California Environmental Protection Agency

Central Coast Regional
Water Quality Control Board

Total Maximum Daily Loads for Sediment Toxicity and Pyrethroid Pesticides in Sediment in the Lower Salinas River Watershed, Monterey County California

Technical Project Report
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TABLE OF CONTENTS

FIGURES

TABLES

LIST OF APPENDICES

LIST OF ACRONYMS AND ABBREVIATIONS

303(d) list	2010 Clean Water Act Section 303(d) List of impaired waters
Agricultural Order	Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands, Order No. RB3-2012-0011
CASQA	California Stormwater Quality Association
CDFW	California Department of Fish and Wildlife
CCAMP	Central Coast Ambient Monitoring Program
Central Coast Water Board	Central Coast Regional Water Quality Control Board
CCC	Criterion Continuous Concentration
CCWQP	Central Coast Water Quality Preservation Inc.
CIMIS	California Irrigation Management Information System
CMC	Criterion Maximum Concentration
CMP	Cooperative Monitoring Program for Irrigated Agriculture
CWA	Clean Water Act
DPR	California Department of Pesticide Regulations

GIS	Geographic Information System
IPM	Integrated Pest Management
Koc	Sorption Coefficient
LC50	Median lethal concentration
MCL	Maximum Contaminant Level
mg/L	Milligrams Per Liter
MS4s	Municipal Separate Storm Sewer Systems
ng/kg	nanogram per kilogram (parts per billion)
ng/L	nanogram per liter (parts per trillion)
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
OAL	Office of Administrative Law
oc	Organic Carbon
ppb	Parts per billion, ug/kg, ng/g, or ug/L
ppm	Parts per million, mg/kg, ug/g or mg/L
PUR	Pesticide Use Report
QAPP	Quality Assurance Project Plan
SWAMP	Surface Water Ambient Monitoring Program
State Water Board	State Water Resource Control Board
TIEs	Toxicity Identification Evaluations
TMDL	Total Maximum Daily Load
TUs	Toxicity Units
ug/g	Microgram per gram (parts per million)
ug/L	Micrograms per liter (parts per billion)
UP3	Urban Pesticide Pollution Prevention
USEPA	United States Environmental Protection Agency
USGS	United States Geologic Survey
WDR	Waste Discharge Requirements

1. INTRODUCTION

1.1. Project Description and Location

This project develops Total Maximum Daily Loads (TMDLs) for sediment toxicity and pyrethroid pesticides in sediment in the lower Salinas River watershed (watershed). Surface waters in the watershed are identified as impaired on the 2010 Clean Water Act Section 303(d) List of impaired waters (303(d) list) due to excessive sediment toxicity to aquatic invertebrates (*Hyalella azteca*). Watershed monitoring data analysis for the TMDL found additional impairments for sediment toxicity and pyrethroid pesticides in sediment, which are addressed in the TMDL. Additionally, several water quality monitoring studies conducted in the watershed link sediment toxicity to concentrations of pyrethroid pesticides in sediment (refer to Appendix A). This report provides the regulatory and technical basis for addressing the impairments by identifying water quality problems, sources of pollutants, and establishing TMDLs, water quality targets, and implementation actions.

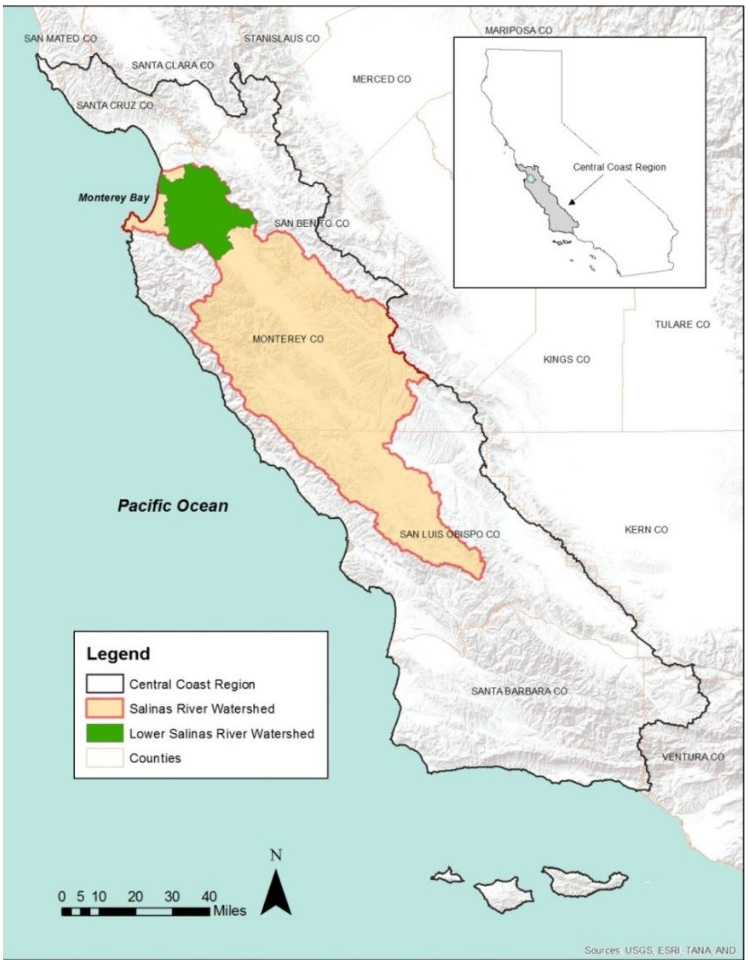

Figure 1-1. General vicinity map of the TMDL project area

1.2. Project Area

The TMDL project area is the lower Salinas River watershed (refer to Figure 1-2), which encompasses an area of approximately 405 square miles in northern Monterey County. It extends from approximately the City of Gonzales north to Monterey Bay and the Pacific Ocean. There are two major drainages in the project area, one is the lower Salinas River and the other is the Reclamation Canal. Section 2 provides more detailed descriptions of the watershed.

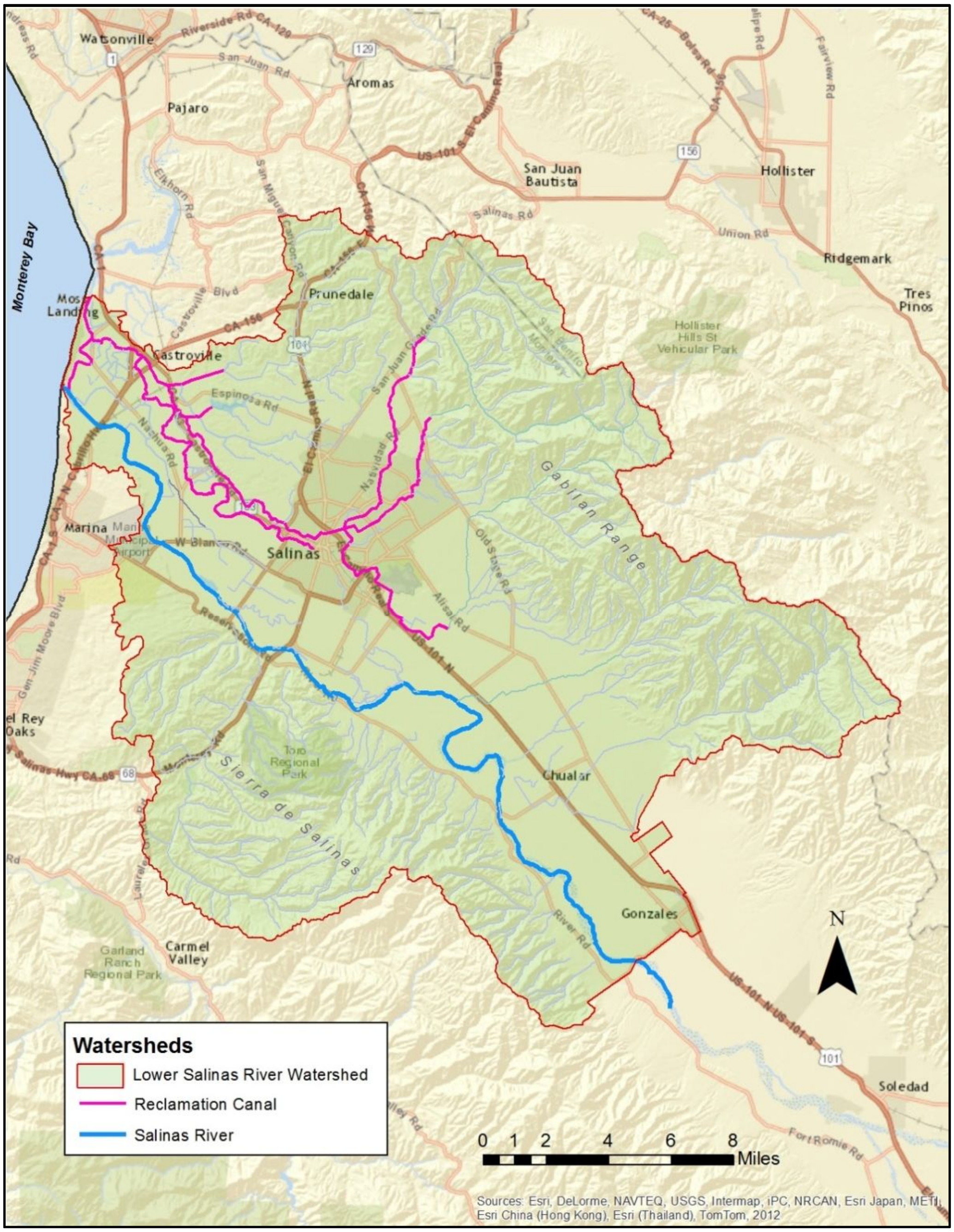

Figure 1-2. Map of project area and major drainages

1.3. Pollutants Addressed

The pollutants addressed in this project are sediments that are toxic to aquatic organisms and pyrethroid pesticides, which are associated with sediment toxicity. Sediments are habitats in streams and lakes for aquatic microorganisms and sediment monitoring and tests with benthic organisms are used to analyze sediments for the presence of toxic chemicals.

The sediment toxicity assessments for the 303(d) list are based on standard USEPA 600 sediment toxicity evaluations to an aquatic invertebrate, *Hyalella azteca* survival (%) 10 days (USEPA, 2002). The monitoring samples were determined to be toxic based on the following definition by the State of California's Surface Water Ambient Monitoring Program (SWAMP): Significant toxicity in the survival endpoint when compared to the negative control based on a statistical test with alpha of less than 5%, and less than the evaluation threshold (both criteria are met) (SWAMP, 2002). The *Hyalella azteca* sediment toxicity compares the survival of a group in a sediment sample to a control group. The evaluation threshold for the toxicity comparison is 80% survival or more.

Studies found sediment toxicity to *Hyalella azteca* to be associated with the presence of pyrethroid pesticides. Some of the studies were conducted in the lower Salinas River watershed and are summarized in Appendix B. Additional studies have established toxicity levels for concentrations of specific pyrethroids in sediments and these concentration levels are used to assess the toxicity levels of pyrethroids in sediment, refer to Section 3.2.

Pyrethroids are synthetic versions of pyrethrins, which are naturally-occurring compounds with insecticidal properties (NPIC, 2014). Pyrethrins are derived from a member of the chrysanthemum plant family. Pyrethroids are structurally similar to natural pyrethrins but are more persistent in the environment and have enhanced biological activity. They have widespread agricultural and urban use; specific pyrethroid pesticides identified in surface waters in the TMDL monitoring assessment include:

- Bifenthrin
- Cyfluthrin
- Cypermethrin
- Esfenvalerate
- Fenvalerate
- Lambda-cyhalothrin
- Permethrin
- Danitol (fenpropathrin)
- Deltamethrin

Pyrethroids have high soil sorption properties and are detected in surface water sediments. Soil sorption along with important pesticide environmental behavior properties such as soil half-life, water solubility, and water half-life are summarized in Table 1-1.

Table 1-1. Summary of pyrethroid physical, chemical, and environmental properties

Common Name	Soil Half-life (days)	Water Solubility (mg/L)	Sorption Coefficient (soil Koc)	Source
Bifenthrin	97-250	<0.001	131,000 – 302,000	(NPIC, 2011)
Cyfluthrin	63	0.002	62,400	(DPR)
Cypermethrin	20	0.004	61,000	(DPR)
Esfenvalerate	39	0.002	215,000	(DPR)
Lambda-cyhalothrin	42.6	0.005	247,000 – 330,000	(DPR)
Permethrin	39.5	0.0055	81,600	(DPR, 2003)

Multiple waterbodies within the lower Salinas River watershed are listed on California's Clean Water Act section 303(d) list for water quality impairments due to sediment toxicity. Additionally, multiple impairments not identified on the current 303(d) list were identified during development of the TMDL; the additional impairments are due to sediment toxicity and the presence of pyrethroid pesticides in sediment. Current 303(d) listings and the additional impairments, all of which are addressed in the TMDL, are summarized in Table 1-2. Although the TMDL identifies and addresses additional impairments, the TMDL process does not directly change the 303(d) list. Changes to the 303(d) list occurs through a separate 303(d) listing process.

Table 1-2 Summary of impairments addressed by this TMDL

Waterbody	303(d) Listed Pollutant	Additional Impairments[1]
Alisal Creek	--	Sediment Toxicity, Pyrethroids
Alisal Slough	Sediment Toxicity	--
Blanco Drain	--	Sediment Toxicity
Chualar Creek	--	Sediment Toxicity
Espinosa Slough	Sediment Toxicity	--
Gabilan Creek	Sediment Toxicity	--
Merrit Ditch	Sediment Toxicity	
Natividad Creek	Sediment Toxicity	Pyrethroids
Old Salinas River	Sediment Toxicity	--
Quail Creek	Sediment Toxicity	--
Salinas Reclamation Canal	Sediment Toxicity	Pyrethroids
Salinas River (lower)	--	Sediment Toxicity, Pyrethroids
Tembladero Slough	Sediment Toxicity	Pyrethroids

[1] Additional impairments are exceedances of water quality objectives in waterbodies identified during TMDL development and subsequent to the most recent 2010 303(d) listing cycle.

1.4. Clean Water Act Section 303(d) List

The basis for protecting our nation's surface waters from pollution is the federal Clean Water Act (CWA). The CWA was originally enacted in 1948 and was extensively revised in 1972 with the goal established "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (USEPA, 2012).

Section 303(d) of the CWA requires states to: 1) identify those waters not attaining water quality standards (these waters are referred to as listed and impaired waters); 2) set priorities for addressing the identified pollution problems; and 3) establish a TMDL for each identified waterbody and pollutant to attain water quality standards. The Water Quality Control Plan-Central Coast Region (Basin Plan), and other applicable plans, serve as the water quality management plan that governs impaired waters in the central coast region. Several waterbodies in the lower Salinas River watershed are listed as impaired due to sediment toxicity on the 2010 303(d) list (refer to Table 1-3 and Figure 1-3).

Table 1-3. Sediment toxicity listing decisions for surface waters in the lower Salinas River watershed and monitoring sites on the 2010 303(d) List

Water Body Name	Monitoring site ID	Exceedances / Samples	Impairments for Sediment Toxicity	Reach Identifier
Alisal Creek	309SA1-2	1/2	No	CAR3097009519990222130537
Alisal Slough	309ASB	2/3	Yes	CAR3091101020090311204028
Blanco Drain	309BLA	0/2	No	CAR3091101019981209161509
Espinosa Slough	309ESP	2/2	Yes	CAR3091101019981230135152
Gabilan Creek	309GAB, 309SG1-3	4/5	Yes	CAR3091900019990304092345
Merrit Ditch	309MER	2/2	Yes	CAR3091101020080604152147
Natividad Creek	309NAD, 309NAD1-3	5/5	Yes	CAR3091101020050531125140
Old Salinas River	309OLD	3/3	Yes	CAR3091101020080611145518
Quail Creek	309QUI	2/2	Yes	CAR3091900020011227140647
Salinas Reclamation Canal	309ALG, 309JON, 309SR1-5	8/9	Yes	CAR3091101019980828112229
Salinas River (lower)	309DAV, 309SAP, 309SSP	1/5	No	CAR3091101020021007193102
Tembladero Slough	309TEH, 309TDW	3/3	Yes	CAR3091101019981209131830

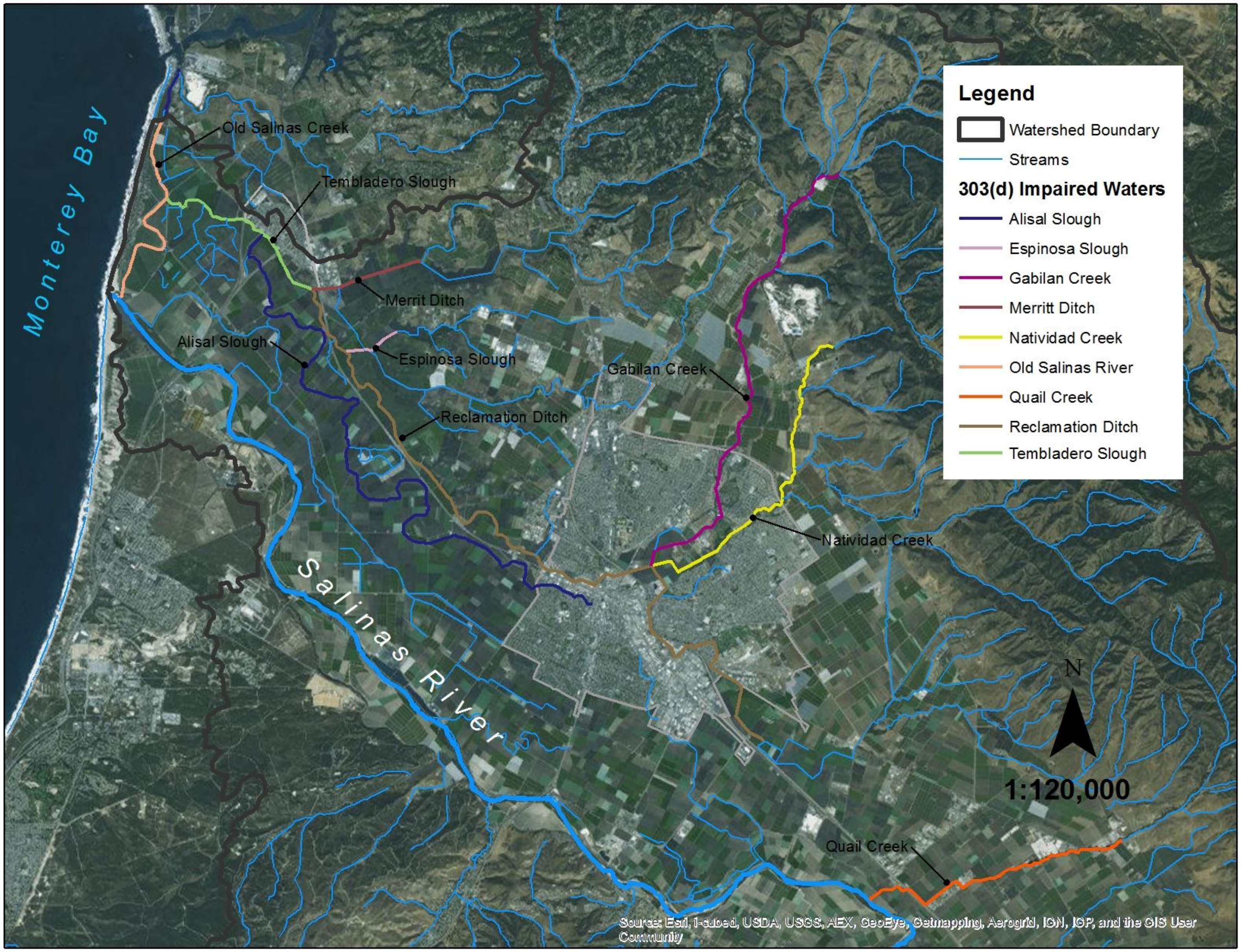

Figure 1-3. Map of sediment toxicity impaired surface waters on the 2010 303(d) list in the watershed

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1.5. Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act (Porter-Cologne) is the state law that establishes and describes the responsibilities and authorities of each of the State and Regional Water Quality Control Boards for the protection of water quality. On the central coast of California, the Central Coast Regional Water Quality Control Board (Central Coast Water Board) establishes water quality objectives and programs by amending the Basin Plan. The TMDLs for this project are proposed as a Basin Plan amendment. Porter-Cologne also contains key definitions for the project such as the following:

> ***"Waters of the state"*** *means any surface water or groundwater, including saline waters, within the boundaries of the state.*
>
> ***"Beneficial uses"*** *of the waters of the state that may be protected against quality degradation include, but are not limited to, domestic, municipal, agricultural and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves.*
>
> ***"Quality of the water"*** *refers to chemical, physical, biological, bacteriological, radiological, and other properties and characteristics of water which affect its use.*
>
> ***"Water quality objectives"*** *means the limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area.*

1.6. Anti-degradation Policy

The state anti-degradation Policy is a resolution in the Basin Plan (Section II.A) intended to maintain the highest level of water quality in the state. It states that wherever the existing quality of water is better than the quality of water established in the Basin Plan as objectives, such existing quality shall be maintained unless otherwise provided by provisions of the state anti-degradation policy. Practically speaking, this means that where water quality is better than necessary to support designated beneficial uses, such existing high water quality shall be maintained and further lowering of water quality is not allowed except under conditions provided for in the anti-degradation policy. The U.S. Environmental Protection Agency (USEPA), Region IX, has also issued detailed guidelines for implementation of federal anti-degradation regulations for surface waters (40 CFR 131.12). The State Water Resources Control Board (State Water Board) has interpreted Resolution No. 68-16 (i.e., the state anti-degradation policy) to incorporate the federal anti-degradation policy in to ensure consistency. It is important to note that federal policy only applies to surface waters, while state policy applies to both surface and ground waters.

Under the state Anti-degradation Policy, whenever the existing quality of water is better than that needed to protect all existing and probable future beneficial uses, the existing high quality shall be maintained unless it has been demonstrated to the state that any change in water quality will be consistent with the maximum benefit of the people of the state, and will not unreasonably affect present and probable future beneficial uses of such water.

1.7. Human Right to Water Law

Water Code section 106.3, the Human Right to Water Law, signed into law September 2012, requires the Water Board to consider how state actions impact the human right to water and creates a state policy priority that directs the Water Board and other state agencies to explicitly consider the human right to water when revising, adopting, or establishing policies, regulations, and grant criteria when those policies, regulations, and grant criteria affect the human right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes within their relevant administrative processes, measures and actions. http://www.leginfo.ca.gov/pub/11-12/bill/asm/ab_0651-0700/ab_685_bill_20120925_chaptered.pdf

The sediment toxicity and pyrethroid pesticide in sediment TMDLs address impacts to aquatic health and specifically toxicity to aquatic invertebrates. The criteria by which these impacts are assessed are in general substantially lower than human health criteria from pyrethroid pesticides.

1.8. Impaired Waters Guidance and Policy

In 2005, State Water Board approved the Impaired Waters Guidance and the Water Quality Control Policy for Addressing Impaired Water: Regulatory Structure and Options (guidance) (SWRCB, 2005). The purpose of the guidance is to establish a consistent framework for developing TMDLs and addressing impaired waters to meet federal regulations and to improve communication with stakeholders. The framework described in the guidance is the basis for the outline of this technical report and is the basis of the overall project work plan. Another purpose of the guidance is to ensure that impaired waters are efficiently and effectively addressed. The guidance outlines regulatory methods for addressing impaired waters and clarifies the TMDL process by providing definitions of key TMDL terms, some of which are list below.

> ***Total Maximum Daily Load (TMDL):*** *A numerical calculation of the loading capacity of a water body to assimilate a certain pollutant and still attain all water quality standards. The sum of the individual waste load allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources and natural background, and a margin of safety (MOS). TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measures that relate to a state's water quality standards.*
>
> ***Impaired Water:*** *A waterbody that has been determined under state policy and federal law to be not meeting water quality standards. An impaired water is a water that has been listed on the California 303(d) list or has not yet been listed but otherwise meets the criteria for listing. A water is a portion of a surface water of the state, including ocean, estuary, lake, river, creek, or wetland. The water currently may not be meeting state water quality standards or may be determined to be threatened and have the potential to not meet standards in the future.*

Pollutants: *The term pollutant is defined in Section 502(6) of the CWA as "dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water."*

Pollution: *The term pollution is defined in Section 502(19) of the CWA as the "man-made or man induced alteration of the chemical, physical, biological, and radiological integrity of water" The term pollution thus includes impairments caused by discharges of pollutants. Pollution is also defined in Section 13050(l) of the California Water Code as an alteration of the quality of the waters of the state by waste to a degree that unreasonably affects either the waters for beneficial uses or the facilities that serve these beneficial uses.*

Water Quality Standard. *Provisions of state and federal law that consist of a designated use or uses for the waters of the United States, water quality criteria for such waters based upon such uses, and an anti-degradation policy. Water quality standards are to protect public health or welfare, enhance the quality of the water, and serve the purpose of the Clean Water Act (40 CFR 131.3). Under California law, designated uses are referred to as beneficial uses. In addition to federally promulgated criteria such as the California Toxics Rule, water quality criteria include California adopted narrative or numerical water quality objectives.*

1.9. Listing Policy

The Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (listing policy) provides guidance on identifying waters that do not meet water quality standards. The listing policy was used by staff in the following data analysis section to confirm impairments on the 303(d) list for sediment toxicity and to evaluate subsequent sediment toxicity and pyrethroid impairments in sediment. Although the listing policy is used for TMDL data analysis, it is a separate process from the 303(d) list evaluation and additional analysis and information gathering may be necessary before incorporating the results of the TMDL analysis into the 303(d) List.

The listing policy has different guidance for different types of pollutants. The policy has guidance for toxicants or conventional pollutants and pesticides are considered toxicants. The toxicity guidance is summarized in Table 1-4.

Table 1-4. Minimum number of measured exceedances needed to place a water segment on the section 303(d) list for toxicants

Sample Size	List if the number of exceedances is equal or greater than
2 – 24	2
25 – 36	3
37 – 47	4
48 – 59	5
60 – 71	6

1.10. Beneficial Uses and Water Quality Objectives

Surface waters in the lower Salinas River watershed are impaired with sediment toxicity and pyrethroid pesticides in sediment. These impairments are in violation of the Basin Plan's general narrative objectives for toxicity and pesticides and therefore aquatic life-related beneficial uses are not being protected. Some of TMDL waterbodies have beneficial uses identified in the Basin Plan and they are listed in Table 1-5 and are described in Table 1-6. The protection of beneficial uses of water is the foundation of water quality protection and is the basis used to establish water quality objectives, which were adopted by the Central Coast Water Board and are described in Chapter 3 of the Basin Plan.

Table 1-5. Basin Plan designated beneficial uses for inland waters in the watershed.

Waterbody Names	MUN	AGR	PRO	IND	GWR	REC1	REC2	WILD	COLD	WARM	MIGR	SPWN	BIOL	RARE	EST	FRESH	COMM	SHELL
Old Salinas River Estuary						X	X	X	X	X	X	X	X	X	X		X	X
Salinas River Lagoon (North)						X	X	X	X	X	X	X	X		X		X	X
Tembladero Slough						X	X	X		X		X		X	X		X	X
Espinosa Lake						X	X	X		X							X	
Espinosa Slough						X	X	X		X							X	
Salinas Reclamation Canal						X	X	X		X							X	
Gabilan Creek	X	X			X	X	X	X		X		X					X	
Alisal Creek	X	X			X	X	X	X	X	X		X					X	
Blanco Drain						X	X	X		X							X	
Salinas River, downstream of Spreckels Gage	X	X				X	X	X	X	X	X					X	X	
Salinas River, Spreckels Gage-Chualar	X	X	X	X	X	X	X	X	X	X	X						X	

Table 1-6. Description of Beneficial Uses

Abbreviations	Descriptions
MUN	Municipal and domestic water supply
AGR	Agricultural supply
PRO	Industrial process supply
IND	Industrial service supply
GWR	Ground water recharge
REC1	Water contact recreation
REC2	Non-Contact water recreation
WILD	Wildlife habitat
COLD	Cold fresh water habitat
WARM	Warm fresh water habitat
MIGR	Migration of aquatic organisms
SPWN	Spawning, reproduction, and/or early development
BIOL	Preservation of biological habitats of special significance
RARE	Rare, threatened, or endangered species
EST	Estuarine habitat
FRESH	Freshwater replenishment
COMM	Municipal and domestic water supply
SHELL	Industrial service supply

The water quality objectives are either specific to a beneficial use or are general objectives for all beneficial uses. The water quality objectives applicable to water toxicity and pesticide detections are general objectives and, therefore, applicable to all inland surface waters, enclosed bays, and estuaries, and are described below:

> <u>General Objective for Toxicity:</u>
> *All waters shall be maintained free of toxic substances in concentrations which are toxic to, or which produce detrimental physiological responses in, human, plant, animal, or aquatic life. Compliance with the objective will be determined by use of indicator organisms, analyses of species diversity, population density, growth anomalies, toxicity bioassays of appropriate duration, or other appropriate methods.*
>
> <u>General Objective for Pesticides:</u>
> *No individual pesticide or combination of pesticides shall reach concentrations that adversely affect beneficial uses. There shall be no increase in pesticide concentrations found in bottom sediments or aquatic life*.

Federal regulations state "TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate *measure*."[Emphasis added](40 CFR § 130.2(i)). To set the appropriate *measures* for the watershed, pesticide concentration levels consistent with the narrative pesticide and toxicity objectives must be identified.

The Basin Plan does not contain numeric objectives for the pyrethroid pesticide pollutants addressed in the TMDL. Therefore, staff evaluated published numeric criteria for the interpretation of narrative toxicity and pesticide water quality objectives. The basis of this evaluation is the Central Valley Regional Quality Control Water Board's Policy for Application of Water Quality Objectives that states that the board will consider *"relevant numerical criteria and guidelines developed and/or published by other agencies and organizations. When considering such criteria, the Water Board will evaluate whether the specific available numeric criteria are relevant, appropriate, and should be applied in determining compliance with the Basin Plan narrative objective."* For the sediment toxicity and pyrethroid pesticideTMDLs and targets, staff has considered criteria from multiple sources to find ones that are appropriate and scientifically defensible.

2. WATERSHED DESCRIPTION

2.1. Topography

The lower Salinas River watershed drains from the City of Gonzales northwest to the Pacific Ocean (refer to Figure 1-1 and Figure 1-2). The watershed is bound on the east by the Gabilan Range that runs in a southeast-northwest direction and it is bound on the west by the Sierra De Salinas Range, which also runs in a southeast-northwest direction. The Salinas River traverses the fluvial valley floor that abounds with extensive irrigated agricultural vegetable crops and berries until it reaches the coastal dunes and Monterey Bay. Sand hills on the northern end of the valley separate the Salinas Valley from the Moro Cojo and Elkhorn Slough watersheds.

2.2. Watershed Drainage Boundaries

The lower Salinas River watershed project area is shown in Figure 1-1 and Figure 1-2. The total watershed area is 249,506 acres or 309 square miles. The watershed is comprised of 18 subwatersheds that are shown in Figure 2-1 and summarized in Table 2-1.

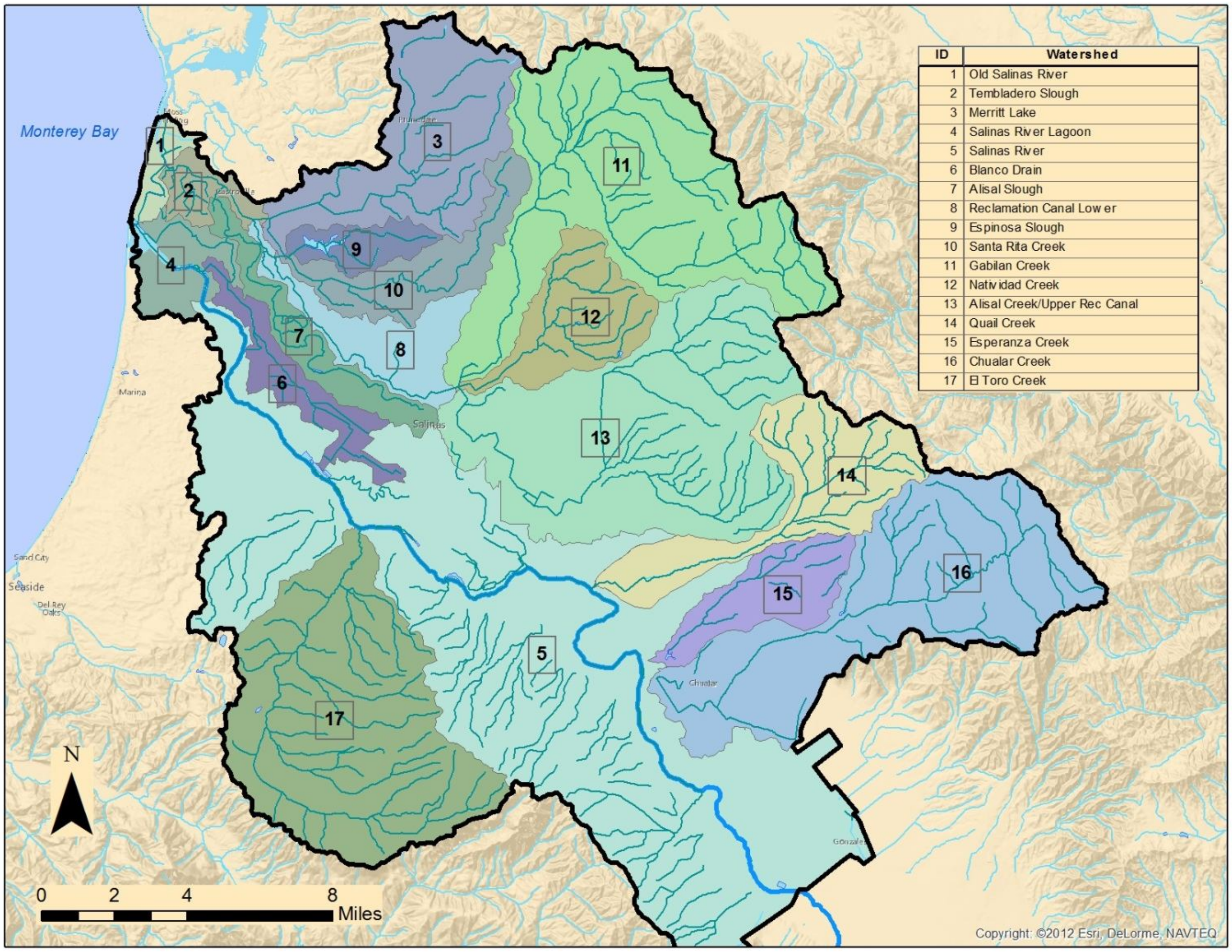

Figure 2-1. Subwatersheds in the lower Salinas River watershed.

Table 2-1. Subwatersheds.

Watershed ID	Subwatershed	Acres	Square Miles
1	Old Salinas River	1,492	2.3
2	Tembladero Slough	2,154	3.4
3	Merritt Lake	14,236	22.2
4	Salinas River Lagoon	3,837	6.0
5	Lower Salinas River	69,774	109.0
6	Blanco Drain	4,442	6.9
7	Alisal Slough	4,621	7.2
8	Reclamation Canal, Lower	5,729	9.0
9	Espinosa Slough	2,655	4.1
10	Santa Rita Creek	6,348	9.9
11	Gabilan Creek	27,957	43.7
12	Natividad Creek	7,337	11.5
13	Alisal Creek/Reclamation Canal, Upper	29,656	46.3

Watershed ID	Subwatershed	Acres	Square Miles
14	Quail Creek	11,097	17.3
15	Esperanza Creek	5,687	8.9
16	Chualar Creek	25,422	39.7
17	El Toro Creek	27,062	42.3
TOTAL		249,506	390

2.3. Hydrology

There are two major stream systems in the lower Salinas River watershed, one is the Salinas River and the other is the Reclamation Canal (Refer to Figure 1-2). The Salinas river flows in a northwesterly directions from the headwaters in San Luis Obispo County to Monterey County and Monterey Bay (refer to Figure 2-2). There are several major tributaries to the Salinas River upstream of the project area including the Nacimiento and San Antonio Rivers and the Arroyo Seco. These tributaries drain large coastal range watersheds and supply water for the valley. There are reservoirs on the Nacimiento and San Antonio Rivers and releases from the reservoirs provide water for groundwater recharge and aquatic habitats along the Salinas River. The Salinas River supports groundwater basins that are pumped for year round agricultural production and municipal supply. In the project area there are several small tributaries to the Salinas River including Chualar Creek, Quail Creek, and Blanco drain. At the coast the Salinas River either outlets to the Salinas Estuary and Monterey Bay or heads north in the Old Salinas River channel to Moss Landing.

The Reclamation Canal System flows from its natural headwaters in the Gabilan Range to the City of Salinas were it becomes a modified earthen drainage. It flows from the City of Salinas to the community of Castroville where it drains into Tembladero Slough. Tembladero Slough outlets into the Old Salinas River Channel, which flows north parallel to the coastline into Moss Landing Harbor at Porterro Road and the Elkhorn Slough Estuary. In summary, the Reclamation Canal System is comprised of four main connected streams: Gabilan Creek, the Reclamation Canal, Tembladero Slough and the Old Salinas River Channel. The are several tributaries, which from the headwaters to the outlet are Natividad Creek, Alisal Creek, Santa Rita Creek and Merrit Ditch. Two sloughs also connect into the Reclamation Canal drainage system; they are the Alisal and Espinosa Sloughs. There are also several lakes in the systems including Carr Lake, which is a drained lake basin farmed in the middle of the City of Salinas, and Merritt and Espinosa Lakes.

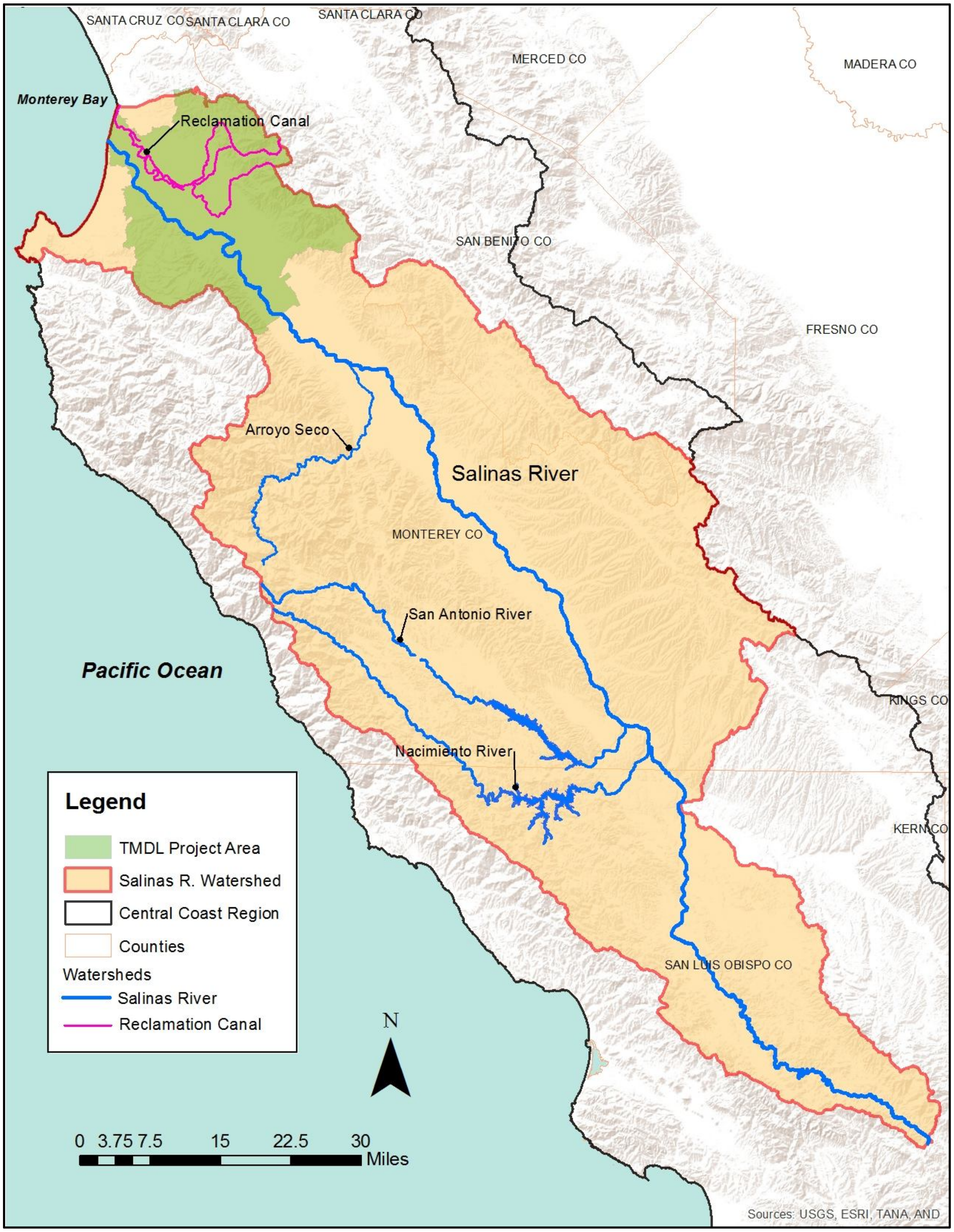

Figure 2-2. Major streams

2.4. Wetland Assessment

Wetlands provide a range of important ecological and hydrological functions in a watershed. In the lower Salinas River watershed, wetlands are ecologically important habitats for fish, wildlife and plants. Streams are important migration corridors for endangered anadromous steelhead that spawn in the headlands of the Salinas River. The estuaries and sloughs in the lower watershed are important fish rearing habitat and habitat for migratory birds. Wetlands also detain runoff and degrade pollutants. Staff assessed the spatial extent of existing wetlands using U.S. Fish and Wildlife Service wetland map layers that are based on the Cowardin wetland classification system (Cowardin, 1979). Wetland geographic information system (GIS) layers were developed for U.S. Fish and Wildlife Service by the Watershed Institute (CoWS, 2008) with features digitized into GIS layers from high-resolution imagery and field verified.

Wetlands areas are summarized according to subwatershed in Table 2-2. and are mapped in Figure 2-3 and in Figure 2-4. Subwatersheds are mapped in Figure 2-1. There are just less than 8,000 acres of wetlands in the entire 250,000 acres watershed, which is about 3% of the total project area. 40% of the wetlands in the project area are located in the Salinas River and Salinas River Lagoon subwatersheds. 40% of the wetlands in the watershed are riverine, 15% are freshwater emergent wetlands and 30% are freshwater forested/scrub wetlands. In the project area there are also 309 acres of estuarine wetlands, which are located primarily in the Salinas River Lagoon watershed (281 acres) along with a small amount in the Old Salinas River watershed (28 acres).

Table 2-2. Inventory of existing wetlands in the watershed

Subwatersheds	**Acres of Wetland**							**Total Acres in the Watershed**	**% Total Wetlands in Watershed**
	Estuarine and Marine Deepwaters and Wetlands	**Freshwater Emergent Wetland**	**Freshwater Forested /Shrub Wetland**	**Freshwater Pond**	**Lake**	**Riverine**	**Total Wetlands**		
Alisal Creek/Upper Rec Canal		62.9	147.7	54.0		396.9	661.5	29,656	2%
Alisal Slough		22.7	1.4	1.4		16.6	42.1	4,621	1%
Blanco Drain		3.9	0.5		0.2	23.5	28.1	4,442	1%
Chualar Creek		55.2	108.0	42.0		312.4	517.6	25,422	2%
El Toro Creek		85.8	230.7	34.1		439.5	790.1	27,062	3%
Esperanza Creek		30.4	8.2	16.7		56.0	111.3	5,687	2%
Espinosa Slough		63.9	44.7	2.3	56.8	10.8	178.5	2,655	7%
Gabilan Creek		168.9	543.8	64.1		273.0	1049.8	27,957	4%
Merritt Lake		136.4	117.1	32.6		82.6	368.7	14,236	3%
Natividad Creek		75.8	81.8	52.1		71.7	281.4	7,337	4%
Old Salinas River	28.3	178.6		2.3		20.3	229.5	1,492	15%
Quail Creek		5.8	48.6	9.4		179.5	243.3	11,097	2%
Reclamation Canal Lower		12.1	7.2	3.4		37.1	59.8	5,729	1%
Salinas River		212.6	981.5	393.6	106.8	1126.2	2820.7	69,774	4%
Salinas River Lagoon	281.0	31.4	64.6	4.1		53.0	434.1	3,837	11%
Santa Rita Creek		15.6	11.5	14.9		52.1	94.1	6,348	1%
Tembladero Slough		3.8	3.5	6.4		26.5	40.2	2,154	2%
Watershed Total	309.3	1165.7	2400.6	733.4	163.8	3177.5	7950.3	249,506	3%
% Total Wetlands	4%	15%	30%	9%	2%	40%	100%		

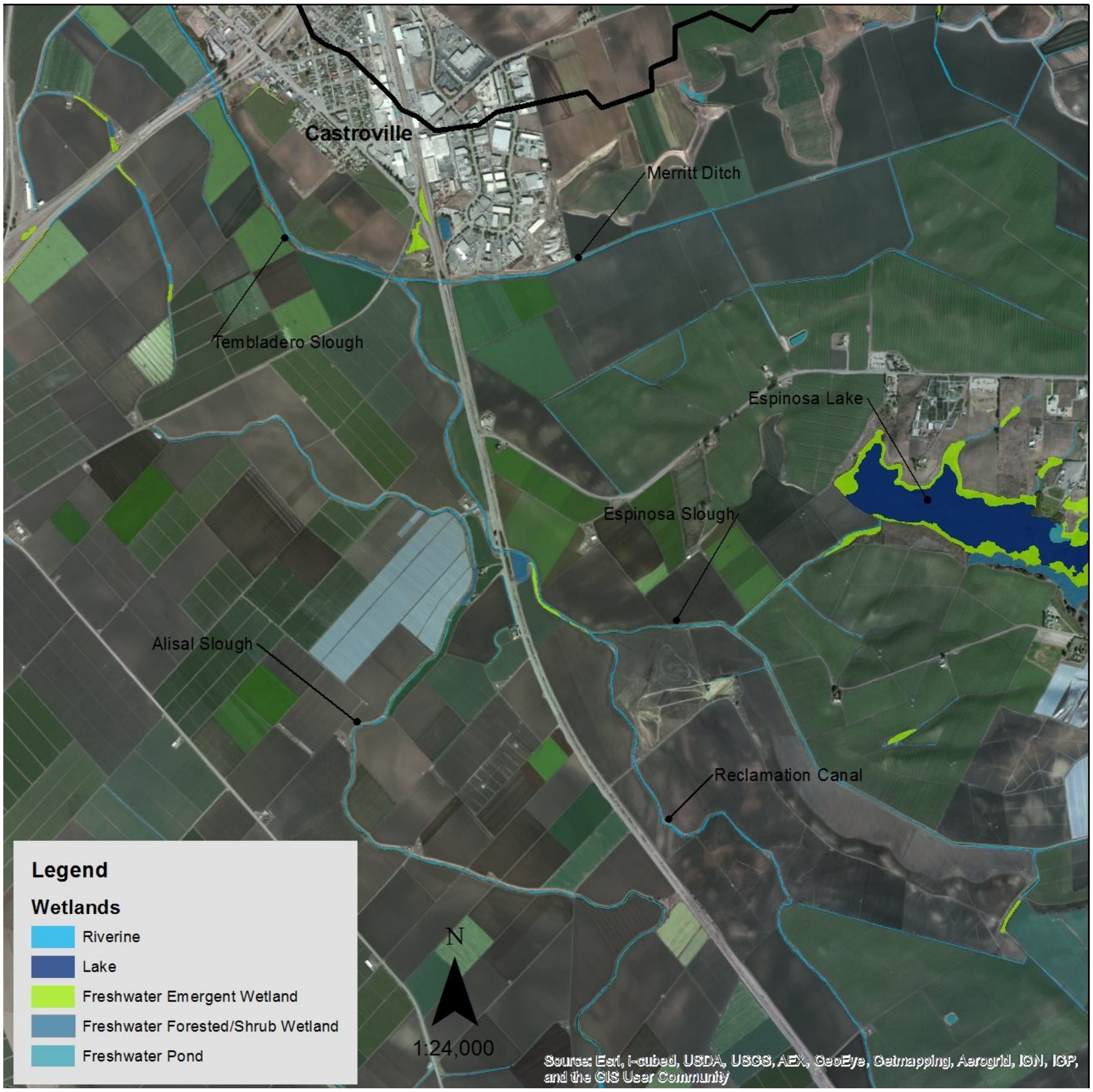

Figure 2-3. Existing wetlands south of Castroville in the Reclamation Canal watershed.

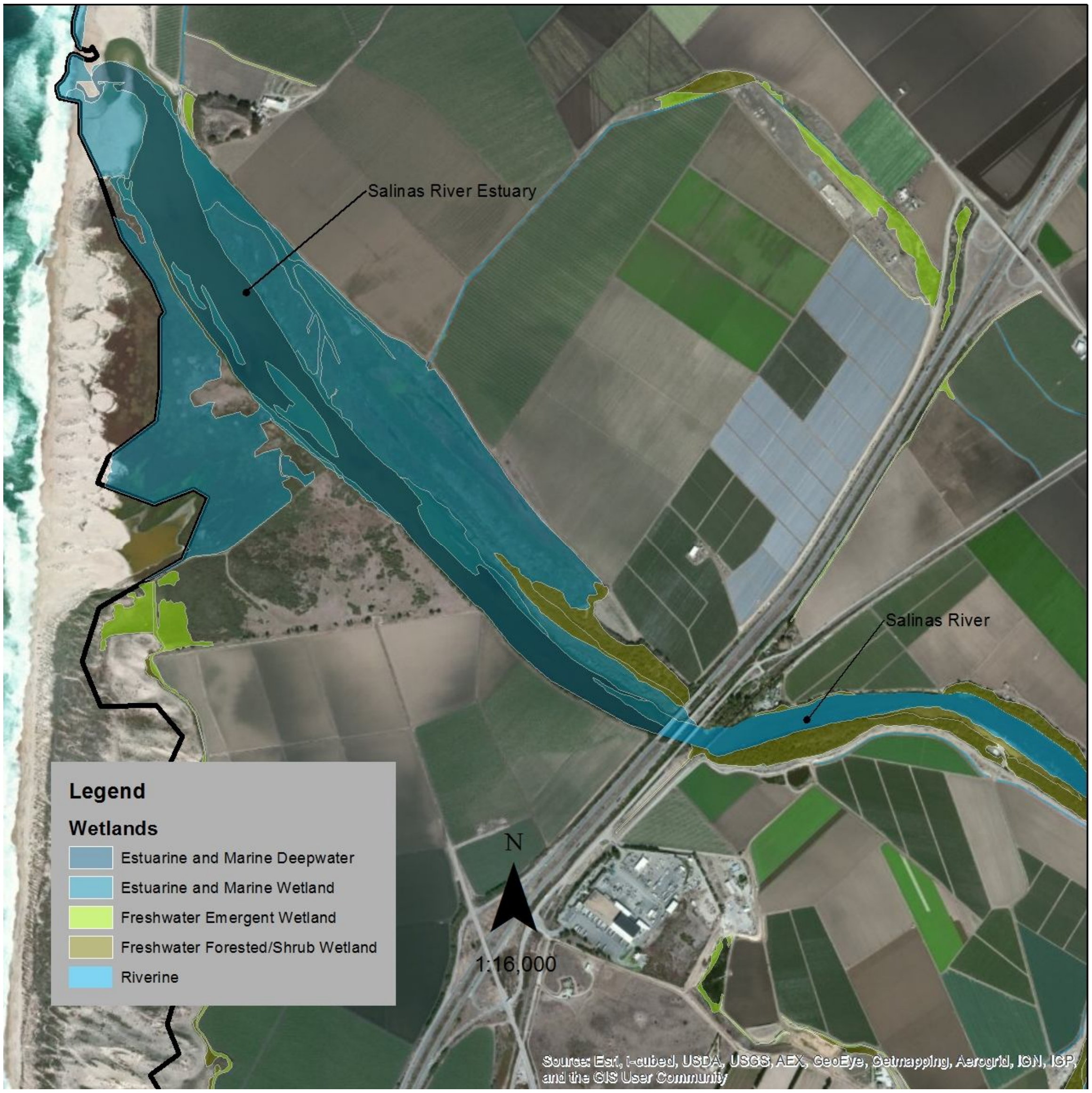

Figure 2-4. Existing Salinas River estuary and adjacent wetlands

2.5. Historical Ecology Wetland Assessment

Historical ecology is a way to understand past and present wetland ecology and hydrology in a watershed. The historical ecology of Elkhorn Slough and lower Salinas River watersheds was researched and mapped by the staff of the Elkhorn Slough Foundation and Elkhorn Slough National Estuarine Research Reserve (Elkhorn Slough Foundation). The Elkhorn Slough Foundation developed a draft historical ecology GIS layer of the lower Salinas River watershed and Reclamation Canal watersheds that is shown in Figure 2-5. A coinciding map of currently existing wetlands is shown in Figure 2-6. The historic map is based on historic accounts and maps of the watershed including: Mexican rancho maps from the early 1800s, early American land surveys, newspaper accounts, soil surveys, and engineering maps and plans (Elkhorn, 2015).

Man has significantly altered the hydrology in the watershed and in the early 1900s plans were drawn for the reclamation district for the construction of canals and laterals. Chief Engineer of Salinas, Lou. G Hare drew plans to reclaim sloughs and lakes in the Tembladero Gabilan watershed (refer to Figure 2-7). Some of the reclaimed areas are Merrit Lake, Espinosa Lake, Santa Rita Slough, Vierra Lake, Boronda Lake, Mill Lake, Carr Lake, Mud Lake and Heinz Lake. The current Reclamation Canal connects and drains these reclaimed areas and the upper watersheds of Natividad and Gabilan Creeks. Historic accounts also indicate that prior to development in the valley; the Salinas River flowed north to Elkhorn Slough, through the Old Salinas River channel and did not breach to the ocean at the location of the current Salinas River Estuary but drained to what is now Moss Landing. Flow in the Old Salinas River channel is now controlled with tide gates.

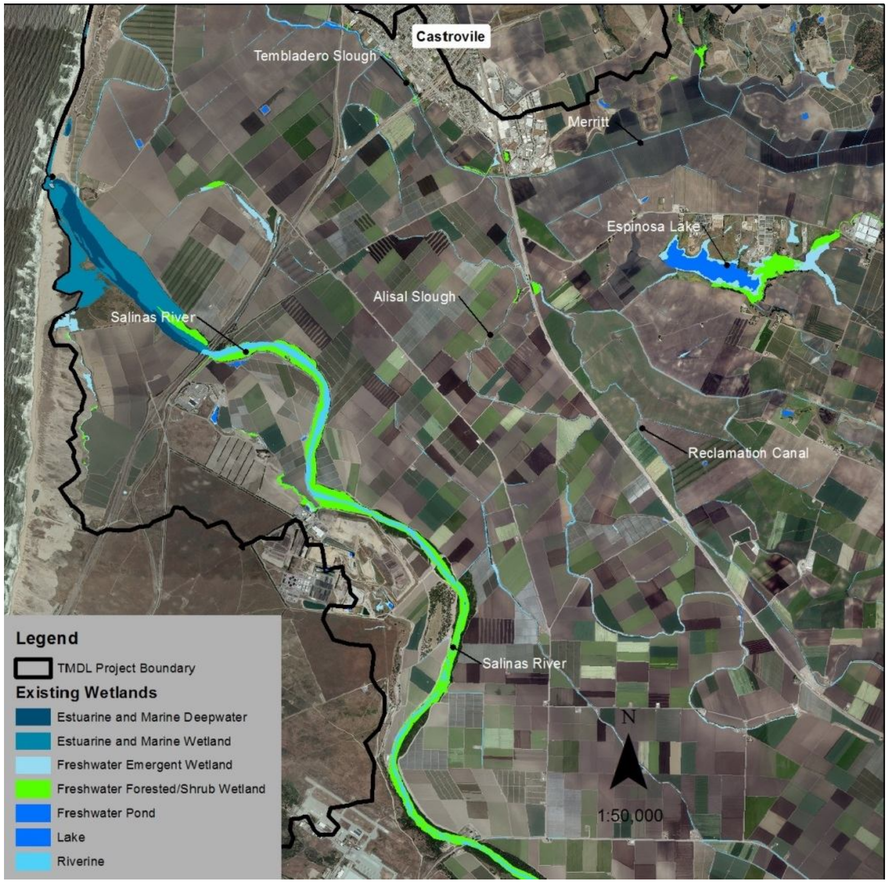

Figure 2-5. Existing wetlands in the lower Salinas watershed

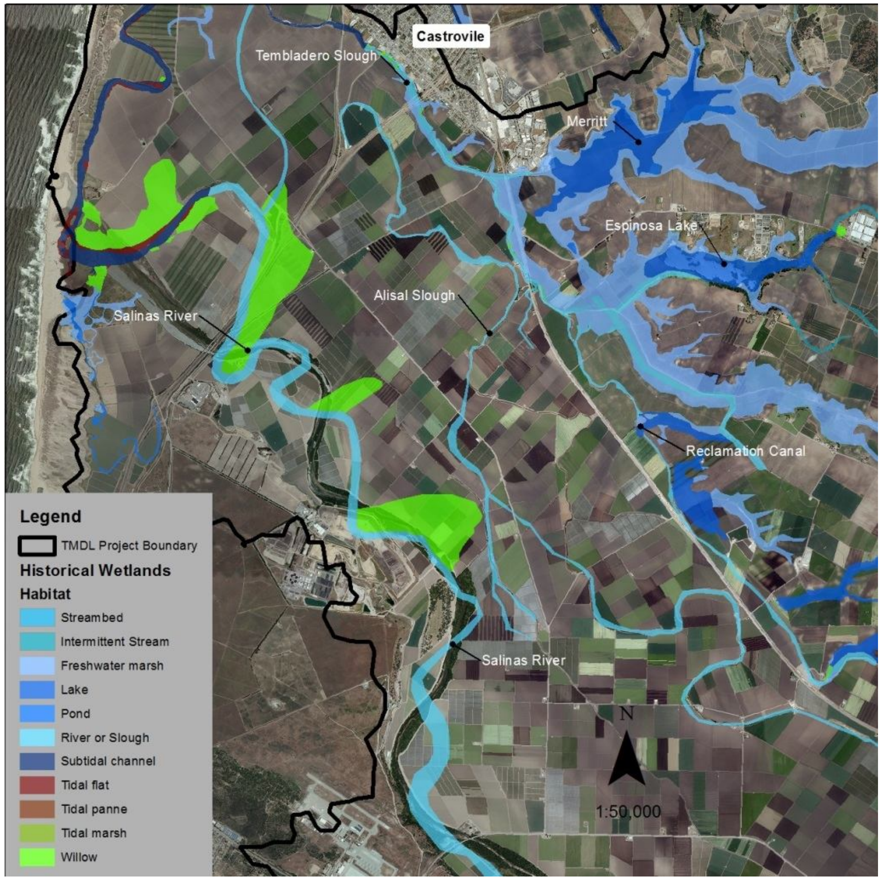

Figure 2-6. Historical wetlands in the lower Salinas watershed

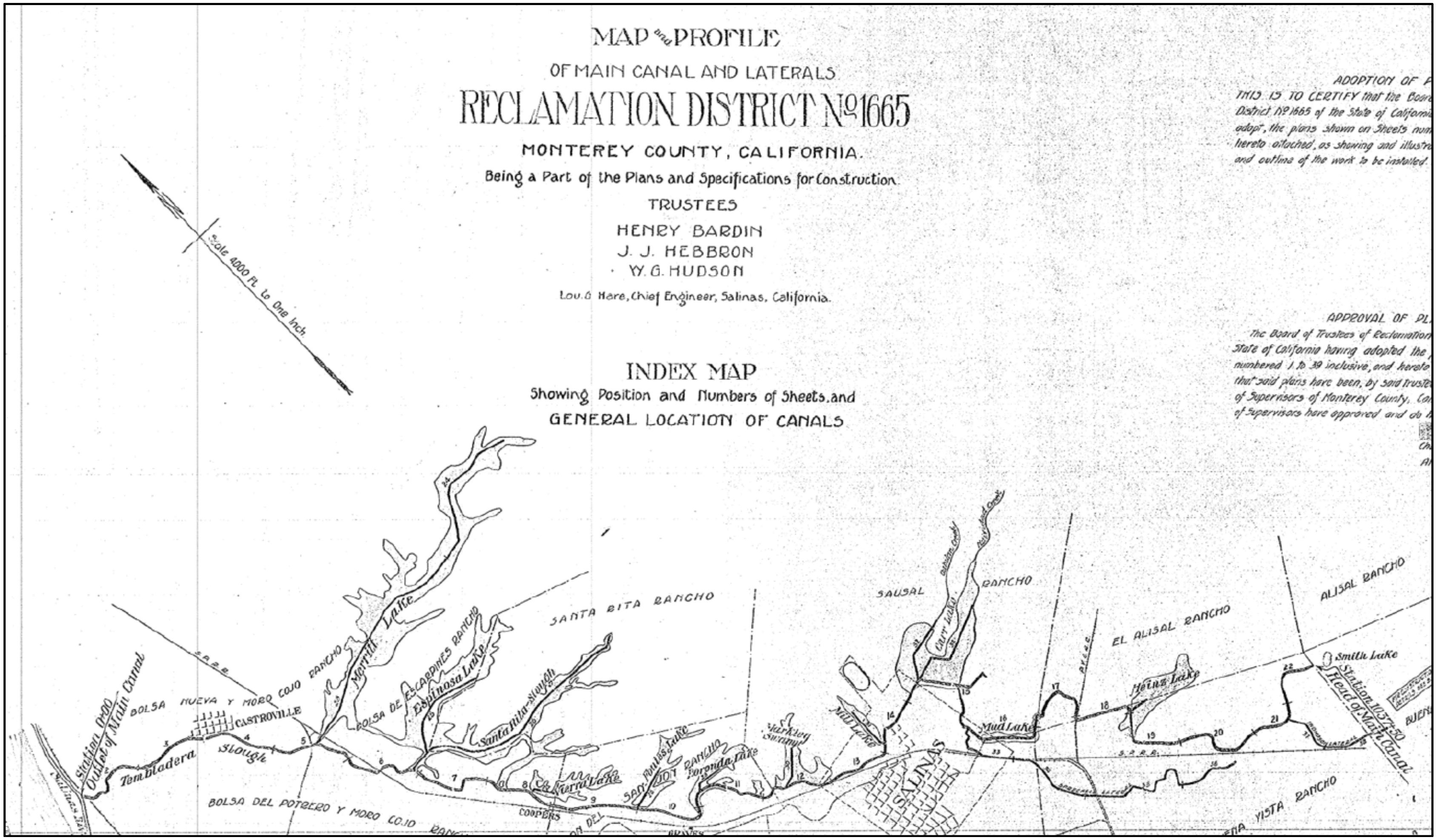

Figure 2-7. Historic map of the Reclamation Canal and laterals

2.6. Communities, Housing and Populations

The lower Salinas River watershed is located in Monterey County and there are five communities in the watershed. Two are incorporated cities; Salinas and Gonzales and three are unincorporated communities under County jurisdiction; Castroville, Spreckels and Chualar. The largest city is the Monterey County seat, Salinas with a population of over 150,000 (Census 2010). Salinas is the major population center of the watershed. Over one third of the Salinas population is foreign born and over 20% of the population is below the poverty level. Additionally, the education level is much lower than the county and state levels.

Table 2-3. Communities in the Salinas River watershed and community and statewide facts

Community Fact	Community						
	Castroville	**Salinas**	**Spreckels**	**Chualar**	**Gonzales**	**Monterey County**	**State of California**
Population	6,481	150,441	673	1,190	8,364	415,057	37,253,956
Foreign born population	3,077	55,776	25	598	3,174	126,439	10,104,739
Housing Units	1,500	42,652	308	256	2,127	139,086	13,667,226
Age (median)	26.8	28.6	36.1	28.3	28.2	32.9%	35.2
Income (median)	52,771	50,587	79,358	58,214	56,415	60,143	61,400
Individuals below Poverty Level	20.7%	20.8%	1.4%	6.4%	16.3%	16.1%	15.3%
Education Attainment: % high school grad or greater	34.4%	60.0%	94.6%	44.9%	54.0%	70.4%	81.0%

Source: 2010 United States Census

2.7. Climate and Evapotranspiration

The lower Salinas River watershed has a cool-summer Mediterranean climate, which is strongly influenced by its location along the Pacific Ocean. The ocean influence has a moderating effect on the average temperatures as indicated in Figure 2-8, which is a summary of climate data from a California Irrigation Management Information System (CIMIS) weather station in Castroville. CIMIS refers to the California Information System and the site is managed by the California Department of Water Resources and the University of California to assist irrigators in managing water resources. There are two CIMIS stations in the watershed, one in Castroville and another referred to as Salinas North, which is located just northwest of the City of Salinas. The automatic sites also record rainfall and evapotranspiration rates, which is the combined evaporation and transpiration waters loss from soil and plants. Evapotranspiration is important information for efficient irrigation scheduling and can aid in reducing irrigation runoff and sedimentation. Rainfall averages around 15 inches per year at the two CIMIS stations and the annual evapotranspiration is about 36 inches per year (refer to Table 2-4).

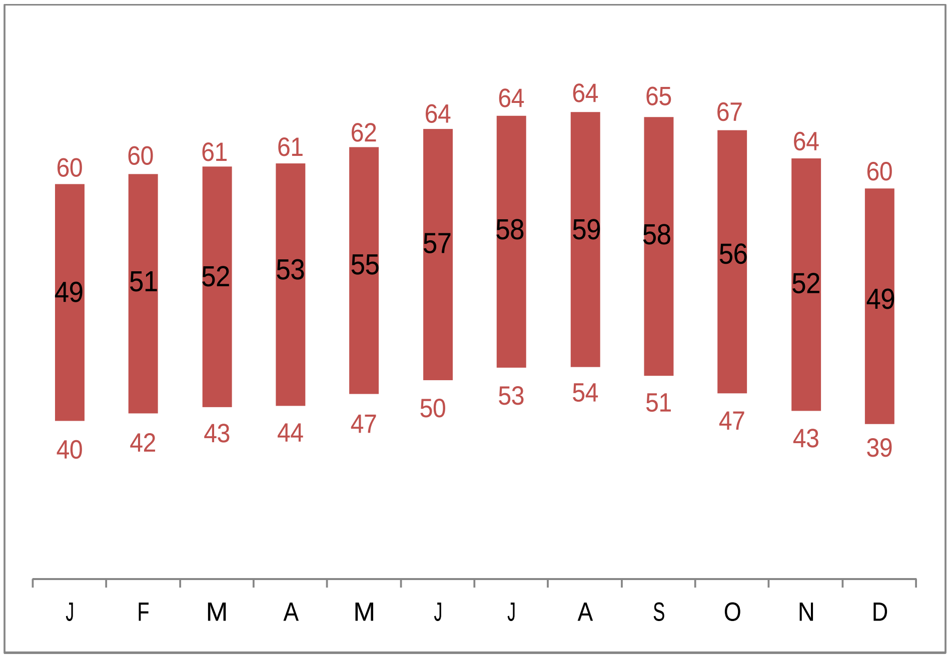

Figure 2-8. Average air temperatures (F) at Castroville CIMIS station. Average max. and min. shown in red and average – average in black (1990 to 2012).

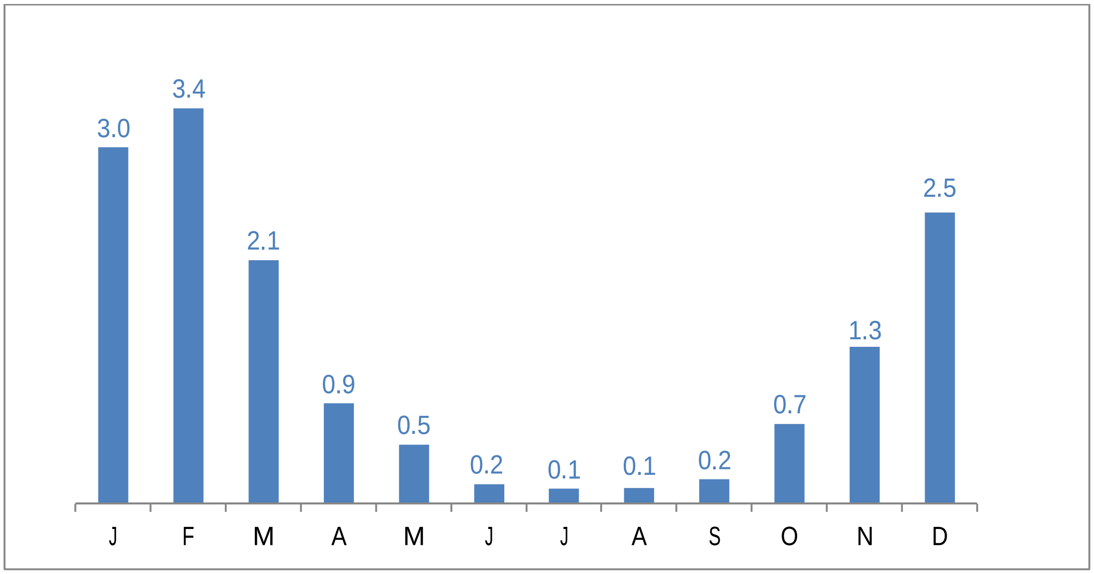

Figure 2-9. Average rainfall in inches at the Castroville CIMIS station.

The rainfall patterns in the lower Salinas River watershed are typical of a Mediterranean climate with little if any summer rainfall and with rain predominantly in the winter months as shown in Figure 2-9, rainfall data for the Castroville CIMIS station.

Table 2-4. Monthly and total annual reference evapotranspiration rates.

Month	Station Name and Id Monthly ETo (inches of water)	
	Castroville - 19	Salinas North - 116
Jan	1.44	1.21
Feb	1.71	1.54
Mar	2.96	2.88
Apr	4.19	4.08
May	4.63	4.56
Jun	4.81	5.16
Jul	4.03	4.47
Aug	3.81	4.3
Sep	2.98	3.2
Oct	2.63	2.75
Nov	1.62	1.5
Dec	1.39	1.23
Total	36.2	36.88

California and the Salinas Valley are experiencing an unprecedented drought and on January 17, 2014, a drought state of emergency was declared by Governor Jerry Brown. In California, 2014 was the third driest in the past 113 years on record and in the Salinas Valley, rainfall was less than half of normal and reservoir levels and most groundwater elevations have greatly declined (MCWRA, 2014).

2.8. Land Use / Land Cover

Land cover analysis using remote sensing tools such as the National Land Cover Data (NLCD) provides a means of interpreting the land use from land areas. Staff used GIS to summarize the NLCD in the watershed using the latest available 2011 dataset. The NLCD is based on 30-meter Landsat digital satellite imagery of the earth. The imagery data is interpreted to thematic classifications of land cover. The interpretation of the lower Salinas River watershed is found in Figure 2-10 and is summarized in Table 2-5 and Figure 2-11. The predominant land covers in the project area are cultivated crops or cropland, which dominates the floor of the valley. 17% of the watershed is developed at several levels of intensity. The watershed is bordered to the northeast and to the southwest with less developed forest and grasslands. Wetlands (open water, woody wetlands, and emergent herbaceous wetlands) comprise only a small area of the total land cover, approximately 2%.

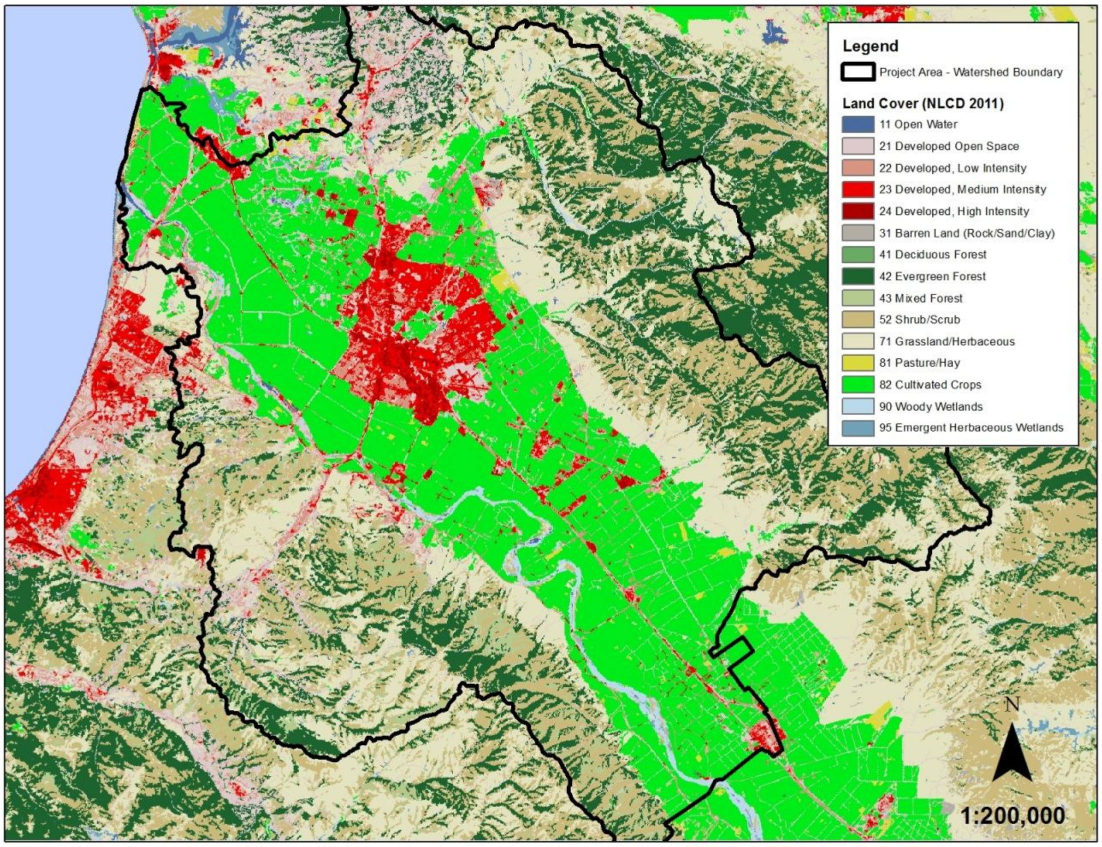

Figure 2-10. Project area percent land cover and acres.

Table 2-5. Land cover in the project area.

Id - Land Cover	Percent	Acres
11 - Open Water (Wetlands)	<1%	498
21 - Developed Open Space	8%	20,502
22 - Developed, Low Intensity	4%	10,847
23 - Developed, Medium Intensity	4%	10,070
24 - Developed, High Intensity	1%	2,038
31 - Barren Land (Rock/Sand/Clay)	0%	591
41 - Deciduous Forest	0%	5
42 - Evergreen Forest	14%	34,584
43 - Mixed Forest	3%	7,298
52 - Shrub/Scrub	17%	42,113
71 - Grassland/Herbaceous	17%	43,370
81 - Pasture/Hay	1%	1,252
82 - Cultivated Crops	29%	72,393
90 - Woody Wetlands	1%	2,922
95 - Emergent Herbaceous Wetlands	<1%	858
Total	100%	249,341

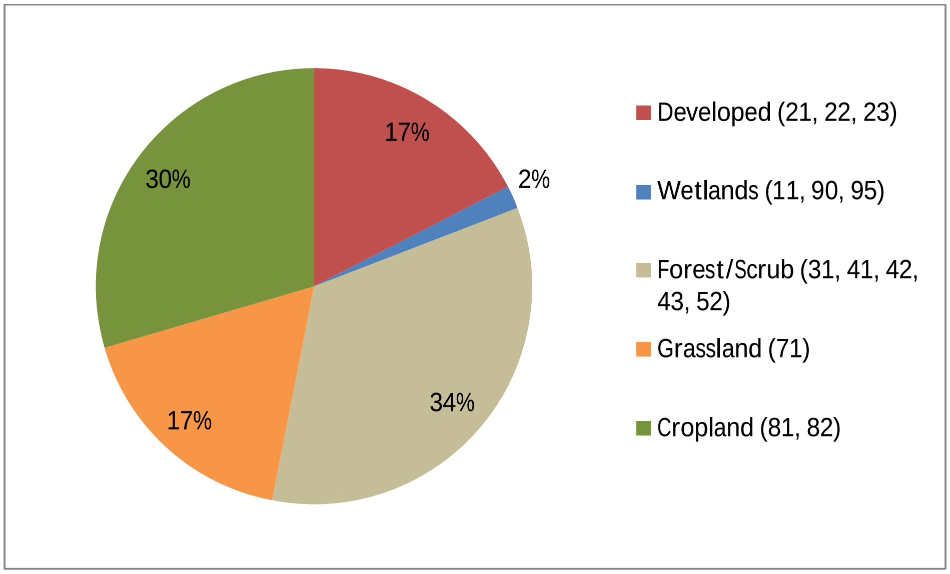

Figure 2-11. Percent NLCD 2011 land cover in the watershed and associated land cover Id numbers summarized by land cover type.

2.9. Farmland

Most of the farmland in the lower Salinas River watershed is considered prime land with the best combination of soil, water, and climatic growing conditions for supporting high yields. The other farmlands in the watershed are still of high value but of somewhat less quality than prime. The farmland mapping also indicates the watershed has extensive grazing land in the foothills as well as other land, which include forests and scrub. Maps of farmland of importance are compiled by the California Department of Conservation Farmland Mapping and Monitoring Program for analyzing impacts on agricultural resources, which is a CEQA component for the TMDL project. The maps also are helpful for understanding general land use spatial patterns in the watershed as illustrated in Figure 2-12.

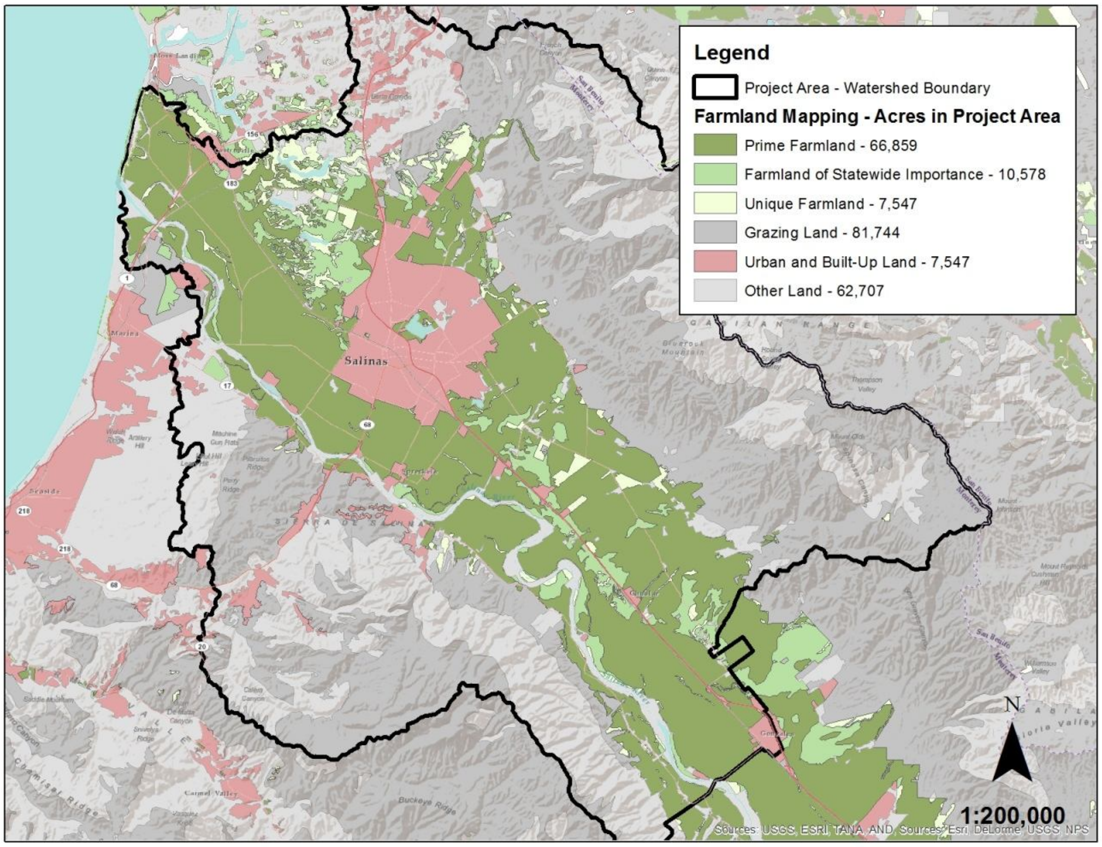

Figure 2-12. Important farmland in the lower Salinas River watershed (2010).

2.10. Major Agricultural Crops

The lower Salinas River watershed is located in Monterey County, one of the most productive agricultural regions in the world with annual crop production in the billions of dollars. The value and production of the county's major crops are summarized in Table 2-6 (Monterey, 2013). The highest value crops in Monterey County are lettuce, strawberries, and broccoli. With the exception of grapes, all of the major crops are grown extensively on prime land in the lower Salinas River watershed.

Table 2-6. Major crops of Monterey County

Crops	Acres*	Value
Artichokes	5,203	$47,390,000
Broccoli	65,577	$426,933,000
Cauliflower	20,987	$163,319,000
Celery	13,570	$217,452,000
Grapes (Wine)	42,986	$226,982,000
Head Lettuce	44,680	$550,628,000
Leaf Lettuce	65,008	$659,646,000
Mushrooms	N/A	$71,534,000
Nursery Products	12,317	$122,676,000
Spinach	12,317	$122,676,000

Strawberries	10,980	$869,488,000
Total of above Crops	276,648	$3,668,394,000

Note: * Production Acres and many sites may produce more than once crop in a year

3. DATA ANALYSIS

3.1. Sediment Toxicity Impairments

This section provides a summary of impaired waters on the 303(d) list in the lower Salinas River watershed along with a summary of additional impairments identified from monitoring data collected following the listing. The impairment assessments are based on the guidance evaluation described in the above Section 1.8 and the following statistical analysis, the standard sediment toxicity evaluation of a sediment sample to an aquatic invertebrate, *Hyalella azteca* survival (%) in 10 days. The monitoring samples were determined to be toxic based on the following definition by SWAMP (2004): Significant toxicity in the survival endpoint when compared to the negative control based on a statistical test with alpha of less than 5%, and less than the evaluation threshold (both criteria are met). The *Hyalella azteca* sediment toxicity compares the survival of a group in a sediment sample to a control group. The evaluation threshold for the toxicity comparison is 80% survival or more.

Toxicity listings and additional monitoring data are summarized in Table 3-1. Thirteen waterbodies in the project area were analyzed for the 303(d) list and of the thirteen; eleven were determined to be impaired for sediment toxicity. The listing decisions and lines of evidence for the 303(d) list are summarized in Appendix A.

Additional monitoring data subsequent to the data analyzed for the 303(d) list was compiled and evaluated for the TMDL (refer to Appendix C). Temporally these data indicate that sediment toxicity is persisting in the watershed following the 303(d) analysis. The 303(d) list analysis was completed with monitoring through 2005 and the additional monitoring data evaluated for the TMDL was monitored from 2006 to 2010. The total monitoring data combined for the TMDL indicates that with the additional data all 13 waterbodies evaluated for the 303(d) list are impaired for sediment toxicity (refer to Table 3-1).

Table 3-1. Summary of toxicity monitoring data and impairments for waterbodies

	303(d) List			**Additional Monitoring Evaluated for the TMDL**		**Total Combined for TMDL**		
Waterbody Name	**Exc.**	**Samples**	**Impaired**	**Exc.**	**Samples**	**Exc.**	**Samples**	**Impaired**
1. Alisal Creek	1	2	No	1	1	2	3	Yes
2. Alisal Slough	2	3	Yes	1	6	3	9	Yes
3. Blanco Drain	0	2	No	2	7	2	9	Yes
4. Chualar Creek	n/a	n/a	n/a	5	9	5	9	Yes
5. Espinosa Slough	2	2	Yes	6	6	8	8	Yes
6. Gabilan Creek	4	5	Yes	2	2	6	7	Yes
7. Merrit Ditch	2	2	Yes	5	6	7	8	Yes
8. Natividad Creek	5	5	Yes	6	6	11	11	Yes

9. Old Salinas River	7	8	Yes	3	3	10	11	Yes
10. Quail Creek	2	2	Yes	9	9	11	11	Yes
11. Salinas Reclamation Canal	8	9	Yes	15	16	23	25	Yes
12. Salinas River (Lower)	1	5	No	2	21	3	26	Yes
13. Tembladero Slough	3	3	Yes	17	19	20	22	Yes
Totals	37	48		74	111	111	159	

Note: Exc. = Exceedance, n/a = not available

3.2. Pyrethroid Pesticide Impairments

The following five waterbodies are identified as impaired for pyrethroids in the TMDL based on toxicity unit (TU) analysis of sediment samples with a mix of pyrethroids in sediment.

- Alisal Creek
- Reclamation Canal
- Natividad Creek
- Salinas River (lower)
- Tembladero Slough.

The combined mix of pyrethroids in a sample has an additive effect on toxicity and TU analysis is a common method for assessing the potential toxicity of pesticide mixtures. TU analysis is the ratio of the sample concentrations in sediment to known/published median lethal concentrations (LC50s).

The pyrethroid TU formula is as follows:

$$\text{Pyrethroid TU} = \frac{\text{sample concentration (oc)}}{\text{Known LC50 concentrations values (oc)}}$$

Pyrethroid TUs for the pyrethroid concentrations measured in sediment are summarized using the following formula:

$$\text{Sum Pyrethroid TUs} = \text{Pyrethroid TU (1)} + \text{Pyrethroid TU (2)}$$

The sample is considered impaired under the following conditions:

$$\text{Sum Pyrethroid TUs} > 1.0$$

LC50s are median lethal concentrations for *Hyalella azteca* in sediments (refer to Table 3-2). *Hyalella azteca* is the same test organism used to assess sediment toxicity for the TMDL (refer to Section 3.1). 1 TU equates to a 50% *Hyalella azteca* test population survival over a 10 day test period and samples were determined to be at toxic concentrations if total pyrethroid TUs were equal or greater than 1 TU. Waterbodies were determined to be impaired if there were sufficient toxicity samples according to the

303(d) listing policy (refer to Table 1-4). According to the listing policy, the minimum number of toxicity exceedances for a waterbody to be impaired for the number samples in Table 3-3 is two. Pyrethroid in sediment monitoring data are compiled in Appendix D-1 and D-2.

Pyrethroid pesticides are very hydrophobic and partition to the organic carbon fraction in sediments (Amweg, 2005) and the organic carbon (oc) normalized concentrations and LC50s are a more accurate indicator of toxicity. The actual concentration of pyrethroid pesticides in the sediment sample is normalized for organic carbon.

Table 3-2. Pyrethroid sediment criteria

Chemical	**LC50[1] ng/g[2] (ppb[3])**	**LC50 ug/g[4] oc[5](ppm[6])**	**Reference**
Bifenthrin	12.9	0.52	(Amweg et al., 2005)
Cyfluthrin	13.7	1.08	(Amweg et al., 2005)
Cypermethrin	14.87	0.38	(Maund et al., 2002) mean value
Deltamethrin	9.9	0.79	(Amweg et al., 2005)
Esfenvalerate	41.8	1.54	(Amweg et al., 2005)
Fenvalerate	41.8	1.54	(Weston et al., 2004)
Lambda-Cyhalothrin	5.6	0.45	(Amweg et al., 2005)
Permethrin	200.7	10.83	(Amweg et al., 2005)

[1]Median lethal concentration (LC50) for amphipods (Hyalella azteca), [2] nano grams per gram (ng/g), [3] parts per billion, [4] microgram per gram (ug/g), [5] organic carbon normalized concentrations (oc), [6] parts per million (ppm)

Table 3-3. Pyrethroid toxicity unit analysis, TUs >1 are highlighted in the table

Date	Project	Waterbody Site ID (Reported LC50)	Pyrethroid Pesticides (TUs)							Total
			Bifenthrin (0.52)	Cyfluthrin (1.08)	Cypermethrin (0.38)	Esfenvalerate/ Fenvalerate (1.54)	Lambda-cyhalothrin (0.45)	Permethrin (10.9)	Deltamethrin (0.79)	
	Alisal Creek/Reclamation Canal									
9/23/2005	Weston	309SA2	ND	ND	ND	ND	0.6	1.2	N/A	**1.8**
9/23/2005	Weston	309SR1	0.6	ND	0.2	0.1	0.5	N/A	N/A	**1.5**
9/23/2005	Weston	309SR2	0.4	0.2	**1**	0.1	0.8	0.4	N/A	**2.9**
9/23/2005	Weston	309SR3	0.3	ND	ND	0.1	0.2	0.3	N/A	0.9
9/23/2005	Weston	309SR4	0.1	0.1	0.4	ND	ND	<0.1	N/A	0.6
9/23/2005	Weston	309SR5	0.6	ND	ND	0.1	ND	ND	N/A	0.7
5/24/2010	CMP	309ALG	**1.79**	0	**1.84**	**1.84**	**2.22**	0.17	N/A	**7.86**
5/25/2010	CMP	309JON	**7.50**	0.78	**3.74**	**1.73**	**2.53**	0.62	N/A	**16.9**
	Natividad Creek									
9/23/2005	Weston	309SN1	ND	ND	ND	ND	**1.6**	0.1	N/A	**1.7**
9/23/2005	Weston	309SN2	0.7	0.1	0.5	<0.1	0.2	<0.1	N/A	**1.5**
9/23/2005	Weston	309SN3	0.8	ND	0.6	<0.1	ND	<0.1	N/A	**1.4**
5/24/2010	CMP	309NAD	**2.03**	0	0	0	0	0	N/A	**2.03**
	Salinas River (lower)									
6/16/2009	SPoT	309DAV	0.29	0.00	0.00	0.07	0.00	0.00	0.00	0.36
6/22/2010	SPoT	309DAV	0.65	0.00	0.26	0.03	0.08	0.10	0.03	**1.14**
9/7/2011	SPoT	309DAV	0.03	0.00	0.00	0.00	0.03	0.00	0.00	0.06
6/5/2012	SPoT	309DAV	0.29	0.14	N/A	0.04	0.35	0.26	0.07	**2.42**
	Tembladero Slough									
7/21/2008	SPoT	309TDW	0.862	0.196	0.000	**1.513**	0.279	0.081	0.000	**2.93**
5/25/2010	CMP	309TEH	**1.33**	0.04	0.63	0.25	0.71	0.08	N/A	**3.04**
6/21/2010	SPoT	309TDW	**1.321**	0.024	0.267	0.343	0.244	0.059	0.029	**2.29**
6/23/2011	SPoT	309TDW	**2.408**	0.036	0.327	0.261	0.204	0.120	0.045	**3.40**
6/5/2012	SPoT	309TDW	0.930	0.054	0.894	0.425	0.403	0.119	0.083	**2.91**

Note: Waterbodies and Site IDs are mapped in Appendix A. Alisal Creek flows directly into the Reclamation Canal and the results are summarized together.

3.3. Special Toxicity and Pesticide Studies and Reports

Several special studies were conducted in the Salinas River watershed that support the identification of sediment toxicity and associated pyrethroid pesticide impairments in the watershed. The individual studies are described here and summarized in further detail in Appendix B. The three individual studies specifically assessed sediment toxicity and pyrethroid impairments in the watershed and the findings of these three studies are summarized in this section. The three studies are:

1. *Pyrethroid Insecticides in California Surface Waters and Bed Sediments: Concentrations and Estimated Toxicities*, (Starner et al., 2006) **– California Department of Pesticide Regulation (DPR) Study**

2. *Patterns of Pyrethroid Contamination and Toxicity in Agricultural and Urban Stream Segments*, (Ng et al., 2008) **– Weston Study**

3. *Follow-up Monitoring Report: Pesticides and Toxicity to Hyalella azteca in Sediments 2010*, Central Coast Water Quality Preservation, Inc. 2010 (CCWQP, 2010) **– Agricultural Follow-up Monitoring Study**

The DPR Study, monitored sites agricultural drainages in the lower Salinas River watershed and found pyrethroid pesticides at toxic concentrations. Impaired waterbodies include the Old Salinas River, Quail Creek and the Reclamation Canal **the potential source of toxicity was esfenvalerate and bifenthrin and crops identified as potential sources were lettuce and spinach.**

In the Weston Study, researchers studied the sources of sediment toxicity and pyrethroid pesticides in agricultural and urban drainages in proximity to the City of Salinas in the lower Salinas River watershed in 2005. They detected sediment toxicity to *Hyalella azteca* and concentrations of pyrethroids in the sediment above levels known to cause toxicity. Streams identified as impaired are Gabilan Creek, Natividad Creek and Alisal Creek/Reclamation Canal. **The Weston study evaluated other pesticides such as chlorpyrifos as sources of toxicity and determined pyrethroids to be the primary source of impairment in sediment.** The study compared pyrethroids in sediments from agricultural and urban drainages and found that primary urban pyrethroids to be cyfluthrin and cypermethrin, lambda-cyhalothrin was found more in agricultural areas and bifenthrin and permethrin were found in both areas. However, the highest concentrations of bifenthrin were in urban drainages.

The Agricultural Follow-up Monitoring Study was conducted in agricultural drainages across the central coast as a follow-up to regular monitoring by Central Coast Water Quality Preservation Inc. (CCWQP). CCWQP is a regional agricultural ambient water quality monitoring program. CCWQP monitors' pesticides and toxicity in sediments on behalf of growers. The CCWQP regularly monitors surface waters in the lower Salinas River watershed and identified surface waterbodies with sediment toxicity. The follow-up monitoring study monitored sediment toxicity and concentrations of organochlorine, organophosphate, and pyrethroids for toxicity. **In the Salinas River watershed 15 sites were sampled for sediment toxicity and 11 sites were toxic with pyrethroid pesticides found as the primary source of sediment toxicity.**

4. NUMERIC TARGETS

The Basin Plan contains general narrative objectives for toxicity and pesticides to protect beneficial uses of water (see Section1.10) and for the TMDL, numeric targets were developed using appropriate water quality criteria to meet the objectives of the Basin Plan. TMDL water quality numeric targets were developed to ascertain when and where the narrative water quality objectives are achieved, and hence, when beneficial uses are protected. The TMDL numeric targets are for aquatic sediment toxicity and pyrethroid pesticides.

4.1. Sediment Toxicity Numeric Target

The sediment toxicity numeric target is a “toxic” result or “fail” in the evaluation of the Basin Plan general objective for toxicity using a standard aquatic toxicity test to determine toxicity in the sediment. The general narrative objective for toxicity is:

All waters shall be maintained free of toxic substances in concentrations which are toxic to, or which produce detrimental physiological responses in, human, plant, animal, or aquatic life.

Sediment Toxicity Numeric Target

Species and method identified in Table 4-1 shall be used to assess whether the sediment toxicity numeric target is achieved. Assessments will be conducted with receiving water(s) sampled at key indicator sites, which will be defined in proper sampling plans with quality assurance and quality controls consistent with SWAMP protocols. Toxicity to invertebrates shall be tested using chronic toxicity test, 10-day sediment exposure with *Hyalella azteca* (USEPA, 2000). It is recommended (not required) that toxicity determinations be based on a comparison of the test organisms' response to the receiving water sample compared to the control using the Test of Significant Toxicity, also referred to as the TST statistical approach (USEPA 2010; Denton et al., 2011). If a sample is declared “fail” (i.e., toxic), then the target is not met and additional receiving water sample(s) should be collected and evaluated for this specific receiving water to determine the pattern of toxicity and whether a toxicity identification evaluation, also referred to as a TIE, needs to be conducted to determine the causative toxicant(s). If the causative toxicant(s) is already known (e.g., based on land use patterns and similar responses in sub-watersheds) then implementation of management practices, management plans etc. should be examined for effectiveness if already in place, or implemented to reduce the toxicant(s).

Table 4-1. USEPA Standard Aquatic Toxicity Tests

Parameter	Test	Biological Endpoint Assessed	Test Method #
Sediment Toxicity	*Hyalella azteca* (10-day chronic)	Survival	USEPA 100.1 using alpha of 0.25

4.2. Pyrethroid Pesticide Numeric Targets

The pyrethroid pesticide numeric targets (pyrethroid targets) are interpretations of the Basin Plan narrative objective for pesticides, which states the following:

Basin Plan Narrative Objective for Pesticides:

No individual pesticide or combination of pesticides shall reach concentrations that adversely affect beneficial uses. There shall be no increase in pesticide concentrations found in bottom sediments or aquatic life.

Two types of pyrethroid targets were developed for the TMDLs, one for the water column to address the partitioning of pyrethroids from sediment to water phase in the aquatic environment and one for sediment to directly address concentrations of pyrethroids in sediment.

a. Numeric Targets for Concentrations of Pyrethroids in Water

UC Davis developed the water criteria (UC Davis Criteria) that are the basis of the water concentration targets for the pyrethroids addressed in the TMDL: bifenthrin, cyfluthrin and lambda-cyhalothrin; refer to Table 4-2 (Palumbo et al., 2010 and Fojut et al., 2010). The UC Davis Criteria represents a concentration of pyrethroids in water that should not affect aquatic life in the lower Salinas River watershed or in other words when a waterbody is protected.

The UC Davis Criteria were developed as criteria protective of aquatic life using a transparent and scientific methodology of statistically evaluating toxicity data for multiple species. The criteria were established for freely dissolved concentrations of the pyrethroids and not concentrations bound to suspended solids and dissolved organic material. For assessment, staff recommends the numeric targets for pyrethroid concentrations in water be compared to the freely dissolved (bioavailable) concentrations of pyrethroids in water and not whole water samples. However, staff supports environmental managers' choosing the appropriate assessment method and recognizes there are situations in which whole water samples may be an appropriate assessment method.

The UC Davis researchers noted that pyrethroid toxicity is inversely proportional to temperature, lower temperatures increase the sensitivity of organisms to pyrethroids, but it was unfeasible for them to incorporate temperature into the criteria.

Table 4-2. Pyrethroid water numeric targets

Chemical	Acute Target – CMC[1] ug/L[3] (ppb[4])	Chronic Target – CCC[2] ug/L (ppb)	Reference
Bifenthrin	0.004	0.0006	(Palumbo et al., 2010)
Cyfluthrin	0.0003	0.00005	(Fojut et al., 2010)
Lambda-cyhalothrin	0.001	0.0005	(Fojut et al., 2010)

[1] CMC – Criterion Maximum Concentration (Acute: 1- hour average). Not to be exceeded more than once in a three-year period.
[2] CCC – Criterion Continuous Concentration (Chronic: 4-day [96-hour] average). Not to be exceeded more than once in a three-year period.
[3] microgram per liter (ug/L), [4] parts per billion

b. Pyrethroid Sediment Concentration Toxicity Unit Target

Pyrethroid sediment concentration toxicity units (pyrethroid TUs) are used as numeric targets for the TMDL using the same TU formula used for the impairment data analysis in section 3.2 and described below.

$$\text{Pyrethroid TU} = \frac{\text{sample concentration (oc)}}{\text{Known LC50 concentrations values (oc)}}$$

Mixtures of pyrethroids pesticides are found to have additive toxicity to invertebrates (Weston and Jackson, 2009) (Lydy et al., 2004). The pyrethroid sediment concentration toxicity unit (TU) targets are a comparison of toxic levels of pyrethroids in sediment to published criteria (refer to Table 4-3). Samples and criteria are for organic carbon normalized concentrations (oc). The pyrethroid TU formula is as follows:

$$\text{Sum Pyrethroid TUs} = \text{Pyrethroid TU (1)} + \text{Pyrethroid TU (2)}$$

The numeric target for the sum pyrethroid TUs is where:

$$\text{Sum Pyrethroid TUs} < 1.0$$

Table 4-3. Pyrethroid sediment criteria

Chemical	LC50[1] ng/g[2] (ppb[3])	LC50 ug/g[4] oc[5](ppm[6])	Reference
Bifenthrin	12.9	0.52	(Amweg et al., 2005)
Cyfluthrin	13.7	1.08	(Amweg et al., 2005)
Cypermethrin	14.87	0.38	(Maund et al., 2002) mean value
Esfenvalerate	41.8	1.54	(Amweg et al., 2005)
Lambda-Cyhalothrin	5.6	0.45	(Amweg et al., 2005)
Permethrin	200.7	10.83	(Amweg et al., 2005)

[1]Median lethal concentration (LC50) for amphipods (*Hyalella azteca*), [2] nano grams per gram (ng/g), [3] parts per billion, [4] microgram per gram (ug/g), [5] organic carbon normalized concentrations (oc), [6] parts per million (ppm)

5. SOURCE ANALYSIS

5.1. Sources of Sediment Toxicity

As noted in the Data Analysis Section 3.1, sediment toxicity was found throughout the lower Salinas River and Reclamation Canal watersheds. The impaired waterbodies were sampled 159 times from 2006 to 2010 for sediment toxicity and 111 samples or 70% were toxic and staff determined that 13 waterbodies are impaired for sediment toxicity. Some of the monitoring was part of special studies, such as one conducted by the CCWQP, that evaluated the sources of sediment toxicity (refer to Section 3.3 and Appendix B for a summary of special studies in the watershed). This study indicates that the most likely source of sediment toxicity is pyrethroid pesticides. Other studies in the watershed, such as ones by DPR and Dr. Don Weston further support the conclusion that pyrethroid pesticides are the source of sediment toxicity based on toxicity unit analysis. Toxicity unit analysis is part of TMDL data analysis, Section 3.2, and this analysis further supports the linkage between sediment toxicity and pyrethroid pesticides.

5.2. Sources of Pyrethroid Pesticides

Pyrethroid pesticides are commonly used in urban and agricultural areas to control insect pests and both land uses are sources of pyrethroids in sediments and associated sediment toxicity impairments in the watershed. This determination is based on watershed land use and county pesticide use reporting analysis, urban pesticide studies, subwatershed water quality data and pesticide use analysis, and special studies.

Watershed Land Use and County Pesticide Use Reporting Analysis

Watershed land use and cover are described in the Watershed Description section of this report, Section 2.2 and major crops are described in Section 2.10. The land use analysis indicates that the watershed is comprised of 30% cropland and 17% developed urban areas and the major crops analysis indicates that strawberries, lettuce and broccoli are the major crops in the county. The largest urban area in the watershed is the City of Salinas and there are two additional small urban areas, the communities of Castroville and Spreckels.

Four surface waters are identified as impaired for pyrethroids in the TMDL: Alisal Creek/Reclamation Canal, Natividad Creek, Salinas River (lower) and Tembladero Slough. These surface waters have both agricultural and urban land uses in their watersheds and the pyrethroids detected have both agricultural and non-agricultural (urban) uses. Agricultural pesticide uses and crop types were reported to the Monterey County Agricultural Commissioner's office and subsequently compiled and reported to DPR. Annual pesticide use reporting data is available from DPR and the pyrethroid data for Monterey County was analyzed for potential crop sources. The major crop sources for pyrethroids detected at toxicity unit levels causing impairment are summarized in Table Table 5-1 and described below:

- **Bifenthrin** – strawberries, artichokes
- **Cypermethrin** – lettuce, spinach, broccoli, peas, other crops
- **Esfenvalerate** – artichoke, broccoli, lettuce
- **Lambda-cyhalothrin** – lettuce

Table 5-1. 2012 agricultural pesticide use and crop type in Monterey Co.

Pesticide Crop Type	Lbs. Active Ingredient Applied	Percent of Total
Bifenthrin		
Strawberry	1873	71%
Artichoke	656	25%
Peas	47	2%
Total Other Ag. Commodities	49	2%
Total	2625	100%
Cypermethrin		
Total Other Ag. Commodities	680	25%
Lettuce, Leaf	486	18%
Lettuce, Head	469	17%
Spinach	289	11%
Broccoli	282	10%
Celery	261	10%
Peas	254	9%
Total	2721	100%
Esfenvalerate		
Artichoke	1267	73%
Broccoli	165	10%
Lettuce, Head	133	8%
Cauliflower	62	4%
Peas, General	54	3%
Total Other Ag. Commodities	52	3%
Total	1732	100%
Lambda-cyhalothrin		
Lettuce, Leaf	2287	47%
Lettuce, Head	1926	40%
Broccoli	291	6%
Total Other Ag. Commodities	161	3%
Cauliflower	78	2%
Peas, General	70	1%
Brussels Sprouts	61	1%
Total	4873	100%

Urban Sources of Pyrethroids

Unlike agricultural pesticide use, urban pesticide use is not reported at the site level; therefore statewide studies were used to determine that urban stormwater is a source of pyrethroid impairment in the watershed. It was determined that within urban sources, professional applications are the primary source and consumer uses a lesser contributor. This determination is based on the assumption that urban pesticide use patterns and practices are similar throughout the state, which is likely for several reasons. The same pyrethroid pesticide products are available to consumers throughout the state and commercial applicators are state regulated by DPR and follow similar application and label requirements.

The California Stormwater Quality Association (CASQA) investigated the presence of pyrethroid pesticides in urban stormwaters throughout the state (CASQA, 2013). CASQA summarized 2,704 sediment monitoring samples from 2005 to 2013 and found detections of a variety of pyrethroid pesticides with bifenthrin most commonly detected. The following are statewide urban detection rates for common pyrethroids.

- Bifenthrin – 69%
- Cyfluthrin – 33%
- Lambda-cyhalothrin – 30%
- Cypermethrin – 29%
- Esfenvalerate/Fenvalerate – 12%
- Permethrin – 50%

DPR conducted a multiyear urban pesticide monitoring study from 2008 to 2011 that found frequent detections of pyrethroids in sediments and at toxic concentrations in several urban watersheds in California (Ensminger et al., 2011). DPR monitored sediments in urban watersheds in Sacramento, the San Francisco Bay area and Orange County. They found all samples contained pyrethroids and they calculated toxicity levels using toxicity unit analysis similar to the analysis used for the pyrethroid impairment analysis in Section 3.2. The median statewide toxicity in the samples was 2.6 TUs and bifenthrin accounted for 77% of the TUs with 10% due to cyfluthrin. It was noted in the study that bifenthrin is commonly applied by professional pest managers for structural pest control and for landscape maintenance applications. Numerous consumer products also contain bifenthrin for home and garden applications. The study also compared concentrations of urban pesticides in rain runoff versus dry season samples and determined that rain runoff is the major transport mechanism. The detections were greater in sediment than water and the authors imply that sediment is the primary matrix particularly given the hydrophobic properties of pyrethroids.

Based on statewide urban pesticide use analysis from an urban use study (TDC Environmental, 2010), pyrethroid pesticides are primarily applied by professional applicators (87%) with a much smaller portion applied by non-professionals (13%). Non-professional applications are unreported consumer home and garden applications, which are uses not regulated by DPR. Although the bulk of urban pyrethroid applications are professional, the study found that a significant amount of non-professional applications still occurred. 20% of the urban bifenthrin use was non-professional and 69% of the lambda cyhalothrin use was non-professional. The study noted that bifenthrin and lambda-cyhalothrin are two of the most frequently detected pyrethroids in urban surface waters.

In 2005, researchers studied patterns of pyrethroid pesticide pollution in urban and agricultural drainages in proximity to the City of Salinas (Weston et al., 2008). The study found cyfluthrin and cypermethrin primarily in urban drainages, lambda-cyhalothrin primarily in agricultural drainages, and bifenthrin and permethrin in mixed drainages. The highest concentrations of bifenthrin were in urban drainages.

Subwatershed Pyrethroid Use Analysis

Staff evaluated sediment toxicity and pyrethroid pesticide impairments in relation to agricultural pyrethroid pesticide use and associated crops in the Alisal Creek/Upper Reclamation Canal subwatershed, which is dominated by agricultural land use (refer to Figure 5-1). The DPR pesticide use reporting database was queried for pyrethroid applications in public land survey map units located within the impaired subwatershed that coincide with water quality monitoring by CCWQP. The public land survey map units are established rectangular land survey boundaries, which are used in part for reporting pesticide use. The CCWQP monitored site 309ALG, Reclamation Ditch at La Guardia, as part of a follow-up monitoring program on May 24, 2010. The monitoring at the site indicates sediment toxicity and TU analysis sediment pyrethroid data indicates that pyrethroids are a potential source of the sediment toxicity (refer to Table 5-2). Pyrethroids detected at levels greater than 1 TU in sediment are bifenthrin, cypermethrin, esfenvalerate/fenvalerate, and lambda-cyhalothrin. Pesticide use reports for the subwatershed were summarize and averaged for 2009 and 2010. The pyrethroids impairments and associated crop sources are as follows:

- Bifenthrin – Strawberries
- Cypermethrin – Lettuce
- Esfenvalerate/Fenvalerate – Lettuce, Broccoli and Cauliflower
- Lambda-cyhalothrin – Lettuce
- Permethrin – Lettuce and Spinach

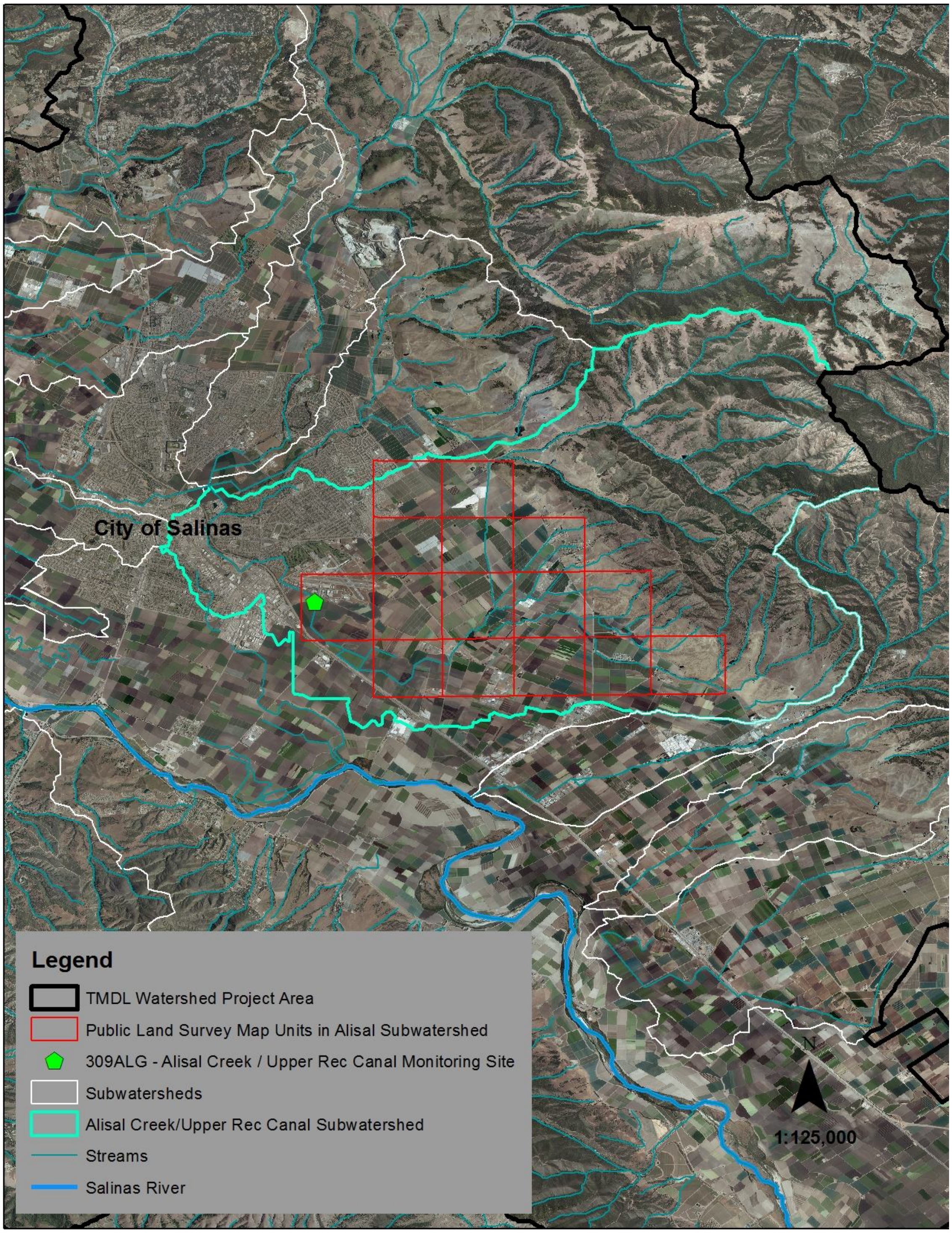

Figure 5-1. Alisal Creek/Upper Reclamation Canal Subwatershed

Table 5-2. Alisal Creek/Upper Reclamation Canal subwatershed pesticide use and TUs, The primary crops are highlighted.

Pesticide (Toxicity Units*) **Crop Type**	**Average Lbs. 2009/2010**	**Percent**
Bifenthrin (1.79 TUs*)		
Broccoli	0.95	1%
Greenhouse Plants In Containers	0.19	0%
Strawberry	119.45	99%
Total	120.59	100%
Cyfluthrin (0 TUs*)		
Greenhouse Plants In Containers	0.04	3%
Spinach	1.01	96%
Total	1.05	100%
Cypermethrin (1.84 TUs*)		
Broccoli	1.19	1%
Broccoli Raab (Rapa, Italian Turnip, Rapini)	12.53	7%
Cauliflower	0.51	0%
Celery, General	7.92	4%
Endive (Escarole)	0.86	0%
Lettuce (Total Head And Leaf)	162.55	86%
Mustard, General	0.49	0%
Radicchio	0.74	0%
Spinach	2.15	1%
Swiss Chard (Spinach Beet)	0.11	0%
Total	189.06	100%
Esfenvalerate (1.84 TUs*)		
Artichoke (Globe)	0.34	2%
Broccoli	6.15	32%
Cauliflower	3.06	16%
Lettuce, Head	9.56	50%
Total	19.10	100%
Lambda-Cyhalothrin (2.22 TUs*)		
Broccoli	0.57	1%
Cauliflower	0.45	0%
Lettuce (Total Head And Leaf)	111.11	99%
Total	112.13	100%

Pesticide (Toxicity Units*) Crop Type	Average Lbs. 2009/2010	Percent
Permethrin (0.17 TUs*)		
Broccoli	3.37	1%
Cauliflower	2.39	0%
Celery, General	5.78	1%
Chicory	3.38	1%
Endive (Escarole)	0.63	0%
Fennel	0.32	0%
Lettuce, Head	167.45	26%
Lettuce, Leaf	260.96	41%
Greenhouse Cut Flowers or Greens	19.04	3%
Greenhouse Plants in Containers	15.50	2%
Radicchio	8.75	1%
Spinach	152.39	24%
Total	639.95	100%
Note: * TUs calculated for monitoring site 309ALG sampled on 5/24/2010, 2009 and 2010 DPR pesticide use reporting and crop types.		

6. Loading Capacity, TMDLs and Allocations

6.1. Loading Capacities and TMDLs

The sediment toxicity and pyrethroid in sediment loading capacities or TMDLs are the amount of pollutants that can be received in surface waters without exceeding the Basin Plan's pesticide and toxicity water quality objectives. TMDLs are calculated as the sum of waste load allocations and load allocation along with a margin of safety. A waste load allocation is a TMDL allocated to point source dischargers in the watershed and a load allocation is a TMDL allocated to nonpoint sources of pollution. According to the Code of Federal Regulations, Title 40, §130.2[i], TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure.

The TMDLs for sediment toxicity are equal to the sediment toxicity unit criteria numeric targets described above in Section 4.1 and the TMDLs for pyrethroid pesticides are equal to the pyrethroid sediment concentration toxicity unit criteria numeric targets described above in Section 4.2.b.

Table 6-1. TMDLs

TMDL	Criteria
Sediment toxicity	Sediment toxicity numeric target
Pyrethroids in sediment	Pyrethroid sediment concentration toxicity unit numeric target

6.2. Linkage Analysis

The goal of the linkage analysis is to establish a link between pollutant loads and water quality such that the loading capacity specified in the TMDLs will result in attaining the numeric target. The linkage analysis therefore represents the critical quantitative link between the TMDL and attainment of the water quality standards. The proposed TMDLs will result in the attainment of the toxicity and pesticide water quality objectives, and therefore the restoration of beneficial uses of waterbodies in the TMDL project area.

The linkage for the toxicity objective is assured by setting the sediment toxicity TMDLs equal to the sediment toxicity numeric target. The linkage for the pesticide objective is assured by setting the pyrethroid TMDLs equal to the pyrethroid sediment concentration toxicity unit numeric target.

6.3. Allocations

The TMDLs are allocated to point source and non-point sources in the watershed. The TMDL source analysis determined irrigated agricultural and urban stormwater are the sources of sediment toxicity and pyrethroid impairments in the watershed. Allocations must be assigned to a responsible party. If the responsible party's discharge is considered a point source, such as urban stormwater, and regulated by an NPDES permit, then they receive a waste load allocation. Irrigated agricultural discharges are considered nonpoint sources (permitted with the Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands, Order R3-2012-0011(Agricultural Order) and they are assigned load allocations.

Point source dischargers receive waste load allocations and non-point source receive load allocations (refer to Table 6-2). The waste load allocations are assigned to communities with National Pollutant Discharge Elimination System (NPDES) permitted Municipal Separate Storm Sewer Systems (MS4s) and both the City of Salinas and the County of Monterey have NPDES municipal stormwater permits in the watershed. With a population of 100,000, the City of Salinas is considered a medium size municipality and has an individual stormwater permit from the Central Coast Water Board. Monterey County's stormwater program is enrolled under a State Water Board adopted general permit for small MS4s, NPDES General Permit No CAS000004. The county program covers the small unincorporated communities of Castroville, Spreckels, and Chualar.

Table 6-2. Waste Load Allocations and Load Allocations

Waste Load Allocations		
Responsible Party	Source	Allocation
City of Salinas - NPDES No. CA00049981	Municipal stormwater	1 & 2
County of Monterey - NPDES No. CAS000004	Municipal stormwater	1 & 2
Load Allocations		
Responsible Party	Source	Allocation
Owners/operators of irrigated agricultural lands in the lower Salinas River watershed	Discharges from irrigated lands	1 & 2

Allocation-1: Equal to Sediment Toxicity TMDLs*

Allocation-2 :Equal to Pyrethroids in Sediment TMDLs*

*The TMDLs are described in Section 6.1

6.4. Margin of Safety

The TMDL requires a margin of safety component that accounts for the uncertainty about the relationship between the pollutant loads and the quality of the receiving water (CWA 303(d)(1)(C)). The margin of safety is incorporated in these TMDLs implicitly though conservative assumptions. The desired water quality is achieved through allocations and targets equal to desired water quality; hence an implicit conservative approach. If, during the TMDL implementation phase staff develops numeric targets and TMDLs that better reflect the desired water quality, the allocations will be set equal to these modified targets and TMDLs.

6.5. Critical Conditions

A critical condition is the combination of environmental factors resulting in the water quality standard being achieved by a narrow margin, i.e., that a slight change in one of the environmental factors could result in exceedance of a water quality standard. Such a phenomenon could be significant if the TMDL were expressed in terms of load, and the allowed load was determined on achieving the water quality standard by a narrow margin. However, this TMDL is expressed as TUs and as toxicity, which are equal to the desired water quality condition. Consequently, there are no critical conditions.

6.6. Seasonal Variation

The TMDLs and allocations are equal to the desired water quality conditions (targets), which are applicable to all seasons and flow-regimes. Therefore, TMDLs and allocations developed on the basis of seasonal variation are not appropriate in this case.

There were insufficient monitoring data for pyrethroids for staff to conclude seasonality of impairment in the project area. However, in an urban pesticide monitoring study conducted by DPR in northern California, DPR found that rainstorms drive more pesticides into urban surface waters and that, generally, more pesticides are detected in first flush rain storms than during later dry season flow or a late spring rainstorms. Also more pesticides were detected in spring rainstorms than during dry season flow (Ensminger, 2011). This anecdotal evidence suggests that implementation efforts, particularly for sediment-bound pesticides, should include focus on wet weather loading. However during the dry season, there is a risk of pyrethroid pollution and toxicity from low flow dry season urban runoff and irrigation runoff; therefore, pyrethroids are a concern year-round.

7. Implementation and Monitoring

7.1. Introduction

The TMDL project takes an interagency approach to comprehensively address water quality problems. Since pesticides and water quality are regulated differently for municipalities than for agriculture, the TMDL has separate implementation plans for each. For example, the Central Coast Water Board regulates agriculture through the Agricultural Order and urban discharges are regulated through municipal stormwater permits. Also DPR has their own regulations for urban use of pyrethroids and on the agricultural side there are USEPA label restrictions that DPR enforces.

The interagency approach is based in part on the California Pesticide Management Plan for Water Quality (California Pesticide Plan), which is an implementation plan of the Management Agency Agreement signed between DPR and the State Water Board, in 1997. The Water Boards and DPR both have responsibilities to protect water quality from the potential adverse effects of pesticides, and the Management Agency Agreement was established to provide a unified cooperative program to protect water quality related to the use of pesticides.

The California Pesticide Plan describes how DPR and the County Agricultural Commissioners will work in cooperation with the State Water Board and the Central Coast Water Board. The California Pesticide Plan is an effort to make state programs addressing pesticides and water quality more understandable, consistent, and efficient. The two agencies have complementary regulatory authorities and programs with DPR regulating pesticide use and the Water Boards regulating discharge to surface waters.

This TMDL implementation plan in part utilizes actions identified in the California Pesticide Plan to minimize the potential movement of pesticides to waters of the state. Some of these actions are outlined below:

- Education and outreach efforts to communicate pollution prevention strategies;
- Cooperative efforts to identify and implement the most appropriate site-specific reduced-risk practices;
- Compliance through restricted use permit requirements, implementation of regulations, or other DPR regulatory authority; and
- State and Regional Water Boards' water quality control plans and regulatory permits and orders.

A companion state document to the California Pesticide Plan is the *Process for Responding to the Presence of Pesticides in Surface Water* (Response Process), which describes how the DPR and the Water Boards will respond to the presence of pesticides in surface water. The Central Coast Water Board has initiated the Response Process by the Executive Office notifying the Director of DPR that water quality objectives for pesticides and toxicity have been violated from the use of currently registered pyrethroid pesticides.

Implementation Plan for Municipalities

The TMDL implementation plan for municipalities utilizes actions identified in the California Pesticide Plan to address pesticide pollution in urban stormwater.

One implementation goal in the urban environments is to apply pesticides in a manner that minimizes the movement of the pesticide from a site and into stormwater systems and receiving waters. These practices are referred to as reduced-risk application practices in the California Pesticide Plan.

The implementation of reduced-risk practices will require regulation, extensive education and outreach, and self-directed implementation to mitigate the effects of pyrethroids in surface waters. A broad approach is necessary since insecticides are applied by both pest control operators, who are hired to apply pesticides, and consumers who are able to directly purchase pesticides from retail stores and apply them at home. Pest control operators are professionals licensed by DPR and regulated at the county level by the Monterey County Agricultural Commissioner. Pest control operators must comply with label and other use restrictions and report pesticide use to the Monterey County Agricultural Commissioner. Ultimately, given the broad urban landscape it is up to pesticide control operators to use pesticides in a manner that is protective of the environment. The regulation of commercial use is under the authority of DPR and DPR implemented urban pyrethroid use restrictions and controls at the state level are the primary means of management practice implementation. Consumer use is not reported or closely regulated making the implementation of management practices or use restrictions challenging. To protect surface waters from consumer use of pesticides, staff recommends education and outreach from the MS4s on appropriate practices.

Education and Outreach

Education and outreach is a key component in implementing reduced-risk practices. There are several education and training recommendations in the California Pesticide Plan designed to increase the awareness of homeowners and pest control operators to prevent pesticide water quality problems. Some of the recommendations include:

- MS4s should develop pamphlets that summarize water quality issues and pyrethroid specific reduced risk practices for distribution by the Monterey County Agricultural Commissioner when they issue permits, register licenses and conduct training.
- MS4s should develop reduce-risk practice fact sheets for the general public that discusses pesticide use and water quality protection.
- Work with MS4 staff on the implementation of integrated pest management and use of reduced runoff pesticide application.
- The MS4s should support efforts by statewide organizations such as California Stormwater Quality Association (CASQA) to have DPR and USEPA develop and implement use restrictions on pesticides such pyrethroids that are detected and cause toxicity in stormwater runoff.
- In addition through the reevaluation process DPR should encourage pesticide manufacturers to provide education materials and workshops in the watershed to educate homeowners and pest control operators on water quality problems.

The MS4s should coordinate with the Monterey County Agricultural Commissioner on programs to educate homeowners and pest control operators on practices to protect water quality from pesticide runoff.

Cooperative Efforts

Commercial pesticide operators should develop self-directed programs that encourage reduced-risk pesticide applications, reduced pesticide use and integrated pest management. Such programs should encourage pollution prevention practices for landscape maintenance and structural pest control applications and offer training and certification.

Required Compliance with DPR Regulations (Urban Surface Water Protection Regulations)

In 2012, DPR approved urban pesticide surface water protection regulations that place restrictions on non-agricultural commercial/professional applications of pyrethroids. The regulations apply to for hire urban applicators such as gardeners, structural applicators, and pest control business. Some of the measures in the regulations include:

- Limiting applications methods in landscapes and on impervious surfaces to spot treatments, crack and crevice treatments and pin stream treatments of one-inch wide or less. Landscape perimeter band and broadcast treatments are permitted in areas in close proximity to buildings but away from impervious surfaces.
- Prohibiting landscape and impervious surface applications within 25 feet of downgradient aquatic habitat and within 10 feet of a downgradient storm drains.
- Prohibiting applications to surfaces with landscape and impervious surfaces with standing water as well as prohibiting direct applications to landscape and municipal storm drain systems.

It is anticipated that these regulations should significantly reduce pesticide contaminated runoff from homes and businesses in urban areas, since the regulations are targeted at the largest group of pyrethroids applicators (DPR, 2012). The effectiveness of the regulations was evaluated as a UC Davis PhD. thesis project (Jorgenson, 2011). It was based on a watershed model in the Sacramento area and the thesis concluded that the regulations would result in an approximately 50% reduction in the mass of pyrethroids applied to pervious surfaces and an 80% reduction of pyrethroids mass applied to impervious surfaces. The model also predicted an over 80% reduction in toxicity (exposure to toxicity units) in surface waters.

The Monterey County Agricultural Commissioner is DPR's regulatory authority at the local level for commercial agricultural and non-agricultural use of pesticides and has an active role in implementing urban regulations. The MS4s should work with DPR and the Monterey County Agricultural Commissioner to demonstrate that the DPR urban pesticide regulations are being implemented effectively.

Required Compliance with Water Board Regulatory Measures

The Central Coast Water Board regulates municipal storm water runoff from communities with MS4s permits in the watershed, the City of Salinas and County of Monterey, under the National Pollution Discharge Elimination System (NPDES) municipal storm water permit program. MS4s do not have the authority to regulate the use of pesticides applied within their jurisdiction. Pesticide use is regulated by DPR but the MS4s do have a legal responsibility for the discharges of pesticides from their stormwater systems regardless of whether they regulate the use or not. The legal responsibility of the MS4s for pesticide discharges in the stormwater system is described in the following excerpt of the Federal Register. Fed Reg vol 64, No 235, p. 68765-66.

> "*The operator of a small MS4 that does not prohibit and/or control discharges into its system essentially accepts ''title'' for those discharges. At a minimum, by providing free and open access to the MS4s that convey discharges to the waters of the United States, the municipal storm sewer system enables water quality impairment by third parties. Section 122.34 requires the operator of a regulated small MS4 to control a third party only to the extent that the MS4 collection system receives pollutants from that third party and discharges it to the waters of the United States. The operators of regulated small MS4s cannot passively receive and discharge pollutants from third parties.*"

Therefore, the MS4s must implement pesticide stormwater management practices required by their stormwater permit requirements. This includes requirements to implement various practices to reduce pesticide loading and the requirement to develop Waste Load Allocation Attainment Programs for TMDLs in their watersheds. Within one year following of adoption of this TMDL by the Office of Administrative Law, or within one year of a stormwater permit renewal, whichever comes first, the two MS4s in the watershed, City of Salinas and Monterey County, shall each develop, submit, and begin implementation of Waste Load Allocation Attainment Plans that identifies actions being taken and the actions they will take to attain their waste load allocations.

Urban stormwater pesticide problems are not unique to the MS4s in the Salinas River watershed, but are problems faced by MS4s throughout the state. Staff recognizes that attainment of water quality goals in the TMDL will rely on the effectiveness of statewide pesticide programs and regulations by California Department of Pesticide Regulation (DPR) to control pesticides. The MS4s are encouraged to participate in statewide programs and regulations to help attain the TMDL and describe in the Waste Load Allocation Attainment Program how the MS4s plan to support and engage in the statewide efforts. MS4s are encouraged to use mitigation measures developed in the DPR surface water regulations as stormwater Best Management Practices (BMPs) in the Waste Load Allocation Attainment Programs. The statewide program is described in the California Pesticide Plan).

Waste load allocations will be achieved through implementation of management practices and strategies to reduce pesticide loading, and waste load allocation attainment will be demonstrated through water quality monitoring. Implementation can be conducted by MS4s specifically and/or through statewide programs addressing urban pesticide water pollution. The Waste Load Allocation Attainment Programs may include participation in statewide efforts, by organizations such as California Stormwater Quality Association (CASQA), that coordinate with DPR and other organizations taking actions to protect water quality from the use of pesticides in the urban environment.

The Waste Load Allocation Attainment Programs shall include:

1. A detailed description of the strategy the MS4 will use to guide BMP selection, assessment, and implementation, to ensure that BMPs implemented will be effective at abating pollutant sources, reducing pollutant

discharges, and achieving waste load allocations according to the TMDL schedule.

2. Identification of sources of the impairment within the MS4's jurisdiction, including specific information on various source locations and their magnitude within the jurisdiction.
3. Prioritization of sources within the MS4's jurisdiction, based on suspected contribution to the impairment, ability to control the source, and other pertinent factors.
4. Identification of BMPs that will address the sources of impairing pollutants and reduce the discharge of impairing pollutants.
5. Prioritization of BMPs, based on suspected effectiveness at abating sources and reducing impairing pollutant discharges, as well as other pertinent factors.
6. Identification of BMPs the MS4 will implement, including a detailed implementation schedule. For each BMP, identify milestones the MS4 will use for tracking implementation, measurable goals the MS4 will use to assess implementation efforts, and measures and targets the MS4 will use to assess effectiveness. MS4s shall include expected BMP implementation for future implementation years, with the understanding that future BMP implementation plans may change as new information is obtained.
7. A quantifiable numeric analysis demonstrating the BMPs selected for implementation will likely achieve, based on modeling, published BMP pollutant removal performance estimates, best professional judgment, and/or other available tools, the MS4's waste load allocations according to the schedule identified in the TMDL. This analysis may incorporate modeling efforts. The MS4 shall conduct repeat numeric analyses as the BMP implementation plans evolve and information on BMP effectiveness is generated. Once the MS4 has water quality data from its monitoring program, the MS4 shall incorporate water quality data into the numeric analyses to validate BMP implementation plans. A detailed description, including a schedule, of a monitoring program the MS4 will implement to assess discharge and receiving water quality, BMP effectiveness, and progress towards any interim targets and ultimate attainment of the MS4s' waste load allocations. The monitoring program shall be designed to validate BMP implementation efforts and quantitatively demonstrate attainment of interim targets and waste load allocations.
8. The MS4 shall establish interim targets (and dates when stormwater discharge conditions will be evaluated) that are equally spaced in time over the TMDL compliance schedule and represent measurable, continually decreasing MS4 discharge concentrations or other appropriate interim measures of pollution reduction and progress towards the waste load allocation. At least one interim target and date must occur during the five-year term of this Order. The MS4 shall achieve its interim targets by the date it specifies in the Waste Load Allocation Attainment Program. If the MS4 does not specify interim targets as described above in its Waste Load Allocation Attainment Program, the interim targets identified in the TMDL apply. If the MS4 does not achieve any interim target by the date specified, the MS4 shall develop and implement more effective BMPs that it can quantitatively demonstrate will achieve the next interim target.
9. A detailed description of how the MS4 will assess BMP and program effectiveness. The description shall incorporate the assessment methods

described in the CASQA Municipal Storm water Program Effectiveness Assessment Guide.

10. A detailed description of how the MS4 proposes to assess its compliance with interim targets and the final waste load allocation.
11. A detailed description of how the MS4 will modify the program to improve upon BMPs determined to be ineffective during the effectiveness assessment.
12. A detailed description of information the MS4 will include in annual reports to demonstrate adequate progress towards attainment of waste load allocations according to the TMDL schedule.
13. A detailed description of how the MS4 will collaborate with other agencies, stakeholders, and the public to develop and implement the Waste Load Allocation Attainment Program or integrated plan.
14. Any other items identified by Integrated Report fact sheets, TMDL Project Reports, TMDL Resolutions, or that are currently being implemented by the MS4 to control its contribution to the impairment, including public education and participation items identified above.

MS4 Monitoring

Staff reviewed the existing stormwater monitoring plan for the City of Salinas stormwater permit it and found it to be very comprehensive. The plan was developed by the city in close coordination with the Central Coast Water Board and it takes into consideration sediment toxicity and pyrethroid impairments from urban stormwater. In particular, the receiving water monitoring component of the plan provides a site in the watershed for assessing whether the city is achieving TMDLs for sediment toxicity and pyrethroids (CCAMP monitoring site 309ALD, Salinas Reclamation Canal at Boronda Road downstream of the city). Additionally, the monitoring plan is coordinated with the regional Agricultural Order monitoring and reporting program and considers influences of up gradient agricultural loading on water quality from areas such as the Gabilan Creek, Natividad Creek and the Reclamation Canal. The city should include monitoring data from agricultural monitoring sites 309GAB, 309NAD, 309ALG, and 309JON in their analysis and reporting. Some of the key components of the city's receiving water monitoring are as follows:

- Annual sediment toxicity monitoring to invertebrates
- Annual sediment monitoring for pyrethroids and total organic carbon
- Stormwater event monitoring for pyrethroids in water (3 storm events)

The city submits an annual report on their stormwater program, which includes sections on TMDL implementation. In the annual report the city should evaluate sediment toxicity and concentrations of pyrethroids in sediment. Pyrethroids in sediment should be evaluated based on a comparison of pyrethroid concentrations normalized for total organic carbon (Michelsen, 1992) to pyrethroid sediment LC50s. Toxicity unit analysis should also be conducted and the results compared to TMDLs.

Staff reviewed the existing stormwater permit for the County of Monterey and the county does not have an adequate monitoring program for the TMDL and must include one in their WAAP. The county monitoring program should be coordinated with monitoring conducted by the City of Salinas and the Agricultural Order monitoring program and reporting program for a comprehensive watershed assessment. Staff recommends that the county utilize monitoring data from existing monitoring stations in proximity to the county's areas of influence and not collect additional samples. Around Castroville, the county should utilize monitoring data from sites 309MER, 309TEH and 309TDW. Since the TMDL depends on statewide implementation by DPR, the county and the city should integrate representative urban catchment monitoring from statewide programs in their annual reports on TMDL implementation.

The MS4s must prepare a detailed description, including a schedule, of a monitoring program the MS4 will implement to assess discharge and receiving water quality, BMP effectiveness, and progress towards any interim targets and ultimate attainment of the MS4s' waste load allocations. The monitoring program shall be designed to validate BMP implementation efforts and quantitatively demonstrate attainment of interim and final waste load allocations. The Central Coast Water Board may approve participation in statewide or regional monitoring programs as meeting all, or a portion of monitoring requirements.

MS4 permits include an adaptive management cycle of water quality control planning, implementation, monitoring, and assessment. The MS4s should integrate monitoring data into the adaptive management cycle and adjust practices accordingly. Based on the monitoring results, the MS4s may need to expand monitoring from receiving waters to smaller urban catchment monitoring of sediment toxicity and pyrethroids.

The assessment of management practice effectiveness is a vital component in assessing progress towards achieving the TMDL and the WAAP shall include an annual assessment of:

- Pesticide use in the watershed
- Pesticide management practices implemented in the watershed
- Pesticide management practice effectiveness.

The annual assessments shall include a spatial distribution of practices and their effectiveness in relation to water quality monitoring sites. Since the MS4s are utilizing state programs to implement the TMDL, the MS4s should provide reporting on the effectiveness of the statewide programs.

Implementation Plan for Irrigated Agricultural Operations

Implementation by growers to achieve the TMDL allocations for owners/operators of irrigated agricultural lands will largely be required through the current and future replacements of the Agricultural order.

In addition to requirements described in the Agricultural Order, this implementation plan recommends establishing new requirements focused on solving the water quality issues addressed in this TMDL. The recommended requirements could be established through future replacements of the Agricultural Order or additional orders, such as through Water Code section 13267.

Current and anticipated requirements regulated by other agencies will play a role in achieving this TMDL.

Finally, staff recommends that growers implement voluntary actions to implement this TMDL.

Current Requirements in the Agricultural Order Implementing this TMDL

The Iterative Process
Finding 10 of theAgricultural Order states:

> *This Order requires compliance with water quality standards. Dischargers must implement, and where appropriate update or improve, management practices, which may include local or regional control or treatment practices and changes in farming practices to effectively control discharges, meet water quality standards and achieve compliance with this Order. Consistent with the Water Board's Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program(NPS Policy, 2004), dischargers comply by implementing and improving management practices and complying with the other conditions, including monitoring and reporting requirements. This Order requires the discharger to address impacts to water quality by evaluating the effectiveness of management practices (e.g.,waste discharge treatment and control measures), and taking action to improve management practices to reduce discharges. If the discharger fails to address impacts to water quality by taking the actions required by this Order, including evaluating the effectiveness of their management practices and improving as needed, the discharger may then be subject to progressive enforcement and possible monetary liability. The Discharger has the opportunity to present their case to the Central Coast Water Board before any monetary liability may be assessed.*

The intent, in part, of finding 10 is for growers to implement management practices to achieve water quality standards along with these TMDL allocations and numeric targets. The grower then assesses whether those implemented management practices are effective and will ultimately achieve water quality standards. If the grower determines through the assessment that the management practices will not achieve water quality standards, then the grower tries other, improved, management practices. The grower implements this trial-assessment, or iterative process, until he or she finds and implements practices that will achieve water quality standards, TMDL allocations, and numeric targets. The Agricultural Order contains reporting requirements that Central Coast Water Board staff will use to verify that the iterative process is being implemented.

Verifying Implementation of the Iterative Process
Central Coast Water Board staff will track implementation of management practices and the iterative process through the following existing Agricultural Order requirements.

- Annual Compliance Form requirement. Tier-2 and Tier-3 ranches are required to submit and keep current an Annual Compliance Form. The Annual Compliance Form includes grower-reported management practices implemented in the management practice categories of:
  - Pesticide Management
  - Irrigation Management
  - Sediment Management

Each management practice category includes subsections of:
  - Practice Implementation: i.e., the management practice
  - Practice Assessment
  - Practice Outcome
- Water Quality Monitoring requirements. Water quality monitoring requirements include:
  - Surface water monitoring. All growers are required to conduct surface water quality monitoring. This is a receiving water monitoring requirement. Most growers elect to fulfill the requirement through a cooperative monitoring program. This requirement includes sediment toxicity monitoring and pyrethroid chemistry monitoring in sediment.
  - Individual discharge monitoring. Some Tier-3 ranches with discharges to receiving waters are required to conduct outfall monitoring. The monitoring requirement includes water toxicity monitoring using *Hyalella azteca* and *Ceriodaphnia sp.*, the former of which is sensitive to pyrethroids.
- Water Quality Buffer Plans
  - All Tier-3 ranches adjacent to or containing a waterbody impaired for turbidity, sediment, or temperature must develop and then immediately implement a Water Quality Buffer Plan by October 1, 2016. The Water Quality Buffer Plan must include the listed waterbody as well as tributaries to the listed waterbody. The purpose of the Water Quality Buffer Plan, and therefore the Water Quality Buffer Plan design, is to control discharges causing or contributing to exceedance of water quality standards, including from pyrethroid pesticides. The following waterbodies are listed on the Clean Water Act section 303(d) list as impaired for turbidity:
    - Merrit Ditch
    - Natividad Creek
    - Old Salinas River
    - Quail Creek
    - Salinas Reclamation Canal
    - Salinas River (lower)
    - Tembladero Slough
- Farm Water Quality Management Plans
  - All growers are required to develop, implement, and keep current a Farm Water Quality Management Plan (Farm Plan). The Farm Plan must be made available to Central Coast Water Board staff upon request. The Farm Plan must include:
    - Treatment or control measures to comply with the Agricultural Order, which includes progress towards achieving water quality standards.
    - Management practices related to pesticide, sediment, and erosion control management and protection of aquatic habitat.
    - A description and schedule for assessing effectiveness and management practices.

Central Coast Water Board staff will use the information above to verify that the iterative process is being implemented by growers. If staff finds that a grower is not implementing the iterative process, staff will progressively implement enforcement authority to achieve grower compliance. Staff will also use this information to track progress toward achieving numeric targets described in this TMDL.

Recommended Agricultural Monitoring Requirements

Staff recommends the following additional water quality monitoring requirements. Existing and recommended expanded monitoring requirements are described in Table 7-1. If implemented, the data generated from the monitoring requirements will be used in conjunction with the existing Agricultural Order requirements outlined above to track progress toward achieving TMDL allocations to owners/operators of irrigated agricultural lands.

Table 7-1. Exiting and TMDL recommended monitoring

Sediment Sampling	**Monitoring Frequency**	
	Existing Ag Order	**TMDL Recommended Monitoring**
Sediment Toxicity – *Hyalella azteca* 10-day	Annually	Annually
Pyrethroid Pesticides in Sediment	Once during the second or third year, concurrent with sediment toxicity sampling	Annually, concurrent with sediment toxicity sampling
Total Organic Carbon	Once during the second or third year, concurrent with sediment toxicity sampling	Annually, concurrent with sediment toxicity sampling

In addition to the monitoring outlined in the table above, staff recommends annual pyrethroid pesticide sediment monitoring in the fall, along with total organic carbon, in the following waterbodies:

- Old Salinas River
- Tembladero Slough
- Merrit Ditch
- Espinosa Slough
- Reclamation Canal

If, during the implementation phase of the TMDL, staff determines that additional information is needed to assess sources and track progress, staff will consider expanding the following requirements to ranches that are not currently required to submit the information. The Executive Officer may require the following through a California Water Code section 13267 order:

- Annual Compliance Form
- Individual Discharge Monitoring
- Water Quality Buffer Plan

Due to the present complexities in monitoring and evaluating freely dissolved concentrations of pyrethroids in water, staff recommends that the monitoring and evaluation of numeric targets for pyrethroid concentrations in water be conducted by state and/or regional monitoring programs such as SWAMP/CCAMP and the DPR surface water monitoring program. Staff recommends these programs and agricultural and municipal stormwater monitoring programs share monitoring results with each other. Staff recommends that the agricultural monitoring program continues to focus monitoring efforts on sediment toxicity and adds annual monitoring concentrations of pyrethroids in sediment.

Regulatory Requirements of Other Agencies for Agricultural Implementation

The DPR requires management measures for the application of agricultural pyrethroid pesticides to protect aquatic life. All surface waterbodies in the Central Coast Region are designated with aquatic life beneficial use designations. The requirements are described as label requirements on agricultural pyrethroid pesticide packaging and include vegetative buffer strip requirements.

Staff has conducted several field visits in the watershed and found a lack of required implementation of buffer zones. Label requirements are enforced by the DPR and Monterey County Agricultural Commissioner. Staff will coordinate with the DPR and the Monterey County Agricultural Commissioner's office during the implementation phase of the TMDL to motivate enforcement of the label requirements. Additionally, staff will assess compliance with label requirements when conducting site visits, when feasible, and will share pertinent findings with the Monterey County Agricultural Commissioner.

The label requirements include the following language:

> <u>Vegetative Buffer Strip</u>
> *Construct and maintain a minimum 10-foot-wide vegetative filter strip of grass or other permanent vegetation between the field edge and down gradient aquatic habitat (such as but not limited to, lakes; reservoirs; permanent stream; marshes or natural ponds; estuaries; and commercial fish farm ponds).*
>
> *Only apply products containing (name of pyrethroid) onto fields where a maintained vegetative buffer strip of at least 10 feet exists between the field and down gradient aquatic habitat. For guidance, refer to the following publications on constructing and maintaining effective buffers Conservation Buffers to Reduce Pesticide Losses. Natural Resources Conservation Services. USDA, NRCS. 2000. Fort Worth, Texas. 21 pp.*
>
> *Buffer Zone for Ground Application (groundboom, overhead chemigation, of airblast)*
> *Do not apply within 25 feet of aquatic habitats (such as but not limited to, lakes, reservoirs, rivers, streams, marshes, ponds, estuaries, and commercial fish ponds).*

DPR and the Monterey County Agricultural Commissioner administer pyrethroid label requirements for buffer zones to protect aquatic habitats. Surface waters are designated with aquatic beneficial uses in the Basin Plan. The beneficial uses with aquatic habitat protection in the Salinas river watershed are Warm Fresh Water Habitat (WARM) and Cold Fresh Water Habitat (COLD). The following surface waterbodies in the watershed are in proximity of agricultural operations in the lower Salinas River watershed and are specifically designated with aquatic habitat beneficial use protections in Table 2-1 of the

Basin Plan; therefore, growers operating adjacent to the following waterbodies or their tributaries must protect aquatic habitats from pyrethroids:

- Old Salinas River Estuary (WARM)
- Tembladero Slough (WARM)
- Espinosa Lake (WARM)
- Espinosa Slough WARM)
- Salinas Reclamation Canal (WARM)
- Gabilan Creek (WARM)
- Alisal Creek (COLD)(WARM)
- Blanco Drain (WARM)
- Salinas River Refuge Lagoon (COLD) (WARM)
- Salinas River (COLD)(WARM)

In addition, the Basin Plan states that surface waterbodies within the Region that do not have a beneficial use designated for them in Table 2-1 of the Basin Plan are automatically assigned aquatic life protection. Examples of some additional surface waterbodies protected as aquatic habitat in the lower Salinas River watershed include:

- Alisal Slough
- Natividad Creek
- Quail Creek
- Chualar Creek
- Esperanza Creek

The Central Coast Water Board and the DPR are jointly responding to the presence of pesticides in surface waters. Violations of water quality objectives are documented in this TMDL. This TMDL technical report has been transmitted to DPR and the Monterey County Agricultural Commissioner. DPR and the Monterey County Agricultural Commissioner are responsible for enforcing label requirements. Label restrictions are the responsibility of USEPA but are enforced by DPR and the Monterey County Agricultural Commissioner.

Voluntary Action Recommendations to Achieve the TMDL

Growers should maximize efficiency wherever possible by coordinating their efforts to achieve TMDL objectives. The Agricultural Order encourages coordinated efforts. Coordinated efforts could include off-farm watershed treatment systems such as vegetative ditches, constructed wetlands, and vegetative treatment systems. On-farm management practices could include the implementation of sediment control practices such as the use of anionic polyacrylamide (PAM), sediment basins and vegetative treatment systems.

Growers could also coordinate efforts to implement the following recommendations:

1. <u>Pyrethroid Pesticide Control Plans</u>: Growers should develop ranch specific pyrethroid pesticide control plans with a reduced-risk application analysis and management practice implementation and effectiveness plan for each pyrethroid used. The pyrethroid pesticide plan should describe how and where pyrethroids are applied on a farm, how long they persist in the environment, where they could be transported in spray drift or runoff, and what practices will be

implemented for pollution control. For each ranch, the plan should include the following:

   a. A list of all pyrethroids used on the ranch;
   b. A description of the crops and pests being treated and production practices;
   c. A description of pyrethroids fate processes: volatilization, photodegradation, microbial or chemical degradation, sorption to soil particles, half- life, etc.;
   d. A site plan showing the ranch irrigation and drainage systems;
   e. An implementation plan with the location of management practices, a description of treatment methods, and evaluation that practices are consistent with pesticide label requirements required by other agencies; and
   f. A plan for assessing the effectiveness of pesticide management practices.

2. Farm Sediment Control and Evaluations: The primary route of pyrethroids into surface waters is the binding to fine soil particles and dissolved organic matter. All growers in the TMDL watershed should evaluate management practices and sediment discharge from their farms. Evaluations could include visual observations and photo documentation of management practices, discharge flow analysis, and measurements of turbidity or suspended sediment.
3. Subwatershed Regional Treatment Systems: Growers should evaluate the potential risk to receiving waters in the watershed from the use of pyrethroids and work with other growers and stakeholders to develop a plan for regional watershed treatment and pollutant assimilation. Staff recommends that growers work collaboratively on regional wetland and vegetative treatment systems to supplement onsite management practices.
4. Subwatershed Water Quality Improvement Reporting: Staff recommends that agricultural dischargers verify water quality improvements by evaluating crops, insect pest population patterns, pesticide use, water quality monitoring data, and management practice implementation in agricultural subwatersheds. Since urban stormwater is a source of sediment toxicity and pyrethroid pesticides in sediment, staff recommends monitoring subwatersheds dominated by irrigated agricultural land use. Recommended agricultural subwatersheds for evaluation include:
   a. Alisal Creek;
   b. Espinosa Slough;
   c. Gabilan Creek;
   d. Merrit Ditch;
   e. Natividad Creek;
   f. Quail Creek; and
   g. Chualar Creek.
5. Education and Outreach: Staff recommends that agricultural operations and pest control advisors and applicators that use pyrethroid pesticides annually complete Central Coast Water Board and/or Monterey County Agricultural Commissioner approved pesticide water quality education courses. Course content should be developed with coordination between the Central Coast Water Board, DPR, the Monterey County Agricultural Commissioner’s office, and industry.

TMDL Monitoring Locations

The existing monitoring programs provide sufficient spatial representation of the watershed land uses and sources of pollution to meet the goals of the TMDL (refer to Table 7-2, Figure 7-1, and Figure 7-2). Existing monitoring programs include agricultural monitoring by CCWQP and DPR, SWAMP monitoring by the statewide Stream Pollution Trends (SPoT) Monitoring Program, watershed monitoring by the Central Coast Ambient Monitoring Program (CCAMP), and municipal stormwater monitoring by the City of Salinas.

The SPoT program measures toxicity and pesticide trends and evaluates land use in major California water sheds. The SPoT program has identified pyrethroid pesticides as an increasing water quality problem and provides a valuable mechanism for monitoring trends in the watershed and in general urban areas. (CCAMP) monitors surface waters in the lower Salinas River watershed on a 5 year rotation and is scheduled to monitor in 2017. CCAMP monitors toxicity and pesticides in sediment as well as conventional parameters.

Table 7-2. TMDL monitoring sites (from existing site locations)

Waterbody/Site ID	Site Location	Monitoring Programs	Primary Land Use	Lat.	Long.
Alisal Creek/Upper Reclamation Canal					
309HRT	Alisal Slough at Hartnell Road	DPR	Agricultural	36.64056	-121.57639
309ALG	Salinas Reclamation Canal at La Guardia	CCWQP, CCAMP, DPR	Agricultural	36.65683	-121.6135
Alisal Slough					
309ASB	Alisal Slough at White Barn	CCWQP, CCAMP	Agricultural	36.72545	-121.73017
Blanco Drain					
309BLA	Blanco Drain below Pump	CCWQP, CCAMP	Agricultural	36.70852	-121.7489
Chualar Creek					
309CRR	Chualar Creek at Chualar River Road	CCWQP, CCAMP, DPR	Agricultural	36.56376	-121.51393
Espinosa Slough					
309ESP	Espinosa Slough upstream from Alisal Slough	CCWQP, CCAMP	Agricultural	36.73684	-121.73386
Gabilan Creek					
309GAB	Gabilan Creek at Boronda Road	CCWQP, CCAMP	Agricultural	36.69223	-121.62918
Merrit Ditch					
309MER	Merrit Ditch upstream from Highway 183	CCWQP, CCAMP	Agricultural	36.75184	-121.74208
Natividad Creek					
309NAD	Natividad Creek upstream from Salinas Reclamation Canal	CCWQP, CCAMP	Agricultural	36.70808	-121.59958

Old Salinas River					
309OLD	Old Salinas River at Monterey Dunes Way	CCWQP, CCAMP	Mixed Agricultural and Urban	36.77229	-121.78785
Quail Creek					
309QUI	Quail Creek at Highway 101	CCWQP, CCAMP, DPR	Agricultural	36.60956	-121.56137
Reclamation Canal					
309ALD	Salinas Reclamation Canal at Boronda Road	City of Salinas	Mixed Agricultural and Urban	36.69025	-121.67952
309JON	Salinas Reclamation Canal at San Jon Road	CCWQP, CCAMP, DPR	Mixed Agricultural and Urban	36.70247	-121.70868
Salinas River					
309DAV	Salinas River at Davis Road	SPoT, CCAMP, DPR	Mixed Agricultural, Urban, and Natural Background	36.64681	-121.70138
309SSP	Salinas River at Spreckels Gage	CCWQP	Mixed Agricultural, Urban, and Natural Background	36.62905	-121.68815
Tembladero Slough					
309TEH	Tembladero Slough at Haro	CCWQP, CCAMP, DPR	Mixed Agricultural and Urban	36.75932	-121.75487
309TDW	Tembladero Slough at Monterey Dunes	SPoT	Mixed Agricultural and Urban	36.77218	-121.78659

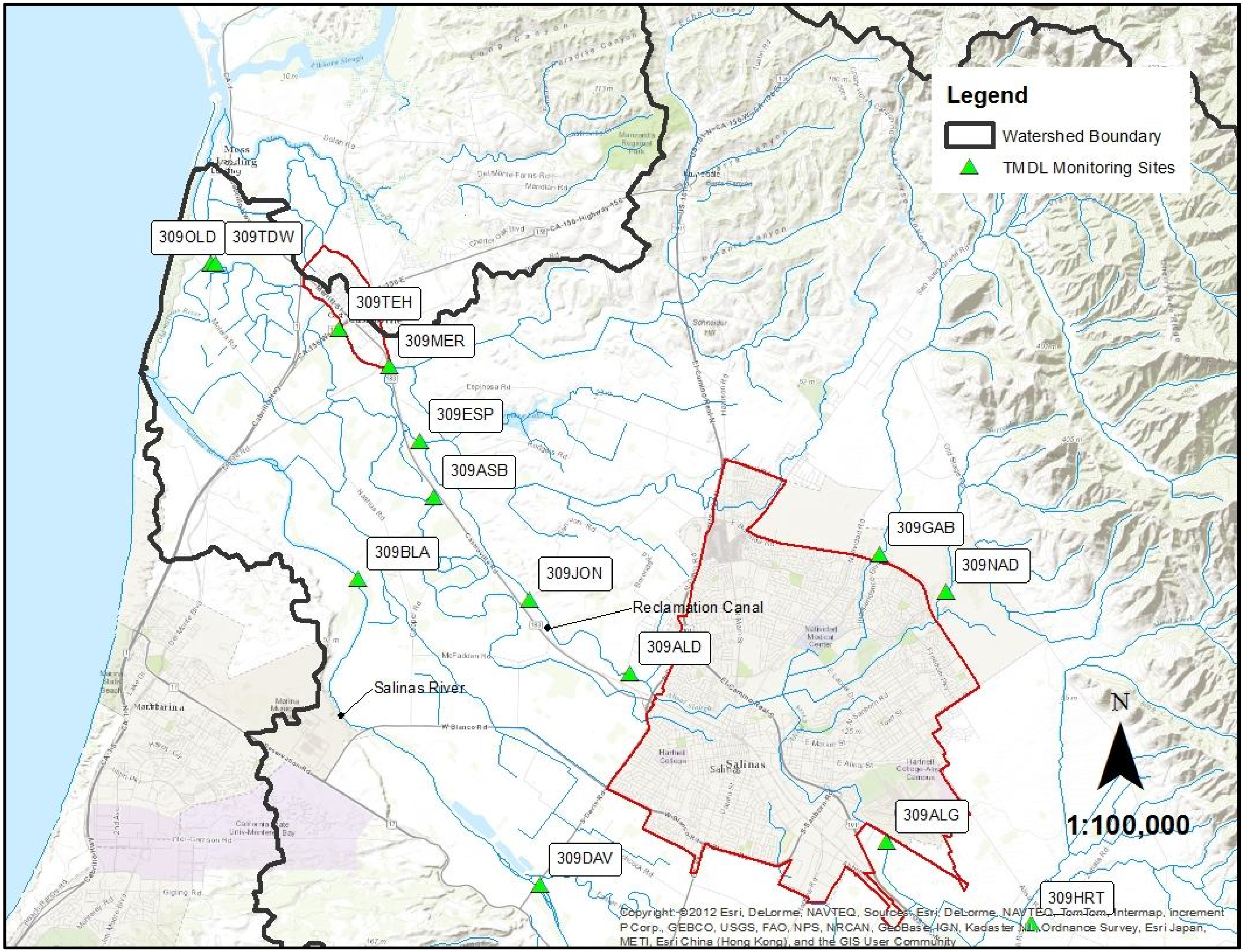

Figure 7-1. TMDL monitoring sites east of the City of Salinas (from existing site locations)

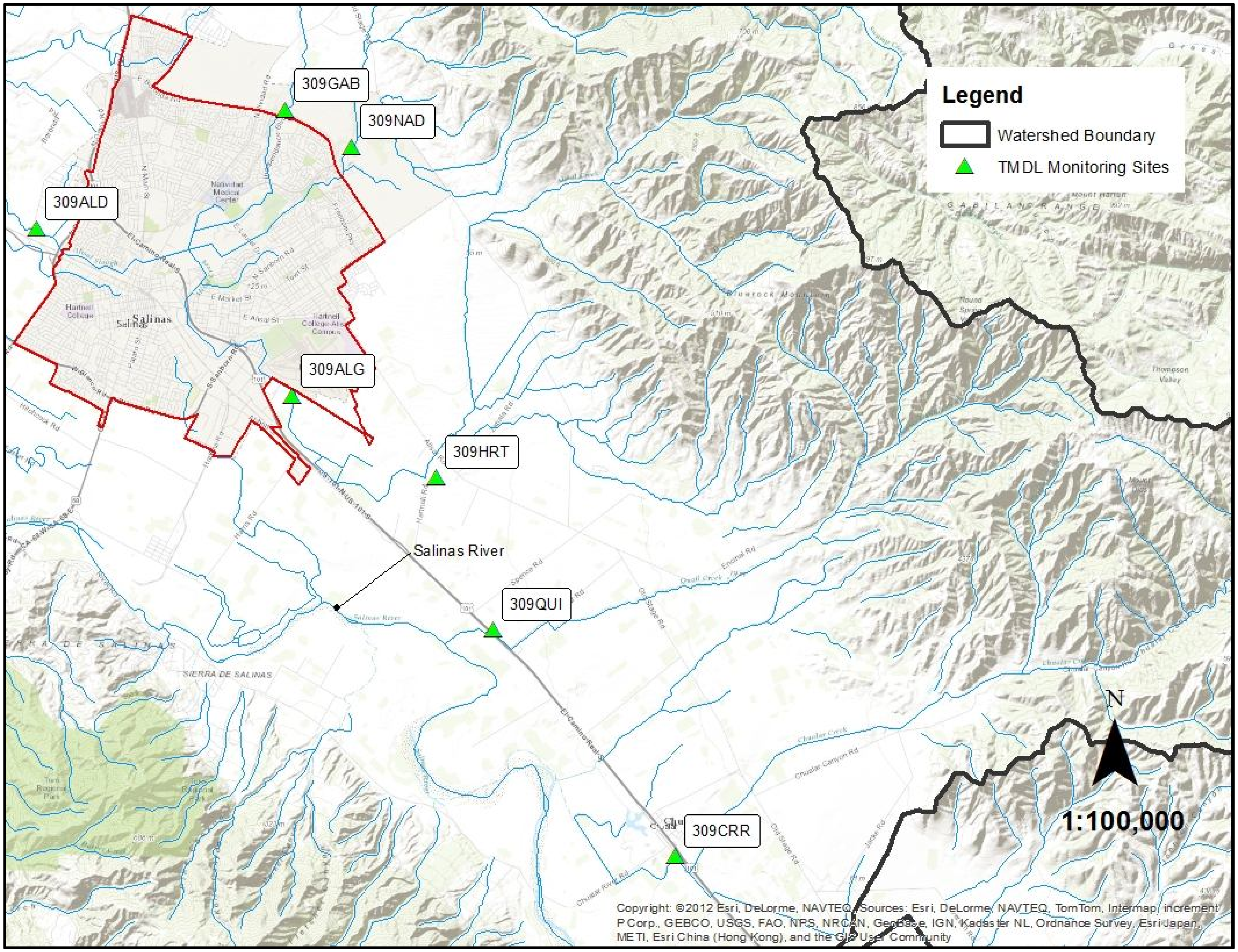

Figure 7-2. TMDL monitoring site west of the City of Salinas (from existing site locations)

7.2. Implementation Summary

The following table contains a summary of existing and future implementation activities. The future activities will be implemented by stormwater programs after TMDL approval.

Table 7-3. Summary of TMDL implementation and activities

TMDL Implementation	Description
Water Board - Agricultural Order	Ongoing farm planning and reporting of management practices and ambient surface water monitoring of TMDL waterbodies.
Water Board and DPR - Management Agency Agreement	Ongoing coordination by DPR and the Central Coast Water Board to address pesticide water quality problems
USEPA – Agricultural use pesticide label buffer requirements for pyrethroid applications	In 2008 USEPA required registrant to begin adding buffer requirements to agricultural use of pyrethroids to protect aquatic habitats. The extent of buffer implementation is uncertain and should be evaluated. Increased implementation and enforcement of regulations may be need.
DPR – Statewide urban surface water protection regulation	In 2012 DPR enacted surface water protection regulations for professional nonagricultural use of pyrethroids.
MS4 – Waste Load Allocation Attainment Plan (WAAP)	One year following adoption of the TMDL by OAL, the MS4s are required to develop WAAPs.

7.3. Cost Estimate and Sources of Funding

As required in the Porter-Cologne Water Quality Act, section 13141, the cost of implementing any agricultural water quality control program must be estimated and potential sources of funding identified prior to implementing a regional water quality control plan.

Section 13141: prior to implementation of any agricultural water quality control program, an estimate of the total cost of such a program, together with an identification of potential sources of financing, shall be indicated in any regional water quality control plan.

Irrigated Agriculture

The existing Agricultural Order requirements are sufficient to attain water quality standards in the project area. The Central Coast Water Board is not approving any new activity, but merely finding that ongoing activities and regulatory requirements are sufficient. Detailed cost information for implementing the Agricultural Order was compiled during the development of the order and cost estimates can be found in: *Central Coast Regional Water Quality Control Board. 2011. Technical Memorandum: Cost Considerations Concerning Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands; in: Appendix F – Staff Recommendations for Agricultural Order (March, 2011).*

In the monitoring section staff recommends additional monitoring of pyrethroid in sediment above the current Agricultural Order monitoring and reporting program requirements. Under the current program the watershed is monitored for toxicity in sediment annually and once during the cycle of the order for pyrethroid concentrations in sediment. Staff recommends increasing the monitoring sediment to annual monitoring of pyrethroid concentrations, which would cost an additional $400 per sample at 13 sites in the watershed. This would increase monitoring costs of the monitoring and reporting program by at least $5,200 per year. Additionally staff recommends adding fall monitoring of perennial streams for pyrethroids in perennial streams. Approximately 6 samples would be added in the fall at approximately $400 per sample for a total of $2,400. The total additional annual monitoring cost is estimated at $7,600.

MS4 Implementation Costs

To implement the TMDL the City of Salinas and the County of Monterey would incur additional costs. The current MS4 and watershed monitoring programs are adequate, however the MS4 are required to implement TMDLs through their permits and will incur addition costs for implementation, analysis and reporting.

Funding Sources

There are several grant funding programs available to stakeholders that currently fund projects in the watershed for non-point source pollution control including Clean Water Act 319(h) grant program and state proposition 84 grants. To facilitate watershed funding staff recommends that stakeholders participate in the areas Integrated Regional Water Management planning process. Additionally, adoption of the TMDL should improve the opportunity for stakeholders to obtain grant funds.

7.4. Timeline and Milestones

There are several processes that must occur in the watershed to achieve the TMDLs and receiving water targets. The first process is to control the discharge of pyrethroids from the landscape; once controlled, pyrethroids residing in stream sediment must either degrade or be transported out the hydrologic system. Since pyrethroids are highly persistent in stream sediments, transport out of the systems is the predicted environmental fate. Staff developed a conceptual model of the watershed to predict the rate of change in the watershed using information on the watershed, the pollutant and related models (refer to Figure 7-3). The assumptions and processes (milestones) of the conceptual model are outlined below:

1. <u>Load reductions from urban and agricultural lands</u>
    a. 17% of the watershed is developed land with potential urban pyrethroid pesticide use. Implementation of DPR urban pesticide regulation is predicted to control 80% of loading from urban watersheds; the DPR regulations were approved in 2012. Staff estimates that within 5 years of approval of the TMDLs urban load reductions should be achieved.
    b. 30% of the watershed is agricultural land with crops treated with pyrethroids. The Agricultural Order and USEPA regulations address pesticide runoff; however, the existing requirements are insufficient to address the problem with pyrethroids. More intensive management practice implementation and oversight are needed to control pyrethroids in agricultural runoff. Staff estimates that it will take 3 years of planning for pyrethroid stewardship and regulatory programs to be developed followed

by approximately 5 years of implementation to achieve load reductions. Total time to achieve agricultural load reductions is estimated at 10 years from adoption of TMDLs.

2. Sediment and pollutant transport from streams
    a. Pyrethroids are very stable in aquatic sediments; therefore, removal from the streams is the predicted fate of sediment pollutants rather than degradation.
    b. The impairments are located primarily in the Tembladero Slough/Reclamation Canal watershed. The drainage channels in the watershed are low gradient earthen channels filled with fine sediments. The sediments should flush out of the channels during high storm events but during low flows are stable.
    c. Silt is mechanically removed from the Reclamation Canal. Impervious urban land use has increased in Salinas and the canal has insufficient hydrologic capacity (MCWRA, 2014), which may accelerate the mobilization and transport of channel sediment and pollutants.
    d. The estimated time for polluted sediments to wash out of receiving waters is 5 years after load allocations from urban and agricultural lands are achieved. This estimate is based on a model of copper transport from the San Francisco Bay watershed (Aqua Terra, 2009). The model predicted that once copper loading from brake pads was controlled, responses in the watershed would take 1 to 5 years depending on channel length and composition and weather. The model found that concrete lined channels responded more quickly than earthen channels.

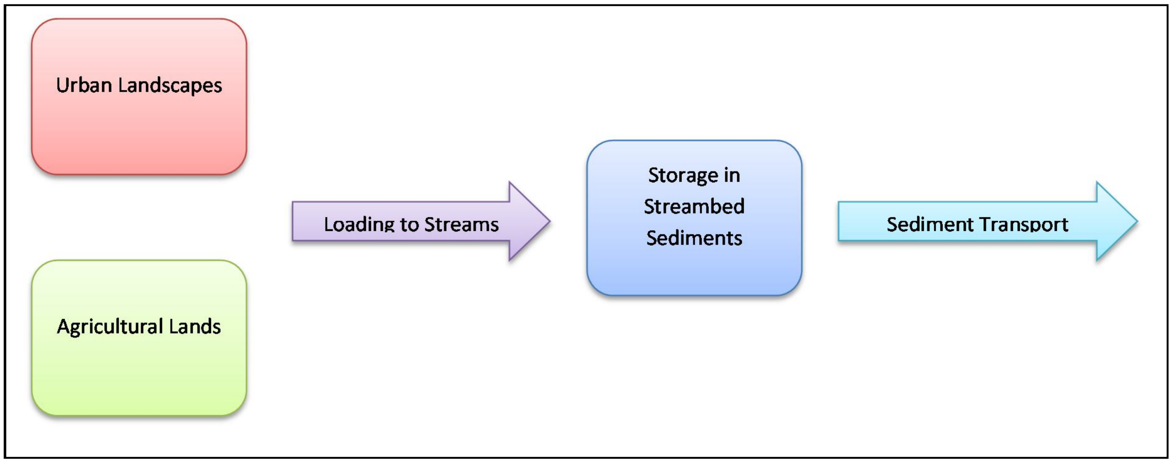

Figure 7-3. Conceptual model diagram

The anticipated date to achieve the pyrethroid target is 15 years after approval of the TMDLs by the Office of Administrative Law. This estimate is based on the above assessment. Milestones for achieving the pyrethroid TMDL are outline in Table 7-4.

Table 7-4. TMDL Timeline and Milestones

Year After Approval	Milestone
Current	Existing DPR urban pyrethroid regulations that were adopted in 2012.
3 Years	Agricultural program developed to address

Year After Approval	Milestone
	sediment toxicity and pyrethroids in sediment
5 Years	Municipal allocations achieved to meet TMDLs
10 years	Agricultural allocations achieved to meet TMDLs
15 Years	Targets achieved in receiving waters as indicators of meeting TMDLs

7.5. Determination of Progress and Attainment of Waste Load Allocations

City of Salinas and the County of Monterey have waste load allocations for toxicity and pyrethroids in sediment. Waste load allocations will be achieved through a combination of implementation of management practices and strategies to reduce pesticide loading and water quality monitoring. To allow for flexibility, Central Coast Water Board staff will assess progress towards and attainment of waste load allocations using one or a combination of the following:

1. Attaining the waste load allocations in the receiving water.
2. Demonstrating compliance by measuring pesticide concentrations and sediment toxicity at stormwater outfalls.
3. Any other effluent limitations and conditions that are consistent with the assumptions and requirements of the waste load allocations.
4. MS4 entities may be deemed in compliance with waste load allocations through implementation and assessment of pollutant loading reduction projects, capable of achieving interim and final waste load allocations identified in this TMDL in combination with water quality monitoring for a balanced approach to determining program effectiveness.

7.6. Determination of Progress and Attainment of Load Allocations

Demonstration of compliance with the load allocations is consistent with compliance with the Agricultural Order. Load allocations will be achieved through a combination of implementation of management practices and strategies to reduce pesticide loading, and water quality monitoring. Flexibility to allow owners and operators from irrigated lands to demonstrate progress toward and attainment of load allocations is a consideration; additionally, staff is aware that not all implementing parties are necessarily contributing to or causing surface water impairments.

To allow for flexibility, Central Coast Water Board staff will assess progress towards and attainment of load allocations using one or a combination of the following:

1. Attaining the load allocations in the receiving water.
2. Attaining toxicity numeric targets in receiving water.
3. Implementing management practices that are capable of achieving interim and final load allocations identified in this TMDL.
4. Providing sufficient evidence to demonstrate that they are and will continue to be

in compliance with the load allocations; such evidence could include documentation submitted by the owner or operator of irrigated lands, to the Executive Officer that the owner or operator is not causing waste to be discharged to impaired waterbodies resulting or contributing to violations of the load allocations.

8. PUBLIC PARTICIPATION

Program staff held several stakeholder meetings during the development of the TMDL. The following is a summary of TMDL meetings and information items:

- January 22, 2015 – Kick-off meeting in Salinas
- March 3, 2015 – CEQA scoping meeting
- April 21, 2015 – Meeting with Grower-Shipper Association of Central California
- December 8, 2015 – Public stakeholder meeting in Salinas

Staff developed an email distribution list to communicate with stakeholders. The distribution list was developed from an existing TMDL distribution list for the watershed.

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