GROUNDWATER QUALITY TREND MONITORING WORK PLAN

Westside Water Quality Coalition

Western Tulare Lake Basin, California

Prepared for:

Westside Water Quality Coalition
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Mr. Joseph D. Hughes
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Subject: **Groundwater Quality Trend Monitoring Work Plan**
Westside Water Quality Coalition
Western Tulare Lake Basin, California

Dear Mr. Hughes:

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler), has prepared the enclosed *Groundwater Quality Trend Monitoring Work Plan* on behalf of Klein, DeNatale, Goldner, LLP, and your client, the Westside Water Quality Coalition (Coalition). The Coalition is acting as a Third-Party Coalition pursuant to Waste Discharge Requirements General Order R5-2013-0120 (General Order) issued by the California Regional Water Quality Control Board in September 2013.

This work plan describes tasks that will be performed to meet the objectives described in the General Order for trend monitoring. A monitoring well network is presented, including the selection criteria used, necessary background information, and a groundwater monitoring schedule. Additionally, groundwater monitoring to support a basin plan amendment is also discussed.

We certify under penalty of law that this document and all attachments were prepared under our direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on our inquiry of the persons who manage the system, or those persons directly for gathering the information, the information submitted is, to the best of our knowledge and belief, true, accurate and complete. We are aware that there are penalties for submitting false information, including the possibility of fine and imprisonment.

Amec Foster Wheeler is pleased to be of service to Klein, DeNatale, Goldner, LLP, and the Coalition. If you have questions about this work plan, please call either of the undersigned.

Sincerely yours,
Amec Foster Wheeler Environment & Infrastructure, Inc.

Jill Ghelerter, PhD
Senior Hydrogeologist

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cc: Greg Hammett, Westside Water Quality Coalition

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amec foster wheeler

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Westside Water Quality Coalition
Western Tulare Lake Basin, California

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This work plan was prepared by the staff of Amec Foster Wheeler Environment & Infrastructure, Inc., under the supervision of the Geologist whose seal and signature appear hereon.

The findings, recommendations, specifications, or professional opinions presented in this work plan were prepared in accordance with generally accepted professional geologic practice and within the scope of the project. No other warranty, express or implied, is provided.

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GROUNDWATER QUALITY TREND MONITORING WORK PLAN

Westside Water Quality Coalition
Western Tulare Lake Basin, California

EXECUTIVE SUMMARY

The Westside Water Quality Coalition (Coalition) is acting as a Third-Party Coalition pursuant to Waste Discharge Requirements General Order R5-2013-0120 (General Order) issued by the California Regional Water Quality Control Board in September 2013. To be in compliance with the General Order, the Coalition is required to submit a work plan that describes a trend groundwater quality monitoring program within the Coalition area. The Coalition has requested that Amec Foster Wheeler Environmental & Infrastructure, Inc., prepare the work plan pursuant to provisions of the General Order.

This work plan describes tasks that will be implemented to meet the objectives described in the General Order for trend groundwater monitoring. The objectives include determining current groundwater conditions related to irrigated lands and gathering data that can be used to evaluate long-term regional trends associated with irrigated lands. A network of 20 monitoring wells has been selected for monitoring groundwater quality trends. These wells are located in both the perched and unconfined/semi-confined aquifers and in and outside of designated high vulnerability areas.

Additionally, a one-time groundwater monitoring event is suggested in non-irrigation areas near the Coalition's eastern boundary. These data will support a basin plan amendment request previously proposed by the Coalition. The monitoring event will include sampling ten wells completed in both the perched and unconfined/semi-confined aquifers.

Finally, this work plan discusses the logistics for conducting groundwater monitoring, such as contacting the well owners/operators and obtaining site access, and provides a monitoring schedule and the reporting requirements.

GROUNDWATER QUALITY TREND MONITORING WORK PLAN

Westside Water Quality Coalition
Western Tulare Lake Basin, California

1.0 INTRODUCTION

The Westside Water Quality Coalition (Coalition) is acting as a Third-Party Coalition pursuant to Waste Discharge Requirements General Order R5-2013-0120 (General Order) issued by the California Regional Water Quality Control Board (RWQCB) in September 2013 (RWQCB, 2013a). The Coalition was formed in 2013 in response to the General Order and to manage compliance with the Irrigated Lands Regulatory Program on behalf of growers. The Coalition was issued a Revised Reissuance Notice of Applicability associated with the General Order in 2014 (RWQCB, 2014). As part of the General Order, the Coalition is required to submit a work plan that describes a groundwater quality monitoring program within the Coalition area.
The Coalition has requested that Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler), prepare the work plan pursuant to provisions of the General Order.

1.1 WESTSIDE WATER QUALITY COALITION

The Coalition area is located on the western boundary of the Tulare Lake Basin (Figure 1). Members of the Coalition include enrolled growers (owners and operators) inside and outside of water districts that use irrigation water. Five water districts are within the Coalition area that provide irrigation water from the California Aqueduct to growers within their respective district boundaries: Belridge Water Storage District (BWSD), Berrenda Mesa Water District (BMWD), Devils Den Water District (DDWD), Dudley Ridge Water District (DRWD), and Lost Hills Water District (LHWD). Other notable areas within the Coalition boundary, but outside of the water district boundaries, are Kettleman Plain, Sunflower Valley, Antelope Plain, Antelope Valley, the Western Supplemental Area, and the Northern Supplemental Area (Figure 1).

1.2 GROWERS WITHIN THE TULARE LAKE BASIN AREA

The General Order describes the requirements for regional monitoring and regional plan development and tracking of groundwater quality. The associated Monitoring and Reporting Program (MRP) of the General Order includes objectives for evaluating groundwater quality and the effects of irrigated agriculture. The MRP states those objectives will be accomplished through a series of reporting requirements. The following subsections summarize previous tasks completed by the Coalition and the purpose of this work plan.

1.2.1 Groundwater Quality Assessment Report

The Coalition was required to submit a *Groundwater Quality Assessment Report* (GAR) that included data that could be used as a technical basis for developing the scope of this work plan and for other reporting requirements within the General Order. One primary goal of the GAR is to determine high and low vulnerability areas. A high vulnerability area (HVA) is generally defined as an area where groundwater quality is known to be impacted or may potentially be impacted due to irrigated agricultural activities. A low vulnerability area (LVA) is defined as any area not designated as a HVA (RWQCB, 2013a).

The Coalition submitted two separate GARs, one for the original Coalition area (including the water districts and Western Supplemental Area) and one for an area that was subsequently added to the original Coalition area (Northern Supplemental Area) by the RWQCB (RWQCB, 2014; Amec Foster Wheeler, 2015a; and Amec Foster Wheeler, 2015b). The GARs included land uses, hydrogeology, soil types, water quality data, HVAs, and LVAs. The GARs were developed using publically available data, beneficial uses for groundwater were discussed, and groundwater sampling and analysis were performed. The data collected during preparation of the GARs and supplemental data collected to support this work plan have been compiled into a database.

The GARs were conditionally approved with the understanding that certain items would be included in future work plans (RWQCB, 2016a). The item numbers to be addressed and the corresponding section within this work plan where that item is discussed is provided below:

Staff Memorandum Item[1]	Groundwater Quality Trend Monitoring Program	Work Plan Section(s)
1.A	X	3.1.5
1.B	X	3.1.5
1.C[2]	X	Appendix A
1.D	X	3.1.4
1.E	X	Appendix B
3	X	3.1 and 3.3.6
8	X	2.0
11	X	(same as item 1.C)
13	X	1.2.1 and 3.1.3
15[3]	X	3.2.1
16	X	3.1.5

1. Staff memorandum items are defined in the approval letter (RWQCBa, 2016).
2. The GARs included nitrogen concentrations in groundwater for wells within the Coalition area. Well construction records for the wells that were sampled are not available (UCD, 2012). Additionally, data that do not contain certified laboratory reports cannot be validated. No such reports are available.
3. Not enough data are available at this time to create cross sections that depict geology, hydrogeology, and groundwater quality.

As part of the conditional approval, the RWQCB supplied the Coalition with a list of locations for potential domestic wells to evaluate for inclusion into the trend monitoring program. The RWQCB suggested that each location should be evaluated for the presence of a domestic potential well that might be suitable for collection of water quality data from first-encountered groundwater (RWQCB, 2016a – Attachment B). A review of high quality satellite imagery supplemented by site reconnaissance of select locations was completed and the results are provided in Appendix A. Additionally, the RWQCB supplied the Coalition with a list of potential references to review that may contain additional groundwater quality data not specifically referenced in the GARs (RWQCB, 2016a – Attachment A). Each reference was reviewed for usable content and the results are provided in Appendix B.

The GARs present areas that were designated as HVAs based on several factors including salinity and nitrate concentrations in groundwater, depth to groundwater, soil types, and nitrate attributed non-agricultural sources. The RWQCB's conditional GAR approval states that salinity should not have been a criteria for designating HVAs, irrespective of salinity's impact on potential beneficial uses of groundwater. The RWQCB designated HVAs based solely on nitrogen concentrations; the HVAs have been revised and are discussed in Section 3.1.5.

1.2.2 Basin Plan Amendment Work Plan

One key factor that resulted from the GARs was that the mineral quality of groundwater within a large portion of the Coalition area is poor due to naturally occurring salinity conditions (Figure 2). The beneficial uses that have been designated for the Tulare Lake Basin groundwater cannot be achieved in these portions of the Coalition due to the elevated salinity in the groundwater (RWQCB, 2013a). The General Order states that if such poor groundwater quality areas are identified, a basin plan amendment could be requested. The Coalition believes that the naturally occurring elevated salinity in groundwater within parts of the Coalition area meets the requirements for de-designating municipal water supply (MUN) and limiting agricultural water supply (AGR). The Coalition submitted a *Basin Plan Amendment Work Plan* (BPAW) for a portion of the Coalition area to the Central Valley Salinity Alternatives for Long-Term Sustainability initiative (CV-SALTS) and to the RWQCB (Amec Foster Wheeler, 2016a). A groundwater monitoring event, which is anticipated to result in additional support for a basin plan amendment, is described in Section 4.0.

1.2.3 Sources Identification Study Work Plan

Sources other than irrigated lands are present within the Coalition boundary that may contribute to poor quality groundwater and elevated nitrate in groundwater (Figure 2, Table 1). The Coalition submitted a *Sources Identification Study Work Plan* that describes a process to estimate the relative impact of salinity and nitrate in groundwater from irrigated lands

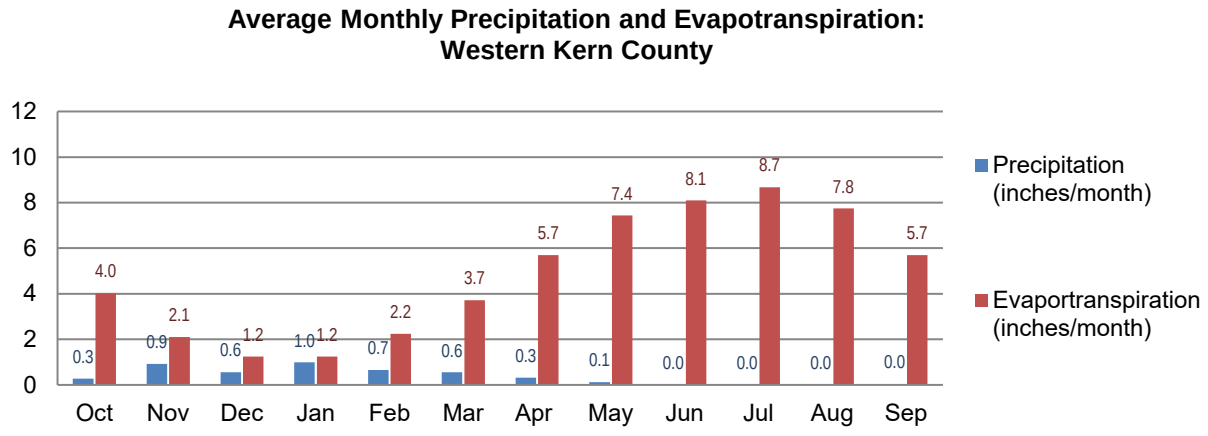
compared to adjacent municipal and industrial sources (Amec Foster Wheeler, 2016b). That work plan presented groundwater data from sources that were publically available. These data demonstrate that those sources may contribute to adversely affecting groundwater quality; some of those sources are summarized in Section 2.0. The sources identified were taken into consideration when groundwater wells were selected for trend monitoring (see Section 3.1.2).

2.0 SOURCES OF GROUNDWATER RECHARGE

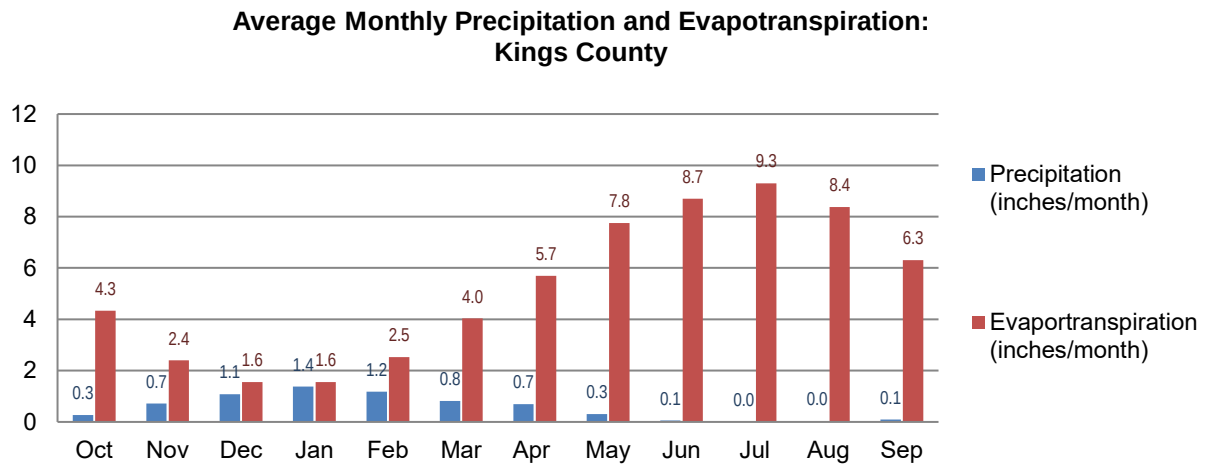
Sources of groundwater recharge can be natural or man-made. Natural sources include percolation of rainfall into drainage courses and lakes. Man-made sources include water transport facilities, agriculture, municipal, and industrial.

2.1 NATURAL SOURCES

The Coalition area is primarily located within Kern County and Kings County (Figure 1). Climate in these areas is characterized as an inland Mediterranean climate with hot and dry summers and cool winters. The average annual precipitation at Blackwells Corner (located at the intersection of Highway 33 and Highway 46 in Kern County) is 4.5 inches (WRCC, 2017), and the average annual reference evapotranspiration for western Kern County is 58 inches (CIMIS, 2009). The following chart is a comparison between the average monthly precipitation and evapotranspiration for western Kern County:

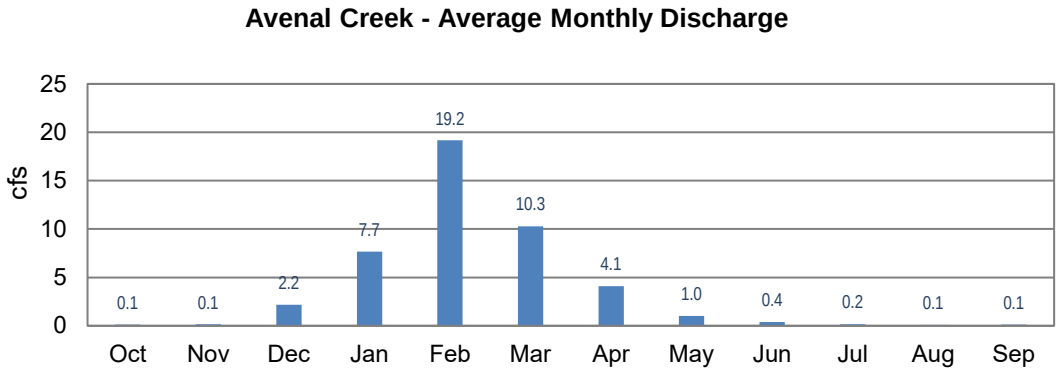


Western Kings County climate is similarly dry; the average annual precipitation at Kettleman City station (due west of Avenal and Interstate 5) is 6.6 inches (WRCC, 2017), and the average annual reference evapotranspiration for Kings County is 62 inches (CIMIS, 2009). The following chart is a comparison between the average monthly precipitation and evapotranspiration for Kings County:



These dry climatic conditions resulted in desiccation of near-surface soils before irrigation development occurred within the Coalition area; these soil characteristics continue to restrict deep percolation of irrigation water.

The Coalition is within the South Valley Floor Hydrologic Unit, specifically HA 558.60 and HA 557.30. Ephemeral stream beds occur in the upper reaches of the hydrologic areas and drain to the east into the southern San Joaquin Valley. Runoff in these streams is not controlled and typically percolates prior to reaching the valley floor. The 100-year, 24-hour storm event for this area ranges from 3 to 3.5 inches (NOAA, 2013). Monthly flow data were collected by the United States Geological Survey (USGS) for only one stream in the uplands of the Coalition area. The following chart shows the average monthly discharge (in cubic feet per second [cfs]) in Avenal Creek (located in northwestern Kern County) for the period from 1961 through 1986 (USGS, 2016):



Although the period of record for Avenal Creek includes several wet years, the average monthly flow is 1.0 cfs, or less, for 7 months of the year. With so little flow, Avenal Creek and the other drainages in the Coalition area are not a significant source of regional groundwater recharge.

2.2 MAN-MADE SOURCES

Man-made sources of potential groundwater recharge include agricultural, municipal, and industrial (Table 1). These sources are supplied by surface water conveyed by the California Aqueduct and its Coastal Branch or by groundwater obtained from groundwater wells within or outside of the Coalition area.

2.2.1 California Aqueduct

The principle man-made feature in the Coalition area is surface water found in the California Aqueduct and its Coastal Branch. The California Aqueduct and its Coastal Branch are concrete lined to conserve water and inhibit groundwater recharge. These man-made canals are not a significant source of groundwater recharge in the Coalition area.

2.2.2 Agriculture Sources

The water districts within the Coalition area operate irrigation supply canals and water storage reservoirs. Most of the water districts' irrigation distribution systems consist of concrete lined canals and piping to conserve water and inhibit groundwater recharge. Similarly, most of the water districts' water storage reservoirs are also lined for water conservation to inhibit groundwater recharge (BWSD, 2013; BMWD, 2013; DRWD, 2012; LHWD, 2013). Irrigation canals and storage reservoirs are not considered a significant source of groundwater recharge within the Coalition area.

Irrigated agriculture is a source of potential groundwater recharge within the Coalition area. Most crops are irrigated with efficient drip or microspray systems (90 percent efficiency) intended to limit soil wetting to the root zone and prevent groundwater recharge. Some crops are irrigated by sprinkler irrigation, which is only slightly less efficient (75 percent efficiency) than drip or microspray systems. These efficient irrigation systems also limit the amount of tailwater runoff from irrigated lands. Some growers have tailwater recovery systems that include lined tailwater ponds. As such, irrigated agriculture is not anticipated to be a significant source of groundwater recharge, except possibly in the immediate vicinity of unlined tailwater ponds and in localized areas where efficient irrigation systems are not in use (BWSD, 2013; BMWD, 2013; DRWD, 2012; LHWD, 2013; and FAO, 1989).

Agricultural drainage disposal facilities consisting of a system of tile drains operated by LHWD are located near the eastern edge of Coalition area in Sections 28, 29, 32, and 33 of Township 25 South, Range 21 East. Although these drainage facilities have historically been a source of groundwater recharge, LHWD facilities have been dry since early 2012 and considered a localized recharge source. Increases in irrigation efficiency have resulted in a significant decrease in tile drainage uptake due to less water passing though the crop root zone.

2.2.3 Municipal Sources

Municipal sources of potential groundwater recharge are sewage treatment plant ponds and their associated land application areas (LAAs). The following entities operate sewage treatment plants that include percolation ponds:

- The City of Avenal (Section 34 of Township 22 South, Range 17 East)
- Lost Hills Utility District (Section 35 of Township 26 South, Range 21 East)
- 5 & 46 Property Owners Association (Section 1 of Township 27 South, Range 21 East)

The City of Avenal also provides treated sewage to William J. Mouren Farming Company, Inc. (MFC), for wastewater reclamation. MFC's LAA is located south of Avenal:

- William J. Mouren Farming Company, Inc. (Sections 27, 28, 33, and 34 of Township 22 South, Range 17 East and Sections 2, 3, and 4 of Township 23 South, Range 17 East)

These municipal sewage treatment plant percolation ponds and associated LAAs are a continuing source of groundwater recharge (RWQCB, 2000a, 2000b, 2000c, and 2007).

2.2.4 Industrial Sources

Industrial sources of potential groundwater recharge include oil producers, food processing plants, and landfills. The oil field operators have used or use percolation ponds for disposal of produced water. Most of the oil field percolation ponds have been closed and replaced with underground injection wells. Injection wells typically inject water into deep, oil-producing formations, although injection into the unsaturated zone is permitted by the California Division of Oil, Gas, and Geothermal Resource (DOGGR) in some oil fields. Produced water ponds are no longer a significant source of groundwater recharge.

Food processing plants and their associated LAA are another source of potential groundwater recharge (RWQCB, 1999, 2012a, 2013b, and 2015). Operators within the Coalition area include:

- Horizon Nut LLC (Sections 20, 26, 27, 28, 35, and 35 of Township 26 South, Range 19 East)
- SunnyGem, LLC (Sections 3, 4, 5, 8, 9, 15, 16, and 21 of Township 28 South, Range 22 East),
- Wonderful Company, King Plant (Sections 11 and 12 of Township 25 South, Range 19 East)
- Wonderful Company, Lost Hills Plant (Sections 13, 23, 24 of Township 26 South, Range 19 East)

Several landfill operations are located within the Coalition area:

- Avenal Municipal Solid Waste Landfill (Section 15 of Township 22 South, Range 17 East)
- Clean Harbors Buttonwillow, LLC (Section 16 of Township 29 South, Range 22 East)
- H. M. Holloway Surface Mine Landfill (Section 30 of Township 26 South, Range 21 East)
- Lost Hills Sanitary Landfill (Section 30 of Township 26 South, Range 21 East)
- Waste Management, Inc. (Section 34 of Township 22 South, Range 18 East, and Section 3 of Township 23 South, Range 18 East)

The U.S. Environmental Protection Agency (EPA) has indicated that leachate generated in landfills is a potential source of salinity and nitrate. However, limited precipitation in Kern County and Kings County is not conducive for leachate formation in landfills. Unlined landfills in arid climates are characterized as “dry” landfills and typically do not exhibit releases of leachate to groundwater. These landfills are not anticipated to be a significant source of groundwater recharge, except possibly from storm water ponds at the landfills during the wet season (RWQCB, 2005, 2006a, 2006b, 2010, and 2012b).

3.0 GROUNDWATER QUALITY TREND MONITORING

This work plan is intended to describe tasks that will be performed to meet the objectives described in the MRP for trend monitoring, determine current groundwater conditions related to irrigated lands, and gather data that can be used to evaluate long-term regional trends associated with irrigated lands.

The General Order indicates that the work plan approach needs to consider: (1) the variety of agricultural commodities produced within the third-party's boundaries (particularly those commodities comprising the most agricultural acreage), (2) the conditions discussed/identified in the GAR related to vulnerability prioritization within the third-party area, and (3) the areas identified in the GAR as contributing significant recharge to urban and rural communities where groundwater serves as a significant supply. The general approach of this work plan is summarized below.

- There are a variety of crops grown within the Coalition area, including irrigated and unirrigated (dry farmed) crops. However, the almond and pistachio orchards comprise more than 82 percent of the irrigated acreage. Groundwater downgradient (east or southeast) of almond and pistachio orchards (Figure 2) is the focus of this work plan.

- The RWQCB designated HVAs within the Coalition area, consisting of Kettleman Plain, DRWD west of Interstate 5 highway, far-eastern Antelope Plain, LHWD east of the Lost Hills anticline, and BWSD east of North/South Belridge oil field (RWQCB, 2016b). This work plan considers monitoring of first-encountered groundwater in each of these areas with the exception of areas identified in the *Sources Identification Study Work Plan*.

- Due to the poor mineral quality of groundwater within the Coalition area, drinking water supply is imported from outside. The City of Avenal (including Avenal State Prison) and Wonderful Hulling & Shelling West Side import surface water from the California Aqueduct. Lost Hills Utility District and Aera Energy, LLC (Spicer City system) import groundwater from outside the Coalition area. As such, this work plan focuses on groundwater quality immediately downgradient of almond and pistachio orchards.

To establish current groundwater quality conditions and evaluate trends, a monitoring well network has been developed. The network consists of proposed wells that could be used for groundwater monitoring within the Coalition area. The following sections describe the criteria used in selecting a monitoring well network, the wells that have been selected, and the proposed field activities, analytical program, and reporting.

3.1 MONITORING WELL NETWORK SELECTION CRITERIA

The following subsections describe the criteria used to select a monitoring well network for trend monitoring.

3.1.1 Principal Irrigated Crops

The first criteria that was used to select potential monitoring wells was to locate irrigated lands within the Coalition area. The United States Department of Agriculture maintains the CropScape website identifying cropping throughout the United States (USDA, 2016). For the Coalition area, CropScape indicates that in 2016, irrigated agriculture comprised about 14 percent of the Coalition area. The principal crops were pistachio and almond orchards, which together made up over 82 percent of irrigated agriculture. The remaining 18 percent of irrigated land is either adjacent to or commingled with the principal crops. These two crops occupy most of the irrigated lands within the Coalition area and are long-term crops. The area occupied by pistachio and almond orchards within the Coalition area were the first criteria used to identify monitoring well locations for potential selection as a trend monitoring well within the Coalition area (Figure 2).

3.1.2 Non-Irrigation Sources

Only a relative small area (14 percent) within Coalition boundary consists of irrigated lands. Operations within the Coalition area exist that may adversely affect groundwater quality and potentially contribute nitrogen to groundwater (Figure 2, Table 1). Selection of trend monitoring wells in areas where non-irrigated nitrogen sources have the potential to affect groundwater are potentially bias monitoring results leading to conclusions that irrigated agriculture was a contributing source to increases of nitrogen in groundwater when it actually may not be.

The second criteria for selecting wells for trend monitoring is their proximity to non-agricultural sources of nitrate. The Coalition submitted a *Sources Identification Study Work Plan* to the RWQCB to evaluate these potential sources and the impacts on areas of irrigated agriculture (Amec Foster Wheeler, 2016b). The sources identified include landfills, sewage treatment plants, oil fields, and other facilities (Table 1). The *Sources Identification Study Work Plan* includes publically available groundwater quality data related to these operations that support further evaluation of these facilities. The *Sources Identification Study Work Plan* has yet to be approved by the RWQCB. Until the Coalition has fully evaluated these potential sources, areas that are downgradient are currently excluded for selecting wells for trend monitoring.

3.1.3 Well Records Database

The MRP states that the use of existing wells for trend monitoring may be cost effective while still yielding data that will meet the objectives of the General Order. Well construction records

were requested from the Department of Water Resources (DWR) for Kern County and Kings County. Well permit records were also requested from the Kern County Department of Environmental Health and Kings County Public Works Department. Amec Foster Wheeler has received the requested records, except well construction records for Kings County from the DWR. A database was created with the records that were obtained. These data were evaluated to establish a foundation for wells that could potentially be selected for trend monitoring. Where possible, trend monitoring wells were selected that have associated well construction records.

3.1.4 First-Encountered Groundwater

The aquifers that should be monitored for trend analysis are those that would potentially receive recharge from irrigation water. The third criteria involved selecting wells for trend monitoring with appropriate screened intervals intersecting the uppermost groundwater aquifer. Beneath the Coalition area are perched, unconfined/semi-confined, and confined aquifers depending on location. The perched and unconfined/semi-confined aquifers have been identified as potential aquifers that may receive recharge from irrigation water because they are first-encountered groundwater.

Perched Zone Groundwater

Perched groundwater appears to correspond to the presence of a shallow clay layer (designated the A-clay). The perched aquifer consists of Pleistocene-Holocene fluvial and flood basin sediments comprised predominately of silts and clay interbedded with sand layers. These sediments overlie the A-clay and grade laterally into younger alluvium to the west. The lateral extent of the A-clay stratigraphic layer is poorly constrained. The A-clay reportedly has been encountered under LHWD at depths of 30 to 60 feet. The DWR has designated a perched zone that is located along the eastern border of the Coalition area (Figure 2; DWR, 2017). Wells selected for trend monitoring that fall within the DWR perched zone boundary are considered appropriate for trend monitoring if they are completed in the perched aquifer. Wells screened in the unconfined/semi-confined zone below the perched aquifer or in the confined zone are not consider appropriate for trend monitoring.

Unconfined/Semi-Confined Aquifer

Unconfined aquifers exist in alluvial sediments of Antelope Valley east of the Lost Hills Anticline and below the perched groundwater in the upper Tulare Formation. The unconfined aquifer consists predominately of coarser alluvial sediments flanking the Temblor Range that grade laterally eastward into finer grained fluvial, marsh, deltaic, and lacustrine deposits. In areas where fluvial deposits become highly interbedded and bifurcated, semi-confined groundwater conditions may be encountered in the upper Tulare Formation. The base of the

unconfined aquifer is defined by the presence of the Modified E-clay (Corcoran Clay equivalent in some areas), where it is present. In areas where the Modified E-clay is absent, an unconfined to semi-confined aquifer extends to the top of the marine formations (Amec Foster Wheeler, 2016a). Wells screened in the unconfined/semi-confined aquifer zone are consider appropriate for trend monitoring in areas where the perched aquifer is absent.

Unconfined/semi-confined groundwater conditions are also encountered in Sunflower Valley and the Kettleman Plain. The unconfined/semi-confined aquifer consists predominately of coarser alluvial sediments flanking the Diablo Range, Reef Ridge, Kreyenhagen Hills, and the Pyramid Hills. Wells screened in the unconfined/semi-confined aquifer zone in Sunflower Valley and the Kettleman Plain are considered appropriate for trend monitoring.

Modified E-Clay and Confined Aquifer Zone

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

Groundwater below the Modified E-clay is encountered in confined conditions. The Tulare Formation below the Modified E-clay consists of unconsolidated interbedded sand, silt, and clay. The nature of these sediments ranges from coarser alluvial fan deposits near the Temblor Range to fine-grained lacustrine, fluvial, and marsh deposits eastward toward the axis of the valley trough (Croft, 1972). Within the Coalition area, confined groundwater is not known to exist as first-encountered groundwater and is isolated from first-encountered groundwater by Modified E-clay. Confined groundwater is not proposed for trend monitoring because it is not susceptible to receiving recharge from irrigation water.

3.1.5 Well Construction Criteria

Well construction is a consideration for selecting wells for groundwater trend monitoring. The shallow groundwater is perched on the A-clay, which inhibits communication with the underlying unconfined/semi-confined groundwater. The unconfined/semi-confined groundwater is isolated from the confined groundwater by the Modified E-clay in areas where it is present. The Modified E-clay inhibits groundwater communication between these two aquifers. In cases where wells have been drilled through confining clay layers and constructed with long screens or multiple screen intervals can cause preferential pathways for vertical migration between aquifers potentially introducing poor quality groundwater into an adjacent aquifer. The amount of communication is dependent on the head differential between the two aquifers.

Wells selected for trend monitoring were of known construction with screened intervals limited to a single aquifer zone. Wells selected for perched zone trend monitoring have screened intervals exclusive to the perched interval. Not all wells selected for trend monitoring in the unconfined/semi-confined aquifer have well construction records available. Of the available well construction records, wells selected for trend monitoring of the unconfined/semi-confined aquifer are screened exclusively in that aquifer. Prior to finalizing the trend monitoring well selection, the screen intervals of the selected well will be obtained.

Based on available well construction information and its relation to the local hydrogeology, criteria for selecting wells based on construction and aquifer zones are shown as follows:

Aquifer	Total Depth (feet)
Perched	Above 52
Unconfined/Semi-confined	52 to 508

3.1.6 Designated Vulnerability Areas

The MRP requires that wells within the selected monitoring well network are located in both HVAs and LVAs. Vulnerability areas were originally defined in the GARs and designated based on nitrate and salinity concentrations in groundwater, depth to groundwater, and sources of nitrate not associated with agricultural irrigation. Although it is well known that salinity in this area is naturally occurring and degrades groundwater quality, the vulnerability areas are being redefined, as requested by the RWCQB, to only include nitrate. The RWQCB designated areas of vulnerable groundwater within the Coalition, which were subsequently adopted by the Coalition as follows:

- high vulnerably area previously proposed by the RWQCB and used by the Coalition for the Nitrogen Management Plan;

- all areas…having nitrate concentrations in groundwater that are 45 milligrams per liter (mg/L) or greater, regardless of salinity concentrations in groundwater; and

- all areas…having nitrate concentrations in groundwater that are 22.5 mg/L (with a trend indicating a statistically significant increasing concentration) or greater, regardless of salinity concentrations in groundwater.

Based on the above guidelines, HVAs proposed by RWQCB (Figure 3) were adopted by the Coalition. Generally, the vulnerable groundwater areas include Kettleman Plain, the far-western portion of Antelope Plain, the area of the Coalition east of the Lost-Hills Anticline, and southern-most part of the Coalition that is east of North/South Belridge Oil Fields. Nitrate data exceeding 45 mg/L were previously submitted as part of the GARs (Amec Foster Wheeler, 2015a and 2015b). The Coalition did not designate HVAs based on 22.5 mg/L, because there are not enough data available to determine a "statistically significant increasing concentration". As the Coalition proceeds with trend monitoring and a sufficient amount of data have been collected, nitrate concentrations trends will continue to be evaluated. Vulnerability designations may be modified as groundwater monitoring proceeds (RWQCB, 2013a).

3.2 MONITORING WELL NETWORK

Based on the criteria above, a monitoring well network (Figure 3) was selected for potential groundwater quality trend monitoring as described in the following subsections.

3.2.1 Preliminary Well Selection

Ideal areas to monitor groundwater quality are downgradient from irrigated agriculture but away from non-irrigation operations that have the potential to impact groundwater (Figure 2). Groundwater occurrence and flow direction were previously described in the GARs and *Sources Identification Study Work Plan* (Amec Foster Wheeler, 2015a, 2015b, and 2016b). Groundwater flow directions are generally toward the east except in the vicinity of an anticline, where groundwater flow is generally radial. Data obtained from the DWR for 2016 in the perched groundwater zone indicate groundwater flow is generally from west to east toward the San Joaquin Valley (Figure 4). A potentiometric surface map of the unconfined/semi-confined aquifers prepared by the USGS in 1955 indicated that groundwater in the Antelope plain flowed generally from west to east also toward the San Joaquin Valley (Figure 5). Localized flow directions within the Sunflower Valley, Kettleman Plain, and Avenal Gap varied considerably due to pumping and topography.

Wells proposed for trend monitoring were selected from the well records database (Table 2, Appendix C) and from other available sources such as USGS publications, DWR public library, previously sampled wells described in the GARs, and from a list supplied by the RWQCB (Appendix A). The wells are located generally downgradient from irrigated agriculture but away from other potential sources of nitrogen. These wells are complete in either the perched or unconfined/semi-confined aquifers in order to monitor first-encountered groundwater in the area they are located. The proposed wells are situated in both HVAs and LVAs (Figure 3).

A total of 20 wells have been selected for the proposed monitoring network (Figure 3). Seven wells are located within the perched aquifer with total depths ranging from 14 to 22 feet, all with 10-foot screen intervals. Thirteen wells were selected in the unconfined/semi-confined aquifer. Not all selected wells in this aquifer have complete well construction records. Based on available records, total well depths ranges between 106 to 500 feet and screen intervals range between 10 to 242 feet. Twelve wells are located within the HVAs, and 8 wells are located within the LVAs.

3.2.2 Field Verification and Access Agreements

The Coalition performed a preliminary reconnaissance of the proposed well locations to confirm the wells' presence and to assess accessibility for sampling. The Coalition will contact the owner/operator to gather specific information regarding sampling of the well and to obtain an access agreement for groundwater sampling. If an access agreement cannot be procured for a well, an alternative well in the area will be substituted.

3.3 WORK PLAN FOR GROUNDWATER MONITORING

The following subsections describe the tasks that will be implemented once the trend monitoring well network has been approved.

3.3.1 Pre-field Logistics

Planning and coordination activities to be conducted in preparing for groundwater sampling include:

- Prepare a site-specific Health and Safety Plan for the planned field work.
- Coordinate monitoring schedule with owner/operators.
- Notify the owner/operators a minimum of 1 week in advance of field operations.
- Obtain field equipment and sample containers necessary for collecting groundwater samples from the wells.
- Coordinating with subcontractors.

3.3.2 Quality Assurance Project Plan

On behalf of the Coalition, Kennedy/Jenks Consultants prepared a quality assurance project plan for the Surface Water Quality Project, Irrigated Lands Sampling and Analytical Program (Surface Water QAPP) for compliance with the General Order (KJC, 2014). Amec Foster Wheeler has reviewed the Surface Water QAPP and we anticipate compliance with the data quality objectives for the trend groundwater monitoring program. However, Amec Foster Wheeler will need to add data quality objectives for laboratory analyses not contemplated in the Surface Water QAPP, including:

- Anions, EPA Method 300
- Cations, EPA Method 200.7

Data quality objectives will include sample preservation procedures, method detection limit, precision, accuracy, and completeness. Also, the Coalition has not yet contracted with a California-certified laboratory for analyses of trend groundwater monitoring samples. Once the laboratory is contracted, Amec Foster Wheeler will prepare an addendum to the Surface Water QAPP to address data quality objectives for the additional analytical methods required for the trend groundwater monitoring program.

3.3.3 Groundwater Sampling Methods

Groundwater samples will be collected on an annual basis from the trend monitoring program wells, and groundwater monitoring within the area of the proposed basin plan amendment will be conducted every 5 years. The procedure used to purge and sample each well will be based on the wellhead access and the static water level measured in the well at the time of sampling. Amec Foster Wheeler will conduct sampling in accordance with the groundwater protocols in Appendix D.

Depth-to-Groundwater Sounding

Measuring the depth to groundwater in each well using a cable reel depth sounder prior to beginning any purging activities will be attempted. The wellhead configuration or a lack of a sounding tube may prevent collection of depth-to-groundwater measurements from some wells. Depth-to-groundwater data will be recorded in the daily field records.

Field Parameters

Field parameters consisting of pH, electrical conductivity (EC), turbidity, and temperature will be measured during purging and recorded in the field notes. The volume of water purged and rate will also be recorded, if the well is metered. Formation water samples will be collected

after field parameters have stabilized. Field parameters will be considered stable after three consecutive measurements indicate pH is within ±0.1 standard unit, EC is within ±10 percent, and turbidity is within ±10 percent or is below 10 Nephelometric turbidity units.

Perched Zone Groundwater Sampling

Groundwater samples collected from the perched zone wells will be collected using a peristaltic pump using low-flow sampling techniques. Clean dedicated tubing will be lowered to a depth corresponding to the upper portion of the well screen. Groundwater will then be purged at a discharge rate of 0.5 to 1 liters per minute until a minimum of three tubing volumes have been evacuated and field parameters stabilize. The samples will be collected from the pump discharge port at a rate of 0.1 to 0.3 liters per minute and then decanted into clean laboratory-provided containers, packed on ice, and transported under chain-of-custody procedures to a California Environmental Laboratory Accreditation Program (ELAP) laboratory. One duplicate set of samples will be collected from one of the perched zone wells along with an equipment blank.

Water Supply Wells with Operational Pumps

Wells completed in the unconfined/semi-confined aquifer that are production wells with operational pumps will be sampled from a sampling port attached to the pumps discharge line. Groundwater samples will be obtained after pumping the well for approximately 5 to 10 minutes to remove stagnant casing water. Field parameters will be measured during purging, and a water sample will be collected after field parameters have stabilized. Groundwater samples will be collected in laboratory-prepared containers packed on ice and transported under chain-of-custody procedures to a California ELAP laboratory.

Water Supply Wells without Pump Infrastructure

Wells completed in the unconfined/semi-confined aquifer that are not equipped with pumps will be sampled with a bladder pump using low-flow sampling techniques. The bladder will be lowered to a depth corresponding to the upper portion of the well screen. Groundwater will then be purged at a discharge rate of 0.5 to 1 liters per minute until a minimum of three tubing volumes have been evacuated and field parameters stabilize. The samples will be collected from the pump discharge port at a rate of 0.1 to 0.3 liters per minute and then decanted into clean laboratory-provided containers, packed on ice, and transported under chain-of-custody procedures to a California ELAP laboratory.

3.3.4 Laboratory Analyses

The MRP states requirements for both annual monitoring and for initial and every 5 years thereafter monitoring. However, as part of the BPAW, the Coalition proposed monitoring on a

5-year basis for groundwater within the proposed area of the BPAW (Figure 3). Groundwater samples will be collected at the indicated frequency, and associated quality assurance samples will be analyzed by a California ELAP laboratory using methods approved by the EPA. The analytical program is summarized in Table 3.

3.3.5 Schedule

The schedule for annual groundwater monitoring is dictated by the MRP. Available monitoring wells will be sampled at a minimum of once per hydrologic water year, which is defined as October 1 through September 30 of the following year (RWQCB, 2013a). Groundwater monitoring will be performed the same time each consecutive year. The Coalition suggests sampling in July of each year because that is the best month to access and sample irrigation wells. It is anticipated the first groundwater monitoring event will be in July 2018.

For the 5-year monitoring proposed within the area of the proposed BPAW (Figure 3), available monitoring wells will be sampled at a minimum of once per 5 hydrologic water years. As with the annual groundwater monitoring, the Coalition suggests sampling in July of each monitoring year because that is the best month to access and sample irrigation wells. It is anticipated the first groundwater monitoring event will be in July 2018.

3.3.6 Trend Evaluation

The goal of groundwater monitoring is to evaluate long-term regional trends of nitrate concentrations potentially related to irrigated agriculture. Trend analysis will initially be evaluated using time-concentration charts prepared for each monitoring well. Several years of monitoring will be required before an adequate data set for statistical analysis can be used to evaluate groundwater trends for monitored constituents. Statistical evaluation will include identifying data outliers and trend analysis evaluation using the Mann-Kendall test method as outlined in *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance* (EPA, 2009).

3.3.7 Reporting

The Coalition will submit a monitoring report that summarizes the groundwater monitoring activities. The monitoring report will include requirements described in the MRP, including but not limited to, a signed transmittal letter, executive summary, description of the Coalition area, a map of the wells that were sampled, tabulation of the analytical data, and time-concentration charts. Once it has been determined that a significant amount of data are available, a long-term regional trend analysis will be included as part of the monitoring reports. In additional to monitoring reports, annual monitoring results will be submitted in Excel format.

Final reports will be in electronic format and submitted by May 1 of the following year to the RWQCB's GeoTracker Database and to the RWQCB's designated staff liaison.

4.0 GROUNDWATER MONITORING TO SUPPORT BASIN PLAN AMENDMENT

Amec Foster Wheeler prepared a BPAW on behalf of the Coalition that was submitted to the RWQCB and CV-SALTS (Amec Foster Wheeler, 2016a). The BPAW includes data that supports the request for a basin plan amendment for a portion of the Coalition area (Figure 6). The RWQCB's Water Quality Control Plan for the Tulare Lake Basin (Tulare Lake Basin Plan) establishes water quality objectives and beneficial uses for the Tulare Lake Basin waters, including the Coalition area (RWQCB, 2013a). The Tulare Lake Basin Plan summarizes criteria to be considered by the RWQCB when granting exceptions to the designated beneficial uses:

1. the total dissolved solids (TDS) must exceed 3,000 mg/L (5,000 micromhos per centimeter [µmhos/cm] EC) and the aquifer cannot be reasonably expected to supply water to a public water system; or

2. there is contamination, either by natural processes or by human activity (unrelated to a specific pollution incident) that cannot be reasonably treated for domestic use by using either Best Management Practices or best economically achievable treatment practices; or

3. the water source cannot provide sufficient water to supply a single well capable of producing an average, sustained yield of 200 gallons per day; or

4. the aquifer is regulated as a geothermal energy producing source or has been exempted administratively pursuant to 40 Code of Federal Regulations (CFR), Section 146.4 for the purpose of underground injection of fluids associated with hydrocarbon or geothermal energy, provided these fluids do not constitute a hazardous waste under 40 CFR, Section 261.3.

Of the four criteria listed above, three of these criteria exist in groundwater within the area proposed for the basin plan amendment. Average TDS of groundwater in some areas exceed the criteria (criterion 1 above). Groundwater in some areas has naturally occurring concentrations of salinity and other constituents that cannot be reasonably treated for MUN (criterion 2 above). Some areas are used for petroleum production for purposes of underground injection of fluids associated with hydrocarbon energy (criterion 4 above). Based on these conditions, the BPAW proposed a basin plan amendment to de-designate MUN and to modify AGR within the Tulare Lake Basin Plan for the areas described in the BPAW (Figure 6).

Groundwater beneath the five water districts located within the BPAW area (BWSD, BMWD, DRWD, DDWD, and LHWD) is not currently used for MUN because it does not meet drinking

water standards for salinity constituents (EC, TDS, sulfate, and boron) and, in some cases, for arsenic. All MUN is imported from outside of the Coalition boundary for the limited areas that uses MUN (Figure 6).

Unconfined/semi-confined and confined groundwater is occasionally used as a backup source of ARG, typically blended with high quality water from the California Aqueduct. The water districts provide AGR water imported from the California Aqueduct to growers that use irrigation water within their respective districts. Perched groundwater beneath the water districts is significantly high in salinity and therefore has no current beneficial uses.

4.1 SUMMARY OF GROUNDWATER CONDITIONS

The quality of perched groundwater inside the Coalition area and just outside the eastern boundary was characterized by the USGS in 1989 from data collected from 25 shallow groundwater wells (USGS, 1993). These perched zone wells were installed to depths of 12.6 to 23.7 feet below ground surface (bgs). The depth to perched groundwater between May and August 1989 was 2.8 to 16.14 feet bgs. The USGS analyzed these perched zone wells for inorganic constituents. These data show that the perched groundwater varied widely in salinity with an average TDS of 14,840 mg/L and EC of 19,064 µmhos/cm. The aquifer cannot be reasonably expected to supply a public water system because perched groundwater in this area exceeded 3,000 mg/L (5,000 µmhos/cm EC).

The USGS summarized the analytical results from 42 water supply wells within the Coalition area sampled between 1930 and 1957 and analyzed for inorganic constituents (USGS, 1959). Amec Foster Wheeler compared these analytical results to water quality criteria for MUN and AGR. These data indicate that unconfined/semi-confined groundwater generally exceed drinking water quality for salinity (TDS, EC, sulfate, and boron) that would require expensive desalination treatment for MUN. The average TDS and sulfate concentrations were 2,528 and 1,112 mg/L, respectively, compared to the corresponding drinking water quality criteria of 1,000 and 500 mg/L, respectively. These average concentrations also exceeded the water quality criteria for AGR-Irrigation of 2,000 mg/L TDS. However, the average concentrations did not exceed the water quality criteria for AGR-Livestock and AGR-Poultry and could be suitable for those uses.

Regulated oilfields located in the BPAW area include Beer Nose, Belridge North, Belridge South, Blackwells Corner, Cal Canal, Devils Den, Dudley Ridge, Lost Hills, Lost Hills Northwest, and Welcome Valley (Figure 2, Table 1). Four of these oilfields (Blackwells Corner, Cal Canal, Devils Den [fresh water in north area only], and Dudley Ridge) were

reported to have “fresh water” as defined by DOGGR as less than 3,000 mg/L TDS (DOGGR, 1998). Oilfield production and underground injection are summarized below:

Oil Field	Depth to Fresh Water[1] (feet)	2015-2016 Production[2]		2015-2016 Injection[2]	
		Oil (barrels)	Gas (mcf)	Water/Steam (barrels)	Gas/Air (mcf)
Antelope Hills	none	4,628,479	923,555	8,016	913,794
Antelope Hills, North	none	6,045,693	828,773	28,943,408	0
Beer Nose	none	368,776	354,805	0	0
Belridge, North	none	92,405,192	261,316,306	563,482,961	26,236,781
Belridge, South	none	1,495,455,423	586,507,947	8,029,453,760	8,334,828
Blackwells Corner	600	454,430	139	2,867,217	0
Cal Canal	800	2,771,127	9,747,212	4,553,860	0
Chico Martinez	none	925,053	124	6,500,842	552
Cymric	none	476,159,993	93,093,401	1,499,585,904	28,383,147
Devils Den	300 (northern part only)	1,169,016	663,987	273,241	0
Dudley Ridge (abandoned)	450	0	0	0	0
Lost Hills	none	349,048,622	565,679,923	2,526,137,296	17,191,541
Lost Hills, Northwest	none	588,494	745,417	3,302,212	0
McDonald Anticline	none	6,305,414	5,458,381	43,082,773	73,379
Monument Junction	none	4,731,622	13,485,408	4,781	0
Shale Flats (abandoned)	none	0	0	0	0
Shale Point	none	52	324,676	0	0
Welcome Valley	none	7,924	0	0	0

1. Total dissolved solids <3,000 mg/L, California Oil and Gas Fields (DOGGR, 1998).
2. February 2015 through May 2016 production/injection from https://secure.conservation.ca.gov/WellSearch. mcf = million cubic feet

Groundwater below the oilfields within the BPAW area are regulated as energy-producing sources and/or perform underground injection of fluids associated with hydrocarbon production. The DOGGR is currently reevaluating aquifer exemptions in California; the updated status of exemptions for groundwater in the oilfields within the proposed basin plan amendment area has not yet been completed.

Based on these conditions, groundwater within the BPAW meets three of the four criteria to be considered by the RWQCB when granting exceptions to the designated beneficial uses:

- the TDS must exceed 3,000 mg/L (5,000 µmhos/cm EC) and the aquifer cannot be reasonably expected to supply water to a public water system; or

- there is contamination, either by natural processes or by human activity (unrelated to a specific pollution incident) that cannot be reasonably treated for domestic use by using either Best Management Practices or best economically achievable treatment practices; or

- the aquifer is regulated as a geothermal energy producing source or has been exempted administratively pursuant to 40 CFR, Section 146.4 for the purpose of underground injection of fluids associated with hydrocarbon or geothermal energy, provided these fluids do not constitute a hazardous waste under 40 CFR, Section 261.3.

4.2 PRELIMINARY WELL SELECTION

Some areas within the basin plan amendment boundary do not include irrigated agriculture and therefore do not require groundwater trend monitoring for purposes of compliance with the General Order. These non-irrigated areas of the Coalition that are within the proposed area for the basin plan amendment are in LHWD east of Interstate Highway 5 (Figure 6). A limited amount of groundwater sampling and analysis is needed in the non-irrigated areas east of Interstate Highway 5 to support the basin plan amendment process. The Coalition proposes a one-time sampling and analysis of additional wells in that area for that purpose.

4.2.1 Wells Selected in the Perched Groundwater

Perched groundwater is characterized by the DWR in their shallow groundwater and agricultural drainage programs (DWR, 2012 and 2015). DWR characterized the perched groundwater problem as follows:

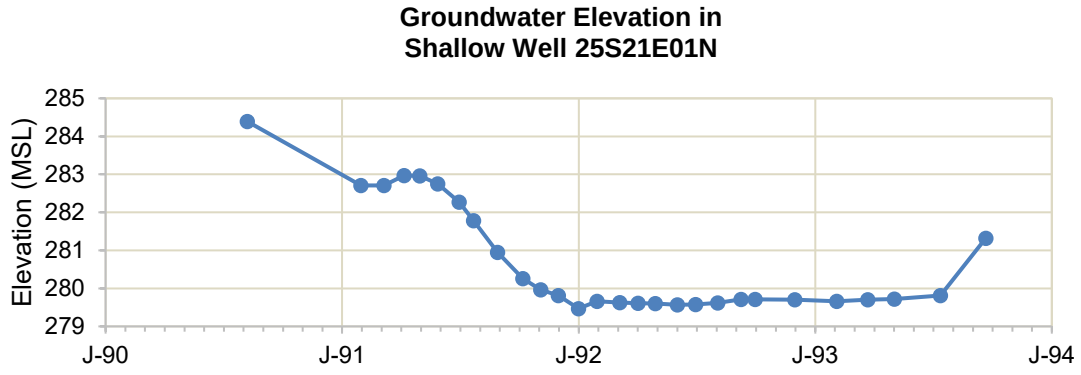
> "Soils on the western side of the valley come from the marine sediments that make up the Coast Range. These soils, high in salts and trace elements, are similar to those that occur in the ocean. Also, just below the surface of much of the valley's soil, is a shallow clay layer that obstructs vertical movement of irrigation water. As salts and minerals from surface soils are leached into the shallow groundwater, the water table rises to within a few feet of the surface and into the root zone. Unless this water is removed, crops growing in these soils eventually die. In the late 1940s, farmers began installing subsurface drains in fields with drainage problems. By 1965, 330 miles of subsurface drains and 750 miles of open ditch drains operated in the valley, delivering drainage water to evaporation ponds and other discharge sites. With this drainage network in operation, the main problem became how to manage and dispose of the salty drainage water."

LHWD operates drainage ponds in the area of perched groundwater and serves subsurface drains within LHWD. The LHWD system consists of six ponds totaling 660 acres just east of Interstate Highway 5. Approximately 6,800 acres of irrigated agriculture west of Interstate Highway 5 is tile drained and produces subsurface drainwater that is routed to the LHWD ponds. Through drainage reduction efforts, the LHWD has been able to reduce drainage

inflows and also reduce the size of the evaporation pond system. Significant cropping pattern changes, installation of micro-irrigation systems, and canal lining in the drainage area are major features in reducing the amount of drainwater collected (LHWD, 2013).

Operation of the drainage ponds is regulated by waste discharge requirements issued by the RWQCB to LHWD in 1993. The LHWD conducts a monitoring and wildlife hazing program at the pond system in compliance with the waste discharge requirement. The amount of drainwater discharged to the evaporation pond system has been reduced from a high of 3,831 acre-feet (AF) in 1989 to less than 100 AF in 2012. During 2012, only one pond totaling 12 acres was utilized (RWQCB, 1993; LHWD, 2013).

The area of perched groundwater extends east of Interstate Highway 5 to the eastern edge of the Coalition area. The area east of Interstate Highway 5 (LHWD Service Area 6) is not used for irrigated agricultural due to elevated salinity in soils and groundwater. Limited groundwater level information is available for perched zone wells. A hydrograph for one shallow well (25S21E01N) for the period between 1990 and 1994 (USGS, 2016) is shown below:



MSL = mean sea level

The above chart shows that groundwater elevations varied from 279.47 to 284.39 feet above mean seal level, which corresponds to a depth range of 5.61 to 10.53 feet. USGS measured groundwater levels in perched zone wells in 1989, which included the LHWD Service Area 6 (Figure 7). The potentiometric surface shows that the groundwater gradient was toward the north-northeast. USGS also collected perched groundwater samples from five of the perched zone wells east of Interstate Highway 5 and analyzed the samples for salinity constituents and nitrate:

Well[1]	Constituent and Result[2]					
	EC (µmhos/cm)	TDS (mg/L)	Cl (mg/L)	NO_3 (mg/L)	SO_4 (mg/L)	B (µg/L)
T26S/R21E-14R	23,100	21,700	1,000	62	14,000	64,000
T26S/R21E-02R	3,170	1,950	340	1.28	740	2,500
T25S/R21E-26P	43,900	44,400	3,400	159	27,000	70,000
T25S/R21E-17H	36,200	25,700	11,000	1.28	5,500	36,000
T25S/R21E-01N	1,800	--	290	<0.443	210	900
MCL[3]	*1,600*	*1,000*	*500*	*45*	*500*	*1,000*

1. Well location by township, range, and section. Locations are shown on Figure 6.
2. EC = electrical conductance, TDS = sum of dissolved solids, Cl = chloride, NO_3 = nitrate, SO_4 = sulfate, B = boron, µmhos/cm = micromhos per centimeter, mg/L = milligrams per liter, µg/L = micrograms per liter, < = less than, and -- = not available.
3. MCL = Maximum Contaminant Level for drinking water. For B, the Notification Level is listed. Concentrations greater than the MCL or equivalent are highlighted in green.

The table above compares the perched groundwater data to drinking water standards; concentrations greater than the MCL, or equivalent, are highlighted. Salinity varied from 1,800 to 43,900 µmhos/cm; each sample exceeded the corresponding MCL of 1,600 µmhos/cm. The principle constituents contributing to salinity were chloride and sulfate. Nitrate exceeded the corresponding MCL of 45 mg/L only in the two highest salinity perched groundwater samples. Boron exceeded the Notification Level of 1,000 µg/L for boron. Well T25S/R21E-01N provided much better quality groundwater than the other perched zone wells, although still higher in salinity that the MCL. Well T25S/R21E-01N is located adjacent the Kern National Wildlife Refuge, which was established in 1960. Perched groundwater quality in that immediate area appears to have benefited from groundwater recharge from the Kern National Wildlife Refuge operations, which uses imported surface water to maintain the refuge.

The Coalition proposes to conduct a one-time resampling of the above five perched groundwater monitoring wells (Figure 6) and the seven perched zone wells of the trend monitoring program (Figure 3) to provide data to support the basin plan amendment. If some of these wells are destroyed, damaged, or unavailable, the Coalition will attempt to obtain permission to sample other perched zone wells in the area. Well construction records for the proposed perched zone wells are provided in Appendix E.

4.2.2 Unconfined/Semi-confined Groundwater

The unconfined/semi-confined aquifer east of Interstate Highway 5 within the Coalition area is below the A-clay and above the Modified E-clay. In 1990, the USGS installed a cluster of monitoring wells in the northeastern part of LHWD (Section 1, Township, 25 South, Range 21 East) to characterize the vertical characteristics of groundwater in this area (USGS, 1994).

Three of the USGS wells were installed in the unconfined/semi-confined aquifer with screen intervals between 52 and 199 feet bgs. A summary of well construction and analytical results for groundwater samples collected in 1990 from the USGS wells is provided in the table below. The table also includes a summary of well construction and analytical results for groundwater samples collected in 2013 from two wells (025S021E26P001M and 026S021E14H002) located within the non-irrigated area of the Coalition that is east of Interstate Highway 5 (Amec Foster Wheeler, 2015a). These two wells are located closer to Lost Hills than the USGS well cluster. The table shows that the three USGS wells exceed MCLs for EC, TDS, boron, and chloride and would not be suitable as a drinking water source without expensive desalination treatment.

Well[1]	Screened Interval[2] (feet)	Sample Date	Constituent and Result[3]					
			EC (µmhos/cm)	TDS (mg/L)	B (µg/L)	Cl (mg/L)	NO_3-N (mg/L)	SO_4 (mg/L)
T25S/R21E-01N2	52-62	8/29/1990	12,000	9,280	9,400	1,300	<0.1	4,600
T25S/R21E-01N3	90-100	8/29/1990	6,250	4,260	2,100	1,200	<0.1	1,500
T25S/R21E-01N4	189-199	8/29/1990	4,540	2,620	1,300	1,200	<0.1	420
T25S/R21E-26P	195-402	5/21/2013	5,100	3,200	3,300	1,400	<11	470
T26S/R1E-14H	163-323	5/21/2013	5,800	4,000	800	1,200	<11	1,300
MCL[4]			*900-1,600*	*500-1,000*	*1,000*	*250-500*	*10*	*250-500*

1. Well designation is by California well numbering system. Well locations shown on Figure 6.
2. Well screened interval in feet below ground surface.
3. EC = electrical conductance, TDS = total dissolved solids, B = boron, Cl = chloride, NO_3-N = nitrate nitrogen, SO_4 = sulfate, µmhos/cm = micromhos per centimeter, mg/L = milligrams per liter, µg/L = micrograms per liter, and < = less than.
4. MCL = Maximum Contaminant Level for drinking water. For B, the Notification Level is listed. Concentrations greater than the MCL or equivalent are highlighted in green.

The Coalition proposes to conduct a one-time sampling event of the above 5 additional unconfined/semi-confined wells (Figure 6) and the 11 unconfined/semi-confined wells of the trend monitoring program that are within the BPAW area (Figure 3) to provide data to support a basin plan amendment. If some of these wells are destroyed, damaged, or unavailable, the Coalition will attempt to obtain permission to sample other unconfined/semi-confined groundwater wells in the area that meet the well selection criteria. Well construction records for the currently proposed monitoring wells are summarized in Table 5 and are provided in Appendix E.

4.3 GROUNDWATER SAMPLING METHODS

Groundwater sampling to characterize groundwater in support of the basin plan amendment will be collected on a one-time basis from 28 wells within the BPAW area (Figure 8). The procedure used to purge and sample each well will be based on the wellhead access and the static water level measured in the well at the time of sampling. Amec Foster Wheeler will conduct sampling in accordance with the trend monitoring procedures described in Section 3.3 and the groundwater monitoring protocols provided in Appendix D.

4.4 LABORATORY ANALYSES

The well water samples and associated quality assurance samples will be analyzed by a California ELAP laboratory using methods approved by the EPA. The samples will be analyzed for general minerals, nitrogen-series constituents, and metals (Table 4).

4.5 SCHEDULE

The schedule for this one-time monitoring event will be dictated by the duration for obtaining access agreements to each of the wells and field verifying that the wells can be accessed and sampled. Groundwater monitoring will commence once the final wells have been selected and site access has been obtained for those wells. It is anticipated that this one-time monitoring event will be conducted concurrently with the trend monitoring sampling event projected for July 2018.

4.6 REPORTING

Based on initial consultation with CV-SALTS staff, the Coalition proposes to prepare a summary of sampling/analytical methods and tables of analytical data. The summary and tables will be presented to CV-SALTS staff to solicit comments/direction on the basin plan amendment and consistency with their on-going salt and nutrient management plan.

5.0 REFERENCES

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TABLE 1

SOURCE IDENTIFICATION SUMMARY

Westside Water Quality Coalition
Western Tulare Lake Basin, California

No.[1]	Potential Source	Source of Salinity	Source of Nitrate
1	Antelope Hills North Oil Field	X	X
2	Antelope Hills Oil Field	X	X
3	Avenal Gap Mine	X	
4	Avenal Solid Waste Disposal Site	X	
5	Avenal State Prison	X	X
6	Avenal Wastewater Treatment Plant	X	X
7	Belridge North Oil Field	X	X
8	Belridge South Oil Field	X	X
9	Blackwells Corner Oil Field	X	X
10	Clean Harbors Disposal Site	X	
11	Chemical Waste Management	X	X
12	Devils Den Oil Field	X	X
13	Five & 46 Property Owners Association	X	X
14	H. M. Holloway Gypsum Mine	X	X
15	Horizon Nut Lost Hills	X	X
16	Kettleman Middle Dome Oil Field	X	X
17	Kettleman North Dome Oil Field	X	X
18	Liberty Composting	X	X
19	Lost Hills Oil Field	X	X
20	Lost Hills Water District Drainage Ponds	X	X
21	Lost Hills North Oil Field	X	X
22	Lost Hills Sanitary Landfill	X	
23	Lost Hills Utility District	X	X
24	Pyramid Hills Oil Field	X	X
25	SunnyGem Spicer	X	X
26	Welcome Valley Oil Field	X	X
27	Wonderful Pistachios King Facility	X	X
28	Wonderful Pistachios Lost Hills Facility	X	X
29	North Belridge Solid Waste Disposal Site	X	X
30	Tulare Lake Drainage District	X	

1. Source locations are shown on Figure 2.

TABLE 2

SUMMARY OF WELL CONSTRUCTION - TREND MONITORING

Westside Water Quality Coalition
Western Tulare Lake Basin, California

Well ID	Well Type	Latitude	Longitude	Top of Casing Elevation (feet)	Ground Surface Elevation (feet)	Well Depth (feet bgs)[2]	Screen Interval (feet bgs)[2]	Casing Size (inches)	Drill Date
Unconfined/Semi-Confined Aquifer									
024S018E23J001M	Unused	35.82349	-119.988846	--[1]	468	106	--	10	--
024S018E33N001M	Irrigation	35.788855	-120.039873	627	625	295	--	14	--
024S020E31K001M	Unused	35.794161	-119.850204	288	288	119	--	10	--
AeraBelridge_5B2	Monitoring	35.441081	-119.630269	336.5	336.1	274	191-211	2	10/26/86
026S019E25M001M	Unused	35.632467	-119.885703	--	670	363	--	--	--
AeraBelridge_19M1	Monitoring	35.56421	-119.760748	521.11	518.81	237	170-200; 220-230	--	--
Starrh_9K_No2	--	35.419402	-119.615797	--	--	500	258-500	--	--
Berrenda Mesa 1	--	35.668823	-120.090742	--	--	--	--	--	--
Lost Hills 5	--	35.680238	-119.867359	--	--	--	--	--	--
023S019E15N001M	--	35.905111	-119.897651	--	--	--	--	--	--
026S018E14N001M	Irrigation	35.660304	-120.008123	670	670	333	135-300	--	--
T25S/R19E-34R3_L3-3	Test	35.703434	-119.905438	--	--	170	155-165	6	01/22/88
24S19E02R001M	--	35.859395	-119.889768	--	--	--	--	--	--

TABLE 2

SUMMARY OF WELL CONSTRUCTION - TREND MONITORING

Well ID	Well Type	Latitude	Longitude	Top of Casing Elevation (feet)	Ground Surface Elevation (feet)	Well Depth (feet bgs)[2]	Screen Interval (feet bgs)[2]	Casing Size (inches)	Drill Date
Perched Aquifer									
T28S/R22E-05F	Piezometer	35.523388	-119.631671	--	--	20	10-20	2	08/01/90
T25S/R21E-31R1_10	Monitoring	35.70518	-119.745008	--	--	19	9-19	2	11/06/98
T27S/R22E-19P1_BEL #6A	Piezometer	35.560633	-119.647388	--	--	20	10-20	2	08/01/90
T26S/R21E-16R1	Piezometer	35.659687	-119.71014	--	--	22	12-22	--	--
T27S/R21E-11A_BEL #2	Piezometer	35.60153	-119.67556	--	-	20	10-20	--	--
T27S/R22E-18B1_BEL #3A	Piezometer	35.586965	-119.64486	--	--	20	10-20	--	--
T25S/R20E-15A	Piezometer	35.757146	-119.799327	--	--	14	4-14	2	06/01/89

1. -- = information not available.

TABLE 3

TREND MONITORING CONSTITUENTS

Westside Water Quality Coalition
Western Tulare Lake Basin, California

Annual Monitoring[1]
Conductivity (at 25 ^{o}C) (µmhos/cm)
pH (pH units)
Dissolved Oxygen (mg/L)
Temperature (^{o}C)
Nitrate as nitrogen (mg/L)
5-Year Monitoring[1]
Total Dissolved Solids (mg/L)
General Minerals[2] (mg/L)

1. ^{o}C = degrees Celsius, µmhos/cm = micromhos per centimeter, and mg/L = milligrams per liter.
2. General minerals consist of carbonate, bicarbonate, chloride, sulfate, boron, calcium, sodium, magnesium, and potassium.

TABLE 4

BASIN PLAN AMENDMENT CONSTITUENTS

Westside Water Quality Coalition
Western Tulare Lake Basin, California

Field Parameters[1]
Conductivity (at 25 °C) (µmhos/cm)
pH (pH units)
Dissolved Oxygen (mg/L)
Temperature (°C)
Metals
Arsenic (total)
Cadmium (total and dissolved)
Copper (total and dissolved)
Lead (total and dissolved)
Molybdenum (total)
Nickel (total and dissolved)
Selenium (total)
Zinc (total and dissolved)
Nutrients
Nitrogen, Nitrate + Nitrite
Other[1]
Total Dissolved Solids (mg/L)
General Minerals[2] (mg/L)

1. °C = degrees Celsius, µmhos/cm = micromhos per centimeter, and mg/L = milligrams per liter.
2. General minerals consist of carbonate, bicarbonate, chloride, sulfate, boron, calcium, sodium, magnesium, and potassium.

TABLE 5

SUMMARY OF WELL CONSTRUCTION - BASIN PLAN AMENDMENT SUPPORT

Westside Water Quality Coalition
Tulare Lake Basin Area, California

Well ID	Well Type	Latitude	Longitude	Top of Casing Elevation (feet)	Ground Surface Elevation (feet)	Well Depth (feet bgs)[2]	Screen Interval (feet bgs)[2]	Casing Size (inches)[2]	Drill Date
Unconfined/Semi-Confined Aquifer									
025S021E01N002M	Test	35.778464	-119.6675	290	--[1]	67	52-62	2	08/15/90
025S021E01N003M	Test	35.778464	-119.6675	290	--	100	90-100	2	08/15/90
025S021E01N004M	Test	35.778464	-119.6675	290	--	204	189-199	3	08/15/90
026S021E14H002M	--	35.667027	-119.673178	237	239	300	--	--	01/01/53
025S021E26P001M	Irrigation	35.719635	-119.679725	--	--	--	--	--	--
LHWD_MitigationWell#3	Irrigation	35.71964	-119.679738	--	--	402	195-402	14	01/01/76
Perched Aquifer									
025S021E01N001M	Test	35.778464	-119.6675	290	--	20	10-20	2	06/01/90
025S021E17H001M	--	35.753575	-119.725973	--	220	17	--	--	--
025S021E26P002M	--	35.717741	-119.681805	--	221	18	--	--	--
026S021E02R001M	--	35.688853	-119.672361	--	234	18	--	--	--
026S021E14R001M	--	35.659686	-119.672361	--	237	18	--	--	--

1. -- = information not available.

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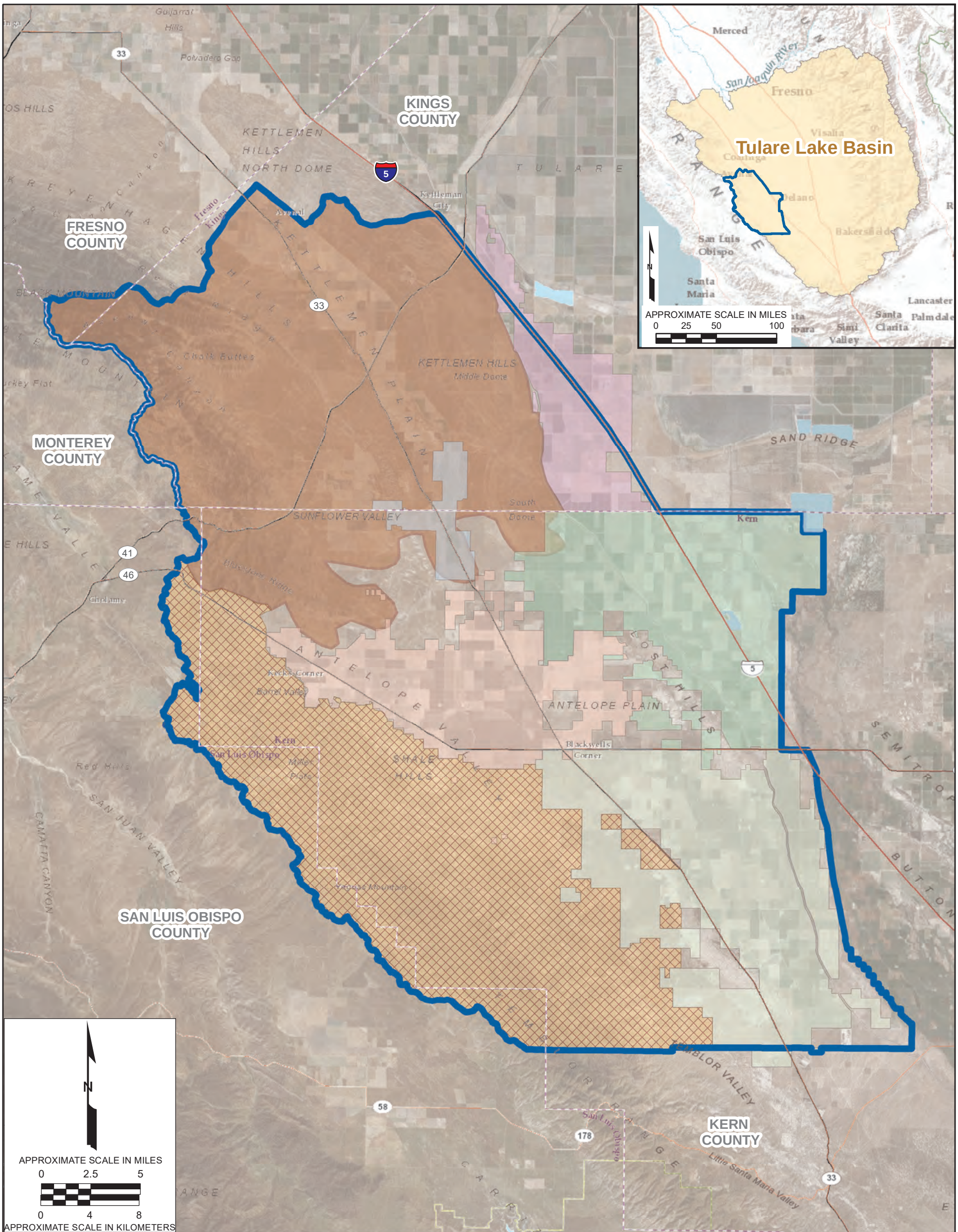

Explanation

- County line
- Westside Water Quality Coalition jurisdiction
- Western Supplemental Area
- Northern Supplemental Area
- Belridge Water District
- Berrenda Mesa Water District
- Devil's Den Water District
- Dudley Ridge Water District
- Lost Hills Water District

Basemap modified from ESRI online shared content, aerial imagery web mapping services.

SITE PLAN
Westside Water Quality Coalition
Western Tulare Lake Basin, California

amec foster wheeler

Date: 05/11/2017	Project No.: FR1216043A	Figure
Submitted By: GLK	Drawn By: JAC	1

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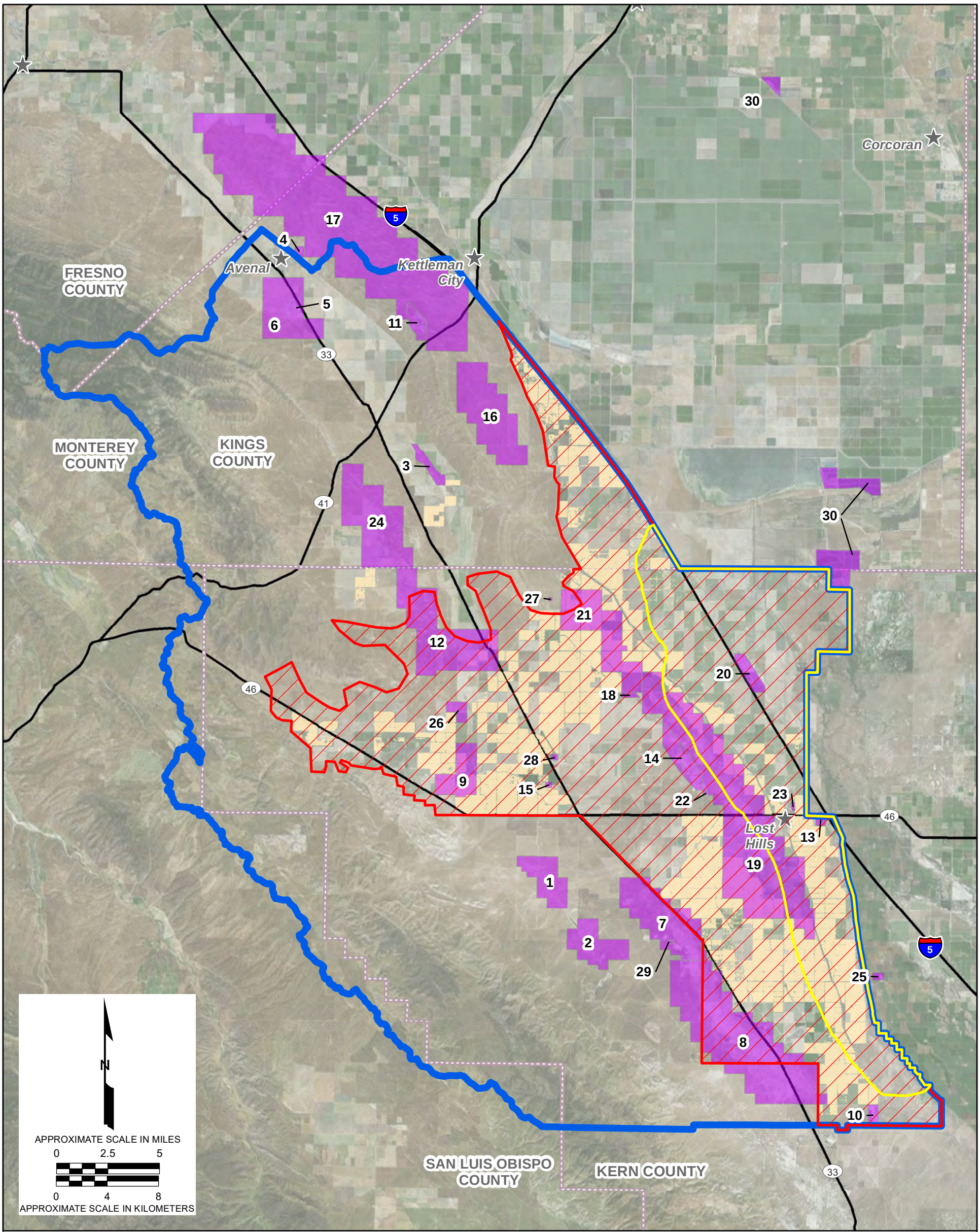

Explanation

- ★ US census populated places
- County line
- Pistachio and almond farmland (2016 Cropscape data)
- Non-irrigation source
- 2 Non-irrigation source reference number
- Westside Water Quality Coalition jurisdiction

Basin Plan Amendment

- Unconfined/Semi-confined aquifer
- Perched aquifer

Basemap modified from ESRI online shared content aerial imagery web mapping services.

WELL SELECTION CRITERIA
Westside Water Quality Coalition
Western Tulare Lake Basin, California

amec foster wheeler

Date: 05/01/2017	Project No.: FR1216043A	Figure
Submitted By: TGS	Drawn By: JAC	2

Note:
See Table 1 for non-irrigation source reference number explanation.

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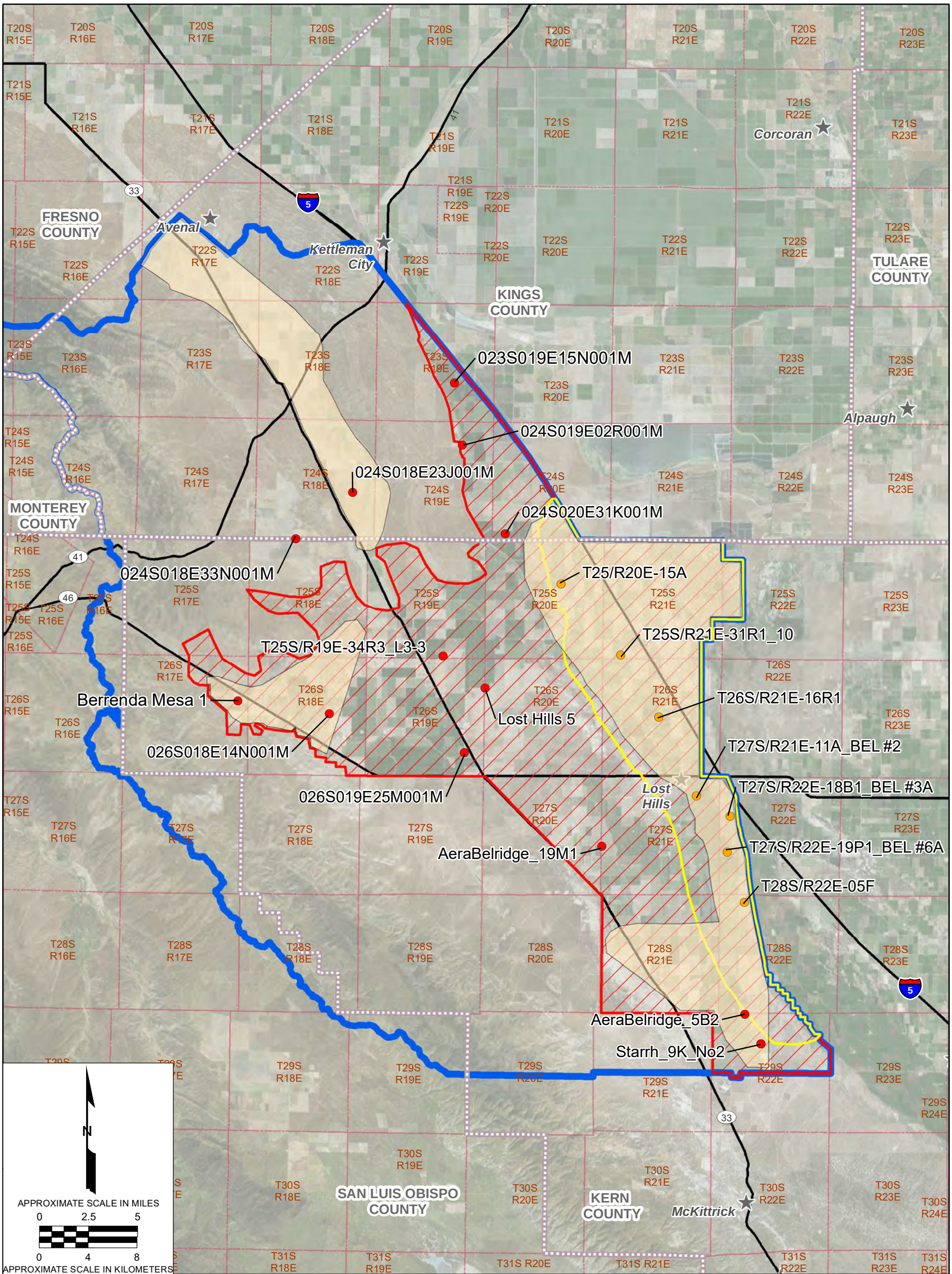

Explanation

- US census populated places
- Well completed in perched aquifer
- Well completed in unconfined/semi-confined aquifer
- County line
- High vulnerability area
- Westside Water Quality Coalition jurisdiction

Basin Plan

- Unconfined/Semi-confined aquifer
- Perched aquifer

Basemap modified from ESRI online shared content, aerial imagery web mapping services.

MONITORING WELL SELECTION - TREND MONITORING
Westside Water Quality Coalition
Western Tulare Lake Basin, California

amec foster wheeler

Date: 05/05/2017	Project No.: FR1216043A	Figure
Submitted By: GLK	Drawn By: JAC	3

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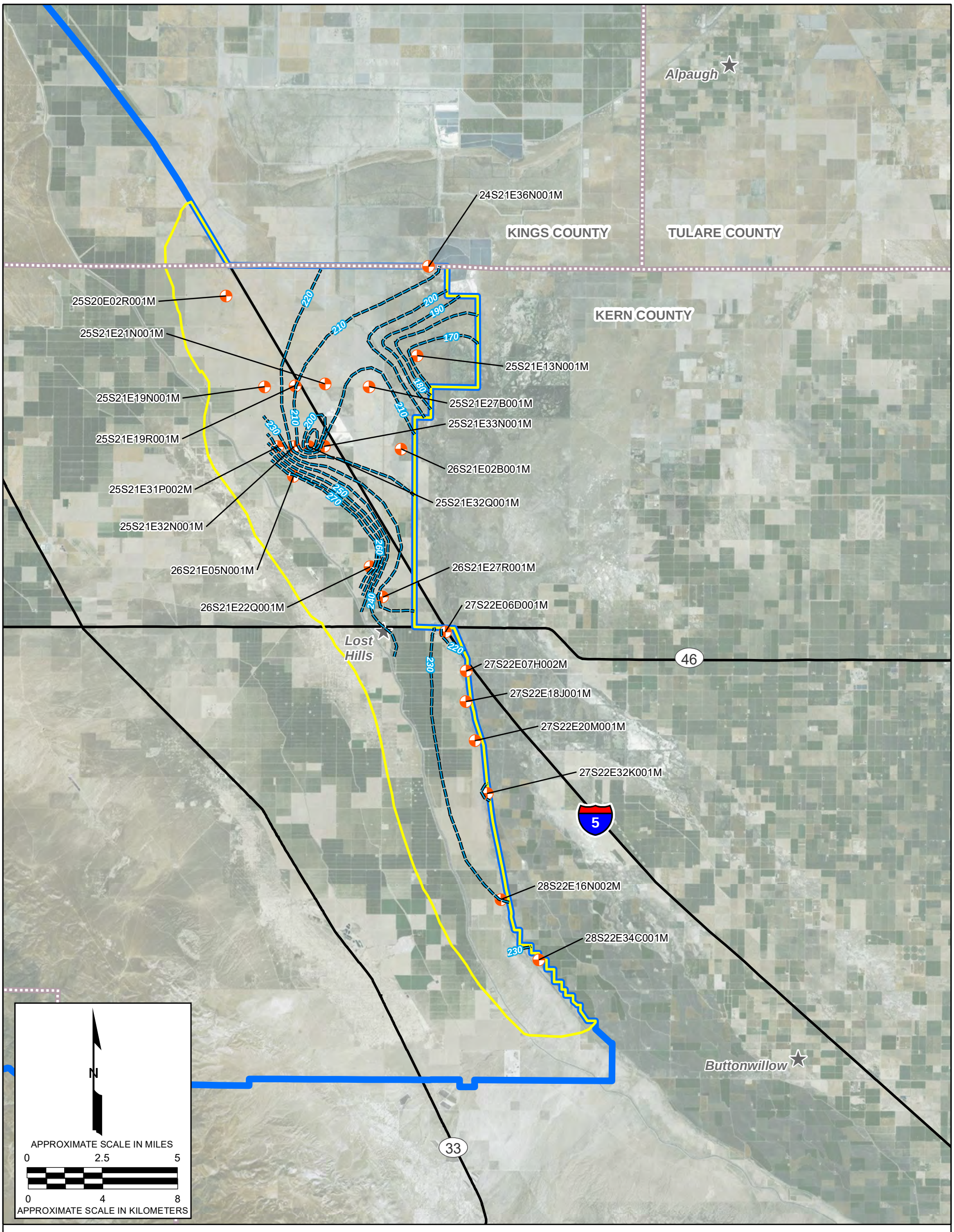

Explanation

- ★ US census populated places
- Well completed in perched aquifer
- 10-foot groundwater elevation contour (feet above mean sea level)
- County line
- Westside Water Quality Coalition jurisdiction
- Perched aquifer

Notes:
1. DWR = Department of Water Resources.
2. Contour lines based on 2016 DWR data.
3. Basemap modified from ESRI online shared content aerial imagery web mapping services.

2016 POTENTIOMETRIC SURFACE MAP - PERCHED AQUIFER
Westside Water Quality Coalition
Western Tulare Lake Basin, California

amec foster wheeler

Date: 05/09/2017	Project No.: FR1216043A	Figure 4
Submitted By: GLK	Drawn By: SCM	

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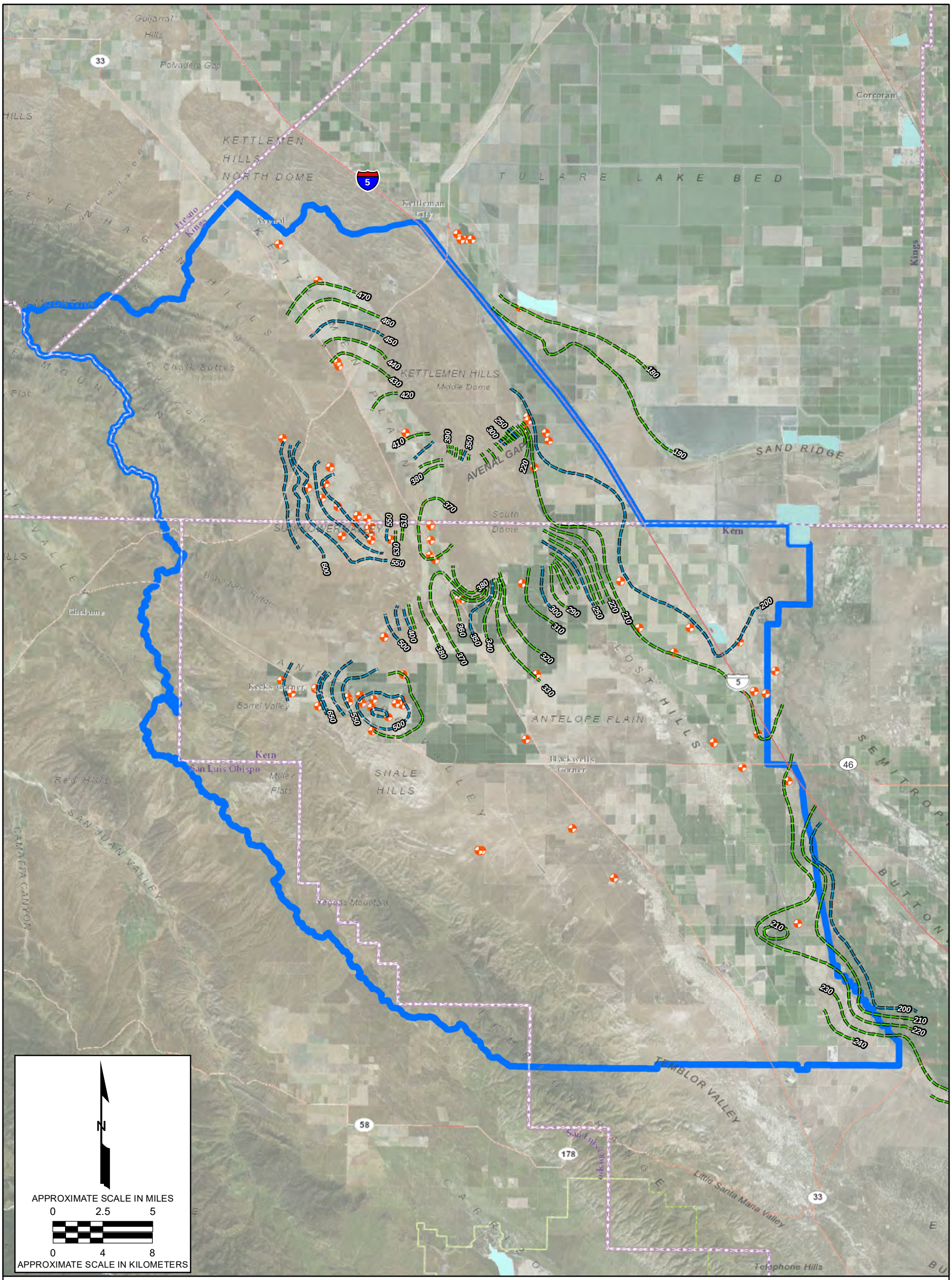

Explanation

- Water supply well location
- County line
- Westside Water Quality Coalition

Groundwater elev. contours (ft above mean sea

- 10-foot
- 50-foot

Notes:
1. Water supply well locations referenced from USGS Water-Supply Paper 1457 Plate 3
2. Basemap modified from ESRI online shared content aerial imagery web mapping services

1955 POTENTIOMETRIC SURFACE MAP - UNCONFINED/SEMI-CONFINED AQUIFER Westside Water Quality Coalition Western Tulare Lake Basin, California		amec foster wheeler
Date: 05/09/2017	Project No.: FR1216043A	Figure
Submitted By: GLK	Drawn By: SCM	5

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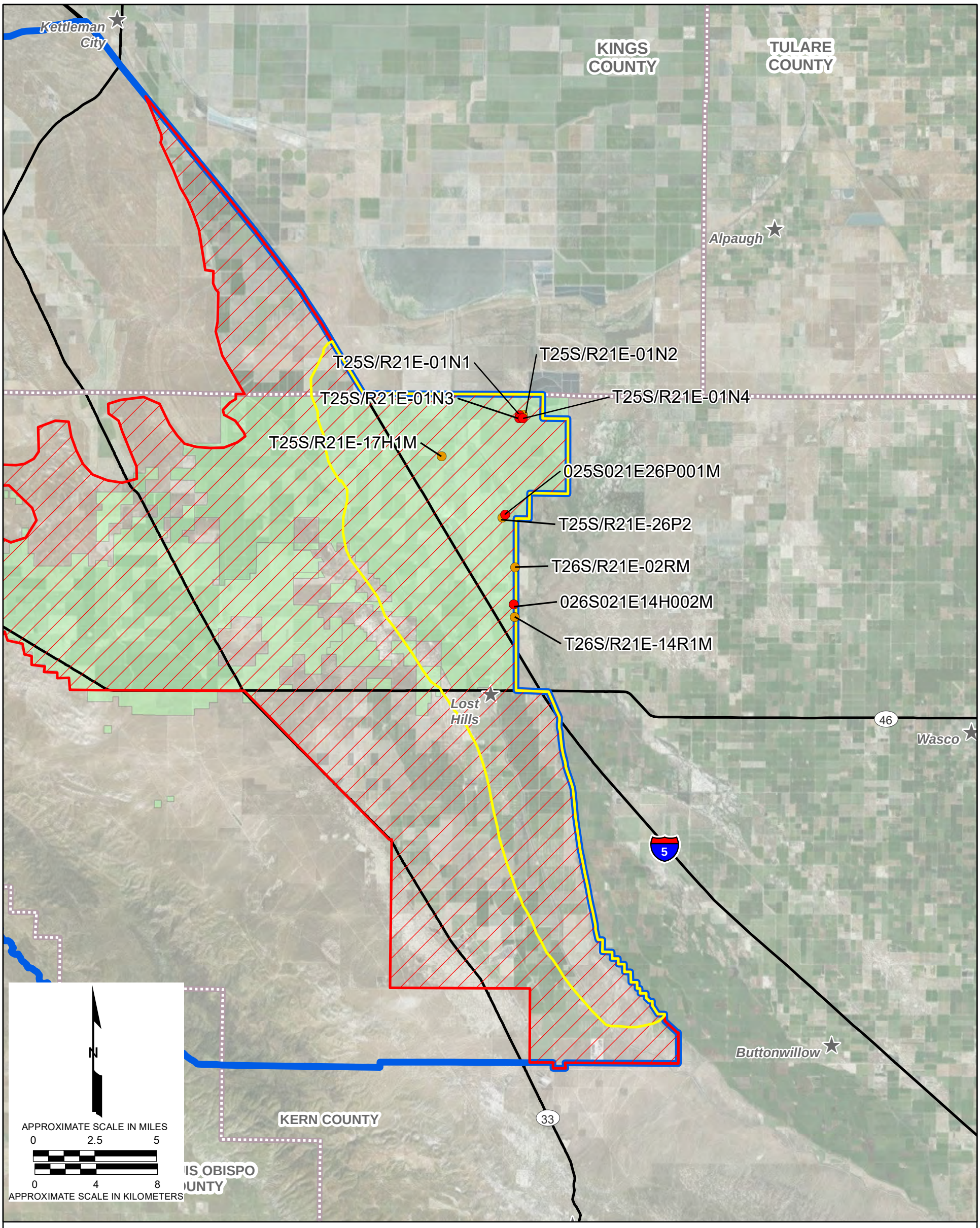

Explanation

- ★ US census populated places
- Well completed in perched aquifer
- Well completed in unconfined/semi-confined aquifer
- County line
- Westside Water Quality Coalition jurisdiction

Basin Plan Amendment

- Unconfined/Semi-confined aquifer
- Perched aquifer

Municipal Water Supply

- Lost Hills utility district

Note:
Basemap modified from ESRI online shared content aerial imagery web mapping services.

ADDITIONAL MONITORING WELLS - BASIN PLAN AMENDMENT
Westside Water Quality Coalition
Western Tulare Lake Basin, California

amec foster wheeler

Date: 05/11/2017	Project No.: FR1216043A	Figure 6
Submitted By: GLK	Drawn By: SCM	

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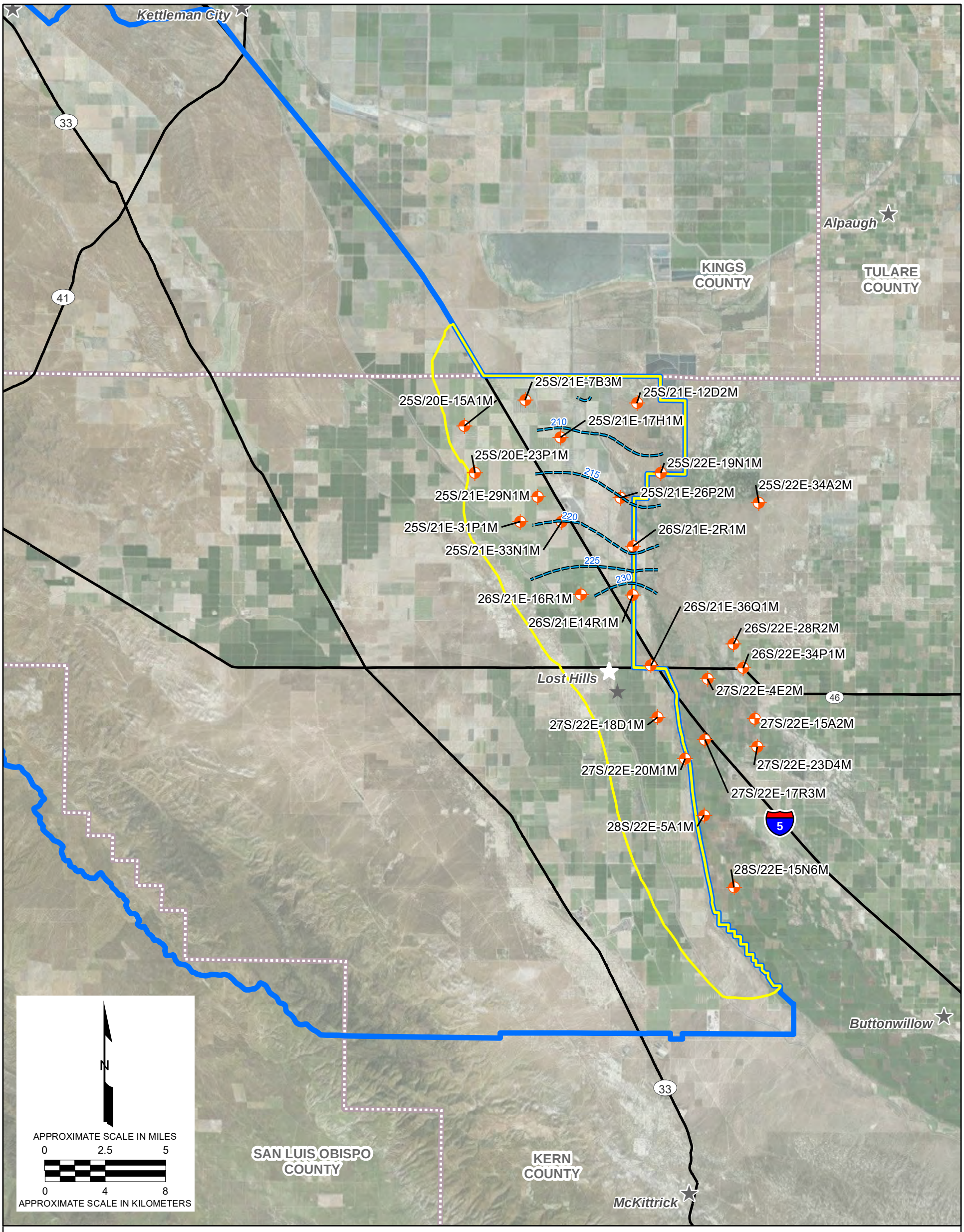

Explanation

- Perched monitoring well location
- 5-foot groundwater elevation contour (feet above mean sea level)
- County line
- Westside Water Quality Coalition jurisdiction
- Perched aquifer

Notes:
1. Data from USGS Open-File Report 92-655, 1989.
2. Basemap modified from ESRI online shared content aerial imagery web mapping services.

1989 POTENTIOMETRIC SURFACE MAP - PERCHED AQUIFER
Westside Water Quality Coalition
Western Tulare Lake Basin, California

amec foster wheeler

Date: 04/25/2017	Project No.: FR1216043A	Figure 7
Submitted By: GLK	Drawn By: JAC	

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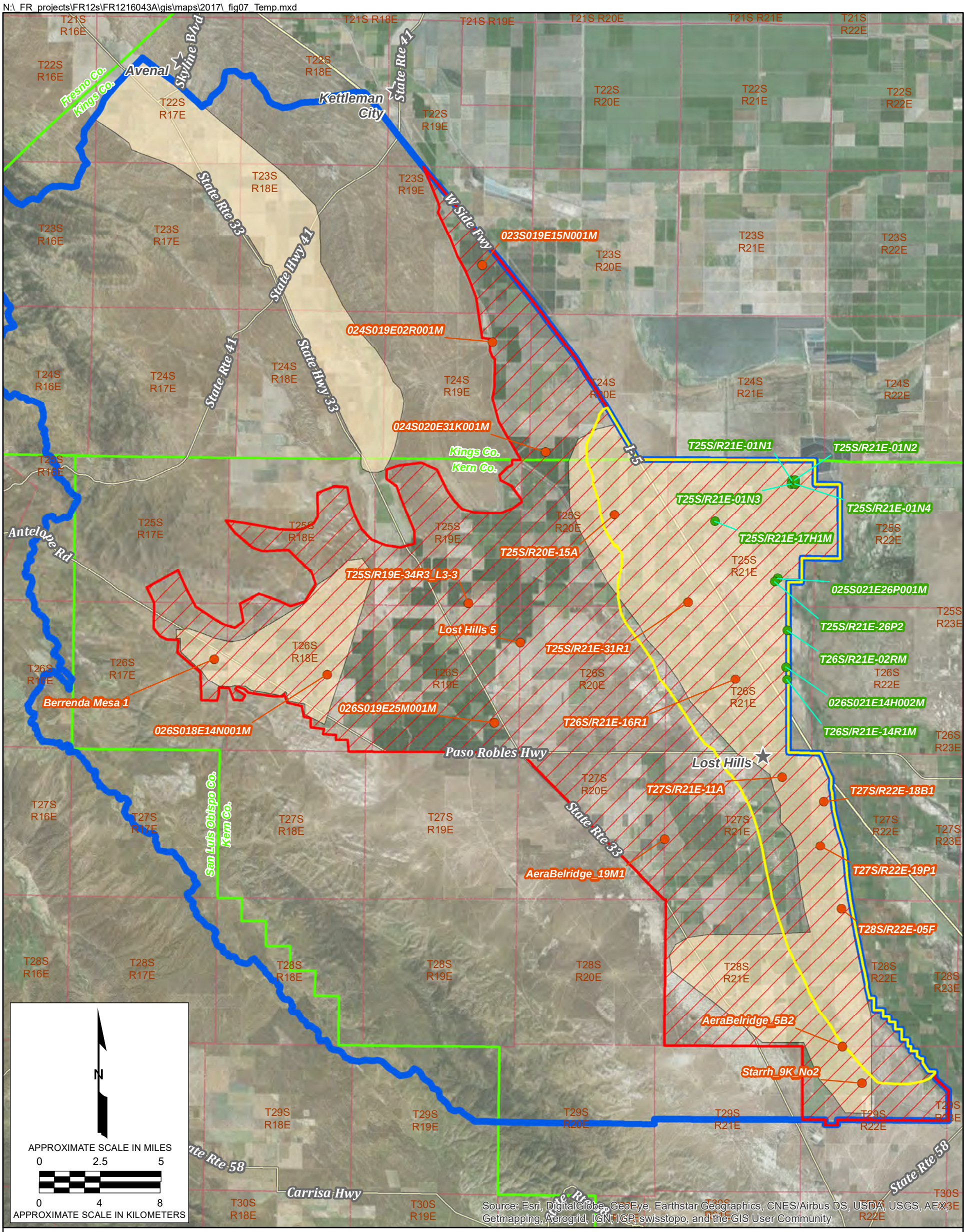


Explanation

- ★ US census populated places
- Well that will be sampled one time
- Well that will be sampled initially, then every five years

Basin Plan

- Unconfined/Semi-confined aquifer
- Perched aquifer
- Westside Water Quality Coalition jurisdiction
- High vulnerability area
- Counties

Basemap modified from ESRI online shared content, aerial imagery web mapping services.

ONE-TIME MONITORING WELL SAMPLING - BASIN PLAN AMENDMENT Westside Water Quality Coalition Western Tulare Lake Basin, California		amec foster wheeler
Date: 05/11/2017	Project No: FR1216043A	Figure 8
Submitted By: Name	Drawn By: SCM	

APPENDIX A

Potential Domestic Supply Well Review

APPENDIX A

POTENTIAL DOMESTIC SUPPLY WELL REVIEW

Westside Water Quality Coalition
Tulare Lake Basin Area, California

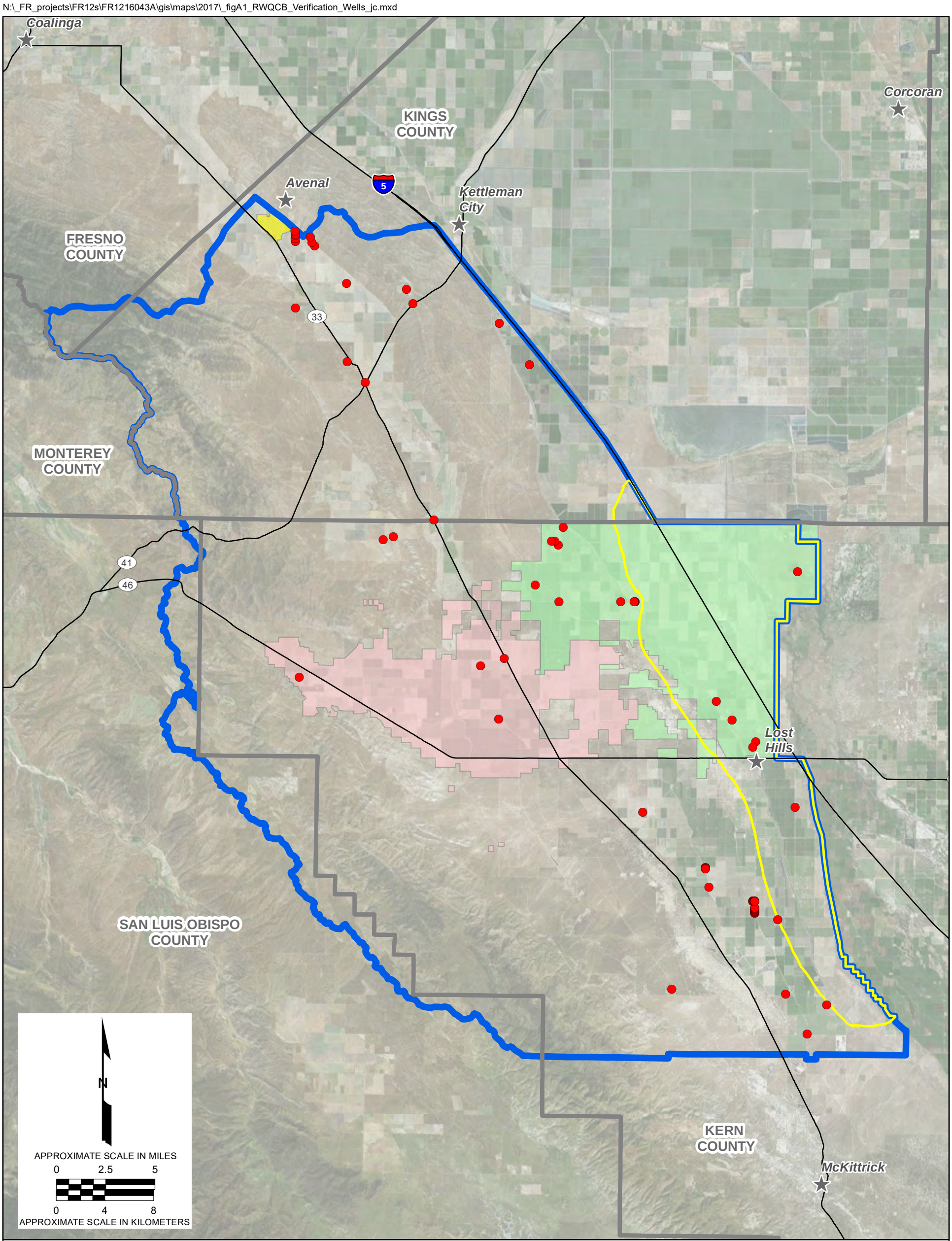
Sites	Latitude	Longitude	T/R/S	Location	Description	Comment
1	35.935351	-119.925638	23S/19E/08	West corner of 25th and Utica Ave	Residence/Business	4/5/17-residence, no well visible
2	35.905111	-119.897651	23S/19E/27	West of I5, E of 25th, S of Utica Ave	Residence/Business	5/4/17-residence, no well visible
3	35.731039	-119.799979	25S/20E/27	S of Twisselman Rd, E of California Aqueduct	Residence	5/4/17-Wonderful employee housing, office and shop, no visible well, served by Aera Spicer City water system?
4	35.731055	-119.800311	25S/20E/27	S of Twisselman Rd, E of California Aqueduct	Residence	
5	35.731045	-119.800725	25S/20E/27	S of Twisselman Rd, E of California Aqueduct	Residence	
6	35.73105	-119.801061	25S/20E/27	S of Twisselman Rd, E of California Aqueduct	Residence	
7	35.657929	-119.726132	26S/21E/20	W of G P Rd, E of California Aqueduct	Residence/Business	4/5/17-near Lost Hills Oil Field, well not visible
8	35.644299	-119.711691	26S/21E/28	S of G P Rd, E of California Aqueduct	Residence/Business	4/5/17-Ritchie Farms scale house, no well visible
9	35.628262	-119.69013	26S/21E/34	W of Lost Hills Rd, E of California Aqueduct	Residence/Business	5/3/17-residence, well apparent north of house
10	35.62403	-119.692688	26S/21E/34	N of Paso Robles Hwy, W of Lost Hills Rd	Mobile Home Park	5/4/17-Lost Hills RV Park, possible well in SW corner
11	35.580089	-119.654011	27S/22E/18	Canal	Residence/Business	5/4/17-confined animals and equip't yard, no well visible
12	35.753681	-119.65331	25S/21E/13	N of Twisselman, W of Line A	Residence	4/5/17-shed, no well visible
13	35.412938	-119.642031	29S/22E/08	N of Delfern Rd, E of Hwy 33	Solar Plant	4/5/17-electrical substation, no well visible
14	35.434389	-119.624399	29S/22E/04	S of 7th Standard Rd, W of California Aqueduct	Residence	4/5/17-pressure tank near shed
15	35.441998	-119.661479	28S/21E/36	N of 7th Standard Rd, E of Lost Hills Road	Facility	5/3/17, BWSD office, no well visible
16	35.496992	-119.66922	28S/21E/13	S of Lerdo Hwy, E of Lost Hills Rd	Facility	4/5/17, Wonderful Orchards office/whse,no well visible
17	35.501703	-119.690049	28S/21E/10	N of Lerdo Hwy, West of Lost Hills Rd	Residence	5/3/17, sites 17-41 are Wonderful employee housing, served by Aera Spicer City water system
18	35.502024	-119.690041	28S/21E/10	N of Lerdo Hwy, West of Lost Hills Rd	Residence	
19	35.502285	-119.69001	28S/21E/10	N of Lerdo Hwy, West of Lost Hills Rd	Residence	
20	35.502557	-119.690049	28S/21E/10	N of Lerdo Hwy, West of Lost Hills Rd	Residence	
21	35.502852	-119.690016	28S/21E/10	N of Lerdo Hwy, West of Lost Hills Rd	Residence	
22	35.503124	-119.689985	28S/21E/10	N of Lerdo Hwy, West of Lost Hills Rd	Residence	
23	35.503396	-119.689991	28S/21E/10	N of Lerdo Hwy, West of Lost Hills Rd	Residence	
24	35.503818	-119.690011	28S/21E/10	N of Lerdo Hwy, West of Lost Hills Rd	Residence	
25	35.504209	-119.689978	28S/21E/10	N of Lerdo Hwy, West of Lost Hills Rd	Residence	
26	35.504554	-119.689978	28S/21E/10	N of Lerdo Hwy, West of Lost Hills Rd	Residence	
27	35.505011	-119.690019	28S/21E/10	N of Lerdo Hwy, West of Lost Hills Rd	Residence	
28	35.505342	-119.690024	28S/21E/10	N of Lerdo Hwy, West of Lost Hills Rd	Residence	
29	35.505592	-119.69005	28S/21E/10	N of Lerdo Hwy, West of Lost Hills Rd	Residence	
30	35.510804	-119.690018	28S/21E/10	N of Lerdo Hwy, West of Lost Hills Rd	Residence	
31	35.510843	-119.690385	28S/21E/10	N of Lerdo Hwy, West of Lost Hills Rd	Residence	
32	35.510808	-119.690713	28S/21E/10	N of Lerdo Hwy, West of Lost Hills Rd	Residence	
33	35.510832	-119.691045	28S/21E/10	N of Lerdo Hwy, West of Lost Hills Rd	Residence	
34	35.510858	-119.691389	28S/21E/10	N of Lerdo Hwy, West of Lost Hills Rd	Residence	
35	35.510701	-119.691666	28S/21E/10	N of Lerdo Hwy, West of Lost Hills Rd	Residence	
36	35.510464	-119.691632	28S/21E/10	N of Lerdo Hwy, West of Lost Hills Rd	Residence	
37	35.510337	-119.691413	28S/21E/10	N of Lerdo Hwy, West of Lost Hills Rd	Residence	
38	35.510364	-119.691061	28S/21E/10	N of Lerdo Hwy, West of Lost Hills Rd	Residence	
39	35.510407	-119.690686	28S/21E/10	N of Lerdo Hwy, West of Lost Hills Rd	Residence	

APPENDIX A

POTENTIAL DOMESTIC SUPPLY WELL REVIEW

Sites	Latitude	Longitude	T/R/S	Location	Description	Comment
40	35.510429	-119.690344	28S/21E/10	N of Lerdo Hwy, West of Lost Hills Rd	Residence	
41	35.510398	-119.690025	28S/21E/10	N of Lerdo Hwy, West of Lost Hills Rd	Residence	
42	35.682605	-119.939451	26S/19E/08	N of Berrenda Mesa Canal, W of Hwy 33	Residence/Business	5/4/17-tailwater pond, shed and boneyard, no well visible
43	35.6879	-119.918063	26S/19E/03	N of Berrenda Mesa Canal, W of Hwy 33	Residence/Business	4/5/17-ranch office/equipt yard, no well visible
44	35.643367	-119.922758	26S/19E/28	N of Berrenda Mesa Canal, W of Hwy 33	Residence/Business	5/4/17-ranch ofice, shop and yard, ag well/sand filters N of pond
45	35.575463	-119.791752	27S/20E/14	N of Brown Material Rd, E of Hwy 33	Facility	4/5/17- Paramount almond huller, well on S of property
46	35.730339	-119.869163	25S/19E/25	S of Twisselman Rd, W of King Rd	Facility	4/5/17-shop and yard, no well visible
47	35.742589	-119.890845	25S/19E/23	N ot Twisselman Rd, W of King Rd	Residence/Business	4/5/17-possible residences, ag well N of driveway
48	35.77218	-119.870282	25S/19E/12	N ot Twisselman Rd, W of King Rd	Facility	4/5/17-Wonderful-King plant, California Aqueduct water supply
49	35.774792	-119.873498	25S/19E/01	N ot Twisselman Rd, W of King Rd	Residence	4/5/17-shed, no well visible
50	35.774851	-119.876168	25S/19E/01	N ot Twisselman Rd, W of King Rd	Facility	4/5/17-shop and yard, possible well W part of site
51	35.785427	-119.865919	25S/20E/06	N ot Twisselman Rd, E of King Rd	Facility	4/5/17-canal pumping station, transfer pumps only
52	35.730783	-119.813206	25S/20E/27	S of Twisselman Rd, E of Nonparell Rd	Residence	4/5/17-residences, no well visible
53	35.535268	-119.734558	27S/21E/32	N of Lerdo Hwy, E of Hwy 33	Residence	5/3/17-sites 54-57 are Wonderful employee housing and shop, possible well N of shop
54	35.534972	-119.734575	27S/21E/32	N of Lerdo Hwy, E of Hwy 33	Residence	
55	35.534632	-119.734547	27S/21E/32	N of Lerdo Hwy, E of Hwy 33	Residence	
56	35.534351	-119.73453	27S/21E/32	N of Lerdo Hwy, E of Hwy 33	Residence	
57	35.52071	-119.731285	28S/21E/05	N of Lerdo Hwy, E of Hwy 33	Facility	4/6/17-warehouse/eqpt yard, canal transfer pumps to N
58	35.789604	-119.982832	24S/18E/36	N of Baker/Hwy 33 interchange, E of Hwy 33	Residence/Business	4/6/17-residence/eqpt yard, no well visible
59	35.777041	-120.019502	25S/18E/03	N of Devils Den Rd, W of Hwy 33	Residence/Business	4/6/17-residence/eqpt yard, elevated water tank visible
60	35.775021	-120.028738	25S/18E/04	N of Devils Den Rd, W of Hwy 34	Facility	4/6/17-shops/eqpt yard,no well visible
61	35.672588	-120.103266	26S/17E/14	N of Kecks Rd, W of Hwy 46	Facility	4/5/17-Industrial, ag well/sand filters N of site
62	35.445152	-119.764283	28S/20E/36	N of Temblor Dr, E of Santos St	School	4/6/17-Belridge school, riser pipes/hydrant visible, no well visible
63	35.963758	-120.064308	23S/18E/06	S of Tehama Ave, E of Hwy 33	Residence/Business	4/6/17-residence/eqpt yard, no well visible
64	35.991115	-120.093646	22S/17E/26	S of Washington St, E of Ave 36	Residence	5/4/17-residence/yard, within Avenal water service area
65	35.993419	-120.096423	22S/17E/23	N of Washington St, E of Ave 36	Facility	4/6/17-warehouse/shop,no well visible
66	35.997632	-120.097889	22S/17E/23	N of Salem Ave, E of Ave 36	Facility	4/6/17-warehouse/shop, no well visible
67	35.994171	-120.111353	22S/17E/22	N of Salem Ave, W of Ave 36	Facility	4/6/17-shop and yard, no well visible
68	35.996327	-120.111434	22S/17E/22	N of Salem Ave, W of Ave 36	Facility	4/6/17-shop and yard, no well visible
69	35.998358	-120.111438	22S/17E/22	N of Salem Ave, W of Ave 36	Facility	4/6/17-shop and yard, no well visible
70	35.999682	-120.1114	22S/17E/22	N of Salem Ave, W of Ave 36	Residence	4/6/17-residence/eqpt yard, well on N side of site
71	36.001666	-120.111977	22S/17E/22	N of Freemont St, W of Ave 36	Facility	4/6/17-Avenal Pub Wks/Animal Shelter, wihtin Avenal water service area
72	35.945008	-120.110452	23S/17E/11	N of Flattop Mountain Rd, W of Hwy 33	Residence	4/6/17-shed, no well visible
73	35.905768	-120.063179	23S/18E/30	N of Reef Station, W of Hwy 33	Residence/Business	5/4/17-Hewitson Cattle Co., no well visible
74	35.890833	-120.046472	23S/18E/32	N of Hwy 41/Hwy 33 interchange, W of Hwy 41	Facility	5/4/17-Reef City, well NE corner of facility
75	35.949021	-120.00399	23S/18E/11	N of Old State Hwy, W of Old State Hwy	Facility	4/6/17-cell tower, no well visible
76	35.959726	-120.010022	23S/18E/03	N end of Skyline Rd	Facility	5/4/17-CWM Kettleman Hills Landfill, imported potable water

N:_FR_projects\FR12s\FR1216043A\gis\maps\2017_figA1_RWQCB_Verification_Wells_jc.mxd



Explanation

- Potential domestic supply wells
- US census populated places
- County line
- Westside Water Quality Coalition jurisdiction
- Perched groundwater area
- Avenal water district
- Berrenda Mesa water district
- Lost Hills water district

Basemap modified from ESRI online shared content, aerial imagery web mapping services.

POTENTIAL DOMESTIC SUPPLY WELLS
Westside Water Quality Coalition
Western Tulare Lake Basin, California

amec foster wheeler

Date: 04/24/2017	Project No.: FR1216043A	Figure
Submitted By: GLK	Drawn By: JAC	A-1

Attachment B
Sites that could potentially contain Domestic Supply Wells within the Coalition's Area

Sites	Latitude	Longitude	Location	Description
1	35.935351	-119.925638	West corner of 25th and Utica Ave	Residence/Business
2	35.905111	-119.897651	West of I5, E of 25th, S of Utica Ave	Residence/Business
3	35.731039	-119.799979	S of Twisselman Rd, E of California Aqueduct	Residence
4	35.731055	-119.800311	S of Twisselman Rd, E of California Aqueduct	Residence
5	35.731045	-119.800725	S of Twisselman Rd, E of California Aqueduct	Residence
6	35.73105	-119.801061	S of Twisselman Rd, E of California Aqueduct	Residence
7	35.657929	-119.726132	W of G P Rd, E of California Aqueduct	Residence/Business
8	35.644299	-119.711691	S of G P Rd, E of California Aqueduct	Residence/Business
9	35.628262	-119.69013	W of Lost Hills Rd, E of California Aqueduct	Residence/Business
10	35.62403	-119.692688	N of Paso Robles Hwy, W of Lost Hills Rd	Mobile Home Park
11	35.580089	-119.654011	S of Rd 345, between Aqueduct and West Side Canal	Residence/Business
12	35.753681	-119.65331	N of Twisselman, W of Line A	Residence
13	35.412938	-119.642031	N of Delfern Rd, E of Hwy 33	Solar Plant
14	35.434389	-119.624399	S of 7th Standard Rd, W of California Aqueduct	Residence
15	35.441998	-119.661479	N of 7th Standard Rd, E of Lost Hills Road	Facility
16	35.496992	-119.66922	S of Lerdo Hwy, E of Lost Hills Rd	Facility
17	35.501703	-119.690049	N of Lerdo Hwy, West of Lost Hills Rd	Residence
18	35.502024	-119.690041	N of Lerdo Hwy, West of Lost Hills Rd	Residence
19	35.502285	-119.69001	N of Lerdo Hwy, West of Lost Hills Rd	Residence
20	35.502557	-119.690049	N of Lerdo Hwy, West of Lost Hills Rd	Residence
21	35.502852	-119.690016	N of Lerdo Hwy, West of Lost Hills Rd	Residence
22	35.503124	-119.689985	N of Lerdo Hwy, West of Lost Hills Rd	Residence
23	35.503396	-119.689991	N of Lerdo Hwy, West of Lost Hills Rd	Residence
24	35.503818	-119.690011	N of Lerdo Hwy, West of Lost Hills Rd	Residence
25	35.504209	-119.689978	N of Lerdo Hwy, West of Lost Hills Rd	Residence
26	35.504554	-119.689978	N of Lerdo Hwy, West of Lost Hills Rd	Residence
27	35.505011	-119.690019	N of Lerdo Hwy, West of Lost Hills Rd	Residence
28	35.505342	-119.690024	N of Lerdo Hwy, West of Lost Hills Rd	Residence
29	35.505592	-119.69005	N of Lerdo Hwy, West of Lost Hills Rd	Residence
30	35.510804	-119.690018	N of Lerdo Hwy, West of Lost Hills Rd	Residence
31	35.510843	-119.690385	N of Lerdo Hwy, West of Lost Hills Rd	Residence
32	35.510808	-119.690713	N of Lerdo Hwy, West of Lost Hills Rd	Residence
33	35.510832	-119.691045	N of Lerdo Hwy, West of Lost Hills Rd	Residence
34	35.510858	-119.691389	N of Lerdo Hwy, West of Lost Hills Rd	Residence
35	35.510701	-119.691666	N of Lerdo Hwy, West of Lost Hills Rd	Residence
36	35.510464	-119.691632	N of Lerdo Hwy, West of Lost Hills Rd	Residence
37	35.510337	-119.691413	N of Lerdo Hwy, West of Lost Hills Rd	Residence
38	35.510364	-119.691061	N of Lerdo Hwy, West of Lost Hills Rd	Residence
39	35.510407	-119.690686	N of Lerdo Hwy, West of Lost Hills Rd	Residence
40	35.510429	-119.690344	N of Lerdo Hwy, West of Lost Hills Rd	Residence
41	35.510398	-119.690025	N of Lerdo Hwy, West of Lost Hills Rd	Residence
42	35.682605	-119.939451	N of Berrenda Mesa Canal, W of Hwy 33	Residence/Business

Attachment B
Sites that could potentially contain Domestic Supply Wells within the Coalition's Area

Sites	Latitude	Longitude	Location	Description
43	35.6879	-119.918063	N of Berrenda Mesa Canal, W of Hwy 33	Residence/Business
44	35.643367	-119.922758	N of Berrenda Mesa Canal, W of Hwy 33	Residence/Business
45	35.575463	-119.791752	N of Brown Material Rd, E of Hwy 33	Facility
46	35.730339	-119.869163	S of Twisselman Rd, W of King Rd	Facility
47	35.742589	-119.890845	N ot Twisselman Rd, W of King Rd	Residence/Business
48	35.77218	-119.870282	N ot Twisselman Rd, W of King Rd	Facility
49	35.774792	-119.873498	N ot Twisselman Rd, W of King Rd	Residence
50	35.774851	-119.876168	N ot Twisselman Rd, W of King Rd	Facility
51	35.785427	-119.865919	N ot Twisselman Rd, E of King Rd	Facility
52	35.730783	-119.813206	S of Twisselman Rd, E of Nonparell Rd	Residence
53	35.535268	-119.734558	N of Lerdo Hwy, E of Hwy 33	Residence
54	35.534972	-119.734575	N of Lerdo Hwy, E of Hwy 33	Residence
55	35.534632	-119.734547	N of Lerdo Hwy, E of Hwy 33	Residence
56	35.534351	-119.73453	N of Lerdo Hwy, E of Hwy 33	Residence
57	35.52071	-119.731285	N of Lerdo Hwy, E of Hwy 33	Facility
58	35.789604	-119.982832	N of Baker/Hwy 33 interchange, E of Hwy 33	Residence/Business
59	35.777041	-120.019502	N of Devils Den Rd, W of Hwy 33	Residence/Business
60	35.775021	-120.028738	N of Devils Den Rd, W of Hwy 34	Facility
61	35.672588	-120.103266	N of Kecks Rd, W of Hwy 46	Facility
62	35.445152	-119.764283	N of Temblor Dr, E of Santos St	School
63	35.963758	-120.064308	S of Tehama Ave, E of Hwy 33	Residence/Business
64	35.991115	-120.093646	S of Washington St, E of Ave 36	Residence
65	35.993419	-120.096423	N of Washington St, E of Ave 36	Facility
66	35.997632	-120.097889	N of Salem Ave, E of Ave 36	Facility
67	35.994171	-120.111353	N of Salem Ave, W of Ave 36	Facility
68	35.996327	-120.111434	N of Salem Ave, W of Ave 36	Facility
69	35.998358	-120.111438	N of Salem Ave, W of Ave 36	Facility
70	35.999682	-120.1114	N of Salem Ave, W of Ave 36	Residence
71	36.001666	-120.111977	N of Freemont St, W of Ave 36	Facility
72	35.945008	-120.110452	N of Flattop Mountain Rd, W of Hwy 33	Residence
73	35.905768	-120.063179	N of Reef Station, W of Hwy 33	Residence/Business
74	35.890833	-120.046472	N of Hwy 41 and Hwy 33 interchange, W of Hwy 41	Facility
75	35.949021	-120.00399	N of Old State Hwy, W of Old State Hwy	Facility
76	35.959726	-120.010022	N end of Skyline Rd	Facility

APPENDIX B

Additional References Review

APPENDIX B

ADDITIONAL REFERENCES REVIEW

Westside Water Quality Coalition
Tulare Lake Basin Area, California

Regional Water Quality Control Board Reference	Additional Groundwater Data
Bertoldi, G L Johnston, R H and Evenson, K D (1991), Ground water in the Central Valley, California - a summary report; USGS 1401A.	None
Boyle, D and others (2012), Groundwater nitrate occurrence - technical report 4 - addressing nitrate in California's drinking water with a focus on Tulare Lake Basin and Salinas Valley Groundwater, UCD.	None
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Kent R, Belitz, K and Fram M S (2014) Groundwater quality data in 7 GAMA study areas, USGS 795.	None

APPENDIX B

ADDITIONAL REFERENCES REVIEW

Regional Water Quality Control Board Reference	Additional Groundwater Data
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Lofgren, B E and Klausing, R L (1969, Land subsidence due to groundwater withdrawal, Tulare-Wasco area, California, USGS 437-B.	Not in Study Area
McMahon, P B (2012) Use of classes based on redox and groundwater age to characterize the susceptibility of principal aquifers to changes in nitrate concentrations, USGS 2012-5220.	None
Meuller, D K (1995), Nutrients in groundwater and surface water of the United States, USGS 87-4066 [sic].	None
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Paul, A P and others (2007) Effects of agriculture and urbanization on quality of shallow groundwater in the arid to semi arid western US, USGS 2007-__.	None
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Attachment A
Additional References

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APPENDIX C

Well Construction Records – Trend Monitoring

30

ORIGINAL
File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do not fill in

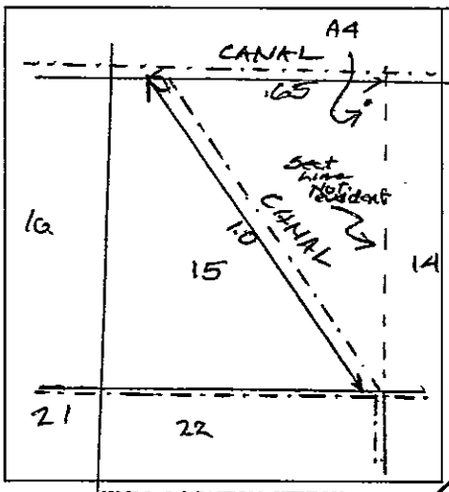
No. 334617

Notice of Intent No. _____
Local Permit No. or Date _____

State Well No. 25/20-15A
Other Well No. _____

(1) OWNER: Name _____
Address _____
City _____ ZIP _____

(2) LOCATION OF WELL (See instructions):
County Kern Owner's Well Number _____
Well address if different from above _____
Township 25S Range 20E Section 15A
Distance from cities, roads, railroads, fences, etc. USGS Clusta Site. Clusta in cotton field - well 100' south of Irrigation ditch on section line



WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic ☐
Irrigation ☐
Industrial ☐
Test Well ☐
Municipal ☐
Other Piezometer ☒ (Describe) STUDY

(5) EQUIPMENT:
Rotary ☒ Reverse ☐
Cable ☐ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK:
Yes ☒ No ☐ Size MONT. SAND
Diameter of bore 3
Packed from _____ to 9 ft.

(7) CASING INSTALLED:
Steel ☐ Plastic ☒ Concrete ☐

(8) PERFORATIONS:
Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	14	2	SCH.40	4	14	0.02 in.

(9) WELL SEAL:
Was surface sanitary seal provided? Yes ☐ No ☒ If yes, to depth _____ ft.
Were strata sealed against pollution? Yes ☐ No ☒ Interval _____ ft.
Method of sealing _____

(10) WATER LEVELS:
Depth of first water, if known _____ ft.
Standing level after well completion _____ ft.

(11) WELL TESTS:
Was well test made? Yes ☐ No ☒ If yes, by whom? _____
Type of test Pump ☐ Bailer ☐ Air lift ☐
Depth to water at start of test _____ ft. At end of test _____ ft.
Discharge _____ gal/min after _____ hours Water temperature _____
Chemical analysis made? Yes ☒ No ☐ If yes, by whom? USGS
Was electric log made Yes ☐ No ☒ If yes, attach copy to this report

(12) WELL LOG: Total depth 14 ft. Completed depth 14 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	2'	Silty clay 2.5Y 4/4 (olive brown)
3'	8'	Silt with fine sand 2.5Y 4/4
8'	12'	Silty clay 2.5Y 4/4 common salt in "veins" Massive indurated structure
12'	13'	No evidence of Sand.
13'	14'	Silty clay 2.5Y 4/4 no visible salts.
14'		Silty clay 2.5Y 4/4 common visible salt veins, Resist Pressure fair to common salt veins.

Work started JUNE 19 89 Completed JUNE 19 89

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signed _____ (Well Driller)
NAME DEPT. OF WATER RESOURCES (Person, firm, or corporation) (Typed or printed)
Address 3374 E. SHIELDS AVENUE
City FRESNO ZIP 93726
License No. _____ Date of this report _____

COMPILED NOT FOR PUBLIC USE WATER CODE SEC. 13752 SYNOPTIC STUDY

DWR 188 (REV. 12-86) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM 86 96355

ORIGINAL
File with DWR

Page ____ of ____

Owner's Well No. 10

Date Work Began 11-6-98, Ended 11-6-98

Local Permit Agency DWR

Permit No. ____ Permit Date ____

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 817189

DWR USE ONLY — DO NOT FILL IN

STATE WELL NO./STATION NO.: 25S/21E-31R01M

LATITUDE ____ LONGITUDE ____

APN/TRS/OTHER ____

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ____ HORIZONTAL ____ ANGLE ____ (SPECIFY)

DRILLING METHOD ____ FLUID ____

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0	6	DRY SILT W/ SMALL AMOUNTS OF SAND
6	20	MOIST SILT W/ SM. AMOUNTS OF SAND

TOTAL DEPTH OF BORING 20 (Feet)

TOTAL DEPTH OF COMPLETED WELL 19 (Feet)

Address FROM TOP OVERPASS OF I5 & TWISSELMAN: .21 MILES

City W. ON TWISSELMAN 2 MILES S. ON DIRT ROAD .11 MILES

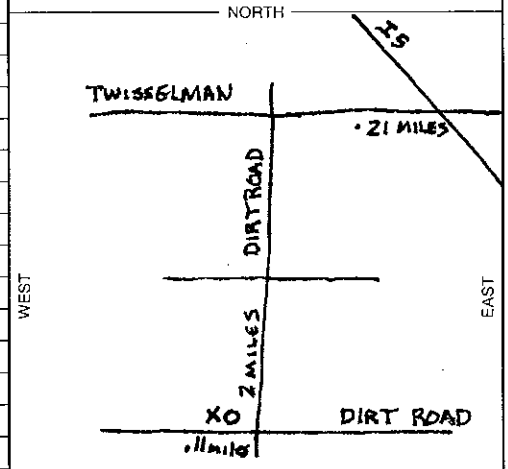
County W. ON DIRT ROAD 42' N. & 2' W. OF TELEPHONE POLE

APN Book ____ Page ____ Parcel Kern Co.

Township 25S Range 21 E Section 31

Latitude ____ DEG. MIN. SEC. NORTH Longitude ____ DEG. MIN. SEC. WEST

LOCATION SKETCH



Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. ***PLEASE BE ACCURATE & COMPLETE.***

ACTIVITY (✓)

____ NEW WELL

MODIFICATION/REPAIR
____ Deepen
____ Other (Specify) ____

____ DESTROY *(Describe Procedures and Materials Under "GEOLOGIC LOG")*

PLANNED USES (✓)

WATER SUPPLY
____ Domestic ____ Public
____ Irrigation ____ Industrial

MONITORING ✓
TEST WELL ____
CATHODIC PROTECTION ____
HEAT EXCHANGE ____
DIRECT-PUSH ____
INJECTION ____
VAPOR EXTRACTION ____
SPARGING ____
REMEDIATION ____
OTHER (SPECIFY) ____

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER 15 (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL ____ (Ft.) & DATE MEASURED ____

ESTIMATED YIELD * ____ (GPM) & TEST TYPE ____

TEST LENGTH ____ (Hrs.) TOTAL DRAWDOWN ____ (Ft.)

** May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	20	4"	10'	10'			PVC Pipe	2"		.01"

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	TYPE: CEMENT (✓)	BENTONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	10		X		
10	20			X	.02 SAND

ATTACHMENTS (✓)

____ Geologic Log
____ Well Construction Diagram
____ Geophysical Log(s)
____ Soil/Water Chemical Analyses
____ Other ____

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME DEPARTMENT OF WATER RESOURCES
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

3374 E SHIELDS — ADDRESS
FRESNO — CITY
CA — STATE
93726 — ZIP

Signed ____ WELL DRILLER/AUTHORIZED REPRESENTATIVE ____ DATE SIGNED ____ C-57 LICENSE NUMBER

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do not fill in

No. 334616

Notice of Intent No. _____
Local Permit No. or Date _____

State Well No. 26/21-16R1
Other Well No. _____

(2) LOCATION OF WELL (See instructions):
County Kern Owner's Well Number _____
Well address if different from above _____
Township 26S Range 21E Section 16R1
Distance from cities, roads, railroads, fences, etc. 0.1 mile west of S.E. corner section 16 At base of power pole 20' from water pipe line vent valve.

WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic ☐
Irrigation ☐
Industrial ☐
Test Well ☐
Municipal ☐
Other ☒ Piezometer (Describe)

(5) EQUIPMENT:
Rotary ☒ Reverse ☐
Cable ☐ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK:
Yes ☐ No ☒ Size MONTE SANDS
Diameter of bore 24
Packed from _____ to 14 ft.

(7) CASING INSTALLED:
Steel ☐ Plastic ☒ Concrete ☐

(8) PERFORATIONS:
Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	22	2	SCH. 40	12	22	0.02 in.

(9) WELL SEAL:
Was surface sanitary seal provided? Yes ☐ No ☒ If yes, to depth _____ ft.
Were strata sealed against pollution? Yes ☐ No ☒ Interval _____ ft.
Method of sealing _____

(10) WATER LEVELS:
Depth of first water, if known _____ ft.
Standing level after well completion _____ ft.

(11) WELL TESTS:
Was well test made? Yes ☐ No ☒ If yes, by whom? _____
Type of test Pump ☐ Bailer ☐ Air lift ☐
Depth to water at start of test _____ ft. At end of test _____ ft.
Discharge _____ gal/min after _____ hours Water temperature _____
Chemical analysis made? Yes ☒ No ☐ If yes, by whom? USGS
Was electric log made Yes ☐ No ☒ If yes, attach copy to this report

(12) WELL LOG: Total depth 22 ft. Completed depth 22 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	1'	Road material
1'	8'	Clay sand with common gravel
		- derived from sedimentary materials
		- Shiles - with quartz color 2.5A
		- 4/A to 5/A with increasing depth
		- clay becomes more discrete as
		- 5-15mm units in sand matrix
9'	11'	Fine sandy loam 2.5Y 5/5
		- few gravel 2-8 mm.
12'	13'	Fine sandy clay loam 2.5A 5/5
14'	22'	Silty clay 2.5A 4/5
		- 18' water.

Work started JUNE 1989 Completed JUNE 1989

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signed _____ (Well Driller)
NAME DEPT. OF WATER RESOURCES (Person, firm, or corporation) (Typed or printed)
Address 3374 E. SHIELDS AVENUE
City FRESNO ZIP 93726
License No. _____ Date of this report _____

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

CONFIDENTIAL
NOT FOR PUBLIC USE
WATER CODE SEC. 13752
SYNOPTIC STUDY

ORIGINAL
File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do not fill in

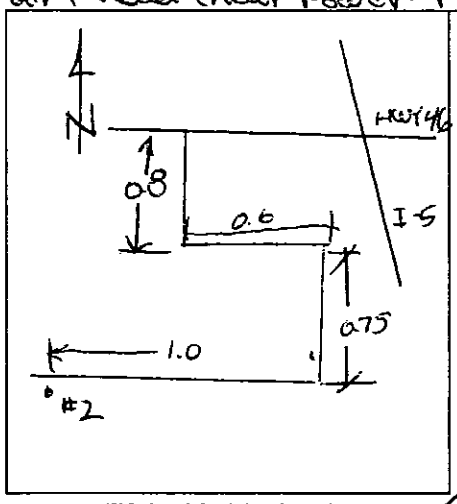
No. 373414

Notice of Intent No. _____
Local Permit No. or Date _____

State Well No. 27/21 – 11A
Other Well No. 3

(2) LOCATION OF WELL (See instructions):

County KERN Owner's Well Number BEL #2
Well address if different from above _____
Township 27S Range 21E Section 11A
Distance from cities, roads, railroads, fences, etc. 0.25 miles w/o HWY 46, 0.1 S/O HWY 46, 0.15 E/B on Dirt Road 3/4 mile S/B on Dirt Road, 1 mile due west on dirt Road (near Power Pole)



WELL LOCATION SKETCH

(3) TYPE OF WORK:

New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:

Domestic ☐
Irrigation ☐
Industrial ☐
Test Well ☐
Municipal ☐
Other Piezometer ☒
(Describe)

(5) EQUIPMENT:

Rotary ☒ Reverse ☐
Cable ☐ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK:

Yes ☒ No ☐ Size Mont. Sand #3
Diameter of bore 22"
Packed from 10 to 20 ft.

(7) CASING INSTALLED:

Steel ☐ Plastic ☒ Concrete ☐

(8) PERFORATIONS:

Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	20	2"	SCH 40	10	20	0.02"

(9) WELL SEAL:

Was surface sanitary seal provided? Yes ☐ No ☒ If yes, to depth _____ ft.
Were strata sealed against pollution? Yes ☐ No ☒ Interval _____ ft.
Method of sealing _____

(10) WATER LEVELS:

Depth of first water, if known _____ ft.
Standing level after well completion _____ ft.

(11) WELL TESTS:

Was well test made? Yes ☐ No ☒ If yes, by whom? _____
Type of test Pump ☐ Bailer ☐ Air lift ☐
Depth to water at start of test _____ ft. At end of test _____ ft.
Discharge _____ gal./min after _____ hours Water temperature _____
Chemical analysis made? Yes ☒ No ☐ If yes, by whom? DWR
Was electric log made Yes ☐ No ☒ If yes, attach copy to this report

(12) WELL LOG:

Total depth 20 ft. Completed depth 20 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)

Work started Aug 19 90 Completed Aug 19 90

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signed _____ (Well Driller)
NAME Dept of Water Resources (Person, firm, or corporation) (Typed or printed)
Address 3374 E. Shields Ave
City Fresno ZIP 93726
License No. _____ Date of this report _____

CONFIDENTIAL
NOT FOR PUBLIC USE
WATER CODE SEC. 13752
KRC project

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES
DRILL HOLE LOG

SHEET 1 of 1
HOLE NO. BEL #2

PROJECT & FEATURE

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	REMARKS
7-11	SW	WELL GRADED SANDS	
11-15	SW	SILTY SANDS w/CLAY (MINOR) PALE GREEN - BROWN	
15-21	SM	SILTY SANDS - VERY FINE SANDS REDDISH BROWN	

ORIGINAL
File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do not fill in 1/3

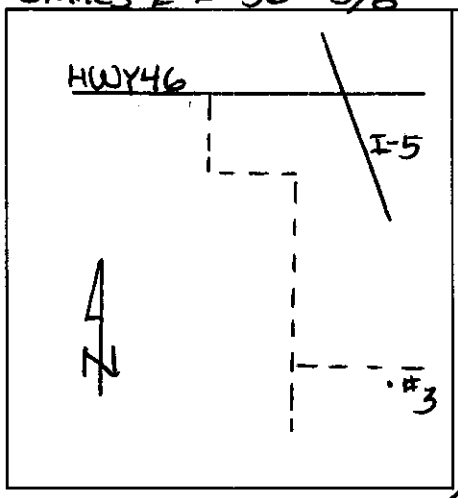
No. 373416

Notice of Intent No. _____
Local Permit No. or Date _____

State Well No. 27/22-18B1
Other Well No. _____

(2) LOCATION OF WELL (See instructions):

County KERN Owner's Well Number BEL #3
Well address if different from above _____
Township 27S Range 22E Section 18B
Distance from cities, roads, railroads, fences, etc. 0.2 miles S/o HWY 46 & I-5 intersection 0.15 mile S/B, well located on left side Proceed 0.6 miles E/B along Dirt Road .6 miles E & 50 S/o



WELL LOCATION SKETCH

(3) TYPE OF WORK:

New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:

Domestic ☐
Irrigation ☐
Industrial ☐
Test Well ☐
Municipal ☐
Other ☒
(Describe) KRF Project

(5) EQUIPMENT:

Rotary ☒ Reverse ☐
Cable ☐ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK:

Yes ☒ No ☐ Size Monterey #3
Diameter of bore 20"
Packed from 10 to 20 ft.

(7) CASING INSTALLED:

Steel ☐ Plastic ☐ Concrete ☐

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	20	10	SCH40	10	20	0.02"

(8) PERFORATIONS:

Type of perforation or size of screen

(9) WELL SEAL:

Was surface sanitary seal provided? Yes ☐ No ☒ If yes, to depth _____ ft.
Were strata sealed against pollution? Yes ☐ No ☒ Interval _____ ft.
Method of sealing _____

(10) WATER LEVELS:

Depth of first water, if known _____ ft.
Standing level after well completion _____ ft.

(11) WELL TESTS:

Was well test made? Yes ☐ No ☒ If yes, by whom? _____
Type of test Pump ☐ Bailer ☐ Air lift ☐
Depth to water at start of test _____ ft. At end of test _____ ft.
Discharge _____ gal/min after _____ hours Water temperature _____
Chemical analysis made? Yes ☒ No ☐ If yes, by whom? _____
Was electric log made Yes ☐ No ☒ If yes, attach copy to this report

(12) WELL LOG: Total depth 20 ft. Completed depth 20 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)

Work started Aug 19 90 Completed Aug 19 90

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signed _____ (Well Driller)
NAME Dept of Water Resources (Person, firm or corporation) (Typed or printed)
Address ~~3389~~ 3374 E Shields Ave
City Fresno ZIP 93726
License No. _____ Date of this report _____

CONFIDENTIAL
NOT FOR PUBLIC USE
WATER CODE SEC. 13752

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

State of California

275/22E-18B01

SHEET: 1 of 1 2/3

The Resources Agency

HOLE NO.: BEL 3

DEPARTMENT OF WATER RESOURCES

DRILL HOLE LOG

ELEV. (feet): ---

DEPTH (feet):

DATE DRILLED:

ATTITUDE: ---

LOGGED BY: JOHN G

DEPTH TO WATER: ---

CONTR.:

DRILL RIG:

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	REMARKS
1-8	SW	SANDY SILT NO CLAYS YELLOW BROWN	
8-11	SM	SILTY SANDS W/CLAY 5% YELLOW-BLACK	
11-18	ML	SILTY-CLAY GREENISH BLACK	
18-21	SM	SILTY SANDS W/CLAY 5% LIGHT GREEN (MICACEOUS)	

27S/22E-18B01

3/3

State of California

The Resources Agency

DEPARTMENT OF WATER RESOURCES

SHEET: 1 of 1

HOLE NO.: BEL 3

DRILL HOLE LOG

ELEV. (feet): ---

DEPTH (feet):

DATE DRILLED:

LOCATION:

CONTR.:

DRILL RIG:

ATTITUDE: ---

LOGGED BY: JOHN G

DEPTH TO WATER: ---

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	REMARKS
0-25	SW	WELL GRADED SANDS - NO CLAYS REDDISH BROWN EXTRAORDINARY! IDENTICAL SOILS THE ENTIRE HOLE.	

ORIGINAL
File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do not fill in

1/2

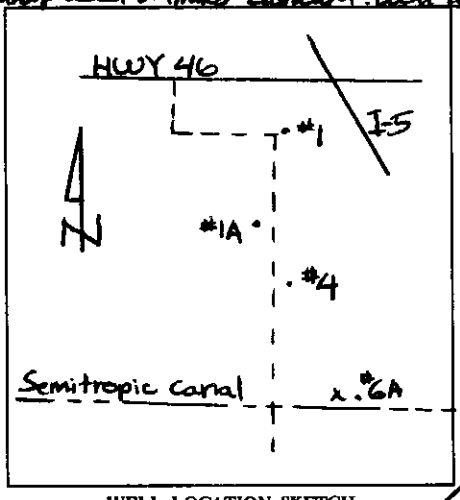
No. 373420

Notice of Intent No. _____
Local Permit No. or Date _____

State Well No. 27/22 - 19P1
Other Well No. _____

(2) LOCATION OF WELL (See instructions):

County KERN Owner's Well Number BEL #6A
Well address if different from above _____
Township 27S Range 22E Section 19P
Distance from cities, roads, railroads, fences, etc. 0.2 mile W/O HWY 46 & I-5 intersection, 0.15 miles South bound; 0.2 miles Eastward Proceed 3.8 miles South bound and turn left on Smithropic Canal and proceed 0.4 miles Eastward. well located on left side.



WELL LOCATION SKETCH

(3) TYPE OF WORK:

New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:

Domestic ☐
Irrigation ☐
Industrial ☐
Test Well ☐
Municipal ☐
Other Piezometer ☒
(Describe)

(5) EQUIPMENT:

Rotary ☒ Reverse ☐
Cable ☐ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK:

Yes ☒ No ☐ Size Mont. Sand #3
Diameter of bore 2"
Packed from 10 to 20 ft.

(7) CASING INSTALLED:

Steel ☐ Plastic ☒ Concrete ☐

(8) PERFORATIONS:

Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	20	2"	SCH 40	10	20	0.02"

(9) WELL SEAL:

Was surface sanitary seal provided? Yes ☐ No ☒ If yes, to depth _____ ft.
Were strata sealed against pollution? Yes ☐ No ☒ Interval _____ ft.
Method of sealing _____

(10) WATER LEVELS:

Depth of first water, if known _____ ft.
Standing level after well completion _____ ft.

(11) WELL TESTS:

Was well test made? Yes ☐ No ☒ If yes, by whom? _____
Type of test Pump ☐ Bailer ☐ Air lift ☐
Depth to water at start of test _____ ft. At end of test _____ ft.
Discharge _____ gal/min after _____ hours Water temperature _____
Chemical analysis made? Yes ☒ No ☐ If yes, by whom? DWR
Was electric log made Yes ☐ No ☒ If yes, attach copy to this report

(12) WELL LOG:

Total depth 20 ft. Completed depth 20 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)

Work started Aug 1990 Completed Aug 1990

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signed _____ (Well Driller)
NAME Dept. of Water Resources (Person, firm, or corporation) (Typed or printed)
Address 3374 E. Shields Ave
City Fresno ZIP 93726
License No. _____ Date of this report _____

ONLY FOR PUBLIC USE
NOT FOR PUBLIC USE
WATER CODE SEC. 13752
KRFC Project

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES
DRILL HOLE LOG

SHEET 1 of 1
HOLE NO. BEL 6A

27S/22E-19P01 2/2

PROJECT & FEATURE

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	REMARKS
1-20	SM	WELL GRADED SANDS - NO FINES JWV	

ORIGINAL
File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

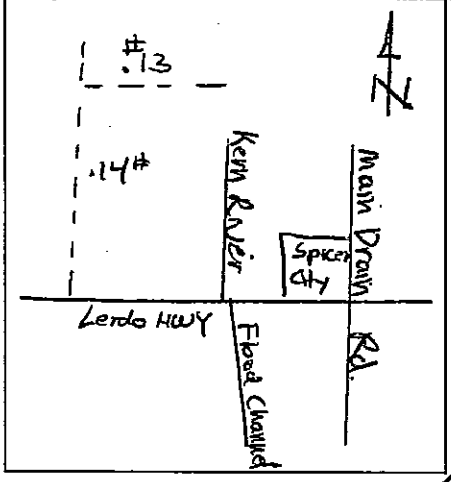
Do not fill in

No. 373410

Notice of Intent No. _____
Local Permit No. or Date _____

State Well No. 28/22-5F
Other Well No. _____

(2) LOCATION OF WELL (See instructions):
County KERN Owner's Well Number BEL #13
Well address if different from above _____
Township 28S Range 22S Section 5F
Distance from cities, roads, railroads, fences, etc. 1.8 miles w/o Lerdo HWY & Main Drain Rd. 1.5 due north on paved road; 0.25 miles East on dirt road well located on left side



WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic ☐
Irrigation ☐
Industrial ☐
Test Well ☐
Municipal ☐
Other Piezometer ☒ (Describe)

(5) EQUIPMENT:
Rotary ☒ Reverse ☐
Cable ☐ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK:
Yes ☒ No ☐ Size #3 MSHA
Diameter of bore 2"
Packed from 10 to 20 ft.

(7) CASING INSTALLED:
Steel ☐ Plastic ☒ Concrete ☐

(8) PERFORATIONS:
Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	20	2"	SCH40	10	20	0.02"

(9) WELL SEAL:
Was surface sanitary seal provided? Yes ☐ No ☒ If yes, to depth _____ ft.
Were strata sealed against pollution? Yes ☐ No ☒ Interval _____ ft.
Method of sealing _____

(10) WATER LEVELS:
Depth of first water, if known _____ ft.
Standing level after well completion _____ ft.

(11) WELL TESTS:
Was well test made? Yes ☐ No ☒ If yes, by whom? _____
Type of test Pump ☐ Bailer ☐ Air lift ☐
Depth to water at start of test _____ ft. At end of test _____ ft.
Discharge _____ gal/min after _____ hours Water temperature _____
Chemical analysis made? Yes ☒ No ☐ If yes, by whom? DWR
Was electric log made Yes ☐ No ☒ If yes, attach copy to this report

(12) WELL LOG: Total depth 20 ft. Completed depth 20 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)

Work started Aug 1990 Completed Aug 1990

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signed _____ (Well Driller)
NAME Dept of Water Resources (Person, firm, or corporation) (Typed or printed)
Address 3374 E. Shields Ave.
City Fresno ZIP 93726
License No. _____ Date of this report _____

CONFIDENTIAL
NOT FOR PUBLIC USE
WATER CODE SEC. 13752
KRFC Project

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES
DRILL HOLE LOG

SHEET 1 of 1
HOLE NO. BEL#13

PROJECT & FEATURE

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	REMARKS
0-11	SM	SILTY SANDS - VERY FINE SANDS	
		Y FINE SANDS SOME CLAY 5% YELLOW BROWN	
10-12	SM	SILTY SANDS - VERY FINE SANDS YELLOW BROWN	
12-20	SM	SILTY SANDS W/CLAY 5% VERY FINE SANDS YELLOW BROWN	

26/18-16M1

REGION 5

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

BASIN
DWR No. 26/18-16M1 MD B & M
OTHER NOS.

COUNTY Kern

NEAR Kecks Corners
Antelope Valley

WELL LOG

LOCATION 2.2 mi SE/o Kecks Corners 36
Antelope Valley

O

DRILLED BY L. E. Williams ADDRESS

DRILLING METHOD Cable tool GRAVEL PACKED DATE COMPLETED 1949

SIZE OF CASING DEPTH 14" STRUCK WATER AT

PERFORATIONS SIZE NO.

WATER LEVEL BEFORE PERFORATING AFTER

TEST DATA: DISCHARGE G. P. M. DRAWDOWN FT. HOURS RUN

OTHER DATA AVAILABLE: WATER LEVEL RECORD 1928 10/55 ANALYSIS Complete

SURFACE ELEV. 725 DATUM MSL SOURCE OF INFORMATION USGS

DEPTH	ELEV. OF BOTTOM OF STRATUM	MATERIAL	THICKNESS	SP. YIELD %	
0 - 42		Surface soil & clay			
90		Dry gravel			
138		Yellow clay			
145		Dry boulders			
149		Yellow clay			
166		Gravel			
168		Clay			
190		Clay & gravel			
210		Clay			
215		Gravel			
220		Clay			
226		Gravel			
236		Clay			
239		Gravel			
245		Clay			

FOR FIELD COPIES USE ALTERNATE LINES

LOG OBTAINED BY R S Ford DATE 4/8/58 SHEET 1 OF 2

FORM 203.

FORM 163A
INVESTIGATION

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

SHEET 2

NUMBER 26/18-16M1

26/18-16M1

WELL LOG

LOCAL DESIGNATION

DEPTH	ELEVATION OF BOTTOM OF STRATUM	MATERIAL	THICKNESS FEET	% VOIDS	ABSOLUTE VOIDS FEET	TOTAL VOIDS FEET
249		Gravel				
253		Clay				
263		Gravel				
296		Yellow clay				
300		Blue shale				

FOR FIELD COPIES USE ALTERNATE LINES

ORIGINAL

File with DWR

N e of Intent No.

L Permit No. or Date

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do not fill in

No. 154332

State Well No. 29/22-5

Other Well No.

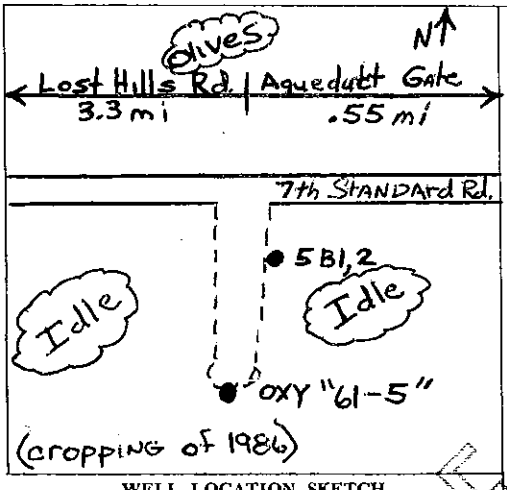
(2) LOCATION OF WELL (See instructions):

County Kern Owner's Well Number 5B shallow 5B Deep

Well address if different from above Belridge Field

Township 29 S. Range 22 E. Section 5 NW 1/4 NE 1/4

Distance from cities, roads, railroads, fences, etc. 1643' W., 90' S. of NE cor. 5-29/22. 75' S. centerline 7th Standard Rd., 3.3 miles E. of Lost Hills Rd.



WELL LOCATION SKETCH

(3) TYPE OF WORK:

New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:

Domestic ☐
Irrigation ☐
Industrial ☐
Test Well ☐
Stock ☐
Municipal ☐
Other Monitors ☒

(5) EQUIPMENT: Percussion Hammer

Rotary ☐ Reverse ☒
Cable ☐ Air ☒
Other ☐ Bucket ☐

(6) GRAVEL PACK: Monterey #8

Yes ☒ No ☐ Size
Diameter of bore 10"
Packed from 175' 28" to 274' 154" ft.

(7) CASING INSTALLED:

Steel ☐ Plastic ☒ Concrete ☐

(8) PERFORATIONS: .020"

Type of perforation or size of screen

	From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
Shallow	0	80	2"	sch 40	80	100	.020"
	100	110	2"	sch 40			
Deep	0	191	2"	sch 40	191	211	.020"
	211	221					

(9) WELL SEAL:

Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 20 ft.
Were strata sealed against pollution? Yes ☒ No ☐ Interval 153-173 ft.
Method of sealing Bentonite Pellets 1/4"

(10) WATER LEVELS:

Depth of first water, if known ft.
Standing level after well completion ft.

(11) WELL TESTS:

Was well test made? Yes ☐ No ☐ If yes, by whom?
Type of test Pump ☐ Bailer ☐ Air lift ☐
Depth to water at start of test ft. At end of test ft
Discharge gal/min after hours Water temperature
Chemical analysis made? Yes ☐ No ☐ If yes, by whom?
Was electric log made? Yes ☐ No ☒ If yes, attach copy to this report

(12) WELL LOG:

Total depth 274 ft. Depth of completed well 274 ft.

from ft. to ft. Formation (Describe by color, character, size or material)

See attached

Two - 2" wells completed in the same borehole

Work started Sept 1986 Completed Oct 3 1986

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

SIGNED Steve Story (Well Driller)

NAME Layne-Western Co. Inc. (Person, firm, or corporation) (Typed or printed)

Address P.O. Box 3216

City Bakersfield, CA Zip

License No. 452609 C-57 Date of this report 12-1-86

ORIGINAL DEPARTMENT PUBLIC USE
WATER CODE SEC. 13752

DWR 188 (REV. 7-76) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES

State No. 29s/22e-5B2

WELL DATA

BRANCH

Depths	REMARKS	REMARKS	Color	Sorting
CUTTINGS AT 5' INTERVALS; NO MUD; Dual-wall percussion hammer				
5-15	VF SAND, silty; rare clasts of CR shale; common whitish carbonate flecks		Lt. yellow brown	VIS
20	M-C SAND, silty		"	VIS
25	C SAND with much F gvl (mostly broken chips of CR shale); prominant silt		"	VIS
30-50	Clayey sandy SILT; occ'l clasts of CR shale		"	VIS
55	F SAND, silty; " " " " "		"	MS
60-70	F-M SAND, silty		"	MS
75	WS silty VF SAND and IS C SAND and GRAVEL		Lt. brown	—
80-85	Clayey SILT with appreciable scattered sand		Lt. yellow brown	—
90-95	Silty CLAY		"	—
100-135	Predominantly CLAY; variable sand & silt in strx		"	—
140	Clayey SILT		Dk "	—
145-195	CLAY, as 100-135		Lt "	—
200-205	Silty CLAY with abundant scattered sand grains		Lt brown	—
210	[Due casing blockage and running sand, no sample]		—	—
* 215	M SAND; subrd-subang; prominent mica and mafics; common orangish feldspar(?); occ'l nubbins of compacted yellowish-brown F sand; Sierran		Gray	WS
220	As 215, but coarse grained		"	"
225	Mixed: (1) as 220; (2) compact clayey sandy silt		—	—
230	As 225 (2)		Tan	—
235	VF-C SAND, silty, clayey; compact; abundant irregular stainings of black manganese and yellow/red limonite. A paleosol? Grayish where unstained; generally a blackish aspect.		—	VIS
* 240	C SAND & GVL; sand as at 220 (with mica, mafics & orange feldspar?); but gravel is subrounded CR shale lozenges to 3 cm & chert.		Gray	IS
245	Clayey sandy SILT; compact; sand to VF size; abundant irregular stains & nodules of orange limonite. Paleosol?		Gray (where unstained)	—
250	Mixed: (1) Clayey sandy SILT, sim. to 245; (2) compact clayey SILT with limonite stainings; (3) C SAND & GVL as 240.		Gray	IS
255	M-C SAND; subrd-subang; mica, mafics, orange feldspar(?); occ'l CR gravel to 10 mm		"	MS
260	Silty CLAY and sandy clayey SILT		Lt. brown	—
265	Clayey SILT; compact; main mass is greenish-gray but there are irregular mottles of yellowish-brown		Greenish-gray	—
269	Clayey silty VF SAND		Bluish-gray	VIS
* 270	VF SAND, some silt; abundant mafics & black mica		"	WS
274	TD; no sample			

* Sample retained

Sorting code: WS, well sorted; MS, moderately sorted; IS, ill sorted; VIS, very ill sorted.

Depths not adjusted to the γ-log

COMPLETION SCHEDULE:

Set the deep 2" piezometer (-5B2) capped bullnose below. Monterey no. 8 sand backfill to 113'. Set isolating seal of 1/4" Volclay tablets 153-173'. For schedule above 153', see form for companion piezometer 29/22-5B1 (in the same borehole).

42

DWR 429 Continuation

*The free Adobe Reader may be used to view and complete this form. However, software must be purchased to complete, save, and reuse a saved form.

File Original with DWR - Owner

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0086593

Page 1 of 1

Owner's Well Number 2

Date Work Began 06/15/2008 Date Work Ended 10/1/2008

Local Permit Agency Kern County - Environmental Health

Permit Number WP 11119 Permit Date 6/9/08

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Geologic Log

Orientation ⦿ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Reverse Rotary Drilling Fluid Polybore

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
50	70	Sand , Light Gravel
70	110	Sand , Clay , Light Gravel
110	140	Sand
140	170	Silt with Sand
170	210	Sand , Gravel
210	260	Sand , Light Gravel
260	290	Sand , Clay , Light Gravel
290	320	Gravel , Sand , Clay
320	360	Sand
360	400	Gravel , Clay
400	440	Sand , Light Clay
440	470	Gravel , Clay
470	500	Gravel , Sand , Clay
500	530	Silt with Sand
530	570	Sand , Clay , Light Gravel
570	590	Sand
590-	620	Sand , Clay , Light Gravel

Total Depth of Boring 620 Feet

Total Depth of Completed Well 610 Feet

Well Owner

Name RTS Agri-Business

Mailing Address 2985 Airport Dr.

City Madera State Ca Zip 93637

Well Location

Address 1/2 Mi. West of Main Drain Rd. 1/2 Mi. South of Lerdo Hwy

City Shafter County Kern

Latitude 35 Deg. 17 Min. 28 Sec. N Longitude 119 Deg. 22 Min. 15 Sec. W

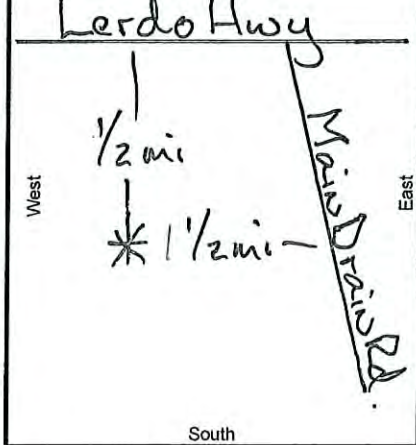
Datum Decimal Lat. Decimal Long.

APN Book 086 Page 170 Parcel 22

Township 28S Range 22E Section 17

Location Sketch

(Sketch must be drawn by hand after form is printed.)



Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

⦿ New Well
○ Modification/Repair
○ Deepen
○ Other
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

⦿ Water Supply
☐ Domestic ☐ Public
☑ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
○ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other

Water Level and Yield of Completed Well

Depth to first water 40 (Feet below surface)

Depth to Static Water Level 40 (Feet) Date Measured 10/02/2008

Estimated Yield * 2,520 (GPM) Test Type Constant Rate

Test Length 12.0 (Hours) Total Drawdown 146 (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	50	40	Conductor	ASTM 139 Grd. B	3/8	34		
0	300	30	Blank	PVC Sch. 80	1	17 1/2		
300	600	30	Screen	PVC Sch. 80	1	17 1/2	Louver	0.050
600	610	30	Blank	PVC Sch. 80	1	17 1/2		
0	290	Annulus	Fill pipe	Low Carbon Steel	Sch. 40	3	Gravel	

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	280	Cement	Sanitary Seal
280	620	Filter Pack	6X12 Col. Silica

Attachments

☐ Geologic Log
☐ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Bakersfield Well & Pump Co.
Person, Firm or Corporation

7212 Fruitvale Avenue Bakersfield CA 93308
Address City State Zip

Signed [signature] 2-9-2009 440537
C-57 Licensed Water Well Contractor Date Signed C-57 License Number

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

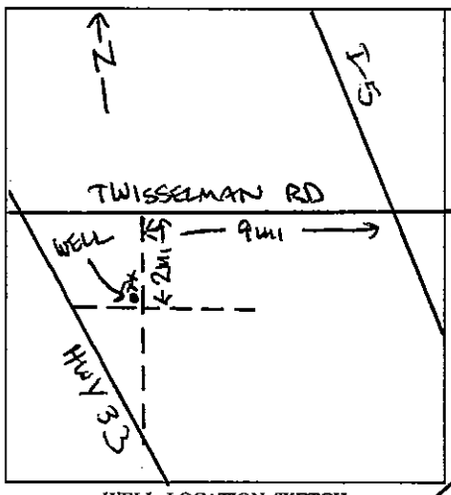
Do not fill in

No. 298419

State Well No. 25S/19E-34R3
Other Well No.

Notice of Intent No.
Local Permit No. or Date

(2) LOCATION OF WELL (See instructions):
County Kern Owner's Well Number L3-3
Well address if different from above
Township 25S Range 19E Section 34R
Distance from cities, roads, railroads, fences, etc.



WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well [X] Deepening [ ]
Reconstruction [ ]
Reconditioning [ ]
Horizontal Well [ ]
Destruction [ ] (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic [ ]
Irrigation [ ]
Industrial [ ]
Test Well [X]
Municipal [ ]
Other [ ]
(Describe)

(5) EQUIPMENT:
Rotary [X] Reverse [ ]
Cable [ ] Air [ ]
Other [ ] Bucket [ ]

(6) GRAVEL PACK:
Yes [X] No [ ] Size 12x20
Diameter of bore 22
Packed from 145 to 170 ft.

(7) CASING INSTALLED:
Steel [ ] Plastic [X] Concrete [ ]

From ft.	To ft.	Dia. in.	Gage or Wall	
0	170	6	SDR21	

(8) PERFORATIONS:
Type of perforation or size of screen

From ft.	To ft.	Slot size
155	165	.03

(9) WELL SEAL:
Was surface sanitary seal provided? Yes [X] No [ ] If yes, to depth 145 ft.
Were strata sealed against pollution? Yes [ ] No [ ] Interval ft.
Method of sealing bentonite grout

(10) WATER LEVELS:
Depth of first water, if known ft.
Standing level after well completion ft.

(11) WELL TESTS:
Was well test made? Yes [ ] No [X] If yes, by whom?
Type of test Pump [ ] Bailer [ ] Air lift [ ]
Depth to water at start of test ft. At end of test ft.
Discharge gal/min after hours Water temperature
Chemical analysis made? Yes [ ] No [X] If yes, by whom?
Was electric log made Yes [ ] No [X] If yes, attach copy to this report

(12) WELL LOG: Total depth 170 ft. Completed depth 170 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	28	sand and gravel
28	40	clay
40	46	sand
46	53	clay
53	63	clayey sand
63	75	sand and gravel
75	170	clayey sand

Work started 19 Completed 1/22 1988

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Signed HYDROLOGIC TECHNICIAN
(Well Driller)
NAME
(Person, firm, or corporation) (Typed or printed)
Address
City ZIP
License No. Date of this report

ORIGINAL
NOT FOR PUBLIC USE
WATER CODE SEC. 13752

APPENDIX D

Groundwater Sampling Protocols

PROTOCOL

SAMPLING OF GROUNDWATER MONITORING WELLS AND WATER SUPPLY WELLS

1.0 INTRODUCTION

This protocol describes the procedures to be followed during sampling of groundwater monitoring wells and water supply wells for laboratory chemical analysis. The laboratory must be certified by the appropriate regulating agency for the analyses to be performed.

The procedures presented herein are intended to be of general use and may be supplemented by a work plan and/or health and safety plan. As the work progresses and if warranted, appropriate revisions may be made by the project manager. Detailed procedures in this protocol may be superseded by applicable regulatory requirements.

2.0 SAMPLING

2.1 SAMPLE COLLECTION

A. Monitoring Wells

Methods for purging and sampling monitoring wells with dedicated and non-dedicated equipment are described in this Section. When practical, the purging and sampling technique adopted for a given site will remain consistent from one sampling event to the next.

A.1 Purging Monitoring Wells

A submersible pump, diaphragm pump, positive displacement pump, which may contain a bladder, or a bailer will be used for evacuating (purging) the monitoring well casing. If the well is to be sampled using equipment that must be separately introduced into the well, the purge intake will be located near the top of the water column for removal of at least one casing volume to remove stagnant water above the screened interval in the well casing; the pump may then be moved to the midscreen interval to complete the purging progress, if required. If a bailer is used to purge the monitoring well, it will be gently lowered into the well to reduce the potential for aeration of water. Purging will progress at a rate intended to minimize differential drawdown between the interior of the well screen and the filter material to limit cascading water along the inside of the well casing. Procedures for purging slowly recharging wells are discussed in Section A.3.

A minimum of four well casing volumes or one saturated borehole volume, whichever is greater, will be removed to purge the well prior to collection of groundwater samples if the well will be purged with non-dedicated equipment. If a low-flow capacity pump is dedicated in the well, the micropurge method described in Section A.4 may be used to reduce the purge volume. If the well goes dry before four casing volumes are removed, the procedure discussed in Section A.3 will be followed. The saturated borehole volume is the volume of water in the well casing plus the volume of water in the filter pack. For a well with a dedicated pump and packer, a casing volume is defined as the volume of water in the well casing below the inflated packer.

Periodic observations of turbidity and measurements of temperature, pH, and specific electrical conductance (SEC) will be made with field equipment during purging to evaluate whether the water samples are representative of the target zone. Samples will be collected when: (1) a minimum of four sets of parameter readings have been taken; and (2) the temperature, pH, and SEC reach relatively constant values, and the turbidity has stabilized.

A.2 Sampling Monitoring Wells

The sampler will wear clean gloves appropriate for the chemicals of concern while collecting the sample. Samples will be collected directly in laboratory-prepared bottles from the sampling device.

Each sampling episode or day should generally begin with the well having the least suspected concentrations of target compounds. Successive wells should generally be sampled in sequence of increasing suspected concentration.

A Teflon® bailer, new disposable bailer, stainless steel positive displacement Teflon® bladder pump with Teflon® tubing, or a clean electric submersible pump with low-flow sampling capacity will be used to collect the water samples for laboratory chemical analysis.

If a bailer is being used to collect the sample, it will be gently lowered into the well below the point where the purge device was located. Samples will collected in the following order: (1) volatile organic compounds; (2) semi-volatile organic compounds; (3) metals; (4) other analytes.

If a bladder pump or electric submersible pump is being used to sample the well for volatile compounds, the flow rate will be adjusted to either: (1) approximately 100 milliliters per minute; (2) a rate specifically selected for the well based on groundwater flow rates and well

hydraulic conditions; or (3) as low as possible. This rate will be maintained until the discharge line has been purged and the sample collected.

A.3 Purging and Sampling Wells With Slow Recharge

Wells that recharge very slowly may be purged dry once, allowed to recharge, and then sampled as soon as sufficient water is available. In this case, at least two sets of parameter readings of field water quality should be taken, one initially and one after recharge.

A.4 Purging and Sampling Wells Using "Micropurge" Sampling Method

Based on current research, a low-flow-rate, reduced purge method may be used to purge and sample a well with a dedicated pump (Barcelona et al., 1994; Kearl et al., 1994). This method may be used if acceptable to applicable agencies. This method assumes the water within the screened interval is not stagnant, and a small change to the natural flow rate in the screened interval will result in samples with particulates and colloidal material representative of groundwater. The pump should be preset in the screen interval at least 24 hours before the sampling event. A minimum of two pump plus riser pipe volumes should be purged at a flow rate of approximately 100 milliliters per minute or as low as possible based on groundwater flow and well hydraulic conditions. Purging should progress until water quality parameters (pH, SEC, temperature) have reached relatively constant values. Dissolved oxygen readings are recommended, if practical.

B. Water Supply Wells

Water supply wells will be sampled by purging the wells for a period of time adequate to purge the pump riser pipe. Alternatively, if the volume of the riser pipe is unknown, the pressure tank will be drained until the pump cycles on, or the well may be purged until three successive field measurements performed 5 to 10 minutes apart have stabilized. If the well is currently pumping, the sample can be taken without purging the well. Water samples will then be collected from the discharge point nearest the well head. Samples will be collected directly into laboratory-prepared bottles.

C. Extraction Wells

Extraction wells will be sampled while extraction is occurring. Samples will be collected from an in-line sampling port after purging the sampling line. Samples will be collected directly into laboratory-prepared bottles.

A WELL SAMPLING AND/OR DEVELOPMENT RECORD will be used to record the following information:

- Sample I.D.
- Duplicate I.D., if applicable
- Date and time sampled
- Name of sample collector
- Well designation (State well numbering system for water supply wells, and unique sequential number for other wells)
- Owner's name, or other common designation for water supply wells
- Well diameter
- Depth to water on day sampled
- Casing volume on day sampled
- Method of purging (bailing, pumping, etc.)
- Amount of water purged
- Extraordinary circumstances (if any)
- Results of instrument calibration/standardization and field measurements (temperature, pH, specific electrical conductance) and observed relative turbidity
- Depth from which sample was obtained
- Number and type of sample container(s)
- Purging pump intake depth
- Times and volumes corresponding to water quality measurement
- Purge rate

2.2 SAMPLE CONTAINERS AND PRESERVATION

Appropriate pre-cleaned sample containers and preservatives for the analyses to be performed will be obtained from the subcontracted analytical laboratory. Frequently requested analyses and sample handling requirements are listed in Table 1.

2.3 SAMPLE LABELING

Sample containers will be labeled before or immediately after sampling with self-adhesive tags having the following information written in waterproof ink:

- AMEC
- Project number
- Sample I.D. number
- Date and time sample was collected
- Initials of sample collector

2.4 QUALITY CONTROL SAMPLES

In order to evaluate the precision and accuracy of analytical data, quality control samples, such as duplicates and blanks, will be periodically prepared. These samples will be collected or prepared and analyzed by the laboratory, as specified in the project Quality Assurance Project Plan (QAPP) or by the project manager.

2.5 HANDLING, STORAGE, AND TRANSPORTATION

Efforts will be made to handle, store, and transport supplies and samples safely. Exposure to dust, direct sunlight, high temperature, adverse weather conditions, and possible contamination will be avoided. Immediately following collection, samples will be placed in a clean chest that contains ice or blue ice (if cooling is required), and will be transported to the subcontracted laboratory as soon as practical, or in accordance with the project QAPP.

3.0 FIELD MEASUREMENTS

Field measurements of temperature, pH, and SEC will be performed on aliquots of groundwater that will not be submitted for laboratory analysis. Field water quality measurements and instrument calibration details will be recorded on the WELL SAMPLING AND/OR DEVELOPMENT RECORD.

3.1 TEMPERATURE MEASUREMENTS

Temperature measurements will be made with a mercury-filled thermometer or an electronic thermistor, and all measurements will be recorded in degrees Celsius.

3.2 pH MEASUREMENT

The pH measurement will be made as soon as possible after collection of the sample, generally within a few minutes. The pH will be measured by immersing the pH probe into an aliquot of groundwater.

The pH meter will be calibrated at the beginning of and once during each sampling day and whenever appropriate, in accordance with the equipment manufacturer's specifications, as outlined in the instruction manual for the specific pH meter used. Two buffers (either pH-4 and pH-7, or pH-7 and pH-10, whichever most closely bracket the anticipated range of groundwater conditions) will be used for instrument calibration.

3.3 SPECIFIC ELECTRICAL CONDUCTANCE MEASUREMENT

SEC will be measured by immersing the conductivity probe into an aliquot of groundwater. The probes used should automatically compensate for the temperature of the sample. Measurements will be reported in units of micro-Siemens (µS) per square centimeter (equivalent to micromhos or µmhos) at 25 degrees Celsius.

The SEC meter will be calibrated at the beginning and once during each sampling day in accordance with the equipment manufacturer's specifications, as outlined in the instruction manual for the SEC meter used. The SEC meter will be calibrated with the available standardized potassium chloride (KCl) solution that is closest to the SEC expected in groundwater below the site.

4.0 DOCUMENTATION

4.1 FIELD DATA SHEETS

A DAILY FIELD RECORD will be completed for each day of fieldwork. A WELL SAMPLING AND/OR DEVELOPMENT RECORD will be used for each well to record the information collected during water quality sampling. Samples may also be recorded on a SAMPLE CONTROL LOG SHEET or in the DAILY FIELD RECORD as a means of identifying and tracking the samples. Following review by the project manager, the original records will be kept in the project file.

4.2 CHAIN-OF-CUSTODY PROCEDURES

After samples have been collected and labeled, they will be maintained under chain-of-custody procedures. These procedures document the transfer of custody of samples from the field to the laboratory. Each sample sent to the laboratory for analysis will be recorded on a CHAIN-OF-CUSTODY RECORD, which will include instructions to the laboratory for analytical services.

Information contained on the triplicate CHAIN-OF-CUSTODY RECORD will include:

- Project number
- Signature of sampler(s)
- Date and time sampled
- Sample I.D.
- Number of sample containers
- Sample matrix (water)
- Analyses required
- Remarks, including preservatives, special conditions, or specific quality control measures
- Turnaround time and person to receive laboratory report
- Method of shipment to the laboratory
- Release signature of sampler(s), and signatures of all people assuming custody.
- Condition of samples when received by laboratory

Blank spaces on the CHAIN-OF-CUSTODY RECORD will be crossed out between the last sample listed and the signatures at the bottom of the sheet.

The field sampler will sign the CHAIN-OF-CUSTODY RECORD and will record the time and date at the time of transfer to the laboratory or to an intermediate person. A set of signatures is required for each relinquished/reserved transfer, including transfer within Amec Foster Wheeler. The original imprint of the chain-of-custody record will accompany the sample containers. A duplicate copy will be placed in the project file.

If the samples are to be shipped to the laboratory, the original CHAIN-OF-CUSTODY will be sealed inside a plastic bag within the ice chest, and the chest will be sealed with custody tape which has been signed and dated by the last person listed on the chain-of-custody. U.S. Department of Transportation shipping requirements will be followed and the sample shipping receipt will be retained in the project files as part of the permanent chain-of-custody document. The shipping company (e.g., Federal Express, UPS, DHL) will not sign the chain-of-custody forms as a receiver; instead the laboratory will sign as a receiver when the samples are received.

5.0 EQUIPMENT CLEANING

Bailers, sampling pumps, purge pumps, and other non-dedicated purging or sampling apparatus will be cleaned before and after sampling each well. Factory new and sealed disposable bailers may be used for sampling, but may not be reused. Thermometers, pH electrodes, and SEC probes that will be used repeatedly will be cleaned before and after sampling each well and at any time during sampling if the object comes in contact with foreign matter.

Purged waters and solutions resulting from cleaning of purging or sampling equipment will be collected and stored properly for future disposal by the client, unless other arrangements have been made.

Cleaning of reusable equipment that is not dedicated to a particular well will consist of the following:

- Bailers - the inside and outside of bailers will be cleaned in a solution of laboratory-grade detergent and potable water, followed by a rinse with deionized (DI) water. They may also be steam-cleaned, followed by a DI water rinse. If samples are to be collected for metals analysis, the Teflon bailer may be rinsed with a pH2 nitric acid solution followed by a double DI rinse.

- Purge Pumps - All downhole, reusable portions of purge pumps will be steam-cleaned on the outside. If the pump does not have a backflow check valve, the inside of the pump and tubing also should be steam-cleaned. For a purge pump with a backflow check valve, the interior of the pump and tubing may be cleaned by pumping a laboratory-grade detergent and potable water solution through the system followed by a potable water rinse, or by steam-cleaning.

- Water Quality Meters - All meters will be cleaned by rinsing the probe portions in DI water, and allowing to air dry.

- Bailer Tripod - The tripod cable will be steam-cleaned or rinsed with DI water.

Sample bottles and bottle caps will be cleaned by the subcontracted laboratory using standard EPA-approved protocols. Sample bottles and bottle caps will be protected from contact with solvents, dust, or other contamination. Sample bottles will not be reused.

6.0 REFERENCES

Barcelona, M.J., et al., 1994, Reproducible Well-Purging Procedures and VOC Stabilization Criteria for Ground-Water Sampling: *Groundwater*, January-February.

Kearl, P.M., et al., 1994, Field Comparison of Micropurging vs. Traditional Ground Water Sampling: *Ground Water Monitoring Review*, Fall.

Attachments: Water and Soil Analytical Methods and Sample Handling
Well Sampling and/or Development Record
Daily Field Record
Chain-of-Custody Record
Sample Control Log Sheet

TABLE 1

WATER AND SOIL ANALYTICAL METHODS AND SAMPLE HANDLING

Parameter	Method	Water Containers[1]	Preservation[1]	Maximum Holding Time[1]
Total Petroleum Hydrocarbons: – as diesel – as gasoline	 GCFID (3550)[2] GCFID (5030)[2]	 2 - 1 liter amber glass 2 - 40 ml VOA glass	 cool on ice HCL to pH 2 in water samples: cool on ice	 14 days (unacidified water, 7 days) 14 days (unacidified water, 7 days)
Benzene, Toluene, Xylene, and Ethylbenzene	EPA 8020	2 - 40 ml VOA glass	HCL to pH 2 in water samples: cool on ice	14 days (unacidified water, 7 days)
Volatile Organics with BTEX	EPA 8021[3]	2 - 40 ml VOA glass	HCL to pH 2 in water samples: cool on ice	14 days (unacidified water, 7 days)
Oil and Grease	5520 E & F (soil)[4] 5520 C & F (water)[4]	2 - 1 liter amber glass	H_2SO_4 to pH <2 in water samples: cool on ice	28 days
Volatile Organics	EPA 8010 EPA 8240[5]	2 - 40 ml VOA glass 2 - 40 ml VOA glass	cool on ice[6] HCl to pH 2 in water samples: cool on ice	14 days (unacidified water, 7 days) 14 days (unacidified water, 7 days)
Semi-volatile Organics	EPA 8270	2 - 1 liter amber glass	cool on ice	7 days for extraction, water 14 days for extraction, soil 40 days for analysis
Polynuclear Aromatic Hydrocarbons	EPA 8310	2 - 1 liter amber glass	cool on ice	7 days, water 14 days, soil
Metals (dissolved)	EPA 7000 series for specific metal	1 - 500 ml plastic	Water Samples: field filtration (0.45 micron filter) and field acidify to pH 2 with HNO_3 except: Cr^{+6} - cool on ice	6 months, except: Hg - 28 days Cr^{+6} - 24 hours, water; 24 hours after prep, soil

Notes:

1 All soil samples should be collected in full, clean brass liners, capped with aluminum foil or Teflon and plastic caps, and sealed with tape. If soil samples are to be analyzed for metals, they may be placed in laboratory-prepared clean glass jars. Soil should be cooled as indicated under Apreservation≅ and maximum holding times apply to both soil and water unless otherwise noted.

2 For analysis in California, use California DHS recommended procedure as presented in LUFT manual using gas chromatography with a flame ionization detector. In other states, local requirements should be followed. Method 3660M is silica gel cleanup.

3 EPA Method 8021 is equivalent to 8010/8020 in series.

4 Method to be used in California Regional Water Quality Control Board North Coast and Central Valley Regions. In other areas, local requirements should be followed. Method 5520F is silica gel cleanup.

5 Chloroethylvinylether may be detected at concentrations below 50 parts per billion due to degradation of HCl. EPA Method 8260B was formerly 8240.

6 If EPA Methods 8010 and 8020 are to be run in sequence, HCl may be added. Check with the project manager before adding acid.

References:

U.S. EPA, 1986, Test Methods for Evaluating Solid Waste - Physical/Chemical Methods - SW-846, Third Edition, July, and final amendments.

California State Water Resources Control Board, 1989, Leaking Underground Fuel Tank (LUFT) Field Manual, Tables 3-3 and 3-4, October.

California Regional Water Quality Control Boards, North Coast, San Francisco Bay, and Central Valley Regions, 1990, Regional Board Staff Recommendations for Initial Evaluation and Investigation of Underground Tanks, 10 August.

WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: _____

Sample ID: _____ Duplicate ID: _____

Sample Depth: _____

Project and Task No.: _____

Project Name: _____

Date: _____

Sampled By: _____

Method of Purging: _____

Method of Sampling: _____

Initial Depth to Water: _____

Depth to Water after Sampling: _____

Total Depth to Well: _____

Well Diameter: _____

1 Casing/Borehole Volume: _____
(Circle one)

4 Casing/Borehole Volumes: _____
(Circle one)

Total Casing/Borehole Volumes Removed: _____

Time	Intake Depth	Rate (gpm)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (µS/cm)	Remarks (color, turbidity, and sediment)

pH CALIBRATION (choose two)					Model or Unit No.:
Buffer Solution	pH 4.0	pH 7.0	pH 10.0		
Field Temperature °C					
Instrument Reading					

SPECIFIC ELECTRICAL CONDUCTANCE (SEC) – CALIBRATION				Model or Unit No.:
KCl Solution (µS/cm=µmhos/cm)	1413 at 25°C	12880 at 25°C		
Field Temperature °C				
Instrument Reading				

NOTES

DAILY FIELD RECORD

Project and Phase Number:	Date:
Project Name:	Field Activity:
Location:	Weather:

PERSONNEL: Name	Company	Time In	Time Out

PERSONAL SAFETY CHECKLIST

	Hard Hat		Safety Goggles		Respirator Required? (Y/N)
	Gloves (Nitrile, Vinyl)		Personal H2S Meter		Respirator Inspected?

DRUM I.D.	DESCRIPTION OF CONTENTS AND QUANTITY	LOCATION

TIME	DESCRIPTION OF WORK PERFORMED

DAILY FIELD RECORD (continued)

Page ____ of ____

Project and Task Number:	Date:

TIME	DESCRIPTION OF WORK PERFORMED

FRE 15237

CHAIN-OF-CUSTODY RECORD

PROJECT NAME:			DATE:	PAGE OF
PROJECT NUMBER:	LABORATORY NAME:	CLIENT INFORMATION:	REPORTING REQUIREMENTS:	
RESULTS TO:	LABORATORY ADDRESS:			
TURNAROUND TIME:				
SAMPLE SHIPMENT METHOD:	LABORATORY CONTACT:		GEOTRACKER REQUIRED	YES NO
	LABORATORY PHONE NUMBER:		SITE SPECIFIC GLOBAL ID NO.	

SAMPLERS (SIGNATURE):

DATE	TIME	SAMPLE NUMBER	ANALYSES														CONTAINER TYPE AND SIZE	Soil (S), Water (W), Vapor (V), or Other (O)	Filtered	Preservative Type	Cooled	MS/MSD	No. of Containers	ADDITIONAL COMMENTS

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME	TOTAL NUMBER OF CONTAINERS:
SIGNATURE:			SIGNATURE:			SAMPLING COMMENTS:
PRINTED NAME:			PRINTED NAME:			
COMPANY:			COMPANY:			
SIGNATURE:			SIGNATURE:			
PRINTED NAME:			PRINTED NAME:			
COMPANY:			COMPANY:			
SIGNATURE:			SIGNATURE:			
PRINTED NAME:			PRINTED NAME:			
COMPANY:			COMPANY:			

1281 East Alluvial Ave., Suite 101
Fresno, California 93720-2659
Tel 559.264.2535 Fax 559.264.7431

amec

SAMPLE CONTROL LOG

Project Name: _____ **Laboratory:** _____

Project and Task No.: _____ Page ____ of ____

Sampling Date	Sampling Time	Sample Number (ID)	C.O.C. Number	Analyses Requested	Turnaround Time, Sample Location, Handling Notes, Chain-of-Custody Remarks, etc. (Duplicate, Blank info, etc.)	Date Sent to Lab	Date Results Due

APPENDIX E

Well Construction Records – Basin Plan Amendment

ORIGINAL
File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do not fill in

No. 331718

Notice of Intent No. _____
Local Permit No. or Date _____

State Well No. 025S021E01N01M
Other Well No. IN-20

(12) WELL LOG: Total depth 20 ft. Completed depth 20 ft.
from ft. 0 to 20 ft. Formation (Describe by color, character, size or material)

(2) LOCATION OF WELL (See instructions):
County Kern Owner's Well Number 01N-20
Well address if different from above _____
Township 25S Range 21E Section 01N
Distance from cities, roads, railroads, fences, etc. _____

WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well [X] Deepening [ ]
Reconstruction [ ]
Reconditioning [ ]
Horizontal Well [ ]
Destruction [ ] (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic [ ]
Irrigation [ ]
Industrial [ ]
Test Well [X]
Municipal [ ]
Other [ ] (Describe)

(5) EQUIPMENT:
Rotary [ ] Reverse [ ]
Cable [ ] Air [ ]
Other [X] Bucket [ ]

(6) GRAVEL PACK:
Yes [X] No [ ] Size 12X20
Diameter of bore 3
Packed from 5 to 20 ft.

(7) CASING INSTALLED:
Steel [ ] Plastic [X] Concrete [ ]

(8) PERFORATIONS:
Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	20	2	Sch 40	10	20	.020

(9) WELL SEAL:
Was surface sanitary seal provided? Yes [X] No [ ] If yes, to depth 5 ft.
Were strata sealed against pollution? Yes [X] No [ ] Interval _____ ft.
Method of sealing Bentonite Grout

(10) WATER LEVELS:
Depth of first water, if known _____ ft.
Standing level after well completion _____ ft.

(11) WELL TESTS:
Was well test made? Yes [ ] No [ ] If yes, by whom? _____
Type of test Pump [ ] Bailer [ ] Air lift [ ]
Depth to water at start of test _____ ft. At end of test _____ ft.
Discharge _____ gal/min after _____ hours Water temperature _____
Chemical analysis made? Yes [ ] No [ ] If yes, by whom? _____
Was electric log made Yes [ ] No [ ] If yes, attach copy to this report

Work started _____ 19__ Completed _____ 19__

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Signed _____ (Well Driller)
NAME _____ (Person, firm or corporation) (Typed or printed)
Address _____
City _____
License No. _____ Date of this report _____

U.S. GEOLOGICAL SURVEY, WRD
2800 COTTAGE WAY, RM. W-2239
SACRAMENTO, CA 95825

CONFIDENTIAL
NOT FOR PUBLIC USE
WATER CODE SEC. 13752

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do not fill in

No. 331719

Notice of Intent No. _____
Local Permit No. or Date _____

State Well No. 025S021E01N02M
Other Well No. 1N-50

(2) LOCATION OF WELL (See instructions):

County Kern Owner's Well Number 01N-50
Well address if different from above _____
Township 25S Range 21E Section 01N
Distance from cities, roads, railroads, fences, etc. _____

WELL LOCATION SKETCH

(3) TYPE OF WORK:

New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:

Domestic ☒
Irrigation ☐
Industrial ☐
Test Well ☒
Municipal ☐
Other ☐ (Describe)

(5) EQUIPMENT:

Rotary ☒ Reverse ☐
Cable ☐ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK:

Yes ☒ No ☐ Size 12X20
Diameter of bore 6
Packed from 45 to 67 ft.

(7) CASING INSTALLED:

Steel ☐ Plastic ☒ Concrete ☐

(8) PERFORATIONS:

Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	67	2	Sch40	52	62	.020

(9) WELL SEAL:

Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 40 ft.
Were strata sealed against pollution? Yes ☒ No ☐ Interval _____ ft.
Method of sealing Bentonite Grout

(10) WATER LEVELS:

Depth of first water, if known _____ ft.
Standing level after well completion _____ ft.

(11) WELL TESTS:

Was well test made? Yes ☐ No ☐ If yes, by whom? _____
Type of test Pump ☐ Bailer ☐ Air lift ☐
Depth to water at start of test _____ ft. At end of test _____ ft.
Discharge _____ gal/min after _____ hours Water temperature _____
Chemical analysis made? Yes ☐ No ☐ If yes, by whom? _____
Was electric log made Yes ☐ No ☐ If yes, attach copy to this report

(12) WELL LOG:

Total depth 67 ft. Completed depth 67 ft.
from ft. 0 to 67 ft. Formation (Describe by color, character, size or material)

Work started _____ 19__ Completed _____ 19__

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signed _____ (Well Driller)
NAME _____ (Person, firm, or corporation) (Typed or printed)
Address _____
City _____ ZIP _____
License No. _____ Date of this report _____

U.S. GEOLOGICAL SURVEY, WRD
2800 COTTAGE WAY, RM. W 2239
SACRAMENTO, CA 95825

CONFIDENTIAL
NOT FOR PUBLIC USE
WATER CODE SEC. 13752

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

ORIGINAL
File with DWR

Do not fill in

No. 331720

Notice of Intent No. _____
Local Permit No. or Date _____

State Well No. 025S021E01N03M
Other Well No. 1N-100

(2) LOCATION OF WELL (See instructions):

County Kern Owner's Well Number 01N-100
Well address if different from above _____
Township 25S Range 21E Section 01N
Distance from cities, roads, railroads, fences, etc. _____

WELL LOCATION SKETCH

(3) TYPE OF WORK:

New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:

Domestic ☐
Irrigation ☐
Industrial ☐
Test Well ☒
Municipal ☐
Other ☐
(Describe)

(5) EQUIPMENT:

Rotary ☐ Reverse ☐
Cable ☐ Air ☐
Other ☒ Bucket ☐

(6) GRAVEL PACK:

Yes ☒ No ☐ Size 12X20
Diameter of bore 6
Packed from 85 to 100 ft.

(7) CASING INSTALLED:

Steel ☐ Plastic ☒ Concrete ☐

(8) PERFORATIONS:

Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	100	2	Sch40	90	100	.020

(9) WELL SEAL:

Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 80 ft.
Were strata sealed against pollution? Yes ☒ No ☐ Interval _____ ft.
Method of sealing Bentonite Grout

(10) WATER LEVELS:

Depth of first water, if known _____ ft.
Standing level after well completion _____ ft.

(11) WELL TESTS:

Was well test made? Yes ☐ No ☐ If yes, by whom? _____
Type of test Pump ☐ Bailer ☐ Air lift ☐
Depth to water at start of test _____ ft. At end of test _____ ft.
Discharge _____ gal/min after _____ hours Water temperature _____
Chemical analysis made? Yes ☐ No ☐ If yes, by whom? _____
Was electric log made Yes ☐ No ☐ If yes, attach copy to this report

(12) WELL LOG:

Total depth 100 ft. Completed depth 100 ft.
from ft. 0 to 100 Formation (Describe by color, character, size or material)

Work started _____ 19__ Completed _____ 19__

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signed Sherm Beard
(Well Driller)

NAME _____
(Person, firm or corporation) (Typed or printed)
Address _____
City _____
License No. _____ Date of this report _____

U.S. GEOLOGICAL SURVEY, WRD
2800 COTTAGE WAY, RM. W-2239
SACRAMENTO, CA 95825

CONFIDENTIAL
NOT FOR PUBLIC USE
WATER CODE SEC. 13752

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

State of California

The Resources Agency

HOLE NO.: 3

DEPARTMENT OF WATER RESOURCES

HOLE LOG

ELEV. (feet):

DEPTH (feet):

DATE DRILLED: 6/20/90

ATTITUDE: Vertical

LOGGED BY: Kaylea Hoppe

DEPTH TO WATER:

LOCATION: Site 3, ~3 miles NE of Lost Hills

CONTR.: Datum Exploration

DRILL RIG: CME 95, hollow-stem auger with continuous core in acrylic tubes

DEPTH	LOG	FIELD CLASSIFICATION AND DESCRIPTION	REMARKS
0.0	CH	0.0-2.5 (est.), FAT CLAY, dusky yellowish brown (10YR2/2), high plasticity, contains ~5-10% medium and fine sand, dry, hard, contains white streaks (effervescent in dilute HCL).	Sample 1, 2, 3 part
	CH	2.5 (est.)-3.5 (est.), FAT CLAY, dusky yellowish brown (10YR2/2) mottled with light olive brown (5Y5/6) and moderate olive brown (5Y4/4), high plasticity, damp, stiff, contains some fine sand and very fine mica flakes.	Sample 3, 4
	CH	3.5-5.0 (est.), FAT CLAY, light olive brown (5Y5/6) with rust colored streaks (~1 cm. long), high plasticity, contains 15-20% fine sand, micaceous, stiff, damp.	Sample 5, 6 part
	CL	5.0-7.5 (est.), LEAN CLAY, dusky yellow (5Y6/4), low plasticity, contains abundant (~25%) very fine sand, micaceous, firm, moist, light olive gray at bottom (5Y5/2).	Sample 6, 7, 8, 9 part
	SP	7.5 (est.)-8.5 (est.), SAND, light olive gray (5Y5/2), very fine grained, poorly graded, micaceous, ~90% quartz, < 5% black sand (magnetite).	Sample 9
	SP	8.5 (est.)-22.00 (est.), SAND, light olive gray (5Y5/2), fine grained, poorly graded, few fines, loose, ~85-90% qtz., micaceous, saturated;	Sample 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 20a part (lost 9.5-10.5, but probably same sand)
		At 15.5 lighter gray color, medium sand, mica is greenish gold, large flakes.	Sample 14
		At 19.5 same dark yellowish orange staining.	Sample 19, 20, 20a, part
	SC	22.0 (est.)-23.5 (est.), CLAYEY SAND, light olive gray(5Y5/2), very fine grained, ~30% fines, poorly graded, dense, fines have slight plasticity, micaceous.	Sample 20a, 21 part

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES
DRILL HOLE LOG

PROJECT & FEATURE Tulare Basin

DEPTH (ELEV.)	LOG	FIELD CLASSIFICATION AND DESCRIPTION	REMARKS
		Y FAT CLAY, light ticity, contains ins calcareous of core (~1 cm. all, dark Mn?	Sample 21, 22, 23, 24, 25
		nodules, nodular structure, stiff, moist. Black nodules and stringers increasing with depth, micaceous.	(possible Mn or ?? organics) At 27.5, Sample 25
	ML	28.0 (est.)-29.0+, SILT, light olive gray (5Y5/2), with rust colored staining, nonplastic, contains very fine sand, micaceous, firm.	Sample 26, 27?
	SP/ SM	29.0+-33.2 (est.), SAND, very fine sand, light olive gray (5Y5/2), some fines (nonplastic), firm, with rust-colored staining on ~5% of material.	Sample 28, 29
		At 33.0, darker gray, no rust color.	Sample 29
	CL	33.2 (est.)-35.5, SANDY LEAN CLAY, light olive gray (5Y5/2), low plasticity, 25-30% fine sand, stiff, nodular structure, sand percent increases downward.	Sample 30, 31, 32?
	SP	35.5-50+, SAND, pale olive (10Y6/2), medium and fine sand, no fines, mostly clean quartz sand, very little mica, loose, subrounded quartz with angular white felds, few rock fragments, biotite and phlogopite? mica.	At 48.0-53.0 quit for the day
		SAME, reduced sand.	Running sands, had to pull out & drill another hole (twice). Completed the well & screened 90-100 feet.
		100.0 Bottom of Hole	

ORIGINAL
File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do not fill in

No. 331721

Notice of Intent No. _____
Local Permit No. or Date _____

State Well No. 025S021E01N04M
Other Well No. IN-200

(2) LOCATION OF WELL (See instructions):

County Kern Owner's Well Number 01N-200
Well address if different from above _____
Township 25S Range 21E Section 01N
Distance from cities, roads, railroads, fences, etc. _____

WELL LOCATION SKETCH

(3) TYPE OF WORK:

New Well [X] Deepening [ ]
Reconstruction [ ]
Reconditioning [ ]
Horizontal Well [ ]
Destruction [ ] (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:

Domestic [ ]
Irrigation [ ]
Industrial [ ]
Test Well [X]
Municipal [ ]
Other [ ]
(Describe)

(5) EQUIPMENT:

Rotary [ ] Reverse [ ]
Cable [ ] Air [ ]
Other [XX] Bucket [ ]

(6) GRAVEL PACK:

Yes [X] No [ ] Size 12X20
Diameter of bore 6
Packed from 180 to 204 ft.

(7) CASING INSTALLED:

Steel [ ] Plastic [XX] Concrete [ ]

From ft.	To ft.	Dia. in.	Gage or Wall
0	204	3	Sch 40

(8) PERFORATIONS:

Type of perforation or size of screen

From ft.	To ft.	Slot size
189	199	.020

(9) WELL SEAL:

Was surface sanitary seal provided? Yes [X] No [ ] If yes, to depth 180 ft.
Were strata sealed against pollution? Yes [X] No [ ] Interval _____ ft.
Method of sealing Bentonite Grout

(10) WATER LEVELS:

Depth of first water, if known _____ ft.
Standing level after well completion _____ ft.

(11) WELL TESTS:

Was well test made? Yes [ ] No [ ] If yes, by whom? _____
Type of test Pump [ ] Bailer [ ] Air lift [ ]
Depth to water at start of test _____ ft. At end of test _____ ft.
Discharge _____ gal/min after _____ hours Water temperature _____
Chemical analysis made? Yes [ ] No [ ] If yes, by whom? _____
Was electric log made Yes [ ] No [ ] If yes, attach copy to this report

(12) WELL LOG:

Total depth 204 ft. Completed depth 204 ft.
from ft. 0 to 204 ft. Formation (Describe by color, character, size or material)

At 61 clayey sand
At 104.5 sand
At 121 clay
at 141 silty clay
At 161 sandy clay
At 181 clayey sand
At 203 sand

Work started _____ 19__ Completed _____ 19__

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signed _____ (Well Driller)
NAME _____ (Type or Print)
Address _____
City _____ ZIP _____
License No. _____ Date of this report _____

U.S. GEOLOGICAL SURVEY, WRD
2800 COTTAGE WAY, RM. W 2239
SACRAMENTO, CA 95825

CONFIDENTIAL
NOT FOR PUBLIC USE
WATER CODE SEC. 13752

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

State of California

SHEET: 1 of 2

The Resources Agency

HOLE NO.: 3

DEPARTMENT OF WATER RESOURCES

HOLE LOG

ELEV. (feet):

DEPTH (feet):

DATE DRILLED: 6/20/90

ATTITUDE: Vertical

LOGGED BY: Kaylea Hoppe

DEPTH TO WATER:

LOCATION: Site 3, ~3 miles NE of Lost Hills

CONTR.: Datum Exploration

DRILL RIG: CME 95, hollow-stem auger with continuous core in acrylic tubes

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State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES
DRILL HOLE LOG

HOLE NO. 3

PROJECT & FEATURE Tulare Basin

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--		nodules, nodular structure, stiff, moist. Black nodules and stringers increasing with depth, micaceous.	At 27.5, Sample 25
--	ML	28.0 (est.)-29.0+, SILT, light olive gray (5Y5/2), with rust colored staining, nonplastic, contains very fine sand, micaceous, firm.	Sample 26, 27?
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--		SAME, reduced sand.	Running sands, had to pull out & drill another hole (twice). Completed the well & screened 90-100 feet.
--		100.0 Bottom of Hole	

25/21-26P1

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

ORIGINAL
File with DWR

Do Not Fill In

№ 112332

State Well No.
Other Well No.

(2) LOCATION OF WELL:

County Kern Owner's number, if any
Township, Range, and Section SE/4 T25 R21E Sec26
Distance from cities, roads, railroads, etc.

(3) TYPE OF WORK *(check)*:

New Well ☒ Deepening ☐ Reconditioning ☐ Destroying ☐
If destruction, describe material and procedure in Item 11.

(4) PROPOSED USE *(check)*:

Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☒ Test Well ☐ Other ☐

(5) EQUIPMENT:

Rotary Rev ☒
Cable ☐
Other ☐

(6) CASING INSTALLED:

STEEL ☒ OTHER:
SINGLE ☒ DOUBLE ☐

From ft.	To ft.	Diam.	Gage or Wall	Diameter of Bore	If gravel packed From ft.	To ft.
0	402	14"	1/4	26"	0	450

Size of shoe or well ring: Bull Nose Size of gravel: 4/16x4
Describe joint 30'

(7) PERFORATIONS OR SCREEN:

Type of perforation or name of screen Saw

From ft.	To ft.	Perf. per row	Rows per ft.	Size in. x in.
195	402	7	3	1/8"x3

(8) CONSTRUCTION:

Was a surface sanitary seal provided? Yes ☒ No ☐ To what depth 60 ft.
Were any strata sealed against pollution? Yes ☐ No ☐ If yes, note depth of strata
From ft. to ft.
From ft. to ft.
Method of sealing

(9) WATER LEVELS:

Depth at which water was first found, if known ft.
Standing level before perforating, if known ft.
Standing level after perforating and developing ft.

(10) WELL TESTS:

Was pump test made? Yes ☐ No ☐ If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
Temperature of water Was a chemical analysis made? Yes ☐ No ☐
Was electric log made of well? Yes ☐ No ☐ If yes, attach copy

(11) WELL LOG:

Total depth 450 ft. Depth of completed well 402 ft.

Formation: *Describe by color, character, size of material, and structure*

ft. to ft.		
0-2	top soil	
2-8	clay	
8-18	sand	
18-27	clay	
27-55	sand	
55-60	clay	
60-75	sand	
75-116	clay	
116-131	sand	
131-145	clay	
145-150	sand	
150-160	clay	
160-170	sand	
170-190	clay	
190-193	sand	
193-195	clay	
195-210	sand	15
210-218	clay	
218-225	sand	7
225-244	clay	
244-257	sand	7
257-264	clay	
264-277	sand	13
277-291	clay	
291-310	sand	19
310-350	clay	
350-355	sand	5
355-361	clay	
361-366	sand	5
366-407	clay	
407-418	sand	11
418-422	clay	91 ft sand
422-431	sand	9
431-450	clay	(Corcoran Clay)

UNCONFINED

Work started Sept 9 1975, Completed Sept 12 1975

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Grabow Well Drilling Co. Inc
(Person, firm, or corporation) (Typed or printed)

Address 12522-9th ave
Hanford, Calif 93230

[SIGNED] Glen E. Grabow
(Well Driller)

License No. 288489 Dated Sept 19, 1975

SKETCH LOCATION OF WELL ON REVERSE SIDE

DWR 188 (REV. 9-68) 67139-750 8-72 30M TRIP ①T OSP

26/21— 1442

Surface		51	
Clay		51	
Sand		87	
Clay	87 to	117	
Sand	117 to	157	0
Clay	157 to	212	1
Sand	212 to	231	
Clay	231 to	260	
Sand	260 to	321	1
Clay	321 to	324	

Drilled by Sage Bros

MICROFILMED Rel 12