

Borrego Water District

May 11, 2005

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SUBJECT: Grant Agreement No. 4600003174 – Final Report on Monitoring Wells

Attached please find the Final Report on subject project. Please release the \$2,758.07, which has been withheld.

cc: Russ Fogarty

Borrego Water District

Final Report

Grant Agreement No. 4600003174

May 11, 2005

1. Report on Monitoring Well No. 1: Linden R. Burzell, District Engineer
2. Reports on Monitoring Well Drilling Program 2004 and 2005, Jerry Rolwing
3. Drillers Log Monitoring Well No. 1
4. Wellenco 3 ARM Caliper Log
5. Wellenco Electric – Natural Gamma: Temp. Log
6. Wellenco Water Quality Lob – 25% porosity
7. Wellenco Spectral Gamma Log
8. Drillers log Monitoring Well No. 3
9. Wellenco 3 ARM Caliper Log
10. Wellenco Electric Natural Gamma – Temp. Log
11. Wellenco Electric – Sonic Porosity Log
12. Wellenco Water Quality Log – 25% porosity
13. Wellenco Water Quality Log – 35% porosity
14. Wellenco Full Wave Sonic Log
15. Wellenco Spectral Gamma Ray Log
16. Wellenco Natural Gamma Temp Log
17. Wellenco Sonic Porosity Log
18. Water Levels, Temperature and Conductivity: Monitoring Well No. 1
19. Water Levels Monitoring Well No. 3
20. Informal Comments on Drilling of Monitoring Well No. 1 by Darby Vickery of DWR
21. Technical Information Record SD-05-1 describing materials encountered in boring of Monitoring Well No. 3 – by Timothy Ross of DWR
22. Samples of Borrego Sun newspaper articles which were routinely published to inform the public of the Monitoring Well program

Borrego Water District
Final Report
Grant Agreement No. 4600003174

Monitoring Well No. 1

State Well No. 10S 6E 21 A2

Ground Elevation: 635 feet above sea level
Static water level at time of drilling: 233 feet
Elevation of water level: 402 feet
Water level at time of continuous monitoring commenced 228 feet
Total depth of test hole: 1,228 feet
Elevation of bottom of test hole: 593 feet below sea level
Bore diameter: 12.25 feet
Casing diameter: 4.26"SS
Casing perforations: 780 – 900 feet
Water level reports attached
Latitude: 33° 10.03 North
Longitude: 116° 20.96 West

Description of Formation: see well log attached hereto

Electrical logs: see attached

Precise depth of zones: see reports attached, requires judgment call

Water quality and samples of cutting: see reports attached: cuttings are in storage boxes at District headquarters

Due to the limited availability of funds only two monitoring wells were drilled. Monitoring Wells No. 1 and 3 were completed. Monitoring Well No. 2 was cancelled.

Report of the 2004 Monitoring Well Program: by Jerry Rolwing, attached

Report and Evaluation of 2004 Program by District Engineer, attached

May 9, 2005

**Borrego Water District
Monitoring Well No. 1
Linden R. Burzell
District Engineer**

The attached drillers log describes the formation encountered in detail. The attached electrical logs by Wellenco provide additional information. The TDS increased substantially near the bottom of the test hole at about 1,180 feet depth of hole (elevation 545' below sea level). This may be an indication that we have reached a depth where marine deposits have intruded the formation and brackish water has been encountered. At 1,128' depth two efforts were made to recover core samples. The formation was very hard, sample one failed completely as the core barrel completely collapsed. Sample two recovered a core several inches long and the core barrel collapsed again. The recovered material was compacted fine material of very low water bearing capability.

The electrical logs attached were requested by Darby Vickery of DHS.

Summary

The formation encountered in Monitoring Well No. 1 proved to be excellent for good wells down to about 1,180 feet depth. That depth is some 250 feet deeper than the nearby wells utilized by the agricultural irrigators, hence, adds to the volume of good water known to be available. The formation below 1,180 feet depth is not likely to be a reliable source. The formation encountered is believed to be the Palm Springs Formation. It has a reputation for wells that produce 1 to 2 gpm per foot of drawdown versus existing wells in this area, which produce 30 – 40 gpm per foot of drawdown in the overlying formation down to 900 feet of depth. Water quality at depths below 1,180 feet is believed to deteriorate based on the limited information from the E-log.

Final Report on Phase I Monitoring Well Project – May 2005

By: Jerry Rolwing

WATER LEVELS:

The In-Situ “Troll 9000” transducer/data collectors have been acquiring data on 10 minute intervals since July 2004. This data is represented on the attached graphs. These graphs are compiled from the data generated from the transducers and converted from pressure readings to down-hole footage utilizing Excel spreadsheets. Time and date data was also manipulated into graph form using Excel. If printed, the data files would cover over 3,500 pages of paper.

The data is the first continuous record of the water table levels and shows a response to the 12 inches of rainfall received in the valley. Although it is not believed that the rainfall had immediate recharge of the aquifer, the lack of pumping because of the precipitation reflects a recovery of the pumping level of the aquifer in monitor well #1 (MW-1). The recent data points show that the water level returned to its previous pumping level once the rain episodes terminated.

The data collected from monitor well #3 (MW-3) reflects a slow recovery over the entire period, possibly from the drilling and development of the monitor well. An aquifer test was performed on MW-3 which is reflected on two of the graphs.

WATER QUALITY:

The conductivity probe of the Troll 9000 collected 10 minute readings of water quality over the same period as the pressure transducer. This data is represented on the attached graphs in the units of microSiemens/cm Actual Conductivity. The graph depicts a show increase in quality over the period and tends to follow the same trend as the water level data. As the data set is collected over the next few years, a direct correlation may become apparent.

TEMPERATURE:

The third probe attached to the Troll 9000 collects and reports the temperature of the down-hole water. The partial season data reflects a drop in the temperature as we moved into the winter months. Again, a full year data set will give a better representation of exactly how the water temperature reacts to the changing seasons.

Borrego Water District
REPORT ON MONITOR WELL DRILLING PROGRAM 2004
By: Jerry Rolwing

BACKGROUND

On July 9, 2003 the California Department of Water Resources (DWR) awarded the Borrego Water District a \$171,000 grant to drill three deep monitor wells. Originally, the three monitor wells were to be drilled along Henderson Canyon Road, beginning at the intersection with DiGiorgio Road and proceeding easterly at one mile intervals. On July 18th, the BWD staff met with Murray Wunderly, San Diego County hydrogeologist, John Peterson, consulting hydrogeologist for BWD, Steve Netto, San Diego State U. graduate student who based his thesis work on the Borrego Valley, Bill Mills, consulting geologist for AAWARE (Agricultural Alliance for Water and Resource Education, an organization of local farmers) and Clark Shimeall, retired geologist and member of SOAC (Save Our Aquifer Coalition, a local concerned citizens group). This consortium of stakeholders reviewed the available data provided by the Henderson/Netto model and concluded that the best use of the grant funding would be to relocate the drill site locations to obtain a better overall understanding of the deep alluvial formation (Palm Spring). The scope of the project was changed to address the Palm Spring Formation and its role as source of future water supplies for the Borrego Valley.

THE REVISED PLAN

The Palm Spring Formation outcrops near Borrego Mountain east of the Borrego Air Ranch and trends deeper as you travel northerly. According to the USGS and Henderson/Netto, the formation could be intercepted under Henderson Canyon Road at a depth of about 1000 feet. BWD had already tapped the Palm Spring Formation in wells drilled by the DiGiorgio Corporation to provide water for the Rams Hill Development. The revised plan was to drill two deep wells in the northern area of the aquifer, one at the intersection of Henderson Canyon Road and Borrego Valley Road and one at the east end of the airport runway, to determine the depth to the Palm Spring Formation and to penetrate it enough to gather data. This data would be used to compare the formation encountered at depth to the known aspects of the formation in the BWD wells to the south. The third well was planned to be drilled fairly shallow (+/- 300 feet) adjacent to the BWD well ID1-8. This well would be utilized as a monitor well for an aquifer test on well ID1-8 to determine whether the formation possessed the capacity of high volume production. The northern wells would be completed to monitor characteristics of the known aquifer such as water level, temperature and conductivity of the water being pumped by the agricultural community. The southern well would be completed mainly to gather data from the aquifer test to be performed on well ID1-8, but would also collect the same data as the northern wells.

THE PREPARATION

In September of 2003 the BWD Board of Directors adopted a negative declaration for the monitor wells as per CEQA (California Environmental Quality Act) requirements. In order to adjust our drilling program, the revised plan was submitted to the DWR and was approved. BWD received the signed contract from the State in early December 2003. In early February 2004 officials from the DWR met with BWD staff to go over the project and to offer two of their staff geologists to assist in the reporting and logging of the drill cuttings associated with the project.

Monitor well #1 (MW-1) was to be drilled in the roadway easement at the corner of Henderson Canyon Road and Borrego Valley Road. To accommodate the needs of the drilling contractor, a temporary easement was obtained from the adjacent property owner. MW-2 was to be drilled in the roadway easement adjacent to a BWD well site granted by the County of San Diego. MW-3 was to be drilled on BWD property next to well ID1-8 at 5037 Borrego Springs Road. District Engineer Lin Burzell drafted the drilling specifications and advertised for bids. Bids were received on March 24, 2004 from four drilling contractors, with Rottman Drilling of Lancaster, California submitting the low bid of \$218,525. The BWD Board of Directors awarded the contract to the low bidder on March 25, 2004. Rottman immediately began the permit process with the County of San Diego for the proposed monitor wells. Unfortunately, the use of the terminology “monitor well” triggered the County hazardous materials unit’s involvement. The County views a monitor well as being associated with some type of contamination and the well construction had to be redesigned to conform to their criteria. This redesign added \$20,000 to the budget in the form of a more expensive seal to be used, confining the one zone of the aquifer we would be monitoring. At this point it was decided that there was sufficient funding for only two of the three wells. MW-2 was deleted from the proposed project due to budget constraints. Drilling permits were issued on April 27th.

DRILLING MW-1

Rottman Drilling mobilized on May 3rd and began drilling on May 4th. Geologist Darby Vickery of the Sacramento DWR office arrived on site and held a safety meeting to insure all present were aware of the possible safety hazards. Geologist Tim Ross of the DWR Southern District office in Glendale arrived later in the day. Drilling continued around the clock for the next three days, changing shifts every 12 hours. Samples were collected by BWD staff and logged by the DWR geologists. The logging consisted of washing the collected sample, examining the texture and color of the sample, assigning a description of the sample based on predetermined charts and documenting the findings on the drill hole log form. Drilling mud consistency was monitored by both the driller and the geologists to insure the proper viscosity was being mixed for the drill hole conditions. Sand grains were analyzed under a microscope by the geologists to assign grain size and make further determinations of the rock type.

The geologists first noted a color change and presence of different rock types at 990 feet which they determined to be the contact with the Palm Spring Formation. The samples became more silty and at 1,100 feet the clays associated with the Palm Spring Formation became more apparent. The drilling progress slowed, representing a harder formation. The drilling was stopped at a total depth of 1238 feet.

Two attempts at retrieving a core sample were made after the drill pipe was retrieved. The first attempt utilized a core barrel designed for sandy formations, which collapsed and was unable to recover the core sample. The second attempt utilized a core barrel designed for a "harder" formation and a small 6-8" sample was recovered and examined by the geologists.

On May 8th Welenco logging company arrived on site to perform a variety of well logs on MW-1. In addition to the electric log requested by BWD, Darby Vickery of the DWR recommended and secured funding above the grant award to run sonic, spectral gamma and caliper logs in each drill hole.

The drill rig was shut down for the Mother's Day holiday and the drill crew returned the following week to seal the bottom 300 feet of the hole and install the 4" casing with screened intervals from 800 to 890 feet.

At the recommendation of the County maintenance foreman, the top of the monitor well casing was set below the road surface so as not to interfere with traffic along the public roadway. A threaded locking cap and a steel flap lid, mounted in concrete, conceal and protect the well and monitoring equipment.

DRILLING MW-3

Drilling MW-3 began on May 18th with a tailgate safety meeting. This well is located approximately 100 feet north of the existing BWD well ID1-8. Since the project was to drill a shallow well which would take less than one day to drill, the DWR sent one geologist, Tim Ross to log the hole. The clays associated with the Palm Spring Formation began showing up at 140 feet. A series of clays varying from red to blue to brown continued to the bottom of the hole. The total depth of the drill hole was 344 feet. A first attempt to log the hole was unsuccessful due to the squeezing clays closing up the hole. Several more passes were made with the drill bit to open the hole enough for the logging equipment. The drill hole was immediately cased with screen intervals from 175 feet to 325 feet. This well casing extends three feet above the land surface and surrounded by metal posts for protection. A threaded locking cap secures the well and monitoring equipment.

MONITORING EQUIPMENT

Both monitor wells are equipped with Troll 9000 down-the-hole monitoring devices from In-Situ Inc. The devices are self contained and continuously record pressure above the transducer, temperature, battery strength, barometric pressure readings through a vented cable to the surface and conductivity of the water.

The Troll 9000 was installed in MW-1 on July 15th at a depth of 300 feet and is taking readings every 10 minutes. The static water level in this well is 228 feet and fluctuates over the course of the day by +/- 1 foot due to pumping in nearby agricultural wells. The temperature of the water is 81 degrees and the conductivity is 744 microSiemens/cm.

The device in MW-3 was installed on June 30th and is collecting data on the same intervals. The water level in this well is 54 feet and remains fairly constant since the District is not currently pumping well ID1-8. The temperature of the water is 78 degrees and the conductivity is 703 microSiemens/cm.

Collecting the data from the devices is accomplished by attaching a data collector to the transducer cable, which is used to both lower and suspend the device from a hook inside the top of the casing. Data is retrieved every two weeks. Quarterly, the devices will be pulled from the well to recalibrate the conductivity meter and replace the batteries.

AQUIFER TESTING/SPECIFIC YIELD

In cooperation with AAWARE and the DWR, at least two aquifer tests will be performed on the two monitor wells. MW-1 is responding to the pumping of an adjacent agricultural well. Details have yet to be worked out on how this test will be performed. MW-3 testing is scheduled for October when the Rams Hill golf course is shut down for overseeding. The DWR has agreed to set up the specifications of these tests. When the testing is complete, data will be provided to the DWR and other hydrogeologists for analysis and interpretation.