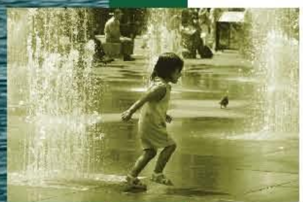

Wastewater Control Measures Study

Prepared for

Central Valley Regional Water Quality Control Board

Drinking Water Policy Workgroup

March 2011

WEST YOST ASSOCIATES

304-06-10-06

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consulting engineers

WATER WASTEWATER STORMWATER

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EXECUTIVE SUMMARY

The Central Valley Regional Water Quality Control Board (Central Valley Water Board) Drinking Water Policy (DWP) Workgroup is responsible for developing a DWP for surface waters of the Central Valley. The DWP Workgroup commissioned a study to provide an evaluation of the current and predicted 2030 loads for drinking water constituents of concern that are discharged by Publicly Owned Treatment Works (POTWs) within the Sacramento River, San Joaquin River and tributary watersheds to the Sacramento San Joaquin River Delta (Delta). This report summarizes the methodology and findings of the study, including an evaluation of the load reductions and associated costs that would result from three future control strategy scenarios.

The DWP Workgroup will use the loading information provided in this report as inputs to an analytical model that predicts changes in ambient water quality at key locations in the Sacramento San Joaquin watershed and within the legal boundary of the Delta as defined under Section 12220 of the California Water Code. This subsequent modeling effort will help provide a basis for the development of a DWP for the Central Valley.

The loading and cost estimates presented in this report apply only to the "major" POTWs that discharge to surface waters in the Sacramento-San Joaquin River watersheds. For purposes of this study, the major POTWs are defined as the facilities that by 2030 are estimated to discharge an average dry weather flow (ADWF) of 1 million gallons per day or greater. In addition, all POTWs that discharge within the legal boundary of the Delta are included as major POTWs, regardless of their predicted flow.

Discharges from the major POTWs comprise 98.6 percent of the total wastewater flow and loads discharged to surface waters in the Sacramento-San Joaquin River watershed. Although the remaining 19 (minor) dischargers represent a small percentage of total flow and loadings discharged, the minor POTWs represent approximately 30 percent of the dischargers that may be affected should new water quality objectives be adopted under the DWP.

The DWP Workgroup identified the following three control strategy scenarios to be evaluated for the major POTWs:

Scenario 1. **2030 Planned Changes** - Currently mandated treatment (i.e. current and/or planned treatment required by adopted in National Pollutant Discharge Elimination System, or NPDES, permits).

Scenario 2. **2030 Plausible** – Mandated treatment plus enhanced biological nutrient removal, followed by chemical phosphorus removal with tertiary clarification, tertiary filtration (if not currently mandated) and ultraviolet (UV) disinfection (if not currently mandated).

Scenario 3. **2030 Outer Boundary** - Mandated treatment plus microfiltration (if not currently provided or planned), reverse osmosis (MF/RO) and UV disinfection (if not currently mandated).

These three scenarios were identified by the DWP Workgroup because each scenario has the potential to reduce salt, organic carbon, pathogen, and/or nutrient loadings discharged by POTWs into the Sacramento-San Joaquin River watersheds. These scenarios are intended to provide a range of potential control measures and are not intended to imply or suggest recommendations by the DWP Workgroup for future implementation.

Major POTW mass loads of organic carbon, total dissolved solids (TDS), and nutrients discharged to the Sacramento River, San Joaquin River and tributary watersheds were calculated for the current conditions and for each of three 2030 scenarios listed above. For the scenarios where treatment levels are expected to remain the same as current levels, actual average effluent quality concentration data was combined with the current ADWF data and applicable growth rates to determine loadings. For all other scenarios, the loadings were determined from current ADWF data, applicable growth rates, and an assumed average concentration that was derived from a review of published literature.

The estimated average daily mass loads of organic carbon and nutrients from major POTWs that discharge to the Sacramento River, San Joaquin River and tributary watersheds to the Delta under current and the three 2030 control strategy scenarios listed above is shown in Figure ES-1. As shown, loadings of total organic carbon and nutrients (with the exception of nitrate and nitrite) are expected to decrease by 2030 as a result of the upgrades that are planned for several of the major POTWs.

TDS data was available for each POTW and was used to calculate the loadings under the Current, 2030 Planned Changes, and 2030 Plausible scenarios. Reverse Osmosis, which will be provided under the 2030 Outer Boundary scenario, is the only treatment process that will result in significant reductions in TDS discharged from POTWs. Therefore, literature-derived values were used to predict TDS loadings under the 2030 Outer Boundary Scenario. The average daily total dissolved solids discharge load under current conditions and under the three 2030 scenarios are as follows:

- <u>2010 Conditions</u>: 1,350,000 pounds per day
- <u>2030 Planned Changes</u>: 2,050,000 pounds per day
- <u>2030 Plausible</u>: 2,050,000 pounds per day
- <u>2030 Outer Boundary</u>: 168,000 pounds per day

Many of the POTWs are planning to implement source control for salinity management, such as incorporating alternative water supplies. This type of improvement is not reflected in the analysis, but could result in significant reductions in salinity loads discharged from these POTWs. In addition, the chemical addition processes that would be included with the enhanced nutrient removal facilities under the 2030 Plausible scenario would actually increase TDS loadings from POTWs. However, a quantification of this increase has not been included in the analysis.

The costs to major POTWs for implementing the added treatment improvements needed under the 2030 Plausible and 2030 Outer Boundary scenario are presented in Table ES-1. In developing these costs it was assumed that future required upgrades would be reasonably represented by the cost of a single treatment train option, scaled based on capacity for the particular POTW.

Table ES-1. Summary of the Estimated Cost of Added Treatment for Major POTWs under Potential 2030 Control Strategy Scenarios

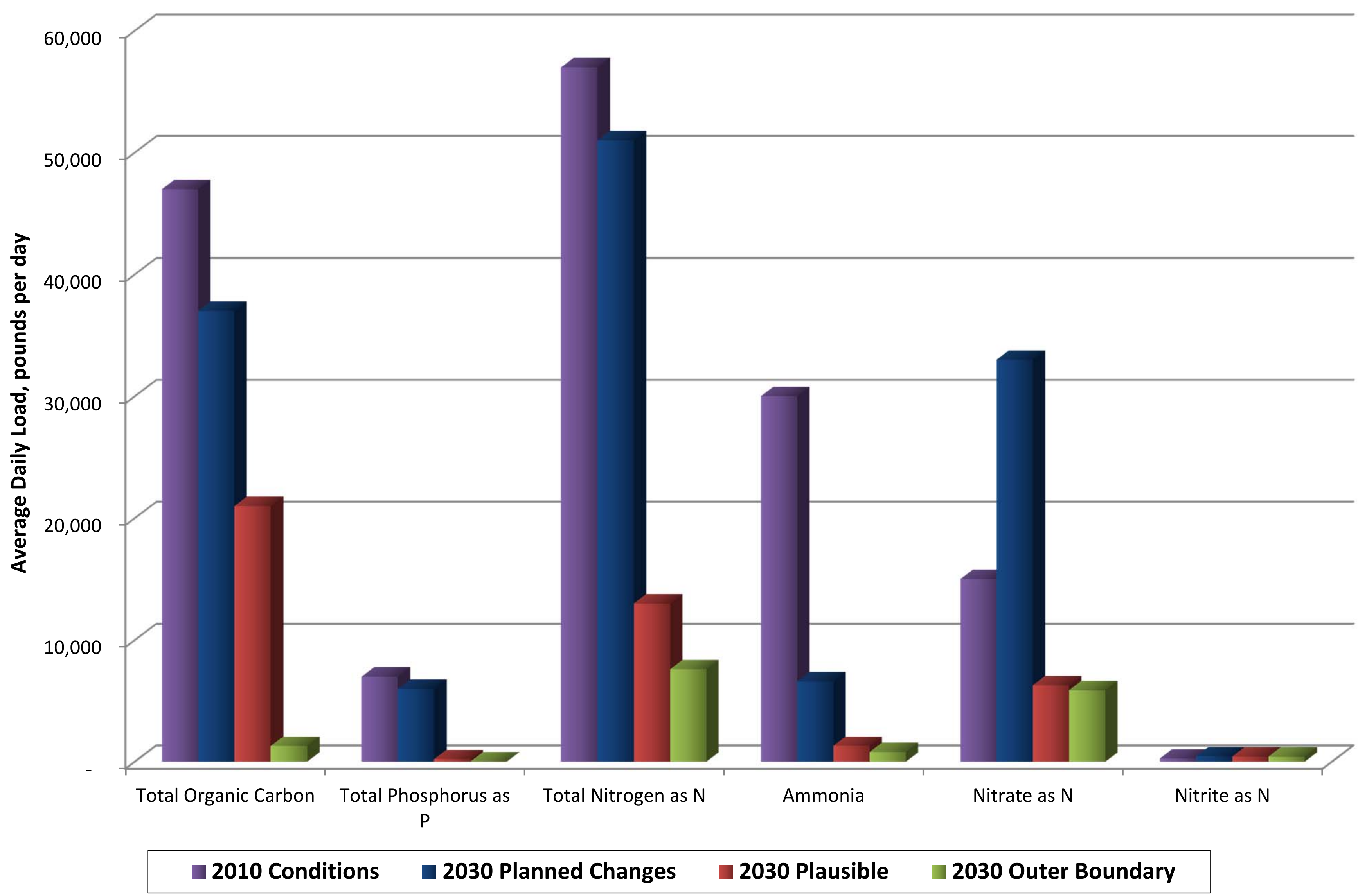
Constituent	2030 Planned Changes	2030 Plausible	2030 Outer Boundary
Estimated Capital Cost, $ billion	Not estimated[a]	$1.7 [b][c]	$9.6[b][c]
Estimated Annual O&M Cost, $ billion per year	Not estimated	$0.1[b][c]	$0.4[b][c]

(a) Most communities have made, or will be making, improvements to their plants to meet existing NPDES requirements. The improvements needed to satisfy currently applicable water quality standards would not result directly from the adoption of a new DWP. Therefore, this study does not assign additional DWP related costs for improvements that will be required to meet current standards and permit requirements. Nevertheless, the cost of planned facility upgrades to ensure compliance with current standards is estimated to range between $3.3 and $5.3 billion.

(b) Costs do not include, and are in addition to, the cost of constructing and operating facilities required for compliance with current permits (i.e. the improvements under the 2030 Planned Changes Scenario).

(c) Estimates are Class 5 planning level estimates (AACE, 2005). ENR 20 Cities Average CCI 8952.

Figure ES-1. Organic Carbon and Nutrient Loadings for Major POTWs Under Varying Control Strategy Scenarios



1.0 INTRODUCTION AND REPORT OVERVIEW

This report has been developed on behalf of the Drinking Water Policy Workgroup that was formed by the Central Valley Regional Water Quality Control Board in support of the development of DWP for surface waters of the Central Valley. This report specifically provides the current and predicted 2030 loads for drinking water constituents of concern discharged by Publicly Owned Treatment Works (POTWs) within the Sacramento River, San Joaquin River and tributary watersheds to the Sacramento-San Joaquin River Delta. In addition, the POTW load reductions and associated costs that would result from two future enhanced treatment scenarios are presented.

The information included herein will be used as inputs to analytical models that will predict changes in ambient water quality at key locations in the Sacramento-San Joaquin watershed and within the legal boundary of the Delta as defined under Section 12220 of the California Water Code. The subsequent modeling effort will help to provide a basis for the development of a DWP for the Central Valley. Figure 1 shows the area encompassed by this study, including the boundary of the Sacramento and San Joaquin River watersheds and the legal Delta.

This report includes the following major sections:

1.0 Introduction and Overview: Provides an introduction to this report and summarizes the content of the report sections.

2.0 DWP Background Information: Describes the purpose of the DWP and how the contents of this report will be used to support the development of this policy.

3.0 Central Valley POTWs: Provides an overview of the current POTWs that were evaluated under this study, and summarizes the data available to characterize the discharges from these POTWs.

4.0 Current POTW Discharger Loads: Provides a summary of the loading calculation results for the current discharge conditions and describes the procedure used for determining these loads.

5.0 2030 Control Strategy Scenarios: Provides a description of the three potential future discharge scenarios that were defined by the DWP Workgroup.

6.0 Projected 2030 POTW Discharger Loads: Provides a summary of the loading calculation results for the three potential future discharge scenarios defined by the DWP Workgroup and describes the procedure used for determining these loads.

7.0 Estimated Cost of Treatment: Includes a description of the cost estimating procedures used to define the costs associated with the implementation of the 2030 Plausible and 2030 Outer Boundary scenarios. Tables summarizing the estimated costs are also provided.

8.0 Other Project Factors: Provides a discussion of non-economic factors that should be considered in evaluating the whether additional treatment requirements are appropriate for POTWs under the DWP.

2.0 DWP BACKGROUND INFORMATION

The Central Valley Water Board is leading a multi-year effort to develop a drinking water policy for surface waters in the Central Valley because water supply agencies have raised concerns that current policies and plans lack water quality objectives for several drinking water constituents of concern, such as organic carbon, nutrients, and pathogens. In response to these concerns, the Central Valley Water Board formed the DWP Workgroup that includes stakeholders representing POTWs, drinking water agencies, municipal urban runoff agencies, agricultural representatives, and State and Federal agencies. The California Urban Water Agencies (CUWA) is also a Workgroup member and stakeholder and has obtained Proposition 50 funds (SWRCB Agreement No. 04-185-555) on behalf of the Workgroup to support the development of the technical studies needed to develop a DWP for the surface waters of the Central Valley.

The DWP Workgroup is currently completing a number of technical studies to assess pollutants from a variety of urban, industrial, agricultural, and natural sources that can affect the quality of the water and can lead to drinking water treatment challenges and potential public health concerns. The following drinking water constituents of concern have been identified by stakeholders as high priority for study and evaluation and are considered in this report:

- Total dissolved solids,
- Nutrients,
- Organic carbon, and
- Pathogens such as *Cryptosporidium* and *Giardia*.

Between 2006 and 2007, conceptual models for organic carbon, nutrients, pathogens and pathogen indicators, and salinity were developed for the DWP Workgroup. The conceptual models produced preliminary loading analysis and identified additional data needs for each of the constituents of concern to refine the loading estimates from the different sources. From these initial efforts, the DWP Workgroup identified the need to evaluate potential control strategies in terms of load reductions and costs and to conduct additional water quality modeling to assess the effectiveness of various load reduction strategies on ambient levels of constituents of concern. The purpose of this study is to evaluate the load reductions and costs associated with three control strategy scenarios identified by the DWP Workgroup as being applicable to POTWs that discharge to surface water. As mentioned previously, the identified loads will be used as inputs to analytical models that will predict changes in ambient water quality at key locations in the Sacramento-San Joaquin watershed and the Delta.

3.0 CENTRAL VALLEY POTWS

This section presents the following information regarding Central Valley POTWs that discharge to the Sacramento River, San Joaquin River and tributary watersheds to the Delta:

- Available POTW Surface Water Discharger Data,
- Flow-Weighted Average POTW Effluent Concentrations,
- Projected POTW Growth Rates,
- Projected 2030 Discharge Flows, and
- Major POTW Treatment Levels.

3.1 Available POTW Surface Water Discharger Data

Attachment A provides a listing of all the POTWs that discharge to the Sacramento River, San Joaquin River and tributary watersheds to the Delta. These POTWs are grouped into the following discharge areas:

- **Sacramento Basin**: POTWs that discharge to the Sacramento River, or tributaries to the Sacramento River (including the American River and its tributaries), upstream of the legal boundary of the Delta;
- **San Joaquin Basin**: POTWs that discharge to the San Joaquin River, or tributaries to the San Joaquin River (including the Stanislaus River and its tributaries), upstream of the legal boundary of the Delta;
- **Delta**: POTWs that discharge within the legal boundary of the Delta;
- **Eastern Delta Tributary**: POTWs that discharge to surface waters that are tributaries to the Delta along the eastern boundary; and
- **Northern Delta Tributary**: POTWs that discharge to surface waters that are tributaries to the Delta along the northern boundary.

All of the loading and cost estimate information presented in this report applies only to the "major" POTWs shown in Attachment A. For purposes of this effort, the major POTWs are defined as the facilities that by 2030 are estimated to discharge to surface waters in the Sacramento-San Joaquin River watersheds at an average dry weather flow (ADWF) of 1 million gallons per day or greater. (Projected 2030 flows are presented in Section 3.4.) In addition, all POTWs that discharge within the legal boundary of the Delta are included as major POTWs. The total ADWF currently discharged by the major POTWs is approximately 344 million gallons per day (mgd) and comprises 98.6 percent of the total wastewater flow discharged to surface waters in the Sacramento-San Joaquin River watersheds. The following available information is provided in Attachment A for each of the major POTWs:

- Agency and facility name
- Receiving water name
- Current facility treatment level and disinfection process

- Planned/mandated facility treatment level and disinfection process
- Estimated service area population
- Current permitted ADWF
- Recent ADWF
- Available data describing average effluent concentrations of the following constituents of concern that were identified by the DWP Workgroup:
  - total organic carbon (TOC)
  - total phosphorus
  - total nitrogen
  - ammonia
  - nitrate-nitrogen
  - nitrite-nitrogen
  - total dissolved solids (TDS)

The "minor" POTWs (those POTWs that by 2030 are estimated to discharge at an ADWF less than 1 mgd) are also listed in Attachment A, and are shaded gray. The total flow currently discharged by the minor POTWs is approximately 4.8 mgd and comprises approximately 1.4 percent of the total wastewater flow discharged to surface waters in the Central Valley. Although the minor dischargers represent a small percentage of total flow (and loadings) discharged, these 19 POTWs represent approximately 30 percent of the facilities that may be affected should water quality objectives be adopted under the DWP. The following information is provided in Attachment A for each of the minor POTWs:

- Agency and Facility Name,
- Receiving Water Name,
- Estimated service area population,
- Current permitted ADWF, and
- Recent ADWF.

Where appropriate, the source for the information included in Attachment A is indicated by color-coding that is defined in the footnotes of the table.

3.2 Flow-Weighted Average POTW Effluent Concentrations

Attachment A includes available "recent" average concentration data for the seven constituents of concern in the wastewater discharged from the major POTWs evaluated under this study. In addition, the "recent" average discharge flow rate is provided for each POTW. Most of the information in Attachment A was provided by the DWP Workgroup; and, as indicated in the footnotes, was either obtained from the current NPDES permit or from monitoring data that has been collected by the discharger. Therefore, the information in Attachment A is derived from data sets that represent varying timelines. In general, effluent concentrations and flows may vary from year to year for a given POTW. Nevertheless, the values provided in Attachment A are expected to provide a reasonable estimate of the current conditions.

Table 1 provides the calculated flow-weighted average concentrations of the available discharger concentration data for each of the five discharge areas using the information provided in Attachment A. The flow weighted concentration for a given discharge area is calculated using the available effluent water quality and current ADWF data as follows:

$$\frac{\sum_{1}^{n} Ci \times Qi}{\sum_{1}^{n} Qi}$$

where:

Ci = *Concentration of the constituent of concern for an individual POTW within the discharge area*

Qi = *Current ADWF for an individual POTW within the discharge area*

Table 1. Flow-Weighted Average Effluent Concentrations of Available Water Quality Data for Existing Major POTW Dischargers in Each Discharge Area, mg/L

Discharge Area	Total Organic Carbon	Total Phosphorus as P	Total Nitrogen as N	Ammonia	Nitrate as N	Nitrite as N	Total Dissolved Solids
Sacramento River Basin	No data	1.5	15	5.0	5.2	0.29	332
San Joaquin River Basin	16	2.5	22	3.1	8.4	0.26	527
Delta	19	2.3	24	18	3.3	0.05	469
Eastern Delta Tributaries	No data	2.0	17	0.3	13	No data	364
Northern Delta Tributaries	12	4.2	14	1.9	8.8	0.20	853

3.3 Projected POTW Growth Rates

The projected growth rates through 2030 for each of the POTW service areas are presented in Table 2.

Table 2. Predicted POTW Service Area Growth Rate Through 2030

Agency	Facility	Predicted Annual Growth Rate	Basis of Predicted Growth Rate
Sacramento Basin Dischargers			
Anderson, City of	Anderson Water Pollution Control Plant	1.2%	DOF 1981 - 2010
Auburn, City of	Wastewater Treatment Plant	1.6%	DOF 1971 - 2010
Chico, City of	Chico Water Pollution Control Plant	3.2%	DOF 1971 - 2010
City of Corning	Corning Wastewater Treatment Plant	1.2%	DOF 1981 - 2010
Colfax, City of	Wastewater Treatment Plant	2.0%	DOF 1971 - 2010
Colusa, City of	Wastewater Treatment Plant	1.0%	DOF 1971 - 2010
Dunsmuir, City of	Wastewater Treatment Plant	0.0%	DOF 1971 - 2010 Negative Growth. Assume 0
Grass Valley, City of	Wastewater Treatment Plant	1.6%	DOF 1981 - 2010
Lincoln, City of	Wastewater Treatment and Reclamation Facility	4.0%	City's projected population growth rate between 2010 and 2020.
Linda County Water District + Marysville	Wastewater Treatment Plant	1.5%	Average of the following three values: City of Marysville's DOF 1971 - 2010; Linda County CCD Census 1980 - 2000; and Projected increase from 3 to 5 mgd over an estimated 20 year period.
Live Oak, City of	Wastewater Treatment Plant	2.7%	DOF 1971 - 2010
Maxwell Public Utilities District	Maxwell Public Utilities District Wastewater Treatment Plant		
Nevada City, City of	Nevada City Wastewater Treatment Plant	0.7%	DOF 1971 - 2010
Nevada County Sanitation District	Cascade Shores Wastewater Treatment Plant	1.3%	DOF 1981 - 2010 for Unincorporated Nevada Co.
Nevada County Sanitation District No. 1	Lake Wildwood Wastewater Treatment Plant	1.3%	DOF 1981 - 2010 for Unincorporated Nevada Co.
Olivehurst PUD	Wastewater Treatment Plant	1.0%	Census 1980 - 2000
Placer County Department of Facility Services	Placer County Sewer Maintenance District No. 1 Wastewater Treatment Plant	0.9%	Projected to increase capacity from 2.18 MGD to 2.7 MGD to accommodate wastewater flows by 2034
Placer County Department of Facility Services	Placer County Sewer Maintenance District No. 3 Wastewater Treatment Plant	1.2%	DOF 1981 - 2010 for Unincorporated Placer Co.
Placerville, City of	Hangtown Creek Water Reclamation Facility	1.5%	DOF 1971 - 2010
Quincy Community Services District	Quincy Wastewater Treatment Plant	0.1%	DOF 1981 - 2010 for Incorporated Plumas Co.
Red Bluff, City of	Red Bluff Wastewater Reclamation Plant	1.3%	DOF 1971 - 2010
Redding, City of	Stillwater Wastewater Treatment Facility	1.1%	DOF 1991 - 2010
Redding, City of	Clear Creek Wastewater Treatment Plant	1.1%	DOF 1991 - 2010
Rio Alto Water District	Lake California Wastewater Treatment Plant	0.4%	DOF 1971 - 2010 for Unincorporated Tehama Co.
Roseville, City of	Pleasant Grove Wastewater Treatment Plant	1.9%	City has projected an increase in population from 115,781 (2010) to 154,356 (2030)
Roseville, City of	Dry Creek Wastewater Treatment Plant	1.9%	
Sewerage Commission-Oroville Region	Sewerage Commission-Oroville Region Wastewater Treatment Plant	1.5%	DOF 1971 - 2010
Shasta County Service Area No. 17	Cottonwood Wastewater Treatment Plant	0.5%	DOF 1971 - 2010 for Unincorporated Shasta Co.
Shasta Lake, City of	City of Shasta Lake Wastewater Treatment Facility	0.6%	DOF 1994 - 2010
United Auburn Indian Community	Thunder Valley Casino Wastewater Treatment Plant	4.7%	Permit states a projected increase in capacity from 0.35 MGD to 0.875 MGD - assume 20 year planning horizon.
Williams, City of	Williams Wastewater Treatment Plant	2.6%	DOF 1971 - 2010
Willows, City of	Willows Wastewater Treatment Plant	0.9%	DOF 1971 - 2010
Yuba City, City of	Wastewater Treatment Facility	3.0%	DOF 1971 - 2010
San Joaquin Basin Dischargers			
Angels, City of	City of Angels Wastewater Treatment Plant	1.0%	DOF 1981 - 2010
Atwater, City of	Wastewater Treatment Facility	1.3%	DOF 1981 - 2010
Calaveras County Water District	Forest Meadows Wastewater Reclamation Plant	1.3%	DOF 1991 - 2010 for Unincorporated Calaveras Co.
Clovis, City of	Clovis Sewage Treatment Plant and Water Reuse Facility	3.1%	DOF 1981 - 2010
Mariposa Public Utility District	Mariposa Wastewater Treatment Facility	0.9%	Census 1990 -2010
Merced, City of	Wastewater Treatment Facility	2.3%	DOF 1981 - 2010
Modesto, City of	Water Quality Control Facility	1.9%	DOF 1981 - 2010
Planada Community Services	Wastewater Treatment Plant	3.0%	Census 1990 - 2010
Turlock, City of	Wastewater Treatment Plant	2.7%	DOF 1981 - 2010
Delta Dischargers			
Brentwood, City of	Wastewater Treatment Plant	3.7%	General Plan growth rate 2000 to 2020
Discovery Bay, Town of	Discovery Bay Wastewater Treatment Facility	5.3%	Census 1990 - 2000
Ironhouse Sanitary District	Ironhouse Sanitary District Wastewater Treatment Plant	3.2%	DOF 2001 - 2010 for Oakley
Lodi, City of	White Slough Water Pollution Control Plant	1.8%	DOF 1971 - 2010
Manteca, City of	City of Manteca Wastewater Quality Control Plant	3.1%	DOF 1981 - 2010
Mountain House Community Services District	Mountain House Wastewater Treatment Plant	6.9%	City projects increase in population from 6,000 (2010) to 44,000 (2040, assumed)
Oakwood Lake Subdivision	Oakwood Lake Subdivision Mining Reclamation Project		
Rio Vista, City of	Northwest Wastewater Treatment Facility	6.3%	DOF 1991 - 2010 x 1.5 (Growth is expected to disproportionally be within this facility's service area.
Rio Vista, City of	Beach Wastewater Treatment Facility	2.1%	DOF 1971 - 2010 x 0.5 (Growth is expected to disproportionately NOT be located in this facility's service area)
Sacramento Regional County Sanitation District	Sacramento Regional Wastewater Treatment Plant	1.2%	2008 to 2025 Projection of Population of Six-County SACOG Region, Center for Continuing Study of the California Economy (CCSCE), March 2010
Stockton, City of	Regional Wastewater Control Facility	2.2%	DOF 1971 - 2010
Tracy, City of	Tracy Wastewater Treatment Plant	3.7%	DOF 1971 - 2010
Eastern Delta Tributary Dischargers			
El Dorado Irrigation District	Deer Creek Wastewater Treatment Plant	4.7%	Census 1980 - 2000 for S. Eldorado County CCD (Includes Cameron Park, Diamond Springs, El Dorado Hills, Pollock Pines, and Shingle Springs)
El Dorado Irrigation District	El Dorado Hills Wastewater Treatment Plant	4.7%	
Galt, City of	Wastewater Treatment Plant and Reclamation Facility	3.4%	General Plan growth rate 2007 to 2030
San Andreas Sanitary District	Wastewater Treatment Plant	1.6%	Census 1990 - 2010
Northern Delta Tributary Dischargers			
Davis, City of	Wastewater Treatment Plant	1.7%	DOF 1981 - 2010
UC Davis	Main Wastewater Treatment Plant	1.8%	Projected increase in population from 45,000 (Current Permit) to 51,700 (Long Range Plan, 2016)
Vacaville, City of	Easterly Wastewater Treatment Plant	3.2%	City projects increase in wastewater flow rate to 15.5 mgd by 2030.
Woodland, City of	Water Pollution Control Facility	1.8%	DOF 1981 - 2010

As indicated in Table 2, the growth rates were determined using the following information:

- Department of Finance (DOF) historic population data for the communities served by the POTW was used whenever available. Annual growth rates were calculated for 10 year periods between 1971 and 2010. The average of the annual growth rates for each decade was assumed to be the long-term growth rate. Some discretion was applied regarding what data to use in the averaging calculation. For example, if a given community experienced a rapid increase in population unique to a single decade, that higher growth rate was not assumed to be characteristic of long-term growth and was excluded from the calculation. Table 2 indicates the specific time period used as the basis for the average long-term rate.
- DOF does not provide population data for smaller communities (such as county-operated Community Service Districts). However, the US Census Bureau does provide population information for these smaller communities. When available, US Census Bureau data from between 1980 and 2000 was used to predict future long-term growth for these areas. Again, annual growth rates for each ten year period were determined and the long-term growth rate was assumed to be the average of the rates in each decade.
- Some of the POTWs serve a number of communities. In some cases, the US Census Bureau provides data for a grouping of communities in a given county. In other cases, either the "incorporated" or "unincorporated" county numbers were used as provided by DOF.
- Finally, where the DOF or US Census Bureau data did not appear to be applicable, data from the communities themselves was identified. Specific data sources included individual NPDES Permits, General Plans, Development Plans, or other readily available documents.
- SACOG's projected growth rate for the six-county region was applied to the Sacramento Regional Wastewater Treatment Plant flow.

3.4 Projected 2030 Discharge Flows

The current discharge flows for the major POTWs provided in Attachment A were combined with the predicted growth rates shown in Table 2 to develop the projected 2030 wastewater flows. In 2008, former Governor Schwarzenegger set an initiative "to achieve a 20 percent reduction in per capita water use statewide by 2020." Although a significant portion of the water use reductions would likely be associated landscape irrigation demand, such reductions would result in some decrease in flow being discharged to POTWs. Therefore, it may be appropriate to adjust the projected 2030 flows to account for future water conservation and, the projected 2030 flows were calculated for the following scenarios:

- No reduction in flow due to conservation,
- 2 percent reduction in total flow due to conservation,
- 5 percent reduction in total flow due to conservation, and
- 10 percent reduction in total flow due to conservation.

The projected flows under these four scenarios were determined using the following equation:

$$Projected\ 2030\ Discharge\ Flow =$$
$$Current\ Discahrge\ Flow\ \times\ 1 + Growth\ Rate\ ^{2030-2010}$$

The projected 2030 flows for each of the major POTW dischargers are provided in Attachment B. A summary of the total flows shown in Attachment B is provided in Table 3, grouped by discharge area.

Table 3. Projected 2030 Wastewater Flows for Existing Major POTW Dischargers, mgd

Discharge Area	Predicted 2030 Flow			
	No Reduction	2% Reduction	5% Reduction	10% Reduction
Sacramento River Basin	96	94	92	87
San Joaquin River Basin	70	70	68	63
Delta	284	277	269	255
Eastern Delta Tributaries	18	17	17	16
Northern Delta Tributaries	36	36	35	33
Total	**504**	**495**	**481**	**454**

Note that 2030 constituent loads, which are presented later in this report, are calculated independent of flow because a reduction in flow due to future water conservation efforts would likely not translate into corresponding load reductions.

Also, there could be a reduction in flows and loads that result from future water recycling initiatives by POTWs. Any flow or load reductions associated with water recycling will not be addressed in this analysis. However, if information on recycling efforts by a given discharger is available, this information will be accounted for in the subsequent analytical modeling that will be conducted to predict water quality impacts in the basin.

3.5 Major POTW Treatment Levels

Attachment A presents treatment levels for each major facility (both currently and/or in the future) as one of the following treatment levels:

- Treatment Level "a" - Secondary Treatment (Includes POTWs with pond treatment systems);
- Treatment Level "b" - Secondary Treatment with Nitrification (Includes POTWs with data demonstrating that complete nitrification is occurring; partial denitrification may also be occurring);
- Treatment Level "c" - Tertiary Treatment (POTWs with filtration facilities in addition to secondary treatment. May or may not include POTWs with advanced disinfection facilities.);

- Treatment Level "d" - Tertiary Treatment with Nitrification (Includes POTWs with data demonstrating that complete nitrification is occurring; partial denitrification may also be occurring); and
- Treatment Level "e" - Tertiary Treatment with Nitrification and Denitrification (NDN).

Table 4 provides a summary of the number of major POTWs and the total amount of flow discharged that currently provide treatment levels in each of the categories listed above. Note that none of the POTWs evaluated under this study have treatment systems specifically designed to provide phosphorus removal; however, tertiary filtration will remove a portion of the phosphorus that is associated with solid materials and the anoxic basin that is typically constructed to provide denitrification could also provide some biological phosphorus removal.

Table 5 provides a summary of the number of major POTWs and the total amount of flow discharged for each of the treatment levels listed above at the 2030 flow condition - assuming the planned and/or mandated facility upgrades have been completed. As shown in Table 5, assuming that the planned and/or mandated facility upgrades are compete by 2030, approximately 80 percent of all wastewater discharged to surface waters from major POTWs within the Central Valley will receive tertiary treatment with NDN and approximately 94 percent of wastewater discharged will be tertiary treated.

Attachment A also shows which of the major POTWs provide, or are planning to provide, UV for disinfection. Table 6 summarizes the number (and the total amount of flow discharged) from these POTWs. As shown, by 2030 approximately 73 percent of wastewater discharged from major POTWs will receive UV disinfection (366 mgd discharged with UV disinfection versus 507 mgd total projected discharge from Table 5).

Table 4. Summary of Current Treatment Levels for Existing Major POTW Dischargers

Treatment Level Category	Total Number	Total Current Flow, mgd	Sacramento River Basin		San Joaquin River Basin		Delta		Eastern Delta Tributary		Northern Delta Tributary	
			Number	Flow, mgd	Number	Flow, mgd	Number	Flow, mgd	Number	Flow, mgd	Number	Flow, mgd
Secondary Treatment	7	182	3	9	1	20	2	147	0	0	1	6
Secondary Treatment w/ Nitrification	7	32	2	8	2	12	1	2	1	2	1	8
Tertiary Treatment	3	13	3	13	0	0	0	0	0	0	0	0
Tertiary Treatment with Nitrification	8	48	6	9	1	11	1	28	0	0	0	0
Tertiary Treatment with NDN	18	68	6	25	1	3	7	26	2	5	2	9
Total	**43**	**344**	**20**	**65**	**5**	**46**	**11**	**203**	**3**	**8**	**4**	**23**

Table 5. Summary of Planned/Mandated Treatment Levels for Existing Major POTW Dischargers[a]

Treatment Level Category	Total Number	Total Projected Flow[b] mgd	Sacramento River Basin		San Joaquin River Basin		Delta		Eastern Delta Tributary		Northern Delta Tributary	
			Number	Flow[b], mgd	Number	Flow[b], mgd	Number	Flow[b], mgd	Number	Flow[b], mgd	Number	Flow[b], mgd
Secondary Treatment	4	25	3	25	0	0	1	0.7	0	0	0	0
Secondary Treatment w/ Nitrification	1	5	0	0	0	0	1	5	0	0	0	0
Tertiary Treatment	2	6	2	6	0	0	0	0	0	0	0	0
Tertiary Treatment with Nitrification	7	63	6	20	0	0	1	43	0	0	0	0
Tertiary Treatment with NDN	29	409	9	46	5	70	8	239	3	18	4	36
Total	**43**	**507**	**20**	**96**	**5**	**70**	**11**	**287**	**3**	**18**	**4**	**36**

[a] Treatment levels do not reflect mandates that could result from future state or federal initiatives beyond those reflected in current permits.
[b] Calculated from current flow data and the growth rates listed in Table 3 for each discharger. Assumes no reduction associated with future conservation efforts.

Table 6. Summary of Current and Planned/Mandated UV Disinfection Facilities for Existing Major POTW Dischargers

Discharge Area		Currently Provide UV Disinfection	Planning to Provide UV Disinfection by 2030
Sacramento River Basin	Number	5	9
	Flow, mgd	29	44
San Joaquin River Basin	Number	1	5
	Flow, mgd	21	70
Delta	Number	6	7
	Flow, mgd	74	222[a]
Eastern Delta Tributaries	Number	1	3
	Flow, mgd	8	18
Northern Delta Tributaries	Number	2	2
	Flow, mgd	13	13
Total	**Number**	**15**	**26**
	Flow, mgd	**87**	**366**

[a] Value assumes that the Sacramento County Regional Sanitation District (SRCSD) will construct UV facilities to provide advanced disinfection. SRCSD has recently received a new NPDES permit that includes limitations on the discharge of disinfection byproducts. Therefore, it is expected that the existing chlorine disinfection system will need to be replaced. Nevertheless, it is uncertain at this time which treatments will ultimately be constructed.

4.0 CURRENT POTW DISCHARGE LOADS

This section presents the current average wastewater loadings for the constituents of concern that have been calculated for each major POTW discharger listed in Attachment A. These loading calculations are intended to represent average conditions and are therefore based on average flows and concentrations. The topics discussed are as follows:

- Current Water Quality Concentrations, and
- Estimated Current POTW Constituent Loads.

4.1 Current Water Quality Concentrations

Where available, actual average effluent quality data provided in Attachment A was combined with the current ADWF data to determine current mass loading. Where effluent data is not available to calculate a loading value, literature-derived concentration values were used to estimate the current loading conditions. Note that TDS data was available to calculate loadings for all POTWs.

Table 7 summarizes average effluent concentrations for the five treatment levels based on the available water quality data provided in Attachment A. (Note that TDS data is not summarized in Table 7 because these concentrations are a function of water supply and are independent of treatment level.) The data in Table 7 provides an indication of the water quality that can be expected for a given treatment level. However, these data alone do not provide a complete picture of water quality associated with a given treatment technology. For example, some of the POTWs may be providing partial nitrification, denitrification and/or added TOC reduction because the facility is currently loaded below the design capacity.

Table 7. Average Concentrations of Available Water Quality Data for Existing Major POTW Dischargers for Each Treatment Level[(a)], mg/L

Treatment Level Category	Total Organic Carbon	Total Phosphorus as P	Total Nitrogen as N	Ammonia	Nitrate as N	Nitrite as N
Secondary Treatment	18	3.8	21	14	1.6	0.47
Secondary Treatment with Nitrification	10	3.0	16	0.4	11	0.05
Tertiary Treatment	No data	No data	No data	12	No data	No data
Tertiary Treatment with Nitrification	11	3.5	21	0.4	17	0.09
Tertiary Treatment with NDN	8.9	0.8	10	0.3	6	0.2

(a) Total dissolved solids data is not included in this table these concentrations are a function of water supply and are independent of treatment level.

Table 8 provides the proposed water quality concentration values that were used for each of the treatment levels when data is not available.

Table 8. Assumed Concentrations for Existing Major POTW Dischargers When Data is Unavailable, mg/L

Treatment Level Category	Total Organic Carbon	Total Phosphorus as P	Total Nitrogen as N	Ammonia	Nitrate as N	Nitrite as N
Secondary Treatment	20[(a)]	5[(a)]	26[(a)(b)(c)]	20[(b)(c)]	3[(a)(c)]	0.1[(a)(d)]
Secondary Treatment w/ Nitrification	10[(a)]	5[(a)(b)]	18[(a)(b)]	0.5[(a)(e)]	15[(a)(e)]	0.1[(a)(d)]
Tertiary Treatment	10[(f)]	3[(b)]	26[(b)]	18[(b)(c)]	5[(a)(c)]	0.1[(a)(d)]
Tertiary Treatment with Nitrification	8[(f)]	3[(a)]	18[(a)(b)]	0.5[(a)(e)]	15[(a)(e)]	0.1[(a)(d)]
Tertiary Treatment with NDN	8[(a)(f)]	1[(a)(g)]	10[(a)(h)]	0.5[(a)(e)(h)]	7[(a)(h)]	0.1[(a)(d)]

(a) Similar to average value of available data.
(b) Tchobanoglous, G.; Burton, F.; 1991.
(c) Typical value for un-nitrified effluent. Assumes some nitrification will occur and nitrification capacity will be slightly greater in tertiary facilities.
(d) Typical value for treated wastewater
(e) Typical value for nitrified effluent. Assumes partial denitrification will occur.
(f) AWWARF, 2008.
(g) USEPA, 2007(a).
(h) Typical value for wastewater treated with NDN.

4.2 Estimated Current POTW Constituent Loads

The average effluent loadings of the seven constituents of concern were calculated for each of the major POTW dischargers in the Central Valley using the following equation:

$$Current\ Discharge\ Load\ \ pounds/day$$
$$= Current\ Average\ Discharge\ Concentration\ \ mg/L\ \ \times 2010\ ADWF\ \ mgd\ \ \times 8.34$$

Attachment C provides a summary table of the calculated current discharge loads for each of the major POTW dischargers in the Central Valley. The table in Attachment C also lists the flows and concentrations used for these calculations. Note that the minor dischargers are listed in the table provided in Attachment C; however, the loadings from these dischargers are not calculated.

Table 9 provides a summary of the total current major POTW discharger loadings within each discharge area. As indicated, the majority of constituent loads are discharged within the legal boundary of the Delta.

Table 9. Estimated Current Total Constituent Mass Loadings For Existing Major POTW Dischargers, pounds per day

Discharge Area	Total Organic Carbon	Total Phosphorus as P	Total Nitrogen as N	Ammonia	Nitrate as N	Nitrite as N	Total Dissolved Solids
Sacramento River Basin	5,600	1,300	9,200	2,900	4,100	60	180,000
San Joaquin River Basin	4,600	1,100	8,100	1,100	3,100	80	200,000
Delta	31,000	4,000	39,000	28,000	6,000	90	800,000
Eastern Delta Tributaries	500	200	800	20	600	10	23,000
Northern Delta Tributaries	2,100	600	2,400	300	1,600	30	170,000
Total	**47,800**	**7,200**	**57,500**	**29,320**	**15,400**	**270**	**1,350,000**

5.0 2030 CONTROL STRATEGY SCENARIOS

This section presents a brief overview of the following scenarios that were analyzed under this study:

Scenario 1. **2030 Planned Changes** - Currently mandated treatment (i.e., current and/or planned treatment required by adopted NPDES discharge permits).

Scenario 2. **2030 Plausible** – Mandated treatment plus enhanced biological nutrient removal, followed by chemical phosphorus removal with tertiary clarification, tertiary filtration (if not currently mandated) and ultraviolet (UV) disinfection (if not currently mandated).

Scenario 3. **2030 Outer Boundary** - Mandated treatment plus microfiltration (if not currently provided or planned), reverse osmosis (MF/RO) and UV disinfection (if not currently mandated).

5.1 Scenario 1 - 2030 Planned Changes

The DWP Workgroup identified the base control strategy scenario for the 2030 loading condition to include mandated improvements that are required under current NPDES permits. The mandated improvements result from of a series of water quality-related policies adopted by US Environmental Protection Agency (USEPA) and by the State Water Resources Control Board and the Regional Water Quality Control Boards. These include the adoption of the National Toxics Rule (NTR), the California Toxics Rule (CTR), and the Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (otherwise known as the State Implementation Plan, or SIP). These adopted policies have resulted in the application of water quality standards for a wide range of trace toxics to all NPDES discharges in the state. In addition, beginning in the late 1990s, the Central Valley Water Board began interpreting narrative water quality standards in the Water Quality Control Plan for the Sacramento River Basin and the San Joaquin River Basin (Basin Plan) as a basis for applying other numeric water quality criteria to surface water dischargers. Such applied water quality criteria include: water quality standards for *water recycling as* defined under *Title 22*, Division 4, Chapter 3 of the California Code of Regulations; USEPA National Recommended Ambient Water Quality Criteria for ammonia and other constituents; and drinking water Maximum Contaminant Level criteria defined under *Title 22*, Division 4, Chapter 15 of the California Code of Regulations.

The policy changes discussed above have resulted in NPDES permit requirements for many POTWs which, depending on the location and receiving water condition, have necessitated the construction and operation of treatment processes not previously required of POTWs including tertiary filtration, UV disinfection, nitrification and denitrification. As indicated in Table 4, a number of POTWs in the Central Valley have already constructed these types of facilities. In addition the following communities are either in the process of upgrading their POTWs or have been mandated to provide upgrades within the next 10 years:

- City of Auburn
- Linda County Water District (includes City of Marysville)

- City of Live Oak
- Placer County Sewer Maintenance District No. 1
- City of Roseville Pleasant Grove Wastewater Treatment Plant (change to UV disinfection)
- City of Atwater
- City of Merced
- City of Modesto
- City of Turlock
- Sacramento Regional County Sanitation District
- El Dorado Irrigation District El Dorado Hills Wastewater Treatment Plant (change to UV disinfection)
- City of Galt
- City of Davis
- City of Vacaville[1]

The improvements that have been or will be completed to satisfy currently applicable standards would not result directly from the adoption of a new DWP. Therefore, this study does not assign additional DWP-related costs that are assumed to be associated with the 2030 Planned Changes scenario. Nevertheless, the cost of planned facility upgrades to comply with current standards is estimated to range between $3.3 and $5.3 billion[2].

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[1] Vacaville is in the process of designing seasonal (summer-only) tertiary filtration for permit compliance. The loading analysis presented herein, however, assumes year-round filtration will be provided. In addition, the added filtration capacity necessary for year-round filtration would represent a site-specific cost not explicitly accounted for in this analysis, other than through estimating contingencies.

[2] This cost is based on actual or estimated per gallon costs for thirteen known mandated POTW treatment upgrade projects. The average cost of upgrades for twelve of the thirteen projects is $7.4 per gallon of ADWF capacity. The Sacramento Regional County Sanitation District (SRCSD) has recently received an NPDES permit that includes several new requirements, and it is uncertain at this time what facilities will be constructed to meet these requirements (and what the total cost will be for these facilities). Compliance costs have been estimated to range from $1.2 to $2.5 billion for treatment of 181 mgd ADWF, and questions remain regarding the completeness of some estimates. (Source of cost information for SRCSD upgrades: Carollo Engineers, 2009; PG Environmental, 2010; and Trussell Technologies Inc., 2010). Including all thirteen upgrade projects and using either the low or high end of the range of estimated cost for upgrades required at the SRCSD facility, the estimated cost per gallon of wastewater treated is either $6.9 or $11 per gallon (at ADWF). The total estimated flow requiring treatment upgrades is approximately 477 mgd ADWF (based on the sum of flow for all tertiary facilities in 2030, see Table 5).

5.2 Scenario 2 - 2030 Plausible

The second control strategy scenario, identified by the DWP Workgroup as a "plausible" scenario, involves providing the highest level of nutrient removal that can be achieved using currently available technologies (absent MF/RO) and advanced UV disinfection. This scenario would require POTWs to construct additional facilities to achieve the following treatment benefits:

- Enhanced biological nutrient removal,
- Chemical phosphorus removal with two stage filtration, and
- Advanced (i.e., full Title 22) UV disinfection (if not currently provided).

5.2.1 Enhanced Biological Nutrient Removal

Enhanced biological nutrient removal consists of two primary components: biological nitrogen removal and enhanced biological phosphorus removal.

Biological nitrogen removal is primarily achieved through nitrification and denitrification reactions. These reactions are facilitated by constructing separate aerobic, anoxic, and anaerobic zones within the secondary bioreactor. There are a number of bioreactor configurations that have been developed for achieving biological nutrient removal (USEPA, 2010). As shown in Tables 4 and 5, a number of POTWs currently have (or are planning to construct) facilities that can provide nitrification and/or denitrification. These configurations generally involve providing an anoxic basin upstream of an aerated basin (or as a zone within an extended aeration basin) and having mixed liquor recycle to return the nitrate-laden effluent to the anoxic zone. In the case of a conventional aeration basin with the anoxic zone and mixed liquor recycle, this treatment configuration is known as the Modified Ludzack-Ettinger (MLE) process. While the MLE process can achieve reliable nitrogen removals (as indicated in Tables 7 and 8), not all of the nitrate formed under the nitrification step can be removed using only this denitrification process.

By adding a second anoxic zone with carbon addition after the MLE process, additional denitrification can occur. This, followed by a final aeration step (to drive off any remaining nitrogen gas), will result in a treatment train that can achieve the "Limit of Technology" (LOT) for nitrogen – consistently producing effluent total nitrogen of 3 mg/L (USEPA, 2010). This treatment train is known as the Four-Stage Bardenpho process. Other LOT nitrogen removal process configurations entail the use of denitrification filters (with methanol addition) following a nitrification system, specialized step-feed processes, and some patented oxidization ditch designs.

Enhanced biological phosphorus removal (EBPR) is typically provided in addition to chemical phosphorus removal (discussed below) because EBPR cost effectively reduces most of the phosphorus in wastewater. Combined, EBPR and chemical phosphorus removal processes can achieve the LOT for phosphorus removal. EBPR is achieved by providing an anaerobic reactor upstream of the aerobic treatment bioreactors. In the case of an enhanced biological nutrient removal system, the anaerobic zone would be located upstream of the Four-Stage Bardenpho process. This is known as the Five-Stage Bardenpho process.

5.2.2 Chemical Phosphorus Removal with Two Stage Filtration

To achieve the LOT for phosphorus removal, both biological and chemical treatment is typically provided. Chemical treatment typically entails adding various chemicals to the wastewater where they react with soluble phosphates to form precipitates. These precipitates are then removed through physical processes such as settling and/or filtration. The effectiveness of phosphorus removal by chemical addition is highly dependent on the solids separation process. Chemical additional followed by two-stage filtration (either through the use of a first and second stage filter or by providing tertiary clarification prior to filtration) has been demonstrated to consistently achieve phosphorus levels of less than 0.1 mg/L (USEPA, 2010) and should be able to generally reduce phosphorus levels below 0.05 mg/L (Neethling, J. B. et al, 2008). Filtration will also reduce total organic carbon, another constituent of concern for the DWP Workgroup, and will likely provide reductions in effluent concentrations of other priority pollutants, such as metals and organic compounds that are adsorbed to solid particles in wastewater.

5.2.3 Advanced UV Disinfection

The DWP Workgroup has identified pathogens such as *Cryptosporidium* and *Giardia* as constituents of concern. To achieve an essentially pathogen-free wastewater, filtration (to produce a very low-solids effluent) followed by application of a disinfectant is necessary. The filtration step would be included with the chemical phosphorus removal facilities discussed above. Typically, the disinfectant used is chlorine or UV light; however ozone has also been shown to be effective. The specific performance standards for a filtration and advanced disinfection systems using chlorine or UV light have been defined by the California Department of Public Health in Title 22 of the California Code of Regulations (Title 22).

The DWP Workgroups has identified a concern that *Cryptosporidium* oocysts are resistant to chlorine disinfection. Also, the use of chlorine for disinfection can lead to the production of harmful chlorine disinfection byproducts. Therefore, the DWP Workgroup has included the use of UV for advanced disinfection under this control strategy scenario. For purposes of this analysis, advanced UV disinfection is assumed to be designed and operated in accordance with the disinfected tertiary recycled water standards defined under Title 22 and with the *Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse, 2nd Edition* (NWRI/AWWARF, 2003).

5.3 Scenario 3 - 2030 Outer Boundary

The third “outer boundary” control strategy scenario identified by the DWP Workgroup involves providing microfiltration/reverse osmosis (MF/RO) and advanced UV disinfection for treatment. The MF/RO treatment process has been demonstrated to effectively remove most constituents found in wastewater – including nutrients and salts. In fact, it is the only treatment technology that can effectively reduce TDS concentrations in wastewater (see Table 10 in the following section of this report). This scenario would require POTWs to construct the following additional facilities:

- MF/RO membrane filters,
- Reject water (brine) disposal, and
- Advanced UV disinfection (if not currently installed).

5.3.1 MF/RO Membrane Filters

MF and RO treatment are physical treatment processes that involve the use of membrane filters to separate constituents from the wastewater. MF filters have a pore size around 0.1 to 10 microns and can remove many particles. These filters cannot remove monovalent ions such as salts, ammonium and nitrate. However, it is necessary to provide MF filters with a pore size of 5 microns or less as a pre-treatment step ahead of RO.

RO membrane filters have a pore size around 0.0001 microns. After wastewater passes through RO filters, it is essentially pure water. In addition to removing all organic molecules and viruses, RO also removes most minerals that are present in the water including monovalent ions, which means that it desalinates and eliminates nutrients from the wastewater.

5.3.2 Reject Water (Brine) Disposal

Disposal of the residual stream from a RO treatment system is a major component of the capital and operating cost. This is particularly true in inland areas where the reject stream cannot readily be delivered to the ocean. The range of brine disposal alternatives that are currently used at RO facilities are as follows:

- Surface water discharge to a brackish or salt water outfall,
- Evaporation ponds,
- Deep well subsurface injection, and
- Zero Liquid Discharge (ZLD).

For coastal discharges, surface water discharge in a deep-water (either brackish or saltwater) outfall may be an option. However, for inland POTWs this option would not be viable. Smaller dischargers could potentially haul their brine waste stream to a POTW that has a permitted deep water outfall (like the East Bay Municipal Utility District treatment plant in Oakland). However, this option would not be viable for all Central Valley POTWs.

Evaporation ponds could also potentially be a viable option for handling of a brine waste stream at smaller POTWs; however, this option requires a significant amount of land and many Central Valley POTWs are not in an area where adequate land is available. Moreover, for solar evaporation to work, local evaporation rates would need to exceed rainfall during most years. Again, there are many portions of the Central Valley where this condition would not be satisfied.

Deep well subsurface injection has also been employed at a number of sites for brine disposal. However, very specific subsurface conditions must exist for subsurface injection to be a viable option. Moreover, the long-term regulatory requirements for such a project are uncertain.

Zero Liquid Discharge (ZLD) is a high recovery treatment option, where the final brine waste is disposed of within the plant boundary and/or at a landfill site. Although this is a very expensive option, it is the only option that is likely to be viable for all Central Valley POTWs. There are a number of approaches to achieve ZLD. In general, ZLD involves thermal concentration (and possibly crystallization) of the brine waste stream to reduce the liquid waste to a manageable volume and produces a solid waste that can be disposed of in a landfill.

5.3.3 Advanced UV Disinfection

To ensure adequate and reliable removal of *Cryptosporidium* and *Giardia* this scenario also involves the use of UV light for disinfection.

6.0 PROJECTED 2030 POTW DISCHARGE LOADS

This section presents the projected 2030 wastewater loadings for the constituents of concern that were calculated for each major POTW discharger listed in Attachment A. The projected loadings were determined for each of the three potential future control strategy scenarios identified by the DWP Workgroup. The topics discussed are as follows:

- Predicted 2030 Water Quality Concentrations, and
- Estimated 2030 POTW Constituent Loads.

6.1 Predicted 2030 Water Quality Concentrations

Similar to the current loading condition discussed previously in this report, actual effluent quality data provided in Attachment A (if available) was combined with the projected ADWF flows to determine loading conditions for the 2030 Planned Changes control strategy scenario. Where actual data is not available, or if the treatment level for a given POTW is expected to change prior to 2030, then the loadings under the 2030 Planned Changes scenario would be based on the average concentrations that were presented in Table 8 in combination with the projected ADWF. TDS data was available for each POTW and was used to calculate the loadings. However, t many of the individual POTWs are planning to implement source control for salinity management, such as incorporating alternative water supplies. This type of improvement is not reflected in the analysis, but could result in significant reductions in salinity loads from POTWs.

For the 2030 Plausible and 2030 Outer Boundary scenarios, published literature was reviewed to develop typical values for average effluent concentrations of TOC, TDS, nitrogen species, and total phosphorus. Table 10 provides the water quality concentration values that were used for these calculations. For the 2030 Plausible scenario, existing TDS water quality data were used to calculate loadings and may not reflect salinity added from the new chemical processes required under this scenario. Also, concentrations of nitrogen compounds in the wastewater under the 2030 Outer Boundary scenario will be slightly different depending on whether nutrient removal is provided by the existing/mandated treatment train.

Table 10. Estimated Average POTW Discharge Concentrations for Potential Future Wastewater Control Strategy Scenarios, mg/L

Wastewater Control Strategy Scenario	Total Organic Carbon	Total Phosphorus as P	Total Nitrogen as N	Ammonia	Nitrate as N	Nitrite as N	Total Dissolved Solids
2030 Plausible	5[a]	0.05[b]	3[c]	0.3[c]	1.5[c]	0.1[d]	Varies[e]
2030 Outer Boundary with Nitrification or NDN Pretreatment	0.3[a][f]	0.003[f][g]	1.8[f][g]	0.1[f][h]	1.5 [f]	0.1[d]	40[f][h]
2030 Outer Boundary with No Nitrogen Removal	0.3[a][f]	0.003[f][g]	1.8[f][g]	1.5[f][i]	0.1[f][i]	0.1[d]	40[f][h]

(a) AWWARF, 2008.
(b) USEPA, 2007(a).
(c) Jeyanayagam. S., 2005.
(d) Typical value for treated wastewater.
(e) The chemical addition processes associated with this scenario would result in TDS concentrations that are greater than current levels. However, such increases are not accounted for in this analysis.
(f) WERF, 2005.
(g) Hazen and Sawyer Environmental Engineers and Scientists, 2008.
(h) Orange County Water District, 2008.

6.2 Projected 2030 POTW Constituent Loads

The projected 2030 POTW discharger loadings for the three control strategy scenarios were calculated by determining the current loadings and applying the growth rates provided in Table 2. This calculation procedure is demonstrated by the following formula:

$$Projected\ 2030\ Discharge\ Load\ (pounds/day) =$$

$$Predicted\ 2030\ Average\ Discharge\ Concentration\ mg/L\ \times 2010\ ADWF\ mgd\ \times 8.34 \times\ 1 + Growth\ Rate\ ^{2030-2010}$$

Attachment D includes tables showing the projected average 2030 wastewater loadings of the constituents of concern for each of the major POTW dischargers in the Central Valley. The information provided in Attachment D is summarized in the following tables and figures:

- Table 11 provides a summary of the total major POTW discharger 2030 loadings within each discharge area for the 2030 Planned Changes scenario (summarized from Attachment D-1).

- Table 12 provides a summary of the total major POTW discharger 2030 loadings within each discharge area for the 2030 Plausible scenario (summarized from Attachment D-2).
- Table 13 provides a summary of the total major POTW discharger 2030 loadings within each discharge area for the 2030 Outer Boundary scenario (summarized from Attachment D-3).
- Figure 2, which is included at the end of this report, provides a graphical comparison of the current loadings to the loadings that would occur under the three future scenarios. Nitrite is not included in Figure 2 because the loadings are not expected to significantly change under any of the scenarios.

Table 11. 2030 Planned Changes Scenario Projected Average Daily Discharge Loads for Existing Major POTW Dischargers, pounds per day

Discharge Location	Total Organic Carbon	Total Phosphorus as P	Total Nitrogen as N	Ammonia	Nitrate as N	Nitrite as N	Total Dissolved Solids[a]
Sacramento River Basin	9,100	1,800	12,700	4,800	5,300	80	269,000
San Joaquin River Basin	4,700	600	5,900	300	4,100	60	314,000
Delta	19,900	3,200	27,900	1,300	20,800	200	1,155,000
Eastern Delta Tributaries	1,200	200	1,500	50	1,000	10	53,000
Northern Delta Tributaries	2,400	300	3,100	200	2,200	30	255,000
Total	**37,300**	**6,100**	**51,100**	**6,650**	**33,400**	**380**	**2,050,000**

[a] TDS loads do not reflect potential reductions that would be associated with future source control efforts or potential negative impacts associated with chemical addition.

Table 12. 2030 Plausible Scenario Projected Average Daily Discharge Loads for Existing Major POTW Dischargers, pounds per day

Discharge Location	Total Organic Carbon	Total Phosphorus as P	Total Nitrogen as N	Ammonia	Nitrate as N	Nitrite as N	Total Dissolved Solids[a]
Sacramento River Basin	4,100	40	2,400	200	1,200	80	269,000
San Joaquin River Basin	3,000	30	1,800	200	900	60	314,000
Delta	11,900	120	7,200	700	3,500	200	1,155,000
Eastern Delta Tributaries	700	10	400	40	200	10	53,000
Northern Delta Tributaries	1,500	20	900	100	500	30	255,000
Total	**21,200**	**220**	**12,700**	**1,240**	**6,300**	**380**	**2,050,000**

[a] TDS loads do not reflect potential reductions that would be associated with future source control efforts or potential negative impacts associated with chemical addition.

Table 13. 2030 Outer Boundary Scenario Projected Average Daily Discharge Loads for Existing Major POTW Dischargers, pounds per day

Discharge Location	Total Organic Carbon	Total Phosphorus as P	Total Nitrogen as N	Ammonia	Nitrate as N	Nitrite as N	Total Dissolved Solids
Sacramento River Basin	200	3	1,500	400	800	80	31,900
San Joaquin River Basin	200	2	1,100	100	900	60	23,700
Delta	700	7	4,300	200	3,500	200	94,000
Eastern Delta Tributaries	40	1	300	10	200	10	6,000
Northern Delta Tributaries	90	1	500	30	500	30	12,300
Total	**1,230**	**14**	**7,700**	**740**	**5,900**	**380**	**170,000**

7.0 ESTIMATED COST OF TREATMENT

This section presents the estimated total costs that would be incurred if the treatment improvements associated with the 2030 Plausible and 2030 Outer Boundary scenarios were constructed at each major POTW in the Central Valley. Given the scope of this analysis, it was necessary to apply a generalized basis of cost that is not specific to any particular treatment plant location. Obviously, the cost for any given POTW may vary significantly up or down from the costs estimated using this methodology. Nevertheless, the estimate is a valid prediction of the aggregate cost for upgrading all POTWs. The approach and estimating results are described in more detail in the following sections:

- Accuracy of the Estimates,
- General Assumptions Regarding Added Treatment Processes,
- General Approach for Estimating Construction Costs,
- Construction Cost Contingencies,
- Capital Cost Allowances,
- O&M Costs, and
- Summary of Estimated Costs.

7.1 Accuracy of the Estimates

The cost estimates presented in this technical memorandum are representative of Class 5 estimates as defined by the Association for the Advancement of Cost Engineering International (AACE, 2005):

> *"Class 5 estimates are generally prepared based on very limited information, and subsequently have wide accuracy ranges….Often, little more than proposed plant type, location, and capacity are known at the time of estimate preparation…The level of project definition required for a Class 5 estimate is 0% to 2% of full project definition…Class 5 estimates are prepared for any number of strategic business planning purposes, such as but not limited to market studies, assessment of initial viability, evaluation of alternate schemes, project screening, project location studies, evaluation of resource needs and budgeting, long-range capital planning, etc…Typical accuracy ranges for Class 5 estimates are -20 percent to -50 percent on the low side, and +30 percent to +100 percent on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances."*

Class 5 estimates rely on stochastic estimating methods including cost/capacity curves and factors, and scaling factors. Scaling factors have been applied to selected estimates or historical construction costs for actual example projects, and to summary studies and published literature characterizing the cost of constructing and operating the identified treatment processes.

7.2 General Assumptions Regarding Added Treatment Processes

Many POTWs already incorporate, or have been mandated to incorporate, one or more elements of the 2030 Plausible and 2030 Outer Boundary future treatment scenarios. It was therefore necessary to identify which components must be added at each POTW, and develop a method for predicting the cost of each treatment element to be added. Each future plant upgrade will be unique. However, it is assumed that future costs are reasonably represented by the cost of a single treatment train option, scaled based on capacity for the particular POTW. In actuality, different combinations of processes could be considered and implemented for any given POTW. This section presents an overview of the approach used to define for each POTW the needs related to the following treatment components:

- Equalization Storage,
- Enhanced Nutrient Removal,
- Filtration and Advanced UV Disinfection, and
- MF/RO.

7.2.1 Equalization Storage

Filtration (including MF and RO) and UV disinfection facilities must be sized to treat the peak wet weather flow. However, flow peaking characteristics and availability of existing flow equalization will vary widely from facility to facility, having a dramatic effect on process sizing and cost of these facilities.

For each facility, there is generally an optimum balance between the cost of constructing and operating equalization storage and the cost associated with constructing larger downstream processes. However, without detailed flow information it is not possible to determine this balance. Therefore, for purposes of this analysis, it has been assumed that if peak flow is more than twice the ADWF, equalization storage would be less costly than sizing larger downstream facilities; however, if peak flow is less than two times ADWF, it will be most cost effective to size all downstream facilities for the peak flow.

Moreover, it has been assumed each POTW that has constructed, or is planning to construct, filtration will fall into one of the following two categories:

- Current ratio of peak flow to ADWF is 2 (or less), and equalization storage will not be needed (example: City of Lodi Water Pollution Control Facility).
- Current ratio of peak flow to ADWF is greater than 2, but equalization storage was constructed along with the filtration facilities reducing the peaking factor to 2 (example: City of Galt Wastewater Treatment Plant).

For both of the above examples, a cost has not been included for equalization storage and downstream filtration and UV disinfection facilities have been sized based on a peaking factor of 2. For the POTWs that have not constructed (or are not planning to construct) filtration facilities, it is assumed that the current peaking factor is greater than 2 and there will also be a cost associated with equalization under both the treatment scenarios evaluated so that downstream filtration and UV disinfection facilities can be sized based on a peaking factor of 2.

7.2.2 Enhanced Nutrient Removal

For all POTWs with existing or planned conventional activated sludge treatment (including plants that employ the Modified Ludzack-Ettinger process or membrane bioreactors), it was assumed that the cost of adding the additional bioreactor components to employ the 5-Stage Bardenpho process would reasonably represent the cost associated with enhanced biological nutrient removal. For an existing oxidation-ditch plant, it was assumed that an upstream anaerobic basin would be provided to allow for biological phosphorus removal. An additional basin and aeration would be provided if the facility is not specifically designed for NDN, and the oxidation ditch/secondary clarification process would be followed by a denitrifying filter with supplemental carbon and a final re-aeration process to strip off any remaining nitrogen gas and ensure final dissolved oxygen limitations can be achieved. For all treatment trains, it was assumed the biological process was followed by additional chemical phosphorus removal process that consists of chemical additional and tertiary clarification.

Separate costs were estimated for each component applicable to each POTW. The applicable POTW components were based on what would need to be added to current/mandated treatment processes to complete the assumed treatment train. For example, all POTWs would require a post-aeration step for final nitrogen stripping/oxygen addition, a final chemical polishing step for the last increment of phosphorous removal, and an upstream anaerobic basin for enhanced biological phosphorous removal. In addition, virtually every facility would require a downstream anoxic zone (or denitrifying filter) with supplemental carbon for achieving the final increment of denitrification. Conversely, relatively few POTWs would require an initial anoxic zone or additional aerated volume once improvements mandated by current permit requirements are implemented.

Finally, the two largest POTWs (City of Stockton and Sacramento Regional County Sanitation District) evaluated under this study employ (or have proposed to employ) fairly unique biological treatment processes. Therefore, the following specific assumptions were made regarding the required upgrades to the biological treatment systems at these two POTWs:

- City of Stockton: This POTW currently relies on a combination of ponds and trickling filters to provide biological treatment and ammonia removal. For the 2030 Plausible scenario, it has been assumed that this facility will not be able to incorporate biological phosphorus removal into the treatment process and it will be necessary to rely solely on chemical phosphorus removal (increasing O&M costs as well as effluent TDS levels). For additional nitrogen removal, a denitrifying filter with carbon addition will be provided.
- Sacramento Regional County Sanitation District: This POTW is assumed to undergo a $2.5 billion upgrade by 2020. The upgraded treatment plant will include the following biological treatment processes: high purity oxygen activated sludge, nitrifying trickling filters, and fluidized bed reactors for denitrification (Carollo Engineers, 2009). (Note the $2.5 billion upgrade would also include MF and advanced UV disinfection.) These facilities will provide most of the nitrogen removal capabilities under the 2030 Plausible scenario. Therefore, it has been assumed for the 2030 Plausible scenario for this facility that the only additional nutrient removal

processes needed are an upstream anaerobic selector for biological phosphorus removal, a final aeration step to provide stripping of nitrogen gas and reaeration, and chemical phosphorus removal facilities. The process train that will ultimately be constructed at the Sacramento Regional County Sanitation District to meet permit requirements is still under planning and review. If an alternative treatment train is identified that does not include the facilities listed above, the total cost associated with the 2030 Plausible scenario presented in this report would be significantly greater.

7.2.3 Filtration and Advanced UV Disinfection

Most of the major POTWs investigated under this study have constructed, or are planning to construct, filtration and advanced disinfection facilities, and it is assumed for this analysis that these facilities are designed and operated accordance with Title 22 regulations. In determining the costs to construct filtration and advanced UV disinfection at individual POTWs the following assumptions were made:

- For the 2030 Plausible scenario, filtration and advanced UV disinfection processes would be added to the treatment train of all POTWs that provide (or are planning to provide) secondary level treatment (i.e. indicated as Future Treatment Level "a" or "b" in Attachment A).
- For the 2030 Outer Boundary scenario, UV disinfection processes would be added to the treatment train of all POTWs that provide (or are planning to provide) secondary level treatment (i.e. indicated as Future Treatment Level "a" or "b" in Attachment A).
- For those POTWs that currently provide (or are planning to provide) filtration, but rely on chlorine for advanced disinfection, it was assumed that the chlorine disinfection facilities would be replaced by an advanced UV disinfection process under both scenarios.

Under all the above cases, the new facilities would be designed in accordance with Title 22 standards, including the requirement to have one redundant unit process.

The process train to be installed at the Sacramento Regional County Sanitation District to meet permit requirements is still under planning and review. If it is determined that UV disinfection will not be needed to meet permit requirements, the total costs associated with both the 2030 Plausible and the 2030 Outer Boundary scenarios presented in this report would be significantly greater.

7.2.4 MF/RO

With the exception of the five major POTWs with existing or planned MF facilities (i.e. City of Clovis, City of Modesto, Ironhouse Community Services District, Rio Vista Northwest Wastewater Treatment Plant, and Sacramento Regional County Sanitation District), it was assumed that all POTWs would need to construct both microfiltration and reverse osmosis treatment facilities under the 2030 Outer Boundary scenario. It was also assumed that all POTWs would employ a ZLD brine treatment option that includes thermal concentration of the waste stream followed by thermal crystallization. The treatment would result in a solid waste that would be disposed of in a landfill.

It is estimated that approximately 223 mgd out of 425 mgd of wastewater discharged in 2030 will have received MF treatment under the 2030 Planned Changes scenario, with the majority of this flow attributed to the Sacramento Regional County Sanitation District. Therefore, the cost to provide MF for this flow is not included in the 2030 Outer Boundary scenario. If the Sacramento Regional County Sanitation District determines that MF will not be needed to meet permit requirements, the total cost associated with the 2030 Outer Boundary scenario presented in this report would be significantly greater.

7.3 General Approach for Estimating Construction Costs

For each treatment process component identified in the previous section, Table 14 provides a general description of the selected project that serves as the basis for the cost estimates, the Engineering New Record Construction Cost Index (ENR CCI) applicable to the project, the capacity for each component (either ADWF or peak flow), and the economy of scale power factor applicable to each process component.

The cost factors listed in Table 14 are further described in the following paragraphs, and were used to determine the base construction costs using the following equation:

$$Base\ Construction\ Cost =$$

$$Example\ Project\ Cost \times \frac{ENR\ CCI_{20\ Cities\ Avg.}}{ENR\ CCI_{Ex.Project}} \times \left(\frac{Treated\ Flow_{POTW}}{Treated\ Flow_{Ex.Project}}\right)^{\substack{Economy\ of\ Scale \\ Power\ Factor}}$$

where:

$ENR\ CCI_{20\ Cities\ Avg}$	= *20 City Average Engineering New Record Construction Cost Index*
$ENR\ CCI_{Ex.Project}$	= *Engineering New Record Construction Cost Index for the Example Project*
$Treated\ Flow_{POTW}$	= *Average or Peak Flow that is projected to require treatment at a given POTW*
$Treated\ Flow_{Ex.\ Project}$	= *Average or Peak Flow that is treated for the Example Project*

Table 14. Basis of Cost Estimates for Added Treatment Components

Process Component	Basis of Scaling			Example Project(s) Notes and References
	Capacity	Power Factor	ENR CCI	
Mixed Basin	ADWF	0.80	7080	Cost basis is bid breakdown for new activated sludge basins from similar projects, including distributed electrical and plant piping costs. Allows for related mechanical equipment including gates and mixers. O&M costs relatively minor, primarily mixing energy cost and equipment maintenance.
Aeration Blower Capacity (Nitrification)	ADWF	0.31	7080	Assume nitrification air demand is 20% of CBOD demand, but scale blower costs based on full aeration demand, i.e., assume that the additional nitrification aeration will be an expansion of an existing aeration system. Basis of cost is recent estimate for expanded blower capacity in a similar project, plus an allowance for blower building expansion.
Aeration Blower Capacity (Final Nitrogen Gas Removal)	ADWF	0.31	7080	Assume post aeration air demand is 5% of CBOD demand, but scale blower costs based on full aeration demand, i.e., assume that the additional nitrification aeration will be an expansion of an existing aeration system. Basis of cost is recent estimate for expanded blower capacity in a similar project, plus an allowance for blower building expansion.
Mixed Liquor Recycle (wall pumps)	ADWF	0.60	9362	Cost basis is recent estimate for retrofitting mixed liquor recycle pumping in an activated sludge plant that includes wall pumping between existing activated sludge basins. Other configurations would likely be more costly.
Denitrifying Filters with Methanol Addition	ADWF	0.89	7446	USEPA WW Management Fact Sheet, Denitrifying Filters (USEPA, 2007(b)) and Municipal Nutrient Removal Technologies (USEPA, 2008)
Methanol Addition	ADWF	0.67	8089	Enhancing Nitrogen Removal with Methanol Addition (Brown, J. A., 2007). Scaling factor based on typical chemical feed system (Benjes, 1980).
Filtration (Title 22 or Equivalent)	Peak Flow	0.89	9362	Based on recent engineer's estimates and bid results for tertiary filtration projects.
Microfiltration	Peak Flow	0.90	9138	Cost basis is recent estimate for Sacramento Regional County Sanitation District facility. Combined cost of MF + RO compares well with multiple sources, including previous estimates completed by West Yost, and data published by WERF (WERF, 2005)
Reverse Osmosis	Peak Flow	0.90	9138	Cost basis is recent estimate for Sacramento Regional County Sanitation District facility. Combined cost of MF + RO compares well with multiple sources, including previous estimates completed by West Yost, and data published by WERF (WERF, 2005). RO cost includes zero liquid discharge treatment and landfill disposal of brine waste stream, which is a substantial portion of the total cost.
Ultraviolet Disinfection	Peak Flow	0.88	7700	Cost basis is multiple projects, and is verified by recent bid results for a recent installation.
Advanced Phosphorus Removal by Chemical Addition & Settling	ADWF	0.85	8596	Cost is a composite of recent estimates for circular clarifiers, plus an allowance for an alum feed system and an additional carbon supplement system for the secondary process. Compares well with reference (Jaing, et al 2005).
Equalization Allowance (equalize to 2.0 peaking factor)	ADWF	0.60	8836	Cost not directly related to plant capacity. Allowance represents one example project.

7.3.1 Example Project Cost

The cost estimates are based on readily available cost data for one or more example projects, and in some cases are based on actual recent bids or detailed estimates. A wide variety of additional sources were also consulted including research reports (WERF, 2005; EPA, 2008; Jiang et. al. 2005; Grey, G.M., 2007, and Chesapeake Bay Program, 2002), detailed engineer's estimates from similar projects and bid tabulations. The number and quality of sources varied between the various processes. In accordance with the scope of this analysis, some of the estimates are based on a single source of cost information. However, in most cases at least a cursory comparison with other sources of information has been completed to validate the initial source(s). The base construction cost for a given process also includes a proportional share of the "distributed costs" associated with typical construction projects such as electrical, instrumentation, yard piping and general site work.

7.3.2 ENR CCI

Each source of cost information for a given project is based on a date and location of the project and must be adjusted to reflect current local conditions. The ENR CCI measures how much it costs to purchase a hypothetical package of goods and services at a specific time compared to the base year. The 20-city average index is published monthly by Engineering News Record and the index can be used to adjust the cost of construction from one location and point in time to a different location and time. For this analysis, the example project cost was multiplied by the ratio of ENR CCI of 8952 (the 20-Cities Average ENR CCI for December 2010) to the ENR CCI for the example project (shown in Table 14). The 20-Cities Average ENR CCI is appropriate for areas within the Central Valley.

7.3.3 Treated Flow

As shown in Table 14, each source of cost information was also associated with a particular amount of treated flow (either ADWF or peak flow, depending on the process). Therefore, the base costs were adjusted to reflect the flow that would require treatment would rate of each of the major POTWs using the following assumptions:

- The wastewater flow that would require treatment at each facility was assumed to reflect a 2 percent reduction in ADWF as a result of conservation.
- The sizing and cost of filtration (including MF and RO) and UV disinfection for all POTWs is based on peak flow capacity, which is assumed to be twice the ADWF.
- The filtration and UV disinfection facilities were assumed to have one redundant treatment unit in accordance with Title 22 regulations.
- The sizing and cost of tertiary clarification for phosphorus removal is based on ADWF; however, a conservative overflow rate was assumed for these facilities to ensure adequate treatment at peak flows.

- The size of new bioreactors that were added as part of the biological nutrient removal process were determined from the ADWF and detention time required for a given bioreactor treatment processes. Basin volumes were estimated using the factors presented in Table 15.

Table 15. Basin Volume Factors for Biological Nutrient Removal

Basin Type	Basin Volume Per MGD of ADWF, gallons	Detention Time, hours[a]
Upstream Anaerobic (Phosphorous Removal)	80,000	1 to 2
Upstream Anoxic (Denitrification); includes 3:1 mixed liquor recycle pumping	120,000	2 to 5
Aeration Basin (Nitrification); include additional aeration	120,000	2 to 5
Second Anoxic Zone (Additional Denitrification); include methanol addition for carbon supplement	160,000	2 to 5
Post Aeration (Nitrogen Stripping); include aeration	30,000	0.5 to 1

[a] Wang, L.K., et. al., 2008.

7.3.4 Economy of Scale Power Factor

The scaling of the example project cost to account for the treatment capacity at a given facility also factored in savings that would result from economies of scale. Specifically, the scaling was assumed to follow an exponential relationship, such that cost varied by the ratio of process capacity that is raised to a power factor. As was shown in Table 14, the power factor varied between the various components, with higher factors applicable to processes that are more closely proportional in cost to capacity, and lower factors applied where the cost is less sensitive to capacity. This methodology provides a valid basis for scaling a given cost reference up or down without detailed site specific information (Benjes, 1980).

7.4 Construction Cost Contingencies

Contingencies are included in the estimates to account for portions of the necessary work that has not been adequately defined due to the level of planning and lack of detailed knowledge of site-specific constraints and requirements. Contingencies can also account for variability in construction economics (bidding climate), and other unpredictable or unexpected project costs. For this analysis, a total contingency of 40 percent is applied to the base construction cost, which includes an estimating contingency (reflecting the level of project definition) and bidding climate variability. Therefore, the total construction cost is determined from the following formula:

$$Total\ Construction\ Cost = 1.4\ \times Base\ Construction\ Cost$$

The total construction cost is an estimate of the probable bid amount for the project. Typically an additional construction contingency of 5% to 10% is reserved at the time of bidding in the construction budget to allow for unforeseen circumstances that might arise during construction.

The construction contingency (not part of the anticipated bid amount) is included below as a project allowance (as part of the project contingencies).

7.5 Capital Cost Allowances

The cost of completing a treatment plant upgrade includes the cost of construction, as well as engineering, project administration, financing costs, legal costs, environmental review and permitting, inspection, and land acquisition. As noted, it is also common practice to budget for changes during construction. Excluding land acquisition, these costs (Capital Cost Allowances) typically range between 35 percent and 70 percent of the price paid to the construction contractor. For the purposes of this analysis, Capital Cost Allowances were assumed to equal 65 percent of construction costs. No allowance is included for land acquisition. Therefore, the total project cost is determined from the following formula:

$$Total\ Project\ Capital\ Cost = 1.65\ \times Total\ Construction\ Cost$$

7.6 O&M Costs

Incremental O&M costs for individual components were developed from a number of cost estimates for specific projects and comparisons with other sources of information (WERF, 2005; EPA, 2008; Jiang et. al. 2005; Grey, G.M., 2007; and Chesapeake Bay Program, 2002) were made to validate the initial source(s). The O&M costs associated with nutrient removal processes were estimated by distributing a single estimated O&M cost among the individual components. In this way, the added cost at each plant could be estimated without double-counting the cost of operating previously installed processes. O&M costs for denitrifying filters, tertiary filtration, chemical phosphorous removal, MF, RO, and UV disinfection were estimated independently from the biological nutrient removal processes. It is acknowledged that operating costs will vary significantly with chemical pricing, required chemical doses, and energy costs. The estimates are intended to represent California labor rates and electrical energy at $0.08 to $0.10 per kilowatt-hour (kWh).

7.7 Summary of Estimated Costs

Table 16 summarizes the total project capital costs and incremental annual O&M costs for the additional treatment facilities that would be required for major POTWs under the 2030 Plausible scenario within the five discharge areas. Table 17 summarizes the total project costs and annual O&M costs for the additional treatment facilities that would be required for major POTWs under the 2030 Outer Boundary scenario within the five discharge areas.

Table 16. 2030 Plausible Scenario - Added Capital and O&M Costs for Major POTW Dischargers After Previously Mandated Upgrades[(a)(b)]

Discharge Area	Estimated Construction Costs, $ million				Estimated Capital Costs, $ million		Annual O&M Costs, $ million
	Nutrient Removal	Title 22 Filtration	UV Disinfection	Total Construction Cost	Capital Cost Allowances	Total Project Capital Costs	
Sacramento River Basin	280	51	52	380	250	630	30
San Joaquin River Basin	140	-	-	140	90	230	10
Delta	330	14	54	400	260	660	40
Eastern Delta Tributaries	46	-	-	46	30	76	4.5
Northern Delta Tributaries	87	-	22	110	72	180	10
Total	**880**	**65**	**130**	**1,080**	**700**	**1,800**	**95**

(a) All costs in December 2010 dollars (ENR CCI 8952)

(b) Costs do not include, and are in addition to, the cost of constructing and operating facilities required for compliance with current permits (i.e. the improvements under the 2030 Planned Changes Scenario).

Table 17. 2030 Outer Boundary Scenario - Added Capital and O&M Costs for Major POTW Dischargers After Previously Mandated Upgrades[(a)(b)]

Discharge Area	Estimated Construction Costs, $ million				Estimated Capital Costs, $ million		Annual O&M Costs, $ million
	MF	RO	UV Disinfection	Total Construction Costs	Capital Cost Allowances	Total Project Capital Costs	
Sacramento River Basin	700	820	52	1,600	1,000	2,600	90
San Joaquin River Basin	250	550	-	800	520	1,300	60
Delta	600	1,900	54	2,600	1,700	4,300	200
Eastern Delta Tributaries	130	150	-	280	180	460	20
Northern Delta Tributaries	260	300	22	580	380	960	30
Total	**1,900**	**3,700**	**130**	**5,900**	**3,800**	**9,600**	**400**

(a) All costs in December 2010 dollars (ENR CCI 8952).

(b) Costs do not include, and are in addition to, the cost of constructing and operating facilities required for compliance with current permits (i.e., the improvements under the 2030 Planned Changes Scenario).

Tables 18 and 19 provide the estimated capital costs for the five different treatment levels under the 2030 Planned Changes scenario on a per gallon of wastewater treated basis. As shown, there is range of costs associated with treatment depending on the level of treatment provided under the 2030 Planned Changes scenario. This is because a number of POTWs are expected to have constructed many of the upgrades needed to satisfy the conditions under the two 2030 treatment scenarios. This is particularly true for the Sacramento Country Regional Wastewater Treatment Plant. It has been assumed for this analysis that the Sacramento Regional County Sanitation District plant will undergo a $2.5 billion upgrade that includes the addition of advanced nitrogen removal, UV disinfection and MF. If an alternative project without an equivalent level of treatment is constructed at this facility, the costs presented herein would increase significantly.

Table 18. 2030 Plausible Scenario Added Capital and O&M Costs for Major POTW Dischargers After Previously Mandated Upgrades[a][b]

Current or Previously Mandated Level of Treatment at Plant to be Upgraded	Predicted 2030 Treated Flow[c], mgd	Total Project Capital Costs[d], $ million	Estimated Capital Cost per Gallon ADWF[e], $/gallon	Annual O&M Costs[d], $ million	O&M Cost per Gallon Treated [f], $/mg treated
Secondary Treatment	25	260	10.4	10	1,096
Secondary Treatment w/ Nitrification	4.4	42	9.5	1.9	1,183
Tertiary Treatment	5.6	47	8.4	2.6	1,272
Tertiary Treatment with Nitrification	61	320	5.2	20	894
Tertiary Treatment with NDN	398	1,100	2.8	60	413
Total	**495**	**1,800**	**3.6**	**95**	**526**

(a) All costs in December 2010 dollars (ENR CCI 8952)
(b) Costs do not include, and are in addition to, the cost of constructing and operating facilities required for compliance with current permits (i.e. the improvements under the 2030 Planned Changes Scenario).
(c) From Table 5. Assumes a 2 percent reduction in flow that requires treatment due to future water conservation efforts.
(d) From Table 16.
(e) Facilities sized to treat the ADWF and an assumed peak flow of 2 x ADWF.
(f) O&M unit costs based on treatment of ADWF.

Table 19. 2030 Outer Boundary Scenario Added Capital and O&M Costs for Major POTW Dischargers After Previously Mandated Upgrades[a][b]

Current or Previously Mandated Level of Treatment at Plant to be Upgraded	Predicted 2030 Treated Flow[c], mgd	Total Project Capital Costs[d], $ million	Estimated Capital Cost per Gallon ADWF[e], $/gallon	Annual O&M Costs[d], $ million	O&M Cost per Gallon Treated [f], $/mg treated
Secondary Treatment	25	710	28.4	25	2,740
Secondary Treatment w/ Nitrification	4	130	29.5	4.0	2,491
Tertiary Treatment	6	170	30.4	5.5	2,691
Tertiary Treatment with Nitrification	61	1,500	24.5	60	2,682
Tertiary Treatment with NDN	398	7,000	17.6	320	2,202
Total	**495**	**9,500**	**19.2**	**400**	**2,216**

(a) All costs in December 2010 dollars (ENR CCI 8952)
(b) Costs do not include, and are in addition to, the cost of constructing and operating facilities required for compliance with current permits (i.e. the improvements under the 2030 Planned Changes Scenario).
(c) From Table 5. Assumes a 2 percent reduction in flow that requires treatment due to future water conservation efforts.
(d) From Table 17.
(e) Facilities sized to treat the ADWF and an assumed peak flow of 2 x ADWF.
(f) O&M unit costs based on treatment of ADWF.

8.0 OTHER PROJECT FACTORS

This section addresses project factors that were not quantified, but should be considered as part of this evaluation. These factors include related facility costs that were possibly not included in the estimates and potential environmental impacts.

8.1 Related Facility Costs Possibly Not Included in Estimates

The cost estimates presented in this report focus on the cost of constructing the identified treatment processes. However, such improvements may trigger the need for additional modifications that have not been identified for individual POTWs. The estimating contingencies may account for some of these additional related costs. These potential additional costs include but are not limited to:

- Expansion of Power Distribution Systems,
- Additional Flow Equalization Storage and/or Associated Odor Control,
- Cost Estimating Issues Specific to MF/RO Processes,
- pH Adjustment and Re- Mineralization, and
- Laboratory, Maintenance and Administrative Facilities.

8.1.1 Expansion of Power Distribution Systems

The distributed costs that were assumed to be associated with a given facility included an allowance for some electrical system improvements. However, the installation of high energy-use facilities like UV, MF, and RO would significantly increase energy demand for a given POTW. In many cases, it is likely that the capacity of power distribution systems and the back-up power generating capacity at POTWs would need to be increased. In some cases, the capacity of the connection from the power grid to the POTW may also need to be increased. The estimating contingencies may not fully account for these types of added costs.

8.1.2 Additional Flow Equalization Storage and/or Associated Odor Control

The need for, configuration, and sizing of additional flow equalization will be highly dependent on influent flow patterns, available land, and proximity to sensitive odor receptors. Equalization basins typically require solids management provisions to reduce odor production and maintain reasonable O&M costs. In some locations, lined, covered basins with foul air treatment may be required to manage odors and limit the footprint of the storage volume. In other cases, open shallow storage may be suitable, with or without active odor treatment. Therefore, costs associated with equalization storage will be highly variable and not directly related to ADWF capacity of a given treatment plant.

Given the variables involved, it is not possible to explicitly predict the cost of storage or the optimum peak rating of the individual POTWs. The previously presented peak-to-average capacity ratings of various processes reflect some peak attenuation associated with equalization storage. Similarly, the capital and operating costs include allowances for equalization storage. However, while the resultant aggregate cost is intended to be representative of a reasonable balance between treatment capacity and storage, constraints associated with a particular location could significantly affect the actual cost for any given installation. The estimating contingencies may not account for all of this potential variability.

8.1.3 Cost Estimating Issues Specific to MF/RO Processes

Membrane treatment and brine treatment and disposal technologies are relatively new and there is little consistency in design parameters between existing installations. Consequently, it is difficult to predict costs for these processes. The Water Environment Research Foundation reports that, "…unit prices…are difficult to compare for the following reasons: maturation of membrane technology and increased competition have driven membrane equipment cost downward; regional differences exist in construction costs; and detailed information is not available on the scope of each bid." (WERF, 2005). The estimating contingencies may or may not fully address the potential variability in actual costs.

8.1.4 Chemical Addition

Many of the processes evaluated in this study would involve some chemical addition to ensure reliable treatment. For reliable nutrient removal under the 2030 Plausible Scenario, methanol addition (or equivalent), alum addition and polymer addition would likely be needed at all POTWs and the cost of these chemical addition facilities were included in the estimates. However, some POTWs may also require the addition of alkalinity and/or volatile fatty acids

(VFAs) to ensure reliable treatment. For these cases, the assumed costs (and estimating contingencies) may or may not fully address these chemical addition needs

In the case of RO, pH adjustment, chlorination, the addition of scale inhibiting chemicals and re-mineralization for the treated water were also included in the estimates. (In addition the TDS concentrations used for the loading estimates assume some post-treatment re-mineralization.) However, depending on the wastewater source and discharge location, the assumed costs (and estimating contingencies) may or may not fully address the need to adjust the characteristics of RO influent and effluent at a given facility.

8.1.5 Laboratory, Maintenance and Administrative Facilities

It will be cost effective to expand laboratory facilities at some POTWs such that additional monitoring analyses can be performed on-site rather than at an outside laboratory. No attempt was made to incorporate the cost of such laboratory expansions, or any increases in maintenance facilities or administrative office space that could be related to implementation of the advanced treatment scenarios.

8.2 Potential Environmental Impacts

This section address the increased energy demand and potential for cross-media impacts associated with the advanced wastewater treatment processes evaluated under this study.

8.2.1 Increased Energy Demand

There is a significant amount of energy used for wastewater treatment, including the energy required to construct facilities, operate facilities and produce and deliver materials and supplies for operations. The addition of the nutrient removal, filtration and disinfection processes that would be provided under the potential future treatment scenarios would significantly increase the overall energy demand from wastewater dischargers in the Sacramento-San Joaquin watershed (as well as increase the associated greenhouse gas emissions from the power plants providing the electricity).

For example, the enhanced nutrient removal technologies require an input of energy beyond that needed for conventional municipal treatment for processes such as:

- Chemical addition facilities operations,
- Additional pumping for recycle flows,
- Additional pumping for filtration, and
- Energy needed to generate the chemicals associated with chemical additional and external carbon sources (USEPA, 2010).

The addition of an RO treatment process at all the major POTWs in the Sacramento-San Joaquin watershed area would result in an unprecedented increase to the amount of energy needed for wastewater treatment. The energy demands associated with RO include:

- Energy required to operate the MF/RO membranes,
- Potential need for additional treatment of brine waste to remove heavy metals and other contaminants from the aqueous phase prior to crystallization and disposal of waste,
- Ultimate disposal of brine and residuals requiring the energy intensive processes of evaporation and crystallization, and
- Energy needed to transport the crystallized brine waste to disposal sites.

8.2.2 Cross Media Impacts

Cross media transfers (i.e. the removal of a pollutant from one medium and its transfer to one or more other media) that are associated with the proposed future wastewater treatment scenarios generally involve two processes: the discharge of gasses to the atmosphere and the generation of biosolids and/or other solid wastes that must be disposed.

Nitrous oxide (N_2O), a greenhouse gas with a global warming potential approximately 300 times that of the contribution of carbon dioxide (CO_2), and nitric oxide (NO) are known to be intermediates of heterotrophic denitrification, and studies have shown that N_2O emissions can be produced by nitrifying bacteria in the aerobic and denitrifying bacteria in the anoxic zone (however, denitrifying bacteria can consume N_2O whereas nitrifying bacteria cannot) (Ahn, et. al., 2009). The enhanced nutrient removal treatment scenario will significantly expand the amount of denitrification capacity at all of the POTWs evaluated under this study. Therefore, it is reasonable to conclude that this potential future treatment scenario will result in increased N_2O emissions.

The chemical phosphorus removal treatment process will significantly increase the amount of solids that must be managed and disposed. Pollutants, such as metals, in the wastewater are not destroyed in this processed, but are just transferred from one medium to another. Moreover, chemical phosphorus removal requires the use of metal salts that further increase the total load of metals and salt that must be disposed (both in the effluent and in the solid waste generated). Many POTWs in the Central Valley rely on land application for solid waste disposal. Therefore, pollutants captured in the solids may be transferred to soils and groundwater.

The MF/RO process removes virtually all constituents from wastewater. However, these constituents are transferred and concentrated into the brine waste stream and eventually into a solid residual. As with the added solid waste generated from the phosphorus treatment, pollutants are simply transferred from one medium to another in the RO treatment process. However, unlike the phosphorus solids, it is likely that the solid residual from the RO process would need to be disposed of in a landfill that provides a high degree of containment.

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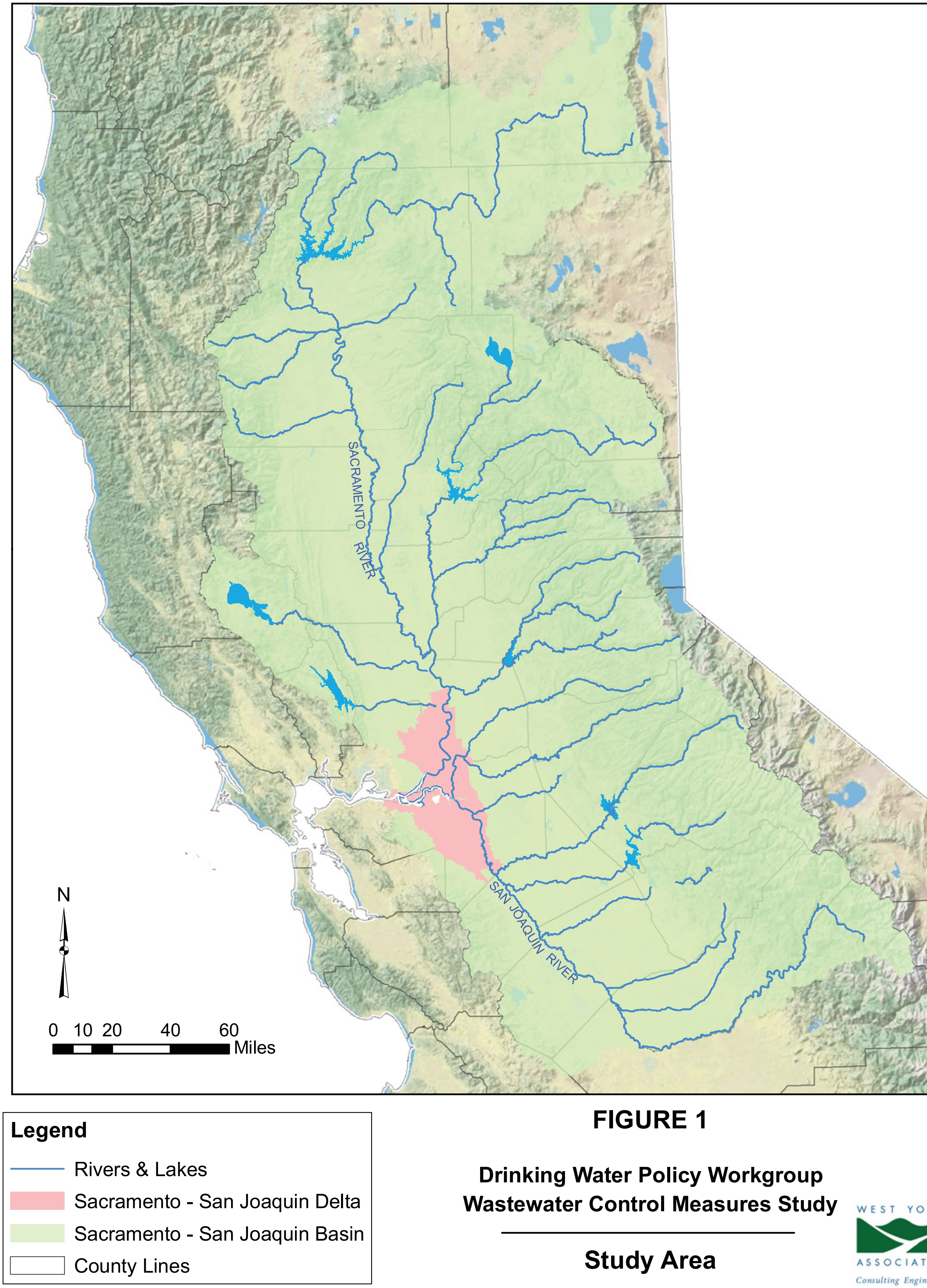


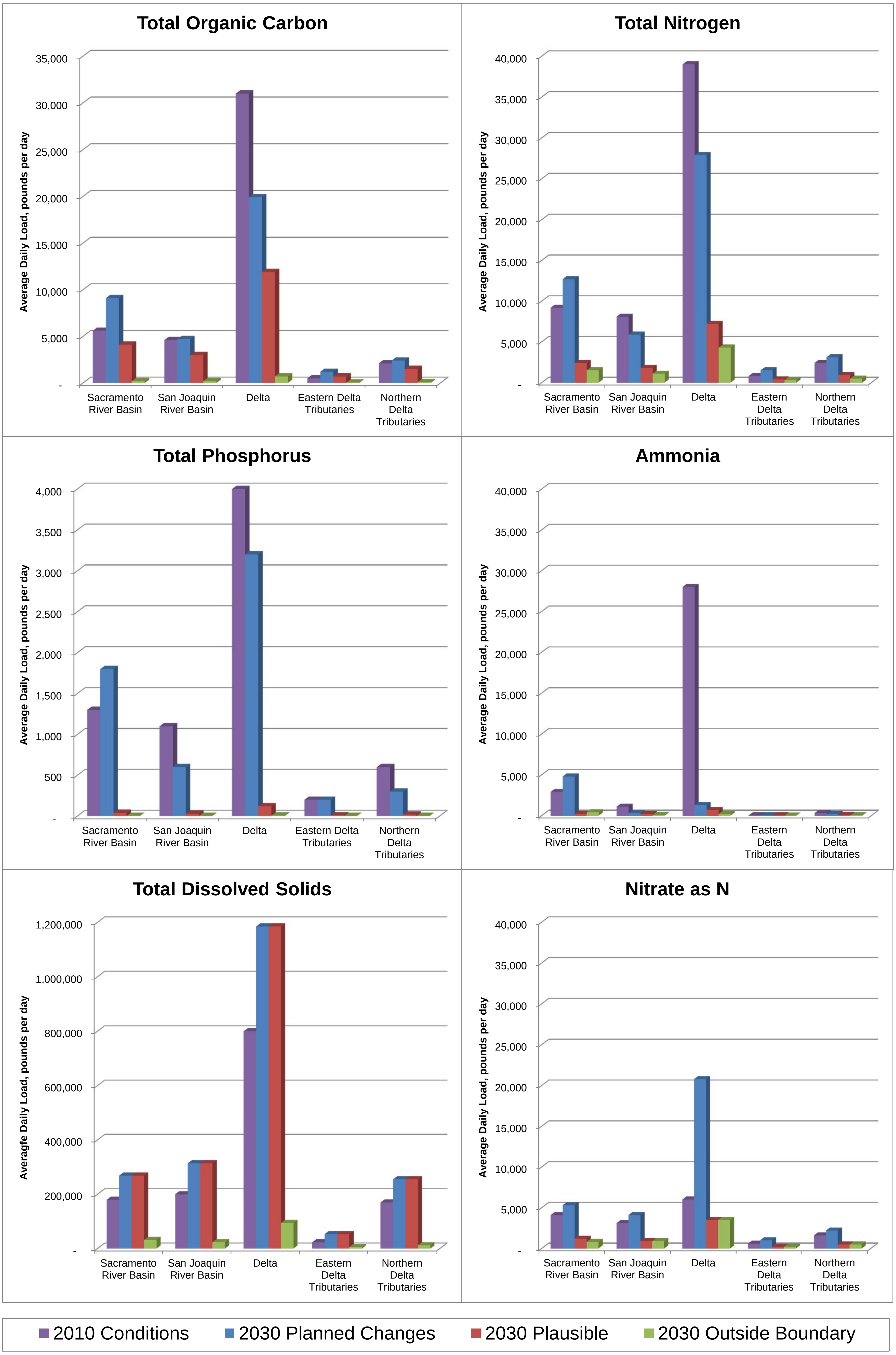
FIGURE 1

Drinking Water Policy Workgroup
Wastewater Control Measures Study

Study Area

WEST YOST ASSOCIATES
Consulting Engineers

Figure 2. Constituent Loading Summary for Major POTWs



ATTACHMENT A

Summary of Available Data for Central Valley POTW Surface Water Dischargers

Attachment A. Summary of Available Data for Central Valley POTW Surface Water Dischargers

Agency	Facility	Receiving Water	Current Treatment Level	Future Treatment Level	Current Disinfectant	Future Disinfectant	Estimated Population	Permitted Dry Weather Flow (MGD)	Recent Effluent Flow Rate (MGD)	Recent Effluent Concentration (mg/L)						
										Total Organic Carbon	Total Phosphorus as P	Total Nitrogen as N	Ammonia as N	Nitrate as N	Nitrite as N	Total Dissolved Solids
Sacramento Basin Dischargers																
Anderson, City of	Anderson Water Pollution Control Plant	Sacramento River	d	d	Chlorine	Chlorine	10,374	2.0	1.0				0.62			234
Auburn, City of	Wastewater Treatment Plant	Auburn Ravine (trib. to Sacramento River)	d	e	Chlorine	UV	12,896	1.67	1.3							243
Chico, City of	Chico Water Pollution Control Plant	Sacramento River	b	a	Chlorine	Chlorine	70,000	12.0	7.6				0.65			398
City of Corning	Corning Wastewater Treatment Plant	Sacramento River	b	a	Chlorine	Chlorine	6,814	1.4	0.883							396
Colfax, City of	Wastewater Treatment Plant	Smuthers Ravine (trib. to American River)	-	-	-	-	1,800	0.2	0.18							
Colusa, City of	Wastewater Treatment Plant	Tributary to Powell Slough (trib. Sacramento River)	-	-	-	-	5,670	0.7	0.5							
Dunsmuir, City of	Wastewater Treatment Plant	Sacramento River	-	-	-	-	3,555	0.41	0.27							
Grass Valley, City of	Wastewater Treatment Plant	Wolf Creek	e	e	UV	UV	12,100	2.78	1.89			11	0.076	7.9		324
Lincoln, City of	Wastewater Treatment and Reclamation Facility	Auburn Ravine Creek (trib to Sacramento River)	e	e	UV	UV	35,000	4.2	3.5			5.8	0.139	2.6	0.083	263
Linda County Water District	Wastewater Treatment Plant	Feather River	a	e	Chlorine	Chlorine	11,374	5.0	3.0		3.8					350
Live Oak, City of	Wastewater Treatment Plant	Reclamation District 777 Lateral Drain No. 1 (trib. to Sutter Bypass)	a	d	Chlorine	UV	8,000	1.4	0.72		6.1	22	**17.1**	0.89	1.1	621
Maxwell Public Utilities District	Wastewater Treatment Plant	Tributary to Lurline Creek (trib. to Sacramento River)	-	-	-	-	1,060	0.2	0.01							
Nevada City, City of	Nevada City Wastewater Treatment Plant	Deer Creek	-	-	-	-	3,050	0.69	0.4							
Nevada County Sanitation District No. 1	Cascade Shores Wastewater Treatment Plant	Gas Canyon	-	-	-	-	200	0.026	0.02							
Nevada County Sanitation District No. 1	Lake Wildwood Wastewater Treatment Plant	Deer Creek	-	-	-	-	7,000	1.12	0.7							
Olivehurst PUD	Wastewater Treatment Plant	Western Pacific Interceptor Drainage Canal (trib. to Feather River)	e	e	UV	UV	10,000	5.1	1.9				1	**9.1**	**0.37**	412
Placer County Department of Facility Services	Placer County Sewer Maintenance District No. 1 Wastewater Treatment Plant	Rock Creek (trib. to Sacramento River)	c	e	Chlorine	UV	16,900	2.18	1.7				**15.1**			374
Placer County Department of Facility Services	Placer County Sewer Maintenance District No. 3 Wastewater Treatment Plant	Miners Ravine (trib. to Sacramento River)	-	-	-	-	1,500	0.3	0.116							
Placerville, City of	Hangtown Creek Water Reclamation Facility	Hangtown Creek (trib. to Weber Creek and the South Fork American River)	e	e	UV	UV	10,335	2.3	1.5							465
Quincy Community Services District	Quincy Wastewater Treatment Plant	Spanish Creek	-	-	-	-	4,451	1.6	0.4							
Red Bluff, City of	Red Bluff Wastewater Reclamation Plant	Sacramento River	d	d	Chlorine	Chlorine	14,815	2.5	1.5				0.1			366
Redding, City of	Stillwater Wastewater Treatment Facility	Sacramento River	d	d	Chlorine	Chlorine	8,500	4.0	2.95				**0.354**			266
Redding, City of	Clear Creek Wastewater Treatment Plant	Sacramento River	c	d	Chlorine	Chlorine	61,800	8.8	8.2				13.5			240
Rio Alto Water District	Lake California Wastewater Treatment Plant	Sacramento River	-	-	-	-	1,600	0.64	0.12							
Roseville, City of	Pleasant Grove Wastewater Treatment Plant	Pleasant Grove Creek (trib. to Sacramento River)	e	e	Chlorine	UV	78,000	12	7.0		0.6		0.33	5.9		382
Roseville, City of	Dry Creek Wastewater Treatment Plant	Dry Creek (trib. to Sacramento River)	e	e	UV	UV	111,000	18	9.3		0.26		0.33	6.3		305
Sewerage Commission-Oroville Region	Sewerage Commission-Oroville Region Wastewater Treatment Plant	Feather River	c	c	Chlorine	Chlorine	34,000	6.5	3.4				**7.9**			307
Shasta County Service Area No. 17	Cottonwood Wastewater Treatment Plant	Cottonwood Creek (trib. to Sacramento River)	-	-	-	-	1,100	0.43	0.11							
Shasta Lake, City of	City of Shasta Lake Wastewater Treatment Facility	Churn Creek (trib. to Sacramento River)	d	c	Chlorine	Chlorine	10,233	1.3	1.0				0.55	**17.2**		228
United Auburn Indian Community	Thunder Valley Casino Wastewater Treatment Plant	Orchard Creek	-	-	-	-		0.875	0.35							
Williams, City of	Williams Wastewater Treatment Plant	Salt Creek (trib. To Colusa Basin Drain)	-	-	-	-	4,794	0.5	0.44							
Willows, City of	Willows Wastewater Treatment Plant	Agricultural Drain C, Colusa Basin Drain	d	d	Chlorine	Chlorine	7,779	1.2	1.2				0.014			313
Yuba City, City of	Wastewater Treatment Facility	Feather River	a	a	Chlorine	Chlorine	52,000	10.5	5.2		**2.75**	22	19	0.19		372

Attachment A. Summary of Available Data for Central Valley POTW Surface Water Dischargers

Agency	Facility	Receiving Water	Current Treatment Level	Future Treatment Level	Current Disinfectant	Future Disinfectant	Estimated Population	Permitted Dry Weather Flow (MGD)	Recent Effluent Flow Rate (MGD)	Recent Effluent Concentration (mg/L)						
										Total Organic Carbon	Total Phosphorus as P	Total Nitrogen as N	Ammonia as N	Nitrate as N	Nitrite as N	Total Dissolved Solids
San Joaquin Basin Dischargers																
Angels, City of	City of Angels Wastewater Treatment Plant	Angels Creek (trib. To Stanislaus River)	-	-	-	-	3,441	0.4	0.34							
Atwater, City of	Wastewater Treatment Facility	Atwater Drain (trib. to San Joaquin River)	b	e	Chlorine	UV	37,000	6.0	3.0		2.9		0.4	6.1		389
Calaveras County Water District	Forest Meadows Wastewater Reclamation Plant	Stanislaus River	-	-	-	-	1,000	0.19	0.07							
Clovis, City of	Clovis Sewage Treatment Plant and Water Reuse Facility	Secondary Discharge: Little Dry Creek (trib. To San Joaquin River)	e	e	UV	UV	89,924	2.8	2.8							480
Mariposa Public Utility District	Mariposa Wastewater Treatment Facility	Mariposa Creek (trib. to San Joaquin River)	-	-	-	-	2,000	0.61	0.2							
Merced, City of	Wastewater Treatment Facility	Hartley Slough (trib. to San Joaquin River	b	e	Chlorine	UV	70,500	12	8.5			14	0.16	10.5	0.04	367
Modesto, City of	Water Quality Control Facility	San Joaquin River	a	e	Chlorine	UV	225,000	70	20	16	1.9	27.6	6.2	4.1	0.35	605
Planada Community Services District	Wastewater Treatment Plant	Miles Creek (trib. to San Joaquin River)	-	-	-	-	6,032	0.53	0.36							
Turlock, City of	Wastewater Treatment Plant	Harding Drain/San Joaquin River	d	e	Chlorine	UV	78,179	20	11.4		**3.53**	19	**0.5**	15		556
Delta Dischargers																
Brentwood, City of	Wastewater Treatment Plant	Marsh Creek (trib. to Delta)	e	e	Chlorine	Chlorine	37,000	5.0	3.2		1		0.2	3.2		1221
Discovery Bay, Town of	Discovery Bay Wastewater Treatment Facility	Old River (trib. to Delta)	b	b	UV	UV	16,000	2.1	1.6							1114
Ironhouse Sanitary District	Ironhouse Sanitary District Wastewater Treatment Plant	San Joaquin River	e	e	UV	UV	31,200	4.3	2.64							210
Lodi, City of	White Slough Water Pollution Control Plant	Dredger Cut (trib. to Delta)	e	e	UV	UV	63,000	7.0	6.3	7.8	0.22	10	0.5	6.4	0.4	361
Manteca, City of	City of Manteca Wastewater Quality Control Plant	San Joaquin River	e	e	UV	UV	80,500	9.87	5.7	9.9		12	0.25	8.5	0.06	450
Mountain House Community Services District	Mountain House Wastewater Treatment Plant	Old River	e	e	UV	UV	6,000	4.5	0.6							615
Oakwood Lake Subdivision	Oakwood Lake Subdivision Mining Reclamation Project	Delta	-	-	-	-										
Rio Vista, City of	Northwest Wastewater Treatment Facility	Sacramento River	e	e	UV	UV	3,400	1.0	0.2				**0.012**	**1.9**	**0.015**	864
Rio Vista, City of	Beach Wastewater Treatment Facility	Sacramento River	a	a	Chlorine	Chlorine	4,500	0.65	0.45							657
Sacramento Regional County Sanitation District	Sacramento Regional Wastewater Treatment Plant	Sacramento River	a	e	Chlorine	UV	1,320,684	181	147	21	2.38	25.5	23	0.19	0.024	390
Stockton, City of	Regional Wastewater Control Facility	San Joaquin River	d	d	Chlorine	Chlorine	326,000	55	28	11		22	0.78	18	0.09	668
Tracy, City of	Tracy Wastewater Treatment Plant	Old River (trib. to Delta)	e	e	Chlorine	Chlorine	65,525	9.0	7.09							1019

Attachment A. Summary of Available Data for Central Valley POTW Surface Water Dischargers

Agency	Facility	Receiving Water	Current Treatment Level	Future Treatment Level	Current Disinfectant	Future Disinfectant	Estimated Population	Permitted Dry Weather Flow (MGD)	Recent Effluent Flow Rate (MGD)	Recent Effluent Concentration (mg/L)						
										Total Organic Carbon	Total Phosphorus as P	Total Nitrogen as N	Ammonia as N	Nitrate as N	Nitrite as N	Total Dissolved Solids
Easterm Delta Tributary Dischargers																
El Dorado Irrigation District	Deer Creek Wastewater Treatment Plant	Deer Creek (trib. to Consumnes River)	e	e	UV	UV	20,000	3.6	3.23				0.05			281
El Dorado Irrigation District	El Dorado Hills Wastewater Treatment Plant	Carson Creek (trib. to Consumnes River)	e	e	Chlorine	UV	20,000	4.0	2.0		2		0.61			480
Galt, City of	Wastewater Treatment Plant and Reclamation Facility	Laguna Creek (trib. to Consumnes River)	b	e	Chlorine	UV	24,000	4.5	2.3			17	0.5	13		381
San Andreas Sanitary District	Wastewater Treatment Plant	San Andreas Creek (trib. to Calaveras River)	-	-	-	-	2,200	1.5	0.2							
Northern Delta Tributary Dischargers																
Davis, City of	Wastewater Treatment Plant	Willow Slough (trib. to Yolo Bypass)	a	e	Chlorine	Chlorine	62,133	7.5	5.9	16.3	5.8	9.6	4.2	2.6	0.4	1109
UC Davis	Main Wastewater Treatment Plant	Putah Creek (trib. To Yolo Bypass)	e	e	UV	UV	45,000	3.6	3.6							634
Vacaville, City of	Easterly Wastewater Treatment Plant	Old Alamo Creek (trib to Ulatis Creek/Delta	b	e	Chlorine	Chlorine	96,735	15	8.2	9.5	3	17	0.32	13.2	**0.05**	636
Woodland, City of	Water Pollution Control Facility	Tule Canal/Yolo Bypass	e	e	UV	UV	50,980	10.4	5.6							1042

Bolded concentrations are maximum effluent concentrations

Facilities with an average flow less than 1 mgd. Not included in loading analysis.
Information from NPDES Permit - Provided by the DWP Workgroup.
Information from NPDES Permit - Provided by West Yost
Population Data provided by or generated from the 2004 USEPA Clean Water Needs Survey. Estimated population for 2008. Data provided by the DWP Workgroup.
Data provided by the DWP Workgroup, per discussion between CVCWA and the Central Valley Regional Water Quality Control Board.
Data from Discharger - Provided by DWP Workgroup
Data from Discharger - Provided by West Yost
Value calculated by West Yost when data is available. Total Nitrogen is assumed to be sum of ammonia, nitrate, and nitrite concentrations plus an assumed 3 mg/L organic nitrogen concentration.
Value calculated by West Yost based on the population numbers and a conservative assumed flow rate of 100 gallons per capita per day (gpcd).
When actual flow data was not available, current flow is assumed to be equal to permitted average dry weather flow rate.

Facility Treatment-Level Categories:
a Secondary Treatment
b Secondary Treatment w/ Nitrification
c Tertiary Treatment
d Tertiary Treatment with Nitrification
e Tertiary Treatment with NDN

ATTACHMENT B

Project 2030 POTW Discharge Flows

Attachment B. Projected 2030 POTW Discharge Flows

Agency	Facility	Permitted Dry	Recent Effluent	Predicted 2030 Flow			
				0% Reduction	2% Reduction	5% Reduction	10% Reduction
Sacramento Basin Dischargers							
Anderson, City of	Anderson Water Pollution Control Plant	2	1	1.3	1.2	1.2	1.1
Auburn, City of	Wastewater Treatment Plant	1.67	1.3	1.8	1.8	1.7	1.6
Chico, City of	Chico Water Pollution Control Plant	12	7.6	14	14	14	13
City of Corning	Corning Wastewater Treatment Plant	1.4	0.883	1.1	1.1	1.1	1
Colfax, City of	Wastewater Treatment Plant	0.2	0.18	0.3	0.3	0.3	0.2
Colusa, City of	Wastewater Treatment Plant	0.7	0.5	0.6	0.6	0.6	0.5
Dunsmuir, City of	Wastewater Treatment Plant	0.41	0.27	0.3	0.3	0.3	0.2
Grass Valley, City of	Wastewater Treatment Plant	2.78	1.89	2.6	2.5	2.5	2.3
Lincoln, City of	Wastewater Treatment and Reclamation Facility	4.2	3.5	7.7	7.5	7.3	6.9
Linda County Water District	Wastewater Treatment Plant	5	3	4.0	4.0	3.8	3.6
Live Oak, City of	Wastewater Treatment Plant	1.4	0.72	1.2	1.2	1.2	1.1
Maxwell Public Utilities District	Wastewater Treatment Plant	0.2	0.01				
Nevada City, City of	Nevada City Wastewater Treatment Plant	0.69	0.4	0.5	0.5	0.4	0.4
Nevada County Sanitation District No. 1	Cascade Shores Wastewater Treatment Plant	0.026	0.02	0.03	0.03	0.02	0.02
Nevada County Sanitation District No. 1	Lake Wildwood Wastewater Treatment Plant	1.12	0.7	0.9	0.9	0.9	0.8
Olivehurst PUD	Wastewater Treatment Plant	5.1	1.9	2.3	2.3	2.2	2.1
Placer County Department of Facility Services	Placer County Sewer Maintenance District No. 1 Wastewater Treatment Plant	2.18	1.7	2.0	2.0	1.9	1.8
Placer County Department of Facility Services	Placer County Sewer Maintenance District No. 3 Wastewater Treatment Plant	0.3	0.116	0.1	0.1	0.1	0.1
Placerville, City of	Hangtown Creek Water Reclamation Facility	2.3	1.5	2.0	2.0	1.9	1.8
Quincy Community Services District	Quincy Wastewater Treatment Plant	1.6	0.4	0.4	0.4	0.4	0.4
Red Bluff, City of	Red Bluff Wastewater Reclamation Plant	2.5	1.5	1.9	1.9	1.8	1.7
Redding, City of	Stillwater Wastewater Treatment Facility	4	2.95	3.7	3.6	3.5	3.3
Redding, City of	Clear Creek Wastewater Treatment Plant	8.8	8.2	10.0	10.0	9.6	9.1
Rio Alto Water District	Lake California Wastewater Treatment Plant	0.64	0.12	0.1	0.1	0.1	0.1
Roseville, City of	Pleasant Grove Wastewater Treatment Plant	12	7	10	10	9.7	9.2
Roseville, City of	Dry Creek Wastewater Treatment Plant	18	9.3	14.0	13.0	13	12
Sewerage Commission-Oroville Region	Sewerage Commission-Oroville Region Wastewater Treatment Plant	6.5	3.4	4.6	4.5	4.4	4.1
Shasta County Service Area No. 17	Cottonwood Wastewater Treatment Plant	0.43	0.11	0.1	0.1	0.1	0.1
Shasta Lake, City of	City of Shasta Lake Wastewater Treatment Facility	1.3	1	1.1	1.1	1.1	1
United Auburn Indian Community	Thunder Valley Casino Wastewater Treatment Plant	0.875	0.35	0.9	0.9	0.8	0.8
Williams, City of	Williams Wastewater Treatment Plant	0.5	0.44	0.7	0.7	0.7	0.7
Willows, City of	Willows Wastewater Treatment Plant	1.2	1.22	1.5	1.4	1.4	1.3
Yuba City, City of	Wastewater Treatment Facility	10.5	5.2	9.4	9.2	8.9	8.5
San Joaquin Basin Dischargers							
Angels, City of	City of Angels Wastewater Treatment Plant	0.4	0.34	0.4	0.4	0.4	0.4
Atwater, City of	Wastewater Treatment Facility	6	3	3.9	3.8	3.7	3.5
Calaveras County Water District	Forest Meadows Wastewater Reclamation Plant	0.19	0.07	0.1	0.1	0.1	0.1
Clovis, City of	Clovis Sewage Treatment Plant and Water Reuse Facility	2.8	2.8	5.2	5.1	4.9	4.6
Mariposa Public Utility District	Mariposa Wastewater Treatment Facility	0.61	0.2	0.2	0.2	0.2	0.2
Merced, City of	Wastewater Treatment Facility	12	8.5	13.0	13.0	13	12
Modesto, City of	Water Quality Control Facility	70	20	29.0	29.0	28	26
Planada Community Services District	Wastewater Treatment Plant	0.53	0.36	0.7	0.6	0.6	0.6
Turlock, City of	Wastewater Treatment Plant	20	11.4	19.0	19.0	18	17
Delta Dischargers							
Brentwood, City of	Wastewater Treatment Plant	5	3.2	6.6	6.5	6.3	6
Discovery Bay, Town of	Discovery Bay Wastewater Treatment Facility	2.1	1.6	4.5	4.4	4.3	4.1
Ironhouse Sanitary District	Ironhouse Sanitary District Wastewater Treatment Plant	4.3	2.64	5.0	4.9	4.7	4.5
Lodi, City of	White Slough Water Pollution Control Plant	7	6.3	9.0	8.8	8.6	8.1
Manteca, City of	City of Manteca Wastewater Quality Control Plant	9.87	5.7	10	10.0	10	9.4
Mountain House Community Services District	Mountain House Wastewater Treatment Plant	4.5	0.6	2.3	2.2	2.2	2.1
Oakwood Lake Subdivision	Oakwood Lake Subdivision Mining Reclamation Project	0	0	0.0	0.0	0	0
Rio Vista, City of	Northwest Wastewater Treatment Facility	1	0.2	0.7	0.7	0.6	0.6
Rio Vista, City of	Beach Wastewater Treatment Facility	0.65	0.45	0.7	0.7	0.6	0.6
Sacramento Regional County Sanitation District	Sacramento Regional Wastewater Treatment Plant	181	147	187	183	177	168
Stockton, City of	Regional Wastewater Control Facility	55	28	43	42	41	39
Tracy, City of	Tracy Wastewater Treatment Plant	9	7.09	15	14	14	13
Easterm Delta Tributary Dischargers							
El Dorado Irrigation District	Deer Creek Wastewater Treatment Plant	3.6	3.23	8.1	7.9	7.7	7.3
El Dorado Irrigation District	El Dorado Hills Wastewater Treatment Plant	4	2	5.0	4.9	4.8	4.5
Galt, City of	Wastewater Treatment Plant and Reclamation Facility	4.5	2.3	4.5	4.4	4.3	4
San Andreas Sanitary District	Wastewater Treatment Plant	1.5	0.2	0.3	0.3	0.3	0.2
Northern Delta Tributary Dischargers							
Davis, City of	Wastewater Treatment Plant	7.5	5.9	8.3	8.1	7.9	7.4
UC Davis	Main Wastewater Treatment Plant	3.6	3.6	5.1	5.0	4.9	4.6
Vacaville, City of	Easterly Wastewater Treatment Plant	15	8.2	15	15	15	14
Woodland, City of	Water Pollution Control Facility	10.4	5.6	8.0	7.8	7.6	7.2

ATTACHMENT C

Current POTW Surface Water Discharger
Effluent Concentrations and Loadings

Attachment C. Current POTW Surface Water Discahrger Effluent Concentrations and Loadings

Agency	Facility	Permitted Dry Weather Flow	Recent Effluent Flow Rate (MGD)	Predicted 2010 Effluent Concentration (mg/L)							Predicted 2010 Effluent Loads (pounds per day)						
				Total Organic Carbon	Total Phosphorus as P	Total Nitrogen as N	Ammonia as N	Nitrate as N	Nitrite as N	Total Dissolved Solids	Total Organic Carbon	Total Phosphorus as P	Total Nitrogen as N	Ammonia as N	Nitrate as N	Nitrite as N	Total Dissolved Solids
Sacramento Basin Dischargers																	
Anderson, City of	Anderson Water Pollution Control Plant	2.0	1.0	8.0	3.0	18	0.62	15	0.1	234	67	25	150	5.2	130	0.8	2,000
Auburn, City of	Wastewater Treatment Plant	1.67	1.3	8.0	3.0	18	0.5	15	0.1	243	87	33	200	5.4	160	1.1	2,600
Chico, City of	Chico Water Pollution Control Plant	12.0	7.6	10	5.0	18	0.65	15	0.1	398	630	320	1,100	41.0	950	6.3	25,000
City of Corning	Corning Wastewater Treatment Plant	1.4	0.883	10	5.0	18	0.5	15	0.1	396	74	37	130	3.7	110	0.7	2,900
Colfax, City of	Wastewater Treatment Plant	0.2	0.18	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Colusa, City of	Wastewater Treatment Plant	0.7	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dunsmuir, City of	Wastewater Treatment Plant	0.41	0.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Grass Valley, City of	Wastewater Treatment Plant	2.78	1.89	8.0	1	11	0.076	7.9	0.1	324	130	16.0	170	1.2	120	1.6	5,100
Lincoln, City of	Wastewater Treatment and Reclamation Facility	4.2	3.5	8.0	1	5.8	0.139	2.6	0.083	263	230	29	170	4.1	76	2.4	7,700
Linda County Water District	Wastewater Treatment Plant	5.0	3	20	3.8	26	20	3.0	0.1	350	500	95	650	500.0	75	2.5	8,800
Live Oak, City of	Wastewater Treatment Plant	1.4	0.72	20	6.1	22	17.1	0.89	1.1	621	120	37	130	100.0	5.3	6.6	3,700
Maxwell Public Utilities District	Wastewater Treatment Plant	0.2	0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nevada City, City of	Nevada City Wastewater Treatment Plant	0.69	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nevada County Sanitation District No. 1	Cascade Shores Wastewater Treatment Plant	0.026	0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nevada County Sanitation District No. 1	Lake Wildwood Wastewater Treatment Plant	1.12	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Olivehurst PUD	Wastewater Treatment Plant	5.1	1.9	8.0	1	10	1	9.1	0.37	412	130	16.0	160	16.0	140	5.9	6,500
Placer County Department of Facility Services	Placer County Sewer Maintenance District No. 1 Wastewater Treatment Plant	2.18	1.7	10	3.0	26	15.1	5.0	0.1	374	140	43	370	210.0	71	1.4	5,300
Placer County Department of Facility Services	Placer County Sewer Maintenance District No. 3 Wastewater Treatment Plant	0.3	0.116	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Placerville, City of	Hangtown Creek Water Reclamation Facility	2.3	1.5	8.0	1	10	0.5	7.0	0.1	465	100	13.0	130	6	88	1.3	5,800
Quincy Community Services District	Quincy Wastewater Treatment Plant	1.6	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Red Bluff, City of	Red Bluff Wastewater Reclamation Plant	2.5	1.5	8.0	3.0	18	0.1	15	0.1	366	100	38	230	1.3	190	1.3	4,600
Redding, City of	Stillwater Wastewater Treatment Facility	4	2.95	8.0	3.0	18	0.354	15	0.1	266	200	74	440	8.7	370	2.5	6,500
Redding, City of	Clear Creek Wastewater Treatment Plant	8.8	8.2	10	3.0	26	13.5	5.0	0.1	240	680	210	1,800	920.0	340	6.8	16,000
Rio Alto Water District	Lake California Wastewater Treatment Plant	0.64	0.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Roseville, City of	Pleasant Grove Wastewater Treatment Plant	12	7	8.0	0.6	10	0.33	5.9	0.1	382	470	35	580	19.0	340	5.8	22,000
Roseville, City of	Dry Creek Wastewater Treatment Plant	18	9.3	8.0	0.26	10	0.33	6.3	0.1	305	620	20	780	26.0	490	7.8	24,000
Sewerage Commission-Oroville Region	Sewerage Commission-Oroville Region Wastewater Treatment Plant	6.5	3.4	10	3.0	26	7.9	5.0	0.1	307	280	85	740	220.0	140	2.8	8,700
Shasta County Service Area No. 17	Cottonwood Wastewater Treatment Plant	0.43	0.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Shasta Lake, City of	City of Shasta Lake Wastewater Treatment Facility	1.3	1	8.0	3.0	18	0.55	17.2	0.1	228	67	25	150	4.6	140	0.8	1,900
United Auburn Indian Community	Thunder Valley Casino Wastewater Treatment Plant	0.875	0.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Williams, City of	Williams Wastewater Treatment Plant	0.5	0.44	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Willows, City of	Willows Wastewater Treatment Plant	1.2	1.22	8.0	3.0	18	0.014	15	0.1	313	81	31	180	0.1	150	1.0	3,200
Yuba City, City of	Wastewater Treatment Facility	10.5	5.2	20	2.75	22	19	0.19	0.1	372	870	120	950	820.0	8.2	4.3	16,000

Attachment C. Current POTW Surface Water Discahrger Effluent Concentrations and Loadings

Agency	Facility	Permitted Dry Weather Flow	Recent Effluent Flow Rate (MGD)	Predicted 2010 Effluent Concentration (mg/L)							Predicted 2010 Effluent Loads (pounds per day)						
				Total Organic Carbon	Total Phosphorus as P	Total Nitrogen as N	Ammonia as N	Nitrate as N	Nitrite as N	Total Dissolved Solids	Total Organic Carbon	Total Phosphorus as P	Total Nitrogen as N	Ammonia as N	Nitrate as N	Nitrite as N	Total Dissolved Solids
San Joaquin Basin Dischargers				-	-	-	-	-	-	-							
Angels, City of	City of Angels Wastewater Treatment Plant	0.4	0.34	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Atwater, City of	Wastewater Treatment Facility	6	3	10	2.9	18	0.4	6.1	0.1	389	250	73	450	10	150	2.5	9,700
Calaveras County Water District	Forest Meadows Wastewater Reclamation Plant	0.19	0.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Clovis, City of	Clovis Sewage Treatment Plant and Water Reuse Facility	2.8	2.8	8.0	1	10	0.5	7.0	0.1	480	190	23	230	12	160	2.3	11,000
Mariposa Public Utility District	Mariposa Wastewater Treatment Facility	0.61	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Merced, City of	Wastewater Treatment Facility	12	8.5	10	5.0	14	0.16	10.5	0.04	367	710	350	990	11	740	2.8	26,000
Modesto, City of	Water Quality Control Facility	70	20	16	1.9	27.6	6.2	4.1	0.35	605	2,700	320	4,600	1,000	680	58	100,000
Planada Community Services District	Wastewater Treatment Plant	0.53	0.36	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Turlock, City of	Wastewater Treatment Plant	20	11.4	8.0	3.53	19	0.5	15	0.1	556	760	340	1,800	48	1,400	10	53,000
Delta Dischargers																	
Brentwood, City of	Wastewater Treatment Plant	5	3.2	8.0	1.0	10	0.2	3.2	0.1	1221	210	27	270	5	85	2.7	33,000
Discovery Bay, Town of	Discovery Bay Wastewater Treatment Facility	2.1	1.6	10	5.0	18	0.5	15	0.1	1114	130	67	240	7	200	1.3	15,000
Ironhouse Sanitary District	Ironhouse Sanitary District Wastewater Treatment Plant	4.3	2.64	8.0	1	10	0.5	7.0	0.1	210	180	22	220	11	150	2.2	4,600
Lodi, City of	White Slough Water Pollution Control Plant	7	6.3	7.8	0.22	10	0.5	6.4	0.4	361	410	12	530	26	340	21.0	19,000
Manteca, City of	City of Manteca Wastewater Quality Control Plant	9.87	5.7	9.9	1	12	0.25	8.5	0.06	450	470	48	570	12	400	2.9	21,000
Mountain House Community Services District	Mountain House Wastewater Treatment Plant	4.5	0.6	8.0	1	10	0.5	7.0	0.1	615	40	5.0	50	3	35	0.5	3,100
Oakwood Lake Subdivision	Oakwood Lake Subdivision Mining Reclamation Project	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rio Vista, City of	Northwest Wastewater Treatment Facility	1	0.2	8.0	1	10	0.012	1.9	0.015	864	13	1.7	17	0.02	3.2	-	1,400
Rio Vista, City of	Beach Wastewater Treatment Facility	0.65	0.45	20	5.0	26	20	3.0	0.1	657	75	19	98	75	11	0	2,500
Sacramento Regional County Sanitation District	Sacramento Regional Wastewater Treatment Plant	181	147	21	2.38	25.5	23	0.19	0.024	390	26,000	2,900	31,000	28,000	230	29	480,000
Stockton, City of	Regional Wastewater Control Facility	55	28	11	3.0	22	0.78	18	0.09	668	2,600	700	5,100	180	4,200	21	160,000
Tracy, City of	Tracy Wastewater Treatment Plant	9	7.09	8.0	1	10	0.5	7.0	0.1	1019	470	59	590	30	410	5.9	60,000

Attachment C. Current POTW Surface Water Discahrger Effluent Concentrations and Loadings

Agency	Facility	Permitted Dry Weather Flow	Recent Effluent Flow Rate (MGD)	Predicted 2010 Effluent Concentration (mg/L)							Predicted 2010 Effluent Loads (pounds per day)						
				Total Organic Carbon	Total Phosphorus as P	Total Nitrogen as N	Ammonia as N	Nitrate as N	Nitrite as N	Total Dissolved Solids	Total Organic Carbon	Total Phosphorus as P	Total Nitrogen as N	Ammonia as N	Nitrate as N	Nitrite as N	Total Dissolved Solids
Easterm Delta Tributary Dischargers																	
El Dorado Irrigation District	Deer Creek Wastewater Treatment Plant	3.6	3.23	8.0	1	10	0.05	7.0	0.1	281	220	27	270	1	190	2.7	7,600
El Dorado Irrigation District	El Dorado Hills Wastewater Treatment Plant	4	2	8.0	2.0	10	0.61	7.0	0.1	480	130	33	170	10	120	1.7	8,000
Galt, City of	Wastewater Treatment Plant and Reclamation Facility	4.5	2.3	10	5.0	17	0.5	13	0.1	381	190	96	330	10	250	1.9	7,300
San Andreas Sanitary District	Wastewater Treatment Plant	1.5	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northern Delta Tributary Dischargers																	
Davis, City of	Wastewater Treatment Plant	7.5	5.9	16.3	5.8	9.6	4.2	2.6	0.4	1109	800	290	470	210.0	130	20.0	55,000
UC Davis	Main Wastewater Treatment Plant	3.6	3.6	8.0	1	10	0.5	7.0	0.1	634	240	30	300	15	210	3.0	19,000
Vacaville, City of	Easterly Wastewater Treatment Plant	15	8.2	9.5	3.0	17	0.32	13.2	0.05	636	650	210	1,200	22	900	3.4	43,000
Woodland, City of	Water Pollution Control Facility	10.4	5.6	8.0	1	10	0.5	7.0	0.1	1042	370	47	470	23	330	4.7	49,000

ATTACHMENT D1 - 3

Projected 2030 POTW Discharge Loads

Attachment D-1. 2030 Planned Changes Scenario Projected POTW Discharge Loads

Treatment Level		Agency	Facility	Predicted 2030 Average Daily Effluent Loads (pounds per day)						
Current	Future			Total Organic Carbon	Total Phosphorus as P	Total Nitrogen as N	Ammonia as N	Nitrate as N	Nitrite as N	Total Dissolved Solids
Sacramento Basin Dischargers										
d	d	Anderson, City of	Anderson Water Pollution Control Plant	85	32	190	6.6	170	1.0	2,500
d	e	Auburn, City of	Wastewater Treatment Plant	120	15	150	7.4	100	1.5	3,600
b	a	Chico, City of	Chico Water Pollution Control Plant	2,400	600	3,000	2,400	360	12	47,000
b	a	City of Corning	Corning Wastewater Treatment Plant	190	47	240	190	28	0.9	3,700
-	-	Colfax, City of	Wastewater Treatment Plant	-	-	-	-	-	-	-
-	-	Colusa, City of	Wastewater Treatment Plant	-	-	-	-	-	-	-
-	-	Dunsmuir, City of	Wastewater Treatment Plant	-	-	-	-	-	-	-
e	e	Grass Valley, City of	Wastewater Treatment Plant	180	22	230	1.6	160	2.2	7,000
e	e	Lincoln, City of	Wastewater Treatment and Reclamation Facility	500	64	370	9.0	170	5.3	17,000
a	e	Linda County Water District	Wastewater Treatment Plant	270	34	340	18	240	3.4	12,000
a	d	Live Oak, City of	Wastewater Treatment Plant	82	31	190	5.1	150	1.0	6,300
-	-	Maxwell Public Utilities District	Wastewater Treatment Plant	-	-	-	-	-	-	-
-	-	Nevada City, City of	Nevada City Wastewater Treatment Plant	-	-	-	-	-	-	-
-	-	Nevada County Sanitation District No. 1	Cascade Shores Wastewater Treatment Plant	-	-	-	-	-	-	-
-	-	Nevada County Sanitation District No. 1	Lake Wildwood Wastewater Treatment Plant	-	-	-	-	-	-	-
e	e	Olivehurst PUD	Wastewater Treatment Plant	160	20	200	20	170	7.2	7,900
c	e	Placer County Department of Facility Services	Placer County Sewer Maintenance District No. 1 Wastewater Treatment Plant	130	17	170	8.5	120	1.7	6,300
-	-	Placer County Department of Facility Services	Placer County Sewer Maintenance District No. 3 Wastewater Treatment Plant	-	-	-	-	-	-	-
e	e	Placerville, City of	Hangtown Creek Water Reclamation Facility	130	18	180	8.5	120	1.8	7,800
-	-	Quincy Community Services District	Quincy Wastewater Treatment Plant	-	-	-	-	-	-	-
d	d	Red Bluff, City of	Red Bluff Wastewater Reclamation Plant	130	49	300	1.7	250	1.7	6,000
d	d	Redding, City of	Stillwater Wastewater Treatment Facility	250	92	540	11	460	3.1	8,000
c	d	Redding, City of	Clear Creek Wastewater Treatment Plant	680	260	1,500	42.0	1,200	8.4	20,000
-	-	Rio Alto Water District	Lake California Wastewater Treatment Plant	-	-	-	-	-	-	-
e	e	Roseville, City of	Pleasant Grove Wastewater Treatment Plant	680	51	850	28	500	8.5	32,000
e	e	Roseville, City of	Dry Creek Wastewater Treatment Plant	900	29	1,100	38	710	11.0	35,000
c	c	Sewerage Commission-Oroville Region	Sewerage Commission-Oroville Region Wastewater Treatment Plant	380	110	1,000	300	190	3.8	12,000
-	-	Shasta County Service Area No. 17	Cottonwood Wastewater Treatment Plant	-	-	-	-	-	-	-
d	c	Shasta Lake, City of	City of Shasta Lake Wastewater Treatment Facility	94	28	250	170	47	0.9	2,100
-	-	United Auburn Indian Community	Thunder Valley Casino Wastewater Treatment Plant	-	-	-	-	-	-	-
-	-	Williams, City of	Williams Wastewater Treatment Plant	-	-	-	-	-	-	-
d	d	Willows, City of	Willows Wastewater Treatment Plant	97	37	220	0.1	180	1.2	3,800
a	a	Yuba City, City of	Wastewater Treatment Facility	1,600	220	1,700	1,500	15	7.8	29,000
San Joaquin Basin Dischargers										
-	-	Angels, City of	City of Angels Wastewater Treatment Plant	-	-	-	-	-	-	-
b	e	Atwater, City of	Wastewater Treatment Facility	260	32	320	17	230	3.2	13,000
-	-	Calaveras County Water District	Forest Meadows Wastewater Reclamation Plant	-	-	-	-	-	-	-
e	e	Clovis, City of	Clovis Sewage Treatment Plant and Water Reuse Facility	350	42	420	22	290	4.2	20,000
-	-	Mariposa Public Utility District	Mariposa Wastewater Treatment Facility	-	-	-	-	-	-	-
b	e	Merced, City of	Wastewater Treatment Facility	900	110	1,100	55	790	11	41,000
a	e	Modesto, City of	Water Quality Control Facility	1,900	250	2,500	120	1,700	25	150,000
-	-	Planada Community Services District	Wastewater Treatment Plant	-	-	-	-	-	-	-
d	e	Turlock, City of	Wastewater Treatment Plant	1,300	160	1,600	82	1,100	16	90,000
Delta Dischargers										
e	e	Brentwood, City of	Wastewater Treatment Plant	430	56.0	560	11	180	5.6	68,000
b	b	Discovery Bay, Town of	Discovery Bay Wastewater Treatment Facility	370	190.0	680	19	560	3.7	42,000
e	e	Ironhouse Sanitary District	Ironhouse Sanitary District Wastewater Treatment Plant	340	41.0	410	21	280	4.1	8,600
e	e	Lodi, City of	White Slough Water Pollution Control Plant	590	17.0	760	37	490	30.0	27,000
e	e	Manteca, City of	City of Manteca Wastewater Quality Control Plant	870	88.0	1,000	22	740	5.3	39,000
e	e	Mountain House Community Services District	Mountain House Wastewater Treatment Plant	150.0	19.0	190	9.5	130	1.9	12,000
-	-	Oakwood Lake Subdivision	Oakwood Lake Subdivision Mining Reclamation Project	-	-	-	-	-	-	-
e	e	Rio Vista, City of	Northwest Wastewater Treatment Facility	44	5.8	58	0.1	11	0.1	4,800.0
a	a	Rio Vista, City of	Beach Wastewater Treatment Facility	110	29	150	110	17	0.6	3,800.0
a	e	Sacramento Regional County Sanitation District	Sacramento Regional Wastewater Treatment Plant	12,000	1,500	15,000	770	11,000	150	610,000
d	d	Stockton, City of	Regional Wastewater Control Facility	4,000	1,100	7,900	280	6,500	32	250,000
e	e	Tracy, City of	Tracy Wastewater Treatment Plant	970	120	1,200	62	850	12	120,000
Easterm Delta Tributary Dischargers										
e	e	El Dorado Irrigation District	Deer Creek Wastewater Treatment Plant	550	68	680	3.3	480	6.8	19,000
e	e	El Dorado Irrigation District	El Dorado Hills Wastewater Treatment Plant	330	83	430	25.0	300	4.3	20,000
b	e	Galt, City of	Wastewater Treatment Plant and Reclamation Facility	290	37	370	19.0	250	3.7	14,000
-	-	San Andreas Sanitary District	Wastewater Treatment Plant	-	-	-	-	-	-	-
Northern Delta Tributary Dischargers										
a	e	Davis, City of	Wastewater Treatment Plant	550	69	690	35.0	480	6.9	77,000
e	e	UC Davis	Main Wastewater Treatment Plant	340	43	430	21.0	300	4.3	27,000
b	e	Vacaville, City of	Easterly Wastewater Treatment Plant	1,000	130	1,300	64	900	13	81,000
e	e	Woodland, City of	Water Pollution Control Facility	530	67	670	33.0	470	6.7	70,000

Treatment Level Category
a Secondary Treatment
b Secondary Treatment w/ Nitrification
c Tertiary Treatment
d Tertiary Treatment with Nitrification
e Tertiary Treatment with NDN

Attachment D-2. 2030 Plausible Scenario Projected POTW Discharge Loads

Agency	Facility	Predicted 2030 Average Daily Effluent Loads (pounds per day)						
		Total Organic Carbon	Total Phosphorus as P	Total Nitrogen as N	Ammonia as N	Nitrate as N	Nitrite as N	Total Dissolved Solids
Sacramento Basin Dischargers								
Anderson, City of	Anderson Water Pollution Control Plant	53	0.5	32	3.2	17	1	2,500
Auburn, City of	Wastewater Treatment Plant	74	0.7	45	4.5	22	1.5	3,600
Chico, City of	Chico Water Pollution Control Plant	600	6	360	36	180	12	47,000
City of Corning	Corning Wastewater Treatment Plant	47	0.5	28	2.8	14	0.9	3,700
Colfax, City of	Wastewater Treatment Plant	-	-	-	-	-	-	-
Colusa, City of	Wastewater Treatment Plant	-	-	-	-	-	-	-
Dunsmuir, City of	Wastewater Treatment Plant	-	-	-	-	-	-	-
Grass Valley, City of	Wastewater Treatment Plant	110	1.1	65	6.5	33	2.2	7,000
Lincoln, City of	Wastewater Treatment and Reclamation Facility	330	3.3	190	19	96	6.4	17,000
Linda County Water District	Wastewater Treatment Plant	180	1.8	100	10	51	3.4	12,000
Live Oak, City of	Wastewater Treatment Plant	51	0.5	31	3.1	15	1	6,300
Maxwell Public Utilities District	Wastewater Treatment Plant	-	-	-	-	-	-	-
Nevada City, City of	Nevada City Wastewater Treatment Plant	-	-	-	-	-	-	-
Nevada County Sanitation District No. 1	Cascade Shores Wastewater Treatment Plant	-	-	-	-	-	-	-
Nevada County Sanitation District No. 1	Lake Wildwood Wastewater Treatment Plant	-	-	-	-	-	-	-
Olivehurst PUD	Wastewater Treatment Plant	96	1	59	5.9	29	2	7,900
Placer County Department of Facility Services	Placer County Sewer Maintenance District No. 1 Wastewater Treatment Plant	85	0.8	51	5.1	25	1.7	6,300
Placer County Department of Facility Services	Placer County Sewer Maintenance District No. 3 Wastewater Treatment Plant	-	-	-	-	-	-	-
Placerville, City of	Hangtown Creek Water Reclamation Facility	85	0.8	51	5.1	26	1.8	7,800
Quincy Community Services District	Quincy Wastewater Treatment Plant	-	-	-	-	-	-	-
Red Bluff, City of	Red Bluff Wastewater Reclamation Plant	82	0.8	49	4.9	25	1.7	6,000
Redding, City of	Stillwater Wastewater Treatment Facility	150	1.5	92	9.2	46	3.1	8,000
Redding, City of	Clear Creek Wastewater Treatment Plant	420	4.2	260	26	120	8.4	20,000
Rio Alto Water District	Lake California Wastewater Treatment Plant	-	-	-	-	-	-	-
Roseville, City of	Pleasant Grove Wastewater Treatment Plant	420	4.2	260	26	130	8.5	32,000
Roseville, City of	Dry Creek Wastewater Treatment Plant	570	5.7	340	34	170	11	35,000
Sewerage Commission-Oroville Region	Sewerage Commission-Oroville Region Wastewater Treatment Plant	190	1.9	110	11	58	3.8	12,000
Shasta County Service Area No. 17	Cottonwood Wastewater Treatment Plant	-	-	-	-	-	-	-
Shasta Lake, City of	City of Shasta Lake Wastewater Treatment Facility	47	0.5	28	2.8	15	0.9	2,100
United Auburn Indian Community	Thunder Valley Casino Wastewater Treatment Plant	-	-	-	-	-	-	-
Williams, City of	Williams Wastewater Treatment Plant	-	-	-	-	-	-	-
Willows, City of	Willows Wastewater Treatment Plant	61	0.6	37	3.7	18	1.2	3,800
Yuba City, City of	Wastewater Treatment Facility	400	4	230	23	120	7.8	29,000
San Joaquin Basin Dischargers								
Angels, City of	City of Angels Wastewater Treatment Plant	-	-	-	-	-	-	-
Atwater, City of	Wastewater Treatment Facility	170	1.7	97	9.7	49	3.2	13,000
Calaveras County Water District	Forest Meadows Wastewater Reclamation Plant	-	-	-	-	-	-	-
Clovis, City of	Clovis Sewage Treatment Plant and Water Reuse Facility	220	2.2	130	13	64	4.2	20,000
Mariposa Public Utility District	Mariposa Wastewater Treatment Facility	-	-	-	-	-	-	-
Merced, City of	Wastewater Treatment Facility	550	5.5	330	33	170	11	41,000
Modesto, City of	Water Quality Control Facility	1200	12	730	73	360	25	150,000
Planada Community Services District	Wastewater Treatment Plant	-	-	-	-	-	-	-
Turlock, City of	Wastewater Treatment Plant	820	8.2	490	49	240	16	90,000
Delta Dischargers								
Brentwood, City of	Wastewater Treatment Plant	270	2.7	170	17	83	5.6	68,000
Discovery Bay, Town of	Discovery Bay Wastewater Treatment Facility	190	2	110	11	56	3.7	42,000
Ironhouse Sanitary District	Ironhouse Sanitary District Wastewater Treatment Plant	210	2.1	120	12	62	4.1	8,600
Lodi, City of	White Slough Water Pollution Control Plant	370	3.7	230	23	110	7.6	27,000
Manteca, City of	City of Manteca Wastewater Quality Control Plant	440	4.4	260	26	130	8.8	39,000
Mountain House Community Services District	Mountain House Wastewater Treatment Plant	95	1.1	57	5.7	28	1.9	12,000
Oakwood Lake Subdivision	Oakwood Lake Subdivision Mining Reclamation Project	-	-	-	-	-	-	-
Rio Vista, City of	Northwest Wastewater Treatment Facility	28	0.3	17	1.7	8.5	0.7	4,800
Rio Vista, City of	Beach Wastewater Treatment Facility	29	0.3	17	1.7	8.5	0.6	3,800
Sacramento Regional County Sanitation District	Sacramento Regional Wastewater Treatment Plant	7700	77	4700	470	2300	150	610,000
Stockton, City of	Regional Wastewater Control Facility	1900	19	1100	110	540	36	250,000
Tracy, City of	Tracy Wastewater Treatment Plant	620	6.2	370	37	180	12	120,000
Eastern Delta Tributary Dischargers								
El Dorado Irrigation District	Deer Creek Wastewater Treatment Plant	330	3.3	200	20	100	6.8	19,000
El Dorado Irrigation District	El Dorado Hills Wastewater Treatment Plant	210	2	130	13	63	4.3	20,000
Galt, City of	Wastewater Treatment Plant and Reclamation Facility	190	2	110	11	57	3.7	14,000
San Andreas Sanitary District	Wastewater Treatment Plant	-	-	-	-	-	-	-
Northern Delta Tributary Dischargers								
Davis, City of	Wastewater Treatment Plant	350	3.5	210	21	100	6.9	77,000
UC Davis	Main Wastewater Treatment Plant	210	2.1	130	13	64	4.3	27,000
Vacaville, City of	Easterly Wastewater Treatment Plant	640	6.4	390	39	190	13	81,000
Woodland, City of	Water Pollution Control Facility	330	3.3	200	20	100	6.7	70,000

Attachment D-3. 2030 Outer Boundary Scenario Projected POTW Discharge Loads

Agency	Facility	Predicted 2030 Average Daily Effluent Loads (pounds per day)						
		Total Organic Carbon	Total Phosphorus as P	Total Nitrogen as N	Ammonia as N	Nitrate as N	Nitrite as N	Total Dissolved Solids
Sacramento Basin Dischargers								
Anderson, City of	Anderson Water Pollution Control Plant	3.2	0.04	19	1.0	17	1.0	420
Auburn, City of	Wastewater Treatment Plant	4.5	0.04	27	1.5	22	1.5	590
Chico, City of	Chico Water Pollution Control Plant	36	0.4	210	180	12	12	4,700
City of Corning	Corning Wastewater Treatment Plant	2.8	0.03	17	14.0	1	0.9	370
Colfax, City of	Wastewater Treatment Plant	-	-	-	-	-	-	-
Colusa, City of	Wastewater Treatment Plant	-	-	-	-	-	-	-
Dunsmuir, City of	Wastewater Treatment Plant	-	-	-	-	-	-	-
Grass Valley, City of	Wastewater Treatment Plant	6.5	0.1	38	2.2	33	2.2	870
Lincoln, City of	Wastewater Treatment and Reclamation Facility	19	0.2	120	6.4	96	6.4	2,600
Linda County Water District	Wastewater Treatment Plant	10	0.1	61	3.4	51	3.4	1,300
Live Oak, City of	Wastewater Treatment Plant	3.1	0.03	19	1.0	15	1.0	410
Maxwell Public Utilities District	Wastewater Treatment Plant	-	-	-	-	-	-	-
Nevada City, City of	Nevada City Wastewater Treatment Plant	-	-	-	-	-	-	-
Nevada County Sanitation District No. 1	Cascade Shores Wastewater Treatment Plant	-	-	-	-	-	-	-
Nevada County Sanitation District No. 1	Lake Wildwood Wastewater Treatment Plant	-	-	-	-	-	-	-
Olivehurst PUD	Wastewater Treatment Plant	5.9	0.1	35	2.0	29	2.0	770
Placer County Department of Facility Services	Placer County Sewer Maintenance District No. 1 Wastewater Treatment Plant	5.1	0.05	31	1.7	25	1.7	680
Placer County Department of Facility Services	Placer County Sewer Maintenance District No. 3 Wastewater Treatment Plant	-	-	-	-	-	-	-
Placerville, City of	Hangtown Creek Water Reclamation Facility	5.1	0.1	31	1.8	26	1.8	670
Quincy Community Services District	Quincy Wastewater Treatment Plant	-	-	-	-	-	-	-
Red Bluff, City of	Red Bluff Wastewater Reclamation Plant	4.9	0.1	30	1.7	25	1.7	650
Redding, City of	Stillwater Wastewater Treatment Facility	9.2	0.1	54	3.1	46	3.1	1,200
Redding, City of	Clear Creek Wastewater Treatment Plant	26	0.2	150	8.4	120	8.4	3,300
Rio Alto Water District	Lake California Wastewater Treatment Plant	-	-	-	-	-	-	-
Roseville, City of	Pleasant Grove Wastewater Treatment Plant	26	0.3	160	8.5	130	8.5	3,400
Roseville, City of	Dry Creek Wastewater Treatment Plant	34	0.3	200	11	170	11.0	4,500
Sewerage Commission-Oroville Region	Sewerage Commission-Oroville Region Wastewater Treatment Plant	11	0.1	69	58.0	4	3.8	1,500
Shasta County Service Area No. 17	Cottonwood Wastewater Treatment Plant	-	-	-	-	-	-	-
Shasta Lake, City of	City of Shasta Lake Wastewater Treatment Facility	2.8	0.03	17	15.0	1	0.9	370
United Auburn Indian Community	Thunder Valley Casino Wastewater Treatment Plant	-	-	-	-	-	-	-
Williams, City of	Williams Wastewater Treatment Plant	-	-	-	-	-	-	-
Willows, City of	Willows Wastewater Treatment Plant	4	0.04	22	1.2	18	1.2	490
Yuba City, City of	Wastewater Treatment Facility	23	0.2	140	120.0	8	7.8	3,100
San Joaquin Basin Dischargers								
Angels, City of	City of Angels Wastewater Treatment Plant	-	-	-	-	-	-	-
Atwater, City of	Wastewater Treatment Facility	10	0.1	58	3.2	49	3.2	1,300
Calaveras County Water District	Forest Meadows Wastewater Reclamation Plant	-	-	-	-	-	-	-
Clovis, City of	Clovis Sewage Treatment Plant and Water Reuse Facility	13	0.2	77	4.2	64	4.2	1,700
Mariposa Public Utility District	Mariposa Wastewater Treatment Facility	-	-	-	-	-	-	-
Merced, City of	Wastewater Treatment Facility	33	0.3	200	11	170	11	4,400
Modesto, City of	Water Quality Control Facility	73	0.7	440	25	360	25	9,800
Planada Community Services District	Wastewater Treatment Plant	-	-	-	-	-	-	-
Turlock, City of	Wastewater Treatment Plant	49	0.5	290	16	240	16	6,500
Delta Dischargers								
Brentwood, City of	Wastewater Treatment Plant	17	0.2	99	5.6	83	5.6	2,300
Discovery Bay, Town of	Discovery Bay Wastewater Treatment Facility	11	0.1	68	3.7	56	3.7	1,500
Ironhouse Sanitary District	Ironhouse Sanitary District Wastewater Treatment Plant	12	0.2	75	4.1	62	4.1	1,700
Lodi, City of	White Slough Water Pollution Control Plant	23	0.3	140	7.6	110	7.6	3,000
Manteca, City of	City of Manteca Wastewater Quality Control Plant	26	0.2	160	8.8	130	8.8	3,500
Mountain House Community Services District	Mountain House Wastewater Treatment Plant	5.7	0.1	34	1.9	28	1.9	760
Oakwood Lake Subdivision	Oakwood Lake Subdivision Mining Reclamation Project	-	-	-	-	-	-	-
Rio Vista, City of	Northwest Wastewater Treatment Facility	2	-	10.0	0.6	9	0.7	230.0
Rio Vista, City of	Beach Wastewater Treatment Facility	2	-	10.0	9	1	0.6	230.0
Sacramento Regional County Sanitation District	Sacramento Regional Wastewater Treatment Plant	470	4.7	2,800	150	2,300	150	62,000
Stockton, City of	Regional Wastewater Control Facility	110	1.1	650	36	540	36	14,000
Tracy, City of	Tracy Wastewater Treatment Plant	37	0.4	230	12	180	12	5,000
Eastern Delta Tributary Dischargers								
El Dorado Irrigation District	Deer Creek Wastewater Treatment Plant	20	0.3	120	6.8	100	6.8	2,800
El Dorado Irrigation District	El Dorado Hills Wastewater Treatment Plant	13	0.3	75	4.3	63	4.3	1,700
Galt, City of	Wastewater Treatment Plant and Reclamation Facility	11	0.2	68	3.7	57	3.7	1,500
San Andreas Sanitary District	Wastewater Treatment Plant	-	-	-	-	-	-	-
Northern Delta Tributary Dischargers								
Davis, City of	Wastewater Treatment Plant	21	0.1	120	6.9	100	6.9	2,800
UC Davis	Main Wastewater Treatment Plant	13	0.1	77	4.3	64	4.3	1,700
Vacaville, City of	Easterly Wastewater Treatment Plant	39	0.4	230	13	190	13	5,100
Woodland, City of	Water Pollution Control Facility	20	0.1	120	6.7	100	6.7	2,700