

Kern River Watershed Coalition Authority

Surface Water Monitoring Plan

Kern County, California • February 2015



Prepared for:



**Kern River
Watershed**
Coalition Authority

Prepared by:

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Kern River Watershed Coalition Authority

Surface Water Monitoring Plan

Revision 1

Kern County, California

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Prepared for:

Kern River Watershed Coalition Authority

Kern County, California

Prepared by:

Provost & Pritchard Consulting Group

Bakersfield, California

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This Surface Water Monitoring Plan is signed by the following certified professionals:

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Abbreviations

cfs	cubic feet per second
CVP	Central Valley Project
DPR.....	California Department of Pesticide Regulation
DWR	California Department of Water Resources
EPA	Environmental Protection Agency
ILRP.....	Irrigated Lands Regulatory Program
JPA.....	Joint Powers Authority
KCWA	Kern County Water Agency
KRWCA	Kern River Watershed Coalition Authority
MCL	Maximum Contaminant Level
MRP	Monitoring and Reporting Program
NRCS.....	Natural Resources Conservation Service
Order	General Order R5-2013-0120
PUR.....	Pesticide Use Report
QAPP	Quality Assurance Project Plan
Regional Board.....	Central Valley Regional Water Quality Control Board
SSJVWQC.....	Southern San Joaquin Valley Water Quality Coalition
SWAMP	Surface Water Ambient Monitoring Program
SWMP.....	Surface Water Monitoring Plan
SWP	State Water Project
SQMP	Surface Water Quality Management Plan
TDS	Total Dissolved Solids
TIE.....	Toxicity Identification Evaluation
TOC.....	Total Organic Carbon
TSS.....	Total Suspended Solids
TMDL.....	Total Maximum Daily Load
WQTL.....	Water Quality Trigger Limit



Executive Summary

The Kern River Watershed Coalition Authority (KRWCA) was formed in 2012 by several districts in Kern County in response to the Kern County Water Agency (KCWA) stepping down as the program manager for the Kern subwatershed portion of the Southern San Joaquin Valley Water Quality Coalition (SSJVWQC). The SSJVWQC was originally formed in 2002 to address water quality issues common to agencies in the Tulare Lake Basin in response to an order by the State's Central Valley Regional Water Quality Control Board (Regional Board) requiring monitoring and reporting programs by watershed coalition groups.. With the passing of General Order R5-2013-0120, the SSJVWQC will cease to be the implementing third party. Multiple third-party groups will implement the order in the Tulare Lake Basin, with each taking on responsibility of their respective regions or sub-regions. The original SSJVWQC's goal, being continued by the KRWCA, is to protect the quality and sustainability of water supplies and rights of its members and landowners.

The KRWCA will continue working with the Regional Board on behalf of its members to comply with the newly adopted General Order for the Irrigated Lands Regulatory Program (ILRP). The following report represents the KRWCA's Surface Water Monitoring Plan (SWMP) as required under the Regional Board Order No. R5-2013-0120. The KRWCA received its Notice of Applicability (NOA) to act as a third-party member on behalf of its growers on February 4, 2014.

Third-Party Area Description

The KRWCA covers most of the Kern River watershed portion of the Tulare Lake Basin. The Tulare Lake Basin is a closed-basin in the Southern San Joaquin Valley. The KRWCA sees the valley floor area as its Primary Area since it contains the bulk of the agricultural activity, with the mountain regions being considered as a Secondary Area due to the lack of farming. In total, the KRWCA's service area encompasses approximately 3.5 million acres.

The KRWCA now represents a majority of the original Kern River subwatershed portion of the SSJVWQC. The KRWCA represents primarily a majority of the Kern County valley floor but as a result of requirements set forth by the Regional Board is generally bounded by the crest of the Sierra Nevada Range on the east, the Buena Vista and West Kern Water Quality Coalitions on the west, the crest of the Tehachapi Range on the south, and the Kern County line on the north. Elevations range from approximately 200 feet above sea level on the valley floor to 14,500 feet above sea level at Mount Whitney near the headwater of the Kern River. The Kern River is the only perennial stream in the KRWCA and has an average annual flow of about 750,000 acre-feet. The north fork flows perennially into Lake Isabella. The south fork is an ephemeral stream as it nears the lake with flows occurring only during the winter and spring months.

Land Use and Management Practices

Irrigated agriculture is one of the largest land uses in the KRWCA, and had value of over \$6 billion in 2013 in Kern County alone. Top commodities varied from tree and vines to row crops that included grapes, almonds, citrus, pistachios, carrots, potatoes, hay, alfalfa and many others. Other land uses in the KRWCA area include pasture lands, urban lands and natural lands.



Although a large amount of the region is dominated by irrigated agriculture, much of the potential exposure is mostly eliminated due to the current and on-going management practices used. Growers in the area have begun to implement management practices in the area that are very innovative for both organic and conventional farming. These techniques are both effective and efficient for getting the most production out of their crops. Irrigation applications are generally timed for maximum benefit and reduction of tailwater generation, where applicable. Irrigation applications by growers are dominated by the use of pressurized systems, such as sprinklers and low-volume drippers and sprinklers. Land management practices have also changed over time. Pest and fertilizer management practices are constantly evolving and being incorporated.

Potential Discharges, Pollutants, and Water Quality Problems

Agricultural discharges in the KRWCA's boundary area are very limited for a variety of reasons. Primary reasons for this is due to limited annual rainfall, the scarcity and value of water and due to the fact that districts in the area generally do not allow discharges to surface water.

Data collected to this point by the SSJVWQC has not shown any persistent problems with agriculturally related discharges of pesticides in the KRWCA area. There is still high potential for exposure due to the region being dominated by irrigated agriculture; however, it is the belief of the KRWCA that because of the management practices used by growers in the area, more real risk may be attributed to spray drift, not irrigation or storm discharges. Due to the arid nature of the region, growers have become very efficient and effective with their use of water and other resources. Irrigation applications, land management, and pest and fertilizer practices have begun to be implemented that reduce the amount of discharges and pollutants used that could find their way to a water resource.

The monitoring in the KRWCA has not triggered a specific management plan to date. With continued public awareness and outreach, the KRWCA hopes to avoid triggering a specific management plan.

Surface Water Monitoring Plan Overview

The KRWCA and its Members are committed to continued development and implementation of a science-based water quality monitoring program designed to determine actual and potential water quality impacts on beneficial uses from agricultural operations in its area. The KRWCA is committed to continuing a monitoring strategy that takes the knowledge gained from the previous Monitoring and Reporting Program (MRP) and expands upon it to ensure that KRWCA surface waters' beneficial uses are protected from influences from agricultural operations.

This document represents the KRWCA's SWMP for the MRP requirement under the Regional Board Order No. R5-2013-0120. KRWCA's SWMP provides information that determines whether discharges, if any, are in compliance with the conditions of the Order, including compliance with applicable water quality standards. The monitoring strategy in the KRWCA SWMP expects to primarily utilize Core Monitoring, Ephemeral Monitoring, and Representative Monitoring. If deemed necessary and useful, Assessment Monitoring and Special Project Monitoring may also be incorporated into the KRWCA monitoring strategy. In addition, this SWMP updates the previous MRP to answer key Program questions listed in the current Order:

1. Are receiving waters to which irrigated lands discharge meeting applicable water quality objectives and Basin Plan Provisions?



2. Are irrigated agricultural operations causing or contributing to identified water quality problems? If so, what are the specific factors or practices causing or contributing to the identified problems?
3. Are water quality conditions changing over time (e.g. degrading or improving as new management practices are implemented)?
4. Are irrigated agricultural operations of Members in compliance with the provisions of the Order?
5. Are implemented management practices effective in meeting applicable receiving water limitations?
6. Are applicable surface water quality management plans effective in addressing identified water quality problems?

Conclusions

The KRWCA takes its role as a third-party member seriously. The goal of the KRWCA is to continue the success of agriculture in its boundary while also maintaining quality and promoting sustainability of the water resource. With an existing MRP already in place, the KRWCA has the ability to preliminarily address the Regional Board's MRP Objectives by answering the six questions set out in the Order.

1. Receiving waters of irrigation and storm discharge regularly and consistently have been within standards provided by the State. Continuing the monitoring effort and management through this SWMP and Order is expected to continue to protect receiving waters.
2. Sources from agricultural operations that may contribute to water quality problems include sediment transport and pesticide use, however, these discharges are mostly captured on site and not discharged into surface water bodies. When exceedances in toxicity and/or constituents occur, continued monitoring and investigation to determine the specific causes will be pursued.
3. Water quality conditions in the KRWCA area should be improving as new innovative management practices are implemented. Monitoring should confirm this. Management practices, for the most part, reduce agricultural discharges to surface waters, which in turn reduces the potential pollution from constituents.
4. At this point in time, most Member irrigated agricultural practices are in compliance with provisions of the Order that have gone into effect. Surface water provisions have been implemented from previous MRP efforts, but as more provisions go into place with continued implementation of the newly adopted Order, the KRWCA will continue to assist members in staying compliant.
5. The growers within the KRWCA have been implementing innovative management practices for some time. These practices contribute to the reduction and/or elimination of agricultural runoff from fields. Irrigation management, pesticide application, field and soil preparation, and harvest management practices all contribute.
6. At this point in time, no management plans have been triggered in the newly formed KRWCA boundary. However, if circumstances change and trigger the need for a surface water quality



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management plan, the KRWCA believes it can develop effective plans for addressing any quality issues.

Table ES-1 relates the MRP requirements of the Order to the applicable section where that requirement is addressed in the SWMP.



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Table ES-1. Applicable SWMP Sections to Address MRP Questions

Applicable SWMP Sections to Address MRP Questions		
MRP Requirement	Requirement	SWMP Section
Q #1	Are receiving waters to which irrigated lands discharge meeting applicable water quality objectives and Basin Plan provisions?	2
Q #2	Are irrigated agricultural operations causing or contributing to identified water quality problems? If so, what are the specific factors or practices causing or contributing to the identified problems?	2, 3
Q #3	Are water quality conditions changing over time (e.g., degrading or improving as new management practices are implemented)?	2
Q #4	Are irrigated agricultural operations of Members in compliance with the provisions of this Order?	3
Q #5	Are implemented management practices effective in meeting applicable receiving water limitations?	2, 3
Q #6	Are the applicable surface water quality management plans effective in addressing identified water quality problems?	2, 8



1 Introduction

The Kern River Watershed Coalition Authority (KRWCA), a Third-Party representative in Kern County, has prepared this Surface Water Monitoring Plan (SWMP) in accordance with the guidelines associated with the Monitoring and Reporting Program (MRP) of Order R5-2013-0120 Waste Discharge Requirements for Growers within the Tulare Lake Basin Area (Order). This SWMP will serve as the work plan for all aspects of the monitoring and reporting required by the Order to manage the quality of surface water within the KRWCA boundary as part of the Irrigated Lands Regulatory Program (ILRP).

1.1 Kern River Watershed Coalition Authority Background

The KRWCA is a joint powers authority (JPA) that was formed in 2012 by most of the irrigation and water districts in Kern County in response to the Kern County Water Agency (KCWA) stepping down as the program manager for the Kern Subwatershed portion of the Southern San Joaquin Valley Water Quality Coalition (SSJWQC). The SSJWQC was originally formed in 2002 to address water quality issues common to agencies in the Tulare Lake Basin in response to the Central Valley Regional Water Quality Control Board (Regional Board) requiring monitoring and reporting programs by watershed coalition groups. For the last two years the KRWCA has managed the Kern subwatershed valley floor portion of the SSJWQC, however with the passing of the Order, the SSJWQC is ceasing to be the implementing third party. Third-party member coalitions representing each subwatershed area are now taking on responsibility for their respective regions or sub-regions.

The KRWCA, which received its Notice of Applicability (NOA) to be a Third-Party member under the new Order on February 4, 2014, covers a majority of the original Kern Subwatershed area on the Central Valley floor (as the primary area), along with the upstream mountain portion of the Kern River Watershed (as a secondary coverage area). The KRWCA boundary grew to the secondary coverage area in response to the Regional Board requirement that third-party members must cover the entire Tulare Lake Basin Area from “mountain crest to crest.”

The goal of the KRWCA, taken over from the SSJWQC, is to protect the quality and sustainability of water supplies and rights of its members and landowners. The KRWCA and its Members plan to continue monitoring efforts and advocacy that will protect and improve water quality and facilitate the success of its grower members.

1.1.1 Member Districts

The KRWCA signed a Joint Powers Agreement between local irrigation and water districts that joined together to represent growers located in the Kern County area. The member districts include:

- Arvin-Edison Water Storage District
- Henry Miller Water District
- Kern Delta Water District
- Kern-Tulare Water District
- North Kern Water Storage District



- Olcese Water District
- Rosedale-Rio Bravo Water Storage District
- Semitropic Water Storage District
- Shafter-Wasco Irrigation District
- Wheeler Ridge-Maricopa Water Storage District

It should be noted that the existing KRWCA formation consisting of water districts may switch to a landowner or grower based entity (i.e. non-profit organization or other).

1.2 Description of Coalition Group Area

The KRWCA is located entirely within the Kern River Subwatershed at the southern end of Regional Board 5. The Kern River Subwatershed area is primarily the Kern County valley floor with a secondary area generally bounded by the crest of the Sierra Nevada Range on the east, the Buena Vista and Westside Water Quality Coalitions on the west, the crest of the Tehachapi Range on the south, and the Kern County line on the north. Elevations range from about 200 feet above sea level on the valley floor to 14,500 feet above sea level at Mount Whitney near the headwater of the Kern River. The KRWCA boundary area is broken into Primary and Secondary areas as shown in **Figure 1-1**. The Primary area, which contains most of the irrigated agriculture of the KRWCA, encompasses approximately 1,024,000 acres in total area. The Secondary area, which primarily contains the mountainous regions and little to no agriculture, adds an additional 2,556,000 acres. The total boundary covers approximately 3,580,000 acres however only about 645,000 acres are typically irrigated.

1.2.1 Kern River

The Kern River is the only perennial stream in the subwatershed. It has an average annual flow of about 750,000 acre-feet. The north and south forks of the Kern River are impounded in Lake Isabella near the eastern edge of the subwatershed. From the Isabella Reservoir, the river flows some 30 miles southwest through a steep and rugged canyon, eventually emptying out on the valley floor. The eastern edge of the valley is marked by foothills that gradually flatten to the valley floor.

The north fork of the Kern River flows perennially into Lake Isabella and is characterized by steep canyon walls with no significant industry. The town of Johnsondale, a former logging community, is located about 20 miles upstream of Kernville. The town of Kernville is located roughly two miles above Lake Isabella. Recreation and fishing are the primary activities on the north fork. Much of the Kern River upstream of the mouth of the Kern River Canyon is designated as a wild and scenic river.

The south fork of the Kern River is an ephemeral stream as it nears Lake Isabella. Several communities exist adjacent to the south fork of the Kern River, including Onyx and Weldon. Generally, flows occur in this stretch of the Kern River during the winter and spring months. It is common for the south fork to dry up completely during the summer and fall. Cattle ranching became the main economic activity within the Kern River Valley during the latter half of the 1870s. Agricultural uses and ranching still contribute both to the economy and to the area's history and heritage. Roughly, 1,000 acres of



harvested cropland are located in the area. A recent land use survey showed crops within the Valley include alfalfa, pasture and grains.¹

Lake Isabella captures flows from the north and south forks of the Kern River behind a 185-foot high earthen dam capable of storing 568,000 acre-feet. The lake lies at an elevation of 2,605 feet above sea level, covers 11,000 acres, and has 38 miles of shoreline when full. However, Lake Isabella is under restrictions by the Army Corps of Engineers not to exceed an elevation of 2,585.5 feet due to the presence of an earthquake fault line near the earthen dam. This elevation restriction limits the capacity of Lake Isabella to 361,250 acre-feet, or 63.6% of maximum.

Once the Kern River reaches the valley floor, water flows through First Point of Measurement, a flow measuring point established in 1893 and continuously used since then. First Point of Measurement is upstream of the major diversion points on the river. Flows at First Point are allocated among water right holders. Just west of First Point is the Beardsley Canal head gate, the first major diversion point for Kern River water, which conveys the water to lands generally north of the river. The North Kern Water Storage District (WSD) operates the Beardsley Canal. Occasionally, North Kern WSD delivers surface water into Poso Creek for direct groundwater recharge. Because the Beardsley Canal diversion point is upstream of the Friant-Kern Canal, there is no potential for Friant-Kern storm water to enter North Kern's service area.

North Kern WSD operates two groundwater recharge areas for seasons when available water supplies exceed its instantaneous demands (i.e., power flows on the Kern River). When demands exceed supplies, it recovers the water and pumps it back into the Beardsley Canal for distribution.

In wetter seasons, North Kern WSD may also use the Calloway Canal to deliver water to its landowners and for groundwater recharge. The Calloway Canal also begins upstream of the Friant-Kern Canal.

The Kern Delta Water District diverts Kern River water to agricultural areas south of the Kern River, and to lands that historically were under the Kern Lake bed. When the Kern Lake and Buena Vista Lakes were in existence, Kern River water fed both lakes via Connecting Slough. Extensive wetlands were associated with the lakes and Connecting Slough. However, since the construction of Isabella Reservoir and because of upstream diversion and use of Kern River water, Connecting Slough is no longer in existence.

The City of Bakersfield delivers its First Point water rights to local water districts for agricultural uses. Some of the water districts are downstream of the Friant-Kern Canal terminus. However, the City of Bakersfield effectuates its deliveries to these agricultural water districts via the Beardsley Canal and/or River Canal.

Twenty miles downstream of First Point is Second Point of Measurement on the Kern River channel, another measuring point established in 1893 as required by the Miller-Haggin parties, which pre-dates a water master on the Kern River. The Buena Vista Water Storage District is the largest water right holder at Second Point of Measurement. Water is diverted from the Kern River or River Canal into the Eastside and Westside Canals, where it flows northerly to serve landowners within the Buena Vista WSD. Today, there is generally only water at Second Point when Kern River runoff exceeds about 150 percent of normal.

¹ Kern County Water Agency land use survey for South Fork, May 2009.



The Eastside and Westside Canals are on the borders of the Buena Vista WSD. All turnouts from the canals are made via Waterman gate valves. The canal banks are well maintained and scraped free of vegetation, providing essentially no habitat beneficial uses.

The Semitropic WSD operates a canal system that bisects the northern portion of the Buena Vista WSD from east to west. The canal system conveys water through pipes or lined canal from the California Aqueduct to its intersection with Semitropic's in-district distribution system. A turnout exists from the canal into the Eastside Canal, providing opportunity for State Water Project water deliveries to be made to waterfowl areas in the Goose Lake Slough area.

At the northern end of the Buena Vista WSD, beneficial uses of water change to wildlife habitat (WILD) because of the existence of duck clubs and waterfowl areas. Most of these receive surface water service from the Eastside Canal. Just south of Highway 46, the Eastside and Westside Canals merge with the Goose Lake Slough. This slough flows north approximately 15 miles to the northern Kern County line. Because of poor soil conditions, no agriculture exists north of Highway 46 in this area.

The Kern River's terminus is at the Kern River-California Aqueduct Intertie, a 3,500 cfs structure is designed to introduce flood flows from the Kern River into the California Aqueduct. This facility is only used during high flow events on the Kern River, although flows from the Kaweah and St. Johns Rivers (via the Friant-Kern Canal) have occasionally been diverted into the Kern River and through the Intertie. The State Department of Water Resources takes monthly water quality samples and analyzes them for inorganic chemistry and pesticides.² Analysis of the data during events when the Intertie was open shows that the Kern River water actually improves the water quality in the California Aqueduct, particularly electrical conductivity.

1.2.2 Friant-Kern Canal

The Friant-Kern Canal (FKC) flows from north to south (San Joaquin River watershed/Millerton Lake near Fresno to Kern River), along the eastern edge of the valley floor, providing irrigation water for several federal water contractors in Fresno, Kings, Tulare and Kern Counties. Surrounding lands slope gently from east to west. The FKC's design is such that rainfall runoff from the eastern foothills is introduced into the Canal to reduce flooding risks and to augment surface water supplies.³ A number of Inlet drains are located within the Kern River subwatershed. It is not yet known how many of these drains allow storm runoff from agricultural fields to enter the Canal. The federal Central Valley Project (CVP) determines the policies and practices governing input of storm water into the FKC, and conducts their own monitoring. The KRWCA exercises no authority over the FKC; thus we view this conveyance as not being eligible for KRWCA monitoring. A sanitary survey of the FKC was completed in 1998. The sanitary survey was updated in 2009.

Water districts and customers that take delivery of water from the FKC within the KRWCA boundary have either concrete-lined or piped distribution systems. Water turned out on the west side of the FKC is generally gravity fed, while turnouts on the east side of the FKC are generally pressurized. At the southernmost point on the FKC, it terminates to the Kern River. During high flow events, excess Friant

² See http://www.water.ca.gov/waterdatalibrary/waterquality/station_county/project_parameters.cfm for historical data at Tehachapi Afterbay (Check 41), which is downstream of the Kern River-California Aqueduct Intertie.

³ Keller-Wegley Engineering. 1998. Sanitary Survey for the Friant-Kern Canal, a report prepared for the Friant Water Users Authority



Division CVP water is diverted into the Kern River channel in Bakersfield. The water is used for groundwater recharge in the Kern River channel or re-diverted downstream into large groundwater recharge facilities on the Kern River Fan (e.g., Kern Water Bank, Pioneer Banking Project, City of Bakersfield's 2800 Acres). In this way, storm water intercepted into the FKC can affect downstream beneficial uses.

1.2.3 State Water Project

The State Water Project (SWP) provides water to Kern County via the California Aqueduct, which travels from north to south on the western portion of the valley floor and into the greater Los Angeles basin. The California Aqueduct does not allow storm or irrigation water to be intercepted, the opposite design philosophy from the CVP, except in the joint reach of the California Aqueduct south of San Luis Reservoir (storm water is intercepted in this joint reach, which does not stretch to Kern County).

At the northwestern portion of Kern County, turnouts deliver SWP water into lined or piped distribution systems. The Semitropic WSD operates a number of turnouts, one of which is intertwined with the Goose Lake Slough. The Cross Valley Canal intersects with the SWP just north of the Kern River and transports SWP water to districts to the east. From this point, SWP water is delivered through various district conveyance systems.

1.2.4 Groundwater Banking Facilities

Various water districts in Kern County have developed groundwater banking and water management programs whereby surface water is recharged during periods of high flow and recovered for use during periods of low flow. In order to facilitate deliveries of previously banked or surface water, several water districts have agreements with the State Department of Water Resources (DWR) to turn in/deliver water into the California Aqueduct. These include the Semitropic WSD, Buena Vista WSD, Kern Water Bank, Kern County Water Agency, Rosedale-Rio Bravo WSD, Arvin-Edison WSD, and Wheeler Ridge-Maricopa WSD. Specific water quality criteria govern such inputs of water into the California Aqueduct. A facilitation group is responsible for reviewing plans and existing quality information and approving the district's plans to introduce water into the SWP.

Each water source is tested for Title 22 constituents prior to its being approved for input into the California Aqueduct. At start-up, each source is tested for constituents of concern (Arsenic, Bromide, Chromium-6, Nitrate, Sulfate, Total Organic Carbon, Total Dissolved Solids, and Uranium).

1.2.5 Minor Creeks and Streams

Poso Creek is the largest of Kern's minor streams and flows from the mountains northeast of Bakersfield to the valley floor (just east of Highway 46 and Highway 99). Poso Creek is monitored by the Cawelo Water District Coalition. Flows on Poso Creek average 20,000–25,000 acre-feet annually, as measured at a stream gage located at Coffee Canyon. The stream gage is operated by Kern County Water Agency (Agency). The creek flows through Cawelo WD, North Kern WSD and Semitropic WSD, terminating in the Kern National Wildlife Refuge and the Goose Lake Canal. In very large flood years it historically has broken out of its channel and flooded lands in the vicinity. Cawelo WD and North Kern WSD often use the dry creek bed for intentional groundwater recharge. Occasionally, Semitropic WSD diverts Friant-Kern water it obtains into Poso Creek for recharge and uses the creek to distribute surface water. Poso Creek is an ephemeral stream that almost never flows the entire year. The U.S. Geologic Survey started



maintaining a stream gauge on Poso during the 1980s. The location of the gauge is in the foothills roughly eight miles east of Highway 65 (which marks roughly the eastern edge of agriculture in the valley) at Coffee Canyon. Hydrographs of this data published by the Kern County Water Agency show that the creek generally runs dry in June-July. The hydrographs are interesting because they reveal that, even in wet years (i.e., Kern River runoff at least 150 percent of normal) Poso Creek does not flow year-round. During flood flow events, Kern River water may be diverted into Poso Creek for recharge. While flowing through its watershed, Poso Creek may pick up petroleum products as it flows through the Mount Poso and Poso Creek oil fields. These fields contain extra heavy crude and are difficult to recover without steam injection technology. We understand that NPDES permits govern all oilfield wastewaters that may be discharged to Poso Creek.

Other minor streams within the KRWCA are quite small with small peak flows and short flow durations typically during large storm events or extremely wet years. Other minor streams include Caliente Creek, San Emigdio Creek, Tecuya Creek, El Paso Creek, Pleitito Creek, and Pleito Creek (Pleitito Creek flows into Pleito Creek). **Figure 1-2** shows the various waterways in the KRWCA area. In very wet years, Caliente Creek has flooded its banks and caused damage to both crops and residential structures. Generally, these minor streams tend to have very low base flows with occasional peaks of short duration (a few hours to days). These minor stream watersheds drain to the north and terminate within the alluvial soils located in the foothills of the San Joaquin Valley.⁴ No useable aquatic habitat is available in any of the minor streams because of the fact that they so seldom have flows of sufficient duration to sustain a fishery. Terrestrial and burrowing animals are found throughout the creek prisms highlighting the amount of dryness.

These creeks do not discharge into a surface stream or waterway, and most of the water evaporates or percolates to groundwater. These creeks are not listed as impaired under the Clean Water Act section 303(d) list (updated 2010) nor the Regional Board's 2010 triennial review of the Water Quality Control Plan for the Tulare Lakebed Basin. Crops around these creeks also tend to have high efficiency irrigation methods, such as drip irrigation, resulting in little to no runoff of a field.

Tecuya Creek flows out of the southern mountains onto the valley floor. It parallels the California Aqueduct just south of the Tejon Industrial Complex. When water is flowing in the creek, its quality ranges from 1,000 to 2,500 mg/L TDS⁴. From its point of emergence from the mountains to north of the Tejon Industrial Complex, there is no agriculture along the creek. Tejon Ranch Corp is restoring the portion of Tecuya Creek that borders the western boundary of the Tejon Industrial Complex.⁴

San Emigdio Creek flows out of the southern mountains onto the valley floor, crossing over the California Aqueduct approximately one-half mile north of Highway 166. Historically, the creek channel ended at approximately Copus Rd and from there meandered across its alluvial fan. The creek routinely flooded farm fields and other adjacent lands, depositing heavy loads of silt (which would subsequently alter the creek's flow path). After flood events in the early 1980s, landowners in the area constructed a confined channel north of Copus Rd to prevent flooding of their adjacent lands. At this time, the confined flood channel (owned and operated by the adjacent landowners) ceased as a natural water body. South of Highway 166 to the mountains there are no agricultural activities. The creek bed itself is generally barren, although a few scattered tamarisk trees and other bushes can be found. Historically, between Highway 166 and the California Aqueduct, the creek is bounded on the east and west with drip

⁴ Tejon RanchCorp. 2009. Tehachapi upland multiple species habitat conservation plan draft environmental impact report. Available at <http://www.tejonranch.com/conservation/habitat-conservation-plan/>.



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irrigated citrus. North of the California Aqueduct the creek adjacent lands are primarily drip-irrigated grapes. Under the previous Conditional Waiver, discussions with landowners north of Copus Road led to removal of potential discharge points where irrigation runoff could have entered the channel.

Pleito Creek flows out of the southern mountains onto the valley floor, crossing over the California Aqueduct approximately one-half mile north of Maricopa Hwy. Historically on the south of the California Aqueduct, crops bordering the creek include drip irrigated grapes, nectarines, and citrus. North of the California Aqueduct, crops bordering the creek historically include drip irrigated almonds and nectarines. North and south of the California Aqueduct, a high levee or berm channelizes both sides of the creek, primarily to protect the adjacent high value permanent crops from flood flows originating in the upper watershed. The creek bed is essentially barren, providing very little aquatic or terrestrial habitat.

Grapevine Creek flows out of the southern mountains near Interstate 5 and travels in a southeasterly direction. A high berm channelizes both sides of the incised creek. Very little irrigated agriculture exists on Grapevine Creek until it reaches Laval Road. At Laval Rd, approximately one quarter-section of drip-irrigated grapes borders the eastern edge of the creek. Approximately one mile north of Laval Rd, the creek bisects more drip-irrigated grapes. Past inspection of the creek bed and surrounding agriculture revealed no opportunities for either storm or irrigation water to enter the creek.

Pastoria Creek flows out of the southern mountains and flows through agriculture just north and south of Laval Rd. The creek is bermed on both sides to channelize its flow and is relatively barren. Agriculture adjacent to the creek has historically been drip-irrigated almonds or drip-irrigated vines. At Laval Rd, the creek completely loses its natural character and becomes integrated into a water conveyance lateral. Past inspection of the creek bed and surrounding agriculture revealed no opportunities for either storm or irrigation water to enter the creek where it maintains its natural character south of Laval Rd.

El Paso Creek flows westerly from the mountains onto the valley floor. Most of the watershed contains non-irrigated lands in the Sierra foothills used primarily for grazing. As the creek moves west towards the valley floor, it bisects a number of crops, primarily carrots, potatoes, and drip irrigated pistachios and vines. The micro irrigation systems effectively eliminate the possibility of irrigation runoff from entering the creek. Inspection of the creek identified a few locations in which storm water could enter the creek. North of Sebastian Road, the creek begins to move northwest through fields while losing much of its natural character. Continuing north, the creek finally reaches its terminus at David Road.

Tejon Creek flows westerly from the mountains onto the valley floor. Just east of the Arvin-Edison Canal and Tejon Spreading Grounds, drip irrigated grapes are the primary crops surrounding the creek. When the creek enters the Tejon Spreading Grounds, it is bounded on both sides by a high berm, bisecting this spreading facility from east to west. Once it emerges from the western side of the Tejon Spreading Grounds, the creek continues on a westerly course for two miles, then turns north for about another mile, at which point the creek becomes undefined. The creek bed's small native and non-native bushes, trees and grass (e.g., *Nicotiana* spp., *Tamarix* spp., *Avena* spp.) along the banks have historically provided some terrestrial habitat value. Irrigated acreage bordering this portion of the creek changes to primarily vegetable and field crops. Drainage pipes have been removed that drained irrigation water into the creek.

Caliente Creek is a 20-mile ephemeral stream flowing out of the eastern foothills. Tehachapi Creek runs into Caliente Creek just upstream of the valley floor. Once it crosses Edison Highway, the creek channel spreads out into an alluvial fan and becomes undefined. Historically, flows on Caliente Creek have



caused flooding problems for agricultural lands in the Edison area, as well as for the City of Lamont. The County of Kern has installed several bermed ponds east of Lamont to reduce flooding by Caliente Creek. The creek's water is known to be very turbid with fine-grained materials, which tend to plug the surface pores of agricultural lands. The Kern County Water Agency has taken electrical conductivity measurements on Caliente Creek with a field meter for a number of years (upstream in the watershed). Typically, electrical conductivity is 600-700 μmhos . This is typical of the southern minor streams from Caliente Creek south. Flows on Caliente Creek are even less frequent than Poso Creek. Crops grown along Caliente Creek include a wide range of annual and permanent plantings. The majority of the crops are drip or sprinkler irrigated.

1.2.6 Water Conveyance Facilities

Paloma Ditch is all that remains as evidence of what was known as Connecting Slough, which historically connected the Kern and Buena Vista Lake beds. Channelization of the Kern River, upstream diversion and use of Kern River water, and the construction of Isabella Reservoir had all combined many decades ago to eliminate the natural lakes and marshes which existed in the southern end of the San Joaquin Valley. An on-farm ditch remains now, known over the last many decades as the Paloma Ditch. This ditch has fixed terminal ends, several intermediate interruptions and has no connection to any waters of the state. The ditch actually consists of three separate components, permanently divided at land ownership transitions. Each component is part of an independent, privately owned and operated on-farm irrigation system. No water is comingled among the separate components. Each separate system is operated to retain water on-farm for irrigation use. There is no potential for water to leave the system to reach waters of the state.

The Kern River Outlet Canal historically received outflows from the ancient Buena Vista Lake and transported it along the west side of the southern San Joaquin Valley to Tulare Lake. The Kern River Outlet Canal was historically known as the Buena Vista Slough. With construction of Isabella Dam, the outlet canal received far less flows, essentially wiping out seasonal flooding along the canal.⁵ Flooding is now limited to extremely wet years (1983 was the last time that significant Kern River water was exported north out of Kern County via the Kern River outlet canal).

At roughly the intersection of Stockdale Hwy and Interstate 5 sits the Tule Elk State Natural Reserve, a 950-acre reserve for Tule Elk in Tupman, California. The primary water source for the Reserve is groundwater, although surface water is occasionally provided on approximately 65 acres of historical wetlands (a.k.a. "elk pen") for direct recharge by Buena Vista Water Storage District; which is not under any obligation to provide water to this wetland. From this point north to the county line, the Kern River Outlet Canal flows through mostly native vegetation, with scattered fields of grain and alfalfa. North of Highway 46, the Outlet Canal flows approximately 15 miles to the Kern County line. Only scattered agriculture is found here due to the poor soils and poor groundwater quality, consisting of grains and alfalfa.

⁵ Conrad ET, Waldron G. 1990. Tule Elk Management in the California State Park System: The Tupman Tule Elk Preserve today. Proceedings of the Western States and Provinces Elk Workshop. Found at <http://www.muledeerworkinggroup.com/Docs/Proceedings/1990-Western States and Provinces Elk Workshop/Tule Elk Management in the California State Park System.pdf>.



The James Canal used to convey Kern River water, when available, across the now-defunct James-Pioneer Improvement District. Much of the Improvement District is now developed to groundwater banking facilities or is urbanized. The upper portion of the James Canal has been filled in for urban development, such that its historical connection with the Kern River is cut off. A section of the James Canal is used to convey surface water for recharge to various percolation basins of the Kern Fan groundwater banking facilities. There are no longer opportunities for storm or irrigation runoff to flow into the James Canal.

1.2.7 Soils

A wide variety of soil types cover the KRWCA boundary ranging from sand and silt alluvial deposits on the valley floor in the Primary Area to rock in the mountainous Secondary Area. Soils near the Kern River as it leaves the Kern Canyon in the foothills tend to be coarser textured, sandy soils and become finer as they spread over the Kern Fan on the valley floor in the KRWCA. These alluvial soils are what have made the primary area of the KRWCA extremely fertile and allowed for great agricultural production. Generally slopes in the primary area, where most agricultural activities occur, are flatter with slopes ranging from 0% to 2%. **Figure 1-3** is a map showing the wide variety of the soils located in the Primary Area of the KRWCA due to the alluvial spreading of the various creeks and streams. **Figure 1-4** is a map showing the generalized soil textures based on the various soil classes. This figure better depicts the change from coarse to fine soils deposited by the Kern River and other creeks as they leave the mountain regions and ponded in the former Kern and Buena Vista Lake beds. Additionally, this figure shows that the soils in the KRWCA can be grouped further into six distinct regions. For the most part, medium grained soils dominate the valley floor, while the west and southwest regions in the former lake beds have finer grained soils.

1.2.8 Climate & Hydrology

The climate in the KRWCA can be defined as a desert based on the amount of rainfall it receives. Desert regions are defined as receiving less than 10 inches of rainfall annually. The long-term average rainfall in the KRWCA is well below that limit at just above six (6) inches, based on historical statistics for the City of Bakersfield. Nearly 80% of the rainfall occurs between November and March, when most crops are not being irrigated. Rainfall during summer months, when irrigation is at its highest is basically negligible. A summary of the temperature and precipitation for the Primary Area of the KRWCA is provided in **Table 1-1**.

Storm intensities are generally insufficient to induce large runoff, except from impervious surfaces such as roads and parking lots typical of urban infrastructure. On the valley floor, average monthly rainfall during the wettest month of the year is only 1.16 inches, or an average of just over 0.04 inches per day. While rainfall intensities can vary, it is clear that generally, rainfall on the valley floor does not generate sufficient runoff volumes of concern.

Temperature in the KRWCA can be classified as hot summer months with mild to cool winter months. Irrigation is at its peak during the summer months when temperatures can easily surpass 100 °F during the day. Winter months are generally fairly mild, but temperature can drop below freezing during nights, which can become problematic for citrus growers in the KRWCA. Some citrus growers use irrigation water in the winter to prevent crops from freezing.



1.2.9 Beneficial Uses

The Second Edition of the Tulare Lake Basin Plan (2004) was reviewed for listed surface water beneficial uses in the KRWCA. As the KRWCA Secondary Area includes the Kern River watershed in the mountainous regions of the Sierra Nevada Mountains, all beneficial uses (MUN through FRSH) are listed.

Table 1-2 depicts Table II-1 from the Basin Plan. However, since the primary focus of the General Order is impacts from irrigated agriculture, only the beneficial uses below Lake Isabella are listed since almost all agriculture in the KRWCA occurs in the primary area on the Valley floor. The beneficial uses below Lake Isabella have been identified as:

- | | |
|----------|---|
| 1. MUN | Municipal |
| 2. AGR | Agricultural Supply |
| 3. IND | Industrial Service Supply |
| 4. PRO | Industrial Process Supply |
| 5. POW | Hydropower Generation |
| 6. REC-1 | Water Contact Recreation |
| 7. REC-2 | Non-Contact Water Recreation |
| 8. WARM | Warm Water Ecosystems |
| 9. WILD | Wildlife Habitat |
| 10. RARE | Rare, Threatened, or Endangered Species |
| 11. GWR | Groundwater Recharge |

The waters of the Kern River are primarily used for MUN, AGR, REC-1, REC-2, WARM, WILD and GWR. Agricultural supply (AGR) represents the most prominent beneficial use within the KRWCA. Several agencies use surface water for groundwater recharge (GWR). Approximately 18% of the urban water supply is provided by the Kern River, while groundwater makes up the rest. Habitat and ecosystem benefits (WARM, WILD, RARE) are also realized during wetter years when water flows. Finally, REC-1 and REC-2 activities occur incidentally as a result of surface flows.

The beneficial uses of IND or PRO do not appear to apply to the Kern River since no uses have been identified that draw water directly from the river. POW is only used at or above Isabella Dam (Lake Isabella) upstream of most agricultural operations.



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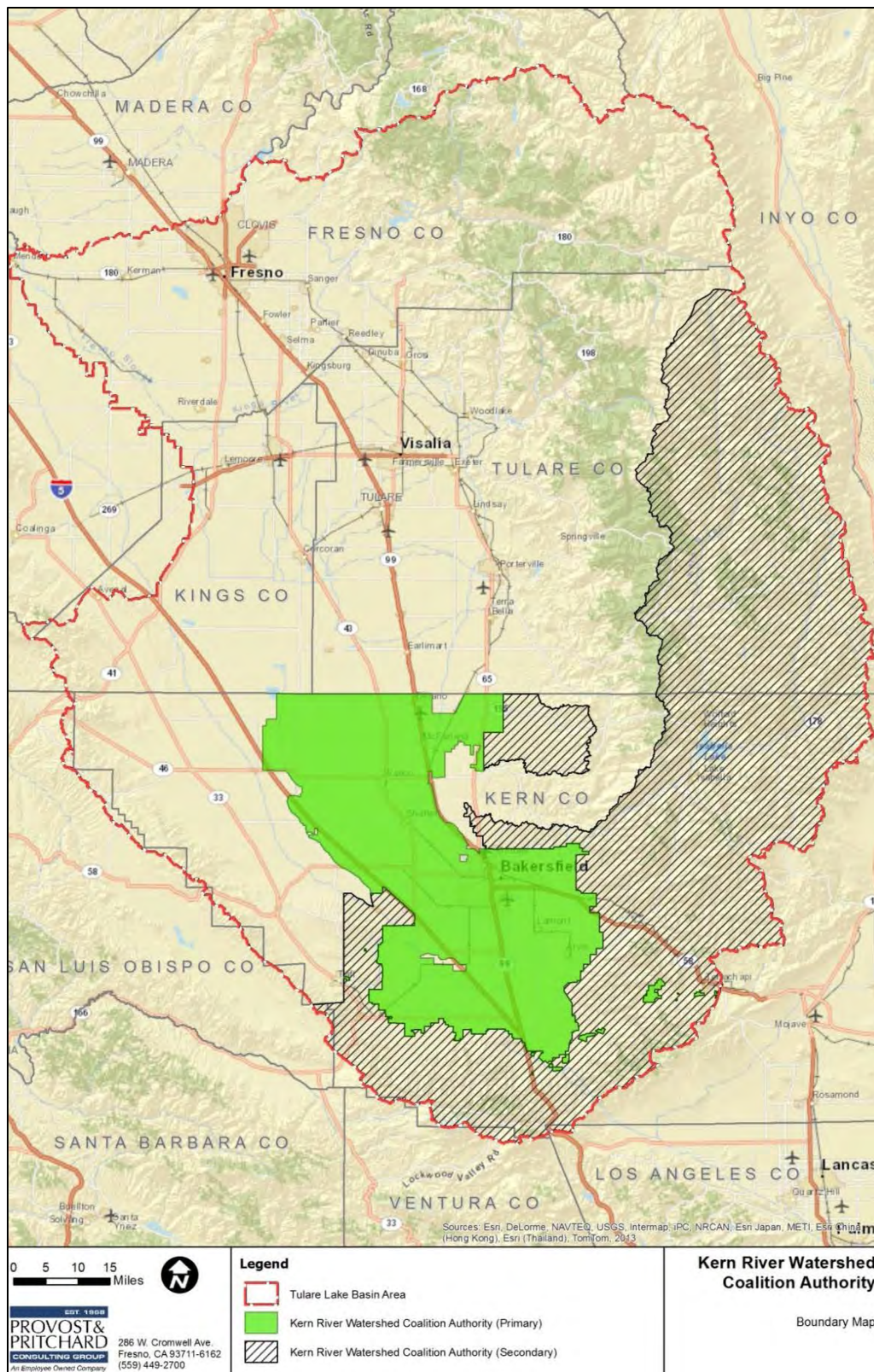


Figure 1-1. KRWCA Location Map



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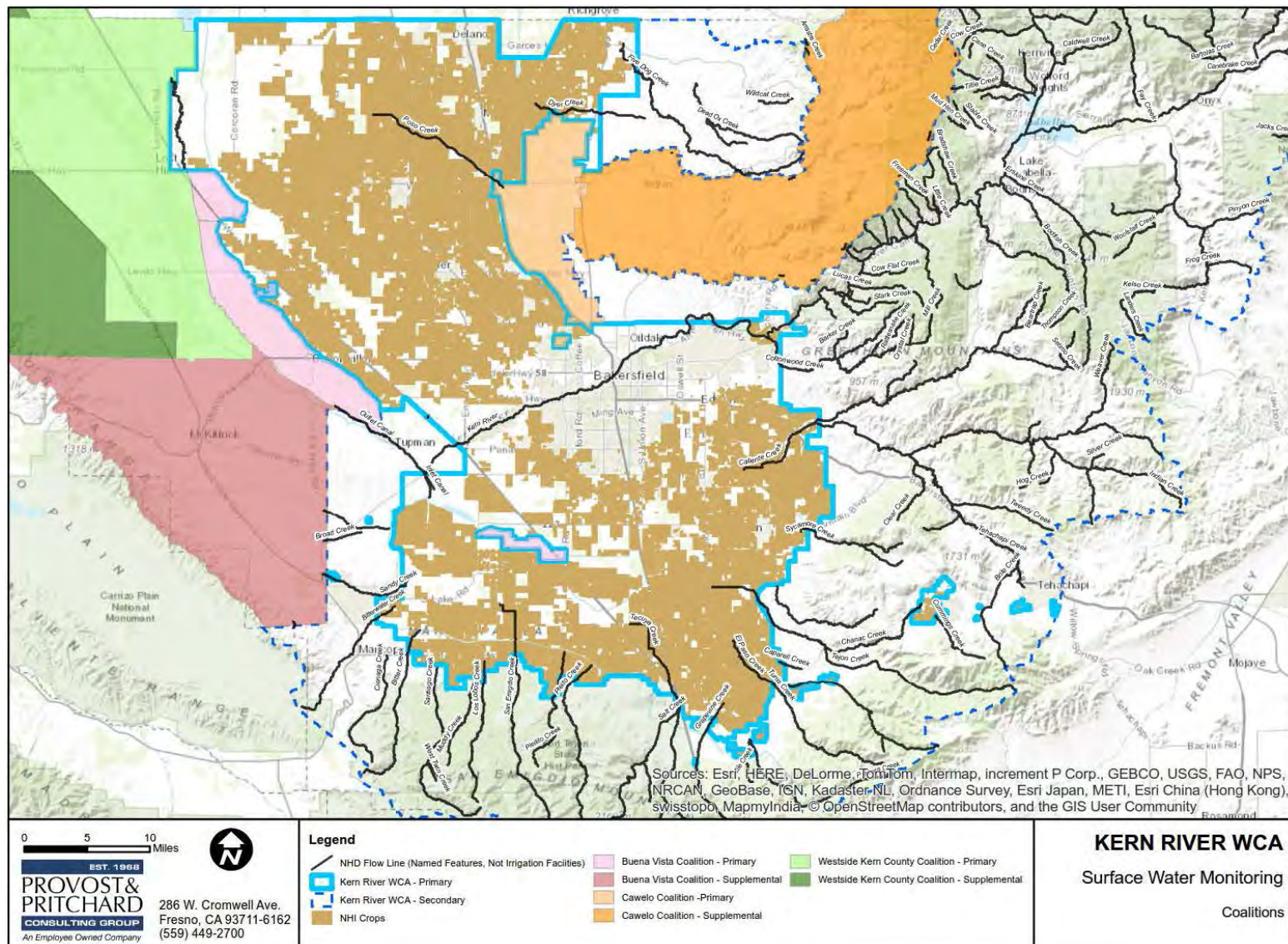


Figure 1-2. Creeks and Streams in the KRWCA Area



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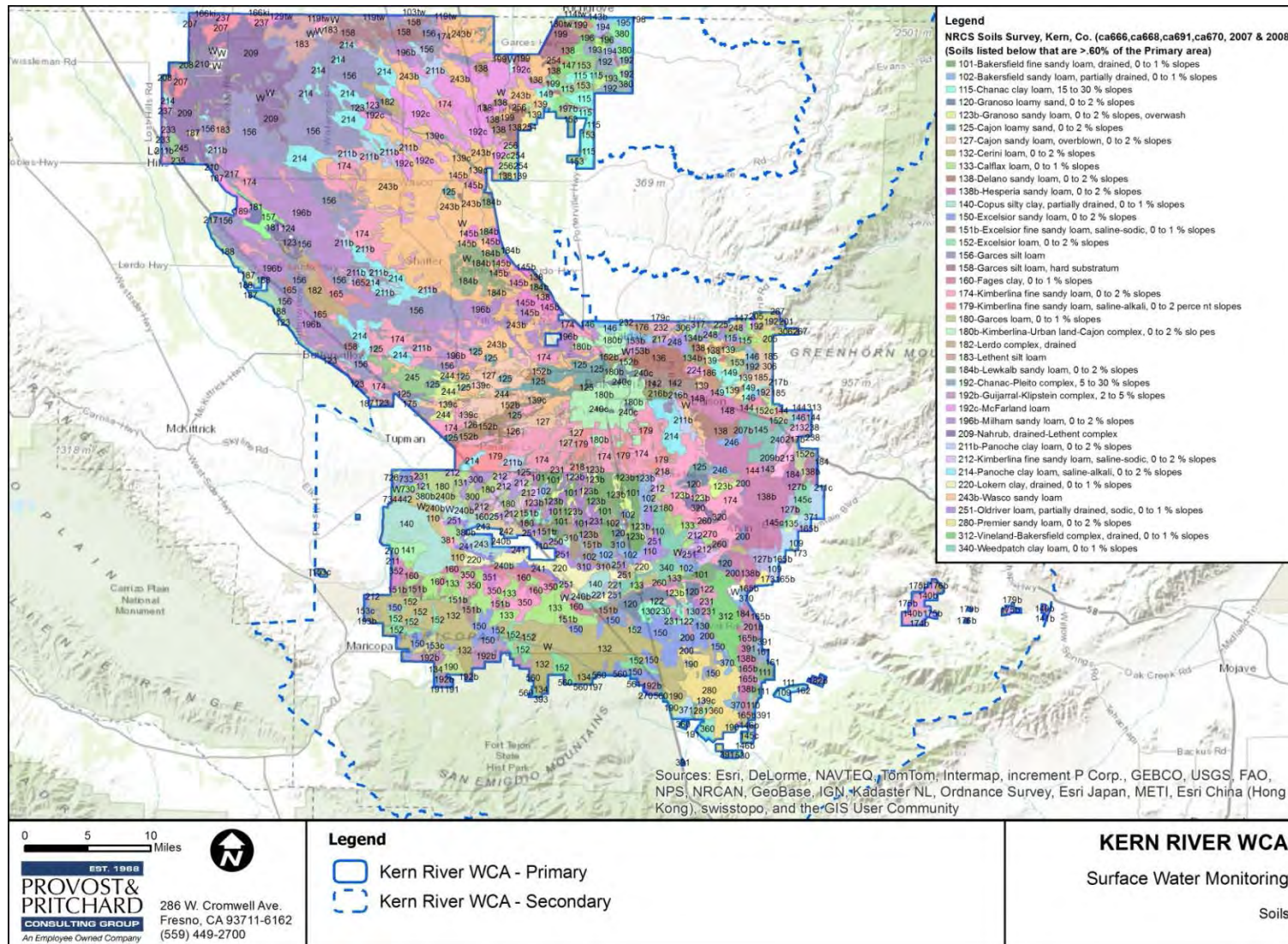


Figure 1-3. Soils of the KRWCA Primary Area



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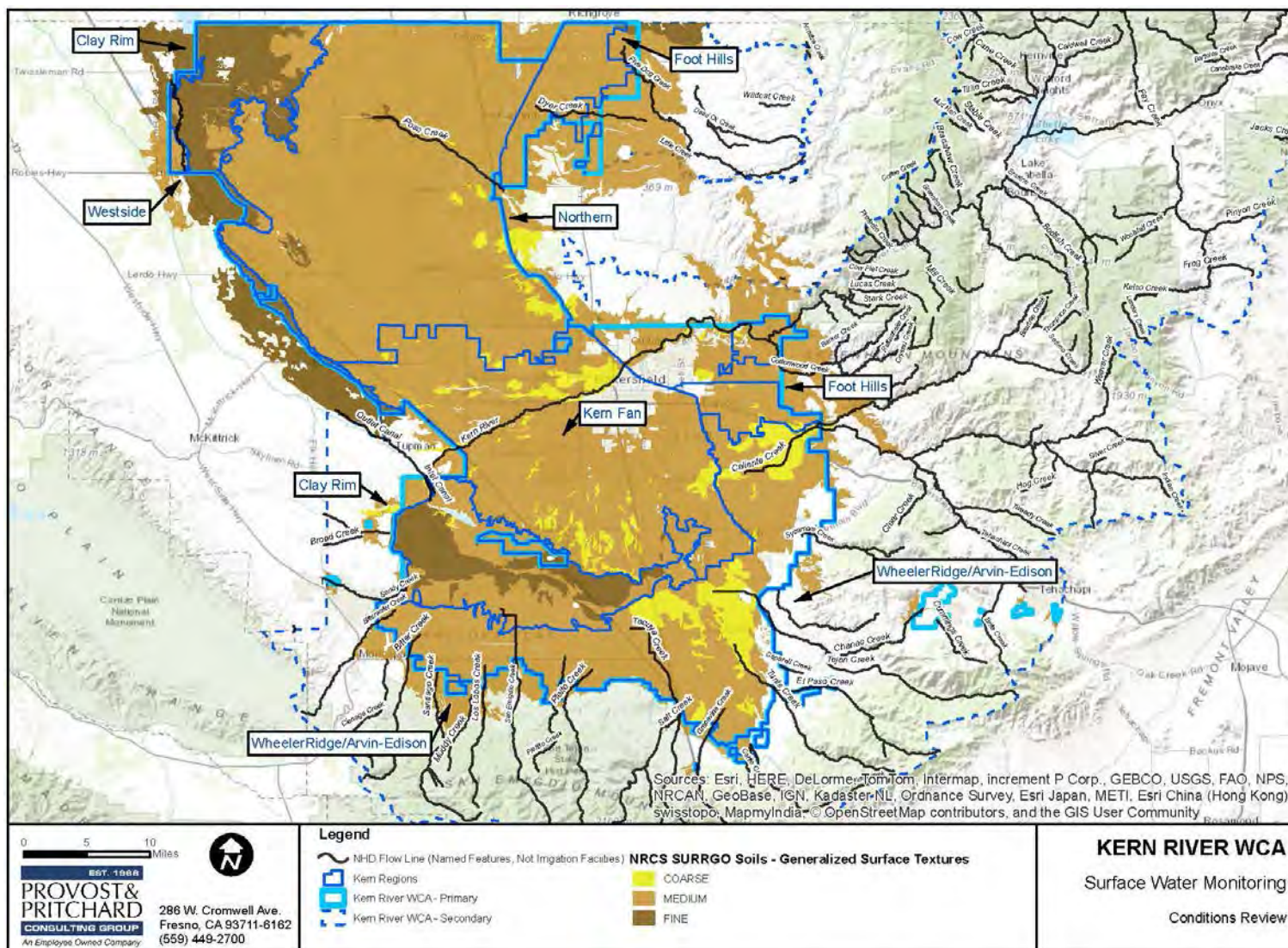


Figure 1-4. Generalized Soil Textures



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Table 1-1. Climate Statistics for the KRWCA Primary Area (based on Bakersfield, CA records)

Climate Statistics for the KRWCA Primary Area (based on Bakersfield, California records)					
Month	Average High Temp. (°F)	Highest Temp. on Record (°F)	Average Low Temp. (°F)	Lowest Temp. on Record (°F)	Avg. Precip. (in)
January	56.2	82	39.3	20	1.04
February	62.8	87	42.4	25	1.16
March	68.7	94	46.5	31	1.12
April	75.0	101	50.2	33	0.67
May	83.5	107	57.5	37	0.21
June	90.9	114	64.2	44	0.07
July	97.1	115	70.5	52	0.01
August	95.8	112	69.0	52	0.04
September	90.0	112	64.0	45	0.10
October	79.4	103	55.0	29	0.30
November	65.7	94	44.6	28	0.59
December	56.6	83	39.0	19	0.85
Total:	76.9	--	53.6	--	6.17



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Table 1-2. Beneficial Uses in the Tulare Lake Basin Plan (2004)

TABLE II-1 TULARE LAKE BASIN SURFACE WATER BENEFICIAL USES														
Stream	MUN	AGR	IND	PRO	POW	REC-1	REC-2	WARM	COLD	WILD	RARE	SPWN	GWR	FRSH
552, 551 Kings River														
North Fork, Upper					*	*	*	*	*	*	*	*	*	*
Main Fork, Above Kirch Flat	*					*	*	*	*	*	*	*	*	*
Kirch Flat to Pine Flat Dam (Pine Flat Reservoir)					*	*	*	*	*	*			*	*
Pine Flat Dam to Friant-Kern	*	*			*	*	*	*	*	*		*	*	*
Friant Kern to Peoples Weir	*	*		*		*	*	*		*			*	
Peoples Weir to Stinson Weir on North Fork and to Empire Weir No. 2 on South Fork		*				*	*	*		*			*	
553, 558 Kaweah River														
Above Lake Kaweah	*				*	*	*	*	*	*	*	*	*	*
Lake Kaweah					*	*	*	*		*			*	*
Below Lake Kaweah	*	*	*	*		*	*	*		*			*	*
555, 558 Tule River														
Above Lake Success	*	*			*	*	*	*	*	*	*	*	*	*
Lake Success		*			*	*	*	*		*			*	*
Below Lake Success	*	*	*	*		*	*	*		*			*	*
554, 557 Kern River														
Above Lake Isabella	*				*	*	*	*	*	*	*	*	*	*
Lake Isabella					*	*	*	*	*	*			*	*
Lake Isabella to KR-1 ⁺					*	*	*	*	*	*	*	*	*	*
Below KR-1 ⁺	*	*	*	*	*	*	*	*		*	*	*	*	*
555, 558 Poso Creek		*				*	*	*	*	*			*	*
552 Mill Creek, Source to Kings River	*					*	*	*		*			*	*
552, 553, 554, 555 Other East Side Streams	*	*				*	*	*	*	*			*	*
556, 559 West Side Streams		*	*	*		*	*	*		*	*		*	*
551, 557, 558 Valley Floor Waters		*	*	*		*	*	*		*	*		*	*

⁺ KR-1; Southern California Edison Kern River Powerhouse No. 1.



2 Surface Water Quality Status

Surface water quality has been monitored by several sources in an effort to characterize watersheds and quantify constituent concentrations. Sources have included the Environmental Protection Agency (EPA), Department of Pesticide Regulation (DPR), and recently Third-party members like the KRWCA. The data collected has allowed for the determination of the current status and general trends of surface water quality. This previously collected data will be used to set a quality starting point for this Surface Water Monitoring Plan (SWMP) and will aid in determining the plan's effectiveness moving forward.

2.1 Current Status

Only one water body in the KRWCA boundary, Isabella Lake, was listed on the 2010 EPA 303(d) list of impaired water bodies for dissolved oxygen and pH, but no sources are known. Isabella Lake is located within the KRWCA Secondary Area that is primarily a mountainous region with little to no agricultural activities. Agricultural activities largely occur in the Primary Area of the KRWCA on the San Joaquin Valley floor. Districts in the KRWCA generally prohibit agricultural drain water from entering surface water bodies. This effort protects surface water and is believed to contribute to the lack of impaired water bodies in the KRWCA.

The KRWCA searched the DPR Surface Water Database, established through an agreement with the State Water Resources Control Board (SWRCB) in 1997, for sampling locations within Kern County and the KRWCA boundary. The DPR database search for pesticide records in Kern County resulted in finding some exceedances for Chlorpyrifos and Glyphosate, however, none of the exceedances occurred at the monitoring sites within the KRWCA boundary. Most data in the database was taken at locations now within another Third-party boundary (Main Drain Canal in Buena Vista Water Quality Coalition). The results from this search provide further evidence that local districts, agencies, and growers are acting in a manner that is protective of the surface water resource.

Surface water sampling for the Kern subwatershed began in 2005 under the direction of the SSJWQC as part of the Irrigated Lands Regulatory Program (ILRP). Sampling included several constituents such as: field and physical parameters, metals, pesticides, and water column and sediment toxicity. This initial monitoring was performed during the winter storm season and summer irrigation season for two monitoring locations in Kern County: the Main Drain Canal and Poso Creek, which are no longer within the new KRWCA boundary. The locations still within the KRWCA boundary, Chanac Creek and El Paso Creek, were incorporated into the sampling effort along with other Kern locations in 2009 with Conditional Waiver R5-2008-0005 (more information about the sampling locations is provided in [Section 4](#)). The Conditional Waiver led to monthly monitoring instead of sampling based on storm or irrigation seasons.

Results collected from sites in Kern County (none in the present KRWCA) indicated that some pesticides, metals, and toxicity can be an issue. However, due to the dryer water years from 2009 to present, and the more ephemeral nature of Kern County creeks, there have not been many opportunities to sample surface water. In the future when more wet water years occur, continuing the sampling effort will further evaluate the presence or lack of pollutants in the KRWCA surface water bodies.



2.2 Monitoring Trends

As previously stated, over the last five (5) years the Kern subwatershed has seen very dry years. Due to the lack of water in the area, limiting sampling opportunities, water quality trends for sites in the KRWCA are not available. As the surface water monitoring effort continues in the future, more data will be collected about possible effects of agricultural activity, if any, on surface water quality.

2.3 Potential Discharges

Possible sources for potential discharges include: agricultural irrigation discharge and drainage, agricultural storm water discharge, and urban runoff. Generally, depths to groundwater do not allow for groundwater discharge to surface water except near areas in foothills and mountains along the Kern River. At these locations there are little to no farming operations that would pollute these discharges. With this SWMP pertaining to irrigated lands only, the focus will be on the agricultural irrigation and storm water discharges.

2.3.1 Agricultural Drainage

Agricultural discharges can impact water quality by directly discharging water containing constituents to a surface water body or operationally through pathways such as spray drift. Water districts in the KRWCA generally do not allow growers to discharge water into conveyance facilities and surface water bodies. This requires growers to capture and recirculate irrigation water on their property, reducing the potential for agricultural discharges. However, potential discharges can come if control is lost on a system. These tend to be rare occurrences that are short in duration.

2.3.2 Storm Water Runoff

Storm water discharges have potential to occur during the winter season when storms are more likely in Kern County. Although most growers in the area have facilities in place to capture water on their property, the duration and intensity of a storm and proximity to a surface water body can potentially lead to storm water runoff discharging into a surface water resource. Roads can also be a conduit for taking storm runoff towards a surface water body. Runoff discharges and flooding are more likely to occur during large events that capture facilities cannot handle. At these times there is potential for water to flow across agriculture and back into a surface water body possibly causing constituent exceedances. If flooding occurs often enough to trigger Surface Water Quality Management Plans (SQMPs), then management practices and facilities to control flooding will be considered for incorporation into the SQMP implementation plan to prevent future exceedances.



3 Agricultural Management Practices

Growers in the KRWCA boundary produce a wide variety of crops which employ a wide variety of management practices. These on-farm management practices are beneficial for growers since they help maximize the efficient use of the water supply and prevent agricultural discharges while maintaining high crop production. KRWCA growers have been innovative over the years in developing and using better practices in water efficiency, soil management, and pesticide and fertilizer application.

3.1 Management Practices Trends in Kern County

Management practices in KRWCA have trended toward being more efficient as water supplies have decreased and available technology has improved. These practices have a two-fold benefit as they not only help a grower's profit with high production from efficient use of available resources, but also reduce potential pollutant discharges from reaching surface water bodies. Growers have implemented, and continue to implement, better practices in the fields of water, pesticide, and fertilizer application along with soil enhancement and control.

3.1.1 Water Application Practices

Surface water deliveries generally begin in March and terminate in September or October, depending upon crop demand and water availability, although some KRWCA areas irrigate year round. In some years, an irrigation or water district may not receive any surface water due to the hydrologic conditions of the source supply. Water supplies are generally limited, such that a grower is constrained from irrigating a field to the point of generating discharges.

Irrigation practices are increasing in efficiency, as the cost of pumping water and the reduction in available surface supplies impact growers' profit margins. Many permanent crops have converted to drip or micro-sprayer irrigation systems and application rates are being matched to crop water usage, reducing the amount of water that can potentially be lost to runoff or delivered below the root zone as deep percolation. However, this efficiency can contribute to increased soil salinity, if less water is applied than is necessary to leach salts below the root zone, to maintain a sustainable and productive crop yield system.

Improvements to water application practices have not only benefited production but have also led to the reduction of field runoff that could potentially discharge pesticides and other pollutants. Benefits of these improvements in water application can potentially allow for:

- Increased distribution uniformity of applied water, which contributes to better irrigation efficiency.
- Change in the amount, rate, or timing of water being applied to the crop to more closely match evapotranspiration. This can lead to improved irrigation efficiency by reducing deep percolation, while maintaining or improving crop production.
- Reduction of erosion caused by irrigation.



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The addition of irrigation water additives may have the potential for reducing pesticides in the tail water by increasing infiltration during irrigation events, which also reduces erosion, and reduces the amount of pesticides that adhere to particulates by promoting the aggregation of dispersed soil colloids. These water additives are primarily added to irrigation water for erosion control and/or improved water infiltration. Examples of additives include polyacrylamide (PAM), gypsum, and humic acid.

In the primary area of the KRWCA, general topography of the irrigated land is flat to gently sloping, so surface irrigation may still be practiced in some areas. In some areas where the slope and soils are adequate, the resulting irrigation efficiencies can be quite good. Irrigators with all practices are generally managing their irrigation carefully, because of the cost and availability of the water. Many growers rely on pumped groundwater at various times of the year, which can be very costly given the depth to water, and are not going to run their irrigation pumps any longer than necessary to properly irrigate their lands.

Some growers have extensive tail water recycling systems. Tail water recovery refers to the practice of collecting, sometimes temporarily storing, re-circulating, and reusing irrigation tailwater in an irrigation distribution system. These systems can contribute to higher irrigation efficiency by facilitating quicker advance across a field with higher flow rates, making infiltration opportunity time more even between the head and tail ends of the field.

3.1.2 Soil Enhancement and Control

Growers within the KRWCA's service area use both organic and conventional farming practices. Reduced tillage practices are being adopted by some growers along with the use of GPS-guided equipment. Increases in fuel costs are dictating less ground preparation which is leaving soil surfaces undisturbed for longer periods of time.

Raised berms at low ends of fields trap sediment as well as suspended or adsorbed pesticides, and reduce runoff of dissolved substances in fields with low slopes and sandy soil types by holding water, increasing runoff retention and allowing for infiltration. This is potentially applicable for both dormant and irrigation seasons.

Water and sediment control basins are used to form a sediment trap and water detention basin. Their purpose is to reduce erosion, trap sediment and pesticides adsorbed to soil particles, reduce and manage runoff, change the flow of nutrients and pesticides, and improve water quality. The control basin can be an earth embankment or a combination ridge and channel. It is generally constructed across the slope and the minor watercourses to form a sediment trap and water detention basin. The basins serve to increase residence time by temporarily storing runoff on-site. The basin releases water slowly, through infiltration or a pipe outlet and tile line. The increased residence time allows suspended particles to settle out, resulting in better water quality. Water and sediment control basins are applicable to both dormant and irrigation seasons.

Buffers are areas of land located along field edges that are maintained in permanent vegetation. The vegetation and soil buildup in buffers slow water movement and increase infiltration. By slowing its movement, field runoff is more likely to infiltrate into soil. Properly designed buffers also trap sediment, thereby reducing the offsite movement of pesticides adsorbed to soil particles. Microbes residing in soil



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and organic matter can then degrade pesticides that infiltrate into the upper soil layer or are trapped by vegetation and plant debris.

Orchard residues are now being shredded on site at a greater rate since the ban on agricultural waste burning has gone into effect. The crop residues are being reincorporated into the soil structure, where they increase the infiltration rates of the soils. This is most beneficial during the winter months. The usage of composted materials is rising as well due to their benefits on soil biota.

Various vegetation management practices help reduce pesticide runoff by increasing soil infiltration, accelerating pesticide degradation at the soil surface and preventing the offsite movement of soil, nutrients, and pesticides during winter storm events. Cover crops can reduce pesticide runoff because pesticide particles are adsorbed to plant surfaces more strongly than to bare soil, pesticide persistence on plant surfaces is shorter than on or in soil, and because cover crops slow or prevent the off-site movement of water and sediment carrying pesticides. There are many types of cover crops, but they can be considered in two main groups: resident vegetation and seeded cover crops. Cover crops are not usually harvested for sale, but can provide several important functions:

- Anchor the soil during winter rains to prevent soil, nutrient, and pesticide runoff.
- Accelerate biodegradation of pesticides at the soil surface.
- Improve water infiltration and soil structure.
- Provide nitrogen (legumes).
- Add organic material to the soil.
- Help control weeds.
- Improve field access during wet weather.
- Provide nectar and habitat for beneficial insects.

Soil management is another component of controlling pesticides. Tillage is the term used for soil mechanical cultivation activities such as plowing, ripping, disking, aerating, and harrowing. These tillage practices are specifically designed to loosen soil, direct water flow, and encourage vegetation growth. If properly conducted, tillage can dramatically reduce runoff and increase infiltration. The effects of tillage on offsite pesticide movement depends greatly upon the specific tillage technique used, soil type, slope, soil organic matter, and a number of other site specific factors. Ripping is commonly used on fields to increase water infiltration. For orchards, shank depth must be shallow enough to avoid damage to tree roots. Ripping significantly increases the infiltration rate of soils and can render fields impassable to heavy equipment such as sprayers used during dormant treatments. Aerating orchard soils with specialized tillage equipment is another way to increase water infiltration. 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, therefore, may reduce pesticide runoff although no studies have been conducted.

3.1.3 Pesticide Application

Integrated pest management (IPM) has been gaining traction within the KRWCA as a means of controlling costs. IPM is an ecosystem-based strategy that focuses on long-term prevention of pests or



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their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism. Pest control materials are selected and applied in a manner that minimizes risks to human health, beneficial and non-target organisms, and the environment. The advent of “softer” materials (more pest specific, less broad spectrum) has further reduced both the frequency and volume of material applications, as now only the target pest is eliminated when a predetermined economic threshold is reached.

Management methods vary, and can be a combination of one or more aspects including biological control, cultural practices, pheromone disruption, pesticide treatment, etc. Biological control includes the use of natural enemies that attack pests. Use of such biological control agents, however, may not be enough to suppress pest populations to prevent them from reaching damaging levels. Cultural practices include field level practices that can affect the intensity of pest infestation. This includes practices such as orchard sanitation or proper pruning and painting of exposed wood to prevent sunburn as well as reduce tree susceptibility to wood-boring insects. Proper irrigation and fertilization may also help reduce certain pests.

Spray control practices are in place with many growers, primarily as a safety issue for field crews. Many growers have the applications done by the same company that sells the chemicals, and these operations recognize the benefits of higher efficiency spray equipment, as they are paid by the acres sprayed, not by the time it takes to do the work. Efficient spray equipment means that individual growers can be covered quicker, and more acres can be done per working day. Chemical costs are reduced due to only mixing what is needed to spray the crop, not the open spaces between the plants (net vs. gross acres). Orchards and row crops both benefit from such equipment.

3.1.4 Fertilizer Application

Fertilizer applications are also more efficient. Soil levels are typically tested during the winter months. Plant tissues are sampled for nutrient levels frequently during the growing season, and many plant nutrients are direct injected into the irrigation systems (known as fertigation) or applied as a foliar spray. Fertigation is characterized by the following advantages (Burt et al, 1995):

- Soil compaction is avoided because heavy equipment never enters the field;
- The crop is not damaged by root pruning, breakage of leaves, or bending over as occurs with conventional application methods;
- Less equipment may be required to apply the fertilizer;
- Less energy is expended in applying the fertilizer;
- Usually less labor is needed to supervise the application;
- The supply of nutrients can be more carefully regulated and monitored;
- The nutrients can be distributed more evenly throughout the entire root zone or soil profile;
- The nutrients can be supplied incrementally throughout the season to meet the actual nutritional requirements of the crop; and,



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- Nutrients can be applied to the soil when crop or soil conditions would otherwise prohibit entry into the field with conventional equipment.

Some fertilizers are applied as banded applications within orchards, and are quickly incorporated by a following irrigation. Others are direct injected into planting beds for quick uptake by the soon to be planted crops.

3.2 Management Practices and Land Use

Management practices used largely depend on the land use or crop on a particular site. Agriculture in the KRWCA is very diverse and accounts for one of the largest land uses in the KRWCA area. **Figure 3-1** spatially shows the crop variety over the KRWCA boundary area. Reviewing the Kern County Agricultural Commissioner's 2013 Annual Crop Report, eight of the top ten commodities are crops. These top crops also show the success and variety that make up much of the farming in the KRWCA as there are vine and tree crops and row crops listed. **Table 3-1** is a summary of the top ten commodities in Kern County for 2013. Kern County growers are national leaders in producing carrots. Kern County growers lead the State in almond production, for which California as a whole produces 80% of the world's almonds. Kern County growers also lead the State in production of pistachios, for which California as a whole produces 99% of the nation's pistachios. For reference, the complete 2013 Annual Crop Report is included in **Appendix A**.

In 2010 the Kern County Water Agency (KCWA) performed a management practices survey at the district level in Kern County. The KCWA asked districts to survey crops in their districts and share different methods and practices in place for the various crops. Several of the management practices are those described in the previous section.

The following tables show the responses from participating districts (within the KRWCA boundary). **Table 3-2** shows the summary for grapes, the number one commodity for Kern County in 2012.

Table 3-3 shows the almond management practices and **Table 3-4** shows cotton management practices. These tables show practices for vine, tree, and row crops. By 2010 many of the districts stated that their growers had converted to more efficient irrigation methods such as drip and microsprinkler. Even cotton, a crop known for surface irrigation, was shown to have buried drip and sprinkler applications. The summary also resulted in showing that most growers have tailwater recovery systems in place to ensure the most efficient use of the water resource. Other practices such as tillage, cover crop, and pesticide/herbicide application were also shared.

The numbering system for the soil types is as follows:

1. Sand
2. Sandy Loam
3. Loam
4. Silty Loam
5. Clay Loam
6. Clay



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Many of the current management practices, particularly those related to pesticide use, are regulated by the Department of Pesticide Regulation (DPR) and the Kern Ag Commissioner. To obtain pesticide use permits, growers must certify that the management practices on their operation satisfy the criteria set by DPR for the crop to be treated and the material label. Absent exceedances of surface water quality parameters, the KRWCA proposes to rely on the DPR and Kern Ag Commissioner for determining management practice effectiveness. In the event of exceedances, the KRWCA will review where the issue originated and analyze the effectiveness of the pertinent current management practices and whether changes need to be considered.

3.3 Future Management Practice Implementation

As surface water monitoring moves forward, exceedances of constituent trigger limits have the potential to occur and possibly lead to implementation of a management plan. As these instances or other learning opportunities occur, the KRWCA and its Members will determine exceedance sources and the solutions to stopping and/or reversing these sources. When the KRWCA learns of successful, site-specific management practices, these practices will be shared with growers through various outreach and implementation efforts. KRWCA growers have been very proactive in implementing the best management practices on their farms as it leads to higher sustainability and efficiency. The KRWCA, in an effort to continue this trend, will document successful management practices and promote such success with implementation and reduced potential of polluting surface water in other areas. Successful management practices are expected to range from on-farm facility modification, changing chemicals, soil management, and/or methods of application (i.e. timing, nozzle calibration, etc.).



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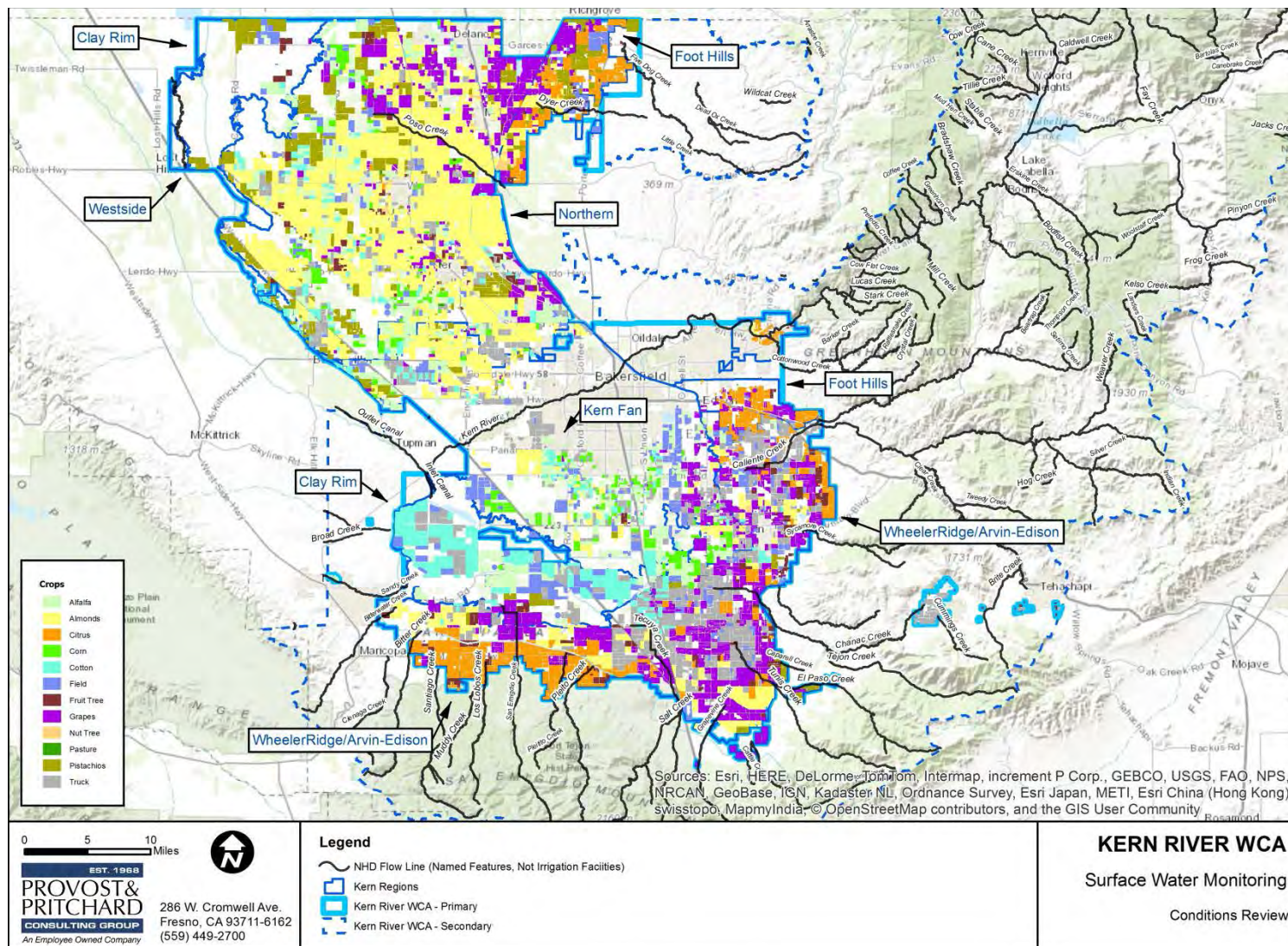


Figure 3-1. KRWCA Primary Area Crop Map (2013)



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Table 3-1. 2013 Top 10 Leading Kern County Commodities

2013 Top 10 Leading Kern County Commodities			
Commodity		Value	2012 Rank
1	Grapes	\$1,822,092,000	1
2	Almonds	\$970,808,000	3
3	Milk	\$764,728,000	2
4	Citrus	\$641,691,000	5
5	Cattle & Calves	\$408,897,000	6
6	Pistachios	\$388,189,000	4
7	Carrots	\$335,088,000	7
8	Hay, Alfalfa	\$217,964,000	8
9	Cotton, including Seed	\$146,537,000	9
10	Potatoes	\$109,222,000	10
Top 10 Total:		\$5,805,216,000	



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Table 3-2. Grape Management Practices from 2010 District Survey

Grape Management Practices from 2010 District Survey							
District	AEWSD	KTWD	NKWS	SWSD		SWID	WRMWS
Crop -->	Grapes	Grapes	Grapes	Wine Grapes	Table Grapes	Grapes	Grapes
Crop Type	Table, Wine, Raisin	Fruit	Table, Wine	Fruit	Fruit	Table, raisins	Table, Wine, Raisin
Soil Type	1 thru 5	Not Specified	All	5	5	1 thru 5	2 thru 4
Crop Rotation	N/A	N/A	N/A	No	No	N/A	N/A
Mechanical Tillage	Light	Light, if any	Not Specified	No	No	Light, if any	Light
Cover Crop	Some	None	Some	Some	Some	None	Some
Herbicide Application Practice(s)	Ground	Ground	Not Specified	Ground	Ground	Ground	Ground
Pesticide Application Practice(s)	Ground, Air	Ground	Not Specified	Ground	Ground	Ground	Ground, Air
Harvest Method(s)	Hand, Mechanical	Hand	Hand, Mechanical	Mechanical	Hand	Hand, Mechanical	Hand, Mechanical
Irrigation Systems	Drip, Furrow, Microsprinkler	Drip, Microsprinkler	Drip, Furrow	Drip, Furrow	Drip, Furrow	Drip, Surface	Drip, Microsprinkler
Drainage System	None, Tailwater Return	None	None	Tailwater Return, Some Tile Drains	Tailwater Return, Some Tile Drains	None, Tailwater Return	None, Tailwater Return



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Table 3-3. Almond Management Practices from 2010 District Survey

Almond Management Practices from 2010 District Survey						
District	AEWSD	KTWD	NKWSD	SWSD	SWID	WRMWS
Crop -->	Almonds	Almonds	Almonds	Almonds	Almonds	Almonds
Crop Type	Nuts	Nut	Nut	Nut, Animal Feed (Hulls)	Nut	Nuts
Soil Type	2 thru 5	Not Specified	All	5	1 thru 5	2 thru 4
Crop Rotation	N/A	N/A	N/A	No	N/A	N/A
Mechanical Tillage	No	Light, if any	Not Specified	No	Light, if any	None
Cover Crop	Some	None	Some	Some	None	Some
Herbicide Application Practice(s)	Ground	Ground	Not Specified	Ground	Ground	Ground
Pesticide Application Practice(s)	Ground	Ground	Not Specified	Ground	Ground	Ground
Harvest Method(s)	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical
Irrigation Systems	Drip, Gravity, Microsprinkler	Drip, Microsprinkler	Border Strip, Drip, Microsprinkler	Border Strip, Drip, Microsprinkler, Sprinkler Border Strip,	Drip, Sprinkler, Surface	Drip, Microsprinkler
Drainage System	None, Tailwater Return	None	None	Tailwater Return, Some Tile Drains	None, Tailwater Return	None, Tailwater Return



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Table 3-4. Cotton Management Practices from 2010 District Survey

Cotton Management Practices from 2010 District Survey					
District	HMWD	NKWS	SWSD	SWID	WRMWS
Crop -->	Cotton	Cotton	Cotton	Cotton	Cotton
Crop Type	Fiber, Seed, Feed	Fiber, Seed, Feed	Fiber, Seed, Feed	Fiber, seed, feed	Fiber, Seed, Feed
Soil Type	All	All	5	1 thru 5	2 thru 6
Crop Rotation	2-3 years, then other field crop or food crop	2 years, then rotate to other field crop	Yes	Rotate to other field crop	2 years, then rotate to other field crop
Mechanical Tillage	Disc Pre-Plant, Cultivate In-Season, Shred and Disc After Harvest, Deep Rip or Chisel	Not Specified	Yes	Disc Pre-Plant, Cultivate In-Season, Shred and Disc After Harvest	Disc Pre-Plant, Cultivate In-Season, Shred and Disc After Harvest
Cover Crop	No	No	No	None	None
Herbicide Application Practice(s)	Ground, Air	Not Specified	Ground, Air	Ground, Air	Ground, Air
Pesticide Application Practice(s)	Ground, Air	Not Specified	Ground, Air	Ground, Air	Ground, Air
Harvest Method(s)	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical
Irrigation Systems	Buried Drip, Sprinkler, Furrow	Sprinkler, Furrow	Furrow, Sprinkler	Sprinkler, Furrow	Sprinkler
Drainage System	Sub-Surface, Tailwater Return	None, Tailwater Return	Tailwater return, some tile drains	None, Tailwater Return	None, Tailwater Return



4 Surface Water Monitoring Site Selection & Rationale

Four different monitoring sites types are made available in the Order for third-party members to use for the surface water monitoring effort. These sites are: 1) fixed, long-term core sites, 2) assessment sites, 3) ephemeral sites, and 4) special project sites. Most of these sites are a continuation from the previous conditional waiver; however, the Order now includes provisions for ephemeral sites. Due to many of the low elevation watersheds and low average annual precipitation totals typical for much of the coalition boundary, the KRWCA believes most of the surface water bodies are ephemeral. For this reason, the KRWCA will make use of representative ephemeral sites to cover much of the boundary.

4.1 Proposed Monitoring Sites

The KRWCA proposes to use four sites to accomplish the surface water monitoring requirement of the Order. Two sites, Chanac Creek and El Paso Creek, were previously established by the Kern subwatershed of the SSJVWQC. The Kern subwatershed monitored six locations under the previous Conditional Waiver, but some of the monitoring sites are now managed by other third-party members. The two sites on the Main Drain Canal are managed by the Buena Vista Coalition. The Poso Creek site is monitored by the Cawelo Water District Coalition. The White River site in the Tulare County portion of Delano-Earlimart ID is now part of the Tule Basin Water Quality Coalition. The two additional sites proposed in this report are new to the monitoring effort. The proposed sites are Tecuya Creek, and a secondary site on Poso Creek. **Figure 4-1** and **Figure 4-2** are maps showing the location of the monitoring sites in the KRWCA. GPS coordinates and proposed Surface Water Ambient Monitoring Program (SWAMP) codes are provided in **Table 4-1**.

4.1.1 Chanac Creek (Core)

Chanac Creek is located in the Cummings Valley in the Tehachapi area that drains a watershed of about 1,225 acres. In the Cummings Valley, agricultural plantings have altered the original creek bed and channelized large portions. The creek bed reappears just downstream of the agricultural activities and runs through non-irrigated pasturelands and natural landscape until it enters Tejon Creek. During the previous conditional waiver the Chanac Creek monitoring site was moved from its established location at Banducci Rd to a location approximately 1.18 miles north of Banducci Rd and 0.8 miles west of Pellicer Rd. This new location is near the westerly edge of agriculture along Chanac Creek. The new location is more likely to show the impacts of irrigated agriculture than the old location. **Figure 4-3** and **Figure 4-4** show the current location of the monitoring site and the crops near the creek.

Chanac Creek will serve as a Core Monitoring Site for the KRWCA. Monitoring will follow the Core Monitoring schedule and monitored parameters described in **Section 5** and **Section 6**, respectively. Monitoring at this location will allow for tracking surface water quality and management practice effectiveness in a mountainous farming region. This area near Tehachapi has a significant amount of farming and sees a different climate than the farming on the Central Valley floor. Due to these differences between valley floor and mountains, this site will only represent the Cummings Valley watershed in which it is located. Core Monitoring was selected due to the lack of background



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information and data from this location in the past. As a Core Monitoring site, the Chanac Creek watershed will receive continuous monitoring with both Assessment and Core parameters (see Core cycle in **Section 5.3**). Continuous monitoring will allow the KRWCA to classify surface water quality in the watershed and to determine long-term water quality trends and confirm management practice effectiveness.

4.1.2 El Paso Creek (Ephemeral)

El Paso Creek is a southern stream with few areas where storm water from irrigated lands can runoff into the creek bed. Habitat values for El Paso Creek are limited because the creek prism is mostly barren and because the extremely porous soils absorb the infrequent storm or irrigation runoff quickly. Because of the infrequent stream flows, there are virtually no beneficial uses to be protected. The site was originally chosen because of the potential for storm runoff into the creek. This creek has had an existing monitoring site for the Kern River watershed, but is now being proposed to move approximately 2 miles north, in an effort to increase the representativeness of El Paso Creek.

El Paso Creek will serve as an Ephemeral Monitoring site as well as Representative Monitoring site for the KRWCA. Monitoring will follow the Ephemeral Monitoring schedule and Ephemeral monitored parameters described in **Section 5** and **Section 6**, respectively. A monitoring site was established under the previous Conditional Waiver and has been dry for several years due to the recent dry years, matching the definition of an ephemeral water body. The KRWCA believes that most surface water bodies in the KRWCA boundary are ephemeral, allowing for the use of El Paso Creek as a Representative Monitoring site. The crops located in the El Paso watershed upstream of the monitoring site (see **Figure 4-6**) include grapes, citrus, fruit and nut trees, and truck crops (vegetables) allowing this monitoring site the ability to capture potential impacts from a variety of management practices. The soils in the El Paso watershed (see **Figure 4-7**) have a variety of coarse and medium grained soils. The mixture of coarse and medium grained soils in this watershed is very similar to the soils in the eastern foothills and valley floor portion of the KRWCA Primary area. The KRWCA proposes to use the El Paso Creek site as representative for surface waters and agricultural activities in the southeastern and eastern regions of the KRWCA boundary south of the Kern River and the region east of Highway 99 north of the Kern River as shown in **Figure 4-14**.

4.1.3 Tecuya Creek (Ephemeral)

Tecuya Creek is a stream that flows north onto the valley floor from the southern mountains of the KRWCA. The creek flows as a natural channel until it crosses under Highway 166. After passing under Highway 166 the creek is channelized and barren, limiting habitat value. Infrequent flows, due to the ephemeral nature of the creek, also limit the beneficial uses present. The creek has few areas where storm water from irrigated lands can runoff into the creek bed. Most entry points into the creek come near Kern County road crossings where runoff from the roadway is drained into the creek bed. The monitoring site location was chosen based on access and the ability to catch potential impacts from a wide variety of crops and management practices.

Tecuya Creek, like El Paso Creek, will serve as an Ephemeral Monitoring site as well as Representative Monitoring site for the KRWCA. Monitoring will follow the Ephemeral Monitoring schedule and Ephemeral monitored parameters described in **Section 5** and **Section 6**, respectively. This is a new monitoring site to be established for the surface water monitoring effort in the Kern River subwatershed



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and is expected to have no flow in dry years and short duration flows during rain events, matching the definition of an ephemeral water body. The KRWCA believes that most surface water bodies in the KRWCA boundary are ephemeral, allowing for the use of Tecuya Creek as one of its Representative Monitoring sites. The crops located in the Tecuya watershed upstream of the monitoring site (see **Figure 4-9**) include grapes, almonds, tomatoes, and truck crops (vegetables) allowing this monitoring site the ability to capture potential impacts from a variety of management practices. Soils in the Tecuya watershed are primarily medium grained soils (see **Figure 4-10**). A majority of the soils in the KRWCA area are of medium grained texture. The KRWCA proposes to use the Tecuya Creek site as representative for surface waters and agricultural activities in the southwestern regions of the KRWCA boundary south of the Kern River as shown in **Figure 4-14**.

4.1.4 Poso Creek (Core)

Poso Creek is one of the largest streams in the KRWCA area and flows from the Sierra Nevada Mountains on the east to the former Tulare Lake bottom on the west side of the valley floor. The creek flows as a natural channel across most of the valley floor. Once it passes Highway 43 the creek becomes channelized and more barren, limiting habitat value. While the Creek sees flows more often due to its larger watershed, dry years result in infrequent or no flows, limiting the beneficial uses present. The creek has few areas where storm water from irrigated lands can runoff into the creek bed. The monitoring site location was chosen based on access and the ability to work in collaboration with the existing monitoring site located in the Cawelo Water District Coalition (see **Figure 4-11**).

Poso Creek will serve as a Core Monitoring site (like the existing site) as well as Representative Monitoring site for the KRWCA. Monitoring will follow the Core Monitoring schedule and Core monitored parameters described in **Section 5** and **Section 6**, respectively. This is a new monitoring site to be established for the surface water monitoring effort in the Kern River sub-watershed and will be linked to the existing monitoring site. The plan will be to utilize the two sites to determine the impacts of irrigated agriculture in the KRWCA. The results at the existing monitoring site will be viewed as baseline conditions entering the KRWCA boundary. Changes in sampling results between the two locations will be viewed as the potential impacts from KRWCA irrigated agriculture. If water is not present at the existing monitoring site, then this site will not be monitored due to lack of a baseline condition for comparison.

The crops located in the Poso watershed upstream of the monitoring site (see **Figure 4-12**) are dominated by almonds with small areas of other fruit and nut trees and row crops. Soils in the Poso watershed are primarily medium grained soils (see **Figure 4-13**). The KRWCA proposes to use the new Poso Creek site as representative for surface waters and agricultural activities in the region north of the Kern River and west of Highway 99 in the KRWCA boundary as shown in **Figure 4-14**.

4.2 Monitoring Site Coordination

Due to the transition of the Kern Subwatershed portion of the SSJVWQC into multiple Third-Party Coalitions, it may be important for the KRWCA and other Coalitions to collaborate on certain surface water bodies or monitoring sites. The Cawelo Water District Coalition and Buena Vista Coalition will be the two primary coalitions for the KRWCA to coordinate with given the location of past monitoring.



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4.2.1 Cawelo Water District Coalition – Poso Creek

The Cawelo Water District Coalition (Cawelo) covers most of the Poso Creek watershed. The current Poso Creek monitoring site is now going to be managed by Cawelo. The location of this site was set in a location that was more likely to have flowing water. Moving further west onto the valley floor, and into the KRWCA area, Poso Creek has more tendency to remain dry during the year. In above average wet years, flows in Poso Creek may reach the portions of the KRWCA boundary. In years such as these, the KRWCA will utilize monitoring at the proposed location and compare data with the existing monitoring site in Cawelo. The KRWCA will see the data from the existing site as background conditions entering the KRWCA boundary. Differences in the result data will be viewed as potential impacts from irrigated agriculture.

4.2.2 Buena Vista Coalition – Main Drain Canal

The Buena Vista Coalition (BVC) primarily covers the Buena Vista Water Storage District (BVWSD) and some of the southwestern foothills of Kern County. The Main Drain is a facility within the BVWSD that has two monitoring locations. With regards to the SWMP, the Main Drain is only relevant to BVWSD and not much coordination is expected to be needed between the KRWCA and BVC.

4.3 Rejected Monitoring Sites

Several surface water locations were not included in the SWMP for various reasons. The primary reason for not monitoring many sites is due to the similarity of the small creeks and streams and proposed use of El Paso Creek as a Representative Monitoring site. Many of the creeks and streams within the KRWCA have small watersheds and are ephemeral in nature, and much like El Paso Creek, only flow during very large rainfall events or wetter years. Other reasons for not monitoring a site include lack of agricultural influence on the creek or lack of a defined channel once on the Valley floor. The Valley floor is the primary focus for monitoring. Additional brief explanations for different sites are provided below.

4.3.1 Caliente Creek

Caliente Creek is one of the channels that emerges from the foothills and becomes too undefined to establish a monitoring station. While Caliente Creek is larger than many of the other ephemeral creeks, it is not defined enough in the agricultural area to establish a successful monitoring site.

4.3.2 San Emigdio Creek

During the previous Conditional Waiver, the KCWA noted several drain pipes into the channel that could discharge storm or tail water in San Emigdio Creek. KCWA staff had discussions with the adjacent landowners regarding these drain pipes and that led to their removal by May 31, 2009. With no direct discharges to the channel and hydrology similar to El Paso Creek, this location was no included in favor of the representative El Paso Creek monitoring site.



4.3.3 Miscellaneous Small Creeks

Several small creeks were not included due to the lack of channel definition or lack of evidence for runoff from agricultural operations entering the channel. These creeks were: Grapevine Creek, Pastoria Creek, and Pleito Creek.

4.3.4 Kern River Outlet Canal

The KCWA performed a physical survey of the Kern River Outlet Canal from the Tule Elk State Natural Reserve to Highway 46 under the previous Conditional Waiver and found two locations where irrigation or storm drainage from neighboring irrigated lands has potential to be introduced. However, this site was not included once the wide width of the Outlet Canal and the infrequency of irrigation were considered. It was determined that it would be unlikely to find sufficient water to draw a sample.

4.3.5 James Canal

The James Canal is no longer connected to agricultural irrigation. The remnants of the James Canal are used to convey surface water for recharge in various percolation basins of the Kern Fan groundwater banking facilities.

4.3.6 Connecting Slough

Much of the original Connecting Slough no longer exists and the remnants have been converted into tail water ponds with recirculating pumps. Runoff from adjacent irrigated lands is now retained on-farm.

4.3.7 Friant-Kern Canal

The Federal CVP designed and operates the inlets into the Friant-Kern Canal that allow introduction of storm water. The KRWCA is not authorized to monitor surface water quality in the canal. The Friant Water Authority (FWA) collects the surface water quality data and regularly provides water quality reports.

4.3.8 Conveyance Facilities

No conveyance facilities are proposed for monitoring under this plan. The KRWCA submits that it is inappropriate to include water conveyance structures as monitoring sites, as it is the KRWCA's opinion that conveyance facilities would not correctly indicate agriculture's impact on surface water. It is the policy of all the Districts within the KRWCA to not allow agricultural drainage water to enter their facilities. Water in these facilities is from the California Aqueduct (SWP) and Friant-Kern Canal (CVP) to be delivered to growers, and is regularly sampled for water quality. Therefore, in order to determine the effect agricultural activities have on surface water bodies, monitoring should be conducted on water bodies that have the potential to receive agricultural runoff instead of water to be delivered to agriculture.



4.4 Selection Rationale Summary

Monitoring sites were selected due to their representativeness for the KRWCA area and existing monitoring history. The KRWCA believes that maintaining the current monitoring sites will continue to develop a strong historical record. As the record develops over time, trends and impacts can be more fully determined. The KRWCA also believes the creeks and streams in the Primary Area are very similar and that the proposed Representative Ephemeral Monitoring sites will satisfy the surface water monitoring at this time. In the future, if exceedances are encountered triggering a SQMP, other sites that were not included may be reviewed and potentially used to aid in monitoring for a SQMP.



Section Four: **Surface Water Monitoring Site Selection & Rationale**

Surface Water Monitoring Plan

Table 4-1. KRWCA Monitoring Sites

KRWCA Monitoring Sites			
Monitoring Site	Latitude	Longitude	Site Code
Chanac Creek	35.1080	118.6239	557CHCPLR
El Paso Creek	35.0733	118.8731	557ELPCRK
Tecuya Creek	35.0951	119.0152	557TECCRK
Poso Creek	35.6812	119.3840	557POSOCK



Section Four: Surface Water Monitoring Site Selection & Rationale

Surface Water Monitoring Plan

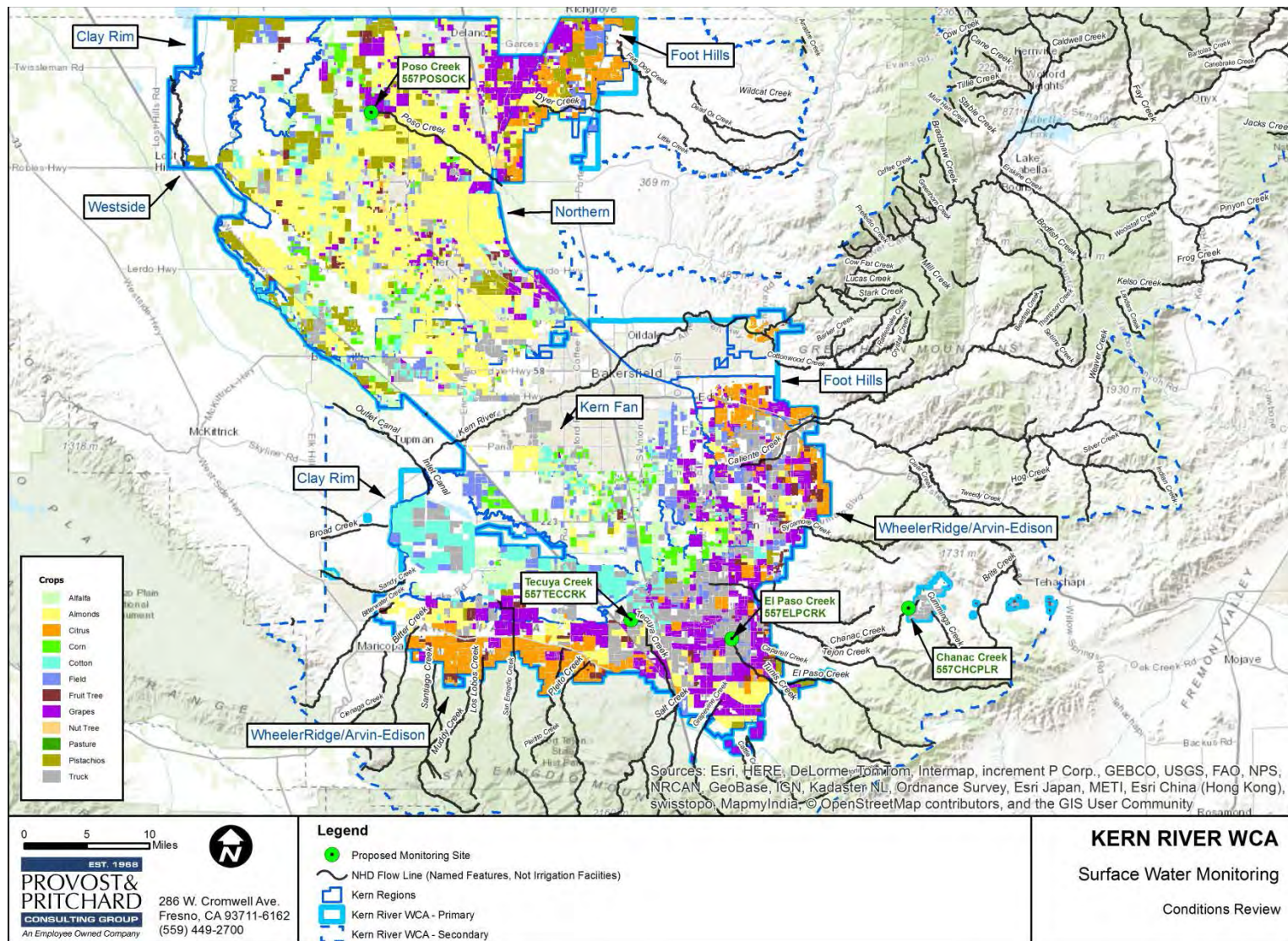


Figure 4-1. Map of KRWCA Monitoring Sites



Section Four: Surface Water Monitoring Site Selection & Rationale

Surface Water Monitoring Plan

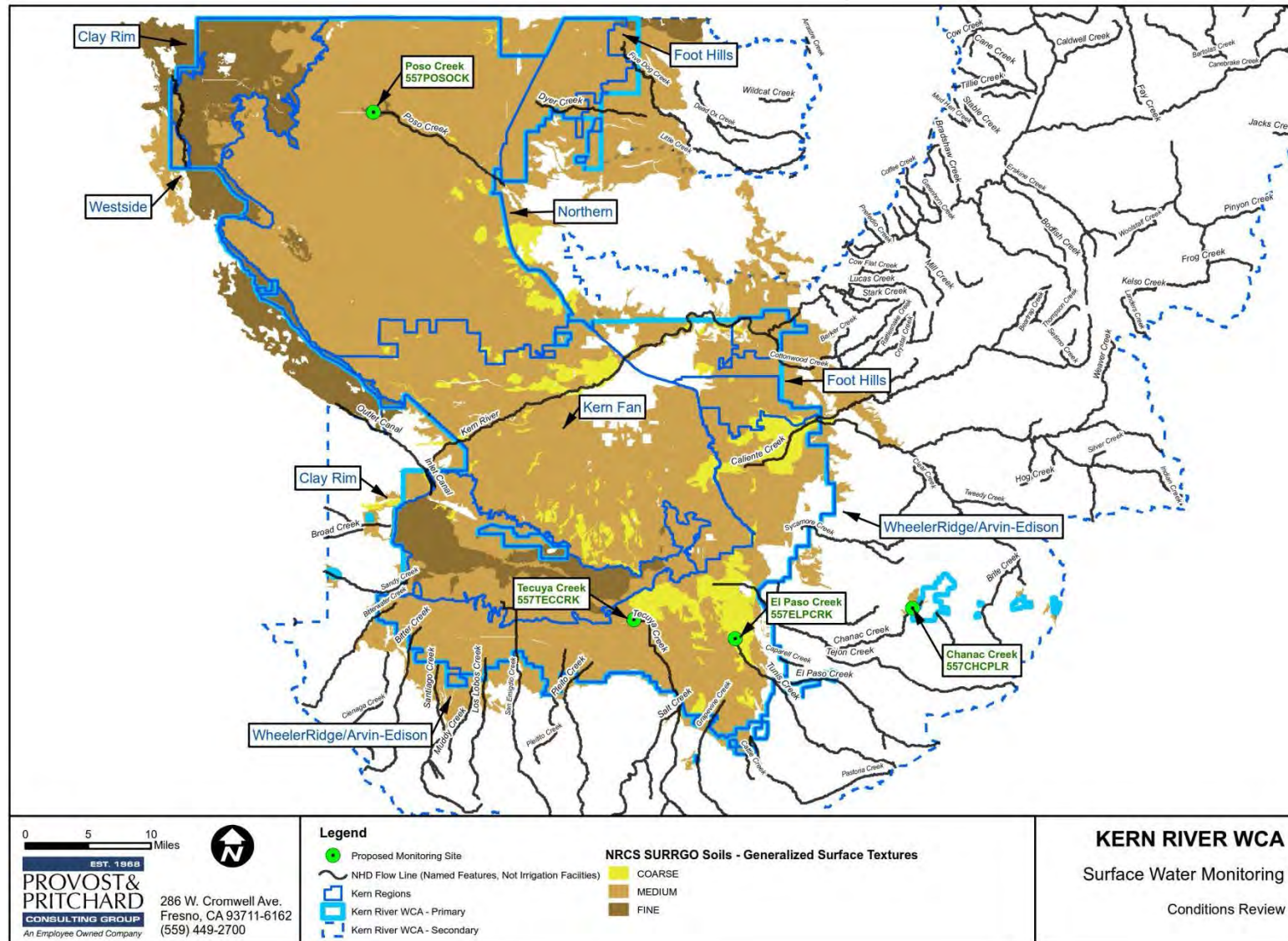


Figure 4-2. KRWCA Monitoring Sites Over Soils



Section Four: Surface Water Monitoring Site Selection & Rationale

Surface Water Monitoring Plan

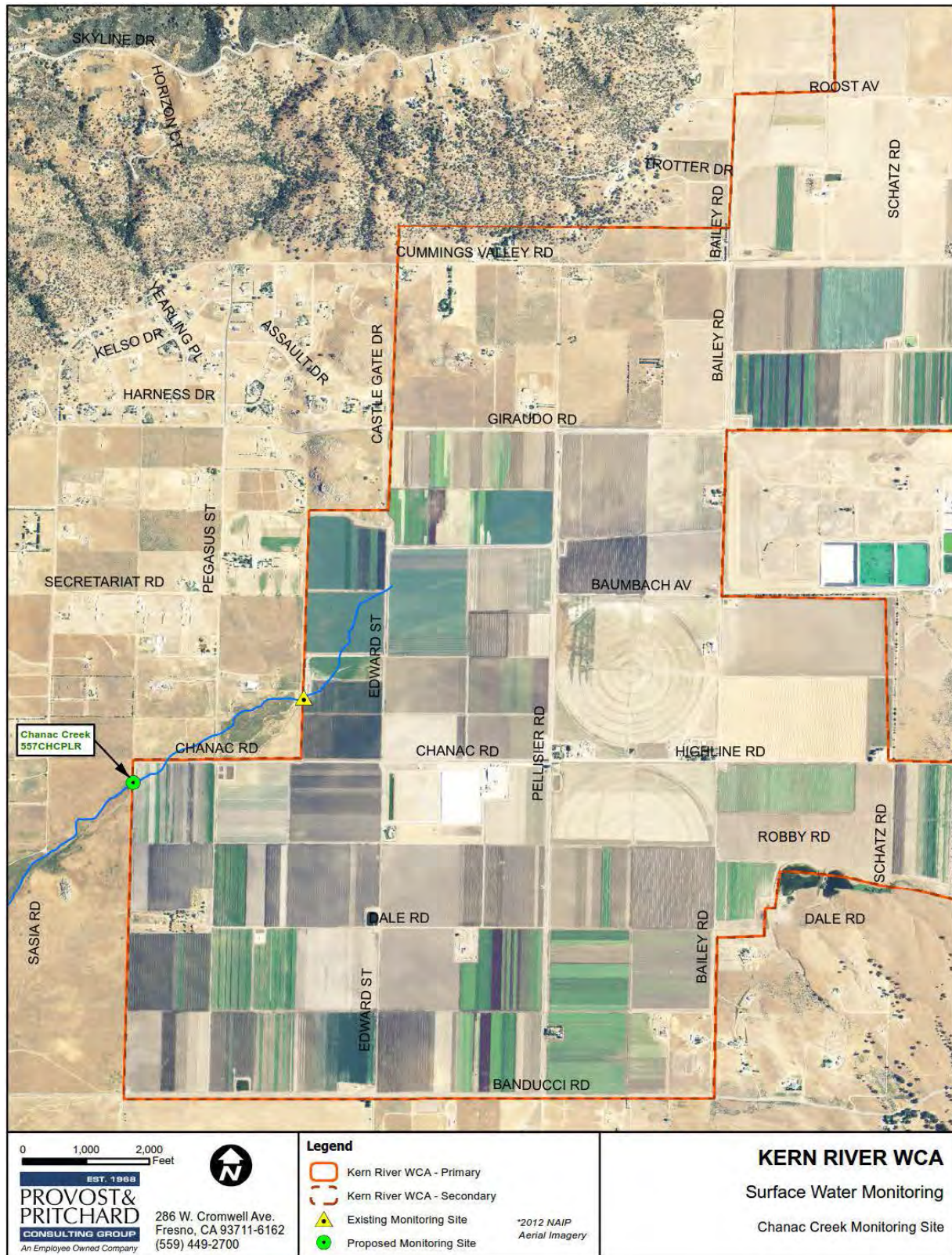


Figure 4-3. Chanac Creek Location Map



Section Four: Surface Water Monitoring Site Selection & Rationale

Surface Water Monitoring Plan

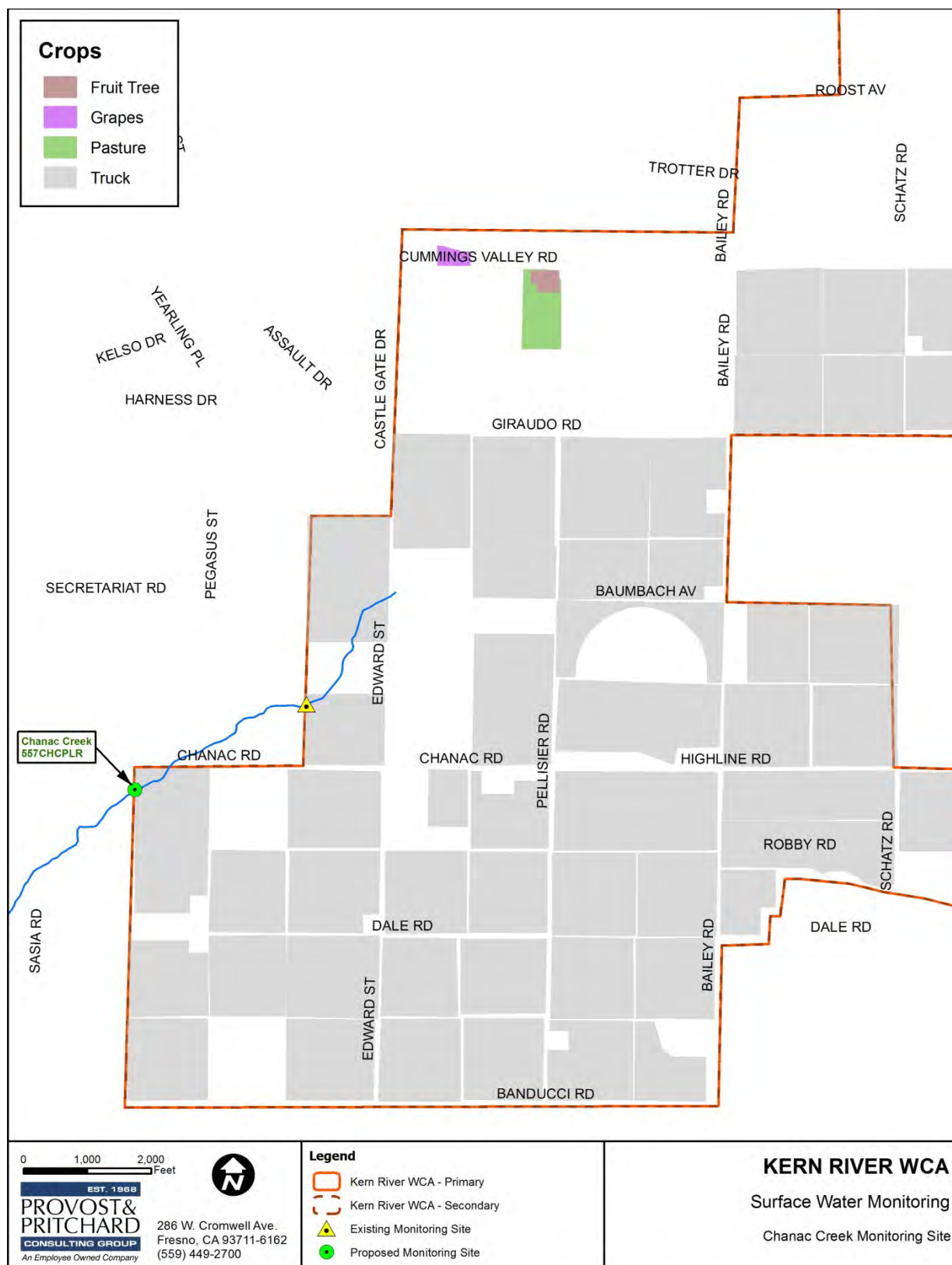


Figure 4-4. Chanac Creek Crop Map



Section Four: Surface Water Monitoring Site Selection & Rationale

Surface Water Monitoring Plan

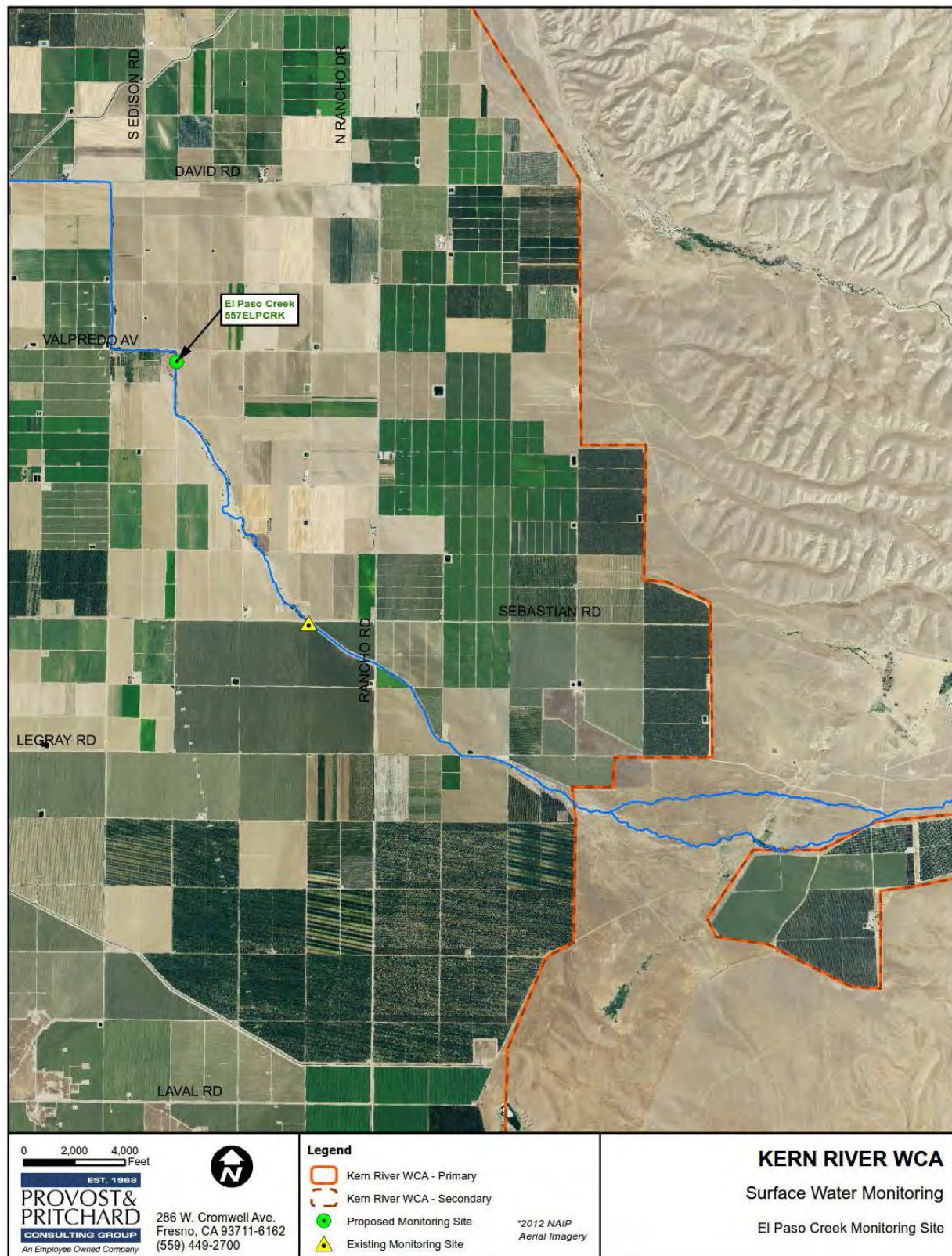


Figure 4-5. El Paso Creek Location Map



Section Four: Surface Water Monitoring Site Selection & Rationale

Surface Water Monitoring Plan

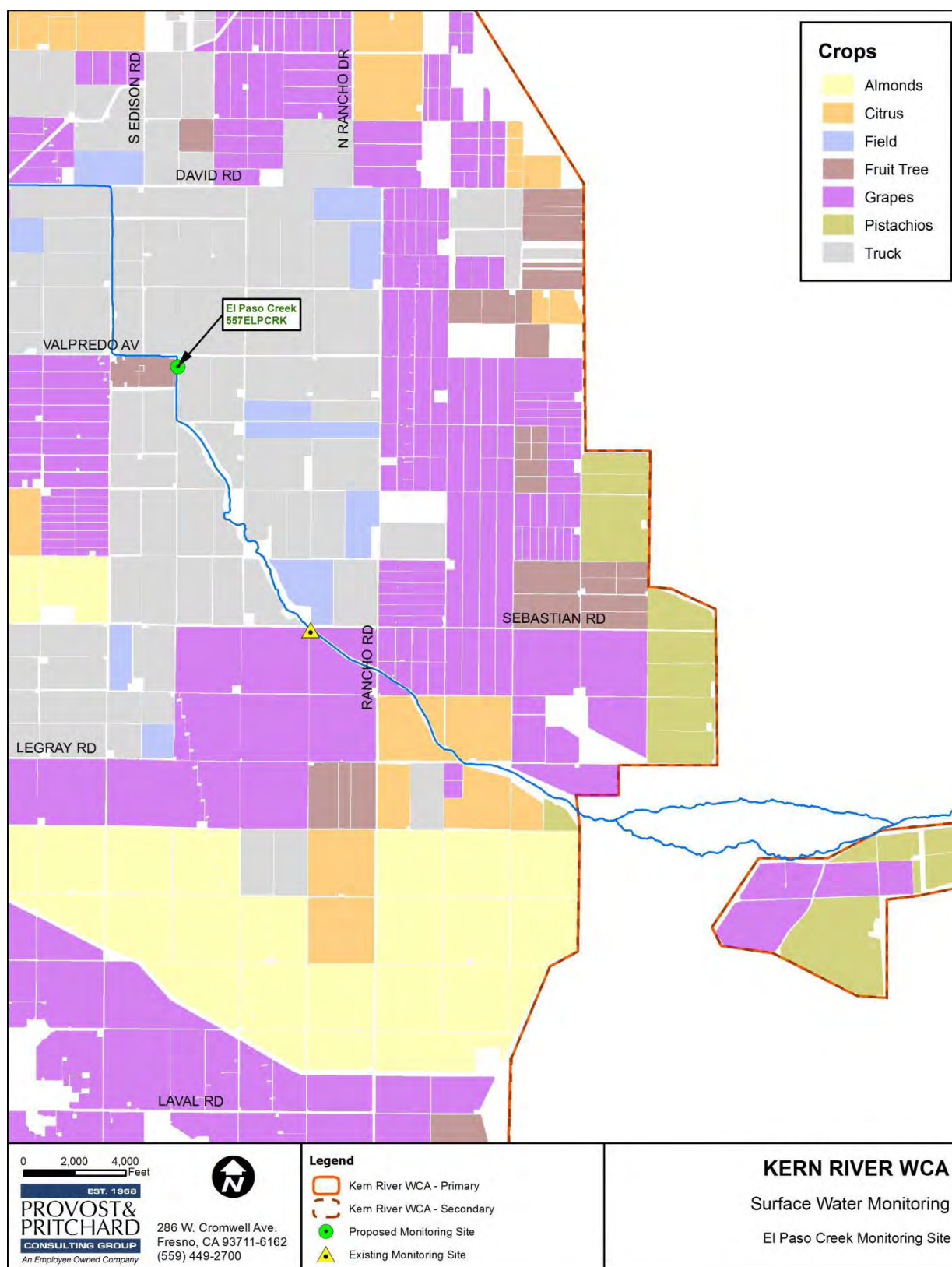


Figure 4-6. El Paso Creek Crops



Section Four: Surface Water Monitoring Site Selection & Rationale

Surface Water Monitoring Plan

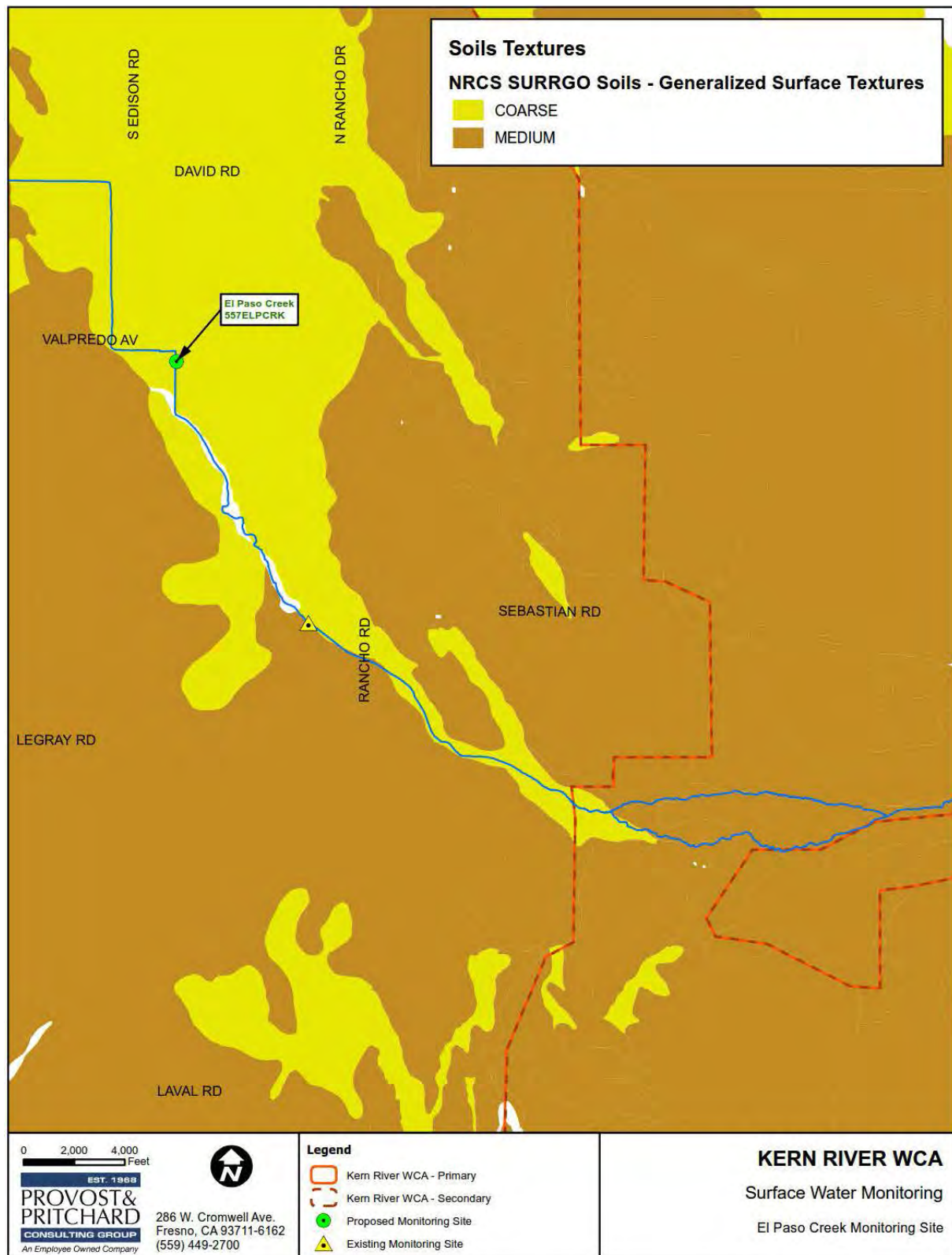


Figure 4-7. El Paso Creek Soils



Section Four: Surface Water Monitoring Site Selection & Rationale

Surface Water Monitoring Plan



Figure 4-8. Tecuya Creek Location Map



Section Four: Surface Water Monitoring Site Selection & Rationale

Surface Water Monitoring Plan

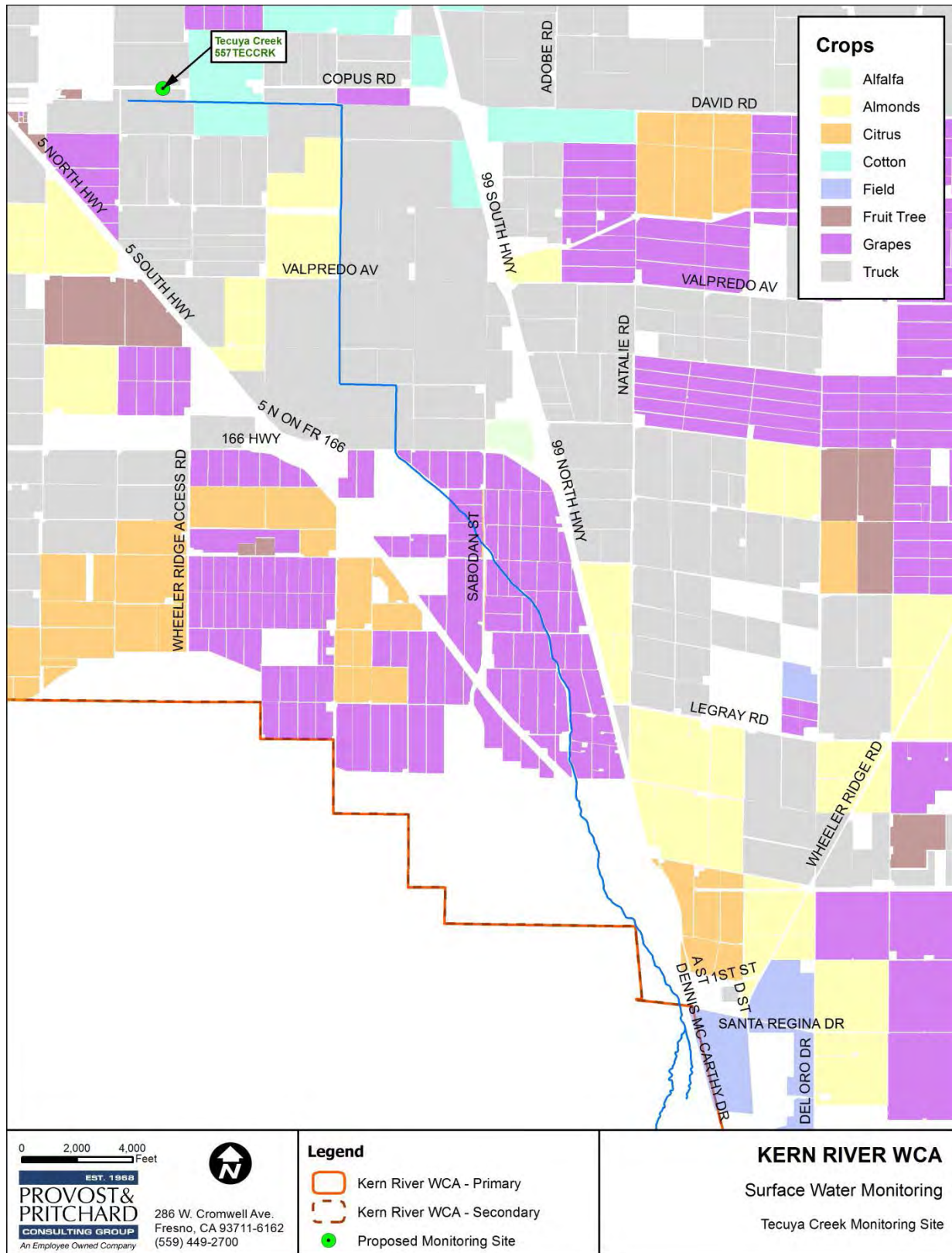


Figure 4-9. Tecuya Creek Crops



Section Four: Surface Water Monitoring Site Selection & Rationale

Surface Water Monitoring Plan

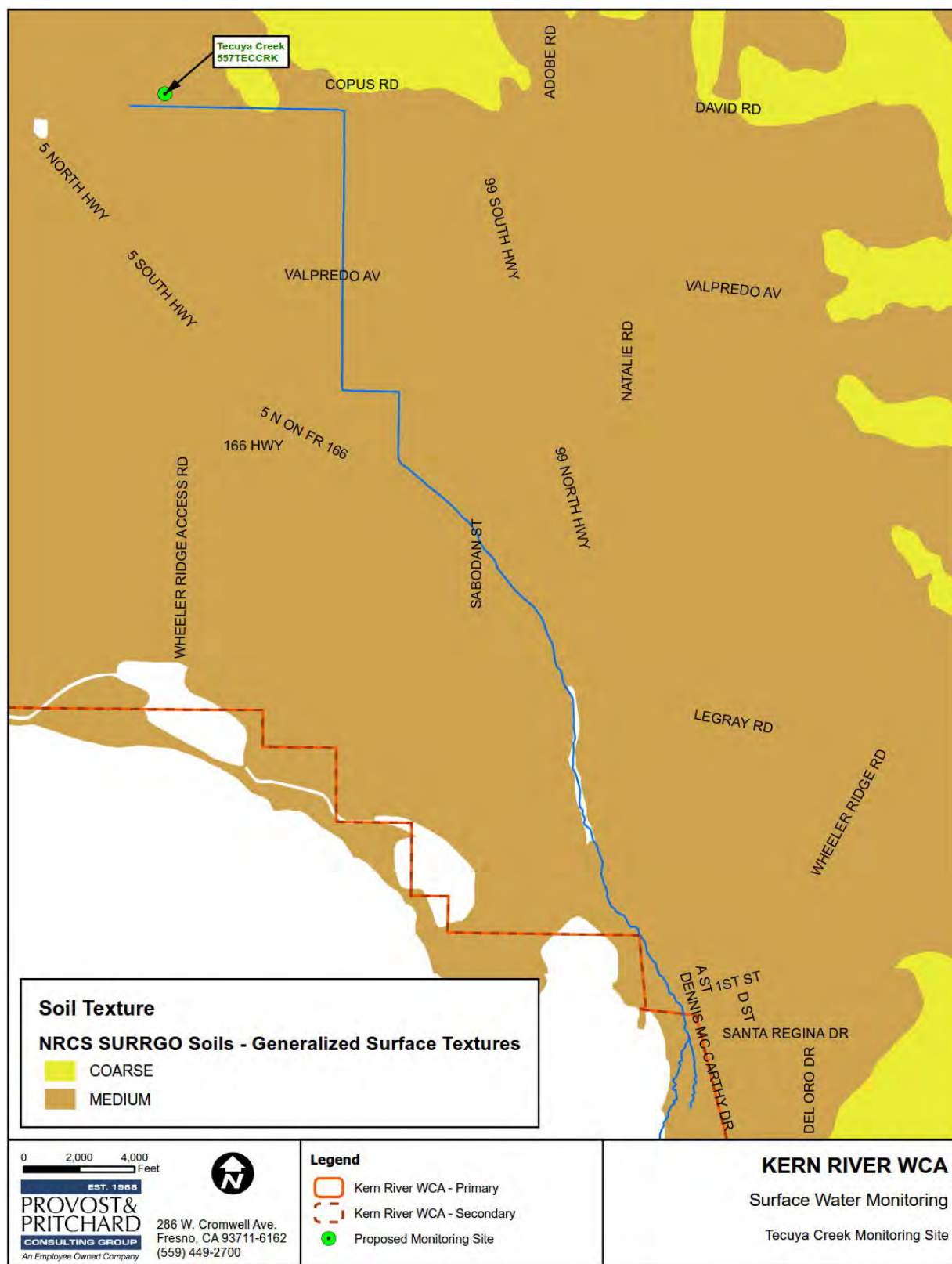


Figure 4-10. Tecuya Creek Soils



Section Four: Surface Water Monitoring Site Selection & Rationale

Surface Water Monitoring Plan

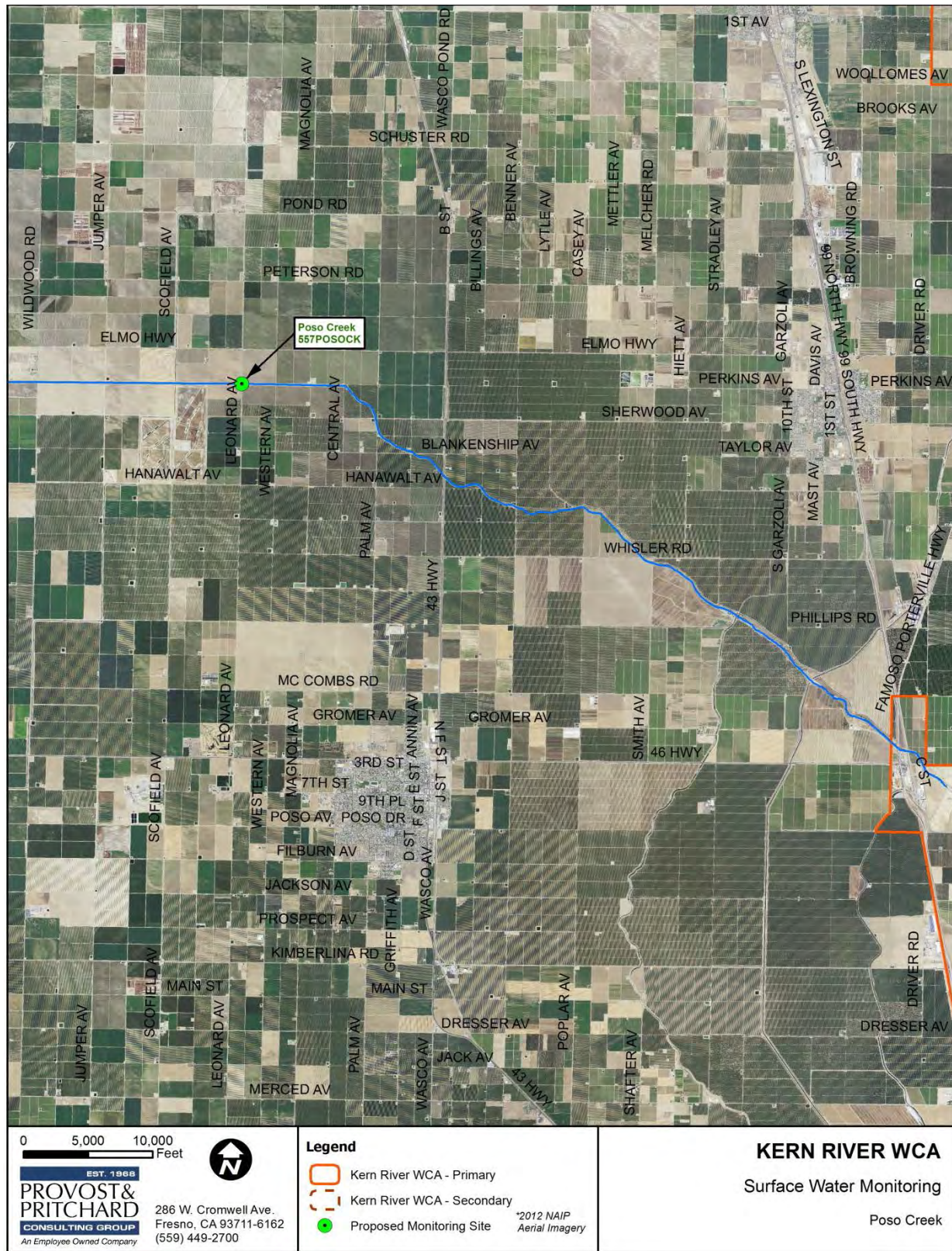


Figure 4-11. Poso Creek Location Map



Section Four: Surface Water Monitoring Site Selection & Rationale

Surface Water Monitoring Plan

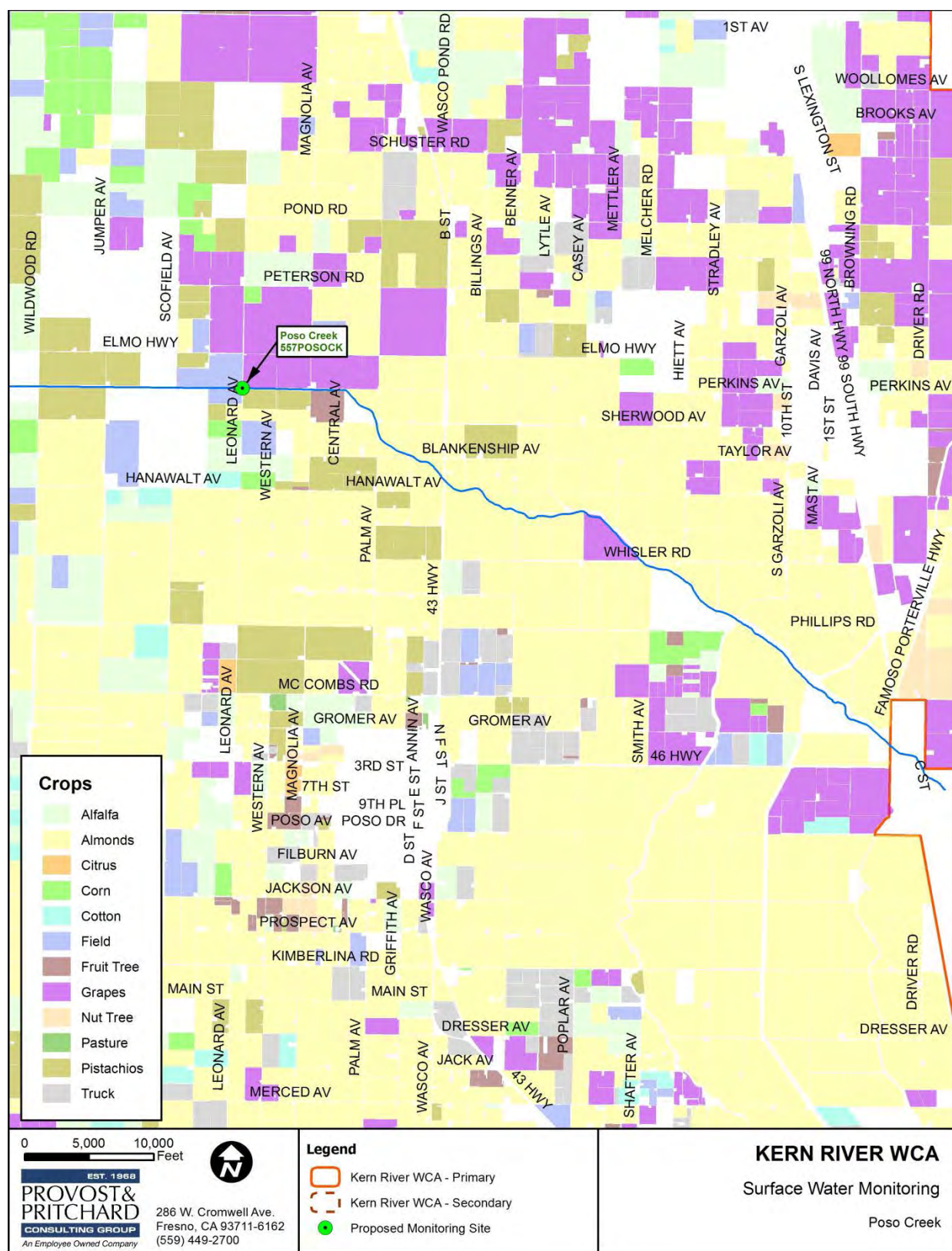


Figure 4-12. Poso Creek Crops



Section Four: Surface Water Monitoring Site Selection & Rationale

Surface Water Monitoring Plan

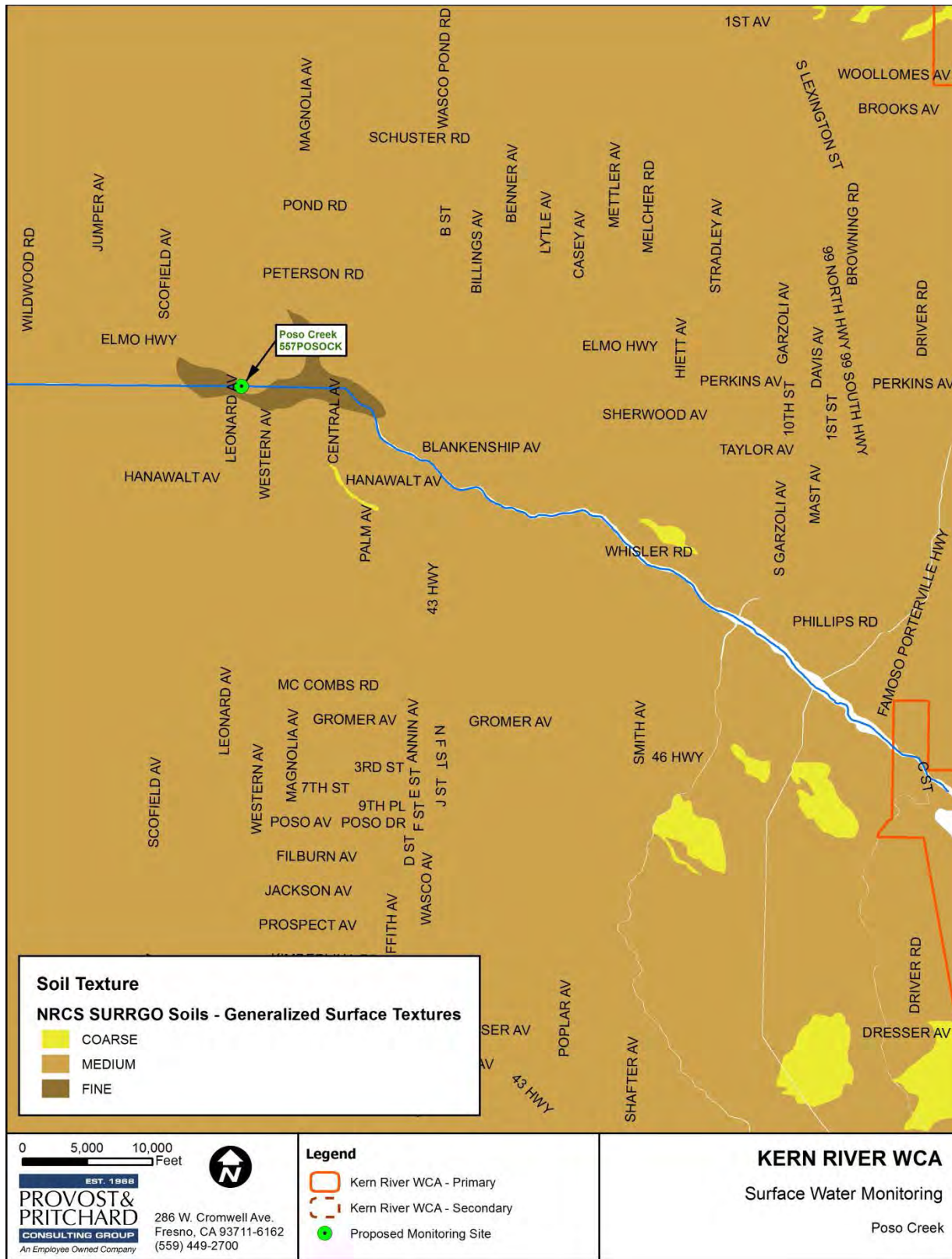


Figure 4-13. Poso Creek Soils



Section Four: Irrigation and Agricultural Management Practices

Groundwater Quality Assessment Report

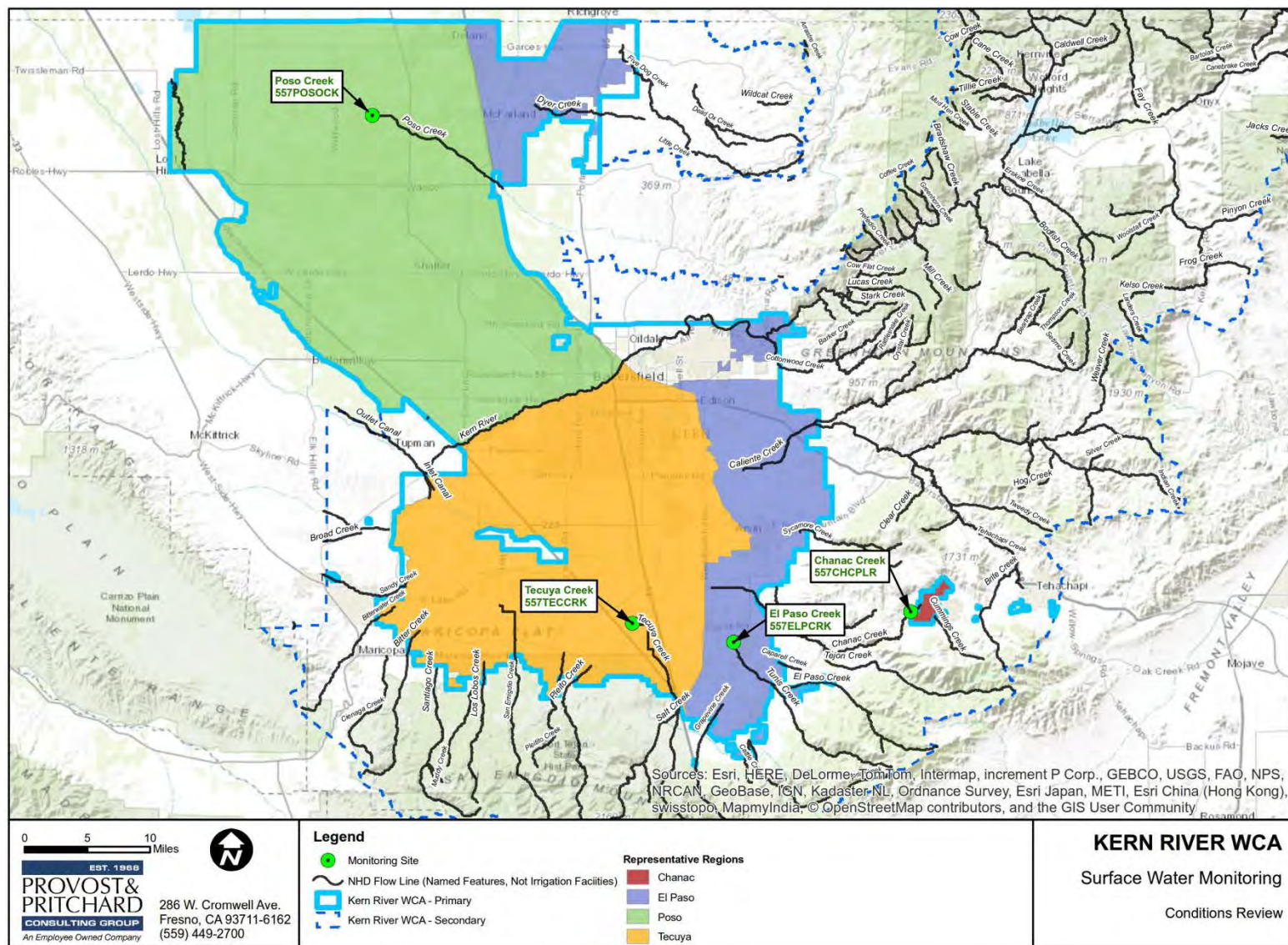


Figure 4-14. Monitoring Site Representative Regions Map



5 Surface Water Monitoring Schedule

Monitoring schedules and frequency will conform to the guidelines set forth by the Regional Board in Attachment B of the Order. The KRWCA plans to continue monthly monitoring at the proposed sampling locations in **Section 4**. However, unlike monitoring under Conditional Waiver R5-2008-2005 that had a set monitoring time each month, the KRWCA will monitor weather and irrigation schedules to capture an event during the month, whenever it may occur. Only one sample will be taken per month. This effort will also aim to satisfy the requirement to capture at least two storm runoff events a year, if such events occur. Records will be kept to identify whether a sample is from a storm or irrigation runoff event. Samples will only be taken when water, flowing or non-flowing, is at least eight (8) inches in depth to allow for proper sample collection and to meet requirements. Water column samples are to be taken at a depth of 0.1 meters (4 inches) below the surface. In addition, standard operating procedure is to submerge the opening of sample containers for filling and also keep submerged while capping the container. To accomplish these procedures without disturbing the channel bed, which may affect the results and quality of the sample, an additional four (4) inches are allotted to make the minimum water depth for sample collection to be eight (8) inches. References to water present for sampling hereafter will be understood to meet these minimum requirements.

5.1 Assessment Monitoring Schedule

Currently, the KRWCA is not proposing an Assessment Monitoring site, however, Year 1 of Core monitoring and potential future sites (i.e. management plan triggered special monitoring sites) are to follow Assessment Monitoring. For Assessment specific sites in the future, the KRWCA will further define the most fitting, site-specific monitoring schedule, but generally proposes to follow a rotating three year cycle where Assessment sites are monitored for all Assessment parameters in Year 1 and then off for Years 2 and 3. This schedule should allow for determining trends and potential impacts to surface water quality by agricultural operations while reducing the financial burden to the KRWCA Members. The KRWCA is electing to follow the water year as its annual reporting period (October 1 to September 30). Samples will only be taken when water is present, but photo documentation will be provided for each month of the one year monitoring cycle.

Assessment Monitoring parameters, when water is present, will include:

- General water quality;
- Pathogens;
- Nutrients;
- Metals;
- Pesticides;
- Water and sediment toxicity parameters; and,
- Possible parameters of concern identified by the Regional Board.

Monitoring parameters and frequency are summarized in **Table 5-1**. More parameter specific information is provided in **Section 6**.



5.2 Ephemeral Monitoring Schedule

The Ephemeral Monitoring Schedule will also go into effect upon approval of this SWMP by the Executive Officer. Many ephemeral creeks and streams do not have long flow times due to their small watersheds, making preparation and communication between the KRWCA and its laboratory, BSK, crucial to the success of ephemeral monitoring. The current plan for the KRWCA will be to monitor rainfall forecasts to identify when water may be present in the channel. When a rainfall event is forecasted, the KRWCA will put the laboratory field personnel on notice, so they are prepared for a sample and be ready to take a sample when needed. As the event approaches, the KRWCA will utilize tools available through Wheeler Ridge – Maricopa Water Storage District (WRMWSD). On the WRMWSD website there is a link to a gage located at the District office that provides real-time climate information. WRMWSD also has staff on call 24 hours a day that would be available for a quick phone call. These tools will be used to confirm an event is taking place and to send the laboratory field personnel if the event is large enough to generate flow.

Ideally having a hydrograph for the ephemeral creeks would allow the KRWCA to know what storms are large enough to generate creek flow and how long the flow may last. However, after researching various data sources this information is not available for the ephemeral creeks in the KRWCA. As the surface water monitoring effort continues and data is gathered, hydrographs may be developed. The current plan and tools will still be needed to calibrate any developed hydrographs with actual events. A draft technical memorandum is provided in **Appendix C** discussing the methodologies and data needs for developing hydrographs, if the task is to be undertaken.

Due to the sporadic nature of ephemeral flows, every sampling event for an Ephemeral Monitoring site will monitor for all parameters, Core and Assessment. These parameters are summarized in **Table 5-1**.

5.3 Core Monitoring Schedule

The Core Monitoring Schedule will commence upon approval of this SWMP by the Executive Officer. Per Order requirements, Core Monitoring will operate on a repeating three year cycle beginning with Assessment parameters in Year 1 and Core parameters in Years 2 and 3. With the KRWCA electing to follow the water year as its annual monitoring period, Year 1 will begin when the SWMP is approved and run through the following September. As mentioned previously, samples will only be taken when water is present, but photo documentation will be provided every month. The Core Monitoring Schedule Cycle is summarized in **Table 5-2**.

Core Monitoring Parameters will consist of monthly sampling for:

- General water quality;
- Pathogens;
- Nutrients;
- Water toxicity; and,
- Possible parameters of concern identified by the Regional Board.

Assessment Monitoring parameters will include:



Section Five: **Surface Water Monitoring Schedule**

Surface Water Monitoring Plan

- Metals;
- Pesticides;
- Sediment toxicity parameters; and,
- All Core parameters.

The monitoring parameters and frequency are summarized in **Table 5-3**. More parameter specific information is provided in **Section 6**.

5.4 Special Monitoring Schedule

Currently, the KRWCA does not have any Special Monitoring sites. The KRWCA will utilize these monitoring tools in cases where a new monitoring site is developed or if exceedances trigger a SQMP that includes developing more surface water monitoring sites. Incorporating this type of monitoring will help to classify surface water quality at a site and/or help the KRWCA track down the source that may be causing exceedances. Further discussion on parameters and schedule will be established during site development or in a SQMP, as necessary.

5.5 Monitoring Prioritization

The KRWCA understands the General Order allows for prioritizing work on specific watersheds and setting a cycle for monitoring sites based on the priority. At this time the KRWCA does not propose a prioritized monitoring schedule for the proposed monitoring locations and will proceed as stated. If in the future circumstances change (i.e. financial, seasonal, change in practices, etc.), the KRWCA will provide a prioritized monitoring schedule and rationale to the Executive Officer in writing for approval.



Section Five: **Surface Water Monitoring Schedule**

Surface Water Monitoring Plan

Table 5-1. Assessment and Ephemeral Monitoring Schedule and Parameters

Assessment and Ephemeral Monitoring Schedule and Parameters	
Parameters	Monitoring Frequency
Photo monitoring (digital)	Every monitoring event (wet or dry)
General Physical Parameters	Monthly
Nutrients	Monthly
Pathogens	Monthly
Water Column Toxicity	Monthly
Metals	Monthly
Pesticides	Monthly
Sediment Toxicity	Twice per year ⁶

⁶ One sample shall be collected between March 1 and April 30; the other sample shall be collected between August 15 and October 15, in conjunction with channel flow events.



Section Five: **Surface Water Monitoring Schedule**

Surface Water Monitoring Plan

Table 5-2. Core Monitoring Cycle

Core Monitoring Cycle			
Monitoring Type	Year 1	Year 2	Year 3
Assessment	X		
Core		X ⁽¹⁾	X

(1) Core will include Assessment parameters exceeding trigger limits in Year 1.



Section Five: **Surface Water Monitoring Schedule**

Surface Water Monitoring Plan

Table 5-3. Core Monitoring Schedule and Parameters

Core Monitoring Schedule and Parameters	
Parameters	Monitoring Frequency
Photo monitoring (digital)	Every monitoring event (wet or dry)
General Physical Parameters	Monthly
Nutrients	Monthly
Pathogens	Monthly
Water Column Toxicity	Monthly
Assessment Monitoring	Once every three years
Parameter(s) of Concern ⁷	Monthly

⁷ Parameter(s) of Concern may be reasonably selected by the Executive Officer from Assessment analyses that result in an exceedance or degradation



6 Monitored Parameters

Surface water monitoring established under previous conditional waivers and continued under this Order comes with a whole suite of parameters that need to be monitored to characterize the state of water quality of a watershed or represented watershed. Primary focus of the monitored parameters is to determine the impact irrigated agriculture may have on surface waters, if applicable. The selection and type of monitored parameters are further discussed in this section. Samples will only be taken when water is present at the monitoring locations. Methods by which each parameter is analyzed will be discussed in the Quality Assurance Project Plan (QAPP) section.

6.1 Field Measurements

Field measurements are quick measurements taken in the field during each sampling event. These measurements (see **Table 6-1**) help to classify the surface water as it is in the field. Field measurements will be taken for all monitoring site types when water is present. When water is not present at a site, only the photo documentation will be collected by the field technician.

6.2 General Physical, Pathogen, and Nutrient Parameters

General physical, pathogen, and nutrient parameters further classify the state of the surface water in the field; however, these parameters are analyzed in a laboratory. These parameters start to determine the quality of the water as dissolved and suspended solids, different forms of Nitrogen, and coliforms are determined. The parameters in **Table 6-2** will be sampled at all monitoring site types.

6.3 Metals

The Regional Board has specified a list of metals to be evaluated for monitoring at sites in each subwatershed. The Third-party member is tasked to evaluate several factors that could lead to inclusion or exclusion of a metal. These factors include but are not limited to: use, geological and hydrogeological conditions, or prior monitoring data. The KRWCA has decided the most cost-effective effort is to currently monitor for all metals listed in the Order by the Regional Board. Laboratories can analyze for the whole spectrum of metals at very small incremental increases or decreases per metal. At this point, it is expected that the effort taken to evaluate the different factors for exclusion would be significantly more costly than the incremental change in metal monitoring costs. The full list of metals to be monitored is summarized in **Table 6-3**. Metals are monitored during Assessment and Ephemeral Monitoring events.

Although the KRWCA is choosing to initially proceed with monitoring all listed metals and metal fractions, it proposes to maintain the ability to re-evaluate metal monitoring in the future. The KRWCA proposes that if conditions change in the future justifying the removal of a metal(s) from the analysis, technical justification reviewing all factors mentioned above will be submitted to the Executive Officer in writing.



6.4 Pesticides

Pesticide parameters are not listed in Attachment B of the Order. The Order states the Executive Officer will provide the list of pesticides requiring monitoring after coordinating with qualified scientists and the Department of Pesticide Regulation. At the time of this report, a Pesticide Evaluation Advisory Workgroup is developing a list of pesticides and evaluation criteria. Until further notice and guidance are provided from this Workgroup, the KRWCA intends to continue monitoring for the pesticides that were in the MRP under the Conditional Waiver R5-2008-0005. Once the pesticide list and evaluation criteria are developed and provided, the KRWCA will review and amend the list. The planned monitored pesticides are listed in **Table 6-4**. Pesticides will be monitored during Assessment and Ephemeral monitoring.

6.5 303(d) Listed Constituents

The Order states that constituents listed on the 303(d) list must be included to the monitored parameters if irrigated agriculture is identified as the source. Upon reviewing the most recent 303(d) list (2010) the only listed water body in the KRWCA boundary is Lake Isabella. The listed constituents are dissolved oxygen and pH, but the source is unknown for both. Although the source is unknown, these parameters are already included to be monitored at every event.

6.6 Toxicity

The Order states that toxicity sampling of the water column and sediment is used for three primary purposes: 1) to evaluate compliance with the Basin Plan, 2) to identify causes of toxicity, and 3) to evaluate the potential cumulative toxic effect if multiple parameters are present. Survival rate or growth of the used organisms in samples will be the main indicator for whether the water or sediment is toxic. The KRWCA will continue to follow toxicity sampling protocols as part of the effort to determine impacts of agriculture on surface water quality.

6.6.1 Water Toxicity

Testing of toxicity in the water column will occur for all monitoring events and will analyze *Ceriodaphnia dubia* (water flea), *Pimephales promelas* (fathead minnow), and *Selenastrum capricornutum* (green algae). Survival rate for the water flea and fathead minnow will be analyzed, and growth will be analyzed for the algae. The triggers for further analysis, known as a Phase I Toxicity Identification Evaluation (TIE), are: 1) either the water flea or fathead minnow see a 50% or greater difference in mortality when comparing the ambient sample to the control, or 2) if there is a 50% or greater reduction in growth for the algae when comparing the ambient sample to the control.

The TIE will be conducted within 48 hours of a detection of reduced survival or growth. The purpose of this evaluation is to determine potential classes of parameters that may have caused the toxicity. General parameter classification and corresponding monitoring results should allow for the KRWCA to determine the source of the toxicity.



6.6.2 Sediment Toxicity

Sediment toxicity sampling is required at all specified monitoring locations if the appropriate sediment is present. If appropriate sediment is not present at the monitoring site, then an alternative site with the appropriate sediment must be designated for the sediment sampling. Appropriate sediments are small soil types such as clay and silt. Since all monitoring locations are in the creek channels, all water quality monitoring locations have the appropriate sediment and no alternative locations are necessary.

Sampling for sediment toxicity occurs only two times each year for Assessment and Ephemeral Monitoring, unlike the water column toxicity that occurs with every sample. One sample will be collected between August 15 and October 15 and the other sample will be collected between March 1 and April 30 each year as specified in the Order. The KRWCA intends to sample sediment in March and September each year. In the unlikely event an issue arises that prevents a sample in either of these months, there will still be flexibility to meet the specified Order requirements.

Sediment analysis will utilize *Hyaella azteca* and follow EPA Method 600/R-99/064. Similar to water toxicity analysis of the water flea and fathead minnow, *Hyaella azteca* is analyzed for organism survival. If less than 80% organism survival compared to the control, further parameters need to be analyzed in the sediment sample. The additional parameters are listed in **Table 6-5**. Performing a TIE is an optional tool that can be used in an event with increased organism mortality. The KRWCA will only perform a TIE on sediment samples if the additional sediment analysis does not detect any of the tested parameters.



Section Six: Monitored Parameters

Surface Water Monitoring Plan

Table 6-1. Measured Field Parameters

Measured Field Parameters	
Field Parameter	Units
Estimated Flow	cfs
Photo Documentation	Site
Conductivity	$\mu\text{S}/\text{cm}$ (at 25 °C)
Temperature	°C
pH	units
Dissolved Oxygen	mg/L



Section Six: Monitored Parameters

Surface Water Monitoring Plan

Table 6-2. Monitored General Physical, Pathogen, and Nutrient Parameters

Monitored General Physical, Pathogen, and Nutrient Parameters		
Hardness (as CaCO ₃)	Soluble Orthophosphate	Total Ammonia (as N)
Total Suspended Solids (TSS)	Unionized Ammonia (calculated)	Total Organic Carbon (TOC)
Turbidity	Nitrogen, Nitrate+Nitrite	<i>E. coli</i>



Section Six: Monitored Parameters

Surface Water Monitoring Plan

Table 6-3. Monitored Metals

Monitoring Metals	
Metal	Fraction
Arsenic	Total
Boron	Total
Cadmium	Total and Dissolved
Copper	Total and Dissolved
Lead	Total and Dissolved
Molybdenum	Total
Nickel	Total and Dissolved
Selenium	Total
Zinc	Total and Dissolved



Section Six: Monitored Parameters

Surface Water Monitoring Plan

Table 6-4. Monitored Pesticide Parameters

Monitored Pesticide Parameters			
Carbamates	Organochlorines	Organophosphorus	Herbicides
Aldicarb	DDD	Azinphos-methyl	Atrazine
Carbaryl	DDE	Chlorpyrifos	Cyanazine
Carbofuran	DDT	Diazinon	Diuron
Methiocarb	Dicofol	Dichlorvos	Glyphosate
Oxamyl	Dieldrin	Dimethoate	Linuron
	Endrin	Dimeton-S	Paraquat dichloride
	Methoxychlor	Disulfoton	Simazine
		Malathion	Trifluralin
		Methamidophos	
		Methidathion	
		Parathion methyl	
		Phorate	
		Phosmet	



Section Six: Monitored Parameters

Surface Water Monitoring Plan

Table 6-5. Sediment Parameters Analyzed with Increased *Hyalella* Mortality

Sediment Parameters	
Bifenthrin	Esfenvalerate/Fenvalerate
Chlorpyrifos	Fenpropathrin
Cyfluthrin	Lambda cyhalothrin
Cypermethrin	Permethrin
Deltamethrin	Piperonyl butoxide (PBO)



7 Quality Assurance Project Plan (QAPP)

The Quality Assurance Project Plan (QAPP) governs the sampling and testing performed under this SWMP. Samples are collected during each month when water is present at each monitoring site, including at least two storm events (if applicable), and sediment samples are taken at two times during the year. Collection and analysis protocols will be established for each monitored constituent and analytical method used. BSK Associates (BSK) will be performing the sampling and photo documentation for the KRWCA and will follow the protocols set forth in the approved QAPP during each sampling event. A brief summary for the different components to sampling are set forth below. The full QAPP is submitted along with this SWMP in **Appendix B** as required by the Order.

7.1 Sample Collection

Sample collection includes several components to be compliant with the MRP requirements of the Order. Photo documentation is required at each site each month regardless of whether the water is present or not. Ambient water and sediment sampling only occur when water is present and during a monthly event. Components of sample collection are summarized below.

7.1.1 Photo Documentation and Field Data

Photo documentation of the monitoring site will be performed at all monitoring events, regardless of whether water is present and/or flowing. Photos will be combined with field sheets to describe the site at each event. Field parameters are also recorded regardless of whether water is present and/or flowing. Field data includes time on site, weather observations, water and sediment characteristics, and any additional site descriptions or comments.

7.1.2 Ambient Water

Sampling for a site generally takes several hours on one day. To perform the water sampling, a specified quantity and type of bottles are filled with water from the channel based on the requirements of the analysis to be performed for a given sampling site as described in **Section 5** and **Section 6** and the QAPP. Collected samples must be stored at a temperature less than or equal to 4°C and must be delivered within 24 hours to the necessary laboratories. Holding times for different constituents will govern the order of analyses performed. All bottles for a site will be given the same sample time and date to track the different results for a site. Quality Control samples such as field duplicates and samples for matrix spike analysis will also be filled during collection and stored and transported in the same manner as the other samples. Field blanks will also be used as part of the quality control process, but these bottles will be filled with deionized water. Flow in the channel will also be measured. Further detail regarding ambient water sampling is provided in the QAPP.

7.1.3 Sediment

Sediment is collected two times per year following the schedule provided in **Section 5**. Samples are taken from the topmost two (2) centimeters (cm) of channel bed substrate and placed into the containers for toxicity testing, grain size and total organic carbon (TOC) analyses. Other containers will



Section Seven: **Quality Assurance Project Plan (QAPP)** **Surface Water Monitoring Plan**

be provided for additional sediment samples in the event any chemical analyses are necessary due to increased toxicity. Sediment samples for chemistry and grain size and TOC are frozen within 48 hours while toxicity and grain size samples are held at 4°C until analysis begins. Further detail regarding sediment sampling is provided in the QAPP.

7.2 Laboratory Analysis

Analysis of samples will be handled by BSK. BSK performs most analyses in-house but subcontracts with Aquatic Bioassay and Consulting Laboratories, Inc. (ABC) for testing of water column and sediment toxicity. BSK and ABC will follow methods authorized by KRWCA and as accepted by the Regional Board and will provide written notification if another method is to be used. The quality assurance manuals and standard operating procedures (SOPs) for these organizations will be part of the KRWCA QAPP, but are also available by contacting the KRWCA. A summary of the analytical methods used and the trigger, reporting, and minimum detection limits are provided in **Table 7-1**.

7.3 Quality Control

Quality assurance and control objectives for sample collection and laboratory analysis are explicitly described in the QAPP. These objectives describe the criteria for making sure results are correct and complete. Criteria include discussion on equipment precision and accuracy, contamination either by the sampler or equipment, and completeness. Precision and accuracy are checked through various duplicate field and lab samples to confirm validity of results. Contamination is prevented through thorough cleaning of equipment and strict adherence to monitoring protocols. Completeness is gauged based on percentage of valid result data that is produced. The goal is to have at least 90% of the data meet all quality criteria. Failure to meet any of the criteria will result in data to be flagged with the appropriate SWAMP/CEDEN flag. Both BSK and KRWCA staff will review data for completeness and flag data as appropriately. The Electronic Data Deliverable (EDD) Checklist and Online Data Checker tools provided by the Regional Board will be utilized to check data submittal format and completeness. Review of the failures may result in rejection of the data.

In addition to the QAPP guiding laboratory and sampling practices, the KRWCA also proposes to follow actions that will reduce bias, variability, and uncertainty. The KRWCA will make an effort to sample the first water flow in a month where water is flowing, and each sample will be taken at the same location at a monitoring site. These two efforts should reduce bias and uncertainty for the monitoring program. This can lead to variability on whether storm or irrigation water is being sampled. This variability will be noted in the field reporting data as to when the sample was taken and what the surrounding lands and weather conditions were during and prior to an event.



Section Seven: Quality Assurance Project Plan (QAPP)

Surface Water Monitoring Plan

Table 7-1. Analytical Methods and Limits

Analytical Methods and Limits					
Constituent	LTIL PQL	BSK Reporting Information			
		RL	MDL	Units	Method
Physical Parameters					
Flow	1	-	-	cfs	Field
pH	0.1	0.1	-	pH Units	Field
EC	100	5	-	umhos/cm	Field
DO	0.1	0.1	-	mg/L	Field
Temp	0.1	-	-	°C	Field
Turbidity	1	0.1	-	NTU	SM 2130B
TDS	10	10	-	mg/L	SM 2540C
TSS	10	10	-	mg/L	SM 2540D
Hardness	10	0.41	0.19	mg/L	SM 2340B
Color	-	1	-	Color Units	SM 2120B
TOC	0.5	0.2	0.047	mg/L	SM 5310C
Pathogens					
E. coli	2	1.1	-	MPN/100mL	SM 9221F
Fecal coliform	2	1.1	-	MPN/100mL	SM 9221E
Water Column Toxicity					
Algae	NA	NA	NA	Cell/mL, % Growth	EPA 821-R-02-013
Water Flea	NA	NA	NA	% Survival	EPA 821-R-02-012
Fathead Minnow	NA	NA	NA	% Survival	EPA 821-R-02-012
Sediment					
Hyaella	NA	NA	NA	% Survival	EPA 600-R-99-064
Carbamates					
Aldicarb	0.5	0.4	0.0089	ug/L	EPA 8321A
Carbaryl	0.5	0.07	0.0078	ug/L	EPA 8321A
Carbofuran	0.5	0.07	0.0042	ug/L	EPA 8321A
Methiocarb	0.5	0.4	0.0054	ug/L	EPA 8321A
Methomyl	0.5	0.07	0.0098	ug/L	EPA 8321A
Thiobencarb	-	0.5	0.006	ug/L	EPA 8270C
Oxamyl	0.5	0.4	0.0413	ug/L	EPA 8321A
Organochlorines					
DDD	0.02	0.01	0.00072	ug/L	EPA 8081A
DDE	0.01	0.01	0.00061	ug/L	EPA 8081A
DDT	0.01	0.01	0.0007	ug/L	EPA 8081A
Dicofol	0.1	0.1	0.015	ug/L	EPA 8270C
Dieldrin	0.01	0.01	0.00097	ug/L	EPA 8081A



Section Seven: Quality Assurance Project Plan (QAPP)

Surface Water Monitoring Plan

Analytical Methods and Limits					
Constituent	LTIL PQL	BSK Reporting Information			
		RL	MDL	Units	Method
Endrin	0.01	0.01	0.00081	ug/L	EPA 8081A
Methoxychlor	0.05	0.01	0.0009	ug/L	EPA 8081A
Toxaphene	-	0.5	0.035	ug/L	EPA 8081A
Organophosphates					
Azinphos-methyl (Guthion)	0.1	0.1	0.032	ug/L	EPA 8270C
Chlorpyrifos	0.015	0.02	0.0029	ug/L	EPA 8270C
Diazinon	0.02	0.02	0.0036	ug/L	EPA 8270C
Dichlorvos	0.1	0.1	0.0048	ug/L	EPA 8270C
Dimethoate	0.1	0.1	0.0075	ug/L	EPA 8270C
Demeton-S (Demeton [O,S])	0.1	0.1	0.025	ug/L	EPA 8270C
Disulfoton	0.05	0.1	0.024	ug/L	EPA 8270C
Malathion	0.1	0.1	0.0046	ug/L	EPA 8270C
Methamidophos	0.2	0.2	0.021	ug/L	EPA 8270C
Methidathion	0.1	0.1	0.011	ug/L	EPA 8270C
methyl Parathion	0.1	0.1	0.003	ug/L	EPA 8270C
Phorate	0.2	0.1	0.0033	ug/L	EPA 8270C
Phosmet	0.2	0.2	0.029	ug/L	EPA 8270C
Herbicides					
Atrazine	0.5	0.5	0.028	ug/L	EPA 8270C
Simazine	0.5	0.5	0.024	ug/L	EPA 8270C
Cyanazine	0.5	0.5	0.036	ug/L	EPA 8270C
Diuron	0.5	0.4	0.0072	ug/L	EPA 8321A
Molinate	-	0.5	0.004	ug/L	EPA 8270C
Glyphosate	5	5	2.1	ug/L	EPA 547
Paraquat	0.5	0.4	0.21	ug/L	EPA 549.2
Linuron	0.5	0.4	0.0061	ug/L	EPA 8321A
Trifluralin	0.05	0.05	0.0056	ug/L	EPA 8270C



Section Seven: Quality Assurance Project Plan (QAPP)

Surface Water Monitoring Plan

Analytical Methods and Limits					
Constituent	LTIL PQL	BSK Reporting Information			
		RL	MDL	Units	Method
Metals					
Arsenic	1	0.2	0.045	ug/L	EPA 200.8
Boron	10	10	4.45	ug/L	EPA 200.8
Cadmium	0.1	0.1	0.025	ug/L	EPA 200.8
Copper	0.5	0.5	0.23	ug/L	EPA 200.8
Lead	0.5	0.2	0.045	ug/L	EPA 200.8
Molybdenum	1	0.5	0.0358	ug/L	EPA 200.8
Nickel	1	0.5	0.051	ug/L	EPA 200.8
Selenium	1	1	0.45	ug/L	EPA 200.8
Zinc	1	1	0.46	ug/L	EPA 200.8
Nutrients					
TKN	0.5	0.5	0.055	mg/L	EPA 351.2
Nitrate-N	0.05	0.06	0.0145	mg/L	EPA 300.0
Nitrite-N	0.05	0.05	0.043	mg/L	EPA 300.0
Ammonia	0.1	0.1	0.029	mg/L	SM 4500-NH3 G
Orthophosphate (as P)	0.01	0.01	0.0051	mg/L	SM 4500-P E
Phosphorus (as P)	0.01	0.01	0.0068	mg/L	EPA 365.4
Pyrethroids					
Bifenthrin	1.0	0.5	0.11	ug/Kg	EPA 8270C
Cyfluthrin	1.0	2.0	0.39	ug/Kg	EPA 8270C
Cypermethrin	1.0	2.0	0.53	ug/Kg	EPA 8270C
Esfenvalerate (+Fenvalerate)	1.0	1.0	0.44	ug/Kg	EPA 8270C
Fenpropathrin	1.0	0.5	0.077	ug/Kg	EPA 8270C
Permethrin (trans-Permethrin)	1.0	0.5	0.074	ug/Kg	EPA 8270C
Lamda Cyhalothrin	1.0	0.5	0.061	ug/Kg	EPA 8270C



8 Reporting

Pursuant to the Monitoring and Reporting Program (MRP) under this Order, the KRWCA must submit its Surface Water Monitoring Plan to the Executive Officer within 180 days of receiving the Notice of Applicability (NOA) to be a Third-party member. The KRWCA received its NOA on February 4, 2014, making the submittal date for the Plan to be August 4, 2014. Any revisions to this Plan, if necessary, will be submitted according to a schedule determined by the Executive Officer.

In addition to development of a Surface Water Monitoring Plan, Quarterly and Annual Monitoring Reports, Exceedance Reports, and potentially Surface Water Quality Management Plans (SQMPs) are to be reported by the KRWCA, similar to requirements of the previous MRP under conditional waiver R5-2008-0005.

8.1 Quarterly Reporting

The purpose of the quarterly reporting is to supply surface water monitoring data to the Regional Board for the previous quarter's results. **Table 8-1** summarizes the due dates for the reporting period. Items to be included with the data for the quarterly reporting are listed on page 23 of Attachment B of the Order.

8.2 Annual Reporting

Annual monitoring reports summarize the previous year's data and KRWCA efforts to inform, implement, and review practices that are to benefit water quality in the group boundary. These reports are quite extensive and include several required components, listed below. Minor changes have been made to the reporting period and due date from the previous MRP under conditional waiver R5-2008-0005. Under the newly adopted Order, the Monitoring and Reporting Program states the reporting period will be a hydrologic water year (October 1 through September 30) instead of a calendar year. Annual reports are due May 1st every year.

1. Signed Transmittal Letter;
2. Title page;
3. Table of contents;
4. Executive Summary;
5. Description of the Coalition Group geographical area;
6. Monitoring objectives and design;
7. Sampling site descriptions and rainfall records for the time period covered under the Monitoring Report;
8. Location map(s) of sampling sites, crops and land uses;
9. Tabulated results of all analyses arranged in tabular form so that the required information is readily discernible;



10. Discussion of data relative to water quality objectives, and water quality management plan milestones/Basin Plan Amendment Workplan updates, where applicable;
11. Sampling and analytical methods used;
12. Associated laboratory and field quality control sample results;
13. Summary of Quality Assurance Evaluation results (as identified in the most recent version of the third-party's approved QAPP for Precision, Accuracy, and Completeness);
14. Specification of the method(s) used to obtain estimated flow at each surface water monitoring site during each monitoring event;
15. Summary of exceedances of water quality objectives/trigger limits occurring during the reporting period and for surface water related pesticide use information;
16. Actions taken to address water quality exceedances that have occurred, including but not limited to, revised or additional management practices implemented;
17. Evaluation of monitoring data to identify spatial trends and patterns;
18. Summary of Nitrogen Management Plan information submitted to the third-party;
19. Summary of management practice information collected as part of Farm Evaluations;
20. Summary of mitigation monitoring;
21. Summary of Education and outreach activities; and
22. Conclusions and recommendations.

8.3 Exceedance Reporting

Exceedance reporting is required when monitoring results show an exceedance of adopted numeric water quality objectives or trigger limits for a monitored parameter. Exceedances must be determined within five (5) business days of receiving laboratory reports. Exceedance reports are to be emailed to a designated Regional Board staff contact the next business day after determining an exceedance. The KRWCA designated contact is Eric Warren, and his email is eric.warren@waterboards.ca.gov.

8.4 Surface Water Quality Management Plans (SQMPs)

The purpose of monitoring surface water quality is to first assess whether waters of the State within the KWRCA boundary are being improved or degraded as a result of farming operations and then make an effort to prevent further degradation. The degradation prevention effort, in part, is attempted to be achieved through Surface Water Quality Management Plans (SQMPs), which are triggered if during a three (3) year period more than one exceedance of the same parameter occurs at the same monitoring location. If this occurs, a schedule for SQMP development and implementation will be provided by the KRWCA to Regional Board staff within 10 business days. The KRWCA will work with Regional Board Staff to develop an approved SQMP in a reasonable timeframe. For a SQMP to be approved, several components needed for inclusion are: physical setting, plan strategy, monitoring methods, and data evaluation methodology. Each component is discussed further in Appendix MRP-1 of Attachment B of the Order. Approved SQMPs will be updated on an annual basis on May 1 of each year the plan is in



Section Eight: **Reporting** **Surface Water Monitoring Plan**

effect. The annual report will review all data collected, landowner outreach, management practice implementation, and any other actions taken during the previous year will be reported and reviewed.

Currently, no SQMP's have been triggered on the monitoring sites within the KRWCA. If at any time during the surface water monitoring effort exceedances trigger the need for a management plan, the KRWCA will follow the requirements set forth in this SWMP along with the Order. In situations where the KRWCA believes exceedances are not likely to be the result of agricultural operations and/or remedied or addressed by a SQMP, the KWRCA will submit to the Executive Officer a request of exemption from development of a SQMP.



Section Eight: **Reporting** Surface Water Monitoring Plan

Table 8-1. Quarterly Surface Water Reporting Schedule

Quarterly Surface Water Reporting Schedule	
Reporting Period	Due Date
October 1 st through December 31 st of previous calendar year	March 1 st
January 1 st through March 31 st of same calendar year	June 1 st
April 1 st through June 30 th of same calendar year	September 1 st
July 1 st through September 30 th of same calendar year	December 1 st



9 KRWCA Contact Information

Nicole Bell

Program Manager

Kern River Watershed Coalition Authority

Phone: (661) 616-6500

Email: nbell@krwca.org



10 Bibliography/References

Below is list of the major references reviewed during development of this KRWCA Surface Water Monitoring Plan. A complete list of references can be made available upon request.

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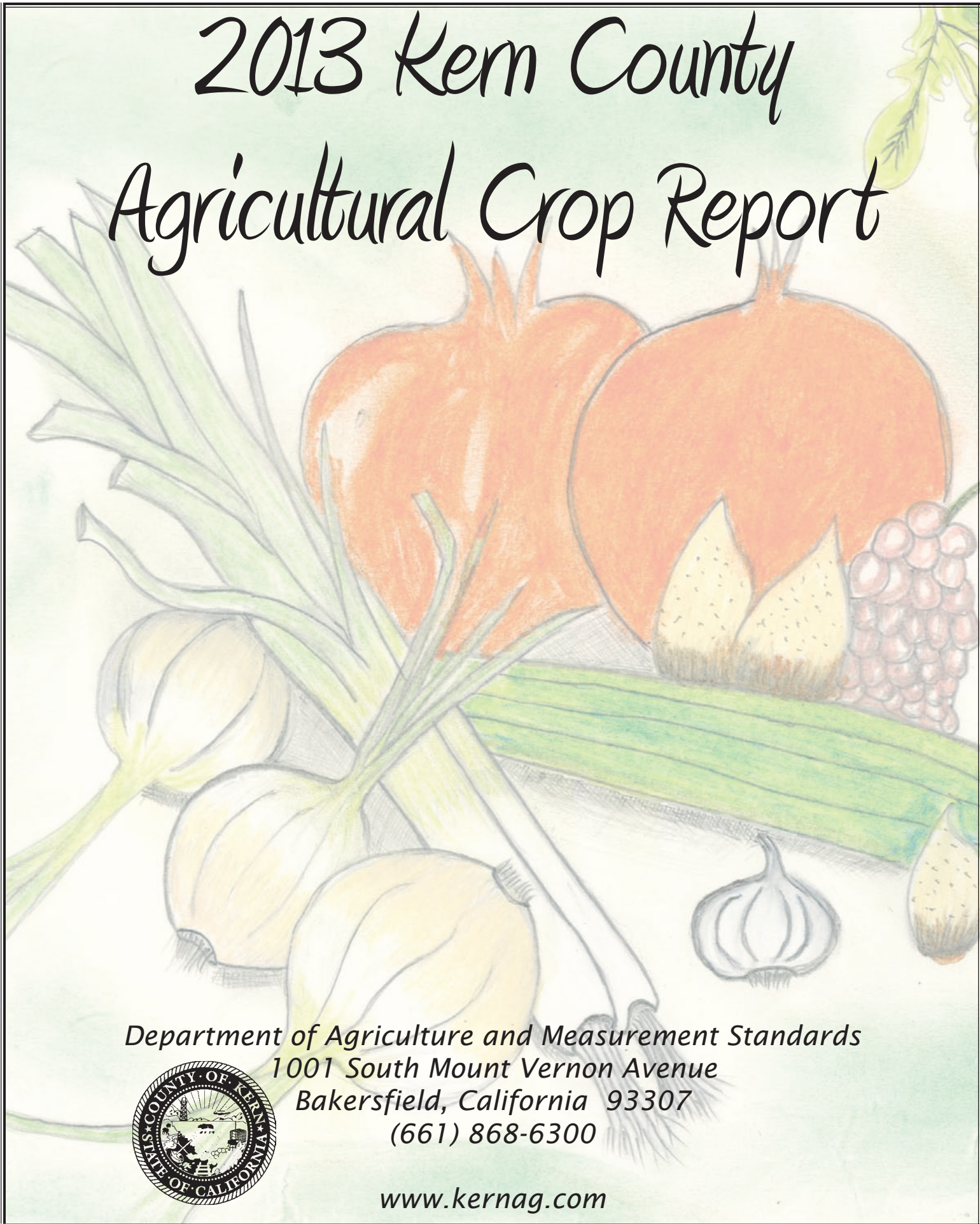
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Appendix A

**Kern Agricultural Commissioner
2013 Annual Crop Report**

2013 Kern County Agricultural Crop Report



Department of Agriculture and Measurement Standards
1001 South Mount Vernon Avenue
Bakersfield, California 93307
(661) 868-6300



www.kernag.com



DEPARTMENT OF AGRICULTURE AND MEASUREMENT STANDARDS

RUBEN J. ARROYO
Agricultural Commissioner
Sealer of Weights and Measures

1001 South Mount Vernon Avenue · Bakersfield, California 93307
Telephone 661-868-6300 · Fax 661-868-6301 · agcomm@co.kern.ca.us

August 12, 2014

THE HONORABLE BOARD OF SUPERVISORS
COUNTY OF KERN

Leticia Perez, Chairman
Mick Gleason David Couch
Zack Scrivner Mike Maggard

AND

John Nilon
County Administrative Officer

KAREN ROSS, SECRETARY
CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE

It is my pleasure to submit the 2013 Kern County Agricultural Crop Report. This annual report presents statistical information on acreage, yield and gross values of Kern County agricultural products in accordance with Sections 2272 and 2279 of the Food and Agricultural Code. The figures in this report represent only gross values and do not take into account the costs of production, marketing, transportation, or other ancillary costs. No attempt is made to reflect net income or loss to the producers of these commodities.

The 2013 gross value of all agricultural commodities produced in Kern County is \$6,769,855,590. This represents an increase (6%) from the revised 2012 crop value (\$6,352,061,100).

The top five commodities for 2013 were Grapes, Almonds, Milk, Citrus and Cattle & Calves, which make up more than \$4.6 Billion (68%) of the Total Value; with the top twenty commodities making up more than 94% of the Total Value.

The 2013 Kern County Crop Report can be found on the Department of Agriculture and Measurement Standards website: www.kernag.com

I would like to thank all the members of the Agriculture and Measurement Standards staff who helped with the compilation and preparation of this report, especially Cerise Montanio, Agricultural Biologist/Inspector, and Glenn Fankhauser, Assistant Director. Most of all, I extend my thanks and appreciation to all of the agricultural producers, contributing organizations and those individuals who provided the necessary information for this report.

Respectfully Submitted,

Ruben J. Arroyo
Agricultural Commissioner/Sealer of Weights and Measures

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Thank you to Kevin Phillips, Gabrielle Baker and Chris Loza, creative and enthusiastic art students at Bakersfield College whose artwork was chosen to be displayed in this years' crop report. Kevin's artwork is featured on the cover, Gabrielle's is on page 2, and Chris' is on page 15.

Note: Numbers published in this report may not compute exactly due to rounding.
Permanent Acreage may differ from actual Harvested Acreage for some commodities.

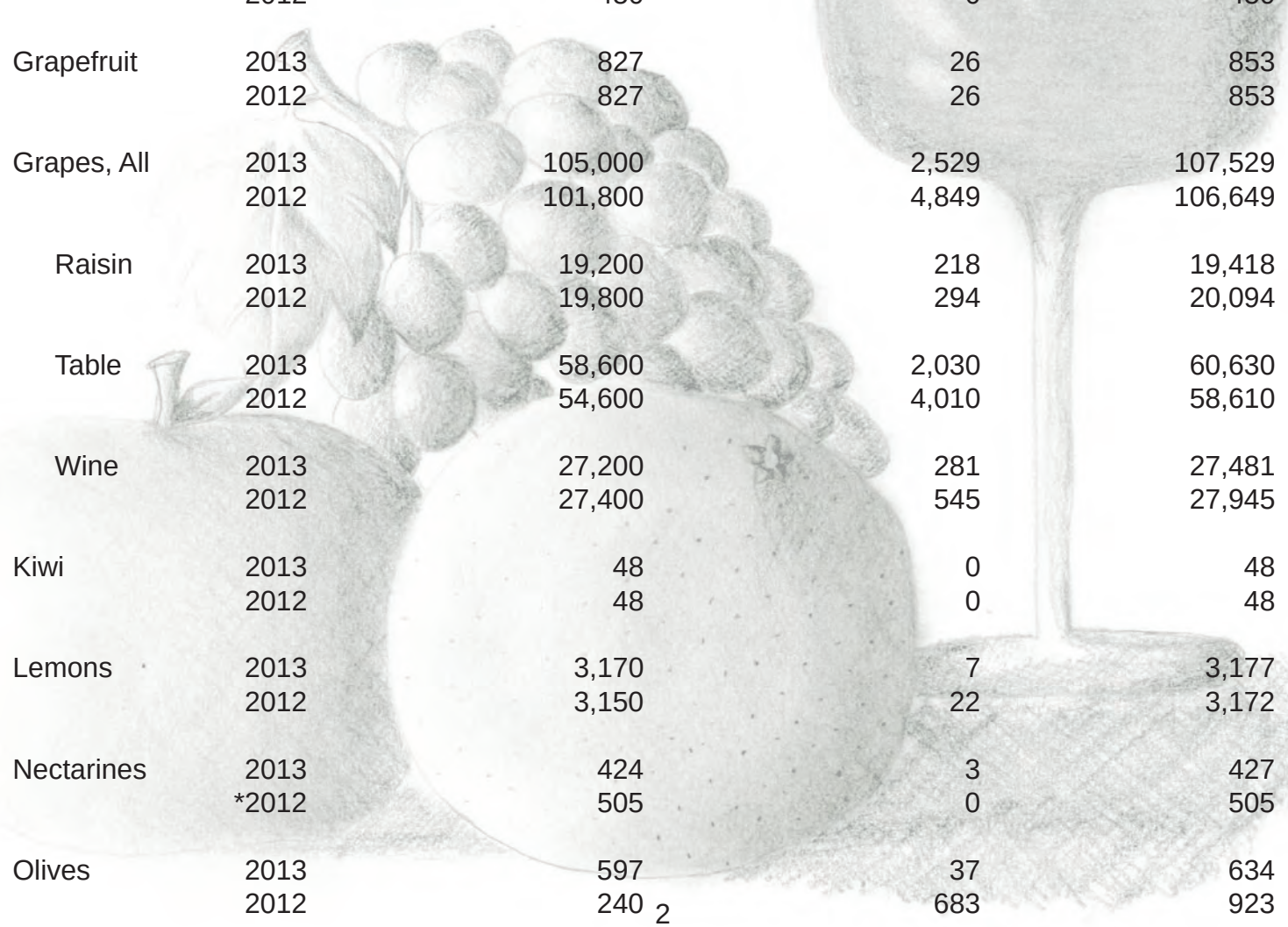
Kern County Department of Agriculture and Measurement Standards
1001 S. Mount Vernon Avenue, Bakersfield, California 93307
(661) 868-6300 phone, (661) 868-6301 fax
website: www.kernag.com
E-mail address: agcomm@co.kern.ca.us

Top 20 Commodities - 2013

	<u>COMMODITY</u>	<u>VALUE</u>	<u>2012 RANKING</u>
1.	Grapes, All	\$ 1,822,092,000	1
2.	Almonds, Including By-Products	970,808,000	2
3.	Milk, Market & Manufacturing	764,728,000	3
4.	Citrus, Fresh & Processing	641,691,000	*5
5.	Cattle & Calves	408,897,000	6
6.	Pistachios	388,189,000	*4
7.	Carrots, Fresh & Processing	335,088,000	7
8.	Hay, Alfalfa	217,964,000	8
9.	Cotton, Including Processed Cottonseed	146,537,000	9
10.	Potatoes, Fresh & Processing	109,222,000	10
11.	Pomegranates, Fresh & Processing	88,474,000	12
12.	Cherries	80,228,000	22
13.	Silage & Forage	68,521,000	11
14.	Bell Peppers, Fresh & Processing	59,659,000	17
15.	Apiary Products	57,755,000	14
16.	Nursery, Fruit and Nut Trees & Vines	56,056,000	13
17.	Tomatoes, Fresh & Processing	55,115,000	15
18.	Eggs & Egg Product	52,055,000	16
19.	Nursery, Roses	45,353,000	19
20.	Onions, Fresh & Dehydrator	35,156,000	20

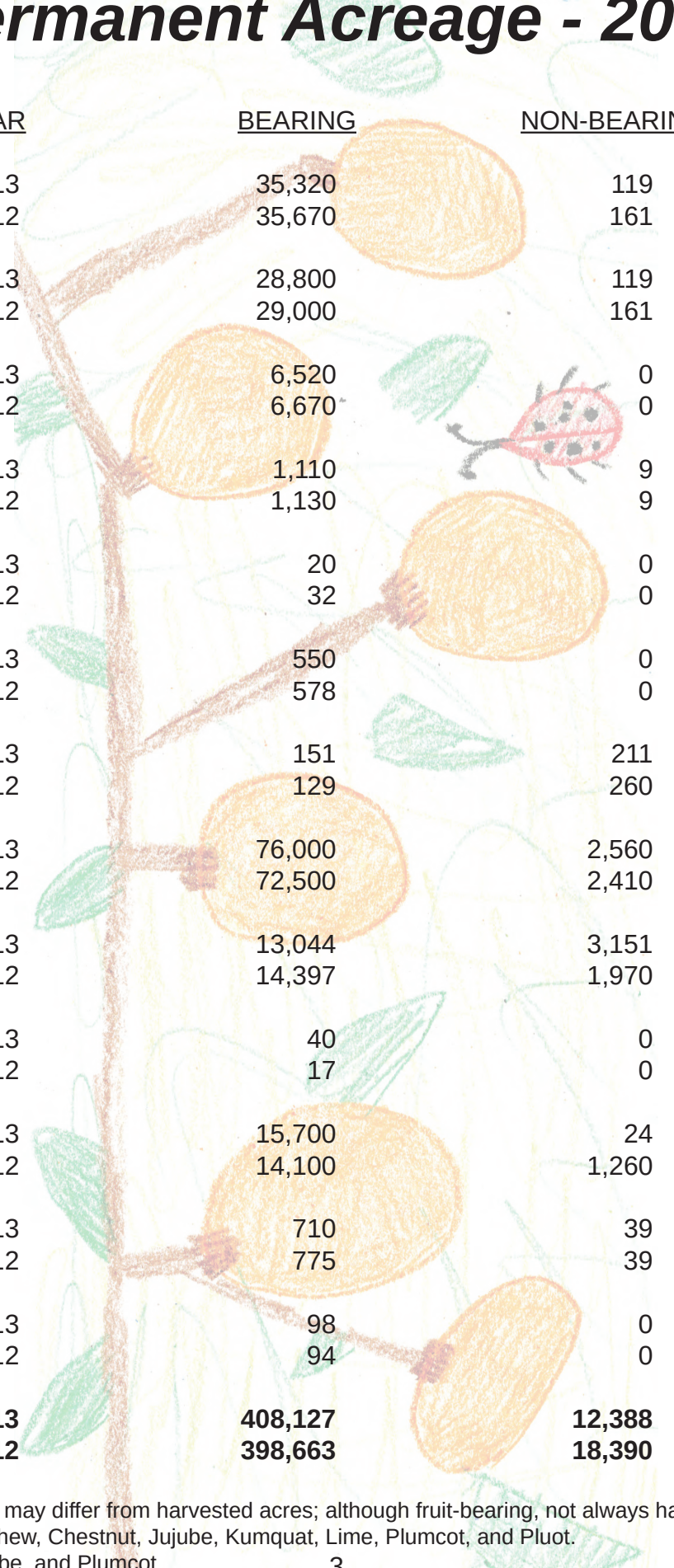
*Revised

Permanent Acreage - 2013



<u>CROP</u>	<u>YEAR</u>	<u>BEARING</u>	<u>NON-BEARING</u>	<u>TOTAL</u>
Almonds	2013	147,000	1,595	148,595
	2012	144,000	4,727	148,727
Apples	2013	1,029	4	1,033
	2012	1,110	3	1,113
Apricots	2013	538	0	538
	2012	469	40	509
Blueberries	2013	635	338	973
	2012	642	69	711
Cherries	2013	5,662	1,736	7,398
	2012	6,000	1,862	7,862
Figs	2013	454	0	454
	2012	450	0	450
Grapefruit	2013	827	26	853
	2012	827	26	853
Grapes, All	2013	105,000	2,529	107,529
	2012	101,800	4,849	106,649
Raisin	2013	19,200	218	19,418
	2012	19,800	294	20,094
Table	2013	58,600	2,030	60,630
	2012	54,600	4,010	58,610
Wine	2013	27,200	281	27,481
	2012	27,400	545	27,945
Kiwi	2013	48	0	48
	2012	48	0	48
Lemons	2013	3,170	7	3,177
	2012	3,150	22	3,172
Nectarines	2013	424	3	427
	*2012	505	0	505
Olives	2013	597	37	634
	2012	240	683	923

Permanent Acreage - 2013



<u>CROP</u>	<u>YEAR</u>	<u>BEARING</u>	<u>NON-BEARING</u>	<u>TOTAL</u>
Oranges, All	2013	35,320	119	35,439
	2012	35,670	161	35,831
Navels	2013	28,800	119	28,919
	2012	29,000	161	29,161
Valencias	2013	6,520	0	6,520
	2012	6,670*	0	6,670
Peaches	2013	1,110	9	1,119
	2012	1,130	9	1,139
Pears	2013	20	0	20
	2012	32	0	32
Pecans	2013	550	0	550
	2012	578	0	578
Persimmons	2013	151	211	362
	2012	129	260	389
Pistachios	2013	76,000	2,560	78,560
	2012	72,500	2,410	74,910
Pomegranates	2013	13,044	3,151	16,195
	2012	14,397	1,970	16,367
Prunes	2013	40	0	40
	2012	17	0	17
Tangerines & Tangelos	2013	15,700	24	15,724
	2012	14,100	1,260	15,360
Walnuts	2013	710	39	749
	2012	775	39	814
Miscellaneous	a/2013	98	0	98
	b/2012	94	0	94
Totals	2013	408,127	12,388	420,515
	*2012	398,663	18,390	417,053

*Revised

Note: Some bearing acres may differ from harvested acres; although fruit-bearing, not always harvested, for various reasons.

a/ Includes: Avocado, Cashew, Chestnut, Jujube, Kumquat, Lime, Plumcot, and Pluot.

b/ Includes: Avocado, Jujube, and Plumcot.



Fruit & Nut Crops - 2013

<u>CROP</u>	<u>YEAR</u>	<u>HARVESTED ACRES</u>	<u>PRODUCTION PER ACRE</u>	<u>TOTAL PRODUCTION</u>	<u>UNIT</u>	<u>UNIT VALUE</u>	<u>TOTAL VALUE</u>
Almonds	2013	147,000	1.14	a/168,000	Ton	\$ 5,490.00	\$ 922,672,000
	2012	144,000	1.13	a/163,000	Ton	\$ 4,770.00	\$ 777,306,000
Almond By-Products	2013	---	---	325,000	Ton	148.00	48,136,000
	2012	---	---	301,000	Ton	148.00	44,551,000
Apricots	2013	---	---	---	Ton	---	---
	2012	---	---	---	Ton	---	---
Blueberries	2013	635	6.72	4,270	Ton	4,520.00	19,290,000
	2012	642	6.15	3,950	Ton	4,090.00	16,144,000
Cherries	2013	5,540	3.09	17,100	Ton	4,690.00	80,228,000
	2012	5,110	0.90	4,580	Ton	5,380.00	24,654,000
Citrus, All	2013	55,017	15.23	837,900	Ton	---	641,691,000
	2012	53,747	17.17	922,700	Ton	---	620,350,000
Grapefruit	2013	827	18.14	15,000	Ton	703.00	10,546,000
	2012	827	18.74	15,500	Ton	765.00	11,857,000
Lemons	2013	3,170	14.79	46,900	Ton	902.00	42,305,000
	2012	3,150	11.56	36,400	Ton	999.00	36,358,000
Oranges, Navels	2013	28,800	11.18	322,000	Ton	679.00	218,777,000
	2012	29,000	13.62	395,000	Ton	713.00	281,834,000
Oranges, Valencia	2013	6,520	15.95	104,000	Ton	644.00	67,019,000
	2012	6,670	14.36	95,800	Ton	675.00	64,697,000
Tangerine & Tangelo	2013	15,700	11.21	176,000	Ton	1,600.00	281,286,000
	2012	14,100	8.30	117,000	Ton	1,660.00	194,200,000
Processing, All Citrus	2013	---	---	174,000	Ton	125.00	21,758,000
	2012	---	---	263,000	Ton	119.00	31,404,000
Grapes, All	2013	105,000	12.87	1,351,300	Ton	---	1,822,092,000
	2012	101,800	11.26	1,146,070	Ton	---	1,498,987,000
<u>Raisin Variety</u>	b/2013	19,200	13.00	249,600	Ton	---	252,947,000
	b/2012	19,800	9.98	197,570	Ton	---	196,567,000
Fresh Market	2013	---	---	124,900	Ton	1,700.00	212,404,000
	2012	---	---	109,900	Ton	1,480.00	162,443,000
Raisins	c/2013	---	---	13,400	Ton	1,650.00	22,047,000
	c/2012	---	---	12,000	Ton	1,900.00	22,831,000
Processing	2013	---	---	11,600	Ton	397.00	4,606,000
	2012	---	---	4,970	Ton	362.00	1,797,000



Fruit & Nut Crops - 2013

<u>CROP</u>	<u>YEAR</u>	<u>HARVESTED ACRES</u>	<u>PRODUCTION PER ACRE</u>	<u>TOTAL PRODUCTION</u>	<u>UNIT</u>	<u>UNIT VALUE</u>	<u>TOTAL VALUE</u>
Crushed	2013	---	---	51,500	Ton	270.00	13,890,000
	2012	---	---	30,100	Ton	315.00	9,496,000
<u>Table Variety</u>	2013	58,600	13.61	797,700	Ton	---	\$ 1,445,006,000
	2012	54,600	12.17	664,500	Ton	---	\$ 1,184,388,000
Fresh Market	2013	---	---	719,000	Ton	\$ 1,990.00	1,427,237,000
	2012	---	---	605,000	Ton	\$ 1,930.00	1,168,654,000
Crushed	2013	---	---	78,700	Ton	226.00	17,769,000
	2012	---	---	59,500	Ton	264.00	15,734,000
<u>Wine Variety</u>	2013	27,200	11.18	304,000	Ton	---	124,139,000
	2012	27,400	10.36	284,000	Ton	---	118,032,000
Crushed	2013	---	---	304,000	Ton	408.00	124,139,000
	2012	---	---	284,000	Ton	416.00	118,032,000
Nectarines	2013	424	8.28	3,510	Ton	1,980.00	6,958,000
	*2012	505	6.44	3,250	Ton	1,810.00	5,891,000
Olives	2013	---	---	---	Ton	---	---
	2012	---	---	---	Ton	---	---
Peaches	2013	1,110	12.97	14,400	Ton	1,130.00	16,227,000
	2012	1,130	14.87	16,800	Ton	1,100.00	18,443,000
Pistachios	2013	76,000	1.23	d/93,300	Ton	4,160.00	388,189,000
	*2012	72,500	1.66	d/120,000	Ton	5,240.00	628,226,000
Tomatoes, Fresh	2013	1,310	15.05	19,720	Ton	724.00	14,274,000
	2012	470	15.37	7,230	Ton	460.00	3,329,000
Tomatoes, Processed	2013	12,000	46.50	558,000	Ton	73.20	40,841,000
	2012	12,000	55.92	671,000	Ton	75.00	50,328,000
Walnuts	2013	710	1.03	d/730	Ton	4,710.00	3,437,000
	2012	775	1.25	d/970	Ton	2,720.00	2,638,000
Miscellaneous	e/2013	17,400	---	222,000	Ton	---	129,354,000
	f/2012	18,900	---	198,000	Ton	---	99,238,000
Totals	2013	422,146	---	3,615,230	Ton	---	\$ 4,133,389,000
	*2012	411,579	---	3,558,550	Ton	---	\$ 3,790,085,000

*Revised

a/ Almond production stated in terms of Nut Meat Equivalents. b/ Total production includes raisins on a Fresh Equivalent basis.

c/ A combined value reflecting free tonnage and reserve tonnage: Dry Ratio: 2013 - 4.60 to 1 2012 - 4.38 to 1

d/ Pistachio and Walnut production stated in terms of In-Shell Equivalents.

e/ Includes: Apple (Fresh & Processed), Apricots, Avocado, Blackberry, Blueberry (Processed), Boysenberry, Cashew, Chestnut, Fig (Fresh & Dry), Jujube, Kiwi, Kumquat, Lime, Olive, Peach (Processed), Pear, Pecan, Persimmon, Plum, Plumcot, Pluot, Pomegranate (Fresh & Juice), Prune, Raspberry, Strawberry, and Quince.

f/ Includes: Apple (Fresh & Processed), Apricots, Avocado, Blackberry, Boysenberry, Fig (Fresh & Dry), Jujube, Kiwi, Lime, Olive, Peach (Processed), Pear, Pecan, Persimmon, Plum, Plumcot, Pluot, Pomegranate (Fresh & Juice), Prune, Raspberry, Strawberry, and Quince.



Seed Crops - 2013

<u>CROP</u>	<u>YEAR</u>	<u>HARVESTED ACRES</u>	<u>TOTAL PRODUCTION</u>	<u>UNIT</u>	<u>UNIT VALUE</u>	<u>TOTAL VALUE</u>
Cotton	2013	771	900	Ton	a/\$ 369.00	\$ 332,000
	2012	3,999	4,970	Ton	a/\$ 343.00	\$ 1,707,000
Field	b/2013	690	380	Ton	---	1,186,000
	c/2012	1,270	3,450	Ton	---	2,070,000
Vegetable	d/2013	860	6,760	Ton	---	3,787,000
	e/2012	1,320	4,220	Ton	---	3,965,000
Totals	2013	f/1,550	8,040	Ton	---	\$ 5,305,000
	2012	f/2,590	12,640	Ton	---	\$ 7,742,000

a/ Includes a per acre approval.

b/ Includes: Alfalfa and Wheat Seed.

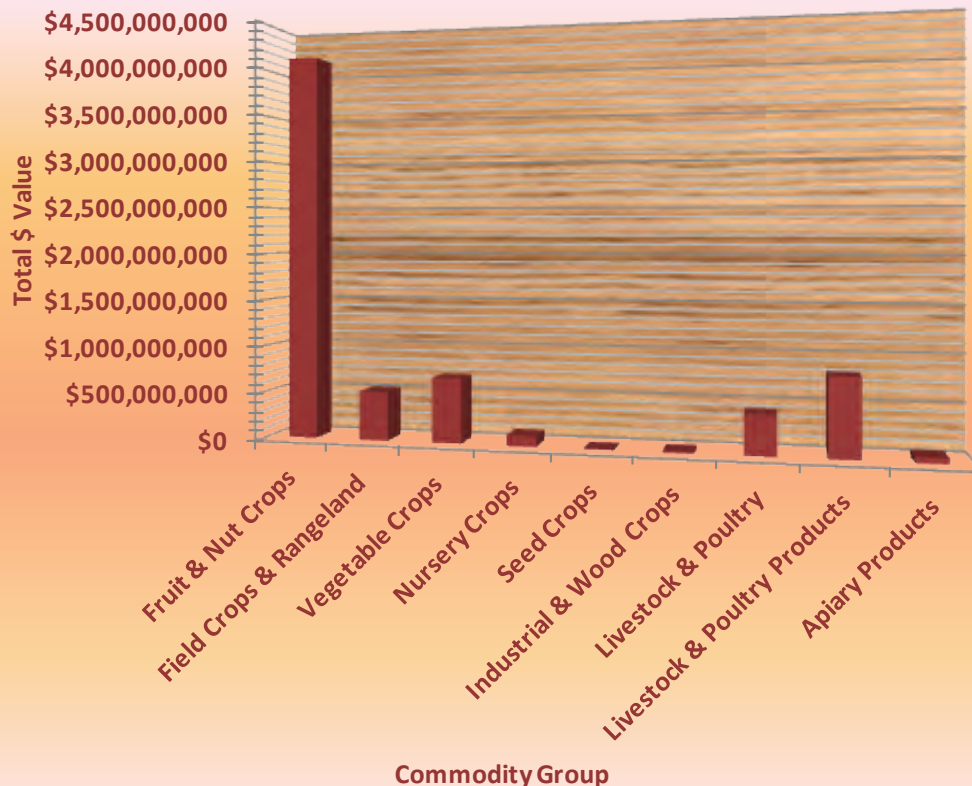
c/ Includes: Alfalfa, Flower, Safflower, Triticale, and Wheat Seed.

d/ Includes: Blackeye, Broccoli, Cabbage, Carrot, Celery, Lettuce, Melon, Onion, and Potato Seed.

e/ Includes: Broccoli, Cabbage, Carrot, Green Onion, Lettuce, Onion, Potato, and Radish Seed.

f/ Does not include cotton acreage.

Total Value Comparison by Commodity Group





Field Crops - 2013

<u>CROP</u>	<u>YEAR</u>	<u>HARVESTED ACRES</u>	<u>PRODUCTION PER ACRE</u>	<u>TOTAL PRODUCTION</u>	<u>UNIT</u>	<u>UNIT VALUE</u>	<u>TOTAL VALUE</u>
Barley	a/2013	4,450	1.80	8,010	Ton	\$ 244.00	\$ 1,954,000
	a/2012	6,000	1.32	7,920	Ton	\$ 250.00	\$ 1,977,000
Beans, Dry Edible	2013	1,841	1.67	3,070	Ton	1,000.00	3,074,000
	2012	2,716	1.80	4,890	Ton	1,030.00	5,052,000
Cotton Lint, Upland & Acala	2013	10,435	b/1,560	32,500	Bale	d/0.99	16,143,000
	2012	22,515	b/1,670	75,000	Bale	d/1.01	37,907,000
Cotton Lint, Pima	2013	35,920	b/1,630	c/117,000	Bale	d/1.68	98,360,000
	2012	33,425	b/1,600	c/107,200	Bale	d/1.30	69,852,000
Cottonseed, Processing	2013	---	---	57,500	Ton	557.00	32,034,000
	2012	---	---	67,300	Ton	593.00	39,878,000
Hay, Alfalfa	2013	116,000	9.03	1,048,000	Ton	208.00	217,964,000
	2012	128,000	8.05	1,031,000	Ton	207.00	213,466,000
Hay, Grain	2013	17,000	5.53	94,000	Ton	213.00	19,977,000
	2012	20,000	3.51	70,100	Ton	178.00	12,506,000
Hay, Other	2013	7,500	3.40	25,500	Ton	175.00	4,463,000
	2012	9,200	6.86	63,100	Ton	155.00	9,773,000
Pasture, Irrigated	2013	7,000	---	---	Acre	140.00	980,000
	2012	7,000	---	---	Acre	140.00	980,000
Pasture, Other	2013	---	---	---	Acre	---	1,640,000
	2012	---	---	---	Acre	---	1,725,000
Pasture, Range	2013	1,488,000	---	---	Acre	12.00	17,851,000
	*2012	1,479,000	---	---	Acre	15.00	22,191,000
Safflower	2013	---	---	---	Ton	---	---
	2012	4,300	0.66	2,840	Ton	535.00	1,518,000
Silage and Forage	2013	93,000	17.11	1,591,000	Ton	43.10	68,521,000
	2012	88,000	20.28	1,785,000	Ton	42.10	75,149,000
Wheat	2013	35,000	2.91	102,000	Ton	280.00	28,519,000
	2012	47,500	2.80	133,000	Ton	265.00	35,294,000
Miscellaneous	e/2013	11,600	---	45,700	Ton	---	10,885,000
	f/2012	13,200	---	54,500	Ton	---	12,106,000
Totals	2013	g/339,746	---	---	---	---	\$ 522,365,000
	*2012	g/381,856	---	---	---	---	\$ 539,374,000

*Revised a/ May contain dryland. b/ Pounds Lint per Acre. c/ 500 Pound Net Weight Bale. d/ Price per Pound.

e/ Includes: Field Corn (Grain), Rape, Rye, Sorghum-Milo, Straw, Sugar Cane, and Triticale.

f/ Includes: Field Corn (Grain), Rape, Sorghum-Milo, Straw and Triticale.

g/ Does not include Range acreage.



Vegetable Crops - 2013

<u>CROP</u>	<u>YEAR</u>	<u>HARVESTED ACRES</u>	<u>PRODUCTION PER ACRE</u>	<u>TOTAL PRODUCTION</u>	<u>UNIT</u>	<u>UNIT VALUE</u>	<u>TOTAL VALUE</u>
Cantaloupe	2013	560	13.39	7,500	Ton	\$ 353.00	\$ 2,651,000
	2012	640	18.44	11,800	Ton	\$ 360.00	\$ 4,249,000
Garlic, Fresh	2013	2,220	8.02	17,800	Ton	1,210.00	21,462,000
	2012	2,170	7.47	16,200	Ton	1,040.00	16,899,000
Garlic, Processed	2013	540	7.24	3,910	Ton	640.00	2,502,000
	2012	848	7.89	6,690	Ton	600.00	4,014,000
Lettuce, Head	2013	---	---	---	Ton	---	---
	2012	---	---	---	Ton	---	---
Onions, Fresh	2013	4,260	20.00	85,200	Ton	264.00	22,496,000
	2012	3,040	20.03	60,900	Ton	232.00	14,120,000
Onions, Dehydrator	2013	3,400	20.47	69,600	Ton	182.00	12,660,000
	2012	3,400	20.71	70,400	Ton	200.00	14,230,000
Peppers, Bell Fresh	2013	2,650	17.70	46,900	Ton	1,240.00	58,229,000
	2012	2,110	18.06	38,100	Ton	1,020.00	38,744,000
Potatoes, All	2013	12,800	29.80	381,400	Ton	---	109,222,000
	*2012	16,810	25.08	421,570	Ton	---	84,761,000
<u>Potatoes, Spring</u>	2013	11,280	31.55	355,900	Ton	---	101,838,000
	*2012	13,490	27.96	377,200	Ton	---	76,187,000
Fresh Market	2013	---	---	180,000	Ton	415.00	74,705,000
	2012	---	---	205,000	Ton	256.00	52,495,000
Processing	2013	---	---	131,000	Ton	200.00	26,145,000
	*2012	---	---	121,000	Ton	187.00	22,669,000
Culls	2013	---	---	44,900	Ton	22.00	988,000
	2012	---	---	51,200	Ton	20.00	1,023,000
<u>Potatoes, Winter</u>	2013	1,520	16.78	25,500	Ton	---	7,384,000
	2012	3,320	13.36	44,370	Ton	---	8,574,000
Fresh Market	2013	---	---	20,400	Ton	356.00	7,257,000
	2012	---	---	35,500	Ton	237.00	8,397,000
Culls	2013	---	---	5,100	Ton	24.90	127,000
	2012	---	---	8,870	Ton	20.00	177,000
Watermelons, Seeded/Seedless	2013	2,220	29.14	64,700	Ton	380.00	24,606,000
	2012	1,830	17.65	32,300	Ton	313.00	10,107,000
Miscellaneous	a/2013	44,900	---	1,328,000	Ton	---	432,961,000
	b/2012	48,500	---	1,409,000	Ton	---	527,025,000



Vegetable Crops - 2013

	<u>YEAR</u>	<u>HARVESTED ACRES</u>	<u>PRODUCTION PER ACRE</u>	<u>TOTAL PRODUCTION</u>	<u>UNIT</u>	<u>UNIT VALUE</u>	<u>TOTAL VALUE</u>
Totals	2013	73,550	---	2,005,010	Ton	---	\$ 686,789,000
	*2012	79,348	---	2,066,960	Ton	---	\$ 714,149,000

*revised

a/ Includes: Artichoke, Arugula, Asparagus, Basil, Beans Green & Succulent (Fresh & Processed), Bok Choy, Broccoli, Brussel Sprouts, Butter Lettuce, Cabbage (Fresh & Processed), Cactus, Carrots (Fresh & Processed), Cauliflower, Chard, Celeriac, Celery, Chive, Cilantro, Collard, Corn (Sweet), Cucumber, Daikon, Dandelion Greens, Dill, Eggplant, Fennel, Gai Choy, Gai Lon, Gourd, Green Onions, Herbs, Kale, Kohlrabi, Lettuce Head, Leaf Lettuce, Leeks, Melons (Other), Mustard, Napa Cabbage, Okra, Parsley (Fresh & Processed), Parsnip, Peas (Fresh & Processed), Peppers (Chili & Processed), Pumpkin, Radishes, Red Beets, Romaine Lettuce, Rosemary, Rutabaga, Sage, Shallots, Spinach, Squash, Sweet Potatoes, Tarragon, Thyme, Tomatillo, Turnips and Yams.

b/ Includes: Artichoke, Arugula, Asparagus, Basil, Beans Succulent (Fresh & Processed), Bok Choy, Broccoli, Brussel Sprouts, Butter Lettuce, Cabbage (Fresh & Processed), Cactus, Carrots (Fresh & Processed), Cauliflower, Chard, Celeriac, Celery, Chinese Greens, Chive, Cilantro, Collard, Corn (Sweet), Cucumber, Daikon, Dandelion Greens, Dill, Eggplant, Fennel, Gai Choy, Gai Lon, Green Onions, Herbs, Kale, Kohlrabi, Lettuce Head, Leaf Lettuce, Leeks, Melons (Other), Mustard, Napa Cabbage, Okra, Parsley (Fresh & Processed), Parsnip, Peas (Fresh & Processed), Peppers (Chili & Processed), Pumpkin, Radishes, Red Beets, Romaine Lettuce, Rutabaga, Shallots, Spinach, Squash, Sweet Potatoes, Tomatillo, Turnips and Yams.

Kern County Certified Farmers' Markets

LOCATION	SEASON	DAY	TIME
Brimhall Farmers' Market NE Corner of Brimhall & Calloway, 9500 Brimhall Rd.	Year Round	S a t u r d a y	9am - 1pm
Clinica Sierra Vista/Delano Community Health Center, 1508 Garces Hwy.	May through N o v e m b e r	T u e s d a y	2pm - 5pm
Clinica Sierra Vista/East Bakersfield Community Health Center, 815 Dr. Martin Luther King Jr. Blvd.	May through N o v e m b e r	T h u r s d a y	10am - 12pm
Clinica Sierra Vista/Lamont Community Health Center, 8787 Hall Rd	May through N o v e m b e r	T u e s d a y	9am - 11am
Haggin Oaks Farmers' Market Corner of Ming & Haggin Oaks, 8800 Ming Ave.	Year Round	S u n d a y	9am - 2pm
Joe's Market 2300 E. Brundage Ln.	May through A u g u s t	S u n d a y	7 : 3 0 a m - 1 : 3 0 p m
Lakeshore Farmers' Market Lakeshore Lodge, 7644 Wofford Heights Blvd.	Year Round	S a t u r d a y	9am - 1pm
Main Street Farmers' Market Tehachapi Rail Road Park, East E St & Green	June through A u g u s t	T h u r s d a y	4pm - 7pm
Nuui Cunni Farmers' Market Lake Isabella 2600 Highway 155	Year Round	S a t u r d a y	9am - 1pm
Oildale Farmers' Market N. Chester & Norris Rd., 1515 N. Chester Ave.	June through S e p t e m b e r	T h u r s d a y	5pm - 8pm
Paramount Produce Day Lost Hills Recreation Center, Lost Hills Rd. & Hwy 46	Year Round	F r i d a y	2pm - 6:30pm
Taft Farmers' Market 400 Kern Street, Kern & 4th Streets	June through A u g u s t	T h u r s d a y	4pm - 7pm
The Market Place Tehachapi 413 S. Curry	June through A u g u s t	T h u r s d a y	4pm - 7pm
Valley Farmers' Market Shafter James St. & Central Ave.	June through A u g u s t	W e d n e s d a y	8am - 1pm
Valley Farmers' Market Bakersfield Golden State Hwy. & F St.	Year Round	S a t u r d a y	8am - 12pm



Nursery Crops - 2013

<u>CROP</u>	<u>YEAR</u>	<u>HARVESTED ACRES</u>	<u>TOTAL PRODUCTION</u>	<u>UNIT</u>	<u>UNIT VALUE</u>	<u>TOTAL VALUE</u>
Christmas Trees	2013	---	200	Tree	---	\$ 8,590
	2012	---	290	Tree	---	\$ 13,100
Fruit and Nut Trees & Vines	a/2013	683	25,795,000	Plant	---	56,056,000
	a/2012	732	28,987,000	Plant	---	57,555,000
Herbaceous Plants	2013	---	---	---	---	933,000
	2012	---	---	---	---	658,000
Ornamental Trees & Shrubs	a/2013	84	307,000	Plant	---	705,000
	a/2012	114	341,000	Plant	---	589,000
Propagative Material	b/2013	---	---	---	---	8,215,000
	2012	---	---	---	---	1,987,000
Roses	2013	1,320	21,379,000	Plant	\$ 2.12	45,353,000
	2012	1,767	17,174,000	Plant	\$ 1.94	33,346,000
Turf	2013	---	---	Sq Ft	---	---
	2012	395	17,193,000	Sq Ft	0.39	6,676,000
Totals	2013	2,087	---	---	---	\$ 111,270,590
	2012	3,008	---	---	---	\$ 100,824,100

a/ Includes container grown plants.

b/ Includes turf value, due to disclosure rules.

Industrial & Wood Crops - 2013

<u>CROP</u>	<u>YEAR</u>	<u>TOTAL PRODUCTION</u>	<u>UNIT</u>	<u>UNIT VALUE</u>	<u>TOTAL VALUE</u>
Almond Shells	2013	189,000	Ton	---	\$ 9,700,000
	2012	185,000	Ton	---	\$ 9,752,000
Biomass & Composting	2013	185,000	Ton	---	3,888,000
	2012	243,000	Ton	---	4,655,000
Timber	a/2013	2,655	Brd Ft	---	187,000
	a/2012	3,943	Brd Ft	---	375,000
Wood for Fuel	2013	1,357	Cord	b/\$ 295.00	401,000
	2012	2,733	Cord	b/\$ 342.00	935,000
Totals	2013	---	---	---	\$ 14,176,000
	2012	---	---	---	\$ 15,717,000

a/ Production and value based on information provided by: Timber Tax Division, Property Tax Department, State Board of Equalization.

b/ Price includes U.S. Forest Service Permits for woodcutting.



Livestock & Poultry - 2013

<u>COMMODITY</u>	<u>YEAR</u>	<u>NUMBER OF HEAD</u>	<u>TOTAL LIVEWEIGHT</u>	<u>UNIT</u>	<u>UNIT VALUE</u>	<u>TOTAL VALUE</u>
Cattle & Calves	2013	341,000	---	Head	\$ 1,200.00	\$ 408,897,000
	2012	328,000	---	Head	\$ 1,170.00	\$ 382,913,000
Sheep & Lambs	2013	95,000	90,000	Cwt	100.00	9,000,000
	2012	95,000	90,000	Cwt	125.00	11,250,000
Hogs	2013	1,756	4,300	Cwt	73.50	316,000
	2012	1,756	3,970	Cwt	66.20	263,000
Ostriches	2013	338	---	---	---	494,000
	2012	212	---	---	---	293,000
Miscellaneous	a/2013	---	---	---	---	219,000
	b/2012	---	---	---	---	359,000
Totals	2013	---	---	---	---	\$ 418,926,000
	2012	---	---	---	---	\$ 395,078,000

a/ Includes: Game Birds for Meat, Registered Freshwater Aquaculturists and Other.

b/ Includes: Game Birds for Meat, Registered Freshwater Aquaculturists and Other.

Livestock & Poultry Products - 2013

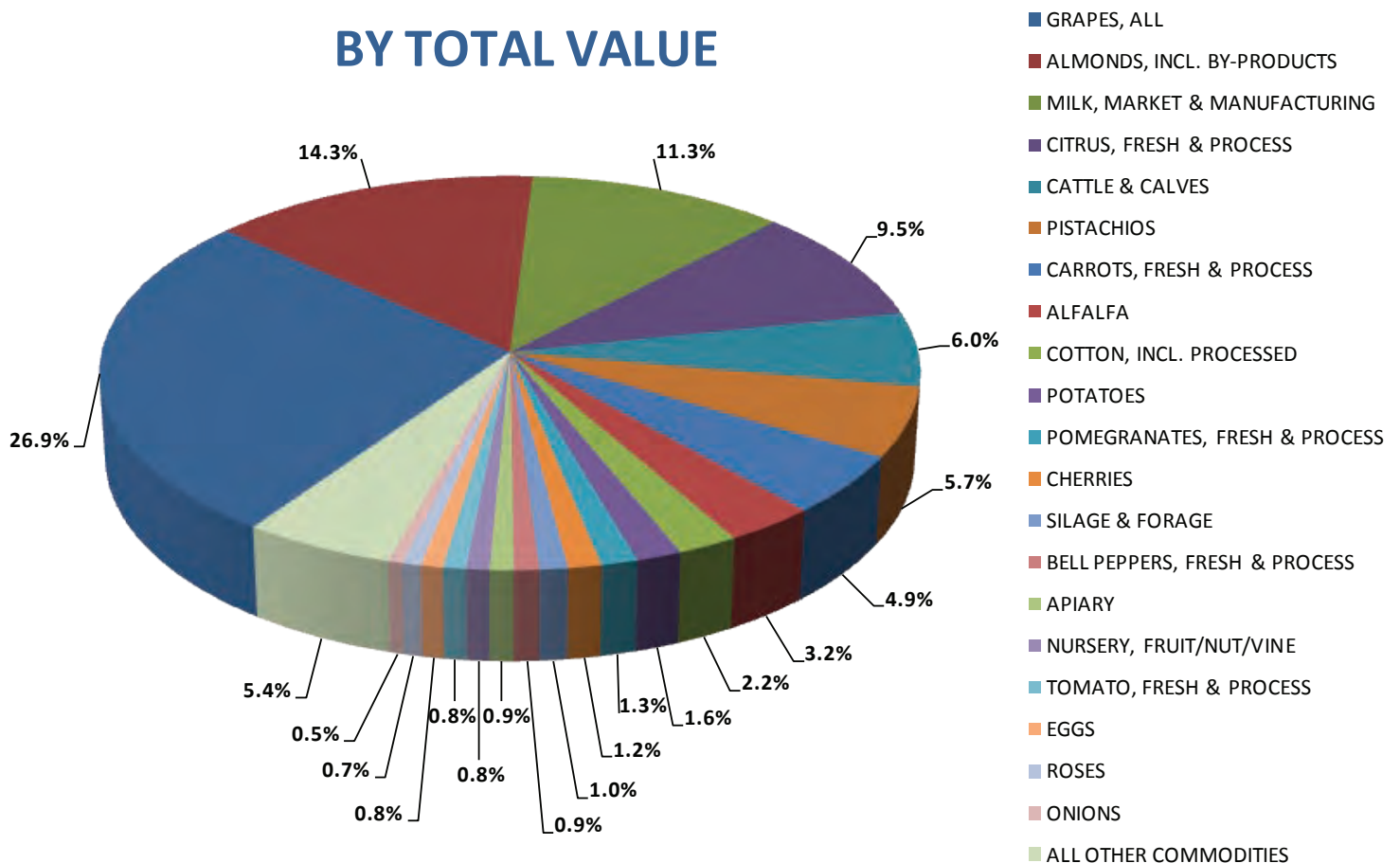
<u>PRODUCT</u>	<u>YEAR</u>	<u>TOTAL PRODUCTION</u>	<u>UNIT</u>	<u>UNIT VALUE</u>	<u>TOTAL VALUE</u>
Milk, Market	2013	40,644,000	Cwt	\$ 18.80	\$ 764,518,000
	2012	40,580,000	Cwt	\$ 17.00	\$ 689,854,000
Milk, Manufacturing	2013	11,500	Cwt	18.30	210,000
	2012	11,500	Cwt	18.10	208,000
Manure	2013	745,000	Ton	---	2,009,000
	2012	694,000	Ton	---	757,000
Wool	2013	750,000	Lb.	1.45	1,088,000
	2012	764,000	Lb.	1.60	1,223,000
Eggs & Egg Product	2013	---	---	---	52,055,000
	2012	---	---	---	40,343,000
Totals	2013	---	---	---	\$ 819,880,000
	2012	---	---	---	\$ 732,385,000



Apiary Products - 2013

COMMODITY	YEAR	TOTAL PRODUCTION	UNIT	UNIT VALUE	TOTAL VALUE
Honey	2013	2,747,000	Lb	\$ 2.10	\$ 5,768,000
	2012	3,908,000	Lb	\$ 1.65	\$ 6,449,000
Beeswax	2013	343,000	Lb	3.25	1,116,000
	2012	489,000	Lb	2.96	1,449,000
Pollination	2013	332,000	Colony	153.00	50,871,000
	2012	330,000	Colony	146.00	48,204,000
Other Apiary Products	2013	---	---	---	---
	2012	---	---	---	605,000
Totals	2013	---	---	---	\$ 57,755,000
	2012	---	---	---	\$ 56,707,000

TOP 20 COMMODITIES BY TOTAL VALUE





Summary - 2013

<u>COMMODITY</u>	<u>YEAR</u>	<u>HARVESTED ACRES</u>	<u>RANGE</u>	<u>TOTAL VALUE</u>
Fruit & Nut Crops	2013	422,146	---	\$ 4,133,389,000
	*2012	411,579	---	\$ 3,790,085,000
Field Crops & Rangeland	2013	339,746	1,488,000	522,365,000
	*2012	381,856	1,479,000	539,374,000
Vegetable Crops	2013	73,550	---	686,789,000
	*2012	79,348	---	714,149,000
Nursery Crops	2013	2,087	---	111,270,590
	2012	3,008	---	100,824,100
Industrial & Wood Crops	2013	---	---	14,176,000
	2012	---	---	15,717,000
Seed Crops	2013	1,550	---	5,305,000
	2012	2,590	---	7,742,000
Livestock & Poultry	2013	---	---	418,926,000
	2012	---	---	395,078,000
Livestock & Poultry Products	2013	---	---	819,880,000
	2012	---	---	732,385,000
Apiary Products	2013	---	---	57,755,000
	2012	---	---	56,707,000
Totals	2013	839,079	1,488,000	\$ 6,769,855,590
	*2012	878,381	1,479,000	\$ 6,352,061,100
Total Value without Timber	2013			\$ 6,769,668,590
	*2012			\$ 6,351,686,100

*revised



*A special Thank You' to the very
artistic students in
Mrs. Smith's 3rd Grade Class at
Norris Elementary School!
Artwork featured throughout this
report courtesy of Macy Haddock,
Karen Cruz, Emma Bradley
and E.J. Flores*

Pest Prevention & Control - 2013

PEST EXCLUSION

<u>INSPECTION TYPE</u>	<u>PREMISES VISITED</u>	<u>SHIPMENTS INSPECTED</u>	<u>PESTS A or Q</u>
CA Overnight	204	378	0
U. S. Post Office	1	1	0
UPS	3	3	0
Federal Express	309	1,795	0
Federal Express Ground	3	17	0
Gypsy Moth	14	14	0
Florida/Southern States	40	324	0
Hawaii	18	23	0
Truck	77	77	0
Specialty Market	149	546	0
Beehives	175	960	0

EXPORT TRAPPING

<u>CROP</u>	<u>TRAPS DEPLOYED</u>	<u>COUNTRY</u>	<u>PEST</u>
Apples	91	Various	Apple Maggot (<i>Rhagoletis pomonella</i>)

PEST DETECTION & TRAPPING

<u>TRAP NAME</u>	<u>NUMBER OF TRAPS DEPLOYED</u>
Jackson Trap	
Light Brown Apple Moth (<i>Epiphyas postvittana</i>)	516
Mediterranean Fruit Fly (<i>Ceratitis capitata</i>)	506
Melon Fruit Fly (<i>Bactrocera curcurbitae</i>)	254
Oriental Fruit Fly (<i>Bactrocera dorsalis</i>)	511
McPhail Trap	
Mexican Fruit Fly (<i>Anastrepha ludens</i>)	269
Delta Trap	
Gypsy Moth (<i>Lymantria dispar</i>)	435
Japanese Beetle Trap (<i>Popillia japonica</i>)	423
Trogotrap Khapra Beetle (<i>Trogoderma granarium</i>)	49
European Corn Borer Trap (<i>Ostrinia nubilalis</i>)	28
European Pine Shoot Moth Trap (<i>Rhyacionia buoliana</i>)	3
Glassy-winged Sharpshooter (<i>Homalodisca coagulata</i>)	239
Champ Trap	394
Mexican Fruit Fly (<i>Anastrepha ludens</i>)	
Yellow Panel Trap	
Asian Citrus Psyllid (<i>Diaphorina citri</i>)	2,553
Delta Trap	
European Grapevine Moth (<i>Lobesia botrana</i>)	3,304

Direct Marketing, Organic Farming, Exports & Pests - 2013

DIRECT MARKETING

DIRECT MARKETING PROGRAM

Direct Marketing is a system that allows Certified Producers to market their produce directly to consumers via Certified Farmers Markets. The Department of Agriculture & Measurement Standards regulates this program to insure that only certified produce is sold at Certified Farmers Markets. See a list of current Certified Farmers' Markets on Page 9 of this report.

ORGANIC FARMING

REGISTERED ORGANIC GROWER PROGRAM

Producers and growers who market their produce as "Organic" or "Organically Grown" must be certified by an accredited certifying agency and are required to register their organic fields with the state. The Department of Agriculture & Measurement Standards inspects these fields to insure compliance with applicable laws and regulations.

Registered Growers and Handlers - 44

Partial listing of registered crops: Alfalfa, Apples, Broccoli, Carrots, Cotton, Lettuce, Melons (Cantaloupe, Watermelons, etc.), Olives, Onions, Oranges, Potatoes, Raisins, Safflower, Stonefruit, Table Grapes, Tomatoes, and Wheat.

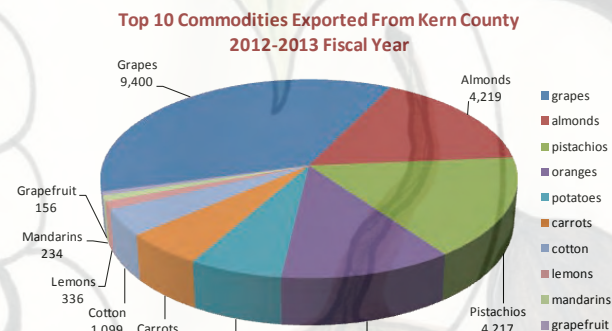
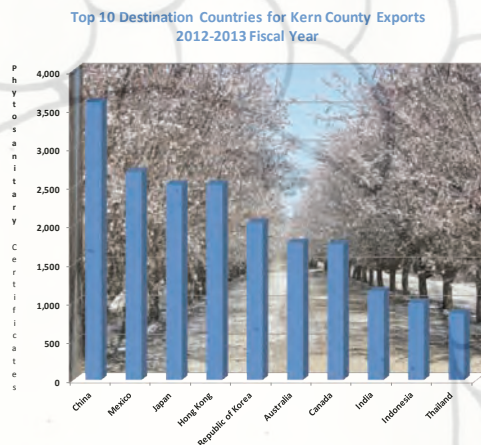
EXPORTS

Phytosanitary Certification is one of the largest programs within the Department of Agriculture. Depending on the agricultural commodity and destination country, Phytosanitary Certification may be required, which attests to the freedom from insects and diseases, by an Accredited Certifying Official (ACO).

Phytosanitary Certificates Issued

31,291

TOP 10 DESTINATION COUNTRIES & PHYTOSANITARY CERTIFICATES ISSUED (listed greatest to least): China (3,592), Mexico (2,696), Japan (2,533), Hong Kong (2,532), Republic of Korea (2,038), Australia (1,778), Canada (1,759), India (1,152), Indonesia (1,009), and Thailand (864)



TOP COMMODITIES EXPORTED (listed greatest to least): Grapes, Almonds, Pistachios, Oranges, Potatoes, Carrots, Cotton, Lemon, Mandarin, and Grapefruit

Kern County issued the 2nd highest total number of Phytosanitary Certificates in the state

PEST ERADICATION

Pink Bollworm Program For Kern County, Cooperative Pink Bollworm Project

Trapping*	0	Natives Detected
Sterile Release*	0	Moths
Plowdown*	46,355	Acres
	15	



Appendix B

Quality Assurance Project Plan (QAPP)

(See QAPP binder and CD for hard copy and electronic copy)

SUBMITTED WITH PREVIOUS SUBMITTAL



Appendix C

**DRAFT Technical Memorandum
Hydrograph Analysis**

MEMORANDUM

To: Matt Klinchuch, PE
From: Debora De La Torre, EIT
Subject: Ephemeral Stream Hydrology Analysis - **DRAFT**
Date: January 22, 2015

Project Information:

The following is to provide preliminary standard operating procedures to forecast flows in the ephemeral streams located in the Kern Coalition Primary area.

Data Needed:

There are limited methods that can aid in forecasting flows for ephemeral streams; the preferred method is the creation of a natural hydrograph. A natural hydrograph is created directly from flow records of a gaged stream. It requires historical precipitation data for the desired basin, and corresponding historical stream gage data containing flow or stream depth of flow information.

Other methods that can help forecast flows in ephemeral streams include a dimensionless unit hydrograph (DUH). A DUH is a hydrograph developed to represent several unit hydrographs and is plotted using the ratio of the basic units, time to peak and peak rate.

Methodology:

To create a natural hydrograph flow and precipitation data must be obtained. The data should include storm precipitation, duration, and corresponding stream flows. For the study area this data was sought out through several public agencies. Data available includes historical precipitation, but there is a lack of stream flow or stream flow depth data for this area. One other alternative is creating a synthetic hydrograph, utilizing data from a gaged stream that contains similar characteristics as the stream to be analyzed. In order to transpose the data several conditions must be met:

- a. Similar geology;
- b. Similar topography;
- c. Similar ground cover; and,
- d. Similar shape.

Collaboration with other agencies in an effort to obtain stream flow data for similar streams within the study area is being conducted, but nothing has been found to date.

DUH:

The procedure to develop a DUH is described below. This hydrograph can be utilized as an initial watershed analysis to estimate flows and duration for different storm events. The method utilized to create the DUH is found using the NRCS TR-55 Manual (USDA. 1986). As an example, a watershed in the Kern primary area was analyzed.

A. Storm Event Data

To create the DUH, basic watershed data needs to be obtained. This data includes:

- a. Precipitation data for a storm event;
- b. 2-year, 24 hour rainfall depth provided by NOAA Atlas 14 (NOAA. 2014);
- c. Watershed slopes;
- d. Roughness coefficients;
- e. Flow lengths; and
- f. Soil information.

B. Initial Abstraction

The initial abstraction reflects all losses before runoff begins, and can be calculated using the following data:

- a. Soil data for the watershed; and,
- b. Total gross area for the watershed.

SCS curve number method can be utilized to calculate the initial abstraction with the following equation:

$$I_a = 0.2 S$$

Where; I_a = Initial abstraction (in); and,
 S = Potential maximum retention after runoff begins (in).

The potential maximum retention after runoff begins, S , was found utilizing equation;

$$S = \frac{1000}{CN} - 10$$

Curve Numbers (CN), provided by NRCS, can be obtained using the tables provided in Chapter 2 of the NRCS TR-55 Manual (USDA. 1986). Soil type, land cover, and factors that might impair or encourage infiltration need to be considered when choosing a CN.

For the proposed study area, the Tecuya watershed was utilized as an example. The watershed was divided into two sub-watersheds to more accurately analyze the watershed. Watershed soil data, and land cover data was obtained for the Tecuya

watershed and weighted CN was established. A breakdown of soil details for Tecuya watershed can be found in attachment two providing a weighted CN of 70.

C. Direct Runoff

Once the initial abstraction is calculated, direct runoff (Q) can be calculated using the following equation:

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S}$$

Where; Q = Direct Runoff (in)

P = rainfall (in)

I_a = Initial Abstraction (in)

S = Potential maximum retention after runoff begins (in)

For the study area, a 2 year, 24 hour precipitation depth was found using NOAA Atlas 14, (NOAA. 2014). The precipitation depth was found for both sub-watersheds by using the centroid location for each sub-watershed.

Table 1: Tecuya sub-watershed data.

Sub-watershed	CN	Gross Area (acres)	Length of Stream (miles)	Centroid of Watershed		2 yr, 24 hour Precipitation Depth (in)	Slope (ft/ft)
				Latitude	Longitude		
1	70	17,528	27	34.938678	-118.968397	1.80	0.299
2	70	19,240	22	34.897726	-119.019659	2.13	0.485

Direct Runoff, Q, for the Tecuya study area is summarized in Table 2.

Table 2: Direct runoff for Tecuya sub-watersheds.

Sub - watershed	2 yr, 24 hour Precipitation Depth (in)	Initial Abstraction (in)	Direct Runoff (in)
1	1.8	0.86	0.17
2	2.13	0.86	0.29

For the study area, it is evident that storm events will need to have a precipitation depth greater than 0.86 inches in order to produce flows within the streams. This can be assumed only if no other prior storm events have occurred, and soil conditions are not at saturation. Stream channel wetting losses to the point of interest may also need to be considered.

Utilizing NOAA Atlas 14, depths that are greater than 0.86 inches have a probability to occur at recurrence intervals greater than 25 years with durations of 60 minutes (NOAA. 2014). Storm events with shorter durations and with depths greater than 0.86 inches are likely to occur with longer recurrence intervals. The probability of storm events producing precipitation depths greater than 0.86 inches decreases with shorter storm durations and increases with longer storm durations. See the highlighted tables in attachment 1, indicating the combinations of storm duration and average recurrence interval that are likely to produce runoff, based on these preliminary calculations.

D. Time of Concentration

Time of concentration (T_c) is a parameter that is needed to create a DUH. Time of concentration provides information on the time for runoff to travel from the hydraulically most distant point of the watershed to a point of interest within the watershed. Time of concentration is calculated by summing all the travel times (T_t) for consecutive components of the drainage system.

Travel time can be calculated using equations for sheet flow, shallow concentrated flow, and Manning's open channel equation. The watershed analyzed will need to be segmented into areas where these different types of flows occur and a travel time calculated for each. Data needed to find travel time include:

- a. Lengths of stream segments;
- b. Land slope;
- c. 2 year, 24 hour precipitation depth provided by NOAA Atlas (NOAA. 2014);
and,
- d. Manning's roughness coefficients.

These equations can be found utilizing NRCS TR-55, Chapter 3, time of concentration and travel time.

For the Tecuya watershed, travel time was calculated for each sub-watershed, segmenting each sub-watershed according to flow characteristics. Data utilized included mean land slope, 2 year, 24 hour precipitation depth obtained from NOAA Atlas 14 (NOAA, 2014), and Manning's roughness coefficients provided in table 3-1, in NRCS TR-55, Chapter 3 (USDA. 1986). The 2 year- 24 hour precipitation depth utilized was found using NOAA Atlas 14 for the centroid of each sub-watershed (NOAA. 2014).

Table 3: Tecuya sub watershed time of concentration.

Sub Watershed	T_c (hours)
1	3.92
2	2.99
Total	6.91

For the study area, time of concentration is large due to the stream length in each sub-watershed. Water located in the most distant point of the watershed lies in the mountain areas, and streams extend to the valley floor.

E. Dimensionless Unit Hydrograph

To create a DUH, the Tabular Hydrograph Method provided in Chapter 5 of the NRCS TR-55 manual (USDA, 1986) can be utilized. This method, however, assumes that all discharges for a stream reach flow at the same velocity, and should be utilized only as an initial design step. This method requires watershed data such as:

- a. Time of concentration;
- b. Travel time;
- c. CN number;
- d. Watershed area;
- e. 24 hr, 2 year precipitation depth provide by NOAA Atlas 14;
- f. Direct Runoff, Q ; and,
- g. Initial abstraction, I_a .

This method utilizes 24-hour rainfall distributions created for the United States. These distributions represent several regions of the United States; type I, IA, II, and III. Types I and IA represent the Pacific maritime climate with wet winters and dry summers. Type IA is the least intense and type II the most intense duration rainfall.

With the information calculated from steps A-D, I_a/P ratios can be developed and tables provided in the TR-55 Manual can be utilized. Information utilized in the tables provided includes $\sum T_t$ for each sub watershed, corresponding T_c , I_a/P ratios, and rainfall distribution type. Utilizing these parameters as inputs, the tables found in exhibit 5 of the NRCS TR-55 manual can be read and utilized to develop hydrograph times and corresponding flow values. The flow at any time can be calculated using the provided equation:

$q = q_t A Q$, where:

q = hydrograph coordinate (cfs) at hydrograph time t

q_t = tabular unit discharge located in exhibit 5 (csm/in) depends on rainfall distribution type

A = drainage area of individual subarea (mi^2)

Q = runoff (in)

There are several limitations to this method. Time of concentration is limited to 2 hours and travel time is limited to 3 hours. If these values are exceeded then the method cannot be utilized. Therefore it is recommended to segment the watershed into multiple homogenous watershed sub-areas.

For the proposed study area, the following data was found, as summarized in Table 4.

Table 4: Tecuya sub watershed calculated data.

Sub-watershed	Area (acres)	Tc (hr)	2 yr, 24 hour precip. Depth (in) P	CN	Runoff Q (in)	I _a	I _a /P	Rainfall Distribution Type
1	17,528	3.92	1.80	70	0.17	0.86	0.48	IA
2	19,240	2.99	2.13	70	0.29	0.86	0.40	IA

For the Tecuya sub-watersheds, the calculated travel times and time of concentration exceed the allowed; therefore, a creation of a DUH cannot be directly developed. The Tecuya watershed will need to be further segmented into smaller sub watersheds in order to meet the limitations and develop a tabular DUH. Other watersheds within the study area can be analyzed in the same manner and a DUH can be developed.

Once this work is completed, it can be used to anticipate when water may be in Tecuya Creek, or a similar watershed's stream. This can then be used to prepare for and mobilize for ephemeral sampling events.

Attachments:

1. NOAA. 2014. [NOAA Atlas 14 Point Precipitation Frequency Estimates: CA. Silver Springs, Md.: National Oceanic and Atmospheric Administration. Available at: http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=ca](http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=ca). Accessed 16 January 2015.
2. [Soil breakdown information for Tecuya watershed.](#)

References:

NOAA. 2014. NOAA Atlas 14 Point Precipitation Frequency Estimates: CA. Silver Springs, Md.: National Oceanic and Atmospheric Administration. Available at: http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=ca. Accessed 15 January 2015.

USDA. 1986. Urban Hydrology for Small Watersheds. NRCS TR-55. Washington, D.C.: United States Department of Agriculture, Natural Resources Conservation Service . Available at: http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044171.pdf. Accessed 15 January 2015.

NOAA's National Weather Service
Hydrometeorological Design Studies Center
Precipitation Frequency Data Server (PFDS)

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NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES: CA

DATA DESCRIPTION

Data type: Units: Time series type:

SELECT LOCATION

1. Manually:

a) Enter location (decimal degrees, use "-" for S and W): latitude: longitude:

b) Select station ([click here for a list of stations used in frequency analysis for CA](#)):

2. Use map:

a) Select location
(move crosshair or double click)
b) Click on station icon
☐ show stations on map

LOCATION INFORMATION:
Name: Lebec, California, US*
Latitude: 34.9387°
Longitude: -118.9684°
Elevation: 1706 ft*

* source: Google Maps

POINT PRECIPITATION FREQUENCY (PF) ESTIMATES WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION NOAA Atlas 14, Volume 6, Version 2

PF tabular

PF graphical

Supplementary information

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PDS-based precipitation frequency estimates with 90% confidence intervals (in inches) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.074 (0.060-0.091)	0.099 (0.081-0.123)	0.134 (0.109-0.167)	0.165 (0.133-0.206)	0.208 (0.163-0.269)	0.244 (0.187-0.322)	0.282 (0.211-0.381)	0.323 (0.235-0.447)	0.381 (0.286-0.550)	0.428 (0.290-0.639)
10-min	0.106 (0.086-0.131)	0.142 (0.116-0.176)	0.193 (0.157-0.239)	0.236 (0.190-0.295)	0.299 (0.233-0.386)	0.349 (0.268-0.461)	0.404 (0.302-0.545)	0.462 (0.337-0.641)	0.546 (0.382-0.788)	0.614 (0.415-0.916)
15-min	0.128 (0.104-0.158)	0.172 (0.140-0.213)	0.233 (0.189-0.289)	0.285 (0.230-0.357)	0.361 (0.282-0.467)	0.423 (0.324-0.557)	0.488 (0.365-0.660)	0.559 (0.407-0.776)	0.660 (0.462-0.953)	0.742 (0.502-1.11)
30-min	0.183 (0.150-0.227)	0.246 (0.201-0.305)	0.334 (0.272-0.415)	0.409 (0.330-0.512)	0.517 (0.404-0.669)	0.606 (0.464-0.799)	0.700 (0.524-0.945)	0.801 (0.583-1.11)	0.946 (0.662-1.37)	1.06 (0.720-1.59)
60-min	0.270 (0.220-0.334)	0.362 (0.296-0.449)	0.492 (0.400-0.611)	0.602 (0.486-0.754)	0.762 (0.595-0.985)	0.892 (0.683-1.18)	1.03 (0.771-1.39)	1.18 (0.859-1.64)	1.39 (0.975-2.01)	1.57 (1.06-2.34)
2-hr	0.414 (0.338-0.512)	0.549 (0.448-0.681)	0.733 (0.596-0.911)	0.887 (0.715-1.11)	1.10 (0.861-1.43)	1.27 (0.975-1.68)	1.45 (1.09-1.96)	1.64 (1.19-2.27)	1.89 (1.32-2.73)	2.09 (1.42-3.13)
3-hr	0.525 (0.429-0.650)	0.694 (0.566-0.860)	0.920 (0.748-1.14)	1.11 (0.893-1.39)	1.37 (1.07-1.77)	1.57 (1.20-2.07)	1.78 (1.33-2.40)	1.99 (1.45-2.77)	2.29 (1.60-3.30)	2.51 (1.70-3.75)
6-hr	0.762 (0.622-0.943)	1.00 (0.817-1.24)	1.32 (1.07-1.64)	1.58 (1.27-1.98)	1.93 (1.51-2.50)	2.20 (1.69-2.90)	2.48 (1.85-3.34)	2.76 (2.01-3.82)	3.13 (2.19-4.53)	3.42 (2.31-5.10)
12-hr	1.03 (0.838-1.27)	1.36 (1.11-1.69)	1.80 (1.47-2.24)	2.16 (1.74-2.70)	2.63 (2.06-3.40)	3.00 (2.29-3.95)	3.36 (2.51-4.54)	3.73 (2.71-5.17)	4.21 (2.95-6.08)	4.57 (3.10-6.83)
24-hr	1.33 (1.19-1.52)	1.80 (1.61-2.05)	2.40 (2.14-2.75)	2.88 (2.55-3.33)	3.53 (3.01-4.22)	4.01 (3.34-4.92)	4.50 (3.65-5.66)	4.99 (3.93-6.47)	5.64 (4.24-7.64)	6.12 (4.44-8.61)
2-day	1.59 (1.43-1.82)	2.19 (1.95-2.50)	2.96 (2.64-3.39)	3.58 (3.17-4.14)	4.42 (3.76-5.29)	5.05 (4.21-6.18)	5.68 (4.61-7.15)	6.32 (4.98-8.20)	7.17 (5.40-9.72)	7.80 (5.66-11.0)

3-day	1.74 (1.56-1.99)	2.42 (2.16-2.76)	3.31 (2.95-3.79)	4.04 (3.57-4.67)	5.02 (4.28-6.01)	5.76 (4.80-7.08)	6.52 (5.29-8.20)	7.29 (5.74-9.45)	8.32 (6.26-11.3)	9.10 (6.60-12.8)
4-day	1.87 (1.67-2.13)	2.61 (2.33-2.98)	3.61 (3.21-4.13)	4.42 (3.90-5.10)	5.52 (4.70-6.61)	6.36 (5.30-7.79)	7.22 (5.86-9.08)	8.10 (6.38-10.5)	9.29 (7.00-12.6)	10.2 (7.40-14.4)
7-day	2.09 (1.87-2.38)	2.96 (2.65-3.38)	4.15 (3.70-4.75)	5.12 (4.53-5.92)	6.47 (5.51-7.75)	7.51 (6.25-9.20)	8.57 (6.95-10.8)	9.66 (7.81-12.5)	11.2 (8.39-15.1)	12.3 (8.92-17.3)
10-day	2.21 (1.98-2.52)	3.16 (2.83-3.61)	4.46 (3.98-5.11)	5.54 (4.90-6.40)	7.05 (6.01-8.44)	8.22 (6.85-10.1)	9.43 (7.65-11.9)	10.7 (8.41-13.8)	12.4 (9.34-16.8)	13.7 (9.96-19.3)
20-day	2.59 (2.32-2.96)	3.76 (3.36-4.29)	5.40 (4.81-6.18)	6.79 (5.99-7.84)	8.77 (7.47-10.5)	10.4 (8.63-12.7)	12.0 (9.74-15.1)	13.8 (10.8-17.8)	16.2 (12.2-21.9)	18.1 (13.1-25.4)
30-day	3.04 (2.72-3.46)	4.41 (3.94-5.03)	6.36 (5.67-7.28)	8.04 (7.11-9.29)	10.5 (8.94-12.6)	12.5 (10.4-15.3)	14.5 (11.8-18.3)	16.7 (13.2-21.7)	19.8 (14.9-26.9)	22.3 (16.2-31.4)
45-day	3.64 (3.26-4.14)	5.24 (4.68-5.98)	7.55 (6.73-8.64)	9.58 (8.46-11.1)	12.6 (10.7-15.0)	15.0 (12.5-18.4)	17.6 (14.3-22.2)	20.4 (16.1-26.5)	24.4 (18.3-33.0)	27.5 (20.0-38.8)
60-day	4.16 (3.73-4.75)	5.94 (5.31-6.78)	8.54 (7.62-9.78)	10.8 (9.58-12.5)	14.3 (12.1-17.1)	17.1 (14.2-20.9)	20.1 (16.3-25.3)	23.4 (18.4-30.3)	28.1 (21.1-38.0)	31.8 (23.1-44.8)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Estimates from the table in csv format: [precipitation frequency estimates](#)

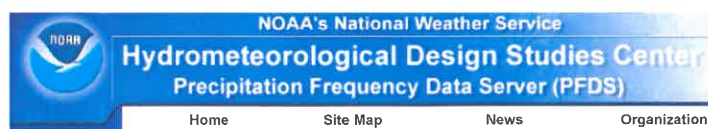
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DATA DESCRIPTION

Data type: Units: Time series type:

SELECT LOCATION

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2. Use map:



POINT PRECIPITATION FREQUENCY (PF) ESTIMATES
WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 6, Version 2

PF tabular

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Supplementary information

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PDS-based precipitation frequency estimates with 90% confidence intervals (in inches) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.093 (0.076-0.115)	0.126 (0.102-0.156)	0.172 (0.139-0.214)	0.211 (0.170-0.265)	0.269 (0.210-0.349)	0.316 (0.242-0.418)	0.368 (0.275-0.497)	0.423 (0.308-0.587)	0.503 (0.352-0.726)	0.569 (0.385-0.849)
10-min	0.133 (0.108-0.165)	0.180 (0.146-0.224)	0.246 (0.200-0.307)	0.303 (0.244-0.380)	0.386 (0.301-0.500)	0.454 (0.347-0.599)	0.527 (0.393-0.712)	0.606 (0.441-0.842)	0.721 (0.504-1.04)	0.816 (0.552-1.22)
15-min	0.161 (0.131-0.200)	0.218 (0.177-0.271)	0.298 (0.241-0.371)	0.366 (0.295-0.460)	0.466 (0.364-0.604)	0.549 (0.419-0.725)	0.637 (0.476-0.861)	0.733 (0.533-1.02)	0.871 (0.609-1.26)	0.986 (0.667-1.47)
30-min	0.216 (0.176-0.268)	0.292 (0.238-0.363)	0.399 (0.324-0.497)	0.491 (0.395-0.617)	0.626 (0.488-0.810)	0.736 (0.563-0.972)	0.854 (0.638-1.16)	0.983 (0.715-1.37)	1.17 (0.817-1.69)	1.32 (0.895-1.98)
60-min	0.310 (0.252-0.384)	0.419 (0.341-0.521)	0.572 (0.464-0.713)	0.705 (0.567-0.885)	0.897 (0.700-1.16)	1.06 (0.807-1.40)	1.23 (0.915-1.66)	1.41 (1.03-1.96)	1.68 (1.17-2.42)	1.90 (1.28-2.83)
2-hr	0.472 (0.384-0.586)	0.632 (0.514-0.785)	0.849 (0.688-1.06)	1.03 (0.830-1.29)	1.29 (1.00-1.67)	1.49 (1.14-1.97)	1.70 (1.27-2.30)	1.93 (1.40-2.67)	2.24 (1.57-3.23)	2.49 (1.68-3.71)
3-hr	0.600 (0.488-0.744)	0.799 (0.649-0.992)	1.06 (0.863-1.33)	1.28 (1.03-1.61)	1.59 (1.24-2.06)	1.83 (1.40-2.42)	2.08 (1.55-2.61)	2.33 (1.70-3.24)	2.69 (1.88-3.88)	2.96 (2.00-4.42)
6-hr	0.892 (0.726-1.11)	1.18 (0.961-1.47)	1.56 (1.27-1.95)	1.87 (1.51-2.35)	2.30 (1.79-2.97)	2.62 (2.00-3.46)	2.95 (2.21-3.99)	3.29 (2.39-4.57)	3.75 (2.62-5.42)	4.10 (2.78-6.12)
12-hr	1.22 (0.992-1.51)	1.62 (1.32-2.02)	2.15 (1.74-2.67)	2.57 (2.07-3.22)	3.14 (2.45-4.06)	3.57 (2.73-4.72)	4.01 (2.99-5.42)	4.45 (3.24-6.18)	5.04 (3.52-7.28)	5.49 (3.71-8.19)
24-hr	1.59 (1.42-1.80)	2.13 (1.91-2.43)	2.84 (2.54-3.25)	3.41 (3.02-3.93)	4.17 (3.56-4.99)	4.75 (3.96-5.81)	5.33 (4.33-6.70)	5.92 (4.66-7.67)	6.70 (5.04-9.08)	7.29 (5.29-10.3)
2-day	1.90 (1.71-2.17)	2.60 (2.33-2.96)	3.51 (3.13-4.00)	4.24 (3.75-4.89)	5.23 (4.47-6.26)	5.99 (5.00-7.33)	6.75 (5.48-8.49)	7.53 (5.93-9.76)	8.58 (6.46-11.6)	9.38 (6.80-13.2)

3-day	2.07 (1.86-2.36)	2.85 (2.56-3.25)	3.89 (3.48-4.44)	4.74 (4.19-5.46)	5.89 (5.03-7.04)	6.78 (5.65-8.29)	7.68 (6.24-9.65)	8.61 (6.78-11.2)	9.87 (7.43-13.4)	10.8 (7.86-15.3)
4-day	2.22 (1.99-2.53)	3.08 (2.76-3.51)	4.23 (3.78-4.84)	5.18 (4.58-5.97)	6.47 (5.52-7.74)	7.47 (6.23-9.15)	8.50 (6.90-10.7)	9.57 (7.53-12.4)	11.0 (8.29-14.9)	12.2 (8.81-17.1)
7-day	2.50 (2.24-2.84)	3.51 (3.14-4.00)	4.87 (4.35-5.56)	6.00 (5.31-6.92)	7.57 (6.46-9.05)	8.80 (7.34-10.8)	10.1 (8.17-12.6)	11.4 (8.96-14.7)	13.2 (9.92-17.9)	14.6 (10.6-20.6)
10-day	2.64 (2.37-3.00)	3.73 (3.34-4.24)	5.21 (4.65-5.95)	6.45 (5.71-7.44)	8.19 (6.99-9.79)	9.56 (7.97-11.7)	11.0 (8.91-13.8)	12.5 (9.81-16.1)	14.5 (10.9-19.7)	16.2 (11.7-22.7)
20-day	3.10 (2.79-3.53)	4.44 (3.98-5.05)	6.29 (5.62-7.18)	7.86 (6.96-9.06)	10.1 (8.63-12.1)	11.9 (9.95-14.6)	13.8 (11.2-17.4)	15.9 (12.5-20.6)	18.7 (14.1-25.4)	21.0 (15.2-29.6)
30-day	3.68 (3.31-4.19)	5.26 (4.71-5.99)	7.48 (6.69-8.55)	9.40 (8.32-10.8)	12.2 (10.4-14.6)	14.5 (12.1-17.7)	16.9 (13.7-21.2)	19.4 (15.3-25.2)	23.1 (17.4-31.4)	26.1 (18.9-36.7)
45-day	4.38 (3.93-4.99)	6.21 (5.57-7.08)	8.82 (7.88-10.1)	11.1 (9.83-12.8)	14.5 (12.3-17.3)	17.2 (14.4-21.1)	20.2 (16.4-25.4)	23.5 (18.5-30.4)	28.1 (21.2-38.1)	32.0 (23.2-45.0)
60-day	5.07 (4.55-5.77)	7.11 (6.37-8.10)	10.1 (8.98-11.5)	12.7 (11.2-14.6)	16.5 (14.1-19.8)	19.7 (16.5-24.2)	23.2 (18.9-29.2)	27.0 (21.3-35.0)	32.6 (24.5-44.2)	37.2 (27.0-52.3)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Estimates from the table in csv format:

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National Weather Service
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Attachment 2:

Soil information for Tecuya watershed.

Particle Size	Hydrologic Group	Runoff	Earth Cover Types	Range of CN	Total Area (acres)
coarse-loamy	A, B	Low Runoff - High Runoff	Grass/herbaceous cover, Crop cover, Tree cover	49-80	6,601
fine	B, C	High Runoff- Very High runoff	Grass/herbaceous cover	62-87	125
fine-loamy	A, B, C	Low runoff - High Runoff	Grass/herbaceous cover	49-87	11,374
loamy	A,B	Low runoff - High Runoff	Grass/herbaceous cover	49-80	1,362
loamy-skeletal	A	Low Runoff - High Runoff	Grass/herbaceous cover	49-63	11,820
not used	A, B,	Low Runoff - High Runoff	Grass/herbaceous cover, Crop cover, Tree cover	49-87	4,568
sandy-skeletal	A	Very Low	Grass/herbaceous cover	49	711
Total					36,561



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