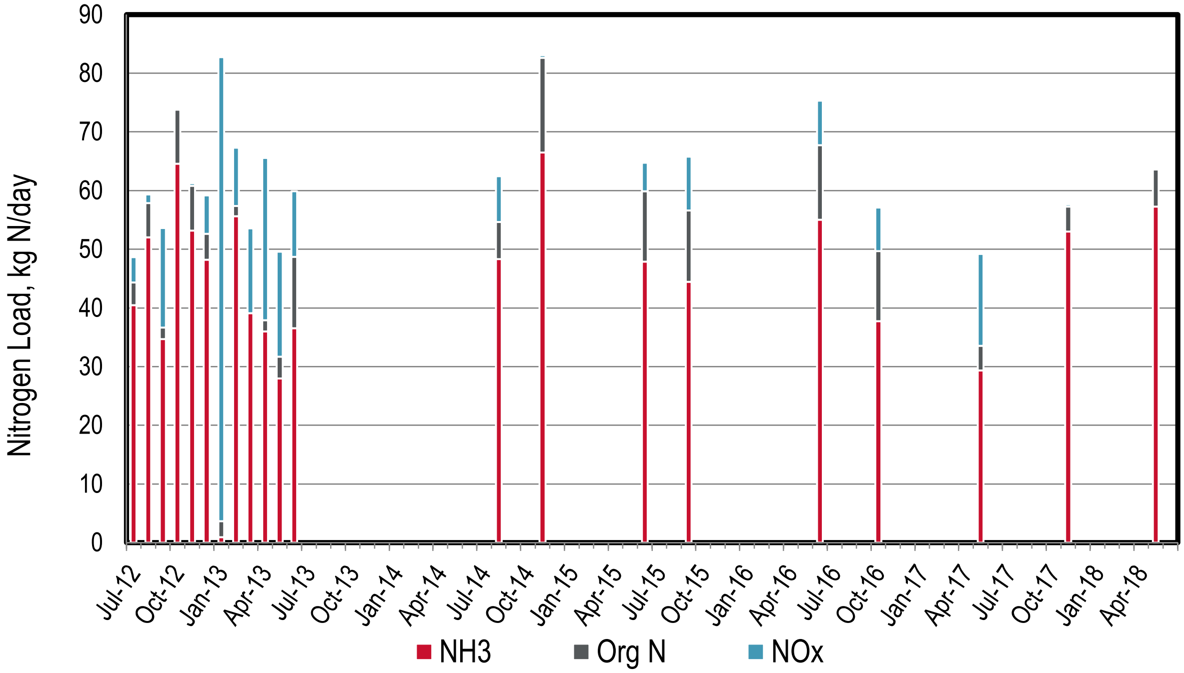

Figure 31-2. Tiburon Monthly Nitrogen Loads

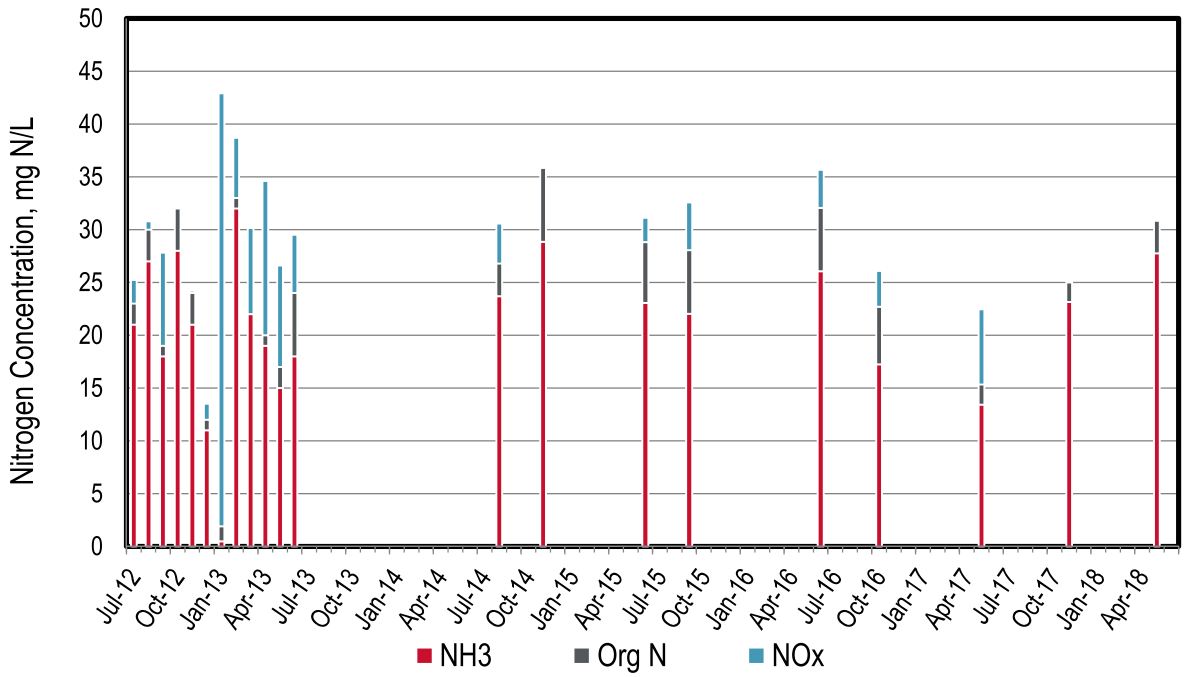

Figure 31-3. Tiburon Monthly Nitrogen Concentrations

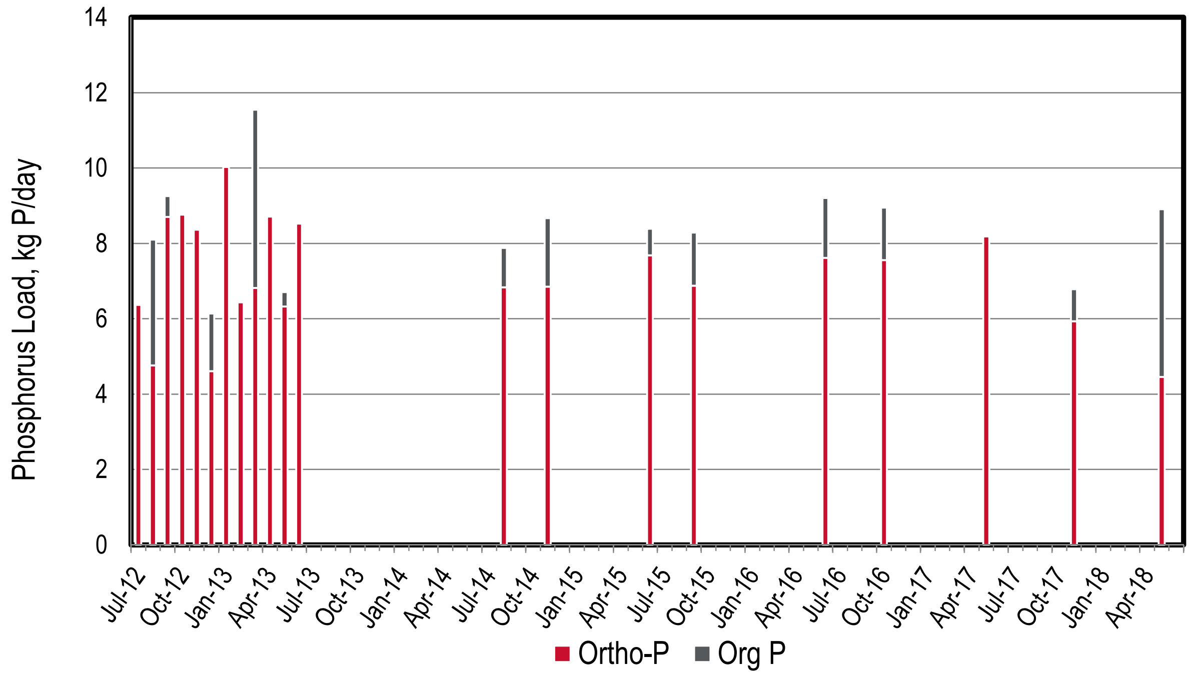

Figure 31-4. Tiburon Monthly Phosphorus Loads

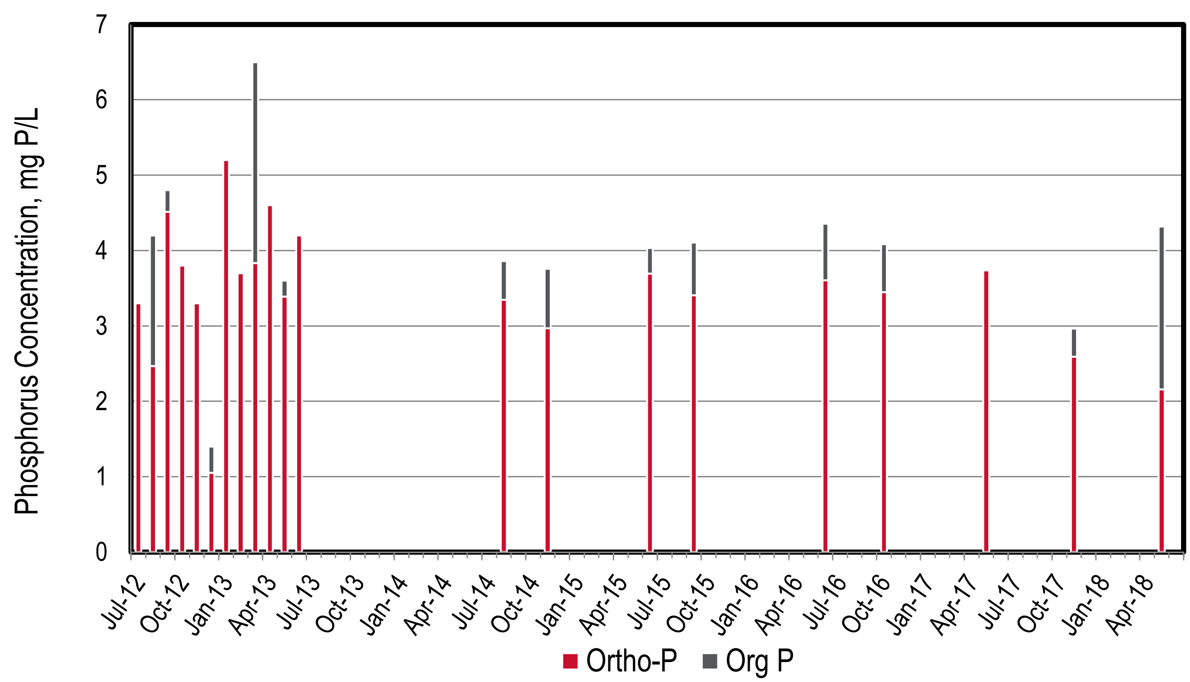

Figure 31-5. Tiburon Monthly Phosphorus Concentrations

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

Table 31-1. Tiburon Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jul-12	0.5	40	44	4	49	7	6
Aug-12	0.5	52	58	2	59	5	8
Sep-12	0.5	35	37	17	54	9	9
Oct-12	0.6	65	74	0	74	14	9
Nov-12	0.7	53	61	0	61	11	8
Dec-12	1.2	48	53	7	59	5	6
Jan-13	0.5	1	4	79	83	13	10
Feb-13	0.5	56	57	10	67	8	6
Mar-13	0.5	39	39	14	54	7	12
Apr-13	0.5	36	38	28	66	12	9
May-13	0.5	28	32	18	50	6	7
Jun-13	0.5	37	49	11	60	10	9
Jul-13	0.6						
Aug-13	0.5						
Sep-13	0.5						
Oct-13	0.5						
Nov-13	0.5						
Dec-13	0.6						
Jan-14	0.5						
Feb-14	0.9						
Mar-14	0.7						
Apr-14	0.7						
May-14	0.6						
Jun-14	0.6						
Jul-14	0.5						
Aug-14	0.5	48	55	8	62	7	8
Sep-14	0.5						
Oct-14	0.5						
Nov-14	0.6	66	83	0	83	7	9

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Dec-14	1.5						
Jan-15	0.7						
Feb-15	0.7						
Mar-15	0.5						
Apr-15	0.6						
May-15	0.6						
Jun-15	0.6	48	60	5	65	8	8
Jul-15	0.5						
Aug-15	0.5						
Sep-15	0.5	44	57	9	66	7	8
Oct-15	0.6						
Nov-15	0.5						
Dec-15	0.8						
Jan-16	1.2						
Feb-16	0.6						
Mar-16	1.0						
Apr-16	0.6						
May-16	0.6						
Jun-16	0.6	55	68	8	75	8	9
Jul-16	0.6						
Aug-16	0.6						
Sep-16	0.5						
Oct-16	0.6	38	50	7	57	8	9
Nov-16	0.6						
Dec-16	0.9						
Jan-17	1.5						
Feb-17	1.5						
Mar-17	0.9						
Apr-17	0.7						
May-17	0.6	29	34	16	49	13	8

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jun-17	0.6						
Jul-17	0.5						
Aug-17	0.6						
Sep-17	0.5						
Oct-17	0.5						
Nov-17	0.6	53	57	0	58	6	7
Dec-17	0.6						
Jan-18	0.8						
Feb-18	0.5						
Mar-18	0.9						
Apr-18	0.8						
May-18	0.5	57	64	0	64	4	9
Jun-18	0.5						
Dry Season Average	**0.5**	**43**	**50**	**9**	**59**	**8**	**8**
Dry Season Trend **	**Up**	***	***	***	***	***	***
Wet Season Average	**0.7**	**45**	**51**	**15**	**67**	**9**	**9**
Average Annual	**0.6**	**44**	**51**	**12**	**63**	**8**	**8**

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis.

*** No statistical dry season trending analysis was performed on nutrient species due to the limited number of samples required for minor dischargers.

32 Treasure Island

Treasure Island discharges to the Central Bay. The plant has a permitted capacity of 2.0 mgd ADWF and a peak wet weather capacity of 4.4 mgd. The current plant flow is approximately 0.3 mgd ADWF. The plant currently nitrifies using trickling filters.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the average monthly values table below, no dry season trends emerge.
- The plant fully nitrified through April 2014 at which time one of the plant's two trickling arm filters became inoperable, resulting in increased effluent ammonia concentrations.
- Prior to April 2014, NOx was the majority of the nitrogen species discharged as would be expected since this plant nitrifies. Since then, the proportion of ammonia relative to NOx has increased.
- Reported ortho-P values were frequently greater than TP values prior to January 2015. This is attributed to a combination of the sampling methodology as discussed in the main report body. Starting in August 2015, the SFPUC began using Inductively Coupled Plasma – Atomic Emission Spectroscopy (ICP-AES) for TP detection. For such instances in Figure 32-4 and Figure 32-5, ortho-P values were set equal to TP. In Table 32-1, the reported ortho-P values were used for the data table.

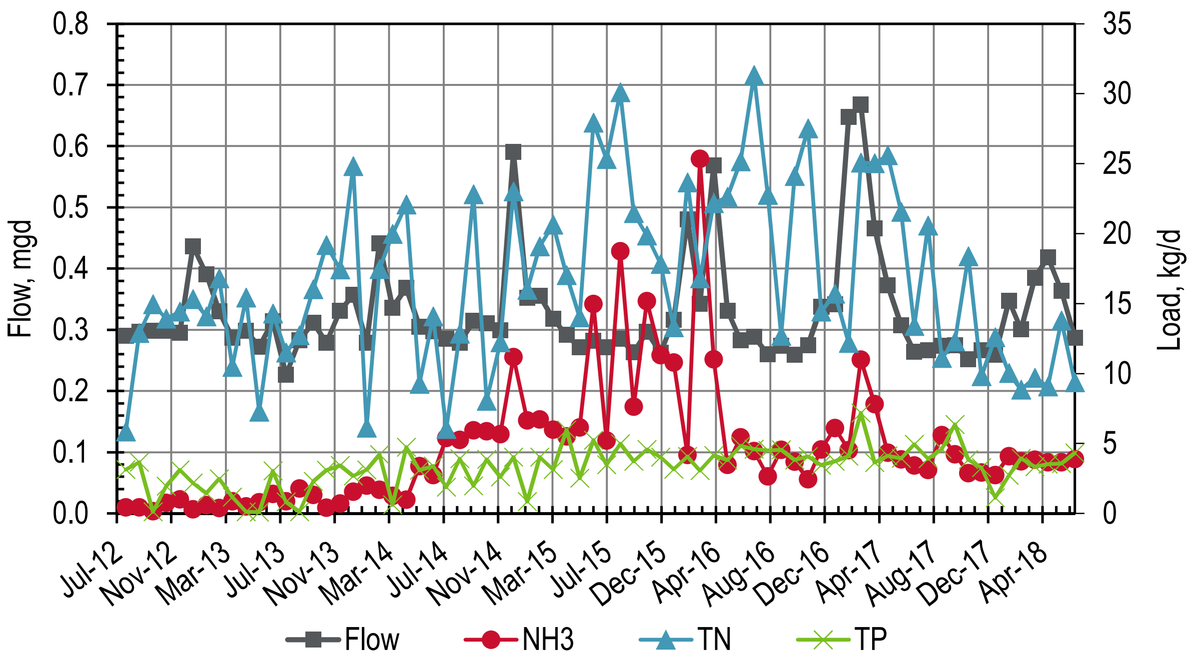

Figure 32-1. Treasure Island Monthly Flows and Loads

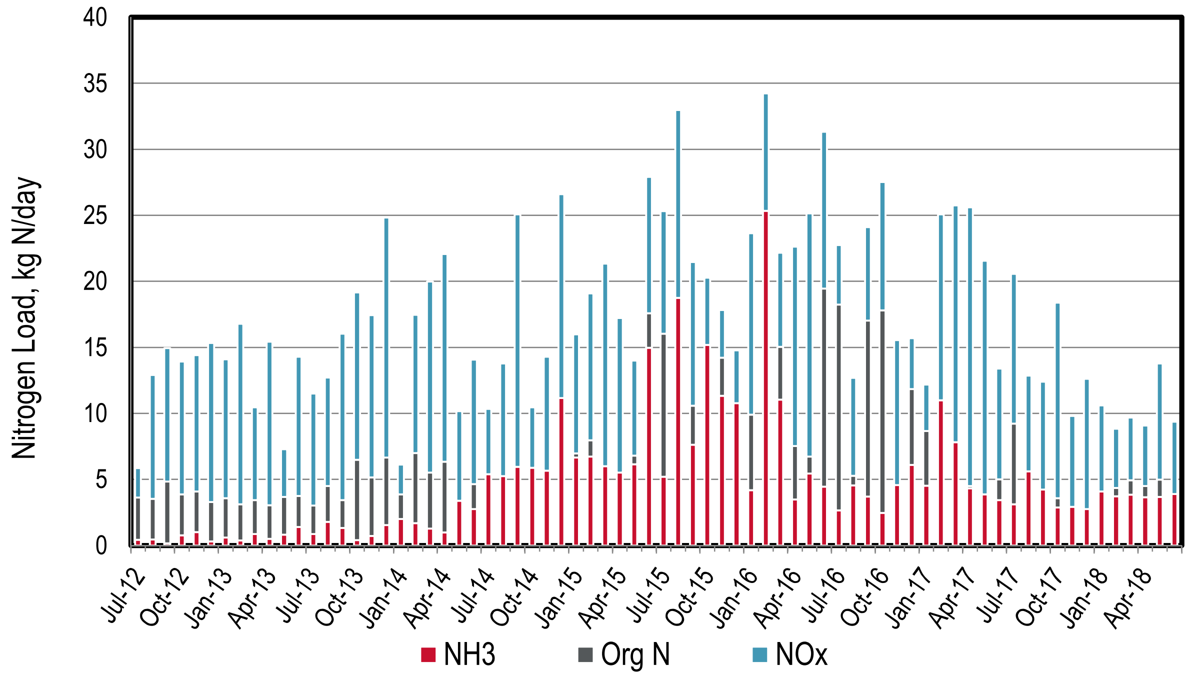

Figure 32-2. Treasure Island Monthly Nitrogen Loads

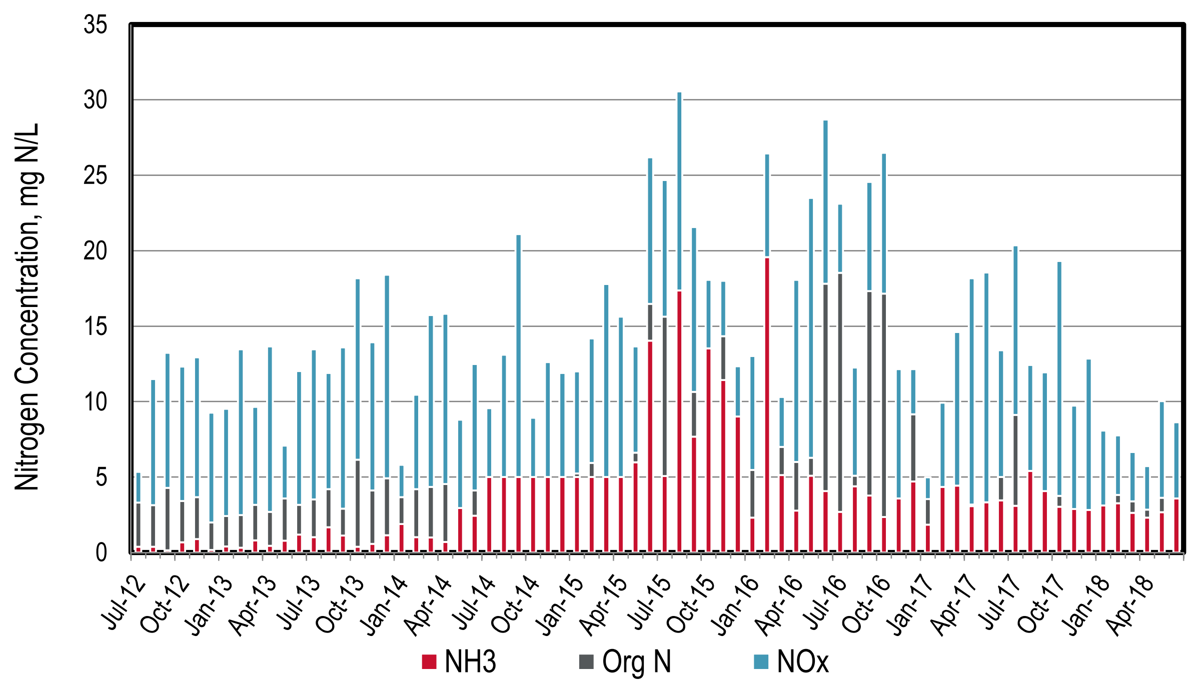

Figure 32-3. Treasure Island Monthly Nitrogen Concentrations

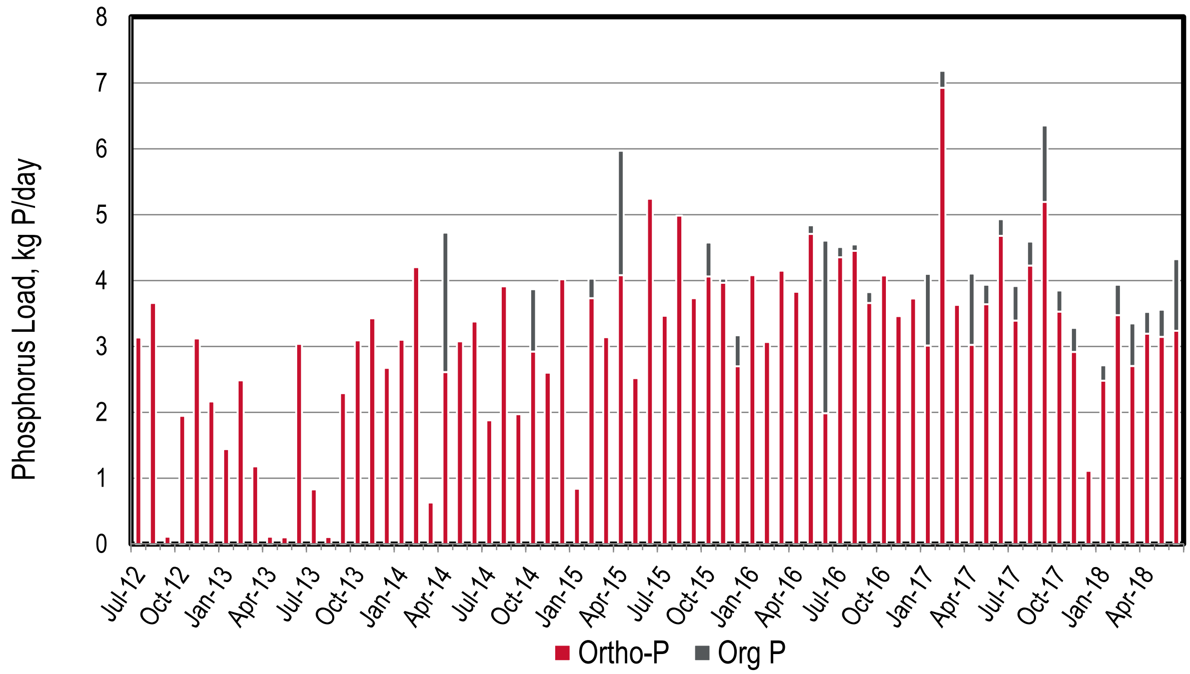

Figure 32-4. Treasure Island Monthly Phosphorus Loads

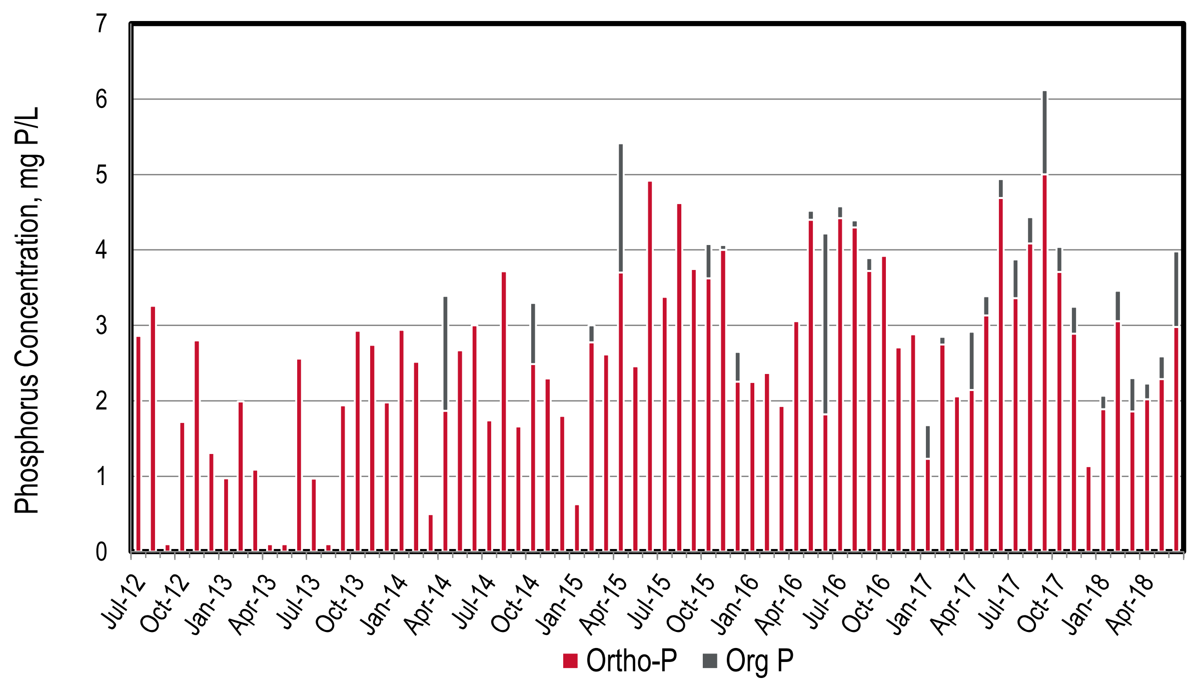

Figure 32-5. Treasure Island Monthly Phosphorus Concentrations

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

Table 32-1. Treasure Island Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jul-12	0.3	0	4	2	6	4	3
Aug-12	0.3	0	4	9	13	4	4
Sep-12	0.3	0	5	10	15	3	0
Oct-12	0.3	1	4	10	14	4	2
Nov-12	0.3	1	4	10	14	4	3
Dec-12	0.4	0	3	12	15	3	2
Jan-13	0.4	1	4	11	14	3	1
Feb-13	0.3	0	3	14	17	4	3
Mar-13	0.3	1	3	7	10	3	1
Apr-13	0.3	1	3	12	15	4	0
May-13	0.3	1	4	4	7	4	0
Jun-13	0.3	1	4	11	14	4	3
Jul-13	0.2	1	3	8	12	1	1
Aug-13	0.3	2	5	8	13	4	0
Sep-13	0.3	1	3	13	16	5	2
Oct-13	0.3	0	7	13	19	4	3
Nov-13	0.3	1	5	12	17	4	3
Dec-13	0.4	2	7	18	25	4	3
Jan-14	0.3	2	4	2	6	3	3
Feb-14	0.4	2	7	10	17	5	4
Mar-14	0.3	1	6	14	20	4	1
Apr-14	0.4	1	6	16	22	3	5
May-14	0.3	3	3	7	9	4	3
Jun-14	0.3	3	5	9	14	4	3
Jul-14	0.3	5	1	5	6	4	2
Aug-14	0.3	5	4	9	13	4	4
Sep-14	0.3	6	4	19	23	5	2
Oct-14	0.3	6	4	5	8	3	4
Nov-14	0.3	6	4	9	12	4	3

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Dec-14	0.6	11	8	15	23	6	4
Jan-15	0.4	7	7	9	16	3	1
Feb-15	0.4	7	8	11	19	4	4
Mar-15	0.3	6	5	15	21	4	3
Apr-15	0.3	6	5	12	17	4	6
May-15	0.3	6	7	7	14	4	3
Jun-15	0.3	15	18	10	28	6	5
Jul-15	0.3	5	16	9	25	5	4
Aug-15	0.3	19	16	14	30	5	5
Sep-15	0.3	8	11	11	21	4	4
Oct-15	0.3	15	15	5	20	4	5
Nov-15	0.3	11	14	4	18	4	4
Dec-15	0.3	11	9	4	13	3	3
Jan-16	0.5	4	10	14	24	4	4
Feb-16	0.3	25	8	9	17	3	3
Mar-16	0.6	11	15	7	22	6	4
Apr-16	0.3	4	8	15	23	4	4
May-16	0.3	6	7	18	25	5	5
Jun-16	0.3	5	20	12	31	2	5
Jul-16	0.3	3	18	5	23	4	5
Aug-16	0.3	5	5	7	13	4	5
Sep-16	0.3	4	17	7	24	4	4
Oct-16	0.3	2	18	10	28	5	4
Nov-16	0.3	5	3	11	14	4	3
Dec-16	0.3	6	12	4	16	4	4
Jan-17	0.6	5	9	4	12	3	4
Feb-17	0.7	11	11	14	25	7	7
Mar-17	0.5	8	7	18	25	4	4
Apr-17	0.4	4	4	21	26	3	4
May-17	0.3	4	4	18	22	4	4

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jun-17	0.3	3	5	8	13	5	5
Jul-17	0.3	3	9	11	21	3	4
Aug-17	0.3	6	4	7	11	4	5
Sep-17	0.3	4	4	8	12	5	6
Oct-17	0.3	3	4	15	18	4	4
Nov-17	0.3	3	3	7	10	3	3
Dec-17	0.3	3	3	10	13	3	1
Jan-18	0.3	4	4	7	10	2	3
Feb-18	0.3	4	4	4	9	3	4
Mar-18	0.4	4	5	5	10	3	3
Apr-18	0.4	4	4	5	9	3	4
May-18	0.4	4	5	9	14	3	4
Jun-18	0.3	4	4	5	9	3	4
Dry Season Average	**0.3**	**4**	**7**	**9**	**17**	**4**	**3**
Dry Season Trend **	**None**	**None**	**None**	**None**	**None**	**-**	**-**
Wet Season Average	**0.4**	**5**	**7**	**10**	**17**	**4**	**3**
Average Annual	**0.3**	**5**	**7**	**10**	**18**	**4**	**3**

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue. Statistical trending was not performed on TP due to the analytical methodology issue discussed in the bullet points.

33 Vallejo Flood and Wastewater District

Vallejo discharges to San Pablo Bay and it has approximately 37,845 service connections. The plant has a permitted ADWF capacity of 15.5 mgd and a peak wet weather capacity of 60 mgd. The current flows are approximately 8.6 mgd ADWF. The plant performs secondary treatment using a trickling filter/solids contact process.

The following observations are made based upon the figures and table in the subsequent pages:

- Average monthly trends suggested a downward trend for flows in the dry season, which may be attributed to increased water conservation.
- There appears to be an upward dry season trend for all nitrogen species except for NOx, which is downward trending.
- Ammonia and NOx had approximately a 50:50 split in TN species during the first couple years of data. Over the last four years, ammonia makes up the majority of the nitrogen species. It appears that the plant performed partial nitrification up until the influent loads exceeded any nitrification capacity was exceeded.
- Phosphorus loads had remained relatively flat over the years, but the last couple years of data seems to indicate more variation.
- The distribution of phosphorus species is predominantly ortho-P.
- The phosphorus concentrations range from 1.3 to 5.3 mg P/L, which suggests some total phosphorus load reduction at the plant.

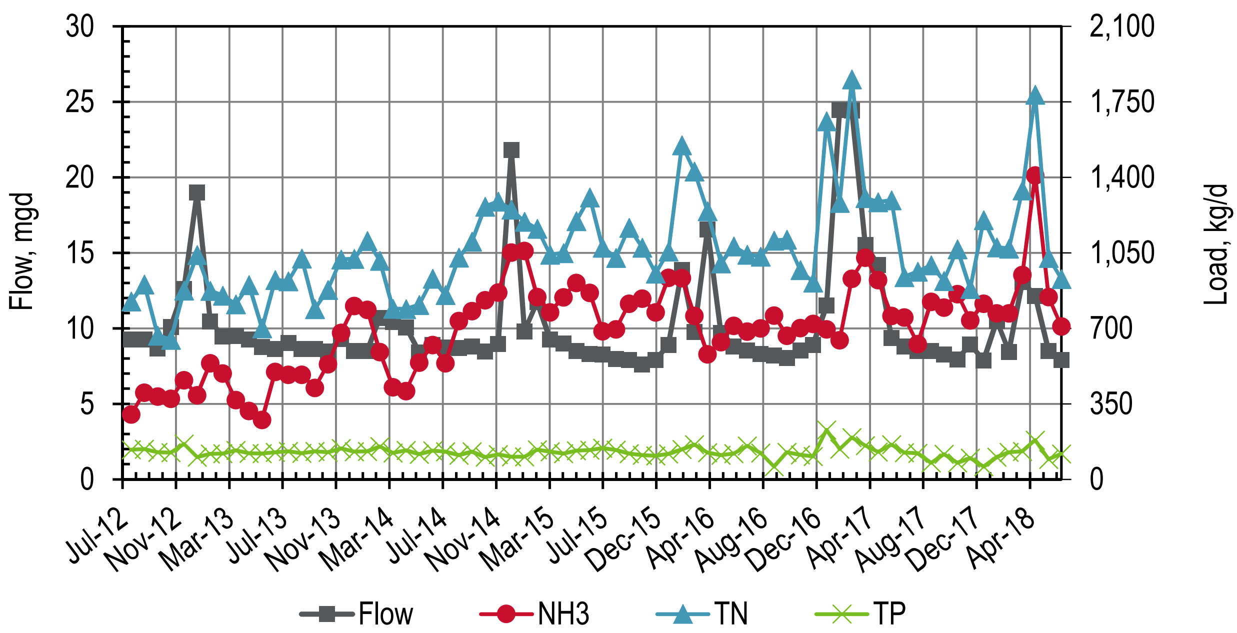

Figure 33-1. Vallejo Monthly Flows and Loads

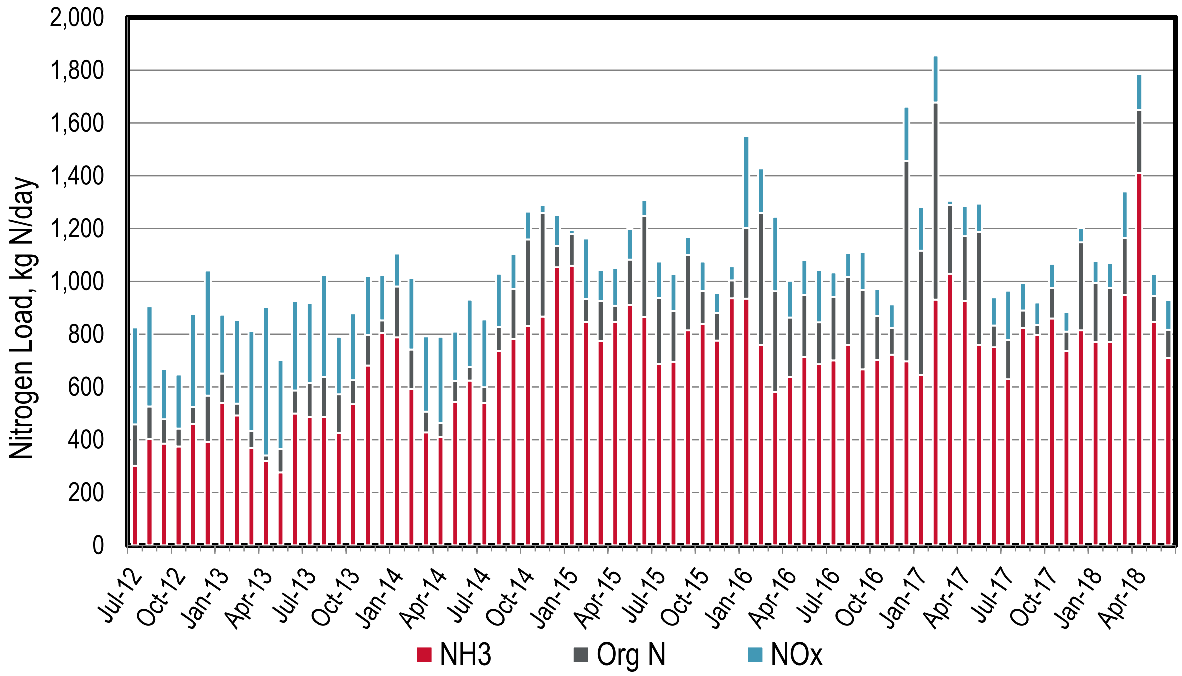

Figure 33-2. Vallejo Monthly Nitrogen Loads

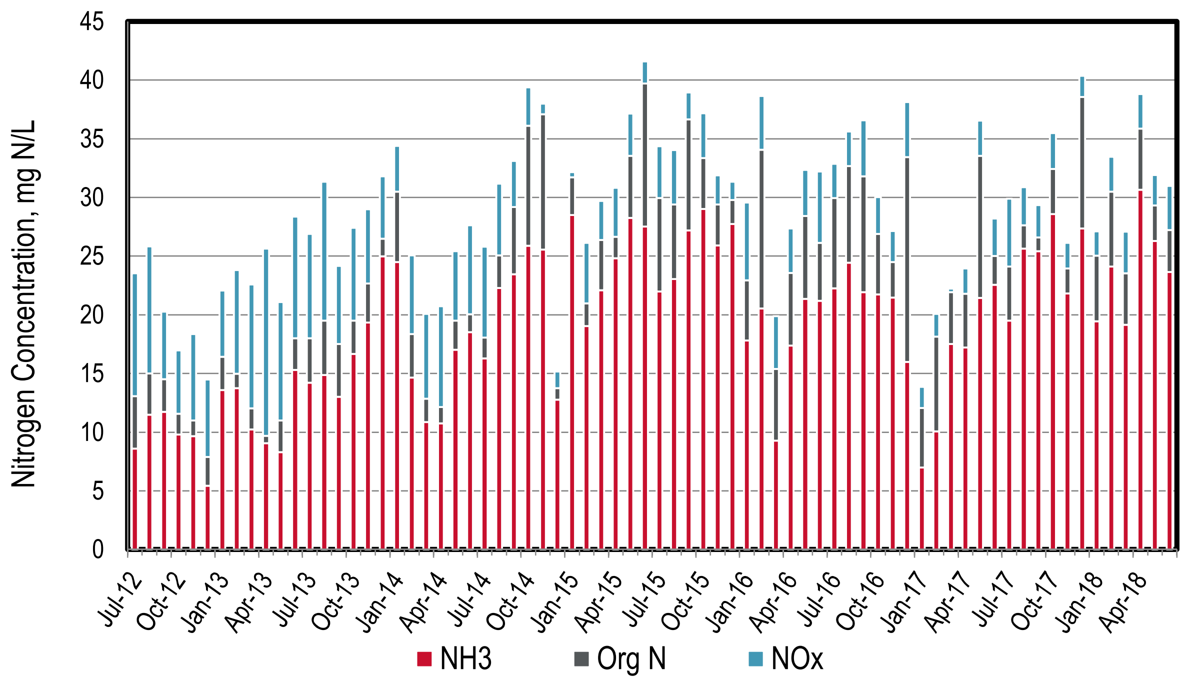

Figure 33-3. Vallejo Monthly Nitrogen Concentrations

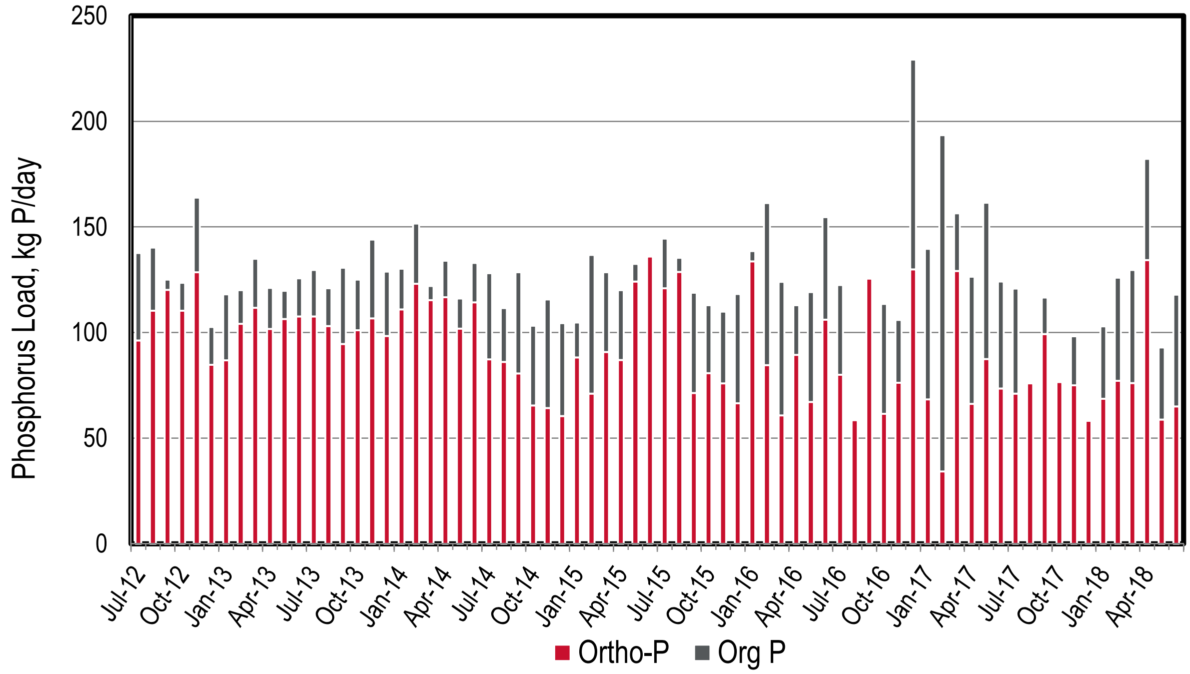

Figure 33-4. Vallejo Monthly Phosphorus Loads

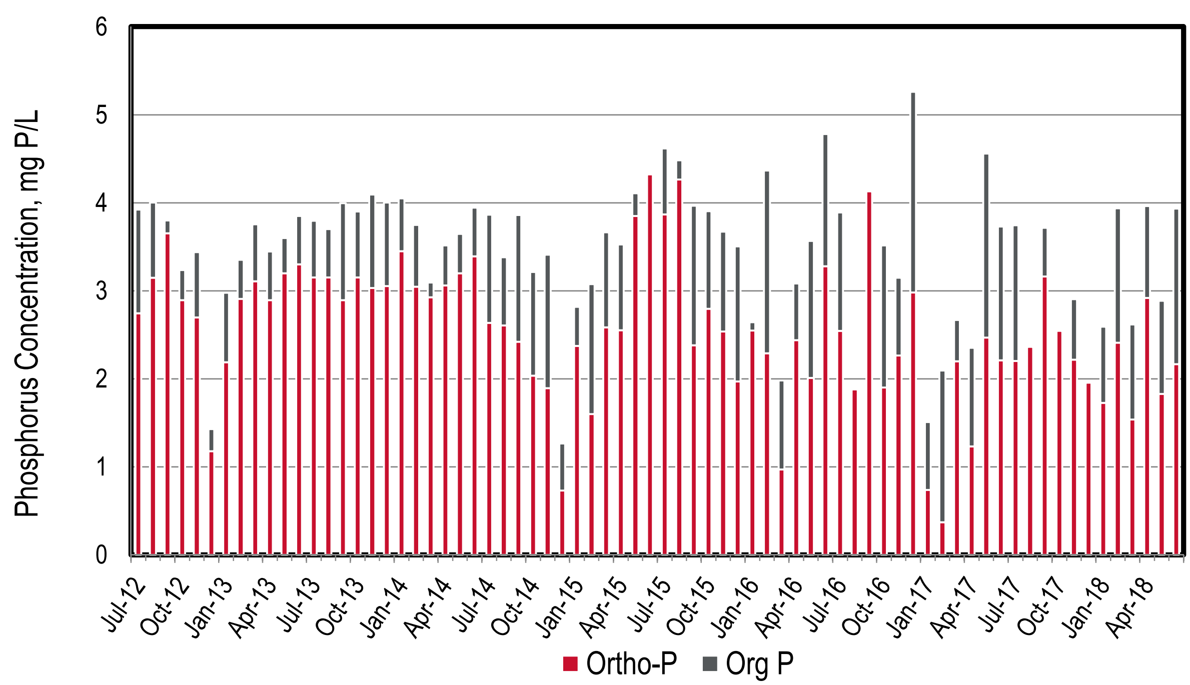

Figure 33-5. Vallejo Monthly Phosphorus Concentrations

Table 33-1. Vallejo Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jul-12	9.3	302	459	367	826	96	138
Aug-12	9.3	402	526	379	905	110	140
Sep-12	8.7	386	477	190	667	120	125
Oct-12	10.1	374	442	206	648	110	123
Nov-12	12.6	461	524	352	876	129	164
Dec-12	19.0	391	567	474	1,041	85	103
Jan-13	10.5	539	651	224	874	87	118
Feb-13	9.5	492	536	317	853	104	120
Mar-13	9.5	368	432	379	812	112	135
Apr-13	9.3	318	341	561	901	102	121
May-13	8.8	276	366	336	701	106	120
Jun-13	8.6	499	587	338	925	108	126
Jul-13	9.0	486	615	304	919	108	130
Aug-13	8.7	486	638	387	1,025	103	121
Sep-13	8.7	426	573	218	790	95	131
Oct-13	8.5	535	625	253	879	101	125
Nov-13	9.3	681	797	222	1,020	107	144
Dec-13	8.5	804	852	171	1,023	98	129
Jan-14	8.5	788	980	126	1,106	111	130
Feb-14	10.7	592	742	272	1,014	123	152
Mar-14	10.4	428	507	285	792	115	122
Apr-14	10.1	410	463	327	790	117	134
May-14	8.4	542	621	188	810	102	116
Jun-14	8.9	624	675	256	931	114	133
Jul-14	8.8	540	599	256	855	87	128
Aug-14	8.7	736	827	201	1,028	86	112
Sep-14	8.8	781	972	131	1,103	81	129
Oct-14	8.5	831	1,159	105	1,264	65	103
Nov-14	9.0	867	1,258	30	1,288	64	116

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Dec-14	21.8	1,053	1,134	118	1,252	60	104
Jan-15	9.8	1,059	1,179	16	1,195	88	105
Feb-15	11.8	846	933	229	1,162	71	137
Mar-15	9.3	775	925	117	1,042	91	129
Apr-15	9.0	846	908	142	1,050	87	120
May-15	8.5	911	1,082	115	1,198	124	132
Jun-15	8.3	865	1,249	59	1,307	143	136
Jul-15	8.3	688	937	138	1,075	121	144
Aug-15	8.0	696	888	140	1,028	129	135
Sep-15	7.9	815	1,099	68	1,167	71	119
Oct-15	7.6	839	964	111	1,075	81	113
Nov-15	7.9	776	880	74	954	76	110
Dec-15	8.9	935	1,004	53	1,057	66	118
Jan-16	13.9	934	1,202	348	1,550	134	138
Feb-16	9.8	758	1,258	170	1,428	85	161
Mar-16	16.6	580	963	281	1,244	61	124
Apr-16	9.7	637	863	139	1,002	89	113
May-16	8.8	713	949	131	1,081	67	119
Jun-16	8.6	686	845	197	1,042	106	155
Jul-16	8.3	701	942	92	1,034	80	122
Aug-16	8.2	760	1,017	91	1,108	68	58
Sep-16	8.0	667	967	145	1,112	129	126
Oct-16	8.5	703	869	102	971	61	114
Nov-16	8.9	722	825	88	913	76	106
Dec-16	11.5	696	1,457	205	1,661	130	229
Jan-17	24.5	646	1,116	166	1,282	68	140
Feb-17	24.4	931	1,677	178	1,856	34	193
Mar-17	15.5	1,028	1,288	17	1,305	129	157
Apr-17	14.2	924	1,171	114	1,286	66	126
May-17	9.4	760	1,188	107	1,295	87	161

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jun-17	8.8	751	833	106	939	74	124
Jul-17	8.5	629	778	187	964	71	121
Aug-17	8.5	824	889	104	993	108	76
Sep-17	8.3	797	834	86	920	99	117
Oct-17	8.0	860	975	92	1,067	106	77
Nov-17	8.9	737	809	74	883	75	98
Dec-17	7.9	815	1,148	54	1,202	131	58
Jan-18	10.5	771	994	82	1,076	69	103
Feb-18	8.5	771	976	95	1,070	77	126
Mar-18	13.1	948	1,165	176	1,341	76	130
Apr-18	12.2	1,410	1,649	136	1,785	134	182
May-18	8.5	846	944	83	1,027	59	93
Jun-18	7.9	709	817	113	929	65	118
Dry Season Average	**8.6**	**643**	**806**	**184**	**990**	**97**	**123**
Dry Season Trend **	**Down**	**Up**	**Up**	**Down**	**Up**	**-**	**None**
Wet Season Average	**11.3**	**735**	**934**	**183**	**1,116**	**92**	**127**
Average Annual	**10.2**	**697**	**881**	**183**	**1,064**	**94**	**126**

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

34 West County Agency Outfall

West County is a common outfall and discharge permit between West County and the City of Richmond which discharges to the Central Bay. They have a combined permitted capacity of 28.5 mgd ADWF (12.5 mgd ADWF for West County and 16.0 mgd ADWF for the City of Richmond) and a combined wet weather capacity of 41 mgd (21.5 mgd for West County and 20.0 mgd for the City of Richmond). The Richmond plant has wet weather capacity greater than 20 mgd though only 20 mgd for full secondary treatment. The current discharge flows are approximately 7.2 mgd ADWF. The Richmond plant performs secondary treatment using activated sludge, whereas the West County plant recently completed a Modified Ludzack-Ettinger (MLE) activated sludge process upgrade.

The following observations are made based upon the figures and table in the subsequent pages:

- The Richmond Plant represents the majority of the discharge flow and load (data not shown). The West County Plant recycles a majority of their flows year-round.
- Based on the table with the average monthly values, there appears to be an emerging dry season upward trend for flow and all nutrient species data.
- Wet season nitrogen and phosphorus loads are typically greater and more variable than the dry season loads.
- Ammonia is the majority of the nitrogen species discharged, regardless of season. This would be expected since the Richmond Plant represents the majority of the discharge load and they do not nitrify. Additionally, West County sends landfill leachate rich in ammonia from their plant to the City of Richmond plant which contributes to the discharge loading.
- Ortho-P values are occasionally greater than TP values for the Section 13257 Letter based on the composite sampling issue discussed in the main report body. Since the Regional Watershed Permit sampling began (July, 2014), the ortho-P values has only exceeded the TP value twice. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations vary between 0.6 to 5.7 mg P/L. Such values suggest P removal as typical effluent TP concentrations range from 4 to 6 mg P/L. There are no P removal facilities at the Richmond Plant so additional sampling is recommended to confirm where P removal is occurring.

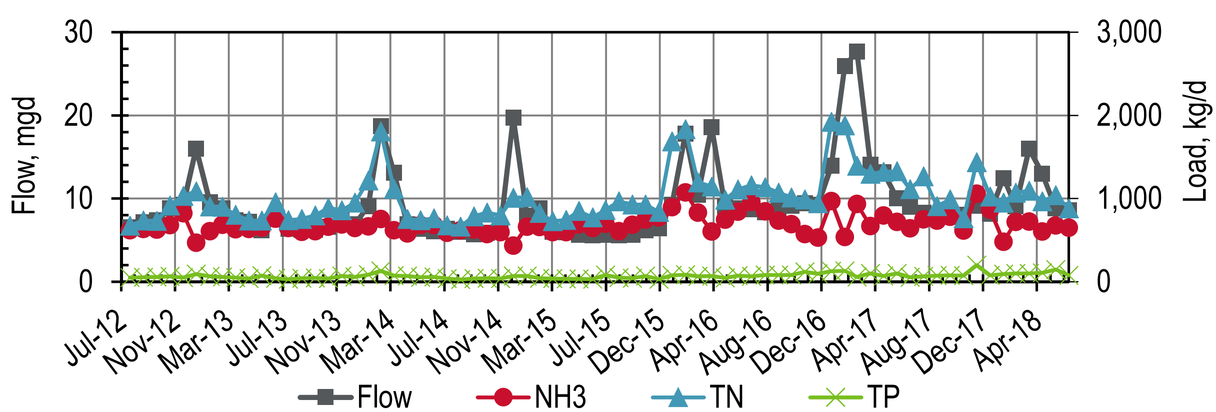

Figure 34-1. West County Monthly Flows and Loads

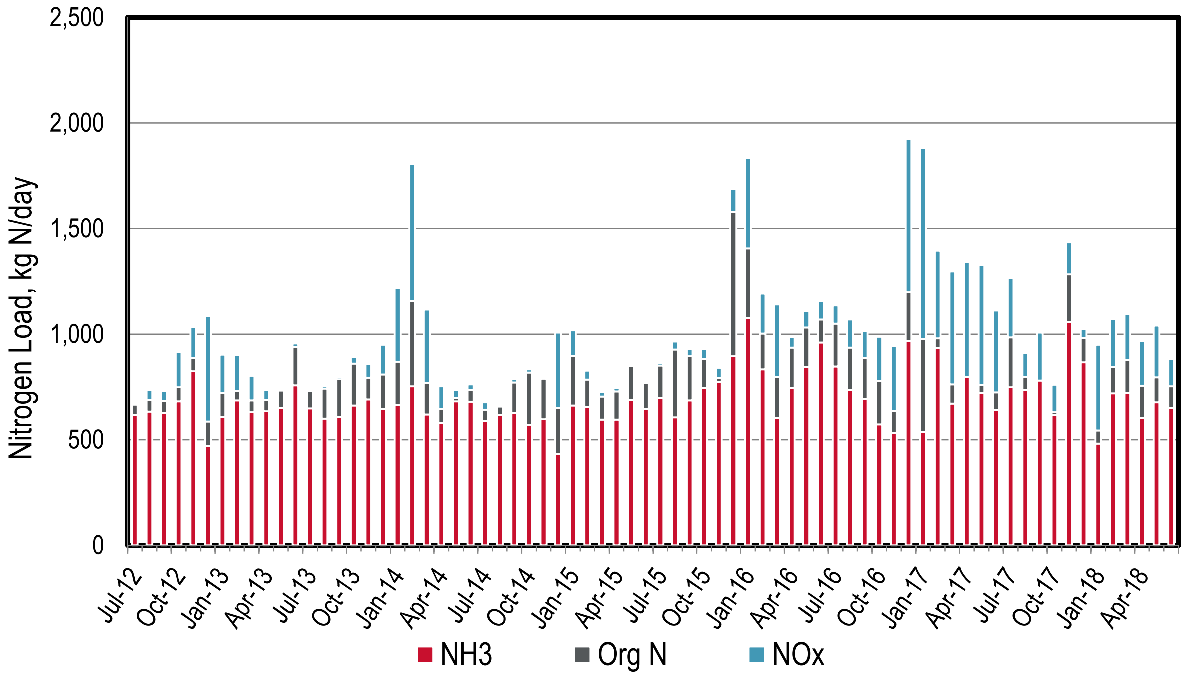

Figure 34-2. West County Monthly Nitrogen Loads

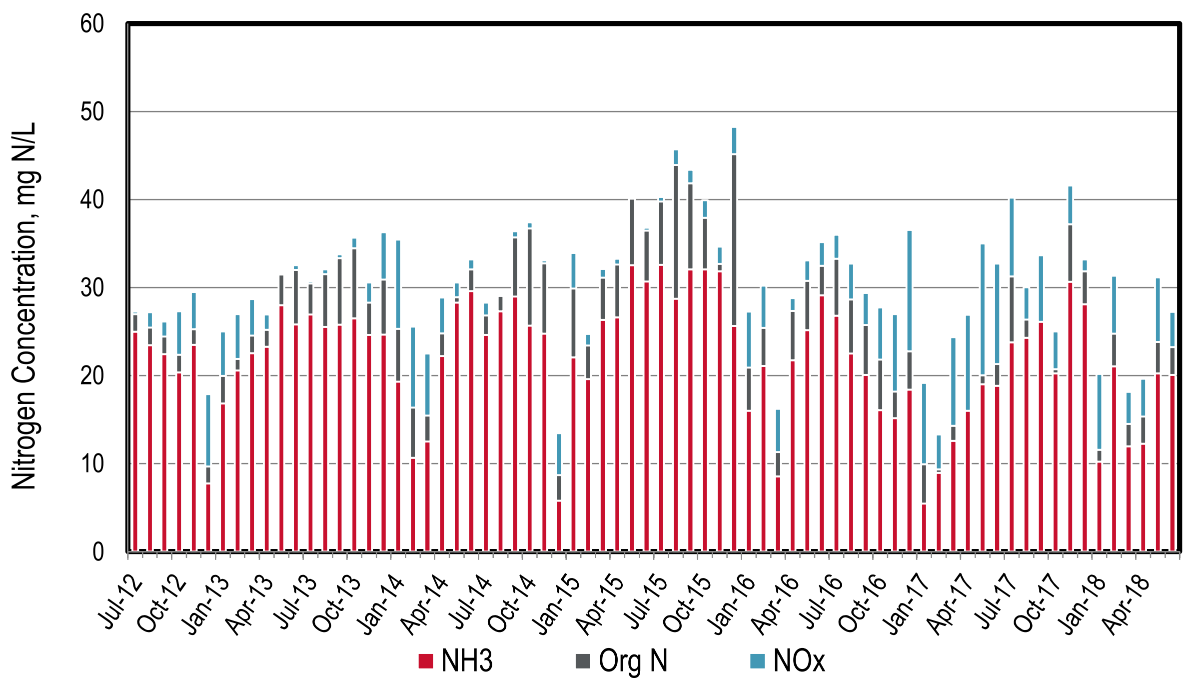

Figure 34-3. West County Monthly Nitrogen Concentrations

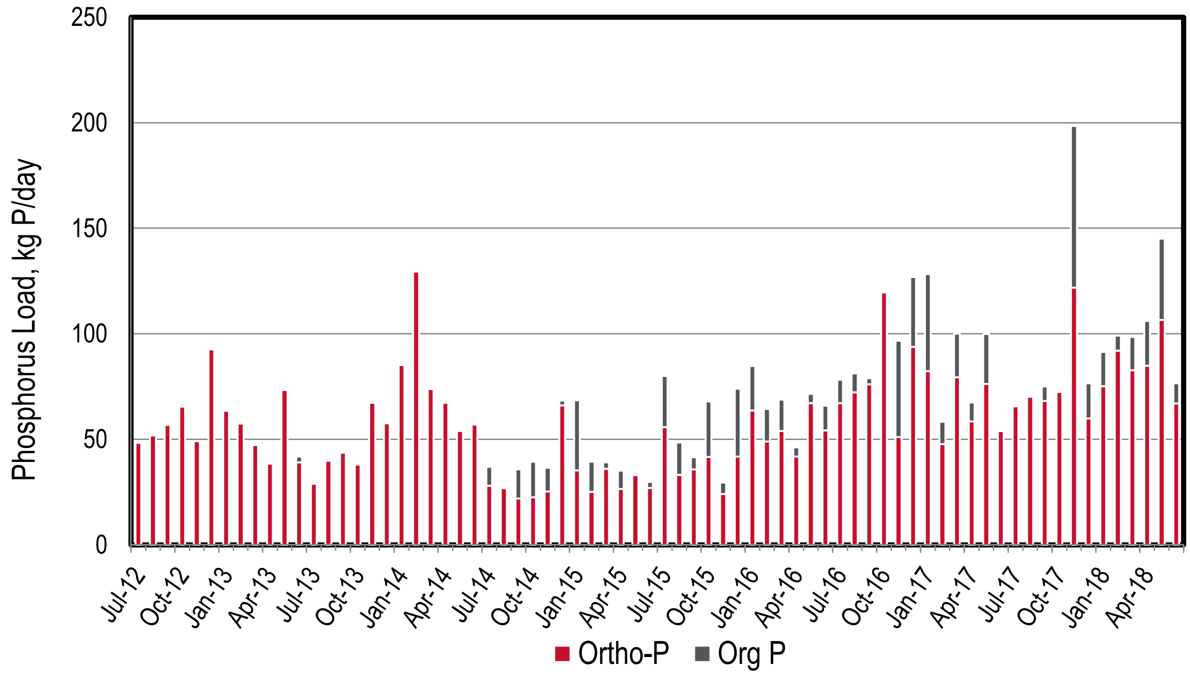

Figure 34-4. West County Monthly Phosphorus Loads

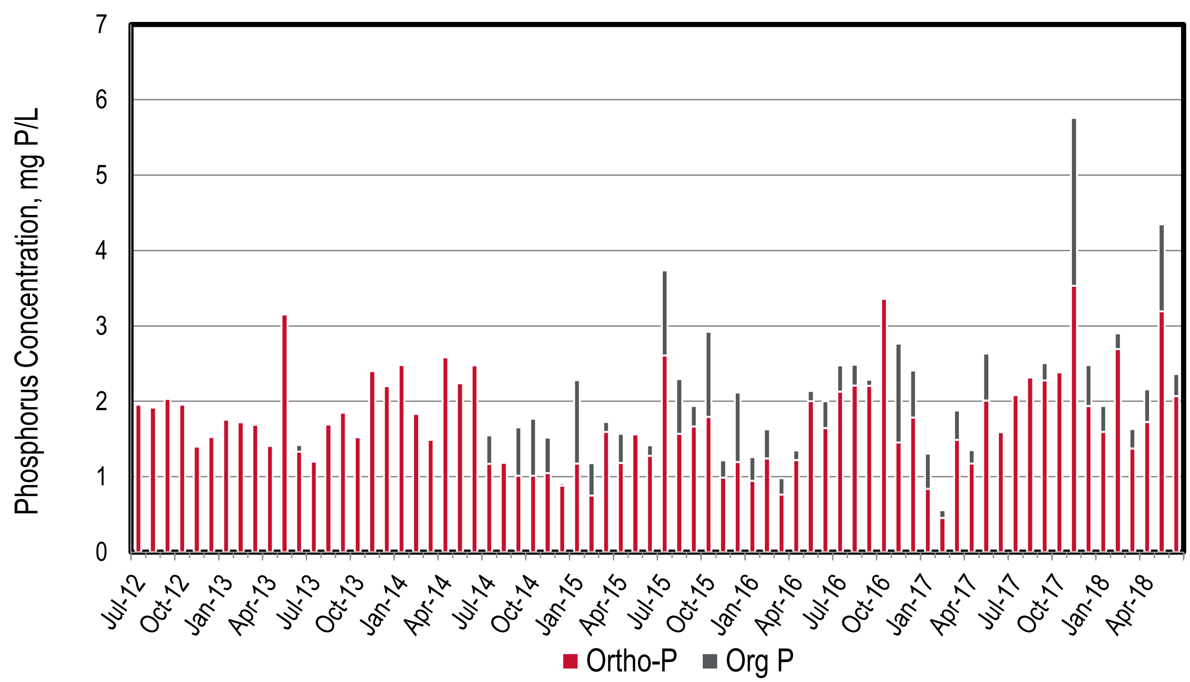

Figure 34-5. West County Monthly Phosphorus Concentrations

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

Table 34-1. West County Monthly Flows and Loads

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jul-12	6.5	618	667	8	675	88	48
Aug-12	7.2	634	688	48	736	85	52
Sep-12	7.4	627	683	47	730	99	57
Oct-12	8.9	682	749	166	914	96	65
Nov-12	9.3	824	887	147	1,033	76	49
Dec-12	16.0	470	587	497	1,084	121	93
Jan-13	9.5	607	721	182	903	68	63
Feb-13	8.8	686	730	169	899	96	57
Mar-13	7.4	631	687	116	803	62	47
Apr-13	7.2	635	688	47	735	54	38
May-13	6.2	652	733	3	736	103	73
Jun-13	7.8	758	940	15	955	39	42
Jul-13	6.4	648	732	6	738	29	29
Aug-13	6.2	601	742	13	754	61	40
Sep-13	6.2	608	786	10	796	48	44
Oct-13	6.6	662	860	30	890	59	38
Nov-13	7.4	690	794	64	857	92	67
Dec-13	6.9	646	809	141	950	82	58
Jan-14	9.1	664	870	348	1,218	108	85
Feb-14	18.7	753	1,158	647	1,805	166	129
Mar-14	13.1	620	767	349	1,117	92	74
Apr-14	6.9	579	646	106	753	127	67
May-14	6.4	681	696	40	737	73	54
Jun-14	6.1	680	737	26	763	91	57
Jul-14	6.3	590	642	35	677	28	37
Aug-14	6.0	618	657	4	661	27	27
Sep-14	5.7	626	771	15	786	22	36
Oct-14	5.9	571	817	15	832	23	39
Nov-14	6.4	596	789	7	796	25	37

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Dec-14	19.8	433	650	358	1,008	66	68
Jan-15	7.9	662	897	121	1,018	35	68
Feb-15	8.8	656	784	43	827	25	39
Mar-15	6.0	596	704	22	726	36	39
Apr-15	5.9	595	729	15	744	26	35
May-15	5.6	689	849	2	849	40	33
Jun-15	5.6	646	768	7	775	27	30
Jul-15	5.7	697	851	12	862	56	80
Aug-15	5.6	606	926	38	965	33	48
Sep-15	5.7	686	896	33	929	36	42
Oct-15	6.1	745	882	46	928	42	68
Nov-15	6.4	772	793	47	840	24	29
Dec-15	9.2	896	1,578	108	1,686	42	74
Jan-16	17.8	1,076	1,406	427	1,833	64	85
Feb-16	10.4	833	1,003	189	1,192	49	64
Mar-16	18.6	602	797	344	1,141	54	69
Apr-16	9.1	745	936	50	986	42	46
May-16	8.9	843	1,032	77	1,109	67	72
Jun-16	8.7	960	1,070	88	1,158	54	66
Jul-16	8.3	846	1,050	86	1,136	67	78
Aug-16	8.6	736	936	134	1,070	72	81
Sep-16	9.1	693	888	126	1,014	76	79
Oct-16	9.4	572	777	210	988	161	120
Nov-16	9.3	531	637	308	944	51	97
Dec-16	13.9	968	1,198	725	1,923	94	127
Jan-17	25.9	536	977	903	1,879	82	128
Feb-17	27.7	935	981	414	1,395	48	58
Mar-17	14.1	671	761	536	1,297	79	100
Apr-17	13.2	796	776	544	1,320	59	67
May-17	10.0	721	760	567	1,328	76	100

Month, Year	Flow mgd	Ammonia kg N/day	TKN kg N/day	NOx kg N/day	Total N kg N/day *	Ortho-P kg P/day	Total P kg P/day
Jun-17	9.0	641	724	388	1,112	54	54
Jul-17	8.3	749	985	280	1,265	81	66
Aug-17	8.0	736	798	112	910	89	70
Sep-17	7.9	781	764	226	990	68	75
Oct-17	8.0	616	630	131	761	81	72
Nov-17	9.1	1,057	1,283	151	1,434	122	199
Dec-17	8.2	867	982	42	1,024	60	77
Jan-18	12.5	481	544	406	950	75	91
Feb-18	9.0	720	846	226	1,071	92	99
Mar-18	16.0	722	877	218	1,095	83	99
Apr-18	13.0	602	755	211	966	85	106
May-18	8.8	677	795	245	1,040	107	145
Jun-18	8.6	651	753	129	882	67	77
Dry Season Average	**7.2**	**690**	**811**	**94**	**905**	**62**	**60**
Dry Season Trend **	**Up**	**Up**	**Up**	**Up**	**Up**	**-**	**Up**
Wet Season Average	**11.0**	**691**	**851**	**234**	**1,085**	**72**	**75**
Average Annual	**9.4**	**690**	**834**	**176**	**1,010**	**68**	**68**

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.