Original Project Title:

Carr Lake Watershed / Reclamation Ditch Subwatershed Assessment and Management Plan

Prepared for MCWRA Board of Directors

Funded by The Federal EPA under the Clean Water Act Section 205j Water Quality Planning Program as,
SWRCB Grant No. 02-098-250-0 and by Reclamation Ditch, Zone 9 Benefit Assessment

The Watershed Institute

Division of Science and Environmental Policy
California State University Monterey Bay
watershed.csumb.edu

100 Campus Center, Seaside, CA, 93955-8001
831 582 4452 / 4431.

Central Coast Watershed Studies | *CCoWS*

Final Report:

Monterey County Water Resources Agency – Reclamation Ditch Watershed Assessment and Management Strategy:

Part A – Watershed Assessment

Acknowledgements

Report prepared by:

- Joel Casagrande (Watershed Institute, FCSUMB)
- Fred Watson, PhD (Project Leader, Watershed Institute, FCSUMB)
- In conjunction with MCWRA Project Manager and Technical Advisory Committee (listed below)

MCWRA Project Manager:

- Manuel Quezada (MCWRA Project Manager)

Technical Advisory Committee (TAC):

- George Fontes (Comgro Inc.)
- Ross Clark (California Coastal Commission, CCC)
- Amanda Bern (CCRWQCB)
- Bryan Largay (Resource Conservation District of Monterey County RCDMC)
- Traci Roberts (Monterey County Farm Bureau, MCFB)
- Carl Niizawa (City of Salinas)
- Kathleen Thomasberg (MCWRA)

Thanks to the following individuals and agencies. Note that the listing of their names here does not necessarily imply that this report reflects their opinions and/or interpretations.

- Mark Angelo (PE) and Karen Worcester (CCRWQCB)
- Laura Lee Lienk, Restoration Ecologist (CSUMB)
- Doug Smith Ph.D, RG, Geologist/Hydrologist, (CSUMB)
- CCoWS Technicians: Julie Hager, Don Kozlowski, Joy Larson, Wendi Newman
- CSUMB Students: Janna Hameister, Jessica Masek, Morgan Wilkinson
- MCWRA: Curtis Weeks, Richard Boyer, German Criollo, Rob Johnson
- City of Salinas: Denise Estrada, Chuck Lerable, Ron Cole
- Vasiliki Vassil (Soquel Creek Watershed Council and CSUMB)
- Jerry J. Smith Ph.D, Fisheries Biologist, (SJSU)
- John Oliver Ph.D, Wetland Ecologist (MLML)
- Gabilan Cattle Company: The Reeves Family, Darrell Boyle
- Emily Hanson & Melanie Bojanowski, Resource Conservation District of Monterey County (RCDMC)
- Don Roberson, co-author of *Atlas of Breeding Birds of Monterey County* (1993)
- David Suddjian, Local bird expert
- Brian Anderson, Department of Environmental Toxicology, University of California, Davis
- Chris Bunn, Crown Packing Co., Inc.
- Dennis Sites, Agricultural Consultant
- Eric Van Dyke (Geographical Ecologist, Elkhorn Slough National Estuarine Research Reserve)
- Michael Cahn, UC Cooperative Extension

[Page intentionally left blank]

Primary audience

The primary audience of this Assessment and Management Strategy is the stakeholders of the Reclamation Ditch Watershed, and associated education, research, and professional entities:

- Stakeholders
  - Land use communities
    - Row-crop agricultural Community
      - Individual growers & shippers
      - Monterey County Farm Bureau
      - Grower Shipper Association
    - Ranching Community
      - Individual ranchers
      - Gabilan Cattle Company
    - Development Interests
      - Salinas Valley Builders Exchange and equivalent representatives
      - Creek Bridge Homes
    - Environmental/restoration/outreach groups
      - Friends of Tembladero (FOT)
      - Friends of Salinas Creeks (FOSC)
      - Return of the Natives (RON)
      - Monterey Bay National Marine Sanctuary Citizens Monitoring Network
      - Audubon Society Local Chapter
  - Agencies
    - Federal Agencies
      - NOAA Fisheries
      - United States Fish and Wildlife Service (USFWS)
      - Environmental Protection Agency (EPA)
      - Monterey Bay National Marine Sanctuary (MBNMS)
    - State Agencies
      - State Water Resources Control Board (SWRCB)
      - Central Coast Regional Water Quality Control Board (CCRWQCB)
      - California Department of Fish Game (CDFG)
      - California Coastal Commission (CCC)
    - Monterey County Agencies/Districts
      - Monterey County Water Resources Agency (MCWRA)
      - Monterey County Planning Department (MCPD)
      - Monterey County Agricultural Commissioner's Office (MCACO)
      - Resource Conservation District of Monterey County (RCDMC)
      - Moss Landing Harbor District
    - Local Cities and unincorporated Monterey County areas
      - City of Salinas

            - Castroville area in unincorporated Monterey County
            - Prunedale area in unincorporated Monterey County
            - Moss Landing area in unincorporated Monterey County

Educational / professional

- Educational and research groups
    - University California Santa Cruz (UCSC)
    - Moss Landing Marine Labs (MLML)
- Consultants:
    - Schaaf and Wheeler Consulting Civil Engineers (SWCCE)
    - John Gilchrist and Associates/Fall Creek Engineering
    - Hagar Environmental Science (HES)
    - Camp Dressser McGee

Table of Contents

[Page intentionally left blank]

List of Figures and Tables

List of Figures

Page

Chapter 1 Introduction

Chapter 2 Historical Conditions

Chapter 3 Socio-economic Context

Chapter 4 Hydrology and Channel Conditions

Chapter 5 Botanical Assessment

Chapter 6 Water Quality Assessment

List of Tables **Page**

[Page intentionally left blank]

Project Summary: Assessment Phase

(one-page summary required under EPA 205(j) funding)

A Watershed Assessment and Management Strategy was completed for the Reclamation Ditch Watershed in northern Monterey County, California, for Monterey County Water Resources Agency (MCWRA). The project was funded by the Federal EPA ($114,630), Monterey County Water Resources Agency Zone 9 Assessments ($46,400), the City of Salinas ($20,000), and in-kind contributions by stakeholders and other agencies, primarily through participation on a Technical Advisory Committee (TAC).

The Assessment found that the Watershed has a unique, nationally vital agricultural economy. Its contemporary landscape is founded on a history of reclaiming land for multiple-uses such as agriculture and urbanization, and protecting all land uses from floods. In the past few decades additional objectives have been introduced, including the need to provide flood control, reduce sedimentation, improve water quality, food safety, and special status species. Channel conditions are generally designed to facilitate runoff. The existence of dry lake beds providing valuable flood storage during the winter and valued agricultural land during other times of the year, provide a key socio-economic dynamic for the watershed. Water quality concerns exist at several sites with respect to nitrate, phosphate, dissolved oxygen, water temperature, fecal coliform indicators, suspended sediment, and the insecticides. There are fifteen Clean Water Act 303(d) listings for water quality impairment within five water bodies in the Watershed, and three listings in the receiving water body downstream (Moss Landing Harbor). The Watershed contains at least five native fish species and supports one Endangered species, two Threatened Species, and three Species of Concern.

The second part of this summary will appear in Part B - Watershed Management Strategy.

[Page intentionally left blank]

Executive Summary

From 2003-2005, the Central Coast Watershed Studies team, of the Watershed Institute at California State University Monterey Bay (CSUMB) completed an Assessment and Management Strategy for the Monterey County Water Resources Agency (MCWRA) entitled the *Carr Lake Watershed/Reclamation Ditch Subwatershed*, which we refer to here simply as "*The Reclamation Ditch Watershed*". The 157 square-mile watershed is almost entirely within Monterey County in California's Central Coast Region, running from its headwaters in the Gabilan Range down to its terminus at a set of tide gates at the entrance to Moss Landing Harbor. Part A of this report contains the Assessment, comprising five elements that collectively assess the function of the watershed, including: Historical Conditions Assessment, Hydrology and Channel Conditions Assessment, Water Quality Assessment, Biological Assessment and a Botanical Assessment. Part B of this report contains the Management Strategy, comprising five main elements: Exisiting Plans, Public Process, Watershed Management Goals, Management Actions, and Management Strategies. Both reports then conclude with References and Appendices.

Initially, the project was entitled the Carr Lake Watershed / Reclamation Ditch Subwatershed Assessment and Management Plan whose project description stated would form the scientific basis for developing a watershed-wide, community based management plan; and for gathering specific information needed for existing studies and planning projects. Due to the limited funding available, the subwatersheds above Carr Lake (Gabilan, Natividad, and Alisal Creeks) would form the project area and become the template for a more comprehensive assessment and management plan, with extensive public input from stakeholders, for the larger Reclamation Ditch Watershed area. The project consultant, the Central Coast Watershed Studies team, of the Watershed Institute at California State University Monterey Bay (CSUMB) and the Techincal Advisory Committee (TAC) recommended to MCWRA to expand the project study area to include the entire 157 square mile Reclamation Ditch watershed area, without additional resources in support. The revised project title is the *Reclamation Ditch Watershed Assessment & Management Strategy*.

The Assessment presented here is primarily a compilation of existing studies and reports, conducted within the study area or adjacent areas, and gathered from various sources. The only new information presented is data from Benthic Macroinvertebrate data acquired through targeted field sampling.

The project cost $161,030 plus in-kind contributions. Primary funding was provided by a Federal EPA grant (#02-098-250-0) of $114,630 through the Clean Water Act Section

205(j) with Zone-9 assessment contributions from the Monterey County Water Resources Agency (MCWRA) in the amount of $46,400. The Watershed Institute (as Foundation of CSUMB) was sub-contracted for $89,770 to lead the technical aspects of the project. The Watershed Institute's role also involved voluntary work. Additional financial commitments were provided by the City of Salinas ($20,000), as well as RCDMC, CCC, CCRWQCB, Comgro, and MCFB, primarily through participation on the TAC.

This document contains Part A – Watershed Assessment. a second document will contain Part B – Watershed Management Strategy.

The primary conclusions of the work are summarized here.

Executive summary of Part A – Watershed Assessment:

- The assessment of the watershed sits within a socio-economic context whereby the need to meet environmental objectives is tempered by the need to do so at 'reasonable cost' to dischargers (such as agriculture, and the City of Salinas). Determination of reasonable cost must take into account the critical role in feeding the nation that is played by the agricultural lands within the watershed, and by the City as the socio-economic center of agriculture in Monterey County. The City is the County seat, and County agricultural production exceeds $3 billion annually, including about 44% of the nation's lettuce, 43% of its broccoli, and 22% of its strawberries. Nearly one-third of County jobs are accounted for directly by agriculture.
- In the past century, the Watershed has undergone dramatic change. The natural grassland and woodland landscape has been largely replaced by agriculture and urban land. Ditches and lake-bottom farms have replaced most of the natural swamps and lakes. Elements of the native fauna have been extirpated or are extinct. Agricultural production in the lowlands has shifted from grain crops and grazing to a nationally vital vegetable crop industry.
- Any Watershed Assessment sits within the context of defined objectives for the Watershed. For the Reclamation Ditch Watershed, these objectives are numerous, including most importantly:
  - The need for urban land
  - The need for agricultural land
  - The need for effective flood control
  - The need for clean water in support of various beneficial uses as regulated under the Clean Water Act and with respect to initiatives by downstream entities such as the Monterey Bay National Marine Sanctuary

  - o The need to comply with relevant laws protecting special status species and/or critical habitat
- The modern Reclamation Ditch essentially attempts to fulfill a community expectation of a flood control system. This expectation exceeds the original intention of the system as simply a means of reclaiming land.
- Current channel conditions predominantly meet agricultural and urban uses. The channels are maintained as excavated, straightened ditches that remove water. However, such needs are not entirely met, since flooding of agricultural and urban land occurs, due to: increased runoff from expanding impervious areas; sub-optimal functioning of the various flow control structures throughout the Ditch system; channel sedimentation from a variety of sources, and; the fact that much of the flood-prone farmland is within the geomorphic floodplain. Flooding is most prevalent during extreme events.
- Channel conditions facilitate delivery of quality-impacted water to downstream areas. Riparian habitat is removed by property owners, from the ditch system adjacent to agricultural lands, primarily as a deterrent to wildlife and natural habitat features.
- A water quality concern is defined as not meeting a water quality objective. This definition is uncertain. Objectives were set during the present project based on regional numeric standards, if they existed, or otherwise, on national standards most commomly used by State and Federal regulators. It is important to note that the existence of 'concerns' may change in the future, simply as a result of changes in the objectives as more becomes known about the relationship between water quality and beneficial uses.
- Relative to current water quality objectives, there are several water quality concerns at sites throughout the middle and lower parts of the watershed. Water quality data were collated from previous studies since 1999. These data were collected under various sampling designs, at various times of year. The following summary statements are thus, biased toward the conditions that were prevalent during sampling. In order to minimize this, sites with fewer than five samples were excluded.
- There are fifteen Clean Water Act 303(d) listings for water quality impairment within five water bodies in the Watershed, and three listings in the receiving water body (Moss Landing Harbor) downstream of the watershed.
- A complete source analysis is beyond the scope of this present study.
- Water quality data suggest that pollutant concentrations decrease with distance away from the most intensively used land. This supports the common understanding that water quality concerns are reduced by increasing residence time in the channel and/or wetland environment – through environmental processes such as deposition, dilution, nutrient uptake, oxygenation, and molecular decomposition.

- Sedimentation of channels and lakes is of concern primarily because it leads to increase flooding risk, necessitating channel maintenance activities.
- The aquatic fauna of the Watershed have shown resilience to the water quality concerns listed above. The lower, more impaired reaches are home to at least five native fish species, as well as at least transient use by one adult steelhead trout. The existence of an actual run or population of steelhead is unknown. The upper reaches support both rainbow trout, and an invertebrate fauna that is typical of intact upland Californian aquatic ecosystems.
- The Watershed contains at least five native fish species and supports one Endangered species, two Threatened Species, and three Species of Concern.
- Observations of the federally threatened California red-legged frog were made in the headwaters, although this species appears to have been extirpated from the lowlands in the Watershed. Observations of the tiger salamander, a federally threatened species, are restricted to pond sites near oak woodland habitat.
- Similarly, bird and mammal diversity is correlated with remaining natural habitat – being lowest in the most intensely developed urban and agricultural areas. Much of this change probably occurred during the creation of the modern landscape in the early 1900s.

1. Introduction

The headwaters of the Reclamation Ditch Watershed looking southwest towards the Santa Lucia Range. Photo: CCoWS, 2000.

Background

Monterey County Water Resources Agency (MCWRA) and, under subcontract, the Central Coast Watershed Studies (CCoWS) team of the Watershed Institute at California State Monterey Bay (CSUMB) were contracted by the California State Water Resources Control Board (SWRCB) to conduct a Watershed Assessment and Management Plan for the Reclamation Ditch Watershed. Primary funding for this Assessment was provided by a grant from the Federal EPA, Clean Water Act, Section 205(j) Water Quality Planning Program implemented through the SWRCB.

The Assessment has two objectives: to form the scientific basis for developing a watershed-wide, community based management plan; and to gather specific information needed for existing studies and planning projects. The Assessment utilizes primarily on previously collected data from various entities along with some recently collected data by the CCoWS team. The only new information presented here relates to Benthic macroinvertebrate data acquired through targeted field sampling during the course of this study.

Study Area

The Reclamation Ditch Watershed (Fig. 1.1) is located in the Central Coast Region of California in northern Monterey County. In total, the watershed drains approximately 407 km^2 (157 mi^2) and is home to nearly 170,000 people with a majority living in Salinas (151,060), Castroville (6,724), and parts of the Prunedale area (16,432) (2000 population provided by United States Census Bureau (USCB), online).

Hydrology

The name "Reclamation Ditch Watershed" was defined by the present project[1] to represent the entire watershed above the Potrero Road tide gates (near Moss Landing) on the Old Salinas River Channel, excluding the influence from the Salinas River itself via the Old Salinas River Channel. The Reclamation Ditch Watershed thus includes the watersheds of: Tembladero Slough, Merritt Lake, Santa Rita Creek, Espinosa Lake, Gabilan Creek, Natividad Creek, Alisal Slough and Alisal Creek. The watershed boundary is shown in Figure 1.1.[2]

The watershed, which includes the Zone 9 Benefit Assessment Area and maintained by MCWRA (Fig. 1.2), drains the northwestern slopes of the Gabilan Range as well as much of the city of Salinas and its surrounding lands. Within the watershed are five main tributaries including Gabilan Creek, Natividad Creek, Alisal Creek, Santa Rita Creek and the Merritt Lake drainage. Gabilan, Natividad, and Alisal Creeks converge at Carr Lake, a seasonal lake in the center of Salinas. During the growing season Carr Lake is a productive agricultural basin along with the following dry lakes: Merritt, Espinosa, Santa Rita Slough, Vierra, Fontes, Boronda, Markley Swamp, and Mill, each critical in providing detention flood storage during the winter months.

Exiting Carr Lake and draining much of the city of Salinas is the Salinas Reclamation Ditch (or simply, the "Reclamation Ditch"). The Ditch, created between 1917 and 1920, is a network of excavated earthen channels used to drain surface runoff generated in the watershed including several old lakes (Cozzens, 1944; SWCCE, 1999). The system drains into Tembladero Slough, then the Old Salinas River Channel, and ultimately into

[1] The title of the project as proposed to SWRCB was "Carr Lake Watershed / Reclamation Ditch Subwatershed Assessment and Management Plan". Some TAC members agreed that the most appropriate study area would be the hydrologic watershed of the Reclamation Ditch system starting at the coastal confluence at Moss Landing Harbor, but excluding minor flows from the much larger Salinas Watershed via the Old Salinas River Channel. The revised project title is the *Reclamation Ditch Watershed Assessment & Management Strategy*.

[2] The mapped boundary is approximate, based on digital elevation analysis and aerial photo interpretation. A known error is that the boundary is too narrow on the south side of the Rec Ditch in industrial East Salinas. A known limitation is the accuracy of the southernmost stretch of the boundary line.

Moss Landing Harbor through the Potrero Tide Gates. Urban runoff from the City of Salinas drains into various channels of the Reclamation Ditch system via numerous stormwater outfalls (Fig. 1.3).

Climate

The Watershed is characterized as having a semi-arid Mediterranean climate with year-round moderate temperatures and seasonal rainfall. The city of Salinas has an average annual temperature of 14.1˚C (57.3˚F) (Fig. 1.4). In summer, coastal fog is common in the morning, however this typically recedes over the Pacific Ocean by mid-afternoon. Average annual precipitation for the City of Salinas is 5.56 cm (14.1inches), with most precipitation occurring between October and April (SVCC, online) (Fig. 1.5). Snow occasionally falls at the highest elevations of Fremont Peak. Wind is also a common feature to the local climate. As temperatures rise inland, cool marine air is spread into the Salinas Valley resulting in strong winds across and down the valley (Allen, 1934; Roberson and Tenney, 1993; Gordon, 1996; Watson et al., 2003).

Geology and Soils

The geology of the Reclamation Ditch Watershed is shown in Figure 1.6. Various forms of igneous intrusive material, such as granodiorite and diorite, as well as metamorphic mica schist dominate the upper elevations of the northern Gabilan Range. The foothills consist of older alluvial fans (middle Pleistocene), undifferentiated Aromas sand formations, and small quantities of marble. Alluvial fan deposits (Holocene) are found in the lower canyons that meet the valley bottom. To the north and east of Salinas, the valley bottom is primarily alluvial fans from the late Pleistocene. To the north and west of the city, much of the land is fluvial terrace deposit from the middle Pleistocene and basin deposits along the Alisal Slough and Blanco Drain systems. The areas that were once covered with the historic lakes of the watershed are also basin deposits. Tembladero Slough and the Old Salinas River Channel traverse through undifferentiated floodplain deposits from the Salinas River.

Finer particle soils, such as clays and clay loams, are most abundant in the lower flatland areas of the watershed (Fig. 1.7). These soils are indicative of wetland areas and are play a large role in the productive agriculture in these areas. Coarser material such as sands, gravely sands and cobble sands are found along the ridgelines, in the alluvial valleys and at the base of the foothills of the watershed. The intermediate sized soils are dominant between the foothills and the city of Salinas.

Land cover and vegetation

Historically, the Reclamation Ditch Watershed had a system of swamplands extending from downtown Salinas to Moss Landing Harbor (Cozzens, 1944; Gordon, 1996). The upland areas, to the east were rolling hills covered in oak savanna and chaparral. At the higher elevations in the Gabilan Range, the hills were a mixture of oak woodland and chaparral with canyons of dense montane riparian vegetation.

Today, much of the lower portion of the watershed has been developed for agricultural and urban uses (Fig. 1.8). The rolling hills just to the north of Salinas and the upper floodplain areas between the Gabilan Range and the City of Salinas have also been converted largely into agriculture and urban uses. The hills of the Gabilan Range are primarily grazing/ranching lands with a small percentage as parklands in Fremont Peak State Park. The canyons within these hills still contain montane riparian vegetation, while the mountain slopes support chaparral, oak woodland and grassland habitats – both native perennial grasses and, more commonly, non-native annual grasses.

The current breakdown of land cover types was estimated using a combination of regional Landsat remote sensing using 2002 data (Newman et al., 2003) and detailed agricultural mapping conducted by the California Department of Water Resources in 1997. Table 1.1 summarizes estimates of the area of each major land cover type. Approximately 40% of the watershed is cropland, with 29% grazing, 23% woody and other natural vegetation, 6% urban and industrial, and 2.6% unclassified.

Table 1.1 Estimated area of major land cover types within the Reclamation Ditch Watershed. Boldface indicates primary data, normal typeface indicates derived data.

		CCoWS 2003 Land cover estimates (Newman et al., 2003)				DWR 1997 land cover estimates
Group	Land cover	km^2	%	km^2	%	km^2
Crops	Vegetables	164.01	40.1%	**158.73**	38.8%	**146.20**
	Strawberries			0.05	0.0%	**0.05**
	Grain/Hay			4.10	1.0%	**4.10**
	Deciduous Fruits/Nuts			1.14	0.3%	**1.14**
Grazing	Grassland	118.99	29.1%	**118.99**	29.1%	
Woody & Other natural	Woodland, forest	92.46	22.6%	**29.89**	7.3%	
	Chaparral			**52.33**	12.8%	
	Other natural vegetation			**10.24**	2.5%	
Urban, industrial	Urban, industrial	22.79	5.6%	**22.18**	5.4%	
	Mining			**0.62**	0.2%	
Unclassified	Unclassified	10.59	2.6%	**10.59**	2.6%	257.36
Total	***Total***			***408.84***		***408.94***

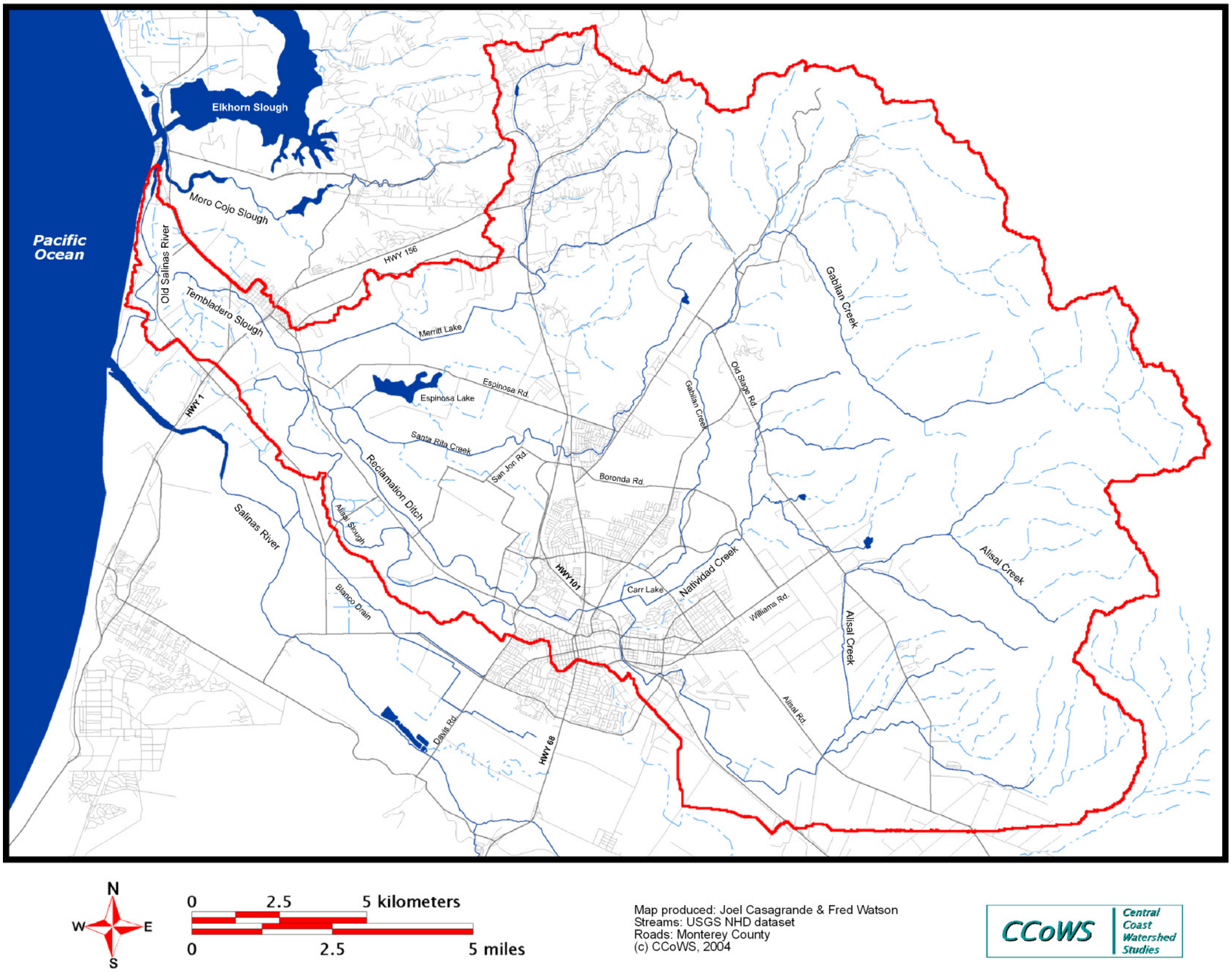


Figure 1.1 The Reclamation Ditch Watershed. Watershed boundary is outlined in red. Major streams/water bodies are depicted in blue and main roads are depicted in light gray.

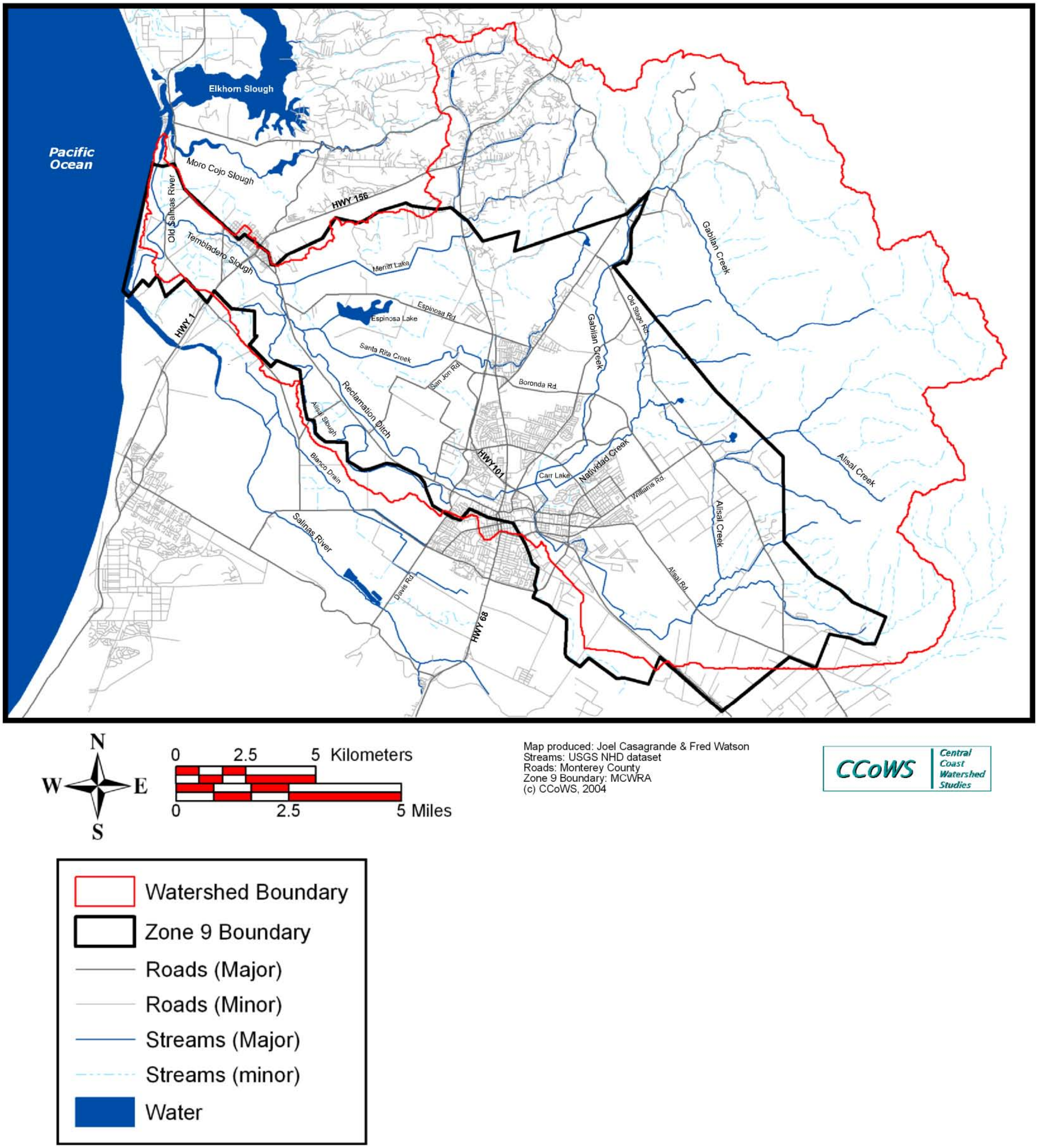


Figure 1.2 The Reclamation Ditch Watershed and the Zone 9 Boundary.

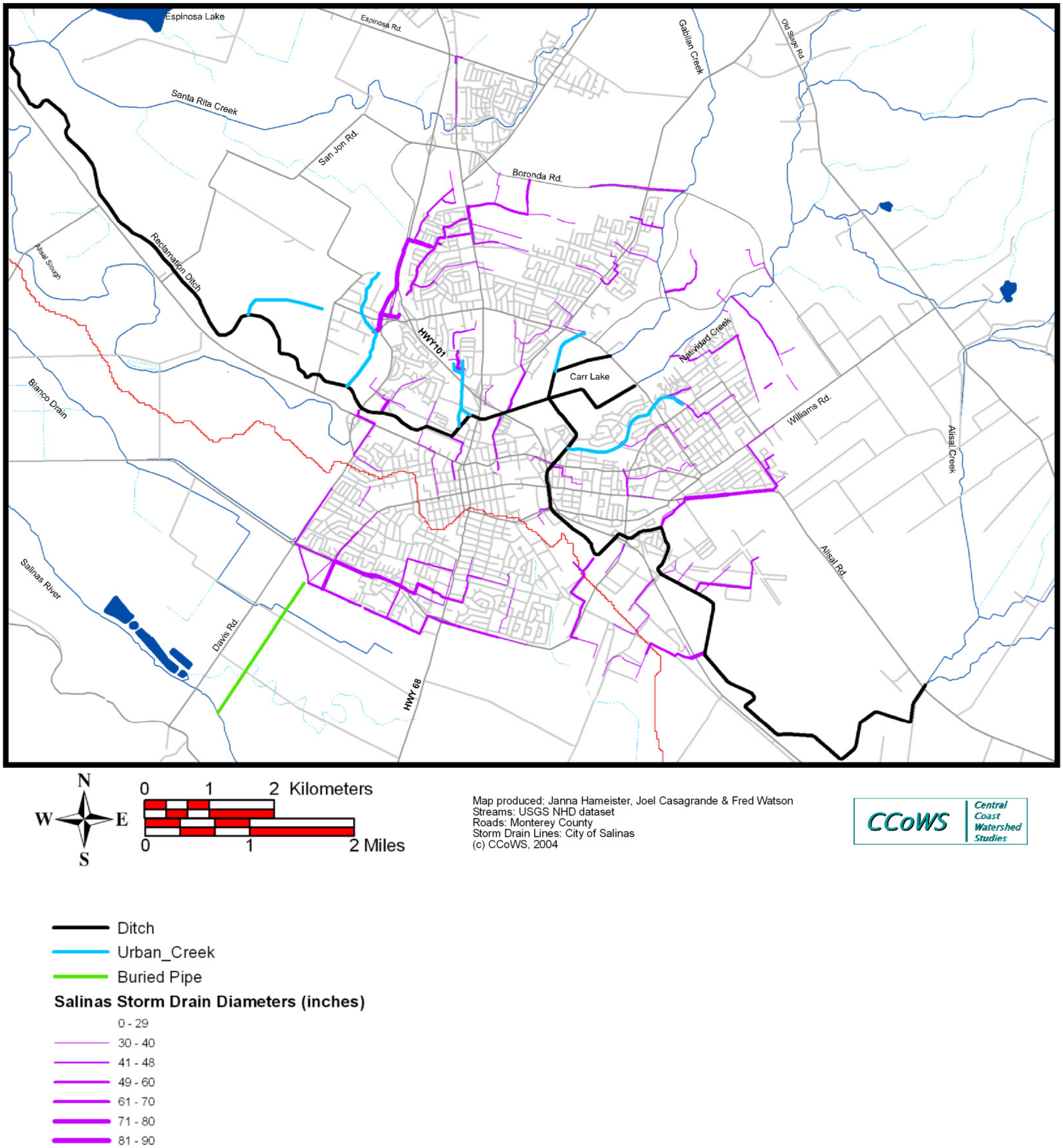


Figure 1.3. Storm drain system for the City of Salinas.

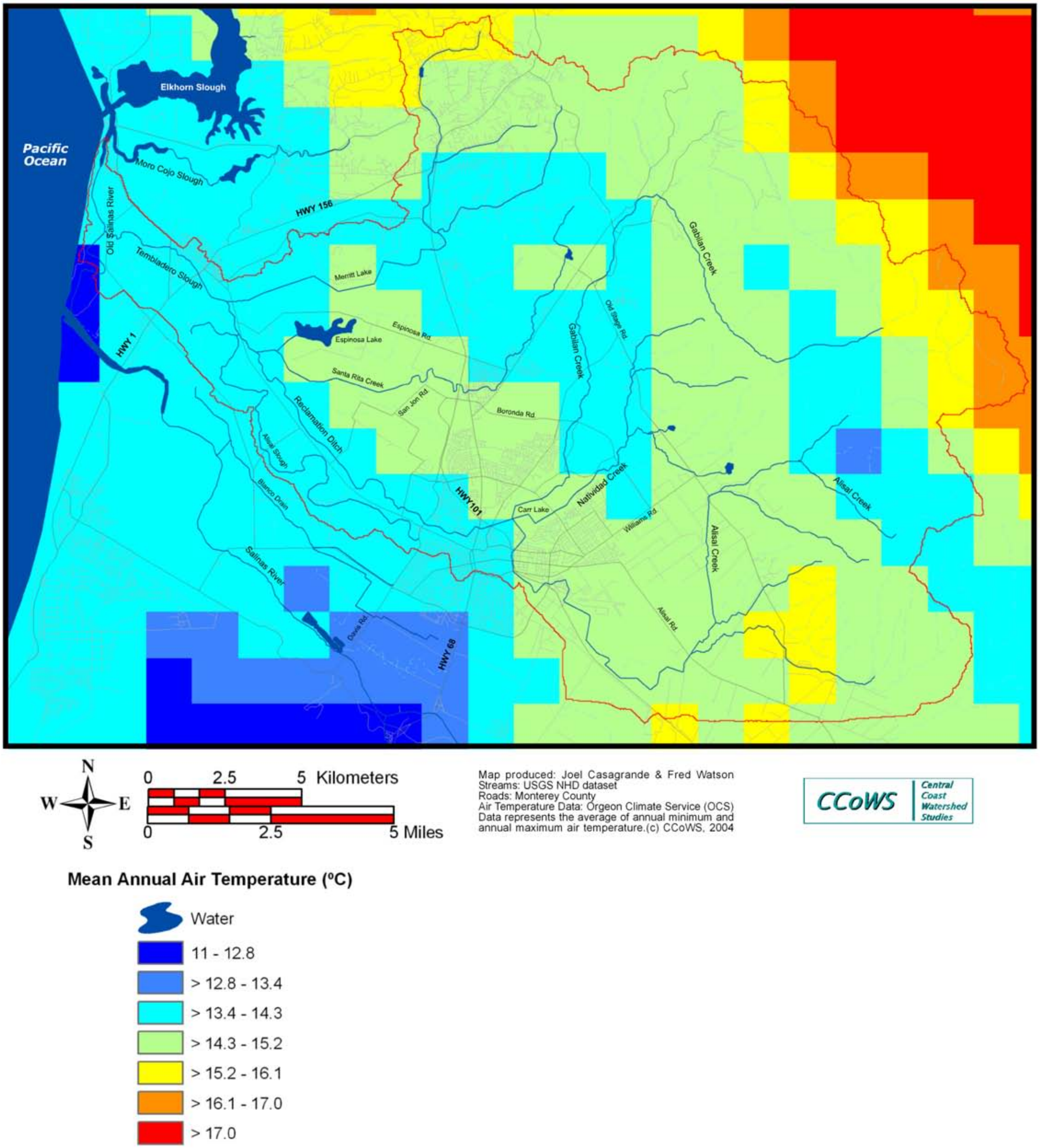


Figure 1.4 Mean annual air temperature for the Reclamation Ditch Watershed and surrounding area.

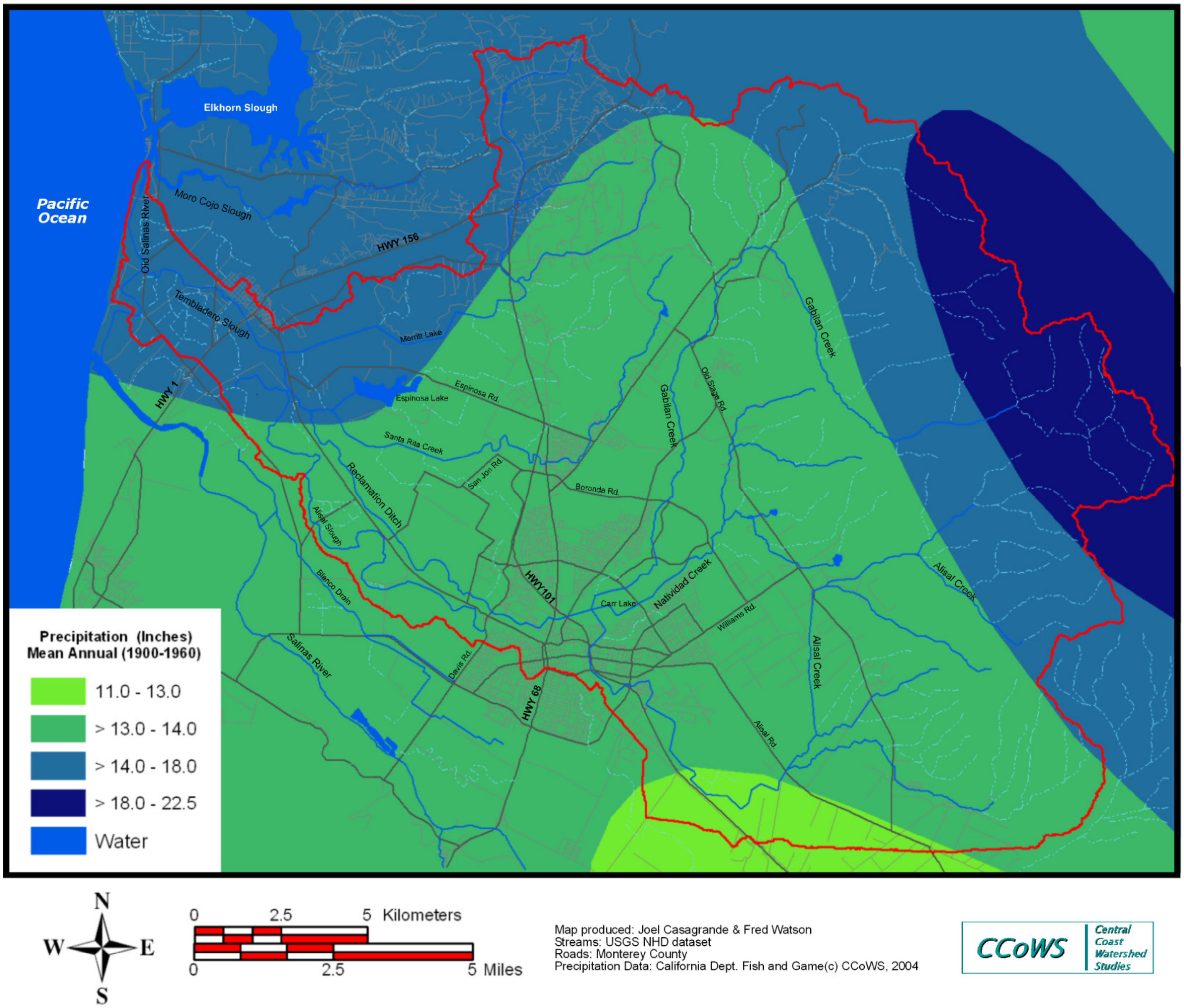


Figure 1.5 Mean annual precipitation for the Reclamation Ditch Watershed and surrounding area.

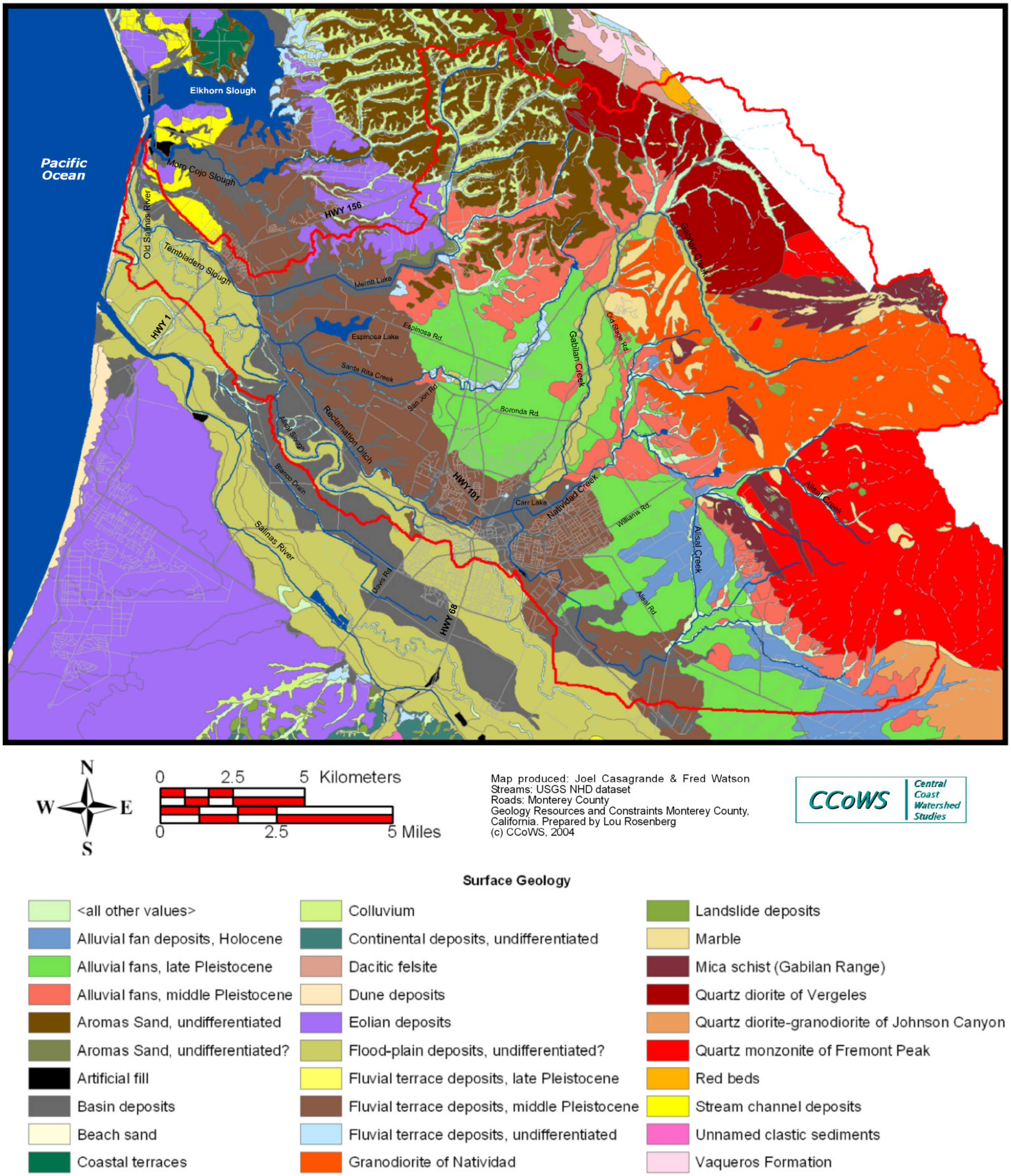


Figure 1.6 Surface geology of the Reclamation Ditch Watershed and surrounding areas.

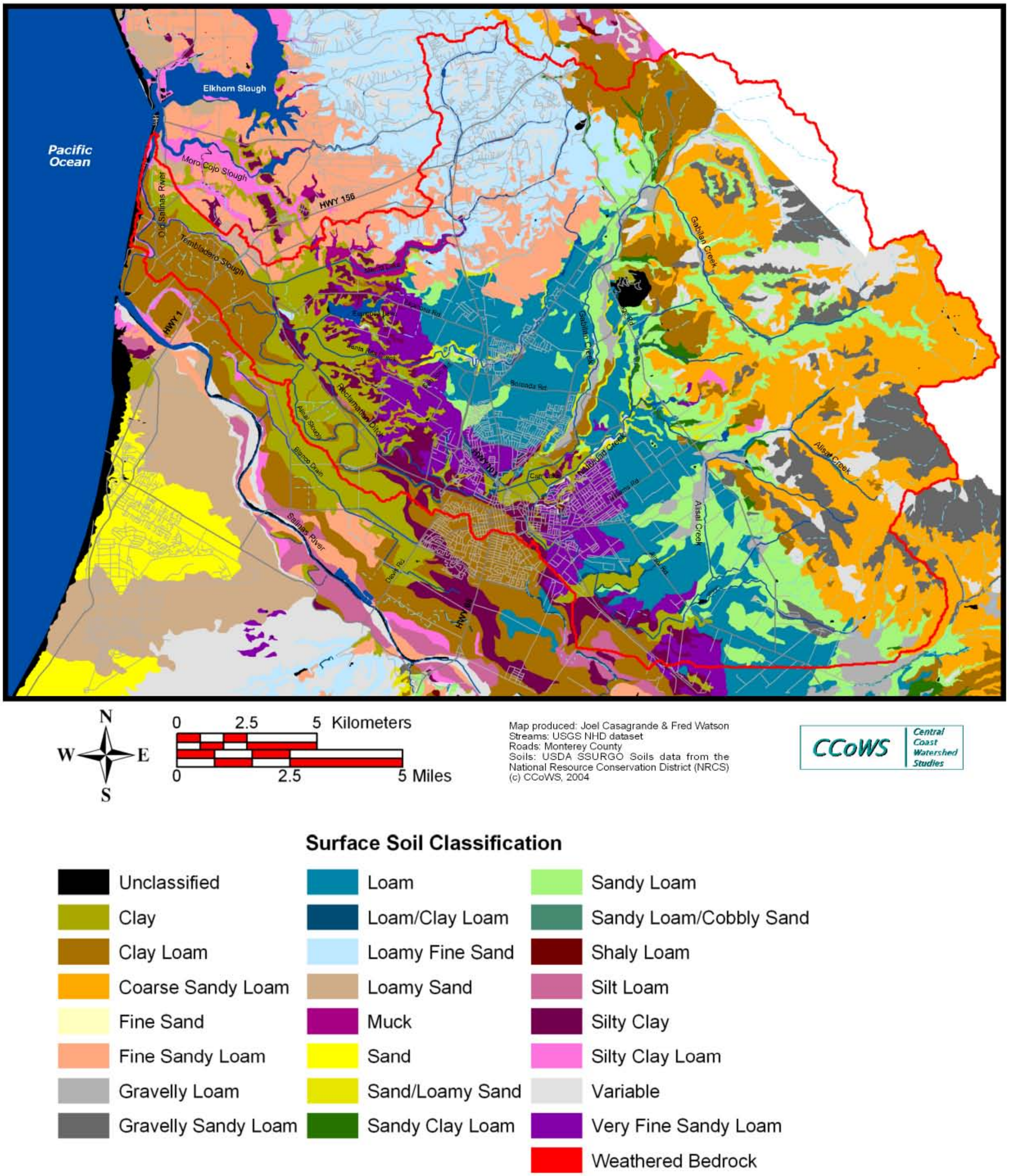


Figure 1.7 Soil texture classification map for the Reclamation Ditch Watershed.

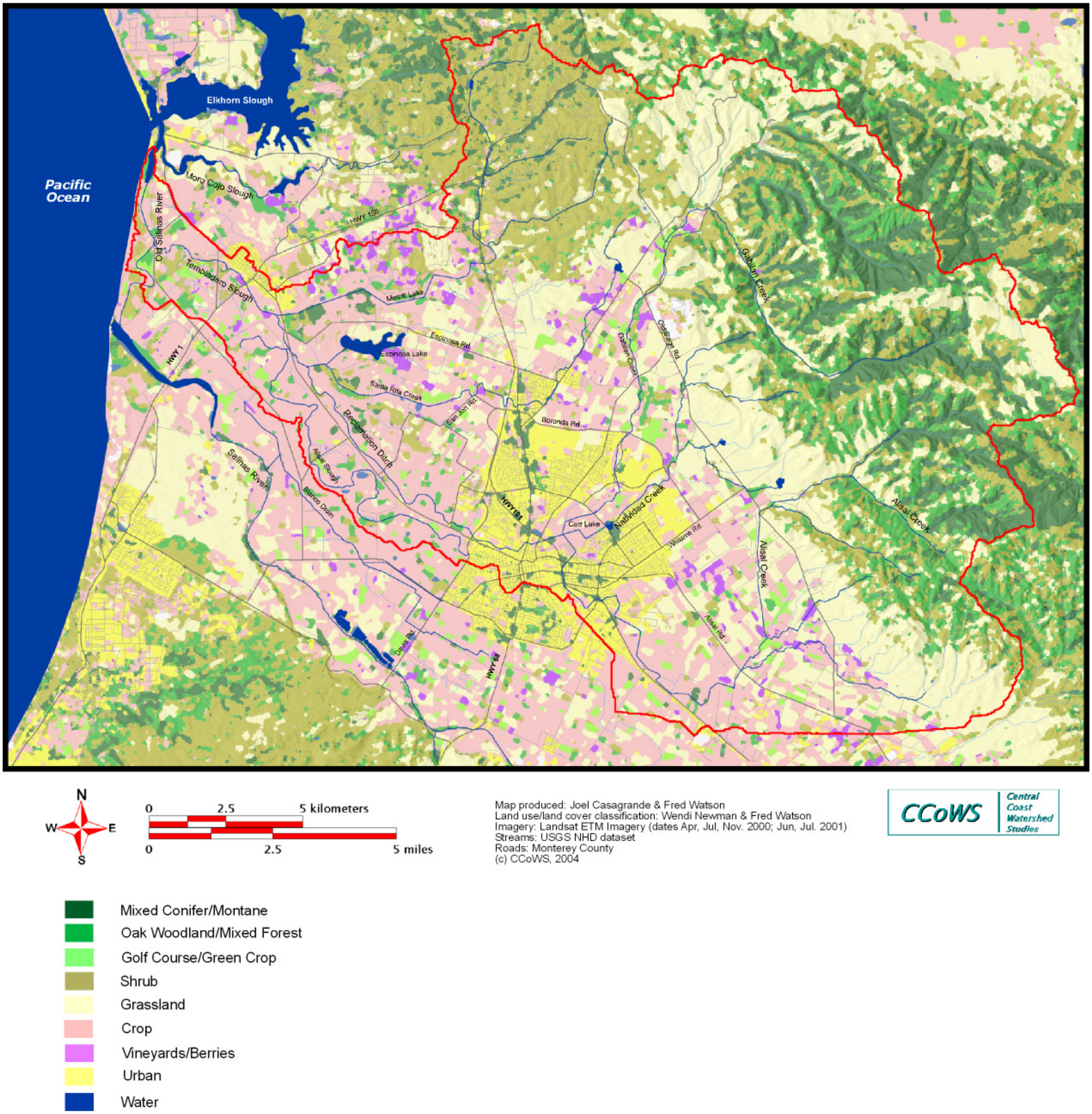


Figure 1.8 Land use/land cover in the Reclamation Ditch Watershed and surrounding area.

2. Historical Conditions

Aerial view of Moss Landing Harbor circa 1940 with Moro Cojo Slough and the Old Salinas River Channel entering Moss Landing Harbor towards the top right. Photo: Courtesy of the Monterey County Agricultural & Rural Life Museum.

Overview and Methods

This chapter outlines the historical conditions and change including wildlife, land use and hydrology in the northern Salinas Valley and is presented in three sub-sections: *Land Use and Population*, *Hydrology*, and *Historical Wildlife*,

Several references were used for this chapter. Many of these provided a complete review of the historical accounts for the area and therefore are used here as definitive sources. These include, but are not limited to: Verardo and Verardo, (1989); Gordon, (1996), Anderson, (2000); and Breschini et al., (2000).

Land Use and Population

Pre-1900

For approximately 10,000 years prior to European settlement, the Ohlone people inhabited the northern Salinas Plain. The Ohlone were primarily nomadic people, hunting elk and deer and harvesting fish, shellfish, seeds and a variety of plants. They utilized the abundant tules for the construction of their canoes and rafts, which were important for their way of life (Anderson, 2000).

The Spanish explorers came to the Salinas Valley in 1769. By 1790, a mission was built in Carmel and the Presidio was established in Monterey (Breschini et al., 2000). The Spanish brought horses and cattle and by the end of the 18th Century they had established several ranches. Cattle and sheep ranching was the dominant economic base of the time (Allen, 1934).

By 1849, the original Mexican land grants had been divided and the land was put up for sale (Anderson, 2000). New settlers began buying the land and established a mixture of farms and ranches. The lowlands quickly became productive farming areas while the foothill and mountainous regions primarily remained as ranch lands. Grain farms,

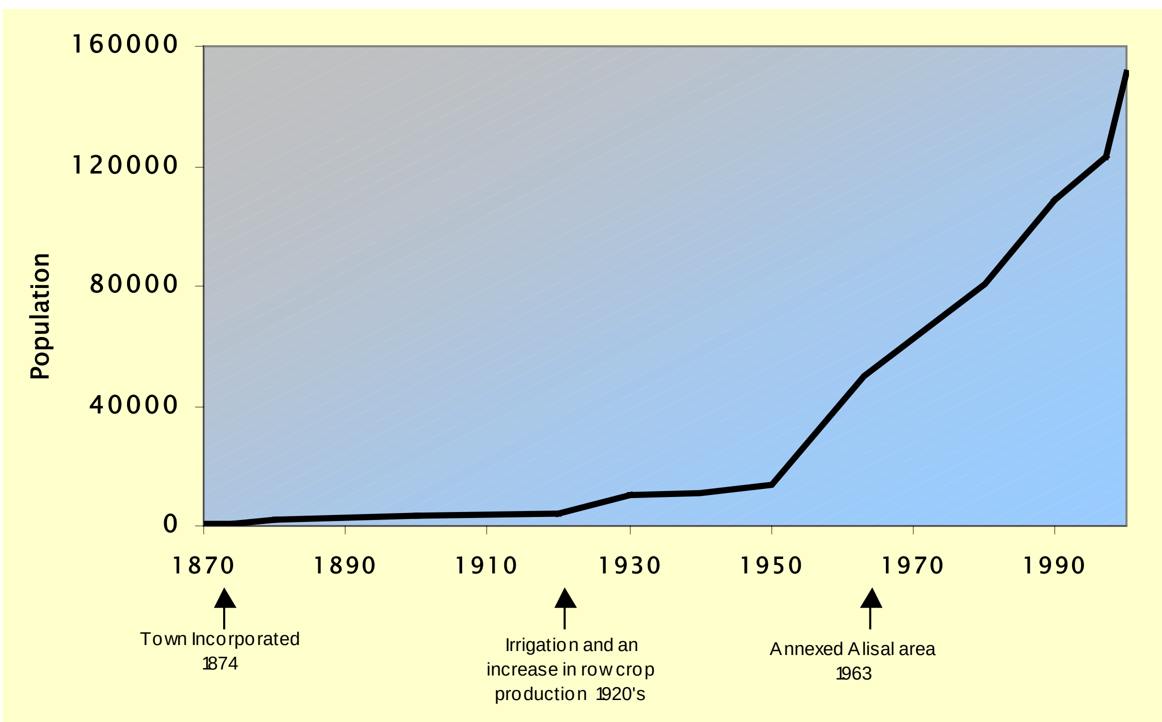


Figure 2.1 City of Salinas population growth between 1870 and 2000. Data sources as published in Breschini et al., (2000), Verardo and Verardo, (1989), and United States Census Bureau (2000).

potatoes and sugar beets became the new dominant land use in valley, especially along the waterways. Cattle and sheep ranching were pushed further into the mountains (Anderson, 2000). In addition, the severe droughts between 1862-1864 have been documented as a significant transition period from cattle ranching to grain farming in the valley (Allen, 1934).

In 1866 a shipping pier was constructed at the junction of Moro Cojo and Elkhorn Sloughs (Allen, 1934; Breschini et al., 2000). The pier provided a way for farmers to distribute their harvest. In addition, the railroad was connected to Salinas in 1872, which allowed for additional transport of the harvest (Allen, 1934).

Starting in the late 1880's, sugar beet production began to increase in the central and northern Salinas Valleys (Allen, 1934). By 1900, sugar beets were one of the dominant crops in the valley, led by the Spreckels Sugar Co..

In the Castroville and Salinas areas, between 1870 and the early 1900's very little changed until the introduction of vegetable farming in the 1910's and 1920's.

When Salinas was first declared a city in 1874, the population was approximately 500-600 people (Breschini et al., 2000) Between 1870 and 1900 the population of Salinas grew to 3304 people (Fig. 2.1).

1900-1950

Between 1900 and 1950 there was considerable change in the watershed to the population, hydrology, and especially land use. In 1900, the population of Salinas was 3,304 (Breschini et al., 2000) and by 1950, the population grew by approximately 10,000 more people (Fig. 2.1).

In December of 1900, The Southern Pacific Railroad company finished its coastal line between San Francisco and Los Angeles. Included in this route was a station in Salinas. This allowed Salinas to become the dominant center of commerce in the Salinas Valley. Soon after came the automobile, which made Salinas even more easily accessible, and forever eliminated the old stage lines (Breschini et al., 2000).

Grain (wheat and barley), sugar beets, potatoes and alfalfa were the dominant crops in the surrounding lands. Potatoes were grown as early as 1852 in the Blanco area[3] and continued early into the 20th Century. These early potato farms were watered only by natural rainfall (Anderson, 2000). Both sugar beets and lettuce require several irrigations

[3] Blanco was the area of land between the Salinas River and the City of Salinas, or near the Blanco Road crossing over the Salinas River.

(Breschini et al., 2000). The infrastructure for irrigation was originally installed for sugar beets and when the price of sugar and thus sugar beets crashed, lettuce and other row crop vegetables were planted instead. Figure 2.3 illustrates the abrupt shift from grains (and sugar beets although not shown) as the former dominant agricultural products of the valley to lettuce as the new dominant crop.

In 1917, Orrin O. Eaton was credited as being the first to plant lettuce in Monterey County (Verardo and Verardo, 1989). In 1922, others started to grow lettuce in the Blanco area. This was the beginning of the lettuce industry, or the introduction of "Green Gold" as noted in Anderson (2000).

Summer droughts often destroyed grain farms throughout the valley. In order to diversify the types of crops, a consistent source of water was needed. Initially, well water irrigation was limited to shallow groundwater. As early as the days of the Missions, irrigation ditches were dug for farms and human consumption (Allen, 1934). These were often unreliable and highly dependent on surface runoff and after the decline of the Missions in 1833, the use of these systems declined (Allen, 1934). Windmills were commonly used throughout the valley to pull groundwater from shallow wells and/or springs. In the late 1800's, a few farms began experimenting with deep wells (>100 ft) that were originally pumped by gasoline-powered engines (Allen, 1934; Anderson, 2000).

Historically, groundwater elevations in the Salinas area were higher than today. Anderson (2000) noted that prior to heavy extraction, groundwater could be found as shallow as 1.5 feet below the surface in the Blanco-Castroville areas. In the Castroville area, 60 farms were using purely artesian springs as their source of water. Figure 2.2 shows groundwater elevations in the area in 1901. The water elevation was within 10 feet or less of the surface in the lowland areas between Salinas and Castroville and in many areas as low as 3 feet or less.

The local Mediterranean climate with warm, dry summers, mild wet winters, long growing season and organic-rich alluvial soils throughout the area create ideal conditions for growing a wide variety of vegetables in the northern Salinas Valley. In addition, the coastal areas along the Old Salinas River Channel provide a unique microclimate for growing crops that rely on cooler conditions (i.e. brussel sprouts and artichokes).

Between 1920 and 1950 agriculture in the Salinas Valley experienced its most significant change. After World War I, reduced sugar prices due to increases in global production and the lack of reliable water sources reduced the production of sugar beets (Allen, 1934). However, sugar beet production did experience a brief increase during World War II due to an import shortage from the Hawaiian and Philippine Islands (Breschini et al., 2000). Beginning in the early 1920's, Claus Spreckels, of the Spreckels Sugar Company and the single largest landowner in the valley at the time, began selling parcels of land

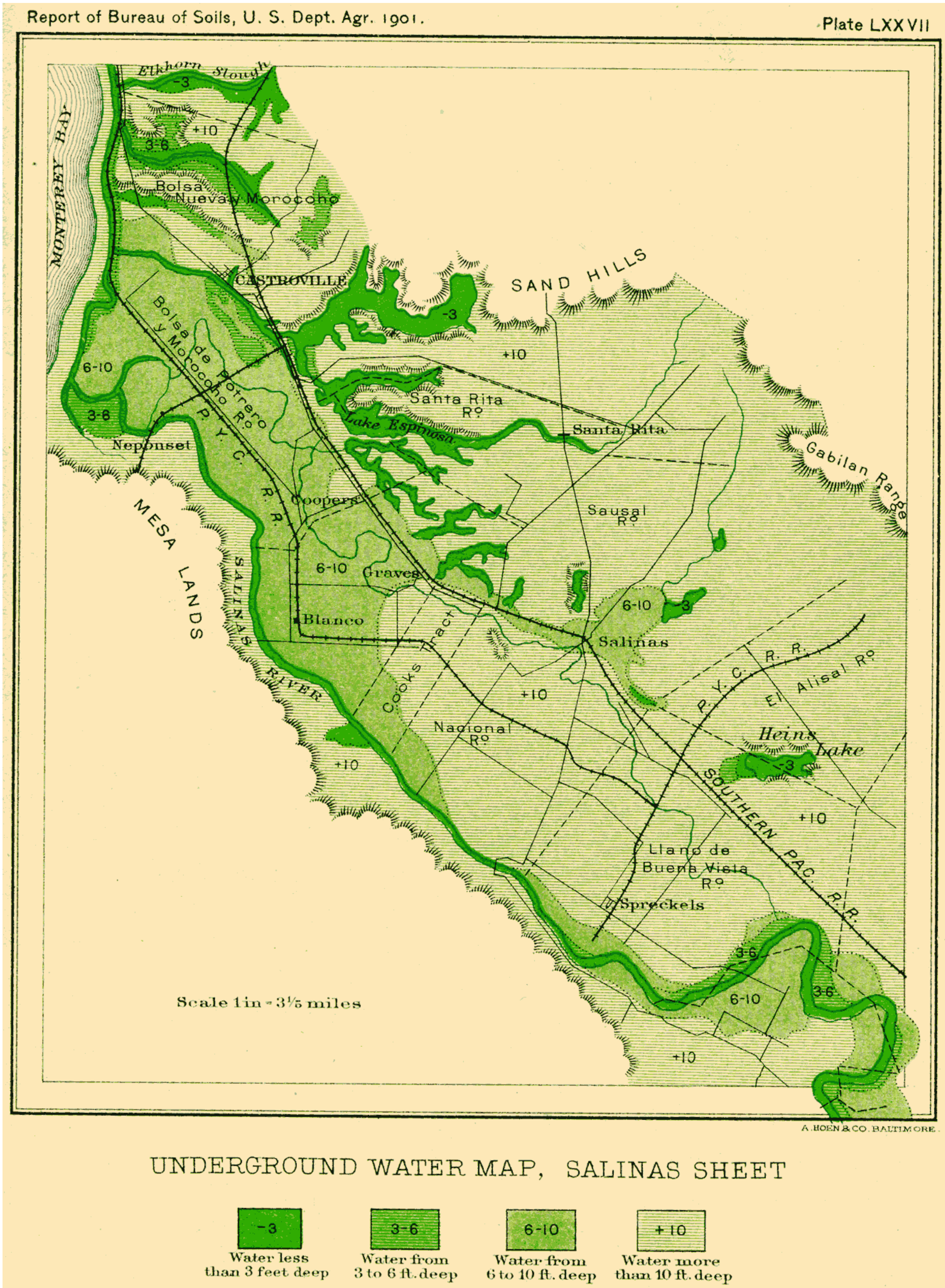


Figure 2.2 Groundwater elevations in the lower Salinas Valley (1901).

that were formerly used to grow sugar beets. At the same time, new crops such as lettuce, broccoli and artichokes were being introduced to the valley (Allen, 1934).

Figure 2.3 illustrates the abrupt shift from grains as the former dominant agricultural products of the valley to lettuce as the new dominant crop.
In 1923, refrigerated (ice-bunkered) rail cars were first introduced, which allowed lettuce and other vegetables to be exported as far away as the eastern United States (Verardo and Verardo, 1989; Breschini et al., 2000). Shortly after, strawberries and broccoli also expanded throughout the Salinas area.

Andrew Molera owned the Moro Cojo Ranch between Castroville and Moss Landing (Breschini et al., 2000). When the Spreckels Sugar Company stopped farming beets on

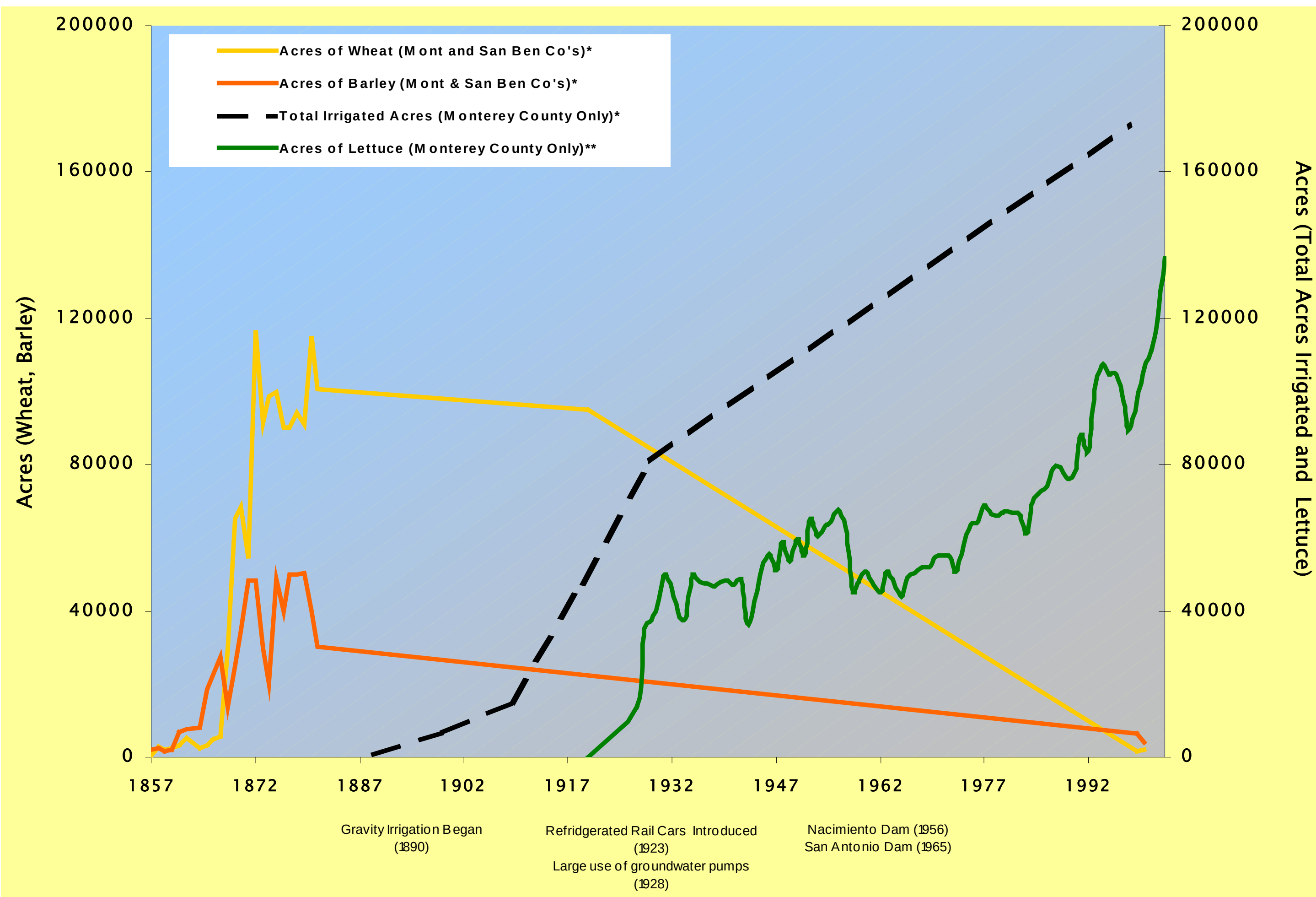


Figure 2.3 Summary of irrigated acreage and crops in Monterey and San Benito County. Graph originally published in Newman et al., 2003, updated August 2004. Original data source: * Breschini et al., 2000, ** Monterey County Agricultural Commission Crop Reports and (1920- 1929 data) Verardo and Verardo (1989).

the ranch, Molera needed a new crop, he acquired some artichoke stocks from a friend in Half Moon Bay, California (Anderson, 2000). Artichoke farming along the coastal areas was a success and by 1929, artichokes were the third largest cash crop in the Salinas Valley.

In 1921, the Oak Grove Berry Farm, near the Sheriff's Posse Grounds in Natividad, was the first significant acreage of strawberries in the Salinas Valley (Anderson, 2000). Unlike artichokes, strawberries took some time to become a dominant crop in the Salinas Valley. In 1998, strawberries were the fourth largest cash crop in the Monterey County (Monterey County Agricultural Commission, Crop Report, 1998).

The City of Salinas benefited from these agricultural advances. The agriculture boom of the 1920's and 30's created numerous jobs, especially for those in the Salinas and Castroville areas. Packing sheds and ice production facilities became common in the cities of Salinas and Castroville.

During the Great Depression of the 1930's, several public works projects were designed and implemented within the watershed. In the City of Salinas, a sewer system, storm drains, parks, and a public golf course were all constructed at this time.

1950-2000

By 1950, the population of Salinas had reached 13,900 and by the end of 20th Century there were 151,060 people living in the city (Fig. 2.1). Urban development has essentially spread out in all directions from the original "Old Town" Salinas, especially in the north and eastern portions- See Figure 2.4. In 1963, the City of Salinas increased its area by one-fourth with annex of lands in the Alisal area to the east (Verardo and Verardo, 1989).

By this time, agriculture had clearly established itself as the dominant economic force in the area. As the 1940's came to an end, there were over 12,000 people employed by the agriculture industry alone (Verardo and Verardo, 1989). Several new changes and benefits to the agriculture business were made during this time. In 1947, Bruce Church was the first to use a sprinkler irrigation system for lettuce seed germination and by 1950 was widely used in the Salinas Valley (Anderson, 2000).

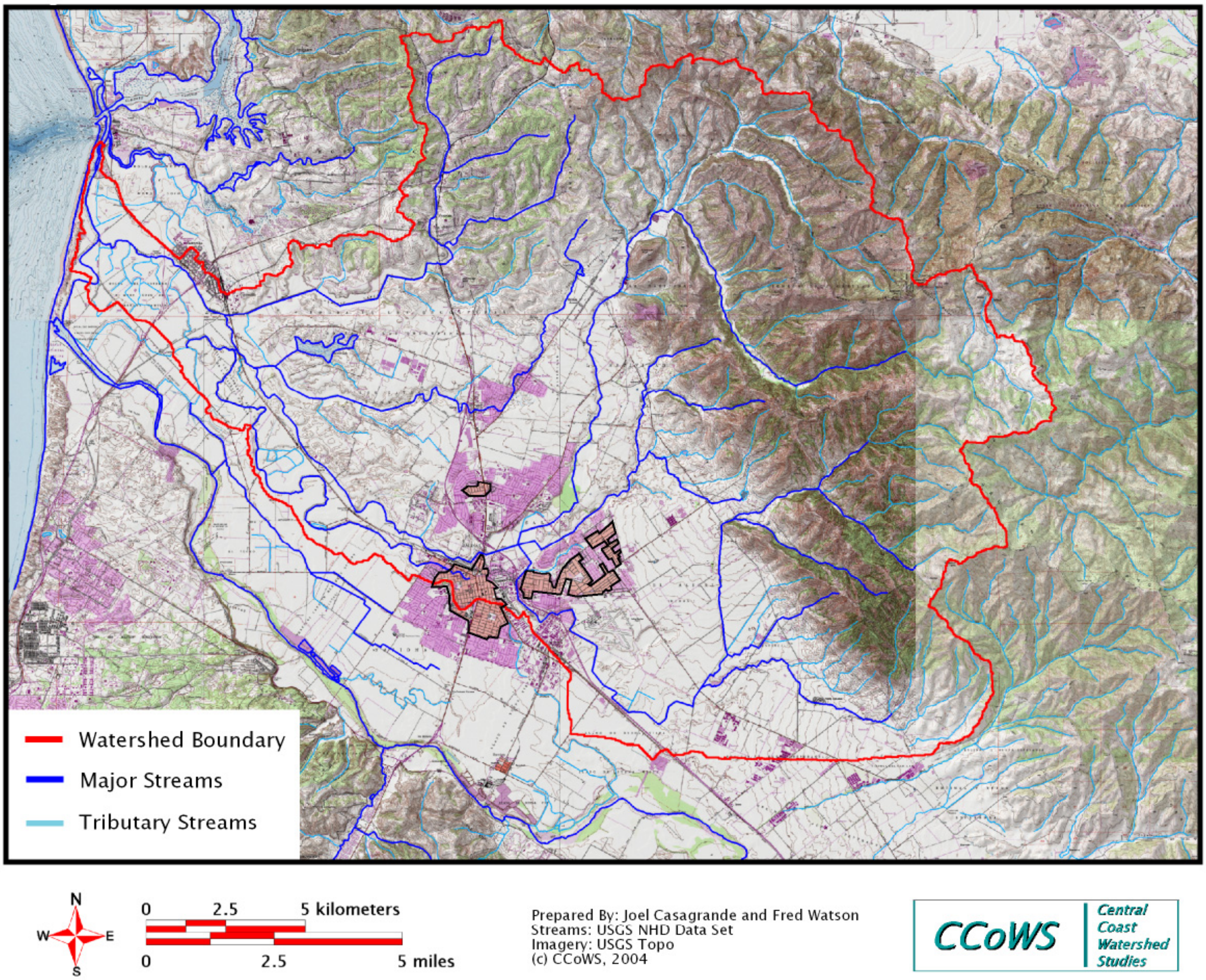


Figure 2.4 Urban growth in the Reclamation Ditch Watershed as of 1947 (orange with black outline) and 1984 (pink).

The use of sprinklers was a much more efficient and water conserving method of irrigation. However, as early as the 1930's, groundwater levels had already begun to show signs of overdraft (Anderson, 2000), with groundwater levels down 100 feet in some areas. Figure 2.5 illustrates the reduction in groundwater levels of the northern Salinas Valley between 1901 (mapped elevation below ground surface) and USGS data between 1970 and 1980 overlaid.

The overdraft of the Salinas Valley aquifer had both economic and environmental consequences. As the water elevations declined, landowners had to pay for deeper wells to be installed. A greater consequence of groundwater overdraft, especially along the coastal areas, was seawater intrusion. With groundwater levels continuing to decline, advancing seawater intrusion was impacting the use of groundwater for agriculture use of shallow wells.

To reduce the intruding seawater, two large reservoirs were constructed in the upper Salinas Valley, Nacimiento Dam and San Antonio Dam. The dams were to function as freshwater storage areas during winter and, in the summer months, the stored water would be released down the Salinas River for groundwater recharge (MCWRA & USACE, 2001; Watson et al., 2003). The construction of Nacimiento Dam, on the Nacimiento River was completed in 1956 and San Antonio Dam, on the San Antonio River, was completed in 1965 (MCWRA & USACE, 2001). In 1997, two related projects called the Monterey County Recycling Projects were completed to reduce the advance of seawater intrusion into the coastal Salinas Valley. The first was a tertiary treatment plant constructed by Monterey Regional Water Pollution Control Agency (MRWPCA). The second project, the Castroville Seawater Intrusion Project (CSIP) built by MCWRA, included a pressurized pipeline distribution system capable of delivering 19,500 acre-feet of irrigation water to the Castroville area (WQOC, 1998). However, seawater intrusion continues to cause concern in the lower Salinas Valley. This is evident in Figures 2.6 & 2.7, which shows increased advances in seawater intrusion in 2003 for both the Pressure 180-Foot and 400-Foot Aquifers. To further assist the CSIP and ensure an adequate supply of water to meet current and future needs, voters of Monterey County in 2002 approved the Salinas Valley Water Project (SVWP), which would include the modification of the Nacimiento Dam spillway, re-operation of both reservoirs, creation of a seasonal inflatable dam on the Salinas River and the installation of a diversion station for irrigation purposes (MCWRA & USACE, 2001).

Agricultural production continued to flourish into the end of the 20th Century. By the mid-1980's, the Salinas Valley had produced a $1 billion annual agriculture industry (Breschini et al., 2000). In 2002, the valley's crop production was at $2.81 billion along with $31.7 million in the livestock, dairy and poultry industries. In 2003, agricultural production continued to climb yielding $3.29 billion along with $34.9 million in the livestock, dairy, and poultry industries (Monterey County, 2003). The social and economic benefits of the watershed's agricultural production are discussed in greater detail in Chapter 3.

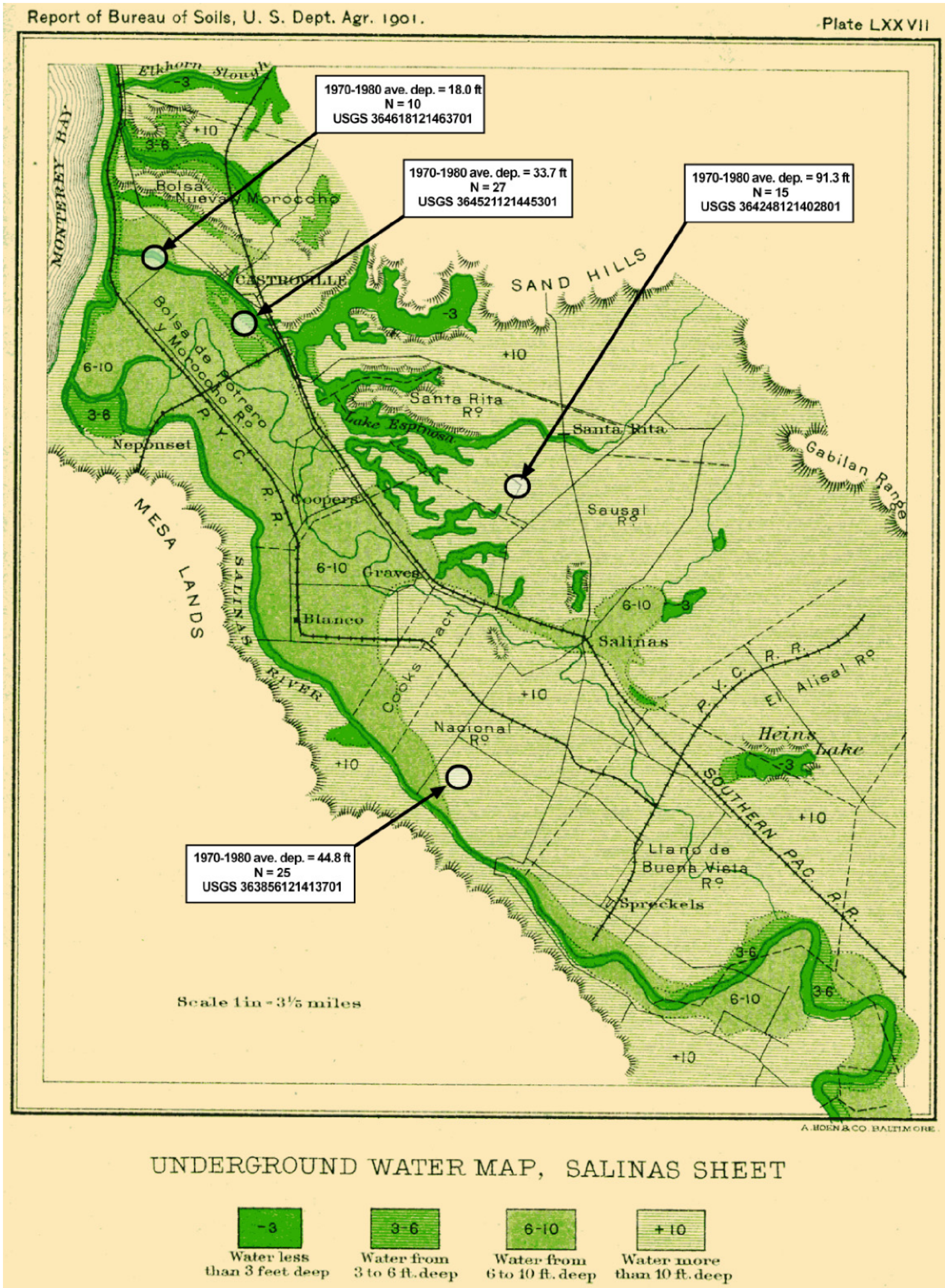


Figure 2.5 Groundwater elevation in the northern Salinas Valley based on USGS groundwater well data (1970-1980) with wells containing at least 10 or more measurements (=N) during that time. Data: USGS online data. Figure reproduced from Watson et al., (2003).

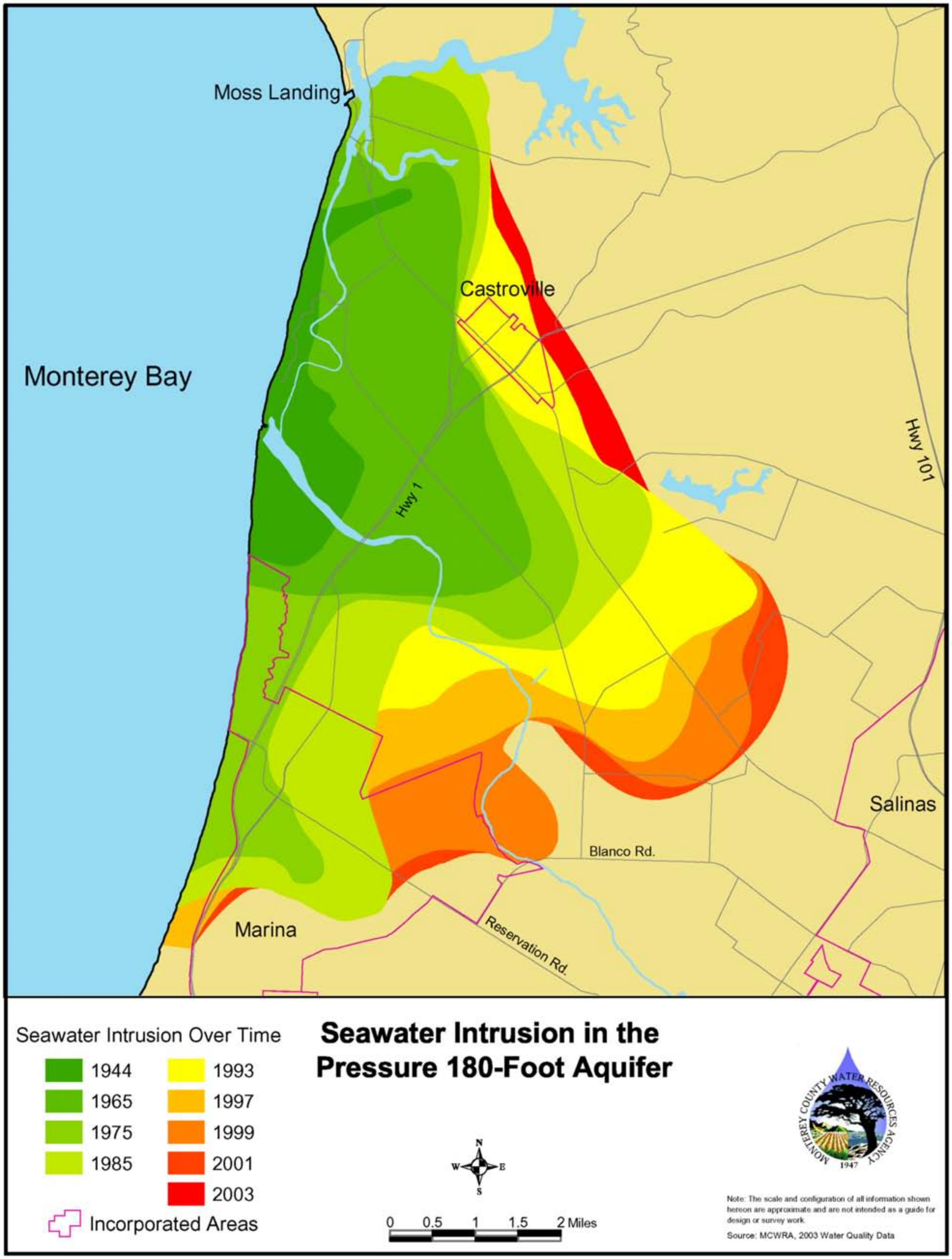


Figure 2.6 Changes in seawater intrusion in the Pressure 180-Foot Aquifer. Source: MCWRA

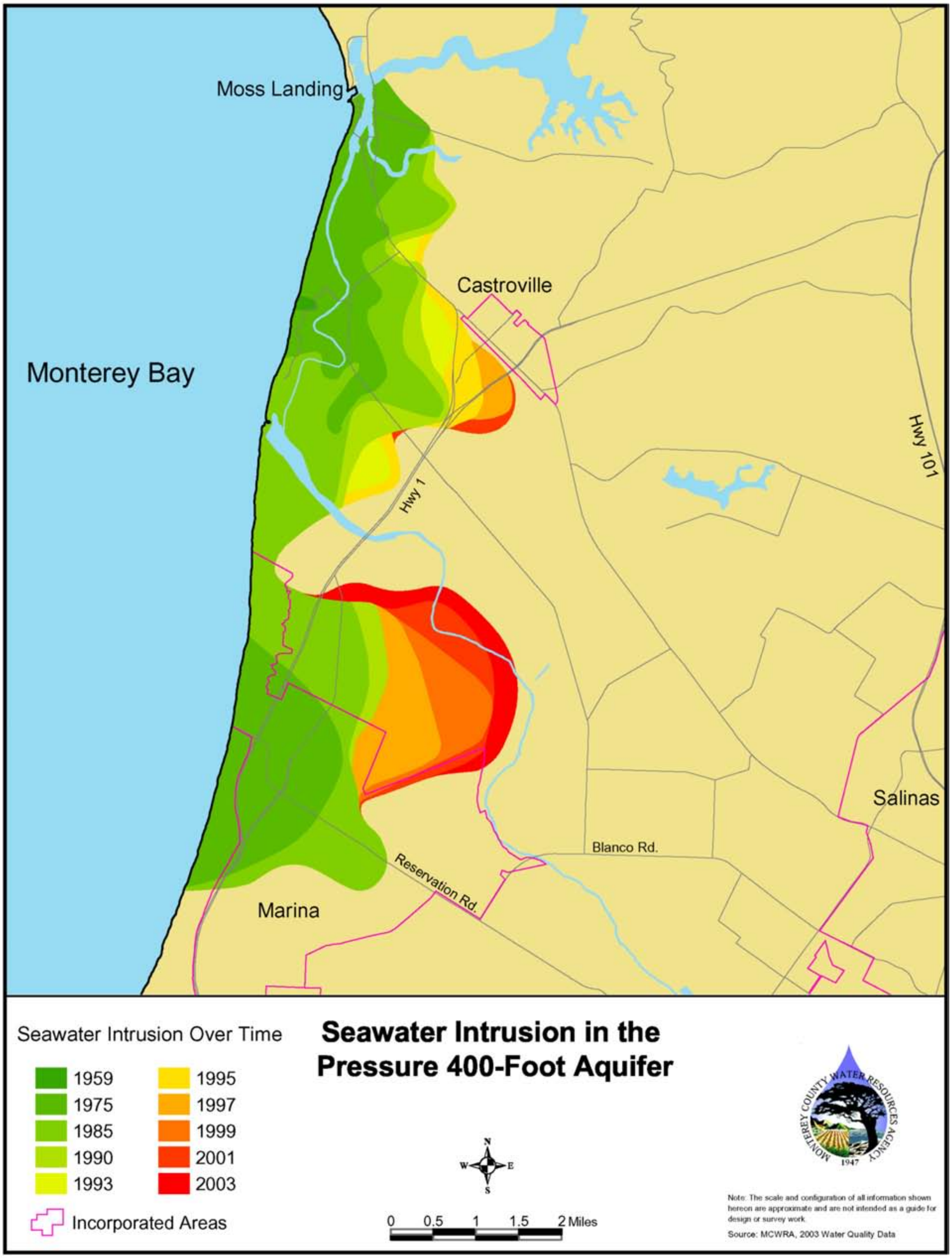


Figure 2.7 Changes in seawater intrusion in the Pressure 400-Foot Aquifer. Source: MCWRA.

Hydrology

Pre-1900

The original hydrology of the Watershed was somewhat different than what it is today. Gabilan Creek and Natividad Creek flowed into Carr Lake, a natural basin near the center of Salinas. To the south, the Alisal Watershed drained into Smith Lake. Between Smith Lake and the southern border of Salinas were two other small lakes, Heinz and Mud Lakes. These basins received local runoff and presumably overflow from Smith Lake during heavy storms.

The chain of lakes continued to the Northwest, between Salinas and Castroville. These lands were characterized by rolling, grass covered hills, each forming small individual drainages (Cozzens, 1944). At the end of each of these small drainages were natural depressions that formed small lakes, or ponds, during winter (Bechtel Corp., 1959). They included, Merritt Lake, Espinosa Lake, Santa Rita Slough, Vierra Lake, Fontes Lake, Boronda Lake, Markley Swamp, and Mill Lake (Figs 2.9 & 2.10). The lakes naturally had poor drainage and were only connected during periods of high runoff. The whole system ultimately drained into Tembladero Slough and into Moss Landing Lagoon (now Moss Landing Harbor) (Cozzens, 1944; Bechtel Corp., 1959).

Ygnacio Villegas, an inhabitant of the mid-nineteenth century (cited by Shumate, 1983) details how a herd of elk were killed by hunters who had chased the animals into the "*treacherous ground called the Tembladeras, located between Castroville and Salinas, and drove the elk into the bog with such speed that the animals could not select their footing, with the result that they killed a hundred or more when they sank into the mire*." During high tide, salt water rose up into some of the more downstream channels and ponds. In summer after the water levels receded, the banks of these ponds were lined with rings of salt, thus leading to the naming of "El Salina", or later known as Salinas (Breschini et al., 2000).

Starting as early as the mid-19th Century, attempts were made to drain portions of the swamps, for use as productive farmlands. Much of the initial work was conducted by Chinese laborers. In the winter of 1890, Carr Lake filled and flooded its adjacent lands, and eventually spilled into the City of Salinas. As a result, Jesse D. Carr modified, or increased, the slow natural drainage of the lake and in doing so, reclaimed approximately 1,475 acres of the lake bottom (Anderson, 2000; Breschini et al., 2000). Eventually, this led to the draining of all the major lakes and much of the adjacent swamplands between Salinas and Castroville. From then on, protecting the newly created valuable farmlands from the natural flooding would become a constant battle.

Figure 2.8 shows that Tembladero Slough remained in its original course (at least much of the lower portions). The Salinas River probably flowed more along the Old Salinas River Channel than it does today although undoubtedly, the high flows went straight to the ocean as they do today.

1900–1950

At the turn of the century, maps of the watershed indicate that much of the original marshlands still remained in their original form (Figs 2.9 & 2.13). Flooding was still a constant concern for those farming in the lowlands, especially near the Blanco area and for much of the city of Salinas (Cozzens, 1944).

The peat swamps and lake bottoms were constantly flooded each winter due to their natural slow drainage to the sea (Cozzens, 1944). As early as 1906, local officials began designing a system that would improve the drainage of the land, while at the same time create more farmland for property owners along the drainage. Starting in 1917, construction began on the large reclamation project. The project area extended from a few kilometers southeast of Salinas (Thompson Lateral near Smith Lake), downstream to Moss Landing Harbor. This area became known as the Reclamation District No. 1665 (Figs 2.9 & 2.10).

By 1920, the original drainage of land was converted into a more efficient drainage system containing one major ditch fed by several small tributary ditches, also known as "laterals". The main canal is currently known as the Salinas Reclamation Canal or the Reclamation Ditch. The Reclamation Ditch follows the original course of the much shallower channel that connected the series of historic lakes and swamps. Hare (1906) titled the original drainage route as Gabilan Creek. The channel was both widened and deepened for better drainage. The side laterals were used to drain the lakes, part of the

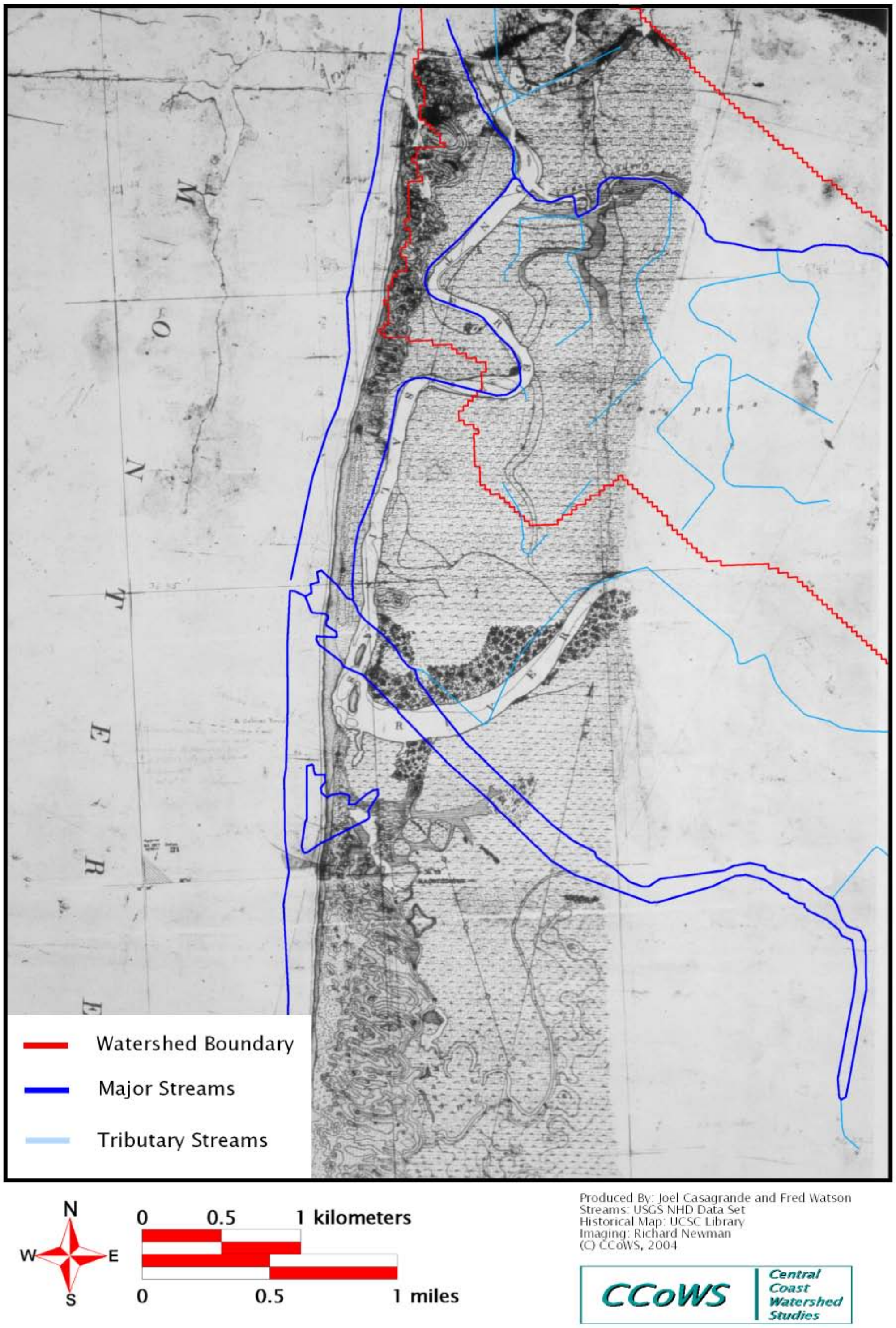


Figure 2.8 The Salinas River as well as the western extent of the Tembladero Slough system in 1854. Current USGS stream paths are overlaid for comparison. Note that the path of the original Salinas River is similar to that of the current Old Salinas River Channel. The discrepancy between the shoreline (blue line) and the shoreline on the original map is likely due to the inaccuracy of the original 1854 map. In reality, the shoreline along the central coast has retreated and not advanced as this map shows. Coordinates used to georeference the original image were taken from the Lat/Long crosses originally drawn on map (left side of image).

Figure 2.9 The original drainage (circa 1906) of the Lower Reclamation Ditch Watershed including the locations of the natural lakes. The straightened black lines represent the early design of the Reclamation Canal; as depicted by Lou Hare, Civil Engineer. Figure reproduced from RDIPAC, 2002.

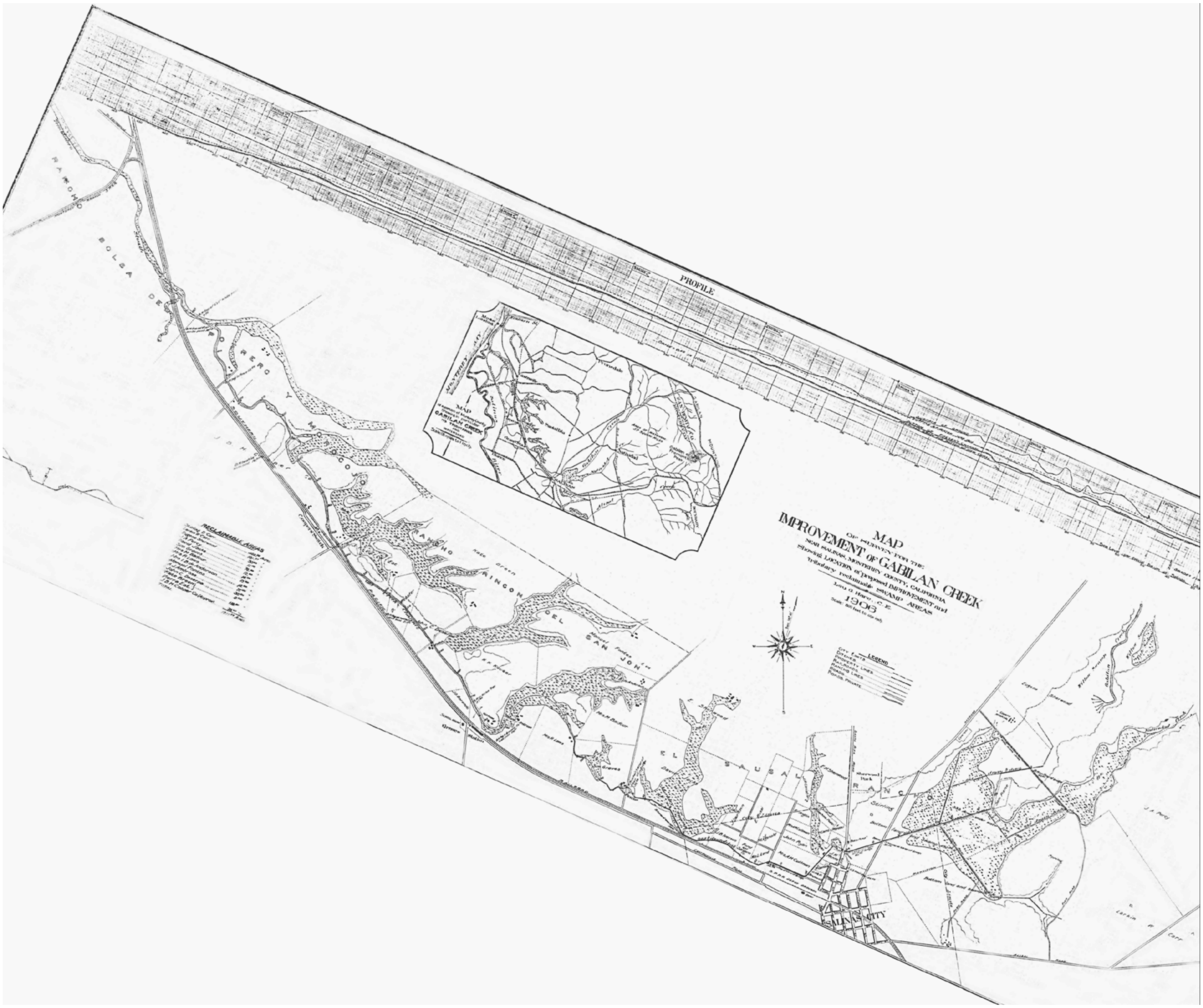


Figure 2.10 A map of the proposed improvement of (Lower) Reclamation Ditch Watershed (1906) by Lou Hare, Civil Engineer. This map better illustrates the size and distribution of the original swamplands (lakes) in and around the City of Salinas. Gabilan and Natividad Creeks are shown entering into Carr Lake on the far right.

growing urban lands into the Reclamation Ditch by either gravity or by large pumps (CDPHBSE, 1952; Bechtel Corp, 1959). The new system allowed water to drain from the lakes or swampland to the Bay more easily. In addition, it provided a substantial amount of new and fertile farmland.

As both urban and agricultural development increased in the watershed so did the runoff. In 1944, H.F. Cozzens, County Surveyor, investigated the feasibility of enlarging the drainage capacity of the Reclamation Ditch – 24 years after its completion. In his report he estimated the total annual runoff from each of the sub-watersheds that contributed to the Reclamation Ditch under 1918 conditions (just prior to the competition of the Reclamation Ditch) – See Figure 2.11. At the time, Cozzens estimated that the total runoff for the entire system during a year in which 14 inches of rain fell was 35,000 acre-feet and at 20 inches of rain, 85,000 acre-feet. In order to effectively carry this expected runoff, Cozzens recommended that the depth of the main ditch would have to be increased from 4 to 8 feet and that the channel bottom width would need to increase from 40 feet to 100 feet, depending on the location and gradient and a wider mouth exiting Carr Lake. Further, Cozzens (1944, p. 7) noted that the additional agricultural development to the north and east of the main ditch was having a significant affect on the hydrology of the system, by stating the following:

> *"…since the construction of the system, there has been a large acreage of upland leveled (land north and east of Carr Lake) and brought under irrigation so that numerous ponds have been drained or eliminated, land furrowed so that water will run off as soon as the ground is saturated, and the land is often irrigated late in the growing season just before a rain, causing a large percentage of the rainfall to run off."*

The original lakes and additional wetland areas east and south of Salinas helped to temporarily detain a substantial amount of the surface runoff from the streams.

Another effect that later arose from improving the drainage of the lakes was the eventual subsidence of the peat lands. The impounded water and natural layer of peat that lined the natural lakes kept groundwater levels saturated throughout most of the year. By draining the lakes and tilling over the rich peat soil, the earth eventually subsided, up to several feet in some areas (Bechtel Corp, 1959). This has since added to the difficulty of efficiently draining these lands during winter runoff.

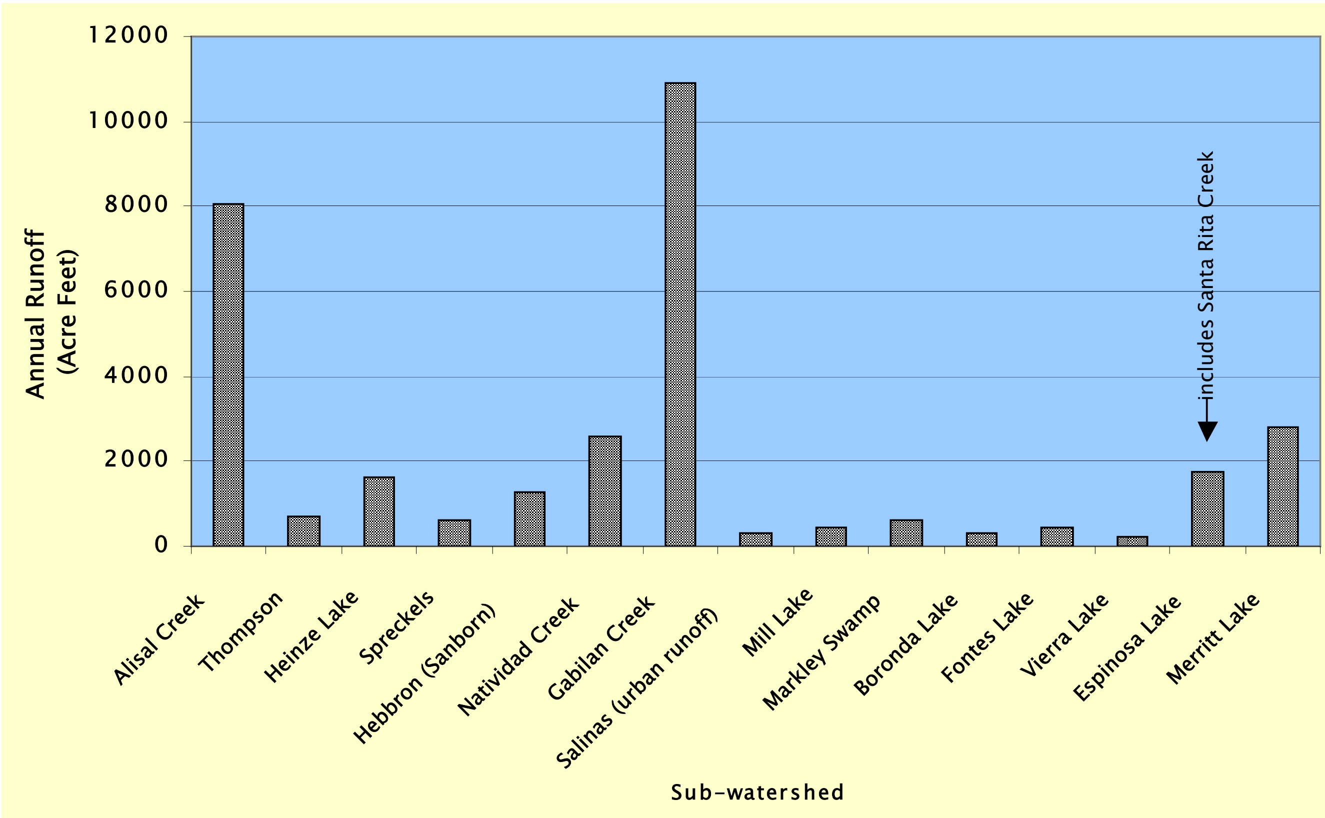


Figure 2.11 Estimated annual runoff (acre feet) in 1918 for each of the sub-watershed units of the Reclamation Ditch Watershed. Data re-produced, originally presented in Cozzens, 1944. The sub watersheds are listed in order starting with the furthest east (Alisal Creek).

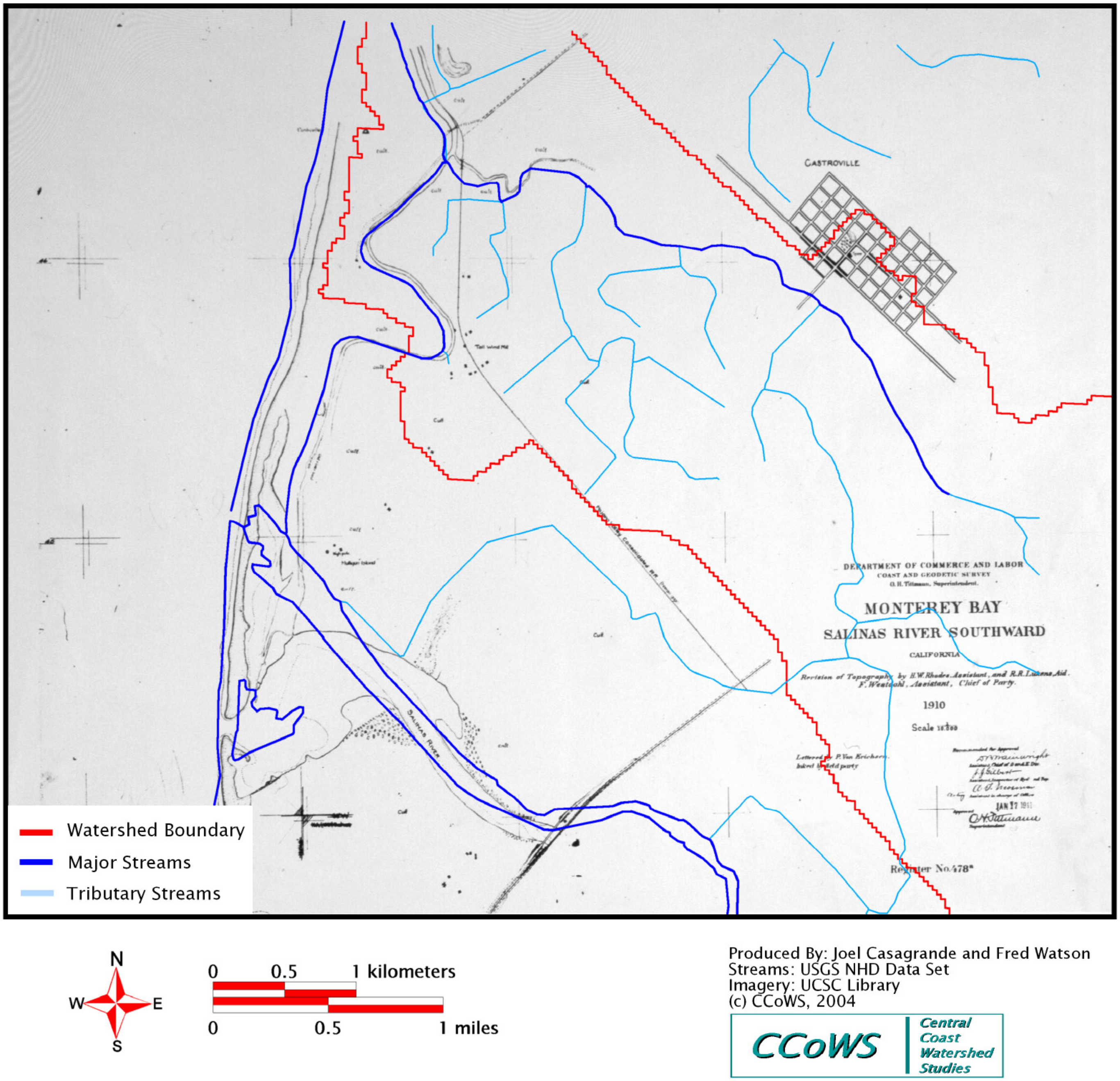


Figure 2.12 The Salinas River Lagoon in 1910. The stream layers are current USGS stream paths overlaid for comparison. Errors in stream path comparison are most likely attributed to the detail of the original mapping and consequent geo-referencing, or spatial correction, done to match with current layers. Coordinates used to georeference the original image were taken from the Lat/Long crosses originally drawn on map (left side of image).

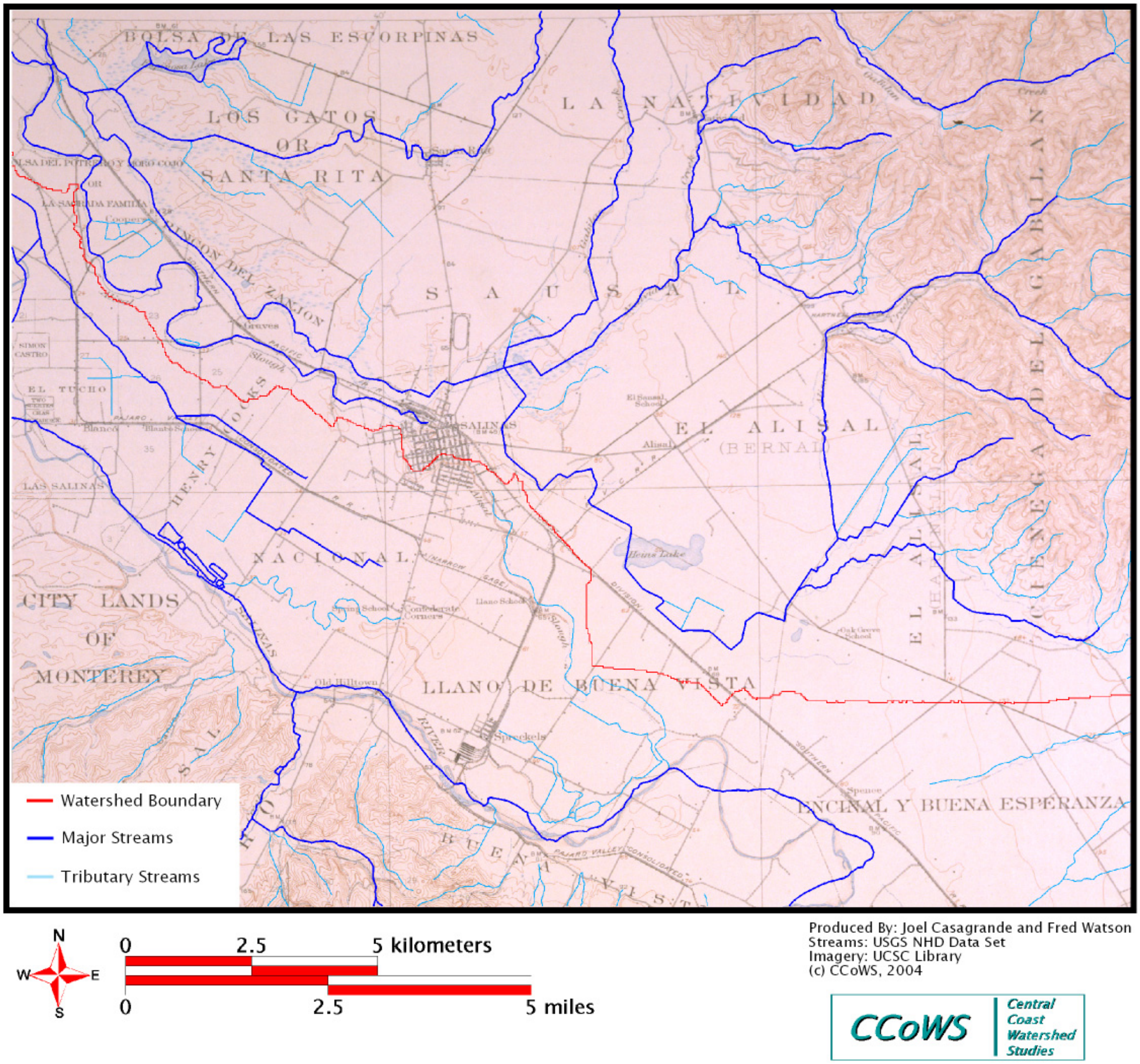


Figure 2.13 The Reclamation Ditch Watershed in 1912. The underlying map is a USGS Topographic Quad of the Salinas area from 1912. The chain of lakes was still present on the map at the time. Current USGS stream paths are overlaid for comparison.

Historically, the Salinas River (now the Old Salinas River Channel) joined with Elkhorn Slough behind a seasonal sandbar. The water was primarily fresh, since Gordon (1996) states that at the turn of the Twentieth Century, the vegetation growing along the east bank of the Salinas River Channel near Moss Landing Harbor comprised relatively of salt-intolerant plants such as tules and cottonwoods. Brackish conditions most likely occurred during and after seasonal sandbar breaches. As of 1944, the terminus of the whole drainage system was still referred to as “Moss Landing Lagoon”, as opposed to Moss Landing Harbor (Cozzens, 1944).

In 1947, the sandbar near the seasonal mouth to Moss Landing Lagoon (Fig. 4.20) was permanently opened to the sea. The mouth was created further south from its original position and in line with the main channel of Elkhorn Slough. This has resulted in significant changes in the function of the original ecosystems of the Old Salinas River, Elkhorn and Moro Cojo Sloughs (Gordon, 1996; Wasson et al., 2001).

1950-2000

Roads, buildings, shopping centers, and their parking lots all have contributed to the growth of impervious surfaces within the watershed. The rapid increase in impervious surfaces leads to an increase in the rate and amount of runoff from storms (Riley, 1998).

By the end of the 1950’s, it was prevalent that the Reclamation Ditch system was not able to completely protect lands from flooding during storms, which was not its original intent. By 1950, the urban and agricultural development had expanded enough to create runoff conditions that were unmanageable by the system during large storm events (Bechtel Corp., 1959; USDA, 1968).

In 1959, the Bechtel Corporation conducted a study investigating a variety of flood control strategies for improving the Reclamation Ditch’s efficiency. Included in this study was the design of a dam and a 4,500-acre foot reservoir on Gabilan Creek near Sugarloaf Peak (approximately 0.5 miles upstream of Crazy Horse Road). The dam would have stored winter runoff to be released during the summer for groundwater recharge in the northern portion of the Salinas Valley.

A majority of the summer flows in the Reclamation Ditch were the result of agricultural and industrial runoff; summer return flows were estimated in 1952 as approximately 4.7 million gallons per day (MGD) by the California Department of Public Health’s Bureau of Sanitary Engineering (CDPHBSE, 1952). In the 1950’s, these discharges were affecting the water quality in the Reclamation Ditch. A 1952 study by the CDPHBSE investigated 16 major industrial discharges into the ditch between July and September of 1952. Food dehydration plants discharged their wastes from dehydrating agricultural products such as lettuce and celery. Results of this study showed that the discharges had significant affects on oxygen depletion and sulfide production as far downstream as Castroville (CDPHBSE, 1952). In addition to poor water quality, strong, foul odors were noticeable during periods of high discharge, especially for those living immediately adjacent to the ditch.

In 1967, The Monterey County Flood Control and Water Conservation District took over all maintenance and assets within and along the Reclamation Ditch, including dredging, cleaning and channel maintenance (RDIPAC, 2002), as mentioned in Chapter 1. Prior to this, the Northern Salinas Valley Mosquito Abatement District conducted all major dredging and cleaning operations (i.e. removal of debris and all riparian vegetation/weeds) in the system.

Between 1960 and the 1990's there were other notable changes to the streams in the watershed. In the 1990's a stretch of the Gabilan Creek channel in the east Laurel neighborhood was realigned for the construction of a housing development (M. Thomas & Co., 1988) (Fig. 2.14). The new course currently supports a vigorous riparian corridor, but lacks a low-flow channel, and experiences significant sediment deposition (Fig. 2.15).

In 1994, Return of the Natives (RON), a non-profit environmental education program of the Watershed Institute, along with the City of Salinas began work on a large riparian corridor restoration project in Natividad Creek, in what is now Natividad Creek Park[4]. Their activities included incorporating hundreds of volunteer hours of both community members and local school children to re-vegetate the Natividad Creek Park with native species and help develop a meeting place for the community to enjoy.

More recently, in 2003/04 RON teamed with John Gilchrist and Associates and Fall Creek Engineering, a local environmental consulting firm, and the City of Salinas, to restore the Laurel Pond wetland area on the lower section of Natividad Creek – also known as simply Lower Natividad (Fig. 2.16). When Laurel Drive was built across the upstream edge of Carr Lake, a smaller upstream portion of Carr Lake became separated in the Natividad Creek arm. For this study this water body is referred to as Laurel Pond.

---

[4] A detailed photo comparison of the project's early progress is available at: http://watershed.csumb.edu/ron/ron_pdf/ncp_park.pdf

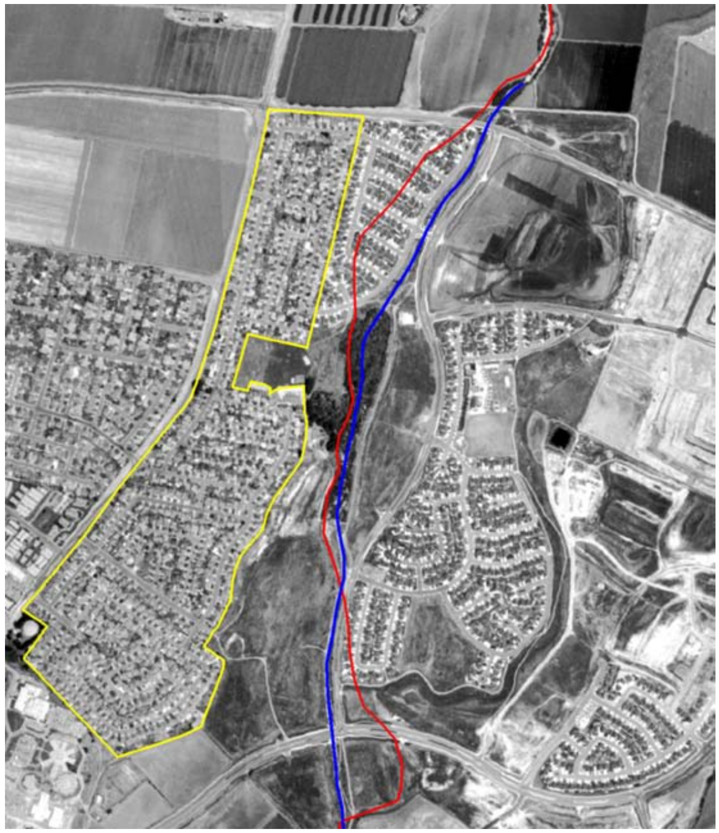


Figure 2.14 Gabilan Creek (between Boronda Rd. and Constitution Blvd.) realignment in the early 1990's. Pre-development stream path is shown in red and current post-development stream path is shown in blue. Urban development in the area as of 1984 is outlined in yellow. Note: Alvarez High School (upper right corner) was not yet built at this time.

During the 1990's two floods occurred in the Reclamation Ditch Watershed – March 1995, and February 1998. Substantial flooding of agricultural lands occurred west of Salinas. These floods are discussed in greater detail in Chapter 4.

Due to flood damage to lands along the Reclamation Ditch and Tembladero Slough in both 1995 and 1998, the Monterey County Water Resources Agency (MCWRA) contracted with Schaaf and Wheeler Consulting Civil Engineers (SWCCE) to evaluate the drainage operations of the Reclamation Ditch system and to provide detailed recommendations for its improvement (SWCCE, 1999; RDIPAC, 2002). In May of 1999, SWCCE completed the Zone 9 and Reclamation Ditch Drainage System Operations Study for MCWRA. A committee was first convened in September 1999 to assist MCWRA to plan for the improved drainage of the system: The Reclamation Ditch Improvement Plan Advisory Committee (RDIPAC).

Figure 2.15 A stretch of Gabilan Creek within the new alignment looking downstream from East Boronda Road. Note sediment deposition in channel. Photo: Joel Casagrande, August 2000.

Figure 2.16 A City of Salinas/Watershed Institute restoration project at Laurel Pond. Laurel Avenue is shown in the upper right corner. Photo: Joel Casagrande, 28 February 2004.

SWCCE (1999) developed several recommendations for improvements to the Zone 9 drainage system based on future growth for the watershed and 100-year flood protection. The recommendations were made for specific reaches listed into twelve different areas of the drainage ditch system from the Tide Gates upstream to Smith Lake in the southern boundary of the Watershed. Budget constraints limited the analysis of additional engineering alternatives.

Recommendations included replacing or modifying the Potrero Tide Gates (SWCCE, 2000), increasing channel capacities in several locations, creating a gravity bypass around the Santa Rita Pump Station, increase the size of the outlet pipe from Markley Swamp to the Reclamation Ditch, and developing elevation capacity curves for Carr, Heinz, and Smith Lakes.

RDIPAC (2002) concluded that many of their recommendations were consistent with those of SWCCE (1999) and added further recommendations including the following:

- Improve Potrero Road Tide Gates
- Conduct a Request For Proposals (RFP) for a watershed management study
- Conduct a joint-planning study of Carr Lake with the City of Salinas
- Enforce existing grading and erosion protection ordinances
- Improve communication and cooperation between regulatory agencies and farmers
- Establish and adopt detention criteria for future developments
- Require new developments to pay impact fees for future storm drain improvements, and
- Expand the Zone 9 boundary to include the entire Reclamation Ditch watershed boundary.

The modern Reclamation Ditch essentially attempts to fulfill a community expectation that it is a flood control system. This expectation exceeds the original intention of the system as a means of reclaiming land for additional uses.

Historical Wildlife

A number of mammal, bird, and fish species were found in the Salinas area prior to the 20th Century that are no longer present today (Extinct and extirpated species, both locally and statewide, Table 2.1). Large mammals such as the grizzly bear, gray wolf, tule elk, and the pronghorn antelope once ranged throughout Salinas Plain (Shumate, 1983; Gordon, 1996; Anderson, 2000). The California condor, clapper rail, and the California least tern were common bird species in the northern Salinas Valley (Roberson and Tenney, 1993; Gordon, 1996). Freshwater fishes that were possibly inhabitants of the fresh, warm water habitats included the thicktailed chub, Sacramento perch, and the tule perch (Snyder, 1913; Moyle, 2002).

The grizzly bear, *Ursus arctos*, was common along the Monterey Bay coast as late as the mid-1800's (Shumate, 1983; Gordon, 1996; Anderson, 2000). In fact, it has been noted that their populations actually expanded significantly in the early to mid-1800's, due to the abundance of easy food provided by early settlers (Allen, 1934; Breschini et al., 2000). It was about this time that the Spanish had begun raising cattle in significant numbers in the Salinas Valley. The cattle industry initially allowed the bear populations in the Salinas Valley to flourish. Breschini et al., (2000, p. 17) stated:

> *"The vast grasslands of the Salinas Plain supported large numbers of cattle, and when the occasional foreign ship came from Peru or San Blas the ranchers would round up their animals and kill them on the spot. They would cut open their bellies and take the fat, leaving everything else behind as food for the bears. Not surprisingly, the bears flourished."*

Also, occasional whales and by-products of whaling fleets washed ashore along Monterey Bay and quickly became common gathering areas for foraging grizzly bears (Gordon, 1996). It is thought that grizzly bears were extirpated from Monterey County just prior to the turn of the 20th Century (Gordon, 1996; Anderson, 2000). Pierce (1992) points out that a large fallen oak tree with the words "*Bear Killed 1900*" still exists on the Reeves Ranch near Fremont Peak, suggesting that the bears might have existed within Monterey County into the 20th Century. Black bears, *Ursus americanus*, are more adapted to forested habitats and were not native to the coast south of San Francisco prior to the 20th Century (Gordon, 1996). This suggests that the bear killed near Fremont Peak in 1900 was a grizzly bear and not a black bear.

The gray wolf, *Canis lupus*, also ranged throughout California. Wolves were extirpated from California around the end of the 19th Century (Gordon, 1996). In Monterey County, wolves were still present in 1849 (Shumate, 1983) but as Gordon noted, they were soon gone from the Monterey County. Their disappearance was likely linked to the loss of prey species – the native herding ungulates (tule elk and pronghorn antelope) of the plains and surrounding hills.

California tule elk, *Cervus elaphus nannodes*, were also common along the coastal lowlands and foothills surrounding Monterey Bay (Shumate, 1983; Gordon, 1996; Anderson, 2000). The elk, which migrated in and out of the Gabilan and Santa Lucia Ranges, frequented the swampy areas where they fed on the abundant aquatic

Table 2.1 Extinct and extirpated species (both locally and statewide), which were previously documented in the northern Salinas Valley.

	Extinct	Extirpated (California)	Extirpated (Reclamation Ditch Watershed)	Rare / Migration Only	Source	Some causes of extinction/extirpation
Mammals						
grizzly bear		X	X		Shumate; Gordon	Hunting, habitat reduction
gray wolf		X	X		Shumate; Gordon	Hunting, habitat reduction
*tule elk**			X		Shumate; Gordon	Habitat reduction, hunting, introduced cattle
pronghorn antelope			X		Shumate; Gordon	Habitat reduction, introduced cattle, hunting
Birds						
clapper rail			X		Gordon, Roberson	Habitat loss, introduced red fox
*California condor***			X		Gordon	Hunting, use of poison control, collecting, power lines
California least tern				X	Gordon, Roberson	Habitat loss, introduced red fox
Fish						
thicktail chub	X	X	X		Moyle, Gobalet	Habitat loss, introduced species
Sacramento perch			X		Moyle, Gobalet	Habitat modification, introduced species
tule perch			X		Moyle, Gobalet	Habitat modification, introduced species

* Present, re-introduced, but only as managed herds.

** Re-introduced into Pfeiffer Big Sur State Park in 1990's. They are soon to be re-introduced into the Pinnacles National Monument December 20th, 2003.

vegetation. Elk were hunted intensely by the early settlers for both food and to eliminate grazing competition for the increasing number of cattle. Anderson (2000) noted that as of 1852, tule elk were still numerous in the Castroville Hills.

These original elk were last seen in San Benito County in 1864 and were gone from the Monterey Bay area in the late 1860's (Gordon, 1996). Currently, herds of tule elk are managed by the California Department of Fish & Game (CDFG) in the Gabilan Range near Fremont Peak, having been introduced from other existing populations in the state (Gabilan Ranch, online). These elk no longer exhibit their natural migration behavior in the watershed and are strictly managed as game.

Pronghorn antelope, *Antilocapra americana*, inhabited the drier grasslands and foothills of the Salinas Valley (Shumate, 1983). They are a fast-running, herding species requiring flat open county for escape from predators (Feldhamer, et al., 2003). There is no documented date for their disappearance from the Gabilan region, but as agriculture and cattle ranching took over in the Salinas Valley in the mid 1800's, they were most likely extirpated as a result of elimination of their habitat (Gordon, 1996; Anderson, 2000).

The clapper rail, *Rallus longirostirs*, and the California least tern, *Sterna albifrons*, were both inhabitants of the shore and tidal marsh habitats. The clapper rail is endemic to the densely vegetated marshlands and is a shy species by nature, seldom coming out into the open (Udvardy, 1977). Clapper rail populations presumably suffered when much of the their marshland habitat in the Tembladero Slough area was drained in the early 20th Century. A few nesting pairs of clapper rail still remained in the Elkhorn Slough system as late as the 1980's (Gordon, 1996). It is presumed that these final nesting pairs fell to predation by the introduced red fox (Roberson and Tenney, 1993; Gordon, 1996). Both the clapper rail and the California least tern are federally and state listed endangered species.

The California least tern's preferred habitat is undisturbed, open, sandy beaches along coasts and river lagoons (Udvardy, 1977) or on bars in estuaries (Roberson and Tenney, 1993). The least tern was common along the beaches near the Salinas River mouth and Elkhorn Slough, with nesting sites reported in Moro Cojo Slough in the 1930's (Carter et al., 1990 as cited in Roberson and Tenney, 1993). Increased use of local beaches by humans and their pets, beach dune development and especially predation by red foxes have eliminated the least tern as a common inhabitant of the Monterey Bay coast.

The last nesting pair of least terns seen in the Monterey Bay was near the Pajaro River mouth in the 1960's, at a site now occupied by ocean-front housing (Gordon, 1996). A least tern was sited along the beaches near the Salinas River Mouth State Beach in 1992 – probably a migrant heading north (Roberson, 1993).

The California condor, *Gymnogyps californianus*, was once a common inhabitant throughout the Salinas Valley and much of California (Udvardy, 1977; Gordon, 1996). They fed on carrion, primarily that of large ungulates, such as pronghorn antelope and elk, and the occasional whale that washed ashore. California condor populations began a rapid decline in the late 19th Century due to a variety of anthropogenic causes. Initially, they were shot or hunted and their large eggs were collected for exhibits and museums across the country. The reduction in condor populations escalated in the 20th Century due to habitat loss, lead poisoning, electrocution from power lines, and thin eggshells, commonly a result of pesticide use; most notably DDT (Roberson and Tenney, 1993; Gordon, 1996). Recent condor re-introductions have included a release at a site in Pinnacles National Monument, on the Gabilan Range to the south of the Reclamation Ditch Watershed (December 20th 2003).

The Salinas River Lagoon Management and Enhancement DRAFT Plan (JGA et al., 1997) reviewed historical records for fish species occurences in the Salinas River Lagoon, Old Salinas River and Tembladero Slough. Records in the Old Salinas River and Tembladero Slough from the 1980s include four native species (Sacramento blackfish, hitch, Sacramento sucker, and threespine stickleback) and two non-native species (goldfish, mosquitofish).

Three species of freshwater fish once likely to have inhabited the swamplands of the watershed are now extinct or extirpated from the northern Salinas Valley. They are the thicktail chub (*Gila crassicauda*), Sacramento perch, (*Archoplites interruptus*), and the tule perch, (*Hysterocarpus traski*). All three fish species were once part of a unique assemblage of fish that preferred warm, slow moving, freshwater ecosystems found at low elevations in the Great Central Valley, Pajaro, and Salinas Watersheds (Snyder, 1913; Hubbs, 1947; Gobalet, 1990; Moyle, 2002).

In general, the thicktail chub is extinct due to a variety of factors including substantial habitat loss, introduction of non-native fish, and water pollution. The Sacramento perch populations have suffered from a number of effects, primarily habitat loss, water pollution, egg and larval predation by introduced fish such as carp, and interspecific competition with invasive centrarchids (i.e. black crappie and bluegill) (Moyle, 2002). Tule perch were more susceptible to poor water quality and all of the factors previously mentioned (Moyle, 2002).

3. Socio-Economic Context

Artichokes one of the many commodities grown in the Reclamation Ditch Watershed. Photo: Fred Watson 30 Oct 2000.

Introduction

This watershed assessment, funded by the Federal EPA under the Clean Water Act, is primarily an environmentally focused endeavor, yet it must be viewed within a socio-economic context, which is centered on a large agricultural industry and within an urban setting. This chapter describes some aspects of these key socio-economic elements. It explains the importance of agriculture as recognized by the Regional Water Quality Control Board, the national dependence on the crops grown in the watershed, the dependence of the workforce on the agricultural industry, and on the City at the center of the watershed.

Regional Context

The need to view environmental objectives within a balanced socio-economic context is recognized by the primary agency responsible for water quality, the CCRWQCB, in Resolution R3-2004-0118 (CCRWQCB, 2004a). This resolution refers to the following text provided in the background section to the Revised Initial Study and Negative Declaration For Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands under the California Environmental Quality Act (CEQA) (CCRWQCB, 2004b). Quotation (emphasis added):

> ***Agriculture in the Central Coast Region***
>
> *Irrigated agriculture in the Central Coast Region comprises approximately 600,000 acres and more than 100 different crops. There are about 2500 agricultural operations in the region that would be enrolled under [the Conditional Waiver] program. Operations range in size from less than ten acres to more than 2000; however, approximately two-thirds of all operations are less than fifty acres. About one-third are less than ten acres. Fewer than 200 operations (less than 8%) exceed 2000 acres. Major crops include vegetable crops (such as lettuce, broccoli, cauliflower, celery, cabbage and spinach), fruits (such as strawberries and wine grapes), cut flowers, and potted plants. Other crops include mushrooms, artichokes, raspberries, asparagus, carrots, onions, snap peas, and many more.*
>
> *Agriculture is concentrated in several major drainages, including the* ***Salinas Valley*** *and upper Salinas watershed, the Pajaro Valley, the lower Santa Maria River, the Santa Ynez Valley and the Santa Barbara coastal area, as well as in numerous small drainages throughout the region.*
>
> *A number of factors make agriculture in the Central Coast region unique. In general, farming is on a smaller scale than in the Central or Imperial Valleys.* ***The Central Coast climate is unique in California and comprises a "niche" in the agricultural industry that distinguishes Central Coast farm products from other areas****. The majority of operations are less than 50 acres. There are no large irrigation districts since most operations use groundwater as their water source. Many properties have been held in families for generations and are leased out rather than sold. The area is considered highly desirable, and growth pressures drive up the price of agricultural rents. There is a mixture of owned and leased lands and many operators own some ranches and lease others. Leases can be either short or long term (one year or more than five years), resulting in varying incentive by lease-holders to implement water quality protection.*
>
> *Crop prices are primarily controlled by the existing market structure. Consolidation in the food industry has resulted in a smaller group of buyers, giving corporate retailers more bargaining power. In addition, local farmers often compete with products from other countries, where the costs of production may be substantially less.* ***The result is that growers often have little control over the price they are paid even though the costs of producing and delivering products continues to rise.*** *Additionally, issues of food safety are increasingly dictating practices growers must use in order to sell crops, and* ***some recommended food***

__safety practices may run counter to water quality protection practices__. Because of these and other factors, the agricultural industry is extremely sensitive to cost increases and management practice requirements.

The associated monitoring and reporting program specified by the CCRWQCB also acknowledges that cost to dischargers is a factor that must be understood in dealing with water quality concerns (CCRWQCB, 2004c):

"Regional Board staff will work with the cooperative monitoring program to develop a __reasonable cost__ to individuals..."

Importance of Reclamation Ditch Watershed Agriculture

On a per-area basis, the Reclamation Ditch Watershed is one of the most productive food growing areas in the world. The United States may depend more on the Reclamation Ditch Watershed for specific foods than any other single watershed of comparable area.

In order to make these observations, statistics were compiled from the USDA National Agricultural Statistics Service at the County, State, and National Level, and from the United Nations Food and Agriculture Organization at the global level (Table 3.1). Data were compiled for the year 2002, since more recent data were not fully compiled at the global level at the time of publication. Watershed-level figures were estimated by taking the corresponding County-level figures, and scaling them by the ratio of row-crop area within the watershed to the corresponding area within the County as a whole. This was possible because DWR land use mapping data include fields denoting parcels used primary for vegetables, strawberries, and other crop groups. The estimates for pounds of produce and dollar value rely on an assumption that the production per acre is the same within the Watershed as it is within the County as a whole.

Referring to Table 3.1, some notable statistics are as follows:

- The watershed produces about half a billion dollars of vegetables and strawberries annually.
- The watershed produces about 9% of the nation's lettuce and 9% broccoli and 22% of the nation's strawberries.
- The watershed produces approximately 6% of the world's strawberries.

Monterey County grows 10% of the nations vegetables, 44% of the nation's lettuce, 43% of its broccoli, and 23% of its strawberries.

[Page intentionally left blank]

Table 3.1. Estimated agricultural statistics for the Reclamation Ditch Watershed, and its geographic context.

Commercial crop statistics, USA, 2002		Rec Ditch Watershed	% of US	% of World	Monterey County	% of County crop	% of US	California	% of CA crop	% of US	United States	% of US crop	World
Land used (acres) (1000s)	Land	101 d	0.004%		2,127 m		0.09%	99,814 c		4.4%	2,263,961 i		
	Total cropland	41 a	0.009%		368 sc	100%	0.08%	10,994 sc	100%	2.5%	434,165 nc	100.0%	
	Irrigated land	39 a	0.071%		253 sc	69%	0.46%	8,709 sc	79%	15.7%	55,311 nc	12.7%	
	Harvested				260 sc	71%	0.09%	8,466 sc	77%	2.8%	302,697 nc	69.7%	
	Vegetables	39 a	1.142%		181 sc	49%	5.26%	1,025 sc	9%	29.9%	3,433 nc	0.8%	
Crops harvested (acres) (1000s)	Vegetables	57 dwr*	1.5%	0.05%	273 sc		7.37%	1,197 sc		32.4%	3,699 nc		118,999 fao
	Lettuce	24 dwr*	7.7%	1.1%	113 sc		36.83%	220 sc		71.6%	307 nc		2,244 fao
	Broccoli	13 dwr*	8.8%		60 sc		42.2%	121 sc		85.2%	142 nc		
	Strawberries	12 dwrs*	21.3%	2.3%	12 sc		22.3%	32 sc		57.6%	56 nc		509 fao
Pounds (millions)	Vegetables	1,660 dwr*	2.1%	0.1%	7,926 cac*		9.8%	44,932 as		55.8%	80,577 as		1,798,075 fao
	Lettuce	931 dwr*	9.1%	2.1%	4,448 cac		43.6%	7,587 cac		74.4%	10,193 fao		44,089 fao
	Broccoli	161 dwr*	8.9%		769 cac		42.6%	1,622 cac		89.7%	1,808 as		
	Strawberries	407 dwrs*	21.6%	5.8%	425 cac		22.5%	1,535 cac		81.4%	1,886 as		7,055 fao
Market value $ (millions)	Total ag. (crops, livestock)				$2,190 sc		1.1%	$25,737 sc		12.8%	$200,646 nc		
	Total certified organic ag.				$10 sc	0.5%	2.5%	$149 sc	0.8%	38.0%	$393 nc	0.4%	
	Total crops				$2,162 sc	100.0%	2.3%	$19,153 sc	100.0%	20.1%	$95,152 nc	100.0%	
	Vegetables	$280 dwr*	2.2%		$1,339 sc	61.9%	10.5%	$4,785 sc	25.0%	37.4%	$12,786 nc	13.4%	
	Lettuce	$154 dwr*	6.8%		$736 cac	34.0%	32.5%	$1,382 cac	7.2%	61.1%	$2,261 qs	2.4%	
	Broccoli	$56 dwr*	10.0%		$266 cac	12.3%	48.0%	$516 cac	2.7%	93.1%	$554 as	0.6%	
	Strawberries	$218 dwrs*	18.7%		$227 cac	10.5%	19.5%	$862 cac	4.5%	74.1%	$1,163 as	1.2%	

a	Estimated from combination of DWR land cover data (1997), and CCoWS land cover data (Newman et al., 2003)
c	http://countingcalifornia.cdlib.org/matrix/s7.html
cac	2002 data, California Agricultural Statistics Service, archiving County Agricultural Commisioners' Reports, http://www.nass.usda.gov/ca/bul/agcom/indexcac.htm
cac*	2002 data, Calculated from California Agricultural Statistics Service, archiving County Agricultural Commisioners' Reports, http://www.nass.usda.gov/ca/bul/agcom/indexcac.htm
d	Digital elevation model analysis (CCoWS)
dwr*	Estimate: 2002 data, County data (2002) scaled by DWR land use data (1997) (proportion of watershed vegetable area to county vegetable area)
dwrs*	Estimate: 2002 data, County data (2002) scaled by DWR land use data (1997) (proportion of watershed strawberry area to county strawberry area)
fao	2002 data, FAOSTAT, http://faostat.fao.org/faostat
i	http://www.infoplease.com/ipa/A0108355.html
m	2002 data, Monterey County Crop Report
nc	2002 data, USDA NASS Census of Agriculture, National
sc	2002 data, USDA NASS Census of Agriculture, California
as	2002 data, USDA NASS Agricultural Statistics, http://www.usda.gov/nass/pubs/agstats.htm
qs	2002 data, USDA NASS QuickStats, calculated from http://www.nass.usda.gov/QuickStats/

[Page intentionally left blank]

Local Importance of Reclamation Ditch Watershed Agriculture

The agricultural industry supports a significant portion of the jobs in the greater Salinas Valley (ADE, 2001). A study conducted by Applied Development Economics (ADE) provided the following summary points:

> "*The agricultural industry cluster accounts for nearly one-third of all the wage and salary jobs in the county. Considering the indirect jobs supported by agriculture activity, the full economic impact of this cluster is likely much higher than job figures would indicate.*"
>
> "*About 75% of the jobs in the county are concentrated in the Greater Salinas and Greater Monterey Peninsula Planning Areas.*"
>
> "*The Salinas area has the greatest concentration of agricultural jobs, followed by the Central Salinas Valley Planning area to the south.*"

Several of the County's top employers are agriculture-related operations based in Salinas or the Reclamation Ditch Watershed. Table 3.2 shows the top 15 employers of Monterey County in 2002. Seven are located in the City of Salinas and four of those are agricultural.

Table 3.2 The fifteen largest employers in Monterey County in 2002. Boldface represents employers directly related to the agriculture industry that are within the Reclamation Ditch Watershed.

Employer	Location	Location/Industry
Arroyo Labor Contracting Svc	Gonzales	Personnel Supply Services
Bud of California	Soledad	**Agricultural**
Community Hospital of the Monterey Peninsula	Monterey	Health
D'Arrigo Brothers Co	**Salinas**	**Agricultural**
Foothill Packing Inc	**Salinas**	**Services, All Others**
Household Credit Svc	Salinas	Business Credit Institutions
Integrated Device Technology	Salinas	Electronic Components & Accessories
McGraw-Hill-CTB	Monterey	Misc. Publishing
Monterey Peninsula College	Monterey	Colleges & Universities
Naval Postgraduate School	Monterey	Government
Norcal Harvesting	**Salinas**	**Agricultural**
Pebble Beach Co.	Pebble Beach	Misc. Amusement, Recreation Services
Premium Harvesting & Packing	**Salinas**	**Agricultural**
Quality Farm Labor	Gonzales	Personnel Supply Services
Salinas Valley Memorial	Salinas	Health

Data source: http://www.calmis.ca.gov/file/majorer/monteer.htm

Population Density In the Reclamation Ditch Watershed

The Reclamation Ditch Watershed is home to a diverse community of approximately 170,000 people. Figure 3.1 shows the distribution and density of the population within the Watershed – mapped according to Census Tracts. Monterey County's population of is one of fastest growing counties in the state of California (LWMC, 1999). In 1997 and 1998, the population of Monterey County grew 4.7% and 2.7% respectively (LWMC, 1999). In the Reclamation Ditch Watershed, the population has experienced significant growth in the past decade, with most of this growth being centered in the City of Salinas. Between 1997 and 2000 the population of Salinas increased by 38.9% from 108,777 (1990) to 151,060 (2000) (USCB, online).

In the Census 2000 data, the population density of the two densest tracts in Salinas was in the top 2% among all 7058 tracts in the State. Other tracts in Salinas and Castroville are moderately dense, while the remainder of the watershed is relatively sparsely populated. Future city development is planned for areas northeast and east of the current boundary of Salinas (City of Salinas, 2002). Recent drafts of the Monterey County DRAFT General Plan shows additional future growth in the watershed in the areas of Castroville, Boronda, Prunedale, and Rancho San Juan.

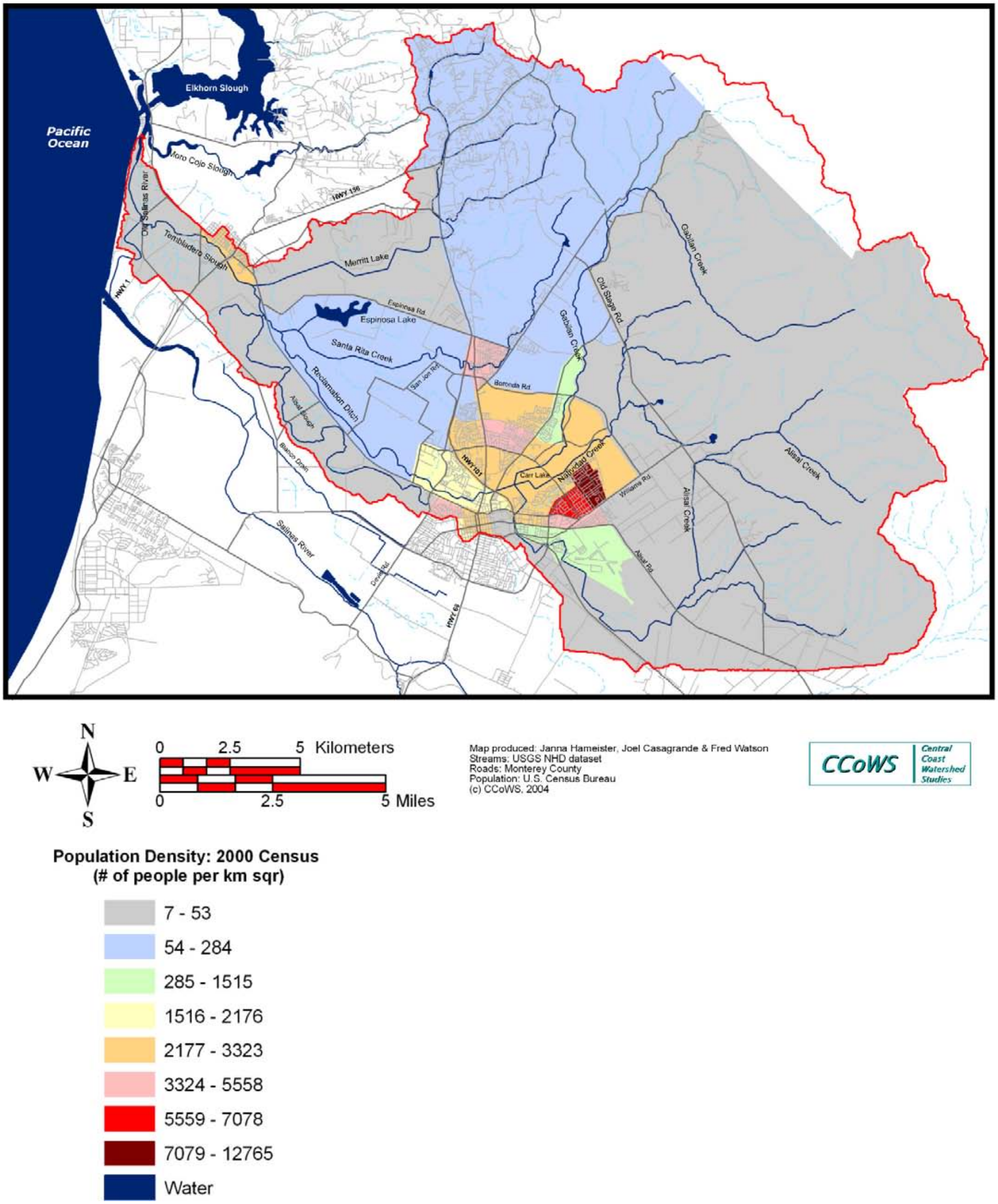


Figure 3.1 Population density (2000) by census tract for the Reclamation Ditch Watershed and surrounding areas.

[Page intentionally left blank]

4. Hydrology and Channel Conditions Assessment

Gabilan Creek at Boronda Road (Looking upstream). Photo: Joel Casagrande February 12, 2001

Overview

This chapter provides an overview of the hydrology of Reclamation Ditch Watershed, and an assessment of its stream channels. This includes a description of flow regime, channel and habitat types, flood history, morphological response to flood flows, and sedimentation trends in the watershed.

General Hydrology

Five main tributaries drain the Reclamation Ditch Watershed: the Merritt Lake and Santa Rita Creek sub-watersheds to the north, Gabilan and Natividad Creeks in the center, and Alisal Creek along the southern boundary.

The hydrologic regime of the water bodies in the study area varies markedly throughout the watershed. The streams of the Gabilan subwatershed are non-perennial in the upper-most sections, perennial or near-perennial in certain reaches mid-way down the range, and then again non-perennial in the lowest parts of the subwatershed as the streams begin to flow over old alluvium at the foot of the range. Upon entering the broad system of alluvial plains that is the Salinas Valley, most of the streams are non-perennial, sparsely vegetated, relatively small ditches (Fig. 4.1). As they near the Cities of Salinas and Castroville, the ditches converge into wider ditches with perennial standing water (urban runoff, ag tailwater, and permitted discharges) in the dry season and storm runoff in the wet season (Figs 4.1 & 4.2). Finally, within a few kilometers of the coast, the ditches flow into an extended brackish, sub-tidal slough. The lowest reaches are joined by overflow (slide-gate controlled) from the Salinas River Lagoon to become a back-beach swale that runs behind the dunes toward Moss Landing Harbor. The whole system is highly episodic, with little or no flow for most of the time, interrupted occasionally by large runoff events. Flooding of managed lands adjacent to streams and channels is not uncommon. This is typical of watersheds in Mediterranean climates, as opposed to those of more temperate climates on the east coast, or further north along the west coast of the United States.

Since pre-European times, the hydrology of the study area has been dramatically altered. An extensive system of interconnected sub-tidal lakes and swamps existed where the ditches exist today. Most of the lakes are now farmed, but still flood regularly during winter storm events, providing valuable detention storage. The impervious area has increased significantly with the expansion of the Cities of Salinas and Castroville. The final result in the middle to lower sections of the watershed is that there is less standing water in the dry season, and more runoff in the wet season.

Following the de-watering of the original lakebeds, land subsidence (Bechtel Corp, 1959) of up to several feet was observed resulting in poor natural drainage of surface waters. . To prevent flooding of both agricultural and urban lands, surface water pump stations have been used to assist in draining the various lakes in providing detention and storage throughout the system. Today, MCWRA operates and maintains five such pumps in the Reclamation Ditch Watershed (Fig. 4.2). There are two pumps in the Merritt Lake sub-watershed (Upper Merritt Pump Station and Lower Merritt Pump Station), two in the Santa Rita/Espinosa Lake sub-watersheds (Espinosa Lake Pump Station and the Chinn Pump Station on Santa Rita Creek), and the Hebbron Heights Pump Station on Sanborn Creek, a small urban tributary that feeds into the Reclamation

Figure 4.1 Non-perennial vs. artificially perennial flow regimes. Picture **A**, non-perennial, is located on Gabilan Creek just upstream from the Hebert Road gage. Picture **B**, perennial, is the Reclamation Ditch at San Jon Road.

Ditch just upstream of Carr Lake.

The Potrero Road tide gates are also intended to assist in surface water conveyance. The tide gates consist of ten box culverts each with a flap gate on the downstream side. During periods of high stream flow and low tide, the gates open by the force of surface runoff. When the tide is high, the gates are designed to remain closed in order to block the incoming salt water, although some seawater does manage to seep in. Local flooding usually occurs when high surface runoff occurs simultaneously with high spring tides. Despite their intended function, the tide gates are also a point of constriction of outgoing flood flows, as identified by the SWCCE “Zone 9” study of 1999, due to their final invert elevation.

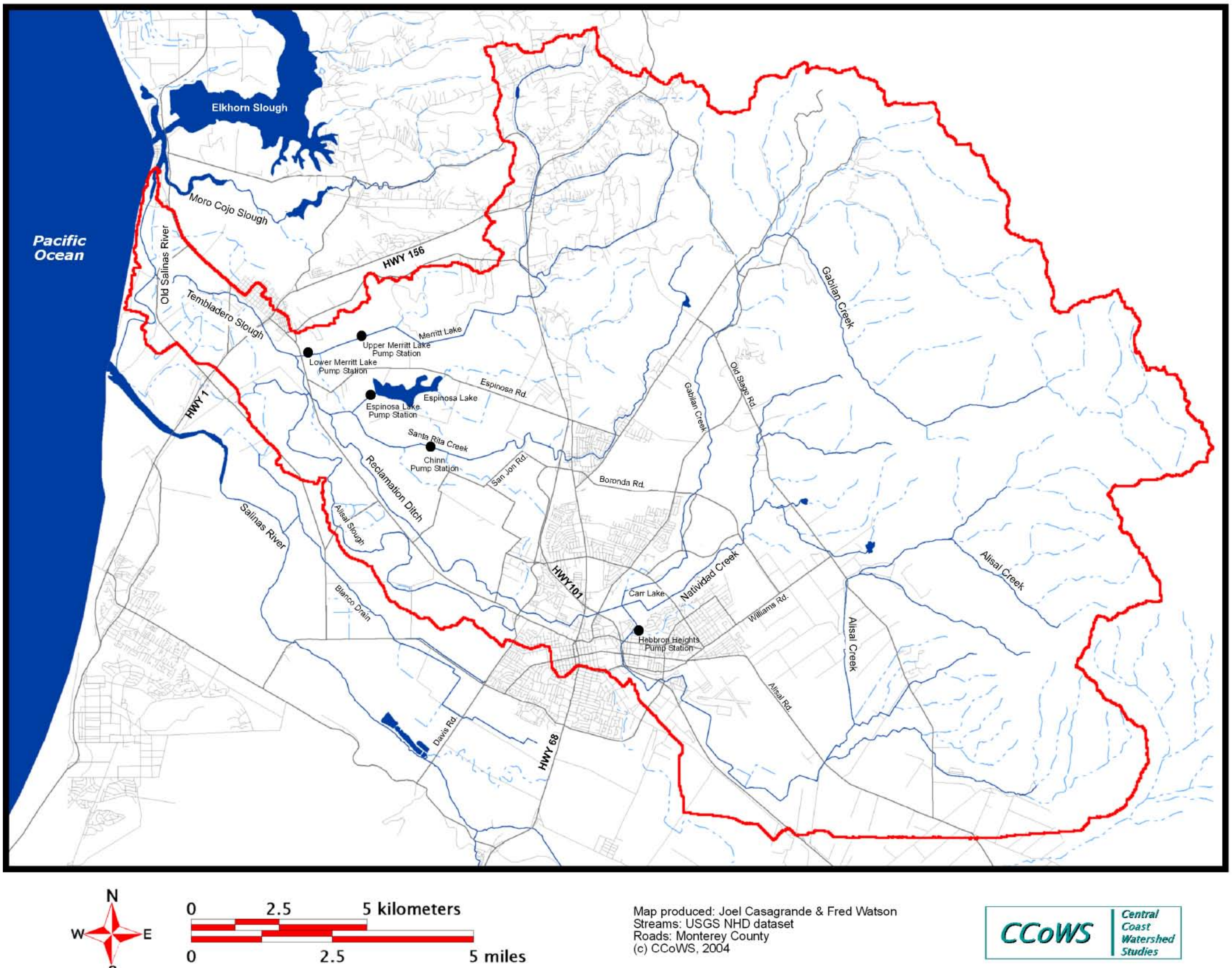


Figure 4.2 Locations of major surface water pump stations in the Reclamation Ditch Watershed.

Flow Duration

The USGS maintains two continuous streamflow gauges in the study area. The gauge on "Gabilan Creek near Salinas" (GAB-HEB[5]) measures the streamflow of the relatively natural watershed immediately below the mountainous headwaters of Gabilan Creek, a watershed area of about 94.7 km^2 (36.6 mi^2). The gauge at the "Reclamation Ditch near Salinas" (REC-JON) measures the flow immediately below the City of Salinas, a watershed area of about 275.9 km^2 (106.5 mi^2), including the watershed of GAB-HEB. The two gauges have a common gauging period in the water years 1971-1985 (REC-JON was discontinued in 1986, and re-instated in 2002). Although this period contained some drought years, on average it was probably a relatively wet period. The mean annual flow at the long-term gauge at nearby Arroyo Seco was 27% higher between 1971 and 1985 than the long-term mean between 1902 and 2001.

The difference in flow regime between the two gauges is an indication of both their differing hydrologic settings (upland versus lowland) and the cumulative effects of human impacts in historic times. Figure 4.3 overlays the flow duration curves (FDCs) of the two gauges, using data from their common period. Streamflow is represented in area-specific terms (mm/day), so as to divide out the effect of differing watershed area.

The flow regime at the upland gauge is naturally dry for most of the year, with streams only flowing in winter. Between the 1971 and 1985 water years, there was no flow at the upstream gauge for 68.3% of days (Fig. 4.3) (which is probably reflective of the natural condition, although perhaps slightly exaggerated by historic groundwater overdraft from the alluvium in the narrow valleys immediately upstream from the gauge). In winter, the stream carried the full volume of the major storms, with a maximum daily flow of 8.4 m^3/s (298 cfs) or 7.7 mm/day (0.3 in./day) - again, reflective of the natural condition, perhaps slightly exaggerated by increased runoff due to soil compaction in grazed areas.

Whereas the upland gauge is dry two thirds of the time, the Reclamation Ditch is perennial downstream of agricultural and urban development (Fig. 4.3). According to USGS estimates, flow only ceased on three days between 1971 and 1985, and on those days, standing water was probably still present throughout most of the Reclamation Ditch. The presence of standing water is reflective of historical conditions, since the area was a system of lakes. However, the presence of dry-season flow is a consequence of dry-season urban discharges and agricultural tailwater. Historically, the lakes were basins, with saltwater influence as far inland as the City of Salinas - hence the name.

[5] See Table 6. for description of CCoWS Site Codes.

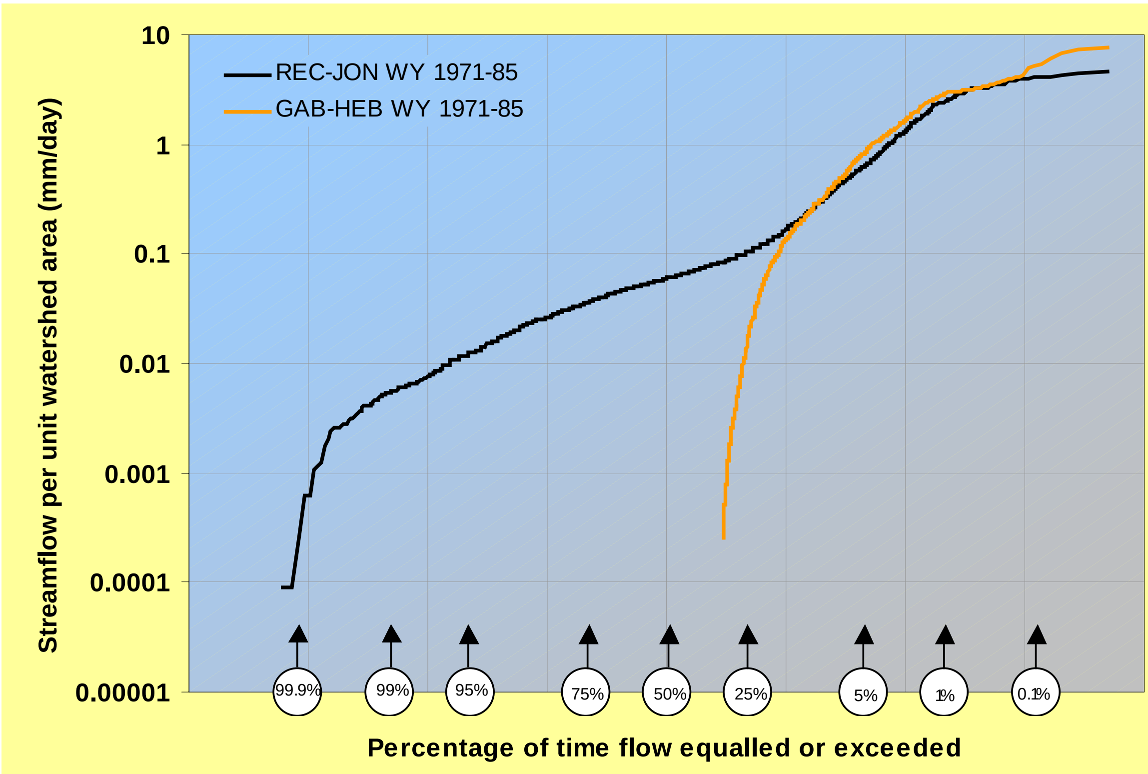


Figure 4.3 Flow duration curves for each of the two USGS Streamflow Gage sites in the Reclamation Ditch Watershed.

During most of winter, the upland and lowland sites carry similar streamflow magnitudes, relative to their watershed area (Fig. 4.3). In the wettest periods, upland streams carry more flow per unit watershed area – a result of their receiving about twice as much precipitation (Fig. 1.5). The maximum flow at REC-JON in the water years 1971-85 was 14.8 m^3/s (524 cfs), or 4.6 mm/day (0.2 in./day).

The timing of storm peaks differs markedly between the upland and lowland gauges. In our field experience, storm flow typically reaches the Reclamation Ditch gauging site from the City of Salinas as quickly as half an hour after significant rain commences. In contrast, the first few storms of the year often generate no flow upstream in Gabilan Creek (Fig. 4.4). When storms do occur, there is a delay of a number of hours between the passing of a storm front and the observation of a storm flow peak at the USGS gauging site.

One might expect to observe long-term trends in the gauging records, such as increases in winter flow in the Reclamation Ditch as the impervious area of the City of Salinas growsand as agricultural and semi-urban development expands eastward. Such trends are not apparent in the flow duration data as evidenced by a sequence of flow duration curves constructed in 4-6 year intervals at each site (not shown). Rather, decadal climate variability overshadows any long-term trends that may be present in the raw flow data. A modeling analysis that accounts for this climate variability may be more apt to discern long-term trends associated with urban and agricultural trends.

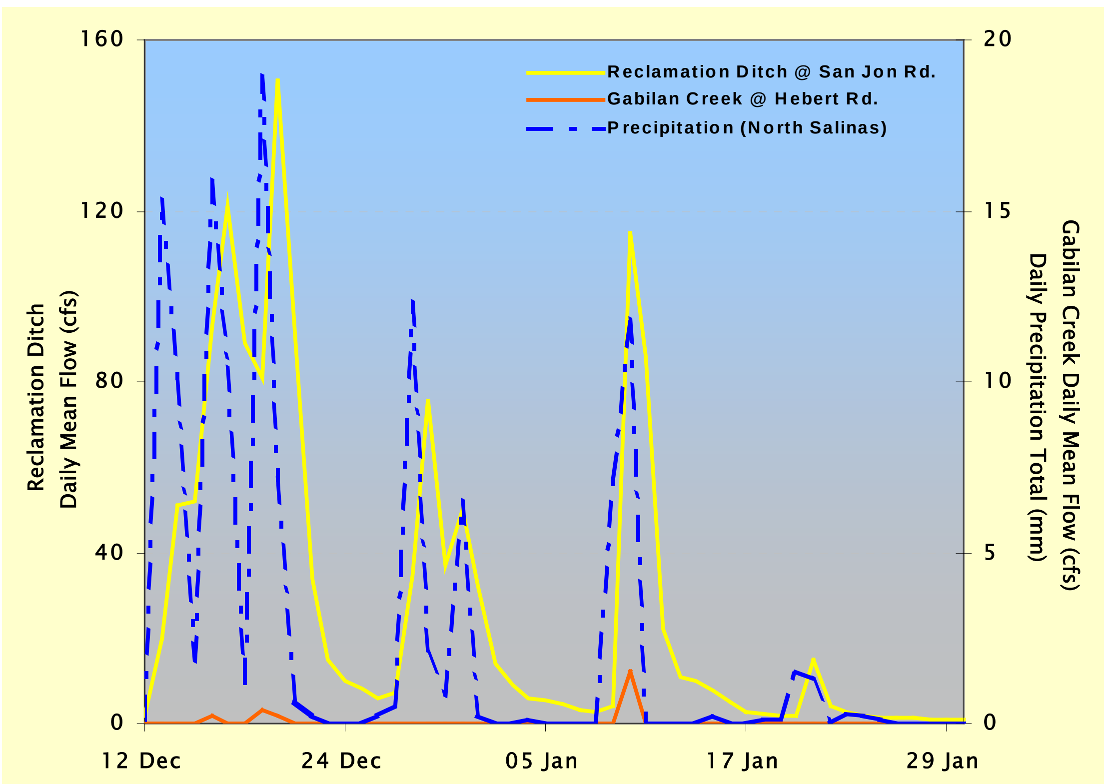


Figure 4.4 A comparison of stream flow response to precipitation in Gabilan Creek and the Reclamation Ditch from late 2003 and early 2004. Note: Although hard to see, there were two small and brief flow responses at the Gabilan Creek gage on the 19th of December and 10th of January. Daily precipitation data is from the California Irrigation Management Information System (CIMIS) and stream flow data is from USGS.

Channel Conditions

The Reclamation Ditch Watershed exhibits a wide range of channel types. Their current conditions are a key indicator of watershed function. The channels of the watershed were classified into 10 types ranging from mountain plateau streams down to brackish sloughs. These types were mapped throughout the watershed using digital orthophotos (dated August 21, 1998[6]) and field reconnaissance, as shown in Figure 4.6. Channel gradients were determined using terrain analysis based on 30-meter elevation models. The individual channel types are described in the following pages.

Mountain Plateau

Slope: 1-3% **Vegetation**: Partially vegetated **Flow**: Seasonal **Substrate**: Gravel

At the southern base of Fremont Peak State Park lies a broad mountain plateau. Many springs originate here to form a section of the headwaters of Gabilan Creek. The stream channels, most of which are ephemeral, are narrow and gentle to moderate gradient. Channel substrate is predominantly gravel and cobble (Figs 4.5 & 4.7) and dominant streamside vegetation is primarily oak savanna with grazed riparian woodland with mixed oak, gray and coulter pines at the highest elevations. Also, there are several seasonal ranch ponds scattered throughout this area, some of which are in stream(Fig. 4.8). Adjacent land uses are predominantly cattle ranching with State Park lands at the highest elevations.

Figure 4.5 Gabilan Creek in the Mountain plateau zone. Photo: Joel Casagrande, September 2000

[6] DOQ's provided by the CDFG. http://casil.ucdavis.edu/casil/usgs.gov/doqq/36121/

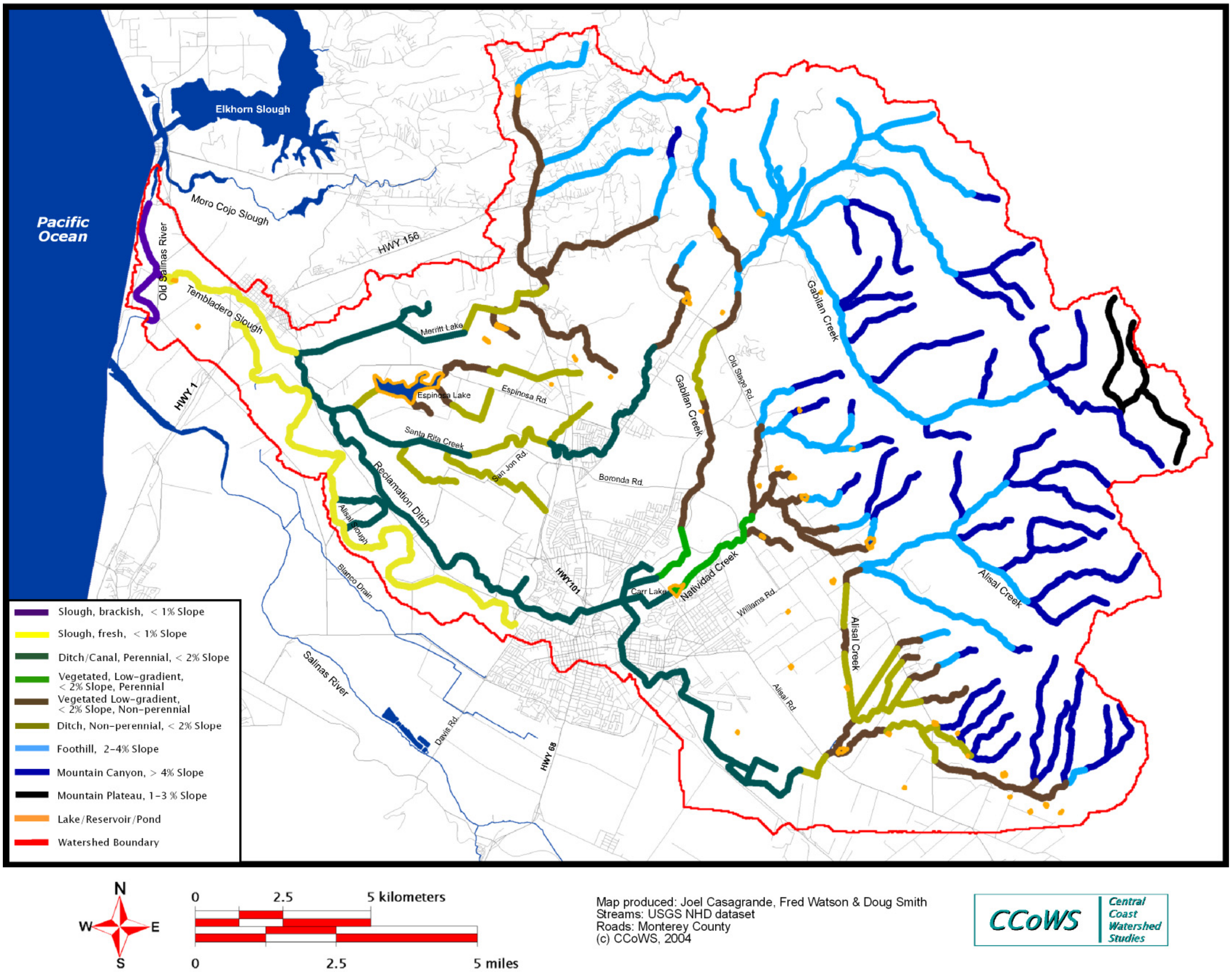


Figure 4.6 Stream channel classification and distribution in the Reclamation Ditch Watershed.

Figure 4.7 Headwaters of Gabilan Creek in the plateau area near Fremont Peak. Photos: Joel Casagrande, September 2000.

Figure 4.8 An in-stream ranch pond on the plateau area south of Fremont Peak State Park. Photo: Joel Casagrande, September 2000.

Mountain Canyon

Slope: > 4% **Vegetation**: Yes **Flow**: Usually **Substrate**: Boulder/cobble

In the steep mountain canyons of the Gabilan Range, streams are typically narrow and of steep gradient (> 4%). Channel substrate is primarily cobble/boulder. Streams generally flow year round, especially in the mid to lower elevations of this zone (Fig. 4.9). Riparian vegetation is dense, usually consisting of big-leaf maples, tan oaks, white alder, and sycamore trees. The dense vegetation helps keep the water temperatures cold throughout the year. Adjacent land use is ranching (Casagrande, 2001). The presence of pools, large woody debris, such as root wads and downed trees, in addition to cool water temperatures and well-oxygenated flow create suitable habitat conditions for fish(Hager, 2001).

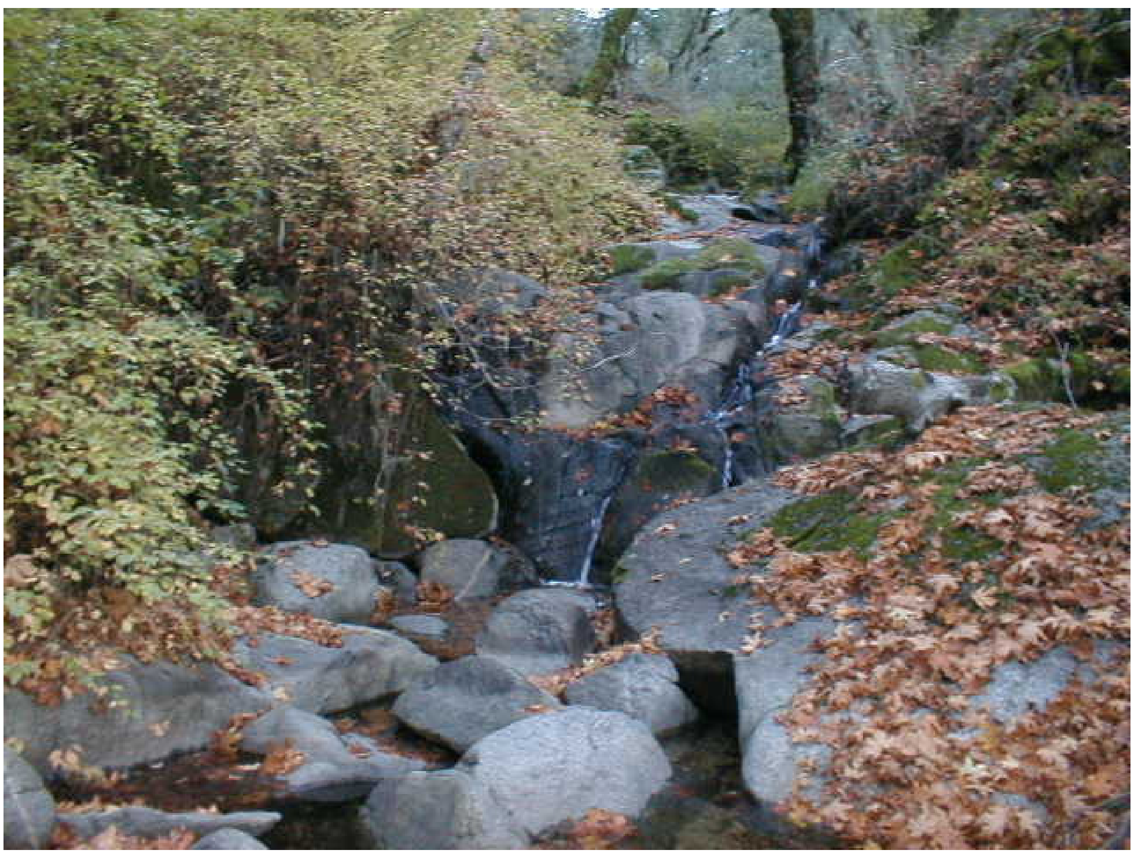


Figure 4.9 The headwaters of Gabilan Creek in the Mountain Canyon zone. Photo: Joel Casagrande, November 2000.

Foothill

Slope: 2-4% **Vegetation**: Yes **Flow**: Usually **Substrate**: Gravel/Sand

In the foothills, streams are usually non-perennial in some locations. Streams reaches classified as foothill streams are defined by their moderate slope (2-4%), smaller average substrate sizes, and shift in riparian species composition (Fig. 4.10). Riparian vegetation is still commonly found throughout much of the foothill stream reaches, although some reaches have lost a substantial portion of their streamside vegetation. Common riparian tree species are willows, box elder, and cottonwoods. Big-leaf maples and tan oaks, more common in the steeper moutain canyons, are no longer present. Foothill reaches are found in the lower canyons and throughout the alluvial fans of the Gabilan Range. The adjacent land uses are predominantly ranching with some areas developed for row crop agriculture (Casagrande, 2001).

Figure 4.10 Gabilan Creek at Crazy Horse Canyon Rd in the Foothill zone. Photo: Joel Casagrande, September 2001.

Vegetated Low Gradient

Slope: < 2% **Vegetation**: Usually vegetated **Flow**: Seasonal **Substrate**: Sand

Between the foothill zone and the city of Salinas, the stream channels are divided into two different categories, *Vegetated low gradient* (VLG) and *Ditch, Non Perennial (DNP)*. To some degree, all of the stream channels within these two classifications have been modified by human developments. Those which still support significant amounts of native riparian vegetation and/or those which have not been deeply channelized are classified here as VLG.

VLG channel characteristics include, a gentle slope (< 2%), predominantly sand substrate, and in most areas lack summer flow. Adjacent land use is row-crop agriculture, residential/urban and ranching lands (Casagrande, 2001). Much of this stream type has been channelized to some extent, thus eliminating its ability to fully access the adjacent floodplain during high runoff events.

Examples of VLG streams exist throughout the watershed, including some that have been restored after being previously de-vegetated (e.g. Natividad Creek Park). Certain VLG reaches support native fish and amphibians, including Veterans Memorial Park (Fig. 4.12) and Natividad Creek Park.

Figure 4.11 Gabilan Creek at Natividad Road with native sycamore trees, a low-flow channel and primarily sandy substrate - Vegetated non-perennial zone. Photo: Joel Casagrande, March 2001.

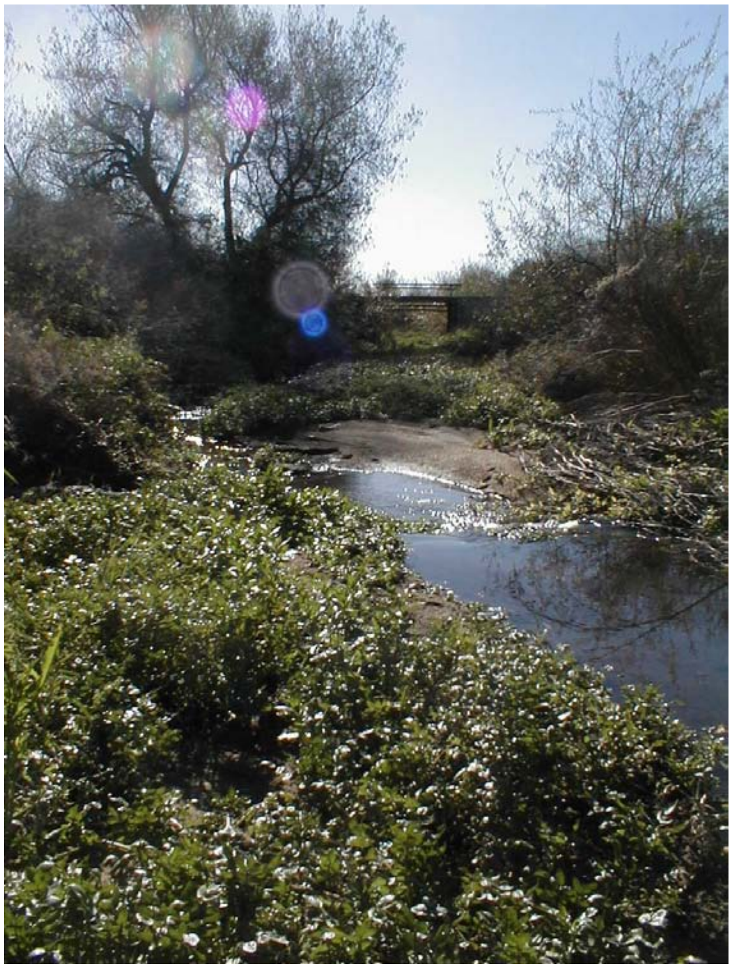


Figure 4.12 Gabilan Creek upstream of Veteran's Memorial Park in Salinas – Vegetated-perennial zone. This reach is channelized; however some mature riparian vegetation still occurs along its banks, and stream flow is artificially perennial due to groundwater pumping from beneath Alvarez High School. Photo: Joel Casagrande, February 2003.

Ditches, Non-Perennial

Slope: < 2% **Vegetation**: Usually vegetated **Flow**: Seasonal/Agricultural Return
Substrate: Sand and fine sediments

Stream reaches classified here as *Ditches, Non-Perennial*, generally have steep banks that are either un-vegetated or support only non-native annual weeds. Such conditions are generally of low habitat quality for riparian-associated organisms, due to the lack of overhead cover, in-channel complexity, and sources of organic detritus. The steep un-vegetated banks are also more susceptible to erosion, particularly during high flows (Figs 4.13 & 4.14). Such bank erosion is a source of sediment that later accumulates in stream channels further downstream, reducing capacity.

Figure 4.13 A channelized section of Gabilan Creek downstream of Hebert Road – Ditch, non-perennial zone. Photo: Joel Casagrande, August 2000.

Figure 4.14 A channelized section of lower Alisal Creek near Hartnell Road. Photo: Fred Watson, December 2003.

Ditches/Canals, Perennial

Slope: < 2% **Vegetation**: generally unvegetated **Flow**: Artificially perennial
Substrate: Fine sediments and sand

Most of the stream channels of lower valley bottom have been reclaimed and converted into ditches or drainage canals (Figs 4.6, 4.16 & 4.15). These ditches generally have steep side slopes, lack access to a floodplain, an undefined low-flow channel and lack suitable cover for fish and other aquatic organisms. Sections of the ditch system are occasionally lined, by property owners, with riprap to protect against erosion. Their dry-season flow today is artificially perennial from local urban and agricultural runoff sources. Channel substrate in the Reclamation Ditch is a mixture of fine-grained sediments, predominantly silts and clays, with small portions of sand.

Much of the native riparian vegetation has been cleared as part of the reclamation ditch construction and by agriculture. Currently, most vegetation growing along the ditches is managed through use of herbicides to enhance drainage flow and to minimize habitat for pest species adjacent to cropland. Riparian vegetation is discussed in further detail in Chapter 7.

The lack of pools and in-stream complexity limits the amount of shelter, or over-wintering habitat, for fish and amphibian species during winter runoff.

Figure 4.15 The Reclamation Ditch upstream of the HWY 183 Bridge - Ditch/Canal, Perennial Zone. Photo: Joel Casagrande, August 2002.

Figure 4.16 The Reclamation Ditch at Victor Way in West Salinas – Ditch/Canal Perennial Zone. Photo: Joel Casagrande, March 2001.

Figure 4.17 Lower Santa Rita Creek near the Chinn Pump Station. Photo: Joel Casagrande, February 2002.

Slough (Freshwater)

Slope: < 2% **Vegetation**: Usually un-vegetated **Flow**: Perennial
Substrate: mixture of silt/clay/sand

The freshwater slough channels are defined here as broad, gentle sloped (< 2%), sinuous channels with slow-moving, perennial water. The perennial water found in these channels is fresh with salinity levels generally lower than 1.5 parts per thousand (ppt). Riparian vegetation, which is managed by use of herbicides, is sparse, occurring in clusters. Where vegetation is present, it is usually annual weeds along with an occasional clump of willows, tules and/or watercress. Examples of these channel types are Alisal Slough and the upper reaches of Tembladero Slough.

Downstream of the HWY 183 crossing, the Reclamation Ditch becomes known as Tembladero Slough. Schaff and Wheeler Consulting Civil Engineers (1999), noted that near the confluence of Tembladero Slough and the Reclamation Ditch, "*the slope…flattens significantly, lowering flow velocity, and allowing increased sediment deposition.*" The present study defines the channel reach between the confluence of Tembladero Slough and the Reclamation Ditch down to just upstream from the Molera Road crossing as freshwater slough (Figs 4.6 & 4.18).

Figure 4.18 Tembladero Slough looking upstream at the confluence of Tembladero Slough (Merritt Lake drainage, on the left) with the Reclamation Ditch (on the right) – Slough (Freshwater) Zone. Photo: Don Kozlowski, March 2003.

Slough (Brackish)

Slope: < 2% **Vegetation**: Usually un-vegetated **Flow**: Perennial
Substrate: mixture of silt/clay

Tidal slough channels are defined as having roughly the same physical characteristics (i.e. gentle, meandering channels with perennial water) as the freshwater sloughs, but that also experience salt concentration fluctuations primarily due to the tidal cycle, with additional brackish water from agricultural return flows. In addition, vegetation tolerant of saltwater, such as pickleweed and or salt grass, is found along the banks, especially near the Potrero Road Tide Gates. Channel substrate is fine silts and clays. These channels are areas of sediment deposition and limited erosion.

Brackish sloughs exist from the Tembladero Slough and Old Salinas River Channel confluence down to the Potrero Road tide gates (Figs 4.6 & 4.19).

The Old Salinas River Channel, Moro Cojo and Elkhorn Sloughs were once predominantly seasonal freshwater estuaries (as evidence by the presence of tules and cottonwoods in the early 20th Century – Gordon, 1996).

Figure 4.19 The Old Salinas River Channel looking upstream from Potrero Road crossing – Slough (Brackish) Zone. Vegetation along the left bank (right side of the photo) is pickelweed, a tidal, salt marsh inhabitant. Along the right bank is a farm road. Photo: Don Kozlowski. March 2003.

Figure 4.20 Salt water marsh habitat upstream of Moss Landing Harbor. Photo: Joel Casagrande November 21, 2001.

Flooding

Historical records of significant flooding, specifically in the Carr Lake Watershed, are not well documented. . Photos documented by Breschini et al., (2000) show flooding on Lake Street[7] in Salinas on March 11, 1911. This flood resulted after Carr Lake (a FEMA Floodway) filled and spread out onto the neighboring streets in the City of Salinas. More recently, during the winter of 1951/52, the Reclamation Ditch was unable to handle “record flows”, which resulted in flooding between the Alisal neighborhood and the City of Salinas (CDPHBSE, 1952).

In 1982/83, a significant storm hit the Central Coast of California. Anderson (2000) noted that 23.44 inches of rain fell on the City of Salinas that year and that the Blanco area along the Salinas River experienced the greatest damage. However, flooding was primarily water flowing slowly over an area causing less harm than faster, scouring flows.

[7] Lake Street is located in the City of Salinas just downstream of Carr Lake.

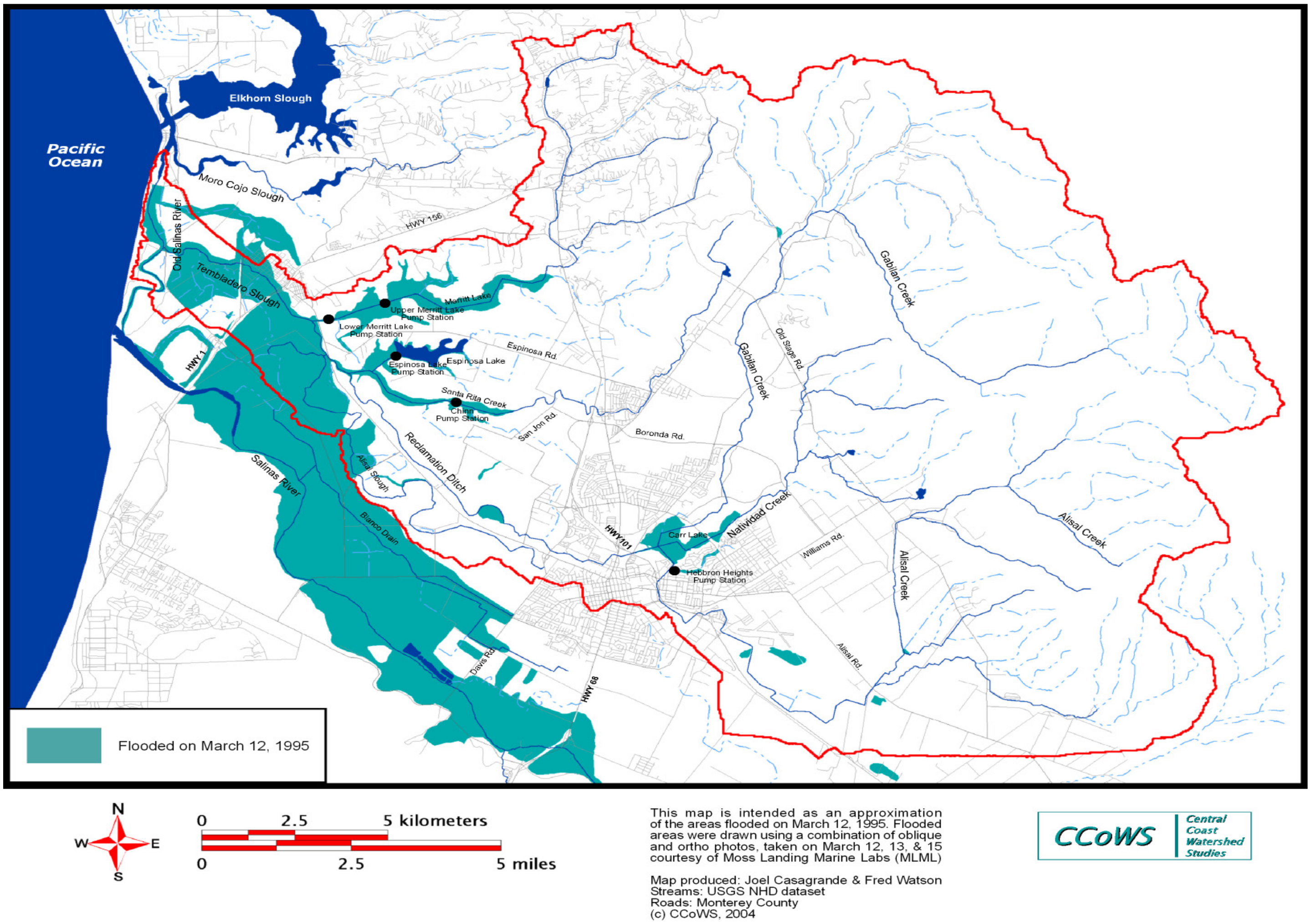


Figure 4.21 Flooded areas of the Northern Salinas River Valley and Reclamation Ditch Watershed at the peak of the flood on March 12, 1995. The flooded areas were interpreted from both oblique aerial photographs (taken March 12 and NASA ER-2, Color IR photos (taken March 15), and then drawn into GIS software.

Figure 4.22. Flooded areas during the March 1995 flood event, looking upstream at the Salinas River.

Figure 4.23. Flooded areas during the March 1995 flood event. Image B shows a nearly filled Carr Lake (upper-center). Images A, B, C illustrate the extent of the flooding in the northern Salinas Valley on March 12, 1995. Photos: John Oliver,

Figure 4.24 An example of the photos used for the evaluating flood extant on March 15, 1995. The photos are NASA ER-2, color infrared. Castroville is shown in the upper left corner and the Salinas River Lagoon in the lower left corner.

Tembladero and Moro Cojo Sloughs were unable to drain fast enough due to the addition of Salinas River water. Each of the pump stations, at Merritt and Espinosa Lakes and on the lower Santa Rita Creek drainage, were not able to discharge incoming runoff due to the additional water from the Salinas River. This led to substantial and prolonged inundation of these areas (Fig.). As a result, Castroville experienced significant flooding throughout much the town, including the entire intersection of HWY 156 and HWY 183.

Flooding was kept to a minimum within the City of Salinas and lands to the east and north of the city. Much of the flooding in this region of the watershed occurred in the historical lake bottom areas, although Carr and Heinz Lakes nearly filled.

During the winter of 1997/98, 30.09 inches of rain fell on the City of Salinas. This was the second highest annual rainfall total recorded since 1861/62. As a result, streamflow in Gabilan Creek reached 1,030 cfs, a 25-year event and the highest flow recorded since records began in 1970. Once again, local flooding occurred in the historical lake bottoms. Carr, Merritt, & Espinosa Lakes were filled with water backed up from the Reclamation Ditch as well as their own local runoff (SWCCE, 1999). Water elevations in Carr Lake reached an elevation of 42.9 ft, only 0.1 ft away from flooding structures above the lake bottom (SWCCE, 1999). However, the Sherwood Lake Mobile Home Park, located in a FEMA Floodway along the southwest corner of the lake, was flooded for 11 days (SWCCE, 2002). For the Salinas River Valley, serious flooding of urban and agricultural lands was largely avoided because the events were smaller, occurred further north, and were less compounding.

Figure compares the hydrographs for Gabilan Creek at Hebert Rd during the 1995 and 1998 flood events. The hydrograph in 1995 shows a much lower peak daily mean flow than the 1998 hydrograph and thus flooding in Salinas and in the lands east and north of Carr Lake was less substantial than in 1998. Conversely, in 1998, rainfall and runoff totals were higher in the northern portion of the watershed and thus flood damage in the Carr Lake Basin was much more intense.

In summary, flooding remains an issue in the Reclamation Ditch Watershed. The continued increase in impervious surfaces has led to increased discharge and faster runoff response throughout the watershed has resulted in the increase in flood damage throughout the watershed. Most of the damage caused from flooding in average years occurs on farmlands, of which most lies within the historical lake bottoms and downstream of the City of Salinas.

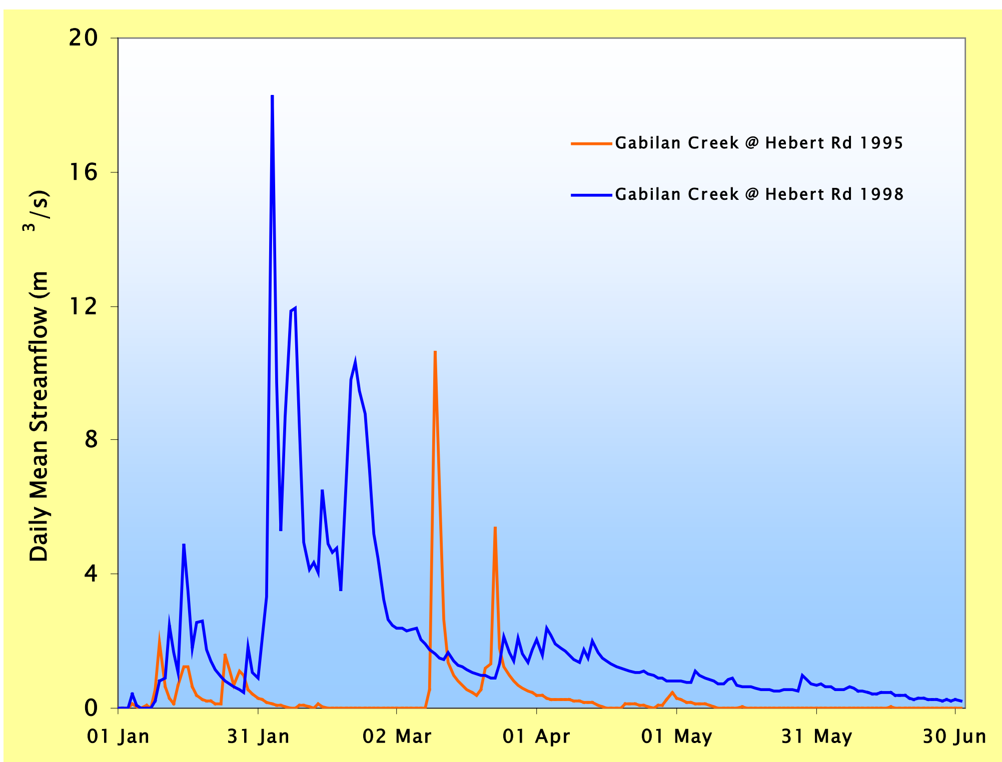


Figure 4.25 A comparison of Gabilan Creek stream flow during the 1995 and 1998 storm season. Stream flow data is from USGS.

Channel Sedimentation and Erosion

Perspective

Sedimentation and erosion in the lower waterways of the Reclamation Ditch Watershed are generally considered ‘concerns’ by agricultural land users in particular and are also key natural processes in certain environmental perspectives. In more recent history, flood risk has probably increased as a result of increased urban runoff without commensurate increases in channel capacity.

Sediment concerns have increased historically as a result of a number of factors. Firstly, the nature of the problem has changed. Historically, sediment was the means by which the fertile floodplains of the watershed were created. Sediment deposition in channels is now known to limit channel capacity to the point of increasing flood risk. Sediment is known to be a transport medium for pollutants such as pesticides.Finally, in historical times, the actual sediment load itself has almost certainly increased as a result of de-vegetation of the landscape.

Today, whenever a channel aggrades with sediment or degrades through erosion, two key viewpoints arise. Sedimentation and erosion is a concern to flood control managers who consider the channel as a means of removing water from the landscape without flooding or loss of land. The environmental perspective of the same phenomena is that these processes are a step toward restoring natural geomorphic function of lowland streams, resulting in increased habitat diversity and increased retention time for immobilization of pollutants.

The Reclamation Ditch Watershed was designed in the early 1900’s for conveyance of water to reclaim land. With the listing of these waterways as being impaired under the Clean Water Act, there has come a revision of this single-use perspective.

In the following sections, we describe: sediment sources, sediment transport, channel sedimentation and channel erosion. Sediment as a water quality constituent is described in the following Chapter.

Sediment Sources

In addition to natural sources, there are numerous sources of sediment as a result of human activity. Based on our experience in the region (see Casagrande, 2001; Watson et al., 2003), these include:

- Agricultural fields
    - during storms or when irrigation generates excessive tailwater, when fields are fallow without cover crops and/or without appropriate sediment management practices
- Agricultural roads
- Grazing land
    - when over-grazed or otherwise de-vegetated, and when cattle have access to channels without riparian vegetation
    - when grazing increases landslide risk (see Smith et al., 2004a; Pinter & Vestal, in press.)
- Urban construction sites
    - when sediment management measures fail
- Channel or ditch erosion
    - when un-vegetated, and/or over-steepened
- Un-paved roads in highland areas
    - when intersecting streams

The following pages contain Figures illustrating a variety of typical sources. Also, a soil erodibility potential map is located in Figure . The map shows that large areas of highly erodable soil have been converted to urban lands (i.e. in between Natividad Creek and Williams Road). Steep terrace lands with high erosion potential near Santa Rita Creek and east of Espinosa Lake are currently being farmed. Other areas of high erosion potential currently exist near the intersection of Alisal Creek and Alisal Road. In general, the watershed consists of soils with moderate to high erodible potential including the mountainous areas in the Gabilan Range.

As described in Chapter 6, numerous beneficial practices have been and continue to be adopted throughout the Watershed to control sediment sources. In the broader region, the Resource Conservation District of Monterey County is active in working with farmers to continually identify and refine best practices, and to facilitate their adoption by others. Beneficial practices include sediment retention basins, vegetated buffer strips, vegetated roadways, contour-aligned bedding, cover crops, drip irrigation, and optimizing irrigation management.

Figure 4.26 Stream bank erosion in Gabilan Creek near Hebert Road. The stream bank is eroding around the base of the drainpipe. Also, fine sediment accumulation in the channel from agricultural return flow becomes a source for during next rain event. Note: lettuce growing in the streambed. Photo: Joel Casagrande, August 2000.

Figure 4.27 A construction site on Davis Road near the Reclamation Ditch. Runoff from sites such is a potential sediment source. Photo: Fred Watson, October 30, 2000.

Figure 4.28 Sediment erosion from a strawberry farm on relatively steep land with highly erodible soil. Photo: Fred Watson March 2000.

Figure 4.29 Sediment rich agricultural field discharge into Gabilan Creek. Photo: Fred Watson, January 2001.

Figure 4.30 Bank erosion in the Reclamation Ditch. The steep walls of the Reclamation Ditch are prone to failure and thus are capable of delivering a significant amount of fine sediments. Photo: Joel Casagrande, 8 Jul 2004.

Figure 4.31 Gully formations along the bare left bank of the Reclamation Ditch. Note the pile of debris accumulating at the bank toe circled in red. Photo: Joel Casagrande 8 Jul 2004

Figure 4.32 Erosion and sediment transport in a roadside ditch near Old Stage Road. Note that the flow in the ditch is already sediment rich prior to reaching the larger bank scour. Photo: Fred Watson Winter 2000.

Figure 4.33 Farm road crossing in Gabilan Creek. Road crossings in the creek channel, as shown here, can supply sediment to the stream channel during winter and summer. Here the creek is flowing (irrigation return flow) from upper right to lower left corner of photo. Photo: Joel Casagrande, August 2000.

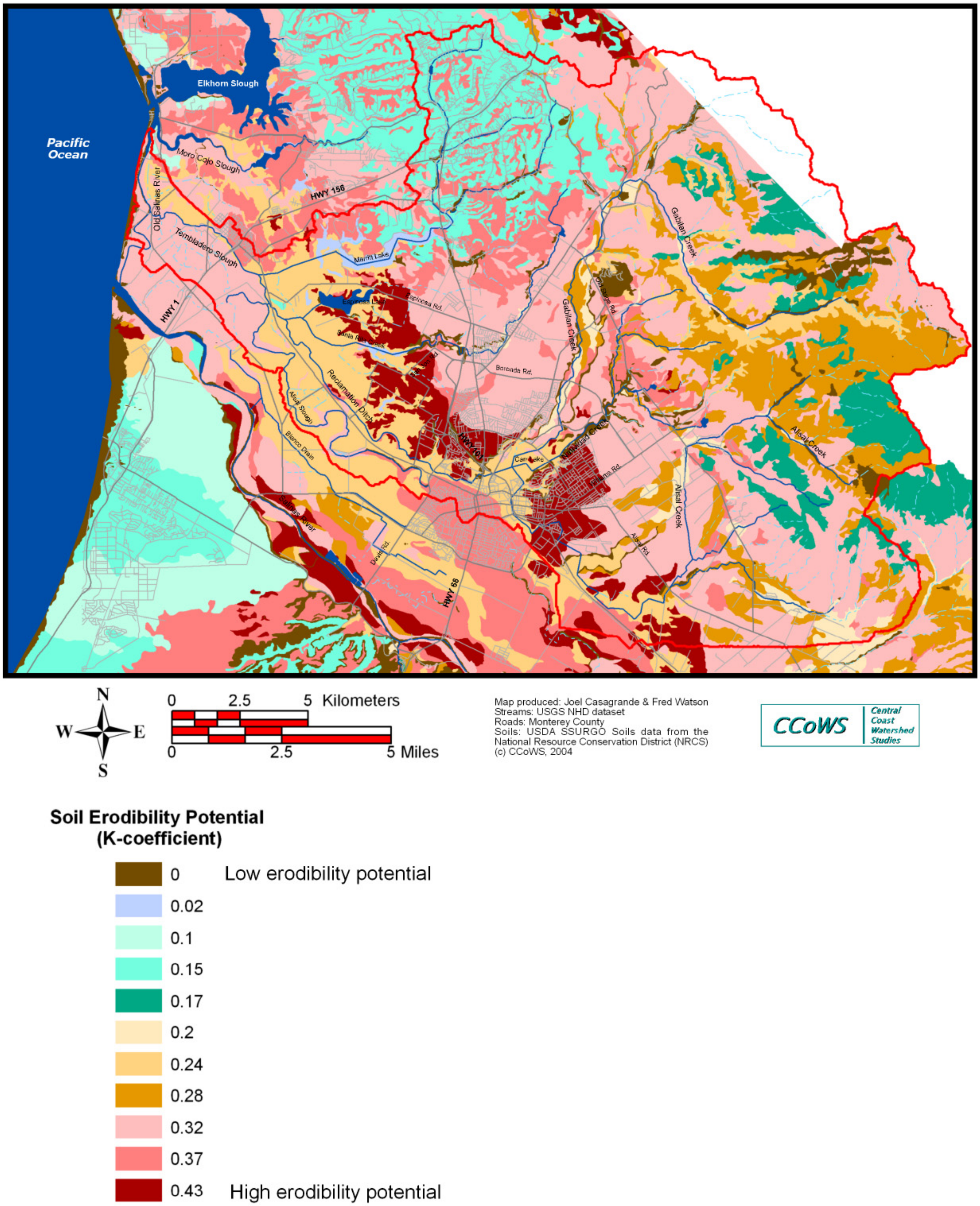


Figure 4.34 Soil erodibility potential in the Reclamation Ditch Watershed (Source: USDA/NRCS SSURGO).

Transport

During summers and winters with below-average rainfall, eroded material is often transported directly into waterways, where it may remain for some time (Watson et al., 2003). This contributes to sedimentation of channels, which are then periodically excavated in order to maintain flood conveyance. In high runoff years, large storm events may scour sediment previously deposited in channels and transport it throughout the watershed, eventually to Moss Landing Harbor and the Monterey Bay National Marine Sanctuary, along with any entrained substances such as pesticides. Such events also bring additional sediment down from the headwaters, leading ultimately to a net increase in sediment, particularly at depositional sites such as floodplains which are farmed (see Salinas River analysis in Watson et al., 2003).

Watson et al., (2003) analyzed suspended sediment and bedload samples taken at numerous sites along the Gabilan system by Casagrande (2001) during five storms from the winter of 2000/2001. Figure 4. summarizes the analysis, showing both estimated totals bedload and calculated increments (or decrements) in bedload along a progression from the headwaters down Gabilan Creek into the City of Salinas and the Reclamation Ditch. The total bedload data taken from only one winter suggest that the upper watershed (grazing lands, some row-crops, and wooded areas) may be the largest source of bedload material that is ultimately delivered to Carr Lake in the City of Salinas. The incremental calculations show that on a per-area basis, row-crop sources may also contribute, that urban bedload sources were not detected, and that channel deposition and re-mobilization are likely to occur. The long-term bedload material budget could be characterized as many years of gradual net deposition, punctuated by occasional years of very high-flow, channel re-mobilization, and delivery of bedload material to downstream areas. The conclusions made by Watson et al., (2003, p. 196) are as follows:

- *Determination of watershed sediment budgets in non-perennial systems is confounded by the dominant influence of episodicity, percolation, and in-channel sediment storage, even when detailed storm-based monitoring is conducted at multiple sites simultaneously for a whole storm season. Conclusions based on monitoring data are thus limited. Decisions based on these data should be cognizant of the inherent uncertainty in the results.*
- *There is good evidence that row-crop agricultural lands contributed the highest suspended sediment loads per unit area under the conditions experienced in 2000-1.*
- *There is good evidence that urban lands contributed the greatest volume of runoff per unit area.*

- *There is some evidence for significant input of coarse material (transported as bedload) from strawberry lands.*
- *There is some evidence that sediment load from grazing lands can be high if not mitigated by stream-bank vegetation*
- *More conclusive results based on in-stream monitoring could be gained through long term (5-10 years) storm-based monitoring programs capable of sampling from large flood flows. The high cost of such programs could be partly offset by carefully thought out improvements in site selection.*

Channel sedimentation and its maintenance

Silt removal maintenance is conducted throughout the watershed. Some reaches of the Reclamation Ditch and Tembladero Slough systems are dredged as needed. MCWRA maintains portions of the Reclamation Ditch mainstem system within the Zone 9 benefit assessment area (See Figure). Accumulation of sediment, debris, and vegetation leads to a decrease in the drainage capacity of the channels and increases the potential for flooding. The costs associated with maintaining the system and of the disposal of the dredged material are also of concern. For example, approximately every three years, 50,000 to 150,000 cubic yards of sediment and debris, contributed by multiple sources, is dredged from Moss Landing Harbor by the Moss Landing Harbor District and hauled to disposal sites (MBNMS, 2003).

Sedimentation is also occurring within and east of the City of Salinas. In Gabilan and Natividad Creeks, the reaches between Carr Lake and the Gabilan Range are areas of significant sand and fine gravel deposition. Sediment removal operations were conducted in this reach following the 1998 storms. A major excavation of Gabilan Creek between East Boronda Road and Constitution Blvd. was completed by the City of Salinas in the fall of 2004, at a cost of $283,500 (Carl Niizawa, pers comm., 2004) (Fig.).

The MCWRA Operations and Maintenance staff maintains portions of the mainstem drainage system from Carr Lake, south to Hartnell Road, and west to the Potrero Tide Gates, including portions of Santa Rita Creek, and the Espinosa and Merritt Lake laterals. MCWRA is currently developing standards for future development projects to mitigate negative impacts, such as sediment yields, to the drainage system.

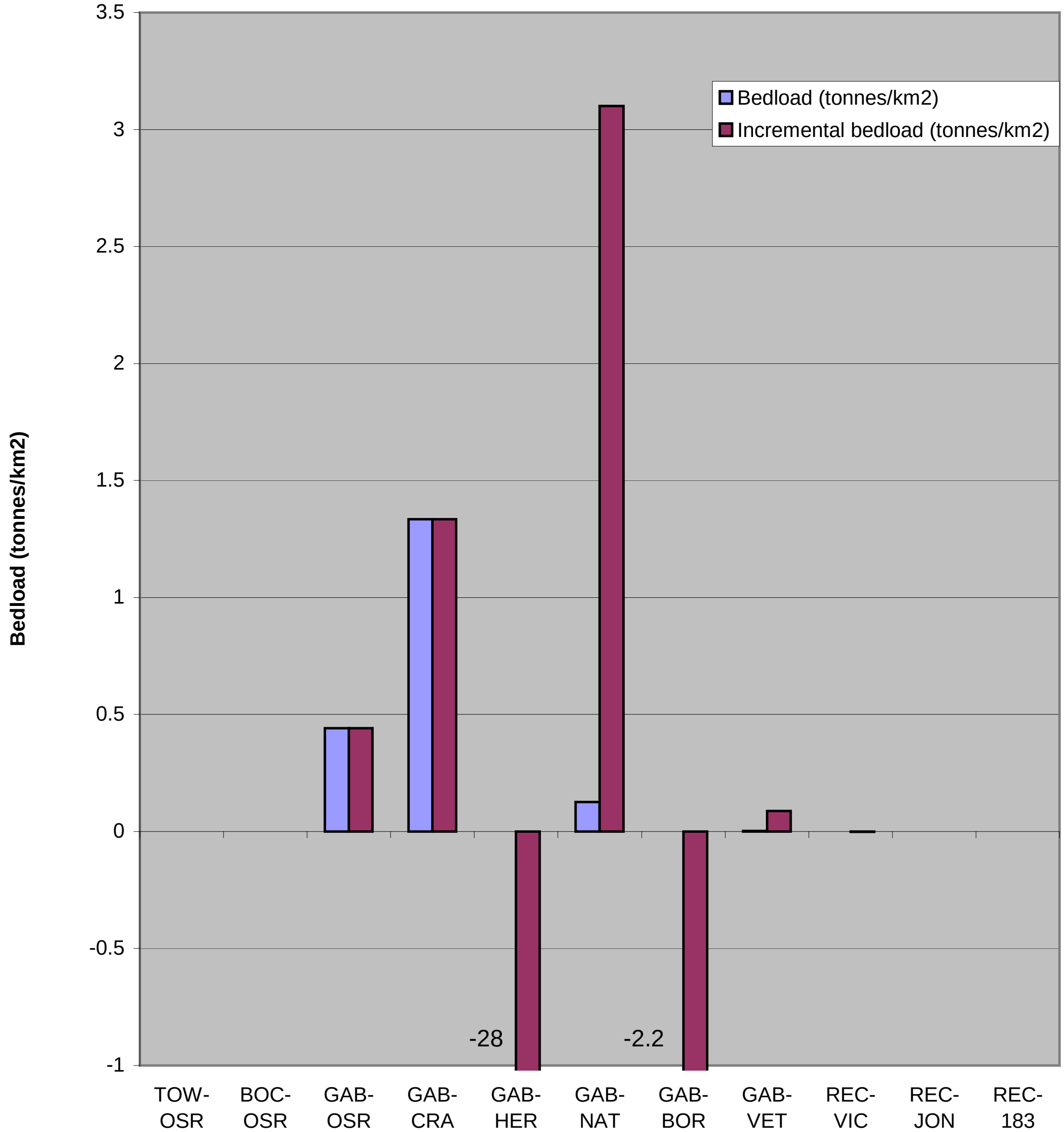


Figure 4.35 Bedload yield per unit area of watershed, during five storms from the winter of 2000/2001, at sampling sites extending from Gabilan Creek into the Reclamation Ditch (from Watson et al., 2003). Blue bars are specific to entire watershed of each sampling site. Purple bars are specific to just the watershed area between successive sampling sites. Positive increments therefore indicate either sources of bedload material in the watershed, or re-mobilization of channel sediments. Negative increments indicate deposition of sediments

The following is a list, created in 2004 by MCWRA's Operations and Maintenance staff, of areas in the Reclamation Ditch system where sediment accumulation occurs and where maintenance is currently needed to keep the channels clear of excess sediment and debris.

- Carr Lake, the Four Corners area is a silt basin (the area where Gabilan, Natividad, Alisal Creeks and the downstream outlet to the Reclamation Ditch meet).
- Reclamation Ditch, approximately ¼ to ½ mile downstream of Hartnell Road, to just upstream of Airport Blvd, and the Carr Lake area. This reach is dredged annually.
- Reclamation Ditch, between Main Street and Boronda Road. Dredged approximately every 15 years.
- Tembladero Slough, between Highway 1 and the Potrero Road Tide Gates. Last dredged in 2001.
- Major tributaries to the Reclamation Ditch also require regular silt / sediment removal including:
    - Santa Rita Creek, upstream of the Chin Pump station
    - Santa Rita Creek, downstream of Hwy 101 for 2 miles
    - Merritt Lake, upper and lower laterals

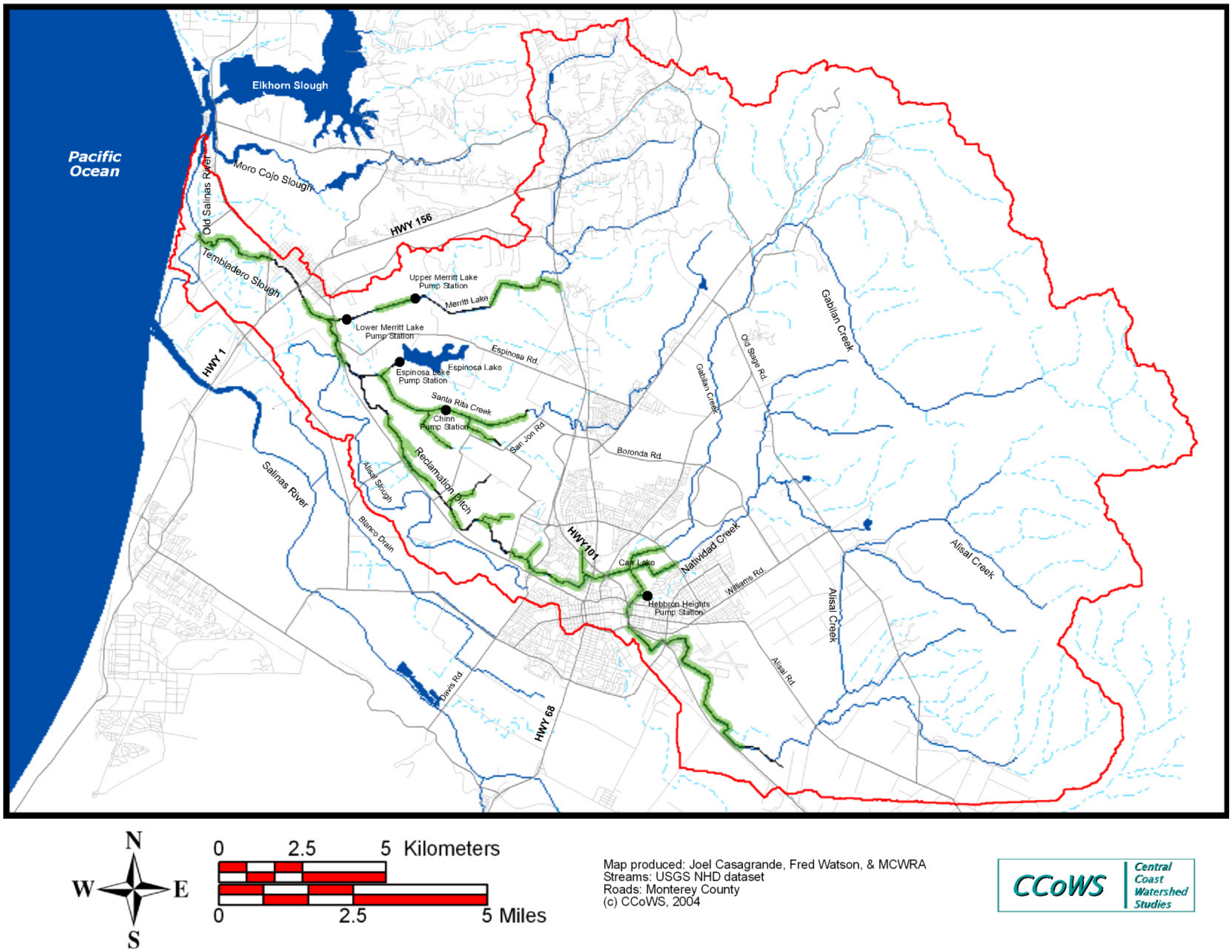


Figure 4.36 MCWRA right-of-way, shown in green, consists of in-fee ownership and maintenance easements granted by property owners within the Reclamation Ditch System.

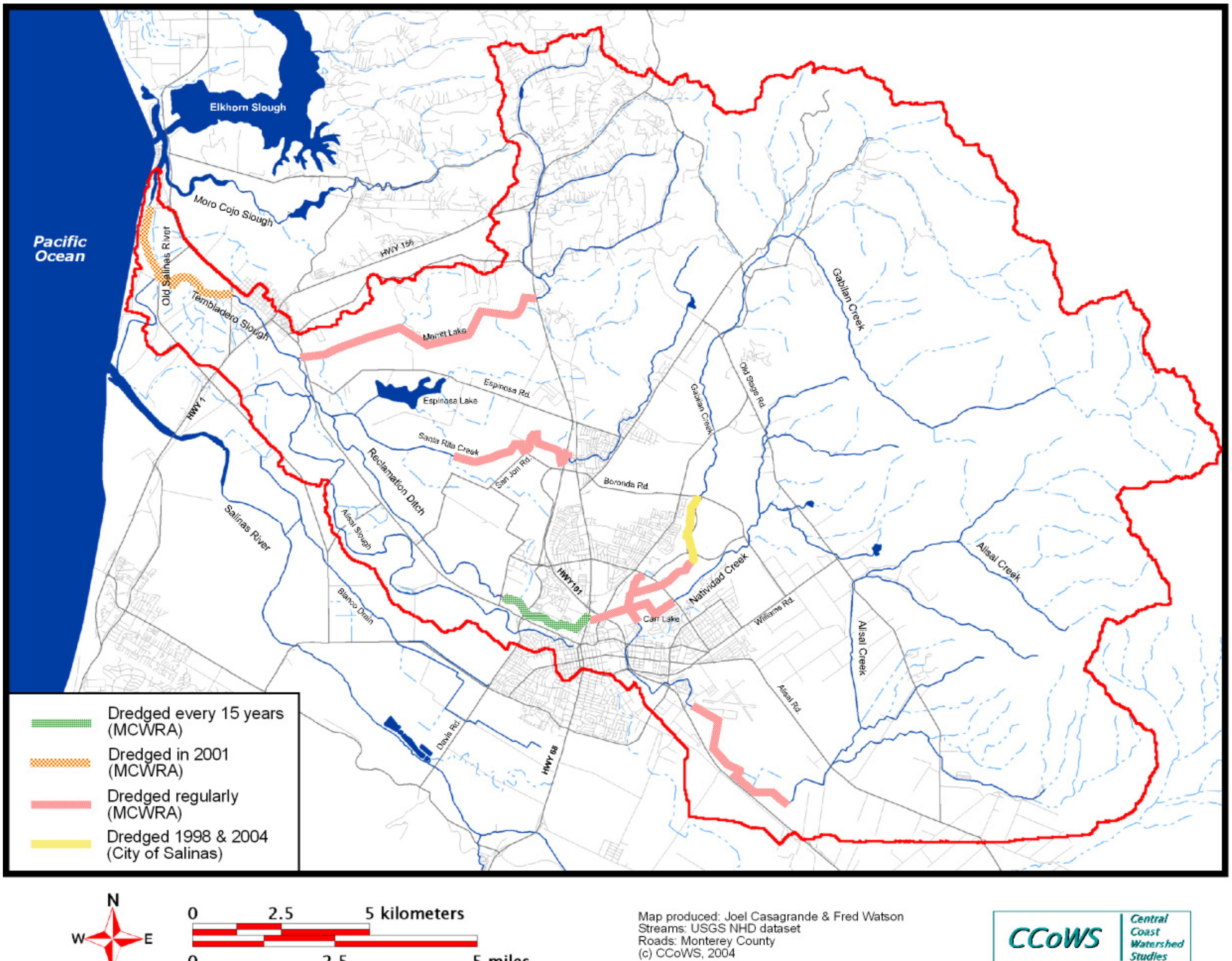


Figure 4.37 Areas and frequency of silt removal and maintenance within the Reclamation Ditch system and lower Gabilan Creek conducted by MCWRA and the City of Salinas.

Channel erosion and its maintenance

MCWRA has recently outlined areas that currently experience erosion problems. They include the following and are shown in Figure :

- Tembladero Slough, areas between Highway 1 and Potrero Road,
- Santa Rita Creek, downstream of San Jon Road,
- Reclamation Ditch, near the Mill Lake lateral,
- Reclamation Ditch, at the North Main Street box culvert,
- Reclamation Ditch near the Sherwood Lake Mobile Home Park and Hebbron Heights Pump Station areas,
- Reclamation Ditch at the Hartnell Road crossing

The MCWRA completed a bank stabilization project during the summer of 2004 on the east side of the Ditch near the North Main Street Culvert at a cost of $168,355 (Richard Boyer[9], pers comm., 2004).

The Hartnell Road crossing has been an erosion concern in the past. However, the Monterey County Public Works has recently installed four new culverts, which will help control the erosion in this area.

With the anticipated development of the watershed upstream of the current urban boundary, channel erosion rates are likely to increase and lead to increased maintenance costs. Over the past 50 years, bank erosion throughout the Reclamation Ditch has increased, most noticeably in and downstream of the City of Salinas.

[9] Richard Boyer, MCWRA.

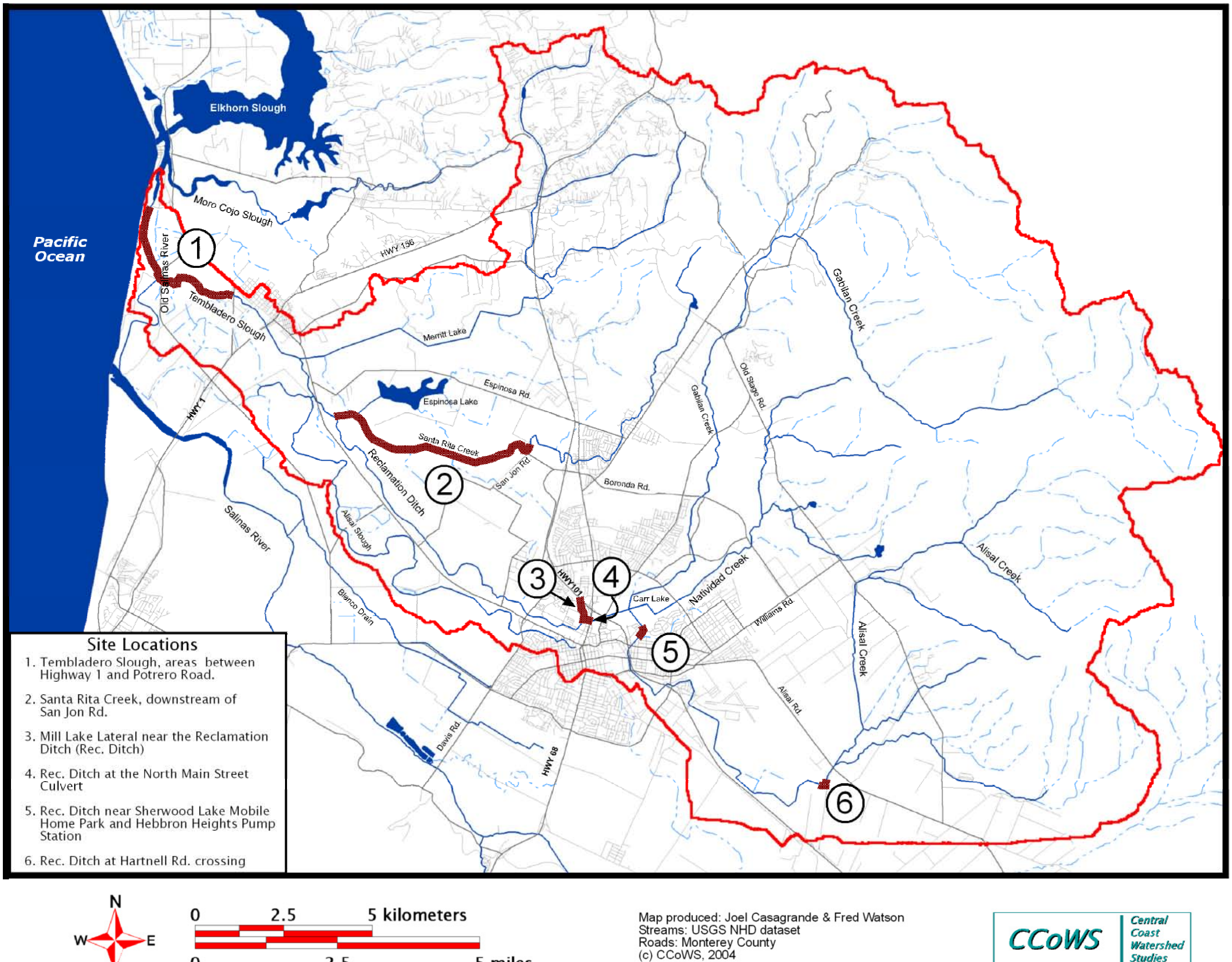


Figure 4.38 Areas within the study area that are currently maintained for stream bank erosion by Monterey County Water Resources Agency.

[Page intentionally left blank]

5. Botanical Assessment

The canopy of mixed riparian forest in the Northern Salinas Valley. Willows, cottonwoods and sycamores, are common tree species in these habitats. Photo: Lars Pierce, 2000.

Introduction

The vegetation of the Reclamation Ditch Watershed is representative of the Californian Central Coast. The dry summers and moist winters in conjunction with the geographic setting produce a mosaic of different vegetation communities including coastal and inland chaparral, grasslands, sand dunes, fresh and saltwater wetlands, mixed and montane riparian forests and oak woodlands and savanna. Figure 1.8 shows the general vegetation types throughout the region.

The present chapter focuses on the vegetation communities found in the riparian zone. The discussion includes the common native and non-native species found within each community, a closer look at non-native weeds, and a general overview of the presence/absence of riparian vegetation in the Reclamation Ditch Watershed.

Riparian vegetation is the vegetation found along the banks of streams, lakeshores, sloughs, or other bodies of water. It is a critical component of the watershed environment, both ecologically and aesthetically. Riparian vegetation is typically abundant with wildlife. It provides important nesting habitats for a variety of birds (Roberson and Tenney, 1993; Suddjian, 2002; see Appendix B) and serves as an important migratory corridor for many species of mammals. The shade from a mature riparian canopy helps to keep water temperatures cool, which results in improved habitat quality for many aquatic organisms. In addition, the leaf litter and detritus from the forest canopy is an important link in the aquatic food chain. Riparian vegetation also helps to prevent erosion by stabilizing stream banks with their root structures. Finally, riparian areas are aesthetically pleasing and provide areas for recreation such as bird watching.

Throughout much of California, riparian vegetation, especially in lowland areas, has been removed, fragmented, or significantly altered as a result of urban and agricultural development, and grazing. One of the largest and best-known examples of this has been the loss and/or degradation of the vast riparian forests in the Sacramento/San Joaquin Valley (Riley, 1998).

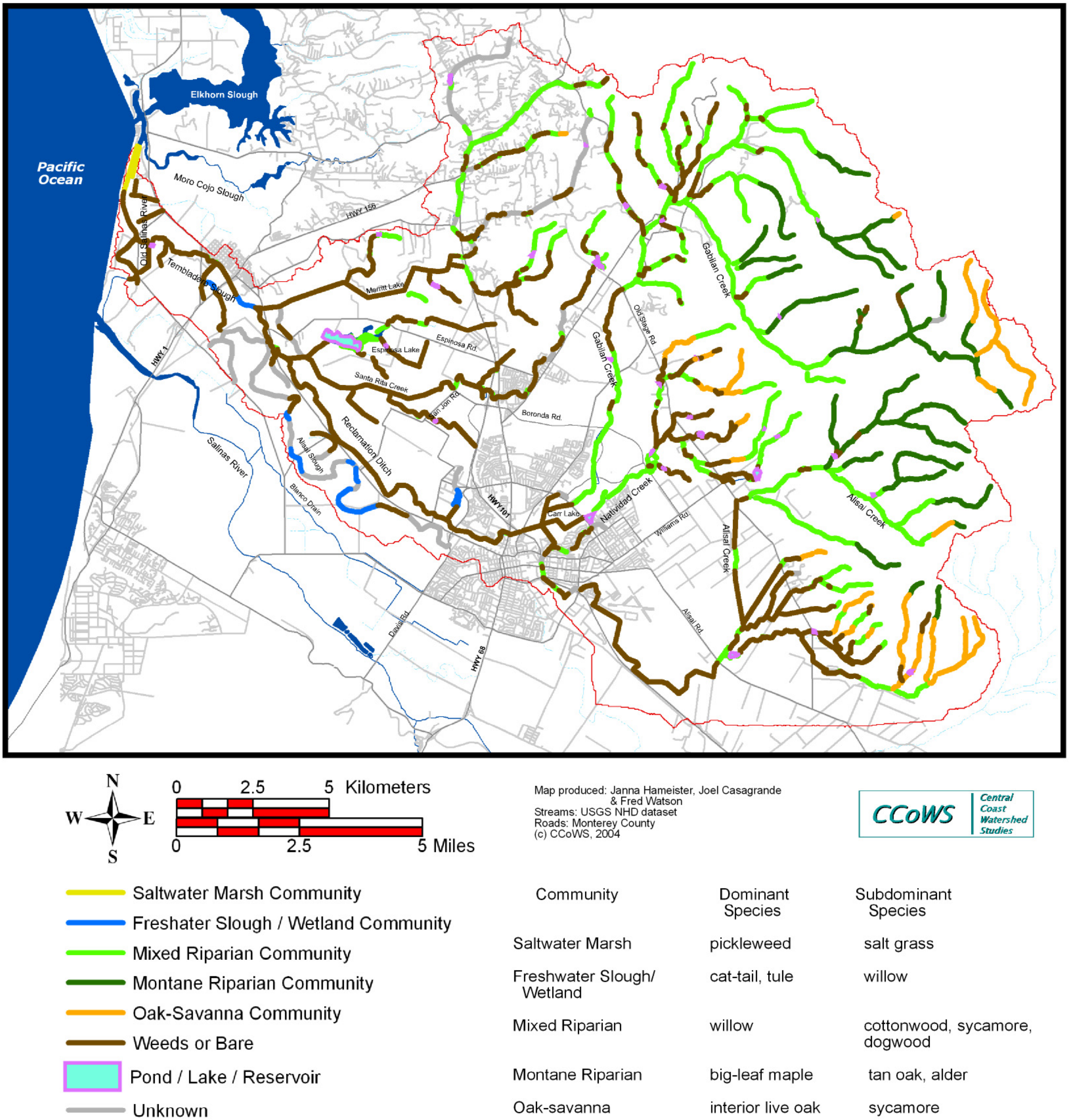
Riparian Vegetation Communities

The riparian vegetation communities (Fig. 5.1) were mapped using a combination of aerial photos (B&W DOQ 1999, Color-ortho 2002), satellite imagery (Landsat), field ground truthing, and abiotic characteristics such as slope, elevation and aspect. Slope, elevation and aspect were used to differentiate between montane vegetation communities and lower elevation mixed riparian communities. Some reaches were marked as “Unknown” due to lack of data. In addition, the California Natural Diversity Database (CNDDB) was reviewed for the presence of plant species with special status as well as for unique natural communities within the Reclamation Ditch Watershed and surrounding areas.

The riparian vegetation communities mapped in Figure 5.1 are defined and described below.

During the summer and fall of 2004, species identification and percent-cover measurements were taken along transects at thirteen stratified sites in the Reclamation Ditch Watershed (Appendix C). Sites were selected within most of the vegetation communities recognized in this study, two sites per riparian community type. Data were collected for three canopy levels – overstory, understory, and groundcover

The following sections describe each community type in detail.



Community	Dominant Species	Subdominant Species
Saltwater Marsh	pickleweed	salt grass
Freshwater Slough/ Wetland	cat-tail, tule	willow
Mixed Riparian	willow	cottonwood, sycamore, dogwood
Montane Riparian	big-leaf maple	tan oak, alder
Oak-savanna	interior live oak	sycamore
Pond/Lake/Reservoir	cat-tail, tule	willow
Weeds or Bare	non-native weeds	

Figure 5.1 Vegetation communities within the riparian zone of the Reclamation Ditch Watershed (Source: Air-photo and field mapping, 2004).

Saltwater Marsh Community

The downstream reaches of the Old Salinas River Channel near Potrero Road contain the tidal saltwater marsh vegetation community. Strips of this vegetation community are found primarily along the left bank of the Old Salinas (between the sand dunes and the channel), while the right bank supports primarily weeds (Figs 5.2, 5.4, & 5.1).

The dominant species found in this community is pickleweed (*Salicornia virginica*). Other species include, salt grass (*Distichlis spicata*), coastal gum plant (*Grindelia stricta*), salt bush (*Atriplex triangularis*), and alkali heath (*Frankenia salina*). The species are distributed according to their tolerance of salt water. The most common non-native and invasive species found in this community are the sea fig (*Carpobrotus chilensis*) and/or hottentot fig (*Carpobrotus edulis*) (both are also commonly referred as ice-plant) (Fig 5.3). Non-native annual weeds and grasses like rip-gut brome (*Bromus diandrus*) generally occur above the high-water line, or in areas that are rarely inundated by saltwater during high tides.

Figure 5.2 Pickleweed salt marsh. At low tide, mudflats become exposed along the fringes of the pickleweed. Note the transition from the dune vegetation community in the background. Photo: Joel Casagrande, 30June 2004.

During the beginning of the 20th Century the Old Salinas River Channel near Moss Landing Harbor supported vegetation more typical of fresh water (tules and cottonwood trees, Gordon 1996). Currently, the lower reaches of the Old Salinas River Channel supports a saltwater marsh community.

Since the 19th Century, significant areas of both salt and freshwater marshlands have been drained for agricultural and urban development (Fig. 5.4).

Figure 5.3 Pickleweed, with the invasive ice-plant immediately above. Note coyote brush and gum plant shrubs competing with ice-plant in the background. Photo: Joel Casagrande, 30 June 2004.

Figure 5.4 The Old Salinas River Channel near Potrero Rd (right bank). Native vegetation here is gone, replaced by annual weeds. Photo: Joel Casagrande, November 2002.

Freshwater Slough/Wetland and Seasonal Pond Communities

The vegetation communities of the Freshwater Slough/Wetland and the Pond/Lake/Reservoir Communities are very similar and therefore are discussed together in this sub-section.

Remnants of the freshwater slough/wetland community are found in reaches of lower Tembladero Slough (upstream of Molera Road), parts of Alisal Slough, Markley Swamp, and Espinosa Lake (Figs 5.5, 5.6, 5.7 & 5.1). Native plants common to the freshwater slough/wetland communities include, cattails (*Typha spp.*), sedges (*Carex spp.*), bullrush (*Scirpus spp.*), willow (*Salix, spp.*), stinging nettles (*Urtica dioica*), duckweed (*Lemna spp.*), watercress (*Rorippa nasturtium-aquaticum*), coyote brush (*Baccharis pilularis*) and many non-native plants.

Much of the original freshwater marsh habitat and vegetation has been drained, filled, or removed (AMBAG, 1997), impacting wildlife, especially birds and fish, as well as the water quality.

Figure 5.5 Freshwater slough/wetland habitat in Alisal Slough. Here, cattails and small willows are the dominant species. Photo: Joel Casagrande, 13 Aug 2004.

Figure 5.6 Freshwater slough/wetland habitat in Markley Swamp. Willows are shown on the right with cattails at center. Non-native weeds are shown growing in the extreme foreground and on the hill in the upper left corner. Photo: Joel Casagrande, 29 Jun 2004.

The creation of small reservoirs, water retention basins, and cattle watering ponds throughout the watershed has helped to preserve remnants of the freshwater wetland vegetation community (Gordon, 1996). Most ponds, depending on how frequently they are drained and how steep the walls are, can support a variety of freshwater wetland plants. Wind and birds help to re-colonize both the vegetation and invertebrate species in the ponds (Fig. 7.). These water bodies can serve as important habitat for a variety of riparian obligate species, particularly amphibians and birds (Gordon, 1996).

Figure 5.7 Espinosa Lake, one of the historic lakes of the Salinas area. Dense groves of willow and cattails line the southeastern corner of the lakeshore (background). The north and northwestern corner of the lake are primarily cattle grazing areas (left side of the photo). Photo: Don Kozlowski, Summer 2002.

Mixed Riparian Community

The Mixed Riparian Community vegetation is found in the riparian corridors of the watershed's foothill and valley floor areas.

The dominant species found in this vegetation community are the willow (*Salix sp.*), California sycamore (*Platanus racemosa*), black cottonwood (*Populus trichocarpa*), box elder (*Acer negundo californicum*), white alder (*Alnus rhombifolia*), and oak (*Quercus spp.*) in the foothill areas. Understory species observed in this community include dogwood (*Cornus spp.*), stinging nettle, California blackberry (*Rubus ursinus*), coyote bush, and poison oak (*Toxicodendron diversilobum*) (Fig. 5.9). Emergent aquatic vegetation species include bullrush, cattails, and watercress.

Each of the major streams in the watershed supports an original or restored Mixed Riparian communitiy in places, especially Gabilan and Natividad Creeks. In these reaches, streamflow is usually non-perennial, although some reaches do have perennial flow.

Several non-native weeds (annual and perennial) are found throughout this community, with most being invasive annuals. The annuals include, poison hemlock (*Conium maculatum*), wild radish (*Raphanus raphanistrum*), and wild mustard (*Brassica kaber*) and perennials include cape ivy (*Delairea odorata*), French broom (*Genista monspessulana*), curly dock (*Rumex crispus*) and giant reed, or arundo (*Arundo donax*).

Non-native trees are also present within this community. The blue gum (*Eucalyptus globulus*), a native of Australia, and the Monterey pine (*Pinus radiata*), a California native restricted to the coast further south near Monterey, have also been observed growing along the streams and ditches of the Reclamation Ditch Watershed.

Mature riparian vegetation was cleared during the 20th Century as agricultural and urban development proceeded. West of the Gabilan Range, adjacent land uses to the riparian corridors are predominantly agricultural and urban. Where riparian vegetation exists, the corridors are generally narrow strips consisting of younger vegetation. In the foothills, the dominant adjacent land use is predominantly cattle grazing. Cattle grazing and has eliminated riparian vegetation along some of the intermittent stream channels in the foothills of the Gabilan Range.

Figure 5.8 Mixed riparian vegetation consisting of willow and sycamore trees with an understory of mixed native and non-native vegetation growing along Gabilan Creek near Natividad Road. Photo: Joel Casagrande, March 2001.

Figure 5.9 Typical understory species found within the mixed riparian community at Towne Creek. Here dogwood, stinging nettle, and California blackberry grow close to the waters edge. Photo: Joel Casagrande, 23 June 2004.

Montane Riparian Community

The Montane Riparian Community is found in the steep sloped canyons of the Gabilan Range, especially in the north and northwest-facing slopes where the microclimates are cooler and perennial streamflow is more common (Fig. 5.10). In steep canyons, the montane riparian vegetation is restricted to narrow strip on the canyon bottoms. The transition between it and the upland oak and chaparral communities is usually abrupt (Grenfell, 1988).

Common tree species in this habitat include, big-leaf maple (*Acer macrophyllum*), white alder (*Alnus rhombifolia.*), tanoak (*Lithocarpus densiflora*), and occasionally California sycamore; the most common however is big-leaf maple (Fig. 5.11). Understory vegetation is sparse, however where present, common species include, stinging nettle, wild blackberry and a variety of ferns and mosses. California buckeye (*Aesculus californica*) is common higher up on the banks.

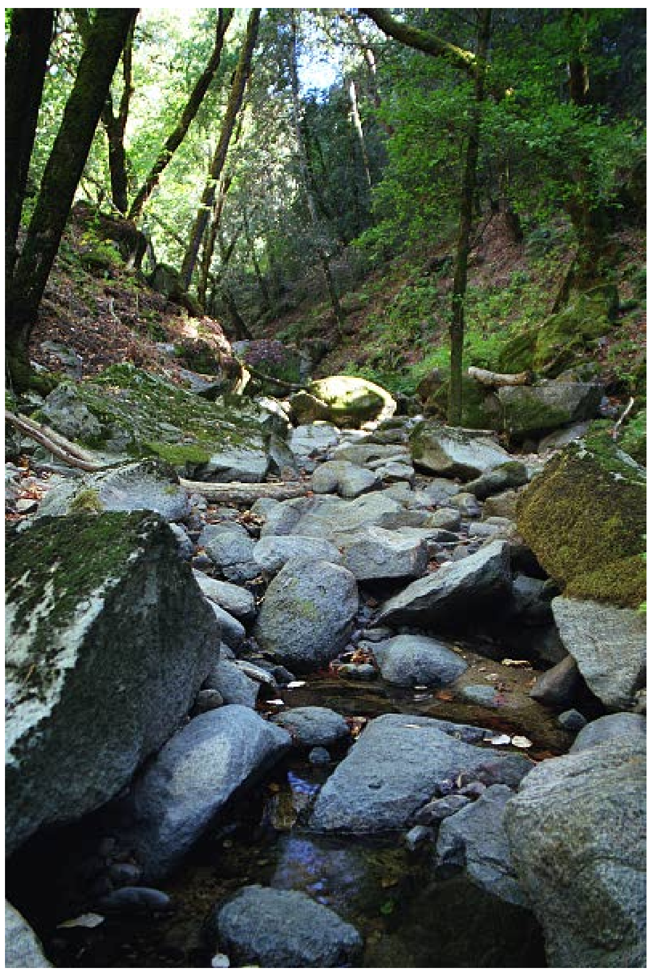


Figure 5.10 Montane riparian vegetation in upper Gabilan Creek. Photo: Joel Casagrande, September 2000.

Figure 5.11 Big-leaf maple and sycamore leaves lying in Gabilan Creek, are a significant source of detritus for many species of benthic macro- invertebrates. Photo: Thor Anderson, September 2000.

Gabilan Ridgeline and Plateau Communities

The highest elevations of the Gabilan Range, or the ridgeline, support two additional communities – the Pine/Oak community and Oak-Savanna.

The Pine/Oak community is found at the highest elevations of the range near Fremont Peak State Park. Tree species include, Coulter pines (*Pinus coulteri*), gray pine (*Pinus sambiniana*), blue oak (*Quercus douglasii*) (Fig. 5.12), coast live oak, black oak (*Quercus kellogii*), interior live oak and Pacific madrone (*Arbutus menziesii*). Shrub communities including manzanita (*Arctostaphylos sp.*), toyon (*Heteromeles arbutifolia*), coyote brush and scrub oak (*Quercus berberidifolia*) grow on the north facing slopes of Fremont Peak, while the south-facing slopes support primarily Oak-Savanna (CSP, 2002).

South of Fremont Peak, and lower in elevation, is a broad plateau that runs along the Gabilan Range ridgeline (Fig. 5.13). This area is predominantly covered by oak-savanna habitat. Prior to European settlement, the west face of the northern Gabilan Range was more wooded, covered primarily by oaks. To gain more grassland for cattle, the early settlers cut and removed the oaks, which for the most part, have been maintained as open grassland ever since (Gordon, 1996).

Figure 5.12 Deciduous blue oaks in dense fog at Fremont Peak State Park. Photo: Joel Casagrande, 29 Jan 2004

Figure 5.13 Oak-Savanna habitat along the ridgeline plateau of the Gabilan Range. The densely vegetated canyon (center) is the headwaters to Gabilan Creek. Photo: Fred Watson, Aug. 2000.

Under the scattered oak trees, the grasslands consist of both native and non-native grasses. Native grassland species include, nodding needlegrass (*Nassella cernua*) and purple needlegrass (*Nassella pulchra*) (the State Grass of California). As early as 1797, wild oats (*Avena fatuna*) were present (Gordon, 1996). Many other European grass species were spread during the 19th Century by the Spanish rancheros followed by other settlers. Species of non-native grasses include, rye grass (*Lolium spp.*) wild oat, brome grass (*Bromus spp.*), red-stem filaree (*Erodium cicutarium*), and red fescue (*Festuca rubra*) (Gordon, 1996; Monterey County, 2001).

Non-native Weeds and Grasses

Non-native weeds and/or grasses are found throughout the Reclamation Ditch Watershed from the Old Salinas River Channel to the headwaters near Fremont Peak. Table 5. is a list of the more common and threatening non-native plants that occur in the Reclamation Ditch Watershed. Weeds are a persistent nuisance for landowners in the watershed. Most of the weeds present in the Reclamation Ditch Watershed thrive in areas of high disturbance, such as roadsides, grazing lands, and ditches (e.g. Fig. 5.15).

Many of the non-native forage grasses found on the Gabilan Range include, wild oats, rip-gut brome, and blue bunch grass. On ranching lands weeds of all varieties compete with the native vegetation and can potentially create large monocultures of non-edible or toxic food such as yellow-star thistle or poison hemlock. In urban streams and ditches, excessive weed growth can increase the potential for flooding, by increasing channel roughness and reducing streamflow velocity.

The adverse impacts of non-native weeds on stream ecosystem health are also critical. Perennial weeds such as arundo, cape ivy, and ice plant are able to out compete and eventually destroy the native riparian species. Figure 5.16 shows a native cottonwood in Gabilan Creek near Crazy Horse Canyon Road that was overgrown by a large infestation of cape ivy. Cottonwoods and other native riparian species are habitat for native birds and wildlife. If left unmanaged, the growth of cape ivy will expand onto adjacent trees and will slowly replace the native vegetation. The giant reed, arundo, is invading the Reclamation Ditch Watershed in places (e.g. along Gabilan Creek downstream of Crazy Horse Road). Blue gum is a tall Australian tree that uses a lot of water, excludes other species through allelopathy, and creates a fire hazard as a result of its dry flaky bark. The resins from the flower of the blue gum have been known to clog the breathing hole of species of native songbirds (Suddjian, 2004).

Table 5.1, listing common non-native weeds and grasses in the Reclamation Ditch Watershed, is shown below.

Table 5.1 Common non-native weeds and grasses in the Reclamation Ditch Watershed.

Species (Scientific Name)	Species (Common Name)	Annual/ Perennial/ Biennial	Habitats
Anthemis cotula	mayweed chamomile	Annual	Riparian areas, disturbed areas
Arundo donax	arundo	Perennial	Riparian areas
Avena fatuna	wild oat	Annual	Coastal slopes, coastal scrub, disturbed sites
Bromus diandrus	ripgut brome	Annual	Coastal dunes, coastal scrub, grasslands
Cardaria draba	hoary cress	Annual	Riparian areas, marshes, ag lands and disturbed areas
Carpobrotus edulis / Carpobrotus chilensis	ice plant (hotentot fig and sea fig)	Perennial	Dune, marsh habitats
Cirsium vulgare	bull thistle	Annual	Riparian areas, marshes, meadows
Conium maculatum	poison hemlock	Annual	Riparian, grasslands, disturbed areas
Cortaderia selloana	pampas grass	Perennial	Coastal dunes, Coastal scrub, pine forests, riparian areas
Cytisus scoparius	Scotch broom	Perennial	Coastal scrub, oak woodlands,
Datura stramonium	jimson weed	Annual	Disturbed areas, riparian areas, roadsides
Erodium cicutarium	red-stem filaree	Annual	Riparian areas, disturbed areas, and roadsides
Eucalyptus globulus	blue gum Eucalyptus	Perennial	Riparian areas, grasslands, moist slopes
Festuca rubra	red fescue	Annual	Grasslands
Foeniculum vulgare	sweet fennel	Perennial	Grasslands
Genista monspessulana	French broom	Perennial	Coastal scrub, oak woodland, grasslands
Hirschfeldia incana	short-pod mustard	Annual	Coastal areas, grasslands, disturbed areas
Lactuca serriola	prickly lettuce	Annual	Riparian areas, disturbed areas
Lepidium latifolium	pepperweed	Perennial	Marshes, riparian areas, wetlands, and grasslands
Lolium spp.	rye-grasses	Annual	Wetland areas, disturbed sites
Malva neglecta	mallow	Annual or Perennial	Riparian areas, disturbed areas
Melilotus spp.	sweet clover	Biennial	Moist areas, disturbed areas
Opuntia spp.	prickly pear cactus	Perennial	Riparian areas, grasslands
Phalaris aquatica	harding grass	Perennial	Coastal areas, moist soils, riparian areas
Picris echioides	bristly oxtongue	Annual	Riparian areas, disturbed areas
Plantago lanceolata	English plantain	Annual	Riparian areas, disturbed sites
Polygonum arenastrum	prostrate knotweed	Annual or Perennial	Disturbed areas, riparian areas
Polypogon monspeliensis	rabbit's foot grass	Annual	Riparian areas, disturbed araes
Raphanus sativus	wild radish	Annual	Riparian areas, disturbed areas
Rubus discolor	Himilayan blackberry	Perennial	Riparian areas, marshes, oak woodlands
Rumex crispus	curly dock	Perennial	Grasslands, riparian areas
Delairea odorata	Cape Ivy (a.k.a. German Ivy)	Perennial	Riparian areas
Xanthium strumarium	common cocklebur	Annual	Riparian areas, disturbed areas

Source(s): California Invasive Plant Council – CAL-IPC available online @: http://groups.ucanr.org/ceppc/Pest%5FPlant%5FList/; Heuslid-Glass & Hernandez, 2004

Figure 5.14 Barren riparian zone on Alisal Slough (scattered tules are present). Compare with Figure 5.5, which was taken just upstream. Photo: Joel Casagrande, 14 Aug 2004.

Figure 5.15 Non-native weeds, both annual and perennial varieties, dominate the banks of the Reclamation Ditch. Here, curly dock, poison hemlock, wild radish, mustard, and others are growing on the right and on the left the vegetation has been cleared (upper bank). Photo: Joel Casagrande, 8 Jul 2004.

Figure 5.16 Cape ivy displacing a cottonwood tree in the riparian zone of Gabilan Creek near Crazy Horse Canyon Road. Photo: Joel Casagrande, August 2000.

Figure 5.17 Non-native grasses and Monterey Pine trees are found on the banks of the Reclamation Ditch near Airport Rd. Photo: Joel Casagrande, 26 Jun 2004

Distribution of Riparian Trees in the Reclamation Ditch Watershed

A separate map was created of the distribution of riparian trees in the watershed, because trees are a primary determinant of riparian function. They create shade, maintain low water temperatures, and create vertically structured habitat for birds (Suddjian, 2002). Figure 5.18 shows the current distribution of riparian trees in the Reclamation Ditch Watershed. Riparian forest was mapped using a combination of aerial photos[10] along with field surveys conducted from public roads.

There are historical accounts of riparian trees and vegetation throughout the lower watershed – in places where trees no longer grow. The banks near Moss Landing Harbor once supported cottonwoods. A photograph taken in 1870, published in Breschini et al., (2000), shows cottonwoods and other freshwater species growing along the banks of the "great bend in the slough" (a historic reach of Alisal Slough near downtown Salinas which no longer exists). Other accounts of riparian vegetation in the lower Reclamation Ditch Watershed include that of Gordon (1996) who quotes a description (Antilsell, 1854-1855, pp. 38-39) of the northern Salinas Valley: "*Much of the land is swampy and overgrown with tule, rush, willows, and marsh vegetation*."

Much of the riparian vegetation on the valley floor was removed or significantly altered long ago during agricultural and urban development. Today, small trees are removed from channels in order to improve streamflow for flood prevention – subject to CDFG permitting restrictions (COS, 2004).

In the foothill areas, the loss of some riparian vegetation has been attributed to livestock grazing (Figs 5.19 & 5.20) and clearing by Spanish Rancheros and white settlers in the 19th Century. Little change has occurred in the montane riparian vegetation community. While some grazing does occur in these reaches, most areas are too steep and dark for forage species to grow in abundance. Young tree saplings are browsed upon by cattle, which reduces reproduction and recruitment of tree species.

[10] Three sources of aerial imagery were used to assess the entire watershed: Color aerial ortho photo courtesy of the City of Salinas (date May 2002), Digital ortho photos courtesy of University California Santa Cruz (UCSC) (date 24 Oct 2000), and Digital ortho photos courtesy of Monterey County (date December 1999).

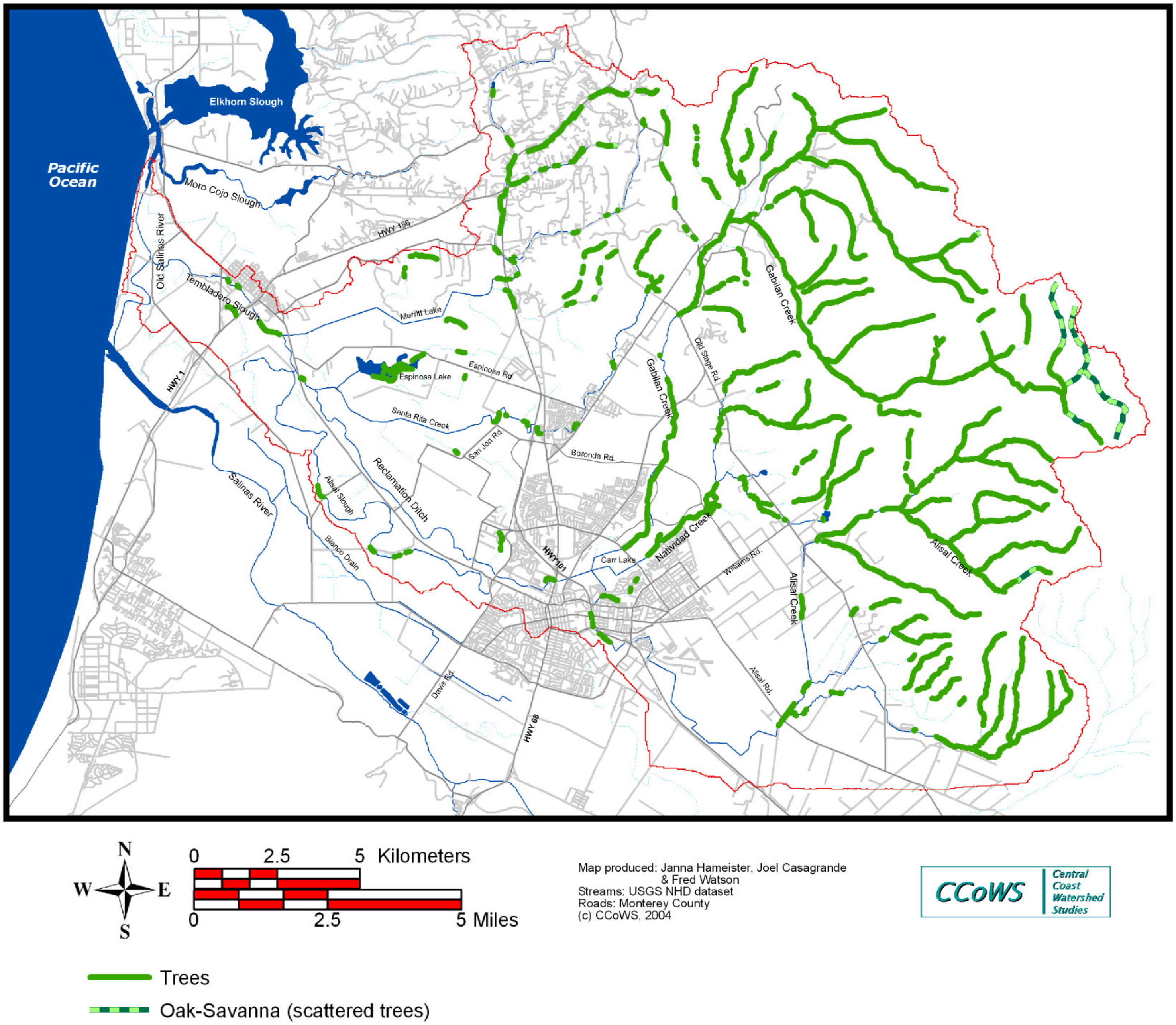


Figure 5.18 Distribution of riparian trees in the Reclamation Ditch Watershed.

Figure 5.19 Erosion along Vierra Creek (a tributary to Gabilan Creek). Photo: Fred Watson, April 2000.

Figure 5.20 Cattle grazing in Alisal Creek. Mature sycamores and oaks are shown in the background, however young tree saplings and understory vegetation are not present. Photo: Fred Watson, 11 Dec. 2003.

Figure 5.21 Removal of streamside vegetation at Towne Creek. Removal of the overhead cover reduced the amount of shade over the stream. Since 2001 some of the vegetation has grown back. Photo: Fred Watson, March 2001.

Distribution of Rare/Listed Plants and Natural Communities

The California Department of Fish and Game Habitat Conservation Division has developed the California Natural Diversity Database (CNDDB). The database, developed in 1979, is continuously updated and supports queries of species occurrence records for California's rare and listed species as well as rare and unique habitat communities. The database is not complete. The database is designed to display all individual species occurrences with a circle indicating the degree of uncertainty, unless a more accurate, irregular-shaped area was mapped using a GPS unit (see Figure 7. -burrowing owl @ Salinas Airport). In addition, observation locations are defined by CDFG as either "specific," or "non-specific", based on the information provide to CDFG. A specific observation is noted with a smaller circular polygon and has a scaled radius size of less than 80m. A non-specific observation can be noted by a series of larger circular polygons with a scaled radius greater than 80 m, depending on the accuracy of the observation. The maximum degree of uncertainty is 8 km (5 miles).

The database was reviewed for the occurrence of special-status plant species and unique natural communities in the Reclamation Ditch Watershed and surrounding area. A total of five endangered plant species, one threatened plant species, and eight plant species of Special Concern occur in the Reclamation Ditch Watershed and surrounding area (Fig. 5.22, Table 5.). A number of unique and natural plant communities occur just outside the watershed (Figure 5.23). Areas with the highest occurrence of plant species of special status were the former Fort Ord, outside of the Reclamation Ditch watershed, and the coastal dune habitats (Fig. 5.22).

One Federally Endangered Species, Yadon's Rein Orchid (*aka* piperia), has been observed in the upper Merritt Lake drainage near Prunedale (Vierra Canyon area). It grows in shallow, moist soils in Monterey pine forest and maritime chaparral communities in northern Monterey County (USFWS, 1998). Monterey spineflower, a Federally Threatened Species, has been observed in the vicinity of the watershed boundary (near Tembladero Slough and near the upper Merritt Lake drainage). Monterey spineflower prefers areas of high disturbance, especially in coastal maritime chaparral. The occurrence of Monterey spineflower is higher on the former Fort Ord, outside of the Reclamation Ditch watershed, where coastal maritime chaparral is more abundant. Several plant Species of Concern are found within and on lands adjacent to the Reclamation Ditch Watershed. Congdon's tarplant and alkali milk vetch have both been observed within the Reclamation Ditch Watershed.

The five unique natural communities that occur in the lands peripheral to the watershed include, Central Dune Scrub, Central Maritime Chaparral, Coastal Brackish Marsh, Coastal and Valley Freshwater Marsh, and Northern Coastal Saltwater Marsh. Although not noted in the CNDDB, a riparian forest community is found throughout the watershed and is considered a sensitive habitat in other studies including the Monterey County DRAFT General Plan (Monterey County, 2004) (Fig. 5.18).

Table 5.2 Threatened and endangered plant species occurring in the Reclamation Ditch Watershed and surrounding area. Source: CNDDB, 2004. Species notes: CDFG, 2004a.

Species (Common name)	Species (Scientific Name)	State Listing	List Date	Federal Listing	List Date	Notes
Yadon's wallflower	Erysimum yardonii	SE	Sep 1984	FE	22 Jun 1992	The U.S. Fish and Wildlife Service listed all as endangered E. menziesii, ssp. eurekense, E. menziesii spp. menziesii, and E. menziesii spp. yardonii.
Contra Costa gold fields	Lasthenia conjugens			FE	18 Jun 1997	
Yadon's rein orchid (aka piperia)	Piperia yadonii			FE	12 Aug 1998	
sand gilia	Gilia tenuiflora ssp. arenaria	ST	Jan 1987	FE	22 Jun 1992	
robust spineflower	Chorizanthe (includes vars. Hartwegii and robusta			FE	04 Feb. 1994	
Monterey spineflower	Chorizanthe pungens var. pungnes			FT	04 Feb. 1994	

SE = California State listed as an Endangered Species
ST = California State listed as a Threatened Species
FE = Federally listed as an Endangered Species

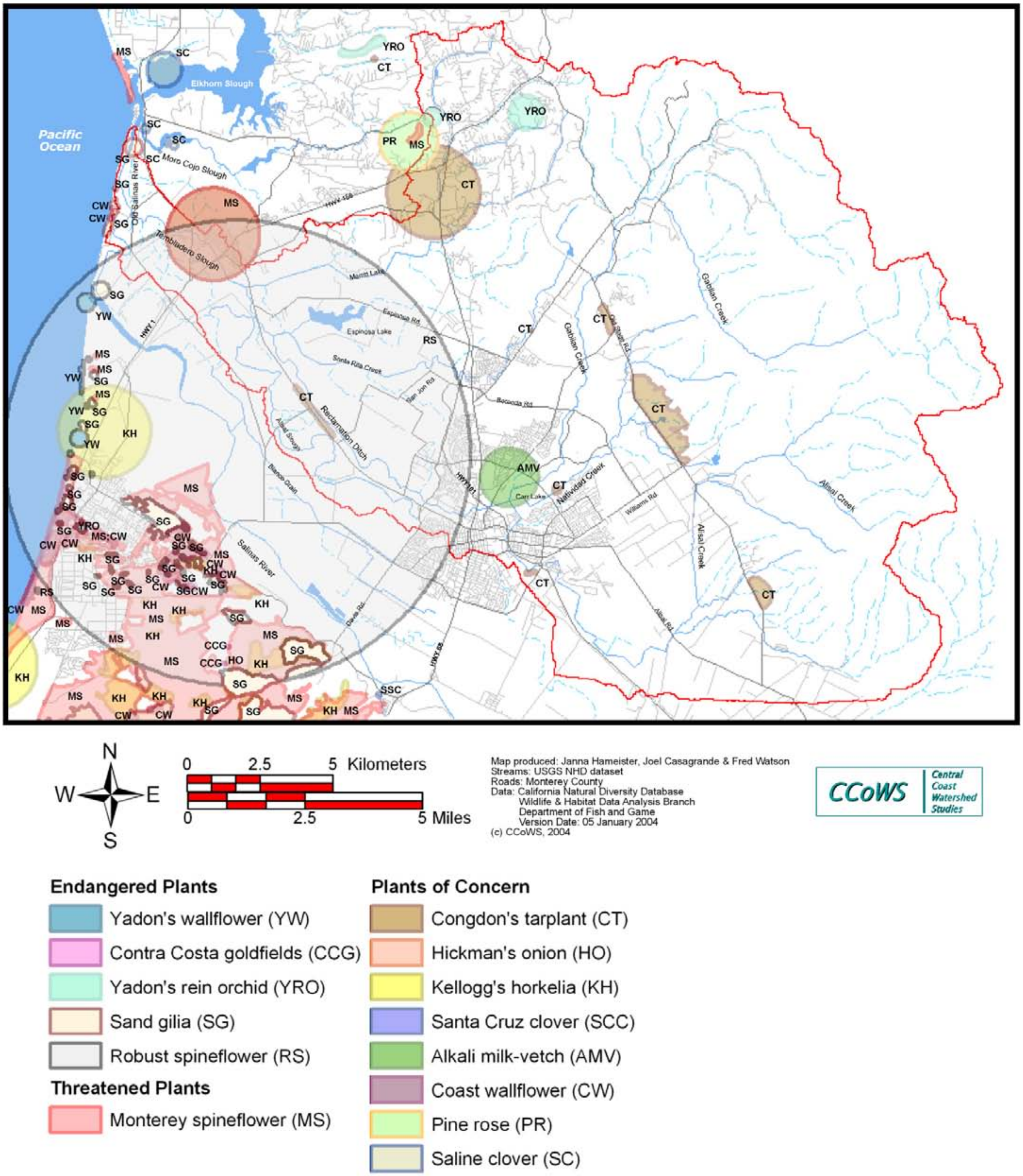


Figure 5.22 Occurrence of endangered, threatened, and species of concern in the Reclamation Ditch Watershed. Data source: CNDDB. Circles indicate the degree of uncertainty in the locations of certain species records.

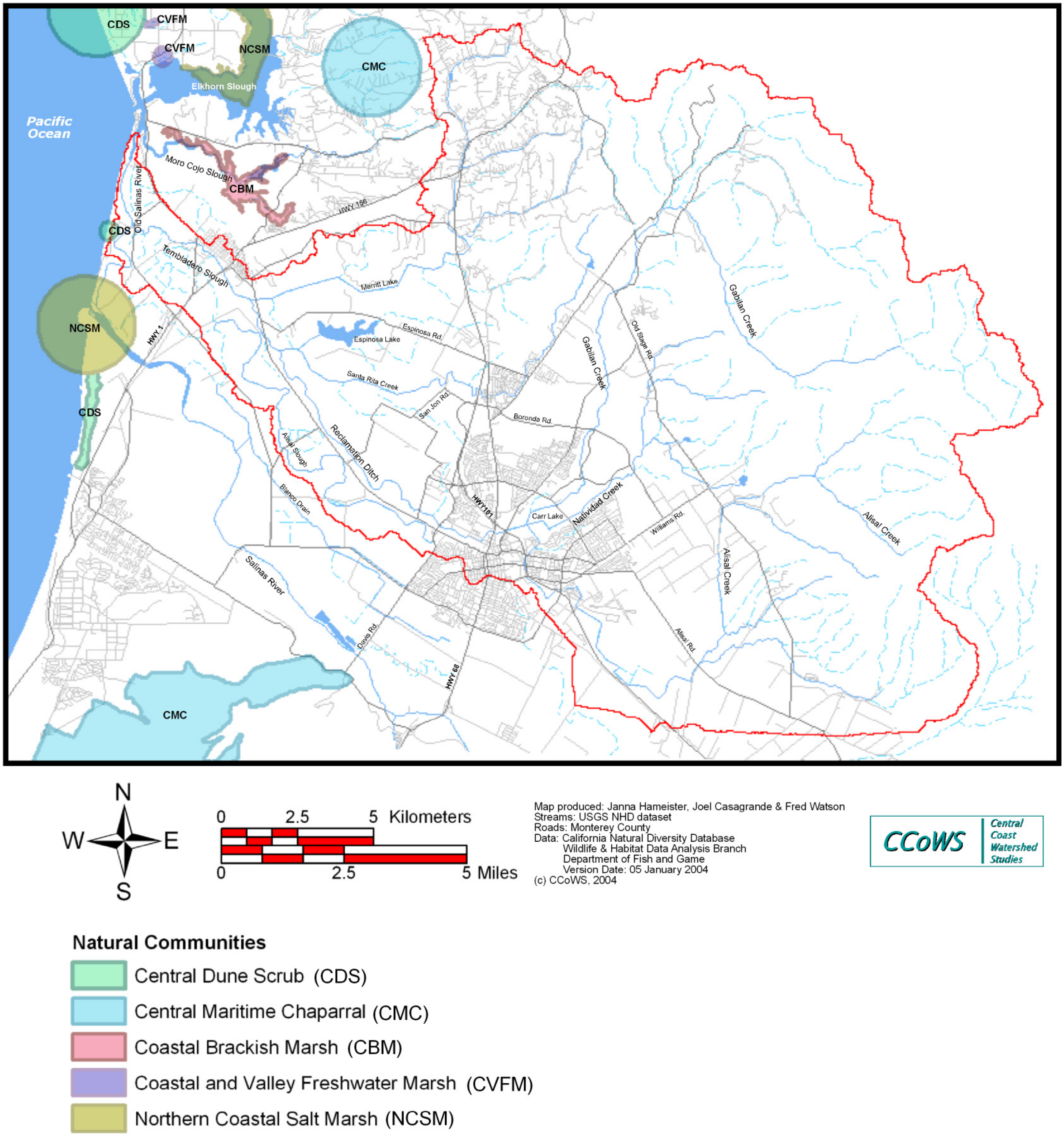


Figure 5.23 Unique Natural Communities within the Reclamation Ditch Watershed and surrounding areas. Data source: CNDDB. Circles indicate the degree of uncertainty in the locations of certain community records.

[Page intentionally left blank]

6. Water Quality Assessment

Reclamation Ditch at San Jon Road. Aquatic plant growth as shown here is a result of nutrient loading and lack of shade cover. Photo: Joel Casagrande, August 17, 2000.

Overview:

Water quality is a key determinant of aquatic ecosystem health and provides insight to the degree of anthropogenic impacts to the environment. In order to better understand the health of the ecosystem, its organisms and their composition and spatial distribution, it is important to understand the temporal and spatial trends of water quality constituents throughout the watershed. Key parameters for aquatic health are temperature, dissolved oxygen, sediment, nutrients (e.g. nitrate, ammonia and phosphate), pesticides, and fecal bacteria. Aquatic ecosystems respond to these constituents in a variety of ways. For example, fish species communities are often structured based on water temperature and channel substrate (sediment) composition. Also, some aquatic species are more tolerant of pollutants than others. Pesticides are often toxic to macroinvertebrates, which in turn form the diet of higher species such as fish.

Specific Beneficial Uses of the Reclamation Ditch Watershed

The Reclamation Ditch Watershed is home to a variety of different ecosystems ranging from lush riparian corridors in the mountain canyons to the tidal mud flats near the Potrero Tide Gates. Each of the major streams and their ecosystems and the water itself, provide benefits, or "beneficial uses" to both the people and the organisms of the Reclamation Ditch Watershed. The term "Beneficial Uses" is a formal concept adopted by the Central Coast Regional Water Quality Control Board (CCRWQCB) to define water quality parameters. Once a water body is listed for a beneficial use, then compatible water quality objectives are used to protect the future of that beneficial use.

There are 24 such Beneficial Uses listed in the Basin Plan (1994) for the Central Coast Region (RWQCB Region 3.)[11]. Beneficial uses for the specific streams, sloughs, lakes, and estuarine habitats of the Reclamation Ditch Watershed are included in the Strategy and are summarized in Table 6.1. The Basin Plan is periodically revised based on new information.

[11] A complete list of the Basin Plan (1994) Beneficial Uses and their definitions is available @: http://www.swrcb.ca.gov/rwqcb3/BasinPlan/BP_text/chapter_2/Chapter2.htm

Table 6.1 Beneficial Uses that apply to waterways of the Watershed (Basin Plan 1994)

Waterway	Objective Code	Objective
Gabilan Creek	REC-1	Water contact recreation
	REC-2	Non-contact water recreation
	MUN	Municipal or domestic supply
	AGR	Agricultural supply
	GWR	Groundwater recharge
	WILD	Wildlife habitat
	WARM	Warm fresh water habitat
	SPWN	Spawning, reproduction, and/or early development
	COMM	Commercial and sport fishing
Alisal Creek	REC-1	Water contact recreation
	REC-2	Non-contact water recreation
	MUN	Municipal or domestic supply
	AGR	Agricultural supply
	GWR	Groundwater recharge
	WILD	Wildlife habitat
	WARM	Warm fresh water habitat
	COLD	Cold fresh water habitat
	SPWN	Spawning, reproduction, and/or early development
	COMM	Commercial and sport fishing
Reclamation Ditch (a.k.a Salinas Reclamation Ditch)	REC-1	Water contact recreation
	REC-2	Non-contact water recreation
	WILD	Wildlife habitat
	WARM	Warm fresh water habitat
	COMM	Commercial and sport fishing
Tembladero Slough	REC-1	Water contact recreation
	REC-2	Non-contact water recreation
	WILD	Wildlife habitat
	WARM	Warm fresh water habitat
	SPWN	Spawning, reproduction, and/or early development
	RARE	Rare, threatened, or endangered species
	EST	Estuarine habitat
	COMM	Commercial and sport fishing
	SHELL	Shellfish harvesting
Espinosa Lake	REC-1	Water contact recreation
	REC-2	Non-contact water recreation
	WILD	Wildlife habitat
	WARM	Warm fresh water habitat
	COMM	Commercial and sport fishing
Espinosa Slough	REC-1	Water contact recreation
	REC-2	Non-contact water recreation
	WILD	Wildlife habitat
	WARM	Warm fresh water habitat
	COMM	Commercial and sport fishing

Water Quality Of Reclamation Ditch Watershed Sites Within Regional Context

CCRWQCB background statements

The primary agency responsible for water quality regulation is the Central Coast Regional Water Quality Control Board (CCRWQCB). The CCRWQCB and its staff recognize the existence of water quality concerns in the region, and in the Reclamation Ditch Watershed. Urban and agricultural sources of water contamination have been the focus of recent Board attention. With respect to urban sources, the following text is excerpted from a staff report to the CCRWQCB in association with the renewal of the Storm Water Discharge permit for the City of Salinas (CCRWQCB Staff, 2004):

> *From Page 9:*
>
> *"Urban areas provide sources. Development and urbanization increases pollutant load, volume, and discharge velocity over background levels. The common result of increased impervious surfaces in urban areas, is that urban pollutants are quickly and efficiently carried to natural water bodies, and increased runoff volumes result in increased erosion rates of receiving waters."*

> *From Page 9 & 10:*
>
> *"Urban pollutants of concern that may be contained in storm water include, but are not limited to: certain heavy metals; sediments; pathogens; petroleum hydrocarbons; polycyclic aromatic hydrocarbons (PAHs), trash, and pesticides; herbicides; and nutrients that cause or contribute to the depletion of dissolved oxygen and/or toxic conditions in the receiving water. Excessive flow rates of storm water may cause or contribute to downstream erosion and/or excessive sediment discharge and deposition in stream channels. The quality and quantity of MS4 discharges may very considerably because of the effects of hydrology, geology, land use, season, and sequence and duration of precipitation events."*

With respect to agricultural sources, the Board provided the following language in the context of the process of the waiver of the need for agricultural dischargers to hold specific waste discharge permits (CCRWQCB, 2004b):

> ***Existing Water Quality in Agricultural Areas***
>
> *Information available to the Regional Board, including information used in identifying impaired water bodies within the Region in accordance with Clean Water Act section 303(d), indicates that irrigation return water and storm water runoff from irrigated lands contains waste that has impacted water quality in the waters of the State within the Region.*

Over the past five years, the Regional Board's Central Coast Ambient Monitoring Program (CCAMP) has provided information to characterize water quality, support waterbody beneficial use determinations, support waterbody listings for impairment, and to evaluate regional priorities. Under CCAMP, the Region has been divided into five rotational monitoring areas, based on hydrologic units such as the Pajaro River, Salinas River and Santa Maria River. Each rotational area is monitored once every five years. CCAMP performs tributary-based, in-stream monitoring at fixed sites throughout the rotational area on a monthly basis. The same sites are monitored again during the next rotational cycle.

Comparison with CCAMP data from the Salinas Valley sub-region

On a five-year rotation, the Central Coast Ambient Monitoring Program (CCAMP) collects monthly water quality samples at numerous sites within each of five sub-regions within the Central Coast Region. The Salinas Valley area was targeted in 1999-2000, with results published by Worcester et al. (2000). The study incorporated data from the Salinas River Watershed, Reclamation Ditch Watershed, Moro Cojo Watershed, and Elkhorn Slough Watershed. Analytes included dissolved oxygen, temperature, nutrients, coliform bacteria, turbidity, dissolved solids, total suspended solids (TSS), chloride, calcium, magnesium, boron, hardness, chlorophyll-a, algal cover, plant cover, water level and estimated velocity, benthic invertebrates, metals in sediments, organic chemicals in sediments (mainly legacy pesticides), toxicity, and tissue bioaccumulation. Monthly sampling (water permitting) of conventional water quality parameters was conducted at 35 sites from February 1999 into the winter months of 2000. Seven of these sites are in the Reclamation Ditch Watershed. Sediment chemistry was sampled once at each of 29 sites.

Table 6. compares the Reclamation Ditch Watershed results with those from the broader sub-region by showing the ranking of data from each site within the sub-region dataset. Only select analytes are shown: nutrients, fecal coliform, and certain legacy pesticides. With respect to these analytes, the Reclamation Ditch Watershed consistently contained at least three out of the five sites with the highest average concentrations in the Salinas Valley sub-region. In many cases, concentrations exceeded water quality attention levels and action levels defined by CCAMP. In summary, the CCAMP data show that in 1999-2000, the Reclamation Ditch Watershed exhibited more water quality concerns than most of the sub-regions. Table 6.2 shows CCAMP Hydrologic Unit Code and translating Watershed.

Comparison with CCAMP data from the entire Central Coast Region

Data from all CCAMP measured waterbodies in the Central Coast Region are compared in Figures 6.1 to 6.5. Mean concentration values were computed by CCAMP for each waterbody (i.e. many waterbodies have more than one sampling site). Mean concentrations are ranked and plotted for nutrients (nitrate, ammonia, phosphate), suspended sediment, and fecal coliforms. Waterbodies within the Reclamation Ditch Watershed are depicted in dark red. Sampled nitrate and ammonia levels in the Reclamation Ditch Watershed were in the top quartile for the Region, and were comparable to other waterbodies- such as sites in the Santa Maria Watershed. Sampled phosphate levels were also in the top quartile, comparable to Regional sites representing a broader geographic area including the Santa Ynez and Santa Maria Watersheds. Sampled total suspended solids levels for streams in the Reclamation Ditch Watershed were in the top quartile at most sites. Gabilan Creek, which drains a mixture of different land use types was in the top four for all waterbodies for TSS. Other waterbodies with high TSS values occurred in intensive agricultural areas (e.g. Quail Creek) and in highly tectonic, erosive, dryland grazing landscapes such as at San Lorenzo Creek, Cuyama River, and Tres Pinos Creek. In Fig. 6.5, fecal coliforms are the only parameter where the Reclamation Ditch Watershed stands out above most other intensively used areas in the region - with 5 of the top 20 waterbodiesin the Region. The highest waterbody average concentrations were observed in the Salinas Reclamation Ditch. In summary, the water quality concerns of the Reclamation Ditch Watershed are similar to those of other agricultural and urban watersheds in the California Central Coast Region.

Please note, the following CCAMP data was collected during a single sampling season, 1999-2000. No conclusive inference about individual sites or sources should be drawn from the following tables.

Table 6.2. Salinas Valley sub-region, water quality rankings for Reclamation Ditch Watershed sites and waterbodies throughout the. – based on CCAMP data 1999-2000. Rankings are given for concentrations of selected water quality analytes, and selected legacy pesticides in sediments. Low rankings indicate higher concentrations.

CCoWS Site Code	CCAMP Site Code	CCAMP Site Name	Reclamation Ditch Watershed?	# water samples	Nitrate rank	Ammonia rank	Ortho-phosphate rank	Fecal coliform rank	# sediment samples	p,p'-DDE rank	Dieldrin rank	Endo-sulfan I rank	Endrin rank
	ELK	Elkhorn Slough at Kirby Park		15					1				
	CAR	Carneros Creek at Blohm Rd		13					1				
	MOR	Moro Cojo Slough at Highway 1		13					1				
	MOS	Old Salinas River at Moss Landing Rd North		13					1				
	SDW	Old Salinas River at Monterey Dunes Way		14					1				
OLS-POT	POT	Old Salinas River at Potrero Rd	Yes	14	5	12	11	9	1	1	3	1	5
TEM-PRE	TEM	Tembladero Slough at Preston Rd	Yes	13	4	5	6	15	1	7	5	2	4
REC-BOR	ALD	Salinas Reclamation Canal down at Boronda Rd	Yes	17	10	2	7	4	1	5	1	NA	2
REC-AIR	ALU	Salinas Reclamation Canal at Airport Rd	Yes	15	6	1	3	2	1	4	7		
	AXX	Salinas Reclamation Canal Drain at Airport Rd	Yes	3	11	4	5	3	-				
ALI-OLS	UAL	Alisal Creek at Old Stage Rd	Yes	6	3	7	4	11	-				
GAB-BOR	GAB	Gabilan Creek at East Boronda Rd	Yes	6	12	13	10	12	1	2	2	NA	1
	SDR	Salinas River Storm Drain		12					1				
	SBR	Salinas River at Highway 1 Bridge		14					1				
	DAV	Salinas River at Davis Rd		21					1				
	QUA	Quail Creek		6					1				
	UQA	Quail Creek at Old Stage Rd		2					-				
	SAC	Salinas River at Chualar Bridge		12					1				
	SEC	Arroyo Seco River		10					1				
	SET	Arroyo Seco River at Thorn Rd		7					-				
	GRN	Salinas River at Greenfield		14					1				
	TOP	Topo Creek		1					-				
	KNG	Salinas River at King City		14					1				
	LOR	San Lorenzo Creek		12					1				
	LOK	San Lorenzo Creek in King City		3					1				
	DSA	Salinas River downstream of San Ardo		16					1				
	USA	Salinas River upstream of San Ardo		16					1				
	NAC	Nacimiento River		15					1				
	SAN	San Antonio River		15					1				
	SUN	Salinas River up stream of the Nacimiento River		4					1				
	EST	Estrella River		4					1				
	PSO	Salinas River at 13th Street		7					1				
	CHO	Cholame Creek at Bitterwater Rd		13					1				
	ATS	Atascadero Creek at Highway 41		22					1				
	SAT	Salinas River at Highway 41		11					-				
		Number of sites or waterbodies reported		**35**	**35**	**35**	**35**	**35**	**29**	**29**	**29**	**18**	**18**

[Page intentionally left blank]

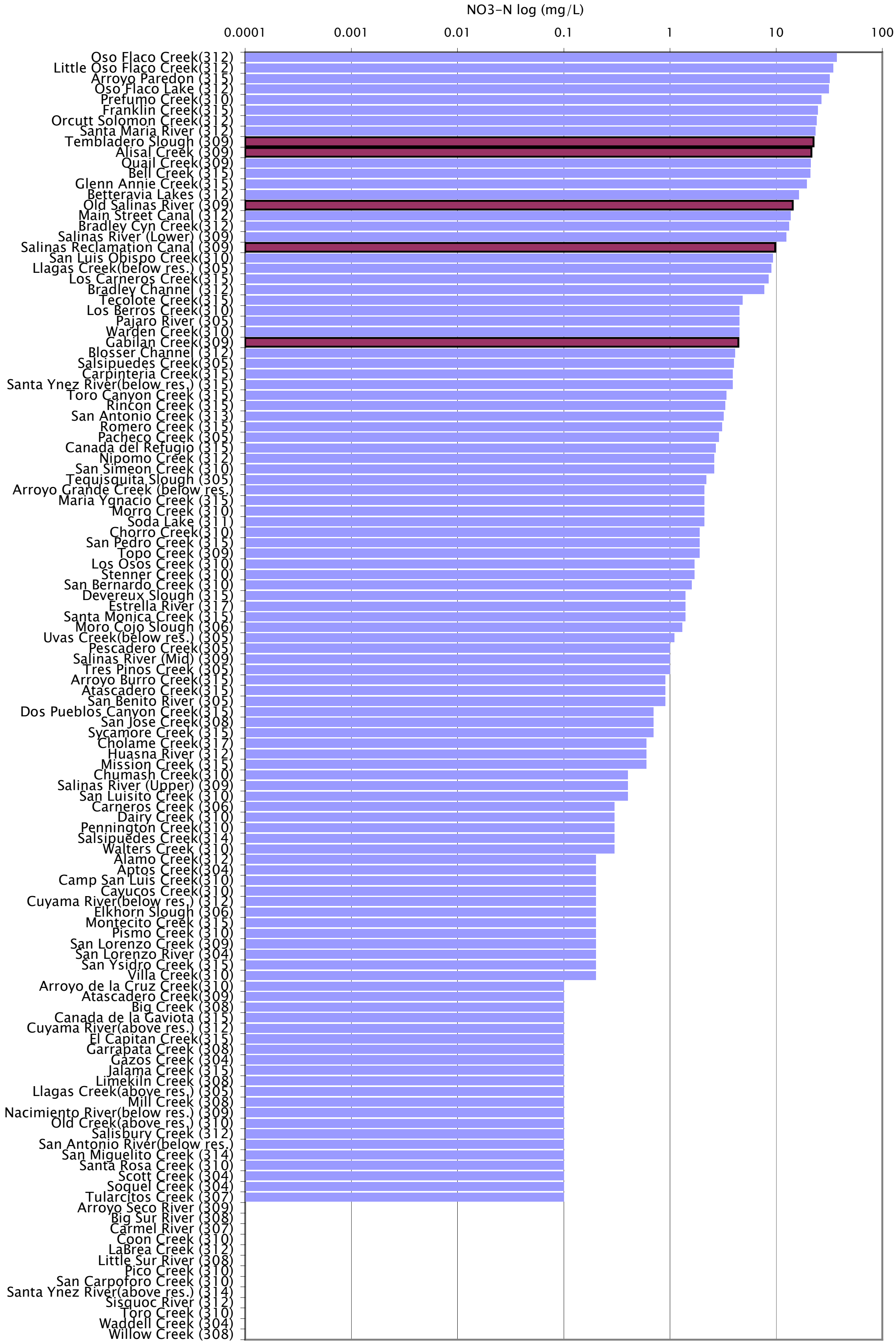


Figure 6.1 Mean nitrate concentrations (NO_3-N) at all CCAMP measured waterbodies throughout the Central Coast Region 3. Waterbodies in the Reclamation Ditch Watershed are shown in dark red **(Units: log scale mg/L)**.

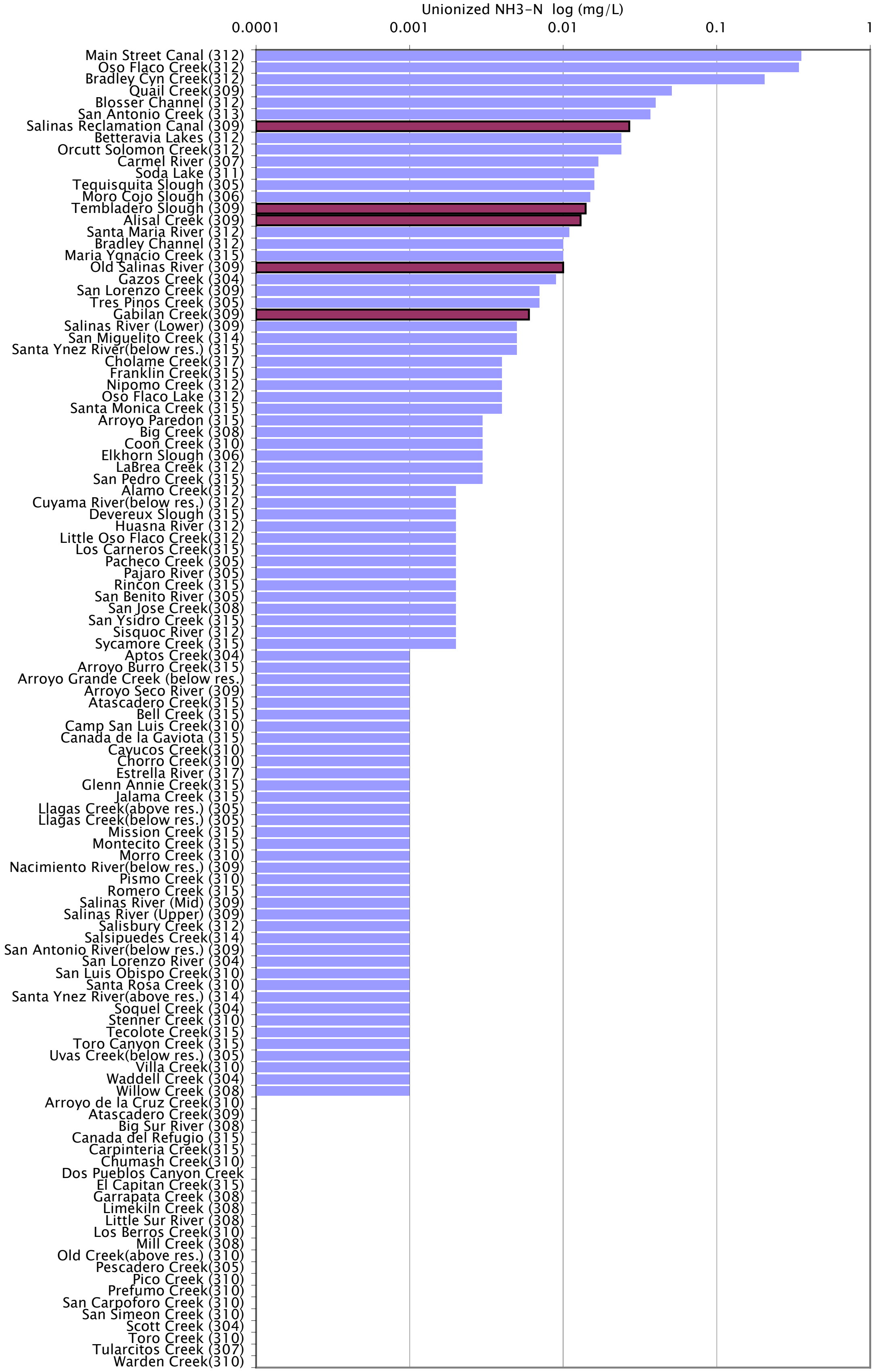


Figure 6.2 Mean unionized ammonia (NH_3-N) at all CCAMP measured waterbodies throughout the Central Coast Region 3. Waterbodies in the Reclamation Ditch Watershed are shown in dark red **(Units: log scale mg/L)**

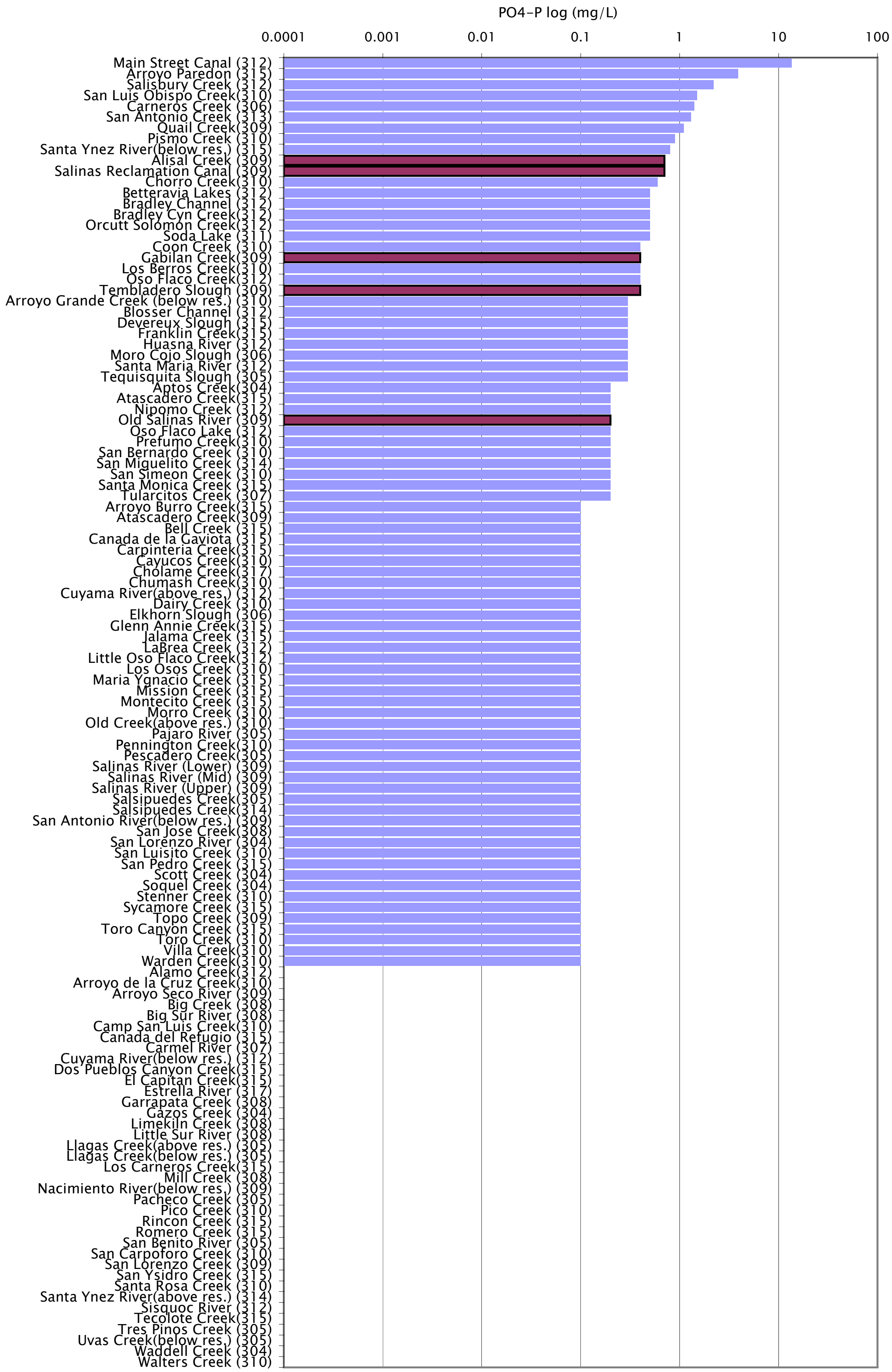


Figure 6.3 Mean phosphate concentrations (PO_4-P) at all CCAMP measured waterbodies throughout the Central Coast Region 3. Waterbodies in the Reclamation Ditch Watershed are shown in dark red **(Units: log scale mg/L)**.

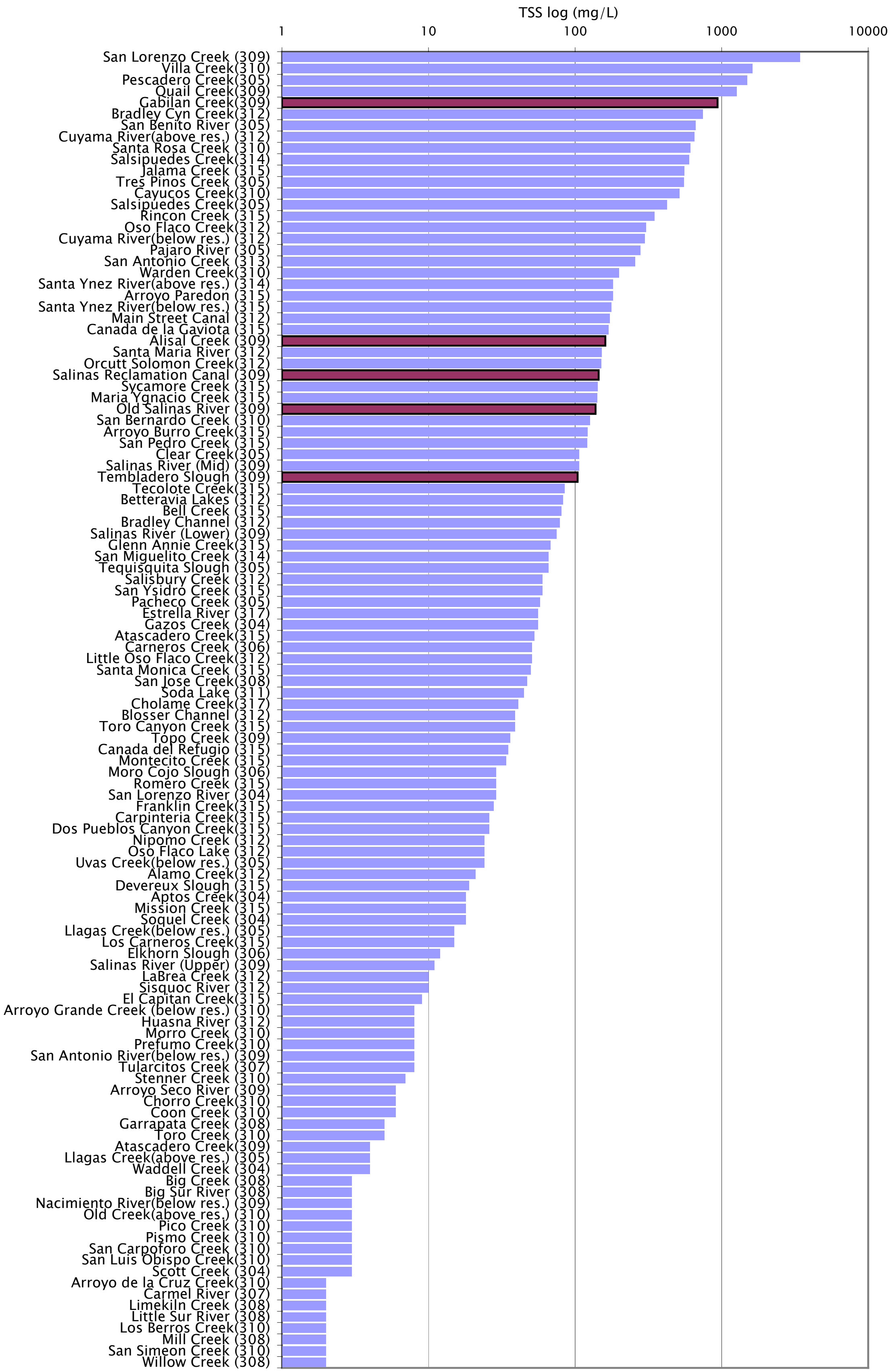


Figure 6.4 Mean total suspended solids (TSS) at all CCAMP measured waterbodies throughout the Central Coast Region 3. Waterbodies in the Reclamation Ditch Watershed are shown in dark red **(Units: log scale, mg/L)**.

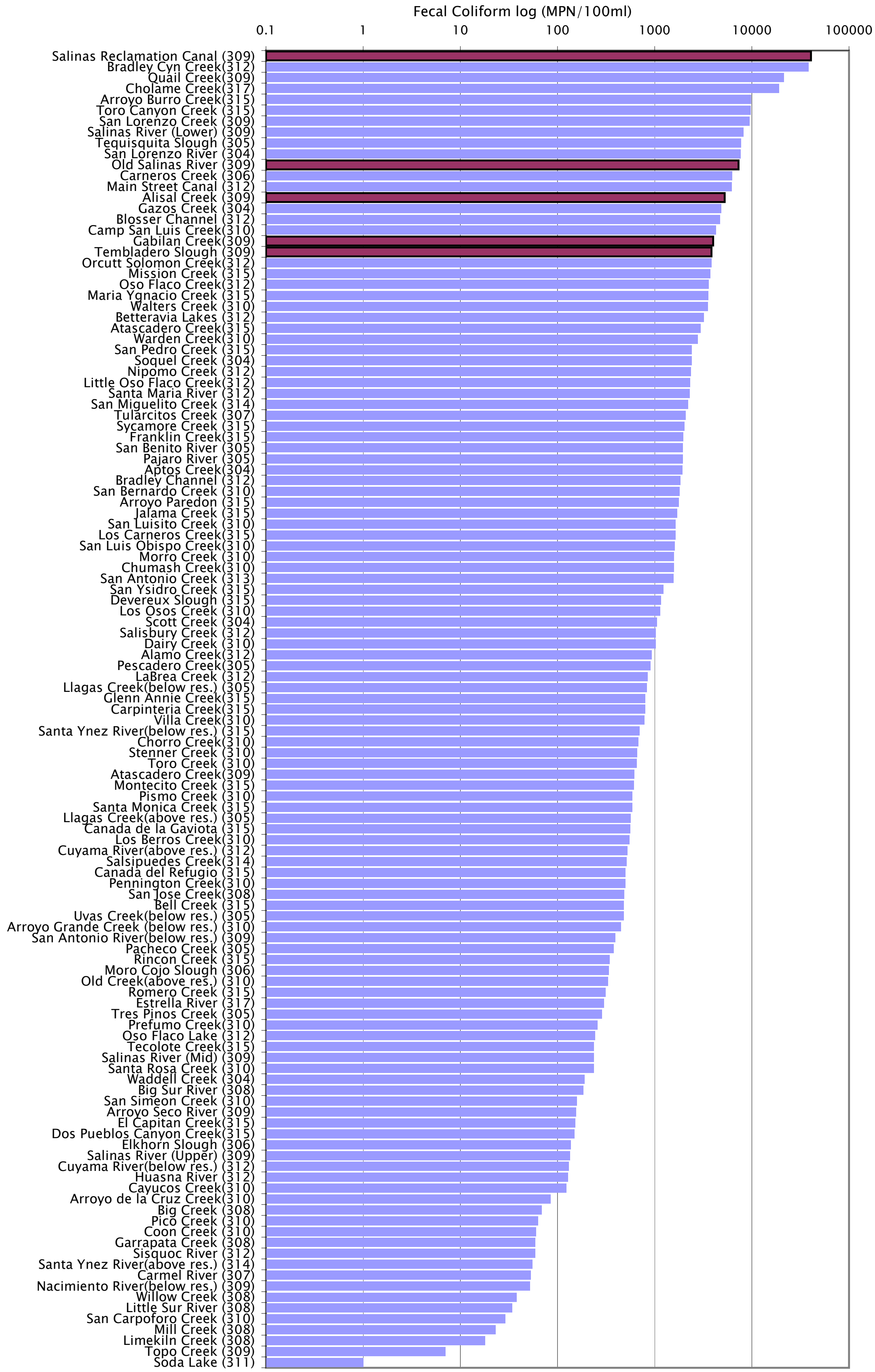


Figure 6.5 Mean fecal colifom at all CCAMP measured waterbodies throughout the Central Coast Region 3. Waterbodies in the Reclamation Ditch Watershed are shown in dark red **(Units: log scale MPN/100 ml)**.

Table 6.3 CCAMP Hydrologic Unit Code and translating Watershed.

CCAMP Hydrologic Unit Code	Watershed
304	Big Basin (Santa Cruz)
305	Pajaro River
306	Bolsa Nueva (Elkhorn Slough)
307	Carmel River
308	Santa Lucia (Big Sur Coast)
309	Salinas (Reclamation Ditch Watershed Included)
310	Estero Bay
311	Carrizo Plain
312	Santa Maria
313	San Antonio
314	Santa Ynez
315	South Coast
316	Channel Islands
317	Estrella River

Legacy pesticides

Legacy pesticides are those that are no longer used, but are persistent in the environment. Many are organochlorine insecticide compounds that were banned primarily in the 1970s. The best known is DDT and its byproducts, DDE and DDT, used in the Reclamation Ditch Watershed apparently for mosquito abatement, agricultural, and urban uses. These compounds are still found in the waters and sediments of the Reclamation Ditch Watershed.

The Salinas River Lagoon Management and Enhancement Plan (JGA et al., 1997) cites a number of studies from the 1980s suggesting that soils in the northern Salinas Valley contain a reservoir of DDT that will continue to release DDT into aquatic environments 'well into the 21st Century'. During relatively quiescent conditions in 1999, CCAMP measured p,p'-DDE in sediments at above 35 μg/kg at OLS-POT and GAB-BOR and above 5 μg/kg at REC-AIR, REC-BOR, and TEM-PRE (Worcester et al., 2000) (see Table 6. for explanation of site codes). Four years later during a storm in March 2003, Kozlowski et al., (2004b) measured p,p'-DDE in sediments at 65 μg/kg at REC-JON, 61 μg/kg at OLS-POT, and 27 μg/kg at TEM-RAI. These concentrations fail to meet objectives pertaining to biological toxicity. Long et al., (1995) define the biological effects range median (ERM) for p,p'-DDE as 27 μg/kg . Kozlowski et al., (2004b) also detected DDT byproducts and Dieldrin in the water column - calculating an export to Moss Landing Harbor and the Monterey Bay National Marine Sanctuary of about 3 grams of DDT byproducts per hour during the storm that was sampled.

The above data are not easily comparable over time because Worcester et al., sampled during a quiescent period, and Kozlowski et al., sampled during a storm - when legacy pesticides are expected to reach elevated levels due to the mobilization of the sediments to which these compunds typically bind. There is however, some evidence for a gradual decline in DDT byproducts levels in the neighboring Blanco Watershed. Here, Mischke et al., (2003) reviewed total DDT levels in 1984 to average 2100 μg/kg, whereas Kozlowski et al., measured levels of 256 and 305 μg/kg respectively at two sites in the watershed.

303d list of Impaired Waterbodies

Several water bodies of the Reclamation Ditch Watershed and others downstream have been listed as having water quality that does not meet set water quality standards defined under Section 303(d) of the 1972 Clean Water Act (Table 6.3). Such water bodies are referred to as “303(d) Listed Water bodies” and are shown in Figure 6.6.

[12] SWRCB 303(d) listings: http://www.swrcb.ca.gov/tmdl/303d_lists.html

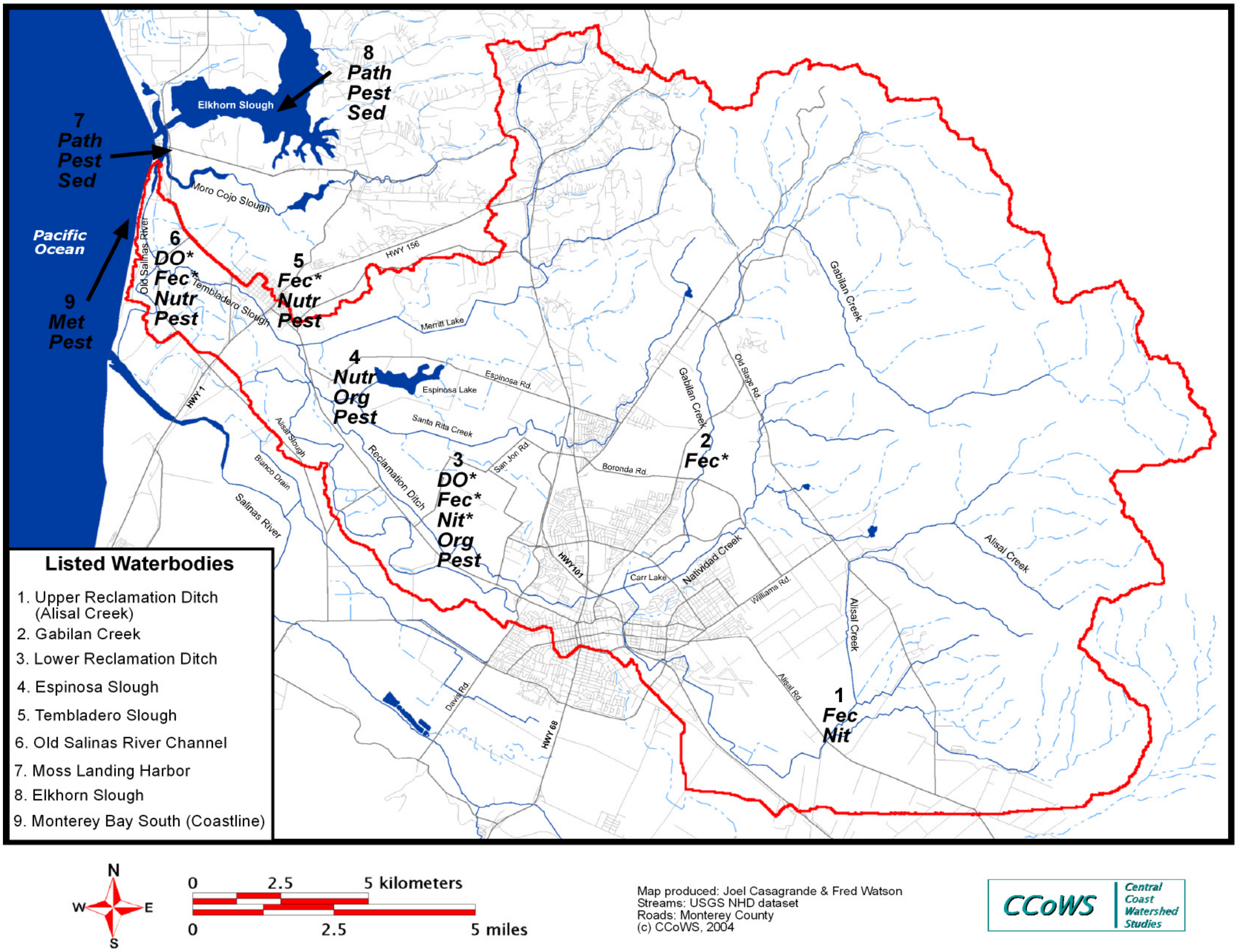


Figure 6.6 Section 303(d) listings for various water bodies within and adjacent to the Reclamation Ditch Watershed.

DO = Low dissolved oxygen
Fec = Fecal Coliform
Nit = Nitrate
Nutr = Nutrients
Org = Priority Organics
Pest = Pesticides
Sed = Sedimentation/Siltation
Met = Metals
* Listings added in 2002 (approved by EPA, 2003). All others were included in the 1998 listing.

Local Water Quality Publications

Since the 1990's, several studies have been conducted on various water quality parameters within the northern Salinas Valley. Some of these are included in Table 6.5.

Table 6.4 Incomplete Bibliography (see Chapter 8 for complete bibliography) for water quality documents of the Northern Salinas Valley area.

Anderson, B., J. Hunt, B. Phillips, P. Nicely, K. Gilbert, V. De Vlaming, V. Connor, N. Richard and R. Tjeerdema. 2003a. Ecotoxicologic impacts of agricultural drain water in the Salinas River, California, USA. Environmental Toxicologic Chemistry 22 (2003). 10 pp.

Anderson, B., J. Hunt, B. Phillips, P. Nicely, V. de Vlaming, V. Connor, N. Richard and R. Tjeerdema. 2003b. Integrated assessment of the impacts of agricultural drainwater in the Salinas River California, USA). Environmental Pollution 124 (2003). 10 pp.

Anderson, T., F. Watson, W. Newman, J. Hager, D. Kozlowski, J. Casagrande, J. Larson, 2003. Nutrients in surface waters of southern Monterey Bay watersheds. Watershed Institute at California State Monterey Bay, Report No. WI-2003-11. Prepared for the Central Coast Regional Water Quality Control. 106 pp. + appendix. http://science.csumb.edu/~ccows/pubs/reports/CCoWS_NutrientSources_030529b_ta.pdf

Casagrande, J. 2001. How does land use effect sediment loads in Gabilan Creek? Senior Thesis, Department of Earth Systems Science and Policy, California State University of Monterey Bay, 49 pp. plus appendix. http://science.csumb.edu/~ccows/pubs/capstones/JCasagrande_FinalThesis.pdf

Worcester, K., Paradies, D., Adams, M., & Berman, D. 2000. Salinas River Watershed Characterization Report 1999. Central Coast Ambient Monitoring Program, Central Coast Regional Water Quality Control Board. 97 pp. http://www.ccamp.org/ccamp/CCAMP_Salinas_Report.pdf

Hager, J., F. Watson, & A. Bern, 2003. Chualar Creek Pilot Project Water Quality Monitoring - March 2001 - December 2002: Final Report. Watershed Institute, California State University Monterey Bay, Report No. WI-2003-08. 65 pp. http://science.csumb.edu/~ccows/pubs/reports/CCoWS_ChualarPilot_031113.pdf

Hunt, J.W., Anderson, B.S., Phillips, B.M., Nicely, P.N., Tjeerdema, R.S., Puckett, H.M.,Stephenson, M., Worcester, K., De Vlaming, V., 2002. Ambient Toxicity Due to Chlorpyrifos and Diazinon in a Central California Coastal Watershed. Environmental Monitoring and Assessment 82: 83-112, 2003.

Kozlowski, D. F. Watson, M. Angelo, J. Larson. 2004. Monitoring chlorpyrifos and diazinon in impaired surface waters of the Lower Salinas Region, Watershed Institute at California State Monterey Bay, Report No. WI-2004-03. Prepared for the Department of Pesticide Regulation (DPR). 59pp. + appendix. http://science.csumb.edu/~ccows/pubs/reports/CCoWS_DPR_FinalReport_040331c.pdf

Kozlowski, D., Watson, F. Angelo, M., & Gilmore, S. 2004. Legacy Pesticide Sampling in Impaired Surface Waters of the Lower Salinas Region. Report to Central Coast Regional Water Quality Control Board, Watershed Institute at California State Monterey Bay, Report No. WI-2004-02. 46 pp. http://science.csumb.edu/~ccows/pubs/reports/CCoWS_LPs_040304_dk.pdf

Larson, J. 2004. In-stream pesticide loads in relation to agricultural pesticide applications. Capstone thesis. Earth Systems Science and Policy, California State University Monterey Bay, 55 pp. http://science.csumb.edu/~ccows/pubs/capstones/jlarson_capstone_040310.pdf

State Water Resources Control Board (SWRCB), 1999. Draft Functional Equivalent Document Consolidated Toxic Hot Spots Cleanup Plan, 318pp. http://swrcb2.swrcb.ca.gov/bptcp/docs/dftfedcp.doc

Watson, F., M. Angelo, T. Anderson, J. Casagrande, D. Kozlowski, W. Newman, J. Hager, D. Smith, B. Curry. 2003. Salinas Valley Sediment Sources. Report No. WI-2003-06, The Watershed Institute, California State University Monterey Bay. Prepared for the Central Coast Regional Water Quality Control Board. 239 pp. http://science.csumb.edu/~ccows/pubs/reports/CCoWS_SalSedReport_030530c.pdf

Data Summary: Parameter Assessment Cards (PAC's)

This section summarizes specific water quality data for the Reclamation Ditch Watershed. A total of 37 sites were sampled by four different entities for a wide variety of water quality parameters between 1999 and 2004 (Fig. 6. & Table 6.). Note the data are biased by the sampling design used by each study and by the seasonality of sampling times. For example, CCAMP data were collected monthly during 1999, and are thus biased toward reflecting ambient (non-storm) conditions. Conversely, some of the CCoWS data were specifically collected during storms, and are thus biased toward representing storm conditions. Due to this bias, these data are used as **synoptic indicators** of the condition of the watershed. No specific conclusions should be drawn from the data for a specific site without further investigation.

The four data sources are: CCoWS, CCAMP, UCSC[15] and the City of Salinas. The temporal range of data is between 1999 and 2004. The complete compilation of the numeric data is given in Appendix D.

Site data are summarized by minimum, maximum, or median values. Median values are used for highly variable data that are more susceptible to outliers due to sampling or laboratory error. Minimum values are used for dissolved oxygen, which is not particularly susceptible to measurement error, and is most critical to aquatic species at low values. Maximum values are used for temperature, which is also readily measured, and is most critical to aquatic species at high values. The summary values for each site were then indicated on watershed maps for spatial reference.

All information on each constituent was summarized using one-page Parameter Assessment Cards (or PAC's). The PAC provide a wide range of basic information, including:

- **Map** - showing median, maximum, or minimum concentration data for each site depending on parameter
- **Disclaimer** - acknowledges biases associated with the data sets.
- **Data Source(s)** - Entities that collected the data
- **Date of Collection** - given as range for each parameter
- **Water Quality Objectives.** These were obtained from various sources in the literature (cited in the PACs). The most pertinent objectives are those set in the Basin Plan maintained by the RWQCB. The Basin Plan defines water quality objectives as numeric or narrative targets used to provide

[15] Unpublished data, Carol Shennan, Center for Agroecology and Sustainable Food Systems, UCSC.

protection of a waterway's defined Beneficial Uses – See Section on Specific Beneficial Uses Of the Reclamation Ditch Watershed. Other Objectives that are referenced have not been adopted by the CCRWQCB nor do not necessarily pertain to this watershed, but are cited for comparison information only. The reader is cautioned that different combinations of Objectives for water quality, freshwater habitat and species have been introduced in the PACs.

- **Parameter Notes** – includes general information for the water quality parameter
- **Potential Concerns** – areas of concern (highlighted on the map with a red or dark red number)
- **General Statistics** – information such as total number of samples and total number of sites.
- **Data Gaps** – notification of lack of sampling in a particular sub-watershed or reach
- **Summary** – general statistics on number of sites that did not meet published water quality objectives.

PACs are presented below for the following constituents:

- Suspended sediment concentration
- Nutrients
    - Nitrate
    - Total Ammonia
    - Phosphate
- Temperature (No numeric values for natural receiving water temperatures are stated in the CCRWQB 1994)
- Dissolved oxygen
- Fecal coliform
- Pesticides
    - Diazinon
    - Chlopyrifos

There are spatial data gaps to this study, most notably: the Merritt Lake sub-watershed, the headwater reaches in the Gabilan Range, the middle reaches of Alisal Creek, and the storm drains from urbanized areas. Most of the headwaters of the Reclamation Ditch Watershed are privately owned with no public access.

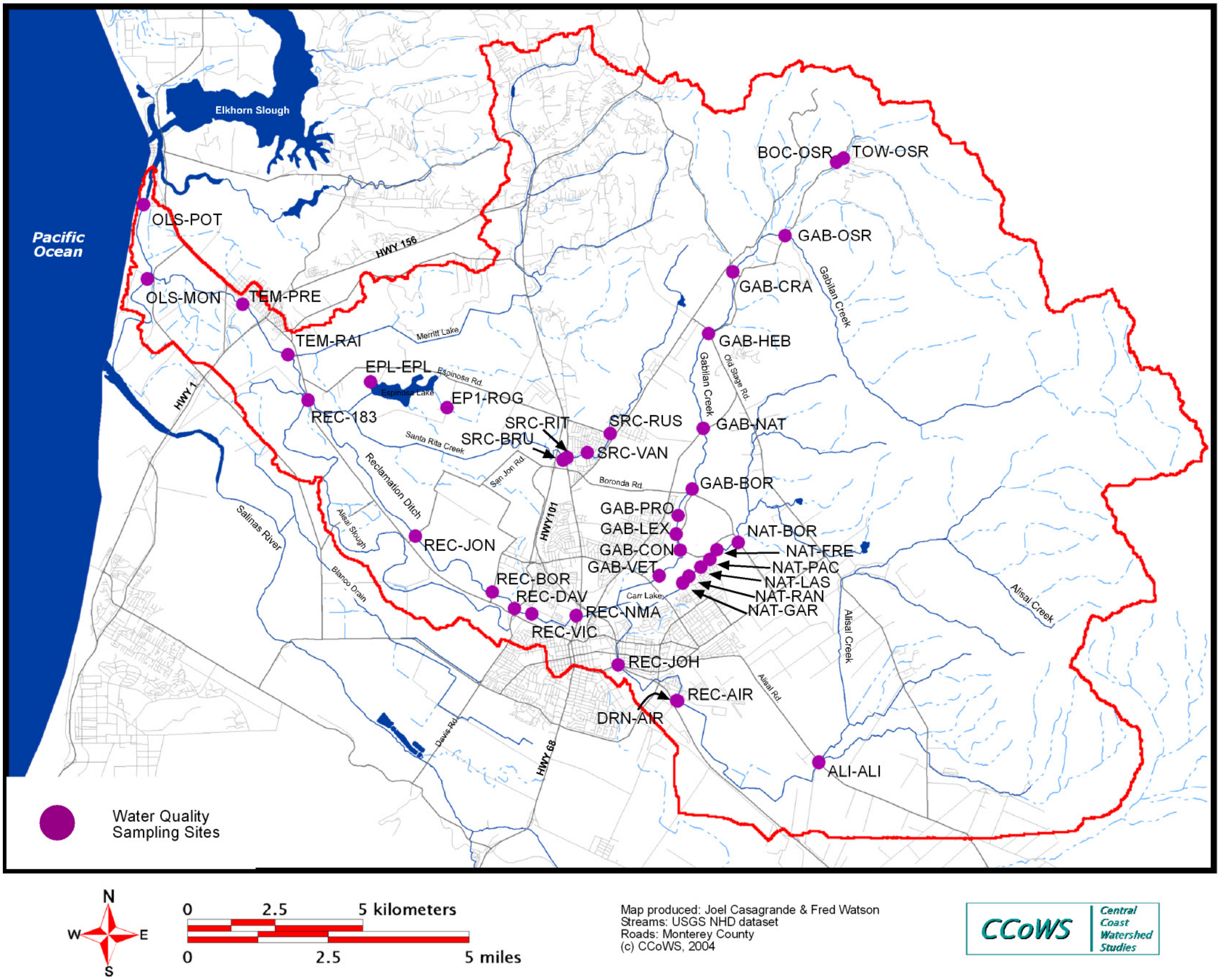


Figure 6.7 Water Quality Sampling Sites in the Reclamation Ditch Watershed.

Table 6.5 Water Quality Monitoring Sites

CCoWS ID	CCAMP ID	**UCSC ID	City of Salinas ID	Waterway Name	Bridge/Road	Easting	Northing	Datum
ALI-ALI	309UAL			Alisal Creek	Alisal Rd.	627189	4056491	NAD83
BOC-OSR				Unnamed tributary to Towne Creek	Old Stage Rd.	627694	4073554	NAD83
DRN-ALI	309AXX			Urban drain at Airport road	nr Airport Rd.	623162	4058237	NAD83
EP1-ROG				Tributary to Espinosa Lake	Rodgers Rd.	616573	4066568	NAD83
EPL-EPL				Espinosa Lake	Northeast corner of lake	614388	4067301	NAD83
GAB-BOR	309GAB		GC1-A	Gabilan Creek	Boronda Rd.	623579	4064256	NAD83
GAB-CON			GC5	Gabilan Creek	Constitution Blvd.	623240	4062520	NAD83
GAB-CRA		GA-CHR	GC-RF2	Gabilan Creek	Crazy Horse Rd.	624740	4070421	NAD83
GAB-HEB		GA-HEB		Gabilan Creek	Hebert Rd.	624041	4068678	NAD83
GAB-LEX			GC4	Gabilan Creek	Lexington Dr.	623240	4062520	NAD83
GAB-NAT				Gabilan Creek	Natividad Rd.	623895	4065983	NAD83
GAB-OSR		GA-OSC		Gabilan Creek	Old Stage Rd.	626227	4071459	NAD83
GAB-PRO			GC3	Gabilan Creek	Provincetown St.	623183	4063503	NAD83
GAB-VET			GC6	Gabilan Creek	Veteran's Park	622630	4061795	NAD83
NAT-BOR			NC1-A	Natividad Creek	Boronda Rd.	624889	4062742	NAD83
NAT-FRE				Natividad Creek	Freedom Way	624279	4062535	NAD83
NAT-GAR			NC6	Natividad Creek	nr Garner Ave.	623312	4061593	NAD83
NAT-LAS			NC4	Natividad Creek	Las Casitas Dr.	623829	4062030	NAD83
NAT-PAC			NC3	Natividad Creek	nr Pacana Cir.	624085	4062263	NAD83
NAT-RAN			NC5	Natividad Creek	Ranchero Dr. (nr Rocca Barton School)	623488	4061779	NAD83
OLS-MON	309OLD			Old Salinas River	Monterey Dunes Colony	608014	4070228	NAD83
OLS-POT	309POT			Old Salinas River	Potrero Rd.	607911	4072333	NAD83
REC-183				Reclamation Ditch	HWY 183	612604	4066775	NAD83
REC-AIR	309ALU		RD1-A	Reclamation Ditch	Airport Rd.	623129	4058253	NAD83
REC-BOR	309ALD			Reclamation Ditch	Boronda Rd.	617873	4061331	NAD83
REC-DAV			RD4-A	Reclamation Ditch	Davis Rd.	618505	4060856	NAD83
REC-JOH			RD2	Reclamation Ditch	John St.	621464	4059263	NAD83
REC-JON				Reclamation Ditch	San Jon Rd.	615668	4062916	NAD83
REC-NMA			RD3	Reclamation Ditch	North Main St.	620269	4060658	NAD83
REC-VIC				Reclamation Ditch	Victor Way	618999	4060710	NAD83
SRC-BRU			SR4	Santa Rita Creek	Brutus St.	619889	4065078	NAD83
SRC-RIT			SR3	Santa Rita Creek	Santa Rita St.	620002	4065150	NAD83
SRC-RUS			SR1-A	Santa Rita Creek	Russell Rd.	621244	4065834	NAD83
SRC-VAN			SR2	Santa Rita Creek	Van Buren Ave.	620580	4065293	NAD83
TEM-PRE	309TEM			Tembladero Slough	Preston Road	610737	4069512	NAD83
TEM-RAI				Tembladero Slough	Railroad Crossing	612031	4068079	NAD83
TOW-OSR				Towne Creek	Old Stage Rd.	627897	4073659	NAD83

Approximate locations based on the Water Quality Sampling Site Map, Fig. 6.8. ** Unpublished data, Carol Shennan, Center for Agroecology and Sustainable Food Systems, UCSC.

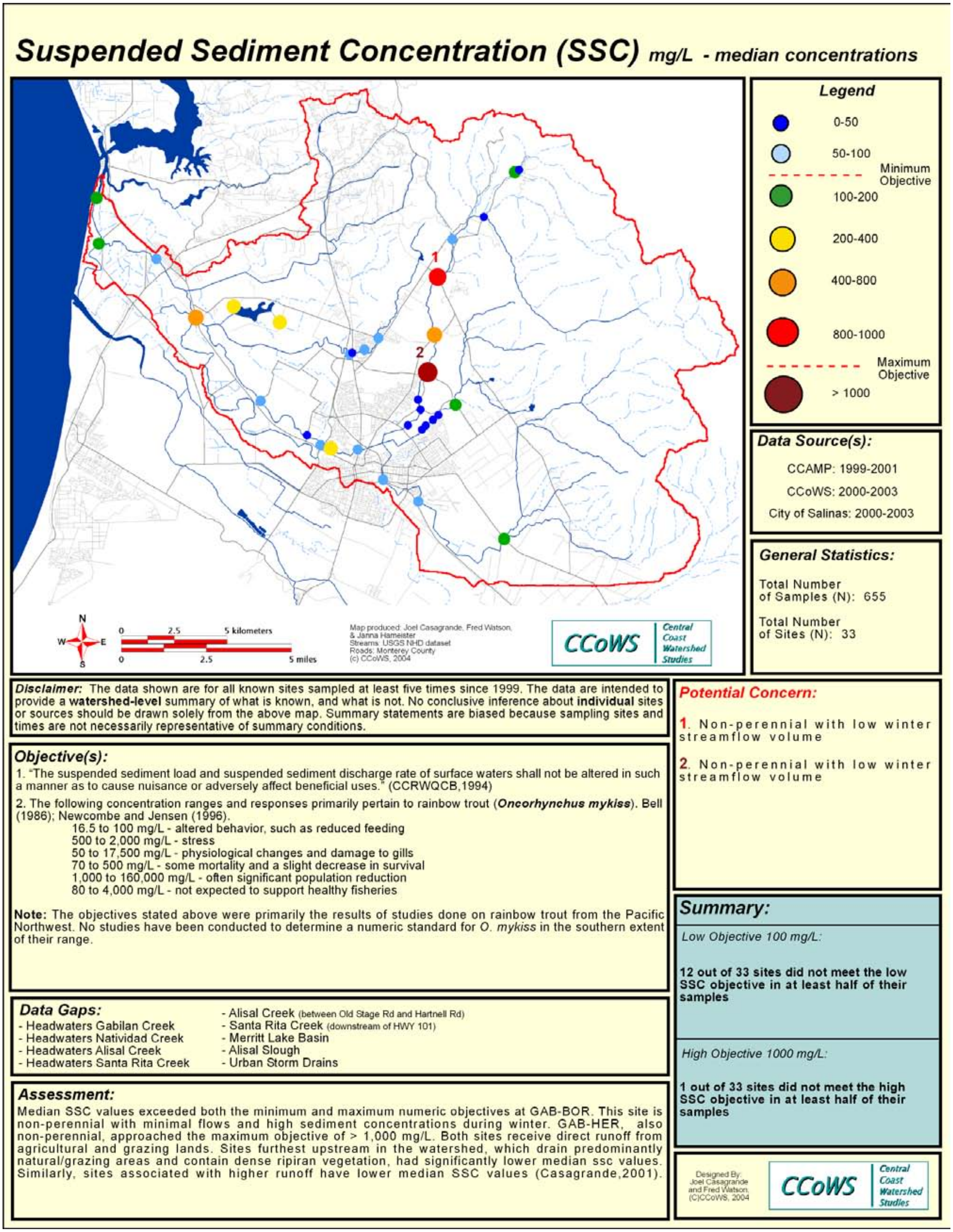


Figure 6.8 An assessment of suspended sediment concentrations (SSC) in the Reclamation Ditch Watershed. The objectives stated above were primarily the result of studies conduct on rainbow trout in the Pacific Northwest.

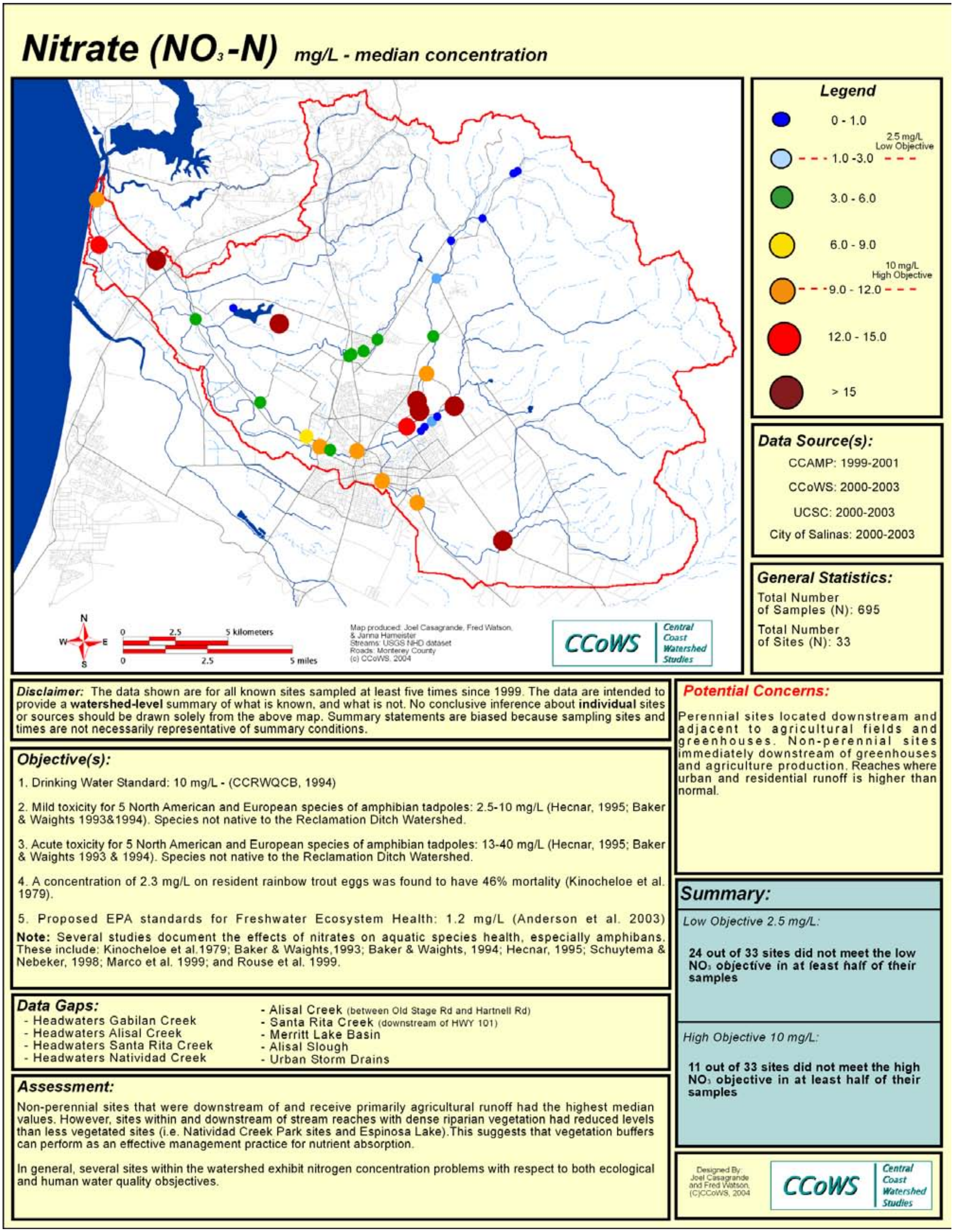


Figure 6.9 An assessment of nitrate concentrations (NO_3-N) in the Reclamation Ditch Watershed. Please note Objective Numbers 2, 3, and 4 pertain to Species that are non-native to the Rec Ditch Watershed. UCSC Report (2000-2003) cited is unpublished.

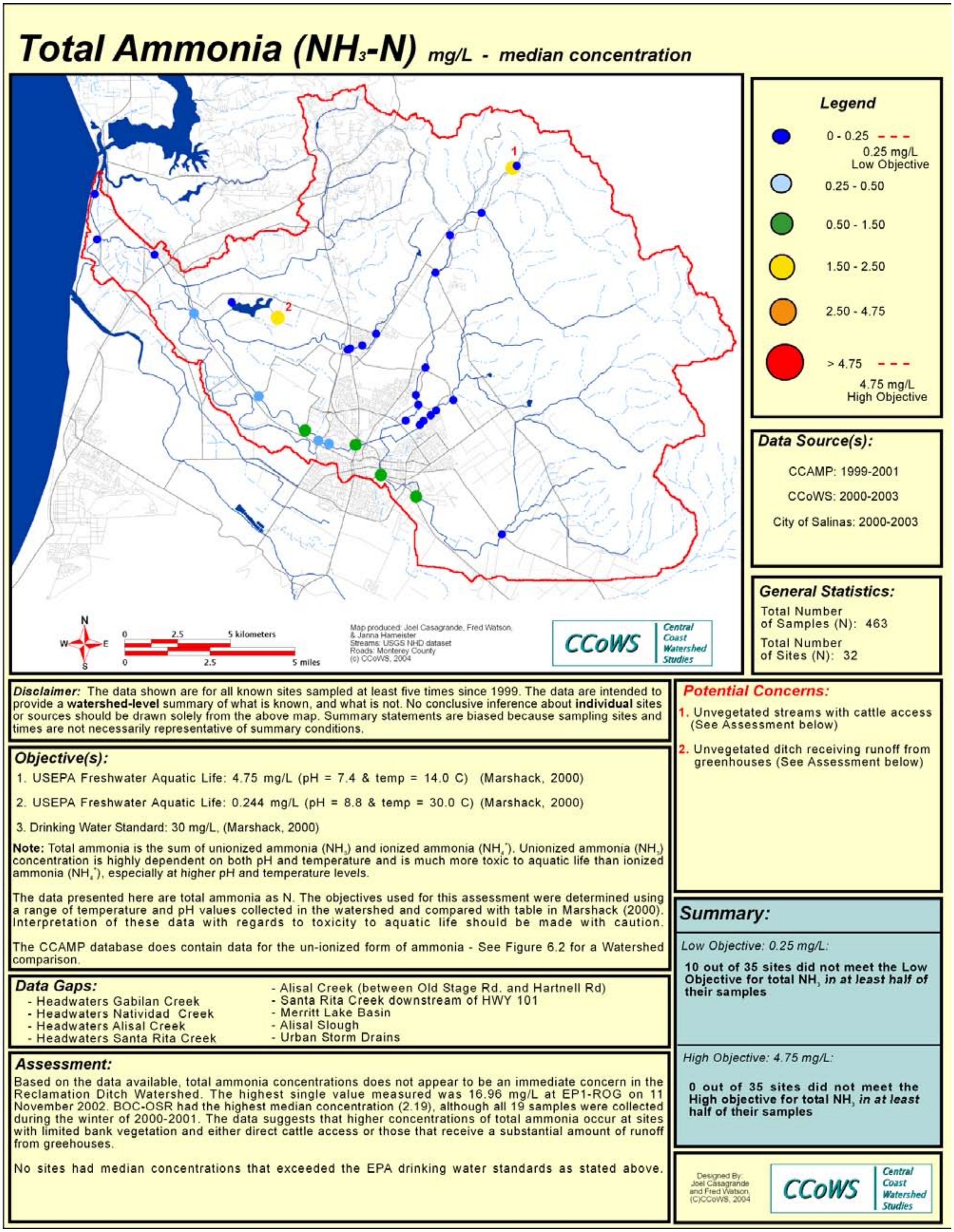


Figure 6.10 An assessment of total ammonia concentrations (NH_3–N) in the Reclamation Ditch Watershed. Please note, interpretation of these data with regards to toxicity to aquatic life should be made with caution.

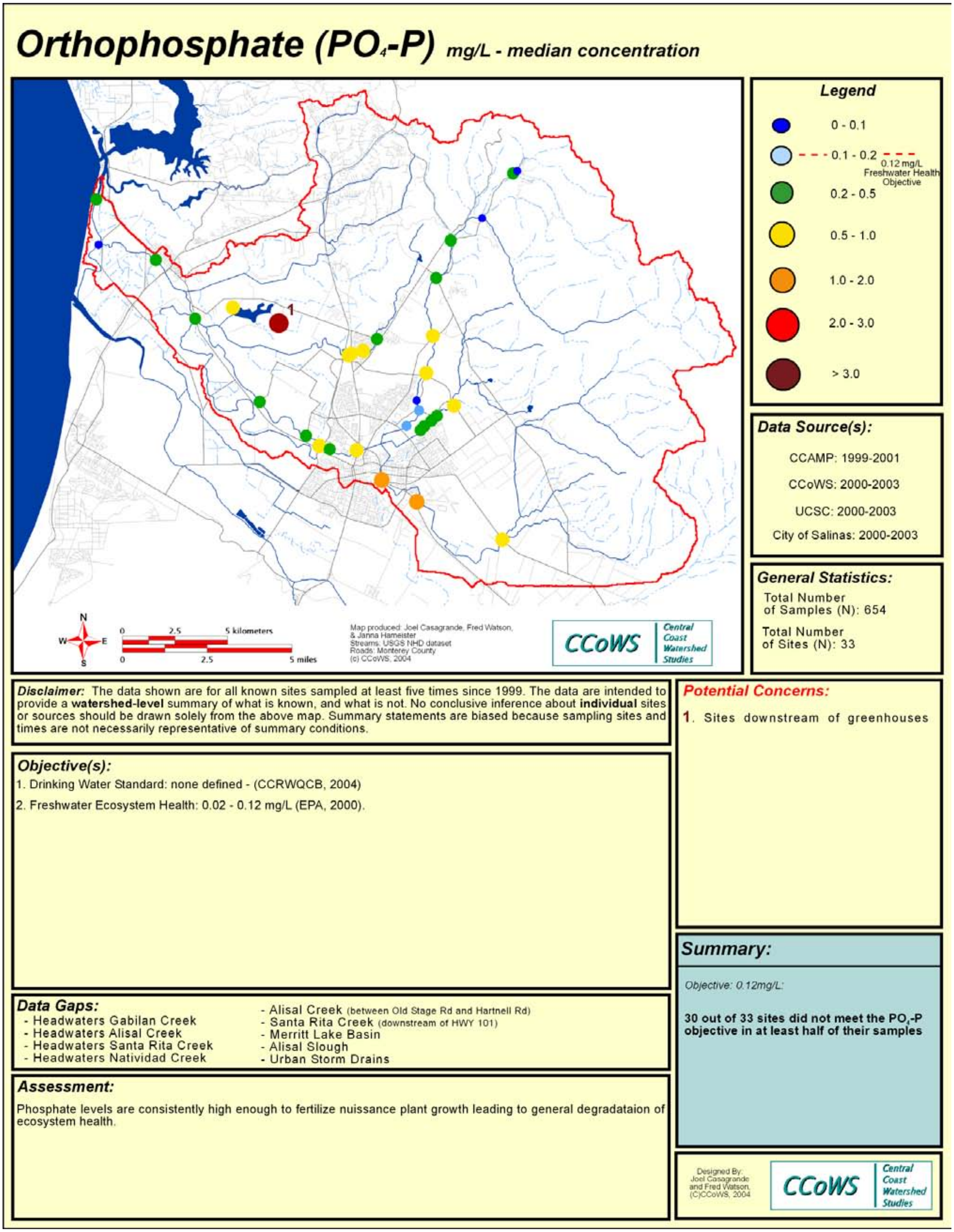
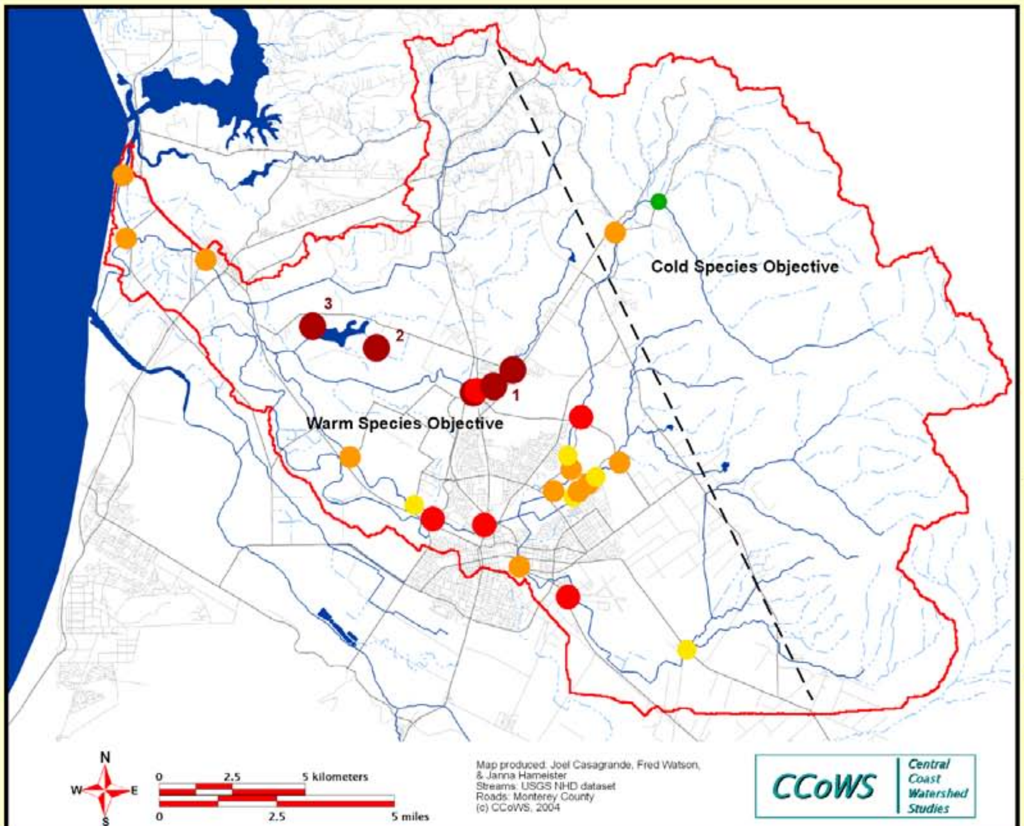
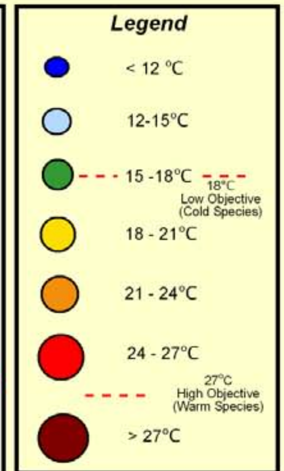


Figure 6.11 An assessment of orthophosphate concentrations (PO_4-P) in the Reclamation Ditch Watershed. UCSC Report (2000-2003) cited is unpublished.

Water Temperature °C - *maximum temperature*





Data Source(s):

CCAMP: 1999-2001

CCoWS: 2000-2004

UCSC: 2000-2003

City of Salinas: 2000-2003

General Statistics:

Total Number of Samples (N): 403

Total Number of Sites (N): 27

Disclaimer: The data shown are for all known sites sampled at least five times since 1999. The data are intended to provide a **watershed-level** summary of what is known, and what is not. No conclusive inference about **individual** sites or sources should be drawn solely from the above map. Summary statements are biased because sampling sites and times are not necessarily representative of summary conditions.

Potential Concerns:

1. Slow moving stream; low overhead vegetative cover.
2. Primarily greenhouse runoff with some row crop return flow; no overhead cover.
3. No concern. Natural shallow lake.

Objective(s):

1. "At no time or place shall the temperature of any water be increased by more than 5°F above natural receiving temperature." (CCRWQCB, 1994)
2. Upper lethal limit for steelhead has been documented at 24°C. (Bell, 1973 as cited in Reiser and Bjornn, 1979)
3. Rainbow trout: optimal temperature for growth: 15-18°C. Moyle (2002)
4. Hitch: acute preferred temperature: 27-29°C. Moyle (2002)
5. Sacramento blackfish: reduced growth: >25°C. Moyle (2002)
6. Sacramento sucker: preferred temperature: 20-25°C. Moyle (2002)
7. Sacramento pikeminnow: acute preferred temperature: 26°C. Moyle (2002)

Note: Water temperature is affected by flow rate, depth, and overhead vegetative cover.

Fish species temperature tolerance differs depending on the species. Rainbow trout, a "cold water" species has a lower temperature tolerance than "warm water species" such as a blackfish. Because of this, different objectives were used to assess the upper and lower watershed (See line on map). Stream flow in the upper watershed is cool and supports cold water species such as trout. The lower perennial sties support warm water species. Sites upstream of the line were assessed using the "cold water species" (i.e. rainbow trout). Sites downstream of the line were assessed based on objectives fit for "warm water species" (i.e. suckers, hitch, blackfish and pikeminnow) all of which are native to the Reclamation Ditch Watershed.

Summary:

Low Objective: 18°C

1 out of 2 cold sites did not meet the low (cold) objective in at least one of their samples

High Objective: 27°C

4 out of 25 warm sites did not meet the high (warm) water temperature objective in at least one of their samples

Data Gaps:

- Headwaters Gabilan Creek
- Headwaters Alisal Creek
- Headwaters Santa Rita Creek
- Headwaters Natividad Creek
- Alisal Creek (between Old Stage Rd and Hartnell Rd)
- Santa Rita Creek (downstream of HWY 101)
- Merritt Lake Basin
- Alisal Slough
- Urban Storm Drains

Assessment:

Water temperature concerns do not appear to be widespread. Sites that did not meet the high (warm) water objective were located within or downstream of significant reaches of exposed, or devegetated bank. While water temperatures at these sites are typically warmer than cooler sites found in protected canyons, they were naturally more shaded, and therefore likely to be cooler than present.

Designed By: Joel Casagrande and Fred Watson, (C)CCoWS, 2004

CCoWS Central Coast Watershed Studies

Figure 6.12 An assessment of water temperature in the Reclamation Ditch Watershed. UCSC Report (2000-2003) cited is unpublished.

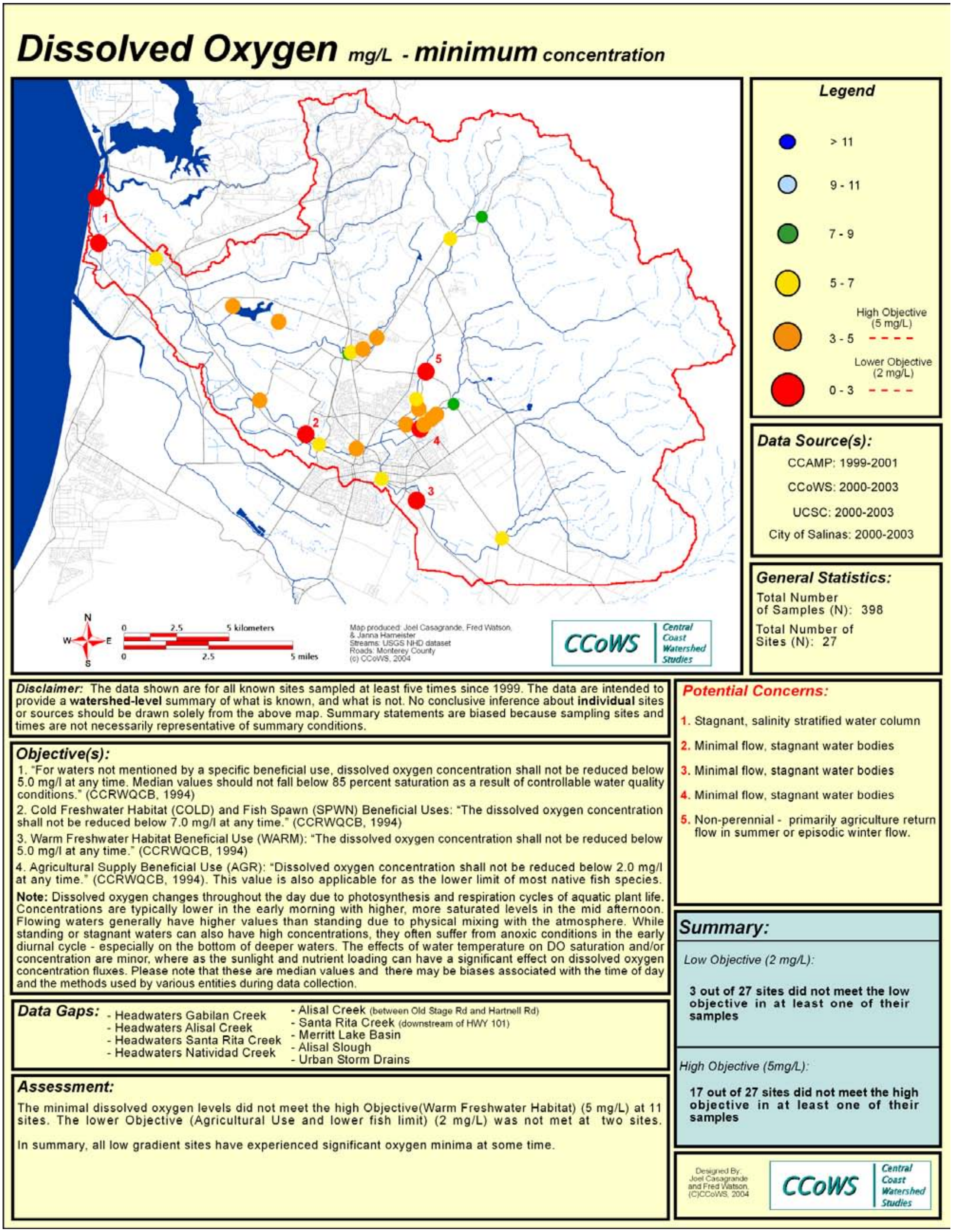


Figure 6.13 An assessment of minimum dissolved oxygen concentrations in the Reclamation Ditch Watershed. UCSC Report (2000-2003) cited is unpublished. Cold Freshwater Habitat Objective of 7 mg/l is not defined in the Legend.

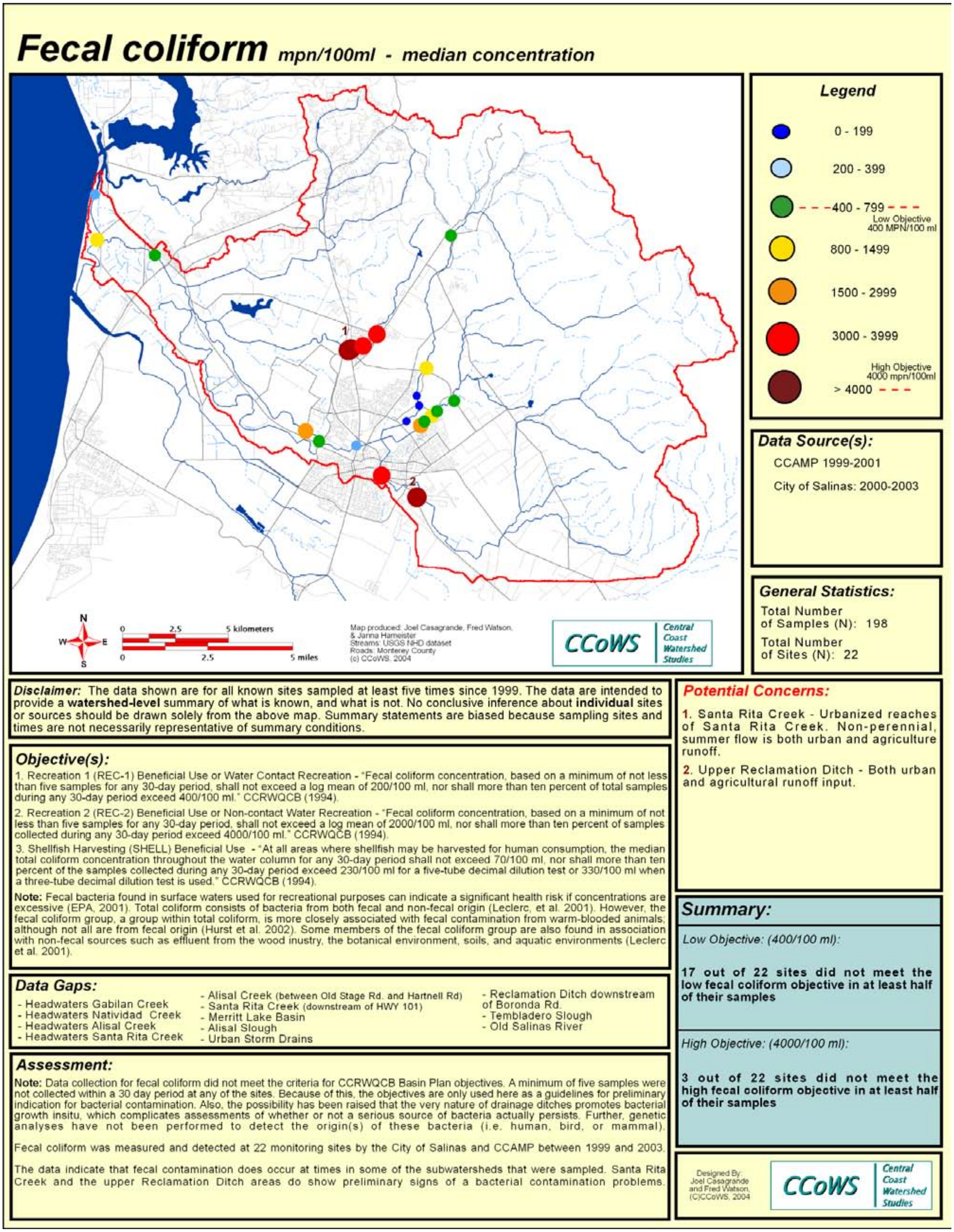


Figure 6.14 An assessment of fecal coliform in the Reclamation Ditch Watershed. Low Objective cited pertains to the maximum exceedence value for REC-1, High Objective is the maximum exceedence value for REC-2.

Pesticides

Chlorpyrifos and Diazinon are two of the most commonly applied and most studied pesticides in use in the region (Hunt et al., 2002; Anderson et al., 2003a; Anderson et al., 2003b; Kozlowski et al., 2004). The maps on the following pages, Figures 6.16 and 6.18, illustrate both the amounts of these pesticides used in agricultural and greenhouse operations during 2002, and the concentrations observed in waterways during 2002-3.

Pesticide application data are collated by the County Agricultural Commissioner during the permitting process. The database includes a field listing the Township, Section, and Range of the application. Since a Section is approximately one square mile, this allows the location of the application to mapped at this scale. The data from all Counties is compiled and checked by the California Department of Pesticide Regulation (DPR). These State-level data were processed by M. Angelo of the CCRWQCB using database software in order to produce an estimate of the annual total pounds of active ingredient applied to each Section. Further details are described by Kozlowski et al., (2004).

Water quality data for diazinon and chlorpyrifos, Figures 6.17 and 6.19, were taken from Kozlowski et al., (2004).

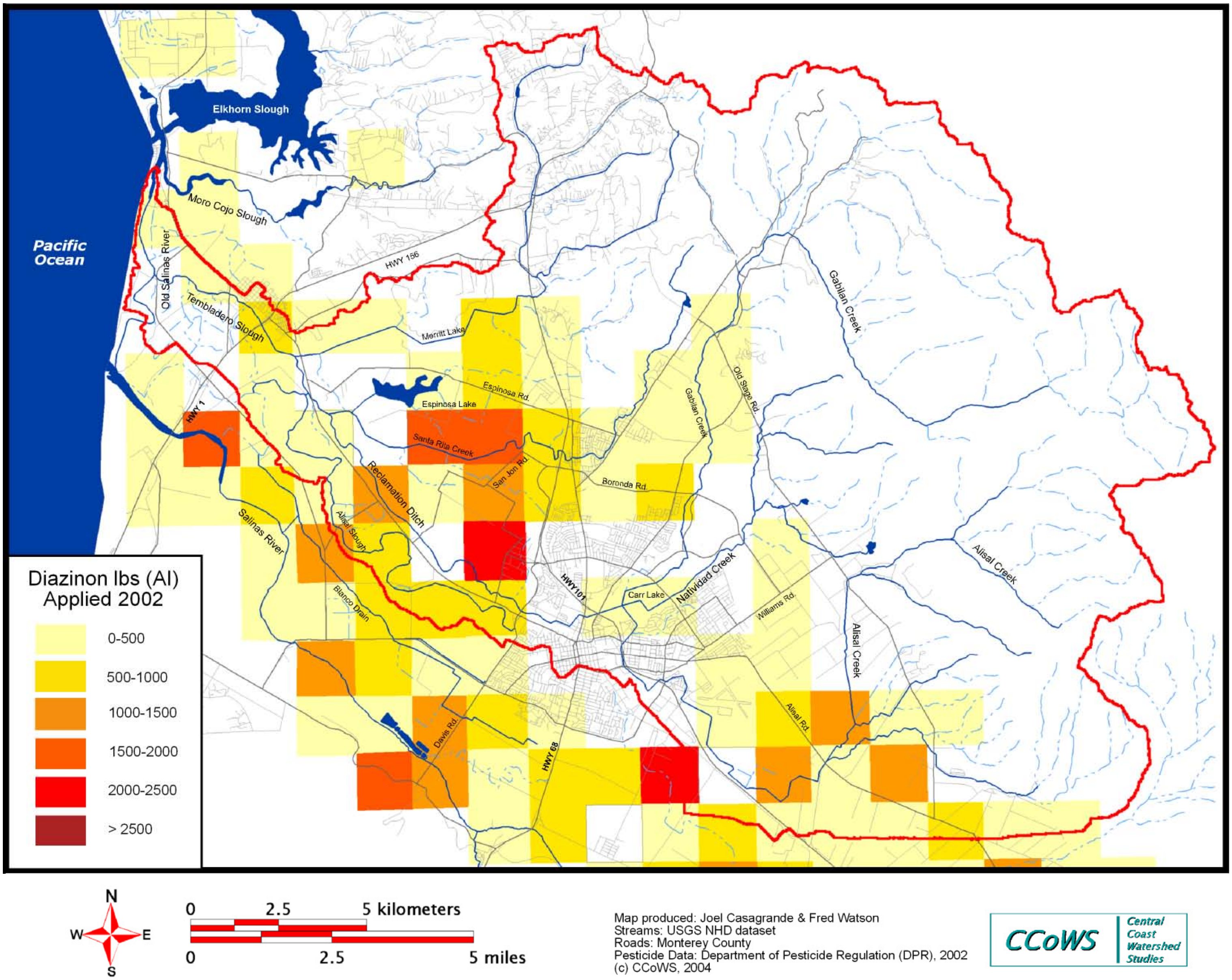
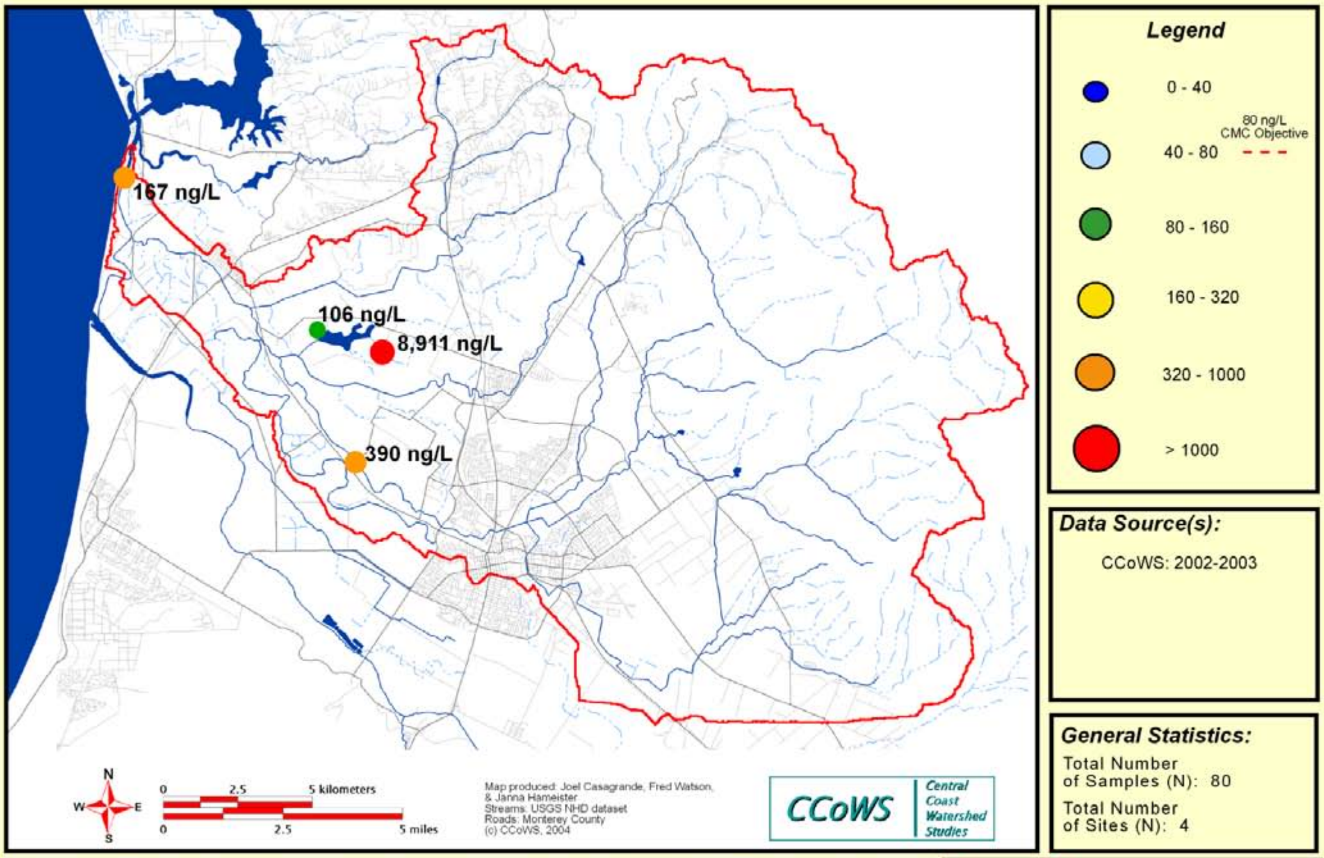


Figure 6.15 Total applied Diazinon: pounds of Active Ingredient (AI) for 2002.

Diazinon *(Total water column Pesticide Concentration - TPC) ng/L - median concentration*



Data Source(s):

CCoWS: 2002-2003

General Statistics:

Total Number of Samples (N): 80

Total Number of Sites (N): 4

Disclaimer: The data shown are for all known sites sampled at least five times since 1999. The data are intended to provide a **watershed-level** summary of what is known, and what is not. No conclusive inference about **individual** sites or sources should be drawn solely from the above map. Summary statements are biased because sampling sites and times are not necessarily representative of summary conditions.

Potential Concerns:

Sites, or reaches, which receive consistent flow from agricultural and urban runoff sources, especially greenhouses.

Objective(s):

The following assessment for the total water column concentration (TPC) of diazinon uses the objectives most commonly used by the California Department of Fish and Game (CDFG). For short-term environmental exposures, CDFG uses the ***Criterion Maximum Concentration (CMC)*** of ***80 parts per trillion ng/L***. In addition, CDFG uses a 50 ng/L *Criterion Continuous Concentration (CCC)* for long-term environmental exposures (Siepmann and Finlayson, 2000 as cited in Kozlowksi et al. 2004).

Note: The solubility of diazinon into water is moderate (60.0 mg/L @ 20^{o}C), however it does not readily absorb into soil or organic matter (soil absorption coefficient (Koc) 1,007 to 1,842) (Azimi-Gaylon et. al. 2001 as cited in Kozlowski et al. 2004). For rainbow trout, the lethal concentration (LC_{50}) that kills 50 % of the individuals tested is 16 parts per billion (ppb) (Montgomery, 1997 as cited in Kozlowski et al. 2004) and 320 ppt for common water fleas (*Ceriodaphnia dubia*) (Baily et al. 1997 as cited in Kozlowski et al. 2004).

In soil, the half-life of diazinon is much less than that of chlorpyrifos, only two to four weeks. In water, the half-life of diazinon is highly dependent on the acidity of the water - the higher the acidity the quicker the breakdown. In neutral solutions (pH = 7), the half life of diazinon can last up to six months (Kozlowski et al. 2004). In general, a chemical's half-life is highly dependent on several factors including, the formulation of the product, the medium that it is adhered to or dissolved in (soil, organic matter, water etc.), condition of the medium (salt water vs. fresh water, or sandy soils vs. clay soils), acidity of the medium, temperature of the medium, and available sunlight (Kozlowski et al. 2004).

Summary:

Objective: 80 parts per trillion (80 ng/L)

4 out of 4 sites did not meet the CMC objective in at least half of their samples

Two sites did not meet the CMC objective in all of their samples

Data Gaps:

- Gabilan Creek
- Natividad Creek
- Alisal Creek
- Santa Rita Creek
- Merritt Lake Basin
- Tembladero Slough

Assessment:

Samples for diazinon TCP were collected at four sites within the Reclamation Ditch Watershed between 2002 and 2003. Samples were collected during both storm events and during ambient conditions. Of the sites sampled, all did not meet the CDFG CMC objectives (Kozlowski et al. 2004). However, sites with stagnant conditions (i.e. OLS-POT and EPL-EPL had lower concentrations, presumably a result of dilution from other sources of water and settling of suspended sediment.

Designed By: Joel Casagrande and Fred Watson, (C)CCoWS, 2004

CCoWS Central Coast Watershed Studies

Figure 6.16 An assessment of TPC Diazinon concentrations in the lower Reclamation Ditch Watershed.

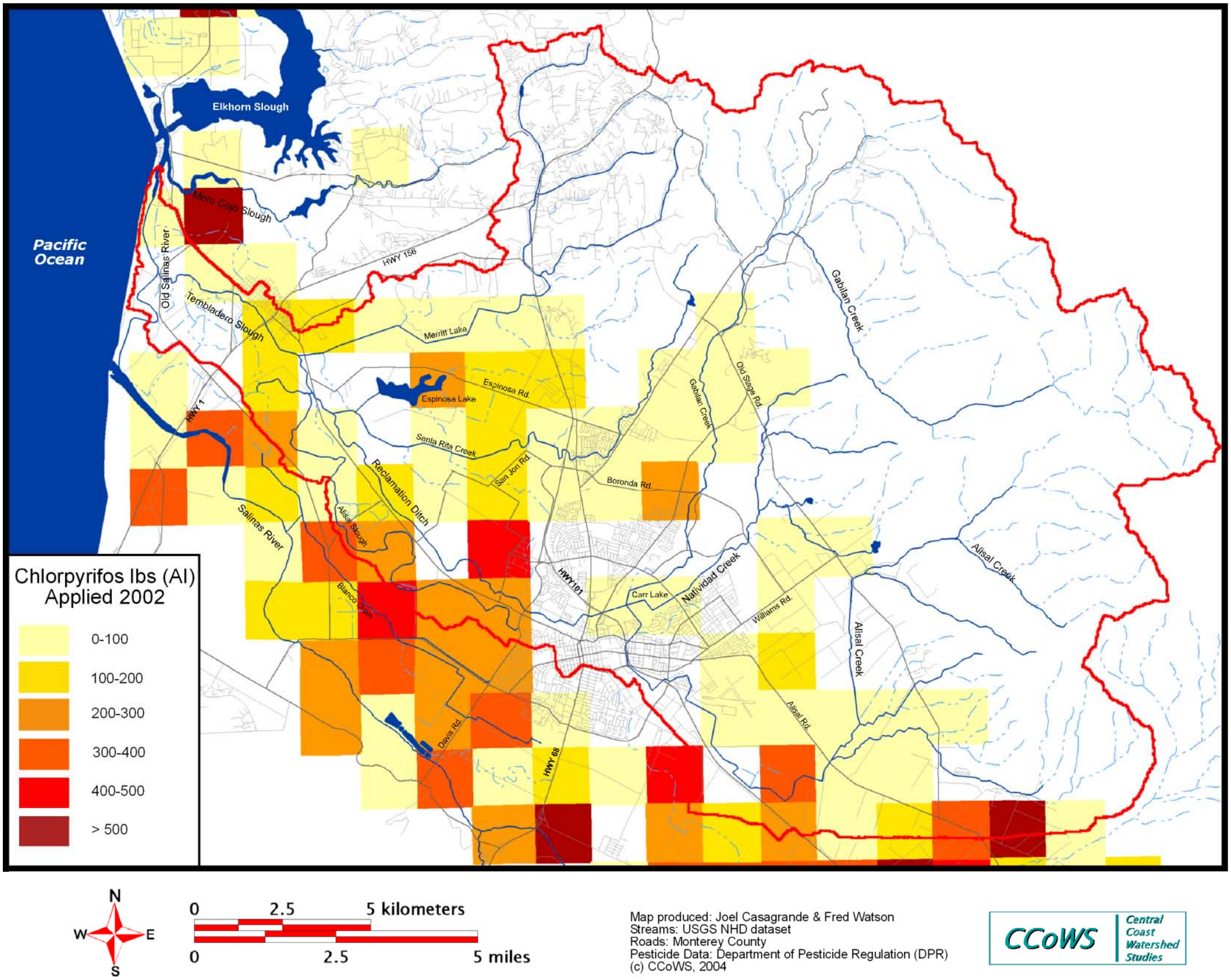
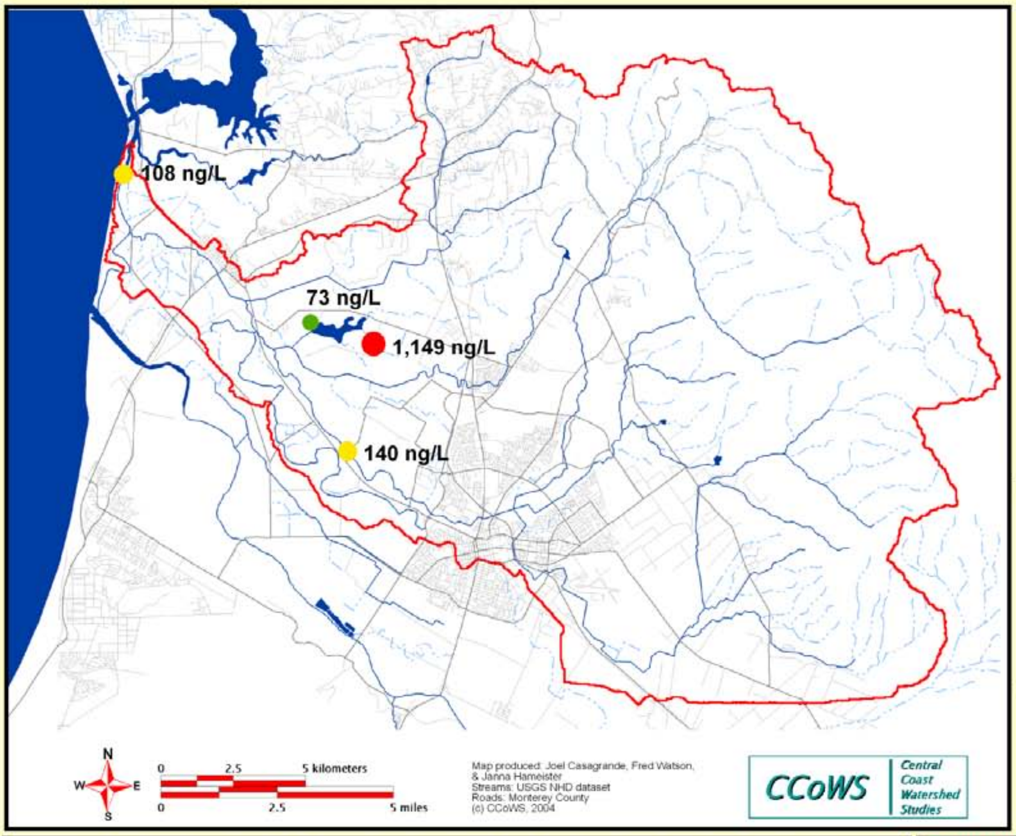


Figure 6.17 Total applied Chlorpyrifos: pounds of Active ingredient (AI) for 2002.

Chlorpyrifros *(Total water column Pesticide Concentration - TPC) ng/L - median concentration*



Legend

- 0 - 10
- 10 - 20 (20 ng/L CMC Objective)
- 20 - 80
- 80 - 200
- 200 - 1000
- > 1000

Data Source(s):

CCoWS: 2002-2003

General Statistics:

Total Number of Samples (N): 80

Total Number of Sites (N): 4

Disclaimer: The data shown are for all known sites sampled at least five times since 1999. The data are intended to provide a **watershed-level** summary of what is known, and what is not. No conclusive inference about **individual** sites or sources should be drawn solely from the above map. Summary statements are biased because sampling sites and times are not necessarily representative of summary conditions.

Potential Concerns:

Sites, or reaches, which receive consistent flow from agricultural and urban runoff sources. However, sites located closer to their source and or with a smaller drainage area tend to have higher concentrations.

Objective(s):

The following assessment for the total water column pesticide concentration (TPC) of chlorpyrifos uses the objectives most commonly used by the California Department of Fish and Game (CDFG). For short-term environmental exposures, CDFG uses the ***Criterion Maximum Concentration (CMC)*** of ***20 ng/L***. In addition, CDFG uses a 14 ng/L *Criterion Continuous Concentration (CCC)* for long-term environmental exposures (Siepmann and Finlayson, 2000 ascited in Kozlowksi et al. 2004).

Note: The solubility of chlorpyrifos into water is poor (0.733 mg/L @ 20°C), however it readily absorbs to soil and organic matter (soil absorption coefficient (K_{OC}) 5300 to 14,800) (Azimi-Gaylon et. al. 2001 as cited in Kozlowski et al. 2004). For rainbow trout, the lethal concentration (LC_{50}) that kills 50 % of the individuals tested is 3 parts per billion (ppb) (Montgomery, 1997 as cited in Kozlowski et al. 2004) and 53 ppt for common water fleas (*Ceriodaphnia dubia*) (Baily et al. 1997 as cited in Kozlowski et al. 2004).

The half life of chlorpyrifos is in soil is anywhere from 2 weeks up to one year depending on the environmental conditions. In general, its half life is highly dependent on several factors: these include the formulation of the product, the medium that it is adhered to or dissolved in (soil, organic matter, water etc.), condition of the medium (salt water vs. fresh water, or sandy soils vs. clay soils), acidity of the medium, temperature of the medium, and available sunlight (Kozlowski et al. 2004).

Summary:

Objective: 20 parts per trillion (20 ng/L)

All sites exceeded the CMC objective in all samples collected during the sampling period.

Data Gaps:

- Gabilan Creek
- Natividad Creek
- Alisal Creek
- Santa Rita Creek
- Merritt Lake Basin
- Tembladero Slough

Assessment:

Samples were collected at four sites within the Reclamation Ditch Watershed for total water column concentrations of chlorpyrifos between 2002 and 2003. Samples were collected during both storm events and during ambient conditions.

Median concentrations for all sites did not meet the CMC Objective for chlorpyrifos (Kozlowski et al. 2004). However, EPL-EPL, had slightly lower levels, presumably due to both dilution of the aqueous concentrations as well as lower suspended sediment concenttraions - a result of depositional processes in the lake.

EP1-ROG had the highest median concentration. This site receives only agricultural return flow (greenhouses and fields) during the dry season and local runoff from agricultural fields during winter storms.

Designed By: Joel Casagrande and Fred Watson, (C)CCoWS, 2004

CCoWS Central Coast Watershed Studies

Figure 6.18 An assessment of TPC Chlorpyrifos concentrations in the Lower Reclamation Ditch Watershed. Please note, one year worth of data collected.

7. Biological Assessment

A red-sided garter snake feeding on a Pacific giant salamander at a pond located near Fremont Peak State Park. Photo: Thor Anderson, September 27, 2000. See Amphibians and Reptiles.

Summary

This chapter summarizes the biological resources of the Reclamation Ditch Watershed including the following groups: Benthic Macroinvertebrates, Fisheries, Amphibians and Reptiles, Birds, and Mammals. The Watershed is home to a wide diversity of species typical of the Central Coast of California.

Benthic Macroinvertebrate data were acquired through targeted field sampling during the present study. All other data are from recent informal observations made by members of the CCoWS team, published accounts, and California Department of Fish and Game's (CDFG) California Natural Diversity Database (CNDDB).

Benthic Macroinvertebrates

Overview and Methods

Benthic Macroinvertebrates (BMIs) are easily seen aquatic invertebrates that live on the bottom of waterbodies such as streams and sloughs. Assessment of BMI communities is a common tool in water quality studies (Merritt & Cummins, 1996; Harrington & Born, 2000), because of the way in which community composition is determined by water quality and overall channel condition. Different BMI taxa (e.g. species, or families) have different tolerances to adverse water quality and different substrate preferences. The presence of sensitive species indicates good conditions.

As noted by the Salinas River Lagoon Management and Enhancement Plan (JGA et al., 1997), there are few existing data on coastal aquatic invertebrates in this Region, other than from the broad estuarine environment of Elkhorn Slough.

In late June of 2004, BMI samples were collected at 15 sites throughout the Reclamation Ditch Watershed (Fig. 7.1) according to a SWRCB-approved Quality Assurance Protection Plan (QAPP, See Appendix F - Watershed Quality Assurance and Project Plan and Monitoring Plan: Invertebrate Sampling for methodology).

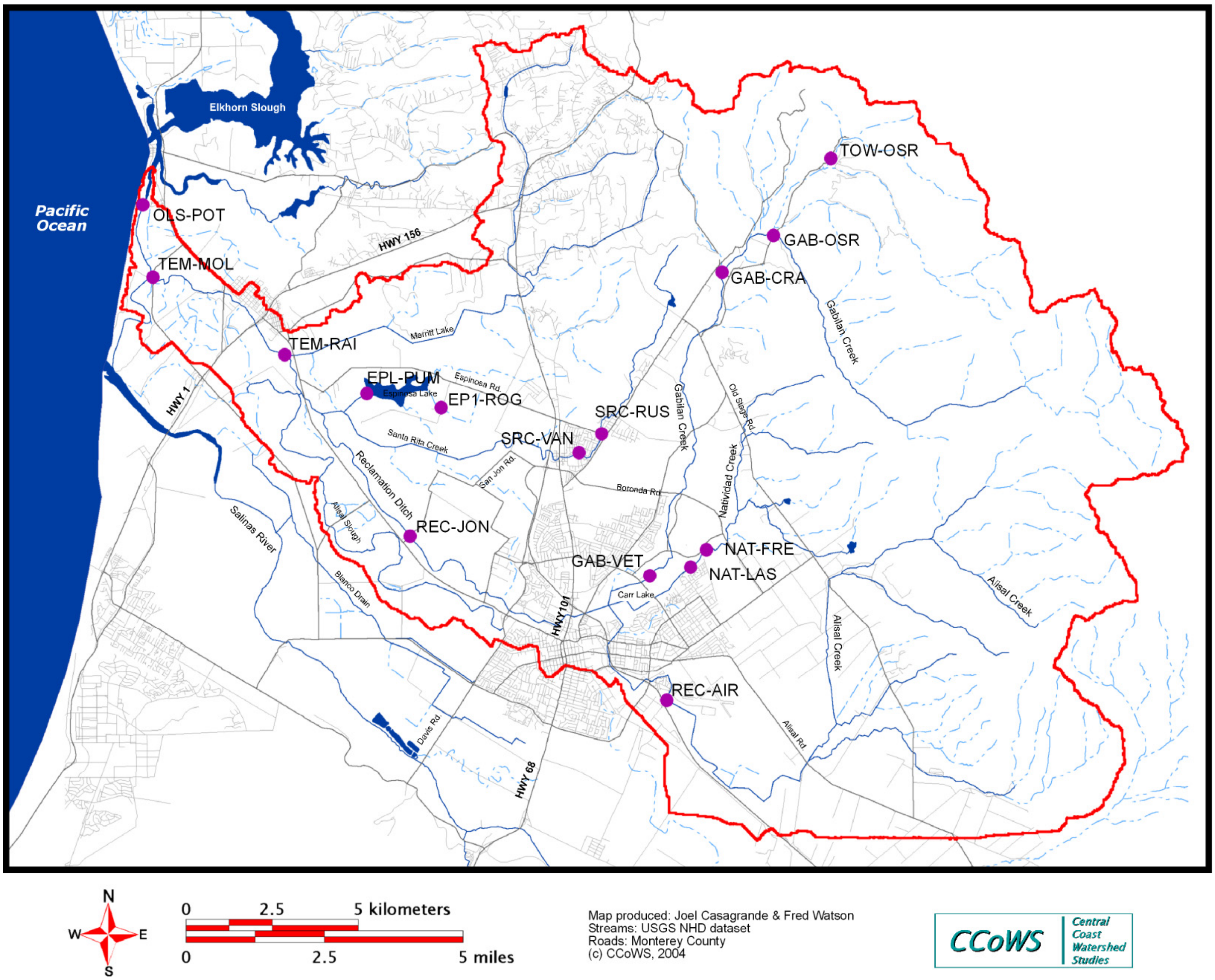


Figure 7.1 BMI sampling locations in the Reclamation Ditch Watershed (Site codes are explained in Table 6.).

Water Quality and Physical Habitat

Morning water temperatures were coolest in the upper watershed sites (TOW-OSR, GAB-OSR, & GAB-CRA). All three sites are well shaded with riparian vegetation and receive water from well-shaded reaches upstream. Slightly warmer temperatures were recorded in Natividad Creek, which is also well shaded. Sites in the lower watershed and in Santa Rita Creek where overhead cover is low or non-existent had significantly higher morning water temperatures. During the late afternoon, many of these sites may reach 25-30° C.

Dissolved oxygen measurements were all above 5 mg/L concentrations except for sites at GAB-VET, SRC-RUS, and REC-JON which all had abundant algae and emergent vegetation in the stream channel and stream flows were minimal. Measurements were all taken at some time between 9:24 AM and 11:51 AM. Daily minima would have occurred a couple of hours earlier, and would be only slightly lower than the observed data (see Watson & Casagrande, 2004, for diurnal time series of DO levels in a highly productive nearby lagoon).

All stream pH levels were within the 6.5 to 8.5 range except for GAB-VET, which was slightly more acidic than the suitable range.

Table 7.1 Site specific water quality and physical habitat features during BMI sampling (Site codes are explained in Table 6.5).

Water Quality							Physical Habitat		
Site	Date/Time	Temp C	DO mg/L	Sal ppt	pH	Sp Cond mS/cm	Substrate (visual estimate) dominant class	Velocity (measured) (m/s)	Overhead cover (visual estimate) %
TOW-OSR	23 Jun 04 09:42	13.75	8.44	0.38	7.31	0.77	gravel/coarse sand	0.079	98%
GAB-OSR	22 Jun 04 11:31	14.47	9.8	0.37	7.56	0.75	coarse sand/gravel	0.427	75%
GAB-CRA	22 Jun 04 10:56	14.97	8.98	0.39	7.15	0.80	sand, silt/clay	0.446	95%
GAB-VET	22 Jun 04 09:24	16.08	4.64	0.68	6.22	1.35	sand	0.209	15%
NAT-FRE	23 Jun 04 11:10	15.66	8.69	0.50	7.66	1.01	silt/clay	0.087	98%
NAT-LAS	23 Jun 04 11:45	15.63	6	0.53	7.48	1.07	fine sand, silt/clay	0.080	75%
SRC-RUS	30 Jun 04 09:37	17.91	4.55	0.35	7.71	0.72	sand	0.026	5%
SRC-VAN	29 Jun 04 11:05	21.10	9.55	0.42	7.9	0.86	sand	0.283	5%
REC-JON	25 Jun 04 09:45	18.81	3.7	0.74	7.78	1.47	silt/clay, fine sand	0.150	1%
REC-AIR	28 Jun 04 10:10	17.83	6.91	0.58	8.43	1.16	silt/clay	0.015	0%
EP1-ROG	25 Jun 04 10:51	24.50	7.5	0.48	7.74	0.97	fine sand, silt/clay	0.381	0%
EPL-PUM	30 Jun 04 11:51	21.69	6.57	1.41	7.98	2.98	sand, silt/clay	0.000	0%
TEM-RAI	28 Jun 04 11:21	19.13	8.56	1.14	7.93	2.22	silt/clay	0.024	0%
TEM-MOL	29 Jun 04 09:45	18.87	8.59	3.15	8.02	5.77	silt/clay	0.07	2%
OLS-POT	30 Jun 04 10:51	19.97	9.24	15.34	7.92	25.12	silt/clay	0.00	0%

The high surface salt concentration at OLS-POT is attributed to seawater through the Potrero Tide Gates during a rising tide. Upstream, TEM-MOL also had brackish waters due to the tide gates, while further upstream TEM-RAI, was only slightly brackish due to both the tide gates and possibly agricultural return flows.

Channel substrate size was largest (gravel/coarse sands) in the upstream sites and became progressively smaller (silt/clay) downstream. The coarse substrate sizes, especially cobbles and large gravels, provide areas for many benthic invertebrate taxa to attach.

Sites furthest upstream in the watershed were much more vegetated and therefore had higher overhead vegetative cover percentage.

Baseline Invertebrate Taxa of the Reclamation Ditch Watershed

A total of 27 different taxa, representing 11+ Orders and 17+ Families, were collected within the Reclamation Ditch Watershed (Table 7.2). Fall and spring are typically the better seasons to sample for BMI's. These samples were collected during the summer, which may explain the low taxa richness throughout.

The pollution tolerance for each taxon was noted using the Hilsenhoff Biotic Index value, as described by Hilsenhoff (1988) (Table 7.2). Ode (2003) points out that the use of this index with all disturbance types can be "*complicated by the fact that the original values are regionally specific and that different organisms can respond uniquely to different pollution or disturbance types. For example, a genus that is highly tolerant to sediment or organic pollution might be very intolerant to disturbance from heavy metals or pesticides. However, this index has been found to be useful as a general measure of community tolerance to human disturbance, although its use should be treated with caution.*"

The lack of a comparable pristine reference site within the Salinas Valley or the Central Coast of California further complicates the detection of key disturbances that may influence macroinvertebrate communities in the Reclamation Ditch Watershed.

The results clearly indicate a dramatic change in invertebrate community composition as one moves from the headwaters to the coast. Much of this change is simply a result of the natural geomorphic gradient, from steep, fresh, cool, oxygenated mountain streams all the way down to sluggish, brackish, turbid and relatively warm sloughs. This is evidenced by strong relationships between summary measures such as taxonomic diversity and geomorphic variables such as substrate composition, and water temperature (see Figs 7.3 & 7.4). Of most interest however, is the degree to which the

[Page intentionally left blank]

Table 7.2 Benthic macroinvertebrates collected in the Reclamation Ditch Watershed. Sites are arranged in order from furthest upstream (left) to furthest downstream (right).

Taxa				Common Name	Feeding Habit	Pollution Tolerance Level (PTL)	Site														
Phylum	Class	Order	Family			(0-10)	TOW-OSR	GAB-OSR	GAB-CRA	GAB-VET	NAT-FRE	NAT-LAS	SRC-RUS	SRC-VAN	REC-AIR	REC-JON	EP1-ROG	EPL-PUM	TEM-RAI	TEM-MOL	OLS-POT
Arthropoda	Insecta	Plecoptera	Nemouridae	stone fly	SH	2	X														
Arthropoda	Insecta	Ephemeroptera	Ameletidae	mayfly	CG	0	X														
Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae	mayfly	SC	2	X														
Arthropoda	Insecta	Ephemeroptera	Baetidae	mayfly	CG	4		X													
Arthropoda	Insecta	Ephemeroptera	Fl.	mayfly		4	X														
Arthropoda	Insecta	Tricoptera	Lepidostomatidae	caddis fly	SH	1	X	X													
Arthropoda	Insecta	Lepidoptera	Pyralidae	aquatic moth	SC	5			X												
Arthropoda	Insecta	Odonata	Cordulegastridae	dragonfly	P	3		X	X												
Arthropoda	Insecta	Odonata	Coenagrionidae	dragonfly	P	8	X	X	X												
Arthropoda	Insecta	Coleoptera	Elmidae	Aquatic beetle	CG	4		X													
Arthropoda	Insecta	Coleoptera	Dytiscidae	Aquatic beetle	P	5	X	X													
Arthropoda	Insecta	Hemiptera	Belostomatidae	Giant water bug	P	8				X											
Arthropoda	Insecta	Diptera	Deuterophlebidae	midge	SC	0		X													
Arthropoda	Insecta	Diptera	Dixidae	midge	CG	2		X													
Arthropoda	Insecta	Diptera	Tipulidae	crane fly	SH	3		X	X												
Arthropoda	Insecta	Diptera	Chironomidae	midge	CG	6	X	X		X	X	X	X			X	X	X	X		
Arthropoda	Insecta	Diptera	Simuliidae	black fly	FC	6	X	X													
Arthropoda	Insecta	Diptera	Stratiomyidae	black soldier fly	CG	8				X											
Arthropoda	Malacostraca	Amphipoda		shrimp/scud	CG	4 - 8	X									X		X		X	X
Arthropoda	Malacostraca	Decapoda		crayfish/crab	CG	6														X	
Arthropoda	Crustacea	Ostracoda		seed shrimps	CG	8		X						X							
Platyhelmenthes	Turbellaria			flatworms	P	4	X	X		X			X	X		X					
Nematoda				roundworms	CG	5											X				
Mollusca	Gastropoda			snails	SC	7	X		X	X	X			X	X	X		X	X		
Mollusca	Pelecypoda			fresh water clam	FC	8	X	X				X				X		X			
Annelidia	Oligochaeta			segmented worms	CG	8	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Annelidia	Hirundinea			leeches	P	10					X		X		X	X			X		
Total (Taxa Richness)							14	15	6	6	4	3	4	4	3	7	3	5	4	2	2
% EPT Taxa							35.7%	13.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Site Average Hilsenhoff's Biotic Index							478.0%	467.0%	566.0%	683.0%	775.0%	733.0%	700.0%	675.0%	833.0%	700.0%	633.0%	700.0%	775.0%	600.0%	700.0%
Taxa with lowest Biotic Index at each site							0	0	3	4	6	6	4	4	7	4	5	<4	6	<4	<4

Feeding Habit = SH = Shredders; FC = Filter/Collectors; CG = Collectors/Gatherers; SG = Scrapers/Grazers; P = Predators

Hilsenhoff Biotic Index (Pollution Tolerance Level) = 0 = least tolerant of organic pollution, 10 = most tolerant of organic pollution:

0.0-3.5	Excellent	No apparent organic pollution
3.51-4.5	Very Good	Possible slight organic pollution
4.51-5.50	Good	Some organic pollution
5.51-6.50	Fair	Fairly significant organic pollution
6.51-7.50	Fairly poor	Significant organic pollution
7.51-8.50	Poor	Very Significant organic pollution

[Page intentionally left blank]

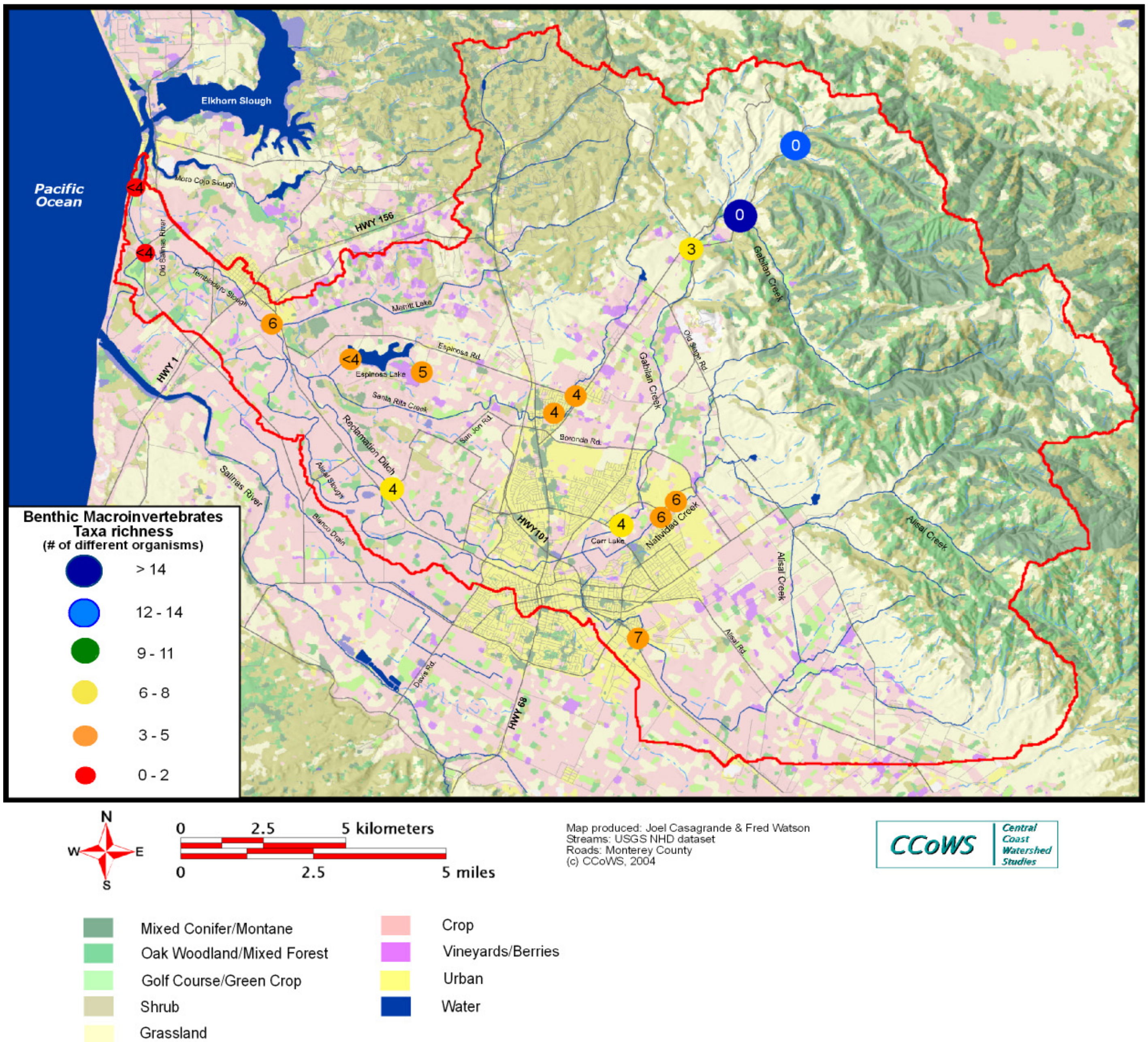


Figure 7.2 BMI taxa richness for all sites in the Reclamation Ditch Watershed. The number in the center of each circle represents lowest Pollution Tolerance Level of any taxon found at the site. The land use layer was added for comparison.

invertebrate communities observed are indicative of anthropogenic factors, such as water pollution. Such cases would appear as exceptions to the natural geomorphic trend. The patterns are described as follows.

Headwater sites were dominated by insects – with high diversity and numerous pollution-intolerant taxa (Gabilan and Towne Creeks at Old Stage Road: GAB-OSR, TOW-OSR). This is generally indicative of good water quality, and in agreement with chemical water quality data. Slightly downstream at Crazy Horse Road (GAB-CRA), insect diversity dropped from 9-11 families to just 4, with the most intolerant taxa no longer present. This is most likely due to increased adjacent agricultural land use, given that the channel and vegetation are otherwise similar to upstream sites. Below this in the heavily

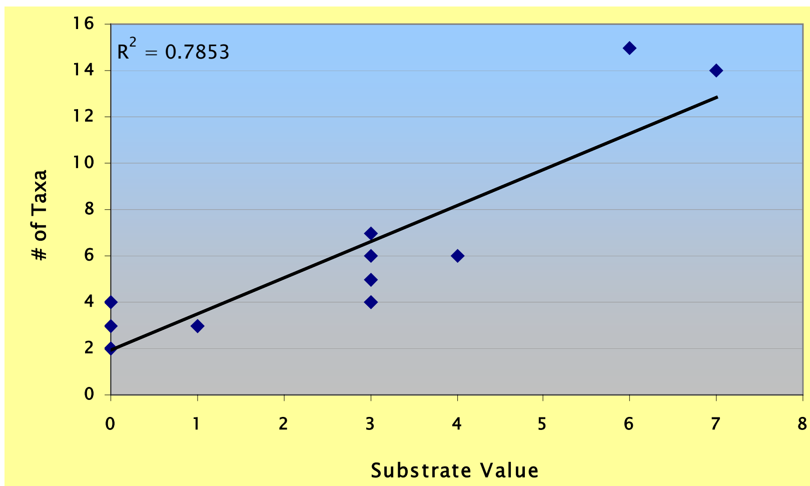


Figure 7.3 BMI taxa richness as a function of channel substrate. Substrate Values: 7 = gravel/coarse sand; 6 = coarse sand/gravel; 5 = coarse sand; 4 = sand; 3 = sand/silt/clay; 2 = fine sand 1= fine sand/silt/clay; 0 = silt/clay

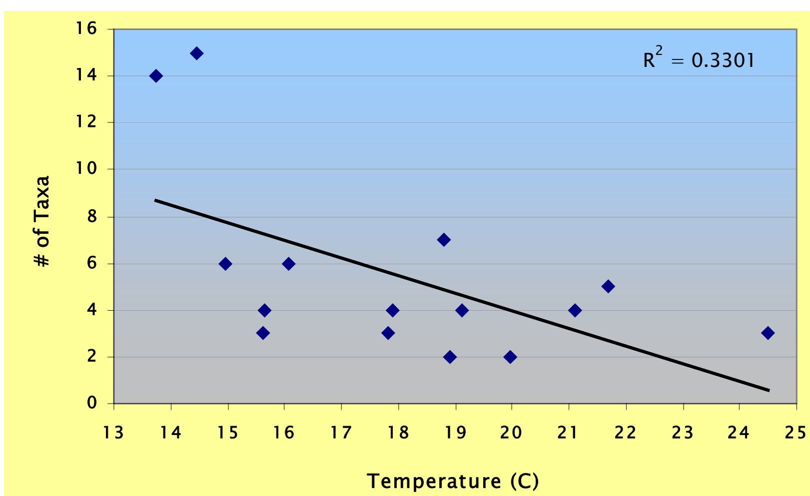


Figure 7.4 BMI taxa richness as a function of water temperature.

urban and agricultural reaches, insect diversity is reduced in most cases to just one family, the chironomids, which are normally found in either naturally sluggish water, and/or polluted water.

The mid-watershed sites are typified by snails, clams, leeches, segmented worms, flatworms, and amphipods (scuds). Within this assemblage, two groups of sites may be roughly characterized, based on whether or not they are limited to just the four most pollution-tolerant taxa: leeches, segmented worms, snails, and chironomids. Sites that fall into this category are in the Reclamation Ditch, Tembladero Slough, Espinosa tributary, and Natividad Creek (REC-AIR, TEM-RAI, EP1-ROG, NAT-FRE). These sites, downstream of large agricultural tractswith minimal overhead vegetative cover, have previously been documented as having poor chemical water quality (see Chapter 6, and also Anderson et al., 2003; Kozlowski et al., 2004; CCAMP). The remaining mid-watershed sites tend to include one or other of the slightly less tolerant taxa, such as flatworms or amphipods, perhaps indicating slightly better aquatic habitat. These sites include sites downstream from urban areas with fairly consistent flow, such as GAB-VET, REC-JON, and SRC-VAN, and the wind-mixed, wetland-influenced site EPL-PUM (on lower Gabilan Creek, the lower Reclamation Ditch, and Santa Rita Creek).

The two most coastal sites (on lower Tembladero Slough and the Old Salinas River Channel: TEM-MOL & OLS-POT) exhibited an invertebrate fauna limited to just those taxa that can withstand sub-tidal brackish conditions: amphipods, crayfish, and segmented worms.

In general, the data show that the aquatic fauna of Reclamation Ditch Watershed are diverse and markedly heterogeneous, largely a result of the geomorphic gradient from steep mountains and foothill creeks, through sluggish ditches and sloughs, to the sub-tidal coast. These data suggest that the natural aquatic ecosystems are different in the lower parts of the watershed and have been impaired by water quality impacts.

Fisheries

General Species Distribution

The Reclamation Ditch Watershed, like the Salinas and Pajaro River Watersheds, contains a fish community similar to that of the Sacramento/San Joaquin Watersheds (Snyder, 1913). A total of eighteen species of fish have been observed between 2000 and 2004 in the Reclamation Ditch Watershed, of which eight species are native while the remaining 10 have been introduced. Figure 7.5 and Table 7.3 summarizes the overall fish assemblages and detail the observed species, general locations of recent sightings, and native/non-native designation.

The South-Central Coast Steelhead Trout Evolutionary Significant Unit (ESU) is listed as a threatened species under the Federal Endangered Species Act. Steelhead trout are rainbow trout (*Onchorhynchus mykiss*) that have migrated to and returned from the ocean as adults. They are the only special status fish species that transiently occurred and was documented in the watershed in 2004. The possible presence of Sacramento perch should be investigated. Historical accounts of steelhead in the Reclamation Ditch Watershed have not been well documented.

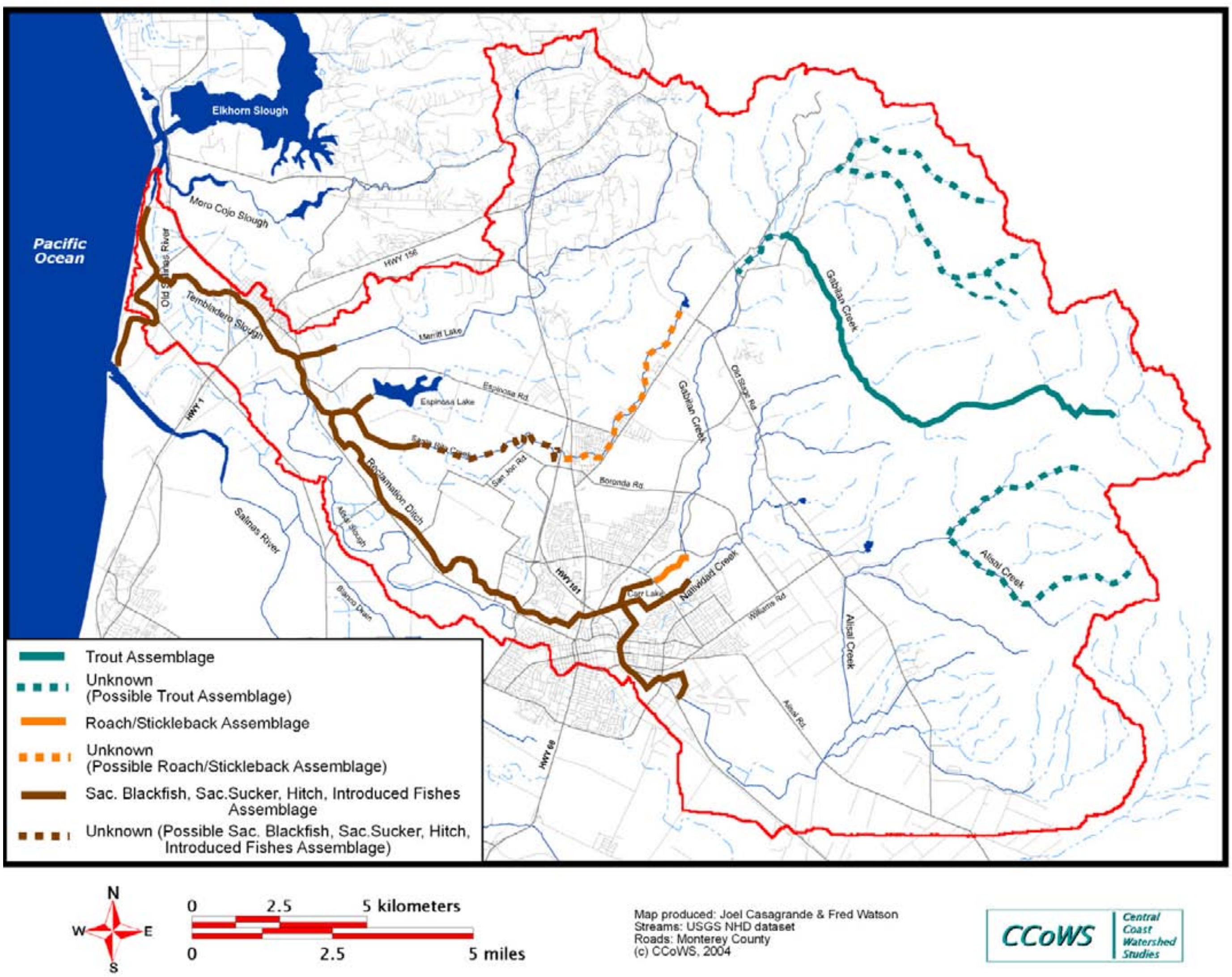


Figure 7.5 Fish assemblages of the Reclamation Ditch Watershed.

Table 7.3 Fish species observed in the Reclamation Ditch Watershed and the location(s) of the observation(s). All observations were made between 2000-2004.

Species Common Name	Species Scientific Name	Origin	Location(s)	Source
rainbow trout/Steelhead	*Oncorhynchus mykiss*	Native	- Gabilan Creek (Upstream of Old Stage Rd Crossing and just downstream of the crossing) - Steelhead found March 6, 2004 near Little River Drive.	Hager, 2001 Casagrande pers. observation
California roach	*Lavinia symmetricus*	Native	- Gabilan Creek nr Veterans Park - Laurel Pond (Natividad Creek) - Santa Rita Creek @ Van Buren Way	Casagrande pers. observation
hitch	*Lavinia exilicauda*	Native	- Old Salinas River/Tembladero Slough/ Rec. Ditch - Laurel Pond (Natividad Creek)	Casagrande pers. observation CDFG, 2002
Sacramento blackfish	*Orthodon microlepidotus*	Native	- Old Salinas River/Tembladero Slough - Laurel Pond (Natividad Creek)	CDFG, 2002 Casagrande pers. observation
Sacramento sucker	*Catostomus occidentalis*	Native	- Old Salinas River/Tembladero Slough - Laurel Pond (Natividad Creek)	CDFG, 2002 Casagrande pers. observation
Sacramento pikeminnow	*Ptychocheilus grandis*	Native	- Old Salinas River/Tembladero Slough	CDFG, 2002
threespine stickleback	*Gasterosteus aculeatus*	Native	- Laurel Pond - Gabilan Creek nr. Veterans Park	Casagrande pers. observation
sculpin (species not stated)	*Cottus spp. (likely prickly sculpin)*	Native	- Old Salinas River/Tembladero Slough	CDFG, 2002
common carp	*Cyprinus carpio*	Non-native	- Reclamation Ditch - Tembladero Slough - Old Salinas River - Laurel Pond (Natividad Creek)	Casagrande pers. observation CDFG, 2002
goldfish	*Carassius auratus*	Non-native	- Laurel Pond (Natividad Creek) - Tembladero Slough	Casagrande pers. observation CDFG, 2002
golden shiner	*Notemigonus chrysoleucas*	Non-native	- Laurel Pond (Natividad Creek)	Casagrande pers. observation, CDFG, 2002
fathead minnow	*Pimephales promelas*	Non-native	- Laurel Pond (Natividad Creek)	Casagrande pers. observation
bluegill	*Lepomis macrochirus*	Non-native	- Laurel Pond (Natividad Creek) - Ranch pond (near headwaters of Gabilan Creek)	Casagrande pers. observation Gabilan Ranch Online
sunfish	*Lepomis sp.*	Non-native	- Laurel Pond (Natividad Creek)	Casagrande pers. observation
largemouth bass	*Micropterus salmoides*	Non-native	- Ranch pond (near headwaters of Gabilan Creek)	Gabilan Ranch Online
brown bullhead	*Ameiurus nebulosus*	Non-native	- Laurel Pond (Natividad Creek)	Casagrande pers. observation
catfish (species not stated)	*Ictalurus spp.*	Non-native	- Ranch pond (near headwaters of Gabilan Creek)	Gabilan Ranch Online
mosquitofish	*Gambusia affinis*	Non-native	- Laurel Pond (Natividad Creek) - Carr Lake - Espinosa Lake - Farm/Stock Ponds (General)	Casagrande pers. observation

Rainbow trout may have existed in the upper Reclamation Ditch Watershed since the 1940's. Bill Tarp's family fished the upper Gabilan near Fremont peak catching 7 to 9 inch trout in the 1940's (Hager, 2001). Rainbow trout were planted in the upper Gabilan by a landowner from some unknown date at least until 1958 (Day, *circa* 1959). In the preceding 40 years, no adult steelhead were observed by that landowner (Day, *circa* 1959). CCoWS sampling crews observed rainbow trout (approx. 6 inches) at the upstream side of Old Stage Road Crossing of Gabilan Creek during spring 2000. In early March 2004, an adult transient female steelhead was found dead in Gabilan Creek near Constitution Blvd. In June 2004, Casagrande observed young trout (1 to 2 inches), along the downstream side of the Old Stage Road Crossing. Please note, above analyses are based solely on observations and cannot be independently confirmed by the California Department of Fish & Game, other than the necropsy performed on the transient female steelhead found in 2004.

To date, no detailed presence/absence assessments of other fish species have been made in the upper Reclamation Ditch Watershed (between the headwaters and Carr Lake). Casagrande et al., (2003) surveyed fish species distribution throughout the Salinas Valley. The regional perspective provided by this work suggests that other species present in these cool, perennial reaches may be riffle sculpin (*Cottus gulosus*) and speckled dace (*Rhinichthys osculus*).

The presence/absence of rainbow trout/steelhead in the headwaters of Alisal, Towne, or Mud Creeks is unknown. Suitable habitat conditions are likely to exist for rainbow trout in the upper reaches of these streams and are noted in Figure 7.5.

The middle reaches (between the Gabilan Mountains and the City of Salinas) of the watershed are non-perennial and thus do not support fisheries.

The downstream habitats of the watershed support the warm-water fish communities (i.e. minnows, suckers and introduced fishes). The reach of Gabilan Creek near Veteran's Memorial Park supports only California roach and threespine stickleback. Several observations at this reach between 2000 and 2004 have revealed only stickleback and roach. On a recent visit to Santa Rita Creek, upstream of Highway 101, Casagrande observed only California roach.

Due to their tolerance of high water temperatures and low dissolved oxygen levels, roach and stickleback are well adapted to living conditions of intermittent streams and heavily altered habitats. At Veterans Memorial Park, summer streamflow is minimal, often, usually only a trickle connecting scattered shallow pools. The source of the water is apparently pumped groundwater from upstream near Alvarez High School (D. Estrada, City of Salinas, pers. comm., 2004). This reach is outlined in Figure 7. as the Roach/Stickleback Assemblage.

The slow, warm water habitats of the Reclamation Ditch, lower Natividad Creek/Laurel Pond, Tembladero Slough, the lower Santa Rita Creek drainage and the Old Salinas River Channel support most of the original warm water fish species, or the Blackfish, Sucker, Hitch Introduced Fishes Assemblage (Fig. 7.5). Species included in this Assemblage include native species such as the Sacramento sucker, Sacramento blackfish, Sacramento pikeminnow, hitch, California roach, threespine stickleback and a variety of non-native fish like carp, fathead minnow and mosquito fish.

In July of 2003, Laurel Pond near Natividad Creek Park was seined as part of a stream restoration project, which required draining the pond (Fig. 2.16). The pond was seined in order to detect the presence of listed species and to relocate native aquatic species utilizing the habitat. The pond contained several native and non-native warm-water fishes (See Table 7.3).

Fish Kills

On June 28th 2002, a fish kill in the lower Tembladero Slough/Old Salinas River drainage was reported to the California Department of Fish and Game (CDFG, 2002). It was estimated that 2,000 fish were killed over 3-4 miles of stream channel. Several species and sizes/age classes were found including Sacramento sucker, Sacramento blackfish, hitch, Sacramento pikeminnow, sculpins, carp, and goldfish. In addition, CCoWS technicians observed a dead hitch at the San Jon Road Bridge on the Reclamation Ditch on July 2, 2002 that appeared to have been dead for a few days (Fig. 7.6).

The cause of death was never determined. Water, sediment and fish tissue samples were collected on June 28th by CDFG and analyzed for pesticide concentrations and signs of suffocation (lack of dissolved oxygen). Also, CDFG reviewed pesticide use reports from the Monterey County Agricultural Commissioner (MCAC). Diazinon was detected in both the water and fish gill tissues at concentrations below the published LC_{50} values for fish (272-8,000 µg/L).

Low dissolved oxygen levels could have also caused the fish kill; although CDFG was unable to collect dissolved oxygen concentrations due to instrument failure.

On October 21, 2003, several dead fish were observed in the Reclamation Ditch at San Jon Road. Carp and hitch were the only species observed. All fish were of large size. The physical appearance of the fish suggests that had they been dead for some time (Figs 7.7).

Fish kills occur episodically throughout California for various reasons. In the context of overall ecosystem health, species diversity, and distribution, the occurrence of fish kills is of importance. Entire species and/or their distribution within a watershed can become extirpated due to a single event such as a sharp reduction in streamflow due to water diversions or the introduction of a chemical toxin such as pesticides or herbicides.

Both chronic and episodic poor water quality conditions have the potential to result in the same outcome – the reduction in population size, diversity, and distribution. Causal mechanisms could involve toxins, lack of oxygen, or both, either directly or indirectly by affecting fish food species (e.g. invertebrates). The frequency of fish kills provides insight into the health and integrity of aquatic habitat.

Figure 7.6 The fish was found dead at the control structure at San Jon Road. Other fish were found at this location as well including juvenile carp. Photo: Joel Casagrande July 1, 2002.

Figure 7.7 A dead carpin the Reclamation Ditch at San Jon Road October 21, 2003. Photo: Don Kozlowski, October 21, 2003.

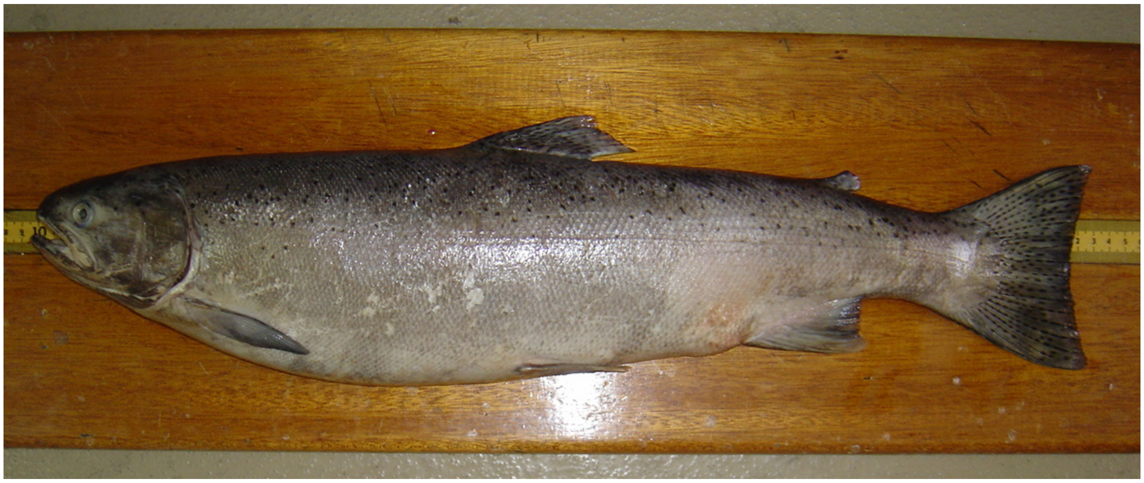


Figure 7.8 A 30" adult gravid female steelhead found dead in Gabilan Creek on March 6, 2004. Photo: courtesy of Tom Gaffney and CDFG, 6 March 2004.

Fish Migration

Most species of fish migrate at different times throughout their lifecycle. For example, steelhead migrates back and forth from freshwater to the ocean at least once in their lifecycle. Sacramento suckers generally migrate upstream in later winter or early spring to spawn in smaller tributary streams (Moyle, 2002). Dams, control structures, and elevated road culverts can fragment migration corridors, which can reduced species population, geographic range, and possibly result in the local extirpation of a species.

In the Reclamation Ditch Watershed, if fish migration and spawning were to occur, it would occur in winter when stream flows are at their highest. Spawning habitat is only found within the upper foothill and mountainous reaches of the Gabilan Range where suitable substrate (gravel/cobble) is dominant and stream flow is still abundant.

In order to reach the spawning habitat upstream, fish would have to navigate through a series of man-made impediments. Most are passable given enough time, streamflow volume/depth and prolonged stream flow duration. The duration of adequate flow in the middle reaches of the Reclamation Ditch Watershed is, in average years, brief and because of this, the migration window is very short.

On March 6th 2004, a 30-inch female steelhead was found dead in Gabilan Creek along Little River Drive (Figs 7.8). The fish had not spawned and was found at the base of a sediment stabilizer structure near Little River Drive 7.9). The fish was examined by staff at the California Department of Fish and Game and was deemed healthy. The exact cause of death was not determined but was possibly the lack of suitable flow combined with a possible migration barrier. Figure 7.10 shows the stream flow present during this spawning attempt. It is likely that the fish entered the watershed during higher flows in late February (i.e. February 28th) yet by early March stream flows in the watershed reduced to levels impassable by a fish of this size.

The presence of an adipose fin and the healthy condition of the caudal fin (i.e. no frayed areas or discoloration resulting from constant nibbling from other fish in the hatchery) suggests that the 2004 fish was a wild trout and not a hatchery fish. Stocking of hatchery fish in the Carmel, Pajaro, Salinas, or Reclamation Ditch Watersheds was banned in 1997 upon the Federal listing of the ESU as Threatened.

Necropsy revealed no evidence of the fish found in 2004 as having been hooked by a fishhook, or having any damage consistent with netting (J. Nelson, CDFG, pers. comm., 2004).

There is not enough evidence to confirm that a steelhead run exists in this watershed. It is possible that the fish are returning to natal spawning areas in the Reclamation Ditch Watershed. It is perhaps more likely that they are strays from runs in the Salinas, Carmel, or Pajaro River Watersheds. Hagar (2004) stated that the sandbar at the Salinas River Lagoon was closed until late February (breached on February 27th by MCWRA). This fish likely began its migration up the Reclamation Ditch Watershed around the same time, or during peak flow on February 26th (Fig. 7.10).

Figure 7.9 The sediment stabilizer structure where an adult female steelhead was found in March 2004. Photo: courtesy of Tom Gaffney, spring 2004.

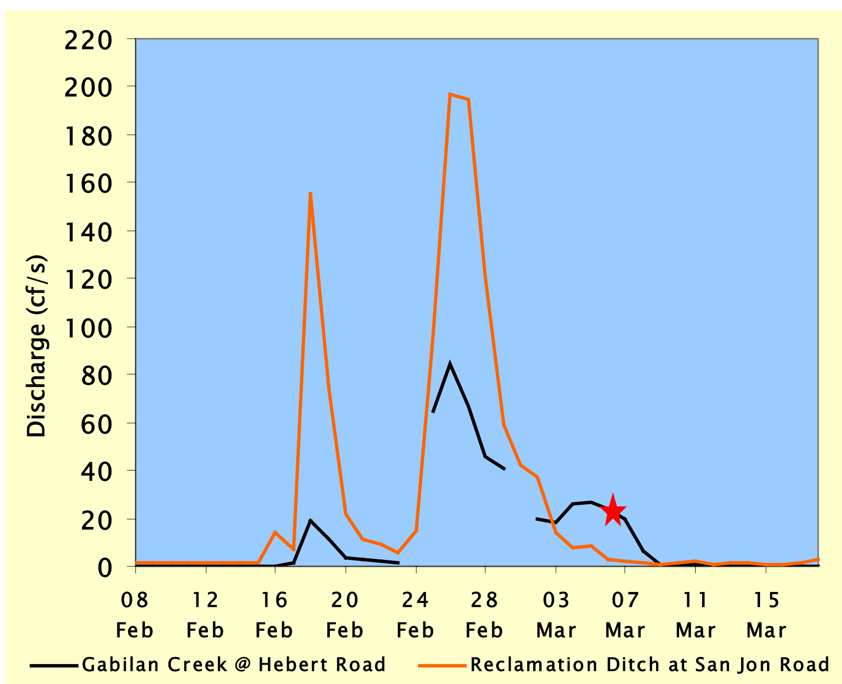


Figure 7.10 A hydrograph for daily mean stream flow in Gabilan Creek and the Reclamation Ditch during the February and March events (Source: USGS, 2004). The red star indicates the date and flow when the steelhead was found.

Amphibians and Reptiles

Between 2000 and 2004, seven species of amphibians and reptiles were observed in the Reclamation Ditch Watershed by CCoWS technicians (Table 7.4). Of these seven species, only the bullfrog is a non-native. In addition, the California Natural Diversity Database (CNDDB) documents rare and listed species in the Reclamation Ditch Watershed and the surrounding area (Fig. 7.26).

California red-legged frogs (*Rana aurora draytonii*) were most likely abundant in the swamplands that once existed between Castroville and Salinas, as suggested by the presence of red-legged frogs in other coastal swamplands of similar habitat type throughout Central California (i.e. the Watsonville Slough System, Waddell Creek Lagoon, Pescadero Creek Lagoon, and the Carmel River Watershed). However, in the Reclamation Ditch Watershed, much of the wetland habitat has been replaced with agricultural lands and urban development and/or has been introduced with non-native predators.

The red-legged frog generally prefers deep ponds, slow-moving streams with abundant tules or sedges (Stebbins, 2003). In coastal areas, they will also utilize slightly brackish marshes adjacent to streams that maintain low salinity levels throughout the breeding and rearing season.

Recent observations of red-legged frogs in the Reclamation Ditch Watershed and the surrounding area have been concentrated in the surrounding foothills and mountainous areas. CCoWS technicians observed two adult red-legged frogs on September 15, 2000 in a ranch pond near Fremont Peak State Park in San Benito County (Figs 7.1 & 7.2).

Table 7.4 Species of amphibian and reptile observed in the Reclamation Ditch Watershed.

Species Common Name	Scientific Name	Origin	Location(s)	Source
Pacific tree frog	*Hyla regillia*	Native	Common throughout study area	Casagrande pers. observation
Red-legged frog	*Rana aurora draytonii*	Native	Ranch pond near Fremont Peak State Park	Casagrande pers. observation
Western toad	*Bufo boreas*	Native	- Gabilan Creek near Boronda Road, near Crazy Horse Rd, near headwaters. - Laurel Pond (Natividad Creek)	Casagrande pers. observation
bullfrog	*Rana catesbeiana*	Non-Native	- Gabilan Creek nr. Veterans Mem. Park - Laruel Pond (Natividad Creek) (Tadpoles)	Casagrande pers. observation
Pacific giant salamander	*Dicamptodon tenebrosus*	Native	Farm pond near headwaters of Gabilan Creek	Casagrande pers. observation
California tiger salamander	*Ambystoma tigrinum*	Native	-Within proposed Rancho San Juan Development Vicinity	CNDDB, 2004 PDC, 2004
western pond turtle	*Clemmys marmorata*	Native	- Laruel Pond (Natividad Creek) - Pond at the Crazy Horse Canyon Landfill	Casagrande pers. observation (MBA, 1992)
Western Fence Lizard	*Sceloporus occidentalis*	Native	Gabilan Creek near Lexington Dr.	Casagrande pers. observation
Northern Alligator Lizard	*Elgaria coerulea coerulea*	Native	Gabilan Creek near Veteran's Memorial Park	Watershed Institute Staff
Western aquatic garter snake	*Thamnophis couchii*	Native	Gabilan Creek near Headwaters. Gabilan Creek near Veteran's Memorial Park	Casagrande pers. observation Watershed Institute Staff
California red-sided garter snake	*Thamnophis sirtalis infernalis*	Native	Farm pond near headwaters of Gabilan Creek	Casagrande pers. observation
Pacific ring-necked snake	*Diadophis punctatus vandenburghi*	Native	Gabilan Creek near Veteran's Memorial Park	Watershed Institute Staff
Pacific gopher snake	*Pituophis catenifer catenifer*	Native	Gabilan Creek at Hebert Road	Casagrande pers. observation

Figure 7.11 A red-legged frog in a ranch pond near Fremont Peak State Park. Photo: Thor Anderson, 15 September 2000.

Figure 7.12 A second red-legged frog warming up in the afternoon sun. Photo: Thor Anderson, 15 September 2000

The California tiger salamander is also known to occur in the Reclamation Ditch Watershed and surrounding areas (CNDDB, 2004). In September of 2004, its status was changed from Species of Concern to a Federally Threatened Species (CDFG, 2005). Tiger salamanders breed in fresh water ponds, large vernal pools and marshes and then migrate to adjacent upland areas where they spend most of their time underground, usually in old rodent burrows associated with oak-savanna or grassland communities (Stebbins, 2003). Their decline is consistent with the removal of this type of habitat in the early 1900s.

Throughout California, tiger salamander populations have been reduced due to habitat loss to urban and agricultural development and the continued encroachment of non-native predators such as bullfrogs, crayfish, mosquito fish, green sunfish and others; many of which have been introduced to the Reclamation Ditch Watershed (USGS, online; USFWS, online; Stebbins, 2003). The CNDDB contains recent tiger salamander observations near the Crazy Horse Canyon area, former Fort Ord Military Base, and the Elkhorn Slough area (Fig. 7.26).

The loss of the historic lakes may have led to a reduction in western pond turtles habitat. There are two sub-species of western pond turtle, the northwestern pond turtle and the southwestern pond turtle. The Southwestern pond turtle is both a Federal and State Species of Concern. The preferred habitat of the pond turtle is deep pools, with abundant structures such as logs or dense vegetation, in slow moving streams, ponds or lakes. The presence of adjacent grassland or oak savanna habitats (habitat mosaics) is also critical for breeding. During the breeding season, female turtles move upland, to open grassland areas where they dig a nest in the earth and lay their eggs (Stebbins, 2003).

Two recent pond turtle sightings have been made in the Reclamation Ditch Watershed. One was observed in the Laurel Pond area of Natividad Creek in the summer of 2003 and another was observed in a pond located on the Crazy Horse Land Fill Property in 1992 (MBA, 1992).

Other special status amphibian and reptile species known to occur within and/or near the watershed are the Santa Cruz long-toed salamander (*Ambystoma macrodactylum corceum*), coast horned lizard (*Phrynosoma coronatum*), and the California black legless lizard which is has been observed on the coastal dunes near Marina (*Anniella pulchra nigra*).

Pacific Tree frogs and western toads were observed in Gabilan Creek near Independence Way in the summer of 2000 (Casagrande, field observation). Both species are still common throughout California, although western toad populations are thought to be in decline throughout their range (Marco et al., 1999; Stebbins, 2003).

Figure 7.13 This juvenile western toad was found in Gabilan Creek near Lexington Drive (off Independence Way). Photo: Joel Casagrande, August 2000.

Figure 7.14 Western fence lizard along the bank of Gabilan Creek. Photo: Joel Casagrande, 21 Aug. 2004.

Figure 7.15 Pacific ring-necked snake. Watershed Institute staff observed this snake during a plant restoration event along Gabilan Creek near Veteran's Memorial Park. (Photo: Watershed Institute Staff, 2004).

Figure 7.16 Pacific gopher snake. This gopher snake was found along the stream bank of Gabilan Creek at Hebert Road. Photo: Thor Anderson, August 2000.

Common native species of reptiles that occur in and around the watershed boundary include, western fence lizard (*Sceloporus gracisus*) (Fig. 7.14), California alligator lizard (*Elgaria multicarinata*), Pacific gopher snake (*Pituophis catenifer catenifer*) (Fig. 7.16), Pacific ring-necked snake (*Diadophis punctatus vandenburghi*) (Fig. 15) northern pacific rattlesnake (*Crotalus viridis oreganos*) and southern pacific rattlesnake (*C. v. helleri*). A complete checklist of amphibian and reptile species possibly occurring in the watershed based on Stebbins (2003) is found in Appendix B.

Birds

Overview

In the Gabilan and Salinas Valley Watersheds, the loss of most of the wetland/riparian habitat has resulted in a decline or extirpation of several species of birds. In the Reclamation Ditch Watershed, a large portion of the coastal maritime chaparral and oak woodland communities has been converted into urban, agricultural and ranching land uses. These habitats are critical foraging areas for many species of songbirds and birds of prey. However, the fragmented remains of each of these communities continue to support a wide variety of birds, most of which are native.

Gordon (1996) details general changes in bird species, habitat utilization, and population range over the past century in the Monterey Bay area. Some species have declined as a result of human settlement, while others have actually increased their population and range. The clearing of oaks and montane forest for pasturelands has led to an increase in habitat for grassland dependent species such as the morning dove (*Zenaida macroura*) and the western meadowlark (*Strunella neglecta*).
Others have benefited from sub-urban development as well such as the house finch (*Carpodacus mexicanus*), American robin (*Turdus migratorius*), American kestrel (*Falco sparverius*), California towhee (*Pipilo crissalis*), and the morning dove (Gordon, 1996).

The great blue heron (*Ardea herodias*), great white egrets (*Casmerodius albus*) (Fig. 7.17, and snowy white egrets (*Egretta thula*) are still relatively common in the Old Salinas River Channel, Moss Landing Harbor, Tembladero Slough, Moro Cojo Slough, and Elkhorn Slough. California brown pelicans (*Pelecanus occidentalis*) and American white pelicans (*Pelecanus erythrorhynchos*) are occasionally seen in the Watershed (Fig 7.18) and Elkhorn Slough.

Certain species found in the Watershed pose specific concerns to agriculture, such Canada geese (*Branta canadensis*) (Fig. 7.19) whose presence among row-crops may indicate a human-health risk due to bacterial contamination (Clark, 2003). Canada geese are of particular concern because their populations are rapidly expanding, they easily habituate to human landscapes, and they are known carriers of human pathogens.

Figure 7.17 Great blue heron (left) at Moss Landing Harbor immediately downstream of the Potrero Tide Gates and a Great white egret in the Salinas River near Davis Road. Photo: (G.B. Heron) Joel Casagrande, 30 June 2004, (G.W. egret) Fred Watson, May 2003.

Figure 7.18 White pelicans in the Old Salinas River Channel. Photo: Joel Casagrande, July 2, 2002.

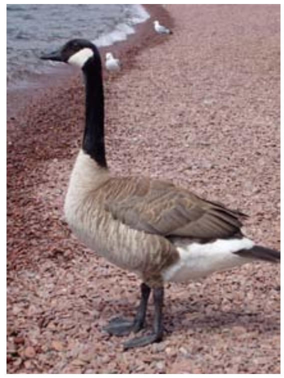


Figure 7.19. Canada goose. Photo: Fred Watson, August 2004.

Figure 7.20 A ranch pond in the upper watershed - habitat for birds, amphibians, and reptiles. Photo: Fred Watson, December 11, 2003.

Reservoirs, ranch ponds, and sediment retention basins have become important habitats for several bird species including a variety of migrating water fowl and song birds such as the red-winged blackbird (*Agelaius phoeniceus)*, a species often associated with wetland habitats (Fig. 7.20). The more permanent ponds and reservoirs are especially valuable because they "preserve part of a marsh flora" that was once wide spread throughout the northern Salinas Valley (Gordon, 1996).

The recently published Rancho San Juan EIR (2004) documents observations of bird species currently listed under federal and/or state statuses. Long-billed curlews (*Numenius americanus*), California horned lark (*Eremophila alpestris actia*), and tricolored blackbird (*Agelaius tricolor*), along with several species of non-listed nesting raptors, were all observed during surveys for the Rancho San Juan development site in 1995 and 2002 (PDC, 2004).

Burrowing owls, which utilize rodent burrows in open grassland habitats, also occur in the watershed. They have been observed nesting in the banks of the Reclamation Ditch (R. Clark, pers. comm., 2004).

Spatial distribution of birds in relation to land use

A first-order analysis of bird habitat quality for the study area was made by mapping breeding bird species richness throughout the study area. In the mid-1990s, Roberson and Tenney (1993) compiled an Atlas of the Breeding Birds of Monterey County by censusing birds with a 4km UTM grid. Trained observers tallied breeding bird species within each grid cell with varying degrees of effort, measured in hours. We found a strong log-linear correlation between the species counts and hours of observation.

This effort-corrected species richness was estimated throughout the study area and is mapped in Figure 7.21. A complete listing of the breeding bird species, identified in Roberson and Tenney (1993) is found in Appendix A (Table 10.2).

In general, greatest species diversity occurs in residual lowland marsh areas, upper wooded areas, and the former Fort Ord (outside study area). Least species diversity occurs in heavily industrial and agricultural areas. This confirms the broad patterns outlined earlier.

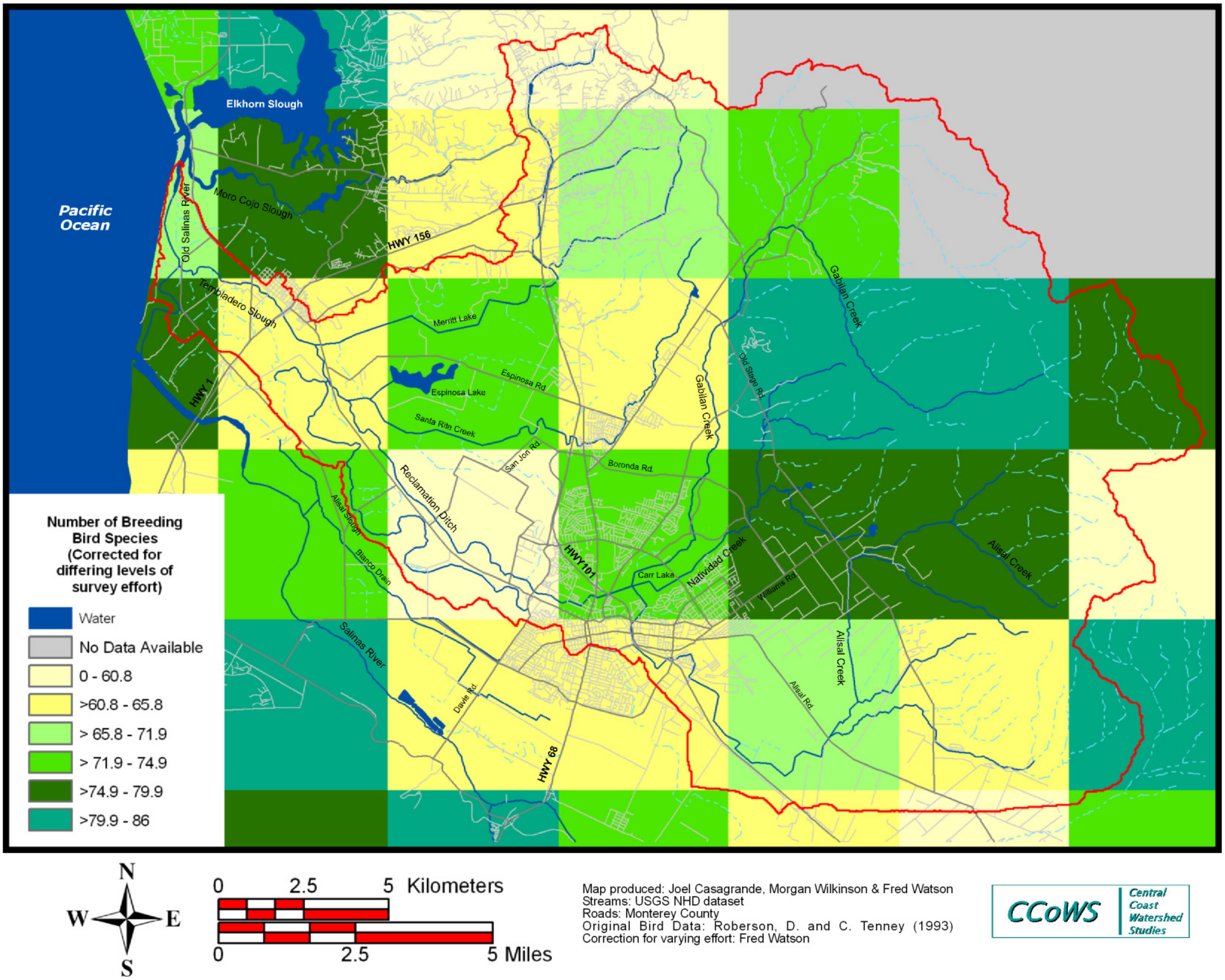


Figure 7.21 Estimated total number of breeding bird species per 4 km^2 area (effort-corrected to nominal 50-hours of observation per area).

Mammals

The mountains of the Gabilan Range support a large variety of fauna including native species such as mule deer (*Odocoileus hemionus*), tule elk (managed) (*Cervus elaphus nannodes*), raccoon (*Procyon lotor*), badger (*Taxidea taxus*), striped skunk (*Mephitis mephitis*), gray fox (*Urocyon cinereoargenteus*), coyotes (*Canis latrans*), bobcat (Felis rufus), mountain lion (*Puma concolor*), brush rabbit (*Sylvilagus bachmani*), black-tailed jackrabbit (*Lepus californicus*), California ground squirrel (Spermophilus beecheyi) and a host of smaller rodents. Introduced species include red fox (*Vulpes vulpes*), wild pig (*Sus scrofa*), and Virginia opossum (*Didelphis virginiana*) (Gabilan Ranch, Online; Fremont Peak State Park, Online) (Figs 7.22, 7.23, & 7.24).

In the foothill areas near Santa Rita Creek, Michael Brandman & Associates (1992) observed western harvest mice (*Reithrodontomys megalotis*), dusky-footed woodrats (*Neotoma fuscipes*), California vole (*Microtis californicu*s), in addition to red fox near the Crazy Horse Landfill area. Dusky-footed woodrat nests were also observed at the Rancho San Juan development site in 1995 and during the surveys in April and June of 2002 (PDC, 2004). During an early storm in October of 2000, CCoWS staff observed a mountain lion crossing Old Stage Road near the bridge over Gabilan Creek.

In general, substantial urban and agricultural development on the valley floor has eliminated, or significantly limited much of the original habitat for large mammals that require a large home range size. Species with large home ranges such as mountain lion, and badger are no longer able to migrate between the Gabilan Range and the oak woodland and grassland habitats on the former Fort Ord. Early development in Salinas was concentrated west of current HWY 101. More recent development is concentrated east of HWY 101, expanding towards the Gabilan Range. Urban and residential land, generally supports lower species diversity than rural areas.

In Figure 7.25, areas shaded green represent current significant habitat acreage for larger mammal species. Solid brown arrows represent possible migration routes. Migrations routes running northwest to southeast along the axis of the Gabilan Range are still relatively underdeveloped. A possible migration route may still exist through eastern Prunedale into the southern extent of the Santa Cruz Mountains, although species would have to cross HWY 101.

Riparian corridors within the urban and agricultural lands provide opportunities to maintain habitat connectivity for residual species such as skunk, raccoon, bobcat, fox, native and non-native rodents, as well as a host of bird species. However, the presence of wildlife species near agricultural areas represents a potential pest, food safety, and economic risk to the agricultural community.

Muskrat (*Ondatra zibethicus*) have been observed in the Tembladero Slough/Reclamation Ditch system (R. Clark pers comm. 2004) as well as Carr Lake. Beaver (*Castor canadensis*), a native to larger streams of California, were once observed in the Tembladero Slough (Gordon, 1996). It is unknown if the beaver was native to the Salinas Valley. Gordon (1996) states that in 1945 five golden beavers from Yuba County were released into the Salinas River near Chualar. They now occupy the Salinas River system from its Lagoon at least as far upstream as Arroyo Seco (CCoWS field observations).

The California sea lion (*Zalophus californianus*), harbor seal (*Phoca vitulina*), and California sea otter (*Enhydra lutris*) are often found in Moss Landing Harbor.

Figure 7.22 Coyote. Photo: Fred Watson, 2002.

Figure 7.23 Mule, or black-tailed deer.
Photo: Fred Watson, 2002.

Figure 7.24 Black-tailed Jackrabbits. Photo: Fred Watson, 2002.

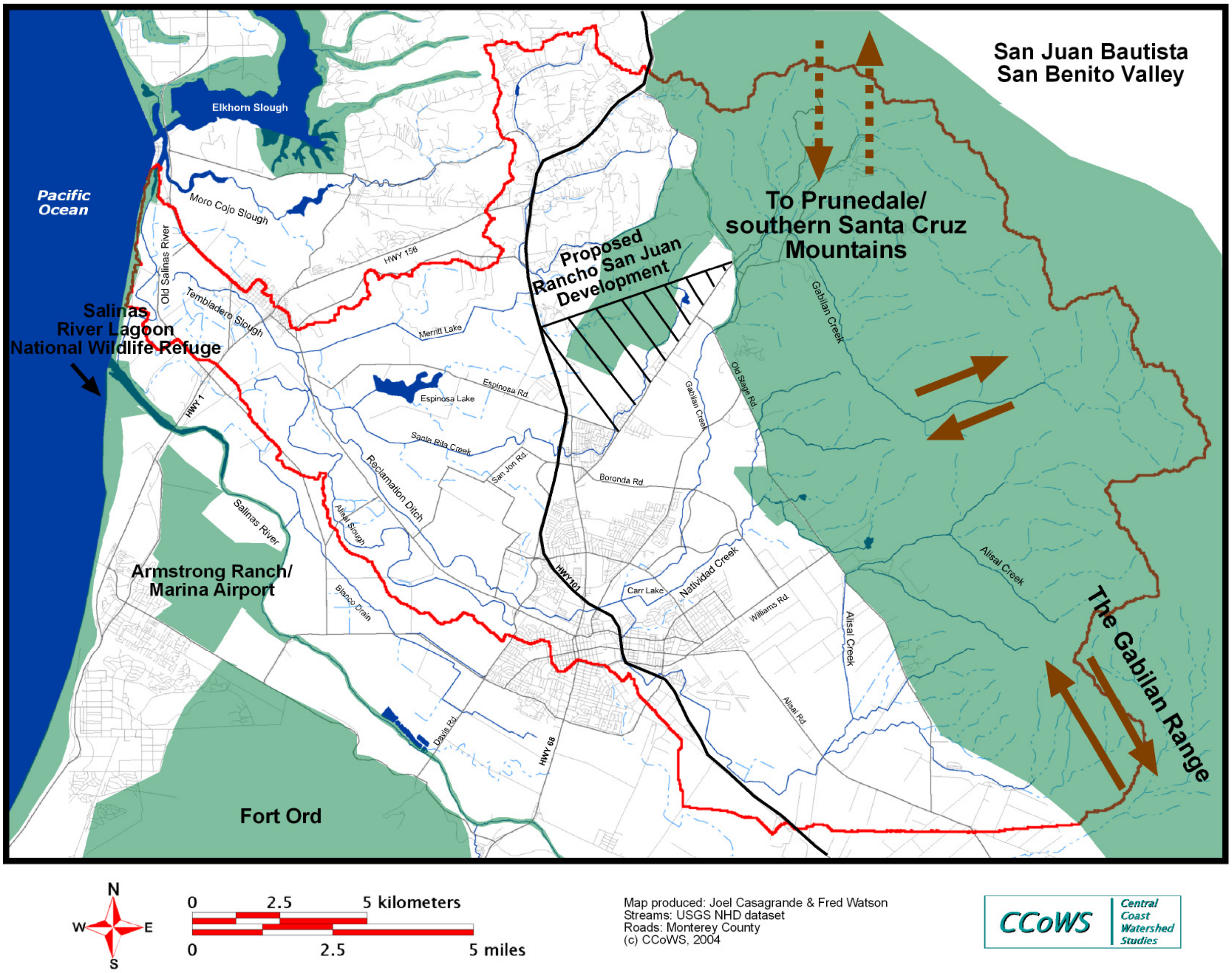


Figure 7.25 Current areas of significant open space and habitat for larger mammals in the Reclamation Ditch Watershed and surrounding areas (shaded green). Arrows represent <u>possible</u> migration routes for larger species such as mountain lion and badger.

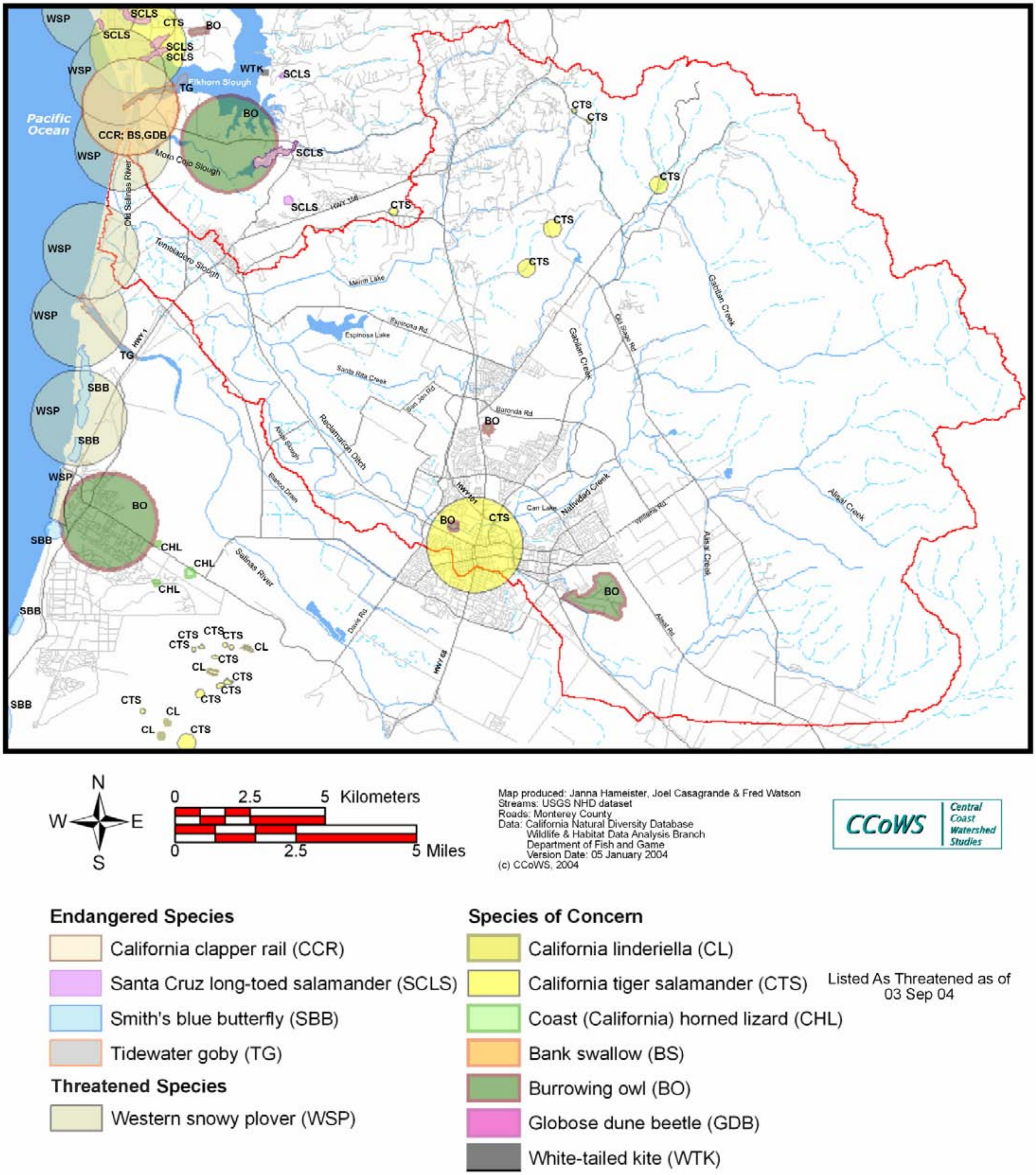


Figure 7.26 Occurrence of endangered and threatened listed species, as well as species of concern in the Reclamation Ditch Watershed. Data source: CNDDB, 2004.

Distribution of Rare/Listed Species

The CNDDB was queried for documented observations of special-status animal species in and around the Reclamation Ditch Watershed (Fig. 7.26), Special-status species are more commonly observed outside the Watershed than inside it.

According to the CNDDB 2004, the database indicates that the Reclamation Ditch Watershed supports one Endangered species, two Threatened species, and three Species of Concern.

8. Bibliography

Allen, R.B., 1934. Economic History of Agriculture in Monterey County, California During the American Period, PhD Dissertation, University Of California, 174 pp.

Anderson, B. 2000. *The Salinas Valley: The History of America's Salad Bowl*, Monterey County Historical Society Inc., Salinas, California.

Anderson, B., J. Hunt, B. Phillips, P. Nicely, K. Gilbert, V. De Vlaming, V. Connor, N. Richard and R. Tjeerdema. 2003a. Ecotoxicologic impacts of agricultural drain water in the Salinas River, California, USA. Environmental Toxicology & Chemistry 22 (2003). Pp. 10.

Anderson, B., J. Hunt, B. Phillips, P. Nicely, V. de Vlaming, V. Connor, N. Richard and R. Tjeerdema. 2003b. Integrated assessment of the impacts of agricultural drainwater in the Salinas River California, USA). Environmental Pollution 124 (2003). Pp. 10.

Anderson, T., F. Watson, W. Newman, J. Hager, D. Kozlowski, J. Casagrande, J. Larson, 2003. Nutrients in surface waters of southern Monterey Bay watersheds. Watershed Institute at California State Monterey Bay, Report No. WI-2003-11. Prepared for the Central Coast Regional Water Quality Control. 106 pp. + appendix. http://science.csumb.edu/%7Eccows/pubs/reports/CCoWS_NutrientSources_030529b_ta.pdf

Applied Development Economics (ADE) 2001. Employment and Cost of Living Trends in Monterey County, Prepared for Monterey County Environmental Resource Policy, 57pp.

Association of Monterey Bay Area Governments (AMBAG), 1997. Northern Salinas Valley Watershed Restoration Plan: Final Report of AMBAG's Water Quality Planning Project Entitled: Nonpoint Source Pollution in Coastal Harbors & Sloughs of the Monterey Bay Region: Problem Assessment & Best Management Practices, multi-chapter document

Baker, J., V. Waights. 1993. The effect of sodium nitrate on the growth and survival of toad tadpoles (*Bufo bufo*) in the laboratory. Herpetological Journal 3: 147-148.

Baker, J., V. Waights. 1994. The effect of nitrate on tadpoles of the tree frog (*Litoria caerulea*), Herpetological Journal 4: 106-108.

Bechtel Corp. 1959. Preliminary Planning Report on Flood Control For Area Tributary to Main Reclamation Ditch Between Alisal Creek Watershed and Monterey Bay, Prepared for Monterey County Flood Control and Water Conservation District Zone 2 Salinas, California. 37 pp + appendix

Bell, M.C., 1986. Fisheries handbook of engineering requirements for biological criteria. U.S. Army Corps of Engineers, Fish Passage Development and Evaluation Program.

Bureau of Land Management (BLM), 1999. Riparian Area Management: A User Guide to Assessing Proper Functioning Condition and the Science for Lentic Areas, U.S. Department of Interior Bureau of Land Management National Applied Resource Science Center

Breschini, G. S., T. Haversat, M. Gudgel, 2000. *10,000 Years on the Salinas Plain: An Illustrated History of Salinas City, California,* additional contributions by Johnston R. B., and B. Anderson, Heritage Media Corp., Carlsbad, Califronia.

California Department of Fish and Game (CDFG), 2002. Pesticide Laboratory Report, Re: Tembladero Slough/Old Salinas River Fish Kill. 3pp.

California Department of Fish and Game (CDFG), 2004a. State and Federally Listed Endangered and Threatened Plants of California, Wildlife and Habitat Data Analysis Branch, 14pp. updated quarterly. http://www.dfg.ca.gov/whdab/pdfs/TEPlants.pdf

California Department of Fish and Game (CDFG), 2005. State and Federally Listed Endangered and Threatened Animals of California, Wildlife and Habitat Data Analysis Branch, 10pp. updated quarterly. http://www.dfg.ca.gov/whdab/pdfs/TEAnimals.pdf

California Department of Public Health Bureau of Sanitary Engineering (CDPHBSE), 1952. Salinas Reclamation Ditch, Prepared for the Central Coast Regional Water Pollution Control Board. 55 pp.

California Natural Diversity Database (CNDDB), 2004. California Department of Fish and Game (CDFG), Wildlife & Habitat Department, Version: January 5, 2004.

California State Parks (CSP), 2002. Fremont Peak State Park Brochure. http://www.parks.ca.gov/pages/564/files/FremontPeak.pdf

Cameron, W., A. Hoffman, J. Langer, 2003. A Vision Plan for Carr Lake Regional Park, 606 Studio Department of Landscape Architecture, California State University, Pomona. Prepared for: The City of Salinas, 167 pp. plus appendix

Camp Dresser & McKee Inc. (CDM). 2004. City of Salinas Storm Water Master Plan, Prepared for the City of Salinas.

Casagrande, J. 2001. How does land use effect sediment loads in Gabilan Creek? Senior Thesis, Department of Earth Systems Science and Policy, California State University of Monterey Bay, 49 pp. plus appendix. http://science.csumb.edu/~ccows/pubs/capstones/Jcasagrande_FinalThesis.pdf

Casagrande, J., Hager, J., Watson, F., & Angelo, M. (2003) Fish Species Distribution and Habitat Quality for Selected Streams of the Salinas Watershed: Summer/Fall 2002. Report to the Central Coast Regional Water Quality Control Board, San Luis Obispo, California. The Watershed Institute, California State University Monterey Bay, WI-2003-02. 86 pp. http://science.csumb.edu/~ccows/pubs/reports/CCoWS_SalFishHabReport_030529_600dpi.pdf

Central Coast Regional Water Quality Control Board (CCRWQCB), 1994. Basin Plan: Region 3, State Water Resource Control Board.

Central Coast Regional Water Quality Control Board (CCRWQCB). 2004a. Resolution No. R3-2004-0118 Approving an Initial Study and Adopting a Negative Declaration for Conditional Waiver of Discharge Requirements for Discharges from Irrigated Lands. July 8 2004. 2 pp. http://www.waterboards.ca.gov/centralcoast/AGWaivers/documents/Item3attach2.pdf

Central Coast Regional Water Quality Control Board (CCRWQCB). 2004b. INITIAL STUDY and Negative Declaration For Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands. July, 2004. 36 pp. http://www.waterboards.ca.gov/centralcoast/AGWaivers/documents/Item3attach1.pdf

Central Coast Regional Water Quality Control Board (CCRWQCB). 2004c. Monitoring and Reporting Program No. R3-2004-117 for Dischargers Enrolled Under Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands. July, 2004. 12 pp.

http://www.waterboards.ca.gov/centralcoast/AGWaivers/documents/Item3attach1.pdf

Central Coast Regional Water Quality Control Board Staff (2004). Staff Report for Regular Meeting of February 11, 2005. Item: Issuance of NPDES Municipal Storm Water Permit (Waste Discharge Requirements Order No. R3-2004-0135), City of Salinas, Monterey County. Prepared on November 24, 2004. http://www.waterboards.ca.gov/centralcoast/Permits/documents/SalinasStaffReport2004draftwithmap.pdf

City of Salinas (COS). 2002. City of Salinas General Plan. Adopted September 17, 2002. City of Salinas, CA. http://www.ci.salinas.ca.us/CommDev/GenPlan/GenPlanFinal/GPindex.html

City of Salinas (COS), 2004. Specifications for 2004 Silt Removal Project at Gabilan Creek Project No. 9127, 79 pp.

Clark, G.M., D.K. Muller, M.A. Mast. 2000. Nutrient concentrations and yields in undeveloped stream basins of the United States. Journal of American Water Resources Association 36: 849-860, no. 4, July 2000.

Clark, L. 2003. A review of pathogens of agricultural and human health interest found in Canada geese. In: Fagerstone, K.A. & Witmer. G.W. (eds), Proc. 10th Wildlife Damage Management Conf. Pp 326-334. http://www.aphis.usda.gov/ws/nwrc/is/03pubs/clar034.pdf

Cozzens, H.F. 1944. Report on Reclamation Ditch District 1665, Compiled pursuant to order of the Board of Supervisors, Monterey County. 21 pp + maps

Day, J.S., circa 1959. Unpublished Report. Gabilan Creek, Personal Observations, local residents. California Department of Fish and Game, 5pp.

Feldhamer, G.A., B.C. Thompson, J.A. Chapman, editors, 2003. *Wild Mammals of North America Second Edition*, The John Hopkins University Press, Baltimore, Maryland.

Gabilan Ranch, 1999. http://www.gabilanranch.com/ranchhistory.html

Grenfell, W. Jr. 1988. California Wildlife Habitat Relationships System, California Department of Fish and Game- California Interagency Wildlife Task Group, 3pp. In: A Guide to Wildlife Habitats of California. 1988.Edited by Kenneth E. Mayer and William F. Laudenslayer, Jr. State of California, Resources Agency, Department of Fish and Game. Sacramento, CA. 166 pp. http://www.dfg.ca.gov/whdab/cwhr/pdfs/MRI.pdf

Gobalet, K.W. 1990. Prehistoric status of freshwater fishes of the Pajaro-Salinas River System of California, *Copeia*, (3), pp. 680-685.

Gordon, B. 1996. *Monterey Bay Area: Natural History and Cultural Imprints Third Edition*, Boxwood Press, Pacific Grove, California.

Grice Engineering and Geology, Inc., Fall Creek Engineering, Inc., John Gilchrist & Associates (GEG et al.,), 1998. Final Report Zone 3 Master Plan Study – Evaluation of Alternative Flood Control Improvements on the Salinas River, Prepared for the Monterey County Water Resources Agency (MCWRA). 99 pp. + appendix

Haff, T.M., G. Geupel, 2001. Summary of work by PRBO at TNC's McCormack Williamson Tract, Cosumnes River Preserve, 2000, 9 pp. http://watershed.ucdavis.edu/crg/product.asp?var=%2224%22

Hagar Environmental Science (HES) 2004. Salinas River Lagoon 2003-2004 Breach Monitoring Report – Final, Prepared for Monterey County Water Resources Agency, 55 pp.

Hager, J. 2001. An evaluation of steelhead habitat and population in the Gabilan Creek Watershed, Senior Thesis, Department of Earth, Systems, Science, and Policy, California State University of Monterey Bay, 38 pp. plus appendix. http://science.csumb.edu/%7Eccows/pubs/capstones/Jhager_FinalThesis.pdf

Hare, L. 1906. Map of Survey For The Improvement of Gabilan Creek Near Salinas, Monterey County, California: Showing Locations of proposed improvement and tributary reclaimable swamplands.

Hecnar S.J. 1995. Acute and chronic toxicity of ammonium nitrate fertilizer to amphibians from Southern Ontario. Environmental Toxicology and Chemistry 4:2131-2137, no. 12

Heuslid-Glass, J. & M.Hernandez, 2004. Invasive Weeds of Salinas Creeks, Return of the Natives (RON), Watershed Institute, California State University Monterey Bay, 52pp.

Hilsenhoff, W.L. 1988. Rapid field assessment of organic pollution with a family level biotic index. The Journal of the North American Benthological Society. 7:65-68.

Hubbs, C.L. 1947. Mixture of marine and freshwater fishes in the lower Salinas River, California. Copiea, 1947(2): 147-149.

Hunt, J.W., Anderson, B.S., Phillips, B.M., Nicely, P.N., Tjeerdema, R.S., Puckett, H.M.,Stephenson, M., Worcester, K., De Vlaming, V., 2002. Ambient Toxicity Due toChlorpyrifos and Diazinon in a Central California Coastal Watershed. Environmental Monitoring and Assessment 82: 83-112, 2003.

Hurst, C.J., R.L. Crawford, G.R. Knudsen, M.J. McInerney, and L.D. Stetzenbach, 2002. *Manual of environmental microbiology (2nd Edition),* Washington D.C.: ASM Press.

John Gilchrist and Associates (JGA), Habitat Restoration Group, Phillip Williams and Associates, Wetlands Research Associates, MCWRA Staff. 1997. Salinas River Lagoon Management and Enhancement Plan.

Volume 1: Plan Text, Volume 2: Technical Appendices. Prepared for The Salinas River Lagoon Task Force and Monterey County Water Resources Agency.

Kincheloe, J.W., G.A. Wedemeyer, D.L.. Koch, 1979. Tolerance of developing salmonid eggs and fry to nitrate exposure. Bull. Environmental Contamination Toxicology 23:575-578.

Kozlowski, D. F. Watson, M. Angelo, J. Larson. 2004a. Monitoring chlorpyrifos and diazinon in impaired surface waters of the Lower Salinas Region, Watershed Institute at California State Monterey Bay, Report No. WI-2004-03. Prepared for the Department of Pesticide Regulation (DPR). 59pp. + appendix.
http://science.csumb.edu/~ccows/pubs/reports/CCoWS_DPR_FinalReport_040331c.pdf

Kozlowski, D., Watson, F. Angelo, M., & Gilmore, S. 2004b. Legacy Pesticide Sampling in Impaired Surface Waters of the Lower Salinas Region. Report to Central Coast Regional Water Quality Control Board, Watershed Institute at California State Monterey Bay, Report No. WI-2004-02. 46 pp.
http://science.csumb.edu/~ccows/pubs/reports/CCoWS_LPs_040304_dk.pdf

Mertes, J.D. & Hall, J.R. (1996) Park, Recreation, Open Space and Greenway Guidelines. National Recreation and Park Association (NRPA),

LandWatch of Monterey County (LWMC), 1999. State of Monterey County 1999. Land Use, Environment, and Infrastructure: Status and Recommendations, 67 pp.

Leclerc, H. D.A.A. Mossel, S.C. Edberg, and C.B. Struijk, 2001. Advances in the bacteriology of the Coliform group: their suitability as markers of microbial water safety. Annu. Rev. Microbiology. 55:201-234.

Long, E.R., MacDonald, D.D., Smith, S.L., & Calder, F.D. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. Environmental Management, 19:81-97.

Marco, A., C. Quilchano, A.R. Blaustein, 1999. Sensitivity to nitrate and nitrite in pond-breeding amphibians from the Pacific Northwest, USA. Environmental Toxicology and Chemistry, Vol. 18. No. 12 pp. 2836-2839

Mark Thomas & Co. Inc., 1988. Hydraulic Design Report: Improvement and Realignment of Gabilan Creek 8 pp. plus appendix

Marshack, J.D., D. Env. 2000. A compilation of water quality goals. Report for Central Valley Regional Water Quality Control Board (CVRWQCB).

Merritt R.W., Cummins, K.W. 1996. An introduction to the aquatic insects of North America, Third Edition, Kendall/Hunt Publishing Company, Dubuque, Iowa.

Michael Brandman & Associates (MBA), 1992. Revised Draft Environmental Impact Report Crazy Horse Landfill Expansion, State Clearinghouse #89092616, Prepared for the City of Salinas, a multi-page document.

Monterey Bay National Marine Sanctuary (MBNMS) 1999. Action Plan IV Agriculture and Rural Lands, 58 pp. + appendix

Monterey Bay National Marine Sanctuary (MBNMS).
http://www.mbnms.nos.noaa.gov/resourcepro/resmanissues/dredge.html

Monterey Bay National Marine Sanctuary (MBNMS), 2003. Joint Management Plan Review Draft Action Plan: Coastal Development: Dredge disposal, 13pp.

Monterey County. 2004. 21st Century Monterey County Draft General Plan: Public Review Draft,
http://www.co.monterey.ca.us/gpu/Reports/0104/

Monterey County, 2003. The 2003 Monterey County Crop Report.
http://www.co.monterey.ca.us/ag/pdfs/crops2003.pdf

Monterey County Water Resource Agency (MCWRA) and United States Army Corps of Engineers (USACE), 2001. Draft Environmental Impact Report/Environmental Impact Statement for the Salinas Valley Water Project.
http://www.co.monterey.ca.us/mcwra/deir_svwp_2001/

Moyle. P.B. 2002. *Inland Fishes of California*, University of California Press, Berkeley, California.

National Oceanic and Atmospheric Administration (NOAA) (2004). *Endangered and Threatened Species; Designation of Critical Habitat for Seven Evolutionarily Significant Units of Pacific Salmon (Oncorhynchus tshawytscha) and Steelhead (O. mykiss) in California; Proposed Rule*. 50 CFR Part 226. Federal Register, Vol. 69, No. 237, December 10, 2004, Proposed Rules.

Newcombe, C.P, and J.O.T Jensen, 1996. Channel suspended sediment and fisheries: synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries Management Vol. 16 No. 4, 34 pp.

Newman, W., F. Watson, M. Angelo, J. Casagrande, B. Feikert 2003. Land use history and mapping in California's Central Coast Region, Watershed Institute at California State Monterey Bay, Report No. WI-2003-14. Prepared for the Central Coast Regional Water Quality Control Board. 87 pp. + appendix.
http://science.csumb.edu/%7Eccows/pubs/reports/CCoWS_LandUseMappingRegion3_WI-2003-03_030512.pdf

Oakins, A. 2001. An assessment and management protocol for Arundo donax in the Salinas Valley Watershed, Senior Thesis, Department of Earth Systems Science and Policy, California State University of Monterey Bay, 51 pp.
http://science.csumb.edu/~ccows/pubs/capstones/Aoakins_FinalThesis.pdf

Ode, P. 2003. List of Californian Macroinvertebrate taxa and standard taxonomic effort, Aquatic Bioassessment Laboratory, California Department of Fish and Game (CDFG), 45pp.

Pierce, M. 1976. *East of the Gabilans*, Western Tanager Press, Santa Cruz, California.

Pinter, N. & Vestal, W.D. In press. El Nino-driven landsliding and post-grazing vegetative recovery, Santa Cruz Island, California. *J. Geophys. Res.*

Project Design Consultants (PDC), 2004. Public Review Draft Environmental Impact Report for the Rancho San Juan Specific Plan and HYH Property Project EIR, SCH No. 2002121142, Prepared for the County Of Monterey, multi-page document.

Reclamation Ditch Improvement Plan Advisory Committee (RDIPAC), 2002. Reclamation Ditch Improvement Plan Recommendations, Prepared for the Monterey County Water Resources Agency Board of Directors, 20 pp. plus appendices.

Riley, A. 1998. *Restoring Streams in Cities: A guide for planners, policymakers, and citizens,* Island Press, Covelo, California

Roberson, D and C Tenney, 1993. *Atlas of the Breeding Birds of Monterey County, California,* Monterey Peninsula Audubon Society, Carmel, California.

Rouse, J.D. C.A. Bishop, J. Struger. 1999. Nitrogen Pollution: An assessment of its threat to amphibian survival. Environmental Health Perspectives Vol. 107, No. 10 pp. 799-803.

Salinas Valley Chamber of Commerce (SVCC).
http://www.salinaschamber.com/community/climate.html

Schaaf and Wheeler Consulting Civil Engineers (SWCCE) 1999. Zone 9 Reclamation Ditch Drainage System Operations Study, Prepared for Monterey County Water Resources Agency, multi-page document.

Schaaf and Wheeler Consulting Civil Engineers (SWCCE), 2000. Potrero Road Tide Gate Study, Prepared for Monterey County Water Resources Agency, 15pp.

Schaaf and Wheeler Consulting Civil Engineers (SWCCE), 2002. Carr Lake Multi-Purpose Flood Control Study, Prepared for the Monterey County Water Resource Agency, 18 pp. + appendix

Shumate, A. 1983 ed. *Boyhood Days: Ygnacio Villegas' Reminiscences of California in the 1850's*, California Historical Society Publication, San Francisco, California.

Schuytema, G.S. and A.V. Nebeker, 1999. Comparative toxicity of ammonium and nitrate compounds to Pacific treefrog and African clawed frog tadpoles. Environmental Toxicology and Chemistry, Vol. 18, No. 10 pp. 2251-2257.

Smith, D., Newman, W., Watson, F., Hameister, J. 2004a. Physical and Hydrologic Assessment of the Carmel River Watershed, California. Report to Carmel River Watershed Conservancy. The Watershed Institute, California State University Monterey Bay, Rep. No. WI-2004-05. 98 pp. http://science.csumb.edu/%7Eccows/pubs/reports/CCoWS_CarmelAssessPhysHyd_050420.pdf

Smith, D. J. Casagrande, M. Vincent, J. McDermott, A. Price, A. Martin, Z. Carlson, 2005. Garrapata Watershed Assessment: Hydrology and Sedimentology (2001 to 2004). Report to California Department of Fish and Game and Garrapata Watershed Council. Watershed Institute, California State University Monterey Bay (CSUMB) Report No. WI-2005-03, 49 pp. http://science.csumb.edu/%7Eccows/pubs/reports/CCoWS_Garra_SedHydro_050223.pdf

Smith, J.J. 1982. Fishes of the Pajaro River System. University of Calif. Publ. Zool. 115: 83-170.

Snyder, J. O. 1913. The fishes of the streams tributary to Monterey Bay, California, Bulletin of the United States Bureau of Fisheries. 32:49-72.

State Water Resources Control Board Central Coast Region (SWRCB), 1994. Basin Plan for the California Central Coast Region 3, http://www.swrcb.ca.gov/rwqcb3/BasinPlan/Index.htm

State Water Resource Control Board (SWRCB), 1998. Chemical and biological measures of sediment quality in the Central Coast Region, No. 5, 84pp. + appendix

State Water Resources Control Board (SWRCB), 1999. Draft Functional Equivalent Document Consolidated Toxic Hot Spots Cleanup Plan, 318pp. http://swrcb2.swrcb.ca.gov/bptcp/docs/dftfedcp.doc

Stebbins, R.C. 2003. *A Field Guide to Western Reptiles and Amphibians Third Edition,* Houghton Mifflin Company, Boston; New York.

Suddjian, D. 2002. Riparian Bird Populations at the Pajaro River: A Look at the Impacts of the 1995 Vegetation Clearing And Subsequent Bird Use Of The Intact and Cutover Riparian Forest, Biological Consulting Services, 19 pp.

Suddjian, D. 2004. Birds and Eucalyptus on the Central California Coast: A love-hate relationship. http://www.elkhornslough.org/CTP/bluegum/Suddjian.doc

Udvardy, M.D.F. 1977. The Audubon Society Field Guide to North American Birds Western Region, Alfred A. Knopf Inc., New York, New York.

United States Army Corps of Engineers (USACE), 2002. Public Notice No. 2627OS, San Francisco District. 3 pp.

United States Census Bureau (USCB), online. http://factfinder.census.gov/home/saff/main.html?_lang=en

United States Department of Agriculture Soil Conservation Service (USDASCS). 1968. Watershed Work Plan - Preliminary Review Draft Tembladero Unit Alisal-Gabilan Watershed Monterey County, California, 15pp.

United States Environmental Protection Agency (EPA) 2000. Ambient water quality criteria recommendations; rivers and streams in nutrient Ecoregion III. http://www.epa.gov/waterscience/criteria/nutrient/ecoregions/rivers/rivers_3.pdf

United States Environmental Protection Agency (EPA) 2001. Protocols for developing pathogen TMDL's (1st Edition). Washington D.C.: Office of Water.

United States Fish and Wildlife Service (USFWS), 1998. Final rule listing five plants from Monterey County, CA, as Endangered or Threatened, Federal Register Vol. 63, No. 155.

United States Fish and Wildlife Service (USFWS), 2002. Salinas River National Wildlife Refuge: Comprehensive Conservation Plan Summary. 70pp.

United States Fish and Wildlife Service (USFWS):
http://sacramento.fws.gov/es/animal_spp_acct/□alifornia_tiger_salamander.htm

United States Geological Survey (USGS). 1999. The quality of our Nation's waters: Nutrients and pesticides. USGS Circular 1225.

http://water.usgs.gov/pubs/circ/circ1225/

United States Geological Survey (USGS):
http://www.npwrc.usgs.gov/narcam/idguide/acalif.htm

Verardo J.D. and D. Verardo. 1989. *The Salinas Valley: An Illustrated History*. Windsor Publications, Inc., Chatsworth, California.

Wasson, K., E. Van Dyke, R. Kvitek, J. Brantner, S. Bane, 2001. Tidal Erosion At Elkhorn Slough.
http://www.elkhornslough.org/research/PDF/tidal_erosion_ES.pdf

Water Quality Operations Committee (WQOC), 1998. Recycled water food safety study, prepared for Monterey County Water Recycling Projects, Sponsored by Monterey County Water Resources Agency and the Monterey Regional Water Pollution Control Agency (MRWPCA), 14pp.
http://www.mrwpca.org/recycled_h20_food_safety.pdf

Watson, F. & J. Casagrande, 2004. Potential effects of groundwater extraction on Carmel Lagoon. Report to California-American Water Company. The Watershed Institute, California State University Monterey Bay, Rep. No. WI-2004-09. 93 pp.
http://science.csumb.edu/%7Eccows/pubs/reports/CCoWS_CalAmLagoonGW_040908_fw.pdf

Watson, F., M. Angelo, T. Anderson, J. Casagrande, D. Kozlowski, W. Newman, J. Hager, D. Smith, B. Curry. 2003. Salinas Valley Sediment Sources. Report No. WI-2003-06, The Watershed Institute, California State University Monterey Bay. Prepared for the Central Coast Regional Water Quality Control Board. 239 pp.
http://science.csumb.edu/%7Eccows/pubs/reports/CCoWS_SalSedReport_030530c.pdf

Worcester, K., Paradies, D., Adams, M., & Berman, D. 2000. Salinas River Watershed Characterization Report 1999. Central Coast Ambient Monitoring Program, Central Coast Regional Water Quality Control Board. 97 pp.
http://www.ccamp.org/ccamp/CCAMP_Salinas_Report.pdf

[Page intentionally left blank]

9. Acronyms and Scientific Units

The following are lists of all acronyms and scientific data units used in the present document.

Table 9.1 Acronyms used in the present study

ADE	Applied Development Economics
AMBAG	Association of Monterey Bay Area Governments
BMI	Benthic Macroinvertebrate
BMP	Best Management Practice
CAFF	California Alliance of Family Farmers
CAL-IP	California Invasive Plant Council
CCAMP	Central Coast Ambient Monitoring Program
CCC	California Coastal Commission
CCoWS	Central Coast Watershed Studies
CCRWQCB	Central Coast Regional Water Quality Control Board
CDFG	California Department of Fish & Game
CDPHBSE	California Department of Public Health Bureau and Sanitary Engineering
CEQA	California Environmental Quality Act
CIMIS	California Irrigation Management Information System
CNDDB	California Natural Diversity Database
CSUMB	California State University Monterey Bay
DOQ	Digital Orthoquad
DPR	Department of Pesticide Regulation
DWR	Department of Water Resources
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESF	Elkhorn Slough Foundation
FCSUMB	Foundation of California State University Monterey Bay
FDA	Food and Drug Administration
FOSC	Friends of Salinas Creeks
FOT	Friends of Tembladero
GEG	Grice Engineering and Geology
GMP	Good Management Practices
HES	Hagar Environmental Science
LWMC	Land Watch Monterey County
MBNMS	Monterey Bay National Marine Sanctuary
MCACO	Monterey County Agricultural Commissioner's Office
MCFB	Monterey County Farm Bureau
MCPD	Monterey County Planning Department
MCWRA	Monterey County Water Resources Agency
MLML	Moss Landing Marine Labs
MRWPCA	Monterey Regional Water Pollution Control Agency
NAS	National Academy of Science
NHD	National Hydrography Dataset
NOAA	National Ocean & Atmospheric Association
NSVMAD	Northern Salinas Valley Mosquito Abatement District

NPDES	National Pollution Discharge Elimination System
NRCS	National Resources Conservation Service
OCS	Oregon Climate Service
PAC	Parameter Assessment Card
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
QAPP	Quality Assurance Protection Plan
RCDMC	Resource Conservation District Monterey County
RDIPAC	Reclamation Ditch Improvement Plan Advisory Committee
RON	Return of the Natives
SMW	State Mussel Watch
SSC	Suspended Sediment Concentration
SVCC	Salinas Valley Chamber of Commerce
SWCCE	Schaaf and Wheeler Consulting Civil Engineers
SWRCB	State Water Resource Control Board
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
TPC	Total (water column) Pesticide Concentration
TSMP	Toxic Substance Monitoring Program
TSS	Total Suspended Solids
UCSC	University of California Santa Cruz
USACE	United States Army Corp of Engineers
USCB	United States Census Bureau
USDA	United States Department of Agriculture
USFWS	United States Fish & Wildlife Service
USGS	United States Geological Survey

Table 9.2 Scientific Units used in the present study.

°C	Temperature in Celsius (Fahrenheit = Temp C*[(9/5)+32]
cfs	Cubic feet per second
ft	Feet
in	Inches
km	Kilometers
m	Meters
m/s	Meters per second
m^3/s	Cubic meters per second
mg/L	Milligrams per litter
MPN/100 ml	Most Probable Number per 100 milliliter
mS/cm	MilliSiemens per centimeter
ng/L	Nanograms per litter
ppt	Parts per thousand
µg/kg	Micrograms per kilogram

10. Appendices

Appendix A – Stakeholder Comments

Comments received from Bob Roach, of the County of Monterey Agricultural Commissioners Office

Draft of the Assessment that was reviewed: 6 December 2004
Comments received: 22 February 2005

Re: Pesticides Page 159 (Page 155 Dec 6, 2004 version)

1) Paragraph 1, Line 1:

Can you really say 'two of the most commonly applied'? I agree they are commonly applied, but am not sure they are the 'most' commonly applied.

2) Paragraph 2, Line 1-2:

The CAC does not 'collate' for data and it is separate from the permit process. All ag and commercial use is reported to the CAC where data entered into a database and sent to DPR for processing, including error checking.

3) Paragraph 2, line 7:

Why do you call it an 'estimate'? Are you considering non-reportable uses, e.g. home uses?

Comments received from Jim Schaaf, of *Schaaf and Wheeler Consulting Civil Engineers*

Draft of the Assessment that was reviewed: 13 January 2005
Comments received: 23 February 2005

The flooding section could have been improved by referencing the stream gage on Gabilan Creek more often. The 1998 peak was 50 percent greater than the 1995 peak and so referring to the Salinas River, a large and slow-reacting watershed, may not tell the story about this smaller and faster-reacting watershed.

The Channel Sedimentation and Erosion section could be improved by placing the observed spot erosion and sedimentation problems into some type of watershed perspective. The section on Sediment Sources does begin with the words, "In addition to natural sources?" Does the reader know if the "natural sources" are equal to what was observed or one-tenth of what was observed or ten or 100 times what was observed? The report would benefit from an assessment of the amount of natural sediment generated in the watershed.

In addition, it seems to me that the cost of channel dredging by the City of Salinas is a number that is not as important as the number of cubic yards removed.

The estimate of 50,000 to 150,000 cubic yards of sediment removed annually from the Moss Landing Harbor amounts to approximately 0.15 acre-feet of sediment per year over the entire 400 or so square miles of watershed that drains there. Is this number significant compared to natural rates of sediment production? The reader can only surmise because no data is presented which would put that large dredging volume in any perspective.

Comments received from Monterey County Farm Bureau Watershed Grower Group
Draft of Assessment that was reviewed: January 14th 2005
Comments received: 8 March 2005

MONTEREY COUNTY FARM BUREAU,
WATERSHED GROWER GROUP
&
MONTEREY COUNTY WATER RESOURCES AGENCY,
AG WATER ADVISORY COMMITTEE

March 4th, 2005

Dear Dr. Fred Watson, Joel Casagrande, and Technical Advisory Committee Members :

Subject : Grower / Rancher / Landowner comments on the *Assessment, Part I* of the *Reclamation Ditch Watershed Assessment and Management Plan*

On behalf of the growers, ranchers, and landowners who participated in a Grower Workshop on February 15th, 2005 to discuss and make comments and suggestions on *Assessment, Part I* of the *Reclamation Ditch Watershed Assessment and Management Plan,* we respectfully submit the following items:

a) This 3.14.05 letter
b) A list of participants at the 2.15.05 workshop
c) Comments documents that were compiled from the 2.15.05 workshop.
These comments were made on the 1.14.05 draft of the *Assessment.*
d) 2001 Nitrate Management grower survey results, MCWRA
e) Table 6.6 descriptive text and appropriate reference from *Water Resources Data Report,Water Year 1994-1995, MCWRA*

Workshop participants request that all of the above items (a through e) be included in the final document of the Watershed Assessment prepared by the Watershed Institute under its contract to the MCWRA and in turn to the State Water Resources Control Board.

The Monterey County Farm Bureau, Watershed Grower Group includes growers, ranchers, and landowners of the Gabilan/Natividad/Alisal creeks and the Alisal and Tembladero Sloughs. All of these sub-watershed areas are in the Reclamation Ditch Watershed as defined in the *Assessment.* In partnership with the Monterey County Water Resources Agency (MCWRA), Agricultural Water Advisory Committee (AWAC) of growers, these two organizations co-sponsored the February 15th Workshop in response to requests from the agricultural community.

The majority of growers, ranchers, and landowner participants at the workshop are residents of the watershed and of the City of Salinas and therefore have the ability to review the document from the perspective of agriculture and of a resident.

Workshop participants hope that the attached set of comments and suggestions will be helpful in pointing out areas that may be confusing to the general public. The purpose and focus of the attached comments is to ensure that long-term planning or conclusions that may emerge from the document, or future iterations of the document, acknowledge the weak public input to the document and the short turnaround time for thorough evaluation.

Overall, workshop participants feel that the current document does not contain sufficient data to provide the information needed for making sound management decisions in the watershed presently or in the future. For example, after reviewing data sources and methods referred to in the Water Quality and Biological sections of the *Assessment*, participants concluded that the large number and variety of data sources, collection methods, and analyses do not allow clear conclusions to be drawn.

Workshop participants are concerned that reference to, and reliance upon, both un-published and non-peer reviewed works could lead to erroneous or even damaging management recommendations.

The growers, land owners, and ranchers of the Reclamation Ditch Watershed look forward to working with the Technical Advisory Committee and project staff to refine the *Watershed Assessment* to meet the needs of Monterey County watershed residents and water and land users.

Sincerely,

Benny Jefferson, Chair
Ag Water Advisory Committee
Monterey County Water Resources Agency

Dirk Giannini, Co-Chair
Water Committee
Monterey County Farm Bureau

Cc:
Richard Morganitini, MCWRA Board Chair
Curtis Weeks, General Manager, MCRWA
Bill Hammond, MCFB Board President
Bob Perkins, Executive Director, MCFB

Participants at the Reclamation Ditch Watershed Assessment
– Grower Workshop, 2.15.05

NAME	COMPANY / OPERATION NAME
Allan Jensen	DJ Farms
Chris Bunn Jr.	Crown Packing
Dale Huss	Ocean Mist
Dennis Piedrafita	
Dirk Giannini	Christensen & Giannini
Don Ikeda	Ikeda Farms
Ed Mora	D'Arrigo Brothers
Gary Higashi	Higashi Farms
Keith Tanimura	Tanimura & Antle
Kent Christensen	Christensen Farms
Kevin Silacci	
Michael Scattini	Louis Scattini & Sons
Pete Silacci	
Robert Silva	Robert J. Silva Farms
Ron Harney	Sam McKinsey Farms
Ross Jensen	Steve Jensen Farms

The above list of participants represents approximately 23,150 agricultural acres in the Reclamation Ditch Watershed.

There are approximately 40,000 acres of crop land in the watershed or about 40% of the total watershed area, according to Table 1.1 of the *Watershed Assessment*.

Chapter 1 – EXECUTIVE SUMMARY of
Part 1: Watershed Assessment

Below are summary statements drawn from each bulleted item of the Executive Summary starting on Page 1

NOTE:

Each statement was reviewed by the grower group for clarity, usefulness of the information, and factual basis. Shaded text are deletions, additions, changes considered important by the grower group.

Numbered statements below correspond to the series of un-numbered bullets in the document.

1. Environmental objectives have a cost associated with them that needs to be balanced with other needs.

2. The natural landscape has largely been replaced by intensive agricultural and urban land uses.

3. The most important Reclamation Ditch Watershed objectives include:
Need for urban land
Need for agricultural land
Need for clean water in support of beneficial uses

Add Special Species Bullet
Add Objective - Flood Control

4. Due to increased runoff from expanding impervious areas, channels designed and maintained to remove water quickly are not always have the capacity to accomplish this.

> *… Leading to severe & chronic flooding in low lying areas.*
> *Change "impervious" to "urban"*
> *Comment- there is more emphasis on ag than urban in document.*

5. Current channel conditions and maintenance do not allow natural habitat features to form.

6. Water quality objectives come from regional numeric standards and other pending Federal standards. These objectives could change as more becomes known about the relationship between water quality and impacts to beneficial uses, which may cause "concerns".

Define stds. that are being used and where it comes from, insert table of objectives, source, and WQ data in WQ Assessment, Section 5 in body of text, see .

Include information in doc about nitrate and source water, ground and reclaimed water (source water may not meet std.)

Include here a table to clearly identify the objectives used in this study, their source and whether they are regulatory thresholds or not. Suggested table title and example below: "Water Quality Objectives Used for this Assessment."

Constituent	**Objective**	**Source**	**Regulatory? (Y/N)**
N	.2 ppm	Jim Smith	N
	10 ppm	Basin Plan	Y

7. There are numerous water quality concerns in the middle and lower part of the watershed.

#7 In first sentence remove words "numerous" and "many"

8. A source analysis is beyond the scope of this project. Likely that each of the major land uses is responsible for at least some of the water quality concern.

Eliminate bullet 8
Combine 1st sentence of bullet 8 as last sentence of bullet #7

9. Based on our data, increasing the distance from a pollutant source suggests a decrease in pollutant concentrations. Therefore, increased "residence time" in a channel or wetland can decrease water quality concerns.

"WQ data suggests" is ambiguous
Need examples of data types, which substantiate statements
Where & what constituents, state

Quality Assurance Plan/ Protocol, where will this be found in document?
Add words…"residence time in channel can increase flooding."

10. Sedimentation of channels and lakes is of concern leading to increase of flood risk. Limited bed load sampling suggests that the upper watershed may be the largest source of sedimentation.

Point is made by first sentence alone. 2nd sentence is un-substantiated.
Delete 2nd sentence, which begins "Limited bed load sampling…"

11. The aquatic fauna of the watershed have shown resilience to the water quality concerns.

Clarify 1st sentence. Use of "resilience" here is unclear. (resistance? No problem surviving?etc)
Show, or site here, the data supporting" home to at least 5 native fish species."
For clarification & accuracy, revise sentence #2 as follows: "The lower, more impaired reaches are home to at least five native fish species as well as at least one steelhead trout." Expanding the significance of this occurrence is speculation until further study is conducted and it is determined whether there is a fish run or not. Until then, using photos of this dead fish misleads the reader to conclude that there is a known steelhead runt. Remove fish photos from document – save for future use.
Not all fish kill are "unexplained." Cause at Tembladero was found to be low DO.

12. Federally listed amphibian species are under pressure within the watershed.

Need more specifics on these findings
Define "under pressure"

13. Bird and mammal diversity is correlated with remaining natural habitat and lowest in intensely developed urban and ag. areas.

Substantiate phrase w/ data.

Please define these terms under the appropriate bullet of the Exec. Summary

1. Beneficial use

2. Bullet 13 "Natural Habitat"

3. Bullet 12 "under pressure"

4. Bullet 11 "resilience"

5. In the WQ Assess under Sediment – hi/low are defined, but "mild" is undefined.

Chapter 12 - SUMMARY AND CONCLUSIONS of
Part 1: Watershed Assessment

Each page provides the main points from the Summary & Conclusions Section
These were reviewed and critiqued by the grower group for clarity, usefulness of information in a watershed assessment, and factual basis

NOTE: Shaded text are the comments and suggested clarifications, deletions, or additions made by the grower group.

1. Historical Conditions Assessment

    a. Land use and hydrology have changed since the mid 1850's.

    b. Conversion from ranching and dry farming to irrigated ag. and urban uses have a profound effect on hydrology, wildlife, vegetation, and local economics.

    c. The 1917 Reclamation Ditch creation was the largest physical change in this watershed.

    d. A sluggish natural water course was converted to a larger ditch to allow ag. production and limit flood frequency.

    e. As urban and agricultural lands grew flooding increased, there were fewer large mammals, and fish habitat was reduced.

Change wording in statement to "as urban lands increased and Ag lands decreased and flooding increased

Add the statement below somewhere in the Executive Summary.
"Regulations are restricting maintenance activities in the Rec. Ditch"
Discussion on Alisal Slough being filled in as City of Salinas was expanded

Paragrph 2: Flood control was not the original purpose of the reclamation ditch. (see text provided for hydrology section below). Please clarify this by deleting last part of last sentence, "and to limit the frequency of flooding in the lower watershed."

Paragraph 3: Add after first sentence: "For example, the aquatic habitat formerly in Alisal Slough was lost to urban development.

Note that urban/residential developments are typically planned in flood plain.

Begin paragraph #3with "Based on historical changes to the watershed,…"

2. Socio-Economic Context

    a. The local and national economy and food system are dependent on the prosperity of agriculture in this watershed.

b. The City of Salinas is densely populated.

Continued increases in the urban population are expected in all cities/towns in the Salinas Valley. Increased impervious surfaces throughout the Valley could exacerbate flooding in the downstream watersheds.

Does increased urbanization in the Salinas Valley cause flooding in the Rec. Ditch area?
– backflow to the old Salinas River Channel.

3. Hydrology and Channel Conditions Assessment

   a. Paragraph 2
      i. Flooding is still a concern
      ii. Flood damage in ag. areas in the western half of the watershed
      iii. Significant damages to crops and farmland (1995 flood)

   b. Paragraph 3,4
      i. Urban expansion has increased runoff
         1. Sediment sources are uncertain
      ii. The combination of grazing, row crop, ag. and urban construction
      iii. Flood control system is challenged by sedimentation and erosion
         1. Management of these is expensive and can cause wq concerns

Same as above – this was an important point to the group and needs to be included appropriately:
"Continued increases in the urban population are expected in all cities/towns in the Salinas Valley. Increased impervious surfaces throughout the Valley could exacerbate flooding in the downstream watersheds. "

Regulatory obstacles reduce the flexibility to maintain the capacity of the Recl Ditch and other drainage ditches throughout the watershed. Upstream development/impervious surfaces and debris in channels are significant problems for downstream areas. Existing culverts throughout the watershed were often installed prior to addl' development and are often undersized. Farmers west of the city of Salinas experience severe, localized flooding destroying crops with untreated stormdrain water from urban lands.

How does increased urbanization in the Salinas Valley cause flooding in the Rec. Ditch area? By backflow to the old Salinas River Channel.

INSERT THE FOLLOWING TEXT : Purpose of the Reclamation Ditch

In the 1920's, the main purpose of the reclamation ditch was for land reclamation and not flood control. Land reclamation was accomplished by construction of a defined *watercourse to drain the standing water and its tributaries. The existence of dry lakes throughout the watershed provided valuable storm water storage and minimized the need for downstream channel capacity.*

As a result of reclaiming the land, the watershed and land uses within it changed resulting in additional agriculture and urban growth. This increase in impervious surfaces lead to a need for flood control throughout the watershed.

More recently, we have seen that increasing upstream impervious surfaces, bank erosion and sedimentation throughout the system often exceed the capacity of the, formerly, dry lakes. The lakes are then unable to evacuate stored flows creating chronic loss of channel capacity

4. Botanical Assessment

Season will have bearing on what is evaluated.
Please provide the Date&Year of Aerial Photography used for plant surveys.

Page 113 – Non-native species
CAL-IPC is referenced but this section should include the A, B, C categories and should be used to prioritize these species rather than just a laundry list. The County of Monterey should be contacted to reference their Weed Management Area (WMA) that has already prioritized 12 specific species for control purposes which are also all A-rated.
For example, the Assessment does not mention "purple star thistle" which is an A-rated (CDFA) noxious weed and is present in the watershed.

Contact Deputy Ag Commissioner Bob Roach,
759-7325.

Benthic macroinvertebrates in the Rec Ditch –
Conclusions drawn from Table 7.2 can be misleading.

5. Water Quality Assessment
   a. Qualifiers in this section
      i. Some water quality impairment may be related to legacy constituents (DDT, DDE) (DDT data suggest that levels are declining).
      ii. There is uncertainty in the definition of a water quality concern.
      iii. There is bias in the available data because data with different sampling times and locations were combined. An unbiased assessment would require random or stratified random sampling.
      iv. Only sites sampled more than five times were included in the analysis.

   b. The watershed contains 16 listings for impaired water quality under the Clean Water Act
      i. Based on data, listings, and other documentation, this watershed is noted for water quality impairments. (see qualifier

c. Data from five different entities at 37 sites in the watershed were compiled for the years 1999 to 2004.

d. For each constituent, "objectives" were defined and "concerns" were defined as failure to meet objectives.

Summary statements for each constituents

Suspended sediment concentrations based on coldwater aquatic habitat

1. Objective:
   a. low 100 mg/L, high 1000 mg/L (*no definition for mild, explain)*

2. Results:
   a. low - 14 out of 35 sites did not meet in ½ of samples
   b. high - 1 out of 35 sites did not meet in ½ of samples

Nitrate concentrations did not meet drinking water objectives

(10 mg/L as N) in 12 out of 33 sites;
or the aquatic ecosystem objective (2.5mg/L as N) in 25 out of 33 sites.

Insert here in Summ & Conclusions text that summarizes the below. Then please include the below text and the referenced 2001 survey results and table 6.6 from MCWRA report into the Water Quality Assessment, Chapter X, to indicate that growers are obliged to use high nitrate

When evaluating nitrate in surface water or runoff from watersheds in Monterey County, it must be realized that ground water utilized for irrigation may contain levels of nitrate higher than the EPA primary drinking water limit of 45mg/L as NO3 or of 10mg/L as N. This ground source water nitrate may be present even when growers have been and are practicing current, proven irrigation and nutrient management practices. Many growers have no alternative to using high nitrate source water from existing wells. Ninety five percent of the source water in the Salinas Valley, Monterey County is ground water. Additionally, recycled water used to irrigate crops in some portions of the county can have high nitrate levels. Two pieces of information are presented from the County Water Agency to indicate that changes in ground water nitrate levels occur extremely slowly and may be difficult to detect without long-term data collection. See Attachment 1, ***2001 Nitrate Management Survey Results Report Salinas Valley, California - August 2002, Interpretation Summary, MCWRA.*** *Over 90% of 96,548 represented acreage in the survey, indicated they had improved nitrate management practices over the past ten years from 1991 to 2001.*

Attachment 2, ***Table 6.6 1995 Nitrate Concentrations****,* ***Salinas Valley Basin, MCWRA Water Resources Data Report Water Year 1994-1995, MCWRA, reprint January 2000,*** *reflects the average ground water nitrate measured from agriculture production wells. For the 1995 summer sampling by the MCWRA , the average nitrate concentration for 262 agriculture production wells in the Salinas Valley was 55 mg/L as NO3 or 12 mg/L as N. This average excludes the deeper 400-Foot aquifer wells in the coastal Salinas Valley, which are protected from the impacts of surface nitrate by confining clay layers.*

Water Temperature

1. Objective: for cold water fish species (18 degees C)
   warm water species (27 degrees C)

2. Results: 4 out of 25 warm water sites did not meet warm water obj.
   1 out of 2 cold water sites did not meet cold water obj.

Dissolved Oxygen

1. Objective : low is 2 mg/L (for ag. use)
   high is 5 mg/L
2. *Results: 2 out of 27 sites did not meet low obj.*
   6 out of 27 sites did not meet the high obj

Fecal Coliform Bacteria

1. Objective: low is 400 colony forming units/100 mL,
   high is 4000 colony forming units/100 mL
2. *Results:* 3 out of 18 sites did not meet the low obj.
   14 out of 18 sites did not meet the high obj.

The strain of Ecoli harmful to humans has not been found. H7157 was not picked up in fields but found in surface water samples. It is not known how it entered the waterway. Of all sampling conducted by the water Treatment plant, it has not been found.

Chlorpyrifos and diazinon

1. Objective: "criterion maximum concentration" = CMC
3. Chlorpyrifos CMC exceeded in 4 out of 4 sites
4. Diazinon CMC exceeded in 50% of the samples

Actual DPR data should be used in the document. Estimates of use amounts are not relevant. Take out "<u>most</u> commonly applied" and leave "commonly applied."

Toxicity

Testing done at 5 sites in the watershed, 4 out of 5 sites were toxic

Overall recommendation to Agency to have the full Assessment "peer reviewed" or at least the entire Water Quality section.

Storm water drainage from urban community landscaping and maintenance efforts may contribute additional nutrients and pesticides to surface waters in the watershed.

Data sited in the Assessment are not sufficient to draw any conclusions. Data are from multiple sources, collected by various methods at many different times of the year and day, and are analyzed by different laboratories.

Please be sure to note when you are siting a source of data that was NOT collected under the same Quality Assurance Plan required by the Regional Board for this Assessment.

Also, please include the QAPP in appendices.

Fish kills- do we know if these were "raised" fish with low resistance due to method of breeding rather than fish spawned in the watershed? – … Fish and Game fish releases can have low survival rates for this reason.

Comparing storm event data from a "first flush" event with one later in the season is misleading to the reader and could result in incorrect evaluation of data and conclusions.

Under “Water Quality Assessment” – water temperature
What criteria were used to established a monitoring site as “warm” or “cold”?

Include table here summarizing water quality data. See example below:

. site name and location	stituent	ctive(s) used	samples exceeding the objective(s)	l # of samples collected from this site	/ Max of results	n	ian

Take wording out that reference data to “Rec1” waters
6b. “number of sites” vague

6. Biological Assessment

<u>a. All data sources</u> were from recently made observations by the CCOWS team and other consulting reports.

<u>b. Human impacts</u> – a number of sites downstream of intensive ag. have lower diversity and low abundance of sensitive species. This observation follows the expectation that human induced pollution and channel alteration disrupt the biological integrity of waterways in the study area.

i. Lower watershed supports very few large mammals, but is a key habitat for small mammals (ag. & urban areas)
ii. Upper watershed supports a managed herd of tule elk.

c. Fish Observations

i. Rainbow trout in the headwaters of Gabilan Creek (Fall/Winter 2000)
ii. Juvenile trout <u>at</u> the Old Stage Rd. crossing at Gabilan Creek (2001)
iii. Juvenile trout <u>below</u> Old Stage Rd. crossing at Gabilan Creek (June 2004)
iv. Several native species and age classes found Laurel Pond / lower Natividad Creek (Summer 2003)
v. Two factors that limit fish species distribution are poor quality water conditions and migration constraints

<u>d. Food Safety</u> - The presence of mammals in and near crops is a threat, real or perceived, that affects the sale of crops.

Appendix B – Checklist of Amphibians and Reptiles

Table 10.1 A Species Checklist of Amphibians and Reptiles. The following is a list of species that are likely to occur in the region/Reclamation Ditch Watershed based on species range maps published in Stebbins (2003).

	Species Common Name	Species Scientific Name
Salamanders and Newts		
	California tiger salamander	*Ambystoma californiense*
	arboreal salamander	*Aneides lugubris*
	Gabilan Mountains Slender Salamander	*Batrachoseps gavilanensis*
	Pacific giant salamander	*Dicamptodon tenebrosus*
	California newt	*Taricha torosa*
Toads and Frogs		
	Western spadefoot toad	*Spea hammondii*
	Western toad	*Bufo boreas*
	Pacific treefrog	*Hyla regilla*
	bullfrog *!	*Rana catesbeiana*
	California red-legged frog	*Rana aurora draytonii*
Turtles		
	Southwestern pond turtle	*Clemmys marmorata*
Lizards		
	Western fence lizard	*Sceloporous occidentalis*
	common side-blotched lizard	*Uta stansburiana*
	coast horned lizard	*Phrynosoma coronatum*
	Western skink	*Eumeces skiltonianus*
	California whiptail	*Cnemidphorus tigris mundus*
	Northern alligator lizard	*Elgaria multicarinata*
Snakes		
	rubber boa	*Charina bottae*
	ring-necked snake	*Diadohis punctatus*
	sharp-tailed snake	*Contia tenius*
	California whipsnake	*Masticphis lateralis*
	Western Yellow-bellied racer	*Coluber constrictor*
	Pacific gopher snake	*Pituophis catenifer*
	California Mountain kingsnake	*Lampropeltis zonata*
	common kingsnake (Caifornia kingsnake)	*Lampropeltis getula*
	California red-sided garter snake	*Thamnophis sirtalis nfernalis*
	Western terrestrial garter snake	*Thamnophis elegans*
	aquatic garter snake	*Thamnophis atratus*
	night snake	*Hypsiglena torquata*
	Northern Pacific rattlesnake	*Crotalus viridis oreganos*

* Non-native Species
! Predatory

[Page intentionally left blank]

Appendix C – Breeding Birds

Table 10.2 Breeding birds of the Reclamation Ditch Watershed. Data extracted from Roberson and Tenney, 1993. Note: The following list is not complete; rather it is only a list of confirmed breeding birds observed in the Reclamation Ditch Watershed by Roberson and Tenney (1993).

Species Common Name	Scientific Name	Riparian Obligate[1]	Riparian Dependent[2]	Riparian Affinity[3]
Acorn Woodpecker	*Melanerpes formicivorus*			3
Allen's Hummingbird	*Selasphorus sasin*			3
American Coot	*Fulica americana*			1
American Crow	*Corvus brachyrhynchos*			3
American Goldfinch	*Carduelis tristis*		X	2
American Kestrel	*Falco sparverius*			3
American Robin	*Turdus migratorius*			2
Anna's Humminbird	*Calypte anna*			3
Ash-Throated Flycatcher	*Myiarchus cinerascens*			2
Barn Owl	*Tuto alba*			3
Barn Swallow	*Hirundo rustica*			3
Bewick's Wren	*Thryomanes bewickii*		X	3
Black Phoebe	*Sayornis nigricans*			1
Black-Headed Grosbeak	*Pheucticus melanocephalus*		X	1
Black-Necked Stilt	*Himantopus mexicanus*			N/A
Blue-Gray Gnatcatcher	*Polioptila caerulea*			N/A
Brewer's Blackbird	*Euphagus cyanocephalus*			2
Brown-Headed Cowbird	*Molothrus ater*			3
Burrowing Owl	*Athene cunicularia*			N/A
Bushtit	*Psaltriparus minimus*			2
California Quail	*Callipepla californica*			3
California Towhee	*Pipilo crissalis*			3
Canyon Wren	*Catherpes mexicanus*			N/A
Cassin's Kingbird	*Tyrannus vociferans*			N/A
Cedar Waxwing	*Bombycilla cedrorum*			3
Chesnut-Backed Chickadee	*Parus rufescens*			N/A
Chipping Sparrow	*Spizella passerina*			N/A
Cinnamon Teal	*Anas cyanoptera*			N/A
Cliff Swallow	*Hirundo pyrrhonota*			2
Common Yellow Throat	*Geothlypis trichas*	X		3
Common Moorhen	*Gallinula chloropus*			N/A
Dark-Eyed Junco	*Junco hyemalis*			N/A
Downy Woodpecker	*Picoides pubescens*			1
European Starling	*Sturnus vulgaris*			3

Gadwall	*Anas stepera*			N/A
Hooded Oriole	*Icterus cucullatus*		X	N/A
Horned Lark	*Eremophila alpestris*			N/A
House Finch	*Carpodacus mexicanus*			3
House Sparrow	*Passer domesticus*			3
House Wren	*Troglodytes aedon*		X	3
Hutton's Vireo	*Vireo huttoni*			N/A
Killdeer	*Charadrius vociferus*			2
Lark Sparrow	*Chondestes grammacus*			3
Lawrence's Goldfinch	*Carduelis lawrencei*			N/A
Lesser Goldfinch	*Carduelis psaltria*		X	N/A
Loggerhead shrike	*Lanius ludovicianus*			N/A
Mallard	*Anas platyrhnchos*			1
Marsh Wren	*Cistothorus palustris*			1
Morning Dove	*Zenaida macroura*			3
Northern Mockingbird	*Mimus polyglottos*			3
Northern Oriole	*Icterus galbula*			N/A
Northern Rough-Winged Swallow	*Stelgidopteryx serripennis*			N/A
Nuttall's Woodpecker	*Picoides nuttallii*			2
Olive-Sided Flycatcher	*Contopus borealis*			N/A
Orange-Crowned Warbler	*Verminora celata*	X		3
Pacific-Slope Flycatcher	*Empidonax difficilis*			2
Pied-Billed Grebe	*Podilymbus podiceps*			1
Pine Siskin	*Carduelis pinus*			N/A
Plain Titmouse	*Parus inornatus*			3
Purple Finch	*Carpodacus purpureus*			N/A
Red-Shouldered Hawk	*Buteo lineatus*			3
Red-Tailed Hawk	*Buteo jamaicensis*			3
Red-Winged Blackbird*	*Agelaius phoeniceus*			2
Rock Dove	*Columba livia*			N/A
Rock Wren	*Salpinctes obsoletus*			N/A
Ruddy Duck	*Oxyura jamaicensis*			N/A
Rufous-Crowned Sparrow	*Aimophila ruficeps*			N/A
Rufous-Sided Towhee	*Pipilo erythrophthalmus*			N/A
Savannah Sparrow	*Passerculus sandwichensis*			3
Snowy Plover	*Charadrius alexandrinus*			N/A
Solitary Vireo	*Vireo solitarius*			N/A
Song Sparrow	*Melospiza melodia*	X		1
Stellar's Jay	*Aphelocoma coerulenscens*			N/A
Swainson's Thrush	*Catharus ustulatus*		X	2
Tree Swallow	*Tachycineta bicolor*		X	2
Tricolored Blackbird	*Agelaius tricolor*			N/A

Violet-Green Swallow	*Tachycinta thalassina*			N/A
Warbling Vireo	*Vireo gilvus*		X	1
Western Bluebird	*Sialia mexicana*			N/A
Western Gull	*Larus occidentalis*			N/A
Western Meadowlark	*Sturnella neglecta*			3
Western Wood-Pewee	*Contopus sordidulud*		X	3
White-Breasted Nuthatch	*Sitta carolinensis*			3
White-Crowned Sparrow	*Zonotrichia leucophrys*			N/A
Wild Turkey	*Melaeagris gallopavo*			N/A
Wilson's Warbler	*Wilsonia pusilla*	X		2
Wrentit	*Chamaea fasciata*			3
Yellow-Billed Magpie	*Pica nuttalli*			3
Total # of Species	**87**	**4**	**10**	**8** (ranked #1)

[1] **Riparian Dependent Species** = means these species place 60-90% of their nests in riparian vegetation or for which 60-90% of their abundance occurs in riparian vegetation during the breeding season.

[2] **Riparian Obligate Species** = Species that place > 90% of their nests in riparian vegetation or of which > 90% of their abundance is in riparian vegetation during the breeding season.

Source Online @: http://www.npwrc.usgs.gov/resource/1998/ripveg/ripveg.htm#contents

[3] **Riparian Affinity**: (1 = riparian obligate, 2 = prefers riparian, 3 = prefers non-riparian) as defined by Haff and Geupel (2001), Source online @: http://watershed.ucdavis.edu/crg/product.asp?var=%2224%22

N/A = not listed

* While the redwing black bird is not noted as a riparian obligate or a species with the highest affinity for riparian areas, in the Salinas Valley Roberson and Tenney (1993) noted that this species was observed breeding primarily in riparian areas.

[Page intentionally left blank]

Appendix D – Riparian Vegetation Species-Site Table

During the summer and fall of 2004, plant species composition and percent cover within three different levels of vegetative canopy were described at 13 sites in the Watershed, representing six different general vegetative communities (Saltwater Marsh, Freshwater Marsh, Bare Ditch/Weeds, Willow, Mixed Riparian, and Oak Woodland). The data are reproduced below courtesy of J. Hameister, collected during 2004 as part of a senior project in Earth Systems Science and Policy, CSUMB:

[Page intentionally left blank]

Table 10.3 Species Matrix. Percent cover for each species and strata are shown. Species that were at the site but not on any transects are undedicated with an X.

					Percent Cover based on combination of all transects													
1-Ground, 2-Mid, 3-Canopy					Satwater Marsh		Bare Ditch/Weeds			Freshwater Slough		Willow		Mixed Riparian			Oak	
Level	Species	Common Name	Nature Serve*	Native	OLS-POT	OLS-POT 2	REC-BOR	REC-VIC	REC-AIR	ALI-COO	Markley	TEM-183	REC-183	GAB-VET	NAT-FRE	GAB-OSR	Fremont	Fremont 2
1	*Distichlis spicata*	saltgrass	G5	Yes	5.7%													
2	*Grindelia stricta var. angustifolia*	marsh gumplant	G4?T3	Yes	0.7%													
2	*Frankenia salina*	alkali heath	G3G4	Yes	0.3%													
2	*Salicornia sp.*	pickleweed		Yes	0.3%													
1	*Grindelia stricta var. angustifolia*	marsh gumplant	G4?T3	Yes	0.3%													
1	*Salicornia sp.*	pickleweed		Yes	46.3%	72.7%												
1	*Conicosia pugioniformis*	false ice plant			27.3%	6.7%												
1	*Frankenia salina*	alkali heath	G3G4	Yes	19.0%	12.3%												
1	*Carpobrotus edulis*	ice plant	GNR		15.0%	7.7%												
2	*Ericameria ericoides*	mock heather	G3?	Yes		5.7%												
2	*Artemisia pycnocephala*	beach sagewort	G4G5	Yes		0.3%												
2	*Cuscuta sp.*	Dodder		Yes	4.7%	0.3%					2.5%							
1		Thatch			22.7%	6.0%	54.5%	58.2%	50.9%	16.2%	43.5%	29.1%		45.3%	64.2%	27.3%	100.0%	
1		Bareground				5.3%	30.6%	17.9%	20.8%	36.2%		7.1%	1.3%	9.4%	10.8%			
1		Water				1.3%	14.9%	18.7%	20.1%	8.5%	0.6%	19.2%			4.5%			
1	*Raphanus sativus*	wild radish	GNR					0.7%			0.7%							
1	*Poacea Family*	grass						1.5%			0.6%							
1	*Opuntia chlorotica*	prickly-pear cactus	G4		X		X	3.0%		0.8%	3.0%							
1		riprap							8.2%							0.9%		
2		thatch			1.3%					7.7%	7.5%	13.2%	18.4%	17.0%				79.0%
1	*Rumex conglomeratus*	Dock	GNR							9.2%								
1		Rubble								2.3%								
2	*Typha latifolia*	broad-leaved cattail	G5	Yes						30.8%	4.3%							
1	*Typha latifolia*	broad-leaved cattail	G5	Yes							6.2%							

Level	Species	Common Name	Nature Serve	Native	OLS-POT	OLS-POT 2	REC-BOR	REC-VIC	REC-AIR	ALI-COO	Markley	TEM-183	REC-183	GAB-VET	NAT-FRE	GAB-OSR	Fremont	Fremont 2
1	*Chamaesyce spp.*	sandmat		Yes							1.9%							
2	*Malva parviflora*	cheeseweed	GNR								1.9%							
1	*Polygonum amphibium var.*	smartweed	G5T5	Yes							5.0%							
2	*Polygonum amphibium var.*	smartweed	G5T5	Yes							11.8%			X				
1	*Polygonum arenastrum*	common knotweed	G5?								5.6%							
2	*Polygonum arenastrum*	common knotweed	G5?								3.1%							
2	*Poacea Family*	grass									2.5%							
2	*Atriplex triangularis*	spearscale			0.7%						14.3%	9.3%						
1	*Malva parviflora*	cheeseweed	GNR								4.3%	0.5%						
1	*Atriplex triangularis*	spearscale									4.3%	9.3%						
2	*Raphanus sativus*	wild radish	GNR									3.8%						
2	*Pseudognaphalium sp*	cudweed	G5	?								0.5%						
1	*Xanthium spinosum*	spiny dot bur	GNR									1.1%						
3	*Conium maculatum*	poison hemlock	G5									2.2%						
2	*Urtica dioica*	stinging nettle	G5	Yes								11.0%						
1	*Salsola tragus*	Russian thistle	GNRTNR									0.5%						
1	*Epilobium brachycarpum*	willow herb	G5	Yes								0.5%		1.9%				
1	*Artemisia douglasiana*	Douglas' Sagewort	G5	Yes									1.3%					
2	*Artemisia douglasiana*	Douglas' Sagewort	G5	Yes									2.6%					
2	*Conyza canadensis*	horseweed	G5	?									2.6%					
2	*Urtica dioica*	stinging nettle	G5	Yes									14.5%			6.4%		
1	*Conium maculatum*	poison-hemlock	G5							3.1%		1.1%	7.9%	0.9%				
2	*Salix sp.*	willow	G4/G5	Yes								0.5%		43.4%	13.6%			
3	*Salix sp.*	willow	G4/G5	Yes							10.6%	23.1%	73.7%	60.4%	59.7%	67.3%		
1	*Conyza canadensis*	horseweed	G5	?									6.6%	3.8%				
3		thatch										14.3%	27.6%	2.8%				
1	*Rorippa nasturtium-aquaticum*	watercress	GNR	Yes						5.4%				11.3%		2.7%		
1	*Picris echioides*	bristly oxtongue	GNR									1.6%		1.9%				
2	*Rorippa nasturtium-aquaticum*	watercress	GNR	Yes										2.8%				
2	*Apiastrum graveolens*	celery (??)												4.7%				

Level	Species	Common Name	Nature Serve	Native	OLS-POT	OLS-POT 2	REC-BOR	REC-VIC	REC-AIR	ALI-COO	Markley	TEM-183	REC-183	GAB-VET	NAT-FRE	GAB-OSR	Fremont	Fremont 2
1	Cyperus eragrostis	Tall Cyperus	G5	Yes										0.9%				
2	*Cyperus eragrostis*	Tall Cyperus	G5	Yes										1.9%				
2	*Epilobium ciliatum*	willowherb	G5	Yes										2.8%				
2	*Equisetum arvense*	horsetail	G5	Yes										0.9%				
2	*Panicum milliaceum (?)*	broomcorn millit (??)												11.3%				
2	*Picris echioides*	bristly oxtongue	GNR											3.8%				
1	*Vicia sativa*	spring Vetch	GNR	Yes										0.9%				
1	*Rubus ursinus*	California blackberry	G5	Yes										1.9%	11.4%	47.3%		
1	*Medicago polymorpha*	bur Clover	GNR												0.6%			
1	*Phalaris aquatica*	harding grass	GNR												0.6%			
1	*Ranunculus californicus*	California buttercup	G5	Yes											0.6%			
1	*Cornus Sp.*	dogwood	G5	Yes											1.1%			
1	*Fescue sp.*	turf grass	G5												1.1%			
1	*Rosa californica*	California wild rose	G4	Yes											1.7%			
1	*Cynodon dactylon*	Bermuda grass	GNR												5.7%			
3	*Sambucus mexicana*	blue elderberry	G5T5?	Yes											6.8%			
3	*Alnus rhombifolia*	white alder	G5	Yes											7.4%			
2	*Cornus Sp.*	dogwood	G5	Yes											8.0%			
3	*Platanus racemosa*	sycamore	G5	Yes										X	12.5%			
2	*Rubus ursinus*	California blackberry	G5	Yes											9.1%	6.4%		
1	*Salix sp.*	willow	G4/G5	Yes											1.7%	1.8%		
3	*Acer negundo*	box elder	G5	Yes											4.5%	20.0%		
2	*Acer negundo*	box elder	G5	Yes											5.1%	2.7%		
1		Rock													1.1%			16.1%
2	*Sambucus mexicana*	blue elderberry	G5T5?	Yes											5.7%			11.3%
1	*Urtica dioica*	stinging nettle	G5	Yes												0.9%		
1	*Cornus sericea ssp. Occidentalis*	western red dogwood	G5T4T5	Yes												0.9%		
2	*Cornus sericea ssp. Occidentalis*	western red dogwood	G5T4T5	Yes												7.3%		

Level	Species	Common Name	Nature Serve	Native	OLS-POT	OLS-POT 2	REC-BOR	REC-VIC	REC-AIR	ALI-COO	Markley	TEM-183	REC-183	GAB-VET	NAT-FRE	GAB-OSR	Fremont	Fremont 2
1	*Clematis Ligusticifolia*	Western Virgin's bower	G5	Yes												21.8%		
2	*Clematis Ligusticifolia*	Western Virgin's bower	G5	Yes												2.7%		
3	*Clamatis ligusticifolia*	Western Virgin's bower	G5	Yes												13.6%		
1		log debris														4.5%		
2	*Euphorbia lathyris*	gopher plant	GNR													0.9%		
2		log debris														0.9%		
3	*Populus sp.*	cottonwood	G5	Yes												X		
2	*Clinopodium douglasii*	yerba buena		Yes													2.5%	
2	*Juncus patens*	spreading rush	G5	Yes													0.8%	
2		unidentified shrub															8.3%	
2	*Lupinus albifrons*	silver lupin	G5	Yes													2.5%	
2	*Ribes sp.*	gooseberry		Yes													0.8%	
2	*Pinus sabiniana*	grey pine	G4	Yes													0.8%	
2	*Pteridium aquilinum var. pubescens*	bracken fern	G5T3T5	Yes													3.3%	
2	*Baccharis pilularis*	coyote bush	G5	Yes													1.7%	
3	*Quercus douglasii*	blue Oak	G4	Yes													30.0%	
3	*Quercus agrifolia*	coast Live Oak	G5	Yes													50.8%	66.1%
3	*Quercus kelloggii*	California black oak	G4	Yes														51.6%
1	*Trichostema lanceolatum*	vinegar weed	G5	Yes														4.8%
2	*Toxicodendron diversilobum*	poison oak	G5	Yes														50.0%

Note: species with (??) after there names are “best guesses” for the species.

* Nature Serve @: http://www.natureserve.org/

Appendix E – Water Quality Data

Table 10.4 Water quality data collected between 1999 and 2004. Note: **ND** equals Non Detects. These results were given a value of 0 for statistical purposes.

Site Code	Date Time	Data Source	Water Temp	Dissolved Oxygen	Salinity	pH	Nitrogen as Ammonia (Total Ammonia)	Nitrogen as Nitrate	Phosphorus as Phosphate	TDS	Transparency	Turbidity	TSS/ SSC	Bedload	Total Coliform	Fecal Coliform	Chlorpyrifos Total Water Column (TPC)	Diazinon Total Water Column (TPC)
			C	mg/L	ppt		NH3-N	NO3-N	PO4-P	mg/L	cm	NTU	mg/L	g/s	MPN/100mL	MPN/100mL	ng/L	ng/L
TOW-OSR	08 Mar 00 15:45	CCoWS									11.10		1.50	0.49				
TOW-OSR	14 Apr 00 10:01	CCoWS								375.21	21.00		47.78	0.00				
TOW-OSR	16 Apr 00 22:42	CCoWS									20.00		71.54					
TOW-OSR	17 Apr 00 15:05	CCoWS								397.32	40.70		32.46					
TOW-OSR	17 Apr 00 23:23	CCoWS								396.00			22.16					
TOW-OSR	18 Apr 00 13:57	CCoWS											11.08					
TOW-OSR	12 Jul 00 16:15	CCoWS																
TOW-OSR	08 Jan 01 02:27	CCoWS						0.45					36.77					
TOW-OSR	08 Jan 01 03:43	CCoWS																
TOW-OSR	08 Jan 01 12:39	CCoWS						0.45		384.78	17.60		40.53					
TOW-OSR	08 Jan 01 19:23	CCoWS						0.45		382.80	48.80		11.50					
TOW-OSR	09 Jan 01 15:40	CCoWS						0.45	0.21	388.74	20.80		32.51					
TOW-OSR	10 Jan 01 12:45	CCoWS					0.06	0.68	0.04	345.84	13.00		64.46					
TOW-OSR	10 Jan 01 17:53	CCoWS							0.05	372.24	15.70		48.88					
TOW-OSR	11 Jan 01 13:22	CCoWS						0.68		384.78	10.30		30.83					
TOW-OSR	12 Jan 01 18:09	CCoWS						0.45		422.40	18.00		21.33					
TOW-OSR	15 Jan 01 15:25	CCoWS						0.68		399.30	26.20		5.00					
TOW-OSR	23 Jan 01 15:16	CCoWS						0.68		409.86	19.00		19.43					
TOW-OSR	24 Jan 01 05:16	CCoWS						0.68		367.62	20.50		64.56					
TOW-OSR	24 Jan 01 12:02	CCoWS					0.08	0.68	0.05	386.76	18.10		35.90					
TOW-OSR	25 Jan 01 19:07	CCoWS					0.11	0.68	0.05	228.36	1.02		1006.07					
TOW-OSR	25 Jan 01 21:33	CCoWS						0.68	0.07	322.08	8.60		99.92					
TOW-OSR	26 Jan 01 02:38	CCoWS						0.90		390.06	28.80		36.24					
TOW-OSR	26 Jan 01 11:05	CCoWS						0.68	0.13	401.28	17.10		43.91					
TOW-OSR	09 Feb 01 20:38	CCoWS						0.68		392.04	16.60		27.41					

TOW-OSR	10 Feb 01 16:09	CCoWS					0.08	0.68		392.70	20.00		32.92					
TOW-OSR	11 Feb 01 06:40	CCoWS					0.06	0.68	0.05	343.20	9.70		92.36					
TOW-OSR	18 Feb 01 15:33	CCoWS					0.13	0.45		407.88	17.90		3.60					
TOW-OSR	19 Feb 01 07:18	CCoWS						0.68										
TOW-OSR	23 Jun 04 09:42	CCoWS	13.75	8.44	0.38	7.31												
min							0.06	0.45	0.04	228.36	1.02		1.50	0.00				
max							0.13	0.90	0.21	422.40	48.80		1006.07	0.49				
mean			13.75	8.44	0.38	7.31	0.09	0.62	0.08	376.88	19.15		74.64	0.25				
median			13.75	8.44	0.38	7.31	0.08	0.68	0.05	387.75	18.00		34.41	0.25				
Total # Samples			**1**	**1**	**1**	**1**	**6**	**20**	**8**	**22**	**23**	**0**	**26**	**2**	**0**	**0**	**0**	**0**
BOC-OSR	14 Apr 00 09:43	CCoWS								277.20	20.20		66.48					
BOC-OSR	16 Apr 00 22:49	CCoWS									5.20		379.46					
BOC-OSR	17 Apr 00 15:03	CCoWS								282.48	32.20		54.37					
BOC-OSR	17 Apr 00 23:18	CCoWS								283.80			11.84					
BOC-OSR	18 Apr 00 14:00	CCoWS											0.00					
BOC-OSR	12 Jul 00 16:10	CCoWS																
BOC-OSR	07 Jan 01 16:16	CCoWS					0.13	0.23	0.05									
BOC-OSR	08 Jan 01 02:10	CCoWS								292.38			41.09					
BOC-OSR	08 Jan 01 04:14	CCoWS					0.13	0.23	0.05	271.92	5.53		202.85					
BOC-OSR	08 Jan 01 12:44	CCoWS					0.12	0.68	0.06	327.36	14.40		41.23					
BOC-OSR	08 Jan 01 19:14	CCoWS					0.16	0.23		331.98	8.30		149.95					
BOC-OSR	09 Jan 01 15:44	CCoWS						0.23		305.58	41.60		25.05					
BOC-OSR	10 Jan 01 12:40	CCoWS					0.33	0.68	0.06	297.00	5.17		478.05					
BOC-OSR	10 Jan 01 18:04	CCoWS					5.10	0.90	0.28	512.82	3.28		161.98					
BOC-OSR	11 Jan 01 13:12	CCoWS					0.79	0.45	0.07	351.12	36.40		21.29					
BOC-OSR	12 Jan 01 18:19	CCoWS					0.80	0.45		374.88	41.70		13.91					
BOC-OSR	23 Jan 01 15:26	CCoWS					0.05	0.23		308.88	31.50		12.10					
BOC-OSR	24 Jan 01 05:23	CCoWS					0.12	0.45	0.05	298.98	9.50		103.03					
BOC-OSR	24 Jan 01 12:10	CCoWS					1.96	0.90	0.10	374.22	12.30		48.33					
BOC-OSR	25 Jan 01 09:43	CCoWS					6.70	0.90	0.27									
BOC-OSR	25 Jan 01 19:21	CCoWS					5.10	0.90	0.06	267.96	0.59		1862.75					
BOC-OSR	25 Jan 01 21:41	CCoWS					6.70	0.90	0.27	388.08	4.80		284.22					

BOC-OSR	26 Jan 01 02:08	CCoWS					4.00	0.68	0.29	402.60	8.80		44.91					
BOC-OSR	26 Jan 01 11:11	CCoWS					2.19	0.68	0.15	351.12	32.50		15.52					
BOC-OSR	09 Feb 01 20:44	CCoWS					0.74	1.13	0.21	357.72	23.20		39.21					
BOC-OSR	11 Feb 01 06:47	CCoWS					1.85	0.90	0.37	364.32	4.01		214.72					
BOC-OSR	18 Feb 01 15:37	CCoWS					0.12	0.45		333.30	18.60		11.30					
BOC-OSR	19 Feb 01 07:23	CCoWS								273.24	4.40		340.17					
min							0.12	0.45	0.06	267.96	0.59		11.30					
max							6.70	1.13	0.37	402.60	32.50		1862.75					
mean							2.96	0.81	0.22	342.29	12.11		351.60					
median							2.19	0.90	0.24	354.42	6.80		129.81					
Total # Samples			**0**	**0**	**0**	**0**	**19**	**20**	**15**	**23**	**22**	**0**	**25**	**0**	**0**	**0**	**0**	**0**
GAB-OSR	08 Mar 00 16:28	CCoWS									38.20		5.78	26.96				
GAB-OSR	13 Apr 00 15:43	CCoWS								379.17	57.50		20.39	35.53				
GAB-OSR	13 Apr 00 16:50	CCoWS								379.17	57.50		0.00					
GAB-OSR	14 Apr 00 09:33	CCoWS								363.00	60.00		27.55					
GAB-OSR	16 Apr 00 22:56	CCoWS								380.16	20.00		273.66					
GAB-OSR	17 Apr 00 03:01	CCoWS								376.20	60.00		10.19					
GAB-OSR	17 Apr 00 14:40	CCoWS								369.60	60.00		0.00	59.35				
GAB-OSR	17 Apr 00 14:52	CCoWS								365.64			10.20					
GAB-OSR	17 Apr 00 23:08	CCoWS								360.36			19.99					
GAB-OSR	18 Apr 00 14:04	CCoWS																
GAB-OSR	03 Jul 00 16:47	CCoWS																
GAB-OSR	12 Jul 00 15:30	CCoWS																
GAB-OSR	11 Oct 00 14:13	CCoWS					0.06	0.39	0.05									
GAB-OSR	25 Oct 00 14:32	CCoWS								425.04	43.15		18.20	0.00				
GAB-OSR	25 Oct 00 20:20	CCoWS								429.00	28.70		2.93					
GAB-OSR	25 Oct 00 20:38	CCoWS																
GAB-OSR	26 Oct 00 10:16	CCoWS								412.50	9.30		51.60	0.00				
GAB-OSR	26 Oct 00 16:36	CCoWS								405.24	9.90		74.61					
GAB-OSR	26 Oct 00 21:57	CCoWS								297.66	1.54		13039.01					
GAB-OSR	27 Oct 00 06:34	CCoWS					0.03	0.34	0.04	411.84	18.70		31.05	0.00				
GAB-OSR	27 Oct 00 09:05	CCoWS					0.03	0.37	0.04	415.14	24.20		11.00					
GAB-OSR	28 Oct 00 11:23	CCoWS								441.54	49.00		18.62					
GAB-OSR	28 Oct 00 19:05	CCoWS					0.06	0.33	0.16	293.04	1.05		395.00					

GAB-OSR	29 Oct 00 00:03	CCoWS				170.94	1.10	1121.18	
GAB-OSR	29 Oct 00 01:07	CCoWS				347.82	5.20	197.18	0.46
GAB-OSR	29 Oct 00 07:08	CCoWS				409.86	28.07	43.83	
GAB-OSR	29 Oct 00 07:24	CCoWS	0.03	0.33	0.05				
GAB-OSR	29 Oct 00 09:25	CCoWS	0.19	0.40	0.23	115.50	0.36	3982.63	0.00
GAB-OSR	29 Oct 00 09:50	CCoWS							
GAB-OSR	29 Oct 00 10:04	CCoWS							
GAB-OSR	29 Oct 00 10:15	CCoWS							
GAB-OSR	29 Oct 00 20:39	CCoWS						31.19	
GAB-OSR	30 Oct 00 21:54	CCoWS	0.05	0.41	0.05	438.90	39.40	15.62	1.96
GAB-OSR	31 Oct 00 21:08	CCoWS	0.03	0.41	0.04	443.52	45.40	18.40	1.02
GAB-OSR	04 Nov 00 12:30	CCoWS				427.68	60.00	27.33	
GAB-OSR	07 Jan 01 15:38	CCoWS		0.23		410.52	22.10	0.00	
GAB-OSR	08 Jan 01 02:40	CCoWS							
GAB-OSR	08 Jan 01 03:35	CCoWS							
GAB-OSR	08 Jan 01 04:23	CCoWS		0.45	0.11	398.64	25.20	56.15	
GAB-OSR	08 Jan 01 08:03	CCoWS		0.45		360.36	27.20	70.13	
GAB-OSR	08 Jan 01 11:27	CCoWS		0.45	0.06	293.70	4.20	217.10	5.86
GAB-OSR	08 Jan 01 12:21	CCoWS		0.45	0.04	363.66	19.40	81.34	
GAB-OSR	08 Jan 01 19:02	CCoWS		0.23		397.32	23.20	40.95	
GAB-OSR	09 Jan 01 15:58	CCoWS		0.23		399.96	28.20	26.19	2.15
GAB-OSR	10 Jan 01 12:25	CCoWS	0.06	0.45	0.15	1590.60	0.89	1411.55	0.90
GAB-OSR	10 Jan 01 18:17	CCoWS		0.68	0.14	204.60	2.32	372.83	8.30
GAB-OSR	10 Jan 01 18:33	CCoWS							
GAB-OSR	10 Jan 01 22:15	CCoWS				287.76	7.50	88.91	3.55
GAB-OSR	11 Jan 01 13:22	CCoWS	0.00	0.45	0.05	335.28	9.80	79.18	5.41
GAB-OSR	11 Jan 01 18:30	CCoWS		0.45	0.03	297.66	8.20	102.44	15.46
GAB-OSR	12 Jan 01 18:30	CCoWS		0.45	0.03	427.02	27.80	20.87	1.31
GAB-OSR	15 Jan 01 15:35	CCoWS		0.34		396.66	29.20	6.72	
GAB-OSR	23 Jan 01 15:35	CCoWS		0.45		406.56	27.00	16.91	3.73
GAB-OSR	24 Jan 01 05:31	CCoWS		0.45	0.15	237.60	3.60	395.97	4.39
GAB-OSR	24 Jan 01 12:22	CCoWS		0.23	0.10	317.46	12.40	52.75	6.16
GAB-OSR	25 Jan 01 19:41	CCoWS	0.07	0.45	0.19	104.94	0.57	2387.30	10.58
GAB-OSR	25 Jan 01 19:50	CCoWS							
GAB-OSR	25 Jan 01 21:55	CCoWS		0.68	0.14	199.98	1.01	723.63	10.52
GAB-OSR	26 Jan 01 02:08	CCoWS		0.45	0.04	365.64	11.80	77.88	6.33

GAB-OSR	26 Jan 01 10:52	CCoWS				0.45	0.03	405.24	28.20	11.20	6.78
GAB-OSR	09 Feb 01 20:25	CCoWS				0.45	0.17	369.60	10.40	69.93	6.02
GAB-OSR	10 Feb 01 16:18	CCoWS				0.45		365.64	15.40	21.27	3.73
GAB-OSR	11 Feb 01 06:57	CCoWS				0.45	0.15	145.86	0.38	538.66	
GAB-OSR	11 Feb 01 08:48	CCoWS						236.94	1.66	399.17	
GAB-OSR	12 Feb 01 08:03	CCoWS						211.86	5.60	234.05	3.98
GAB-OSR	18 Feb 01 15:30	CCoWS				0.23		416.46	20.80	9.28	2.53
GAB-OSR	19 Feb 01 07:10	CCoWS				0.45	0.12	112.20	1.35	882.24	163.74
GAB-OSR	19 Feb 01 07:28	CCoWS									
GAB-OSR	04 Oct 00 10:04	UCSC	15.13	9.37	8.08						
GAB-OSR	25 Oct 00 10:04	UCSC	13.64	9.75	7.72						
GAB-OSR	07 Nov 00 10:04	UCSC	13.82	9.77	7.73						
GAB-OSR	22 Nov 00 10:04	UCSC	10.67	10.67	7.75						
GAB-OSR	06 Dec 00 10:04	UCSC	10.79	9.58	7.58						
GAB-OSR	19 Dec 00 10:04	UCSC	9.90	10.83	7.89						
GAB-OSR	04 Jan 01 10:04	UCSC	9.40	11.10	8.20						
GAB-OSR	11 Jan 01 13:55	UCSC	10.23	10.23	8.11						
GAB-OSR	16 Jan 01 10:04	UCSC	7.81	11.54	7.86						
GAB-OSR	30 Jan 01 10:04	UCSC	9.37	10.94	8.48						
GAB-OSR	13 Feb 01 10:04	UCSC	10.67	10.55	7.91						
GAB-OSR	27 Feb 01 10:04	UCSC	14.13	9.65	7.97						
GAB-OSR	05 Mar 01 10:04	UCSC									
GAB-OSR	13 Mar 01 10:04	UCSC	14.32	9.69	7.99						
GAB-OSR	24 Mar 01 10:04	UCSC									
GAB-OSR	10 Apr 01 10:04	UCSC	12.74	10.29	8.04						
GAB-OSR	21 Apr 01 10:04	UCSC									
GAB-OSR	24 Apr 01 10:04	UCSC	15.71	9.92	8.04						
GAB-OSR	08 May 01 10:04	UCSC	17.33	10.45	8.23						
GAB-OSR	22 May 01 10:04	UCSC	16.25	10.75	8.13						
GAB-OSR	05 Jun 01 10:04	UCSC	15.12	11.75	8.21						
GAB-OSR	19 Jun 01 10:04	UCSC	16.35	11.10	8.14						
GAB-OSR	02 Jul 01 10:04	UCSC	17.59	10.25	8.19						
GAB-OSR	18 Jul 01 10:04	UCSC	14.76	10.61	8.38						
GAB-OSR	01 Aug 01 10:04	UCSC	14.47	9.57	8.69						
GAB-OSR	20 Aug 01 10:04	UCSC	13.99	9.60	8.54						
GAB-OSR	04 Sep 01 10:04	UCSC	14.38	10.90	8.45						

GAB-OSR	05 Oct 01 10:04	UCSC	17.55	10.45	8.32
GAB-OSR	23 Oct 01 10:04	UCSC	14.25	9.85	8.20
GAB-OSR	21 Nov 01 10:04	UCSC	14.28	9.05	8.56
GAB-OSR	04 Dec 01 10:04	UCSC	10.02	10.35	8.42
GAB-OSR	18 Dec 01 10:04	UCSC	10.79	9.85	8.49
GAB-OSR	03 Jan 02 10:04	UCSC	12.79	9.88	8.28
GAB-OSR	16 Jan 02 10:04	UCSC	7.47	11.80	8.57
GAB-OSR	30 Jan 02 10:04	UCSC	6.89	12.01	8.64
GAB-OSR	13 Feb 02 10:04	UCSC	11.38	10.44	8.81
GAB-OSR	28 Feb 02 10:04	UCSC	14.87	9.61	7.95
GAB-OSR	28 Mar 02 10:04	UCSC			
GAB-OSR	10 Apr 02 10:04	UCSC	15.14	10.41	8.10
GAB-OSR	25 Apr 02 10:04	UCSC	14.29	9.97	8.24
GAB-OSR	09 May 02 10:04	UCSC	13.38	8.38	8.31
GAB-OSR	23 May 02 10:04	UCSC	14.55	10.32	8.48
GAB-OSR	06 Jun 02 10:04	UCSC	14.63	10.09	8.43
GAB-OSR	19 Jun 02 10:04	UCSC			8.30
GAB-OSR	17 Jul 02 10:04	UCSC	15.50	10.90	8.26
GAB-OSR	31 Jul 02 10:04	UCSC	16.50	9.76	7.97
GAB-OSR	14 Aug 02 10:04	UCSC	16.50	11.26	8.43
GAB-OSR	27 Aug 02 10:04	UCSC	16.30	11.47	8.26
GAB-OSR	10 Sep 02 10:04	UCSC	16.50	11.10	8.27
GAB-OSR	25 Sep 02 10:04	UCSC	15.02	9.62	8.43
GAB-OSR	08 Oct 02 10:04	UCSC	15.16	9.43	8.32
GAB-OSR	22 Oct 02 10:04	UCSC	12.80	9.58	8.45
GAB-OSR	05 Nov 02 10:04	UCSC	12.05	9.76	8.39
GAB-OSR	19 Nov 02 12:00	UCSC	11.23	9.66	8.19
GAB-OSR	03 Dec 02 12:14	UCSC	10.82	7.72	8.26
GAB-OSR	17 Dec 02 13:26	UCSC	11.51	10.18	8.22
GAB-OSR	29 Dec 02 10:00	UCSC			
GAB-OSR	14 Jan 03 13:12	UCSC	13.00	9.12	8.01
GAB-OSR	28 Jan 03 14:24	UCSC	13.82	9.19	8.06
GAB-OSR	11 Feb 03 13:55	UCSC	11.69	8.14	9.61
GAB-OSR	20 May 03 13:35	UCSC	16.03	8.54	8.25
GAB-OSR	03 Jun 03 12:00	UCSC	14.14	8.54	8.35
GAB-OSR	17 Jun 03 12:14	UCSC	14.57	9.00	8.47

GAB-OSR	01 Jul 03 12:57	UCSC	15.84	9.63	8.35		
GAB-OSR	15 Jul 03 12:57	UCSC	15.16	9.70	8.20		
GAB-OSR	29 Jul 03 13:26	UCSC	16.06	9.43	8.16		
GAB-OSR	12 Aug 03 10:04	UCSC	15.35	9.92	8.25		
GAB-OSR	26 Aug 03 10:04	UCSC	17.39	7.76	8.34		
GAB-OSR	04 Oct 00 10:04	UCSC				0.26	0.12
GAB-OSR	25 Oct 00 10:04	UCSC				0.43	0.07
GAB-OSR	07 Nov 00 10:04	UCSC				0.11	0.21
GAB-OSR	22 Nov 00 10:04	UCSC				0.50	0.15
GAB-OSR	06 Dec 00 10:04	UCSC				0.29	
GAB-OSR	19 Dec 00 10:04	UCSC				0.45	0.13
GAB-OSR	04 Jan 01 10:04	UCSC				0.44	0.10
GAB-OSR	11 Jan 01 13:55	UCSC				0.46	0.11
GAB-OSR	16 Jan 01 10:04	UCSC				0.46	0.10
GAB-OSR	30 Jan 01 10:04	UCSC				0.55	0.06
GAB-OSR	13 Feb 01 10:04	UCSC				0.29	0.02
GAB-OSR	27 Feb 01 10:04	UCSC				0.26	0.04
GAB-OSR	05 Mar 01 10:04	UCSC				0.44	0.01
GAB-OSR	13 Mar 01 10:04	UCSC				0.42	0.11
GAB-OSR	24 Mar 01 10:04	UCSC				0.39	0.11
GAB-OSR	10 Apr 01 10:04	UCSC				0.54	0.01
GAB-OSR	21 Apr 01 10:04	UCSC				0.45	0.04
GAB-OSR	24 Apr 01 10:04	UCSC				0.58	0.02
GAB-OSR	08 May 01 10:04	UCSC				0.72	0.01
GAB-OSR	22 May 01 10:04	UCSC				0.68	0.01
GAB-OSR	05 Jun 01 10:04	UCSC				0.64	0.15
GAB-OSR	19 Jun 01 10:04	UCSC				1.18	0.04
GAB-OSR	02 Jul 01 10:04	UCSC				1.14	0.11
GAB-OSR	18 Jul 01 10:04	UCSC				1.09	0.05
GAB-OSR	01 Aug 01 10:04	UCSC				1.38	0.16
GAB-OSR	20 Aug 01 10:04	UCSC				1.15	0.04
GAB-OSR	04 Sep 01 10:04	UCSC				1.33	0.03
GAB-OSR	20 Sep 01 10:04	UCSC				1.13	0.03
GAB-OSR	05 Oct 01 10:04	UCSC				0.49	0.02
GAB-OSR	23 Oct 01 10:04	UCSC				0.30	0.08
GAB-OSR	21 Nov 01 10:04	UCSC				0.68	0.01

GAB-OSR	04 Dec 01 10:04	UCSC	0.62	0.05
GAB-OSR	18 Dec 01 10:04	UCSC	0.71	0.01
GAB-OSR	03 Jan 02 10:04	UCSC	0.63	0.05
GAB-OSR	16 Jan 02 10:04	UCSC	0.97	0.05
GAB-OSR	30 Jan 02 10:04	UCSC	1.00	0.06
GAB-OSR	13 Feb 02 10:04	UCSC	0.85	0.02
GAB-OSR	28 Feb 02 10:04	UCSC	1.16	0.02
GAB-OSR	28 Mar 02 10:04	UCSC	0.47	0.03
GAB-OSR	10 Apr 02 10:04	UCSC	0.41	0.02
GAB-OSR	25 Apr 02 10:04	UCSC	0.49	0.02
GAB-OSR	09 May 02 10:04	UCSC	0.59	0.04
GAB-OSR	23 May 02 10:04	UCSC	0.41	0.05
GAB-OSR	06 Jun 02 10:04	UCSC	0.51	0.06
GAB-OSR	19 Jun 02 10:04	UCSC	0.91	0.03
GAB-OSR	17 Jul 02 10:04	UCSC	0.61	0.05
GAB-OSR	31 Jul 02 10:04	UCSC	1.07	0.02
GAB-OSR	14 Aug 02 10:04	UCSC	1.08	0.04
GAB-OSR	27 Aug 02 10:04	UCSC	3.64	0.10
GAB-OSR	10 Sep 02 10:04	UCSC	0.70	0.03
GAB-OSR	25 Sep 02 10:04	UCSC	0.47	0.03
GAB-OSR	08 Oct 02 10:04	UCSC	0.74	0.05
GAB-OSR	22 Oct 02 10:04	UCSC	0.38	0.01
GAB-OSR	05 Nov 02 10:04	UCSC	0.59	0.03
GAB-OSR	19 Nov 02 12:00	UCSC	0.31	0.18
GAB-OSR	03 Dec 02 12:14	UCSC	0.29	0.04
GAB-OSR	17 Dec 02 13:26	UCSC	0.17	0.06
GAB-OSR	14 Jan 03 13:12	UCSC	0.29	0.05
GAB-OSR	28 Jan 03 14:24	UCSC	0.32	0.06
GAB-OSR	11 Feb 03 13:55	UCSC	0.31	0.03
GAB-OSR	25 Feb 03 12:28	UCSC	0.29	0.05
GAB-OSR	11 Mar 03 13:12	UCSC	0.26	0.03
GAB-OSR	25 Mar 03 13:26	UCSC	0.17	0.20
GAB-OSR	08 Apr 03 13:40	UCSC	0.35	0.09
GAB-OSR	22 Apr 03 13:12	UCSC	0.19	0.07
GAB-OSR	06 May 03 12:57	UCSC	0.20	0.04
GAB-OSR	20 May 03 13:40	UCSC	0.28	0.05

GAB-OSR	03 Jun 03 12:00	UCSC						0.20	0.11									
GAB-OSR	17 Jun 03 12:14	UCSC						0.22	0.09									
GAB-OSR	01 Jul 03 12:57	UCSC						0.21	0.06									
GAB-OSR	15 Jul 03 12:57	UCSC						0.29	0.04									
GAB-OSR	29 Jul 03 13:26	UCSC						0.27	0.05									
GAB-OSR	12 Aug 03 10:04	UCSC						0.73	1.16									
GAB-OSR	26 Aug 03 10:04	UCSC						0.41	0.06									
GAB-OSR	26 Aug 03 10:04	UCSC						0.42	0.06									
GAB-OSR	08 Sep 03 10:04	UCSC						0.36	0.03									
GAB-OSR	23 Sep 03 10:04	UCSC						0.30	0.04									
GAB-OSR	07 Oct 03 10:04	UCSC						0.30	0.01									
GAB-OSR	18 Nov 03 10:04	UCSC						0.16	0.04									
GAB-OSR	02 Dec 03 10:04	UCSC						0.08	0.04									
GAB-OSR	16 Dec 03 10:04	UCSC						0.12	0.03									
GAB-OSR	22 Jun 04 11:31	CCoWS	14.47	9.80	0.37	7.56												
min			6.89	7.72	0.37	7.56	0.00	0.08	0.01	104.94	0.36		0.00	0.00				
max			17.59	12.01	0.37	9.61	0.19	3.64	1.16	1590.60	60.00		13039.01	163.74				
mean			13.62	10.01	0.37	8.24	0.06	0.52	0.08	363.81	21.44		515.59	13.22				
median			14.29	9.88	0.37	8.25	0.05	0.45	0.05	369.60	19.40		47.71	4.19				
Total # Samples			**62**	**62**	**1**	**63**	**11**	**114**	**105**	**52**	**51**	**0**	**54**	**30**	**0**	**0**	**0**	**0**
GAB-CRA	17 Apr 00 15:19	CCoWS								364.32	14.70		123.56	334.78				
GAB-CRA	17 Apr 00 23:02	CCoWS								363.00			70.71					
GAB-CRA	18 Apr 00 14:10	CCoWS											10.96	258.77				
GAB-CRA	03 Jul 00 16:30	CCoWS																
GAB-CRA	12 Jul 00 14:30	CCoWS																
GAB-CRA	11 Oct 00 11:30	CCoWS					0.03	0.21	0.04									
GAB-CRA	11 Oct 00 13:55	CCoWS					0.04	0.25	0.08									
GAB-CRA	25 Oct 00 14:59	CCoWS								381.15	45.00		0.00	0.00				
GAB-CRA	25 Oct 00 20:50	CCoWS								393.69	19.50		2641.16					
GAB-CRA	26 Oct 00 10:37	CCoWS									60.00							
GAB-CRA	26 Oct 00 21:10	CCoWS					0.07	0.61	0.54	258.72	0.72		1923.47					
GAB-CRA	27 Oct 00 07:01	CCoWS					0.06	0.43	0.21				28.84	1.05				
GAB-CRA	27 Oct 00 08:15	CCoWS					0.04	0.41	0.17				1830.43	395.87				
GAB-CRA	27 Oct 00 13:30	CCoWS								405.90	23.10		20.19					

GAB-CRA	28 Oct 00 12:15	CCoWS				398.64	40.50	15.21	
GAB-CRA	28 Oct 00 19:12	CCoWS				413.82	13.60	15.00	
GAB-CRA	29 Oct 00 00:10	CCoWS				248.16	1.20	1013.85	
GAB-CRA	29 Oct 00 01:29	CCoWS				310.86	2.40	342.75	
GAB-CRA	29 Oct 00 07:40	CCoWS	0.05	0.61	0.22	394.02	17.22	171.53	
GAB-CRA	29 Oct 00 08:05	CCoWS							7117.20
GAB-CRA	29 Oct 00 10:25	CCoWS	0.17	0.83	1.12	182.16	0.49	2915.74	107.33
GAB-CRA	29 Oct 00 10:55	CCoWS							
GAB-CRA	29 Oct 00 21:00	CCoWS	0.30	0.69	0.09	413.82	15.80	51.03	56546.66
GAB-CRA	30 Oct 00 20:54	CCoWS	0.43	0.68	0.10	388.74	20.20	36.18	151.60
GAB-CRA	31 Oct 00 21:31	CCoWS	0.26	0.60	0.10	419.76	43.40	17.80	0.00
GAB-CRA	04 Nov 00 12:39	CCoWS				419.10	5.20	16032.93	
GAB-CRA	07 Jan 01 15:28	CCoWS		0.23					
GAB-CRA	07 Jan 01 15:58	CCoWS				387.42	19.00	14.70	
GAB-CRA	08 Jan 01 03:26	CCoWS		0.23		386.76	20.80	12.28	
GAB-CRA	08 Jan 01 04:36	CCoWS							
GAB-CRA	08 Jan 01 08:03	CCoWS	0.09	0.45	0.23	174.90	19.60	8.99	5.35
GAB-CRA	08 Jan 01 11:40	CCoWS		1.36	1.20	446.16	9.60	83.33	4.56
GAB-CRA	08 Jan 01 11:55	CCoWS							
GAB-CRA	08 Jan 01 11:59	CCoWS							
GAB-CRA	08 Jan 01 12:54	CCoWS		0.90	0.47	363.00	5.80	116.57	1.65
GAB-CRA	08 Jan 01 18:46	CCoWS		0.23	0.23	370.92	22.70	11.27	
GAB-CRA	09 Jan 01 16:17	CCoWS		0.23		378.84	28.80	20.29	7.80
GAB-CRA	10 Jan 01 11:52	CCoWS		0.45	0.05	362.34	19.00	20.66	4.69
GAB-CRA	10 Jan 01 12:11	CCoWS							
GAB-CRA	10 Jan 01 18:40	CCoWS	0.07	0.90	0.47	275.22	1.18	566.69	1.04
GAB-CRA	10 Jan 01 22:25	CCoWS	0.15	1.13	0.32	316.14	5.20	804.75	91.56
GAB-CRA	11 Jan 01 13:35	CCoWS	0.07	1.58	1.08	477.84	21.20	10.35	9.08
GAB-CRA	11 Jan 01 18:46	CCoWS		0.45	0.15	308.88	8.20	114.59	39.98
GAB-CRA	12 Jan 01 18:43	CCoWS		0.45	0.03	399.96	29.00	21.96	60.56
GAB-CRA	15 Jan 01 15:49	CCoWS	0.13			417.78	29.80	8.78	0.78
GAB-CRA	23 Jan 01 15:47	CCoWS		0.23		382.80	23.10	24.57	5.31
GAB-CRA	24 Jan 01 05:58	CCoWS	0.00	1.36	0.78	405.90	9.40	89.86	5.81
GAB-CRA	24 Jan 01 12:36	CCoWS		0.68	0.43	318.78	6.60	92.05	52.08
GAB-CRA	25 Jan 01 19:59	CCoWS	0.05	1.81	1.75	227.70	0.51	3406.97	415.62
GAB-CRA	25 Jan 01 20:07	CCoWS							

GAB-CRA	25 Jan 01 22:11	CCoWS				0.23	0.90	0.22	195.36	0.79	1454.41	789.44
GAB-CRA	26 Jan 01 01:41	CCoWS				0.27	0.68	0.15	293.70	3.80	291.14	26.17
GAB-CRA	26 Jan 01 01:52	CCoWS										
GAB-CRA	26 Jan 01 10:36	CCoWS				0.07	0.68		390.72	26.70	41.15	9.47
GAB-CRA	09 Feb 01 20:55	CCoWS				0.06	0.90	0.20	327.36	6.40	103.64	29.56
GAB-CRA	10 Feb 01 16:32	CCoWS					0.90	0.51	362.34	8.90	96.60	38.44
GAB-CRA	11 Feb 01 07:14	CCoWS				0.13	0.90	0.62	198.66	0.94	1830.43	131.45
GAB-CRA	11 Feb 01 08:54	CCoWS							231.00	1.57	427.55	31.83
GAB-CRA	12 Feb 01 08:18	CCoWS							293.04	2.23	219.38	77.34
GAB-CRA	18 Feb 01 16:00	CCoWS					0.45		409.86	23.20	5.58	16.00
GAB-CRA	19 Feb 01 06:53	CCoWS				0.07	0.90	0.74	174.24	0.62	1913.94	919.47
GAB-CRA	19 Feb 01 07:32	CCoWS										
GAB-CRA	19 Feb 01 14:27	CCoWS					0.68	0.35	328.02	11.20	266.61	
GAB-CRA	24 Apr 02 10:40	CCoWS				0.03	0.50	0.25				
GAB-CRA	04 Oct 00 10:00	UCSC	16.92	9.55	8.34							
GAB-CRA	25 Oct 00 10:00	UCSC	14.55	9.48	7.74							
GAB-CRA	07 Nov 00 10:00	UCSC	13.71	9.92	7.75							
GAB-CRA	22 Nov 00 10:00	UCSC	10.56	11.21	7.71							
GAB-CRA	05 Dec 00 10:00	UCSC	11.20	10.85	7.75							
GAB-CRA	19 Dec 00 10:00	UCSC	10.33	10.86	8.14							
GAB-CRA	04 Jan 01 10:00	UCSC	10.07	11.25	8.16							
GAB-CRA	16 Jan 01 10:00	UCSC	8.24	11.89	7.70							
GAB-CRA	30 Jan 01 10:00	UCSC	9.99	11.21	8.11							
GAB-CRA	13 Feb 01 10:00	UCSC	10.90	10.52	7.81							
GAB-CRA	27 Feb 01 10:00	UCSC	15.07	9.54	7.97							
GAB-CRA	13 Mar 01 10:00	UCSC	15.48	9.53	7.98							
GAB-CRA	24 Mar 01 10:00	UCSC										
GAB-CRA	10 Apr 01 10:00	UCSC	12.86	10.15	8.05							
GAB-CRA	08 May 01 10:00	UCSC	18.41	9.21	8.14							
GAB-CRA	22 May 01 10:00	UCSC	17.70	9.55	8.15							
GAB-CRA	05 Jun 01 10:00	UCSC	17.14	9.95	8.09							
GAB-CRA	19 Jun 01 10:00	UCSC	17.50	10.20	7.93							
GAB-CRA	02 Jul 01 10:00	UCSC	21.10	9.27	8.23							
GAB-CRA	18 Jul 01 10:00	UCSC	15.55	10.85	8.43							
GAB-CRA	01 Aug 01 10:00	UCSC	15.07	9.52	8.57							
GAB-CRA	20 Aug 01 10:00	UCSC	14.48	9.80	8.55							

GAB-CRA	04 Sep 01 10:00	UCSC	16.12	10.00	8.32
GAB-CRA	05 Oct 01 10:00	UCSC	17.30	10.10	8.36
GAB-CRA	23 Oct 01 10:00	UCSC	14.73	10.25	8.15
GAB-CRA	21 Nov 01 10:00	UCSC	14.66	9.02	8.63
GAB-CRA	04 Dec 01 10:00	UCSC	5.99	10.81	8.54
GAB-CRA	18 Dec 01 10:00	UCSC	10.97	10.85	8.61
GAB-CRA	03 Jan 02 10:00	UCSC	14.03	10.40	8.29
GAB-CRA	16 Jan 02 10:00	UCSC	6.75	13.28	8.65
GAB-CRA	30 Jan 02 10:00	UCSC	6.85	12.86	8.88
GAB-CRA	13 Feb 02 10:00	UCSC	11.86	12.95	9.18
GAB-CRA	28 Feb 02 10:00	UCSC	16.11	11.95	8.36
GAB-CRA	28 Mar 02 10:00	UCSC			
GAB-CRA	10 Apr 02 10:00	UCSC	17.35	9.95	8.25
GAB-CRA	25 Apr 02 10:00	UCSC	14.05	8.89	8.32
GAB-CRA	09 May 02 10:00	UCSC	16.01	9.31	8.43
GAB-CRA	23 May 02 10:00	UCSC	16.47	9.98	8.61
GAB-CRA	06 Jun 02 10:00	UCSC	16.16	9.42	8.39
GAB-CRA	19 Jun 02 10:00	UCSC			8.34
GAB-CRA	17 Jul 02 10:00	UCSC	16.50	11.36	8.37
GAB-CRA	31 Jul 02 10:00	UCSC	17.80	9.70	8.00
GAB-CRA	14 Aug 02 10:00	UCSC	17.20	9.55	8.17
GAB-CRA	27 Aug 02 10:00	UCSC	17.60	10.26	8.14
GAB-CRA	10 Sep 02 10:00	UCSC	17.80	10.37	7.94
GAB-CRA	25 Sep 02 10:00	UCSC	15.49	9.34	8.22
GAB-CRA	08 Oct 02 10:00	UCSC	15.69	8.71	8.27
GAB-CRA	22 Oct 02 10:00	UCSC	12.80	9.17	8.51
GAB-CRA	05 Nov 02 10:00	UCSC	11.17	9.92	8.56
GAB-CRA	19 Nov 02 10:00	UCSC	12.51	8.55	8.21
GAB-CRA	03 Dec 02 10:00	UCSC	10.21	9.55	8.40
GAB-CRA	17 Dec 02 10:00	UCSC	11.80	9.22	8.31
GAB-CRA	29 Dec 02 10:00	UCSC			
GAB-CRA	14 Jan 03 13:05	UCSC	13.43	10.81	8.21
GAB-CRA	28 Jan 03 14:25	UCSC	15.43	10.98	8.44
GAB-CRA	11 Feb 03 13:55	UCSC	11.74	10.18	9.69
GAB-CRA	20 May 03 13:25	UCSC	16.71	7.62	8.24
GAB-CRA	03 Jun 03 11:50	UCSC	14.46	8.14	8.43

GAB-CRA	17 Jun 03 12:00	UCSC	14.60	8.18	8.61		
GAB-CRA	01 Jul 03 13:10	UCSC	16.85	8.37	8.26		
GAB-CRA	15 Jul 03 12:50	UCSC	15.55	9.32	8.39		
GAB-CRA	29 Jul 03 13:15	UCSC	16.59	9.03	8.39		
GAB-CRA	12 Aug 03 00:10	UCSC	16.73	8.44	8.11		
GAB-CRA	26 Aug 03 13:30	UCSC	18.61	6.41	8.34		
GAB-CRA	04 Oct 00 10:00	UCSC				0.07	0.32
GAB-CRA	25 Oct 00 10:00	UCSC				1.53	0.47
GAB-CRA	07 Nov 00 10:00	UCSC				0.58	0.25
GAB-CRA	22 Nov 00 10:00	UCSC				0.28	0.16
GAB-CRA	06 Dec 00 10:00	UCSC				0.11	
GAB-CRA	19 Dec 00 10:00	UCSC				0.25	0.10
GAB-CRA	04 Jan 01 10:00	UCSC				0.27	0.11
GAB-CRA	16 Jan 01 10:00	UCSC				0.48	0.13
GAB-CRA	30 Jan 01 10:00	UCSC				0.76	0.10
GAB-CRA	13 Feb 01 10:00	UCSC				0.78	0.02
GAB-CRA	27 Feb 01 10:00	UCSC				0.59	0.08
GAB-CRA	13 Mar 01 10:00	UCSC				0.63	0.13
GAB-CRA	24 Mar 01 10:00	UCSC				0.57	0.12
GAB-CRA	10 Apr 01 10:00	UCSC				0.38	0.01
GAB-CRA	24 Apr 01 10:00	UCSC				0.11	0.41
GAB-CRA	08 May 01 10:00	UCSC				0.23	0.78
GAB-CRA	22 May 01 10:00	UCSC				0.16	0.08
GAB-CRA	05 Jun 01 10:00	UCSC				0.99	0.29
GAB-CRA	19 Jun 01 10:00	UCSC				2.67	0.17
GAB-CRA	02 Jul 01 10:00	UCSC				2.35	0.59
GAB-CRA	18 Jul 01 10:00	UCSC				0.59	0.23
GAB-CRA	01 Aug 01 10:00	UCSC				0.26	0.19
GAB-CRA	20 Aug 01 10:00	UCSC				0.30	0.25
GAB-CRA	04 Sep 01 10:00	UCSC				3.85	0.39
GAB-CRA	20 Sep 01 10:00	UCSC				0.32	0.24
GAB-CRA	05 Oct 01 10:00	UCSC				0.33	0.02
GAB-CRA	23 Oct 01 10:00	UCSC				1.09	0.03
GAB-CRA	07 Nov 01 10:00	UCSC					
GAB-CRA	21 Nov 01 10:00	UCSC				1.89	0.22
GAB-CRA	04 Dec 01 10:00	UCSC				1.66	0.14

GAB-CRA	18 Dec 01 10:00	UCSC	0.97	0.07
GAB-CRA	03 Jan 02 10:00	UCSC	1.66	0.13
GAB-CRA	16 Jan 02 10:00	UCSC	0.79	0.03
GAB-CRA	30 Jan 02 10:00	UCSC	1.12	0.11
GAB-CRA	13 Feb 02 10:00	UCSC	0.36	0.05
GAB-CRA	28 Feb 02 10:00	UCSC	0.28	0.03
GAB-CRA	14 Mar 02 10:00	UCSC		
GAB-CRA	28 Mar 02 10:00	UCSC	0.16	0.05
GAB-CRA	10 Apr 02 10:00	UCSC	0.15	0.03
GAB-CRA	25 Apr 02 10:00	UCSC	0.50	0.09
GAB-CRA	09 May 02 10:00	UCSC	0.92	0.17
GAB-CRA	23 May 02 10:00	UCSC	0.06	0.13
GAB-CRA	06 Jun 02 10:00	UCSC	2.26	0.20
GAB-CRA	19 Jun 02 10:00	UCSC	0.84	0.62
GAB-CRA	17 Jul 02 10:00	UCSC	0.12	0.78
GAB-CRA	31 Jul 02 10:00	UCSC	0.46	0.26
GAB-CRA	14 Aug 02 10:00	UCSC	0.15	0.31
GAB-CRA	27 Aug 02 10:00	UCSC	1.20	0.02
GAB-CRA	10 Sep 02 10:00	UCSC	2.36	0.12
GAB-CRA	25 Sep 02 10:00	UCSC	0.08	0.19
GAB-CRA	08 Oct 02 10:00	UCSC	2.45	0.23
GAB-CRA	22 Oct 02 10:00	UCSC	0.06	0.08
GAB-CRA	05 Nov 02 10:00	UCSC	0.03	0.24
GAB-CRA	19 Nov 02 12:03	UCSC	6.05	0.46
GAB-CRA	03 Dec 02 12:22	UCSC	0.11	0.20
GAB-CRA	17 Dec 02 13:35	UCSC	1.00	0.26
GAB-CRA	14 Jan 03 13:05	UCSC	0.76	0.12
GAB-CRA	28 Jan 03 14:25	UCSC	0.62	0.08
GAB-CRA	11 Feb 03 13:55	UCSC	0.66	0.04
GAB-CRA	11 Feb 03 13:55	UCSC	0.65	0.03
GAB-CRA	25 Feb 03 12:35	UCSC	0.58	0.07
GAB-CRA	11 Mar 03 13:20	UCSC	0.71	0.08
GAB-CRA	25 Mar 03 13:35	UCSC	0.65	0.27
GAB-CRA	08 Apr 03 13:30	UCSC	0.37	0.19
GAB-CRA	22 Apr 03 13:00	UCSC	0.18	1.28
GAB-CRA	06 May 03 12:50	UCSC	0.08	0.15

GAB-CRA	20 May 03 13:25	UCSC						0.08	0.33									
GAB-CRA	03 Jun 03 11:50	UCSC						4.88	0.30									
GAB-CRA	17 Jun 03 12:00	UCSC						0.04	0.53									
GAB-CRA	01 Jul 03 13:10	UCSC						0.07	0.41									
GAB-CRA	15 Jul 03 12:50	UCSC						0.09	0.43									
GAB-CRA	29 Jul 03 13:15	UCSC						0.21	0.40									
GAB-CRA	12 Aug 03 10:00	UCSC						26.70	0.37									
GAB-CRA	26 Aug 03 10:00	UCSC						0.94	1.03									
GAB-CRA	08 Sep 03 10:00	UCSC						0.12	0.99									
GAB-CRA	23 Sep 03 10:00	UCSC						0.02	0.92									
GAB-CRA	07 Oct 03 10:00	UCSC						0.25	0.49									
GAB-CRA	21 Oct 03 10:00	UCSC						0.02	0.66									
GAB-CRA	18 Nov 03 10:00	UCSC						4.66	1.39									
GAB-CRA	02 Dec 03 10:00	UCSC						1.50	0.31									
GAB-CRA	16 Dec 03 10:00	UCSC						0.42	0.26									
GAB-CRA	May-00	City of Salinas	15.00	9.20		8.70	0 (ND)	0.20	0.05	398.00		2.00	0.00		1100.00	500.00		
GAB-CRA	Dec-00	City of Salinas	11.30	10.00		7.90	0 (ND)	0.20	0.19	407.00		2.00	0.00		500.00	80.00		
GAB-CRA	Apr-01	City of Salinas	12.10	9.90		7.90	0 (ND)	2.50	0.00	415.00		1.00	0.00		5000.00	20.00		
GAB-CRA	Nov-01	City of Salinas	12.40	10.30		8.40	0 (ND)	0.20	0.27	450.00		5.00	0.00		5000.00	1700.00		
GAB-CRA	Jun-02	City of Salinas	17.10	6.50		8.20	0 (ND)	0.00	0.55	464.00		675.00	6.00		2200.00	800.00		
GAB-CRA	Jan-03	City of Salinas	11.00	10.80		7.90	0 (ND)	0.20	0.15	440.00		3.00	0.00		1700.00	140.00		
GAB-CRA	Jun-03	City of Salinas	13.80	9.60		8.10	0.07	0.40	0.89			32.00	38.00		16000.00	700.00		
GAB-CRA	22 Jun 04 10:56	CCoWS	14.97	8.98	0.39	7.15												
min			5.99	6.41	0.39	7.15	0.00	0.00	0.00	174.24	0.49	1.00	0.00	0.00	500.00	20.00		
max			21.10	13.28	0.39	9.69	0.43	26.70	1.75	477.84	60.00	675.00	16032.93	56546.66	16000.00	1700.00		
mean			14.22	9.89	0.39	8.26	0.09	1.00	0.32	351.68	15.31	102.86	716.08	1933.95	4500.00	562.86		
median			14.85	9.91	0.39	8.26	0.07	0.57	0.22	381.15	13.60	3.00	51.03	31.83	2200.00	500.00		
Total # Samples			**68**	**68**	**1**	**69**	**31**	**123**	**116**	**51**	**45**	**7**	**55**	**35**	**7**	**7**	**0**	**0**
GAB-HER	14 Feb 01 15:20	CCoWS																
GAB-HER	06 Mar 00 10:15	CCoWS																
GAB-HER	13 Apr 00 17:22	CCoWS								375.54	25.50		137.86	213.25				
GAB-HER	14 Apr 00 09:00	CCoWS								361.35	22.50		252.49	210.84				
GAB-HER	14 Apr 00 09:14	CCoWS									42.20							
GAB-HER	14 Apr 00 10:45	CCoWS																

GAB-HER	16 Apr 00 23:07	CCoWS				372.24	42.20	36.41	
GAB-HER	17 Apr 00 02:47	CCoWS				358.38	27.80	81.55	
GAB-HER	17 Apr 00 14:25	CCoWS				362.34	4.50	456.28	132.90
GAB-HER	17 Apr 00 22:49	CCoWS				367.62		166.43	336.39
GAB-HER	18 Apr 00 14:19	CCoWS						78.41	245.38
GAB-HER	03 Jul 00 16:00	CCoWS							
GAB-HER	29 Oct 00 01:48	CCoWS				262.68	1.16	3607.86	24.83
GAB-HER	29 Oct 00 11:15	CCoWS	0.13	1.41	0.62	279.18	0.21	8921.21	2.07
GAB-HER	04 Nov 00 12:55	CCoWS				415.80	60.00	8.97	
GAB-HER	07 Jan 01 03:28	CCoWS							
GAB-HER	10 Jan 01 11:35	CCoWS	0.18	9.49	0.06	244.20	0.66	1904.26	
GAB-HER	10 Jan 01 11:42	CCoWS							
GAB-HER	10 Jan 01 17:37	CCoWS	0.15	11.07	0.25	270.60	0.91	789.86	
GAB-HER	10 Jan 01 19:06	CCoWS	0.10	2.03	0.64	265.32	0.61	1864.83	
GAB-HER	10 Jan 01 21:45	CCoWS		2.48	0.39	254.10	1.08	623.77	
GAB-HER	11 Jan 01 18:10	CCoWS	0.10	2.26	0.43	351.12	0.67	1230.43	0.00
GAB-HER	11 Jan 01 18:13	CCoWS							
GAB-HER	24 Jan 01 05:05	CCoWS							
GAB-HER	24 Jan 01 06:16	CCoWS							
GAB-HER	24 Jan 01 11:50	CCoWS							
GAB-HER	25 Jan 01 20:17	CCoWS		2.26	1.38	231.66	0.21	10067.24	0.00
GAB-HER	25 Jan 01 20:23	CCoWS							
GAB-HER	25 Jan 01 22:37	CCoWS	0.24	1.13	0.26	182.82	0.60	2352.53	
GAB-HER	25 Jan 01 22:56	CCoWS							0.00
GAB-HER	26 Jan 01 01:20	CCoWS	0.25	2.48	0.23	225.06	1.41	814.65	0.00
GAB-HER	26 Jan 01 10:33	CCoWS							
GAB-HER	09 Feb 01 20:11	CCoWS	0.10	1.13	0.66	283.80	2.10	631.90	
GAB-HER	10 Feb 01 15:51	CCoWS	0.06	8.58	1.31	346.50	1.01	778.29	0.00
GAB-HER	10 Feb 01 15:58	CCoWS							
GAB-HER	11 Feb 01 06:07	CCoWS	0.06	4.07	0.48	238.26	0.37	5156.03	0.00
GAB-HER	11 Feb 01 07:30	CCoWS				213.18	0.49	3702.22	
GAB-HER	11 Feb 01 08:40	CCoWS		1.58	0.57	194.70	0.47	1600.62	
GAB-HER	12 Feb 01 06:28	CCoWS				188.76	1.80	596.36	
GAB-HER	12 Feb 01 08:30	CCoWS				226.38	0.72	1544.43	
GAB-HER	19 Feb 01 06:40	CCoWS	0.14	2.26	0.82	199.32	0.34	1975.51	0.00
GAB-HER	19 Feb 01 07:36	CCoWS				180.18	0.39	2294.86	

GAB-HER	19 Feb 01 14:19	CCoWS					0.05	5.65	0.80				2.47					
GAB-HER	24 Apr 02 11:15	CCoWS					0.12	1.81	0.70									
GAB-HER	11 Jan 01 14:00	UCSC						10.02	0.21									
GAB-HER	05 Mar 01 10:00	UCSC						2.70	0.39									
GAB-HER	21 Apr 01 10:00	UCSC						3.61	0.41									
GAB-HER	03 Jan 02 10:00	UCSC						3.65	0.46									
min							0.05	1.13	0.06	180.18	0.21		2.47	0.00				
max							0.25	11.07	1.38	415.80	60.00		10067.24	336.39				
mean							0.13	3.98	0.55	278.89	9.23		1845.63	83.26				
median							0.12	2.48	0.47	264.00	0.96		802.25	1.04				
Total # Samples			**0**	**0**	**0**	**0**	**13**	**20**	**20**	**26**	**26**	**0**	**28**	**14**	**0**	**0**	**0**	**0**
GAB-NAT	14 Apr 00 08:38	CCoWS								309.54	10.00		224.86					
GAB-NAT	14 Apr 00 08:39	CCoWS								308.22	12.80		177.16	0.63				
GAB-NAT	14 Apr 00 10:57	CCoWS																
GAB-NAT	16 Apr 00 23:15	CCoWS																
GAB-NAT	17 Apr 00 02:35	CCoWS								267.96	9.60		132.52					
GAB-NAT	17 Apr 00 14:04	CCoWS								370.26	4.40		596.44	206.38				
GAB-NAT	17 Apr 00 22:31	CCoWS								363.66			221.26	73.57				
GAB-NAT	18 Apr 00 14:23	CCoWS											45.58					
GAB-NAT	25 Jan 01 20:37	CCoWS					0.10	3.61	0.86	97.68	0.24		6714.61	45.86				
GAB-NAT	26 Jan 01 10:29	CCoWS																
GAB-NAT	09 Feb 01 20:05	CCoWS																
GAB-NAT	10 Feb 01 15:36	CCoWS					0.15	6.10	0.59	139.92	6.80		92.75	0.72				
GAB-NAT	11 Feb 01 05:19	CCoWS						4.74	0.83	130.02	1.28		5681.63					
GAB-NAT	11 Feb 01 05:37	CCoWS												150.44				
GAB-NAT	11 Feb 01 07:39	CCoWS								180.18	0.24		5884.20	99.42				
GAB-NAT	11 Feb 01 08:28	CCoWS					0.06	3.84	0.71	188.10	0.32		4210.96	482.41				
GAB-NAT	11 Feb 01 12:00	CCoWS								216.48	0.74		1102.46	18.47				
GAB-NAT	12 Feb 01 06:35	CCoWS								79.86	1.32		565.80					
GAB-NAT	12 Feb 01 08:38	CCoWS								109.56	0.63		979.33	29.65				
GAB-NAT	12 Feb 01 08:55	CCoWS																
GAB-NAT	13 Feb 01 16:50	CCoWS																
GAB-NAT	19 Feb 01 06:29	CCoWS					0.14	2.94	0.84	98.34	0.25		6423.76	703.04				
GAB-NAT	19 Feb 01 06:32	CCoWS																

GAB-NAT	19 Feb 01 08:07	CCoWS								156.42	0.25		6812.79	162.27				
GAB-NAT	19 Feb 01 14:13	CCoWS																
min							0.06	2.94	0.59	79.86	0.24		45.58	0.63				
max							0.15	6.10	0.86	370.26	12.80		6812.79	703.04				
mean							0.11	4.25	0.77	201.08	3.49		2491.63	164.41				
median							0.12	3.84	0.83	180.18	1.01		787.88	86.50				
Total # Samples			**0**	**0**	**0**	**0**	**4**	**5**	**5**	**15**	**14**	**0**	**16**	**12**	**0**	**0**	**0**	**0**
GAB-BOR	01 Feb 99 11:45	CCAMP	12.20	10.93			0.07	0.63	0.10				299.00		1100.00	700.00		
GAB-BOR	01 Mar 99 12:10	CCAMP	17.70	9.16		8.29	0.02	0.85	0.08				100.00		1600.00	1600.00		
GAB-BOR	05 Apr 99 12:00	CCAMP	11.70	10.55		8.13	0.00	0.94	0.08				92.00		5000.00	1600.00		
GAB-BOR	10 May 99 11:45	CCAMP	22.60	7.75		8.07	0.24	10.79	0.66				2010.00		5000.00	2200.00		
GAB-BOR	07 Jul 99 04:40	CCAMP	13.20	14.38														
GAB-BOR	07 Jul 99 09:55	CCAMP	20.20	11.25		8.08	0.12	10.56	0.56				1160.00		9000.00	900.00		
GAB-BOR	26 Jul 99 05:40	CCAMP																
GAB-BOR	26 Jul 99 10:25	CCAMP																
GAB-BOR	27 Jul 99 13:50	CCAMP																
GAB-BOR	31 Aug 99 10:30	CCAMP																
GAB-BOR	28 Sep 99 10:55	CCAMP																
GAB-BOR	02 Nov 99 09:45	CCAMP																
GAB-BOR	09 Nov 99 10:20	CCAMP																
GAB-BOR	30 Nov 99 12:00	CCAMP																
GAB-BOR	26 Jan 00 12:20	CCAMP																
GAB-BOR	10 Feb 00 14:00	CCAMP	14.65	9.15	1.70	7.98	0.41	2.40	0.64	260.00			1960.00		160000.00	17000.00		
GAB-BOR	08 Mar 00 17:15	CCoWS									10.80		2.77	35.97				
GAB-BOR	13 Apr 00 00:00	CCoWS																
GAB-BOR	14 Apr 00 00:00	CCoWS																
GAB-BOR	15 Apr 00 00:00	CCoWS																
GAB-BOR	16 Apr 00 00:00	CCoWS																
GAB-BOR	17 Apr 00 02:30	CCoWS																
GAB-BOR	17 Apr 00 13:08	CCoWS								424.38	1.80		1006.78	61.49				
GAB-BOR	17 Apr 00 22:22	CCoWS								403.26			417.01					
GAB-BOR	18 Apr 00 14:29	CCoWS																
GAB-BOR	12 Feb 01 11:10	CCoWS								133.98	0.29		5667.02					
GAB-BOR	12 Feb 01 11:13	CCoWS								131.34	0.24		4399.55					

GAB-BOR	12 Feb 01 11:14	CCoWS																
GAB-BOR	12 Feb 01 11:16	CCoWS																
GAB-BOR	12 Feb 01 11:19	CCoWS								132.00	0.35		3303.74					
GAB-BOR	12 Feb 01 11:22	CCoWS																
GAB-BOR	12 Feb 01 11:24	CCoWS																
GAB-BOR	12 Feb 01 11:25	CCoWS																
GAB-BOR	12 Feb 01 11:26	CCoWS																
GAB-BOR	12 Feb 01 11:27	CCoWS					0.18	5.42	1.01									
GAB-BOR	12 Feb 01 11:35	CCoWS								138.60	0.38		2951.01	13.91				
GAB-BOR	12 Feb 01 11:41	CCoWS																
GAB-BOR	12 Feb 01 11:45	CCoWS												6.70				
GAB-BOR	12 Feb 01 11:53	CCoWS								135.30	0.45		2710.39					
GAB-BOR	19 Feb 01 07:46	CCoWS								108.90	0.24		5960.04	0.00				
GAB-BOR	19 Feb 01 07:54	CCoWS																
GAB-BOR	Feb-01	CCoWS																
GAB-BOR	May-00	City of Salinas	18.30	6.50		7.40	0.05	14.00	0.26	532.00		1.00	0 (ND)		1600.00	500.00		
GAB-BOR	Dec-00	City of Salinas	14.30	2.10		6.60	0 (ND)	27.70	0.33	461.00		1.00	0 (ND)		3000.00	20.00		
GAB-BOR	Apr-01	City of Salinas	17.40	5.20		7.30	0.22	17.10	5.20	546.00		2100.00	1080.00		16000.00	800.00		
GAB-BOR	Nov-01	City of Salinas	16.20	2.80		7.90	0.45	16.00	0.58	551.00		408.00	483.00		9000.00	8000.00		
GAB-BOR	Jun-02	City of Salinas	26.20	7.50		7.80	0.33	16.20	2.31	670.00		1075.00	2060.00		16000.00	800.00		
GAB-BOR	Jan-03	City of Salinas	NO FLOW															
GAB-BOR	Jun-03	City of Salinas	15.50	7.00		8.10	0.14	16.50	1.10	535.00		200.00	2390.00		16000.00	2400.00		
min			11.70	2.10	1.70	6.60	0.00	0.63	0.08	165.00	0.24	1.00	0.00	0.00	1100.00	20.00		
max			26.20	14.38	1.70	8.29	0.45	27.70	5.20	670.00	10.80	2100.00	5960.04	61.49	160000.00	17000.00		
mean			17.30	7.65	1.70	7.74	0.21	12.51	1.16	399.40	1.82	630.83	2214.90	23.61	24060.00	3422.00		
median			16.20	7.75	1.70	7.98	0.16	10.79	0.58	461.00	0.37	304.00	1960.00	13.91	7000.00	1250.00		
Total # Samples			**13**	**13**	**1**	**11**	**13**	**13**	**13**	**15**	**8**	**6**	**21**	**5**	**12**	**12**	**0**	**0**
GAB-PRO	May-00	City of Salinas	21.00	8.00		8.20	0 (ND)	23.90	0.22	633.00		7.00	11.00		1600.00	1600.00		
min			21.00	8.00		8.20	0.00	23.90	0.22	633.00		7.00	11.00		1600.00	1600.00		
max			21.00	8.00		8.20	0.00	23.90	0.22	633.00		7.00	11.00		1600.00	1600.00		
mean			21.00	8.00		8.20		23.90	0.22	633.00		7.00	11.00		1600.00	1600.00		
median			21.00	8.00		8.20		23.90	0.22	633.00		7.00	11.00		1600.00	1600.00		
Total # Samples			**1**	**1**	**0**	**1**	**1**	**1**	**1**	**1**	**0**	**1**	**1**	**0**	**1**	**1**	**0**	**0**

GAB-LEX	May-00	City of Salinas	19.50	10.50		7.30	0 (ND)	8.60	0.08	114.00		1.00	0 (ND)		1600.00	500.00		
GAB-LEX	Dec-00	City of Salinas	17.10	7.70		7.40	0 (ND)	29.30	0.24	145.00		0.00	5.00		500.00	20.00		
GAB-LEX	Apr-01	City of Salinas	16.40	5.40		7.20	0.06	29.50	0.06	237.00		1.00	0 (ND)		3000.00	20.00		
GAB-LEX	Nov-01	City of Salinas	18.40	9.40		8.20	0.12	22.50	0.10	182.00		16.00	41.00		16000.00	340.00		
GAB-LEX	Jun-02	City of Salinas	20.80	7.90		7.70	0.13	21.80	0.09	158.00		1084.00	0 (ND)		9000.00	20.00		
GAB-LEX	Jan-03	City of Salinas	18.00	8.80		6.00	0.40	37.10	0.14	133.00		1.00	18.00		700.00	20.00		
GAB-LEX	Jun-03	City of Salinas	19.10	10.40		8.10	0.06	21.40	0.09	9.00		1.00	0 (ND)		16000.00	80.00		
min			16.40	5.40		6.00	0.00	8.60	0.06	9.00		0.00	0.00		500.00	20.00		
max			20.80	10.50		8.20	0.40	37.10	0.24	237.00		1084.00	41.00		16000.00	500.00		
mean			18.47	8.59		7.41	0.11	24.31	0.11	139.71		157.71	21.33		6685.71	142.86		
median			18.40	8.80		7.40	0.06	22.50	0.09	145.00		1.00	18.00		3000.00	20.00		
Total # Samples			**7**	**7**	**0**	**7**	**7**	**7**	**7**	**7**	**0**	**7**	**7**	**0**	**7**	**7**	**0**	**0**
GAB-CON	May-00	City of Salinas	21.50	9.40		7.30	0 (ND)	27.90	0.07	191.00		0.00	0 (ND)		188.00	188.00		
GAB-CON	Dec-00	City of Salinas	15.10	8.60		7.56	0 (ND)	29.90	0.25	178.00		0.00	0 (ND)		3500.00	80.00		
GAB-CON	Apr-01	City of Salinas	16.50	3.80		7.60	0 (ND)	28.40	0.07	222.00		0.00	0 (ND)		2200.00	20.00		
GAB-CON	Nov-01	City of Salinas	18.00	9.50		8.20	0.08	27.50	0.14	204.00		6.00	16.00		3000.00	1300.00		
GAB-CON	Jun-02	City of Salinas	22.80	7.20		8.00	0.07	25.90	0.06	237.00		1200.00	0 (ND)		16000.00	20.00		
GAB-CON	Jan-03	City of Salinas	17.50	9.40		6.70	0.18	31.00	0.12	159.00		2.00	113.00		1300.00	130.00		
GAB-CON	Jun-03	City of Salinas	17.80	7.40		9.30	0 (ND)	28.80	0.12	105.00		1.00	22.00		16000.00	210.00		
min			15.10	3.80		6.70	0.00	25.90	0.06	105.00		0.00	0.00		188.00	20.00		
max			22.80	9.50		9.30	0.18	31.00	0.25	237.00		1200.00	113.00		16000.00	1300.00		
mean			18.46	7.90		7.81	0.05	28.49	0.12	185.14		172.71	50.33		6026.86	278.29		
median			17.80	8.60		7.60	0.00	28.40	0.12	191.00		1.00	22.00		3000.00	130.00		
Total # Samples			**7**	**7**	**0**	**7**	**7**	**7**	**7**	**0**	**0**	**7**	**7**	**0**	**7**	**7**	**0**	**0**
GAB-VET	17 Apr 00 01:18	CCoWS								710.82	58.00		10.19					
GAB-VET	17 Apr 00 13:35	CCoWS								569.58	4.10		407.75	123.34				
GAB-VET	17 Apr 00 21:39	CCoWS								638.88				92.12				
GAB-VET	17 Apr 00 21:57	CCoWS								641.52			75.11					
GAB-VET	18 Apr 00 14:35	CCoWS											21.44					
GAB-VET	11 Jan 01 12:10	CCoWS					0.07	8.81	0.00	277.20	6.60		66.52	0.00				
GAB-VET	11 Jan 01 12:38	CCoWS																

GAB-VET	11 Jan 01 17:35	CCoWS						9.94	0.05	319.44	27.20		16.65			
GAB-VET	11 Jan 01 17:48	CCoWS														
GAB-VET	12 Jan 01 17:26	CCoWS					0.08	0.68		656.70	26.60		2.43			
GAB-VET	15 Jan 01 14:21	CCoWS					0.08	20.56					0.00			
GAB-VET	23 Jan 01 16:23	CCoWS					0.49	25.07		670.56	24.40		38.76			
GAB-VET	24 Jan 01 06:32	CCoWS						18.75		484.44	28.60		40.85			
GAB-VET	24 Jan 01 06:46	CCoWS														
GAB-VET	25 Jan 01 23:25	CCoWS					0.10	2.03	0.29	125.40	8.60		147.21	0.00		
GAB-VET	25 Jan 01 23:35	CCoWS														
GAB-VET	26 Jan 01 10:09	CCoWS						10.39	0.05	368.94	25.00		7.78			
GAB-VET	09 Feb 01 19:37	CCoWS					0.12	4.29	0.17	186.12	26.20		52.05			
GAB-VET	10 Feb 01 17:01	CCoWS					0.07	9.71		358.38	25.90		5.02			
GAB-VET	11 Feb 01 07:57	CCoWS					0.12	1.81	0.24	112.20	8.70		94.34	6.45		
GAB-VET	11 Feb 01 08:09	CCoWS														
GAB-VET	11 Feb 01 08:15	CCoWS														
GAB-VET	12 Feb 01 06:50	CCoWS								523.38	20.80		24.97			
GAB-VET	12 Feb 01 12:09	CCoWS					0.10	4.07	0.22	163.68	6.00		49.58			
GAB-VET	12 Feb 01 12:24	CCoWS					0.10	3.84	0.24	155.10	7.40		69.62	0.00		
GAB-VET	12 Feb 01 12:41	CCoWS														
GAB-VET	13 Feb 01 16:30	CCoWS								703.56	22.90		3.21	0.00		
GAB-VET	18 Feb 01 16:25	CCoWS						24.40		704.22	23.00		36.60			
GAB-VET	19 Feb 01 06:08	CCoWS					0.13	19.43		548.46	29.40		52.89	73.30		
GAB-VET	19 Feb 01 08:25	CCoWS								133.00	9.50		38.16	0.00		
GAB-VET	19 Feb 01 13:52	CCoWS					0.08	6.10	0.94	188.10	0.59		857.65			
GAB-VET	May-02	CCoWS						24.89	0.07							
GAB-VET	May-00	City of Salinas	22.30	10.40		7.60	0 (ND)	27.90	0.07	156.00		0.00	0 (ND)		188.00	188.00
GAB-VET	Dec-00	City of Salinas	11.70	8.00		7.42	0 (ND)	27.70	0.22	182.00		1.00	0 (ND)		2800.00	20.00
GAB-VET	Apr-01	City of Salinas	15.10	6.30		7.60	0 (ND)	26.30	0.12	214.00		2.00	107.00		9000.00	20.00
GAB-VET	Nov-01	City of Salinas	15.40	8.40		8.30	0.05	0.20	0.15	184.00		30.00	55.00		16000.00	300.00
GAB-VET	Jun-02	City of Salinas	18.40	6.20		7.30	0.53	21.80	0.16	213.00		1190.00	64.00		5000.00	110.00
GAB-VET	Jan-03	City of Salinas	18.50	9.00		7.40	0.07	30.60	0.15	171.00		4.00	0 (ND)		9000.00	170.00
GAB-VET	Jun-03	City of Salinas	16.30	7.20		8.20	0 (ND)	26.50	0.10	108.00		8.00	8.00		16000.00	40.00
GAB-VET	22 Jun 04 09:24	CCoWS	16.08	4.64	0.68	6.22										
min			11.70	4.64		6.22	0.00	0.20	0.00	108.00	0.59	0.00	0.00	0.00	188.00	20.00
max			22.30	10.40		8.30	0.53	30.60	0.94	710.82	58.00	1190.00	857.65	123.34	16000.00	300.00

mean			16.72	7.52		7.51	0.12	14.82	0.19	360.95	19.47	176.43	87.14	32.80	8284.00	121.14		
median			16.19	7.60		7.51	0.08	14.57	0.15	277.20	22.95	4.00	40.85	0.00	9000.00	110.00		
Total # Samples			**8**	**8**	**1**	**8**	**19**	**24**	**17**	**29**	**20**	**7**	**30**	**9**	**7**	**7**	**0**	**0**
SRC-RUS	May-00	City of Salinas	17.00	9.80		8.40	0.17	6.10	0.64	430.00		9.00	9.00		1600.00	1600.00		
SRC-RUS	Dec-00	City of Salinas	14.00	10.20		7.40	0.08	0.50	0.50	222.00		73.00	125.00		16000.00	9000.00		
SRC-RUS	Apr-00	City of Salinas	14.20	9.80		7.90	0.07	3.60	0.26	377.00		32.00	27.00		16000.00	9000.00		
SRC-RUS	Nov-01	City of Salinas	16.10	8.50		7.80	0.26	2.90	0.65	859.00		790.00	314.00		16000.00	16000.00		
SRC-RUS	Jun-02	City of Salinas	23.10	8.40		8.70	0.08	9.00	0.41	526.00		816.00	16.00		16000.00	1400.00		
SRC-RUS	Jan-03	City of Salinas	12.00	8.20		7.60	0.30	3.80	0.29	688.00		20.00	60.00		16000.00	3000.00		
SRC-RUS	Jun-03	City of Salinas	27.50	18.50		8.40	0.15	16.20	0.57	687.00		80.00	155.00		9000.00	20.00		
SRC-RUS	30 Jun 04 09:37	CCoWS	17.91	4.55	0.35	7.71												
min			12.00	4.55		7.40	0.07	0.50	0.26	222.00		9.00	9.00		1600.00	20.00		
max			27.50	18.50		8.70	0.30	16.20	0.65	859.00		816.00	314.00		16000.00	16000.00		
mean			17.73	9.74		7.99	0.16	6.01	0.47	541.29		260.00	100.86		12942.86	5717.14		
median			16.55	9.15		7.85	0.15	3.80	0.50	526.00		73.00	60.00		16000.00	3000.00		
Total # Samples			**8**	**8**	**1**	**8**	**7**	**7**	**7**	**7**	**0**	**7**	**7**	**0**	**7**	**7**	**0**	**0**
SRC-VAN	May-00	City of Salinas	17.50	8.00		8.30	0.10	6.50	0.61	467.00		14.00	8.00		1600.00	500.00		
SRC-VAN	Dec-00	City of Salinas	12.90	9.10		7.40	0 (ND)	0.20	0.59	275.00		65.00	48.00		16000.00	3000.00		
SRC-VAN	Apr-01	City of Salinas	15.10	10.80		8.10	0.06	3.80	0.39	395.00		87.00	62.00		16000.00	9000.00		
SRC-VAN	Nov-01	City of Salinas	17.30	9.10		7.80	0.19	3.60	0.73	862.00		880.00	388.00		16000.00	16000.00		
SRC-VAN	Jun-02	City of Salinas	27.70	6.30		8.70	0.09	10.80	0.71	600.00		913.00	108.00		16000.00	1700.00		
SRC-VAN	Jan-03	City of Salinas	12.50	8.60		7.60	3.10	5.40	0.98	563.00		110.00	846.00		16000.00	16000.00		
SRC-VAN	Jun-03	City of Salinas	25.10	4.50		7.40	0.12	2.70	0.53	510.00		90.00	54.00		16000.00	20.00		
SRC-VAN	29-Jun-04	CCoWS	21.1	9.55	0.42	7.9												
min			12.50	4.50	0.42	7.40	0.00	0.20	0.39	275.00		14.00	8.00		1600.00	20.00		
max			27.70	10.80	0.42	8.70	3.10	10.80	0.98	862.00		913.00	846.00		16000.00	16000.00		
mean			18.65	8.24	0.42	7.90	0.52	4.71	0.65	524.57		308.43	216.29		13942.86	6602.86		
median			17.40	8.85	0.42	7.85	0.10	3.80	0.61	510.00		90.00	62.00		16000.00	3000.00		
Total # Samples			**8**	**8**	**1**	**8**	**7**	**7**	**7**	**7**	**0**	**7**	**7**	**0**	**7**	**7**	**0**	**0**
SRC-RIT	May-00	City of Salinas	17.50	12.00		8.30	0.09	7.40	0.63	458.00		13.00	7.00		1600.00	300.00		
SRC-RIT	Dec-00	City of Salinas	14.10	11.40		8.40	0 (ND)	0 (ND)	0.62	266.00		57.00	21.00		16000.00	9000.00		

SRC-RIT	Apr-01	City of Salinas	15.50	9.10		8.20	0 (ND)	3.40	0.38	400.00		55.00	32.00		16000.00	9000.00		
SRC-RIT	Nov-01	City of Salinas	17.20	8.80		7.80	0.18	3.60	0.75	924.00		890.00	360.00		16000.00	16000.00		
SRC-RIT	Jun-02	City of Salinas	25.80	6.90		8.00	0.12	10.40	0.64	614.00		952.00	36.00		16000.00	1100.00		
SRC-RIT	Jan-03	City of Salinas	9.50	9.00		7.30	1.40	4.90	0.82	500.00		270.00	225.00		16000.00	16000.00		
SRC-RIT	Jun-03	City of Salinas	26.60	6.30		7.60	0.11	2.00	0.64	525.00		225.00	151.00		16000.00	20.00		
min			9.50	6.30		7.30	0.00	0.00	0.38	266.00		13.00	7.00		1600.00	20.00		
max			26.60	12.00		8.40	1.40	10.40	0.82	924.00		952.00	360.00		16000.00	16000.00		
mean			18.03	9.07		7.94	0.27	4.53	0.64	526.71		351.71	118.86		13942.86	7345.71		
median			17.20	9.00		8.00	0.11	3.60	0.64	500.00		225.00	36.00		16000.00	9000.00		
Total # Samples			**7**	**7**	**0**	**7**	**7**	**7**	**7**	**7**	**0**	**7**	**7**	**0**	**7**	**7**	**0**	**0**
SRC-CAS	May-00	City of Salinas	17.00	12.50		8.60	0.08	8.60	0.63	485.00		12.00	8.00		240.00	240.00		
SRC-CAS	Dec-00	City of Salinas	13.80	13.40		9.30	0 (ND)	0 (ND)	0.54	233.00		49.00	22.00		16000.00	9000.00		
SRC-CAS	Apr-01	City of Salinas	19.00	18.40		9.50	0.16	2.00	0.75	397.00		61.00	150.00		16000.00	16000.00		
SRC-CAS	Nov-01	City of Salinas	17.90	9.20		8.00	0.16	3.60	0.72	878.00		860.00	385.00		16000.00	16000.00		
SRC-CAS	Jun-02	City of Salinas	29.80	7.10		9.80	0.12	10.60	0.40	559.00		855.00	66.00		16000.00	1300.00		
SRC-CAS	Jan-03	City of Salinas	10.00	12.00		8.40	0.42	4.90	0.62	465.00		140.00	228.00		16000.00	9000.00		
SRC-CAS	Jun-03	City of Salinas	30.60	10.30		8.80	0.63	1.10	0.49	698.00		65.00	59.00		90.00	20.00		
min			10.00	7.10		8.00	0.00	0.00	0.40	233.00		12.00	8.00		90.00	20.00		
max			30.60	18.40		9.80	0.63	10.60	0.75	878.00		860.00	385.00		16000.00	16000.00		
mean			19.73	11.84		8.91	0.22	4.40	0.59	530.71		291.71	131.14		11475.71	7365.71		
median			17.90	12.00		8.80	0.16	3.60	0.62	485.00		65.00	66.00		16000.00	9000.00		
Total # Samples			**7**	**7**	**0**	**7**	**7**	**7**	**7**	**0**	**0**	**7**	**7**	**0**	**7**	**7**	**0**	**0**
NAT-BOR	01-Aug-02 23:10	CCoWS					8.30		1.29									
NAT-BOR	May-00	City of Salinas	17.00	9.90		7.90	0.66	27.00	0.22	678.00		4.00	0 (ND)		9000.00	2400.00		
NAT-BOR	Dec-00	City of Salinas	12.20	8.50		7.90	0 (ND)	7.90	0.72	275.00		112.00	126.00		5000.00	5000.00		
NAT-BOR	Apr-01	City of Salinas	18.00	8.70		7.50	1.20	21.10	2.00	647.00		594.00	607.00		16000.00	80.00		
NAT-BOR	Nov-01	City of Salinas	13.60	7.70		7.40	0.14	34.30	0.27	974.00		18.00	73.00		9000.00	230.00		
NAT-BOR	Jun-02	City of Salinas	NO FLOW															
NAT-BOR	Jan-03	City of Salinas	10.50	7.60		5.30	0 (ND)	29.90	0.43	928.00		14.00	60.00		16000.00	300.00		
NAT-BOR	Jun-03	City of Salinas	22.80	9.20		7.40	0.09	20.90	0.63	579.00		700.00	1020.00		16000.00	1100.00		
min			10.50	7.60		5.30	0.00	7.90	0.22	275.00		4.00	0.00		5000.00	80.00		
max			22.80	9.90		7.90	8.30	34.30	2.00	974.00		700.00	1020.00		16000.00	5000.00		

mean			15.68	8.60		7.23	1.48	23.52	0.79	680.17		240.33	377.20		11833.33	1518.33		
median			15.30	8.60		7.45	0.14	24.05	0.63	662.50		65.00	126.00		12500.00	700.00		
Total # Samples			**6**	**6**	**0**	**6**	**7**	**6**	**7**	**6**	**0**	**6**	**6**	**0**	**6**	**6**	**0**	**0**
NAT-FRE	01 Aug 02 23:30	CCoWS					6.50	34.30	0.95									
NAT-FRE	May-00	City of Salinas																
NAT-FRE	Dec-00	City of Salinas																
NAT-FRE	Apr-01	City of Salinas	18.80	8.00		7.50	0.08	17.10	0.92	683.00		59.00	53.00		5000.00	500.00		
NAT-FRE	Nov-01	City of Salinas																
NAT-FRE	Jun-02	City of Salinas	19.70	9.02		7.80	0.14	1.40	0.47	393.00		11.00	9.00		1600.00	16000.00		
NAT-FRE	Jan-03	City of Salinas																
NAT-FRE	Jun-03	City of Salinas	15.10	7.10		8.00	0 (ND)	13.30	0.81	608.00		50.00	22.00		16000.00	900.00		
NAT-FRE	23 Jun 04 11:10	CCoWS	15.66	8.69	0.50	7.66												
min			15.10	7.10	0.50	7.50	0.00	1.40	0.47	393.00		11.00	9.00		1600.00	500.00		
max			19.70	9.02	0.50	8.00	6.50	34.30	0.95	683.00		59.00	53.00		16000.00	16000.00		
mean			17.32	8.20	0.50	7.74	1.68	16.53	0.79	561.33		40.00	28.00		7533.33	5800.00		
median			17.23	8.35	0.50	7.73	0.11	15.20	0.87	608.00		50.00	22.00		5000.00	900.00		
Total # Samples			**4**	**4**	**1**	**4**	**4**	**4**	**4**	**3**	**0**	**3**	**3**	**0**	**3**	**3**	**0**	**0**
NAT-PAC	May-00	City of Salinas	17.00	6.80		7.90	0.12	0.50	0.36	584.00		5.00	0 (ND)		9000.00	2400.00		
NAT-PAC	Dec-00	City of Salinas	13.90	5.70		6.90	0.06	0.50	0.23	163.00		77.00	43.00		16000.00	16000.00		
NAT-PAC	Apr-01	City of Salinas	18.60	13.40		8.00	0.06	15.30	0.80	665.00		25.00	15.00		9000.00	110.00		
NAT-PAC	Nov-01	City of Salinas	14.60	8.80		8.00	0.10	0.70	0.49	707.00		53.00	35.00		16000.00	1700.00		
NAT-PAC	Jun-02	City of Salinas	18.80	9.50		7.50	0.09	0.40	0.41	576.00		13.00	57.00		16000.00	500.00		
NAT-PAC	Jan-03	City of Salinas	11.00	4.20		6.60	0 (ND)	0.70	0.41	530.00		6.00	6.00		16000.00	300.00		
NAT-PAC	Jun-03	City of Salinas	14.60	4.00		7.70	0 (ND)	13.90	0.80	608.00		60.00	60.00		9000.00	220.00		
min			11.00	4.00		6.60	0.00	0.40	0.23	163.00		5.00	0.00		9000.00	110.00		
max			18.80	13.40		8.00	0.12	15.30	0.80	707.00		77.00	60.00		16000.00	16000.00		
mean			15.50	7.49		7.51	0.06	4.57	0.50	547.57		34.14	36.00		13000.00	3032.86		
median			14.60	6.80		7.70	0.06	0.70	0.41	584.00		25.00	39.00		16000.00	500.00		
Total # Samples			**7**	**7**	**0**	**7**	**7**	**7**	**7**	**7**	**0**	**7**	**7**	**0**	**7**	**7**	**0**	**0**
NAT-LAS	01 Aug 02 23:40	CCoWS					0.03	8.10	1.13									
NAT-LAS	May-00	City of Salinas	16.00	4.20		7.50	0.10	0.20	0.32	600.00		3.00	0 (ND)		3000.00	3000.00		

NAT-LAS	Dec-00	City of Salinas	13.50	6.50		6.90	0 (ND)	0.50	0.22	170.00		53.00	26.00		16000.00	3000.00		
NAT-LAS	Apr-01	City of Salinas	12.80	17.00		8.40	0 (ND)	11.90	0.65	622.00		20.00	16.00		9000.00	40.00		
NAT-LAS	Nov-01	City of Salinas	14.00	5.40		8.50	0.12	0.90	0.48	630.00		38.00	26.00		16000.00	1100.00		
NAT-LAS	Jun-02	City of Salinas	21.10	9.90		7.40	0 (ND)	4.10	0.13	457.00		5.00	8.00		16000.00	230.00		
NAT-LAS	Jan-03	City of Salinas	12.00	5.60		6.40	0 (ND)	0.70	0.39	550.00		11.00	7.00		16000.00	110.00		
NAT-LAS	Jun-03	City of Salinas	15.70	6.10		7.40	0.06	14.60	0.76	620.00		30.00	24.00		16000.00	800.00		
NAT-LAS	23 Jun 04 12:00	CCoWS	15.63	6.00	0.53	7.48												
min			12.00	4.20	0.53	6.40	0.00	0.20	0.13	170.00		3.00	0.00		3000.00	40.00		
max			21.10	17.00	0.53	8.50	0.12	14.60	1.13	630.00		53.00	26.00		16000.00	3000.00		
mean			15.09	7.59	0.53	7.50	0.04	5.13	0.51	521.29		22.86	15.29		13142.86	1182.86		
median			14.82	6.05	0.53	7.44	0.02	2.50	0.44	600.00		20.00	16.00		16000.00	800.00		
Total # Samples			**8**	**8**	**1**	**8**	**8**	**8**	**8**	**7**	**0**	**7**	**8**	**0**	**7**	**7**	**0**	**0**
NAT-RAN	May-00	City of Salinas	16.00	6.70		8.10	0.08	0 (ND)	0.11	615.00		43.00	69.00		1700.00	40.00		
NAT-RAN	Dec-00	City of Salinas	13.30	4.60		6.50	0.06	0.50	0.33	186.00		44.00	28.00		16000.00	3000.00		
NAT-RAN	Apr-01	City of Salinas	20.80	12.50		8.10	0 (ND)	8.60	0.60	646.00		25.00	40.00		3000.00	40.00		
NAT-RAN	Nov-01	City of Salinas	14.40	5.50		8.00	0.25	4.50	0.51	763.00		39.00	31.00		16000.00	500.00		
NAT-RAN	Jun-02	City of Salinas	22.60	9.10		8.00	0 (ND)	0 (ND)	0.18	524.00		40.00	66.00		5000.00	1700.00		
NAT-RAN	Jan-03	City of Salinas	12.50	7.60		6.10	0.06	0.70	0.33	523.00		19.00	24.00		16000.00	700.00		
NAT-RAN	Jun-03	City of Salinas	18.40	17.80		8.40	0.83	12.60	0.46	620.00		13.00	27.00		3000.00	130.00		
min			12.50	4.60		6.10	0.00	0.00	0.11	186.00		13.00	24.00		1700.00	40.00		
max			22.60	17.80		8.40	0.83	12.60	0.60	763.00		44.00	69.00		16000.00	3000.00		
mean			16.86	9.11		7.60	0.18	3.84	0.36	553.86		31.86	40.71		8671.43	872.86		
median			16.00	7.60		8.00	0.06	0.70	0.33	615.00		39.00	31.00		5000.00	500.00		
Total # Samples			**7**	**7**	**0**	**7**	**7**	**7**	**7**	**0**	**0**	**7**	**7**	**0**	**7**	**7**	**0**	**0**
NAT-GAR	May-00	City of Salinas	16.00	1.70		7.40	0.15	0 (ND)	0.32	582.00		28.00	34.00		16000.00	1100.00		
NAT-GAR	Dec-00	City of Salinas	14.10	3.70		7.10	0 (ND)	0 (ND)	0.39	1240.00		17.00	11.00		23.00	1600.00		
NAT-GAR	Apr-01	City of Salinas	20.10	11.90		7.20	0.27	0.40	0.36	977.00		4.00	0 (ND)		16000.00	210.00		
NAT-GAR	Nov-01	City of Salinas	15.40	8.70		7.90	0.11	1.40	0.29	1020.00		15.00	12.00		16000.00	9000.00		
NAT-GAR	Jun-02	City of Salinas	19.70	10.70		8.00	4.00	0.90	1.38	495.00		7.00	8.00		16000.00	16000.00		
NAT-GAR	Jan-03	City of Salinas	9.50	2.80		5.90	0 (ND)	0 (ND)	1.30	959.00		40.00	26.00		16000.00	16000.00		
NAT-GAR	Jun-03	City of Salinas	16.10	2.90		7.80	0.19	0.40	0.53	608.00		5.00	17.00		16000.00	20.00		
min			9.50	1.70		5.90	0.00	0.00	0.29	495.00		4.00	0.00		23.00	20.00		

max			20.10	11.90		8.00	4.00	1.40	1.38	1240.00		40.00	34.00		16000.00	16000.00		
mean			15.84	6.06		7.33	0.67	0.44	0.65	840.14		16.57	18.00		13717.57	6275.71		
median			16.00	3.70		7.40	0.15	0.40	0.39	959.00		15.00	14.50		16000.00	1600.00		
Total # Samples			**7**	**7**	**0**	**7**	**7**	**7**	**7**	**7**	**0**	**7**	**7**	**0**	**7**	**7**	**0**	**0**
ALI-ALI	28 Jul 99 12:15	CCAMP	18.78	7.99	0.60	7.95	1.48	23.82	0.76				66.00					
ALI-ALI	31 Aug 99 10:00	CCAMP				8.12	0.10	16.63	0.79				117.00					
ALI-ALI	28 Sep 99 10:00	CCAMP	15.30	11.53		8.08	0.18	17.53	0.31				144.00					
ALI-ALI	01 Oct 99 06:25	CCAMP	16.00	7.50														
ALI-ALI	02 Nov 99 09:20	CCAMP	12.00	8.70		8.44	0.11	6.07	0.30				356.00					
ALI-ALI	09 Nov 99 09:50	CCAMP																
ALI-ALI	03 Jan 00 10:50	CCAMP																
ALI-ALI	26 Jan 00 13:00	CCAMP	11.90	6.88		7.65	0.25	35.73	1.39	783.00			197.00					
min			11.90	6.88	0.60	7.65	0.10	6.07	0.30	783.00			66.00					
max			18.78	11.53	0.60	8.44	1.48	35.73	1.39	783.00			356.00					
mean			14.80	8.52	0.60	8.05	0.42	19.96	0.71	783.00			196.94					
median			15.53	7.99	0.60	8.08	0.18	17.53	0.76	783.00			170.50					
Total # Samples			**5**	**5**	**1**	**5**	**5**	**5**	**5**	**1**	**0**	**0**	**5**	**0**	**0**	**0**	**0**	**0**
REC-AIR	01 Feb 99 14:30	CCAMP	11.80	9.60		7.86	0.24	15.51	1.22				515.00		160001.00	30000.00		
REC-AIR	01 Mar 99 11:40	CCAMP	15.10	8.84		7.97	0.63	7.42	0.36				210.00		160001.00	220.00		
REC-AIR	05 Apr 99 11:05	CCAMP	10.10	11.87		8.81	0.24	11.46	0.43				69.00		160000.00	110.00		
REC-AIR	10 May 99 11:30	CCAMP	14.20	8.36		7.78	2.87	24.49	1.72				927.00		50000.00	11000.00		
REC-AIR	03 Jun 99 09:45	CCAMP	14.30	7.45		7.13	3.69	21.35	0.86				198.00		160001.00	9000.00		
REC-AIR	07 Jul 99 04:15	CCAMP	17.90	2.81														
REC-AIR	07 Jul 99 09:30	CCAMP	17.40	4.53		7.69	1.31	21.35	1.19				98.00		160000.00	160000.00		
REC-AIR	26 Jul 99 05:25	CCAMP	18.13	2.51														
REC-AIR	26 Jul 99 10:15	CCAMP	17.54	3.16	0.60													
REC-AIR	27 Jul 99 14:00	CCAMP	18.94	10.21	0.60	8.42	0.40	17.30	1.32				44.00		160001.00	11000.00		
REC-AIR	31 Aug 99 10:20	CCAMP				7.86	1.48	6.29	0.69				146.00		160000.00	17000.00		
REC-AIR	28 Sep 99 10:30	CCAMP	16.60	4.65		8.08	0.77	42.25	0.46				60.00		160001.00	160000.00		
REC-AIR	01 Oct 99 06:40	CCAMP	16.80	2.25														
REC-AIR	02 Nov 99 09:35	CCAMP	14.00	3.98		8.00	0.27	6.07	0.50				26.00		160001.00	24000.00		
REC-AIR	09 Nov 99 10:00	CCAMP	14.20	3.43		7.41	1.89	6.29	0.89				47.00		160001.00	160001.00		

REC-AIR	30 Nov 99 11:10	CCAMP	12.11	4.36		7.49	2.21	4.49	0.30				56.00		160000.00	9000.00		
REC-AIR	03 Jan 00 10:55	CCAMP	8.00	9.63		8.12	0.64	10.00	0.29	607.00			23.60		160001.00	160001.00		
REC-AIR	26 Jan 00 12:35	CCAMP	11.30	10.06		7.71	0.19	12.07	1.74	334.00			530.00		90000.00	900.00		
REC-AIR	10 Feb 00 12:10	CCAMP	13.61	8.33	0.80	7.52	5.82	2.19	2.16	123.00			167.00		160001.00	2300.00		
REC-AIR	May-00	City of Salinas	19.00	10.00		8.60	3.60	28.80	2.03	805.00		66.00	99.00		16000.00	5000.00		
REC-AIR	Dec-00	City of Salinas	19.60	8.00		4.10	5.79	4.70	3.50	222.00		240.00	237.00		16000.00	16000.00		
REC-AIR	Apr-01	City of Salinas	22.40	7.10		8.50	1.90	21.40	1.90	616.00		154.00	133.00		16000.00	5000.00		
REC-AIR	Nov-01	City of Salinas	18.70	8.10		7.80	4.60	11.00	2.00	794.00		100.00	63.00		16000.00	16000.00		
REC-AIR	Jun-02	City of Salinas	20.80	9.00		8.70	0.56	2.00	4.85	859.00		29.00	20.00		16000.00	800.00		
REC-AIR	Jan-03	City of Salinas	9.00	8.60		5.80	0.46	3.40	2.40	392.00		1500.00	674.00		160000.00	170.00		
REC-AIR	Jun-03	City of Salinas	25.80	11.40		8.80	0.19	11.00	0.79	808.00		32.00	80.00		16000.00	20.00		
REC-AIR	28 Jun 04 10:10	CCoWS	17.83	6.91	0.58	8.43												
min			8.00	2.25	0.58	4.10	0.19	2.00	0.29	123.00		29.00	20.00		16000.00	20.00		
max			25.80	11.87	0.80	8.81	5.82	42.25	4.85	859.00		1500.00	927.00		160001.00	160001.00		
mean			16.18	6.95	0.65	7.75	1.94	13.40	1.50	556.00		303.00	184.88		107800.35	38365.10		
median			16.70	8.05	0.60	7.86	1.04	11.00	1.20	611.50		100.00	98.50		160000.00	10000.00		
Total # Samples			**26**	**26**	**4**	**23**	**22**	**22**	**22**	**10**	**0**	**7**	**22**	**0**	**22**	**22**	**0**	**0**
REC-JOH	May-00	City of Salinas	18.50	5.50		7.70	2.49	13.10	0.79	984.00		56.00	76.00		16000.00	9000.00		
REC-JOH	Dec-00	City of Salinas	12.90	8.30		8.30	0.88	4.50	1.70	671.00		150.00	119.00		16000.00	2400.00		
REC-JOH	Apr-01	City of Salinas	22.90	6.50		7.80	7.40	25.90	1.80	976.00		92.00	92.00		16000.00	5000.00		
REC-JOH	Nov-01	City of Salinas	18.30	7.30		7.70	2.00	9.90	1.56	1140.00		140.00	117.00		16000.00	16000.00		
REC-JOH	Jun-02	City of Salinas	16.10	9.10		9.30	0.50	5.60	0.62	1210.00		47.00	36.00		16000.00	3000.00		
REC-JOH	Jan-03	City of Salinas	11.00	9.00		6.90	0.50	5.60	1.20	580.00		450.00	325.00		16000.00	2200.00		
REC-JOH	Jun-03	City of Salinas	18.90	5.20		8.00	0.40	10.40	0.50	1210.00		50.00	60.00		16000.00	20.00		
min			11.00	5.20		6.90	0.40	4.50	0.50	580.00		47.00	36.00		16000.00	20.00		
max			22.90	9.10		9.30	7.40	25.90	1.80	1210.00		450.00	325.00		16000.00	16000.00		
mean			16.94	7.27		7.96	2.02	10.71	1.17	967.29		140.71	117.86		16000.00	5374.29		
median			18.30	7.30		7.80	0.88	9.90	1.20	984.00		92.00	92.00		16000.00	3000.00		
Total # Samples			**7**	**7**	**0**	**7**	**7**	**7**	**7**	**7**	**0**	**7**	**7**	**0**	**7**	**7**	**0**	**0**
REC-NMA	May-00	City of Salinas	18.52	3.50		6.80	3.48	18.90	0.80	921.00		14.00	23.00		16000.00	260.00		
REC-NMA	Dec-00	City of Salinas	12.10	4.80		8.00	0.30	3.60	0.44	414.00		110.00	117.00		16000.00	9000.00		
REC-NMA	Apr-01	City of Salinas	24.60	6.70		7.30	1.10	18.50	0.67	996.00		61.00	64.00		16000.00	230.00		

REC-NMA	Nov-01	City of Salinas	18.60	6.80		7.60	1.50	4.10	1.59	572.00		120.00	93.00		5000.00	16000.00		
REC-NMA	Jun-02	City of Salinas	20.70	8.70		7.90	0.54	11.40	0.56	831.00		17.00	23.00		16000.00	130.00		
REC-NMA	Jan-03	City of Salinas	11.00	7.80		6.50	0.40	8.30	0.95	548.00		270.00	112.00		16000.00	500.00		
REC-NMA	Jun-03	City of Salinas	25.70	18.60		8.70	0.15	10.10	0.53	1145.00		8.00	23.00		16000.00	300.00		
min			11.00	3.50		6.50	0.15	3.60	0.44	414.00		8.00	23.00		5000.00	130.00		
max			25.70	18.60		8.70	3.48	18.90	1.59	1145.00		270.00	117.00		16000.00	16000.00		
mean			18.75	8.13		7.54	1.07	10.70	0.79	775.29		85.71	65.00		14428.57	3774.29		
median			18.60	6.80		7.60	0.54	10.10	0.67	831.00		61.00	64.00		16000.00	300.00		
Total # Samples			**7**	**7**	**0**	**7**	**7**	**7**	**7**	**0**	**0**	**7**	**7**	**0**	**7**	**7**	**0**	**0**

REC-VIC	27 Oct 00 09:25	CCoWS					0.64	5.96	0.39	256.74			3055.51					
REC-VIC	29 Oct 00 00:31	CCoWS								155.71	4.20		235.93					
REC-VIC	31 Oct 00 20:34	CCoWS					0.50	6.45	0.66	485.10	6.00		159.30					
REC-VIC	07 Jan 01 16:52	CCoWS					1.42	11.75	0.30	812.46			70.13					
REC-VIC	08 Jan 01 02:20	CCoWS					0.37	5.20	0.30	133.32	1.86		745.73					
REC-VIC	08 Jan 01 02:57	CCoWS																
REC-VIC	08 Jan 01 04:10	CCoWS					0.10	3.16	0.27	394.68	3.40		387.83					
REC-VIC	08 Jan 01 06:56	CCoWS					0.78	1.58	0.43	261.36	2.57		273.96	7.39				
REC-VIC	08 Jan 01 09:35	CCoWS					0.17	1.81	0.29	127.38	4.40		283.92					
REC-VIC	08 Jan 01 09:40	CCoWS																
REC-VIC	08 Jan 01 11:42	CCoWS					0.41	2.48	0.23	159.06	5.40		320.46					
REC-VIC	08 Jan 01 12:00	CCoWS																
REC-VIC	08 Jan 01 18:16	CCoWS					2.50	4.07	0.73	184.14	3.80		230.72					
REC-VIC	09 Jan 01 14:57	CCoWS					0.43	2.26	0.40	283.14	8.20		83.92					
REC-VIC	10 Jan 01 10:50	CCoWS					0.13	5.20	0.24	346.50	3.16		159.47					
REC-VIC	10 Jan 01 11:12	CCoWS					0.66	4.74	0.31									
REC-VIC	10 Jan 01 16:50	CCoWS					2.18	0.91	0.18	95.70	4.00		159.47					
REC-VIC	10 Jan 01 23:11	CCoWS					0.73	4.74	0.44	147.84	1.52		270.04					
REC-VIC	11 Jan 01 11:47	CCoWS					0.37	5.42	0.57	199.32	0.94		319.18					
REC-VIC	11 Jan 01 17:15	CCoWS								297.66	3.60		533.95					
REC-VIC	12 Jan 01 17:02	CCoWS					0.33	5.42	0.55	248.82	2.13		237.48					
REC-VIC	15 Jan 01 13:59	CCoWS					0.52	10.39	0.70	361.02	2.22		185.95					
REC-VIC	23 Jan 01 14:33	CCoWS					0.63	6.10	0.27	808.50	11.80		47.01					
REC-VIC	24 Jan 01 04:45	CCoWS					0.62	4.52	0.22	246.18	8.20		160.73					
REC-VIC	24 Jan 01 07:01	CCoWS					0.24	0.90	0.19	111.54	7.40		212.13					

REC-VIC	24 Jan 01 11:10	CCoWS					0.61	2.71	0.24	129.36	5.00		149.83					
REC-VIC	25 Jan 01 18:31	CCoWS					0.49	2.71	0.25	180.84	2.01		558.37					
REC-VIC	25 Jan 01 18:39	CCoWS																
REC-VIC	25 Jan 01 21:10	CCoWS					0.20	0.68	0.19	50.16	4.40		540.68					
REC-VIC	26 Jan 01 00:34	CCoWS					0.13	2.26	0.26	100.98	2.40		479.76					
REC-VIC	26 Jan 01 09:53	CCoWS					0.19	4.97	0.75	142.56	0.72		1190.28					
REC-VIC	26 Jan 01 15:03	CCoWS					0.22	4.97	0.63	219.12	0.96		116.81					
REC-VIC	18 Feb 01 16:42	CCoWS					0.50	12.42	0.13	663.96	19.60		32.78					
REC-VIC	19 Feb 01 05:53	CCoWS					0.17	1.13	0.15	145.20	6.80		247.45					
REC-VIC	19 Feb 01 08:44	CCoWS								70.62	5.00		203.47					
REC-VIC	01 Jul 02 00:00	CCoWS					0.00	9.90	0.38	853.38	27.60		66.95					
REC-VIC	01 Jul 02 17:49	CCoWS	23.91	17.25	0.63													
REC-VIC	19 Sep 03 08:34	CCoWS	15.94	5.07	0.82	7.46				1044.00								
REC-VIC	19 Sep 03 17:02	CCoWS	23.34	24.87	0.79	8.25				1016.00								
min			15.94	5.07	0.63	7.46	0.00	0.68	0.13	50.16	0.72		32.78	7.39				
max			23.91	24.87	0.82	8.25	2.50	12.42	0.75	1044.00	27.60		3055.51	7.39				
mean			21.06	15.73	0.75	7.86	0.56	4.65	0.37	325.22	5.49		378.04	7.39				
median			23.34	17.25	0.79	7.86	0.43	4.74	0.30	219.12	4.00		235.93	7.39				
Total # Samples			**3**	**3**	**3**	**2**	**29**	**29**	**29**	**32**	**29**	**0**	**31**	**1**	**0**	**0**	**0**	**0**
REC-DAV	May-00	City of Salinas	18.00	6.00		7.90	6.21	27.00	0.90	945.00		4.00	6.00		800.00	40.00		
REC-DAV	Dec-00	City of Salinas	13.30	5.70		6.90	0.42	5.90	0.36	504.00		94.00	83.00		16000.00	16000.00		
REC-DAV	Apr-01	City of Salinas	19.00	8.70		8.00	4.00	17.10	1.10	739.00		73.00	63.00		16000.00	1700.00		
REC-DAV	Nov-01	City of Salinas	17.20	6.90		7.70	1.80	4.10	1.72	580.00		97.00	74.00		16000.00	16000.00		
REC-DAV	Jun-02	City of Salinas	21.00	13.50		8.80	0.15	11.90	0.65	1060.00		11.00	49.00		16000.00	220.00		
REC-DAV	Jan-03	City of Salinas	10.00	9.00		6.70	0.47	7.70	0.95	580.00		260.00	40.00		16000.00	500.00		
REC-DAV	Jun-03	City of Salinas	24.80	26.60		9.10	0.19	9.20	0.25	860.00		19.00	70.00		3000.00	80.00		
min			10.00	5.70		6.70	0.15	4.10	0.25	504.00		4.00	6.00		800.00	40.00		
max			24.80	26.60		9.10	6.21	27.00	1.72	1060.00		260.00	83.00		16000.00	16000.00		
mean			17.61	10.91		7.87	1.89	11.84	0.85	752.57		79.71	55.00		11971.43	4934.29		
median			18.00	8.70		7.90	0.47	9.20	0.90	739.00		73.00	63.00		16000.00	500.00		
Total # Samples			**7**	**7**	**0**	**7**	**7**	**7**	**7**	**7**	**0**	**7**	**7**	**0**	**7**	**7**	**0**	**0**
REC-BOR	14 Apr 00 13:47	CCoWS								827.97	14.30		108.21					

REC-BOR	01 Feb 99 12:45	CCAMP	10.10	9.37		7.85	0.24	3.15	0.59				385.00		160001.00	17000.00		
REC-BOR	01 Mar 99 12:30	CCAMP	15.40	8.90		8.02	0.16	3.60	0.18				120.00		17000.00	900.00		
REC-BOR	05 Apr 99 12:30	CCAMP	11.10	12.13		7.81	0.11	7.42	0.21				35.00		160001.00	1600.00		
REC-BOR	05 Apr 99 12:45	CCAMP				7.80				490.00			33.00		160001.00	3000.00		
REC-BOR	10 May 99 12:00	CCAMP	15.70	10.20		8.20	0.29	9.44	0.43				45.00		35000.00	5000.00		
REC-BOR	10 May 99 12:15	CCAMP				8.23	0.30	9.44	0.43				40.00		160001.00	1700.00		
REC-BOR	03 Jun 99 10:20	CCAMP	10.50	3.33		7.27	2.13	12.81	0.46				62.00		160001.00	160001.00		
REC-BOR	03 Jun 99 10:30	CCAMP				7.30	2.13	12.81	0.50				66.00		160001.00	160001.00		
REC-BOR	07 Jul 99 05:00	CCAMP	18.70	3.61														
REC-BOR	07 Jul 99 10:15	CCAMP	18.30	9.80		8.05	1.39	3.60	0.50				27.00		1600.00	1600.00		
REC-BOR	26 Jul 99 05:55	CCAMP	19.06	10.50														
REC-BOR	26 Jul 99 10:30	CCAMP	18.25	2.70	0.80													
REC-BOR	27 Jul 99 13:40	CCAMP	17.60		0.70	7.98	0.82	8.99	0.56				20.00		9000.00	500.00		
REC-BOR	31 Aug 99 10:45	CCAMP				8.17	1.97	3.82	0.56				13.00		3000.00	210.00		
REC-BOR	28 Sep 99 11:30	CCAMP	18.70	4.59		8.00	2.87	8.76	0.50				5.00		5000.00	110.00		
REC-BOR	01 Oct 99 06:50	CCAMP	17.10	0.61														
REC-BOR	02 Nov 99 09:50	CCAMP	13.80	1.20		8.33	4.67	4.94	0.59				7.00		17000.00	2400.00		
REC-BOR	09 Nov 99 10:30	CCAMP	13.00	0.49		7.26	0.50	1.62	0.69				39.00		160001.00	160001.00		
REC-BOR	30 Nov 99 13:00	CCAMP				7.50												
REC-BOR	30 Nov 99 13:00	CCAMP	11.52	2.15		7.22	1.64	7.64	0.24				66.00		28000.00	9000.00		
REC-BOR	03 Jan 00 11:20	CCAMP	6.10	7.13		8.11	1.64	16.25	0.22	745.00			58.00		3000.00	3000.00		
REC-BOR	26 Jan 00 11:50	CCAMP	11.80	6.59		7.63	0.21	7.19	0.79	372.00			170.00		50000.00	900.00		
REC-BOR	10 Feb 00 13:30	CCAMP				8.16	0.08	2.49	0.12	346.00			45.20					
REC-BOR	10 Feb 00 13:45	CCAMP	14.61	8.00	0.70	7.65	0.32	1.43	0.26	128.00			270.00		160000.00	90000.00		
min			6.10	0.49	0.70	7.22	0.08	1.43	0.12	128.00			5.00		1600.00	110.00		
max			19.06	12.13	0.80	8.33	4.67	16.25	0.79	745.00			385.00		160001.00	160001.00		
mean			14.52	5.96	0.73	7.83	1.19	6.97	0.44	416.20			79.27		80478.17	34273.50		
median			15.01	6.59	0.70	7.92	0.66	7.30	0.48	431.00			45.10		42500.00	2700.00		
Total # Samples			**18**	**17**	**3**	**20**	**18**	**18**	**18**	**6**	**1**	**0**	**20**	**0**	**18**	**18**	**0**	**0**
REC-JON	13 Apr 00 00:00	CCoWS								611.82	26.70	30.10						
REC-JON	13 Apr 00 17:57	CCoWS								740.30	22.50		14.16					
REC-JON	14 Apr 00 07:29	CCoWS								889.68	28.10		20.77					
REC-JON	14 Apr 00 11:23	CCoWS								998.91	30.70		28.42					
REC-JON	14 Apr 00 11:43	CCoWS									30.10							

REC-JON	14 Apr 00 12:04	CCoWS				1096.26	28.60	25.17	
REC-JON	14 Apr 00 12:17	CCoWS							
REC-JON	14 Apr 00 12:24	CCoWS					21.90		
REC-JON	14 Apr 00 12:37	CCoWS					24.20		
REC-JON	14 Apr 00 12:53	CCoWS					24.00		
REC-JON	14 Apr 00 13:45	CCoWS							
REC-JON	14 Apr 00 15:17	CCoWS				609.84	11.20	11.28	
REC-JON	14 Apr 00 15:39	CCoWS					15.00		0.00
REC-JON	14 Apr 00 17:30	CCoWS				755.04	15.90	98.62	
REC-JON	15 Apr 00 05:06	CCoWS				599.28	31.20	24.42	
REC-JON	15 Apr 00 10:21	CCoWS				658.68	27.40	47.05	
REC-JON	16 Apr 00 21:47	CCoWS				879.12	25.00	76.45	
REC-JON	16 Apr 00 22:14	CCoWS							
REC-JON	16 Apr 00 23:56	CCoWS				890.34	50.40	52.95	
REC-JON	17 Apr 00 00:08	CCoWS							
REC-JON	17 Apr 00 01:56	CCoWS				890.34	27.40	30.58	
REC-JON	17 Apr 00 03:28	CCoWS				897.60	45.40	30.58	
REC-JON	17 Apr 00 12:40	CCoWS				166.98	7.50	91.74	
REC-JON	17 Apr 00 15:44	CCoWS				189.42	7.80	159.28	1.00
REC-JON	17 Apr 00 21:01	CCoWS				222.42		76.74	
REC-JON	18 Apr 00 14:52	CCoWS						10.24	
REC-JON	03 Jul 00 18:29	CCoWS							
REC-JON	11 Oct 00 13:12	CCoWS	1.02	13.59	2.11				
REC-JON	20 Oct 00 12:10	CCoWS	0.47	10.53	0.42				
REC-JON	25 Oct 00 13:37	CCoWS				1230.90	34.60	19.08	0.00
REC-JON	25 Oct 00 15:32	CCoWS							
REC-JON	25 Oct 00 19:05	CCoWS				1013.43	26.60	25.69	0.00
REC-JON	25 Oct 00 19:45	CCoWS				975.48	22.00	27.05	
REC-JON	25 Oct 00 21:24	CCoWS				687.72	14.90	89.71	
REC-JON	25 Oct 00 22:58	CCoWS							
REC-JON	26 Oct 00 08:19	CCoWS				611.82	12.00	45.15	
REC-JON	26 Oct 00 11:00	CCoWS				568.26	6.20	484.37	
REC-JON	26 Oct 00 11:10	CCoWS					7.60		
REC-JON	26 Oct 00 11:18	CCoWS							
REC-JON	26 Oct 00 11:21	CCoWS				527.34	4.80	150.09	
REC-JON	26 Oct 00 11:32	CCoWS							

REC-JON	26 Oct 00 11:37	CCoWS				4.22	6.40	204.68	
REC-JON	26 Oct 00 11:41	CCoWS							
REC-JON	26 Oct 00 13:51	CCoWS	0.75	2.45	0.43	283.80	7.45	125.52	0.00
REC-JON	26 Oct 00 14:38	CCoWS							
REC-JON	26 Oct 00 14:56	CCoWS							
REC-JON	26 Oct 00 15:19	CCoWS							
REC-JON	26 Oct 00 16:50	CCoWS	0.70	2.39	0.37	306.24	5.20	109.00	
REC-JON	26 Oct 00 20:14	CCoWS				141.90	1.72	1042.25	
REC-JON	26 Oct 00 20:37	CCoWS	0.44	1.52	0.30				
REC-JON	26 Oct 00 22:30	CCoWS				97.68	1.98	369.17	
REC-JON	27 Oct 00 05:48	CCoWS	0.77	5.00	0.56				
REC-JON	27 Oct 00 07:40	CCoWS	0.59	5.59	1.06	196.02	0.35	3991.04	
REC-JON	27 Oct 00 12:57	CCoWS				232.32	0.50	1234.84	
REC-JON	27 Oct 00 13:55	CCoWS				238.92	0.51	1418.47	
REC-JON	28 Oct 00 10:55	CCoWS				296.34	1.30	255.16	
REC-JON	28 Oct 00 18:38	CCoWS	0.08	0.65	0.22	324.72	1.74	110.00	
REC-JON	28 Oct 00 19:38	CCoWS	0.39	4.28	0.68	335.28	1.71	115.00	
REC-JON	28 Oct 00 23:38	CCoWS				297.66	1.94	523.87	
REC-JON	29 Oct 00 00:40	CCoWS				194.70	3.00	313.41	
REC-JON	29 Oct 00 02:29	CCoWS				123.42	4.89	233.36	
REC-JON	29 Oct 00 08:45	CCoWS	0.39	2.93	0.52	159.72	3.30	271.77	
REC-JON	29 Oct 00 12:32	CCoWS	0.44	3.92	0.57	177.54	2.40	562.08	
REC-JON	29 Oct 00 19:59	CCoWS	0.24	3.31	0.61	194.70	1.94	315.61	0.00
REC-JON	30 Oct 00 20:20	CCoWS	0.42	3.06	0.66	305.91	5.80	98.71	
REC-JON	31 Oct 00 20:16	CCoWS	0.69	15.36	0.82	482.46	7.60	66.39	
REC-JON	04 Nov 00 11:57	CCoWS				857.34	17.80	44.53	
REC-JON	07 Jan 01 14:02	CCoWS	0.31	14.46	0.31	814.44	22.00	54.28	
REC-JON	08 Jan 01 01:25	CCoWS							
REC-JON	08 Jan 01 03:05	CCoWS	0.56	13.55	0.41	856.02	18.20	37.04	
REC-JON	08 Jan 01 03:45	CCoWS							
REC-JON	08 Jan 01 04:00	CCoWS							
REC-JON	08 Jan 01 06:07	CCoWS	0.98	13.10	0.40	826.98	8.20	150.70	2.86
REC-JON	08 Jan 01 09:04	CCoWS	0.95	2.26	0.34		2.00	363.64	0.00
REC-JON	08 Jan 01 09:14	CCoWS							0.00
REC-JON	08 Jan 01 09:53	CCoWS	1.15	1.81	0.30	217.80	1.95	551.04	
REC-JON	08 Jan 01 10:02	CCoWS							

REC-JON	08 Jan 01 10:14	CCoWS					1.12	1.81	0.43						
REC-JON	08 Jan 01 10:19	CCoWS													
REC-JON	08 Jan 01 10:28	CCoWS													
REC-JON	08 Jan 01 11:30	CCoWS					0.51	1.58	0.37	129.36	1.89		98.71		
REC-JON	08 Jan 01 12:24	CCoWS											66.39		
REC-JON	08 Jan 01 13:24	CCoWS					0.48	1.58	0.23	106.26	4.78		44.53		
REC-JON	08 Jan 01 18:04	CCoWS					0.42	4.52	0.22	182.82	2.67		54.28		
REC-JON	09 Jan 01 14:43	CCoWS						3.61	0.45	297.66	7.98				
REC-JON	10 Jan 01 10:35	CCoWS					0.65	4.29	0.37	349.80	5.00		37.04		
REC-JON	10 Jan 01 16:30	CCoWS					0.29	1.36	0.11	104.28	2.90				
REC-JON	11 Jan 01 00:00	CCoWS					0.15	2.71	0.32	106.92	1.34				
REC-JON	11 Jan 01 11:23	CCoWS					0.40	4.29	0.64	149.82	0.93		150.70		
REC-JON	11 Jan 01 17:06	CCoWS					0.32	3.61	0.35	168.30	1.64		363.64		
REC-JON	11 Jan 01 19:15	CCoWS					0.38	3.16	0.38	147.84	1.91		376.16		
REC-JON	12 Jan 01 16:39	CCoWS					0.32	5.65	0.54	227.04	2.59		330.53		
REC-JON	12 Jan 01 16:50	CCoWS													
REC-JON	15 Jan 01 13:51	CCoWS					0.46	8.89	0.60	371.58	2.30		129.48		
REC-JON	23 Jan 01 14:56	CCoWS					0.52	10.39	0.10	769.56	17.20		59.06		
REC-JON	23 Jan 01 15:24	CCoWS													
REC-JON	24 Jan 01 04:34	CCoWS					0.11	1.81	0.27	243.54	9.40		89.14		
REC-JON	24 Jan 01 07:15	CCoWS					0.61	3.84	0.29	295.68	4.40		390.83		
REC-JON	24 Jan 01 10:55	CCoWS					0.23	1.13	0.25	116.16	5.50		121.25		
REC-JON	25 Jan 01 18:19	CCoWS					0.43	2.94	0.38	267.96	4.40		129.54		
REC-JON	25 Jan 01 21:24	CCoWS					0.21	1.81	0.27	122.76	3.40		541.99		
REC-JON	26 Jan 01 00:17	CCoWS					0.23	0.90	0.21	81.84	3.60		341.42		
REC-JON	26 Jan 01 09:44	CCoWS					0.22	4.07	0.78	139.26	0.65		1928.09		
REC-JON	26 Jan 01 14:47	CCoWS					0.20	4.29	0.73	145.20	1.00		623.88		
REC-JON	18 Feb 01 16:52	CCoWS					0.35	12.88		618.42	16.10		34.99		
REC-JON	19 Feb 01 05:41	CCoWS					0.42	13.10	0.30	586.08	11.60		80.50		
REC-JON	19 Feb 01 08:54	CCoWS								85.80	5.30		261.18		
REC-JON	12 Nov 01 11:40	CCoWS					1.60	4.29	2.16	813.12	1.30		1534.97		
REC-JON	23 May 02 12:05	CCoWS						3.98	0.93						
REC-JON	01 Jul 02 00:00	CCoWS	23.78	24.19	0.60		0.00	6.20	0.01	772.20	12.60		143.68		
REC-JON	08 Jul 02 12:15	CCoWS	21.84	17.32	0.68	9.15	0.02	9.80	0.38	1222.32	18.50		96.20	158.65	353.73
REC-JON	29 Aug 02 11:24	CCoWS					0.00	6.60	1.52	1053.36	20.80	7.78	22.10	144.72	727.54
REC-JON	13 Sep 02 12:16	CCoWS					0.10	6.70	0.57	1112.10	24.30	4.63	40.27	85.63	1639.12

REC-JON	25 Sep 02 13:15	CCoWS					0.45	0.77	0.82	997.26	29.10	6.64	11.10				76.01	273.26
REC-JON	22 Oct 02 12:20	CCoWS	14.52	5.47	0.72	7.97	0.01	5.10	1.25	1222.32	26.10	13.50	22.28				127.68	340.58
REC-JON	06 Nov 02 15:45	CCoWS					0.11	5.50	0.31	1069.20	27.20	17.40	37.07				436.34	102.82
REC-JON	08 Nov 02 05:03	CCoWS					0.53	1.10	0.44	221.76	5.40	102.00	90.42				1390.21	7832.30
REC-JON	08 Nov 02 17:37	CCoWS					0.32	0.80	1.33	171.60	3.00	273.00	232.32				3039.45	844.40
REC-JON	11 Nov 02 15:10	CCoWS					0.45	1.80	0.74	363.66	20.00	43.00	85.62				154.07	485.77
REC-JON	16 Dec 02 08:47	CCoWS																
REC-JON	15 Feb 03 17:25	CCoWS					1.53	9.70	4.21	611.82	26.70	30.10	12.15				189.20	392.47
REC-JON	18 Feb 03 10:45	CCoWS																
REC-JON	19 Feb 03 13:30	CCoWS					0.28	8.20	0.28	475.20	9.90	90.80	85.27				134.90	986.30
REC-JON	20 Feb 03 15:20	CCoWS					0.83	6.70	1.92	395.34	5.80	217.00	143.69				241.24	1948.81
REC-JON	13 Mar 03 10:00	CCoWS	16.75	8.10	0.68	8.67	0.43	15.20	1.29	0.86	29.10	14.50	75.42				127.88	266.02
REC-JON	15 Mar 03 05:15	CCoWS					0.68	1.70	0.91	0.33	4.30	388.00	486.03				823.44	1664.18
REC-JON	17 Mar 03 13:15	CCoWS					0.28	2.30	3.80	0.26	6.80	183.00	93.35				200.64	388.51
REC-JON	19 Apr 03 12:30	CCoWS					0.01	9.20	0.32	729.30	18.40	28.00	23.72				66.53	915.31
REC-JON	31 May 03 09:45	CCoWS	17.29	6.37	0.81	8.48	0.40	13.10	1.46	1056.66	29.80	14.50	54.52				101.06	183.64
REC-JON	10 Jun 03 11:00	CCoWS	18.09	11.77	0.63	8.57	2.65	11.05	0.64	851.40	21.80	21.60	12.17				96.45	398.73
REC-JON	14 Jul 03 13:30	CCoWS	22.97	8.38	0.70	8.29				883.08	14.20	68.30	20.63				106.72	379.61
REC-JON	03 Aug 03 12:30	CCoWS	21.64	14.01	0.74	8.21				914.10	12.30	62.40	136.88				105.40	300.25
REC-JON	18 Sep 03 13:44	CCoWS	19.63	15.54	0.73	8.11				866.58	29.80	19.30	84.73				224.59	318.91
REC-JON	19 Sep 03 08:49	CCoWS	17.10	6.37	0.77	7.89				984.00								
REC-JON	19 Sep 03 17:17	CCoWS	21.87	22.79	0.81	8.32				1047.00								
REC-JON	21 Oct 03 11:40	CCoWS	17.49	8.18	0.88	8.24				1112.10	29.00	5.60	9.33				71.24	372.14
REC-JON	25 Jun 04 09:45	CCoWS	18.81	3.70	0.74	7.78												
min			14.52	3.70	0.60	7.78	0.00	0.65	0.01	4.22	0.35	4.63	9.33	0.00	0.00	0.00	66.53	102.82
max			23.78	24.19	0.88	9.15	2.65	15.36	4.21	1230.90	50.40	388.00	3991.04	2.86	0.00	0.00	3039.45	7832.30
mean			19.37	11.71	0.73	8.31	0.50	5.53	0.71	529.65	12.91	74.60	255.41	0.43	#DIV/0!	#DIV/0!	368.27	959.75
median			18.81	8.38	0.73	8.27	0.42	4.17	0.43	475.20	7.80	29.05	92.55	0.00	#NUM!	#NUM!	139.81	390.49
Total # Samples			**13**	**13**	**13**	**12**	**62**	**64**	**63**	**97**	**102**	**22**	**94**	**9**	**0**	**0**	**22**	**22**
REC-183	08 Jan 01 03:19	CCoWS					0.14	20.33	0.15	952.38			28.66					
REC-183	08 Jan 01 11:03	CCoWS					0.87	6.55	0.24	348.48	3.60		571.21					
REC-183	08 Jan 01 11:19	CCoWS																
REC-183	08 Jan 01 13:34	CCoWS					0.76	1.58	0.35	140.58	1.67		819.73	7.91				
REC-183	08 Jan 01 13:45	CCoWS																

REC-183	08 Jan 01 17:25	CCoWS					0.42	4.07	0.22	182.16	3.35	256.80	0.00
REC-183	08 Jan 01 17:50	CCoWS											
REC-183	09 Jan 01 14:20	CCoWS						5.65	0.35	380.82	10.80	139.80	
REC-183	09 Jan 01 14:32	CCoWS											
REC-183	10 Jan 01 10:02	CCoWS					0.35	3.61	0.33	363.66	5.50	119.04	
REC-183	10 Jan 01 10:20	CCoWS											
REC-183	10 Jan 01 15:45	CCoWS					0.52	6.10	0.45	363.66	1.25	913.04	
REC-183	10 Jan 01 16:20	CCoWS											
REC-183	10 Jan 01 23:35	CCoWS								196.02	1.24	714.67	
REC-183	10 Jan 01 23:55	CCoWS					0.24	4.07	0.35				
REC-183	11 Jan 01 11:20	CCoWS					0.44	4.97	0.68	242.22	0.72	906.13	2.62
REC-183	11 Jan 01 16:52	CCoWS					0.38	6.33	0.52	300.30	1.27	622.12	
REC-183	11 Jan 01 19:30	CCoWS					0.28	4.29	0.49	215.82	1.38	640.53	
REC-183	12 Jan 01 16:13	CCoWS					0.32	7.00	0.64	301.62	1.72	479.90	
REC-183	12 Jan 01 16:28	CCoWS											
REC-183	15 Jan 01 13:31	CCoWS					0.67	7.00	0.27	640.86	1.99	194.70	
REC-183	23 Jan 01 15:16	CCoWS								897.60	18.00	74.52	
REC-183	24 Jan 01 04:22	CCoWS					0.28	9.26	0.43	642.18	4.40	299.57	
REC-183	24 Jan 01 07:25	CCoWS								437.58	3.20	573.86	
REC-183	24 Jan 01 07:29	CCoWS					0.53	7.68	0.22				
REC-183	24 Jan 01 07:31	CCoWS											
REC-183	24 Jan 01 10:37	CCoWS					0.46	4.74	0.36	267.30	2.40	711.34	
REC-183	24 Jan 01 10:45	CCoWS											
REC-183	25 Jan 01 18:04	CCoWS					2.52	2.94	0.36	463.98	5.40	454.75	
REC-183	25 Jan 01 21:36	CCoWS					0.76	8.81	0.29	413.16	0.94	966.54	
REC-183	25 Jan 01 23:45	CCoWS					0.24	2.03	0.32	137.28	1.00	1284.34	
REC-183	26 Jan 01 00:07	CCoWS											
REC-183	26 Jan 01 09:35	CCoWS					0.33	4.52	0.49	191.40	1.01	875.16	
REC-183	26 Jan 01 14:30	CCoWS					0.23	5.87	0.70				
REC-183	26 Jan 01 14:37	CCoWS								269.28	1.05	1004.30	
REC-183	18 Feb 01 17:01	CCoWS					0.44	10.84	0.10	894.30	8.50	157.13	
REC-183	19 Feb 01 05:29	CCoWS					0.59	11.07	0.21	817.74	3.60	498.05	
REC-183	19 Feb 01 09:02	CCoWS								559.02	1.37	1321.50	
REC-183	01 Jul 02 17:31	CCoWS					0.00	8.70	0.00	1102.86	18.90	117.80	
REC-183	02 Jul 02 10:52	CCoWS	23.02	24.89	0.66								
REC-183	19 Sep 03 09:00	CCoWS	16.57	7.17	0.92	7.66				1167.00			

REC-183	19 Sep 03 17:31	CCoWS	21.70	19.81	0.91	8.14				1171.00								
min			16.57	7.17	0.66	7.66	0.00	1.58	0.00	137.28	0.72		28.66	0.00				
max			23.02	24.89	0.92	8.14	2.52	20.33	0.00	1172.00	18.90		1321.50	7.91				
mean			20.43	17.29	0.83	7.90	0.51	6.58	0.36	525.25	4.17		567.12	3.51				
median			21.70	19.81	0.91	7.90	0.42	5.99	0.35	380.82	1.99		572.53	2.62				
Total # Samples			**3**	**3**	**3**	**2**	**23**	**24**	**24**	**29**	**25**	**0**	**26**	**3**	**0**	**0**	**0**	**0**
EP1-ROG	12 Nov 01 12:22	CCoWS					0.84	16.04	4.37	397.32	0.70		3308.29					
EP1-ROG	08 Jul 02 13:35	CCoWS	28.36	6.90	0.71	8.31	2.41	30.70	3.36	1079.76	5.20			0.00			1148.73	741793.70
EP1-ROG	29 Aug 02 15:17	CCoWS					4.27	33.10	12.48	1001.88	9.40	108.00	83.25				225.25	23141.06
EP1-ROG	13 Sep 02 14:00	CCoWS					2.13	40.40	2.65	1504.80	7.30	152.00	410.37				28467.07	291895.90
EP1-ROG	25 Sep 02 15:50	CCoWS						5.38		871.20	18.80	47.90	83.56				3255.67	95321.82
EP1-ROG	22 Oct 02 13:30	CCoWS	17.71	8.66	0.53	8.28	2.24	24.20	2.72	883.74	4.10	257.00	375.59				4388.08	229226.13
EP1-ROG	06 Nov 02 17:30	CCoWS					0.22	94.80	6.03	2019.60	14.20	170.00	378.67				618.62	4054.50
EP1-ROG	08 Nov 02 18:30	CCoWS					0.69	18.40	1.59	642.18	2.20	517.00	1002.86				2003.02	12799.94
EP1-ROG	11 Nov 02 15:50	CCoWS					16.96	56.70	9.72	1104.84	7.50	114.00	213.10				4080.07	12860.21
EP1-ROG	16 Dec 02 00:00	CCoWS																
EP1-ROG	15 Feb 03 18:00	CCoWS					10.80	46.40	4.88	1310.76	15.30	57.00	126.12				1396.96	18606.24
EP1-ROG	19 Feb 03 10:30	CCoWS																
EP1-ROG	19 Feb 03 12:45	CCoWS					1.67	20.80	5.92	589.38	7.90	158.00	263.07				1648.83	6096.03
EP1-ROG	20 Feb 03 15:55	CCoWS					2.07	29.90	2.07	933.90	14.00	47.30	157.02				921.82	8911.18
EP1-ROG	13 Mar 03 10:45	CCoWS	16.76	9.84	0.89	8.19	2.70	30.40	13.44	1122.00	16.30	42.10	144.69				1140.05	2888.14
EP1-ROG	15 Mar 03 04:00	CCoWS					0.95	10.45	1.71	198.00	2.60	885.00	1176.57				14808.92	9355.27
EP1-ROG	17 Mar 03 14:00	CCoWS					0.47	26.10	2.04	666.60	5.10	258.00	126.20				416.37	2606.73
EP1-ROG	19 Apr 03 13:00	CCoWS					0.81	31.20	2.00	997.26	4.20	302.00	299.01				411.57	6673.69
EP1-ROG	31 May 03 10:30	CCoWS	22.04	4.90	0.38	8.08	2.08	28.30	13.08	853.38	1.49	975.00	1014.98				247.87	709.81
EP1-ROG	10 Jun 03 12:00	CCoWS	22.50	7.89	0.47	8.10	0.45	23.55	4.88	737.22	8.80	133.00	150.92				137.64	1024.42
EP1-ROG	14 Jul 03 13:30	CCoWS	26.98	5.87	0.63	7.97				778.80	16.80	46.40	176.00				236.81	1179.63
EP1-ROG	03 Aug 03 14:09	CCoWS	27.46	6.95	0.43	7.75				1071.84	21.80	35.90	111.11				1041.78	969.25
EP1-ROG	19 Sep 03 09:30	CCoWS								696.30	16.70	53.80	274.17				6025.83	19603.44
EP1-ROG	21 Oct 03 12:15	CCoWS	22.33	8.15	0.77	8.03				986.70	12.60	88.20	215.27				1249.31	2161.78
min			16.76	4.90	0.38	7.74	0.22	5.38	1.59	198.00	0.70	35.90	83.25	0.00			137.64	709.81
max			28.36	9.84	0.89	8.31	16.96	94.80	13.44	2019.60	21.80	975.00	3308.29	0.00			28467.07	741793.70
mean			23.18	7.41	0.59	8.05	3.04	31.49	5.47	929.43	9.68	222.38	480.51	0.00			3517.63	71041.85
median			22.50	7.50	0.53	8.08	2.07	29.10	4.37	908.82	8.35	123.50	215.27	0.00			1148.73	8911.18

Total # Samples			**9**	**9**	**9**	**9**	**17**	**18**	**17**	**22**	**22**	**20**	**21**	**1**	**0**	**0**	**21**	**21**
EPL-EPL	08 Jul 02 15:00	CCoWS	29.41	21.17	2.79	9.79	0.00	0.20	0.39	3814.80	3.50		804.43				116.03	400.37
EPL-EPL	29 Aug 02 14:15	CCoWS					0.15	0.00	0.37	3946.80	3.30	444.00	448.27				81.78	427.36
EPL-EPL	13 Sep 02 13:15	CCoWS					0.03	0.20	0.10	3742.20	1.35	1040.00	1088.56				55.00	391.43
EPL-EPL	25 Sep 02 14:00	CCoWS					0.04	0.00	-0.01	4045.80	1.17	729.00	821.80				753.33	12754.91
EPL-EPL	23 Oct 02 13:45	CCoWS	14.97	12.98	2.43	8.54	0.03	0.00	0.05	3795.00	2.20	510.00	566.26				87.00	918.88
EPL-EPL	06 Nov 02 16:30	CCoWS					0.12	-0.30	0.09	3399.00	3.10	345.00	374.46				299.54	436.58
EPL-EPL	15 Nov 02 09:10	CCoWS					4.04	-0.20	1.14	2950.20	11.00	84.30	97.53				56.00	31.97
EPL-EPL	13 Mar 03 15:50	CCoWS	19.86	6.46	1.33	7.44	2.25	0.20	2.67	1650.00	3.00	639.00	592.16				47.00	102.57
EPL-EPL	17 Mar 03 14:30	CCoWS					2.01	1.10	0.72	1320.00	7.60	154.00	137.76				182.36	390.92
EPL-EPL	19 Apr 03 14:07	CCoWS					0.09	0.00	4.01	1557.60	8.20	111.00	106.06				41.44	109.90
EPL-EPL	31 May 03 11:06	CCoWS	20.78	7.17	1.64	8.34	0.19	2.00	1.92	1907.40	6.60	139.00	170.61				73.61	53.55
EPL-EPL	10 Jun 03 12:30	CCoWS	22.57	3.88	1.78	7.92	2.69	5.40	1.46	2039.40	3.37	287.00	222.24				63.00	64.20
EPL-EPL	14 Jul 03 14:25	CCoWS								2461.80	6.40	182.00	245.47				75.00	81.75
EPL-EPL	03 Aug 03 13:37	CCoWS	24.34	9.94	1.97	8.18				2494.80	6.10	177.00	253.53				66.00	24.23
EPL-EPL	19 Sep 03 10:15	CCoWS								2329.80	21.21	605.00	829.42				83.92	97.67
EPL-EPL	21 Oct 03 12:50	CCoWS	19.27	7.45	1.94	7.70				2376.00	6.20	232.00	322.97				51.20	89.34
min			14.97	3.88	1.33	7.44	0.00	-0.30	-0.01	1320.00	1.17	84.30	97.53				41.44	24.23
max			29.41	21.17	2.79	9.79	4.04	5.40	4.01	4045.80	21.21	1040.00	1088.56				753.33	12754.91
mean			20.77	9.12	1.90	8.17	0.90	0.64	0.99	2605.78	5.62	360.16	422.30				127.86	964.70
median			20.78	7.45	1.94	8.18	0.14	0.10	0.56	2444.40	4.80	287.00	348.72				74.30	106.23
Total # Samples			**7**	**7**	**7**	**7**	**12**	**12**	**12**	**16**	**16**	**15**	**16**	**0**	**0**	**0**	**16**	**16**
TEM-PRE	01 Mar 99 15:10	CCAMP	16.40	7.98		8.42												
TEM-PRE	29 Mar 99 12:00	CCAMP	14.20	9.56		8.06	0.60	20.45	0.36				70.00					
TEM-PRE	26 Apr 99 10:40	CCAMP				8.06	0.81	22.70	0.76				47.00		240001.00	1400.00		
TEM-PRE	26 Apr 99 10:45	CCAMP	15.30	6.66		8.15												
TEM-PRE	01 Jun 99 10:05	CCAMP	17.30	9.82		8.55												
TEM-PRE	01 Jun 99 11:00	CCAMP				8.76	0.07	30.34	0.63				81.00		3000.00	500.00		
TEM-PRE	28 Jun 99 16:45	CCAMP				8.26	0.06	22.92	0.01				152.00		5000.00	900.00		
TEM-PRE	29 Jun 99 16:45	CCAMP	21.80			9.55												
TEM-PRE	06 Jul 99 04:45	CCAMP	21.60															
TEM-PRE	26 Jul 99 14:00	CCAMP	17.70	9.19		8.41	0.07	30.11	0.59				28.00		1700.00	30.00		

TEM-PRE	27 Jul 99 06:05	CCAMP	17.48	10.54	1.20													
TEM-PRE	27 Jul 99 11:45	CCAMP	17.26	8.14	1.20													
TEM-PRE	08 Sep 99 11:20	CCAMP	17.60	5.69		8.44	0.12	23.60	0.46				71.00					
TEM-PRE	27 Sep 99 14:15	CCAMP	21.70			8.55	0.05	13.26	0.40				77.00					
TEM-PRE	27 Sep 99 14:25	CCAMP				8.61	0.05	13.26	0.40				78.00					
TEM-PRE	06 Oct 99 04:00	CCAMP	19.20	7.52														
TEM-PRE	01 Nov 99 14:50	CCAMP	16.40	6.00		8.08	2.38	8.31	1.09				87.00		4900.00	490.00		
TEM-PRE	06 Dec 99 11:30	CCAMP				7.94	1.07	10.56	0.46				54.00		2400.00	240.00		
TEM-PRE	10 Jan 00 10:45	CCAMP				8.53	0.16	11.82	0.17	1260.00			58.00		5400.00	240.00		
TEM-PRE	07 Feb 00 10:45	CCAMP	13.40	8.39		8.18	0.82	40.00	0.66	1380.00			74.00		35000.00	2300.00		
TEM-PRE	07 Mar 00 14:10	CCAMP				7.96	0.27	11.87	0.50	553.00			266.00					
min			13.40	5.69	1.20	7.94	0.05	8.31	0.01	553.00			28.00		1700.00	30.00		
max			21.80	10.54	1.20	9.55	2.38	40.00	1.09	1380.00			266.00		240001.00	2300.00		
mean			17.67	8.14	1.20	8.38	0.50	19.94	0.50	1064.33			87.92		37175.13	762.50		
median			17.39	8.14	1.20	8.41	0.16	20.45	0.46	1260.00			74.00		4950.00	495.00		
Total # Samples			**14**	**11**	**2**	**17**	**13**	**13**	**13**	**3**	**0**	**0**	**13**	**0**	**8**	**8**	**0**	**0**
TEM-MOL	08 Mar 00 12:36	CCoWS									5.80		2.25	0.00				
TEM-MOL	12 Nov 01 13:31	CCoWS					0.06	18.98	0.94	2105.40	3.00							
TEM-MOL	01 Jul 02 16:50	CCoWS					0.00	28.00	0.00	2190.00	9.60		165.37					
TEM-MOL	02 Jul 02 09:54	CCoWS	24.14	33.62	1.03													
TEM-MOL	02 Jul 02 09:54	CCoWS	24.04	32.53	1.03													
TEM-MOL	02 Jul 02 09:54	CCoWS	23.87	37.71	1.11													
TEM-MOL	03 Jul 02 16:20	CCoWS	18.58	19.16	1.54													
TEM-MOL	03 Jul 02 16:20	CCoWS	19.78	0.84	25.95													
TEM-MOL	29 Jun 04 09:45	CCoWS	18.87	8.59	3.15	8.02												
min			18.58	0.84	1.03	8.02	0.00	18.98	0.00	2105.40	3.00		2.25	0.00				
max			24.14	37.71	25.95	8.02	0.06	28.00	0.94	2190.00	9.60		165.37	0.00				
mean			21.55	22.07	5.63	8.02	0.03	23.49	0.47	2147.70	6.13		83.81	0.00				
median			21.83	25.85	1.33	8.02	0.03	23.49	0.47	2147.70	5.80		83.81	0.00				
Total # Samples			**6**	**6**	**6**	**1**	**2**	**2**	**2**	**2**	**3**	**0**	**2**	**1**	**0**	**0**	**0**	**0**
OLS-MON	12 Nov 01 13:22	CCoWS					0.37	12.88	0.42	6428.40	7.40							
OLS-MON	01 Jul 02 16:31	CCoWS					0.00	27.00	0.00	3650.00	11.20		180.49					

OLS-MON	03 Jul 02 16:04	CCoWS	17.85	17.94	1.69										
OLS-MON	03 Jul 02 16:04	CCoWS	21.20	14.20	8.17										
OLS-MON	03 Jul 02 16:04	CCoWS	21.39	12.45	8.73										
OLS-MON	01 Mar 99 14:25	CCAMP	17.10			8.38						180.60			
OLS-MON	29 Mar 99 15:50	CCAMP	18.00	12.32		7.83	0.41	15.51	0.56			74.40	82.00		
OLS-MON	26 Apr 99 09:55	CCAMP				8.21	0.57	24.72	0.53			20.00	28.00	5000.00	130.00
OLS-MON	01 Jun 99 10:30	CCAMP				8.90	0.09	18.65	0.01			190.00	402.00	500.00	50.00
OLS-MON	28 Jun 99 15:55	CCAMP				8.50	0.12	5.62	0.05			130.00	279.00	1600.00	300.00
OLS-MON	28 Jun 99 16:05	CCAMP				8.47	0.14	5.62	0.06			125.00	329.00	1700.00	300.00
OLS-MON	29 Jun 99 15:55	CCAMP	22.00	8.56		9.04						136.10			
OLS-MON	26 Jul 99 13:30	CCAMP	17.80	7.63		9.11	0.11	13.48	0.02			200.00	578.00	2100.00	500.00
OLS-MON	27 Jul 99 05:30	CCAMP	16.42	5.43	2.00										
OLS-MON	27 Jul 99 11:10	CCAMP	12.87	7.98	2.00										
OLS-MON	08 Sep 99 10:45	CCAMP	17.00	3.58		8.71	0.24	10.34	0.15			21.00	554.00		
OLS-MON	27 Sep 99 13:35	CCAMP	21.20	7.89		8.94	0.08	4.72	0.16			124.00	276.00		
OLS-MON	06 Oct 99 04:35	CCAMP	15.30	1.83											
OLS-MON	01 Nov 99 14:15	CCAMP	17.60	6.70		9.16	0.03	6.07	0.00			34.00	96.00	3300.00	230.00
OLS-MON	06 Dec 99 10:50	CCAMP				8.42	0.05	1.19	0.06			19.00	40.00	5400.00	350.00
OLS-MON	10 Jan 00 10:15	CCAMP				8.26	0.07	2.36	0.12	1200.00		60.00	108.00	2400.00	490.00
OLS-MON	07 Feb 00 10:00	CCAMP	12.70	8.95		8.19	0.73	29.89	0.63	1720.00		35.00	57.50	24000.00	1750.00
OLS-MON	07 Mar 00 13:40	CCAMP	11.50	9.91		7.97	0.30	11.12	0.59	567.00		170.00	212.00		
OLS-MON	26 Apr 01 11:00	CCAMP	16.59	7.66	12.58	7.81	0.27	42.47	0.52	13000.00		62.00	27.00	11000.00	7000.00
OLS-MON	31 May 01 11:00	CCAMP	21.69	5.98	1.77	8.25	0.06	9.48	0.05	1640.00		154.30	160.00	35000.00	4600.00
OLS-MON	28 Jun 01 09:30	CCAMP	19.64	5.00	3.26	8.52	0.07	10.47	0.05	3580.00		92.70	76.00	24000.00	24000.00
OLS-MON	06 Jul 01 05:28	CCAMP	18.14	5.59	2.28	8.57						197.30			
OLS-MON	25 Jul 01 10:23	CCAMP	18.86	6.64	4.69	8.74	0.16	13.28	0.16	5150.00		63.80	62.00	24000.00	24000.00
OLS-MON	29 Aug 01 02:46	CCAMP	15.89	11.08	-0.02	9.12						136.00			
OLS-MON	30 Aug 01 09:19	CCAMP	17.02	7.11	2.21	9.09	0.05	25.39	0.02	2570.00		75.30	78.00	13000.00	1100.00
OLS-MON	18 Sep 01 10:11	CCAMP	16.22	6.86	1.95	8.63	0.09	18.56	0.06	2170.00		227.30	230.00	9200.00	5400.00
OLS-MON	16 Oct 01 10:44	CCAMP	15.76	5.72	4.58	7.79						194.20		16000.00	16000.00
OLS-MON	13 Nov 01 10:21	CCAMP	15.20	5.27	0.29	7.36						648.20		240000.00	92000.00
OLS-MON	20 Dec 01 09:41	CCAMP	9.69	11.81	5.03	8.07						16.00		900.00	30.00
OLS-MON	21 Jan 02 11:00	CCAMP	8.89	10.81	2.05	7.78						64.60			
min			8.89	1.83	-0.02	7.36	0.00	1.19	0.00	567.00	7.40		27.00	500.00	30.00
max			22.00	17.94	12.58	9.16	0.73	42.47	0.63	13000.00	11.20		578.00	240000.00	92000.00

mean			16.80	8.27	3.72	8.44	0.19	14.71	0.20	3788.67	9.30		192.75		23283.33	9901.67		
median			17.02	7.65	2.21	8.47	0.11	12.88	0.06	2570.00	9.30		134.00		7300.00	800.00		
Total # Samples			**27**	**26**	**17**	**27**	**7**	**21**	**21**	**21**	**11**	**2**	**27**	**20**	**18**	**18**	**18**	**0**
OLS-POT	26 Apr 99 09:45	CCAMP	13.50	9.62		8.58									1700.00	26.00		
OLS-POT	01 Jun 99 08:30	CCAMP	17.20	7.59		8.37												
OLS-POT	01 Jun 99 09:20	CCAMP					0.90	22.02	0.27				191.00		22000.00	300.00		
OLS-POT	28 Jun 99 15:40	CCAMP				8.80	0.07	14.38	0.13				169.00		5000.00	170.00		
OLS-POT	29 Jun 99 11:40	CCAMP	18.70	10.46		8.99												
OLS-POT	06 Jul 99 04:35	CCAMP	16.40	4.35														
OLS-POT	26 Jul 99 13:00	CCAMP	16.20	6.64		8.35	0.07	22.47	0.24				102.00		2400.00	110.00		
OLS-POT	26 Jul 99 13:15	CCAMP				8.51	0.08	23.15	0.25				115.00		900.00	140.00		
OLS-POT	27 Jul 99 05:15	CCAMP	16.97	4.52	7.10													
OLS-POT	27 Jul 99 11:00	CCAMP	17.30	4.06	22.00													
OLS-POT	08 Sep 99 10:30	CCAMP				8.67	0.06	19.10	0.33				108.00					
OLS-POT	08 Sep 99 17:15	CCAMP	15.80	4.79		7.82												
OLS-POT	27 Sep 99 13:20	CCAMP	19.60	6.75		8.77	0.04	4.27	0.17				47.00					
OLS-POT	06 Oct 99 04:45	CCAMP	16.20	2.63														
OLS-POT	01 Nov 99 15:30	CCAMP	16.40	9.65		8.55	0.03	0.79	0.11				62.00		3300.00	490.00		
OLS-POT	06 Dec 99 10:30	CCAMP				8.36	0.04	1.35	0.08				45.00					
OLS-POT	06 Dec 99 10:45	CCAMP				8.34	0.07	1.28	0.08				42.00		3500.00	240.00		
OLS-POT	10 Jan 00 09:45	CCAMP				8.36	0.08	11.80	0.24	2020.00			57.00		790.00	490.00		
OLS-POT	07 Feb 00 09:45	CCAMP	13.20	8.79		8.24	0.54	27.87	0.59	3560.00			36.70		92000.00	54000.00		
OLS-POT	07 Mar 00 13:30	CCAMP	11.10	9.49		7.91	0.34	10.22	0.53	1860.00			170.00					
OLS-POT	12 Nov 01 14:07	CCoWS					0.20	12.20	0.50	10104.60	10.30		123.72					
OLS-POT	01 Jul 02 15:19	CCoWS	19.56	22.69	18.65		0.01	3.70	0.00	8.80	8.80		253.81					
OLS-POT	03 Jul 02 07:37	CCoWS	16.38	17.50	3.73													
OLS-POT	09 Jul 02 10:45	CCoWS	21.82	21.31	4.92	9.02	0.05	0.60	0.07	9.34	10.40		157.98				114.73	104.06
OLS-POT	29 Aug 02 09:45	CCoWS					0.00	19.70	0.64	3841.20	16.00	44.80	53.08				64.46	120.80
OLS-POT	13 Sep 02 10:48	CCoWS					0.03	31.30	0.34	4818.00	10.40	53.40	43.85				54.21	214.81
OLS-POT	25 Sep 02 10:00	CCoWS					0.00	4.95	0.29	6831.00	12.50	53.00	91.01				45.61	112.96
OLS-POT	22 Oct 02 15:20	CCoWS	14.60	8.49	5.23	8.16	0.21	6.90	0.23	10758.00	13.90	47.10	107.95				123.19	493.60
OLS-POT	08 Nov 02 18:32	CCoWS					0.73	9.30	0.73	1485.00	3.00	233.00	296.76				236.55	410.95
OLS-POT	11 Nov 02 11:00	CCoWS					0.14	0.40	0.22		19.00	41.00	118.02				120.41	167.31
OLS-POT	11 Nov 02 12:30	CCoWS					0.10	0.00	0.07		26.50	13.10	9.32					

OLS-POT	14 Feb 03 15:50	CCoWS					0.46	17.20	0.40	10018.80	8.80	115.00	241.02				117.56	211.07
OLS-POT	19 Feb 03 14:50	CCoWS					0.11	0.60	0.55	6514.20	17.00	40.80	108.97				131.27	65.00
OLS-POT	20 Feb 03 17:15	CCoWS					0.08	1.00	0.16	6514.20	17.00	40.80	108.97				111.62	256.36
OLS-POT	12 Mar 03 13:25	CCoWS	20.94	9.38	12.52	7.84	0.22	8.70	0.78	1016.40	4.10	427.00	550.12				87.60	421.99
OLS-POT	17 Mar 03 15:30	CCoWS					0.29	5.00	0.31	666.60	3.90	4869.00	379.06				135.36	394.34
OLS-POT	19 Apr 03 08:55	CCoWS					1.17	21.20	0.75	548.46	8.60	103.00	136.00				70084.21	86549.65
OLS-POT	31 May 03 11:40	CCoWS	21.30	7.48	1.47	8.19	0.54	27.60	1.47	518.76	10.80	76.40	97.70				60.16	262.53
OLS-POT	09 Jun 03 13:00	CCoWS	20.11	11.30	6.98	8.31	0.01	16.30	0.72	7.19	3.19	303.00	328.55				59.00	100.58
OLS-POT	15 Jul 03 15:10	CCoWS	22.54	10.38	11.50	8.41				1279.74	8.80	116.00	439.58				84.00	64.16
OLS-POT	04 Aug 03 09:54	CCoWS	21.76	7.30	3.79	8.16				452.76	11.20	66.00	107.95				62.30	26.50
OLS-POT	19 Sep 03 12:15	CCoWS								1444.08	23.40	31.50	168.88				107.86	128.84
OLS-POT	21 Oct 03 14:30	CCoWS	18.74	8.66	5.54	8.00				9167.40	24.00	20.60	90.96				55.10	84.35
OLS-POT	30 Jun 04 10:51	CCoWS	19.97	9.24	15.34	7.92												
min			11.10	2.63	1.47	7.41	0.00	0.00	0.00	7.19	3.00	13.10	9.32		790.00	26.00	45.61	26.50
max			22.54	22.69	31.33	9.02	1.17	31.30	1.47	31230.00	26.50	4869.00	550.12		92000.00	54000.00	70084.21	86549.65
mean			17.70	8.99	14.30	8.27	0.22	11.51	0.38	7673.60	12.35	352.34	151.70		14621.11	6218.44	3781.85	4746.84
median			17.09	8.58	12.52	8.31	0.08	9.76	0.28	5719.00	10.60	53.40	108.97		3300.00	240.00	107.86	167.31
Total # Samples			**22**	**22**	**12**	**23**	**30**	**30**	**30**	**23**	**22**	**19**	**34**	**0**	**9**	**9**	**19**	**19**
Total # of Samples All Sites			**412**	**407**	**91**	**406**	**461**	**701**	**660**	**568**	**440**	**206**	**669**	**142**	**202**	**202**	**96**	**78**

[Page intentionally left blank]

Appendix F – Watershed Quality Assurance and Project Plan and Monitoring Plan: Invertebrate Sampling

The QAPP and MP were produced as a separate document that was finalized, submitted to SWRCB, and approved in mid 2004.

Appendix G – Submission of data to STORET database

All water quality data collected as part of the project has been submitted to the U.S. Environmental Protection Agency’s STORET database (i.e. MS Excel files were submitted for this purpose by FCSUMB to MCWRA and thence to SWRCB).