East San Joaquin Water Quality Coalition
1201 L Street
Modesto, CA 95354

March 31, 2004

Mr. Robert Schneider
Chair, California Regional Water Quality Control Board
Central Valley Region

Thomas Pinkos
Executive Officer, California Regional Water Quality Control Board
11020 Sun Center Drive #200
Rancho Cordova, California 95670-6114

Mr. Schneider, Mr. Pinkos:

Please find enclosed the Watershed Evaluation Report (WER) and the Monitoring and Reporting Program (MRP) on behalf of the East San Joaquin Water Quality Coalition.

The WER and MRP were prepared by members of the Coalition Technical Committee with the assistance of Michael Johnson and input from local leaders within the Coalition area.

Please understand that these documents are dynamic and will continue to improve over time as we better understand the numerous water quality monitoring efforts that are underway by the Regional Board and others within the region.

Today, I began to check schedules of Mr. Johnson and Coalition Board of Directors to coordinate a date in mid April time to meet with Regional Board staff Shakoora Azimi and Bill Croyle. We look forward to their comments on these documents and also solicit your input on how we can best proceed to implement this program.

Sincerely,

Parry Klassen
Executive Director
Coalition for Urban/Rural Environmental Stewardship
559-325-9855

Wayne Zipser
Manager
Stanislaus County Farm Bureau
209-522-7278

cc: Board Members

Watershed Evaluation Report
East San Joaquin Water Quality Coalition

April 1, 2004

Introduction

The East San Joaquin River Water Quality Coalition (Coalition) was formed in 2003 to enhance and improve water quality in the East San Joaquin River watershed, while sustaining the economic viability of agriculture, associated values of managed wetlands and sources of safe drinking water. The Coalition is comprised of more than 16 supporting agricultural entities and as of April 1, 2004, 1000 landowner/operators of irrigated farmland have joined with local governments throughout the coalition area to improve water quality in the region.

The Coalition developed and submitted its Notice of Intent (NOI) to meet the newly adopted water quality regulations to Central Valley Regional Water Quality Control Board (Regional Board) on November 1, 2003. On February 9, 2004, the Regional Board issued a Notice of Applicability (NOA) to the Coalition verifying the NOI was complete and approved.

This Watershed Evaluation Report (WER) is prepared as mandated by the Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands Resolution No. R5-2003-0105, in efforts to assess the sources and impacts of waste in discharges from irrigated lands. The accompanying Monitoring and Reporting Program Plan provides the mechanism necessary to track progress in reducing the amount of waste discharged that affects the quality of the waters within the East San Joaquin Valley Watershed coalition boundaries.

The WER has three main components. The first section of the report contains a description of the watershed characteristics. More specifically, the first section of the report provides data and information describing the area's hydrology and drainage patterns, land use and crop data, chemical application, and programs and applicable management projects used to reduce or eliminate agriculture irrigation's adverse effects on water quality in the receiving waterbodies. Information gathered for this section is based on data available on the California Department of Pesticide Regulation website, Geographic Information System land use data obtained from the California Department of Water Resources, and the relevant County Agricultural Commissioner's 2002 Agricultural Crop and Livestock Reports. The information presented is based on the most updated data available at the time this report was written.

The second section of the report identifies the coalition's priorities with respect to work on specific subwatersheds and water quality parameters. Rationale for site selection, specific constituents and sampling information are provided in the Monitoring and Reporting Program Plan document. Locations to be sampled are selected based on the status of the water body as an intermediate-sized drainage with irrigated agriculture located upstream. In many instances (see below), the proposed sampling sites are located a significant distance upstream of the confluence of the intermediate-sized drainage with the San Joaquin River. In these instances, the location of the proposed sample site is established to eliminate impacts from urban runoff that may enter the water body.

The third section of the report lists known projects and programs that focus on evaluating management practices. An implementation plan is presented to aid in identifying and tracking the progress of water quality management practices that are installed or implemented in the coalition area and report monitoring results.

1 East San Joaquin Valley Watershed Setting

1.1 General Characteristics

The East San Joaquin (ESJ) Water Quality Coalition watershed area includes Stanislaus, Merced, Tuolumne and Mariposa Counties and portions of Calaveras County and comprises a total of approximately 1,230,281 acres (acreage for Stanislaus and Merced Counties only). Of this total, approximately 633,812 acres (52%) are considered irrigated agriculture (based on 1996 Stanislaus County and 1995 Merced County land use data, Department of Water Resources portal through http://www.waterplan.water.ca.gov/landwateruse/landuse/ludataindex.htm). The watershed that drains into the Coalition area is bordered by the crest of the Sierra Nevada on the east and the San Joaquin River on the west, the Stanislaus River on the North to the Chowchilla River on the South. There are four major tributaries in the watershed: Chowchilla River, Merced River, Tuolumne River and Stanislaus River (Figure 1a). These rivers are all tributaries of the San Joaquin River and drain from east to west. The ESJ watershed area also includes within its boundaries four irrigation districts, Oakdale Irrigation District, Merced Irrigation District, Turlock Irrigation District, and Modesto Irrigation District.

For monitoring purposes, the irrigated farmland that is outside of the drainage area managed by the aforementioned irrigation districts is divided into six regions of irrigated farmland based on geographic location, hydrology, and types of crops grown. The six regions, as shown in Figure 1b, are Little John Creek, Dry Creek-Tuolumne River, Dry Creek-Merced River, Fahrens Creek, Deadman Creek, and San Joaquin Flats. The Little Johns Creek region occupies the extreme northeast corner of the ESJ (Figure 2a, 2b). The Dry Creek-Tuolumne River region is located immediately south of the Little Johns Creek region, east of the Oakdale and Modesto Irrigation Districts, and north of the Dry Creek-Merced River region (Figure 3a, 3b). The Dry Creek-Merced River region is located south of the Dry Creek-Tuolumne River region, west of the Turlock Irrigation District, north of the Merced Irrigation District and Fahrens Creek region (Figure 4a, 4b). The Deadman Creek region is located at the southern extent of the ESJ region (Figure 5a, 5b). The Fahrens Creek region is located in the southeast portion of the ESJ watershed. The Merced Irrigation District lies to the west, the Dry Creek-Merced River region to the north and the Deadman Creek region to the south (Figure 6a, 6b). The San Joaquin Flats region is a noncontiguous clustering of irrigated land located along the mainstem of the SJR and along the main rivers that drain into the SJR. These lands are primarily to the west of the irrigation districts along the SJR or along the corridors of the rivers on land not associated with the irrigation districts (Figure 7).

1.1.1 Climate

Summer temperatures are usually hot in the valley, ranging from the mid 80's to mid 90's (^{o}F) for average high temperatures and the mid to upper 50's for average summer low temperatures. The upland areas are slightly cooler but generally remain hot throughout the summer. In the winter, temperatures are usually moderate in the valley with average high temperatures in the mid to upper 50's and average low temperatures in the low 40's. Annual precipitation on the valley floor in the Coalition region is variable but averages about 13-15 inches per year (City of Merced precipitation data). Over the last several years, the average annual precipitation in the Coalition geographic area has varied from 9 to 17 inches. Rainfall occurs predominantly during the winter as is typical for a

Mediterranean climate and rainfall is heterogeneously distributed throughout the winter period. Typical winters are characterized by several small storms with one or two major storms providing the bulk of the precipitation for the winter. There appears to be no discernible pattern as to when during the winter these large storms occur.

Figure 1a. The East San Joaquin Water Quality Coalition region.
Data from 1996 DWR land use maps. See text for details.

East San Joaquin Water Quality Coalition: Land Cover, Major Streams

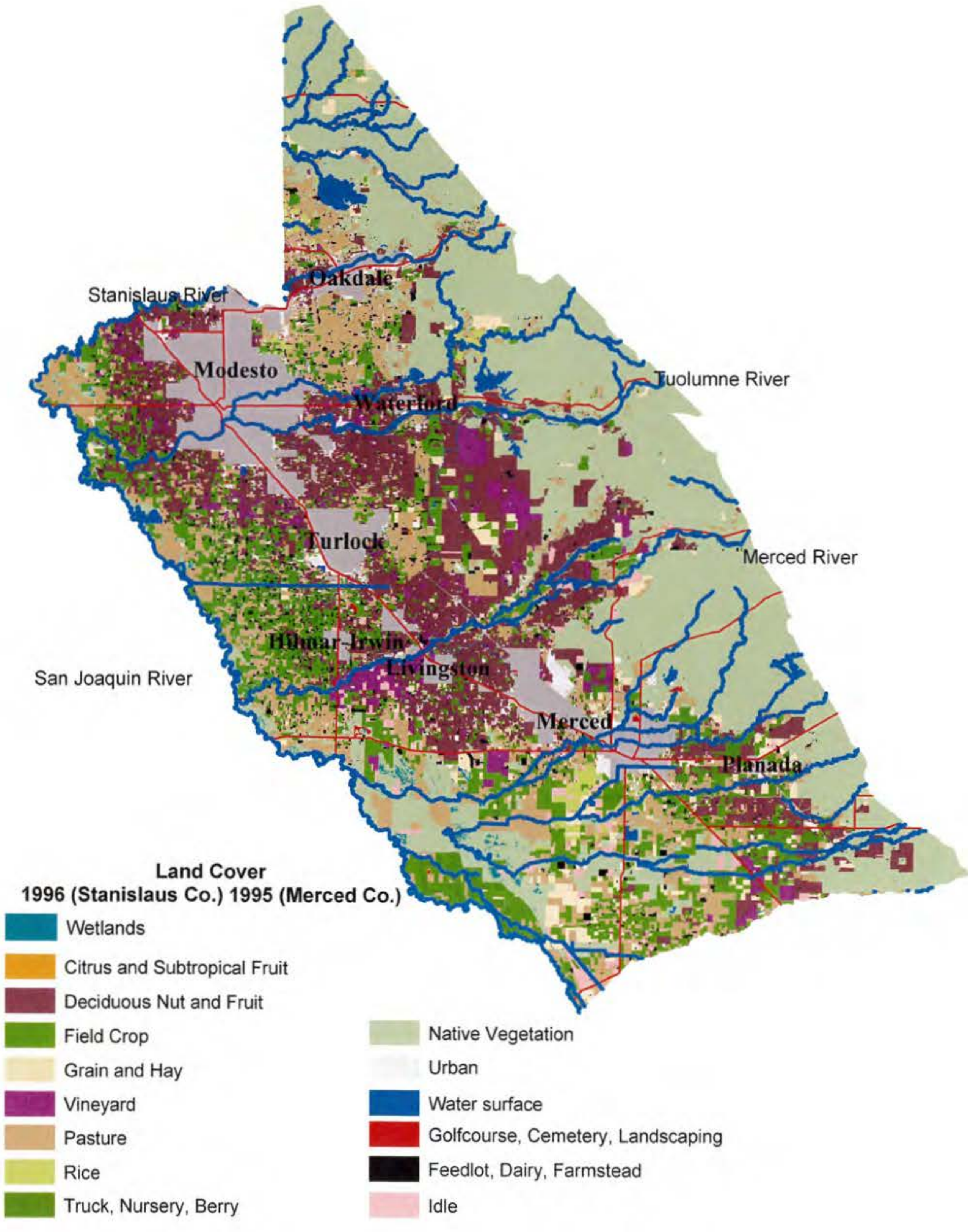


Figure 1b. The geographic boundaries of the East San Joaquin Water Quality Coalition with the sub watershed regions.

East San Joaquin Water Quality Coalition Monitoring Areas

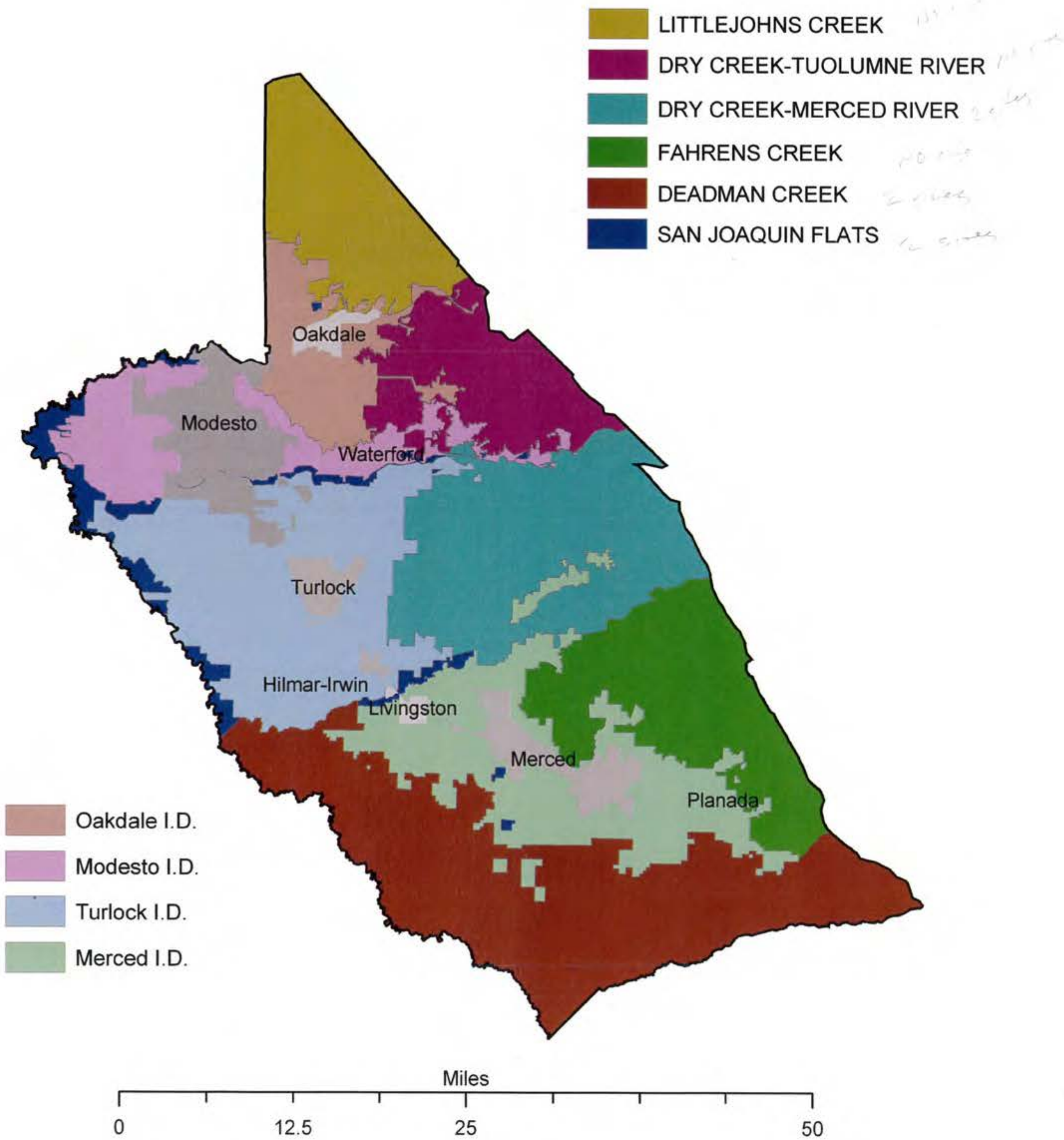
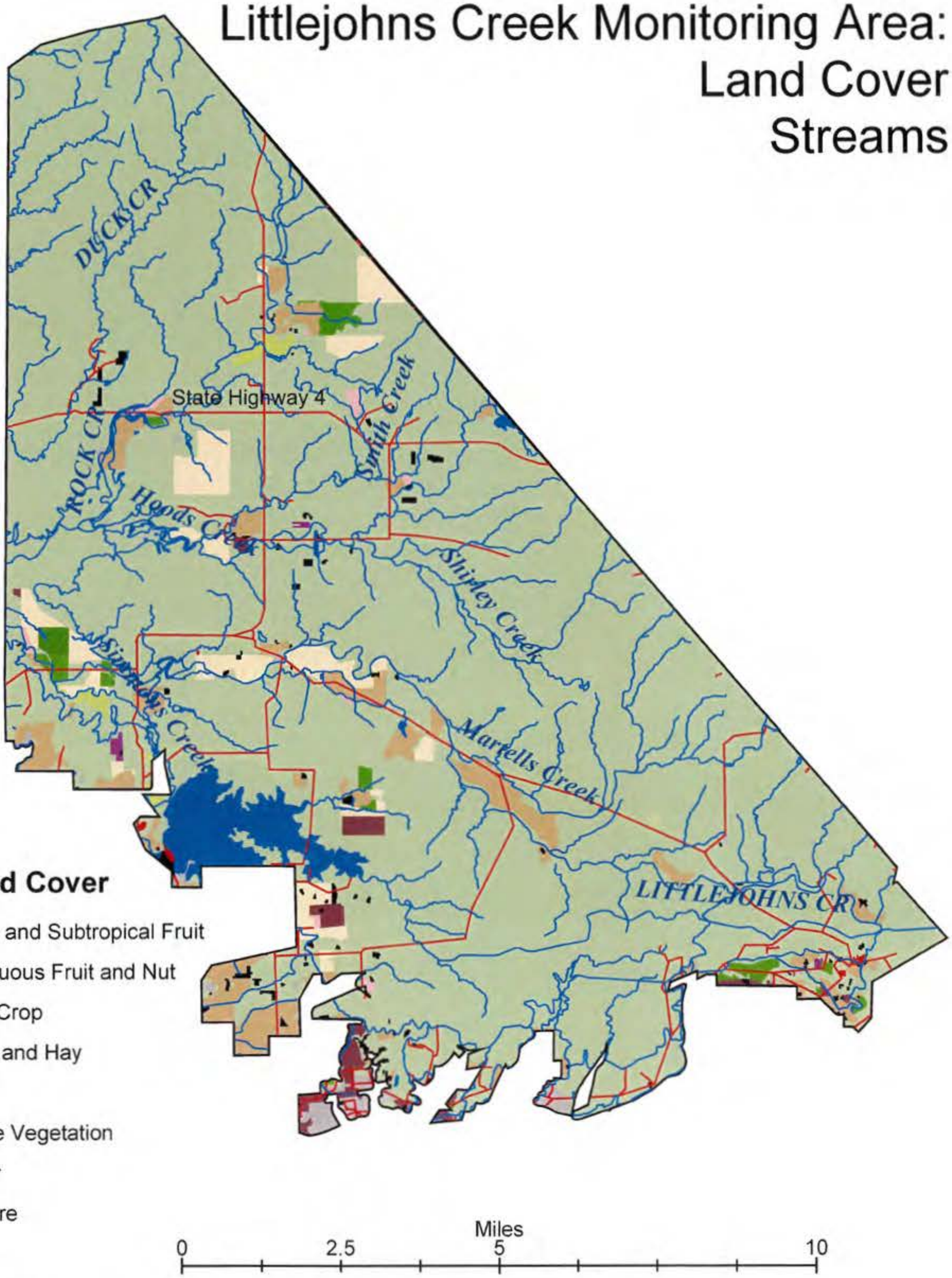


Figure 2a. Little John Creek region land cover.

Littlejohns Creek Monitoring Area: Land Cover Streams



1996 Land Cover

- Citrus and Subtropical Fruit
- Deciduous Fruit and Nut
- Field Crop
- Grain and Hay
- Idle
- Native Vegetation
- Water
- Pasture
- Rice
- Vineyard
- Truck, Nursery, Berry
- Urban
- Golf Course, Cemetery, Landscaping
- Feedlot, Dairy, Farmstead

Figure 2b. Little John Creek region with irrigated and non-irrigated lands. Non-irrigated vegetation includes all classes of native vegetation and non-irrigated pasture and cropland.

Littlejohns Creek Monitoring Area: Irrigated vs Non-irrigated

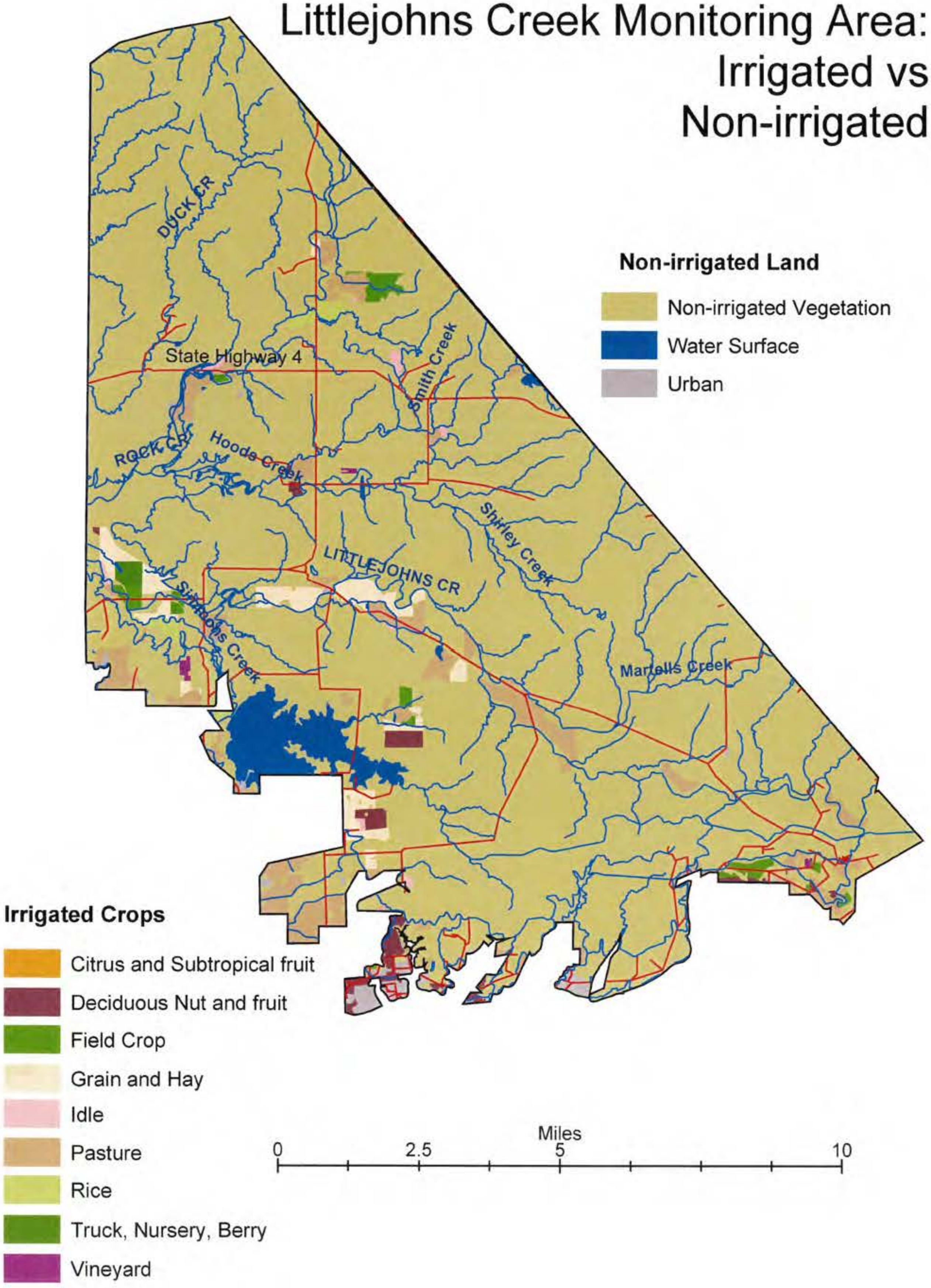
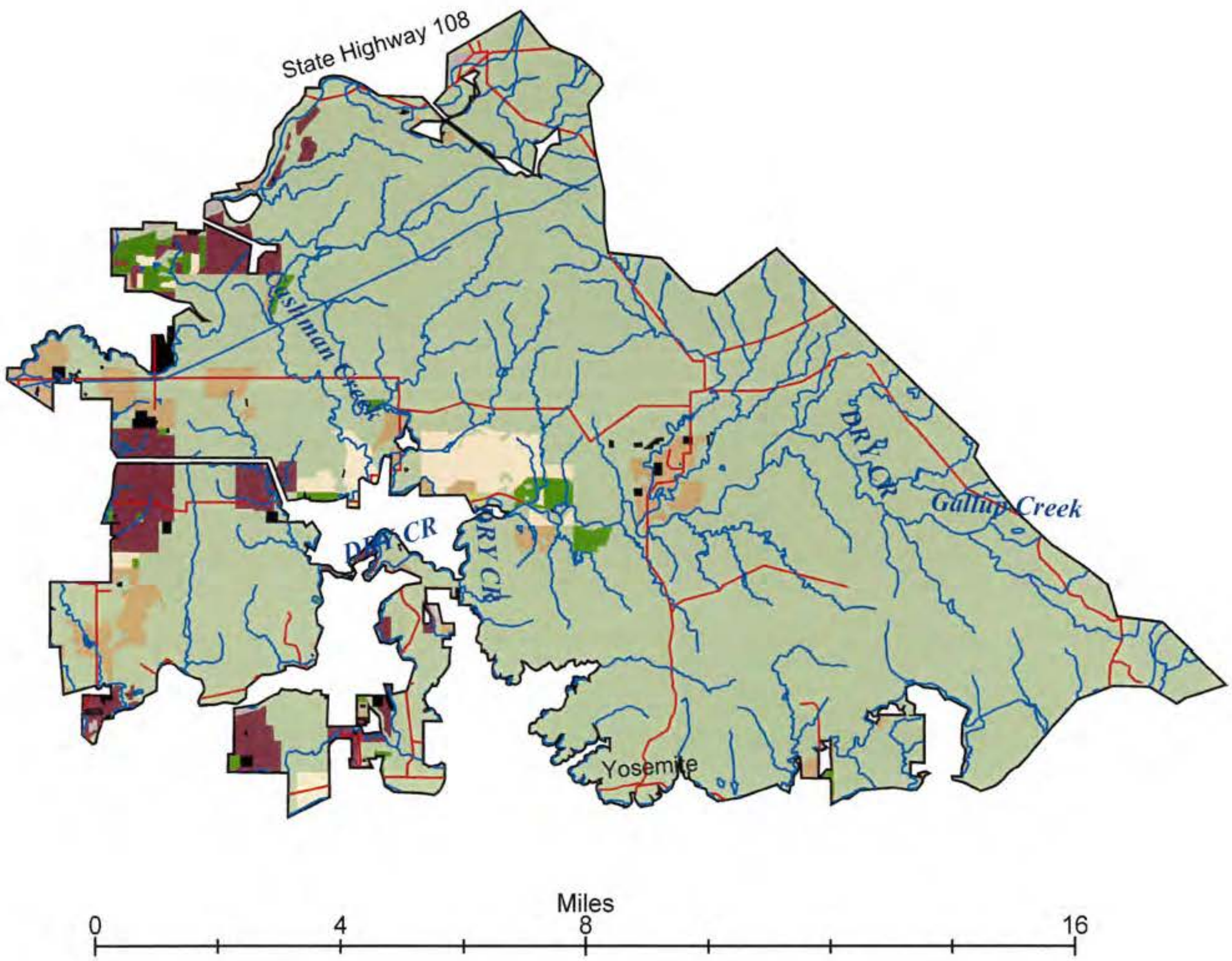


Figure 3a. Dry Creek-Tuolumne River region land cover. Data from 1996 DWR land use maps. See text for details.

Dry Creek-Tuolumne River Monitoring Area: Land Cover, Streams



1996 Land Cover

- Citrus and Subtropical Fruit
- Deciduous Nut and Fruit
- Field Crop
- Grain and Hay
- Pasture
- Rice
- Truck, Nursery, Berry
- Vineyard
- Idle
- Native Vegetation
- Water surface
- Feedlot, Dairy, Farmstead
- Urban
- Golfcourse, Cemetery, Landscaping

Figure 3b. Dry Creek-Tuolumne River region with irrigated and non-irrigated lands. Non-irrigated vegetation includes all classes of native vegetation and non-irrigated pasture and cropland.

Dry Creek-Tuolumne River Monitoring Area: Irrigated vs Non-irrigated

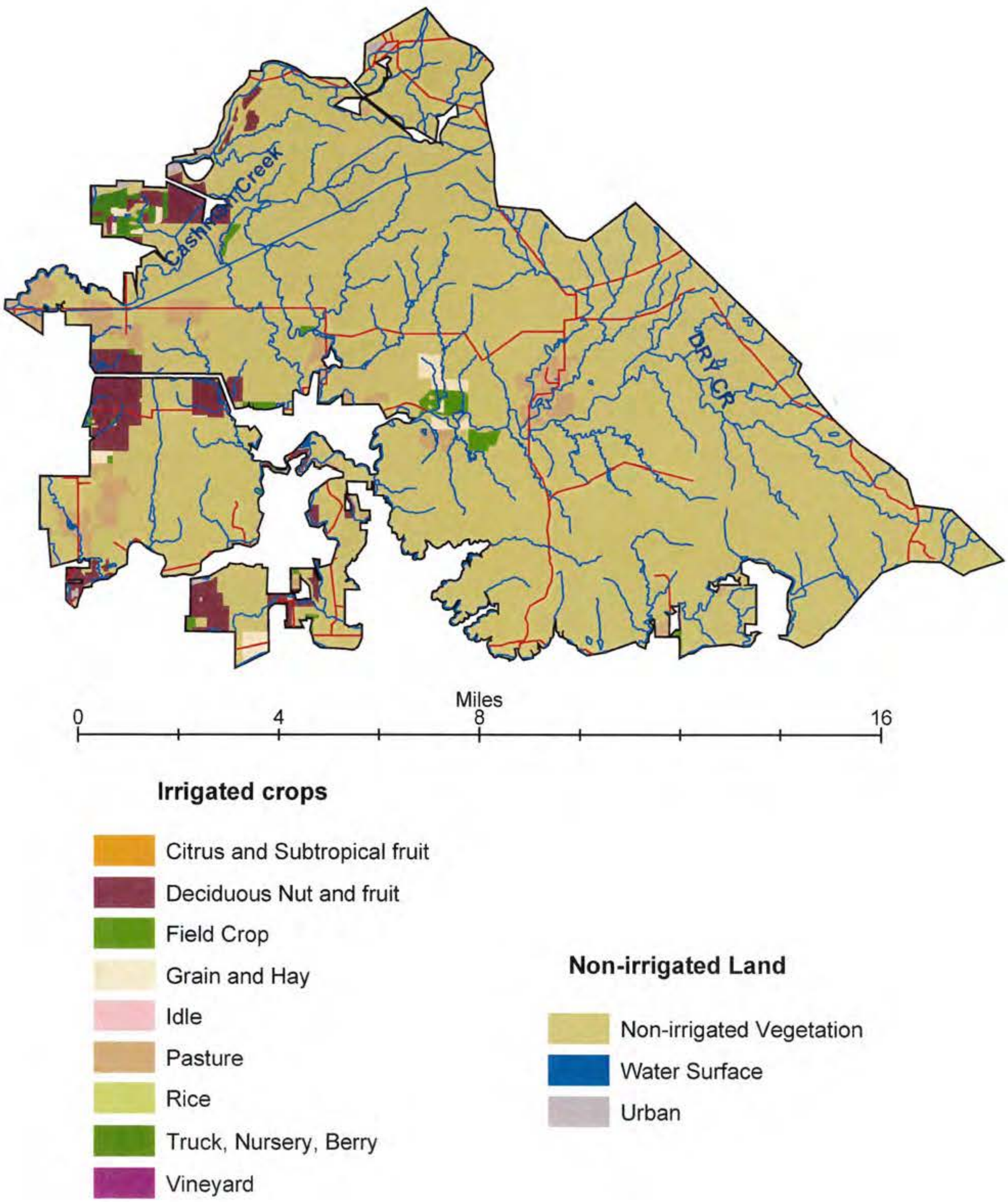


Figure 4a. Dry Creek-Merced River region land cover. Data from 1996 DWR land use maps. See text for details.

Dry Creek-Merced River Monitoring Area: Land Cover, Streams

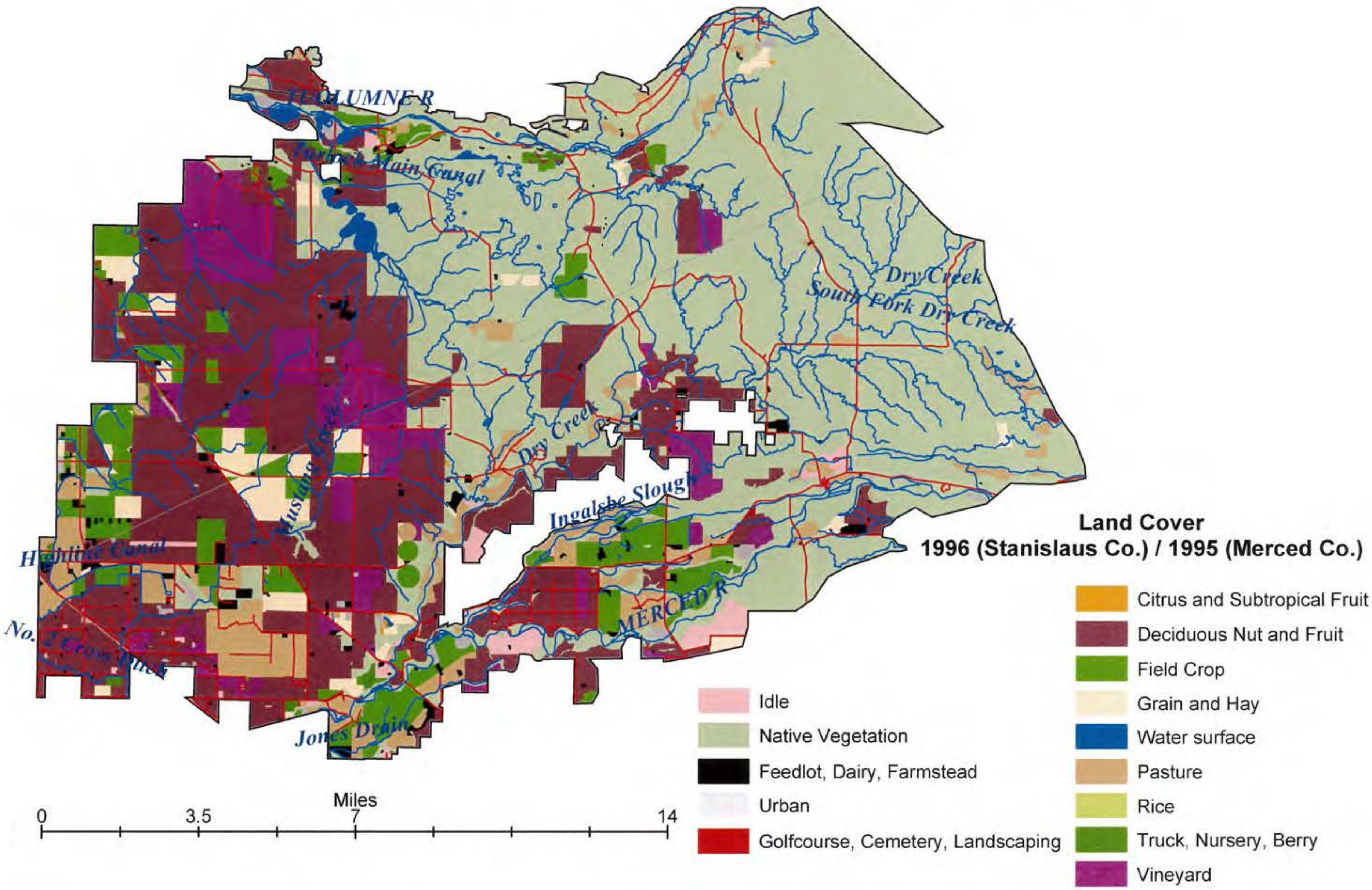


Figure 4b. Dry Creek-Merced River region with irrigated and non-irrigated lands. Non-irrigated vegetation includes all classes of native vegetation and non-irrigated pasture and cropland.

Dry Creek-Merced River Monitoring Area: Irrigated vs Non-irrigated

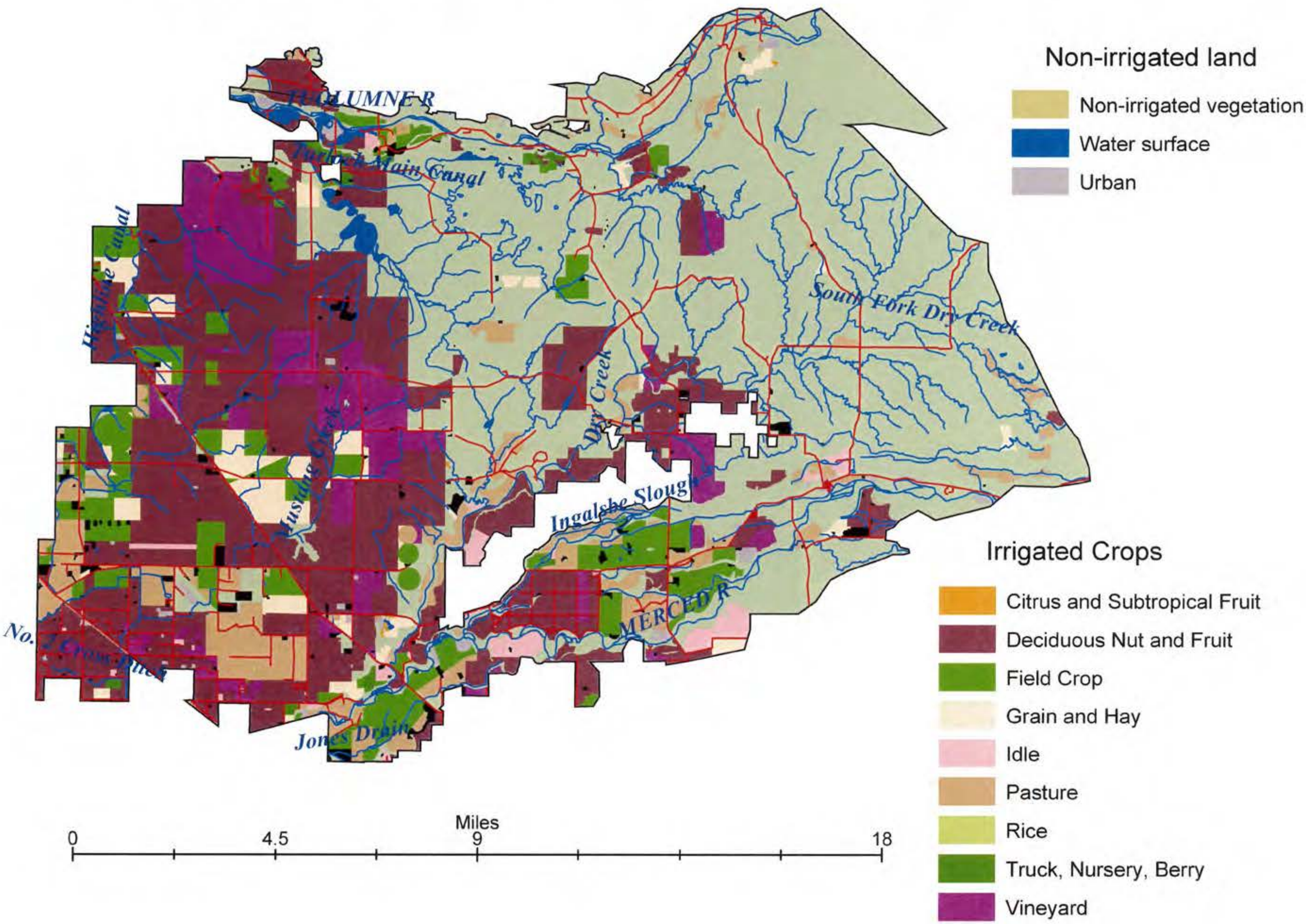


Figure 5a. Deadman Creek region land cover.
Data from 1996 DWR land use maps. See text for details.

Deadman Creek Monitoring Area: Land Cover and Streams

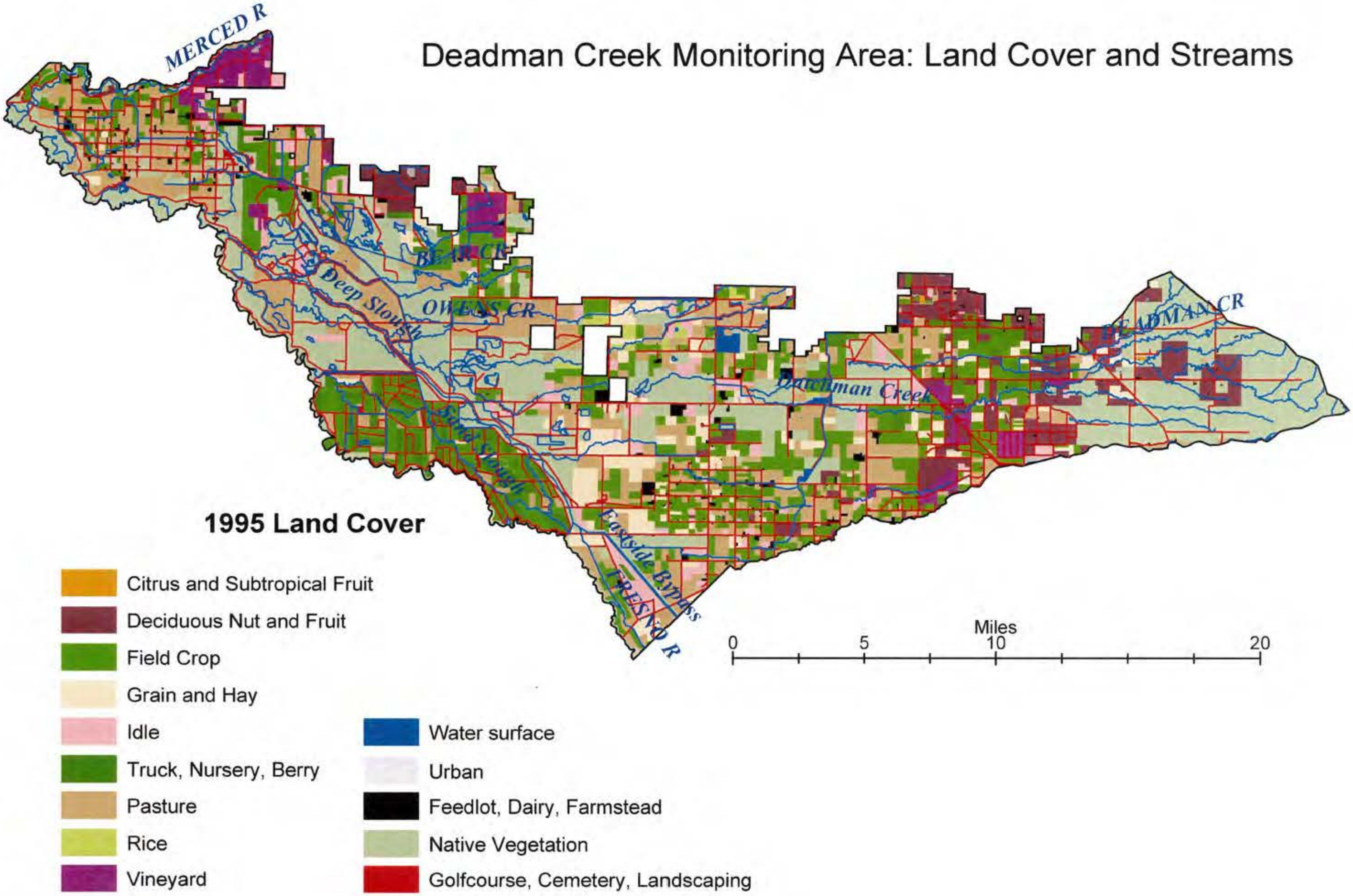


Figure 5b. Deadman Creek region with irrigated and non-irrigated lands. Non-irrigated vegetation includes all classes of native vegetation and non-irrigated pasture and cropland.

Deadman Creek Monitoring Area: Irrigated vs Non-irrigated

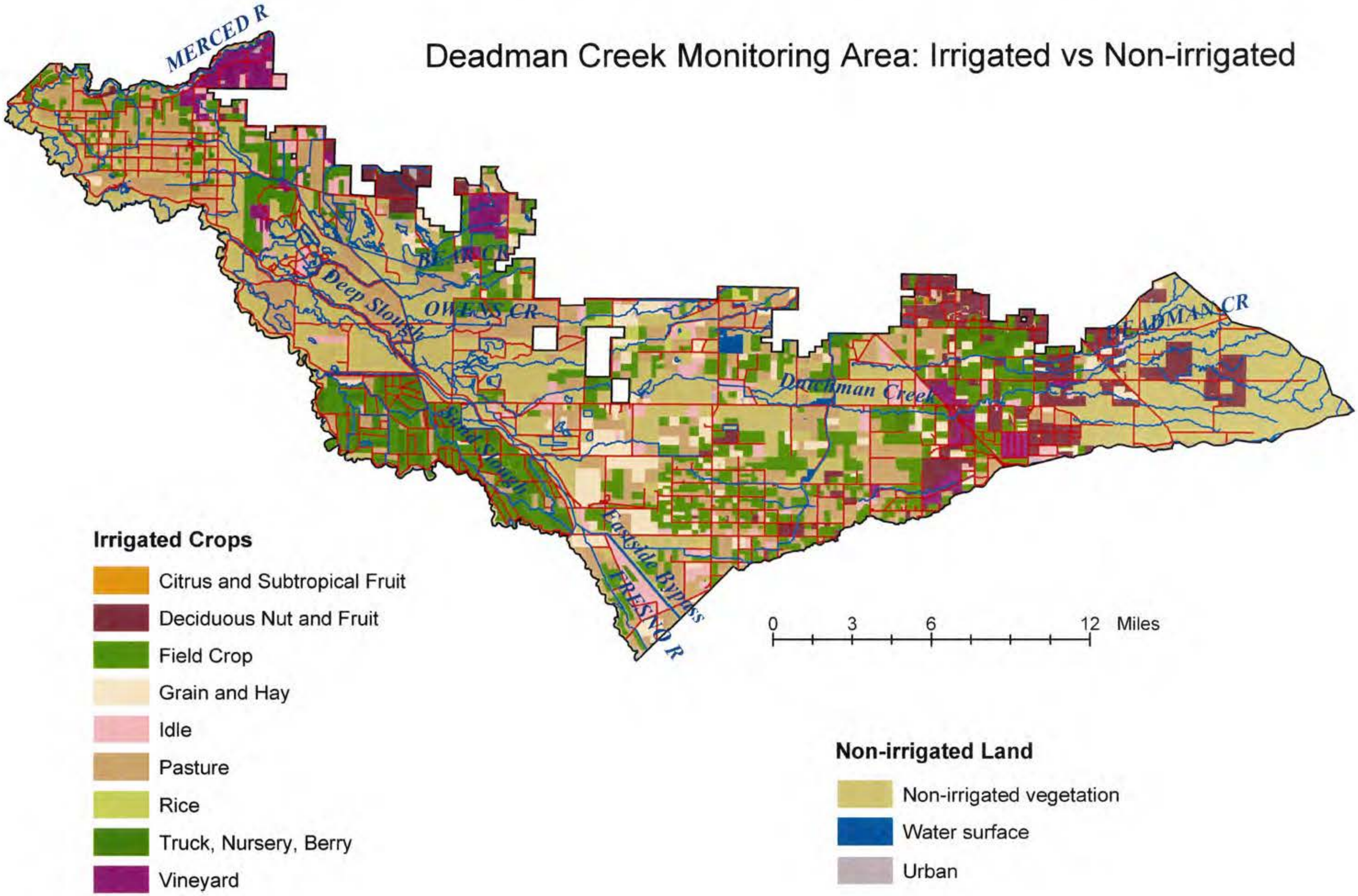


Figure 6a. Fahrens Creek region land cover.
Data from 1996 DWR land use maps. See text for details.

Fahrens Creek Monitoring Area: Land Cover and Streams

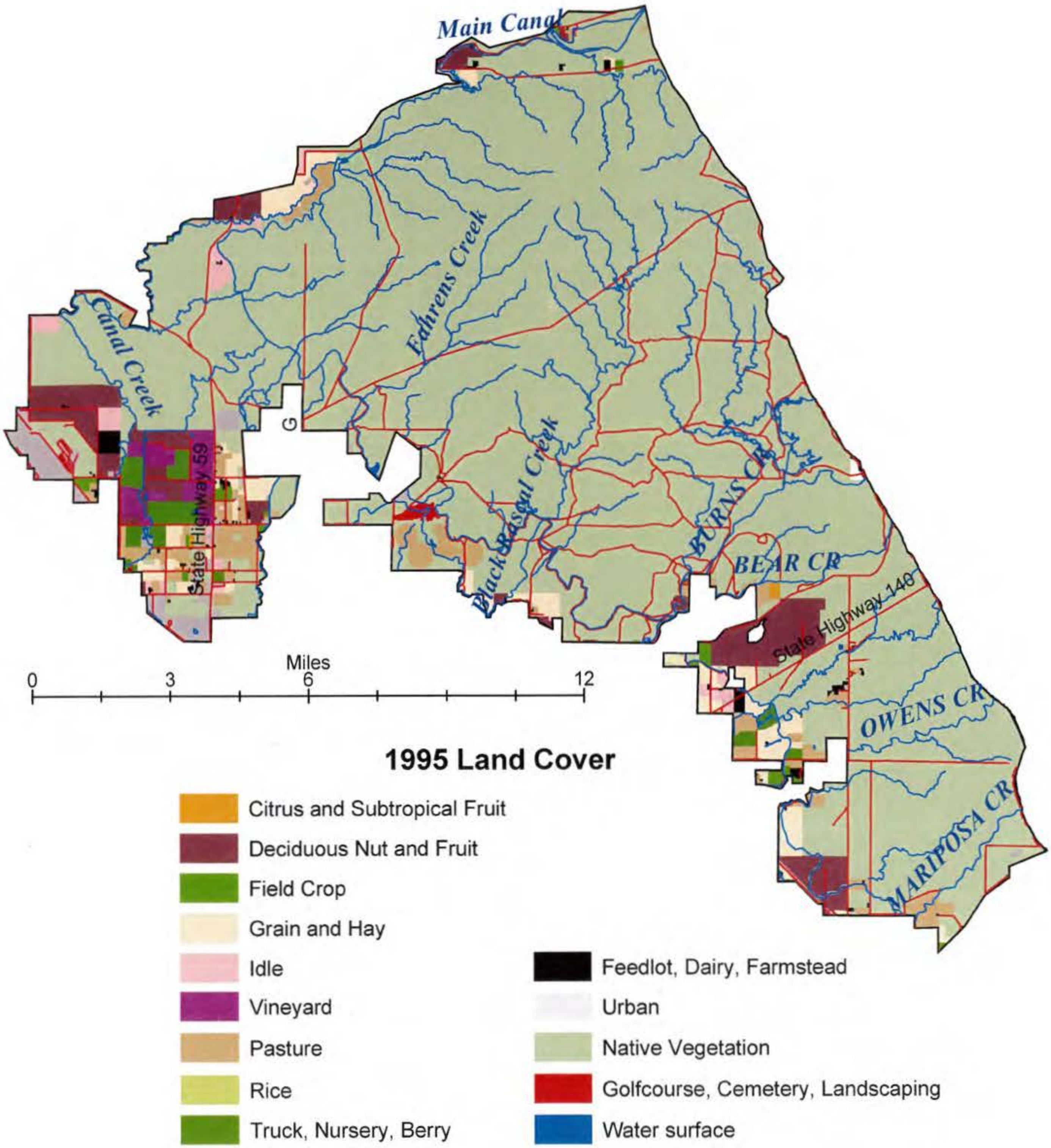


Figure 6b. Fahrens Creek region with irrigated and non-irrigated lands. Non-irrigated vegetation includes all classes of native vegetation and non-irrigated pasture and cropland.

Fahrens Creek Monitoring Area: Irrigated vs Non-irrigated

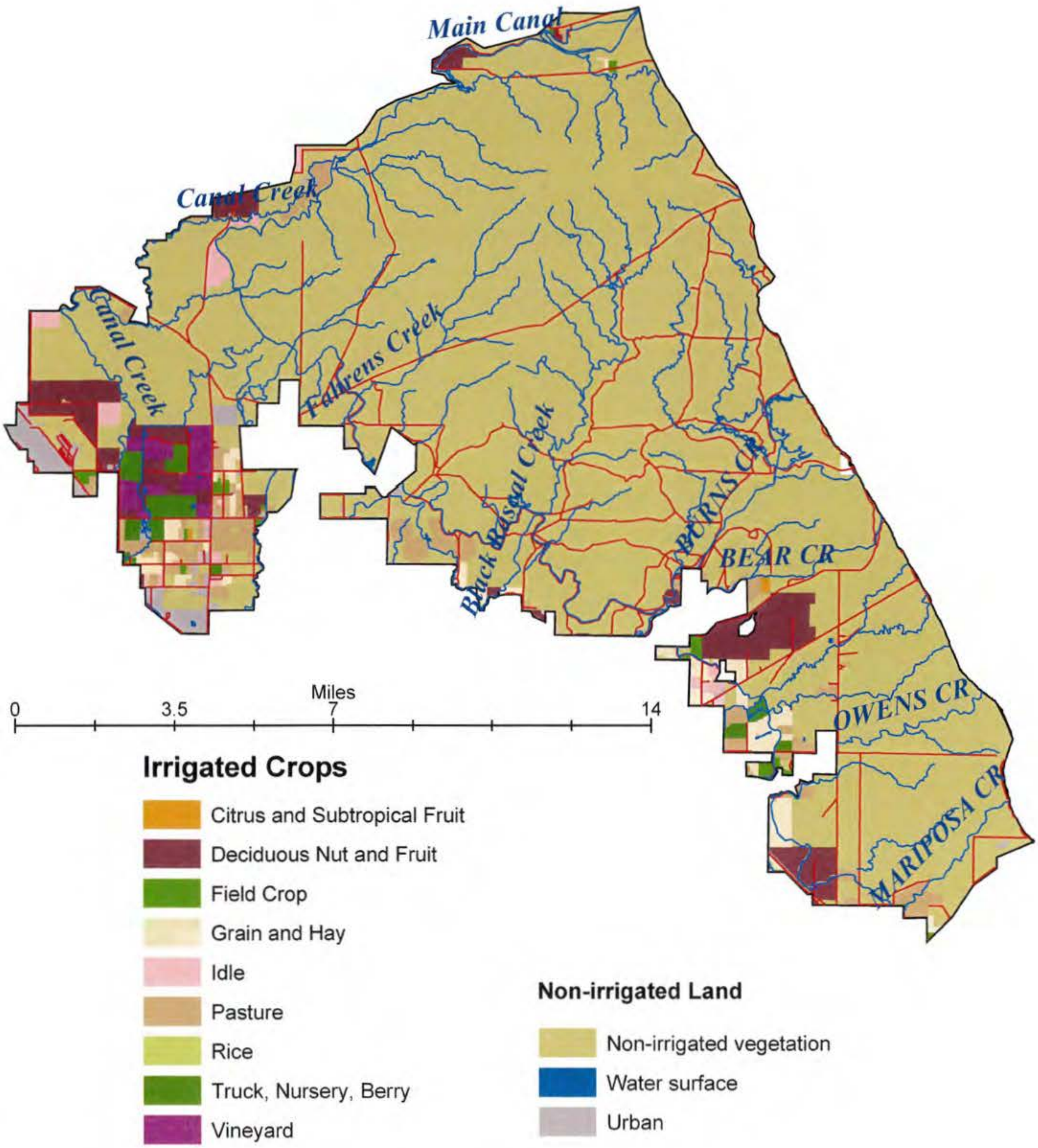


Figure 7. San Joaquin Flats land cover.

San Joaquin Flats Monitoring Area: Land Cover and Streams

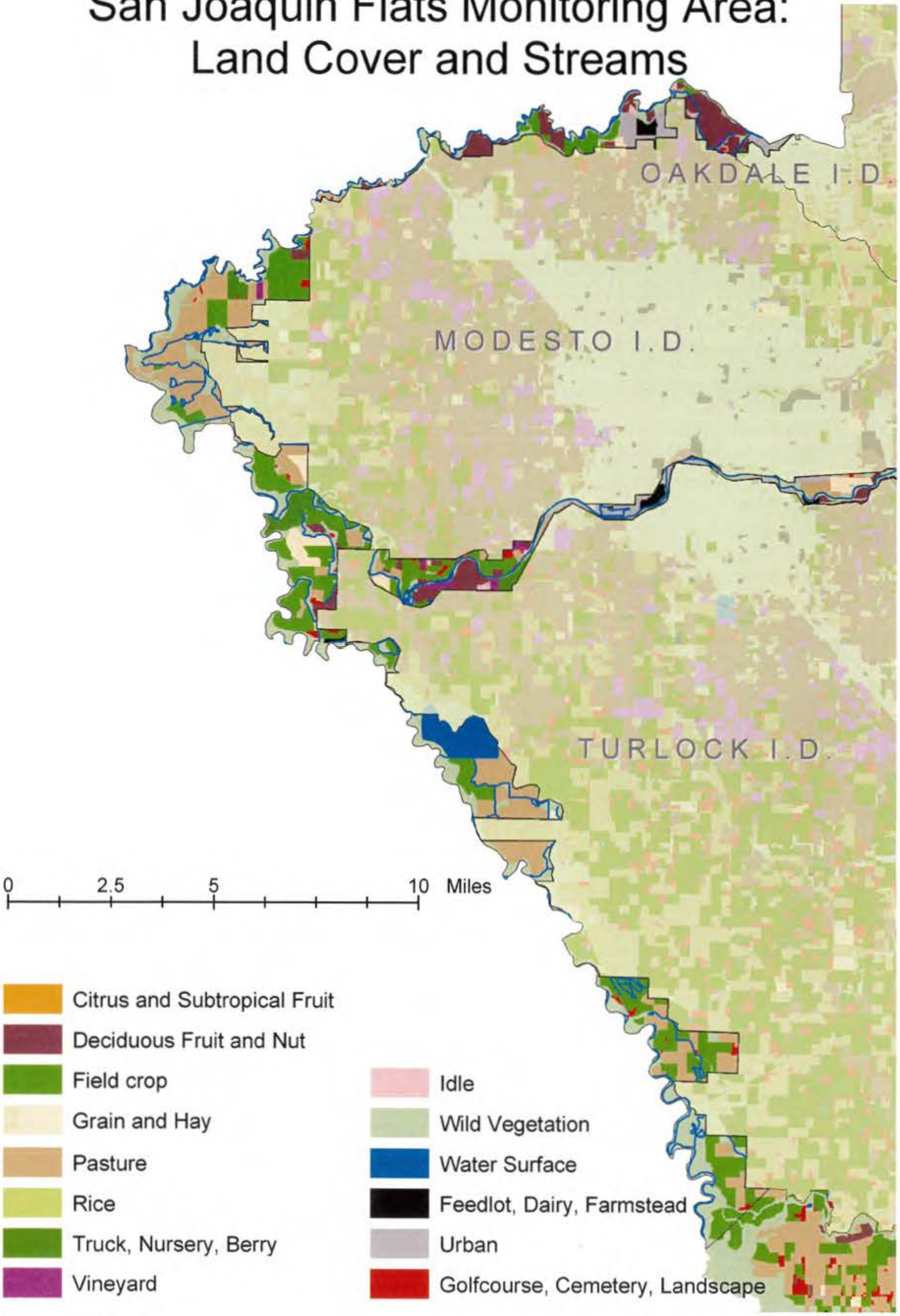


Figure 8. Relative infiltration rates of soils in the Coalition region.

East San Joaquin Water Quality Coalition: Relative Infiltration Rates

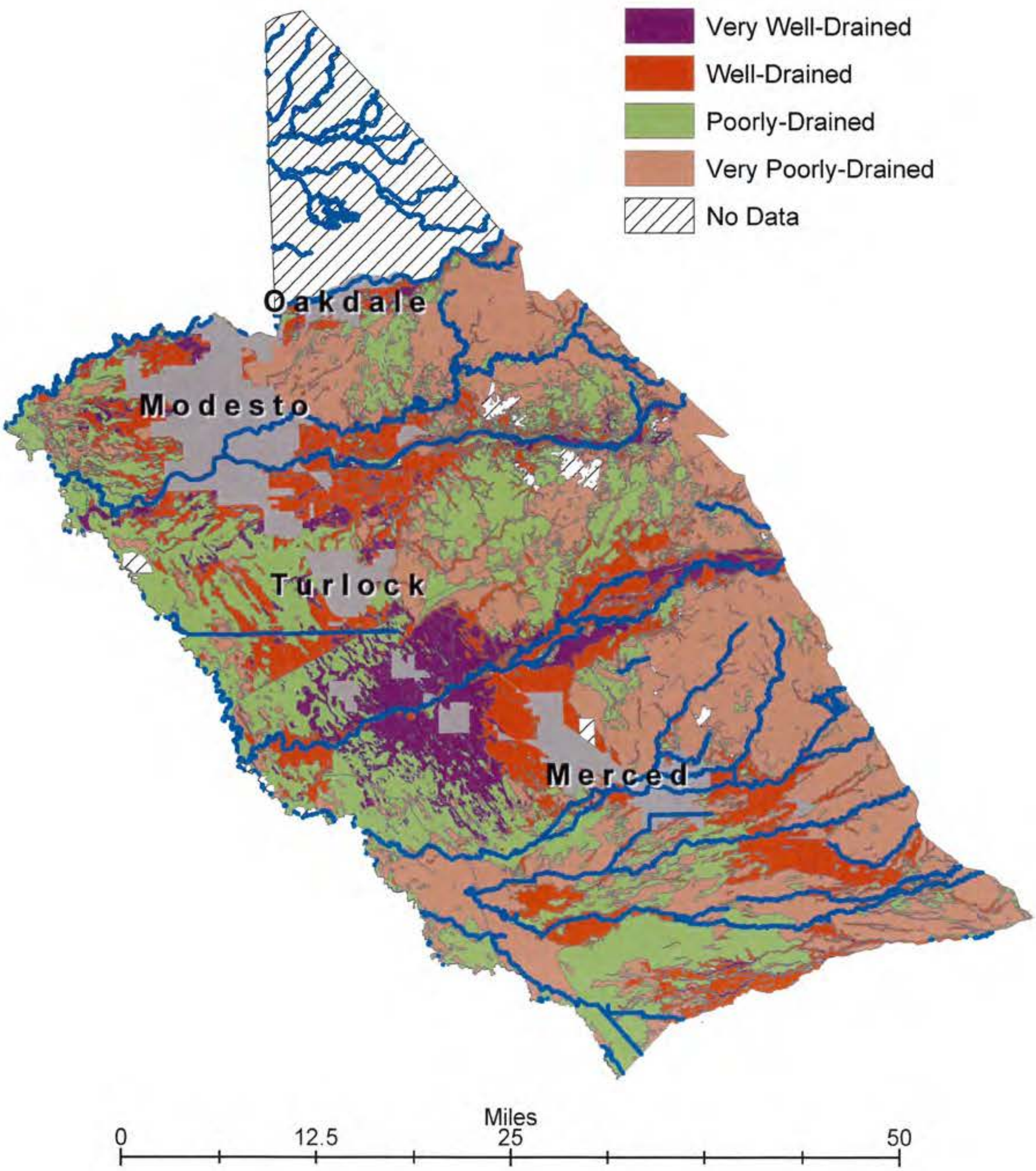


Figure 9. Impaired water bodies in the Coalition region with proposed monitoring sites.

1.1.2 Hydrology/drainage pattern/discharge locations

As indicated above, there are several main rivers that cross the Coalition area from east to west. In addition, there are numerous small creeks that have their headwaters in the foothills and western portion of the Sierra Nevada mountain range. Many of these are ephemeral with no flow from early summer through the first rains of the winter. The drainages described below include the main tributaries, and the intermediate to small sized water bodies that generally, although not always, maintain flow during the entire year.

Little John Creek Region (Figure 2a): The main water bodies in the region are Little John Creek and Hoods Creek, both of which flow into the Farmington Flood Control Basin. The basin serves as a detention basin during periods of high flow, but the two creeks merge at the basin into a single channel. Once the channel leaves the Farmington Flood Control basin, it flows into Duck Creek and eventually into French Camp Slough in the San Joaquin/Delta Coalition geographic area.

Dry Creek-Tuolumne River (Figure 3a): The main water bodies flowing through the region are the Tuolumne River and Dry Creek, with Dry Creek entering the Tuolumne River outside of the region in the city of Modesto. Cashman Creek is a smaller water body that flows into Dry Creek in the region.

Dry Creek-Merced River (Figure 4a): The main water bodies flowing through this region are the Merced River and Dry Creek (not the same Dry Creek as in the Dry Creek-Tuolumne River region). Ingalsbe Creek is a smaller water body that flows into the Merced River above Dry Creek. The other main water body is the Highline Canal, which flows south from the Turlock Main Drain and provides irrigation water to a large region north of Merced.

Deadman Creek (Figure 5a): There are several intermediate sized water bodies that drain the irrigated agricultural land within the region. The primary waterbodies are Deadman Creek, Duck Slough, Owens Creek, Deep Slough, and Mariposa Slough. Deadman Creek drains into Duck Slough, which joins with Owens Creek at Deep Slough and eventually flows into the SJR. Sand Slough drains into Mariposa Slough and eventually into the SJR.

Fahrens Creek (Figure 6a): There are only a few small sized drainages in this region. Fahrens Creek drains into Black Rascal Creek, into Canal Creek, and eventually into Bear Creek before draining into Deep Slough and the SJR. Burns Creek drains into Bear Creek.

San Joaquin Flats (Figure 7): There are no intermediate sized drainages in these areas. Most of the larger drainages to the SJR consist of ancestral river channel sloughs that collect water from surrounding areas.

1.1.3 Soils

Soils maps reveal a complicated mosaic of soil types in the coalition area. Generally, the soils throughout most of the coalition region are sandy, well drained soils (Figure 8). Soils in the immediate proximity to the SJR have higher clay content and are not well drained. These soils typically need surface drains to remove water during periods of high rainfall and occasionally during the irrigation season. The soils in the southern part of Merced County also contain high clay content. The majority of the area is a poorly drained saline-alkali basin.

1.1.4 Land use/irrigated lands

Based on the Department of Water Resources Land Use/Land Cover databases, the Coalition area covers 1,230,281 acres. Of that total, 633,812 acres are irrigated. The six regions within the Coalition where monitoring will occur, cover 724,118 acres (58.9%). The remaining acres are part of the four irrigation districts or are urban lands.

Within the entire Coalition region, wild vegetation covers 447,732 acres (36%) of the area and includes land cover classes such as natural riparian areas, parks, and open rangeland. Non-irrigated land uses cover 115,837 acres (9.4%), and include primarily urban lands with some acreage in feedlots and impoundments. The remaining acres are irrigated agriculture. Land uses within the coalition area are summarized below and presented in Table 1 both as totals for the entire coalition area and the six monitoring areas as delineated in Figures 2-7.

Little John Creek (Figure 2b): There are only 6,423 acres of irrigated agriculture in this region, which comprises only 7.7% of the 85,841 acres within the region. Two categories of irrigated agriculture account for almost three-quarters of the irrigated land in the region. The largest amount of irrigated land is irrigated pasture (52.9%), with irrigated grain and hay making up an additional 21.7%.

Dry Creek-Tuolumne River (Figure 3b): There are 7,493 acres of the land categorized as irrigated agriculture out of almost 79,561 acres (9.4%). Deciduous nut and fruits and irrigated pasture are the two largest categories of irrigated land with deciduous nuts and fruits accounting for 40.2% and irrigated pasture accounting for 37.5% of the irrigated land.

Dry Creek-Merced River (Figure 4b): There are 71,997 acres (46%) of irrigated agriculture in the region out of a total acreage of 157,365. Deciduous nut and fruits (54%), field crops (14%), vineyards (14%), and irrigated pasture (13%) make up the majority of the remaining acreage.

Deadman Creek (Figure 5b): There are 142,445 acres of irrigated agriculture (59%) in the region out of a total acreage of 242,243. Field crops (32%) and pasture (32%) make up the majority of the irrigated acreage with a smaller portion of the irrigated agriculture in deciduous nuts and fruits (12%).

Fahrens Creek (Figure 6b): There are 15,317 acres of irrigated agriculture (12.6%) in the region out of a total acreage of 121,688. Deciduous nut and fruits (31%), irrigated pasture (24%), and irrigated grains and hay (13%) make up the majority of the irrigated acreage.

San Joaquin Flats (Figure 7): There are 24,409 acres of irrigated agriculture (65%) in the region out of a total acreage of 37,421. Irrigated pasture (36%), field crops (31%), and deciduous nut and fruits (20%) and make up the majority of the irrigated acreage.

Table 1. Land uses in the East San Joaquin River Coalition area.
Acreages are based on Department of Water Resources land use maps from 1996 (Stanislaus County) and 1995 (Merced County) and are available at http://www.waterplan.water.ca.gov/landwateruse/landuse/ludataindex.htm.

Land Use	Irrigated/ Non-Irrigated	Total Area, Acres						
		Coalition Area	Deadman Creek	Fahrens Creek	Dry-Mreced	Dry Creek-Tuolumne River	Little John Creek	San Joaquin Flats
Citrus and subtropical fruit	I	680	77	73	51	1	0	7
Deciduous nut and fruit	I	214780	16699	4797	38700	3016	597	4796
Feedlot, dairy, farmstead	NI	27185	4000	575	1947	461	440	580
Field crop	I	145893	45936	466	10166	674	583	7458
Golf course, cemetery, landscape	NI	4295	313	161	0	0	32	333
Grain and hay	I	29827	13104	2062	3355	617	1395	992
Grain and hay	NI	4538	84	1036	1010	480	974	0
Idle	I	23164	10422	977	1615	0	160	202
Pasture	I	166657	45943	3642	9489	2811	3398	8769
Rice	I	7358	1211	0	2	40	259	0
Truck, nursery, berry	I	30775	12196	1230	430	332	125	830
Urban	NI	84359	1408	1904	1045	151	507	1599
Vineyard	I	33323	7279	1093	9804	2	66	1153
Water surface	NI	9738	947	92	1216	86	1724	1145
Wild vegetation	NI	447732	82623	103579	78535	70891	75582	9557

1.1.5 Valuable aquatic resources

Two primary aquatic resources exist in the Coalition area, wetlands and fisheries resources. Wetlands are associated with riparian areas along many of the water bodies in the region. Another major type of wetlands are vernal pools, which are distributed across the Coalition area in many of the more upland areas. Vernal pools receive water during the winter rains and require an aquatard to maintain standing water for a period into the spring. These wetlands maintain a unique flora and fauna and are protected by the Clean Water Act, however they are not considered to be a focal point of the Phase I Agricultural Waiver Monitoring and Reporting Program Plan. Generally, vernal pools and irrigated agriculture are not found together, although there are exceptions.

Several fisheries are considered important in the Coalition area. Steelhead trout (*Onchorynchus mykiss*) were common in the region prior to the building of the dams on all of the major tributaries of the San Joaquin River. Once the dams were built, historic spawning grounds were eliminated and with them, most of the wild salmonids in the San Joaquin Valley. Currently, no permanent steelhead stocks exist in the drainages of the San Joaquin River system despite occasional reports of fish in the Tuolumne and Merced Rivers. The California Department of Fish and Game considers the Tuolumne River to have suitable habitat to support a steelhead run if one could become established.

Chinook salmon (*Onchorynchus tshawytscha*) are present in the San Joaquin River system and are found in all major tributaries in the region. All of the major tributaries are considered to be impaired for salmonid spawning and/or migration habitat as is the main stem of the San Joaquin River (Table II-1 of the Sacramento/San Joaquin River Basin Plan).

1.2 Agricultural Characteristics

1.2.1 Crop Types

Over 50 types of commercial crops are produced within the coalition area (mainly Stanislaus and Merced Counties). The most prevalent crops by acres are almonds, tomatoes, hay, sweet potatoes, cotton, silage, beans, wheat, peaches, melons, and grapes.

1.2.2 *Production practices*

Production practices vary based on crop type, soils, climate and other factors. Individual crop production calendars (see Appendix 1 for crop production calendars for Sacramento Valley, calendars for the San Joaquin Valley are not expected to change substantially) illustrate when specific management practices are performed throughout a year. In general, practices outlined in the timelines do not change from year to year. In this report, Crop Production Calendars have been developed for seven major crops in the coalition region, including irrigated pasture, prunes, walnuts, alfalfa, olives, peaches, and processing tomatoes. Crop Production Calendars for crops planted on fewer acres in coalition area are under development by coalition members and will be included in the first annual report.

Historical monitoring results show that production practices impact surface water primarily through winter storm runoff and irrigation return flows. Winter storm runoff can transport pesticides applied to dormant orchards, sediment that can contain pesticides that bind to sediment from orchards or tilled fields (row/field crops), and nutrients from pasture and confined animal facilities. Irrigation return flows can transport pesticides applied before irrigation, sediment (with pesticides/nutrients) from tilled fields (row/field crops), or dissolved salts.

1.2.3 Chemicals used

Chemicals used on irrigated farmland vary by crop, pest, Integrated Pest Management (IPM) considerations and other factors. Based on data obtained from the California Department of Pesticide Regulation (CDPR) online database, 12 million lbs. of agricultural chemicals (insecticides, herbicides and fungicides, etc.) were used in crop production in the coalition region in 2002. A majority of applications were in Merced and Stanislaus Counties (Table 2) and are applied year round. The most commonly used chemicals for the counties in the Coalition area are listed in Tables 3 through 7.

Table 2. Total amount of agricultural chemical use by county (2002).
(Data from CDPR website http://calpip.cdpr.ca.gov/cfdocs/calpip/prod/main.cfm)

County	Total lbs. Active Ingredient Applied
Calaveras	32,182
Mariposa	1,081
Merced	6,677,292
Stanislaus	5,186,928
Tuolumne	40,396

Table 3. Calaveras County agricultural chemical use information (2002). Shown are the ten chemicals most used for agriculture and the primary site uses for irrigated lands. All data were derived from queries of the CDPR online database.

Chemical Name	Use Type*	Total lbs. Active Ingredient Applied	Total Lbs. Active Ingredient Applied by site Use	Site Use	Time of Application
Sulfur	F I	9347	9347	Grapes, Wine	March-Oct.
Petroleum Oil, Unclassified	I F M A	9250	9245	Apple	Feb.-May
			5	Walnut (English Walnut, Persian Walnut)	April
Glyphosate, Isopropylamine Salt	H	3886	524	Walnut (English Walnut, Persian Walnut)	Jan.-Sept.
			414	Grapes, Wine	Year Round
			56	Pistachio (Pistache Nut)	Feb.-Aug.
			19	Olive (All Or Unspec)	Year Round
			18	Cherry	June, Nov.
			2	Apple	Feb.-June
			0.4	Nectarine	Feb.
			0.4	Peach	Feb.
Copper Hydroxide	F M N	1318	762	Walnut (English Walnut, Persian Walnut)	April, May
			533	Apple	Feb.
			23	Grapes (All)	April
Copper Sulfate (Pentahydrate)	F	495	495	Walnut (English Walnut, Persian Walnut)	April
Alpha-(Para-Nonylphenyl)-Omega-Hydroxypoly(Oxyethylene	A	455	118	Grapes (All)	March-July
			3	Cherry	Nov.
Lime-Sulfur	F	391	387	Grapes (All)	Feb.-April
			4	Apple	March
Mancozeb	F	267	260	Apple	March-May
			8	Grapes (All)	May
Phosmet	I	242	242	Apple	April
Simazine	H	235	202	Grapes (All)	Jan.-March, Dec.
			24	Walnut (English Walnut, Persian Walnut)	March, April
			8	Olive (All Or Unspec)	Jan., Dec.
			1	Apple	March

* Refer to end of Table 7

Table 4. Merced County agricultural chemical use information (2002). Shown are the ten chemicals most used for agriculture and the primary site uses for irrigated lands. All data were derived from queries of the CDPR online database.

Chemical Name	Use Type*	Total lbs. Active Ingredient Applied	Total Lbs. Active Ingredient Applied by site Use	Site Use	Time of Application
Sulfur	F I	2490771	1039583	Tomatoes (All)	May-Seot.
			1013481	Grapes	May-Sept.
			168756	Sugarbeet, General	June-Nov.
			108543	Peach	Feb.-Aug.
			65994	Pistachio (Pistache Nut)	May-Aug.
			49662	Corn (Forage - Fodder)	June-Aug.
			14112	Almond	Feb.-Nov.
			9434	Cotton, General	July-Sept.
			5200	Nectarine	March-July
			3194	Alfalfa (Forage - Fodder) (Alfalfa Hay)	July
			1999	Cantaloupe	Aug.
			1785	Corn, Human Consumption	June
1,3-Dichloropropene	U	740007	582177	Sweet Potato	Feb.-May, Nov., Dec.
			55184	Almond	Year Round
			23433	Tomatoes (All)	March, April
			19320	Watermelons	Nov.
			19054	Peach	Feb., Nov., Dec.
			9731	Grapes	Feb., Nov.
			7425	Cantaloupe	Nov.
			2902	Melons	Nov.
			2228	Beans (All)	Nov.
			1745	Nectarine	Nov.
			482	Plum (All)	Nov.
Metam-Sodium	U H F M L	442406	180445	Sweet Potato	March-July
			133043	Tomatoes (All)	Feb.-April
			33522	Almond	Jan., April
			28029	Cotton, General	March-June
			24418	Strawberry (All Or Unspec)	July, Aug.
			23552	Cantaloupe	Arch-May
			11718	Barley, General	Feb.-Aug.
			5984	Watermelons	April, May
			1693	Vegetables (All Or Unspec)	March
Petroleum Oil, Unclassified	I F M A	421241	342304	Almond	Year Round
			30705	Pistachio (Pistache Nut)	Feb.
			20961	Peach	Jan., March
			9903	Plum (All)	Jan., Feb., July
			8136	Cherry	Jan., Feb., Aug.
			4611	Apricot	Jan., Feb., July
			2033	Apple	Jan.

			1313	Walnut (English Walnut, Persian Walnut)	May, June
			972	Nectarine	Jan., July
			291	Pear	Jan.
Mineral Oil	I A	268500	167991	Almond	Jan.-Sept.
			53274	Peach	Year Round
			32219	Plum (All)	Jan., March, Aug.
			13324	Apricot	Jan.-March
			967	Nectarine	Jan., March, Aug.
			257	Alfalfa (Forage - Fodder) (Alfalfa Hay)	Jan., March, Aug.
			194	Cherry	Jan.
			144	Cotton, General	March-Oct.
			81	Wheat (Forage - Fodder)	Jan., Feb.
			16	Corn (Forage - Fodder)	June
Glyphosate, Isopropylamine Salt	H	232145	122600	Almond	Year Round
			45201	Cotton, General	Year Round
			12867	Tomato (All)	Year Round
			12225	Grapes (All)	Year Round
			7820	Peach	Year Round
			7319	Pistachio (Pistache Nut)	Year Round
			5907	Corn (Forage - Fodder)	Jan.-Oct.
			4285	Walnut (English Walnut, Persian Walnut)	Year Round
			2106	Alfalfa (Forage - Fodder) (Alfalfa Hay)	Jan.-Sept.
			1782	Corn, Human Consumption	Jan.-July
			1628	Fig	Year Round
			1527	Cantaloupe	Jan.-Sept.
			1410	Plum (All)	Year Round
			403	Apricot	Jan.-June
			366	Melons	Sept.
Methyl Bromide	U I H N	142435	25745	Almond	Jan.-March, Oct.-Dec.
			4040	Peach	Jan., Feb., Oct., Nov.
			3665	Fruiting Vegetables (All Or Unspec)	Oct., Nov.
			1401	Walnut (English Walnut, Persian Walnut)	Jan., Feb., Nov.
Trifluralin	H	114743	111425	Almond	Feb.-Oct.
			79821	Alfalfa (Forage - Fodder) (Alfalfa Hay)	Year Round
			15899	Cotton, General	Year Round
			7870	Tomato (All)	Feb.-Nov.
			743	Beans (All)	April-June
			503	Safflower, General	Jan.-Nov.
			278	Cantaloupe	June-Nov.
			136	Corn (Forage - Fodder)	May, Oct.
			102	Asparagus (Spears, Ferns, Etc.)	June
			60	Peppers (Fruiting Vegetable), (Bell,Chili, Etc.)	April-July
Glutamic Acid	F P	102917	102908	Almond	Feb.-March
			8	Tomatoes (All)	July
Propargite	I	98661	31273	Almond	March-Sept.

			4296	Cotton, General	June-Aug.
			3570	Walnut (English Walnut, Persian Walnut)	May-Aug.
			3014	Grapes (All)	June-Aug.
			2512	Corn, Human Consumption	May-July
			1058	Beans (All)	July-Sept.
			372	Cherry	July
			149	Cantaloupe	June
			41	Peach	July-Aug.
			18	Nectarine	Aug.

* Refer to end of Table 7

Table 5. Stanislaus County agricultural chemical use information (2002). Shown are the ten chemicals most used for agriculture and the primary site uses for irrigated lands. All data were derived from queries of the CDPR online database.

Chemical Name	Use Type*	Total lbs. Active Ingredient Applied	Total Lbs. Active Ingredient Applied by site Use	Site Use	Time of Application
Metam-Sodium	U H F M L	1119128	949200	Lettuce, Leaf (All Or Unspec)	Year Round
			276812	Watermelons	May-Oct.
			15378	Mustard, General	Year Round
			13264	Cabbage	Jan.-Sept.
			12721	Beets, General	Year Round
			11825	Swiss Chard (Spinach Beet)	Year Round
			11481	Collards	Year Round
			10353	Fennel (All Or Unspec)	Jan.-Oct.
			10280	Bok Choy (Wong Bok)	Year Round
			9480	Basil (Bush, Garden, Sweet)	March-Aug.
			8615	Strawberry (All Or Unspec)	July-Dec.
			8470	Leek	Jan.-Aug.
			7827	Cilantro (Chinese Parsley, Coriander Leaves)	Year Round
			5466	Kale	Year Round
			4854	Dill	Year Round
			4031	Turnip, General	Year Round
			3641	Almond	March, May, Oct.
			2378	Chinese Radish/Daikon (Lobok, Japanese Radish)	Jan.-Oct.
			2078	Kohlrabi	Year Round
			2058	Celery, General	March-Sept.
			1984	Spinach	Year Round
			1913	Dandelion (Chinese Dandelion, Gow Gay)	Year Round
			1672	Celeriac (Celery Root)	Feb.-July
			1496	Parsley (Leafy Vegetable)	May-Oct.
Sulfur	F I	1085655	707256	Grapes (All)	April-Sept.
			182307	Peach	Feb.-Aug.
			117465	Tomatom(All)	June-Oct.
			49335	Almond	Feb.-Sept.
			5409	Cherry	March-Aug.
			4935	Plum (All)	March, April
			4346	Sugarbeet, General	July-Sept.
			4323	Walnut (English Walnut, Persian Walnut)	March, April, Dec.
			3278	Parsley (Leafy Vegetable)	Aug.
			3278	Squash (All Or Unspec)	June-Aug.
			2993	Apple	April-June
			1381	Nectarine	Feb.-June
			1132	Pumpkin	Sept.
			396	Beans, Dried-Type	June-Sept.
Petroleum Oil, Unclassified	I F M A	528871	173359	Almond	Year Round

			27761	Apple	Jan.-June
			25181	Apricot	Jan.-May
			18243	Peach	Year Round
			5664	Citrus Fruits (All Or Unspec)	May, June
			4997	Walnut (English Walnut, Persian Walnut)	Jan.-Sept.
			2431	Plum (All)	Jan.
			1922	Cherry	Jan.-March. Dec.
			1402	Nectarine	Jan., March, July. Dec.
Mineral Oil	I A	510650	250223	Walnut (English Walnut, Persian Walnut)	Jan.-Aug.
			102382	Almond	Year Round
			39689	Peach	Year Round
			26274	Apricot	Jan.-March, July, Dec.
			23441	Apple	Jan.-March
			1413	Cherry	Jan.-March, Dec.
			1248	Nectarine	Jan., Dec
			682	Pear	Feb., May
			163	Plum (All)	Jan., Sept.
1,3-Dichloropropene	U	446333	126114	Almond	Jan.., Aug.-Nov.
			54465	Parsley (Leafy Vegetable)	Oct.-Dec.
			54439	Sweet Potato	Feb.-April, Nov.
			49049	Walnut (English Walnut, Persian Walnut)	July-Nov.
			25655	Peach	March, Aug.-Oct.
			12877	Cherry	Oct.
			10278	Celery, General	July
			8968	Grapes (All)	Aug.,Sept.
			1821	Prune (All)	Oct.
			1052	Beans, Dried-Type	Aug.
			740	Nectarine	Nov.
			319	Apple	Nov.
			313	Apricot	Oct.
Copper Hydroxide	F M N	221779	101034	Almond	Year Round
			62235	Walnut (English Walnut, Persian Walnut)	Jan.-July
			32750	Peach	Jan.-March, Nov., Dec.
			10103	Apricot	Jan.-March
			4075	Grapes (All)	April
			3984	Cherry	Jan.-March, Dec.
			2253	Nectarine	Jan.-March, Dec.
			1006	Alfalfa (Forage - Fodder) (Alfalfa Hay)	March
			662	Apple	Jan.-March
			328	Plum (All)	Jan., Oct.
			229	Cabbage	Year Round
			208	Citrus Fruits (All Or Unspec)	Sept., Nov.
Glyphosate, Isopropylamine Salt	H	162212	102256	Almond	Year Round
			25687	Walnut (English Walnut, Persian Walnut)	Year Round
			19898	Grapes (All)	Year Round

			3655	Peach	Year Round
			3097	Corn (Forage - Fodder)	May-Aug.
			2011	Tomatoes (All)	Jan.-May
			1904	Apricot	Year Round
			958	Cherry	Year Round
			863	Citrus Fruits (All Or Unspec)	March-Sept.
			787	Apple	Year Round
			561	Beans, Dried-Type	March, May, Dec.
			261	Nectarine	Year Round
			239	Cantaloupe	Jan., July
			221	Plum (All)	Year Round
Propargite	I	110071	54695	Almond	Feb.-Sept.
			34987	Corn (Forage - Fodder)	April-Aug.
			14811	Walnut (English Walnut, Persian Walnut)	April-Sept.
			3687	Beans, Dried-Type	July-Sept.
			2355	Grapes (All)	Jully, Aug.
			647	Cherry	June-Sept.
			232	Corn, Human Consumption	Aug.
			66	Peach	July-Sept.
			27	Plum (All)	Aug.
Ziram	F M	76388	64174	Almond	Feb.-April
			4790	Apricot	Feb.-April
			2912	Peach	Feb.-March, Nov.
			105	Nectarine	March, Nov.
Chlorpyrifos	I	63865	30445	Almond	Year Round
			19303	Walnut (English Walnut, Persian Walnut)	Feb.-Sept.
			4649	Corn (Forage - Fodder)	March-Sept.
			3710	Peach	Jan., March, Dec.
			3308	Alfalfa (Forage - Fodder) (Alfalfa Hay)	March-Oct.
			868	Apple	Jan.-Aug.
			743	Citrus Fruits (All Or Unspec)	June, July
			308	Sugarbeet, General	July-Sept.
			281	Grapes (All)	March
			201	Cherry	Jan., Feb.
			14	Nectarine	Dec.
			3	Strawberry (All Or Unspec)	Feb.-April, Nov.

* Refer to end of Table 7

Table 6. Toulumne County agricultural chemical use information (2002). Shown are the ten chemicals most used for agriculture and the primary site uses for irrigated lands. All data were derived from queries of the CDPR online database.

Chemical Name	Use Type*	Total lbs. Active Ingredient Applied	Total Lbs. Active Ingredient Applied by site Use	Site Use	Time of Application
Glyphosate, Isopropylamine Salt	H	22533	20	Apple	May-Sept.
			13	Grapes (All)	Jan., May, Dec.
			10	Olive (All Or Unspec)	March-Oct.
			2	Pear	April-June
			1	Boysenberry (Boysens)	March-Oct.
			1	Peach	April
Petroleum Oil, Unclassified	I F M A	1682	1412	Apple	Feb., March
			99	Pear	Feb., July
			85	Cherry	Feb.
			85	Peach	Feb.
Mancozeb	F	497	497	Apple	March-May
Phosmet	I	479	465	Apple	April-Aug.
			15	Pear	July
Oryzalin	H	153	150	Apple	Dec.
Diazinon	I	83	71	Apple	Feb.-July
			4	Cherry	Feb.
			4	Peach	Feb.
			4	Pear	Feb.
Poly-I-Para-Menthene	I	71	71	Apple	May-Sept.
Metam-Sodium	U H F M L	51	51	Boysenberry (Boysens)	Oct.
Carbaryl	I N	49	46	Apple	April-June
			2	Pear	June
Lime-Sulfur	F	47	46	Boysenberry (Boysens)	Feb
Oxyfluorfen	H	38	38	Apple	Dec.

* Refer to end of Table 7

Table 7. Mariposa County agricultural chemical use information (2002). Shown are the ten chemicals most used for agriculture and the primary site uses for irrigated lands. All data were derived from queries of the CDPR online database.

Chemical Name	Use Type*	Total lbs. Active Ingredient Applied	Total Lbs. Active Ingredient Applied by site Use	Site Use	Time of Application
Sulfur	F I	601	601	Grapes (All)	April-July
Glyphosate, Isopropylamine Salt	H	174	46	Grapes (All)	Feb.-June
Potash Soap	H I A	70	70	Grapes (All)	June-Aug.
Simazine	H	11	2	Grapes (All)	March
Azoxystrobin	F	9	9	Grapes (All)	May-Aug.
Oxyfluorfen	H	8	8	Grapes (All)	Feb.-March
Myclobutanil	F	7	7	Grapes (All)	May-Aug.
Oryzalin	H	7	4	Grapes (All)	March
Propargite	I	6	6	Grapes (All)	June-July
Alkylaryl Poly(Oxyethylene) Glycol	A	4	1	Apple	March-July
			3	Grapes (All)	June-July

*Use Type = Describes the most common use(s) for a pesticide active ingredient. If there is more than one use for the chemical, the most common use is listed first (www.pesticideinfo.org).

F = Fungicide
H = Herbicide
I = Insecticide
M = Microbiocide
A = Adjuvant
N = Nematocide
U = Fumigant
L = Algicide
O = Molluscicide
W = Water Treatment
P = Plant Growth Regulator
D = Defoliant
S = Solvent
PH = pH Adjustment

The potential threat to surface water quality posed by each of these pesticides can vary widely and is based on physical characteristics of the pesticide, application method, time of year applied, and weather conditions during application, among other factors. In the Best Management Practices (BMP) Compilation for each crop is a description of the primary pesticides used on major crops grown in the coalition region along with BMPs that have potential to prevent movement into surface water. An example of such a compilation for almonds is provided in Appendix 2.

The pesticide label is another source of information on means to prevent or limit movement of products into surface water. The registrants of diazinon, an insecticide listed as impairing water quality in several waterways in the Coalition region, have recently enacted new California label changes that require use of BMPs when applying the product to orchards during the dormant season. The registrants for Lorsban (chlorpyrifos), are in the process of revising the US EPA product label to include practices for protecting water quality that are expected to be in place by 2005. Label restrictions for all insecticides applied to orchards during the dormant season are in development by the CDPR and could be in effect by 2006.

1.2.4 Application Methods

The majority of pesticides in the coalition area are applied either by ground equipment or aerial applicators. (See Crop Production Calendars in Appendix 1 for timing of applications).

- Orchards: Orchard air blast sprayers are commonly used to spray for pests in the tree canopy. Herbicides are applied in orchards using ground equipment with nozzles directed at the soil. A small percentage of acreage is treated with backpack sprayers.
- Row/Field crops: Row and field crops are treated by ground equipment with nozzles directed at the crop canopy or soil. Applications by fixed wing aircraft or helicopters are made to both row and orchard crops. A small percentage of acreage is treated with backpack sprayers.

1.2.5 Inventory of Management Practices

The coalition and cooperating entities have compiled lists of BMP programs applicable to crops grown in the coalition area, that are either currently in use or have shown promise in protecting surface water (see Table 8). Depending on the constituent and existing field and crop management practices, a landowner or operator might need to adopt anywhere from a single BMP to numerous BMPs to reduce or eliminate a threat to water quality, and may take advantage of several of the programs listed below. Through the coalition cooperating entities, landowners or operators will have access to experts from various public and private firms who can provide assistance in selecting and installing BMPs.

Table 8. Summary of BMP related programs within the Coalition area.

Agency	Program Description	Publications	Outreach
Natural Resources Conservation Service	Information on BMPs related to land management, sediment transport and habitat protection, among other areas.	The NRCS "Index of Conservation Practices and Specifications" list hundreds of practices and information on installation.	NRCS organizes field days and workshops to promote adoption of management practices. Funding: Landowners are eligible for grants and other financial assistance through the Environmental Quality Incentive Program (EQIP) and (other programs).
University of California Cooperative Extension	Information on pest management, irrigation management and pesticide safety among other areas. Also performs research on various production practices.	The U.C Agriculture and Natural Resources (UCANR) Publications department has developed "Production Manuals" for six major crops and "Integrated Pest Management (IPM) Guidelines" for 29 crops grown in the Central Valley. These publications include information on low risk pest and nutrient management practices that would often be components of an overall farm plan to protect surface water.	UC Farm Advisors organize regular grower update meetings on various crop and pest management issues. Continuing education credits are provided to growers who attend for maintaining county pesticide application permits.
Commodity Groups	Information on production	Each commodity group has	Each commodity group holds

(Plums, Almonds, Peaches, Tomatoes, Walnuts, Melons):	practices, research funding; outreach programs to growers.	various reference materials for growers outlining crop management practices.	an annual meeting along with regional meetings with presentations on production issues. Each group also has periodic in-house newsletters that cover various marketing and production issues. California Dried Plum Board: The board is coordinating several projects that are examining the effectiveness of BMPs for the reduction of runoff from dormant orchard sprays/ Almond Board of California: The board is funding research on low risk approaches to control overwintering pests and has funded research on the effectiveness of BMPs used in almonds.
County Agricultural Commissioners:	County regulatory enforcement agency for pesticide use and handling.	Each county has a manual or handbook that outlines local and state regulations regarding handling and applying of pesticides. Growers review these manuals in advance of tests taken to receive a Pesticide Applicator Permit, a license	CAC hold periodic continuing education meetings for growers and Pest Control Advisors (PCAs). These meeting can cover regulations, production practices and various subjects related to proper use and handling of pesticides.

		needed to purchase and apply pesticides.	
Coalition for Urban/ Rural Environmental Stewardship:	A non-profit education organizing focusing on promoting pesticide and nutrient BMPs; also develops and coordinates research projects on BMPs.	CURES produces booklet on BMPs for orchard, row crops and other uses of pesticides.	CURES organizes and develops presentations for grower and PCA meetings that cover water regulations and various BMPs to protect surface water.
Resource Conservations Districts:	Grower managed entities based in each county that coordinate projects and programs related to resource management.		Outreach: RCDs organize periodic educational workshops and meetings on subject related to resource conservation.
Farm Input Suppliers:	Private firms that sell farm inputs and provide information through licensed Pest Control Advisors (PCAs)	Publications: Farm input suppliers distribute product specific information including product labels, Material safety Data Sheets (MSDS) and other publications related to proper use of farm inputs such as pesticides and nutrients.	Outreach: Staff PCAs have frequent personal contact with landowners to advise on pesticide recommendations
Natural Resources Conservation Service (NRCS)- EQIP Program:	The Environmental Quality Incentives Program (EQIP) was reauthorized in the Farm Security and Rural Investment Act of 2002 (Farm Bill) to provide a voluntary conservation program for farmers and ranchers that promotes agricultural production and environmental quality as compatible national goals. EQIP		EQIP activities are carried out according to an environmental quality incentives program plan of operations developed in conjunction with the producer that identifies the appropriate conservation practice or practices to address the resource concerns. The practices are subject to

	offers financial and technical help to assist eligible participants install or implement structural and management practices on eligible agricultural land.		NRCS technical standards adapted for local conditions. The local conservation district approves the plan.

Information on the effectiveness of BMPs in reducing pollution varies depending on the individual practice. Many of the BMPs in use or with potential for widespread use are currently being researched to determine effectiveness in California. Limited information on BMPs is available from other parts of the country that may or may not be relevant to California growing conditions. Numerous programs are examining the effectiveness of BMPs or can provide assistance to landowners in selection and installation of BMPs. Over the next two years, research projects performed by coalition entities are expected to develop considerable new data on these practices.

1.2.6 Known water Quality Improvement Programs and Techniques Associated with Discharge from Irrigated Lands

Over the next several years, the Coalition will begin compiling data on use of BMPs by landowners in areas where water quality problems have been detected. After information on appropriate BMPs is communicated to landowners, surveys will be performed to gauge the level of adoption by landowners (after giving landowners adequate time to implement the BMP).

1.3 Water Quality

1.3.1 Historical Water Quality Data

The region has a long history of water quality studies on a variety of constituents. Sampling has been conducted on chemical water quality, toxicity, and benthic macroinvertebrate communities by several agencies and academic institutions including the Central Valley Regional Water Quality Control Board (CVRWQCB), California Department of Pesticide Regulation, California Department of Water Resources, California Department of Transportation, University of California Davis, and the U.S. Geological Survey (Table 9, Table 10). Constituents sampled for include organophosphate pesticides, metals, drinking water constituents, nutrients, and dissolved oxygen. An overwhelming majority of programs have monitored for organophosphate pesticides. The Coalition watershed area will continue to be monitored as part of programs such as the organophosphate Total Maximum Daily Load monitoring program, and the Agricultural Waiver Phase II monitoring program, both performed by the CVRWQCB. Some of the monitoring programs and locations are associated with monitoring storm water runoff from urban areas or transportation corridors and are not relevant when addressing runoff from irrigated agriculture.

Table 9. Historical chemical water quality data from the Coalition area.
Programs are only listed from the last 10 years. The list may not be inclusive of every program or study conducted in the Coalition area.

Source	Author	Sample period	Site Name	LAT	LONG	Constituent	Link
DPR		1993	Merced River at Oakdale Road	37.4544	-120.6077	Chlorpyrifos	http://www.cdpr.ca.gov/docs/sw/sitepages/24-1.txt
DPR		1993	Turlock Irrigation Drain #6, 200 yards w of Central Ave	37.4522	-120.5950	Chlorpyrifos	http://www.cdpr.ca.gov/docs/sw/sitepages/24-1.txt
TMDL	JMIE/AEAL	2003	Dry Creek (Tuolumne) at Gallo Bridge	37.6364	-120.9832	Diaz. & Chlorp.	TMDL monitoring by UC Davis
TMDL	JMIE/AEAL	2003	Merced River at River Road	37.3505	-120.9610	Diaz. & Chlorp.	TMDL monitoring by UC Davis
TMDL	JMIE/AEAL	2003	San Joaquin River at Crows Landing	37.4320	-121.0122	Diaz. & Chlorp.	TMDL monitoring by UC Davis
TMDL	JMIE/AEAL	2003	Stanislaus River at Orange Blossom	37.7895	-120.7626	Diaz. & Chlorp.	TMDL monitoring by UC Davis
TMDL	JMIE/AEAL	2003	Tuolumne River at Santa Fe Road	37.6230	-120.8982	Diaz. & Chlorp.	TMDL monitoring by UC Davis
TMDL	JMIE/AEAL	2003	Tuolumne River at Shiloh Road Bridge	37.6033	-121.1306	Diaz. & Chlorp.	TMDL monitoring by UC Davis
USGS	Zamora et al.	2001	Dry Creek (Merced) near Snelling	37.5797	-120.4249	Diaz. & Chlorp.	http://www.cDPR.ca.gov/docs/sw/contracts/USGS_03-4091.pdf
USGS	Kratzer et al.	2000	Dry Creek (Tuolumne) at Claus Road	37.6570	-120.9202	Diaz. & Chlorp.	http://water.usgs.gov/pubs/wri/wri02-4103/wri024103.pdf
USGS	Zamora et al.	2001	Dry Creek (Tuolumne) at Claus Road	37.6570	-120.9202	Diaz. & Chlorp.	http://www.cDPR.ca.gov/docs/sw/contracts/USGS_03-4091.pdf
USGS	Kratzer et al.	2000	Dry Creek (Tuolumne) at Gallo Bridge	37.6364	-120.9832	Diaz. & Chlorp.	http://water.usgs.gov/pubs/wri/wri02-4103/wri024103.pdf
USGS	Kratzer et al.	2000	Highline Spillway to Merced River	37.3875	-120.8036	Diaz. & Chlorp.	http://water.usgs.gov/pubs/wri/wri02-4103/wri024103.pdf
USGS	Kratzer et al.	2000	Livingston Canal at Livingston Tplant	37.4068	-120.7245	Diaz. & Chlorp.	http://water.usgs.gov/pubs/wri/wri02-4103/wri024103.pdf
USGS	Zamora et al.	2001	McHenry stormdrain at Bodem St., Modesto	37.6464	-120.9856	Diaz. & Chlorp.	http://www.cDPR.ca.gov/docs/sw/contracts/USGS_03-4091.pdf
USGS	Kratzer et al.	2000	Merced River at River Road	37.3505	-120.9610	Diaz. & Chlorp.	http://water.usgs.gov/pubs/wri/wri02-4103/wri024103.pdf
USGS	Zamora et al.	2001	Merced River at River Road	37.3505	-120.9610	Diaz. & Chlorp.	http://www.cDPR.ca.gov/docs/sw/contracts/USGS_03-4091.pdf
USGS	Kratzer et al.	2001	Merced River near Stevenson	37.3707	-120.9295	Diaz. & Chlorp.	http://water.usgs.gov/pubs/wri/wri02-4103/wri024103.pdf
USGS	Zamora et al.	2001	Merced River near Stevenson	37.3707	-120.9295	Diaz. & Chlorp.	http://www.cDPR.ca.gov/docs/sw/contracts/USGS_03-4091.pdf
USGS	Kratzer et al.	2000	San Joaquin River at Lander Avenue	37.2954	-120.8504	Diaz. & Chlorp.	http://water.usgs.gov/pubs/wri/wri02-4103/wri024103.pdf

USGS	Zamora et al.	2001	San Joaquin River at Lander Avenue	37.2954	-120.8504	Diaz. & Chlorp.	http://www.cDPR.ca.gov/docs/sw/contracts/USGS_03-4091.pdf
USGS	Kratzer et al.	2000	Stanislaus River at Ripon	37.7300	-121.1094	Diaz. & Chlorp.	http://water.usgs.gov/pubs/wri/wri02-4103/wri024103.pdf
USGS	Zamora et al.	2001	Stanislaus River at Ripon	37.7300	-121.1094	Diaz. & Chlorp.	http://www.cDPR.ca.gov/docs/sw/contracts/USGS_03-4091.pdf
USGS	Kratzer et al.	2000	Tuolumne River at Modesto	37.6272	-120.9864	Diaz. & Chlorp.	http://water.usgs.gov/pubs/wri/wri02-4103/wri024103.pdf
USGS	Zamora et al.	2001	Tuolumne River at Modesto	37.6272	-120.9864	Diaz. & Chlorp.	http://www.cDPR.ca.gov/docs/sw/contracts/USGS_03-4091.pdf
USGS	Kratzer et al.	2000	Tuolumne River at Shiloh Road Bridge	37.6033	-121.1306	Diaz. & Chlorp.	http://water.usgs.gov/pubs/wri/wri02-4103/wri024103.pdf
USGS	Zamora et al.	2001	Tuolumne River at Shiloh Road Bridge	37.6033	-121.1306	Diaz. & Chlorp.	http://www.cDPR.ca.gov/docs/sw/contracts/USGS_03-4091.pdf
DPR		0	San Joaquin River at Lander Avenue	37.2954	-120.8504	Diazinon	http://www.cDPR.ca.gov/docs/sw/sitepages/24-11.txt
DPR		1994	Stevinson Spillway	37.3771	-120.9272	Diazinon	http://www.cDPR.ca.gov/docs/sw/sitepages/24-3.txt
Nawqa		0	Merced River at River Road	37.3505	-120.9610	Field measurements	http://ca.water.usgs.gov/sanj_nawqa/data_sw/swlip.field.html
Nawqa		0	Merced River at River Road	37.3505	-120.9610	major inorganic compunds	http://ca.water.usgs.gov/sanj_nawqa/data_sw/swlip.majors.html
CEPA	RWQCBCVR	1998	San Joaquin River at Crows Landing	37.4320	-121.0122	Metals	http://www.swrcb.ca.gov/~rwqcb5/available_documents/water_studies/SJR.PDF
CEPA	RWQCBCVR	1998	San Joaquin River at Fremont Ford	37.3101	-120.9295	Metals	http://www.swrcb.ca.gov/~rwqcb5/available_documents/water_studies/SJR.PDF
CEPA	RWQCBCVR	1998	San Joaquin River at Hills Ferry	37.3502	-120.9755	Metals	http://www.swrcb.ca.gov/~rwqcb5/available_documents/water_studies/SJR.PDF
CEPA	RWQCBCVR	1998	San Joaquin River at Lander Avenue	37.2954	-120.8504	Metals	http://www.swrcb.ca.gov/~rwqcb5/available_documents/water_studies/SJR.PDF
CEPA	RWQCBCVR	1998	San Joaquin River at Maze Blvd.	37.6412	-121.2276	Metals	http://www.swrcb.ca.gov/~rwqcb5/available_documents/water_studies/SJR.PDF
DPR		2002	Tuolumne River at Shiloh Road Bridge	37.6033	-121.1306	metolachlor/alachlor and deg	2002data_draft AEAL database
Nawqa		0	Merced River at River Road	37.3505	-120.9610	Nutrients and organic carbon	http://ca.water.usgs.gov/sanj_nawqa/data_sw/swlip.nut_orgc.html
DPR		1994	Livingston Spillway	37.4084	-120.7211	OP's	http://www.cDPR.ca.gov/docs/sw/sitepages/24-5.txt
City of Modesto	ATL	0	McHenry stormdrain at Bodem St, Modesto	37.6464	-120.9856	Pesticides	49
DPR		1995	Dry Creek (Tuolumne) at Claus Road	37.6570	-120.9202	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/50-4.txt
DPR		1995	Dry Creek (Tuolumne) at Leask Bridge near Waterford	37.6742	-120.7117	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/50-10.txt
DPR	Bacey	-	Highline Spillway to Merced River	37.3875	-120.8036	Pesticides	74
DPR		0	Highline Spillway to Merced River	37.3875	-120.8036	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/24-4.txt

DPR		0	McHenry stormdrain at Bodem St., Modesto	37.6464	-120.9856	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/50-5.txt
DPR		0	Merced River at Hatfield State Park	37.3508	-120.9606	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/24-6.txt
DPR		1993	Merced River at River Road	37.3505	-120.9610	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/24-7.txt
DPR		1995	Ninth St storm drain at 7th St Bridge, Modesto	37.6303	-120.9936	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/50-6.txt
DPR		1995	Oakdale Irrigation District at Ellenwood Raod near Waterford	37.6733	-120.7733	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/50-11.txt
DPR		0	San Joaquin River at Fremont Ford	37.3101	-120.9295	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/24-9.txt
DPR		0	San Joaquin River at Hills Ferry	37.3502	-120.9755	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/50-29.txt
DPR		0	San Joaquin River at Maze Blvd.	37.6412	-121.2276	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/50-2.txt
DPR		1995	Sonoma Storm drain at Scenic Dr, Modesto	37.6528	-120.9517	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/50-3.txt
DPR		1995	Tuolumne River at Carpenter Rd Bridge	37.6089	-121.0297	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/50-17.txt
DPR		1995	Tuolumne River at Mitchell Rd Bridge	37.6169	-120.9378	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/50-20.txt
DPR	Starner	37439	Tuolumne River at Shiloh Road Bridge	37.6033	-121.1306	Pesticides	76
DPR		2002	Tuolumne River at Shiloh Road Bridge	37.6033	-121.1306	Pesticides	2002data_draft AEAL database
DPR		2002	Tuolumne River at Shiloh Road Bridge	37.6033	-121.1306	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/50-16.txt
DPR		1995	Turlock Irrigation district Ceres Main Spillway	37.6091	-120.9195	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/50-22.txt
DPR		0	Turlock Irrigation District Drain #3 at Jennings Road Bridge	37.5369	-121.0661	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/50-19.txt
DPR		0	Turlock Irrigation District Drain #5	37.4644	-121.0300	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/50-24.txt
DPR		1995	Turlock Irrigation District Hickman Spillway	37.6314	-120.7364	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/50-12.txt
DPR	Bacey	-	Westport Drain at Quisenberry Road	37.5396	-121.0842	Pesticides	74
DPR		2002	Westport Drain at Quisenberry Road	37.5396	-121.0842	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/50-30.txt
DPR		1995	Westside Storm Drain at Neece Dr., Modesto	37.6253	-120.9983	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/50-21.txt
DPR		2002	Tuolumne River at Shiloh Road Bridge	37.6033	-121.1306	pyrethroids	2002data_draft AEAL database
	Don Weston	2003	TID # 3 at Jennings Road (Site 10)	37.5368	-121.0661	Sediment Sampling	data from CVRWQCB

DPR	1995	Tuolumne River at Roberts Ferry Bridge	37.6358	-120.6172	Simazine	http://www.cDPR.ca.gov/docs/sw/sitepages/50-13.txt
ATL	2003	TID # 3 at Jennings Road (Site 10)	37.5368	-121.0661	Toxicity Testing	http://www.swrcb.ca.gov/rwqcb5/programs/irrigated_lands/UCDStudyPlan3-07-03.pdf
DPR	2002	Tuolumne River at Shiloh Road Bridge	37.6033	-121.1306	Triazines/Herbicides	2002data_draft AEAL database

Table 10. Benthic macroinvertebrate bioassessment data from the Coalition area. All data have been collected by UC Davis.

Site Name	Sample Period	LAT	LONG
Bear Creek @ Bert Crane Rd.	2000- present	37.2556	-120.6519
Merced River @ River Rd.	2000- present	37.3497	-120.9578
Ingalsbe Slough @ J17	2000- present	37.4918	-120.5578
Merced River @ J16/Oakdale	2000- present	37.4540	-120.6092
Merced River @ Hwy 59	2000- present	37.4702	-120.5005

1.3.2 Known Water Quality Issues and Limited Water Bodies

Eleven water bodies within the Coalition area are listed on the EPA 303d list as impaired water bodies (Table 11). Generally these locations are along the mainstem of the San Joaquin River, but also occur along the lower reaches of the main tributaries. Essentially the entire San Joaquin River through the Coalition area is on the 303d list. Listings include (but are not limited to) numerous constituents from selenium and boron to legacy pesticides (DDT), ammonia, electrical conductivity, and diazinon and chlorpyrifos. Unknown toxicity is also listed as a cause of impairment for several water bodies. Despite the fact that all listed water bodies are located downstream of urban regions known to discharge organophosphate pesticides, metals, and numerous other constituents, municipal discharge is listed as the source of impairment for only one site, Harding Drain. Agriculture is listed as a source of impairment for all sites on the 303d list, and 10 of the 11 sites are listed for either or both chlorpyrifos and diazinon. The exception is Mud Slough, which is listed for pesticides generally. Figure 9 shows the impaired water bodies within the Coalition region with the proposed monitoring sites as outlined in the Monitoring and Reporting Program Plan.

1.3.3 Potential Water Quality Problems

For the foreseeable future, there is the potential for runoff of organophosphate pesticides both during the dormant spray season and during the irrigation season. It is anticipated that the water bodies will remain listed on the 303d list for organophosphate pesticides suggesting that these constituents will require monitoring in the Coalition area. As there is a shift in usage from organophosphates to pyrethroid pesticides, the potential exists for the movement of these compounds to water bodies. Due to their extreme affinity for organic compounds, pyrethroids may become an issue for sediments and not primarily a cause of water column toxicity. Although analytical techniques for isolation and identification of pyrethroids are being developed, testing water and sediment for these compounds is still problematic and finding laboratories capable of performing these analyses at a reasonable cost may be difficult.

Table 11. Impaired water bodies as listed on the EPA 303d list.

Water Body Type	Water Body Name	Calwater Watershed	Pollutant Stressor	Potential Sources	Estimated Size Affected	Proposed TMDL Completion
R	Harding Drain (Turlock Irrigation District Lateral #5)	53550000				
			Unknown Toxicity	Agriculture	8.3 Miles	
			Ammonia	Municipal Point Sources	8.3 Miles	
			Ammonia	Agriculture	8.3 Miles	
			Chlorpyrifos	Agriculture	8.3 Miles	
			Diazinon	Agriculture	8.3 Miles	
R	Merced River, Lower (McSwain Reservoir to San Joaquin River)	53550000				
			Chlorpyrifos	Agriculture	50 Miles	
			Diazinon	Agriculture	50 Miles	
			Group A Pesticides	Agriculture	50 Miles	
R	Mud Slough	54120000				
			Unknown Toxicity	Agriculture	13 Miles	
			Pesticides	Agriculture	13 Miles	
			Boron	Agriculture	13 Miles	
			Selenium	Agriculture	13 Miles	
			Electrical Conductivity	Agriculture	13 Miles	
R	Newman Wasteway	54120000				
			Chlorpyrifos	Agriculture	8.3 Miles	
			Diazinon	Agriculture	8.3 Miles	
R	Salt Slough (upstream from confluence with San Joaquin River)	54120000				
			Unknown Toxicity	Agriculture	17 Miles	
			Boron	Agriculture	17 Miles	
			Electrical Conductivity	Agriculture	17 Miles	
			Chlorpyrifos	Agriculture	17 Miles	
			Diazinon	Agriculture	17 Miles	
R	San Joaquin River (Bear Creek to Mud Slough)	53570000				
			Unknown Toxicity	Source Unknown	14 Miles	
			Boron	Agriculture	14 Miles	2003
			Mercury	Resource Extraction	14 Miles	
			Electrical Conductivity	Agriculture	14 Miles	2003
			Chlorpyrifos	Agriculture	14 Miles	2004
			DDT	Agriculture	14 Miles	
			Diazinon	Agriculture	14 Miles	2004

			Group A Pesticides	Agriculture	14	Miles	
R	San Joaquin River (Mendota Pool to Bear Creek)	53570000					
			Unknown Toxicity	Source Unknown	67	Miles	
			Boron	Agriculture	67	Miles	2003
			Electrical Conductivity	Agriculture	67	Miles	2003
			Chlorpyrifos	Agriculture	67	Miles	2004
			DDT	Agriculture	67	Miles	
			Diazinon	Agriculture	67	Miles	2004
			Group A Pesticides	Agriculture	67	Miles	
R	San Joaquin River (Merced River to South Delta Boundary)	54400000					
			Unknown Toxicity	Source Unknown	43	Miles	
			Boron	Agriculture	43	Miles	2003
			Mercury	Resource Extraction	43	Miles	
			Electrical Conductivity	Agriculture	43	Miles	2003
			Chlorpyrifos	Agriculture	43	Miles	2004
			DDT	Agriculture	43	Miles	
			Diazinon	Agriculture	43	Miles	2004
			Group A Pesticides	Agriculture	43	Miles	
R	San Joaquin River (Mud Slough to Merced River)	53570000					
			Unknown Toxicity	Source Unknown	3	Miles	
			Boron	Agriculture	3	Miles	2003
			Mercury	Resource Extraction	3	Miles	
			Selenium	Agriculture	3	Miles	
			Electrical Conductivity	Agriculture	3	Miles	2003
			Chlorpyrifos	Agriculture	3	Miles	2004
			DDT	Agriculture	3	Miles	
			Diazinon	Agriculture	3	Miles	2004
			Group A Pesticides	Agriculture	3	Miles	
R	Stanislaus River, Lower	53530000					
			Unknown Toxicity	Source Unknown	59	Miles	
			Mercury	Resource Extraction	59	Miles	
			Diazinon	Agriculture	59	Miles	
			Group A Pesticides	Agriculture	59	Miles	
R	Tuolumne River, Lower (Don Pedro Reservoir to San Joaquin River)	53550000					
			Unknown Toxicity	Source Unknown	60	Miles	
			Diazinon	Agriculture	60	Miles	
			Group A Pesticides	Agriculture	60	Miles	

Water Body Type Abbreviation: R = Rivers and Streams

2 East San Joaquin Water Quality Coalition Watershed Priorities

Based on the historical water quality problems, the current and foreseeable land uses in the Coalition area, the priorities for the Coalition are to: 1) monitor for toxicity in the water bodies within the Coalition area, 2) determine the cause of any toxicity that is present by a combination of Toxicity Identification Evaluations and analysis of water for specific chemical constituents, 3) focus the available resources on the regions that maintain the largest amount of irrigated agriculture (Deadman Creek, Dry Creek-Merced River, and San Joaquin Flats), and 4) implement outreach programs aimed at reducing delivery of constituents to the water bodies in the Coalition area (see below for details).

3 East San Joaquin Water Quality Coalition Management Practices

3.1 East San Joaquin Water Quality Coalition Implementation Plan

Currently, outreach and BMP implementation efforts include communicating with landowners and operators in the Coalition region about conditional waiver requirements, organizational efforts of the Coalition and Subwatershed groups and the status of regional monitoring program development and implementation. Outreach to landowners and operators is currently being performed through various activities including grower meetings and workshops, articles in newsletters and trade press, Coalition websites postings and mailings to coalition members.

The Coalition will develop a template for its general outreach program after the first year monitoring is complete. Each Subwatershed will revise the template to meet their individual needs. The Coalition will hold a Subwatershed initiation meeting before starting an outreach program to discuss the template and its implementation. The template will include such items as the watershed setting, hydrology, crops, pesticides, information sources, contacts and monitoring plans for the BMPs. The following organizations are enlisted to accomplish this task.

- County Agricultural Commissioners
- County Farm Bureaus
- Resource Conservation Districts
- Association of Resource Conservation Districts
- University of California farm advisors
- Natural Resource Conservation Service Districts
- Farm input suppliers
- Crop consultants and Pest Control Advisors
- Coalition for Urban/Rural Environmental Stewardship (CURES)
- Irrigation and drainage districts
- California Association of Pest Control Advisors (CAPCA)
- Pesticide Applicators Professional Associations
- California Plan Health Association

Commodity Groups (CA Dried Plum Board, Almond Board of CA, CA Cling Peach Advisory Board, etc.)

Other agricultural entities

The Coalition and its Subwatersheds will use its GIS capabilities to map and track the progress of water quality management practices. The Coalition and its Subwatersheds will take a separate approach in tracking water quality issues related to irrigation return flow discharges and storm water discharges. This tracking may occur in several ways: "On-Farm Practices" information sheets filed by landowners or operators at the county agricultural commissioner's office; workshops held where farmers develop their own conservation plans, with the technical assistance of the Resource Conservation Districts (RCD), NRCS, UC Cooperative Extension and other groups and agencies, commodity groups or farm input suppliers. GIS mapping will present a graphic display of management practices implemented throughout a subwatershed A website has been started (www.esjcoalition.org) which is further helping in the dissemination and collection of information for the coalition.

After results from the initial round of water monitoring are available, the coalition will begin communicating with its Subwatersheds about those results. If no toxicity is detected in Subwatershed drainage, those results will be communicated to landowners and operators along with general information about coalition monitoring and outreach plans. Landowners and operators will be contacted on an annual basis through the mail, at Coalition events or on the website about water quality programs being offered by local and regional organizations.

Should monitoring indicate toxicity in the water or sediment, it will be the Coalition's responsibility to notify the affected Subwatershed landowners and operators about problems and work to solve those problems. The Coalition will work with the Subwatershed group to develop a Response Plan that is consistent with the Coalition's Response plan on file with the MRP and which meets regulatory requirements. Depending on the causes of toxicity, solutions could include a targeted outreach program with landowners and operators adopting best management practices or modifying uses of specific farm inputs to prevent movement of the constituent of concern into the impacted surface water. Details on the Coalition's Response Plan are described in the MRP and suggested Subwatershed actions are listed below in a three-phase approach.

Three Phase approach

If actionable toxicity or an exceedance of a state or federal standard is detected at a monitoring site, the Coalition will address the problem using a three-phased approach. The approach represents a framework for implementing the Response Plan as described in the MRP.

Pesticides

Phase I

1) Contact landowners in the impacted Subwatershed or drainage via email or mailed correspondence. The following information will be provided:

    - Identification of the constituent detected (pesticide, nutrient, sediment, etc.);

- Identification of the potential lands in the sub watershed that could contribute to runoff;
- Identification of the potential crops where the constituent could have been applied (or could have originated);
- A plan for action, developed by coalition cooperating entities that includes a list of potential BMPs, time frames for implementation and information on agencies or resources to assist in adopting BMPs. A template implementation plan for the specific constituent causing toxicity will be developed by the Coalition technical committee, and if necessary, revised to meet the individual needs of subwatersheds.
- A description of potential actions that local or state regulators could take if subsequent monitoring does not show mitigation of the toxicity.

2) Organize Outreach meetings in the effected Subwatershed or drainage
    - Landowners and operators will also be informed of the monitoring results through outreach meetings or presentations held in the Subwatershed or drainage areas and organized by the Subwatershed and cooperating entities. The same information described in 1) will be covered in presentations and handout materials.

Phase II

If successive monitoring results show ongoing toxicity or no improvement in discharge levels for constituents of concern, Phase II of the plan will be implemented. Phase II includes continued landowner outreach describing monitoring results and promotion of BMPs to mitigate the problem as described in Phase I.

In addition, the Coalition or its Subwatershed may request the implementation of a mandatory Product Stewardship Program. This program, lead by the County Agricultural Commissioners, the California Department of Pesticide Regulation (DPR) and pesticide registrants and suppliers, consists of working with Landowners and Operators on BMPs that are specific to a product's use.

Phase III

If additional monitoring results show no improvement in toxicity or pesticide levels, local and state agencies such as County Agricultural Commissioners may take actions such as requiring localized permit conditions be developed and implemented to prevent movement of the pesticide into local waterways. DPR also has the option to place a product into a formal Product Reevaluation.

Other Constituents

Phase I

(Same as Pesticides)

Phase II

If successive monitoring shows no improvement in an identified problem discharge, then phase II will be implemented. Phase II may include a focused outreach program in the area led by the Coalition and those entities with expertise on BMPs such as NRCS, UC Extension, RCDs and CURES. This outreach and BMP implementation will concentrate on areas identified to be associated with the discharges and will involve working with landowners and operators to implement programs to address those concerns.

Phase III

If additional monitoring results show no improvement in problem discharges, then Phase III will be implemented. Phase III will recommend that landowners develop a Farm Conservation Plan or similar plan designed to address the specific constituent. The affected landowners will be encouraged to work with NRCS and associated entities to develop and implement the plan.

3.2 East San Joaquin Water Quality Coalition Communications Report

Any evidence of statistically significant toxicity and the identification of a specific chemical constituent in surface water that could result in the exceedance of an established water quality standard(s) will trigger a Communications Report (CR) to the Central Valley Regional Water Quality Control Board (CVRWQCB). The CR will be submitted to the CVRWQCB in the form of a letter and will be submitted within 10 days of the receipt of results. The CR will include the site, date, water quality exceedance, and any supporting data deemed necessary to document the exceedance. This exceedance will also trigger the Phased approach as outlined in the Implementation Plan provided above.

Appendix 1– Crop Calendars for alfalfa, almond, irrigated pasture, olive, peach processing tomato and prune production.

Al[illegible]a Production - Calendar Of Operations In The S[illegible]ramento Valley

(Source: University of California Cooperative Extension. Dan Putnam, Statewide Extension Specialist, Rachael Long, Jerry Schmierer, Mick Canevari, and Allan Fulton, UC Farm Advisors)

Crops are complex biological systems, which makes it difficult to accurately predict every management practice. Each "X" represents a reasonable probability that the cultural practice would occur at the time indicated. Not all of these management practices are implemented in every field every year. Site-specific conditions will determine if a specific management practice is necessary.

Farm Operation	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
First Year (fall, winter, and spring plantings may occur - fall recommended)												
Soil Test	X	X	X	X	X	X	X	X	X	X	X	X
Primary Tillage (rip/level)		X	X	X				X	X			
Pre-plant Fertilizer		X	X						X	X		
Secondary Tillage (disc, harrow, pack)									X	X		
Planting disease & insect resistant varieties	X	X	X							X	X	X
Irrigation (often sprinklers for germination)			X	X					X	X		
Irrigation (flood after stand establishment)				X	X	X	X	X	X	X		
Post-emergence weed control		X	X	X						X	X	
Rodent control			X	X				X	X	X		
Egyptian alfalfa weevil control (seldom)			X									
Blue alfalfa and pea aphid control (seldom)				X	X							
Beet and yellow striped armyworm control							X	X				
Alfalfa caterpillar control							X	X				
Harvest / Curing/Baling				X	X	X	X	X	X	X		
Subsequent years (typical life of stand: 4 yrs, 6-7 cuts/year)												
Pre and post-emergence weed control	X	X	X	X	X	X	X				X	X
Plant tissue tests				X	X	X	X	X				
Fertilizer applications					X	X					X	X
Rodent control	X	X	X	X				X	X	X	X	X
Irrigation				X	X	X	X	X	X	X		
Egyptian alfalfa weevil control			X	X								
Blue alfalfa and pea aphid control (seldom)				X	X							
Beet and yellow striped armyworm control							X	X				
Alfalfa caterpillar control							X	X	X			
Harvest/Curing/Baling				X	X	X	X	X	X	X		

Almond Production - Calendar Of Operations In The Sacramento Valley

(Source: University of California Cooperative Extension. Joe Connell, Bill Krueger, Richard Buchner, Wilbur Reil, Franz Niederholzer, and Allan Fulton, UC Farm Advisors)

Crops are complex biological systems, which makes it difficult to accurately predict every management practice. Each "X" represents a reasonable probability that the cultural practice would occur at the time indicated. Not all of these management practices are implemented in every field every year. Site-specific conditions will determine if a specific management practice is necessary.

Farm Operation	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Pruning and brush disposal	X	X	X				X				X	X
Dormant season insect management	X											
Winter sanitation for insect control	X											
Pre-emergence weed control (in-row)	X	X									X	X
Pollination (honey bees)		X	X									
Frost Protection		X	X	X								
Vegetation management (middles)			X	X	X	X	X	X	X			
Shot hole disease management			X	X								
Brown rot disease management		X										
Scab disease management				X	X							
Anthracnose disease management		X	X	X	X							
Rust management						X	X	X				
Irrigation				X	X	X	X	X	X	X		
Leaf analysis for nutrient management							X					
Fertilizer and gypsum application			X	X		X	X					
Vertebrate pest management	X	X	X	X	X	X	X			X	X	X
Foliar fertilization			X	X	X						X	
In-season insect management (w/o dormant):												
Navel Orange Worm					X	X	X					
Peach twig borer		X			X		X					
San Jose Scale				X								
Ants						X	X					
Web spinning mites						X	X	X				
Post-emergence herbicides (in-row)				X	X	X	X	X				
Harvest								X	X	X		

Irrigated Pasture - Calendar Of Operations In The Sacramento Valley

(Source: University of California Cooperative Extension. Larry Forero, Glenn Nader, Barbara Reed, and Allan Fulton, UC Farm Advisors)

Crops are complex biological systems, which makes it difficult to accurately predict every management practice. Each "X" represents a reasonable probability that the cultural practice would occur at the time indicated. Not all of these management practices are implemented in every field every year. Site-specific conditions will determine if a specific management practice is necessary.

Farm Operation	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
First Year												
Pre-plant soil test									X			
Pre-plant fertilizer									X			
Seedbed preparation (disc, harrow, pack)									X			
Planting (fall planting recommended)										X		
Post-emergence irrigation (if rain absent)										X		
Spring planting (alternatively)			X	X								
Broadleaf weed management				X								
Pull checks and irrigate				X	X	X	X	X	X	X		
Haying or grazing					X	X	X	X	X	X		
Subsequent years (typical life: 5 – 7 years)												
Leaf tissue analysis				X	X							
Fertilizers applied			X	X	X							
Weed and blackberry management				X	X			X	X	X		
Irrigation				X	X	X	X	X	X	X		
Clip (if feed is not grazed sufficiently)						X	X	X				
Harrow (aerate, remove thatch, etc…)			X									
Haying or grazing				X	X	X	X	X	X	X		

Olive Production - Calendar Of Operations In The Sacramento Valley

(Source: University of California Cooperative Extension. Joe Connell, Bill Krueger, and Allan Fulton, UC Farm Advisors)

Crops are complex biological systems, which makes it difficult to accurately predict every management practice. Each "X" represents a reasonable probability that the cultural practice would occur at the time indicated. Not all of these management practices are mplemented in every field every year. Site-specific conditions will determine if a specific management practice is necessary.

Farm Operation	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Olive knot management			X	X							X	X
Fertilize with nitrogen		X[a]	X[a]	X[a]	X[b]	X[b]	X[b]					
Irrigation			X	X	X	X	X	X	X	X		
Fruit Thinning						X						
Mow orchard middles				X[ab]	X[ab]	X[ab]	X[a]	X[a]	X[a]			
Post-emergence weed control				X	X		X					
Pruning and brush disposal				X	X	X						
Leaf analysis for nutrient management							X					
Olive Fly monitoring				X	X	X	X	X	X	X	X	
Olive Fly management						X	X	X	X	X	X	
Black Scale monitoring				X	X		X	X	X			
Black Scale management				X[p]	X[p]	X[p]	X[i]	X[i]			X[i]	X[i]
Harvest									X	X		
Peacock spot management										X	X	
Pre-emergence weed control	X										X	X

a = flood irrigated
b = drip or microsprinkler irrigation
p = pruning to facilitate heat mortality of Black Scale
i = insecticide may be needed for effective control of Black Scale

Peach Production - Calendar Of Operations In The Sacramento Valley

(Source: University of California Cooperative Extension. Janine Hasey, Bill Olson, Richard Buchner and Allan Fulton, UC Farm Advisors)

Crops are complex biological systems, which makes it difficult to accurately predict every management practice. Each "X" represents a reasonable probability that the cultural practice would occur at the time indicated. Not all of these management practices are implemented in every field every year. Site-specific conditions will determine if a specific management practice is necessary.

Farm Operation	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Prune and brush disposal	X	X									X	X
Shot hole disease management	X										X	X
Leaf Curl disease management	X	X										X
Dormant season insect management	X	X										X
Vegetation management (middles)			X	X	X	X	X	X	X	X		
Post-emergence herbicides (in-row)				X	X	X	X					
Brown rot disease management		X	X				X					
Powdery mildew management			X	X	X							
Rust management				X	X							
Hand fruit thinning				X	X	X						
Irrigation				X	X	X	X	X				
Fertilizer application				X				X				
In-season insect management (w/o dormant)												
Oriental fruit moth					X	X	X					
Peach twig borer					X	X						
Leafrollers (OBLR)				X	X	X						
Hemiptera bugs				X	X							
Thrips			X									
Web spinning mites						X	X	X				
Hand harvest							X	X	X			
Pre-emergence herbicides (in-row)											X	X

Processing Tomato Production - Calendar Of Operations In The Sacramento Valley

(Source: University of California Cooperative Extension. Gene Miyao, Michael Murray, and Allan Fulton, UC Farm Advisors)

Crops are complex biological systems, which makes it difficult to accurately predict every management practice. Each "X" represents a reasonable probability that the cultural practice would occur at the time indicated. Not all of these management practices are implemented in every field every year. Site-specific conditions will determine if a specific management practice is necessary.

Farm Operation	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Primary tillage (disk, subsoil, landplane)							X	X	X	X		
Spring tillage (limited)			X	X	X							
Soil amendments (gypsum etc…)								X	X	X		
Soil test									X	X		
List beds and shape								X	X	X		
List beds and shape (spring) limited			X	X	X							
Late winter/spring weed control	X	X	X	X								
Pre-plant & post emergence herbicides		X	X	X	X	X						
Direct seed planting		X	X	X	X							
(or) transplant			X	X	X	X						
Starter fertilizers		X	X	X	X	X						
Tissue tests, post-plant side-dress fertilizer			X	X	X	X						
Layby herbicides			X	X	X	X						
Irrigation (end early Sept)			X	X	X	X	X	X				
Cultivation			X	X	X	X	X	X				
Water-run N fertilizer						X	X	X				
Bacterial speck control			X	X								
Russet mite and flea beetle control			X	X	X							
Black mold control								X	X	X		
Cutworm control				X	X	X						
Potato aphid control						X	X	X				
Beet Armyworm control						X	X	X	X			
Tomato fruit worm control							X	X	X			
Stink bug control						X	X	X	X			
Ethephon Harvest Aid						X	X	X	X			
Harvest							X	X	X	X		

Prune Production - Calendar Of Operations In The Sacramento Valley

(Source: University of California Cooperative Extension. Richard Buchner, Bill Olson, Franz Niederholzer, Wilbur Reil, Bill Krueger, and Allan Fulton, UC Farm Advisors)

Crops are complex biological systems, which makes it difficult to accurately predict every management practice. Each "X" represents a reasonable probability that the cultural practice would occur at the time indicated. Not all of these management practices are implemented in every field every year. Site-specific conditions will determine if a specific management practice is necessary.

Farm Operation	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Pruning And Brush Disposal	X	X	X	X							X	X
Dormant Season Insect Management	X	X									X	X
Brown Rot Disease Management			X									
Scab Disease Management			X									
Vertebrate Pest Management				X	X	X						
Prune Rust Disease Management					X	X	X					
Insect Management (W/O Dormant):												
Mealy Plum Aphid			X	X	X	X	X					
Leaf Curl Plum Aphid			X	X								
Peach Twig Borer			X	X	X							
Oblique Banded Leafroller			X		X	X						
Scale (Crawlers)					X							
Web Spinning Mites						X	X					
Mechanical Thinning				X	X							
Vegetation Management (Middles)				X	X	X	X	X	X	X		
Irrigation				X	X	X	X	X	X			
Nitrogen Fertilizer				X	X	X	X					
Potassium/Gypsum Fertigation					X	X	X					
Foliar Potassium Fertilizer Application					X	X	X					
Leaf Tissue Analysis							X					
Harvest								X	X			
Replace Trees – Backhoe And Fumigate									X	X	X	
Leaf Removal And Foliar Zinc Application										X	X	
Soil Applied Potassium Fertilizer										X	X	X

Ap, .dix 2. Inventory of BMPs for Almonds

Crop: Almonds	
Compilation of Best Management Practices to Protect Surface Water from Farm Runoff	
Pesticide Application BMPs	
Dormant Season Sprays	
Monitoring	If orchard has history of worm damage, it is not recommended to skip the dormant spray. However, if no dormant spray is applied, monitor for peach twig borer larvae associated with blooms or emerging shoots, as well as twig strikes resulting from feeding by the emerging larvae. If larvae are observed associated with blooms or emerging shoots, Bacillus thuringiensis (Bt) can be applied during bloom. Once strikes are observed, it is probably too late for bloom time Bt sprays to be effective.
Dormant Diazinon and Oil Spray	Diazinon combined with dormant oil during the dormant season. Diazinon applications are frequently alternated with non-OP pesticides to prevent resistance from developing to either diazinon or non-OP pesticides. Information is being developed on earlier timing of winter OP applications when less rainfall is likely or when the rainfall is more likely to be absorbed into the soil rather than runoff. Reduced rates: additional data is needed to demonstrate effects at varying pest (aphid) densities.
No Dormant Treatment or Dormant Oil Only Treatment	Dormant insecticide spray is not applied or an oil only treatment is made. Skipping dormant insecticide sprays has been successful in almonds when pest pressure is low or non-existent.
Alternate Year Dormant OP Pesticide With Yearly Oil Spray	Use dormant OP every other year but use dormant oil on an annual basis. In years with no dormant OP used the following may be necessary: Additional in-season treatments for peach twig borer. Additional in-season treatments for mites are possible following in-season applications of carbaryl, esfenvalerate and permethrin.

Dormant Spray (Non-OP Pesticides) and Oil	Pyrethroids (permethrin and esfenvalerate) and carbamates (carbaryl) for peach twig borer in the delayed-dormant or dormant season. Residues of the pyrethroid insecticides permethrin and esfenvalerate persist on bark and may impact naturally occurring predator mites for extended periods of time after dormant season and in-season applications. Mite outbreaks caused by use of pyrethroids may require additional miticide treatments over and above those normally applied. While pyrethroids remain effective for controlling peach twig borers in most areas, greatly increased tolerance by peach twig borer to pyrethroids has been identified in the Sacramento Valley, raising the possibility of resistance. In general, insects become resistant to pyrethroids more rapidly than other classes of pesticides. Some registered products are not widely used in the dormant season because of possible effects on non-target organisms or because of label restrictions. For example, carbaryl cannot be used in orchards where honeybees are present and endosulfan use is restricted near water or wetlands. Non-OP pesticides can affect non-target organisms in water and the potential for offsite movement from runoff has not been well studied. If a non-OP pesticide is applied as a dormant spray, precautions such as on-site practices (following sections) should be taken to prevent movement into surface waters. Laboratory exposures indicate that fish and invertebrates are particularly sensitive to pyrethroids. Pyrethroid persistence may mean that they will be transported off site. If so, they may be bioavailable to fish in water or to invertebrates in sediment. Sediment toxicity may result after pyrethroids are transported into water bodies.
Spinosad and Oil as Dormant Spray	Spinosad (Success Naturalyte insect control) is a low-risk pesticide for control of peach twig borer. Peach twig borer shoot strikes should be monitored in each generation as well as nuts for the presence or indication of larvae. If monitoring indicates that any of the pest species require additional control measures, they can be applied in-season.
Bloomtime Sprays of Bacillus thuringiensis (Bt) For Peach Twig Borer.	Treatments of Bt at bloom to control over-wintering peach twig borer larvae. Peach twig borer shoot strikes should be monitored in each generation, as well as nuts for the presence or indication of larvae. If monitoring indicates that any of the pest species require additional control measures, treatments can be applied in-season.
Pheromone Mating Disruption for Peach Twig Borer	Mating disruption relies on releasing pheromones through dispensers distributed throughout an orchard or applied as a spray. It has been shown to be effective against peach twig borer in almond orchards (although some details of application and effective rates of specific products are incomplete). It is most effective in orchards with low moth populations that are not close to other untreated peach twig borer hosts or almond orchards. Efficacy is reduced by small orchard size, uneven terrain, reduced pheromone application rates, applying too low in the tree, improper timing, and high insect pressure. Pheromone mating disruption cannot be considered a stand-alone system. It is selective for the target pest so monitoring for other orchard pests as well as peach twig borer is necessary.
Dormant Season Spray BMPs	

Restrict dormant spray applications (except oil alone) to ground applications only.
Do not apply within 100 feet upslope of any sensitive aquatic site that may drain into a river or tributary unless runoff is contain or diverted from the sensitive aquatic site. Waters that are contained or diverted must be held for 72 hours before they can be released into a sensitive aquatic site.
Maintain a vegetative buffer strip a minimum of 10 feet wide from the edge of the field to sensitive aquatic sites.
Do not apply dormant sprays (except oil alone) when soil moisture is at field capacity and a storm is predicted in the next 48 hours.
Do not apply dormant sprays (except oil alone) when surface runoff to sensitive aquatic sites from a rain event could occur within 48 hours after the application.
Make dormant applications only when insect-scouting information indicates pest populations have reached damaging levels. (See University of California Integrated Pest Management Guidelines for almonds.)
Apply only when wind speed is 3-10 mph at the application site as measured by an anemometer outside of the orchard on the upwind side.
When air currents are moving (>3 mph) toward sensitive aquatic sites, commence applications on side nearest the site and proceed spraying away from the water body.
Spray last three rows upwind of bodies of water using nozzles on one side only, with spray directed away from sensitive aquatic sites.
Reduce the maximum rate of application and the number of applications.
Alternate the dormant use of organophosphorous and pyrethroid insecticides with other environmentally reduced risk pesticides or make application in season according to University of California Integrated Pest Management recommendations.

Dormant Orchard Field Practice BMPs	
Sanitation Practices	Knock off "mummy fruit" to reduce pest problems.
Orchard Floor Vegetation During Dormant Season	Seeded or resident vegetation growing on orchard floors that is later mowed or disked. Resident Vegetation - existing, unplanted mixture of annual or perennial weeds, crop species and/or native grasses and forbs which has adapted to management methods used in the orchard. Seeded vegetation - cover crops that include many types of cultivated species including legumes (bell beans, peas, clover, medics and vetches) and grasses such as cereal grains, turf grasses and sudan grass.

	Resident or Seeded Vegetation (continued)	Benefits	Orchard floor vegetation can reduce dormant spray pesticide runoff to surface water. several ways: - Can be easily encouraged to grow in the fall or early winter by a post harvest irrigation or early rains and requires little to no management to establish. - Reduction in runoff volume through increased water infiltration. - Reduction in sheet erosion caused by rainfall impact on bare ground. - Decrease in pesticide mass carried by sediment. - Shorter pesticide persistence (faster breakdown) on vegetation than soil. - Adsorption of pesticides to plant surfaces. - Anchors soil during winter rains preventing soil, nutrient and pesticide runoff. - Allows pesticides to break down and be filtered onsite. Adds organic material to the soil. Accelerates the biodegradation of pesticides in soil. Can reduce plant parasitic nematodes by antagonism. Legume cover crops fix atmospheric nitrogen and release it to the orchard crop during the growing season. Improves water infiltration, soil aeration and soil texture. Improves soil fertility. Assists in weed control (seeded covers). Improves orchard access during wet weather. Cover crops provide nectar sources, pollen and prey for beneficial predators.

		Drawbacks	Difficult to manage .. noxious weeds are present and requires mechanical or herbic... control in late winter or early spring if overgrown. Increased cover and feed for gophers, ground squirrels and mice (also higher populations from increased habitat and reduced predation). Increased humidity can potentially create conditions for fungal diseases. Potentially increased nematode populations with summer-grown cover crop. Higher water use with perennial cover crops. Sprinklers can be blocked by climbing vetches. Blooming cover crops can compete with tree crops for pollinator insects if not mowed. Increased danger of frost damage. A tall, dense cover crop can reduce nighttime temperatures by up to 5 or 6 degrees, increasing the potential for frost damage. However, orchards with closely mowed cover crops and moist soil may be only about 1 degree colder than bare soil. Alternate row cover cropping can reduce the difference even more. Mowing before frost reduces the risk of frost damage. Trash (plant residue, particularly grasses) at harvest can hinder almond pick-up. However, growing an annual legume cover crop mix that can be mowed and allowed to decompose over summer causes fewer harvest problems. In almonds, perennials may interfere with harvest. Perennials are most suited for stone fruit orchards.
Cover Crop Management	Cover and Green Manure Crop	Plants are disked to incorporate organic material and improve soil fertility and tilth. Disking (or mowing) is generally done when plants are in full-bloom to post-bloom stage, depending on frost potential and soil moisture conditions.	
	Mowed Cover Crop	Managed by mowing to maintain at least 60% ground cover where erosion is possible. Mowing to 3-4 inches prior to frost can reduce cold temperature damage potential. Mowing intervals can often allow adequate seed production for following season re-growth. Mowed cover crops reduce dust during harvest operations and improve water infiltration rates.	
	Disked Cover Crop	Plants typically disked at full-bloom to post-bloom stage, depending on condition of the target crop, weather and soil moisture conditions. Maintain at least 60% ground cover where erosion is possible. Mowing to 3-4 inches prior to frost can reduce potential for cold temperature damage.	
Vegetative Buffers	Areas or strips of land surrounding an orchard that are maintained in permanent vegetation. To effectively trap pesticides, buffers must slow water runoff and increase infiltration so that pesticides can be trapped and degraded in buffer soil and vegetation. Vegetative buffers are a tool to further improve water quality and provide additional benefits such as wildlife habitat and stream bank protection. For best success, they should be used in conjunction with other mitigation practices.		

	Benefits	Can be used to manage soil, water, nutrients and pesticides while minimizing environmental impacts. Effective in trapping eroded sediment, reducing runoff of pesticides that are adsorbed to soil particles. Note: some pesticides (e.g. OPs) are highly water soluble and don't adsorb to soil particles as readily as others (e.g. pyrethroids).
	Drawbacks	California-based research is limited on the potential for orchard filter strips and grassed waterways to reduce OP pesticide loading, although the practices have been shown to be effective in other regions of the U.S. Uncertainties of buffers include: appropriate dimensions for volume of water flow; appropriate plant species and plant density for the soil types and rainfall zones; considerations for various locations; slope and channel dimensions for grassed waterways; and dimensions for constructed wetlands. Can require growers to set aside productive acreage.
Vegetative Filter Strips	Areas of grass or other permanent vegetation used to reduce sediment, organics, nutrients, pesticides and other contaminants in runoff to maintain or improve water quality. Vegetative filter strips are located between crop fields and water bodies, i.e. grassed roadways. Plant material captures rainfall and retains nutrients. Roadways can be grassed or sod planted, as can sprayer mixing pads and wellheads. Depending upon the site, a full border around an orchard may not be necessary for mitigating impacts to surface water. Filter strips could be planted at low ends of fields or in other critical zones.	
	Benefits	Slows runoff allowing sediment to drop out of suspension. Traps sediment with adsorbed pesticide residues. Increases water infiltration into the soil profile. Catches some pesticide drift, preventing it from reaching the soil.
	Drawbacks	If water runoff is channeled, a grass strip may not effectively trap the adsorbed pesticides.
Vegetative Barriers	Narrow, permanent strips of stiff stemmed, erect, dense, perennial vegetation established in parallel rows and perpendicular to the dominant slope of the field.	
	Benefits	Effective in dispersing concentrated flow, thus increasing sediment trapping and water infiltration.
	Drawbacks	If water runoff is channeled, a vegetative barrier may not effectively trap the adsorbed pesticides.
Grassed Waterways	Natural or constructed channels planted in permanent vegetation and located in an area where runoff concentrates. Constructed waterways can be graded to carry surface water at a non-erosive velocity to a stable outlet. Waterways are most effective in trapping sediment and dissolved chemicals when designed to spread concentrated water flow evenly cross a vegetative filter adjacent to waterways.	
	Benefits	Helps slow the flow of water to a non-erosive level. Provides a means of trapping sediment, nutrients, and pesticides while preventing gully erosion. Provides habitat and cover for wildlife.
	Drawbacks	Overgrown channels causing waterway breaching and flooding can restrict storm flows. Due to the concentrated flow that normally occurs in waterways, sediment trapping and water infiltration can be minimal with large runoff events, but substantial with smaller events.

Riparian Buffers	Trees and shrubs planted adjacent to streams, lakes, ponds and wetlands. Forest buffers are frequently combined with an understory of perennial grass buffers.	
	Benefits	Helps lower water temperatures by shading the water body. Protects stream banks and slows out-of-bank flood flows. Deep tree roots may intercept nitrate entering streams in shallow subsurface flow and provide soil carbon for microbial energy. Microbes can denitrify nitrate and degrade pesticides. Woody vegetation provides food and cover for wildlife. Contributes energy sources to aquatic communities.
	Drawbacks	If water runoff is channeled, riparian buffers may not effectively trap pesticides.
Constructed Wetlands	Wetlands constructed at tile outlets or as part of riparian buffer systems for degrading pesticides and denitrifying nitrates.	
	Benefits	Provides confined area for breakdown of pesticides in water.
	Drawbacks	Land needed for constructed wetlands is not readily available in high production areas. Available land can be costly.
Hedgerows	Fences of shrubs or trees in, across, or around a field. Hedgerows can include an understory composed of perennial native grasses and forbs, a shrub midstory composed of California native species and occasionally a discontinuous overstory of valley and foothill trees.	
	Benefits	May reduce erosion by having perennial vegetation on a portion of the field. If runoff flows across the hedgerow in sheet flow, sediment can be trapped, reducing the amount of sediment and sediment-borne pesticides from entering surface waters. Can attract beneficial insects and provide competition against invasive weeds. Windbreaks and hedgerows can provide drift mitigation, potentially reducing off-site movement of pesticides. Because many of the native species used in hedgerows have deep roots that hold the soil and increase water permeability, there may be a reduction in water runoff and off site movement of sediment. This could reduce runoff of pesticides in the dissolved and sediment-borne phases of field runoff. However, no studies have quantitatively measured the reductions in OP pesticide runoff.
	Drawbacks	Certain plant species may attract pests that can attack the crop or neighboring crops. Careful consideration must be given to the species of vegetation selected and the types of insects that may be attracted. Plant species can provide habitat and attract endangered species. Safe Harbor Agreements are available to protect growers where a practice is implemented that could attract endangered species to their farms, a factor that should be evaluated and addressed before establishing hedgerows. Some species can grow 10-15 feet wide, so space must be allowed for equipment to pass.

<table>
<tr><td rowspan="3">Reducing or Eliminating the Herbicide-Sprayed Berm</td><td colspan="2">Berm areas of orchards sprayed with herbicides represent a bare conduit for runoff of rainfall or irrigation water. By allowing vegetation to grow and reducing the berm width or seasonal spraying of the berm, runoff potential from an orchard could be reduced.
Options
- Reduce strip spray widths by 25%.
- Apply herbicide in January/February after sprouted grass covers the berm.
- Spray a 5-foot square block around trees to keep the trunk area clean but leave vegetation on the remainder of the row berm.
- Stop spraying herbicides at the next-to-the-last tree in each row, leaving a vegetative barrier surrounding the orchard.
- Eliminate use of pre-emergence herbicides.</td></tr>
<tr><td>Benefits</td><td>Cost Savings
Reduction in runoff volume through increased soil infiltration.
Decrease in soil erosion and movement of pesticides with soil borne runoff.
Shorter pesticide persistence on vegetation than soil and better absorption on plant surfaces (faster degradation on plant matter). An orchard floor that is completely vegetated versus 25% bare soil has greater area for these mechanisms to function.</td></tr>
<tr><td>Drawbacks</td><td>Vegetation on berms can be difficult to manage in almond orchards.
Vegetation control can be difficult if excessive growth occurs before herbicide is applied.</td></tr>
<tr><td colspan="3">In-Season Spray BMPs</td></tr>
<tr><td colspan="3">Insecticides & Herbicides</td></tr>
<tr><td>Monitoring</td><td colspan="2">If several twig strikes are seen on each tree by mid-April, in-season sprays should be applied for peach twig borer control timed to pheromone trap catches and the phenology model for peach twig borer.</td></tr>
<tr><td>Drift</td><td colspan="2">The ability to detect products in streams and rivers at parts per trillion levels leaves little room for error.
To prevent problems, equipment operators must take extra care when spraying near sensitive areas and bodies of water.
Shutoff equipment when making row turns.
Avoid spraying when wind is blowing toward waterways or other sensitive areas.
Leave buffer zone to protect sensitive areas.</td></tr>
<tr><td>Managing Irrigation Runoff</td><td colspan="2">Tailwater return systems can alleviate excess runoff preventing runoff from moving into surface waters.
Use vegetative barriers (see dormant orchard field practices) to filter runoff prior to leaving site.
Use of drip irrigation, especially buried drip has reduced or eliminated irrigation-induced runoff.</td></tr>
<tr><td>Cultural Controls</td><td colspan="2">Reduce dusty conditions in orchards by oiling or watering roadways and maintaining a groundcover. Prevent water stress, as this condition results in higher mite populations and makes trees more susceptible to damage.
The use of broad-spectrum materials in-season, such as pyrethroids, carbamates, and organophosphates (unless organophosphate-resistant predator mites are present in the orchard); will often result in spider mite outbreaks.</td></tr>
</table>

Ste dship BMPs	
Mixing / Loading/Cleanup	
Concrete or Asphalt Pad	Use concrete or asphalt pad that drains to a central sump
Proximity of mixing/loading area	Take precautions to insure that the minimum distance between any mixing/loading area and any ditches, canals or streams that feed into nearby rivers is at least 100 feet. Take precautions to insure that the minimum distance between any mixing/loading area and pump is at least 100 feet.
Equipment	Check equipment for cracked / broken hoses, valves, etc. Calibrate prior to each application. Use spray nozzles adjusted for crop canopy. Use nozzles with large droplet size to minimize drift.
Tank filling	Fill tank to 1/3 to ½ full prior to the addition of chemicals. Use air gap to prevent tank overfilling. Use backflow valve on the fill tube.
Personnel	Person(s) always present during mixing/loading operations. Person(s) trained to take corrective action when necessary.
Storage Areas	Have spill containment capability to protect from runoff into any nearby surface waters. Use impermeable surface (coated or sealed concrete) with curbs for floors.
Cleanup	Mix rinseate with water and reapply to field. Clean equipment on appropriate pad at least 300 feet from surface waters. Triple rinse empty containers and dispose of in landfill or recycling area.
Nutrient/Fertilizer Application BMPs	
Soil, Tissue and Water Testing	Base N fertilizer amount and timing on crop needs and production goals. Before applying N early in the growth cycle, assess the amount of nitrate already present by soil (or soil solution) sampling and analysis. Use plant tissue sampling for mid- and late season fertilizer decisions. Measure nitrate levels in the irrigation water and adjust N fertilizer rate accordingly.
Application Timing	When applying manure shortly before a crop is planted, determine the nutrient content of the manure and the amount of nitrate already present in the soil. Apply manure at a rate consistent with the crop nutrient requirements. Split applications of N fertilizer. No not apply excessive single amounts of fertilizer N during the rainy season. For fertilizer application during fall tillage, use only low N-containing materials such as N:P2O5:K2O equal to 1:3:3. Higher N materials may be appropriate if a crop is to be planted soon.

Fertilizer Placement	Place N fertilizer materials where maximum plant uptake will occur. Incorporate N fertilizer into the crop bed by either placing fertilizer on or near the seed row and watering it in, knifing fertilizer into the bed or broadcasting fertilizer then listing it up into the bed. Incorporate manures and other organic amendments into soil with consideration of the timing of conversion of manure N to other forms.	
Irrigation	Adopt surge irrigation. Improve irrigation uniformity by turning irrigation water on and off as it flows down the furrow. If fields are more than 1000 feet long, consider cutting the furrow run length in half with a corresponding decrease in set time. Use high flow rates initially to get water down the field and then cut back to finish off the irrigation. Avoid doing the opposite. Use practices that increase uniformity among furrows (e.g. torpedoes, extra tractor trips, etc.) Collect surface water runoff for recirculation or reuse in other fields.	
Application Practices	Clean-up fertilizer spills promptly. Shut off fertilizer applicators during turns and use check valves when possible. Maintain proper calibration of fertilizer application equipment. Whenever injecting fertilizer into irrigation water, ensure backflow does not occur. Rinse water from fertilizer tanks should be evenly spread throughout a field. Fertilizer tanks and equipment should be cleaned by rinsing in the field or at a properly designed wash facility. Rinse water and/or sludge should be evenly spread across a field using good agronomic practices. When equipment is parked, use care to prevent material from leaking into storage area. If equipment is known to be in disrepair, completely remove fertilizer material before parking equipment. When transferring fertilizer into on-farm storage or into a fertilizer applicator, take care not to allow materials to accumulate on the soil. Good housekeeping practices should be implemented to prevent contamination of groundwater and/or surface water.	
Cover Crops	If conditions permit, grow a cover crop to use excess nitrogen and prevent leaching rather than leaving fields fallow during the rainy season.	
Sediment Control BMPs		
Water and Sediment Control Basins	Constructed earth embankments or a combination ridge and channel. Constructed across the slope and minor watercourses to form a sediment trap and water detention basin.	
	Benefits	Trap sediment and pesticides adsorbed to soil particles. Reduce and manage onsite and downstream runoff. Divert the flow of dissolved substances such as nutrients and pesticides. Improve the farmability of sloping land, reduce water course and gully erosion. Improve downstream water quality.

	Drawbacks	Basins are not viable for many [illegible]hard areas in California, primarily because considerable lan[illegible] acreage would be required to manage the volumes of water typically produced in rainfall events, especially in the Sacramento Valley.
PAM Applications	PAM is a polymer compound injected or fed into irrigation water at the head of a field supply ditch or discharge point. Applications rates range from 5-8 pounds per acre with the material typically metered into the head ditch with a gandy-type applicator	
	Benefits	In newly formed furrows, soil does not move down the row or erode when irrigation water is treated with PAM. Suspended soil particles drop out of irrigation water containing PAM. After an irrigation containing PAM, furrow erosion and transport of sediment is greatly reduced in subsequent irrigations. Erosion reductions of 95% have been documented in numerous field trials and commercial applications in the San Joaquin Valley.
	Drawbacks	Additional cost
Tailwater Return Systems	Benefits	Use of tailwater can offer substantial savings in irrigation power consumption if the water supply is groundwater. A tailwater recovery system increases yields because of higher irrigation efficiencies. A tailwater recovery system will not save all the tailwater, but it can increase irrigation efficiency by 25 to 30 percent.
	Drawbacks	The loss of the area required for a reuse pit and periodic maintenance of the pump, storage and return facilities.
Compaction / Wheel Rutting	Wheel ruts formed by equipment passing through wet fields can create channels for water and sediment to runoff from orchards. Where possible, minimize creation of wheel ruts with dormant orchard sprayers, brush shredders or other equipment when orchard floor is saturated.	
Drainage System Management	Filtering runoff water through vegetation allowed to grow in drainage ditches may help mitigate offsite movement of sediment as well as pesticides dissolved in storm runoff.	
Avoiding Channelization of Streams and Creeks	Allowing streams to naturally flow and meander can increase runoff retention and infiltration. A modified or channeled stream could also be restored to a more natural state by re-establishment of the riparian vegetation, which also provides stream bank protection.	
Berms at Low Ends of Fields (sandy soils, low slope)	Raised berms at low ends of fields can trap sediment and adsorbed pesticides reducing runoff of dissolved substances in fields with low slopes and sandy soil types. Berms hold back water, increasing runoff retention and allowing infiltration.	

<table>
<tr><td>Pla[illegible]g 90 degrees to Grade</td><td colspan="2">Planting orchards and performing tractor work [illegible] degrees to the grade to reduce erosion and provide for grea[illegible] water penetration and retention.
Practice is very site-specific and would not be easily adaptable to many existing orchards, particularly those that are flood irrigated.</td></tr>
<tr><td>Aeration</td><td colspan="2">Use of specialized tillage equipment to break crusts and aerate orchard soils with the intent of increasing water penetration and retention, thus reducing runoff.
Aeration improves the soil profile with minimal disruption to the orchard floor. A finishing process may be required, however, for almond orchards where shake-and-sweep harvest methods are used. Aeration may reduce OP pesticide runoff although no studies have been conducted.</td></tr>
<tr><td>Ripped Resident Vegetation</td><td colspan="2">In orchards with permanent or semi-permanent sod, vegetation is ripped at various lengths and/or depths.
Ripping significantly increases soil water due to increased infiltration and porosity. Heavy rains after fall ripping can leave orchards impassable to heavy equipment such as orchard sprayers. In recent research, ripped resident vegetation performed the best for infiltration and reduced diazinon transport, followed by non-ripped resident vegetation and bare ground being the least effective.</td></tr>
<tr><td rowspan="3">Improving soil texture (tilth)</td><td colspan="2">Practices such as tillage, gypsum applications or actions of earthworms have potential to increase water penetration and reduce runoff in compacted soils or where an impermeable soil layer exists. However, no studies have been conducted to show efficacy in reducing OP pesticide runoff with these approaches.</td></tr>
<tr><td>Benefits</td><td>Increased water penetration resulting in less runoff and increased recharging of the soil profile.
Less water runoff means less potential for pesticides to be transported off-site.</td></tr>
<tr><td>Drawbacks</td><td>Tillage can increase erosion under some conditions and necessitate additional orchard floor finishing work (scraping).
Results vary with soil type and, under some conditions, compaction could increase.
Improved soil permeability may increase movement of nitrate and other chemicals into groundwater.
The balance of benefits versus disadvantages is not clear at this time and more research is needed.</td></tr>
</table>

Reference:

Integrated Pest Management for Almonds 2nd Edition: University of California Statewide IPM Project. 1992. 199pp.

http://ipm.ucdavis.edu/PMG/selectnewpest.almonds.html

Orchard Practices for Protecting Surface Water: Coalition for Urban/Rural Environmental Stewardship (http://www.curesworks.org)

Mixing and Loading Crop Sprayers, Tips and Techniques, Protecting Water Quality: Coalition for Urban/Rural Environmental Stewardship (http://www.curesworks.org)

Field and Row Crop Sprayers, Tips and Techniques, Protecting Water Quality: Coalition for Urban/Rural Environmental Stewardship (http://www.curesworks.org)

Almond Production Manual: University of California, Division of Agriculture and Natural Resources. 1996. 294pp.

Monitoring and Reporting Program Plan
East San Joaquin Water Quality Coalition

April 1, 2004

Introduction

The East San Joaquin River Water Quality Coalition (hereafter referred to as the Coalition) was formed in 2003 to enhance and improve water quality in the East San Joaquin River watershed, while sustaining the economic viability of agriculture, associated values of managed wetlands and sources of safe drinking water. The Coalition is comprised of more than 16 supporting agricultural entities and 1000 landowner/operators (as of April 1, 2004) of irrigated farmland that have joined with local governments throughout the coalition area to improve water quality in the region.

The Coalition developed and submitted its Notice of Intent (NOI) to meet the newly adopted water quality regulations to Central Valley Regional Water Quality Control Board (Regional Board) on November 1, 2003. On February 9, 2004, the Regional Board issued a Notice of Applicability (NOA) to the Coalition verifying the NOI was complete and approved. This Monitoring and Reporting Program Plan (MRPP) is prepared as mandated by the Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands Resolution No. R5-2003-0105, and provides the mechanism necessary to track progress in reducing the amount of waste discharged that affects the quality of the waters within the East San Joaquin Valley Watershed coalition boundaries. The accompanying Watershed Evaluation Report (WER) provides an assessment of the sources and impacts of waste in discharges from irrigated lands.

The MRPP has three main components. The first section of the report contains a description of the watershed characteristics and provides data and information describing the area's hydrology and drainage patterns, land use and crop data, chemical application, and programs and applicable management projects used to reduce or eliminate agriculture irrigation's adverse effects on water quality in the receiving waterbodies. Information gathered for this section is based on data available on the California Department of Pesticide Regulation website (http://calpip.cdpr.ca.gov/cfdocs/calpip/prod/main.cfm), GIS data obtained from the California Department of Water Resources, and the relevant County Agricultural Commissioners 2002 Agricultural Crop and Livestock Reports. The information presented is based on the most updated data available at the time this report was written.

The second section of the report identifies the coalition's priorities with respect to Phase I monitoring in specific subwatersheds. Priorities for sampled constituents are based on currently established water quality impairments as listed on the US EPA's 303d listed water bodies. Specific constituents and sampling information are provided, as are locations to be sampled. All locations are based on the status of the water body as an intermediate-sized drainage with irrigated agriculture located upstream. In many instances (see below), the proposed sampling locations are located a significant distance upstream of the confluence of the intermediate-sized drainage with the San Joaquin River. In these instances, the location of the proposed sample site is established to eliminate any urban runoff that may enter the water body.

The third section of the report provides preliminary information on the Quality Assurance Program Plan and monitoring protocols. At the time of submission, contracts are not in place to conduct sampling and analysis and consequently, laboratory quality assurance documentation is not available. This documentation will be made available as soon as contracts are in place.

1 EAST SAN JOAQUIN VALLEY WATERSHED SETTING

1.1 General Characteristics

The East San Joaquin (ESJ) Water Quality Coalition watershed area includes Stanislaus, Merced, Tuolumne and Mariposa Counties and portions of Calaveras County and comprises 1,230,281 total acres (acreage for Stanislaus and Merced Counties only). Of this total, approximately 633,812 acres (52%) are considered irrigated agriculture (based on 1996 Stanislaus County and 1995 Merced County land use data, Department of Water Resources portal through http://www.waterplan.water.ca.gov/landwateruse/landuse/ludataindex.htm). The watershed is bordered by the crest of the Sierra Nevada on the east and the San Joaquin River on the west, the Stanislaus River on the North to the Chowchilla River on the South. There are four major tributaries in the watershed: Chowchilla River, Merced River, Tuolumne River and Stanislaus River (Figure 1a). These rivers are all tributaries of the San Joaquin River and drain from east to west. The ESJ watershed area also includes within its boundaries four irrigation districts, Oakdale Irrigation District, Merced Irrigation District, Turlock Irrigation District, and Modesto Irrigation District.

For monitoring purposes, irrigated farmland that is outside of the drainage area managed by the aforementioned irrigation districts is divided into six regions based on geographic location, hydrology, and types of crops grown. The six regions, as shown in Figure 1b, are Little John Creek, Dry Creek-Tuolumne River, Dry Creek-Merced River, Fahrens Creek, Deadman Creek, and San Joaquin Flats. The Little John Creek region occupies the extreme northeast corner of the Coalition area (Figure 2a, 2b). The Dry Creek-Tuolumne River region is located immediately south of the Little John Creek region, east of the Oakdale Irrigation District and Modesto Irrigation District, and north of the Dry Creek-Merced River region (Figure 3a, 3b). The Dry Creek-Merced River region is located south of the Dry Creek-Tuolumne River region, west of the Turlock Irrigation District, north of the Merced Irrigation District and Fahrens Creek region (Figure 4a, 4b). The Deadman Creek region is located at the southern extent of the ESJ region (Figure 5a, 5b). The Fahrens Creek region is located in the southeast portion of the ESJ watershed. The Merced Irrigation District sits to the west, the Dry Creek-Merced River region to the north and the Deadman Creek region to the south (Figure 6a, 6b). The San Joaquin Flats region is a noncontiguous clustering of land located along the mainstem of the SJR and along the main rivers that drain into the SJR. These lands are primarily to the west of the irrigation districts along the SJR or along the corridors of the rivers on land not associated with the irrigation districts (Figure 7).

Based on the Department of Water Resources Land Use/Land Cover databases, the Coalition area inclusive of the Irrigation Districts covers 1,230,281 acres including 633,812 acres of irrigated agriculture. Of the 1.23 million acres, the six regions within the Coalition area cover 724,118 acres (58.9%). The remaining acres outside of the coalition area are part of the four irrigation districts or are urban lands. Wild vegetation covers 420,076 acres (58%) of the coalition area and includes land cover classes such as natural riparian areas, parks, and open rangeland. Nonirrigated land uses cover 24,941 (3.4%) acres and includes primarily urban land uses with some acreage in feedlots and impoundments. The remaining 279,101 acres (38.5%) are irrigated agriculture. Land uses within the coalition area are summarized below and presented in Table 1 both as totals for the entire coalition area and the six monitoring areas as delineated in Figures 2-7.

Figure 1a. ESJ Water Quality Coalition region with major rivers and land use.

East San Joaquin Water Quality Coalition: Land Cover, Major Streams

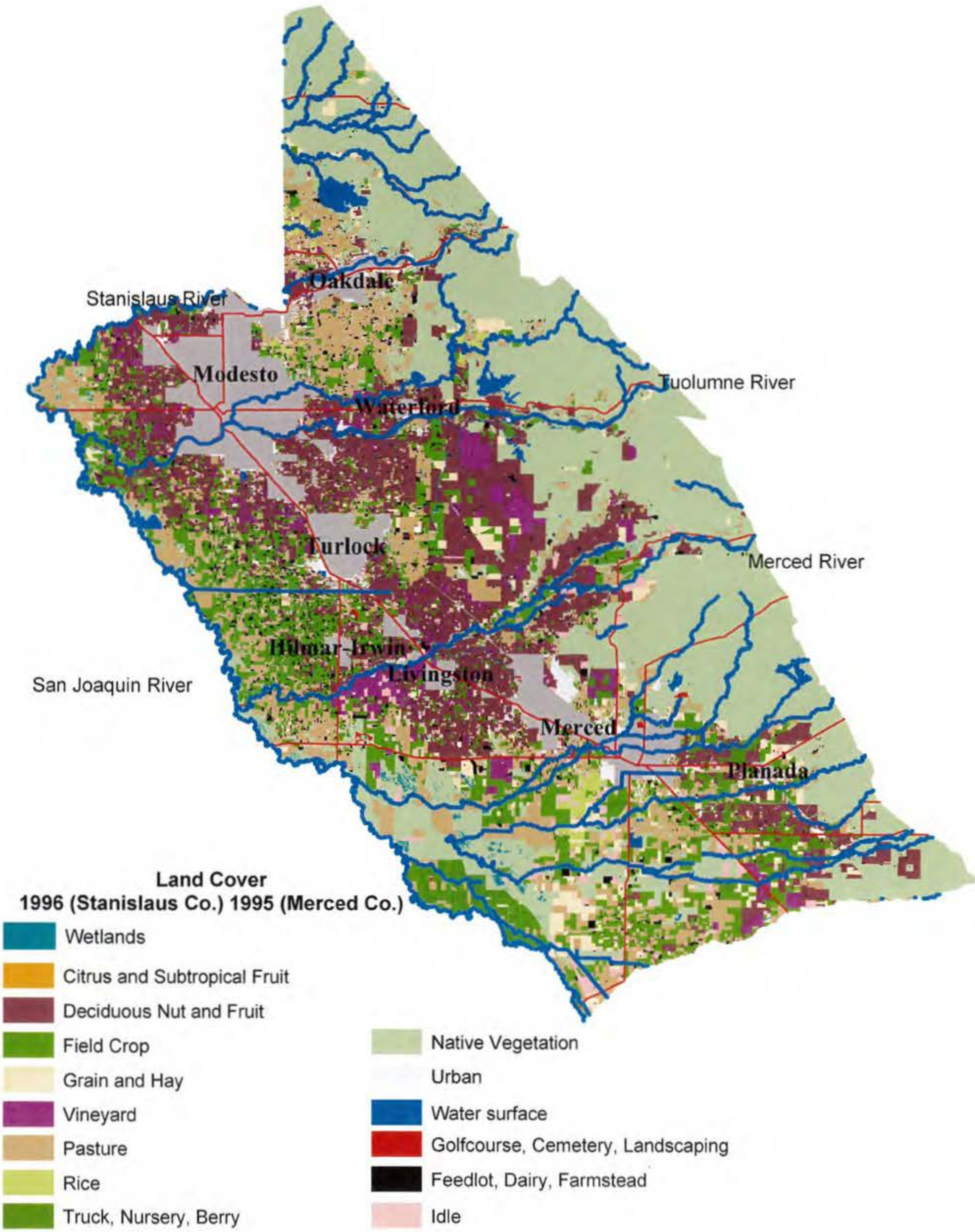


Figure 1b. Subwatersheds within the East San Joaquin Water Quality Coalition region.

East San Joaquin Water Quality Coalition Monitoring Areas

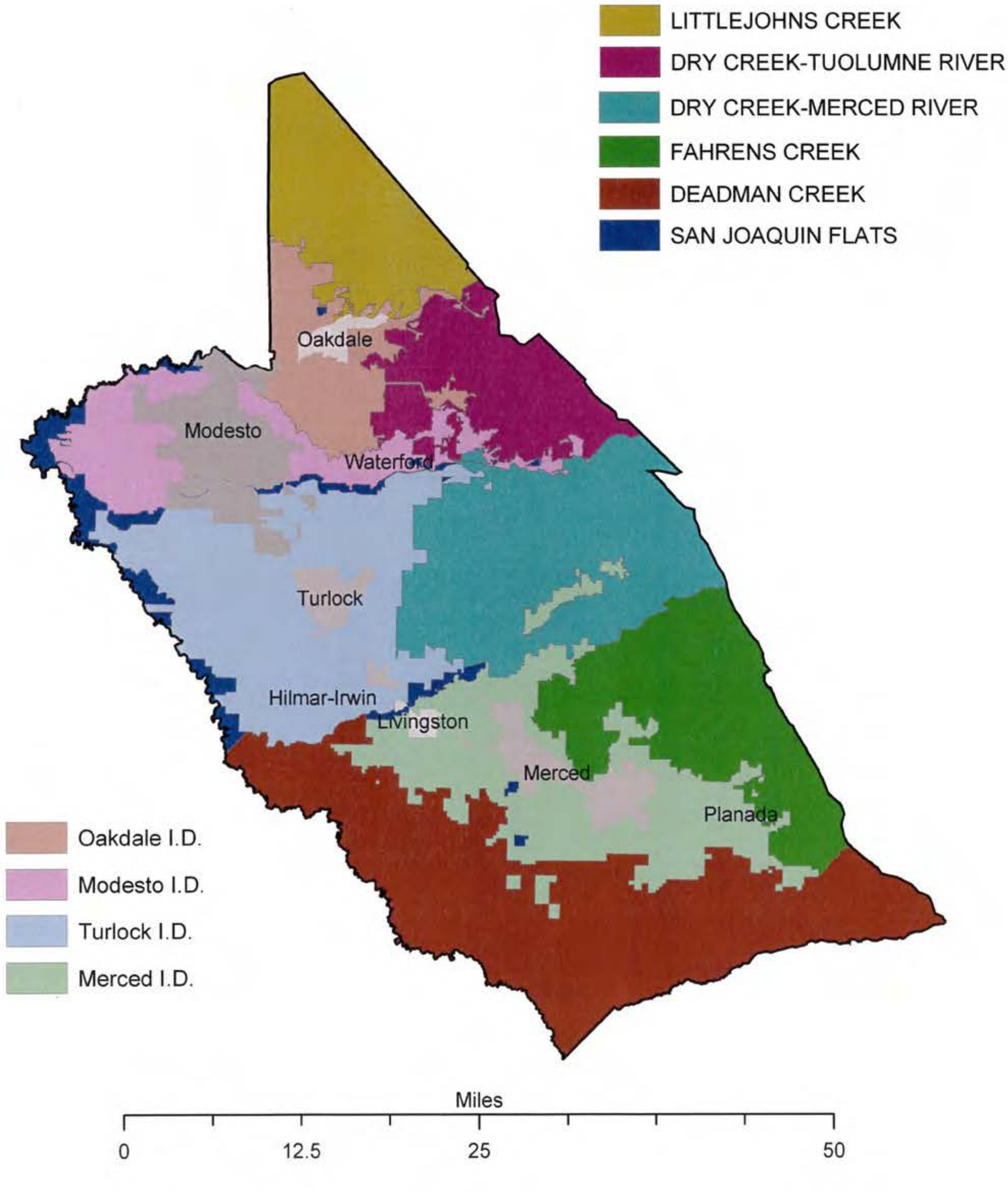


Figure 2a. Little John Creek region land cover.

Data from 1996 DWR land use maps. See text for details.

Littlejohns Creek Monitoring Area: Land Cover Streams

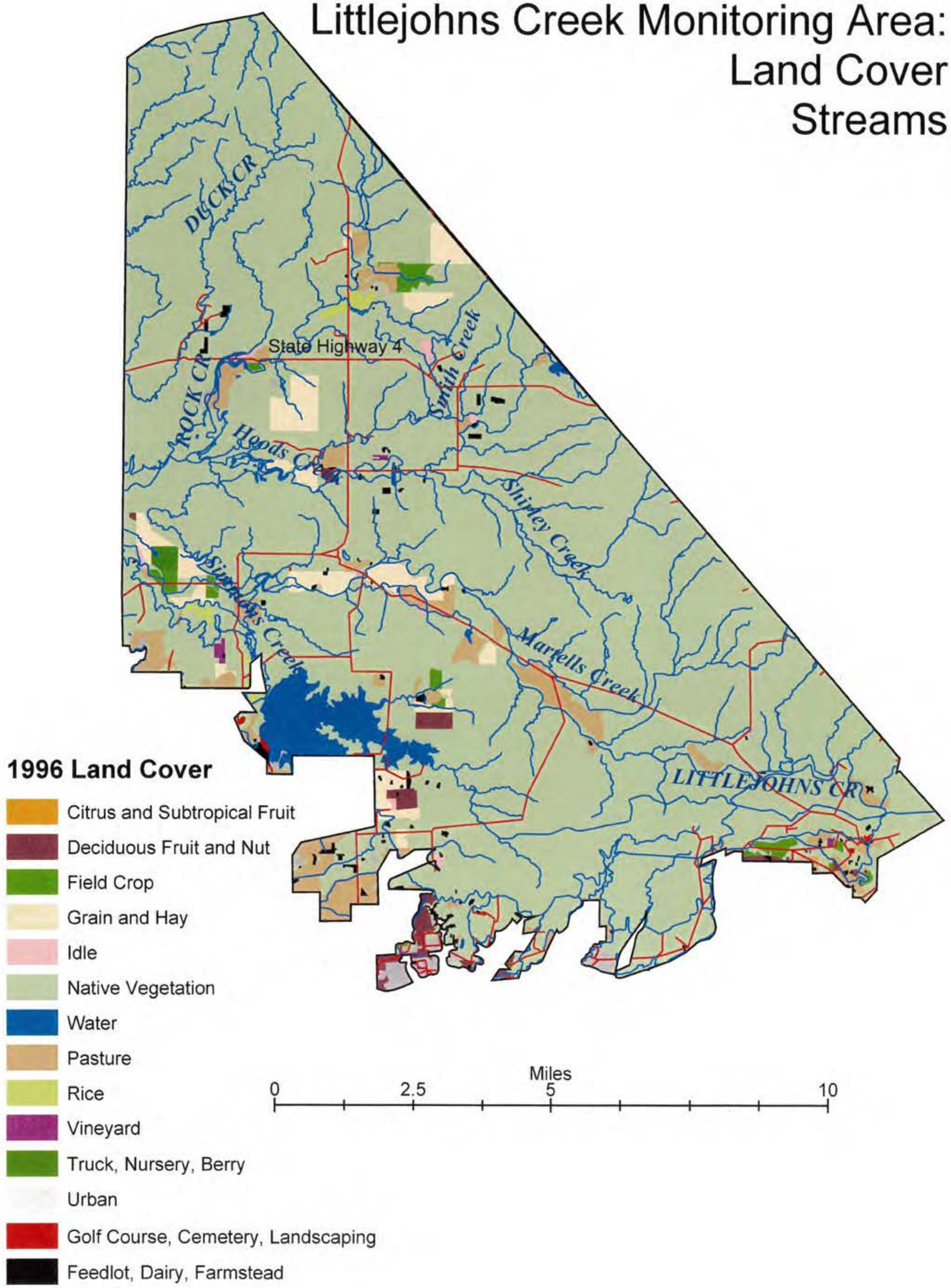


Figure 2b. Little John Creek region with irrigated croplands and non-irrigated lands.

Non-irrigated vegetation includes all classes of native vegetation and non-irrigated pasture and cropland.

Littlejohns Creek Monitoring Area: Irrigated vs Non-irrigated

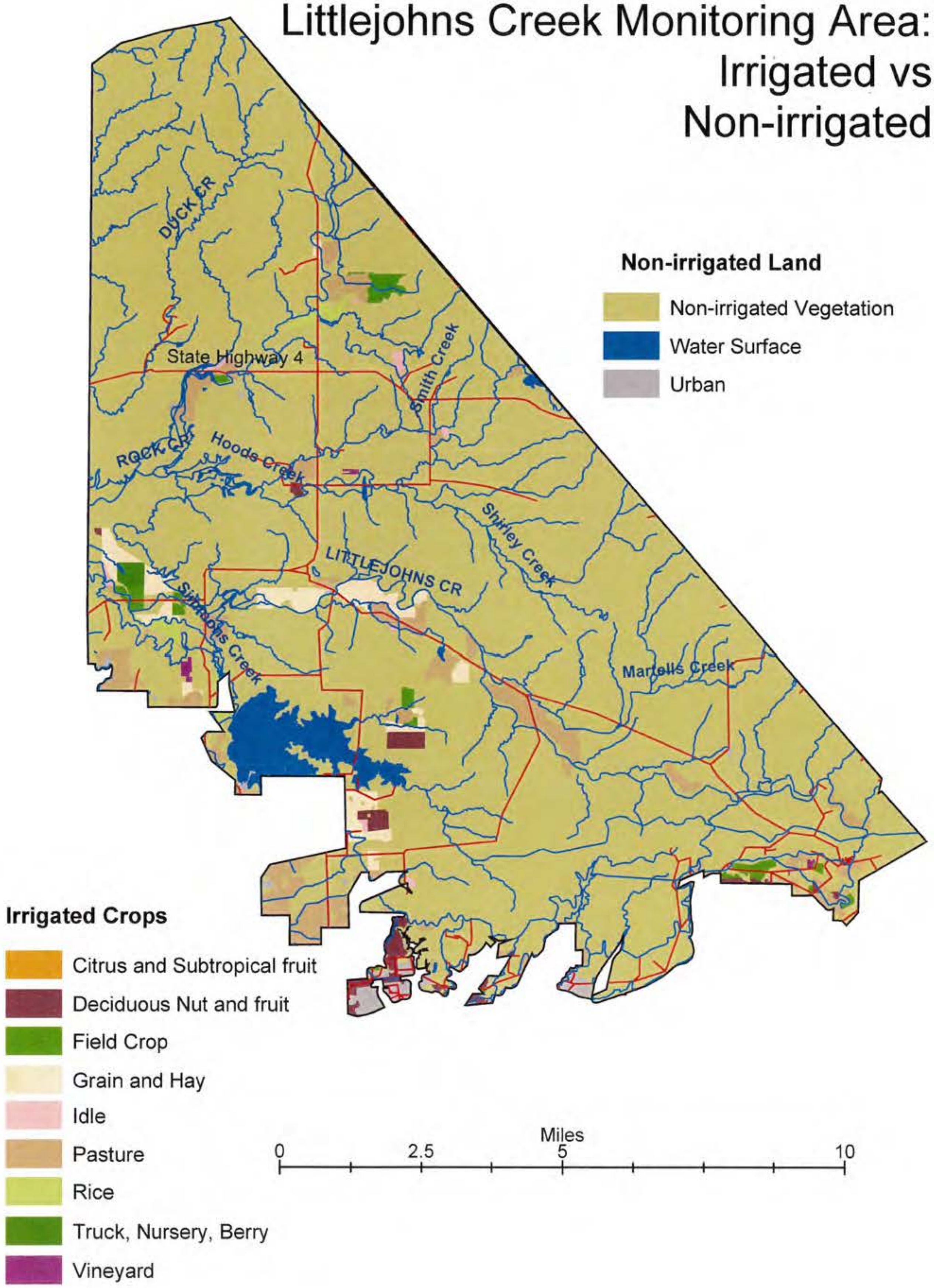
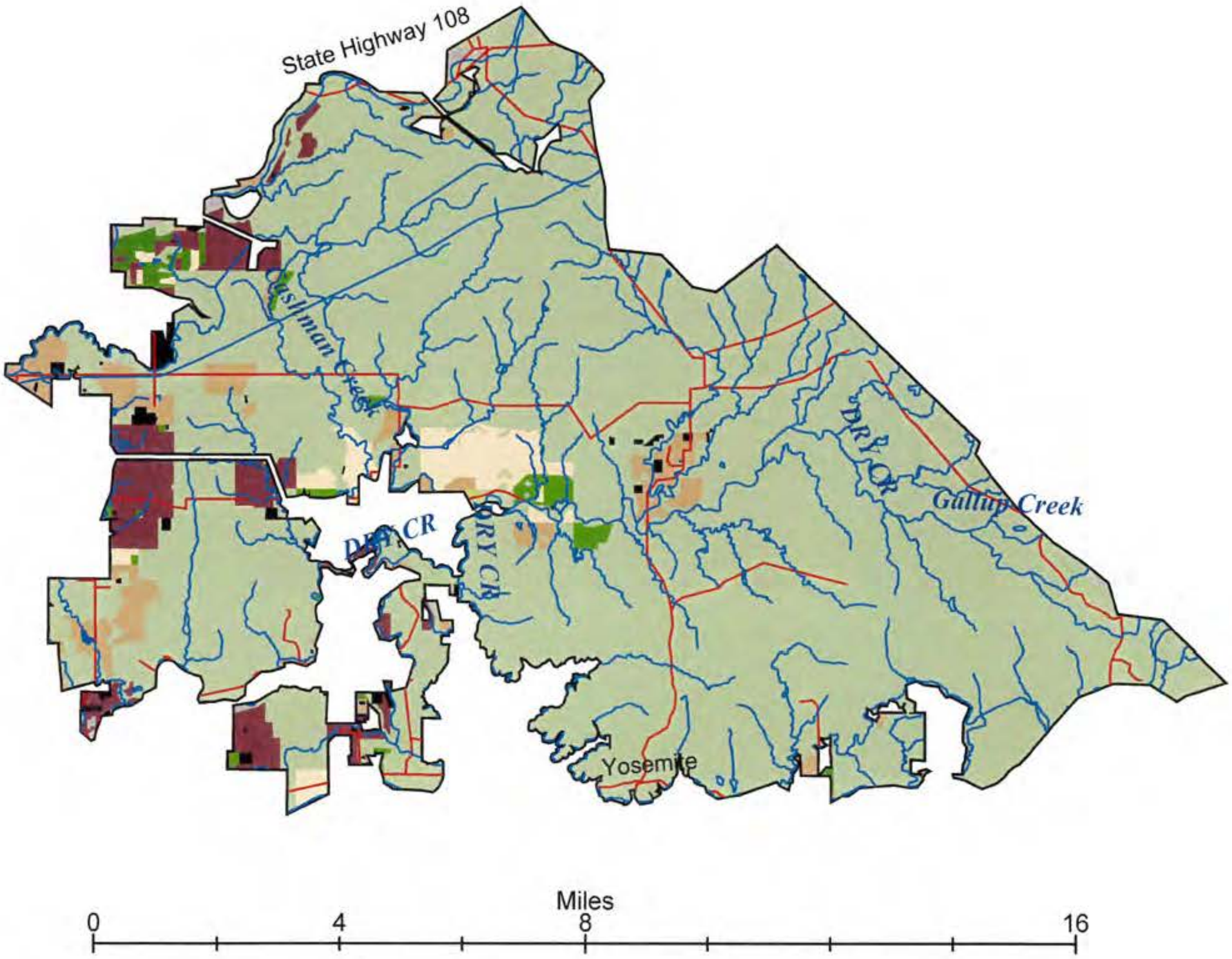


Figure 3a. Dry Creek-Tuolumne River region land cover.
Data from 1996 DWR land use maps. See text for details.

Dry Creek-Tuolumne River Monitoring Area: Land Cover, Streams



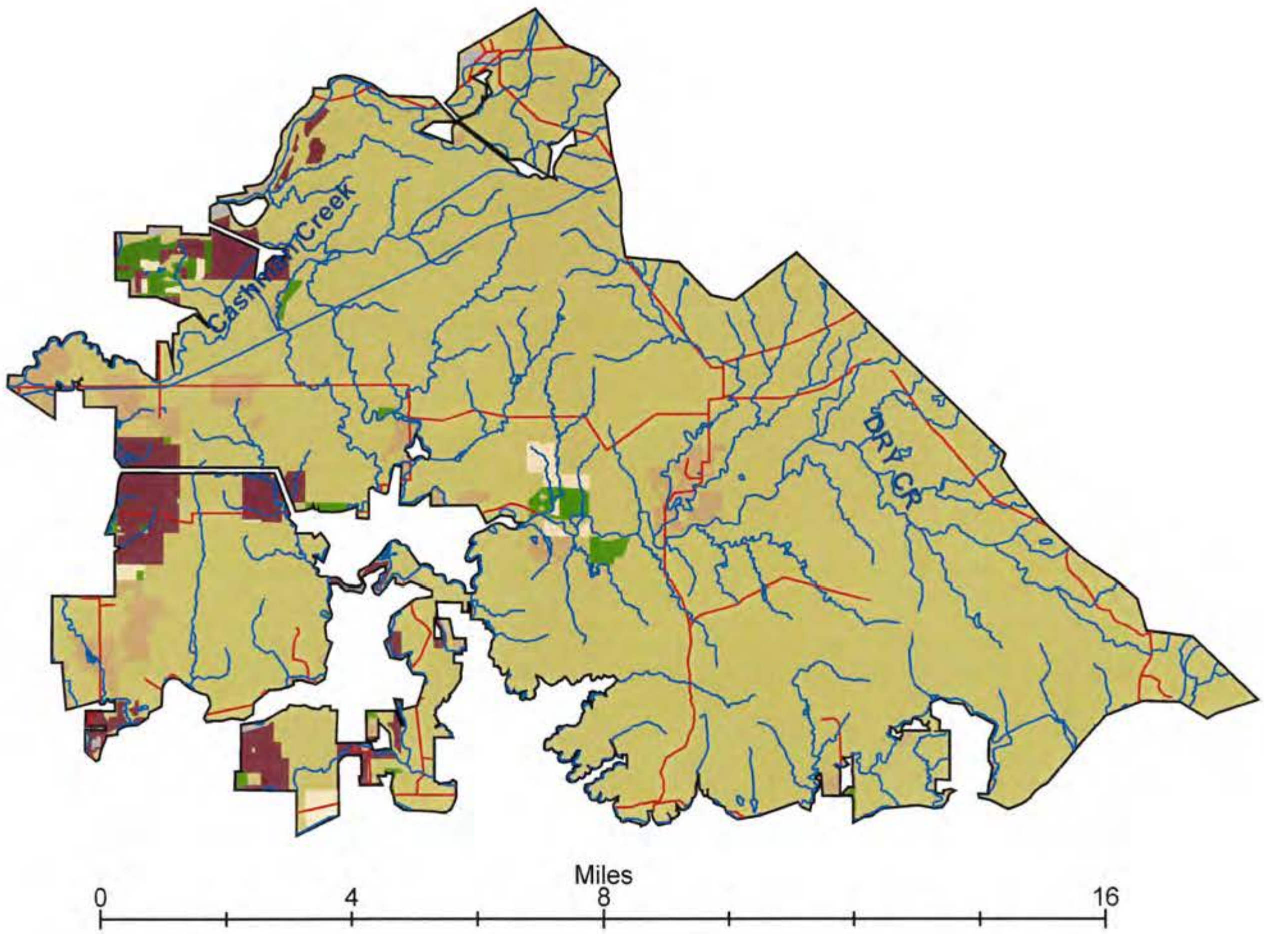
1996 Land Cover

- Citrus and Subtropical Fruit
- Deciduous Nut and Fruit
- Field Crop
- Grain and Hay
- Pasture
- Rice
- Truck, Nursery, Berry
- Vineyard
- Idle
- Native Vegetation
- Water surface
- Feedlot, Dairy, Farmstead
- Urban
- Golfcourse, Cemetery, Landscaping

Figure 3b. Dry Creek-Tuolumne River region with irrigated and non-irrigated lands.

Non-irrigated vegetation includes all classes of native vegetation and non-irrigated pasture and cropland.

Dry Creek-Tuolumne River Monitoring Area: Irrigated vs Non-irrigated



Irrigated crops

- Citrus and Subtropical fruit
- Deciduous Nut and fruit
- Field Crop
- Grain and Hay
- Idle
- Pasture
- Rice
- Truck, Nursery, Berry
- Vineyard

Non-irrigated Land

- Non-irrigated Vegetation
- Water Surface
- Urban

Figure 4a. Dry Creek-Merced River region land cover.

Data from 1996 DWR land use maps. See text for details.

Dry Creek-Merced River Monitoring Area: Land Cover, Streams

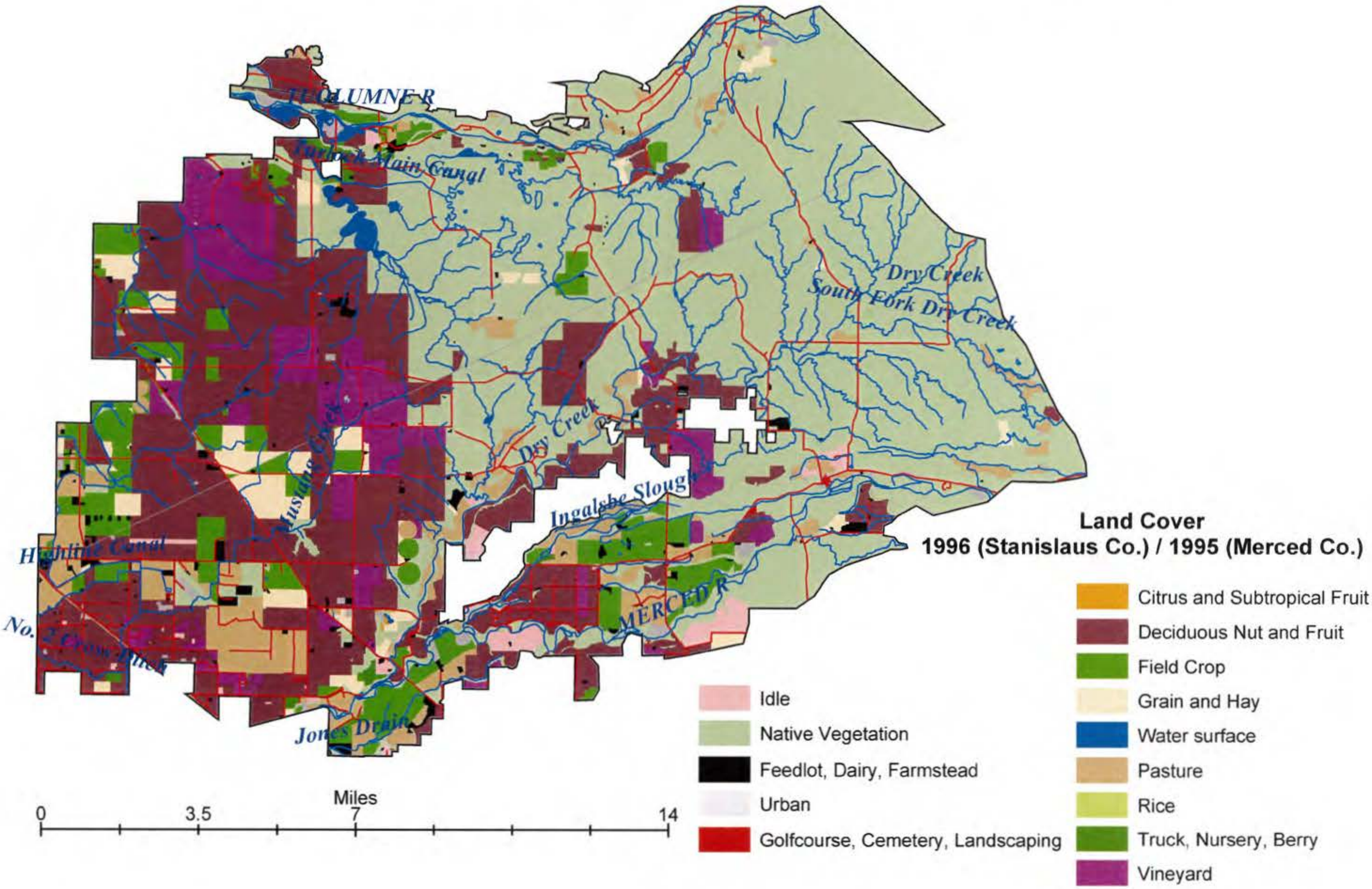


Figure 4b. Dry Creek-Merced River region with irrigated and non-irrigated lands.

Non-irrigated vegetation includes all classes of native vegetation and non-irrigated pasture and cropland.

Dry Creek-Merced River Monitoring Area: Irrigated vs Non-irrigated

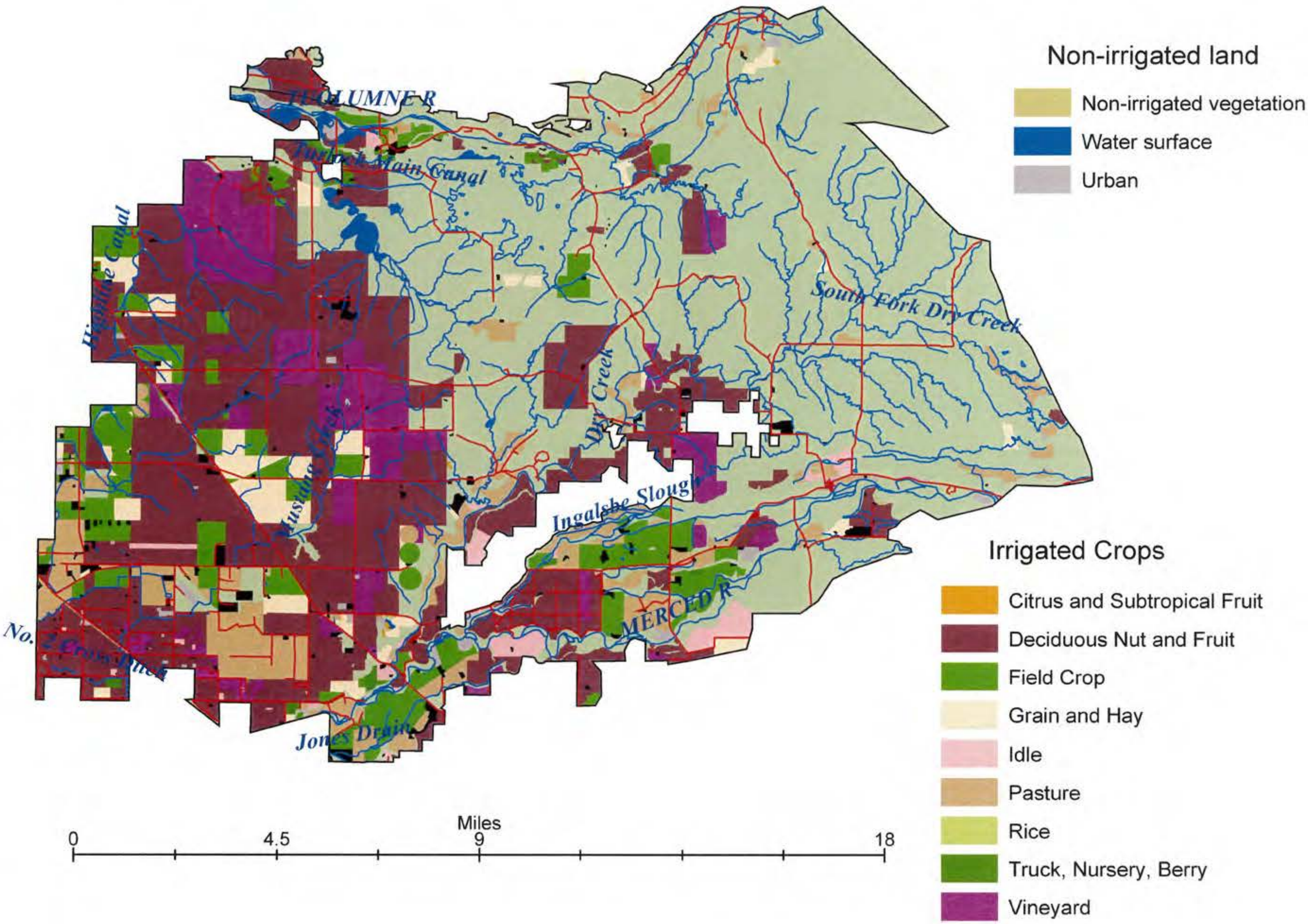


Figure 5a. Deadman Creek region land cover.

Data from 1996 DWR land use maps. See text for details.

Deadman Creek Monitoring Area: Land Cover and Streams

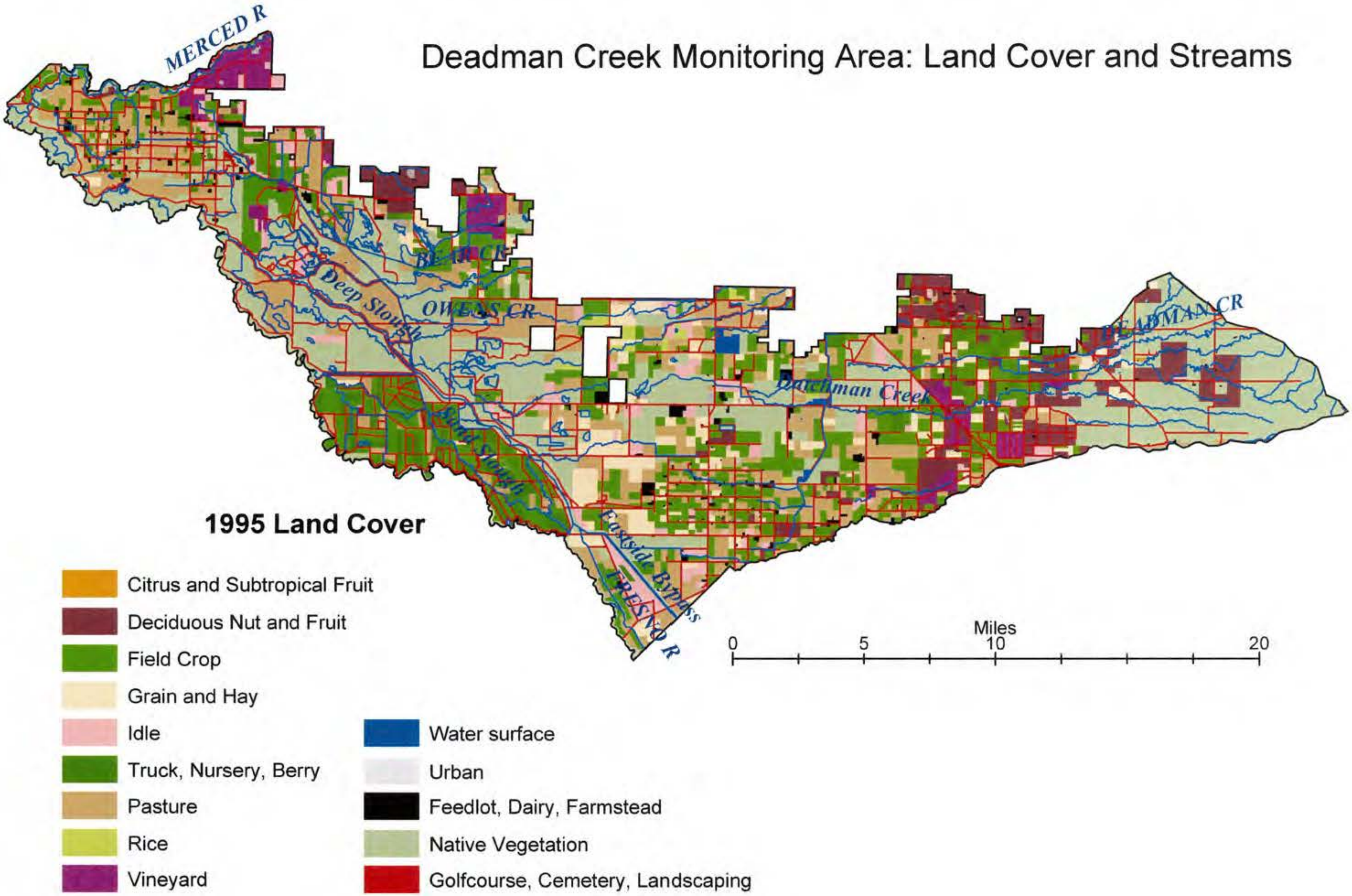


Figure 5b. Deadman Creek region with irrigated croplands and non-irrigated lands.

Non-irrigated vegetation includes all classes of native vegetation and non-irrigated pasture and cropland.

Deadman Creek Monitoring Area: Irrigated vs Non-irrigated

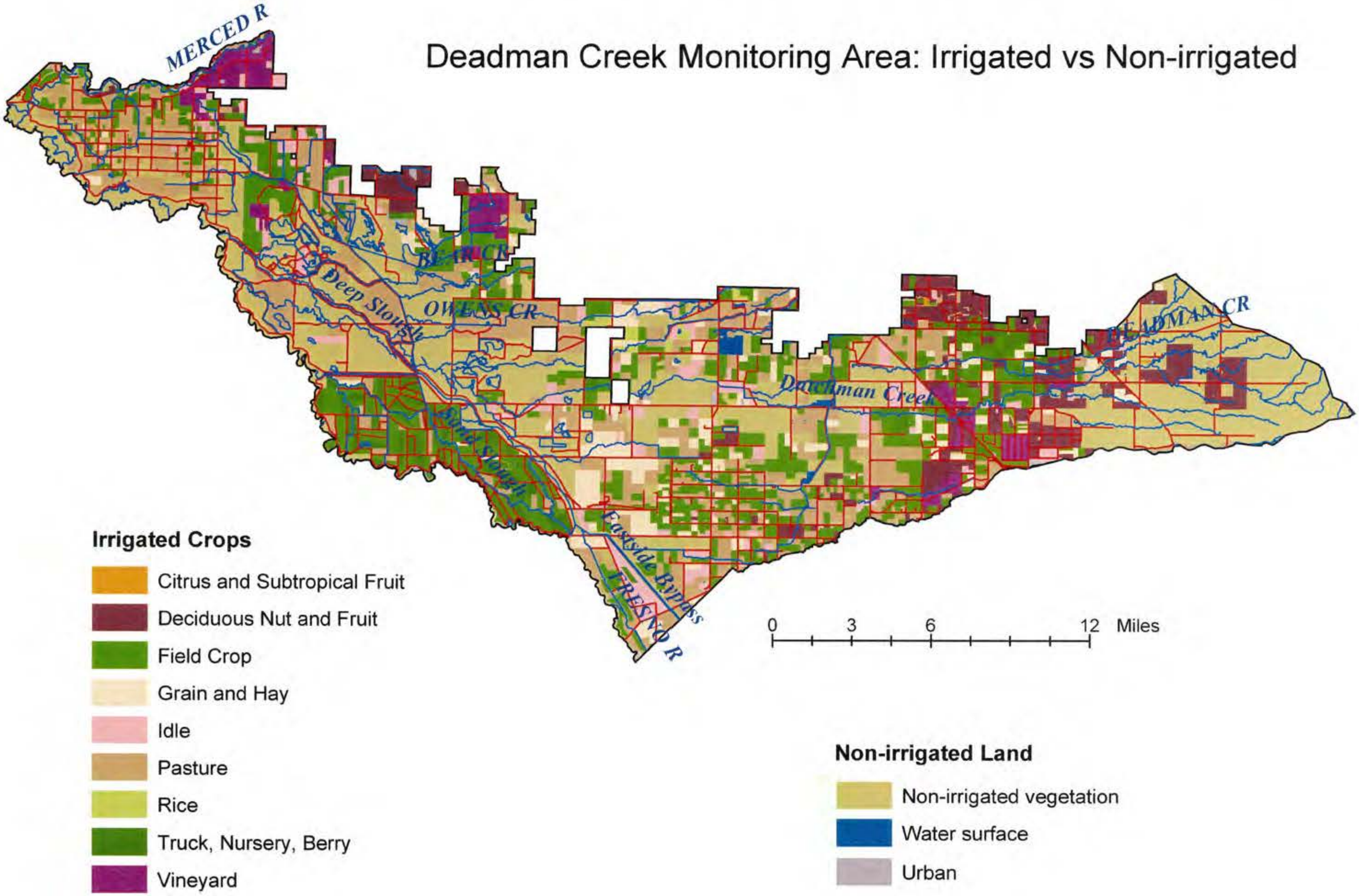


Figure 6a. Fahrens Creek region land cover.

Data from 1996 DWR land use maps. See text for details.

Fahrens Creek Monitoring Area: Land Cover and Streams

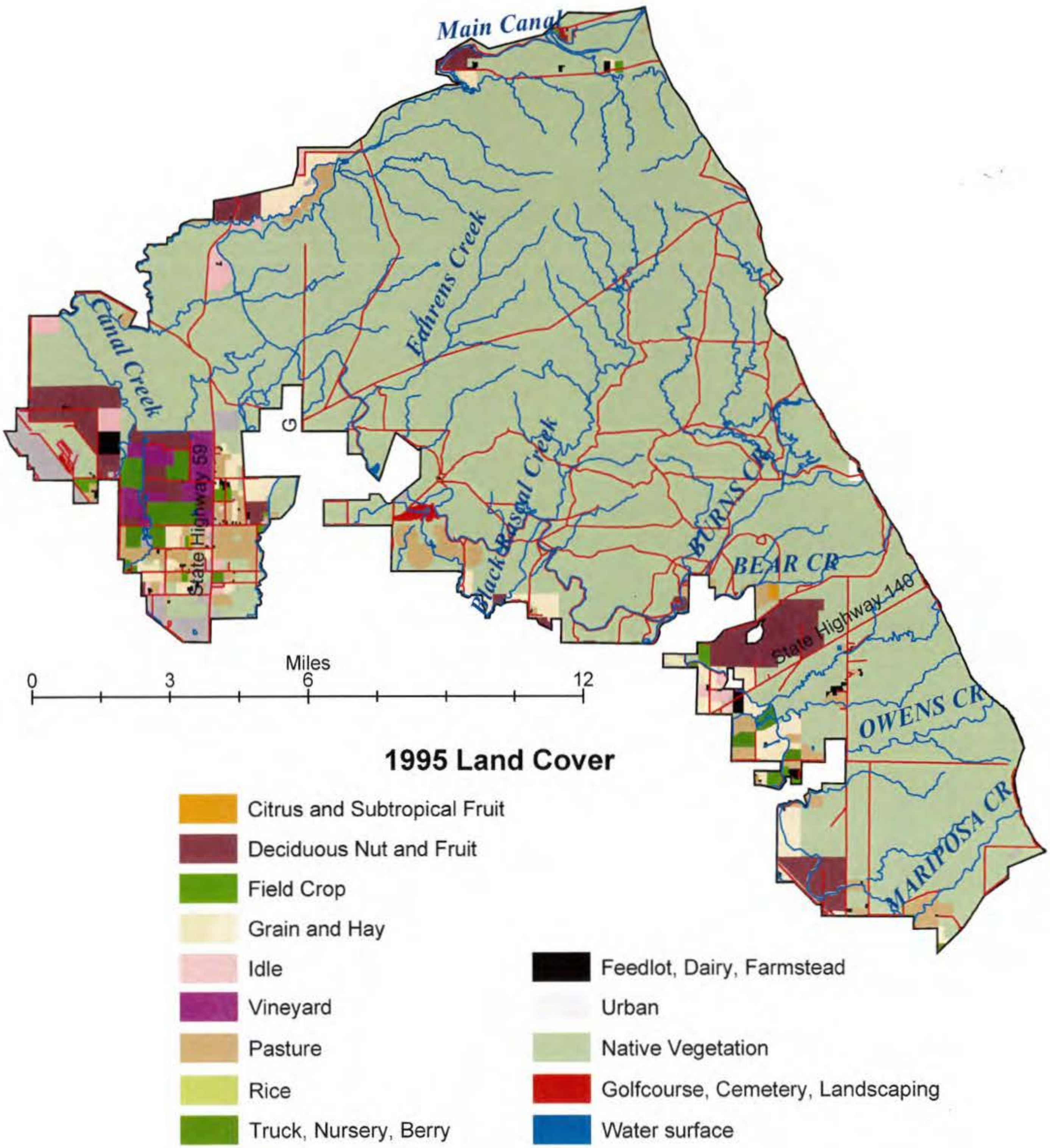


Figure 6b. Fahrens Creek region with irrigated croplands and non-irrigated lands.

Non-irrigated vegetation includes all classes of native vegetation and non-irrigated pasture and cropland.

Fahrens Creek Monitoring Area: Irrigated vs Non-irrigated

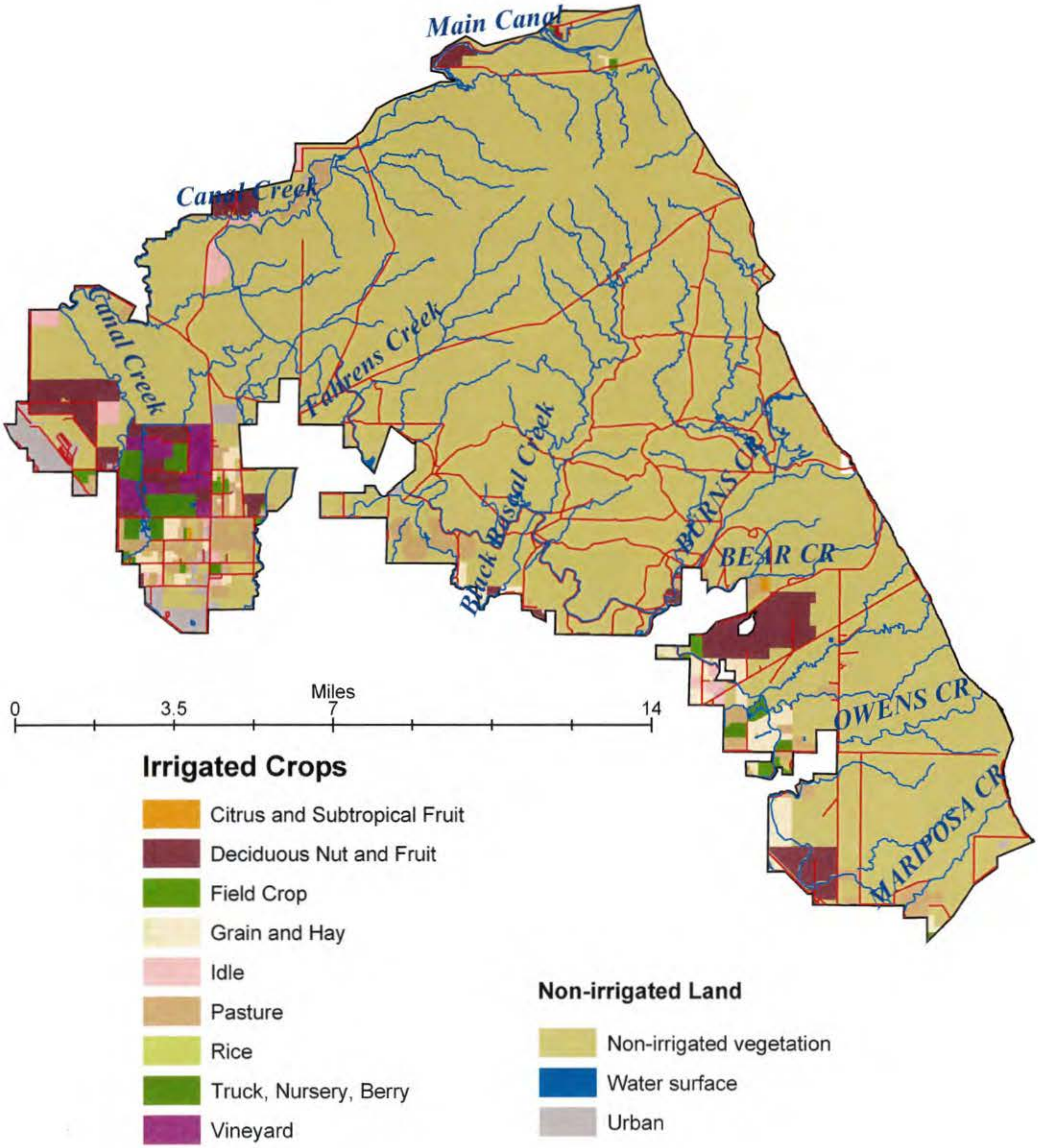


Figure 7. San Joaquin Flats region land cover.

Data from 1996 DWR land use maps. See text for details.

San Joaquin Flats Monitoring Area: Land Cover and Streams

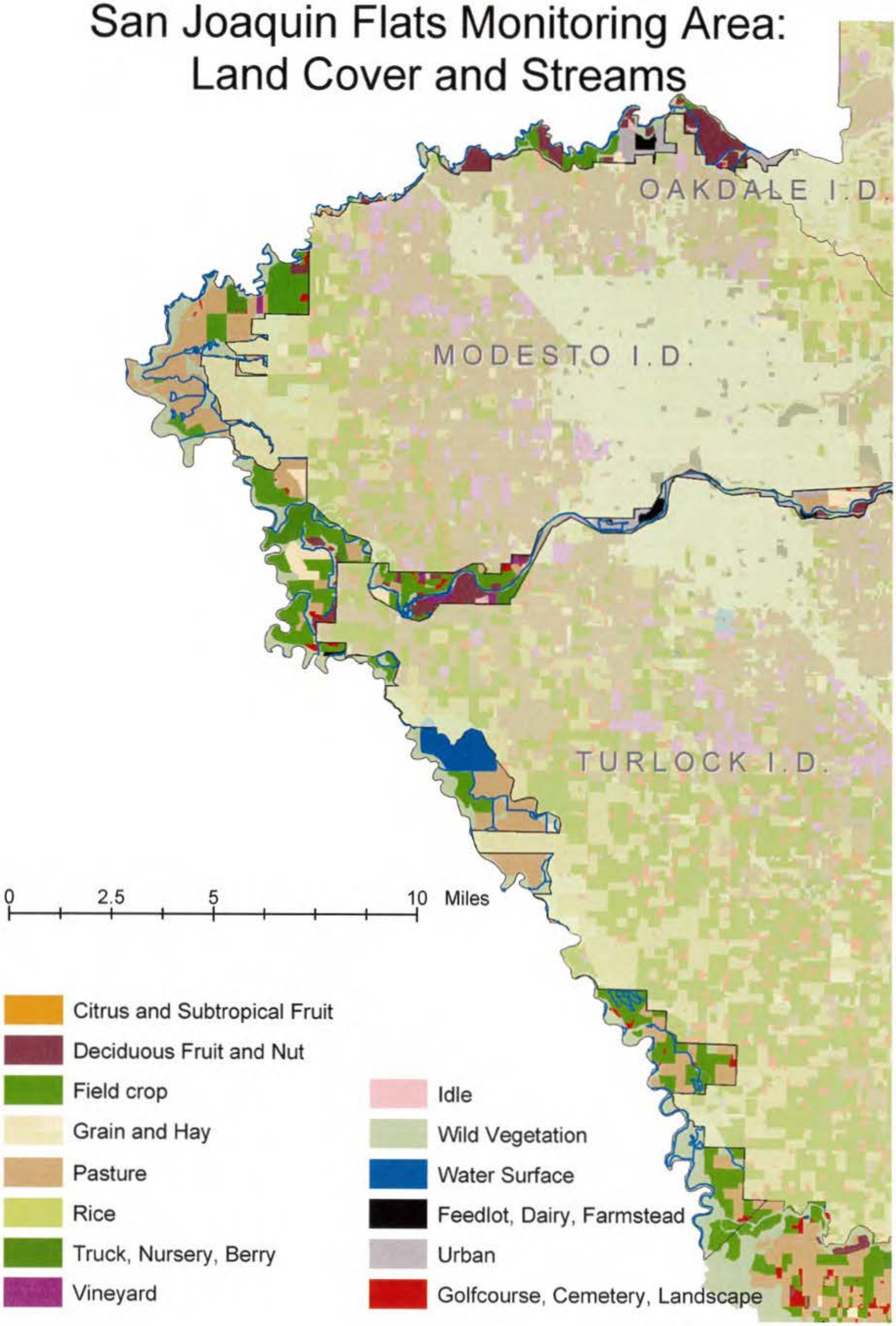


Table 1. Land uses in the East San Joaquin River Coalition area.

Acreages are based on Department of Water Resources land use maps available at http://www.waterplan.water.ca.gov/landwateruse/landuse/ludataindex.htm.

Land Use	Irrigated/ Non-Irrigated	Total Area, Acres						
		Coalition Area	Deadman Creek	Fahrens Creek	Dry-Mreced	Dry Creek-Tuolumne River	Little John Creek	San Joaquin Flats
Citrus and subtropical fruit	I	680	77	73	51	1	0	7
Deciduous nut and fruit	I	214780	16699	4797	38700	3016	597	4796
Feedlot, dairy, farmstead	NI	27185	4000	575	1947	461	440	580
Field crop	I	145893	45936	466	10166	674	583	7458
Golf course, cemetery, landscape	NI	4295	313	161	0	0	32	333
Grain and hay	I	29827	13104	2062	3355	617	1395	992
Grain and hay	NI	4538	84	1036	1010	480	974	0
Idle	I	23164	10422	977	1615	0	160	202
Pasture	I	166657	45943	3642	9489	2811	3398	8769
Rice	I	7358	1211	0	2	40	259	0
Truck, nursery, berry	I	30775	12196	1230	430	332	125	830
Urban	NI	84359	1408	1904	1045	151	507	1599
Vineyard	I	33323	7279	1093	9804	2	66	1153
Water surface	NI	9738	947	92	1216	86	1724	1145
Wild vegetation	NI	447719	82623	103579	78535	70891	75582	9557

1.2 Watershed monitoring overview

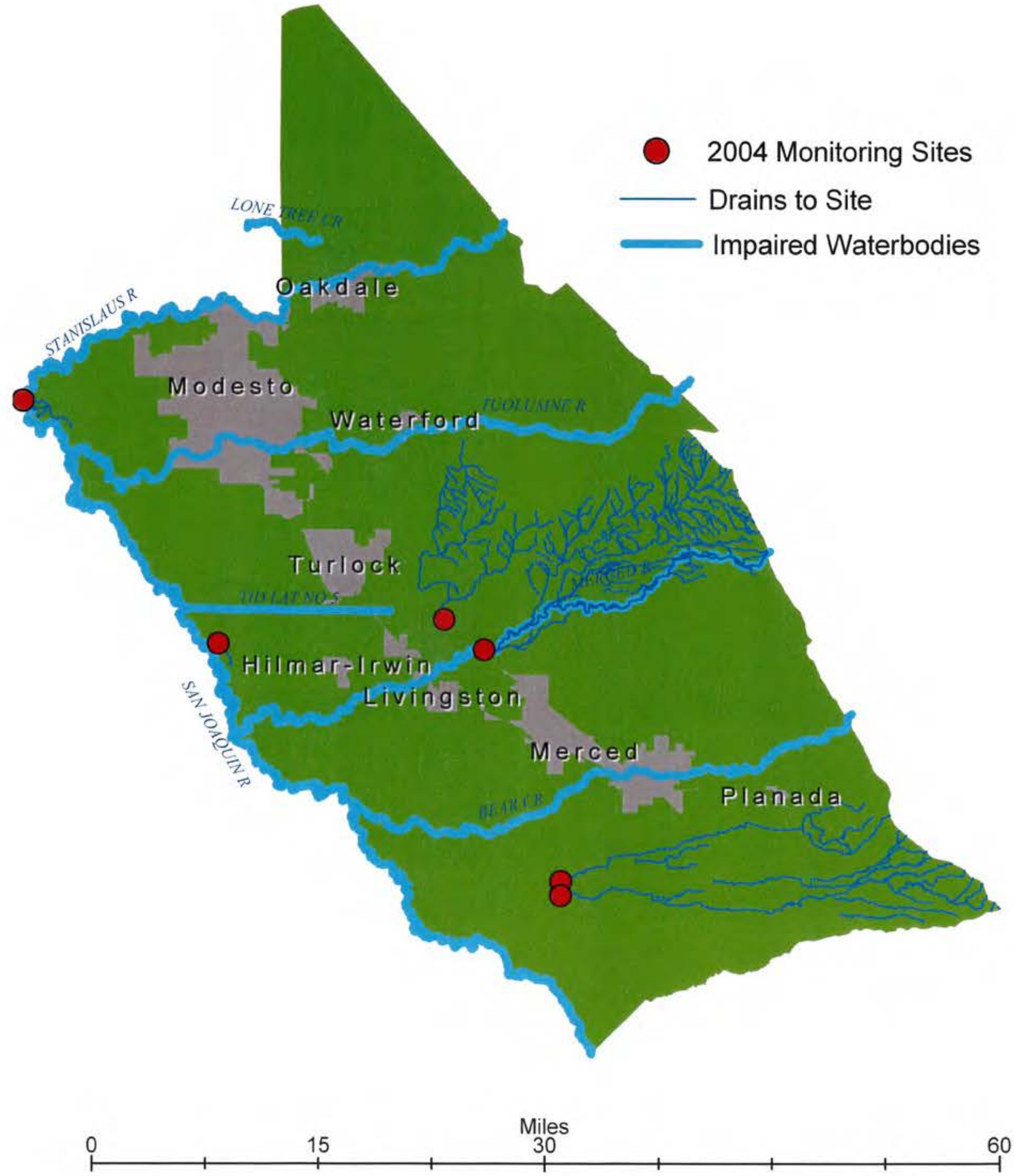
The region has a long history of water quality monitoring studies on a variety of constituents. Sampling has been conducted on chemical water quality, toxicity, and benthic macroinvertebrate communities by several agencies and academic institutions including the Central Valley Regional Water Quality Control Board (CVRWQCB), California Department of Pesticide Regulation, California Department of Water Resources, California Department of Transportation, University of California Davis, and the U.S. Geological Survey (Figure 8). Constituents include organophosphate pesticides, metals, drinking water constituents, nutrients, and dissolved oxygen. An overwhelming majority of programs have monitored for organophosphate pesticides. The Coalition watershed area will continue to be monitored as part of CVRWQCB programs such as the organophosphate Total Maximum Daily Load monitoring program, the Statewide Ambient Monitoring Program (SWAMP), and the Agricultural Waiver Phase II monitoring program. Additional monitoring is proposed under the Comprehensive Monitoring, Assessment, and Research Program (CMARP), a joint venture of several state and federal agencies through CalFed. Other programs and locations are associated with monitoring storm water runoff from urban areas or transportation corridors and are not relevant when addressing runoff from irrigated agriculture.

The Coalition proposes to sample at six sites within the Coalition area (Table 2). These sites were selected based on the following criteria: 1) intermediate sized water bodies, 2) located upstream from water bodies known to be impaired, 3) location upstream of urban influences, 4) presence of a reasonable amount of irrigated agriculture upstream, 5) site provides coverage of irrigated agriculture in the coalition area, and 6) overall anticipated cost of sampling. All of these criteria were necessary for a site to be included in the proposed list. Consequently, even though all of the water bodies in the Coalition area are technically upstream of 303d listed water bodies, the downstream listing by itself was not sufficient for inclusion on the list of sampling locations. All sites also needed to be intermediate in size in the reaches that are located upstream of urban centers, and also drain irrigated agriculture. These criteria generally place the sites in the eastern portions of the Coalition area. The criterion used to establish intermediate size is a winter flow during a major storm event of approximately 500 cfs. As the Agricultural Conditional Waiver Monitoring Program moves to Phase 2 and Phase 3, small water bodies will be sampled. Because the soils in the eastern portion of the Coalition area are very sandy with a high infiltration rate, sites selected for monitoring during the winter runoff season may not be sampled through the entire irrigation season due to lack of flow (see below). Flow will be established by on-site measurements using flow meters. Finally, it is anticipated that the cost of sampling will be high resulting in a relatively small number of sites proposed for monitoring.

Figure 8. Water quality monitoring sites and constituents for various monitoring programs conducted in the Coalition region.

Refer to the Watershed Evaluation Report for specifics on the programs (Table 9).

East San Joquin Water Quality Coalition: Impaired Waterbodies



East San Joaquin Water Quality Coalition: 2004 Monitoring Sites and Previously Sampled Sites

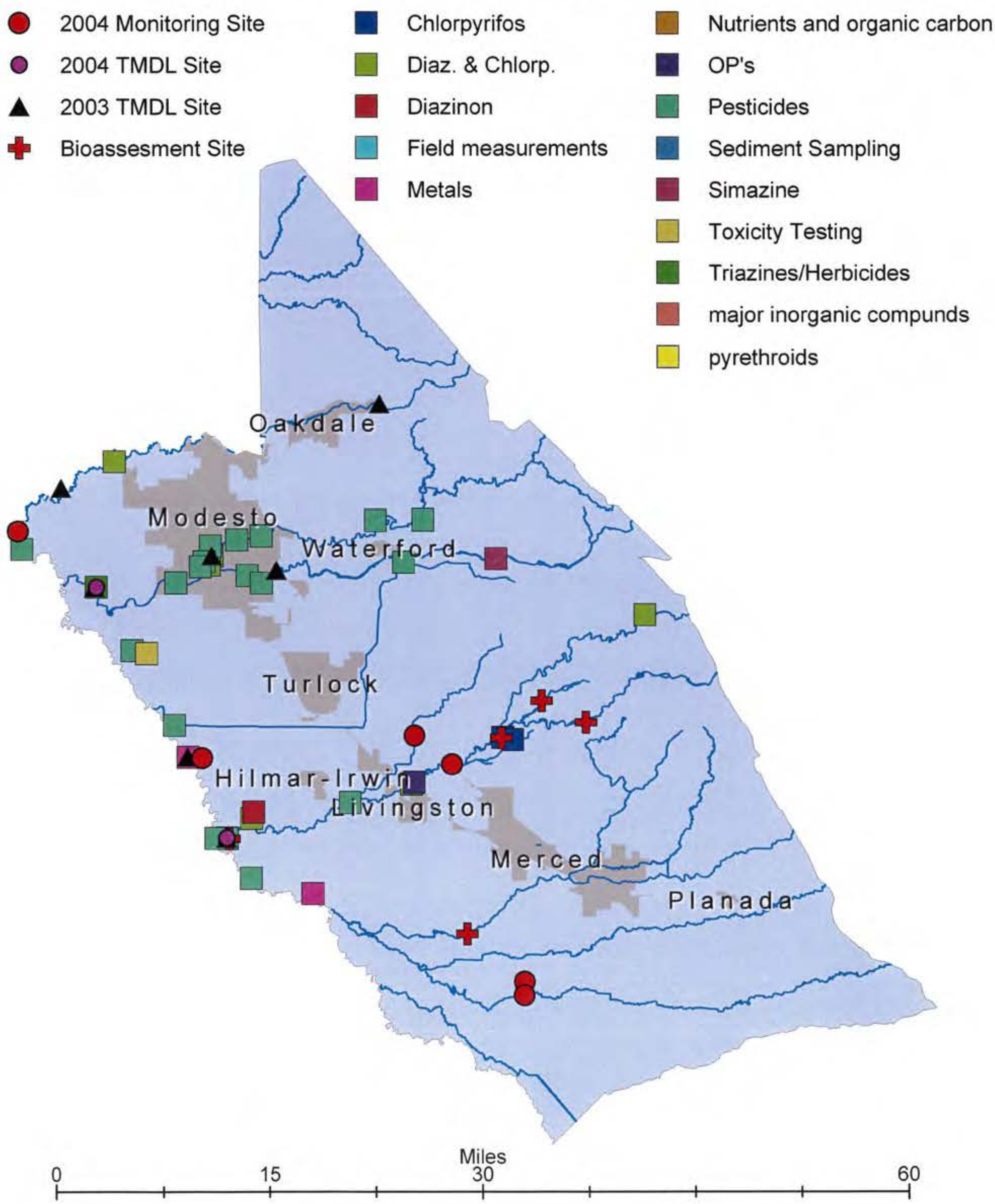


Table 2. Sites proposed for sampling during the Phase 1 Agricultural Waiver Monitoring Program.

Region	Site description	Lat/Long
Deadman Creek	Duck Slough @ Lone Tree Road	37.2077/-120.5781
Deadman Creek	Dutchman's Creek @ Lone Tree Road	37.1944/-120.5784
Dry Creek-Merced River	Highline Canal @ Lombardy Road	37.4556/-120.7208
Dry Creek-Merced River	Merced River @ Santa Fe	37.4271/-120.6722
San Joaquin Flats	Riley Slough @ confluence with SJR	37.6589/-121.2327
San Joaquin Flats	August Road Drain upstream of Crows Landing bridge (Hogin Road)	37.4311/-120.9937

1.3 Description of phased monitoring conducted at proposed sampling sites

The monitoring associated with the Conditional Agriculture Waiver is developed in three phases. Phase 1 monitoring, described here, includes analyses of physical parameters, selected drinking water constituents, toxicity testing, and pesticide use evaluation. Sampling will be conducted during the dormant spray season and during the irrigation season using two different protocols (Figures 9, 10).

1.3.1 Dormant spray/winter runoff season sampling protocol

During the dormant spray/winter runoff season, the primary concern is the mobilization and movement of soluble constituents in storm water runoff during and following winter rains. These constituents can move from locations where applications take place to water bodies within the Coalition's area. Although sediment is also mobilized during this period, until flows decrease and sediment is deposited on the bottoms of the channels, it does not pose a significant risk to aquatic taxa. Sediment itself may be problematic for a number of reasons, e.g., high turbidity may reduce feeding by resident fish. However, sediment toxicity becomes a potential problem primarily during the irrigation season. Coupled with the difficulty of sampling sediment during periods of high bed movement, the Coalition will not test sediment for toxicity during the winter dormant season.

Sampling will be initiated during a storm event when a 0.5" rain is forecast for the Coalition area. Sampling will occur during the first winter rain after the initiation of dormant spraying, and a second storm during the winter. County Agricultural Commissioners will be consulted to confirm the initiation of pesticide applications. A single grab sample will be collected from each storm event. The sample will be a vertically integrated sample collected from a bridge or similar structure according to the protocols specified in the Quality Assurance Program Plan QAPP appended below. Sampling will be conducted to collect water during or shortly after the peak of they hydrograph. In Figure 9, sampling is indicated to begin anywhere from 15 to 60 hours after the initiation of the storm event. Examination of several hydrographs from storms in the Coalition area from the last two years suggests that the timing of the peak of the hydrograph varies according to total rainfall, rainfall intensity, soils, and antecedent conditions. The Coalition will attempt to develop a formal decision tree to better predict the timing of the peak of the hydrograph for the proposed monitoring sites. The decision tree will be presented to the CVRWQCB for review and discussion prior to the initiation of sample collection during the winter runoff season.

During the initial sampling, multiprobe/multiparameter instruments will be used to collect standard water quality data in the field (see Table 3), and water will be collected for laboratory analysis of total organic carbon, *E. coli*, color, turbidity, total dissolved solids, and water column toxicity. Acute toxicity testing will be conducted using the invertebrate, *Ceriodaphnia dubia*, and the larval fathead minnow, *Pimephales promelas*, according to standard USEPA acute toxicity test methods[1]. In addition, where it is appropriate to identify toxicity caused by herbicides, 96-hr toxicity tests with the green algae *Selenastrum capricornutum*, will be

[1] USEPA. 2002. Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fifth Edition. Office of Water, Washington, D.C. EPA-821-R-02-012.

Figure 9. Dormant spray season water sampling procedures.

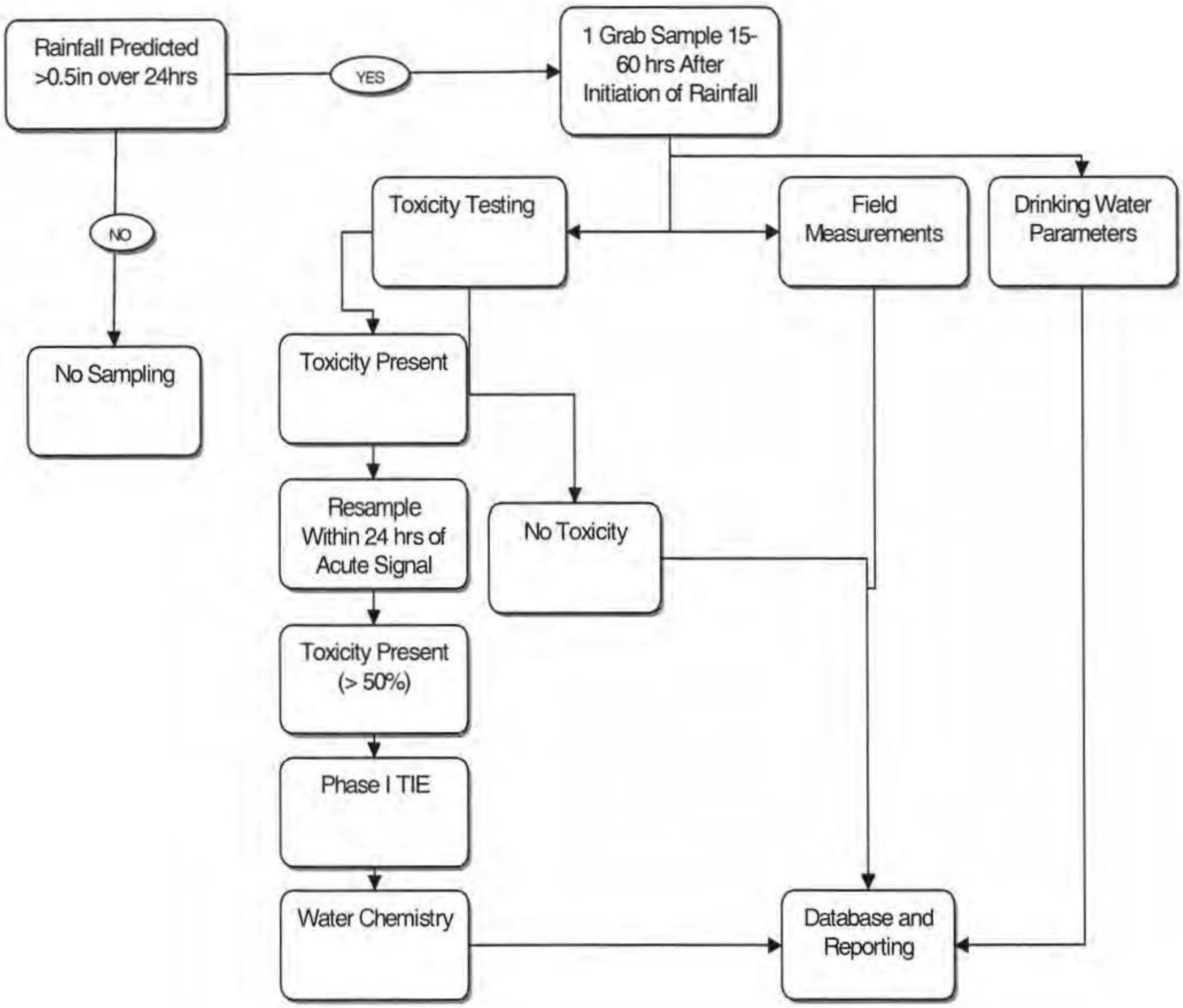


Figure 10. Irrigation season sampling procedure.

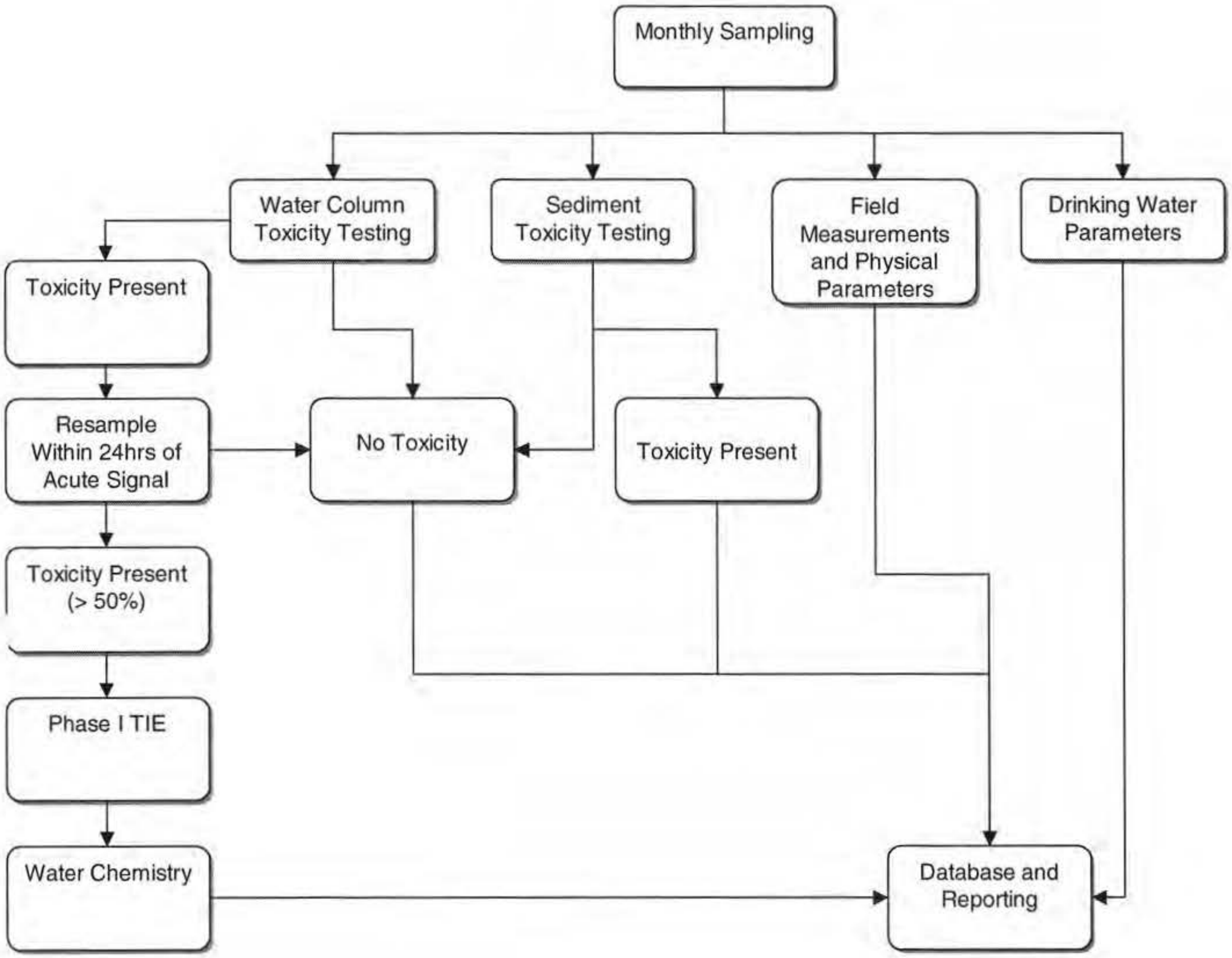


Table 3. Constituents to be monitored during the three monitoring phases.

Constituent	Quantitation Limit	Reporting Unit	Monitoring Phase
Physical Parameters			
Flow	N/A	CFS (Ft^3/Sec)	Phase 1, 2 & 3
PH	N/A	pH	Phase 1, 2 & 3
Electrical Conductivity	N/A	µmhos/cm	Phase 1, 2 & 3
Dissolved Oxygen	N/A	Mg O_2/L	Phase 1, 2 & 3
Temperature	N/A	Degrees Celsius	Phase 1, 2 & 3
Color	N/A	ADMI	Phase 1, 2 & 3
Turbidity	N/A	NTUs	Phase 1, 2 & 3
Total Dissolved Solids	N/A	mg/L	Phase 1, 2 & 3
Total Organic Carbon	N/A	mg/L	Phase 1, 2 & 3
Drinking Water:			
E. *Coli*	[b]	ug/L	Phase 1
Total Organic Carbon	[b]	ug/L	Phase 1
Toxicity Test			
Water Column Toxicity	[b]		Phase 1 & 3
Sediment Toxicity	[b]		Phase 1 & 3
Pesticides [a]			
Carbamates	[b]	ug/L	Phase 2 (Phase 3) [c]
Organochlorines	[b]	ug/L	Phase 2 (Phase 3) [c]
Organophosphorus	[b]	ug/L	Phase 2 (Phase 3) [c]
Pyrethroids	[b]	ug/L	Phase 2 (Phase 3) [c]
Herbicides	[b]	ug/L	Phase 2 (Phase 3) [c]
Metals [a]			
Cadmium	[b]	ug/L	Phase 2 (Phase 3) [c]
Copper	[b]	ug/L	Phase 2 (Phase 3) [c]
Lead	[b]	ug/L	Phase 2 (Phase 3) [c]
Nickel	[b]	ug/L	Phase 2 (Phase 3) [c]
Zinc	[b]	ug/L	Phase 2 (Phase 3) [c]
Selenium	[b]	ug/L	Phase 2 (Phase 3) [c]
Arsenic	[b]	ug/L	Phase 2 (Phase 3) [c]
Boron	[b]	ug/L	Phase 2 (Phase 3) [c]
Nutrients [a]			
Total Kjeldahl Nitrogen	[b]	ug/L	Phase 2 (Phase 3) [c]
Phosphorus	[b]	ug/L	Phase 2 (Phase 3) [c]
Potassium	[b]	ug/L	Phase 2 (Phase 3) [c]

[a] In addition to TIEs, sites identified as toxic in the initial screen shall be re-sampled to estimate the duration of the toxicant in the waterbody. Additional samples upstream of the original site may also be collected to determine the potential source(s) of the toxicant in the watershed.

[b] Quantitation limits must be lower than LC50 or other applicable federal or state toxic or risk limits.

[c] Pesticides, metals and/or nutrients suspected in causing toxicity will be monitored in Phase 3.

conducted[2]. The water column toxicity testing will be used as an indicator of toxicity to resident biota from constituents that are water-soluble. If toxicity testing indicates significant toxicity is present, a second sample will be collected from the site and a second set of toxicity tests initiated. Water will also be collected in sufficient quantity to perform a Phase I Toxicity Identification Evaluations (TIE) if the second test also indicates toxicity is present. Because Phase I TIEs are often inconclusive if toxicity is only marginally significant, and due to the substantial cost of the Phase I TIE, the TIE will be initiated only if mortality of the sample organism is greater than or equal to 50% relative to the controls. The Phase I TIE[3] will be conducted to determine the general class (i.e., metals, non-polar organics such as pesticides, surfactants, etc.) of chemical causing toxicity. Regardless of the level of significance in the second toxicity test, if the test is statistically significant, water will be submitted for analysis of whatever constituent(s) is relevant for the specific site. In addition, if funding allows further samples will be collected upstream for water quality analysis in an attempt to identify sources. All positive results will trigger a Communication Report to the CVRWQCB, and all data will be entered into a database that is compatible with the Statewide Ambient Monitoring Program Database (SWAMP).

1.3.2 Irrigation season sampling

Irrigation season sampling will be conducted monthly from early April through September provided there is measurable flow at a site. All parameters measured during the winter runoff sampling will be included in the irrigation season sampling, and bimonthly sediment toxicity testing will be added to the suite of tests. Sediment toxicity testing using the invertebrate species *Hyalella azteca* or *Chironomus tentans* according to USEPA methods[4] will be conducted for hydrophobic (sediment bound) wastes that are present in the water body. If toxicity is detected during the initial water column toxicity test, a second sample will be collected and retested. If the second test indicates significant toxicity (>50% of the test organisms die), a Phase I TIE and chemical analysis will be conducted to determine the cause of toxicity. The Phase I TIE[5] will be conducted to determine the general class (i.e., metals, non-polar organics such as pesticides, surfactants, etc.) of chemical causing toxicity. If funding allows, additional samples collected upstream of the original site will be collected for chemical analysis to determine the potential source(s) of the toxicant in the watershed.

Sediment toxicity tests will be performed on a bimonthly basis only during the irrigation season. The dormant spray season is typified by intermittent high flows that mobilize sediment from the surrounding landscape and move that sediment to the water bodies. With sufficient rainfall to mobilize sediment off the landscape, accompanying flows are often sufficient to move the sediment in the channel to locations downstream. Because sediment is expected to be relatively nonmobile during the irrigation season, and toxicity in the sediment is not expected to disappear

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[2] USEPA. 2002. Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, Fourth Edition. Office of Water, Washington, D.C. EPA-821-R-02-013.
[3] USEPA. 1998. Methods for Aquatic Toxicity Identification Evaluations. Phase I Toxicity Characterization Procedures. Office of Research and Development, Duluth, MN. EPA-600-3-88-034.
[4] USEPA. 1994. Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates. Office of Research and Development, Washington, D.C. EPA-600-R-94-024.
[5] USEPA. 1998. Methods for Aquatic Toxicity Identification Evaluations. Phase I Toxicity Characterization Procedures. Office of Research and Development, Duluth, MN. EPA-600-3-88-034.

within a few days, only one sediment sample will be tested for toxicity even if significant toxicity is indicated. No TIEs are proposed for sediment toxicity even if the result of the toxicity test indicates significant toxicity. Sediment TIE tests are still under development and would most probably implicate only a limited range of potential causes (sediment-bound chemicals). Regardless of the causes of toxicity in sediment, the primary BMPs implemented to reduce the toxicity would function to reduce the amount of sediment delivered to the water body. It is also probably true that sediment toxicity can't be reliably tracked upstream. Because the movement of sediment-bound chemicals is episodic and the distance the sediment moves is dependent on flows, particle size, shear stress of the bed, and channel morphology, simply finding a highest upstream site with sediment toxicity will not necessarily narrow the search for sources. Identifying locations on the landscape where sediment delivery could be reduced would be relatively easy and BMPs would presumably reduce all causes of toxicity resulting from sediment-bound contaminants.

A brief description of each region and the rationale for the sampling locations is provided. Monitoring for Phase I is not proposed for all regions because the water bodies in all regions did not satisfy the five criteria as described above. Many of the regions contain a very small amount of irrigated agriculture that do not received substantial applications during the dormant spray season, and there are generally no return flows during the summer irrigation season. For other regions, many of the sites maintain flowing water only during the winter, and consequently, sampling at these sites will be conducted only during the winter, or during the first few months of the irrigation season when flowing water is present. If no water is present for sampling, the site will be photographed for documentation.

Information must be collected from dischargers on the type of management practices that are being used, the degree to which they are being implemented within the watershed, and how effective they are in protecting waters of the state through all phases of monitoring. Phase 1 monitoring is the focus of this document and is to be conducted for a period of two years. Monitoring during Phase 2 will include general physical parameters, pesticide use evaluation, and chemical analyses of pesticides, metals, and nutrients. Phase 2 will be designed based on the results of Phase 1 monitoring. It is expected that this phase will begin 2 years after the start of Phase 1. Phase 3 will be designed to determine statistically significant changes in constituent concentrations based on various management practices. Phase 3 monitoring will begin two years from the start of Phase 2 monitoring.

1.4 Contact information for Coalition

All Coalition sampling and reporting will be the responsibility of Parry Klassen, Board Chairman, East San Joaquin Water Quality Coalition.

2 LITTLE JOHN CREEK SUBWATERSHED

2.1 Subwatershed description

The Little Johns Creek region occupies the extreme northeast corner of the ESJ (Figure 2a, 2b). The main water bodies in the region are Little John Creek and Hoods Creek, both of which flow into the Farmington Flood Control Basin. The basin serves as a detention basin during periods of high flow, but the two creeks merge at the basin into a single channel. Once the channel leaves the Farmington Flood Control basin, it flows into Duck Creek and eventually into French Camp Slough in the San Joaquin/Delta Coalition geographic area. There are only 6,423 acres of irrigated agriculture in this region, which comprises only 7.7% of the 85,841 acres within the region. Two categories of irrigated agriculture account for almost three-quarters of the irrigated land in the region. The largest amount of irrigated land is irrigated pasture (52.9%), with irrigated grain and hay making up an additional 21.7%.

2.2 Summary of historical and ongoing monitoring

There are no historical or ongoing monitoring programs in the Little Johns Creek region.

2.3 Description of monitoring phases

Based on the extremely small amount of irrigated agriculture, and the location and the types of irrigated agriculture that predominate in this subwatershed, the Coalition propose not to conduct monitoring in this region.

3 DRY CREEK-TUOLUMNE RIVER SUBWATERSHED

3.1 Subwatershed description

The main water bodies flowing through the region are the Tuolumne River and Dry Creek, with Dry Creek entering the Tuolumne River outside of the region in the city of Modesto (Figure 3a, 3b). Cashman Creek is a smaller water body that flows into Dry Creek in the region. There are 7,493 acres of the land categorized as irrigated agriculture out of almost 79,561 acres (9.4%). Deciduous nut and fruits and irrigated pasture are the two largest categories of irrigated land with deciduous nuts and fruits accounting for 40.2% and irrigated pasture accounting for 37.5% of the irrigated land.

3.2 Summary of historical and ongoing monitoring

There have been numerous historical monitoring programs in this region and there continue to be ongoing monitoring. These efforts are summarized in Table 4.

3.3 Monitoring sites/sampling locations/monitoring events and frequencies

Based on the extremely small amount of irrigated agriculture, and the location and the types of irrigated agriculture that predominate in this subwatershed, the Coalition propose not to conduct monitoring in this region.

3.4 Monitoring parameters

None

Table 4. Historical sampling in the Dry Creek-Tuolumne River region.

Source	Author	Sample period	Site Name	LAT	LONG	Constituent	Link
TMDL	JMIE/AEAL	2003	Dry Creek (Tuolumne) at Gallo Bridge	37.6364	-120.9832	Diaz. & Chlorp.	TMDL monitoring by UC Davis
TMDL	JMIE/AEAL	2003	Merced River at River Road	37.3505	-120.9610	Diaz. & Chlorp.	TMDL monitoring by UC Davis
TMDL	JMIE/AEAL	2003	San Joaquin River at Crows Landing	37.4320	-121.0122	Diaz. & Chlorp.	TMDL monitoring by UC Davis
TMDL	JMIE/AEAL	2003	Stanislaus River at Orange Blossom	37.7895	-120.7626	Diaz. & Chlorp.	TMDL monitoring by UC Davis
TMDL	JMIE/AEAL	2003	Tuolumne River at Santa Fe Road	37.6230	-120.8982	Diaz. & Chlorp.	TMDL monitoring by UC Davis
TMDL	JMIE/AEAL	2003	Tuolumne River at Shiloh Road Bridge	37.6033	-121.1306	Diaz. & Chlorp.	TMDL monitoring by UC Davis
USGS	Kratzer et al.	2000	Dry Creek (Tuolumne) at Claus Road	37.6570	-120.9202	Diaz. & Chlorp.	http://water.usgs.gov/pubs/wri/wri02-4103/wri024103.pdf
USGS	Zamora et al.	2001	Dry Creek (Tuolumne) at Claus Road	37.6570	-120.9202	Diaz. & Chlorp.	http://www.cDPR.ca.gov/docs/sw/contracts/USGS_03-4091.pdf
USGS	Kratzer et al.	2000	Dry Creek (Tuolumne) at Gallo Bridge	37.6364	-120.9832	Diaz. & Chlorp.	http://water.usgs.gov/pubs/wri/wri02-4103/wri024103.pdf
USGS	Kratzer et al.	2000	Tuolumne River at Modesto	37.6272	-120.9864	Diaz. & Chlorp.	http://water.usgs.gov/pubs/wri/wri02-4103/wri024103.pdf
USGS	Zamora et al.	2001	Tuolumne River at Modesto	37.6272	-120.9864	Diaz. & Chlorp.	http://www.cDPR.ca.gov/docs/sw/contracts/USGS_03-4091.pdf
USGS	Kratzer et al.	2000	Tuolumne River at Shiloh Road Bridge	37.6033	-121.1306	Diaz. & Chlorp.	http://water.usgs.gov/pubs/wri/wri02-4103/wri024103.pdf
USGS	Zamora et al.	2001	Tuolumne River at Shiloh Road Bridge	37.6033	-121.1306	Diaz. & Chlorp.	http://www.cDPR.ca.gov/docs/sw/contracts/USGS_03-4091.pdf
DPR		2002	Tuolumne River at Shiloh Road Bridge	37.6033	-121.1306	metolachlor/alachlor and deg	2002data_draft AEAL database
DPR		1995	Dry Creek (Tuolumne) at Claus Road	37.6570	-120.9202	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/50-4.txt
DPR		1995	Dry Creek (Tuolumne) at Leask Bridge near Waterford	37.6742	-120.7117	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/50-10.txt
DPR		1995	Sonoma Storm drain at Scenic Dr, Modesto	37.6528	-120.9517	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/50-3.txt
DPR		1995	Tuolumne River at Carpenter Rd Bridge	37.6089	-121.0297	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/50-17.txt
DPR		1995	Tuolumne River at Mitchell Rd Bridge	37.6169	-120.9378	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/50-20.txt
DPR	Starner	?	Tuolumne River at Shiloh Road Bridge	37.6033	-121.1306	Pesticides	
DPR		2002	Tuolumne River at Shiloh Road Bridge	37.6033	-121.1306	Pesticides	2002data_draft AEAL database
DPR		2002	Tuolumne River at Shiloh Road Bridge	37.6033	-121.1306	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/50-16.txt

4 DRY CREEK-MERCED RIVER SUBWATERSHED

4.1 Subwatershed description

The main water bodies flowing through this region are the Merced River and Dry Creek (not the same Dry Creek as in the Dry Creek-Tuolumne River region) (Figure 4a, 4b). Ingalsbe Creek is a smaller water body that flows into the Merced River above Dry Creek. The other main water body is the Highline Canal, which flows south from the Turlock Main Drain and provides irrigation water to a large region north of Merced. There are 71,997 acres of irrigated agriculture (46%) in the region out of a total acreage of 157,365. Deciduous nut and fruits (54%), field crops (14%), vineyards (14%), and irrigated pasture (13%) make up the majority of the remaining acreage.

4.2 Summary of historical and ongoing monitoring

There have been numerous historical monitoring programs in this region and there continue to be ongoing monitoring. These efforts are summarized in Table 5.

4.3 Monitoring sites/sampling locations/monitoring events and frequencies

There is a relatively large amount of irrigated agriculture in this subwatershed, the largest proportion in deciduous nuts and fruits. Consequently, the Coalition proposes two sites for monitoring, the Highline Canal at Lombardy Road and the Merced River at Santa Fe (Table 2, Figure 11a, 11b). As outlined above, two samples at each site will be monitored during the winter storm season; the first sample collected during the first major storm after application of pesticides during the dormant spray season. Irrigation season sampling will be conducted for 6 months (April-September) if irrigation starts as early as March. Sediment sampling will be conducted 3 times during the irrigation season.

4.4 Monitoring parameters

The monitoring parameters are provided in Table 3.

Table 5. Historical monitoring in Dry Creek-Merced River region.

Source	Author	Sample period	Site Name	LAT	LONG	Constituent	Link
DPR		1993	Merced River at Oakdale Road	37.4544	-120.6077	Chlorpyrifos	http://www.cdpr.ca.gov/docs/sw/sitepages/24-1.txt
TMDL	JMIE/AEAL	2003	Merced River at River Road	37.3505	-120.9610	Diaz. & Chlorp.	TMDL monitoring by UC Davis
USGS	Zamora et al.	2001	Dry Creek (Merced) near Snelling	37.5797	-120.4249	Diaz. & Chlorp.	http://www.cDPR.ca.gov/docs/sw/contracts/USGS_03-4091.pdf
USGS	Kratzer et al.	2000	Highline Spillway to Merced River	37.3875	-120.8036	Diaz. & Chlorp.	http://water.usgs.gov/pubs/wri/wri02-4103/wri024103.pdf
USGS	Kratzer et al.	2000	Merced River at River Road	37.3505	-120.9610	Diaz. & Chlorp.	http://water.usgs.gov/pubs/wri/wri02-4103/wri024103.pdf
USGS	Zamora et al.	2001	Merced River at River Road	37.3505	-120.9610	Diaz. & Chlorp.	http://www.cDPR.ca.gov/docs/sw/contracts/USGS_03-4091.pdf
USGS	Kratzer et al.	2001	Merced River near Stevenson	37.3707	-120.9295	Diaz. & Chlorp.	http://water.usgs.gov/pubs/wri/wri02-4103/wri024103.pdf
USGS	Zamora et al.	2001	Merced River near Stevenson	37.3707	-120.9295	Diaz. & Chlorp.	http://www.cDPR.ca.gov/docs/sw/contracts/USGS_03-4091.pdf
Nawqa		0	Merced River at River Road	37.3505	-120.9610	Field measurements	http://ca.water.usgs.gov/sanj_nawqa/data_sw/swlip.field.html
Nawqa		0	Merced River at River Road	37.3505	-120.9610	major inorganic compunds	http://ca.water.usgs.gov/sanj_nawqa/data_sw/swlip.majors.html
Nawqa		0	Merced River at River Road	37.3505	-120.9610	Nutrients and organic carbon	http://ca.water.usgs.gov/sanj_nawqa/data_sw/swlip.nut_orgc.html
DPR	Bacey	-	Highline Spillway to Merced River	37.3875	-120.8036	Pesticides	
DPR		0	Highline Spillway to Merced River	37.3875	-120.8036	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/24-4.txt
DPR		0	Merced River at Hatfield State Park	37.3508	-120.9606	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/24-6.txt
DPR		1993	Merced River at River Road	37.3505	-120.9610	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/24-7.txt

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Figure 11a. Highline Canal @ Lombardy Road monitoring site.

East San Joaquin Water Quality Coalition
Highline Canal Monitoring Site: Lombardy

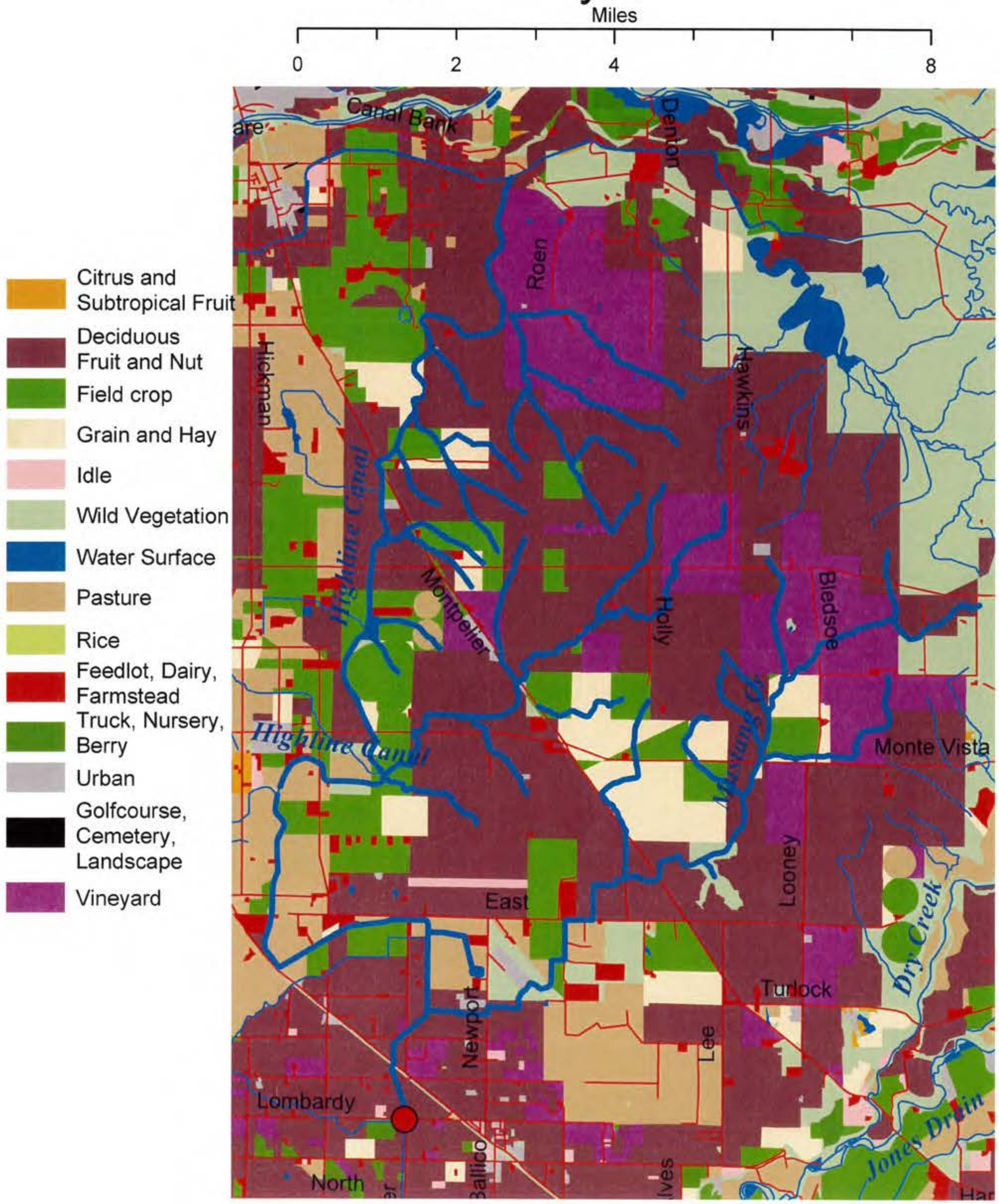
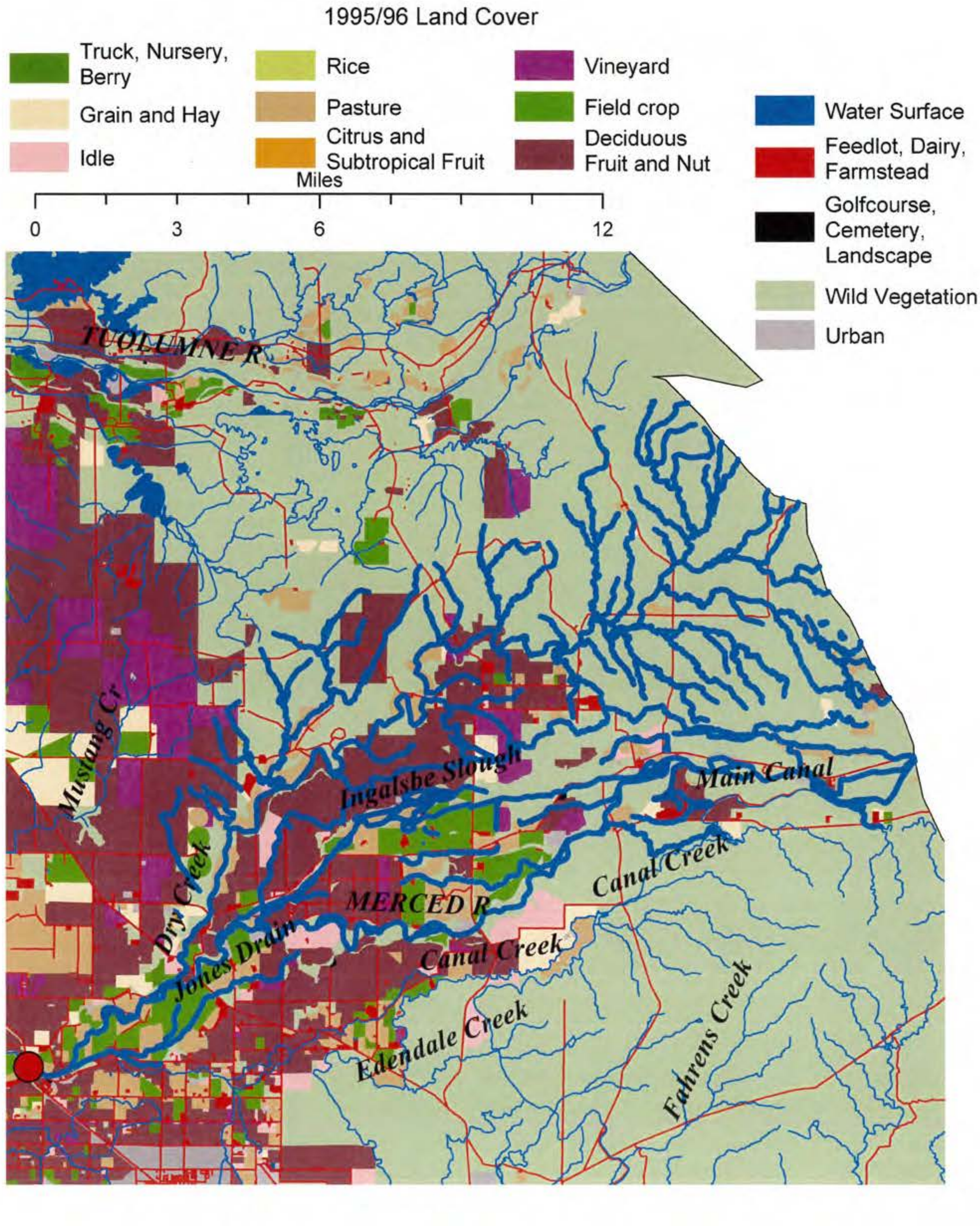


Figure 11b. Merced River @ Santa Fe monitoring site.

East San Joaquin Water Quality Coalition
Merced River Monitoring Site:
Santa Fe



5 DEADMAN CREEK SUBWATERSHED

5.1 Subwatershed description

There are several intermediate sized water bodies that drain the irrigated agricultural land within the region (Figure 5a, 5b). The primary waterbodies are Deadman Creek, Duck Slough, Owens Creek, Deep Slough, and Mariposa Slough. Deadman Creek drains into Duck Slough, which joins with Owens Creek at Deep Slough and eventually flows into the SJR. Sand Slough drains into Mariposa Slough and eventually into the SJR. There are 142,445 acres of irrigated agriculture (59%) in the region out of a total acreage of 242,243. Field crops (32%) and pasture (32%) make up the majority of the irrigated acreage with a smaller portion of the irrigated agriculture in deciduous nuts and fruits (12%).

5.2 Summary of historical and ongoing monitoring

There have been numerous historical monitoring programs in this region and there continue to be ongoing monitoring. These efforts are summarized in Table 6.

5.3 Monitoring sites/sampling locations/monitoring events and frequencies

Although there is a significant amount of irrigated agriculture, a relatively small amount of irrigated land exists in this region above urban areas. Consequently, two sites Duck Slough @ Lone Tree Road, and Dutchman's Creek @ Lone Tree Road, are proposed for monitoring in this region (Figure 12a, 12b). As outlined above, two samples at each site will be monitored during the winter storm season; the first sample collected during the first major storm after application of pesticides during the dormant spray season. Irrigation season sampling will be conducted for 6 months (April-September) if irrigation starts as early as March. Sediment sampling will be conducted 3 times during the irrigation season.

5.4 Monitoring parameters

Monitoring parameters are provided in Table 3.

Table 6. Historical and ongoing monitoring programs in the Deadman Creek subwatershed.

Source	Author	Sample period	Site Name	LAT	LONG	Constituent	Link
TMDL	JMIE/AEAL	2003	Merced River at River Road	37.3505	-120.9610	Diaz. & Chlorp.	TMDL monitoring by UC Davis
USGS	Kratzer et al.	2000	Merced River at River Road	37.3505	-120.9610	Diaz. & Chlorp.	http://water.usgs.gov/pubs/wri/wri02-4103/wri024103.pdf
USGS	Zamora et al.	2001	Merced River at River Road	37.3505	-120.9610	Diaz. & Chlorp.	http://www.cDPR.ca.gov/docs/sw/contracts/USGS_03-4091.pdf
USGS	Kratzer et al.	2001	Merced River near Stevenson	37.3707	-120.9295	Diaz. & Chlorp.	http://water.usgs.gov/pubs/wri/wri02-4103/wri024103.pdf
USGS	Zamora et al.	2001	Merced River near Stevenson	37.3707	-120.9295	Diaz. & Chlorp.	http://www.cDPR.ca.gov/docs/sw/contracts/USGS_03-4091.pdf
USGS	Kratzer et al.	2000	San Joaquin River at Lander Avenue	37.2954	-120.8504	Diaz. & Chlorp.	http://water.usgs.gov/pubs/wri/wri02-4103/wri024103.pdf
USGS	Zamora et al.	2001	San Joaquin River at Lander Avenue	37.2954	-120.8504	Diaz. & Chlorp.	http://www.cDPR.ca.gov/docs/sw/contracts/USGS_03-4091.pdf
DPR		0	San Joaquin River at Lander Avenue	37.2954	-120.8504	Diazinon	http://www.cDPR.ca.gov/docs/sw/sitepages/24-11.txt
Nawqa		0	Merced River at River Road	37.3505	-120.9610	Field measurements	http://ca.water.usgs.gov/sanj_nawqa/data_sw/swlip.field.html
Nawqa		0	Merced River at River Road	37.3505	-120.9610	major inorganic compunds	http://ca.water.usgs.gov/sanj_nawqa/data_sw/swlip.majors.html
CEPA	RWQCBCVR	1998	San Joaquin River at Fremont Ford	37.3101	-120.9295	Metals	http://www.swrcb.ca.gov/~rwqcb5/available_documents/water_studies/SJR.PDF
CEPA	RWQCBCVR	1998	San Joaquin River at Hills Ferry	37.3502	-120.9755	Metals	http://www.swrcb.ca.gov/~rwqcb5/available_documents/water_studies/SJR.PDF
CEPA	RWQCBCVR	1998	San Joaquin River at Lander Avenue	37.2954	-120.8504	Metals	http://www.swrcb.ca.gov/~rwqcb5/available_documents/water_studies/SJR.PDF
Nawqa		0	Merced River at River Road	37.3505	-120.9610	Nutrients and organic carbon	http://ca.water.usgs.gov/sanj_nawqa/data_sw/swlip.nut_orgc.html
DPR	Bacey	?	Highline Spillway to Merced River	37.3875	-120.8036	Pesticides	
DPR		0	Highline Spillway to Merced River	37.3875	-120.8036	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/24-4.txt
DPR		0	Merced River at Hatfield State Park	37.3508	-120.9606	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/24-6.txt
DPR		1993	Merced River at River Road	37.3505	-120.9610	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/24-7.txt
DPR		0	San Joaquin River at Fremont Ford	37.3101	-120.9295	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/24-9.txt
DPR		0	San Joaquin River at Hills Ferry	37.3502	-120.9755	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/50-29.txt

Figure 12a. Duck Slough @ Lone Tree Road monitoring site.

East San Joaquin Water Quality Coalition
Duck Slough Monitoring Site: Lone Tree Road

1995 Land Cover

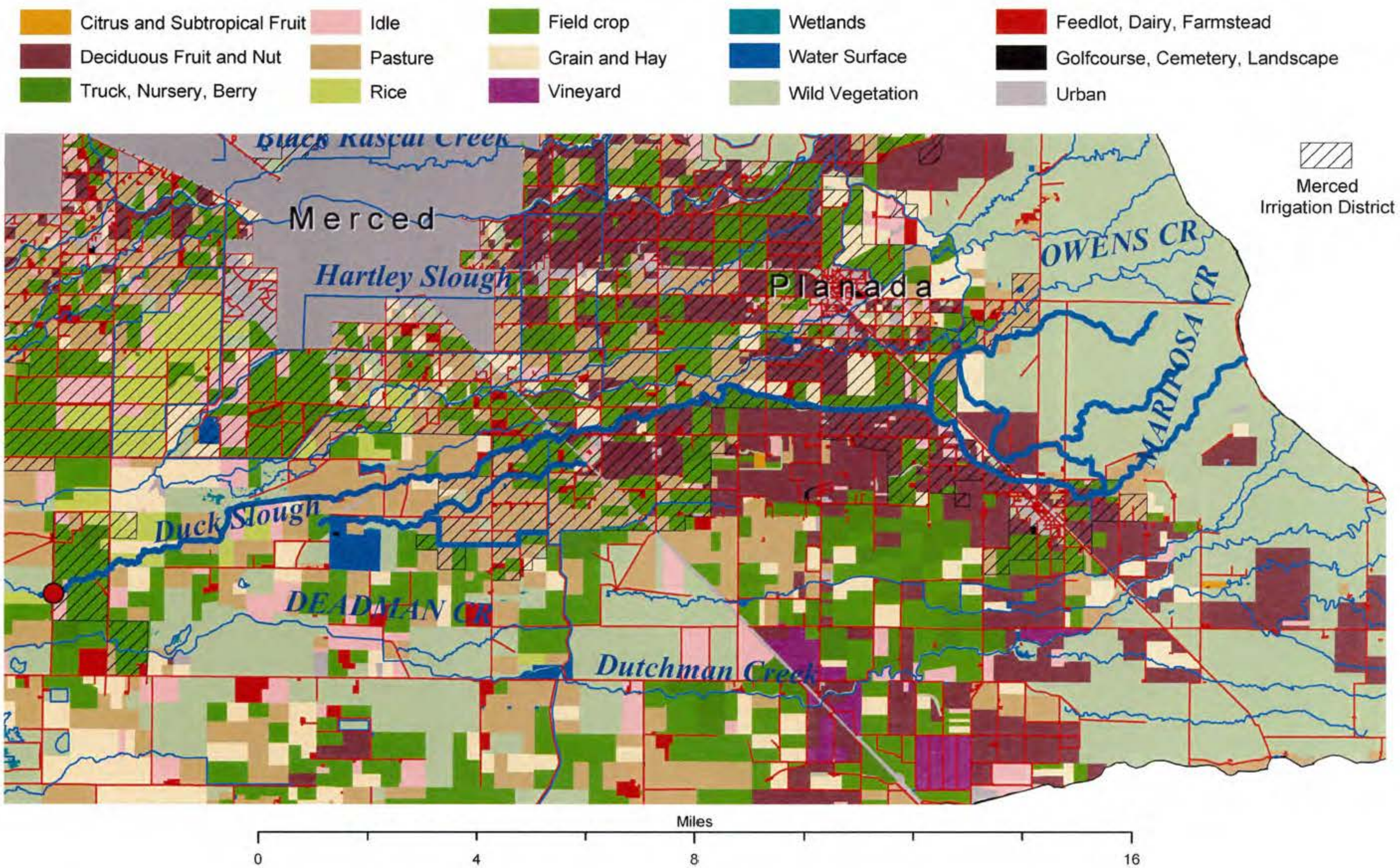


Figure 12b. Dutchman's Creek @ Lone Tree Road monitoring site.

6 FAHRENS CREEK SUBWATERSHED

6.1 Subwatershed description

There are only a few small sized drainages in this region. Fahrens Creek drains into Black Rascal Creek, into Canal Creek, and eventually into Bear Creek before draining into Deep Slough and the SJR (Figure 6a, 6b). Burns Creek drains into Bear Creek. There are 15,317 acres of irrigated agriculture (12.6%) in the region out of a total acreage of 121,688. Deciduous nut and fruits (31%), irrigated pasture (24%), and irrigated grains and hay (13%) make up the majority of the irrigated acreage.

6.2 Summary of historical and ongoing monitoring

There are no historical or ongoing monitoring programs in the Faherns Creek region.

6.3 Description of monitoring phases

Based on the extremely small amount of irrigated agriculture, and the location and the types of irrigated agriculture that predominate in this subwatershed, the Coalition propose not to conduct monitoring in this region.

7 SAN JOAQUIN FLATS SUBWATERSHED

7.1 Subwatershed description

There are no intermediate sized drainages in these areas. Most of the larger drainages to the SJR consist of ancestral river channel sloughs that collect water from surrounding areas (Figure 7). There are 24,409 acres of irrigated agriculture (65%) in the region out of a total acreage of 37,421. Irrigated pasture (36%), field crops (31%), and deciduous nut and fruits (20%) and make up the majority of the irrigated acreage.

7.2 Summary of historical and ongoing monitoring

There have been numerous historical monitoring programs in this region and there continue to be ongoing monitoring. These efforts are summarized in Table 7.

7.3 Monitoring sites/sampling locations/monitoring events and frequencies

Although there is a relatively small amount of irrigated agriculture, most of the land in the subwatershed is irrigated agriculture. Much of the irrigated agriculture immediately near the San Joaquin River is on poorly drained soils resulting in some agricultural return flows. Consequently, two sites Riley Slough @ confluence with the San Joaquin River, and August Road Drain upstream of the Crows Landing Bridge, are proposed for monitoring in this region (Figure 13a, 13b). As outlined above, two samples at each site will be monitored during the winter storm season; the first sample collected during the first major storm after application of pesticides during the dormant spray season. Irrigation season sampling will be conducted for 6 months (April-September) if irrigation starts as early as March. Sediment sampling will be conducted 3 times during the irrigation season.

7.4 Monitoring parameters

Monitoring parameters are provided in Table 3.

Table 7. Historical and ongoing monitoring programs in the San Joaquin Flats region.

Source	Author	Sample period	Site Name	LAT	LONG	Constituent	Link
TMDL	JMIE/AEAL	2003	San Joaquin River at Crows Landing	37.4320	-121.0122	Diaz. & Chlorp.	TMDL monitoring by UC Davis
TMDL	JMIE/AEAL	2003	Tuolumne River at Santa Fe Road	37.6230	-120.8982	Diaz. & Chlorp.	TMDL monitoring by UC Davis
USGS	Kratzer et al.	2000	Stanislaus River at Ripon	37.7300	-121.1094	Diaz. & Chlorp.	http://water.usgs.gov/pubs/wri/wri02-4103/wri024103.pdf
USGS	Zamora et al.	2001	Stanislaus River at Ripon	37.7300	-121.1094	Diaz. & Chlorp.	http://www.cDPR.ca.gov/docs/sw/contracts/USGS_03-4091.pdf
CEPA	RWQCBCVR	1998	San Joaquin River at Crows Landing	37.4320	-121.0122	Metals	http://www.swrcb.ca.gov/~rwqcb5/available_documents/water_studies/SJR.PDF
DPR		0	San Joaquin River at Maze Blvd.	37.6412	-121.2276	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/50-2.txt
DPR		1995	Tuolumne River at Carpenter Rd Bridge	37.6089	-121.0297	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/50-17.txt
DPR		1995	Tuolumne River at Mitchell Rd Bridge	37.6169	-120.9378	Pesticides	http://www.cDPR.ca.gov/docs/sw/sitepages/50-20.txt

Figure 13a. Riley Slough at the confluence with the San Joaquin River monitoring site.

East San Joaquin Water Quality Coalition
Riley Slough Monitoring Site: Confluence with SJR

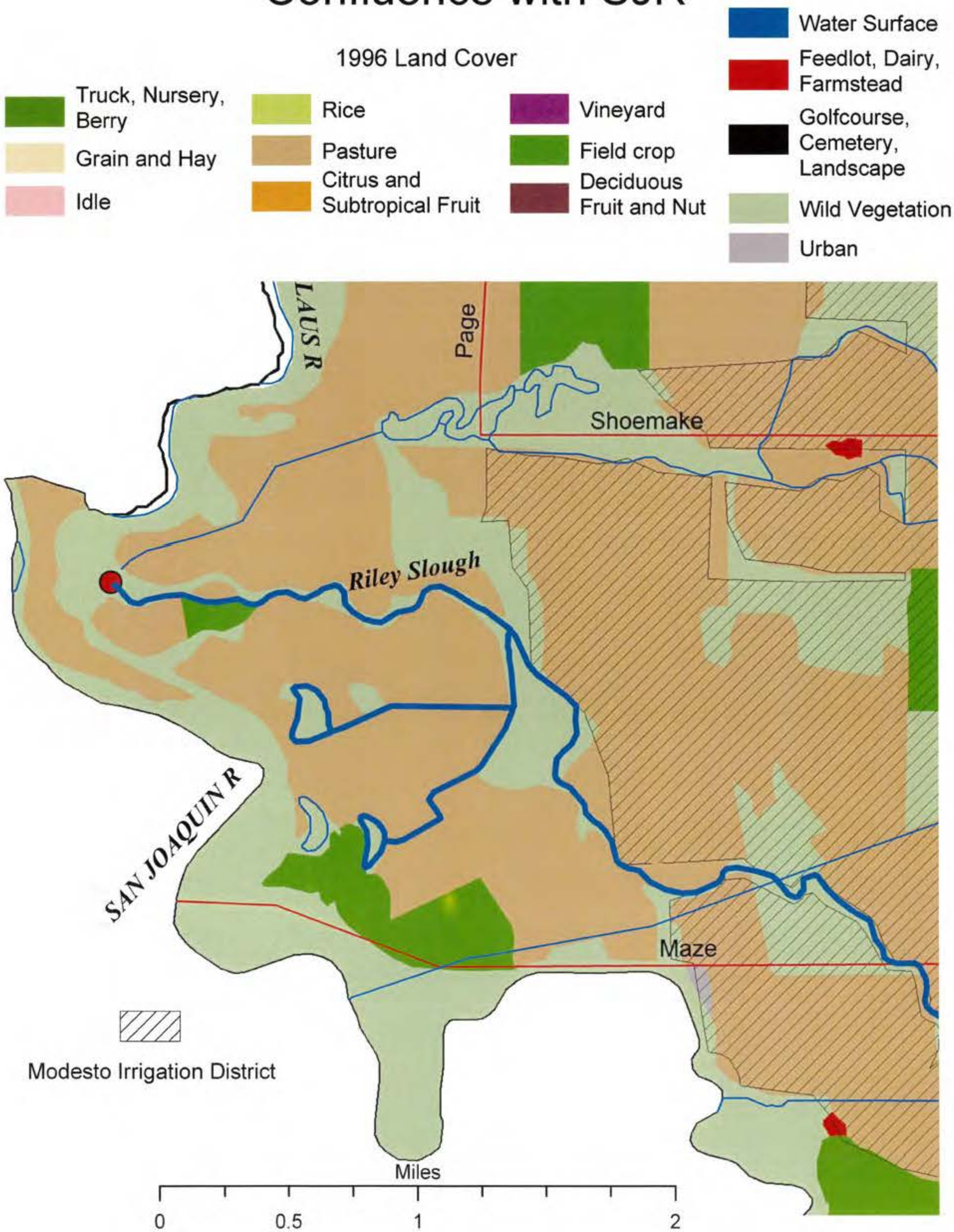
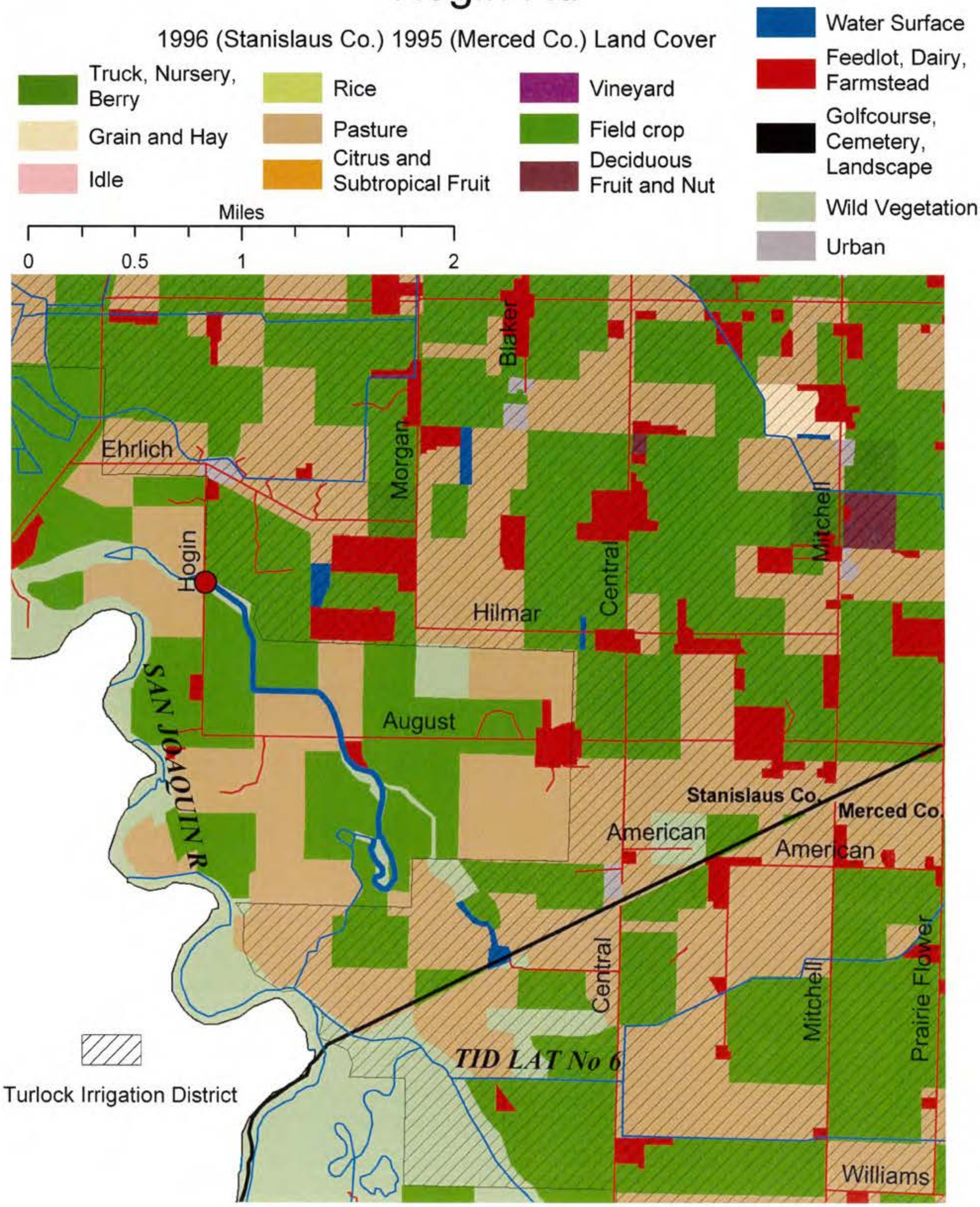


Figure 13b. August Road Drain upstream of the Crows Landing Bridge monitoring site.

East San Joaquin Water Quality Coalition
SJR Flood Plain Drain Monitoring Site:
Hogin Rd



8 QUALITY ASSURANCE PROGRAM PLAN

The Quality Assurance Program Plan is adapted from the QAPP prepared by the CVRWQCB for their Phase II Agricultural Waiver Monitoring Program. Appropriate changes have been made to the QAPP to reflect the monitoring program proposed by the ESJWQC. Not included are QAPP protocols for water column or sediment toxicity testing. The QAPP is attached as Appendix 1.

9 MONITORING PROTOCOLS - SAMPLE COLLECTION METHODS

Monitoring protocols are outlined in the QAPP, which is attached as Appendix 1.

10 LABORATORY QUALITY ASSURANCE MANUAL

The laboratories that will conduct the water quality analyses and the toxicity testing have not been determined. When the final contracts are executed, a laboratory quality assurance manual will be submitted.

11 Appendix 1. QAPP for Monitoring program.

QUALITY ASSURANCE PROJECT PLAN
(QAPP)

Designed for the Phase I Agricultural Waiver Monitoring Program
In the East San Joaquin Water Coalition Region

PROJECT MANAGEMENT

TITLE PAGE AND APPROVALS

Quality Assurance Project Plan For Monitoring in the East San Joaquin Water Quality Coalition Region

Approved by: ___________________________________

Distribution List

Name	*Agency*	*Contact Number*

TABLE OF CONTENTS

A. PROJECT MANAGEMENT

Title page and Approval
This section is located on page 1.

Distribution list
This section lists the groups or individuals to whom this document has been distributed. This section is located on page 2.

Project Organization and Responsibility

This Quality Assurance Project Plan (QAPP) describes the quality assurance requirements for the irrigated lands conditional waiver Phase I Monitoring Program. Contractors conducting sample collection and sample analyses under the Agricultural Waiver Phase I Monitoring Program for the Coalition will be required to adhere to the procedures outlined in this document. This QAPP was developed originally by the Central Valley Regional Water Quality Control Board (CVRWQCB)'s staff and has been modified to adequately describe monitoring in the ESJWQC region.

Problem Definition
The overall goal of the monitoring in the Coalition area is to ensure that current and potential uses of the watersheds' resources are sustained, restored, and where possible, enhanced with an emphasis on examining the degree to which beneficial uses of water bodies are attained.

Project Description

Project Objectives and Approach

This monitoring program is a dynamic activity that will change over time as information is accumulated and new information is identified. This QAPP is designed to be a long-term effort that will provide information to promote the understanding of conditions within watersheds and to assess the relative health of the watersheds.

Measurement

Because this monitoring program is a dynamic activity, the list of constituents will change over time as new information is gathered and new questions are identified. Table A-1 lists the main constituents of concern that will be monitored during the first year, 2004.

TABLE A- 1. CONSTITUENTS TO BE MONITORED

Constituent	Quantitation Limit	Reporting Unit
General Parameters:		
Flow	N/A	CFS (Ft^3/Sec)
pH	N/A	pH

Constituent	Quantitation Limit	Reporting Unit
Electrical Conductivity	N/A	mhos/cm
Dissolved Oxygen	N/A	mg O_2/L
Temperature	N/A	Degrees Celsius
Color	N/A	Color Units
Turbidity	N/A	NTUs
Total Dissolved Solids	N/A	mg/L
Total Organic Carbon	N/A	mg/L
Toxicity Test:		
Water Column Toxicity		
Sediment Toxicity		
Chemical Anayses:		
Pesticides [(a,b)]		
Organophosphorus	(a)	µg/L
Pyrethroids	(a)	µg/L

(a,b) reporting limit is different for each individual pesticide. Refer to Reporting Limits and Detection Limits Table B-4; testing is to be conducted only if water column toxicity testing results in a significantly positive test.

Project Schedule

The Phase 1 sampling duration is two years and is anticipated to begin in July 2004 and continue until June of 2006. The monitoring is tentatively scheduled for storm seasons that begin in December and continue through March, and irrigation seasons that begin in April and continue until the end of September. It is anticipated that the storm season monitoring will include monitoring during one major storm immediately after dormant spraying has commenced. Irrigation season monitoring will include bi-monthly sampling during the peak irrigation season.

Sampling Schedule

The frequency of the sample collection will vary for different constituents of concern and for each water body. A breakdown of sampling sites, sampling frequency, and analytical parameters are included in the MRPP.

Quality Objectives and Criteria for Data Measurement

The objective of data collection for this monitoring program is to produce data that represents, as closely as possible, *in-situ* conditions of water bodies in the ESJWQC region. This objective will be achieved by using accepted methods to collect and analyze surface water, sediment, and possibly biota samples. Assessing the monitoring program's ability to meet this objective will be accomplished by evaluating the resulting laboratory measurements in terms of detection limits, precision, accuracy, representativeness, comparability, and completeness, as presented in Section B of this document.

Training and Certification

All staff performing field or laboratory procedures shall receive training to ensure that the work is conducted correctly and safely. At a minimum, all staff shall be familiar with the field guidelines and sample collection procedures and, the laboratory standard operating procedures (SOP) included in this QAPP. All contractors and staff conducting fieldwork must receive field safety training. All work shall be performed under the supervision of experienced staff or a field coordinator. A copy of the safety training records must be filed in the project file with the contractors.

Documentation and Records

Data to be Included in Reports

For each sampling event, the responsible contractor shall provide the ESJWQC Contract Manager with copies of the field data sheets (relevant pages of field logs) and copies of the Chain of Custody (COC) forms for all samples submitted for analysis. At a minimum, the following sample-specific information will be provided for each sample collected:
Sample ID

- Monitoring location
- Sample type (e.g., grab or composite type [Cross-sectional, flow-proportional, etc.])
- Number of sub-samples in composite (if applicable)
- Quality Control (QC) sample type (on field data sheet)
- Date and time (s) of collection (Military Time)
- Requested analyses (specific parameters or method references)

For each sample analyzed, the responsible contractor shall provide the ESJWQC Contract Manager a final analytical report that includes, at a minimum, the following sample-specific information:

- Sample ID
- Date of sample receipt
- Date of extraction and analysis
- Analytical method(s)
- Measured value of the analyte or parameter
- Method detection limit
- Reporting limit

In addition, the Contractors shall provide results from all laboratories QC procedures (blanks, calibration standard, laboratory spikes, matrix spikes, reference materials, etc.) and the sample IDs associated with each analytical sample batch.

Reporting Format

All results meeting data quality objectives and results having satisfactory explanations for deviations from objectives shall be reported on the Laboratory Final Report. The final results shall include the results of all field and laboratory quality control samples. The Contractors may provide a summary of the data with the final laboratory data sheet.

B. DATA ACQUISITION

Sampling Design

The sampling locations are selected based on historical data, on-going monitoring and an evaluation of current agricultural activities within each region in the ESJWQC. The six sample sites and their locations are described in detail in the text of the MRPP.

Classification of Measurements as Critical

All measurements shall be classified as Critical (e.g., required to achieve project objectives or have a limit on the number of errors in order to be acceptable). Critical measurements will undergo closer scrutiny during the data gathering and review process. The expected number of samples, specific analytical methods and procedures, and defined acceptance criteria for QC samples (as described in Section B5) shall be included as part of the critical measurement.

Validation of Any Non-standard Methods

For non-standard sampling and analysis methods, sample matrices, or other unusual situations, appropriate method validation study information shall be documented to confirm the performance of the method for the particular need. The purpose of this validation method is to assess the potential impact on the representativeness of the data generated. For example, if a non-standard method is used, rigorous validation of the method may be necessary. Such validation studies may include round-robin studies performed by USEPA or other organizations. If previous validation studies are not available, some level of single-user validation study should be performed during the project and included as part of the project's final report.

Field Procedure

Field Safety Procedures

All staff must receive field safety training prior to conducting fieldwork. One resource for training is the CVRWQCB Sampling Field Manual, which consists of emergency information, field safety, site information, maps, and sampling SOPs (Azimi-Gaylon, *et al.* 2002).

Sample Collection Methods

Proper sampling techniques must be used to ensure that a sample is representative of the flow in the cross section whenever possible. When possible, samples must be collected using a standard multi-vertical depth integrating method to obtain the most representative isokinetic sample possible. By using this method, the water entering the sampler is hydrodynamically equivalent to the portion of the stream being sampled. Abbreviated sampling methods (that is, weighted-bottle or dip sample) can be used for collecting a sample representative of the stream chemistry. Surface Water Sampling SOP is included in *Attachment 1* of this QAPP.

Sample Storage, Preservation and Holding Times

Sample containers are pre-cleaned according to USEPA specification for the appropriate methods. Table B-1 lists the sample container, storage and preservation requirements for this QAPP.

In the field, all samples will be packed in wet ice or frozen ice packs during shipment, so that they will be kept at approximately 4°C. Samples will be shipped in insulated containers. All caps and lids will be checked for tightness prior to shipping.

All samples will be handled, prepared, transported and stored in a manner so as to minimize bulk loss, analyte loss, contamination, or biological degradation. Sample containers will be clearly labeled with an indelible marker. Where appropriate, samples may be frozen to prevent biological degradation. Water samples will be kept in glass or polyethylene bottles and kept cool at a temperature of 4°C until analyzed. Maximum holding times for specific analyses are listed on the following pages.

Ice chests are sealed with tape before shipping. Samples are placed in the ice chest with enough ice to completely fill the ice chest. Request for analysis forms are placed in an envelope and taped to the top of the ice chest or they may be placed in a plastic zip lock bag and taped to the inside of the ice chest lid. It is assumed that samples in tape-sealed ice chests are secure whether being transported by staff vehicle, by common carrier, or by commercial package delivery. The receiving laboratory has a sample custodian(s) who examines the samples for correct documentation, proper preservation and holding times.

Contract laboratories will follow sample custody procedures outlined in their QA plans. Contract laboratory QA plans are on file with the respective laboratory.

All samples remaining after successful completion of analyses will be disposed of properly. It is the responsibility of the personnel of each analytical laboratory to ensure that all applicable regulations are followed in the disposal of samples or related chemicals.

Chain-of-custody procedures require that possession of samples be traceable from the time the samples are collected until completion and submittal of analytical results. A complete chain-of-custody form is to accompany the transfer of samples to the analyzing laboratory.

TABLE B-2: SUMMARY OF SAMPLE CONTAINER, VOLUME, INITIAL PRESERVATION, AND HOLDING TIME RECOMMENDATIONS FOR WATER SAMPLES

Parameters for Analysis in WATER Samples	Recommended Containers (all containers pre-cleaned)	Typical Sample Volume (ml)	Initial Field Preservation	Maximum Holding Time (analysis must start by end of max)
Physical Parameters[1]				
Color	1 liter glass or polyethylene	500 ml	Cool to 4°C, dark	48 hours at 4°C, dark
Turbidity	"	150 ml	"	48 hours at 4°C, dark
Total Dissolved Solids (TDS)	"	1000 ml	"	7 days at 4°C, dark
Pathogens, TOC and THMs in Drinking Water and Surface Water				
E. Coli	Factory-sealed, pre-sterilized, disposable Whirl-pak® bags or 125 ml sterile plastic (high density polyethylene or polypropylene) container	100 ml volume sufficient for both E. coli and Enterococcus analyses	Sodium thiosulfate is pre-added to the containers in the laboratory (chlorine elimination). Cool to 4°C; dark.	STAT: 6 hours at 4°C, dark; lab must be notified well in advance
Total Organic Carbon (TOC)	40 ml glass vial	40 ml (one vial)	Cool to 4°C, dark	28 days at 4°C, dark

Synthetic Organic Compounds in Water Samples				
PESTICIDES & HERBICIDES* □Organophosphate Pesticides □Organochlorine Pesticides □Carbamates □Pyrethroids □Herbicides □Fungicides □Paraquot/diquot	1-L I-Chem 200-series certified trace clean amber glass bottle, with Teflon lid-liner (per each sample type)	1000 ml (one container) ***Each sample type requires 1000 ml in a separate container**	Cool to 4°C, dark If chlorine is present, add 0.1g sodium thiosulfate	Keep at 4°C, dark, up to 7 days. Extraction must be performed within the 7 days; analysis must be performed within 40 days of extraction.
Toxicity Testing - Water Samples				
TOXICITY IN WATER	Four 2.25 L amber glass bottles	9000 ml	Cool to 4°C, dark	14 days at 4°C, dark

Field Log

Field crews shall be required to keep a field log for each sampling event. The following items should be recorded in the field log for each sampling event:

- time of sample collection;
- sample ID numbers, including etched bottle ID numbers for Teflon™ mercury sample containers and unique IDs for any replicate or blank samples;
- the results of any field measurements (temperature, D.O., pH, conductivity, turbidity) and the time that measurements were made;
- qualitative descriptions of relevant water conditions (e.g. color, flow level, clarity) or weather (e.g. wind, rain) at the time of sample collection;
- a description of any unusual occurrences associated with the sampling event, particularly those that may affect sample or data quality.

The field crews shall have custody of samples during field sampling. Chain of custody forms will accompany all samples during shipment to contract laboratories. All water quality samples will be transported to the analytical laboratory directly by the field crew or by overnight courier.

Laboratory Custody Log

Laboratories shall maintain custody logs sufficient to track each sample submitted and to verify that samples are preserved, extracted and analyzed within specified holding times.

Sample Identification Scheme

All samples must be uniquely identified to ensure that results are properly reported and interpreted. Samples must be identified such that the site, sampling location, matrix, and sample type (Normal field sample or QC sample) can be distinguished by a data reviewer or user.

Field Measurements

For all water bodies sampled, pH, temperature, dissolved oxygen, and specific conductance are measured prior to collecting samples for laboratory analyses. Calibration and operation of the instruments are presented in *Attachment 2* of this QAPP.

QC Sample Collection

Field blanks and field duplicates are collected at a frequency of about 1 per 20 normal samples. Additional sample containers will be collected for matrix spike analyses at frequency of about 1 per 20 normal samples.

Field Instrument Calibration

Routine calibration must be performed prior to and during use to ensure instruments are operating properly and produce accurate and reliable data. Calibration should be performed at a frequency recommended by the manufacturer. If field calibration reveals that the instrument is outside established accuracy limits, the instrument should be serviced in the field. Back-up instruments must be available for each of the critical real-time instruments used in the field. Instructions for field instrument calibration can be found in Attachment 2 of this QAPP.

Decontamination Procedures

All field and sampling equipment that may contact samples must be decontaminated after each use in a designated area. A detailed description of cleaning procedures for water sampling equipment is included in *Attachment 3* of this QAPP.

Field Documentation

All field activities must be adequately and consistently documented to support data interpretation and ensure defensibility of any data used for decision-making. Pertinent field information, including (as applicable), the width, depth, flow rate of the stream, the surface water condition and location of the tributaries are recorded on the field sheets. Sample control information is documented on the field sheet and chain of custody form.

Example of field data sheets and other documentation required for field procedure are included in *Attachment 4* of this QAPP. Field personnel must record the following information:

- Name(s) of field personnel
- Site / sampling location identification
- Date and time of sample collection
- Field calibrationAll field measurements such as pH, temperature, dissolved oxygen and conductivity (when applicable)
- Observation of weather and conditions that can influence sample results
- Any problems encountered during sampling
- Sample Custody and Documentation

Sample possession during all sampling efforts must be traceable from the time of collection until results are reported and verified by the laboratory and samples are disposed. Sample custody procedures provide a mechanism for documenting information related to sample collection and handling.

Documentation Procedures

The field activities coordinator is responsible for ensuring that the field sampling team adheres to proper custody and documentation procedures. Field datasheets are completed for all samples collected during each sampling activity. Field personnel have the following responsibilities:

- Keep an accurate written record of sample collection activities on the field forms
- Ensure that all entries are legible, written in waterproof ink and contain accurate and inclusive documentation of the field activities
- Date and initial daily entries
- Note errors or changes using a single line to cross out the entry and date and initial the change
- Complete the chain of custody forms accurately and legibly
- A label is affixed to each sample collected. Sample labels uniquely identify samples with an identification number including date and time of sample collection and the initials of the sampling person.

Chain-of-Custody Form

A chain-of-custody form is completed after sample collection, and prior to sample shipment or release. The chain-of-custody form, sample labels, and field documentation are crossed-checked to verify sample identification, type of analyses, and number of containers, sample volume, preservatives and type of containers.

Information to be included in the chain of custody forms includes:

- Sample identification
- Date and time of collection
- Sampler(s) names

- Analytical method(s) requested
- Sample matrix
- Signature blocks for release and acceptance of samples
- Any comments to identify special conditions or requests

Sample transfer between field staff and laboratory is documented by signing and dating "relinquished by" and "received by" blocks whenever sample possession changes. If samples are not shipped on the collection day, they are refrigerated in a sample control area with temperature no greater than 4 degree centigrade. An example of chain-of-custody form is shown in Figure B-2.

Figure B-2: Example of Chain of Custody

DFG REQUEST FOR ANALYSIS AND CHAIN OF CUSTODY RECORD

Page_____ of _____

Sampler	Send Results To	Lab Number
Address UC Davis 1490 Drew Ave Suite 150	Address	Field Number
City Davis Zip 95616 CA	City Zip CA	Lab Storage

Ice Chest Temp at Log-in:	Analysis Requested >>>		Water Quality P.	Nutrients	Pathogens	THM's	Trace Elements	Hardness	Water Column Tox	Sediment Tox	Others (specify)		OCH Pesticides	OP Pesticides	Pyrethroids	Carbamates	Herbicides	Others (specify)			Plastic	Glass	Vial	Whirlpak
Sample Identification/Location	Collection																							
	Date	Time																						

Comments/Special Instructions

Samples Reliquished By (Signature)	Print Name	Date	Received By (Signature)	Print Name	Date

Sample Shipments and Handling

All sample shipments are accompanied by the chain-of-custody form, which identifies the content. The original form accompanies the shipment and a copy is retained in the project file.

All shipping containers are secured with chain-of-custody seals for transportation to the laboratory. Samples are shipped to the contract laboratories according to Department of Transportation standard. If the ice is packed with the samples, the ice must contact each sample and be approximately 2 inches deep at the top and bottom of the cooler. The ice may be contained in re-closeable bags, but must contact the samples to maintain temperature. The method(s) of shipments, courier name, and other pertinent information is entered in the "Received By" or "Remark" section of the chain of custody form.

The following procedures are used to prevent bottle breakage and cross-contamination:

- Prior to packaging, outside of the bottles need to be rinsed off with DI water.
- Bubble wrap or foam pouches are used to keep glass bottles from contacting one another to prevent breakage.
- All samples are transported inside hard plastic coolers or other contaminated free shipping containers.
- The coolers are taped shut and sealed with chain-of-custody seals to prevent accidental opening.
- If pre-arrangements are not made, prior to shipment of the samples field staff must notify laboratory sample control.

Laboratory Custody Procedures

The following sample control activities must be conducted in the laboratory:

- Initial log-in and verification of samples received with the chain of custody form;
- Document any discrepancies noted during log-in on the chain of custody;
- Verify sample preservation such as temperature;
- Notify the project coordinator if any problems or discrepancies are identified;
- Proper sample storage, including daily refrigerator temperature monitoring and sample security;
- Distribute samples or notify the laboratory of sample arrival; and
- Return shipment of coolers

Analytical Method Requirements

Water Chemistry Analysis

Water quality samples may be analyzed for filtered (dissolved) or unfiltered/ whole (total) fractions of the samples. Pesticide analyses must be conducted on whole water. Prior to analysis of any environmental samples, the laboratory must have demonstrated the ability to meet the minimum performance requirements for each analytical method. Initial demonstration of laboratory capability includes the ability to produce the project-reporting limit, the ability to generate acceptable precision and recovery, and other analytical and quality control as stated in this QAPP.

Analytical methods used in this monitoring program and detection limit and project quantitation limits are listed in Table B-4.

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TABLE B-4: LABORATORY DETECTION AND REPORTING LIMIT REQUIREMENTS

MediumName	MethodName	AnalyteName	FractionName	Units	ChemAgency Code	MDL	RL	INSTRUMENTATION
GENERAL PARAMETERS								
samplewater	SM 2120B Mod	Color	None	Color Units	DFG-WPCL	2.0	5.0	FIA
samplewater	SM 2130B	Turbidity	None	NTU	DFG-WPCL	1	1	Nephelometer
samplewater	SM 2540C	Solids	Total Dissolved	mg/L	DFG-WPCL	10	10	
samplewater	EPA 415.1	Organic Carbon	Total	mg/L	DFG-WPCL	0.2	0.5	
PATHOGENS								
samplewater	Quantitray	E Coli	None	MPN/100mL	Contract Lab			
HERBICIDES								
samplewater	EPA 619	Atrazine	None	µg/L	DFG-WPCL	0.02	0.05	GC-NPD/GC-MS
samplewater	EPA 619	Cyanazine	None	µg/L	DFG-WPCL	0.02	0.05	GC-NPD/GC-MS
samplewater	EPA 547	Glyphosate	None	µg/L	DFG-WPCL	2.0	5.0	HPLC-FLUORESENCE
samplewater	WPCL	Molinate	None	µg/L	DFG-WPCL	0.1	0.2	GC-NPD/GC-MS
samplewater	WPCL	Paraquat dichloride	None	µg/L	DFG-WPCL	0.2	0.5	HPLC-MS
samplewater	EPA 619	Simazine	None	µg/L	DFG-WPCL	0.02	0.05	GC-NPD
samplewater	WPCL	Thiobencarb	None	µg/L	DFG-WPCL	0.1	0.2	GC-NPD/GC-MS
CARBAMATE PESTICIDES/HERBICIDES								
samplewater	EPA 632 Mod	Aldicarb	None	µg/L	DFG-WPCL	0.01	0.05	HPLC-MS
samplewater	EPA 632 Mod	Captan	None	µg/L	DFG-WPCL	0.05	0.1	HPLC-MS
samplewater	EPA 632 Mod	Carbaryl	None	µg/L	DFG-WPCL	0.01	0.02	HPLC-MS
samplewater	EPA 632 Mod	Carbofuran	None	µg/L	DFG-WPCL	0.01	0.02	HPLC-MS
samplewater	EPA 632 Mod	Diuron	None	µg/L	DFG-WPCL	0.002	0.005	HPLC-MS
samplewater	EPA 632 Mod	Linuron	None	µg/L	DFG-WPCL	0.002	0.005	HPLC-MS
samplewater	EPA 632 Mod	Methiocarb	None	µg/L	DFG-WPCL	0.15	0.25	HPLC-MS
samplewater	EPA 632 Mod	Methomyl	None	µg/L	DFG-WPCL	0.01	0.02	HPLC-MS
PYRETHROID PESTICIDES								
samplewater	EPA 1660 Mod	Biphenthrin	None	µg/L	DFG-WPCL	0.005	0.01	GC-ECD/GC-MS
samplewater	EPA 1660 Mod	Cyfluthrin	None	µg/L	DFG-WPCL	0.005	0.01	GC-ECD/GC-MS
samplewater	EPA 1660 Mod	Cypermethrin	None	µg/L	DFG-WPCL	0.01	0.05	GC-ECD/GC-MS
samplewater	EPA 1660 Mod	Esfenvalerate/Fenvalerate	None	µg/L	DFG-WPCL	0.002	0.01	GC-ECD/GC-MS
samplewater	EPA 1660 Mod	Permethrin	None	µg/L	DFG-WPCL	0.01	0.02	GC-ECD/GC-MS
ORGANOPHOSPHATE PESTICIDES								
samplewater	EPA 8140,8141A	Azinphos-Methyl	None	µg/L	DFG-WPCL	0.03	0.05	GC-FPD
samplewater	EPA 8140,8141A	Chlorpyrifos	None	µg/L	DFG-WPCL	0.003	0.005	GC-FPD
samplewater	EPA 8140,8141A	Diazinon	None	µg/L	DFG-WPCL	0.003	0.005	GC-FPD
samplewater	EPA 8140,8141A	Dimethoat	None	µg/L	DFG-WPCL	0.03	0.05	GC-FPD
samplewater	EPA 8140,8141A	Disulfoton	None	µg/L	DFG-WPCL	0.01	0.05	GC-FPD
samplewater	EPA 8140,8141A	Malathion	None	µg/L	DFG-WPCL	0.03	0.05	GC-FPD

samplewater	EPA 8140,8141A	Methamidophos	None	µg/L	DFG-WPCL	0.10	0.2	GC-FPD
samplewater	EPA 8140,8141A	Methidathion	None	µg/L	DFG-WPCL	0.03	0.05	GC-FPD
samplewater	EPA 8140,8141A	Methyl Parathion	None	µg/L	DFG-WPCL	0.01	0.05	GC-FPD
samplewater	EPA 8140,8141A	Parathion	None	µg/L	DFG-WPCL	0.01	0.02	GC-FPD
samplewater	EPA 8140,8141A	Phorate	None	µg/L	DFG-WPCL	0.05	0.2	GC-FPD
samplewater	EPA 8140,8141A	Phosmet	None	µg/L	DFG-WPCL	0.05	0.2	GC-FPD

Detection and Quantitation Limits

Method detection limits (MDL) and quantitation limits (QLs) must be distinguished for proper understanding and data use. The MDL is the minimum analyte concentration that can be measured and reported with a 99% confidence that the concentration is greater than zero. The QL represents the concentration of an analyte that can be routinely measured in the sampled matrix within stated limits and confidence in both identification and quantitation. For this program, QLs must be verifiable by having the lowest non-zero calibration standard or calibration check sample concentration at or less than the QL.

For this program, QLs have been established based on the verifiable levels and general measurement capabilities demonstrated for each method to meet the DQO. These QLs should be considered as maximum allowable limits to be used for laboratory data reporting; data produced by different laboratories will be comparable at these levels. Note that samples diluted for analysis or corrected for percent moisture for sediment or tissue samples may have sample-specific QLs that exceed these QLs. This will be unavoidable in some cases.

When selecting an analytical method during the DQO process, data users must be sure to evaluate the QLs to verify that the method will meet the quantitation requirements for use in modeling, comparison with applicable water quality standards, or other planned uses. This approach ensures that the analytical method sensitivity has been considered and that the methods used can produce data that satisfy users' needs, making the most effective use of resources.

Method Detection Limit Studies

Each laboratory performing analyses under this program must routinely conduct MDL studies to document that the MDLs are less than the project-specified QLs. If any analytes have MDLs that do not meet the project QLs, the following steps must be taken:

1. Perform a new MDL study using concentrations sufficient to prove analyte identification at concentrations less than the QLs
2. If the MDLs still do not meet the QLs, another laboratory capable of meeting the QLs must be selected to perform the analyses for the method.

No samples may be analyzed until the issue has been resolved. MDL study results must be available for review during audits, data review, or as requested. Current MDL study results must be reported at the beginning of every project for review and inclusion in project files.

The MDL shown in Table B-4 is meant to illustrate current laboratory capabilities. Some laboratories may have MDLs that are outside this range; however, as long as they are less than the QLs, and the lowest non-zero calibration standard or calibration check sample concentrations are at or less than the QLs, no variances to this QAPP are required. For Definition of Procedures for the determination of MDL's, refer to USEPA procedures for establishing MDL's (USEPA, 1984).

Seven aliquots of a standard spiked at five times the expected MDL or five aliquots of standards spiked at three concentration levels (2xQL, 5xQL, 20xQL) are taken through the analytical method sample processing steps. The data are then evaluated and used to calculate the MDL following the procedures described. If the calculated MDL is less than three times below the spiked concentration, another MDL study must be performed using a lower concentration

Project Quantitation Limits

Laboratories generally establish limits that are reported with the analytical results; these may be called reporting limits, detection limits, reporting detection limits, or other terms. The limits that are reported with data are called quantitation limits under this program. These laboratory limits must be less than or equal to the project QLs included in this QAPP and the laboratories must have documentation to support quantitation at those levels.

Laboratories must report analytical results between the MDL and project QL. These results must be reported as the numerical values and qualified as estimates. Reporting as "trace" or "<QL" is not acceptable. The QC reviewers and data users must assess this information's usability. The contracted laboratories detection limit studies are presented in *Attachment 6* of this QAPP.

Laboratory Standards and Reagents

With the exception of common laboratory solvents, all stock standards and reagents must be tracked through the laboratory. Standards must comply with method-specified holding time requirements. The preparation and use of all working standards must be recorded in bound laboratory notebooks that document standard traceability to U.S. EPA, A2LA or National Institute for Standards and Technology (NIST) criteria. Records must provide sufficient detail to allow determination of the identity, concentration, and viability of the standards including any dilutions performed to obtain the working standard. Date of preparation, analyte or mixture, concentration, name of preparer, lot or cylinder number, and expiration date, if applicable, is recorded on each working standard.

Analytical Methods

Pesticide/herbicide Analytical Methods

Sample Extraction for Organochlorines, Organophosphorus, Triazines, Selective Herbicides, and Pyrethroids – EPA 3510C
A measured volume of sample (1.0 L) is extracted with methylene chloride (DCM) using a separatory funnel (liq/liq technique). The DCM extract is dried with sodium sulfate, evaporated using a Kuderna-Danish (K-D) apparatus and solvent exchanged into petroleum ether. The extract is concentrated using a micro-snyder (micro K-D) apparatus to approximately 1.0 ml and finally adjusted to 2.0 ml with iso-octane.

Sample Preparation for Selective Herbicides – EPA 3535
A measured volume of sample (1.0 L) is acidified with sulfuric acid: DI water (1:1) to $pH \leq 2$, the acidified sample is then eluted through a pre-conditioned C18 (Sep-Pak) column. The target herbicides are eluted from the C18 column with 2.0 ml methanol.

Sample Preparation for Carbamates – EPA 3510CM
A measured volume of sample (1.0 L) is extracted with methylene chloride (DCM) using a separatory funnel. The DCM extract is dried with sodium sulfate, evaporated to almost dryness using rotary evaporator and finally adjusted to 2.0 ml with methanol.

Instrumentation Methods

Organophosphorus Pesticides – EPA 8141A
The samples are analyzed using an Agilent 6890 plus, equipped with two FPD detectors in phosphorous mode, EPC split-splitless injector, Agilent auto-sampler and dual 60 meter capillary columns (DB5 and DB17) (0.25 mm ID and 0.25 µm film thickness) connected to a single injection port using a "Y" fit connector.

Triazines – EPA 619
The samples are analyzed using a GC Varian 3600, equipped with two TSD detectors, 7890 injector, 8200 autosampler and dual 30 meter capillary columns (DB5 and DB17) (0.25 mm ID and 0.25 µm film thickness) connected to a single injection port using a "Y" fit connector.

Selective Herbicides – EPA 1656M
The samples are analyzed using an Agilent 1100 high performance liquid chromatograph/mass spectrometer (HPLC-MS) using atmospheric pressure electrospray ionization in negative and/or positive mode.

Glyphosate/AMPA – EPA 547
The samples are analyzed by direct injection using a Hewlett Packard 1100 HPLC equipped with post column derivatization, and fluorescence detector.

Pyrethroids – EPA 1660M
The samples are analyzed using an Agilent 6890 plus, equipped with two micro ECD detectors, EPC split-splitless injector, Agilent auto-sampler and dual 60 meter capillary columns (DB5 and DB17)(0.25 mm ID and 0.25 µm film thickness) connected to a single injection port using a "Y" fit connector.

Carbamates – EPA 632M
The samples are analyzed by Agilent 1100 liquid chromatograph/mass spectrometer (HPLC-MS) using atmospheric pressure electrospray ionization in positive mode.

Inorganic Analytical Methods

Trace Elements by ICP-MS – EPA 1638
Inductively coupled plasma-mass spectrophotometer is used in the analysis of water samples. No digestion is required prior to analysis for dissolved elements in water samples. The method measures ions produced by a radio-frequency inductively coupled plasma. Analyte species originating in a liquid are nebulized and the resulting aerosol is transported by plasma gas and introduced by means of an interface into a mass spectrometer. The ions produced in the plasma are sorted according to their mass-to charge ratios and quantified with a channel electron multiplier. Interferences must be assessed and valid corrections applied or the data flagged to indicate problems. Interference correction must include compensation for background ions contributed by the plasma gas, reagents, and constituents of the sample matrix.

Samples are run with no dilution. Standard curves are run for all elements of concern. All samples, standards, SRM's, and blanks are made up in a 1-2 % Nitric acid solution. Blanks, standard reference materials, matrix spikes and calibration standards are run with all samples.

Color - SM 2120B Mod
Color is determined using an automated colorimetric method equivalent to the visual comparison method, SM 2120B. Potassium hexachloroplatinate and cobalt(II) chloride hexahydrate are used to prepare the color standards. The samples and standards are buffered at pH 6.8 during analysis and the product is read at 410nm. Because color is pH dependent, the pH at which color was determined must be reported with results.

TDS – SM 2540 C
A representative sample aliquot is filtered through a glass fiber filter. The filtrate is then evaporated in a pre-weighed dish and then dried to constant weight at 180°C. The difference between the final dish weight and initial dish weight represents the total dissolved solids.

Turbidity – SM 2130B
The method is based upon a comparison of the intensity of light scattered by a sample under defined conditions with the intensity of light scattered by a standard reference suspension of formazin. The higher the intensity of scattered light, the higher the turbidity

Quality Control Requirements
The quality control assessments used in Ag Waiver Phase II monitoring program are discussed below. Quality control requirements and schedules are summarized in Tables B-5 through B-8. Detailed procedures for preparation and analysis of quality control samples are provided in the analytical method documents or Standard Operating Procedures (SOP).

Data Quality Objectives and Quality Assurance Objectives

Data Quality Objectives (DQOs) and Quality Assurance Objectives (QAOs) are related data quality planning and evaluation tools for all sampling and analysis activities. A consistent approach for developing and using these tools is necessary to ensure that enough data are produced and are of sufficient quality to make decisions for this study.

DQOs and Data Use Planning

DQOs specify the underlying reason for collection of data, data type, quality, quantity, and uses of data collection.

For this program, data is needed for identification of sources and evaluation of management practices effectiveness.

Data Quality Category

For this study, definitive data using standard US Environmental Protection Agency (EPA) or other reference methods are performed by the USGS laboratory, the California Department of Food and Agriculture, California Department of Fish and Game, and others with Regional Board staff approval. Data are analyte-specific and the organic compounds identification and quantitation are confirmed. These methods have standardized QC and documentation requirements, providing supporting information necessary to verify all reported results.

Quality Assurance Objectives (QAOs)

Quality assurance objectives are the detailed QC specifications for precision, accuracy, representativeness, comparability and completeness (PARC). The QAOs presented in this QAPP represent the minimum acceptable specifications for field and analysis that should be considered routinely for field and analytical procedures. The QAOs are then used as comparison criteria during data quality review by the agency that is responsible for collecting data to determine if the minimum requirements have been met and the data may be used as planned.

Development of Precision and Accuracy Objectives

Laboratory control spikes (LCSs) are used to determine the precision and accuracy objectives. LCSs are fortified with target compounds to monitor the laboratory precision and accuracy. Field duplicates measure sampling precision and variability for comparison of project data. Acceptable relative percent difference (RPD) is less than 25 for field duplicate analyses. If field duplicate sample results vary beyond these objectives, the results are further evaluated to identify the cause of the variability.

Precision Accuracy Representativeness Completeness (PARC) Definitions

Precision
Precision measures the reproducibility of repetitive measurements. Precision is evaluated by calculating the RPD between duplicate spikes, duplicate sample analyses or field duplicate samples and comparing it with appropriate precision objectives established in this QAPP. Analytical precision is developed using repeated analyses of identically prepared control samples. Field duplicate samples analyses results are used to measure the field QA and matrix precision. Interpretation of precision data must include all possible sources of variability.

Accuracy
Accuracy measures correctness, or how close a measurement is to the true or expected value. Accuracy is measured by determining the percent recovery of known concentrations of analytes spiked into field sample or reagent water before extraction. The stated accuracy objectives for Laboratory control spikes or matrix spikes should reflect the Qualitative Objectives anticipated concentrations and/ or middle of the calibration range.

Representativeness
Representativeness is obtained by using standard sampling and analytical procedures listed and referenced in this QAPP to generate data that are representative of the sites.

Comparability
The comparability of data produced by and for this program is predetermined by the commitment of its staff and contracted laboratories to use standardized methods, where possible, including EPA-approved analytical methods, or documented modifications thereof, which provide equal or better results. These methods have specified units in which the results are to be reported.

Measurements are made according to standard procedure, or documented modifications thereof which provide equal or better results, using common units such as Celsius, feet, feet/sec, mg/L, Φg/L, mg/kg, etc. Analytical procedures are set by the USEPA approval list published in 40 CFR 136.

Completeness

Completeness is calculated for each method and matrix for an assigned group of samples. Completeness for a data set is defined as the percentage of unqualified and estimated results divided by the total number of the data points. This represents the usable data for data interpretation and decision-making. Completeness does not use results that are qualified as rejected or unusable, or that were not reported as sample loss or breakage. The overall objective for completeness is 95% for this project.

Internal Quality Control (QC)

Internal quality control (QC) is achieved by analyzing a series of duplicate, blank, spike and spike duplicate samples to ensure that analytical results are within the specified QC objectives. The QC sample results are used to quantify precision and accuracy and identify any problem or limitation in the associated sample results. The internal QC components of a sampling and analyses program will ensure that the data of known quality are produced and documented. The internal QC samples, frequency, acceptance criteria and corrective action required to meet project objectives are presented in the upcoming sections of this QAPP.

Field Quality Control

Field QC samples are used to assess the influence of sampling procedures and equipment used in sampling. They are also used to characterize matrix heterogeneity. For basic water quality analyses, quality control samples to be prepared in the field will consist of field blanks, field duplicates and matrix spikes (when applicable). The number of field duplicates and field blanks are set to achieve an overall rate of at least 5% of all analyses for a particular parameter. The external QA samples are rotated among sites and events to achieve the overall rate of 5% field duplicate samples and 5% field blanks (as appropriate for specific analyses).

Field Blanks

The purpose of analyzing field blanks is to demonstrate that sampling procedures do not result in contamination of the environmental samples. Field blanks will be prepared and analyzed for all analytes of interest at the rate of one per sample event, along with the associated environmental samples. Field blanks will consist of laboratory-prepared blank water processed through the sampling equipment using the same procedures used for environmental samples. If any analytes of interest are detected at levels greater than the Reporting Limit (RL) for the parameter, the sampling crew should be notified so that the source of contamination can be identified (if possible) and corrective measures taken prior to the next sampling event. If the concentration in the associated samples is less than five times the value in the field blank, the results for the environmental samples may be unacceptably affected by contamination and should be qualified as *below detection* at the reported value.

Field Duplicates

The purpose of analyzing field duplicates is to demonstrate the precision of sampling and analytical processes. Field duplicates will be prepared at the rate of one per sampling event, and analyzed along with the associated environmental samples. Field duplicates will consist of two aliquots from the same composite sample, or of two grab samples collected in rapid succession.

If an RPD greater than 25% is confirmed by reanalysis, environmental results will be qualified as *estimated*. The sampling crew should be notified so that the source of sampling variability can be identified (if possible) and corrective measures taken prior to the next sampling event.

Laboratory Quality Control

Laboratory QC is necessary to control the analytical process within method and project specifications, and to assess the accuracy and precision of analytical results.

For basic water quality analyses, quality control samples prepared in the contract laboratory (s) will typically consist of equipment blanks, method blanks, laboratory control samples, laboratory duplicates and surrogate added to each sample (organic analysis).

Equipment Blanks

The purpose of analyzing equipment blanks (EB) is to demonstrate that sampling equipment is free from contamination. Prior to using sampling equipment for the collection of environmental samples, the laboratory responsible for cleaning and preparation of the equipment will prepare bottle blanks and sampler blanks. These will be prepared and analyzed at the rate of one each per batch of bottles or sampling equipment. The blanks will be analyzed using the same analytical methods specified for environmental samples. If any analytes of interest are detected at levels greater than the MDL, the source(s) of contamination should be identified and corrected, the affected batch of bottles or equipment should be re-cleaned, and new equipment blanks should be prepared and analyzed.

Bottle blanks will consist of one of each type of sample container required for water quality analyses, selected randomly from the set of available bottles. The bottles will be filled with laboratory-prepared blank water (acidified to $pH < 2$ for metals samples) and allowed to stand for a minimum of 24 hours before analysis.

Sampler blanks will consist of laboratory-prepared blank water processed through the sampling equipment using the same procedures used for environmental samples.

Method Blanks

The purpose of analyzing method blanks is to demonstrate that the analytical procedures do not result in sample contamination. Method blanks (MB) will be prepared and analyzed by the contract laboratory at a rate of at least one for each analytical batch.

Method blanks will consist of laboratory-prepared blank water processed along with the batch of environmental samples. If the result for a single MB is greater than the MDL, or if the average blank concentration plus two standard deviations of three or more blanks is greater than the RL, the source(s) of contamination should be corrected, and the associated samples should be reanalyzed. If reanalysis is not possible, the associated sample results should be qualified as *below detection* at the reported blank value.

Laboratory Control Samples

The purpose of analyzing laboratory control samples (LCS) is to demonstrate the accuracy of the analytical method. Laboratory control samples will be analyzed at the rate of one per sample batch. Laboratory control samples will consist of laboratory fortified method blanks. If recovery of any analyte is outside the acceptable range for accuracy, the analytical process is not being performed adequately for that analyte. In this case, if the matrix spikes are also outside the acceptable range, the LCS and associated samples should be reanalyzed. If reanalysis is not possible, the associated sample results should be qualified as low or high biased.

Laboratory Duplicates

The purpose of analyzing laboratory duplicates is to demonstrate the precision of the analytical method. Laboratory duplicates will be analyzed at the rate of one pair per sample batch. Laboratory duplicates will consist of two analyses of the same sample. If the Relative Percent Difference (RPD) for any analyte is greater than the precision criterion *and* the absolute difference between duplicates is greater than the RL, the analytical process is not being performed adequately for that analyte. In this case, the laboratory duplicates should be reanalyzed. If reanalysis is not possible, the associated sample results should be qualified as *not reproducible* due to analytical variability.

Matrix Spikes and Matrix Spike Duplicates

The purpose of analyzing matrix spikes and matrix spike duplicates is to demonstrate the performance of the analytical method in a particular sample matrix. Matrix spikes and matrix spike duplicates will be analyzed at the rate of one pair per sample batch. Each matrix spike and matrix spike duplicate will consist of an aliquot of laboratory-fortified environmental sample. Spikes concentrations should be added at five to ten times the reporting limit for the analyte of interest.

If matrix spike recovery of any analyte is outside the acceptable range, the results for that analyte have failed the acceptance criteria. If recovery of laboratory control samples is acceptable, the analytical process is being performed adequately for that analyte, and the problem is attributable to the sample matrix. Attempt to correct the problem (by dilution) and re-analyze the samples and the matrix spikes. If the matrix problem can't be corrected, qualify the results for that analyte as appropriate (low or high biased) due to matrix interference.

If the matrix spike duplicate RPD for any analyte is greater than the precision criterion, the results for that analyte have failed the acceptance criteria. If the RPD for laboratory duplicates is acceptable, the analytical process is being performed adequately for that analyte, and the problem is attributable to the sample matrix. Attempt to correct the problem (by dilution, concentration, etc.) and re-analyze the samples and the matrix spike duplicates. If the matrix problem can't be corrected, qualify the results for that analyte as *not reproducible*, due to matrix interference. *The following tables, B-6 through B-9 present the QC requirements for water quality samples at a specific criteria.*

TABLE B-4 QUALITY CONTROL REQUIREMENTS FOR CONVENTIONAL CONSTITUENTS

Data Acceptability Criteria for Conventional Constituents in Water (Physical Parameters and Nutrients)				
Sample Type	**Objective**	**Frequency of Analysis**	**Acceptance Criteria**	**Corrective Action**
External Calibration				
Calibration Standards (3 standards over the expected range of sample target analyte conc., with the lowest conc. Std at or near the MDL).	Full calibration: Establish relationship between instrument response and target analyte conc.	Follow procedures in specific analytical protocols. A min. 5 point calib.: Each set up, major disruption, and when routine calib check exceeds specific control limits.	Linear regression, r>0.995.	Determine cause and take appropriate corrective action. Recalibrate and reanalyze all suspect samples or flag all suspect data.
Calibration Verification				
Calibration Check Standards (minimum of one mid-range standard prepared independently from initial calibration standards).	Verify calibration.	After initial calibration or recalibration. Every 20 samples.	%Recovery = 80 - 120%	Determine cause and take appropriate corrective action. Recalibrate and reanalyze all suspect samples or flag all suspect data.
Method Detection Limit Determination (MDL)				
Spiked matrix samples (analyte-free water samples to which known amounts of target analytes have been added; one spike for each target analyte at 3-***10*** times the estimated MDL).	Establish or confirm MDL for analyte of interest.	Seven replicate analyses prior to use of method. Re-evaluation of MDL annually.	Replicate spike %RSD <25%	Redetermine MDL.
Accuracy and Precision Assessment				
Reference materials (SRMs or CRMs, covering the range of expected target analyte conc).	Assess method performance (initial method validation and routine accuracy assessment).	Method validation: As many as required to assess accuracy and precision of method before routine analysis of samples. Routine accuracy assessment: one (preferably blind) per 20 samples or one batch.	Measured value <95% confidence intervals, if certified. Otherwise, %Recovery = 80-120%	Determine cause and take appropriate corrective action. Recalibrate and reanalyze all suspect samples or flag all suspect data.

Table B-4 Quality Control Requirements for Conventional Constituents (Continued)

Data Acceptability Criteria for Conventional Constituents in Water (Physical Parameters and Nutrients)				
Sample Type	**Objective**	**Frequency of Analysis**	**Acceptance Criteria**	**Corrective Action**
Matrix spikes (field water samples to which known amounts of target analytes have been added: 0.5 to ***10*** times the concentration of analyte of interest or ***10*** times MQL). Does not apply to solids analysis.	Assess matrix effects and accuracy (%R) routinely.	One per 20 samples or one per batch, whichever is more frequent.	%Recovery = 80-120% or Control Limits based on 3x the standard deviation of laboratory's actual method recoveries.	Determine cause and take appropriate corrective action. Recalibrate and reanalyze all suspect samples or flag all suspect data. Zero percent recovery requires rejection of all suspect data.
Matrix spike replicates (replicate aliquots of matrix spike samples; 0.5 to ***10*** times the concentration of analyte of interest or ***10*** times MQL). Does not apply to solids analysis.	Assess method precision routinely.	One duplicate per 20 samples or one per batch, whichever is more frequent.	RPD <25% for duplicates.	Determine cause, take appropriate corrective action. Recalibrate & reanalyze all suspect samples or flag all suspect data.
Laboratory Duplicate	Assess method precision	One per 20 samples or one per batch, whichever is more frequent.	RPD <25% for duplicates.	Determine cause, take appropriate corrective action. Recalibrate & reanalyze all suspect samples or flag all suspect data.
Field Duplicate (replicate aliquots of water field samples).	Assess method precision routinely. Assess total variability (i.e., population variability, field or sampling variability, & analytical method variability.)	One field duplicate per 20 samples	RPD <25% for duplicates.	Determine cause and take appropriate corrective action. Recalibrate and reanalyze all suspect samples or flag all suspect data.

Table B-4 Quality Control Requirements for Conventional Constituents (Continued)

Data Acceptability Criteria for Conventional Constituents in Water (Physical Parameters and Nutrients)				
Sample Type	**Objective**	**Frequency of Analysis**	**Acceptance Criteria**	**Corrective Action**
Contamination Assessment				
Laboratory Blanks (System blank: method, processing, bottle, reagent).	Assess contamination from equipment, reagents, etc.	One system blank per 20 samples or one per batch, whichever is more frequent. At least one system blank per batch. One reagent blank prior to use of a new batch of reagent and whenever method blank exceeds control limits.	Blanks <MDL for target analyte.	Determine cause of problem (e.g., contaminated reagents, equipment), remove sources of contamination, and reanalyze all suspect samples or flag all suspect data.
Field Blanks (travel blanks, equipment blanks).	Assess contamination from equipment, from air, from surrounding environment, etc.	Random performance evaluation during field audit; field blanks <MDL for analyte of interest. If acceptable performance, no field blanks required for one year. If non-acceptable, 5% field blanks must be conducted during the year until next field audit.	Blanks <MDL for target analyte.	Determine cause of problem (e.g., equipment contamination, improper cleaning, exposure to airborne contaminants, etc.), remove sources of contamination, & reanalyze all suspect samples or flag all suspect data.
External QA Assessment				
Accuracy-based performance evaluation samples submitted to new laboratories by QA Program.	Initial demonstration of laboratory capability.	Once prior to routine analysis of field samples.	Determined by study manager.	Determine cause of problem and reanalyze sample. Do not begin analysis of field samples until laboratory initial capability is clearly demonstrated.
General Provisions				
Acceptable Data Set: CCV Recoveries must be within control limits, & either SRM or Spiked Matrix recoveries must also be within control limits.				

TABLE B-5 QUALITY CONTROL REQUIREMENTS FOR VOLATILE ORGANIC (THM)

Data Acceptability Criteria for Volatile Organic Analytes (THMs) in Water

Sample Type	Objective	Frequency of Analysis	Acceptance Criteria	Corrective Action
Internal Calibration Method				
Calibration Standard (minimum of 5 levels over the expected range of sample target analyte conc., with the lowest conc. Std at or near the MDL).	Full calibration: Establish relationship between instrument response and target analyte conc.	Follow procedures in specific analytical protocols. A min. 5 point calib.: Each set up, major disruption, and when routine calibration check exceeds specific control limits.	% RSD for CCCs <30%. RF for SPCCs >0.1 except 1,1,2,2-tetrachloroethane which is 0.3.	Determine cause and take appropriate corrective action. Recalibrate and reanalyze all suspect samples or flag all suspect data.
Calibration Verification				
Calibration Check Standard (minimum of one mid-range standard prepared independently from initial calibration standards).	Verify calibration.	Mid-level calibration run every 12 hours.	RF for SPCCs same as inititial calibration. RF of CCCs must be <20% difference from initial calibration.	Determine cause and take appropriate corrective action. Recalibrate and reanalyze all suspect samples or flag all suspect data.
Method Detection Limit Determination				
Spiked matrix sample (analyte-free water samples to which known amounts of target analytes have been added; one spike for each target analyte at 3-***10*** times the estimated MDL).	Establish or confirm MDL for analyte of interest.	Seven replicate analyses prior to use of method. Re-evaluation of MDL annually.	Replicate spike %RSD <25%	Redetermine MDL.
Accuracy and Precision Assessment				
Reference material (SRMs or CRMs, covering the range of expected target analyte conc).	Assess method performance (initial method validation and routine accuracy assessment).	Method validation: As many as required to assess accuracy and precision of method before routine analysis of samples. Routine accuracy assessment: one (preferably blind) per 20 samples or one batch.	Measured value <95% confidence intervals, if certified. Otherwise, %Recovery = 75-125%.	Failure of any of the accuracy and precision control limits require the following: Determine cause and take appropriate corrective action.

Table B-5 Quality Control Requirements for Volatile Organic (TMH) (Continued)

Data Acceptability Criteria for Volatile Organic Analytes (THMs) in Water

Sample Type	Objective	Frequency of Analysis	Acceptance Criteria	Corrective Action
				Recalibrate and reanalyze all suspect samples or flag all suspect data.
Matrix spike (field water samples to which known amounts of target analytes have been added: 0.5 to ***10*** times the concentration of the analyte of interest or ***10*** times the MQL).	Assess matrix effects and accuracy (%Recovery) routinely.	One per 20 samples or one per batch, whichever is more frequent.	%Recovery = 75-125% or Control Limits based on 3x the standard deviation of laboratory's actual method recoveries.	See Reference Materials Corrective Action. Zero percent recovery requires rejection of all suspect data.
Matrix spike replicate (replicate aliquots of matrix spike samples; 0.5 to ***10*** times the concentration of the analyte of interest or ***10*** times the MQL).	Assess method precision routinely.	One duplicate per 20 samples or one per batch, whichever is more frequent.	RPD <25% for duplicates.	See Reference Materials Corrective Action.
Field Duplicate (replicate aliquots of water field samples).	Assess method precision routinely. Assess total variability (i.e., population variability, field or sampling variability, and analytical method variability).	One field duplicate per 20 samples	RPD <25% for duplicates.	Determine cause and take appropriate corrective action. Recalibrate and reanalyze all suspect samples or flag all suspect data.
Contamination Assessment				
Laboratory Blank (System blank: method, processing, bottle, reagent).	Assess contamination form equipment, reagents, etc.	One system blank per 20 samples or one per batch, whichever is more frequent.	Blanks <MDL for target analyte.	Determine cause of problem (e.g., contaminated reagents, equipment), remove sources of contamination, and reanalyze all suspect

Table B-5 Quality Control Requirements for Volatile Organic (TMH) (Continued)

Data Acceptability Criteria for Volatile Organic Analytes (THMs) in Water				
Sample Type	**Objective**	**Frequency of Analysis**	**Acceptance Criteria**	**Corrective Action**
				samples or flag all suspect data.
Field Blank (travel blanks, equipment blanks).	Assess contamination from equipment, from air, from surrounding environment, etc.	One travel/field equipment blank is required per 20 (or less) field samples collected for volatile organic compounds in water for each sampling "event".	Blanks <MDL for target analyte.	Determine cause of problem (e.g., equipment contamination, improper cleaning, exposure to airborne contaminants, etc.), remove sources of contamination, & reanalyze all suspect samples or flag all suspect data.
Routine Monitoring of Method Performance for Organic Analysis				
Surrogate Spike (Prepared from chemicals of similar structure to target analytes or isotopically labelled target analyte).	Assess method performance and estimate recovery of target analytes analyzed by GC or GC/MS. Determine RRF's of organic target analytes quanitated by isotope dilution techniques.	Performed in every calibration standard, field sample, and blank analyzed for organics by GC or istope dilution GC-MS; added to samples prior to extraction.	%Recovery = 75-125%.	Determine cause of problem (e.g., incomplete extraction or digestion, contamination, inaccurate preparation of internal standard), take appropriate corrective action, and reanalyze all suspect samples or flag all suspect data.

Table B-5 Quality Control Requirements for Volatile Organic (TMH) (Continued)

Data Acceptability Criteria for Volatile Organic Analytes (THMs) in Water				
Sample Type	**Objective**	**Frequency of Analysis**	**Acceptance Criteria**	**Corrective Action**
External QA Assessment				
Accuracy-based performance evaluation samples submitted to new laboratories by QA Program.	Initial demonstration of laboratory capability.	Once prior to routine analysis of field samples.	Determined by study manager.	Determine cause of problem and reanalyze sample. Do not begin analysis of field samples until laboratory initial capability is clearly demonstrated
CA-ELAP annual performance evaluations, as appropriate.	Ongoing demonstration of laboratory capability.	One exercise per year.	Determined by study manager.	Determine cause of problem and reanalyze sample. Further corrective action to be determined by QA manager.
General Provisions				
Acceptable Data Set: CCV Recoveries must be within control limits, & either SRM or Spiked Matrix recoveries must also be within control limits.				

TABLE B-6 QUALITY CONTROL REQUIREMENTS FOR ORGANIC COMPOUNDS

Data Acceptability Criteria for Synthetic Organic Compounds in Water (non-volatiles) in water: Pesticides, Herbicides and Fungicides				
Sample Type	**Objective**	**Frequency of Analysis**	**Acceptance Criteria**	**Corrective Action**
Internal/External Calibration				
Calibration Standards (5 standards over the expected range of sample target analyte conc., with the lowest conc. Std at or near the MDL).	Full calibration: Establish relationship between instrument response and target analyte conc.	Follow manufacturer's or procedures in specific analytical protocols. A min. 5 point calib.: Each set up, major disruption, and when routine calibration check exceeds specific control limits.	Linear regression, r>0.995 or %RSD <10%.	Determine cause and take appropriate corrective action. Recalibrate and reanalyze all suspect samples or flag all suspect data.
Calibration Verification				
Calibration Check Standards (minimum of one mid-range standard prepared independently from initial calibration standards).	Verify calibration.	After initial calibration or recalibration and at the end of the analysis sequence and every 20 samples.	%R = 85-115%.	Determine cause and take appropriate corrective action. Recalibrate and reanalyze all suspect samples or flag all suspect data.
Method Detection Limit Determination				
Spiked matrix samples (analyte-free water samples to which known amounts of target analytes have been added; one spike for each target analyte at 5 times the estimated MDL) or spiked at 3 concentrations with 1 level close to estimated RL.	Establish or confirm MDL for analyte of interest.	Seven replicate analyses prior to use of method, or 5 replicates at 3 concentrations with 1 level close to estimated RL. Re-evaluation of MDL annually.	Replicate spike %RSD <25%	Redetermine MDL.

Table B-6 Quality Control Requirements for Organic Compounds (Continued)

Data Acceptability Criteria for Synthetic Organic Compounds in Water (non-volatiles) in water: Pesticides, Herbicides and Fungicides				
Sample Type	**Objective**	**Frequency of Analysis**	**Acceptance Criteria**	**Corrective Action**
Accuracy and Precision Assessment				
Matrix spikes (field water samples to which known amounts of target analytes have been added: 0.5 to ***10*** times the concentration of the analyte of interest or ***10*** times the MQL).	Assess matrix effects and accuracy (%Recovery) routinely.	One per 20 samples or one per batch, whichever is more frequent.	%Recovery = 65-135% or Control Limits based on 3x the standard deviation of laboratory's actual method recoveries.	Determine cause and take appropriate corrective action. Recalibrate and reanalyze all suspect samples or flag all suspect data.
Matrix spike replicates (replicate aliquots of matrix spike samples; 0.5 to ***10*** times the concentration of the analyte of interest or ***10*** times the MQL).	Assess method precision routinely.	One duplicate per 20 samples or one per batch, whichever is more frequent.	RPD <25% for duplicates.	See Matrix Spike Corrective Action.
Laboratory control spikes (laboratory water to which known amounts of target analytes have been added: 0.5 to ***10*** times the concentration of the analyte of interest or ***10*** times the MQL).	Assess method accuracy (%Recovery) routinely.	One per 20 samples or one per batch, whichever is more frequent.	%Recovery = 65-135% or Control Limits based on 3x the standard deviation of laboratory's actual method recoveries.	See Matrix Spike Corrective Action.
Field Duplicate (replicate aliquots of water field samples).	Assess method precision routinely. Assess total variability (i.e., population variability, field or sampling variability, and analytical method variability.)	One field duplicate per 20 samples	RPD <25% for duplicates.	Determine cause and take appropriate corrective action. Recalibrate and reanalyze all suspect samples or flag all suspect data.

Table B-6 Quality Control Requirements for Organic Compounds (Continued)

Data Acceptability Criteria for Synthetic Organic Compounds in Water (non-volatiles) in water: Pesticides, Herbicides and Fungicides

Sample Type	Objective	Frequency of Analysis	Acceptance Criteria	Corrective Action
Contamination Assessment				
Laboratory Blanks (System blank: method, processing, container, reagent).	Assess contamination from equipment, reagents, etc.	One system blank per 20 samples or one per batch, whichever is more frequent. At least one system blank per batch. One reagent blank prior to use of a new batch of reagent and whenever method blank exceeds control limits.	Blanks <3xMDL or less than MQL whichever is less for target analytes.	Determine cause of problem (e.g., contaminated reagents, equipment), remove sources of contamination, and reanalyze all suspect samples or flag all suspect data.
Field Blanks (travel blanks, equipment blanks).	Assess contamination from equipment, from air, from surrounding environment, etc.	Random performance evaluation during field audit; field blanks <3xMDL or <MQL for analyte of interest. If acceptable performance, no field blanks required for one year. If non-acceptable, 5% field blanks must be conducted during the year until next field audit.	Blanks <3xMDL or less than MQL whichever is less for target analytes.	Determine cause of problem (e.g., equipment contamination, improper cleaning, exposure to airborne contaminants, etc.), remove sources of contamination, and reanalyze all suspect samples or flag all suspect data.
Routine Monitoring of Method Performance for Organic Analysis				
Surrogate Spikes (Prepared from chemicals of similar structure to target analytes not in target list or isotopically labelled target analyte).	Assess method performance and estimate recovery of target analytes analyzed by GC, GC/MS and HPLC-MS.	In every calibration standard, sample, and blank analyzed for organics by GC, GC-MS and HPLC-MS; added to samples prior to extraction if available.	%Recovery = 75-125% or Control Limits based on 3x the standard deviation of laboratory's actual method recoveries.	Determine cause of problem (e.g., incomplete extraction or digestion, contamination, inaccurate preparation of internal standard),

Table B-6 Quality Control Requirements for Organic Compounds (Continued)

Data Acceptability Criteria for Synthetic Organic Compounds in Water (non-volatiles) in water: Pesticides, Herbicides and Fungicides

Sample Type	Objective	Frequency of Analysis	Acceptance Criteria	Corrective Action
				take appropriate corrective action, and reanalyze all suspect samples or flag all suspect data.
External QA Assessment				
Accuracy-based performance evaluation samples submitted to new laboratories by QA Program.	Initial demonstration of laboratory capability.	Once prior to routine analysis of field samples.	Determined by study manager.	Determine cause of problem and reanalyze sample. Do not begin analysis of field samples until laboratory initial capability is clearly demonstrated.
General Provisions				
Acceptable Data Set: CCV Recoveries must be within control limits & Spiked Matrix recoveries or Laboratory Control Spikes must also be within control limits.				

Instrumentation and Equipment Preventative Maintenance

Sample Equipment Cleaning Procedures

Equipment used for sample collection will be cleaned according to the specific procedures documented in each Sampling SOP (example: sampling equipment cleaning SOP is included in *Attachment 3* of this QAPP).

At least one equipment blank is generated and analyzed with each group of samples collected in a given day. In addition, for all analytes where contamination is considered a significant concern, field blanks will be collected and analyzed as directed in Section B-5 of this document. If the results of these analyses indicate any contamination, the source will be identified and corrected, and the equipment will be re-cleaned and re-tested. The combined regimen of equipment blanks and field blanks is considered to provide adequate control against potential systematic equipment contamination problems.

Analytical Instrument and Equipment Testing Procedures and Corrective Actions

Testing, inspection, maintenance of analytical equipment used by the contract laboratory, and corrective actions shall be documented in the Quality Assurance manuals for each analyzing laboratory.

Instrument Calibration and Frequency

Analytical Procedures and Calibration

This section briefly describes analytical methods and calibration procedures for samples that will be collected under various monitoring programs.

Most of the methods included in this quality assurance project plan (QAPP) are published by the U.S. EPA. Some of the methods are published in:

- *Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater* (EPA-600/4-85 054)
- *U.S. EPA Methods for Chemical Analysis of Water and Wastes* (EPA-600/4-79-020, third edition, 1983)
- *Methods for Determination of Organic Compounds in Drinking Water* (EPA-600/4-88/039)

This involves using linear calibration and non-linear calibration procedures. For this program, only the linear calibration with options of using an average response factor or a linear regression is specified for organic analysis. Non-linear calibration is not allowed since using this calibration option creates a potential for poor quantitation or biased concentrations of compounds at low or high concentrations (near the high and low ends of the calibration range). For example, if laboratories calibrate for an OP Pesticide compound by GC or GC/MS at a concentration range of 0.5 to 100 µg/L, the instrument detector response has a potential for approaching the saturation point around 50 to 100 µg/L. The detector does not respond proportionally to the analyte concentration present, and the resulting reported concentration is biased low. These biased concentrations would not be representative of the concentrations in the sample. Laboratories shall prepare an initial 5-point calibration curve, where the low level standard concentrations is less than or equal to the analyte quantitation limits. For inorganic analysis, laboratories shall follow the analytical method requirements and, at a minimum, perform a 3 point calibration curve.

Inspection and Requirements for Supplies and Consumables

Gloves, sample containers, and any other consumable equipment used for sampling will be inspected by the sampling crew on receipt and will be rejected/returned if any obvious signs of contamination (torn packages, etc.) are observed. Inspection protocols and acceptance criteria for laboratory analytical reagents and other consumables are documented in the Quality Assurance Manuals for individual laboratories. Laboratory QA Manuals are made available for review at the analyzing laboratory.

Quality Control Requirements for Indirect Measurements

Water quality data collected by this monitoring program is intended to complement data collected by several other programs such as: the USGS National Water Quality Assessment program (NAWQA), monitoring efforts by the DWR, DPR, USBR, and the City of Sacramento. Each of these programs has its own quality assurance and quality control requirements. It is anticipated that data reported by these programs can be used without limitation for the purposes of the Ag Waiver Program.

Data Management

Copies of field logs, copies of chain of custody forms, original preliminary and final lab reports, and electronic media reports will be sent to the Regional Board Staff. The field crew will retain original field logs. The contract laboratory will retain original chain of custody forms. The contract laboratory(s) will retain copies of the preliminary and final data reports.

Concentrations of chemicals and toxicity endpoints, and all numerical biological parameters will be calculated as described in the referenced method document for each analyte or parameter, or laboratory operating procedures.

The data generated from the various monitoring programs will be transmitted to GIS staff and converted to a standard database format maintained on personal computers in the GIS staff offices. After data entry or data transfer procedures are completed for each sample event, data will be inspected for data transcription errors, and corrected as appropriate. After the final QA checks for errors are completed, the data are added to the final database. The production of data tables is generated from this database.

In cases where environmental results are less than the reporting limit for a parameter, the results will be reported as "less than" the reporting limit; e.g. an analytical result of 4 µg/L for an analyte with a reporting limit of 5 µg/L will be reported as <5 µg/L.

In cases where field blank results exceed the acceptance criteria, data collected during the associated sample run will be qualified and reported as follows:

- Measured environmental sample concentrations greater than or equal to 5 times the field blank level will be reported with no qualification.
- Measured environmental sample concentrations less than 5 times the field blank level will be qualified as "less than" the measured value, (e.g. if a field blank is equal to 1.5 µg/L, a measured environmental concentration of 4.0 µg/L will be reported as <4.0 µg/L).
- Any data qualifications resulting from QC analyses will be reported with the environmental data as appropriate.

C. ASSESSMENT AND OVERSIGHT

Data Assessment Procedure

Measurement data must be consistently assessed and documented to determine whether project quality assurance objectives (QAOs) have been met, quantitatively assess data quality and identify potential limitations on data use. Assessment and compliance with quality control procedures will be undertaken during the data collection phase of the project:

- Performance assessment of the sampling procedures will be performed by the field sampling crews. Corrective action shall be carried out by the field sampling crew and reported to the quality assurance manager.

- The laboratory is responsible for following the procedures and operating the analytical systems within the statistical control limits. These procedures include proper instrument maintenance, calibration of the instruments, and the laboratory QC sample analyses at the required frequency (i.e. method blanks, laboratory control samples, etc.). Associated QC sample results are reported with all sample results so the project staff can evaluate the analytical process performance.

All project data must be reviewed as part of the data assessment. Review is conducted on a preparation batch basis by assessing QC samples and all associated field sample results.

Project data review established for this project includes the following steps:

- Initial review of analytical and field data for complete and accurate documentation, chain of custody procedures, analytical holding times compliance, and required frequency of field and laboratory QC samples;
- Evaluation of analytical and field blank results to identify random and systematic contamination;
- Comparison of all spike and duplicate results with project objectives for precision and accuracy;
- Assigning data qualifiers flags to the data as necessary to reflect limitations identified by the process; and
- Calculating completeness by matrix and analyte.

The responsible agency conducting the data assessment is responsible for ensuring that data qualifier flags are assigned, as needed, based on the established QC criteria.

Quality Assurance Report

A quality assurance report will be prepared by the responsible agency at the end of each year or end of the contract as stated in each contract. The quality assurance report will summarize the results of QA/QC assessment and evaluations, including precision, accuracy, comparability, representativeness and completeness of the data. The report will be distributed to all parties involved in the contract.

Corrective Actions

During the course of sample collection and analysis in this study, the laboratory supervisors and analysts, and field supervisors and team members will make sure that all measurements and procedures are followed as specified in this QAPP, and measurements meet the prescribed acceptance criteria. If a problem arises, prompt action to correct the immediate problem and to identify its root causes is imperative. Any related systematic problems must also be identified.

Problems regarding analytical data quality that require corrective action are documented in the laboratories' QA/QC Guidance. Problems regarding field data quality that may require corrective action are documented in the field data sheets.

Analytical Data and Quality Assurance Report

The Contractors, as stated in each contract, will prepare a report after conducting data validation.

The elements described below will be addressed and included in the report:

- Description of the project including the number of samples, analyses, completeness and any significant problems or occurrences that influence data use.
- The QA/QC activities performed during this project.
- QC sample results, type and number of samples including the results that did not meet the projective objectives, and the impact on usability.
- Tables of analytical results for usable and unusable data.

Site Management

The responsible contractors will observe field activities to ensure tasks are conducted according to the project specifications. The field coordinator is equipped with a cellular telephone for improved communication among the team members. Decontamination of field equipment will occur at a designated area assigned by the field manager. Access for sites is coordinated through Regional Board staff. This includes obtaining any necessary permits and coordinating with facilities and units where site activities will take place.

D. DATA VALIDATION AND USABILITY

Data Validation and Audit

Laboratory Data Review, Verification and Reporting

The laboratory quality assurance manual will be used to accept, reject or qualify the data generated by the laboratory. The laboratory management will be responsible for validating the data generated by the laboratory.

The laboratory personnel will verify that the measurement process was "in control" (i.e. all specified data quality objectives were met or acceptable deviations explained) for each batch of samples before proceeding with analysis of a subsequent batch. In addition, each laboratory will establish a system for detecting and reducing transcription and/or calculation errors prior to reporting data.

The laboratory analyst performing the analyses is responsible for the reduction of the raw data generated at the laboratory bench to calculate the concentrations.

The analytical process includes verification or a quality assurance review of the data. This includes:

- Verifying the calibration samples for compliance with the laboratory and project criteria;
- Verifying that the batch QC were analyzed at a proper frequency and the results were within specifications;
- Comparing the raw data (e.g. chromatogram) with reported concentration for accuracy and consistency;
- Verifying that the holding times were met and that the reporting units and quantitation limits are correct;
- Determining whether corrective action was performed and control was re-established and documented prior to reanalysis of QC or project samples;
- Verifying that all project and QC sample results were properly reported and flagged; and
- Preparing batch narratives that adequately identify and discuss any problems encountered.

The QC check is conducted at several levels by the laboratory analyst, supervisors, and laboratory quality assurance staff. The specific procedures are documented in the laboratory quality assurance manual. After the data have been reviewed and verified, the laboratory reports are signed for release and distributions. Raw data and supporting documentation is stored in confidential files by laboratory document control.

Only data, which have met data quality objectives, or data, which have acceptable deviations, explained will be submitted by the laboratory. When QA requirements have not been met, the samples will be reanalyzed when possible and only the results of the reanalysis will be submitted, provided they are acceptable.

Data Users Audit And Validation

All laboratories will be audited during the duration of this monitoring program once this QAPP is affected. The audits are independent of sample collection and analysis.

Technical System Audit:

A technical system audit is a quantitative review of a sampling or analytical system. Qualified technical staff members who have the authority to act independently of the laboratory, field and project management perform audits.

The laboratory system audit results are used to review operations and ensure that the technical and documentation procedures provide valid and defensible data.

Critical items for a laboratory system audit include:

- Sample storage procedures;
- Availability of and compliance with calibration procedures and documentation requirements;
- Standard operating procedures;
- Source and handling of standards;
- Completeness of data forms, notebooks and other records of analysis and QC activities;
- Data review and verification procedures;
- Data storage, filing and record keeping procedures;
- Sample custody procedures;
- Establishments and use of quality control procedures, control limits and corrective actions that comply with specification in this QAPP;
- Operating conditions of the facilities and the equipment;
- Documentation of the instruments maintenance activities; and
- Laboratory staff training and documentation.

Critical items for sampling system audits includes:

- Calibration procedures and documentation for field meter; Field activity documentation in logbooks and sampling data sheets;
- Minimization of potential sample contamination in the field by using proper equipment decontamination procedures;
- Availability of SOPs and compliance to ensure proper sample collection, storage and transportation procedures;
- Compliance with established chain of custody procedures for sample documentation and transfer to the laboratory; and
- Field staff training and implementation of project-specific-requirements.

The checklist for each audit contains detailed questions regarding the critical items, requesting yes/no answers and comments. The laboratory manager and the field coordinator must prepare a corrective action plan to address any findings or negative observations noted in the project audit report. The corrective action plan must address the immediate corrective actions and procedures that will be implemented to prevent recurrence of the problems noted.

Performance Evaluation Audits

Performance evaluation audits quantitatively assess the data produced by a measurement system. Performing an evaluation audit involves submitting certified samples for each analytical method. The matrix standards are selected to reflect the concentration range expected for the sampling program. The performance evaluation audit evaluates whether the measurement system is operating within the project control limit specified in this QAPP and the data produced meet the project and analytical quality control specifications.

The performance evaluation (PE) samples are prepared and submitted to the laboratory by the quality assurance group. Critical items for the performance evaluation audits are:

- Accurate identification of the analytes included in the PE samples
- Quantitation within acceptance limits
- Accurate reporting of results and any problems identified
- Acceptable analytical batch QC sample results

These items are used to identify when a system is outside acceptable control limits. Any problem associated with PE samples must be evaluated to determine the influence on field samples analyzed during the same time period. The laboratory must provide a written response to any PE sample result deficiencies.

Data Validation

Data validation is a data quality audit and is conducted to verify whether an analytical method has been performed according to the method and project specifications, and the results have been correctly calculated and reported. The responsible agency according to each contract will conduct the data validation prior to submitting the data to CVRWQCB. Specific items that are reviewed during data validation are:

- Chain of custody records
- Documentation of the laboratory procedures (e.g., standard preparation records, run logs, data reduction and verification)
- Accuracy of data reduction, transcription, and reporting
- Adherence to method-specific calibration procedures and quality control parameters
- Precision and accuracy of recorded results

Field Technical Audits

According to each contract the responsible agency routinely observes field operations to ensure consistency and compliance with sampling specifications presented in the QAPP. Audit checklists document field observations and activities.

E. REVISIONS TO THE QUALITY ASSURANCE PROJECT PLAN

The purpose of this section is to document significant additions, deletions and revisions to the approved QAPP for this project, and to provide the rationale for these changes. Because this is the first version of this QAPP, no further information is presented in this section.

F. REFERENCES

Azimi-Gaylon, S. 2000. Quality Assurance Project Plan for the San Joaquin River TMDL Unit.

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USGS. 1995. United States Geological Survey. Open-file report 95 -181. Method of Analysis by the U.S. Geological Survey National Water Laboratory Determination of Pesticides in Water.

G. ATTACHMENTS

Standard Operating Procedure (SOP) for Surface Water Sampling

1. PURPOSE

This SOP describes procedures for collecting surface water samples from main stems, tributaries and drainages in the Coalition area. A standard multi-vertical depth integrating method may be used to collect the samples. This SOP describes the planning, decontamination, sample collection and quality control (QC) procedures for surface water sampling.

2. TERMS AND DEFINITIONS

Grab sample	A sample collected from one location/depth
Composite sample	A sample comprised of a designated number of sub-samples that have been combined. A composite sample represents the waters overall composition.
Techma	Specially designed cage sampler that fits a 3L Teflon bottle and is generally attached on a rope and karabiner
QC	Quality control
COC	Chain of Custody

3. EQUIPMENT AND SUPPLIES

Field sheets, COC sheet, maps, Avery Weatherproof labels, sharpie permanent markers, clear tape
1L Amber Glass bottles and pole sampler
Cooler with ice
Field parameter meter
Decontamination supplies as 5-gallon carboy with DI water, Methanol, Liquinox soap, Methanol waste container
Gloves (nitrile) for safety and to eliminate cross contamination
Techma cage sampler with rope, bungee cord and karabiner; 3L Teflon bottle
Safety equipment: Life Preserver, Orange Safety Vest, Road Cones, Slow Sign

4. PROCEDURES

Surface water sampling involves the following steps:

4.1. Labeling the Sample Bottle

- Use pre-printed labels for each site. The label should include the site name, site ID number, date, sample time, and your initials
- Complete the printed label with an extra-fine-point Sharpie. Cover the entire label with a piece of clear tape to prevent peeling
- Use 24-hour military time for the sample time; round to the nearest 10 minutes. For example: a sample collected at 09:52 would have the sample time on the label and Chain of Custody (COC) form rounded off to 09:50; a sample collected at 09:57 would be rounded up to 10:00; 09:55 would also be rounded up to 10:00. Use the following format for the date: mm/dd/yy

Merced River @ River Road
Date_09/10/03____
Time_10:50_Initials_AW__
I.D. 11273500

4.2. Completing the Field Sheet

The sections below address the correspondent sections on the field sheet and describe the information that needs to be included.

Sampling Information Section

- Sampling Type is "total". Add sampler initials
- Sampler Bottle: 1L amber glass bottle or polyethylene bottle is used for grab sample, 3L Teflon bottle is used for bridge sample
- Sampling Method: vertical integrated grab is collected from a bridge, grab is collected from the bank
- Stage: will become apparent with experience, also can be researched later on the web. Note the stage of the staff gauge is present and calculate the discharge back in the lab.

Sample Collection Section

- Check box for collected constituents by noting the # of sub samples, e.g. (Color, Turbidity, TDS and TOC samples collected under Water Quality Parameters), that would be 4 sub samples.
- Environmental Sample (Time): Fill in the rounded sampling time in military time for the collected constituents
- If a quality control sample is scheduled, place a check type of sample

Field Measurements Section

Use Field parameter meter(s); Use the equipment calibration SOP to calibrate the field equipment. Allow the probe to soak in native water for a few minutes for the reading to stabilize. Note the values for temperature, pH, DO and EC on the field sheet along with the appropriate units (e.g. ^{o}C, mS, µS, mg O_2/L).

- BANK SAMPLE: measure directly from river edge
- BRIDGE SAMPLE: after pouring off the sample use excess water from the 3L Teflon bottle for the field measurements; rinse the probe and plastic container with water from the 3L bottle before pouring another portion into the measuring container. Measure water parameters soon after pouring off the sample so that conditions (temperature) do not change for example in hot weather conditions

At the end of the day fill the electrode storage cap with electrode storage solution before placing the meter in its case.

Recalibrate the Field parameter meters as recommended by vendor. Record recalibration date on a piece of labeling tap and affix to the inside panel of the meter case and make notes in the calibration logbook at the IOE.

Note anything significant or unusual on the back of the field sheet; for example waste disposal, irrigation runoff, foam on water surface, dead fish, etc.

Original field sheets stay with the ESJWQC Project Manager.

4.3. Collecting an Environmental Sample

Always wear clean gloves during the sampling procedure!

BANK SAMPLE

- Using bungee cord, affix a 1L amber glass bottle to the sampling pole
- Check to insure the bottle is secure
- Remove the cap (wear clean glove!)
- Immerse the bottle until bubbles stop. Fill completely; do not leave any headspace
- Replace the cap (still wearing the clean glove!)
- Rinse the outside of the bottle with deionized water
- Slip the bottle into a foam sleeve
- Place the sample directly into a cooler (up to 15 1L bottles can be placed in one cooler).
- Make sure there is no glass-to-glass contact

BRIDGE SAMPLE

1. Put on your orange safety vest. Always be aware of traffic and use caution while sampling from a bridge
2. At the van, put the 3L Teflon bottle into the TECHMA cage, secure it with the bungee cord (you will loose the bottle, if the bungee cord is not strapped around the bottle!), and remove the cap
3. Wearing leather gloves, carefully lower the bottle from the bridge railing to the water surface. Do not lower too fast or the bottle may be propelled from the cage upon impact. Perform a triple rinse with native water. Fill the bottle at least ¼ full for each rinse
4. To collect the sample, fill the bottle $1/4^{th}$ at each of three equally spaced verticals (submerge for about 3-5 seconds), being careful to avoid contact between the bottle and anything but river water, especially when moving between verticals
5. Return to the van
6. Remove the 3L bottle from the TECHMA cage and swirl the water until completely mixed
7. The second person has already labeled the sample bottle. While wearing clean gloves the second person removes the bottle cap and holds the sample bottle as the sampler pours from the 3L Teflon bottle into the sample bottle. After the sample bottle is completely filled the second person then recaps the sample bottle
8. Rinse the outside of the sample bottle with deionized water, place the bottle in a protective sleeve and store it in the cooler.

The last thing to do before filling any amber glass sample bottle, regardless of method, is to remove the lid. The first thing to do after filling any amber glass sample bottle, regardless of method, is to replace the lid. If you have more than one sample bottle to fill, remove each lid just prior to filling the bottle. The person that opens and closes the 1L Amber glass bottle always wears new clean gloves for this procedure and does not touch anything but the cap.

4.4. Cleaning the Sampling Equipment

Clean the 3L bottle after sampling with the following procedure:

- While wearing gloves, add 10% liquinox soap mixture (2-3 squeezes) and approximately 50ml of deionized water to the Teflon bottle. Place the cap on the bottle and swirl the soap around inside the bottle until the entire inside surface has been covered with suds. Un-cap the bottle and pour the soap onto the ground. Rinse the bottle and cap using deionized water until no suds remain inside the bottle or on the cap
- Poor 5-10ml of methanol into the bottle and swirl, with the cap on, until methanol has covered the entire inside surface of the bottle. Carefully pour the waste methanol into the methanol waste container. Seal the methanol bottle and waste container with Parafilm to prevent fume leakage. *Methanol is dangerous—do not inhale or touch!*
- The 3L bottle is ready for the next sampling and should be stored, with the cap on, inside the TECHMA cage

4.5. Collecting a Quality Control Sample

View the QC Schedule to find out which type of QC sample you should collect that day

- ***Field duplicate:***

Mark the sampling time of the duplicate sample by adding **3 minutes** to the time of the environmental sample (e.g. environmental sample collected at 14:00 then duplicate time is 14:03). **Do not** indicate *duplicate* on the label or on the COC!

BRIDGE SAMPLE

From the single 3L Teflon filled using the procedure above pour the collected water into two 1L bottles; one for the environmental sample and one for duplicate sample

BANK SAMPLE

Fill two 1L bottles with one reach of the pole sampler; one for the environmental sample and one for the duplicate.

-- ***Matrix Spike:***

For the matrix spike sample add **9 minutes** to the time of the environmental sample (e.g. environmental sample collected at 14:00 then spike time is 14:09) and mark as "matrix spike" on the **COC** *and* **label**. It should be made obvious so that the lab knows that this sample needs to be spiked.

BRIDGE SAMPLE

From the single 3L Teflon filled using the procedure above pour the collected water into two 1L bottles; one for the environmental sample and one for the matrix spike.

BANK SAMPLE

Fill two 1L bottles with one reach of the pole sampler; one for the environmental sample and one for the matrix spike.

-- ***Blank sample:***

Do not indicate blank on label or on COC. Time offset: add **1 minute** to the time of the environmental sample (e.g. environmental sample collected at 14:00 then blank time is 14:01).

BRIDGE SAMPLE

BEFORE TAKING ENVIRONMENTAL SAMPLE:

a) Rinse the clean 3L Teflon bottle three times with deionized water (approximately 50ml for each rinse)
b) Fill the 3L bottle 2/3 full with deionized water and pour into a 1L bottle for the blank.

BANK SAMPLE

Fill one 1L bottle with deionized water for the blank sample.

Whoever did not fill out the field sheet and COC should double-check all of the recorded times for completeness and error at the end of the sampling day!

Check ice level

The temperature of the ice chest should be around 4°C. Make sure to add ice if necessary.
If you can't manage to deliver the samples to the designated lab on time, make sure that there is enough ice in the cooler till the samples get delivered the following day.

5. Sample Delivery

Samples need to be delivered within 4 days to: Contracting Laboratory

6. Completing a Chain of Custody form

Complete a Chain of Custody form for each sampling day.

The original COC's will stay in the contractor's laboratory. Be sure to have lab personal make you a copy of the COC. Upon return, fax a copy of the COC to the ESJWQC Project Manager, then place our copy of the COC in the prepared folder at the IOE. After faxing, put your name, date, and time of fax on our copy and file it

Sample transfer between field staff and laboratory is documented by **signing and dating** "relinquished by" and "received by" blocks whenever sample possession changes.
The document must have both yours **and** the lab's signature before faxing it to the Coalition Project Manager.

ATTACHMENT 2: FIELD INSTRUMENT CALIBRATION SOP

Meter Calibration
Standard Operating Procedures

Purpose: This standard operation procedure (SOP) provides a detailed description for the calibration of the OAKTON Portable Waterproof pH/CON 10 Meter (Model #35630-02)

Note: All calibrations used pH/conductivity/temperature probes designed for the OAKTON Portable Waterproof pH/CON 10 Meter (Model #35630-02) only.

Step 1: Reset pH and conductivity to the factory defaults.

To reset pH, make sure the meter is in pH mode, then:

1.) While in measurement mode, press CAL/MEAS and hold for 3 seconds.
2.) The meter will prompt RST in the upper display and CAL in the lower display.
3.) Press enter to reset the meter to its factory defaults. The screen will flash all characters, then return to measurement mode once the meter is reset.

To reset conductivity, make sure the meter is in conductivity mode, and then follow steps 1-3 above.

Step 2: Preparing the pH/CON meter for calibration.

1.) Remove the protective rubber cap of the probe before calibration.
2.) Wet the probe in tap water for 10 minutes before calibrating or taking readings to saturate the pH electrode surface and minimize drift.

Step 3: 3-point (OAKTON pH 4.00, 7.00 and 10.00) pH calibration.

1.) If necessary, press the MODE key to select pH mode. The pH indicator appears in the upper right hand corner of the display.
2.) Rinse the probe thoroughly with de-ionized water or a rinse solution. Do not wipe the probe; this causes a build-up of electrostatic charge on the glass surface.
3.) Dip the probe into the calibration buffer. The end of the probe must be completely immersed into the sample. Stir the probe gently to create a homogenous sample.
4.) Wait for the measured pH value to stabilize. The READY indicator will display when the reading stabilizes.
5.) Press CAL/MEAS to enter pH calibration mode. The primary display will show the measured reading, while the smaller secondary display will indicate the pH standard buffer solution. Scroll up or down until the secondary display value is the same as the pH buffer value you are using (pH 4.00, 7.00 or 10.00).
6.) Wait for the measured pH value to stabilize. The READY indicator will display when the reading stabilizes.
7.) After the READY indicator turns on, press ENTER to confirm calibration. A confirming indicator (CON) flashes and disappears. The meter is now calibrated at the buffer indicated in the secondary display.

8.) The secondary display automatically scrolls to the next buffer calibration option. Scroll up or down to select the next buffer value you want to calibrate (pH 4.00, 7.00 or 10.00).
9.) Rinse the probe with de-ionized water or a rinse solution, and place it in the next pH buffer.
10.) Follow steps 5-8 for additional calibration points.
11.) When calibration is complete, press CAL/MEAS to return to pH measurement mode.

Note: If the selected buffer value is not within +/-1.00 pH from the measured value: the electrode and buffer icon blink and the ERR annunciator appears in the lower left corner of the display. These indicators also flash if the buffer used in not the same as the buffer value on the secondary display.

Step 4: Conductivity Calibration

1.) Pour out two separate portions of the calibration standard and one of deionized water into separate clean containers. Choose a calibration solution value that is approximately 2/3 the full-scale value of the measurement range (e.g. in the 0 to 1999 µS range, use a 1413 µS solution for calibration). A 447 µS standard solution is generally adequate in this study.
2.) If necessary, press the MODE key to select the Conductivity Mode. The µS or mS indicator will appear on the right side of the display.
3.) Rinse your probe with deionized water, then rinse the probe in one of the portions of calibration standard.
4.) Immerse the probe into the second portion of calibration standard. The meter's autoranging function selects the appropriate conductivity range (four ranges are possible). Be sure to tap the probe to remove air bubbles. Air bubbles will cause errors in calibration.
5.) Wait for the reading to stabilize. The READY indicator lights when the reading is stable.
6.) Press the CAL/MEAS key. The CAL indicator appears above the primary display. The primary display shows the factory default and the secondary display shows the temperature.
7.) Scroll up or down to the value of your conductivity standard. Press and hold the scroll keys to go faster. The meter automatically compensates for temperatures using a factor of 2.00% per C.
8.) Press the ENTER key to confirm calibration. Upon calibration, the CON indicator appears briefly. The meter automatically switches back into Measurement mode. The display now shows the calibrated, temperature compensated conductivity value.
9.) For calibration in other ranges (Maximum: 4 ranges) repeat steps 1 through 9 with the appropriate calibration standards.

Note: if the calibration value input into the meter is different from the factory default value displayed by more than 30%, the ERR annunciator appears in the lower left corner of the display. Clean probe with alcohol. Verify that your calibration standard is fresh and accurate.

*Steps were transposed from the OAKTON Portable Waterproof pH/CON 10 Meter (Model #35630-02) manual of operating instructions (68X230403 rev2 01 / 02).

ATTACHMENT 3: CLEANING EQUIPMENT FOR WATER SAMPLING SOP

STANDARD OPERATING PROCEDURE

Title: Sample Equipment Cleaning

SOP No: SJR TMDL 004

Revision No: 1

Effective Date: Oct 2001

References: SJR sample collection protocol, USGS Surface-Water Cleaning Procedures 1998.

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes procedures for field equipment cleaning during sampling events. In addition, this SOP describes the quality control (QC) procedures for each type of instrument cleaning.

2.0 APPLICABILITY

The procedures described in this SOP are applicable to standard equipment cleaning procedures. Cleaning methods are specified in this SOP.

3.0 TERMS AND DEFINITIONS

QC-	Quality Control
SOP-	Standard Operating Procedure
MeOh-	Methanol
DI-	De-ionized Water

4.0 EQUIPMENT AND PROCEDURES

4.1 Equipment and Supplies

- Latex gloves for cleaning when using potentially hazardous chemicals
- Clean zip-lock bags for cleaned containers
- Liqui-Nox soap for pre-rinse
- MeOh for final rinse
- Container for MeOh waste
- Container for 100% MeOh
- Container for DI water for rinsing

4.2 Procedures

1. Disassemble the used sampler into component parts (bottle, cap, nozzle) so that all of the pieces can be thoroughly wetted with various rinses. Discard the previously used holding bag (do not attempt to clean it for reuse).
2. Wearing appropriate disposable gloves, thoroughly rinse the sampler components with DI. Use a stream of DI from the wash bottle, if required.

3. If a 3-L Teflon sampler will be used for collecting samples for analysis of organic compounds only, change gloves. Follow the procedures listed below: Refer to the USGS Surface Water Cleaning Procedures 1998 for more information on cleaning procedures.
   - Use Liqui-Nox to wash out all applicable equipment. Use only 2 to 3 squirts from a squirt bottle since the Liqui-Nox is in high concentration
   - Rinse the cap and bottle of the 3-L Teflon sampler thoroughly with deionized water and Liqui-Nox until agitated rinse water produces no more suds.
   - Change to solvent resistant gloves.
   - Rinse the cap and bottle of the 3-L Teflon sampler with pesticide-grade methanol thoroughly.
   - Collect the used methanol into a container labeled "waste container" for safe storage and delivery for appropriate disposal.

4. Reassemble sampler once all the components are dried. If the sampler is dedicated to sampling for organic compounds, then double wrap sampler in plastic bags for storage and transport.

East San Joaquin Water Quality Coalition ________ Date: ____ - ____ - _______

AG WAIVER FIELD SAMPLING FORM

Site Name: ________________________ Start Time: ______________

Sampling Team: ____________________ End Time: ______________

Field Measurements

Water Temp.: ___________ pH: _________ EC: __________ DO: ____________

Flow: ___________ft/sec. Stage: _________ Water parameter taken (circle one): in situ / plastic container

Weather and water conditions

Weather: (circle one)

Sky: clear, partly cloudy, cloudy

Precipitation: none, light, medium, heavy, snow, mist

Wind: calm, light breeze, gusty

Temp: cool, cold, warm, hot

Stream conditions: (circle applicable)

Color: brown, green, blue, grey, turbid, clear

Stream Mixing: (circle one) Well-mixed, stratified, poorly mixed, unknown, other_____

Sampling information

Sampling type:_________ Sampler initials:__________ **Sampler bottle:** (circle one) Glass Teflon Plastic other: _________

Sampling location: (circle one or more): Wading, Boat, Bridge, Float, Upstream, Downstream, Right Bank, Left Bank (facing downstream)

Sampling method: (check one) vertical Integrated-grab, grab, # of sub samples in composite: _____

Samples collected

Samples Collected	Water Quality Parameters	Nutrients	Pathogens and THM's	Metals And Hardness	Pesticides	Water Column Toxicity	Sediment Toxicity
# Of sub samples or Comments							
Environ. Sample Times (24 hour)							
Field Duplicate							
Field Blank / Equipment blank							
Spike							