Kern River Watershed Coalition Authority

A joint powers authority to serve as coordinator and coalition group under the Irrigated Lands Regulatory Program
in the Kern River watershed portion of Kern and Tulare Counties
12109 Highway 166, Bakersfield, CA 93313-9630

January 10, 2013

VIA EMAIL TO:
awlaputz@waterboards.ca.gov

Dr. Karl Longley, Chair
Jon Costantino, Vice Chair
Sandra Meraz, Board Member
Jennifer Moffitt, Board Member
Carmen Ramirez, Board Member
Robert Schneider, Board Member
Pamela Creedon, Executive Officer
Clay Rodgers, Assistant Executive Officer
Central Valley Regional Water Quality Control Board
11020 Sun Center Drive, #200
Rancho Cordova, CA 95670-6114

Re: Comments of Kern River Watershed Coalition Authority re draft "Waste Discharge Requirements General Order for Discharges from Irrigated Lands Within the Central Valley Region for Dischargers not Participating in a Third-Party Group" (November 2012 draft)

Dear Board Chair, Vice Chair, Members, Ms. Creedon and Mr. Rodgers:

As you may be aware, the Kern River Watershed Coalition Authority (Authority) is a joint powers authority composed of most of the agricultural water districts within the San Joaquin Valley portion of Kern County, including portions of southern Tulare County within multi county districts. The Authority administers the existing surface water program under the Coalition Group Conditional Waiver for the Kern River Sub-watershed ("Kern") of the Southern San Joaquin Valley Water Quality Coalition ("SSJ Coalition"), of which we are a part. The Kern area includes the watershed areas of the Kern River, Poso Creek, Rag Gulch and White River. As you are aware we have though the SSJ Coalition participated in various processes to develop a workable "Third Party" coalition administered order for our area, and we remain committed to that effort, however whether that effort will be successful remains uncertain. We provide these comments on the above referenced draft Order (**"Individual Order"**) on behalf of our member districts and the landowners within each of our members, who may for whatever reason, choose not to join a coalition, or if for any reason ultimately there is not a coalition administered Order for our area.

As described further at the hearing and workshop in Bakersfield on November 30, 2012, there are unique conditions within Kern that need to be taken into account when drafting the Tulare Lake Basin Area Order and above referenced Order specific to Kern. The information presented by our Coalition at the

November 30, 2012 hearing and workshop and our prior correspondence is equally applicable to this draft Individual Order as it applies to growers in Kern.

Copies of the Power Point presentations of our experts and a draft report prepared by Timothy G. Souther submitted at the November 30th workshop, which have been admitted into the record for the Tulare Lake Basin Area Order, are attached hereto. Also attached are preliminary comments dated August 10, 2012, regarding the draft Tulare Lake Basin Area Order. For your convenience, I will summarize the key points of our experts' testimony, as reflected in the above-mentioned PowerPoint slides:

Mr. Gailey has demonstrated:

1. In part because of significantly deeper groundwater in Kern, there are significant transit times between surface water application and any changes in groundwater quality;
2. About 85% of the groundwater is at depths not previously studied, which Mr. Gailey has now preliminarily analyzed;
3. Nitrates residing in the unsaturated zone are an ongoing and legacy source for years to come, regardless of current farming practices; and
4. The significant costs of ineffective groundwater monitoring programs warrant further study.

Mr. Sanden of the UC Extension Service provided "on the ground" information on the high level of irrigation efficiency and nitrogen use efficiency currently employed in Kern.

Dr. Kimmelshue demonstrated:

1. The significant shift in Kern in the last 20 years or so to permanent crops and to a lesser extent dairies;
2. The very efficient current irrigation practices in Kern for the most part results in a low nitrate hazard to groundwater;
3. The crops having the greater potential to affect groundwater are generally associated with the dairy industry that is already regulated; and
4. His approach and conclusions are similar to those reached by other researchers, although his analysis is specific to Kern. Some of this recent research was funded in part by the State Water Resources Control Board.

Mr. Souther demonstrated that for the Westside of the Kern area there is little or no usable groundwater and the groundwater which is available is of such quality to prevent its use for municipal and agricultural purposes.

Additionally various farmers testified concerning their irrigation practices, often involving "deficit irrigation" applications.

It is also noted that Ms. Fenton of Kern County's Public Health Department testified concerning Kern County's efforts to protect water quality, and that there are few issues remaining to be resolved in terms of Kern's local communities providing safe water within the MCL limits for nitrates for its residents.

While the regulatory requirements under this proposed Individual Order may be somewhat different than the July 2012 review draft that we have previously commented on for the Tulare Lake Basin Area, and whatever order may ultimately be adopted for such Area, and in many instances the Individual Order regulatory requirements are more onerous, the testimony of our experts and others, as summarized above, is equally applicable for the Individual Order as it relates to Kern. The draft Individual Order and accompanying documents presents no credible information or evidence to rebut what we have summarized above as applicable within Kern. Further, we ask that the changes that were made to the Eastern San Joaquin General Order pursuant to ag interest requests are also made, where applicable, in the Individual General Order. For example, please modify finding 7 in the individual order to align with finding 5 in R5-2012-0016 by adding the footnote which states, "Water that travels through or remains on the surface of a Member's agricultural fields includes ditches and other structures (e.g. ponds, basins) that are used to convey supply or drainage water within that Member's parcel or between contiguous parcels owned or operated by that Member."

We do not question the jurisdiction of the Regional Board to prevent pollution of groundwater. However, as you know, the jurisdiction of the Regional Board is not unlimited. The Regional Board's regulatory authority is limited to "ensure the reasonable protection of beneficial uses" and pollution "is defined in part as the alteration of quality of waters of the state by waste to a degree which unreasonably affects . . . beneficial uses".

Based on the information provided on November 30th by our experts and others, it appears that except for those practices that are already covered under the dairy order, current farming practices for a significant portion of the Kern sub-watershed do not pose a sufficiently serious threat to groundwater so as to warrant the type of monitoring and other regulation as contemplated in the draft Individual Order. Put another way, the cost of the "cure" so far outweighs the seriousness of the threat as to make the proposed regulatory scheme unreasonable on its face. Under the unique conditions which predominate the Kern sub-watershed, a "one size fits all" approach should be rejected in favor of a more targeted and precise program, one which takes into account, among other things, soils, depth to groundwater, crop types and irrigation practices in determining regulatory priorities. Absent such an approach, the proposed Individual Order would fail to achieve the reasonableness threshold set forth in your authorizing statutes. Finally, there is no basis for assuming in Kern that everyone who irrigates is a "discharger" under the Porter-Cologne Act, as the draft Individual Order and other draft orders suggest.

It you have any questions or we can provide additional information regarding any of the foregoing, please contact us.

Very Truly Yours,

Eric Averett
Chair

Attachments: AMEC Report
11/30/12 Expert Power Points
8/10/12 Comment letter

WESTSIDE WATER DISTRICTS' PRELIMINARY WATER QUALITY REPORT

Prepared by Timothy G. Souther and Gary L. Kramer of
AMEC Environment & Infrastructure, Inc. and
Reviewed by Greg A. Hammett of
Belridge Water Storage District
for

Belridge Water Storage District,
Berrenda Mesa Water District,
Dudley Ridge Water District, and
Lost Hills Water District

Abstract: *Four California water districts (Belridge Water Storage District, Berrenda Mesa Water District, Dudley Ridge Water District, and Lost Hills Water District) are located along the southwestern border of the Tulare Lake Basin in western Kern and Kings Counties of California. The Districts have requested that AMEC Environment & Infrastructure, Inc. (AMEC) prepare a summary of groundwater information within the Districts to address the Irrigated Lands Regulatory Program of California Regional Water Quality Control Board, Central Valley Region (RWQCB). The most recent version of the program includes regulation of discharges to groundwater from irrigated lands. This report summarizes groundwater information for the Districts' areas from reports published by federal, state and local agencies. These published reports demonstrate that groundwater below the Districts is of sufficiently poor mineral quality that it is unsuitable for municipal water supply and is only rarely used for agricultural water supply after substantial blending with imported, high quality, surface water supplies. These poor quality groundwater conditions are consistent with several of the exceptions described in the "Sources of Drinking Water" policy (Resolution 88-63) originally adopted by the State Water Resources Control Board (1988) and subsequently by the Regional Water Quality Control Board. Based on the poor quality of groundwater in the area, the Districts ask the RWQCB to use its discretion under the "Sources of Drinking Water Policy" and other Tulare Lake Basin Plan policies to exempt farmers within the Districts from groundwater regulation under the Irrigated Lands Regulatory Program.*

The California Regional Water Quality Control Board – Central Valley Region (RWQCB) is embarking on the long-term Irrigated Lands Regulatory Program (ILRP) for the Tulare Lake Basin (Basin) in central California. The most recent versions of the ILRP (RWQCB, 2012) propose to regulate discharges to groundwater from irrigated agriculture. Four water districts along the western edge of the Basin (Belridge Water Storage District, Berrenda Mesa Water District, Dudley Ridge Water District, and Lost Hills Water District, collectively identified as the Districts and shown on Figure 1) have retained AMEC Environment & Infrastructure, Inc. (AMEC), to prepare a summary report describing groundwater resources within the Districts to assist the RWQCB in considering how to implement the ILRP along the western edge of the Basin. This white paper is the first installment of AMEC's work on behalf of the Districts and includes a summary of area geology, climate, surface waters, and groundwater on a regional scale based on review of published regional reports.

In the California Water Plan, the Department of Water Resources (DWR, 2009) found: "In the western (San Joaquin) valley area, groundwater quality is often poor, and availability is highly variable. In addition, drainage problem areas have developed with high water tables with high total dissolved solids." Groundwater below the Districts is naturally of poor mineral quality, primarily due to contact with marine sediments derived from the Temblor Range that borders the San Joaquin Valley on the west. Those marine sediments and their associated salts have been transported by alluvial processes into the valley. Groundwater in the Districts occurs in perched, unconfined, semi-confined, and confined aquifers. Groundwater quality in each of these zones typically exceeds 2,000 milligrams per liter (mg/L) of total dissolved solids (TDS) and contains other inorganic chemicals (arsenic) that prevent use of groundwater as a potable water supply. For municipal water supply, water is imported into the Districts and treated as necessary. Groundwater use for agricultural irrigation is limited by high TDS and boron concentrations. As such, groundwater irrigation has been almost completely replaced by imported surface water irrigation from the State Water Project (SWP) (California Aqueduct).

THE DISTRICTS

The Belridge Water Storage District (BWSD) encompasses 92,000 acres of land in western Kern County (Figure 1). BWSD slopes from the Antelope Hills and Belridge Oil Field on the west to the California Aqueduct in the valley floor on the east. The BWSD has a contract for 121,508 acre-feet per year of irrigation water from the SWP to about 52,000 acres of developed agricultural land between Highway 33 on the west and the Kern River Floodway on the east and California Highway 46 and the community of Lost Hills on the north (BWSD, 2012). This allocation of SWP water amounts to about 2.3 acre-feet per acre annually. No established communities are present within the BWSD. Oil field operations are present along the west side of California Highway 46 and immediately south of Lost Hills. A food processing plant along Highway 46 is also within the BWSD.

Groundwater beneath the BWSD is of poor mineral quality and is not used for potable water supply, but is occasionally blended with SWP surface water and used for irrigation. Oil field operations in the Belridge Oil Field extract oil and produced water (brine) that is re-injected into exempted aquifers for disposal or use in water or steam flood enhanced petroleum recovery operations in accordance with regulations of the California Division of Oil, Gas, and Geothermal Resources (DOGGR). BWSD participates in several water banking projects, located immediately adjacent to the Kern River, to develop water supplies for use in dry years.

Berrenda Mesa Water District (BMWD) encompasses 55,440 acres of land in the upper Antelope Plain (Figure 1). BMWD extends north and west of BWSD and is bordered by California Highway 46 on the south, the Coastal Aqueduct along the north, and Lost Hills Oil Field on the west. BMWD has a contract for 92,600 acre-feet per year of irrigation water from the SWP to 49,000 acres of developed agricultural land. This SWP allocation amounts to about 1.9 acre-feet per acre annually. BMWD includes the small community of Blackwell's Corner at the intersection of Highway 46 and Highway 33 and extends southeast almost to the community of Lost Hills. BMWD also includes a food processing plant along Highway 46. Groundwater from the BMWD is of poor mineral quality and is not used for potable water supply. Groundwater is imported from the Lost Hills Utility District (LHUD) for potable supply in Blackwell's Corner; LHUD imports water from 13 miles further east and beyond the borders of any of the Districts. BMWD participates in water banking projects, located immediately adjacent the Kern River, to develop water supplies that can be available during dry years.

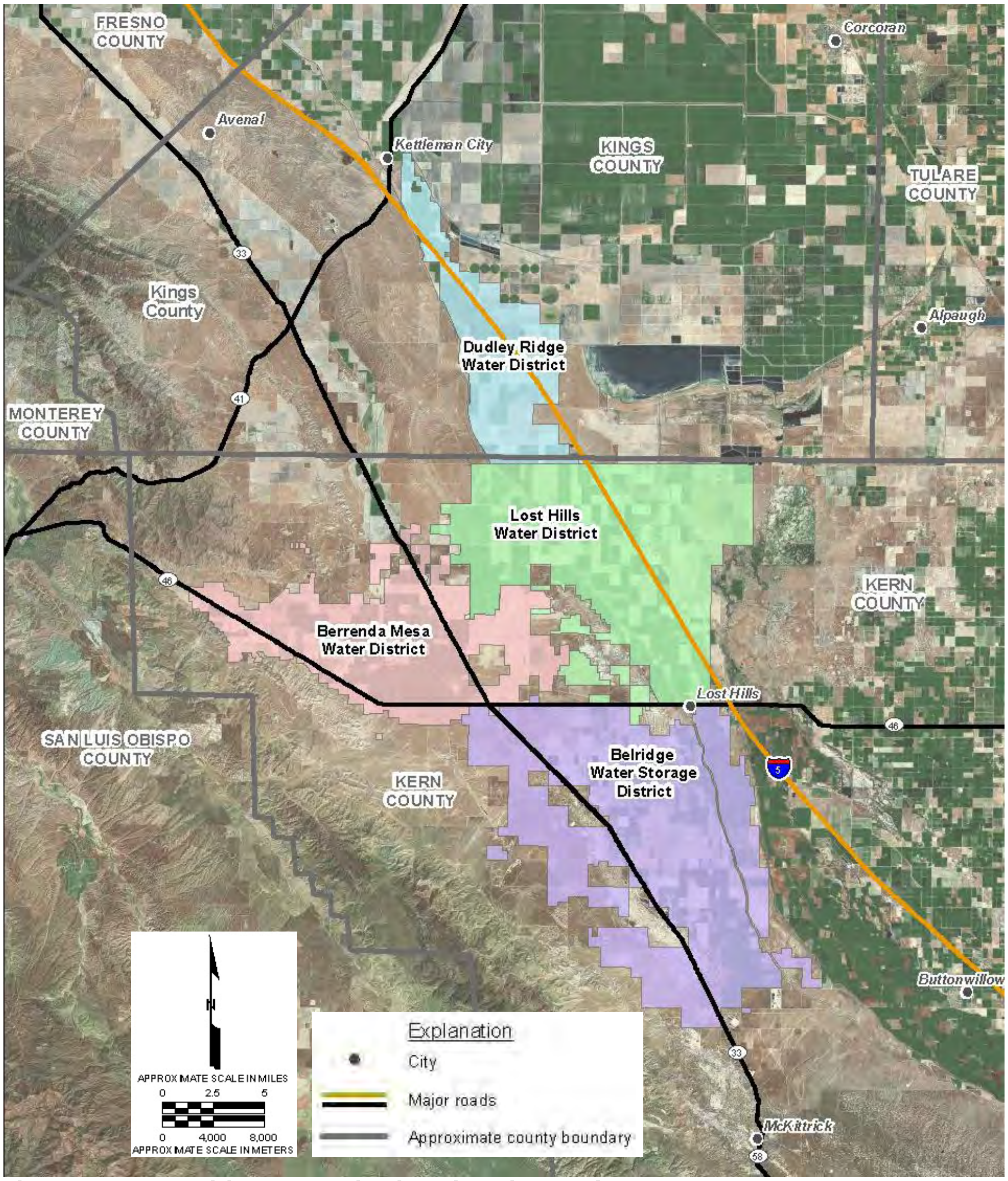


Figure 1 – Westside Water Districts (Study Area)

Dudley Ridge Water District (DRWD) encompasses 37,600 acres of land extending north of the border of Kings and Kern counties on the south, the California Aqueduct on the west, Tulare Lake Bed on the east, and a narrow strip of land on either side of Interstate Highway 5 north to (but not including) Kettleman City (Figure 1). DRWD has a contract for 50,343 acre-feet per year of SWP water that is currently used on 17,000 acres of developed agricultural land. This allocation of SWP water amounts to about 2.9 acre-feet per acre annually. DRWD does not include established communities, although its northern border abuts the community of Kettleman City. Groundwater from the DRWD is of poor mineral quality and is not used for drinking water; DRWD indicates that one well (Section 17, 23S/20E) is used for toilets and sinks (bottled water used for drinking). DRWD participates in the water banking projects, located immediately adjacent to the Kern River, to develop water supplies that can be available during dry years.

Lost Hills Water District (LHWD) encompasses 72,183 acres of land and extends east of BMWD to the Kern National Wildlife Refuge (Refuge), south to the community of Lost Hills, and north to the border of Kings and Kern counties (Figure 1). LHWD supplies 119,110 acre-feet per year of SWP water to about 56,000 acres of developed agricultural land (LHWD, 2012). This allocation of SWP water amounts to about 2.2 acre-feet per acre annually. LHWD abuts the community of Lost Hills to the south and includes a food processing plant along King Road. Devils Den Oil Field borders LHWD along the northwest and Lost Hills Oil Field borders along the south of LHWD. Oil field operators extract oil and re-inject associated brine into exempted aquifers for disposal or use in water or steam flood enhanced petroleum recovery operations. Groundwater from the LHWD is of poor mineral quality and is not used for potable water supply. Groundwater is imported from 13 miles east of LHWD for potable supply in the community of Lost Hills (KIRWMP, 2011). In water short years, LHWD purchases supplemental water.

Prior to delivery of SWP water to the Districts, the DWR prepared evaluations of the feasibility of providing water from the California Aqueduct to the Districts (DWR, 1963 and 1964). DWR's evaluation of existing surface and groundwater conditions in the Districts are provided in the following paragraphs.

<u>Belridge Water Storage District, Antelope Plain and Lost Hills Water Districts</u>
(Antelope Plain Water District is now the Berrenda Mesa Water District)

"There is no usable surface water supply in these three districts except for sporadic flood flows. These districts are relatively undeveloped and have generally similar ground water conditions. There are no commercially irrigated lands in the Belridge Water Storage District. A few thousand acres are irrigated by ground water in the Antelope Plain Water District, and about 10,000 acres are irrigated in the Lost Hills Water District from groundwater and occasional surface water from the Kern River.

The yields of existing wells are for the most part low, and the quality of groundwater is poor. Crops produced on these lands are limited to those which are tolerant to poor quality water. Any significant additional development of these districts is dependent upon an imported water supply.

Ordinarily, in an area having ground water, there is the opportunity to make efficient use of imported water supplies by re-using that portion of the water which percolates beyond the crop root zone to the underlying ground water basin. In these districts, however, the material under-lying the surface is very dry, and it is believed that virtually all percolating water would be absorbed for several decades.

In these districts the existing poor quality of ground water provides an additional problem. Even the percolation of additional water will not improve these waters to the point where they could be used without mixing with surface supplies. It seems highly doubtful, however, that this would have any appreciable effect prior to 1990."

<u>Dudley Ridge Water District</u>

"For all practical purposes, there is no local surface water supply available to the District. Only occasionally during storms do the normally dry arroyos of the Kettleman hills have sufficient runoff to reach the District.

At present, the principal water supply for irrigation of land in the District is conveyed some 40 miles from sources to the east located outside the District.

There are some producing wells in the extreme northern part of the District that supply a small portion of the present water supply. Most wells that have been drilled, however, have been abandoned due to poor yield and poor quality of groundwater. Studies made for this report indicate that it would be physically possible to recapture percolate from future imported supply, but the poor quality of water underlying the area would make it unsuitable for reuse, at least for a significant number of years. It is planned that this supply will be used outside the District after water is received from the California Aqueduct."

CLIMATE

Climate in the Districts is characterized as an inland Mediterranean climate with hot and dry summers and cool winters. The average annual precipitation at the Blackwell's Corner and Kettleman City stations is 4.5 and 6.6 inches, respectively (WRCC, 2012). The average annual reference evapotranspiration for DRWD is 58 inches and for BWSD, BMWD, and LHWD is 62 inches (CIMIS, 2009). These climatic conditions resulted in desiccation of soils before irrigation development within the Districts that restricts deep percolation of irrigation water.

SURFACE WATER

All of the Districts are within the South Valley Floor Hydrologic Unit (specifically HA 558.60 and HA 557.30) (RWQCB, 2004). Ephemeral stream beds occur in the upper reaches of the HAs and drain to the east (BWSD, BMWD, DRWD, and LHWD) into the Districts. Runoff in these streams is not controlled and typically percolates prior to reaching the valley floor. The 100-year, 24-hour storm for this area ranges from 3 to 3.5 inches (NOAA, 2012).

Irrigation canals and drainage facilities are the main surface water features within the Districts. Besides these features, the dominant surface water features in the area of BWSD, BMWD, DRWD, and LHWD are the California Aqueduct, its Coastal Aqueduct, and the Refuge. Other surface water features in the area include the Tulare Lake Bed, Goose Lake, and Kern/Buena Vista Lake.

The designated beneficial uses of surface water in South Valley Floor Hydrologic Unit are agricultural supply (AGR); industrial supply (IND); process water supply (PRO); non-contact water recreation (REC-2); warm freshwater habitat (WARM); wildlife habitat (WILD); rare, threatened, or endangered species (RARE); and groundwater recharge (GWR) (RWQCB, 2004). The uplands (above the Districts) consist of 11 relatively small watersheds of 9 to 104 square miles (Figure 2) that produce little runoff ranging from 100 to 2,700 acre-feet per year (USGS, 1983).

Wetlands occur within the Refuge and the Goose Lake wetlands. The 11,249-acre-Refuge is located just west of the LHWD and includes approximately 5,000 to 6,500 acres of seasonal wetlands, irrigated moist soil units, and riparian habitat. Upland areas of the Refuge total about 3,600 acres of grassland, alkali playa, and valley sink scrub habitats. Water supply for the Refuge is provided by the California Aqueduct. The Water Management Plan for the Refuge (USBR, 2011) indicates:

"Groundwater has elevated levels of boron, arsenic and sodium. The depth to ground water makes the pumping very expensive. All wells are inactive with deteriorated casings and only four of the wells have pumps. These wells would only be used in a short-term emergency and only if money were available to pay the pumping costs."

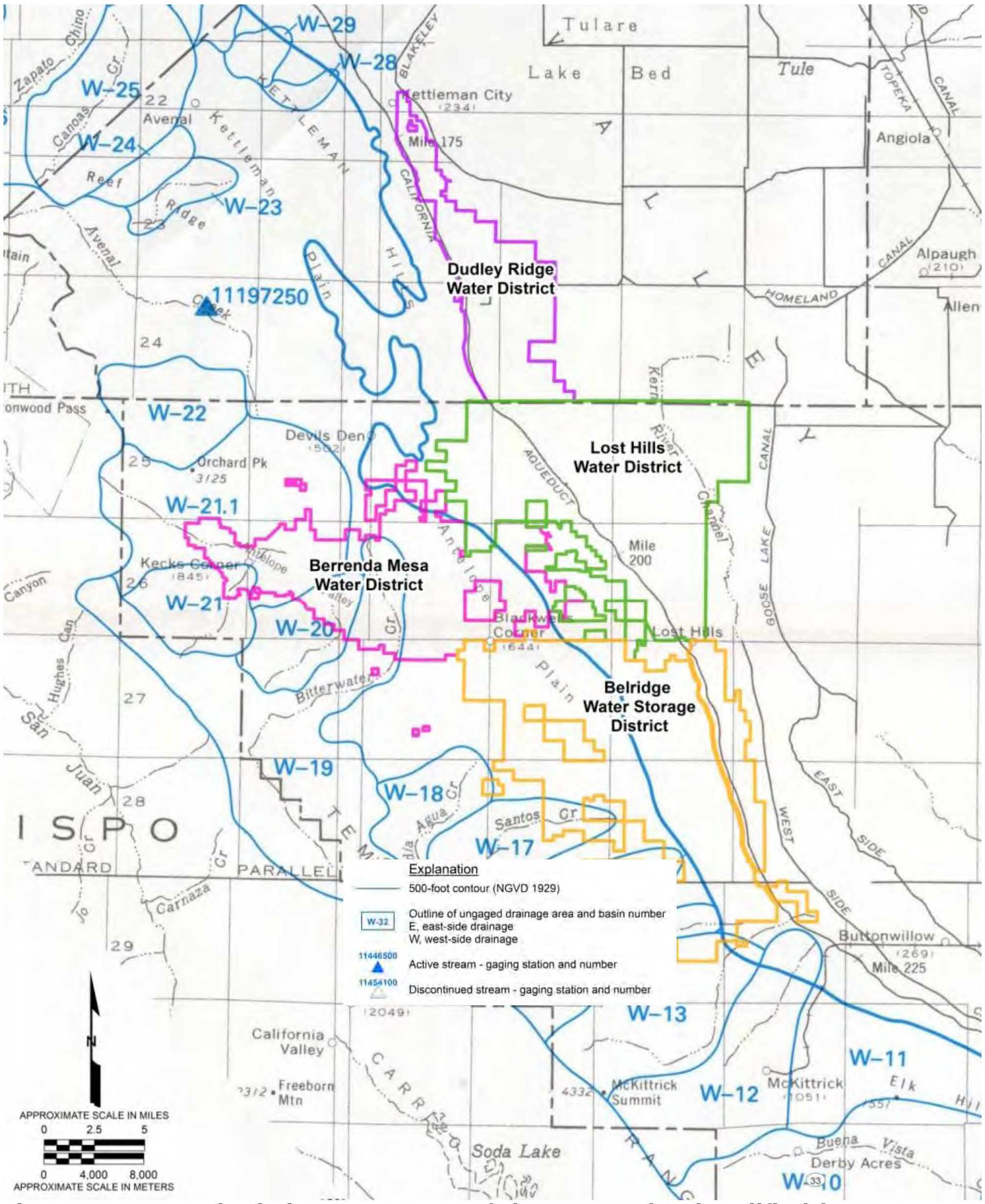


Figure 2 – Watersheds in Western Kern/Kings Counties (modified from USGS 1983)

Goose Lake is a privately held, ephemeral wetland that is habitat for threatened or endangered species. Goose Lake is located between Wasco and Lost Hills in western Kern County, but not within any of the Districts. The United States Bureau of Reclamation (USBR) is attempting to organize a management plan at Goose Lake for species protection. The USBR indicates that the wetland contains native alkali grassland and native alkali scrub habitat. Goose Lake is reportedly maintained by surface waters from a variety of sources (USBR, 2012).

SURFACE WATER QUALITY

Other than water in the California Aqueduct, very little surface water monitoring data have been collected recently within the Districts. California Aqueduct water delivered to the Districts averages 440 mg/L TDS (KIRWMP, 2011). The electrical conductance (EC) of water in the California Aqueduct at Kettleman City (Station C21) has ranged from 130 to 813 µmhos/cm and averaged about 500 µmhos/cm over the past five years (DWR, 2012). This range of ECs is roughly equivalent to a TDS range of 100 to 570 mg/L.

No Total Maximum Daily Load has been established for surface waters within the Districts (SWRCB, 2012c). The Southern San Joaquin Valley Water Quality Coalition has been monitoring a surface water station at the Main Drain Canal at Highway 46 (558MDCH46) since 2004. The TDS concentrations in the Main Drain Canal water has ranged from 270 to 2,410 mg/L over the period from 2004 through 2008 (SWRCB, 2012a).

GEOLOGY

The Districts are in the southwestern portion of the San Joaquin Valley. Regional geology in the southwestern San Joaquin Valley is characterized by a long history of structural deformation associated with tectonic movement along the continental borderland, including the prominent and still active San Andreas Fault. Uplift of the Sierra Nevada east of the valley, later uplift of the Temblor Range on west side, and formation of the deep structural trough beneath the valley floor, have resulted in the accumulation of more than 20,000 feet of marine and terrestrial sediments of Cretaceous to Holocene age throughout the basin (Maher et al., 1975).

REGIONAL STRATIGRAPHY

The stratigraphy of the southwestern San Joaquin Valley comprises marine sedimentary rocks from the Jurassic/Cretaceous through Tertiary Periods and unconsolidated non-marine sediments from Late Tertiary and Quaternary Periods (Figure 3).

The oldest marine sediments are exposed in the Temblor Range from north of Highway 41 south to Highway 58. Younger marine formations are exposed to the east, approaching the valley floor. The stratigraphic relationships of these formations are complex, owing to the significant structural deformation present on the west side of the valley.

The continental Tulare Formation overlies various marine formations along the west side of the valley. In many areas, the Tulare Formation is overlain by younger alluvium. In areas where the Tulare Formation is absent, the younger alluvium directly overlies older marine sediments.

The Tulare Formation and overlying alluvium consist of coarse-grained facies east of the Temblor Range associated with alluvial fan deposition from the upland of the Temblor Range. West of the Kettleman and Lost Hills areas, these coarse-grained alluvial facies become interbedded with fine-grained facies associated with lacustrian, fluvial, deltaic, and marshland deposits from the pre-historic and historic Tulare Lake and Goose Lake, as well as the Kern River flood plain situated between them (Croft, 1972; Page, 1983). The Tulare Formation and overlying alluvial sediments comprise the major aquifers beneath the San Joaquin Valley. These are discussed in further detail below (see Hydrogeology).

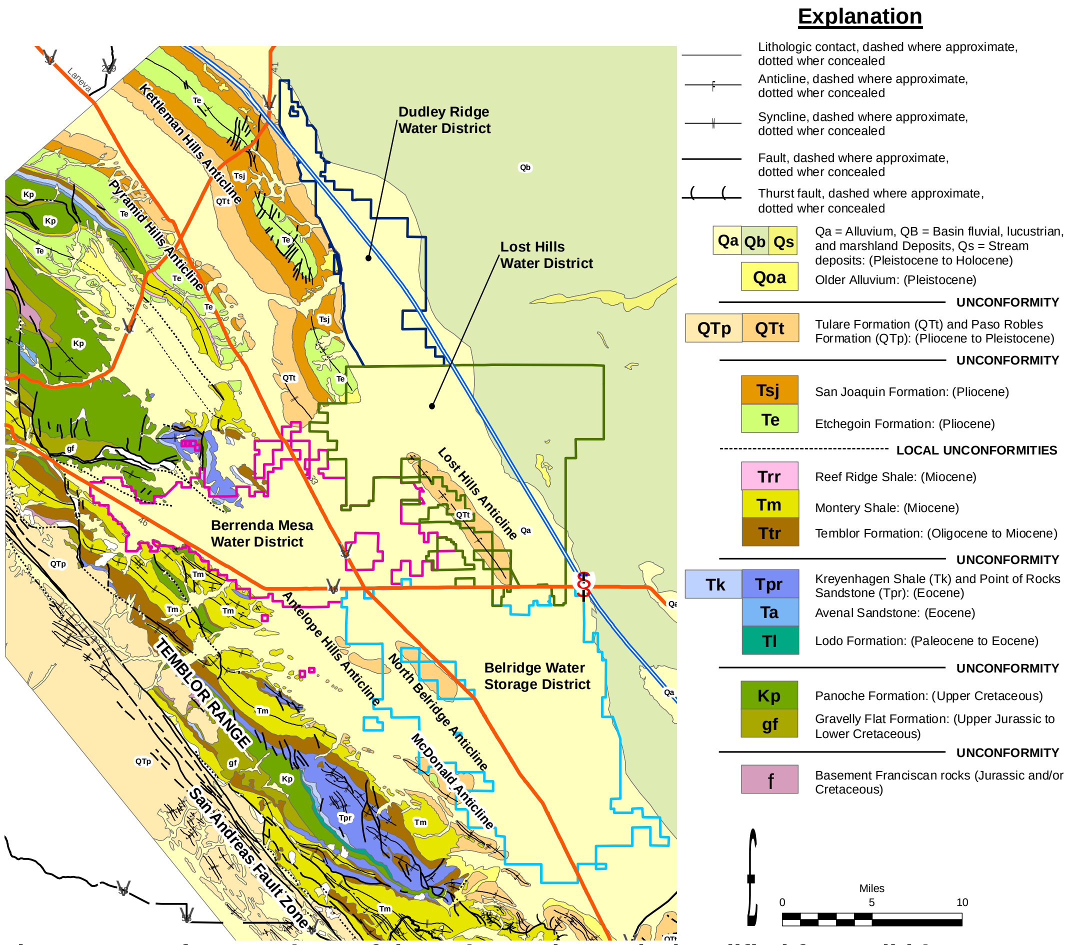


Figure 3 – Surface Geology of the Tulare Lake Basin (modified from Dibblee, 1973, Graham et al. 1999, Hilton et al. 1963, and Dale et al. 1966)

The following Figure 4 is a generalized geologic cross-section of the southern San Joaquin Valley.

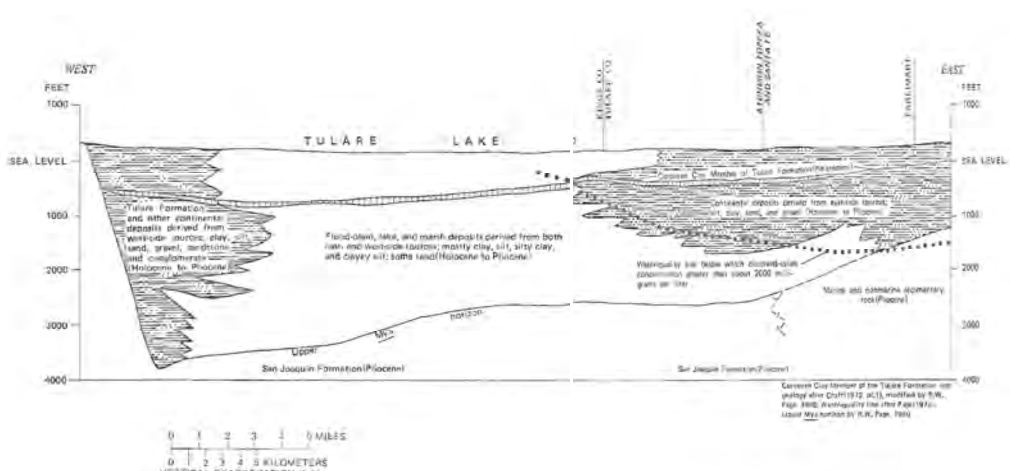


Figure 4 – Generalized Cross Section of The Tulare Formation, Southern San Joaquin Valley (Page, 1983)

REGIONAL STRUCTURAL GEOLOGY

The topography and geology of the southwestern San Joaquin Valley has been shaped by the regional tectonic environment and subsequent erosion. The dominant structure in the region is the San Andreas Fault. The regional stress field developed by slip along the irregular fault trace of the San Andreas has resulted in ancillary faulting within the Temblor Range paralleling the San Andreas. Furthermore, regional compressional forces along this margin have resulted in the uplift and formation of highly folded and faulted marine sediments in the Temblor Range and the development of a series of en-echelon anticlines and synclines east of the Temblor Range that either plunge to the southeast or are doubly-plunging toward the northwest and southeast.

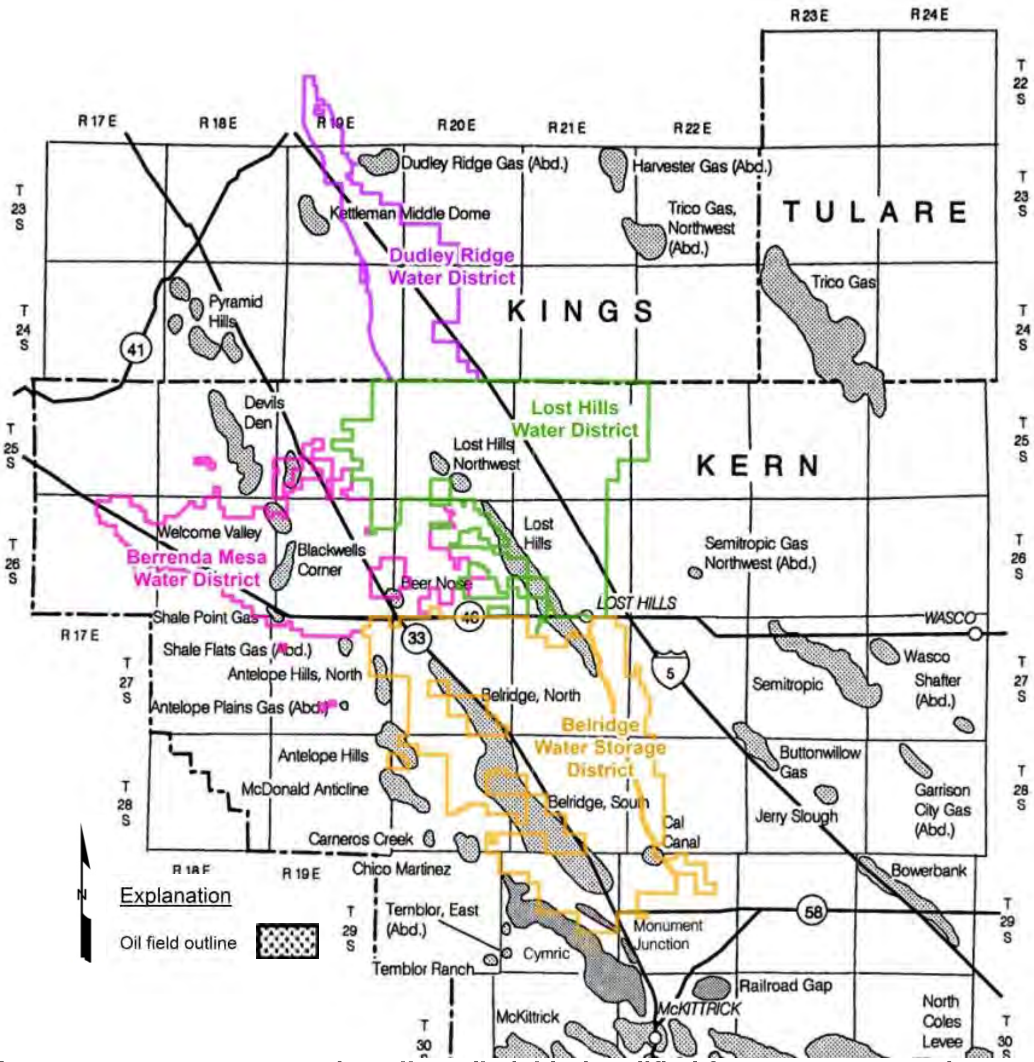
Several anticlines and synclines that have been exposed in the vicinity of the Districts include: (1) the Kettleman Hills anticline west of DRWD, northwest of LHWD, and northeast of BMWD; (2) Pyramid Hills anticline and syncline north of BMWD; (3) the Lost Hills anticline bisects portions of the southeastern portion of the LHWD and is east of BMWD and north of BWSD; (4) highly folded Monterey Shale of the Shale Hills lies adjacent to the western boundary of BMWD; (5) the North Antelope Hills anticline is situated west of the BWSD; (6) the North Belridge anticline is located within the BWSD; (7) the McDonald anticline is situated west of the BWSD; and (8) the northern extension of the Elk Hills anticline lies west of the southwestern portion of the BWSD (Dibblee, 1973; and Graham et al., 1999).

Post-Pliocene deposition of marine and terrestrial sediments occurred under the tectonic environment of the San Andreas Fault and associated developing anticline and synclines. Deposition associated with tectonic movement over time results in the incremental deformation of these sediments as the duration and magnitude of deformations progresses over time. This has implications on the occurrence and flow of groundwater in aquifers that have developed in the Tulare Formation, older alluvium, and alluvial sediments adjacent to the Temblor Range. These structures have also contributed to the localization of oil and gas resources in the region.

ECONOMIC GEOLOGY

Within the Tulare Lake Basin, mineral resources are mined to produce aggregates, precious metals, petroleum, and natural gas. For this summary, we are focusing on production of oil and gas within the Districts' areas.

Oil and gas recovery operations occur immediately adjacent to each of the Districts or historically within portions of the Districts. Designated oil fields include North Antelope Hills, Antelope Hills, McDonald Anticline, Carneros Creek, Chico Martinez, Cymric, Monument Junction, North Belridge and South Belridge Oil Fields east the BWSD; Deer Nose, Welcome Valley, Shale Point Gas, and Blackwells Corner Oil Fields adjacent BMWD; Lost Hills Oil Field between BMWD and LHWD and within portions of BWSD and LHWD; and Kettleman Middle Dome west of DRWD. Oil field operations extract various grades of petroleum, natural gas, and associated produced water (brine). The brine is re-injected into designated exempt aquifers for disposal or use in water or steam flood enhanced petroleum recovery operations in accordance with regulations of the DOGGR.



Figures 5 – West San Joaquin Valley Oil Fields (modified from DOGGR, 1998)

Formations that produce oil and gas generally do not produce usable groundwater as a drinking water source because of dissolved petroleum and salts in the water. For example, the reported TDS in brine produced in the North Belridge Oil Field ranges from 21,400 to 42,000 mg/L. Current production zones range from 1,000 to more than 15,000 feet in depth. However, some of the early oil and gas production was much shallower; the average depth of production from the shallow Tulare Formation wells in Lost Hills Oil Field and South Belridge Oil field were 200 and 400 feet in depth, respectively (DOGGR, 1998). The State Water Resources Control Board (SWRCB) authorized exempted aquifers for reinjection of brine water back into these oil producing zones (DOGGR, 1981). Until recently, the RWQCB regulated percolation pond discharges of produced oil/gas brine water in westside oil fields. These discharges have affected the quality of shallow groundwater below and downgradient within the Districts (RWQCB, 2006). The following example hydrogeologic section (Figure 6) for brine ponds in Belridge Oil Field is cited in RWQCB, 2006.

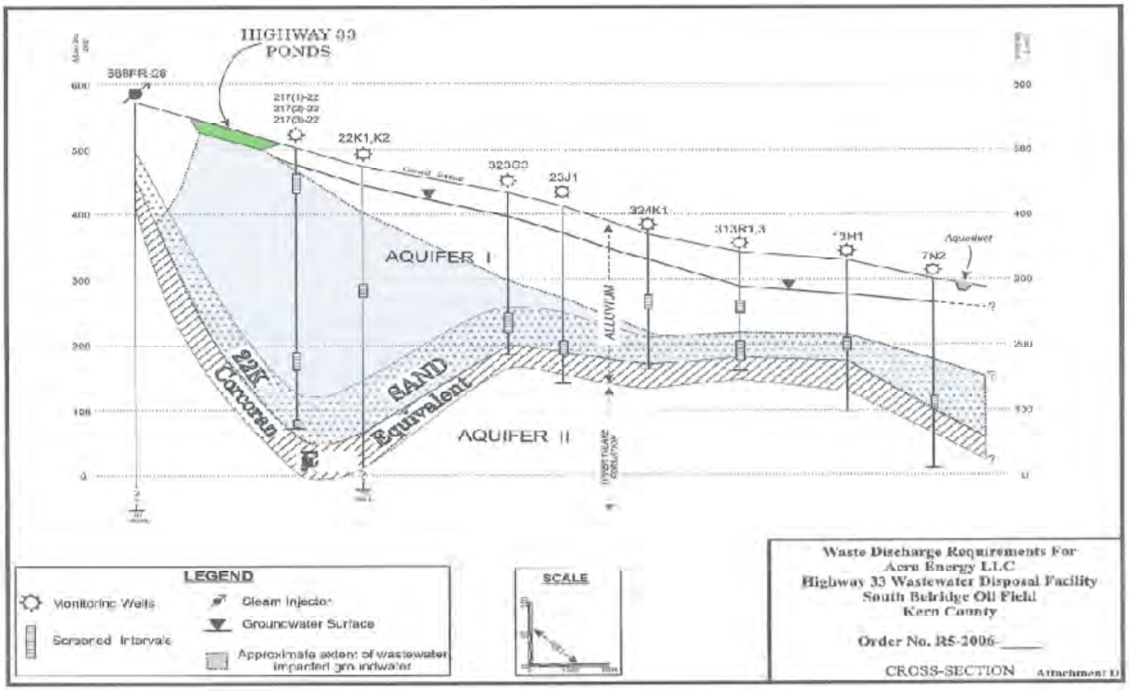


Figure 6 - West-East Geologic Cross-Section, South Belridge Oil Field (RWQCB, 2006)

This cross section shows that oil field brine ponds have affected groundwater downgradient within BWSD (between the Highway 33 ponds and the California Aqueduct). Only a few of the former oil field ponds have included such detailed groundwater monitoring. However, there is a potential that other historic or current oil field operations have resulted in similar downgradient groundwater effects within each of the Districts.

HYDROGEOLOGY

The Districts are all within Detailed Analysis Units (DAUs) designed by the Tulare Lake Basin Plan (RWQCB, 2005):

> BWSD, BMWD, and LHWD in DAU 259
> DRWD in DAU 246

The designated beneficial uses of groundwater in DAU 259 and DAU 246 are municipal supply (MUN), AGR, and IND (RWQCB, 2005). Groundwater in each of the Districts occurs as perched (unconfined), semi-confined, and confined groundwater.

AQUIFER SYSTEMS

Groundwater beneath the Districts occurs under perched, unconfined, and confined conditions. Areas of shallow perched groundwater within the Districts appear to correspond to the presence of a shallow clayey until (designated the A-clay) beneath the Districts. The perched aquifer consists of Pleistocene-Holocene fluvial and flood basin sediments comprised predominately of silts and clay interbedded with sand layers (Hilton et al., 1963; Croft, 1972). These sediments overlie the A-clay and grade laterally into younger alluvium to the west. The areal extent of perched aquifers appears centered on an axis along the Kern River Flood Channel between Goose Lake and Tulare Lake beds and lie east of the California Aqueduct (DWR, 2008). The lateral extents of the A-clay are poorly constrained. The A-clay reportedly has been encountered under LHWD at depths of 30 to 60 feet (PPEG, 2007).

Unconfined aquifers exist in alluvial sediments of Antelope Valley east of the Lost Hills Anticline and below the perched groundwater in the upper Tulare Formation. The unconfined aquifer consists predominately of coarser alluvial sediments flanking the Temblor Range that grade laterally eastward into finer grained fluvial, marsh, deltaic, and lucustrian deposits between Goose Lake and Tulare Lake. In areas where fluvial deposits become highly interbedded and bifurcated, semi-confined groundwater conditions may be encountered in the upper Tulare Formation. The base of the unconfined aquifer is defined by the presence of the E-clay where it is present. In areas where the E-clay is absent the unconfined aquifer extends to the top of the marine formations.

The modified E-clay described in Page (1986) forms the major regional aquitard that separates the upper unconfined aquifer from the lower confined aquifer in the southwestern San Joaquin Valley. In the Districts, it has been encountered in wells east of the California Aqueduct (Page, 1986). The E-clay is also known to underlie DRWD and portions of LHWD east of the Lost Hills Anticline, but appears absent west of this structure beneath the Antelope Plain (PPEG, 2007) and BMWD. The presence of the E-clay beneath BWSD west of the aqueduct is poorly constrained. The depth at which the E-clay is encountered varies due to the presence of anticline and syncline structures along the west side of the valley. It is encountered as shallow as 100 feet along the east limb of Lost Hills (PPEG, 2007) to as deep as 900 feet near the southwest edge of Tulare Lake bed (Page, 1986). The thickness of the E-clay ranges from 8 feet south of Lost Hills to 205 feet near the southwest edge of Tulare Lake bed (Page, 1986).

Groundwater below the E-clay is encountered in confined conditions. The Tulare Formation below the E-clay consists of unconsolidated interbedded sand, silt, and clay. The nature of these sediments ranges from coarser alluvial fan deposits near the Temblor Range to fine-grained lucustran, fluvial, and marsh deposits eastward toward the axis of the valley trough (Croft, 1972).

GROUNDWATER OCCURRENCE

The California Department of Water Resources (DWR) indicates that perched groundwater occurs below the Districts (DWR, 2011). Perched water in portions of the BWSD, LHWD, and DRWD ranges in depth from 5 to 20 feet (Figure 7). DWR does not identify perched groundwater in the BMWD, although it may be present in some areas.

The DWR does not characterize the occurrence of semi-confined or confined groundwater within the Districts due to lack of current data. However, the Kern County Water Agency (KCWA) indicates the depth to groundwater in the Districts (except BMWD and DRWD) in 2001 was between 50 and 100 feet with a general gradient to the east.

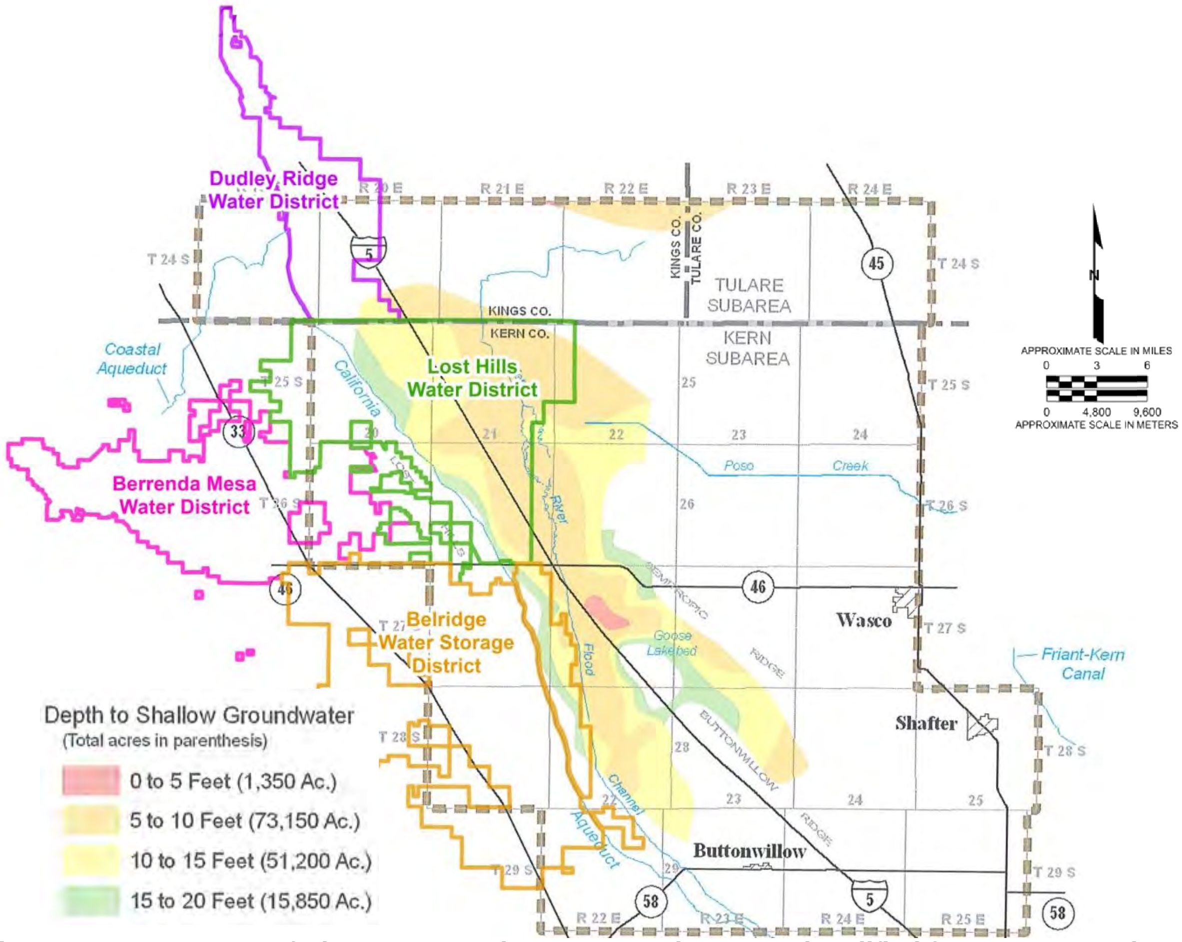


Figure 7 – 2008, Areas of Shallow Groundwater, Lost Hills Areas (modified from DWR, 2008)

GROUNDWATER QUALITY

AMEC reviewed groundwater quality data from several sources. These included the RWQCB, DWR, KCWA, United States Geological Survey (USGS), and private sector consultants and non-governmental coalitions. These materials are discussed in the following subsections.

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD

The designated beneficial uses of groundwater in DAU 259 and DAU 246 are MUN, AGR, and IND (Basin Plan; RWQCB, 2005). The Basin Plan indicates that "Ground waters shall not contain chemical constituents in concentrations that adversely affect beneficial uses." For salinity, the Basin Plan indicates that "All ground waters shall be maintained as close to natural concentrations of dissolved solids as is reasonable…the water quality objectives for groundwater salinity control the rate of increase." For the Westside Hydrographic Unit (includes DAU 259 and DAU 246), the groundwater quality objective is an annual increase in electrical conductance (EC) of 1 micromho per centimeter (µmhos/cm).

For MUN, the Basin Plan specifies that "water designated MUN shall not contain concentrations of chemical constituents in excess of maximum contaminant levels (MCLs, Section 64431 through 64449, Title 22, California Code of Regulations)." For purposes of this evaluation, we compared groundwater below the Districts to the MCLs (Table 1).

Table 1
Maximum Contaminant Levels for Municipal Water Supply

Constituent	Primary/Secondary	Maximum Contaminant Level
Electrical Conductance	Secondary MCL	900 umhos/cm – Recommended 1,600 umhos/cm – Upper 2,200 umhos/cm – Short-Term
Total Dissolved Solids	Secondary MCL	500 mg/L – Recommended 1,000 mg/L – Upper 1,500 mg/L – Short-Term
Arsenic	Primary MCL	10 µg/L

Upper Maximum Contaminant Level (MCL) is acceptable if it is neither reasonable nor feasible to provide Recommended MCL water. Short -Term MCL is only acceptable on a temporary basis pending development of Recommended MCL water. µmhos/cm = micromho per centimeter, mg/L = milligrams per liter, and µg/L = micrograms per liter.

We assume that groundwater that exceeds an EC of 2,200 µmhos/cm, a TDS concentration of 1,500 mg/L, or an arsenic concentration of 10 micrograms per liter (µg/L) is not currently suitable as a source for MUN and would not be suitable for MUN in the future without expensive treatment to remove salts and/or arsenic.

The Basin Plan does not specify constituent concentrations for protection of AGR. For purposes of this evaluation, we compared groundwater below the Districts to the water quality guidelines published in *Water Quality for Agriculture* (Table 2, NATO, 1994).

Table 2
Water Quality Criteria for Agricultural Water Supply

Constituent	Irrigation Problem	Restriction on Use
Electrical Conductance	Salinity	<700 umhos/cm – None >3,000 umhos/cm – Severe
Total Dissolved Solids	Salinity	<450 mg/L – None >2,000 mg/L – Severe
Boron	Crop Sensitivity	<0.7 mg/L – None >3 mg/L – Severe
Sodium Adsorption Ratio	Infiltration	(severity varies with EC)

Based on Table 2, we will assume that groundwater exceeding an EC of 3,000 µmhos/cm, a TDS concentration of 2,000 mg/L or a boron concentration of 3 mg/L is not currently suitable for use as AGR and would not be suitable in the future without substantial dilution with fresh water. Sodium adsorption ratio (SAR) is used in conjunction with EC to evaluate irrigation water for infiltration problems; elevated salinity offsets the adverse soil infiltration effects of elevated SAR. SAR values as high as 40 are not typically a severe problem, unless EC is less than 2,900 µmhos/cm. Groundwater below the Districts has ECs ranging from 639 to 68,300 µmhos/cm and SAR should not result in an infiltration problem, except for the lower EC ground waters (less than 2,900 µmhos/cm).

The Basin Plan does not specify constituent concentrations for protection for IND, but indicates that "Uses of water for industrial activities do not depend primarily on water quality…"
For purposes of this evaluation, we assume that water quality criteria for MUN and/or AGR should normally be appropriate for IND.

CALIFORNIA DEPARTMENT OF WATER RESOURCES

Perched groundwater quality is characterized by the DWR using EC in µmhos/cm. In the BWSD, LHWD, and DRWD, the perched water EC ranges from 2,000 to greater than 20,000 µmhos/cm (Figure 8). Compared to the Secondary Drinking Water Standard for EC (900 µmhos/cm Recommended and 2,200 µmhos/cm for Short-term Use, Section 64449, Title 22, California Code of Regulations), the quality of perched groundwater is not suitable as a drinking water source. (Generally, TDS in mg/L is approximately 0.7 of EC in µmhos/cm.)

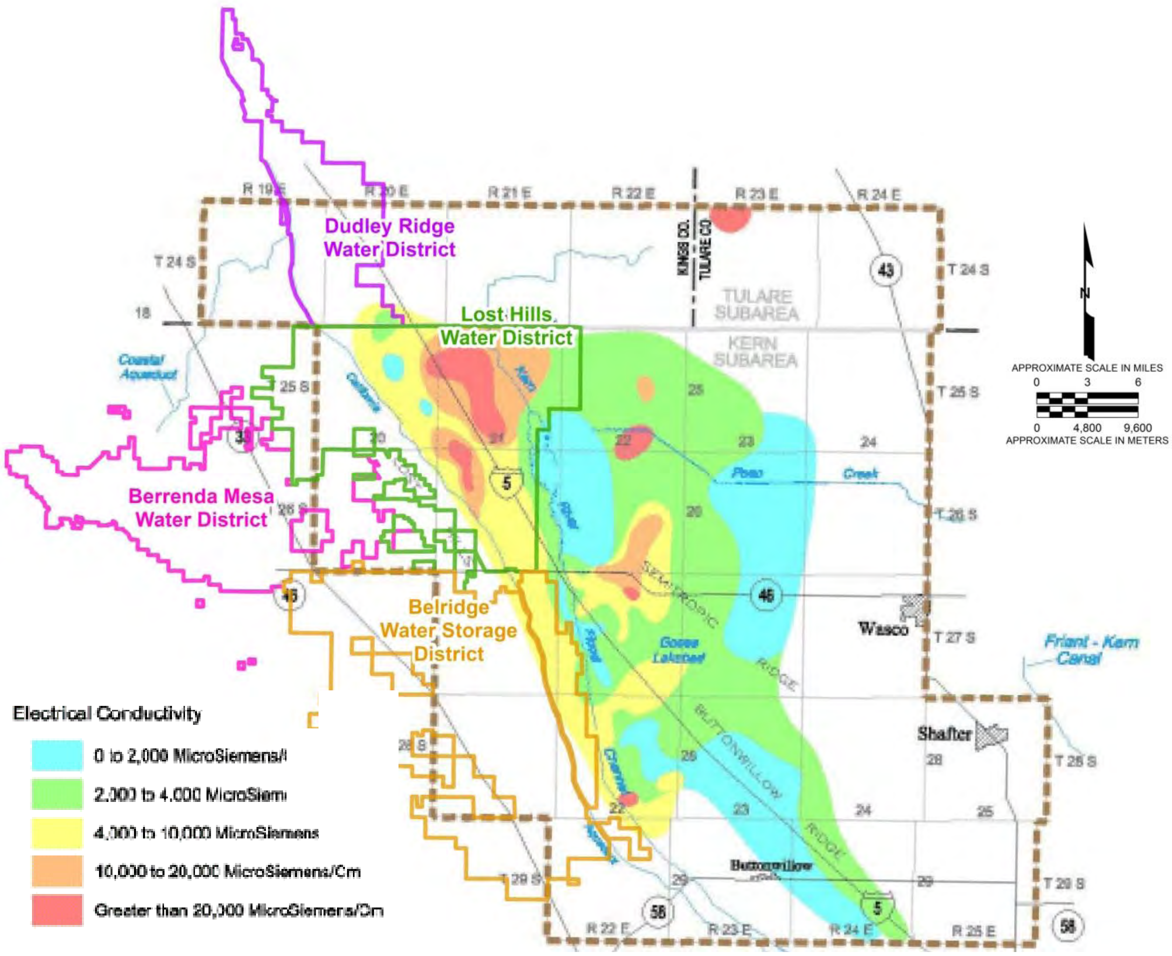


Figure 8 – 2001, Electrical Conductivity in Shallow Groundwater, Lost Hills Area (modified from DWR, 2001)

In 1993, the DWR published the results of a 1991 study of shallow groundwater in the vicinity of eastern part BWSD (DWR, 1993). Initially, DWR installed 88 shallow piezometers (20 feet deep) and 15 deeper piezometers (up to 55 feet deep) in the eastern part of BWSD and the nearby Buena Vista Water Storage District (BVWSD). In 1992, the DWR collected depth-to-water measurements and groundwater samples from the 55 piezometers. DWR found that the depth to shallow water below BWSD ranged from 5 to 10 feet on the eastern edge of BWSD to about 20 feet below the California Aqueduct. DWR indicated that groundwater generally flowed from west to east and groundwater EC varied from about 3,000 µmhos/cm along the eastern edge of BWSD to more than 18,000 µmhos/cm under the California Aqueduct (Figure 9).

Figure 9 – Electrical Conductivity in Groundwater Below BWSD and BVWSD (modified from DWR, 1993)

DWR also arranged for analysis of 55 groundwater samples for selected inorganic chemical constituents including EC, TDS, and arsenic. Concentration ranges for samples collected below BWSD are summarized in Table 3.

Table 3
Range of Shallow Groundwater Quality, BWSD, 1992

Location	EC (µmhos/cm)	TDS (mg/L)	Arsenic (µg/L)
DWR Piezometers	639 – 68,300	365 – 61,500	0 – 336
Upper MUN	*2,200*	*1,500*	*10*
Upper AGR	*3,000*	*2,000*	--

These data show that groundwater below BWSD varies dramatically in areal distribution of mineral concentrations. Although isolated areas below the eastern part of BWSD may provide fair mineral quality shallow groundwater, much of the shallow groundwater below BWSD exceeded Secondary MCLs for EC (900 to 2,200 µmhos/cm) and TDS (500 to 1,500 mg/L) and the Primary MCL for arsenic (10 µg/L). Based on these data, shallow groundwater below much of BWSD is not suitable as a reliable source of MUN, without expensive treatment to remove salts and arsenic. These data also show that much of the shallow groundwater below BWSD exceeded recommended agricultural water quality criteria for EC (3,000 µmhos/cm) and TDS (2,000 mg/L). Based on these data, groundwater below most of BWSD is not suitable as a reliable source for AGR, without substantial dilution with fresh water.

KERN COUNTY WATER AGENCY

The KCWA characterized the quality of unconfined groundwater in the general area of the BWSD and LHWD using TDS (in mg/L) from historic data (Figure 10) (KCWA, 2005). Unconfined groundwater below the BWSD and LHWD ranged from 1,500 to greater than 5,000 mg/L TDS. Compared to the Secondary Drinking Water Standard for TDS (500 mg/L Recommended and 1,500 mg/L for Short-Term Use, Section 64449, Title 22, California Code of Regulations), the perched groundwater of these concentrations is not suitable as a drinking water source without expensive treatment to remove salts.

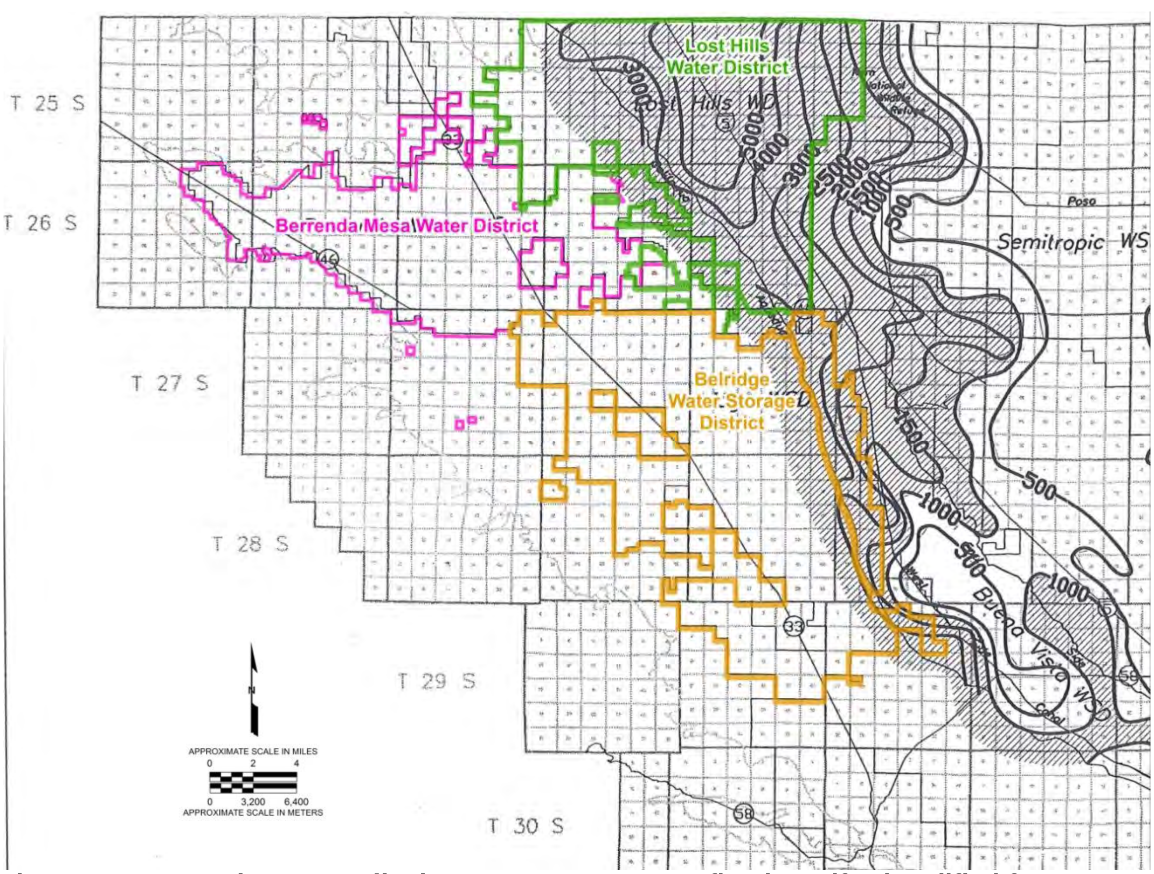


Figure 10 – Groundwater Quality in Kern County, Unconfined Aquifer (modified from KCWA, 2005)

The KCWA also characterized the quality of confined groundwater in the BWSD and LHWD using TDS in mg/L from historic data (Figure 11). Confined groundwater below the BWSD and LHWD ranged from 500 to greater than 4,000 mg/L TDS. Compared to the Secondary Drinking Water Standard for TDS (500 mg/L Recommended to 1,500 mg/L for Short-Term Use, Section 64449, Title 22, California Code of Regulations), the quality of confined groundwater is unlikely suitable as a drinking water source.

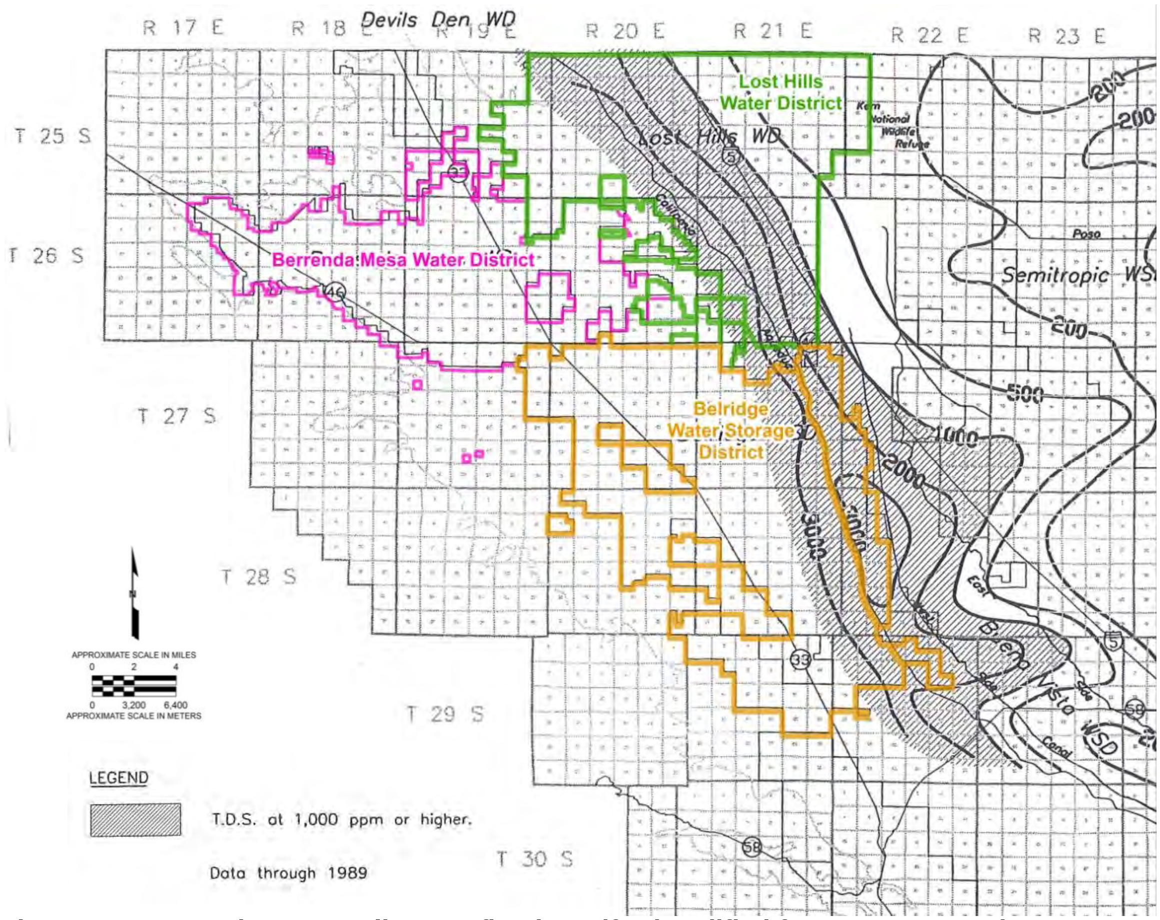


Figure 11 – Groundwater Quality, Confined Aquifer (modified from KCWA, 2005)

UNITED STATES GEOLOGICAL SURVEY

In 1989, the USGS conducted a study of groundwater quality within the Tulare Lake Basin (USGS, 1992). The study involved collection of water samples from 117 shallow wells and analysis of the samples for minerals and metals. The study report summarized TDS concentrations in shallow groundwater as shown on Figure 12.

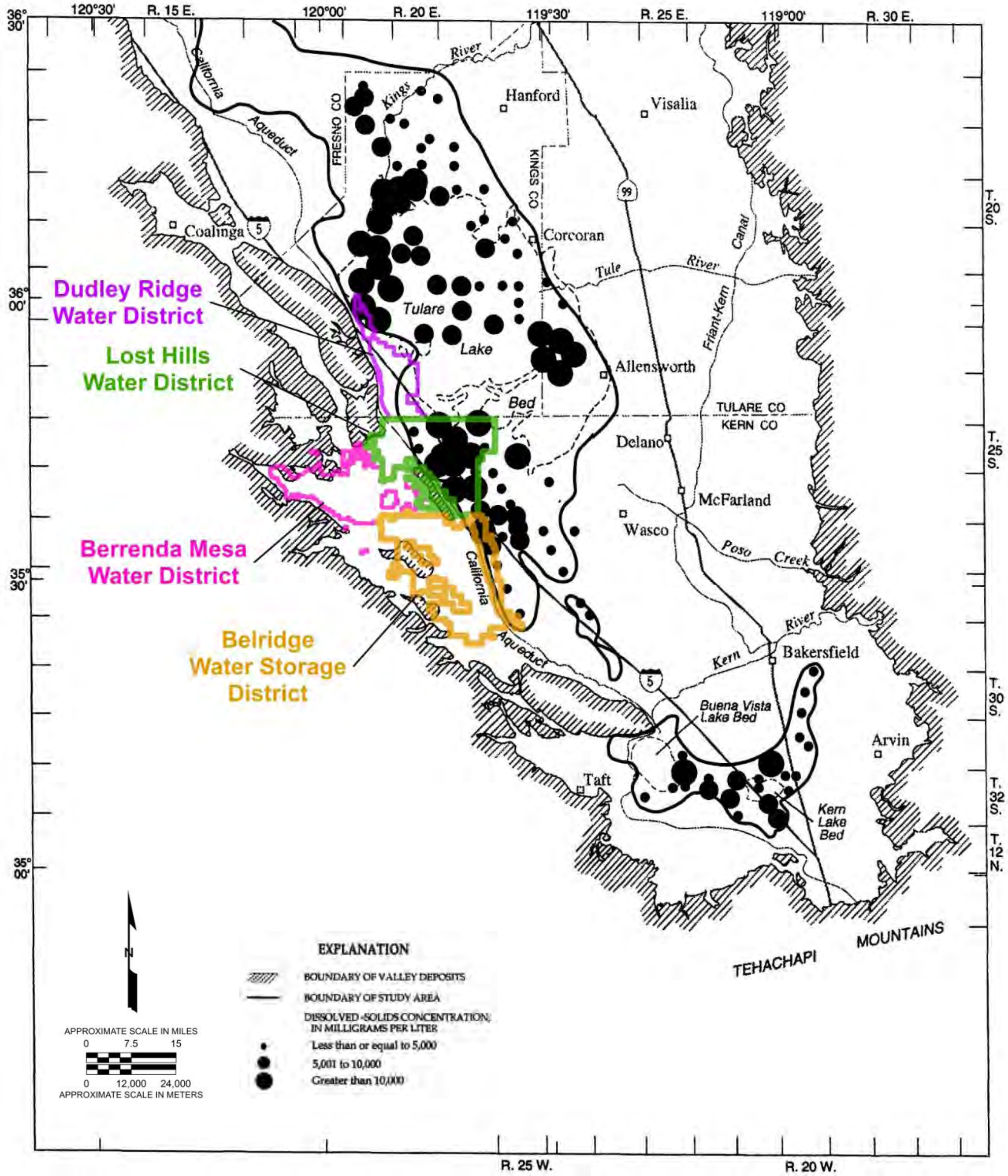


Figure 12 – Distribution of TDS in Shallow Groundwater (modified from USGS, 1992)

Figure 12 shows that TDS in groundwater within the BWSD, DRWD, and LHWD varies dramatically from less than 5,000 mg/L to greater than 10,000 mg/L. When compared to the secondary MCL of 500 to 1,500 mg/L, shallow groundwater within the BWSD, LHWD, and DRWD is not suitable for MUN, without expensive treatment for removal of salts. This report also identified reported arsenic concentrations in shallow groundwater that exceeded the corresponding MCL within the BWSD, DRWD, and LHWD.

In an earlier study of groundwater in the area (USGS, 1959), wells in BMWD and DRWD were sampled by USGS for analysis of salts. Between 1953 and 1955, the USGS sampled wells within BMWD (Township 26 and Ranges 16, 17, and 8) for general mineral analyses and generated the map summary shown on Figure 13.

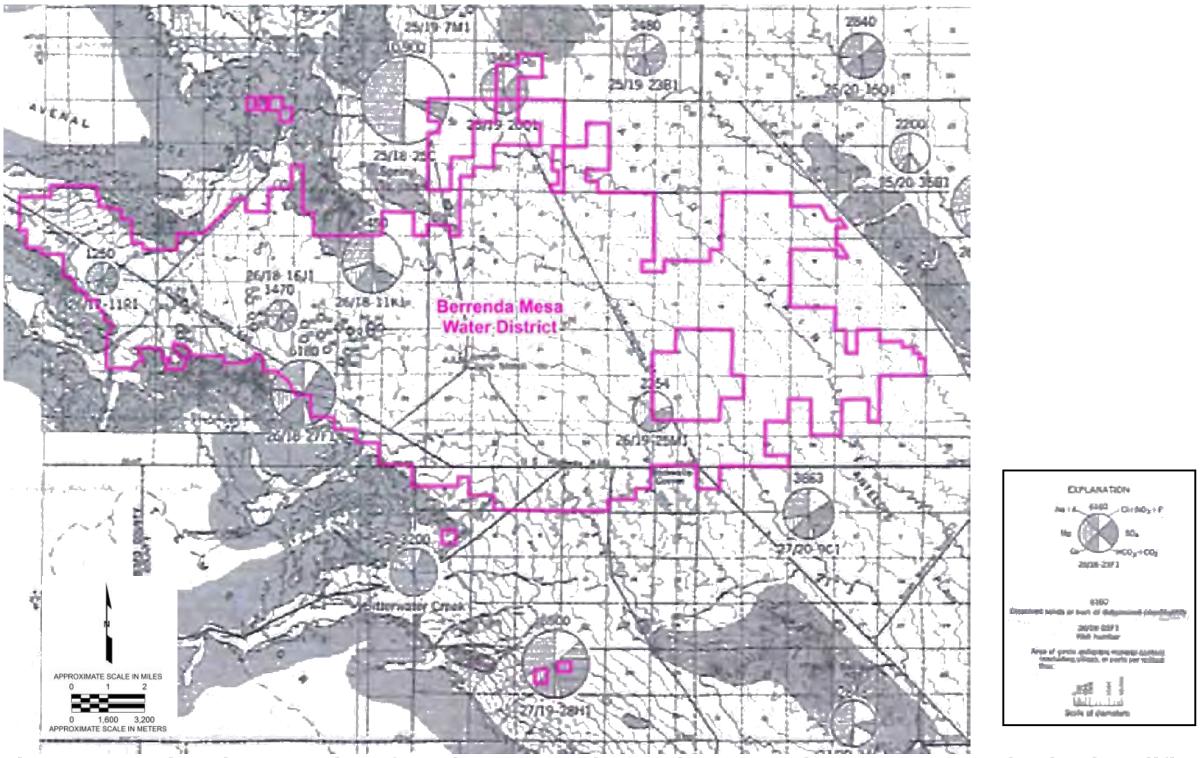


Figure 13 – Chemical Quality of Typical Groundwater in Berrenda Mesa Water District (modified from USGS, 1959)

The TDS of groundwater in BMWD ranged from 1,250 to 6,180 mg/L compared to the MCL of 500 to 1,500 mg/L, which indicates that the groundwater was not suitable for MUN, without expensive treatment to remove salts. TDS and boron (ranging from 0.3 to 11 mg/L) typically exceeded the recommended water quality criteria for agriculture (NATO, 1985) for TDS (2,000 mg/L) and boron (3 mg/L), which indicates that groundwater in this area was not suitable for AGR without substantial blending with SWP water.

Between 1953 and 1955, the USGS sampled wells in Township 22, Range 19 near Kettleman City and in Township 24, Range 19 in the southwest part of DRWD for general mineral analyses and generated the summary shown on Figure 14.

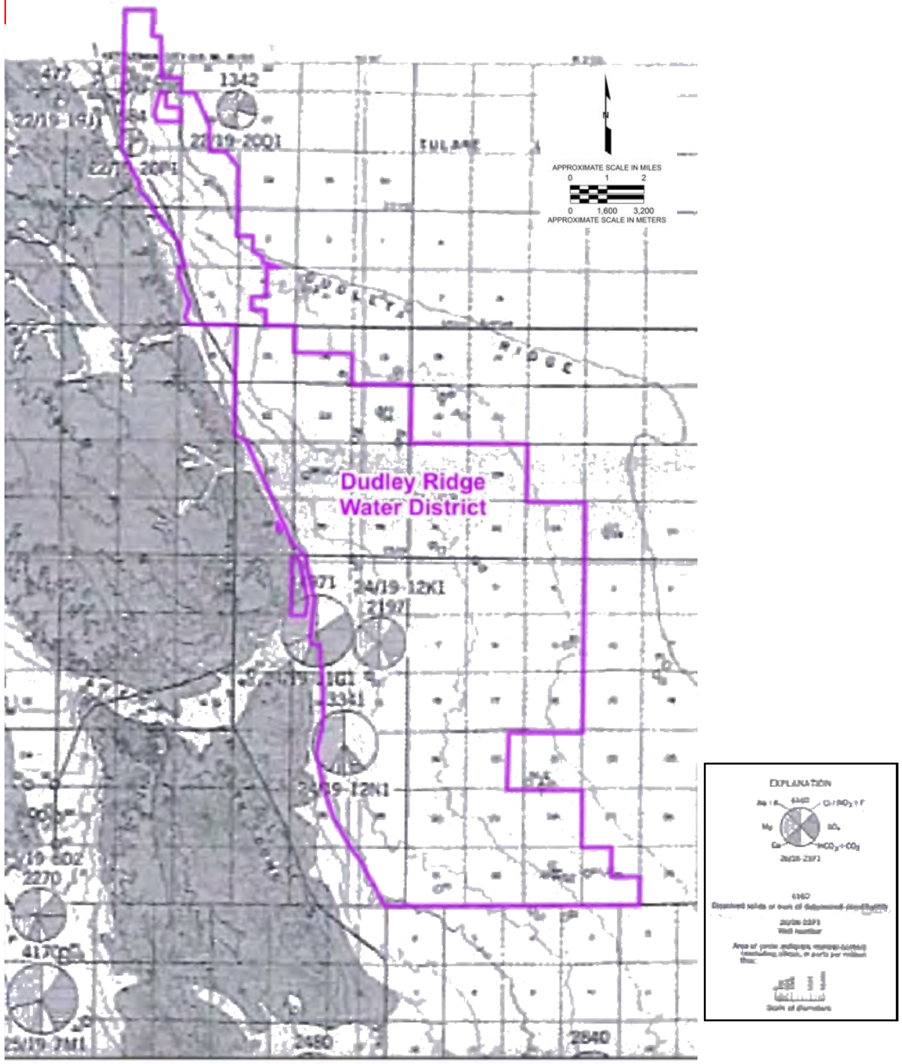


Figure 14 – Chemical Quality of Typical Groundwater for Dudley Ridge Water District (modified from USGS, 1959)

The TDS of groundwater in DRWD near Kettleman City ranged from 584 to 1,342 mg/L compared to the MCL of 500 to 1,500 mg/L, which indicates that the groundwater is marginally suitable for MUN. However, TDS in southwest DRWD ranged from 2,197 to 4,971 mg/L, which indicates that the groundwater was not suitable for MUN, without expensive treatment to remove salts. TDS and boron in southwest DRWD (ranging from 0.9 to 4.9 mg/L) typically exceeded the recommended water quality criteria agriculture (NATO, 1985) for TDS (2,000 mg/L) and boron (3 mg/L), which indicates that groundwater in this area was not suitable for AGR without substantial blending with SWP water.

In 1990, the USGS conducted some groundwater assessment work in the Tulare Lake Basin at the Refuge near LHWD. The assessment work involved installation of cluster wells at one location to assess the vertical differences in water quality, particularly for dissolved metals. The cluster consisted of wells completed to approximately 20, 50, 100, and 200 feet below ground surface and the wells were sampled in August 1990. Water samples from the well cluster near LHWD (designated 1N) were collected at 15, 57, 95, and 194 feet below ground surface, respectively. Table 4 summarizes the results for constituents the USGS analyzed from samples collected at well cluster 1N.

Table 4
Groundwater Quality with Depth N1 Well Cluster, Northeastern LHWD

Well	**EC (µmhos/cm)**	**TDS (mg/L)**	**Arsenic (µg/L)**	**Boron (mg/L)**	**SAR (unitless)**
1N-15’	1,750	1,270	6	0.87	6
1N-57’	12,000	9,280	16	9.4	29
1N-95’	6,250	4,260	10	2.1	13
1N-194’	4,540	2,620	8	1.3	10
Upper MUN	*2,200*	*1,500*	*10*	--	--
Upper AGR	*3,000*	*2,000*	--	*3*	*(varies w/EC)*

SAR calculated based on concentrations of bicarbonate, calcium, magnesium, and sodium.

The above data show that groundwater in the vicinity of the Refuge (northeastern LHWD) varies in quality with depth. The better quality shallow groundwater at 15 feet below ground surface is likely associated with imported SWP water used to maintain the wetlands that subsequently recharged from the wetlands to the shallow aquifer within the Refuge. These data show that groundwater below 20 feet in depth exceeded Secondary MCLs for EC (900 to 2,200 µmhos/cm) and TDS (500 to 1,500 mg/L) and the Primary MCL for arsenic (10 µg/L). Groundwater in this area is not suitable as a source of MUN without expensive treatment to remove salts and arsenic. These data also show that groundwater below 20 feet in depth exceeded recommended water quality criteria for agriculture (NATO, 1995) for EC (3,000 µmhos/cm), TDS (2,000 mg/L) and boron (3 mg/L). However, SAR would not appear to represent an infiltration problem because the average EC is greater than 2,900 µmhos. Groundwater in this area is not suitable for AGR without substantial dilution with SWP water. Blending groundwater with higher quality irrigation water would need to account for the effects of the elevated SAR in groundwater.

OTHER GROUNDWATER STUDIES

In 1976, Bookman-Edmonston Engineering, Inc. (BEE), evaluated groundwater conditions in BMWD (BEE, 1976). BMWD asked BEE to evaluate the feasibility of blending poor quality groundwater from the district with SWP water to provide an additional source of irrigation water supply. BEE reviewed the readily available groundwater information and found:

> “Mineral analyses of ground water are available for two wells, both of which are reported to be about 360 feet deep. Well 26/19-12L1 produced sodium sulfate water with a TDS concentration of 3,660 mg/L, a boron content of 2.7 mg/L and a chloride ion concentration of 629 mg/L. Water from well 26/19-25M1 was also sodium sulfate in character and contained 2,354 mg/L of TDS, 1.2 mg/L of boron and 505 mg/L of chloride. The total dissolved solids content is estimated to be about 3,000 milligrams per liter, which renders the water marginal to unsuitable for irrigation of most crops.”

Based on this information, BEE recommended installation and testing of a prototype groundwater extraction well (26/19-29A), which was completed in 1977 (BEE, 1977). BEE installed a 14-inch diameter well with perforations between 650 and 1,160 feet in depth. BEE pump tested the well and found:

> "…on the basis of observed data, the well is capable of producing at a short-term rate of not more than 450 gallons per minute. It is probable that prolonged pumping will cause a lowering of the water level and a coincident decline in yield."

A water sample from well 26/19-29A was collected by BEE in May 1977 and analyzed for inorganic constituents (see Table 5).

Table 5
Groundwater Quality, BMWD

Well	EC (µmhos/cm)	TDS (mg/L)	Boron (mg/L)	SAR (unitless)
26/19-29A-650/1160'	4,000	2,583	1.8	16.7
Upper MUN	*2,200*	*1,500*	--	--
Upper AGR	*3,000*	*2,000*	*3*	*(varies w/EC)*

SAR calculated based on concentrations of bicarbonate, calcium, magnesium and sodium.

These data show that groundwater in BMWD exceeded Secondary MCLs for EC (900 to 2,200 µmhos/cm) and TDS (500 to 1,500 mg/L). Groundwater in this area is not suitable as a source of MUN without expensive treatment to remove salts. These data also show that groundwater in BMWD exceeded recommended agricultural water quality criteria for EC (3,000 µmhos/cm) and TDS (2,000 mg/L). However, SAR would not appear to represent an infiltration problem because the average EC is greater than 2,900 µmhos/cm. Groundwater in this area is not suitable for AGR without substantial blending with fresh water and may not be hydraulically sustainable. Blending groundwater with higher quality irrigation water would need to account for the effects of the elevated SAR in groundwater.

In 2006, AMEC conducted a vertical characterization of groundwater quality at the proposed Westlake Farms Proposed Biosolids Composting Project, which is immediately adjacent the eastern part of DRWD near Utica Avenue. Water samples were collected from ten groundwater monitoring wells. Two of the wells are representative of groundwater quality from 11 to 26 feet (MW1) and from 80 to 100 feet (MW101). Data from these two wells are summarized in Table 6.

Table 6
Groundwater Quality with Depth, East of DRWD

Well	EC (µmhos/cm)	TDS (mg/L)	Arsenic (µg/L)	Boron (mg/L)	SAR (unitless)
MW1-11/26'	23,000	20,000	54	8.5	28
MW101-80/100'	16,000	16,000	38	7.4	22
Upper MUN	*2,200*	*1,500*	*10*	--	--
Upper AGR	*3,000*	*2,000*	--	*3*	*(varies w/EC)*

SAR calculated based on concentrations of bicarbonate, calcium, magnesium and sodium.

Similar to the data summarized above, groundwater adjacent the eastern part of DRWD exceeded Secondary MCLs for EC (900 to 2,200 µmhos/cm) and TDS (500 to 1,500 mg/L) and the Primary MCL for arsenic (10 µg/L). Groundwater in this area is not suitable as a source of MUN without expensive treatment to remove salts and arsenic. These data also show that groundwater adjacent the eastern part of DRWD exceeded recommended agricultural water quality criteria for EC (3,000 µmhos/cm), TDS (2,000 mg/L) and boron (3 mg/L). However, SAR would not appear to represent an infiltration problem because the EC is greater than 2,900 µmhos/cm. Groundwater in this area is not suitable for AGR without substantial blending with fresh water. Blending groundwater with higher quality irrigation water would need to account for the effects of the elevated SAR in groundwater.

MUNICIPAL WATER SUPPLY

In 2012, the SWRCB conducted a study of communities that rely on contaminated groundwater (SWRCB, 2012b). Only two community water systems with groundwater supply were identified in the immediate vicinity of the Districts; LHUD and Kettleman City Community Services District (Figure 17).

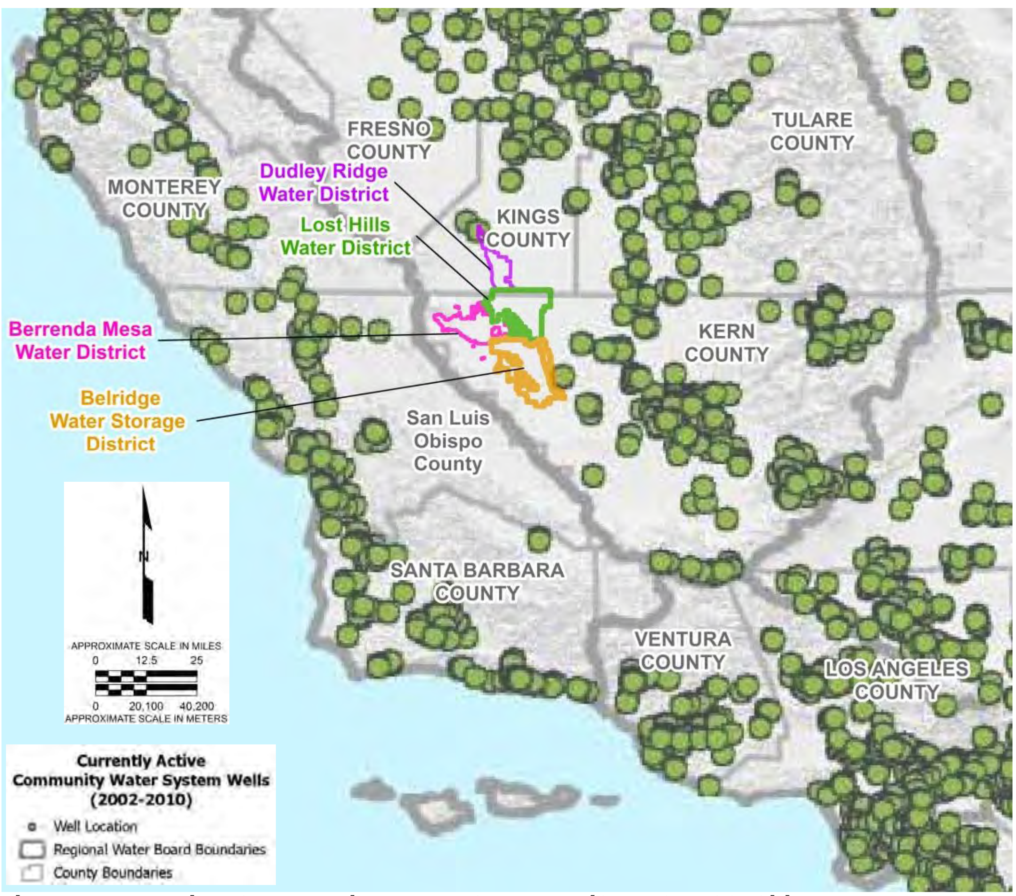


Figure 17 – Active Community Water Systems (SWRCB, 2012b)

Both communities are immediately adjacent to the Districts and listed as having contaminated wells. Lost Hills is situated between BWSD and LHWD, and Kettleman City is located just north of DRWD (Figure 18). LHUD water system was listed for elevated arsenic concentrations ranging from 12 to 51 µg/L. Kettleman City water system was listed for arsenic concentrations ranging from 12 to 160 µg/L. The well water from both communities exceeds the primary MCL of 10 µg/L of arsenic. The community of Lost Hills imports groundwater from wells 13 miles east of any of the Districts. The Kettleman City Community Services District (KCCSD) currently uses water from two local wells that are just north of DRWD. In either case, the arsenic is likely a naturally occurring condition, unrelated to agricultural irrigation. KCCSD is currently working with the California Department of Public Health to develop a treated municipal water supply from the California Aqueduct to replace groundwater (CDPH, 2012).

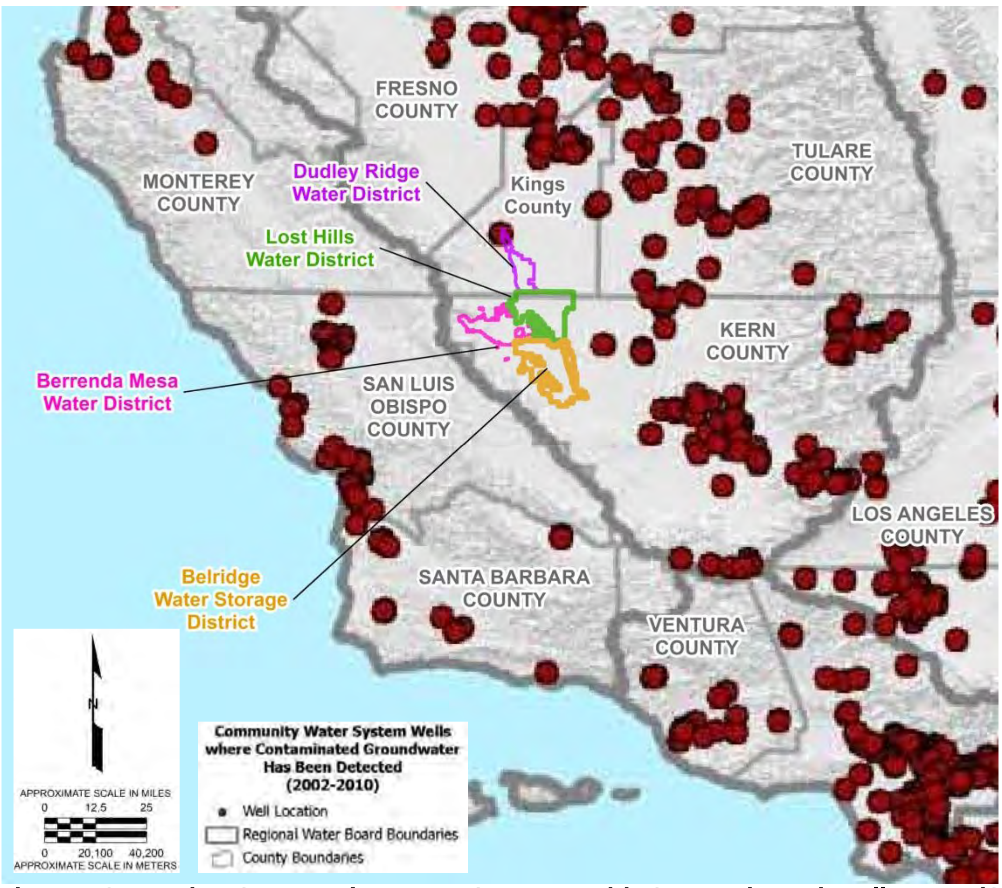


Figure 18 – Active Community Water Systems with Contaminated Well Water (SWRCB, 2012b)

AGRICULTURAL WATER SUPPLY

As described previously, the principle irrigation water supply for the Districts is the SWP from deliveries from the California Aqueduct. Alternative water supplies include groundwater banked in storage near Bakersfield and purchase of water on the open market. Groundwater is not typically used for irrigation within the Districts due to the presence of elevated salts and boron concentrations. According to the Districts, groundwater has occasionally been diluted with SWP water for irrigation, but this has apparently occurred rarely.

Crop types irrigated within the Districts have changed dramatically over the past two decades. More permanent crops have been developed in conjunction with more efficient irrigation systems. For example, LHWD indicates that cotton and other row crops (sprinkler irrigation) that were predominate in 1990 (64 percent of irrigated acreage within LHWD) have been almost completely replaced with orchards and vines (drip or fan jet irrigation) as of 2012 (99 percent of acreage in LHWD).

According to Encyclopedia of Water Science, sprinkler irrigation varies from 60 to 85 percent efficient, while drip and fan jet systems typically average 85 percent irrigation efficiency (Howell, 2003). Based on the dramatic change in cropping pattern in LHWD, development of more efficient irrigation systems, and implementation of irrigation management practices by farmers in LHWD, very little irrigation water would be expected to percolate below the root zone of crops. Irrigation efficiency and management practices have contributed to a decline in the amount of water collected in LHWD tile drains. In 1990, LHWD tile drains produced 3,088 acre feet of water that was discharged to the LHWD evaporation disposal basins (PPEG, 2012). The water volume generated from the LHWD tile drains in 2011 was only 94 acre-feet. This dramatic decline of almost 3,000 acre-feet in the volume of tile drainage is a result, at least in part, of the change to permanent crops, more efficient irrigation systems, and irrigation management practices within the district.

Similar changes to permanent crops and efficient irrigation systems have occurred in BWSD, BMWD, and DRWD. While the changes may not be as dramatic as in LHWD, the permanent crops and efficient drip/fanjet irrigation systems have also been implemented in the other Districts, to some degree. In addition, 20 percent of the formerly irrigated acreage in BMWD has returned to dry land farming, which uses no irrigation water. In the other Districts, we would expect to see a similar decline in irrigation water percolating below crop root zones, commensurate with the implementation of efficient irrigation systems, management practices, and the return to dry land farming.

PROCESS WATER SUPPLY

Industrial facilities within the Districts that require potable water (food processing plants) treat water from the California Aqueduct (RWQCB, 1996 and 1999). Groundwater within the oil fields is used for water and steam flood enhanced recovery operations and is treated, if necessary, to achieve the required water quality. Groundwater is also used for non-potable purposes at biosolids composting facilities. No other PRO uses are known within the Districts.

SUMMARY

Groundwater within the Districts is generally of poor mineral quality (generally greater than 2,000 mg/L TDS) and contains other mineral constituents (arsenic) that have prevented its use for drinking water. The quality of groundwater varies dramatically in its horizontal and vertical distribution. As such, groundwater within the Districts, except in the far northern part of DRWD (Kettleman City), is not used for municipal water supply. Imported water is used for drinking water within most of the Districts' area due to the poor mineral quality of groundwater encountered beneath them.

The poor mineral quality of groundwater (EC, TDS, and boron) has also prevented its use for agricultural irrigation. Based on the poor quality of groundwater within the Districts, they are provided irrigation water from the SWP from the California Aqueduct. According to the Districts, farmers have occasionally blended groundwater with imported SWP water to make up irrigation water. However, significant dilution is required to meet irrigation water quality objectives, rendering this practice uneconomical.

In the RWQCB's Tulare Lake Basin Plan, groundwater within the Districts is designated as having the beneficial use of MUN, in part based on the SWRCB's *Sources of Drinking Water Policy* (SWRCB, 1988). Based on the above information, groundwater within the Districts:

- range from 1,000 mg/L TDS to more than 10,000 mg/L TDS and, as such, is not used for MUN and is not anticipated to be used for MUN, except in northern end of DRWD (Kettleman City);
- is administratively exempted from MUN for the purpose of underground injection of fluids into exempted aquifers associated with the production of oil and gas in some areas of each District; and
- contains naturally occurring salts and petroleum and, in some areas, is impacted by oil field operations, such that it cannot be reasonably treated for MUN.

Based on the above, the protection of MUN uses within the Districts would not appear warranted, based on the exemptions of the Sources of Drinking Water Policy (RWQCB, 2004). The burden to farmers within the Districts, including costs, of protection for MUN would not appear to bear a reasonable relationship to the benefit to the groundwater resource that might be obtained from the proposed ILRP program. The Districts have asked AMEC to convey their request for the RWQCB to exempt farmers within the Districts from groundwater regulation under the ILRP.

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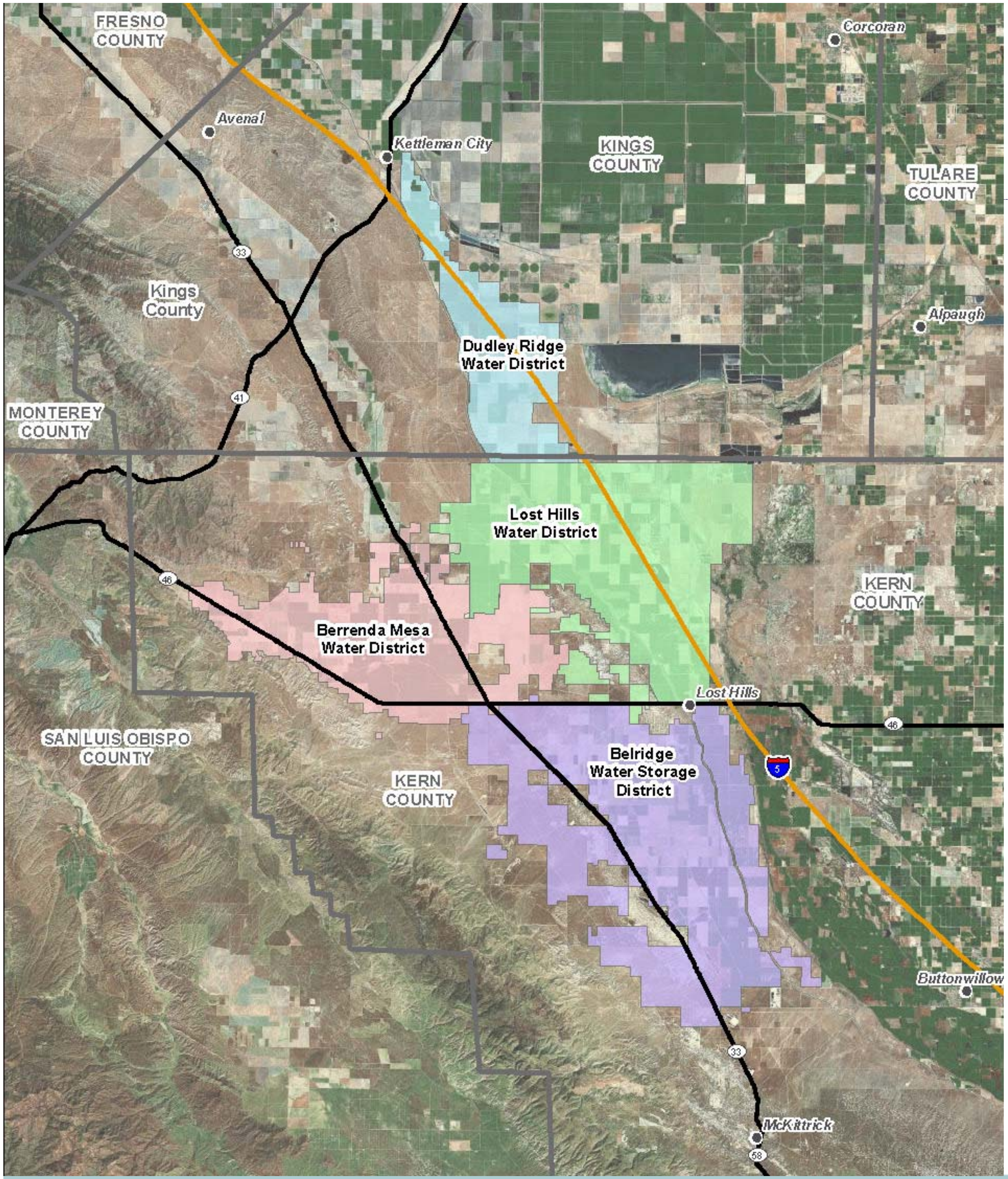
Westside Water Districts Preliminary Water Quality Report

Timothy G. Souther and Gary L. Kramer
AMEC Environment & Infrastructure, Inc.



Belridge Water Storage District

Berrenda Mesa Water District

Dudley Ridge Water District

Lost Hills Water District

Groundwater Quality
(USGS, 1959)

District	**TDS**	**Boron**
Criterion	**(mg/L)**	**(mg/L)**
Belridge Water Storage District	2,848 to 6,500	0.4 to 9.5
Berrenda Mesa Water District	1,250 to 6,800	0.3 to 11.0
Dudley Ridge Water District	584 to 4,971	0.9 to 4.9
Lost Hills Water District	2,200 to 6,660	3.4 to 10.0
MUN (SMCL)	*500 to 1,500*	---
AGR (WQA)	*450 to 2,000*	*0.7 to 3.0*

SMCL = Secondary Maximum Contaminant Level (64449, Title 22, CCR) .

<500 mg/L TDS is Recommended

<1,500 mg/L TDS is Short-Term Use Only

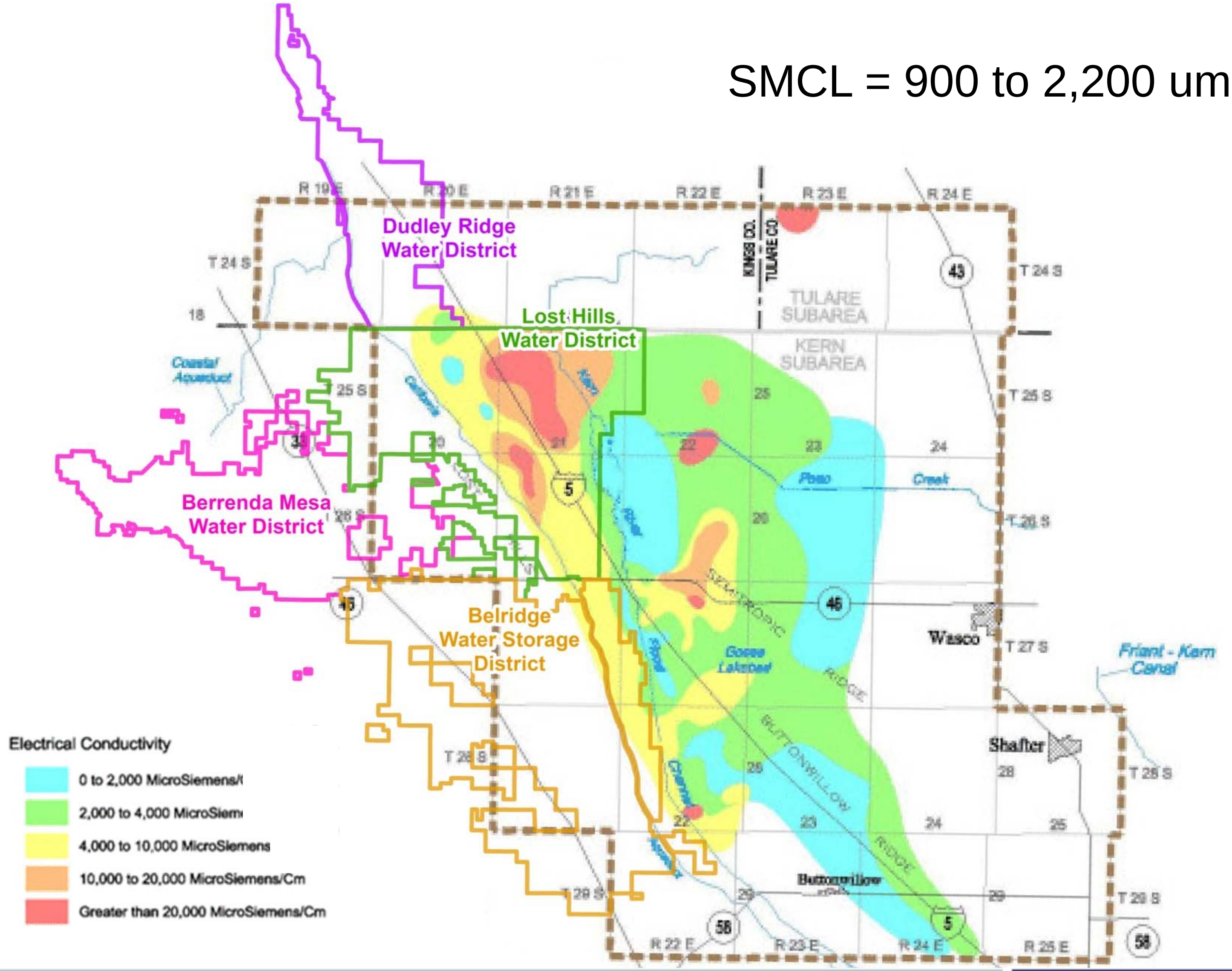
WQA = Water Quality for Agriculture, FAO Drainage Paper 29, 1994.

<450 mg/L TDS and <0.7 mg/L Boron is No Restriction

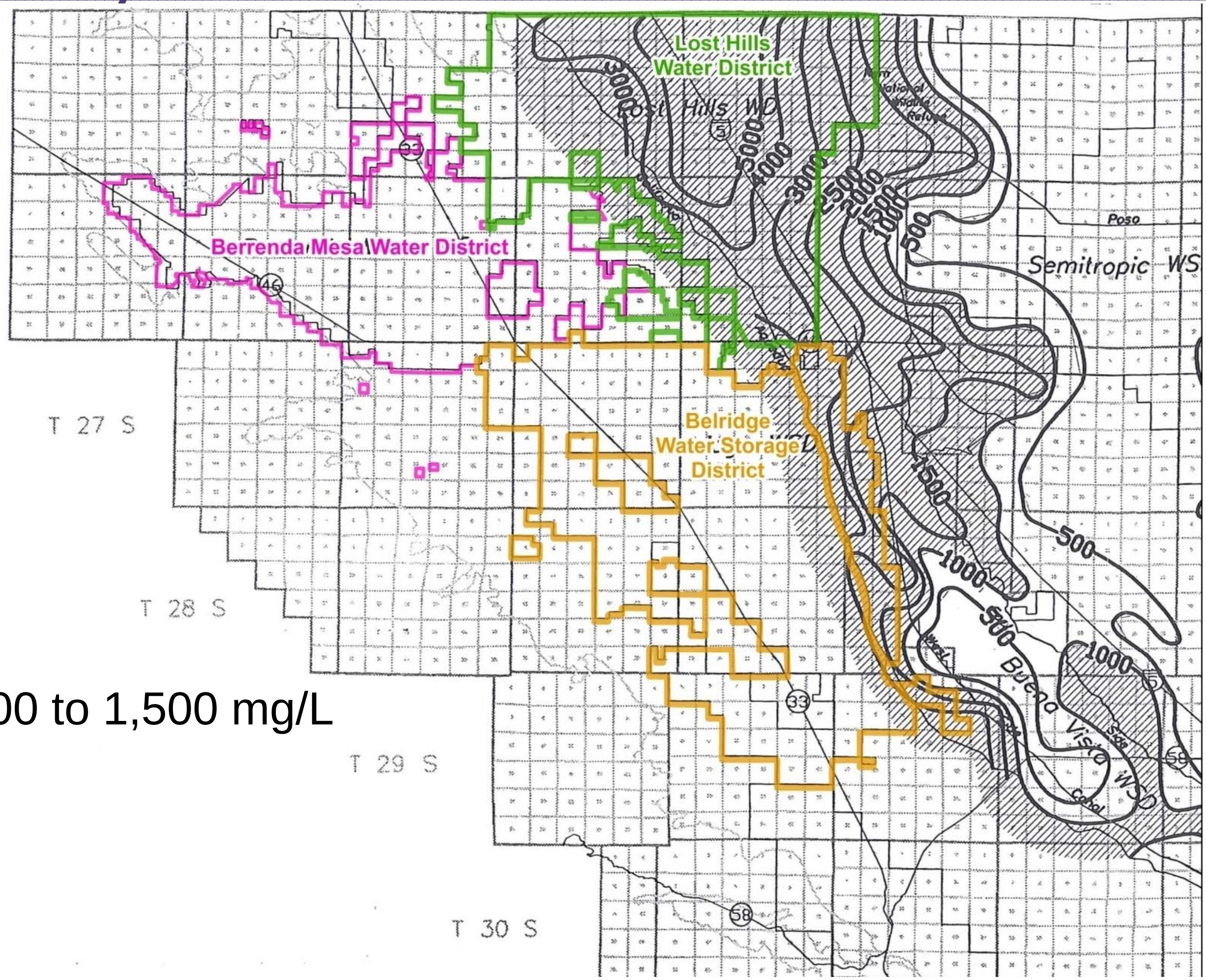
>2,000 mg/L TDS and >3 mg/L Boron is Severe Restriction

Perched Groundwater Quality Electrical Conductance (DWR, 2001)

SMCL = 900 to 2,200 umhos/cm

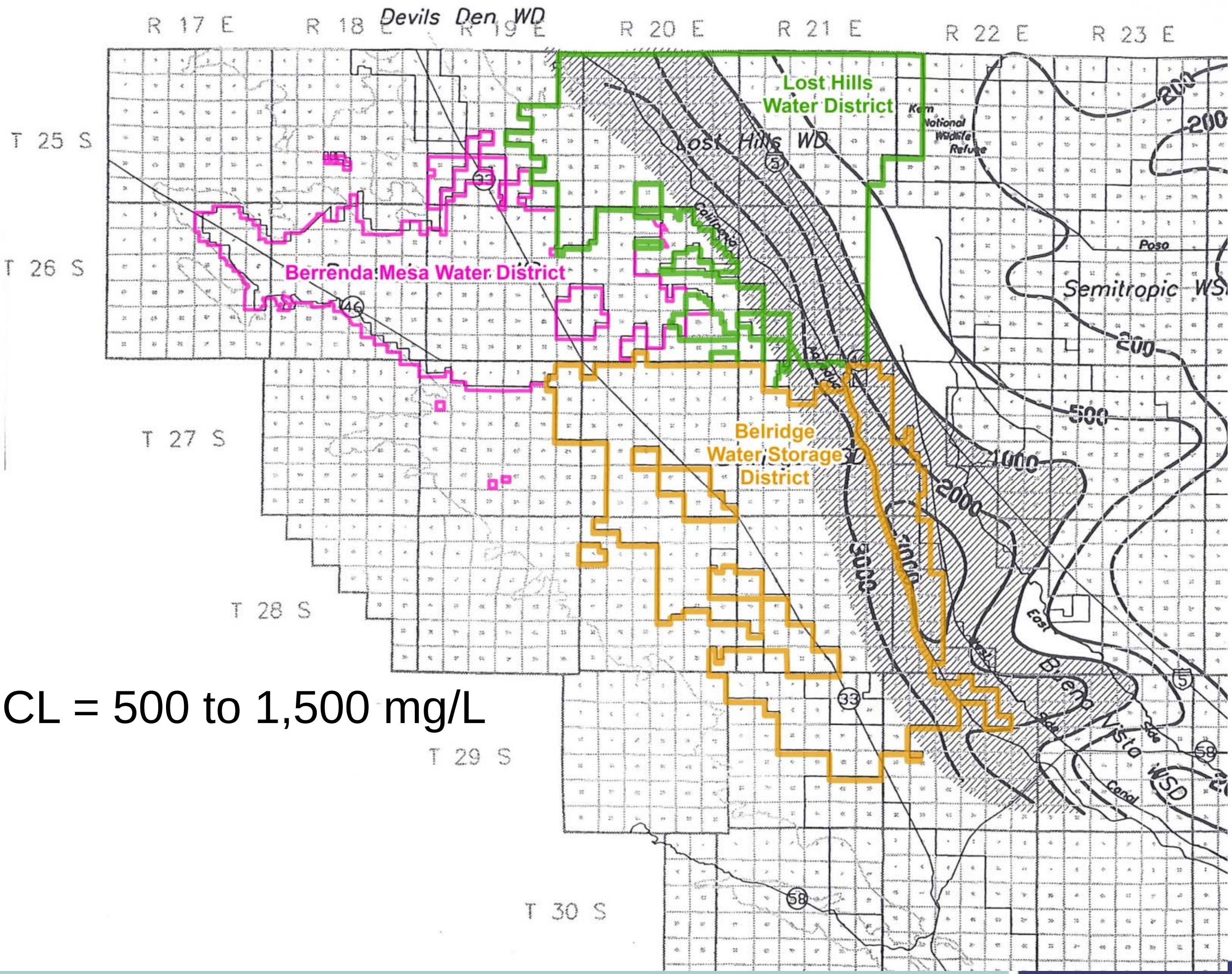


Unconfined Groundwater Quality
Total Dissolved Solids (mg/L)
(KCWA, 2005)



SMCL = 500 to 1,500 mg/L

Confined Groundwater Quality Total Dissolved Solids (mg/L) (KCWA, 2005)



SMCL = 500 to 1,500 mg/L

Currently Active Community Water Systems Relying on Groundwater (SWRCB, 2012)

Preliminary Findings

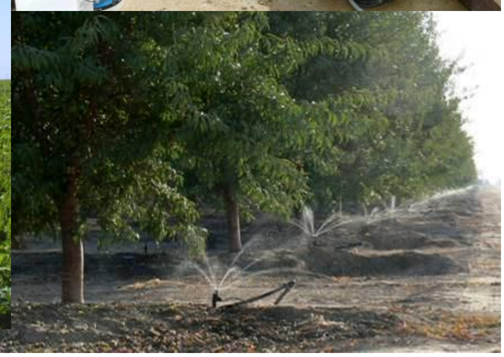
MUN - Groundwater within the Districts is generally of poor mineral quality (generally >2,000 mg/L TDS) and contains other mineral constituents (arsenic) that have prevented its use for drinking water. Groundwater within the Districts, except near the far northern part of DRWD (Kettleman City), is not used for municipal water supply.

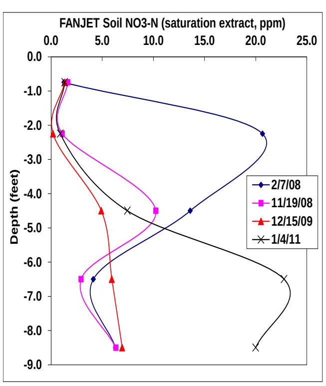
AGR - The poor mineral quality of groundwater (TDS, and boron) has prevented its use for agricultural irrigation. Based on the poor quality of groundwater within the Districts, they have obtained irrigation water supply from the California Aqueduct.

CVRWQCB Workshop on ILRP
Bakersfield 11/30/12

Blake Sanden – Irrigation Advisor, Kern County
UCCE 1031 S. Mt. Vernon Ave, Bakersfield CA 93307

blsanden@ucdavis.edu
http://cekern.ucdavis.edu/Irrigation_Management/





Nitrogen use efficiency (NUE) in 5 year Kern almond trial:
1) Efficiency of N retained in soil

LEACHING FRACTION ESTIMATE (from Cl concentration at depth)				Estimated Nitrogen Use Efficiency, NUE (Sanden)			
2/7/08	11/19/08	12/15/09	1/4/11	2/7/08	11/19/08	12/15/09	1/4/11
0.50	0.36	0.24	0.76	97%	97%	99%	96%
0.12	0.16	0.13	0.60	89%	99%	100%	98%
0.07	**0.05**	**0.07**	0.08	**96%**	**98%**	**98%**	97%
0.23	0.18	0.11	**0.07**	96%	98%	97%	**93%**
0.28	0.28	0.27	0.17	92%	92%	92%	85%

(Average Cl_{irrig} concentration = 2.2 meq/l. Total Cl @ 950 lb/yr)

Nitrogen use efficiency (NUE) in 5 year almond trial:
2) NUE by crop export

3 Year Average Kernel Yield (2009-11):	3,743 lb/ac
Annual N Fertilizer Application:	275 lb/ac
Annual N Export from Crop:	246 lb/ac
3 Year Average NUE:	**89.6%**

Paramount Farming Company ranch-wide average applied water and soil NO3-N concentrations from 2008-12 (Note: applied water is for the whole year and less than CIMIS calculated ET for almonds)

	Almond Mature	Almond Dvlpt
EASTSIDE		
[1]Avg Applied Water	43.0	25.8
Acres	13,582	835
[2]0-4 ft Avg Soil NO3-N	5.7	--
[3]No. of samples	324	
WESTSIDE		
Avg Applied Water	48.2	0.0
Acres	22,960	0
0-4 ft Avg Soil NO3-N	4.0	--
No. of samples	700	
ALL PFC		
Avg Applied Water	**46.3**	**25.8**
Acres	**36,542**	**835**
0-4 ft Avg Soil NO3-N	**4.5**	**--**
No. of samples	**1,024**	

[1]Weighted 2008-2012 average annual applied water by PFC division

[2]Not all fields sampled. Some fields sampled in more than one location. Mature or development (immature) status not designated. All locations sampled in 12" increments to 4 feet. Thus, total number of field locations = No. of samples/4.

[3]Total number of samples in one foot increments from either 2011 or 2012 when the most number of samples were taken.

Agronomic Changes and Management Impacts in the Kern Sub Basin

Central Valley Regional Water Quality Control Board Workshop

Bakersfield, CA

November 30, 2012

Joel Kimmelshue, PhD

NewFields

Structure

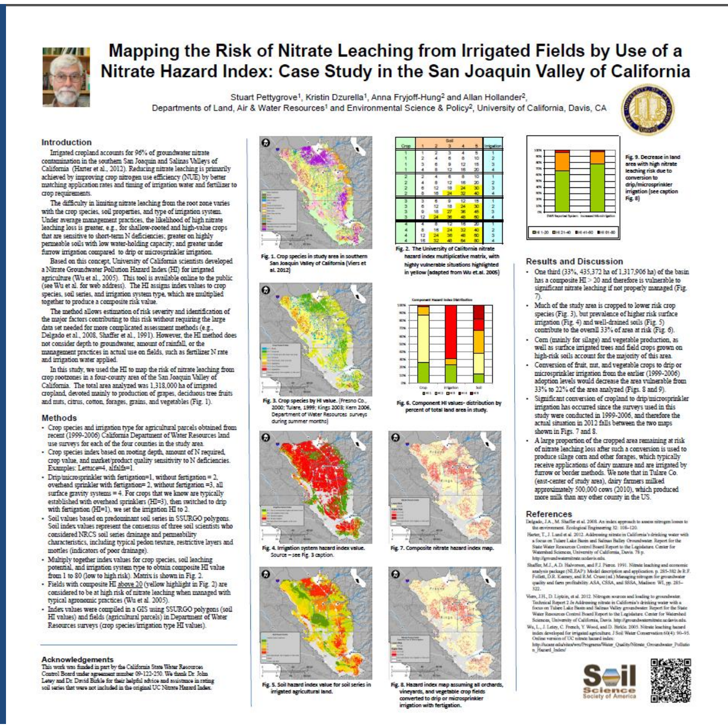
- Nitrate Hazard Index Approach
- Past Research
- Independent Analysis
- Main Influencing Factors
  - Soil Type
  - Crop Type
  - Irrigation Method
- Conclusions

Accepted Nitrogen Impact Assessment

- Nitrate Hazard Index Approach
  - Published by the Southwestern States and Pacific Islands Regional Water Quality Program and the University of California Center for Water Resources (Universities of Arizona, California, Nevada, etc.)
  - Includes decades of research/approaches (since the 1970s)
  - National Academy of Sciences Water Science & Technology Board – Chose Hazard Index as preferred method - **"<u>It is consistent with the recommendations of the nutrient Technical Advisory Committee (TAC) appointed by the CA State Water Resources Control Board</u>."**

Plant Accumulation of Nitrogen

- Amount of N accumulated by a crop depends on:
  - Amount of N supplied by fertilizer and soil reserves
  - Genetic potential of crop to take up N
  - Growth and yield potential of crop
  - **<u>Ability to retain N in rooting zone (impacted by: soil type, crop type, irrigation method)</u>**



Southern San Joaquin Valley Nitrate Hazard Index Approach

Soil, Crop and Irrigation Methods approach used to create relative Nitrate Hazard Index

Spatial Data Sources: DWR Crop Mapping - (Fresno Co., 2000; Tulare, 1999; Kings 2003; Kern 2006)

	Soil					
Crop	1	2	3	4	5	Irrigation
1	1	2	3	4	5	1
1	2	4	6	8	10	2
1	3	6	9	12	15	3
1	4	8	12	16	20	4
2	2	4	6	8	10	1
2	4	8	12	16	20	2
2	6	12	18	24	30	3
2	8	16	24	32	40	4
3	3	6	9	12	15	1
3	6	12	18	24	30	2
3	9	18	27	36	45	3
3	12	24	36	48	60	4
4	4	8	12	16	20	1
4	8	16	24	32	40	2
4	12	24	36	48	60	3
4	16	32	48	64	80	4

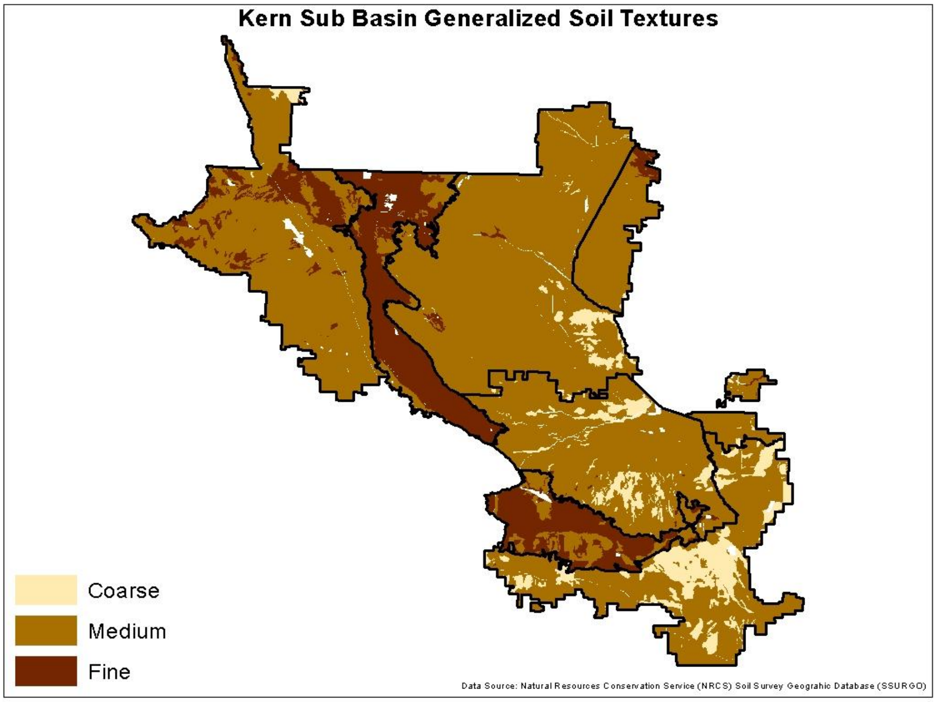
Pettygrove, et al, 2012

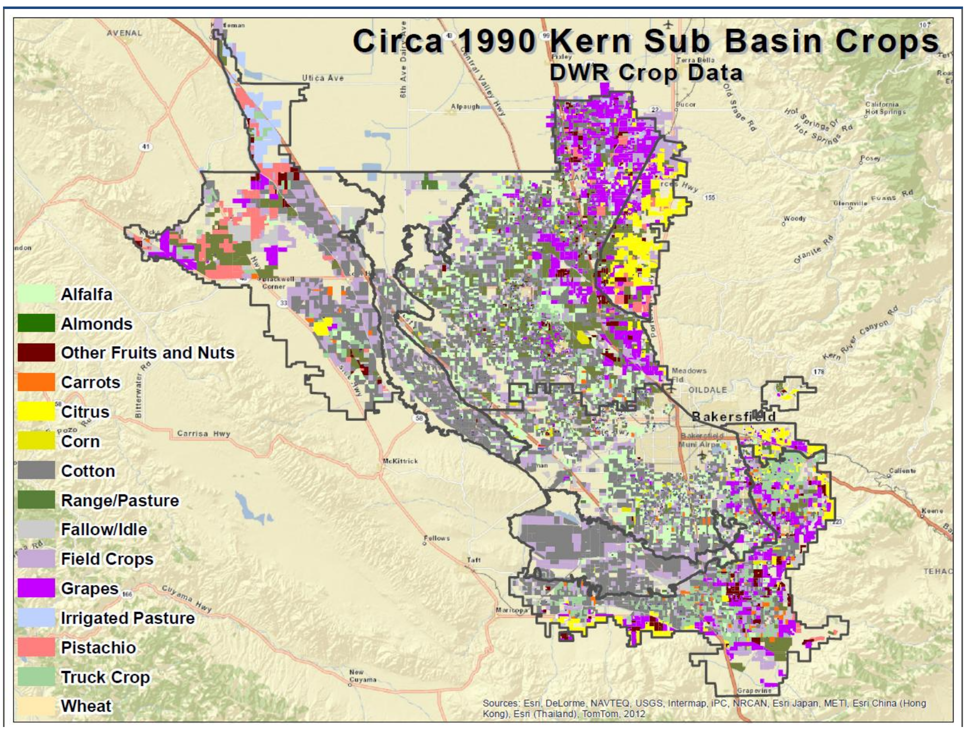
Southern San Joaquin Valley Nitrate Hazard Index Conclusions - Pettygrove, et al, 2012

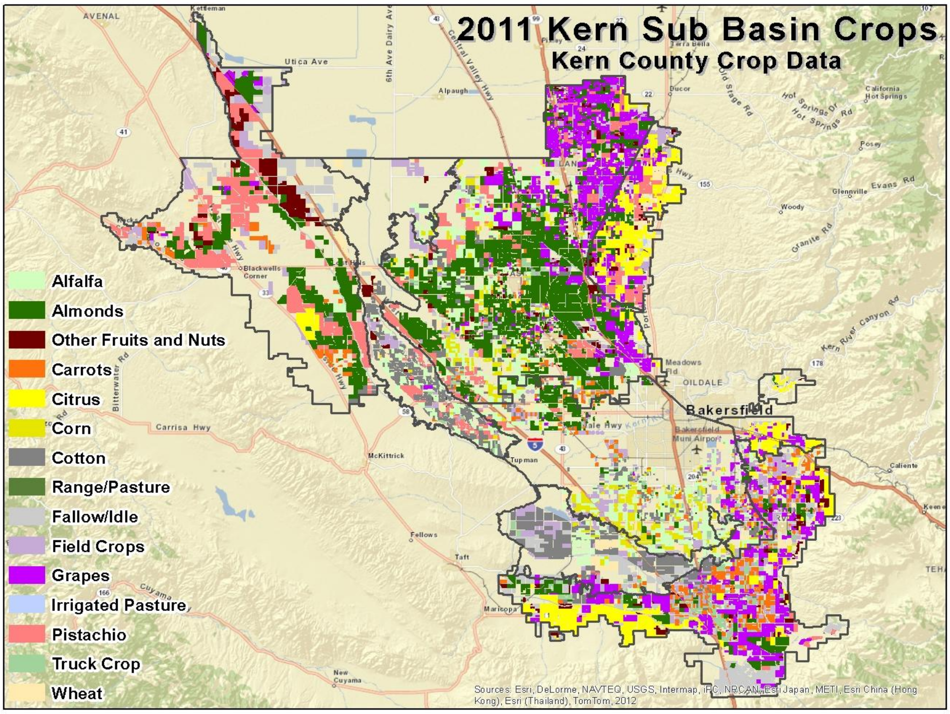
- 33% of basin has a significant N leaching potential
- That 33% is driven by gravity/surface irrigation practices on various crops and well-drained soils
- Conversion to drip/micro systems would result in a low leaching potential (Nitrate Hazard Index) for certain crops
- Significant conversion to these systems has occurred since the DWR 1999-2006 base layers (crop type and irrigation methods) were used.
- Following conversion, a large area remaining at risk is silage corn and other forages, receiving dairy manure applications via furrow or border-check methods.

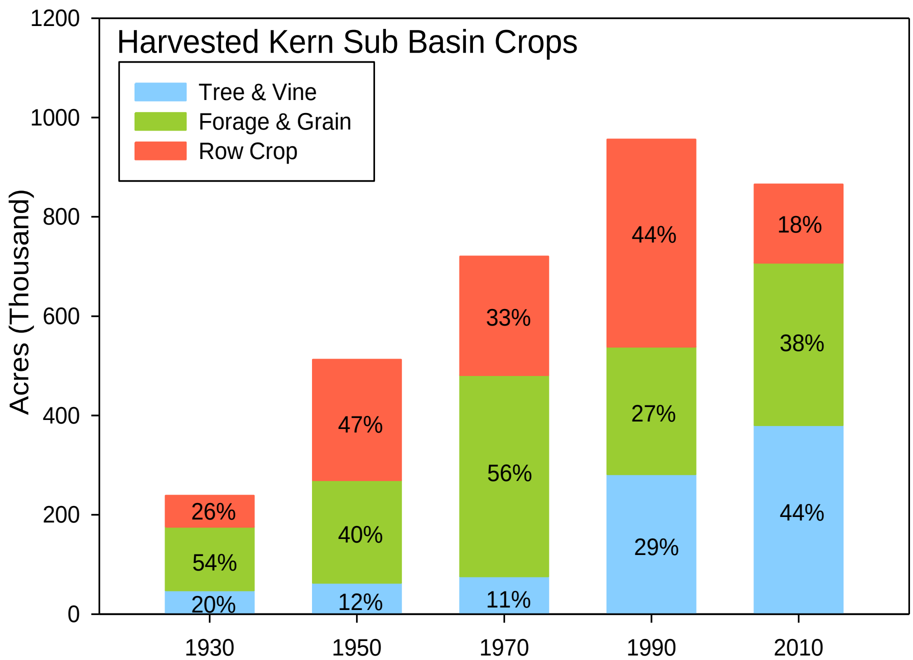
Independent Analysis

- Focuses on Kern Sub Basin area only
- Uses Kern Sub Basin specific information
  - recent (2011) Kern County crop coverage
  - local climatic conditions
  - local irrigation methods
  - local agronomic knowledge specific to the Kern Sub Basin obtained from Blake Sanden and others
- Performed analysis for representative scenarios in the Kern Sub Basin area
- Our analysis aligns well in approach and enhances conclusions of Pettygrove, et al. 2012 and other researchers

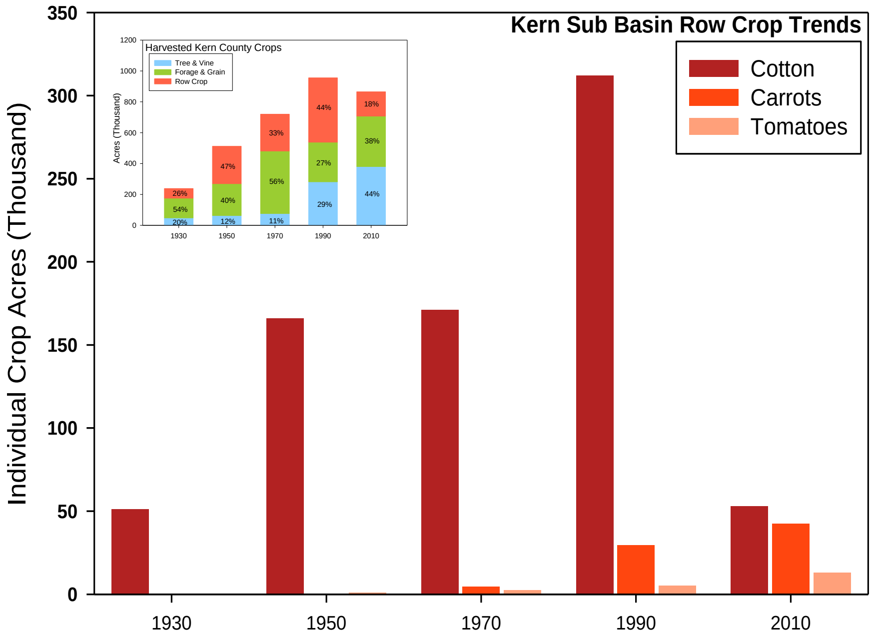

Kern Sub Basin Generalized Soil Textures
Coarse
Medium
Fine
Data Source: Natural Resources Conservation Service (NRCS) Soil Survey Geograhic Database (SSURGO)


Circa 1990 Kern Sub Basin Crops
DWR Crop Data
Alfalfa
Almonds
Other Fruits and Nuts
Carrots
Citrus
Corn
Cotton
Range/Pasture
Fallow/Idle
Field Crops
Grapes
Irrigated Pasture
Pistachio
Truck Crop
Wheat
Bakersfield
Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2012

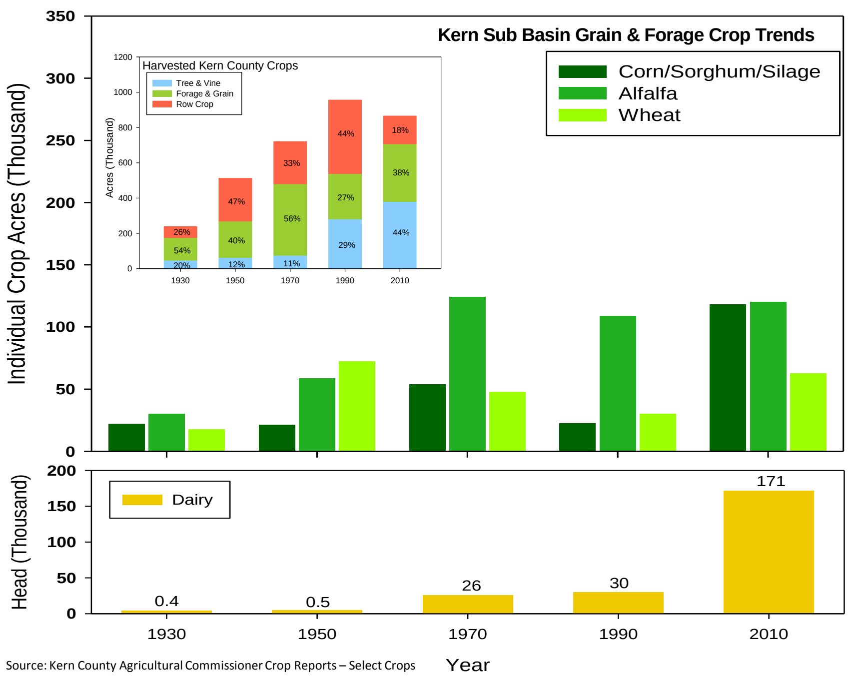




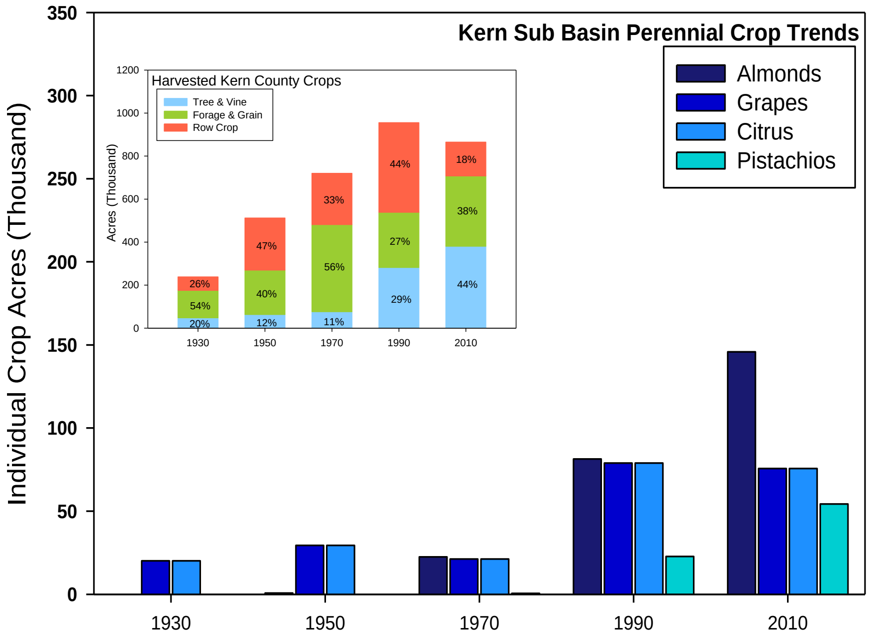
Source: Kern County Agricultural Commissioner Crop Reports – Does not include fallow land, 1st leaf orchards and is Kern County only



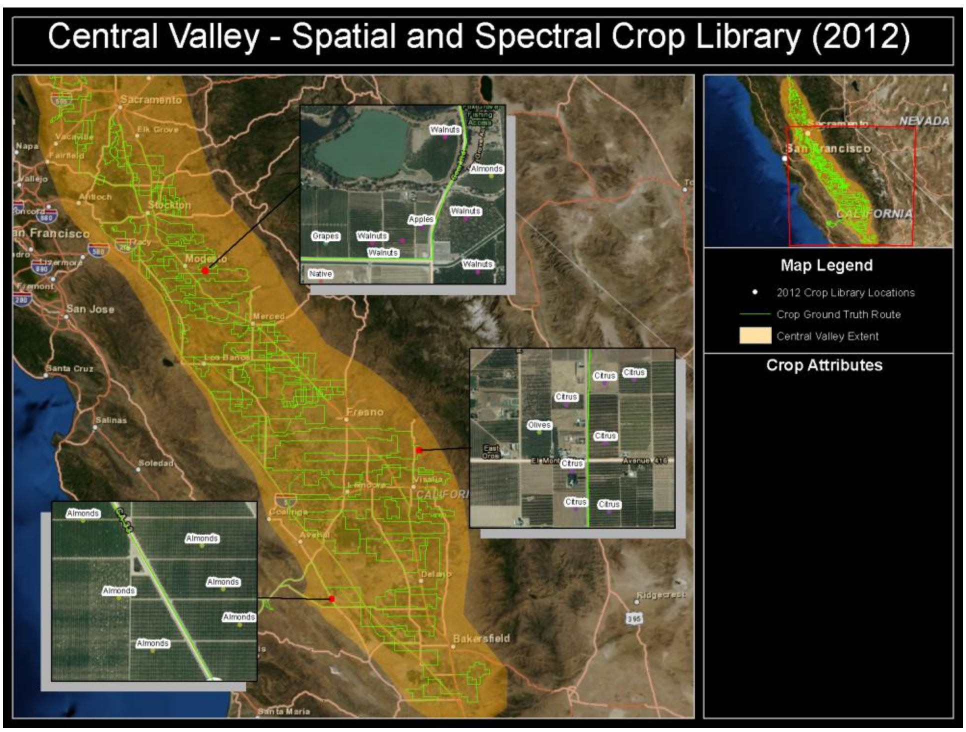
Source: Kern County Agricultural Commissioner Crop Reports – Select Crops

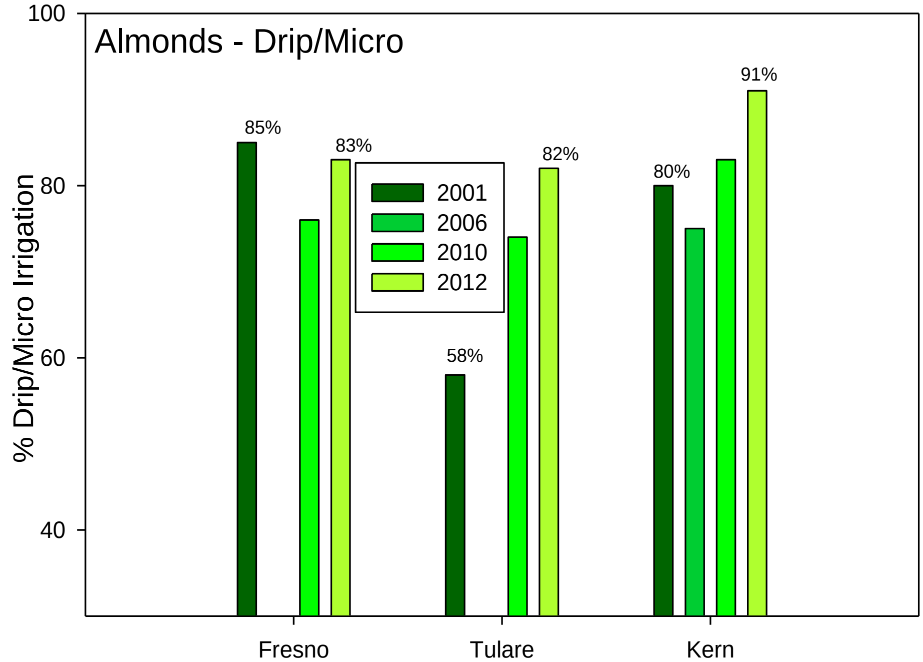


Source: Kern County Agricultural Commissioner Crop Reports – Select Crops

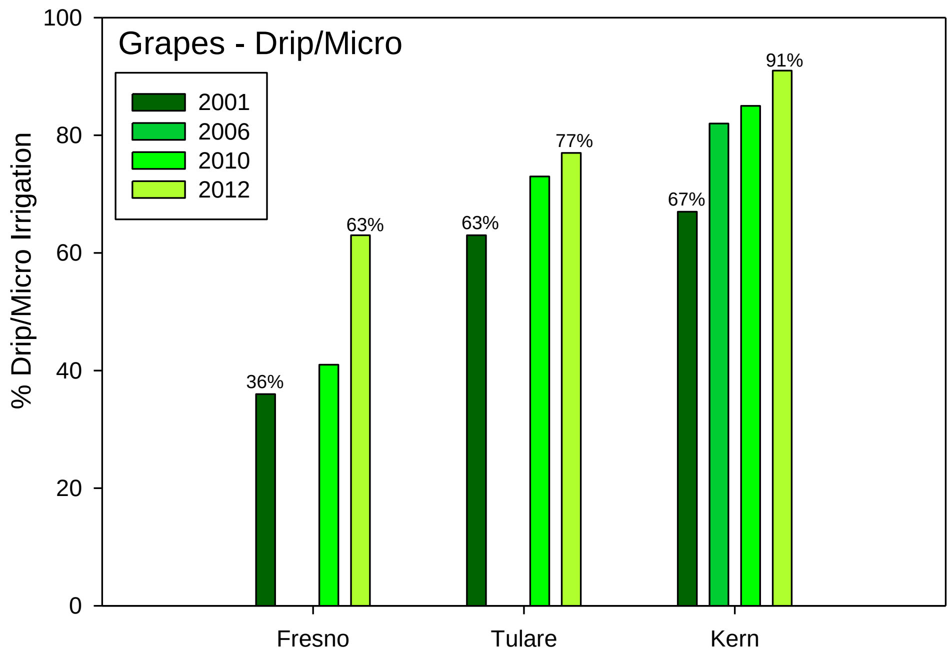


Source: Kern County Agricultural Commissioner Crop Reports – Select Crops





Data Source: 2001, 2010 DWR Irrigation Method Surveys, 2006 DWR Crop Survey, 2012 NewFields



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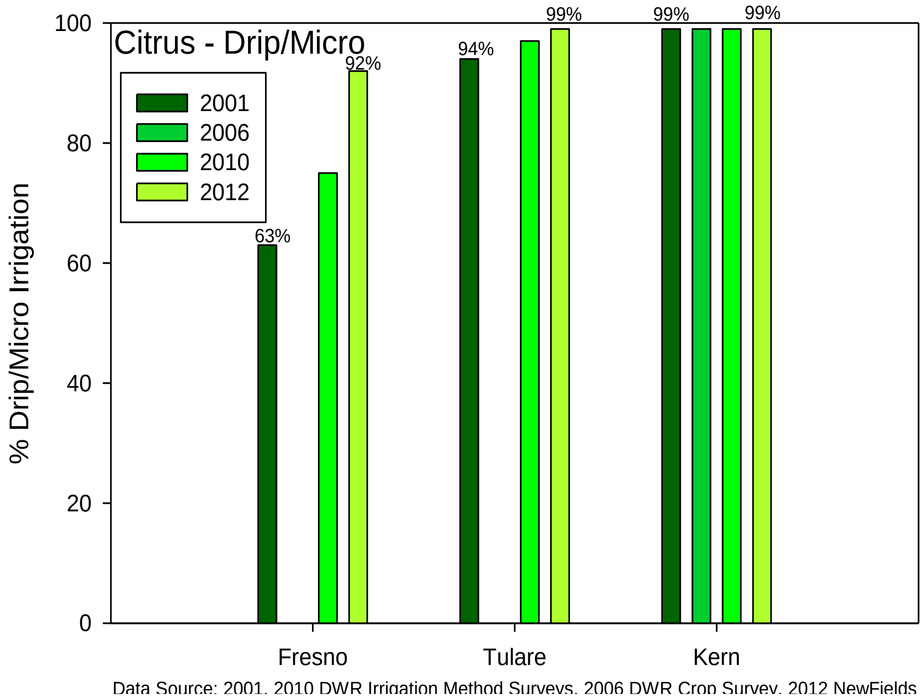
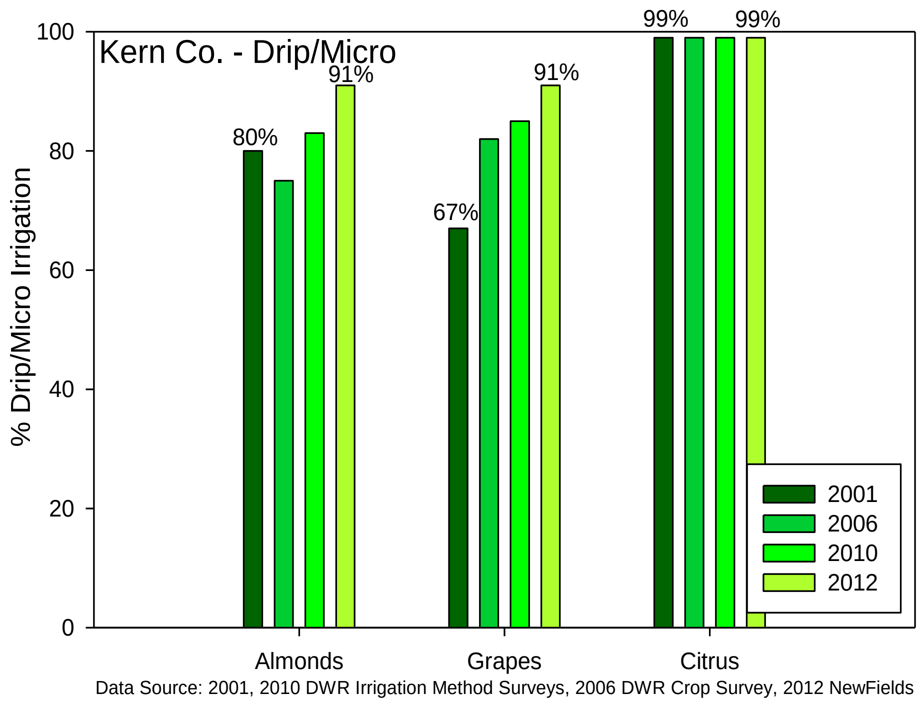

Citrus - Drip/Micro
% Drip/Micro Irrigation
0
20
40
60
80
100
2001
2006
2010
2012
63%
92%
94%
99%
99%
99%
Fresno
Tulare
Kern
Data Source: 2001, 2010 DWR Irrigation Method Surveys, 2006 DWR Crop Survey, 2012 NewFields


Kern Co. - Drip/Micro
% Drip/Micro Irrigation
0
20
40
60
80
100
80%
91%
67%
91%
99%
99%
2001
2006
2010
2012
Almonds
Grapes
Citrus
Data Source: 2001, 2010 DWR Irrigation Method Surveys, 2006 DWR Crop Survey, 2012 NewFields

Conclusions of Analysis

- Nitrate Hazard Index Approach
  - Universally accepted as qualitative method to estimate nitrate leaching hazard
  - Work performed recently by UC Davis (e.g. Pettygrove, et al, 2012) was unable to use current (2011/2012) land use and irrigation practices
  - It was not the purpose of this work to review historic trends/future projections
- Increase in Permanent Crops
  - Deep rooted permanent crops account for approximately 45-50% of the crop mix within the Kern Sub-Basin as of 2011 and continue to increase in plantings
  - Of these crops (almonds, pistachios, grapes, citrus, pomegranates, etc.), over 90% are irrigated with drip/micro systems and result in limited return flow to groundwater.
  - These changes have resulted in a significant reduction in the nitrate leaching hazard to groundwater over time
  - Similar conclusions were reached by other researchers

Conclusions of Analysis

- Increase in Dairy
  - Approximately one-third (30-35%) of remaining acreage is mostly associated with dairies (corn silage, alfalfa, sorghum, sudan grass, etc.)
  - This land base/crop type is separately regulated
- Decrease in Non-Dairy Related Field and Row Crops
  - Over the past 20+ years, perennial fruit and nut crops, along with dairies have significantly replaced field and row crops.
  - The remaining crops (15-25%) consist of cotton, carrots, potatoes, truck crops and other field and row crops
- Irrigation and N Use Efficiencies in Kern sub-watershed are likely the highest in the Central Valley
- Conditions in Kern Sub Basin are different than other areas of the Valley and it would appear to warrant a different regulatory approach

SGI hydrogeology THE SOURCE GROUP, INC.

COMMENTS ON HYDROGEOLOGIC POINTS OF CONCERN FOR THE KRWCA AREA

IRRIGATED LANDS REGULATORY PROGRAM

November 30, 2012

Robert M. Gailey, P.G., C.HG.

PRESENTATION OUTLINE

- UNIQUE ASPECTS OF THE KRWCA AREA
- SUMMARY OF POINTS REGARDING DRAFT ORDER GROUNDWATER MONITORING PROGRAM
- DETAILS OF SELECTED TECHNICAL POINTS

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- UNIQUE ASPECTS OF THE KRWCA AREA
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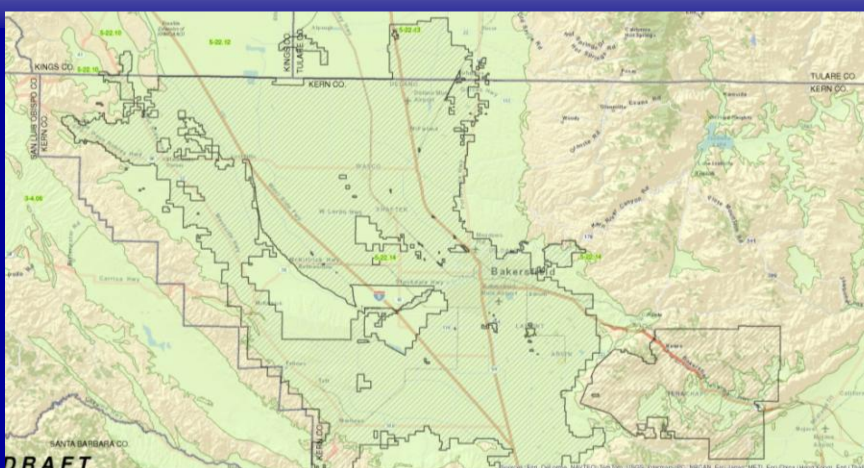
KRWCA AREA



THE KRWCA AREA IS UNIQUE AMONG REGIONS CONSIDERED FOR REGULATION

- Part of a Closed Groundwater Basin
- Groundwater Use and Management Operations
- Significant Depth to Water
- Nitrate Impact Less Pronounced

THE KRWCA AREA IS UNIQUE AMONG REGIONS CONSIDERED FOR REGULATION

- Part of a Closed Groundwater Basin
  - Water quality impacts from nitrogen accumulate unless denitrification occurs
  - Impacts from both past and present activities
  - Impacts from all industries – not just crop agriculture
- Groundwater Use and Management Operations
- Significant Depth to Water
- Nitrate Impact Less Pronounced

THE KRWCA AREA IS UNIQUE AMONG REGIONS CONSIDERED FOR REGULATION

- Part of a Closed Groundwater Basin
- Groundwater Use and Management Operations
  - Extraction from water supply wells
  - Significant recharge operations
  - Potential to move water around subbasin
- Significant Depth to Water
- Nitrate Impact Less Pronounced

THE KRWCA AREA IS UNIQUE AMONG REGIONS CONSIDERED FOR REGULATION

- Part of a Closed Groundwater Basin
- Groundwater Use and Management Operations
- Significant Depth to Water
  - Depth varies across area
  - Areas where depth is greater than to north
- Nitrate Impact Less Pronounced

AVERAGE DEPTH TO GROUNDWATER

- Analysis of DWR Data from North to South

• East San Joaquin Watershed	88 feet
• Kings Subbasin	87 feet
• Kaweah Subbasin	102 feet
• Tulare Lake Subbasin	77 feet
• Tule Subbasin	159 feet
• Kern Subbasin	219 feet

Note: Calculation of averages included data declustering at the township-range level

THE KRWCA AREA IS UNIQUE AMONG REGIONS CONSIDERED FOR REGULATION

- Part of a Closed Groundwater Basin
- Groundwater Use and Management Operations
- Significant Depth to Water
- Nitrate Impact Less Pronounced
  - Quality of first-encountered groundwater
  - Appears better than to north

UC DAVIS NITRATE STUDY ASSESSMENT OF NITRATE IMPACTS

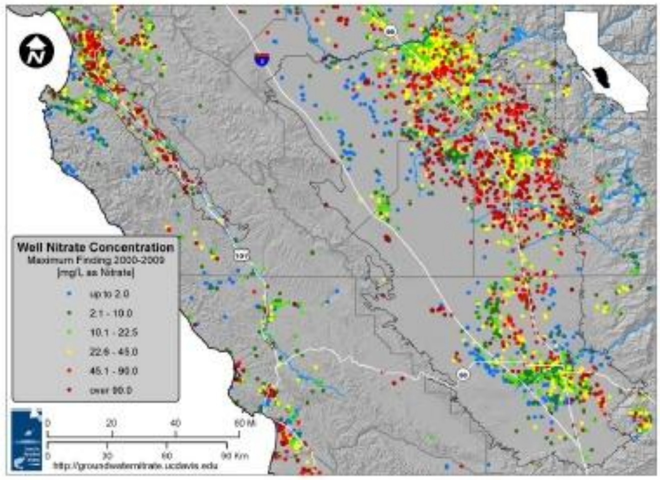
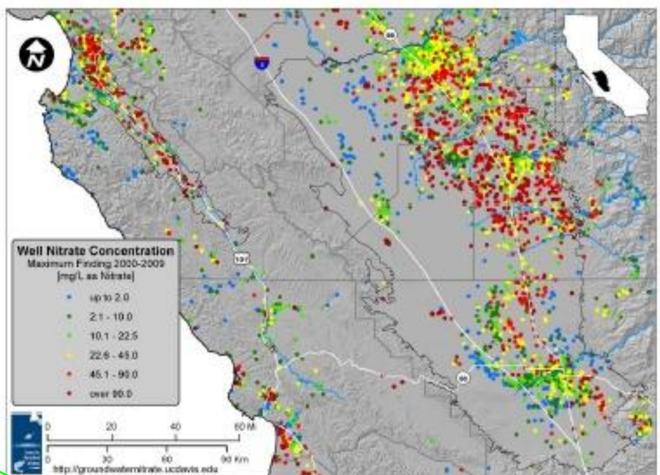


Figure 42. Maximum concentration of nitrate in wells with at least one sample during the decade 2000 to 2010

UC DAVIS NITRATE STUDY ASSESSMENT OF NITRATE IMPACTS



Worst Case

Figure 42. Maximum concentration of nitrate in wells with at least one sample during the decade 2000 to 2010

PRESENTATION OUTLINE

- UNIQUE ASPECTS OF THE KRWCA AREA
- SUMMARY OF POINTS REGARDING DRAFT ORDER GROUNDWATER MONITORING PROGRAM
- DETAILS OF SELECTED TECHNICAL POINTS

SUMMARY OF POINTS

Preliminary Findings

- There are likely to be complexities (i.e. time lags) associated with interpreting groundwater quality data in the KRWCA area.
- Implementing a large-scale monitoring program before the complexities are explored could result in significant unnecessary costs.
- Further study or an interim regulatory step would increase the likelihood that the monitoring will meet the intent of the order.

PRESENTATION OUTLINE

- UNIQUE ASPECTS OF THE KRWCA AREA
- SUMMARY OF POINTS REGARDING DRAFT ORDER GROUNDWATER MONITORING PROGRAM
- DETAILS OF SELECTED TECHNICAL POINTS

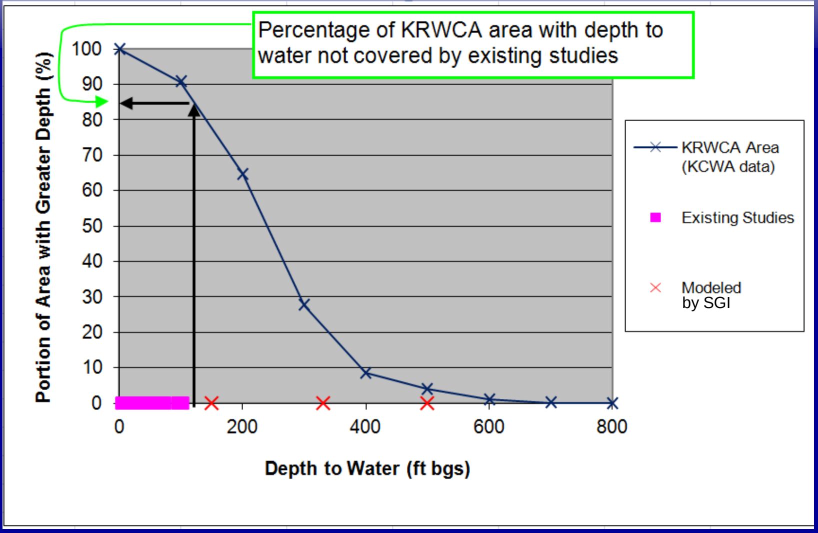
SELECTED POINTS

1. Time lags exist between agricultural activities at ground surface and changes in groundwater quality as a result of a thick unsaturated zone.
2. Nitrate residing in the unsaturated zone acts as an ongoing source to groundwater years after nitrogen is applied at ground surface.
3. The potential costs of an insufficiently planned groundwater quality monitoring program necessitate further study or an interim regulatory step before any full-scale monitoring occurs.

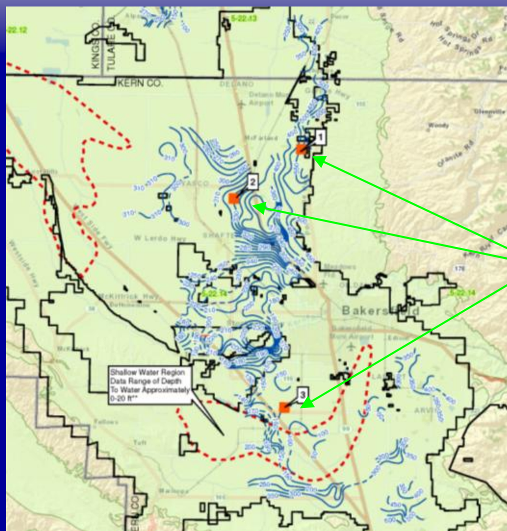
SELECTED POINTS

1. Time lags exist between agricultural activities at ground surface and changes in groundwater quality as a result of a thick unsaturated zone.
2. Nitrate residing in the unsaturated zone acts as an ongoing source to groundwater years after nitrogen is applied at ground surface.
3. The potential costs of an insufficiently planned groundwater quality monitoring program necessitate further study or an interim regulatory step before any full-scale monitoring occurs.

DEPTH TO WATER OVER KRWCA

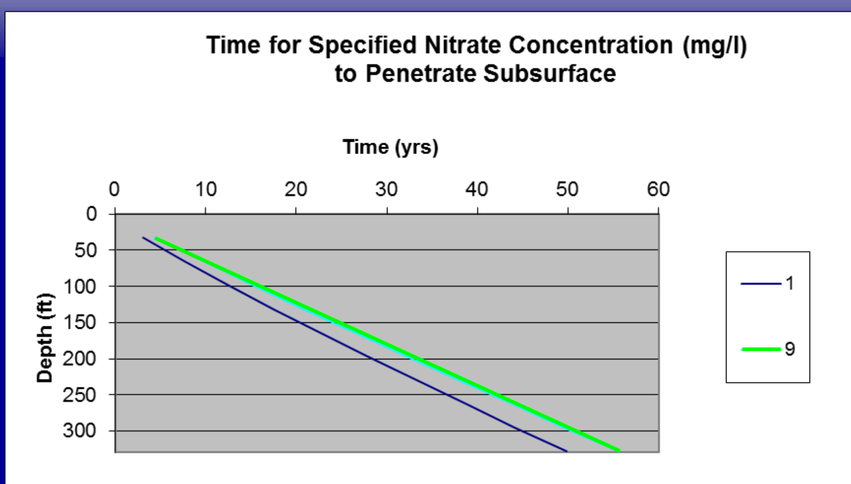


REPRESENTATIVE SITES MODELED



Preliminary modeling performed by SGI includes site-specific unsaturated zone stratigraphy.

MODELING RESULTS (Middle Depth - 330')

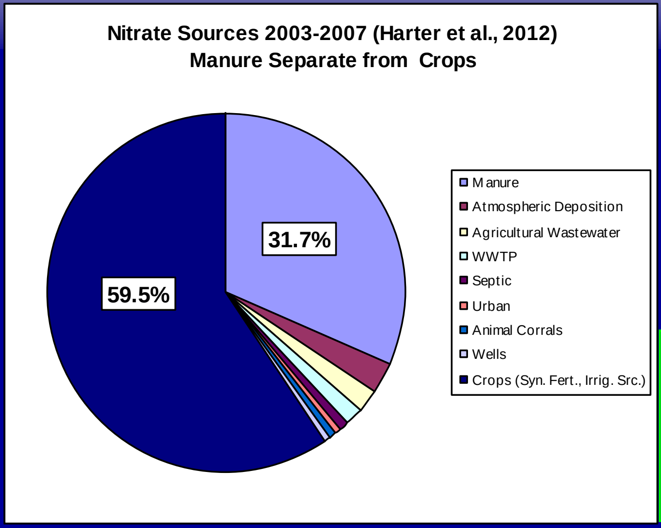


Almonds, Drip/Micro, Coarse Soil, Interlayed Clay & Sand

SELECTED POINTS

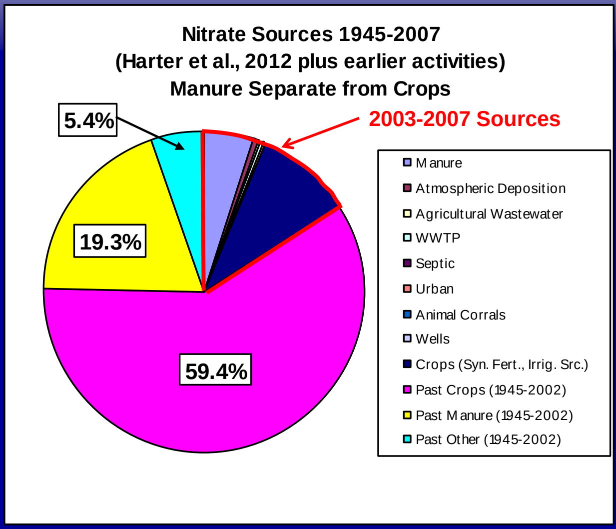
1. Time lags exist between agricultural activities at ground surface and changes in groundwater quality as a result of a thick unsaturated zone.
2. Nitrate residing in the unsaturated zone acts as an ongoing source to groundwater years after nitrogen is applied at ground surface. Thus, addressing current farming practices through this proposed regulation will have little affect on this legacy issue.
3. The potential costs of an insufficiently planned groundwater quality monitoring program necessitate further study or an interim regulatory step before any full-scale monitoring occurs.

UC DAVIS ASSESSMENT OF NITRATE LOADING TO GROUNDWATER

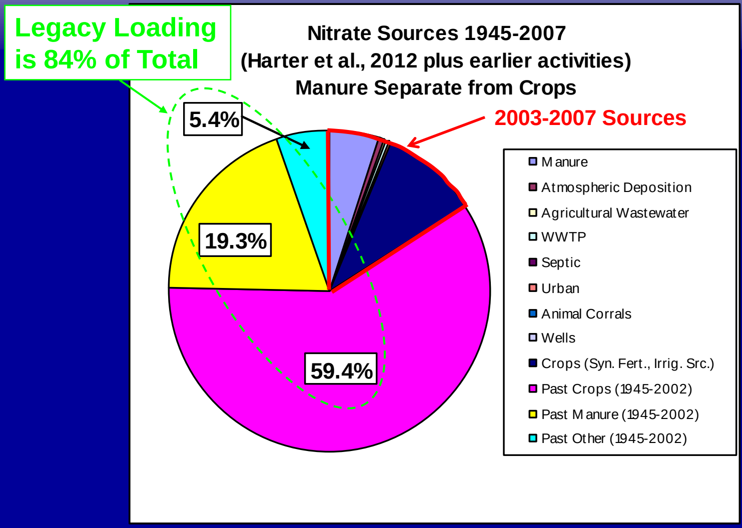


Presented only for the purposes of discussion. The details of this analysis have not been reviewed.

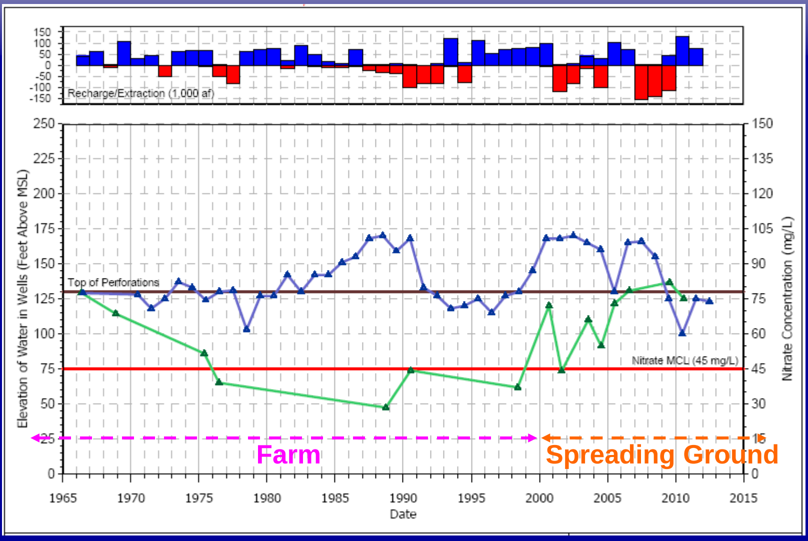
EXTENSION OF UC DAVIS NITRATE ASSESSMENT BACK IN TIME



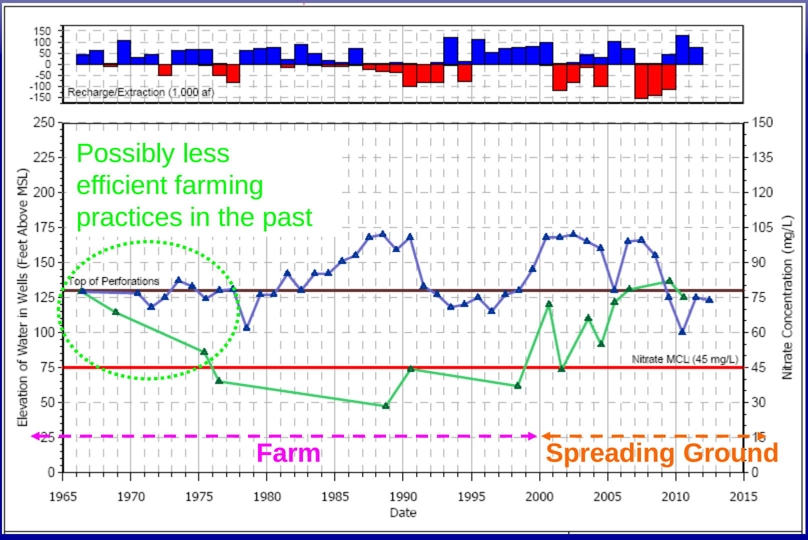
EXTENSION OF UC DAVIS NITRATE ASSESSMENT BACK IN TIME



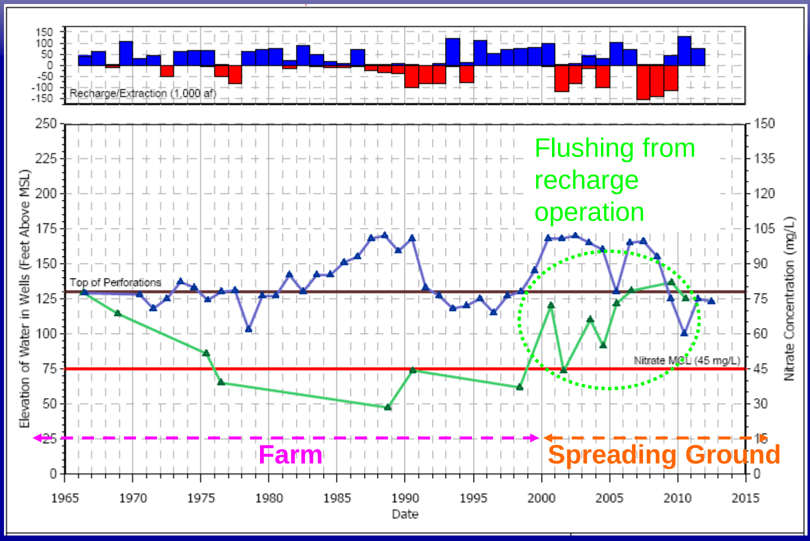
NITRATE FLUSHING FROM THE UNSATURATED ZONE



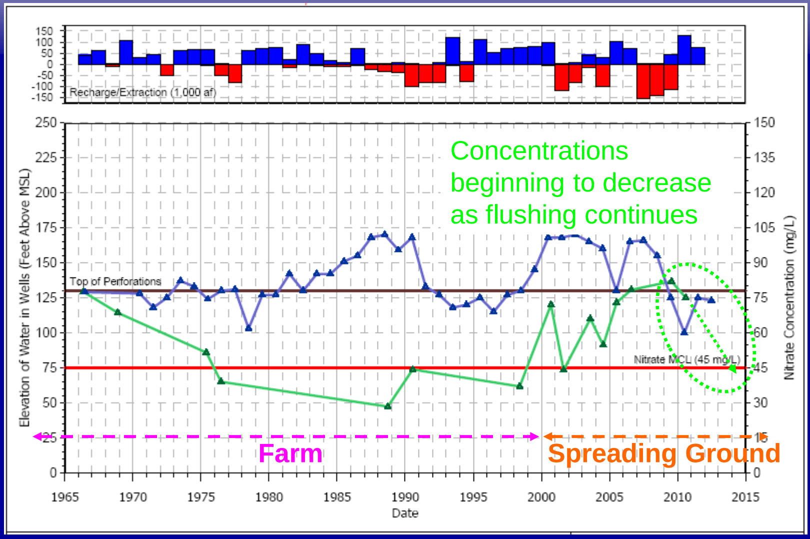
NITRATE FLUSHING FROM THE UNSATURATED ZONE



NITRATE FLUSHING FROM THE UNSATURATED ZONE



NITRATE FLUSHING FROM THE UNSATURATED ZONE



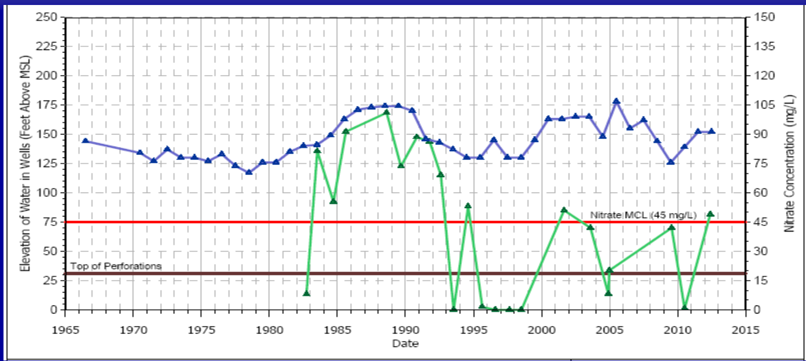
SELECTED POINTS

1. Time lags exist between agricultural activities at ground surface and changes in groundwater quality as a result of a thick unsaturated zone.
2. Nitrate residing in the unsaturated zone acts as an ongoing source to groundwater years after nitrogen is applied at ground surface.
3. The potential costs of an insufficiently planned groundwater quality monitoring program necessitate further study or an interim regulatory step before any full-scale monitoring occurs.

POTENTIAL COSTS

- Implementation of Large Groundwater Monitoring Program as Presented in Draft Order
- Impacts to Farming Practices Required Based Upon Unclear Monitoring Results

DATA FROM THE KRWCA AREA



<u>**What would we conclude from these data?**</u>

CONCLUSION

Per the information provided above, the KRWCA area is unique, groundwater quality monitoring data interpretation is expected to be complex, area-wide monitoring will be expensive, and a one-size-fits-all groundwater monitoring approach is not appropriate.

Kern River Watershed Coalition Authority

A joint powers authority to serve as coordinator and coalition group under the Irrigated Lands Regulatory Program in the Kern River watershed portion of Kern and Tulare Counties
12109 Highway 166, Bakersfield, CA 93313-9630

August 10, 2012

VIA EMAIL TO:
dsholes@waterboards.ca.gov

Karl Longley, Chair
Jon Costantino, Vice Chair
Katherine Hart, Board Member
Sandra Meraz, Board Member
Jennifer Moffitt, Board Member
Carmen Ramirez, Board Member
Robert Schneider, Board Member
Pamela Creedon, Executive Officer
Clay Rodgers, Assistant Executive Officer
Central Valley Regional Water Quality Control Board
11020 Sun Center Drive, #200
Rancho Cordova, CA 95670-6114

Re: Comments of Kern River Watershed Coalition Authority re Interested Party review of draft Waste Discharge Requirements General Order for Members of a Third Party Group within the Tulare Lake Basin (July 2012)

Dear Board Chair, Vice Chair, Members, Ms. Creedon and Mr. Rodgers:

Introduction/Summary

As you may be aware, the Kern River Watershed Coalition Authority (Authority) is a joint power authority, a public agency, composed of most of the agricultural water districts within that portion of Kern County that would be subject to the above referenced draft order, including portions of southern Tulare County within multi county districts. It administers the existing surface water program under the Coalition Group Conditional Waiver for the Kern River Sub-watershed ("Kern") of the Southern San Joaquin Valley Water Quality Coalition ("SSJ Coalition"), of which we are a part. The Kern area includes the watershed areas of the Kern River, Poso Creek, Rag Gulch and White River. We incorporate by reference the comments submitted by the SSJ Coalition, dated August 10, 2012, and supplement them as follows, as it relates to the Kern area.

Our fundamental disagreement with the proposed General Order is its broad application to all groundwater in Kern—in concept we have no problem with the current surface water program and remain committed to implement it. If the Kern area is subject to a General Order affecting groundwater, it should be tailored to our specific circumstances, as discussed below.

The Authority and its public agency water districts are concerned with water quality in our area. After all, it is our landowners and residents that drink the water and use it for beneficial uses outside of agricultural uses. Our member districts have for many decades been engaged in monitoring of groundwater levels and quality and have implemented some of the most state-of-the-art water management and water banking programs within the State. As the local officials charged with managing water resources in Kern, we are the best prepared to address water quality issues in our area and are doing so. We are concerned that the current staff proposal layers a significant monitoring and reporting obligation upon the landowner (which may be duplicative to monitoring activities already undertaken in Kern) and does little to address what we understand to be the primary focus of the order, preservation of groundwater quality.

Although not clearly stated, the proposed General Order appears to include an assumed presumption that anyone who irrigates discharges "waste" and pollutes our groundwater basin. For the reasons noted below, we do not believe that this apparent assumption can be substantiated by the facts in Kern. As will be described further below, there is no evidence that normal farming practices in Kern, as they exist now, are unreasonably affecting groundwater quality and causing nitrate levels to materially increase. The proposed new massive regulatory program will by the staff's own admission cost tens of millions of dollars per year to Kern area growers and in our judgment lead to minimal if any beneficial impact insofar as improving groundwater quality in our area.

Additionally, we note this **proposed General Order appears to be a "rush to regulate"**—aside from the upcoming August 21st workshop (which we appreciate being scheduled) the Board and its staff have done little to reach out, engage with and educate the agricultural community as to the need for, purposes or contents of the proposed order, and most farmers are unaware of this proposal. Normally, to solve a problem, the first step is to educate others affected as to its existence, extent and gravity. This would usually be followed by a request for input and suggestions from those affected as to how to solve the problem. Voluntary attempts to solve the problem would then be encouraged. If these voluntary approaches do not work, then it would be time to ask for or propose regulation. The Regional Board has followed none of these preliminary steps, it has simply proposed regulation with insufficient time for input and suggestions from the affected community. In fact, the only interaction with the agricultural community in the Kern area to date has been initiated by us.

Background

There are approximately 1,040,000 irrigated acres in the Kern sub-watershed area, of which approximately 303,000 acres are enrolled in the present surface water program under the Conditional Waiver. The limited area under the present surface water program is because there are very few streams and creeks in our area. The present surface water program is successfully being implemented. We have actionable "exceedances" only in one area and for that area a Management Plan has been prepared and submitted to the Regional Board.

The Kern area is distinguishable from other areas in the Central Valley Region and is designated by the Department of Water Resources as the Kern-Sub Basin, a separate and distinct hydrologic unit of the Tulare Lake Basin. The following is preliminary information and findings and will be further substantiated through evidence presented during the public review period for this proposed General Order, if it is to proceed as the staff has indicated. In particular, we point out the following:

1. The average depth to groundwater in the Kern area is 238 feet (calculated as of 2010). This average depth does not take into account the Westside area at all, generally located uphill of the California Aqueduct, for which informed sources assumed there is no or little usable groundwater[1] which the Regional Board staff insists would be subject to this proposed Order. Any groundwater in these areas, all of which is highly saline, is much deeper. Our average depth to groundwater (excluding the Westside) compares as follows to other areas:

Region	Average Depth to Groundwater
East S. J.	**83 feet**
Kaweah Sub-Basin	101 feet
Kern	**238 feet**
Kings Sub-Basin	92 feet
Tulare Lake Sub-Basin	89 feet
Tule Sub-Basin	163 feet

With increasing depth to groundwater, the likelihood that all of the constituents in any applied water will reach groundwater decreases. The thicker vadose zone provides greater opportunities for ion exchanges and changes to any chemically unstable constituents such as nitrate.

2. Irrigation practices in the Kern area are some of the most advanced in the State. As a result of increasing water costs and to improve efficiency and production, many growers have switched away from traditional flood and furrow irrigation years ago and now utilize some form of low application sprinklers (mostly micro spray) or drip technology. It is reported that Kern area on-farm irrigation efficiency is 95%[2]. Accordingly, with water being applied through more efficient irrigation practices employed in our area, there is less likelihood of any "wastes" moving down to groundwater.

3. Information from experts in Kern, including Farm Advisors, Farm Managers, Certified Crop Advisors and growers themselves, indicate that nitrogen fertilizers are not being applied in excessive amounts. It is a known fact that California growers today are much more agronomically educated and economically knowledgeable than their predecessors. The majority of people involved with production agriculture, and nitrogen fertilization in

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[1] Wood P.R. and G.H. Davis 1959 Ground-Water Conditions in the Avenal-McKittrick Area, Kings and Kern Counties. California, Geological Survey Water-Supply Paper 1457. Washington, D.C. Department of the Interior and U.S. Bureau of Reclamation.

[2] Sanden, Blake. 2008. How Good is Water Use Efficiency in California Agriculture? Bakersfield, CA.: University of California Cooperative Extension Kern County. Available at: http://cekern.ucdavis.edu/Irrigation_Management/How_Good_is_Water_Use_Efficiency_in_California_Agriculture/. Accessed August 7, 2012.

particular, are familiar with the Law of Diminishing Returns. In fact, crop fertilization is often used to illustrate this concept, which is used in many other disciplines.

In 2011, the total acreage in Kern County composed of fruit and nut tree crops was 385,319 acres. Bearing almond acreage was 151,765 acres, or a significant 39.4% of the total fruit and nut tree crop acreage. Almonds are the most researched California tree crop for obvious reasons. The Almond Board of California[3] (ABC) has provided growers with an immense amount of information regarding almond nutrition. Consequently, it can be reasonably concluded that most of this acreage must be under careful nutrient management translating to careful nutrient management of a high percentage of permanent Kern County cropland.

4. We have some of the most advanced and clearly the largest water banking projects in the world in Kern. (Attached is a map showing the location and general characteristics of each.) Some of these projects are "partnerships" with urban agencies throughout the State. Most of the projects involve pumping stored groundwater back to the California Aqueduct for "return" and use, either in Kern or other areas of the State. All such water returned to the California Aqueduct is already subject to water quality guidelines, as specified by the Department of Water Resources. The fundamental purpose of these banks would be threatened by the intrusion of poor quality groundwater. This clearly creates motivation within Kern to protect our groundwater quality.

5. There are a few areas (approximately 4% of Kern area water systems serving about 0.2% of the overall population) on the valley floor, where communities have drinking water systems which have delivered water that exceeded the nitrate MCL since 2005. In conjunction with EPA's Safe Drinking Water Search (SDWIS) database and the California Department of Public Health, we have compiled the attached table summarizing water systems within the Kern area with reported nitrate MCL exceedances in the last 8 years, along with resolution of each, if known. In several instances, these issues have already been addressed or can be addressed by hooking up to existing public water supplies. Fortunately in Kern, most of our population is in larger metropolitan areas or towns where there has been adequate funding to address water quality issues, although the record will show most of the problems are for constituents other than nitrates. We are prepared to assist with resolution of any remaining issues. "Bottom line", this multi-million dollar per year regulatory program will do very little if anything to provide safe drinking water to our residents!

6. In major areas where drinking water sources have in the past had higher nitrate levels exceeding the MCL, it is evident that much of that "pollution" came from sources other than agriculture. The most significant area of nitrates in drinking water is the Rosedale area, generally west of the City of Bakersfield, which for the most part is in an unincorporated non-sewered area, with residents relying on septic systems.

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[3] Almond Board of California. 2010 and 2011. Almond Sustainability Modules. Modesto, Cal.: Almond Board of California. Available at: http://www.almondboard.com/Growers/Sustainability/SustainabilityModules/Pages/Default.aspx. Accessed 07 August 2012.

7. Essentially the entire Kern sub-coalition is "covered" with organized water and similar districts and agencies (see attached map), those being the members of the Authority. All of these agencies manage groundwater as part of their responsibilities, to the extent that they have usable supplies. Many of them have long adopted AB 3030 or SB 1938 groundwater management plans, that include groundwater quality monitoring components.

These are just a few facts distinguishing the Kern area from others. Further information will be developed. Of course, we welcome an opportunity to meet with the Board and/or staff to engage in an exchange of information and discuss these issues further.

We also note, although not unique necessarily to our area, to the extent the Regional Board and staff may place any reliance on the report entitled "Addressing Nitrate in California's Drinking Water" (Harter and Lund, January, 2012), many of the assumptions and calculations in that report are clearly in error. Please refer to our letter of May 23, 2012, to the State Board providing our preliminary review, a copy of which is attached.

The Regional Board's Jurisdiction

To be clear, there is no question the Regional Board has jurisdiction to prevent pollution of groundwater—and we want the Regional Board to exercise its jurisdiction to protect groundwater where appropriate for the benefit of our landowners and residents, and to protect our unique water banking assets.

However, as you know, the Regional Board's jurisdiction is not unlimited. Among other things Water Code section 13263, under which this proposed General Order would be advanced, provides in part "The requirements shall implement any relevant water quality control plans that have been adopted, and shall take into consideration . . .the provisions of Section 13241." Water Code Section 13241 in turn provides in pertinent part that water quality control plans are to "ensure the <u>reasonable</u> protection of beneficial uses. . .however, it is recognized that it may be possible for the quality of water to be changed to some degree without <u>unreasonably</u> affecting beneficial uses." Similarly, Water Code section 13050(l) defines "pollution", which is what the Regional Board is to prevent, in part as the "alteration of quality of waters of the state by waste to a degree which <u>unreasonably affects</u>. . .waters for beneficial uses."[4]

That is, the Board's authority to adopt a general order pursuant to section 13263 is subject to providing "reasonable protection" of beneficial uses of groundwater and it does not have the authority to adopt regulations that do not reasonably protect groundwater from some "waste". Based on the facts as we know them to be in our area, we do not believe anyone can credibly assert that the proposed General Order meets this standard, at least as it applies to the Kern area.

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[4] In Finding 23 of the proposed General Order, Water Code Section 13267 is cited as a source of authority for the proposed order. Assuming that Section is a valid basis for the proposed order, along the same lines of the cited authorities above requiring "reasonableness," it is noted that Section 132367(b)(1) (which is quoted in Finding 22) provides in part "<u>The burden, including costs of these reports shall bear a reasonable relationship to the need for the reports and the benefits to be obtained from the reports.</u>"

Furthermore, if there were some modest benefits to implementing the proposed General Order, in light of the staff's estimated cost to implement this program of approximately $120 per acre per year, or approximately $125,000,000 per year for our area, how could this program satisfy any cost-benefit analysis? And even if the staff's estimate is excessive, in light of the fact Kern growers have already significantly implemented efficient farming and irrigation practices, let's say it is only 10% of the estimate, is approximately $12,500,000 per year justified? **In light of this extreme cost , and lack of any clearly defined benefits to be obtained through the proposed General Order (at least as applied to Kern), how can it be said that the proposal meets the legal standard of a "reasonable" regulation of water quality?**

Conclusion

For reasons noted above, we do not believe the Regional Board has jurisdiction to impose the proposed General Order upon the Kern area as it relates to groundwater and/or that the proposed General Order would constitute an unlawful overly burdensome and unreasonable regulation. If, however, the Regional Board provides for a General Order applicable to the Kern area, we encourage that it develop a new approach.

To that end, if the Regional Board continues to assert that a General Order must be in place for the Kern area we respectfully request that (i) the Kern area be as a separate coalition area, (ii) a proposed order be drafted to be reflective of local conditions and institutions and be efficient, cost effective and practical, (iii) a proposed order should include flexibility to incorporate the latest available science and data, both existing or available later, and (iv) that additional time be allowed for your staff to work with us to develop such an order and allow for adequate public review. We stand ready to work with you and your staff to implement such an approach.

Thank you for consideration of our views.

Very truly yours,

Eric Averett, Chairman

cc: Senator Michael Rubio
Senator Jean Fuller
Assemblywoman Shannon Grove
Kern County Board of Supervisors

Attachments: Water banking projects in Kern Sub-watershed;
Drinking water systems exceeding the nitrate MCL since 2005;
Kern Sub-coalition water district agency and map;
May 23, 2012 letter to SWRCB regarding UC Davis Report

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May 22, 2012

Charles R. Hoppin, Chairman and Members
State Water Resources Control Board
1001 I Street
Sacramento, CA 95814

Re: Comments on UC Davis Report On Nitrate In Groundwater

Dear Chair Hoppin and Members of the Board :

I am a registered agricultural and civil engineer with extensive experience with water quality issues, including assisting numerous dairymen with the Dairy General Order. I represent the Kern River Watershed Coalition Authority that currently administers the surface water program in Kern County.

As we consider promising options to deal with nitrate issues, I urge you to keep in mind that agriculture is an important industry and has a part in this issue. While water quality is very important, we need to maintain competitiveness and the viability of agriculture in the state. The potential options being considered portend radically higher operating costs. If the rationale for action is in this UC Davis report, we need to look at the report very carefully. Wise decisions must be made based on sound data to ensure good results, finding the optimal and reasonable path forward. The UC Davis report was a monumental effort and it has been a big undertaking just to review it. We have only begun to review the report. The following are some preliminary comments and observations of fundamental shortcomings and incorrect assumptions on which the report relies—based on additional review we will undoubtedly have further comments.

We are concerned about the design of the study: leaching to groundwater is deduced by subtracting estimates of other outputs from estimated inputs, with attendant errors. We fear that errors can be magnified in this way. Direct empirical analysis regarding leaching is lacking. The report suggests that approximately $200 million per year is wasted over 3.12 million acres. It is difficult to believe that farmers could waste an average of $64/ac. This averages out to 137 lb/ac/yr N going to groundwater, a very large number compared to typical nitrogen fertilizer recommendations. See attachment A. The report notes that there is significant uncertainty (+/- 30%) in the 195 Gg N/yr leaching estimate to groundwater. Based on my review of the assumptions below, I submit that this must be much lower.

The report lacks measurements and makes many significant assumptions. One of these assumptions was that the growth of the dairy industry created an excess pool of nitrogen that is unabsorbed by crops. The report fails to take into account that dairies are under a General Order of Waste Discharge Requirements which includes mandatory nutrient management plans (NMPs). The report acknowledged that little is known about the amount of synthetic fertilizer applied on fields receiving manure, but assumed that much of the manure applied on and off dairies was not used beneficially. Largely, it was assumed that crop needs were met by synthetic fertilizer and much of the manure was applied as surplus.

Figure ES-2 in the UC Davis report suggests that nitrogen from land-applied dairy manure is nearly enough to meet the harvest uptake of 3.12 million acres of crops. Assuming an uptake of 425 lb N/ac for double cropped wheat and corn (attachment A) and 10% atmospheric losses, the 127 Gg N/yr of land-applied dairy manure can be utilized on approximately 423,000 acres. This is 32% more than the 320,000 acres that is estimated to be under dairy management. See equation 1.

$$127\,Gg\,N * 90\% * \frac{lb}{453.6\,g} * \frac{ac}{425\,lb} * \frac{1}{1.4} = 423{,}000\,ac$$

Equation 1

The 320,000 acres of dairy land that is available can harvest 62 Gg N/yr. See equation 2.

$$320{,}000\,ac * \frac{425\,lb\,N}{ac} * \frac{453.6\,g}{lb} = 62\,Gg\,N$$

Equation 2

The 381 Gg N/yr applied over 3.12 million acres averages out to 242 lb N/ac/yr. This seems in the acceptable range given the table of nitrogen uptake values in attachment A. The simple average of all crop uptakes in this table is 200 lb/ac. However, looking at the average harvest uptake over the study area raises some doubt. 130 Gg N/yr averaged over 3.12 million acres yields 92 lb N/ac/yr. See equation 3. This is very low, perhaps 1/2 to 1/3 of what it should be, judging by the nitrogen uptake values in attachment A.

$$\frac{130\,Gg\,N}{yr} * \frac{1}{3{,}120{,}000\,ac} * \frac{lb}{453.6\,g} = \frac{92\,lb}{ac * yr}$$

Equation 3

If dairy land and the associated harvest uptake (calculated in equation 2) is taken out and averaged over the remaining acres, it further supports that the harvest value is significantly underestimated. See equation 4. This is much less than the lowest values on the table in attachment A.

$$\frac{(130-62)\,Gg\,N}{yr} * \frac{1}{2{,}800{,}000\,ac} * \frac{lb}{453.6\,g} = \frac{54\,lb}{ac * yr}$$

Equation 4

The data that this report is based on is five years old. Several notable changes have occurred in this time, and would likely affect the data. The Dairy General Order has been implemented and data is being collected that could potentially address some of the assumptions that were made. There has been increased adoption of subsurface drip irrigation (SSDI) and other low volume irrigation methods with higher irrigation efficiencies and precision water and nutrient application. Higher irrigation efficiencies result in less deep percolation and less opportunity for nutrients to leave the root zone.

It is important to note that the whole study area is not homogeneous. The Kern sub-watershed is different in several ways. The study assumed a typical groundwater recharge rate of 1 ac*ft/ac/yr. I submit that the average in Kern is significantly less than that, due to good irrigation efficiency and even regulated deficit irrigation. Due to reductions in available water supplies, Kern is chronically water-short. Water is rationed and valuable, and the same is true for nitrogen fertilizers. I believe that the state of nutrient management in the Kern sub-watershed is good, as farmers already have a profit motivation to be good stewards. There are other unique issues in Kern such as moisture deficient soils, aquitards, and naturally occurring brackish waters that all indicate a low threat to groundwater quality, even if deep percolation existed.

Altogether, this report raises questions regarding conclusions that can be made about current impacts. What we are seeing in groundwater now are legacy issues. In light of the questions that we have and the importance of the subject, we would like to have more outreach sessions regarding assumptions that were made and how the conclusions may be different with different assumptions. We'd like an opportunity to help with better assumptions. One of the biggest assumptions that we've questioned above has been regarding manure applications. We submit that synthetic applications likely went down as manure became available. We are concerned whether similar assumptions were applied to sludge applications as well. We do not agree with assumptions that manure or other resources are not being used beneficially by farmers, especially in light of the Dairy General Order. With indicated harvest uptake numbers likely underestimated, leaching has to be much lower than 138 lb/ac/yr. Agriculture can't be wasting an average of $64/ac/yr.

Please continue to strive for a true assessment of legacy vs. current issues and use good data and conclusions to make wise, optimal, and reasonable decisions.

Respectfully,

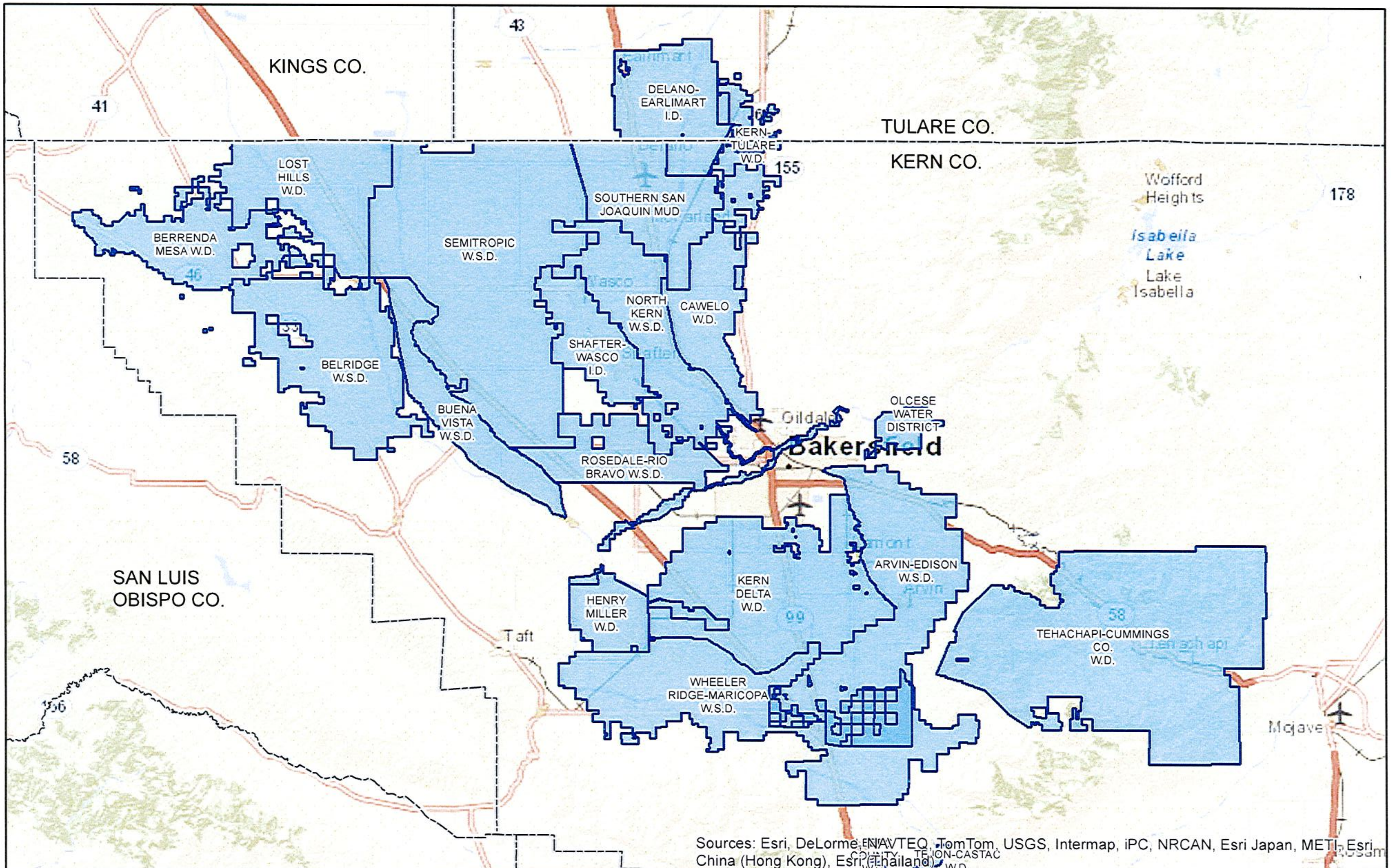
John Schaap
RAE 563, RCE 61754

Attachment A. Table of nitrogen uptake for various crops.

Attachment A

Plant Food Utilization by Various Crops
Western Fertilizer Handbook, 8th edition

Crop	N, lb/ac	
Field crops		
Barley	160	
Canola (whole plant)	240	
Corn (grain)	240	
Corn (silage)	250	
Cotton (lint)	180	
Grain sorghum	250	
Oats	115	
Rice	110	
Safflower	200	
Sugar Beets	255	
Wheat	175	
		198 average
Vegetable crops		
Asparagus	95	
Beans (snap)	175	
Broccoli	80	
Cabbage	270	
Celery	280	
Lettuce	95	
Potatoes (Irish)	270	
Squash	85	
Sweet potatoes	155	
Tomatoes	180	
		169 average
Fruit and nut crops		
Almonds (in shell)	200	
Apples	120	
Cantaloupes	220	
Grapes	125	
Oranges	265	
Peaches	95	
Pears	85	
Prunes	90	
		150 average
Forage crops		
Alfalfa	480	
Bromegrass	220	
Clover-grass	300	
Orchardgrass	300	
Sorghum-sudan	325	
Timothy	150	
Vetch	390	
		309 average
Average	201	



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Kern River Watershed Coalition Authority

Water Districts

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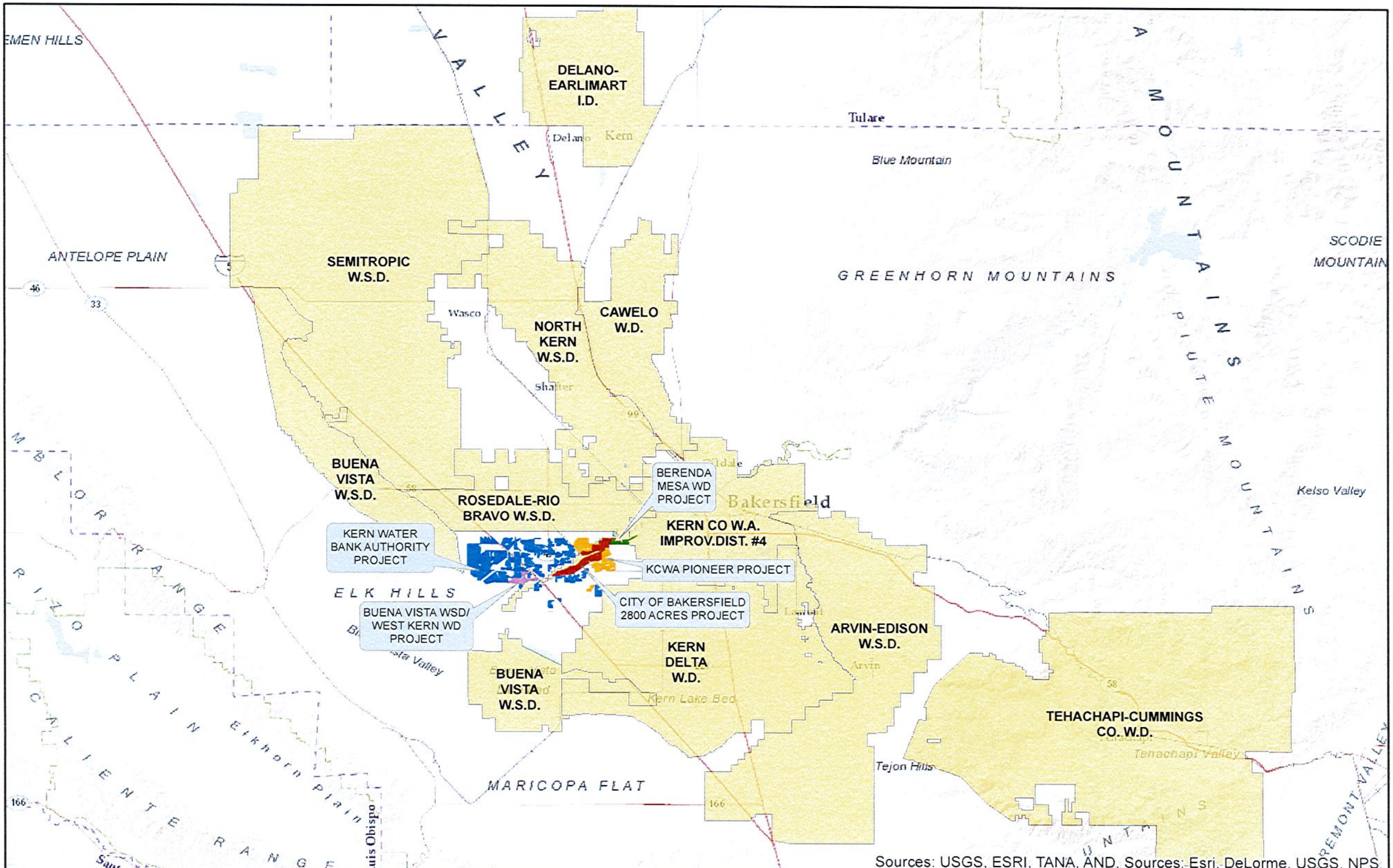

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Legend

Districts With Groundwater Banking Programs

Kern River Watershed Coalition Authority

Districts with Groundwater Banking Facilities and Other Regional Banking Facilities

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Water System Name	Population Served[1]	No. of Connections[2]	Number of Exceedances				Most recent NO_3 conc.[1], ppm NO_3	Compliance Period[1]	Solutions Identified[2]
			2005-2007	2008-2010	2011	2012			
Arvin Community Services District	14,713	3,536	2	2					Issue resolved, as affected well is offline. Replacing when funds are available.
Brock Mutual WC[3]	500	155		2					Consolidate w Vaughn Water Co. Well on to be put on standby or abandoned.
East Wilson Road Water Company	35				4	1	54	1st Qtr 2012	Connection to East Niles CSD. They got a planning grant and are extending a pipeline and will abandon affected wells.
Enos Lane Public Utility District	270	82	1				52.1	2nd Qtr 2007	Options: Nitrate blending treatment OR consolidate w Vaughn Water Co.
Gooselake Water Company	80	32		1			48.3	4th Qtr 2008	Options: Drill 2nd well OR consolidate w nearby water system.
I & I Farms Inc.	50		1		3	1	74	1st Qtr 2012	RO treatment (assumed)
Murray Family Farms Fruit Stand	50			1		1	50	1st Qtr 2012	RO treatment (assumed)
Orange Grove RV Park[3]	200	180	2						Considering connection to East Niles CSD.
San Joaquin Estates Mutual Water Co	165				2	1	57	1st Qtr 2012	Options: Consolidate w East Niles, drill new well, OR treat water
Seventh Standard Mutual	66	22	2	2	1	1	46	1st Qtr 2012	Install water delivery pipeline & new lines & meters to residents. Consolidating with Oildale Mutual.
Son Shine Properties	500	106		2	1		49	4th Qtr 2011	Consolidation with Arvin CSD pending.
Sun Pacific Shippers - Maricopa Water Sys	350				2	1	48	1st Qtr 2012	RO treatment (assumed)
Wheeler Farms Headquarters	25	13			4	1	140	1st Qtr 2012	RO treatment (assumed)
Wilson Road Water Community	72			3	4	1	76	1st Qtr 2012	Options: water treatment or intertie with East Niles CSD
Total Exceedance by Year			**8**	**13**	**21**	**8**			

[1] Information from database search on EPA's SDWIS website (http://oaspub.epa.gov/enviro/sdw_form_v2.create_page?state_abbr=CA)

[2] Information from database search from CA Dept. of Public Health for unincorporated water systems

[3] Water system added from database search from CA Dept. of Public Health for incorporated water areas