Memorandum

Date:	July 31, 2009		
To:	Doug Carman, Paramount Citrus	Project:	14180.001
From:	David Bean, PG, CHg	cc:	

Subject: Potential Groundwater Impacts from Proposed Southern California Edison San Joaquin Cross Valley Loop Alternative Routes 2 and 6

As requested by James Jordan of Paramount Citrus (Paramount), AMEC Geomatrix, Inc. (AMEC), has reviewed the Southern California Edison Draft Environmental Impact Report (DEIR) for the proposed San Joaquin Cross Valley Loop. In particular, AMEC focused on potential impacts to groundwater resulting from installation of high voltage electrical power towers and associated transmission lines, pads and roads along Alternative Routes 2 and 6 as presented in the DEIR (Figure 1).

Groundwater is the primary source of drinking water for most communities in California and the major source of irrigation water for most agricultural areas. In the Valley, groundwater is typically found in deep alluvial aquifers comprised of sand and gravel, and groundwater recharge is primarily from percolation of water from streams, rivers, and applied water. In the foothills on the east side of the Valley, groundwater is more typically found in fractured bedrock and groundwater recharge occurs through percolation of rain and snow melt through fractures in the bedrock. Although the western half of the new rights-of-way of Alternative Routes 2 and 6 overlie significant alluvial aquifers, the eastern half of Alternative Routes 2 and 6 are located in areas where groundwater is found primarily in fractured bedrock characteristic of the foothills, or in areas consisting of shallow alluvial aquifers over fractured bedrock.

Previous Investigations

In 2008, AMEC conducted an extensive survey of groundwater resources in the vicinity of Rayo Ranch on behalf of Paramount (AMEC, 2008). Project Alternative Routes 2 and 6 cut directly through this study area as they extend from the existing Big Creek 1-Rector/Big Creek 3-Rector 220 kilovolt (kV) transmission line right-of-way along Road 148 eastward into the foothills to connect to the existing Big Creek 3-Springville/Big Creek 4-Springville 220 kV transmission line (Figure 1).

Groundwater beneath the Rayo Ranch area (located in the path of both Alternative Routes 2 and 6 west of Colvin Mountain) is found in a shallow alluvial aquifer overlying a fractured bedrock aquifer. The alluvial aquifer ranges from just a few tens of feet thick at the base of Colvin Mountain to approximately 250 to 300 feet thick near Road 148.

East of Colvin Mountain (where Alternative Routes 2 and 6 converge), groundwater beneath the Cottonwood Creek (Elderwood/Dutch Colony) and Antelope Valley (including Sentinel Butte)

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area is also found in a shallow alluvial aquifer overlying a fractured bedrock aquifer. On this eastern portion of Alternative Routes 2 and 6 the alluvial aquifer ranges from just a few tens of feet thick to only a few feet thick at the base of the foothills.

The limited well construction data available for the Cottonwood Creek and Antelope Valley area indicate that the wells are relatively shallow and are completed in alluvial and fractured bedrock. Information provided by farmers in the area east of Colvin Mountain indicates that groundwater supply is extremely inconsistent. Wells in some areas have good yields while many wells that are drilled provide no usable water. This is consistent with the results of our surveys and, in our experience, is characteristic of the Sierra foothill region. Groundwater is not consistently available across the small alluvial-filled valleys. Some areas are underlain by fractured bedrock filled with water while other areas are underlain by dry fractures or fractures isolated from recharge areas so they do not have enough groundwater flow or storage to provide a long-term supply. Relocating a well, even a short distance in a fractured bedrock aquifer, can be very unpredictable.

Groundwater elevation data collected by the California Department of Water Resources (DWR) and the United States Geological Survey (USGS) were used to prepare long-term hydrographs from 1980 to 2007 for over 60 wells in the area (Figure 2). Some of our more important observations are:

- Groundwater elevations tend to vary seasonally 5 to 10 feet, rising in the wet winter months and falling in the dry summer months when wells are pumped for irrigation.
- Groundwater elevations also vary in response to decadal-scale drought cycles, rapidly declining 20 to 30 feet during drought periods and quickly recovering during wet periods.

The same groundwater elevation data were used to evaluate seasonal (Fall and Spring) groundwater flow patterns over 25 years. Some of our more important observations are:

- Groundwater flows generally from east to west from the foothills areas (i.e. Cottonwood Creek drainage and Antelope Valley) to the Valley trough west of Highway 99 (Figure 3).
- The groundwater gradient is consistent in direction and magnitude during both Fall and Spring and during wet and dry periods.

In the Cottonwood Creek drainage area there is a strong correlation between groundwater elevation data from DWR and USGS, stream flow data from the USGS, and precipitation data from the National Oceanographic and Atmospheric Administration (Figure 4). This indicates that the Cottonwood Creek drainage and Antelope Valley are very important groundwater recharge areas on the east side of the Valley.

The data also show a strong correlation between groundwater elevations wells in the Elderwood area, wells south of Colvin Mountain, and wells west of Colvin Mountain (Figure 2). This

indicates that the foothill area on the east side of the valley is an important recharge source for local wells, including those south and west of Colvin Mountain, and many square miles of productive farm land.

The data show that depth to groundwater has historically ranged from 10 to 80 feet below ground surface in the Elderwood area (Figure 5). However, as recently as 2007, depth to groundwater was between 10 and 40 feet, depending on location.

Our conclusion is that the local aquifer system is not laterally extensive and does not have diverse sources of recharge. The data indicate the local aquifer has a limited recharge area because the local effects are so quickly evident. The seasonal variation in groundwater elevations, the decline during drought periods and subsequent recovery during wet periods indicates that local recharge is extremely important to the local aquifer system. As a result, in this aquifer system even a small impairment of the local recharge capability can have a significantly adverse impact.

Potential Groundwater Impacts

At the request of Paramount, we have reviewed the DEIR with particular focus on the potential impacts Alternative Routes 2 and 6 may have on groundwater resources and the availability of agricultural irrigation supplies in the vicinity of the Rayo Ranch, the Elderwood area, and Antelope Valley.

As a result of this review, we believe the DEIR is deficient because it fails to adequately address potential significant adverse impacts to groundwater. These impacts result from the installation of power poles and service roads in several areas, particularly along the eastern alignments of Alternative Routes 2 and 6 in the Elderwood and Antelope Valley areas.

DEIR Pages 2-20 to 2-33 describe the poles, towers, and roads required for the project. Foundations for tubular power poles will be 6 to 10 feet in diameter and 20 to 60 feet deep. Groundwater is at a depth of 10 to 40 feet along much of the alignment. Dewatering may be necessary to construct foundations for as many as 38 poles. Dewatering in a limited aquifer system during a period of drought may adversely affect local water supply wells and may permanently damage the aquifer system through compaction and sealing of alluvial and fractured bedrock in the vicinity of the borings. In addition, once cemented in place, the foundations are likely to become permanent local barriers to recharge and groundwater flow in both alluvial and fractured bedrock. Because the transmission of groundwater through the fractured bedrock cannot accurately be mapped, the impact of pouring cement into the fractures intersected by an individual foundation cannot be predicted with any certainty. Once the concrete is poured and the impacts are known, however, they are very hard to reverse. It is likely that the concrete will cut off the downstream flow in the sealed fractures, or possibly redirect the water flowing in the sealed fractures to some other fracture or fracture system. Any wells relying on those sealed fractures will experience decreased flow or possibly a complete loss of flow. Because it is virtually impossible to determine the route water takes to a well, all wells in the vicinity of a new foundation must be considered at risk.

DEIR Pages 3-10 to 3-12 describe Alternative Route 2 and indicate that new permanent roads will cover over about 28 acres of land. Approximately 5 acres of new road surface appear to be in the recharge areas of Elderwood area and Antelope Valley. These 5 acres of graded and compacted road may have an adverse impact on the rate water can recharge. As a result, more water may run off in rain events and may be lost to the aquifer. An additional 9 acres will be "permanently disturbed." The definition of "permanently disturbed" includes areas where other impervious surfaces are located. Therefore, these 9 acres may further reduce recharge capacity.

DEIR Pages 4.8-4 to 5 and 4.8.14 describe the sediments beneath the Alternative Routes as consisting of "three stratigraphic units: continental deposits, older alluvium, and younger alluvium. For the most part, assessable groundwater occurs within an unconfined state throughout the study area." The DEIR also indicates "The groundwater basins underlying the study area are relatively large, predominantly unconfined, and heavily impacted by existing agricultural demands. Groundwater use is not proposed for the Proposed Project or alternative, and they would otherwise have negligible impact upon existing groundwater supplies and processes." These statements may be reasonable for the portion of the project on the Valley floor. However, the DEIR fails to consider the shallow alluvial and fractured bedrock aquifers at the base of the foothills (i.e. the Elderwood area and Antelope Valley). As described above, the local aquifer system beneath this area is not laterally extensive and does not have diverse sources of recharge. This local aquifer system is also being put to extensive beneficial use for domestic and agricultural supply. Dewatering for foundations would exacerbate local overdraft during the current drought conditions, and installation of foundations may have significant impacts on groundwater supplies and processes by reducing recharge and disrupting groundwater flow.

Particular Areas of Concern

DEIR Appendix C Pages 17-20 Alternative Route 2 – Structures 55-73 are located in the Rayo Ranch area east of Colvin Mountain. Along this alignment the shallow alluvium aquifer thins from a few hundred feet thick to only a few tens of feet thick. Approximately 2,700 feet of new roads will be required to construct 20 structures. Installation of roads, pads, and power poles may reduce recharge potential and, as discussed above, create barriers to groundwater flow by sealing fractures, especially on the eastern end of the alignment. Available data suggest a significant amount of groundwater flow occurs through fractures and into the alluvium in this area, so the concrete foundations can potentially block a significant amount of the flow, which would adversely affecting wells required to irrigate local farms.

DEIR Appendix C Pages 20-21 Alternative Route 2 – Structures 74-78 are located on the west side of Colvin Mountain overlying a primarily fractured bedrock aquifer. Approximately 2,100 feet of new roads will be required to construct 4 structures. Installation of roads, pads, and power poles may reduce recharge potential and create barriers to groundwater flow by sealing bedrock fractures. Available data suggest a significant amount of groundwater flow occurs through fractures in this area, so if concrete foundations are installed in the fractured

bedrock aquifer it is likely that they will inhibit a significant amount of groundwater flowing west into the Rayo Ranch area.

DEIR Appendix C Pages 21-23 Alternative Route 2 – Structures 78-91 are located in Mud Springs Gap along the north of Colvin Mountain. This is an area of shallow alluvium overlying fractured bedrock. Approximately 4,000 feet of new roads will be required to construct 13 structures. Installation of roads, pads, and power poles may reduce recharge potential and create barriers to groundwater flow by sealing fractures. Available data suggest a significant amount of groundwater flow occurs through fractures in this area, so if concrete foundations are installed in the fractured bedrock aquifer it is likely that they will inhibit a significant amount of groundwater flowing through the Mud Springs Gap and adversely affecting wells required to irrigate local farms. In this area it may not be possible to construct new wells that will effectively replace any impacted wells. In addition, impacts to recharge and groundwater flow in this area may impact downgardient areas to the west and south.

DEIR Appendix C Pages 23-25 Alternative Route 2 – Structures 92-100 are located in the Elderwood area. This is a significant recharge area when water is present in Cottonwood Creek. Structure 93 is located adjacent to the main channel of Cottonwood Creek. Installation of roads, pads, and power poles may reduce the recharge potential of the area and create barriers to groundwater flow in both alluvium and fractured bedrock. In addition, several water supply wells are located along this section of alignment. Wells located in the path of alignment will need to be relocated. As indicate above, the availability and location of groundwater in this area is unpredictable and difficult to determine, so relocating wells will likely be very challenging, expensive, and potentially impossible. The impediment to groundwater flow, especially in the bedrock, should be considered significant because there is no way to ensure that it does not cause adverse impacts. In addition, impacts to recharge and groundwater flow in this area may impact downgradient areas to the west and south.

DEIR Appendix C Pages 25-27 Alternative Route 2 and Alternative Route 6 – Structures 101-115 are located in Sentinel Butte and Antelope Valley. This is a relatively undisturbed recharge area with several ephemeral streams. Approximately 6,500 feet of new roads will be required. Installation of roads, pads, and power poles may reduce the recharge potential of the area and create barriers to groundwater flow in the primarily fractured bedrock aquifer. Several water supply wells, including a high yield “wagon-wheel” or radial collector well, reportedly will need to be relocated along this section of alignment. A radial collector well has a large diameter central caisson with horizontal perforated pipes extending radially into a thin shallow aquifer. Typical radial collector wells now cost between $3,000,000 and $5,000,000 to construct. While it is possible to install a new radial collector well in this area, there is no guarantee that it will have the desired yield. As indicated above, the availability and location of groundwater in the Sentinel Butte/Antelope Valley area is unpredictable and difficult to determine, so relocating wells will likely be very challenging, expensive, and potentially impossible. The impediment to groundwater flow, especially in the bedrock, should be considered significant because there is no way to ensure that it does not cause adverse impacts. In addition, impacts to recharge and groundwater flow in this area may impact downgardient areas to the west and south.

Conclusion

While the individual impact of certain individual structures on groundwater recharge in the Rayo Ranch, the Elderwood area, and Antelope Valley may be less than significant, the cumulative impacts of the roads, multiple pads, deep foundations and multiple structures on groundwater recharge cannot be so easily dismissed. The DEIR does not acknowledge or address the significant risk and negative impact that sealing of one bedrock fracture by a single concrete foundation in the Elderwood area and Antelope Valley can have on groundwater flow. Replacement of wells in this thin alluvial and fractured bedrock aquifer is difficult and costly.

In summary, the DEIR is deficient because of the following:

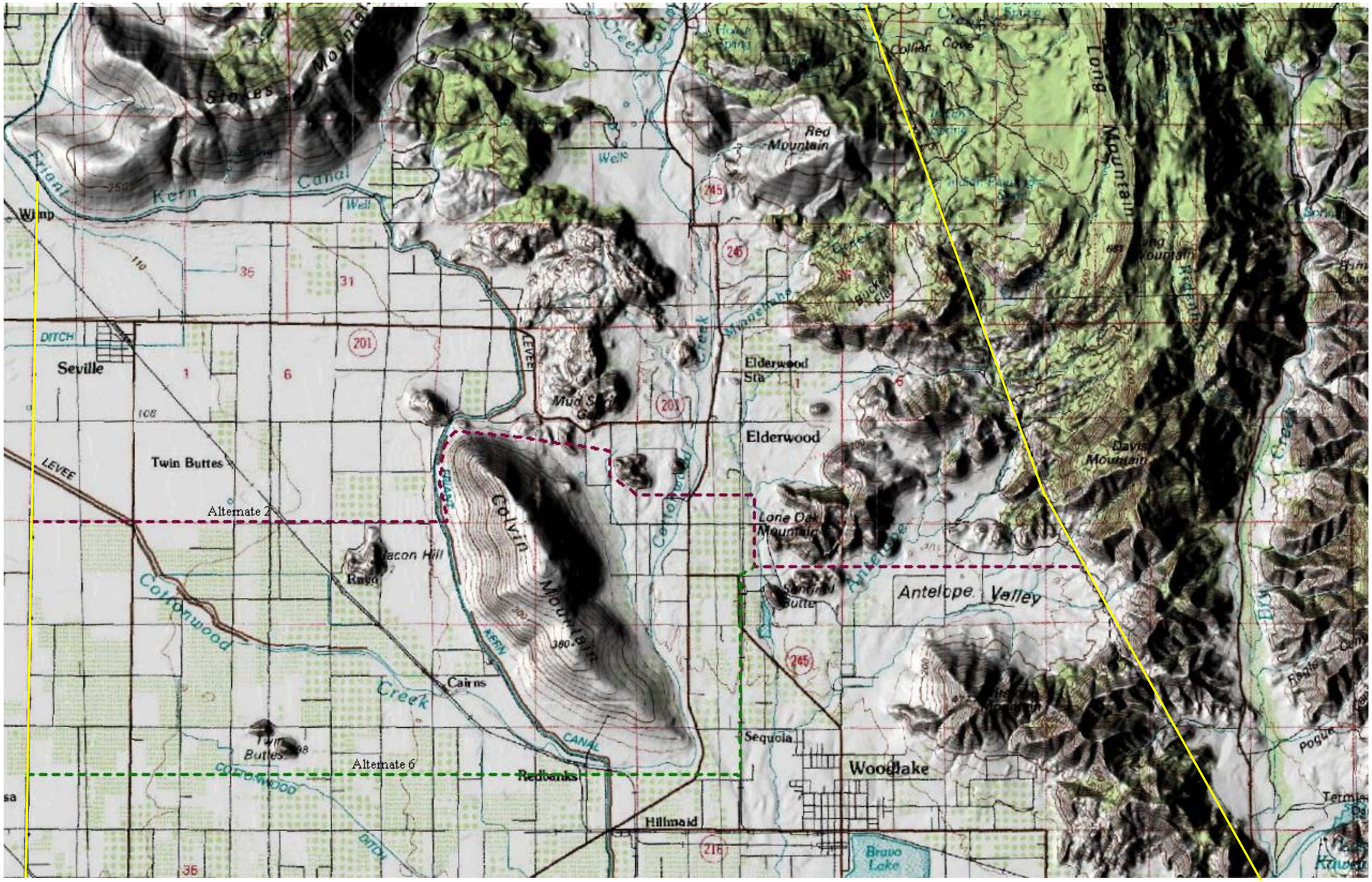
- The DEIR comparison of potential groundwater impacts from the various alternatives is deficient.
- The DEIR fails to acknowledge the risks of construction on groundwater recharge and resources in the foothill areas of Alternative Routes 2 and 6.
- The DEIR also fails to acknowledge the risks of construction of roads and foundations to existing water supply wells in the shallow alluvium and fractured bedrock aquifers beneath Alternative Routes 2 and 6.

Attachments: Figure 1 – Location Map and Alternative Routes 2 and 6
Figure 2 – DWR Well Hydrographs
Figure 3 – Water Surface Elevation – Spring 2007
Figure 4 – Correlation between Precipitation, Stream Flow, and Groundwater Elevation in Cottonwood Creek Valley
Figure 5 – Hydrographs of Selected Wells Showing Relationship between Groundwater in Cottonwood Creek Valley, Antelope Valley, and West of Colvin Mountain

References

AMEC Geomatrix, Inc., 2008, Evaluation of Groundwater Resources, Paramount Citrus Rayo Ranch, Tulare County, California, November (AMEC, 2008).

Croft, M.G. and Gordon, G.V, 1968, Geology, Hydrology, and Quality of Water in the Hanford-Visalia Area, San Joaquin Valley, California, USGS Open-File Report 68-67 (Croft and Gordon, 1968).



Explanation

- Alternate Route 2
- Alternate Route 6
- Existing 220 Kilovolt Transmission Lines

LOCATION MAP AND ALTERNATIVE ROUTES 2 AND 6

SCE San Joaquin Cross Valley Loop DEIR
Visalia, California

By: dmb	Date: 07/29/09	Project : 14180.001
AMEC Geomatrix		Figure 1

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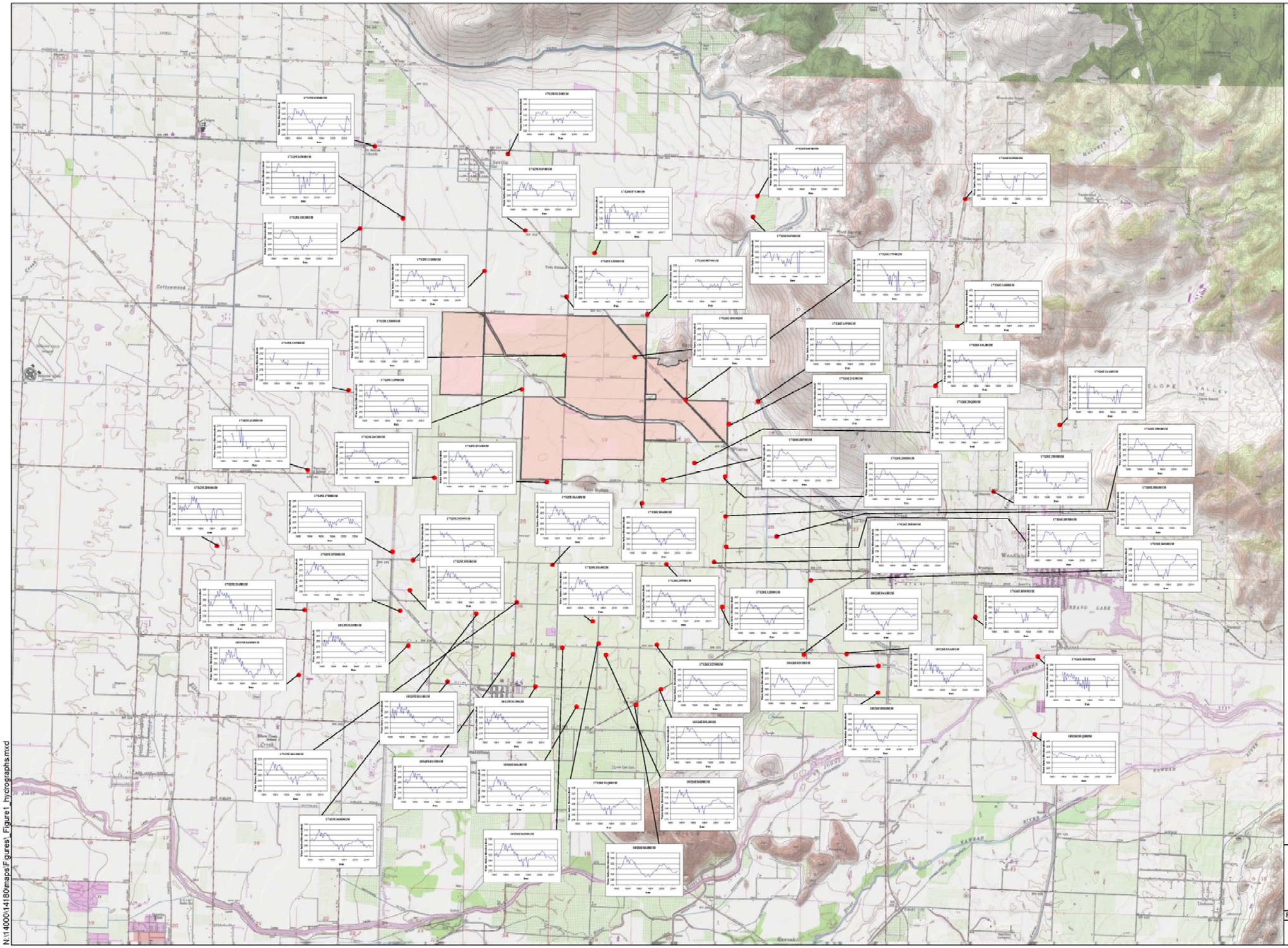

Explanation

- DWR well location
- Rayo Ranch boundary

Hydrograph showing water surface elevation from 1980 - 2007.

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APPROXIMATE SCALE IN FEET

0 6,000

0 1,800

APPROXIMATE SCALE IN METERS

Note: Base map modified from U.S.G.S. 7.5 minute topographic quadrangle maps Monson, Ivanhoe, Woodlake, Exeter, Stokes Mountain, Orange Cove South, Auldand, Rocky Hill, Visalia, CA

DWR WELL HYDROGRAPHS
SCE San Joaquin Cross Valley Loop DEIR
Visalia, California

By: SDE	Date: 09/05/2008	Project No. 14180.000
AMEC Geomatrix		Figure 2

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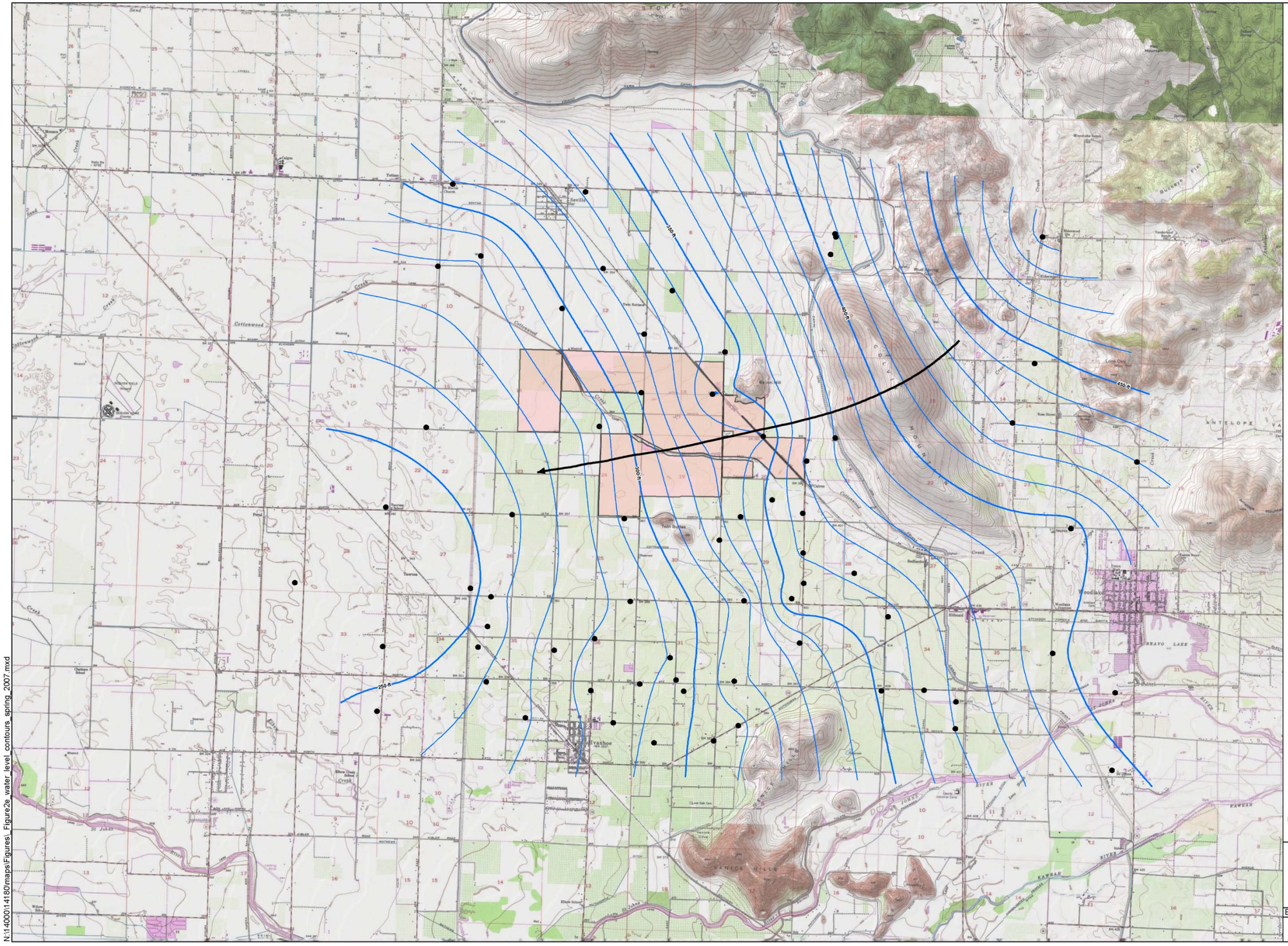

Explanation

- DWR well location
- 250 — Water surface elevation in fmsl
- Generalized direction of groundwater flow
- Ranch boundary

Notes:
1. fmsl = feet above mean sea level
2. Contour interval 10 feet

APPROXIMATE SCALE IN FEET

0 6,000

0 1,800

APPROXIMATE SCALE IN METERS

Note: Base map modified from U.S.G.S. 7.5 minute topographic quadrangle maps Monson, Ivanhoe, Woodlake, Exeter, Stokes Mountain, Orange Cove South, Aukland, Rocky Hill, Visalia, CA

WATER SURFACE ELEVATION - SPRING 2007
SCE San Joaquin Cross Valley Loop DEIR
Visalia, California

By: SDE	Date: 09/05/2008	Project No. 14180.000
AMEC Geomatrix		Figure 3

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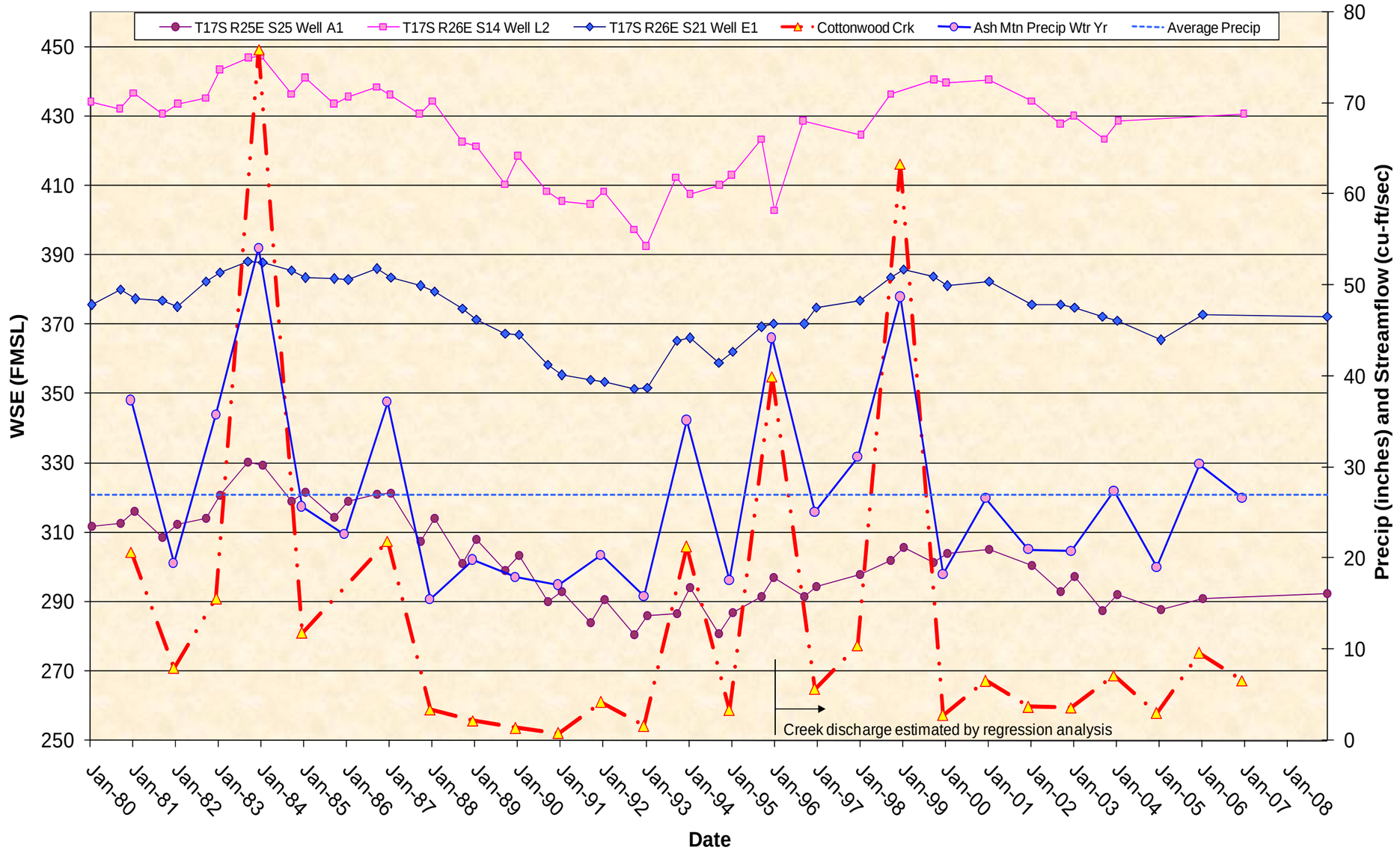
Groundwater Level, Precipitation, and Streamflow



CORRELATION BETWEEN PRECIPITATION,
STREAM FLOW, AND GROUNDWATER ELEVATION
IN COTTONWOOD CREEK VALLEY

SCE San Joaquin Cross Valley Loop DEIR
Visalia, California

By: dmb	Date: 07/29/09	Project : 14180.001
AMEC Geomatrix		Figure 4

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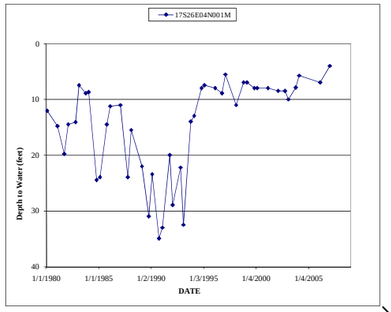

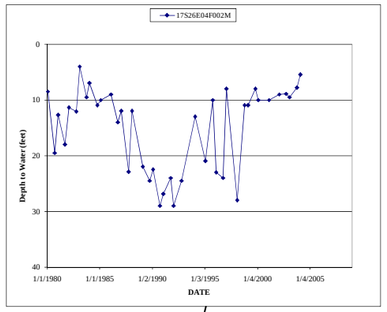

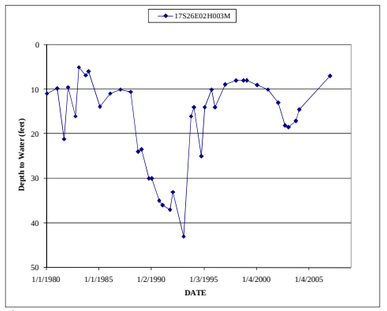

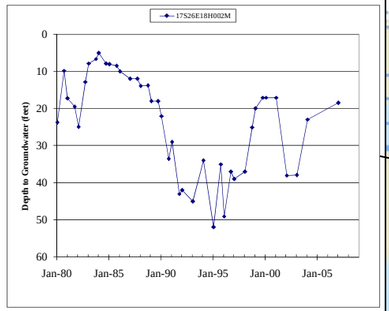

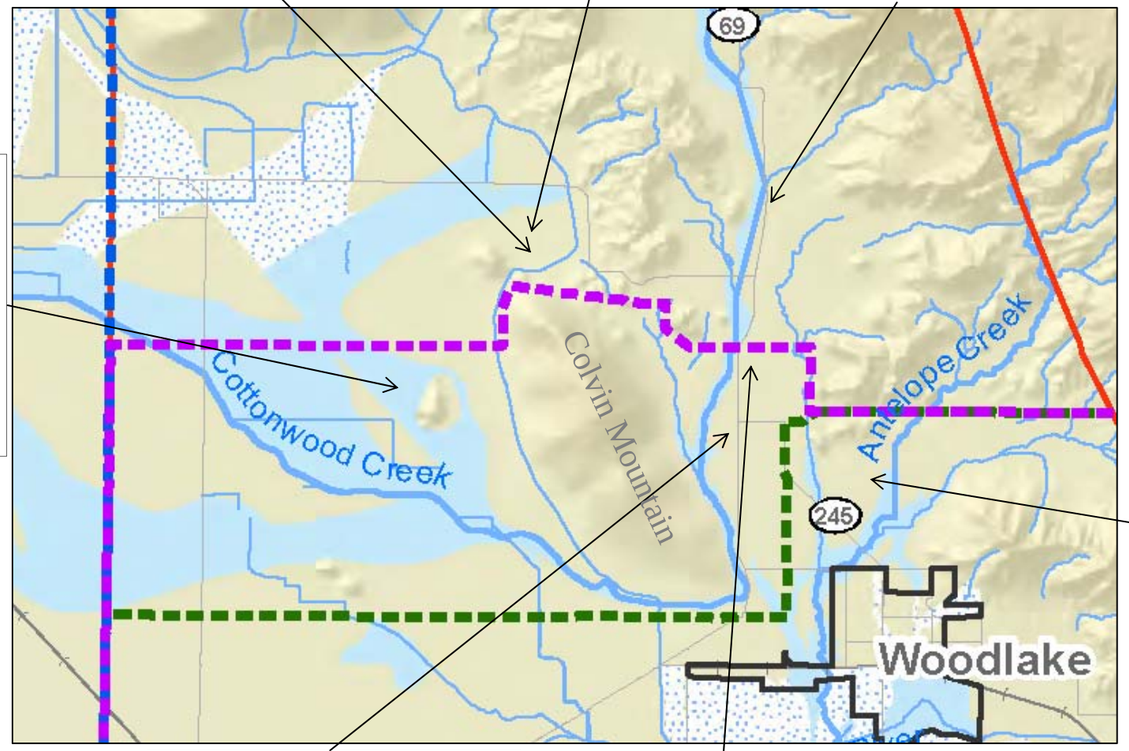

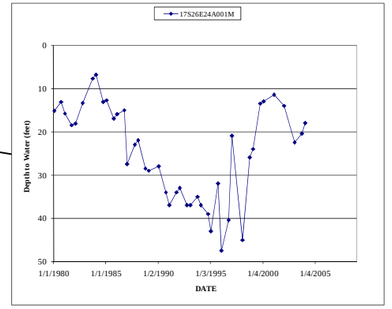

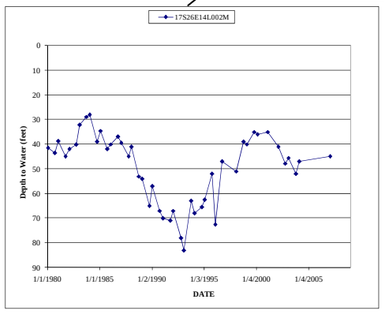

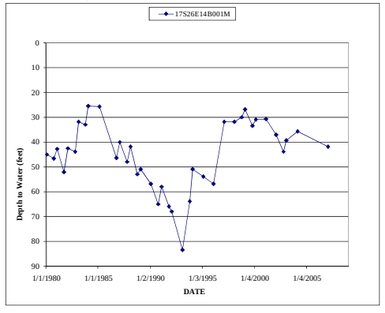

Explanation

- Alternate Route 2
- Alternate Route 6
- Existing 220 Kilovolt Transmission Lines

HYDROGRAPHS OF SELECTED WELLS SHOWING RELATIONSHIP BETWEEN GROUDNWATER IN COTTONWOOD CREEK VALLEY, ANTELOPE VALLEY, AND WEST OF COLVIN MOUNTAIN

SCE San Joaquin Cross Valley Loop DEIR
Visalia, California

By: dmb	Date: 07/29/09	Project : 14180.001
AMEC Geomatrix		Figure 5

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