

Project Number: WCUD03-003-3.2.1

Memorandum Report
LONGLEY LANE WATER TREATMENT PLANT
MONITORING WELL
CONSTRUCTION AND TESTING

Prepared for:

Washoe County Utility Division
4930 Energy Way
Reno, Nevada 89520-0027

August 25, 2004

Prepared by:

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INTRODUCTION

The Longley Lane Water Treatment Plant Monitoring Well is located in Washoe County southeast of the Reno Tahoe International Airport (Figure 1). The well site is within the SE ¼ of Section 20, Township 19 North, Range 20 East, M.D.B.&M. at a location that is within the Washoe County Utility Division corporation yard at 3031 Longley Lane, Reno, Nevada. (Figure 2). The corporation yard is under consideration as a potential site for a regional water treatment plant which will remove iron, manganese, and arsenic from wells operated by the Washoe County Utility Division.

The Longley Lane Water Treatment Plant Monitoring Well was drilled and tested specifically to:

- Assess the chemical quality of the groundwater in the aquifer in the southeast Truckee Meadows. Of particular interest are iron, manganese, and arsenic, the concentrations of which are known to be above the Drinking Water Standards in this area of the Truckee Meadows.
- Evaluate the hydraulic properties of the aquifer materials.
- Assess the potential yield of a production well at this site.
- Provide the design criteria for a subsequent production well, if such a well is warranted.

ECO:LOGIC Consulting Engineers was retained by the Washoe County Utility Division to provide hydrogeologic consulting services relevant to the design of the drilling and sampling program, provide well-site hydrogeologic and quality-assurance services during the drilling program, identify zones in the aquifer to be investigated for groundwater quality and aquifer properties, obtain samples of the groundwater for chemical analysis, and to assess the results of the drilling and testing program. ECO:LOGIC also obtained the monitoring well waiver (M/O-1331) from the Nevada Division of Water Resources needed to construct the well and a temporary NPDES permit (TNEV2004375) from the Nevada Division of Environmental Protection needed to discharge water during test pumping. ECO:LOGIC also coordinated the drilling program with the Washoe County Airport Authority so that air traffic was made aware of the presence of the drill rig.

The monitoring well was drilled and constructed by WDC Exploration of Zamora, California under subcontract to ECO:LOGIC. WDC also provided the test pumping equipment. ECO:LOGIC orchestrated the pumping tests and analyzed the test data to evaluate the hydraulic properties of the aquifer materials. A water sample was collected from the monitoring well near the end of the pumping test and submitted to a State of Nevada certified laboratory for analysis.

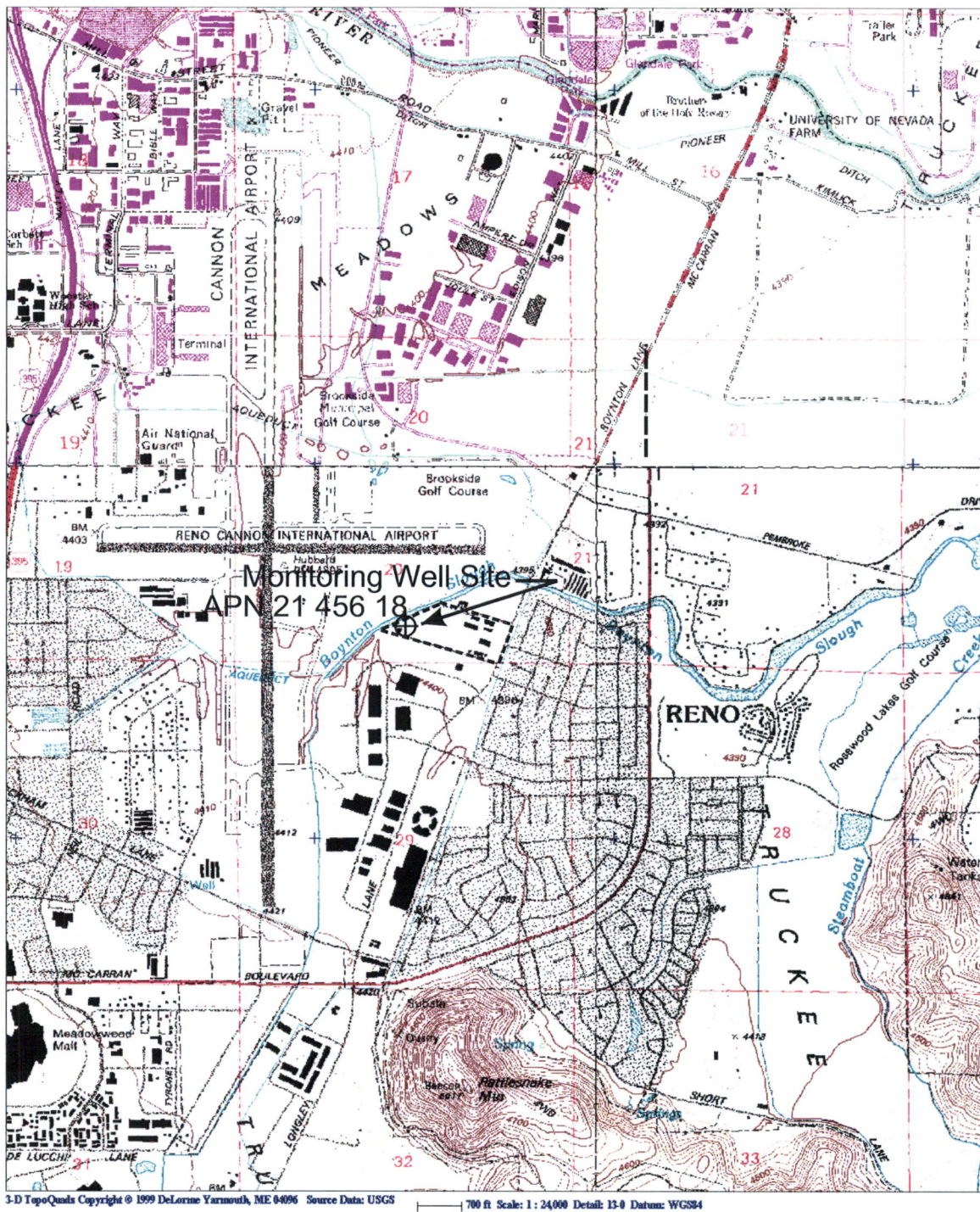


FIGURE 1. WCUD LONGLEY LANE WATER TREATMENT PLANT PROJECT LOCATION MAP.

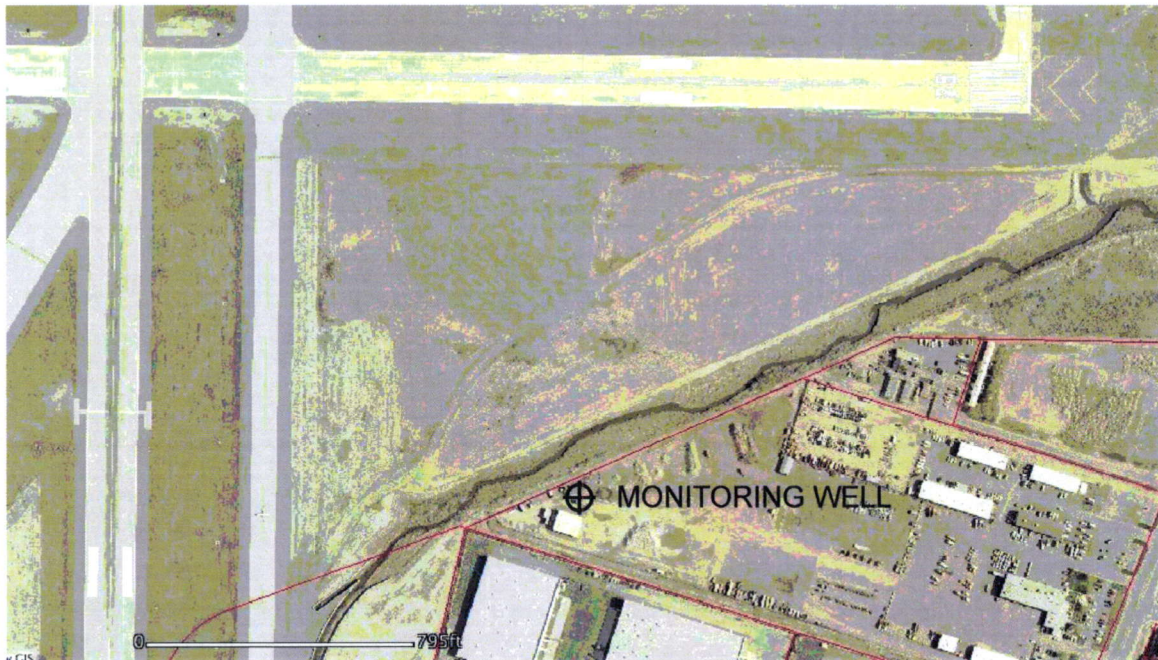


FIGURE 2.
WCUD LONGLEY LANE WATER TREATMENT PLANT MONITORING WELL
LOCATION.

This report:

- Summarizes the drilling and testing program.
- Presents an evaluation of the hydraulic properties of the aquifer at this locale.
- Discusses the probable yield of a production well at this site.
- Provides the results of chemical analyses of groundwater sampled from the well.
- Presents design recommendations for a production well, should the County elect to complete a production well at this site.
- Assesses the likely interference on other wells in the vicinity that might arise from pumping a production well at this site.

WELL CONSTRUCTION SUMMARY

The Longley Lane Water Treatment Plant Monitoring Well was drilled by the mud-rotary method. The drilling equipment included a portable drilling mud system consisting of fluid tanks equipped with de-sanders and shaker screens which remove the drill cuttings and suspended solids from the drilling fluid. The mud system helps maintain properties of the drilling fluid which facilitate collection of representative samples of the formation material. These formation samples, or drill cuttings, were obtained from the drilling-fluid returns for each five-foot interval penetrated by the borehole. Select samples of the drill cuttings were analyzed for size and gradation. Drill cuttings were dispersed at the site upon completion of the project. Drilling fluids and turbid water resulting from well development were disposed of at the drying beds at the Truckee Meadows Water Authority's Glendale Water Treatment Plant.

The target depth for the monitoring well was 500 feet. It was drilled in two phases. The first phase entailed drilling a nominal 8-inch diameter pilot hole to the target depth of 500 feet. Upon completion of drilling to the target depth, a suite of borehole geophysical logs was completed. The logging suite included spontaneous potential, point resistance, short- and long-normal resistivity, lateral resistivity, natural gamma radiation, and caliper logs. Copies of the geophysical log printouts are provided in the Appendix. Select geophysical logs are provided for comparison with the lithology and well construction details in Figure 3. The lithologic and borehole geophysical log data were used to design the completed well. The second phase of well construction entailed back-grouting the pilot hole to a depth of 320 feet and reaming the pilot hole to a diameter of 10 5/8 inches to a depth of 320 feet.

Chronology

- July 14, 2004 – WDC Exploration mobilized drilling equipment to the site.
- July 15 – Ten feet of 12-inch diameter conductor casing were installed and the pilot hole was drilled to a depth of 140 feet.
- July 16 – The 8 1/2-inch diameter pilot hole was advanced to a depth of 440 feet.
- July 17 – The borehole was advanced to the target depth of 500 feet and borehole geophysical logs were acquired.
- July 19 – The borehole was cleaned to the bottom and plugged with neat-cement grout from 320 to 500 feet below the land surface.
- July 20 – The borehole was reamed to a diameter of 10 5/8 inches from the land surface to a depth 320 feet.
- July 21 – The tremie pipe was installed, followed by the 6 5/8-inch diameter well casing. The filter pack was installed to a depth of 135 feet.
- July 22 – The filter pack was placed to a depth of 120 feet, a bentonite/sand grout cutoff was placed from above the filter pack, the sanitary seal was installed, and the temporary conductor casing was removed.
- July 29 – Well development using the drill rig was initiated.
- July 30 – The drilling equipment was demobilized from the project and the development rig was mobilized to the site. The test pump was installed and well development using the test pump was initiated.
- August 2 – Well development using the test pump was completed.
- August 3 – The 4-hour duration step-drawdown test was performed.
- August 4 – The 24-hour duration constant-discharge test started.

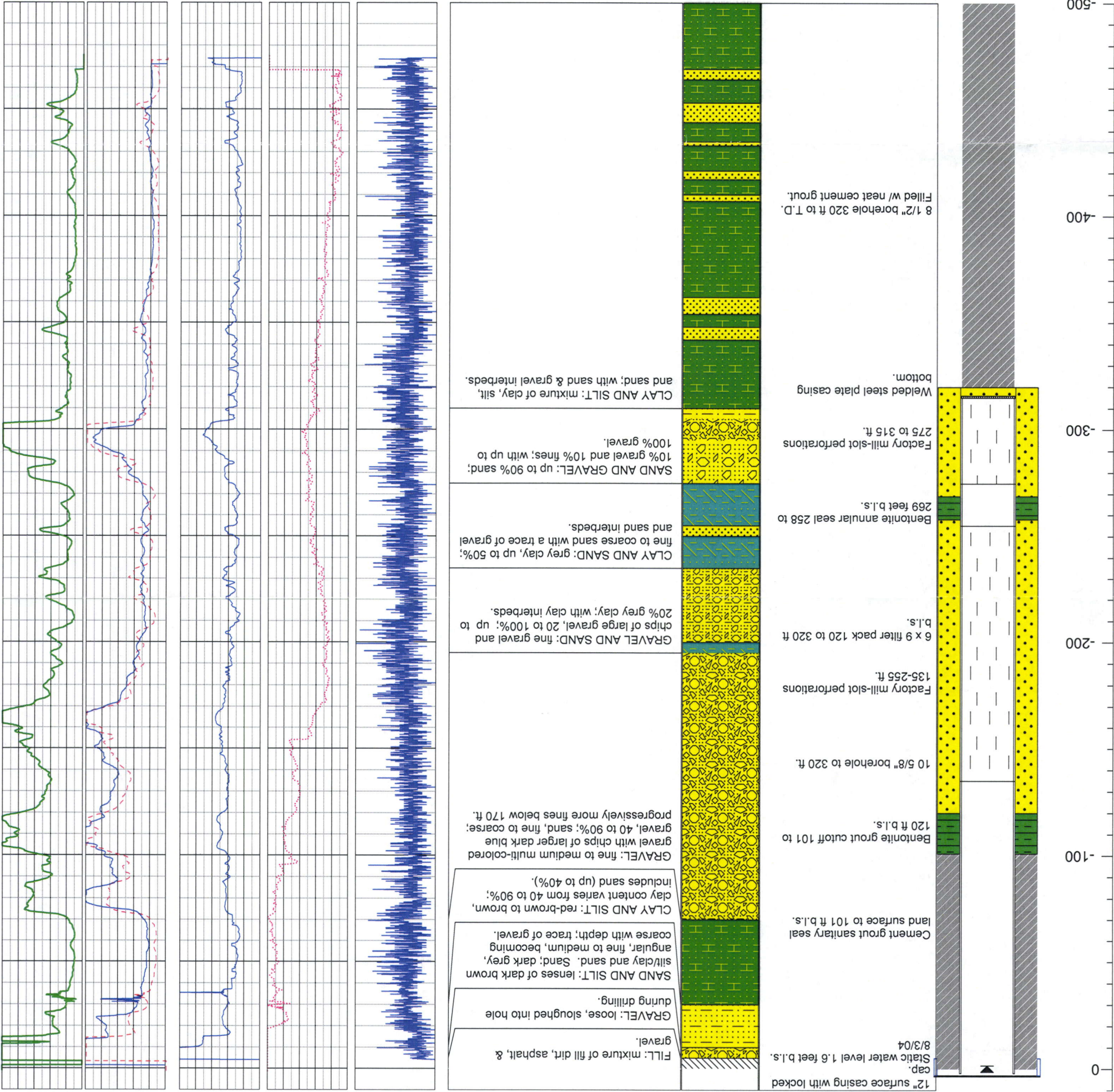
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Project: Washoe County Longley Lane Water Treatment Facility
Location: SE 1/4 Section 20, T.19N., R.20E.
Well: Longley Lane Monitoring Well
Borehole Depth: 500 feet Diameter: 10.5" 0 to 320, 8.5" 315 to T.D.
Drilling Contractor: WDC Exploration - Nevada
Logged by: Bryan Kearney
Completion Date: 7/20-27/04

Well Construction

Lithology

Borehole Geophysical Logs



August 5 – The constant-discharge test ended.
August 6 - The test pump was removed from the well.

Lithology

ECO:LOGIC personnel logged the formation samples in the field as the borehole was advanced. The borehole penetrated unconsolidated alluvial deposits comprising gravel, sand, silt and clay, and mixtures of these materials. An abbreviated geologic log is provided in Figure 3 and the complete field lithologic log of the borehole is provided in the appendix.

Monitoring Well Construction

The borehole was completed as a monitoring well. Its final depth and the perforated intervals of the casing were based on a review of the samples of the formation materials penetrated by the borehole and an examination of the borehole geophysical logs. This information suggested that the highly permeable geologic materials were encountered between the depths of approximately 68 and 200 feet below land surface (b.l.s.) with additional permeable strata to a depth of 310 feet b.l.s. Below 310 feet, the formation primarily comprised clay and silt with sand interbeds and occasional gravel. As a result, the lower portion of the borehole was backfilled with neat-cement grout to a depth of 320 feet. The grout was placed by pumping via a tremie pipe. The tremie was raised as the grout displaced the drilling fluid from the borehole.

The monitoring well was constructed with 6 5/8-inch outside diameter 0.188-inch wall-thickness steel well casing to a depth of 315 feet in a 10 5/8-inch diameter borehole to a depth of 320 feet. Factory mill-slot perforations with an aperture width of 3/32-inch were placed in the depth intervals of 135 to 255 and 275 to 315 feet b.l.s. The casing was joined by welding. The annular space surrounding the well screen was filled with a nominal 6-9 mesh size silica-sand filter pack from the bottom of the borehole to a depth of 120 feet b.l.s. An intermediate annular seal was placed between 258 and 269 feet b.l.s. The filter pack and annular seal were installed via a tremie pipe to ensure its proper placement. The tremie was raised as the filter pack filled the annulus. A bentonite grout cutoff was placed above the filter pack. The annular space above a depth of 101 feet was sealed with neat-cement grout placed by pumping through the tremie pipe.

Well construction details are summarized in Table 1 and illustrated in Figures 3.

TABLE 1. LONGLEY LANE WATER TREATMENT PLANT MONITORING WELL CONSTRUCTION DETAILS		
Conductor Casing	0 to 10 feet b.l.s.	12 ¾-inch O.D. x 0.250-inch wall thickness steel.
Blank casing	+2 to 135 feet b.l.s. and 255 to 275 feet b.l.s.	6 5/8-inch O.D. x 0.188-inch wall thickness ASTM A 53B steel.
Perforated Interval	135 to 255 feet b.l.s. and 275 to 315 feet b.l.s..	6 5/8-inch O.D. x 0.188-inch wall thickness ASTM A 53B steel w/ 3/32-inch aperture-width factory mill slots
Filter pack	120 to 258 feet b.l.s. and 269 to 320 feet b.l.s.	6 x 9 mesh Colorado Silica Sand. The filter pack was placed using a tremie pipe. Fluid was circulated through the tremie during installation.
Intermediate seal	258 to 269 feet b.l.s.	Mixture of bentonite and sand placed via a tremie.
Grout cutoff	101 to 120 feet b.l.s.	Granular bentonite
Sanitary Seal	Land surface to 100 feet b.l.s.	Neat cement grout in the annulus surrounding the 6 5/8-inch casing from the land surface to 101 feet b.l.s. All grout was placed by pumping via a tremie pipe.
Protective Casing	+2.5 feet to 3.5 feet b.l.s	12-inch diameter steel welded to the conductor casing, equipped w/ locked cap and surrounded by a concrete pad.

Well Development

The primary reasons for development are to remove residual drilling fluid and restore any damage to the formation that may have resulted from well construction. Formation damage includes plugging of the formation due to invasion of drilling mud or a buildup of a filter cake on the formation/borehole interface.

Well development was initiated after the sanitary seal cured. This initial development work entailed air-lift pumping the well for 7 ½ hours using the drill-rig mounted air compressor to remove residual drilling fluids. After the residual drilling fluid was removed, the well was alternately surged and pumped with the test pump for 14 hours until the discharge was visibly clean. The drilling fluid and initial water pumped from the well during development were contained on site and later hauled to the drying beds at the Truckee Meadows Water Authority's Glendale Water Treatment Plant.

WELL TESTING

TESTING SUMMARY

Equipment

Testing of the Longley Lane Water Treatment Plant Monitoring Well was accomplished using a submersible turbine test pump powered by a diesel generator provided by WDC Exploration. The pump bowls were set at a depth of 144 feet b.l.s. The discharge was conveyed to a Boynton Slough under the terms of the temporary NPDES permit obtained from the Nevada Division of Environmental Protection. The pumping rate was controlled with a gate valve and measured with a McCrometer flow meter in the discharge pipe. A stilling well was installed to the top of the pump to facilitate measuring water levels. Water levels in the well were monitored with an In-Situ MiniTROLL™ data logger equipped with a 30 p.s.i.g. pressure transducer. The data logger was accessed through a laptop computer and field data plots were continuously updated as testing progressed.

Step Testing

Step testing entails pumping the well at progressively higher rates while monitoring the water levels in the pumped well. The purpose of a step test is to evaluate the performance of the well over a range of pumping rates and to assess the overall hydraulic efficiency of the well. Knowledge of the efficiency of the well helps to assess the performance of a subsequent larger-diameter production well that might be pumped at higher rates.

Static water level: 5.9 feet below the top of the stilling well (top of stilling well was 3.3 feet above the land surface).

Testing commenced: 07:20 hrs 8/03/04.

Test duration: 4 hours 2 minutes (242 minutes).

Testing terminated: 11:22 hrs 8/03/04.

The step-drawdown test comprised four steps. The drawdown data are illustrated in Figure 4 and provided in digital format in the Appendix.

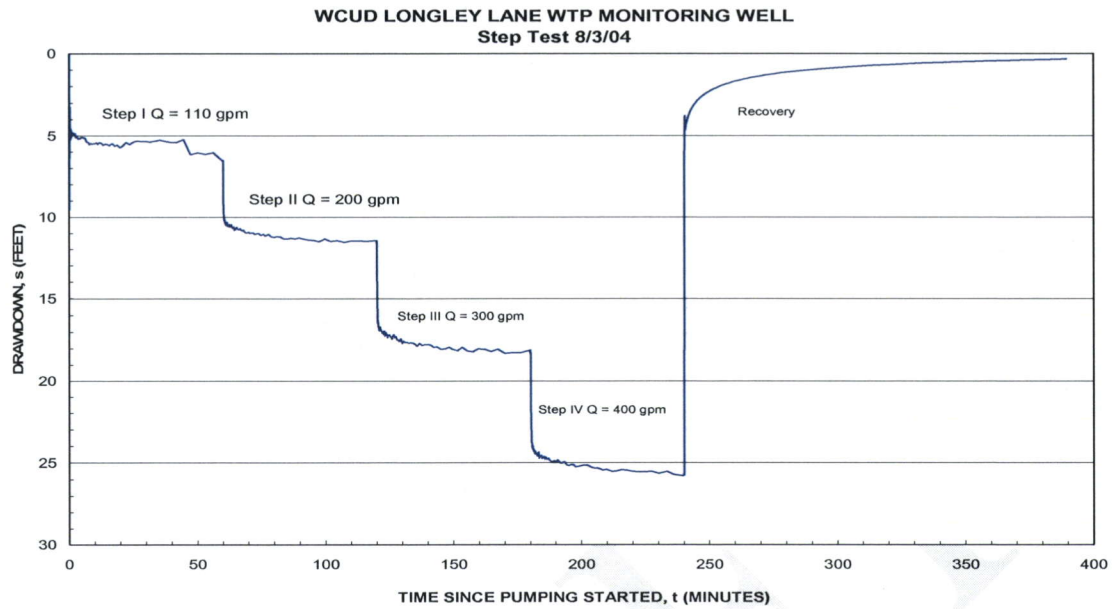


FIGURE 4. STEP DRAWDOWN TEST DATA.

The step test is summarized below in Table 2 and Figure 5.

Table 2
LONGLEY LANE WATER TREATMENT PLANT MONITORING WELL
STEP TEST SUMMARY.

Step	Duration t (Minutes)	Pumping Rate Q (gpm)	Drawdown s (feet)	Specific Capacity C _s (gpm/ft)
I	60	110	6.58	16.72
II	60	200	11.53	17.35
III	60	300	18.2	16.48
IV	60	400	25.77	15.52

LONGLEY LANE MONITORING WELL STEP TEST 8/03/04

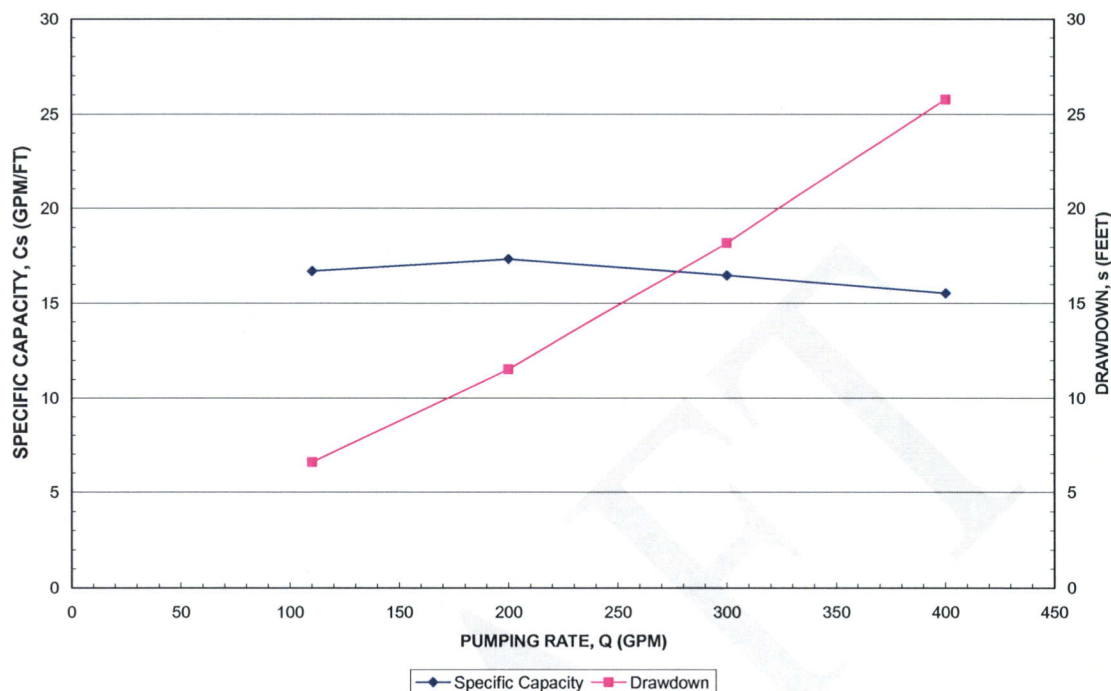


FIGURE 5. STEP TEST SUMMARY

Constant-Discharge Testing

The purpose of the constant-discharge test is to evaluate the hydraulic characteristics of the aquifer. These parameters influence the long-term performance of a well and are necessary to evaluate the potential impacts on nearby wells due to pumping. The constant-discharge test entailed pumping the monitoring well at a constant rate for 24 hours while monitoring the water level in the pumped well. Constant-discharge testing ensued after the water levels in the well recovered over night following the step test. At the conclusion of the pumping test, water levels in the wells were monitored for a recovery period of approximately 24 hours.

Static water level: 5.8 feet below the top of the stilling well (top of stilling well was 3.3 feet above the land surface).

Pumping commenced: 07:30 hours 8/04/04

Discharge rate: approximately 400 gpm

Test duration: 24 hours

Pumping terminated: 07:30 hours 8/05/04

Pumping level at the conclusion of the pumping test: 34.04 feet below the top of the stilling well.

Drawdown in the well at conclusion of test: 28.24 feet

Figure 6, below, shows the drawdown and recovery data for the test. The test data are provided in digital format in the Appendix along with the field data sheets and field data plots.

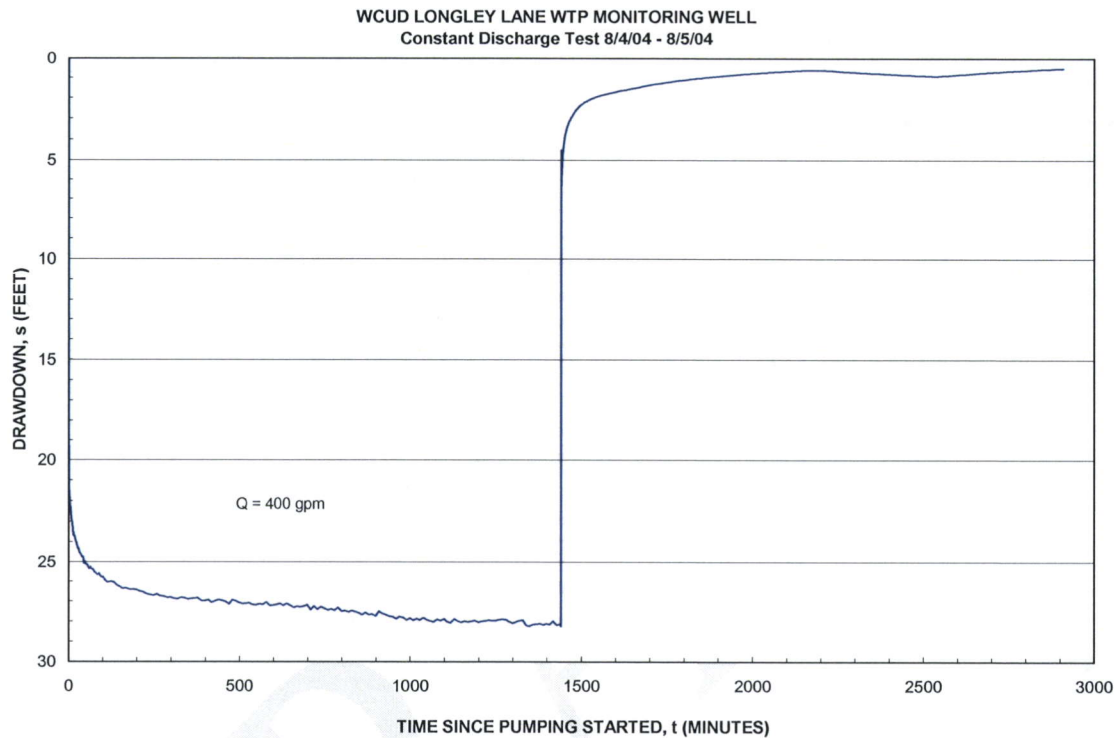


FIGURE 6. CONSTANT-DISCHARGE TEST DRAWDOWN DATA.

PUMPING-TEST DATA ANALYSIS

Analysis of the test data was accomplished in two phases. The first phase entailed a graphical analysis of the data in the field as testing progressed. The second phase entailed numerical inversion of the test data using the computer program WHIP (Well Hydraulics Interpretation Package ver. 3.22: Hydro-Geo Chem, Inc., 1988). The numerical analysis was initiated in the field and completed upon return to the office. The solution was judged to be adequate when both the step test and constant-discharge test data could be simulated using similar aquifer properties. These properties are:

Transmissivity: 6,500 feet²/day (49,000 gallons per day per foot width of aquifer)
Coefficient of storage: 0.0065

These values are indicative of a highly transmissive, semi-confined aquifer.

Step-Drawdown Testing Results

The results of the step-drawdown test data analysis are illustrated in Figure 7. The figure depicts the observed drawdown in the well and compares it to simulated drawdown calculated on the basis of the average well and aquifer parameters determined from the analysis of the test data.

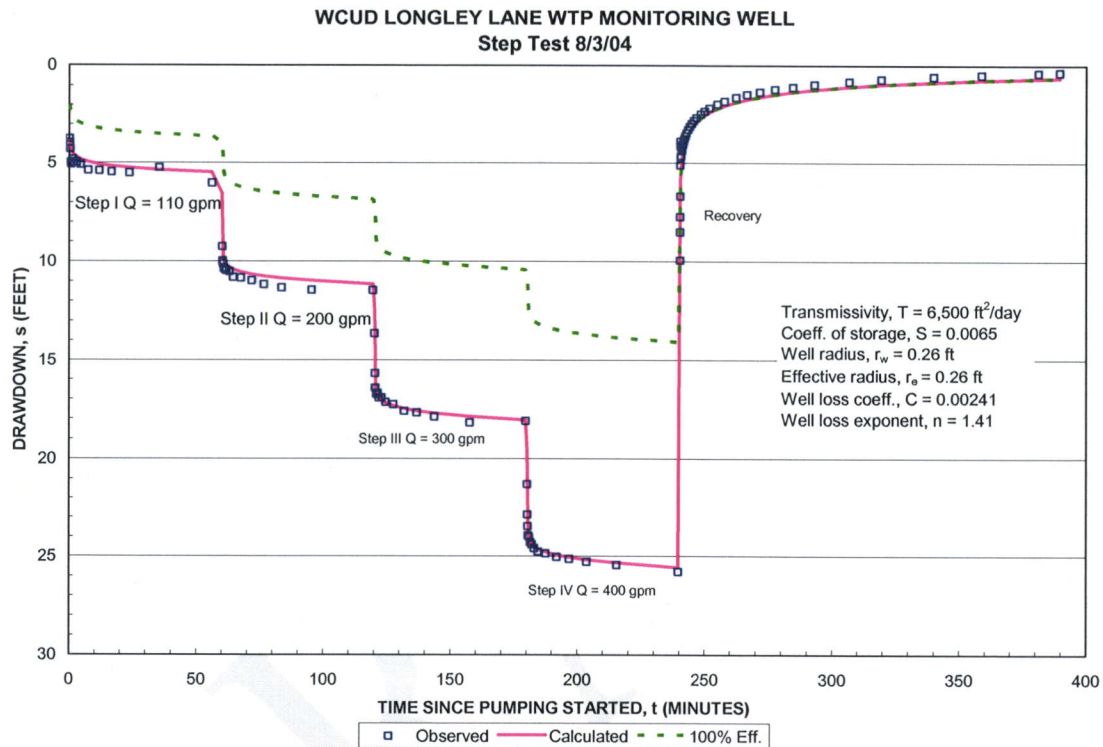


Figure 7 shows a good correlation between the observed data and simulated drawdown. Comparison between the observed drawdown and the theoretical drawdown for a 100% efficient well indicates that the monitoring well is relatively inefficient. Calculated efficiency for $t \approx 60$ minutes is summarized in Table 3.

Table 3
LONGLEY LANE WATER TREATMENT PLANT MONITORING WELL EFFICIENCY

Step	Duration t (minutes)	Pumping Rate Q (gpm)	Calculated Drawdown s (feet)	Theoretical Drawdown at 100% Eff. (feet)	Efficiency %
I	60	110	5.5	3.65	66
II	60	200	11.15	6.48	58
III	60	300	17.88	10.42	58
IV	60	400	25.55	14.08	55

Constant-Discharge Testing Results

The results of the analysis of the drawdown and recovery data from the constant-discharge test are depicted in Figures 8a and 8b, which provide plots of drawdown versus time using both arithmetic and logarithmic time scales. The plots compare observed and simulated drawdown in the well based on the aquifer and well properties determined from the analysis.

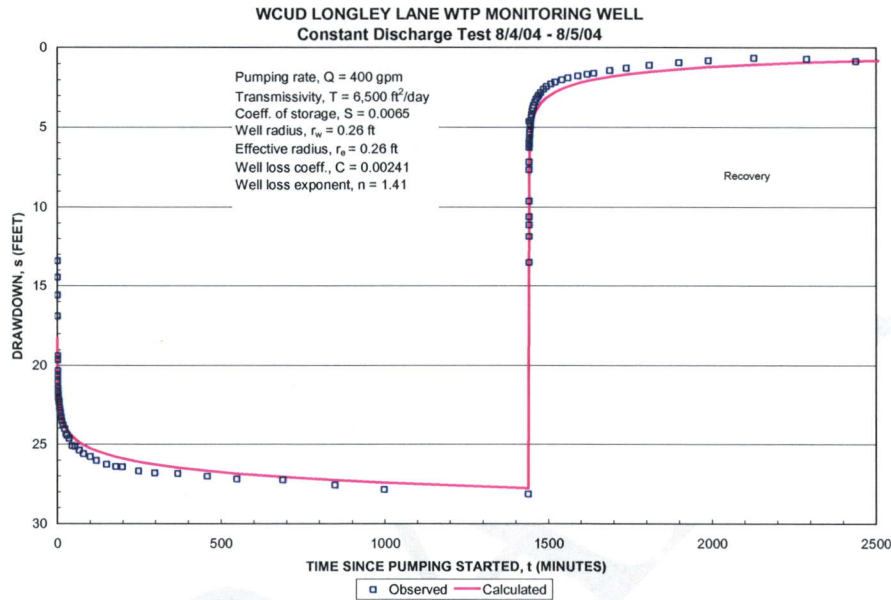


FIGURE 8a

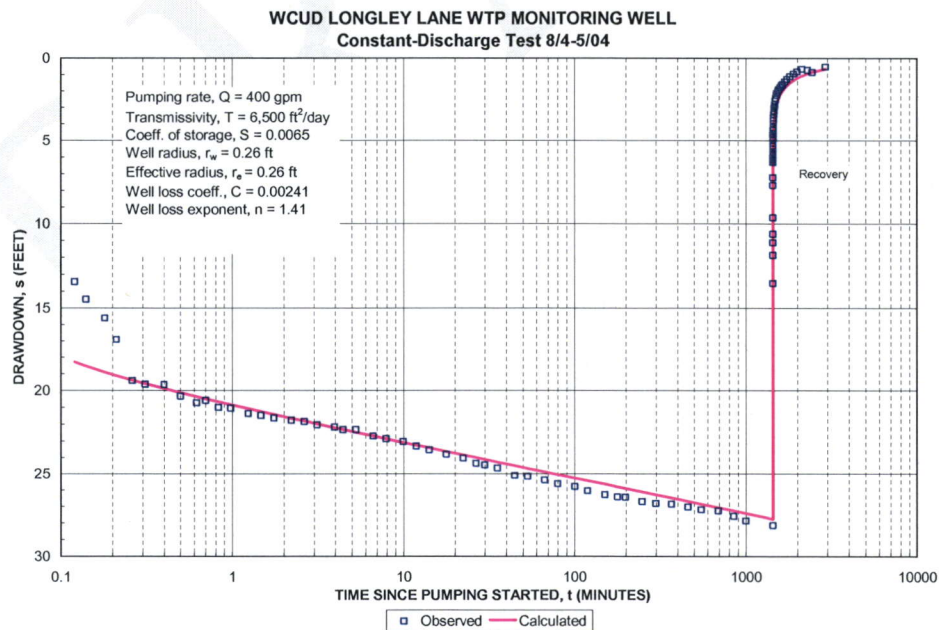


FIGURE 8b

LONGLEY LANE WATER TREATMENT PLANT MONITORING WELL CONSTANT-DISCHARGE TEST ANALYSIS RESULTS.

WATER CHEMISTRY RESULTS

A water sample was collected by ECO:LOGIC on August 5, 2004 near the conclusion of the constant-discharge test. The well was sampled for analysis of major cations, major anions, and trace metals, which include Phase II and V inorganic constituents, Synthetic Organic Chemicals (SOCs), Volatile Organic Chemicals (VOCs), and radionuclides. Additional samples were collected for iron, manganese and arsenic after one, three, and eight hours of pumping and a large bulk sample of the water was collected for an analysis of the treatability of the water by CH2M-HILL.

The water samples were submitted to Sierra Environmental Monitoring, a State of Nevada certified laboratory. The results of the laboratory analyses for iron, manganese, and arsenic are provided in Table 4. The analytical results from last water sample are provided in Table 5 and the laboratory report is provided in the appendix.

The data in Table 4, below, indicate that the concentration of iron was consistently below the secondary drinking water standard, manganese was below the recommended secondary drinking water standard of 0.10 mg/l but greater than the recommended standard of 0.05 mg/l, and arsenic was below the current MCL of 0.50 mg/l, but in excess of the revised MCL which becomes effective in January 2006.

TABLE 4. LONGLEY LANE WATER TREATMENT PLANT MONITORING WELL IRON, MANGANESE AND ARSENIC CONCENTRATION.					
	Concentration (mg/l)				MCL
Date Time	8/4/04 08:30	8/4/04 10:30	8/4/04 15:30	8/5/04 06:00	
Arsenic	0.032	0.033	0.032	0.32	0.50 ^a /0.010 ^b
Iron	0.110	0.07	0.06	<0.05	0.6 ^c /0.3 ^d
Manganese	0.083	0.069	0.061	0.056	0.1 ^c /0.05 ^d
Notes:	a. Primary standard. b. Primary standard, effective January 2006. c. Secondary standard, maximum. d. Secondary standard, recommended.				

A discussion of the water quality data will be inserted upon receipt of the data.

<p align="center">Table 5. LONGLEY LANE WATER TREATMENT PLANT MONITORING WELL WATER CHEMISTRY DATA FOR SAMPLE COLLECTED AUGUST 5, 2004.</p>		
ANALYTE	CONCENTRATION (mg/l unless noted otherwise)	MCL (mg/l unless noted otherwise)
Phase II Inorganic Chemicals		
Fluoride		4
Barium		2
Cadmium		0.005
Chromium		0.1
Mercury		0.002
Selenium		0.05
Asbestos (fibers longer than 10µm)	not analyzed	7 million
Nitrate		10 as (N)
Nitrite		1 as (N)
Total Nitrate + Nitrite		10 as (N)
Phase V Inorganic Chemicals		
Antimony		0.006
Beryllium		0.004
Cyanide		0.2
Nickel		0.1
Thallium		0.002
Arsenic		0.010
Secondary Drinking Water Standards		
Chloride		400
Color		15
Copper		1
Foaming Agents (MBAS)		0.5
Iron		0.6
Magnesium		150
Manganese		0.1
Odor (T.O.N.)		3
pH (Std. Units)		6.5-8.5
Silver		0.1
Sulfate		500
Total Dissolved Solids (TDS)		1,000
Zinc		5
Fluoride		2
Radionuclides		
Gross α activity (pCi/l)		15
Radium ²²⁶ (pCi/l)		3
Uranium (mg/l)		0.03 (proposed)
Gross β activity (pCi/l)		50
Phase I & II Volatile Organic Chemicals		
Vinyl Chloride		0.002
Benzene		0.005
Carbon tetrachloride		0.005
1,2-Dichloroethane		0.005

Trichloroethylene (TCE)		0.005
Para-Dichlorobenzene		0.075
1,1-Dichloroethylene		0.007
1,1,1-Trichloroethane		0.2
cis-1,2-Dichloroethylene		0.07
1,2-Dichloropropane		0.005
Ethylbenzene		0.7
Monochlorobenzene		0.1
o-Dichlorobenzene		0.6
Styrene		0.1
Tetrachloroethylene (PCE)		0.005
Toluene		1
Trans-1,2-Dichloroethylene		0.01
Xylenes (total)		10
Phase V Volatile Organic Chemicals		
Dichloromethane		0.005
1,2,4-Trichlorobenzene		0.07
1,1,2-Trichloroethane		0.005
Phase II Synthetic Organic Chemicals		
Alachlor		0.002
Aldicarb		0.003
Aldicarb sulfoxide		0.004
Aldicarb sulfone		0.002
Atrazine		0.003
Carbofuran		0.04
Chlordane		0.002
Dibromochloropropane		0.0002
2,4-D		0.07
Ethylene dibromide		0.00005
Heptachlor		0.0004
Heptachlor epoxide		0.0002
Lindane		0.0002
Methoxychlor		0.04
Polychlorinated biphenyls		0.0005
Pentachlorophenol		0.001
Toxaphene		0.003
2,4,5-TP		0.05
Disinfection By-Products (interim)		
Chloroform		0.10 (TTHM)

Phase V Synthetic Organic Chemicals		
Benzo[a]pyrene		0.0002
Dalapon		0.2
Di (2-ethylhexyl) adipate		0.4
Di (2-ethylhexyl) phthalate		0.006
Dinoseb		0.007
Diquat		0.02
Endothall		0.1
Endrin		0.002
Glyphosate		0.7
Hexachlorobenzene		0.001
Hexachlorocyclopentadiene		0.05

Oxamyl (Vydate)	n.d	0.2
Picloram	n.d	0.5
Simazine	n.d	0.004
2,3,7,8-TCDD (Dioxin)	Not analyzed	3×10^{-8}

Note: n.d. signifies not detected.

DRAFT

ANALYSIS OF PROBABLE WELL YIELD

Probable Well Yield

The probable performance of a production well at this locale was evaluated on the basis of the information provided in the monitoring well logs and pumping test results. This evaluation was accomplished through simulations of pumping for a 16-inch diameter, 315 feet deep production well. Pumping rates of 1,500 and 1,800 gpm were simulated to bracket a probable design pumping rate for a production well at this locale. The computer program WHIP (the same program used to analyze the test data) was used to calculate drawdown in the well and the aquifer.

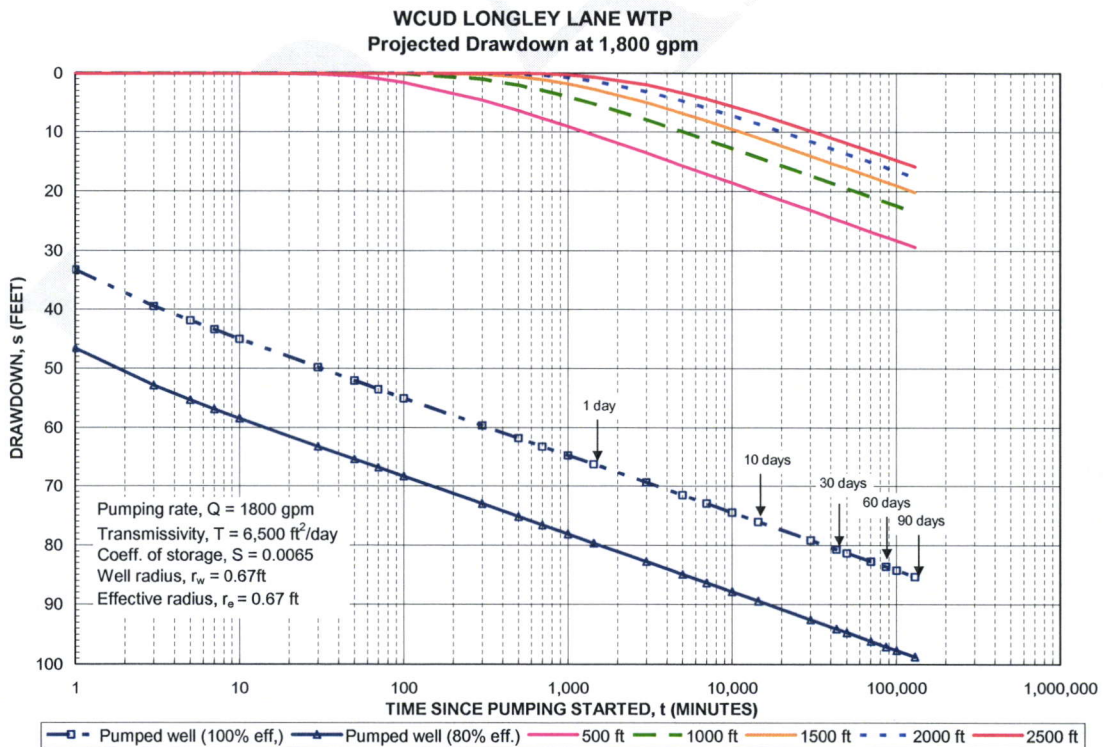
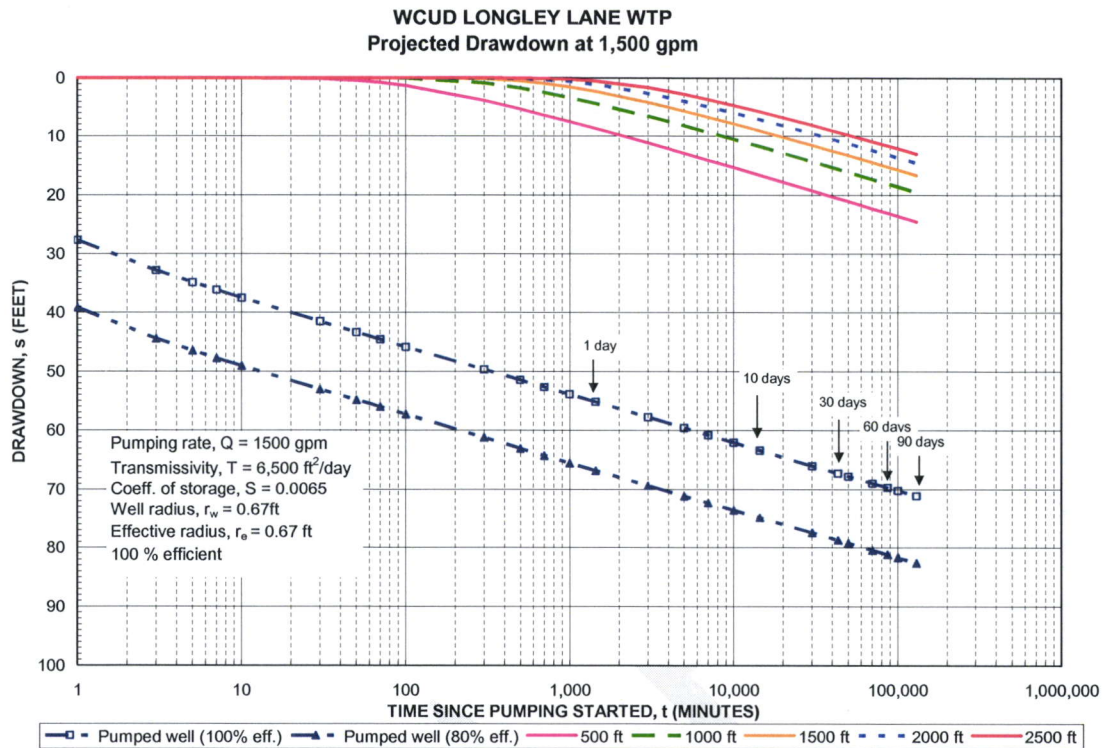
The principal assumptions for the analysis include:

- The well radius is 16 inches.
- The well depth is 315 feet.
- Initial static water level is approximately 3 feet below the land surface.
- Transmissivity is 6,500 feet²/day (49,000 gpd/ft).
- Coefficient of storage was assumed to be 0.0065. No increase in storage coefficient as a consequence of delayed yield was invoked.
- The aquifer is uniform, isotropic, and infinite in areal extent.
- No recharge to the aquifer occurs during the simulation period.
- The well is 80% efficient. Properly constructed wells can achieve efficiencies of greater than 90%.
- The well is pumped 24 hours per day, 7 days per week for a period of 90 days.

The results of the simulations are depicted in Figure 9a and 9b. From Figure 9a, it is anticipated that the water level in the aquifer immediately outside of the well casing would be drawn down to a depth of approximately 75 feet below the land surface after 90 continuous days of pumping at a rate of 1,500 gpm and that the pumping level in the well might be expected to approach a depth of 86 feet. The geologic and geophysical logs for the monitoring well indicate that the principal aquifer begins at a depth of 68 feet b.l.s. and that no significant aquitards are present from the top of the aquifer to a depth of 200 feet, so that the pumping level would not be drawn down significantly below the top of the aquifer.

From Figure 9b, it is anticipated that the water level in the aquifer immediately outside of the well casing would be drawn down to a depth of approximately 88 feet below the land surface after 90 continuous days of pumping at a rate of 1,800 gpm and that the pumping level in the well might be expected to approach a depth of 102 feet. It is good practice limit the drawdown in a well completed in an unconfined aquifer to no more than two-thirds of the saturated thickness [Driscoll, 1986]. In this case, less than 10% of the total aquifer thickness would be dewatered in the immediate vicinity of the well, so that dewatering of the aquifer will have little impact on well performance.

Preliminary plans call for a production well to be located approximately 800 feet east to northeast of the monitoring well site. Conditions in the aquifer might be somewhat different at the proposed production well site and these differences could influence the performance of the production well.



PREDICTED PERFORMANCE OF A PRODUCTION WELL AT THE LONGLEY LANE WATER TREATMENT PLANT MONITORING WELL SITE.

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POTENTIAL INTERFERENCE EFFECTS

The two simulations of production well performance also included the potential interference from pumping a production well at Longley Lane Water Treatment Plant Monitoring Well site. Interference drawdowns were calculated for distances of 500 feet, 1,000 feet, 1,500, 2,000 feet, and 2,500 feet from the pumped well. These are listed in Table 6.

TABLE 6. PROJECTED INTERFERENCE DRAWDOWN FROM A PRODUCTION WELL AT THE PROPOSED WATER TREATMENT FACILITY.					
Radial Distance, r (feet)					
Drawdown, s (feet)					
Pumping Rate	500	1,000	1,500	2,000	2,500
1500 gpm	24.5	19.6	16.8	14.7	13.2
1,800 gpm	29.4	23.5	20.1	17.7	15.8
Assumes pumping 24 hours/day for 90 days.					

PRODUCTION WELL DESIGN RECOMMENDATIONS

The available information suggests that it is highly likely that a well capable of providing 1,500 to 1,800 gallons per minute can be completed at the site of the Longley Lane Water Treatment Plant monitoring well. The production well may be located approximately 800 feet to the east or northeast of the monitoring well. Because the water-bearing alluvial deposits in the southeast Truckee Meadows are not uniform, there is a possibility that the conditions for the production well may differ from those at the monitoring well site. Consequently, a pilot hole should be drilled as part of the production well program to confirm the design based on the monitoring well 800 feet away.

Recommendations for the design of a production well at this site include capable of producing 1,500 to 1,800 gallons per minute include:

Drilling method – Reverse circulation. This method utilizes relatively clean water as the drilling fluid. It minimizes the potential for formation damage during drilling and results in less time needed to develop the well. The drilling equipment should include portable mud tanks and these should be equipped with de-sanders and shaker screens to maintain a high-quality, low-solids drilling fluid. The pilot hole should also be drilled by the reverse circulation method.

Well depth – 315 feet. Completing the well deeper is not expected increase the well yield significantly because the deeper formation materials are less permeable than the sands in the upper portion of the aquifer.

Casing diameter – 16 5/8 inches outside diameter x 5/16 inch wall thickness.. The optimum casing diameter for wells yielding 800 to 1,800 gpm is 16 inches (Driscoll, 1986). 16 inch diameter well casing easily accommodates a 1,800 gpm pump without being excessively large for a pump capable of 1,500 gpm.

Borehole diameter – 26 inches. A minimum diameter of 24 inches is necessary to maintain the proper annular space surrounding the 16-inch diameter well casing plus a 3-inch diameter gravel-fill pipe and 2-inch diameter external sounding

tube. Larger diameters require more materials (filter pack and cement grout for seals) and reduce the efficacy of well development.

Filter pack – Colorado Silica Sand 6 x 9 mesh size. This size and gradation represents readily-available materials that will retain the finest size of the permeable formation materials penetrated by the monitoring well borehole (see sieve analyses plots in the appendix).

Screen aperture-width – 0.090 inches. The slot size will retain at least 90% of the filter pack.

Screen type – shaped wire continuous slot well screen, Type 316 stainless steel.

Continuous slot well screen provides the highest percentage of open area per lineal foot screen. Type 316 stainless steel will extend the life of the well screen and enable chemical treatment of the screen to maintain optimum well efficiency, if required. Type 316 stainless steel has the advantage over Type 304 stainless steel because it is resistant to hydrochloric acid-based chemical treatments which may cause stress fracturing of Type 304 steel.

Screened interval – approximately 100 linear feet placed below a depth of 135 feet.

Sanitary seal - land surface to a depth of 100 feet. A minimum seal depth of 100 feet b.l.s. is required for public water supply wells. Because the formation materials are relatively uniform, a sanitary seal deeper than 100 feet b.l.s. (say 130 feet) does not offer significantly more protection against contamination originating at the land surface.

DRAFT

SOURCES OF INFORMATION

Driscoll, F.G., Ph.D., 1986. Groundwater and Wells: Johnson Filtration Systems.

Hydro Geo Chem, 1988. Well Hydraulics Interpretation Package, ver. 3.22: computer program for the analysis of pumping test data.

DRAFT

APPENDIX

DRILLER'S REPORT (WELL LOG)

WELL CONSTRUCTION SUMMARY

GEOLOGIC LOG

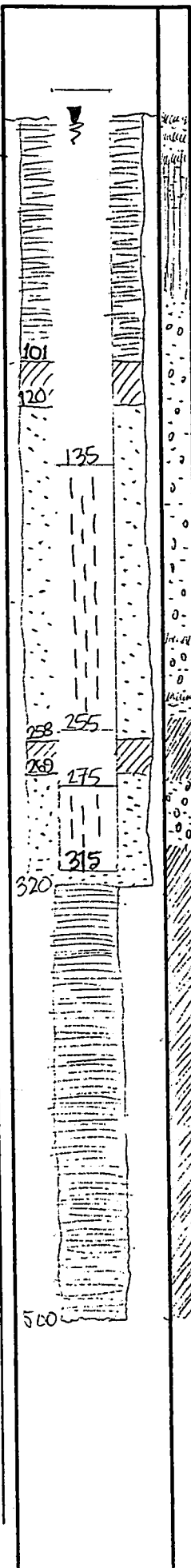
BOREHOLE GEOPHYSICAL LOGS

PUMPING TEST DATA

LABORATORY REPORTS

LOCATION 3031 Longley Lane Reno
PERSONNEL Peter Sinclair, Bryan Kearney

PROJECT Longley WWTP Monitoring Well
WCLUD 03-003 3.2.1



CONSTRUCTION SUMMARY FOR WELL LL WWTP-MW

LOCATION OR COORDS.: E 1/2

ELEVATION: GROUND LEVEL 0

SE 1/4 Sec 20 T19N R20E

TOP OF CASING 2.97'

DRILLING SUMMARY:

TOTAL DEPTH 500-feet

BOREHOLE DIAMETER 10 5/8-inch

DRILLER WDC Exploration

RIG STAR 30K

BIT(S) 8 1/2" pilot, 10 5/8" (reamed)
tri-cone

DRILLING FLUID bentonite

SURFACE CASING 2.97'-2.03' bgs.

WELL DESIGN:

BASIS: GEOLOGIC LOG X

BASIS: GEOPHYSICAL LOG X

CASING STRING(S) C=CASING S=SCREEN

+2 -135 C1

135 -255 S1

255 -275 C1

275 -315 S1

CASING: C1 6" sch 40 blank pipe

C2

C3

C4

S1 6" sch 40 mill slot pipe

S2

S3

S4

CENTRALIZERS 155, 235, and
295 feet

FILTER MATERIAL Three super
sacks, 6x9 spheres.

CEMENT 40 sacks - bottom
35 sacks - sanitary seal

OTHER 8 sacks bent. gel &
8 sacks Monterey sand - sealant

CONSTRUCTION TIME LOG:

TASK	START DATE TIME	END DATE TIME
DRILLING:		
<u>8 1/2" pilot</u>	<u>7/15/04 10:12</u>	<u>7/17/04 10:38</u>
<u>10 5/8" borehole</u>	<u>7/20/04</u>	<u>7/20/04 12:40</u>
GEOPHYS. LOGGING:		
	<u>7/17/04 12:34</u>	<u>7/17/04 13:39</u>
CASING:		
<u>6 5/8" steel</u>	<u>7/21 10:20</u>	<u>7/21 13:10</u>
FILTER PLACEMENT:		
	<u>7/21 14:30</u>	<u>7/22 07:10</u>
CEMENTING	<u>7/22 07:20</u>	<u>7/22 13:00</u>
DEVELOPMENT	<u>7/29 12:23</u>	<u>8/2 18:11</u>
OTHER:		
<u>Int. seal</u>	<u>7/21 15:30</u>	<u>7/21 15:52</u>

WELL DEVELOPMENT:

1. Airlifted w/ 2" tremmie for
7.5 hours H1.
2. Pumped w/ test pump from
144' for 14 hours H1.

COMMENTS:

1. w.l. 1.38' bgs 8/2/04 6:58



0-5

5-10

10-15

15-20

20-25

25-30

30-35

35-40

40-45

45-50

50-55

55-60

60-65

65-70

70-75

75-80

80-85

85-90

90-95

95-100

100-105

105-110

110-115

115-120

120-125

125-130

130-135

135-140

140-145

145-150

150-155

155-160

160-165

165-170

170-175

175-180

180-185

185-190

190-195

195-200

200-205

205-210

210-215

215-220

220-225

225-230

230-235

235-240

240-245

245-250

250-255

255-260

260-265

265-270

270-275

275-280

280-285

285-290

290-295

295-300

300-305

305-310

310-315

315-320

320-325

325-330

330-335

335-340

340-345

345-350

350-355

355-360

360-365

365-370

370-375

375-380

380-385

385-390

390-395

395-400

400-405

405-410

410-415

415-420

420-425

425-430

430-435

435-440

440-445

445-450

450-455

455-460

460-465

465-470

470-475

475-480

480-485

485-490

490-495

495-500

LOG OF BOREHOLE

BOREHOLE Longley Lane Monitoring Well

PAGE 1 OF 7

LOC. OR COORDS. _____

N39°29.573', W119°45.712'

DRILLER WDC

GROUND ELEV. _____

TOTAL DEPTH 500 - feet

RIG STAR 30K

BOREHOLE DIAM. 8 1/2 - inch pilot
reamed to 10 5/8 (320 feet)

BIT(S) 12" 8 1/2" tri-cone

FLUID bentonite

START

FINISH

DATE 7/15/04

7/17/04

TIME 10:12

10:38

GEOPHYS. LOG ☒ YES ☐ NO

HOW LEFT _____

LOCATION 3031 Longley Lane, Reno
LOGGED BY B. Kearney

PROJECT Longley Lane WWTP
Monitoring Well

DEPTH	PEN. RATE	CIRC. RET. LOSS	AIR LIFT Q (GPM)	MATERIAL	SYM-BOL	DESCRIPTION AND COMMENTS
5	<1 ft/min					Fill gravel, asphalt, dirt to 3ft, 3-5 ft = clays/silts 90%, sands 10%.
10	11:20					dk. brown clay/silt, hard, slightly moist < 10% sand, trace gravel upper 2ft., lower (7-10') sand
15	13:02					dk. grey angular sand, fine-med., fairly well sorted
20	13:07					same, 10% silts
25						multicolor sand, coarsening, tr. gravel
30	13:11					sand 80% med., 20% coarse
35						clay/silt 50%, med/fine sand 40%, coarse 10%, trace gravel (clay lens?)
40	13:28					med/coarse sand, sub ang., trace clay
45						clay 50%, med/coarse sand 50%
50	13:40					red/brown clayey silt 80%, fine sand 20%, trace coarse sand/gravel
55						increasing fine sand, trace gravel
60	13:54					increasing clay to 90%, lt. brown
65						increasing sand to 30%
70	14:21					red/brown silts/clays 90%, sand 10% fine
75						brown silts/clays 40%, med. sand 40% fine sand 20%
						angular med. sand, qtz-pyrite 50%, dk blue chips 50%

LOG OF BOREHOLE

BOREHOLE Langley Lane Monitoring Well

PAGE 2 OF 7

LOC. OR COORDS. N 39° 29.573', W 119° 45.712'

DRILLER WDC

GROUND ELEV. _____

START 7/15/04 FINISH 7/17/04

TOTAL DEPTH 500-feet

TIME 10:12 10:38

BOREHOLE DIAM. 8 1/2" pilot
reamed to 10 5/8-inch (320')

RIG SIAR 30K

GEOPHYS. LOG ☒ YES ☐ NO

BIT(S) 8 1/2" tri-cone

HOW LEFT _____

FLUID benzoinite

DEPTH	PEN. RATE	CIRC. RET. LOSS	AIR LIFT Q (GPM)	MATERIAL	SYM-BOL	DESCRIPTION AND COMMENTS
80	14:34				..	sand 40%, dk. blue chips 60% (volcs.?)
85					oo	fine gravel, chips
90	15:25				..	multicolor sand 40%, dk. blue chips 60%
95					oo	fine gravel, multicolor, chips dk. blue
100	15:37				oo	dk blue chips, gravel, some multicolor
105					oo	fine sand, some dk. blue chips
110	16:24				..	fine sand 70%, coarse sand 30%
115					oo	coarse sand 50%, fine gravel angular, 50%
120	16:41				oo	dk. blue, some fine sand
125					oo	same
130	17:11				oo	coarse sand 40%, fine/med angular gravel 60%
135					oo	coarse sand 20%, fine gravel 80%
140	17:27				oo	increasing sand to 60%, fine gravel 40%
145	7:48	7/16/04			oo	coarse sand 80%, fine gravel 20%
150	8:05				oo	fine/med sand 95%, gravel 5%
					oo	same, increasing gravel
					oo	coarse sand 90%, silt/clay 10% trace gravel
					oo	same

LOCATION 3031 Langley Lane, Reno
LOGGED BY B. Kearney

PROJECT Langley Lane NWTP
Monitoring Well

LOG OF BOREHOLE

BOREHOLE Longley Lane Monitoring Well

PAGE 3 OF 7

LOC. OR COORDS: N 39° 29.573' W 119° 45.712'

DRILLER WDC

GROUND ELEV. _____

START 7/15/04 FINISH 7/17/04

TOTAL DEPTH 500 - feet

TIME 10:12 10:38

BOREHOLE DIAM. 8 1/2 - inch pilot
reamed 10 5/8 - inch (320')

RIG STAR 30K

GEOPHYS. LOG ☒ YES ☐ NO

BIT(S) 8 1/2 tri-cone

HOW LEFT _____

FLUID bentonite

DEPTH	PEN. RATE	CIRC. RET. LOSS	AIR LIFT Q (GPM)	MATERIAL	SYM-BOL	DESCRIPTION AND COMMENTS
155						coarse sand 40%, med. sand 60%, trace fines, trace gravel, multicolored
160	8:17					increasing gravel to 30%
165						coarse sand 90%, gravel 10% chips
170	8:36					fairly well sorted coarse sand, ~100%, tr. gravel
175						increasing fine gravels to 30%
180	8:50					gravel 40%, coarse sand 60%
185						coarse sand chips 90%, fine gravel 10%, dk. blue
190	9:04					dk. blue fine gravel chips 50%, coarse sand 50%
195						same
200	9:13 12:57					dk grey clay 20%, coarse sand 50%, gravel 30%
205						fine gravels & gravel size chips ~100% some sand chips mostly dk blue
210	13:08					increasing sand & sand size chips
215						grey clay 10%, coarse sand 50%, gravel & gravel size chips 40%
220	13:18 13:27					clay to 20%, coarse sand 40%, fine gravel 40%
225						decreasing fines, sand chips 80%, fine gravel 20%

LOCATION 2031 Longley Lane, Reno
LOGGED BY B. Kearney

PROJECT Longley Lane WWTP
Monitoring Well

LOG OF BOREHOLE

BOREHOLE Longley Lane Monitoring Well

PAGE 4 OF 7

LOC. OR COORDS. N 39° 29.573, W 119° 45.712'

DRILLER WDC

GROUND ELEV. _____

START 7/15/04 FINISH 7/17/04
DATE 10:12 TIME 10:38

TOTAL DEPTH 500 - feet

RIG STAR 304

BOREHOLE DIAM. 8 1/2 - inch pilot, reamed 10 5/8 - inch (320')

BIT(S) 8 1/2" tricone

GEOPHYS. LOG ☒ YES ☐ NO
HOW LEFT _____

FLUID bentonite

DEPTH	PEN. RATE	CIRC. RET. LOSS	AIR LIFT Q (GPM)	MATERIAL	SYM-BOL	DESCRIPTION AND COMMENTS
230	13:44					grey fines 30%, coarse sand 30%, fine gravel 40%
235						clay 50%, sand 20%, fine gravel 30%
240	13:55 14:01					decreasing fines, decreasing gravel, increasing sand
245						fines 50%, coarse sand 40%, fine gravel 10%
250	14:19					fines 50%, coarse sand 20%, fine gravel 30%
255						decreasing fines, increasing coarse sand
260	14:31 14:36					coarse sand > fines.
265						grey fines 30%, sand 40%, gravel 30%
270	14:40					increasing fines
275						clay to 80%
280	14:55					same
285						decreasing fines, sand 80%, gravel 20%
290						same
295						fines 10%, sand 90%, trace gravel
300	15:15					same w/ increasing gravel

LOCATION 3031 Longley Lane, Reno
LOGGED BY B. Kearney

PROJECT Longley Lane WWT
Monitoring Well

LOG OF BOREHOLE

BOREHOLE Longley Lane Monitoring Well

PAGE 5 OF 7

LOC. OR COORDS. N 39° 29.573', W 119° 45.712'
 GROUND ELEV. _____
 TOTAL DEPTH 600-feet
 BOREHOLE DIAM. 8 1/2-inch pilot
reamed 10 5/8-inch (320')

DRILLER WDC

RIG STAR 30K

BIT(S) 8 1/2" tricone

FLUID bentonite

START 7/15/04 FINISH 7/17/04
 DATE 10:12 TIME 10:38
 GEOPHYS. LOG ☒ YES ☐ NO
 HOW LEFT _____

DEPTH	PEN. RATE	CIRC. RET. LOSS	AIR LIFT Q(GPM)	MATERIAL	SYM-BOL	DESCRIPTION AND COMMENTS
305	15:22					finer 10%, sand 80%, fine gravel 10%
310						finer 10%, sand 20%, fine gravel 70%
315						decreasing gravel
320	15:54					finer 40%, sand 20%, gravel 40%
325	16:00					finer 60%, sand 20%, gravel 20%
330						same
335						increasing fines
340	16:22					finer 40%, coarse sand 30%, fine gravel 10%
345	16:29					increasing gravel to 30%
350						increasing clay, increasing gravel
355						clay 30%, sand 50%, fine gravel 20%
360	16:40					increasing clay, decreasing gravel
365						clay 60%, sand 30%, gravel 10%
370						increasing sand
375						

LOCATION 3031 Longley Lane, Reno
 LOGGED BY B. Kearney

PROJECT Longley Lane WWTP
Monitoring Well

LOG OF BOREHOLE

BOREHOLE Longley Lane Monitoring Well

PAGE 6 OF 7

LOC. OR COORDS. <u>N 39° 29.573' W 119° 45.712'</u>	DRILLER <u>WDC</u>	START DATE <u>7/15/04</u>	FINISH DATE <u>7/17/04</u>
GROUND ELEV. _____		TIME <u>10:12</u>	TIME <u>10:38</u>
TOTAL DEPTH <u>500-feet</u>	RIG <u>STAR 30K</u>	GEOPHYS. LOG <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	
BOREHOLE DIAM. <u>8 1/2-inch pilot</u>	BIT(S) <u>9 1/2 tricone</u>	HOW LEFT _____	
<u>reamed 10 5/8-inch (320')</u>	FLUID <u>bentonite</u>		

DEPTH	PEN. RATE	CIRC. RET. LOSS	AIR LIFT Q (GPM)	MATERIAL	SYM-BOL	DESCRIPTION AND COMMENTS
380			17:10 17:20			clay 50%, sand 40%, gravel 10%
385						same
390						clay 80%, sand 10%, gravel 10%
395						same
400			17:47 17:56			clay 50%, sand 10%, trace gravel
405						same
410						increasing sand, clay >> sand
415						sand 40%, clay 50%, gravel 10%
420			18:18 18:21			decreasing sand
425						clay 80%, sand 20%, trace gravel
430						clay 60%, gravel 30%, sand 10%
435						decreasing gravel, increasing sand
440			18:42			clay 80%, sand 20%, trace gravel
445						gravel 80%, clay 20% probably gravel falling into borehole
450						clay 60%, gravel 40%

LOCATION 3031 Longley Lane, Reno
LOGGED BY B. Kearney

PROJECT Longley Lane WWSP
Monitoring Well

LOG OF BOREHOLE

BOREHOLE Longley Lane Monitoring Well

PAGE 7 OF 7

LOC. OR COORDS. N 39° 29.573' W 119° 45.712'

DRILLER WDC

GROUND ELEV. _____

TOTAL DEPTH 500-feet

RIG STAR 30K

BOREHOLE DIAM. 8 1/2-inch pilot
reamed 10 5/8-inch (to 320')

BIT(S) 8 1/2" tricone

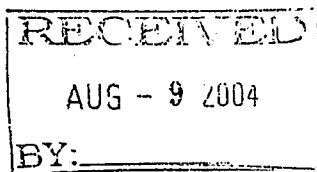
FLUID bentonite

START 7/15/04 FINISH 7/17/04
DATE 7/15/04 TIME 10:12 10:38
GEOPHYS. LOG X YES NO
HOW LEFT _____

DEPTH	PEN. RATE	CIRC. RET. LOSS	AIR LIFT Q (GPM)	MATERIAL	SYM-BOL	DESCRIPTION AND COMMENTS
455					///	increasing sand
460					///	clay 60%, sand 20%, gravel 20%
465	21 ft/min				///	increasing clay, still some gravel (likely falling into borehole)
470					///	same, clay stiffer
475					///	
480	10:14 10:23				///	
485					///	increasing sand
490					///	increasing sand to 50%, clay / sand lenses?
495					///	dark clay, stiff
500	10:28				///	clay > sand
borehole completed to 500'						

LOCATION 3031 Longley Lane, Reno
LOGGED BY B. Kearney

PROJECT Longley Lane WWTP
Monitoring Well



Sierra
Environmental
Monitoring, Inc.

Laboratory Analysis Report Report ID: 62492

Eco Logic Consulting Engineers
Attn: Dale Bugenig
10381 Double R Blvd.
Reno, NV 89521

Date: 8/9/2004
Client: ECO-500
Taken by: B. Kearney
PO #: 5500001827

Sample ID: S200408-0303 Customer Sample ID: WCUD03-003.3.2.1-1 Date Sampled: 8/4/2004 Time Sampled: 8:30 AM Date Received: 8/5/2004

Parameter	Method	Result	Units Of Measure	MCL	Analyst	Date Analyzed
Arsenic - ICP-MS	EPA 200.8	0.032	mg/L	0.01 mg/L	Tretten	8/9/2004
Iron - ICP-OES	EPA 200.7	0.11	mg/L	0.3 mg/L	Li	8/9/2004
Manganese - ICP-MS	EPA 200.8	0.083	mg/L	0.05 mg/L	Tretten	8/9/2004

SAMPLE WATER AS TESTED DID ☒ DID NOT MEET DRINKING WATER STANDARDS.

Sample ID: S200408-0304 Customer Sample ID: WCUD03-003.3.2.1-2 Date Sampled: 8/4/2004 Time Sampled: 10:30 AM Date Received: 8/5/2004

Parameter	Method	Result	Units Of Measure	MCL	Analyst	Date Analyzed
Arsenic - ICP-MS	EPA 200.8	0.033	mg/L	0.01 mg/L	Tretten	8/9/2004
Iron - ICP-OES	EPA 200.7	0.07	mg/L	0.3 mg/L	Li	8/9/2004
Manganese - ICP-MS	EPA 200.8	0.069	mg/L	0.05 mg/L	Tretten	8/9/2004

SAMPLE WATER AS TESTED DID ☒ DID NOT MEET DRINKING WATER STANDARDS.

Sample ID: S200408-0305 Customer Sample ID: WCUD03-003.3.2.1-3 Date Sampled: 8/4/2004 Time Sampled: 3:30 PM Date Received: 8/5/2004

Parameter	Method	Result	Units Of Measure	MCL	Analyst	Date Analyzed
Arsenic - ICP-MS	EPA 200.8	0.032	mg/L	0.01 mg/L	Tretten	8/9/2004
Iron - ICP-OES	EPA 200.7	0.06	mg/L	0.3 mg/L	Li	8/9/2004
Manganese - ICP-MS	EPA 200.8	0.061	mg/L	0.05 mg/L	Tretten	8/9/2004

SAMPLE WATER AS TESTED DID ☒ DID NOT MEET DRINKING WATER STANDARDS.



Sierra
Environmental
Monitoring, Inc.

**Laboratory
Analysis Report
Report ID: 62492**

Eco Logic Consulting Engineers
Attn: Dale Bugenig
10381 Double R Blvd.
Reno, NV 89521

Date: 8/9/2004
Client: ECO-500
Taken by: B. Kearney
PO #: 5500001827

Sample ID:	Customer Sample ID	Date Sampled	Time Sampled	Date Received		
S200408-0306	WCUD03-003.3.2.1-4	8/5/2004	6:00 AM	8/5/2004		
Parameter	Method	Result	Units Of Measure	MCL	Analyst	Date Analyzed
Arsenic - ICP-MS	EPA 200.8	0.032	mg/L	0.01 mg/L	Tretten	8/9/2004
Iron - ICP-OES	EPA 200.7	<0.05	mg/L	0.3 mg/L	Li	8/9/2004
Manganese - ICP-MS	EPA 200.8	0.056	mg/L	0.05 mg/L	Tretten	8/9/2004

SAMPLE WATER AS TESTED DID X DID NOT MEET DRINKING WATER STANDARDS.

Approved By: _____

Sierra Environmental Monitoring, Inc

Date: 8/9/2004

This report is applicable only to the sample received by the laboratory. The liability of the laboratory is limited to the amount paid for this report. This report is for the exclusive use of the client to whom it is addressed and upon the condition that the client assumes all liability for the further distribution of the report or its contents.

AQUIFER TEST DATA

City Washoe County Address 2031 Langley Lane, Reno County Washoe State NV

Date 8/2/04 Company performing test ECO-LOGIC Measured by B. Kearney

Well No. Langley Ln. MW Distance from pumping well 0 Type of test Step - 100 gal/min Test No. 1

Measuring equipment Mini-tri data logger w/ 32 pins TDX / Meterometer 4" meter

Time Data		Water Level Data		Discharge Data		Comments on factors affecting test data
Pump on: Date <u>8/3</u> Time <u>7:20</u> (H)		Static water level <u>5.90 ft</u>		How Q measured <u>Meter</u>		
Pump off: Date <u>8/3</u> Time <u>11:22</u> (H)		Measuring point <u>Top of 54" well</u>		Depth of pump/air line <u>144"</u>		
Duration of aquifer test: Pumping _____ Recovery _____		Elevation of measuring point <u>4.5' + 3.33'</u>		Previous pumping? Yes <u>X</u> No _____		
				Duration <u>12 hrs</u>	End <u>9/2</u>	

Date	Clock time	Time since pump started min	Time since pump stopped min	Water level measurement (ft)	Correction or Conversion	Water level change s or s'	EQ gallons x100 Discharge measurement	Q gpm	Q _{avg}	
8/3	7:20	0		5.90		—	25888	0		
	7:21	1.04		10.75		4.85		100		
	7:23	3.13		10.98		5.08				
	7:26	5.27		11.00		5.10				
	7:27	7.03		11.30		5.40				
	7:31	10.54		11.33		5.43				
	7:34	13.27		11.47		5.57				
	7:37	16.72		11.38		5.48				
	7:40	19.89		11.62		5.72				
	7:45	25.05		11.26		5.36				
	7:50	29.78		11.24		5.34				
	7:56	35.41		11.16		5.26				
	8:00	39.73		11.30		5.40				
	8:05	44.59		11.15		5.25				8:06 - surged to clear meter
	8:11	50.05		11.95		6.05				
	8:20	59.49		12.09		6.19				pH = 7.6, 15.9°C, 296m

AQUIFER TEST DATA

o Washoe County Address 2031 Longley Lane Reno County Washoe State NV

Date 8/2/01 Company performing test ECOL OGIC Measured by B. Kearney

Well No. Longley Lake MW Distance from pumping well 0 Type of test step - 200 gal/min Test No. 1

Measuring equipment Mini-trail data logger w/30 psi TDX / McCrometer 4" meter

Time Data		Water Level Data		Discharge Data		Comments on factors affecting test data
Pump on: Date <u>8/3</u> Time <u>7:20</u> (t.)		Static water level <u>5.90 ft</u>		How Q measured <u>meter</u>		
Pump off: Date _____ Time _____ (r.)		Measuring point <u>top of steel well</u>		Depth of pump/air line <u>144'</u>		
Duration of aquifer test: Pumping _____ Recovery _____		Elevation of measuring point <u>1.5 + 3.33'</u>		Previous pumping? Yes <u>x</u> No _____		
				Duration <u>10 hrs</u> End <u>8/2</u>		

Date	Clock time	Time since pump started (t)	Time since pump stopped (r)	t/r	(feet)	Water level measurement	Correction or Conversion	Water level	dd Water level change s or s'	ΣQ gallons $\times 100$ Discharge measurement	Q gpm Rate	\bar{Q}_{avg}	
8/3	8:20	0				12.48			6.58		200		
	8:21	1.04				16.39			10.49				
	8:23	2.95				16.42			10.52				
	8:25	4.97				16.66			10.76				
	8:27	7.03				16.72			10.82				
	8:30	9.95				16.84			10.94				8:26 - 16.6' w.l. w/ sonar
	8:34	13.28				16.93			11.03				
	8:36	15.79				16.96			11.06				pH: 7.80, 283 μ , 15.2°C
	8:40	19.89				17.14			11.24	25981			
	8:45	25.05				17.24			11.34				
	8:50	29.79				17.20			11.3				8:50 - 17.71, 297 μ , 15.0°C
	8:56	35.41				17.35			11.45				9:00 - 2602800 gal
	9:00	39.74				17.25			11.35				9:10 - 2602900 gal
	9:05	44.59				17.37			11.47				
	9:10	49.05				17.38			11.48			210	9:15 - 17.73, 305 μ , 15.0°C
	9:15	53.49				17.37			11.47				

AQUIFER TEST DATA

On Washoe County Address 3031 Longley Lane, Reno County Washoe State NV

Date 8/3/04 Company performing test ECO-LOGIC Measured by B. Kearney

Well No. Longley Ln. MW Distance from pumping well 0 Type of test SLCP - 300 gal/min Test No. 1

Measuring equipment Mini-troll data logger w/ 30 psi TDX / Meterometer 4" meter

Time Data				Water Level Data				Discharge Data				Comments on factors affecting test data
Pump on: Date	<u>8/3</u>	Time	<u>7:20</u> (t)	Static water level	<u>5.90 ft</u>			How Q measured	<u>meter</u>			
Pump off: Date	<u>8/3</u>	Time	<u>11:22</u> (r)	Measuring point	<u>top of casing</u>			Depth of pump/air line	<u>144"</u>			
Duration of aquifer test:				Elevation of measuring point	<u>15.1333</u>			Previous pumping? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>				
Pumping								Duration	<u>10 hrs</u>	End	<u>8/2</u>	

Date	Clock time	Time since pump started	Time since pump stopped	t/r	(feet)	Water level measurement	Correction or Conversion	Water level	dd	Water level change s or s'	ΣQ gallons $\times 100$ Discharge measurement	Q gpm	$\bar{Q}_{AV.}$	
8/3	7:21	0				17.43				11.53	26053	300		
	9:22	1.04				22.6				16.7				
	9:24	2.95				22.85				16.55				
	9:26	4.97				23.08				17.12				9:26 - pH: 7.73 306 μ , 14.7°C
	9:28	7.03				23.24				17.34				9:30 - 2603000 gal
	9:31	9.95				23.53				17.68				
	9:34	12.8				23.55				17.65				
	9:36	15.79				23.74				17.84				9:40 - 2611000 gal
	9:41	19.89				23.66				17.76			300	9:42 - pH: 7.72 308 μ , 14.7°C
	9:46	25.05				23.94				18.04				
	9:50	29.79				23.96				18.06				
	9:56	35.41				24.04				18.14				
	10:00	39.73				24.2				18.21				10:05 - pH: 7.69 311 μ , 14.7°C
	10:05	44.69				24.09				18.19				10:08 - 24.15' w.l. w/ sounder
	10:11	50.05				24.19				18.25			305	10:10 - 2620200 gal
	10:20	59.49				24.02				18.12				

AQUIFER TEST DATA

of Washoe County Address 3551 Langley Lane, Reno County Washoe State NV

Date 8/3/84 Company performing test FCO-LOGIC Measured by B. Kearney

Well No. Langley Lane MW Distance from pumping well x Type of test step - 400 gal/min. Test No. 4

Measuring equipment Mini-tron data logger w/ 30psi TDX / McCombs 4" meter

Time Data Pump on: Date <u>8/3</u> Time <u>7:20</u> (L) Pump off: Date <u>8/3</u> Time <u>11:22</u> (R) Duration of aquifer test: _____ Pumping _____ Recovery _____		Water Level Data Static water level <u>5.90 feet</u> Measuring point <u>top of well</u> Elevation of measuring point <u>5333</u>		Discharge Data How Q measured <u>meter</u> Depth of pump/air line <u>144'</u> Previous pumping? Yes <u>x</u> No _____ Duration <u>10 hrs</u> End <u>8/2</u>		Comments on factors affecting test data
-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--	--------------------------------------------------------------------------------------------------------------------------------------------------	--	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--	-----------------------------------------

Date	Clock time	Time since pump started t	Time since pump stopped r	t/r	Time since pump started + 180 min	(feet) Water level measurement	Correction or Conversion	Water level	dd Water level change s or s'	Σ Q gallons 400 Discharge measurement	Q gpm Rate	Q av	
8/3	10:21	0			30	24.19			18.29	26238	400		
	10:22	1.04			30	30.15			24.25				
	10:24	2.95				30.48			24.58				
	10:26	4.97				30.59			24.69				
	10:28	7.03				30.62			24.72				10:30 - pit: 7.69, 313u, 14.7°C
	10:31	9.95				30.86			24.96				
	10:34	13.26				30.85			24.95				
	10:37	15.79				31.01			25.11				
	10:41	19.89				31.07			25.17				
	10:46	25.05				31.22			25.32				
	10:51	29.79				31.31			25.41				10:47 - pit: 7.69, 314u, 14.7°C
	10:56	35.41				31.33			25.43				10:50 - 31.32 u. l. sand.
	11:01	39.74				31.43			25.53			400	11:00 - 2639400 gal
	11:05	44.60				31.45			25.55				11:02 - pit: 7.67, 314u, 14.6°C
	11:11	50.04				31.53			25.63				
	11:17	56.16				31.62			25.72				
	11:20	59.49				31.67			25.77	26483			

AQUIFER TEST DATA

City Washoe County Address 3031 Longley Lane Reno County Washoe State NV

Date 8/3/04 Company performing test ECO-LOGIC Measured by B. Kearney

Well No. Longley Lake MW Distance from pumping well 0 Type of test step recovery Test No. 1

Measuring equipment Ministrol data logger

Time Data		Water Level Data		Discharge Data		Comments on factors affecting test data
Pump on: Date <u>8/3</u>	Time <u>7:20</u> (r)	Static water level <u>5.90 Feet</u>		How Q measured <u>meter</u>		
Pump off: Date <u>8/3</u>	Time <u>11:22</u> (r)	Measuring point <u>top of casing</u>		Depth of pump/air line <u>140'</u>		
Duration of aquifer test:		Elevation of measuring point <u>15.133'</u>		Previous pumping? Yes <u>X</u> No <u></u>		
Pumping	Recovery			Duration <u>10 hrs</u> End <u>6/2</u>		

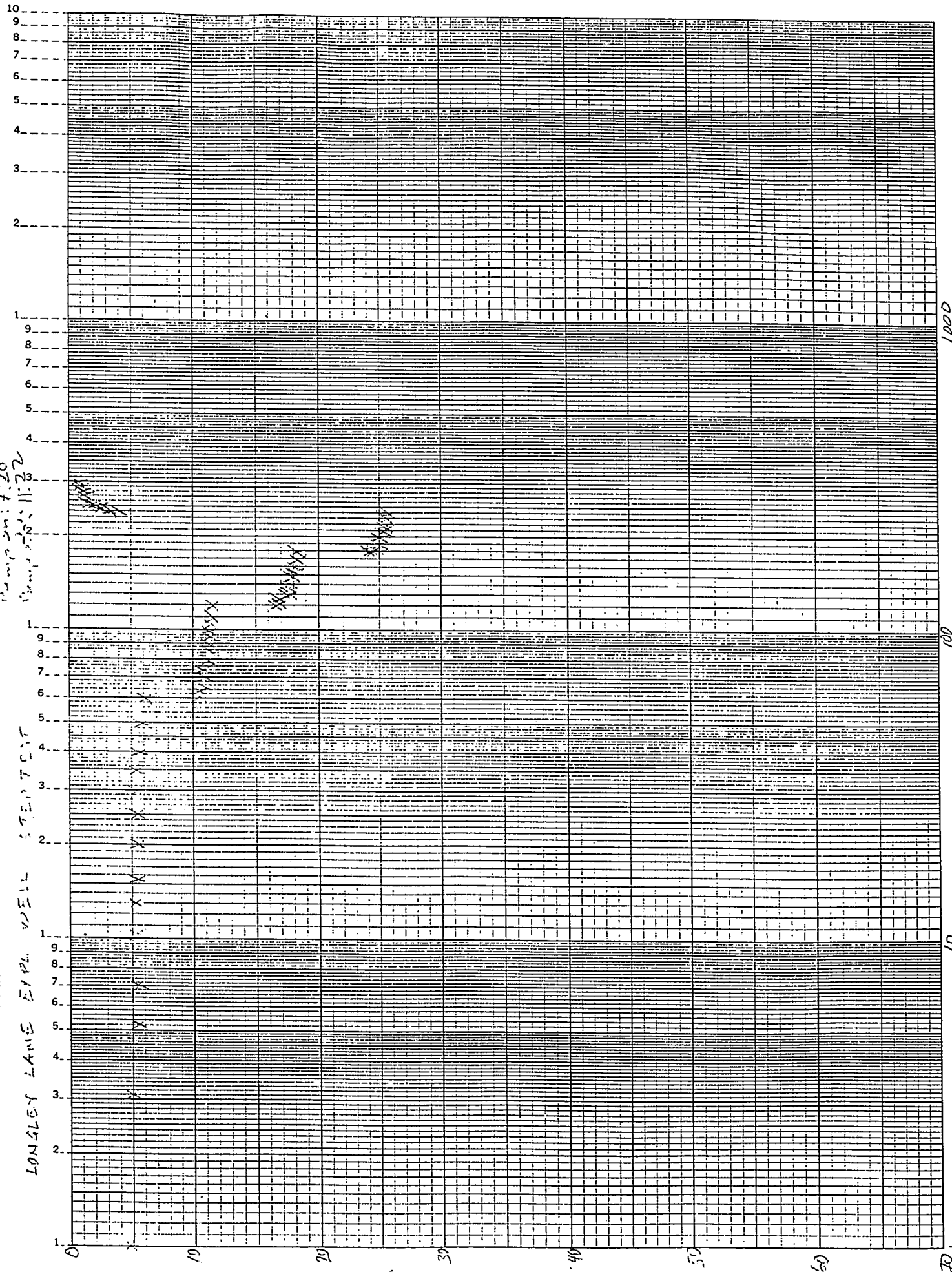
Date	Clock time	Time since pump started	Time since pump stopped	Time since pump started	Water level measurement	Correction or Conversion	Water level	dd rec. Water level change s or s'	ΣQ gpm x 100 Discharge measurement	Q gpm Rate	Q _{av}	
8/3	11:22	0			240		31.61		26483	0	0	
	11:23	1.04					10.09					
	11:25	3.13					9.22					
	11:26	4.97					8.83					
	11:29	7.03					8.52					
	11:31	9.55					8.22					
	11:35	13.28					7.96					
	11:37	15.79					7.80					
	11:41	19.89					7.61					11:47-7.41' w.l. sounded
	11:47	25.05					7.44					
	11:51	29.79					7.28					
	11:57	35.41					7.15					
	12:01	39.74					7.06					
	12:06	44.60					6.98					
	12:12	50.05					6.90					
	12:21	59.49					6.78					

KEE SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 6010

LONGLEY LANE EPILEPSY TEST

8/3/52
Run on 7:20
Run on 11:22



1000

100

10

TIME IN MINUTES STARTED AT (MINUTES)

WCU03-003.3.2.1

Page 1 of 3

AQUIFER TEST DATA

Owner Washoe County Address 3031 Longley Lane, Reno County Washoe State NVDate 3/4/04 Company performing test ECO LOGIC Measured by B. Kearney, P. SinclairWell No. Longley Lane MW Distance from pumping well 0 Type of test constant Q - 400 cfm/min Test No. 2Measuring equipment Mini-toll data logger - 132 m 1/2" 1/4" (connector 4" meter)

Time Data		Water Level Data		Discharge Data		Comments on factors affecting test data
Pump on: Date <u>8/4</u>	Time <u>7:30</u> (L)	Static water level <u>2.30</u>	How Q measured <u>meter</u>	Depth of pump/air line <u>100'</u>	Previous pumping? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	
Pump off: Date <u>8/5</u>	Time <u>7:30</u> (R)	Measuring point <u>top of casing</u>	Duration <u>10 hrs</u>	End <u>8/2</u>		
Duration of aquifer test: Pumping <u>24 hrs</u> Recovery <u>24 hrs</u>		Elevation of measuring point <u>12,023'</u>				

Date	Clock time	Time since pump started t	Time since pump stopped r	t/r	Water level measurement	Correction or Conversion	Water level	Water level change (3 or 5')	ΣQ gals $\times 100$ Discharge measurement	Rate	Day	Comments on factors affecting test data
8/4	7:00	0			5.80			—	26493	400		
	7:12	1.04			26.86		21.06					
	7:24	2.08			24.61		22.01					
	7:36	3.12			24.01		22.30					
	7:48	4.16			23.54		22.76					
	8:00	5.20			23.02		23.02					
	8:12	6.24			22.45		23.65					
	8:24	7.28			22.57		23.70					
	8:36	8.32			22.02		23.89					
	8:48	9.36			22.03		24.23					8:52 - pH: 7.73, 31.1, 25.7
	9:00	10.40			22.74		24.44					
	9:12	11.44			22.40		24.64					
	9:24	12.48			20.53		24.77					
	9:36	13.52			20.89		25.09					
	9:48	14.56			20.92		25.12					
	10:00	15.60			21.17		25.37					
	10:12	16.64			21.17		25.37					
	10:24	17.68			21.19		25.39					2nd AS sample collected 10:32 am
	10:36	18.72			21.39		25.59					
	10:48	19.76			21.40		25.60					
	11:00	20.80			21.57		25.77					
	11:12	21.84			21.84		26.04					
	11:24	22.88			21.81		26.01					
	11:36	23.92			21.98		26.18					
	11:48	24.96			22.07		26.27					
	12:00	26.00			22.16		26.36					
	12:12	27.04			22.15		26.35					
	12:24	28.08			22.20		26.40					

AQUIFER TEST DATA

Owner Washoe County Address 431 Longley Lane County Washoe State NVDate 8/4-8/5/04 Company performing test LOW LOGIC Measured by P. Sinclair, B. KearneyWell No. Longley Land MW Distance from pumping well Type of test constant Q - 400 gal/min Test No. 2Measuring equipment Mini-logger, 2320-3081, 1/4" ID, 1/2" OD, 1/2" L

Time Data					Water Level Data					Discharge Data			Comments on factors affecting test data
Pump on: Date	Time	(L)	Pump off: Date	Time	(R)	Static water level	Measuring point	Elevation of measuring point	How Q measured	Depth of pump/air line	Previous pumping? Yes	No	
Pumping	24 hrs		Recovery	24 hrs					Duration	10 hrs	End	11:00	
Date	Clock time	Time since pump started t	Time since pump stopped r	1/r	Water level measurement	Correction or Conversion	Water level	Water level change (s or s')	ΣQ gal	Discharge measurement	Rate		
8/4	10:47	197.7			32.22			26.42					EC = 320 $\mu\text{Si}/\text{cm}^1$, T=15.3°C
	11:07	217.7			32.34			26.54					PH = 7.65, 1140 hrs.
	11:27	237.7			32.47			26.67	27527		409		1145 hrs
	11:47	257.7			32.45			26.65	27713		413		1230 hrs
	12:07	277.7			32.56			26.76					
	12:27	297.7			32.56			26.76					32.72 ft, 1319 hrs
	12:47	317.7			32.68			26.88					(sand - TOSW)
	13:07	337.7			32.63			26.83					EC = 321 $\mu\text{Si}/\text{cm}^1$, T=14.8°C
	13:37	367.7			32.64			26.84					PH = 7.64, 1500 hrs.
	14:07	397.7			32.77			26.97					
	14:37	427.7			32.78			26.98	28447		408		1530 hrs
	15:07	457.7			32.82			27.02					3rd, AS sample
	15:37	487.7			32.79			26.99					collected 1535 hrs
	15:07	517.7			32.90			27.10					
	16:37	547.7			32.98			27.18					
	17:07	577.7			32.85			27.05	2893750		409		1730 hrs
	18:07	637.7			32.91			27.11					EC = 322 $\mu\text{Si}/\text{cm}^1$, T=14.6
	18:27	657.7			33.10			27.30					PH = 7.65, 1830 hrs
	19:07	697.7			32.98			27.18					
	20:07	757.7			33.24			27.44					
	20:57	807.7			33.27			27.47					21:00 - PH: 7.65, 323 μ , 14.2°C
	21:07	817.7			33.34			27.54					
	22:07	877.7			33.47			27.67					
	22:37	907.7			33.30			27.50					
	23:07	937.7			33.55			27.75					23:00 - PH: 7.65, 323 μ , 14.2°C
	23:37	967.7			33.57			27.77	30408		408		23:30 - 3040800 gallons
8/5	0:07	997.7			33.65			27.85					
	1:07	1097.7			33.76			27.96					1:00 - PH: 7.65, 322 μ , 13.9°C

AQUIFER TEST DATA

on Washoe County Address 3031 Longley Lane County Washoe State NV

Date 8/4/04 - 8/5/04 Company performing test ECO-LOGIC Measured by B. Kearney

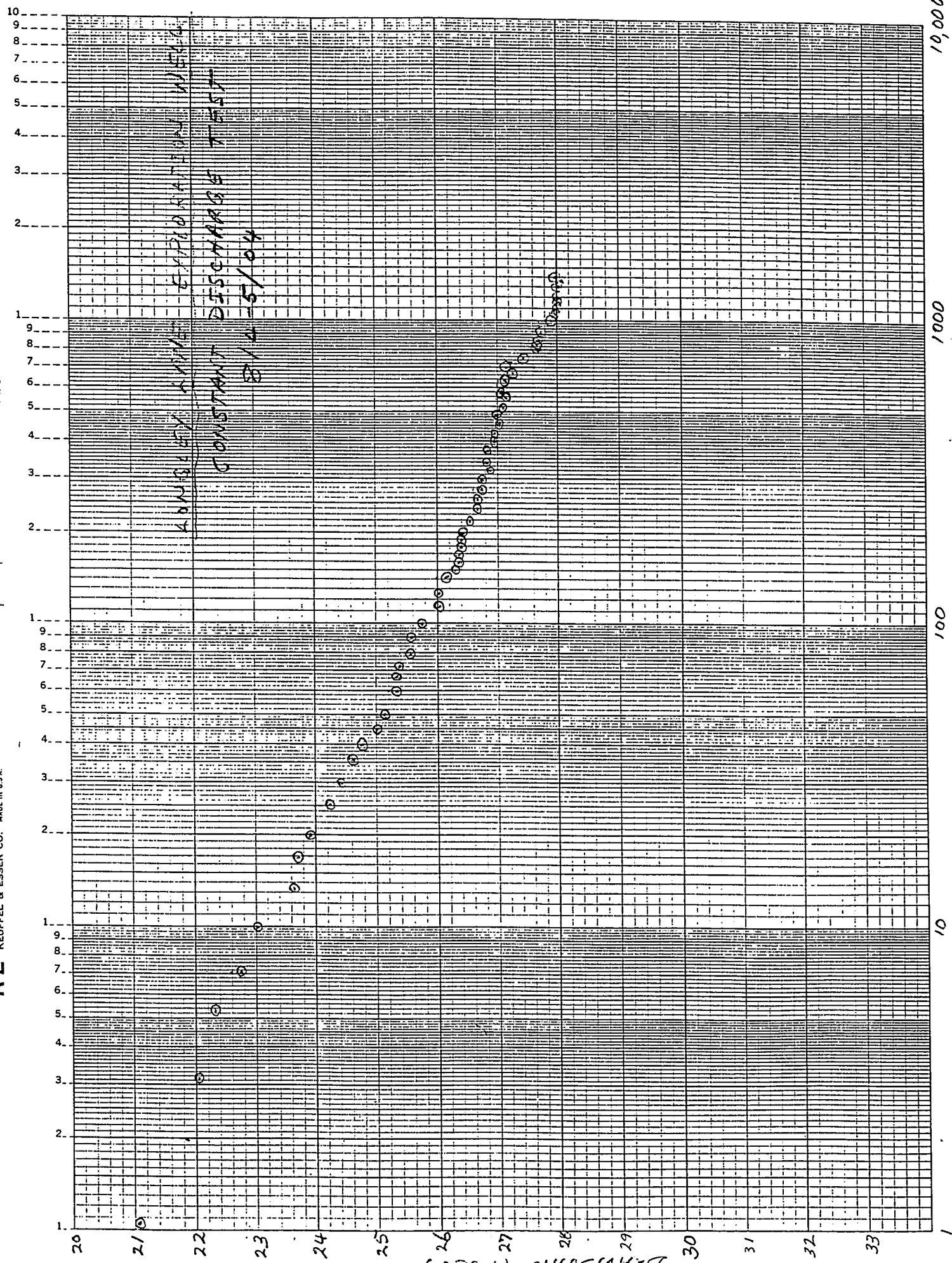
Well No. Longley Lake MW Distance from pumping well 0 Type of test constant Q - 400 gal/min Test No. 2

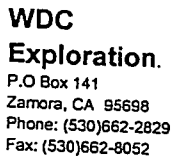
Measuring equipment Mini-trill data logger w/ 30 psi TDX / Mcrometer 4" meter

Time Data		Water Level Data		Discharge Data		Comments on factors affecting test data
Pump on: Date <u>8/4</u>	Time <u>7:30</u> (L)	Static water level <u>5.80'</u>		How Q measured <u>meter</u>		
Pump off: Date <u>8/5</u>	Time <u>7:30</u> (L)	Measuring point <u>top of still well</u>		Depth of pump/air line <u>194'</u>		
Duration of aquifer test: <u>24 hrs</u>	Recovery <u>24 hrs</u>	Elevation of measuring point <u>15.43.33</u>		Previous pumping? Yes <u>Y</u> No <u>N</u>		
				Duration <u>10 hrs</u> End <u>8/2</u>		

Date	Clock time	Time since pump started	Time since pump stopped	Water level measurement	Correction or Conversion	Water level	Water level change s or s'	$\sum Q$ galls x 100 Discharge measurement	Q gpm Rate	\bar{Q}_{AV}	
8/5	1:37	1087		33.75		27.95			400		
	2:07	1117		33.86		28.06					
	2:37	1147		33.84		28.04					
	3:07	1117		33.79		27.99					3:00 - pH: 7.64, 332 μ , 13.7°C
	3:37	1207		33.78		27.98		31388		408	w.l. - 33.84' sound.
	4:07	1237		33.75		27.95					3:30 - 31388 (10) galls + 1.
	4:37	1267		33.69		27.89					
	5:07	1297		33.88		28.08					5:00 - pH: 7.65, 321 μ , 13.5°C
	5:37	1327		33.73		27.93		31878		408	5:30 - 31878 (10) galls + 1.
	6:07	1357		33.94		28.14					
	6:37	1387		33.96		28.16					
	7:07	1417		33.99		28.19					
	7:27	1437		33.93		28.13					
	7:30							32368			7:30 - 32368 (10) galls + 1.
											at end of test
											begin recovery
											recovery ended 8/6/04, 8:15

[REDACTED] 7: [REDACTED] 8/11
 [REDACTED] 7:30 8/15
 dump off: 46 6010





WC4D03-003
T3.2

Date: 08/25/04

Client			Date: 08/25/04
Eco:Logic			Project Name
Billing Address			Longley Rd.
10381 Double R Blvd.			Project Location
City	State	Zip Code	Reno, NV
Reno	NV	89521	Client Project Manager
Attention	Project Number		Dale Bugenig
Accounts Payable			WDC Operations Manager
Contract Number	PO/Authorization Number		Jim Whitley

Accounts Payable		Jim Whitley	
Contract Number	PO/Authorization Number	Application	Terms
		1	Net 45
WDC Invoice Number	Amount Authorized	Invoice Period	
0804-ECO14B-110	\$48,240.00	7/15/04 to 8/15/04	

[illegible]