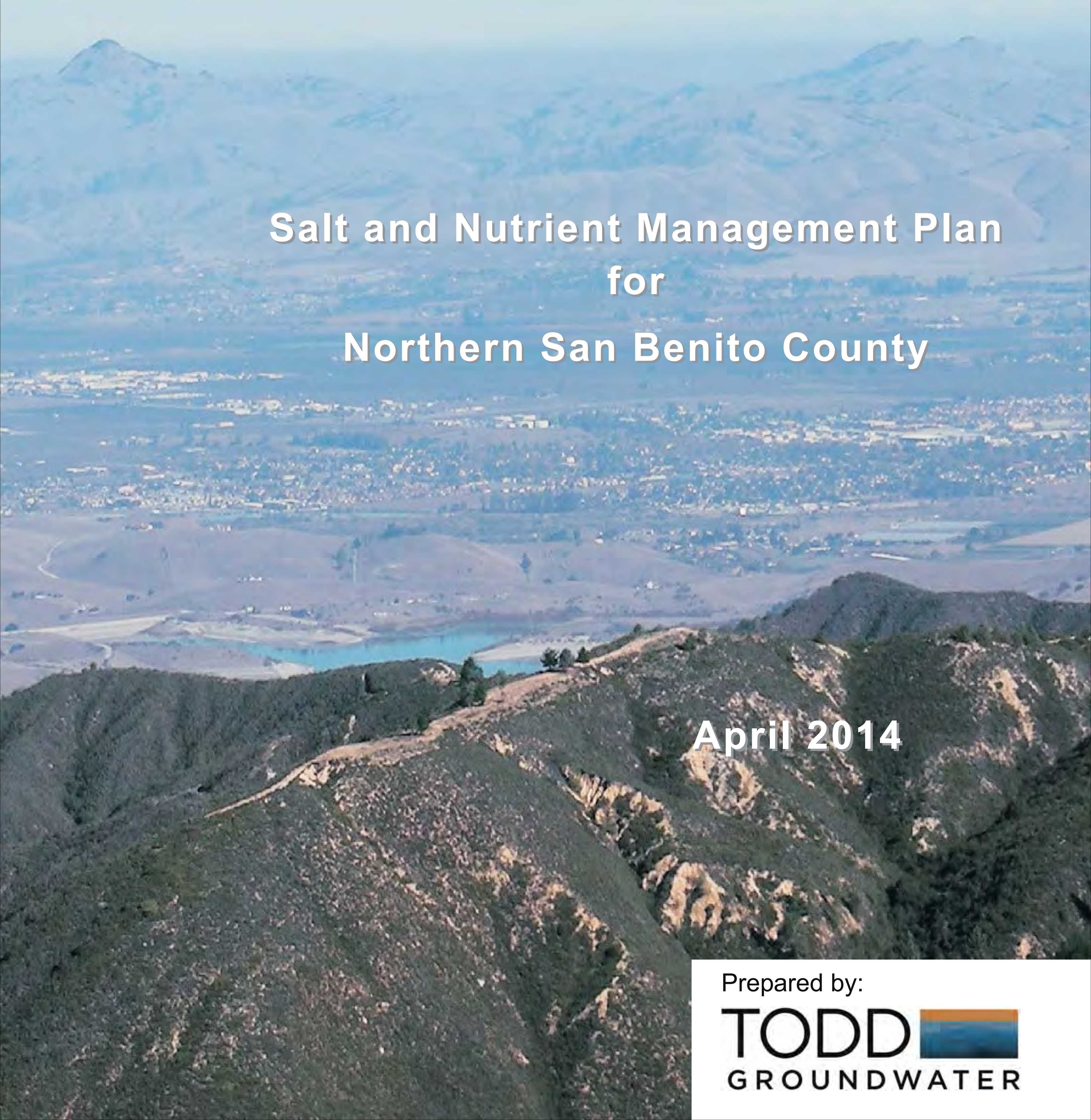

San Benito County Water District

Salt and Nutrient Management Plan for Northern San Benito County

April 2014

Prepared by:

TODD GROUNDWATER

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San Benito County Water District
San Benito County, California

Salt and Nutrient Management Plan

for

Northern San Benito County

April 2014

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PROFESSIONAL CERTIFICATION

This Salt and Nutrient Management Plan has been prepared under the direct supervision and with the support of the California Professional Geologists/Certified Hydrogeologists whose stamps and signatures appear below. The information contained in this plan has been prepared in accordance with the generally accepted principles and practices of their profession.

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List of Acronyms

AC	Assimilative Capacity
ACB	Assimilative Capacity Benchmark
AF	Acre-feet
AFY	Acre-feet per year
AGR	Agricultural Water Supply
AWQA	Agriculture Water Quality Alliance
BMPs	Best Management Practices
BSBPO	Basin Specific Basin Plan Objective
CA66	California NADP Monitoring Station 66, Pinnacles National Monument
CALSIM II	California State Water Project Operations Model
CASTNET	Clean Air Status and Trends Network
CDFA	California Department of Food and Agriculture
CCCRCDs	Central Coast Coalition of Resources Conservation Districts
CCWQC	Central Coast Water Quality Coalition
County	San Benito County
CVP	Central Valley Project
District	San Benito County Water District
DWR	California Department of Water Resources
DWWTP	Hollister Domestic Waste Water Treatment Plant
ET	Evapotranspiration
ft-msl	Feet mean sea level
GIS	Geographic Information Systems

GBPO	General Basin Plan Objective
GW	Groundwater
HNE	Hollister Northeast Subbasin
HSE	Hollister Southeast Subbasin
HW	Hollister West Subbasin
HUA	Hollister Urban Area
IWWTP	Hollister Industrial Waste Water Treatment Plant
IRWM	Integrated Regional Water Management
lbs/ac	Pounds per acre
LPRCD	Loma Prieta Resource Conservation District
MCL	Maximum Contaminant Level
MIL	Mobile Irrigation Laboratory
MG	Million gallons
MGD	Millions of gallons per day
mg/L	Milligrams per liter
M&I	Municipal and Industrial
MOU	Memorandum of Understanding
MUN	Municipal and domestic water supply
NADP	National Atmospheric Deposition Program
NRCS	U.S. Department of Agriculture, Natural Resources Conservation Service
N	Nitrogen
N_2	Nitrogen Gas
NE	Northeast
NO_3	Nitrate
RWQCB	Central Coast Regional Water Quality Control Board
SARE	Sustainable Agriculture Research and Education
SCCRCD	Santa Cruz County Resources Conservation District
SCVWD	Santa Clara Valley Water District
SSCWD	Sunnyslope County Water District
SMCL	Secondary Maximum Contaminant Level
SNMP	Salt Nutrient Management Plan
S/Ns	Salts and Nutrients
SE	Southeast
SWRCB	State Water Resources Control Board
TDS	Total Dissolved Solids
TM	Technical Memorandum
TP	Tres Pinos Subbasin
UC Davis	University of California at Davis
UL	Urban Landscape
umhos/cm	Micromhos per centimeter
USEPA	United States Environmental Protection Agency
USGS	United States Geological Society
WDR	Waste Discharge Requirement
WRF	Water Recycling Facility

WWTP	Waste Water Treatment Plant
WY	Water Year

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Executive Summary

The State Water Resources Control Board (SWRCB) Recycled Water Policy encourages increased use of recycled municipal wastewater as a safe, local, drought-proof, and highly reliable source of water supply (SWRCB, 2013). The Policy also encourages recharge of stormwater as a clean local water supply. Because of potential water quality concerns associated with recycled water, the Policy requires completion of a Salt and Nutrient Management Plan (SNMP) for all groundwater basins in California by 2014. The purpose of the SNMP is to identify all sources of salts and nutrients (both current and future) in the basins and to manage those salt and nutrient sources in a manner that ensures that groundwater is safe for drinking and all other beneficial uses.

If the SNMP analysis finds that water quality objectives are being exceeded or are threatened to be exceeded in the future, implementation measures are identified to manage salt and nutrient sources. Recycled water projects are assessed in terms of the use of the groundwater basin's available assimilative capacity. Assimilative capacity is the difference between average salt and nutrient concentrations in the basin and the respective basin plan objectives.

This Salt and Nutrient Management Plan (SNMP) report has been prepared by Todd Engineers for San Benito County Water District (District) with input from local stakeholders.

Stakeholder Process

The Policy states that development of the SNMP shall be a stakeholder driven process. In order to keep stakeholders informed of the SNMP process and to seek their feedback, the District hosted four workshops. In addition, the District posted all SNMP materials on their website, providing access for review and comments on all draft work products. Over fifty stakeholders were included in the outreach efforts, with a focus on those whose activities and operations may impact salt and nutrient (S/N) management (e.g., agricultural interests, water and wastewater dischargers, and recycled water producers). Other stakeholders included municipalities, water agencies, private well owners, environmental groups, regulatory staff, and the general public.

Hydrogeologic Conceptual Model

The hydrogeologic conceptual model describes the Study Area characteristics necessary to account for all inflows and outflows of S/Ns. The Study Area encompasses approximately 200 square miles within the San Benito County portion of the California Department of Water Resources (DWR) Gilroy-Hollister Groundwater Basin. Based on local geology, water supply infrastructure, and political boundaries, the Gilroy-Hollister Groundwater Basin was further subdivided into twelve subbasins. The hydrogeology of each subbasin was evaluated to estimate the average aquifer thickness, S/N mixing thickness, and porosity.

Water is supplied to municipal, rural, and agricultural users in the Study Area from imported Central Valley Project water, local surface water, local groundwater, and recycled water. The volume of water supplied from each source is a key component of the water balance that is the foundation of the S/N balance. The water balance includes specific inflows and outflows. The largest inflows over the last ten years in the Study Area are subsurface groundwater inflow from adjacent subbasins and surrounding hills (34%), rainfall percolation (21%), and natural stream recharge (18%). A total of 23% is groundwater recharge from agricultural irrigation return flows, managed aquifer recharge, and wastewater pond percolation. The remaining (4% is from septic system percolation, water line leaks, and domestic irrigation return flows. Subbasin outflows include agricultural pumping (54%), subsurface outflow (29%) and municipal/domestic groundwater pumping (17%).

Existing Groundwater Quality

Total Dissolved Solids (TDS) and nitrate have been selected as the most appropriate indicators of S/Ns in the Study Area. To identify the current average S/N groundwater concentration in each subbasin, mean TDS and nitrate concentrations measured in wells were interpolated using Geographical Information Systems (GIS). The subbasin averages serve as a snapshot and allow for the calculation of each subbasins' assimilative capacity, namely, the difference between the average groundwater concentration and the applicable water quality objective. Applicable objectives from the Central Coast Regional Water Quality Control Board Basin Plan (Basin Plan) include general objectives for nitrate in eight of the subbasins and basin-specific objectives for nitrate and TDS in four of the subbasins. A TDS benchmark objective of 1,200 milligrams per liter (mg/L) was used in eight subbasins that do not have a TDS objective specified in the Basin Plan. Relative to the applicable water quality objectives, each subbasin currently has available assimilative capacity for both TDS and nitrate.

Baseline Period Salt and Nutrient Balance

TDS and nitrate mass balances accounting for all subbasin inflows and outflows were developed from the volumes and concentrations associated with eleven S/N factors over the baseline period (2002 to 2011). In order to simulate the effect of S/N loading (and unloading) on groundwater quality in each subbasin, a spreadsheet mixing model was developed. The mixing model incorporates the existing volume of groundwater and mass of TDS and nitrate in storage and tracks the annual change in groundwater storage and S/N mass for each subbasin. Because there may be uncertainties in the loading assumptions, simulated results are compared to observed groundwater concentrations to calibrate the loading assumptions. S/N loading concentrations for agricultural irrigation return flows, rainfall recharge, and municipal pumping were adjusted through the calibration process.

The simulated results of the calibrated mixing model for TDS in each subbasin for the baseline period show that the average groundwater concentrations are relatively stable. These trends are consistent with observed groundwater concentration trends. The TDS trends generally reflect the large buffering capacity of the existing groundwater in storage and the muted impact of salt loading on groundwater at lower aquifer depths. Nitrate results indicate a small, steady increase in concentrations during the baseline period of between 1 and 6 milligrams per liter (mg/L) in nine subbasins with three subbasins showing stable concentrations trends. Elevated nitrate concentrations have been a recognized, long-term concern in the Study Area; however, the mixing model increases in basin averages are larger than would be expected based on observed groundwater concentration trends. Therefore, the simulated nitrate average, after calibration, may overestimate actual concentrations.

The relative percentage of the TDS mass load from each of the various sources varies significantly across the Study Area, with subsurface groundwater inflow or agricultural irrigation return flows constituting the largest mass in most subbasins. Other major sources are natural stream percolation and rainfall percolation. The largest source of nitrate loading in most basins is agricultural return flows. Other sources of nitrate mass load are subsurface groundwater inflow and septic system percolation.

Goals, Objectives, and Implementation Measures

Goals and objectives allow assessment of projected changes in loading sources and concentrations. Implementation measures are programs and activities to manage S/N loading. Goals, objectives, and implementation measures have been developed over a decade of regional integrated work as defined in the Hollister Urban Area Water and Wastewater Master Plan (AECOM, 2011), San Benito County 2035 Draft General Plan (San Benito County, 2012), and the Central Coast Regional Water Quality Control Board's (RWQCB) Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands, and other documents and sources of data. Collectively, these and other key documents articulate the goals of improving the quality of source water, recycled water, and wastewater effluent as well as preserving agricultural lands while reducing nutrient loading. SNMP S/N management goals will be reached through specific implementation measures that include capital improvement projects, water supply diversification, salt and nutrient management, water conservation, and educational outreach.

Future Water Quality and Assimilative Capacity

The goals, objectives, and implementation measures were used to quantify the volumes and quality of source water inflows and outflows (S/N balance) for the future planning period extending from 2012 to 2021. Hydrologic conditions in 2011 were used to simulate the volume of natural inflows and outflows during the future planning period. Adjustments were made to the source water supply for municipal water and agricultural supply based on the predicted mix of groundwater and Federal Central Valley Project (CVP) imported water to meet a target hardness goal established by the District in their recent Optimization Study. This change in source water produces a corresponding improvement in wastewater and recycled water quality.

Based on the mixing model results, future groundwater quality conditions and assimilative capacity are estimated for each subbasin. The results indicate that all but two subbasins will have declining or stable TDS concentrations and all subbasins will retain available assimilative capacity through 2021. By 2021, the average nitrate concentration increases slightly (less than 10 mg/L nitrate) in nine subbasins, and is stable in three subbasins. No subbasins will exceed the applicable water quality objectives; therefore there is available nitrate assimilative capacity in each subbasin through 2021.

Anti-degradation Analysis

The Recycled Water Policy established impacts evaluation criteria, such that a single recycled water project may use less than 10% of the available assimilative capacity (and multiple recycled water projects may use less than 20% of the available assimilative capacity) until such time as a SNMP is adopted. If these criteria are satisfied, the associated anti-degradation analysis would only need to document the projected future assimilative capacity use.

The SNMP analysis demonstrates that the both single and multiple recycled water irrigation projects planned through 2021 use less than 1% of the available TDS and nitrate assimilative capacity. Therefore, the irrigation projects meet the Recycled Water Policy criteria. The future projection analysis shows that recycled water irrigation is a small component of S/N loading in the Study Area. Further, the benefits in terms of sustainability and reliability of recycled water use cannot be overstated. The SNMP analysis finds that recycled water use can be increased while still protecting groundwater quality for beneficial uses.

SNMP Monitoring Plan

The Recycled Water Policy states that the SNMP should include a monitoring program that consists of a network of monitoring locations adequate to determine whether the concentrations of S/Ns are consistent with applicable water quality objectives. The District has developed a comprehensive database and groundwater monitoring program and also compiles and assesses data from other programs such as groundwater quality data reported to the RWQCB and California Department of Public Health (CDPH). These data and analyses are reported triennially in the District's Groundwater Report. The existing data were found to be adequate to characterize average subbasin groundwater quality and to allow comparison with water quality objectives. This existing program and reporting will be used to fulfill the SNMP Monitoring Program requirements. Nonetheless, 13 additional wells were added to the existing program to make the program more robust.

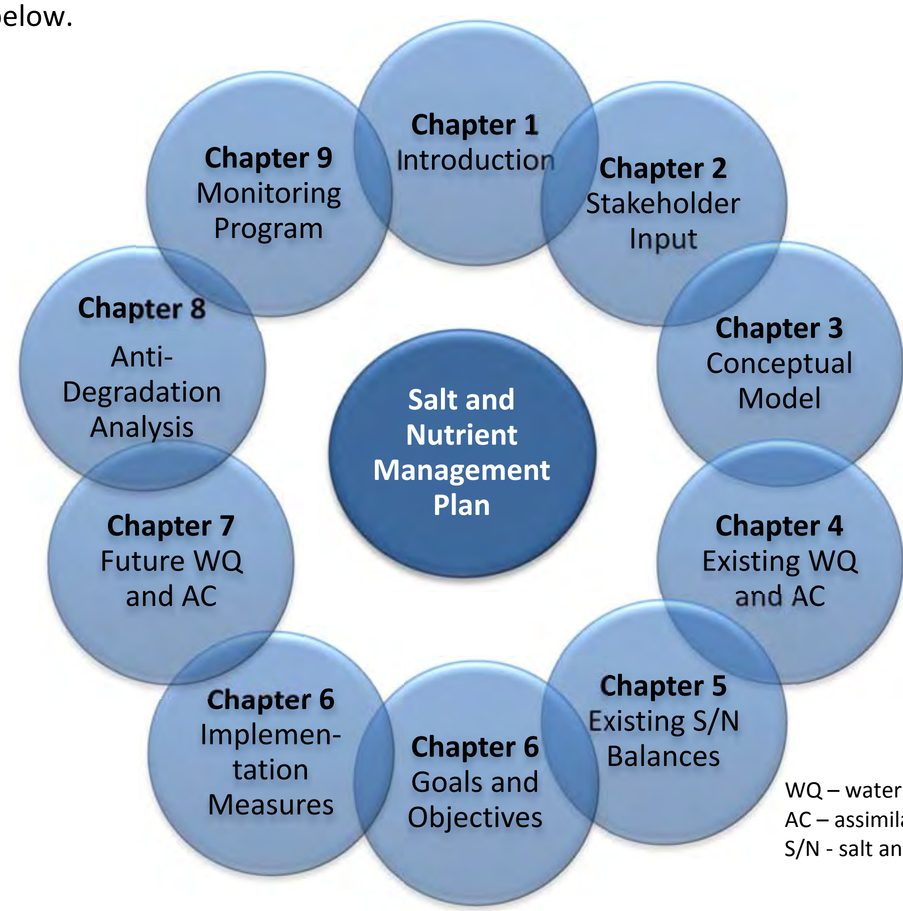
1 Introduction

In February 2009, the SWRCB adopted Resolution No. 2009-0011, which established a statewide Recycled Water Policy[1]. The policy encourages increased use of recycled water and local stormwater capture. It also requires local water and wastewater entities, together with local S/N contributing stakeholders to develop a SNMP for each groundwater basin or subbasin in California. It is the intent of the policy that salts and nutrients from all sources be managed on a basin-wide or watershed-wide basis in a manner that ensures attainment of water quality objectives and protection of beneficial uses.

This SNMP has been prepared by Todd Engineers for District with input from stakeholders. The geographic extent of the SNMP is an approximately 200 square mile area located in Northern Benito County. The SNMP is one component of the Pajaro River Watershed IRWM Plan Update.

1.1 SNMP Organization

The SNMP is organized into an Executive Summary and nine chapters including the components shown below.



WQ – water quality
AC – assimilative capacity
S/N - salt and nutrient

[1] Draft amendments to the policy were issued in September 2012 and in January 2013. The amendments were adopted at the January 22, 2013 Board meeting.

In addition, supporting materials for the SNMP are located at the end of the report in the following four appendices:

Appendix A – Stakeholder List

Appendix B - Technical Memorandum (TM) - 1, *Hydrogeologic Conceptual Model,* describes the Study Area hydrogeologic conditions including water balances and existing groundwater quality and available assimilative capacity.

Appendix C - TM-2, *Salt and Nutrient Balance and Fate and Transport Analysis,* describes the baseline period S/N balance, water quality, simulated baseline period water quality, and calibration process. Anticipated future changes in the S/N balances are described based on stated plans, goals, and implementation measures. Future groundwater for the future planning period is simulated and future assimilative capacity is estimated.

Appendix D – The *SNMP Monitoring Plan* summarizes the monitoring program and reporting proposed to monitor S/Ns in the Study Area.

2 Stakeholder Process

The role of the SNMP stakeholders is to review and comment on work products, assist in the development of goals and objectives and loading estimates and assumptions, and help identify and develop S/N management measures. This chapter describes how stakeholders were identified and invited to participate in developing the SNMP.

Participation by local agencies, communities, organizations, and landowners was an important part of the SNMP process. Appendix A lists over 50 stakeholders.

2.1 Stakeholder Identification

Initially, stakeholders were identified from an existing IRWM stakeholder list. After each stakeholder meeting, any new stakeholders in attendance were added to the list. The stakeholders included those whose activities and operations may impact S/N management in Northern San Benito County, including agricultural interests, wastewater dischargers, and recycled water producers. Other stakeholders included municipalities, water agencies, private well owners, environmental groups, regulatory staff, and the general public. Appendix A lists over fifty stakeholders who were included in the SNMP development.

2.2 Stakeholder Notification

An initial public notice announced to the community that the Pajaro River Watershed IRWM region had been awarded a $1 million DWR grant to update and enhance the IRWM Plan for the region. Once the SNMP process was underway, stakeholders were notified twice prior to each stakeholder workshop. The first notice was published two weeks in advance of each workshop; the second notice was published one week prior to each workshop. A total of four workshops were held. The first workshop notice was published in the Weekend Pinnacle, while the remaining three workshop notices were published in the Hollister Free Lance.

Stakeholders were also notified about upcoming workshops via email and the District's website. The District created a link on their home page to a SNMP page that provided access to all draft SNMP work products including:

- SNMP Work Plan
- TM-1 - Hydrogeologic Conceptual Model
- TM-2 - Salt and Nutrient Balance and Fate and Transport Analysis
- Draft SNMP Report
- SNMP Monitoring Program
- Workshop 1 presentation and meeting notes
- Workshop 2 presentation and meeting notes
- Workshop 3 presentation and meeting notes
- Workshop 4 presentation and meeting notes

2.3 Stakeholder Meetings

In order to keep stakeholders informed of the SNMP and to seek their feedback, The District hosted four workshops at their District Office in Hollister. Each workshop included a PowerPoint slide presentation with ample time allocated for comments, questions, and answers. Stakeholder participation was tracked via sign-in sheets. After each workshop, the presentation and meeting notes were posted on the District's webpage. The dates, times, and content of each workshop are summarized below.

Workshop 1 March 7, 2012 2:00 pm

- Introduction to SNMPs
- Stakeholder Process
- Proposed SNMP Approach
- Schedule

Workshop 2 October 18, 2012 1:30 PM

- Overview of SNMP Process
- Existing Water Quality
- Exising Basin Assimilative Capacity
- Mixing Model and Calibration
- Salt and Nutrient Balance

Workshop 3 February 26, 2013 10:00 AM

- SWRCB Recycled Water Policy Overview
- Current Groundwater Quality and Assimilative Capacity
- Goals and Objectives
- Implementation Measures
- Future Groundwater Quality and Assimilative Capacity

Workshop 4 July 17, 2013 10:00 AM

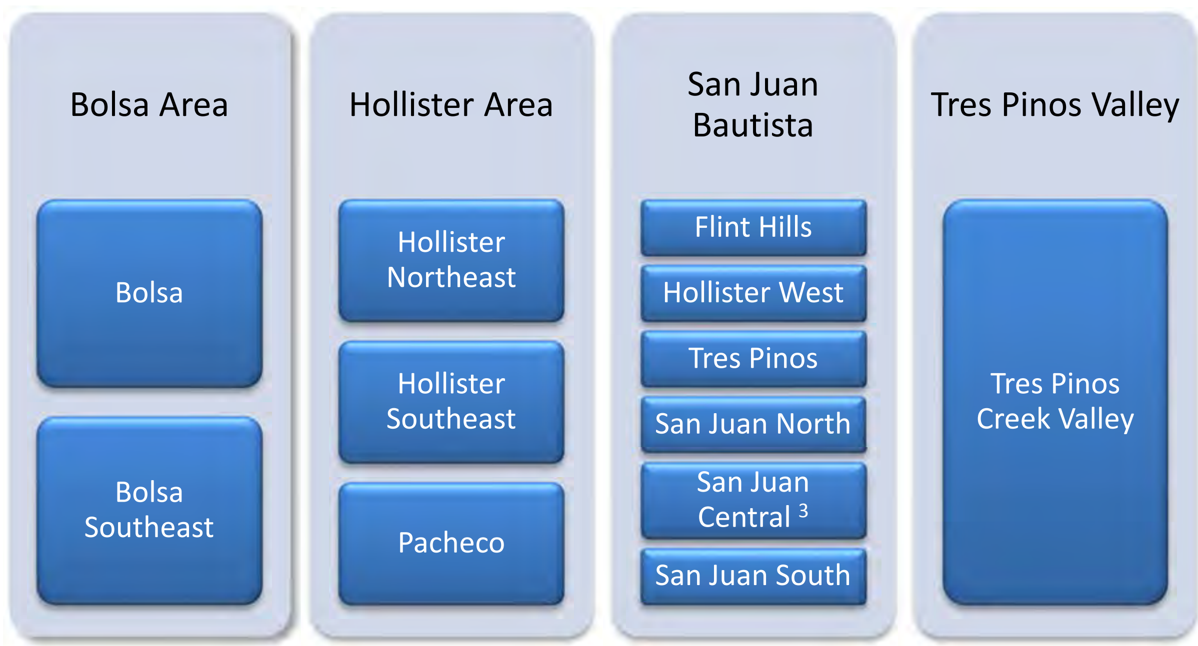
- Monitoring Plan
- Overview of Draft SNMP
- Future Groundwater Quality and Assimilative Capacity
- Implementation Measures

3 Hydrogeologic Conceptual Model

The hydrogeologic conceptual model provides the basis for subsequent S/N loading and assimilative capacity estimates. The conceptual model includes the Study Area hydrogeologic conditions, water balances, and existing water quality. The water balance documents the volume of annual basin inflows and outflows (natural and managed groundwater recharge, subsurface groundwater flow, groundwater extraction, etc.). The existing water quality conditions for groundwater, local surface water, imported water, recycled water, and wastewater quality are fundamental mass load parameters for the S/N balance. In addition, existing groundwater quality provides the baseline for predicting future loading, and groundwater quality trends help provide a calibration metric for loading estimates.

3.1 Study Area

The Study Area covers approximately 200 square miles located in the San Benito County (County) portion of the Gilroy-Hollister Groundwater Basin, which includes the Bolsa Area, Hollister Area, San Juan Bautista, and Tres Pinos Valley groundwater subbasins[2] as defined by the DWR in Bulletin 118 (DWR, 2003). The Gilroy portion of the Gilroy-Hollister Basin lies in Santa Clara County and is not included in the Study Area. The DWR subbasins and basins are shown in **Figure 1**. For purposes of this study, the Bolsa, San Juan Bautista, and Hollister Subbasins are further subdivided as shown in **Figure 2** and in the chart below.



[2] Tres Pinos Valley is classified as a basin by DWR, but for simplicity it is referred to as a subbasin in the SNMP report.

[3] San Juan Central includes the District's designated Paicines Valley.

The District has formed three zones of benefit in the County. Zone 6 (shaded red in **Figure 2**) includes the most developed, studied and actively managed part of the County. Accordingly, Zone 6 is the area with the most available data to support the SNMP analyses. Because the District has historically described water balances in terms of the District-designated subbasins within Zone 6, these District subbasin designations were maintained for the S/N loading and assimilative capacity analyses. Nonetheless, the portions of the DWR-designated Bolsa, Hollister, and San Juan subbasins that extend beyond the Zone 6 boundaries were also included in the SNMP Study Area and considered in the SNMP analyses. Data in these areas outside of Zone 6 are sparse.

Figure 3 shows a 2010 land use map of the Study Area prepared for TM-1. In the northern Study Area, 50% of the acreage is farmland, 35% is native vegetation, and the remaining 15% is urban and rural residential. Urban areas include the cities of Hollister and San Juan Bautista, and the community of Tres Pinos. The central and southern part of the Study Area is less developed and more sparsely populated with 89% native vegetation and 10% cropland. The remaining 1% of acreage includes urban and rural residential lands.

3.2 Aquifers and Groundwater Occurrence

The DWR-designated basin and subbasins include valley areas composed of Holocene and late Pleistocene alluvial deposits with relatively high permeability and upland areas composed of mainly Pliocene-Pleistocene continental deposits of moderate permeability. The Flint Hills and most of the central San Juan Subbasin encompass areas of elevated, lower permeability Pliocene continental deposits, which would likely yield relatively small quantities of groundwater. The valley-fill units were deposited in alluvial fan and fluvial environments from a variety of source rocks and directions. These deposits interfinger in the subsurface, making the differentiation of discrete aquifers difficult on a regional basis. This also results in variable aquifer properties across the Study Area (LSCE, 1991; Faye, 1974).

Groundwater generally occurs under both unconfined and confined conditions in the Study Area. Surficial clay deposits, especially in the Bolsa and northern San Juan subbasins, create non-continuous confining layers.

3.2.1 Aquifer Parameters

In order to assess loading and mixing for subsequent SNMP analyses, subbasin mixing zones and porosity were estimated. Subbasin mixing zones and porosity were calculated from the estimated thickness of each basin or subbasin. The mixing zone in each basin or subbasin is assumed to be less than the total thickness, recognizing the layered nature of the sediments and increased impacts of surface contaminant releases in shallow zones. This is a conservative assumption, because it reduces the total volume of the mixing zone and increases the apparent impacts of S/N loading. **Table 1** presents subbasin area, mixing zone, and porosity estimates that are used for subsequent analyses.

Table 1 Subbasin Characteristics

SNMP Subbasin	Area (acres)	Average Aquifer Thickness (feet)	Mixing Thickness (feet)	Porosity
Bolsa	20,907	700	400	0.15
Bolsa Southeast	2,689	700	400	0.15
Flint Hills	8,153	300	250	0.15
Hollister Northeast	11,381	700	400	0.15
Hollister Southeast	6,947	700	400	0.15
Hollister West	6,051	700	400	0.15
Pacheco	10,469	700	400	0.15
San Juan Central	21,791	400	350	0.15
San Juan North	11,873	400	350	0.15
San Juan South	24,214	300	250	0.15
Tres Pinos	4,736	400	350	0.15
Tres Pinos Creek Valley	3,387	350	300	0.15

3.2.2 Water Levels and Flow

In general, water levels in the northern Study Area currently range from about 480 feet mean sea level (ft-msl) in the southeastern corner to below 80 ft-msl near the pumping depression in the Bolsa Subbasin. Imported water, managed percolation, and decreased groundwater use have resulted in groundwater levels at or near their historic highs in most of the northern Study Area in recent years. The exception to this increasing trend is observed in a persistent pumping depression in the Bolsa Subbasin, which does not receive CVP imported water and relies on solely groundwater for water supply. Water levels are near 130 ft-msl at the San Juan Subbasin outflow near the confluence of the San Benito and the Pajaro rivers.

See Appendix B , Figure 7 for a 2010 groundwater contour map for the central and northern Study Area.

Groundwater in the Study Area generally flows from southeast to northwest. In the northern Study Area, groundwater flows from the southeast and eastern portions of the basin toward the western and northwestern portions of the basin to the Pajaro River. General flow directions in the Bolsa Subbasin have been reversed due to groundwater pumping. Groundwater in the Bolsa Subbasin near the Pajaro River flows southeast toward the pumping depression.

3.3 Water Supply

Water is supplied to municipal, rural, and agricultural users from four sources:

- District purchased and imported CVP water,

- Local surface water stored and released in District-owned and operated Hernandez and Paicines reservoirs,
- Local groundwater pumped from wells, and
- Recycled water used for irrigation.

The CVP water is delivered to agricultural, municipal, and industrial customers in Zone 6. Reservoir releases into Tres Pinos Creek and the San Benito River augment groundwater recharge during the dry season. Within the urban areas, groundwater is pumped by the City of Hollister, Sunnyslope County Water District (SSCWD), and other small local purveyors. Many small communities and rural residents rely on private wells. Recycled water is used for irrigation in Hollister at the Brigantino Riverside Park and the Hollister Municipal Airport.

3.4 Water Use

Total water use throughout the entire Study Area is not known, but most of the water use occurs in the northern Study Area. In the area with CVP deliveries (Zone 6), total water use—including CVP water and groundwater—has ranged between 35,000 and 50,000 acre-feet per year (AFY) for the last decade; both agricultural use and municipal use has generally declined in recent years. The relative amount of imported and groundwater used in the northern Study Area varies significantly from year to year based on availability of imported water supplies. In 2011, groundwater supplied approximately 49% and imported water supplied approximately 51% of the water used for agriculture, municipal, domestic, and industrial supply in Zone 6. Agricultural irrigation accounted for 79% of the total water use in Zone 6 in 2011.

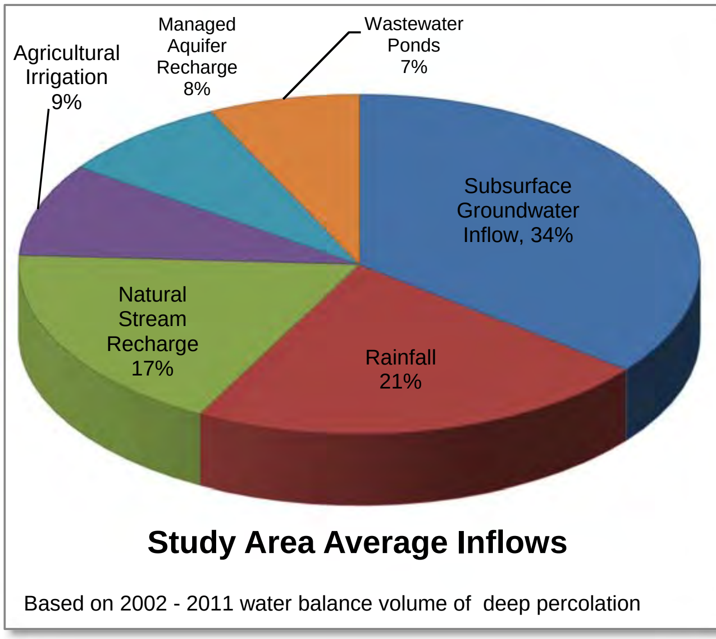
The Bolsa Subbasin, the central and southern San Juan Subbasin, and the Tres Pinos Valley Basin rely on groundwater for 100% of their water supply. Based on the past ten years of water balance estimates, groundwater pumped from Central San Juan Subbasin averaged 1,500 AFY. Groundwater pumped from the Tres Pinos Valley averaged 500 AFY. No production wells have been identified in the Flint Hills and groundwater pumping in the area is assumed to be zero.

3.5 Water Balance Inflows, Outflows, and Change in Storage

The water balance, reported annually by the District, provides estimates of specific inflows and outflows for each District-designated subbasin. District water balances were compiled for a ten-year baseline period, 2002 to 2011. In order to encompass the entire SNMP Study Area, water balances were also prepared for the southern San Juan Subbasin and the Flint Hills. In addition, volumes for septic system return flow, municipal/domestic return flow, and sewer/water line leakage were derived from the water balance. Refer to Appendix B, Chapter 3, for the methodology used to estimate the volume of these additional components.

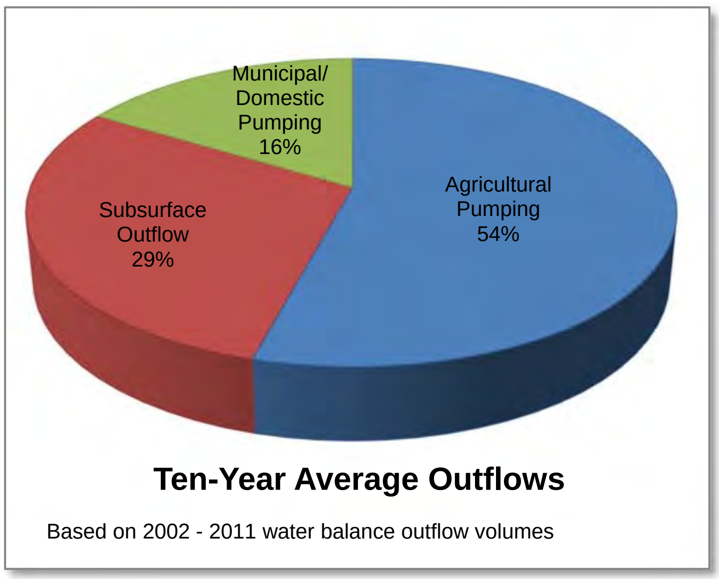
3.5.1 Inflows

The chart to the right shows the relative proportion of average inflows during the baseline period for the Study Area. Minor inflows not shown on the chart include septic systems recharge (2%), sewer/water line leaks (1%), and domestic/municipal irrigation return flows (1%). Within five subbasins (Bolsa, Bolsa Southeast, Hollister West, Pacheco, and Tres Pinos) subsurface groundwater inflow is the largest volume of inflow. Deep percolation of rainfall is the largest volume of inflow in Flint Hills, Hollister Northeast, Hollister Southeast, San Juan North, and San Juan South. In the San Juan Central and Tres Pinos Creek Valley, natural stream deep percolation is the largest component of inflow.



3.5.2 Outflows

The chart to the right illustrates the average outflows from the Study Area between 2002 and 2011. The largest component, agricultural groundwater pumping, is measured using hour meters on irrigation wells in Zone 6 and is estimated for the surrounding areas based on the soil moisture balance and crop water demands. The amount of agricultural pumping is dependent on the volume of CVP imports and the amount and timing of rainfall, because spring rains decrease total irrigation demand, and growers adjust groundwater pumping to compensate for changes in the availability of CVP imports.



Agricultural groundwater pumping is the largest outflow in Bolsa, Bolsa Southeast, Hollister Northeast, San Juan Central, San Juan North and Tres Pinos Creek Valley. In Hollister West, Hollister Southeast, and Tres Pinos, the largest outflow is municipal and domestic groundwater pumping. In the Pacheco and San Juan North subbasins, subsurface groundwater outflow is the largest component of outflow. There are no natural stream outflows within the Study Area, except during very wet years. These outflows are highly variable, difficult to estimate, and relatively small. Therefore, stream outflows are not included in the S/N balance analysis.

3.5.3 Change in Storage

Annual change in storage varies for individual subbasins from year to year. Over half of the subbasins have a negative cumulative change in storage at the end of ten-year baseline period. Subbasins with a positive change in storage include: Bolsa, Flint Hills, Pacheco, San Juan South, and Tres Pinos Creek Valley.

Refer to Appendix B, TM-1 for the water balance inflows, outflows, and change in storage for each subbasin in the Study Area.

4 Existing Groundwater Quality

TDS and nitrate have been selected as the most appropriate indicators of S/Ns in the Study Area. Total salinity is commonly expressed in terms of TDS[4] in milligrams per liter (mg/L). Because TDS water quality data are widely available for source waters (both inflows and outflows) in the Study Area and because TDS is a general indicator of total salinity, TDS is an appropriate indicator of S/Ns. TDS fate and transport is relatively simple, as it does not undergo significant transformation in the environment. Nutrients are represented by nitrate and are reported in this SNMP as nitrate as nitrate (nitrate-NO_3)[5]. Nitrate that ultimately reaches groundwater has undergone a number of transformation processes as part of the complex nitrogen cycle. As a result, the nutrient balance estimates the losses of applied nitrogen that occur with each transformation process. Elevated nitrate concentrations have been an ongoing groundwater quality challenge in the northern Study Area.

4.1 Existing Groundwater Quality

The current basin averages for TDS and nitrate concentrations were calculated using a GIS analysis of interpolated TDS and nitrate concentrations contours, shown on **Figures 4** and **5**, respectively. The interpolations are based on all observed data, with more weighting given to newer data (2007 – 2010) in areas where both recent and historical data are available. Average TDS and nitrate concentrations for each subbasin are shown in **Table 2**.

In reviewing time concentration data, TDS trends are somewhat mixed; however, more wells show decreasing trends (12 wells) than increasing trends (2 wells). Nitrate trends are also somewhat mixed; however, more wells show decreasing trends (11 wells) than increasing trends (5 wells).

4.2 Applicable Water Quality Objectives

The subbasin average concentrations serve as a snapshot of water quality conditions and allow for comparison of groundwater concentrations with applicable water quality objectives across the Study Area. The Central Coast Basin Plan (RWQCB, 2011) states that groundwater shall not contain concentrations of chemical constituents in excess of the limits specified in California Code of Regulations, Title 22, Chapter 15, Article 4, referred to in this SNMP as General Basin Plan Objectives (GBPOs). The GBPO for nitrate is 45 mg/L, the primary maximum contaminant level (MCL). **Table 2** lists numeric GBPOs for groundwater with municipal and domestic water supply (MUN) and agricultural water supply (AGR) beneficial uses in the Central Coast. There is no primary MCL for TDS listed in Title 22, Chapter 15, Article 4; however, the CDPH has adopted Secondary Maximum Contaminant Levels (SMCLs) for TDS. SMCLs address aesthetic issues related to taste, odor, or appearance of the water and are not related to health effects. However, elevated TDS concentrations can affect its desirability for irrigation uses. The

[4] Most of the water quality data in the Study Area include direct measurement of TDS in mg/L. Some groundwater quality is reported as specific conductance in micromhos per centimeter. These data were converted to TDS in mg/L based on Kilburn, 1972: TDS mg/L = (Specific conductance x 0.721) – 125.

[5] Water quality data reported as nitrate as nitrogen (nitrate-N) were multiplied by 4.425 to convert to nitrate-NO_3.

recommended SMCL for TDS is 500 mg/L with an upper limit of 1,000 mg/L. It has a short-term limit of 1,500 mg/L.

In addition to the above objectives, the Central Coast Regional Water Quality Control Board (RWQCB) has established certain Basin-Specific Basin Plan Objectives (BSBPOs) for selected groundwaters that are intended to serve as a water quality baseline for evaluating water quality management. The Basin Plan (RWQCB, 2011) states that these objectives are median values based on data averages for groundwater and that these objectives are based on preservation of existing quality or water quality enhancement believed attainable following control of point sources. The BSBPO for total nitrogen is 5 mg/L for the Hollister Subbasin and Tres Pinos Basin. This value is half the MCL for nitrate plus nitrite as nitrogen (as N), which is 10 mg/L. Assuming 100% of the nitrogen is in the form of nitrate, the objective can be converted into a BSBPO for nitrate-NO_3 of 22.5 mg/L. The TDS BSBPOs are 1,200 mg/L for the Hollister Subbasin and 1,000 mg/L for the Tres Pinos Basin as shown in Table 2.

In the absence of GBPOs or BSBPOs for the DWR San Juan Bautista and Bolsa subbasins, a TDS Assimilative Capacity Benchmark (ACB) was needed in the SNMP to calculate the available assimilative capacity. Table 2 presents a TDS ACB of 1,200 mg/L for the DWR San Juan and Bolsa Subbasins. Ambient groundwater quality in the San Juan Bautista and Bolsa subbasins is similar to or slightly poorer than in the Hollister Subbasin; so use of the same TDS BSBPO from this subbasin is deemed reasonable. The GBPO for nitrate (45 mg/L) has been applied to assimilative capacity calculations in the DWR San Juan Bautista and Bolsa subbasins. Average San Juan North groundwater quality (1,198 mg/L) is nearly at the ACB for TDS (1,200 mg/L); therefore, very limited assimilative capacity exists in that subbasin.

4.3 Assimilative Capacity

Assimilative capacity, shown on Table 2, is calculated by comparing the subbasin average ambient concentrations with water quality objectives. All subbasins have existing assimilative capacity for TDS and nitrate, although very limited assimilative capacity exists in San Juan North.

> All subbasins have existing assimilative capacity for TDS and nitrate

Table 2 Existing Groundwater Quality and Assimilative Capacity

DWR Groundwater Basin/Subbasin	SNMP Subarea	TDS (mg/L)				Nitrate-NO_3 (mg/L)			
		GW Average	Basin Specific Basin Plan Objective [6]	Assimilative Capacity Benchmark [7]	Assimilative Capacity	GW Average	Basin Specific Basin Plan Objective [8]	General Basin Plan Objective [9]	Assimilative Capacity
Bolsa Area	Bolsa [1, 5, 10]	670	-	1,200	530	3.9	-	45	41.1
Bolsa Area	Bolsa SE [1]	1,006	-	1,200	194	15.4	-	45	29.6
San Juan Bautista	Flint HIlls [4]	376	-	1,200	824	3.0	-	45	42.0
San Juan Bautista	Hollister West [1, 11]	1,019	-	1,200	181	21.7	-	45	23.3
San Juan Bautista	Tres Pinos [1]	995	-	1,200	205	8.9	-	45	36.1
San Juan Bautista	San Juan North [1]	1,198	-	1,200	2	14.6	-	45	30.4
San Juan Bautista	San Juan Central [2]	794	-	1,200	406	9.5	-	45	35.5
San Juan Bautista	San Juan South [3]	720	-	1,200	480	5.0	-	45	40.0
Hollister Area	Hollister NE	741	1,200	-	459	11.4	22.5	-	11.1
Hollister Area	Hollister SE [1]	1,030	1,200	-	170	7.6	22.5	-	14.9
Hollister Area	Pacheco [1]	533	1,200	-	667	8.2	22.5	-	14.3
Tres Pinos Valley	Tres Pinos Cr Valley [2]	720	1,000	-	280	5.0	22.5	-	17.5

1 - Average groundwater concentrations based on interpolation of median well concentration data and contours

2 - Average groundwater concentrations based on average concentration of all available sampling events

3 - Average groundwater concentrations in Tres Pinos Creek Valley applied to San Juan South

4 - Average groundwater concentrations based on one sampling event for Live Oak Water Association

5 - Acreage and average TDS groundwater concentration does not include the elevated TDS hotspot in the north of the Bolsa Area, which has had historical TDS detections as high as 59,000 mg/L; if this hotspot is included in the calculation, the average TDS in the Bolsa Area is 1,534 mg/L and the average concentration exceeds the assimilative capacity benchmark, and the area would have no available assimilative capacity for additional TDS loading

6 - Objectives established in the Basin Plan for DWR Hollister Area Subbasin and Tres Pinos Valley Basin

7 - In the absence of a General Basin Plan Objective, an Assimilative Capacity Benchmark is selected to calculate assimilative capacity

8 - Basin Plan Objective is 5 mg/L Nitrogen, which is equivalent to 22.5 mg/L Nitrate-NO_3 assuming Nitrate-NO_3 is 100% of Nitrogen

9 - For Municipal and Domestic Supply, California Code of Regulations, Title 22, Chapter 15

10 - 80% of the Bolsa Sub-Area is within the DWR Bolsa Subbasin and 20% is within the Hollister Subbasin; for the assimilative capacity calculation, the Bolsa Benchmark is used

11 - 80% of the Hollister West Sub-Area is within the San Juan Bautista DWR Subbasin and 20% is within the Bolsa Subbasin; for the assimilative capacity calculation, the San Juan Bautista Benchmark is used

GW - Groundwater TDS - Total Dissolved Solids mg/L - milligrams per liter NO_3 -Nitrate

5 Existing Salt and Nutrient Balance

The S/N mass balances developed for each subbasin are based on the volumes of inflow and outflow for each S/N loading/unloading factor and their associated TDS and nitrate concentrations. The balances also consider any added TDS and nitrogen from other sources as well as fate and transport processes, which can both increase and decrease concentrations. This chapter describes the methodology and data used to estimate the S/N mass balances and identifies the individual and cumulative effect on groundwater quality in the Study Area over the baseline period (2002 to 2011). Pie charts for each subbasin illustrate the relative mass contribution of each S/N inflow.

5.1 Methodology

In order to simulate the effect of current (and planned future) S/N loading on groundwater quality in each subbasin, a spreadsheet mixing model was developed. The mixing model was designed to incorporate the existing volume of groundwater and mass of TDS and nitrate in storage and to track the annual change in groundwater storage and S/N mass for each subbasin. As discussed in Chapter 3, the mixing zone in each subbasin was assumed to be less than the total estimated aquifer thickness and was estimated based on the typical depth tapped by production wells. This is a conservative assumption, as it reduces the total volume of the mixing zone and increases the apparent potential impacts of S/N loading.

The water balance provides estimates of specific inflows and outflows from water year[6] (WY) 2002 to 2011. The sensitivity of groundwater quality within each subbasin to individual S/N loading/unloading factors was identified through numerous simulations, and selected S/N loading estimates and assumptions were refined to ensure a reasonable agreement between simulated and observed groundwater quality conditions over the baseline period (WY 2002 to 2011).

One of the primary limitations of the spreadsheet mixing model is the assumption of instantaneous mixing of introduced salts and nutrients with ambient groundwater within a subbasin. This results in an overestimation of the rate at which effects from a given S/N load migrates from shallow groundwater to deeper groundwater.

5.2 Inflow and Outflow Water Quality

The concentration/mass of each S/N factor is discussed below. Summary tables for each factor can be found in Appendix C.

5.2.1 Surface Water Quality

The average TDS and nitrate concentrations of streams were calculated for each subbasin using available data from 1998 to 2006. No data were available for the San Juan South and Tres Pinos Creek Valley, therefore data from Tres Pinos Creek within the Central San Juan Subbasin were

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[6] A water year runs from October 1 through September 30 of the following year.

assumed to be representative of surface water quality in these areas. There are no streams within the Bolsa Southeast and Flint Hills subbasins.

5.2.2 Rainfall and Atmospheric Dry Deposition Quality

Nitrate and TDS loading from rainfall was estimated from the 2002 – 2011 average concentration reported by the National Atmospheric Deposition Program (NADP) at the Pinnacles National Monument station (CA66). Nitrogen concentrations were adjusted to reflect assumed losses from denitrification (10%) and plant uptake (56%[7]). The area of loading was assumed to be cropland and urban landscaped areas. Loading in paved areas is assumed to be zero due to runoff of stormwater flows. Average TDS concentrations in percolating rainfall (2.8 mg/L) measured at CA66 were increased to 150 mg/L reflecting the assumed dissolution of TDS in geologic formations through contact with very low TDS rain water.

Nitrate loading from dry atmospheric deposition was estimated from atmospheric total nitrogen dry deposition concentrations (2003 – 2009) measured by the Clean Air Status and Trends Network (CASTNET) station in Pinnacles. Dry deposition of nitrogen in urbanized areas is assumed to run off with stormwater flows, or to be removed by nitrogen-fixing processes in turf areas (UC Davis, 2012). However, dry deposition in farmed areas is likely to leach into groundwater (UC Davis, 2012). Therefore, the average nitrogen dry deposition is multiplied by the crop acreage, after accounting for denitrification (10%) and crop uptake (56%). Dry deposition of TDS is assumed to be negligible.

5.2.3 Groundwater Quality

Groundwater moves salts between subbasins and to the surface for irrigation and other consumptive uses. The TDS and nitrate concentrations of groundwater vary widely throughout the Study Area. In order to estimate the quality of groundwater flowing in and out of each subbasin, a volume-weighted concentration for each subsurface groundwater inflow source was calculated. The volumes were based on 2006 to 2011 averages from the water balances. The TDS and nitrate concentrations for inter-basin groundwater flow are the average TDS and nitrate concentration in the source subbasin (Table 1). The TDS and nitrate concentration of groundwater inflow into the Study Area along the east, west, and southern subbasin boundaries is estimated from the water quality database. TDS and nitrate concentrations in groundwater inflow to the north are based on the average concentrations of wells in the Llagas subbasin along the northern Study Area boundary. TDS and nitrate outflows are represented by the average groundwater subbasin concentrations.

Municipal, rural domestic, and agricultural pumping removes salts and nitrate from the groundwater subbasins. Pumping volumes are quantified each year as part of the water balance update. The concentration of TDS and nitrate in extracted groundwater at domestic wells and agricultural wells is represented by the average concentration calculated within the respective subbasin. The concentrations of TDS and nitrate in groundwater pumped from

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[7] Crop uptakes rates are from UC Davis (2012); the average plant uptake for all crops in the Study Area is 56 percent.

municipal wells are represented by the averages from municipal wells in the subbasin where pumping occurs.

5.2.4 Mineral Dissolution

Beginning in the 1930's, groundwater samples indicated elevated levels of TDS in groundwater in the Study Area. Elevated TDS has been ascribed to the natural presence of marine sediments and to added salts due to agricultural irrigation. As discussed above, TDS concentration trends in groundwater are relatively stable. Therefore, it is assumed that a steady state between groundwater and subsurface geology has been reached with respect to TDS. As a result, mineral dissolution is not considered as a load factor, with the exception of precipitation percolation.

5.2.5 Agricultural Irrigation Source Water Quality

CVP imported water stored in San Justo Reservoir is delivered to agricultural customers in Zone 6. The average TDS of CVP water is 298 mg/L and the average nitrate is 3.6 mg/L, based on water samples collected between 2003 and 2006. In addition, the Zone 6 subbasins use groundwater for irrigation. The proportion of CVP versus groundwater use varies each year; therefore blended water quality concentrations for TDS and nitrate were calculated for each WY between 2002 and 2011, based on relative percentage of groundwater and CVP water used within each subbasin. The Bolsa, San Juan Central, San Juan South and Tres Pinos Creek Valley subbasins rely on groundwater for 100% of their water supply. Therefore, the irrigation water quality in these subbasins reflects the average groundwater quality in each individual subbasin.

A three-fold increase in TDS concentration was applied to account for evapotranspiration (ET) (Yates, 2003b). The predicted concentration of irrigation return flows with application of this ET factor was in close agreement with data from thirteen tile drains in the San Juan South Subbasin.

5.2.6 Agricultural Return Flow Water Quality

The predominant land use in the northern Study Area is agriculture (Figure 3). Changes in crop acres between WY 2002 and 2010 were estimated by Todd (2012a) based on 2010 US Department of Agriculture aerial photography. It is assumed that crop acres identified for 2010 can be used to represent 2002 – 2011 conditions (Todd, 2012a). There are over forty types of crops grown in San Benito County. Nitrogen based fertilizer application rates were developed for each crop based on published fertilizer demand data (UC Davis, 2012) and on estimates made in Santa Clara County (SCVWD, 2012) and San Benito County (Yates, 2003b). Nitrogen fertilizer application rates are commonly estimated as pounds of nitrogen per acres. **Table 3** shows values for each major crop class (e.g., truck, grain, pasture). To estimate a value for truck and deciduous crop classes, which have many different crop types, a weighted average of the acreage and application rate for each individual crop was calculated.

Table 3 Estimated Nitrogen Application and Losses by Crop Class

Crop Class	Average N[1] lbs/ac	Crop Uptake Rate[2]	Net N after uptake	Gaseous Losses[3]	Net N Input lbs/ac
Olives/Citrus	67	0.50	34	0.1	30
Deciduous	104	0.47	55	0.1	49
Field	214	0.75	54	0.1	48
Grain	167	0.78	37	0.1	33
Pasture	31	0.50	16	0.1	14
Truck	189	0.44	106	0.1	95
Vineyards	44	0.46	24	0.1	21

1 - Nitrogen fertilizer application rates represent averages for individual crops derived from SCVWD (2012), Yates (2003b), and UC Davis (2012); Crop class values are weighted averages

2 - Derived from weighed average of the area of individual crops within the crop class; crop uptake rates from UC Davis (2012)

3 - UC Davis (2012)

lbs/ac - pounds per acre N - nitrogen

Nitrogen fertilizer uptake rates vary considerably between different crop types. Loss rates for each crop class were estimated based on values reported by University of California at Davis (UC Davis, 2012) values. For truck and deciduous crop classes, a weighted average of various individual crop acres within each crop class was used to estimate uptake rates within each crop class. Losses due to denitrification and volatilization were assumed to be 10% (UC Davis, 2012). Once the nitrogen reaches groundwater, it has undergone oxidation and generally is in the form of nitrate. In order to calculate the concentration, the dry mass was divided by the volume of deep irrigation percolation. The concentration of nitrate in irrigation source water was added to the return flow nitrate concentration.

Over 80% of the fertilizers applied in San Benito County are nitrogen based compounds (CDFA, 2008). Potassium and phosphorous fertilizers are assumed to be largely taken up by the crops, and therefore, not considered to be significant sources of salts (EKI, 2010). As a result, incremental TDS loads associated with non-nitrogenous fertilizers are not estimated.

Soil amendments applied within the Study Area are predominately gypsum (hydrated calcium sulfate) and lime (calcium oxide) with minor amounts of copper, iron, sulfur, and sulfuric acid (CDFA, 2009). California Department of Food and Agriculture (CDFA) data from 2002 to 2008 suggests that usage of gypsum has declined from pre-2000 levels. An application rate of 100 pounds per acre was estimated from the CDFA data and input from local stakeholders who apply gypsum. The dry mass was divided by the volume of deep irrigation percolation. The concentration of source water TDS, adjusted for ET, was added to the irrigation return flow TDS concentration.

5.2.7 Managed Recharge Water Quality

Local surface water is stored in and released from the District-owned and operated Hernandez and Paicines reservoirs for percolation in Tres Pinos Creek and the San Benito River to augment groundwater recharge during the dry season. The water balance reflects recharge from reservoir percolation within the Hollister West, Hollister Southeast, Northern San Juan, and Tres Pinos subbasins in various WYs between 2002 and 2011. The water quality of the local surface water is assumed to be the average for each of the subbasins, as measured between 1998 and 2006.

Percolation of CVP was a management tool used to expedite recovery from historical groundwater lows in the late 1990s. The historical water balances reflect percolation of CVP within Hollister West, Tres Pinos, San Juan South and San Juan Central Subbasins. In more recent years, the volume of managed percolation decreased in response to high groundwater levels and reduced CVP imports. Between 2002 and 2008, the TDS and nitrate load includes an estimate of loading from CVP percolation. Between 2009 and 2011, there was no managed percolation. The average TDS in CVP water is 298 mg/L and the average nitrate is 3.6 mg/L, based on water samples collected between 2003 and 2006.

5.2.8 Municipal Wastewater and Recycled Water Quality

The major Waste Water Treatment Plants (WWTPs) in San Benito County are operated by four service providers: the City of Hollister, City of San Juan Bautista, SSCWD, and Tres Pinos County Water District. The San Juan Bautista plant is not included as a loading factor because the unnamed tributary of San Juan Creek that receives plant effluent flows usually gains flow along the affected reach and the WWTP discharge is on the southwest side of the San Andreas Fault (separating the area for the groundwater subbasin) (Todd, 2011a). These conditions prevent the effluent from recharging the San Juan Subbasin. Discharges from the Cielo Vista Estates WWTP, the Aromas-San Juan Unified School District WWTP, the Casa de Fruta WWTP, and the Betabel Valley Recreational Vehicle Resort were not included in this analysis due to the small amount of effluent discharged.

Treated wastewater is disposed in ponds located within the San Juan South, Hollister West, and Tres Pinos subbasin. The volume of percolation into the three subbasins from these ponds is a component of the annual water balance. The average TDS and nitrate effluent concentrations, based on available effluent data between 2002 and 2011, were used to calculate the S/N load from the wastewater treatment ponds. The TDS and nitrate concentrations of pond effluent in Tres Pinos and San Juan subbasins were adjusted to reflect the blend of wastewater from the two WWTPs. **Table 4** summarizes the WWTP pond percolation volume and quality. It also includes the estimated volume of sewer line leakage, discussed below (Section 5.2.10).

Table 4 WWTP Effluent Flows and Subbasin Percolation

WWTP	Effluent Flows (AFY)	Per-cent	TDS (mg/L)	NO_3 (mg/L)	WWTP Perc Subbasin	Sewer Leak Return Flows (AFY)	Sewer Leaks in Subbasins (AFY)				
							TP	HNE	HW	HSE	SJN
Tres Pinos	26	11%	1,894	5.5							
Ridgemark	216	89%	1,801	0.8							
Total	**242**		1,811	1.3	TP	24	24				
Hollister Domestic	2152	84%	1,162	6.6							
Hollister Industrial (50%)	414	16%	1,425	26.6							
Total	**2566**		1,204	9.8	SJN	257		86	86	86	
Hollister Industrial (50%)	414	100%	1,425	26.6	HW	41			41		
San Juan	154				Outside	15					15

Flows and water quality based on 2006 to 2011 data reported in TM-1 (Appendix B)
Outside - percolation takes place outside of the Study Area
TDS and Nitrate concentrations from Table 13 TM-1 (Appendix B)
Sewer leaks are 10 percent of effluent flows
WWTP Perc Subbasin - geographic location of WWTP pond
HNE - Hollister Northeast
HW- Hollister West
SJN - San Juan North
AFY - Acre-feet per year
NO_3 - Nitrate
TDS - Total Dissolved Solids
HSE - Hollister Southeast
TP - Tres Pinos
mg/L - milligrams per Liter
Perc - percolation to groundwater
WWTP - Wastewater Treatment Plant

The City of Hollister delivers a relatively small volume of recycled water from its Water Reclamation Facility for irrigation. Treated wastewater is discharged from the facility's percolation ponds and delivered to Brigantino Park to irrigate open space and landscaping. In addition, recycled water is also used for spray irrigation at the Hollister Municipal Airport. Under conditions stipulated by the City's Master Reclamation Requirements adopted by the RWQCB in 2008 (Order No. R3-2008-0069), irrigation and fertilization are carefully controlled. The conditions include provisions such that nitrogen applications cannot exceed the amount required by plants and over-irrigation cannot occur. The nitrogen and irrigation application rates were established in a Nutrient Management Plan (CH2MHILL, 2011). During 2010 and 2011, the nutrient load was reported to be less than that identified in the Nutrient Management Plan; therefore, no additional nitrate load is included in the S/N balance (City of Hollister, 2011).

5.2.9 Municipal and Domestic Irrigation Return Flow Water Quality

Much of the urban landscape irrigation water is provided by the City of Hollister, SSCWD, and other small local purveyors. The majority of the small local purveyors have only one or two groundwater wells. These systems provide water to communities such as mobile home parks and homeowners' associations and to transient populations at schools, parks, and businesses. There are no available data to derive a load from urban fertilizer use on golf courses, parks, and domestic lawns within these service areas. The upper limit of leaching from fertilizer applications on golf courses and turf is estimated at 8.9 pounds per acre (UC Davis, 2012). This assumes an application rate of 45 pounds of nitrogen per acre per year, of which 36 pounds is lost before reaching groundwater.

Two methods were used to calculate the acreage of turf. The first method used the 2010 DWR land use classification for Urban Landscape (UL). The second method assumed turf to be 17% of the total urbanized area in the 2010 land use map, based on an average of the typical urban turf range (12 to 23%) reported by UC Davis (2012). For the load estimate, the estimated acreage was based on the higher acreage of the two methods.

The number of rural households within each subbasin was based on the number of septic systems, described below. The rural irrigation return flow estimate assumed an average lawn size of 1,000 square feet[8] and the same net rate of nitrate leached as developed for urban fertilizer application (8.9 feet per acre). Rural domestic irrigation was estimated for the water balance in Tres Pinos Creek Valley. Domestic irrigation in Bolsa and San Juan Central and South subbasins was assumed to be insignificant. The average pumping between 2005 and 2008 for each subbasin was used to represent the entire calibration period (WY 2002 to 2011). The S/N load associated with irrigation was based on the average groundwater concentration within each subbasin with a three-fold TDS increase to account for ET. Irrigation percolation was assumed to be 10% of applied irrigation. Nitrate leaching was assumed to be 34% of the source groundwater concentration.

5.2.10 Water and Sewer System Loss Water Quality

Water system losses from pipe leakage within the Hollister Urban Area (HUA) were estimated to be 7% of demand, based on the "system losses" reported in the 2010 HUA Urban Water Management Plan (Todd, 2011a). It is recognized that system losses also include meter error and unaccounted uses, such as fire flows and hydrant flushing. This estimate was applied to all Zone 6 water service areas. A volume weighted average of TDS and nitrate was calculated for those subbasins based on a blended volume of CVP and groundwater.

Sewer system loses from pipe leakage have not been reported within the Study Area. Amick (2000) reports a range of 12 to 25% leakage. The load was calculated assuming a 12% loss rate of the volume of effluent. TDS and nitrate in leaking sewer lines were assumed to be the same as septic system return flows, described below. Table 4 includes the volume of sewer line leakage in subbasins that are sewered.

5.3 Septic Systems Return Flow Water Quality

Fate and transport studies from onsite wastewater systems have yielded a range of values for the amount of total nitrogen in effluent that ultimately recharges groundwater as nitrate.

[8] Based on the EBMUD study of an average of a large lot and a small lot (Opitz, 1995).

Variables include the initial concentration of total nitrogen in the effluent, the fraction of the total nitrogen that is in the form of ammonium, and the percent of ammonium transformed into nitrate. Mass loads were estimated assuming an average effluent concentration of 63 mg/L total nitrogen, of which 53 mg/L is present as ammonium (Lowe, 2009). The percentage of total nitrogen as ammonium closely matches the value reported by United States Environmental Protection Agency (USEPA, 2002). The remaining nitrogen in the effluent is assumed to be organic nitrogen, which accumulates with sludge that remains in the septic tank until it is cleaned out (Seiler, 1996). In fine-textured soils, between 10 and 20% of ammonium undergoes denitrification (USEPA, 2002). Given that over 75% of the soils in the Study Area are fine-grained soils (sandy clay loams to clay), a reasonable assumption is that 15% of the ammonium is denitrified. Applying these assumptions, the net loss of nitrogen is 30%, 15% loss to organic nitrogen and 15% loss of ammonium by denitrification. Ammonium readily undergoes nitrification to nitrite then nitrate in soil. The net nitrate leached is added to the average concentration of nitrate within each subbasin, assuming all the dwellings serviced by septic systems rely on groundwater. The concentration of nitrate in the septic system return flow ranges from 202 mg/L to 214 mg/L. A salt increase of 200 mg/L is assumed to result from household water uses (Kaplan, 1987). This mass was added to the average concentration of TDS for each subbasin. The TDS of septic leachate ranges from 733 to 1,398 mg/L.

5.4 Mixing Model Calibration

The mixing model simulates the average concentrations of TDS and nitrate within each subbasin on an annual basis while considering the buffering capacity of the existing volume of groundwater and S/N mass in storage. The loading (and unloading) assumptions used in the mixing model were manually calibrated by comparing preliminary simulation results (annual concentrations and concentration trends) over the baseline period (2002 to 2011) to observed average background concentrations and historical trends. In most of the Study Area, water quality has remained stable over recent years (2004-2010). Other areas, like the eastern portion of the northern San Juan Subbasin, have shown variable but generally decreasing trends in some key constituents like nitrate and TDS. Water quality trends were discussed in TM-1 (Appendix B).

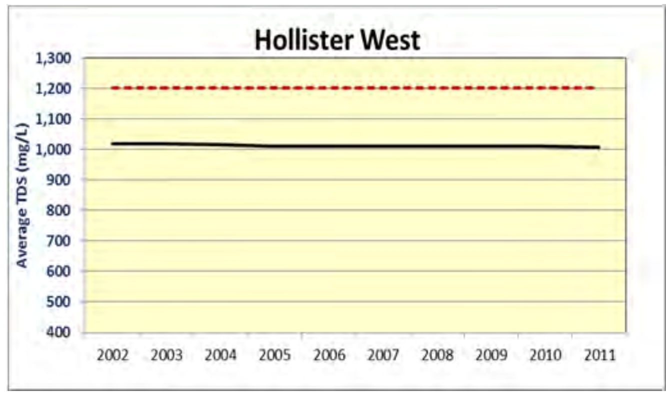
Individual loading factors with higher levels of uncertainty were refined in some instances so that simulated results matched background concentrations and observed concentration trends for wells in a given subbasin. All refinements to key loading assumptions in the mixing model were applied across the entire Study Area and not selectively applied to individual subbasin. Following several iterations, the following adjustments to key S/N loading estimates were incorporated in the final calibrated mixing model:

1. Comparison of initial simulated groundwater nitrate concentrations across the Study Area to actual background groundwater nitrate concentrations indicated that either a) nitrate concentrations in irrigation return flow (with fertilizer added) were overestimated or b) additional nitrate attenuation in the vadose zone was not captured in the mixing model. To account for the attenuation of nitrate and to match observed groundwater quality concentrations and trends, nitrate concentrations in irrigation return flow were reduced by a factor of 40 (60% attenuation).

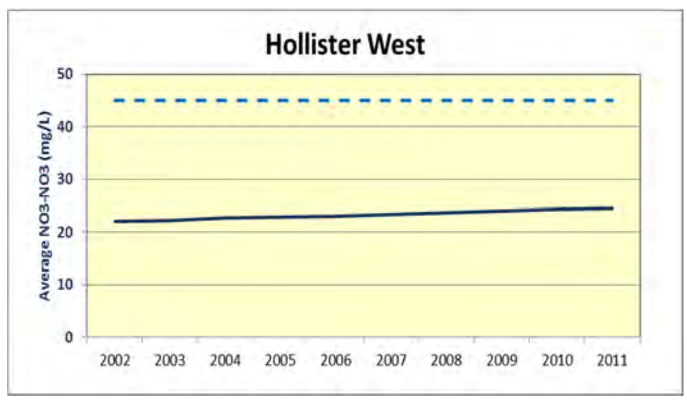
2. To account for mineral dissolution along rainfall recharge flowpaths, the TDS concentration was adjusted from 2.8 to 150 mg/L.
3. In the subbasins with municipal pumping, TDS concentrations declined slightly. The mixing model initially used the basin average for the municipal pumping outflow. The average basin TDS concentration is higher than the average TDS in extracted groundwater. Therefore, TDS was adjusted to reflect average water quality in production wells.

5.5 Overview of Baseline Period Mixing Model Results

This section summarizes the simulated results of the calibrated mixing model for TDS in each subbasin for the baseline period of 2002 through 2011. In brief, the average groundwater concentrations have not changed significantly as a result of estimated salt loading. The chart to the right shows an example output for TDS from the mixing model for the Hollister West Subbasin. The black line is the annual average concentration, and the red line is the ACB. These mixing model trends are consistent with observed well concentration trends. The TDS trends generally reflect the large buffering capacity of the existing groundwater in storage and the muted impact of salt loading at lower aquifer depths.



Nitrate results indicate a slow but steady increase during the end of the baseline period of between 1 and 6 mg/L in all subbasins except Flint Hills, San Juan Central, San Juan South, and Tres Pinos where trends are stable. The chart to the right shows simulated nitrate concentrations for Hollister West. The black line is average nitrate concentration, while the blue dotted line is the GBPO. Elevated nitrate has been a long-term problem in the Study Area, especially in hot spot areas (see Figure 5). However, the simulated increases in basin averages are larger than would be expected based on observed groundwater quality trends. As reported in TM-1, 77 percent of wells analyzed had decreasing or stable trends. This indicates that the simulated nitrate average, after calibration, may overestimate actual conditions.



Calibrated mixing model results for all 12 basins/subbasins are shown in Figures 7 and 8 in Appendix B.

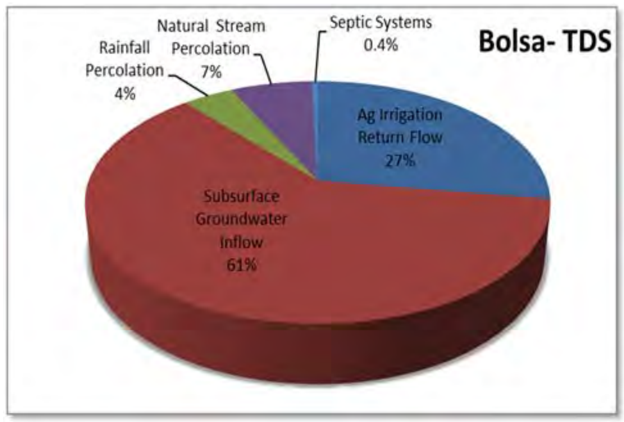
5.6 Overall Salt and Nutrient Balance

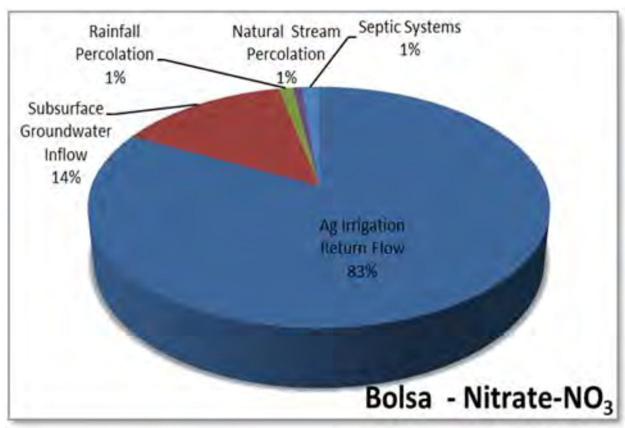
TDS and nitrate mass balances were developed based on water balance volumes and water quality described above. The results for each subbasin, described below, are accompanied by two pie charts to illustrate the relative percent of TDS and nitrate mass input contributed by each source. Outflows and change in concentration at the end of the baseline period are also discussed.

It is noted that all inflows with any measurable concentration of TDS and nitrate add S/N mass; however, if the source water concentration that reaches groundwater is less than the ambient average groundwater concentration (i.e., precipitation percolation), than that loading source will act to improve the existing groundwater quality. Return flows that have higher TDS and nitrate concentrations than ambient existing groundwater quality will both add mass and increase concentrations.

5.6.1 Bolsa

The pie charts at right illustrate the relative percentage of TDS and nitrate loading factors in the Bolsa Subbasin for the baseline period. The biggest source of TDS load in the Bolsa Subbasin is subsurface groundwater inflow resulting from the relatively high volume of subsurface inflow from Pacheco and Bolsa Southeast subbasins. The average TDS in Pacheco (533 mg/L) is relatively low compared to the Bolsa Southeast TDS (1,003 mg/L) so this loading source acts to improve groundwater quality. In addition, in 2009, 2010, and 2011 groundwater inflow was received from the Llagas Subbasin to the north, which also has better TDS groundwater quality than the Bolsa Subbasin. Agricultural pumping is the major TDS outflow. Annual change in mass varies with an overall increase in cumulative mass of 12,000 tons. There is a small net increase in TDS of 4 mg/L over the ten-year period.



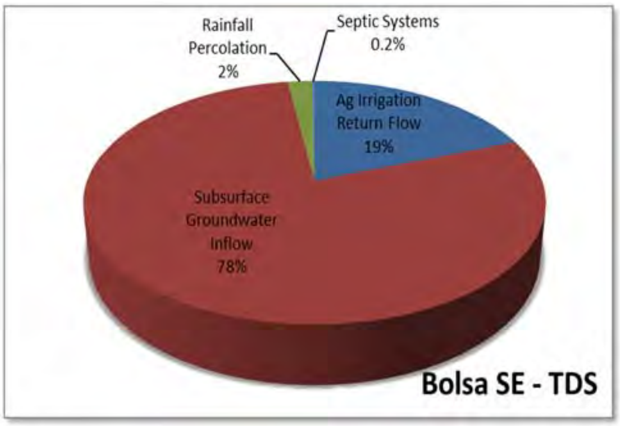


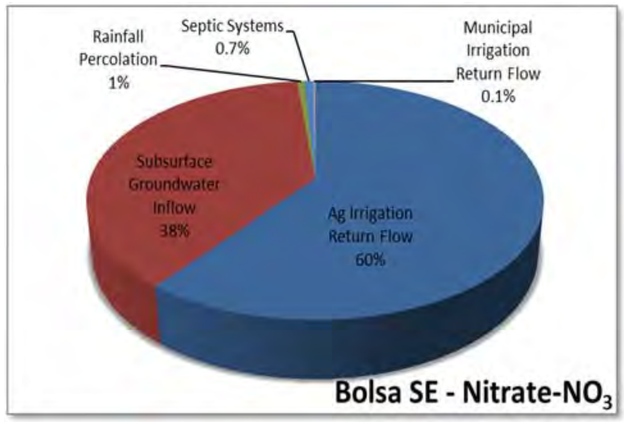
The largest nitrate inflow is from agricultural return flows, while the largest outflow is from agricultural pumping. Over 5,000 tons of nitrate accumulates in the Bolsa Subbasin over ten years, with an increase in nitrate of 3 mg/L.

5.6.2 Bolsa Southeast

The pie charts below illustrate the relative percentage of TDS and nitrate loading factors in the Bolsa Southeast Subbasin for the baseline period. TDS inflows are dominated by subsurface groundwater inflow from Hollister West. Agricultural pumping is the largest outflow. Annual change in TDS mass varies with an overall increase in cumulative mass over the ten-year baseline period of nearly 300 tons. Over the ten-year period, there is an increase in TDS concentration of 4.2 mg/L.

Irrigation return flows are the largest inflow of nitrate, while the largest outflow is agricultural pumping. The cumulative change in mass is generally increasing, ending the ten-year period with a net addition of 1,200 tons of nitrate. The ending concentration reflects a 5.8 mg/L increase in nitrate.



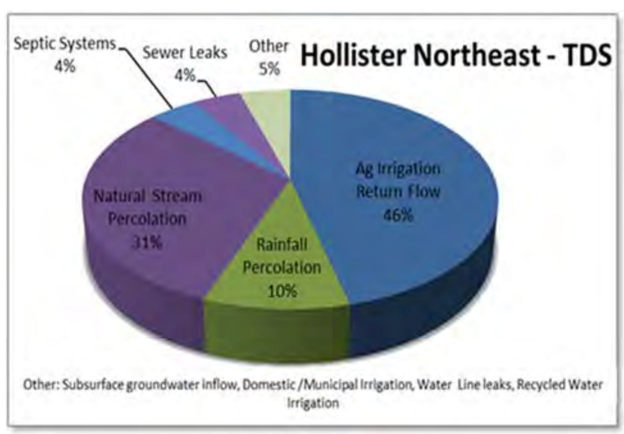


5.6.3 Flint Hills

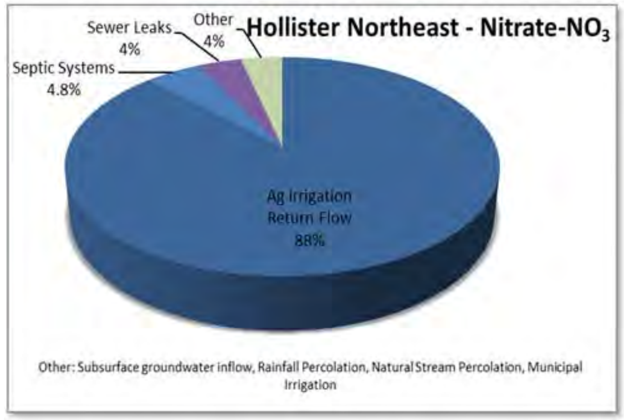
As previously mentioned, there is no significant land use activity in the Flint Hills Subbasin. During the ten-year period, rainfall percolation in 2002, 2004, and 2005 was the only source of TDS inflow; therefore no pie chart is shown. The water balance does not indicate any corollary outflow during those years; therefore there is a calculated net accumulation of TDS of 150 tons. Rainfall percolation also introduces a less than one ton of nitrate during the ten-year period into the subbasin.

5.6.4 Hollister Northeast

Agricultural irrigation return flow is the largest inflow of TDS mass into Hollister Northeast (see figure at right). The largest outflow is agricultural pumping. There is also a large subsurface groundwater outflow component. The combined outflows exceed the inflows resulting in a net loss of 9,000 tons and TDS concentrations decreased 9 mg/L over ten years.



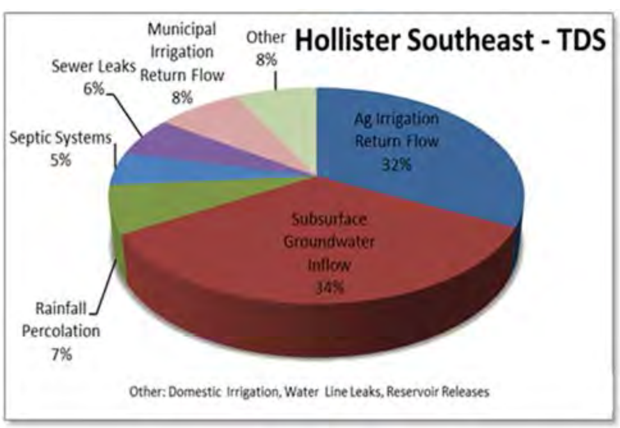
Agricultural irrigation return flows contribute the largest inflows of nitrate in the Hollister Northeast Subbasin. The largest outflow is agricultural pumping. The accumulation of nitrate results in an increase of 4.7 mg/L over the ten-year period with a gain of over 4,000 tons of nitrate.

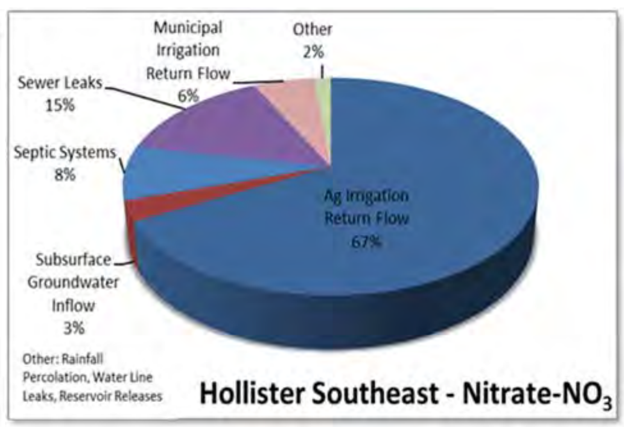


5.6.5 Hollister Southeast

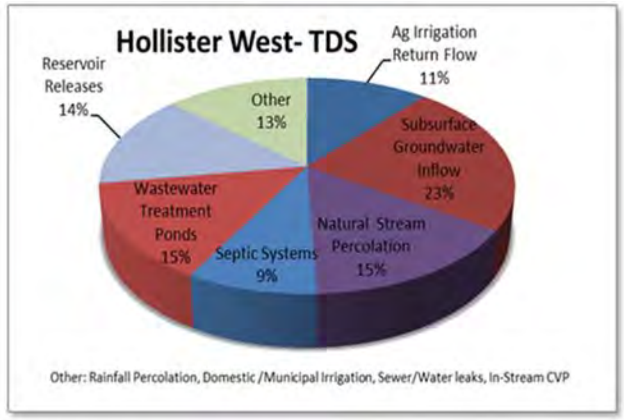
As shown below, the largest inflow of TDS in Hollister Southeast is subsurface groundwater inflow from outside the Study Area to the east. Municipal and domestic groundwater pumping are the largest outflows of TDS. Over the ten-year period, outflows exceed inflows resulting in a net loss of about 8,000 tons of TDS and a decline in concentration of 11 mg/L.

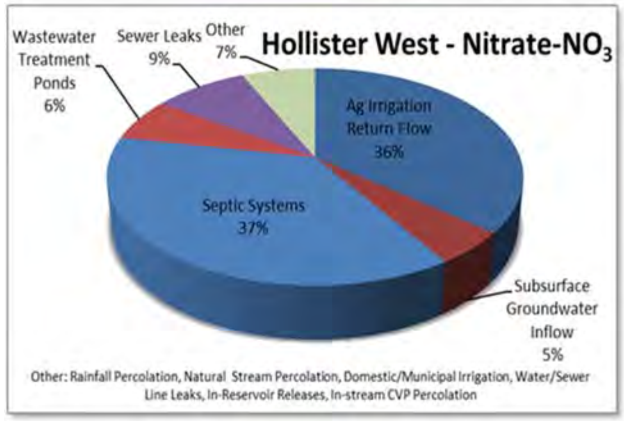
There is a net gain in nitrate over the ten-year period of 1,000 tons and an increase in concentration of 2 mg/L. The largest inflow is irrigation return flow, while the largest outflow is agricultural pumping.





5.6.6 Hollister West





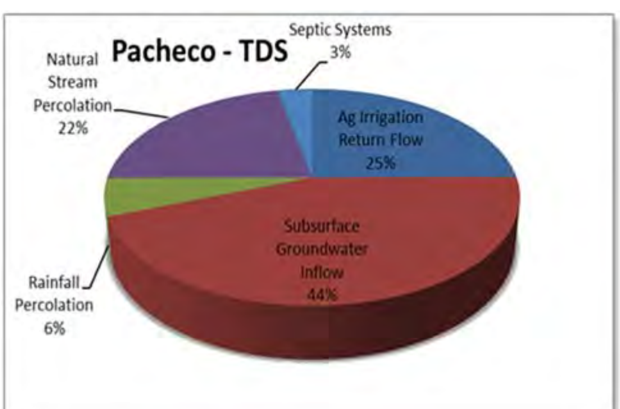
Hollister West has the highest number of individual load sources, reflecting the mix of rural and urban land uses. Groundwater underflow from Tres Pinos Valley is the biggest source of TDS, followed by natural stream percolation, and WWTP pond percolation. Over the baseline period, there is a net decrease in TDS concentration of 11 mg/L. Municipal and domestic pumping is the largest TDS outflow with a total net cumulative loss of over 10,000 tons.

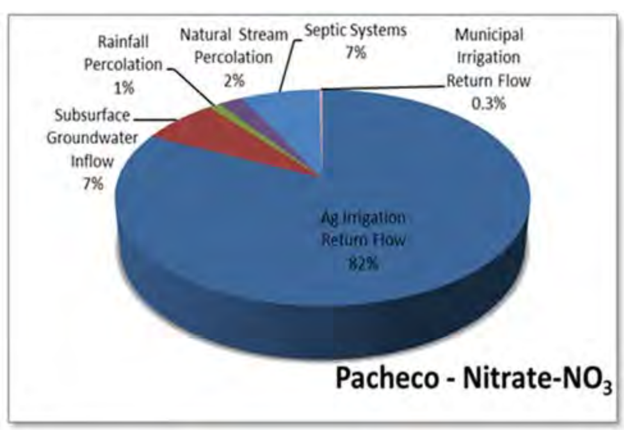
The two largest inflows of nitrate are agricultural and septic systems return flows. Municipal and domestic pumping are the largest outflows. After ten years, nitrate concentrations increased 3 mg/L and over 1,200 tons of nitrate accumulated.

5.6.7 Pacheco

As shown below, the largest TDS inflow in the Pacheco Subbasin is subsurface groundwater inflow from outside the Study Area to the east and from the Hollister East Subbasin to the south. Groundwater outflow to the Bolsa Subbasin is the largest outflow. Net inflows after ten years exceed outflows, resulting in a cumulative gain of nearly 4,000 tons of TDS, and a concentration increase of nearly 1 mg/L.

Nitrate inflows are dominated by agricultural return flows. Subsurface groundwater outflow is the largest outflow of nitrate. There is a gain of about 3,500 tons of nitrate and an increase in concentration of 4 mg/L after ten years.

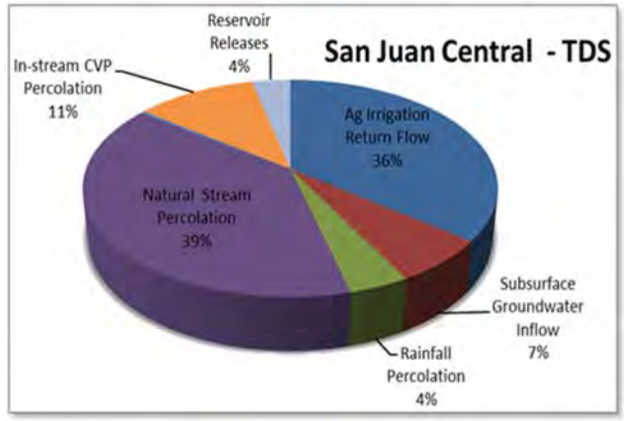


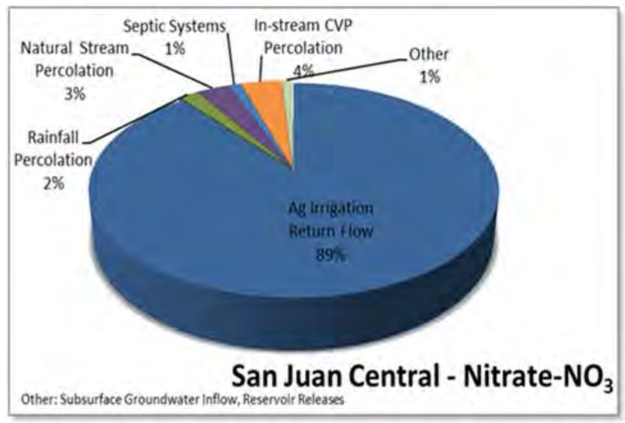


5.6.8 San Juan Central

Total overall TDS and nitrate inflows and outflows from San Juan Central are low, reflecting the limited land use activities.

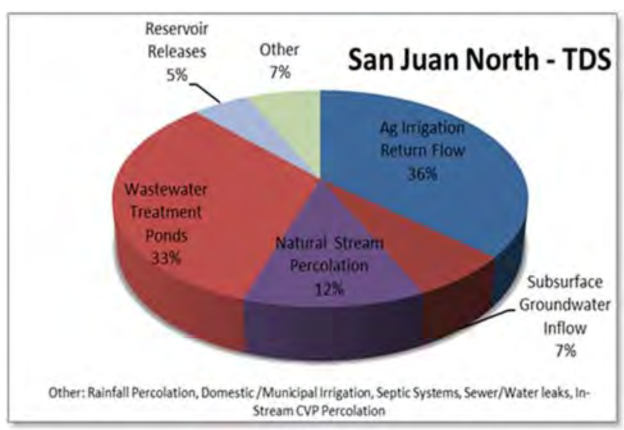
The largest inflow of TDS and nitrate is agricultural irrigation. Outflows for both TDS and nitrate are dominated by agricultural pumping. At the end of the ten-year period, there is little change in concentration with TDS decreasing by 1 mg/L and nitrate increasing by 0.5 mg/L.



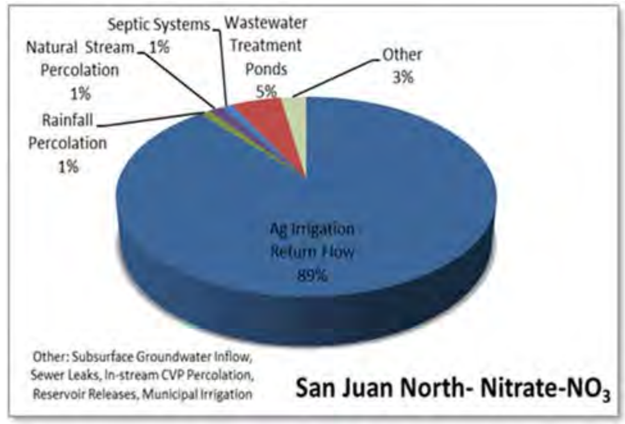


5.6.9 San Juan North

As shown at right, in the San Juan North Subbasin, agricultural return flows and wastewater percolation are the largest inflows of TDS. Agricultural pumping is the largest outflow. Over the ten-year period, outflows exceeded inflows resulting in a net loss of over 26,000 tons of TDS. This results in a decrease in concentration of 18 mg/L. The average basin concentration is 1,180 mg/L, which is slightly below the ACB (1,200 mg/L).

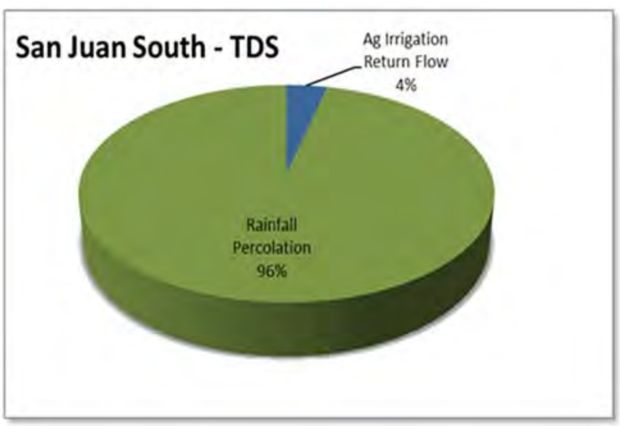


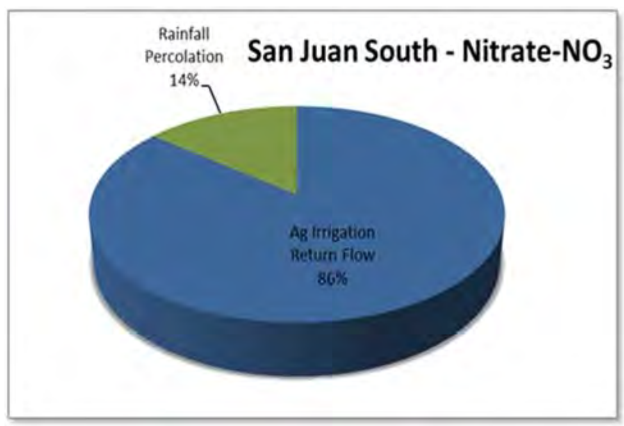
Nitrate inflows, shown to the right, in the San Juan North Subbasin are dominated by agricultural return flows, which exceed outflows from agricultural pumping, yielding a net addition of nearly 4,000 tons of nitrate. After ten years, the average nitrate concentration increases from 14.6 to 19.4 mg/L.



5.6.10 San Juan South

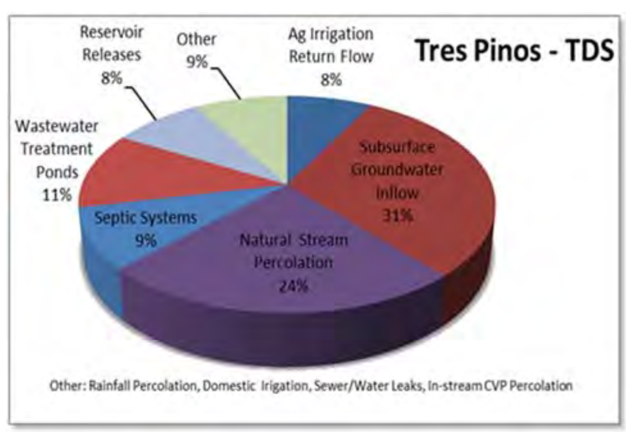
Mass loading in San Juan South Subbasin reflects the natural conditions of rainfall recharge and groundwater outflow. There is only a minor agricultural activity in this subbasin. Groundwater outflows of TDS and nitrate are larger than rainfall inflows; therefore there is a net loss of TDS over the ten-year period of about 1,700 tons of TDS and 15 tons of nitrate.



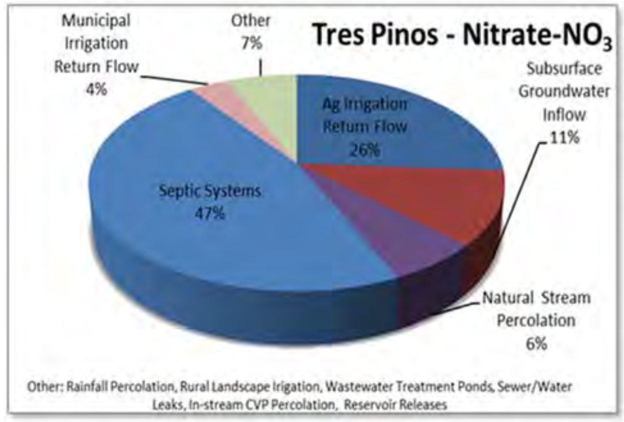


5.6.11 Tres Pinos

Subsurface groundwater underflow constitutes the largest inflow and outflow of TDS. Total outflows exceed inflows, resulting in a net loss of about 7,000 tons of TDS. After ten years, the concentration of TDS in Tres Pinos is 978 mg/L, which is slightly below the BSBPO, 1,000 mg/L.

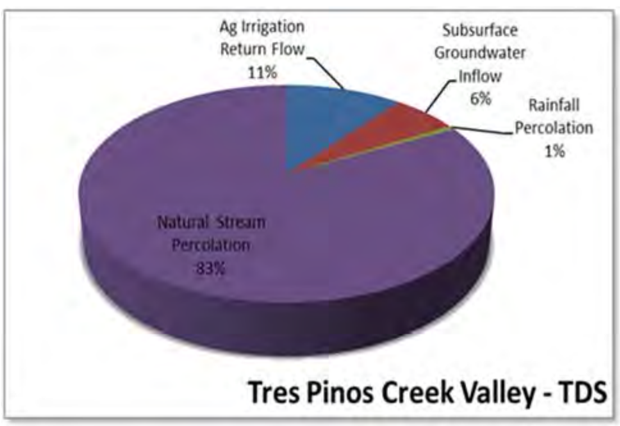


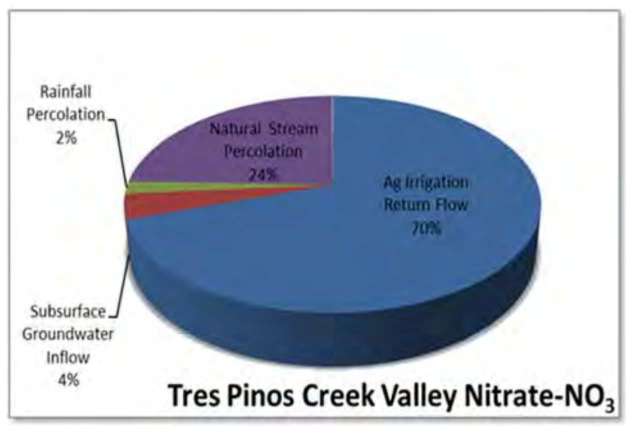
Septic systems are the largest inflow of nitrate in Tres Pinos. Groundwater pumping for domestic and municipal supply as wells as groundwater outflow constitute the two largest outflows of nitrate. After ten years, the nitrate concentration increases by 3 mg/L. There is a net increase in nitrate mass of 900 tons.



5.6.12 Tres Pinos Creek Valley

The largest inflow of TDS is natural stream recharge. The largest outflow is subsurface groundwater outflow. Inflows exceed outflows, resulting in a 4.8 mg/L increase in TDS concentration and a net mass load addition of over 4,000 tons. At the end of ten years, there was a 1.3 mg/L increase in nitrate. The largest inflow is irrigation return flows, while the largest outflow is subsurface groundwater outflow. There is a net gain of 300 tons of nitrate and a 1.3 mg/l nitrate increase in the subbasin.





6 Goals, Objectives, and Implementation Measures

Goals and objectives allow assessment of projected changes in loading sources and concentrations (groundwater, CVP water, wastewater, recycled water, and stormwater). Implementation measures are programs and activities to manage S/N loading. The SNMP goals, objectives, and implementation measures have been developed over a decade of regional integrated work to optimize water supply and reduce S/N loading in groundwater in the Study Area. Within the HUA the regional work was formalized in 2004 in a Memorandum of Understanding (MOU) between the City of Hollister, the County, and the District. The MOU was amended in 2008 to include SSCWD. The signatories to the MOU have created a Master Plan for water supply and wastewater within the HUA. Outside of the urban area, reductions in nitrogen and TDS loading in agricultural subbasins are being addressed by voluntary education programs offered by the District and others, best management practices (BMP's), and by recent regulations adopted by the RWQCB.

Key findings related to goals/objectives and implementation measures are listed below.

- Recycled water is currently used for irrigation only
- Recycled water use for irrigation is predicted to increase in the future
- Stormwater and imported water recharge have been water balance components in the past but future artificial recharge will be limited by elevated groundwater levels in recharge areas and the potential of spreading zebra mussels found in San Justo Reservoir
- Municipal water use will increase due to population growth with most of the additional water provided by imported CVP supplies
- Urban S/N loading is well documented and programs to reduce loading are active and ongoing, including:
    - Optimization of source water sources to improve source water quality
    - Planned upgrades and new water treatment plants to improve source water quality
- Improvement of source water quality will result in a noticeable improvement in wastewater and recycled water quality
- Reduction in TDS loading will occur because of the Water Softener Rebate Program
- Reductions in agricultural TDS and nitrate loads will occur as a result of regulatory actions and several outreach programs directed to BMPs for irrigation, and nitrogen, amendment, and pesticide use

6.1 Goals

The SNMP embraces the goals established through the HUA Water and Wastewater Master Plan (AECOM, 2011), San Benito County 2035 Draft General Plan (San Benito County, 2012), and the RWQCB's Conditional Waiver of Waste Discharge Requirements for Discharges from

Irrigated Lands (Agricultural Waiver), adopted in 2012 (Agricultural Order No. R3-2012-0011). Goals/objectives from these regional efforts in the Study Area include the following:

Source water

- Improve source water quality (TDS target - 500 mg/L)
- Increase water supply reliability and sustainability
- Reduce per capita water consumption
- Reduce the occurrence of high groundwater levels

Wastewater

- Develop regional solutions
- Upgrade WWTPs

Agriculture

- Preserve farmland
- Implement nutrient best management practices

Recycled Water

- Expand recycled water use
- Improve recycled water quality (TDS target - 700 mg/L)

Stormwater

- Augment available water supply with stormwater captured at the IWWTP

Salt and Nutrient Management Plan Goals

6.2 Implementation Measures

Implementation measures for the SNMP are actions that will reduce S/N loading in Study Area groundwater subbasins. Actions related to each of the goal topics are described below. Source water and wastewater are closely linked as reduction of salt in source water will bring a corresponding reduction in salt in wastewater effluent. Implementation actions include capital improvements, educational outreach, and diversifying water supply sources.

> Implementation measures, summarized here, are described in detail in Appendix C, Chapter 5

6.2.1 Source Water Implementation Measures

Source water implementation measures are targeted for subbasins that rely on a combination of CVP and local groundwater. CVP water is significantly lower in TDS; however, available supply varies from year to year. In addition, use of CVP water is constrained by the existing water treatment capacity. In 2012 the District completed an Optimization Study (Yates, 2012) to minimize the total cost of meeting municipal water demand with the HUA while improving water quality by selecting from a variety of water sources to meet a target of 175 mg/L hardness. The model generated a base case scenario considering over 80 years of hydrologic conditions. This source water quality improvement goal will be achieved by implementing the following actions:

- Upgrading Lessalt Water Treatment Plant
- Constructing West Hills Water Treatment Plant
- Providing new treated water storage
- Purchasing water on the spot market wheeled through the San Luis Reservoir
- Banking water with Semi-Tropic Water Storage District
- Installing new groundwater wells in Pacheco and Hollister Northeast subbasins
- Urban well demineralization
- Water use efficiency training for agricultural and residential customers

6.2.2 Wastewater Implementation Measures

The wastewater treatment facilities use a number of treatment methods, which result in varying effluent quality. The parties to the HUA MOU (Hollister, SSCWD, and the County) have committed to reducing these high concentrations by lessening the TDS of supplied water (Todd, 2011a). Currently, the other wastewater treatment facilities (SSCWD and Tres Pinos) produce effluent that meets the Title 22 requirements for undisinfected secondary recycled water, which is disposed of through evaporation and/or percolation. SSCWD is currently upgrading their wastewater treatment facilities to produce higher quality effluent to meet waste discharge requirements. Some upgrades are anticipated to be completed in autumn 2013 (SSCWD, 2011). Eventually, SSCWD's upgrade of the Ridgemark WWTP will result in production of disinfected tertiary recycled water available for golf course irrigation. However, the implementation time frame for the upgrade to disinfected tertiary treatment is uncertain at this time. Current salinity requirements for the Ridgemark WWTP (Waste Discharge Requirement (WDR) Order R3-2004-0065) include 1,200 mg/L for TDS, 200 mg/L each for sodium and chloride, and 5 mg/L each for nitrate and ammonia (both as nitrogen) (SSCWD, 2009; AECOM, 2011).

Improvements in source water quality will result in lower salts in wastewater effluent. In addition educational programs and WWTP capital programs will result in reduced S/N loading to groundwater. Specific implementation measures include:

- Water softener rebate program
- Water softener homeowner education/outreach

- Ridgemark WWTP upgrades and new pipeline

6.2.3 Agriculture Implementation Measures

Agriculture is vital to the economic future of Northern San Benito County. Accordingly, a key objective in the Draft San Benito County 2035 General Plan is to preserve prime farmland (San Benito County, 2012). Total agricultural water use in the District's Zone 6 has remained relatively low in recent years (Todd, 2012a). This is indicative of long-term systemic changes in agriculture including water-conserving irrigation practices and shifts to lower water use crops. A 2010 statewide survey (DWR, 2010) reported that over 73% of San Benito County crops are irrigated by low-volume irrigation (i.e., micro- or mini-sprinklers and surface and buried drip irrigation).

S/N management in irrigated agricultural lands has become the focus of recent regulatory action by RWQCB. In 2012 the RWQCB issued Agricultural Order No. R3-2012-001, a Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands (Agricultural Order). The permit requires that growers implement practices to reduce nitrate leaching into groundwater and improve surface water receiving water quality. Specific requirements for individual growers are structured into three tiers based on the relative risk their farm poses to water quality. Growers must enroll, pay fees, and meet various monitoring and reporting requirements according to the tier to which they are assigned.

> The RWQCB estimates that 94% of irrigated acres in their Region are enrolled in the Agricultural Order. This represents over 4,000 farms/ranches.

A recent study of nitrogen fertilizer use in California determined that statewide sales of nitrogen fertilizer have increased between 1945 and 2008, however, for most crops, less nitrogen is applied per unit of product today than in 1973 (Rosenstock, et al., 2013). While much is being done to use nitrogen efficiently, there is a lack of reliable, comprehensive information to support accomplishing this goal. One local farmer commented that using fertilizers more efficiently can help save significantly on costs, so there is a strong incentive to better understand crop uptake rates. The Agricultural Order acknowledges that "many owners and operators of irrigated lands within the Central Coast Region have taken actions to protect water quality". However, in the Study Area no mechanism exists to document these actions. Information provided by farming stakeholders suggests that local farmers are taking the following actions:

- Nitrogen testing of soils pre- and post-harvest to better manage applications
- Field-testing sprinkler efficiency
- Metering wells to measure water use
- Lining drainage ditches with nitrogen-fixing crops to slow runoff and capture nitrogen

Specific implementation measures for agriculture include:

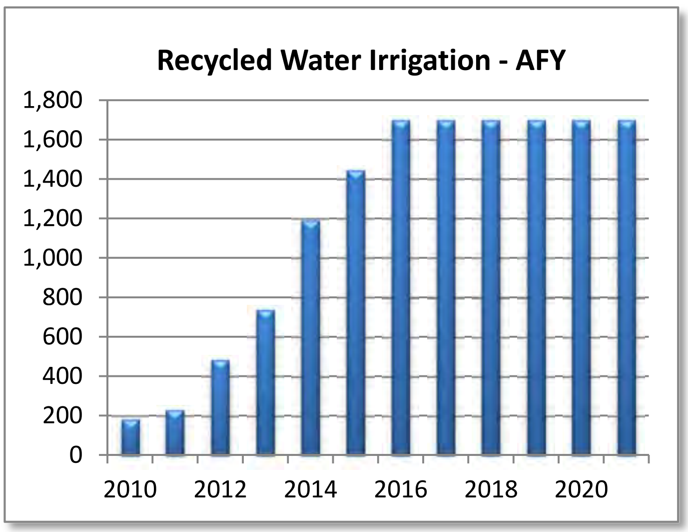
- Training growers in water efficient irrigation practices
- Implementing S/N management BMPs

- Monitoring groundwater at individual farms or in cooperation with nearby farms under the Agricultural Order
- Installing backflow devices on irrigation systems that supply fertilizers or other chemicals under the Agricultural Order
- Submitting annual Agricultural Order Compliance Forms

There are many organizations that provide ongoing educational and training outreach programs to encourage water conservations, livestock management, watershed protection, and fertilizer, amendment, and pesticide BMPs. Organizations and selected activities include:

- The Water Resources Association of San Benito County (http://www.wrasbc.org/) provides outreach on water conservation measures and BMPs for fertilizer efficiency.
- The Central Coast Water Quality Coalition (CCWQC) (http://www.centralcoastrcandd.org/info.htm) was recently awarded a grant to produce pesticide BMPs workshops.
- The Central Coast Coalition of Resource Conservation Districts (CCCRCDs) was recently awarded a Sustainable Agriculture Research and Education (SARE) grant to develop BMPs for irrigation and fertilizer. They will be holding a series of training workshops and use of the Mobile Irrigation Laboratory (MIL) program.
- The U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) (http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/about/), with funding from the Agriculture Water Quality Alliance (AWQA), has distributed Nitrogen-Nitrate quick test kits throughout San Benito and Santa Clara counties to help growers optimize fertilizer application.
- The Santa Cruz County Resource Conservation District (SCCRCD) and Ecology Action (EA) have conducted outreach and compiled reference materials in the Livestock and Land Program (http://livestockandland.org/) to educate livestock owners on BMPs.

6.2.4 Recycled Water Implementation Measures



The wastewater treatment facilities use a number of treatment methods, which result in varying effluent quality. Current requirements for recycled water use are administered by Title 22 of the California Code of Regulations. However, the effluent streams from these treatment facilities have high levels of TDS. Under conditions stipulated by the City of Hollister's Master Reclamation Requirements adopted by the RWQCB in 2008 (Order No. R3-2008-0069), irrigation and fertilization at the airport and park is carefully controlled. The conditions include provisions such that nitrogen applications cannot exceed the amount required by plants and over-irrigation cannot occur. The nitrogen and irrigation application rates were established in a Nutrient Management Plan (CH2MHILL, 2011).

Recycled water irrigation will be increasing from 230 AFY (2011) to 1,700 AFY (2016). The volumes currently applied at the airport and park site are expected to remain the same. New projects include irrigation of an agricultural area northwest of Hollister. Upgrades of the Ridgemark WWTP will eventually result in production of disinfected tertiary recycled water available for irrigation at the Ridgemark Golf Course, although the implementation time frame is uncertain at this time. In addition, the San Juan Oaks Golf Course plans to irrigate with recycled water.

Implementation actions include:

- Implementing Nutrient Management Plans at recycled water irrigation sites
- Upgrading Ridgemark WWTP
- Studying recycled water and stormwater blending and treatment options

6.2.5 Stormwater Implementation Measures

TDS in stormwater is substantially lower than recycled water and stormwater could be put to beneficial use. Stormwater reuse is not likely to be a significant factor in the Study Area; however it has been considered by the City of Hollister as part of the Storm Drain Master Plan (Wallace Group, 2011). The HUA Master Plan calls for an engineering study of the feasibility of blending recycled water and stormwater. Some stormwater is directed to the Hollister Industrial Waste Water Treatment Plant (IWWTP) via a combined sewer system for treatment and discharge to percolation and evaporation ponds. The IWWTP receives approximately 0.2 million gallons (MG) of stormwater flow per inch of rainfall. Stormwater goals and management measures for the City of Hollister were recently updated in the Stormwater Management Plan (Wallace Group, 2011).

Implementation measures for stormwater include:

- Studying feasibility of blending recycled water and stormwater
- Managing pollutants in urban runoff through BMPs
- Establishing local hydromodification control criteria
- Public outreach on pollution prevention

7 Future Water Quality and Assimilative Capacity

The goals and objectives described in Chapter 6 were used to quantify the volumes and quality of source water inflows (and outflows) for the future projected S/N balance for a period extending from 2012 to 2021. Based on the mixing model results, future groundwater quality conditions and assimilative capacity are estimated for each subbasin.

The 2011 S/N balance volumes and water quality were used in the 2012 to 2021 projection for the following components:

- Natural stream percolation
- Precipitation
- Managed recharge
- Subsurface groundwater inflow (adjusted for minor return flows)
- Septic system return flows

Appendix C , TM-2, provides more details on assumptions for the future projection.

The sections below summarize the assumptions and adjustments to other S/N components to account for changing conditions in the future projection period.

7.1 Municipal Water Use and Quality Projection

Yates (2012) developed a base case projection of municipal use for 2015 that reflects an optimized mix of groundwater and CVP water to meet a hardness target of 175 mg/L at the lowest cost. The District has a contract for CVP water extending to 2027 for a maximum of 8,250 AFY of municipal and industrial water. The Optimization Base Case assumes an annual water demand of 7,126 AFY and an external water bank capacity of 4,500 AFY. The projection used State Water Project Operations Model (CalSim II) model output for estimates of CVP water delivery within the Study Area. Urban groundwater supply includes existing SSCWD and City of Hollister wells, new wells located in Pacheco, and “East Side” wells located near the Hollister Conduit at Arroyo Dos Picachos. Use of CVP water is expected to increase, while groundwater use is expected to decline resulting in improved water quality with respect to TDS and nitrate.

7.2 Future Agricultural Irrigation Return Flows

For the projection, the 2011 cropping patterns are assumed to be representative of future conditions through 2021. Accordingly, the volume of pumping is held constant at the 2011 level for subbasins using only groundwater. The demand will be met by 17,134 AFY of groundwater and 19,000 AFY of CVP water, based on the Optimization Base Case scenario. The ratio of applied water to deep percolation established in 2011 was applied to 2012 to 2021. Deep percolation is generally 10% of applied water, but varies slightly between the subbasins as calculated by the soil moisture conditions in the 2011 water balance.

7.3 Future Wastewater Treatment and Recycled Water Use and Quality

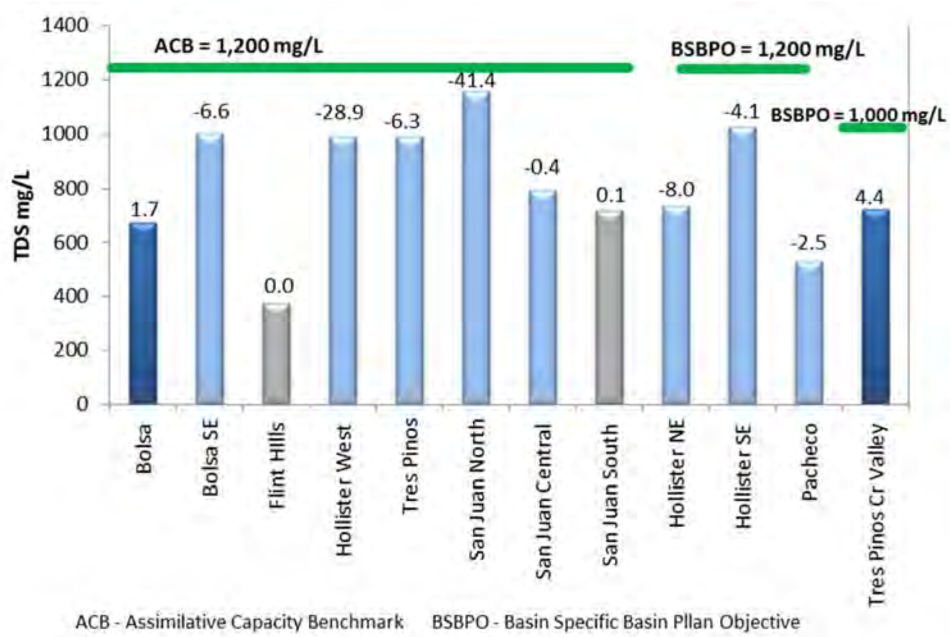
Wastewater volume was developed based on the Optimization Base Case urban municipal use scenario for the DWWTP/Water Recycling Facility (WRF), IWWTP, and Ridgemark I and II. Predicted effluent quality for these facilities was estimated based on based on treatment plant upgrades and permit requirements. The Tres Pinos WWTP volume and quality was based on permit requirements, discussed in Chapter 6. The quality of predicated sewer line leakage reflects effluent flows.

Tables 18 and 19 in Appendix C , TM-2, show the predicted effluent and recycled water quality percolating to groundwater.

Recycled irrigation increases from 230 AFY (2011) to 1,500 AFY (2016 through 2021). The basins/ subbasins with recycled water use were identified based on the locations of current and future planned areas of recycled water irrigation. The volumes currently applied at the airport and park site are assumed to remain constant. The remaining recycled water is planned to be applied to an agricultural area northwest of Hollister, which overlies four subbasins: Hollister Southeast, Hollister Northeast, Bolsa Southeast, and Hollister West. Ridgemark recycled water is assumed to be applied at the Ridgemark Golf Course in the Tres Pinos Subbasin.

7.4 Results

The bar graph below illustrates the TDS concentration in mg/L at the end of the projection time period, 2021. The change in concentration in mg/L between the current subbasin average (2011) and the 2021 average is shown above each bar. For example, the TDS average basin concentration in 2021 is 28.9 mg/L lower than the 2011 average in the Hollister West Subbasin. The light blue, grey, and dark blue bars indicate subbasins with a predicted decreased, stabilized, or increased concentration, respectively, between 2011 and 2021. The green lines show the assimilative capacity water quality thresholds, discussed below in Section 7.5.

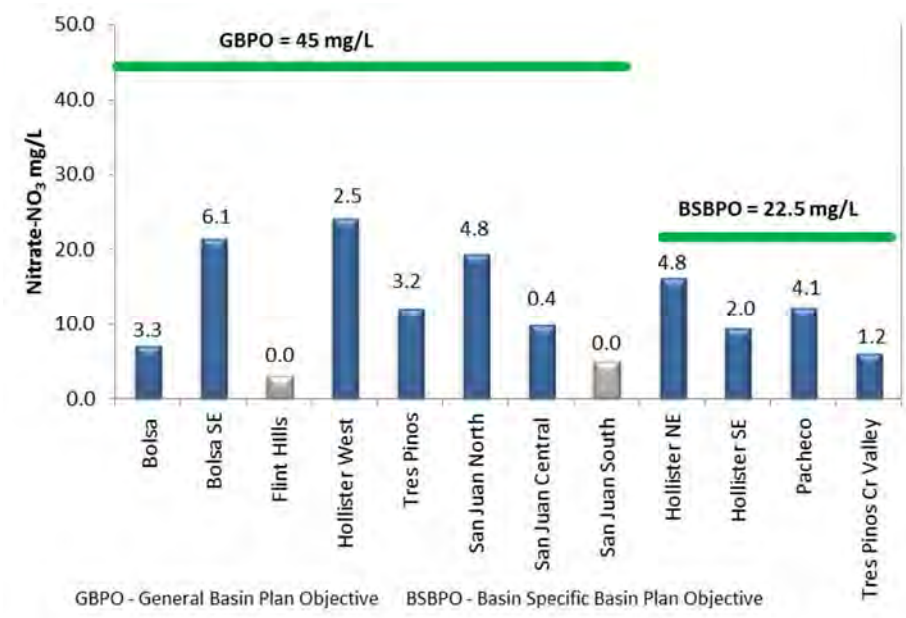


As shown in the graph, the results indicate that all but two subbasins will decrease or stabilize in TDS concentration by 2021. The Bolsa Subbasin does not have groundwater outflows during the projection time period, so there is a significant accumulation of mass and a slight increase in concentration. In Tres Pinos Creek Valley, natural stream percolation resulted in an increase in TDS concentration. During the projection period, natural stream percolation was held at the 2011 volume. During the baseline period, natural stream percolation volumes varied between wet and dry years.

Some noteworthy differences in TDS loading between the calibration period and the future projection include:

- The Hollister West, San Juan Central, and Tres Pinos subbasins had net losses of TDS mass during the calibration period, but had net gains during the projection period. In the Hollister West, San Juan Central and Tres Pinos subbasins, the mass increases are associated with an increase in the volume of groundwater in storage. Therefore, even though the mass is increasing, the average concentration decreases in Hollister West, Tres Pinos and San Juan Central subbasins.
- The Bolsa Subbasin had a net gain of about 40,000 tons of TDS mass compared to the calibration period, which showed a TDS mass increase of 12,000 tons. However, the concentration in 2021 (672 mg/L) is only slightly higher at the end of the calibration period (670 mg/L), because the volume of groundwater in storage increases by 39,000 acre-feet (AF) in 2021. During 2006 through 2008, groundwater outflow removed over 50,000 tons of TDS. Between 2012 through 2021, there is no groundwater outflow.
- The Bolsa Southeast Subbasin has a net loss of TDS due to the steady agricultural pumping that occurs between 2012 and 2021. In terms of mass, outflows exceed inflows by nearly 10,000 tons by 2021, and there is a net loss of groundwater in storage of 6,000 AF. As a result, the concentration of TDS decreases by 6.6 mg/L, compared to the calibration period where TDS increased by 4 mg/L.

Nitrate results are shown on the bar graph below. The change in concentration in mg/L between the current subbasin average (2011) and the 2021 average is shown above each bar. The green lines show the assimilative capacity water quality thresholds, discussed below in Section 7.5. Nitrate trends in concentration are virtually unchanged between the calibration period and the future projection period. Increases in concentration are small, well below 10 mg/L nitrate by 2021.



7.5 Future Projected Assimilative Capacity

Future groundwater quality and assimilative capacity is summarized on **Table 5**. During the baseline calibration period, the San Juan North was nearly at its assimilative capacity for TDS. However, water quality improves in San Juan North during the future scenario; therefore there is over 26 mg/L of additional assimilative capacity added (Table 5). Other basins retain nearly all their existing assimilative capacity for TDS in the future scenario.

No subbasins exceed the applicable GBPO (45 mg/L) or BSBPO (22.5 mg/L) by 2021, therefore there is available nitrate assimilative capacity in each subbasin. The average concentration increases slightly in each subbasin, except Flint Hills and San Juan South.

7.6 Additional Implementation Actions

As described in Chapter 6, there are many existing and planned implementation measures to manage salt and nutrients and protect receiving water quality. The need for additional implementation measures beyond those currently being done or planned is dictated by future water quality and water quality trends. Based on the existing and projected groundwater quality, existing and planned implementation measures are adequate to manage S/Ns on a sustainable basis in the Study Area. Based on this analysis, no additional implementation measures are warranted beyond those that have been implemented and those that are already planned before 2021. Nonetheless, the SNMP management process is active and ongoing and continued water quality monitoring will ascertain the effectiveness of implementation measures.

As described in Chapter 6, the largest data gap in assessing salt and nutrient loading is the availability of data on fertilizer application, BMPs, and potential BMP-induced improvements in receiving water quality. As programs are developed and implemented and data is collected under the RWQCB-issued Agricultural Order, it may be possible to better assess salt and nutrient loading in the future.

Table 5 Future Groundwater Quality and Assimilative Capacity

DWR Groundwater Basin/Subbasin	SNMP Subarea	TDS (mg/L)				Nitrate-NO_3 (mg/L)			
		GW Average [1]	Basin Specific Basin Plan Objective [2]	Assimilative Capacity Benchmark [3]	Assimilative Capacity	GW Average	Basin Specific Basin Plan Objective [4]	General Basin Plan Objective [5]	Assimilative Capacity
Bolsa Area	Bolsa [6]	672	-	1,200	528	7.2	-	45	37.8
Bolsa Area	Bolsa SE	999	-	1,200	201	21.5	-	45	23.5
San Juan Bautista	Flint HIlls	376	-	1,200	824	3.0	-	45	42.0
San Juan Bautista	Hollister West [7]	990	-	1,200	210	24.2	-	45	20.8
San Juan Bautista	Tres Pinos	989	-	1,200	211	12.1	-	45	32.9
San Juan Bautista	San Juan North	1,157	-	1,200	43	19.4	-	45	25.6
San Juan Bautista	San Juan Central	794	-	1,200	406	9.9	-	45	35.1
San Juan Bautista	San Juan South	720	-	1,200	480	5.0	-	45	40.0
Hollister Area	Hollister NE	733	1,200	-	467	16.2	22.5	-	6.3
Hollister Area	Hollister SE	1,026	1,200	-	174	9.6	22.5	-	12.9
Hollister Area	Pacheco	530	1,200	-	670	12.3	22.5	-	10.2
Tres Pinos Valley	Tres Pinos Cr Valley	724	1,000	-	276	6.2	22.5	-	16.3

1 - Projected TDS and nitrate concentrations simulated in mixing model

2 - Basin Specific Objectives established in the Basin Plan for CDWR Hollister Area Subbasin and Tres Pinos Valley Basin

3 - In the absence of a Basin Specific Plan Objective, an Assimilative Capacity Benchmark is used to calculate assimilative capacity

4 - Basin Plan Objective is 5 mg/L Nitrogen, which is equivalent to 22.5 mg/L Nitrate-NO_3 assuming Nitrate-NO_3 is 100% of Nitrogen

5 - For Municipal and Domestic Supply, based on California Code of Regulations, Title 22, Chapter 15

6 - 80% of the Bolsa Sub-Area within the DWR Bolsa Subbasin; 20% is within the Hollister Subbasin; for the assimilative capacity calculation, the Bolsa Benchmark is used

7 - 80% of the Hollister West Sub-Area is within the San Juan Bautista DWR Subbasin; 20% is within the Bolsa Subbasin; for the assimilative capacity calculation, the San Juan Bautista Benchmark is used

TDS - Total Dissolved Solids   mg/L - milligrams per liter NO_3-Nitrate   SE - Southeast   NE - northeast CR - creek

8 Anti-Degradation Assessment

8.1 Recycled Water Irrigation Projects

Recycled water irrigation project(s) included in the WY 2012 to WY 2021 future projection are:

- Hollister Domestic Wastewater Treatment Plant (WWTP) Projects: 484 acre-feet per year (AFY) of tertiary treated recycled water in 2012 increasing to 1,500 AFY in 2021 used for irrigation applied on farmland overlapping four subbasins (Hollister Northeast, Hollister South, Hollister West, and Bolsa Southeast), on the Hollister Municipal Airport (Hollister Northeast Subbasin), and on Brigantino Park (Hollister West Subbasin).
- Ridgemark WWTP Project: 200 AFY of tertiary treated recycled water for irrigation on the Ridgemark Golf Course (Tres Pinos Subbasin) WY 2014 through WY 2021.

8.2 SWRCB Recycled Water Policy Criteria

Section 9 Anti-Degradation of the SWRCB's Recycled Water Policy states, in part:

a. *The State Water Board adopted Resolution No. 68-16 as a policy statement to implement the Legislature's intent that waters of the state shall be regulated to achieve the highest water quality consistent with the maximum benefit to the people of the state.*

b. *Activities involving the disposal of waste that could impact high quality waters are required to implement best practicable treatment or control of the discharge necessary to ensure that pollution or nuisance will not occur, and the highest water quality consistent with the maximum benefit to the people of the state will be maintained…..*

d. *Landscape irrigation with recycled water in accordance with this Policy is to the benefit of the people of the State of California. Nonetheless, the State Water Board finds that the use of water for irrigation may, regardless of its source, collectively affect groundwater quality over time. The State Water Board intends to address these impacts in part through the development of salt/nutrient management plans described in paragraph 6.*

   (1) A project that meets the criteria for a streamlined irrigation permit and is within a basin where a salt/nutrient management plan satisfying the provisions of paragraph 6(b) is in place may be approved without further antidegradation analysis, provided that the project is consistent with that plan.

   (2) A project that meets the criteria for a streamlined irrigation permit and is within a basin where a salt/nutrient management plan satisfying the provisions of paragraph 6(b) is being prepared may be approved by the Regional Water Board by demonstrating through a salt/nutrient mass balance or similar analysis that the project uses less than 10 percent of the available assimilative capacity as estimated by the project proponent in a basin/sub-basin (or multiple projects

using less than 20 percent of the available assimilative capacity as estimated by the project proponent in a basin/sub-basin).

8.3 Assessment

The average TDS and nitrate concentrations and available assimilative capacities for baseline conditions and the future planning period with recycled water irrigation projects were discussed in TM-2 *Hydrogeologic Conceptual Model*, Appendix B. **Table 6** summarizes assimilative capacities for the five subbasins where recycled water will be used for irrigation. The simulated mixing model results indicate that with or without recycled water irrigation projects, all subbasins have assimilative capacity relative to their respective water quality thresholds. For WY 2012 to WY 2021, **Table 7** presents the difference in mixing model TDS and nitrate concentrations with and without the recycled water irrigation projects. The difference, shown for concentrations in mg/L and percentage of assimilative capacity used, represents the change in concentrations and use of assimilative capacities by just the recycled water projects.

As shown on Table 7, the Ridgemark WWTP project in the Tres Pinos Subbasin uses less than 1% of the available assimilative capacity for TDS and nitrate. Therefore, this irrigation project meets the Recycled Water Policy criterion of using less than 10% of the available assimilative capacity. The multiple projects associated with the Hollister Domestic WWTP in the Bolsa Southeast, Hollister West, Hollister Northeast, and Hollister Southeast Subbasins also use less than 1% of the assimilative capacity for TDS and nitrate. In Bolsa Southeast and Hollister Northeast, nitrate concentrations decrease slightly with the recycled irrigation projects because the recycled water quality is relatively low in nitrate compared with other sources. These irrigation projects also meet the Recycled Water Policy criterion of using less than 20% of the assimilative capacity. The future projection analysis shows that recycled water irrigation is a small component of S/N loading.

In addition to the minimal negative, and in some cases positive, water quality impacts associated with recycled water irrigation project(s) in the Study Area, the Recycled Water Policy and other state-wide planning documents recognize the tremendous need for and benefits of increased recycled water use in California. As stated in the Recycled Water Policy "*The collapse of the Bay-Delta ecosystem, climate change, and continuing population growth have combined with a severe drought on the Colorado River and failing levees in the Delta to create a new reality that challenges California's ability to provide the clean water needed for a healthy environment, a healthy population and a healthy economy, both now and in the future. ...We strongly encourage local and regional water agencies to move toward clean, abundant, local water for California by emphasizing appropriate water recycling, water conservation, and maintenance of supply infrastructure and the use of stormwater (including dry-weather urban runoff) in these plans; these sources of supply are drought-proof, reliable, and minimize our carbon footprint and can be sustained over the long-term."* Clearly, the benefits in terms of sustainability and reliability of recycled water use cannot be overstated. The SNMP analysis finds that recycled water use can be increased while still protecting groundwater quality.

Table 8 provides an explanation of how proposed future recycled projects are in compliance with SWRCB Resolution No. 68-16.

Table 6 Groundwater Quality and Assimilative Capacity

SNMP Subarea	TDS (mg/L)				Nitrate-NO_3 (mg/L)			
	GW Average [1]	BSBPO [2]	AC Bench-mark [3]	AC	GW Average [1]	BSBPO [4]	GBPO [5]	AC
Baseline Conditions (2011)								
Bolsa SE	1,006	-	1,200	194	15.4	-	45	29.6
Hollister West	1,019	-	1,200	181	21.7	-	45	23.3
Tres Pinos	995	-	1,200	205	8.9	-	45	36.1
Hollister NE	741	1,200	-	459	11.4	22.5	-	11.1
Hollister SE	1,030	1,200	-	170	7.6	22.5	-	14.9
Future Projection (2021) With Recycled Water Projects								
Bolsa SE [6]	999	-	1,200	201	21.5	-	45	23.5
Hollister West [7]	990	-	1,200	210	24.2	-	45	20.8
Tres Pinos	989	-	1,200	211	12.1	-	45	32.9
Hollister NE	733	1,200	-	467	16.2	22.5	-	6.3
Hollister SE	1,026	1,200	-	174	9.6	22.5	-	12.9
Future Projection (2021) With No Recycled Water Projects								
Bolsa SE [6]	998	-	1,200	202	21.5	-	45	23.5
Hollister West [7]	989	-	1,200	211	24.2	-	45	20.8
Tres Pinos	988	-	1,200	212	12.1	-	45	32.9
Hollister NE	732	1,200	-	468	16.2	22.5	-	6.3
Hollister SE	1,025	1,200	-	175	9.6	22.5	-	12.9

SNMP - Salt and Nutrient Management Plan
TDS - Total Dissolved Solids
mg/L - milligrams per liter
NO_3 -nitrate
AC - assimilative capacity
BSBPO - Basin Specific Basin Plan Objective
GBPO - General Basin Plan Objective
CDWR - California Department of Water Resources
NE - northeast
SE - southeast
GW - groundwater

1 - Baseline conditions and the current groundwater basin averages; future projection based on the 2021 mixing model

2 - BSBPOs established in the Basin Plan for CDWR Hollister Area Subbasin

3 - In the absence of a BSBPO, an Assimilative Capacity Benchmark is used to calculate assimilative capacity

4 - GBPO is 5 mg/L Nitrogen, which is equivalent to 22.5 mg/L Nitrate-NO_3 assuming Nitrate-NO_3 is 100% of Nitrogen

5 - For Municipal and Domestic Supply, based on California Code of Regulations, Title 22, Chapter 15

6 - 80% of the Bolsa Sub-Area is within the DWR Bolsa Subbasin; 20% is within the Hollister Subbasin. For the assimilative capacity calculation, the Bolsa Benchmark is used

7 - 80% of the Hollister West Subarea is within the San Juan Bautista DWR Subbasin; 20% is within the Bolsa Subbasin. For the assimilative capacity calculation, the San Juan Bautista Benchmark is used

Table 7 Assimilative Capacity Usage With and Without Recycled Water Projects

SNMP Subbasin	TDS		Nitrate-NO_3	
	mg/L	percent	mg/L	Percent
	Change 2011 to 2021 (mg/L) [1]	AC Used [2,3]	Change 2011 to 2021 (mg/L) [1]	AC Used [2,3]
Future Projection With Recycled Water Projects				
Bolsa SE	-6.6	-3.3%	6.05	25.70%
Hollister West	-28.9	-14.4%	2.50	12.02%
Tres Pinos	-6.3	-3.1%	3.20	9.73%
Hollister NE	-8.0	-4.0%	4.80	76.31%
Hollister SE	-4.1	-2.1%	2.00	15.49%
Future Projection Without Recycled Water Projects				
Bolsa SE	-7.7	-3.8%	6.06	25.74%
Hollister West	-29.5	-14.7%	2.49	11.96%
Tres Pinos	-6.7	-3.4%	3.19	9.70%
Hollister NE	-8.5	-4.2%	4.81	76.48%
Hollister SE	-4.6	-2.3%	1.99	15.38%
Difference - Impacts of Only Recycled Water Projects				
Bolsa SE	1.1	0.6%	-0.01	-0.05%
Hollister West	0.7	0.3%	0.01	0.06%
Tres Pinos	0.5	0.2%	0.01	0.03%
Hollister NE	0.5	0.1%	-0.01	-0.16%
Hollister SE	0.5	0.3%	0.01	0.11%

SNMP - Salt and Nutrient Management Plan
mg/L - milligrams per liter
AC - assimilative capacity
NE - northeast
TDS - Total Dissolved Solids
NO_3 -nitrate
SE - southeast

1 - Negative number indicate decrease in groundwater concentration and increase in available AC
2 - Assimilative capacity in 2021 with recycled water project(s), see Table 1
3 - A negative percent is an increase in available AC

Table 8 Anti-Degradation Assessment

<table>
<tr><th>SWRCB Resolution No. 68-16 Component</th><th>Anti-Degradation Assessment</th></tr>
<tr><td>Water quality changes associated with proposed recycled water projects are consistent with the maximum benefit of the people of the State.</td><td rowspan="3">• The Hollister Domestic WWTP irrigation projects will not use more than 20% of the available AC (use less than 1%)
• The Ridgemark WWTP irrigation project will not use more than 10% of the available AC (use less than 1%)
• Recycled water irrigation projects will not cause groundwater quality to exceed applicable BPOs
• Use of recycled water for irrigation to replace imported water is consistent with the SWRCB Policy, which encourage reliance on local, drought-resistant water supplies</td></tr>
<tr><td>The water quality changes associated with proposed recycled water projects will not unreasonably affect present and anticipated beneficial uses.</td></tr>
<tr><td>The water quality changes will not result in water quality less than prescribed in the Basin Plan.</td></tr>
<tr><td>The projects are consistent with the use of best practicable treatment or control to avoid pollution or nuisance and maintain the highest water quality consistent with maximum benefit to the people of the State.</td><td>• A TDS target of 500 mg/L with a not-to-exceed concentration of 700 mg/L for recycled water will be met by source water improvements and groundwater demineralization
• The Ridgemark WWTP will be upgraded to produce tertiary recycled water</td></tr>
<tr><td>The proposed projects are necessary to accommodate important economic or social development.</td><td>• The recycled water projects are an integral part of water and wastewater master plans for the Hollister Urban Area</td></tr>
<tr><td>Implementation measures are being or will be implemented to help achieve BPOs in the future.</td><td>• Various measures, as described in TM -2, Section 5, have been or will be implemented in the Study Area to address salts and nutrients
• Improvement in source water quality resulting from the District's Optimization Study (TM-2, Section 6) will improve WWTP effluent quality</td></tr>
</table>

SWRCB – State Water Resources Control Board
AC – assimilative capacity
SE – southeast
TDS – Total Dissolved Solids
WWTP – Wastewater treatment plant
BPOs – Basin Plan Objectives
NE – northeast
mg/L – milligrams per liter

9 SNMP Groundwater Monitoring Plan

The Recycled Water Policy states that the SNMP should include a monitoring program that consists of a network of monitoring locations "... adequate to provide a reasonable, cost-effective means of determining whether the concentrations of salts, nutrients, and other constituents of concern as identified in the salt and nutrient plans are consistent with applicable water quality objectives." Additionally, the SNMP "... must focus on basin water quality near water supply wells and areas proximate to large water recycling projects, particularly groundwater recharge projects. Also, monitoring locations shall, where appropriate, target groundwater and surface waters where groundwater has connectivity with the adjacent surface waters." The preferred approach is to "... collect samples from existing wells if feasible as long as the existing wells are located appropriately to determine water quality throughout the most critical areas of the basin. The monitoring plan shall identify those stakeholders responsible for conducting, sampling, and reporting the monitoring data. The data shall be reported to the Regional Water Board at least every three years." With regard to constituents of emerging concern (CECs), the Recycled Water Policy Attachment A states that "Monitoring of health-based CECs or performance indicator CECs is not required for recycled water used for landscape irrigation due to the low risk for ingestion of the water."

Groundwater quality investigations in the Study Area date back to the 1930s. To further understanding of basin-wide water quality and to optimize their monitoring program, the District developed a comprehensive water quality database and water quality monitoring program (Todd Engineers, 2004). Based on that program, the District coordinates sampling, collection, and reporting of groundwater quality data. The data are analyzed and reported every three years in the District's Groundwater Report. This is a voluntary program.

The water quality data in the triennial Groundwater Report include data collected by the District, and data available from other entities including the RWQCB, CDPH, and other sources. The existing District monitoring program and groundwater quality database were used to characterize S/N groundwater quality and trends for the SNMP water quality assessment. The existing data were found to be adequate to support the analysis. Accordingly, the SNMP Monitoring Program proposes to use the District's existing groundwater quality monitoring program as the basis for a comprehensive monitoring plan that satisfies the requirements of the Recycled Water Policy. Some additions to the existing program are suggested to provide a more robust program. These additions include two new wells in the Paicines Valley Area and additional shallow wells in the northern San Juan Basin as described in Appendix D. A total of 13 additional wells are proposed.

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Figures

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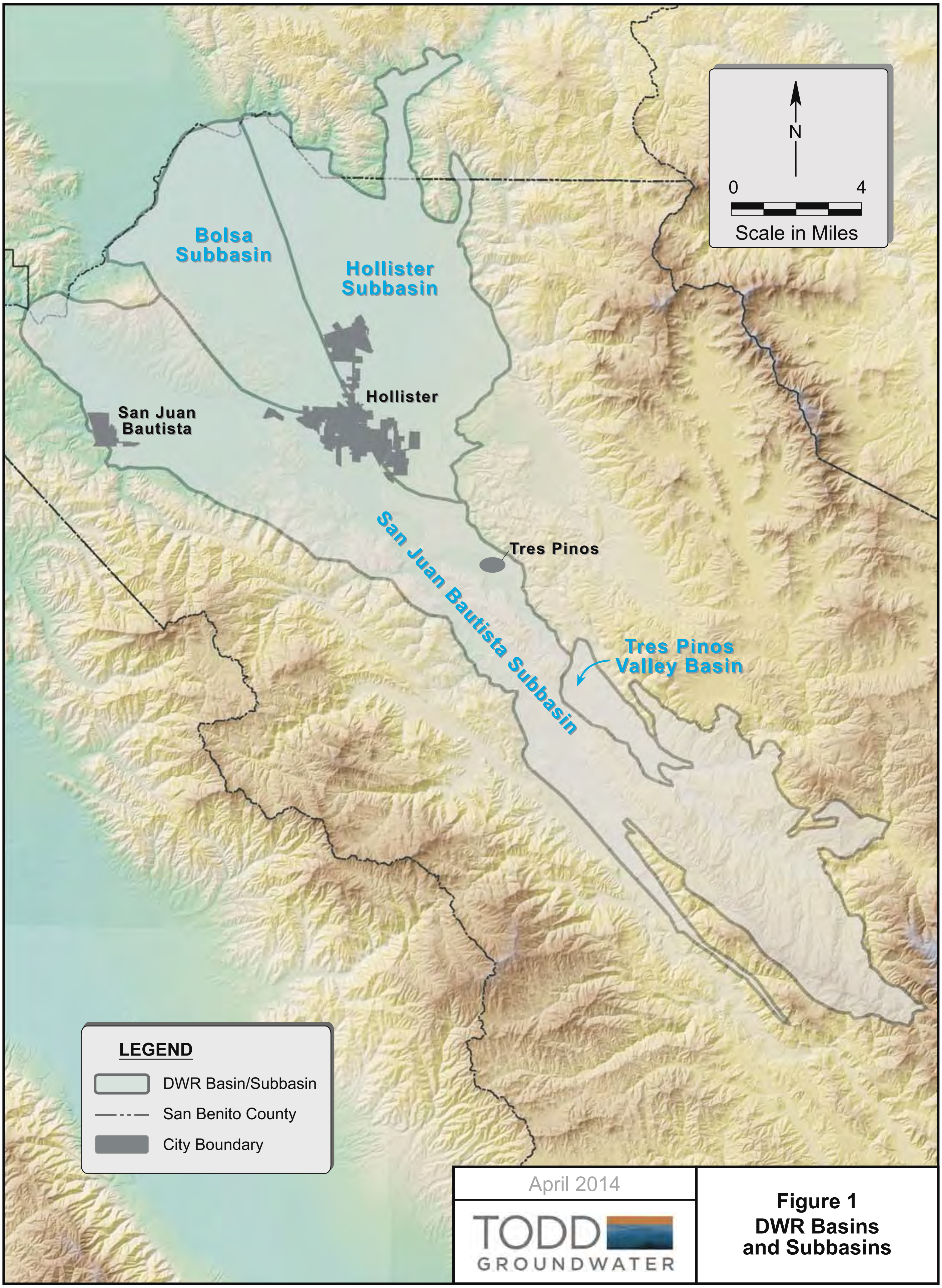

Figure 1
DWR Basins and Subbasins

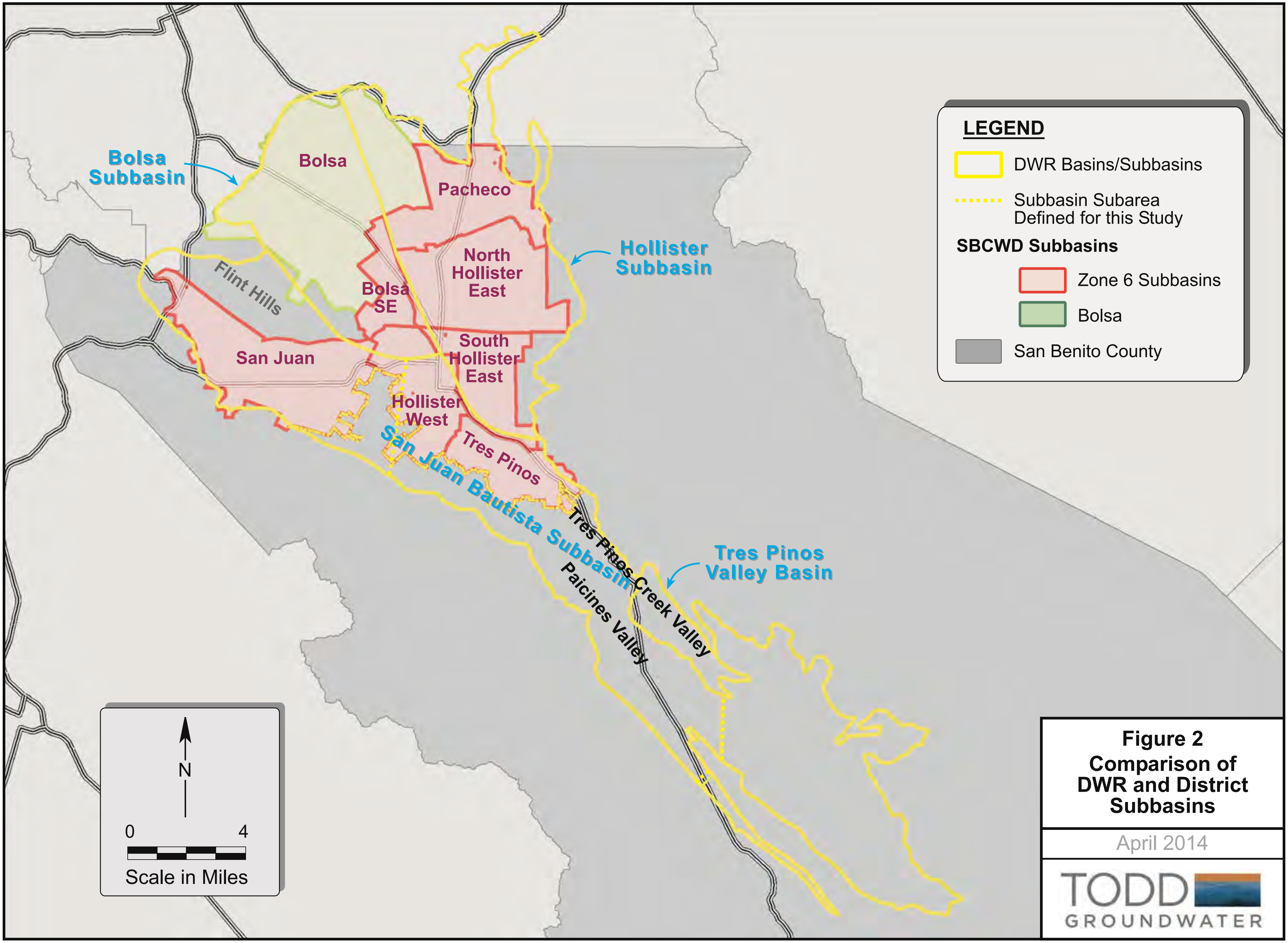

Figure 2
Comparison of DWR and District Subbasins

April 2014

TODD GROUNDWATER

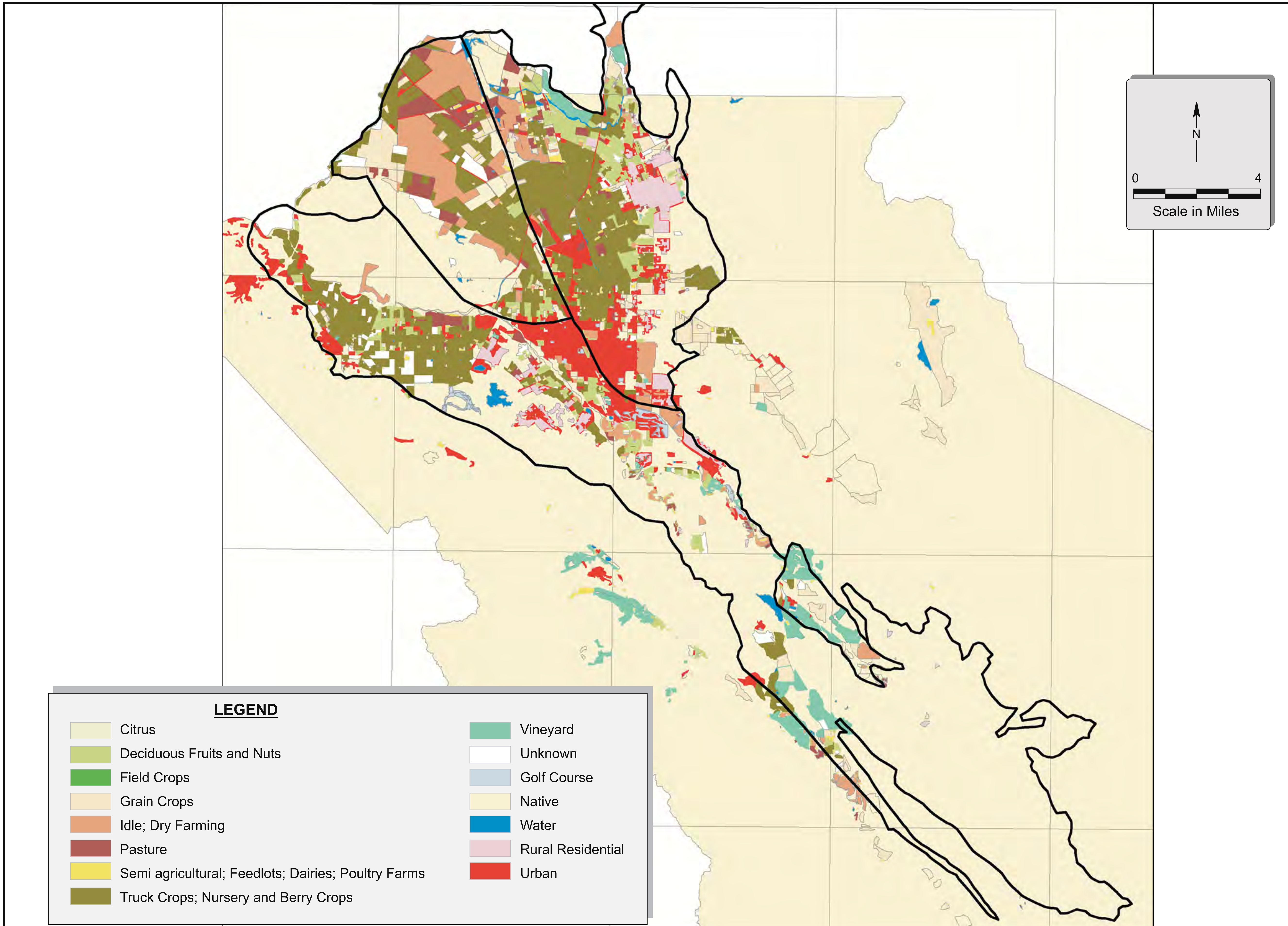

Figure 3
2010
Land Use

April 2014

TODD GROUNDWATER

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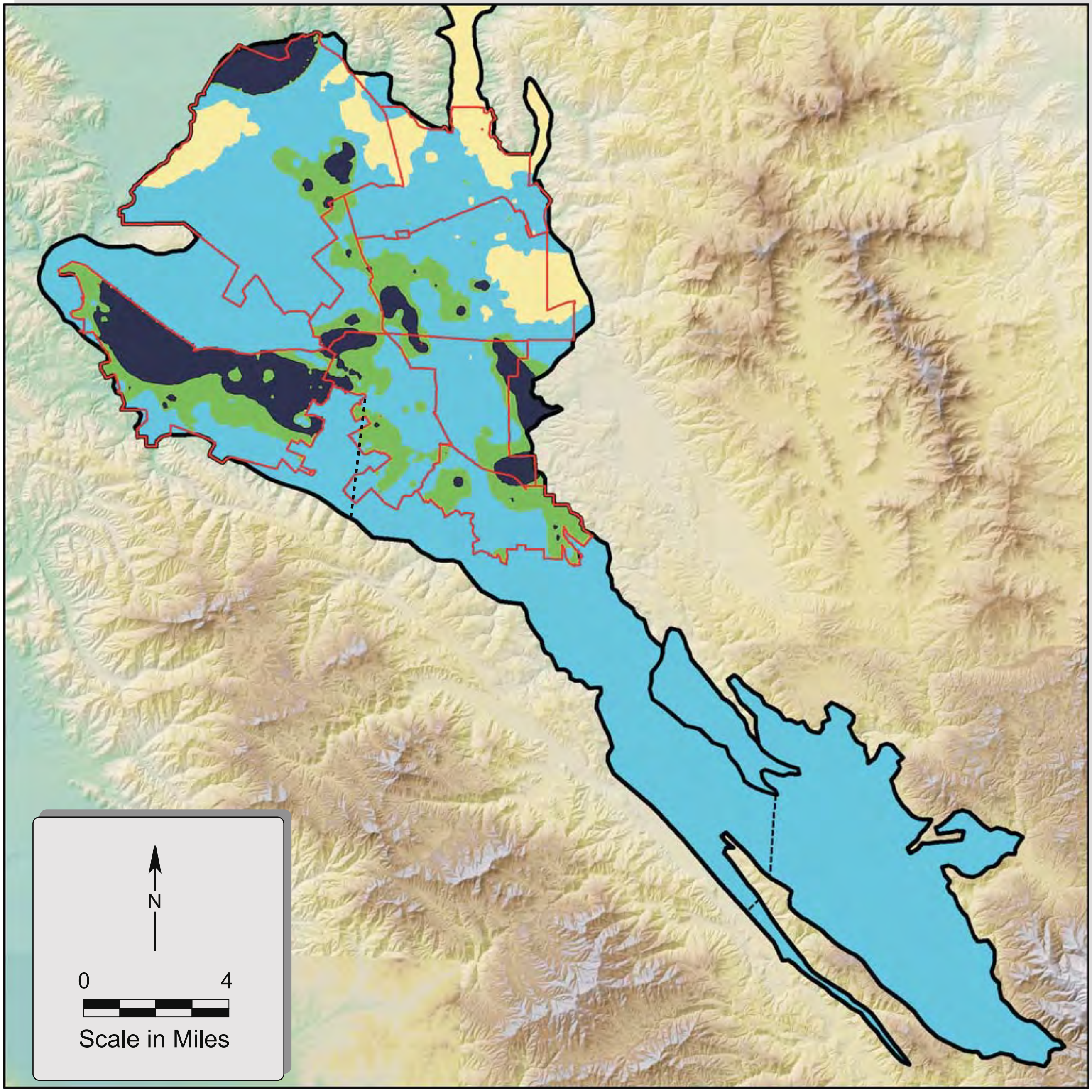


LEGEND

- DWR Basin/Subbasin Boundary
- District Subbasin Boundary
- Subbasin Subarea defined for this Study

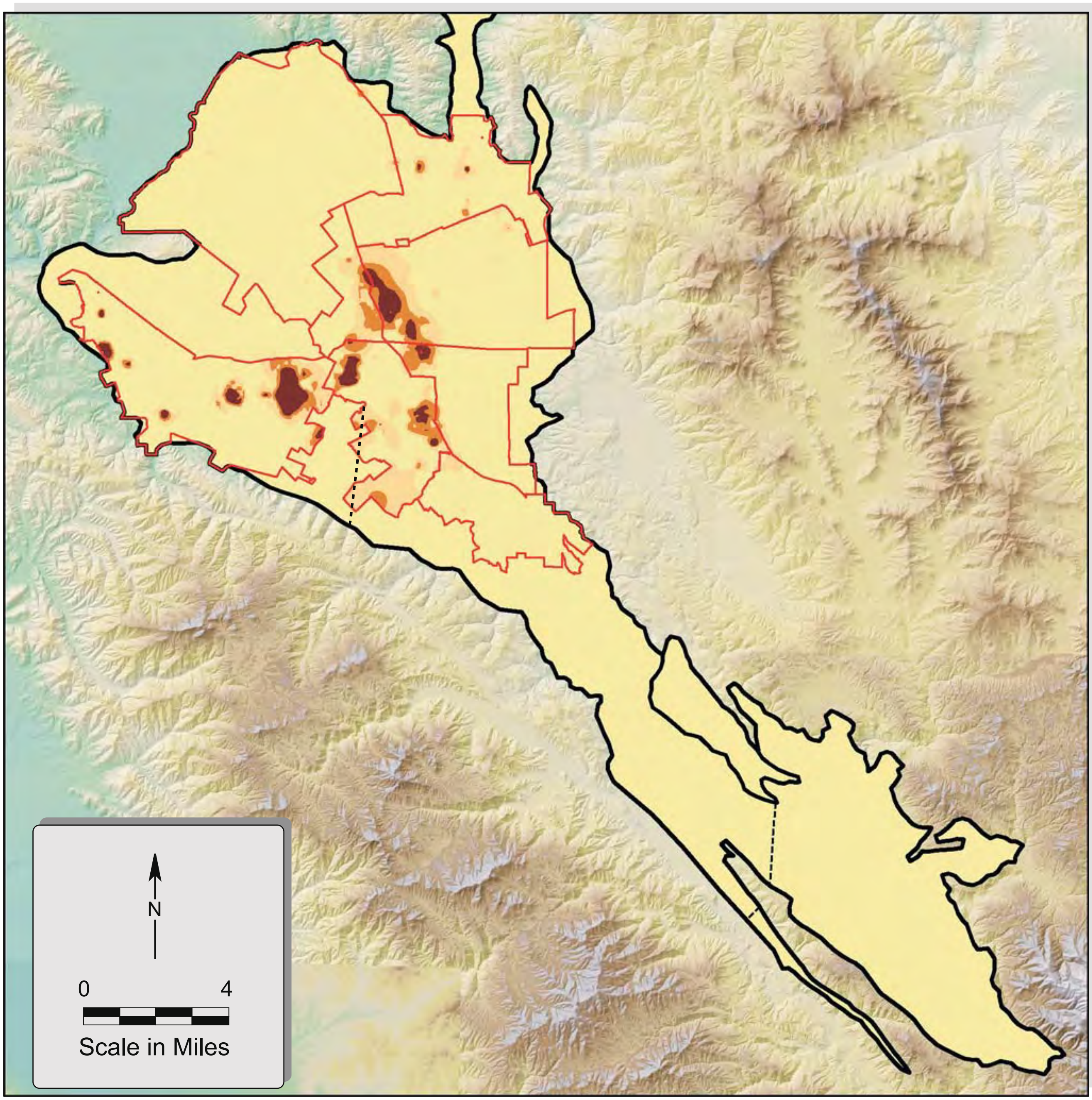
TDS Concentration

- <500 mg/L
- 500 - 1,000 mg/L
- 1,000 - 1,200 mg/L
- > 1,200 mg/L

April 2014

TODD GROUNDWATER

Figure 4
Interpolated TDS Concentrations



LEGEND

- DWR Basin/Subbasin Boundary
- District Subbasin Boundary
- Subbasin Subarea defined for this Study

Nitrate-NO_3 Concentration

- 0 - 20 mg/L
- 20 - 30 mg/L
- 30 - 45 mg/L
- > 45 mg/L

April 2014

TODD GROUNDWATER

Figure 5
Interpolated Nitrate-NO_3 Concentrations

Appendix A

Stakeholder List

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Stakeholders - Northern San Benito County Salt and Nutrient Management Plan

Agency/Organization	Contact
2nd Nature	Nicole Beck
Amah Mutsun Tribal Band	Charlene Sul
Apricot King	Gary Gonzales
Anzar High School	Bill Rupert
Aromas Water District	Vickie Morris
Betabel RV Park	betabel@betabelrv.com
Bolado Park Golf Club	Steve Janisch
California Department of Public Health	Jan Swagert
California Department of Water Resources	ccrf@water.ca.gov
Central Coast Agricultural Task Force	Darlene Din
Central Coast Agricultural Water Quality Coalition	Mary Ellen Dick
Central Coast Regional Water Quality Control Board	Cecille DeMartini, Matt Keeling
Central Coast Resource Conservation & Development Council	Jeff Rodriguez
City of Hollister	Clint Quilter
City of San Juan Bautista	Roger Grimsley
County of San Benito Public Works	Steve Wittry
Earth Bound Farms	Richard Paulus, Lisette Knight
Environmental Justice Coalition for Water	Colin Bailey
Felice Farms	Joe Newman
Gilroy Gaits	GilroyGaits@yahoo.com
Grower-Shipper Association of Central California	Abby Taylor-Silva
Gutierrez Associates	Lidia Gutierrez
Pajaro River Watershed Council	Carol Presley
Pajaro Valley Water Management Agency	Casey Meusel
Planning and Conservation League Foundation	pclmail@pcl.org
Ridgemark Golf & Country Club	Eric Boyd
Sabor Farms	Richard Bianchi
San Benito Cattlemen's Association	P.O. Box 820 Hollister, CA 95024
San Benito County Agricultural Commission	Ron Ross
San Benito County Agricultural Land Trust	Paul Hain
San Benito County Business Council	jconklinmkting@aol.com
San Benito County Chamber of Commerce	bryn@sanbenitocountychamber.com
San Benito County Farm Bureau	sbcfb@garlic.com
San Benito County Water District	Jeff Cattaneo, Dale Rosskamp
San Benito County Wine Growers Association	ald@derosewine.com
San Benito Resource Conservation District	Kellie Guerra
San Juan Oaks Golf Course	Scott Fuller
Santa Clara Valley Water District	Tracy Hemmeter
Sierra Club, Loma Prieta Chapter	Mandy Rose
South County Regional Wastewater Authority	Tom Haglund
Sunnyslope County Water District	Don Ridenhour
The Nature Conservancy	Daniel Roth
Todd Engineers	Sally McCraven
Trical, Incorporated	John Ivanovich
Tres Pinos County Water District	Ray Creech
Tres Pinos School	Lou Medeiros
Trueleaf (Pride of San Juan)	Vince Brigantino
US Department of Agriculture, Natural Resources Conservation Service	Daniel Little
Water Resources Association of San Benito County	Shawn Novak
Water Strategies	Linda Spencer
Wilbur Ellis	Aaron Tilley, Joel Wiley
Wildlands, Inc.	Wildlands, Inc.

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Appendix B

Hydrogeologic Conceptual Model (TM-1)

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San Benito County Water District
San Benito County, California

FINAL

Technical Memorandum 1
Hydrogeologic Conceptual Model
for
Northern San Benito County
Salt and Nutrient Management Plan

May 2013

Prepared by:

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1 Introduction

Task 1 of the San Benito County Water District (District) Salt and Nutrient Management Plan (SNMP) (Todd, 2012) is documentation of the hydrogeologic conceptual model of the Study Area. The SNMP for the District is being conducted as one task of the Integrated Regional Water Management Plan (IRWMP) for the Pajaro River Watershed.

The goal of the hydrogeologic characterization is to provide the basis for subsequent salt and nutrient loading and assimilative capacity estimates. Accordingly, the conceptual model will describe the Study Area hydrogeologic conditions including water balances and existing water quality, which provide the basis for loading calculations. The water balance documents annual basin inflows and outflows (natural and managed groundwater recharge, subsurface groundwater flow, groundwater extraction, etc.). The existing water quality conditions for groundwater, local surface water, imported water, recycled water, and wastewater quality will be documented to support the SNMP analyses. Existing water quality provides the baseline for future loading estimates and groundwater quality trends help provide a calibration for loading estimates.

2 Hydrogeologic Setting

2.1 Physical Setting

The Study Area includes the San Benito County (County) portion of the Gilroy-Hollister Groundwater Basin, which includes the Bolsa, Hollister, and San Juan Bautista groundwater subbasins as defined by the California Department of Water Resources (DWR) in Bulletin 118 (DWR, 2003). The Gilroy portion of the basin lies in Santa Clara County and is not included in the Study Area. The Study Area also includes the Tres Pinos Valley Groundwater Basin. These subbasins and basins are show in **Figure 1**. For purposes of this study, the San Juan Subbasin is divided into northern, central, and southern areas. The Study Area covers approximately 200 square miles situated between and including portions of the Diablo Range to the east and the Gabilan Range to the west (**Figure 2**).

In the northern and central portion of the Study Area, the subbasins and basins predominantly include low lying valleys. An outcrop of consolidated sedimentary units, referred to as the Lomerias Muertas and Flint Hills, rises up to 1,000 feet above the valley floor in the northern San Juan Bautista Subbasin (Figure 2). The southern portion of the San Juan Bautista Subbasin includes elevated uplands areas within the Diablo Range along the watershed of the Tres Pinos Creek and a small arm of moderate permeability material located east of the San Benito River.

2.2 Surface Water

The Study Area covers a portion of the Pajaro River watershed and is drained by tributaries of the Pajaro River. The main tributaries through the Study Area include the San Benito River and Tres Pinos Creek. Tres Pinos Creek flows into the San Benito River west of the community of Tres Pinos and the San Benito River joins the Pajaro River west of Lomerias Muertas and Flint Hills (Figure 2).

The San Benito River, Tres Pinos Creek, and tributaries are dry much of the year, flowing mainly during wet winter conditions.

The Pajaro River forms the northern boundary of San Benito County. Flow in the river is controlled by Pacheco Pass Dam operated by Pacheco Pass Water District. The Llagas and Uvas creeks flow into the Pajaro River from the north in Santa Clara County.

There are currently five active USGS stream gauges in the County, located on Pajaro River, San Benito River, Tres Pinos Creek, and Clear Creek.

2.3 Geologic Setting

The Study Area lies within the Coast Ranges of California, a series of elongated ranges and valleys with a predominantly northwesterly trend. The topography is formed by folding and faulting of basement rocks in the area, leaving low-lying valleys, which have been infilled with sediments. Basin fill material consists of unconsolidated to poorly consolidated alluvium of Tertiary and Quaternary age. The Quaternary alluvial deposits compose the valley floors and generally define the groundwater basins and subbasins in the central and northern Study Area. As defined by the DWR, the San Juan Subbasin also encompasses large areas of elevated hills comprised of continental deposits. **Figure 3** shows a geologic map (CGS, 2002) of the Study Area.

Numerous investigators have recognized the difficulty in describing the subsurface stratigraphy of the alluvial valleys, due, in part, to sparse geophysical log data and a lack of distinctive textures and composition among the sedimentary units (Kilburn, 1972; Faye 1974 and 1976; LSCE, 1991). General summaries of the basin and subbasin lithologies are provided below based on simplified subsurface data on well logs and surface geologic mapping.

2.3.1 Bolsa Subbasin

The alluvium in the northern portion of the Bolsa Subbasin appears to have a relatively high proportion of sands and gravels, possibly due to the proximity and influence of the Pajaro River. Surficial deposits in the subbasin are predominantly clay, but the underlying alluvium appears coarse-grained from limited driller's logs and exceeds a thickness of 200 feet in the north-central portion of the subbasin. Driller's logs just west of the Calaveras fault trace indicate alluvium composed of almost entirely clay (~90 percent) in some wells.

2.3.2 Hollister Subbasin

The eastern rim of this subbasin contains outcrops of older alluvial sediments (Figure 3). Although these deposits are characterized by a framework of coarse-grain gravels and sands, a clay matrix presumably limits the permeability. The overlying younger alluvium west of the older alluvium outcrop is thought to contain proportionately more coarse-grained sediments and represent the alluvial fans sourced from the Diablo Range. Silt and clay units apparently thicken to the west with increasing proximity to the Calaveras fault. Older deposits have been displaced vertically along the Calaveras fault and crop out on the western edge of the subbasin (Figure 3).

2.3.3 San Juan Bautista Subbasin

Investigations indicate that both surficial and subsurface alluvium in the alluvial valley of the northern San Juan Subbasin contain large percentages of clay with thin and discontinuous sand lenses. Jenkins (1973) interprets terrace deposits of silt as infill deposits of a large paleo-lake that covered a large portion of the subbasin. An exception to the fine-grain nature of the San Juan alluvium is the coarse-grain San Benito River gravels deposited in and below the course of the San Benito River. Terrace deposits that rim the channel gravels west of Hollister are more coarse-grained than the silty terrace deposits elsewhere in the northern portion of the subbasin. Paleo-channels of the San Benito River likely represent the highest permeabilities where they exist in the subsurface.

Because of the thin and relatively low permeability alluvium in the subbasin, underlying Tertiary-age sedimentary rock of the Purisima Formation is also tapped by water supply wells.

The Lomerias Muertas and Flint Hills (subsequently referred to as the Flint Hills) are located in the northeast corner of the northern San Juan Bautista Subbasin. The hills are underlain by continental mudstone. The area is undeveloped.

The central and southern portion of the San Juan Subbasin is not well characterized. The Central portion of the San Juan Subbasin west of Tres Pinos Valley Basin is referred to as the Paicines Valley and is underlain by Plio-Pleistocene nonmarine deposits and River Terrace Deposits. The approximate area of the Paicines Valley is shown in **Figure 4**. As mapped by DWR, the San Juan Subbasin includes a large area in the Diablo Range south and east of the Tres Pinos Valley Basin, here referred to as Upper Tres Pinos Creek area (southern San Juan Subbasin) that is underlain by Pliocene or early Pleistocene continental sediments (CGS, 2002). Thin alluvium is thought to occur along the upper Tres Pinos Creek (LSCE, 1981). DWR has also mapped a narrow southwestern leg of the San Juan Subbasin south of the Tres Pinos Valley Basin as shown on Figure 3. This leg lies in the low foothills east of the San Benito River. Units outcropping in this area are also Pliocene or early Pleistocene continental sediments.

2.3.4 Tres Pinos Valley Basin

The Tres Pinos Valley Basin occupies a small alluvial valley of the Tres Pinos Creek upstream of the community of Tres Pinos. The basin is comprised of Quaternary alluvium and non-marine terrace deposits (Figure 3).

2.3.5 Groundwater Basin Depths

The depth to consolidated Tertiary units and other bedrock units beneath the alluvium and Plio-Pleistocene sediments is not well characterized. Kapple (1979) indicates that the Quaternary-age aquifers, including the unconsolidated basin fill, San Benito Gravels, and an undifferentiated sedimentary unit, range in thickness up to 1,300 feet in the Hollister Subbasin. Generalized cross sections prepared for a San Benito County Groundwater Study (LSCE, 1991) generally corroborate this interpretation with alluvium estimated to average about 700 feet thick in the Bolsa and Hollister subbasins.

In alluvial valley of the northern San Juan Subbasin, the alluvium appears to be thinner than in the Bolsa and Hollister subbasins and is estimated to be about 400 feet thick. Wells deeper than this in the northern San Juan Subbasin may be producing water from the underlying Purisima Formation. The Purisima Formation is thought to reach thicknesses in the subsurface of more than 1,500 feet in the northern portion of the Subbasin (Kilburn, 1972); although, most of the water quality data in the northern San Juan Subbasin are from wells less than 350 feet deep.

There are no wells located in the Flint Hills area of the northern San Juan subbasin; however, there are data available for one well located on the west side of the San Juan Bautista alluvial Valley. The well is screened in the same continental mudstones formation that underlies the Flint Hills and is 300 feet deep.

The central (Paicines Valley) and southern San Juan Subbasin are not well characterized. Several irrigation wells in the Paicines Valley penetrate alluvial deposits to depths ranging from 100 to 500 feet below ground surface (ft-bgs) (LSCE, 1991). A review of driller's logs in the area indicated an average alluvial depth of 400 feet. The alluvial thickness in the southern San Juan Subbasin (Upper Tres Pinos Creek area) is thought to be less than 100 feet (LSCE, 1991); however, Pliocene or early Pleistocene continental sediments of moderate permeability underlie the remainder of the Upper Tres Pinos Creek Watershed. Based on a review of driller's logs, the average well depth in the southern San Juan Subbasin is about 300 feet. For further analysis, an average alluvial thickness of 400 feet is assumed for the central San Juan Subbasin (Paicines Valley) and an aquifer (alluvium and continental deposits) thickness of 300 feet is assumed for the southern San Juan Subbasin (Upper Tres Pinos Creek area and arm above the San Benito River).

LSCE (1991) reports wells in the Tres Pinos Valley Basin encounter alluvial deposits ranging from 135 to 630 ft-bgs. The DWR (2003) report that the alluvial material is generally less than 100 feet thick. A review of driller's logs in the area indicates an average depth to bedrock of 360 feet. For further SNMP analyses, an average alluvial thickness of 350 feet is assumed for the Tres Pinos Valley Basin.

2.3.6 Geologic Faults

Major geologic faults, including the San Andreas and Calaveras faults, cut through the area disrupting rock units and shaping the valleys (Figure 3). In the northern Study Area, the San Andreas Fault forms the southwestern boundary of the San Juan Subbasin. Numerous additional faults that are related to the San Andreas system have been mapped and trend parallel or subparallel to the San Andreas Fault trace. Of these, the Calaveras Fault is the most extensively mapped. The Calaveras Fault runs through the center of the Study Area and separates the Bolsa Subbasin from the northern Hollister Subbasin.

Other faults in the northern Study Area related to the San Andreas system have shaped the eastern side of the Hollister subbasin. Although some of these faults have been mapped in the outcropping bedrock, fault traces across the valley floor are unknown. Linear-trending groundwater quality changes in the Study Area may be associated with some of these faults or related faults. The Study Area is extremely complex due to intensive faulting and deformation along the Calaveras and San Andreas fault zone (LSCE, 1991).

2.4 Hydrogeology

While the Study Area includes the Bolsa, Hollister, San Juan Bautista subbasins and the Tres Pinos Valley Basin as defined by DWR (2003), the District defines hydrogeologic subbasins differently than DWR. As shown in Figure 4, the District defines eight subbasins in the northern Study Area including the Bolsa; Bolsa Southeast; Pacheco; Tres Pinos; San Juan; and Northeast, Southeast and West Hollister. The District defined two additional subbasins in the central Study Area including the Tres Pinos Creek Valley and the Paicines Valley. These subbasins have been defined based on a combination of infrastructure subdivisions (San Felipe subsystems), political boundaries (e.g., District's Zone 6), and geologic structures such as faults (Jones & Stokes, March 1997; Yates, 2002).The District has formed three zones of benefit in the County. Zone 6 (shaded red in Figure 4) includes the most developed, studied and actively managed part of the County. Accordingly, Zone 6 is the area with the most available data to support the SNMP analyses. Because the District has historically described water balances in terms of the 10 District-designated subbasins (Pacheco, Bolsa, Bolsa Southeast, San Juan, Hollister West, and Hollister Northeast. Hollister Southeast, Tres Pinos, Tres Pins Creek Valley, and Paicines), these District subbasin designations will be maintained for the salt and nutrient loading and assimilative capacity analyses. Nonetheless, the portions of the DWR-designated Bolsa, Hollister, and San Juan subbasins that extend beyond the Zone 6 boundaries will also be included in the SNMP Study Area and considered in the SNMP analyses. It should be noted that data in these areas outside of Zone 6 are sparse.

In addition, several other groundwater basins are defined by DWR in the County as shown in **Figure 5**. Due to lack of data and a funding mechanism and sparse population, these basins are not included in the SNMP analyses.

2.4.1 Aquifers and Groundwater Occurrence

The geologic materials underlying the groundwater basin and subbasins do not fall into two categories of permeability, such as bedrock and basin fill. Some upland areas such as the Lomerias Muertas, Flint Hills and hills in the upper Tres Pinos Creek drainage in the south San Juan Bautista Subbasin are simply upward folds of the same formations that make up much of the groundwater basins and subbasins in the valley areas. These upland areas may store and transmit some groundwater to the valley basins. This is presumably why these areas are included in the DWR-designated basin areas. **Figure 6** shows the geologic formations loosely grouped into four permeability classes based on the age and type of material. The DWR-designated basin and subbasins include valley areas comprised of Holocene and late Pleistocene alluvial deposits with relatively high permeability and upland areas comprised of mainly Pliocene-Pleistocene continental deposits of moderate permeability. The Flint Hills and most of the central San Juan Subbasin encompasses areas of elevated relatively lower permeability Pliocene continental deposits, which would likely yield less quantities of groundwater. The valley-fill units were deposited in alluvial fan and fluvial environments from a variety of source rocks and directions. These deposits interfinger in the subsurface, making the differentiation of discrete aquifer packages difficult on a regional basis. This also results in variable aquifer properties across the Study Area (LSCE, 1991; Faye, 1974).

Groundwater generally occurs in the Study Area under both unconfined and confined conditions. Surficial clay deposits, especially in the Bolsa and northern San Juan subbasins, create non continuous confining layers.

2.4.2 Aquifer Parameters

In order to assess loading and mixing for subsequent SNMP analyses, subbasin mixing zones and porosity must be estimated. Estimation of mixing zone is based on the estimated thickness of each basin or subbasin. The mixing zone in each basin or subbasin is assumed to be less than the total thickness due to the layered nature of the sediments and increased impacts of surface contaminant releases in the shallows zone. This is a conservative assumption, since it reduces the total volume of the mixing zone and increases the impacts of salt and nutrient loading. **Table 1** presents subbasin area, mixing zone, and porosity estimates to be used for subsequent analyses. Mixing thicknesses may be adjusted base on the loading calibration process.

Table 1 Subbasin Parameters

Subbasin/Basin	Area (acres)	Average Aquifer Thickness (feet)	Mixing Thickness (feet)	Porosity
Bolsa	20,907	700	400	0.15
Bolsa Southeast	2,689	700	400	0.15
Hollister Northeast	11,381	700	400	0.15
Hollister Southeast	6,947	700	400	0.15
Hollister West	6,051	700	400	0.15
Northern San Juan	11,873	400	350	0.15
Flint Hills	8,153	300	250	0.15
Central San Juan (Paicines Valley)	21,791	400	350	0.15
Southern San Juan	24,214	300	250	0.15
District Tres Pinos	4,736	400	350	0.15
DWR Tres Pinos Valley	3,387	350	300	0.15
Pacheco	10,469	700	400	0.15

DWR – California Department of Water Resources

2.4.1 Water Levels and Flow

The District's quarterly groundwater level monitoring program includes over 100 wells in the northern and central Study Area. There is no organized collection of groundwater levels in the southern San Juan Subbasin (LSCE, 1991).

Water levels vary over time in response to varying precipitation, groundwater pumping, and both natural and artificial recharge conditions. Water levels are estimated to have been at historic highs prior to 1913 before development of groundwater resources (Kilburn, 1972). When groundwater levels are high, these layers create artesian conditions. A 1924 U.S. Geological Survey (USGS) study delineated a 25-square mile area of artesian flow in the Bolsa Subbasin (Clark, 1924). After about 1945, groundwater extraction lowered the water table in the northern Study Area; although, flowing wells are currently observed in the Hollister Subbasin due to near historic high groundwater levels in 2010 and 2011 (Todd, 2012). In drought conditions of the late 1970s, water levels in some areas declined more than 150 feet from the estimated historic highs (Creegan & D'Angelo, 1990).

Water levels in wells typically fluctuate 5 to 15 feet on a seasonal basis except in the Bolsa Subbasin where water levels in confined aquifers have seasonal fluctuations of more than 30 feet (Yates, 2003).

The effects of geologic faults on groundwater levels have been documented by numerous investigators (Kilburn, 1972; LSCE, 1991; Todd, 1994a). Water level changes across the Calaveras Fault have been the focus of most of the analyses, but water level changes across some of the minor faults have also been observed.

Measured water levels in the central and northern part of the Study Area for October 2011 and estimated groundwater levels in the southern Study Area are shown on **Figure 7**. Because, there is no groundwater level monitoring program in the southern Study Area, estimated groundwater elevation contours were generated for the southern Study Area assuming groundwater levels were approximately 30 ft-bgs, consistent with depths to groundwater in the central Study Area. Imported water, managed percolation, and decreased groundwater use have resulted in groundwater levels at or near their historic highs in most of the northern Study Area in recent years. The exception to this increasing trend is observed in a persistent pumping depression in the Bolsa Subbasin.

In general, water levels in the northern Study Area currently range from about 480 feet mean sea level (ft-msl) in the southeastern corner to below 80 ft-msl near the pumping depression in the Bolsa Subbasin. The Bolsa Subbasin does not receive Central Valley Project (CVP) imported water and relies on solely groundwater for water supply. Water levels are near 130 ft-msl at the San Juan Subbasin outflow near the confluence of the San Benito and the Pajaro rivers (Figure 7).

Groundwater in the Study Area generally flows from southeast to northwest. In the northern Study Area, groundwater flows from the southeast and eastern portions of the basin toward the western and northwestern portions of the basin to the Pajaro River. As shown by the arrows on Figure 7, general flow directions in the Bolsa Subbasin have been reversed due to groundwater pumping. Groundwater in the Bolsa Subbasin near the Pajaro River flows southeast toward the pumping depression.

Groundwater north of the Pajaro River in the adjacent Llagas Subbasin in Santa Clara County flows southeast into the Bolsa Subbasin. This is a concern with respect to potential water quality impacts documented in that subbasin. Wastewater disposal impacts from food processing and municipal wastewater ponds are a potential concern. Wastewater disposal ponds are located less than two miles from the Pajaro River.

2.4.2 Water Use

Four sources provide water supply for the municipal, rural, and agricultural land uses in the Study Area. These are water purchased and imported from the CVP by the District, local surface water stored in and released from the District-owned and operated Hernandez and Paicines reservoirs (see Figure 5), local groundwater pumped from wells, and a limited amount of recycled water used as park irrigation. Water stored in the two reservoirs is released for percolation in Tres Pinos Creek and the San Benito River to augment groundwater recharge during the dry season. Use of recycled water for irrigation is in the initial phases of development.

Since 1987, the District has purchased CVP water from the U. S. Bureau of Reclamation. The District has a 40-year contract (extending to 2027) for a maximum of 8,250 acre-feet per year (AFY) of municipal and industrial (M&I) water and 35,550 AFY of agricultural water. San Justo Reservoir (see Figure 5) is used exclusively to store and regulate imported CVP water. The imported water is delivered to agricultural, municipal, and industrial customers in the Zone 6 (District's designated Pacheco, Bolsa Southeast, Northern San Juan, Hollister Northeast, Hollister Southeast, Hollister West, and Tres Pinos subbasins).

While the District is the CVP wholesaler and has jurisdiction for water management throughout the County, much of the population is served by water purveyors including the City of Hollister, Sunnyslope County Water District (SSCWD), and other small local purveyors. The majority of the small local purveyors have only one or two groundwater wells. These systems provide water to communities such as mobile home parks and homeowners' associations and to transient populations at schools, parks, and businesses. Some communities within the County are not served by water districts or do not have water systems that provide water service. These communities and rural residents rely on private wells and groundwater. More than 500 domestic and agriculture wells have been drilled in the northern Study Area (Zone 6). Development and associated well density south of Zone 7 is less with and an estimated total of 30 wells in the Central Study Area and 16 wells in the southern Study Area. Agriculture has historically represented the largest water use in the northern Study Area, a condition that continues today.

Total water use throughout the Study Area is not known, but most of the water use occurs in the northern Study Area. In the area with CVP deliveries (Zone 6), total water use—including CVP water and groundwater—has ranged between 35,000 and 50,000 AFY for the last decade; both agricultural use and municipal use has generally declined in recent years.

The relative amount of imported and groundwater used in the northern Study Area varies significantly from year to year based on availability of imported water supplies. In 2011, groundwater supplied approximately 49 percent and imported water supplied approximately 51 percent of the water used for agriculture, municipal, domestic, and industrial supply in the Zone 6. Agricultural irrigation accounted for 79 percent of the total water use in Zone 6 in 2011.

The Bolsa Subbasin, the central and southern San Juan Subbasin and the Tres Pinos Valley Basin rely on groundwater for 100 percent of their water supply. Based on the past ten years of water balance estimates, groundwater pumped from the Paicines Valley (Central San Juan Subbasin) has ranged between 1,000 and 5,400 AFY with an average of 1,500. Groundwater pumped from the Tres Pinos Valley has ranged from 300 to 1,800 AFY with an average of 500 AFY. Based on the small number of wells (16) and the low pumping rates listed on driller's logs (average 27 gallons per minute), wells in the southern Study Area support only domestic and small application irrigation uses. Assuming usage of 200 gallons per day per well yields less than 0.3 AFY of groundwater production in the southern Study Area. No production wells have been identified in the Flint Hills and groundwater pumping in the area is assumed to be zero.

2.4.3 Water Balance

In order to estimate salt and nutrient loading, it is necessary to have an understanding of the historic and predicted future water inflows and outflows (i.e., the water balance). The water balance changes from year to year based primarily on precipitation patterns and the availability of imported water supplies. As part of the SNMP analysis, future groundwater quality will be estimated for the years 2012 to 2022. The preliminary approach for loading includes three water balance scenarios applied to the next 10 years of loading:

1) assume average rainfall and CVP deliveries, update any land and water use changes identified in various general and urban water management plans;
2) assume slightly drier than average conditions (20%) with reduced rainfall and CVP deliveries, update any land and water use changes identified in various general and urban water management plans;
3) assume slightly wetter conditions (20%) with increased rainfall and CVP deliveries at full contract levels, update any land and water use changes identified in various general and urban water management plans.

This approach should bracket a range of potential loading.

The water balance provides estimates of specific inflows and outflows for each individual subbasin. The water balance is prepared for each water year and for each District-designated subbasin as part of annual reporting. Water balances from 2002 to 2011 were examined to select an average rainfall year to use in the future loading estimates. The water balances are provided in Appendix A. Water year 2008-09 was selected to represent dry year conditions, water year 2005-06 represents wet year conditions, and water year 2010-11 represents average year conditions for subsequent predictions of future groundwater quality.

In order to encompass the entire SNMP Study Area, water balances have also been prepared for the southern San Juan Subbasin and the Flint Hills. These areas consist primarily of uplands, so the source of inflow is percolation of rainfall. This was estimated using a soil moisture balance methodology. This method accounts for rainfall, soil moisture storage, and evapotranspiration; the remaining water becomes runoff and recharge. In general, only a few years have significant rainfall recharge and most years have zero recharge. For simplicity, outflows (including groundwater outflow, some streamflow and minor pumping) are assumed to occur in the same year as inflow for the southern San Juan Subbasin. No production wells were identified and there are no significant streams in the Flint Hills area.

2.4.3.1 Inflows

There are five major sources of inflow to the Study Area. These include:

- natural stream percolation,
- percolation of reservoir releases,
- deep percolation (from rainfall and/or irrigation),
- percolation of reclaimed water, and
- subsurface groundwater inflow.

In the past, managed percolation of CVP water was also a major inflow; however, this has not occurred since 2007.

2.4.3.2 Outflows

The major outflows from the Study Area are groundwater pumping (agricultural, municipal, industrial, and domestic) and subsurface outflow. Agricultural groundwater pumping is measured using hour meters on irrigation wells in Zone 6 and is estimated for the surrounding areas based on the soil moisture balance and crop water demands. The amount of agricultural pumping is dependent on the volume of CVP imports and the amount and timing of rainfall, because spring rains decrease total irrigation demand, and growers adjust groundwater pumping to compensate for changes in the availability of CVP imports.

3 Water Quality

Water has the ability to naturally dissolve salts and nutrients along its journey in the hydrologic cycle. The types and quantity of salts and nutrients present determine whether the water is of suitable quality for its intended uses. Salts and nutrients present in natural water result from many different sources including atmospheric gases and aerosols, weathering and erosion of soil and rocks, and from dissolution of existing minerals below the ground surface. Additional changes in concentrations can result due to ion exchange, precipitation of minerals previously dissolved, and reactions resulting in conversion of some solutes from one form to another such as the conversion of nitrate to gaseous nitrogen. In addition to naturally occurring salts and nutrients, anthropogenic activities can add salts and nutrients.

Addition of new water supply sources, either through intentional or unintentional recharge, can change the groundwater quality either for the worse by introducing a contamination or for the better by diluting some existing contaminants in the aquifer. The District has been providing imported water from the Bay-Delta system for water supply and recharge since the 1987. Local runoff has also been recharged. Another important influence on groundwater quality is unintentional recharge, which can occur when irrigation water exceeds evaporation and plant needs and infiltrates into the aquifer. For example, irrigation water can carry pesticides, fertilizers, and amendments from the yard or field into the aquifer. Similarly, recycled water used for landscape irrigation also can introduce salts and nutrients.

3.1 Water Quality Monitoring

A comprehensive water quality database for the District was created in 2004 and is regularly updated with readily available local data. The database covers the northern and central Study Area and no data are available for the southern Study Area. A comprehensive update of the water quality database occurs on a triennial basis. The database was last updated in November 2010 to include the most recent data available from the District, Regional Water Quality Control Board Central Coast Region (RWQCB) California Department of Public Health (CDPH), City of Hollister, SSCWD, and other sources. Accordingly, water quality conditions observed in 2010 provide the baseline for estimating future salt and nutrient groundwater quality in subsequent SNMP analyses.

There are currently 18 wells in the District's monitoring program in the northern and central Study Area. The District also monitors other wells in the northern and central Study Area as needed.

The RWQCB is responsible for enforcing all water quality standards for permitted or other discharges in San Benito County. There are 25 facilities in the Study Area with recent water quality data. Available data for these sites and other sites with historical water quality data are included in the water quality database. **Figure 8** shows the general location of these facilities and **Tables 2** and **3** contains information regarding the facilities. Table 2 includes sites with recent water quality information and Table 3 includes sites with historical water quality data.

The CDPH is responsible for enforcing drinking water standards. Approximately 120 water systems in San Benito County are required to submit water quality data to CDPH and these data are included in the water quality database.

The SSCWD operates five active water supply wells and one inactive well. Water quality data from these wells along with data from six monitoring wells near their wastewater disposal ponds are also included the database.

Water quality data for effluent discharged to the City of Hollister, San Juan, SSWD, and Tres Pinos Water District wastewater treatment ponds are included in the database.

Table 2 Regulated Facilities with Recent Water Quality Data

Name	Current or Former Operations	# of Wells	Potential Constituents of Concern	Order Number	Notes
Aromas-San Juan USD (Anzar High School)	High school with a wastewater treatment facility	6	salinity, nitrogen species	96-36	
BAE Systems (United Defense)	Ballistics Testing	67	perchlorate, nitrogen species	R3-2055-0113	
Casa De Fruta	Fruit stand/tourist attraction with a wastewater treatment facility	4	salinity, nitrogen species		
Chevron 9-9156	Gas station with a leaking underground storage tank	11	BTEX	00-68	
Cielo Vista Estates	Housing development with a wastewater treatment facility	4	TDS, Na, Cl, Nitrogen		
E Ranch Milk	Gas station with a leaking underground storage tank	23	BTEX and other organics, pH, EC	98-68	
El Modeno Gardens	Commercial nursery irrigation runoff	5	salinity, nitrogen species	99-050	
El Toro	Leaking underground storage tank	14	BTEX		
GAF Leatherback Industries Warehouse Facility	Former Saturator	4	VOCs, Petroleum products		Ceased Operations in 2007, RWQCB Site Opened April 2009
Granite Rock Co	Sand and gravel quarry	3	turbidity	R3-2005-0063	
Hollister Domestic WWTP	Domestic wastewater treatment facility for the City of Hollister	38	salinity, nitrogen species	87-47	
Hollister Industrial WWTP	Industrial wastewater treatment facility for the City of Hollister	12	salinity, nitrogen species	00-020	
John Smith Landfill	Waste disposal	> 18	organic, inorganic, metals	R3-2002-001	
Laverone Property (BK Towing)	Leaking underground storage tank	13	BTEX	92-101	

Name	Current or Former Operations	# of Wells	Potential Constituents of Concern	Order Number	Notes
McCormick Teledyne	Explosive products for the aerospace and automotive safety industries	30	perchlorate, nitrogen species, metals, salinity		
MK Ballistics (United Defense)	Ballistics Testing	5	perchlorate	CU-06-00123	
Natural Food Selection/ Earthbound Farms	Fruit and Vegetable processing wastes	4	salinity, nitrogen species	R3-2004-006	
Rancho Justo Company	Golf course with domestic wastewater disposal system	4	salinity, nitrogen species		
Sambrailo Packaging		9	BTEX		
San Juan Bautista WWTP	Wastewater disposal	3	salinity, nitrogen species	R3-2003-0087	
Soil Serv	Fertilizer and Pesticide storage	13	pesticides, nitrogen species, salinity		
Sunnyslope WWTP	Wastewater disposal	6	salinity, nitrogen species		
Tres Pinos WWTP	Wastewater disposal		salinity, nitrogen species	99-101	
Western Farm Service	Fertilizer and Pesticide storage	10	pesticides, nitrogen species, salinity	01-052	
Whittaker Ordinance	Manufacturing	224	perchlorate	99-006	

Table 3 Summary of Regulated Facilities with Historical Water Quality Data

Name	Current or Former Operations	# of Wells	Potential Constituents of Concern	Order Number	Notes
Betabel Valley RV Resort	Recreational vehicle camp with a wastewater treatment facility	2	salinity, nitrogen species	88-23	No recent information
Biosystems Management	Biosolids waste disposal	4	salinity, nitrogen species, metals		closed
Chevron 9-1898	Gas station with a leaking underground storage tank	9	BTEX, MTBE		closed
Gibson Farms Inc.	Fruit producer (processing wastes)	3	salinity, nitrogen species	R3-2004-0066	closed
Nyland Ranch Warehouse	Leaking underground storage tank	4	salinity, boron		closed
PG &E / City of Hollister Fire Department	Leaking underground storage tank	4	BTEX		Closed 7/21/92
San Juan Bautista City Yard	Underground storage tanks	6	BTEX		No recent information
TOSCO Facility #3738		3	BTEX		Soil samples only
Victory Gas and Food	Gas station	13	BTEX		No recent information

3.1 Water Quality Objectives

Table 4 lists numeric General Basin Plan Objectives (GBPOs) for groundwater with municipal and domestic water supply (MUN) and agricultural water supply (AGR) beneficial uses in the Central Coast. The CDPH has adopted Secondary Maximum Contaminant Levels (SMCLs) for TDS. SMCLs address aesthetic issues related to taste, odor, or appearance of the water and are not related to health effects; although, elevated TDS concentrations can affect its desirability for irrigation uses. The recommended SMCL for TDS is 500 mg/L with an upper limit of 1,000 mg/L. It has a short-term limit of 1,500 mg/L.

The primary maximum contaminant level (MCL) for nitrate plus nitrite as nitrogen (as N) is 10 milligrams per liter (mg/L). The primary MCL for nitrate as nitrate (as NO_3) is 45 mg/L. These MCLs are based on a health concern due to methemoglobinemia, or “blue baby syndrome,” which affects infants, ruminant animals (such as cows and sheep) and infant monogastrics (such as baby pigs and chickens). Elevated levels may also be unhealthy for pregnant women (SWRCB, 2010).

In addition to the above objectives, the RWQCB has established certain Basin-Specific Basin Plan Objectives (BSBPOs) for selected groundwaters and surface waters that are intended to serve as a water quality baseline for evaluating water quality management. The Basin Plan (RWQCB, June 2011) states that these objectives are median values based on data averages (for groundwater) or annual mean values (for the San Benito River); and objectives are based on preservation of existing quality or water quality enhancement believed attainable following control of point sources. Accordingly, these objectives appear to be set at or below ambient background. The number of samples, dates of collection, and locations, which were the basis for development of the objectives, are not provided. The BSBPO for total nitrogen is 5 mg/L for the Hollister Subbasin and Tres Pinos Basin. This value is ½ the MCL for nitrogen. Assuming 100 percent of the nitrogen is in the form of nitrate, the objective can be converted into a BSBPO for nitrate-NO_3 of 22.5 mg/L. The TDS BSBPOs are 1,200 mg/L for the Hollister Subbasin and 1,000 mg/L for the Tres Pinos Basin as shown in **Table 5**. The TDS BSBPO for San Benito River of 1,400 mg/L is provided in **Table 6**.

In the absence of BSBPOs for DWR San Juan Bautista and Bolsa Subbasins, a TDS Assimilative Capacity Benchmark (ACB) is needed for the SNMP to calculate the assimilative capacity. **Table 7** presents a TDS assimilative capacity benchmark of 1,200 mg/L for the DWR San Juan and Bolsa Subbasins. Ambient groundwater quality in the San Juan Bautista and Bolsa Subbasins is similar to or slightly poorer than in the Hollister subbasin; so use of the same TDS objective is deemed reasonable. The GBPO for nitrate-NO_3 (45 mg/L) will be applied to assimilative capacity calculations in the DWR San Juan Bautista and Bolsa Subbasins.

Table 4 General Basin Plan Objectives

Parameter	Units	MUN	AGR
TDS	mg/L	500/1,000/1,500[1]	450
Nitrate (as NO_3)	mg/L	45	100[2]
Nitrate + Nitrite-N	mg/L	10	100 [2]

MUN – municipal AGR – agricultural mg/L – milligrams per liter

1 - The levels specified for TDS and chloride are the “recommended” levels for constituents with secondary maximum contaminant levels

2 - For livestock watering

Table 5 Basin-Specific Basin Plan Objectives

Parameter	Units	MUN	
		Hollister	Tres Pinos
TDS	mg/L	1,200	1,000
Nitrogen (as N)	mg/L	5	5
Nitrate (as NO_3)	mg/L	22.5	22.5

TDS – total dissolved solids MUN – municipal mg/L – milligrams per liter

Table 6 San Benito River Basin Plan Objectives

Parameter	Units	Concentration
TDS	mg/L	1,400

TDS – total dissolved solids mg/L – milligrams per liter

Table 7 Assimilative Capacity Benchmarks

Parameter	Units	MUN	
		Bolsa	San Juan
TDS	mg/L	1,200	1,200

TDS – total dissolved solids MUN – municipal mg/L – milligrams per liter

3.2 Summary of Groundwater Quality Conditions

Water quality studies have identified constituents of concern (COCs) including boron, chloride, hardness, metals, nitrate, sulfate, potassium, and TDS. Currently, in some parts of the Study Area, COC concentrations do not meet water quality standards necessary to support beneficial uses of water resources. In addition to the historical COCs, current operations by regulated facilities have introduced new local COCs, including perchlorate, metals, and volatile organic chemicals.

In most areas of the Study Area, water quality has remained stable over recent years (2004-2010). Other areas, like the eastern portion of the northern San Juan Subbasin, have shown variable but generally decreasing trends in some key constituents like nitrate and chloride. This localized change in water quality results from local factors including nearby regulated facilities, land use changes, and changes in groundwater levels. Current baseline water quality is characterized in terms of TDS and nitrate. These constituents vary both over time and space in the Study Area and indicate general trends in salt and nutrient loading.

3.2.1 Total Dissolved Solids

TDS is a measure of the combined content of all dissolved inorganic and organic substances in a water sample and is a general measure of the salinity of water. It is a prime indicator of the general suitability of water for use. Dissolved solids in groundwater are naturally related to the interaction of water with the atmosphere, soil, and rock. Dissolved solids in groundwater can be artificially elevated due to land use and anthropogenic effects.

Figure 9 shows maximum TDS concentrations based on historical and recent (2007 – 2010) water quality data. TDS has exceeded the BSBPO or ACB of 1,200 mg/L in recent sampling (2007-2010) in the northern and central San Juan, Hollister Northeast, Hollister Southeast, Hollister West, and Tres Pinos subbasins. The northern portions of the Bolsa and Pacheco subbasins show relatively lower concentrations, as does the Tres Pinos Valley. The northern San Juan has the highest levels of TDS. Exceptionally high TDS concentrations observed in the northern Bolsa Subbasin are believed to be related to natural conditions associated with historical wetlands located in the area.

Figure 10 shows interpolated TDS concentrations for the Study Area. The interpolations are based on all the observed data, with more weighting given to newer data in areas where both recent and historical data are available. Due to the lack of water quality monitoring data in the southern San Juan Subbasin, it is assumed that TDS concentrations in this area are the same as observed in the Tres Pinos Valley Basin because most of the southern San Juan Subbasin is in the Tres Pinos Creek watershed. No wells were identified in the Flint Hills. Water quality in the Flint Hills is based on data from one well located on the west side of the northern San Juan Bautista alluvial valley. This well is screened in the same continental mudstones that underlie the Flint Hills.

Based on the interpolation presented in Figure 10, the Geographical Information System (GIS) spatial analyst tool was used to extract average concentrations for each subarea. Average TDS and nitrate concentrations in each subarea are shown in **Table 8** and **Figure 11**. There is a hot spot of highly elevated TDS detections at the northern edge of the Bolsa Subbasin. TDS concentrations in this area range from 19,000 to 59,000 mg/L. The elevated concentrations are localized and believed to be related to an ancient wetlands that existed in the area. These elevated concentrations were not included in the Bolsa Subbasin average because they are so high they skew the average. The subbasin averages serve as a snapshot for each subbasin, allow a simple comparison of water quality conditions across the Study Area, and provide the baseline for future loading estimates.

Figure 11 and Table 8 show the average TDS and nitrate concentrations and available assimilative capacity in the Study Area basins and subbasins. Average TDS concentrations in most basins/subbasins in the Study Area are high, near 1,000 mg/L, the upper SMCL. The average TDS concentration in the northern San Juan Subbasin is the highest of all the subbasins in the Study Area and is just at the ACB or 1,200 mg/L. The average TDS concentration in the Pacheco Subbasin and Flint Hills area is the lowest of the subareas. Average TDS concentrations near 1,000 mg/L in the Bolsa Southeast, Hollister Southeast, Hollister West, and District Tres Pinos indicate limited available assimilative capacity for additional loading. Applying the ACB concentration (1,200 mg/L) to the San Juan North Subbasin indicates, on average, there is very little available assimilative capacity (2 mg/L) in this subbasin.

Figure 12 shows time concentration plots for TDS in District monitoring wells and **Table 9** shows trends in TDS and nitrate for District monitoring wells in each subbasin/basin. Due to the limited amount of data, trends were identified through visually inspection of time concentration plots. No trend analysis is possible for the southern Study Area and Flint Hills, where there is no active monitoring program. There is very limited data in the Central San Juan and Tres Pinos Valley areas.

As shown in Table 9, TDS trends are somewhat mixed; however, more wells show decreasing trends (12 wells) than increasing trends (2 wells). Wells downstream of wastewater treatment ponds near Highway 156 in the San Juan Subbasin show a decrease in concentrations, possibly due to the reduced percolation of wastewater in recent years. However, water quality samples in this region continue to have high TDS concentrations relative to the rest of the subbasin and Study Area.

Table 8 Average Constituent Concentrations by Subbasin

DWR Groundwater Basin/Subbasin	SNMP Subarea	TDS (mg/L)				Nitrate-NO_3 (mg/L)			
		GW Average	Basin Specific Basin Plan Objective [6]	Assimilative Capacity Benchmark [7]	Assimilative Capacity	GW Average	Basin Specific Basin Plan Objective [8]	General Basin Plan Objective [9]	Assimilative Capacity
Bolsa Area	Bolsa [1, 5, 10]	670	-	1,200	530	3.9	-	45	41.1
Bolsa Area	Bolsa SE [1]	1,006	-	1,200	194	15.4	-	45	29.6
San Juan Bautista	Flint HIlls [4]	376	-	1,200	824	3.0	-	45	42.0
San Juan Bautista	Hollister West [1, 11]	1,019	-	1,200	181	21.7	-	45	23.3
San Juan Bautista	Tres Pinos [1]	995	-	1,200	205	8.9	-	45	36.1
San Juan Bautista	San Juan North [1]	1,198	-	1,200	2	14.6	-	45	30.4
San Juan Bautista	San Juan Central [2]	794	-	1,200	406	9.5	-	45	35.5
San Juan Bautista	San Juan South [3]	720	-	1,200	480	5.0	-	45	40.0
Hollister Area	Hollister NE	741	1,200	-	459	11.4	22.5	-	11.1
Hollister Area	Hollister SE [1]	1,030	1,200	-	170	7.6	22.5	-	14.9
Hollister Area	Pacheco [1]	533	1,200	-	667	8.2	22.5	-	14.3
Tres Pinos Valley	Tres Pinos Cr Valley [2]	720	1,000	-	280	5.0	22.5	-	17.5

1 - Average groundwater concentrations based on interpolation of 2007-2010 median well concentration data and contours

2 - Average groundwater concentrations based on average concentration of all available sampling events

3 - Average groundwater concentrations in Tres Pinos Creek Valley applied to San Juan South

4 - Average groundwater concentrations based on one sampling event for Live Oak Water Association

5 - Acreage and average TDS groundwater concentration does not include elevated TDS in the north

6 - Basin Specific Objectives established in the Basin Plan for CDWR Hollister Area Subbasin and Tres Pinos Valley Basin

7 - In the absence of a Basin Specific Plan Objective, an Assimilative Capacity Benchmark is used to calculate assimilative capacity

8 - Basin Plan Objective is 5 mg/L Nitrogen, which is equivalent to 22.5 mg/L Nitrate-NO_3 assuming Nitrate-NO_3 is 100% of Nitrogen

9 - For Municipal and Domestic Supply, based on California Code of Regulations, Title 22, Chapter 15

10 - 80% of the Bolsa Sub-Area within the DWR Bolsa Subbasin; 20% is within the Hollister Subbasin. For the assimilative capacity calculation, the Bolsa Benchmark is used

11 - 80% of the Hollister West Sub-Area is within the San Juan Bautista DWR Subbasin; 20% is within the Bolsa Subbasin. For the assimilative capacity calculation, the San Juan Bautista Benchmark is used

GW - Groundwater TDS - Total Dissolved Solids mg/L - milligrams per liter NO_3 -Nitrate

Table 9 Summary of Trend Analyses

Subbasin/Basin	No. of Wells Analyzed	Percent Wells with Increasing Trend	Percent Wells with Decreasing Trend	Percent of Wells with no Trend
Bolsa				
Total Dissolved Solids	2	0	0	100
Nitrate-NO_3	2	0	0	100
Bolsa Southeast				
Total Dissolved Solids	1	0	100	0
Nitrate-NO_3	1	100	0	0
Hollister Northeast				
Total Dissolved Solids	1	0	0	100
Nitrate-NO_3	1	0	0	100
Hollister Southeast				
Total Dissolved Solids	2	50	50	0
Nitrate-NO_3	2	50	50	0
Hollister West				
Total Dissolved Solids	3	0	100	0
Nitrate-NO_3	3	0	100	0
Pacheco				
Total Dissolved Solids	2	0	100	0
Nitrate-NO_3	2	0	100	0
San Juan North				
Total Dissolved Solids	6	17	67	17
Nitrate-NO_3	6	17	67	17
Flint Hills				
Total Dissolved Solids	No data			
Nitrate-NO_3				
San Juan Central				
Total Dissolved Solids	Data insufficient to determine trends			
Nitrate-NO_3	4	0	0	100
District Tres Pinos				
Total Dissolved Solids	2	0	50	50
Nitrate-NO_3	2	0	50	50
DWR Tres Pinos Valley				
Total Dissolved Solids	Data insufficient to determine trends			
Nitrate-NO_3	3	66	0	33
Southern San Juan				
Total Dissolved Solids	No data			
Nitrate-NO_3				

3.2.2 Nitrate as NO_3

Nitrogen compounds are part of a complex cycle involving the production and breakdown of nitrogen (N_2) gas, nitrite, nitrate, and ammonia. In a natural setting, a delicate balance is maintained such that no excess nitrate is available to be leached beyond the root zone. Elevated nitrate concentrations have been an ongoing groundwater quality challenge in the northern Study Area. The primary sources of nitrate in Study Area include synthetic fertilizers, waste water disposal, septic systems, and animal waste.

Figure 13 shows the maximum concentrations of nitrate as NO_3 from 2007 to 2010 and historically. Shallow groundwater typically contains higher concentrations of nitrate than deeper groundwater. The highest recent concentrations occurred in shallow wells in the northern San Juan Subbasin. It should be noted that many of the samples from the northern San Juan Subbasin are from monitoring wells positioned downgradient from wastewater percolation ponds. Localized areas of nitrate above 45 mg/L have been detected in the northern San Juan, Pacheco, Hollister Northeast, Hollister Southeast, Hollister West, and Tres Pinos.

Figure 14 shows interpolated nitrate concentrations for the Study Area. The interpolations and average concentrations for each subarea were estimated as described above for TDS. The average concentrations and available assimilative capacity for each subarea are listed and plotted in Table 8 and Figure 11, respectively. As shown in Figure 11 and Table 8, average nitrate concentrations in all subareas are below the GBPO of 45 mg/L. In addition, the Hollister West, Hollister Southeast, and Pacheco Subbasins are below the BSBPO of 22.5 mg/L. The Hollister West Subbasin shows an average nitrate concentration above 20 mg/L, while the Bolsa Southeast, Hollister Northeast, and northern San Juan subbasins show average nitrate concentrations above 10 mg/L. Based on the average concentrations in each subarea, there is currently available assimilative capacity for additional loading of nitrate. Nonetheless, isolated hot spots exceed the nitrate GBPO of 45 mg/L and BSBPO of 22.5 mg/L.

Figure 15 shows time concentration plots of nitrate from the District's monitoring network in the northern Study Area. There is very limited data in the Central San Juan and Tres Pinos Valley areas. Trends for nitrate in these areas are based on CDPH data. There is no data available for the Flint Hills or southern San Juan Subbasin. As shown in Table 9, nitrate trends are somewhat mixed; however, more wells show decreasing trends (11 wells) than increasing trends (5 wells). Most wells downstream of the wastewater treatment ponds near Highway 156 in the northern San Juan subbasin show a decrease in concentrations, possibly due to the reduced percolation of wastewater in recent years.

3.2.3 Water Quality Standards and Exceedances

Table 10 shows the number of samples that have exceeded the applicable GBPOs, BSBPOs, and ACBs for TDS and nitrate between 2007 and 2010. No wells exceeded water quality thresholds in the Bolsa, Bolsa Southeast, or Paicines Valley. TDS exceeded 1,200 mg/L in 28 percent of samples in the Hollister Northeast Subbasin, 29 percent in the Hollister Southeast, 24 percent in the Hollister West, zero percent in the Pacheco, 57 percent in the northern San Juan, and 35 percent in the Tres Pinos. Nitrate exceeded 45 mg/L in 6 percent of samples in the Hollister

Northeast Subbasin, 37 percent in the Hollister Southeast, 25 percent in the Hollister West, 5 percent in the Pacheco, 17 percent in the northern San Juan, and zero percent in the Tres Pinos. Nitrate exceeded the BSBPO of 22.5 mg/L in 17 percent in the Hollister Northeast Subbasin, 71 percent in the Hollister Southeast, and 32 percent in the Hollister West.

Table 10 Summary of Samples Exceeding Water Quality Standards (2007-2010)

Subbasin/Basin	No. of Samples Analyzed	No. of Samples Exceeding General Basin Plan Objectives [1]	Percent Samples Exceeding Water Quality Standard	No. of Samples Exceeding Basin Specific Objectives[2]/ Assimilative Capacity Benchmarks [3]	Percent Samples Exceeding Basin Specific Objectives/ Assimilative Capacity Benchmarks
Bolsa					
Total Dissolved Solids	13	-	-	0	0
Nitrate-NO_3	58	0	0	-	-
Bolsa Southeast					
Total Dissolved Solids	7	-	-	0	0
Nitrate-NO_3	6	0	0	-	-
Hollister Northeast					
Total Dissolved Solids	54	-	-	15	28
Nitrate-NO_3	132	8	6	23	17
Hollister Southeast					
Total Dissolved Solids	21	-	-	6	29
Nitrate-NO_3	59	22	37	42	71
Hollister West					
Total Dissolved Solids	142	-	-	34	24
Nitrate-NO_3	391	97	25	-	32
Pacheco					
Total Dissolved Solids	26	-	-	0	0
Nitrate-NO_3	4	82	5	24	
Northern San Juan					
Total Dissolved Solids	161	-	-	92	57
Nitrate-NO_3	238	40	17	-	-
District Tres Pinos					
Total Dissolved Solids	94	-	-	33	35
Nitrate-NO_3	75	0	0	-	
CDWR Tres Pinos Valley					
Total Dissolved Solids	No data				
Nitrate-NO_3	16	0	0	-	
Paicines Valley (Central San Juan)					
Total Dissolved Solids	1	-	-	0	0
Nitrate-NO_3	22	0	0	-	-
Southern San Juan					
Total Dissolved Solids	No data				
Nitrate-NO_3					

1 – General Obasin Plan Objectives: nitrate-NO_3 = 45 mg/L

2 - Basin-Specific Objectives: TDS = 1,200 mg/L, nitrate-NO_3 = 22.5 mg/L for Hollister Northeast, Hollister Southeast, and Pacheco; TDS = 1,000 mg/L for CDWR Tres Pinos Valley

3 - Assimilative Capacity Benchmarks: TDS = 1,200 mg/L for Bolsa, Bolsa Southeast, District Tres Pinos, Hollister West, Northern San Juan, Central San Juan and Southern San Juan

3.3 Summary of Surface Water Quality Conditions

Surface water quality data are available back to the early 1970s for some drainages in the Study Area. Surface water quality is not regularly monitored for laboratory analysis, but special monitoring studies have been conducted including the District's Surface Water Monitoring Program and the RWQCB Central Coast Ambient Monitoring Program (RWQCB, 2003). Data were usually collected in the first quarter when surface water flows are available. Most of the drainages cease to flow naturally during dry periods. In addition, the District regularly collects flow, electrical conductivity, temperature, pH, and nitrate (as nitrogen) field measurements at a number of locations in the northern Study Area.

Basin-wide data from all of the Study Area stations are summarized for each subbasin where data are available on **Table 11**. **Figures 16** and **17** show maximum TDS and nitrate concentrations, respectively, in surface water in the Study Area. There are no available surface water quality data for the Tres Pinos Valley and the southern San Juan Subbasin.

Similar to groundwater conditions, the northern streams on the east side of the Study Area contain the lowest TDS levels, including Pacheco Creek, Arroyo de las Viboras, and Arroyo Dos Picachos (Figure 16). However, the surface water data vary over a wider range than groundwater data on a monitoring point basis.

Maximum TDS concentrations greater than 1,200 mg/L are observed in the San Benito River, San Juan Creek, Santa Ana Creek, Arroyo Dos Picachos, and Tequisquita Slough. TDS concentrations in the San Benito River and San Juan Creek increase with distance downstream.

Nitrate concentrations are less than 20 mg/L in most surface water stations in the Study Area. Maximum concentrations greater than 45 mg/L are observed in the San Juan Creek in the San Juan Subbasin and in Llagas Creek north of the Study Area.

Average TDS and nitrate concentrations for each basin/subbasin in the central and northern Study Area are shown in **Figure 18**. The bar charts illustrate the highest TDS and nitrate concentrations are seen in the northern San Juan Subbasin.

3.4 Summary of Imported Water Quality Conditions

Imported water quality varies with wet and dry years and seasonally. Generally, CVP water is significantly better quality with respect to salts and nutrients compared with groundwater. **Table 12** shows minimum, maximum, and average TDS and nitrate concentrations in imported water based on samples collected between 2003 and 2006. The average TDS in 298 mg/L and the average nitrate is 3.6 mg/L.

Table 11 Summary of Surface Water Quality Data (1998 - 2006)

Constituent	Units	Concentration		
		Minimum	Maximum	Average
Bolsa				
Total Dissolved Solids	mg/L	130	1420	825
Nitrate-NO_3	mg/L	0.0	22.0	5.8
Bolsa Southeast				
Total Dissolved Solids	mg/L	No major surface water bodies		
Nitrate-NO_3	mg/L			
Hollister Northeast				
Total Dissolved Solids	mg/L	148	1354	508
Nitrate-NO_3	mg/L	3.0	4.0	3.3
Hollister Southeast				
Total Dissolved Solids	mg/L	930	950	940
Nitrate-NO_3	mg/L	2.8	4.6	3.7
Hollister West				
Total Dissolved Solids	mg/L	110	1800	793
Nitrate-NO_3	mg/L	0.0	26.0	3.0
Pacheco				
Total Dissolved Solids	mg/L	146	1376	515
Nitrate-NO_3	mg/L	0.0	26.0	5.8
Northern San Juan				
Total Dissolved Solids	mg/L	306	2642	1441
Nitrate-NO_3	mg/L	0.4	343.0	78.6
District Tres Pinos				
Total Dissolved Solids	mg/L	400	1332	848
Nitrate-NO_3	mg/L	1.0	7.0	3.1
DWR Tres Pinos Valley				
Total Dissolved Solids	mg/L	No data		
Nitrate-NO_3	mg/L			
Central San Juan				
Total Dissolved Solids	mg/L	700	930	792
Nitrate-NO_3	mg/L	1.0	5.0	2.5
Southern San Juan				
Total Dissolved Solids	mg/L	No data		
Nitrate-NO_3	mg/L			

mg/L – milligrams per liter

Table 12 Summary of Imported Water Quality Data (2003 - 2006)

Constituent	Concentration (milligrams per liter)		
	Minimum	**Maximum**	**Average**
Total Dissolved Solids	230	380	298
Nitrate-NO_3	0.0	6.1	3.6

3.5 Summary of Waste Water Quality Conditions

The major wastewater treatment plants (WWTPs) in San Benito County are operated by four service providers: the City of Hollister, City of San Juan Bautista, Sunnyslope Water District, and Tres Pinos Water District (see Figure 8). The City of Hollister operates both domestic and industrial WWTPs. Treated wastewater from these facilities is disposed in ponds. The majority of residents and businesses in the unincorporated county rely on stand-alone septic tanks and in-ground disposal or small-scale treatment systems. Wastewater disposal from WWTPs, small scale systems, and septic systems represent sources of salt and nutrient loading to groundwater.

Table 13 shows the average volumes of effluent flows from the WWTPs between 2006 and 2011. The City of Hollister produces significantly higher wastewater flows compared with the other facilities.

Table 14 provides effluent water quality data for the WWTPs. All plants produce effluent that is above the Basin Plan Objective of 1,200 mg/L (no TDS data are available for the San Juan WWTP). Trend data for TDS indicates relatively stable concentrations for the Sunnyslope and Hollister Domestic WWTPs, while the Hollister Industrial WWTP shows a slight increasing trend in TDS concentrations in effluent. Tres Pinos WWTP data are insufficient to ascertain trends.

Nitrate in effluent is relatively low except for the Hollister Industrial WWTP, which exhibited one detection above the maximum concentrations above the MCL of 45 mg/L in 2006. All other nitrate detections are below the MCL.

Figures 19 and **20** show concentration time plots for TDS and nitrate in effluent, respectively. TDS in the Hollister Domestic, Hollister Industrial and Sunnyslope WWTPs appear relatively stable. No TDS data were available for the San Juan WWTP and only a few data points were available for nitrate. The Hollister Domestic and Hollister Industrial WWTPs show a decreasing trend in nitrate concentrations, while, nitrate in Sunnyslope WWTP effluent appears to be relatively stable. There is not enough nitrate data available for the San Juan WWTP to assess a trend. .

Table 13 Summary of Average WWTP Effluent Flows (2006 to 2011)

TPWWTP	SJWWTP	COHDWWTP	COHIWWTP	SSWWTP
Acre-foot per Year				
25.9	153.6	2,151.9	828.8	216.3

TPWWTP – Tres Pinos Wastewater Treatment Plant
SJWWTP – San Juan Wastewater Treatment Plant
COHDWWTP – Hollister Domestic Wastewater Treatment Plant
COHIWWTP – Hollister Industrial Wastewater Treatment Plant
SSWWTP - Sunnyslope Wastewater Treatment Plant

Table 14 Summary of Wastewater Quality Data

Constituent	Concentration (milligrams per liter)		
	Minimum	Maximum	Average
Tres Pinos WWTP			
Total Dissolved Solids[1]	1,652	2,200	1,894
Nitrate-NO_3[2]	2	9	5.5
San Juan WWTP[3]			
Total Dissolved Solids	No data		
Nitrate-NO3	0.7	10.6	4.8
Hollister Domestic WWTP[4]			
Total Dissolved Solids	880	1,610	1,162
Nitrate-NO3	0.0	26.5	6.6
Hollister Industrial WWTP[5]			
Total Dissolved Solids	920	1,730	1,425
Nitrate-NO3	1.0	133	26.6
Sunnyslope WWTP[6]			
Total Dissolved Solids	1400	3,200	1,801
Nitrate-NO3	0.01	4.3	0.8

1 – 2005 to 2010 Data from RWQCB, February 2012
2 – 2008 TO 2009 Data from Discharge Self Reporting Report
3 – 2002 to 2004 Data
4 – 2004 to 2010 Data
5 – 2003 to 2011 Data
6 – 2003 to 2010

3.6 Summary Precipitation Water Quality Conditions

Precipitation also recharges groundwater. Water quality available from the National Atmospheric Deposition Program for a climate station at Pinnacles National Monument is provided in **Table 15**. Electrical conductivity was converted to TDS based on the linear relationship between the two variables (Hem, 1989) as follows:

TDS (mg/L) = 0.59 x Electrical Conductivity (umhos/cm)

As shown in the table, TDS and nitrate concentrations in precipitation are very low and precipitation provides dilution for salts and nutrients.

Table 15 Summary of Water Quality in Precipitation

Year	TDS	Nitrate
	milligrams per liter	
2002	3	0.3
2003	3	0.3
2004	3	0.3
2005	2	0.2
2006	3	0.2
2007	3	0.2
2008	3	0.2
2009	3	0.4
2010	2	0.1

4 Land Use

The predominant land use in the northern Study Area is agriculture. **Figure 21** shows an updated 2010 land use map of the Study Area. The predominant land use in the northern Study Area is agriculture. Urban areas include the cities of Hollister and San Juan Bautista. The small community of Tres Pinos is located in the central Study Area. Urban areas cover approximately 12 percent of the northern Study Area. The remaining acreage is predominantly agriculture and native vegetation with approximately 20 percent of the land area used for crops and 69 percent native vegetation. Remaining land uses include pasture, vineyards, and idle land. The central and southern part of the Study Area is less developed and more sparsely populated with large swaths of native land and smaller areas of agricultural land.

5 References

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Figures

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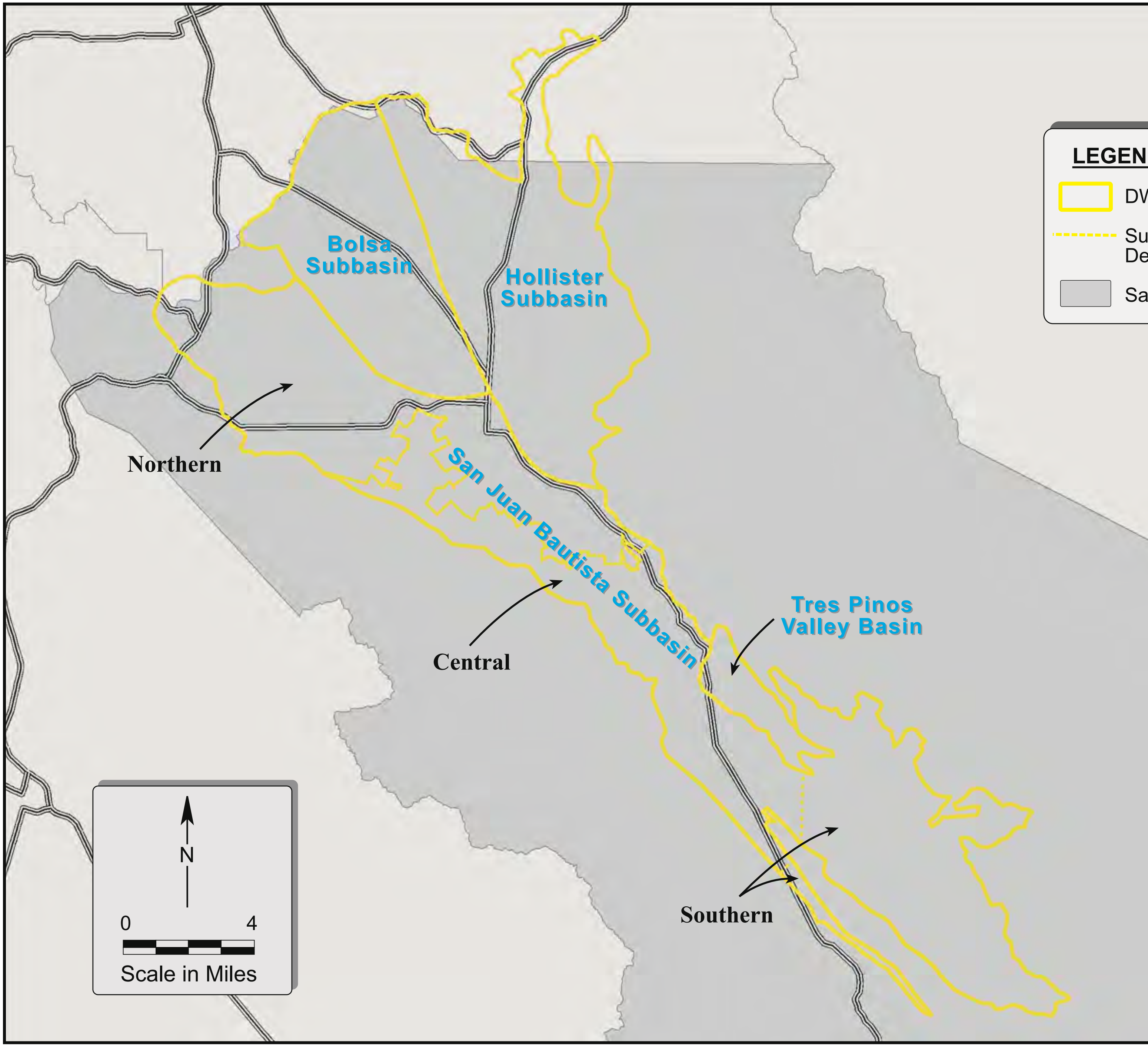

Figure 1
Study Area

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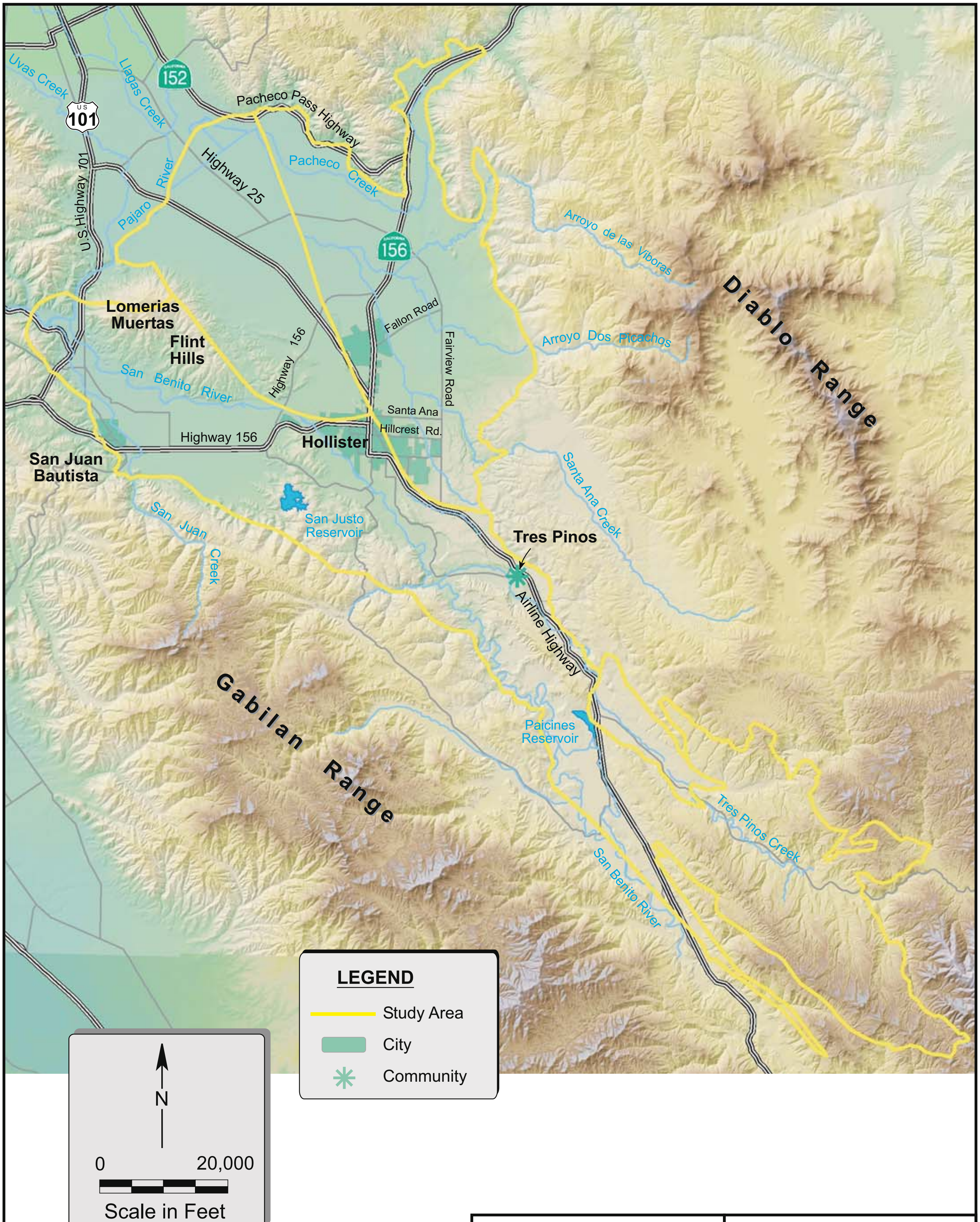
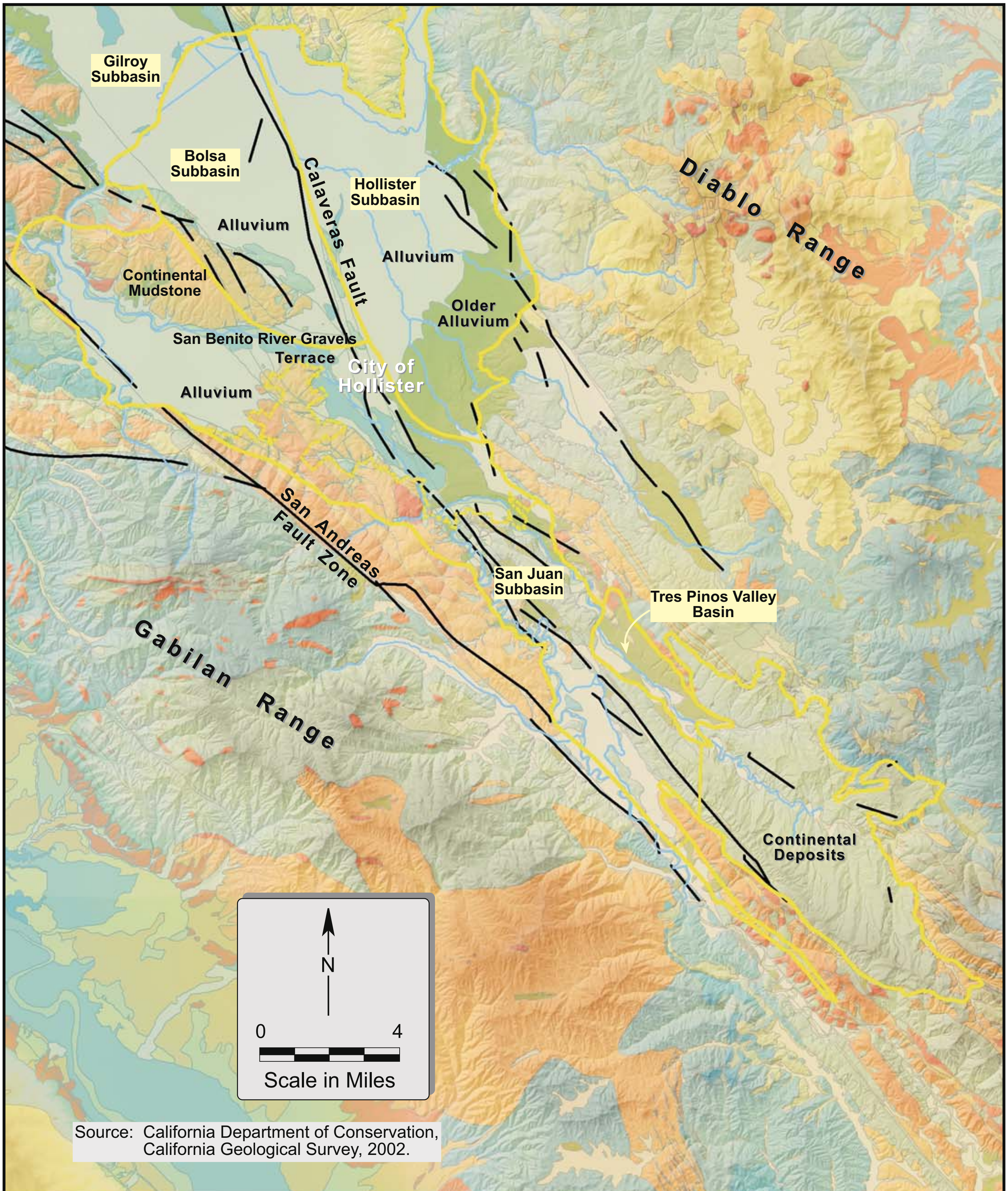


May 2013	**Figure 2**
TODD ENGINEERS Alameda, California	**Study Area Topography**



LEGEND

- CDWR Basin and Subbasin Boundaries
- Subbasin Subarea Defined for this Study
- Fault

May 2013	**Figure 3** **Geologic Map**
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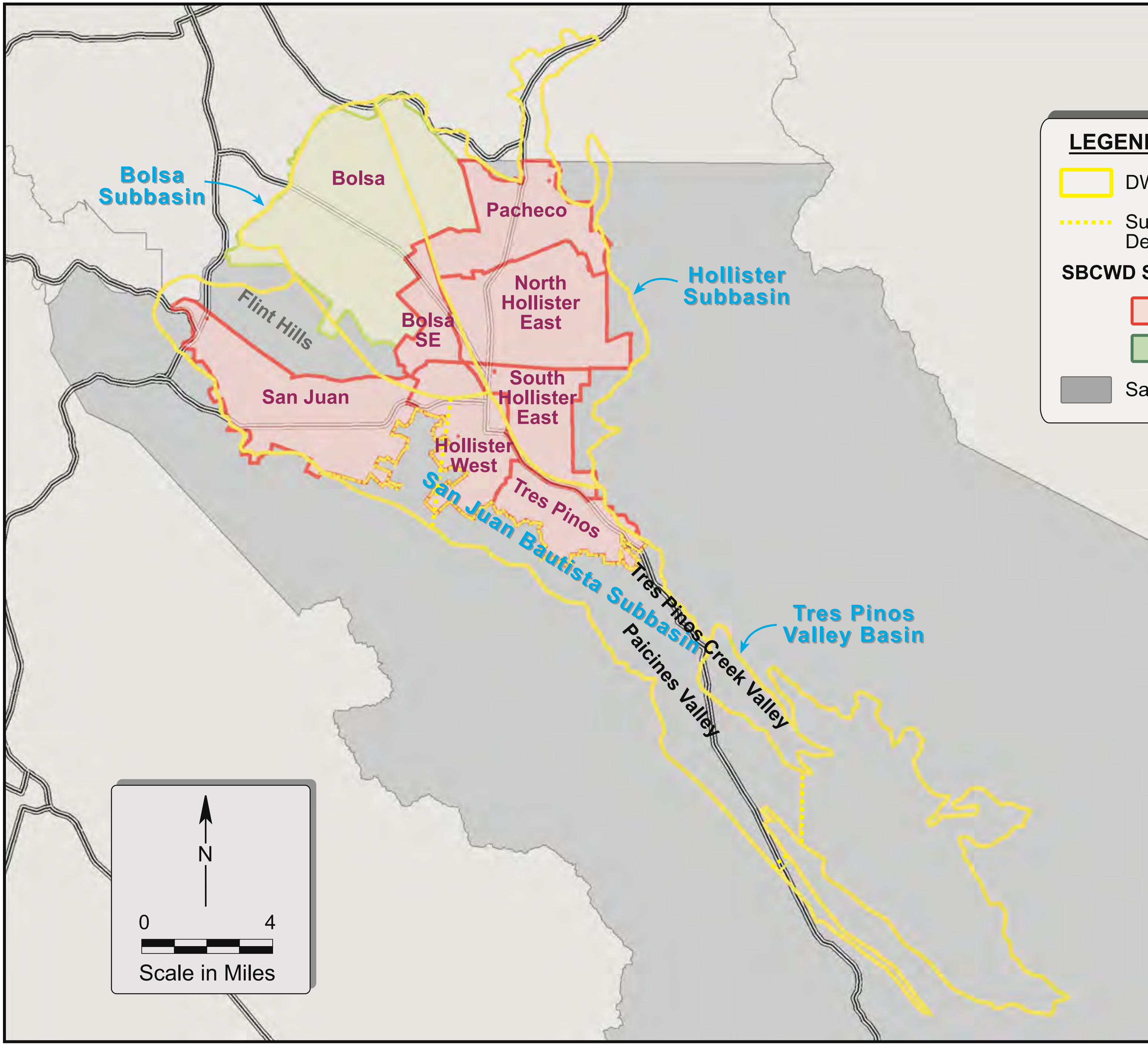

Figure 4
Comparison of DWR and District Subbasins

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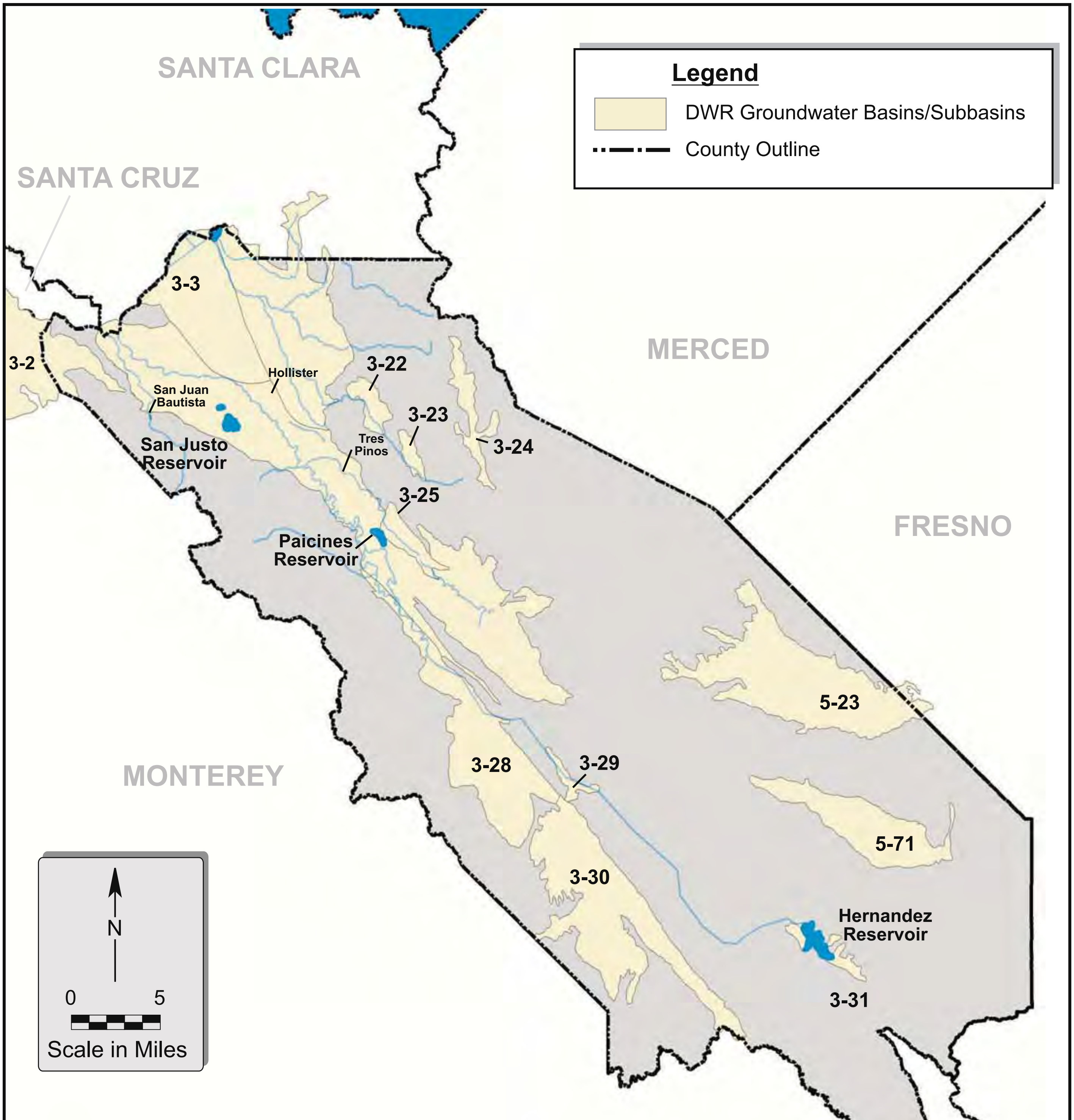

DWR Groundwater Basins/Subbasins

3-2 Pajaro Valley
3-3 Gilroy Hollister Valley
- 3-3.02 Bolsa Area
- 3-3.03 Hollister Area
- 3-3.04 San Juan Bautista Area

3-22 Santa Ana Valley
3-23 Upper Santa Ana Valley
3-24 Quien Sabe Valley
3-25 Tres Pinos Valley
3-28 San Benito River Valley
3-29 Dry Lake Valley
3-30 Bitter Water Valley
3-31 Hernandez Valley
5-23 Panoche Valley
5-71 Vallecitos Valley

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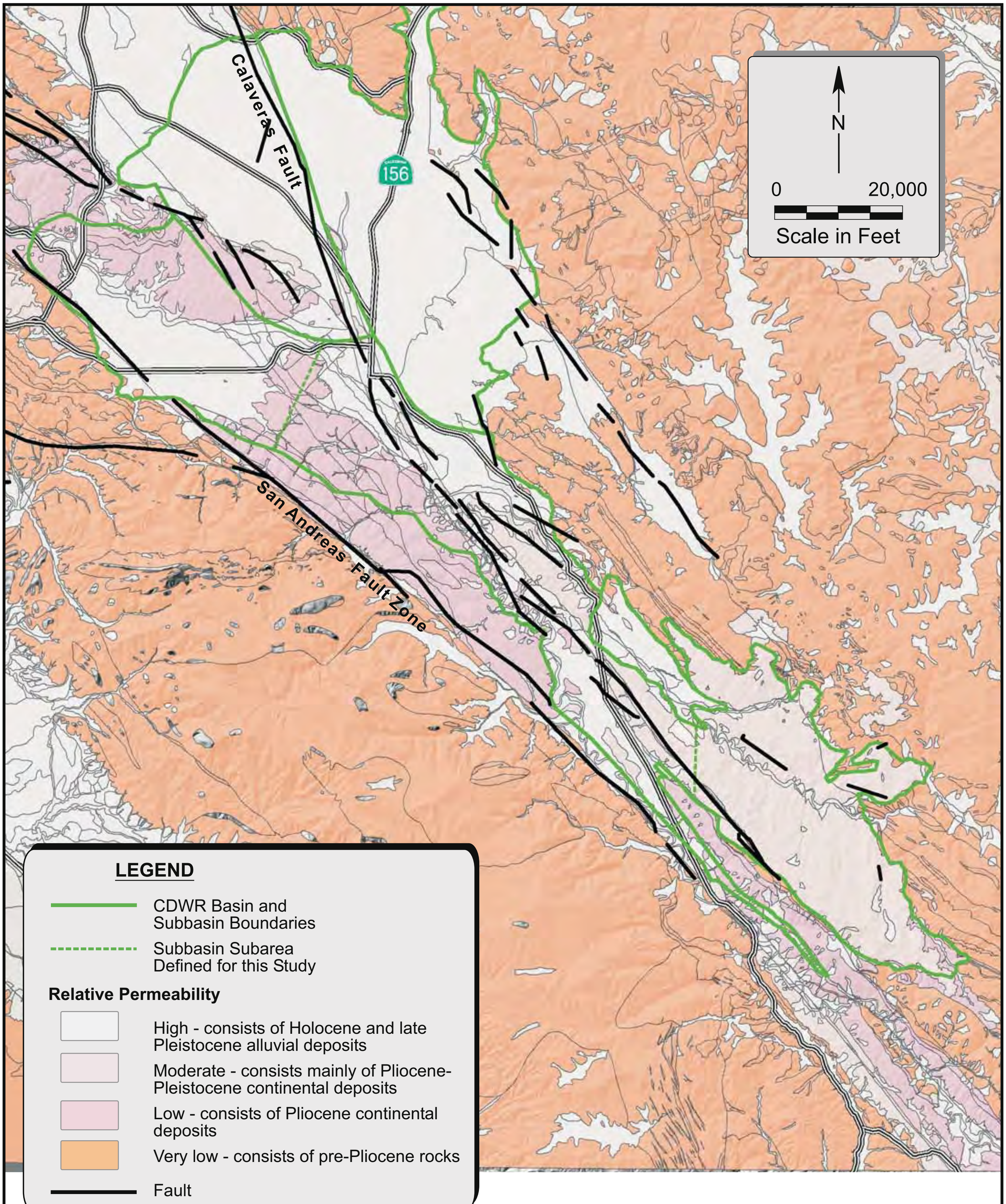
Figure 5
DWR Groundwater Basins/Subbasins in San Benito County



Source: California Department of Conservation, California Geological Survey, 2002.

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Figure 6
Relative Permeability and Major Faults

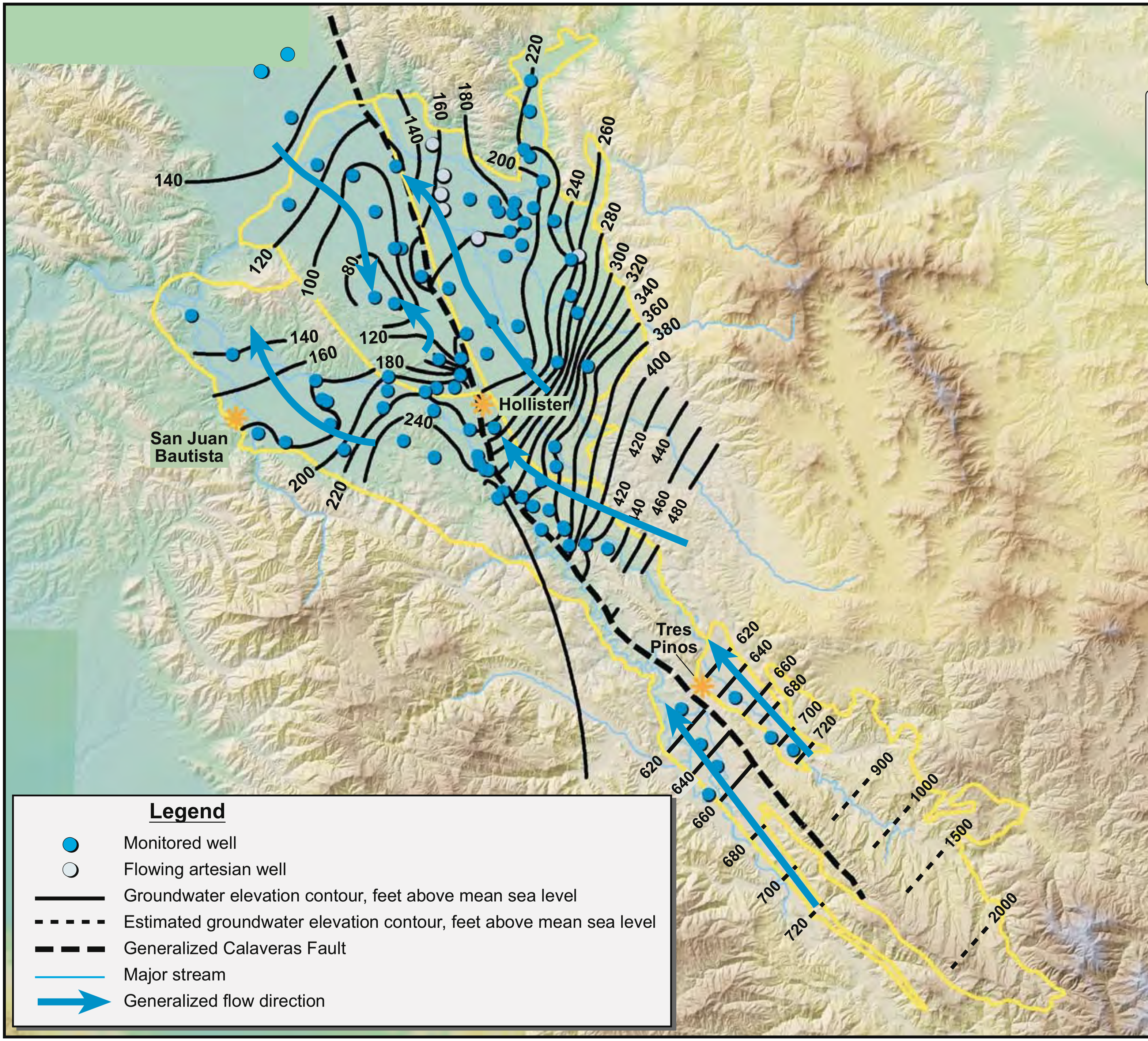

Figure 7
Groundwater Elevations October 2011

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Alameda, California

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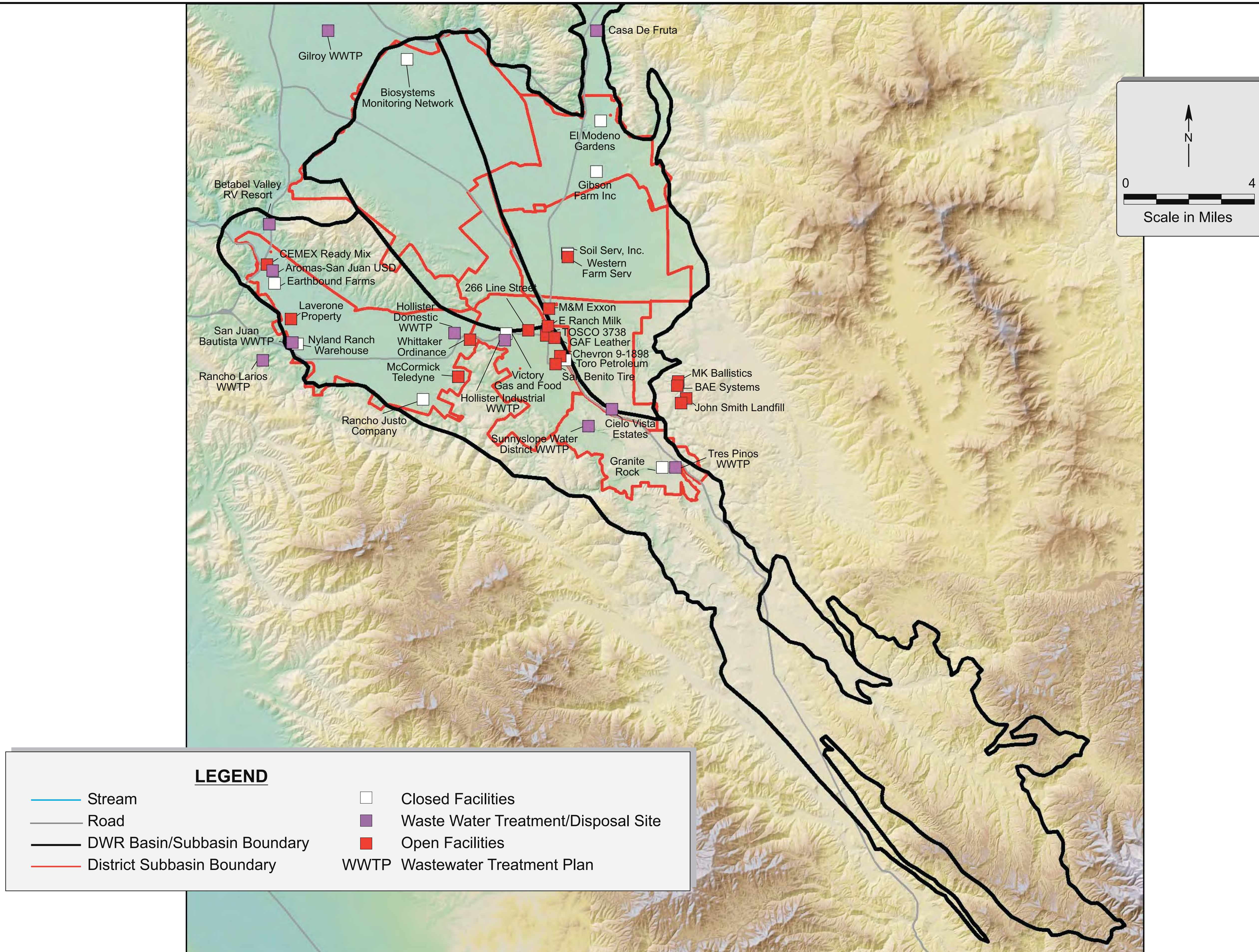

Figure 8
Locations of Regulated Facilities

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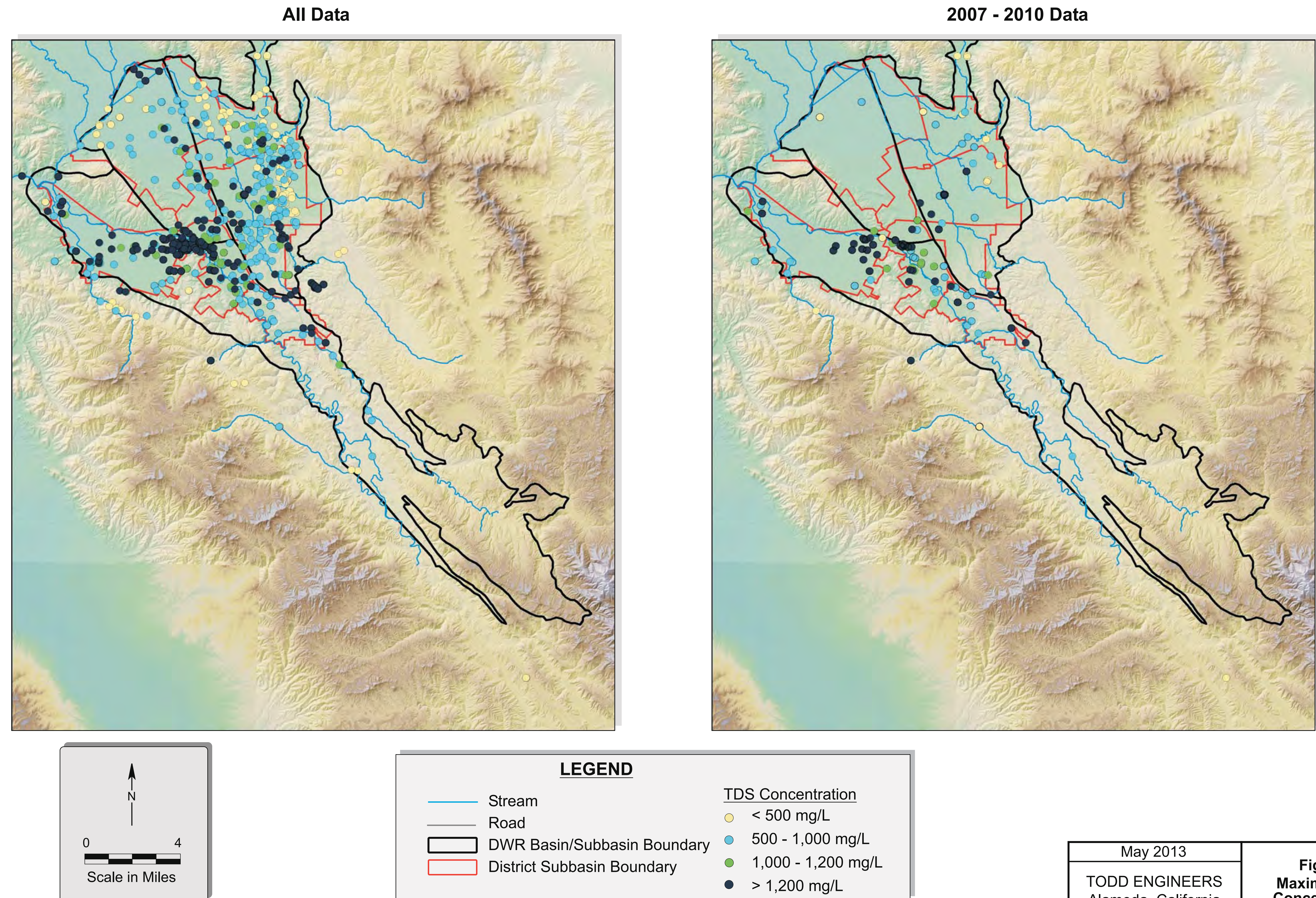

LEGEND

Stream
Road
DWR Basin/Subbasin Boundary
District Subbasin Boundary

TDS Concentration
< 500 mg/L
500 - 1,000 mg/L
1,000 - 1,200 mg/L
> 1,200 mg/L

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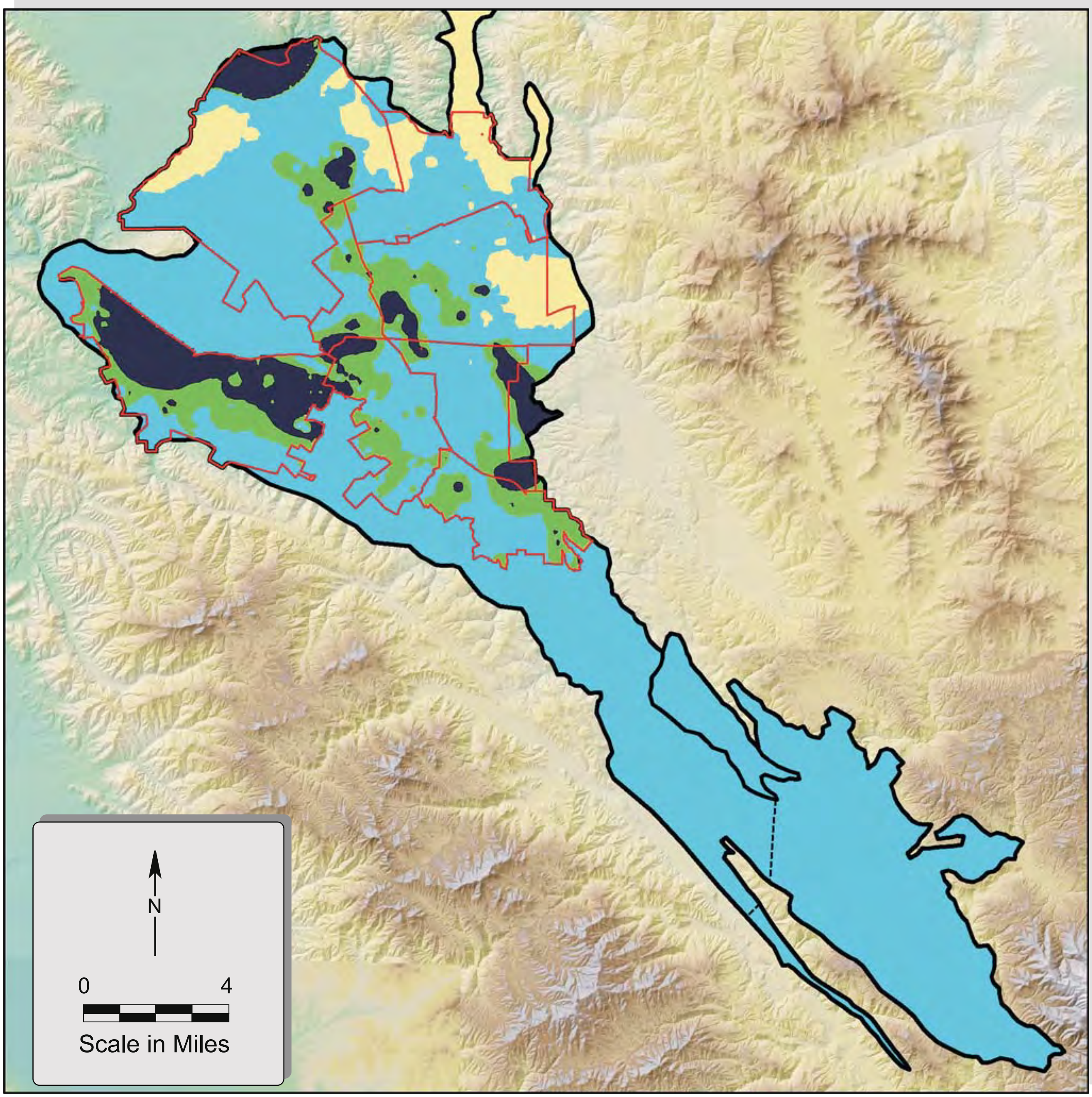
Figure 9
Maximum TDS Concentrations



LEGEND

DWR Basin/Subbasin Boundary
District Subbasin Boundary
Subbasin Subarea defined for this Study

TDS Concentration
<500 mg/L
500 - 1,000 mg/L
1,000 - 1,200 mg/L
> 1,200 mg/L

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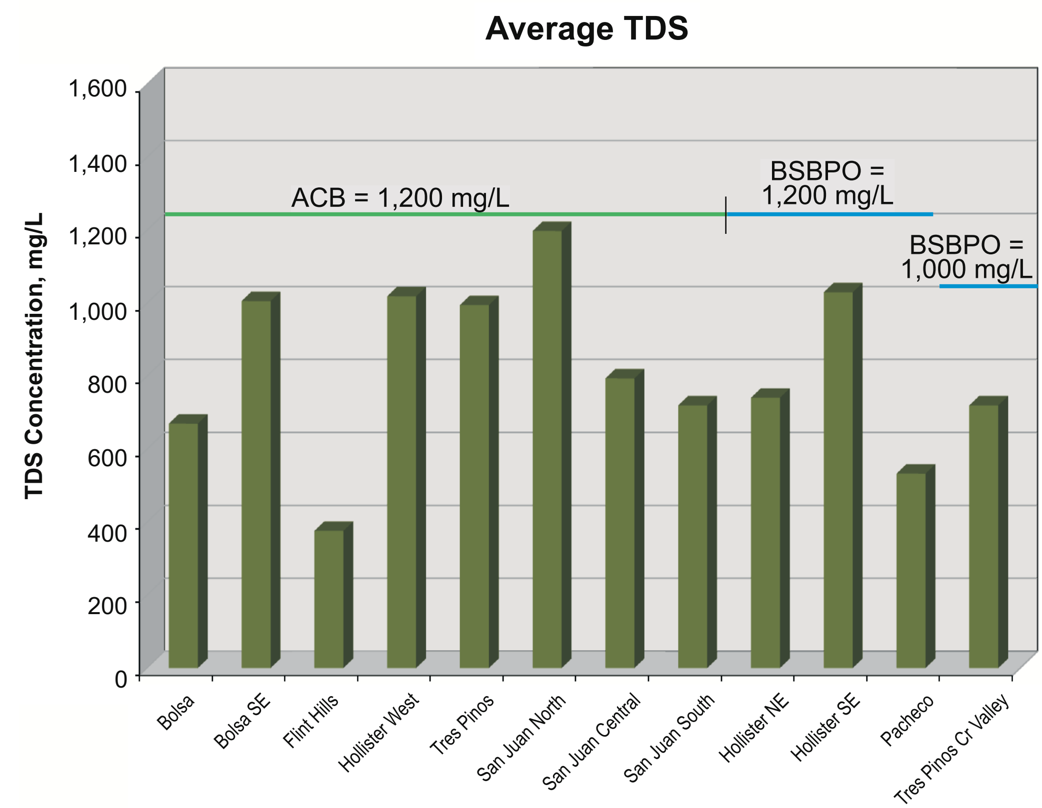
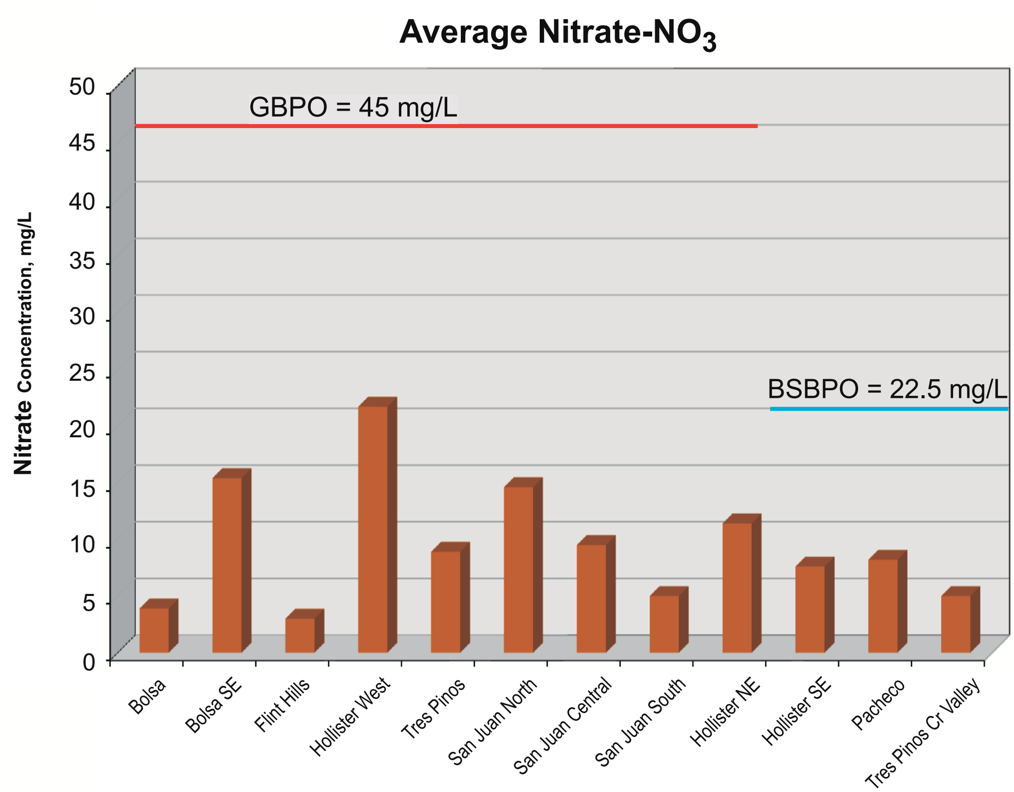
Figure 10
Interpolated TDS Concentrations





Legend

- BSBPO - Basin Specific Basin Plan Objective
- GBPO - General Basin Plan Objective
- ACB - Assimilative Capacity Benchmark

May 2013 TODD ENGINEERS Alameda, California	**Figure 11** **Average TDS and Nitrate by Basin/Subbasin**

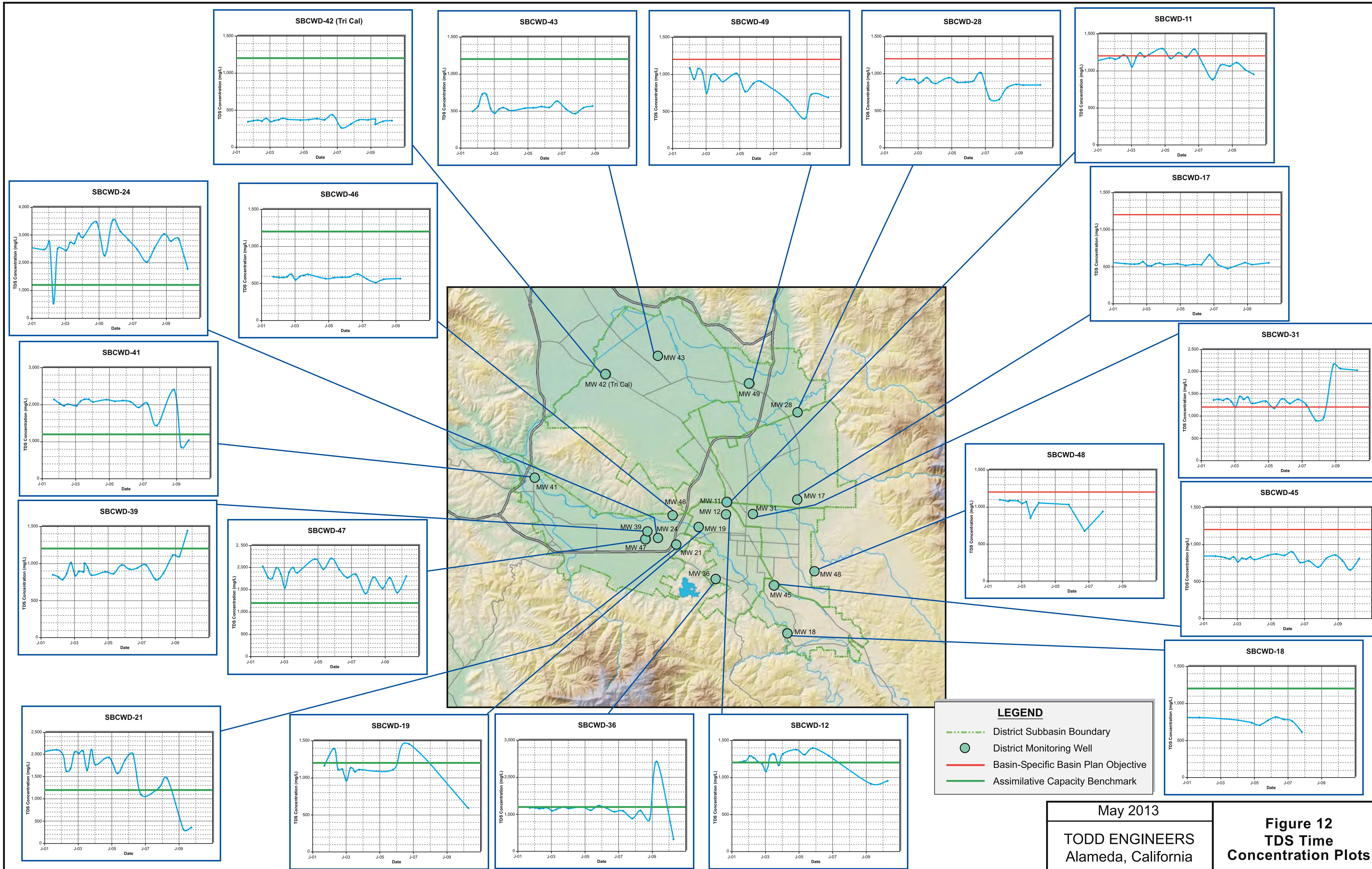


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Figure 12
TDS Time Concentration Plots

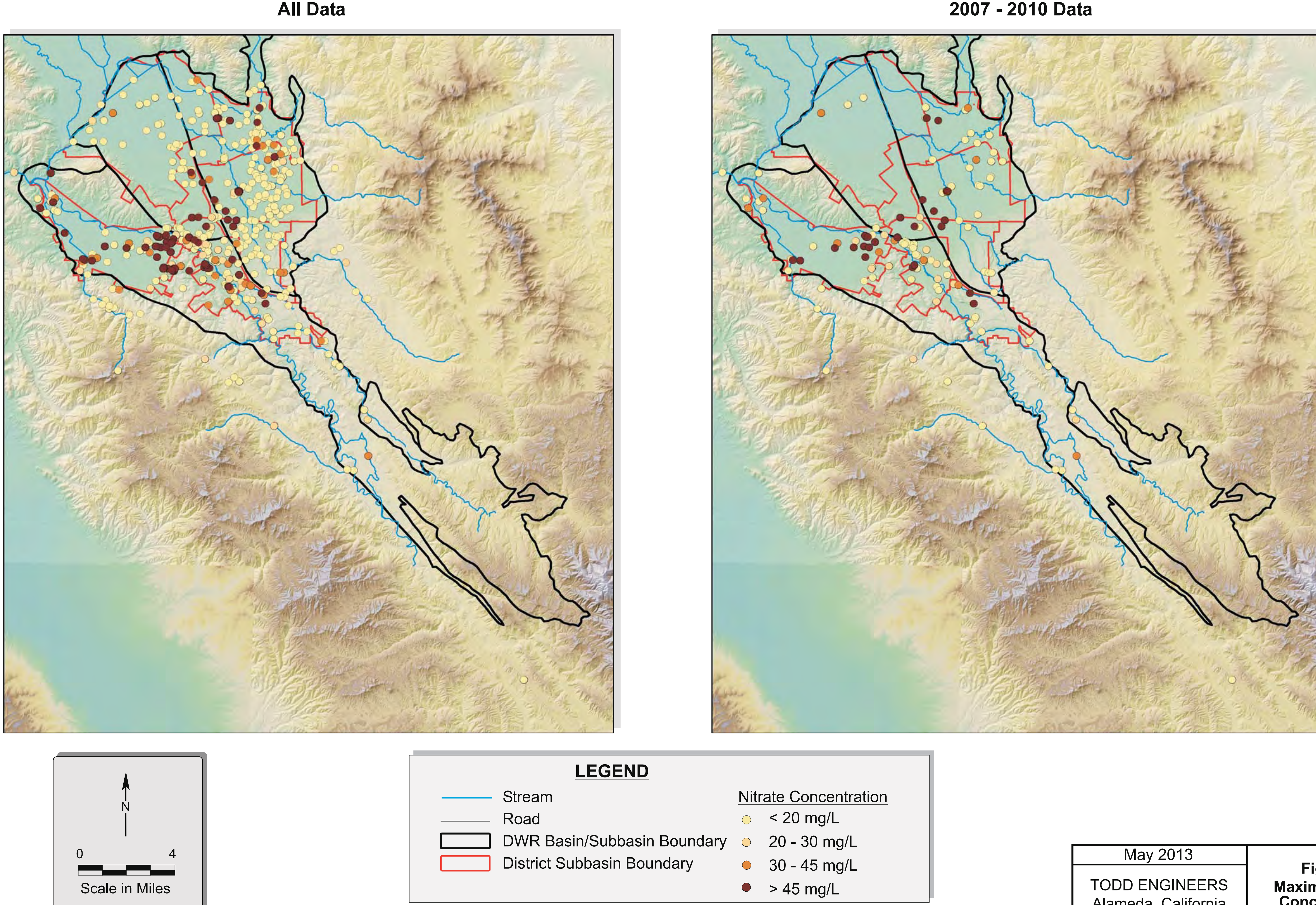

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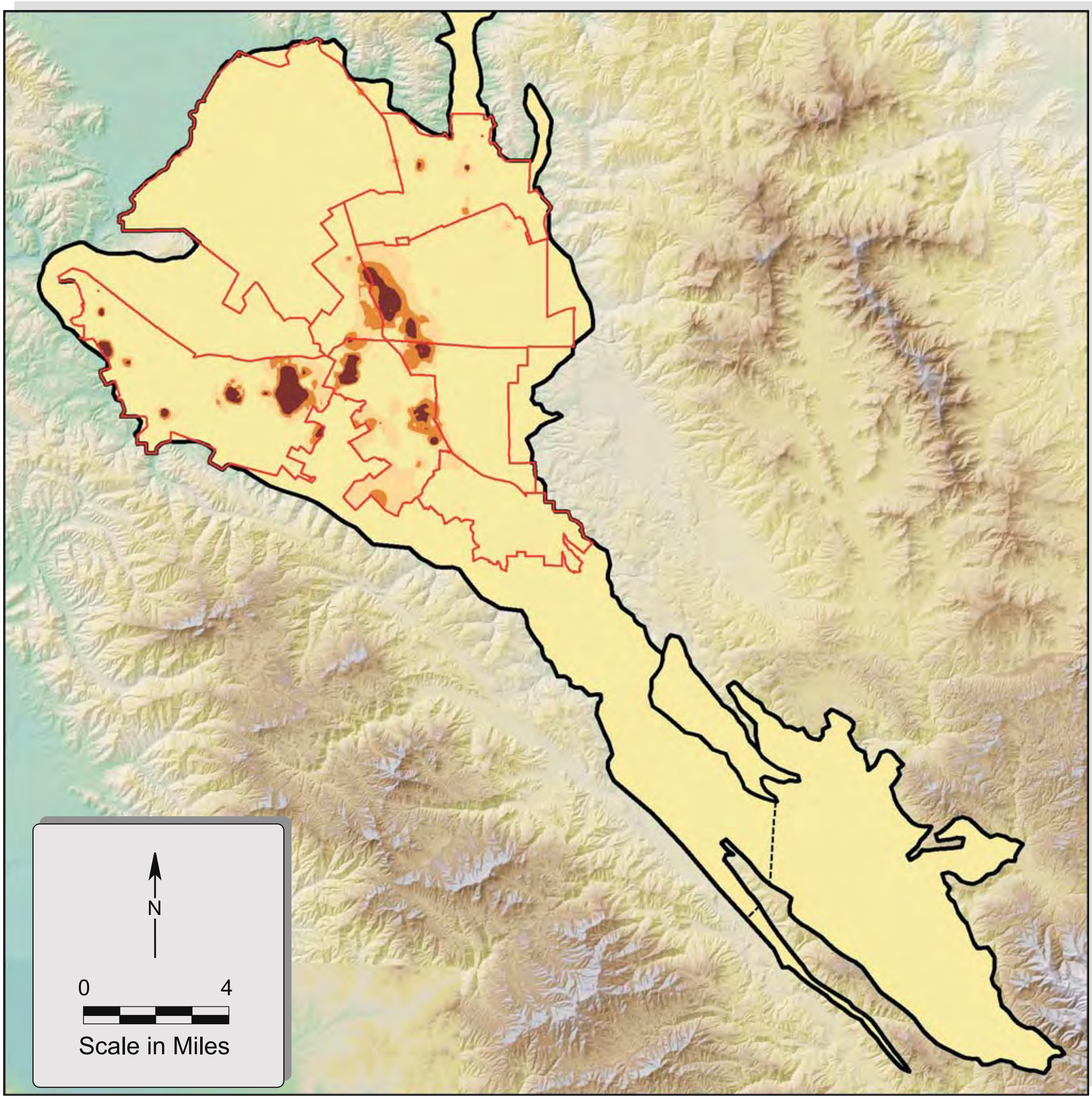
Figure 13
Maximum Nitrate Concentrations



LEGEND

DWR Basin/Subbasin Boundary
District Subbasin Boundary
Subbasin Subarea defined for this Study

Nitrate Concentration
0 - 20 mg/L
20 - 30 mg/L
30 - 45 mg/L
> 45 mg/L

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Figure 14
Interpolated Nitrate Concentrations

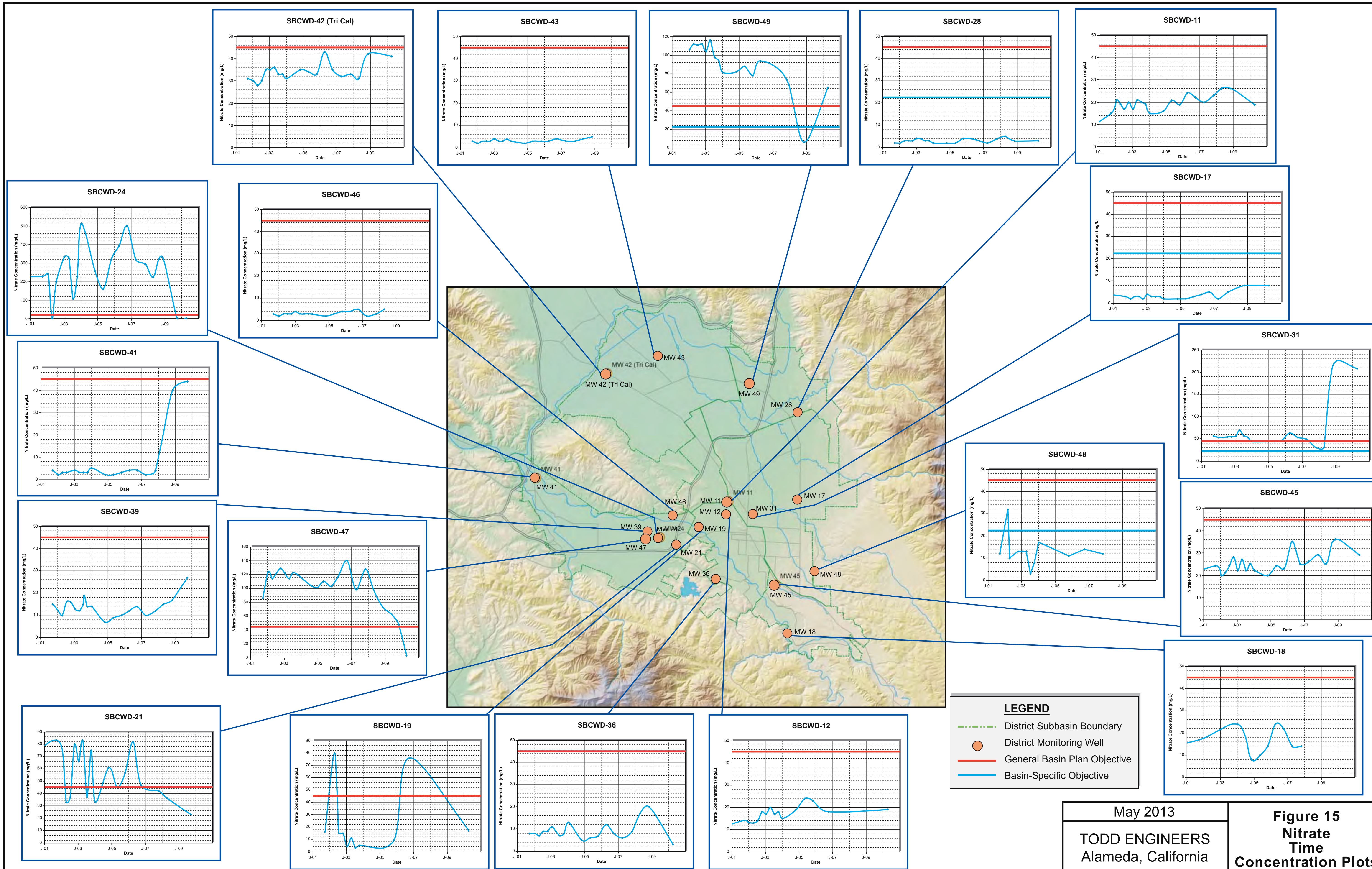

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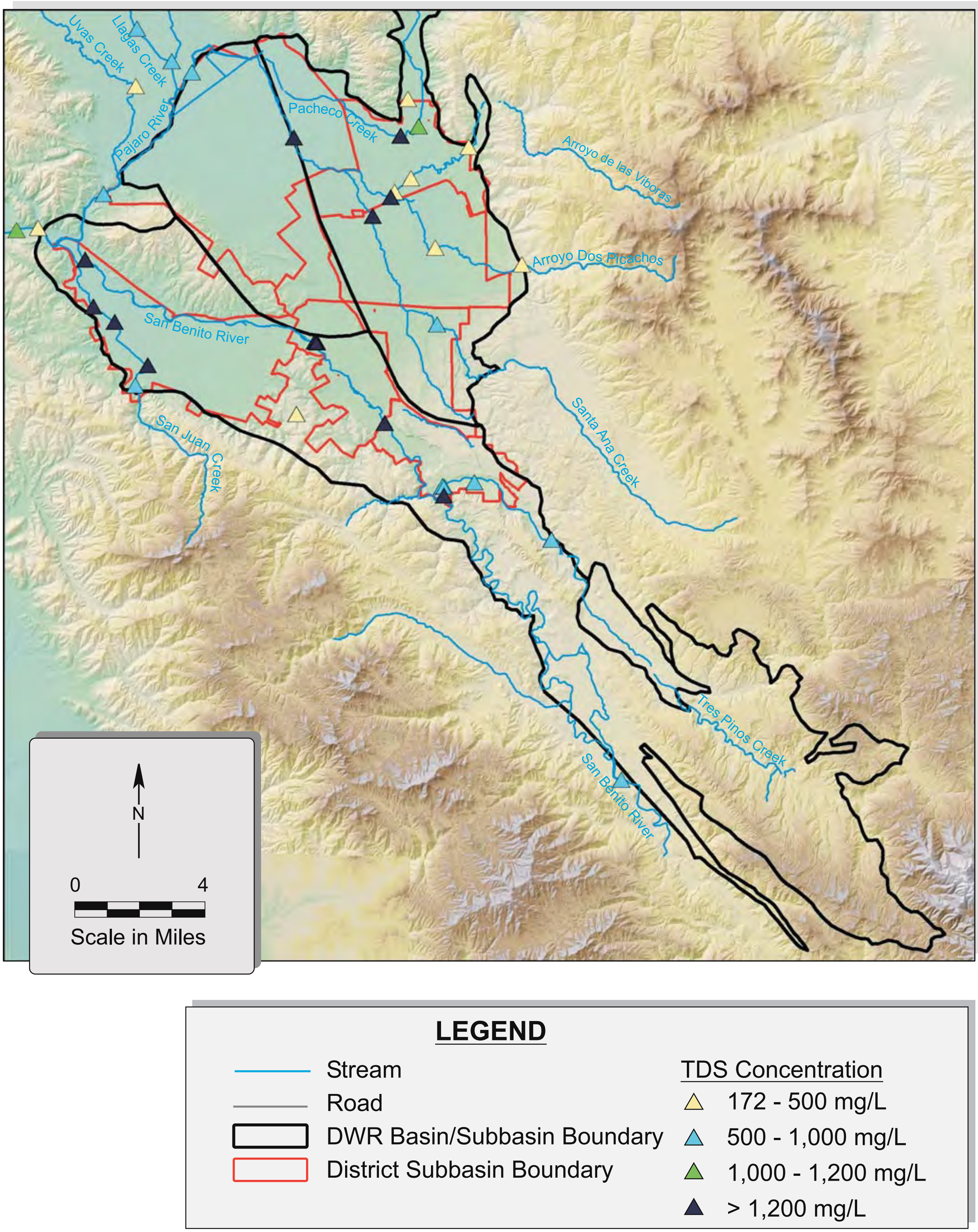
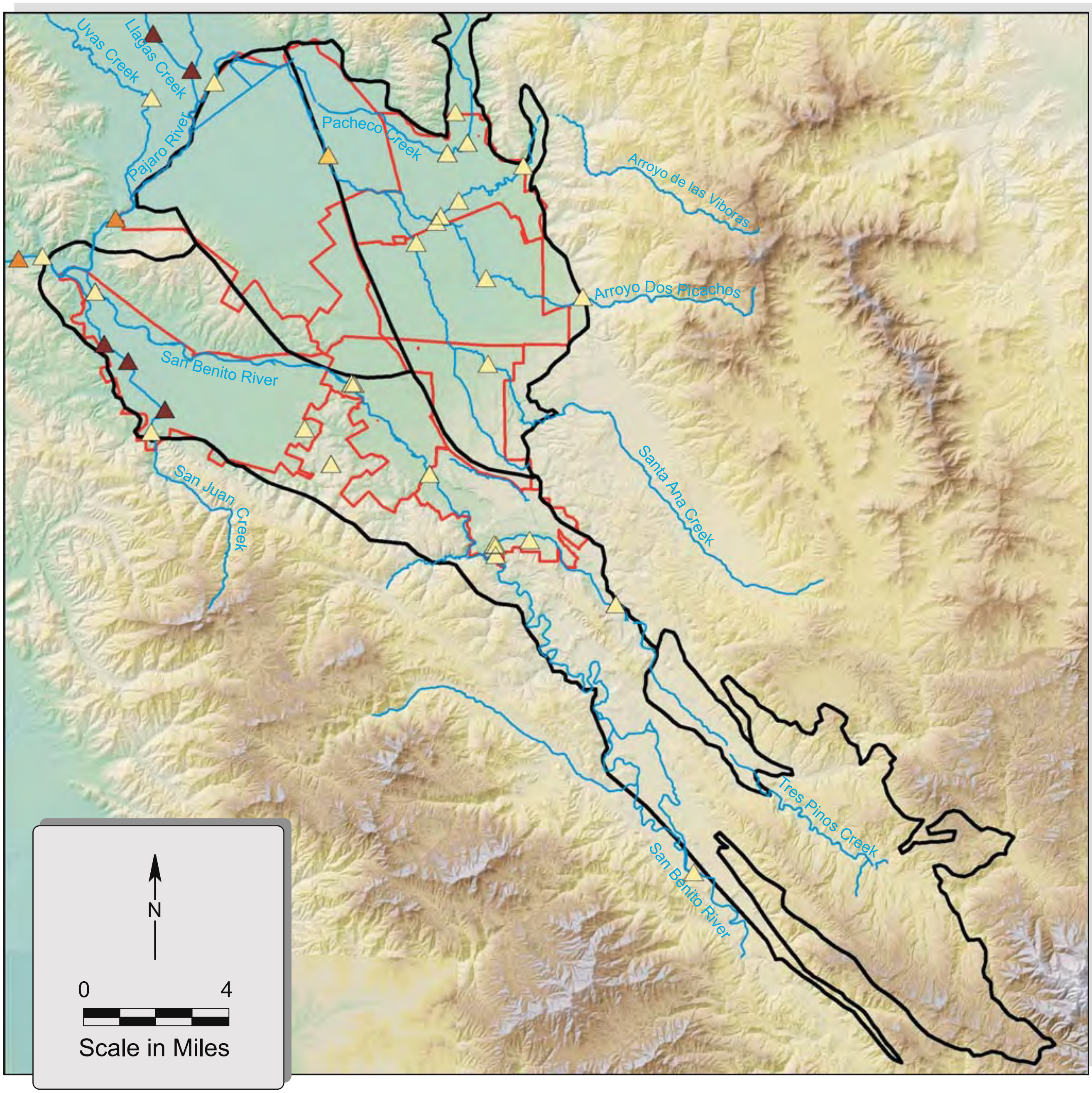
Figure 15
Nitrate Time Concentration Plots



May 2013	**Figure 16**
TODD ENGINEERS Alameda, California	**TDS in Surface Water**



LEGEND

Stream	Nitrate Concentration
Road	< 20 mg/L
DWR Basin/Subbasin Boundary	20 - 30 mg/L
District Subbasin Boundary	30 - 45 mg/L
	> 45 mg/L

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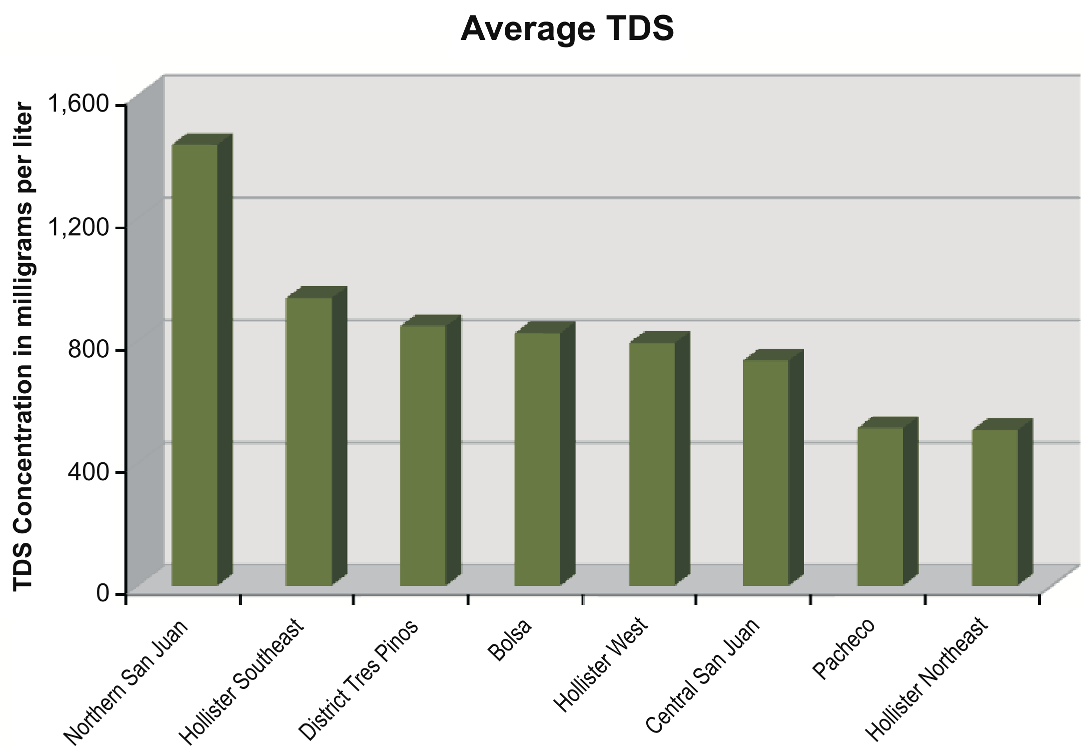
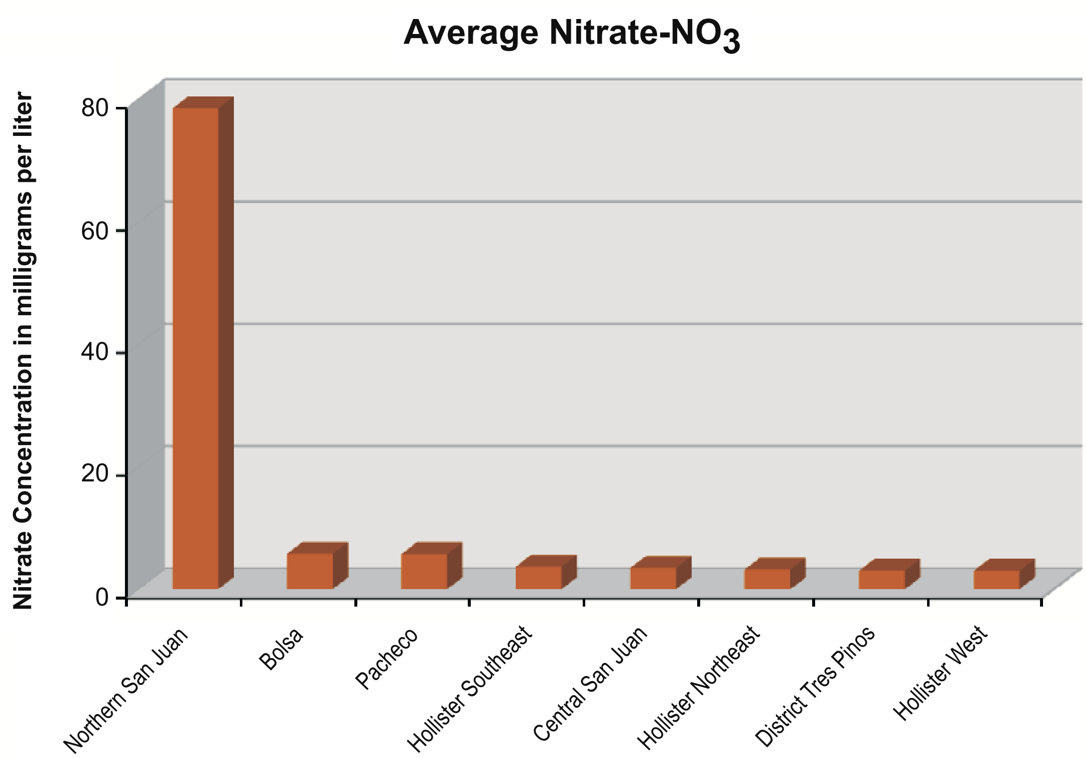
Figure 17
Nitrate in Surface Water





May 2013	**Figure 18**
TODD ENGINEERS Alameda, California	**Average TDS and Nitrate in Surface Water by Basin/Subbasin**

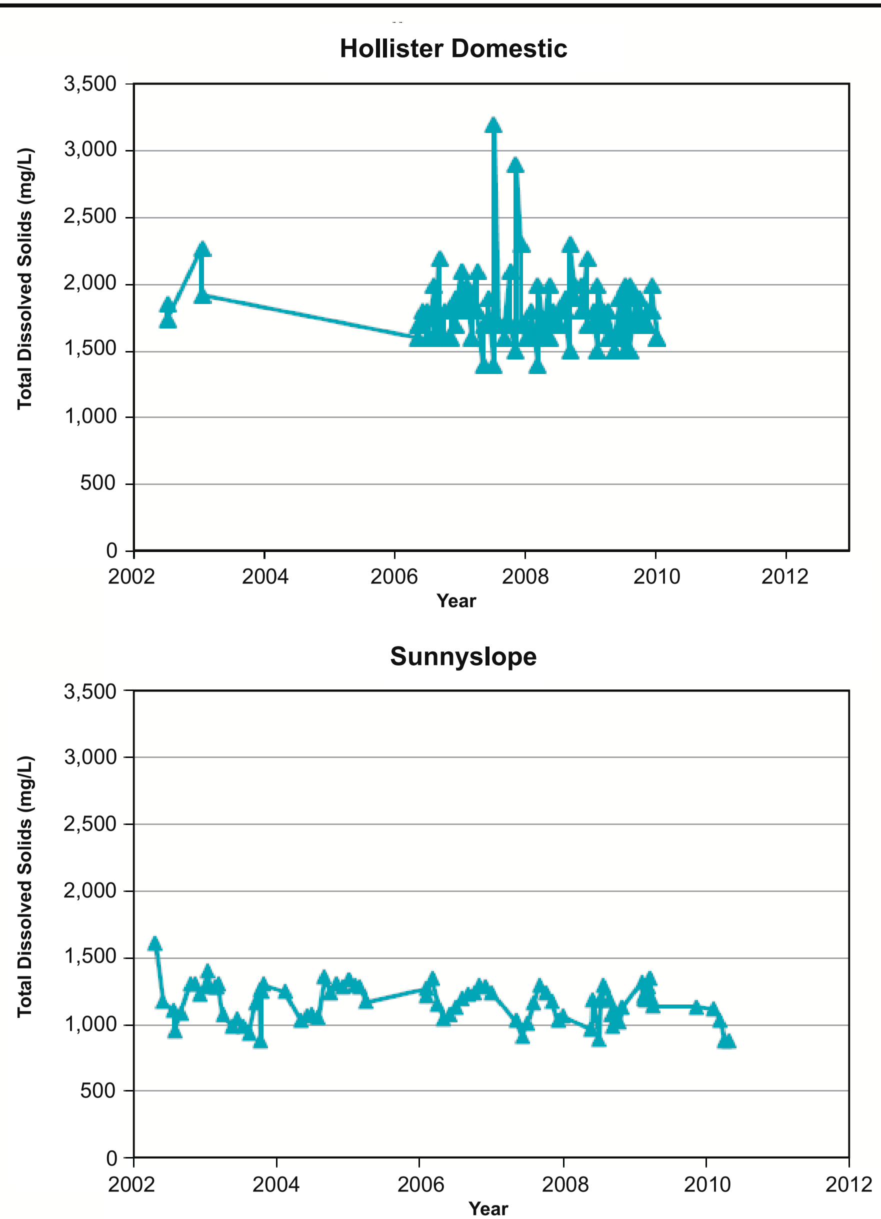


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Figure 19
TDS
in Effluent

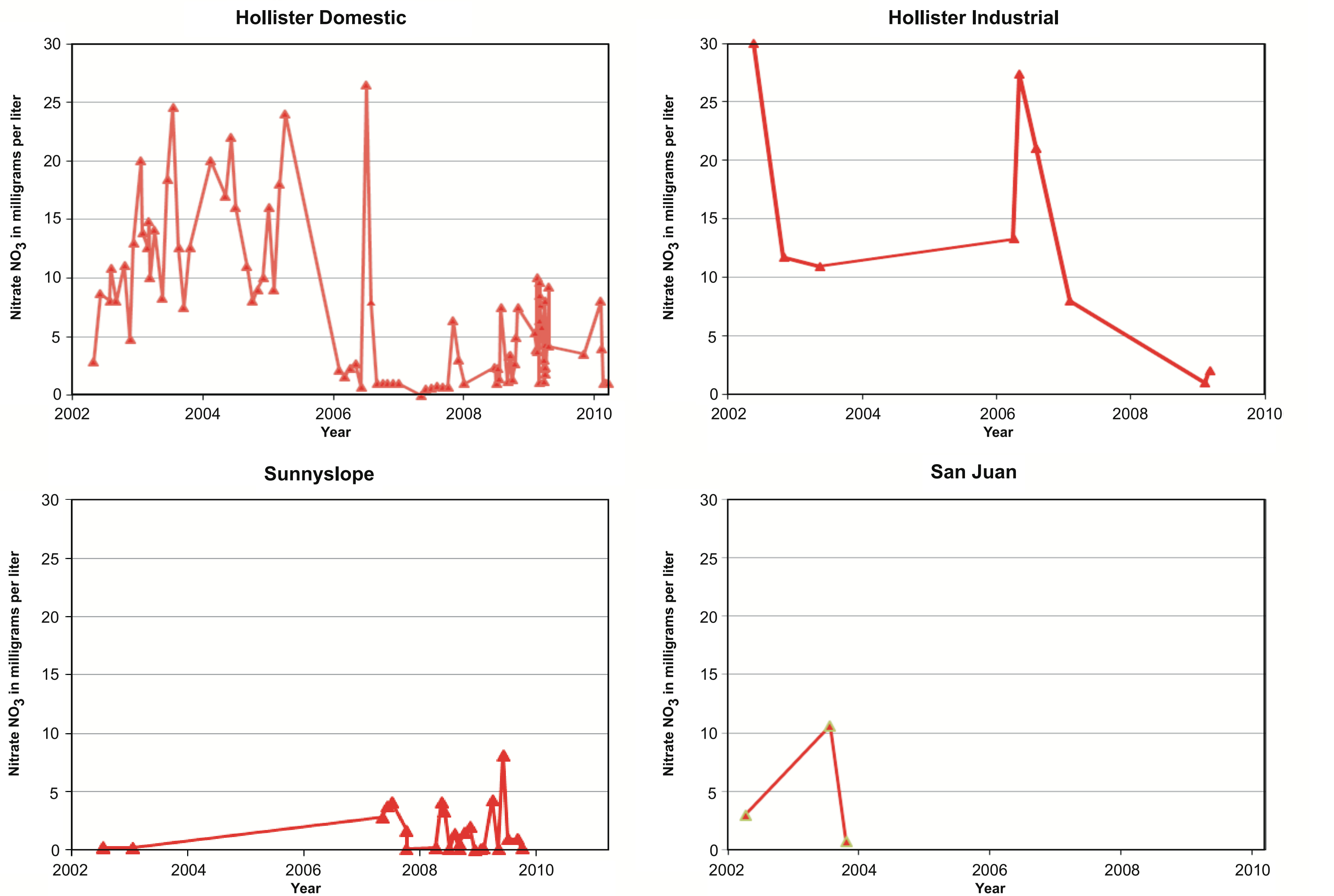

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Figure 20
Nitrate in Effluent

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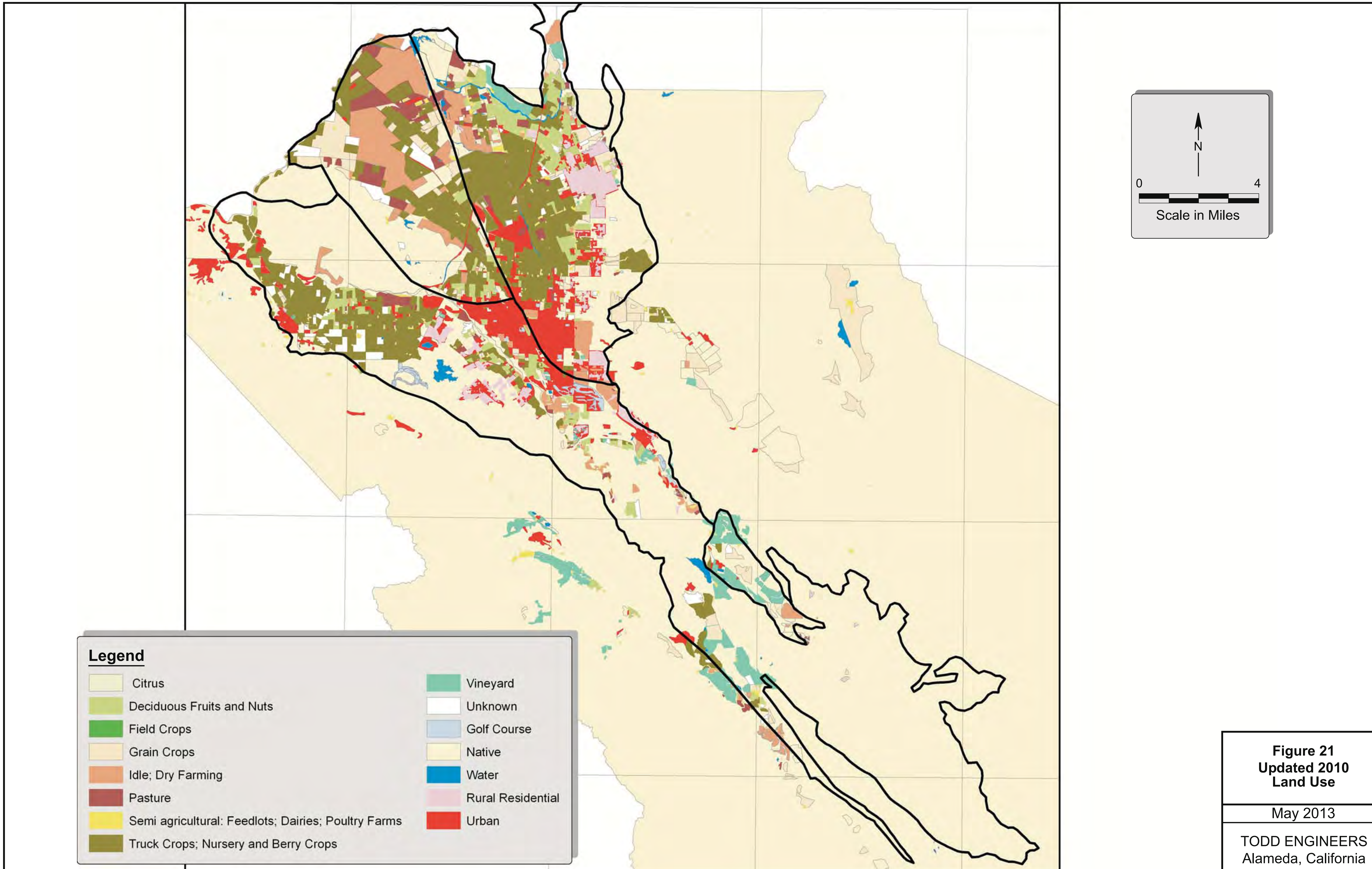

Figure 21
Updated 2010
Land Use

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Appendix A

Water Balances Water Year 2002 to 2011

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Water Balance for Water Year 2002

	Pacheco	Bolsa Southeast	Northern San Juan	Hollister West	Hollister East N	Hollister East S	Tres Pinos	Zone 6 Subtotal	Bolsa	Paicines Area	Tres Pinos Valley	Flint Hills	Southern San Juan	Grand Total
Inflows														
Stream percolation (1)														
Natural streamflow	655	0	256	921	1,061	0	1,287	4,180	1,000	1,455	1,115	0	0	7,750
Reservoir releases	2	0	0	470	0	81	569	1,122	0	0	0	0	0	1,122
CVP Percolation	0	0	231	1,181	0	0	1,196	2,608	0	1,866	0	0	0	4,474
Deep percolation through soils														0
Rainfall (2)	1,348	536	3,132	1,479	1,680	686	842	9,703	1,696	551	0	114	344	12,408
Irrigation (3)	596	268	1,335	221	632	258	128	3,438	1,224	541	174	0	0	5,377
Reclaimed water percolation	0	0	2,402	1,243	0	0	307	3,952	0	0	0	0	0	3,952
Groundwater inflow	1,000	2,000	500	2,000	510	490	1,000	7,500	7,000	0	0	0	0	14,500
Total	3,601	2,804	7,856	7,515	3,883	1,515	5,329	32,503	10,920	4,413	1,289	114	344	49,583
Outflows														
Wells														
Agricultural	2,149	2,179	6,641	1,564	1,149	425	1,150	15,257	12,235	5,413	1,743	0	0	34,648
Domestic and M & I (4)	173	14	930	5,013	365	649	2,844	9,988	0	0	47	0	0	10,035
Groundwater outflow	2,000	500	2,000	2,000	1,000	0	2,000	9,500	0	500	500	0	0	10,500
Total	4,322	2,693	9,571	8,577	2,514	1,074	5,994	34,745	12,235	5,913	2,290	0	344	55,183
Storage change														
Inflows - outflows	(721)	111	(1,715)	(1,062)	1,369	441	(665)	(2,242)	(1,315)	(1,500)	(1,001)	114	0	(5,944)
Water level change	(301)	566	(1,158)	(938)	802		(1,541)	(2,570)	379	NM	NM	NM	NM	(2,191)

NM - not measured

1 Natural stream recharge in the Pacheco Subbasin, the Paicines area of the San Juan Bautista Subbasin, and Tres Pinos Valley Basin is limited to zero to preserve correct colum totals which is calculated as (well pumping = groundwater outflow) - (deep percolation through soils_ =/- net annual storage change

2 Deep percolation of rainfall is calculated using a soil moisture budget model with the same crop-soil zones used in the calibrated grounddwater model developed by Yates and Zhang (2001). Rainfall percolation equals total simulated percolation minus percolation of irrigation water.

3 Deep percolation of irrigation water is assumed to equal 10% of applied irrigation water.

4 Use of domestic and municipal and industrial groundwater in the Bolsa Subbasin and Paicines area of the San Juan Subbasin was not estimated; it was greater than zero but much less than agricultural use. Municipal groundwater in the Tres Pinos Valley Basin were estimated for water year 2000.

5 Outflow from Southern San Juan, including groundwater outflow and minor well pumping (0.3 AFY), is assumed to occur in the same year as inflow.

Water Balance for Water Year 2003

	Pacheco	Bolsa Southeast	Northern San Juan	Hollister West	Hollister East N	Hollister East S	Tres Pinos	Zone 6 Subtotal	Bolsa	Paicines Area	Tres Pinos Valley	Flint Hills	Southern San Juan	Grand Total
Inflows														
Stream percolation (1)														
Natural streamflow	2,166	0	1,366	1,846	1,052	0	2,090	8,520	500	409	227	0	0	9,656
Reservoir releases	0	0	0	605	0	133	336	1,074	0	0	0	0	0	1,074
CVP Percolation	0	0	726	1,150	0	0	767	2,643	0	255	0	0	0	2,898
Deep percolation through soils														0
Rainfall (2)	313	109	860	632	436	178	353	2,881	586	119	23	0	0	3,609
Irrigation (3)	551	265	1,320	263	606	248	101	3,354	840	108	34	0	0	4,336
Reclaimed water percolation	0	0	2,223	1,218	0	0	303	3,744	0	0	0	0	0	3,744
Groundwater inflow	1,000	2,000	1,500	2,000	510	490	1,000	8,500	7,000	0	0	0	0	15,500
Total	4,030	2,374	7,995	7,714	2,604	1,049	4,950	30,716	8,926	891	284	0	0	40,817
Outflows														
Wells														
Agricultural	2,258	2,159	6,506	1,963	833	308	891	14,918	8,399	1,082	336	0	0	24,735
Domestic and M & I (4)	167	16	928	4,259	272	484	1,914	8,040	0	0	47	0	0	8,087
Groundwater outflow	1,500	500	1,500	1,500	1,000	0	2,000	8,000	0	500	500	0	0	9,000
Total	3,925	2,675	8,934	7,722	2,105	792	4,805	30,958	8,399	1,582	883	0	0	41,822
Storage change														
Inflows - outflows	105	(301)	(939)	(8)	499	257	145	(242)	527	(691)	(599)	0	0	(1,005)
Water level change	322	361	1,029	465	1,844		13	4,034	78	NM	NM	NM	NM	4,112

NM - not measured

1 Natural stream recharge in the Pacheco Subbasin, the Paicines area of the San Juan Bautista Subbasin, and Tres Pinos Valley Basin is limited to zero to preserve correct colum totals which is calculated as (well pumping = groundwater outflow) - (deep percolation through soils_ =/- net annual storage change

2 Deep percolation of rainfall is calculated using a soil moisture budget model with the same crop-soil zones used in the calibrated grounddwater model developed by Yates and Zhang (2001). Rainfall percolation equals total simulated percolation minus percolation of irrigation water.

3 Deep percolation of irrigation water is assumed to equal 10% of applied irrigation water.

4 Use of domestic and municipal and industrial groundwater in the Bolsa Subbasin and Paicines area of the San Juan Subbasin was not estimated; it was greater than zero but much less than agricultural use. Municipal groundwater in the Tres Pinos Valley Basin were estimated for water year 2000.

5 Outflow from Southern San Juan, including groundwater outflow and minor well pumping (0.3 AFY), is assumed to occur in the same year as inflow.

Water Balance for Water Year 2004

	Pacheco	Bolsa Southeast	Northern San Juan	Hollister West	Hollister East N	Hollister East S	Tres Pinos	Zone 6 Subtotal	Bolsa	Paicines Area	Tres Pinos Valley	Flint Hills	Southern San Juan	Grand Total
Inflows														
Stream percolation (1)														
Natural streamflow	1,628	0	1,118	705	786	0	1,189	5,426	500	61	(50)	0	0	5,937
Reservoir releases	0	0	0	882	0	135	2	1,019	0	0	0	0	0	1,019
CVP Percolation	0	0	58	340	0	0	794	1,192	0	30	0	0	0	1,222
Deep percolation through soils														0
Rainfall (2)	887	307	2,005	1,312	1,311	535	833	7,190	1,159	224	63	532	1,604	10,772
Irrigation (3)	585	313	1,385	217	661	270	128	3,559	927	122	36	0	0	4,644
Reclaimed water percolation	0	0	2,556	768	21	0	290	3,635	0	0	0	0	0	3,635
Groundwater inflow	1,000	2,000	1,500	1,500	255	245	500	7,000	6,500	0	0	0	0	13,500
Total	4,100	2,620	8,622	5,724	3,034	1,185	3,736	29,021	9,086	437	49	532	1,604	40,729
Outflows														
Wells														
Agricultural	2,276	2,395	6,941	1,626	734	272	1,086	15,330	9,270	1,218	363	0	0	26,181
Domestic and M & I (4)	185	11	1,180	3,345	474	842	2,118	8,155	0	0	47	0	0	8,202
Groundwater outflow	1,500	1,000	1,000	2,000	1,000	0	1,500	8,000	0	250	250	0	0	8,500
Total	3,961	3,406	9,121	6,971	2,208	1,114	4,704	31,485	9,270	1,468	660	0	1,604	42,883
Storage change														
Inflows - outflows	139	(786)	(499)	(1,247)	826	71	(968)	(2,464)	(184)	(1,031)	(611)	532	0	(3,758)
Water level change	154	(1,511)	(482)	(1,101)	(61)		(1,175)	(4,176)	287	(1,031)	(610)	NM	NM	(5,530)

1 Natural stream recharge in the Pacheco Subbasin, the Paicines area of the San Juan Bautista Subbasin, and Tres Pinos Valley Basin is limited to zero to preserve correct colum totals which is calculated as (well pumping = groundwater outflow) - (deep percolation through soils_ =/- net annual storage change

2 Deep percolation of rainfall is calculated using a soil moisture budget model with the same crop-soil zones used in the calibrated grounddwater model developed by Yates and Zhang (2001). Rainfall percolation equals total simulated percolation minus percolation of irrigation water.

3 Deep percolation of irrigation water is assumed to equal 10% of applied irrigation water.

4 Use of domestic and municipal and industrial groundwater in the Bolsa Subbasin and Paicines area of the San Juan Subbasin was not estimated; it was greater than zero but much less than agricultural use.

5 Outflow from Southern San Juan, including groundwater outflow and minor well pumping (0.3 AFY), is assumed to occur in the same year as inflow.

Water Balance for Water Year 2005

	Pacheco	Bolsa Southeast	Northern San Juan	Hollister West	Hollister East N	Hollister East S	Tres Pinos	Zone 6 Subtotal	Bolsa	Paicines Area	Tres Pinos Valley	Flint Hills	Southern San Juan	Grand Total
Inflows														
Stream percolation (1)														
Natural streamflow	2,000	0	1,512	1,936	2,342	0	3,749	11,539	500	1,197	2,587	0	0	15,823
Reservoir releases	0	0	0	527	0	0	0	527	0	0	0	0	0	527
CVP Percolation	0	0	1,152	2,021	0	0	1,351	4,524	0	1,249	0	0	0	5,773
Deep percolation through soils														0
Rainfall (2)	1,701	849	2,359	1,515	1,292	528	772	9,016	2,350	382	93	100	301	12,242
Irrigation (3)	419	235	1,150	213	606	248	80	2,951	417	106	33	0	0	3,507
Reclaimed water percolation	0	0	2,553	662	22	0	253	3,490	0	0	0	0	0	3,490
Groundwater inflow	1,000	2,000	1,500	1,500	255	245	1,000	7,500	5,500	0	0	0	0	13,000
Total	5,120	3,084	10,226	8,374	4,518	1,020	7,205	39,547	8,767	2,934	2,713	100	301	54,362
Outflows														
Wells														
Agricultural	1,128	1,837	5,655	1,477	887	361	711	12,056	7,697	1,057	334	0	0	21,144
Domestic and M & I (4)	192	12	953	3,607	640	699	1,667	7,770	0	0	52	0	0	7,822
Groundwater outflow	2,000	1,000	2,000	2,000	1,000	0	1,500	9,500	500	500	500	0	0	11,000
Total	3,320	2,849	8,608	7,084	2,527	1,060	3,878	29,326	8,197	1,557	886	0	301	39,966
Storage change														
Inflows - outflows	1,800	235	1,618	1,290	1,990	(39)	3,327	10,221	570	1,377	1,827	100	0	14,095
Water level change	744	2,263	1,493	1,578	1,844		2,927	10,849	885	1,376	1,828	NM	NM	14,938

1 Natural stream recharge in the Pacheco Subbasin, the Paicines area of the San Juan Bautista Subbasin, and Tres Pinos Valley Basin is limited to zero to preserve correct colum totals which is calculated as (well pumping = groundwater outflow) - (deep percolation through soils_ =/- net annual storage change

2 Deep percolation of rainfall is calculated using a soil moisture budget model with the same crop-soil zones used in the calibrated grounddwater model developed by Yates and Zhang (2001). Rainfall percolation equals total simulated percolation minus percolation of irrigation water.

3 Deep percolation of irrigation water is assumed to equal 10% of applied irrigation water.

4 Use of domestic and municipal and industrial groundwater in the Bolsa Subbasin and Paicines area of the San Juan Subbasin was not estimated; it was greater than zero but much less than agricultural use.

5 Outflow from Southern San Juan, including groundwater outflow and minor well pumping (0.3 AFY), is assumed to occur in the same year as inflow.

Water Balance for Water Year 2006

	Pacheco	Bolsa Southeast	San Juan	Hollister West	Hollister East N	Hollister East S	Tres Pinos	Zone 6 Subtotal	Bolsa	Paicines	Tres Pinos Creek Valley	Flint Hills	Southern San Juan	Grand Total
Inflows														
Stream percolation														
Natural streamflow*	1,659	0	1,410	1,134	2,681	0	378	7,263	500	238	2,521	0	0	10,522
Reservoir releases	0	0	587	1,222	0	0	407	2,217	0	0	0	0	0	2,217
CVP Percolation	0	0	0	451	0	0	1	452	0	0	0	0	0	452
Deep percolation through soils														0
Rainfall+	1,763	699	5,499	1,396	1,937	922	842	13,059	3,853	451	110	0	0	17,472
Irrigation	447	252	1,262	194	782	171	100	3,207	623	102	32	0	0	3,964
Reclaimed water percolation	0	0	2,402	606	0	0	249	3,257	0	0	0	0	0	3,257
Groundwater inflow	4,000	3,750	500	2,750	568	682	4,000	16,250	6,000	500	500	0	0	23,250
Total	7,869	4,700	11,660	7,753	5,968	1,775	5,978	45,704	10,976	1,290	3,162	0	0	61,133
Outflows														
Wells														
Agricultural	1,029	1,856	5,822	1,422	790	473	842	12,234	6,234	1,016	316	0	0	19,800
Domestic and M & I	180	8	919	3,211	471	821	1,645	7,255	0	0	49	0	0	7,304
Groundwater outflow	4,250	2,000	2,000	3,750	1,500	0	2,750	16,250	5,250	500	500	0	0	22,500
Total	5,458	3,864	8,741	8,383	2,761	1,294	5,238	35,739	11,484	1,516	865	0	0	49,604
Storage change														
Inflows - outflows	2,411	837	2,919	(630)	3,207	481	741	9,965	(508)	(225)	2,298	0	0	11,529
Water level change	410	245	442	770	1,539		409	3,815	1,195	0	0	NM	NM	5,010

*Rejected recharge was assumed to be 50 % for Pacheco; natural percolation in San Juan subbasin was also decreased by 50 percent to represent rejected recharge.
+Deep percolation from rainfall was decreased by 20 percent to account for additional runoff and rejected recharge during wet times.

Water Balance for Water Year 2007

	Pacheco	Bolsa Southeast	San Juan	Hollister West	Hollister East N	Hollister East S	Tres Pinos	Zone 6 Subtotal	Bolsa	Paicines	Tres Pinos Creek Valley	Flint Hills	Southern San Juan	Grand Total
Inflows														
Stream percolation														
Natural streamflow*	799	0	25	73	319	0	24	1,241	500	34	2,673	0	0	4,448
Reservoir releases	0	0	767	2,297	0	0	766	3,830	0	0	0	0	0	3,830
CVP Percolation	0	0	0	216	0	0	88	304	0	0	0	0	0	304
Deep percolation through soils														0
Rainfall	378	179	1,166	287	367	35	66	2,478	759	96	17	0	0	3,350
Irrigation	457	257	1,218	214	1,036	33	95	3,311	709	116	35	0	0	4,170
Reclaimed water percolation	0	0	2,354	614	0	0	158	3,126	0	0	0	0	0	3,126
Groundwater inflow	4,500	3,000	250	3,000	568	682	3,000	15,000	6,000	500	500	0	0	22,000
Total	6,135	3,436	5,781	6,701	2,290	750	4,197	29,290	7,968	746	3,224	0	0	41,228
Outflows														
Wells														
Agricultural	810	1,998	6,562	1,662	1,739	628	849	14,248	7,086	1,156	350	0	0	22,840
Domestic and M & I	224	7	1,096	3,456	491	1,010	2,013	8,297	0	0	46	0	0	8,343
Groundwater outflow	4,250	2,000	500	2,750	1,500	0	1,250	12,250	1,500	500	500	0	0	14,750
Total	5,284	4,005	8,158	7,868	3,730	1,638	4,112	34,795	8,586	1,656	896	0	0	45,932
Storage change														
Inflows - outflows	851	(569)	(2,377)	(1,168)	(1,440)	(888)	85	(5,505)	(618)	(910)	2,328	0	0	(4,704)
Water level change	(958)	(1,466)	(2,530)	(400)	(2,909)		(220)	(8,482)	(862)	0	0	NM	NM	(9,344)

* No rejected recharge removed.

Water Balance for Water Year 2008

	Pacheco	Bolsa Southeast	San Juan	Hollister West	Hollister East N	Hollister East S	Tres Pinos	Zone 6 Subtotal	Bolsa	Paicines	Tres Pinos Creek Valley	Flint Hills	Southern San Juan	Grand Total
Inflows														
Stream percolation														
Natural streamflow*	1,131	0	496	275	726	0	92	2,719	500	146	2,669	0	0	6,035
Reservoir releases	0	0	412	564	0	0	188	1,164	0	0	0	0	0	1,164
CVP Percolation	0	0	0	6	0	0	0	6	0	0	0	0	0	6
Deep percolation through soils														0
Rainfall	1,111	556	4,414	898	1,603	547	594	9,723	2,928	224	41	0	0	12,916
Irrigation	322	233	958	151	775	26	66	2,531	789	126	37	0	0	3,483
Reclaimed water percolation	0	0	2,209	629	0	0	158	2,996	0	0	0	0	0	2,996
Groundwater inflow	4,750	4,000	250	3,000	236	764	3,500	16,500	7,000	500	500	0	0	24,500
Total	7,314	4,790	8,739	5,522	3,341	1,337	4,597	35,639	11,217	996	3,247	0	0	51,099
Outflows														
Wells														
Agricultural	1,703	2,001	6,744	1,143	1,752	887	567	14,796	7,889	1,255	372	0	0	24,313
Domestic and M & I	197	13	1,053	3,232	661	662	2,130	7,947	0	0	47	0	0	7,994
Groundwater outflow	5,500	1,250	250	3,500	1,500	0	2,500	14,500	1,250	500	500	0	0	16,750
Total	7,400	3,264	8,046	7,875	3,913	1,549	5,197	37,243	9,139	1,755	919	0	0	49,056
Storage change														
Inflows - outflows	(85)	1,525	693	(2,353)	(573)	(212)	(600)	(1,605)	2,078	(759)	2,328	0	0	2,043
Water level change	(298)	2,483	174	1,009	(403)		(158)	2,807	1,796	0	0	NM	NM	4,603

* No rejected recharge removed.

Water Balance for Water Year 2009

	Pacheco	Bolsa Southeast	San Juan	Hollister West	Hollister East N	Hollister East S	Tres Pinos	Zone 6 Subtotal	Bolsa	Paicines	Tres Pinos Creek Valley	Flint Hills	Southern San Juan	Grand Total
Inflows														
Stream percolation														
Natural streamflow	771	0	666	1,517	449	0	506	3,910	500	0	413	0	0	4,823
Reservoir releases	0	0	1,013	2,318	0	0	773	4,104	0	0	0	0	0	4,104
CVP Percolation	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Deep percolation through soils														0
Rainfall	767	424	2,515	676	691	57	185	5,314	1,185	182	31	0	0	6,712
Irrigation	494	185	910	340	511	66	111	2,618	721	114	34	0	0	3,488
Reclaimed water percolation	0	0	2,190	214	0	0	191	2,594	0	0	0	0	0	2,594
Groundwater inflow	3,422	1,500	260	2,032	489	511	1,644	9,858	4,000	0	--	0	0	13,858
Total	5,454	2,109	7,554	7,098	2,140	634	3,409	28,398	6,407	296	478	0	0	35,579
Outflows														
Wells														
Agricultural	3,106	2,073	10,943	1,495	3,174	361	600	21,753	7,213	1,140	344	0	0	30,450
Domestic and M & I	264	9	1,013	2,691	421	777	2,271	7,446	0	0	0	0	0	7,446
Groundwater outflow	2,000	1,000	19	1,500	2,159	0	2,000	8,678	0	0	1,644	0	0	10,322
Total	5,370	3,082	11,975	5,686	5,753	1,139	4,871	37,876	7,213	1,140	1,988	0	0	48,218
Storage change														
Inflows - outflows	84	(974)	(4,421)	1,412	(3,612)	(505)	(1,462)	(9,478)	(807)	(845)	(1,510)	0	0	(12,639)
Water level change	1,639	(5,338)	(437)	(431)	4,710		1,913	2,055	(3,372)	(343)	(366)	NM	NM	(2,026)

Adjustments

Adjusted Bolsa SE/Hollister West subsurface flow

Adjusted Bolsa/Pacheco subsurface flow

Adjusted Bolsa/Bolsa SE subsurface flow

Assumed all San Benito River flows percolate within the basin

Water Balance for Water Year 2010

	Pacheco	Bolsa Southeast	San Juan	Hollister West	Hollister East N	Hollister East S	Tres Pinos	Zone 6 Subtotal	Bolsa	Paicines	Tres Pinos Creek Valley	Flint Hills	Southern San Juan	Grand Total
Inflows														
Stream percolation														
Natural streamflow	671	0	701	993	467	0	331	3,164	500	0	(316)	0	0	3,348
Reservoir releases	0	0	829	1,755	0	0	585	3,169	0	0	0	0	0	3,169
CVP Percolation	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Deep percolation through soils														0
Rainfall	806	407	2,611	749	670	47	152	5,444	1,403	231	43	0	0	7,121
Irrigation	433	150	766	301	416	56	88	2,210	629	103	33	0	0	2,975
Reclaimed water percolation	0	0	1,940	18	0	0	191	2,150	0	0	0	0	0	2,150
Groundwater inflow	2,870	2,874	36	2,021	557	484	1,901	10,742	6,600	0	--	0	0	17,341
Total	4,780	3,431	6,883	5,837	2,111	587	3,248	26,877	9,132	334	(240)	0	0	36,103
Outflows														
Wells														
Agricultural	2,517	1,896	8,745	1,614	3,088	651	575	19,086	6,294	1,032	326	0	0	26,739
Domestic and M & I	36	0	816	2,467	266	455	1,111	5,152	0	0	0	0	0	5,152
Groundwater outflow	3,108	1,473	19	2,874	1,619	0	2,000	11,093	0	0	1,901	0	0	12,994
Total	5,661	3,370	9,580	6,955	4,972	1,107	3,686	35,331	6,294	1,032	2,227	0	0	44,885
Storage change														
Inflows - outflows	(881)	61	(2,697)	(1,118)	(2,861)	(520)	(438)	(8,454)	2,838	(698)	(2,467)	0	0	(8,782)
Water level change	(1,335)	5,443	(811)	(477)	(2,032)		(2,485)	(1,696)	4,631	(2,036)	(1,067)	NM	NM	(168)

Adjustments

- Bolsa SE not adjusted due to uncertainty in the observed groundwater levels
- Reduced Pacheco and Hollister East stream flow to 25 % of calculated
- Reduced subsurface outflow from Pacheco
- Reduced subsurface inflow from Pacheco outside basin
- Reduced subsurface inflow into Tres Pinos
- Assumed 50% of San Benito River flows out of the basin

Water Balance for Water Year 2011

	Pacheco	Bolsa Southeast	San Juan	Hollister West	Hollister East N	Hollister East S	Tres Pinos	Zone 6 Subtotal	Bolsa	Paicines Area	Tres Pinos Creek Valley	Flint Hills	Southern San Juan	Grand Total
Inflows														
Stream percolation														
Natural streamflow	896	0	2,272	1,948	693	0	812	6,622	500	1,304	3,003	0	0	11,428
Reservoir releases	0	0	846	764	0	0	318	1,929	0	511	0	0	0	2,440
CVP Percolation	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Deep percolation through soils														0
Rainfall	1,627	475	3,034	1,383	1,099	131	348	8,097	1,919	452	120	0	0	10,588
Irrigation	435	150	767	301	391	55	88	2,187	577	101	32	0	0	2,898
Reclaimed water percolation	0	0	2,040	233	0	0	202	2,475	0	0	0	0	0	2,475
Groundwater inflow	3,037	3,055	100	2,019	432	468	2,003	11,115	6,676	0	--	0	0	17,790
Total	5,995	3,680	9,059	6,648	2,615	654	3,772	32,424	9,672	2,369	3,155	0	0	47,620
Outflows														
Wells														
Agricultural	1,910	2,775	4,664	1,801	915	332	390	12,787	5,775	1,013	322	0	0	19,896
Domestic and M & I	82	6	322	2,139	72	628	2,064	5,315	0	0	0	0	0	5,315
Groundwater outflow	3,191	1,500	3,600	3,055	2,000	0	2,000	15,346	0	0	2,003	0	0	17,349
Total	5,183	4,281	8,587	6,995	2,987	960	4,454	33,447	5,775	1,013	2,325	0	0	42,560
Storage change														
Inflows - outflows	812	(601)	473	(347)	(372)	(306)	(682)	(1,023)	3,897	1,356	830	0	0	5,060
Water level change	389	(2,508)	(523)	(198)	570		228	(2,042)	(2,239)	852	2,334	NM	NM	(1,095)

Adjustments

Bolsa not adjusted due to uncertainty in the observed groundwater levels

Reduced Pacheco stream flow to 25% of calculated

Assumed 58% of San Benito River flows out of the basin

Reduced deep peroclation in San Juan and parts of Bolsa

Adjusted Holliseter West/Tres Pinos interaction

Reduced subsurface inflow from Pacheco outside basin and Holliser East

Increased groundwater outflow from San Juan

Appendix C

Salt and Nutrient Balance and Fate and Transport Analysis (TM-2)

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San Benito County Water District
San Benito County, California

Final

Technical Memorandum 2
Salt and Nutrient Balance
and
Fate and Transport Analysis
for
Northern San Benito County
Salt and Nutrient Management Plan

May 2013

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List of Acronyms

ACB	Assimilative Capacity Benchmark
AG MIN	Agricultural Mineral Soil Amendments
AF	Acre-feet
AFY	Acre-feet per year
BSBPO	Basin Specific Basin Plan Objective
CA66	California NADP Monitoring Station 66, Pinnacles National Monument
CALSIM II	California State Water Project Operations Model
CASTNET	Clean Air Status and Trends Network
CDFA	California Department of Food and Agriculture
CDWR	California Department of Water Resources
County	San Benito County
CVP	Federal Central Valley Project
District	San Benito County Water District
DWWTP	Hollister Domestic Waste Water Treatment Plant
ET	Evapotranspiration
GIS	Geographic Information Systems
GBPO	General Basin Plan Objective
HUA	Hollister Urban Area
HH	Household
IWWTP	Hollister Industrial Waste Water Treatment Plant

IRWMP	Integrated Regional Water Management Plan
MCL	Maximum Contaminant Level
MG	Million gallons
MGD	Million gallons per day
mg/L	Milligrams per liter
M&I	Municipal and Industrial
MOU	Memorandum of Understanding
NADP	National Atmospheric Deposition Program
NE	Northeast
NO_3	Nitrate
RWFP	Recycled Water Future Plans
RWQCB	Central Coast Regional Water Quality Control Board
SBCWD	San Benito County Water District
SE	Southeast
SCVWD	Santa Clara Valley Water District
SMCL	Secondary Maximum Contaminant Level
SNMP	Salt Nutrient Management Plan
S/Ns	Salts and Nutrients
SRWSs	Self-Regenerating Water Softeners
SSCWD	Sunnyslope County Water District
SWRCB	State Water Resources Control Board
TDS	Total Dissolved Solids
TM	Technical Memorandum
UC Davis	University of California at Davis
UL	Urban Landscape
umhos/cm	micromhos per centimeter
USEPA	United States Environmental Protection Agency
USGS	United States Geological Society
WDR	Waste Discharge Requirements
WRF	Water Recycling Facility
WTP	Water Treatment Plant
WWTP	Waste Water Treatment Plant
WY	Water Year

1 Introduction

In February 2009, the State Water Resources Control Board (SWRCB) adopted Resolution No. 2009-0011, which established a statewide Recycled Water Policy[1]. The policy encourages increased use of recycled water and local stormwater. It also requires local water and wastewater entities, together with local salt/nutrient-contributing stakeholders to develop a salt and nutrient management plan (SNMP) for each groundwater basin or subbasin in California. It is the intent of the policy that salts and nutrients from all sources be managed on a basin-wide or watershed-wide basis in a manner that ensures attainment of water quality objectives and protection of beneficial uses.

This Technical Memorandum (TM-2) *Salt and Nutrient Balance and Fate and Transport Analysis* has been prepared by Todd Engineers for San Benito County Water District (District) and other the stakeholders. It fulfills Tasks 3 (Salt and Nutrient and Fate and Transport Analysis) and 5 (Recycled Water and Stormwater Goals and Objectives) of the Project Management Plan for the Pajaro River Watershed Integrated Regional Water Management (IRWM) Plan SNMP (Todd, 2012a). The SNMP is one component of the IRWMP. This TM-2 builds upon TM-1, *Hydrogeologic Conceptual Model* (Todd, 2012c), which describes the Study Area hydrogeologic conditions including water balances and existing water quality and assimilative capacity. Existing assimilative capacity is the difference between existing groundwater quality and groundwater quality objectives. TM-1 and TM-2, along with other SNMP tasks, will be integrated into the San Benito County SNMP.

The goal of the Salt and Nutrient Loading/Fate and Transport Analysis is to develop a salt and nutrient (S/N) balance that estimates current and future S/N loading and future changes to groundwater quality concentrations relative to Basin Plan Objectives. Accordingly, TM-2 describes the current S/N balance and anticipated future changes based on stated plans, goals, and implementation measures. Given the inherent uncertainties in estimating individual loading/unloading factors (i.e., S/N inflows and outflows), the balance is calibrated by comparing predicted baseline groundwater quality to actual observed groundwater quality data for a 10-year baseline period from Water Year (WY) 2001-02 to 2010-11[2]. Using a spreadsheet model, the mass load is mixed into a groundwater basin or subbasin volume. The result is a predicted concentration of salt and nitrate for each basin/subbasin. The predicted change is compared to historic trends in each basin/subbasin during the WY 2002 to 2011 calibration period. Adjustments to the loads and fate and transport factors are made to calibrate the spreadsheet model to observed conditions. The result is a calibrated S/N balance for baseline conditions.

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[1] Draft amendments to the policy were issued in September 2012 and in January 2013. The amendments were adopted at the January 22, 2013 Board meeting.

[2] Unless otherwise indicated, all years are reported as Water Years (WY). A water year begins on October 1 and ends on September 30 of the following year. The WY is reported as the ending year. For example October 1, 2010 through September 30, 2011 reported as WY 2011.

The calibrated load factors are then reviewed and revised based on anticipated future changes. For example, upgrades to wastewater treatment plants, increases in imported water use, and demineralization of groundwater result in changes to individual load factors.

The Study Area covers approximately 200 square miles located in the San Benito County (County) portion of the Gilroy-Hollister Groundwater Basin, which includes the Bolsa, Hollister, San Juan Bautista, and Tres Pinos Valley Groundwater Basin groundwater basins/subbasins as defined by the California Department of Water Resources (DWR) in Bulletin 118 (DWR, 2003). The Gilroy portion of the Gilroy-Hollister Basin lies in Santa Clara County and is not included in the Study Area. The CDWR subbasins and basins are shown in **Figure 1**. For purposes of this study, the Bolsa, Hollister, and San Juan Subbasins are further subdivided as shown in **Figure 2**. The Bolsa Subbasin is divided into the Bolsa and Bolsa Southeast. The Hollister Subbasin is divided into the Pacheco, Hollister Northeast, and Hollister Southeast. The San Juan Bautista Subbasin is divided into the Flint Hills, Hollister West, Tres Pinos, San Juan North, San Juan Central, and San Juan South. Most data collected in the Study Area are from the District's Zone 6 area (Figure 2).

Figure 3 shows a 2010 land use map of the Study Area prepared for TM-1. In the northern Study Area, 50% of the acreage is farmland, 35% is native vegetation, and the remaining 15% is urban and rural residential. Urban areas include the cities of Hollister and San Juan Bautista, and the community of Tres Pinos. The central and southern part of the Study Area is less developed and more sparsely populated with 89% native vegetation and 10% cropland. The remaining 1% of acreage includes urban and rural residential lands.

2 Existing Water Quality and Assimilative Capacity

2.1 Selected Indicator Salts and Nutrients and Fate and Transport

TM-1 discussed available water quality data for total dissolved solids (TDS) and nitrate as nitrate (nitrate-NO_3), and presented a summary of groundwater quality trends. TDS and nitrate-NO_3 have been selected as the most appropriate indicators of S/Ns in the Study Area. Total salinity is commonly expressed in terms of TDS[3] in milligrams per liter (mg/L). Because TDS monitoring data are widely available for local water resources (both inflows and outflows) and because TDS is a general indicator of total salinity, TDS is an appropriate indicator of S/Ns. TDS fate and transport is relatively simple, as it does not undergo significant transformation in the environment. Nutrients are represented by nitrate-NO_3[4]. Nitrate that ultimately reaches groundwater has undergone a number of transformation processes as part of the complex nitrogen cycle. As a result, the nutrient balance estimates the losses of applied nitrogen that occur with each transformation process. Elevated nitrate concentrations have been an ongoing groundwater quality challenge in the northern Study Area.

2.2 Existing Groundwater Quality and Assimilative Capacity

The current basin average for TDS and nitrate-NO_3 calculated in TM-1 is based on a Geographical Information System (GIS) analysis of interpolated TDS and nitrate-NO_3 concentrations, shown on **Figures 4 and 5**, respectively. The interpolations are based on all the observed data, with more weighting given to newer data in areas where both recent and historical data are available. Water quality monitoring data are lacking in the southern San Juan Subbasin. Accordingly, it is assumed that TDS and nitrate-NO_3 concentrations in this area are the same as observed in the Tres Pinos Valley Basin, because most of the southern San Juan Subbasin is in the Tres Pinos Creek watershed. No wells were identified in the Flint Hills. Consequently, water quality in the Flint Hills is estimated using data from one well located on the east side of the northern San Juan Subbasin. This well is screened in the same continental mudstones that underlie the Flint Hills.

Average TDS and nitrate-NO_3 concentrations and available assimilative capacity in each basin/subarea are shown in **Table 1** and **Figure 6**. The basin/subbasin averages serve as a snapshot and allow for a simple comparison of groundwater quality across the Study Area and provide the baseline for future loading estimates. Assimilative capacity is calculated by comparing the basin/subbasin average ambient concentrations with water quality objectives. The Central Coast Basin Plan (RWQCB, 2011) states that groundwater shall not contain concentrations of chemical constituents in excess of the limits specified in California Code of Regulations, Title 22, Chapter 15, Article 4, referred to in this TM as General Basin Plan Objectives (GBPOs). The GBPO for nitrate-NO_3 is 45 mg/L, the primary maximum contaminant

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[3] Most of the water quality data in the Study Area includes direct measurement of TDS in mg/L. Some groundwater quality is reported as specific conductance in micromhos per centimeter (µmhos/cm). These data were converted to TDS in mg/L based on Kilburn, 1972: TDS mg/L = (Specific conductance x 0.721) – 125.

[4] Water quality data reported as nitrate as N (mg/L) were multiplied by 4.425 to convert to nitrate as NO_3.

level (MCL). **Table 1** lists numeric GBPOs for groundwater with municipal and domestic water supply (MUN) and agricultural water supply (AGR) beneficial uses in the Central Coast. There is no primary MCL for TDS listed in Title 22, Chapter 15, Article 4; however, the CDPH has adopted Secondary Maximum Contaminant Levels (SMCLs) for TDS. SMCLs address aesthetic issues related to taste, odor, or appearance of the water and are not related to health effects; although, elevated TDS concentrations can affect its desirability for irrigation uses. The recommended SMCL for TDS is 500 mg/L with an upper limit of 1,000 mg/L. It has a short-term limit of 1,500 mg/L.

In addition to the above objectives, the RWQCB has established certain Basin-Specific Basin Plan Objectives (BSBPOs) for selected groundwaters that are intended to serve as a water quality baseline for evaluating water quality management. The Basin Plan (RWQCB, 2011) states that these objectives are median values based on data averages for groundwater; and objectives are based on preservation of existing quality or water quality enhancement believed attainable following control of point sources. The BSBPO for total nitrogen is 5 mg/L for the Hollister Subbasin and Tres Pinos Basin. This value is ½ the MCL for nitrate plus nitrite as nitrogen (as N), which is 10 mg/L. Assuming 100% of the nitrogen is in the form of nitrate, the objective can be converted into a BSBPO for nitrate-NO_3 of 22.5 mg/L. This value will be applied to the assimilative capacity calculations in the Hollister Subbasin and Tres Pinos Basin. The TDS BSBPOs are 1,200 mg/L for the Hollister Subbasin and 1,000 mg/L for the Tres Pinos Basin as shown in Table 1.

In the absence of GBPOs or BSBPOs for the CDWR San Juan Bautista and Bolsa subbasins, a TDS Assimilative Capacity Benchmark (ACB) is needed for the SNMP to calculate the available assimilative capacity. Table 1 presents a TDS ACB of 1,200 mg/L for the CDWR San Juan and Bolsa Subbasins. Ambient groundwater quality in the San Juan Bautista and Bolsa subbasins is similar to or slightly poorer than in the Hollister Subbasin; so use of the same TDS BSBPO from this subbasin is deemed reasonable. The GBPO for nitrate-NO_3 (45 mg/L) will be applied to assimilative capacity calculations in the CDWR San Juan Bautista and Bolsa subbasins.
All basins/subbasins have existing assimilative capacity for TDS and nitrate-NO_3. Average San Juan North groundwater quality (1,198 mg/L) is nearly at the ACB for TDS (1,200 mg/L), and therefore possesses very limited existing assimilative capacity.

3 Water Balance

In order to estimate the current salt and nutrient balance, it is necessary to have an understanding of the baseline period Study Area water inflows and outflows (i.e., the water balance). The water balance changes from year to year based on a number of factors including precipitation, availability of imported water supplies, subsurface inflow and outflow, and groundwater pumping. The difference between the basin inflow and outflow is the change in storage.

The various groundwater inflows and outflows are estimated in the District's Annual Groundwater Reports. The methodology used to estimate the water balances is presented in detail in the Annual Groundwater Report for Water Year 2011 (Todd, 2011b). As reported in TM-1, water balances were also developed for San Juan South and Flint Hills. The Hollister East water balance was redone to reflect the split of this basin into two subbasins: Hollister Northeast and Hollister Southeast. For the S/N balance, groundwater inflow was divided into sub-categories to account for return flows that have differing water quality. These include septic system return flows, sewer line leakage, water line leakage, recycled water return flows, and domestic irrigation return flows. **Appendix A** includes the volume and source water for all inflows and outflows.

3.1 Recharge (Inflows)

Major components of groundwater replenishment in the Study Area include:

- Deep percolation of precipitation
- Agricultural irrigation return flows
- Natural stream deep percolation
- Subsurface groundwater inflow
- Managed aquifer recharge
- Wastewater Treatment Plant (WWTP) pond percolation

These components represent the largest volume of inflows in the Study Area. Deep percolation of precipitation is the largest volume of inflow in five of the subbasins including: Flint Hills, Hollister Northeast, Hollister Southeast, San Juan North, and San Juan South. Natural stream deep percolation is the largest component of inflow in San Juan Central and Tres Pinos Creek Valley. In Bolsa, Bolsa Southeast, Hollister West, Pacheco, and Tres Pinos, subsurface groundwater inflow is the largest groundwater inflow volume.

In order to account for minor flow sources that carry salts and nutrients that are not considered in the annual water balance, additional estimates were made. The minor inflows include septic system return flows, recycled water irrigation, water line leakage, sewer line leakage, and landscape irrigation return flows. In order to preserve the water balance, subsurface groundwater inflows were adjusted to account for the volume of the additional return flows. The methodology for estimating each minor inflow is described below.

3.1.1 Septic System Return Flows

The majority of residents and businesses in unincorporated areas of county rely on stand-alone septic tanks and in-ground disposal or small-scale treatment systems. An estimate of the number of onsite wastewater systems per subbasin within Zone 6 was developed from rural domestic water use between 2005 and 2008, which is metered by the District. This estimate was compared to the number of septic system permits recorded in the San Benito County Department of Environmental Health's database from 1953 to the present. The street address was used to geocode the location within subbasins in order to tally the number of permits. Adjustments to the number of septic systems were made accordingly. Outside of Zone 6, the number of systems was estimated solely from the number of system permits within each subbasin. Domestic water use in the Flint Hills and San Juan South subbasins is assumed to be insignificant; therefore no septic system return flow was estimated for these areas.

The septic system discharge volume is based on an estimate of indoor water use as a percent of total annual use. Total daily per capita water use is assumed to be 161 gallons per capita per day with 2.8 persons per household (District, 2012a). This yields a total per household use of 0.5 acre-feet per year (AFY). Indoor water use is assumed to be 50% of total use (District, 2012a). Therefore, per household septic discharge is 0.25 AFY. **Table 2** summarizes the estimated number of rural households within each basin/subbasin, and the corresponding indoor and outdoor water use.

3.1.2 Recycled Water Irrigation

Two sites are currently receiving recycled water for irrigation use: the Brigantino Riverside Park (45 acres) and the Hollister Municipal Airport (247 acres). The Brigantino Park reuse site is located in the Hollister West Subbasin and the Hollister Airport reuse site is located in the Bolsa Southeast Subbasin (City of Hollister, 2011). Annual irrigation capacity is about 138 AFY at Brigantino Park and about 803 AFY at the Airport (AECOM, 2011). Irrigation with recycled water has increased since 2009. In 2010, total recycled water irrigation was 183 acre-feet (AF) and in 2011 total recycled water irrigation was 230 AF.

3.1.3 Water Line Leakage

Water line leakage was estimated based on values reported in the Urban Water Management Plan (Todd, 2011a). Water line leakage is assumed to be 7% of total water use, based on the Urban Water Management Plans estimated "system losses".

3.1.4 Sewer Line Leakage

Sewer leakage is generally not reported, and therefore difficult to estimate. Literature values often vary over a considerable range. For example, an US Environmental Protection Agency (USEPA) study (Amick, 2000) lists a range of leakage between 12 and 49% of total influent flow. For the S/N balance analysis, sewer line leakage is assumed to 12%, which is at the low end of the range reported by the USEPA.

3.1.5 Landscape Irrigation Return Flows

The annual water balance assumes an agricultural irrigation efficiency of 90%. This indicates that the evapotranspirative (ET) demands of the vegetation consume 90% of the water applied, and that the remaining 10% potentially becomes deep percolation. Based on this established water balance relationship, irrigation return flows were assumed to be 10% of applied water. For residential landscaping, applied water is estimated to be 50% of total water use, consistent with the assumption for 50% indoor water use discussed above for septic system return flows. In rural areas, this volume was estimated from the number of households on septic systems. In Zone 6, this estimate was based on municipal water use reported annually by the District. The irrigation efficiency for residential landscaping is assumed to be 90%.

3.1.6 Adjusted Groundwater Inflow

The minor inflows were summed and compared to the reported groundwater inflow for WY 2002 to 2011. To prevent a negative groundwater inflow volume and to be consistent with reported annual change in storage volumes, minor inflows were reduced as follows:

- Water line leakage volume was reduced from 5 to 7% in all basins/subbasins
- Sewer line leakage volume was reduced from 10 to 12% in all basins/subbasins
- Landscape irrigation return flows were reduced from 7 to 10% in all basins/subbasins
- Septic system and irrigation return flow volumes were reduced to 0 AF in San Juan Central and Tres Pinos Creek Valley in 2002, 2003, 2004, and 2010 to balance the 0 AF of groundwater inflow
- Water line leakage, sewer line leakage, septic system return flows, and irrigation return flows were further reduced by 50% in San Juan North in 2010 to balance below average groundwater inflows

3.2 Outflows

Appendix A presents the volume and source waters comprising outflows. Outflows include groundwater pumping, stream discharge, and subsurface groundwater outflow. Agricultural groundwater pumping is the largest outflow in Bolsa, Bolsa Southeast, Hollister Northeast, San Juan Central, San Juan North and Tres Pinos Creek Valley. In Hollister West, Hollister Southeast, and Tres Pinos, the largest outflow is municipal and domestic groundwater pumping. In the Pacheco and San Juan North subbasins, subsurface groundwater outflow is the largest component of outflow. There are no natural stream outflows within the Study Area, except during very wet years. These outflows are highly variable, difficult to estimate, and relatively small. Therefore, stream outflows are not included in the S/N balance analysis.

3.3 Overall Water Balance and Change in Storage

Table 3 is a summation of total inflows, outflows, annual change in storage, and cumulative change in storage for 2002 to 2011. The change in storage is equal the volume reported in annual reports. As stated above, groundwater inflows were adjusted to preserve the reported change in storage. Annual change in storage for individual basins/subbasins varies from year to year. Over half of the basins/subbasins have a negative cumulative change in storage at the end of 10-year baseline period. Basins/subbasins with a positive change in storage include Bolsa, Flint Hills, Pacheco, San Juan South, and Tres Pinos Creek Valley.

4 Baseline Period Salt and Nutrient Balances

The salt and nutrient balances in the Study Area consider the volumes of inflow and outflow and their associated TDS and nitrate-NO_3 concentrations. The balances also consider any added TDS and nitrogen from other sources as well as fate and transport processes, which can both increase and decrease concentrations. This section describes the methodology and data used to estimate S/N loading for eleven factors and identifies their individual and cumulative effect on groundwater quality in the Study Area over the baseline period (2002 to 2011). The eleven factors are:

- Surface water
- Precipitation
- Groundwater
- Mineral dissolution
- Irrigation source water
- Agricultural return flows
- Managed recharge
- Municipal wastewater and recycled water
- Municipal irrigation return flows
- Water and sewer line losses
- Septic systems

4.1 Methodology

In order to simulate the effect of current (and planned future) S/N loading on groundwater quality in each subbasin, a spreadsheet mixing model was developed. The mixing model was designed to incorporate the existing volume of groundwater and mass of TDS and nitrate-NO_3 in storage and to track the annual change in groundwater storage and S/N mass for each basin/subbasin. TM-1 (Todd, 2012c) estimated the mixing zones and porosity for each basin/subbasin. The mixing zone in each basin/subbasin was assumed to be less than the total estimated aquifer thickness and was estimated based on the typical depth tapped by production wells. This is a conservative assumption, as it reduces the total volume of the mixing zone and increases the potential impacts of salt and nutrient loading. **Table 4** shows the existing mass of TDS and nitrate-NO_3 within each basin/subbasin.

The water balance provides estimates of specific inflows and outflows from WY 2002 to 2011. Section 3 described the methodology for developing inflows and outflows in the Study Area. The sensitivity of groundwater quality within each basin/subbasin to individual S/N loading factors was identified through numerous simulations, and selected S/N loading estimates and assumptions were refined to ensure a reasonable agreement between simulated and observed groundwater quality conditions over the baseline period (WY 2002 to 2011).

One of the primary limitations of the spreadsheet mixing model is the assumption of instantaneous mixing of introduced salts and nutrients with ambient groundwater within a basin/subbasin. This results in an overestimation of the rate at which effects from a given salt and nutrient load migrates from shallow groundwater to deeper groundwater.

4.2 Inflow and Outflow Water Quality

4.2.1 Surface Water Quality

Average TDS and nitrate-NO_3 concentrations of streams were reported in TM-1 (Todd, 2012c) for each basin/subbasin using available data from 1998 to 2006. No data were available for the San Juan South and Tres Pinos Creek Valley, therefore data from Tres Pinos Creek within the Central San Juan Subbasin was assumed to be representative of surface water quality in these areas. There are no streams within the Bolsa Southeast and Flint Hills subbasins. **Table 5** summarizes surface water quality in each basin/subbasin.

There are no natural stream outflows within the Study Area, except during very wet years. These outflows are highly variable, difficult to estimate, and relatively small. Therefore, stream outflows are not included in the S/N balance analysis.

4.2.2 Rainfall and Atmospheric Dry Deposition Quality

Nitrate-NO_3 and TDS loading from rainfall was estimated from the 2002 – 2011 average concentration reported by the National Atmospheric Deposition Program (NADP) at the Pinnacles National Monument station (CA66). Nitrogen concentrations were adjusted to reflect assumed losses from denitrification (10%) and plant uptake (56%[5]). The area of loading was assumed to be cropland and urban landscaped areas. Loading in paved areas is assumed to be zero due to runoff of stormwater flows. The acreage for cropland is derived from the 2010 land use update (Todd, 2012b). Derivation of urban landscape acreage is described in Section 4.10 *Municipal Irrigation*. Average TDS concentrations in percolating rainfall (2.8 mg/L) measured at CA66 were increased to 150 mg/L reflecting the assumed dissolution of geologic formation TDS via contact with very low TDS rain water.

Nitrate-NO_3 loading from dry atmospheric deposition was estimated from atmospheric total nitrogen dry deposition concentrations (2003 – 2009) measured by the Clean Air Status and Trends Network (CASTNET) station in Pinnacles. Dry deposition of nitrogen in urbanized areas is assumed to runoff with stormwater flows, or to be removed by nitrogen-fixing processes in turf areas (UC Davis, 2012). However, dry deposition in farmed areas is likely to leach into groundwater (UC Davis, 2012). Therefore, the average nitrogen dry deposition is multiplied by the crop acreage, after accounting for denitrification (10%) and crop uptake (56%). Dry deposition of TDS is assumed to be negligible.

4.2.3 Groundwater Quality

Groundwater flow moves salts between basins/subbasins and to the surface for irrigation and other consumptive uses. The TDS and nitrate-NO_3 concentration of groundwater varies widely throughout the Study Area. In order to quantify the quality of groundwater flowing in and out of each basin/subbasin, a volume-weighted concentration for each subsurface groundwater inflow source was calculated. The volumes were based on 2006 to 2011 averages from the

[5] Crop uptakes rates are from UC Davis (2012); the average plant uptake for all crops in the Study Area is 56%.

water balances. The TDS and nitrate-NO_3 concentrations for inter-basin groundwater flow are the average TDS and nitrate-NO_3 concentration in the source basin/subbasin (Table 1). The TDS and nitrate-NO_3 concentration of groundwater inflow into the Study Area along the east, west, and southern basin/subbasin boundaries is estimated from the water quality database. TDS and nitrate-NO_3 concentrations in groundwater inflow to the north are based on the average concentrations of wells in the Llagas Subbasin along the northern Study Area boundary. **Table 6** shows groundwater inflow and outflow directions with corresponding TDS and nitrate-NO_3 concentrations. Outflow TDS and nitrate-NO_3 is the average groundwater basin/subbasin concentration.

Municipal, rural domestic, and agricultural pumping removes salts and nitrate-NO_3 from the groundwater basins/subbasins. Pumping volumes are quantified each year as part of the water balance update. The concentration of TDS and nitrate-NO_3 in extracted groundwater at domestic wells and agricultural wells is represented by the average concentration calculated within the respective basin/subbasin. Pumping from municipal wells is represented by the averages from municipal wells in the basins/subbasin where pumping occurs.

4.2.4 Mineral Dissolution

Dissolved solids in groundwater are naturally related to the interaction of water with the atmosphere, soil, and rock. Additional changes in concentrations can result due to ion exchange, precipitation of minerals previously dissolved, and reactions resulting in conversion of some solutes from one form to another. Beginning in the 1930's, groundwater samples indicated elevated levels of TDS in groundwater in the Study Area. Elevated TDS has been ascribed to the natural presence of marine sediments and to added salts due to agricultural irrigation. There have been no increasing groundwater quality trends in TDS identified (Todd, 2004). Therefore, it is assumed that a steady state between groundwater and geology has been reached with respect to mineral dissolution. As a result, mineral dissolution is not considered as a load factor.

4.2.5 Irrigation Source Water Quality

Central Valley Project (CVP) imported water stored in San Justo Reservoir is delivered to agricultural customers in the Zone 6 (District's designated Bolsa Southeast, Pacheco, Hollister Northeast, Hollister Southeast, Hollister West, San Juan South and Tres Pinos subbasins). The average TDS of CVP water is 298 mg/L and the average nitrate-NO_3 is 3.6 mg/L, based on water samples collected between 2003 and 2006 (Todd, 2012c). In addition, these seven subbasins also use groundwater for irrigation. The proportion of CVP versus groundwater use varies each year depending on the volume of CVP imports and the amount and timing of rainfall, because spring rains decrease total irrigation demand, and growers adjust groundwater pumping to compensate for changes in the availability of CVP imports. To reflect this variability, blended water quality concentrations for TDS and nitrate-NO_3 were calculated for each WY between 2002 and 2011, based on relative percentage of groundwater and CVP water used within each subbasin. The Bolsa, San Juan Central, San Juan South and Tres Pinos Creek Valley basins/subbasins rely on groundwater for 100% of their water supply. Therefore, the irrigation water quality in these basins/subbasins reflects the average groundwater quality in each individual basin/subbasin (Table 1).

Evapotranspiration of the irrigation water results in concentration of TDS in percolating irrigation water. A three-fold increase in concentration was assumed to account for ET[6] (Yates, 2003). Data from thirteen tile drains in the San Juan South Subbasin were reviewed to confirm the ET concentration factor. The average tile drain TDS concentration measured between 2003 and 2008 of TDS was 2,270 mg/L. The average estimated TDS of irrigation water during this same time period was 776 mg/L. Applying the three-fold concentration factor yielded a TDS of 2,330 mg/L, which is only slightly higher than the measured average. **Appendix B** lists the estimated annual TDS and nitrate-NO_3 concentrations in irrigation water between WY 2002 and 2011.

4.2.6 Agricultural Return Flow Water Quality

The predominant land use in the northern Study Area is agriculture (Figure 3). Changes in crop acres between WY 2002 and 2010 were estimated by Todd (2012b) based on 2010 US Department of Agriculture aerial photography. It is assumed that crop acres identified for 2010 can be used to represent 2002 – 2011 conditions (Todd, 2012b).

4.2.6.1 Nitrate

There are over forty types of crops grown in San Benito County. Nitrogen based fertilizer application rates were developed for each crop based on published fertilizer demand data (UC Davis, 2012) and on estimates made in Santa Clara County (SCVWD, 2012) and San Benito County (Yates, 2003). Nitrogen fertilizer application rates are commonly estimated as pounds of nitrogen per acres. **Table 7** shows values for each major crop class (e.g., truck, grain, pasture). To estimate a value for truck and deciduous crop classes, which have many different crop types, a weighted average of the acreage and application rate for each individual crop was calculated. For example, within the deciduous crop class, walnuts constitute over half the 2010 acreage, and have an estimated higher nitrogen application than apples, apricots or cherries. Therefore the average fertilizer application rate within the deciduous class is slightly higher to reflect the larger area of irrigated land with walnut fertilizer application rates.

Nitrogen fertilizer uptake rates vary considerably between different crop types. Loss rates for each crop class were estimated based on values reported by UC Davis (2012) values. For truck and deciduous crop classes, a weighted average of various individual crop acres within each crop class was used to estimate uptake rates within each crop class. Losses due to denitrification and volatilization were assumed to be 10% (UC Davis, 2012). Once the nitrogen reaches groundwater, it has undergone oxidation and generally is in the form of nitrate. In order to calculate the concentration, the dry mass was divided by the volume of deep irrigation percolation. **Table 8** shows the net nitrogen input by crop class, total acres, and total mass that potentially leaches to groundwater. The Bolsa, Hollister Northeast, Pacheco, and San Juan North subbasins have the largest load of nitrogen fertilizers.

[6] The three-fold concentration factor is based on a typical water budget with 18 inches of irrigation and 6 inches of deep percolation.

4.2.6.2 TDS

Over 80% of the fertilizers applied in San Benito County are nitrogen based compounds (CDFA, 2008). Potassium and phosphorous fertilizers are assumed to be largely taken up by the crops, and therefore, not considered to be significant sources of salts (EKI, 2010). As a result, incremental TDS loads associated with non-nitrogenous fertilizers are not estimated.

Soil amendments applied within the Study Area are predominately gypsum (hydrated calcium sulfate) and lime (calcium oxide) with minor amounts of copper, iron, sulfur, and sulfuric acid (CDFA, 2009). Yates (2003) reported that amendments are not needed each year, and are limited to more problematic areas. Historically, an estimate of 2,000 pounds per acre applied to 10% of cropland each year (Yates, 2003) has matched well with published values from the California Department of Food and Agriculture (CDFA). This equates to a rate of 200 pounds per acre. However, CDFA data from 2002 to 2008 suggests that usage has gone down by about 50%. As shown in **Table 9**, the average agricultural amendment use during this time period was just less than 4,700 tons in San Benito County. The historic average was about 8,300 tons. Therefore, the application rate was reduced to 100 pounds per acre.

4.2.7 Managed Recharge Water Quality

Local surface water is stored in and released from the District-owned and operated Hernandez and Paicines reservoirs for percolation in Tres Pinos Creek and the San Benito River to augment groundwater recharge during the dry season. The water balance reflects recharge from reservoir percolation within the Hollister West, Hollister Southeast, Northern San Juan, and Tres Pinos subbasins in various WYs between 2002 and 2011. The water quality of the local surface water is assumed to be the average for each of the subbasins, as measured between 1998 and 2006 (Table 5).

Percolation of CVP was a management tool used to expedite recovery from historical groundwater lows in the late 1990s. The historical water balances reflect percolation of CVP within Hollister West, Tres Pinos, San Juan South and San Juan Central Subbasins. In more recent years, the volume of managed percolation decreased in response to high groundwater levels and reduced CVP imports. Between 2002 and 2008, the TDS and nitrate-NO_3 load includes an estimate of loading from CVP percolation. Between 2009 and 2011, there was no managed percolation. The average TDS in CVP water is 298 mg/L and the average nitrate-NO_3 is 3.6 mg/L, based on water samples collected between 2003 and 2006.

4.2.8 Municipal Wastewater and Recycled Water Quality

The major WWTPs in San Benito County are operated by four service providers: the City of Hollister, City of San Juan Bautista, Sunnyslope County Water District (SSCWD), and Tres Pinos County Water District. The San Juan Bautista plant is not included because the unnamed tributary of San Juan Creek that receives its effluent usually gains flow along the affected reach and the WWTP discharge is on the southwest side of the San Andreas Fault (Todd, 2011b). These conditions prevent the effluent from recharging the San Juan Subbasin.

The City of Hollister owns and operates two WWTPs; the domestic wastewater treatment plant/water reclamation facility (DWWTP/WRF) and the industrial wastewater treatment plant (IWWTP). The DWWTP/WRF receives wastewater flow from all municipal and most industrial customers within Hollister City limits, including portions of the SSCWD service area. Treated wastewater is discharged to percolation ponds or used for turf irrigation at the Brigantino Riverside Park and the Hollister Municipal Airport. The IWWTP treats seasonal industrial wastewater from a tomato cannery and a portion of the City's stormwater. Only one of the canneries is currently in operation with a mid-June through mid-October canning season. Some stormwater is directed to the Hollister IWWTP via a combined sewer system for treatment and discharge to percolation and evaporation ponds. The IWWTP receives approximately 0.2 million gallons (MG) of stormwater flow per inch of rainfall. Stormwater is from the area between the cannery and treatment plant (Rose, 2012). The IWWTP is a conventional aerated pond treatment system that produces secondary-treated discharge to evaporation and percolation ponds, which recharge the Hollister West and San Juan groundwater subbasins (Todd 2011a).

SSCWD operates the Ridgemark wastewater treatment system, consisting of two wastewater treatment plants that serve residential needs and a few commercial businesses located near the Ridgemark Golf Course. The treatment systems are designated Ridgemark I and II. The Ridgemark I facility currently includes two treatment ponds and four disposal ponds. The Ridgemark II facility includes two treatment ponds and two disposal ponds. The two facilities are connected by a pipeline to allow diversion of flow from Ridgemark II to Ridgemark I.

Cielo Vista Estates WWTP is operated by San Benito County and treats wastewater from the 75 single-family homes in the Cielo Vista Estates residential development. About 18 AFY of effluent is discharged to a leach field (Todd, 2011a). The salt and nutrient load from the Cielo Vista Estates WWTP is not included in this analysis due to the small amount of effluent. Furthermore, wastewater planning documents for the Hollister Urban Area (HUA) suggest that future discharge requirements for the Cielo Vista Estates WWTP will be more stringent and that the plant's raw wastewater could be conveyed to the City's WRF (AECOM, 2011).

The Aromas-San Juan Unified School District WWTP is a small WWTP that serves Anzar High School in the Aromas-San Juan Unified School District. The Casa de Fruta WWTP treats wastewater from the Casa de Fruta fruit stand and tourist attraction while the Betabel Valley Recreational Vehicle Resort likely treats onsite generated wastewater. These three facilities were also not included in the analysis because of their small size and lack of information.

Table 10 summarizes the WWTP pond percolation volume and quality. It also includes the estimated volume of sewer line leakage, discussed below (Section 4.2.10). Treated wastewater is disposed in ponds located within the San Juan South, Hollister West, and Tres Pinos subbasin. The volume of percolation into the three subbasins from these ponds is a component of the annual water balance. The average TDS and nitrate-NO_3 concentrations, as summarized in TM-1, were used to calculate the S/N load from the wastewater treatment ponds. The TDS and nitrate-NO_3 concentration of pond effluent in Tres Pinos and San Juan subbasins was adjusted to reflect the blend of wastewater from the two WWTPs.

The City of Hollister delivers a relatively small volume of recycled water from its WRF for irrigation. Treated wastewater is discharged from the facility's percolation ponds and delivered to Riverside Park to irrigate open space and landscaping. In addition, recycled water is also used for spray irrigation at the Hollister Municipal Airport. Under conditions stipulated by the

City's Master Reclamation Requirements adopted by the Central Coast Regional Water Quality Control Board (RWQCB) in 2008 (Order No. R3-2008-0069), irrigation and fertilization is carefully controlled. The conditions include provisions such that nitrogen applications cannot exceed the amount required by plants and over-irrigation cannot occur. The nitrogen and irrigation application rates were established in a Nutrient Management Plan (CH2MHILL, 2011). During 2010 and 2011, the nutrient load was reported to be less than that identified in the Nutrient Management Plan; therefore, no additional nitrate-NO_3 load is included in the S/N balance (City of Hollister, 2011).

Total salt loading associated with recycled water was reported to be 315 tons in calendar year 2010 (City of Hollister, 2011). For 2011, 298 tons was calculated based on reported volumes applied to the airport and park during WY 2011, and TDS measured in calendar year 2011. Salt loading to groundwater was calculated, assuming that deep percolation of irrigation water equals 10% of applied water.

4.2.9 Irrigation Return Flow Water Quality

Much of the urban landscape irrigation water is provided by the City of Hollister, SSCWD, and other small local purveyors. The majority of the small local purveyors have only one or two groundwater wells. These systems provide water to communities such as mobile home parks and homeowners' associations and to transient populations at schools, parks, and businesses. There are no available data to derive a load from urban fertilizer use on golf courses, parks, and domestic lawns within these service areas. The upper limit of leaching from fertilizer applications on golf courses and turf is estimated at 8.9 pounds per acre (UC Davis, 2012). This assumes an application rate of 45 pounds of nitrogen per acre per year, of which 36 pounds is lost before reaching groundwater.

Two methods were used to calculate the acreage of turf. For the load estimate, the estimated acreage was based on the higher acreage of the two methods. The first method used the 2010 CDWR land use classification for Urban Landscape (UL). The second method assumed turf to be 17% of the total urbanized area in the 2010 land use map, based on an average of the typical urban turf range (12 to 23%) reported by UC Davis (2012).

Rural households within each basin/subbasin were estimated for the onsite wastewater system calculation. The rural irrigation return flow estimate assumed an average lawn size of 1,000 square feet[7] and the same net rate of nitrate-NO_3 leached as developed for urban fertilizer application (8.9 feet per acre). Rural domestic irrigation was estimated for the water balance in Tres Pinos Creek Valley. Domestic irrigation in Bolsa and San Juan Central and South subbasins was assumed to be insignificant. The average pumping between 2005 and 2008 for each subbasin was used to represent the entire calibration period (WY 2002 to 2011). The salt and nutrient load associated with irrigation was based on the average groundwater concentration within each basin/subbasin with a three-fold TDS increase to account for ET. Irrigation percolation was assumed to be 10% of applied irrigation. Nitrate-NO_3 leaching was assumed to be 34% of the source groundwater concentration.

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[7] Based on the EBMUD study of an average of a large lot and a small lot (Opitz, 1995).

4.2.10 Water and Sewer System Loss Water Quality

Water system losses from pipe leakage within HUA are estimated to be 7% of demand, based on the "system losses" reported in the 2010 HUA Urban Water Management Plan (Todd, 2010). This estimate was applied to all Zone 6 water service areas. A volume weighted average of TDS and nitrate-NO_3 was calculated for those basins/subbasins based on a blended volume of CVP and groundwater.

Sewer system loses from pipe leakage have not been reported within the Study Area. Amick (2000) reports a range of 12 to 25% leakage. The load was calculated assuming a 12% loss rate of the volume of effluent. TDS and nitrate-NO_3 in leaking sewer lines were assumed to be the same as septic system return flows, described below. Table 10 includes the volume of sewer line leakage in basins/subbasins that are sewered.

4.2.11 Septic Systems Return Flow Water Quality

Fate and transport studies from onsite wastewater systems have yielded a range of values for the amount of total nitrogen in effluent that ultimately recharges groundwater as nitrate-NO_3. Variables include the initial concentration of total nitrogen in the effluent, the fraction of the total nitrogen that is in the form of ammonium, and the percent of ammonium transformed into nitrate. Mass loads were estimated assuming an average effluent concentration of 63 mg/L total nitrogen, of which 53 mg/L is present as ammonium (Lowe, 2009). The percentage of total nitrogen as ammonium closely matches the value reported by USEPA (2002). The remaining nitrogen in the effluent is assumed to be organic nitrogen, which accumulates with sludge that remains in the septic tank until it is cleaned out (Seiler, 1996). In fine-textured soils, between 10 and 20% of ammonium undergoes denitrification (USEPA, 2002). Given that over 75% of the soils in the Study Area are fine-grained soils (sandy clay loams to clay), a reasonable assumption is that 15% of the ammonium is denitrified. Applying these assumptions, the net loss of nitrogen is 30%, 15% loss to organic nitrogen and 15% loss of ammonium by denitrification. Ammonium readily undergoes nitrification to nitrite then nitrate in soil. The net nitrate leached is added to the average concentration of nitrate-NO_3 within each basin/subbasin, assuming all the dwellings serviced by septic systems rely on groundwater. A salt increase of 200 mg/L is assumed to result from household water uses (Kaplan, 1987). This mass was added to the average concentration of TDS for each basin/subbasin.

Table 11 summarizes the concentration of TDS and nitrate-NO_3 in septic system return flows.

4.3 Mixing Model

The description of the mixing model calibration process and simulation results over the baseline period is provided along with the resulting salt and nutrient balances for each basin/subbasin during the baseline time period. The same general approach used for baseline groundwater quality conditions is also used to predict the effect of planned future projects on S/N loading and groundwater quality.

4.3.1 Calibration

The spreadsheet mixing model was developed to evaluate the effect of current and planned future S/N loads on overall groundwater quality in the Study Area. The mixing model simulates the average concentrations of TDS and nitrate-NO_3 within each basin/subbasin on an annual basis while considering the buffering capacity of the existing volume of groundwater and S/N mass in storage. The loading (and unloading) assumptions used in the mixing model were manually calibrated by comparing preliminary simulation results (annual concentrations and concentration trends) over the baseline period (2002 to 2011) to observed average background concentrations and historical trends. In most of the Study Area, water quality has remained stable over recent years (2004-2010). Other areas, like the eastern portion of the northern San Juan Subbasin, have shown variable but generally decreasing trends in some key constituents like nitrate-NO_3 and TDS. Water quality trends were discussed in TM-1.

Individual loading factors with higher levels of uncertainty were refined in some instances so that simulated results matched background concentrations and observed concentration trends for wells in a given subbasin. All refinements to key loading assumptions in the mixing model were applied across the entire Study Area and not selectively applied to individual subbasin. Following several iterations, the following adjustments to key S/N loading estimates were incorporated in the final calibrated mixing model:

1. Comparison of initial simulated groundwater nitrate concentrations across the Study Area to actual background groundwater nitrate concentrations indicated that either a) nitrate concentrations in irrigation return flow (with fertilizer added) were overestimated or b) additional nitrate attenuation in the vadose zone was not captured in the mixing model. To account for the attenuation of nitrate and to match observed groundwater quality concentrations and trends, nitrate concentrations in irrigation return flow were reduced by a factor of 40 (60% attenuation).

2. To account for mineral dissolution along rainfall recharge flowpaths, the TDS concentration was adjusted from 2.8 to 150 mg/L.

3. In the subbasins with municipal pumping, TDS concentrations declined slightly. The mixing model initially used the basin average for the municipal pumping outflow. The average basin TDS concentration is higher than the average TDS in extracted groundwater. Therefore, TDS was adjusted to reflect average water quality in production wells.

4.3.2 Mixing Model Results

Figures 7 and **8** show the simulated results of the calibrated mixing model for TDS and nitrate, respectively, in each subbasin for the baseline period of 2002 through 2011. Each chart shows the simulated average concentration. The TDS charts illustrate that the average groundwater concentrations have not changed significantly as a result of recent historical salt loading. These trends are consistent with observed well concentration trends analyzed and reported in TM-1. The TDS trends generally reflect the large buffering capacity of the existing groundwater in storage and the muted impact of salt loading on the surface at lower aquifer depths.

Figure 8 shows increasing nitrate trends in nine of the subbasins. Elevated nitrate has been a long-term problem in the basin, especially in hot spot areas (see Figure 5). However, the increases in basin averages are larger than would be expected based on data in available wells.

TM-1 reported that 77% of wells analyzed had decreasing or no trend. The simulated nitrate average, after calibration, may overestimate actual conditions.

4.3.3 Overall Salt and Nutrient Balance

TDS and nitrate mass balances were developed based on water balance volumes and water quality described above. TDS and nitrate inflows, outflows, and change in storage (expressed in tons for each subbasin) are presented in **Appendix C**. **Figure 9** and **Figure 10** present the balances graphically.

4.3.3.1 Bolsa

As shown in Figure 9, the biggest source of TDS load in the Bolsa Subbasin is subsurface groundwater inflow resulting from the relatively high volume of subsurface inflow from Pacheco and Bolsa Southeast Subbasin (Table 6). The average TDS in Pacheco (533 mg/L) is relatively low compared to the Bolsa Southeast TDS (1,003 mg/L). In addition, in 2009, 2010, and 2011 groundwater inflow was received from the Llagas Subbasin to the north. Agricultural pumping is the major TDS outflow. Annual change in mass varies with an overall increase in cumulative mass of 12,000 tons. There is a net increase in TDS of 4 mg/L over the 10 year period.

Nitrate inflows are largest from agricultural return flows, while the largest outflows are from agricultural pumping. Over 5,000 tons of nitrate accumulates in the Bolsa Subbasin over 10-years, with an increase in nitrate of 3 mg/L.

4.3.3.2 Bolsa Southeast

TDS inflows are dominated by subsurface groundwater inflow from Hollister West. Agricultural pumping is the largest outflow. Annual change in TDS mass varies with an overall increase in cumulative mass over the 10-year baseline period of nearly 300 tons. Over the ten year period, there is an increase in TDS concentration of 4.2 mg/L.

Irrigation return flows are the largest inflow of nitrate, while the largest outflow is agricultural pumping. The cumulative change in mass is generally positive, ending the 10-year period with a net addition of 1,200 tons of nitrate. The ending concentration reflects a 5.8 mg/L increase in nitrate.

4.3.3.3 Flint Hills

As previously mentioned, there is no significant land use activity in the Flint Hills Subbasin. During the 10-year period, rainfall percolation was the only source of TDS inflow. This occurred in 2002, 2004, and 2005. The water balance does not indicate any corollary outflow during those years; therefore there is a calculated net accumulation of TDS of 150 tons. Rainfall percolation also introduces a less than one ton of nitrate during the 10-year period into the subbasin.

4.3.3.4 Hollister Northeast

Agricultural irrigation return flow is the largest inflow of TDS into Hollister Northeast. The largest outflow is agricultural pumping. There is also large groundwater outflow component. The combined outflows exceed the inflows resulting in a net loss of 9,000 tons and a TDS concentration decreased 9 mg/L over 10 years.

Agricultural irrigation return flows contribute the largest inflows of nitrate. The largest outflow is agricultural pumping. The accumulation of nitrate results in an increase of 4.7 mg/L over the ten-year period with a gain of over 4,000 tons of nitrate.

4.3.3.5 Hollister Southeast

The largest inflow of TDS in Hollister Southeast is subsurface groundwater inflow from outside the Study Area to the east. Municipal and domestic groundwater pumping is the largest outflow of TDS. Over the ten-year period, outflows exceed inflows resulting in a net loss of about 8,000 tons of TDS and a decline in concentration of 11 mg/L.

There is a net gain in nitrate over the 10-year period of 1,000 tons and an increase in concentration of 2 mg/L. The largest inflow is irrigation return flow, while the largest outflow is agricultural pumping.

4.3.3.6 Hollister West

Hollister West has the highest number of individual load sources, reflecting the mix of rural and urban land uses. Groundwater underflow from Tres Pinos was the biggest source of TDS. There is a net decrease in TDS concentration of 11 mg/L. Municipal and domestic pumping is the largest TDS outflow with a total net cumulative loss of over 10,000 tons.

The two largest inflows of nitrate are agricultural return flows and septic systems return flows. Municipal and domestic pumping is the largest outflow. After ten years, nitrate concentrations increased 3 mg/L and over 1,200 tons of nitrate accumulated.

4.3.3.7 Pacheco

The largest TDS inflow in the Pacheco Subbasin is subsurface groundwater inflow from outside the Study area to the east and from the Hollister East Subbasin to the south. Groundwater outflow to the Bolsa Subbasin is the largest outflow. Net inflows after 10 years exceed outflows, resulting in a cumulative gain of nearly 4,000 tons of TDS, and a concentration increase of nearly 1 mg/L. Nitrate inflows are dominated by agricultural return flows. Subsurface groundwater outflow is the largest outflow of nitrate. There is a gain of about 3,500 tons of nitrate and an increase in concentration of 4 mg/L after 10 years.

4.3.3.8 San Juan Central

As indicated on Figures 9 and 10, overall inflows and outflows from San Juan Central are low, reflecting the limited land use activities. The largest inflow of TDS and nitrate is agricultural irrigation. Outflows for both TDS and nitrate are dominated by agricultural pumping. At the end of the ten-year period, there is little change in concentration with TDS decreasing by 1 mg/L and nitrate increasing by 0.5 mg/L.

4.3.3.9 San Juan North

In San Juan North, agricultural return flows and wastewater percolation are the largest inflows of TDS. Agricultural pumping is the largest outflow. Over the 10-year period, outflows exceeded inflows resulting in a net loss of over 26,000 tons of TDS. This results in a decrease in concentration of 18 mg/L. The average basin concentration is 1,180 mg/L, which is slightly below the ACB (1,200 mg/L).

Inflows dominated by agricultural inflows exceeded outflows from agricultural pumping, yielding a net addition of nearly 4,000 tons of nitrate. After ten years, the average nitrate concentration increases from 14.6 to 19.4 mg/L.

4.3.3.10 San Juan South

Mass loading in San Juan South reflects the natural conditions of rainfall recharge and groundwater outflow. There is only a minor amount of agricultural activity in this subbasin. Groundwater outflows of TDS and nitrate are larger than rainfall inflows; therefore there is a net loss of TDS over the 10-year period of about 1,700 tons of TDS and 15 tons of nitrate.

4.3.3.11 Tres Pinos

Subsurface groundwater underflow constitutes the largest inflow and outflow of TDS. Total outflows exceed inflows, resulting in a net loss of about 7,000 tons of TDS. After 10 years, the concentration of TDS in Tres Pinos is 978 mg/L, which is slightly below the BSBPO, 1,000 mg/L.

Septic systems are the largest inflow of nitrate in Tres Pinos. Groundwater pumping for domestic and municipal supply as wells as groundwater outflow constitute the two largest outflows of nitrate. After 10-years the nitrate concentration increases by 3 mg/L. There is a net increase in nitrate mass of 900 tons.

4.3.3.12 Tres Pinos Creek Valley

The largest inflow of TDS is natural stream recharge. Largest outflow is subsurface groundwater outflow. Inflows exceed outflows resulting in a 4.8 mg/L increase in TDS concentration and a net mass load addition of increase of over 4,000 tons.

At the end of ten years there was a 1.3 mg/L increase in nitrate. The largest inflow is irrigation return flows, while the largest outflow is subsurface groundwater outflow. There is a net gain of 300 tons of nitrate and a 1.3 mg/l nitrate increase in the subbasin.

5 Goals and Objectives and Implementation Measures

In conformance with the Recycled Water Policy, this TM-2 addresses estimated recycling and stormwater recharge/use goals and objectives. Implementation measures are plans and actions intended to reduce S/N loading in the Study Area. Currently implemented and planned implementation measures are discussed in this section, because there is overlap between goals and objectives and implementation measures in terms of their impacts on S/N loading.

In addition to recycled water and stormwater use/capture goals and objectives, other land use and source water use changes also may affect S/N loading in the future. Accordingly, volumes and quality for the following source water has been estimated for the future planning period from WY 2011-12 to 2020-21:

- Recycled water
- Stormwater
- Wastewater
- CVP Imported Water

Land use changes affecting S/N loading include changes in:

- Urban areas
- Agricultural areas and cropping patterns
- Sewered/unsewered areas

The goals and objectives and implementation measures are used to quantify the volumes and quality of source water inflows (and outflows) for the future projected S/N balance, groundwater quality, assimilative capacity, and anti-degradation analysis. The projected source water volumes and quality are incorporated into the future projections of S/N balance discussed in Section 6.

The outgrowth of ongoing planning efforts in the Study Area has been the establishment of goals and objectives guiding groundwater and source water management and implementation measures to improve reliability and quality of water used for water supply. **Table 12** highlights guiding goals developed for the HUA Water and Wastewater Master Plan (AECOM, 2011) and quality and quantity goals for groundwater, CVP, municipal, wastewater, and recycled water have been established as part of the master planning process. Stormwater reuse is not likely to be a significant factor in the S/N balance; however it has been considered by the City of Hollister as part of the Storm Drain Master Plan (Wallace Group, 2011) and is included in Table 12. **Table 13** list current and near term (current to 2015) and intermediate term (2016 to 2023) implementation measures to manage salts and nutrients.

Regional integrated work to reduce salt and nutrient loading in groundwater has made significant progress in the past decade. In 2004 Hollister, the County, and the District executed a Memorandum of Understanding (MOU) forming a partnership to undertake the development of a water and wastewater master plan for the HUA. The MOU was amended in 2008 to include SSCWD. These parties have undertaken a coordinated effort to plan water supply and wastewater strategies for the HUA. These strategies include the collection and treatment of wastewater as well as disposal and recycled water use. Planning for improved water quality and recycled water use has included preparation of the following documents:

- San Benito County Regional Recycled Water Project Feasibility Study Report (RMC, 2005)
- City of Hollister Long-Term Wastewater Management Program for the DWWTP and IWWTP, (HydroScience , 2005)
- SSCWD Long-Term Wastewater Management Plan (RMC, 2006)
- Recycled Water Feasibility Study Update Technical Memorandum (HDR, 2008a)
- HUA Water and Wastewater Master Plan (HDR, 2008b)
- HUA Master Plan Implementation Program Coordinated Water Supply and Treatment Plan (HDR and RMC, 2010)
- Final Program EIR, HUA Water and Wastewater Master Plan and Coordinated Water Supply and Treatment Plan (AECOM, 2011).

Additionally, Tres Pinos CWD is to submit a salt and nutrient management program to the RWQCB by early 2014 (RWQCB, 2012).

Stormwater management measures for the City of Hollister were recently updated in the Stormwater Management Plan (Wallace, 2011). The goal for stormwater management is to achieve long term watershed protection by establishing local hydromodification control criteria, annual reporting, pollutant load characterization, and public outreach.

The MOU, described above, set a TDS target of 500 mg/L with a not-to-exceed concentration of 700 mg/L for recycled water. Recycled water quality objectives would be met by source water improvements and groundwater demineralization (AECOM, 2011). Capital improvement projects include:

Near Term [before 2015]

- Lessalt Water Treatment Plant (WTP) upgrades
- New West Hills WTP
- Demineralization of urban wells
- New pipeline from Lessalt WTP to Ridgemark
- Ridgemark WWTP upgrades at Ridgemark I (and decommissioning Ridgemark II)
- Transmission pipeline extension to Wright/McCloskey area

Intermediate Term [2015-2023]

- New treated water storage tanks
- North County Groundwater Bank
- New urban wells
- Expansion of WRF
- Cielo Vista WWTP connection to WRF

Use of recycled water has been divided into phases. Phase 1 recycled water use has been implemented and amounts to about 950 AFY. The near term plans for recycled water use have a focus primarily on agricultural irrigation. The near term plans include a recycled water transmission system to provide high quality water to mainly agriculture but may also provide water to parks and golf courses. However, use of this recycled water is contingent upon the salinity levels being reduced to meet crop, landscaping and regulatory requirements (AECOM, 2011). Recycled water is currently being used to irrigate the Hollister Municipal Airport and Brigantino Park. Near term improvements include a 2.5 mile pipeline extension and delivery of recycled water for irrigation to the Wright Road/McCloskey Road corridor. Near term improvements, to be implemented when recycled water production exceeds demand, might include use in the Lone Tree area, Santa Ana Valley, East of Fairview Road, San Juan Valley, or other areas (AECOM, 2011). Use of recycled water from the WRF would increase to about 1,500 AFY by 2016 and to about 50% of the total wastewater effluent flow by 2021 (District, 2012a and 2012b).

The upgraded Ridgemark WWTP would also produce disinfected tertiary recycled water for use as irrigation on the Ridgemark Golf Course. However, the water is expected to have relatively high salt content and may need blending with groundwater or CVP water (AECOM, 2011). The golf course would use about 158 to 261 AFY of recycled water, depending upon the supply with which it is blended (AECOM, 2011). The implementation time frame for upgrade of the Ridgemark WWTP to disinfected tertiary treatment is uncertain at this time.

The direct use of CVP water for municipal and industrial (M&I) purposes has been limited by the available treatment capacity of the Lessalt WTP, which provides treatment for CVP water for local municipal uses (mainly to the City of Hollister and the SSCWD). Other M&I uses of CVP water include urban irrigation, golf course irrigation, and potable supply for the Stonegate community. The Lessalt WTP, completed in 2002 with a nominal design capacity of 3 million gallons per day (MGD), has operated at an average rate less than 1.6 MGD (1,800 AFY) due to hydraulic constraints, process limitations, and reductions in CVP water availability (Todd, 2011a). Recognizing the Lessalt WTP as an under-utilized asset, improvements at the WTP are expected to increase the operational capacity and use of CVP water in the planning horizon.

The District conducted a recent Optimization Study (Yates, 2012a) of future municipal supply and demand for 2015. The study reflects planned water treatment capacity upgrades and the future availability of CVP supplies for municipal and industrial demand. The study's "Optimization Base Case" scenario, used to help predict S/N loading in the future projection period, is described in detail below.

The discharge of salt brine from self-regenerating water softeners (SRWSs) in homes in the Study Area has a negative impact on TDS levels in recycled water and wastewater effluent. These SRWSs remove the hardness for a pre-determined volume of water until it no longer has capacity, and must be regenerated by flushing a salt brine solution through the exhausted tank. As a result, brine consisting of water, salt and hardness minerals is discharged into the sewer. In areas with hard water and depending on the number of SRWSs in the service area, it is estimated that SRWSs can contribute between 8 and 25% of the TDS in the wastewater entering the WWTP (WateReuse, 2011). The District, on behalf of the Water Resources

Association of San Benito County (WRA) and in cooperation with Santa Clara Valley Water District, has funded a Water Softener Rebate Program in part with a Water Use Efficiency Grant (part of the 2004 Proposition 50 grant program). The grant began in May 2007 and has been extended to December 2014. The program provides rebates (between $150 and $300) to customers who agree to abandon and/or replace their pre-1999 inefficient water softener system with a newer, more efficient means of water softening. As of 2013, 535 rebates have been issued. Recent research indicates that there are efficient, cost-effective no salt water treatment alternative commercially available (WateReuse, 2013). The District also provides literature on the issues of salt pollution and proper maintenance of water softeners and directs the public to a Los Angeles County Sanitation District's website with useful information on SRWS alternatives (http://www.lacsd.org/wastewater/automatic_water_softeners/alternatives.asp).

In 2012 the RWQCB issued a Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands (Agricultural Order). The Agricultural Order establishes groundwater monitoring rules and requires growers to document implementation of BMPs. As listed in Table 12, the overall purpose of the regulation is to prevent impairment of receiving waters (surface water and groundwater). Implementation measures (Table 13) include use of BMPs for irrigation efficiency and S/N management. Groundwater and surface water receiving water monitoring is required by the Agricultural Order either at individual farms or in cooperation with nearby farms. An Irrigation and Nutrient Management Plan is required for some farms. The specific requirements for individual growers are structured into three tiers based on the relative risk their farm poses to water quality.

There are many educational and training outreach programs to encourage water conservations, livestock management, watershed protection, and fertilizer, amendment, and pesticide BMPs.

The WRA (http://www.wrasbc.org/) provides outreach on water conservation measures and BMPs for fertilizer efficiency.

The Central Coast Water Quality Coalition (CCWQC) (http://www.centralcoastrcandd.org/info.htm) covers the counties of Santa Barbara, San Luis Obispo, Monterey, Santa Cruz, San Benito and Santa Clara with goals of enhancing and sustaining the good health of watersheds and improving rural economic conditions consistent with a long-term sustainable economy through a number of outreach and education programs. They were awarded a recent grant to produce pesticide BMPs workshops.

The Central Coast Coalition of Resources Conservation Districts (CCCRCDs) are leaders in on-the-ground conservation efforts including outreach and education in water conservation, watershed protection, creek restoration, and grower workshops. They were recently awarded a Sustainable Agriculture Research and Education (SARE) grant in April 2013 to develop BMPs for irrigation and fertilizer BMPs. They will be holding a series of training workshops and use of the Mobile Irrigation Laboratory (MIL) program. The MIL is a service that provides onsite evaluations of individual irrigation systems. The MIL testing can be used to help growers develop irrigation water management plans tailored to their individual needs.

The U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) (http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/about/) is a conservation leader for all natural resources, ensuring private lands are conserved, restored, and more resilient to environmental challenges, like climate change. The NRCS works with private landowners through conservation planning and assistance designed to benefit the soil, water, air, plants, and animals that result in productive lands and healthy ecosystems. With funding from the Agriculture Water Quality Alliance (AWQA), they have distributed Nitrogen-Nitrate quick test kits throughout San Benito and Santa Clara counties to help growers optimize fertilizer application.

AWQA (http://www.awqa.org/) is a partnership of agriculture industry groups, resource conservation agencies, researchers, and environmental organizations working towards protection and enhancement of water in the Monterey Bay National Marine Sanctuary and the adjacent watersheds while sustaining a world class production agriculture region through voluntary collaboration with managers of agricultural and rural lands.

The Loma Prieta Resource Conservation District (LPRCD) (http://www.lomaprietarcd.org/home.html) was created to develop and administer a program of soil, water, and related resource conservation in Southern Santa Clara County but also overlaps with activities in San Benito County.

The Santa Cruz County Resources Conservation District (SCCRCD) and Ecology Action (EA) have conducted outreach and compiled reference materials in the Livestock and Land Program (http://livestockandland.org/) to educate livestock owners on BMPs.

6 Salt and Nutrient Balance Future Projection: 2012 to 2021

Based on projected changes in source water inflow and outflow volumes and quality, adjustments to the S/N load were made, and the mixing model was run for a period extending from 2012 to 2021. The District's Optimization Study (Yates, 2012a) was used to predict municipal supply water sources as described below.

6.1 Optimization Base Case Hydrologic Conditions

The District's Optimization Study of urban water supply/demand projections incorporates a linear optimization model prepared by Yates (2012a), which is designed to minimize the total cost of meeting municipal water demand for the HUS while improving water quality by selecting from a variety of water sources. The model generated an Optimization Base Case projection considering over 80 years of hydrologic conditions. For agricultural water use, the projection assumes that the 2011 irrigation volumes are representative of future conditions. This assumption reflects the water conserving practices of farmers, plus a key objective in the Draft San Benito County 2035 General Plan to preserve prime farmland (San Benito County, 2012). The Optimization Base Case projection reflects average hydrologic conditions between 1922 and 2003 (Yates, 2012a). This historical period of record includes three droughts: 1928-1935, 1976-1977 and 1987-1992. This same time period is simulated by the California State Water Project Operations Model (CalSim II) used by the CDWR for water supply planning. Yates (2012a) used CalSim II model output for estimates of CVP water delivery within the Study Area. Average rainfall in the Study Area between 1922 and 2003 is 14 inches. For the S/N future projection, WY 2011 was selected to represent average conditions. Rainfall in 2011 was 13 inches which is 92% of long-term average. WY 2011 followed a relatively normal year in 2010 with 12 inches of rainfall (86% of the long-term average). **Appendix D** is a table of water balance inflows and outflows for 2012 to 2021. A ten-year summary of water balance inflows, outflows, and change in storage is shown on **Table 14**.

The 2011 S/N balance volumes and water quality were used in the 2012 to 2021 projection for the following components:

- Natural stream percolation
- Precipitation
- Managed recharge
- Subsurface groundwater inflow (adjusted for minor return flows)
- Septic system return flows

The sections below describe the assumptions and adjustments to other S/N components to account for changing conditions in the future projection period.

6.2 Municipal Water Use and Quality Projection

Yates (2012a) developed a base case projection of municipal use for 2015 that reflects an optimized mix of groundwater and CVP water to meet a hardness target of 175 mg/L at the lowest cost. The District has a contract for CVP water extending to 2027 for a maximum of 8,250 AFY of M&I water. The Optimization Base Case assumes an annual water demand of 7,126 AF and an external water bank capacity of 4,500 AF. Urban groundwater demand includes existing SSCWD and City of Hollister wells, new wells located in Pacheco, and “East Side” wells located near the Hollister Conduit at Arroyo Dos Picachos. **Table 15** summarizes the breakdown of water supply from CVP and groundwater sources along with the anticipated quality of the blended water within each basin/subbasin for municipal use. Use of CVP water is expected to increase, while groundwater use is expected to decline resulting in improved water quality with respect to TDS and NO_3.

6.3 Future Agricultural Irrigation Water Sources, Flow, and Quality and Return Flows

Total agricultural water use has remained relatively low in recent years, at about 17% less than the average used in 1988. In 2011, the CVP allocation to agriculture increased, but agricultural water use did not increase. This is indicative of long-term systemic changes in agriculture including water-conserving irrigation practices and shifts to lower water use crops. The decreased agricultural water demand is predicted to be a continuing long-term change in Zone 6 (Todd, 2011b). Given the County’s expressed goal to preserve farmland in the foreseeable future, the acres of farmland are not expected to change (San Benito County, 2012). For the projection, the 2011 cropping patterns are assumed to be representative of future conditions through 2021.

Table 16 summarizes the breakdown of water supply from CVP and groundwater sources along with the anticipated quality of the blended water within each basin/subbasin for agricultural irrigation use. The District has a contract (extending to 2027) for a total CVP agricultural allocation of 35,550 AFY. The Optimization Base Case agricultural CVP use is 19,000 AFY, based on 2011 CVP use. Total demand (CVP plus groundwater) is set at the 2011 demand of 36,135 AFY. Therefore, groundwater pumping would be 17,134 AFY. The volume of pumping is held constant at the 2011 level for basins/subbasins using only groundwater. CVP water was allocated to basins/subbasins using both CVP and groundwater in proportion to the 2011 use.

The ratio of applied water to deep percolation established in 2011 was applied to 2012 to 2021. Deep percolation is generally 10% of applied water, but varies slight between the basins/subbasins as calculated by the soil moisture conditions in the 2011 water balance.

6.4 Future Wastewater Treatment and Recycled Water Use and Quality

Table 17 summarizes the wastewater and recycled water flows expected to accompany the Optimization Base Case urban municipal use scenario. Predicted pond discharge is shown for DWWTP/WRF, IWWTP, Ridgemark I and II, and Tres Pinos WWTP. As indicated on **Table 17**, recycled irrigation increases from 230 AF (2011) to 1,500 AF (2016 through 2021). The basins/ subbasins with recycled water use were identified based on the locations of current and future planned areas of recycled water irrigation. The volumes currently applied at the airport and park site are assumed to remain constant. The remaining recycled water is planned to be applied to an agricultural area northwest of Hollister, which overlies four subbasins: Hollister Southeast, Hollister Northeast, Bolsa Southeast, and Hollister West.

The wastewater treatment facilities use a number of treatment methods, which result in varying effluent quality. Current requirements for recycled water use are administered by Title 22 of the California Code of Regulations. However, the effluent streams from these treatment facilities have high levels of TDS. The parties to the MOU (Hollister, SSCWD, and the County) have committed to reducing these high concentrations by reducing the TDS of supplied water (Todd, June 2011a). Currently, the other wastewater treatment facilities (Sunnyslope and Tres Pinos) produce effluent that meets the Title 22 requirements for undisinfected secondary recycled water, which is disposed of through evaporation and/or percolation. SSCWD is currently upgrading their wastewater treatment facilities to produce higher quality effluent to meet waste discharge requirements. Upgrades are anticipated to be completed in the Fall of 2013 (SSCWD, 2011). Eventually, SSCWD's upgrade of the Ridgemark WWTP will result in production of disinfected tertiary recycled water available for golf course irrigation. The time frame for implementation of the upgrade to disinfected tertiary treatment is uncertain at this time. Salinity requirements for the Ridgemark WWTP (Waste Discharge Requirement (WDR) Order R3-2004-0065) include 1,200 mg/L for TDS, 200 mg/L each for sodium and chloride, and 5 mg/L each for nitrate and ammonia (both as nitrogen) (SSCWD, 2009 and AECOM, 2011).

Table 18 shows the predicted effluent water quality (based on treatment plant upgrades and permit requirements) that will percolate to groundwater from the pond discharges and from leaking sewer lines. **Table 19** shows the future predicted recycled water quality that will percolate to groundwater from recycled water irrigation.

6.5 Results

Figures 11 (TDS) and **12** (nitrate-NO_3) illustrate the change in concentration during the projection time period, 2012 to 2021. **Table 20** and **Figure 13** show the projected groundwater basin concentrations in 2021 for each basin/subbasin and the available assimilative capacity compared to the TDS BSBPO/ACBand the nitrate-NO_3GBPO/BSBPO.

As shown in **Figure 14,** most of the TDS inflows and outflows are held constant during this projection; therefore the cumulative change of mass either steadily increases (e.g., Bolsa and Tres Pinos subbasins), decreases (e.g., Hollister Northeast and San Juan North subbasins), or is stable (Hollister Southeast and Hollister West subbasins). Although the calibration shows gains and losses in cumulative mass, the overall TDS trends are unchanged in many basins. Likewise, the change in concentration is similar to that of the baseline calibration period. Some noteworthy differences in TDS between the calibration period and the future projection include:

- The Hollister West, San Juan Central, and Tres Pinos subbasins had net losses of TDS mass during the calibration period, but had net gains during the projection period. In the Hollister West, San Juan Central and Tres Pinos subbasins, the mass increases are associated with an increase in the volume of groundwater in storage. Therefore, even though the mass is increasing the average concentration decreases in Hollister West, Tres Pinos and San Juan Central subbasins.
- The Bolsa Subbasin had a net gain of about 40,000 tons of TDS mass compared to the calibration period, which showed a TDS mass increase of 12,000 tons. During 2006

through 2008, groundwater outflow removed over 50,000 tons of TDS. Between 2012 through 2021, there is no groundwater outflow. The concentration in 2021 (672 mg/L) is slightly higher than at the end of the calibration period (670 mg/L).

- The Bolsa Southeast Subbasin has a net loss of TDS due to the steady agricultural pumping that occurs between 2012 and 2021. In terms of mass, outflows exceed inflows by nearly 10,000 tons by 2021, and there is a net loss of groundwater in storage of 6,000 AF. As a result, the concentration of TDS decreases by 7 mg/L, compared to the calibration period where TDS increased by 4 mg/L.

Nitrate-NO_3 trends in concentration (**Figure 15**) are virtually unchanged between the calibration period and the future projection period. Increases in concentration are small, well below 10 mg/L nitrate-NO_3 by 2021.

6.6 Future Projected Assimilative Capacity

During the baseline calibration period, the San Juan North was nearly at its assimilative capacity for TDS. However, water quality improves in San Juan North during the future scenario; therefore there is over 26 mg/L of additional assimilative capacity added (**Table 20**). Other basins retain nearly all their existing assimilative capacity for TDS in the future scenario.

No basins/subbasins exceed the applicable GBPO (45 mg/L) or BSBPO (22.5 mg/L) by 2021, therefore there is available nitrate assimilative capacity in each basin/subbasin. The average concentration increases slightly in each subbasin, except Flint Hills and San Juan South.

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Tables

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Table 1 Existing Groundwater Quality and Assimilative Capacity

DWR Groundwater Basin/Subbasin	SNMP Subarea	TDS (mg/L)				Nitrate-NO_3 (mg/L)			
		GW Average	Basin Specific Basin Plan Objective [6]	Assimilative Capacity Benchmark [7]	Assimilative Capacity	GW Average	Basin Specific Basin Plan Objective [8]	General Basin Plan Objective [9]	Assimilative Capacity
Bolsa Area	Bolsa [1, 5, 10]	670	-	1,200	530	3.9	-	45	41.1
Bolsa Area	Bolsa SE [1]	1,006	-	1,200	194	15.4	-	45	29.6
San Juan Bautista	Flint HIlls [4]	376	-	1,200	824	3.0	-	45	42.0
San Juan Bautista	Hollister West [1, 11]	1,019	-	1,200	181	21.7	-	45	23.3
San Juan Bautista	Tres Pinos [1]	995	-	1,200	205	8.9	-	45	36.1
San Juan Bautista	San Juan North [1]	1,198	-	1,200	2	14.6	-	45	30.4
San Juan Bautista	San Juan Central [2]	794	-	1,200	406	9.5	-	45	35.5
San Juan Bautista	San Juan South [3]	720	-	1,200	480	5.0	-	45	40.0
Hollister Area	Hollister NE	741	1,200	-	459	11.4	22.5	-	11.1
Hollister Area	Hollister SE [1]	1,030	1,200	-	170	7.6	22.5	-	14.9
Hollister Area	Pacheco [1]	533	1,200	-	667	8.2	22.5	-	14.3
Tres Pinos Valley	Tres Pinos Cr Valley [2]	720	1,000	-	280	5.0	22.5	-	17.5

1 - Average groundwater concentrations based on interpolation of 2007-2010 median well concentration data and contours

2 - Average groundwater concentrations based on average concentration of all available sampling events

3 - Average groundwater concentrations in Tres Pinos Creek Valley applied to San Juan South

4 - Average groundwater concentrations based on one sampling event for Live Oak Water Association

5 - Acreage and average TDS groundwater concentration does not include elevated TDS in the north

6 - Basin Specific Objectives established in the Basin Plan for CDWR Hollister Area Subbasin and Tres Pinos Valley Basin

7 - In the absence of a Basin Specific Plan Objective, an Assimilative Capacity Benchmark is used to calculate assimilative capacity

8 - Basin Plan Objective is 5 mg/L Nitrogen, which is equivalent to 22.5 mg/L Nitrate-NO_3 assuming Nitrate-NO_3 is 100% of Nitrogen

9 - For Municipal and Domestic Supply, based on California Code of Regulations, Title 22, Chapter 15

10 - 80% of the Bolsa Sub-Area is within the DWR Bolsa Subbasin and 20% is within the Hollister Subbasin; for the assimilative capacity calculation, the Bolsa Benchmark is used

11 - 80% of the Hollister West Sub-Area is within the San Juan Bautista DWR Subbasin and 20% is within the Bolsa Subbasin; for the assimilative capacity calculation, the San Juan Bautista Benchmark is used

GW - Groundwater TDS - Total Dissolved Solids mg/L - milligrams per liter NO_3 -Nitrate SE - Southeast NE - northeast

CR - Creek

Table 2 Volume of Septic System Return Flows

Basin/Subbasin	Estimated Number of Rural Households [1]	Water Use/HH (AFY) [2]	Total Water Use in Subbasin (AFY)	Indoor Use/Septic Discharge (AFY)	Outdoor Use (AFY)
		AFY			
BOLSA	138	0.5	67	33	33
BOLSA SE	22	0.5	11	5	5
FLINT HILLS	0	0.0	0	0	0
HOLLISTER NE	684	0.5	170	85	85
HOLLISTER SE	200	0.5	73	36	36
HOLLISTER WEST	1,800	0.5	873	437	437
PACHECO	473	0.5	229	115	115
SAN JUAN CENTRAL	87	0.5	20	10	10
SAN JUAN NORTH	493	0.5	49	24	24
SAN JUAN SOUTH	0	0.0	0	0	0
TRES PINOS	1,453	0.5	582	291	291
TRES PINOS CR VALLEY	1	0.5	0.5	0.2	0.2

1 - Rural households estimated from San Benito County permit data and metered domestic pumping

2 - Water Use per household assumes 161 gallons per day per person, 2.8 persons per household, and 50 percent indoor use (District, 2012)

AFY - acre-feet per year

CR - creek

HH - household

NE - Northeast

SE - Southeast

Table 3 Water Balance (2002 - 2011) Summary and Annual and Cumulative Change in Storage

Year	BOLSA	BOLSA SE	FLINT HILLS	HOLLISTER NE	HOLLISTER SE	HOLLISTER WEST	PACH- ECO	SAN JUAN CENTRAL	SAN JUAN NORTH	SAN JUAN SOUTH	TRES PINOS	TRES PINOS CR VALLEY
INFLOWS												
2002	10,920	2,804	114	3,883	1,515	7,515	3,601	4,413	7,856	345	5,329	1,289
2003	8,926	2,374	0	2,604	1,049	7,714	4,030	891	7,995	1	4,950	284
2004	9,086	2,620	532	3,034	1,185	5,724	4,100	437	8,622	1,605	3,736	49
2005	8,767	3,084	100	4,518	1,020	8,374	5,120	2,934	10,226	302	7,205	2,713
2006	10,976	4,700	0	5,968	1,775	7,753	7,869	1,290	11,660	1	5,978	3,162
2007	7,968	3,436	0	2,290	750	6,701	6,135	746	5,781	1	4,197	3,224
2008	11,217	4,790	0	3,341	1,337	5,522	7,314	996	8,739	1	4,597	3,247
2009	6,407	2,109	0	2,140	634	7,098	5,454	296	7,554	1	3,409	478
2010	9,132	3,431	0	2,116	587	5,842	4,780	334	6,883	1	3,248	-240
2011	9,672	3,680	0	2,622	654	6,652	5,995	2,379	9,059	1	3,772	3,155
OUTFLOWS												
2002	(12,235)	(2,693)	0	(2,514)	(1,074)	(8,577)	(4,322)	(5,913)	(9,571)	(344)	(5,994)	(2,290)
2003	(8,399)	(2,675)	0	(2,105)	(792)	(7,722)	(3,925)	(1,582)	(8,934)	(1)	(4,805)	(883)
2004	(9,270)	(3,406)	0	(2,208)	(1,114)	(6,971)	(3,961)	(1,468)	(9,121)	(1,605)	(4,704)	(660)
2005	(8,197)	(2,849)	0	(2,527)	(1,060)	(7,084)	(3,320)	(1,557)	(8,608)	(302)	(3,878)	(886)
2006	(11,484)	(3,864)	0	(2,761)	(1,294)	(8,383)	(5,458)	(1,516)	(8,741)	(1)	(5,238)	(865)
2007	(8,586)	(4,005)	0	(3,730)	(1,638)	(7,868)	(5,284)	(1,656)	(8,158)	(1)	(4,112)	(896)
2008	(9,139)	(3,264)	0	(3,913)	(1,549)	(7,875)	(7,400)	(1,755)	(8,046)	(1)	(5,197)	(919)
2009	(7,213)	(3,082)	0	(5,753)	(1,139)	(5,686)	(5,370)	(1,140)	(11,975)	(1)	(4,871)	(1,644)
2010	(6,294)	(3,370)	0	(4,972)	(1,107)	(6,955)	(5,661)	(1,032)	(9,580)	(1)	(3,686)	(2,227)
2011	(5,775)	(4,281)	0	(2,987)	(960)	(6,995)	(5,183)	(1,013)	(8,587)	(1)	(4,454)	(2,325)
ANNUAL CHANGE IN STORAGE												
2002	(1,315)	111	114	1,369	441	(1,062)	(721)	(1,500)	(1,715)	1	(665)	(1,001)
2003	527	(301)	0	499	257	(8)	105	(691)	(939)	0	145	(599)
2004	(184)	(786)	532	826	71	(1,247)	139	(1,031)	(499)	0	(968)	(611)
2005	570	235	100	1,990	(39)	1,290	1,800	1,377	1,618	0	3,327	1,827
2006	(508)	837	0	3,207	481	(630)	2,411	(225)	2,919	0	741	2,298
2007	(618)	(569)	0	(1,440)	(888)	(1,168)	851	(910)	(2,377)	0	85	2,328
2008	2,078	1,525	0	(573)	(212)	(2,353)	(85)	(759)	693	0	(600)	2,328
2009	(807)	(974)	0	(3,612)	(505)	1,412	84	(845)	(4,421)	0	(1,462)	(1,166)
2010	2,838	61	0	(2,856)	(520)	(1,113)	(881)	(698)	(2,697)	0	(438)	(2,467)
2011	3,897	(601)	0	(365)	(306)	(343)	812	1,367	473	0	(682)	830
CUMMULATIVE CHANGE IN STORAGE												
2002	(1,315)	111	114	1,369	441	(1,062)	(721)	(1,500)	(1,715)	1	(665)	(1,001)
2003	(788)	(190)	114	1,868	698	(1,070)	(616)	(2,191)	(2,654)	1	(520)	(1,600)
2004	(972)	(976)	646	2,693	770	(2,317)	(477)	(3,222)	(3,153)	1	(1,488)	(2,211)
2005	(402)	(741)	746	4,684	730	(1,027)	1,323	(1,845)	(1,535)	1	1,839	(384)
2006	(910)	96	746	7,891	1,211	(1,657)	3,734	(2,070)	1,384	1	2,580	1,914
2007	(1,528)	(473)	746	6,451	323	(2,825)	4,585	(2,980)	(993)	1	2,665	4,242
2008	550	1,053	746	5,878	111	(5,178)	4,499	(3,739)	(300)	1	2,065	6,570
2009	(257)	79	746	2,266	(394)	(3,766)	4,583	(4,584)	(4,722)	1	603	5,405
2010	2,581	140	746	(590)	(913)	(4,879)	3,702	(5,282)	(7,419)	1	166	2,938
2011	6,478	(462)	746	(955)	(1,219)	(5,222)	4,514	(3,915)	(6,946)	1	(516)	3,768

All values in acre-feet per year   See Appendix A for individual inflow and outflow components   CR - Creek   NE - Northeast   SE - Southeast

2010 Volumes for Hollister East and Hollister West reflect a small amount of recycled water irrigation returns that is not included in the Annual Reprt

Table 4 Mass of TDS and Nitrate-NO_3 in Storage

Basin/Subbasin	Area (acres)	Average Aquifer Thickness (feet)	Mixing Thickness (feet)	Porosity	Volume (AF)	TDS (mg/L)	Salt (tons)	Nitrate-NO_3 (mg/L)	Nitrate-NO_3 (tons)
BOLSA	20,907	700	400	0.15	1,254,420	670	**1,143,028**	3.9	**6,653**
BOLSA SE	2,689	700	400	0.15	161,340	1,006	**220,739**	15.4	**3,379**
FLINT HILLS	8,153	300	250	0.15	305,738	376	**156,342**	3	**1,247**
HOLLISTER NE	11,381	700	400	0.15	682,860	741	**688,159**	11.4	**10,587**
HOLLISTER SE	6,947	700	400	0.15	416,820	1,030	**583,881**	7.6	**4,308**
HOLLISTER WEST	6,051	700	400	0.15	363,060	1,019	**503,143**	21.7	**10,715**
PACHECO	10,469	700	400	0.15	628,140	533	**455,326**	8.2	**7,005**
SAN JUAN CENTRAL	21,791	400	350	0.15	1,144,028	794	**1,235,367**	9.5	**14,781**
SAN JUAN NORTH	11,873	400	350	0.15	623,333	1,198	**1,015,583**	14.6	**12,377**
SAN JUAN SOUTH	24,214	300	250	0.15	908,025	720	**889,138**	5	**6,175**
TRES PINOS	4,736	400	350	0.15	248,640	995	**336,460**	8.9	**3,010**
TRES PINOS CR VALLEY	3,387	350	300	0.15	152,415	720	**149,245**	5	**1,036**

See TM-1 (Todd, 2012c) for aquifer thickness and porosity data

TDS and NO_3 subbasin concentrations are area weighted averages reported in TM-1 (Todd, 2012c)

AF - acre-feet

CR - Creek

GW - groundwater

mg/L - milligrams per Liter

MCL - Maximum Contaminant Level

NE - Northeast

NO_3 - Nitrate

SE - Southeast

TDS - Total Dissolved Solids

Table 5 Surface Water Quality

Basin/Subbasin	TDS mg/L	Nitrate-NO_3 mg/L
BOLSA	825	5.8
BOLSA SE	No SW	No SW
HOLLISTER NE	508	3.3
HOLLISTER SE	940	3.7
HOLLISTER WEST	793	3
PACHECO	515	5.8
SAN JUAN CENTRAL	792	2.5
SAN JUAN NORTH	1,441	78.6
SAN JUAN SOUTH [1]	736	3.5
TRES PINOS	848	3.1
TRES PINOS CR VALLEY [1]	736	3.5

Modified after Todd (2012c) Table 10; based on 1998-2006 data

No SW - no surface water in water balance

1 - No data available; average based on Tres Pinos Creek data in San Juan Central

CR - Creek

NE - Northeast

NO_3 - Nitrate

SE - Southeast

SW - surface water

TDS - Total Dissolved Solids

Table 6 Quality of Subsurface Groundwater Inflows and Outflows

	2006	2007	2008	2009	2010	2011	2006	2007	2008	2009	2010	2011	% of Total	TDS [5] mg/L	NO [5] mg/L
	INFLOW (AFY)						Percent of Total Flow								
Hollister NE															
In to Hollister East - East Boundary [1]	568	568	682	489	557	432	100%	100%	100%	100%	100%	100%	100%	**200**	5
Hollister SE															
In to Hollister East - East Boundary [1]	208	208	104	167	139	152	31%	31%	31%	33%	29%	32%	31%	1200	5
In to Hollister East - East Boundary [1]	472	472	236	345	345	316	69%	69%	69%	67%	71%	68%	69%	1200	5
Total in to Hollister East	**680**	**680**	**340**	**511**	**484**	**468**								**1200**	**10**
Hollister West															
In to Hollister West from outside basin [1]	57	53	31	32	21	19	2%	2%	1%	2%	1%	1%	1%	1000	10
In to Hollister West from Tres Pinos [2]	2,621	3,058	2,621	2,000	2,000	2,000	98%	98%	99%	98%	99%	99%	99%	995	8.9
Total in to Hollister West	**2,678**	**3,112**	**2,652**	**2,032**	**2,021**	**2,019**								**995**	**9**
Pacheco															
In to Pacheco from outside basin [1]	2,281	2,661	2,852	1,000	1,000	1,000	56%	59%	61%	29%	35%	33%	45%	300	5
In to Pacheco from outside basin [1]	186	217	232	263	251	37	5%	5%	5%	8%	9%	1%	5%	300	5
From Hollister East across northeast Boundary [2]	0	0	0	0	0	0	0%	0%	0%	0%	0%	0%	0%	741	11.4
From Hollister East across northwest Boundary	1,619	1,619	1,619	2,159	1,619	2,000	40%	36%	34%	63%	56%	66%	49%	741	11.4
Total in to Pacheco	**4,086**	**4,497**	**4,703**	**3,422**	**2,870**	**3,037**								**517**	**8**
San Juan															
Across northern southeast boundary [1]	24	27	29	21	7	19	10%	10%	10%	8%	20%	19%	13%	1000	5
Across southern southeast boundary [1]	212	237	254	239	29	81	90%	90%	90%	92%	80%	81%	87%	1000	5
Total in to San Juan	**236**	**264**	**283**	**260**	**36**	**100**								**1000**	**5**
Tres Pinos															
In To Tres Pinos from San Juan Central [1]	**3,853**	**3,082**	**3,596**	**1,644**	**1,901**	**2,003**	100%	100%	100%	100%	100%	100%	100%	**794**	**9.5**
Bolsa															
In to Bolsa from Pacheco (NE Boundary) [1]	2,477	2,477	3,302	1,000	1,981	2,064	40%	40%	48%	25%	30%	31%	36%	533	8.2
In to Bolsa from Pacheco (SW Boundary) [1]	1,690	1,690	2,253	1,000	1,127	1,127	27%	27%	33%	25%	17%	17%	24%	533	8.2
In to Bolsa from Bolsa SE [1]	1,985	1,985	1,323	1,000	2,018	1,985	32%	32%	19%	25%	31%	30%	28%	1,006	15.4
In to Bolsa from Llagas [2]				1,000	1,473	1,500	0%	0%	0%	25%	22%	22%	12%	500	10
Total in to Bolsa	**6,152**	**6,152**	**6,879**	**4,000**	**6,600**	**6,676**								**662**	**10**
Bolsa SE															
In to Bolsa SE from Hollister West	**3,883**	**2,848**	**3,883**	**1,500**	**2,874**	**3,055**	100%	100%	100%	100%	100%	100%	100%	**1,019**	**21.7**
Flint Hills [3]	**0**	**0**	**0**	**0**	**0**	**0**	100%	100%	100%	100%	100%	100%	100%	500	5
San Juan Central [3]	**102**	**116**	**126**	**114**	**103**	**101**	100%	100%	100%	100%	100%	100%	100%	500	5
Tres Pinos Creek Valley [3]	**32**	**35**	**37**	**34**	**33**	**32**	100%	100%	100%	100%	100%	100%	100%	500	5
San Juan South [3]	**0**	**0**	**0**	**0**	**0**	**0**	100%	100%	100%	100%	100%	100%	100%	500	5
	OUTFLOW (AFY)						Percent of Total Flow								
Out of Bolsa [4]	**5,358**	**1,339**	**1,206**	**0**	**0**	**0**	100%	100%	100%	100%	100%	100%	100%	**670**	**4**
San Juan [2]	**21**	**21**	**37**	**19**	**19**	**15**	100%	100%	100%	100%	100%	100%	100%	**1,198**	**14.6**

Volumes from Annual Report (Todd, 2011) AFY - acre-feet per year mg/L - milligrams per Liter NE - Northeast NO_3 - Nitrate SE- Southeast TDS - Total Dissolved Solids

1 - TDS and NO_3 concentration from wells on basin margin

2 - TDS and NO_3 concentrations are the average from source basin (Table 1)

3 - Estimate based on limited available data

4 - Bolsa TDS average does not include elevated TDS in the north

5 - TDS and NO_3 concentrations are volume weighted averages for basins with multiple sources

Table 7 Estimated Nitrogen Application and Losses by Crop Class

Crop Class	Average N[1] lbs/ac	Crop Uptake Rate[2]	Net N after uptake	Gaseous Losses[3]	Net N Input lbs/ac
Olives/Citrus	67	0.50	34	0.1	30
Deciduous	104	0.47	55	0.1	49
Field	214	0.75	54	0.1	48
Grain	167	0.78	37	0.1	33
Pasture	31	0.50	16	0.1	14
Truck	189	0.44	106	0.1	95
Vineyards	44	0.46	24	0.1	21

1 - Nitrogen fertilizer application rates represent averages for individual crops derived from SCVWD (2012), Yates (2003), and UC Davis (2012); Crop class values are weighted averages

2 - Derived from weighed average of the area of individual crops within the crop class; crop uptake rates from UC Davis (2012)

3 - UC Davis (2012)

lbs/ac - pounds per acre

N - nitrogen

Table 8 Nitrogen Application in Study Area

Crop Class	BOLSA	BOLSA SE	FLINT HILLS	HOLLISTER NE	HOLLISTER SE	HOLLISTER WEST	PACHECO	SAN JUAN CENTRAL	SAN JUAN NORTH	SAN JUAN SOUTH	TRES PINOS	TRES PINOS CR VALLEY	TOTAL
Acres Olives/Citrus	-	-	-	-	-	78	-	-	18	-	-	-	96
Net N Input (lbs/ac)	-	-	-	-	-	30	-	-	30	-	-	-	
TONS to GW	-	-	-	-	-	1.17	-	-	0.27	-	-	-	
Acres Deciduous	368	128	-	702	78	696	1,816	178	649	1	463	3	5,084
Net N Input (lbs/ac)	49	49	-	49	49	49	49	49	49	49	49	49	
Tons to GW	9.11	3.17	-	17.38	1.93	17.23	44.95	4.41	16.07	0.03	11.46	0.07	
Acres Field	883	0	-	95	60	21	164	247	991	15	25	59	2,561
Net N Input (lbs/ac)	48	48	-	48	48	48	48	48	48	48	48	48	
Tons to GW	21.26	0.00	-	2.28	1.45	0.52	3.96	5.95	23.87	0.35	0.61	1.42	
Acres Grain	2,137	196	-	409	301	126	594	308	71	57	82	254	4,536
Net N Input (lbs/ac)	33	33	-	33	33	33	33	33	33	33	33	33	
Tons to GW	35.34	3.24	-	6.76	4.98	2.08	9.82	5.10	1.18	0.94	1.36	4.20	
Acres Pasture	2,042	22	-	251	28	125	181	86	284	39	24	28	3,110
Net N Input (lbs/ac)	14	14	-	14	14	14	14	14	14	14	14	14	
Tons to GW	14.24	0.15	-	1.75	0.19	0.87	1.26	0.60	1.98	0.27	0.17	0.20	
Acres Truck	4,468	1,339	-	4,573	806	991	2,858	477	5,293	-	226	60	21,090
Net N Input (lbs/ac)	95	95	-	95	95	95	95	95	95	-	95	95	
Tons to GW	212.71	63.73	-	217.72	38.36	47.20	136.07	22.71	252.02	-	10.74	2.85	
Acres Vineyard	-	-	-	4	9	2	618	999	24	-	97	940	2,693
Net N Input (lbs/ac)	-	-	-	21	21	21	21	21	21	-	21	21	
Tons to GW	-	-	-	0.04	0.10	0.02	6.61	10.68	0.26	-	1.04	10.05	
Tons to GW TOTAL	**293**	**70**	**-**	**246**	**47**	**69**	**203**	**49**	**296**	**2**	**25**	**19**	**1,318**

See Table 9 for Net N Input calculation assumptions
Acreage based on Todd (2012a)
Grain may include some field crops
Pasture includes permanent pasture and alfalfa
CR - Creek
GW - groundwater
lbs/ac - pounds per acre
mg/L - milligrams per Liter
N - nitrogen
NE - Northeast
SE - Southeat

Table 9 CDFA Reported Amendment Sales in San Benito County

Calendar Year	Gypsum (tons)	Lime (tons)	Subtotal (tons)	AG MIN Total (tons)
1997	360	8,428	8,788	9,090
1998	1,010	9,528	10,538	10,680
1999	630	9,098	9,728	10,192
2000	5,499	8,194	13,693	13,949
2001	788	5	793	926
2002	4,730	191	4,921	5,109
		AVERAGE	**8,077**	**8,324**
2002	4,730	191	4,921	5,109
2003	2,511	3,670	6,181	6,321
2004	5,964	445	6,409	6,670
2005	2,062	220	2,282	2,602
2006	1,007	115	1,122	1,524
2007	5,566	676	6,242	7,098
2008	2,875	232	3,107	3,500
		AVERAGE	**4,323**	**4,689**

Source: CDFA (2002 - 2008)
http://www.cdfa.ca.gov/is/ffldrs/Fertilizer_Tonnage.html
AG MIN - includes minor amounts (less than 10 percent on average) of sulphur and sulphuric acid
AG - agricultural
CDFA - California Department of Food and Agriculture
MIN - minerals

Table 10 WWTP Effluent Flows and Subbasin Percolation

WWTP	Effluent Flows (AFY)	Percent	TDS (mg/L)	NO3 (mg/L)	WWTP Perc Subbasin	Sewer Leak Return Flows (AFY)	Sewer Leaks in Subbasins (AFY)				
							TP	HNE	HW	HSE	SJN
Tres Pinos	25.9	11%	1,894	5.5							
Ridgemark	216.3	89%	1,801	0.8							
Total	**242.2**		1,811	1.30	TP	24	24				
Hollister Domestic	2,151.90	84%	1,162	6.6							
Hollister Industrial (50%)	414.4	16%	1,425	26.6							
Total	**2566.3**		1,204	9.83	SJN	257		86	86	86	
Hollister Industrial (50%)	414.4	100%	1,425	26.6	HW	41			41		
San Juan	153.6				Outside	15					15

Flows and water quality based on 2006 to 2011 data reported in TM-1 (Todd, 2012b)
Outside - percolation takes place outside of the Study Area
TDS and Nitrate concentrations from Table 13 TM-1 (Todd, 2012b)
Sewer leaks are 10 percent of effluent flows
WWTP Perc Subbasin - geographic location of WWTP pond
HNE - Hollister Northeast
HW- Hollister West
HSE - Hollister Southeast
SJN - San Juan North
TP - Tres Pinos
AFY - Acre-feet per year
mg/L - milligrams per Liter
NO_3 - Nitrate
Perc - percolation to groundwater
TDS - Total Dissolved Solids
WWTP - Wastewater Treatment Plant

Table 11 Septic System Return Flow Quality

	BOLSA	BOLSA SE	FLINT HILLS	HOLLISTER NE	HOLLISTER SE	HOLLISTER WEST	PACHECO	SAN JUAN CENTRAL	SAN JUAN NORTH	SAN JUAN SOUTH [5]	TRES PINOS	TRES PINOS CR VALLEY
Nitrate												
Septic Tank Ammonium as Nitrogen [1]	53	53	-	53	53	53	53	53	53	-	53	53
Ammonium after denitrification as Nitrogen [2]	45	45	-	45	45	45	45	45	45	-	45	45
Nitrate as NO_3	199	199	199	199	199	199	199	199	199	199	199	199
Nitrate in source groundwater [3]	3.9	15.4	-	11.4	7.6	21.7	8.2	9.5	14.6	-	8.9	5
Total nitrate - NO_3 in septic return flow	**203**	**215**	**202**	**211**	**207**	**221**	**208**	**209**	**214**	**204**	**208**	**204**
TDS												
TDS in source groundwater [3]	670	1,006	-	741	1,030	1,019	533	794	1,198	-	995	720
Household addition of TDS [4]	200	200	-	200	200	200	200	200	200	-	200	200
Total TDS in septic return flow	**870**	**1,206**	**-**	**941**	**1,230**	**1,219**	**733**	**994**	**1,398**	**-**	**1,195**	**920**

All values are in mg/L
1 - Septic tank ammonium from Lowe (2009)
2 - Denitrification assumed to be 15 percent (EPA, 2002)
3 - See Table 1 for source groundwater TDS and nitrate
4 - Household addition of TDS (Kaplan, 1987)
5 - There are no septic system returns in Flint Hills and San Juan South
CR - Creek
mg/L - milligrams per Liter
NE - Northeast
NO_3 - Nitrate
SE - Southeast
TDS - Total Dissolved Solids

Table 12 Source Water Goals and Objectives

	Overall Goals and Objectives	Reference
Overall Purpose of the *Hollister Urban Area Water and Wastewater Master Plan*	►Improve the quality of municipal drinking water, industrial supply, and recycled water for urban and agricultural irrigation users. ►Provide a reliable and sustainable water supply to meet the current and future demands of the Hollister Urban Area (HUA). ►Implement goals for the Hollister Water Reclamation Facility to be the primary wastewater treatment plant for incorporated and unincorporated lands in the HUA to protect groundwater quality and public health.	AECOM (2011)
Specific Program Objectives of the *Hollister Urban Area Water and Wastewater Master Plan*	►Improve municipal, industrial, and recycled water quality. ► Increase the reliability of the water supply. ► Coordinate infrastructure improvements. ► Consider regional water and wastewater issues and solutions.	AECOM (2011)
Purpose of RWQCB's Waiver for Discharges from Irrigation Lands	►To prevent agricultural discharges from impairing the waters that receive the discharges.	SWRCB (2012)
Groundwater Goals and Objectives		
Quantity	**North County Groundwater Bank (4,000-6,000 AFY) objectives:** ►Reduce occurrence of high groundwater levels. ► Improve management and use of high quality water from seasonal streams. ► Provide opportunities for percolation and storage of imported supplies. ► Provide additional supply of high quality water to meet the needs of the HUA.	AECOM (2011)
Quality	**Current conditions**: Municipal wells ($CaCO_3$=400 mg/L). Groundwater ($CaCO_3$=340-480 mg/L, TDS=800-1,200 mg/L). **North County Groundwater Bank**: TDS less than 500 mg/L; Hardness less than 120 mg/L.	Yates (2010) AECOM (2011)
CVP Goals and Objectives		
Quantity	**For municipal**: Contract amount = 8,250 AFY; average historical use 5,457 AFY; multiple dry year reduction = 4,125 AFY. **For agriculture**: Contract amount = 35,500 AFY; reductions will occur in dry years; could not be available in multiple dry-year period.	Yates (2012) AECOM (2012)
Quality	TDS=200-300 mg/L, $CaCO_3$=110 mg/L, San Luis Reservoir=120 mg/L $CaCO_3$.	

Table 12 Source Water Goals and Objectives

Municipal Water		
Quantity	Base case scenario annual water demand of 7,126 AFY (in 2015).	Yates (2012)
Quality	North County Groundwater Bank mixing target of 175 mg/L CaCO3; Wellhead treatment then blending target of 300 mg/L TDS; Groundwater Management Plan Update drinking water objectives: TDS=500 mg/L, hardness=120 mg/L.	AECOM (2011)
Wastewater		
RWQCB	TDS=1,200 mg/L, nitrogen as N=5 mg/L.	RWQCB (2008)
Ridgemark WWTP	TDS=1,200 mg/L, nitrate as N=5 mg/L (WDR R3-2004-0065).	SSCWD (2009)
Tres Pinos WWTP	TDS=1,500 mg/L until October 2016 then 1,200 mg/L, nitrate as N=10 mg/L until October 2016 then 5 mg/L.	RWQCB (2012)
Current Quality	WRF TDS=1,200 mg/L, Ridgemark TDS up to 1,800 mg/L.	AECOM (2011)
Target Quality	MOU target 500 mg/L with a not-to-exceed level of 700 mg/L TDS, below 700 mg/L TDS by 2015.	
Recycled Water		
Quantity	Base case scenario recycled water use is 1,500 AFY (in 2015).	District (2012b)
Target Quality	MOU target 500 mg/L with a not-to-exceed level of 700 mg/L TDS, below 700 mg/L TDS by 2015.	AECOM (2011)
Stormwater		
Reuse Quantity	Stormwater water captured at the IWWTP could be put to beneficial reuse in consideration of the following factor: 1. Stormwater could increase the water supply available to end users.	Wallace Group (2011)
Target Quality	2. TDS in stormwater is substantially lower than recycled water and would result in a net reduction in TDS.	

AFY - acre-feet per year
$CaCO_3$ - calcium carbonate
CVP - Central Valley Project
IWWTP - Industrial Wastewater Treatment Plant
mg/L - milligrams per Liter
MOU - Memorandum of Understanding
MCL - Maximum Contaminant Level
TDS - Total Dissolved Solids
WRF - Water Recycling Facility
WWTP - Wastewater Treatment Plant
NO_3 -Nitrate
N - nitrogen

Table 13 Source Water Implementation Measures

Implementation Measures				
Groundwater	**CVP**	**Wastewater**	**Recycled Water**	**Stormwater**
Near Term (current to 2015)				
• Water use efficiency training (agricultural/residential users) •Salt Reduction for Industrial Customers • North County Groundwater Bank • Demineralization of Urban Wells (Phase I) • Non-Structural Solutions (e.g., water conservation) • RWQCB Agricultural Order actions include use of BMPs for irrigation efficiency and nutrient and salinity management • Public outreach and training from the WRASBC, CCWQC, CCCRCD, NRCS, AWQA, LPRCD, SCCRCD, and EA for fertilizer, irrigation, and amendment BMPs and watershed protection • Existing and proposed SNMP groundwater monitoring and reporting to ensure groundwater quality protection	• Water use efficiency training (agricultural/residential users) • Purchases or Transfers of Imported Water Supplies • North County Groundwater Bank • Lessalt Water Treatment Plant Upgrades • Construction of West Hills WTP • New Treated Water Storage • Non-Structural Solutions (e.g., water conservation)	• Water Softener Rebate Program • Water Softener Homeowner Education/Outreach • Ridgemark Wastewater Treatment Plant Upgrades • Non-Structural Solutions (such as salinity education, softener ordinances and other measures)	• BMPs for recycled water irrigation on the Brigantino Riverside Park and Hollister Airport reuse sites: 1. Any fertilizer spills on the site will be promptly managed. 2. Visual observations will document irrigation efficiency. 3. Recycled water quality will be monitored regularly and supplemental fertilizer applications will be adjusted accordingly. 4. Irrigation events will be carefully managed to reduce the potential for unintentional deep percolation losses. CH2MHill (2011)	• Stormwater BMPs in SWMP • RWQCB Agricultural Order actions include use of BMPs for surface water receiving water quality • Public outreach and training from the WRASBC, CCWQC, CCCRCD, NRCS, AWQA, LPRCD, SCCRCD, and EA for fertilizer, irrigation, and amendment BMPs and watershed protection • District surface water monitoring program

Table 13 Source Water Implementation Measures

Intermediate Term (2016 to 2023)				
• New Urban Wells • North County Groundwater Bank • Demineralization of Urban Wells (Phase 2)	• New Treated Water Storage	• Expansion of City of Hollister Water Reclamation Facility • Cielo Vista Estates Connection to City of Hollister Water Reclamation Facility	• Engineering study of recycled water and stormwater blending and treatment	• Engineering study of recycled water and stormwater blending and treatment

References: AECOM (2011), City of Hollister (2009, 2011), State Water Board (2012), Wallace Group (2011)

BMPs - best management practices

SWMP - Stormwater Management Plan

WRASBC - Water Resources Association of San Benito County

CCWQC - Central coast Water Quality Coalition

CCCRCD - Central Coast Coalition of Resource Conservation Districts

NRCS - U.S. Department of Agriculture, Natural Resources Conservation Service

AWQA - Agriculture Water Quality Alliance

LPRCD - Loma Prieta Resource Conservation District

SCCRCD - Santa Cruz County Resource Conservation District

EA - Ecology Action

Table 14 Future Water Balance Summary (2012 - 2021) and Annual and Cumulative Change in Storage

Year	BOLSA	BOLSA SE	FLINT HILLS	HOLLISTER NE	HOLLISTER SE	HOLLISTER WEST	PACH- ECO	SAN JUAN CENTRAL	SAN JUAN NORTH	SAN JUAN SOUTH	TRES PINOS	TRES PINOS CR VALLEY
	INFLOWS											
2012	9,672	3,683	0	2,625	657	6,642	5,995	2,379	8,965	1	3,795	3,155
2013	9,672	3,686	0	2,628	660	6,631	5,995	2,379	8,628	1	3,789	3,155
2014	9,672	3,690	0	2,631	664	6,621	5,995	2,379	8,292	1	3,601	3,155
2015	9,672	3,693	0	2,634	667	6,610	5,995	2,379	7,955	1	3,601	3,155
2016	9,672	3,696	0	2,638	670	6,613	5,995	2,379	7,701	1	3,602	3,155
2017	9,672	3,696	0	2,638	670	6,613	5,995	2,379	7,701	1	3,602	3,155
2018	9,672	3,696	0	2,638	670	6,613	5,995	2,379	7,701	1	3,602	3,155
2019	9,672	3,696	0	2,638	670	6,613	5,995	2,379	7,701	1	3,602	3,155
2020	9,672	3,696	0	2,638	670	6,613	5,995	2,379	7,701	1	3,602	3,155
2021	9,672	3,696	0	2,638	670	6,613	5,995	2,379	7,701	1	3,602	3,155
	OUTFLOWS											
2012	(5,775)	(4,280)	0	(2,973)	(839)	(6,584)	(5,167)	(1,013)	(8,524)	(1)	(4,057)	(2,325)
2013	(5,775)	(4,279)	0	(2,959)	(719)	(6,173)	(5,151)	(1,013)	(8,462)	(1)	(3,660)	(2,325)
2014	(5,775)	(4,278)	0	(2,946)	(598)	(5,762)	(5,135)	(1,013)	(8,399)	(1)	(3,262)	(2,325)
2015	(5,775)	(4,276)	0	(2,932)	(477)	(5,351)	(5,119)	(1,013)	(8,337)	(1)	(2,865)	(2,325)
2016	(5,775)	(4,276)	0	(2,932)	(477)	(5,351)	(5,119)	(1,013)	(8,337)	(1)	(2,865)	(2,325)
2017	(5,775)	(4,276)	0	(2,932)	(477)	(5,351)	(5,119)	(1,013)	(8,337)	(1)	(2,865)	(2,325)
2018	(5,775)	(4,276)	0	(2,932)	(477)	(5,351)	(5,119)	(1,013)	(8,337)	(1)	(2,865)	(2,325)
2019	(5,775)	(4,276)	0	(2,932)	(477)	(5,351)	(5,119)	(1,013)	(8,337)	(1)	(2,865)	(2,325)
2020	(5,775)	(4,276)	0	(2,932)	(477)	(5,351)	(5,119)	(1,013)	(8,337)	(1)	(2,865)	(2,325)
2021	(5,775)	(4,276)	0	(2,932)	(477)	(5,351)	(5,119)	(1,013)	(8,337)	(1)	(2,865)	(2,325)
	ANNUAL CHANGE IN STORAGE											
2012	3,897	(597)	0	(348)	(182)	58	828	1,367	441	0	(262)	830
2013	3,897	(592)	0	(331)	(58)	458	845	1,367	167	0	130	830
2014	3,897	(588)	0	(314)	66	858	861	1,367	(107)	0	338	830
2015	3,897	(584)	0	(297)	189	1,259	877	1,367	(381)	0	736	830
2016	3,897	(580)	0	(294)	192	1,262	877	1,367	(635)	0	737	830
2017	3,897	(580)	0	(294)	192	1,262	877	1,367	(635)	0	737	830
2018	3,897	(580)	0	(294)	192	1,262	877	1,367	(635)	0	737	830
2019	3,897	(580)	0	(294)	192	1,262	877	1,367	(635)	0	737	830
2020	3,897	(580)	0	(294)	192	1,262	877	1,367	(635)	0	737	830
2021	3,897	(580)	0	(294)	192	1,262	877	1,367	(635)	0	737	830
	CUMMULATIVE CHANGE IN STORAGE											
2012	3,897	(597)	0	(348)	(182)	58	828	1,367	441	0	(262)	830
2013	7,794	(1,189)	0	(680)	(240)	516	1,673	2,733	608	0	(132)	1,660
2014	11,691	(1,777)	0	(994)	(175)	1,375	2,534	4,100	500	0	206	2,490
2015	15,589	(2,361)	0	(1,292)	14	2,633	3,410	5,467	119	0	942	3,320
2016	19,486	(2,941)	0	(1,586)	207	3,895	4,287	6,833	(516)	0	1,679	4,150
2017	23,383	(3,522)	0	(1,881)	399	5,157	5,163	8,200	(1,152)	0	2,416	4,980
2018	27,280	(4,102)	0	(2,175)	592	6,418	6,040	9,567	(1,787)	0	3,153	5,811
2019	31,177	(4,683)	0	(2,469)	784	7,680	6,917	10,933	(2,422)	0	3,889	6,641
2020	35,074	(5,263)	0	(2,764)	977	8,942	7,793	12,300	(3,058)	0	4,626	7,471
2021	38,971	(5,844)	0	(3,058)	1,169	10,204	8,670	13,667	(3,693)	0	5,363	8,301

All values in Acre-feet per year

Table 15 Future Municipal Water Supply Sources, Quantity, and Quality (2012 - 2021)

Source		2012	2013	2014	2015 - 2021
CVP	AFY [1]	2,500	4,000	4,000	5,119
Municipal Wells		5,249	3,541	3,334	1,225
East Side GW		0	0	0	682
Pacheco GW		0	0	0	100
Total		**7,749**	**7,541**	**7,334**	**7,126**
CVP [2]	TDS (mg/L)	298	298	298	298
Municipal Wells [3]		800	800	800	800
East Side GW [4]		-	-	-	300
Pacheco GW [4]		-	-	-	430
CVP and GW Blend [5]		**638**	**534**	**526**	**386**
CVP [2]	Nitrate-NO_3 (mg/L)	3.6	3.6	3.6	3.6
Municipal Wells [6]		21.5	21.5	21.5	21.5
East Side GW [7]		-	-	-	-
Pacheco GW [7]		-	-	-	-
CVP and GW Blend [5]		**15.7**	**12.0**	**11.7**	**7.1**

1 - Base Case CVP, municipal groundwater, eastside groundwater, and Pacheco groundwater volumes for 2015 from Yates (2012a); 2012 to 2014 values projected from current conditions

2 - CVP average of 2003-2008 samples (see Technical Memorandum 1)

3 - TDS average of 11 active Hollister and Sunnyslope wells, not flow weighted

4 - Eastside and Pacheco TDS based on average of wells in the area of interest (Yates, 2012b)

5 - Volume weighted concentration

6 - Municipal wells based on the average of municipal wells in the Hollister West Subbasin

7 - East Side is the groundwater basin aveage for Hollister Southeast; Pacheco is the groundwater basin average for Pacheco

AF - Acre-feet
AFY - acre-feet per year
CVP - Central Valley Project
GW - Groundwater
mg/L - milligrams per liter
NO_3 -Nitrate
TDS - Total Dissolved Solids

Table 16 Future Agricultural Irrigation Water Sources, Quantity, and Quality (2012 - 2021)

Subbasin	AFY			% CVP	% Ground-water	Blended Water (mg/L)		
	CVP	Ground-water	Total			TDS	TDS with ET Factor	NO_3
BOLSA	0	5,775	5,775	0%	1.00	670	2,010	4
BOLSA SE	829	2,175	3,004	28%	0.72	811	2,432	12
FLINT HILLS	0	0	0	0%	0.00	0	0	0
HOLLISTER NE	7,282	717	8,000	91%	0.09	338	1,013	4
HOLLISTER SE	790	260	1,050	75%	0.25	479	1,438	5
HOLLISTER WEST	778	1,412	2,190	36%	0.64	763	2,288	15
PACHECO	2,805	1,497	4,302	65%	0.35	380	1,139	5
SAN JUAN CENTRAL	0	1,013	1,013	0%	1.00	794	2,382	10
SAN JUAN NORTH	6,352	3,656	10,009	63%	0.37	627	1,880	8
SAN JUAN SOUTH	0	1	1	0%	1.00	720	2,160	5
TRES PINOS	165	306	471	35%	0.65	750	2,251	7
TRES PINOS CR VALLEY	0	322	322	0.00	1.00	720	2,160	5
TOTAL	**19,000**	**17,134**	**36,135**	**0.53**	**47%**			

Assumes a 3-fold increase in TDS due to evaporation

AFY - acre-feet per year

CR - Creek

CVP - Central Valley Project

ET - evapotranspiration

GW - Groundwater

NE - Northeast

NO_3 -Nitrate

SE - Southeast

TDS - Total Dissolved Solids

mg/L - milligrams per liter

Table 17 Future Wastewater and Recycled Water Irrigation Flows (2012 - 2021)

Water Year	Zone 6 M&I Water Use	Hollister WWTPs					Sunnyslope WWTPs			Tres Pinos WWTP
		DWWTP/WRF				IWWTP	Ridgemark I & II			
Current		**Current Wastewater Volumes (AFY)**								
Water Year	**Zone 6 M&I Water Use[1]**	**Total Effluent[2]**	**Effluent % of Water Use**	**Pond Discharge[3]**	**Used for Irrigation[3]**	**Pond Discharge[3]**	**Pond Discharge[3]**		**Discharge % of Water Use**	**Pond Discharge[3]**
2010	7,349	2,506	34%	2,323	183	573	209		3%	26
2011	7,749	2,384	31%	2,154	230	612	210		3%	26
Future		**Estimated Future Base Case Wastewater Volumes (AFY)**								
Water Year	**Projected Zone 6 M&I Water Use4**	**Total Effluent (assume 33% of Zone 6 Water Use)**		**Pond Discharge[5]**	**Used for Irrigation[6]**	**Pond Discharge[7]**	**Total Effluent (assume 3% of Zone 6 Water Use)**	**Pond Discharge[5]**	**Used for Irrigation[8]**	**Discharge[9]**
2012	7,749	2,557		2,073	484	584	232	232	0	26
2013	7,541	2,489		1,751	738	556	226	226	0	27
2014	7,334	2,420		1,428	992	528	220	20	0	27
2015	7,126	2,352		1,106	1,246	500	214	14	0	28
2016 to 2021	7,126	2,352		852	1,500	500	214	14	0	28

1 - 2010 and 2011 water use from SBCWD Annual Reports (Todd, December 2010 and December 2011)

2 - Total effluent is pond discharge plus irrigation use.

3 - 2010 and 2011 pond discharge from Table D-3 in SBCWD Annual Reports (Todd, December 2010 and December 2011); 2010 and 2011 irrigation use also from Annual Reports

4 - Assume 2012 water use is the same as 2011; 2015 water use from Yates (May 16, 2012); assume linear decrease from 2012-2015 and 2016-2022 remain at 2015 water use

5 - Difference between total effluent and irrigation use

6 - 2016 irrigation use of 1,500 AF from 10/10/12 meeting with Jeff Cattaneo; assume linear increase from 2011-2016 and 2017-2022 same as 2016

7 - IWWTP percolation of industrial WW and storm water expected to continue (Dennis Rose email 10/31/12); 2015 discharge from UWMP (Todd, June 2011); assumed linear decrease from 2011-2015; assumed 2016-2022 discharge to be the same as 2015

8 - The implementation time frame for Ridgemark WWTP upgrades to disinfected tertiary are uncertain at this time; eventually irrigation of golf course would use about 158 to 216 of recycled water, depending upon supply with which it is blended (AECOM, 2011).

9 - Assumed 2% population growth rate/year in Tres Pinos (derived from AMBAG, 2008) and a corresponding 2% increase in wastewater discharge

AFY - acre-feet per year
AMBAG - Association of Monterey Bay Area Governments
CVP - Central Valley Project
District - San Benito County Water District
IWWTP - Industrial Wastewater Treatment Plant
M&I - municipal and industrial
UWMP - Urban Water Management Plan
WW - Wastewater
WWTP - Wastewater Treatment Plant

Table 18 Future Average Wastewater Flows and Quality (2012 - 2021)

WWTP	Effluent Flows (AFY) [1]	Percent	TDS (mg/L)	NO_3 (mg/L)	TDS (mg/L)	NO_3 (mg/L)	WWTP Pond Perc Subbasin [4]	Sewer Leak Return Flows (AFY) [5]	Sewer Leak Volume in Subbasins (AFY)				
			2012-2015 [2]	2012-2015 [2]	2016 - 2021 [3]	2016 - 2021 [3]			TP	HNE	HW	HSE	SJN
Tres Pinos	27	21%	1,417	5.5	800	5.5							
Ridgemark	101	79%	1,450	0.8	800	0.8							
Blended Total	**128**		**1,443**	**1.79**	**800**	**2**	TP	13	13				
Hollister Domestic	1,442	73%	1,162	6.6	800	6.6							
Hollister Ind 50%	534	27%	1,425	26.6	1,425	26.6							
Blended Total	**1,976**		**1,233**	**12.00**	**969**	**12.0**	SJN	198		66	66	66	
Hollister Ind 50%	534	100%	1,425	26.6	1,425	26.6	HW	53			53		
San Juan	154		1,200	25	1,200	25	Outside	15					15

1 - Effluent is the average of 2012-2021 flows from Table 17

2 - 2012 to 2015 average effluent quality estimated from plant upgrades and RWQCB permit requirements

3 - 2016 to 2021 effluent quality reflects TDS reductions in municipal supply source water plus an additional 200 mg/L from household use (Kaplin, 1987)

4 - WWTP Perc Subbasin - geographic location of WWTP pond

5 - Sewer leaks are 10 percent of effluent flows

AFY - acre-feet per year

HNE - Hollister Northeast

HSE - Hollister Southeast

HW- Hollister West

Ind - Industrial Wastewater Treatment Plant

mg/L - milligrams per Liter

NO_3 -Nitrate

Outside - percolation takes place outside of the Study Area

Perc - percolation

SJN - San Juan North

TDS - Total Dissolved Solids

TP - Tres Pinos

WWTP - Wastewater Treatment Plant

Table 19 Future Recycled Water Quality (2012 - 2021)

Basin/Subbasin	TDS (mg/L)	TDS w/ ET (mg/L)	NO_3 (mg/L)	Facility	Source WWTP
2012-2016					
HNE, HS, HW, BSE	954	2,862	6.6	Ag Lands	HDWTP
Tres Pinos	954	2,862	0.8	Ridgemark Golf	
HNE	800	2,400	6.6	Airport	HDWTP
HW	800	2,400	6.6	Brig. Park	HDWTP
2016 - 2021					
HNE, HS, HW, BSE	800	2,400	6.6	Ag Lands	HDWTP
Tres Pinos [1]	800	2,400	0.8	Ridgemark Golf	Ridgemark
HNE	800	2,400	6.6	Airport	HDWTP
HW	800	2,400	6.6	Brig. Park	HDWTP

1 - Time frame for upgrade of the Ridgemark WWTP to disinfected tertiary is uncertain at this time.

Ag - agricultural

BSE - Bolsa Southeast

Brig - Brigantino Park

ET - Three-fold increase in TDS due to evapotranspiration

HDWTP - Hollister Domestic Wastewater Treatment Plan

HNE - Hollister Northeast

HSE - Hollister Southeast

HW- Hollister West

mg/L - milligrams per liter

NO_3 -Nitrate

RWFP - Recycled Water

SJN - San Juan North

TDS - Total Dissolved Solids

WWTP - Wastewater Treatment Plant

Table 20 Future Groundwater Quality and Assimilative Capacity

DWR Groundwater Basin/Subbasin	SNMP Subarea	TDS (mg/L)				Nitrate-NO_3 (mg/L)			
		GW Average [1]	Basin Specific Basin Plan Objective [2]	Assimilative Capacity Benchmark [3]	Assimilative Capacity	GW Average	Basin Specific Basin Plan Objective [4]	General Basin Plan Objective [5]	Assimilative Capacity
Bolsa Area	Bolsa [6]	672	-	1,200	528	7.2	-	45	37.8
Bolsa Area	Bolsa SE	999	-	1,200	201	21.5	-	45	23.5
San Juan Bautista	Flint HIlls	376	-	1,200	824	3.0	-	45	42.0
San Juan Bautista	Hollister West [7]	990	-	1,200	210	24.2	-	45	20.8
San Juan Bautista	Tres Pinos	989	-	1,200	211	12.1	-	45	32.9
San Juan Bautista	San Juan North	1,157	-	1,200	43	19.4	-	45	25.6
San Juan Bautista	San Juan Central	794	-	1,200	406	9.9	-	45	35.1
San Juan Bautista	San Juan South	720	-	1,200	480	5.0	-	45	40.0
Hollister Area	Hollister NE	733	1,200	-	467	16.2	22.5	-	6.3
Hollister Area	Hollister SE	1,026	1,200	-	174	9.6	22.5	-	12.9
Hollister Area	Pacheco	530	1,200	-	670	12.3	22.5	-	10.2
Tres Pinos Valley	Tres Pinos Cr Valley	724	1,000	-	276	6.2	22.5	-	16.3

1 - Projected TDS and nitrate concentrations simulated in mixing model

2 - Basin Specific Objectives established in the Basin Plan for CDWR Hollister Area Subbasin and Tres Pinos Valley Basin

3 - In the absence of a Basin Specific Plan Objective, an Assimilative Capacity Benchmark is used to calculate assimilative capacity

4 - Basin Plan Objective is 5 mg/L Nitrogen, which is equivalent to 22.5 mg/L Nitrate-NO_3 assuming Nitrate-NO_3 is 100% of Nitrogen

5 - For Municipal and Domestic Supply, based on California Code of Regulations, Title 22, Chapter 15

6 - 80% of the Bolsa Sub-Area within the DWR Bolsa Subbasin; 20% is within the Hollister Subbasin; for the assimilative capacity calculation, the Bolsa Benchmark is used

7 - 80% of the Hollister West Sub-Area is within the San Juan Bautista DWR Subbasin; 20% is within the Bolsa Subbasin; for the assimilative capacity calculation, the San Juan Bautista Benchmark is used

TDS - Total Dissolved Solids mg/L - milligrams per liter NO_3 -Nitrate SE - Southeast NE - northeast CR - creek

Figures

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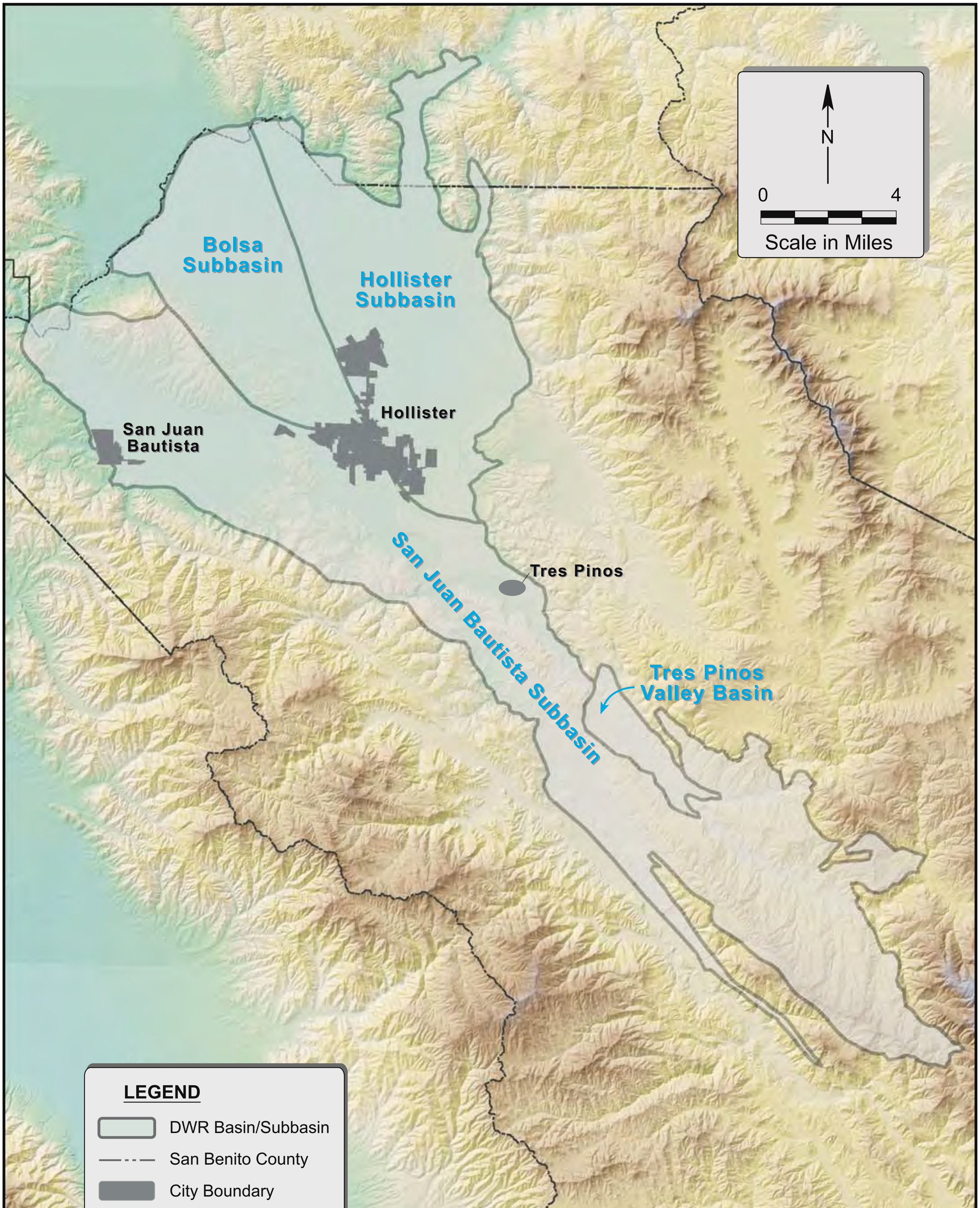

May 2013	Figure 1 DWR Basins and Subbasins
TODD ENGINEERS Alameda, California	

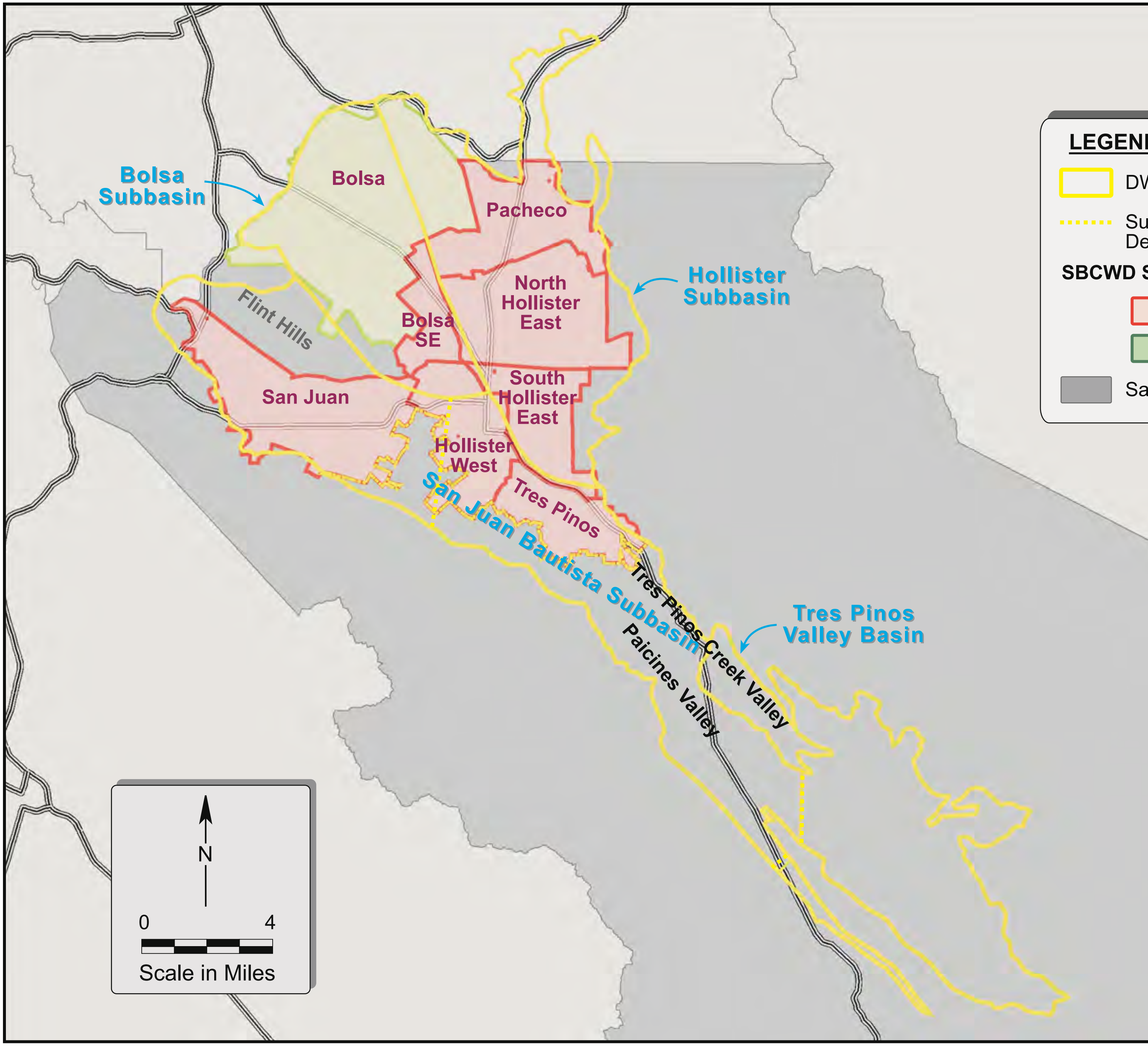

Figure 2
Comparison of DWR and District Subbasins

May 2013

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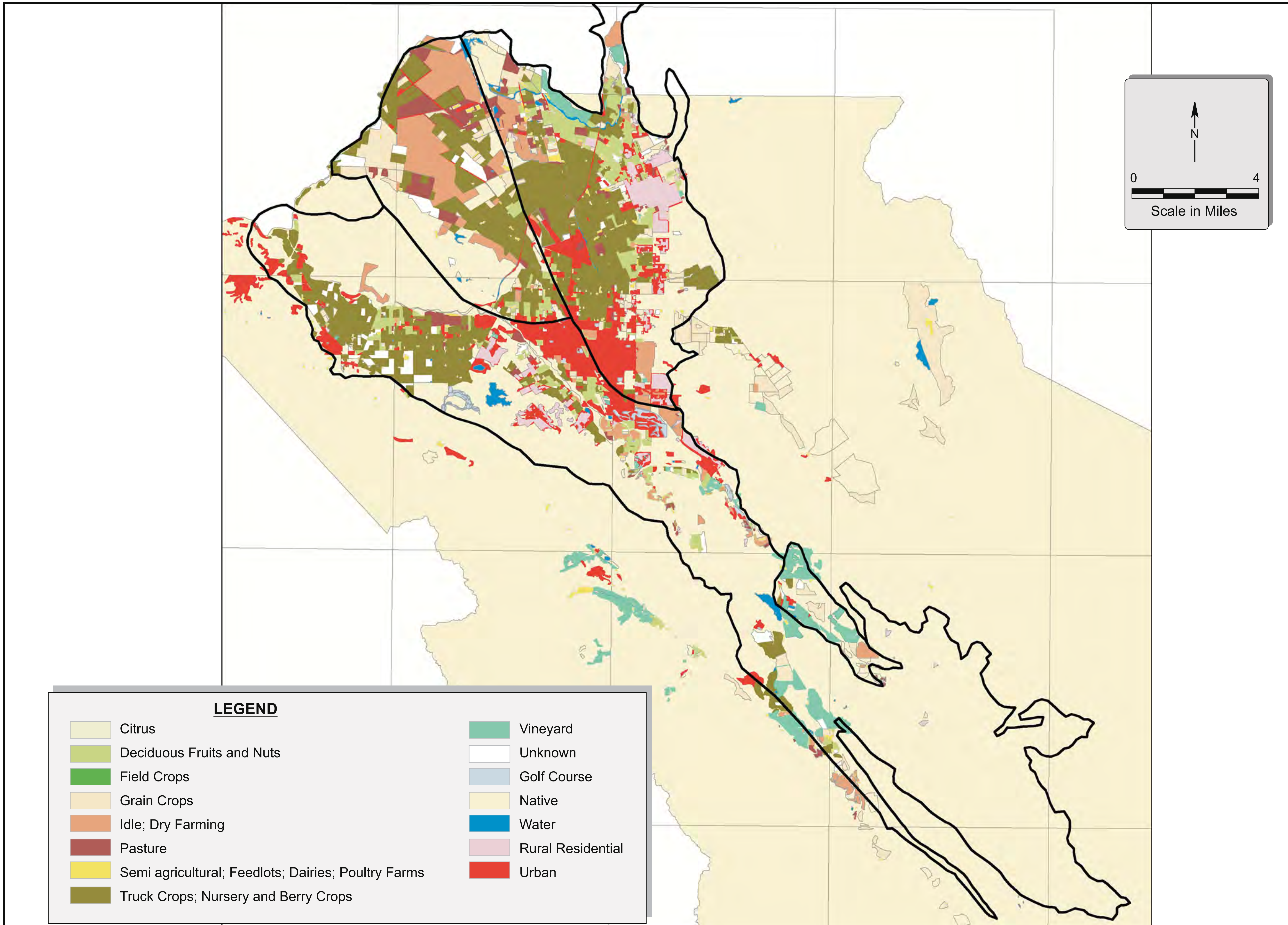

Figure 3
2010
Land Use

May 2013

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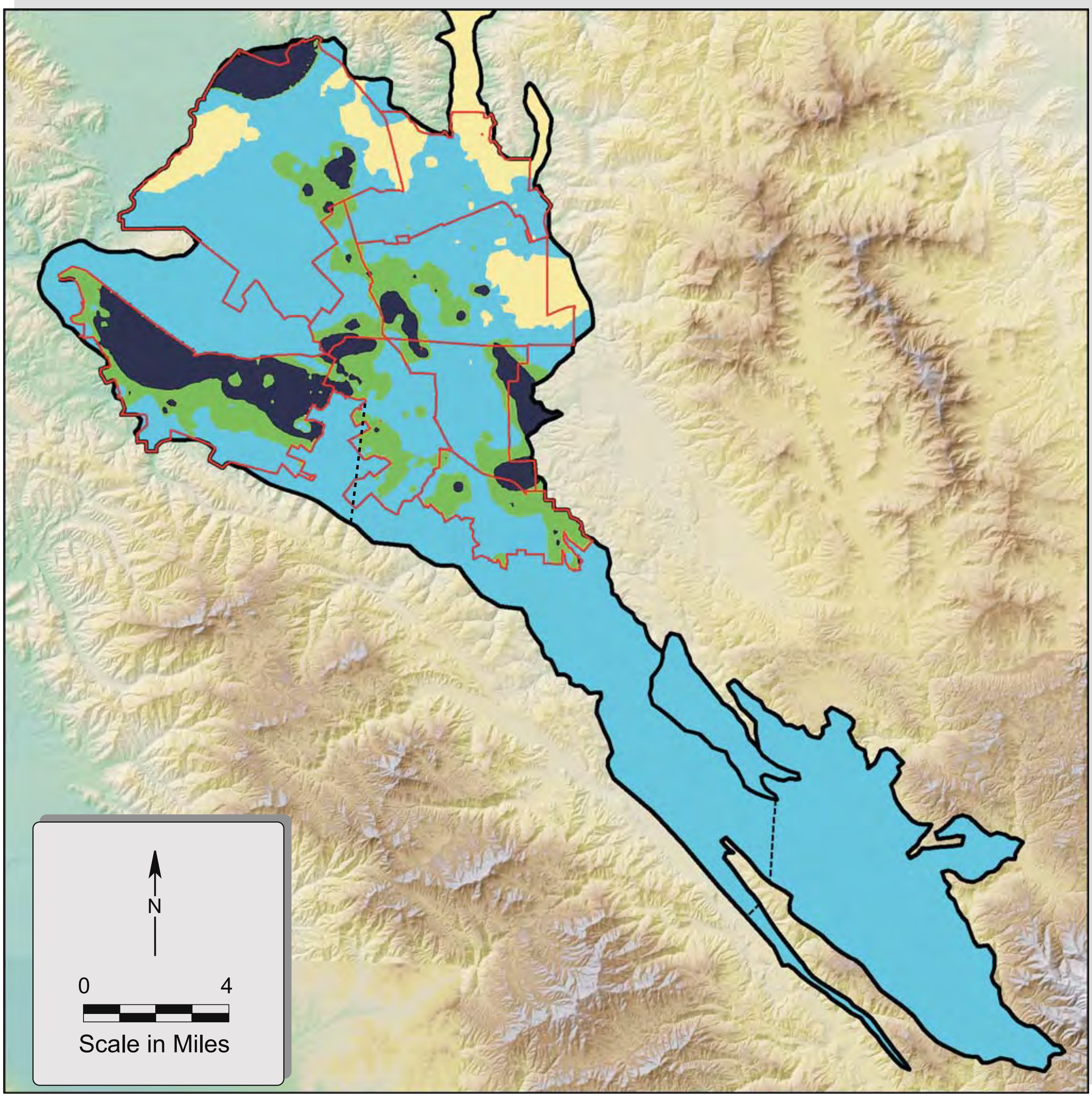

LEGEND

DWR Basin/Subbasin Boundary	
District Subbasin Boundary	
Subbasin Subarea defined for this Study	

TDS Concentration

- <500 mg/L
- 500 - 1,000 mg/L
- 1,000 - 1,200 mg/L
- > 1,200 mg/L

May 2013

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Figure 4
Interpolated TDS Concentrations

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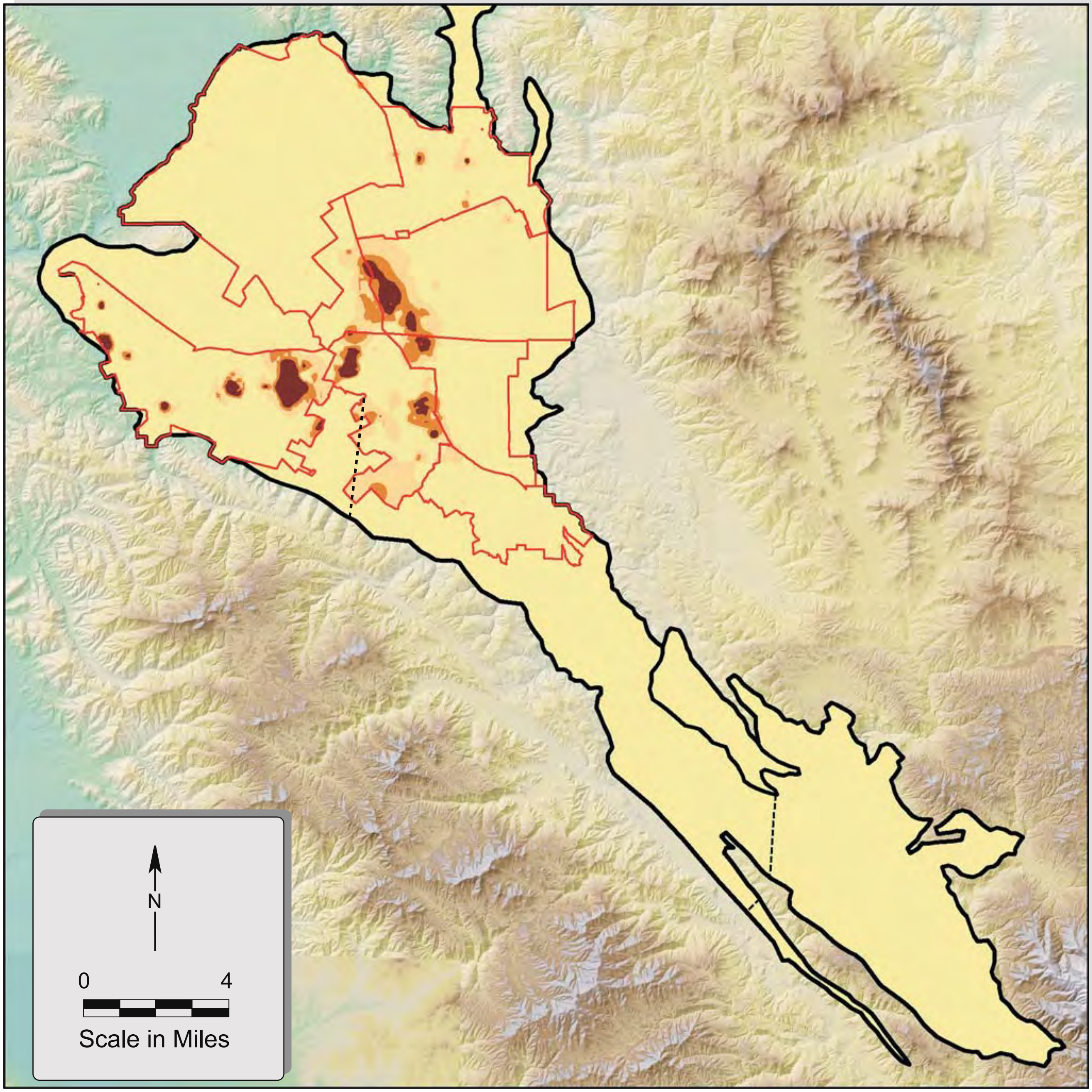
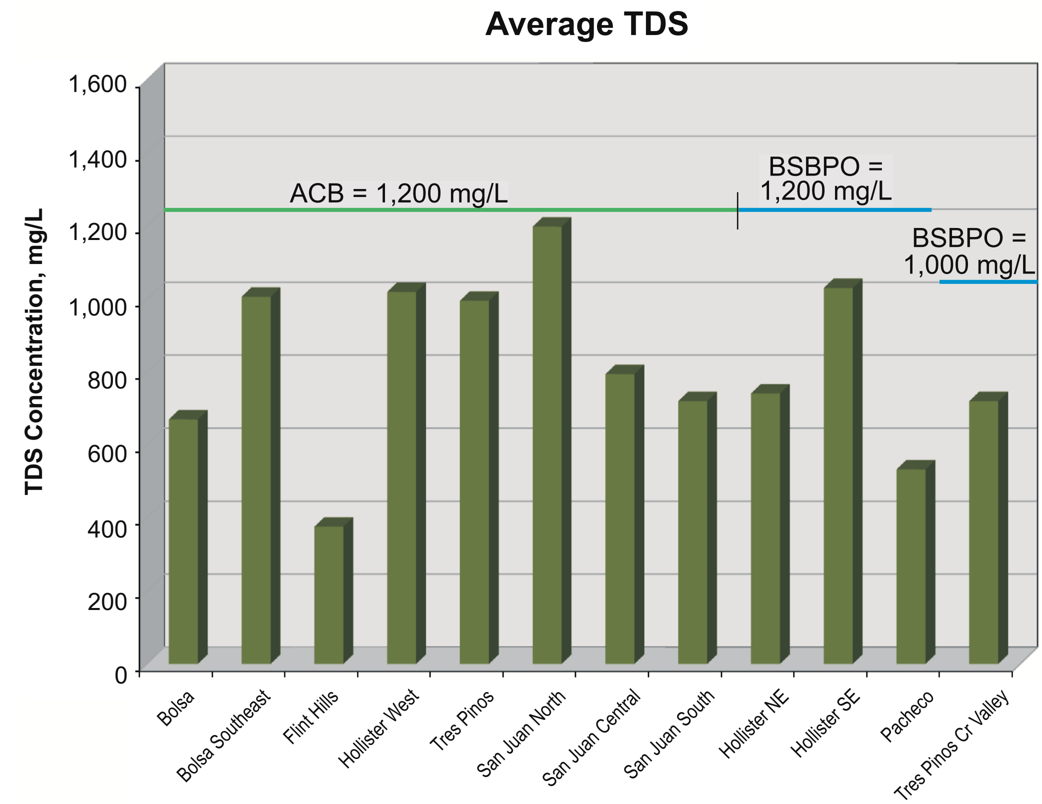


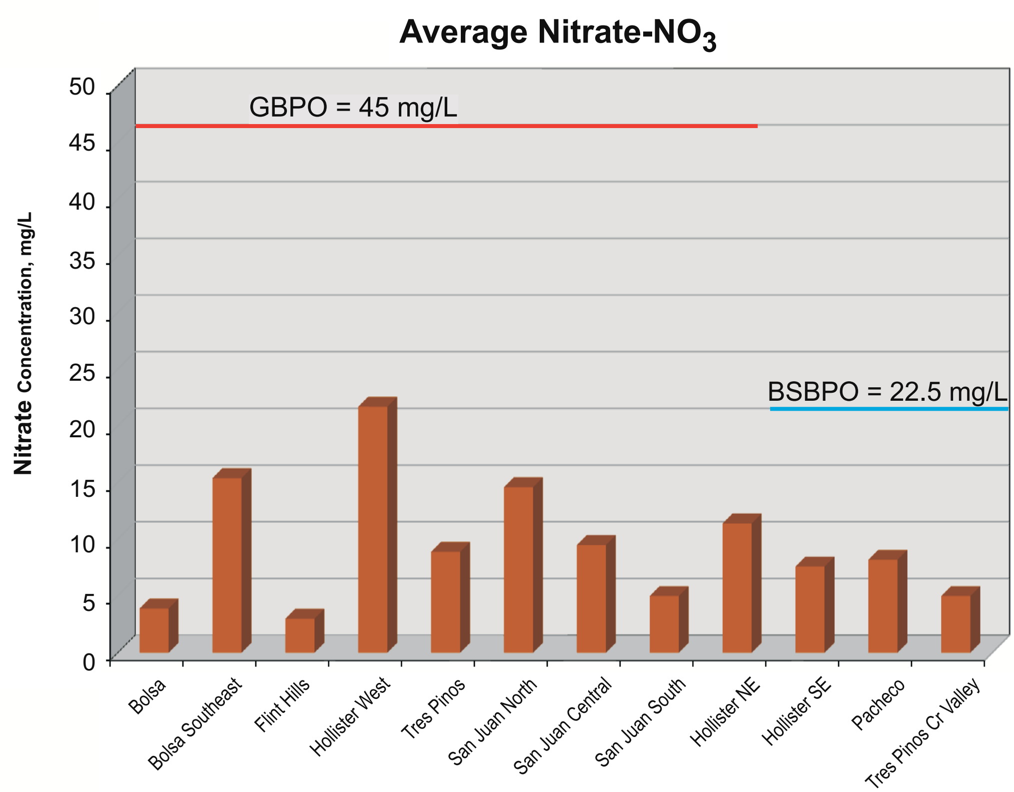
LEGEND

DWR Basin/Subbasin Boundary
District Subbasin Boundary
Subbasin Subarea defined for this Study

Nitrate-NO_3 Concentration
- 0 - 20 mg/L
- 20 - 30 mg/L
- 30 - 45 mg/L
- > 45 mg/L

May 2013	**Figure 5**
TODD ENGINEERS Alameda, California	**Interpolated Nitrate-NO_3 Concentrations**





Legend

- BSBPO - Basin Specific Basin Plan Objective
- GBPO - General Basin Plan Objective
- ACB - Assimilative Capacity Benchmark

May 2013

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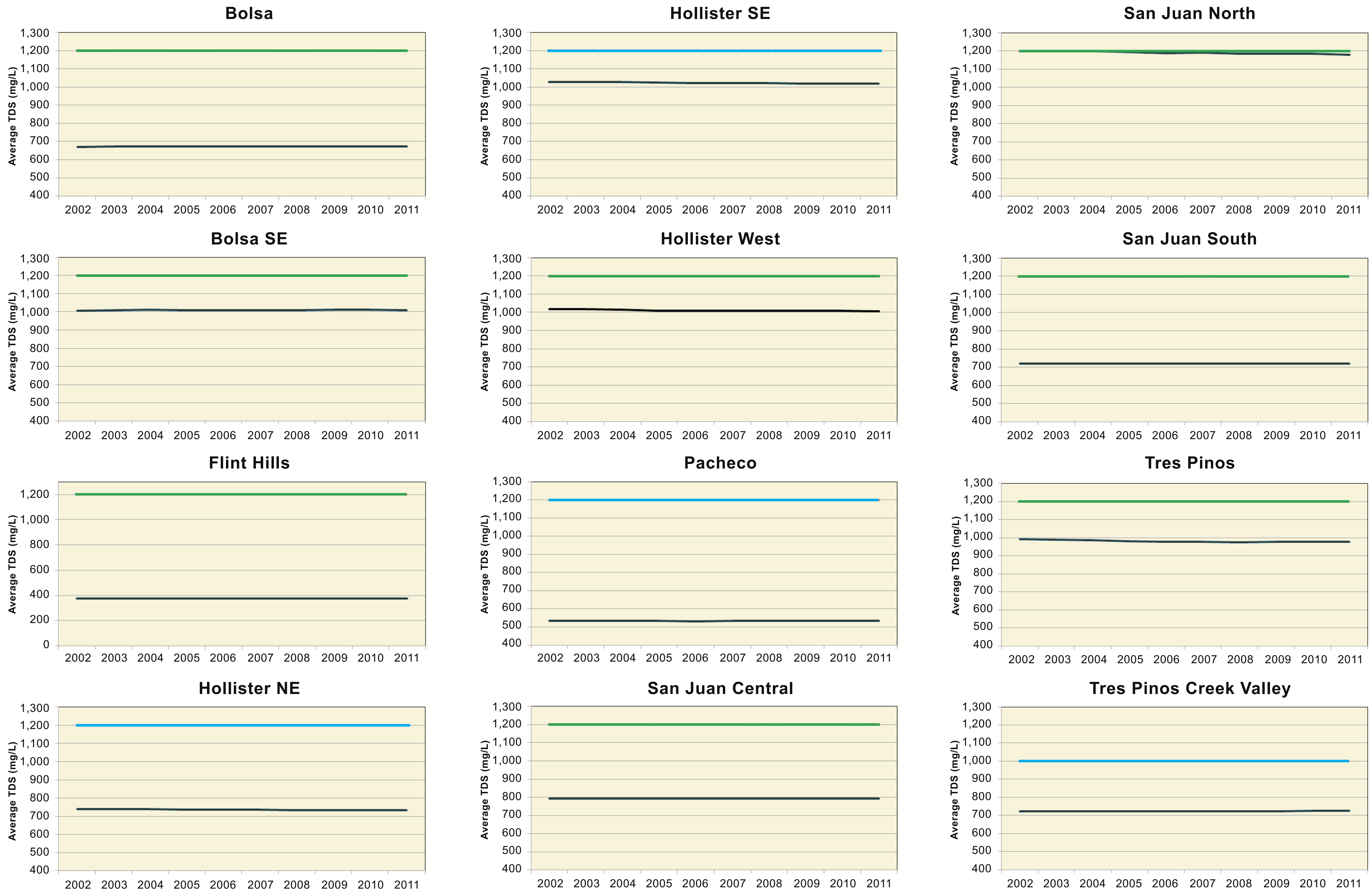
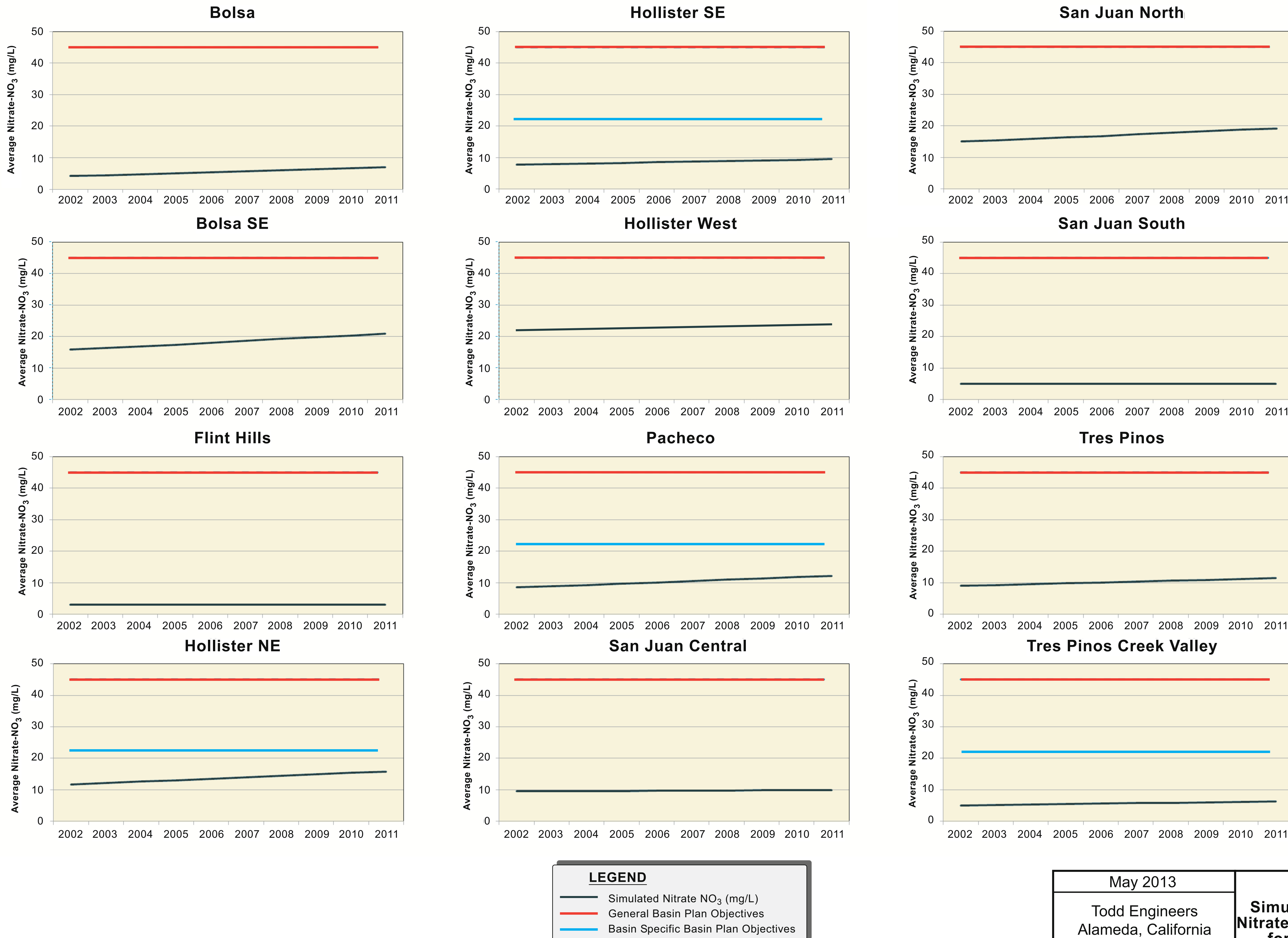
Figure 6
Average TDS and Nitrate by Basin/Subbasin



May 2013	Figure 7
Todd Engineers Alameda, California	**Simulated Groundwater TDS Concentrations for Baseline Period**



May 2013

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Figure 8
Simulated Groundwater Nitrate-NO_3 Concentrations for Baseline Period

May 2013

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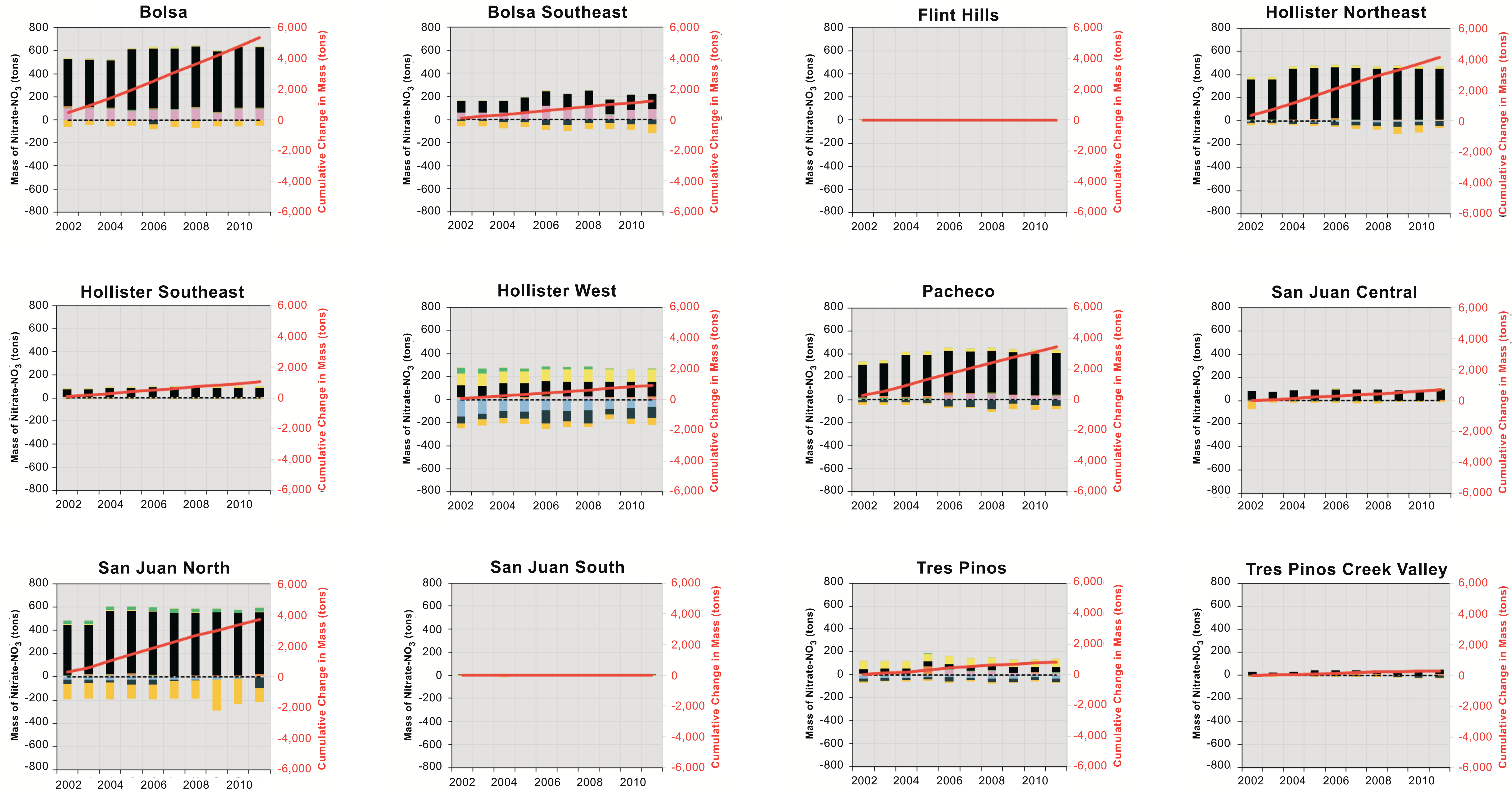
Figure 9
TDS
Mass Balance
for Baseline Period



LEGEND

Inflows

- Rural Landscape Return Flow
- Wastewater Treatment Pond Percolation
- Septic Systems Return Flow
- Agricultural Irrigation Return Flow
- Natural Stream Percolation
- Rainfall Percolation
- Subsurface Groundwater Inflow
- Municipal Irrigation Return Flow
- Reservoir Release Groundwater Percolation
- In-Stream CVP Percolation
- Sewer Leak
- Recycled Water Irrigation Return Flow

Outflows

- Municipal and Domestic Pumping
- Subsurface Groundwater Outflow
- Agricultural Pumping

- Cumulative Change in Storage

May 2013

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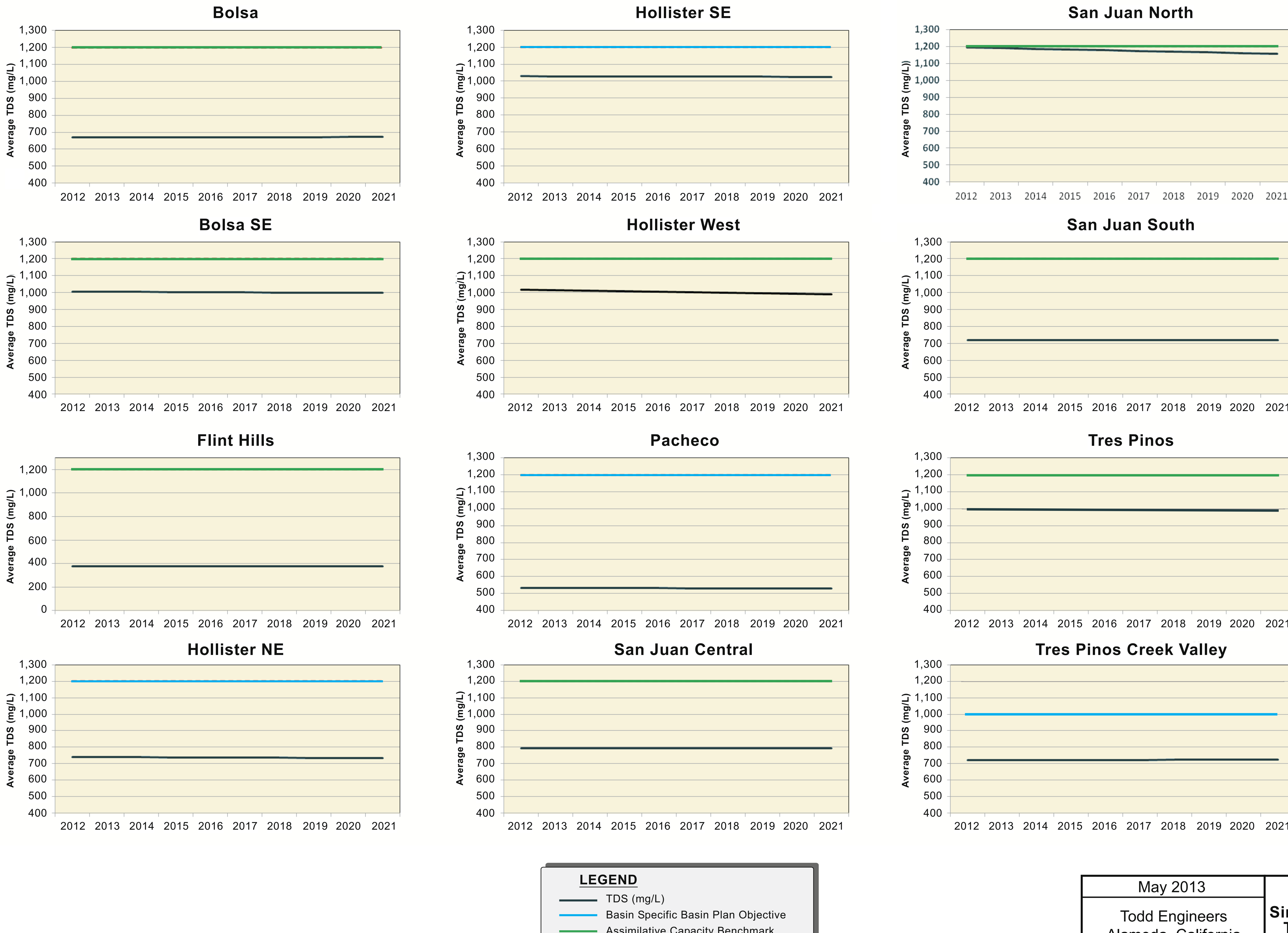
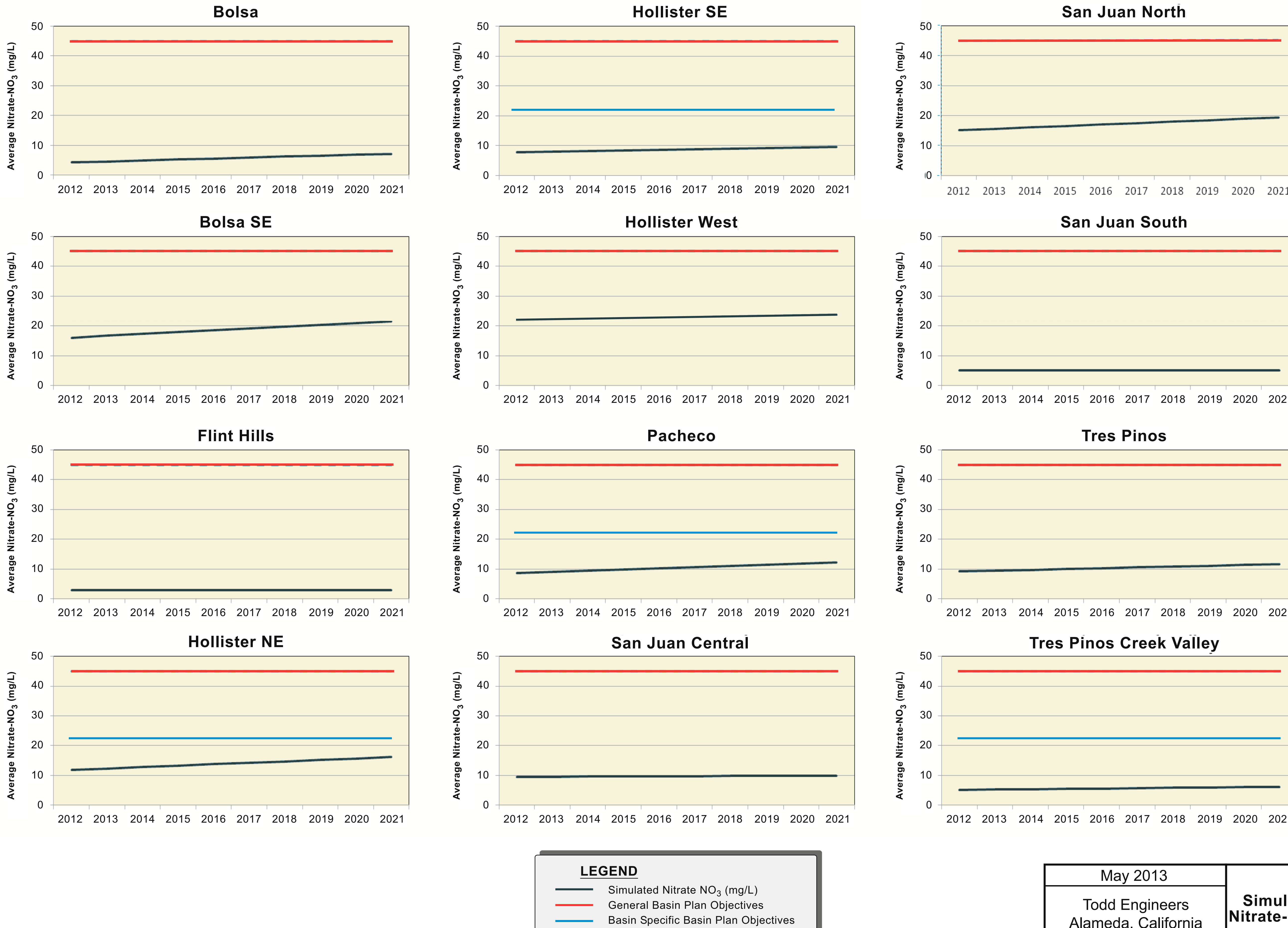
Figure 10
Nitrate-NO_3 Mass Balance for Baseline Period



May 2013	**Figure 11**
Todd Engineers Alameda, California	**Simulated Groundwater TDS Concentrations 2012 - 2021**



May 2013

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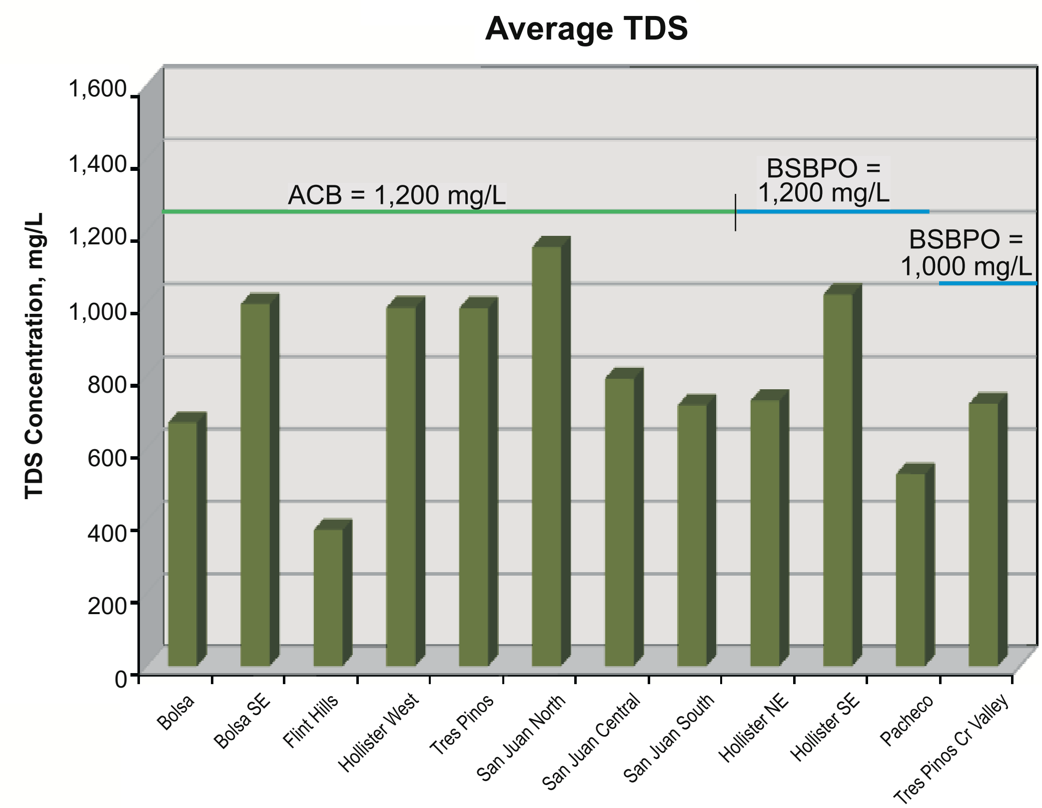
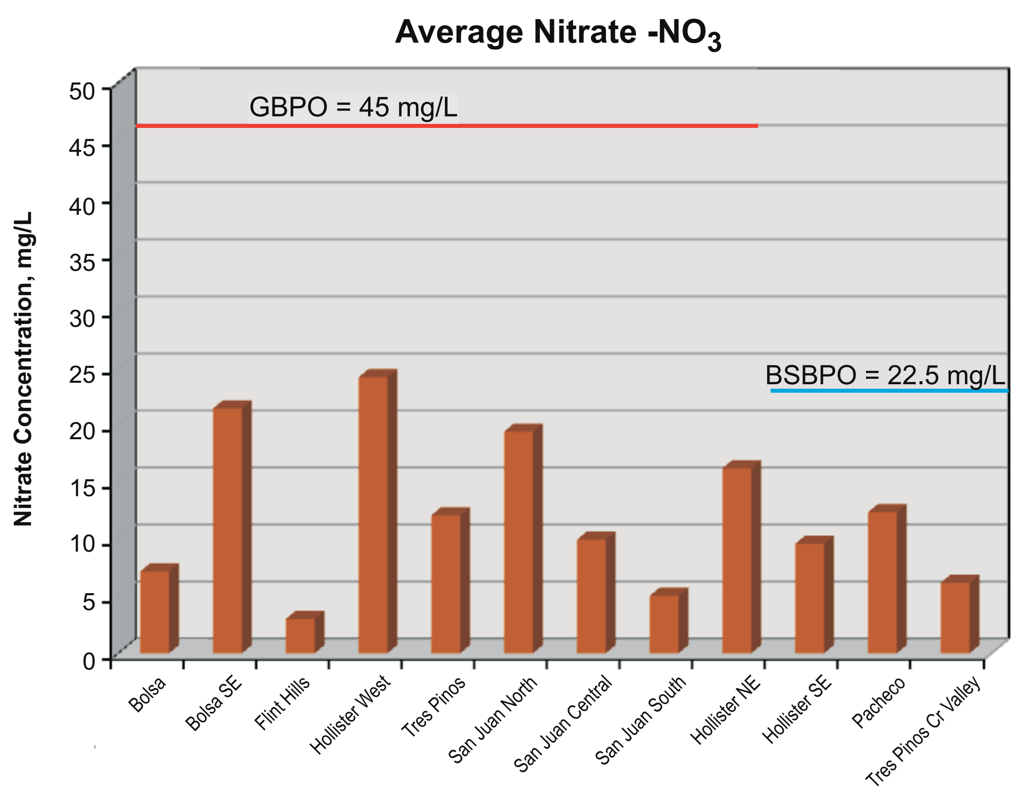
Figure 12
Simulated Groundwater Nitrate-NO_3 Concentrations 2012 - 2021





Legend

- BSBPO - Basin Specific Basin Plan Objective
- GBPO - General Basin Plan Objective
- ACB - Assimilative Capacity Benchmark

May 2013	**Figure 13**
TODD ENGINEERS Alameda, California	**Future Average TDS and Nitrate by Basin/Subbasin**

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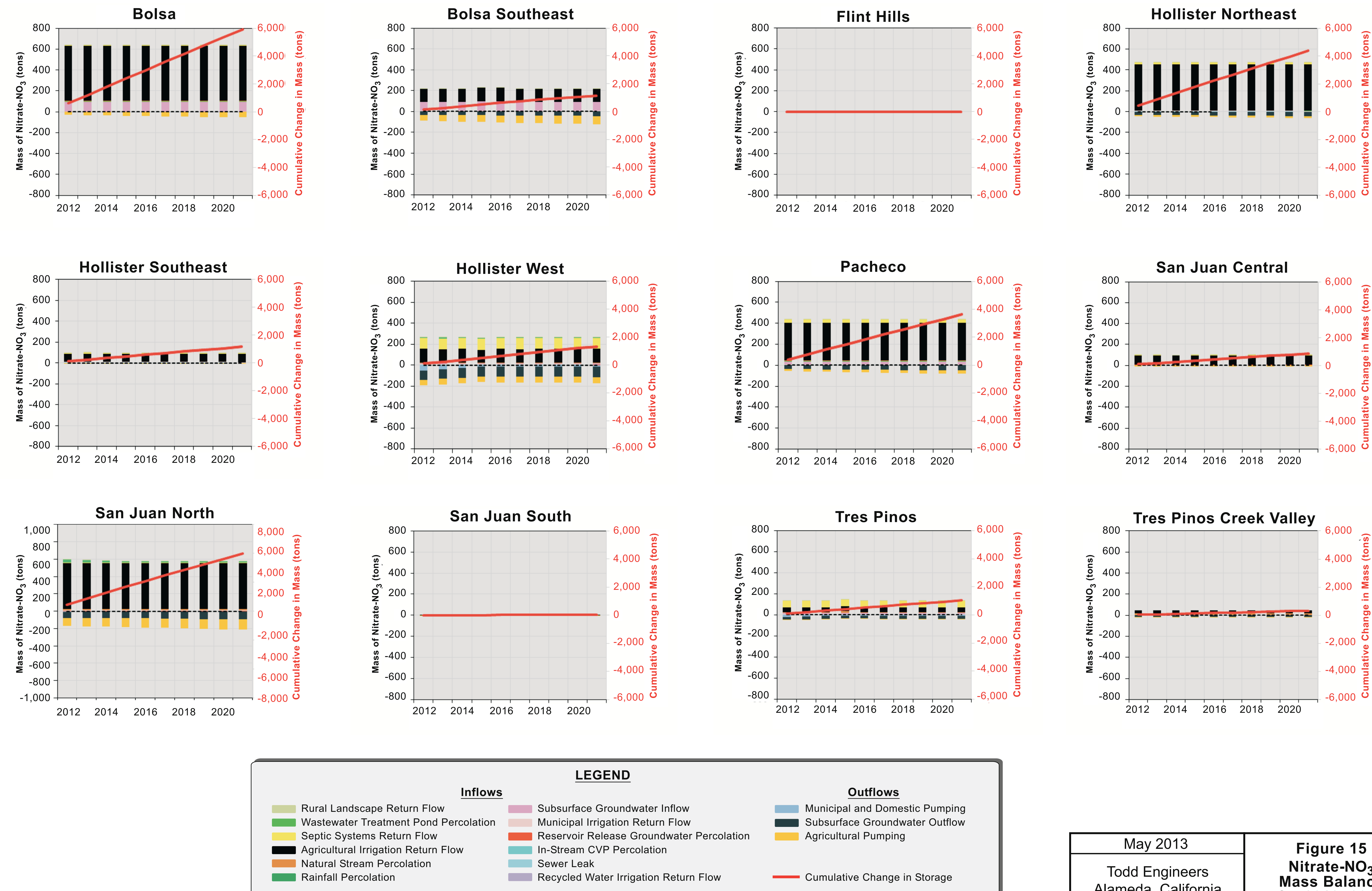
May 2013 Todd Engineers Alameda, California	**Figure 14** **TDS Mass Balance for 2012 - 2021**



May 2013

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Figure 15
Nitrate-NO_3 Mass Balance for 2012 -2021

Appendix A

Water Balance 2002 - 2011

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Water Balance Inflows and Outflows (AFY)

Water Year	BOLSA	BOLSA SE	FLINT HILLS	HOLLISTER NE	HOLLISTER SE	HOLLISTER WEST	PACHECO	SAN JUAN CENTRAL	SAN JUAN NORTH	SAN JUAN SOUTH	TRES PINOS	TRES PINOS CR VALLEY
RAINFALL DEEP PERCOLATION												
2002	1,696	536	114	1,680	686	1,479	1,348	551	3,132	344	842	0
2003	586	109	0	436	178	632	313	119	860	0	353	23
2004	1,159	307	532	1,311	535	1,312	887	224	2,005	1,604	833	63
2005	2,350	849	100	1,292	528	1,515	1,701	382	2,359	301	772	93
2006	3,853	699	0	1,937	922	1,396	1,763	451	5,499	0	842	110
2007	759	179	0	367	35	287	378	96	1,166	0	66	17
2008	2,928	556	0	1,603	547	898	1,111	224	4,414	0	594	41
2009	1,185	424	0	691	57	676	767	182	2,515	0	185	31
2010	1,403	407	0	670	47	749	806	231	2,611	0	152	43
2011	1,919	475	0	1,099	131	1,383	1,627	452	3,034	0	348	120
AGRICULTURAL IRRIGATION RETURN FLOWS												
2002	1,224	268	0	632	258	221	596	541	1,335	1	128	174
2003	840	265	0	606	248	263	551	108	1,320	1	101	34
2004	927	313	0	661	270	217	585	122	1,385	1	128	36
2005	417	235	0	606	248	213	419	106	1,150	1	80	33
2006	623	252	0	782	171	194	447	102	1,262	1	100	32
2007	709	257	0	1,036	33	214	457	116	1,218	1	95	35
2008	789	233	0	775	26	151	322	126	958	1	66	37
2009	721	185	0	511	66	340	494	114	910	1	111	34
2010	629	150	0	416	56	301	433	103	766	1	88	33
2011	577	150	0	391	55	301	435	101	767	1	88	32
NATURAL STREAM DEEP PERCOLATION												
2002	1,000	0	0	1,061	0	921	655	1,455	256	0	1,287	1,115
2003	500	0	0	1,052	0	1,846	2,166	409	1,366	0	2,090	227
2004	500	0	0	786	0	705	1,628	61	1,118	0	1,189	(50)
2005	500	0	0	2,342	0	1,936	2,000	1,197	1,512	0	3,749	2,587
2006	500	0	0	2,681	0	1,134	1,659	238	1,410	0	378	2,521
2007	500	0	0	319	0	73	799	34	25	0	24	2,673
2008	500	0	0	726	0	275	1,131	146	496	0	92	2,669
2009	500	0	0	449	0	1,517	771	0	666	0	506	413
2010	500	0	0	467	0	993	671	0	701	0	331	(316)
2011	500	0	0	693	0	1,948	896	1,304	2,272	0	812	3,003

Water Balance Inflows and Outflows (AFY)

Water Year	BOLSA	BOLSA SE	FLINT HILLS	HOLLISTER NE	HOLLISTER SE	HOLLISTER WEST	PACHECO	SAN JUAN CENTRAL	SAN JUAN NORTH	SAN JUAN SOUTH	TRES PINOS	TRES PINOS CR VALLEY
CONTROLLED RESERVOIR RELEASES FOR GROUNDWATER RECHARGE												
2002	0	0	0	0	81	470	2	0	0	0	569	0
2003	0	0	0	0	133	605	0	0	0	0	336	0
2004	0	0	0	0	135	882	0	0	0	0	2	0
2005	0	0	0	0	0	527	0	0	0	0	0	0
2006	0	0	0	0	0	1,222	0	0	587	0	407	0
2007	0	0	0	0	0	2,297	0	0	767	0	766	0
2008	0	0	0	0	0	564	0	0	412	0	188	0
2009	0	0	0	0	0	2,318	0	0	1,013	0	773	0
2010	0	0	0	0	0	1,755	0	0	829	0	585	0
2011	0	0	0	0	0	764	0	511	846	0	318	0
MANAGED GROUNDWATER RECHARGE WITH CVP WATER												
2002	0	0	0	0	0	1,181	0	1,866	231	0	1,196	0
2003	0	0	0	0	0	1,150	0	255	726	0	767	0
2004	0	0	0	0	0	340	0	30	58	0	794	0
2005	0	0	0	0	0	2,021	0	1,249	1,152	0	1,351	0
2006	0	0	0	0	0	451	0	0	0	0	1	0
2007	0	0	0	0	0	216	0	0	0	0	88	0
2008	0	0	0	0	0	6	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0	0	0	0	0
WWTP POND PERCOLATION												
2002	0	0	0	0	0	1,243	0	0	2,402	0	307	0
2003	0	0	0	0	0	1,218	0	0	2,223	0	303	0
2004	0	0	0	21	0	768	0	0	2,556	0	290	0
2005	0	0	0	22	0	662	0	0	2,553	0	253	0
2006	0	0	0	0	0	606	0	0	2,402	0	249	0
2007	0	0	0	0	0	614	0	0	2,354	0	158	0
2008	0	0	0	0	0	629	0	0	2,209	0	158	0
2009	0	0	0	0	0	214	0	0	2,190	0	191	0
2010	0	0	0	0	0	18	0	0	1,940	0	191	0
2011	0	0	0	0	0	233	0	0	2,040	0	202	0

Water Balance Inflows and Outflows (AFY)

Water Year	BOLSA	BOLSA SE	FLINT HILLS	HOLLISTER NE	HOLLISTER SE	HOLLISTER WEST	PACHECO	SAN JUAN CENTRAL	SAN JUAN NORTH	SAN JUAN SOUTH	TRES PINOS	TRES PINOS CR VALLEY
SUBSURFACE GROUNDWATER INFLOW (ADJUSTED) [1]												
2002	6,965	1,994	0	317	246	1,278	879	0	432	0	571	0
2003	6,965	1,994	0	317	246	1,278	879	0	1,432	0	571	0
2004	6,465	1,994	0	62	1	778	879	0	1,432	0	71	0
2005	5,465	1,994	0	62	1	778	879	0	1,432	0	571	0
2006	5,965	3,744	0	375	438	2,028	3,879	489	432	0	3,571	500
2007	5,965	2,994	0	375	438	2,278	4,379	489	182	0	2,571	500
2008	6,965	3,994	0	43	520	2,278	4,629	489	182	0	3,071	500
2009	3,965	1,494	0	296	267	1,311	3,300	0	192	0	1,215	0
2010	6,565	2,868	0	364	240	1,299	2,748	0	1	0	1,472	0
2011	6,641	3,049	0	239	224	1,297	2,916	0	32	0	1,574	0
WATER LINE LEAKAGE												
2002	0	0	0	10	65	74	1	0	15	0	54	0
2003	0	0	0	10	65	74	1	0	15	0	54	0
2004	0	0	0	10	65	74	1	0	15	0	54	0
2005	0	0	0	10	65	74	1	0	15	0	54	0
2006	0	0	0	10	65	74	1	0	15	0	54	0
2007	0	0	0	10	65	74	1	0	15	0	54	0
2008	0	0	0	10	65	74	1	0	15	0	54	0
2009	0	0	0	10	65	74	1	0	15	0	54	0
2010	0	0	0	10	65	74	1	0	7	0	54	0
2011	0	0	0	10	65	74	1	0	15	0	54	0
SEWER LINE LEAKAGE												
2002	0	0	0	86	86	127	0	0	15	0	24	0
2003	0	0	0	86	86	127	0	0	15	0	24	0
2004	0	0	0	86	86	127	0	0	15	0	24	0
2005	0	0	0	86	86	127	0	0	15	0	24	0
2006	0	0	0	86	86	127	0	0	15	0	24	0
2007	0	0	0	86	86	127	0	0	15	0	24	0
2008	0	0	0	86	86	127	0	0	15	0	24	0
2009	0	0	0	86	86	127	0	0	15	0	24	0
2010	0	0	0	86	86	127	0	0	8	0	24	0
2011	0	0	0	86	86	127	0	0	15	0	24	0

Water Balance Inflows and Outflows (AFY)

Water Year	BOLSA	BOLSA SE	FLINT HILLS	HOLLISTER NE	HOLLISTER SE	HOLLISTER WEST	PACHECO	SAN JUAN CENTRAL	SAN JUAN NORTH	SAN JUAN SOUTH	TRES PINOS	TRES PINOS CR VALLEY
SEPTIC SYSTEMS RETURN FLOWS												
2002	33	5	0	85	36	437	115	0	24	0	291	0
2003	33	5	0	85	36	437	115	0	24	0	291	0
2004	33	5	0	85	36	437	115	0	24	0	291	0
2005	33	5	0	85	36	437	115	0	24	0	291	0
2006	33	5	0	85	36	437	115	10	24	0	291	0
2007	33	5	0	85	36	437	115	10	24	0	291	0
2008	33	5	0	85	36	437	115	10	24	0	291	0
2009	33	5	0	85	36	437	115	0	24	0	291	0
2010	33	5	0	85	36	437	115	0	12	0	291	0
2011	33	5	0	85	36	437	115	10	24	0	291	0
RURAL LANDSCAPE IRRIGATION RETURN FLOWS												
2002	2	0.3	0	4	2	22	6	0	1	0	15	0
2003	2	0.3	0	4	2	22	6	0	1	0	15	0
2004	2	0.3	0	4	2	22	6	0	1	0	15	0
2005	2	0.3	0	4	2	22	6	0	1	0	15	0
2006	2	0.3	0	4	2	22	6	1	1	0	15	0
2007	2	0.3	0	4	2	22	6	1	1	0	15	0
2008	2	0	0	4	2	22	6	1	1	0	15	0
2009	2	0	0	4	2	22	6	0	1	0	15	0
2010	2	0	0	4	2	22	6	0	1	0	15	0
2011	2	0	0	4	2	22	6	1	1	0	15	0
MUNICIPAL IRRIGATION RETURN FLOWS												
2002	0	0	0	8	54	62	0	0	12	0	45	0
2003	0	0	0	8	54	62	0	0	12	0	45	0
2004	0	0	0	8	54	62	0	0	12	0	45	0
2005	0	0	0	8	54	62	0	0	12	0	45	0
2006	0	0	0	8	54	62	0	0	12	0	45	0
2007	0	0	0	8	54	62	0	0	12	0	45	0
2008	0	0	0	8	54	62	0	0	12	0	45	0
2009	0	0	0	8	54	62	0	0	12	0	45	0
2010	0	0	0	8	54	62	0	0	6	0	45	0
2011	0	0	0	8	54	62	0	0	12	0	45	0

Water Balance Inflows and Outflows (AFY)

Water Year	BOLSA	BOLSA SE	FLINT HILLS	HOLLISTER NE	HOLLISTER SE	HOLLISTER WEST	PACHECO	SAN JUAN CENTRAL	SAN JUAN NORTH	SAN JUAN SOUTH	TRES PINOS	TRES PINOS CR VALLEY
RECYCLED WATER IRRIGATION RETURN FLOWS												
2002	0	0	0	0	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0	0	0	0	0	0
2004	0	0	0	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0	0	0	0
2006	0	0	0	0	0	0	0	0	0	0	0	0
2007	0	0	0	0	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0	0	0	0	0
2010	0	0	0	5	0	5	0	0	0	0	0	0
2011	0	0	0	7	0	4	0	0	0	0	0	0
AGRICULTURAL PUMPING												
2002	(12,235)	(2,179)	0	(1,149)	(425)	(1,564)	(2,149)	(5,413)	(6,641)	0	(1,150)	(1,743)
2003	(8,399)	(2,159)	0	(833)	(308)	(1,963)	(2,258)	(1,082)	(6,506)	(1)	(891)	(336)
2004	(9,270)	(2,395)	0	(734)	(272)	(1,626)	(2,276)	(1,218)	(6,941)	(1)	(1,086)	(363)
2005	(7,697)	(1,837)	0	(887)	(361)	(1,477)	(1,128)	(1,057)	(5,655)	(1)	(711)	(334)
2006	(6,234)	(1,856)	0	(790)	(473)	(1,422)	(1,029)	(1,016)	(5,822)	(1)	(842)	(316)
2007	(7,086)	(1,998)	0	(1,739)	(628)	(1,662)	(810)	(1,156)	(6,562)	(1)	(849)	(350)
2008	(7,889)	(2,001)	0	(1,752)	(887)	(1,143)	(1,703)	(1,255)	(6,744)	(1)	(567)	(372)
2009	(7,213)	(2,073)	0	(3,174)	(361)	(1,495)	(3,106)	(1,140)	(10,943)	(1)	(600)	(344)
2010	(6,294)	(1,896)	0	(3,088)	(651)	(1,614)	(2,517)	(1,032)	(8,745)	(1)	(575)	(326)
2011	(5,775)	(2,775)	0	(915)	(332)	(1,801)	(1,910)	(1,013)	(4,664)	(1)	(390)	(322)

Water Balance Inflows and Outflows (AFY)

Water Year	BOLSA	BOLSA SE	FLINT HILLS	HOLLISTER NE	HOLLISTER SE	HOLLISTER WEST	PACHECO	SAN JUAN CENTRAL	SAN JUAN NORTH	SAN JUAN SOUTH	TRES PINOS	TRES PINOS CR VALLEY
DOMESTIC AND MUNICIPAL PUMPING												
2002	0	(14)	0	(365)	(649)	(5,013)	(173)	0	(930)	0	(2,844)	(47)
2003	0	(16)	0	(272)	(484)	(4,259)	(167)	0	(928)	0	(1,914)	(47)
2004	0	(11)	0	(474)	(842)	(3,345)	(185)	0	(1,180)	0	(2,118)	(47)
2005	0	(12)	0	(640)	(699)	(3,607)	(192)	0	(953)	0	(1,667)	(52)
2006	0	(8)	0	(471)	(821)	(3,211)	(180)	0	(919)	0	(1,645)	(49)
2007	0	(7)	0	(491)	(1,010)	(3,456)	(224)	0	(1,096)	0	(2,013)	(46)
2008	0	(13)	0	(661)	(662)	(3,232)	(197)	0	(1,053)	0	(2,130)	(47)
2009	0	(9)	0	(421)	(777)	(2,691)	(264)	0	(1,013)	0	(2,271)	0
2010	0	(0)	0	(266)	(455)	(2,467)	(36)	0	(816)	0	(1,111)	0
2011	0	(6)	0	(72)	(628)	(2,139)	(82)	0	(322)	0	(2,064)	0
GROUNDWATER OUTFLOW												
2002	0	(500)	0	(1,000)	0	(2,000)	(2,000)	(500)	(2,000)	(344)	(2,000)	(500)
2003	0	(500)	0	(1,000)	0	(1,500)	(1,500)	(500)	(1,500)	0	(2,000)	(500)
2004	0	(1,000)	0	(1,000)	0	(2,000)	(1,500)	(250)	(1,000)	(1,604)	(1,500)	(250)
2005	(500)	(1,000)	0	(1,000)	0	(2,000)	(2,000)	(500)	(2,000)	(301)	(1,500)	(500)
2006	(5,250)	(2,000)	0	(1,500)	0	(3,750)	(4,250)	(500)	(2,000)	0	(2,750)	(500)
2007	(1,500)	(2,000)	0	(1,500)	0	(2,750)	(4,250)	(500)	(500)	0	(1,250)	(500)
2008	(1,250)	(1,250)	0	(1,500)	0	(3,500)	(5,500)	(500)	(250)	0	(2,500)	(500)
2009	0	(1,000)	0	(2,159)	0	(1,500)	(2,000)	0	(19)	0	(2,000)	(1,644)
2010	0	(1,473)	0	(1,619)	0	(2,874)	(3,108)	0	(19)	0	(2,000)	(1,901)
2011	0	(1,500)	0	(2,000)	0	(3,055)	(3,191)	0	(3,600)	0	(2,000)	(2,003)

Source: Todd (2012b) AFY - acre-feet per year CR - creek WWTP - wastewater treatment plant

1 - Groundwater inflows adjusted to account for minor inflows from septic system returns, sewer line leaks, water line leaks, recycled water return flows, and domestic irrigation return flows

Appendix B

Agricultural Irrigation Source Water Quality

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Agricultural Irrigation Source Water Quality

WATER YEAR	BASIN/ SUBBASIN	AFY			% CVP	% GW	SOURCE WATER (mg/L)				BLENDED WATER (mg/L)		
		CVP	GW	TOTAL			CVP TDS	CVP NO_3	GW TDS	GW NO_3	TDS	TDS with ET [1]	NO_3
2002	BOLSA	0	12,235	12,235	0%	100%	298	3.6	670	4	670	2,010	4
2002	BOLSA SE	497	2,179	2,676	19%	81%	298	3.6	1,006	15	875	2,624	13
2002	FLINT HILLS	0	0	0	0%	0%	298	3.6	376	3	0	0	0
2002	HOLLISTER NE	6,499	1,149	7,648	85%	15%	298	3.6	741	11	365	1,094	5
2002	HOLLISTER SE	823	425	1,248	66%	34%	298	3.6	1,030	8	547	1,642	5
2002	HOLLISTER WEST	643	1,564	2,207	29%	71%	298	3.6	1,019	22	809	2,427	16
2002	PACHECO	3807	2,149	5,956	64%	36%	298	3.6	533	8	383	1,148	5
2002	SAN JUAN CENTRAL	6704	5,413	12,117	55%	45%	298	3.6	794	10	520	1,559	6
2002	SAN JUAN NORTH	0	6,641	6,641	0%	100%	298	3.6	1,198	15	1,198	3,594	15
2002	SAN JUAN SOUTH	0	0	0	0%	0%	298	3.6	720	5	0	0	0
2002	TRES PINOS	126	1,150	1,276	10%	90%	298	3.6	995	9	926	2,779	8
2002	TRES PINOS CR VALLEY	0	1,743	1,743	0%	100%	298	3.6	720	5	720	2,160	5
2003	BOLSA	0	8,399	8,399	0%	100%	298	3.6	670	4	670	2,010	4
2003	BOLSA SE	493	2,159	2,652	19%	81%	298	3.6	1,006	15	874	2,623	13
2003	FLINT HILLS	0	0	0	0%	0%	298	3.6	376	3	0	0	0
2003	HOLLISTER NE	6,563	833	7,396	89%	11%	298	3.6	741	11	348	1,044	4
2003	HOLLISTER SE	832	308	1,140	73%	27%	298	3.6	1,030	8	496	1,488	5
2003	HOLLISTER WEST	665	1,963	2,628	25%	75%	298	3.6	1,019	22	837	2,510	17
2003	PACHECO	3,254	2,258	5,512	59%	41%	298	3.6	533	8	394	1,183	5
2003	SAN JUAN CENTRAL	0	1,082	1,082	0%	100%	298	3.6	794	10	794	2,382	10
2003	SAN JUAN NORTH	6,692	6,506	13,198	51%	49%	298	3.6	1,198	15	742	2,225	9
2003	SAN JUAN SOUTH	0	0	0	0%	0%	298	3.6	720	5	0	0	0
2003	TRES PINOS	116	891	1,007	12%	88%	298	3.6	995	9	915	2,744	8
2003	TRES PINOS CR VALLEY	0	336	336	0%	100%	298	3.6	720	5	720	2,160	5
2004	BOLSA	0	9,270	9,270	0%	100%	298	3.6	670	4	670	2,010	4
2004	BOLSA SE	740	2,395	3,135	24%	76%	298	3.6	1,006	15	839	2,517	13
2004	FLINT HILLS	0	0	0	0%	0%	298	3.6	376	3	0	0	0
2004	HOLLISTER NE	7,375	734	8,109	91%	9%	298	3.6	741	11	338	1,014	4
2004	HOLLISTER SE	934	272	1,206	77%	23%	298	3.6	1,030	8	463	1,389	5
2004	HOLLISTER WEST	541	1,626	2,167	25%	75%	298	3.6	1,019	22	839	2,517	17
2004	PACHECO	3,578	2,276	5,854	61%	39%	298	3.6	533	8	389	1,168	5
2004	SAN JUAN CENTRAL	0	1,218	1,218	0%	100%	298	3.6	794	10	794	2,382	10
2004	SAN JUAN NORTH	6,905	6,941	13,846	50%	50%	298	3.6	1,198	15	749	2,248	9
2004	SAN JUAN SOUTH	0	0	0	0%	0%	298	3.6	720	5	0	0	0
2004	TRES PINOS	194	1,086	1,280	15%	85%	298	3.6	995	9	889	2,668	8
2004	TRES PINOS CR VALLEY	0	363	363	0%	100%	298	3.6	720	5	720	2,160	5
2004	BOLSA		7,697	7,697	0%	100%	298	3.6	670	4	670	2,010	4

Agricultural Irrigation Source Water Quality

WATER YEAR	BASIN/ SUBBASIN	AFY			% CVP	% GW	SOURCE WATER (mg/L)				BLENDED WATER (mg/L)		
		CVP	GW	TOTAL			CVP TDS	CVP NO_3	GW TDS	GW NO_3	TDS	TDS with ET [1]	NO_3
2005	BOLSA SE	514	1,837	2,351	22%	78%	298	3.6	1,006	15	851	2,553	13
2005	FLINT HILLS	0	0	0	0%	0%	298	3.6	376	3	0	0	0
2005	HOLLISTER NE	6,335	887	7,222	88%	12%	298	3.6	741	11	352	1,057	5
2005	HOLLISTER SE	964	361	1,325	73%	27%	298	3.6	1,030	8	497	1,492	5
2005	HOLLISTER WEST	659	1,477	2,136	31%	69%	298	3.6	1,019	22	797	2,390	16
2005	PACHECO	3,062	1,128	4,190	73%	27%	298	3.6	533	8	361	1,084	5
2005	SAN JUAN CENTRAL	0	1,057	1,057	0%	100%	298	3.6	794	10	794	2,382	10
2005	SAN JUAN NORTH	5,841	5,655	11,496	51%	49%	298	3.6	1,198	15	741	2,222	9
2005	SAN JUAN SOUTH	0	0	0	0%	0%	298	3.6	720	5	0	0	0
2005	TRES PINOS	90	711	801	11%	89%	298	3.6	995	9	917	2,751	8
2005	TRES PINOS CR VALLEY	0	334	334	0%	100%	298	3.6	720	5	720	2,160	5
2006	BOLSA	0	6,234	6,234	0%	100%	298	3.6	670	4	670	2,010	4
2006	BOLSA SE	661	1,856	2,517	26%	74%	298	3.6	1,006	15	820	2,460	12
2006	FLINT HILLS	0	0	0	0%	0%	298	3.6	376	3	0	0	0
2006	HOLLISTER NE	7,028	790	7,817	90%	10%	298	3.6	741	11	343	1,028	4
2006	HOLLISTER SE	1,236	473	1,709	72%	28%	298	3.6	1,030	8	501	1,502	5
2006	HOLLISTER WEST	515	1,422	1,937	27%	73%	298	3.6	1,019	22	827	2,481	17
2006	PACHECO	3,441	1,029	4,469	77%	23%	298	3.6	533	8	352	1,056	5
2006	SAN JUAN CENTRAL	0	1,016	1,016	0%	100%	298	3.6	794	10	794	2,382	10
2006	SAN JUAN NORTH	6,800	5,822	12,622	54%	46%	298	3.6	1,198	15	713	2,139	9
2006	SAN JUAN SOUTH		0	0	0%	0%	298	3.6	720	5	0	0	0
2006	TRES PINOS	161	842	1,004	16%	84%	298	3.6	995	9	883	2,649	8
2006	TRES PINOS CR VALLEY	0	316	316	0%	100%	298	3.6	720	5	720	2,160	5
2007	BOLSA	0	7,086	7,086	0%	100%	298	3.6	670	4	670	2,010	4
2007	BOLSA SE	572	1,998	2,570	22%	78%	298	3.6	1,006	15	848	2,545	13
2007	FLINT HILLS	0	0	0	0%	0%	298	3.6	376	3	0	0	0
2007	HOLLISTER NE	7,284	1,739	9,023	81%	19%	298	3.6	741	11	383	1,150	5
2007	HOLLISTER SE	1,041	628	1,669	62%	38%	298	3.6	1,030	8	573	1,720	5
2007	HOLLISTER WEST	492	1,662	2,155	23%	77%	298	3.6	1,019	22	854	2,563	18
2007	PACHECO	3,763	810	4,573	82%	18%	298	3.6	533	8	340	1,019	4
2007	SAN JUAN CENTRAL	0	1,156	1,156	0%	100%	298	3.6	794	10	794	2,382	10
2007	SAN JUAN NORTH	5,622	6,562	12,185	46%	54%	298	3.6	1,198	15	783	2,348	10
2007	SAN JUAN SOUTH		0	0	0%	0%	298	3.6	720	5	0	0	0
2007	TRES PINOS	105	849	954	11%	89%	298	3.6	995	9	918	2,754	8
2007	TRES PINOS CR VALLEY	0	350	350	0%	100%	298	3.6	720	5	720	2,160	5

Agricultural Irrigation Source Water Quality

WATER YEAR	BASIN/ SUBBASIN	AFY			% CVP	% GW	SOURCE WATER (mg/L)				BLENDED WATER (mg/L)		
		CVP	GW	TOTAL			CVP TDS	CVP NO_3	GW TDS	GW NO_3	TDS	TDS with ET [1]	NO_3
2008	BOLSA	0	7,889	7,889	0%	100%	298	3.6	670	4	670	2,010	4
2008	BOLSA SE	333	2,001	2,334	14%	86%	298	3.6	1,006	15	905	2,715	14
2008	FLINT HILLS	0	0	0	0%	0%	298	3.6	376	3	0	0	0
2008	HOLLISTER NE	4,946	1,752	6,698	74%	26%	298	3.6	741	11	414	1,242	6
2008	HOLLISTER SE	426	887	1,313	32%	68%	298	3.6	1,030	8	792	2,377	6
2008	HOLLISTER WEST	366	1,143	1,509	24%	76%	298	3.6	1,019	22	844	2,532	17
2008	PACHECO	1,517	1,703	3,220	47%	53%	298	3.6	533	8	422	1,267	6
2008	SAN JUAN CENTRAL	0	1,255	1,255	0%	100%	298	3.6	794	10	794	2,382	10
2008	SAN JUAN NORTH	2,837	6,744	9,581	30%	70%	298	3.6	1,198	15	931	2,794	11
2008	SAN JUAN SOUTH	0	0	0	0%	0%	298	3.6	720	5	0	0	0
2008	TRES PINOS	88	567	655	13%	87%	298	3.6	995	9	901	2,703	8
2008	TRES PINOS CR VALLEY	0	372	372	0%	100%	298	3.6	720	5	720	2,160	5
2009	BOLSA	0	7,213	7,213	0%	100%	298	3.6	670	4	670	2,010	4
2009	BOLSA SE	179	2,073	2,252	8%	92%	298	3.6	1,006	15	950	2,849	14
2009	FLINT HILLS	0	0	0	0%	0%	298	3.6	376	3	0	0	0
2009	HOLLISTER NE	3,123	3,174	6,296	50%	50%	298	3.6	741	11	521	1,564	8
2009	HOLLISTER SE	194	361	555	35%	65%	298	3.6	1,030	8	774	2,323	6
2009	HOLLISTER WEST	213	1,495	1,708	12%	88%	298	3.6	1,019	22	929	2,787	19
2009	PACHECO	1,206	3,106	4,312	28%	72%	298	3.6	533	8	467	1,402	7
2009	SAN JUAN CENTRAL	0	1,140	1,140	0%	100%	298	3.6	794	10	794	2,382	10
2009	SAN JUAN NORTH	1,454	10,943	12,397	12%	88%	298	3.6	1,198	15	1,092	3,277	13
2009	SAN JUAN SOUTH	0	0	0	0%	0%	298	3.6	720	5	0	0	0
2009	TRES PINOS	70	600	670	10%	90%	298	3.6	995	9	922	2,766	8
2009	TRES PINOS CR VALLEY	0	344	344	0%	100%	298	3.6	720	5	720	2,160	5
2010	BOLSA	0	6,294	6,294	0%	100%	298	3.6	670	4	670	2,010	4
2010	BOLSA SE	207	1,896	2,103	10%	90%	298	3.6	1,006	15	936	2,809	14
2010	FLINT HILLS	0	0	0	0%	0%	298	3.6	376	3	0	0	0
2010	HOLLISTER NE	4,277	3,088	7,365	58%	42%	298	3.6	741	11	484	1,451	7
2010	HOLLISTER SE	285	651	937	30%	70%	298	3.6	1,030	8	807	2,421	6
2010	HOLLISTER WEST	274	1,614	1,888	15%	85%	298	3.6	1,019	22	914	2,743	19
2010	PACHECO	1,743	2,517	4,260	41%	59%	298	3.6	533	8	437	1,311	6
2010	SAN JUAN CENTRAL	0	1,032	1,032	0%	100%	298	3.6	794	10	794	2,382	10
2010	SAN JUAN NORTH	3,215	8,745	11,960	27%	73%	298	3.6	1,198	15	956	2,868	12
2010	SAN JUAN SOUTH	0	0	0	0%	0%	298	3.6	720	5	0	0	0
2010	TRES PINOS	65	575	640	10%	90%	298	3.6	995	9	925	2,774	8
2010	TRES PINOS CR VALLEY	0	326	326	0%	100%	298	3.6	720	5	720	2,160	5

Agricultural Irrigation Source Water Quality

WATER YEAR	BASIN/ SUBBASIN	AFY			% CVP	% GW	SOURCE WATER (mg/L)				BLENDED WATER (mg/L)		
		CVP	GW	TOTAL			CVP TDS	CVP NO_3	GW TDS	GW NO_3	TDS	TDS with ET [1]	NO_3
2011	BOLSA		5,775	5,775	0%	100%	298	3.6	670	4	670	2,010	4
2011	BOLSA SE	229	2,775	3,004	8%	92%	298	3.6	1,006	15	952	2,856	15
2011	FLINT HILLS	0	0	0	0%	0%	298	3.6	376	3	0	0	0
2011	HOLLISTER NE	7,084	915	8,000	89%	11%	298	3.6	741	11	349	1,046	4
2011	HOLLISTER SE	718	332	1,050	68%	32%	298	3.6	1,030	8	529	1,588	5
2011	HOLLISTER WEST	389	1,801	2,190	18%	82%	298	3.6	1,019	22	891	2,673	18
2011	PACHECO	2,392	1,910	4,302	56%	44%	298	3.6	533	8	402	1,207	6
2011	SAN JUAN CENTRAL	0	1,013	1,013	0%	100%	298	3.6	794	10	794	2,382	10
2011	SAN JUAN NORTH	5,344	4,664	10,009	53%	47%	298	3.6	1,198	15	717	2,152	9
2011	SAN JUAN SOUTH	0	1	1	0%	100%	298	3.6	720	5	720	2,160	5
2011	TRES PINOS	81	390	471	17%	83%	298	3.6	995	9	875	2,625	8
2011	TRES PINOS CR VALLEY	0	322	322	0%	100%	298	3.6	720	5	720	2,160	5

1 - TDS concentrated due to evapotranspiration
AFY - acre-feet per year
CR - Creek
CVP - Central Valley Project
ET - evapotranspiration
GW - Groundwater
mg/L - milligram per liter
NO_3 -Nitrate
TDS - Total Dissolved Solids

Appendix C

Salt and Nitrate Mass Balances 2002 - 2011

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Bolsa TDS Balance											
Water Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Average**
TDS Inflow											
Ag Irrigation Return Flow	3,842	2,792	3,030	1,636	2,200	2,433	2,653	2,468	2,217	2,075	2,534
Subsurface Groundwater Inflow	6,275	6,275	5,825	4,924	5,374	5,374	6,275	3,572	5,914	5,983	5,579
Rainfall Percolation	346	120	236	479	786	155	597	242	286	391	364
Natural Stream Percolation	1,122	561	561	561	561	561	561	561	561	561	617
Rural Landscape Fertilizer	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Return Flow	5	5	5	5	5	5	5	5	5	5	5
Septic Systems	40	40	40	40	40	40	40	40	40	40	40
Wastewater Treatment Ponds	-	-	-	-	-	-	-	-	-	-	-
Recycled Water Irrigation	-	-	-	-	-	-	-	-	-	-	-
Sewer Leaks	-	-	-	-	-	-	-	-	-	-	-
Water Leaks	-	-	-	-	-	-	-	-	-	-	-
In-stream CVP Percolation	-	-	-	-	-	-	-	-	-	-	-
Reservoir Release	-	-	-	-	-	-	-	-	-	-	-
Municipal Irrigation Return Flow	-	-	-	-	-	-	-	-	-	-	-
Total Inflow	11,629	9,792	9,696	7,644	8,965	8,567	10,130	6,887	9,022	9,054	9,139
TDS Outflow											
Agricultural Pumping	(11,149)	(7,664)	(8,471)	(7,042)	(5,702)	(6,475)	(7,217)	(6,598)	(5,763)	(5,290)	(7,137)
Subsurface Groundwater Outflow	-	-	-	(457)	(4,802)	(1,371)	(1,144)	-	-	-	(777)
Municipal and Domesic Pumping	-	-	-	-	-	-	-	-	-	-	-
Total Outflow	(11,149)	(7,664)	(8,471)	(7,500)	(10,504)	(7,846)	(8,361)	(6,598)	(5,763)	(5,290)	(7,915)
Change in Mass											
Annual Change in Mass	481	2,128	1,225	144	(1,539)	721	1,769	289	3,260	3,764	1,224
Cummulative Change in Mass	481	2,608	3,833	3,977	2,438	3,160	4,929	5,218	8,477	12,241	

All values in tons

Bolsa Nitrate-NO_3 Balance											
Water Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Average**
Nitrate-NO_3 Inflow											
Ag Irrigation Return Flow	526	524	524	521	522	523	523	523	522	522	523
Subsurface Groundwater Inflow	99	99	92	78	85	85	99	56	93	94	88
Rainfall Percolation	8	7	7	8	8	7	8	7	8	8	8
Natural Stream Percolation	8	4	4	4	4	4	4	4	4	4	4
Rural Landscape Fertilizer	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Return Flow	0.07	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
Septic Systems	9	9	9	9	9	9	9	9	9	9	9
Wastewater Treatment Ponds	-	-	-	-	-	-	-	-	-	-	-
Recycled Water Irrigation	-	-	-	-	-	-	-	-	-	-	-
Sewer Leaks	-	-	-	-	-	-	-	-	-	-	-
Water Leaks	-	-	-	-	-	-	-	-	-	-	-
In-stream CVP Percolation	-	-	-	-	-	-	-	-	-	-	-
Reservoir Release	-	-	-	-	-	-	-	-	-	-	-
Municipal Irrigation Return Flow	-	-	-		-			-	-	-	-
Total Inflow	649	643	636	620	629	628	643	600	636	637	632
Nitrate-NO_3 Inflow											
Agricultural Pumping	(65)	(49)	(58)	(52)	(45)	(54)	(64)	(61)	(56)	(54)	(56)
Subsurface Groundwater Outflow	-	-	0	(3)	(38)	(11)	(10)	0	0	0	(6)
Municipal and Domesic Pumping	-	-	0	0	0	0	0	0	0	0	-
Total Outflow	(65)	(49)	(58)	(55)	(82)	(65)	(74)	(61)	(56)	(54)	(62)
Change in Mass											
Annual Change in Mass	584	594	579	565	546	563	570	539	580	583	570
Cummulative Change in Mass	584	1,179	1,757	2,322	2,869	3,432	4,002	4,540	5,121	5,704	

All values in tons

Bolsa Southeast TDS Balance											
Water Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Average**
TDS Inflow											
Ag Irrigation Return Flow	1,041	1,030	1,156	900	842	974	946	802	656	669	902
Subsurface Groundwater Inflow	2,764	2,764	2,764	2,764	5,189	4,150	5,536	2,071	3,975	4,226	3,620
Rainfall Percolation	109	22	63	173	143	37	113	86	83	97	93
Natural Stream Percolation	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Fertilizer	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Return Flow	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Septic Systems	9	9	9	9	9	9	9	9	9	9	9
Wastewater Treatment Ponds	-	-	-	-	-	-	-	-	-	-	-
Recycled Water Irrigation	-	-	-	-	-	-	-	-	-	-	-
Sewer Leaks	-	-	-	-	-	-	-	-	-	-	-
Water Leaks	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
In-stream CVP Percolation	-	-	-	-	-	-	-	-	-	-	-
Reservoir Release	-	-	-	-	-	-	-	-	-	-	-
Municipal Irrigation Return Flow	0	0	0	0	0	0	0	0	0	0	0
Total Inflow	3,924	3,826	3,992	3,848	6,184	5,170	6,605	2,970	4,724	5,002	4,624
TDS Outflow											
Agricultural Pumping	(2,981)	(2,955)	(3,287)	(2,525)	(2,547)	(2,739)	(2,748)	(2,848)	(2,606)	(3,813)	(2,905)
Subsurface Groundwater Outflow	(684)	(684)	(1,372)	(1,375)	(2,745)	(2,741)	(1,717)	(1,374)	(2,025)	(2,061)	(1,678)
Municipal and Domesic Pumping	(19)	(22)	(15)	(16)	(11)	(10)	(18)	(12)	(1)	(9)	(13)
Total Outflow	(3,684)	(3,661)	(4,674)	(3,917)	(5,302)	(5,489)	(4,484)	(4,234)	(4,631)	(5,883)	(4,596)
Change in Mass											
Annual Change in Mass	239	165	(682)	(69)	882	(319)	2,122	(1,264)	93	(882)	28
Cummulative Change in Mass	239	404	(278)	(347)	535	215	2,337	1,073	1,166	284	

All values in tons

Bolsa Southeast Nitrate-NO_3 Balance											
Water Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Average**
Nitrate-NO_3 Inflow											
Ag Irrigation Return Flow	130	129	130	129	129	129	129	128	128	128	129
Subsurface Groundwater Inflow	59	59	59	62	117	88	118	44	85	90	78
Rainfall Percolation	1.4	1.2	1.3	1.5	1.4	1.3	1.4	1.3	1.3	1.4	1.4
Natural Stream Percolation	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Fertilizer	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Return Flow	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Septic Systems	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Wastewater Treatment Ponds	-	-	-	-	-	-	-	-	-	-	-
Recycled Water Irrigation	-	-	-	-	-	-	-	-	-	-	-
Sewer Leaks	-	-	-	-	-	-	-	-	-	-	-
Water Leaks	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
In-stream CVP Percolation	-	-	-	-	-	-	-	-	-	-	-
Reservoir Release	-	-	-	-	-	-	-	-	-	-	-
Municipal Irrigation Return Flow	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297	0.297
Total Inflow	192	191	192	194	249	221	250	176	215	221	210
Nitrate-NO_3 Inflow											
Agricultural Pumping	(46)	(47)	(54)	(43)	(45)	(50)	(52)	(55)	(52)	(78)	(52)
Subsurface Groundwater Outflow	(10)	(11)	(23)	(23)	(48)	(50)	(32)	(27)	(40)	(42)	(31)
Municipal and Domesic Pumping	(0.3)	(0.3)	(0.2)	(0.3)	(0.2)	(0.2)	(0.3)	(0.2)	(0.0)	(0.2)	(0.2)
Total Outflow	(56)	(58)	(77)	(67)	(94)	(100)	(84)	(82)	(92)	(121)	(83)
Change in Mass											
Annual Change in Mass	135	133	115	127	156	120	166	93	123	100	127
Cummulative Change in Mass	135	268	383	510	666	786	952	1,046	1,169	1,269	

All values in tons

Flint Hills TDS Balance											
Water Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Average**
TDS Inflow											
Ag Irrigation Return Flow	-	-	-	-	-	-	-	-	-	-	0
Subsurface Groundwater Inflow	-	-	-	-	-	-	-	-	-	-	-
Rainfall Percolation	23	-	109	20	-	-	-	-	-	-	15
Natural Stream Percolation	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Fertilizer	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Return Flow	-	-	-	-	-	-	-	-	-	-	-
Septic Systems	-	-	-	-	-	-	-	-	-	-	-
Wastewater Treatment Ponds	-	-	-	-	-	-	-	-	-	-	-
Recycled Water Irrigation	-	-	-	-	-	-	-	-	-	-	-
Sewer Leaks	-	-	-	-	-	-	-	-	-	-	-
Water Leaks	-	-	-	-	-	-	-	-	-	-	-
In-stream CVP Percolation	-	-	-	-	-	-	-	-	-	-	-
Reservoir Release	-	-	-	-	-	-	-	-	-	-	-
Municipal Irrigation Return Flow	-	-	-	-	-	-	-	-	-	-	-
Total Inflow	23	-	109	20	-	-	-	-	-	-	15
TDS Outflow											
Agricultural Pumping	-	-	-	-	-	-	-	-	-	-	-
Subsurface Groundwater Outflow	-	-	-	-	-	-	-	-	-	-	-
Municipal and Domesic Pumping	-	-	-	-	-	-	-	-	-	-	-
Total Outflow	-	-	-	-	-	-	-	-	-	-	0
Change in Mass											
Annual Change in Mass	23	-	109	20	-	-	-	-	-	-	15
Cummulative Change in Mass	23	23	132	152	152	152	152	152	152	152	

All values in tons

Flint Hills Nitrate-NO_3 Balance											
Water Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Average**
Nitrate-NO_3 Inflow											
Ag Irrigation Return Flow	-	-	-	-	-	-	-	-	-	-	-
Subsurface Groundwater Inflow	-	-	-	-	-	-	-	-	-	-	-
Rainfall Percolation	0.0	-	0.2	0.0	-	-	-	-	-	-	0.0
Natural Stream Percolation	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Fertilizer	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Return Flow	-	-	-	-	-	-	-	-	-	-	-
Septic Systems	-	-	-	-	-	-	-	-	-	-	-
Wastewater Treatment Ponds	-	-	-	-	-	-	-	-	-	-	-
Recycled Water Irrigation	-	-	-	-	-	-	-	-	-	-	-
Sewer Leaks	-	-	-	-	-	-	-	-	-	-	-
Water Leaks	-	-	-	-	-	-	-	-	-	-	-
In-stream CVP Percolation	-	-	-	-	-	-	-	-	-	-	-
Reservoir Release	-	-	-	-	-	-	-	-	-	-	-
Municipal Irrigation Return Flow	-	-	-	-	-	-	-	-	-	-	-
Total Inflow	0.04	-	0.17	0.03	-	-	-	-	-	-	0.02
Nitrate-NO_3 Inflow											
Agricultural Pumping	-	-	-	-	-	-	-	-	-	-	-
Subsurface Groundwater Outflow	-	-	-	-	-	-	-	-	-	-	-
Municipal and Domesic Pumping	-	-	-	-	-	-	-	-	-	-	-
Total Outflow	-	-	-	-	-	-	-	-	-	-	-
Change in Mass											
Annual Change in Mass	0.04	-	0.17	0.03	-	-	-	-	-	-	0.02
Cummulative Change in Mass	0.04	0.04	0.21	0.24	0.24	0.24	0.24	0.24	0.24	0.24	

All values in tons

Hollister Northeast TDS Balance											
Water Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Average**
TDS Inflow											
Ag Irrigation Return Flow	1,242	1,163	1,214	1,174	1,395	1,620	1,309	1,086	821	556	1,158
Subsurface Groundwater Inflow	86	86	17	17	102	102	12	81	99	65	67
Rainfall Percolation	343	89	267	264	395	75	327	141	137	224	226
Natural Stream Percolation	733	727	543	1,618	1,852	221	502	310	323	479	731
Rural Landscape Fertilizer	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Return Flow	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8
Septic Systems	109	109	109	109	109	109	109	109	109	109	109
Wastewater Treatment Ponds	-	-	-	-	-	-	-	-	-	-	-
Recycled Water Irrigation	-	-	-	-	-	-	-	-	22	27	5
Sewer Leaks	109	109	109	109	109	109	109	109	109	109	109
Water Leaks	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94	9.94
In-stream CVP Percolation	-	-	-	-	-	-	-	-	-	-	-
Reservoir Release	-	-	-	-	-	-	-	-	-	-	-
Municipal Irrigation Return Flow	25	25	25	25	25	25	-	25	25	25	22
Total Inflow	2,670	2,331	2,307	3,339	4,010	2,283	2,390	1,884	1,668	1,617	2,450
TDS Outflow											
Agricultural Pumping	(1,158)	(838)	(738)	(891)	(792)	(1,738)	(1,752)	(3,168)	(3,081)	(913)	(1,507)
Subsurface Groundwater Outflow	(1,008)	(1,006)	(1,005)	(1,004)	(1,504)	(1,500)	(1,500)	(2,155)	(1,616)	(1,995)	(1,429)
Municipal and Domesic Pumping	(365)	(272)	(474)	(641)	(472)	(492)	(662)	(421)	(266)	(72)	(414)
Total Outflow	(2,531)	(2,116)	(2,218)	(2,536)	(2,767)	(3,729)	(3,913)	(5,744)	(4,963)	(2,979)	(3,350)
Change in Mass											
Annual Change in Mass	139	215	89	802	1,243	(1,446)	(1,522)	(3,860)	(3,295)	(1,363)	(900)
Cummulative Change in Mass	139	353	443	1,245	2,489	1,042	(480)	(4,340)	(7,635)	(8,998)	

All values in tons

Hollister Northeast Nitrate-NO_3 Balance											
Water Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Average**
Nitrate-NO_3 Inflow											
Ag Irrigation Return Flow	440	440	440	440	441	443	441	443	439	439	441
Subsurface Groundwater Inflow	4	4	1	1	5	5	1	4	5	3	3
Rainfall Percolation	5.0	4.6	4.9	4.9	5.1	4.6	5.0	4.7	4.7	4.8	4.8
Natural Stream Percolation	5	5	4	11	12	1	3	2	2	3	5
Rural Landscape Fertilizer	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Return Flow	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Septic Systems	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3
Wastewater Treatment Ponds	-	-	-	-	-	-	-	-	-	-	-
Recycled Water Irrigation	-	-	-	-	-	-	-	-	-	-	-
Sewer Leaks	19	19	19	19	19	19	19	19	19	19	19
Water Leaks	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153
In-stream CVP Percolation	-	-	-	-	-	-	-	-	-	-	-
Reservoir Release	-	-	-	-	-	-	-	-	-	-	-
Municipal Irrigation Return Flow	4.355	4.355	4.355	4.355	4.355	4.355	4.355	4.355	4.355	4.355	4.355
Total Inflow	503	502	498	505	511	503	498	502	499	498	502
Nitrate-NO_3 Inflow											
Agricultural Pumping	(18)	(13)	(12)	(15)	(14)	(32)	(34)	(63)	(64)	(19)	(29)
Subsurface Groundwater Outflow	(16)	(16)	(17)	(17)	(27)	(28)	(29)	(43)	(33)	(43)	(27)
Municipal and Domesic Pumping	(6)	(4)	(8)	(11)	(9)	(9)	(13)	(8)	(5)	(2)	(8)
Total Outflow	(39)	(34)	(37)	(44)	(50)	(70)	(76)	(115)	(102)	(63)	(63)
Change in Mass											
Annual Change in Mass	464	468	461	460	462	433	422	387	397	435	439
Cummulative Change in Mass	464	932	1,392	1,853	2,314	2,747	3,170	3,557	3,954	4,388	

All values in tons

Hollister Southeast TDS Balance											
Water Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Average**
Groundwater Inflow											
Ag Irrigation Return Flow	640	565	574	567	414	141	148	273	249	183	375
Subsurface Groundwater Inflow	402	402	2	2	715	715	849	436	392	366	428
Rainfall Percolation	140	36	109	108	188	7	112	12	10	27	75
Natural Stream Percolation	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Fertilizer	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Return Flow	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Septic Systems	61	61	61	61	61	61	61	61	61	61	61
Wastewater Treatment Ponds	-	-	-	-	-	-	-	-	-	-	-
Recycled Water Irrigation	-	-	-	-	-	-	-	-	-	-	-
Sewer Leaks	73	73	73	73	73	73	73	73	73	73	73
Water Leaks	38.07	38.07	38.07	38.07	38.07	38.07	38.07	38.07	38.07	38.07	38.07
In-stream CVP Percolation	-	-	-	-	-	-	-	-	-	-	-
Reservoir Release	104	170	173	-	-	-	-	-	-	-	45
Municipal Irrigation Return Flow	95	95	95	95	95	95	95	95	95	95	95
Total Inflow	1,561	1,449	1,133	952	1,592	1,139	1,384	996	925	851	1,198
TDS Outflow											
Agricultural Pumping	(595)	(431)	(380)	(503)	(660)	(873)	(1,232)	(501)	(903)	(460)	(654)
Subsurface Groundwater Outflow	-	-	-	-	-	-	-	-	-	-	-
Municipal and Domesic Pumping	(1,232)	(919)	(1,599)	(1,327)	(1,559)	(1,917)	(1,257)	(1,476)	(865)	(1,192)	(1,334)
Total Outflow	(1,827)	(1,349)	(1,979)	(1,831)	(2,218)	(2,790)	(2,489)	(1,977)	(1,768)	(1,652)	(1,988)
Change in Mass											
Annual Change in Mass	(266)	99	(846)	(879)	(626)	(1,651)	(1,105)	(982)	(843)	(802)	(790)
Cummulative Change in Mass	(266)	(167)	(1,013)	(1,892)	(2,518)	(4,170)	(5,275)	(6,257)	(7,099)	(7,901)	

All values in tons

Hollister Southeast Nitrate-NO_3 Balance											
Water Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Average**
Nitrate-NO_3 Inflow											
Ag Irrigation Return Flow	85	88	85	85	84	84	84	84	84	84	85
Subsurface Groundwater Inflow	3	3	0	0	6	6	7	4	3	3	4
Rainfall Percolation	1.4	1.2	1.3	1.3	1.5	1.2	1.3	1.2	1.2	1.2	1.3
Natural Stream Percolation	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Fertilizer	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Return Flow	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Septic Systems	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
Wastewater Treatment Ponds	-	-	-	-	-	-	-	-	-	-	-
Recycled Water Irrigation	-	-	-	-	-	-	-	-	-	-	-
Sewer Leaks	19	19	19	19	19	19	19	19	19	19	19
Water Leaks	0.383	0.383	0.383	0.383	0.383	0.383	0.383	0.383	0.383	0.383	0.383
In-stream CVP Percolation	-	-	-	-	-	-	-	-	-	-	-
Reservoir Release	0	1	1	-	-	-	-	-	-	-	0
Municipal Irrigation Return Flow	7.160	7.160	7.160	7.160	7.160	7.160	7.160	7.160	7.160	7.160	7.160
Total Inflow	127	130	123	123	128	127	128	125	125	124	126
Nitrate-NO_3 Inflow											
Agricultural Pumping	(4)	(3)	(3)	(4)	(5)	(7)	(11)	(4)	(8)	(4)	(5)
Subsurface Groundwater Outflow	-	-	-	-	-	-	-	-	-	-	-
Municipal and Domesic Pumping	(3)	(2)	(4)	(3)	(4)	(5)	(3)	(4)	(2)	(3)	(3)
Total Outflow	(7)	(6)	(7)	(7)	(9)	(12)	(14)	(8)	(10)	(7)	(9)
Change in Mass											
Annual Change in Mass	119	124	116	115	119	115	115	117	114	117	117
Cummulative Change in Mass	119	243	360	475	594	709	824	941	1,055	1,172	

All values in tons

Hollister West TDS Balance											
Water Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Average**
TDS Inflow											
Ag Irrigation Return Flow	832	1,000	845	795	756	850	622	1,392	1,226	1,196	951
Subsurface Groundwater Inflow	1,730	1,730	1,053	1,053	2,745	3,083	3,083	1,774	1,758	1,755	1,976
Rainfall Percolation	302	129	268	309	285	59	183	138	153	282	211
Natural Stream Percolation	993	1,991	760	2,088	1,223	78	296	1,636	1,071	2,101	1,224
Rural Landscape Fertilizer	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Return Flow	90.8	90.8	90.8	90.8	90.8	90.8	90.8	90.8	90.8	90.8	90.8
Septic Systems	724	724	724	724	724	724	724	724	724	724	724
Wastewater Treatment Ponds	2,409	2,360	1,488	1,283	1,174	1,190	1,218	414	36	452	1,202
Recycled Water Irrigation	-	-	-	-	-	-	-	-	19	15	3
Sewer Leaks	211	211	211	211	211	211	211	211	211	211	211
Water Leaks	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01	103.01
In-stream CVP Percolation	479	466	138	819	183	88	2	-	-	-	217
Reservoir Release	507	652	951	568	1,318	2,477	608	2,500	1,893	824	1,230
Municipal Irrigation Return Flow	258	258	258	258	258	258	258	258	258	258	258
Total Inflow	8,637	9,714	6,889	8,301	9,069	9,210	7,399	9,240	7,541	8,011	8,401
TDS Outflow											
Agricultural Pumping	(2,167)	(2,716)	(2,249)	(2,041)	(1,954)	(2,280)	(1,570)	(2,055)	(2,217)	(2,473)	(2,172)
Subsurface Groundwater Outflow	(2,772)	(2,075)	(2,766)	(2,764)	(5,154)	(3,772)	(4,806)	(2,061)	(3,948)	(4,196)	(3,431)
Municipal and Domesic Pumping	(5,815)	(4,941)	(3,880)	(4,184)	(3,725)	(4,009)	(3,749)	(3,122)	(2,862)	(2,482)	(3,877)
Total Outflow	(10,755)	(9,732)	(8,896)	(8,989)	(10,834)	(10,061)	(10,124)	(7,237)	(9,027)	(9,151)	(9,481)
Change in Mass											
Annual Change in Mass	(2,118)	(18)	(2,006)	(688)	(1,765)	(851)	(2,726)	2,002	(1,486)	(1,140)	(1,080)
Cummulative Change in Mass	(2,118)	(2,136)	(4,142)	(4,830)	(6,595)	(7,447)	(10,172)	(8,170)	(9,656)	(10,796)	

All values in tons

Hollister West Nitrate-NO_3 Balance											
Water Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Average**
Nitrate-NO_3 Inflow											
Ag Irrigation Return Flow	127	123	128	123	127	125	126	132	130	130	127
Subsurface Groundwater Inflow	15	15	9	9	25	28	28	16	16	16	18
Rainfall Percolation	2.2	1.9	2.1	1.7	2.2	1.8	2.0	1.9	1.9	2.1	2.0
Natural Stream Percolation	4	8	3	8	5	0	1	6	4	8	5
Rural Landscape Fertilizer	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Return Flow	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
Septic Systems	131.3	131.3	131.3	131.3	131.3	131.3	131.3	131.3	131.3	131.3	131.3
Wastewater Treatment Ponds	45	44	28	24	22	22	23	8	1	8	22
Recycled Water Irrigation	-	-	-	-	-	-	-	-	-	-	-
Sewer Leaks	31	31	31	31	31	31	31	31	31	31	31
Water Leaks	2.194	2.194	2.194	2.194	2.194	2.194	2.194	2.194	2.194	2.194	2.194
In-stream CVP Percolation	6	6	2	10	2	1	0	-	-	-	3
Reservoir Release	2	2	4	2	5	9	2	9	7	3	5
Municipal Irrigation Return Flow	6.811	6.811	6.811	6.811	6.811	6.811	6.811	6.811	6.811	336.140	39.744
Total Inflow	373	371	347	349	359	359	353	344	331	668	385
Nitrate-NO_3 Inflow											
Agricultural Pumping	(46)	(59)	(49)	(45)	(44)	(52)	(36)	(48)	(53)	(59)	(49)
Subsurface Groundwater Outflow	(59)	(45)	(61)	(62)	(116)	(86)	(111)	(48)	(94)	(101)	(78)
Municipal and Domesic Pumping	(147)	(125)	(98)	(105)	(94)	(101)	(94)	(79)	(72)	(63)	(98)
Total Outflow	(252)	(228)	(208)	(212)	(254)	(239)	(242)	(175)	(219)	(223)	(225)
Change in Mass											
Annual Change in Mass	121	143	139	137	105	120	111	169	113	445	160
Cummulative Change in Mass	121	264	403	540	644	764	875	1,044	1,157	1,602	

All values in tons

Pacheco TDS Balance											
Water Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Average**
Groundwater Inflow											
Ag Irrigation Return Flow	1,243	886	1,242	618	954	946	867	1,254	1,084	1,027	1,012
Subsurface Groundwater Inflow	618	618	618	618	2,728	3,079	3,255	2,321	1,933	2,051	1,784
Rainfall Percolation	275	64	181	347	360	77	227	156	164	332	218
Natural Stream Percolation	459	1,517	1,140	1,401	1,162	560	792	540	470	627	867
Rural Landscape Fertilizer	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Return Flow	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
Septic Systems	114	114	114	114	114	114	114	114	114	114	114
Wastewater Treatment Ponds	-	-	-	-	-	-	-	-	-	-	-
Recycled Water Irrigation	-	-	-	-	-	-	-	-	-	-	-
Sewer Leaks	-	-	-	-	-	-	-	-	-	-	-
Water Leaks	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39
In-stream CVP Percolation	-	-	-	-	-	-	-	-	-	-	-
Reservoir Release	1	-	-	-	-	-	-	-	-	-	0
Municipal Irrigation Return Flow	1	1	1	1	1	1	1	1	1	1	1
Total Inflow	2,724	3,213	3,309	3,111	5,332	4,790	5,269	4,400	3,780	4,165	4,009
TDS Outflow											
Agricultural Pumping	(1,558)	(1,637)	(1,651)	(819)	(746)	(587)	(1,234)	(2,252)	(1,827)	(1,387)	(1,370)
Subsurface Groundwater Outflow	(1,450)	(1,088)	(1,088)	(1,452)	(3,082)	(3,079)	(3,988)	(1,450)	(2,255)	(2,317)	(2,125)
Municipal and Domesic Pumping	(125)	(121)	(134)	(139)	(130)	(162)	(143)	(191)	(26)	(60)	(123)
Total Outflow	(3,133)	(2,846)	(2,874)	(2,411)	(3,958)	(3,828)	(5,365)	(3,893)	(4,108)	(3,764)	(3,618)
Change in Mass											
Annual Change in Mass	(409)	367	435	701	1,374	962	(96)	507	(329)	401	391
Cummulative Change in Mass	(409)	(41)	394	1,095	2,469	3,431	3,335	3,842	3,513	3,915	

All values in tons

Pacheco Nitrate-NO_3 Balance											
Water Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Average**
Nitrate-NO_3 Inflow											
Ag Irrigation Return Flow	364	364	364	362	362	362	362	364	363	363	363
Subsurface Groundwater Inflow	10	10	10	10	43	49	51	37	30	32	28
Rainfall Percolation	4.9	4.6	4.8	5.0	5.1	4.6	4.8	4.7	4.7	5.0	4.8
Natural Stream Percolation	5	17	13	16	13	6	9	6	5	7	10
Rural Landscape Fertilizer	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Return Flow	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Septic Systems	32.4	32.4	32.4	32.4	32.4	32.4	32.4	32.4	32.4	32.4	32.4
Wastewater Treatment Ponds	-	-	-	-	-	-	-	-	-	-	-
Recycled Water Irrigation	-	-	-	-	-	-	-	-	-	-	-
Sewer Leaks	-	-	-	-	-	-	-	-	-	-	-
Water Leaks	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
In-stream CVP Percolation	-	-	-	-	-	-	-	-	-	-	-
Reservoir Release	0	-	-	-	-	-	-	-	-	-	0
Municipal Irrigation Return Flow	1.268	1.268	1.268	1.268	1.268	1.268	1.268	1.268	1.268	1.268	1.268
Total Inflow	417	429	425	427	457	455	460	445	437	441	439
Nitrate-NO_3 Inflow											
Agricultural Pumping	(24)	(27)	(28)	(15)	(14)	(11)	(25)	(47)	(40)	(31)	(26)
Subsurface Groundwater Outflow	(22)	(18)	(19)	(26)	(57)	(60)	(81)	(30)	(49)	(52)	(41)
Municipal and Domesic Pumping	(2)	(2)	(2)	(2)	(2)	(3)	(3)	(4)	(1)	(1)	(2)
Total Outflow	(48)	(46)	(49)	(43)	(74)	(74)	(108)	(82)	(89)	(85)	(70)
Change in Mass											
Annual Change in Mass	369	383	376	384	383	381	352	364	348	356	370
Cummulative Change in Mass	369	752	1,128	1,511	1,895	2,276	2,627	2,991	3,339	3,695	

All values in tons

San Juan Central TDS Balance											
Water Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Average**
TDS Inflow											
Ag Irrigation Return Flow	1,262	465	510	458	444	489	522	484	449	443	553
Subsurface Groundwater Inflow	-	-	-	-	333	333	333	-	-	-	100
Rainfall Percolation	112	24	46	78	92	20	46	37	47	92	59
Natural Stream Percolation	1,567	441	66	1,289	256	37	158	-	-	1,404	522
Rural Landscape Fertilizer	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Return Flow	-	-	-	-	1.7	1.7	1.7	-	-	1.7	0.7
Septic Systems	-	-	-	-	14	14	14	-	-	14	6
Wastewater Treatment Ponds	-	-	-	-	-	-	-	-	-	-	-
Recycled Water Irrigation	-	-	-	-	-	-	-	-	-	-	-
Sewer Leaks	-	-	-	-	-	-	-	-	-	-	-
Water Leaks	-	-	-	-	-	-	-	-	-	-	-
In-stream CVP Percolation	756	103	12	506	-	-	-	-	-	-	138
Reservoir Release	-	-	-	-	-	-	-	-	-	551	55
Municipal Irrigation Return Flow	-	-	-	-	-	-	-	-	-	-	-
Total Inflow	3,698	1,033	634	2,332	1,140	894	1,073	521	497	2,506	1,433
TDS Outflow											
Agricultural Pumping	(5,845)	(1,167)	(1,314)	(1,141)	(1,095)	(1,246)	(1,353)	(1,230)	(1,113)	(1,092)	(1,660)
Subsurface Groundwater Outflow	(540)	(539)	(270)	(540)	(539)	(539)	(539)	-	-	-	(351)
Municipal and Domesic Pumping	-	-	-	-	-	-	-	-	-	-	-
Total Outflow	(6,385)	(1,707)	(1,584)	(1,680)	(1,634)	(1,785)	(1,893)	(1,230)	(1,113)	(1,092)	(2,010)
Change in Mass											
Annual Change in Mass	(2,687)	(674)	(950)	652	(494)	(891)	(819)	(708)	(617)	1,413	(578)
Cummulative Change in Mass	(2,687)	(3,361)	(4,311)	(3,660)	(4,154)	(5,045)	(5,864)	(6,572)	(7,189)	(5,775)	

All values in tons

San Juan Central Nitrate-NO_3 Balance											
Water Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Average**
Nitrate-NO_3 Inflow											
Ag Irrigation Return Flow	92	89	88	89	89	89	89	89	89	89	89
Subsurface Groundwater Inflow	-	-	-	-	3	3	3	-	-	-	1
Rainfall Percolation	1.9	1.7	1.8	1.8	1.8	1.7	1.8	1.8	1.8	1.8	1.8
Natural Stream Percolation	5	1	0	4	1	0	0	-	-	4	2
Rural Landscape Fertilizer	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Return Flow	-	-	-	-	0.01	0.01	0.01	-	-	0.01	0.00
Septic Systems	-	-	-	-	2.9	2.9	2.9	-	-	2.9	1.2
Wastewater Treatment Ponds	-	-	-	-	-	-	-	-	-	-	-
Recycled Water Irrigation	-	-	-	-	-	-	-	-	-	-	-
Sewer Leaks	-	-	-	-	-	-	-	-	-	-	-
Water Leaks	-	-	-	-	-	-	-	-	-	-	-
In-stream CVP Percolation	9	1	0	6	-	-	-	-	-	-	2
Reservoir Release	-	-	-	-	-	-	-	-	-	2	0
Municipal Irrigation Return Flow	-	-	-	-	-	-	-	-	-	-	-
Total Inflow	108	93	91	101	98	97	98	91	91	100	97
Nitrate-NO_3 Inflow											
Agricultural Pumping	(70)	(14)	(16)	(14)	(13)	(15)	(17)	(15)	(14)	(14)	(20)
Subsurface Groundwater Outflow	(6)	(6)	(3)	(7)	(7)	(7)	(7)	-	-	-	(4)
Municipal and Domesic Pumping	-	-	-	-	-	-	-	-	-	-	-
Total Outflow	(76)	(21)	(19)	(20)	(20)	(22)	(23)	(15)	(14)	(14)	(24)
Change in Mass											
Annual Change in Mass	32	73	71	81	78	75	74	76	77	86	72
Cummulative Change in Mass	32	105	176	257	335	410	485	560	637	723	

All values in tons

San Juan North TDS Balance											
Water Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Average**
Groundwater Inflow											
Ag Irrigation Return Flow	6,893	4,362	4,601	3,843	4,040	4,259	4,009	4,425	3,355	2,612	4,240
Subsurface Groundwater Inflow	587	1,947	1,947	1,947	587	247	247	261	2	44	782
Rainfall Percolation	639	175	409	481	1,122	238	900	513	533	619	563
Natural Stream Percolation	339	1,811	1,482	2,005	1,870	33	657	883	929	3,013	1,302
Rural Landscape Fertilizer	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Return Flow	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
Septic Systems	46	46	46	46	46	46	46	46	23	46	44
Wastewater Treatment Ponds	3,935	3,641	4,187	4,182	3,935	3,856	3,618	3,587	3,178	3,342	3,746
Recycled Water Irrigation	-	-	-	-	-	-	-	-	-	-	-
Sewer Leaks	22	22	22	22	22	22	22	22	11	22	21
Water Leaks	17.44	17.44	17.44	17.44	17.44	17.44	17.44	17.44	8.72	17.44	16.57
In-stream CVP Percolation	94	294	24	467	-	-	-	-	-	-	88
Reservoir Release	-	-	-	-	778	1,018	547	1,343	1,099	1,122	591
Municipal Irrigation Return Flow	44	44	44	-	-	-	-	-	-	-	13
Total Inflow	12,622	12,367	12,785	13,017	12,424	9,743	10,070	11,104	9,145	10,842	11,412
TDS Outflow											
Agricultural Pumping	(10,820)	(10,606)	(11,315)	(9,215)	(9,461)	(10,602)	(10,909)	(17,645)	(14,097)	(7,508)	(11,218)
Subsurface Groundwater Outflow	(3,259)	(2,445)	(1,630)	(3,259)	(3,250)	(808)	(404)	(31)	(31)	(5,795)	(2,091)
Municipal and Domesic Pumping	(797)	(795)	(1,011)	(817)	(787)	(939)	(902)	(868)	(699)	(276)	(789)
Total Outflow	(14,875)	(13,846)	(13,956)	(13,291)	(13,498)	(12,349)	(12,215)	(18,543)	(14,827)	(13,580)	(14,098)
Change in Mass											
Annual Change in Mass	(2,254)	(1,479)	(1,171)	(274)	(1,074)	(2,606)	(2,145)	(7,439)	(5,682)	(2,738)	(2,686)
Cummulative Change in Mass	(2,254)	(3,733)	(4,904)	(5,178)	(6,252)	(8,858)	(11,003)	(18,442)	(24,124)	(26,861)	

All values in tons

San Juan North Nitrate-NO_3 Balance											
Water Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Average**
Nitrate-NO_3 Inflow											
Ag Irrigation Return Flow	551	541	542	539	539	540	539	541	537	534	540
Subsurface Groundwater Inflow	3	10	10	10	3	1	1	1	0	0	4
Rainfall Percolation	6.4	5.6	6.0	6.1	7.2	5.7	6.8	6.2	6.2	6.3	6.3
Natural Stream Percolation	2	11	9	12	11	0	4	5	5	18	8
Rural Landscape Fertilizer	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Return Flow	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Septic Systems	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	3.5	7.1	6.7
Wastewater Treatment Ponds	32	30	34	34	32	31	30	29	26	27	31
Recycled Water Irrigation	-	-	-	-	-	-	-	-	-	-	-
Sewer Leaks	3	3	3	3	3	3	3	3	2	3	3
Water Leaks	0.148	0.148	0.148	0.148	0.148	0.148	0.148	0.148	0.074	0.148	0.140
In-stream CVP Percolation	1	4	0	6	-	-	-	-	-	-	1
Reservoir Release	-	-	-	-	5	6	3	8	6	7	3
Municipal Irrigation Return Flow	3.848	3.848	3.848	3.848	3.848	3.848	3.848	3.848	3.848	3.848	3.848
Total Inflow	610	614	615	620	612	599	598	605	590	606	607
Nitrate-NO_3 Inflow											
Agricultural Pumping	(132)	(134)	(148)	(124)	(132)	(152)	(161)	(268)	(220)	(121)	(159)
Subsurface Groundwater Outflow	(40)	(31)	(21)	(44)	(45)	(12)	(6)	(0)	(0)	(93)	(29)
Municipal and Domesic Pumping	(23)	(23)	(29)	(23)	(22)	(27)	(26)	(25)	(20)	(8)	(23)
Total Outflow	(194)	(187)	(198)	(192)	(199)	(190)	(193)	(293)	(241)	(222)	(211)
Change in Mass											
Annual Change in Mass	416	427	417	429	412	409	406	312	349	385	396
Cummulative Change in Mass	416	843	1,260	1,689	2,101	2,510	2,916	3,227	3,577	3,961	

All values in tons

San Juan South TDS Balance											
Water Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Average**
TDS Inflow											
Ag Irrigation Return Flow	6	6	6	6	6	6	6	6	6	6	6
Subsurface Groundwater Inflow	-	-	-	-	-	-	-	-	-	-	-
Rainfall Percolation	70	-	327	61	-	-	-	-	-	-	46
Natural Stream Percolation	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Fertilizer	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Return Flow	-	-	-	-	-	-	-	-	-	-	-
Septic Systems	-	-	-	-	-	-	-	-	-	-	-
Wastewater Treatment Ponds	-	-	-	-	-	-	-	-	-	-	-
Recycled Water Irrigation	-	-	-	-	-	-	-	-	-	-	-
Sewer Leaks	-	-	-	-	-	-	-	-	-	-	-
Water Leaks	-	-	-	-	-	-	-	-	-	-	-
In-stream CVP Percolation	-	-	-	-	-	-	-	-	-	-	-
Reservoir Release	-	-	-	-	-	-	-	-	-	-	-
Municipal Irrigation Return Flow	-	-	-	-	-	-	-	-	-	-	-
Total Inflow	76	6	333	67	6	6	6	6	6	6	51
TDS Outflow											
Agricultural Pumping	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Subsurface Groundwater Outflow	(337)	-	(1,570)	(294)	-	-	-	-	-	-	(220)
Municipal and Domesic Pumping	-	-	-	-	-	-	-	-	-	-	-
Total Outflow	(338)	(1)	(1,571)	(295)	(1)	(1)	(1)	(1)	(1)	(1)	(221)
Change in Mass											
Annual Change in Mass	(262)	5	(1,238)	(228)	5	5	5	5	5	5	(170)
Cummulative Change in Mass	(262)	(257)	(1,496)	(1,724)	(1,719)	(1,715)	(1,710)	(1,705)	(1,701)	(1,696)	

All values in tons

San Juan South Nitrate-NO_3 Balance											
Water Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Average**
Nitrate-NO_3 Inflow											
Ag Irrigation Return Flow	3	3	3	3	3	3	3	3	3	3	3
Subsurface Groundwater Inflow	-	-	-	-	-	-	-	-	-	-	-
Rainfall Percolation	0.2	-	0.6	0.2	-	-	-	-	-	-	0.1
Natural Stream Percolation	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Fertilizer	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Return Flow	-	-	-	-	-	-	-	-	-	-	-
Septic Systems	-	-	-	-	-	-	-	-	-	-	-
Wastewater Treatment Ponds	-	-	-	-	-	-	-	-	-	-	-
Recycled Water Irrigation	-	-	-	-	-	-	-	-	-	-	-
Sewer Leaks	-	-	-	-	-	-	-	-	-	-	-
Water Leaks	-	-	-	-	-	-	-	-	-	-	-
In-stream CVP Percolation	-	-	-	-	-	-	-	-	-	-	-
Reservoir Release	-	-	-	-	-	-	-	-	-	-	-
Municipal Irrigation Return Flow	-	-	-	-	-	-	-	-	-	-	-
Total Inflow	3	3	3	3	3	3	3	3	3	3	3
Nitrate-NO_3 Inflow											
Agricultural Pumping	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Subsurface Groundwater Outflow	(2)	-	(11)	(2)	-	-	-	-	-	-	(2)
Municipal and Domesic Pumping	-	-	-	-	-	-	-	-	-	-	-
Total Outflow	(2)	(0)	(11)	(2)	(0)	(0)	(0)	(0)	(0)	(0)	(2)
Change in Mass											
Annual Change in Mass	1	3	(7)	1	3	3	3	3	3	3	1
Cummulative Change in Mass	1	3	(4)	(3)	(0)	3	5	8	11	14	

All values in tons

Tres Pinos TDS Balance											
Water Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Average**
Groundwater Inflow											
Ag Irrigation Return Flow	530	423	510	345	408	403	287	465	379	361	411
Subsurface Groundwater Inflow	616	616	77	616	3,856	2,776	3,316	1,312	1,589	1,700	1,648
Rainfall Percolation	172	72	170	157	172	13	121	38	31	71	102
Natural Stream Percolation	1,484	2,410	1,371	4,324	436	28	106	583	382	936	1,206
Rural Landscape Fertilizer	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Return Flow	59.1	59.1	59.1	59.1	59.1	59.1	59.1	59.1	59.1	59.1	59.1
Septic Systems	473	473	473	473	473	473	473	473	473	473	473
Wastewater Treatment Ponds	791	780	747	652	641	408	408	492	492	521	593
Recycled Water Irrigation	-	-	-	-	-	-	-	-	-	-	-
Sewer Leaks	36	36	36	36	36	36	36	36	36	36	36
Water Leaks	65.37	65.37	65.37	65.37	65.37	65.37	65.37	65.37	65.37	65.37	65.37
In-stream CVP Percolation	485	311	322	548	0	36	-	-	-	-	170
Reservoir Release	656	388	2	-	470	883	217	891	675	367	455
Municipal Irrigation Return Flow	-	-	-	-	-	-	-	-	-	-	-
Total Inflow	5,367	5,634	3,833	7,275	6,616	5,180	5,087	4,413	4,181	4,590	5,218
TDS Outflow											
Agricultural Pumping	(1,556)	(1,201)	(1,462)	(955)	(1,125)	(1,130)	(755)	(797)	(765)	(519)	(1,026)
Subsurface Groundwater Outflow	(2,706)	(2,697)	(2,019)	(2,014)	(3,671)	(1,664)	(3,328)	(2,657)	(2,660)	(2,661)	(2,608)
Municipal and Domesic Pumping	(3,272)	(2,202)	(2,437)	(1,918)	(1,893)	(2,316)	(2,450)	(2,613)	(1,278)	(2,375)	(2,275)
Total Outflow	(7,535)	(6,100)	(5,917)	(4,887)	(6,689)	(5,110)	(6,533)	(6,068)	(4,703)	(5,555)	(5,910)
Change in Mass											
Annual Change in Mass	(2,168)	(466)	(2,085)	2,388	(72)	71	(1,445)	(1,654)	(523)	(965)	(692)
Cummulative Change in Mass	(2,168)	(2,634)	(4,719)	(2,331)	(2,403)	(2,332)	(3,777)	(5,431)	(5,954)	(6,919)	

All values in tons

Tres Pinos Nitrate-NO_3 Balance											
Water Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Average**
Nitrate-NO_3 Inflow											
Ag Irrigation Return Flow	46	46	46	46	46	46	46	46	45	46	46
Subsurface Groundwater Inflow	7	7	1	7	46	33	40	16	19	20	20
Rainfall Percolation	1.2	1.0	1.2	1.1	1.2	0.9	1.1	0.9	0.9	1.0	1.0
Natural Stream Percolation	5	9	5	64	2	0	0	2	1	3	9
Rural Landscape Fertilizer	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Return Flow	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Septic Systems	82.4	82.4	82.4	82.4	82.4	82.4	82.4	82.4	82.4	82.4	82.4
Wastewater Treatment Ponds	1	1	1	0	0	0	0	0	0	0	0
Recycled Water Irrigation	-	-	-	-	-	-	-	-	-	-	-
Sewer Leaks	5	5	5	5	5	5	5	5	5	5	5
Water Leaks	0.613	0.613	0.613	0.613	0.613	0.613	0.613	0.613	0.613	0.613	0.613
In-stream CVP Percolation	6	4	4	7	0	0	-	-	-	-	2
Reservoir Release	2	1	0	-	2	3	1	3	2	1	2
Municipal Irrigation Return Flow	6.257	6.257	6.257	6.257	6.257	6.257	6.257	6.257	6.257	6.257	6.257
Total Inflow	164	164	153	221	191	179	183	163	164	167	175
Nitrate-NO_3 Inflow											
Agricultural Pumping	(14)	(11)	(14)	(9)	(12)	(12)	(8)	(9)	(9)	(6)	(10)
Subsurface Groundwater Outflow	(24)	(25)	(19)	(20)	(38)	(18)	(37)	(30)	(31)	(32)	(27)
Municipal and Domesic Pumping	(34)	(24)	(27)	(22)	(23)	(29)	(31)	(34)	(17)	(33)	(27)
Total Outflow	(73)	(60)	(61)	(51)	(72)	(58)	(76)	(73)	(57)	(71)	(65)
Change in Mass											
Annual Change in Mass	92	104	92	169	119	121	107	90	107	96	110
Cummulative Change in Mass	92	195	288	457	576	697	804	894	1,001	1,097	

All values in tons

Tres Pinos Creek Valley TDS Balance											
Water Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Average**
TDS Inflow											
Ag Irrigation Return Flow	578	167	173	164	160	170	177	168	163	162	208
Subsurface Groundwater Inflow	-	-	-	-	340	340	340	-	-	-	102
Rainfall Percolation	-	5	13	19	22	3	8	6	9	24	11
Natural Stream Percolation	1,116	227	(50)	2,589	2,524	2,675	2,672	413	(316)	3,006	1,486
Rural Landscape Fertilizer	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Return Flow	-	-	-	-	0.0	0.0	0.0	-	-	-	0.0
Septic Systems	-	-	-	-	0	0	0	-	-	-	0
Wastewater Treatment Ponds	-	-	-	-	-	-	-	-	-	-	-
Recycled Water Irrigation	-	-	-	-	-	-	-	-	-	-	-
Sewer Leaks	-	-	-	-	-	-	-	-	-	-	-
Water Leaks	-	-	-	-	-	-	-	-	-	-	-
In-stream CVP Percolation	-	-	-	-	-	-	-	-	-	-	-
Reservoir Release	-	-	-	-	-	-	-	-	-	-	-
Municipal Irrigation Return Flow	-	-	-	-	-	-	-	-	-	-	-
Total Inflow	1,695	399	136	2,773	3,046	3,189	3,197	588	(144)	3,192	1,807
TDS Outflow											
Agricultural Pumping	(1,707)	(330)	(357)	(328)	(311)	(345)	(366)	(338)	(321)	(317)	(472)
Subsurface Groundwater Outflow	(490)	(491)	(246)	(492)	(492)	(492)	(492)	(1,617)	(1,871)	(1,974)	(866)
Municipal and Domesic Pumping	(46)	(46)	(46)	(51)	(48)	(45)	(46)	-	-	-	(33)
Total Outflow	(2,242)	(867)	(649)	(871)	(851)	(882)	(904)	(1,955)	(2,192)	(2,291)	(1,370)
Change in Mass											
Annual Change in Mass	(548)	(468)	(513)	1,901	2,195	2,308	2,293	(1,368)	(2,337)	902	437
Cummulative Change in Mass	(548)	(1,016)	(1,529)	373	2,568	4,876	7,169	5,801	3,464	4,366	

All values in tons

Tres Pinos Creek Valley Nitrate-NO_3 Balance											
Water Year	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**Average**
Nitrate-NO_3 Inflow											
Ag Irrigation Return Flow	34	34	34	34	34	34	34	34	34	34	34
Subsurface Groundwater Inflow	-	-	-	-	3	3	3	-	-	-	1
Rainfall Percolation	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9
Natural Stream Percolation	5	1	(0)	12	12	13	13	2	(2)	14	7
Rural Landscape Fertilizer	-	-	-	-	-	-	-	-	-	-	-
Rural Landscape Return Flow	-	-	-	-	0.00	0.00	0.00	-	-	-	0.00
Septic Systems	-	-	-	-	0.1	0.1	0.1	-	-	-	0.0
Wastewater Treatment Ponds	-	-	-	-	-	-	-	-	-	-	-
Recycled Water Irrigation	-	-	-	-	-	-	-	-	-	-	-
Sewer Leaks	-	-	-	-	-	-	-	-	-	-	-
Water Leaks	-	-	-	-	-	-	-	-	-	-	-
In-stream CVP Percolation	-	-	-	-	-	-	-	-	-	-	-
Reservoir Release	-	-	-	-	-	-	-	-	-	-	-
Municipal Irrigation Return Flow	-	-	-	-	-	-	-	-	-	-	-
Total Inflow	40	36	34	47	50	51	51	36	33	49	43
Nitrate-NO_3 Inflow											
Agricultural Pumping	(12)	(2)	(3)	(2)	(2)	(3)	(3)	(3)	(3)	(3)	(4)
Subsurface Groundwater Outflow	(3)	(4)	(2)	(4)	(4)	(4)	(4)	(13)	(16)	(17)	(7)
Municipal and Domesic Pumping	(0)	(0)	(0)	(0)	(0)	(0)	(0)	-	-	-	(0)
Total Outflow	(16)	(6)	(5)	(7)	(7)	(7)	(7)	(16)	(19)	(20)	(11)
Change in Mass											
Annual Change in Mass	24	29	30	40	43	44	43	20	14	29	32
Cummulative Change in Mass	24	54	83	123	167	210	254	274	289	318	

All values in tons

Appendix D

Future Projected Water Balance 2012 – 2021

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Future Projected Water Balances 2012 - 2022

	BOLSA	BOLSA SE	FLINT HILLS	HOLLISTER NE	HOLLISTER SE	HOLLISTER WEST	PACHECO	SAN JUAN CENTRAL	SAN JUAN NORTH	SAN JUAN SOUTH	TRES PINOS	TRES PINOS CR VALLEY
RAINFALL DEEP PERCOLATION												
2012	1,919	475	0	1,099	131	1,383	1,627	452	3,034	0	348	120
2013	1,919	475	0	1,099	131	1,383	1,627	452	3,034	0	348	120
2014	1,919	475	0	1,099	131	1,383	1,627	452	3,034	0	348	120
2015	1,919	475	0	1,099	131	1,383	1,627	452	3,034	0	348	120
2016	1,919	475	0	1,099	131	1,383	1,627	452	3,034	0	348	120
2017	1,919	475	0	1,099	131	1,383	1,627	452	3,034	0	348	120
2018	1,919	475	0	1,099	131	1,383	1,627	452	3,034	0	348	120
2019	1,919	475	0	1,099	131	1,383	1,627	452	3,034	0	348	120
2020	1,919	475	0	1,099	131	1,383	1,627	452	3,034	0	348	120
2021	1,919	475	0	1,099	131	1,383	1,627	452	3,034	0	348	120
AGRICULTURAL IRRIGATION RETURN FLOWS												
2012	577	150	0	391	55	301	435	101	767	1	88	32
2013	577	150	0	391	55	301	435	101	767	1	88	32
2014	577	150	0	391	55	301	435	101	767	1	88	32
2015	577	150	0	391	55	301	435	101	767	1	88	32
2016	577	150	0	391	55	301	435	101	767	1	88	32
2017	577	150	0	391	55	301	435	101	767	1	88	32
2018	577	150	0	391	55	301	435	101	767	1	88	32
2019	577	150	0	391	55	301	435	101	767	1	88	32
2020	577	150	0	391	55	301	435	101	767	1	88	32
2021	577	150	0	391	55	301	435	101	767	1	88	32
NATURAL STREAM DEEP PERCOLATION												
2012	500	0	0	693	0	1,948	896	1,304	2,272	0	812	3,003
2013	500	0	0	693	0	1,948	896	1,304	2,272	0	812	3,003
2014	500	0	0	693	0	1,948	896	1,304	2,272	0	812	3,003
2015	500	0	0	693	0	1,948	896	1,304	2,272	0	812	3,003
2016	500	0	0	693	0	1,948	896	1,304	2,272	0	812	3,003
2017	500	0	0	693	0	1,948	896	1,304	2,272	0	812	3,003
2018	500	0	0	693	0	1,948	896	1,304	2,272	0	812	3,003
2019	500	0	0	693	0	1,948	896	1,304	2,272	0	812	3,003
2020	500	0	0	693	0	1,948	896	1,304	2,272	0	812	3,003
2021	500	0	0	693	0	1,948	896	1,304	2,272	0	812	3,003

Future Projected Water Balances 2012 - 2022

	BOLSA	BOLSA SE	FLINT HILLS	HOLLISTER NE	HOLLISTER SE	HOLLISTER WEST	PACHECO	SAN JUAN CENTRAL	SAN JUAN NORTH	SAN JUAN SOUTH	TRES PINOS	TRES PINOS CR VALLEY
CONTROLLED RESERVOIR RELEASES FOR GROUNDWATER RECHARGE												
2012	0	0	0	0	0	764	0	511	846	0	318	0
2013	0	0	0	2	53	51	2	0	13	0	57	0
2014	0	0	0	0	0	764	0	511	846	0	318	0
2015	0	0	0	0	0	764	0	511	846	0	318	0
2016	0	0	0	0	0	764	0	511	846	0	318	0
2017	0	0	0	0	0	764	0	511	846	0	318	0
2018	0	0	0	0	0	764	0	511	846	0	318	0
2019	0	0	0	0	0	764	0	511	846	0	318	0
2020	0	0	0	0	0	764	0	511	846	0	318	0
2021	0	0	0	0	0	764	0	511	846	0	318	0
GROUNDWATER RECHARGE WITH CVP WATER												
2012	0	0	0	0	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0	0	0	0	0
2014	0	0	0	0	0	0	0	0	0	0	0	0
2015	0	0	0	0	0	0	0	0	0	0	0	0
2016	0	0	0	0	0	0	0	0	0	0	0	0
2017	0	0	0	0	0	0	0	0	0	0	0	0
2018	0	0	0	0	0	0	0	0	0	0	0	0
2019	0	0	0	0	0	0	0	0	0	0	0	0
2020	0	0	0	0	0	0	0	0	0	0	0	0
2021	0	0	0	0	0	0	0	0	0	0	0	0
WWTP PERCOLATION												
2012	0	0	0	0	0	219	0	0	1,946	0	225	0
2013	0	0	0	0	0	205	0	0	1,609	0	219	0
2014	0	0	0	0	0	191	0	0	1,272	0	20	0
2015	0	0	0	0	0	177	0	0	936	0	21	0
2016	0	0	0	0	0	177	0	0	682	0	21	0
2017	0	0	0	0	0	177	0	0	682	0	21	0
2018	0	0	0	0	0	177	0	0	682	0	21	0
2019	0	0	0	0	0	177	0	0	682	0	21	0
2020	0	0	0	0	0	177	0	0	682	0	21	0
2021	0	0	0	0	0	177	0	0	682	0	21	0

Future Projected Water Balances 2012 - 2022

	BOLSA	BOLSA SE	FLINT HILLS	HOLLISTER NE	HOLLISTER SE	HOLLISTER WEST	PACHECO	SAN JUAN CENTRAL	SAN JUAN NORTH	SAN JUAN SOUTH	TRES PINOS	TRES PINOS CR VALLEY
SUBSURFACE GROUNDWATER INFLOW (ADJUSTED)												
2012	6,641	3,049	0	273	247	1,328	2,912	0	31	0	1,559	0
2013	6,641	3,049	0	273	247	1,328	2,912	0	31	0	1,559	0
2014	6,641	3,049	0	273	247	1,328	2,912	0	31	0	1,559	0
2015	6,641	3,049	0	273	247	1,328	2,912	0	31	0	1,559	0
2016	6,641	3,049	0	273	247	1,328	2,912	0	31	0	1,559	0
2017	6,641	3,049	0	273	247	1,328	2,912	0	31	0	1,559	0
2018	6,641	3,049	0	273	247	1,328	2,912	0	31	0	1,559	0
2019	6,641	3,049	0	273	247	1,328	2,912	0	31	0	1,559	0
2020	6,641	3,049	0	273	247	1,328	2,912	0	31	0	1,559	0
2021	6,641	3,049	0	273	247	1,328	2,912	0	31	0	1,559	0
WATER LINE LEAKAGE												
2012	0	0	0	2	64	61	2	0	16	0	69	0
2013	0	0	0	2	64	61	2	0	16	0	69	0
2014	0	0	0	2	64	61	2	0	16	0	69	0
2015	0	0	0	2	64	61	2	0	16	0	69	0
2016	0	0	0	2	64	61	2	0	16	0	69	0
2017	0	0	0	2	64	61	2	0	16	0	69	0
2018	0	0	0	2	64	61	2	0	16	0	69	0
2019	0	0	0	2	64	61	2	0	16	0	69	0
2020	0	0	0	2	64	61	2	0	16	0	69	0
2021	0	0	0	2	64	61	2	0	16	0	69	0
SEWER LINE LEAKAGE												
2012	0	0	0	66	66	119	0	0	15	0	13	0
2013	0	0	0	66	66	119	0	0	15	0	13	0
2014	0	0	0	66	66	119	0	0	15	0	13	0
2015	0	0	0	66	66	119	0	0	15	0	13	0
2016	0	0	0	66	66	119	0	0	15	0	13	0
2017	0	0	0	66	66	119	0	0	15	0	13	0
2018	0	0	0	66	66	119	0	0	15	0	13	0
2019	0	0	0	66	66	119	0	0	15	0	13	0
2020	0	0	0	66	66	119	0	0	15	0	13	0
2021	0	0	0	66	66	119	0	0	15	0	13	0

Future Projected Water Balances 2012 - 2022

	BOLSA	BOLSA SE	FLINT HILLS	HOLLISTER NE	HOLLISTER SE	HOLLISTER WEST	PACHECO	SAN JUAN CENTRAL	SAN JUAN NORTH	SAN JUAN SOUTH	TRES PINOS	TRES PINOS CR VALLEY
RECYCLED WATER IRRIGATION RETURN FLOWS												
2012	0	3	0	10	3	8	0	0	0	0	0	0
2013	0	6	0	13	6	11	0	0	0	0	0	0
2014	0	10	0	16	10	14	0	0	0	0	10	0
2015	0	13	0	20	13	17	0	0	0	0	10	0
2016	0	16	0	23	16	20	0	0	0	0	10	0
2017	0	16	0	23	16	20	0	0	0	0	10	0
2018	0	16	0	23	16	20	0	0	0	0	10	0
2019	0	16	0	23	16	20	0	0	0	0	10	0
2020	0	16	0	23	16	20	0	0	0	0	10	0
2021	0	16	0	23	16	20	0	0	0	0	10	0
SEPTIC SYSTEMS RETURN FLOWS												
2012	33	5	0	85	36	437	115	10	24	0	291	0
2013	33	5	0	85	36	437	115	10	24	0	291	0
2014	33	5	0	85	36	437	115	10	24	0	291	0
2015	33	5	0	85	36	437	115	10	24	0	291	0
2016	33	5	0	85	36	437	115	10	24	0	291	0
2017	33	5	0	85	36	437	115	10	24	0	291	0
2018	33	5	0	85	36	437	115	10	24	0	291	0
2019	33	5	0	85	36	437	115	10	24	0	291	0
2020	33	5	0	85	36	437	115	10	24	0	291	0
2021	33	5	0	85	36	437	115	10	24	0	291	0
RURAL LANDSCAPE IRRIGATION RETURN FLOWS												
2012	2	0	0	4	2	22	6	1	1	0	15	0
2013	2	0	0	4	2	22	6	1	1	0	15	0
2014	2	0	0	4	2	22	6	1	1	0	15	0
2015	2	0	0	4	2	22	6	1	1	0	15	0
2016	2	0	0	4	2	22	6	1	1	0	15	0
2017	2	0	0	4	2	22	6	1	1	0	15	0
2018	2	0	0	4	2	22	6	1	1	0	15	0
2019	2	0	0	4	2	22	6	1	1	0	15	0
2020	2	0	0	4	2	22	6	1	1	0	15	0
2021	2	0	0	4	2	22	6	1	1	0	15	0

Future Projected Water Balances 2012 - 2022

	BOLSA	BOLSA SE	FLINT HILLS	HOLLISTER NE	HOLLISTER SE	HOLLISTER WEST	PACHECO	SAN JUAN CENTRAL	SAN JUAN NORTH	SAN JUAN SOUTH	TRES PINOS	TRES PINOS CR VALLEY
MUNICIPAL IRRIGATION RETURN FLOWS												
2012	0	0	0	2	53	51	2	0	13	0	57	0
2013	0	0	0	2	53	51	2	0	13	0	57	0
2014	0	0	0	2	53	51	2	0	13	0	57	0
2015	0	0	0	2	53	51	2	0	13	0	57	0
2016	0	0	0	2	53	51	2	0	13	0	57	0
2017	0	0	0	2	53	51	2	0	13	0	57	0
2018	0	0	0	2	53	51	2	0	13	0	57	0
2019	0	0	0	2	53	51	2	0	13	0	57	0
2020	0	0	0	2	53	51	2	0	13	0	57	0
2021	0	0	0	2	53	51	2	0	13	0	57	0
AGRICULTURAL PUMPING												
2012	(5,775)	(2,775)	0	(915)	(332)	(1,801)	(1,910)	(1,013)	(4,664)	(1)	(390)	(322)
2013	(5,775)	(2,775)	0	(915)	(332)	(1,801)	(1,910)	(1,013)	(4,664)	(1)	(390)	(322)
2014	(5,775)	(2,775)	0	(915)	(332)	(1,801)	(1,910)	(1,013)	(4,664)	(1)	(390)	(322)
2015	(5,775)	(2,775)	0	(915)	(332)	(1,801)	(1,910)	(1,013)	(4,664)	(1)	(390)	(322)
2016	(5,775)	(2,775)	0	(915)	(332)	(1,801)	(1,910)	(1,013)	(4,664)	(1)	(390)	(322)
2017	(5,775)	(2,775)	0	(915)	(332)	(1,801)	(1,910)	(1,013)	(4,664)	(1)	(390)	(322)
2018	(5,775)	(2,775)	0	(915)	(332)	(1,801)	(1,910)	(1,013)	(4,664)	(1)	(390)	(322)
2019	(5,775)	(2,775)	0	(915)	(332)	(1,801)	(1,910)	(1,013)	(4,664)	(1)	(390)	(322)
2020	(5,775)	(2,775)	0	(915)	(332)	(1,801)	(1,910)	(1,013)	(4,664)	(1)	(390)	(322)
2021	(5,775)	(2,775)	0	(915)	(332)	(1,801)	(1,910)	(1,013)	(4,664)	(1)	(390)	(322)
DOMESTIC AND MUNICIPAL PUMPING												
2012	0	(5)	0	(58)	(507)	(1,728)	(66)	0	(260)	0	(1,667)	0
2013	0	(4)	0	(44)	(387)	(1,317)	(50)	0	(197)	0	(1,270)	0
2014	0	(3)	0	(30)	(266)	(907)	(34)	0	(135)	0	(872)	0
2015	0	(1)	0	(17)	(146)	(496)	(18)	0	(73)	0	(475)	0
2016	0	(1)	0	(17)	(146)	(496)	(18)	0	(73)	0	(475)	0
2017	0	(1)	0	(17)	(146)	(496)	(18)	0	(73)	0	(475)	0
2018	0	(1)	0	(17)	(146)	(496)	(18)	0	(73)	0	(475)	0
2019	0	(1)	0	(17)	(146)	(496)	(18)	0	(73)	0	(475)	0
2020	0	(1)	0	(17)	(146)	(496)	(18)	0	(73)	0	(475)	0
2021	0	(1)	0	(17)	(146)	(496)	(18)	0	(73)	0	(475)	0

Future Projected Water Balances 2012 - 2022

	BOLSA	BOLSA SE	FLINT HILLS	HOLLISTER NE	HOLLISTER SE	HOLLISTER WEST	PACHECO	SAN JUAN CENTRAL	SAN JUAN NORTH	SAN JUAN SOUTH	TRES PINOS	TRES PINOS CR VALLEY
GW OUTFLOW												
2012	0	(1,500)	0	(2,000)	0	(3,055)	(3,191)	0	(3,600)	0	(2,000)	(2,003)
2013	0	(1,500)	0	(2,000)	0	(3,055)	(3,191)	0	(3,600)	0	(2,000)	(2,003)
2014	0	(1,500)	0	(2,000)	0	(3,055)	(3,191)	0	(3,600)	0	(2,000)	(2,003)
2015	0	(1,500)	0	(2,000)	0	(3,055)	(3,191)	0	(3,600)	0	(2,000)	(2,003)
2016	0	(1,500)	0	(2,000)	0	(3,055)	(3,191)	0	(3,600)	0	(2,000)	(2,003)
2017	0	(1,500)	0	(2,000)	0	(3,055)	(3,191)	0	(3,600)	0	(2,000)	(2,003)
2018	0	(1,500)	0	(2,000)	0	(3,055)	(3,191)	0	(3,600)	0	(2,000)	(2,003)
2019	0	(1,500)	0	(2,000)	0	(3,055)	(3,191)	0	(3,600)	0	(2,000)	(2,003)
2020	0	(1,500)	0	(2,000)	0	(3,055)	(3,191)	0	(3,600)	0	(2,000)	(2,003)
2021	0	(1,500)	0	(2,000)	0	(3,055)	(3,191)	0	(3,600)	0	(2,000)	(2,003)

See Todd (2012b) for adjustments made in the water balance for each year

Groundwater inflows adjusted to account for minor inflows from septic system returns, sewer line leaks, water line leaks, recycled water return flows, and domestic irrigation return flows

Appendix D

SNMP Monitoring Plan

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San Benito County Water District
San Benito County, California

Salt and Nutrient Management Plan
Monitoring Program
Northern San Benito County

July 2013

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1 Introduction

This technical memorandum (TM) describes the proposed Salt and Nutrient Management Plan (SNMP) Groundwater Monitoring Program for the Study Area. The SNMP is being prepared for the San Benito County Water District (District) and stakeholders in the Study Area. The Study Area includes the San Benito County (County) portion of the Gilroy-Hollister Groundwater Basin, which includes the Bolsa, Hollister, and San Juan Bautista groundwater subbasins and the Tres Pinos Valley Groundwater Basin as defined by the California Department of Water Resources (DWR) in Bulletin 118 (DWR, 2003)(see **Figure 1**). Stakeholders include water and wastewater agencies and salt and nutrient contributors to the groundwater basins/subbasins.

In February 2009, the State Water Resources Control Board (SWRCB) adopted Resolution No. 2009-0011, which established a statewide Recycled Water Policy.[1] With respect to monitoring, the Recycled Water Policy states that the SNMP should include a monitoring program that consists of a network of monitoring locations ". . . adequate to provide a reasonable, cost-effective means of determining whether the concentrations of salts, nutrients, and other constituents of concern as identified in the salt and nutrient plans are consistent with applicable water quality objectives." Additionally, the SNMP ". . . must focus on basin water quality near water supply wells and areas proximate to large water recycling projects, particularly groundwater recharge projects. Also, monitoring locations shall, where appropriate, target groundwater and surface waters where groundwater has connectivity with the adjacent surface waters." The preferred approach is to ". . . collect samples from existing wells if feasible as long as the existing wells are located appropriately to determine water quality throughout the most critical areas of the basin. The monitoring plan shall identify those stakeholders responsible for conducting, sampling, and reporting the monitoring data. The data shall be reported to the Regional Water Board at least every three years." With regard to constituents of emerging concern (CECs), the Recycled Water Policy Attachment A states that "Monitoring of health-based CECs or performance indicator CECs is not required for recycled water used for landscape irrigation due to the low risk for ingestion of the water."

The purpose of this TM is to describe the SNMP Groundwater Quality Monitoring Program for the Study Area including groundwater sampling locations, sampling frequency, constituents monitored, sampling protocols and associated quality assurance and quality control (QA/QC) procedures, data analysis and evaluation criteria, and reporting. The entities responsible for monitoring and reporting will also be described.

[1] Draft amendments to the Recycled Water Policy were released in May 2012, September 2012, October 2012 (SWRCB hearing change sheets), and January 2013. The Recycled Water Policy Amendment was adopted by the SWRCB on January 22, 2013.

2 Background

The subbasins and basins in the Study Area are shown in Figure 1. While the Study Area includes the Bolsa, Hollister, San Juan Bautista subbasins and the Tres Pinos Valley Basin as defined by DWR (2003), the District defines hydrogeologic subbasins differently than DWR. As shown in **Figure 2**, the District defines eight subbasins in the northern Study Area including the Bolsa; Bolsa Southeast; Pacheco; Tres Pinos; San Juan; and Northeast, Southeast and West Hollister. The District defines two additional subbasins in the central Study Area including the Tres Pinos Creek Valley and the Paicines Valley. These subbasins have been defined based on a combination of infrastructure subdivisions (San Felipe subsystems), political boundaries (e.g., District's Zone 6), and geologic structures such as faults. The District has formed three zones of benefit in the County. Zone 6 (shaded red in Figure 2) includes the most developed, studied and actively managed part of the County. Accordingly, Zone 6 is the area with the most available groundwater quality data.

Groundwater quality investigations in the Study Area date back to the 1930s. To further understanding of basin-wide water quality and to optimize their monitoring program, the District developed a comprehensive water quality database and water quality monitoring program (Todd Engineers, 2004). Based on that program, the District coordinates sampling, collection, and reporting of groundwater quality data. The data are analyzed and reported every three years in the District's Groundwater Report, most recently for water year 2010 (October 1 through September 30) (Todd, 2010). This is a voluntary program.

The water quality data summarized in the triennial Groundwater Report updates include data collected by the District; data available from other entities including the Regional Water Quality Control Board (RWQCB), California Department of Public Health (CDPH), City of Hollister, Sunnyslope County Water District (SSCWD); and other sources as described in the *Development of a Water Quality Monitoring Program Hollister Groundwater Basin* (Todd, 2004) and subsequent triennial Groundwater Reports (Todd, 2007 and 2010).

The existing District monitoring program and groundwater quality database were used to characterize salt and nutrient (S/N) groundwater quality and trends for the SNMP water quality assessment. The existing data were found to be adequate to support the analysis. Accordingly, this SNMP Monitoring Program proposes to use the District's existing groundwater quality monitoring program as the basis for a comprehensive monitoring plan that satisfies the requirements of the Recycled Water Policy. Some additions to the existing program are suggested to provide a more robust program.

3 SNMP Groundwater Quality Monitoring Program

3.1 Monitored Parameters

Total dissolved solids (TDS) and nitrate are the indicator salts and nutrients (S/Ns) selected for the Northern San Benito County SNMP. Total salinity is commonly expressed in terms of TDS in milligrams per liter (mg/L). TDS data are available for source waters (both inflows and outflows) in the Study Area. While TDS can be an indicator of anthropogenic impacts such as infiltration of runoff, soil leaching, and land use, there is also a natural background TDS concentration in groundwater. The background TDS concentration in groundwater can vary considerably based on purity and crystal size of the formation minerals, rock texture and porosity, the regional structure, origin of sediments, the age of the groundwater, and many other factors (Hem, 1989).

Nitrate is a widespread contaminant in California groundwater. High levels of nitrate in groundwater are associated with agricultural activities, septic systems, confined animal facilities, landscape fertilization, and wastewater treatment facility discharges. Nitrate is the primary form of nitrogen detected in groundwater. Nitrate data are available for source waters (both inflows and outflows) in the Study Area. Natural nitrate levels in groundwater are generally very low (typically less than 10 mg/L for nitrate as nitrate (nitrate-NO_3). Nitrate is commonly reported as either nitrate-NO_3 or nitrate as nitrogen (nitrate-N); and one can be converted to the other. Nitrate-NO_3 is the form of nitrate selected for assessment for this SNMP.

The SNMP monitoring program uses TDS and nitrate as S/N indicator chemicals.

3.2 Monitoring Programs

The current District groundwater monitoring program includes data collected by the District and other programs directed by the RWQCB and CDPH. The SNMP Monitoring Program will include data from these ongoing programs and additional proposed monitoring wells. The SNMP monitoring program will also collect and consider data from any other special studies conducted in the Study Area. The three major programs are described in the following sections.

3.3 San Benito County Water District (District)

Currently 19 production wells and one multiple completion nested well are sampled by the District as part of its ongoing groundwater monitoring program (**Figure 3**). The production wells are used for domestic or agricultural purposes. Because these wells are not owned by the District, their sampling is subject to continuing agreement with the well owners. The nested well (referred to as the AB303 Well because it was constructed and tested by the District through an AB303 grant) is designated in yellow on Figure 3. The AB303 Well has five depth discrete screened intervals allowing characterization of the vertical variability in water quality. Available well completion information for these wells is provided in **Table 1**. Attempts to locate well driller's logs and construction information for most of the wells in the monitoring program have been unsuccessful, and construction information for most wells is not available. With respect to vertical distribution of monitoring in the basin, it appears that the District is predominantly monitoring relatively shallow production zones. Although the District's program does not contain sufficient well construction information to document the exact zones being monitored, the average well depth for District-monitored wells is estimated at 300 feet.

Table 1 District's Current Monitoring Program

District Well Number	Latitude	Longitude	Total Depth (ft-bgs)	Screen Interval (ft-bgs)
MW 11	36.87063	-121.41523		
MW 12	36.86373	-121.41555		
MW 17	36.87292	-121.36427		
MW 18	36.79551	-121.3701		
MW 19	36.85629	-121.43492		
MW 21	36.84574	-121.45111		
MW 24	36.84949	-121.46428		
MW 28	36.92361	-121.36535		
MW 31	36.86426	-121.39629		
MW 36	36.82643	-121.4223		
MW 39	36.85329	-121.47189	305	120-240
MW 41	36.88291	-121.55356		
MW 42	36.94383	-121.50333	270	27-50
MW 43	36.95495	-121.46612		
MW 45	36.8227	-121.38075		
MW 46	36.86267	-121.45392		
MW 47	36.84873	-121.47345		
MW 48	36.83187	-121.35102	300	
MW 49	36.93927	-121.40005		
MW 51	36.798615	-121.366359		
MW 52	36.832446	-121.357906		
AB303 Well A	36.906055	-121.372009	700	45-55
AB303 Well B	36.906055	-121.372009	700	170-190
AB303 Well C	36.906055	-121.372009	700	225-235
AB303 Well D	36.906055	-121.372009	700	490-510
AB303 Well E	36.906055	-121.372009	700	660-690

ft-bgs - feet below ground surface

The wells are sampled for Title 22 general mineral and physical properties and inorganics twice per year, typically in the spring and fall. **Table 2** lists the parameters monitored.

Table 2 List of Parameters Monitored by the District

• Temperature (field)	• Manganese
• pH (field and lab)	• MBAS (Anionic surfactants)
• Electrical conductivity (field and lab)	• Mercury
• Apparent Color	• Nickel
• Odor Threshold	• Nitrate
• Aluminum	• Potassium
• Arsenic	• Selenium
• Barium	• Silver
• Cadmium	• Sodium
• Calcium	• Sulfate
• Chloride	• Zinc
• Chromium	• Bicarbonate
• Copper	• Carbonate
• Fluoride	• Total Hardness as $CaCO_3$
• Iron	• Total Alkalinity
• Lead	• Total Dissolved Solids
• Magnesium	• Turbidity
	• Hydroxide

The District's quality control/quality assurance (QA/QC) procedures include collection of field temperature and conductivity measurements while the well is being purged to ensure that physical parameters have stabilized before collecting a sample. Sampling procedures follow guidelines from analytical laboratories for the constituents to be analyzed. Sampling containers are furnished by the laboratory. A state certified laboratory is used for analysis.

A number of shallow monitoring wells were installed in the northern San Juan Subbasin as part of a joint investigation conducted by the District and City of Hollister (Yates, 2002). These wells were installed near existing deeper screened production wells. The shallow monitoring wells were installed and the well pairs monitored for groundwater levels to assess the occurrence and causes of shallow groundwater in the area. As discussed in the SNMP report, the northern San Juan Subbasin has the highest average TDS concentration of all the subbasins/basin in the Study Area, with an average concentration approaching 1,200 mg/L. In order to better understand the shallow groundwater quality and sources of TDS loading, these shallow wells will be monitored for TDS and nitrate twice per year as part of the SNMP Monitoring Program. The available well completion information for these wells is provided in **Table 3**. **Figure 4** shows the location of the wells.

Table 3 Additional Wells for District's Monitoring Program

District Well Number	Depth Zone	Well_No	Latitude	Longitude	Total Depth (ft-bgs)	Screen Interval (ft-bgs)
Northern San Juan Subbasin						
SJ MW 1S	Shallow	San Juan Cr at MW-18	36.85045	-121.5377		
SJ MW 2S	Shallow	12S/04E-21N001	36.86832	-121.5429	30	15-25
SJ MW 3S	Shallow	12S/04E-29J003	36.86044	-121.5454	39	15-30
SJ MW 4S	Shallow	12S/04E-27L002	36.85719	-121.5214	25	15-25
SJ MW 5S	Shallow	12S/04E-34D001	36.84998	-121.5248	35	20-35
SJ MW 6S	Shallow	12S/04E-34H003	36.84806	-121.5091	30	15-30
SH MW 7S	Shallow	12S/04E-26L002	36.85715	-121.5042	55	25-55
SJ MW 8S	Shallow	12S/05E-30L001	36.8572	-121.4636	35	20-35
SJ MW 9S	Shallow	12S/05E-31G006	36.84893	-121.4598	45	20-45
SJ MW 10S	Shallow	12S/05E-28N005	36.85605	-121.4347	40	30-40
SJ MW 11S	Shallow	13S/05E-03C002	36.83906	-121.4117	55	35-55
Paicines Valley Area						
MW-53	Deep	14S/06E-26F	36.71635	-121.2921		
MW-54	Deep	14S/06E-26H001	36.69104	-121.2719		

ft-bgs - feet below ground surface

During the SNMP stakeholder outreach process, the RWQCB indicated that additional monitoring in the central portion of the Study Area would be helpful in characterizing water quality in this area. As a result, the District has identified two new monitoring wells in the Paicines Valley area that will be added to the District's monitoring program. These are private wells and sampling is subject to continuing agreement with the well owners. These wells will be monitored for general mineral and physical properties twice per year. The available well completion information for these wells is provided in Table 3. The well locations are shown in Figure 4.

There are no monitoring wells or available groundwater quality data in the southern portion of the Study Area. This area is relatively undeveloped with limited S/N loading sources or groundwater use. Much of the southern portion of the Study Area is upland areas underlain by consolidated bedrock units and not part of the alluvial basins typically used to define groundwater basins in the area. Therefore, monitoring in this area is not proposed or deemed necessary.

3.4 Regional Water Quality Control Board (RWQCB)

The RWQCB (Region 3) is responsible for enforcing all water quality standards for permitted or other discharges in the Central Coast region (including San Benito County). As a part of enforcement, the RWQCB may require monitoring from a regulated facility to ensure no adverse impact to groundwater or surface water. Water quality data from regulated sites are available on the RWQCB web portal Geotracker, provided by the RWQCB staff, or acquired directly from the regulated facilities. These data are entered into the District's water quality database and may be considered when assessing local area water quality in the Study Area. **Figure 5** shows the locations of wells with data available from the RWQCB. Most of these wells monitor shallow groundwater.

The RWQCB typically requires that data submitted be collected in compliance with an approved Sampling and Analysis and QA/QC Plan and that samples be analyzed at a state-certified laboratory.

3.4.1 Recycled Water Irrigation Monitoring

Currently two sites are receiving recycled water for irrigation: Brigantino Park and the Hollister Airport (**Figure 6**). Both sites have site-specific quarterly groundwater monitoring and reporting requirements. There is one upgradient well and four downgradient wells at Brigantino Park (**Figure 7**) and two upgradient and 6 sidegradient or downgradient monitoring wells at the Hollister Airport (**Figure 8**). The SNMP has determined that S/N water quality impacts from existing and proposed future recycled water irrigation projects use less than 1% of the available assimilative capacity in the basins/subbasins where recycled water use for irrigation occurs. The future projection analysis shows that recycled water irrigation will continue to be a very small component of S/N loading. Recycled water TDS quality is near or lower than the ambient groundwater quality and recycled water nitrate quality is considerably lower than the ambient groundwater quality beneath the existing irrigation sites. Monitoring individual recycled water irrigation sites does not appear warranted given the very small loading associated with this source relative to other loading sources, as other sources are likely to have the dominant impact on the ambient groundwater quality near the irrigation sites. This is demonstrated by elevated S/N concentrations observed at Brigantino Park prior to application of recycled water and higher concentrations in upgradient wells than downgradient wells at the Airport Site (City of Hollister, 2011). Because of the impacts of other more significant S/N loading sources, site-specific monitoring at recycled water irrigation sites is not meaningful. The Study Area wide groundwater quality monitoring program proposed in this SNMP Monitoring Plan is adequate to assess S/N water quality and water quality trends on a basin-wide or subbasin-wide basis.

3.4.2 Irrigated Lands Order

The RWQCB Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands (Order No. R3-201200011) requires groundwater monitoring for certain types (tiers) of agricultural land uses. The RWQCB has indicated that, due to public concerns about maintaining parcel confidentiality, groundwater quality data generated from this program might not be readily available to the general public. Nonetheless, the RWQCB may be able to provide amalgamated groundwater quality information for "general areas" (DeMartini, 2013). Water quality data available from this program will be considered in characterizing conditions in the Study Area.

3.5 Department of Public Health

The CDPH is responsible for enforcing drinking water standards for public drinking water systems. A public drinking water system is a system for the provision of water for human consumption through pipes or other constructed conveyances that has 15 or more service connections or regularly serves at least 25 individuals daily at least 60 days out of the year. Private domestic wells and irrigation wells are not regulated by the CDPH. Approximately 120 water systems in San Benito County are required to submit water quality data to CDPH. These data are available from CDPH and are incorporated into the District's water quality database and used to characterize groundwater quality concentrations and trends. While the CDPH does not release location information, locations were estimated based on system addresses, or known well locations. **Figure 9** shows the locations of wells with CDPH data.

Public groundwater purveyors are obligated to collect groundwater samples to determine compliance with maximum contaminant levels (MCLs) in accordance with monitoring schedules developed by CDPH based on the size of the water system. Purveyors are required to submit data directly to CDPH via electronic transfer. The constituents monitored and the frequency of monitoring varies based on the well, size of the water system, and history of water quality monitoring results.

The DPH (formally California Department of Health Services (DHS)) has established formal sampling procedures summarized in the *Water Sampling Manual* (DHS, 2006). Water suppliers are to send samples to State-certified laboratories and follow the sampling and QA/QC requirements of those laboratories. Samples are to be taken before the check valve on the wellhead and collected after the well has been pumped sufficiently to ensure that the sample represents the groundwater source.

Laboratories are to meet various requirements available on DPH's website:

http://www.cdph.ca.gov/certlic/drinkingwater/Pages/Labinfo.aspx

QA/QC may include the analysis of duplicates and equipment, field, trip, method, and instrument blanks.

3.6 Adequacy of Proposed Monitoring Program

In general, the proposed SNMP Monitoring Program described above is deemed adequate to monitor the spatial variability and transient change in S/N groundwater quality as required by the Recycled Water Policy. Specifically, the proposed monitoring program does monitor basin water quality near water supply wells and near areas of groundwater/surface water connectivity. Moreover, a number of wells are located within or proximate to areas of recycled water use.

The existing monitoring program and database were found to be adequate to characterize groundwater quality to support the SNMP analysis and a few additional wells have been proposed to make the program more robust.

The largest identified gap in the database and monitoring program is the limited well construction data available. Construction data are only available for about 60 percent of the wells, limiting evaluation of water quality changes with depth. With the exception of the District's monitoring data, all of the data are collected by other entities and QA/QC procedures cannot be controlled. Many of these data limitations are mitigated by the large amount of data collected and the general basin-wide evaluation purpose for which data are used. Additional wells have been added to the program to provide shallow depth information for the northern San Juan Subbasin, while the District's nested well provides depth-discrete information in the Hollister North East Subbasin. Two wells also are proposed for monitoring in the Paicines Valley.

3.7 Data Analysis and Reporting

3.7.1 Responsible Party

The monitoring data described above will be collected and compiled by the District. The data will be analyzed and reported to the RWQCB every three years as part of the District's triennial Groundwater Report. The SNMP report will include the following:

- Discussion of TDS and nitrate groundwater quality including,
    - Water quality concentration maps,
    - Time-concentration plots,
    - Evaluation of vertical variation in water quality,
    - Comparison of detections with basin-specific basin plan objectives (BSPOs), and
- Status of recycled water use and stormwater capture projects and implementation measures

3.7.2 Evaluation Criteria

The criteria or performance measures to evaluate groundwater quality are the TDS and nitrate trends and concentrations. The BSPOs are the primary evaluation criteria used to assess S/N groundwater quality. Accordingly, the monitoring report should discuss whether S/N concentration trends are generally consistent with the patterns described and predicted in SNMP. TDS and nitrate groundwater quality should be compared with BSPOs to determine if overall basin groundwater quality meets basin plan objectives and will continue to meet BSPOs in the future.

3.7.3 Sampling Protocols and QA/QC

Groundwater sampling is conducted by trained professionals from the District. Sampling of wells in the District Monitoring Program follows standard monitoring well sampling guidelines such as those presented in the *National Field Manual for the Collection of Water-Quality Data* (USGS, 2012). It is assumed that data collected by other entities is collected and analyzed in accordance with standard QA/QC protocols as described above.

Purging and Sampling

Generally, the wells have been pumped prior to sample collection, or are purged. Purging is conducted until field instruments indicate that water quality parameters (pH, ORP, specific conductance, and temperature) have stabilized and turbidity measurements are below five Nephelometric Turbidity Unit (NTUs). The pumping or purging demonstrate that the sample collected is representative of formation water and not stagnant water in the well casing or well filter pack.

All groundwater samples are collected in laboratory-supplied, pre-labeled containers and include prescribed preservatives.

Record Keeping and Sample Transport

All field measurements are recorded in a field logbook or worksheets and the sample containers are labeled correctly and recorded on the chain-of-custody form. The applicable chain-of-custody sections are completed and forwarded with the samples to the laboratory. Upon receipt of the samples at the laboratory, laboratory personnel complete the chain-of-custody.

QA/QC

Field QA/QC

QA/QC assessment of field sampling includes use of field blanks. Field blanks identify sample contamination that is associated with the field environment and sample handling. These samples are prepared in the field by filling the appropriate sample containers with the distilled water used for cleaning and decontamination of all field equipment. One field blank per sampling event is collected.

Laboratory QA/QC

Samples are sent to a State-certified laboratory that has in place a documented analytical QA/QC program that includes procedures to reduce variability and errors, identify and correct measurement problems, and provide a statistical measure of data quality. The laboratory conducts all QA/QC procedures in accordance with its QA/QC program. All QA/QC data is reported in the laboratory analytical report, including: the method, equipment, and analytical detection limits, the recovery rates, an explanation for any recovery rate that is less than 80 percent, the results of equipment and method blanks, the results of spiked and surrogate samples, the frequency of quality control analysis, and the name of the person(s) performing the analyses. Sample results are reported unadjusted for blank results or spike recovery.

Database QA/QC

Because the data compiled and entered into the database may come from numerous external sources, methods to ensure data quality are limited. The data entry process has focused on obtaining electronic data wherever available to limit transcription errors. Data are checked against the original source (electronic or paper) after entry into the database.

The database also has certain built-in controls to maintain the integrity of the data. The chemical table contains the identification of the agency responsible for collecting/storing the data, allowing each record to be traced to its original source. The location table has fields that document the original source of sampling location information and well construction data. Every record in both the chemical table and the location table has a primary key that was developed to require data in certain fields and prevent repetition in a table. This primary key does not allow a repeating entry with the same agency, the same sampling event, and the same chemical as an existing entry in the database. Sampling events must also be unique. If a water sample is analyzed as a duplicate sample for field and laboratory quality control, data entered into the database must reflect that fact it is a duplicate sample in the sampling event (Sample ID). In addition to these protections, regular evaluation of the data in the context of a basin-wide characterization also allows for data outliers to be identified. The chemical table contains a QA/QC field that allows notes to be tied to questionable records.

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Figure

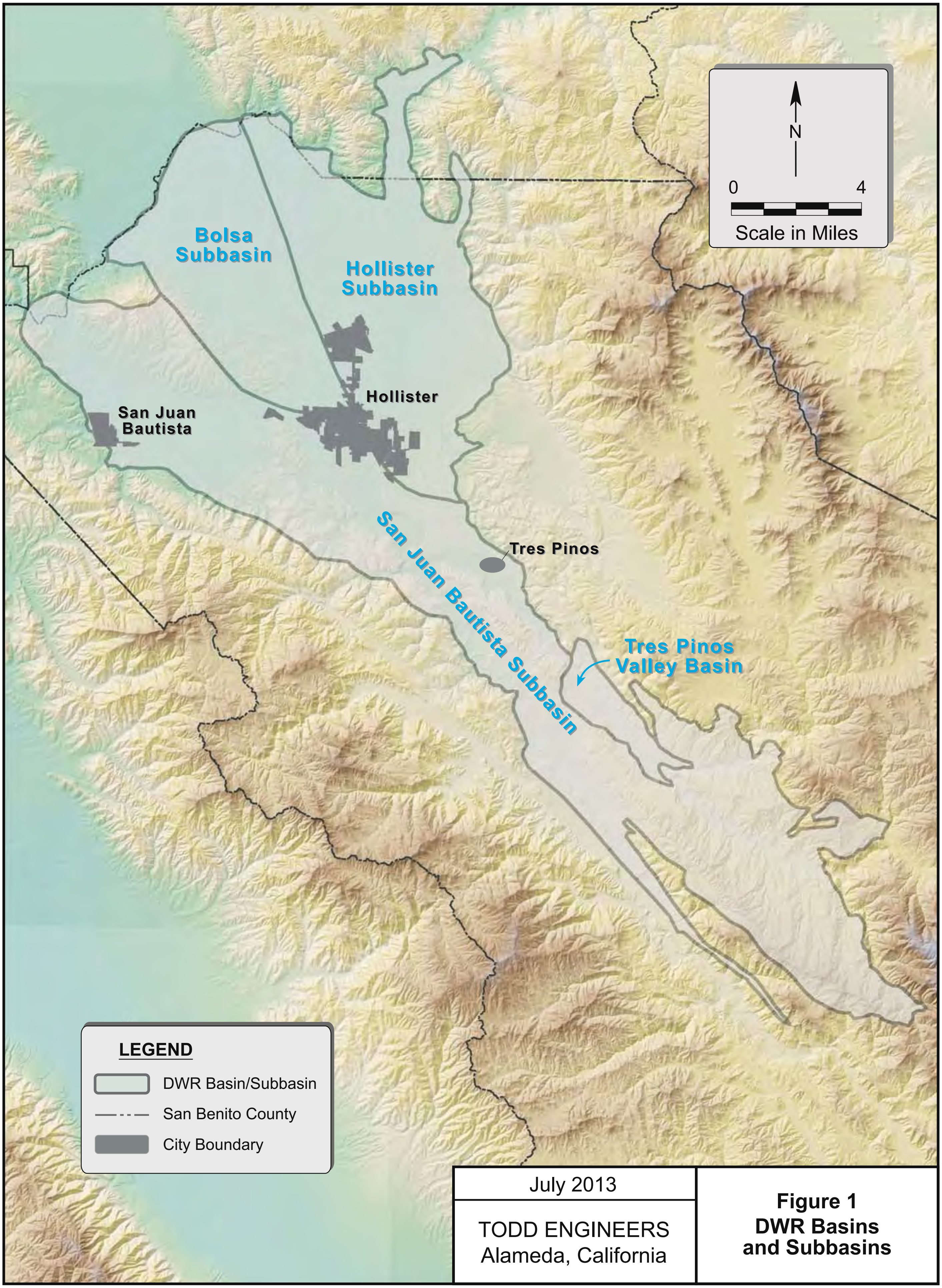

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Figure 1
DWR Basins and Subbasins

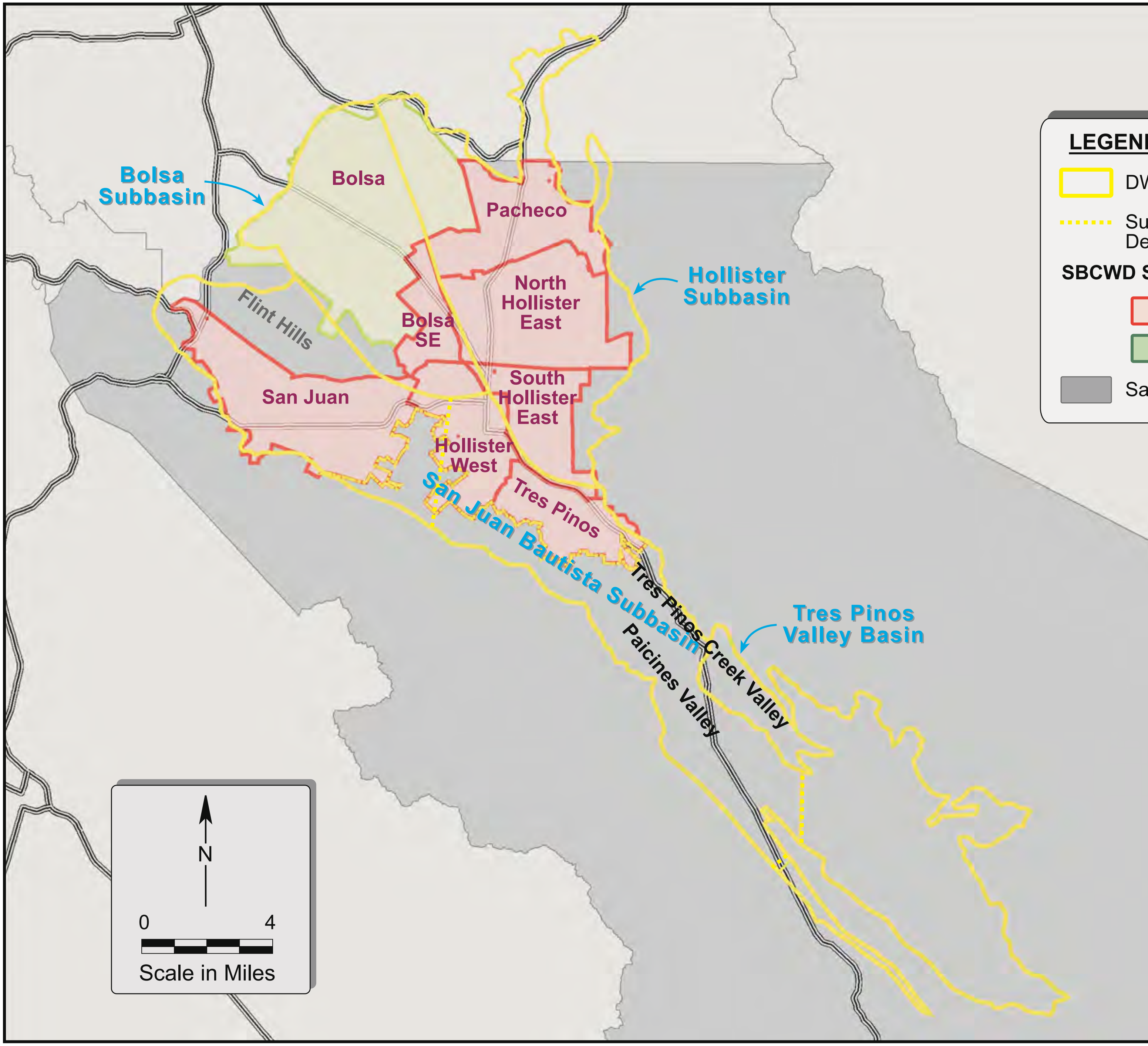

Figure 2
Comparison of DWR and District Subbasins

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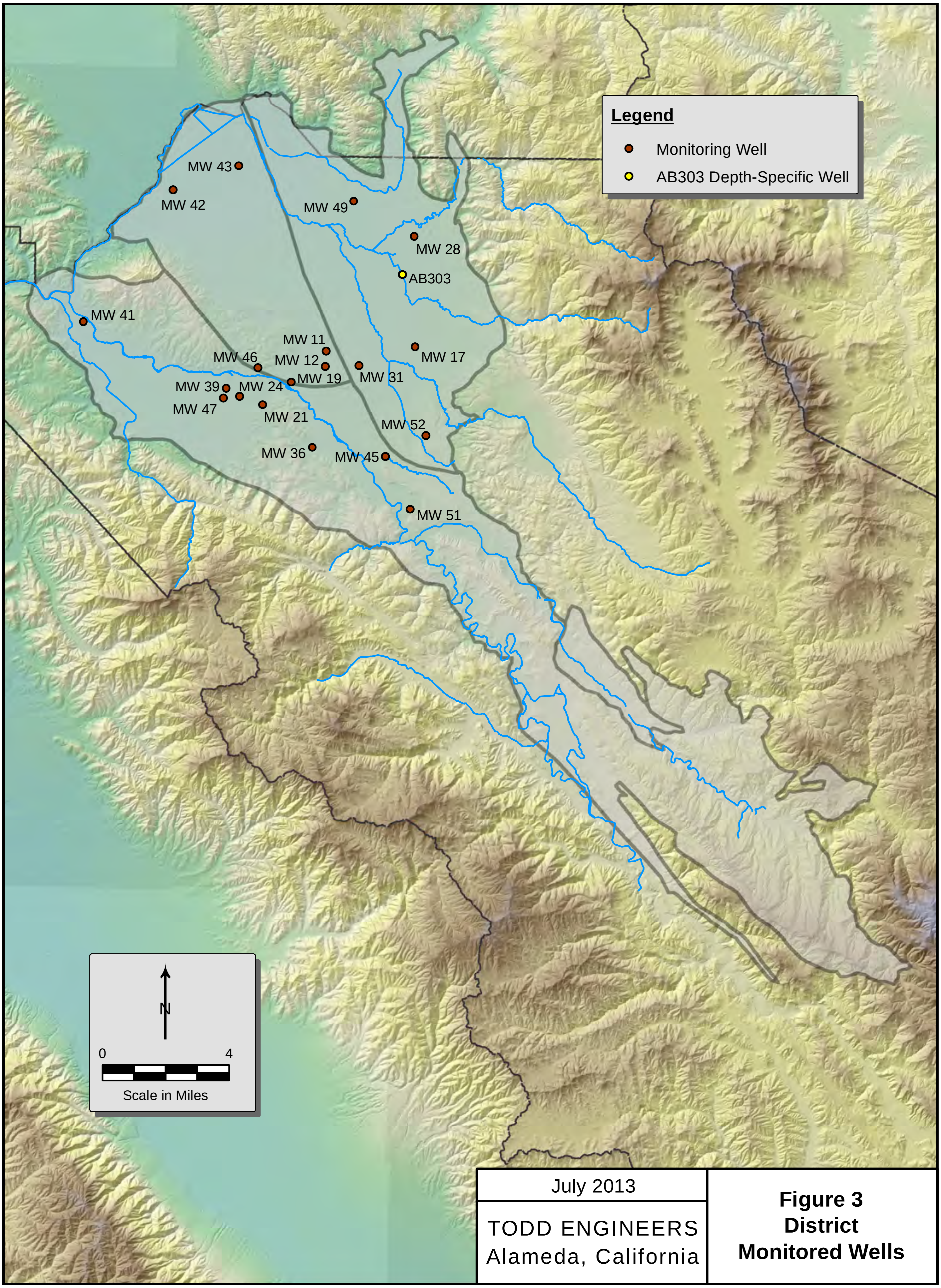

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Figure 3
District
Monitored Wells

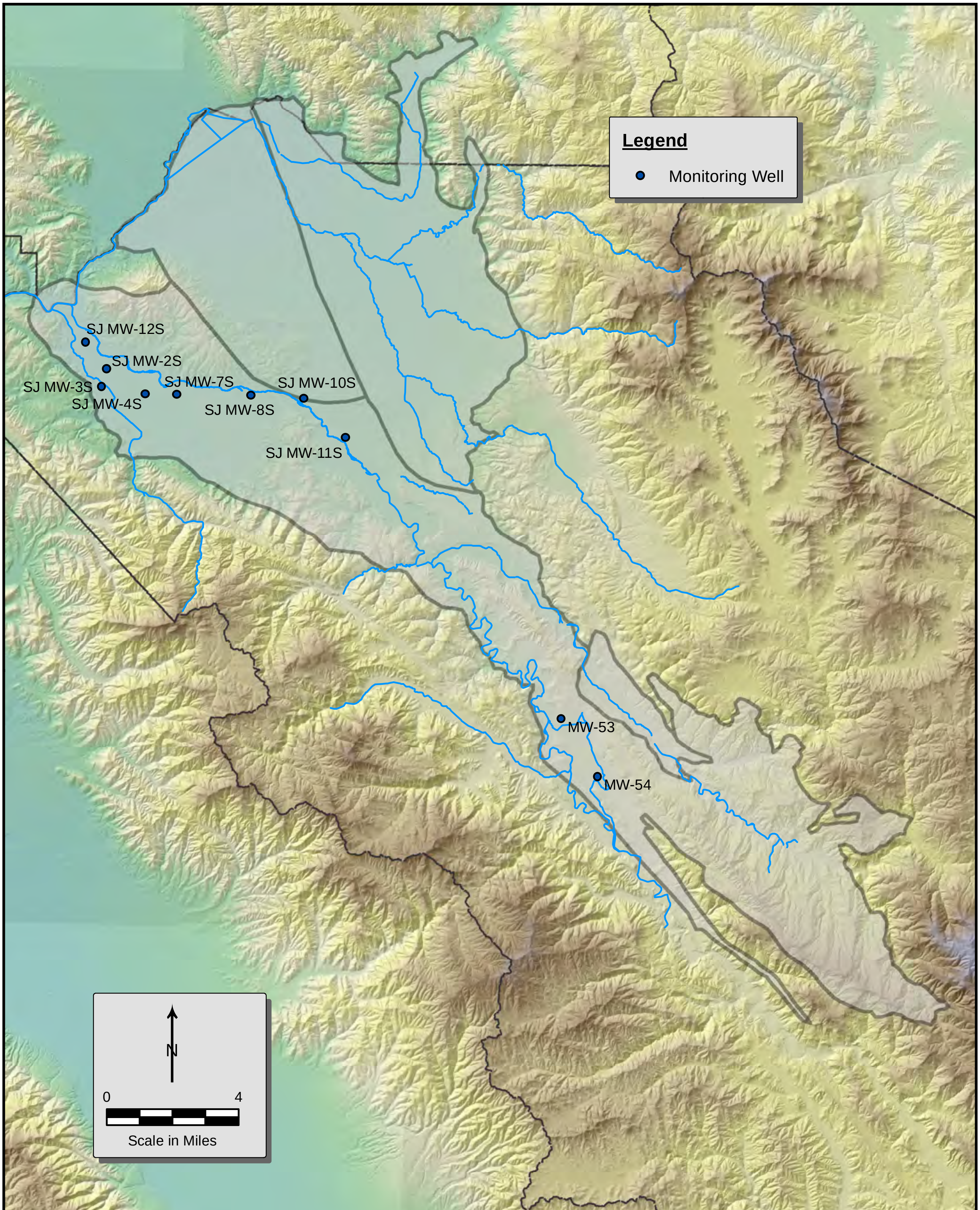

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Figure 4
Additional Monitored Wells

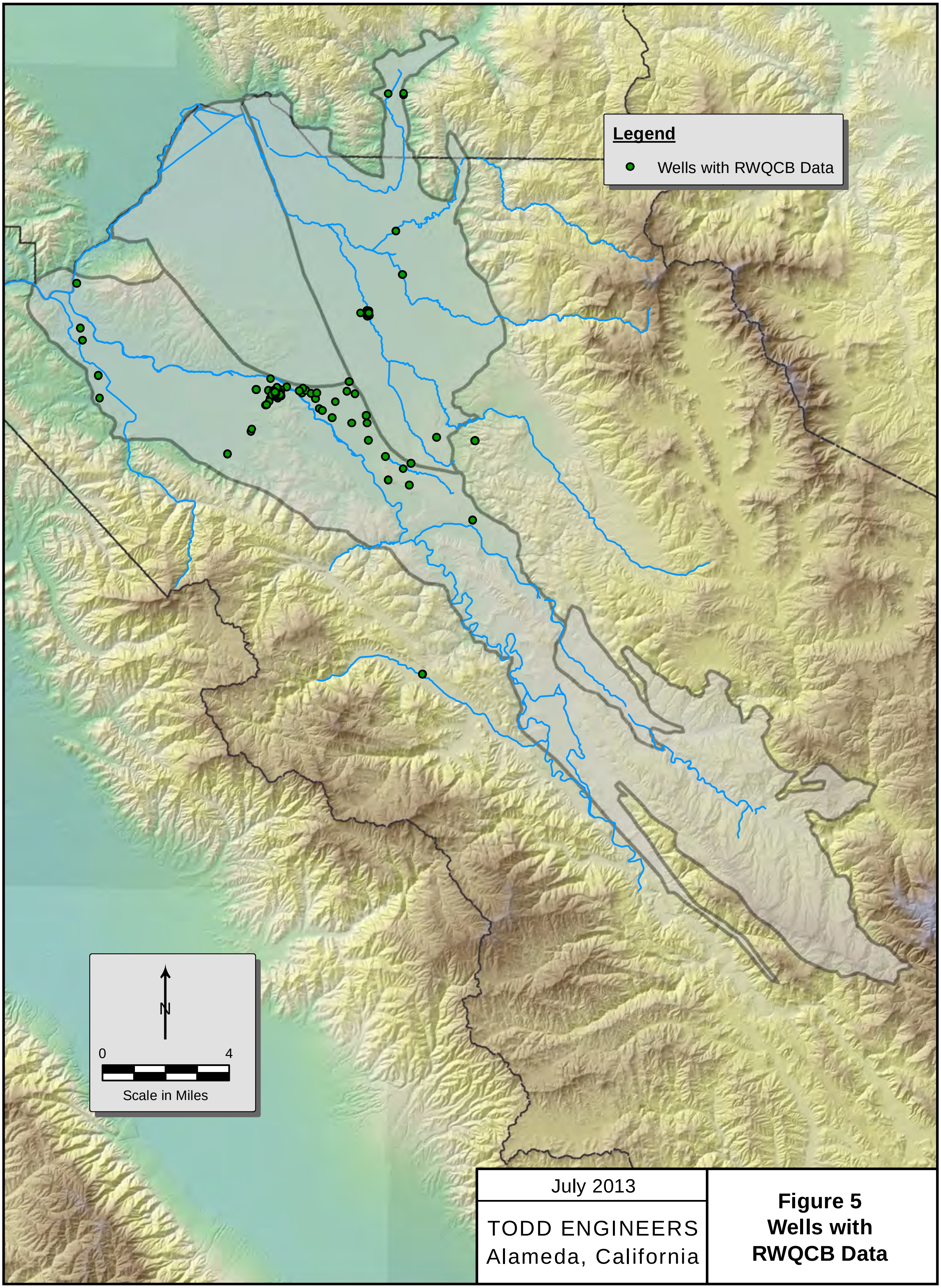

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Figure 5
Wells with
RWQCB Data

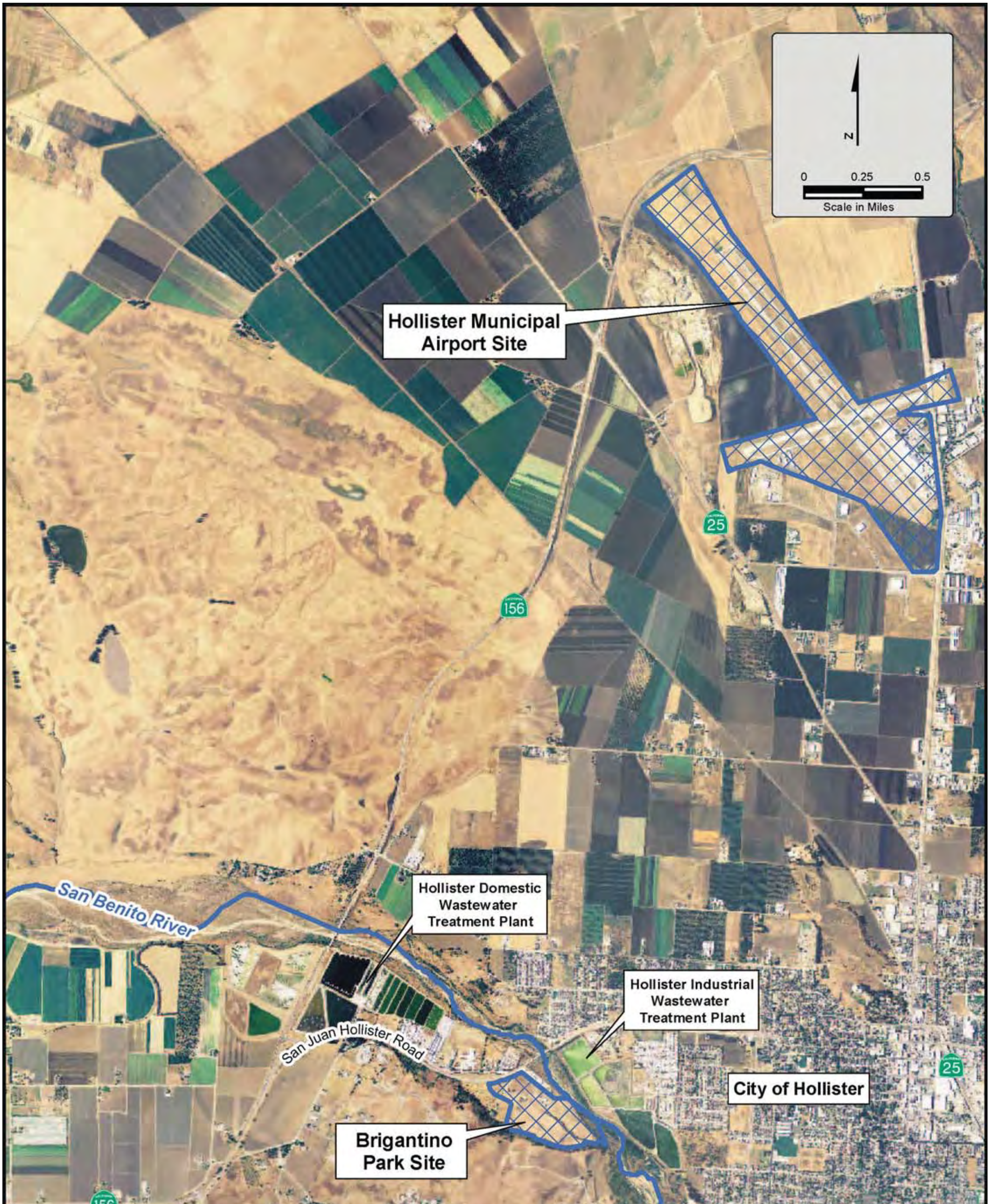

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Figure 6
Recycled Water Use Areas

Figure 7
Brigantino Park Groundwater Monitoring Wells

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July 2013	Figure 8 Municipal Airport Groundwater Monitoring Wells
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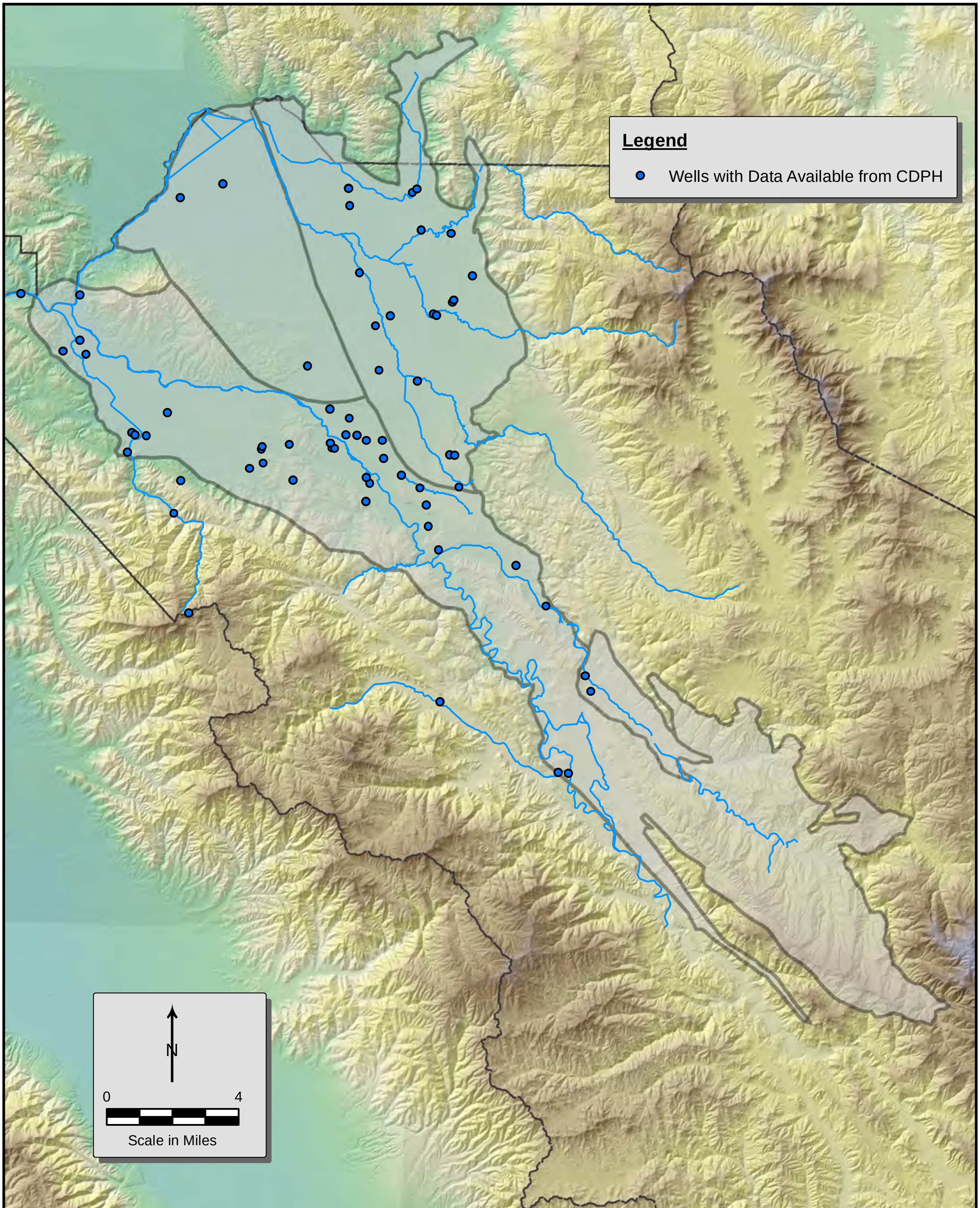

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Figure 9
Wells Monitored for CDPH