

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**

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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 shown 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 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 NO₃) 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-NO₃ 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-NO₃ (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-NO₃ assuming Nitrate-NO₃ 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 NO₃ -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 NO₃

Nitrogen compounds are part of a complex cycle involving the production and breakdown of nitrogen (N₂) 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 NO₃ 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 Objectives²/ Assimilative Capacity Benchmarks³	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-NO₃ = 45 mg/L

2 - Basin-Specific Objectives: TDS = 1,200 mg/L, nitrate-NO₃ = 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 is 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 WWTP³			
Total Dissolved Solids	No data		
Nitrate-NO ₃	0.7	10.6	4.8
Hollister Domestic WWTP⁴			
Total Dissolved Solids	880	1,610	1,162
Nitrate-NO ₃	0.0	26.5	6.6
Hollister Industrial WWTP⁵			
Total Dissolved Solids	920	1,730	1,425
Nitrate-NO ₃	1.0	133	26.6
Sunnyslope WWTP⁶			
Total Dissolved Solids	1400	3,200	1,801
Nitrate-NO ₃	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:

$$\text{TDS (mg/L)} = 0.59 \times \text{Electrical Conductivity (umhos/cm)}$$

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.

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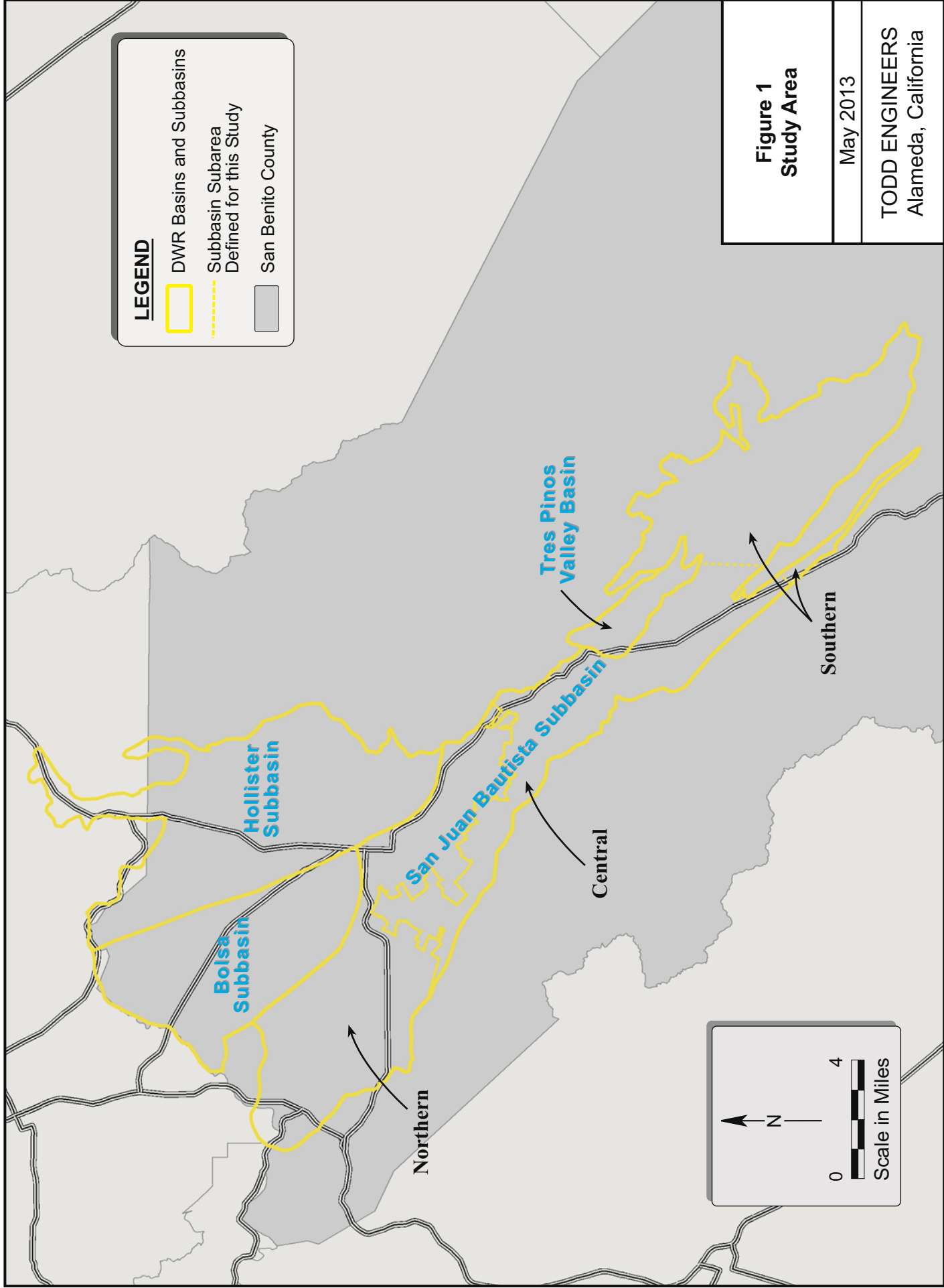
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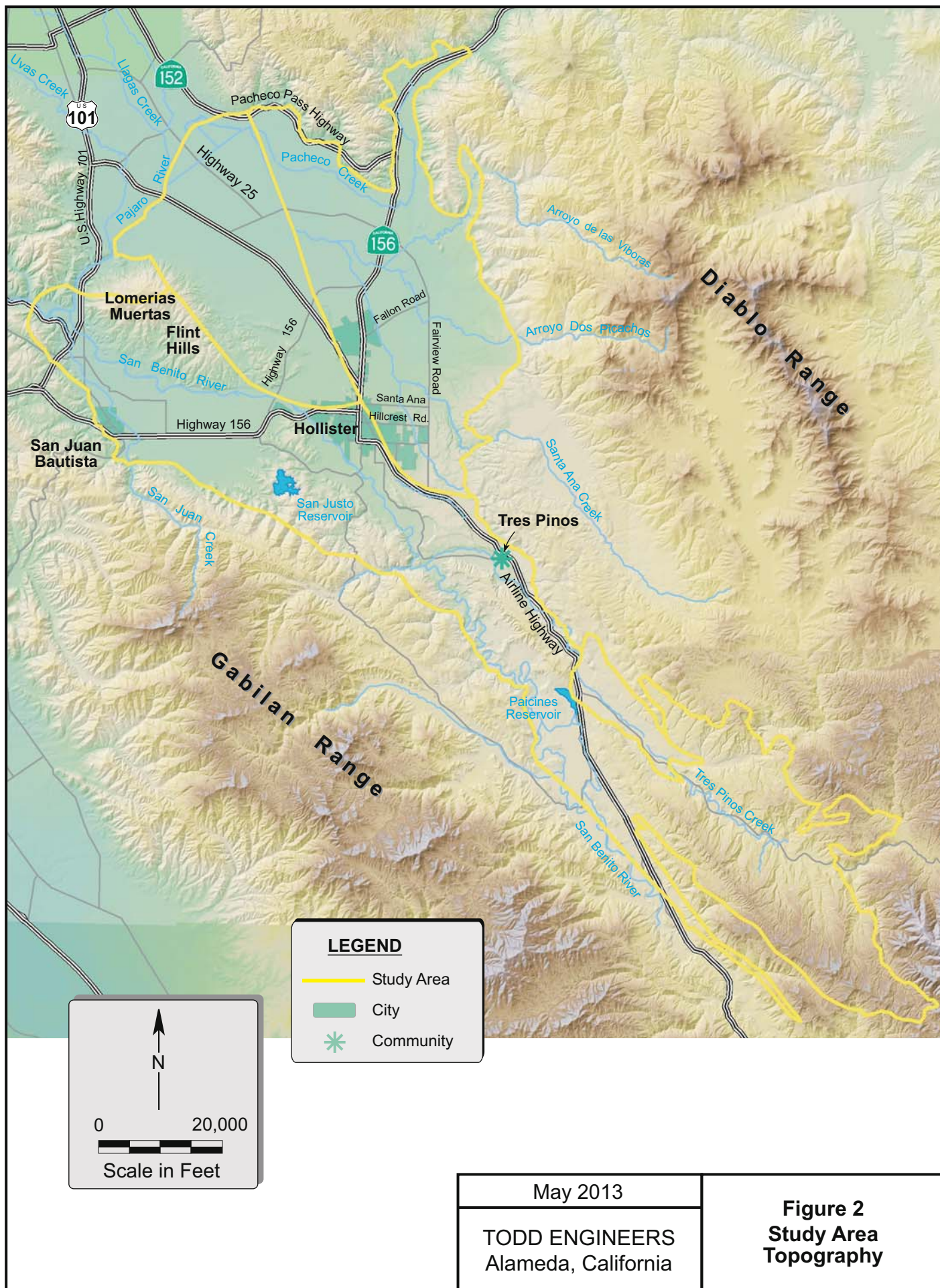
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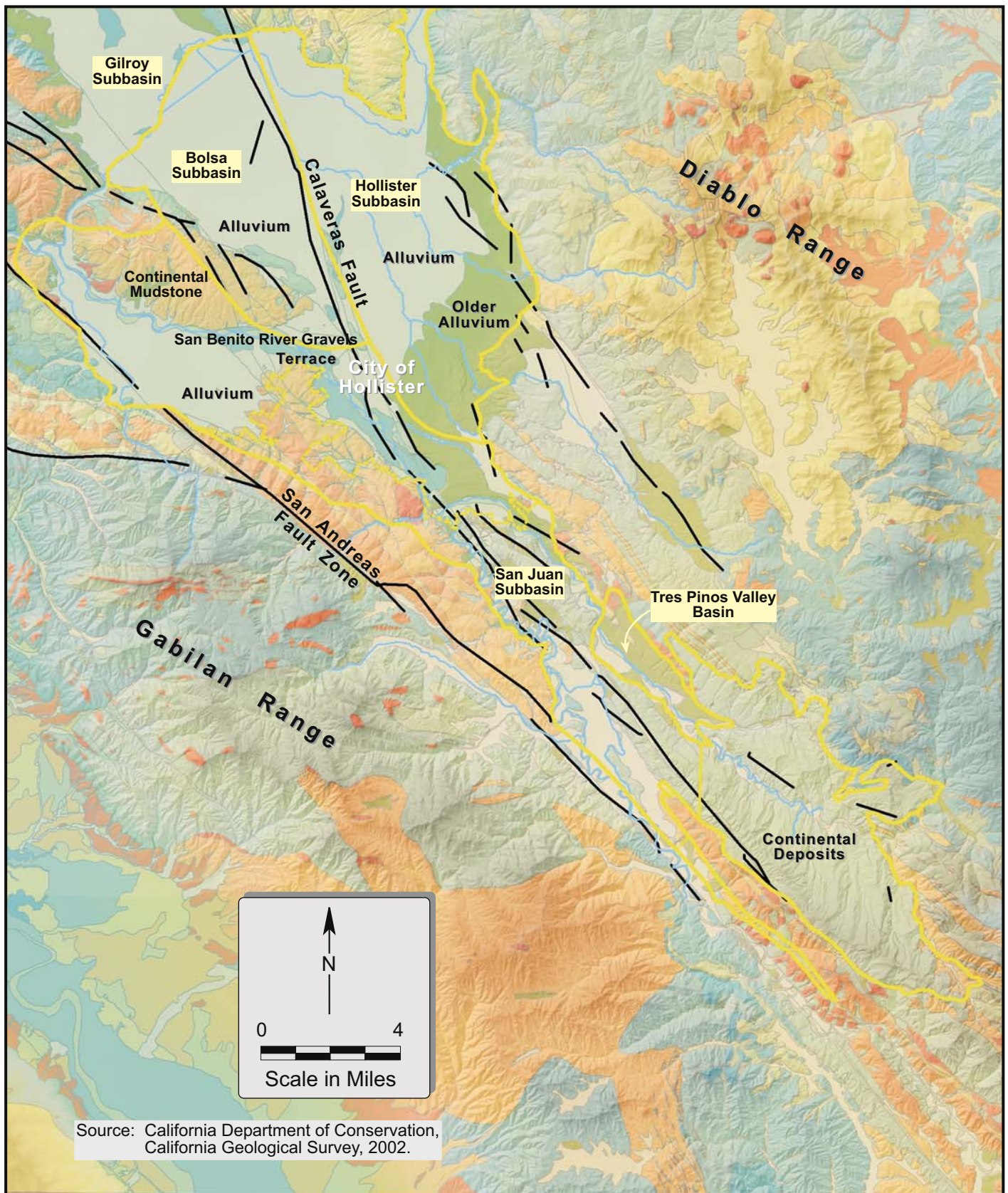
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Figures

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LEGEND

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

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Figure 3
Geologic Map

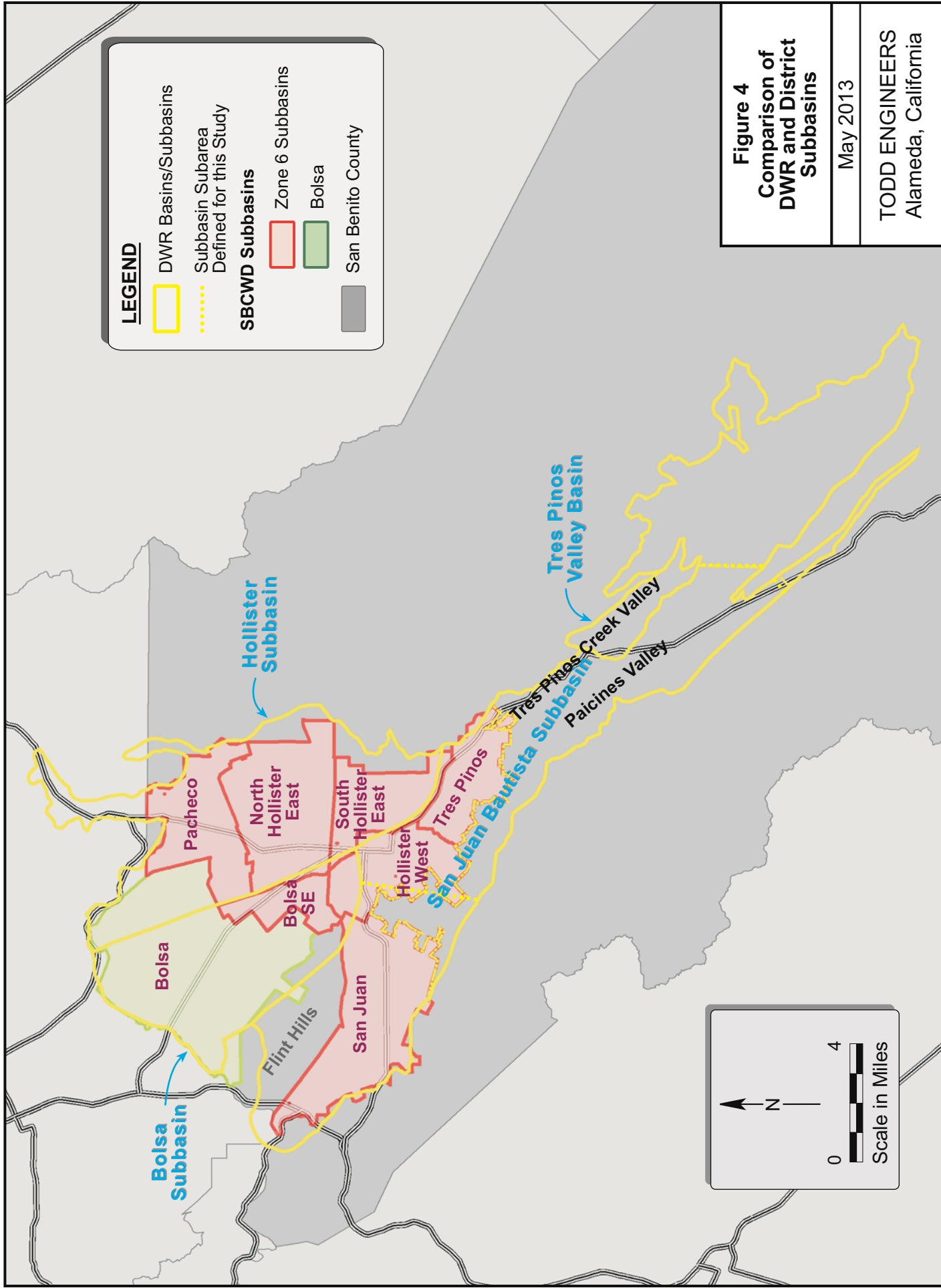
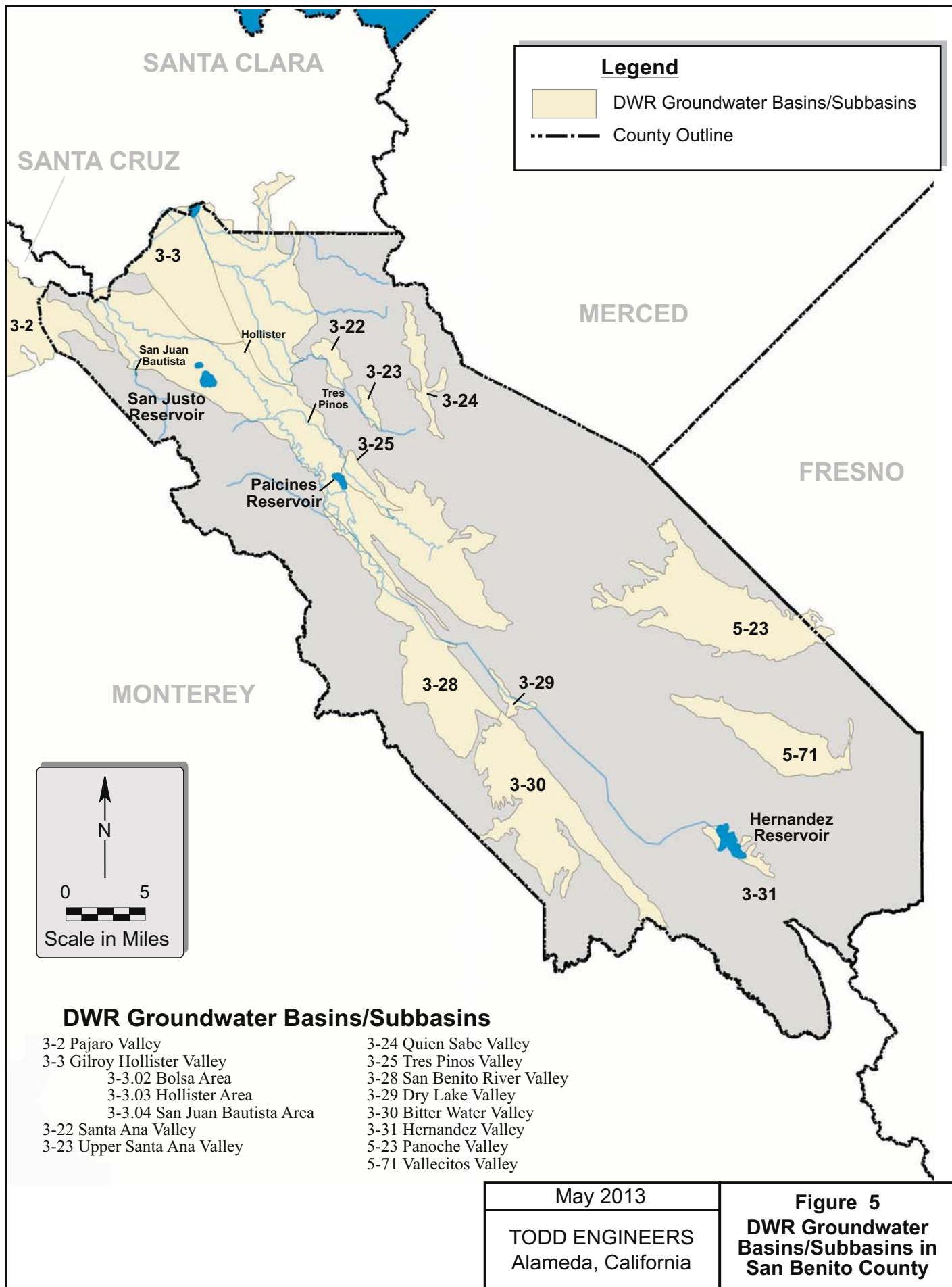
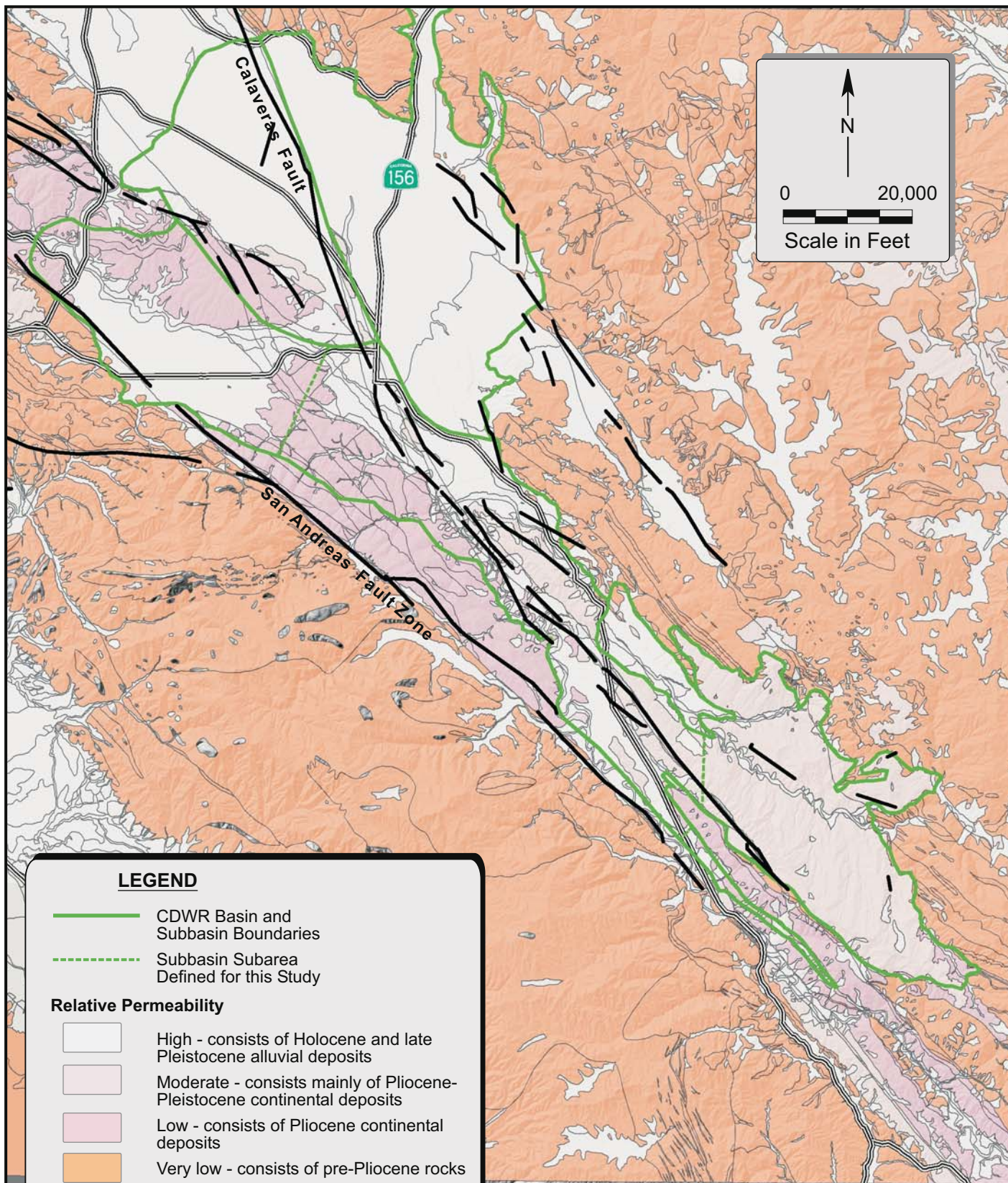


Figure 4
Comparison of
DWR and District
Subbasins

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

May 2013

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Figure 6
Relative Permeability
and Major Faults

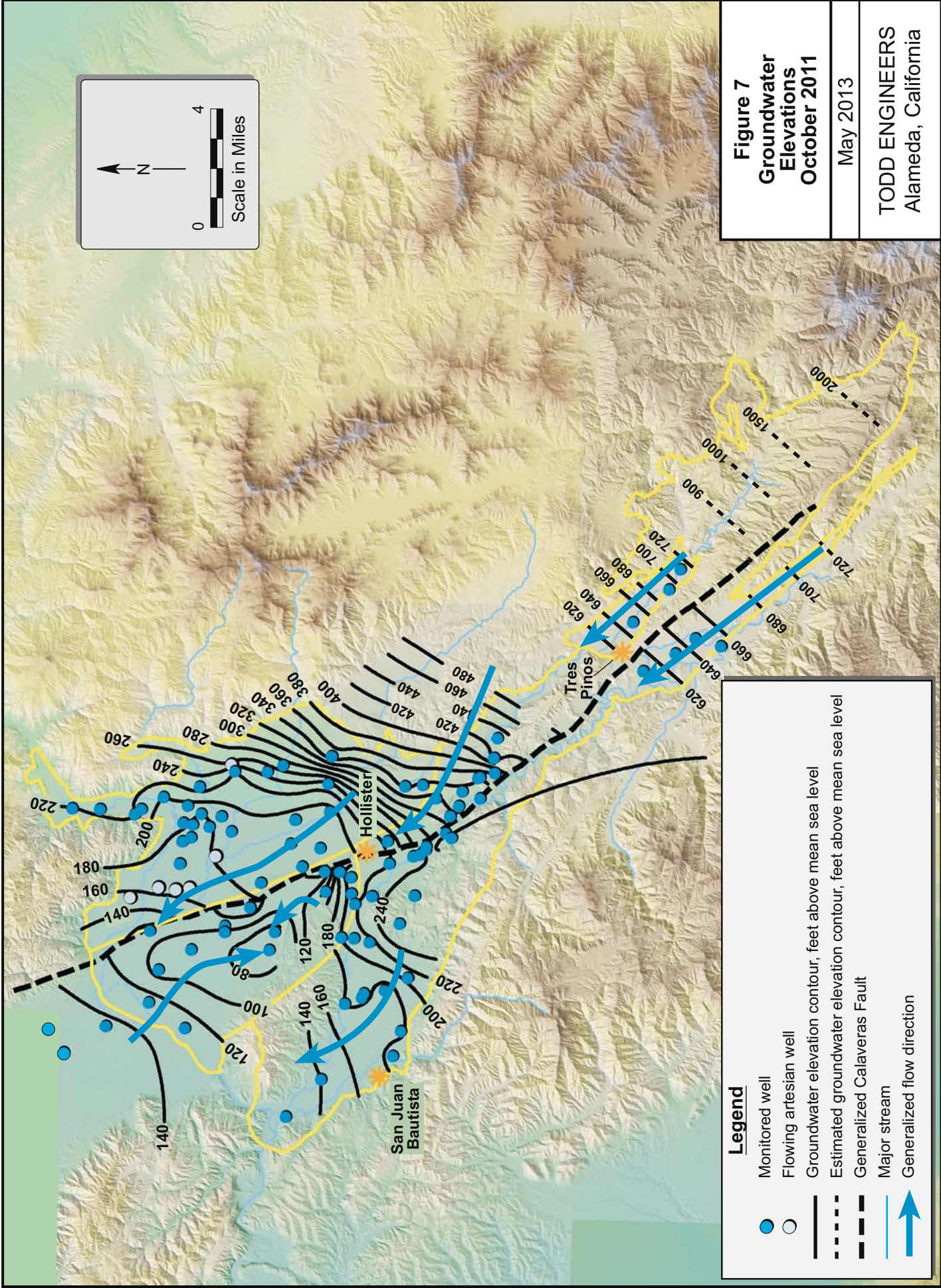
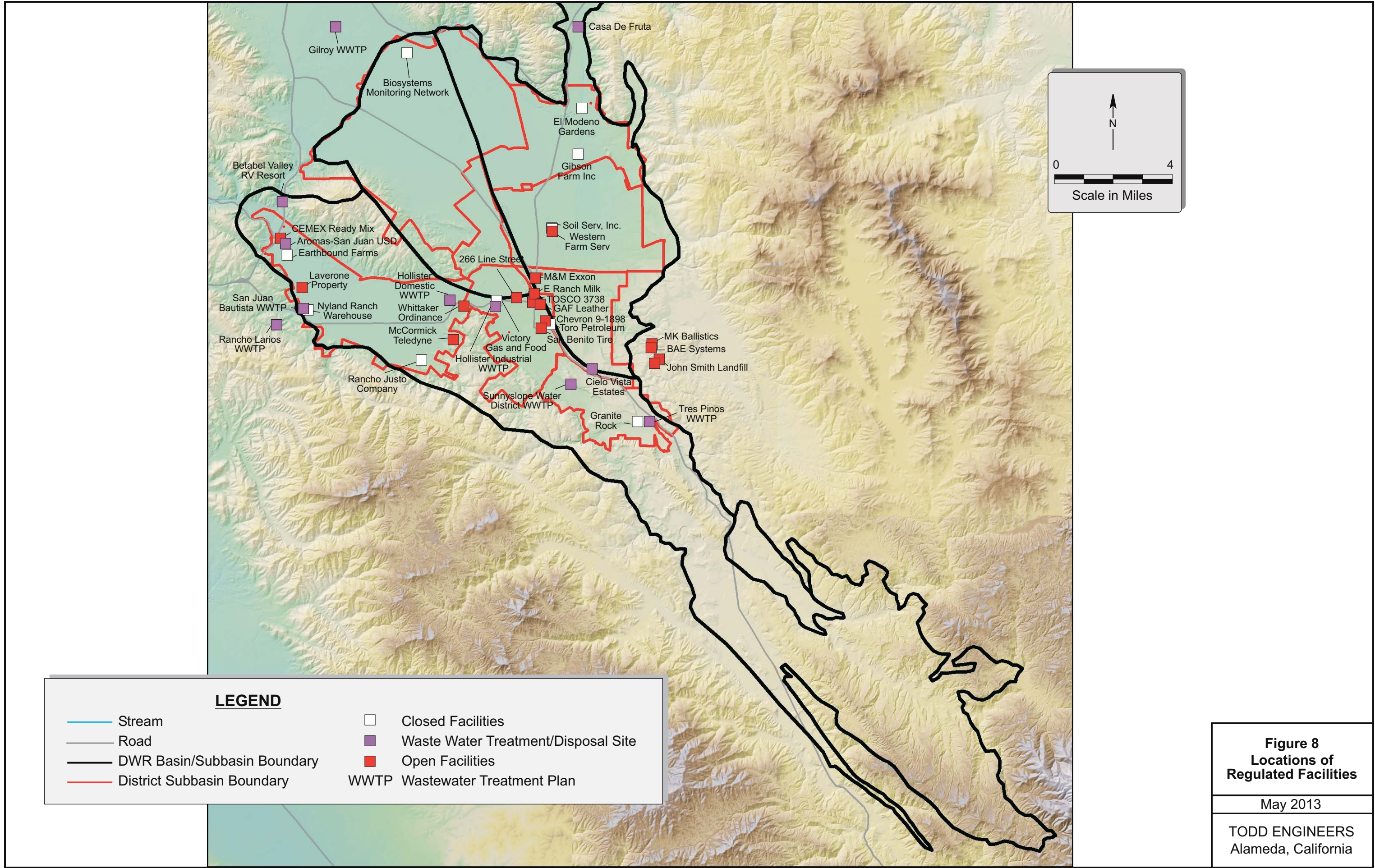


Figure 7
Groundwater
Elevations
October 2011

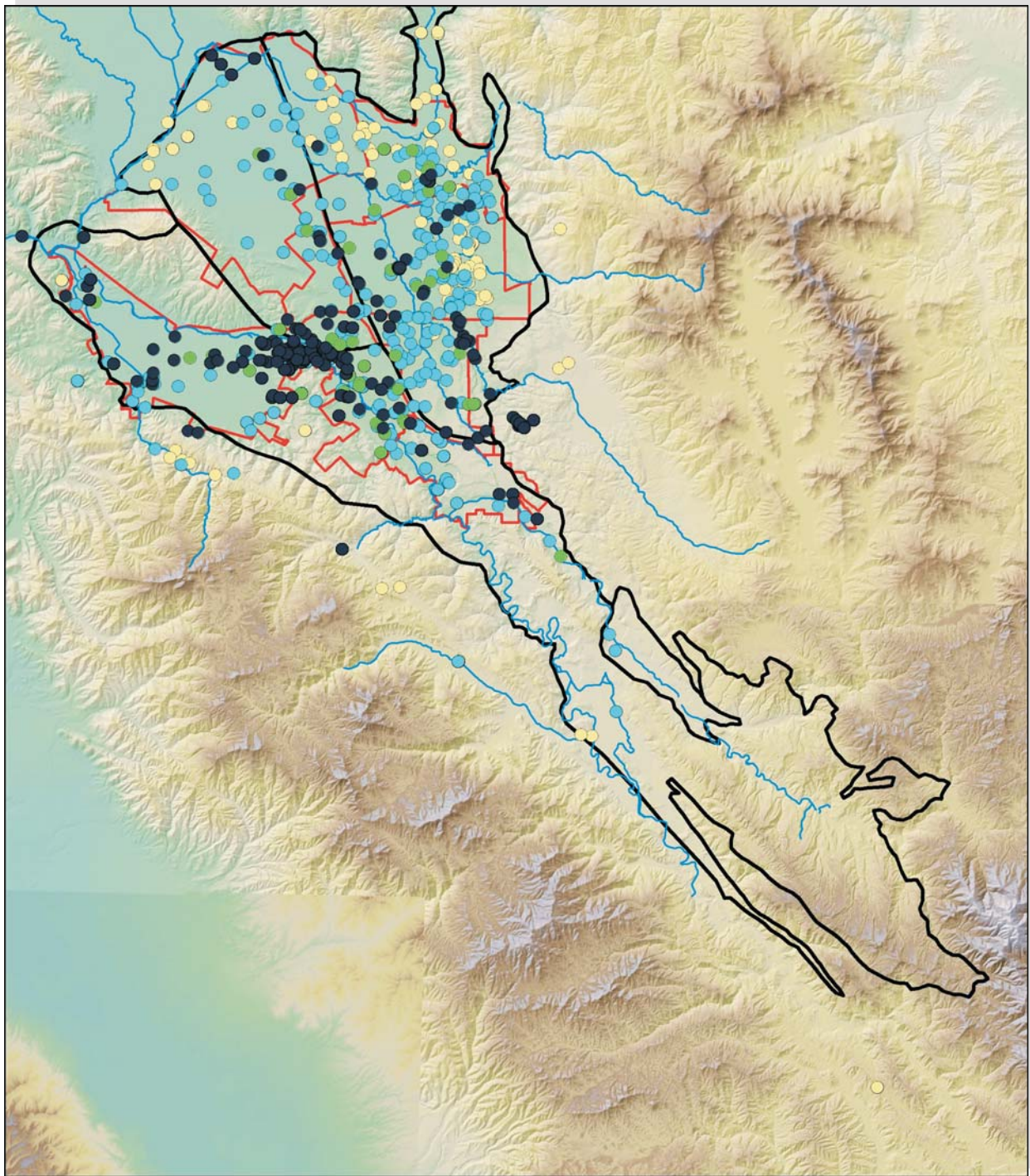
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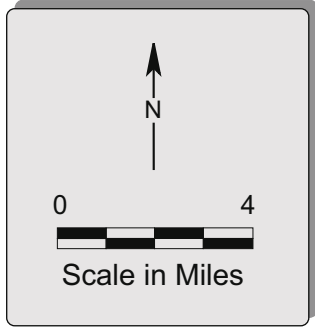
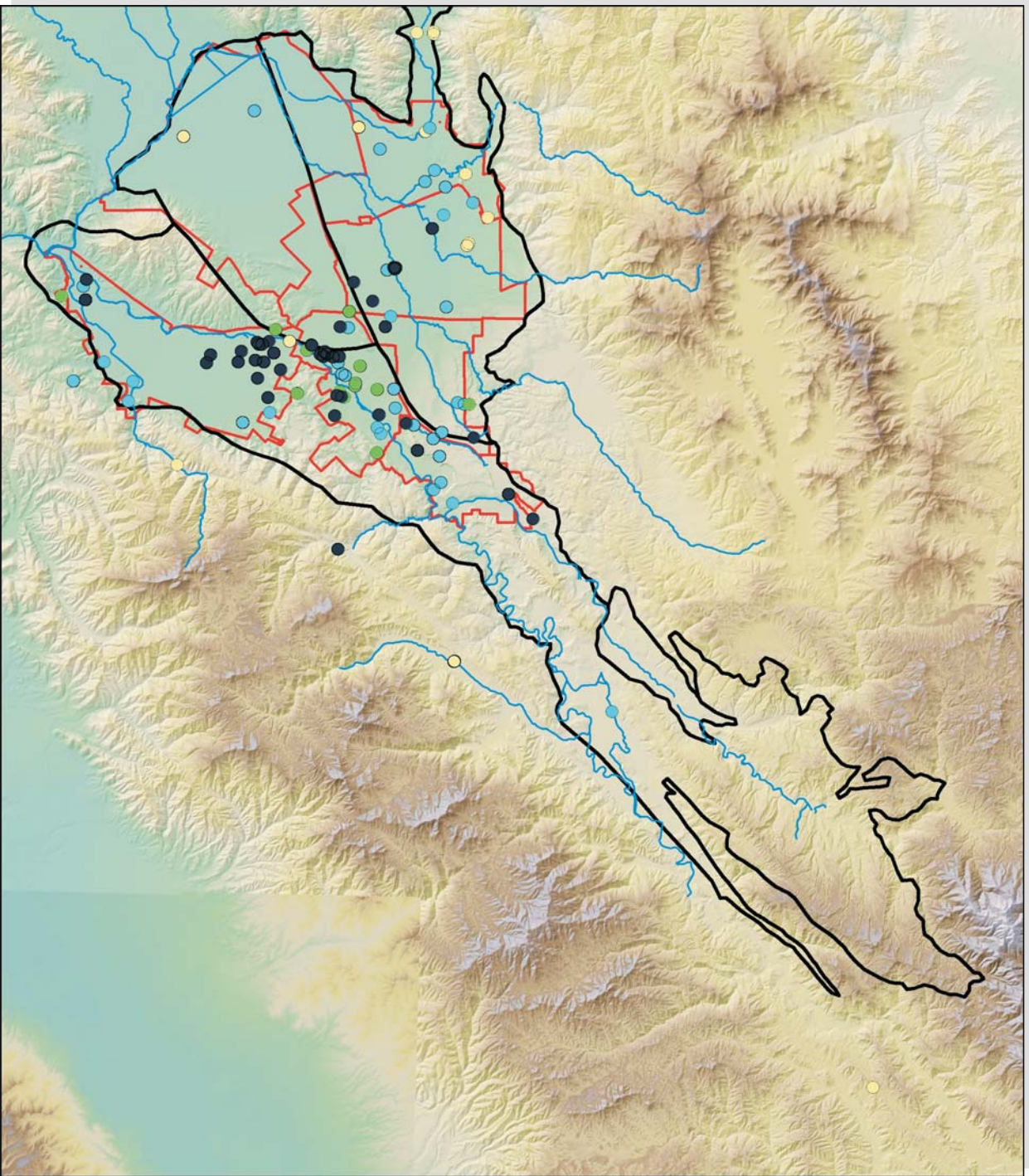
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All Data



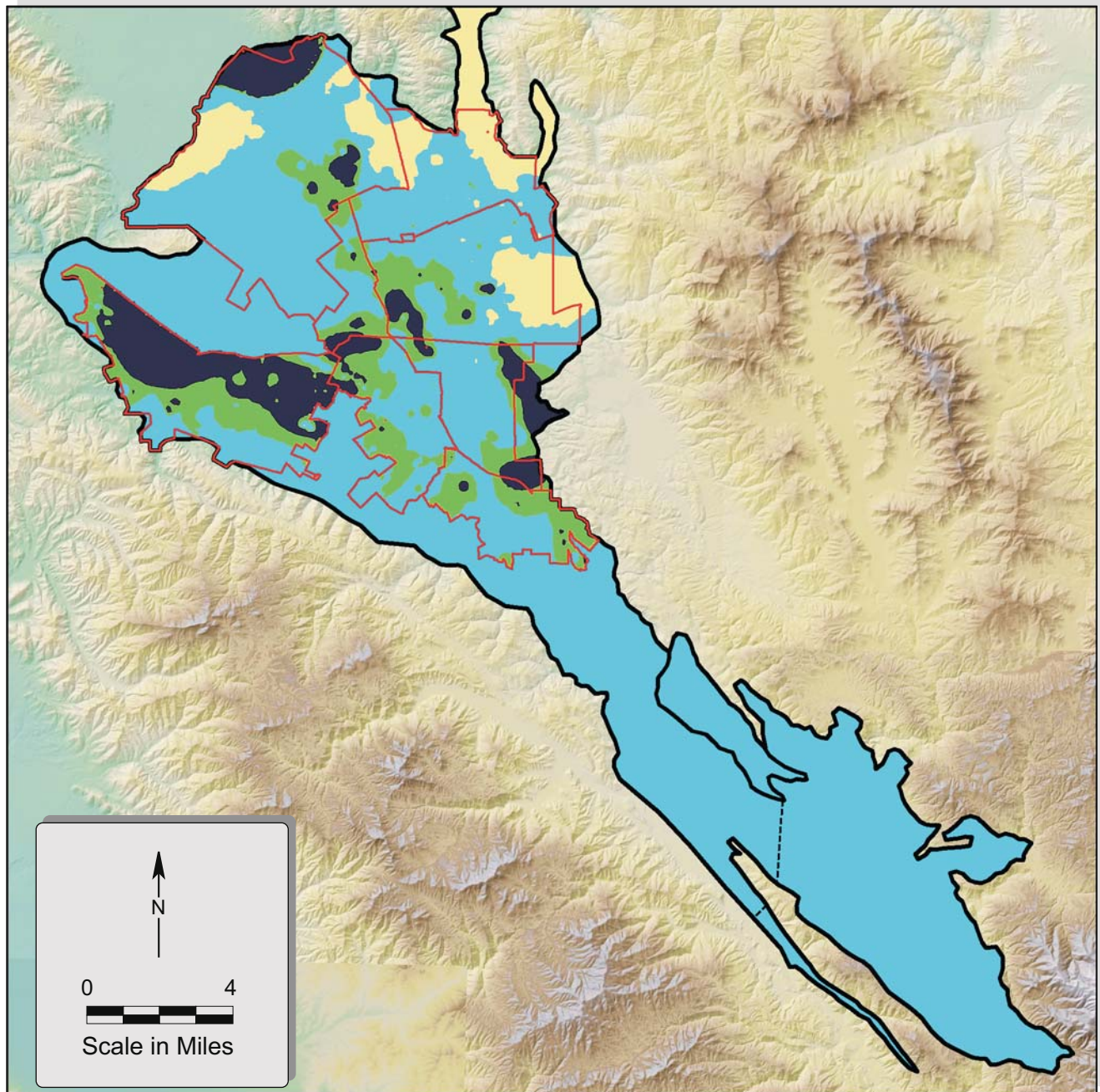
2007 - 2010 Data



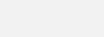
LEGEND

- 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



LEGEND

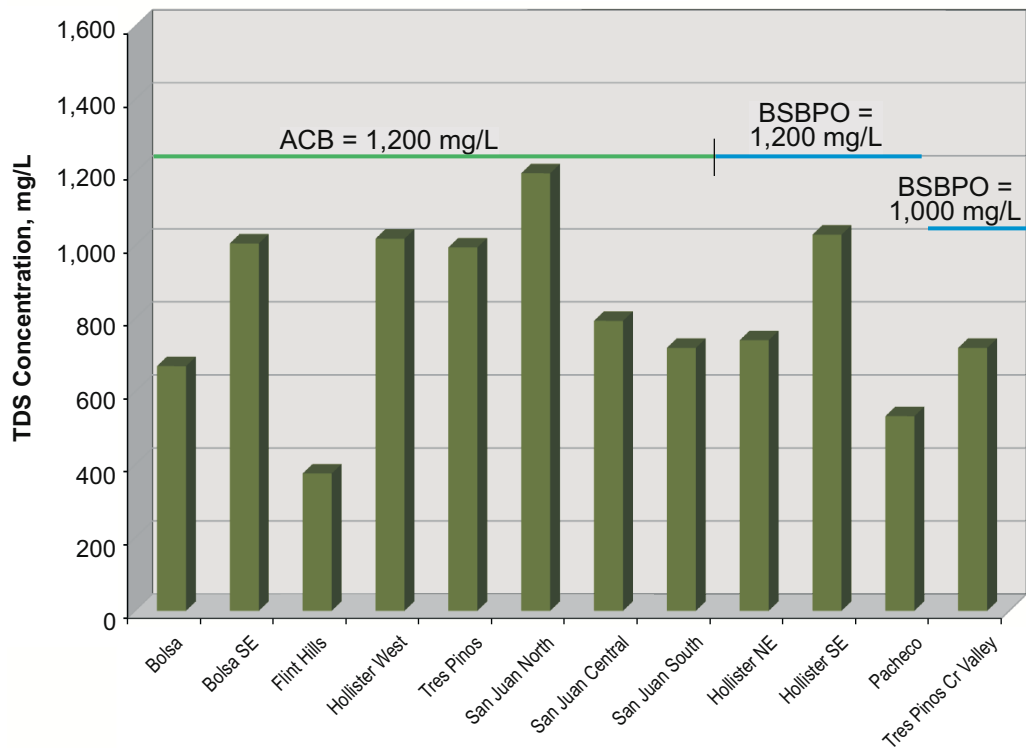
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	District Subbasin Boundary		500 - 1,000 mg/L
	Subbasin Subarea defined for this Study		1,000 - 1,200 mg/L
			> 1,200 mg/L

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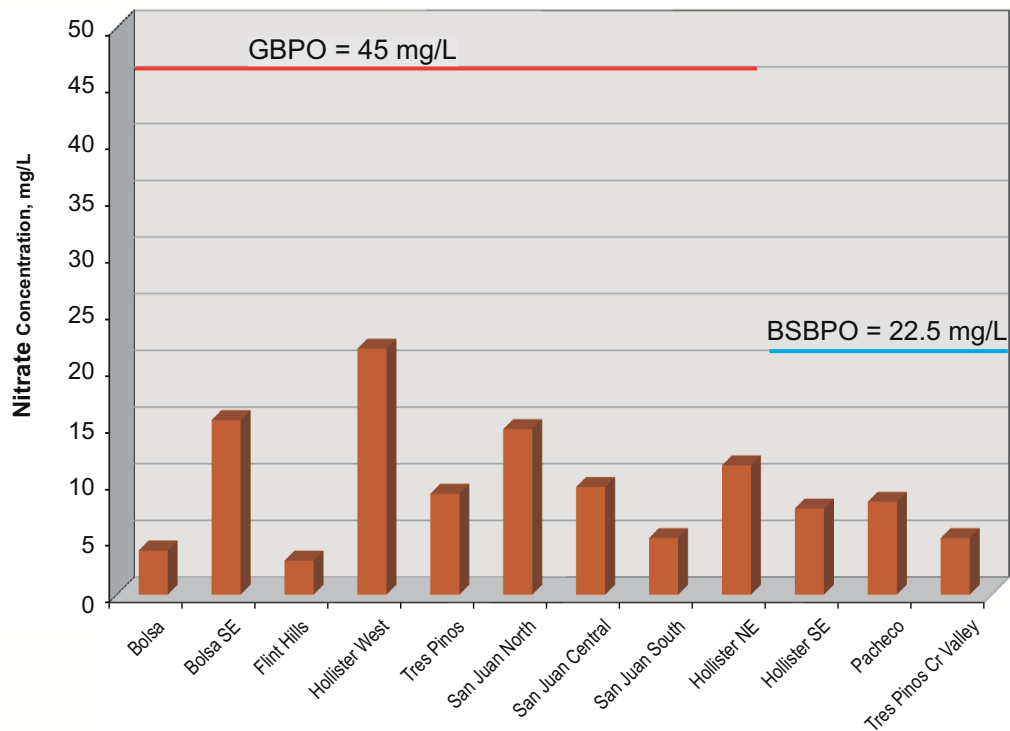
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Figure 10
Interpolated
TDS Concentrations

Average TDS



Average Nitrate-NO₃



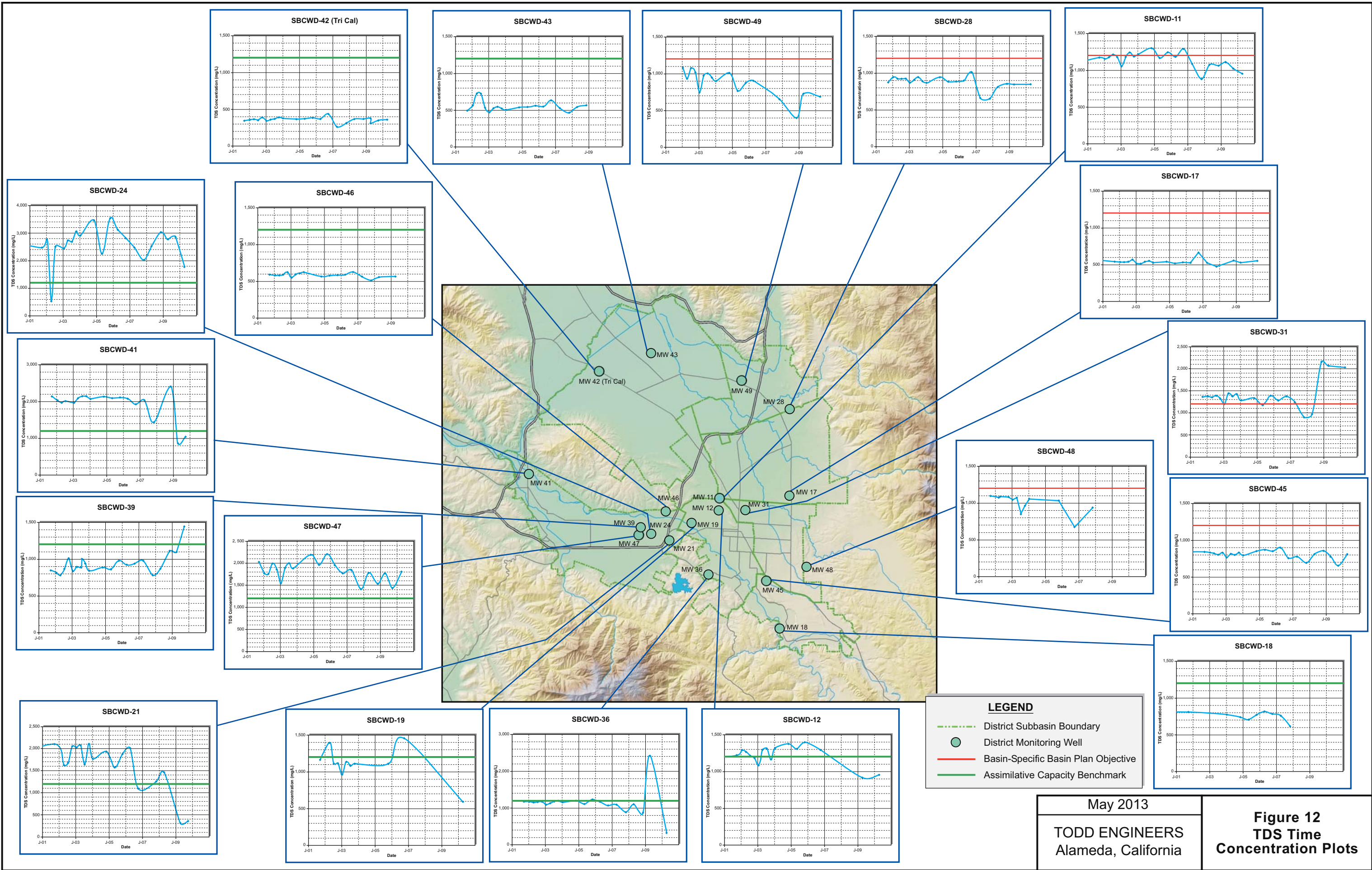
Legend

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

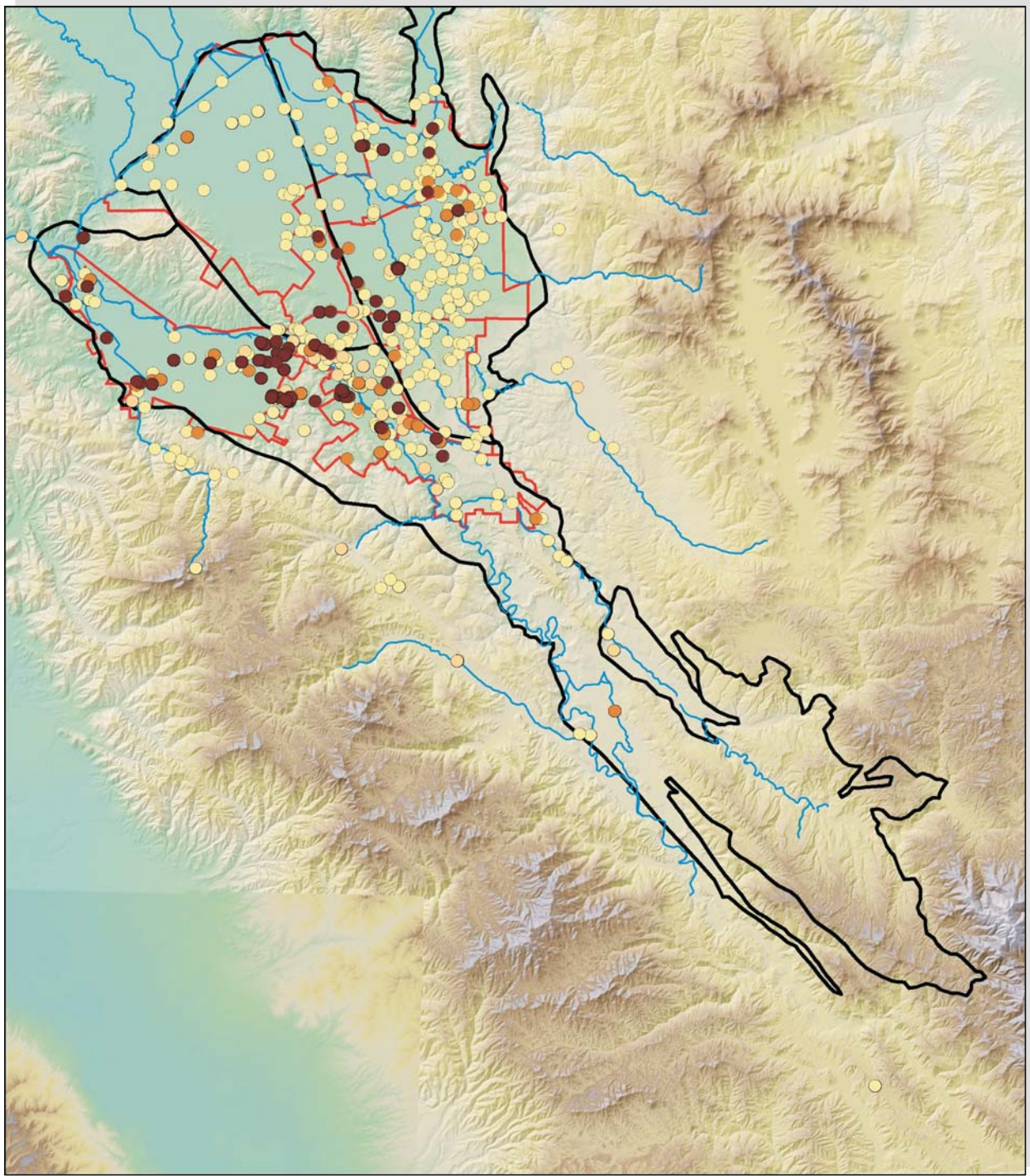
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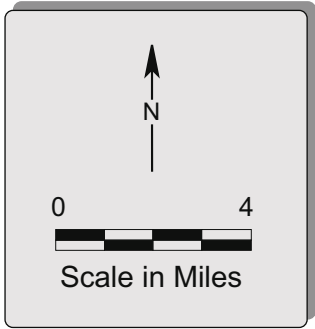
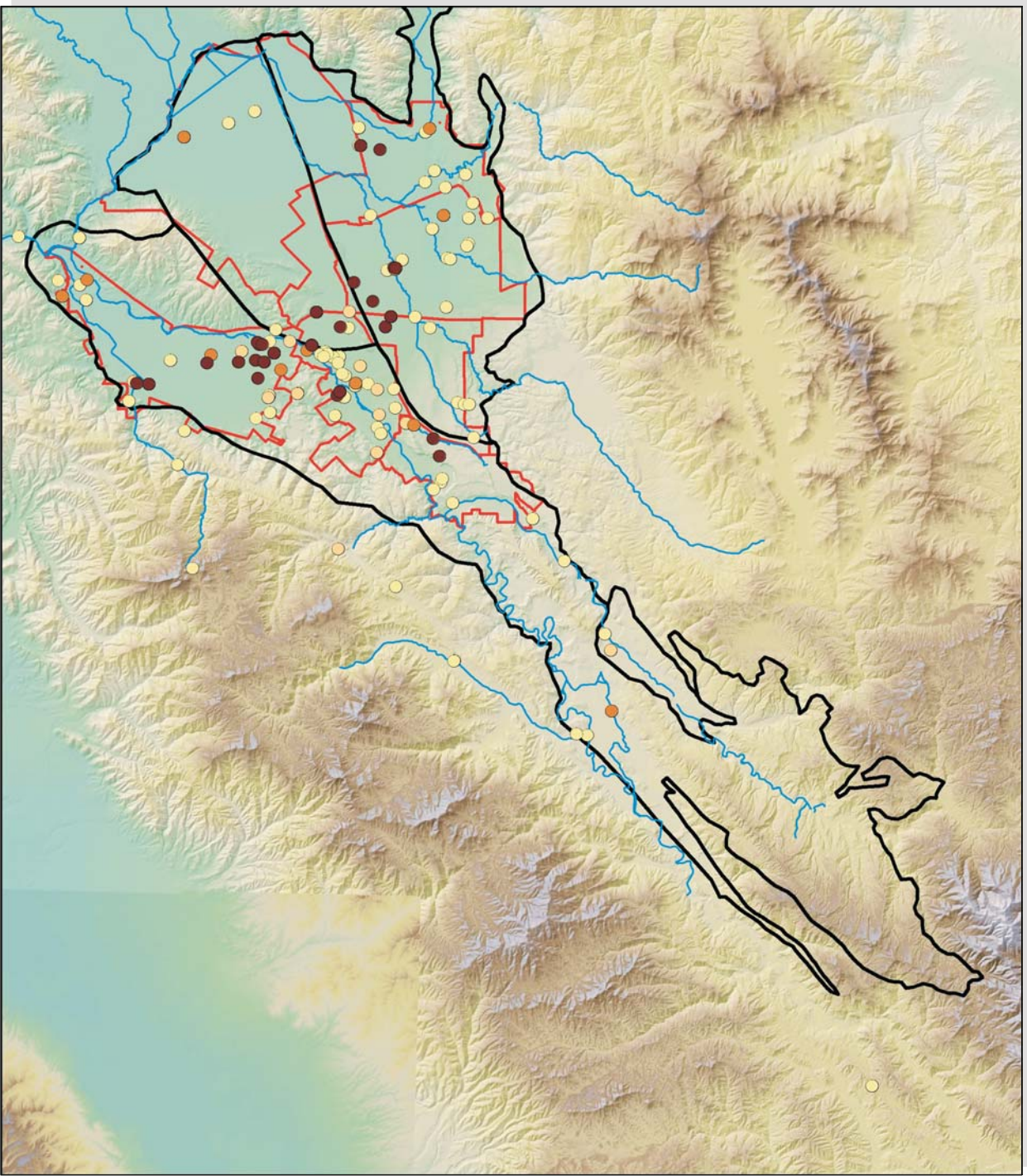
Figure 11
Average TDS
and Nitrate
by Basin/Subbasin



All Data



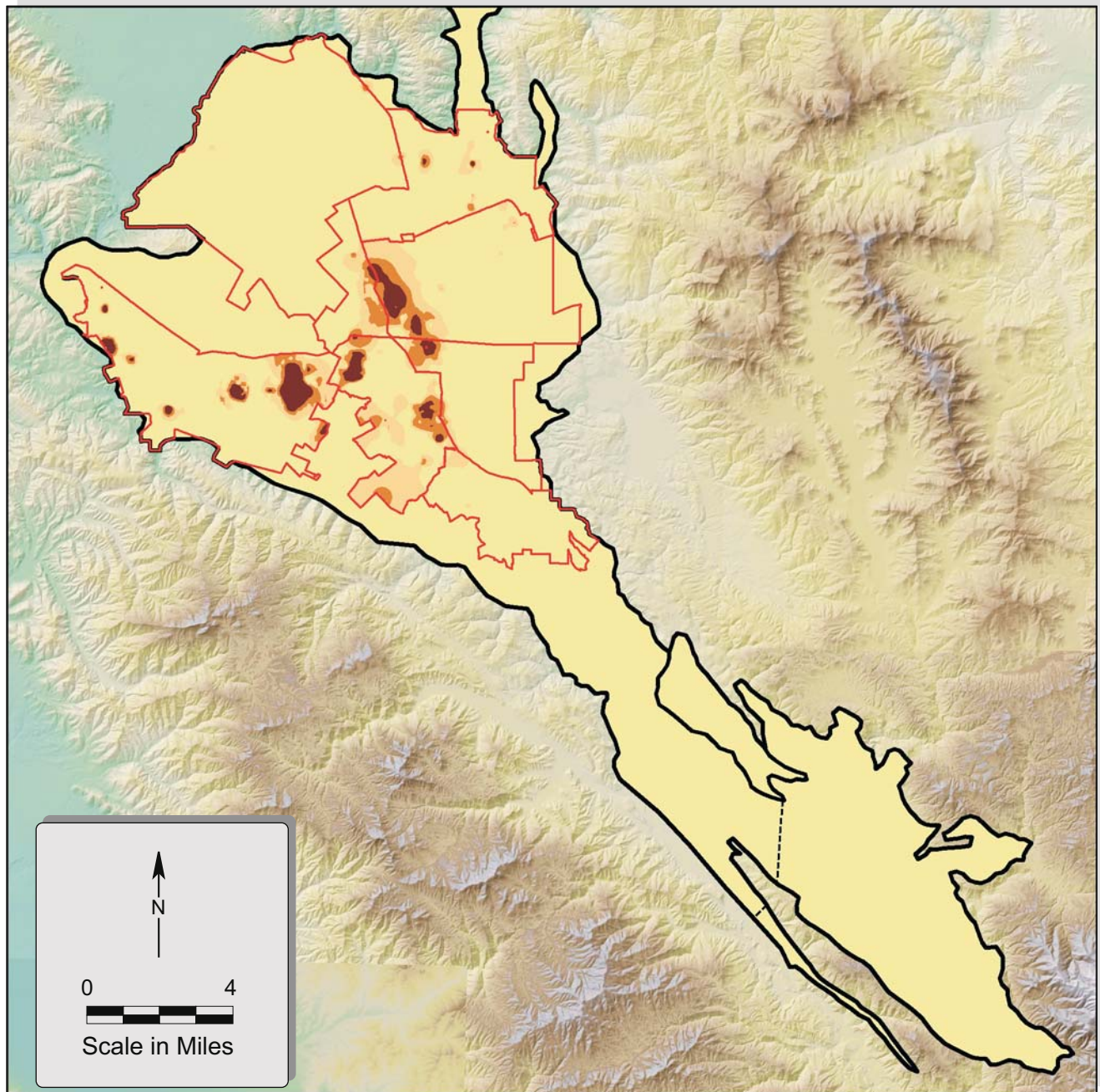
2007 - 2010 Data



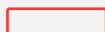
LEGEND

- Stream
- Road
- DWR Basin/Subbasin Boundary
- District Subbasin Boundary

- Nitrate Concentration**
- < 20 mg/L
 - 20 - 30 mg/L
 - 30 - 45 mg/L
 - > 45 mg/L



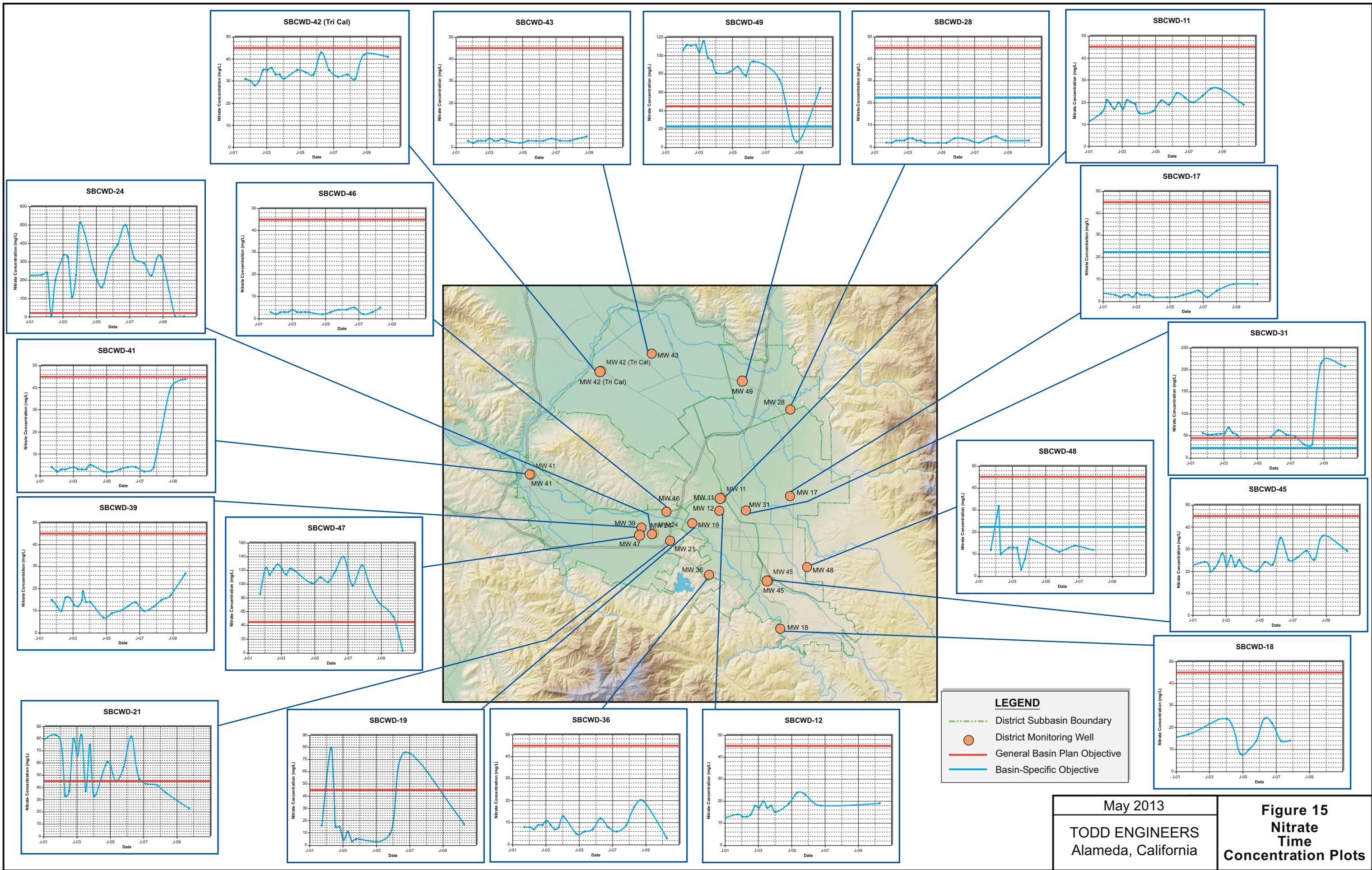
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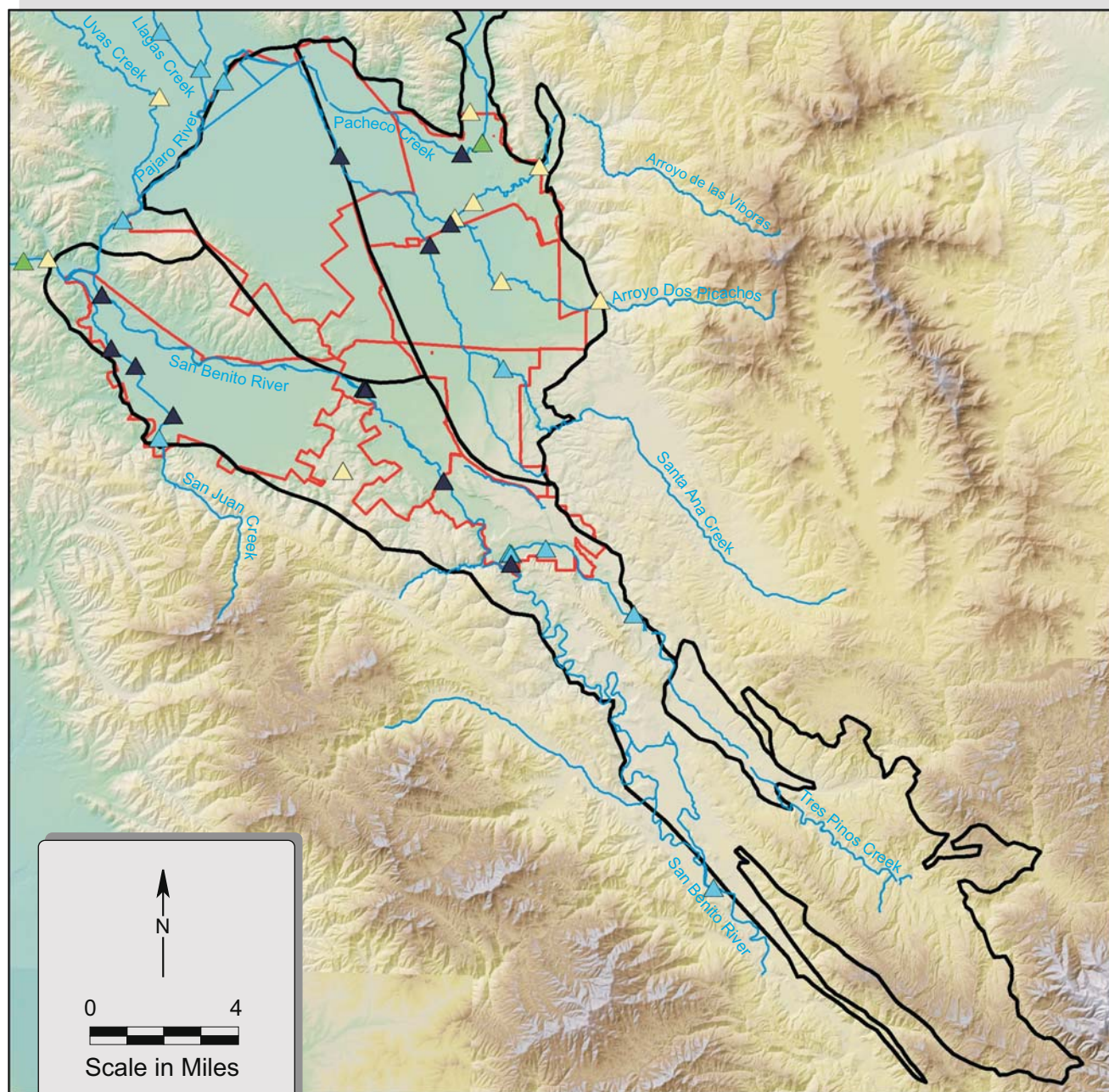
	DWR Basin/Subbasin Boundary	<u>Nitrate Concentration</u>
	District Subbasin Boundary	 0 - 20 mg/L
	Subbasin Subarea defined for this Study	 20 - 30 mg/L
		 30 - 45 mg/L
		 > 45 mg/L

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Figure 14
Interpolated
Nitrate Concentrations





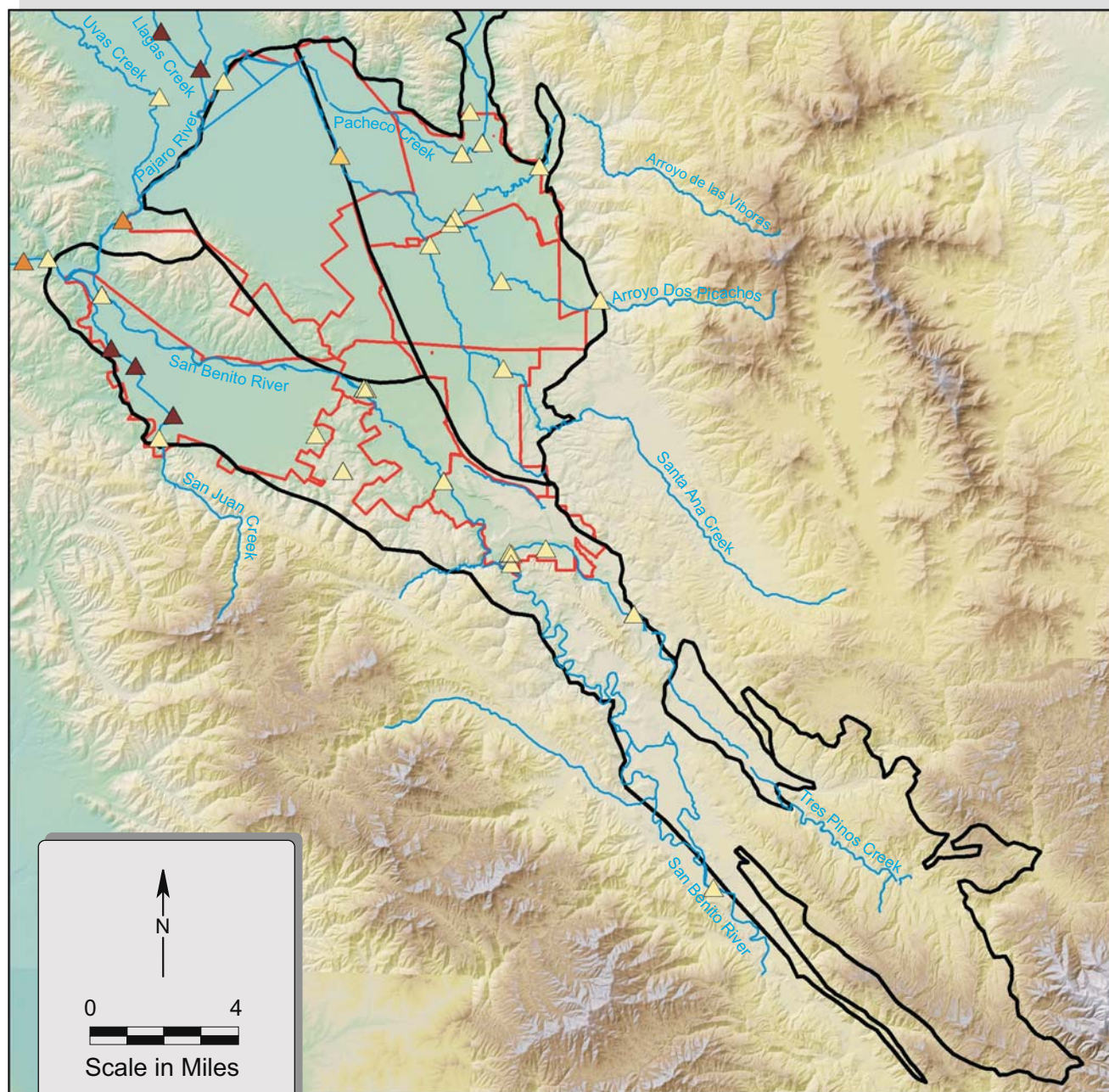
LEGEND

	Stream	<u>TDS Concentration</u>	
	Road		172 - 500 mg/L
	DWR Basin/Subbasin Boundary		500 - 1,000 mg/L
	District Subbasin Boundary		1,000 - 1,200 mg/L
			> 1,200 mg/L

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Figure 16
TDS
in Surface Water



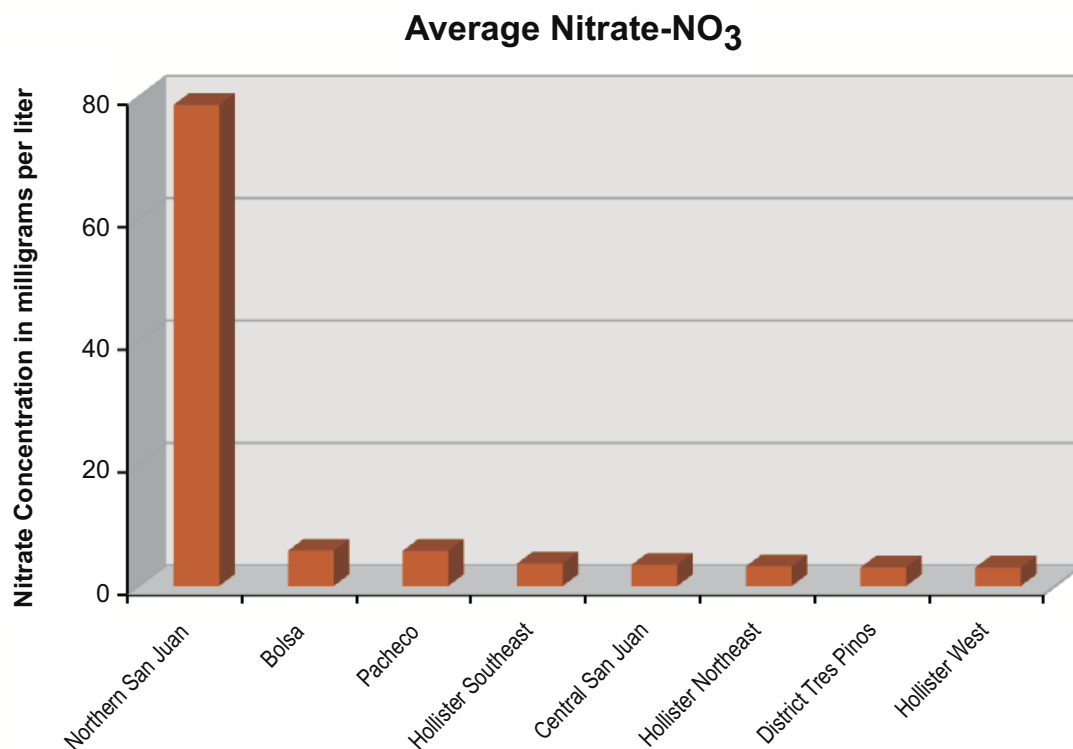
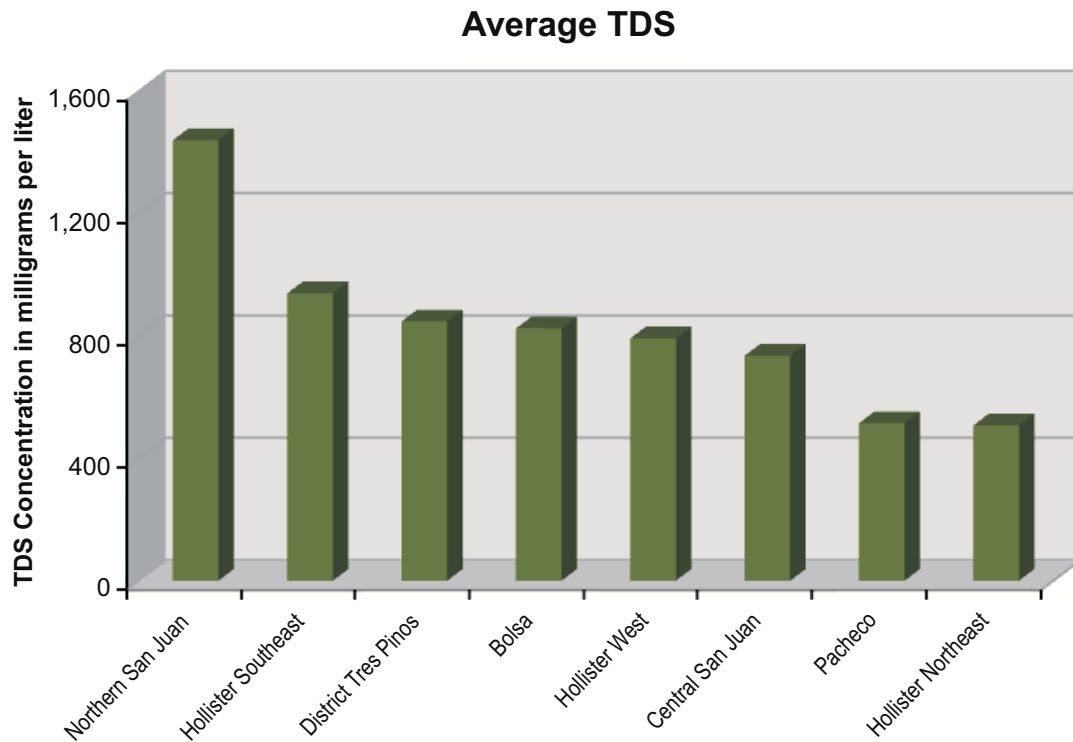
LEGEND

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

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Figure 17
Nitrate
in Surface Water

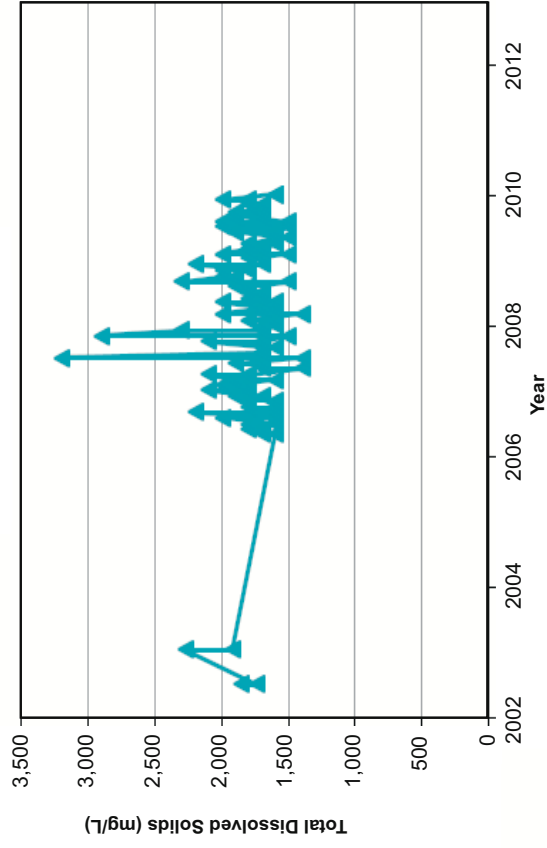


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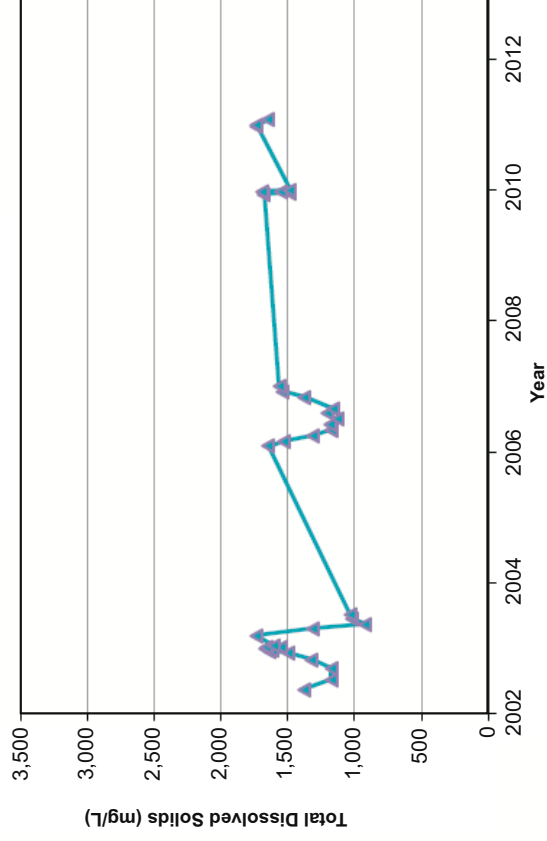
TODD ENGINEERS
Alameda, California

Figure 18
Average TDS and
Nitrate in Surface Water
by Basin/Subbasin

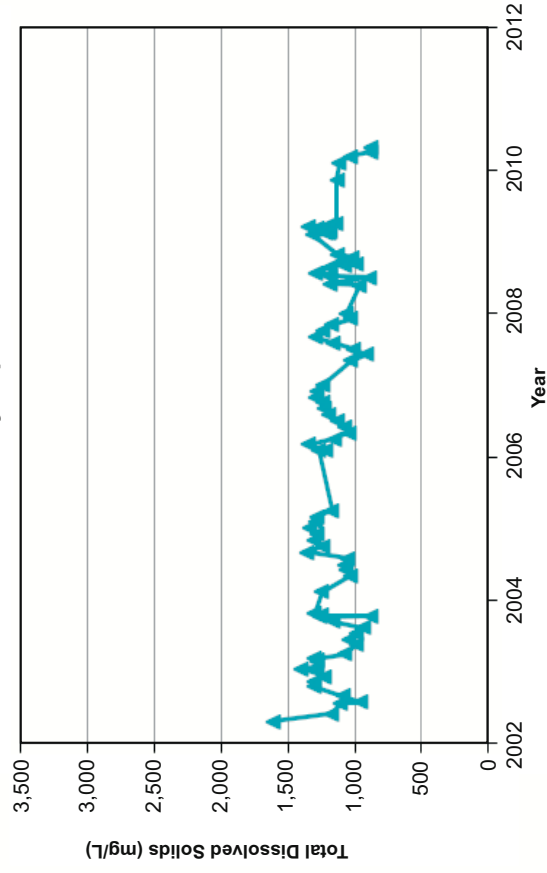
Hollister Domestic



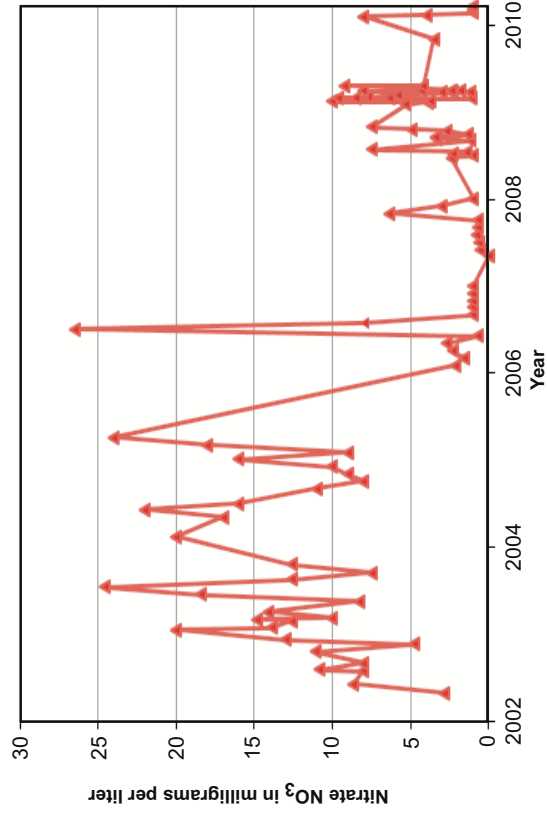
Hollister Industrial



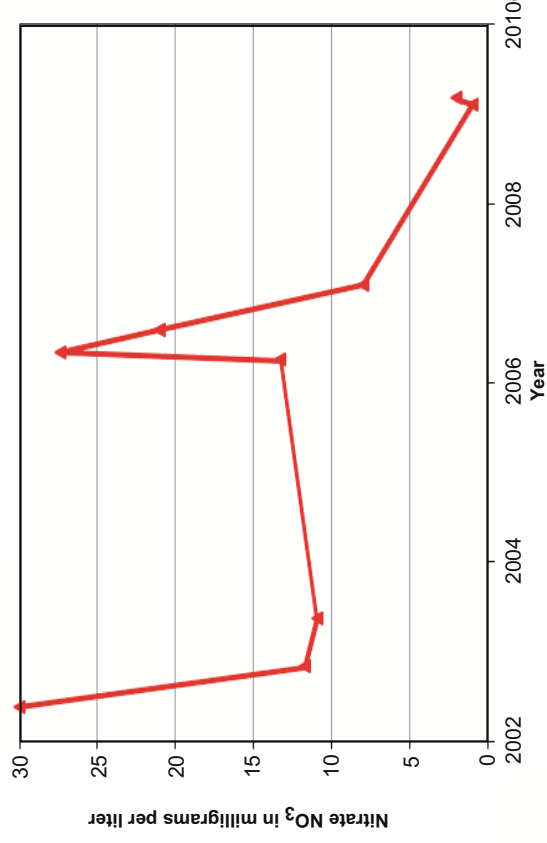
Sunnyslope



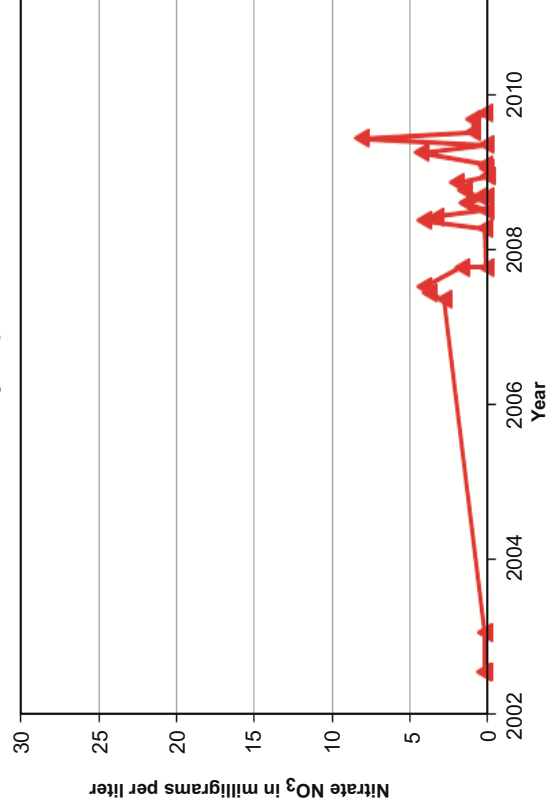
Hollister Domestic



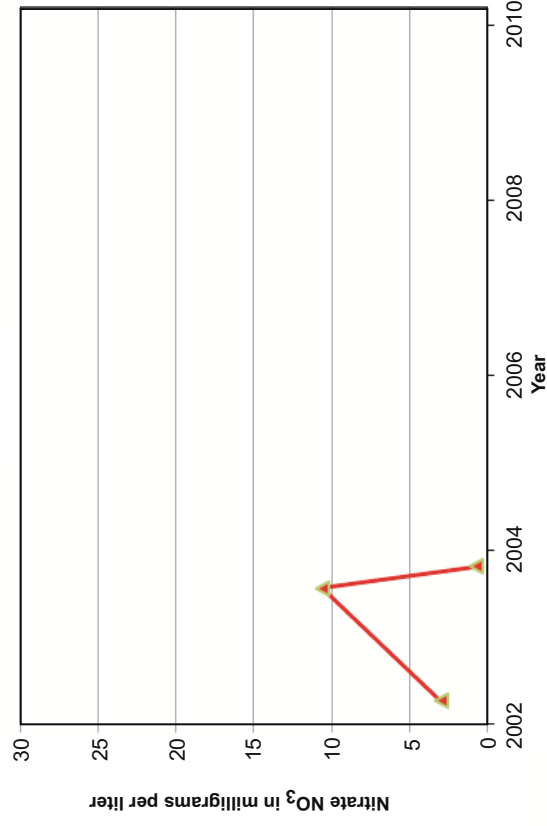
Hollister Industrial



Sunnyslope



San Juan

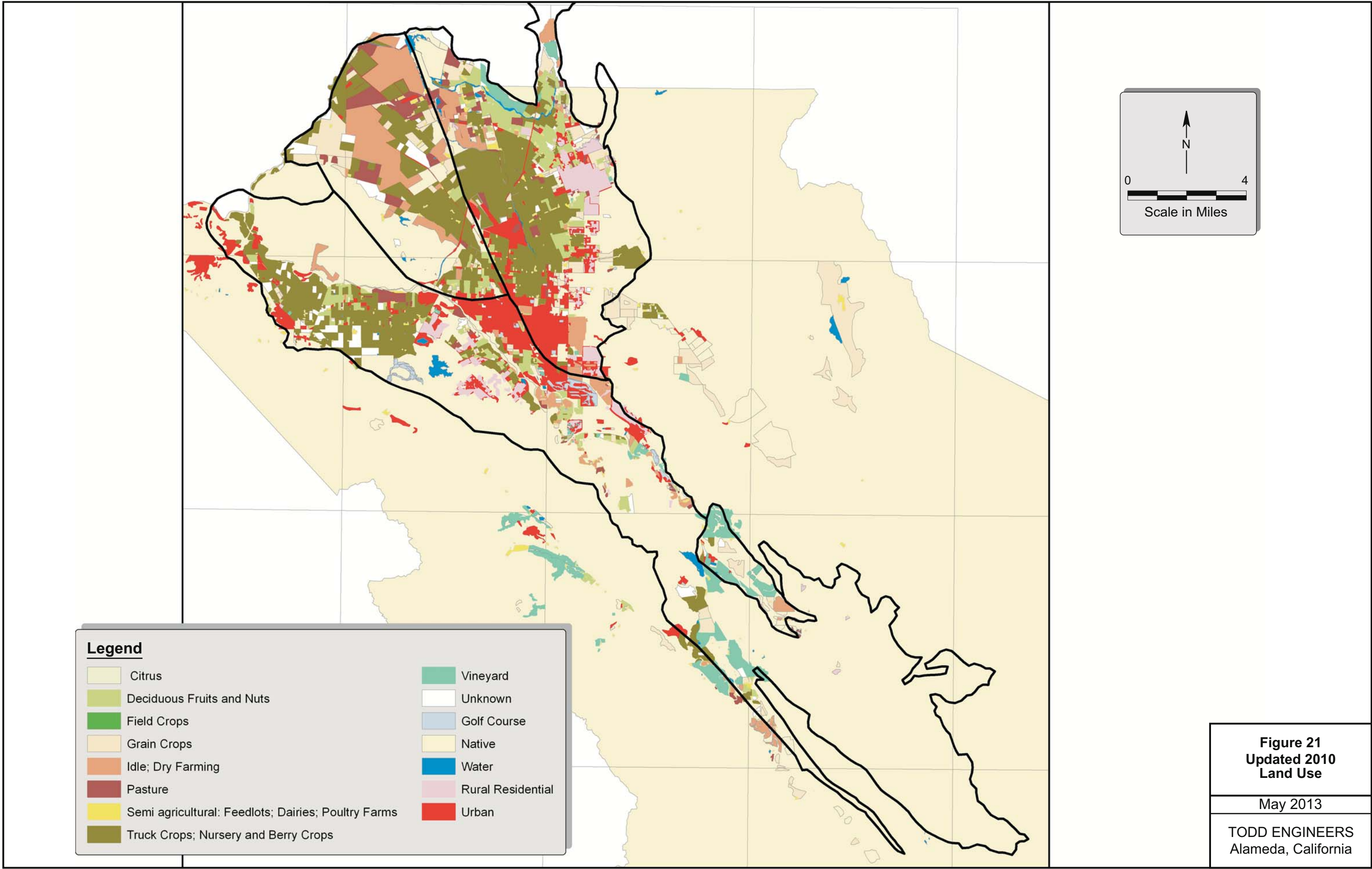


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Figure 20
Nitrate
in Effluent

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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 column 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 column 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 column 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 column 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 grounddwatner 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
- 5 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														
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														
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 percolation in San Juan and parts of Bolsa
- Adjusted Hollister West/Tres Pinos interaction
- Reduced subsurface inflow from Pacheco outside basin and Hollister East
- Increased groundwater outflow from San Juan