TECHNICAL MEMORANDUM
PRODUCTION WATER WELL ASSESSMENT

PREPARED FOR

RANCHO MURIETA COMMUNITY SERVICES DISTRICT

PREPARED BY:

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An NV5 Company

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Project No.: SAB115703

December 12, 2013
Revision 0

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0 EXECUTIVE SUMMARY

A phased approach task order program was initiated by the Rancho Murieta Community Services District (RMCSD, Client, or District) in 2012. The program's goal is to find a sustainable ground water resource in RMCSD's service area. Dunn Environmental, Inc., An NV5 Company (DE) was retained by RMCSD to identify a suitable location for ground water well development.

Currently, RMCSD relies solely on surface water supplies from the Cosumnes River to meet water demand. Based on a water supply and demand analysis completed by RMCSD, surface water supplies may be augmented with ground water. Drought period planning indicated that 600 acre-feet annually, which correlates with a ground water yield of 370 gallons per minute (gpm), will meet projected water demand. Grant funding, which has been awarded to RMCSD through the State of California Local Ground Water Assistance Program, may be used to assist in ground water resource development to supplement existing supplies.

To prepare this Technical Memorandum, DE reviewed five previous hydrogeologic reports, area well logs, developed a preliminary hydrogoelogic conceptual model for the work plan, performed a 2012 surface geophysical analysis using electrical resistivity profiles and completed two testholes in 2013, complete with downhole geophysical logging and limited water quality sampling.

Goal:

- Identify ground water production areas within the confined alluvial basin located on the west margin of the RMCSD that support a demand of 600 acre-feet or 370 (gpm).

The primary investigation summary, findings and conclusions are as follows:
Summary and Findings:

- Past ground water investigations, completed by others, generally supported a ground water well specific yield in excess of the anticipated ground water demand for drought preparedness of 600 ac-ft per year (which has been calculated by RMCSD);

- In 2012, surface geophysical electrical resistivity profiles, completed by NORCAL Geophysical Consultants, were generated to aid in determining the preferred geology and testhole locations. Two profile lines were completed using a Wenner array to generate a profile to 300 feet below grade surface (bgs). Findings from the profiles indicated that aquifer permeable sands and silts at

depth were overlain by less permeable clays across the study area. Paleo-channels were identified in the resistivity profiles as higher resistivity;

- Borehole geology, geophysical and water quality information were used to refine the hydrogeology and identify ground water production areas;

- Target geologic features for aquifer recharge, discharge and ground water production are detailed in Section 4;

- Water production zones were generally identified 180 feet bgs. Boring logs indicated basement as shallow as 375 feet in the area of primary interest and close to RMCSD's facilities;
- Based on previous investigations and resistivity profiles, two testhole locations were chosen to identify alluvial aquifers, shorten distance from existing pipeline features and determine specific capacities of a production well. The testholes were drilled in August and September 2013. Bedrock was encountered between 360 and 380 feet bgs in both testholes as metamorphic sedimentary and volcanic rock. Water production zones were identified between 180 and 300 feet bgs for the two testholes. Borehole and surface geophysical responses indicated that each testhole had significant layers with significant water production potential well yields ranging from 150 to 500 gpm;
- Water quality samples were collected from each testhole during the drilling phase. A total of five samples, three from the first testhole (TH-B) and two from the second testhole (TH-A), were collected. Two primary maximum contaminant level (MCL) exceedances were observed for parameter arsenic for TH-A. One secondary MCL exceedance for parameter iron was observed from 280 to 300 feet for TH-B. Five secondary MCL exceedances for parameter manganese were observed for the sampled zones.

Conclusions:

- Up to two production wells may be necessary to achieve the stated well production goal. Production wells should be completed within 50-feet radius of the 2013 testhole locations. The production wells should be constructed with a nominal 8-inch-diameter PVC well casing to allow aquifer pump testing to accurately determine specific well yields. (Refer to the Recommendation Section and Figure 4 for proposed production well design.)
- Production well options:

- Option 1 – Complete one production well (PW-B) near the TH-B location. Construct production well and complete aquifer testing and water quality analysis. Based on the testhole drilling and water quality observed at the TH-B location, a test-well location (PW-B) is more likely to meeting the well production goal of 370 gpm. The nearest connection point to the distribution system is approximately 3,000 feet away, based on a preliminary estimate of $100/foot for pipeline construction; cost may exceed $300,000 for the conveyance pipeline alone.
- Option 2 – Complete production well (PW-A) near the TH-A location. Construct production well and complete aquifer testing and water quality analysis. Based on the findings of the first production well, the District can evaluate whether a second production well is necessary near the TH-A site to meet the well production goal of 370 gpm.

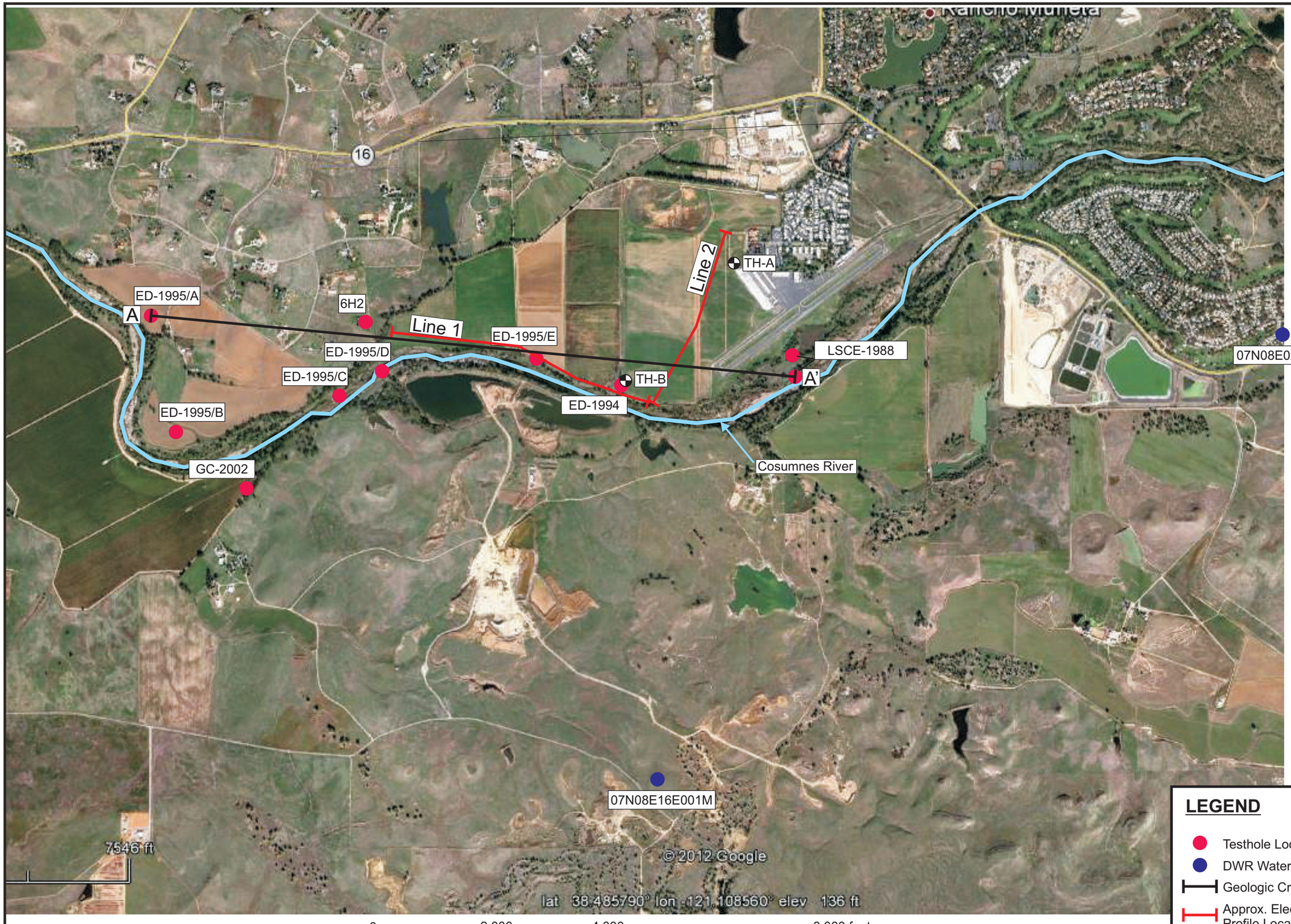
1 SETTING AND PURPOSE

The DE/DA Team was retained by RMCSD to assist with identifying a suitable location for ground water well development. RMCSD relies solely on surface water supplies from the Cosumnes River to meet water demand. As part of RMCSD's drought preparedness plan, the District plans to construct a ground water well or wells to augment surface water supplies during drought years. Grant funding through the State of California Local Ground Water Assistance Program, which has been awarded to RMCSD, may be used to assist in ground water resource development.

RMCSD provides essential services, including drinking water, to the community of Rancho Murieta. RMCSD serves an area of approximately 3,500 acres, which includes about 2,500 households, and an estimated population of 6,000. The RMCSD service area is located in the eastern margin of the Sacramento River Valley, within Sacramento County, approximately 21 miles southeast of downtown Sacramento. State Highway 16 runs through the RMCSD service area and is a major traffic artery connecting Sacramento with Sierra Foothill communities. Surface elevation within the service area ranges from 200 feet Mean Sea Level (MSL) in the east to 120 feet MSL in the west. The Cosumnes River is a significant surface water feature in the general area and drains from east to west; it is fed mainly by rainfall run off and snowmelt from the Sierra Nevada. The Cosumnes River is currently the sole source of drinking water. Surface water is stored and treated in several off-stream reservoirs. The river course is depicted in Figure 1.

Land use to the east of Highway 16 is characterized by residential development and the Rancho Murieta Golf Course. To the west of Highway 16 limited residential and commercial land use is present. The Rancho Murieta Airport, Equestrian Center and irrigated agriculture are the dominant land uses east of Highway 16. Major soil types in the area include the Hadselville-Pentz complex, Keyes sandy loam, Mokelumne gravelly loam, Pardee-Ranchoseco complex and Vina fine sandy loam. These soils are typically well-drained. However, bedrock is commonly found in the near surface and may limit ground water recharge potential.

The DE/DA Team presented a phased approach proposal on June 22, 2012, for the investigation effort. The proposal was approved at the July 18, 2012 RMCSD board meeting and a contract was issued. A draft Technical Memorandum was prepared as a deliverable, per Tasks 1 and 2 of the contract. A second draft Technical Memorandum was provided to RMCSD in the fall of 2012 for review of activities completed through that time period. This Technical Memorandum has been updated to include the 2012 and 2013 investigation findings.



LEGEND

- Testhole Location (Approx.)
- DWR Water Level Well (Approx.)
- Geologic Cross Section
- Approx. Electrical Resistivity Profile Location
- Proposed Testhole Location

SITE MAP WITH CROSS SECTION LINE, GEOPHYSICAL PROFILES AND TESTHOLE LOCATIONS
RANCHO MURIETA CSD
SACRAMENTO COUNTY, CALIFORNIA

DATE: 12/02/2013
SCALE: 1":1,680'
PROJECT NO: 157-03
DRAWN: JF, MM
CHECKED: PFD
FIGURE: 1

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2 REGIONAL GEOLOGY AND HYDROGEOLOGY

RMCSD is located along the eastern margin of the South American subbasin of the Sacramento Valley Ground Water Basin (Ground Water Basin No. 5-21.65). The South American subbasin is bounded on the north by the American River, to the west by the Sacramento River, to the south by the Mokelumne and Cosumnes Rivers and the Mesozoic basement rocks of the Sierra Nevada Foothills to the east. The ground water resources of the South American subbasin are described in considerable detail in Bulletin 118, Individual Basin Description. The surface geologic map indicates that the Modesto Formation, Mehrten Formation, Valley Springs Formation and Salt Springs Slate are located within close proximity to the site. The eastern margin of the South American subbasin is characterized by non-water bearing Jurassic-age Salt Spring Slate Formation (Jss) (see Figure 2). The Salt Spring Slate consists of metamorphosed sedimentary rocks on which water-bearing formations were deposited.

Significant recharge and water bearing geologic formations within the subbasin are described as follows:

- Older alluvium consists of loosely to moderately compacted sand, silt and gravel deposited in alluvial fans during the Pliocene and Pleistocene. In the study area (Figure 2), these deposits are identified as the Modesto Formation (Qm2) and Riverbank Formation (Qr). These units are moderately permeable, however. Due to the shallow nature, ground water quality impacts from agriculture or other man-made activities are common.

    - Alluvial and Tertiary Sand and Gravel Erosional and Depositional Sequences – As documented throughout the Sierra Foothills, and of significance hydrogeologically, are the erosional and depositional sequences that contain significant sand and gravels from historical channel deposition within the laterally confined alluvial basins.

- The Mehrten Formation (MPm) underlies the Modesto and Riverbank Formation and outcrops along the eastern edge of the subbasin and consists of interbedded clays, silts, "black sands" and gravels. Mehrten Formation sands and gravels are permeable and have known water well high specific yields. Additional sands and gravels related to alluvial systems and buried stream channels may provide additional aquifer recharge potential and target zones for water well production.

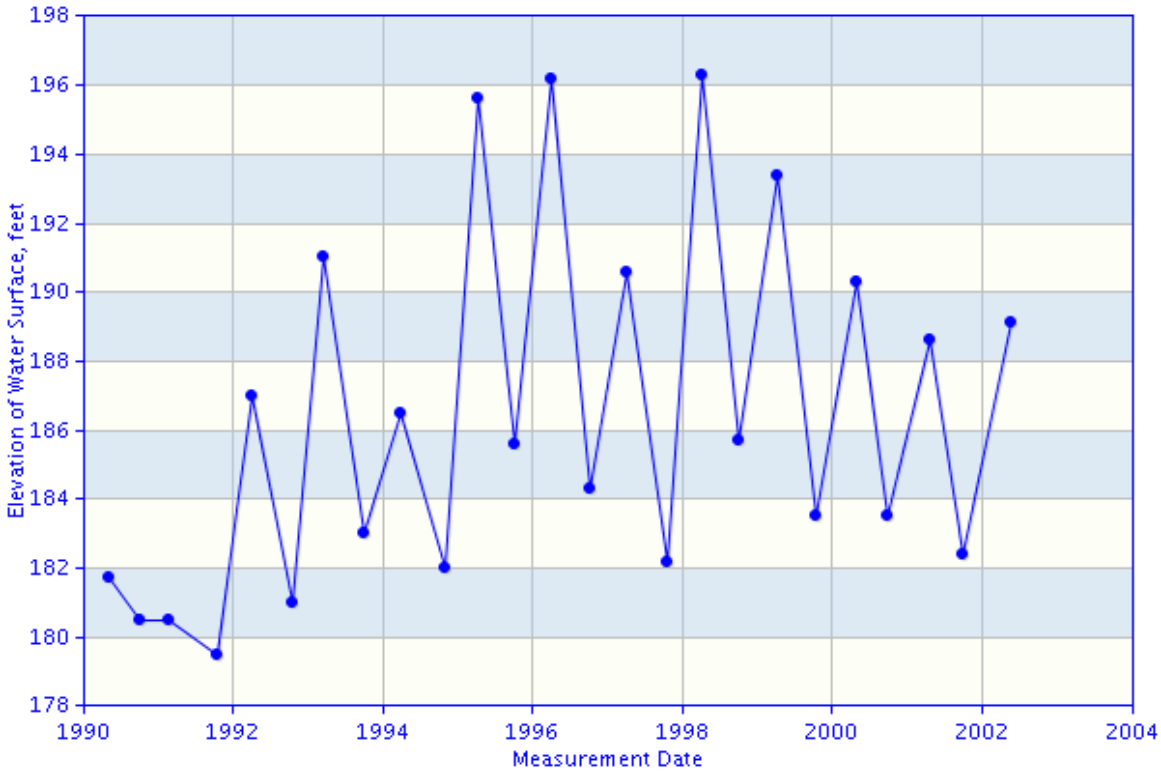
- Valley Springs Formations (Mvs) and Ione Formation (Ei) exist beneath the Mehrten Formation and are thought to be a transitional aquifer system. The Ione

Formation has limited sands and gravels regionally, and this formation is known for extensive fine-grained, silty, clay layers.

2.1 GROUND WATER LEVEL INFORMATION

Two historic monitoring wells were identified close to the RMCSD on the Department of Water Resources website. The first monitoring well (07N08E16E001M) has water level data from 1968 to 1970 and indicates water levels between 110.5 and 113.5 feet MSL. As depicted in Figure 1, the well is located approximately 1.5 miles south-southwest of the Rancho Murieta Airport. The second monitoring well (07N08E02L001M, depicted below) has water level data from 1990 to 2002. It was destroyed in 2002. The well is located approximately 1.5 miles east of the Rancho Murieta Airport. The well is identified as a stock well. Monitoring data indicates water levels fluctuate between 179 to 197 feet MSL. Water level drops and increases of up to 14 feet have been observed historically. These water level responses support a non-overdraft condition (or stable water conditions) within this part of the basin.

Ground Water Level Data
Well 07N08E02L001M (Ground Surface Elevation 198 feet MSL)



GEOLOGY MAP WITH CROSS SECTION LINE, GEOPHYSICAL PROFILES AND TESTHOLE LOCATIONS
RANCHO MURIETA CSD
SACRAMENTO COUNTY, CALIFORNIA

N

Qm2
Pl
MPm
ΦMvs
Qa
Qr
Ei
Jss
Qha
af
Line 1
Line 2
ED-1995/A
A
6H2
ED-1995/D
ED-1995/C
ED-1995/B
ED-1995/E
ED-1994
TH-A
TH-B
LSCE-1988
A'
07N08E02L001M
GC-2002
07N08E16E001M

0 2,000 4,000 8,000 feet

LEGEND

af	Artificial Fill
Qa	Alluvium
Qm	Modesto Formation
Qr	Riverbank Formation
Pl	Laguna Formation
MPm	Mehrten Formation
Mvs	Valley Springs Formation
Ei	Ione Formation
Jss	Salt Spring Slate Formation
	Testhole Location (Approx.)
	DWR Water Level Well (Approx.)
	Geologic Cross Section
	Approx. Electrical Resistivity Profile Location
	Completed Testhole Location

DATE: 12/02/2013
SCALE: 1":1,680'
PROJECT NO: 157-03
DRAWN: JF, MM
CHECKED: PFD
FIGURE: 2

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3 PREVIOUS INVESTIGATIONS

Several previous investigations have been conducted on the potential for ground water resources in the RMCSD area. Investigation reports dating from 1988 to 2003 were reviewed. The following summarizes these reports:

- 1988 Ludhorff & Scalamini Consulting Engineers: Myers Bros Well Drilling completed two testholes south of the Rancho Murieta Airport near the Cosumnes River. Downhole geophysical was completed by Welenco and was available for review. The investigation report, if one was prepared, was not available for review.
- 1994 Eaton Drilling & Helmick-Lerner: Eaton Drilling completed a testhole to a depth of 390 feet. The consulting firm Helmick & Lerner completed a Testhole Log Interpretation Report and zones for water-well development were identified from 240 to 330 feet bgs.
- 1995 Eaton Drilling & Helmic-Lerner: Eaton Drilling completed an additional five testholes to depths ranging from 500 to 700 feet bgs. Driller's logs and partial geophysical logs for the five testholes were available for review.
- 2002 GeoConsultants: Electrotulleric soundings were completed for 17 locations; one location was selected for testhole drilling and sampling. Electrotulleric logs, boring log and downhole geophysical logs were reviewed.
- 2003 HDR: Completed a review of previous work and available regional hydrogeologic information. No additional testholes were completed as part of this investigation.

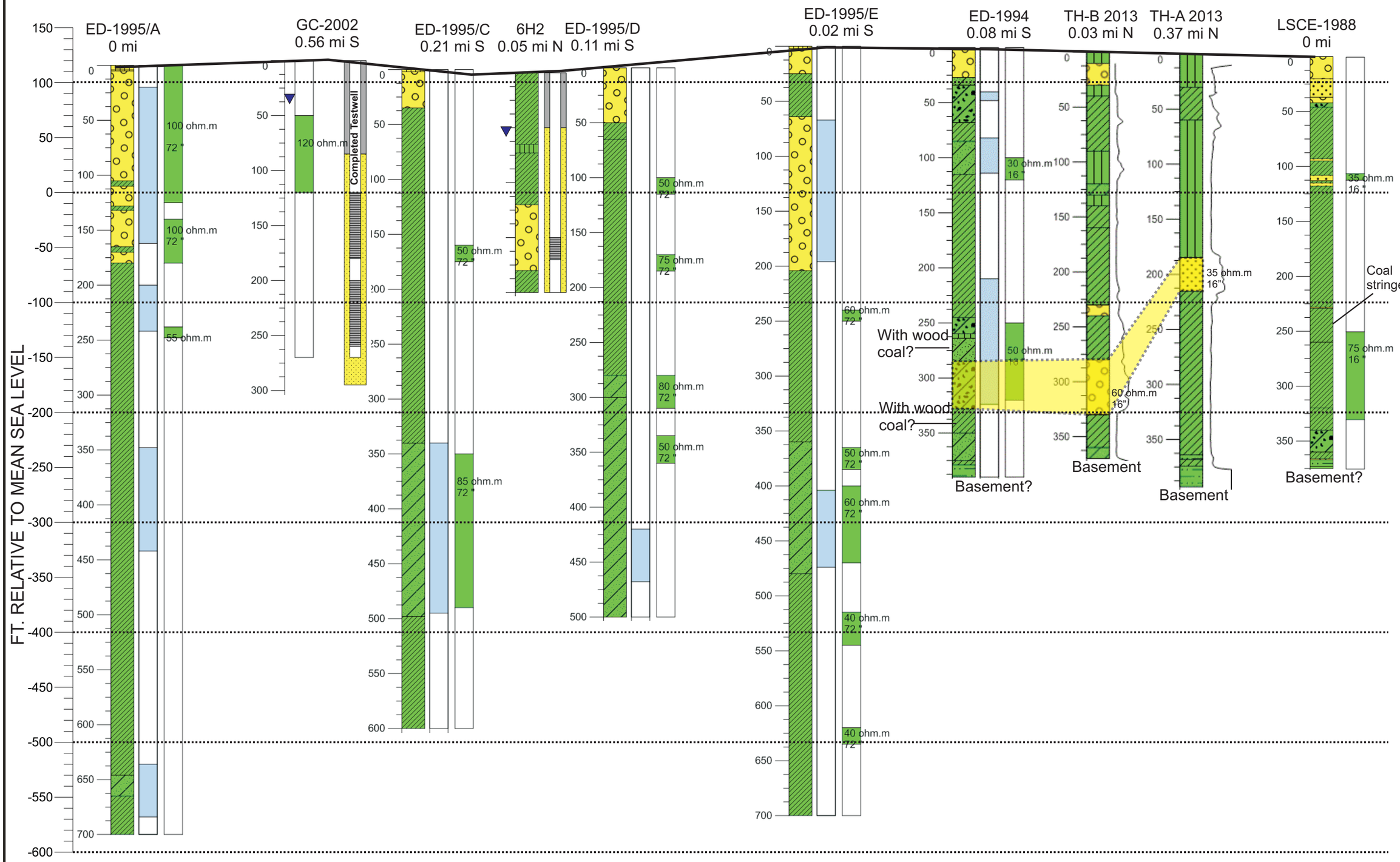
3.1 1988 – LUDHORFF & SCALMANINI

During 1988, Ludhorff & Scalmanini Consulting Engineers (LSCE) directed the completion of two testholes south of the Rancho Murieta Airport, north of the Cosumnes River. Refer to Figure 1 for testhole locations. A well driller's log and geophysical log were available for Testhole No. 1 (southern testhole shown on Figure 1). The testhole was completed to 375 feet bgs. The well driller's log identified the following sand or gravel intervals: 9 to 42, 93 to 95, 108 to 113, 115 to 118, 228 to 229 and 366 to 367 feet. Based on the geophysical log, potential sand and gravel (high resistivity zones) were identified from 0 to 40, 56 to 60, 104 to 114, 220 to 224 and 250 to 332 feet. Based on the testhole findings, basement was encountered at 367 feet. LSCE estimated the encountered strata could achieve production of 400 to 500 gpm, but below the 1988 stated project goal of 1,000 to 1,500 gpm. Geologic formations encountered were interpreted as follows: Modesto Formation from 0 to 118 feet, Valley Springs 118 to 220 feet and Ione Formation 220 to 367 feet. Refer to Figure 3 for a depiction of the LSCE-1988 boring.

A - WEST

Note: Boreholes are projected onto the cross section line and geologic unit correlation depicted in the figure may not accurately represent real world spatial relationships between boreholes.

A' - EAST



HYDROGEOLOGIC CROSS SECTION A-A'
RANCHO MURIETA CSD
SACRAMENTO COUNTY, CALIFORNIA

DATE: 10/10/2013
SCALE: Horz 1":900', Vert 1":84'
PROJECT NO: 157-03
DRAWN: MM/JF/CT
CHECKED: PFD
FIGURE: 3

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3.2 1994 & 1995 – EATON DRILLING

Eaton Drilling in association with Helmick-Lerner, completed a total of six testholes between 1994 and 1995. Well driller's logs and downhole geophysical logs were available for review; however, geophysical logs were not available for the entire borehole depth of each completed testhole. In 1994 Eaton completed the testhole shown on Figure 1 as ED-1994. The testhole was completed to 390 feet bgs and well driller and geophysical logs were available. The well driller's log identified sand and gravel horizons from 2 to 27 and 68 to 115 feet. Below 115 feet, sand and gravel were found with significant amounts of clay present. The Helmick-Lerner assessment identified zones for ground water production development from 40 to 48, 82 to 114 and 210 to 324 feet. The referenced investigation concluded that a production well with screen from 240 to 330 feet bgs will have an estimated production capacity of 500 gpm, comparable to the 2013 test-hole findings. Refer to Figure 3 for a depiction of this information.

During the summer of 1995, Eaton Drilling completed an additional five testholes to evaluate ground water resources. Testholes were completed to depths of 500 to 700 feet. Refer to Figure 1 for a depiction of testhole locations shown as ED-1995/A through ED-1995/E. A testhole evaluation prepared by Helmick-Lerner identified four potential water-bearing formations in testhole ED-1995/A, found between 20 and 684 feet bgs; thickness ranged from 42 to 142 feet. Testholes ED-1995/B, C and D each found one water-bearing formation. The depth of water-bearing formations ranged from 70 to 468 feet bgs and thickness ranged from 45 to 155 feet. Testhole ED-1995/E encountered two water-bearing formations from 67 to 196 and 404 to 474 feet. Refer to Figure 3 for depiction of the depth information. The Eaton Drilling cover letter concluded that, based on the available data completed, production wells would not meet the 1995 stated project goal of 2,000 gpm.

3.3 2002 – GEOCONSULTANTS

In 2002, two separate work efforts were completed by GeoConsultants to investigate ground water resources in the area. In late 2001, electrotulleric soundings were completed at 17 sites around the RMCSD service area. Electrotulleric soundings estimated the depth and thickness of saturated horizons below the surface. The most promising electrotulleric site was selected to complete a testhole and water well. The location of the testhole is shown as GC-2002 on Figure 1. The testhole was completed to 295 feet bgs; Mehrten Formation was identified above 190 feet bgs. The testhole was reamed to 12-inches diameter and a testwell constructed using 6-inch-diameter casing. The testwell had 120 feet of screened interval at 120 to 180 and 200 to 260 feet. Refer to Figure 3 for the testhole and well completion information.

Once the testwell development was done, constant rate aquifer testing was completed. Static water level before the pump test was 39.00 feet bgs, water level declined to 63.95 feet bgs or 24.92 feet of drawdown. Average pump rate over the 24 hours was 108.19 gpm. During recovery, the well achieved 97 percent recovery within 2 hours of pump shutdown. The calculated specific capacity is 4.3 feet/gpm. Based on the pump and recovery test average transmissivity was estimated as 14,317 gallons per day(gpd)/foot. Save yield for 6 inch diameter well was estimated as 350 gpm.

GeoConsultants collected field parameters during the pump test. The report indicates that RMCSD staff collected a water sample near the end of the 24-hour test. However, water quality data was not included in the report.

3.4 2003 – HDR

In 2003, HDR complete a review of four different drought preparedness options. Three options included new or increased surface reservoir storage and one option evaluating ground water resource options. Options ranged from $3.5 to 41.2 million in cost. No new ground water investigation boreholes were completed as part of this work effort.

4 CONCEPTUAL HYDROGEOLOGIC MODEL

The 2010 updated geologic map of the project area is presented on Figure 2. The geologic map shows the Mesozoic basement rocks to the east of Highway 16 and north of the Cosumnes River. Based on the geologic map, Cenozoic units have an estimated regional dip of 4.5° to the southwest (400 feet drop over approximately 1 mile). The previous testhole investigations identified basement rock at depths ranging from 360 to greater than 700 feet bgs. Target geologic features for aquifer recharge, discharge and ground water production can be summarized as follows:

- Well sites are located in the existing Cosumnes River alluvial basin.
- Sand and gravel horizons have been identified with depth above basement material.
- The alluvial paleo-channel target horizons consist of the sand and gravel units within the Mehrten, Valley Springs and Ione Formations. The Hydrogeologic Cross Section A-A' presented in Figure 3 shows the presence of potential water bearing formations to depths greater than 400 feet bgs.
- Water bearing units range in thickness from 10 to 50 feet.
- Due to potential erosional features and a regional dip to the southwest, water bearing formations are expected be better developed further west than near bedrock highs.
- Testholes LSCE-1988 and ED-1994 noted the presence of coal or lignite layers below 250 feet. Water quality may be adversely affected by the presence of these formations.
- Stratified sequences of paleo-channel sand and gravels facilitate recharge and water well production areas.
- Surface geophysical Electrical Resistivity (ER) profiling was completed. ER profiles identified high-resistive material from surface to 50 feet bgs. This resistive material is correlated to the sand and gravel deposits identified in previous testholes. Resistive material is typically underlain by layers of less resistive material ranging in thickness from 50 to 200 feet and is interpreted as fine-grained material identified in testholes. Resistivity increases with depth, with the interval from 200 to 300 feet bgs typically more resistive than the immediately overlying unit. This increased resistivity was correlated to sand and gravel horizons in testhole ED-1994 and the testhole TH-B location.

The resistive material at surface is interpreted to be the Modesto and Riverbank Formation with possible Mehrten Formation at the western portion of Profile Line 1. This interpretation is based upon the Modesto Formation deposits at surface for both the profile locations as shown on Figure 1. The Mehrten and Valley Springs contact as shown on Figure 1 can be projected through the Modesto deposits and intersects the

Profile Line 1 approximately midway. The low-resistive material below the Modesto/Mehrten formations is interpreted to include the fine grained members of the Valley Springs and Ione Formations. The moderately resistive material present at the base of the profile is interpreted to be interbedded sands within the Ione clays.

5 SURFACE GEOPHYSICS AND TESTHOLE DRILLING

5.1 SURFACE GEOPHYSICS RATIONALE – 2012

Based on the previous investigations, the conceptual hydrogeologic model, and in consultation with NORCAL Geophysical Consultants, surface ER profiling was selected to assist in identifying preferred hydrogeology and testhole locations for future production well development. ER profiling has historically been successful in identifying electrically resistive layers or buried stream channel deposits to depths of 300 feet bgs. Two geophysical profiles, Line 1 and 2, are shown on Figure 1 and Appendix B – Plate 1.

Geophysical profile Line 1 has a general east-west orientation and was completed sub-parallel to the regional dip. The profile covers approximately 5,000 feet and passes through the vicinity of testholes ED-1994 and ED-1995/E. This profile identifies potential water-bearing horizons along dip direction.

Geophysical profile Line 2 was completed in a north-south orientation nearly parallel to regional strike. This profile assists in identifying buried migrating stream channels with depth. The profile covers approximately 3,500 feet and passes through the vicinity of testhole ED-1994.

The completed geophysical profiles are used to refine testhole locations and target areas of high resistivity, which can be correlated to sand and gravel horizons.

5.2 METHODS

The ER survey was conducted from August 21 through 24, 2012, by NORCAL Geophysical Consultants of Cotati, California (NORCAL). ER surveys were completed for profiles Line 1 and Line 2, which were 4,950 and 3,480 feet in length respectively. Figures produced by NORCAL are included in Appendix B as Plates 1 through 3. Refer to the Appendix B – Plate 1 for the location of each line. Geophysical interpretation and the resistivity profiles are provided as Plate 2 and Plate 3.

The ER survey was completed as a Wenner array of 56 electrodes. Electrode spacing was 30 feet. Data acquisition was completed using an Advanced Geosciences Inc. (AGI) SuperSting R1 IP Earth Resistivity/IP Meter. The profiles were located and staked in the field using an aerial photo map and a 300-foot-measuring tape. Completed profiles were surveyed by NORCAL using a Trimble GEOXH6000 handheld GPS. Data processing to determine the best fit model was completed using EarthImager, written by AGI of Austin, Texas. Contoured ER profiles were generated using Surfer 9.0, written by Golden Software of Golden, Colorado.

5.3 2012 SURFACE GEOPHYSICAL FINDINGS

The general features of the two profiles are similar. High resistivity material (greater than 30 ohm-m) exists from 0 to 100 feet of ground surface, underlain by approximately 50 to 200 feet of low-resistive material or clay (less than 11 ohm- m), with moderately resistive material (greater than 11 and less than 30 ohm-m) from 200 to the maximum depth of the profile at 300 feet. Higher resistive sediments are observed with depth. Note that with depth, geophysical resolution does decrease due to the stratigraphic variation and the averaging of resistive nature of the overlying sediments. The ability to identify thin, interbedded layers of gravel with depth is limited with this investigation tool.

RESISTIVITY PROFILE LINE 1

Along the eastern half of the profile, near-surface, high-resistive units (greater than 80 ohm-m) attain a thickness of up to 100 feet. To the west, these near-surface deposits thin to 25 to 50 feet thick deposits and are also less resistive (30 to 80 ohm-m). A section of moderately resistive material is present at surface from 2,000 to 2,400 horizontal feet. The low resistive layer (less than 11 ohm-m) is present 50 to 100 feet bgs, and attains thickness of 125 to 200 feet. The contours between this low resistive layer and overlying moderately resistive material undulate, a possible indication of an erosive contact and penetration to depth. This low resistive layer is not horizontally continuous at two locations: Stations 1,800 and 2,700 feet. Moderately resistive material exists at the base of the profile, appearing at depth of 175 feet bgs or greater.

RESISTIVITY PROFILE LINE 2

At surface, deposits of up to 50 feet in depth of higher resistivity (greater than 50 ohm-m) material are present. Moderately resistive (22 to 50 ohm-m) material is sporadically present at surface at the northern 1,200 feet of the profile. A low-resistive layer, approximately 50 to 200 feet in thickness, is present at depths of 50 to 100 feet bgs. This low-resistive layer is thickest from Station 1,600 to 2,700 feet horizontal, is approximately 50 to 100 feet thick at the southern end, and pinches out at the northern end. Moderately resistive material is present below the low resistive clay layer. This moderately resistive layer is dominant from 400 to 1,200 horizontal feet and resistivity ranges up to approximately 25 ohm-m, and appears at 100 to 150 feet bgs at the northern end of the profile.

REFINED CONCEPTUAL MODEL AND DATA OBJECTIVES

One of the data objectives of the surface geophysics is to identify basin wide sequences and variations which may indicate preferred bedding, erosion patterns and infill deposits that will increase both the production capacity and sustainability of a ground water resource. Both geophysical profiles depict, in general, a bedded sequence of the coarse grained deposits, underlain by a thick low permeable (low resistivity) clay bed and then further by a higher permeable interbedded sands and silts. Inference from the resistivity increases with depth support—a coarsening downward sequence from approximately 50 feet bgs to a depth of 300 feet bgs.

Paleo-channels or historic tertiary sand and gravel resistive features have been identified near RMCSD. The increased resistivity noted on Line 1, included as Appendix B – Plate 2, at Station 1,850 feet can be interpreted as a paleo-channel. This is due to the u-shaped nature of the feature and the increased resistance relative to the surrounding material. The increased resistivity at Station 2,700 feet does not display the same u-shape, but can also be interpreted to be an erosional feature associated with fluvial processes.

The geophysical profile results corroborate the boring log and areas of interest indicated in Figure 3. Permeable sediments are generally correlated with resistive layers, and zones of interest identified by Eaton and DE are correlated with increased resistivity. The sandy clays and gravel and clays identified in the ED-1994 boring log from 250 to 300 feet bgs are correlated to the moderately resistive materials (11 to 30 ohm-m) seen near the bottom 50 to 100 feet of the resistivity profile. The surficial gravels found at ED-1995/E are reflected in resistivity profile Line 1. Borehole geophysics of ED-1995/E identified downhole geophysics resistivity exceeding 50 ohm-m from 60 to 205 feet bgs. This interval is described on the driller's log as silty, sandy gravel. This interval corresponds to the increased surface ER noted at Line 1, Station 2,700 feet.

ER profile Line 2 shows formations within the 50 to 100 feet bgs have resistivity above 50 ohm-m, which corresponds to the near surface sand and gravel layers identified in testholes and Line 1. The increased resistivity observed on Line 2, included as Appendix B – Plate 3, from Station 400 to 1,200 feet can be correlated to sand and gravel deposits. From Station 2,800 feet to the end of Line 2, increased resistivity is observed within 50 to 250 feet bgs. This increased resistivity can be correlated to sand and gravel units. It is important to note that Jurassic basement material can also result in increased resistivity. Basement material was found at 380 feet bgs in ED-1994; several testholes completed for the Elk Grove Unified School District northwest of Jackson Rd and Stonehouse Rd found basement material from 20 to 200 feet bgs; the surface geologic map (Figure 2) identifies basement less than 5,000 feet east of Line 2. The presence of

basement material above 300 feet bgs may also result in increased resistivity noted in the north end of Line 2.

The refined conceptual model from the geophysics was used to locate the referenced 2013 testholes. Target depths were between 200 and 600 feet for the 2013 drilling program.

5.4 2013 TESTHOLE DRILLING, WATER QUALITY SAMPLING DURING DRILLING AND DOWNHOLE GEOPHYSICS

5.4.A FIRST TESTHOLE (TH-B)

Testhole drilling was performed by Fredrick Well Drilling of Jackson, California, C-57 License Number 333800. Testhole drilling activities were initiated on August 20, 2013 at location TH-B (refer to Figure 2). A temporary conductor casing was installed to 40 feet on August 20th. Drilling at TH-B was completed using a T3W rig. Air rotary techniques were used to a depth of 340 feet bgs where a gravelly sand sequence was encountered, which caused the driller concerns regarding borehole stability. The driller switched to a mud-rotary technique and continued drilling from 340 feet bgs on August 30, 2013. The total depth of 378 feet was reached on August 30th with refusal to very hard metamorphic bedrock. A geophysical log was run after drilling was completed. Geophysics consisted of temperature, gamma, 16- and 64-inch normal and SP logs and was performed by West Coast Well Logging Services of Rancho Cordova, California. Water producing zones of sandy gravel or gravelly sand were encountered from 230 to 240 feet bgs and 280 to 330 feet bgs and were confirmed with geophysical logging. Wood fragments were noted from 240 to 280 feet bgs.

Three water samples were collected from TH-B on August 20, 2013: the first was collected at first-encountered water (110 to 120 feet bgs) with a flow of 30 gpm, the second was collected at 230 to 240 feet bgs with a cumulative flow of 60 gpm, and the final sample was collected from 280 to 300 feet bgs, with a cumulative flow of approximately 150 gpm. Water quality results are presented in Table 1 and are discussed in more detail below. TH-B was abandoned as per Sacramento County Well Permit requirements, from the borehole bottom to surface on September 10, 2013 using 10.3 sack cement slurry. A representative from the Sacramento County Environmental Management Department (SCEMD) was present for the abandonment.

5.4.B SECOND TESTHOLE (TH-A)

Drilling activities at TH-A (Figure 2) were initiated on September 13, 2013 using air-rotary techniques. A sand interval encountered at 185 feet bgs resulted in a switch to mud rotary drilling techniques at a depth of 200 feet bgs. Drilling using mud rotary

commenced on September 14th and the total depth of 393 feet bgs was reached on September 17th. A geophysical log was run after drilling was completed on September 17th and consisted of temperature, gamma, 16- and 64-inch normal and SP logs. Geophysical logging was performed by West Coast Well Logging Services of Rancho Cordova, California. A water producing zone of sand was encountered from 185 to 215 feet bgs and was confirmed with geophysical logging.

Two water samples were collected from TH-A on September 13, 2013: the first was collected at 100 feet bgs with a flow of 20 gpm and the second was collected at 200 feet bgs with a cumulative flow rate of 100 gpm. Water quality results are summarized in Table 1 and discussed in detail below. TH-A was abandoned on September 18th using 10.3 sack cement slurry as required by the Sacramento County Well Permit. A representative from SCEMD was present for the abandonment.

5.5 TESTHOLES FINDINGS AND SURFACE GEOPHYSICAL PROFILES

Borehole geologic logging and downhole geophysial findings support the surface geophysics and hydrogeologic conceptual model. Both TH-A and TH-B encountered significant sand layers with depth. TH-A is located at Station 2960 feet on Line 2, which shows increasing resistivity with depth. For Line 2, it appears that the 11 ohm-m surface resistivity is a good indicator of sand or gravel material that is laterally continuous.

Testhole TH-B is located near ED-1994 shown on Line 1. Line 1 shows increased resistivity with depth and 11 ohm-m resistivity contour line shown at 220 feet bgs on Line 1 corresponds with the first significant sand units observed in TH-B at around 230 feet bgs.

The hydrogeologic cross section shown on Figure 3 shows a correlation between sand layers found in TH-A and TH-B and ED-1994. Based on the horizontal distance between the boreholes, the apparent dip is 2°; this is consistent with a regional dip of approximately 4°. The depth of water-bearing sand ranges from 180 to 270 feet in depth and thickness ranges from 30 to 50 feet.

5.6 GROUND WATER SAMPLING RESULTS

Water quality grab samples were collected during the air rotary phase of the testhole drilling and submitted to California Laboratory Services of Rancho Cordova, California under chain-of-custody documentation. Grab samples were collected from the borehole returns. Temporary well casing installations were not used and the water quality reflects a composite of water producing zones at the point of sampling. Elevated turbidity required the completion of laboratory filtering of water samples. Upon receipt

by the analytical laboratory, samples were laboratory filtered to reduce potential elevated metals related to the turbidity of the samples. Field parameters of pH, specific conductance, temperature and turbidity were also collected for the sampled zones.

Field parameters for TH-B were as follows: pH ranged from 6.56 to 8.27, conductivity ranged from 409 to 497 µS/cm, temperature ranged from 19.57 to 19.85 °C, and turbidity ranged from 259.0 to 974.3 NTU.

Field parameters for TH-A were as follows: pH ranged from 8.18 to 8.23, specific conductance ranged from 576 to 639 µS/cm, temperature ranged from 21.9 to 23.5 °C, and turbidity was noted as cloudy.

Table 1
Water Quality Results – Selected Parameters
RMCSD Testhole Drilling

Sample Name			**TH-A 100**	**TH-A 200**	**TH-B 110-120**	**TH-B 230-240**	**TH-B 280-300**
Sample Date			**9/13/2013**	**9/13/2013**	**8/20/2013**	**8/20/2013**	**8/20/2013**
Parameter	Units	MCL†					
pH (Field)		6.5-8.5*	8.18	8.23	6.56	8.27	8.18
Specific Conductance (Field)	µs/cm	900*	576	639	439	409	497
Temperature (Field)	°C		21.9	23.5	19.70	19.57	19.85
Turbidity (Field)	NTU	5	Cloudy	Cloudy	974.3	259.0	278.1
Chloride	mg/L	250*	8.6	85	19	18	43
Fluoride	mg/L	2	0.20	0.16	0.13	0.19	0.15
Nitrate as NO3	mg/L	45	4.4	<0.50	0.72	0.56	13
Sulfate	mg/L	250*	55	120	140	110	120
TDS	mg/L	500*	290	420	390	390	420
Arsenic	mg/L	0.01	**0.018**	**0.013**	0.0029	0.0053	0.0032
Calcium	mg/L		23	30	36	34	22
Iron	mg/L	0.3*	<0.100	<0.100	<0.100	<0.100	**0.5**
Magnesium	mg/L		13	11	13	9.7	9.1
Manganese	mg/L	0.05*	**0.15**	**0.12**	**0.37**	**0.14**	**0.33**
Potassium	mg/L		3.8	5.1	3.6	4.4	2.1
Sodium	mg/L		33	83	33	36	72

† CCR Title 22 Section 64431 and 64449 MCL

* Title 22 Secondary MCL, Values are dissolved analyses except for the field parameters.

Water quality results, provided in Table 1, were as follows: chloride ranged from 8.6 to 85 mg/L, fluoride ranged from 0.13 to 0.20 mg/L, nitrate as NO3 ranged from 0.56 to 13

mg/L, sulfate ranged from 55 to 140 mg/L, total dissolved solids ranged from 290 to 420 mg/L, arsenic ranged from 0.0029 to 0.018 mg/L, calcium ranged from 22 to 36 mg/L, iron ranged from non-detect to 0.500 mg/L, magnesium ranged from 9.1 to 13 mg/L, manganese ranged from 0.12 to 0.37 mg/L, potassium ranged from 2.1 to 5.1 mg/L and sodium ranged from 33 to 83 mg/L. Refer to Appendix C for analytical laboratory reports.

Water quality was compared to California Code of Regulations (CCR) Title 22 Maximum Contaminant Limit (MCL). Two primary MCL exceedances were observed for parameter arsenic for TH-A. One secondary MCL exceedance for parameter iron was observed from 280 to 300 feet for TH-B. Five secondary MCL exceedances for parameter manganese were observed for samples collected from both TH-A and TH-B.

Water quality sampling shows that both testhole locations would require some form of water treatment. The primary MCL exceedance for arsenic in TH-A may indicate more expensive treatment will be required at TH-A location. It is important to note that observed metal parameter exceedances may be related to sample turbidity. Ground water produced from wells with a gravel envelope that have undergone proper well development with turbidity meeting the Title 22 requirement of 5 NTU, may not exhibit metal parameter MCL exceedances.

6 POTENTIAL GROUND WATER PRODUCTION

Based on the surface geophysical profile and completed testholes, water bearing sand layers were found below 180 feet bgs and thickness ranged up to 50 feet. During 2013, airlifting flow was measured and ranged from 100 to 150 gpm. A flow estimate during airlifting is typically a conservative estimate of expected ground water production from a constructed well. Based on the testhole findings, specific capacity of encountered sand units is expected to range from 5 to 10 gpm per foot of drawdown. Based on these findings, specific capacity and encountered sand unit thickness of 30 to 50 feet, flow at TH-A and TH-B locations can range from 150 gpm up to 500 gpm.

The calculated flow is consistent with the findings presented in previous studies; the following two options are presented:

- Option 1: Based on the investigation findings, a single well located near the TH-B location is more likely to achieve the production goal of 370 gpm than a single well located near TH-A. However, significant expenditure will be required in order to connect a well at this location since the nearest connection point to the existing distribution system is approximately 3,000 feet.

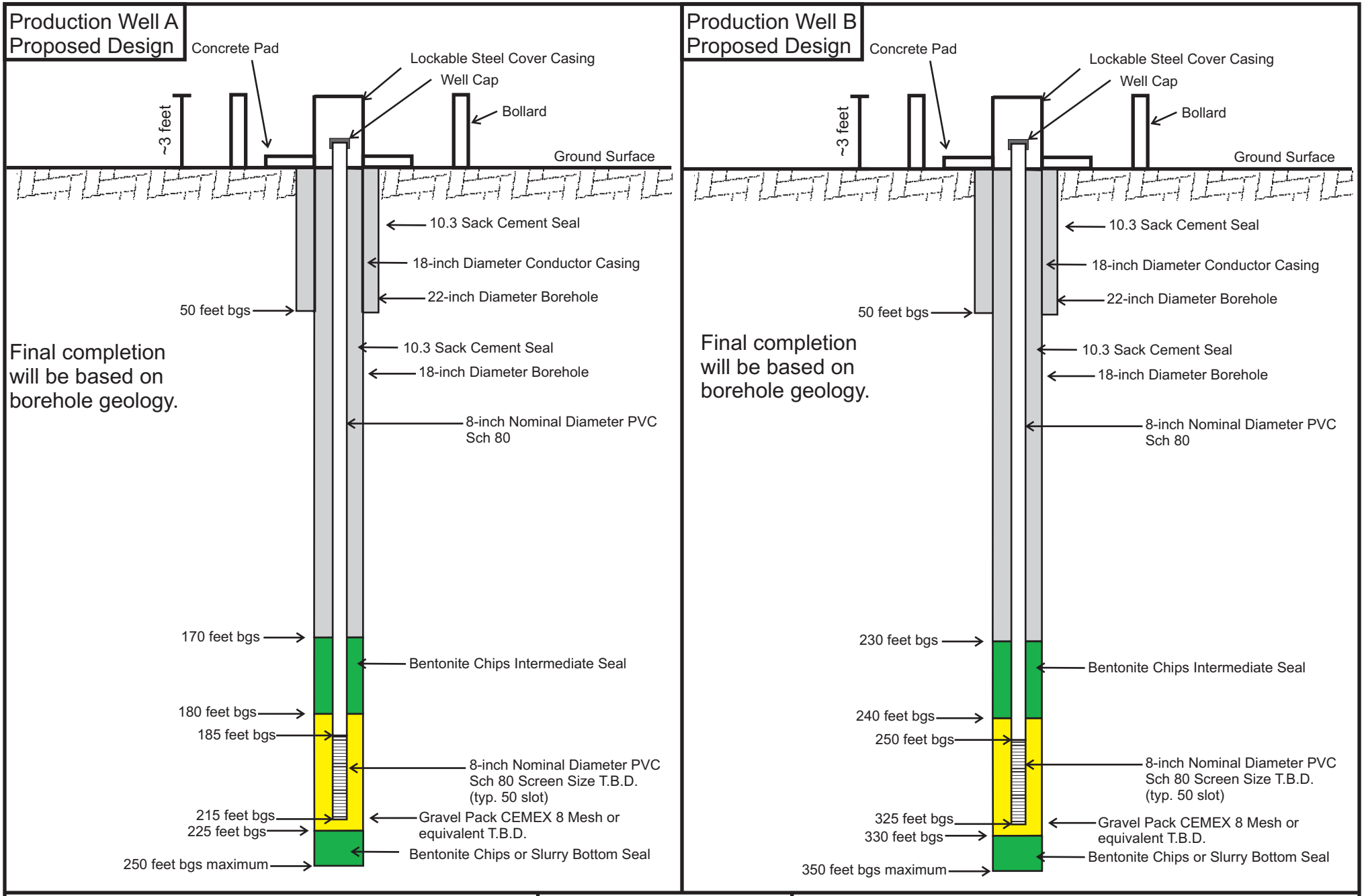
- Option 2: Complete one production well near the TH-A location. Based on the aquifer testing and water quality analysis findings of the first production well, the District can evaluate whether a second production well near TH-A is necessary to meet production goals.

7 RECOMMENDATIONS

Based on the investigation efforts to-date, findings summarized above and in the Executive Summary – Section 0, DE recommends the following:

- In order to assess and measure ground water (as referenced in the 2012 DE Proposal – Task 3B), DE recommends that up to two production wells should be considered, using the phased approach discussed below.
- Up to two production wells should be considered. They should be located within 50 feet of the 2013 testhole locations. The production wells should be constructed with a nominal 8-inch-diameter PVC well casing to allow aquifer pump testing to accurately determine specific well yields. Refer to Figure 4 for proposed test-well design. A Request for Bid Technical Specifications is provided in Attachment C. Production well options are as follows:
    - Option 1: Based on the testhole findings and water quality observed at the TH-B, a production well location (PW-B) near TH-B is more likely to meeting the well production goal. This option will result in significant additional cost over and above the well construction cost, since the nearest connection point to the distribution system is approximately 3,000 feet away.
    - Option 2: Complete one production well, possibly two, near TH-A as referenced above. The benefit of this location relates specifically to the cost savings of a distribution pipe.
- Prior to construction, a drinking water source assessment (DWSAP) should be completed, submitted and approved by the California Department of Public Health.
- Pump testing should include step test to determine well and aquifer efficiency and long-term, constant-rate-pump test. Specific yield for each well will be determined from these tests.
- Long-term pump tests will be used to assess aquifer characteristics and aquifer basin sustainability.
- During aquifer testing, additional water quality samples should be collected and analyzed for Title 22 water quality constituents. The parameter list should be based on constituents for concern. An analysis for complete Title 22 list of parameters is not considered warranted. Additional water quality analyses will help refine the need for water quality treatment.

- Based on the results of pump testing and water quality sampling, the production wells can be operated as municipal supply wells.



Dunn ENVIRONMENTAL, INC.
An NV5 Company

DATE: 12/02/2013
SCALE: Not to Scale
PROJECT NO: SAB115703
DRAWN: CT
CHECKED: PFD, JF
FIGURE: 4

PROPOSED PRODUCTION WELL DESIGN
RANCHO MURIETA CSD
SACRAMENTO COUNTY, CA

APPENDIX A

BORING LOGS TH-A AND TH-B

Dunn ENVIRONMENTAL, INC.
An NV5 Company

▽ First Encountered Water

Boring Log and Proposed Test Well

DE Project No.: 157-03
DE Project: Rancho Murieta Community Service District
Test Hole (TH)-A

Location: Rancho Murieta, CA
Driller: Fredrick Pump and Supply
Drilling Method: Air and Mud Rotary, 6" Bore
Geologist: J. Fourie, P.G., Patrick F. Dunn C.Hg.
Reviewed by: J. Fourie, Patrick F. Dunn
Published Date: December 12, 2013

Date and Time	Depth (ft)	Geologic Log	USCS Description	SP (mv) 100 125 150 175 200	16" (blue) 64" (red) (ohmmeter^2/m) 0 20 40	Proposed Production Well Completion
	0		Sandy Silt (ML); dark yellowish brown 10YR 3/4; 15 - 20% fine sand; 10 - 15%, angular to sub angular; moist; soft; loose.			
			Sandy Silt (ML); dark yellowish brown 10YR 3/4; 15 - 20% fine sand; 5 - 10% medium sand, angular to sub rounded; low plasticity; moist.			
			Sandy Silt (ML); dark yellowish brown 10YR 3/4, 15 - 20% fine sand, 10 - 15%, angular to sub angular; moist; soft; loose.			
	▽		Sandy Clay (CL); light grayish brown 10YR 6/2; 15 - 20% fine sand; 5% medium sand; trace fine gravel; angular to sub angular; medium plasticity; wet; first water estimate production 3.5 - 5 gpm, not sampled.			
			Clay (CL); bluish gray 10BG 5/1; <10% fine sand; medium plasticity; moist; very little water additional water production.			
			Clay (CL); bluish gray 10BG 5/1; <10% fine sand; medium plasticity; moist; very little water additional water production.			
			Silt (ML); bluish gray 10BG 5/1; no coarse grains; weakly cemented. Increased water production, flow not measured.			
			Silt (ML); very dark gray 10YR 3/1; no coarse grains; weakly cemented.			
			Silt (ML); very dark gray 10YR 3/1 and gray 10YR 6/1; interbedded; no coarse grains; weakly cemented.			
			Silt (ML); very dark gray 10YR 3/1; no coarse grains; weakly cemented. Water production measured, 20 gpm, collect water sample.			
	100		Silt (ML); bluish gray 10BG 5/1; trace fine sand content; weakly cemented.			
			Silt (ML); bluish gray 10BG 5/1; trace fine sand content; weakly cemented; low plasticity.			
			Silt (ML); bluish gray 10BG 5/1; trace fine sand content; weakly cemented; low plasticity.			
			Sand (SP); bluish gray 5B 6/1; no fines; medium grained, sub rounded, soft, not cemented; 70% quartz, remainder is greenish gray fine grained lithics (metamorphic?). Water production measured, 100 gpm, collect water sample.			
	200		Silty Clay (CL); gray to black; 10 - 15% sand; minor wood fragments; organics as wood/lignite; hard drilling; wet.			
			Silty Clay (CL); light brown to gray; trace to 15% fine sand to gravel (sands wash-down from above); hard drilling.			
			Clay (CL); light brown to gray; trace to 15% medium sand; trace coarse.			
			Clay (CL) to Shale interbedded; light brown and black shale; Silty Clay (CL); high plasticity; interbedded sand potential.			
	300		Silty Clay (CL); brown and gray; high plasticity; trace fine sand; soft.			
			Clay (CL); dark gray 5YR 4/1; 5 - 10% fine sand, angular; medium plasticity.			
			Clay (CL); dark gray 5YR 4/1; 5 - 10% fine sand, angular; medium plasticity.			
			Metamorphic bedrock; greenish gray 10GY 5/1; fine grained; hard; metavolcanic. Pull-down pressured 800 psi.			
			Clay (CL); greenish gray 10G 6/1; 5 - 10% fine sand; soft; low plasticity.			
			Metamorphic bedrock; greenish gray 10GY 5/1; fine grained; hard; metavolcanic; 5% milky quartz cuttings. Pull-down pressured 1000 psi.			

Dunn ENVIRONMENTAL, INC.
An NV5 Company

▽ First Encounetered Water

Boring Log and Proposed Test Well

DE Project No.: 157-03
DE Project: Rancho Murieta Community Service District
Test Hole (TH)-B

Location: Rancho Murieta, CA
Driller: Fredrick Pump and Supply
Drilling Method: Air and Mud Rotary, 6" Bore
Geologist: C. Tremblay
Reviewed by: J. Fourie, Patrick F. Dunn
Published Date: December 12, 2013

Date and Time	Depth (ft)	Geologic Log	USCS Description	SP (mv) 0 20 40	16" (blue) 64" (red) (ohmmeter^2/m) 0 20 40	Proposed Production Well Completion
	0		Sandy Silt (ML); dark brown (10YR 3/3); 10% clay, 30% fine sand, <5% coarse sand; soft, loose, low to no plasticity, dry.			
			Silty Gravel (GM); dark brown (10YR 3/3); 35% silt, 20% fine to medium sand; soft, loose, no plasticity; gravel is up to 20mm long, subrounded to angular; appears to be pieces of siltstone, sandstone and metamorphics; moist.			
			Silty Gravel (GM); brown (10YR 4/3); 30-35% silt, 10% fine sand; soft, loose, no plasticity; gravel coarse (20-40mm), rounded to subangular; matamorphics, igneous/volcanics; wet.			
			Silty Sand (SM); brown (10YR 4/3); 25% silt, 5-10% gravel; soft, loose, no plasticity; gravel generally fine (<20mm) with isolated coarser pieces; wet.			
			Sandy Clay (CL); greenish gray (Gley 1 6/10GY); 10-15% fine sand; loose, hard, no plasticity; sand is fine grained pieces of siltstone to claystone; wet.			
			Sandy Clay (CL) as above; clay is softer, sand still claystone pieces.			
			Silty Clay (CL); greenish gray (Gley 1 5/5G); 15% silt, <5% fine sand; very hard, consolidated; claystone pieces 10-15mm long.			
			Silty Clay (CL); greenish gray (Gley 1 6/10GY); 15% silt, trace fine sand; cohesive, soft, moderate plasticity.			
			Clay (CL); greenish gray (Gley 1 5/5G); claystone - hard, consolidated pieces up to 10mm long.			
			Silt (ML); dark greenish gray (Gley 1 4/5G); siltstone pieces slightly hard and consolidated.			
	100		Silty Sand (SM); greenish gray (Gley 1 5/5G); 30% silt; soft, loose, no plasticity.			
			Silt (ML); dark greenish gray (Gley 1 4/5G); siltstone pieces slightly hard and consolidated; dark grayish brown clay (soft, cohesive, moderate plasticity) at 117 feet; 30 GPM flow, sample collected.			
			Clayey Sand (SC); bluish gray (Gley 2 5/10B); 25-30% fine sand; moderately hard, cohesive, low plasticity.			
			Siltstone (ML); hard green siltstone and soft brown-black clay (possibly ligninte); 70% siltstone, 30% clay.			
			Clay (CL); dark greenish gray (Gley 1 4/5GY); <10% fine sand; soft, cohesive, moderate to high plasticity, sticky.			
			Claystone (CL); dark greenish gray (Gley 1 4/5G); very hard, cohesive, claystone pieces 10mm and smaller.			
			Sandy Silt (ML); greenish gray (Gley 1 5/10GY); 10-15% fine sand; siltstone pieces with sand; hard, cohesive, no plasticity.			
			Sandy Clay (CL); dark greenish gray (Gley 1 4/10GY); 15-20% fine sand; claystone and soft clay mixture; claystone is hard, consolidated; clay is soft, cohesive, low plasticity.			
			Sandy Clay (CL) as above; greenish gray Gley 1 6/5G.			
	200		Sandy Clay (CL) as above; <10% fine sand.			
			Sandy Clay (CL); greenish gray (Gley 1 5/5G); 35-40% fine sand; soft, slightly loose, low plasticity.			
			Sandy Clay (CL) as above with 10-15% siltstone/claystone pieces.			
			Sandy Gravel (GM); mottled green, white and black; 15% clay, 20% silt, 25-30% fine to coarse sand; fine to coarse gravel (up to 25mm long); metamorphics and igneous; loose, soft. 60 GPM total flow, sample collected.			
			Sandy Clay and Wood (CL); greenish gray (Gley 1 5/10GY); 25-30% fine sand, 50-60% wood fragments; clay is soft, slightly cohesive.			
			Claystone and Wood (CL); dark greenish gray (Gley 1 4/5G); hard, consolidated; 35-40% wood fragments.			
			Claystone and Wood (CL); dark greenish gray (Gley 1 4/5G); claystone is coarse sand sized, hard, consolidated; fine sand in collection bin and limited sand in sample.			
			Claystone and Wood as above; 10-15% wood, potentially washout from above.			
	300		Gravelly Sand (SW); mottled green, white and black; 50% fine sand, 35-40% coarse sand, 10% fine gravel; little fines; siltstone, metamorphics, igneous; trace wood fragments; 150 GPM total flow.			
			Gravelly Sand (SW) as above; increase fine sand to 60%, decrease gravel to 10-15%.			
			Gravelly Sand (SW) as above; increase gravel to 20-25%, fine gravel; flow at 150 GPM, sample collected.			
			Sandy Clay (CL); black (5Y 2.5-1) to dark gray (10YR 4/1); 25-30% sand; soft, cohesive, some hard siltstone pieces, low plasticity.			
			Sandy Clay (CL); greenish gray (Gley 1 5/5G); 15-20% fine to medium sand; slightly stiff, cohesive, low to moderate plasticity.			
			Clayey Sand (SC); dark greenish gray (Gley 1 4/5G); 25-30% clay; sand fine to coarse sized; soft, slightly cohesive, no plasticity; siltstone, metamorphics and volcanics.			
			Shale bedrock (Sh); dark greenish gray (Gley 1 4/10GY) to black (Gley 1 2.5/1); very hard, consolidated shale with some green crystals (secondary crystallization?); does not appear weathered.			

APPENDIX B

NORCAL GEOPHYSICAL FIGURES

LEGEND

———	ELECTRICAL RESISTIVITY LINE
⊕	APPROXIMATE BORING LOCATION
◇	PROPOSED TEST HOLE

SCALE
0 400 800 1600
(1 inch = 800 feet)

DRAFT

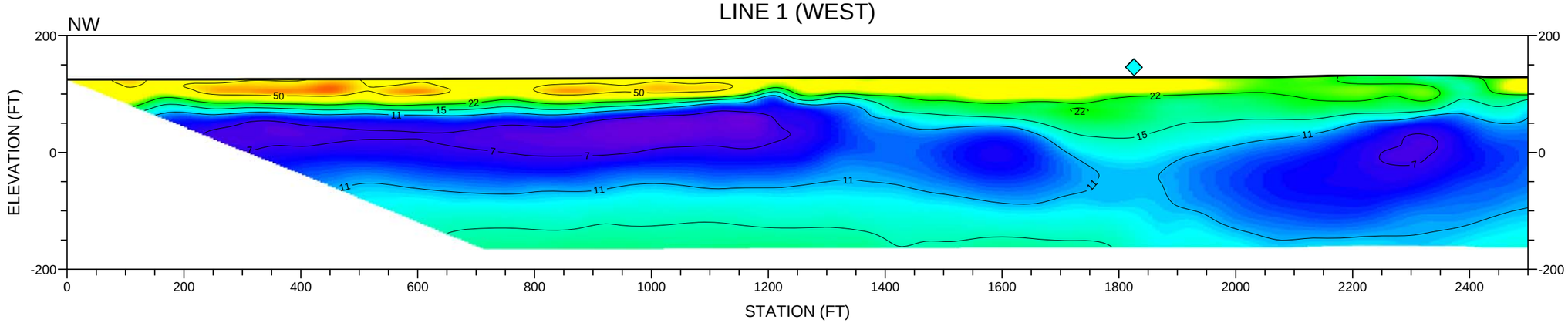
NORCAL

SITE LOCATION MAP
RANCHO MURIETA COMMUNITY SERVICE DISTRICT
ELECTRICAL RESISTIVITY SURVEY

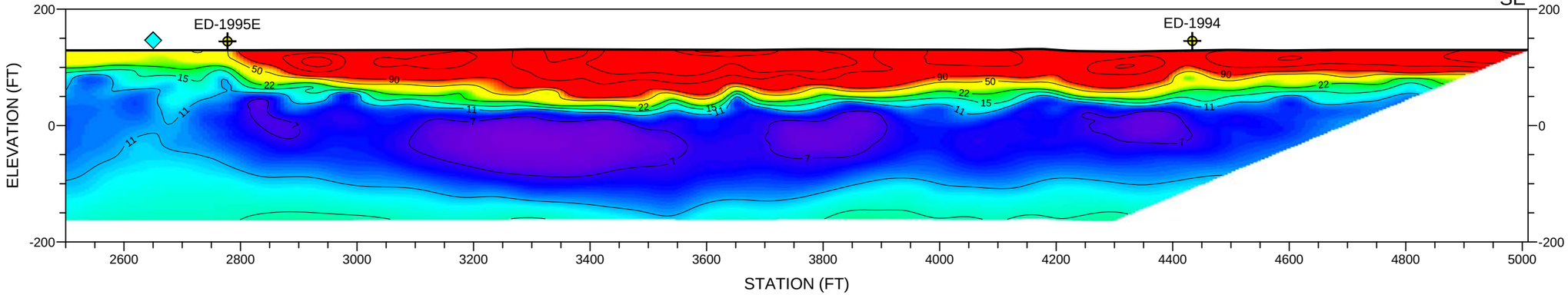
LOCATION: RANCHO MURIETA, CALIFORNIA
CLIENT: DUNN ENVIRONMENTAL, INCL
JOB #: 12-952.05
NORCAL GEOPHYSICAL CONSULTANTS INC.
DATE: SEP. 2012
DRAWN BY: G.RANDALL
APPROVED BY: DJK

PLATE 1

LINE 1 (WEST)



LINE 1 (EAST)



ELECTRICAL RESISTIVITY

10 20 30 40 50 60 70 80 90

(OHM-M)

DRAFT

LEGEND	
⌖	APPROXIMATE BORING LOCATION
◇	PROPOSED TEST HOLE

SCALE

0 100 200 400

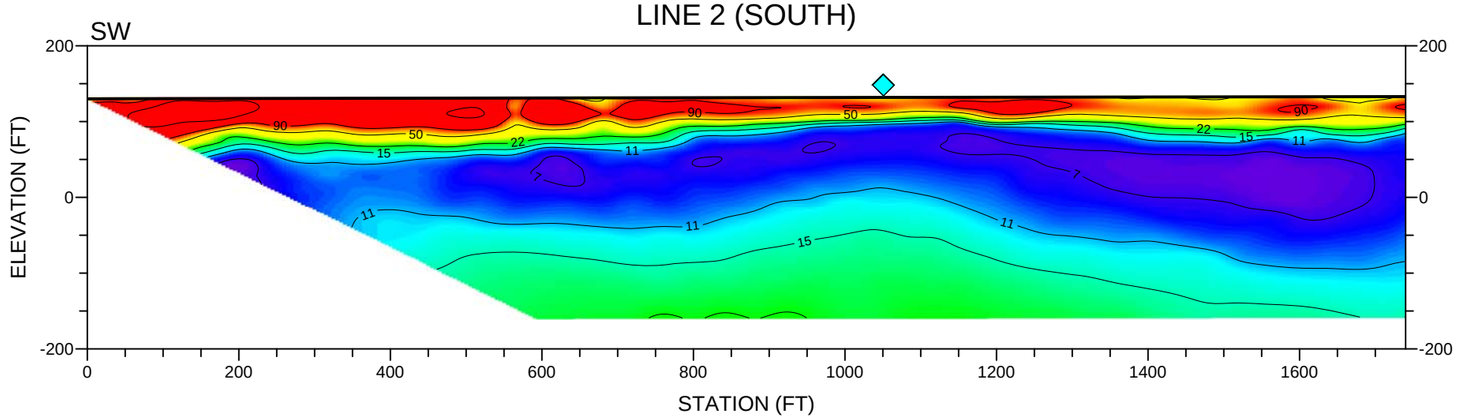
(1 inch = 200 feet)

NORCAL

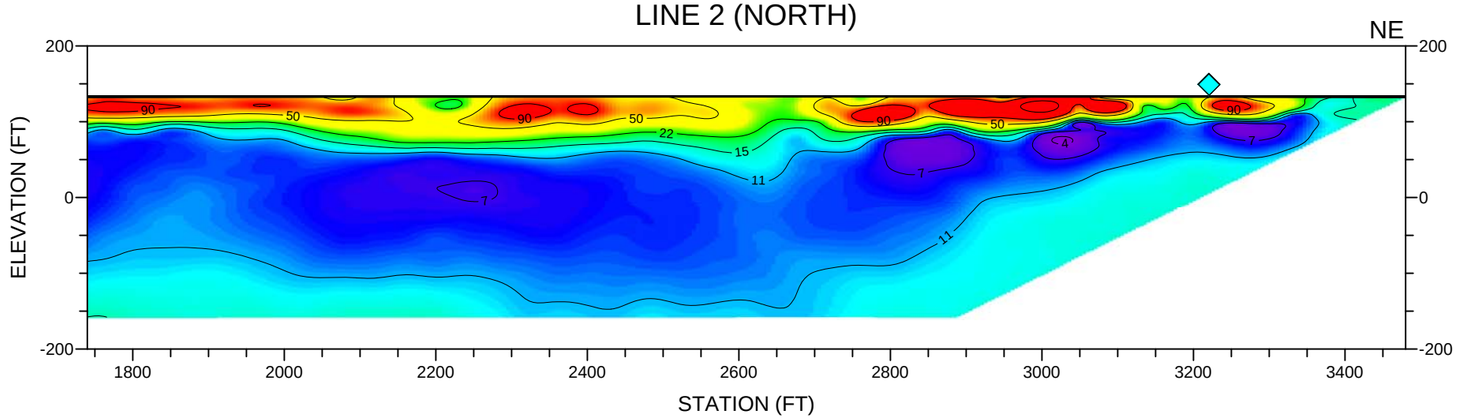
ELECTRICAL RESISTIVITY PROFILE - LINE 1
RANCHO MURIETA
COMMUNITY SERVICE DISTRICT

	LOCATION: RANCHO MURIETA, CALIFORNIA		
	CLIENT: DUNN ENVIRONMENTAL, INC.		PLATE 2
JOB #: 12-952.05	NORCAL GEOPHYSICAL CONSULTANTS INC.		
DATE: SEP. 2012	DRAWN BY: G.RANDALL	APPROVED BY: DJK	

LINE 2 (SOUTH)



LINE 2 (NORTH)



ELECTRICAL RESISTIVITY

10 20 30 40 50 60 70 80 90

(OHM-M)

DRAFT

LEGEND	
◇	PROPOSED TEST HOLE

SCALE

0 100 200 400

(1 inch = 200 feet)

NORCAL

ELECTRICAL RESISTIVITY PROFILE - LINE 2
RANCHO MURIETA
COMMUNITY SERVICE DISTRICT

LOCATION: RANCHO MURIETA, CALIFORNIA

CLIENT: DUNN ENVIRONMENTAL, INC.

JOB #: 12-952.05

NORCAL GEOPHYSICAL CONSULTANTS INC.

DATE: SEP. 2012

DRAWN BY: G.RANDALL

APPROVED BY: DJK

PLATE 3

APPENDIX C

LABORATORY ANALTICAL REPORTS

CALIFORNIA LABORATORY SERVICES

3249 Fitzgerald Road Rancho Cordova, CA 95742

August 27, 2013

CLS Work Order #: CWH0800
COC #:

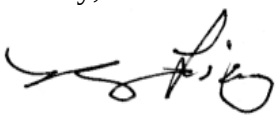
Cassie Tremblay
Dunn Environmental
5060 Robert J. Mathews, Ste 2
El Dorado Hills, CA 95672

Project Name: RMCSD

Enclosed are the results of analyses for samples received by the laboratory on 08/20/13 16:10. Samples were analyzed pursuant to client request utilizing EPA or other ELAP approved methodologies. I certify that the results are in compliance both technically and for completeness.

Analytical results are attached to this letter. Please call if we can provide additional assistance.

Sincerely,



James Liang, Ph.D.
Laboratory Director

CA DOHS ELAP Accreditation/Registration number 1233

CALIFORNIA LABORATORY SERVICES

08/27/13 09:28

Dunn Environmental	Project: RMCSD	
5060 Robert J. Mathews, Ste 2	Project Number: 157-03	**CLS Work Order #: CWH0800**
El Dorado Hills, CA 95672	Project Manager: Cassie Tremblay	COC #:

CWH0800 1 of 1

Chain of Custody

Project No.: 157-03 | Project Name: RMCSD | Sampler (Signature): | (Print): Cassie Tremblay

Sample Identification Number	Date	Time	Water	Soil	Other	Sampling Location	No. of Containers	TDS, Hardness as CaCO3, NO3	As, Fe, Mn *	Total Cations + Anions	Page 1 of 1 <--- Preservative
TH-B 110-120	8/20/13	11:52	✓				2	✓	✓	✓	Remarks: all parameters
TH-B 230-240	8/20/13	13:35	✓				2	✓	✓	✓	* Run as lab dissolved
TH-B 280-300	8/20/13	14:45	✓				2	✓	✓	✓	- email copy of results to catremblay@dunnenviro.com and pfdunn@dunnenviro.com and jfavie@dunnenviro.com

Report To: Dunn Environmental, 5060 Robert J Mathews Ste 2, El Dorado Hills CA 95762

Invoice To: Paul Siebensohn, Rancho Murieta Comm Services Dist., 15160 Jackson Rd, PO Box 1050, Rancho Murieta CA 95683

Copy To:

Relinquished By: (Signature)	Date/Time	Received By: (Signature)	Date/Time
Cassie Tremblay (Print)	Company: Dunn Env	(Print)	Company
Relinquished By: (Signature)	Date/Time	Received By: (Signature)	Date/Time
(Print)	Company	Erin Orellana (Print)	Company 8/20/13 1610 5°C

Dunn Environmental
5060 Robert J. Mathews, Ste 2
El Dorado Hills, CA 95672

Project: RMCSD
Project Number: 157-03
Project Manager: Cassie Tremblay

CLS Work Order #: CWH0800
COC #:

Conventional Chemistry Parameters by APHA/EPA Methods

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
TH-B 110-120 (CWH0800-01) Water	**Sampled: 08/20/13 11:52 Received: 08/20/13 16:10**								
Chloride, Dissolved	**19**	0.50	mg/L	1	CW05454	08/21/13	08/21/13	EPA 300.0	
Fluoride, dissolved	**0.13**	0.10	"	"	"	"	"	"	
Nitrate as NO3, Dissolved	**0.72**	0.50	"	"	"	"	"	"	
Sulfate, Dissolved	**140**	2.5	"	5	"	"	"	"	
Total Dissolved Solids	**390**	10	"	1	CW05462	08/21/13	08/22/13	SM2540C	
TH-B 230-240 (CWH0800-02) Water	**Sampled: 08/20/13 13:35 Received: 08/20/13 16:10**								
Chloride, Dissolved	**18**	0.50	mg/L	1	CW05454	08/21/13	08/21/13	EPA 300.0	
Fluoride, dissolved	**0.19**	0.10	"	"	"	"	"	"	
Nitrate as NO3, Dissolved	**0.56**	0.50	"	"	"	"	"	"	
Sulfate, Dissolved	**110**	2.5	"	5	"	"	08/22/13	"	
Total Dissolved Solids	**390**	10	"	1	CW05462	08/21/13	08/22/13	SM2540C	
TH-B 280-300 (CWH0800-03) Water	**Sampled: 08/20/13 14:45 Received: 08/20/13 16:10**								
Chloride, Dissolved	**43**	2.5	mg/L	5	CW05454	08/21/13	08/21/13	EPA 300.0	
Fluoride, dissolved	**0.15**	0.10	"	1	"	"	"	"	
Nitrate as NO3, Dissolved	**13**	0.50	"	"	"	"	"	"	
Sulfate, Dissolved	**120**	2.5	"	5	"	"	"	"	
Total Dissolved Solids	**420**	10	"	1	CW05462	08/21/13	08/22/13	SM2540C	

Dunn Environmental
5060 Robert J. Mathews, Ste 2
El Dorado Hills, CA 95672

Project: RMCSD
Project Number: 157-03
Project Manager: Cassie Tremblay

CLS Work Order #: CWH0800
COC #:

Metals (Dissolved) by EPA 200 Series Methods

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
TH-B 110-120 (CWH0800-01) Water	**Sampled: 08/20/13 11:52**		**Received: 08/20/13 16:10**						
Arsenic	**2.9**	2.0	µg/L	1	CW05510	08/22/13	08/26/13	EPA 200.8	
Calcium	**36000**	1000	"	"	CW05511	08/22/13	08/23/13	EPA 200.7	
Iron	ND	100	"	"	"	"	"	"	
Magnesium	**13000**	1000	"	"	"	"	"	"	
Manganese	**370**	20	"	"	"	"	"	"	A-COM
Potassium	**3600**	1000	"	"	"	"	"	"	
Sodium	**33000**	1000	"	"	"	"	"	"	
TH-B 230-240 (CWH0800-02) Water	**Sampled: 08/20/13 13:35**		**Received: 08/20/13 16:10**						
Arsenic	**5.3**	2.0	µg/L	1	CW05510	08/22/13	08/26/13	EPA 200.8	
Calcium	**34000**	1000	"	"	CW05511	08/22/13	08/23/13	EPA 200.7	
Iron	ND	100	"	"	"	"	"	"	
Magnesium	**9700**	1000	"	"	"	"	"	"	
Manganese	**140**	20	"	"	"	"	"	"	A-COM
Potassium	**4400**	1000	"	"	"	"	"	"	
Sodium	**36000**	1000	"	"	"	"	"	"	
TH-B 280-300 (CWH0800-03) Water	**Sampled: 08/20/13 14:45**		**Received: 08/20/13 16:10**						
Arsenic	**3.2**	2.0	µg/L	1	CW05510	08/22/13	08/26/13	EPA 200.8	
Calcium	**22000**	1000	"	"	CW05511	08/22/13	08/23/13	EPA 200.7	
Iron	**500**	100	"	"	"	"	"	"	
Magnesium	**9100**	1000	"	"	"	"	"	"	
Manganese	**330**	20	"	"	"	"	"	"	A-COM
Potassium	**2100**	1000	"	"	"	"	"	"	
Sodium	**72000**	1000	"	"	"	"	"	"	

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Project: RMCSD
Project Number: 157-03
Project Manager: Cassie Tremblay

CLS Work Order #: CWH0800
COC #:

Conventional Chemistry Parameters by APHA/EPA Methods - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch CW05454 - General Prep										
Blank (CW05454-BLK1)				Prepared & Analyzed: 08/21/13						
Nitrate as NO3, Dissolved	ND	0.50	mg/L							
Chloride, Dissolved	ND	0.50	"							
Sulfate, Dissolved	ND	0.50	"							
Fluoride, dissolved	ND	0.10	"							
LCS (CW05454-BS1)				Prepared & Analyzed: 08/21/13						
Sulfate, Dissolved	5.22	0.50	mg/L	5.00		104	80-120			
Nitrate as NO3, Dissolved	2.16	0.50	"	2.00		108	80-120			
Fluoride, dissolved	2.05	0.10	"	2.00		102	80-120			
Chloride, Dissolved	5.39	0.50	"	5.00		108	80-120			
LCS Dup (CW05454-BSD1)				Prepared & Analyzed: 08/21/13						
Chloride, Dissolved	5.47	0.50	mg/L	5.00		109	80-120	1	20	
Fluoride, dissolved	2.19	0.10	"	2.00		109	80-120	7	20	
Sulfate, Dissolved	5.28	0.50	"	5.00		106	80-120	1	20	
Nitrate as NO3, Dissolved	2.17	0.50	"	2.00		109	80-120	0.6	20	
Matrix Spike (CW05454-MS1)		**Source: CWH0780-01**		Prepared & Analyzed: 08/21/13						
Sulfate, Dissolved	25.0	0.50	mg/L	5.00	20.3	94	75-125			
Nitrate as NO3, Dissolved	5.49	0.50	"	2.00	3.39	105	80-120			
Chloride, Dissolved	47.9	0.50	"	5.00	45.2	54	75-125			QM-4X
Fluoride, dissolved	2.16	0.10	"	2.00	0.110	103	75-125			
Matrix Spike Dup (CW05454-MSD1)		**Source: CWH0780-01**		Prepared & Analyzed: 08/21/13						
Chloride, Dissolved	47.7	0.50	mg/L	5.00	45.2	49	75-125	0.5	25	QM-4X
Fluoride, dissolved	2.12	0.10	"	2.00	0.110	101	75-125	2	25	
Sulfate, Dissolved	24.8	0.50	"	5.00	20.3	89	75-125	0.9	25	
Nitrate as NO3, Dissolved	5.42	0.50	"	2.00	3.39	102	80-120	1	20	

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Project: RMCSD
Project Number: 157-03
Project Manager: Cassie Tremblay

CLS Work Order #: CWH0800
COC #:

Conventional Chemistry Parameters by APHA/EPA Methods - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch CW05462 - General Preparation										
Blank (CW05462-BLK1)				Prepared: 08/21/13 Analyzed: 08/22/13						
Total Dissolved Solids	ND	10	mg/L							
Duplicate (CW05462-DUP1)		**Source: CWH0800-01**		Prepared: 08/21/13 Analyzed: 08/22/13						
Total Dissolved Solids	ND	10	mg/L		386				20	

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El Dorado Hills, CA 95672

Project: RMCSD
Project Number: 157-03
Project Manager: Cassie Tremblay

CLS Work Order #: CWH0800
COC #:

Metals (Dissolved) by EPA 200 Series Methods - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch CW05510 - EPA 3020A										
Blank (CW05510-BLK1)				Prepared: 08/22/13 Analyzed: 08/26/13						
Arsenic	ND	2.0	µg/L							
LCS (CW05510-BS1)				Prepared: 08/22/13 Analyzed: 08/26/13						
Arsenic	104	2.0	µg/L	100		104	85-115			
Matrix Spike (CW05510-MS1)		**Source: CWH0862-01**		Prepared: 08/22/13 Analyzed: 08/26/13						
Arsenic	116	2.0	µg/L	100	6.77	109	70-130			
Batch CW05511 - EPA 3010A										
Blank (CW05511-BLK1)				Prepared: 08/22/13 Analyzed: 08/23/13						
Calcium	ND	1000	µg/L							
Iron	ND	100	"							
Magnesium	ND	1000	"							
Manganese	ND	20	"							
Potassium	ND	1000	"							
Sodium	ND	1000	"							
LCS (CW05511-BS1)				Prepared: 08/22/13 Analyzed: 08/23/13						
Calcium	11300	1000	µg/L	10000		113	85-115			
Iron	5350	100	"	5000		107	85-115			
Magnesium	10400	1000	"	10000		104	85-115			
Manganese	566	20	"	500		113	85-115			
Potassium	12700	1000	"	12500		102	85-115			
Sodium	12900	1000	"	12500		103	85-115			
Matrix Spike (CW05511-MS1)		**Source: CWH0806-01**		Prepared: 08/22/13 Analyzed: 08/23/13						
Calcium	65300	1000	µg/L	10000	55100	102	70-130			
Iron	5390	100	"	5000	313	102	70-130			
Magnesium	36300	1000	"	10000	26600	97	70-130			
Manganese	552	20	"	500	4.60	110	70-130			
Potassium	18100	1000	"	12500	5620	100	70-130			
Sodium	29400	1000	"	12500	16700	102	70-130			

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El Dorado Hills, CA 95672

Project: RMCSD
Project Number: 157-03
Project Manager: Cassie Tremblay

CLS Work Order #: CWH0800
COC #:

Metals (Dissolved) by EPA 200 Series Methods - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch CW05511 - EPA 3010A										
Matrix Spike (CW05511-MS2)		**Source: CWH0850-04**		Prepared: 08/22/13		Analyzed: 08/23/13				
Calcium	10200	1000	µg/L	10000	91.8	101	70-130			
Iron	4930	100	"	5000	ND	99	70-130			
Magnesium	9650	1000	"	10000	ND	96	70-130			
Manganese	518	20	"	500	ND	104	70-130			
Potassium	11400	1000	"	12500	ND	91	70-130			
Sodium	12100	1000	"	12500	147	96	70-130			

CALIFORNIA LABORATORY SERVICES

08/27/13 09:28

Dunn Environmental	Project: RMCSD	
5060 Robert J. Mathews, Ste 2	Project Number: 157-03	**CLS Work Order #: CWH0800**
El Dorado Hills, CA 95672	Project Manager: Cassie Tremblay	COC #:

Notes and Definitions

QM-4X	The spike recovery was outside of QC acceptance limits for the MS and/or MSD due to analyte concentration at 4 times or greater the spike concentration. The QC batch was accepted based on LCS and/or LCSD recoveries within the acceptance limits.
A-COM	Run by ICP-MS (EPA200.8)
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit (or method detection limit when specified)
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

CALIFORNIA LABORATORY SERVICES

3249 Fitzgerald Road Rancho Cordova, CA 95742

September 20, 2013

CLS Work Order #: CWI0576
COC #: 139665

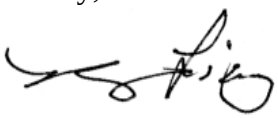
Jaco Fourie
Dunn Environmental
2495 Natomas Park Dr. 4th floor
Sacramento, CA 95833

Project Name: RMCSD

Enclosed are the results of analyses for samples received by the laboratory on 09/13/13 14:44. Samples were analyzed pursuant to client request utilizing EPA or other ELAP approved methodologies. I certify that the results are in compliance both technically and for completeness.

Analytical results are attached to this letter. Please call if we can provide additional assistance.

Sincerely,



James Liang, Ph.D.
Laboratory Director

CA DOHS ELAP Accreditation/Registration number 1233

CALIFORNIA LABORATORY SERVICES

Dunn Environmental
2495 Natomas Park Dr. 4th floor
Sacramento, CA 95833

Project: RMCSD
Project Number: [none]
Project Manager: Jaco Fourie

CLS Work Order #: CWI0576
COC #: 139665

CLS - Labs CHAIN OF CUSTODY CLS ID No.: CWI0576 LOG NO. 139665

REPORT TO:
NAME AND ADDRESS: Jaco Fourie, 2495 Natomas Park Dr. 4th floor, Sacramento, CA 95833
PROJECT MANAGER: Jaco Fourie PHONE#
PROJECT NAME: RMCSD
SAMPLED BY: J.F.
JOB DESCRIPTION:
SITE LOCATION:

CLIENT JOB NUMBER:
DESTINATION LABORATORY:
X CLS (916) 638-7301
3249 FITZGERALD RD.
RANCHO CORDOVA, CA.
95742
☐ OTHER

PRESERVATIVES: HNO_3

ANALYSIS REQUESTED: TDS, As, Fe, Mn, Mg#, Total Cation & anions

GEOTRACKER:
EDF REPORT ☐ YES ☐ NO
GLOBAL ID:
COMPOSITE:
FIELD CONDITIONS:

TURN AROUND TIME: 1 DAY, 2 DAY, 3 DAY, 5 DAY
SPECIAL INSTRUCTIONS OR ALT. ID:

DATE	TIME	SAMPLE IDENTIFICATION	MATRIX	CONTAINER NO.	CONTAINER TYPE	PRESERVATIVE				5 DAY	SPECIAL INSTRUCTIONS
9/13/13	12:05	TH-A 100 ft	H_2O	2	1L Poly	+	X	X	X	X	* Run analysis as dissolved, to be lab filtered.
9/13/13	13:00	TH-A 200 ft	H_2O	2	1L	+	X	X	X	X	

INVOICE TO: Paul Siebensohn
RMCSD, 15160 Jackson Rd, P.O. Box 1050, Rancho
P.O. Murieta, CA 95683
QUOTE #

SUSPECTED CONSTITUENTS

PRESERVATIVES: (1) HCL (2) HNO_3 (3) = COLD (4) = NaOH (5) = H_2SO_4 (6) = $Na_2S_2O_3$ (7) =

RELINQUISHED BY (SIGN)	PRINT NAME / COMPANY	DATE / TIME	RECEIVED BY (SIGN)	PRINT NAME / COMPANY
	J. Fourie Dunn Env.	9/13/13 14:44		

RECD AT LAB BY: DATE / TIME: 9/13/13 1444 CONDITIONS / COMMENTS: 18/1°C

SHIPPED BY: ☐ FED X ☐ UPS ☐ OTHER AIR BILL #

LAB

Dunn Environmental
2495 Natomas Park Dr. 4th floor
Sacramento, CA 95833

Project: RMCSD
Project Number: [none]
Project Manager: Jaco Fourie

CLS Work Order #: CWI0576
COC #: 139665

Conventional Chemistry Parameters by APHA/EPA Methods

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
TH-A 100ft (CWI0576-01) Water	**Sampled: 09/13/13 12:05**		**Received: 09/13/13 14:44**						
Chloride, Dissolved	**8.6**	0.50	mg/L	1	CW06047	09/13/13	09/14/13	EPA 300.0	
Fluoride, dissolved	**0.20**	0.10	"	"	"	"	"	"	
Nitrate as NO3, Dissolved	**4.4**	0.50	"	"	"	"	"	"	
Sulfate, Dissolved	**55**	2.5	"	5	"	"	09/16/13	"	
Total Dissolved Solids	**290**	10	"	1	CW06138	09/17/13	09/18/13	SM2540C	
TH-A 200ft (CWI0576-02) Water	**Sampled: 09/13/13 13:00**		**Received: 09/13/13 14:44**						
Chloride, Dissolved	**85**	5.0	mg/L	10	CW06047	09/13/13	09/16/13	EPA 300.0	
Fluoride, dissolved	**0.16**	0.10	"	1	"	"	09/14/13	"	
Nitrate as NO3, Dissolved	ND	0.50	"	"	"	"	"	"	
Sulfate, Dissolved	**120**	5.0	"	10	"	"	09/16/13	"	
Total Dissolved Solids	**420**	10	"	1	CW06138	09/17/13	09/18/13	SM2540C	

Dunn Environmental
2495 Natomas Park Dr. 4th floor
Sacramento, CA 95833

Project: RMCSD
Project Number: [none]
Project Manager: Jaco Fourie

CLS Work Order #: CWI0576
COC #: 139665

Metals (Dissolved) by EPA 200 Series Methods

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
TH-A 100ft (CWI0576-01) Water	**Sampled: 09/13/13 12:05**		**Received: 09/13/13 14:44**						
Arsenic	**18**	2.0	µg/L	1	CW06228	09/19/13	09/19/13	EPA 200.8	
Calcium	**23000**	1000	"	"	CW06232	09/19/13	09/19/13	EPA 200.7	
Iron	ND	100	"	"	"	"	"	"	
Magnesium	**13000**	1000	"	"	"	"	"	"	
Manganese	**150**	20	"	"	"	"	"	"	
Potassium	**3800**	1000	"	"	"	"	"	"	
Sodium	**33000**	1000	"	"	"	"	"	"	
TH-A 200ft (CWI0576-02) Water	**Sampled: 09/13/13 13:00**		**Received: 09/13/13 14:44**						
Arsenic	**13**	2.0	µg/L	1	CW06228	09/19/13	09/19/13	EPA 200.8	
Calcium	**30000**	1000	"	"	CW06232	09/19/13	09/19/13	EPA 200.7	
Iron	ND	100	"	"	"	"	"	"	
Magnesium	**11000**	1000	"	"	"	"	"	"	
Manganese	**120**	20	"	"	"	"	"	"	
Potassium	**5100**	1000	"	"	"	"	"	"	
Sodium	**83000**	1000	"	"	"	"	"	"	

Dunn Environmental
2495 Natomas Park Dr. 4th floor
Sacramento, CA 95833

Project: RMCSD
Project Number: [none]
Project Manager: Jaco Fourie

CLS Work Order #: CWI0576
COC #: 139665

Conventional Chemistry Parameters by APHA/EPA Methods - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch CW06047 - General Prep										
Blank (CW06047-BLK1)				Prepared & Analyzed: 09/13/13						
Chloride, Dissolved	ND	0.50	mg/L							
Fluoride, dissolved	ND	0.10	"							
Sulfate, Dissolved	ND	0.50	"							
Nitrate as NO3, Dissolved	ND	0.50	"							
LCS (CW06047-BS1)				Prepared & Analyzed: 09/13/13						
Nitrate as NO3, Dissolved	2.14	0.50	mg/L	2.00		107	80-120			
Chloride, Dissolved	5.31	0.50	"	5.00		106	80-120			
Sulfate, Dissolved	5.18	0.50	"	5.00		104	80-120			
Fluoride, dissolved	2.12	0.10	"	2.00		106	80-120			
LCS Dup (CW06047-BSD1)				Prepared: 09/13/13 Analyzed: 09/14/13						
Sulfate, Dissolved	5.19	0.50	mg/L	5.00		104	80-120	0.2	20	
Nitrate as NO3, Dissolved	2.08	0.50	"	2.00		104	80-120	3	20	
Fluoride, dissolved	2.20	0.10	"	2.00		110	80-120	3	20	
Chloride, Dissolved	5.36	0.50	"	5.00		107	80-120	0.9	20	
Matrix Spike (CW06047-MS1)		**Source: CWI0516-03**		Prepared: 09/13/13 Analyzed: 09/14/13						
Fluoride, dissolved	2.70	0.10	mg/L	2.00	0.720	99	75-125			
Chloride, Dissolved	26.7	0.50	"	5.00	21.8	98	75-125			
Sulfate, Dissolved	35.9	0.50	"	5.00	31.5	89	75-125			
Nitrate as NO3, Dissolved	2.92	0.50	"	2.00	0.840	104	80-120			
Matrix Spike Dup (CW06047-MSD1)		**Source: CWI0516-03**		Prepared: 09/13/13 Analyzed: 09/14/13						
Fluoride, dissolved	2.70	0.10	mg/L	2.00	0.720	99	75-125	0.2	25	
Nitrate as NO3, Dissolved	2.89	0.50	"	2.00	0.840	103	80-120	1	20	
Chloride, Dissolved	26.5	0.50	"	5.00	21.8	94	75-125	0.9	25	
Sulfate, Dissolved	35.9	0.50	"	5.00	31.5	89	75-125	0.04	25	

Dunn Environmental
2495 Natomas Park Dr. 4th floor
Sacramento, CA 95833

Project: RMCSD
Project Number: [none]
Project Manager: Jaco Fourie

CLS Work Order #: CWI0576
COC #: 139665

Conventional Chemistry Parameters by APHA/EPA Methods - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch CW06138 - General Preparation										
Blank (CW06138-BLK1)				Prepared: 09/17/13 Analyzed: 09/18/13						
Total Dissolved Solids	ND	10	mg/L							
Duplicate (CW06138-DUP1)		**Source: CWI0578-02**		Prepared: 09/17/13 Analyzed: 09/18/13						
Total Dissolved Solids	592	10	mg/L		588			0.7	20	

Dunn Environmental
2495 Natomas Park Dr. 4th floor
Sacramento, CA 95833

Project: RMCSD
Project Number: [none]
Project Manager: Jaco Fourie

CLS Work Order #: CWI0576
COC #: 139665

Metals (Dissolved) by EPA 200 Series Methods - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch CW06228 - EPA 3020A										
Blank (CW06228-BLK1)				Prepared & Analyzed: 09/19/13						
Arsenic	ND	2.0	µg/L							
LCS (CW06228-BS1)				Prepared & Analyzed: 09/19/13						
Arsenic	97.4	2.0	µg/L	100		97	85-115			
Matrix Spike (CW06228-MS1)		**Source: CWI0764-01**		Prepared & Analyzed: 09/19/13						
Arsenic	106	2.0	µg/L	100	4.80	102	70-130			
Matrix Spike (CW06228-MS2)		**Source: CWI0737-02**		Prepared & Analyzed: 09/19/13						
Arsenic	117	2.0	µg/L	100	15.6	102	70-130			
Batch CW06232 - EPA 3010A										
Blank (CW06232-BLK1)				Prepared & Analyzed: 09/19/13						
Calcium	ND	1000	µg/L							
Iron	ND	100	"							
Magnesium	ND	1000	"							
Manganese	ND	20	"							
Potassium	ND	1000	"							
Sodium	ND	1000	"							
LCS (CW06232-BS1)				Prepared & Analyzed: 09/19/13						
Calcium	9630	1000	µg/L	10000		96	85-115			
Iron	4800	100	"	5000		96	85-115			
Magnesium	9920	1000	"	10000		99	85-115			
Manganese	500	20	"	500		100	85-115			
Potassium	13200	1000	"	12500		106	85-115			
Sodium	13800	1000	"	12500		110	85-115			

Dunn Environmental
2495 Natomas Park Dr. 4th floor
Sacramento, CA 95833

Project: RMCSD
Project Number: [none]
Project Manager: Jaco Fourie

CLS Work Order #: CWI0576
COC #: 139665

Metals (Dissolved) by EPA 200 Series Methods - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch CW06232 - EPA 3010A										
Matrix Spike (CW06232-MS1)		**Source: CWI0764-01**		Prepared & Analyzed: 09/19/13						
Calcium	33100	1000	µg/L	10000	17200	159	70-130			QM-7
Iron	5990	100	"	5000	671	106	70-130			
Magnesium	13700	1000	"	10000	3340	104	70-130			
Manganese	758	20	"	500	171	117	70-130			
Potassium	15100	1000	"	12500	1970	105	70-130			
Sodium	28600	1000	"	12500	16300	98	70-130			
Matrix Spike (CW06232-MS2)		**Source: CWI0736-01**		Prepared & Analyzed: 09/19/13						
Calcium	57400	1000	µg/L	10000	46900	105	70-130			
Iron	5220	100	"	5000	ND	104	70-130			
Magnesium	21600	1000	"	10000	11500	101	70-130			
Manganese	541	20	"	500	ND	108	70-130			
Potassium	15500	1000	"	12500	2650	103	70-130			
Sodium	32300	1000	"	12500	18700	109	70-130			

Dunn Environmental	Project: RMCSD	
2495 Natomas Park Dr. 4th floor	Project Number: [none]	**CLS Work Order #: CWI0576**
Sacramento, CA 95833	Project Manager: Jaco Fourie	COC #: 139665

Notes and Definitions

QM-7	The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on acceptable LCS/LCSD recovery.
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit (or method detection limit when specified)
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

APPENDIX D

DRAFT REQUEST FOR BID - TECHNICAL SPECIFICATIONS

Dunn
ENVIRONMENTAL, INC.
An NV5 Company

Request for Bid – Technical Specifications

Draft Request for Bid: Proposed Rancho Murieta Community Services District Production Well Installation, Sacramento County, California

Date: October 2013

Dunn Environmental, Inc. (DE), an NV5 Company, has prepared this Request for Bid (RFB) for planned drilling activities for the Rancho Murieta Community Services District (RMCSD) in Sacramento County, California. Drilling activities are required to provide suitable production wells for ground water well development. RMCSD relies solely on surface water supplies from the Cosumnes River to meet water demand. As part of the RMCSD drought preparedness plan, the District plans to construct a ground water well or wells to augment surface water supplies during drought years. Grant funding through the State of California Local Ground Water Assistance Program awarded to RMCSD may be used to assist in ground water resource development. The Technical Memorandum No 1 - New Water Well Background Data Summary, Surface Geophysics, Hydrogeologic Conceptual Model, Testhole Drilling and Water Quality Findings, dated October 2013 (TM1) is available upon request.

The drilling effort will install two production wells close to previously drilled test holes. Up to two ground water production wells are planned. Anticipated borehole depths range from 250 to 350 feet below ground surface (bgs) for each well. Previously completed test hole locations are shown on Attachment C- 1 as TH-A and TH-B and proposed production well locations are shown as PW-A and PW-B.

Bid Item No. 1 – Mobilization and Demobilization

Mobilization and demobilization costs should be quoted as a **lump sum**. Driller will obtain the required County well drilling permits. The mobilization fee should include costs for relocating between production well sites and restoring each drilling site to suitable development conditions. Additional efforts for flood protection using grading and well pad construction will be completed by RMCSD or another contractor.

Material submittals must be approved by the district representative before mobilization.

Bid Item No. 2 – Production Well Drilling (Two Alternatives)

As referenced two production wells are planned. Drilling depths range from 250 to 350 feet bgs. For bidding purposes, total production well drilling depth is estimated at a total of **600 feet for two water wells.** Soil samples are to be collected every ten (10) feet during production well drilling. DE has determined that mud rotary drilling is the preferred technique to achieve the project goals. The anticipated production well diameter is a minimum of eighteen inches. Down hole equipment shall be decontaminated between borings. Decontamination will be high pressure wash at a minimum.

The bid should be provided on a **per foot** basis. During production well drilling, soil samples should be collected every ten (10) feet and presented to the on-site geologist for logging. Drill cuttings are not expected to be contaminated and may be disposed of on-site.

Bid Item No. 3 – Geophysical Logging

At borehole termination, the borehole will be stabilized for down hole geophysical logging consisting of focused resistivity, resistivity (16-inch and 64-inch), conductivity and spontaneous potential geophysical logs. Close attention will be paid to the drill fluid resistivity and the potential impact on geologic and pore water quality interpretation.

Upon completion of borehole drilling, geophysics and grain size analyses, aquifer zones for production well construction will be finalized.

Bid Item No. 4 – Production Well Construction

Conductor Casing

Prior to drilling activities, an 18-inch steel conductor casing will be installed to 50 feet bgs. A minimum 22-inch diameter bucket auger or equivalent will be used to drill to 50 feet bgs with soil samples collected every ten (10) feet for logging. After placement of the conductor casing, a 10.3 sack cement slurry will be installed to seal the conductor casing. No drilling activities will occur for a minimum of 24-hours to allow the cement to cure. Drilling activities will commence after the conductor casing has been installed.

Well Casing and Screen

Once the boring has been advanced to final depth, screen placement will be based upon observed lithology and geophysical logging. Production wells will be constructed using 8-inch inside diameter Schedule 80 PVC casing. Well casing and screen shall meet the ASTM Standard D-1785. Casing will be manufactured by Monoflex™, Certainteed™ or approved equivalent. Refer to the Attachments C-2a and C-2b for typical well casing installation depths. The riser pipe and screen casings will be flush thread joints with O-rings. The bottom cap will be flush-thread jointed or slip cap secured with stainless steel screws. The proposed well screen design is then 0.050-inch machine slotted screen. Screen size will be determined based on quick turnaround sieve analysis to be completed. Anticipated screen length is 30 to 70 feet for each well.

The well casing will be centered in the borehole using adjustable stainless steel centralizers. Centralizers will maintain a separation of two inches minimum between the casing and borehole wall. Centralizers will not be placed opposite well screen or within the gravel pack interval. Centralizers will be spaced a maximum of 50 feet apart, with at least 1 centralizer within 50 feet from surface. The "j" plug design will be used for the Well caps. Refer to Attachments C-2a and C-2b for Proposed Production Well Detail for PW-A and PW-B.

Filter Pack

Based on aquifer formation grain size analyses, the gravel pack design will be finalized. The proposed gravel pack is a CEMEX No. 8 Mesh Sand (or approved equivalent based on grain size) for a proposed 0.050 inch slot screen. Alternative filter pack may be used if approved by the DE Project Manager. Filter pack will be placed using a tremmie pipe.

Bentonite Seal

At least ten feet of bentonite chips will be used for well seals between the filter pack and cement grout. Bentonite seal will consist of sodium bentonite graded chips. Bentonite shall be a Baroid HolePlug™ 3/8" or approved equivalent. Bentonite seals are expected to be below the water table and will be placed using a tremmie pipe. The tremmie pipe will be removed slowly to allow filter pack and bentonite to settle into the annular space opposite the well screen and prevent borehole collapse.

Cement Grout

A neat cement grout will be installed in the borehole from above the bentonite seal to ground surface. Cement grout will consist of a 10.3-sack cement slurry. Cement grout will be placed using a tremmie pipe and pumped into place. Once the cement grout is allowed to settle, more will be added until it is brought to the surface. A Sacramento County Environmental Health Representative must be present for seal placement unless directed otherwise by the County.

Refer to the Bid Table for an estimate of materials needed. The bid should be provided on a **per foot** basis for well building materials (well casing, screen, filter pack, bentonite, grout seal, and centralizers).

Bid Item No. 5 – Production Well Development and Pump Testing (pump sizing)

Once production well construction is complete, production wells will be developed. Full well development will not be performed until at least 48 hours after well seal placement. Development will consist of surging the well with a swab, then bailing the well to remove sediments brought into the well. The procedure will be repeated until coarse sediment is removed. After surging and bailing activities, a variable speed pump or airlift may be used to further develop the well, if possible, to obtain the lowest turbidity attainable. Development will continue until the water retrieved is substantially free of visible, settleable solids and field parameters of pH, specific conductivity, temperature, and turbidity stabilize. A minimum of ten well casing volumes will be removed during well development. A turbidity of 5 Nephelometric Turbidity Units (NTU) or lower will be the goal.

After the production wells have been developed, a 4-hour step test will be conducted to determine the well performance, assist in the pump design and long term pump test. The potential step tests will be 100, 250, 350 and 400 gpm. A 24 hour constant pump test will be completed after the step test.

A total of **24 hours** of development time is anticipated for both production wells. Estimate should be provided on a **per hour** basis. An additional 8 hours is anticipated for the step test.

Bid Item No. 6 – Above Ground Completion

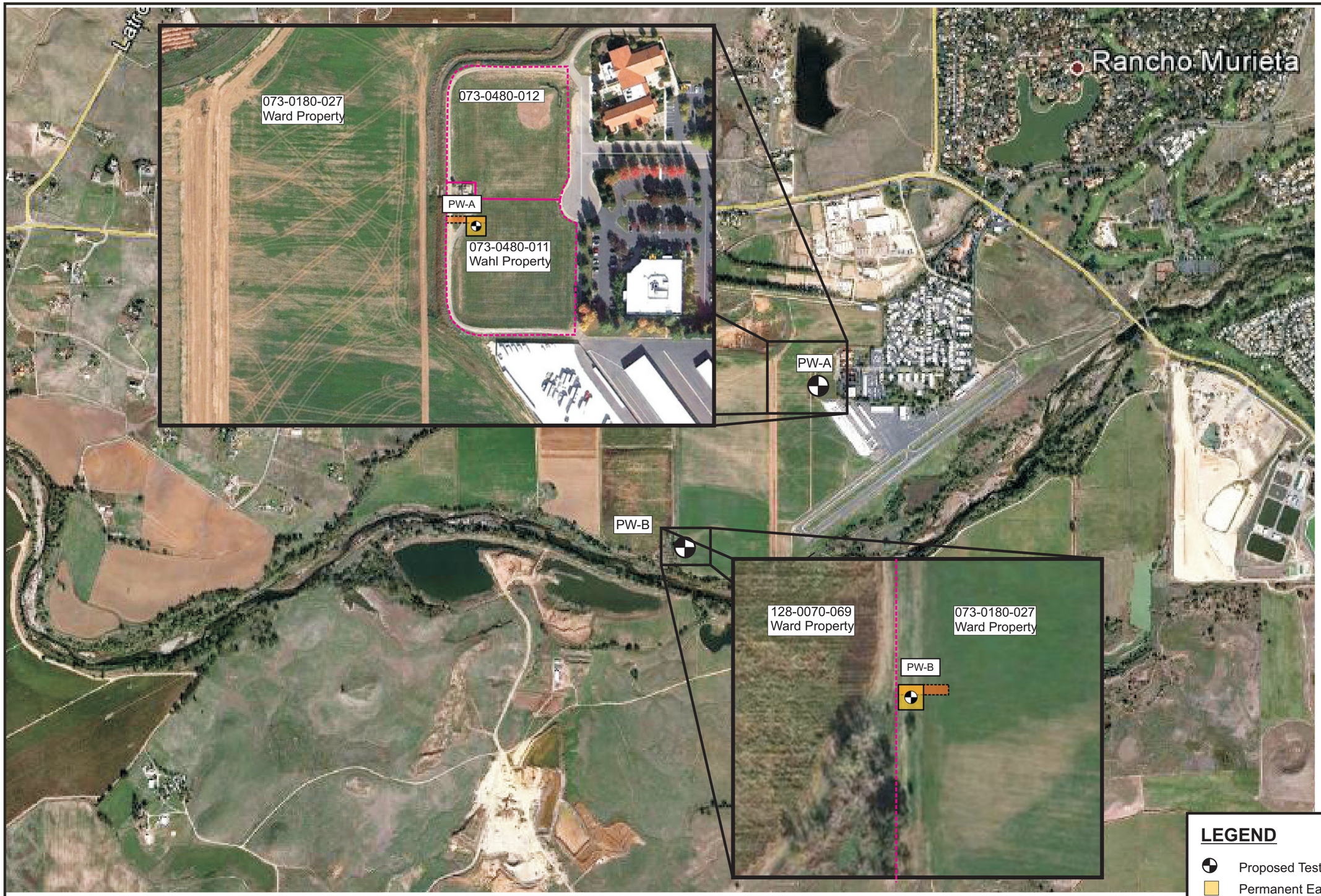
Once construction is completed and development is completed, production wells will be protected above grade using a lockable steel security casing. Security casing should extend approximately three feet above and three feet below grade surface. A minimum three feet square concrete pad shall be constructed around each security casing. Security casings shall be protected using three inch diameter steel bollards. Additional sets of bollards may be necessary to protect clustered installations. Necessary grading activities for flood protection are addressed under the mobilization/demobilization bid item. Refer to Attachments 2a and 2b for a depiction of the anticipated well design. Above ground completions must be quoted on a **per well** basis.

Schedule

Pursuant to RMCSD requirements production wells should be constructed within a one month time frame per well. Please indicate equipment capability and availability to complete the required work effort.

Attachments

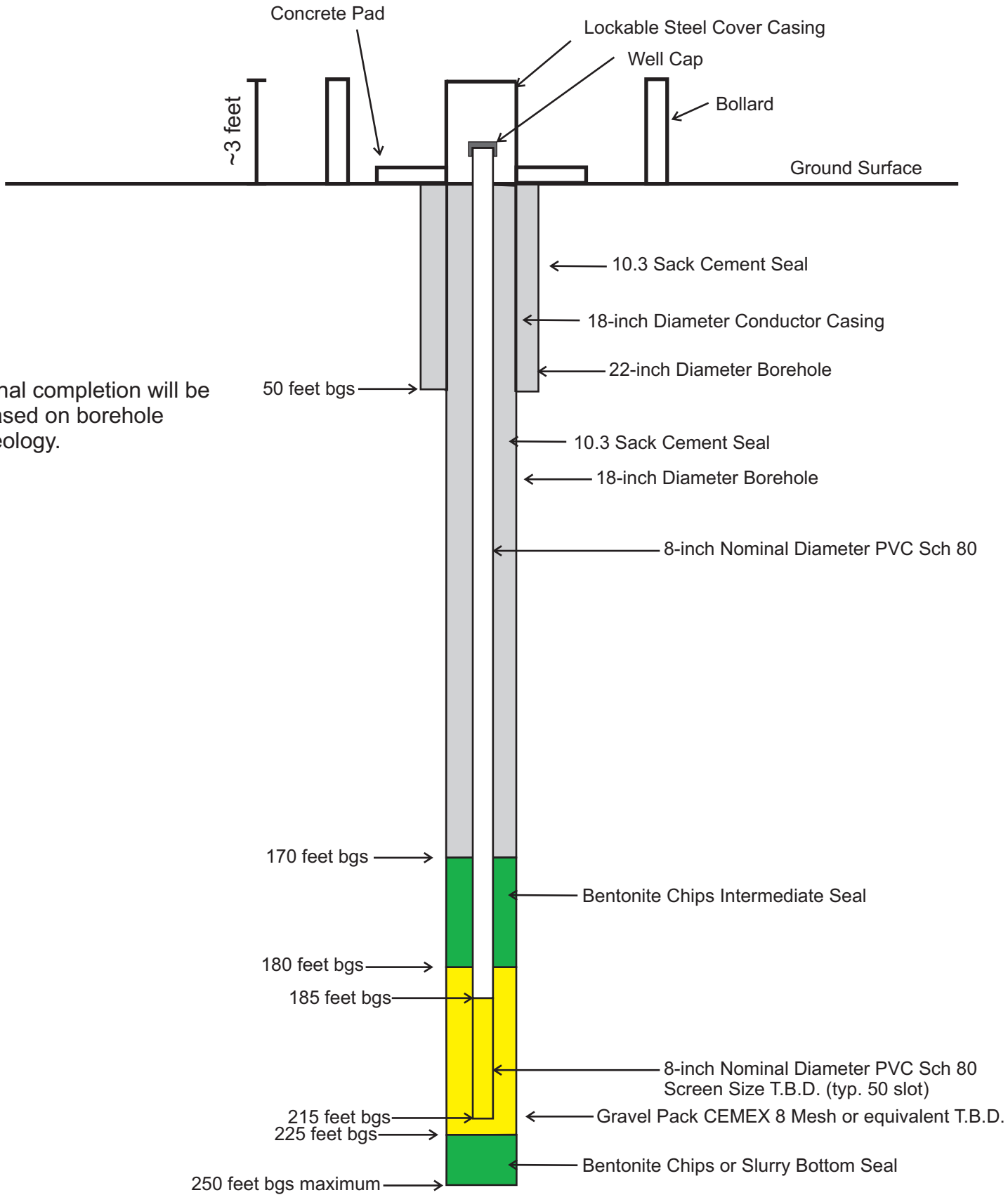
Attachement C-1 - Site Map with Test Hole Locations
Attachment C-2a - Proposed Production Well Detail PW-A
Attachment C-2b - Proposed Production Well Detail PW-B
Bid Table



SITE MAP WITH TEST HOLE LOCATIONS
RANCHO MURIETA CSD
SACRAMENTO COUNTY, CALIFORNIA

DATE: 10/22/2013
SCALE: As Shown
PROJECT NO: SAB115703
DRAWN: JF, MM, CT
CHECKED: PFD
FIGURE: 1

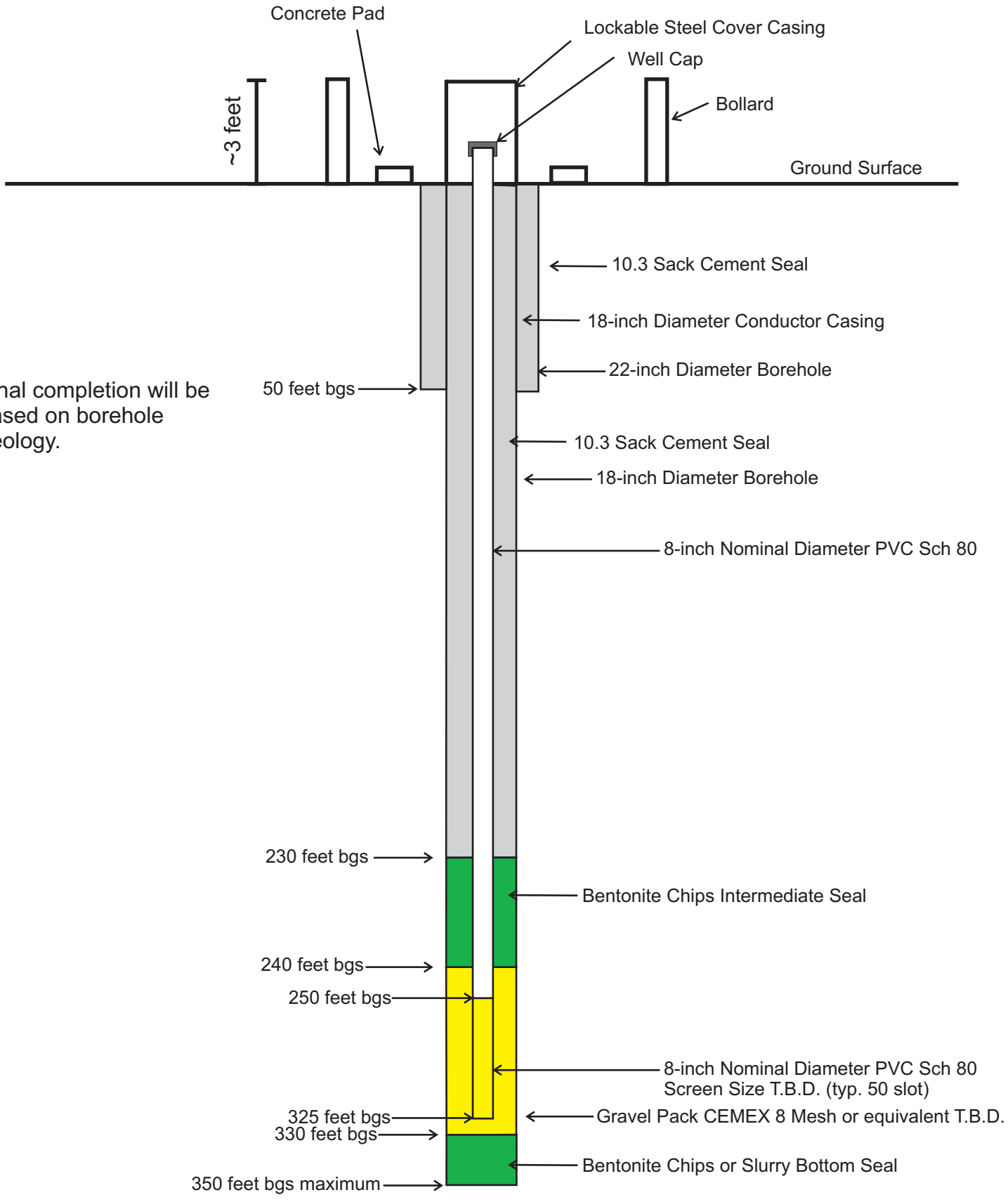
Dunn
ENVIRONMENTAL, INC.



Dunn ENVIRONMENTAL, INC.

DATE: 10/22/2013
SCALE: Not To Scale
PROJECT NO: SAB115703
DRAWN: CT
CHECKED: PFD
FIGURE: 2a

PROPOSED PRODUCTION WELL
DESIGN PW-A
RMCSD
SACRAMENTO COUNTY, CALIFORNIA



Dunn ENVIRONMENTAL, INC.

DATE: 10/22/2013
SCALE: Not To Scale
PROJECT NO: SAB115703
DRAWN: CT
CHECKED: PFD
FIGURE: 2b

PROPOSED PRODUCTION WELL
DESIGN PW-B
RMCSD
SACRAMENTO COUNTY, CALIFORNIA

Bid Tab Sheet
Production Well Driling and Construction
Rancho Murieta Community Services District

Bid Item No.	Item Description	Unit*	Estimated Quantity	Unit Price ($)	Item Price ($)
1	Mobilization and demobilization	LS	2	$0.00	$0.00
2	Production Well drilling	FT	600	$0.00	$0.00
3	Geophysical Logging	EA	2	$0.00	$0.00
4	Production Well Construction				
	8 Inch diameter Sch 80 PVC Casing	LF	440	$0.00	$0.00
	8 Inch diameter Sch 80 PVC 0.050 Screen	LF	70	$0.00	$0.00
	Filter Pack	LF	135	$0.00	$0.00
	Bentonite Seal	LF	20	$0.00	$0.00
	10.3 Sack Cement Grout	LF	500	$0.00	$0.00
	Stainless Steel Centralizers	EA	9	$0.00	$0.00
5	Well Development	HR	24	$0.00	$0.00
5a	Step Test	HR	8	$0.00	$0.00
6	Above Ground Completion	EA	2	$0.00	$0.00
	Total Base Bid				**$0.00**

*EA: Each, HR: Hourly Rate, LF: Lineal Feet, LS: Lump Sum.