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Innovative Strategies for Environmental and Natural Resource Management

Water Supply Assessment

Solargen Panoche Valley Solar Farm

Panoche Valley, California

Submitted to County of San Benito

by Geologica Inc.

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EXECUTIVE SUMMARY

Solargen Energy Inc. (Solargen) is developing a 420MW solar photo-voltaic power generation facility on approximately 4,885 acres in Panoche Valley, San Benito County California. The proposed Project is currently in the preliminary design and permitting phase. GEOLOGICA has prepared this Water Supply Assessment (WSA) for the proposed Project to assess whether sufficient water is available to meet projected demand subject to reasonably foreseeable variations in climatic conditions pursuant to the provisions of Senate Bill (SB) 610. Because there is no public water system to serve the Project, the County of San Benito, as the lead agency for the Project under CEQA, is responsible for preparing the WSA.

The proposed Project, known as the Panoche Valley Solar Farm, requires water for dust control during the phased construction as well as for washing of solar panels during operations. The only water supply available in Panoche Valley is groundwater from the Panoche Valley aquifer, which is an unadjudicated groundwater basin.

Panoche Valley is located approximately 35 miles southeast of Hollister, CA between the Diablo Range Mountains to the west and the Panoche Hills on the east. The valley floor comprises approximately 12,000 acres; the entire Panoche Valley groundwater basin consists of approximately 33,000 acres. Sediments that fill the basin consist of intermingled and interbedded gravels and clays. There are approximately 47 water wells in the groundwater basin, mainly on the valley floor. Available data suggests that most of these wells produce water from one or more gravel zones within the upper 80 to 400 feet of valley fill, and that these zones vary between wells less than 100 feet apart. At least two wells appear to be completed in deeper zones, perhaps as deep as 1,000 feet.

The existing water wells in the valley were originally drilled for irrigation, domestic use and for livestock water. Although significant pumping for irrigation was conducted throughout the valley through the early 1970s, it is now limited to a few hundred acres southeast of the site. With declining irrigation and groundwater extraction, groundwater levels have risen from approximately 100 feet below ground surface (bgs) during the period of significant irrigation to between 30 and 60 feet bgs at the most recent measurements (GEOLOGICA, 2010).

Current groundwater use in the valley is estimated to total approximately 180 acre-feet per year (AFY). The extraction rate is lower in winter when livestock need less water and there is no irrigation. Approximately 7.5 AFY of groundwater is currently extracted from wells located on the project site for livestock watering. Anticipated project water needs range from approximately 18 to 37.4 AFY during the proposed 5-year phased project construction period, stabilizing at approximately 25.5 AFY during long-term operations. As cattle grazing is phased out and replaced by winter sheep grazing, water demand for livestock watering will be reduced to 0.35-0.56 AFY, primarily during the winter wet season.

Water quality within the valley is generally acceptable for drinking water; groundwater meets the EPA and California Primary Drinking Water Standards, but some wells in the southern part of the valley and some of the deeper wells do not meet the secondary standards (for taste and aesthetics) and therefore the water may not be desirable for drinking water. Irrigation with on-site groundwater may not be suitable for all crops due to elevated concentrations of boron, sodium and to a lesser extent, total dissolved solids and conductivity.

A water budget for the Panoche Valley groundwater basin was developed using published data and information. This analysis indicated that the basin receives approximately 21,000 AFY of precipitation during a normal/average year (and no other influx), of which 9,870 acre-feet is lost from runoff, 8,243 acre-feet is lost from evapo-transpiration, 180 acre-feet is extracted for current uses including domestic supply, livestock watering, and limited irrigation. Based on the difference between inflow and outflow components, normal/average aquifer recharge was estimated to be approximately 2,700 AFY. Although these numbers may vary with annual variations in precipitation, groundwater usage, and run-off, and site specific data were limited for several components of the water budget, the observed rise in the water table (since irrigation declined) supports the conclusion that the Panoche Valley aquifer is currently being recharged by precipitation infiltration.

The reliability of the water supply available to meet demand in the valley was assessed assuming that annual groundwater recharge is directly proportional to annual total precipitation, and, consequently, that proportionately less recharge occurs in dry years than in wet years. A review of the rainfall record for the valley obtained from the Western Regional Climate Center indicates that 1953 had the lowest single year precipitation total while the rainfall totals in 1988, 1989, and 1990 were the driest three year period in the record for the valley. These data were used to estimate groundwater supply for normal/average, a single dry year, and a multi-year period for comparison to projected groundwater demand. Water needs for the project were estimated for the construction phase, expected to take approximately 5 years, and operational years in 5 year increments. Water needs for the project are projected to rise from 18 AFY the first year, to 37.4 AFY the fifth year (including 18 AFY demand for construction and 19.4 AFY demand for Phase 1-4 facility operations), and thereafter remain constant at approximately 25.5 AFY. Non-project water needs in Panoche Valley were conservatively projected to increase from approximately 180 AFY currently to approximately 216 AFY in 20 years assuming a 1% annual growth in domestic, irrigation, and livestock water needs in the valley.

In all cases, available supply in the form of groundwater recharge from precipitation infiltration is expected to exceed demand, even in the event of three successive dry years. Impacts to water quality from the proposed Project are expected to be less than significant.

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1. INTRODUCTION

The 420 megawatt (MW) Panoche Valley Solar Farm will be located on approximately 4,885 acres. At build-out the Panoche Valley Solar Farm will consist of approximately 3,000,000 to 4,000,000 pole-mounted, silicon-based solar photovoltaic panels and associated electrical equipment, an electrical substation, and an operations and maintenance building. The project will be built in 5 phases over 5 years. Phase one of the Project will be approximately 20 megawatts (MW) in size and the remaining phases will be approximately 100MW each.

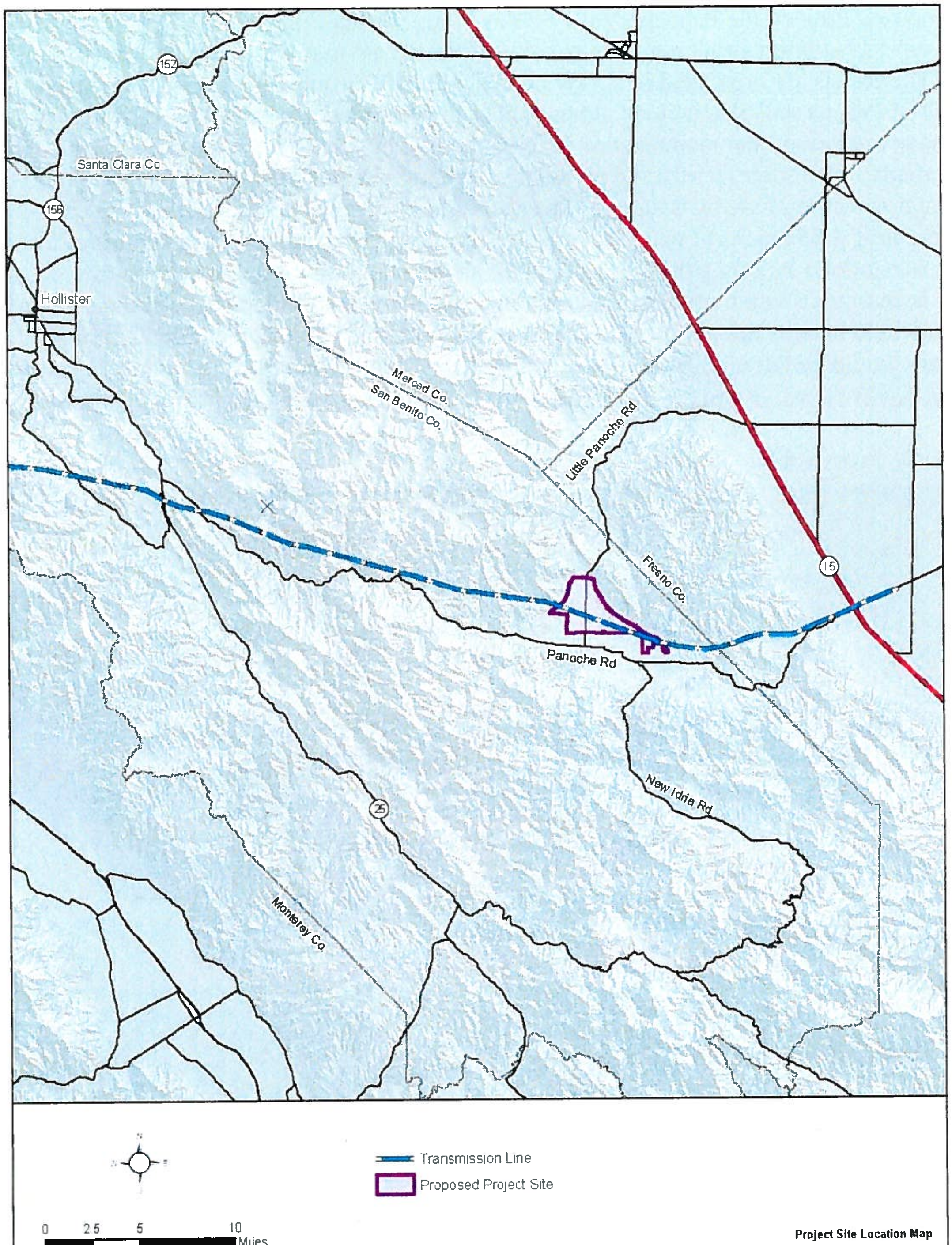
In consideration of the proposed Project, San Benito County (County), the Lead Agency under the California Environmental Quality Act (CEQA), is conducting an environmental review to support preparation of an Environmental Impact Report (EIR) for the Panoche Valley Solar Farm project. The environmental review includes providing an assessment of water supply adequacy for the proposed Project.

The California Water Code (Water Code) Sections 10910 through 10915 were amended by the enactment of Senate Bill 610 (SB 610) in 2002. SB 610 requires an assessment of whether available water supplies are sufficient to serve the demand generated by the Project, as well as the reasonably foreseeable cumulative demand in the region over the next 20 years under average normal year, single dry year and multiple dry year conditions. This report provides an assessment of the available water supply to serve the proposed Project, based on the sections of the Water Code amended by SB 610.

1.1 PROJECT LOCATION

The proposed Project would be located approximately 0.75 miles north of the intersection of Panoche Road and Little Panoche Road, in eastern San Benito County (see **Figure 1**). The site is located approximately 2 miles southwest of the Fresno County Line and the Panoche Hills, and approximately 15 miles west of Interstate 5 and the San Joaquin Valley. The project would be located within Township 15S, Range 10E, Sections 3-5, 8-11, 13-17, and 20-25 and Township 15S, Range 11E, Sections 18, 20, 29, and 30 of the United States Geologic Survey's Cerro Colorado, Llanada, Mercy Hot Springs, and Panoche 7.5-minute topographic quadrangle maps.

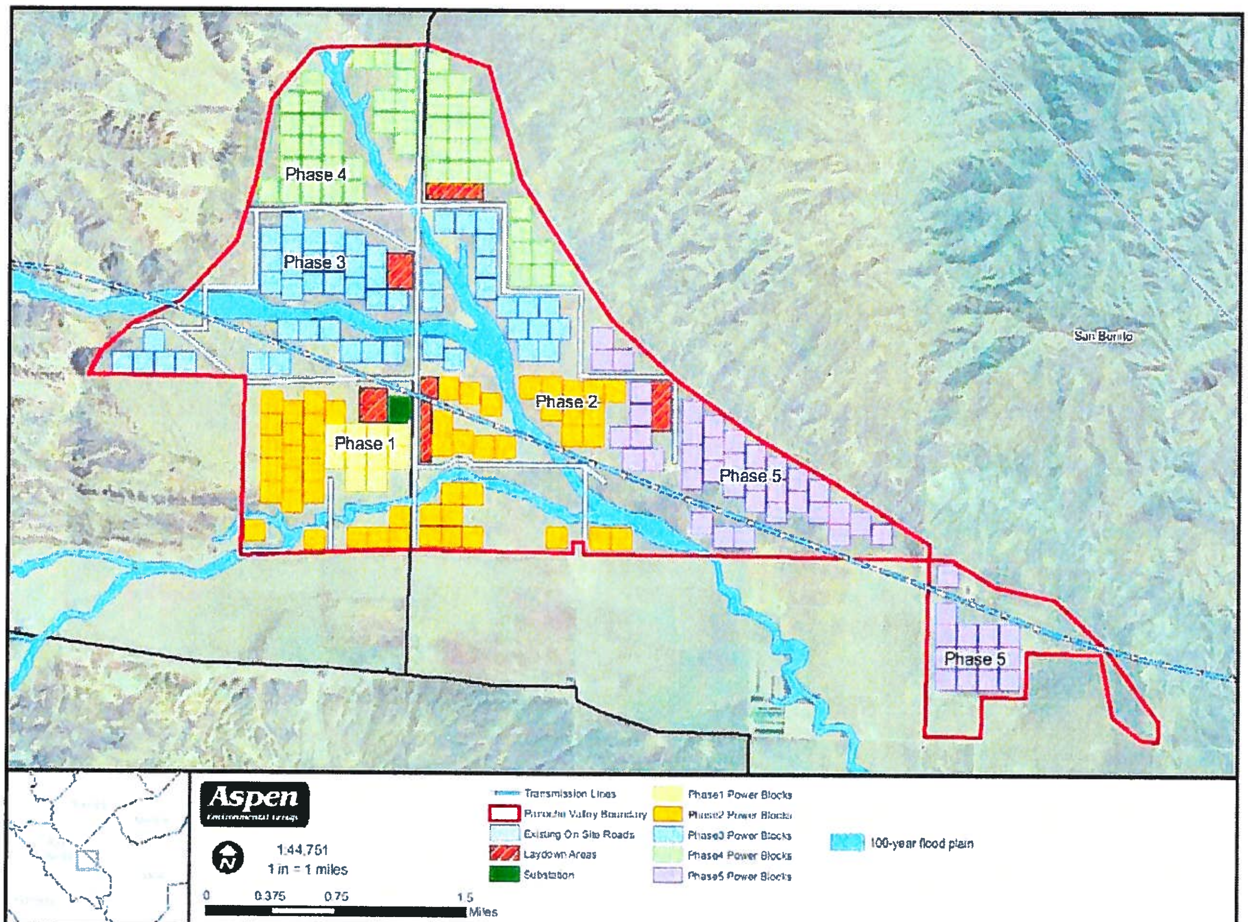
Figure 1. Project Site Location Map



1.2 PROJECT DESCRIPTION

The proposed Project, the Panoche Valley Solar Farm, includes pole-mounted photovoltaic panels on steel support structures. The panels will be placed in rows approximately 15 to 65 feet apart. The panels are organized in 2 MW blocks with one or more inverter and a transformer per block. The Project will also include, among other improvements, a substation, a water treatment system, an operations and maintenance (O&M) facility, high-voltage collection system, and access roads. The solar facility and all associated components would be located on property under option for purchase by Solargen. The proposed Project would be installed over an area of approximately 4,885 acres (7.6 square miles). However, the proposed design confines the solar arrays, substation (including the O&M building and transmission interconnection towers), and on-site access roads to a footprint of approximately 2,437 acres, and buried electrical collection conduit would occupy approximately 37 acres. The remaining acreage within the project boundary would be left undisturbed. Undisturbed areas would include on-site drainages and riparian buffer zones. **Figure 2** illustrates the layout of the proposed Project on the property.

Figure 2. Proposed Site Layout



June 2010

The proposed Project will be constructed in phases as follows:

Table 1. Planned Construction Phases

Phase#	MWe	Other Components	Construction Year	Operations Year
Phase 1	20 MW	Substation, O&M, R.O. facilities	1	2+
Phase 2	+100 MW	-	2	3+
Phase 3	+100 MW	-	3	4+
Phase 4	+100 MW	-	4	5+
Phase 5	+100 MW	-	5	6+

1.3 PUBLIC WATER SYSTEM INFORMATION

The proposed Project is located in an unincorporated area in eastern San Benito County. No existing public water system services the Project area. No state regulated public water systems were identified in the Panoche Valley groundwater basin[1]. Two small water systems which are not regulated by the state were identified in Panoche Valley. These consist of the water well and ancillary equipment supplying the Panoche Inn at 29960 Panoche Road, and, a water well and ancillary equipment supplying the Panoche School at 31441 Panoche Road. The two small water systems utilize groundwater from the Panoche Valley aquifers for drinking water supply. All water for the proposed Project would come from groundwater supply wells owned and operated by the Project proponent, Solargen, located on the Project property.

1.4 WATER SUPPLY PLANNING UNDER SB 610

SB 610 was passed in 2002 and amended Sections 10910 through 10915 of the California Water Code by requiring that a Water Supply Assessment (WSA) be completed for certain types of development projects subject to CEQA. The County has concluded that the Panoche Valley Solar Farm Project is not a "project" as that term is defined in Water Code 10912 and that a WSA is not required under SB-610. Nevertheless, the County has decided to prepare a WSA for the Panoche Valley Solar Farm Project in order to provide additional information on the potential impacts of the proposed Project. The purpose of the WSA presented in sections that follow below is to determine whether there are sufficient supplies of water to serve the Project over the next 20 years, and, to evaluate the reliability and vulnerability of the water supply for the Project to seasonal or climatic shortages in the average water year, a single dry water year, and multiple dry water years.

2. PROPOSED PROJECT WATER CONSUMPTION/ WATER RIGHT

Water consumption for the proposed project includes dust control during construction, and panel washing plus fire protection and domestic needs for the on-site O&M facilities during the operational life of the project. To optimize power generation from the proposed Project, the photovoltaic panel surfaces would be washed twice annually during the dry season. The panel

[1] Telephone communication with Jan Sweigert, California Department of Public Health, Drinking Water Program, District 5, September 23, 2010.

washing crew would traverse the site in a small all terrain vehicle, which would be fitted with a trailer containing a water tank and pump to operate a high pressure sprayer. Total annual consumption for panel cleaning was estimated based on cleaning panels twice yearly, but only during the dry season from April through November, and assuming that approximately one gallon/panel is required for cleaning, plus a 30% contingency. Estimates of the amount of water needed for construction dust control were provided by Power Engineers, Inc. (PEI). Groundwater will also be pumped for domestic needs of the O&M facility and for fire suppression requirements (approximately 16,000 gallons per year, or 0.05 AFY) and sheep grazing (0.35-0.56 AFY) on the project property. Total projected annual water consumption is presented in the **Table 2**.

Table 2. Panoche Valley Solar Farm Estimated Water Consumption*

Year	1	2	3	4	5	10	15	20
Cleaning Operations								
Plant Capacity (MW)		20	120	220	320	420	420	420
panels		197,531	1,185,185	2,172,839	3,160,494	4,148,148	4,148,148	4,148,148
gallons of water required/year		395,062	2,370,370	4,345,679	6,320,987	8,296,296	8,296,296	8,296,296
pumping rate (gpm)	0	1.13	6.76	12.40	18.04	23.68	23.68	23.68
pumping rate (AFY)	0	1.21	7.27	13.34	19.40	25.46	25.46	25.46
Facility O&M et al								
Fire suppression system supply & domestic water for O&M facility (AFY)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Live stock watering (sheep) (AFY)	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
gallons of water required/year	198,769	198,769	198,769	198,769	198,769	198,769	198,769	198,769
pumping rate (gpm)	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38
pumping rate (AFY)	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61
Construction								
gallons of water required/year	5,865,318	5,865,318	5,865,318	5,865,318	5,865,318	0	0	0
pumping rate (gpm)	11.16	11.16	11.16	11.16	11.16	0	0	0
Construction water needs (AFY)	18	18	18	18	18	0	0	0
Total Water Need								
pumping rate (gpm)	**11.5**	**12.7**	**18.3**	**23.9**	**29.6**	**24.1**	**24.1**	**24.1**
pumping rate (AFY)	**18.6**	**19.8**	**25.9**	**31.9**	**38**	**26.1**	**26.1**	**26.1**

See detailed assumptions below.

*Source: Geologica (2010)

Assumptions in Table 2

1. 7407 solar panels per megawatt
2. 1 gallon of demineralized wash water needed per panel per washing event plus a 30% contingency
3. 2 washing events per year
4. Dry season duration in minutes = 350,400
5. Assumes 24/7 operations, cleaning water pumped only in dry season
6. Water needs for livestock watering estimated to range from 0.35-0.56 AFY; 0.56 AFY used for projected future use

Based on these calculations it is estimated that the annual water needs of the proposed project range from approximately 18 to 38 AFY over the first 5 years and approximately 26.1 AFY after construction of 420 MW of solar generation is completed and operating. Water will be pumped at a maximum rate of 11 to 30 gpm during the dry season and slightly over 11 gpm during the wet season during the construction phase. During the operational phase of the project, groundwater pumping will be limited to the dry season (April to November). This annual consumption will be needed over the life of the project.

The Panoche Valley groundwater basin is an unadjudicated groundwater basin. Owners of land overlying an unadjudicated groundwater basin commonly have a right to withdraw groundwater for reasonable beneficial use on their property without a license or permit (CDWR, 2009).

3. Water Supply

Residents of Panoche Valley utilize local groundwater as their sole source of water supply. Sections below describe the geologic setting, identified groundwater-bearing zones, and estimated hydrologic budget for the Panoche Valley groundwater basin.

3.1 Geologic Setting

Panoche Valley is a northwest-southeast trending basin comprised of shallow alluvium underlain by Quaternary non-marine terrace deposits and Plio-Pleistocene non-marine sediments. The easternmost Diablo Range provides the northwest boundary and consists of Franciscan Formation. The northeast and southeast boundaries consist of Upper Cretaceous marine sedimentary rocks of the Great Valley sequence while Lower Miocene marine rocks form the southwest basin boundary[2]. The valley was formed by the uplift of the Diablo Range and the late Quaternary folding uplift of the Panoche Hills.[3]

The rapid formation of the valley caused it to fill with coarse-grained sediments conducive to the transmission of groundwater. The non-marine terrace deposits and sediments which fill the basin represent a complex of coalescing alluvial fans and local drainage fills eroded from the rising Diablo Range (Franciscan Formation). These deposits form series of stream terraces and nested and overlapping alluvial fans. The upper 1,000 feet or more of the surficial sediment deposits are

[2] Bulletin 118, Subbasin 5-23, Panoche Valley Groundwater Basin, 2003
[3] Lettis, William,1982.USGS OFR 82-526.

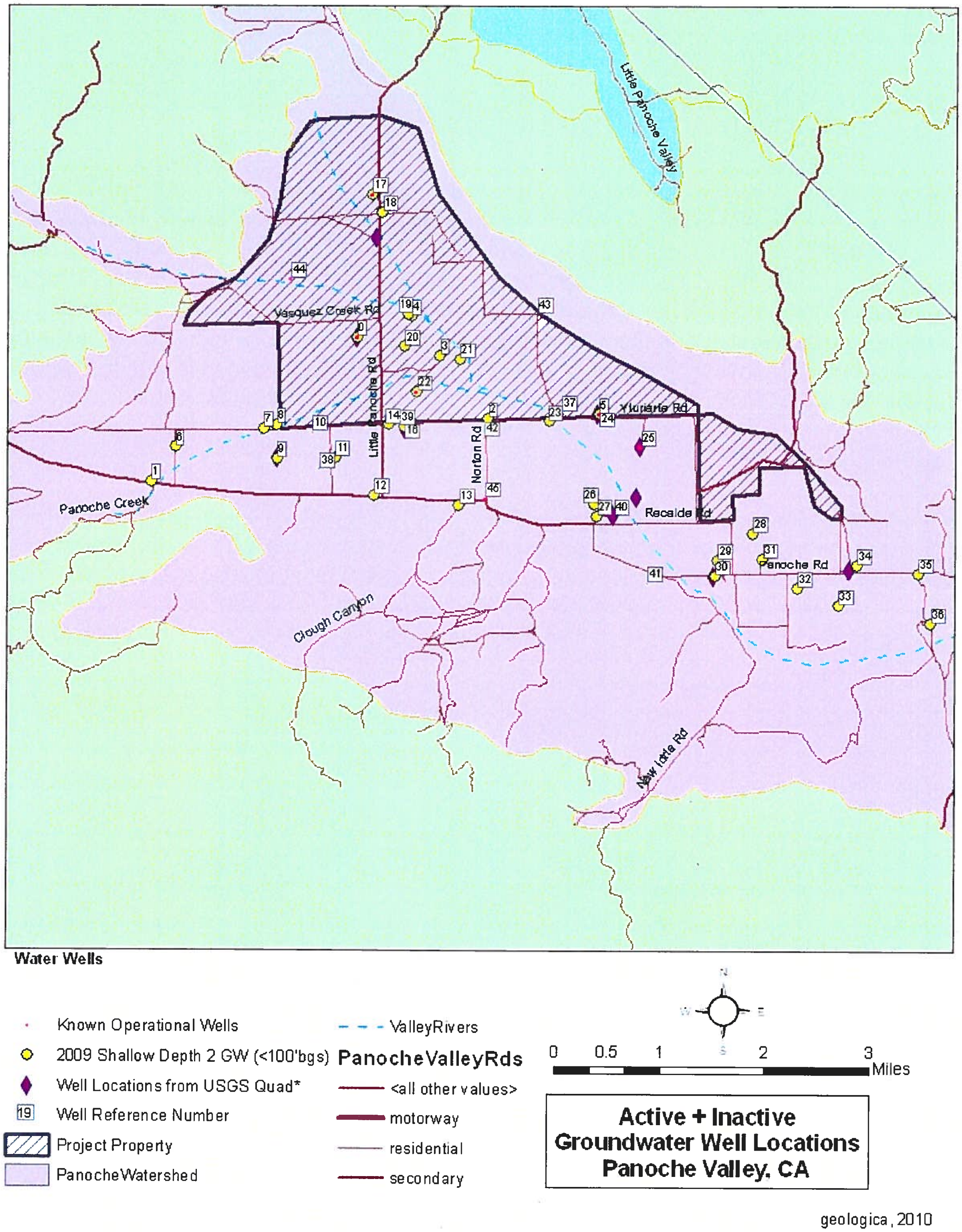
comprised of intermingled and interbedded gravels and clays with lateral discontinuity resulting from the complex and dynamic depositional environment of overlapping of fluvial and alluvial deposits.

3.2 GROUNDWATER-BEARING ZONES

Based on well logs, water levels, and groundwater chemistry, the Panoche Valley groundwater basin appears to have two primary groundwater-bearing zones, each divided into smaller sub-zones. The upper aquifer appears to be subdivided into 2 to 3 zones, one from 90 to 170 feet below ground surface (bgs), and the others between 180 and 400 feet bgs. Driller logs identify zones of higher permeability, mostly gravels, within these aquifers that are semi-confined by alternating discontinuous layers of silts and clays (GEOLOGICA, 2010). Many of the wells in the valley were drilled to roughly 600 feet bgs, but then finished in the 200 to 400 foot deep range, as sediments encountered below depths of 400 feet bgs tend to be comprised primarily of silts and clays with no significant groundwater yield. The locations of wells identified in the valley are shown in **Figure 3**.

Based on personal correspondence with local residents, it is estimated that at least two wells (#10 and #25) are over 1,000 feet deep and at least one of these (#10) reportedly produced 600 to 700 gallons per minute (gpm) for crop irrigation during a period of more intensive agriculture in the 1970's. These wells are distinguished by generally greater depth to water, approximately 200 ft bgs, compared to water levels of 50 to 100 ft bgs for shallower wells in the valley, and differing water chemistry.

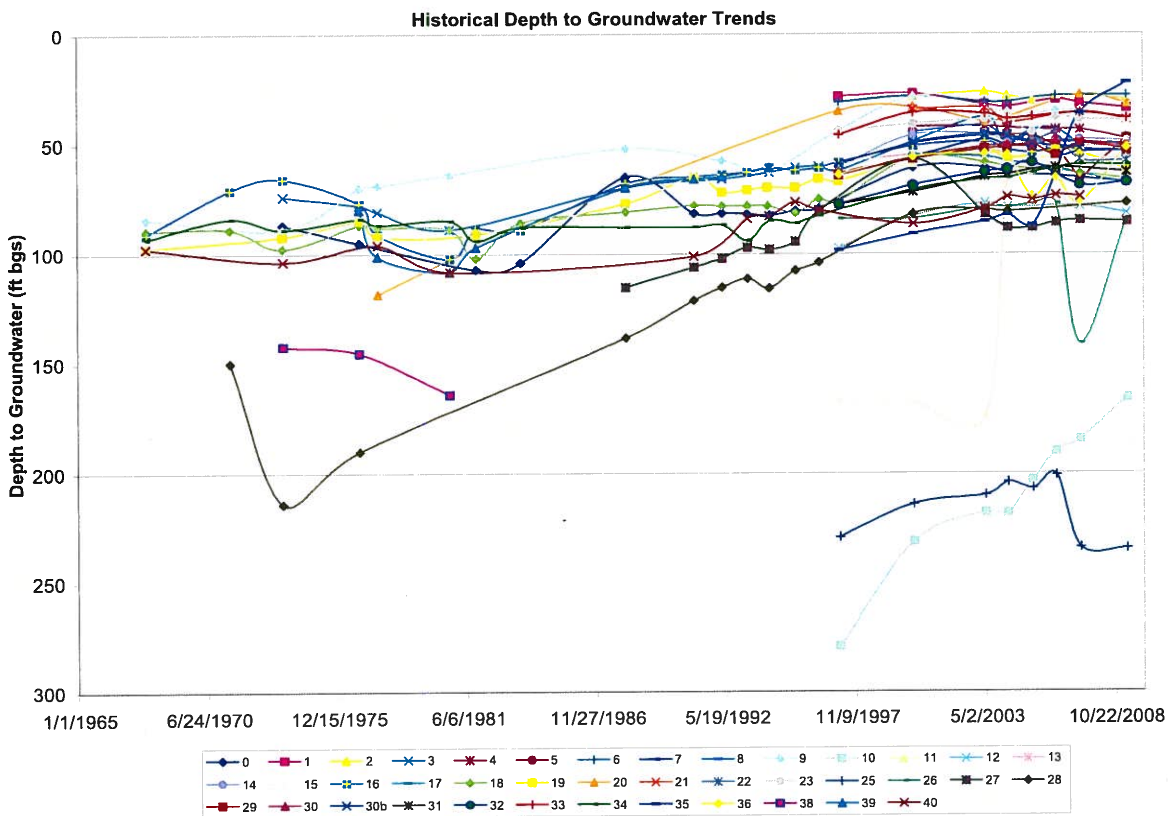
Figure 3. Locations of Wells Identified in Panoche Valley



3.3 DEPTH TO GROUNDWATER

As part of their groundwater resources database, the California Department of Water Resources (CDWR) collects data on water wells across the state. In the Panoche Valley, CDWR has data for depth to groundwater since the late 1960s. The data available includes initial water levels recorded on driller's well logs and sporadic, sometimes, annually, other times every 5 or so years, until the late 1990s when annual monitoring began. Well locations are shown on **Figure 3**. These data are summarized on **Figure 4**.

Figure 4. Summary of Historical Depth to Groundwater Measurements in Wells in Panoche Valley



The groundwater levels and the general depth to groundwater have changed dramatically over the last half century as the agricultural uses have evolved within the valley. The CDWR (2003) reported in *California's Groundwater (Bulletin 118 - Update 2003)* that there was a general trend of rising water levels in Panoche Valley from the 1970's to 2000 noting that water levels rose as much as 130 feet and typically over 40 feet over the entire basin in that period. Field reconnaissance by CDWR staff identified less than 40 acres of irrigated agricultural land in the valley in August 2001. CDWR (2003) reported that discussion with a life long resident of Panoche Valley indicated that extensive areas of alfalfa were in production in the 1940's, and cotton was grown over large areas in the 1950's and 1960's. Both crops need significant irrigation water for successful crops. The amount of irrigated acreage reportedly peaked in the early 1970s and has decreased to a few acres in the southeast part of the valley today

(GEOLOGICA, 2010). As shown on **Figure 4**, groundwater levels in the Panoche Valley have risen steadily from low levels observed in the early 1970s, with the most rapid rise in the late 1970's and 1980's. With the exception of a few wells that exhibit more variable depth to water, within the last 5 years, groundwater levels appear to be stable or slowly rising in many wells in the valley.

3.4 PANOCHE VALLEY WATER BUDGET

The extent of the 33,000 acre[4] Panoche Valley watershed is shown on **Figure 4**. Principal inflow and outflow components are discussed below. Limited data are available to estimate hydrologic budget components.

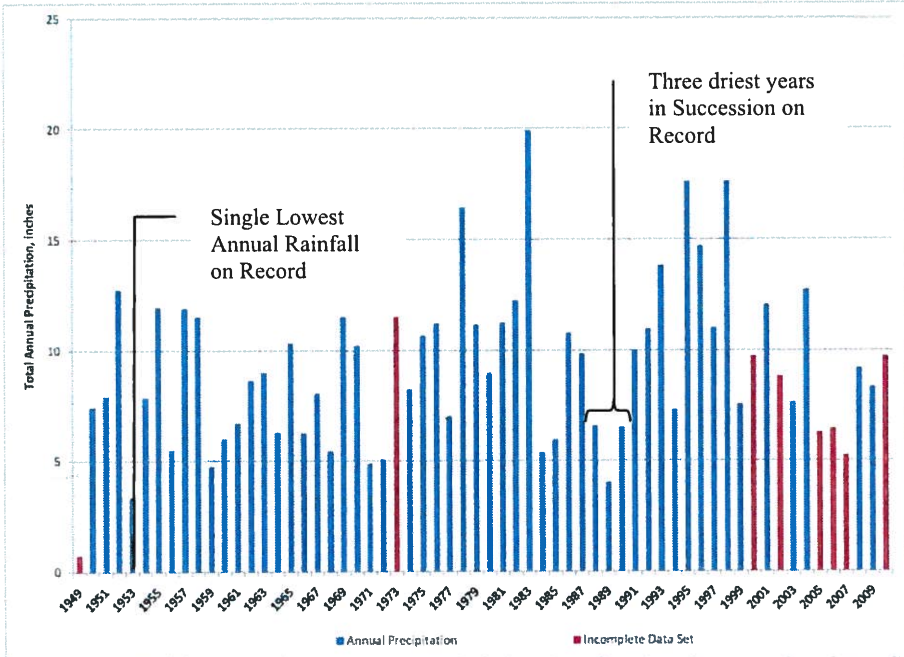
3.4.1 Rainfall

In flux of water into Panoche Valley is limited to rainfall within the drainage basin. Average rainfall[5] varies over the Panoche Valley, with 10-12 inches of rain falling annually on the western edge of the valley, and as little as 5-6 inches falling to the north and east. An average value of 7 inches of precipitation was estimated for the approximately 12,000 acres of range land in the valley floor and 8 inches per year in the surrounding 21,000 acres of sparsely vegetated uplands yielding a total of approximately 21,000 AFY of potential precipitation recharge for the Panoche Valley Basin.

Total annual precipitation recorded at the Panoche Valley weather station for the Western Regional Climate Center (WRCC) from 1949 to 1995 averaged 9.69 inches (WRCC, 2010). The driest single year with a complete data set was recorded in 1953 with a total precipitation of 3.34 inches, or 35% of the average annual precipitation. The driest three year period with a complete data set was recorded between 1988 and 1990 with annual rainfall totals of 6.55, 4.01, and 6.49 inches (WRCC, 2010). Data for total annual precipitation in Panoche Valley from the WRCC are illustrated on **Figure 5**.

[4] "Digital Map of the Hydrogeologic Provinces of California." USGS. GIS Shapefile. 2003
[5] Bulletin 118, Subbasin 5-23, Panoche Valley Groundwater Basin, 2003

Figure 5. Annual Precipitation Totals Recorded in Panoche Valley



3.4.2 Stormwater Runoff and Potential Infiltration

GEOLOGICA (2010) estimated stormwater runoff coefficients for the valley floor and upland portions of the watershed using the procedure described in the CalTrans Stormwater Handbook (2007) as tabulated in **Table 3** below:

Table 3. Stormwater Runoff Coefficients of Valley and Hillsides

	Valley Floor		Upland Areas	
Relief	Flat	0.1	Hilly	0.25
Soil Infiltration Potential	Normal	0.06	Slow	0.1
Vegetal Cover	Excellent	0.06	Poor to fair	0.1
Surface Storage	Low	0.09	negligible	0.1
Runoff Coefficient		0.31		0.55

Lower runoff coefficients for an alpine grassland environment have been reported in the literature at roughly 0.18-0.25 depending on land usage, seasonal variations, and density of surface soils.[6] Using the runoff coefficients estimated from the CalTrans Handbook, average runoff rates of 2,170 AFY and 7,700 AFY were estimated for the relatively flat valley floor and

[6] Leitinger, Georg, et al. "Seasonal dynamics of surface runoff in mountain grassland ecosystems differing in land use". Journal of Hydrology, May 2010, Pages 95-104

hilly upland areas, respectively. These correspond to potential infiltration rates (direct precipitation minus runoff) of approximately 4,830 and 6,300 AFY, for the valley floor and upland areas, respectively, based on the assumed rainfall distribution discussed in Section 3.4.1.

3.4.3 Evapotranspiration

Evapotranspiration (the combination of water lost by evaporation and transpired by plants) is a significant hydrologic outflow component. Evapotranspiration (ET) rates are highly variable, depending on seasonal characteristics, plant cover, climatic conditions, and precipitation rates. ET in arid desert grasslands tends to be highest during peak growing seasons and lowest in dry and dormant periods.[7] The Panoche Valley maintains two peak natural growing seasons (without the influence of irrigation) in the spring and fall. In the spring, primary growth is roughly late February through late April, when rain is most prevalent and temperatures begin to warm again. During the summer months, conditions become too arid and without irrigation, the grasses covering most of the valley floor dry up. In the fall rain again falls and re-stimulates growth. In winter months, it is not uncommon for temperatures to drop to freezing points and grassland growth becomes more dormant.

Within the Panoche Valley, grasslands are primarily found along the roughly 12,000 acres[8] of valley floor. However, the entire groundwater basin is more than 33,000 acres. The remaining ecosystems within the basin are primarily low vegetative hillsides which encircle the Valley and contribute the primary groundwater recharge within the valley. Land cover consists primarily of sparse grasses and occasional oak trees and other low growth native trees.

During peak growing seasons, arid grassland ecosystems may see monthly averaged evapotranspiration rates peak around 2 mm per day. In dormant and cold months ET rates may average as low as 0.15 mm per day.[9] For an eco-climate similar to that of the Panoche Valley floor, annual evaporation averages roughly 300 mm per year. However, the thin ground cover and sparse wooded regions of the surrounding hillsides demand far less water, with an average evapotranspiration rate of roughly 50 mm per year. Applying the average ET rate of 50 mm per year to the estimated 21,000 acres of upland areas yields an average annual ET rate of approximately 3,400 AFY. For the valley floor, assuming an evapotranspiration rate of 300 mm per year would yield a potential annual ET rate of over 11,000 AFY; however, this exceeds the potential infiltration rate of approximately 4,830 AFY, consequently, for the hydrologic budget calculation, we assumed that the annual ET rate in the valley floor would be on the order 4,830 AFY.

3.4.4 Current Water Use in Panoche Valley

As noted previously, residents, businesses, schools, and landowners in Panoche Valley utilize local groundwater as their sole source of water supply. Groundwater is obtained from water wells located on the subject property and throughout Panoche Valley as shown on **Figure 4**. A

[7] Mielnick, P. et al, "Long-term measurements of CO2 flux and evapotranspiration in a Chihuahuan desert grassland", Journal of Arid Environments. September 15, 2004.
[8] Based on personal correspondence with local rancher Ronnie Douglas, April 8, 2010.
[9] Ibid. Mielnick, 2004

survey of water use in the Panoche Valley groundwater basin was conducted in April 2010; field observations and assumptions used to estimate water use are detailed in Appendix 5 of the Panoche Valley Hydrologic Study (GEOLOGICA, 2010). The field well survey identified a total of 47 water wells in the valley. Of these, 21 of the wells were inactive in April 2010, the remainder are currently used for domestic supply, livestock watering, and/or irrigation. Note that some of the wells are used for multiple purposes.

- Domestic Supply – For calculating human consumption, an estimate of 50 gallons per day per person was used to cover consumption and domestic needs within a household. Seven residences with active wells were identified that are used for domestic supply purposes with an average of three people per household. In addition, the Panoche Inn restaurant property and the Panoche School pump water from wells for domestic supply purposes. Total current water use for domestic supply in the basin was estimated to be approximately 2 AFY.

- Livestock Watering – Based on discussion with local ranchers, requirements for watering cattle range from approximately 2 gallons per day per animal in winter and to approximately 20 gallons per day per animal in summer. Sixteen wells primarily serving cattle watering needs were identified in the basin. The McCullough property well is also used to provide water for 50 to 75 cattle. The Douglas ranch well at the south end of the valley provides water for a variety of livestock including 30 cattle, one buffalo, 12 to 15 horses, and approximately 2 dozen sheep. In addition, the well on another property at the south end of the valley is used to provide water for approximately 100 chickens. Total current water use for livestock watering in the basin was estimated to be approximately 25 AFY.

- Irrigation – The largest current consumer of water in the valley is the Saunders organic farm in the southeastern end of the valley, which irrigates its crops throughout the year, but to a varying degree depending on weather and crop type. Based on discussion with a neighbor, irrigation usage was estimated at roughly 600 gpm for 5 hours/day during the summer growing season, which is a little over 180,000 gal/day. Groundwater from the Panoche Valley groundwater basin is also used for irrigation on the Douglas ranch, the McCullough homestead, and two other properties in the valley (GEOLOGICA, 2010, Appendix 5). Total current water use for irrigation in the basin was estimated to be approximately 153 AFY.

The summary above includes two small water systems located in Panoche Valley which are not regulated by the state. These include the water well and ancillary equipment supplying the Panoche Inn at 29960 Panoche Road, and, a water well and ancillary equipment supplying the Panoche School at 31441 Panoche Road. The Panoche Inn was estimated to use approximately 0.3 AFY for water supply for the restaurant and two nearby houses with three permanent residents. The Panoche School was estimated to use approximately 0.5 AFY for water supply purposes for 12 to 15 students and staff.

GEOLOGICA (2010) estimated total groundwater usage in Panoche Valley to range from between 58,000 gpd in the cold (wet) season from November to April and 240,000 gpd in the warm (dry) season) from May to October. Based on these results, current annual groundwater extraction in the valley was estimated to total approximately 180 AFY.

3.4.5 Current On-Site Water Use

Geologica (2010) estimated current groundwater use on the Project property (on-site use) to be approximately 7.5 AFY, of which 11% occurs in the wet season from November to April and 89% in the dry season from May through October. Water is withdrawn from six active wells on the Property for livestock watering only; no residential or irrigated agriculture occurs in this area.

3.4.6 Hydrologic Budget Evaluation

The principal inflow component in the hydrologic budget for the Panoche Valley groundwater basin is direct precipitation. Currently, there is a small amount of irrigated agriculture and associated irrigation return water. Panoche Creek, Bitter Root Creek, Aquilas Creek, Griswold Creek, and various unnamed intermittent streams that enter the valley from upland areas redistribute precipitation runoff in the valley but no net surface water flow into the valley was identified. Because the Panoche Valley aquifers are essentially isolated from adjacent groundwater systems by bedrock rises, no groundwater inflow is expected.

The principal outflow components consists of evapotranspiration, surface water discharge from Panoche Creek, groundwater flow out of the valley and existing groundwater extraction for domestic, irrigation, and stock watering wells. The potentiometric surface in the groundwater aquifers in the valley is located at least 50 feet bgs, consequently, little groundwater discharge to Panoche Creek occurs; surface water flows in Panoche Creek primarily result from stormwater runoff and to a lesser extent, recovery of bank storage. The valley aquifers appear to be in a more or less steady-state condition; water levels rose for several decades following the termination of large scale irrigated agriculture in the 1970's but appear to have stabilized within the last 5 years. The current groundwater flow rate out of the aquifer which is believed to occur primarily at the south end of the valley, was estimated as the difference between the total inflow components and the sum of outflow components (evapotranspiration, surface water runoff, and current pumping) and totals approximately 2,690 AFY as detailed in **Table 4** below. Because groundwater levels in the Panoche Valley aquifers are currently approximately steady, the net groundwater recharge rate which is composed of precipitation not lost to evaporation or runoff is equal to the groundwater outflow rate of approximately 2,690 AFY. The estimated 2,690 AFY groundwater recharge rate represents approximately 13% of the estimated 21,000 AFY of annual precipitation to the valley groundwater basin.

3.4.7 Current Groundwater Budget Condition

The CDWR noted in the 2003 update to Bulletin 118 – *California's Groundwater* that the Panoche Valley aquifer appeared to be "recovering from a past period of groundwater pumping", and, that the historic "development of wells and agriculture may have outpaced the ability of the basin to replenish itself and led to the discontinuation of widespread use of the groundwater resource". In other words, prior to the 1970's, the Panoche Valley aquifer likely was in an overdraft condition in which groundwater withdrawals for agriculture may have exceeded available groundwater recharge.

The CDWR (2003) did not comment on whether the Panoche Valley aquifer is currently in an overdraft condition. However, Bulletin 118 does note that water levels in the Panoche Valley aquifer have risen substantially from lower levels observed prior to 1970. Additional water level information collected by CDWR after the 2003 update to Bulletin 118 and water level measurements made by GEOLOGICA (2010) in the valley in April 2010, and, the general stabilization of water levels in wells in the valley illustrated on **Figure 4** support the conclusion that the Panoche Valley aquifer is currently not in an overdraft condition. As discussed in Section 3.4.6, the amount of groundwater available for use is limited by available groundwater recharge to approximately 2,690 acre-feet in an average/normal water year. Implications of the potential affects of drought conditions on the available groundwater supply are discussed in Section 3.6.

Table 4. Estimated Panoche Valley Groundwater Budget Calculations

Hydrologic Inflow Components		Rate Acre-ft/yr
Direct Precipitation		
Valley Floor	*7 in/yr over 12,000 acres*	7,000
Upland Areas	*8 in/yr over 21,000 acres*	14,000
Groundwater Inflow	*assumed negligible*	0
Surface Water Inflow	*assumed negligible*	0
Irrigation Return Flow	*assumed negligible*	0
	Total	21,000

Hydrologic Outflow Components		
Potential Evapotranspiration		
Valley Floor	*300 mm/yr over 12,000 acres*	4,830
Upland Areas	*50 mm/yr over 21,000 acres*	3,430
Groundwater Outflow	*Difference between sum of inflow and outflow components*	2,690
Surface Water Outflow	*Runoff Coefficient times Precipitation*	
Valley Floor	*C=0.31 over 12,000 acres*	2,170
Upland Areas	*C=0.55 over 21,000 acres*	7,700
Irrigation, Stock Watering, Domestic Supply Wells	*Based on Geologica, 2010 field survey*	*180*
	Total	21,000

As noted previously, the hydrologic budget components have considerable uncertainty. Data to develop a water budget are limited. A number of simplifying assumptions were factored into this evaluation.

3.5 AVAILABLE WATER SUPPLY

Based on the discussion in the preceding section, the average annual groundwater recharge rate to the Panoche Valley aquifers was estimated to be approximately 2,700 AFY, while current groundwater use in the valley was estimated at approximately 180 AFY. The amount of groundwater available to supply water users in the valley on average is at least 2,690 AFY, which is the estimated amount that can be recovered without "mining" the aquifer and reducing water levels in the Panoche Valley aquifers. Provided groundwater consumption in any year does not exceed groundwater recharge, no reduction in water levels is expected. Mitigation measures for the Project include measuring, recording and reporting groundwater use by the Project, as well as monitoring/reporting local groundwater levels to verify that the groundwater use required for the Project does not adversely impact other beneficial uses of groundwater in Panoche Valley.

3.6 WATER SUPPLY RELIABILITY ASSESSMENT

The water supply available for potential development without adversely impacting natural resources and other groundwater users in the valley was assumed to be equal to or less than the calculated groundwater recharge rate. For an average or normal water year, the amount of groundwater recharge was calculated based on the mean annual precipitation recorded in Panoche Valley of 9.69 inches based on data obtained from the WRCC (2010). Less groundwater recharge occurs in dry years with the estimated annual recharge assumed to be directly proportional to the annual precipitation total. For the driest year on record which was observed in 1953 with 3.34 inches of precipitation, groundwater recharge was assumed to be reduced to 34% of the amount available in a normal year; the amount of annual groundwater recharge occurring in three successive dry years was similarly estimated to be reduced in proportion to the available precipitation infiltration. Estimated groundwater recharge rates (water supply) available for normal and dry year conditions are tabulated in **Table 5**.

Table 5. Water Supply Available in Drought Years

	Average(1)/ Normal Water Year	Single Dry(2) Water Year	Multiple Dry Years(3)		
			Year 1	Year 2	Year 3
Annual Precipitation, inches	9.69	3.34	6.55	4.01	6.49
Percentage of Normal Year Rainfall	100%	34%	68%	41%	67%
Estimated Groundwater Recharge Rate, AFY	2,690	927	1,818	1,113	1,802

(1) Based on data recorded at Panoche Valley weather station, 1949 to 2010, WRCC (2010).
(2) Based on total annual precipitation recorded in 1953.
(3) Based on total annual precipitation recorded in 1988, 1989, and 1989, respectively.

4. EXISTING WATER QUALITY

GEOLOGICA (2010) reviewed available water quality data for groundwater in Panoche Valley and the Project site. Groundwater samples collected and analyzed from wells on the Project site in April 2010 indicated that site groundwater meets primary drinking water standards, but fails to meet secondary drinking standards for sulfate, manganese, and Total Dissolved Solids (see **Table 6**). For use for irrigation purposes, the groundwater on site is acceptable with slight to moderate restrictions. Towards the southern part of the site and south of the site, some water samples exceeded secondary drinking water standards for TDS and sulfate. Secondary drinking water standards address aesthetic and cosmetic water quality and therefore these waters may not be desirable for use as drinking water.

Washing the solar photovoltaic panels will require water with very low TDS. Consequently, an on-site water treatment facility has been proposed to reduce on-site well water containing unacceptably high TDS concentrations for panel washing. The water treatment system will consist of a Double Pass Reverse Osmosis (DPRO) system capable of producing up to 20 gpm of demineralized water. The treatment system would produce reject water at a rate of approximately 9 gpm that would be piped to a series of evaporation ponds comprising approximately 2 acres in total. The ponds will be equipped with a liner system to protect underlying groundwater quality. Residue would be periodically removed from the ponds and disposed of at an approved facility. Impacts on groundwater quality related to the proposed Project are expected to be less than significant.

Table 6. Summary of Site Groundwater Quality Data

ANALYTE	Drinking Water Standard[2]	MCL[2] or Secondary Level[2] (mg/l)	Well						
			0	4[4]	17[4]	19[4]	22	44	45[5]
General Minerals									
Alkalinity, Total			220	240	180	220	220	230	300
Chloride	Secondary	250	33	47	29	38	57	32	49
Conductivity (umho/cm)			830	820	670	680	1,400	730	2,000
Cyanide	Primary (CA)	0.15	NA	NA	<0.025	<0.25	NA	NA	NA
Fluoride	Primary	2.0	<1	0.63	<0.5	0.5	0.7	<1	<1.0
Hardness (Ca, Mg-$CaCO_3$)			260	220	190	170	12	200	740
Nitrate (N)	Primary	10	2.2	0.7	5.4	5.7	3.4	2.7	<0.23
Nitrite(N)	Primary	1	NA	0.63	<0.15	0.5	0.7	NA	NA
Sulfate	Secondary	250	120	86	80	36	450	46	630
Silica (SiO_2)			41	46	29	27	17	20	44
Total Dissolved Solids (TDS)	Secondary	500	540	470	370	380	890	380	1,400
pH (pH units)	Secondary	6.5-8.5	7.66	7.58	8.03	7.76	7.53	7.6	7.62
Color (color units)	Secondary	15 units	NA	<1	2.5	<1	NA	NA	NA
Odor (T.O.N.)	Secondary	3 TON	NA	<1	<1	3	NA	NA	NA
MBAS	Secondary	0.5	NA	<0.1	<0.1	<0.1	NA	NA	NA
Metals									
Aluminium	Primary (CA)	1			NA				
Antimony	Primary	0.006	ND	ND	ND	ND	ND	ND	ND
Arsenic	Primary	0.010	ND	ND	ND	ND	ND	ND	ND
Barium	Primary	2	0.048	0.053	0.049	0.16	ND	0.11	0.012
Beryllium	Primary	0.004	ND	ND	ND	ND	ND	ND	ND
Boron			1.4	1.8	0.38	1.8	1	1.1	1.6
Cadmium	Primary	0.005	ND	ND	ND	ND	ND	ND	ND
Calcium			63	56	40	41	5.3	63	190
Chromium	Primary	0.1	ND	ND	0.023	0.007	ND	ND	ND
Cobalt			ND	ND	ND	ND	ND	ND	ND
Copper	Primary	1.3	ND	ND	ND	ND	ND	ND	ND

Flouride	Primary	4	ND	0.63	ND	0.5	0.7	ND	ND
Iron	Secondary	0.3	ND	ND	ND	ND	ND	ND	ND
Lead	Primary	0.005	ND	ND	ND	ND	ND	ND	ND
Magnesium			24	22	24	19	0.03	24	64
Manganese	Secondary	0.05	ND	ND	ND	ND	ND	ND	0.22
Mercury	Primary	0.002	ND	ND	ND	ND	ND	ND	ND
Molybdenum			ND	ND	ND	ND	ND	ND	ND
Nickel			ND	ND	ND	ND	ND	ND	ND
Potassium			2.3	2.2	1.4	2.2	4	2.3	4.9
Selenium	Primary	0.05	ND	ND	ND	ND	ND	ND	ND
Silver	Secondary	0.10	ND	ND	ND	ND	ND	ND	ND
Sodium			78	80	50	73	950	78	140
Thallium	Primary	0.0005	ND	ND	ND	ND	ND	ND	ND
Vanadium			ND	ND	ND	ND	ND	ND	ND
Zinc	Secondary	5	0.044	0.074	ND	0.022	ND	0.075	<0.02

Notes:

1 - Source: Geologica (2010).

2 - Primary and Seconday Drinking Water Standards or TT action levels as defined by the US EPA, June, 2006 inless noted with CA for California Standards.MCL = Maximum Contaminant Levels are legally enforceable standards that apply to public water systems; Secondary Levels are suggested but not enforceable guidelines for drinking water.

3 - Results are HIGHLIGHTED IN GRAY for those that exceed the Primary or Secondary MCL.

4 - These samples analyzed for drinking water standards.

5 - Off-site well at Panoche School.

6 - ND = Not detected.

7 - NA = Not analyzed.

8 - <0.02 = Not detected above concentration listed.

5. Supply and Demand Comparison

Available water supply and current and projected demand are discussed below in the context of available information regarding climatic variability as required by SB 610. As noted in Section 3.4, current groundwater use in Panoche Valley groundwater basin was estimated to be approximately 180 AFY. Due to local climatic conditions, a return to the high groundwater demand occurred during the period of more intensive agricultural irrigation in the 1960s and 1970s is unlikely. Currently, a number of houses and ranches in Panoche Valley are unoccupied or idle. With improving economic conditions, increased local water demand for domestic supply, limited irrigation, and livestock watering is expected. The population of the Bay Area is expected to grow 15 % over the next 20 years (ABAG, 2010). Population forecasts for Panoche Valley and associated potential increase in local water demands were not identified, however, assuming a similar annual growth rate, approximately 0.8%, rounded up to 1%, conservatively allows for growth in local groundwater usage, outside of demand related to the proposed project. The projected non-project water demand in Panoche Valley based on a 1% annual increase in demand and Project water demand (from **Table 2**) were used to estimate total projected water demand. **Table 7** compares projected total water demand to available groundwater supply (from **Table 5)** for normal (average) precipitation conditions, a single dry year represented by the data for 1953 and a series of three dry years represented by the data for 1988, 1989, and 1990.

Table 7. Projected Water Supply and Demand Comparison

Condition	Non-Project Water Demand Acre-feet	Project Water Demand Acre-feet	Total Demand Acre-feet	Available Supply Acre-feet	Supply Deficit Acre-feet
Construction Period					
Normal	180	38	218	2,700	none
Single Dry Year	180	38	218	931	none
Multi-Year Drought					
Year 1	180	38	218	1,825	none
Year 2	180	38	218	1,117	none
Year 3	180	38	218	1,808	none
5th Year of Proposed Project					
Normal	189	26.1	215.1	2,700	none
Single Dry Year	189	26.1	215.1	931	none
Multi-Year Drought					
Year 1	189	26.1	215.1	1,825	none
Year 2	189	26.1	215.1	1,117	none
Year 3	189	26.1	215.1	1,808	none
10th Year of Proposed Project					
Normal	198	26.1	224.1	2,700	none
Single Dry Year	198	26.1	224.1	931	none
Multi-Year Drought					
Year 1	198	26.1	224.1	1,825	none
Year 2	198	26.1	224.1	1,117	none
Year 3	198	26.1	224.1	1,808	none
15th Year of Proposed Project					
Normal	207	26.1	233.1	2,700	none
Single Dry Year	207	26.1	233.1	931	none
Multi-Year Drought					
Year 1	207	26.1	233.1	1,825	none
Year 2	207	26.1	233.1	1,117	none
Year 3	207	26.1	233.1	1,808	none
20th Year of Proposed Project					
Normal	216	26.1	242.1	2,700	none
Single Dry Year	216	26.1	242.1	931	none
Multi-Year Drought					
Year 1	216	26.1	242.1	1,825	none
Year 2	216	26.1	242.1	1,117	none
Year 3	216	26.1	242.1	1,808	none

6. Conclusions Regarding Water Supply Reliability and Demand

Based on the comparison of projected water demand and available water supply, it appears that sufficient water will be available in the Panoche Valley groundwater basin under varying climatic conditions including the most limiting single dry water year condition, a period of three successive dry years, and conservatively assuming growth in local non-project (domestic, irrigation, and livestock watering) water demand over the next 20 years. This Water Supply Assessment demonstrates that the water supply available in the Panoche Valley groundwater basin is sufficient under normal and dry years, including consideration of projected future demands on the supply, to meet the water supply needs of the proposed Project as well as existing and future users.

7. References

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