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REPORT OF MONITORING WELL INSTALLATION

Panoche Energy Center Site
Fresno County, California

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This Report of Monitoring Well Installation for the Panoche Energy Center Site in western Fresno County, California was prepared by URS Corporation (URS) for Panoche Energy Center, LLC (Client) in a manner consistent with the level of care and skill ordinarily exercised by professional engineers, geologists, and environmental scientists in the geographic area of the site at this time. URS provides no other warranties, either express or implied, concerning the contents of this report, which was prepared under the technical direction of the undersigned.

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REPORT OF MONITORING WELL INSTALLATION

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1.0 INTRODUCTION

This report has been prepared by URS Corporation (URS) on behalf of Panoche Energy Center, LLC (Client). The report describes the methodology and results of the recent monitoring well installations and groundwater monitoring at the Panoche Energy Center site (Site) in Fresno County, California. The location of the Site and the surrounding area are depicted on Figure 1.

Client is currently seeking approval from the California Energy Commission (CEC) to construct and operate a power generation facility at the Site. The Panoche Energy Center (PEC) is a proposed simple-cycle power generation project that will include four natural gas-fired combustion turbine generators. Process water for the PEC will be supplied via two onsite supply wells to be completed within a confined aquifer underlying the Corcoran Clay. Safety water will be supplied by a single, relatively shallow onsite supply well completed within a semi-confined aquifer overlying the Corcoran Clay. Client submitted an Application for Certification (AFC) for the PEC project to the CEC in August 2006. During the data adequacy review process, CEC staff requested site-specific groundwater data for the water-bearing zone that is proposed for project water supply. In response, Client retained a drilling contractor to install three monitoring wells at the Site, and retained URS to provide construction observation and groundwater monitoring services.

The remainder of this report summarizes the scope of work conducted in accordance with the client-approved workplan and is comprised of the following sections:

- Section 2.0 summarizes the geologic setting of the Site.
- Section 3.0 summarizes the construction observation and groundwater monitoring.
- Section 4.0 summarizes findings of the groundwater monitoring.
- Section 5.0 presents a summary of the report and recommendations.
- Section 6.0 presents limitations for this report.
- Section 7.0 presents pertinent references.
- Tables 3 and 4 and figures are presented following Section 6.0.
- Appendix A presents the well permits issued by Fresno County for installation of the monitoring wells.
- Appendix B presents the lithologic log with part of the electric log shown for reference.
- Appendix C presents the downhole geophysical log.
- Appendix D presents the laboratory report for sieve testing of cuttings from the completion intervals and the sand filter packs of the monitoring wells.
- Appendix E presents drillers tally sheets for installation of the monitoring wells.
- Appendix F presents morning reports for drilling and installation of the monitoring wells.

- Appendix G presents the laboratory reports for initial groundwater samples collected from the new monitoring wells.

2.0 GEOLOGIC SETTING

The PEC is located on the Panoche Creek alluvial fan within the San Joaquin Valley portion of the Great Valley geomorphic province. The most extensive geomorphic units in the province include dissected uplands, low alluvial plains and fans, river flood plains and channels, and overflow lands and lake bottoms. The region persisted as a lowland or shallow marine embayment during the entire Cenozoic and at least the later Mesozoic. In the late Cenozoic, much of the area was occupied by shallow brackish and freshwater lakes, particularly in the San Joaquin Valley, which has had interior drainage in its southern third since the Pliocene. Lake Corcoran formerly spread over much of the northern San Joaquin Valley during the middle and late Pleistocene. The associated, diatomaceous-lacustrine clay know as the Corcoran Clay or E-Clay covers more than 5,000 square miles of the San Joaquin Valley and is the confining layer for the most extensive confined aquifer in the San Joaquin Valley (Poland and Evenson, 1966; Croft, 1972; Page, 1986; Norris and Webb, 1990).

2.1 Regional Geology

The San Joaquin Valley is an asymmetrical basin defined by the Coast Ranges to the west, the Tehachapi Mountains to the south, the Sierra Nevada to the east, and the delta of the San Joaquin and Sacramento Rivers to the north. The axis of the valley trough is closer to the Coast Ranges than to the Sierra Nevada (Belitz and Heimes, 1990). The oldest rocks in the area are basement complex rocks underlying the basin that form much of the Tehachapi Mountains, San Emigdio Mountains, and the southern Sierra Nevada. The basement rocks are composed of a mass of plutonic and metamorphic rocks commonly referred to as the Sierra Nevada batholith of pre-Tertiary age. The basin is filled with more than 14,000 feet of rocks of Jurassic, Cretaceous, Tertiary, and Quaternary age (Croft, 1972).

The Site is situated on a thick section of Quaternary surficial sediments and older alluvium underlain by tertiary sediments. The Corcoran Clay is an extensive diatomaceous-lacustrine clay deposit of low permeability that divides the groundwater flow system into a confined hydrogeologic unit and an overlying semi-confined hydrogeologic unit (Davis and Poland, 1957). The Corcoran Clay was encountered in nearby USGS water well at a depth of about 666 feet below ground surface (bgs) (USGS, 1987). The Corcoran Clay ranges in thickness from 20 to 120 feet and is estimated to be about 100 to 120-feet thick underlying the Site (Page, 1986, Belitz and Heimes, 1990).

2.2 Regional Hydrogeology

The aquifer system comprising the Westside Subbasin consists of unconsolidated continental deposits of Tertiary and Quaternary age. These deposits form an unconfined to semi-confined aquifer overlying a confined aquifer. These aquifers are separated by an aquitard that is composed of the Corcoran Clay member of the Tulare Formation. The aquifers are recharged by subsurface inflow from the west, east and northeast and by percolation of applied surface water. The deposits of the semi-confined hydrogeologic unit above the Corcoran Clay are typically alluvium derived from the Coast Ranges. These deposits can include Sierran-derived sand east of the Site. The two hydrogeologic units differ in texture, hydrologic properties, and oxidation state. In contrast to Coast Ranges alluvium, the Sierran sand is reduced in the valley trough. The Sierran deposits are highly permeable and historically have been tapped by wells as a source of irrigation water (Belitz and Heimes, 1990). Sierran sands do not generally extend very far to the west of the axis of the valley trough, and the semi-confined hydrogeologic unit underlying the Site is dominated by Coast Range alluvium. Groundwater within the Coast Ranges alluvium is generally of sulfate or bicarbonate type with relatively high dissolved mineral concentration and is generally considered to be of relatively low quality. Groundwater within the Coast Ranges alluvium is generally considered to be of relatively low quality due to the presence of water-soluble deleterious minerals within the parent rocks (Davis et al., 1959; Bull and Miller, 1975; Gilliom et al., 1989).

The unconfined to semi-confined aquifer above the Corcoran Clay includes younger alluvium, older alluvium, and part of the Tulare Formation. These deposits consist of highly lenticular, poorly sorted clay, silt, and sand intercalated with occasional beds of well-sorted sand.

The deposits of the confined hydrogeologic unit below the Corcoran Clay used as aquifers for groundwater production consist of poorly consolidated floodplain, deltaic, alluvial fan, and lacustrine deposits of the Tulare Formation. In general, groundwater in the confined aquifer generally contains smaller quantities of dissolved minerals and a higher concentration of sodium than groundwater in the overlying semi-confined aquifer (Davis et al., 1959). Brackish or saline groundwater underlies the fresh groundwater in the confined aquifer.

Many of the agricultural production wells in the study area are perforated below the Corcoran Clay (Belitz and Heimes, 1990). About 75 to 80 percent of the groundwater pumped for irrigation was from the confined aquifer (Davis and Poland, 1957; Bull and Miller, 1975). Groundwater withdrawal from the confined aquifer generated large-scale ground subsidence prior to delivery of surface water for agricultural water supply replacement beginning in the 1960's (Poland et al., 1975). Today, readily available, relatively high quality surface water supplants agricultural use of groundwater in the region except in times of drought when surface water supplies are curtailed.

2.2.1 Groundwater Subbasins

The Project Site is located in the Westside Subbasin of the San Joaquin Valley Groundwater Basin. The Westside Subbasin consists mainly of the lands in Westlands Water District. It is located between the Coast Range foothills on the west and the San Joaquin River Drainage and Fresno Slough on the east. The subbasin is bordered on the southwest by the Pleasant Valley Groundwater Subbasin and on the west by Tertiary marine sediments of the Coast Ranges, on the north and northeast by the Delta-Mendota Groundwater Subbasin, and on the east and southeast by the Kings and Tulare Lake Groundwater Subbasins (DWR, 2003).

2.2.2 Subbasin Groundwater Occurrence and Flow

The development of irrigated agriculture in the western San Joaquin Valley including the Panoche Fan area has significantly altered the groundwater flow system. Percolation of irrigation water past crop roots has caused a rise in the altitude of the water table in mid-fan and distal fan areas. Pumpage of groundwater from wells caused a lowering of the potentiometric surface of the confined aquifer over much of the western valley. Percolation of irrigation water has replaced infiltration of intermittent streamflow as the primary mechanism of recharge. Pumpage of groundwater from wells and crop evapotranspiration have replaced natural evapotranspiration and seepage to streams in the valley trough as the primary mechanisms of discharge. The combination of percolation and pumpage has resulted in development of a large downward hydraulic-head gradient in the semi-confined aquifer and has created a groundwater divide east of the Site. Decreases in groundwater pumping following delivery of surface-water have allowed consequent recovery in hydraulic head throughout the groundwater flow system. The present-day groundwater flow system is in a transient state and is adjusting to the stresses placed upon it in both the past and present (Belitz and Heimes, 1990).

2.2.3 Subbasin Groundwater Quality

Groundwater in the Westside Subbasin is generally of the sulfate or bicarbonate type. The waters of the semi-confined aquifer are generally high in calcium and magnesium sulfate. Groundwater below 300 feet and above the Corcoran Clay shows a tendency towards decreased dissolved solids with increased depth. Most of the groundwater of the confined aquifer is of the sodium sulfate type. Fresh groundwater in the confined aquifer generally contains less dissolved solids than the unconfined aquifer. Groundwater in the Westside Subbasin can have an upper range of dissolved solids concentrations between 2,000 and 3,000 milligrams per liter (mg/L). Dissolved solids concentrations in shallow groundwater can be greater than 10,000 mg/L at some locations. Locally, the base of fresh groundwater is defined as groundwater with total dissolved solids exceeding 2,000 parts per million (equivalent to mg/L) total dissolved solids, which is too high for irrigating crops (Westlands, 2006).

3.0 CONSTRUCTION OBSERVATION AND GROUNDWATER MONITORING

URS performed construction observation and groundwater monitoring activities required to assess the groundwater quality parameters at three depths below the Site. URS was responsible for lithologically logging the test hole based on returned cuttings and collecting groundwater samples from each well. Client contracted directly with a qualified, licensed well drilling contractor who performed the drilling, downhole geophysical logging, well construction, and development of the three monitoring wells. URS personnel observed the drilling activities intermittently, with nearly continuous observation during test hole drilling. URS personnel directed downhole geophysical logging of the test hole and interpreted the associated geophysical log. In addition, URS personnel continuously observed installation of the well casings and annular materials and most of the development of the three monitoring wells.

Two well casings were completed within one boring drilled to a depth of 1,510 feet bgs. The third completion was installed within a second boring drilled adjacent to monitoring wells MW-1 and MW-2 due to potential instability of the first hole. Well locations are depicted on Figure 2.

One of the wells was completed with the screened interval in the semi-confined aquifer above the Corcoran Clay and the other two wells were completed with the screened intervals in the underlying confined aquifer. The scope of work included water quality analyses intended to satisfy project and regulatory requirements for site-specific groundwater data.

Drilling, lithologic and downhole geophysical logging, well construction, development and groundwater sampling occurred over a 4-week period beginning in early October 2006. The work was conducted under the oversight of a California-registered geologist. The procedures used were in accordance with those described in the Scope of Work (URS, 2006a). Field work conformed with the Site's safe work plan (URS, 2006b). The investigative activities are summarized below:

- The drilling contractor obtained permits for well construction from the County of Fresno. Copies of the two permits are provided in Appendix A. The drilling contractor contacted the regional underground service alert provider and submitted a ticket for excavation of the soil borings prior to beginning work.

- A URS senior geologist provided ongoing oversight of field staff during the investigation through periodic site visits, daily debriefing meetings, and frequent contact via mobile telephone. Client was apprised of key findings as the investigation progressed through telephone conversations and transmittals of morning reports. Morning reports summarizing progress are provided in Appendix F.

- Bradley and Sons, Inc. of Del Rey, California, a California C-57 licensed drilling contractor provided drilling services using an Ingersoll-Rand TH-60 drilling rig. An approximately 8 3/4-inch diameter test hole was advanced to a depth of approximately 1,510 feet below ground surface (bgs) using the rotary-wash ("mud rotary") drilling method. During drilling, a URS field geologist prepared a lithologic log of the test hole based on cuttings returned in the drilling fluid at approximately 10-foot intervals. The lithologic log was prepared based on the Unified Soil Classification System (USCS) and generally accepted geologic interpretive descriptions. Portions of the drilled cuttings from each interval were secured in specially designed chip trays suitable for review and archiving. Drilled cuttings from selected intervals of the borehole were submitted for sieve analysis by a geotechnical laboratory for comparison with well screen slot size and filter pack grain size.

- After drilling, a downhole geophysical log of the test hole was obtained using spontaneous potential (SP), short-normal resistivity (16-inch spacing), and long-normal resistivity (64-inch spacing) instruments. Natural gamma and temperature logs were also run. A subsequent attempt to complete additional geophysical logs was blocked by an obstruction of the test hole at a depth of about 760 feet bgs.

- After geophysical logging, the test hole was reamed to a diameter of approximately 12 inches for installation of a nested set of two groundwater monitoring wells screened at different depth intervals. The test hole was reamed to a total depth of 1,360 feet bgs prior to well installation. The first monitoring well (MW-1) was completed with a 20-foot screened interval in the lower portion of the confined aquifer at a depth of approximately 1,302 to 1,322 feet bgs. A deeper screened interval of 1,320 to 1,340 was intended for the well but was not feasible because the drag bit used to ream the test hole twisted off within the borehole at a depth of approximately 1,325 feet bgs while tripping out of the hole. The installed screened interval is at a higher elevation within the target sand than specified based on interpretation of the electric log. The 10-foot long sump planned for the lower completion was deleted to keep the screened interval as deep as possible. The second monitoring well (MW-2) was completed with a 20-foot screened interval in the upper portion of the confined aquifer at a depth of approximately 1,100 to 1,120 feet bgs. A 10-foot long sump was installed below the screened interval as planned for the second completion.

- MW-3 was completed with a screened interval in the semi-confined aquifer at a depth of approximately 440 to 460 feet bgs. A 10-foot long sump was also completed as planned in MW-3. Monitoring well MW-3 was installed in a second borehole located about 10-feet to the north of monitoring wells MW-1 and MW-2.

- Figures 3 and 4 show monitoring well construction diagrams. All three groundwater monitoring-wells were constructed of 2-inch nominal diameter, Schedule 40, steel casing with a 20-foot long section of 0.020-inch machine slotted steel screen. Flush threaded connections were made up with polytetrafluoroethylene (PTFE) tape and tack welded. Strap-on stainless steel centralizers were installed at roughly 100-foot intervals while the well casings were tripped into the hole. Annular materials were installed via tremie pipe. Annular materials included a number 8-16 sand filter pack for the screened intervals of each monitoring well. Screened intervals for monitoring wells MW-1, MW-2, and MW-3 were isolated by installing ¼ inch coated bentonite tablets above each filter pack interval within depth intervals identified as low resistivity clay intervals based on interpretation of the electric log. Neat-cement grout seals were pumped into the annular space between the uppermost bentonite tablet seal and the ground surface for monitoring wells MW-1/MW-2 and MW-3. Drillers tally sheets for construction of the monitoring wells are provided in Appendix E.

- Well development commenced after the completion of grouting. Well development was accomplished by surging and air-lift pumping. Air-lift pumps displace water from the well bore by forcing compressed air into tubing extending below the water surface within the well bore. Temperature, conductivity, pH, and qualitative sediment content of the discharge water were monitored periodically to ensure that representative groundwater samples could be obtained. Development continued until the discharged water was relatively clear and the temperature, pH, and electrical conductivity (EC) of the discharged water was relatively stable. Extracted development water was discharged to the ground surface near the wells. The estimated total amount of water extracted during well development is provided in Table 1.

Table 1
Monitoring Well Development
Panoche Energy Center
Fresno County, California

Monitoring Well	Estimated Purge Volume (Gallons)	Development Date
MW-1	1,000	October 24 and 25, 2006
MW-2	3,510	
MW-3	4,500	October 27, 2006

Note: Purge volumes based on periodic estimates of flow rate from air-lift pump water discharge line using bucket and stopwatch.

- Groundwater samples were collected at the conclusion of the air-lift pumping of the wells due to the deep static water levels. Groundwater samples were collected from MW-1, MW-2, and MW-3 from the air-lift pump water discharge line following development of the wells. Temperature, conductivity, pH, and qualitative sediment content of the discharge water were measured prior to sampling to ensure that representative groundwater samples were obtained. Samples were secured in coolers with ice using a chain of custody procedure and transported to the analytical laboratory. Samples were submitted to The Twining Laboratories in Fresno, California, a California-certified environmental analytical laboratory for testing. The groundwater samples were analyzed for a suite of parameters and constituents that include general water quality and water chemistry using US Environmental Protection Agency (US EPA) and other appropriate methods (see Section 4.2.2).

- Quality assurance/quality control measures during the groundwater investigation included analysis of blind duplicate samples submitted from the field as well as laboratory blank, control spike, control spike duplicate, matrix spike and matrix spike duplicate, and duplicate samples.

- Figure 5 shows the locking monuments and bollards installed to protect the monitoring wells from damage by vehicles or vandals.

- Approximate locations of the wells were measured using a hand held global positioning system (GPS) unit. The elevation of the ground surface at the well heads was estimated based on a 2006 survey of the Site and surrounding area by URS.

4.0 FINDINGS

The subsections below present the findings regarding lithology and groundwater at the Site.

4.1 Lithology

The lithology in the area of the Site, based on the lithologic log and downhole geophysical survey is generally comprised of fine-grained (clays and silts) and coarse-grained (sands and gravels) sediments typical of alluvial fan settings. The lithologic and downhole geophysical logs for the test hole are presented in Appendices B and C, respectively.

4.1.1 Lithologic Log

Predominantly fine to coarse sediments (gravels and sands) with interbedded finer grain units were encountered to a depth of 650 feet bgs. Distinctive blue clay associated with the Corcoran Clay was first encountered in drill cuttings at about 650 feet bgs. The thickness of the Corcoran Clay was difficult to quantify based on cuttings, partly due to its similarity to underlying units of the Tulare formation, but it was estimated to be approximately 110 feet thick. From approximately 850 feet bgs, it was noted that the unit was similar to the Corcoran Clay but that the drilling was much harder and the unit seemed to be more consolidated with a higher sand content. Predominantly fine to medium grained sands with interbedded clayey sands were encountered from approximately 980 to 1,430 feet bgs. Finer grained sandy clays and clayey sands were recovered from approximately 1,430 bgs to the bottom of the borehole.

Drilled cuttings from selected intervals of the borehole were submitted for sieve analysis by a geotechnical laboratory. Cuttings from 450 to 460, 1,110 to 1,120, and 1,330 to 1,340 feet bgs were submitted for analysis. Sieve analyses of drilled sediments are useful for the selection of appropriate filter pack when designing a production well. The analysis involves passing a sediment sample through a series of calibrated screens to quantify sorting and grain size. Sieve data are provided in Appendix D.

4.1.2 Geophysical Logs

Geophysical logging was conducted after the test hole was drilled to its total depth of 1,510 feet bgs. Geophysical logs help to characterize subsurface hydrogeologic conditions that cannot be readily determined from drilled cuttings.

A resistivity and SP electric log was run for the test hole from ground surface to 1,500 feet bgs. Natural gamma and temperature logs were run with the electric log. Final designs of the wells were based on interpretation of the lithologic and geophysical logs for the test hole. Additional geophysical logs could not be completed due to obstruction of the test hole at a depth of about 760 feet bgs after the first tool run. A general description and interpretation of each geophysical log is presented below.

4.1.2.1 Electric Log

The electric log consists of a SP log, a short-normal (16-inch spacing) resistivity log, and a long-normal (64-inch spacing) resistivity log, which were recorded simultaneously. The SP log measured naturally occurring electrical signals and is used mainly for lithologic correlations or for differentiating non-permeable strata in a clay-sand sequence. The SP log can also be used to calculate estimated water quality. The short-normal and long-normal resistivity logs are measured as the reciprocal of a formation's electrical conductivity. The increase or decrease of a formation's resistivity is partially controlled by its porosity. Because groundwater is an electrical conductor, its presence in the interconnected pores reduces the overall formation resistivity. Typically, silt and clay units will have lower resistivity values in comparison to sand and gravel units. The short-normal resistivity log measures the resistivity of the formation near the borehole, while the long-normal resistivity log measures the resistivity at a greater distance from the borehole. The long-normal and short-normal logs measure similar resistivities in non-permeable clay zones, although the two logs may also show similar responses in highly permeable zones where drilling fluid invasion is extensive.

The electric log for the test hole indicates predominantly medium-grained sediments (gravels and sands) to about 330 feet bgs with resistivities exceeding 15 ohmmeters^2 per meter (ohmmeters^2/m). From 330 to 470 feet bgs the electric log indicates predominantly fine grained sediments (clay and silt) with interbeds of coarser materials (resistivity between 5 and 25 ohmmeters^2/m). From 470 to 770 feet bgs, the long and short normal resistivities are less than 10 ohmmeters^2/m, indicating clay and silt, probably corresponding to the Corcoran Clay and other fine grained sediments. The Corcoran Clay appears to be represented by a zone of low resistivity extending from about 650 to 770 feet bgs. Medium grained sediments (gravels and sands) with interbedded fine-grained sediments occur from approximately 770 to 1,440 feet bgs based on resistivities ranging from 10 to 50 ohmmeters^2/m. From about 1,440 feet bgs to the bottom of the logged interval, the long and short normal resistivities are less than 5 ohmmeters^2/m, indicating the presence of clay and silt deposits.

4.1.2.2 Gamma-Ray Log

The gamma-ray log measures the naturally occurring gamma emissions from the decay of unstable elements in the formation surrounding the borehole. One of the most significant and the most abundant radioactive elements is potassium-40. As potassium-40 decays, it emits electromagnetic radiation, which the gamma-ray probe detects and records. The greater the counting rate, the higher the amount of potassiuim-40 in the formation. Minerals such as feldspar, biotite, and several clay minerals contain potassium-40. Consequently, an increase in clay content in the strata typically results in an elevated gamma-ray response. However, in many portions of California, arkosic (feldspar-rich, poorly weathered) sand formations are present, which also have high gamma-ray emissions.

The gamma-ray log for the test hole shows a fairly consistent gamma count from ground surface to about 470 feet bgs, at which depth the gamma count increases. The increase in gamma counts at 470 feet bgs correlates well with the electric log, and indicates an increase in fine grain sediments with higher clay content.

4.1.2.3 Temperature Log

The temperature survey provides a relative indication of the ambient groundwater temperature. Changes in temperature can in some cases be related to influx of formation water from the aquifer into the open hole or well.

Based on the temperature survey log, ambient temperatures within the test hole ranged from 80 to 86 degrees Fahrenheit. No significant influxes or outflows were apparent based on the temperature survey.

4.2 Groundwater

The geologic characteristics identified in the lithologic log and geophysical logs of the test hole indicate that the formations between about 170 feet and 470 feet bgs and between 770 and 1,350 feet bgs appear to represent potential areas for groundwater production. The upper interval is part of the semi-confined aquifer, and the lower interval is part of the confined aquifer underlying the Site. Groundwater production from approximately 470 to 770 and 1,350 to 1,500 feet bgs would be expected to be negligible due to presence of the thick deposits of fine-grained sediments in those intervals.

4.2.1 Groundwater Occurrence

Subsequent to development of the monitoring wells, static water levels were approximately 390 to 386 feet bgs for the confined aquifer monitoring wells (MW-1 and MW-2 respectively) and 178 feet bgs for the semi-confined aquifer monitoring well (MW-3). Measured depths to water are provided in Table 2.

Table 2
Depths and Elevations of Groundwater
Panoche Energy Center
Fresno County, California

Monitoring Well	Depth to Groundwater (Feet Below Top of Casing)	Elevation of Groundwater (Feet Above Mean Sea Level)
MW-1	389.98	22
MW-2	386.05	26
MW-3	177.55	234

Note: Depths to groundwater measured December 4, 2006. Casing stickups are approximately 2 feet above ground surface. Top of casing assumed to be approximately 412 feet above mean sea level.

Varying depths to groundwater in the three monitoring wells indicates that seals placed between the screened intervals of each completion during construction and the installation of monitoring well MW-3 within a second hole proved to be effective.

4.2.2 Groundwater Quality

Groundwater samples were analyzed for the following constituents and parameters by the analytical laboratory using the methods shown:

- Ammonia as nitrogen by US EPA Method 350.2
- Biochemical oxygen demand (5 day) by SM5210B / US EPA Method 405
- Chemical oxygen demand by US EPA Method 410.1
- Cyanide by SM4500CN-E
- Fluoride by US EPA Method 300.0
- General minerals dissolved by various methods
- ICP scan by various methods
- Mercury by US EPA Method 245.1
- Nitrate as NO_3 by US EPA Method 300.0
- o-Phosphate by US EPA Method 300.0
- Total Phosphorous (TKP) by US EPA Method 365.4
- Sulfide by US EPA Method 376.1
- Total organic carbon by SM5310B
- Total suspended solids by US EPA Method 160.2
- Turbidity by US EPA Method 180.1

Analytical results reported for groundwater quality parameters such as biochemical oxygen demand (BOD) and chemical oxygen demand (COD) may have been influenced by the sampling method. Groundwater samples were collected from the air-lift pump water discharge line at the conclusion of the air-lift pumping of the wells due to the deep static water levels.

Groundwater in the semi-confined confined aquifers differs greatly in total concentration of dissolved salts and in the relative abundance of various constituents. Less pronounced differences between groundwater within the upper and lower portions of the confined aquifer are also apparent. Laboratory reports are presented in Appendix G and the results are summarized in Tables 3 and 4. No apparent data quality problems were identified during review of the quality analysis / quality control (QA/QC) sample results.

4.2.2.1 Semi-Confined Aquifer Water Quality

Laboratory analytical results for groundwater collected from monitoring well MW-3 indicate that dissolved salts and the abundance of various constituents is generally higher than groundwater samples collected from the underlying confined aquifer. The concentration of silica was reported as 46 mg/L, which is reportedly within the operational range of use for cooling water in the proposed power generation facility. No other specific parameters or constituents have been identified as critical to the suitability of groundwater for use as process water within the proposed facility. However, a specific conductance value of 3,000 microsiemens per centimeter (µS/cm), hardness of 1,100 milligrams equivalent $CaCO_3$ per liter, a TDS of 2,900 mg/L, and undesirable concentrations of other constituents indicate relatively poor water quality within the represented portion of the semi-confined aquifer (see Tables 3 and 4).

Detected constituents in the groundwater sample (MW-3) collected from the semi-confined aquifer were compared to water quality limits for drinking water and agricultural use published by the Central Valley Regional Water Quality Control Board (RWQCB, 2003). The comparison was intended to indicate the suitability of the sampled groundwater for use as drinking water or agricultural water. Based on the analytical reports, the sampled groundwater appears to be a poor candidate for use as a drinking or agricultural water supply without treatment. Detected concentrations of nitrate as NO_3 and sulfate as SO_4 exceeded US EPA primary maximum contaminant limits (MCLs) for drinking water. The reported turbidity value may also exceed US EPA and California Department of Health Services (CDHS) primary MCLs for drinking water but may have been negatively influenced by air-lift pumping. Specific conductance as well as total dissolved solids (TDS) and manganese concentrations exceeded CDHS and/or US EPA Secondary MCLs for drinking water. Specific conductance also exceeded agricultural water quality limits in addition to chloride, TDS, boron, selenium, and sodium concentrations.

4.2.2.2 Confined Aquifer Water Quality

Laboratory analytical results for groundwater collected from monitoring well MW-2 indicate that dissolved salts and the abundance of various constituents is generally lower than groundwater samples collected from the overlying semi-confined aquifer. The concentrations of silica were reported as 33 mg/L, which is reportedly within the operational range of use for cooling water in the proposed power generation facility. No other specific parameters or constituents have been identified as critical to the suitability of groundwater for use as process water within the proposed facility. However, specific conductance values of 1,100 µS/cm, TDS concentrations of 840 mg/L, and undesirable concentrations of other constituents indicate relatively poor water quality within the represented portion of the confined aquifer (see Tables 3 and 4).

Laboratory analytical results for groundwater collected from monitoring well MW-1 indicate that dissolved salts and the abundance of various constituents is generally higher than groundwater samples collected from the upper portion of the confined aquifer and lower than the groundwater samples collected from the semi-confined aquifer. The concentrations of silica were reported as 33 mg/L, which is reportedly within the operational range of use for cooling water in the proposed power generation facility. No other specific parameters or constituents have been identified as critical to the suitability of groundwater for use as process water within the proposed facility. However, specific conductance values of 1,500 µS/cm, TDS concentrations of 1,100 mg/L, and undesirable concentrations of other constituents indicate relatively poor water quality within the represented portion of the confined aquifer (see Tables 3 and 4).

Analytical results were generally consistent between groundwater samples MW-1 and MW-2 and their associated field blind duplicate samples (MW-4 and MW-5, respectively).

Detected constituents in the groundwater samples collected from both the upper (MW-2 and MW-5) and lower (MW-1 and MW-4) portions of the confined aquifer were compared to water quality limits for drinking water and agricultural use published by the Central Valley Regional Water Quality Control Board (RWQCB, 2003). The comparison was intended to indicate the suitability of the sampled groundwater for use as drinking water or agricultural water. Based on the analytical reports, the sampled groundwater appears to be a poor candidate for use as a drinking or agricultural water supply without treatment. The reported turbidity value may also exceed US EPA and CDHS primary MCLs for drinking water but may have been negatively influenced by air-lift pumping. Specific conductance and pH values as well as TDS, and iron concentrations exceeded CDHS and/or US EPA Secondary MCLs for drinking water and agricultural water quality limits. Detected concentrations of sulfate as SO4 exceeded US EPA secondary MCLs for drinking water. Boron, molybdenum, and sodium concentrations also exceeded agricultural water quality limits.

5.0 SUMMARY AND CONCLUSIONS

URS performed construction observation and groundwater monitoring activities required to assess the groundwater quality parameters in three hydrogeologic units below the Site. Client contracted directly with a qualified, licensed well drilling contractor who performed the drilling, downhole geophysical logging, well construction, and development of the three monitoring wells.

The lithology in the area of the Site is generally comprised of fine-grained (clays and silts) and coarse-grained (sands and gravels) sediments typical of alluvial fan settings based on the lithologic log and a downhole geophysical survey. The Corcoran Clay appears to be represented by a zone of low resistivity extending from about 650 to 770 feet bgs. The Corcoran Clay divides the groundwater flow system underlying the Site into a confined aquifer and an overlying semi-confined aquifer.

The formations between about 170 feet and 470 feet bgs and between 770 and 1,350 feet bgs have the greatest potential for groundwater production. Static water levels were approximately 390 to 386 feet bgs for the confined aquifer monitoring wells (MW-1 and MW-2 respectively) and 178 feet bgs for the semi-confined aquifer monitoring well (MW-3) in December 2006. Based on interpretation of the available data, installation of production wells in the zones with the greatest potential for groundwater production appears to be feasible. Process water production wells at the Site would likely be screened from 1,000 to 1,350 feet bgs.

Laboratory analytical results for groundwater collected from monitoring well MW-1 indicate that dissolved salts and the abundance of various constituents is generally higher than groundwater samples collected from the upper portion of the confined aquifer and lower than the groundwater sample collected from the semi-confined aquifer. Salinity of the groundwater appears to increase with increased depth in the confined aquifer. Undesirable parameter values and concentrations of various constituents indicate relatively poor water quality within all of the represented portions the aquifers. Several parameters or constituents in each sample analyzed exceeded drinking water or agricultural water limits. The sampled groundwater appears to be a poor candidate for use as a drinking or agricultural water supply without treatment.

Client should consider the following recommendations for groundwater quality monitoring at the PEC Site:

- The locations of monitoring wells MW-1, MW-2, and MW-3 should be surveyed by a California licensed Professional Land Surveyor.

- Process water production well design should incorporate data developed from monitoring wells installed at the Site.
- A groundwater-monitoring program to determine baseline groundwater quality and levels should be established prior to construction of the proposed power generation facility.
- A groundwater-monitoring program should be implemented during operation of the facility to monitor changes in groundwater levels or quality associated with pumping groundwater for use at the PEC.

6.0 LIMITATIONS

The findings and recommendations discussed herein are in accordance with generally accepted engineering practices in Fresno County at this time. The findings are based on data collected from specific depths at a single location. Any findings regarding the conditions at other depths or locations is solely an interpretation based the data acquired. Such findings regarding conditions underlying the Site may not accurately represent all conditions that may be encountered. No warranties, either express or implied, are made as to the professional advice provided under the terms of URS' agreement with Client. The passage of time, natural processes, human intervention on the Site or adjacent properties, or changes in regulations can cause altered conditions that may invalidate the findings and recommendations presented within.

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Tables 3 and 4

Figures

APPENDIX A

Fresno County Well Permits

APPENDIX B

Lithologic and Electric Log

APPENDIX C

Downhole Geophysical Log

APPENDIX D

Laboratory Report for Sieve Testing

APPENDIX E

Drillers Tally Sheets

APPENDIX F

Morning Reports

APPENDIX G

Laboratory Reports for Groundwater Samples