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February 4, 2015

Attn: Mr. Dean Hubbard
1685 E Street
Fresno, CA 93251

Subject: Groundwater Quality Assessment Report
Buena Vista Coalition

Mr. Hubbard

Enclosed with this letter is the Groundwater Quality Assessment Report (GAR) for the Buena Vista Coalition (BVC.) The report was developed to meet the requirements of the Waste Discharge Requirements for Growers within the Tulare Lake Basin that are members of a Third Party Group, Order R5-2013-0120.

If you have a question in regards to this report please contact Mr. Tim Ashlock, PE at 661.979.6182 or 661.324.1101, or by email at tim@bvh2o.com.

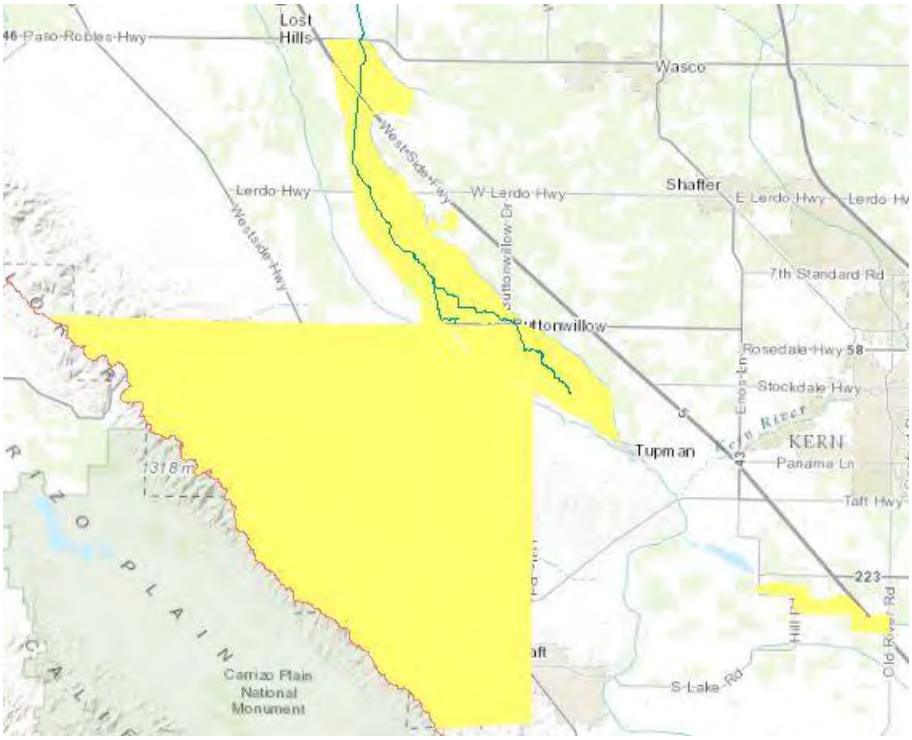
Respectfully,

Tim Ashlock, PE
Buena Vista Coalition

BUENA VISTA COALITION (BVC)

GROUND WATER QUALITY ASSESSMENT REPORT

February 2015



R5-201300120

Buena Vista Coalition

525 N. Main St.

Buttonwillow, CA 93206

BUENA VISTA COALITION
GROUNDWATER QUALITY ASSESSMENT REPORT

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BUENA VISTA COALITION
GROUNDWATER QUALITY ASSESSMENT REPORT

I. INTRODUCTION

The Buena Vista Coalition (BVC) has prepared this Groundwater Assessment Report (GAR) in accordance with the Central Valley Regional Water Quality Control Board's (RWQCB) General Order R5-2013-0120 (Order). The Order delineates Waste Discharge Requirements for growers within the Tulare Lake Basin Area who are members of a third party group.

This Order covers both irrigated waste discharges from irrigated lands, as well as storm water run-off from the same irrigated lands. The purpose of the GAR is to analyze existing monitoring data and provide the foundation for designing the Management Practices Evaluation Program (MPEP) and the Groundwater Quality Trend Monitoring Program, as well as identifying high vulnerability groundwater areas where a groundwater quality management plan must be developed and implemented.

The GAR must gather sufficient data to establish whether existing or newly implemented management practices comply with the ground water receiving limitations of the Order. The order defines these limitations as:

> Wastes discharged from Member operations shall not cause or contribute to an exceedance of applicable water quality objectives in the underlying ground water, unreasonably affect applicable beneficial uses, or cause or contribute to a condition of pollution or nuisance.

Additionally the groundwater monitoring must answer these critical questions.

1. What are irrigated agriculture's impacts to the beneficial uses of groundwater and where has groundwater been degraded or polluted by irrigated agriculture operations (horizontal and vertical extent)?
2. Which irrigated agriculture management practices are protective of groundwater quality and to what extent is that determination affected by site conditions (e.g. depth to groundwater, soil type, and recharge)?
3. To what extent can irrigated agriculture's impact on groundwater quality be differentiated from other potential sources of impact (e.g. nutrients from septic tanks or dairies)?
4. What are the trends in groundwater quality beneath irrigated areas (getting better or worse) and how can we differentiate between ongoing impact, residual impact, (vadose zone) or legacy contamination.
5. What properties (soil type, depth to groundwater, infiltration/recharge rate, denitrification/nitrification, fertilizer and pesticide application rates, preferential pathways through the vadose zone [including well seals, abandoned or standby wells], contaminant portioning and mobility[solubility constants]) are the most important

factors in degradation of groundwater while we're identifying management practices that are protective of groundwater?

6. What are the transport mechanisms by which irrigated agricultural operations impact deeper groundwater systems? At what rate is this impact occurring and are there measures that can be taken to limit or prevent further degradation of deeper groundwater while we're identifying management practices that are protective of groundwater?
7. How can we confirm that management practices implemented to improve groundwater quality are effective?

Additionally the Groundwater Monitoring Advisory Workgroup (GMAW) reached a consensus that the most important constituents of concern related to agriculture's impacts to the beneficial uses of groundwater are nitrate (NO3) and salinity. In addition to addressing the nitrate problem the presence of nitrates in groundwater at elevated levels would serve as indicators of other potential problems associated with irrigated agricultural practices.

High vulnerability for groundwater is defined as "Areas identified in the approved GAR "…where known groundwater quality impacts exist for which irrigated agricultural operations are a potential contributor or where conditions make groundwater more vulnerable to impacts from irrigated agricultural activities." (see section IV.A.3 of the MRP) or areas that meet any of the following requirements for the preparation of a Groundwater Quality Management Plan (see section VIII.I of the Order): (1) there is a confirmed exceedance (considering applicable averaging periods) of a water quality objective of applicable water quality trigger limit (trigger limits are described in section VII of the MRP) in a groundwater well and irrigated agriculture may cause or contribute to the exceedances; (2) the Basin Plan requires development of a groundwater quality management plan for a constituent or constituents discharged by irrigated agriculture; or (3) the Executive Officer determines that irrigated agriculture may be causing or contributing to a trend of degradation of groundwater that may threaten applicable Basin Plan beneficial uses.

I.1 Purpose of the Groundwater Quality Assessment Report

> "The purpose of the GAR is to provide the technical basis informing the scope and level of effort for implementation of the Order's groundwater monitoring and implementing provisions."

I.2 Objectives of the Groundwater Assessment Report

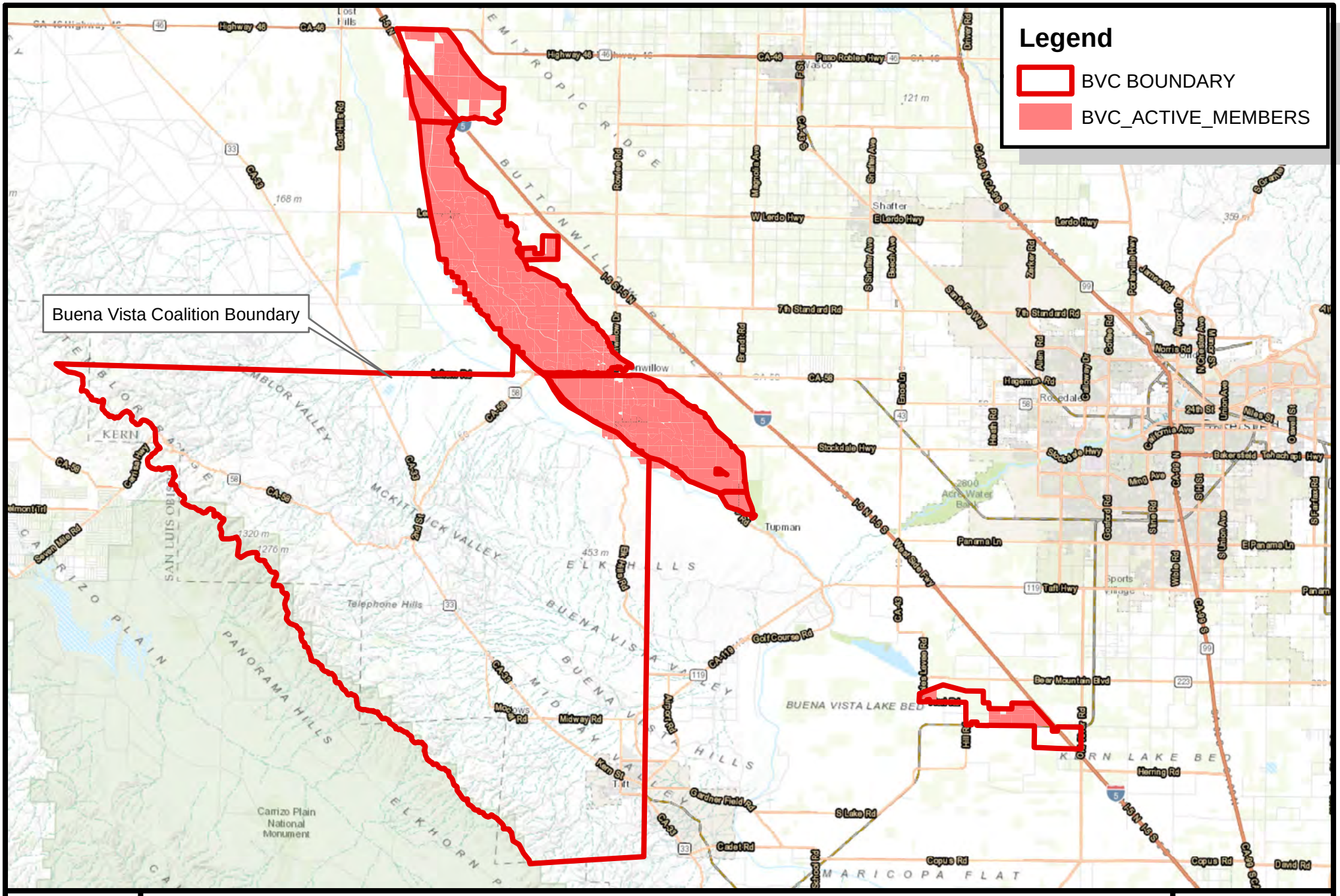
The main objectives of the GAR are:

1. Provide an assessment of all applicable and relevant data and information to determine the high and low vulnerability areas. Low vulnerability is the areas that are not high vulnerability, as previously defined;
2. Establish priorities for implementation and studies of high vulnerability areas;

3. Provide a basis for establishing workplans to assess groundwater trends;
4. Provide a basis for establishing workplans and priorities to evaluate the effectiveness of agricultural management practices to protect groundwater quality; and
5. Provide a basis for establishing groundwater quality management plans in high vulnerability areas and priorities for implementing those plans.

I.3 Coalition Area and Members

The Buena Vista Coalition was originally formed under the previous Order in June, 2013. At that time it consisted of the growers of the Buena Vista Water Storage District (BVWSD). When the new Order was approved, the BVC again requested to represent the members of the BVWSD as a Coalition. This included lands both in the Buttonwillow Service Area (BSA and the Maples Service Area (MSA.) However, at that time the Regional Board wanted the forming coalitions to cover all of the lands of the watershed of the Tulare Lake Basin. The BVC was asked to expand its borders south and west, as shown on the attached, Figure 1. Most of this land was un-farmed, and the few additional parcels which have joined the BVC were adjacent to the Westside Canal and the Kern River Flood Channel Canal. The lands east of the Westside Canal are a part of the Main Drain Canal sub-watershed. The lands west of the Westside Canal are part of the Kern River Watershed as storm water can drain into the Kern River Flood Channel Canal.



BUENA VISTA COALITION

COALITION BOUNDARIES

Figure 1

II – DECSRIPTION OF COALITION AREA

The irrigated farm land of the BVC is in historical swampland, between historic Kern Lake and Buena Vista Lake, the MSA, and about 6 miles north of both the historic Buena Vista Lake, and the new Buena Vista Aquatic Recreation Area with Lake Webb and Lake Evans, the BSA. Both are flat lands, which received Kern River floodwaters. It is flat land with no natural water channels. On the west side of the BVC, both in BVC lands and just outside BVC lands lies the Kern River Flood Channel Canal. This canal was built to direct Kern River floodwaters around the lands of the BVWSD. After the building of the Isabella Dam, and with the subsequent development of agriculture and recharge facilities, flooding does not occur as it historically has. This has been reduced even more with the construction of the Kern River Intertie, which connects the Kern River to the SWP.

The primary lands of the expanded boundary are oilfields. There currently is no agriculture in these lands, except for lands directly adjacent to the BVWSD in its southern end.

In the lands of the BSA there is about 70’ elevation change (300’ in the south and 230’ in the north) in the 25 miles from the southern tip to the northern end. Typically the elevations on the east side of the BVC are similar to the west side, with minor slopes toward the Main Drain Canal. The Main Drain Canal was built at the low point in the mid 1800’s to help drain the original swamp.

In the MSA the land is essentially flat in the east-west direction, with the canal built at about the 295’ contour.

II.1 Climate and Hydrology

The climate of the BVC is arid with an average of less than six inches of rain per year. The summers are hot and dry, while the winters are less dry, and are foggy with normal rainfalls. The BVWSD office is a co-op weather station, where daily rains and temperature highs and lows are recorded. The natural vegetation is minimal, and all agriculture requires irrigation, either from surface supplies or groundwater. The groundwater table in the north portion of the BSA is similar to historic natural levels. In the southern portion of the BSA the water levels are below natural levels, primarily due to groundwater outflow, not from groundwater pumping. The groundwater of the MSA follows its surrounding lands. It is too small an area to have much impact compared to its neighbors.

In northern portions of the BVC there areas exist of both shallow groundwater and perched groundwater. In some places the two likely intersect. The perched groundwater table, which at one time was rising has been dropping, which has allowed some farm lands to be brought back into production. In the northern portion of the BSA, especially in lands to the west the farmland overlies groundwater not suitable for farming, due to very high TDS.

Table 1.Summary Climate Characteristics

Climate Characteristic	Value
Average Annual Precipitation	5.64 inches
Minimum Monthly Precipitation (Avg. July Minimum	0.47 inches
Maximum Monthly Precipitation (Avg. February Maximum)	1.07 inches
Minimum Temperature (Avg. December Minimum)	34.5° F
Maximum Temperature (Avg. July Maximum)	98.4° F

Source: Western Regional Climate Center Station 041244 over the Period from January 1, 1940 through February 28, 2013.

Although the lands of the MSA are capable of having perched groundwater, currently the farming operations are not impacted by shallow waters. This land also use both surface waters and groundwater for their farming operations.

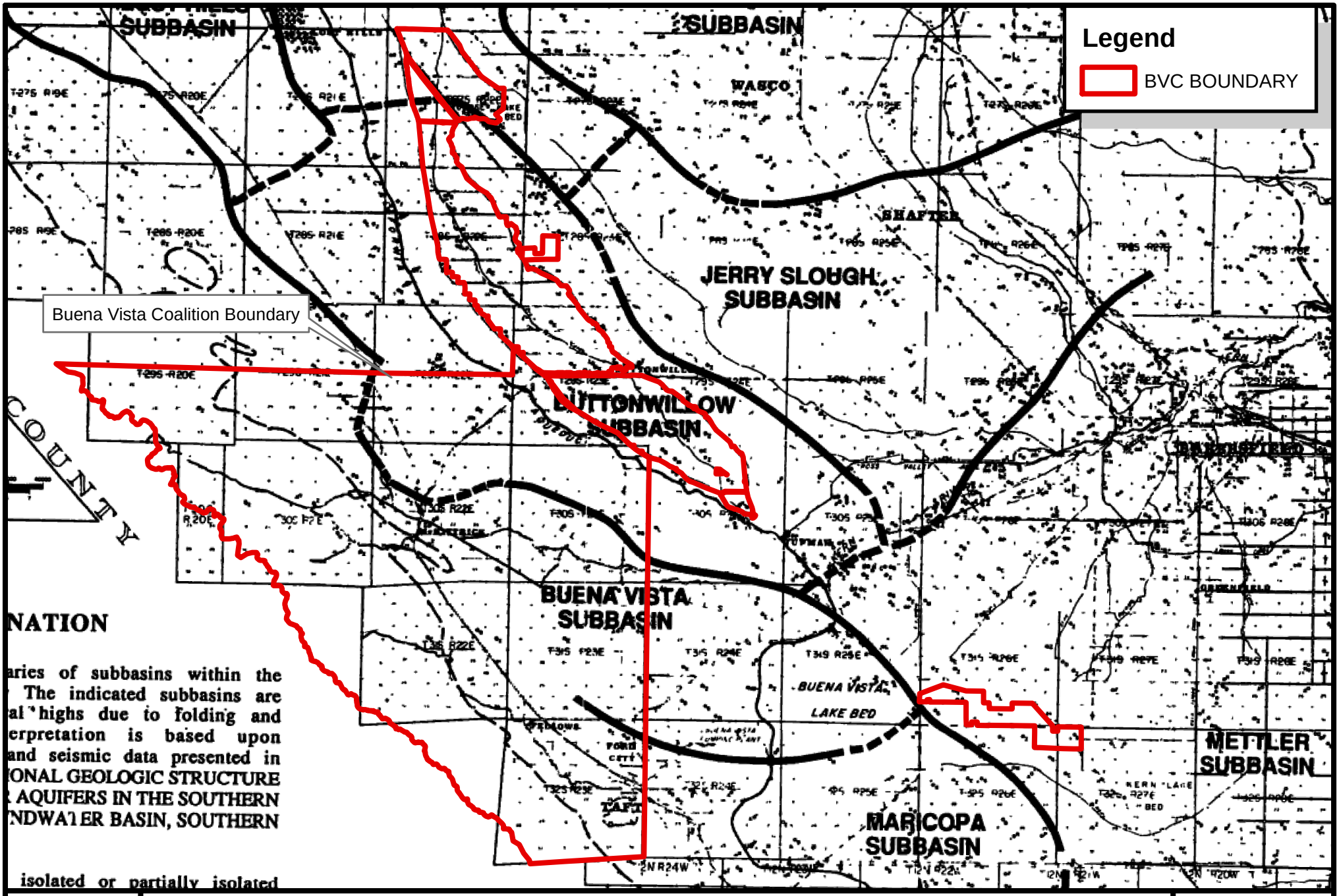
The lands in the BVC but outside the BVWSD typically are only served by groundwater. The BVC is a part of the Tulare Lake Groundwater Basin, and part of the DWR defined sub-basin Kern. It appears the Kern sub-basin, which is more of a political delineation then geologic has several sub-basins. The BSA is within one of these sub-basins, the Buttonwillow sub-basin. This is shown in Figure 2. (Pacific Geotechnical Inc. Study for Kern County Water Agency)

A contour map is provided which shows the depth to groundwater, Figure 3. Figure 4 shows depth to perched groundwater in the northern portion of the BVC. Figure 5 shows the depth to groundwater in 1920. In the northern portion of the BVC the water elevations are similar to 100 years ago. The south has had declines in water levels, but not as severe at the balance of the Kern Water Basin. Note that this map also has a line through the BVC dividing good water versus bad water. Neither good water nor bad water are defined quantitatively.

II.2. Land Use

Most of the lands of the original BVC are farmed. North of I-5 much of the lands have been purchased outright, or by easement to conservation lands. 2800 acres of land are covered by conservation easements, and another 1700 acres owned by California Waterfowl. These lands typically have unirrigated uplands, with wetland ponds which receive some irrigation.

Also in the southern area of the BSA is the community of Buttonwillow. This unincorporated area of Kern County is served by a public water company with its wells within the area of the BVC. The BVWSD does not have any domestic water. The lands of the MSA are all row crops, typically cotton or alfalfa, with some grain. A large portion of the MSA is not covered by this Order, as it is under the Dairy Order, although no actual dairy is within the MSA boundaries. Lands adjacent to the MSA have seen some conversion to permanent crops, pistachios, but none of the lands of the MSA have converted.



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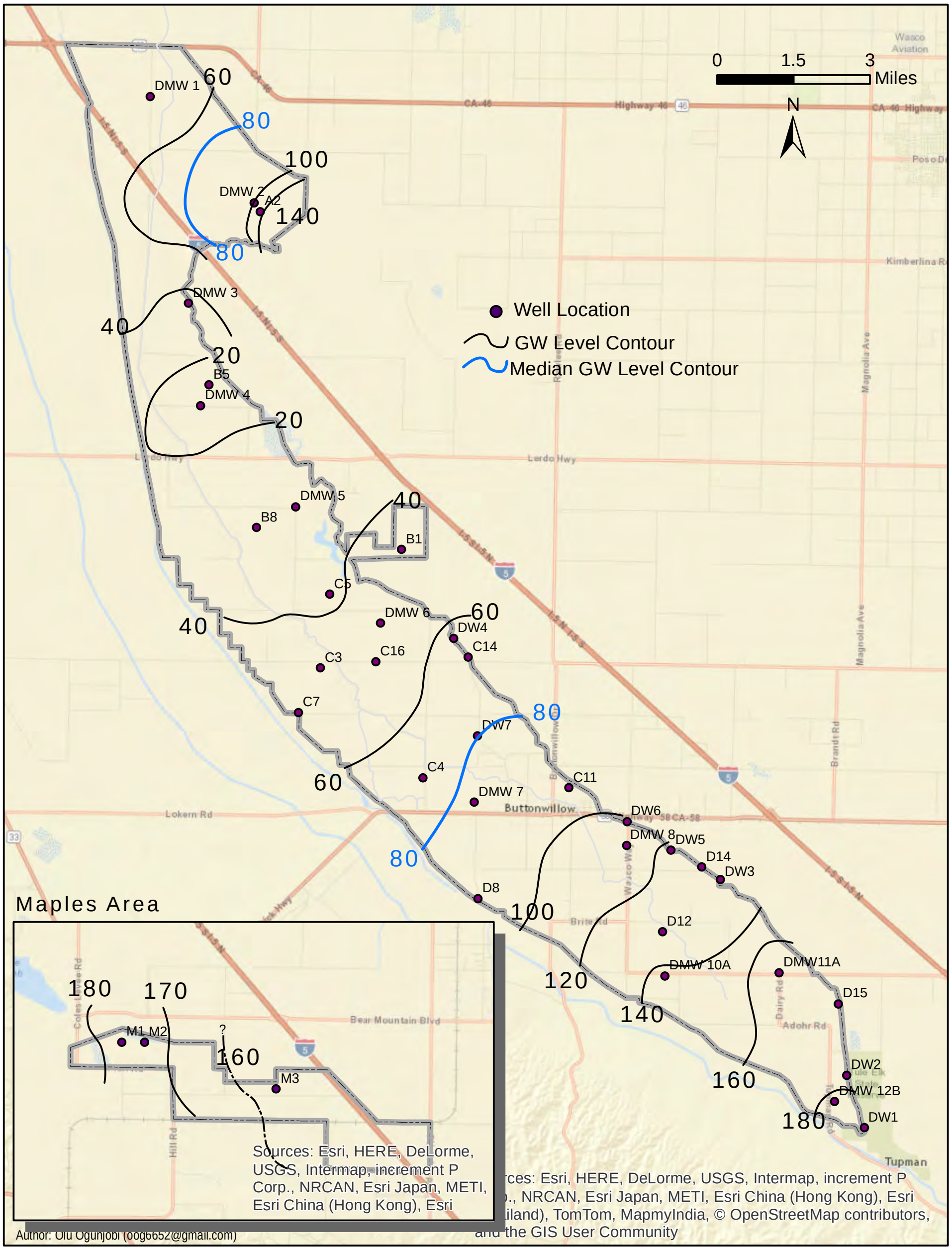
KERN SUB-BASIN (DWR 118) SUB-SUB-BASINS

Figure 2

Groundwater Level Contour Map-Jan 2015 (ft)



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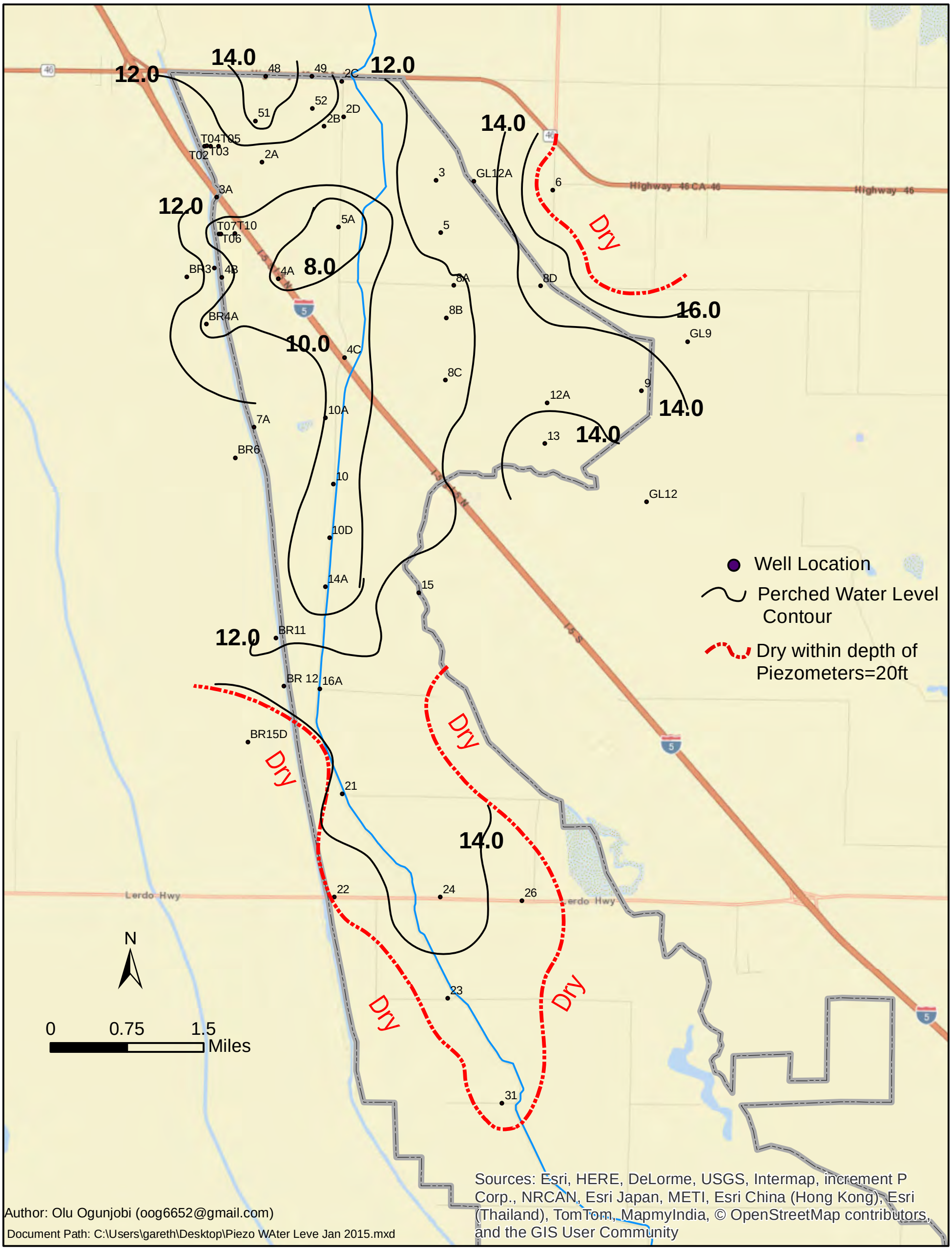
DEPTH TO GROUNDWATER, CONTOUR MAP

Figure 3

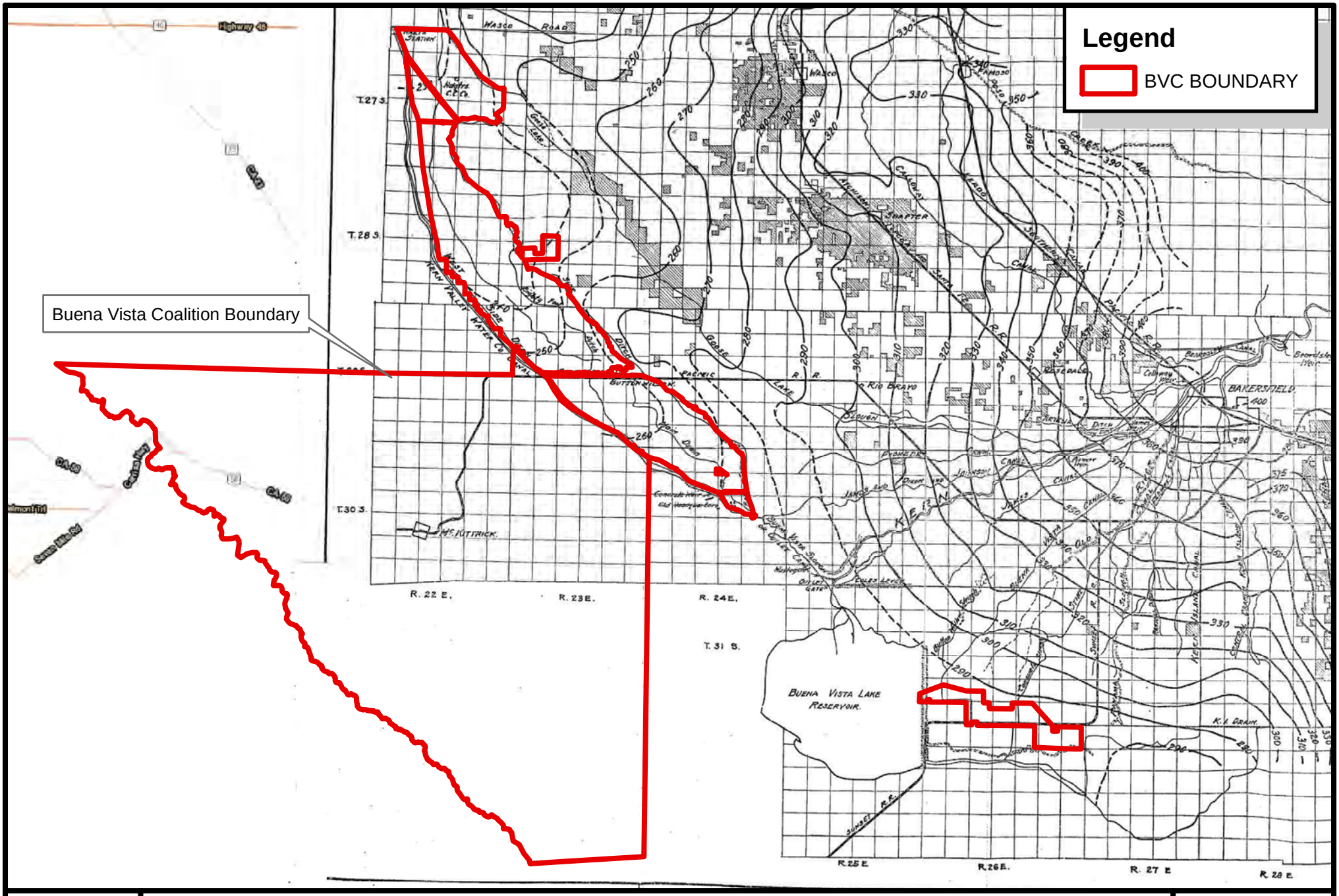
Perched Water Level (ft)- Jan 2015



BUENA VISTA COALITION

DEPTH TO PERCHED WATER, CONTOUR MAP

Figure 4



BUENA VISTA COALITION

DEPTH TO GROUNDWATER, CONTOUR MAP 1920

Figure 5

The BSA for almost 100 years has been dominated by three crops, cotton, alfalfa, and grain. In the last 10 years major portions of the BVC have converted to permanent crops, with the primary three crops being pistachios, dried-on-the-vine raisins, and pomegranates. Additionally, there has been a rotation of tomatoes added to the crop list. Growers have plans for many more conversions from row crops to permanent crops. Other crops are statistically insignificant. Due to the heavy soils there are no root crops, carrots or potatoes grown in the BVC.

A crop map is attached, Figure 6. This map just separates row crops from permanent crops, as management and farming practices vary more on these lines than on the type of row crop or permanent crop.

In dry years some farmers are forced to fallow some of their ground due to lack of water. This option does not exist with permanent crops. The supplemental lands of the BVC beyond the BVWSD follow similar crop patterns.

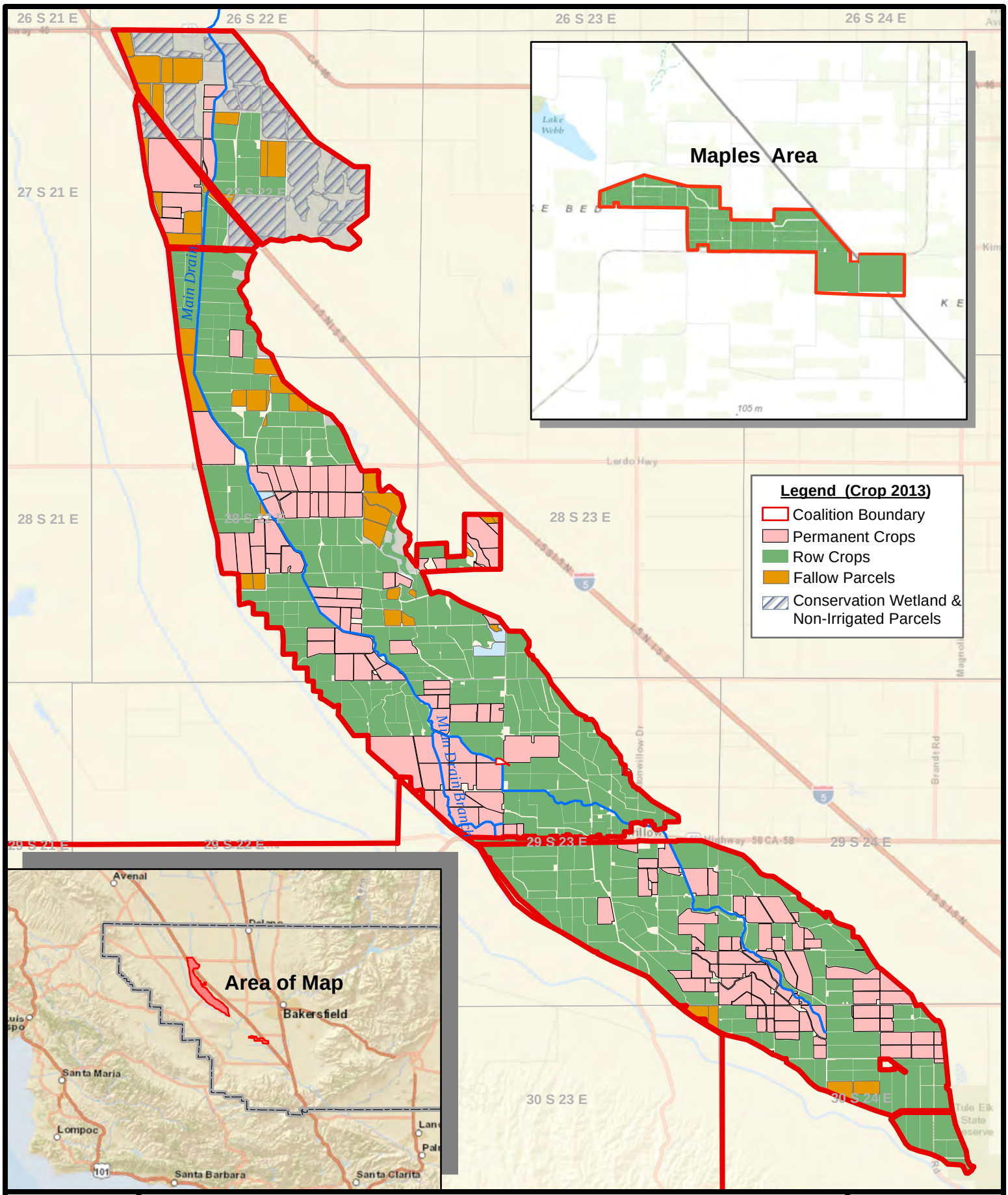
II.3 Groundwater Recharge Operations within the BVC

There are two methods of significant recharge to the groundwater within the BVC. One has been operational for over 100 years, the other is in the process of being developed. The historical method of recharge has been the operation of unlined canals delivering agricultural water to the growers in the BVWSD of the BVC. These canals are at or near the border of the irrigated lands of the BVC in the BSA, and in the middle of the lands of the MSA. Losses from these canals can be significant. For example, in 2013 53,000 a-f of water was delivered into the BVWSD canals, and only 35,000 a-f of water was delivered to farm headgates. The recharge of 18,000 a-f was a loss of 34%. When larger supplies of water are available, the percentage delivered to grower headgates improves.

In the northern section of the BSA there is a perched groundwater issue. The BVWSD is building a pipeline delivery system for the north to minimize groundwater recharge to the perched table. However this will require monitoring of the TDS in the groundwater to assure that the high TDS water in the north and west portions of the BVC do not expand.

There are four primary supply canals in the BVWSD in the BSA, and one in the MSA. These canals will all continue to be used as recharge canals, even if the entire BVWSD is served by pipelines. It is felt these canals will be more effective than the traditional pond.

In 2014 the BVWSD purchased an exclusive easement covering 1100 acres, Palm Farms. This land is to be used for recharge facilities, as well as recovery of the water. This proposed recharge facility, The Palms, is currently going through environmental review. Minor field work has confirmed just below the clay, about 8-10’ below the existing ground surface, is a white river sand. It is felt that with some work this could be a very efficient recharge facility.



BUENA VISTA COALITION

CROP MAP

Figure 6

Also flowing through the District is the Main Drain Canal. This drain almost has a continuous flow, however the flow is very low, which is unlikely to have enough volume to significantly impact the groundwater table or groundwater quality. But it flows through the community of Buttonwillow, and currently even receives their storm run-off.

The attached Figure 7, shows the primary five recharge canals, (Maples, Eastside, Westside, Eighty Foot and Arizona) the Main Drain Canal, and the Palms. Also shown are the community wells which serve the domestic uses in the unincorporated area of Buttonwillow. All domestic water in Buttonwillow comes from these wells.

II.3 Soils

The surface soils of the irrigated farm land of the BVC are similar. Most of the topsoil is a heavy soil. These clays are very slow draining. This is expected from former swamp land. The irrigated lands west of the Kern River Flood Channel tend towards better draining soils. Despite the tight, heavy soils of the BSA and MSA, both overlie groundwater tables where the irrigation wells can provide the necessary water, if the quality is suitable. Figure 8 shows the surface soils of the BVC.

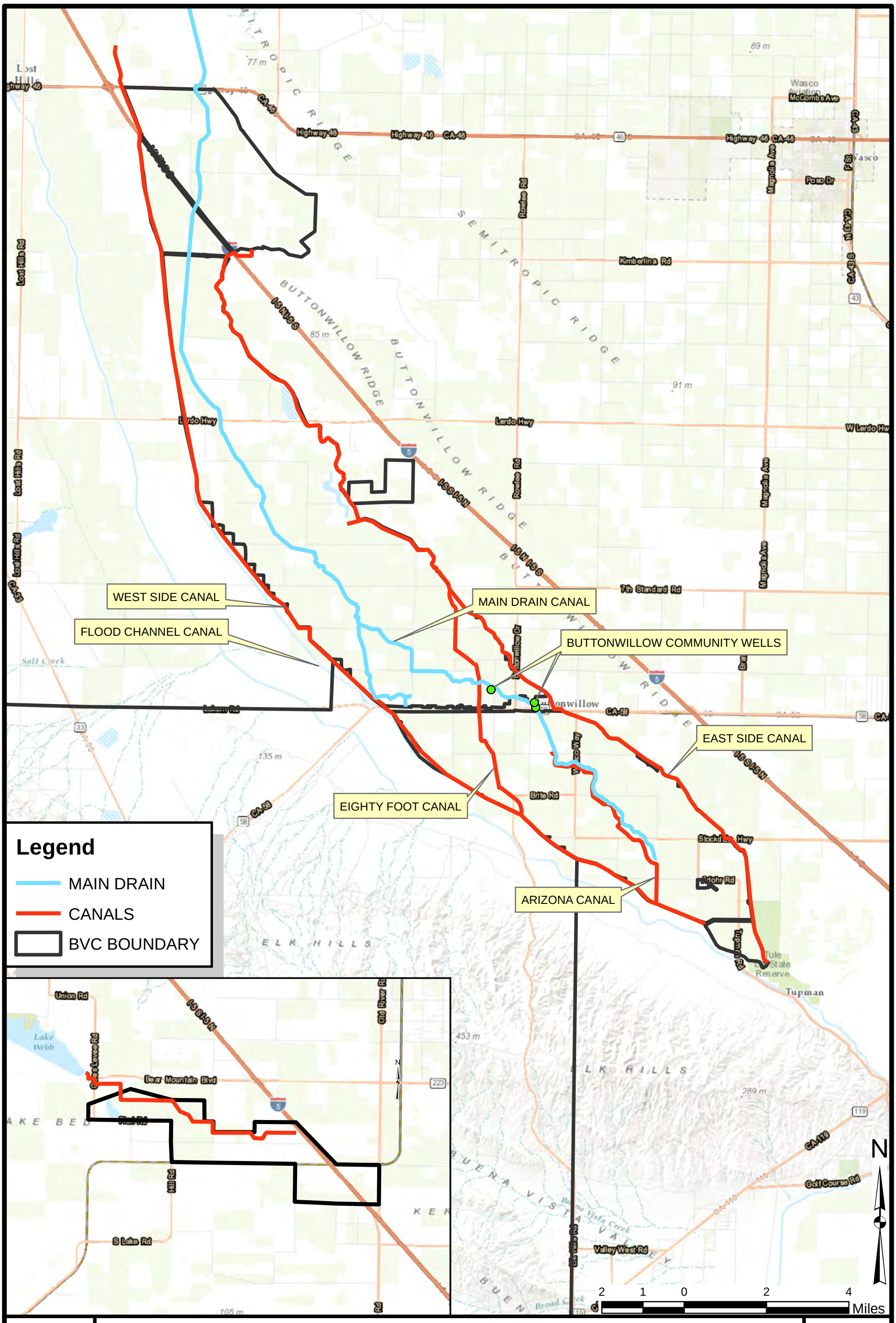
II.4 Beneficial Uses

Per the Basin Plan the groundwater of the areas of the BVC have the following beneficial uses; Agriculture, Municipal, Industrial, and Wildlife. At times in the past readings of the shallow groundwater for TDS could have classified the water non-beneficial, (see 1993 DWR Geologic Study on Perched Water in Northern BVWSD, Appendix A.) Although these readings have improved, and most, if not all of the water in the BVWSD is classified for beneficial use, this water still is difficult to use for agricultural purposes. However this high TDS water has existed prior to groundwater pumping, and is a natural occurrence in the Buttonwillow sub-basin. See Figure 9 which shows the EC of the groundwater of the BVC. The line from Figure 5 delineating good water and bad water is copied onto this Figure of current EC measurements.

II.5 Water Quality Impairments

The groundwater in a portion of the BVC has high TDS, but not so high to be considered non-beneficial. However, practically it is of little use for irrigation of crops. These high TDS levels occur naturally, and have not changed much from agricultural practices in the last 100 years. However they must be monitored to see if the quality is remaining stable or changing, and if the area is stable or changing.

The northern area in the perched water table had high readings of nitrates in the 1993 DWR study, although the data was from 1990. Sometime between 1990 and 1994 the Lost Hills truck stop area at I-5 upgraded its sewage treatment plant from leaching ponds. The BVWSD records indicate high nitrates in 1993, and then never again. Very high readings in both 1990 and 1993, and then very low readings for the next 20 years indicates the old readings are no longer relevant



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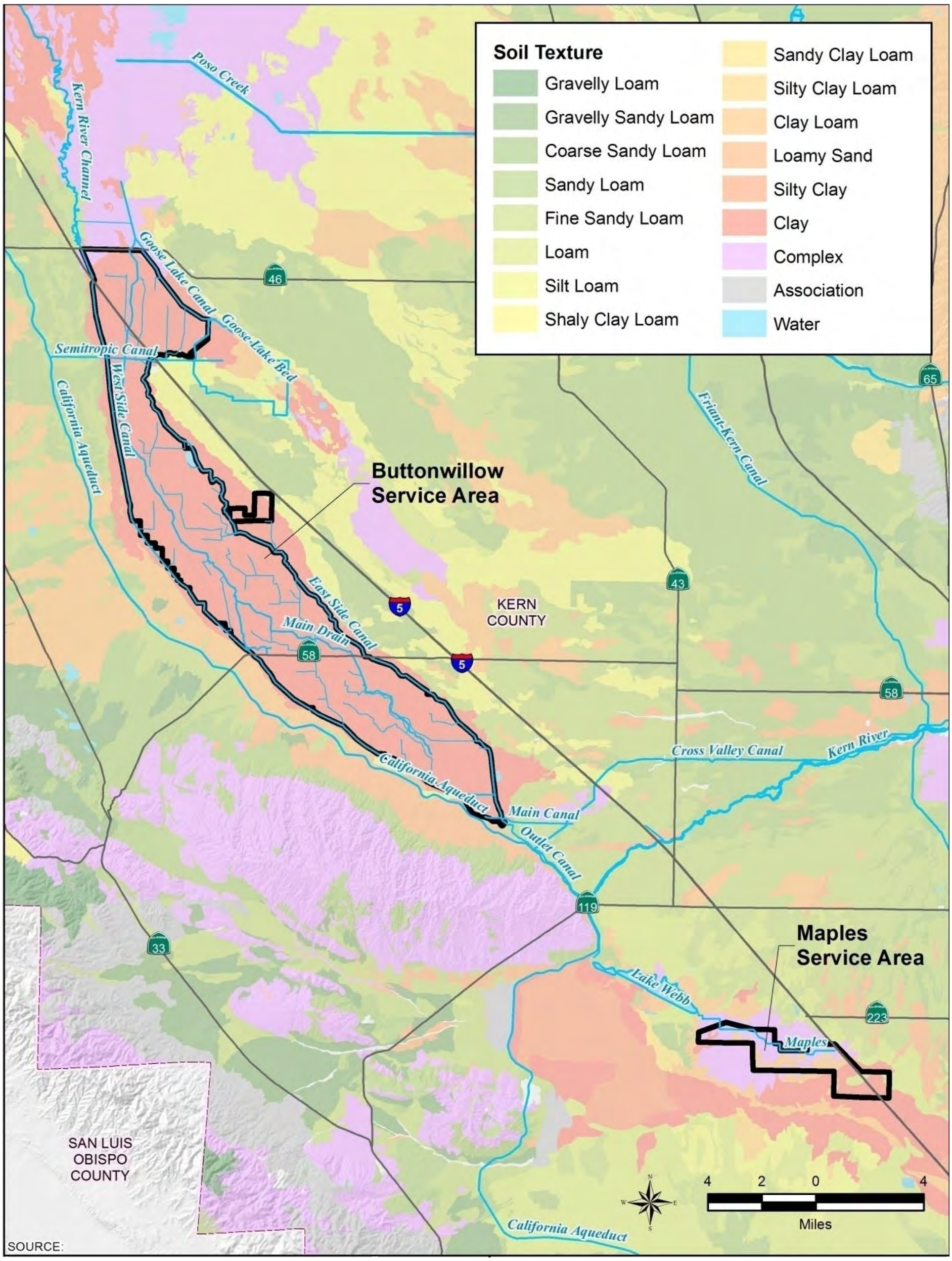
LOCATION OF RECHARGE FACILITIES IN THE BVC

Figure 7



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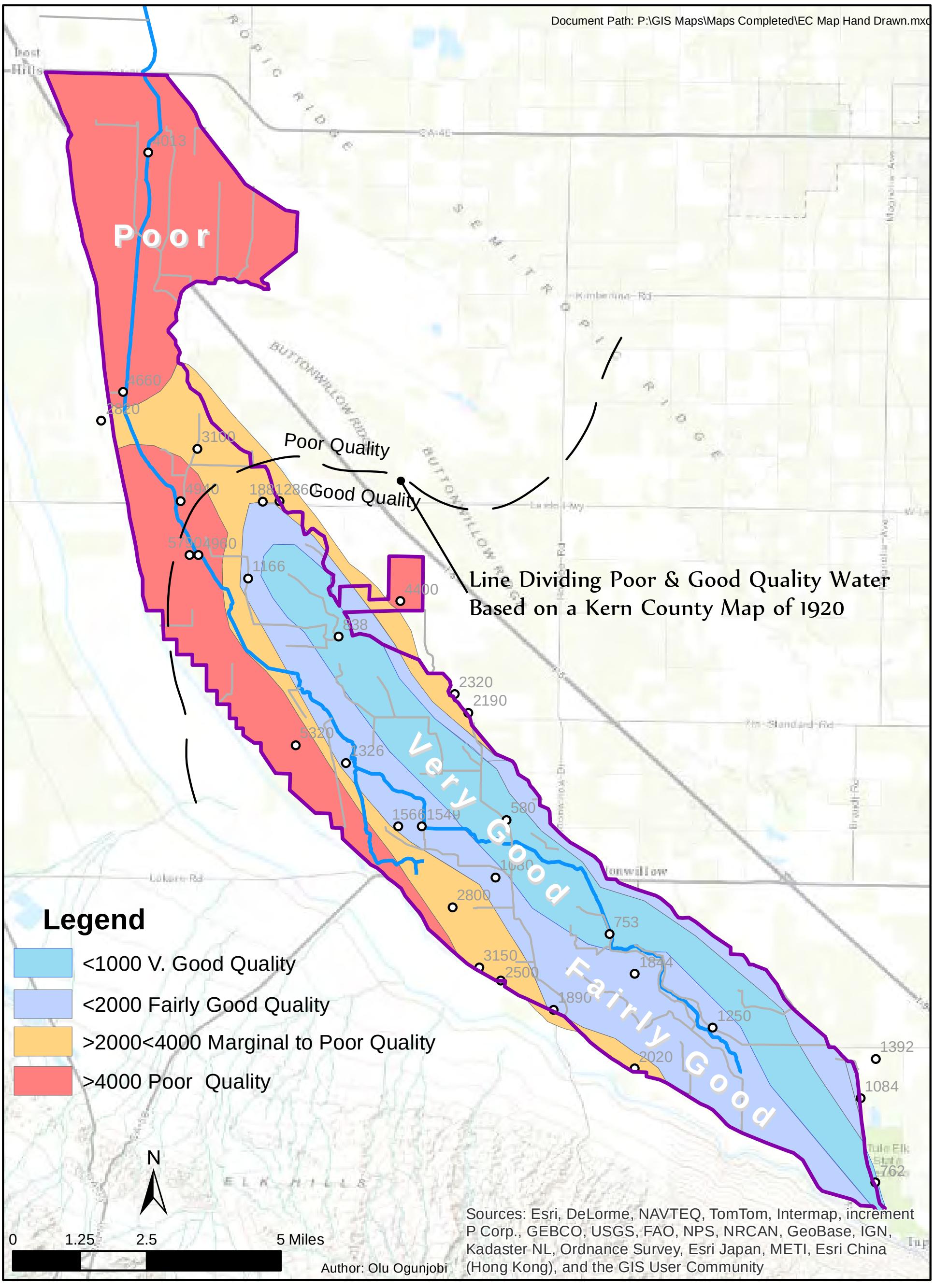
SOILS MAP

Figure 8



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BSA GROUNDWATER ELECTROCONDUCTIVIEY IN MS (MAY 2014)

Figure 9

And should be discarded. It is highly likely that the drop in the nitrate levels was a result of the sewage treatment plant upgrade. With the depth to water level at about 5' in the north end of the BVC in 1990, (see 1993 DWR report) the potential for impacts from the original sewage treatment plant is very high.

Farm management practices have changed in the farmlands to the west of the BVC, which has allowed the perched water table to recede which also decreases the agricultural impacts.

Much of the groundwater in the BVC, especially in the BSA, has many impairments which would require treatment for use of this water for municipal purposes. However, these items, like arsenic, are not at a level where they impact agricultural use. These constituents show as exceedances in the Main Drain SQMP. And these exceedances are shown in Appendix 12. No surface water was delivered to the BVC growers in 2014. Any exceedance in the Main Drain Canal was either from farming practices, or due to native groundwater.

There are minimal locations where there are nitrogen exceedances. This impairment does not limit the water's use for agriculture. However these locations are also near both recharge facilities and the domestic wells for the DAC of Buttonwillow. Shown in Appendix B are recent samples taken from their water system showing acceptable levels of nitrogen.

II.6 Data Collection Information

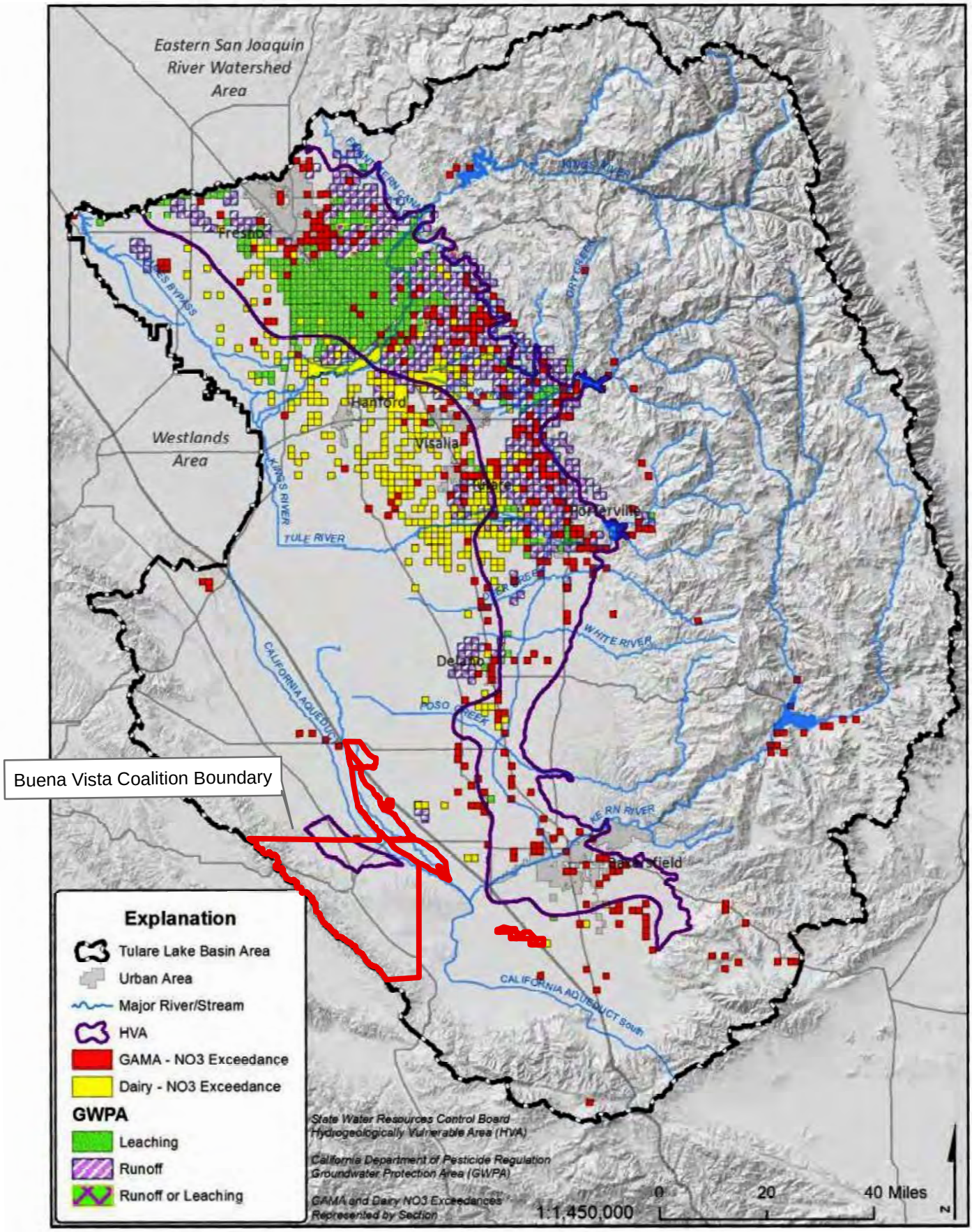
Through the BVWSD the BVC has access to all of the BVWSD groundwater information. This includes information supplied to CASGEM. This includes 7 BVWSD wells, 14 monitoring wells, as well as frequent access to data from growers. These information combined with outside sources like Department of Pesticide Regulation, United States Geologic Survey (USGS) State Water Board Groundwater Ambient Monitoring and Assessment GAMA. Buttonwillow Community Services District, and the Kern County Water Agency.

II.6.a Data Summary Pesticides

Figure 10 is taken from the Department of Public Health and the State Water Board, with the BVC overlaid on the map. This shows there are no areas requiring pesticide monitoring in the BVC at this time.

II.6.b Data Summary Nitrates

The BVC with its extensive monitoring of growers and BVWSD wells has data showing readings from deep wells. The BVWSD is in the process of gathering additional data of nitrate readings in the perched water table in the north. These have not been monitored for nitrates since 1990. However in areas where deep monitoring wells had exceedances in 1993, similar to readings from the 1990 DWR data collection in the perched table, have not shown exceedances in over 20 years.



BUENA VISTA COALITION

GROUNDWATER PROTECTION AREAS

Figure 10

Data needs to be gathered to correlate this with current readings in the perched water table. Interestingly in the 1993 DWR report there was no discussion of the high nitrate readings.

II.6.c Hydrogeologically Vulnerable Areas (HVA)

Figure 10 shows areas determined to be HVA, where groundwater may be more vulnerable to groundwater contamination. There are no areas in the BVC classified as HVA.

III. GROUNDWATER QUALITY ASSESSMENT REPORT DATA REVIEW AND ANALYSIS

The well data for the constituents of primary concern are relatively good. There is only one area of the BVC which historically and continues to have exceedances of nitrates. This is an area where the clay surface soil is not as thick as most of the BVC lands. Analysis of the source of these nitrates was attempted to be made, as there are two potential non-irrigated agricultural sources nearby. About 1.4 miles north of the BVWSD DW #6 is a sewage treatment plant. About 0.5 miles west is an area where a crop dusting business used to operate.

Studies indicate that it is possible to analyze the NO3 and determine if its source was human, chemical, or irrigated agriculture waste. The type of testing and studies of this nature are beyond the capabilities and knowledge of most local testing laboratories. The BVC did attempt to analyze this data, but could not conclusively prove that irrigated agriculture was not the source. The lab was not comfortable reporting their results. This leaves agriculture as a potential source.

There is little data, if any, showing water samples at first encountered groundwater. A review of areas where groundwater is shallow and samples of first encountered groundwater are available might help determine how constituents travel through the clay soils to groundwater, and give guidance to potential problems.

The northern end of the BVC with its shallow groundwater, both perched and non-perched, does not have a lot of agriculture wells, due to the high TDS in the groundwater. These lands typically are served by surface water, or by groundwater from other areas of the BVWSD and transported north with BVWSD canals. However in 1993 the DWR did a study at the request of BVWSD, as the perched groundwater table had increased since the building of the SWP, and a reason for why was being sought, as well as a potential solution.

The data was gathered in 1990, which had very high nitrate readings. The DWR study was published in 1993. Sometime in the time frame from 1991-1994 at the commercial area at Highway 46 and I-5, just west of the Kern River Flood Channel Canal and the BVWSD the sewage treatment plant was upgraded. BVC monitoring wells with perforations at 260-300 and 280-300 feet below ground had readings almost as high as the shallow groundwater. By 1994 through the most recent samples the readings had dropped so that only one monitoring well had a sample between 0.4-10 (mcl-45), with the other being below 0.4. It is felt that both the improved farm management practices on the farm land west of the Kern River Flood Channel Canal and the sewage treatment plant upgrade are the reasons for the change, as well as being the sources of the problem in the past.

It appears that the BVC has high TDS inflows into its groundwater. Both perched and in the unconfined/semi-confined zone show higher TDS readings on the east and west of the BVC, with the lowest readings in the trough, where the high TDS could be diluted by better agriculture water, especially from the unlined canals. Since the BVWSD is considering removing the Westside

Canal from use, and delivering water in the north through a Northern Area Pipeline, the waters of this region will need to be monitored to ensure the new project does not reduce the quantities or beneficial uses of the existing groundwater. Studies have shown that both the change in the groundwater and salt balance should be insignificant. (GEI 2014.)

Groundwater in the BVC has naturally occurring high levels of Arsenic, Boron, Molybdenum, EC, and TDS. The Main Drain Canal when running tailwater has exceedances of chlorpyrifos too.

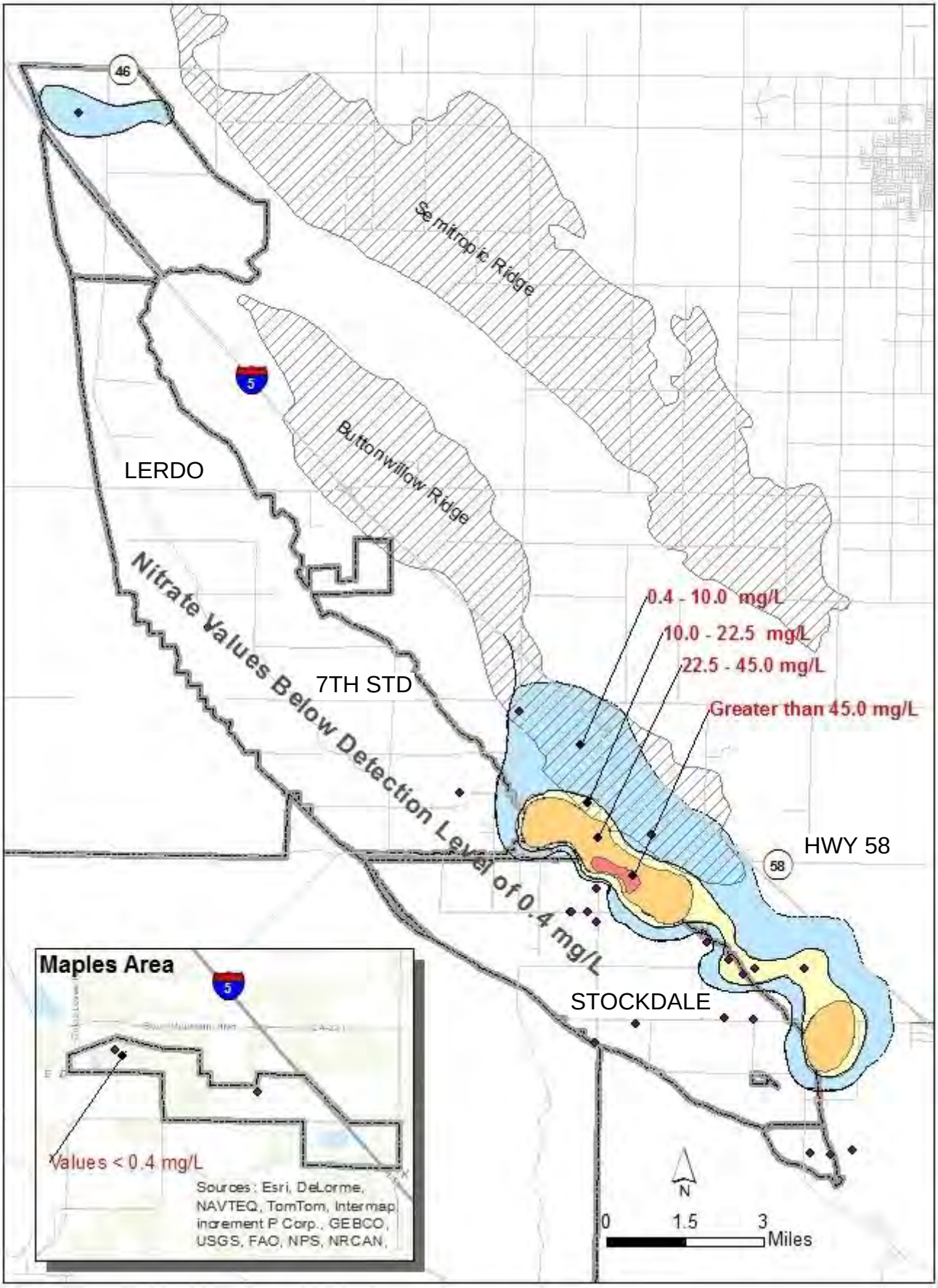
III.1 Exceedances

In Figure 11 the Nitrates in the BVC are shown. Figure 10 shows some NO3 exceedances. In the BVC the only ones shown are the locations of the 1990 shallow water data that have been discarded due to changed conditions. However along the east side of the BVC, just at its eastern edge exceedances of nitrates have occurred.

There are major exceedances for EC and TDS, but these are not caused by agriculture, and agriculture through recharging may actually be diluting this water some.

Figure 12 shows the exceedances in the Main Drain Canal from 2011-2014. This testing is part of the BVWSD/BVS's SQMP for the Main Drain, (Appendix C.) This was included for two purposes.

1. The drain water is often reflective of the natural groundwater.
2. The chlorpyrifos which is found in the Main Drain needs to be monitored to insure it is not leaching into the groundwater.



BUENA VISTA COALITION

NITRATE LEVELS IN BVC AREA

Figure 11

2014 Main Drain Water Quality Exceedances

Sample Location	Sample Date	Lab ID	Testing Lab	Flows (CFS)	Arsenic	Boron	Molybdenum	Selenium	Conductivity	TDS	pH	Dissolved Oxygen	Chlorpyrifos	Diuron	Fecal Coliform	Ceriodaphnia Bioassy
					ug/L	ug/L	ug/L	ug/L	umhos/cm	mg/L		mg/L	ug/L	ug/L	MPN/100ml	% Survival
					10	700	10	5	700	450	6.5-8.3	>5	0.015	2	400 (235)	<50%
MDC @ Hwy 46 558MDCH46	1/26/2014	No Sample	FGL													
MDC @ Hwy 46 558MDCH46	2/25/2014	No Sample	FGL													
MDC @ Hwy 46 558MDCH46	3/29/2014	No Sample	FGL													
MDC @ Hwy 46 558MDCH46	4/29/2014	No Sample	FGL													
MDC @ Hwy 46 558MDCH46	5/28/2014	No Sample	FGL													
MDC @ Hwy 46 558MDCH46	6/26/2014	No Sample	FGL													
MDC @ Hwy 46 558MDCH46	7/29/2014	No Sample	FGL													
MDC @ Hwy 46 558MDCH46	8/27/2014	A4H2307-03	BSK	57.7					1100	650			0.031			
MDC @ Hwy 46 558MDCH46	9/24/2014			45.8		720	15		1200	750						
MDC @ Hwy 46 558MDCH46																
MDC @ Hwy 46 558MDCH46																
MDC @ Hwy 46 558MDCH46																
MDC @ Hwy 46 558MDCH46																
MDC @7th Std. Rd. 551MDC7SR	1/26/2014	No Sample	FGL													
MDC @7th Std. Rd. 551MDC7SR	2/25/2014	VI 1440517-003	FGL		12.9						8.33		0.4			
MDC @7th Std. Rd. 551MDC7SR	3/29/2014	No Sample	FGL													
MDC @7th Std. Rd. 551MDC7SR	4/29/2014	VI 1441228-003	FGL		16.8				1500	1060			0.136			
MDC @7th Std. Rd. 551MDC7SR	5/28/2014	VI 1441689-003	FGL	4	14.2				1860	1280			0.091			
MDC @7th Std. Rd. 551MDC7SR	6/26/2014	VI 1442225-003	FGL		14.3				1740	1210						
MDC @7th Std. Rd. 558MDC7SR	7/29/2014	VI 1442713-003	FGL		16.2				1690	1170	8.5		0.02			
MDC @7th Std. Rd. 558MDC7SR	8/27/2014	A4H2307-01	BSK	2.77	15				1400	940			0.031			
MDC @7th Std. Rd. 551MDC7SR	9/24/2014	No Sample														
MDC @7th Std. Rd. 558MDC7SR																
MDC @7th Std. Rd. 551MDC7SR																
MDC @7th Std. Rd. 551MDC7SR																
MDC @7th Std. Rd. 551MDC7SR																

*Sediment Samples Only

BUENA VISTA COALITION - FIGURE 12.1

2013 Main Drain Water Quality Exceedances

Sample Location	Sample Date	Lab ID	Testing Lab	Flows (CFS)	Arsenic	Boron	Molybdenum	Selenium	Conductivity	TDS	pH	Dissolved Oxygen	Chlorpyrifos	Diuron	Fecal Coliform	Ceriodaphnia Bioassy
					ug/L	ug/L	ug/L	ug/L	umhos/cm	mg/L		mg/L	ug/L	ug/L	MPN/100ml	% Survival
					10	700	10	5	700	450	6.5-8.3	>5	0.015	2	400 (235)	<50%
MDC @ Hwy 46 558MDCH46	1/30/2013	VI 1340195-001	FGL	1	14.2		16.5		1720	1160			0.12			
MDC @ Hwy 46 558MDCH46	2/27/2013	VI 1340430-001	FGL	2	15.8	944	20.6		2070	1310	8.50					
MDC @ Hwy 46 558MDCH46	3/26/2013	VI 1340633-001	FGL	0	12.2	2350	57.1		4290	2750	8.50					
MDC @ Hwy 46 558MDCH46	4/30/2013	VI 1340972-001	FGL	4	24.8	1300	22.6		2520	1580			0.28			0
MDC @ Hwy 46 558MDCH46	5/28/2013	No Sample	FGL	0												
MDC @ Hwy 46 558MDCH46	6/25/2013	No Sample	FGL	0												
MDC @ Hwy 46 558MDCH46	7/23/2013	VI 1342432-001	FGL	0	13.6		12.6		977	599						
MDC @ Hwy 46 558MDCH46	8/28/2013	VI 1343129-001	FGL	0												
MDC @ Hwy 46 558MDCH46	9/30/2013	No Sample	FGL	0												
MDC @ Hwy 46 558MDCH46	10/15/2013	VI 1344094-001*	FGL													
MDC @ Hwy 46 558MDCH46	10/25/2013	No Sample	FGL	0												
MDC @ Hwy 46 558MDCH46	11/20/2013	No Sample	FGL	0												
MDC @ Hwy 46 558MDCH46	12/20/2013	No Sample	FGL	0												
MDC @7th Std. Rd. 551MDC7SR	1/30/2013	VI 1340195-003	FGL		15.1		14.0		1450	1040			0.11	30		
MDC @7th Std. Rd. 551MDC7SR	2/27/2013	VI 1340430-003	FGL		14.9		17.2		1570	1060					3000	
MDC @7th Std. Rd. 551MDC7SR	3/26/2013	No Sample	FGL													
MDC @7th Std. Rd. 551MDC7SR	4/30/2013	VI 1340972-003	FGL		17.6		10.0		1050	690			0.59			0
MDC @7th Std. Rd. 551MDC7SR	5/28/2013	VI 1341423-003	FGL		12.8		12.8		1500	1070			0.23			0
MDC @7th Std. Rd. 551MDC7SR	6/25/2013	VI 1341975:-003	FGL	2	14.4		10.7		1140	714						
MDC @7th Std. Rd. 551MDC7SR	7/23/2013	VI 1342432-003	FGL	23	14		12.2		1094							
MDC @7th Std. Rd. 551MDC7SR	8/28/2013	VI 1343129-003	FGL		12				912	590						
MDC @7th Std. Rd. 551MDC7SR	9/30/2013	No Sample	FGL	0												
MDC @7th Std. Rd. 558MDC7SR	10/15/2013	VI 1344094-003*	FGL													
MDC @7th Std. Rd. 551MDC7SR	10/25/2013	No Sample	FGL	0												
MDC @7th Std. Rd. 551MDC7SR	11/20/2013	No Sample	FGL	0												
MDC @7th Std. Rd. 551MDC7SR	12/20/2013	No Sample	FGL	0												

*Sediment Samples Only

BUENA VISTA COALITION - FIGURE 12.2

2012 Main Drain Water Quality Exceedances

	Sample Location	Sample Date	Lab ID	Testing Lab	Measured Flows (CFS) *Water Delivery	Arsenic ug/L	Boron ug/L	Molybdenum ug/L	Selenium ug/L	Conductivity umhos/cm	TDS mg/L	pH	Dissolved Oxygen mg/L	Conductivity umhos/cm	Chlorpyrifos ug/L	Diuron ug/L	Fecal Coliform MPN/100ml	
						10	700	10	5	700	450	6.5-8.3	>5	700	0.015	2	400 (235)	WQ Limit
1	MDC Hwy 46	1/25/2012	VI 1240155-001	FGL	9	16.1	1080	16.7	1.64	2070	1290	7.47	3.03	2075	ND	1.5	130	
2	MDC 7th Standard	1/25/2012	VI 1240155-003	FGL		14.7	576	10.5	0.692	1350	895	7.88	8.52	1348	ND	0.4	3000	
1	MDC Hwy 46	2/28/2012	VI 1240408-001	FGL	3	17.2	793	22.4	1.76	2020	1220	8.99	11.94	1870	ND	1.3	300	
2	MDC 7th Standard	2/28/2012	VI 1240408-003	FGL		14.1	583	11.7	0.871	1670	1040	8.25	9.79	1551	ND	ND	50000	
1	MDC Hwy 46	3/28/2012	VI 1240634-001	FGL	< 1	14	504	13.1	5.76	1280	814	9.09	14.68	1200	0.026	8.2	230	
2	MDC 7th Standard	3/28/2012	VI 1240634-003	FGL		12.7	436	14.1	6.35	1100	677	9.06	14.39	1204	0.12	0.31	24000	
	MDC @ Hwy 46 558MDCH46	4/25/2012			5													
	MDC @ Hwy 46 558MDCH46	5/23/2012	VI 1241050-001	FGL	8	26.0	1060	19.7		2130	1340							
	MDC @ Hwy 46 558MDCH46	6/27/2012	VI 1241341-001	FGL	27	11.2				872	482						230	
	MDC @ Hwy 46 558MDCH46	7/31/2012	VI 1241662-001	FGL	7	12.3							4.13				700	
	MDC @ Hwy 46 558MDCH46	8/30/2012	VI 1242091-001	FGL	8	12.8		11.3		983	573							
	MDC @ Hwy 46 558MDCH46	9/27/2012	VI 1242302-001	FGL	2	11.5	1870	34.8		3240	2020		4.10				300	
	MDC @ Hwy 46 558MDCH46	10/30/2012	VI 1242644-001	FGL	7							9.33					30	
	MDC @ Hwy 46 558MDCH46	11/27/2012	VI 1242889-001	FGL	6							8.34					70	
	MDC @ Hwy 46 558MDCH46	12/26/2012	VI 1243179-001	FGL	3												30	
	MDC @7th Std. Rd. 551MDC7SR	4/25/2012														0.49		
	MDC @7th Std. Rd. 551MDC7SR	5/23/2012		FGL		14.9	912	13.1		2110	1370					0.27		
1	MDC @7th Std. Rd. 551MDC7SR	6/27/2012	VI 1241341-003	FGL		11.6				745							130	
2	MDC @7th Std. Rd. 551MDC7SR	7/31/2012	VI 1241662-003	FGL													1300	
	MDC @7th Std. Rd. 551MDC7SR	8/30/2012	VI 1242091-003	FGL		12.3												
	MDC @7th Std. Rd. 551MDC7SR	9/27/2012	VI 1242302-003	FGL		14.6				1080	713						2200	
	MDC @7th Std. Rd. 551MDC7SR	10/30/2012	VI 1242644-003	FGL		11.7				908	574						230	

Source: Buena Vista Water Storage District

BUENA VISTA COALITION - FIGURE 12.3

2011 Main Drain Water Quality Exceedances

	Sample Location	Sample Date	Sample ID	Testing Lab	Measured Flows (CFS)	Arsenic ug/L	Boron ug/L	Molybdenum ug/L	Conductivity umhos/cm	TDS mg/L	Ammonia Nitrogen mg/L	pH	Temp C	Conductivity umhos/cm	Chlorpyrifos ug/L	Dimethoate ug/L	Ceriodaphnia Bioassy % Survival	Fecal Coliform MPN/100ml	
						10	700	10	700	450	1.5	6.5-8.3		700	0.015	1	<50%	400	WQ Limits
1	MDC Hwy 46	1/27/2011	VI 1140171-001	FGL	0				377	218	ND	8.79	11.4	371				30	
2	MDC Hwy 46	2/24/2011	VI 1140422-001	FGL	18				584	366	0.402	7.95	13.2	579				1300	
3	MDC Hwy 46	3/30/2011	VI 1140701-001	FGL	0	25.4	702	41.3	1500	929	0.298	7.93	17.1	1486	0.053	ND	100	30	
4	MDC Hwy 46	4/25/2011	VI 1140858-001	FGL	25	11.3	148	6.13	259	140	0.407	8.1	20.8	238	0.072	ND	100	220	
5	MDC Hwy 46	5/31/2011	VI 1141154-001	FGL	44	4.15	112	2.25	332	198	0.065	8.13	17.6	337	ND	ND	100		
6	MDC Hwy 46	6/29/2011	VI 1141396-001	FGL	24	7.88	115	5.62	271	169	0.099	7.61	22.6	269	ND	ND	100	30	
7	MDC Hwy 46	7/28/2011	VI 1141676-001	FGL	11	13.4	166	6.32	406	258	0.283	7.39	25.8	432	0.32	1.3	45	500	
8	MDC Hwy 46	8/31/2011	VI 1142103-001	FGL	47	13.3	213	6.4	527	325	0.03	7.73	26.7	545	0.53	ND	0	900	
9	MDC Hwy 46	9/29/2011	VI 1142374-001	FGL	30	7.45	226	4.68	587	362	ND	7.44	24.1	597	0.16	ND	100	80	
10	MDC Hwy 46	12/28/2011	VI 1143237-003	FGL	14	11.9	371	11.7	946	552	0.062	8.15	6.2	1080	ND	ND	100	170	
11	MDC 7th Standard	1/27/2011	VI 1140171-003	FGL					1990	1260	0.066	7.94	12.1	1982				140	
12	MDC 7th Standard	2/24/2011	VI 1140422-003	FGL					431	266	0.547	8.02	11.5	431				17000	
13	MDC 7th Standard	3/30/2011	VI 1140422-003	FGL															
14	MDC 7th Standard	4/25/2011	VI 1140858-003	FGL		11	121	5.41	223	134	0.575	7.72	22.4	221	0.13	ND	100	3000	
15	MDC 7th Standard	5/31/2011	VI 1141154-003	FGL		11.6	123	8.21	243	157	0.163	7.55	20.5	244	0.058	ND	100		
16	MDC 7th Standard	6/29/2011	VI 1141396-003	FGL		18.1	114	7.51	188	167	0.07	7.39	22.7	190.3	ND	ND	95	5000	
17	MDC 7th Standard	7/28/2011	VI 1141676-003	FGL		11.6	134	4.64	398	247	1.9	7.56	28.5	396	0.29	ND	35	8000	
18	MDC 7th Standard	8/31/2011	VI 1142103-003	FGL		11.9	184	5.02	502	308	ND	7.68	26.6	499	1.4	ND	0	2200	
19	MDC 7th Standard	9/29/2011	VI 1142374-003	FGL		13.5	1130	23.8	2170	1370	ND	8.21	26.2	2041	0.51	ND	100	500	
20	MDC 7th Standard	12/28/2011	VI 1143237-001	FGL		5.47	92.7	2.87	391	217	ND	8.02	6.3	362	ND	ND	100	50	

Source: Buena Vista Water Storage District

BUENA VISTA COALITION - FIGURE 12.4

IV. Agricultural Management Practices Evaluation

There are typically two types of management practices in the BVC. There is a style of growing for the old, traditional row crops, cotton, alfalfa, and grains. There is a different style of operation for the newer permanent crops within the BVC. Because of the way this farm land was developed in the late 1800's, it does not follow methods which would be standard today, or even 50 years ago. Similarly most of the BVWSD delivery facilities are the same or similar to what was built in the 1880's when pumping of water was non-existent.

IV.1 Current Management Practices

Surface water is delivered to fields by unlined canals. These canals typically divert water to the fields by gravity flow. Row crops are typically irrigated by flood or furrow irrigation. Almost none of the individual farms have tailwater sumps to gather field run-off, rather it flows to the Main Drain Canal through a series of small unlined drains. Historically these drain waters have been used for irrigation by growers in the northern areas where groundwater is bad. Historically water was free, and so growers had little incentive to reclaim this tailwater if free surface water was available. In part due to new state laws, the BVWSD now charges for water and sells its reclaimed water at a reduced price and at half a normal allotment. Hopefully this will still be enough incentive to reclaim the tailwater in very wet years. Typically the supply canals would operate 90 days a year, and the drains only when actual irrigation occurs, but the collector drains like the Main Drain Canal might flow 10 months a year.

The permanent crops that are being installed are all on a drip or fan-jet irrigation system. They have abandoned their drain connections, and if no upstream users, the actual drains. These systems typically have a reservoir which is fed either by gravity flow still, or by a booster pump. There are no off farm drains in the supplemental area of the BVC or the MSA.

Occasionally a vegetable crop is grown using sprinklers, and tomatoes are grown with a drip tape. However, these systems are typically operated from irrigation wells, as their fields are not set-up for using canal water in this delivery system.

IV.2 Future Management Practice Implementation

Irrigated agricultural operations are a potential contributor where conditions make groundwater more vulnerable to impacts from irrigated agricultural activities The BVWSD is in the process of changing its delivery method in the northern half of the BSA. It will install a pipeline delivery system in 2015. It is expected that all of the traditional delivery canals will no longer be used from 2016 going forward in the northern portion of the BVWSD. This change is for many reasons. Not using unlined canals in the area of perched and shallow groundwater, should help lower the perched water table, which would increase yields. The irrigation season for permanent crops is much longer than the traditional row crops, and the losses from the unlined canals would consume more than the available BVWSD water supply. It is uneconomical to fill unlined canals

for just one user. Although there will continue to be a reduction of drain water, the Main Drain Canal will likely continue to deliver reclaimed water in the north. Its flow volumes however, will continue to diminish, both due to fewer drains, as well as more reclaimed water users in the southern portion of the BSA.

As the Northern Area Pipeline is finally becoming a reality, after over 6 years of consideration, the growers in the south are now taking up the cue. Although no formal planning has begun, it is expected that pipelines will soon follow in the south. In the south however, the major canals will continue to be operated as recharge basins. With their depth and spacing they will continue to be effective means of percolating recharge water. Since no planning has started it must be presumed some unlined canals will still supply the various piping systems. As these changes occur, monitoring plans may be be adjusted.

Regardless of the supply system, the Main Drain Canal will likely continue to operate as a District wide tailwater system. If the BVWSD can accomplish its goals of keeping the water within its boundaries the ebb and flow of the Main Drain Canal and its tributaries may actually mimic the historical river flows, although at a much reduced flow. This may be helpful for native plants and animals. The movement of the water might keep this water aerated more than 50 tailwater sumps.

It is also expected that fields will continue to be developed into permanent crops. This will continue to reduce the use of drains. Despite the fairly high quantity of water supply available to the BVWSD, it is expected that some farm land will always be devoted to seasonal row crops.

IV.3 Farm Practices Which are a Potential Contributor to Making Groundwater More Vulnerable to Impacts

The lands of the BVC are fairly consistent throughout the entire coalition, even the lands of the MSA, which is 15 miles away from the southern end of the BSA. That is because both areas were former swamplands formed by the Kern River. All of the surface soils are primarily clays, with just the type and thickness being the difference. So discussions about farm management practices are fairly universal for the BVC lands.

The surface soil is a fairly impermeable clay, see Figure 8. This is the type of soil which typically does not make the groundwater more vulnerable.

The permanent crops are irrigated with the drip or similar style irrigation, which also does not make the groundwater more likely to be compromised by irrigated agriculture. However most of the drip systems have reservoirs, and in some areas, primarily in the southern portion of the BVC, these reservoirs penetrate through the clay layer and into the sands, where they could impact the groundwater. However, most of the reservoirs are lined, primarily with clay, not concrete or a plastic liner. This, if installed and maintained properly should keep these reservoirs from impacting the groundwater, and potentially having negative impacts.

The flood and furrow irrigation are the type of irrigating practices which could cause impact to groundwater. If the soil is ripped deep enough the water could percolate through the otherwise impermeable clays. There is no deep ripping for the typical row crops, mostly discing. The avoidance of deep ripping in the areas of flood and furrow irrigation limits the risk associated with the excess water needed to flood or furrow irrigate.

In addition to soil and irrigation system the type of crop is the third and last leg of the stool when determining if farm conditions are more likely to contribute to groundwater degradation. The seven primary crops in the BVC will be considered: cotton, alfalfa, grains, tomatoes, pistachios, pomegranates, and dried-on-the-vine-raisins. Factors to be considered are rooting depth, nitrogen recommendation, ratio of N in crop top/nitrogen recommended, fraction of crop top removed with the harvested portion.

Many processes have been used to consider these type solutions, often referred to as a Nitrogen Hazard Index. Using the method approved for use by the Central Coast Regional Water Quality Control Board for compliance the following table covering over 90% of the BVC crops can be used.

Table 2
Nitrogen Hazard Index
CCRWQCB IRLP Annual Compliance Form

Crop		Soil	Irrigation	**TOTAL**
grapes	1	2	1	**2**
pistachio, pomegranate	2	2	1	**4**
tomatoes	3	2	1	**6**
alfalfa	1	2	4	**8**
cotton, wheat	2	2	4	**16**

Total is the sum of the three factors.

In this system any number 19 or lower is a low probability of risk to cause negative impact to the ground water. It should also be noted that this was using the general soil type for the region Buttonwillow. Other methods would rate the soil like this, all clay as a 1, but the permanent crops have 2 added to their soil for deep ripping. This would give results as shown in Table 3.

Table 3
Nitrogen Hazard Index
Methods Proposed by Land IQ

Crop		Soil	Irrigation	**TOTAL**
grapes	1	3	1	**3**
pistachio, pomegranate	2	3	1	**6**
tomatoes	3	1	1	**3**
alfalfa	1	1	4	**4**
cotton, wheat	2	1	4	**8**

Total is the sum of the three factors.

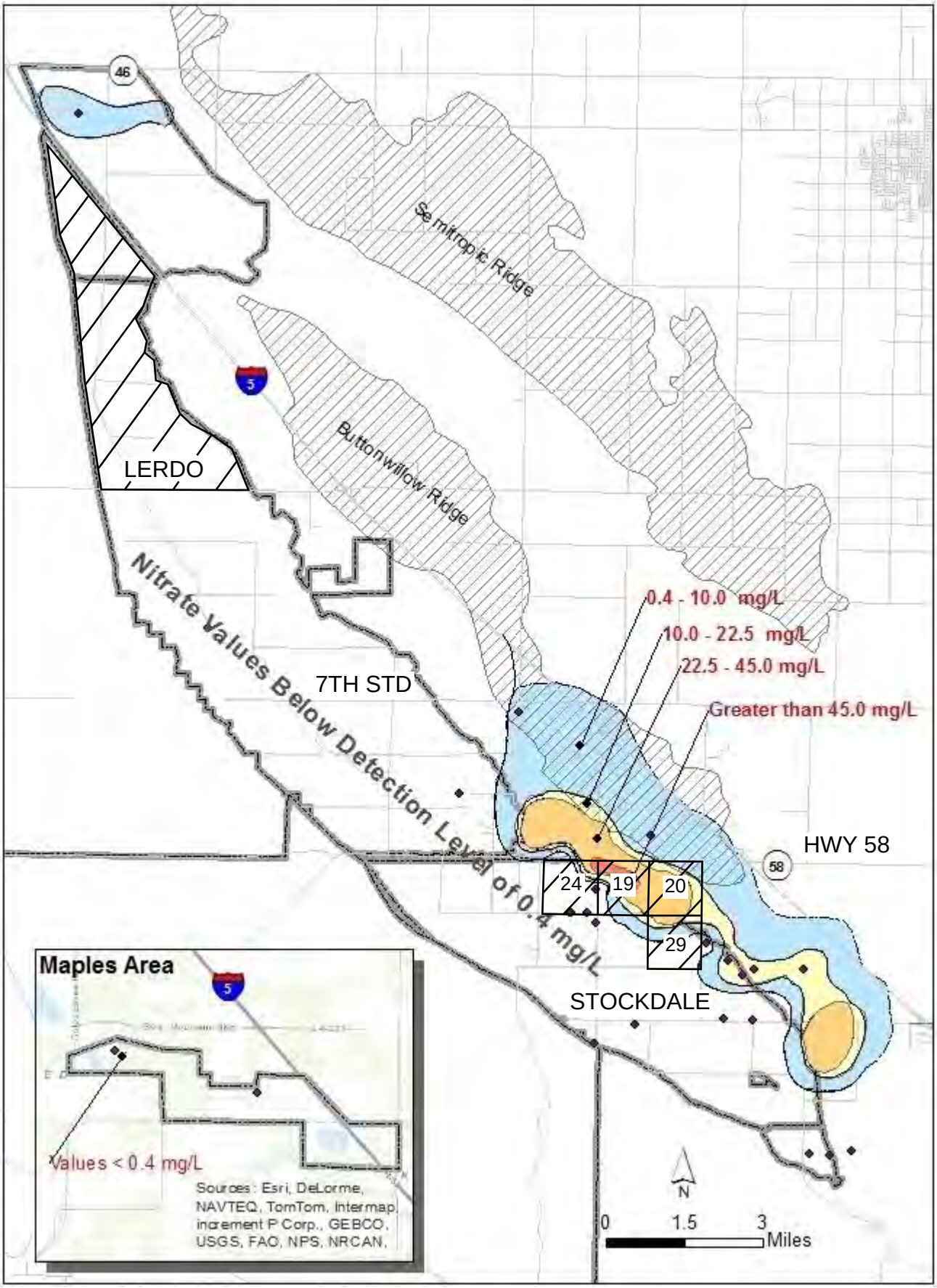
This ranking gives extremely low values for the land of the BVC. Using either system, one can see that that agricultural practices in the BVC are not presumed to lead to impacts to the groundwater from irrigation practices. The highest scoring crop, cotton is on the decline in the BVC, similar to all of the Southern San Joaquin Valley. Cotton acreage in the BVC in 2008 was 13,354 acres. In 2014 it was down to 9,455 acres. It is not believed that this number was reduced significantly due to the drought. The trend is towards crops which are even less likely to impact the groundwater. There are over 1,000 more acres each being planted to dried-on-the-vine raisins and pistachios in 2014. That is close to another 5% conversion this year.

V. Designation of High and Low Vulnerability Areas

Two areas will be currently designated as high vulnerability. There are readings of irrigation wells exceeding the mcl for NO3 along the eastern border of the BVC, beginning at State Highway 58 and Wasco Way adjacent to the Eastside Canal and traveling southeast along the canal, as shown on Figure 11. There are four sections, shown in Figure 13 that will be designated high vulnerability. These sections are 24. T29S, R23E, and 19, 20 and 29 of T29S, R24E. Adjacent sections to the north, west, and south all have readings which do not have exceedances. This area is fairly close to the domestic wells of the DAC of Buttonwillow as shown on Figure 7.

The second area of the BVC which will be designated as high vulnerability is the land north of Lerdo Highway, with a north limit at I-5. These are the portions of sections 2, 3, 4, 5, 8, 9, 10, 11 T28S, R22E, which are in the BVC. Also in this zone are the following partial sections 16, 17, 18, 20, 21, 28, 29, 32, 33 all of T27S, R22E. This area has been designated as high vulnerability. This choice was made due to high nitrate readings in 1990, shallow groundwater, both perched and non-perched, and inflows of natural groundwater, especially with high TDS into the area. This area includes the spot on the map which is Spicer City, which barely exists anymore. There is a store, four homes, but also a juicing and bottling plant. All are served from the same domestic well which requires significant treatment by reverse osmosis to be used in the juicing operation, as well as for the homes.

The lands which have exceedances of TDS due to native groundwater may need to be a part of a Basin Amendment Process to exclude the water from the Irrigated Lands Regulatory Program. The exceedances do not appear to be caused by, or negatively impacted by agriculture.



BUENA VISTA COALITION

HIGH VULNERABILITY AREA

Figure 13

VI. Prioritizations

The Order gives a list of items which can be used to help prioritize the areas for carrying out the Order, including conducting monitoring programs and carrying out required studies.

These items include:

1. Identified exceedances of water quality objectives for which agriculture is the cause, or a contributing source; or
2. The proximity of the high vulnerability area to areas contributing recharge to urban and rural communities where groundwater serves as a significant source of water.

These are just two from the list of seven to give guidance on prioritizing, yet they are enough to make this a high priority area for the steps of monitoring and management practices evaluation from the MPEP. These wells are very close to both the recharge facility of the Eastside Canal (directly adjacent) as well as close to the community wells. The wells showing high nitrates are BVWSD owned wells and should be able to be managed in a manner to allow for detailed monitoring and follow-up management.

The community of Spicer City and the surrounding high vulnerability areas are not a high priority. It is unlikely that the native groundwater there will ever be suitable for municipal use. As shown on Figure 5 and Figure 9, Spicer City was on the “poor quality” side of the line in 1920, before agriculture was making significant impacts to groundwater. Since any municipal use will always require treatment, this area would be the lowest priority for conducting monitoring programs and carrying out required studies. Additionally, in the data gathered in 1990 by the DWR, two locations in this area designated high vulnerability actually had readings of TDS of 3850 and 6050, which would classify this groundwater as not having a beneficial use at that time.

All other areas of the BVC will be classified as low vulnerability.

References

Buena Vista Water Storage District, June 2014 *Agriculture Water Management Plan*.

Buena Vista Water Storage District, September 2015, *Assessment of Potential Groundwater Impacts, Northern Area Pipeline Project.*

Buena Vista Water Storage District, May 2014, *Groundwater Management Plan*.

California Department of Water Resources, 1993, Shallow Groundwater Study Buena Vista Water Storage District.

Crewdson, Robert A., *The Geology and Groundwater Hydrology of the Buena Vista Water Storage District, Buttonwillow*, CA including *Descriptions of Relevant Facilities and Operation*s, Sierra Scientific Services, Bakersfield, CA May 2013.

Land IQ, Memorandum for KRWCA Board Members, *NHI Analysis for KRWCA Groundwater Assessment Report*, August 2014.

Pacific Geotechnical Consultants, Draft *Study of the Regional Geologic Structure Related to Ground Water Aquifers in the Southern San Joaquin Valley Groundwater Basin, Kern County California*, 1991.

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES
San Joaquin District

SHALLOW GROUND WATER STUDY

BUENA VISTA WATER STORAGE DISTRICT

Memorandum Report

May 1993

DOUGLAS P. WHEELER
Secretary for Resources
The Resources Agency

PETE WILSON
Governor
State of California

DAVID N. KENNEDY
Director
Department of
Water Resources

State of California

The Resources Agency

Memorandum

Date: May 24, 1993

To:
1. James H. Cooper
2. Brian E. Smith
3. Louis A. Beck

From: W. Gary Shanks 8-421-5950
Agricultural Drainage Section
San Joaquin District
Department of Water Resources

Subject: Shallow Ground Water Study -- Buena Vista Water Storage District

Brackish, shallow ground water underlies a large portion of the west side of the San Joaquin Valley. This condition is caused by naturally saline soils and clay beds of low permeability that restrict the downward percolation of irrigation water. The shallow water and the resultant accumulation of salts in the root zones of plants are threatening the future of agriculture in some parts of the Valley. In its 1986 report on the San Joaquin Valley Drainage Monitoring Program, the California Department of Water Resources estimated that 1.7 million acres of land lie in present or potential drainage problem areas -- areas in which the depth to ground water is less than 20 feet.

The Buena Vista Water Storage District in western Kern County lies within such a problem area. Concerned about decreased cropland productivity and the potential for degradation of the local ground water aquifer, Buena Vista Water Storage District officials in 1989 asked the Department of Water Resources to conduct a localized study of its shallow ground water problem to define the extent of the perched water and propose mitigative measures. This report presents the results of that study.

SURNAME | Shanks 6/15/93 | Smith 6/24 | Smith | Beck 6/14

DWR 155 (Rev. 2/86)

Introduction

This report discusses the sources, extent, and potential impacts of shallow ground water in the northern portion of the Buena Vista Water Storage District (BVWSD). It also discusses efforts undertaken by the California Department of Water Resources (DWR) and BVWSD to evaluate and mitigate these problems.

Background

In February 1989, DWR's San Joaquin District received a letter from BVWSD requesting assistance in determining the source of rising shallow ground water levels that were apparently occurring in the northwest part of BVWSD. This condition was manifested by standing water in the Kern River Flood Channel. Since this water was brackish, BVWSD was concerned about a potential threat to the underlying aquifer and the decline of farmland productivity from brackish ground water moving into the area.

For the past decade, DWR and BVWSD officials have suspected that increased irrigation east and west of BVWSD has caused poor-quality ground water to flow into BVWSD's northwestern sector. Irrigation east of BVWSD has been occurring for decades but has increased with the importation of water into the area from the California Aqueduct. Irrigation applications west of BVWSD began with the completion of the aqueduct. Evidence suggests that this increased irrigation has created a significant ground water flow into BVWSD.

Inflow of brackish ground water into BVWSD threatens to degrade BVWSD's ground water supplies, whose quality is generally good. A secondary problem, as identified by the U.S. Soil Conservation Service in a report prepared for BVWSD and other local agencies in 1985, is a common one throughout much of the San Joaquin Valley -- irrigation water percolating downward and accumulating on clay beds of low permeability, then rising to a level that threatens the productivity of cropland (SCS, 1985). As water levels rise closer to the surface, salts (both naturally occurring and those in the irrigation water) are concentrated in the soil by evaporation and transpiration. This continual addition of salts to the soil profile can decrease soil permeability, exacerbating the problem of rising ground water.

Potential solutions to this problem have been studied for many years. Two of the most widely discussed proposals include an outfall to the ocean and a master drain. However, as stated in a 1985 report by SCS, these projects have faced many political, environmental, and financial obstacles. Even evaporation ponds are coming under more and more scrutiny by regulatory agencies.

SCS, in its 1985 report, proposed a combination of underground drains, pumps, ditches, and evaporation ponds to maintain farmland productivity in the study area. That report also discussed the environmental concerns that must be addressed before such a project is implemented.

BVWSD and DWR decided to cooperatively study the sources and extent of the shallow ground water and determine mitigation measures that would prevent the problem from worsening and allow farming to continue in the study area.

Study Area Setting

The study area covers approximately 80 square miles in western Kern County (Figure 1). The central portion of the area lies within the San Joaquin Valley trough, a region of naturally low topography. The study area is bounded on the north by State Highway 46, on the east by Semitropic and Buttonwillow Ridges, on the south by Perral Road (2 miles south of Lerdo Highway), and on the west by the California Aqueduct.

Ground elevations range between about 280 feet on the eastern and western peripheries of the area to approximately 235 feet in the Valley trough and Goose Lake Bed.

The Kern River Flood Channel, a north-south-trending channel which carries floodwater from the Kern River northward to Tulare Lake during periods of high flow, transects the western portion of the study area. Interstate Highway 5 crosses the area from northwest to southeast.

Geology

Geologic units within the study area consist of older alluvium and flood basin deposits (Figure 2.) Older alluvium is found on Semitropic and Buttonwillow Ridges and west of the Kern River Flood Channel. Flood basin deposits occur in low-lying areas to the east of the flood channel and in Goose Lake Bed.

Older alluvium consists of poorly sorted, moderately permeable, lenticular deposits of clay, silt, sand, and gravel. According to a 1963 report by Hilton and others, beneath Semitropic and Buttonwillow Ridges, the older alluvium is nearly indistinguishable from the fine-grained, dark-colored flood basin deposits in low-lying portions of the study area.

Flood basin deposits include those fine-grained materials deposited on overflow lands and in slough areas by sluggish floodwaters. These deposits consist chiefly of relatively impermeable silt and clay interbedded with some moderately to poorly permeable sand layers. The thickness of the flood basin deposits is unknown because they overlie fine-grained lacustrine and swamp deposits which are a facies of the older alluvium. However, it is estimated that the flood basin deposits are on the order of 50 feet thick (Hilton, 1963).

The "A" clay, the uppermost of five prominent clay beds that have been identified in Valley sediments, underlies the eastern half of the study area. The western boundary of this bed, as identified by Croft in his 1972 report, nearly coincides with the Kern River Flood Channel (Figure 2). According to Croft, the "A" clay lies approximately 40 feet beneath the study area and its thickness is generally less than 60 feet. Its continuity beneath the eastern half of the study area is open to question (Croft, 1972).

Hydrology

Throughout much of the Valley, ground water exists in two relatively distinct aquifer systems -- a confined system beneath the Corcoran Clay (a pervasive lacustrine clay bed that underlies a large portion of the Valley) and an unconfined or semiconfined system

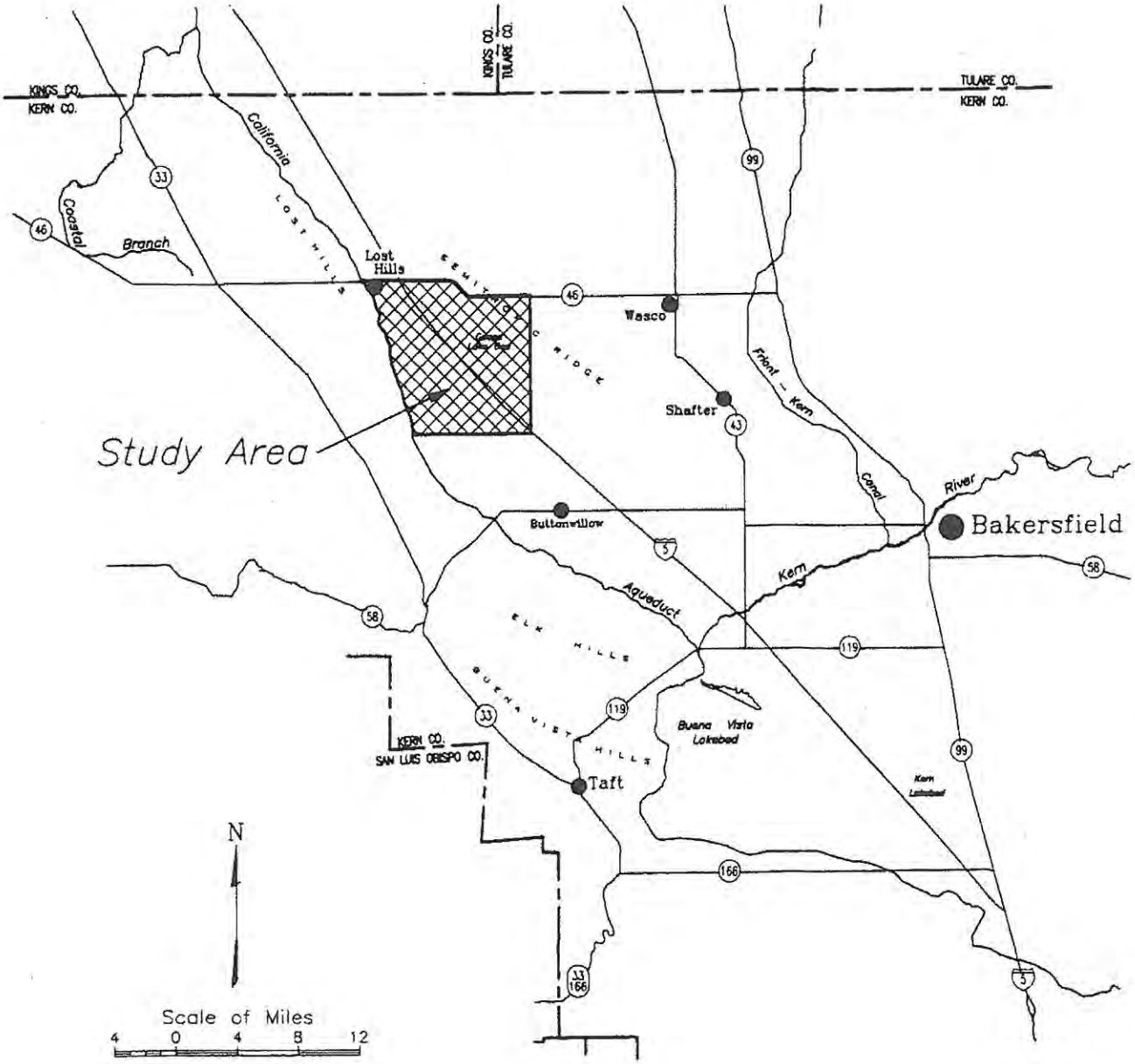
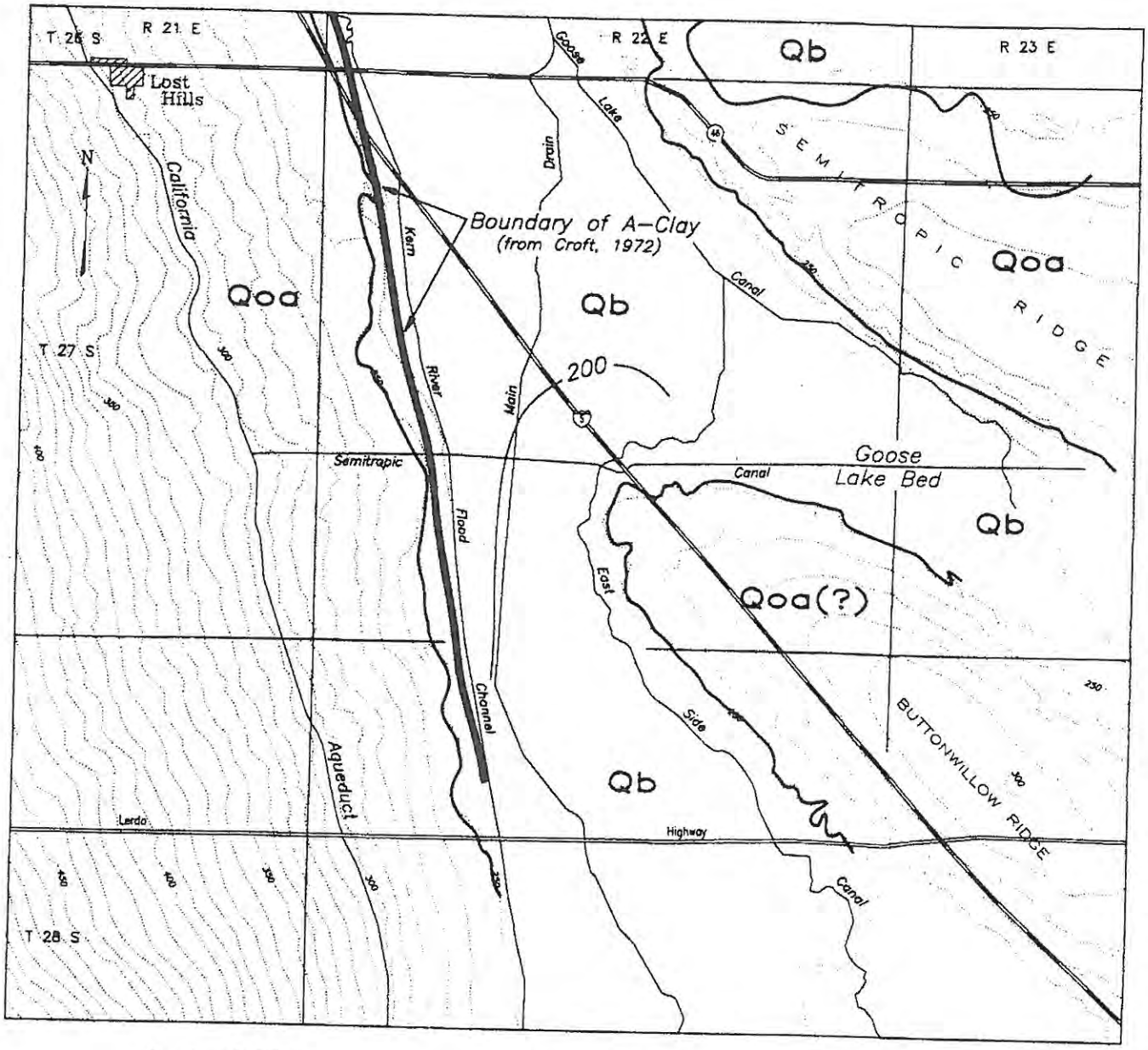


Figure 1. Location Map



Scale of Miles

1 0 1 2

Geologic Contact

200 Structural contour showing elevation of base of A-Clay (from Croft, 1972)

Qb Flood Basin Deposits – Relatively impermeable silt and clay interbedded with some moderately to poorly permeable sand layers. Not an important source of ground water. However, locally may yield sufficient supplies for domestic use.

Qoa Older Alluvium – Poorly sorted lenticular deposits of clay, silt, sand, and gravel. May be loosely consolidated to cemented. Moderately to highly permeable, and together with underlying unconsolidated deposits, yields large quantities of water to wells.

Figure 2. Geologic Map of the Buena Vista Water Storage District Study Area

(from Hilton, McClelland, and Klausing, 1963)

above this clay bed. In some literature, a third water body is identified -- one that is "perched" above the "A" clay or other shallow clay beds. Other studies, however, contend that this shallow water body is not truly perched above a dry zone but that it is in hydraulic continuity with the regional unconfined/semiconfined aquifer system. The wells drilled for the installation of shallow piezometers for this study were not deep enough to support or refute either theory. The shallow ground water in BVWSD may be perched on relatively impermeable clay beds or it may be part of the regional unconfined/semiconfined aquifer.

Procedures

DWR developed a monitoring program to determine the extent of the current drainage problem and evaluate mitigative measures. This program consisted of installing 88 shallow (20 feet deep) piezometers throughout the study area. Added to this monitoring grid were 31 existing piezometers -- 14 belonging to the Kern County Water Agency, 5 DWR piezometers along the California Aqueduct, and 12 piezometers drilled for the Kern Water Bank and other DWR projects. In areas where ground water was deeper than 20 feet, 12 deeper piezometers (up to 55 feet deep) were installed by a private drilling contractor under contract to BVWSD. All 131 piezometers in the monitoring grid were surveyed for elevations above mean sea level by DWR.

During the drilling of the 20-foot piezometers, soils from selected borings were logged to determine their vertical and areal variability.

Fifty-six piezometers were sampled in the summer of 1990 for water quality analyses. Ground water elevations and electrical conductivity measurements were taken from all accessible piezometers in July 1992.

Results

Depth to water in July 1992 is plotted on Figure 3. This figure shows that water lies within 10 feet of the ground surface throughout much of the study area, specifically in the Valley trough and around Goose Lake Bed. In areas of higher ground elevation, depth to water is greater, ranging between 20 and 40 feet in the Belridge area (west of the Kern River Flood Channel) and beneath Buttonwillow Ridge.

Figure 4 plots ground water elevations in July 1992. This figure shows subsurface flow into the study area from the west at a gradient of approximately 5 to 10 feet per mile. Subsurface flow into the area from the east and southeast is also indicated, although the gradient is not so well defined.

In the central portion of the study area, the gradient is nearly flat. In the vicinity of Goose Lake Bed, a localized ground water depression exists (possibly caused by agricultural pumping at the time measurements were taken). In the northern portion of the study area, ground water flow is northward at a very shallow gradient.

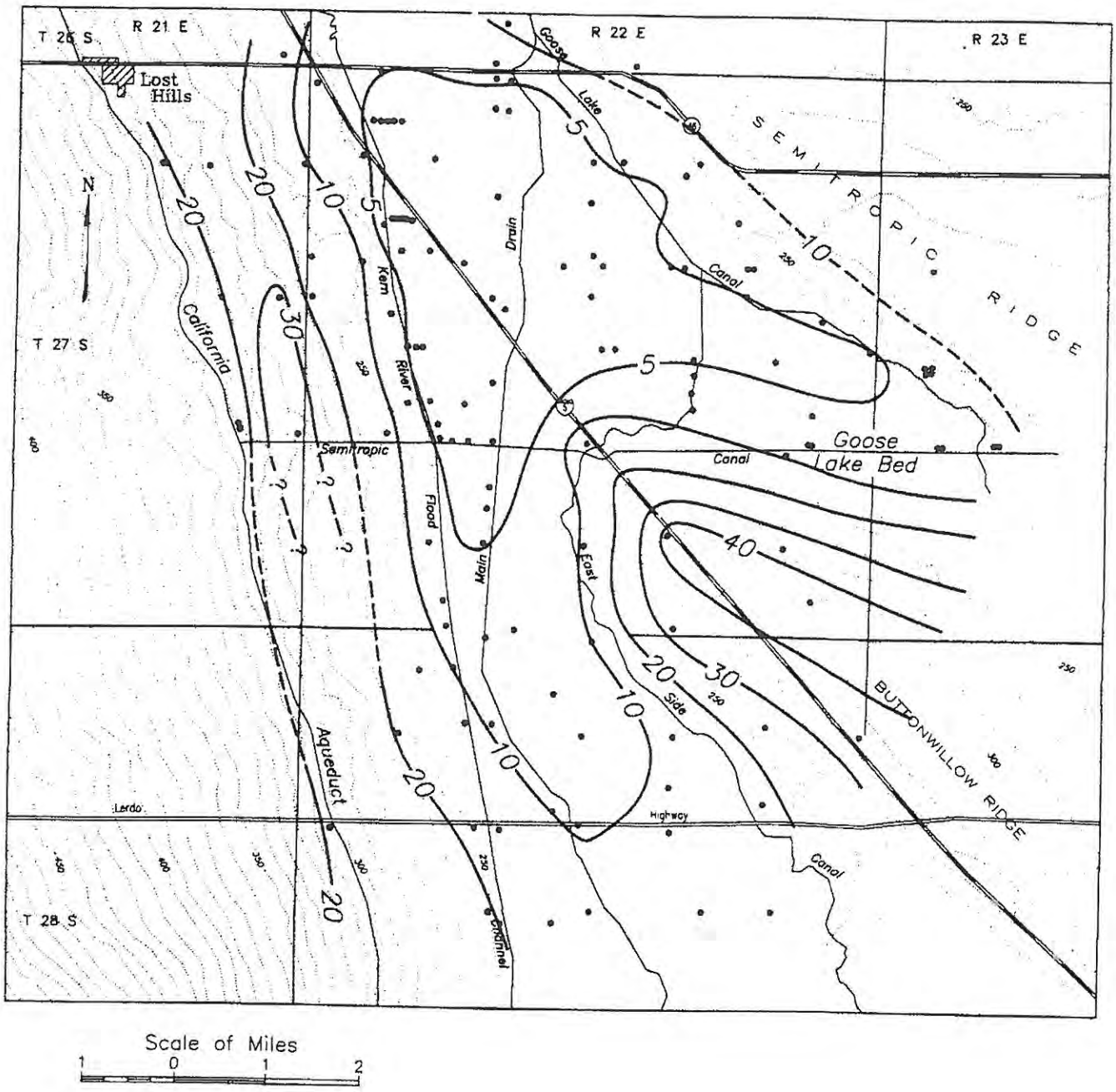
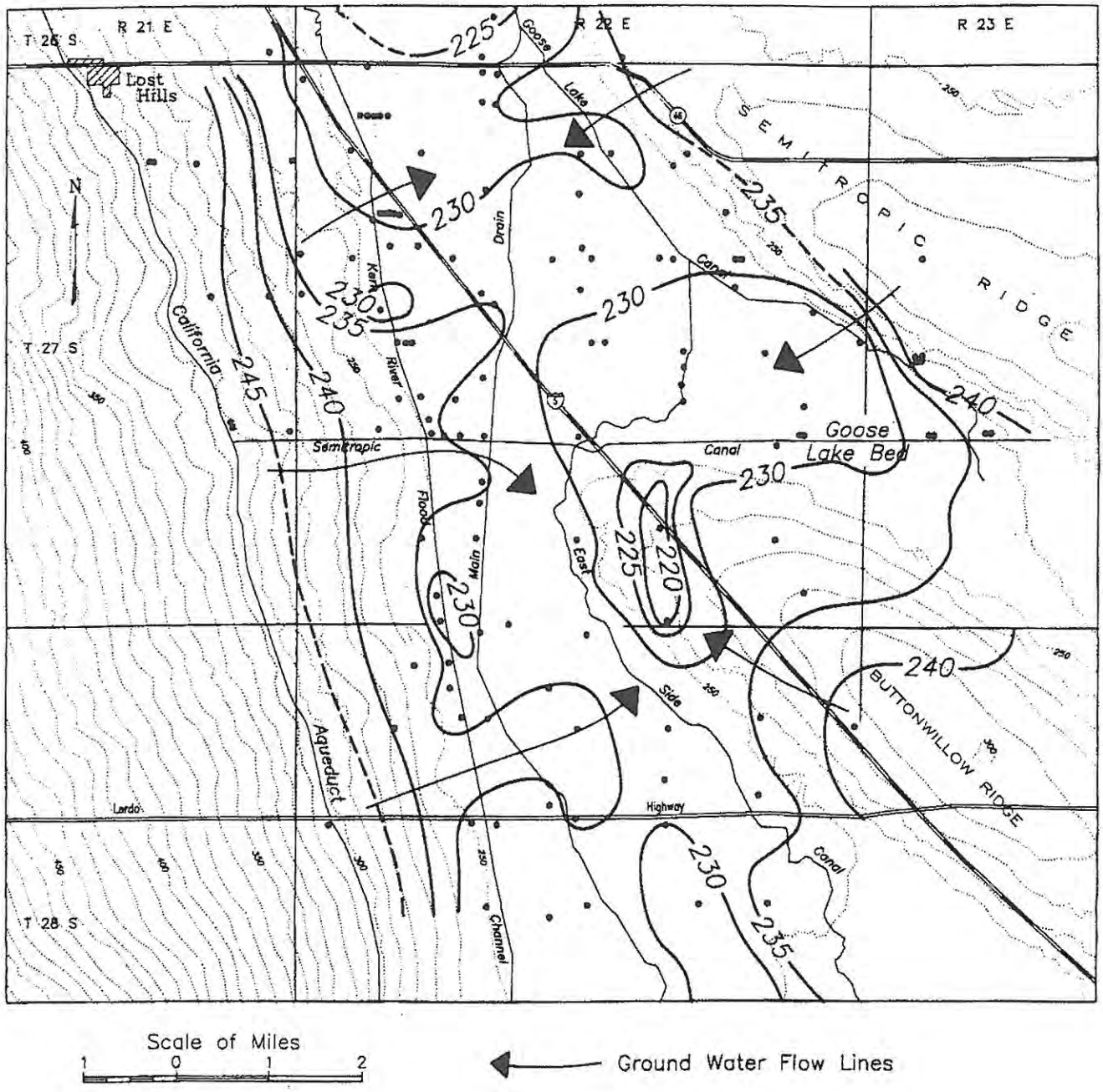


Figure 3. Depth to Water, July 1992 (feet)



Scale of Miles
1 0 1 2

Ground Water Flow Lines

Figure 4. Ground Water Surface Elevations, July 1992 (feet)

Electrical conductivity measurements taken from shallow piezometers in July 1992 are plotted on Figure 5. This figure shows that ground water with the lowest conductivity occurs in the central portion of the study area, while poorer quality water lies to the east and west. The decrease in conductivity from the periphery toward the center of the study area may be the result of dilution of poor-quality ground water by good-quality irrigation water.

Tables 1 and 2 tabulate results from water quality analyses made in the summer of 1990. These analyses suggest a difference in water types between ground water in the Belridge area (west of the Kern River Flood Channel) and that in the eastern portion of the study area. In water samples from both areas, sodium is the most prevalent cation (in percent reacting value), but with respect to anions, there is an apparent difference. Waters from the Belridge area generally contain higher percentages of sulfate than do waters from the BVWSD area, which are richer in chloride.

Soil samples logged during the drilling of DWR piezometers indicate that the study area is underlain by interbedded deposits of sand, silt, clay, and mixtures thereof. Logs from the Belridge area, west of the flood channel, indicate primarily fine-grained deposits (silt and clay). East of the flood channel, deposits consist of interbedded sand, silt, and clay with no identifiable, laterally continuous beds.

Mitigation Efforts

With the information on water levels and flow directions acquired during the ground water study, DWR and BVWSD applied to the State Water Resources Control Board (SWRCB) for a grant to install a ground water "interceptor" using eucalyptus trees to lower the ground water table and intercept ground water flowing into the area from the west.

In 1991, with financial assistance from SWRCB, DWR and BVWSD planted approximately 25,000 eucalyptus trees on farmland east of and parallel to the Kern River Flood Channel. Planting began at Highway 46 and extended, in a 120-foot-wide strip, southward for approximately 3 miles (Figure 6). An additional 10,000 trees were planted in the spring of 1992 in the same general area.

Although this project was designed to intercept subsurface flow from the west, not to lower water levels in the area, a localized water level decline in the vicinity of the eucalyptus plots may result.

The effect of the agroforestry project on ground water levels will not be determinable for several years, when the eucalyptus trees begin to mature.

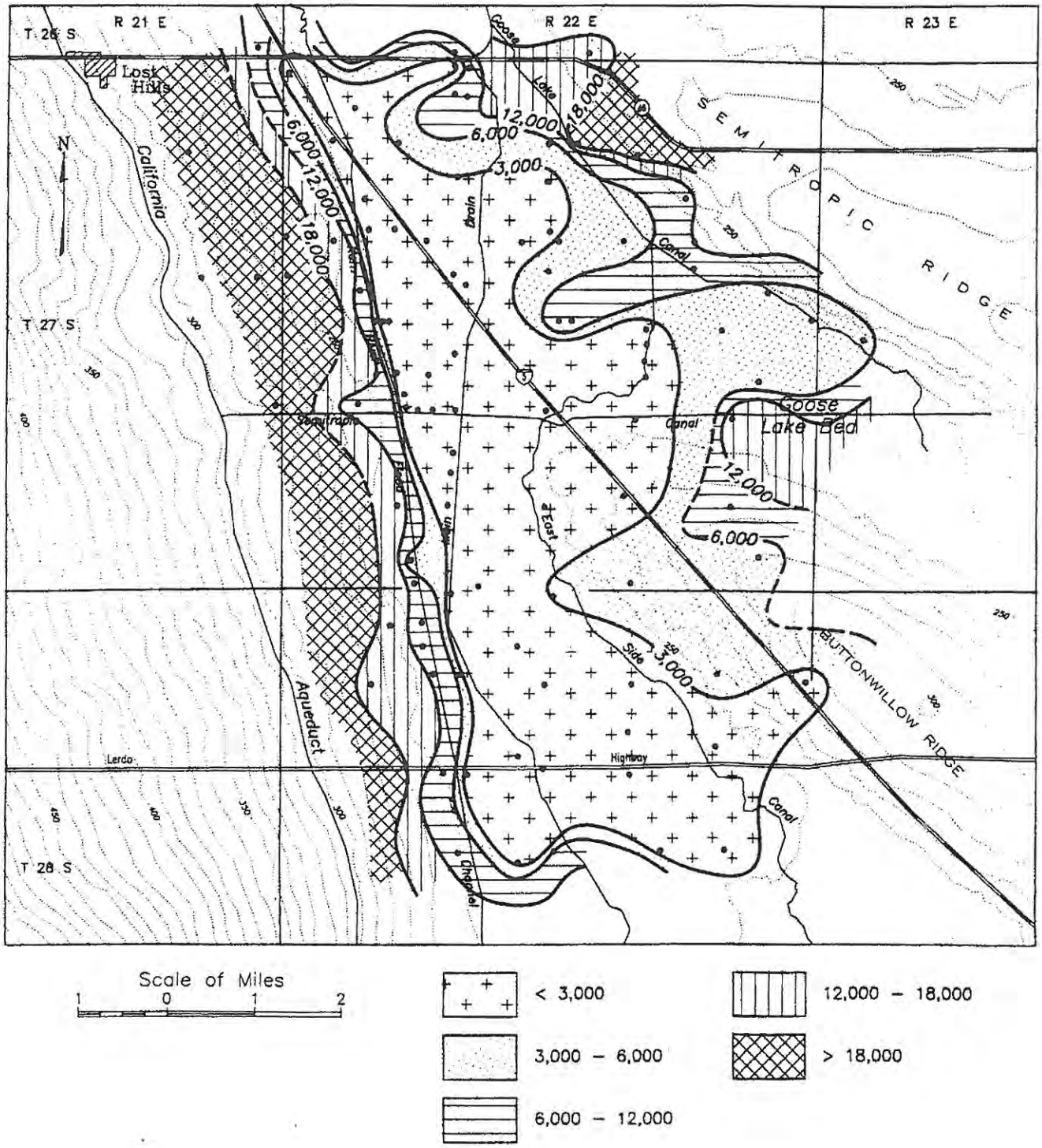


Figure 5. Electrical Conductivity, July 1992 (micromho/cm)

TABLE 1

CONCENTRATIONS OF COMMON MINERALS AND SELECTED MINOR ELEMENTS
1990
(milligrams per liter)

Well Number	Month Sampled	EC	Ca	Mg	Na	K	Alk. as $CaCO_3$	HCO_3	SO_4	Cl	NO_3	As	Se	TDS
27/21-01G1	August	68,300	600	1,290	18,800	5.6	312	380	16,300	21,700	11.0	0.002	0.074	61,500
27/21-12A1	August	9,400	608	155	1,740	4.0	133	162	4,790	525	245.0	0.002	0.003	8,600
27/22-04R1	June	5,280	201	181	766	3.4	368	449	876	1,040	171.0	0.027	0.002	3,520
27/22-05A1	June	3,970	233	63	541	2.8	317	386	382	922	20.0	0.014	0.000	2,430
27/22-05H1	June	6,210	204	101	1,040	2.9	425	518	621	1,490	40.0	0.013	0.002	3,890
27/22-05P1	June	2,580	20	15	529	1.0	146	178	360	495	2.1	0.008	0.000	1,500
27/22-06B1	August	9,670	12	18	2,380	2.3	846	1,031	2,460	1,230	138.0	0.336	0.004	6,960
27/22-06D1	August	2,490	73	25	455	4.8	265	323	752	174	1.8	0.006	0.015	1,700
27/22-06K1	June	8,390	200	116	1,510	32.0	275	335	1,560	1,810	0.2	0.025	0.000	5,740
27/22-07H1	June	910	34	10	160	2.8	292	356	58	78	1.0	0.072	0.004	594
27/22-07N1	August	30,200	500	330	7,110	8.5	300	366	5,550	8,290	3.8	0.005	0.023	22,900
27/22-07R1	June	639	40	13	64	2.2	132	161	48	90	0.0	0.004	0.000	365
27/22-08H1	June	2,690	64	21	492	3.2	283	345	707	264	2.2	0.003	0.000	1,760
27/22-08P1	June	1,870	139	44	184	1.5	215	262	266	330	0.3	0.002	0.000	1,150
27/22-09H1	June	2,520	112	23	395	5.4	228	278	607	308	1.5	0.155	0.001	1,680
27/22-09H2	June	1,850	77	35	267	2.2	277	338	181	263	119.0	0.032	0.002	1,140
27/22-09J1	June	1,730	74	12	244	2.5	34	41	290	327	3.0	0.006	0.000	1,050
27/22-10A1	June	29,100	328	72	7,440	2.0	219	267	8,920	5,540	214.0	0.818	0.001	23,800
27/22-15D1	June	2,800	136	72	357	2.9	281	343	450	470	68.0	0.032	0.000	1,840
27/22-15N2	June	11,000	402	264	1,920	2.0	306	373	4,060	1,420	92.0	0.017	0.003	9,110
27/22-16H1	June	3,270	92	72	500	1.1	319	389	371	535	112.0	0.020	0.001	2,110
27/22-16M4	June	3,080	207	23	397	2.5	187	228	453	606	2.9	0.010	0.000	1,940
27/22-17N1	June	1,630	104	17	207	3.2	128	156	364	213	2.3	0.001	0.000	1,060
27/22-18B1	August	8,430	15	29	1,970	18.0	851	1,038	2,330	898	9.4	0.122	0.022	6,030
27/22-18E1	August	49,500	555	1,000	13,200	3.0	197	240	15,100	12,900	328.0	0.001	0.278	49,500
27/22-18J1	August	4,840	560	133	398	13.0	0	0	1,840	743	0.3	0.036	0.000	3,970
27/22-20H1	June	2,460	136	25	356	7.8	174	212	488	400	2.3	0.005	0.000	1,610
27/22-20J1	June	2,440	129	29	330	10.0	99	121	489	429	0.9	0.050	0.000	1,570
27/22-20L1	June	2,200	211	46	170	4.0	153	187	292	461	4.9	0.023	0.000	1,450
27/22-20M1	August	12,300	259	117	2,760	8.3	107	130	4,310	1,670	39.0	0.000	0.007	9,740
27/22-20R3	June	931	53	11	123	2.2	133	162	110	134	1.2	0.042	0.001	550
27/22-21R2	June	1,950	15	7	368	1.2	133	162	351	294	2.3	0.102	0.000	1,190

TABLE 1 (continued)

CONCENTRATIONS OF COMMON MINERALS AND SELECTED MINOR ELEMENTS
1990
(milligrams per liter)

Well Number	Month Sampled	EC	Ca	Mg	Na	K	Alk. as $CaCO_3$	HCO_3	SO_4	Cl	NO_3	As	Se	TDS
27/22-23E5	June	2,170	6	2	470	0.7	341	416	288	291	7.0	0.165	0.000	1,330
27/22-25D2	June	37,100	400	354	9,240	7.3	456	556	11,200	8,070	1.1	0.253	0.003	31,200
27/22-31P1	August	4,870	560	90	637	1.7	87	106	2,360	207	205.0	0.000	0.084	4,490
27/22-32A1	June	2,500	121	33	355	5.6	40	49	772	310	0.3	0.002	0.003	1,760
27/22-32C1	August	14,200	520	25	3,020	4.9	242	295	4,400	2,540	4.7	0.001	0.001	11,100
27/22-33A1	June	778	52	17	85	1.1	142	173	64	118	3.2	0.035	0.000	456
27/22-33P1	June	2,180	109	13	328	3.8	238	290	368	336	5.0	0.001	0.000	1,370
28/22-04K1	June	3,080	197	20	399	16.0	52	63	457	672	28.0	0.537	0.000	1,960
28/22-04N1	June	5,870	406	116	692	3.3	181	221	838	1,440	22.0	0.016	0.002	3,850
28/22-05A2	June	2,070	118	13	293	4.6	203	248	344	330	2.3	0.031	0.000	1,300
28/22-05C1	August	9,540	237	77	1,960	8.2	200	244	1,800	2,140	4.6	0.210	0.141	6,470
28/22-05F1	August	13,600	398	101	3,140	1.9	133	162	7,060	624	109.0	0.003	0.016	12,300
28/22-05R2	August	44,000	38	235	12,000	35.0	447	545	10,900	11,300	248.0	0.014	0.004	36,600
28/22-06F1	August	9,930	400	70	2,120	2.7	92	112	5,130	282	124.0	0.003	0.058	8,940
28/22-09A1	June	3,230	114	46	556	2.1	408	497	860	267	42.0	0.002	0.000	2,240
28/22-10A1	June	1,870	104	36	249	4.4	276	337	351	217	25.0	0.006	0.001	1,210
28/22-11R1	June	1,100	57	15	144	4.1	131	160	176	151	0.3	0.009	0.000	664
28/22-13N1	June	2,820	27	11	562	2.7	152	185	638	372	15.0	0.035	0.000	1,790
28/22-14P1	June	945	63	10	108	4.0	175	213	127	104	7.0	0.007	0.000	588
28/22-15N6	June	6,940	471	106	883	3.4	244	297	716	1,840	10.0	0.023	0.000	4,550
28/22-16A1	June	7,020	236	108	1,370	23.0	403	491	2,720	493	159.0	0.004	0.004	5,570
28/22-16D1	June	1,460	55	10	260	3.2	226	276	239	154	13.0	0.017	0.002	927
28/22-17C1	August	7,180	219	49	1,480	36.0	236	288	3,280	290	89.0	0.006	0.003	5,870
28/22-21B1	June	4,800	328	57	673	6.5	202	246	794	1,040	10.0	0.004	0.000	3,200

Abbreviations

EC = electrical conductivity
Ca = calcium
Mg = magnesium
Na = sodium
K = potassium

Alk. = alkalinity
$CaCO_3$ = calcium carbonate
HCO_3 = bicarbonate
SO_4 = sulfate
Cl = chloride

NO_3 = nitrate
As = arsenic
Se = selenium
TDS = total dissolved solids

TABLE 2

PERCENT REACTING VALUE OF COMMON MINERALS

Well Number	Location of Well Relative to Kern River Flood Channel	Calcium	Magnesium	Sodium	Potassium	Bicarbonate	Sulfate	Chloride	Nitrate
27/21-01G1	West	3	11	86	0	1	35	64	0
27/21-12A1	West	26	11	64	0	2	82	12	3
27/22-04R1	East	17	26	57	0	13	32	51	5
27/22-05A1	East	29	13	58	0	16	20	64	1
27/22-05H1	East	16	13	71	0	13	20	66	1
27/22-05P1	East	4	5	91	0	12	31	57	0
27/22-06B1	East	1	1	98	0	16	49	33	2
27/22-06D1	West	14	8	77	0	20	60	19	0
27/22-06K1	East	12	11	76	1	6	36	57	0
27/22-07H1	East	18	9	73	1	63	13	24	0
27/22-07N1	West	7	8	86	0	2	33	66	0
27/22-07R1	East	34	18	47	1	43	16	41	0
27/22-08H1	East	12	7	81	0	20	53	27	0
27/22-08P1	East	37	19	43	0	22	29	49	0
27/22-09H1	East	23	8	69	1	18	49	34	0
27/22-09H2	East	21	16	63	0	30	20	40	10
27/22-09J1	East	24	6	69	0	4	38	58	0
27/22-10A1	East	5	2	94	0	1	53	45	1
27/22-15D1	East	24	21	55	0	19	32	45	4
27/22-15N2	East	16	17	67	0	5	64	30	1
27/22-16H1	East	14	18	67	0	21	25	49	6
27/22-16M4	East	35	6	58	0	12	31	56	0
27/22-17N1	East	33	9	57	1	16	47	37	0
27/22-18B1	West	1	3	96	1	19	53	28	0
27/22-18E1	West	4	12	84	0	1	46	53	1
27/22-18J1	West	49	19	31	1	0	65	35	0
27/22-20H1	East	28	8	63	1	14	41	45	0
27/22-20J1	East	27	10	61	1	8	42	50	0
27/22-20L1	East	48	17	34	0	14	27	59	0
27/22-20M1	West	9	7	84	0	2	64	34	0
27/22-20R3	East	30	10	60	1	30	26	43	0
27/22-21R2	East	4	3	92	0	15	40	45	0
27/22-23E5	East	1	1	98	0	32	28	39	1
27/22-25D2	East	4	6	89	0	2	50	48	0
27/22-31P1	West	44	12	44	0	3	82	10	6
27/22-32A1	East	25	11	63	1	3	63	34	0
27/22-32C1	West	16	1	82	0	3	54	43	0
27/22-33A1	East	34	18	48	0	38	18	44	1
27/22-33P1	East	26	5	68	0	22	35	43	0
28/22-04K1	East	34	6	59	1	3	32	63	2
28/22-04N1	East	34	16	50	0	6	28	65	1
28/22-05A2	East	30	5	64	1	20	35	45	0
28/22-05C1	West	11	6	82	0	4	37	59	0
28/22-05F1	West	12	5	83	0	2	87	10	1
28/22-05R2	West	0	4	96	0	2	41	57	1
28/22-06F1	West	17	5	78	0	2	90	7	2
28/22-09A1	East	17	11	72	0	24	52	22	2
28/22-10A1	East	27	16	57	1	29	38	32	2
28/22-11R1	East	27	12	60	1	25	35	40	0
28/22-13N1	East	5	3	91	0	11	49	39	1
28/22-14P1	East	36	9	54	1	38	29	32	1
28/22-15N6	East	33	12	54	0	7	21	72	0
28/22-16A1	East	15	11	74	1	10	70	17	3
28/22-16D1	East	18	6	76	1	32	35	31	1
28/22-17C1	West	14	5	80	1	6	83	10	2
28/22-21B1	East	32	9	58	0	8	33	59	0

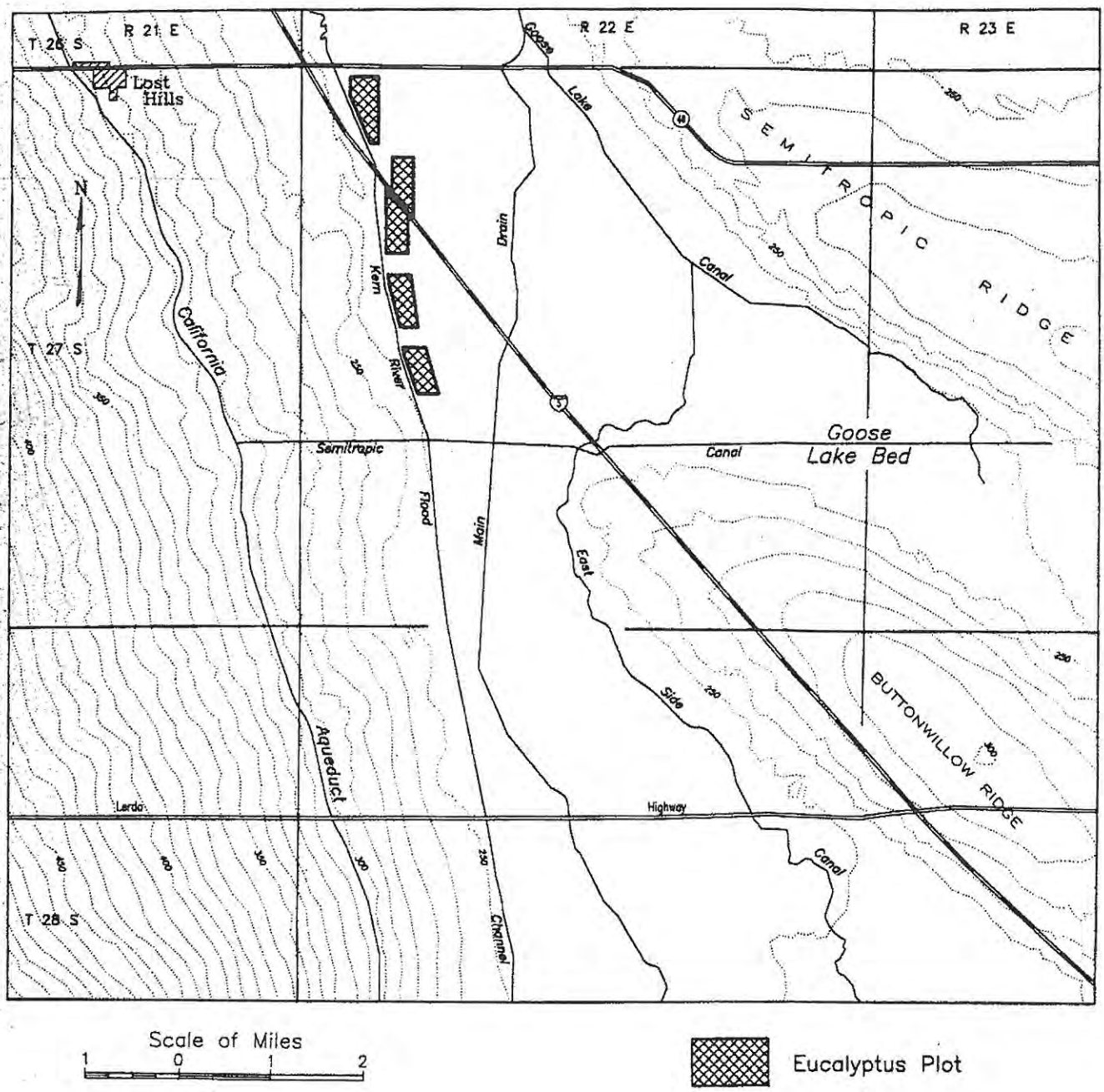


Figure 6. Locations of Eucalyptus Plots Along the Kern River Flood Channel

Conclusions

Ground water lies at a depth of 10 feet or less throughout a large portion of the study area. This condition is the result of both natural and anthropogenic processes, as irrigation water applied in excess of plant requirements percolates downward through beds of low permeability and flows down-gradient into the trough of the Valley from both the east and west. Irrigation in the trough itself also contributes to the high water table.

From the flow lines shown on Figure 4, it appears that the rising water level in the Kern River Flood Channel is the result of subsurface flow into the channel from the west. This flow is most probably caused by irrigation in the Belridge area.

A difference in water types appears to exist between ground water in the Belridge area and that east of the flood channel. Sodium-sulfate-type water is more prevalent in the Belridge area, while the Buena Vista area is characterized by more chloride-rich ground water.

Electrical conductivity decreases from the fringes of the study area toward the trough -- an apparent effect of dilution of poor-quality shallow ground water by relatively good-quality irrigation water.

Recommendations

Along with the adoption of more efficient irrigation practices in the area, the drainage system proposed by SCS seems to be the only current means of mitigating the problem of salty, shallow ground water in the immediate future. An agroforestry project could form a major component of such a system by concentrating drainage water and thereby minimizing the volume of disposal ponds that would be required.

Since the problem of rising shallow ground water appears to have several sources, DWR recommends that local water agencies work together toward a mutually beneficial solution. DWR recommends that agencies continue to monitor water levels in the area during the maturation of the eucalyptus trees so that their effect as a ground water interceptor can be evaluated. These data on ground water levels and ground water chemistry can then be used to determine an appropriate mitigation system and possibly aid in determining the relative impacts from upslope sources.

Works Cited

M. G. Croft. 1972. *Subsurface Geology of the Late Tertiary and Quaternary Water-Bearing Deposits of the Southern Part of the San Joaquin Valley, California.* U.S. Geological Survey Water-Supply Paper 1999-H.

Hilton, G. S., et al. 1963. *Geology, Hydrology, and Quality of Water in the Terra Bella-Lost Hills Area, San Joaquin Valley, California.* Open-File Report. U.S. Geological Survey, Sacramento, California.

United States Soil Conservation Service. 1985. *Leland Freeborn Watershed, Kern County, California.* Preauthorization Report prepared for Buena Vista Resource Conservation District, Buena Vista Water Storage District, and Semitropic Water Storage District.

2012 Consumer Confidence Report

Water System Name: **Buttonwillow County Water District** Report Date: June 26, 2013

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Type of water source(s) in use: Groundwater

Name & location of source(s): Well #02 (Milo Avenue), Well #03 (Highway 58), Well #04 (Westside Village)

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Time and place of regularly scheduled board meetings for public participation: Third Wednesday of each Month at 5:30 PM, at the Ag Center Bldg, 289 Main Street, Buttonwillow, CA 93206

For more information, contact: Regina Houchin, Secretary Phone: (661)764-5405

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ppt: parts per trillion or nanograms per liter (ng/L)

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pCi/L: picocuries per liter (a measure of radiation)

The sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves naturally-occurring minerals and, in some cases, radioactive material, and can pick up substances resulting from the presence of animals or from human activity.

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- *Pesticides and herbicides*, that may come from a variety of sources such as agriculture, urban stormwater runoff, and residential uses.
- *Organic chemical contaminants*, including synthetic and volatile organic chemicals, that are by-products of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff, agricultural application, and septic systems.
- *Radioactive contaminants*, that can be naturally-occurring or be the result of oil and gas production and mining activities.

In order to ensure that tap water is safe to drink, the USEPA and the state Department of Public Health (Department) prescribe regulations that limit the amount of certain contaminants in water provided by public water systems. Department regulations also establish limits for contaminants in bottled water that provide the same protection for public health.

Tables 1, 2, 3, 4, 5, 7, and 8 list all of the drinking water contaminants that were detected during the most recent sampling for the constituent. The presence of these contaminants in the water does not necessarily indicate that the water poses a health risk. The Department allows us to monitor for certain contaminants less than once per year because the concentrations of these contaminants do not change frequently. Some of the data, though representative of the water quality, are more than one year old.

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Microbiological Contaminants (complete if bacteria detected)	Highest No. of Detections	No. of months in violation	MCL	MCLG	Typical Source of Bacteria
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Fecal Coliform or *E. coli*	(In the year)	0	A routine sample and a repeat sample detect total coliform and either sample also detects fecal coliform or *E. coli*	0	Human and animal fecal waste

TABLE 2 – SAMPLING RESULTS SHOWING THE DETECTION OF LEAD AND COPPER

Lead and Copper (complete if lead or copper detected in the last sample set)	No. of samples collected	90th percentile level detected	No. sites exceeding AL	AL	PHG	Typical Source of Contaminant
Lead (ppb) Sampled 9/29/09	10*	ND		15	0.2	Internal corrosion of household water plumbing systems; discharges from industrial manufacturers; erosion of natural deposits
Copper (ppm) Sampled 9/29/09	10*	.13		1.3	0.3	Internal corrosion of household plumbing systems; erosion of natural deposits; leaching from wood preservatives

TABLE 3 – SAMPLING RESULTS FOR SODIUM AND HARDNESS

Chemical or Constituent (and reporting units)	Sample Date	Level Detected	Range of Detections	MCL	PHG (MCLG)	Typical Source of Contaminant
Sodium (ppm)	11/18/10	148	76-210	none	none	Salt present in the water and is generally naturally occurring
Hardness (ppm)	11/18/10	218	65-370	none	none	Sum of polyvalent cations present in the water, generally magnesium and calcium, and are usually naturally occurring

**Any violation of an MCL or AL is asterisked. Additional information regarding the violation is provided later in this report.*

TABLE 4 – DETECTION OF CONTAMINANTS WITH A PRIMARY DRINKING WATER STANDARD						
Chemical or Constituent (and reporting units)	**Sample Date**	**Level Detected**	**Range of Detections**	**MCL [MRDL]**	**PHG (MCLG) [MRDLG]**	**Typical Source of Contaminant**
Nitrate (AS NO3)	12/19/12	8.2	1.4 – 15	45	45	Runoff and leaching from fertilizer use; leaching from septic tanks and sewage; erosion of natural deposits
Arsenic (ppb)	12/19/12	4.65	2.2-7.1	10	5	Erosion of natural products; runoff from orchards, glass and electronics production wastes.
Disinfection Byproducts						
TTHMs (Total Trihalomethanes) (ppb)	8/20/12	12	12	80	N/A	Byproduct of drinking water chlorination

TABLE 5 – DETECTION OF CONTAMINANTS WITH A SECONDARY DRINKING WATER STANDARD						
Chemical or Constituent (and reporting units)	**Sample Date**	**Level Detected**	**Range of Detections**	**MCL**	**PHG (MCLG)**	**Typical Source of Contaminant**
Color	12/22/11	1.0	1.0	15	N/A	Naturally-occurring organic materials
Turbidity	12/22/11	0.14	0.14	5	N/A	Soil runoff

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Additional General Information on Drinking Water

Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that the water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the USEPA's Safe Drinking Water Hotline (1-800-426-4791).

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. USEPA/Centers for Disease Control (CDC) guidelines on appropriate means to lessen the risk of infection by *Cryptosporidium* and other microbial contaminants are available from the Safe Drinking Water Hotline (1-800-426-4791).

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Arsenic: While your drinking water meets federal and state standard for arsenic, it does contain low levels of arsenic. The arsenic standard balances the current understanding of arsenic's possible health effect against the cost of removing arsenic from drinking water. The California Department of Health Services continues to research the health effects of low levels of arsenic, which is a mineral known to cause cancer in humans at high concentrations and is linked to other health effects such as skin damage and circulatory problems.

Summary Information for Violation of a MCL, MRDL, AL, TT, or Monitoring and Reporting Requirement

We are required to monitor your drinking water for specific contaminants on a regular basis. Results of regular monitoring are an indicator of whether or not your drinking water meets health standards. During 2012, we did not complete all monitoring for the lead and copper rule as required and therefore cannot be sure of the quality of the drinking water during that time.

Buttonwillow County Water District
P.O. Box 274
Buttonwillow, CA 93206

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IMPORTANT
2012 Consumer Confidence Report

Este informe contiene información muy importante sobre su agua beber. Traduzcalo o hable con alguien que lo entienda bien.

2013 Consumer Confidence Report

Water System Name: **Buttonwillow County Water District** Report Date: June 27, 2014

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Lead and Copper (complete if lead or copper detected in the last sample set)	No. of samples collected	90th percentile level detected	No. sites exceeding AL	AL	PHG	Typical Source of Contaminant
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Copper (ppm) Sampled 9/27/13	10*	.045		1.3	0.3	Internal corrosion of household plumbing systems; erosion of natural deposits; leaching from wood preservatives

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Chemical or Constituent (and reporting units)	Sample Date	Level Detected	Range of Detections	MCL	PHG (MCLG)	Typical Source of Contaminant
Sodium (ppm)	12/16/13	146	79-200	none	none	Salt present in the water and is generally naturally occurring
Hardness (ppm)	12/16/13	237	80-400	none	none	Sum of polyvalent cations present in the water, generally magnesium and calcium, and are usually naturally occurring

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Nitrate (AS NO3)	12/16/13	3	<.440 – 10	45	45	Runoff and leaching from fertilizer use; leaching from septic tanks and sewage; erosion of natural deposits
Nitrite (as N) ppm	12/16/13	.01	<.005 - .0098	1	1	Runoff and leaching from fertilizer use; leaching from septic tanks and sewage; erosion of natural deposits
Arsenic (ppb)	12/16/13	2.9	<2 - 6	10	5	Erosion of natural products; runoff from orchards, glass and electronics production wastes.
Barium (ppm)	12/16/13	.0048	.0037 – .0055	1	2	Discharge of oil drilling wastes and from metal refineries; erosion of natural deposits.
Fluoride (ppm)	12/16/13	.0009	<.00050 - .0014	2.0	1	Erosion of natural deposits; water additive which promotes strong teeth; discharge from fertilizer and aluminum factories.
Radiological						
Gross Alpha Particle (pCi/L)	12/22/11	6	0 – 12	15	(0)	Erosion of natural deposits.
Disinfection Byproducts						
TTHMs (Total Trihalomethanes) (ppb)	8/26/13	9	9	80	N/A	Byproduct of drinking water chlorination

TABLE 5 – DETECTION OF CONTAMINANTS WITH A SECONDARY DRINKING WATER STANDARD						
Chemical or Constituent (and reporting units)	**Sample Date**	**Level Detected**	**Range of Detections**	**MCL**	**PHG (MCLG)**	**Typical Source of Contaminant**
Color	12/16/13	1.0	1.0	15	N/A	Naturally-occurring organic materials
Chloride (ppm)	12/16/13	189	46 – 350	500	N/A	Runoff/leaching from natural deposits: seawater influence
Iron (ppb)	12/16/13	197	<50 – 590	300	N/A	Leaching from natural deposits; industrial wastes
Specific Conductance (EC)	12/16/13	1188	534-1820	1600	N/A	Substances that form ions when in water; seawater influence
Sulfate (ppm)	12/16/13	237	110-340	500	N/A	Runoff/leaching from natural deposits; industrial wastes
Total Dissolved Solids (TDS) (ppm)	12/16/13	743	330-1200	1000	N/A	Runoff/leaching from natural deposits.
Turbidity	12/16/13	0.58	0.3 - 1	5	N/A	Soil runoff

Table 6 - Detection of Unregulated Contaminants					
Chemical or Constituent (and reporting units)	**Sample Date**	**Level Detected**	**Range of Detection**	**Notification Level**	**Health Effects Language**
Bicarbonate Alkalinity (ppm)	12/16/13	70	24 - 92	N/A	
Calcium (ppm)	12/16/13	95	32 - 160	N/A	
Magnesium (ppm)	12/16/13	.54	.29 - .75	N/A	
pH (Units)	12/16/13	8	7.97-8.24	N/A	

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Buttonwillow County Water District
P.O. Box 274
Buttonwillow, CA 93206

APPENDIX C

Water Quality Management Plan – August 2012
Main Drain

Buena Vista Water Storage District
525 N. Main Street
P.O. Box 756
Buttonwillow, CA 93206

Members of:
Kern River Watershed Coalition Authority
Southern San Joaquin Valley Water Quality Coalition

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1. Introduction

a. Purpose

Per the California Regional Water Quality Control Board Central Valley Region Monitoring and Reporting Program Order No. R5-2008-0005 for the Irrigated Lands and Regulatory Program, if more than one exceedance of the same water quality parameter at the same location occurs within a three-year period then a Management Plan is required by the Central Valley Regional Water Quality Control Board (Regional Board).

Buena Vista Water Storage District (District) owns and operates the Main Drain located in the Kern River watershed approximately 20 miles west of Bakersfield where one of several water quality sampling sites is located for the Kern River Sub-Basin portion of the Monitoring and Reporting Program administered by the Southern San Joaquin Valley Water Quality Coalition. This sampling location on the Main Drain at Highway 46, identified as SWQ_STA-1, has yielded a number of exceedances within a three year period and therefore requires a Management Plan. Additionally, per the preliminary draft of the 2012 Main Drain Management Plan, three different sampling sites on the Main Drain were added where corresponding water quality analysis indicated additional exceedances. Please see Appendix A for data summary.

b. Background

Approximately 50,000 acres of land within the District boundaries are enrolled in the Irrigated Lands Regulatory Program (ILRP) under the Southern San Joaquin Valley Water Quality Coalition (SSJVWQC). Of those lands within the District most farming operations include the use of row or flood irrigation methods and either directly or indirectly utilize the Main Drain for irrigation runoff. Cotton, alfalfa and grains continue to be the primary crops within the District but the District is seeing a growing trend of permanent crops such as pistachio and pomegranate trees which generate little or no irrigation runoff.

The Main Drain is over 20 miles long and runs almost the entire length of the Buttonwillow Service Area of the District. The Main Drain leaves the District boundary at Highway 46, Section 33, Township 26 South, Range 22 East, and ties into the Goose Lake Canal which can convey irrigation runoff to and beyond the Kern National Wildlife Refuge which is approximately eight miles downstream from Highway 46. Please see Appendix B for District map.

c. Watershed Description and Land Uses

The Main Drain is over 20 miles long and runs almost the entire length of the Buttonwillow Service Area (BSA) of the District. Elevation in the District ranges from 290 feet above sea level in the southern portion to about 232 feet above sea level in the north. The Main Drain essentially bisects through the middle of the BSA, draining the area from the south to the north by collecting runoff directly from agricultural fields or from a series of lateral drains throughout

the BSA. Additionally, the Main Drain passes through the small community of Buttonwillow where storm runoff from the community enters the drain.

The District receives irrigation water supplies from the Kern River and the State Water Project but groundwater is also used to meet crop demands. The District is an agricultural irrigation district and the entirety of the District's surface water supply is used for agricultural and environmental uses with no urban deliveries. As noted earlier, most farming operations within the District employ row or flood irrigation methods which typically generate irrigation runoff that regularly finds its way to the Main Drain. With cotton, alfalfa and grains continuing to be the primary crops within the District, typical irrigation cycles occur during the winter months of January and February (pre-irrigation) and the summer period of late May through August (irrigation season). Because of these typical irrigation cycles the agricultural runoff normally enters the Main Drain during the corresponding months but the Main Drain can also see significant flows during the other months of the year due to additional agricultural operations or storm runoff.

Please See Appendix C for a 2011 crop map and crop summary.

d. Summary of Water Quality Exceedances

There were a number of water quality exceedances that occurred from water samples taken from the Main Drain ranging from toxicity in water and soil (higher priority) to elevated levels of total dissolved solids (lower priority). Please see Appendix A for tables summarizing Main Drain water quality exceedances from August 2006 to January 2012.

2. Management Plan Approach for Specific Categories

a. Overview – Parameter Prioritization Rationales (RWQCB Item 1)

Implementation of Main Drain Management Plan parameters will be categorized into three priority tiers. An increase in parameter priority tier is contingent upon the frequency and magnitude of exceedances and the ability of agricultural management practices to favorably increase water quality. Higher tiered priorities will receive accelerated scheduling in comparison to lower tiered priorities because of a greater likelihood of adverse affects to beneficial uses and the higher probability that perceived agricultural sources are culpable. Registered pesticides and toxicity will receive the *highest priority* for Management Plan implementation. Secondly, legacy pesticides and trace metals will receive an *intermediate priority* for implementation. Thirdly, salinity, dissolved oxygen (DO), pathogens and pH will be assigned a *low priority* due to the probability that these parameters may have originated from non-agricultural sources and consequently will require greater time periods to identify and develop solutions.

The following Table illustrates the prioritization rationale of parameters to be addressed by the Management Plan:

Table 1: Management Plan Prioritization Rationales

MANAGEMENT PLAN PARAMETER CATEGORY	PRIORITY TIER	RATIONALE BEHIND PRIORITIZATION
Registered Pesticides	HIGH	High probability for adverse affect to aquatic life and of agricultural source origination. Possible improvements with successful ag management techniques.
Water and Sediment Toxicity	HIGH	High probability for adverse affect to aquatic life and of agricultural source origination. Possible improvements with successful ag management techniques when specific sources of toxicity are identified.
Legacy Organophosphate and Organochlorine Pesticides	INTERMEDIATE	Low potential to adversely affect aquatic life. High probabilities of past agricultural origins, but residential / commercial origins are possible.
Trace Metals	INTERMEDIATE	Intermediate potential for adversity to aquatic life and beneficial uses, however a strong possibility of natural occurrences. Consequently, multiple management programs may have to be implemented.
Salinity (Includes both TDS and Ec)	LOW	Low probability for adverse affect to aquatic life, but high adverse potential to irrigated agriculture. Increased salinity concentrations from irrigated lands and other sources. Multiple management strategies to cover designated sources.
Pathogens (Specifically E. coli) (RWQCB Item 8)	LOW	Low adverse potential to aquatic life, but high possibility to adversely affect other beneficial uses, such as human consumption. Attempts will be made to identify potential upgradient E. coli sources.
DO and pH	LOW	Intermediate potential to adversely affect aquatic life, low possibility to affect other beneficial uses.

As referenced above, a portion of the exceedances of contaminants being addressed by this Management Plan can reasonably be assumed to be caused by irrigated agricultural land use but also may be influenced by urban runoff from the Buttonwillow community and baseline levels in the irrigation water source. As a result, each of the stages of the Management Plan will address the following components as appropriate:

1. Strategy for identification of irrigated agricultural sources that may be the cause of the water quality problem:

    - Evaluation of water quality monitoring data
    - Evaluation of District chemical application records
    - Evaluation of District water delivery, flow rate, and drain operations
    - Review Department of Pesticide Regulation, Pesticide Use Report records
    - Perform study to determine region of potential contributing irrigation practices and agricultural operations
    - Evaluate potential non-agricultural sources
    - Routine field-level visual observations of Main Drain and potential influences
    - Special studies as necessary to isolate potential sources

2. Identification of potential management practices to be implemented that address the exceedances and identify the process for evaluation and tracking of current or recently implemented management practices (RWQCB Item2):
    - Determine existing management practices by conducting surveys using both direct communications with growers and the Grower Survey Form that follows:

GROWER SURVEY FORM (RWQCB Item 3)

Type of Crop(s) Grown: Row | Field | Orchard | Vineyard | Pasture | Other

NOTES: _____

Nutrient Management: Lab Analysis | Periodic/Timing | Book Values | Tissue Samples

NOTES: _____

Where Does Pesticides/Fertilizers/Loading Occur: Impervious Pad | Bare Soil | Off-site

NOTES: _____

Mixing/Loading Management Practices: Backflow Prevention | Air Gap | Operator Present At All Times

NOTES: _____

Rinseate/Empty Pesticide Containers: Triple Rinsed | Rinseate Reapplied to field | Recycled

NOTES: _____

Spray Equipment Management: Use of Correct Nozzles | Calibration |Outside Nozzle Shutoff

NOTES: _____

Irrigation: Optimize Efficiency | Tailwater Return | Scheduling/Instruments | Lab Analysis

NOTES: _____

Dormant Sprays: Check weather | Setbacks | Minimize Drift | Alternatives to Diazinon/Chlorpyrifos

NOTES: _____

- (RWQCB Item 2 and 3) The method for management practice tracking and evaluation of management practice effectiveness will consist of the following: An initial determination of existing management practices shall be well-documented by observations and reporting so that any Management Plan deficiencies can be rectified and/or new management practices implemented. This will ultimately lead to an evaluation of the effectiveness of the new management practices by ***comparison*** between initial and/or deficient plans with recently implemented plans.

  (RWQCB Item 4) Perform follow-up communications with growers as necessary if management practice deficiencies were observed and/or communicated by the grower. Follow-up communications will collect additional data and information to ***compare and contrast*** in written form, the implementation and fulfillment of agricultural management practices that should increase beneficial use water quality and meet the corresponding goals of the Management Plan.

- (RWQCB Item 6) Collaborate with appropriate organizations, institutions and other coalitions (See Pg. 11 for a list of organizations) to determine appropriate additional general and commodity specific management practices and perform grower outreach to determine applicability, reasonableness, feasibility of additional management practices.

3. Management practice implementation schedule:

   The general schedule for Management Plan implementation includes the schedules for implementation of the potential management practices and can be reviewed in Appendix D. Below is a schedule summary for management practice implementation for the different stages of the Management Plan:

Registered Pesticides & Toxicity	March 2014 & May 2014
Legacy Pesticides & Trace Metals	February 2015
Dissolved Oxygen & pH	February 2016
Salinity	May 2016

   Many of the management practices can potentially be common to the different stages of the Management Plan and therefore already implemented prior to the stated schedule. Consideration of this information will be necessary in order to accurately assess management practices during the evaluation portions for later stages of the plan and in determination of added management practices.

4. (RWQCB Item 5) Management Practice Performance Goals for the Evaluation of the effectiveness of the Management Plan during Implementation:

The successful completion of the different stages of the Management Plan will ultimately be determined by the Executive Officer of the Regional Board. Generally there are four possible pathways for successful completion of a Management Plan stage:

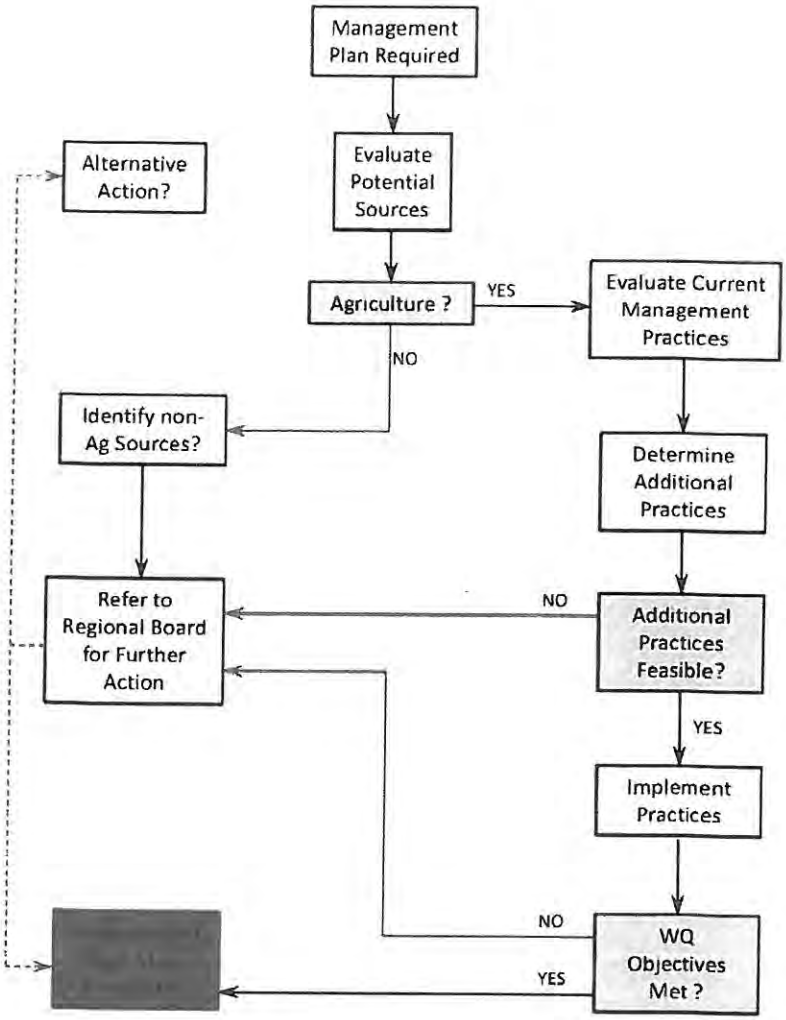
- Agriculture is confirmed not to be a source of the exceedances, and the issue is referred to Regional Board Staff for other appropriate actions;
- Agriculture is confirmed as a potential source, the source is eliminated or controlled, and compliance with water quality objectives is demonstrated;
- Agriculture is a potential source, but compliance with water quality objectives is not achievable by reasonable and economically feasible agricultural management practices;
- No conclusion can be reached regarding the probable sources of exceedances, and reasonable efforts to identify the sources have been exhausted.

The criteria for completion of each of these pathways are illustrated in the following Figure 1 and the specific information and data used for the pathways will be documented for each element of the Management Plan. Progress of the Management Plan stages will be reported to and discussed with the Regional Board on a quarterly basis.

(RWQCB Item 5) Interim goals will also be implemented to keep track of the Management Plan progress. These goals will include outreach efforts with growers and related parties such as documenting the number of meetings between BVWSD and its members, number of workshops, US Mail/email communications, advisory assistance for management practice identification/ implementation and ultimately positive changes in water quality. All goals can be quantified with documented and reported progress toward them in the annual Management Plan Progress Reports. The evaluation of Management Plan effectiveness will be predicated on accomplishing the following performance goals:

- Completion of source identification and evaluation
- Documented outreach to Coalition members and return of Grower Surveys
- Documentation of initial (baseline) management practices from surveys
- Implementation of additional management practices by grower-members
- Quantified decrease in the number of exceedances or detections in test samples with the goals and schedule established in the Management Plan Progress Report

Figure 1 – Management Plan Completion Flow Chart



Management Practice Performance Goals and a Schedule for Performance Goal Implementation and Evaluation:

The general schedule for the Management Plan incorporates the schedules for the pathways to achieving goals as described above and can be reviewed in Appendix D. Below is a schedule summary of pathway completion for each stage of the Management Plan:

Registered Pesticides & Toxicity	2nd & 3rd Quarters 2014
Legacy Pesticides & Trace Metals	2nd Quarter 2015
Dissolved Oxygen & pH	2nd Quarter 2016
Salinity	3rd Quarter 2016

5. Effective monitoring schedule.

The success of the Management Plan potentially relies on an effective water quality monitoring sampling program. Ultimately the concern for water quality issues center on the quality of the Main Drain water as it leaves the District boundary at Highway 46 and potentially enters other Waters of the State. This location is the last downstream sampling station on the Main Drain and will continue to be a standard sampling station throughout each of the different Management Plan stages. Sampling at this site will be done on a monthly basis and water quality analysis will be performed for the exceedances of concern. If there is a no flow condition during a scheduled sample collection at this location then that month's sampling event will be omitted. For the year 2011 there were 10 monthly sampling events and for 2010 there were 9 monthly sampling events.

A second sampling site is located on the Main Drain at Seventh Standard Road. This sampling location was introduced in the 2009 draft of the Management Plan to help identify potential sources of water quality issues and has continued to be sampled on a monthly basis. Data provided by this sampling station may prove to be useful in determining potential sources of water quality issues and will continue to be sampled on a monthly basis unless there is a no flow condition at this location. If at some point throughout the Management Plan process it is determined this sampling location no longer provides value to the process then, with the Regional Board's approval, this sampling site will be temporarily suspended or eliminated. Conversely, if it is determined that additional sampling sites may be necessary then the Regional Board will be consulted to determine the appropriate frequency and locations of the additional sampling events.

6. Process and schedule for evaluating management practice effectiveness.

The successful completion of the Management Plan will, in all likelihood, rely on implementation of reasonable and feasible management practices. It will be necessary to not only determine the appropriate management practices to implement but to also evaluate the effectiveness of those implemented practices. The process to help determine the appropriate management practices for each stage of the Management Plan will use the following guidelines:

- Determine existing management practices by conducting surveys using both direct communications with growers and survey forms
- Perform follow-up communications with growers as necessary to collect sufficient data
- (RWQCB Item 6) Collaborate with appropriate organizations, institutions and other coalitions to determine appropriate additional general and commodity

specific management practices. The following organizations are identified as capable of determining appropriate management practices:
University of California Cooperative Extension (UCCE)
County Agricultural Departments/Commissioners
Resource Conservation Districts (RCD)
Natural Resource Conservation Service (NRCS)
Coalition for Urban/Rural Environmental Stewardship (CURES)
Certified Crop Advisors/Pest Control Advisors (ASA/CAPCA)

- Perform grower outreach to determine applicability, reasonableness, and feasibility of additional management practices

Once the appropriate practices are implemented, a process to evaluate and document the effectiveness of the management practices will be necessary to determine if water quality objectives were met which completes the Management Plan stage or if further consultation with the Regional Board is necessary. The process to help determine the effectiveness of management practices for each stage of the Management Plan will use the following guidelines:

- Evaluate the number of Growers that are properly implementing appropriate management practices through direct communication and surveys
- Perform field-level visual surveys to assist in evaluation of properly implemented practices
- Continue water quality monitoring per monitoring schedule
- Analyze water quality data to determine trends or response to practices
- Report findings to Regional Board

The general schedule for Management Plan incorporates the schedules for evaluating management practice effectiveness as described above and can be reviewed in Appendix D. Below is a schedule summary for evaluating management practice effectiveness for each stage of the Management Plan:

Registered Pesticides & Toxicity	August 2014 & November 2014
Legacy Pesticides & Trace Metals	August 2015
Dissolved Oxygen & pH	August 2016
Salinity	November 2016

7. Identification of the participants and Coalition Group that will implement the Management Plan:

Currently, growers that have the potential to impact the Main Drain water quality with irrigation activities are entirely within the District boundaries and are members of the Southern San Joaquin Valley Water Quality Coalition (SSJVWQC).

The SSJVWQC was formed in 2002 for the purpose of jointly and cooperatively addressing water quality issues common to the water and resource agencies in the Tulare Lake Basin. Four major river systems are included in the Coalition: the Kings River, Kaweah River, Tule River and Kern River watersheds. Each sub-watershed has a lead coordinator that provides the SSJVWQC with supporting effort and documents associated with their respective sub-watershed regions to implement the Irrigated Lands Regulatory Program.

The Main Drain is located within the Kern River sub-watershed where previously the Kern County Water Agency represented the Kern River sub-watershed as the lead coordinator reporting to the SSJVWQC. As of January 1, 2012 the Kern River Watershed Coalition Authority was formed and now represents the Kern interests in matters regarding the SSJVWQC and the ILRP.

Given that all growers within the Main Drain watershed are located within the District and the District owns and operates the Main Drain, the District typically administers and coordinates ILRP efforts on behalf of its in-District landowners. Accordingly, the District coordinates with the Kern River sub-watershed group regarding activities surrounding the Main Drain and will continue to do so for the purposes of the Management Plan. Below is Table 2 summarizing the participating parties and their corresponding responsibilities for implementation of the plan.

Table 2 - Main Drain Management Plan Implementation

Management Plan Tasks	Responsible Party
Management Plan Schedule	District
Management Plan Development and Submittal	District
Management Plan Review and Acceptance	RB
Management Plan Implementation	District
Management Plan Updates and Meetings	District/RB
Provide Progress Updates/Reports to Subwatershed	District
Report on Plan Activities for Required MRP Reporting	KRWCA
MRP Reporting to Regional Board	SSJVWQC

District- Buena Vista Water Storage District
KRWCA - Kern River Watershed Coalition Authority
SSJVWQC - Southern San Joaquin Valley Water Quality Coalition
RB - Central Valley Regional Water Quality Board

8. Identified routine schedule of reporting to the Regional Water Board:

   The District will meet with the Regional Board Staff on a quarterly basis to discuss Management Plan implementation, progress and any other applicable aspects of the plan to help ensure the successful implementation of the plan. Written reports and supporting documents will be provided on the same quarterly schedule. Please see Appendix D for the quarterly schedule.

b. Development and Implementation Schedule

The schedule for Main Drain Management Plan Development and Implementation was submitted to the Regional Board January 23, 2012.

Due to the multiple and various exceedances reported on the Main Drain the approach for this Management Plan is to first address occurrences or contaminants that are considered to be of a higher priority for surface waters such as registered pesticides and toxicity in the water and soil. Then after the process is well underway the next stage will begin and subsequent stages in the same manner for the lower priority issues. The following is the general order by which the Management Plan will address the exceedances:

Registered Pesticides & Toxicity in Water and Soil
Legacy Pesticides & Trace Metals
Salinity
Dissolved Oxygen & pH

Please see Appendix D for the Main Drain Management Plan Development and Implementation Schedule.

c. Documentation and Management Plan Reporting (RWQCB Item 7)

Management Plan reporting will supply timely and adequate information pertaining to achievement of performance goals. Documentation of source identification evaluations, evaluations of the effectiveness of management plan implementation, identification of deficiencies and required changes that may have to be implemented, will all be addressed. All these evaluations will be conducted and reported annually in concert with the Annual Monitoring Report. Data reports will continue to be submitted on a quarterly schedule.

Since the BVWSD is conducting ILRP operations under a Management Plan, the BVWSD will not be required to report Main Drain exceedances of the constituents covered by the Management Plan within the seven (7) day requirement per the Monitoring and Reporting Program (MRP), and exceedance reports will be submitted to the Regional Board in accordance with the Management Plan.

d. Registered Pesticides

Exceedances of registered pesticides are considered high priority and will be addressed in the first stage of the Management Plan. Registered pesticides are pesticides that are legally registered for agricultural use and pesticides that are banned for use will be addressed under the Legacy Pesticide and Metals Stage.

Currently the only registered pesticide that has been shown to exceed water quality limits multiple times at the same location within a three-year period is chlorpyrifos. There have been a number of known exceedances since January 2010 and are summarized in Table 2 below.

Table 3 - Main Drain Chlorpyrifos Exeedances

Date	Hwy 46 (ug/L)	7th Standard Rd. (ug/L)
1/26/2010	0.019	
3/24/2010	0.06	0.092
4/27/2010	0.12	0.077
5/19/2010	0.08	0.076
6/24/2010		0.023
7/27/2010	0.06	0.19
8/25/2010	0.34	0.35
9/29/2010	0.046	0.05
3/30/2011	0.053	
4/25/2011	0.072	0.13
5/31/2011		0.058
7/28/2011	0.32	0.29
8/31/2011	0.53	1.4
9/29/2011	0.16	0.51

WQ Limit = .015 ug/L

Chlorpyrifos is a organophosphate insecticide that is only registered for agricultural use in the U.S. and is used under many different trade names such as Bordan, Detmol UA, Dowco 179, Dursban, Empire, Eradex, Lorsban, Paqeant, Piridane, Scout, Stipend and Tricel. Chlorpyrifos is commonly used for cotton but also used for alfalfa and wheat crops which are the three top crops within the District.

Although this Management Plan will currently address chlorpyrifos as the only registered pesticide, if future exceedances of additional registered pesticides that would normally trigger a management plan occur during the implementation process of this current Management Plan then the Regional Board will be consulted to determine if the inclusion of the new contaminants into the existing process will be appropriate.

Successful completion of this stage of the Management plan will require following the appropriate pathways as described earlier in this Management Plan using thorough evaluations, analysis, and sufficient data.

e. Toxicity in Water and Soil

Exceedances of toxicity in water and soil are considered high priority and will be addressed in the first stage of the Management Plan. Three species that are used to determine toxicity in water and sediment samples, *Ceriodaphnia dubia*, *Selenastrum capricornutum* and *Hyalella azteca*, have indicated statistically significant mortality since 2005 and are summarized in Table 4 below.

Table 4 - Main Drain Significant Mortality

	Hwy 46 (ug/L)			7th Standard Rd. (ug/L)		
Date	CD (%)	SC (%)	HA (%)	CD (%)	SC (%)	HA (%)
8/31/2005		45	5			
4/10/2006		17				
7/12/2007			0			
8/27/2008		40	29			
2/18/2009		20				
7/28/2011	45			35		
8/31/2011	0			0		

CD - *Ceriodaphnia dubia*
SC - *Selenastrum capricornutum*
HA - *Hyalella azteca*

Ceriodaphnia dubia is a tiny copepod that is commonly referred to as a water flea and is widely used in water column toxicity and bioaccumulation tests. Acute toxicity testing was performed per guidelines prescribed under EPA method EPA-821-R-02-12.

Selenastrum capricornutum is a fresh water algae used to estimate the chronic toxicity of effluents and receiving waters. Chronic toxicity testing was performed per guidelines prescribed in EPA method EPA-821-R-02-013.

Hyalella azteca is a freshwater amphipod that is commonly used in laboratory sediment toxicity and bioaccumulation tests. Sediment toxicity testing was performed per guidelines of EPA method EPA/600/R-99/064.

Successful completion of this stage of the Management plan will require following the appropriate pathways as described earlier in this Management Plan using thorough evaluations, analysis, and sufficient data.

f. Legacy Pesticides and Metals

Exceedances of banned pesticides or legacy pesticides along with exceedances of trace metals are considered a lower priority than pesticides or toxicity and will be addressed in this stage of the Management Plan.

Historical uses are considered the most likely source for legacy pesticides and it could prove unfeasible to employ a process to identify potential sources. Additionally, these pesticides are no longer used and therefore there would be no appropriate management practice to implement aside from potential sediment discharge control which could also be potentially unfeasible.

Trace metals are known to be present in a variety of sources including surface water, groundwater, natural geological sources, urban runoff and also from agriculture. Understanding the local water irrigation sources, there is a strong potential the source of the trace metal exceedances will be attributed to importation via water supplies.

A legacy pesticide has been detected and a number of trace metal exceedances were detected beginning in August of 2008 and are summarized in Table 5 below.

Table 5 - Legacy Pesticide and Metal Exceedances

	Hwy 46 (ug/L)			7th Standard Rd. (ug/L)		
Date	DDE	Arsenic	Mo	DDE	Arsenic	Mo
8/27/2008						
2/18/2009						
5/27/2009						
6/29/2009	0.0035					
8/27/2009	0.007					
9/29/2009	0.008					
1/26/2010						
2/21/2010						
3/24/2010						
4/27/2010						
9/29/2010						
3/30/2011		25.4	41.3			
4/25/2011		11.3			11	
5/31/2011					11.6	
6/29/2011					18.1	
7/28/2011		13.4			11.6	
8/31/2011		13.3			11.9	
9/29/2011					13.5	23.8
12/28/2011		11.9	11.7			
1/25/2012		16.1	16.7		14.7	10.5

Boron exceedances will be addressed within the Salinity stage of this Management Plan.

Successful completion of this stage of the Management plan will require following the appropriate pathways as described earlier in this Management Plan using thorough evaluations, analysis, and sufficient data.

g. Dissolved Oxygen and pH

This stage of the Management Plan will address the exceedances of dissolved oxygen (DO) and pH and is considered a lower priority stage. Dissolved oxygen analysis measures the amount of gaseous oxygen dissolved in water. Oxygen gets into water by diffusion from the surrounding air, by aeration, as a waste product of photosynthesis and other means. There are many factors that can affect the levels of DO including temperature, conditions for photosynthesis, flow rate, organisms, TDS and agricultural related operations. The pH of water can also be affected by TDS or other minerals and metals along with agricultural runoff.

This is considered a lower priority due to the efforts of the preceding stages that will likely improve the DO and pH levels or it potentially could be determined that source water is a major contributing factor with few or no directly effective management practices. Below is Table 6 summarizing the DO and pH exceedances.

Table 6 - Dissolved Oxygen and pH Exceedances

	Hwy 46		7th Standard Rd. (ug/L)		Buttonwillow Dr.	
Date	DO (mg/L)	pH	DO (mg/L)	pH	DO (mg/L)	pH
7/27/2008		8.66				
8/27/2008		9.19				
8/27/2009		8.97				
2/21/2010		8.63				
3/24/2010		8.32				
4/27/2010		8.85				
5/19/2010			2.8		3.69	
6/24/2010					4.72	
7/14/2010		8.36				
8/25/2010			4.9			
1/27/2011		8.79				
1/25/2012	3.03					

Successful completion of this stage of the Management plan will require following the appropriate pathways as described earlier in this Management Plan using thorough evaluations, analysis, and sufficient data.

h. Salinity

This stage of the Management Plan will address the exceedances of total dissolved solids (TDS), electrical conductivity (EC), and boron. Salinity is an issue that affects many regions of the San Joaquin Valley including areas within Kern County and the District.

Although this Management Plan applies to the surface waters of the Irrigated Lands Regulatory Program, many, if not all, of the salt management practices will be developed or evolve from the groundwater aspects of the Long-Term Irrigated Lands Program and region specific General Orders. The Regional Board has begun efforts to address salinity problems in the Central Valley and to develop solutions to improve the salinity issues.

This stage of the management plan is deferred to the later stages due to the potential overlap with the currently developing groundwater General Orders and possible developing salt management practices. New information, practices, and requirements can greatly impact the factors used to determine the pathways as described earlier in this Management Plan.

Pending the outcome of the groundwater General Order, this stage of the Management Plan can either be required to follow the appropriate pathways as described earlier in this Management Plan using thorough evaluations, analysis, and sufficient data or the requirement of this stage can be relieved by management practices set forth in the General Order.

Appendix A

Exceedance Summary Tables

2012 Main Drain Water Quality Exceedances

	Sample Location	Sample Date	Sample ID	Testing Lab	Measured Flows (CFS)	Arsenic ug/L	Boron ug/L	Molybdenum ug/L	Conductivity umhos/cm	TDS mg/L	Dissolved Oxygen mg/L	Conductivity umhos/cm	Fecal Coliform MPN/100ml	
							700	10	700	450	>5	700	400 (235)	WQ Limit
1	MDC Hwy 46	1/25/2012	VI 1240155-001	FGL	9	16.1	1080	16.7	2070	1290	3.03	2075	130	
2	MDC 7th Standard	1/25/2012	VI 1240155-003	FGL		14.7	576	10.5	1350	895	8.52	1348	3000	

Source: Buena Vista Water Storage District

Table: 2011 Summary

Reg. Pesticides

2011 Main Drain Water Quality Exceedances

	Sample Location	Sample Date	Sample ID	Testing Lab	Measured Flows (CFS)	Arsenic ug/L	Boron ug/L	Molybdenum ug/L	Conductivity umhos/cm	TDS mg/L	Ammonia Nitrogen mg/L	pH	Temp C	Conductivity umhos/cm	Chlorpyrifos ug/L	Dimethoate ug/L	Ceriodaphnia Bioassy % Survival	Fecal Coliform MPN/100ml
						10	700	10	700	450	1.5	6.5-8.3		700	0.015	1	<50%	400
1	MDC Hwy 46	1/27/2011	VI 1140171-001	FGL	0				377	218	ND	8.79	11.4	371				30
2	MDC Hwy 46	2/24/2011	VI 1140422-001	FGL	18				584	366	0.402	7.95	13.2	579				1300
3	MDC Hwy 46	3/30/2011	VI 1140701-001	FGL	0	25.4	702	41.3	1500	929	0.298	7.93	17.1	1486	0.053	ND	100	30
4	MDC Hwy 46	4/25/2011	VI 1140858-001	FGL	25	11.3	148	6.13	259	140	0.407	8.1	20.8	238	0.072	ND	100	220
5	MDC Hwy 46	5/31/2011	VI 1141154-001	FGL	44	4.15	112	2.25	332	198	0.065	8.13	17.6	337	ND	ND	100	
6	MDC Hwy 46	6/29/2011	VI 1141396-001	FGL	24	7.88	115	5.62	271	169	0.099	7.61	22.6	269	ND	ND	100	30
7	MDC Hwy 46	7/28/2011	VI 1141676-001	FGL	11	13.4	166	6.32	406	258	0.283	7.39	25.8	432	0.32	1.3	45	500
8	MDC Hwy 46	8/31/2011	VI 1142103-001	FGL	47	13.3	213	6.4	527	325	0.03	7.73	26.7	545	0.53	ND	0	900
9	MDC Hwy 46	9/29/2011	VI 1142374-001	FGL	30	7.45	226	4.68	587	362	ND	7.44	24.1	597	0.16	ND	100	80
10	MDC Hwy 46	12/28/2011	VI 1143237-003	FGL	14	11.9	371	11.7	946	552	0.062	8.15	6.2	1080	ND	ND	100	170
11	MDC 7th Standard	1/27/2011	VI 1140171-003	FGL					1990	1260	0.066	7.94	12.1	1982				140
12	MDC 7th Standard	2/24/2011	VI 1140422-003	FGL					431	266	0.547	8.02	11.5	431				17000
13	MDC 7th Standard	3/30/2011	VI 1140422-003	FGL														
14	MDC 7th Standard	4/25/2011	VI 1140858-003	FGL		11	121	5.41	223	134	0.575	7.72	22.4	221	0.13	ND	100	3000
15	MDC 7th Standard	5/31/2011	VI 1141154-003	FGL		11.6	123	8.21	243	157	0.163	7.55	20.5	244	0.058	ND	100	
16	MDC 7th Standard	6/29/2011	VI 1141396-003	FGL		18.1	114	7.51	188	167	0.07	7.39	22.7	190.3	ND	ND	95	5000
17	MDC 7th Standard	7/28/2011	VI 1141676-003	FGL		11.6	134	4.64	398	247	1.9	7.56	28.5	396	0.29	ND	35	8000
18	MDC 7th Standard	8/31/2011	VI 1142103-003	FGL		11.9	184	5.02	502	308	ND	7.68	26.6	499	1.4	ND	0	2200
19	MDC 7th Standard	9/29/2011	VI 1142374-003	FGL		13.5	1130	23.8	2170	1870	ND	8.21	26.2	2041	0.51	ND	100	500
20	MDC 7th Standard	12/28/2011	VI 1143237-001	FGL		5.47	92.7	2.87	391	217	ND	8.02	6.3	362	ND	ND	100	50

WQ Limits

Source: Buena Vista Water Storage District

Main Drain @ Highway 46 - (558MDCH46)
(35.6161, -119.6149)
Kern Sub-watershed, Kern County

Source: Regional Board

SUMMARY OF EXCEEDANCES LEADING TO MANAGEMENT PLAN(S)

DRAFT

Management Plan Required	Units	Water Quality Limit	Source	Protected Beneficial Use	Date and Concentration of Exceedance 2006 - 2009																	
					8/30/2006	1/31/2007	8/15/2007	7/27/2008	8/27/2008	2/18/2009	5/27/2009	6/29/2009	8/27/2009	9/29/2009	1/26/2010	2/21/2010	3/24/2010	4/27/2010	5/19/2010	7/14/2010	8/25/2010	9/29/2010
Flow (for reference)	cfs	N/A	Reference	N/A	12		69	7	8	NR		20	4	4								
pH	pH Units	6.5-8.3	TLBP	ANY				8.66	9.18				8.97			8.63	8.32	8.85		8.36		
DDE	µg/L	0.001	NAWQC	FALP								0.0035	0.007	0.008								
Toxaphene	µg/L	0.0002	NAWQC	FALP							0.037	0.036										
Boron	µg/L	700.0	WQA	AGR					740	900	996			1002	1260	1210	2580	1200				1150
Total Dissolved Solids	mg/L	450.0	WQA	AGR	640	590	550	480	1120	1260	1380	610	1190	1410	1510	1770	2410	970				1560
Chlopyrifos	µg/L	0.0150	SSJRBP	FALP											0.019		0.06	0.12	0.08	0.06	0.34	0.05
EC	µS/cm	700	WQA	AGR														1557				2340
E. Coli	MPN/100 mL	235	QCW86	REC-1											2420	1550						

Existing Management Plans		Statistically Significant Toxicity						
		8/31/2005	4/10/2006	6/28/2006	8/30/2006	7/12/2007	8/27/2008	2/18/2009
Flow (for reference)	cfs	9		32	12	22	8	
Selenastrum capricornutum	% Growth Reduction	45	17				40	20
Hyalella azteca	% Survival	5		80	60	0	29	

6/29/2009 DDE result flagged, value above MDL (0.001 µg/L) but below PQL (0.005 µg/L)

5/27/2009 and 6/29/2009 Toxaphene results flagged, value above MDL (0.01 µg/L) but below PQL (0.05 µg/L)

8/31/2005 Hyalella test control failure. 87.5% survival of control population

SSJRBP - Sacramento and San Joaquin River Basin Plan

TLBP - Tulare Lake Basin Plan

FALP - Freshwater Aquatic Life Protection

WQA - Water Quality for Agricultre (Ayers & Westcot)

AGR - Agricultural Supply

NAWQC - National Ambient Water Quality Criteria

QCW86 - USEPA Quality Criteria for Water, 1986

REC-1 = Water Contact Recreation

Main Drain at 7th Standard - (558MDC7SR)
(35.4416, 119.5498)
Kern Sub-watershed, Kern County

SUMMARY OF EXCEEDANCES LEADING TO MANAGEMENT PLAN(S)

DRAFT

Source: Regional Board

Management Plan Required	Units	Water Quality Limit	Source	Protected Beneficial Use	Date and Concentration of Exceedance 2006 - 2010						
					3/24/2010	4/27/2010	5/19/2010	6/24/2010	7/27/2010	8/25/2010	9/29/2010
Flow (for reference)	cfs	N/A	Reference	N/A							
EC	µmhos/cm	700	WQA	AGR	1425	1587					1436
DO	mg/L	5	TLBP	FALP			2.8			4.9	
E. Coli	MPN/100 mL	235	QCW86	REC-1						260	365
Chlorpyrifos	µg/L	0.015	SSJRBP	FALP	0.092	0.077	0.076	0.023	0.190	0.350	0.050

AGR - Agricultural Supply
TLBP - Tulare Lake Basin Plan
SSJRBP - Sacramento/San Joaquin River Basin Plan
FALP - Freshwater Aquatic Life Protection
WQA - Water Quality for Agriculture (Ayers & Westcot)
QCW86 - USEPA Quality Criteria for Water, 1986

Main Drain at Buttonwillow - (558MDCBWD)
(35.4038, -119.4740)
Kern Sub-watershed, Kern County

SUMMARY OF EXCEEDANCES LEADING TO MANAGEMENT PLAN(S)

DRAFT

Source: Regional Board

Management Plan Required	Units	Water Quality Limit	Source	Protected Beneficial Use	Date and Concentration of Exceedance 2006 - 2010	
					5/19/2010	6/24/2010
Flow (for reference)	cfs	N/A	Reference	N/A	Low	Low
Dissolved Oxygen	mg/L	5	TLBP	FALP	3.69	4.72

TLBP - Tulare Lake Basin Plan

FALP - Freshwater Aquatic Life Protection

Main Drain at Front Street - (558MDCFST)
(35.3996, -119.4645)
Kern Sub-watershed, Kern County

Source: Regional Board

SUMMARY OF EXCEEDANCES LEADING TO MANAGEMENT PLAN(S)

DRAFT

Management Plan Required	Units	Water Quality Limit	Source	Protected Beneficial Use	Date and Concentration of Exceedance 2006 - 2010	
					4/27/2010	5/19/2010
Flow (for reference)	cfs	N/A	Reference	N/A	Unknonw	Unknown
E. Coli*	MPN/100 mL	235	QCW86	REC-1	3000	500

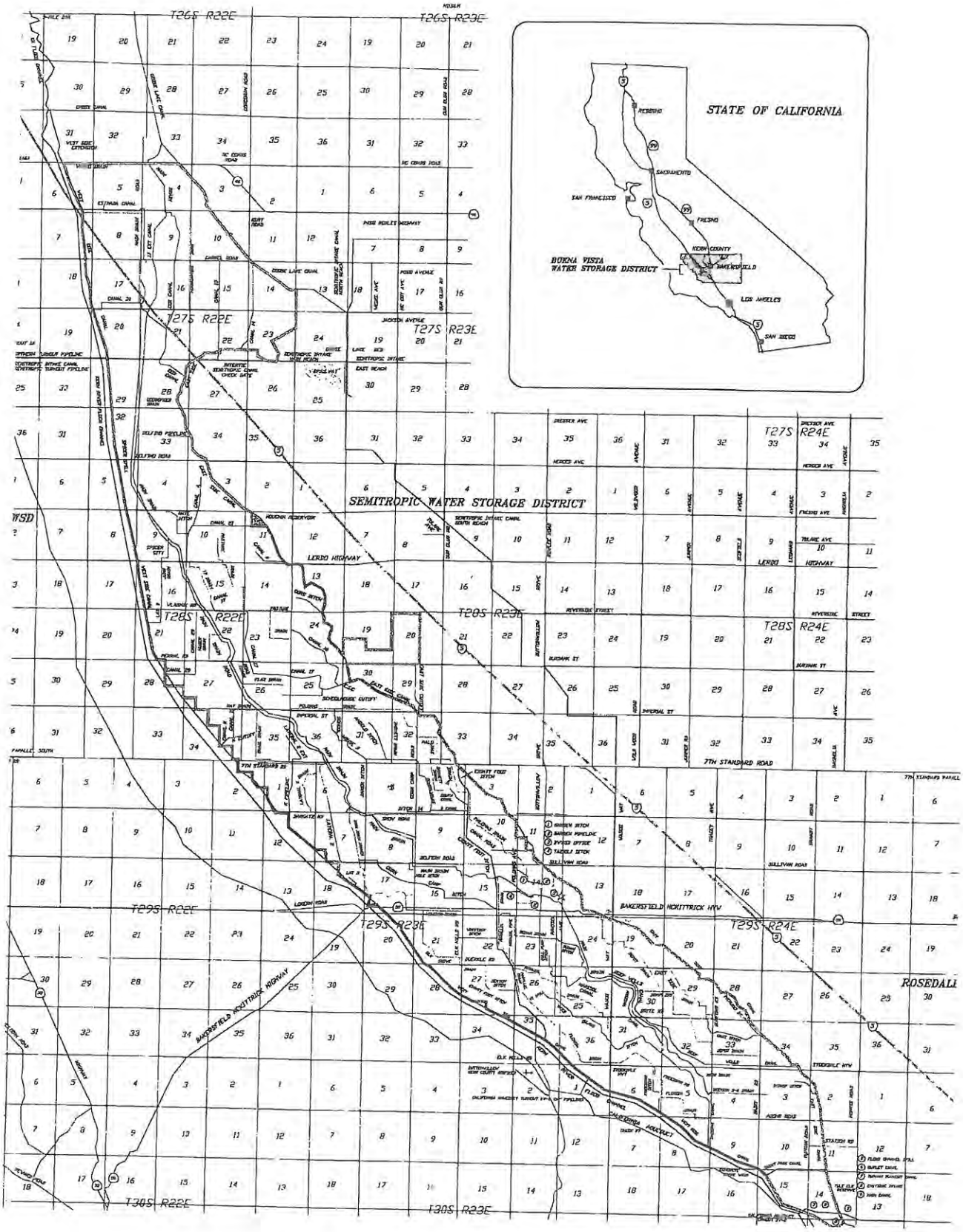
QCW86 - USEPA Quality Criteria for Water, 1986

REC-1 = Water Contact Recreation

*E. Coli taken from Coalition summary, unable to find lab sheets

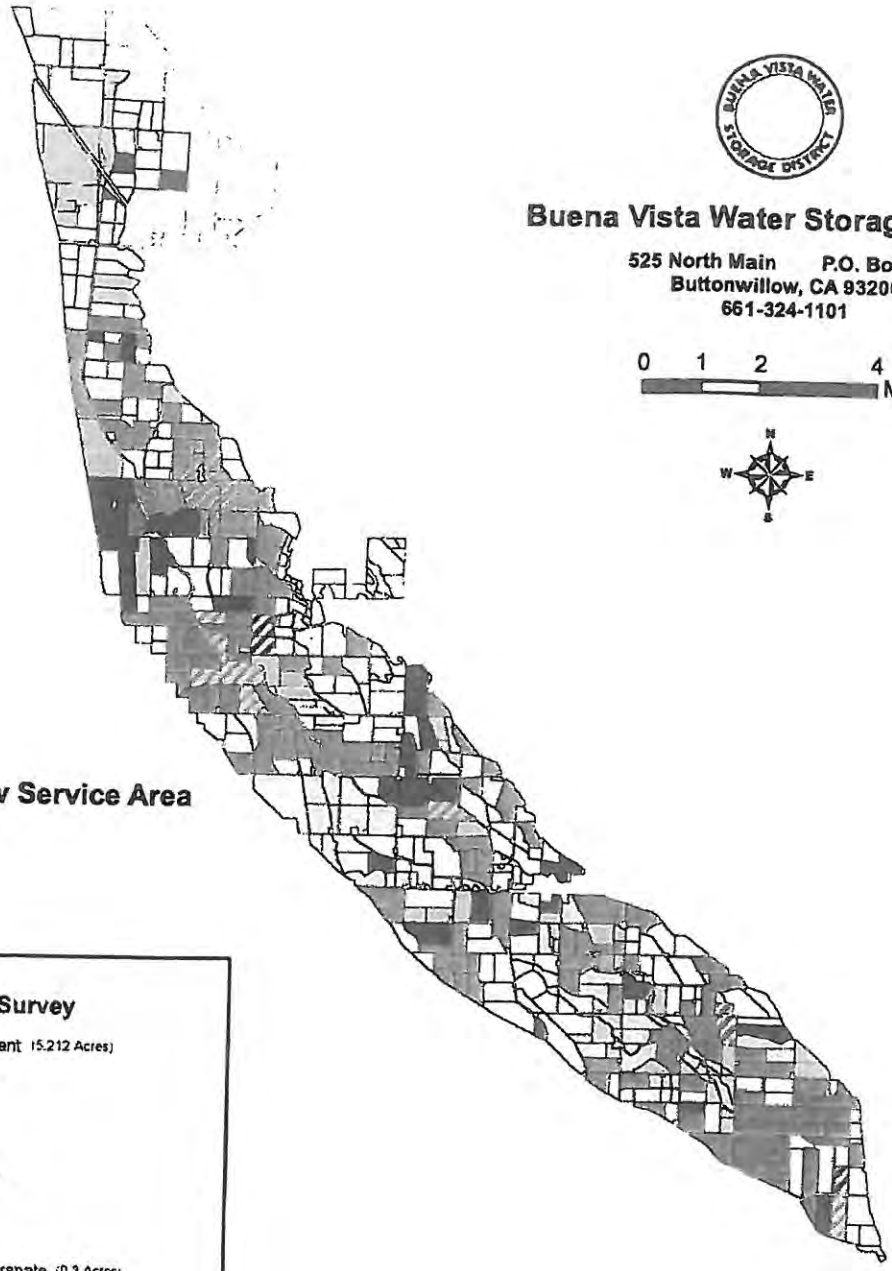
Appendix B

District Map


STATE OF CALIFORNIA
REDDING
SACRAMENTO
SAN FRANCISCO
FRESNO
KERN COUNTY
BAKERSFIELD
BUENA VISTA WATER STORAGE DISTRICT
LOS ANGELES
SAN DIEGO
SEMITROPIC WATER STORAGE DISTRICT
T26S R22E
T26S R23E
T27S R22E
T27S R23E
T27S R24E
T28S R22E
T28S R23E
T28S R24E
T29S R22E
T29S R23E
T29S R24E
T30S R22E
T30S R23E
LERDO HIGHWAY
BAKERSFIELD HOKITTRICK HWY
7TH STANDARD ROAD
ROSEDALE

Appendix C

District 2010 Crop Map



Buena Vista Water Storage District

525 North Main P.O. Box 756
Buttonwillow, CA 93206
661-324-1101

0 1 2 4 Miles

N W E S

Buttonwillow Service Area

2010 Crop Survey

- Conservation Easement (5,212 Acres)
- Alfalfa (11,193.0 Acres)
- Cherry (40.5 Acres)
- Corn (588.4 Acres)
- Cotton (13,652.4 Acres)
- Grapes (34.6 Acres)
- Milo (764.8 Acres)
- Mix - Pistachio/Pomegranate (0.3 Acres)
- Mix - Pistachio/Wheat (85.4 Acres)
- Oats (2231.3 Acres)
- Olive (80.0 Acres)
- Onion (800.2 Acres)
- Open (2,445.8 Acres)
- Pistachio, M (722.8 Acres)
- Pistachio, Y (3,127.8 Acres)
- Pomegranate, M (1.8 Acres)
- Pomegranate, Y (1,473.2 Acres)
- Sudan (1,305.4 Acres)
- Tiffany (45.0 Acres)
- Tomato (320.6 Acres)
- Wheat (3,610.5 Acres)

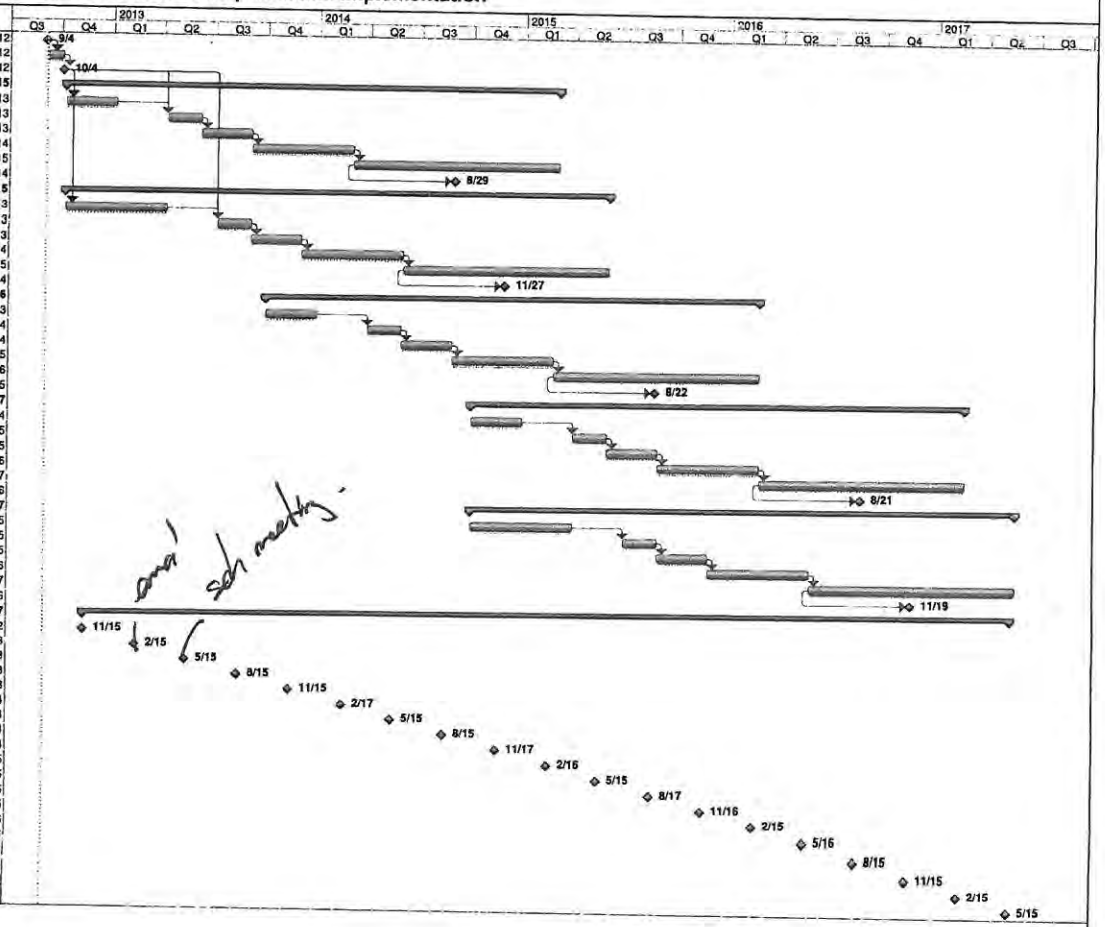
Maples Service Area

Appendix D

Schedule for Updated Management Plan Development and Implementation

Buena Vista Water Storage District
Main Drain
Schedule for Updated Management Plan Development and Implementation

ID	Task Name	Duration	Start	Finish
1	Submit schedule for updated management plan development	0 days	Tue 9/4/12	Tue 9/4/12
2	RWQCB review	30 edays	Tue 9/4/12	Thu 10/4/12
3	RWQCB approval	0 days	Thu 10/4/12	Thu 10/4/12
4	**Registered pesticides**	**625 days**	**Mon 10/8/12**	**Mon 3/2/15**
5	Source ID and evaluation	90 edays	Mon 10/8/12	Sun 1/6/13
6	Source evaluation report	60 edays	Sat 4/6/13	Wed 6/5/13
7	Baseline management practice surveys	90 edays	Wed 6/5/13	Tue 9/3/13
8	Identify additional practices and establish goals and schedule for management practice implementation	180 edays	Tue 9/3/13	Sun 3/2/14
9	Begin Implementation	365 edays	Sun 3/2/14	Mon 3/2/15
10	Assessment of effectiveness	0 days	Fri 8/29/14	Fri 8/29/14
11	**Toxicity**	**689 days**	**Mon 10/8/12**	**Sun 5/31/15**
12	Source ID and evaluation	180 edays	Mon 10/8/12	Sat 4/6/13
13	Source evaluation report	60 edays	Fri 7/5/13	Tue 9/3/13
14	Baseline management practice surveys	90 edays	Tue 9/3/13	Mon 12/2/13
15	Identify additional practices and establish goals and schedule for management practice implementation	180 edays	Mon 12/2/13	Sat 5/31/14
16	Begin Implementation	365 edays	Sat 5/31/14	Sun 5/31/15
17	Assessment of effectiveness	0 days	Thu 11/27/14	Thu 11/27/14
18	**Legacy pesticides and Trace Metals**	**625 days**	**Tue 10/1/13**	**Tue 2/23/16**
19	Source ID and evaluation	90 edays	Tue 10/1/13	Mon 12/30/13
20	Source evaluation report	60 edays	Sun 3/30/14	Thu 5/29/14
21	Baseline management practice surveys	90 edays	Thu 5/29/14	Wed 8/27/14
22	Identify additional practices and establish goals and schedule for management practice implementation	180 edays	Wed 8/27/14	Mon 2/23/15
23	Begin Implementation	365 edays	Mon 2/23/15	Tue 2/23/16
24	Assessment of effectiveness	0 days	Sat 8/22/15	Sat 8/22/15
25	**DO and pH**	**625 days**	**Wed 10/1/14**	**Wed 2/22/17**
26	Source ID and evaluation	90 edays	Wed 10/1/14	Tue 12/30/14
27	Source evaluation report	60 edays	Mon 3/30/15	Fri 5/29/15
28	Baseline management practice surveys	90 edays	Fri 5/29/15	Thu 8/27/15
29	Identify additional practices and establish goals and schedule for management practice implementation	180 edays	Thu 8/27/15	Tue 2/23/16
30	Begin Implementation	365 edays	Tue 2/23/16	Wed 2/22/17
31	Assesment of effectiveness	0 days	Sun 8/21/16	Sun 8/21/16
32	**Salinity**	**689 days**	**Wed 10/1/14**	**Tue 5/23/17**
33	Source ID and evaluation	180 edays	Wed 10/1/14	Mon 3/30/15
34	Source evaluation report	60 edays	Sun 6/28/15	Thu 8/27/15
35	Baseline management practice surveys	90 edays	Thu 8/27/15	Wed 11/25/15
36	Identify additional practices and establish goals and schedule for management practice implementation	180 edays	Wed 11/25/15	Mon 5/23/16
37	Begin Implementation	365 edays	Mon 5/23/16	Tue 5/23/17
38	Assessment of effectiveness	0 days	Sat 11/19/16	Sat 11/19/16
39	**Quarterly progress meetings**	**1172 days**	**Thu 11/15/12**	**Mon 5/15/17**
40	4th qtr 2012	0 days	Thu 11/15/12	Thu 11/15/12
41	1st qtr 2013	0 days	Fri 2/15/13	Fri 2/15/13
42	2nd qtr 2013	0 days	Wed 5/15/13	Wed 5/15/13
43	3rd qtr 2013	0 days	Thu 8/15/13	Thu 8/15/13
44	4th qtr 2013	0 days	Fri 11/15/13	Fri 11/15/13
45	1st qtr 2014	0 days	Mon 2/17/14	Mon 2/17/14
46	2nd qtr 2014	0 days	Thu 5/15/14	Thu 5/15/14
47	3rd qtr 2014	0 days	Fri 8/15/14	Fri 8/15/14
48	4th qtr 2014	0 days	Mon 11/17/14	Mon 11/17/14
49	1st qtr 2015	0 days	Mon 2/16/15	Mon 2/16/15
50	2nd qtr 2015	0 days	Fri 5/15/15	Fri 5/15/15
51	3rd qtr 2015	0 days	Mon 8/17/15	Mon 8/17/15
52	4th qtr 2015	0 days	Mon 11/16/15	Mon 11/16/15
53	1st qtr 2016	0 days	Mon 2/15/16	Mon 2/15/16
54	2nd qtr 2016	0 days	Mon 5/16/16	Mon 5/16/16
55	3rd qtr 2016	0 days	Mon 8/15/16	Mon 8/15/16
56	4th qtr 2016	0 days	Tue 11/15/16	Tue 11/15/16
57	1st qtr 2017	0 days	Wed 2/15/17	Wed 2/15/17
58	2nd qtr 2017	0 days	Mon 5/15/17	Mon 5/15/17



and sch meeting

Project: 2012-0120_BVmgmtplan
Date: Tue 9/4/12

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone