DRAFT

WATER AVAILABILITY ASSESSMENT FOR APACHE MESA SUBDIVISION, SOUTHERN SANDOVAL COUNTY, NEW MEXICO

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prepared for

Mark Goodwin & Associates
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WATER AVAILABILITY ASSESSMENT FOR APACHE MESA SUBDIVISION, SOUTHERN SANDOVAL COUNTY, NEW MEXICO

INTRODUCTION

At the request of Mark Goodwin and Associates Inc., John Shomaker & Associates, Inc. (JSAI) has performed a hydrogeologic investigation at the proposed Apache Mesa Subdivision. The proposed subdivision is located along Highway 165, in the southwest quarter of Township 13 North, Range 4 East, Section 35 (Figure 1). The Apache Mesa Subdivision is classified as a Type II subdivision according to the Sandoval County, New Mexico, Subdivision Ordinance. The Apache Mesa Subdivision will consist of 35 lots that are about 1 acre in size. Ground water will be used to provide all water for the Apache Mesa Subdivision. Individual domestic wells will be drilled under New Mexico Office of the State Engineer (NMOSE) 72-12-1 NMSA for each lot in the subdivision.

OBJECTIVES

The objective of the hydrogeologic investigation conducted between September and December 2003 was to assess the potential for completing domestic ground-water supply wells for the Apache Mesa Subdivision and whether or not the ground water available at the Apache Mesa Subdivision can sustain a 100-year supply in accordance with the hydrogeologic regulations included in the Sandoval County, New Mexico, Land Subdivision Regulations. This report follows the guidelines set forth in Section 8.6 and Appendix A of the Sandoval County, New Mexico, Land Subdivision Regulations, for a geohydrologic report for proposed subdivisions in which the source of water will be individual or shared domestic wells, permitted under NMOSE 72-12-1 NMSA.

GEOHYDROLOGY

The subdivision site is located along the eastern margin of the Albuquerque Basin. The Albuquerque Basin is a north-south trending basin related to the extensional rifting (pulling apart) along the Rio Grande Rift. Within the region surrounding the subdivision site, the primary basin fill rocks are the Quaternary- to Tertiary-age sediments of the Santa Fe Group. Figure 2 presents a geologic map of the Apache Mesa Subdivision and surrounding area, and Figure 3 presents a west-east geologic cross-section of the subdivision. The Santa Fe Group has been separated into three mapable units (Johnson, 2000) based on deposition characteristics. These units are presented below.

1) The Upper Santa Fe Group axial river deposits consist of relatively coarse-grained sands and gravels that are well sorted and weakly cemented. Thin mud layers are interbedded between the sands and gravels. This unit is a fluvial deposit consisting of stream channel and floodplain sediments of the ancestral Rio Grande. This unit is mapped at the surface to the north and west of the subdivision site and is one of the most productive aquifers in the Albuquerque Basin.

2) The Upper, Middle, and Lower Santa Fe Group piedmont deposits are divided into 4 lithofacies defined by varying amounts of conglomerate, sandstone, and mudstone. These sediments originated from Paleozoic and Mesozoic-age rocks of the Sandia uplift, which were eroded and deposited as alluvial fans along the slope of the Sandia Mountains. This unit is mapped at the surface to the east and west of the subdivision site and is about 2,500 to 3,500 ft thick beneath the subdivision site. These sediments generally produce less water than the axial river deposits, but still produce adequate amounts of good quality water.

3) The Loma Barbon member of the Arroyo Ojito Formation consists of fine-grained sandstone with interbedded mudstone. Because these sediments are fine grained and well consolidated, they do not produce as much water as the other Santa Fe Group deposits described above, and the water is of poorer quality. The Loma Barbon member of the Arroyo Ojito Formation is mapped at the surface to the west of the subdivision site.

To the east of the subdivision site lie the Proterozoic, Paleozoic, and Mesozoic-age crystalline and sedimentary rocks of the Sandia Mountains. Faults in the area are related to rifting and are typically west-side down, steeply-dipping normal faults with north-south trends (Johnson, 2000).

The subdivision site falls within the hydrogeologic zone B2a of Johnson (2000), which consists of relatively permeable gravel and sand, with minor mudstone. These Upper Santa Fe Group sediments are 2,500 to 3,500 ft thick and produce sufficient quantity and quality of water for domestic purposes (Johnson, 2000). Depth to productive ground water ranges from 250 to 450 ft in zone B2a (Figure 4). Ground-water residence times are on the order of a few years to tens of years. Ground water flows west to northwest at the Apache Mesa Subdivision and in the surrounding area, as shown in the water-level elevation contour map (Figure 5).

In hydrogeologic zone B2a, transmissivity is moderate, ranging from 70 to over 200 feet squared per day (ft^2/day). Hydraulic conductivities range from about 3 to 7 ft/day. However, near the subdivision site both transmissivity and hydraulic conductivity values are much higher, with transmissivity values ranging from 90 to over 13,000 ft^2/day, and hydraulic conductivities exceeding 200 ft/day (Johnson, 2000).

Water quality in zone B2a ranges from excellent to good, with total dissolved solids (TDS) concentrations varying from 220 to 420 milligrams per liter (mg/L). At the subdivision site, in the northernmost part of zone B2a, the TDS concentration is typically below 300 mg/L, with calcium and bicarbonate as the major dissolved ions (Johnson, 2000). In zone B2a, trace elements such as arsenic, iron, and manganese may be present in concentrations that exceed New Mexico Environment Department/Drinking Water Bureau (NMED/DWB) standards.

AQUIFER PUMPING TEST AND WATER-QUALITY SAMPLING RESULTS FOR APACHE MESA TEST WELL RG-81338

Drilling, Completion, and Development of RG-81338

Murray Drilling Company of Bernalillo, New Mexico, was contracted to drill a test well at the proposed subdivision site. Drilling began on October 27, 2003, in the southwest quarter of Township 13 North, Range 4 East, Section 35. The contractor drilled a 7-7/8-inch borehole to 760 feet below ground level (ft bgl), using the direct mud rotary method. Following drilling of the borehole, 5-inch outer diameter schedule 40 PVC casing and screen were installed. A total of 150 ft of screen was installed from 610 to 760 ft bgl. The bottom of the casing was capped off. Blank casing was installed from 610 ft bgl to 2 ft above ground level (agl). The well record submitted to the NMOSE and the well completion diagram for well RG-81338 are included in Appendix A.

Initial well development was performed by jetting water through the screen in order to remove mud cake, and to help settle the gravel pack. Following the jetting, the well was airlifted in order to remove additional sediments that accumulated during the initial development. JSAI was not present during drilling, casing, or initial development. On November 12, 2003, a 7.5-horsepower submersible test pump was installed to a depth of 509 ft bgl. Development pumping took place on November 12 and 13, 2003. The well was pumped at varying flow rates in order to remove fine-grained sediments and repair formation damage that occurred during drilling.

Step-Drawdown Pumping Test

JSAI performed a step-drawdown pumping test at well RG-81338 on November 14, 2003, using a 7.5-horsepower submersible pump. The step-drawdown test was used to determine a flow rate for the constant-rate aquifer pumping test and to estimate the efficiency of the well. The pumping test consisted of four 60-minute pumping steps, with an increase in flow of 4 gpm at each step, followed by the collection of recovery data. Flow rate was measured with a Blue-White 10-40 gpm flow meter and verified using a calibrated 5-gallon bucket. JSAI collected water-level measurements at 1-minute intervals during pumping and

recovery using a miniTroll 2000 transducer/data-logger and Win-Situ 4.0 software, and a wire-line sounder. A 1-inch (interior diameter) sounding tube was installed in the well for measuring water levels. Table 1 presents the results from the step-drawdown pumping test. Figure 6 presents a plot of the step-drawdown test.

Table 1. Results from the step-drawdown pumping test performed on November 14, 2003, Apache Mesa Subdivision, southern Sandoval County, New Mexico

step no.	flow rate, gpm	drawdown, ft	Q/s, gpm/ft
starting water level = 449.95 ft bgl			
1	20	4.83	4.14
2	24	6.23	3.85
3	28	7.44	3.76
4	32	8.78	3.64

gpm/ft gallons per minute per foot of drawdown
Q/s specific capacity
ft bgl feet below ground level

A Bierschenk analysis was performed to determine the efficiency of the well using the results from the step-drawdown aquifer pumping test (Bierschenk, 1964). The results of the Bierschenk analysis are presented in Table 2. The efficiency of the well decreases with increasing pumping rates due to increased effects of turbulent flow due to water moving through the aquifer, filter gravel, and screen.

Table 2. Results of the Bierschenk analysis of step-drawdown pumping test results, Apache Mesa Subdivision, southern Sandoval County, New Mexico

flow rate, gpm	efficiency, percent
20	78.58
24	75.36
28	72.38
32	69.64
40	64.72*

*estimated from results

Constant-Rate Pumping Test

JSAI performed a constant-rate pumping tests at well RG-81338 on November 17, 2003, using a 7.5-horsepower submersible pump. The pumping test was performed to assess the hydraulic properties of the aquifer near the well. Flow rate was measured with a Blue-White 10-40 gpm flow meter and verified using a calibrated 5-gallon bucket. JSAI collected water-level measurements at 1-minute intervals during pumping and recovery using a miniTroll 2000 transducer/data-logger and Win-Situ 4.0 software, and a wire-line sounder. A 1-inch (interior diameter) sounding tube was installed in the well for measuring water levels. The well was pumped at 28 gpm for 1,440 minutes (24 hours). The non-pumping water level prior to the test was 449.56 ft bgl. The pumping level at the end of the constant-rate test was 457.28 ft bgl, at which point the well had been pumped at a rate of about 28 gpm for 1,440 minutes. The specific capacity of the well after 1,440 minutes of pumping was 3.6 gallons per minute per foot (gpm/ft), with a maximum drawdown of 7.79 ft occurring after 531 minutes of pumping 28 gpm. The specific capacity is a measure of the productivity of the well in terms of discharge rate and drawdown, and this well was capable of producing water at a rate of 3.6 gpm for each foot of water-level decline in the well. A selection of the drawdown and recovery measurements from the constant-rate pumping test at well RG-81338 is included in Appendix B.

Drawdown and recovery data were plotted on a semi-logarithmic plot (Figure 7), and the data were analyzed using the Cooper-Jacob (1946) "straight-line" method. Aquifer transmissivity near well RG-81338 was calculated from both the drawdown curve and the recovery curve. A transmissivity of 823.5 ft^2/d was calculated from the drawdown curve, while a transmissivity of 2,459.7 ft^2/d was calculated from the recovery curve. Table 3 is a summary of the constant-rate pumping test.

The transmissivity calculated from the drawdown curve is probably a more reliable value because there are more data points defining the straight line. The transmissivity value from the drawdown curve was checked using the "specific capacity and transmissivity slide rule" method of Walton (1970). In this method, a rearranged form of the Theis equation is used to calculate low-end transmissivity using a large storage coefficient of 0.1 for near water

table conditions. The well was assumed to be 70 percent efficient, and the specific capacity from the pumping test was adjusted accordingly. The low-transmissivity value based on the "specific capacity and transmissivity slide rule" method was calculated to be 1,010 ft^2/d, which confirms that the value of 823.5 ft^2/d from the drawdown curve is a conservative value.

Table 3. Summary of the constant-rate aquifer pumping test at RG-81338, Apache Mesa Subdivision, southern Sandoval County, New Mexico

starting water level, ft bgl	pumping rate, gpm	specific capacity, gpm/ft	calculated transmissivity, ft^2/d	
			drawdown	recovery
449.56	28	3.6	823.5	2,459.7

ft bgl feet below ground level
gpm/ft gallons per minute per foot of drawdown
ft^2/d feet squared per day

Water-Quality Analysis

Samples were collected from well RG- 81338 for water-quality analysis 90 minutes before the end of the 24-hour constant-rate pumping test on November 18, 2003. Samples were submitted to Hall Environmental Analysis Laboratory of Albuquerque, New Mexico. Samples to be analyzed for dissolved metal concentrations were filtered in the field with 0.45 micrometer filters. Samples were delivered to Hall Environmental Analysis Laboratory for analysis within 24 hours of sampling the well. Table 4 summarizes the results of the water-quality analysis, and the laboratory report and chain-of-custody documentation are attached as Appendix C. Concentrations of all water-quality parameters listed in Table 4 are below the NMED/DWB standards, except the arsenic concentration, which is above the standard of 0.01 mg/L that will be effective January 23, 2006. However, the standard for arsenic until January 23, 2006, is 0.05 mg/L, and the arsenic concentration in water sampled from well RG-81338 is lower than the current NMED/DWB standard and maximum contaminant level.

Table 4. Results of the water-quality laboratory analysis, sampled from RG-81338 on November 18, 2003, Apache Mesa Subdivision, southern Sandoval County, New Mexico

constituent	unit	result	MCL	NMED/DWB standards
antimony	mg/L	<0.001	0.006	0.006
arsenic	mg/L	**0.011**	0.05	0.01[1]
barium	mg/L	0.072	2	2.0
beryllium	mg/L	<0.003	0.004	0.004
cadmium	mg/L	<0.002	0.005	0.005
chromium	mg/L	<0.006	0.1	0.1
cyanide	mg/L	<0.005	0.2	0.2
fluoride	mg/L	0.33	4.0	4.0
lead	mg/L	<0.005	0.015	0.015
mercury	mg/L	<0.0004	0.002	0.002
nickel	mg/L	<0.01	0.1	(a)
nitrate	mg/L	0.16	10	10
nitrite	mg/L	<0.1	1	1
selenium	mg/L	0.003	0.05	0.05
thallium	mg/L	<0.001	0.002	0.002
alkalinity	mg/L	230	(a)	(a)
aluminum	mg/L	<0.02	0.05 to 0.2[3]	0.05-0.2[2]
calcium	mg/L	68	(a)	(a)
chloride	mg/L	35	250[3]	250[2]
color	c.u.	<5.0	15[3]	15[2]
copper	mg/L	<0.006	1.3	1.0[2]
foaming agents (surfactants)	mg/L	<1.0	0.5[3]	0.5[2]
hardness ($CaCO_3$)	mg/L	230	250[3]	(a)
iron	mg/L	<0.02	0.3[3]	0.3[2]
manganese	mg/L	0.002	0.05[3]	0.05[2]
odor	TON	<1.0	3[3]	3[2]
pH	units	7.67	6.5 to 8.5[3]	6.5 to 8.5[2]
silver	mg/L	<0.005	0.1[3]	0.1[2]
sodium	mg/L	52	100[3]	(a)
sulfate	mg/L	73	250[3]	250[2]
total dissolve solids	mg/L	430	500[3]	500[2]
turbidity	NTU	<0.50	5[3]	(a)
zinc	mg/L	0.12	5[3]	5[2]

MCL Maximum contaminant level as published in the Sandoval County Land Subdivision Regulations
[1]arsenic values effective January 23, 2006. Until then, the MCL is 0.05 mg/L.
[2]Secondary (aesthetic-related) standards
[3]Secondary maximum contaminant level as in the Sandoval County Land Subdivision Regulations
values in **bold** exceed the NMED/DWB standard

NMWQCC	New Mexico Water Quality Control Commission	(a)	No standard available
mg/L	milligrams per liter	NTU	nephelometric turbidity units
c.u.	color units	n/a	no standard applies
		T.O.N.	threshold odor number

GROUND-WATER AVAILABILITY

The Land Subdivision Regulations of Sandoval County, New Mexico, require a continuous 100-year water supply beneath each subdivision site. The maximum allowable diversion per lot in this subdivision, will be 0.50 ac-ft/yr. JSAI performed this hydrogeologic assessment with the understanding that the water diverted by each lot will be 0.50 ac-ft/yr.

Recharge

Recharge to the aquifer beneath the Apache Mesa Subdivision was assumed to occur from storm-water flow over the Quaternary-age Piedmont alluvium and Quaternary- to Tertiary-age Upper Santa Fe Group deposits mapped at the surface, and storm-water flow in arroyo bottoms. The mean annual precipitation at the Apache Mesa Subdivision was calculated to be 9.13 inches (0.76 ft), which is the mean annual precipitation calculated for the period of record 1941 to 1981 at the Bernalillo 1 NNE weather station and 1983 to 2002 at the Corrales weather station (excluding years for which 3 or 4 months of precipitation data were missing), as provided by the Western Regional Climate Center. The use of average precipitation values from this long period of record accounts for drought conditions. Recharge over each subdivision site, is estimated using the equation

$$\text{recharge} = P \times 0.025 \times A_i,$$

where P is the mean annual precipitation (0.76 ft), A_i is the area of infiltration (about 35 acres of Quaternary-age piedmont and Quaternary- to Tertiary-age Upper Santa Fe Group), and 0.025 is the percentage of precipitation recharging the aquifer beneath the subdivision site. Recharge estimates for the subdivision are presented in Table 5.

Table 5. Estimated recharge, Apache Mesa Subdivision, southern Sandoval County, New Mexico

aquifer	acreage of subdivision site	recharge, ac-ft/yr
Quaternary-age piedmont and Upper Santa Fe Group	35	0.67
total subdivision	**35**	**0.67**

ac-ft/yr acre-feet per year

Ground Water in Storage

Ground water in storage available in the aquifer beneath the subdivision was estimated using the method

$$S = Ac \times SY \times ST \times RC$$

where:

S = ground water in storage, in ac-ft
Ac = size of tract, in acres
SY = specific yield for unconfined aquifer (0.1)
ST = saturated thickness of aquifer (1000 ft for the Upper Santa Fe Group)
RC = recovery factor (0.8)

A conservative value for saturated thickness of 1,000 ft was used for the Upper Santa Fe Group, since it is 2,500 to 3,500 ft thick and the depth to productive ground water ranges from 250 to 450 ft. The well RG-81338 completed and tested in the subdivision does not penetrate the entire saturated thickness of the aquifer, since it was completed to a total depth of 760 ft. Estimates of ground water in storage for the subdivision, assuming no recharge, no return flow from septic systems, all lots pumping 100 percent of allowable diversion each year, and pumping from all lots beginning at the same time, are presented in Table 6. An unconfined storage value was used to calculate ground water in storage because there was no evidence during well drilling, completion, or aquifer testing that water is present as confined storage. Each lot has sufficient water for a 100-year continuous supply.

Table 6. Ground water in storage, Apache Mesa Subdivision, southern Sandoval County, New Mexico

aquifer	Upper Santa Fe Group	total subdivision
acreage of subdivision site	35	**35**
estimated aquifer saturated thickness, ft	1,000	**1,000**
specific yield[b]	0.1	**0.1**
recharge, ac-ft/yr	0	**0**
total ground water in storage, ac-ft	3,500	**3,500**
recoverable ground water in storage,[a] ac-ft	2,800	**2,800**
number of lots	35	**35**
water required for 100-yr continuous supply, ac-ft	1,750	**1,750**
percent of total recoverable ground water in storage that is required for a 100-yr continuous supply	62.5	**62.5**
recoverable ground water in storage remaining after 100 years, ac-ft	1,050	**1,050**

[a]Multiplied by a recovery factor of 0.8
[b]dimensionless

ac-ft/yr acre-feet per year

Ground-Water Flow Model to Assess Impacts of Pumping Apache Mesa Subdivision Wells on Aquifer

Long-term drawdowns in the Apache Mesa Subdivision and the surrounding region as a result of pumping 35 wells in the subdivision (one well per lot at full build-out) at a rate of 0.50 ac-ft/yr (0.31 gpm) per well, were simulated using Visual MODFLOW, a version of the U.S. Geological Survey MODFLOW code (McDonald and Harbaugh, 1988).

The objectives of modeling were to determine the maximum 100-year drawdown in the Apache Mesa Subdivision as a result of pumping the subdivision wells, and to determine the effect of pumping on nearby wells located within 1 mile of the subdivision. The model developed for the simulation was a one-layer superposition model. Model grid spacing was uniformly 0.125 miles, and the model consisted of 12 rows and 12 columns covering an area of 9 square miles (Figure 8). The model was made sufficiently large to minimize boundary effects, given the relatively large transmissivity values and small pumping rate in the model. No boundary conditions were placed on the model. The layer thickness was 350 ft and the

specific storage was 0.00003 for consolidated rocks such as Cretaceous-age rocks to the east of the subdivision, and 0.0003 for unconsolidated rocks such as Quaternary- to Tertiary-age Upper Santa Fe Group. Recharge to the aquifer was not included in the model simulation.

The various aquifer units in the model area were assigned different hydraulic properties reflective of results of aquifer pumping tests completed in the area and published values for the rock types (Table 7; Table 8, Figure 8). The transmissivity values reported for the Upper Santa Fe Group in the model area range from 72 to 4,095 ft^2/d (Johnson, 2000). Transmissivities were assigned to the different hydrogeologic zones in the model area according to the pumping tests that have been conducted in the zones. A relatively conservative transmissivity value of 823.5 ft^2/d, calculated from the drawdown curve from the 24-hour constant-rate pumping test of well RG-81338, and a corresponding hydraulic conductivity value of 5.49 ft/d, were used for the Upper Santa Fe Group at the Apache Mesa Subdivision. A transmissivity value of 21 ft^2/d, and a corresponding hydraulic conductivity value of 0.52 ft/d, were used for the Cretaceous-age rocks. This transmissivity value was estimated for the Cretaceous-age Menefee Formation 1 mile east of the model area (Turner Environmental Consultants, 1998; Newcomer, 1994).

The effective porosity was set equal to the specific yield and the total porosity was 1.5 times the effective porosity. The model was run as a "type zero" confined aquifer with constant storativity and constant transmissivity values. JSAI performed a sensitivity analysis by running the model as a "type 3" variable transmissivity model. The "type 3" model results were slightly different from the "type zero" model results. Although the areas of maximum drawdowns coincided for the two models, the "type 3" drawdowns were very similar to the "type zero" drawdowns.

Model results indicate that the drawdown in the Upper Santa Fe Group aquifer beneath the subdivision after 100 years of pumping 35 wells in the Apache Mesa Subdivision would have a maximum value of about 1.4 ft, which would take place over an area of several acres in the southwest quadrant of Township 13 North, Range 4 East, Section 35, along the northern boundary of the Apache Mesa Subdivision (Figure 9). Model results indicate maximum drawdowns of about 1.1 ft in the aquifer after 100 years over an area of about 1 square mile in parts of Sections 34 and 35 of Township 13 North, Range 4 East, and Section 2 of Township 12 North, Range 4 East, centered around the Apache Mesa Subdivision.

Table 7. Hydraulic properties assigned to the aquifers beneath the Apache Mesa Subdivision, southern Sandoval County, New Mexico

geologic unit(s)	well screen interval, ft	hydraulic conductivity, ft/d	transmissivity, ft^2/d	aquifer test references
Upper Santa Fe Group of hydrogeologic zone B3	20	11.3	226	Geohydrology Associates, Inc., 1995 John Shomaker & Associates, Inc., 1987 Turner Environmental Consultants, 1997
Upper Santa Fe Group of hydrogeologic zone B2a	150	5.49	823.5	this report
Upper Santa Fe Group of hydrogeologic zone B2b	200	0.36	72	Geohydrology Associates, Inc., 1995
Cretaceous-age rocks of hydrogeologic zones R2, R3, and R4	40	0.52	21	Turner Environmental Consultants, 1998 Newcomer, 1994

ft/d feet per day ft^2/d feet squared per day

Table 8. Model inputs for the aquifers beneath the Apache Mesa Subdivision, southern Sandoval County, New Mexico

geologic unit(s)	color scheme on Figure 8	model saturated thickness, ft	hydraulic conductivity, ft/d	specific storage S_S, 1/ft	specific yield S_y, dimensionless	effective porosity, dimensionless	total porosity, dimensionless
Upper Santa Fe Group of hydrogeologic zone B3	purple	350	11.3	0.0003	0.1	0.1	0.15
Upper Santa Fe Group of hydrogeologic zone B2a	blue	350	5.49	0.0003	0.1	0.1	0.15
Upper Santa Fe Group of hydrogeologic zone B2b	grass green	350	0.36	0.0003	0.1	0.1	0.15
Cretaceous-age rocks of hydrogeologic zones R2, R3, and R4	white	350	0.52	0.00003	0.01	0.01	0.015

[a] Geohydrology Associates, Inc., 1995; John Shomaker & Associates, Inc., 1987; Turner Environmental Consultants, 1997
[b] based on 24-hour constant-rate aquifer pumping test conducted at well RG-81338 in the Apache Mesa Subdivision described in this report
[c] Geohydrology Associates, Inc., 1995
[d] Turner Environmental Consultants, 1998; Newcomer, 1994
ft/d feet per day

Pumping Levels in Well RG-81338 After 100 Years as a Result of Pumping Apache Mesa Subdivision Wells

The pumping level calculated for test well RG-81338 at the end of 100 years as a result of pumping wells within the subdivision is presented in Table 9. The pumping level was calculated based on the 100-year drawdown estimate from the ground-water flow model and the short-term drawdown estimate from the aquifer pumping test performed on the well.

Table 9. Calculated 100-year pumping level in test well RG-81338 completed and test-pumped in the Apache Mesa Subdivision when pumping 0.60 acre-feet per year

well	total depth of well, ft	non-pumping water level in well, ft bgl	water column in well, ft	short-term drawdown in well, ft	long-term drawdown in well, ft	pumping level after 100 years, ft bgl	percent of water column remaining, ft
RG-81338	760	449.6	310.4	7.8	1.4	458.8	97

ft bgl feet below ground level

Long-Term Drawdown at Subdivision Site Boundaries as a Result of Pumping Apache Mesa Subdivision Wells

Long-term drawdown of the water table at the boundaries of the subdivision was estimated using the ground-water flow model described above. The model-simulated 100-year drawdown at the subdivision boundaries ranged from 1.1 ft near the southeastern boundary to 1.4 ft near the northern boundary of the subdivision (Figure 9).

Effects of Pumping Apache Mesa Subdivision Wells on Surrounding Wells

The effect of pumping within the Apache Mesa Subdivision on wells located outside the subdivision was estimated using the ground-water flow model described above. The effects of pumping on wells within a 1-mile radius of the subdivision boundaries are summarized in Appendix D. Well RG-43248, completed in the Upper Santa Fe Group adjacent to the Apache Mesa Subdivision, was most affected by pumping within the

subdivision. The 100-year drawdown in RG-43248 was 1.1 ft, and 99 percent of the starting water column remained in the well after 100 years. Wells RG-43031, RG-58560, RG-11802, and RG-44347, completed in the Upper Santa Fe Group west of the Apache Mesa Subdivision, had model-simulated drawdowns of 1.1 ft. Wells RG-32505 and RG-58639, completed in the Upper Santa Fe Group east of the Apache Mesa Subdivision, also had model-simulated drawdowns of 1.1 ft. Wells RG-67590, RG-68855, and RG-72457, completed in the Upper Santa Fe Group north of the Apache Mesa Subdivision, also had model-simulated drawdowns of 1.1 ft.

Albuquerque Ground-Water Flow Model to Assess Long-term Impacts of Pumping Surrounding Wells on Aquifer at Apache Mesa Subdivision

JSAI ran the Ground-Water Flow Model of the Albuquerque Basin (Tiedeman et al., 1998) to estimate 100-year drawdowns in the Apache Mesa Subdivision wells as a result of pumping wells of the surrounding Placitas area in addition to the Albuquerque Basin. These 100-year drawdown estimates were considered in the determination of whether or not a 100-year water supply exists for the subdivision. The Albuquerque model cell in which the Apache Mesa Subdivision is located is row 13, column 44. An observation well was placed in this model cell to represent the subdivision. The model-simulated drawdown after 100 years at the subdivision was 23 ft. It should be noted that the Albuquerque model (Tiedeman et al., 1998) was built to run to year 2040 and not to year 2100, as it was projected for the current study, and the model assumes pumping of ground-water at the full extent allowed by existing water rights. The model does not account for future reductions in ground water pumping by the City of Albuquerque that may occur as a result of the San Juan-Chama Project. Thus, the Albuquerque model provides a conservative estimate of the maximum 100-year drawdown at the Apache Mesa Subdivision. Using the Albuquerque model results, the pumping level in test well RG-81338 after 100 years of pumping the Apache Mesa Subdivision wells and the surrounding wells of the Placitas area and Albuquerque Basin would be 481.8 ft, and 90 percent of the starting water column would remain after 100 years.

Hydrographs to Assess Long-term Impacts of Pumping Surrounding Wells on Aquifer at Apache Mesa Subdivision

A hydrograph from the area surrounding the Apache Mesa Subdivision was used to predict the 100-year drawdown at Apache Mesa Subdivision. Historical water level measurements were recorded between June 1982 and December 2001 at U. S. Geological Survey monitor well 351843106294501, located in the southeastern quadrant of Section 34, Township 13 North, Range 4 East. This is the only well in the U.S. Geological Survey ground-water levels database within a 1-mile radius of the Apache Mesa Subdivision with water level data that spans at least a decade to the present day. The well is located less than a quarter mile from the subdivision. The water level data from the well show a strong linear trend, and the linear equation [depth to water = (0.0006 * time) + 410.12] was fit to the trend (Figure 10). The linear equation was used to determine depth to water at Apache Mesa Subdivision in years 2000 and 2100, and a 100-year drawdown of 22 ft was calculated. Using the hydrograph projection, the pumping level in test well RG-81338 after 100 years of pumping the Apache Mesa Subdivision wells and the surrounding wells of the Placitas area and Albuquerque Basin would be 482.8 ft, and 90 percent of the starting water column would remain after 100 years.

Impact of Pumping Apache Mesa Subdivision Wells on Nearby Springs and Streams

Most springs and streams within the vicinity of Apache Mesa Subdivision are ephemeral , and flow primarily in response to spring snowmelt or heavy storm runoff (Johnson, 2000). The nearest perennial stream to Apache Mesa Subdivision is Las Huertas Creek, located one and a half miles north of the subdivision. Las Huertas Creek is intermittent over more than 50 percent of its reach between the headwaters and Placitas and the perennial portion of the creek is in the upper reaches of the headwaters (Brekhus et al., 1991). Las Huertas is a losing stream in much of its lower reaches, and about 48 percent of streamflow is lost to infiltration between the Las Huertas picnic area and the ditch association diversion (Johnson, 2000). Thus, ground-water pumping from the Apache Mesa Subdivision will have no effect on flow in Las Huertas Creek.

CONCLUSIONS

The Upper Santa Fe Group aquifer beneath the Apache Mesa Subdivision are capable of providing a 100-year supply of water to the subdivision based on the methods used in this report to estimate ground water in storage and long-term drawdown. Recharge to the aquifer occurs from storm-water flow over outcrops of Tertiary-age Upper Santa Fe Group.

Well RG-81338, completed in the Upper Santa Fe Group aquifer, was pumped for 24 hours at a constant rate of 28 gpm. The specific capacity of the well was 3.6 gpm/ft when pumping 28 gpm. The transmissivity estimated from the drawdown curve from well RG-81338 was 823.5 ft^2/d.

Constant pumping of ground water for 100 years by Apache Mesa Subdivision wells was simulated to have a relatively low impact on the saturated thickness of the aquifer beneath the subdivision and the drawdown of the water table at the subdivision boundaries. The model-simulated maximum 100-year drawdown within the subdivision was estimated to be about 1.4 ft. The model-simulated 100-year drawdown at the subdivision boundaries ranged from 1.1 to 1.4 ft. The maximum model-simulated 100-year drawdown for wells surrounding the subdivision was about 1.1 ft, in wells located directly east, west, and north of the Apache Mesa Subdivision. Running the Albuquerque model (Tiedeman et al., 1998) and projecting hydrograph trends indicate 100-year drawdowns between 22 and 23 ft at the Apache Mesa Subdivision as a result of pumping surrounding wells of Placitas and the Albuquerque Basin.

Because Las Huertas Creek is a losing stream in the sections near the Apache Mesa Subdivision, the flow in the creek will not be affected by pumping Apache Mesa Subdivision wells.

The field and analytical ground-water-quality results for the test wells show that the Upper Santa Fe Group aquifer produces good quality water that should not require treatment. Homeowners should have their water tested by a laboratory prior to using the water as a potable supply.

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ILLUSTRATIONS

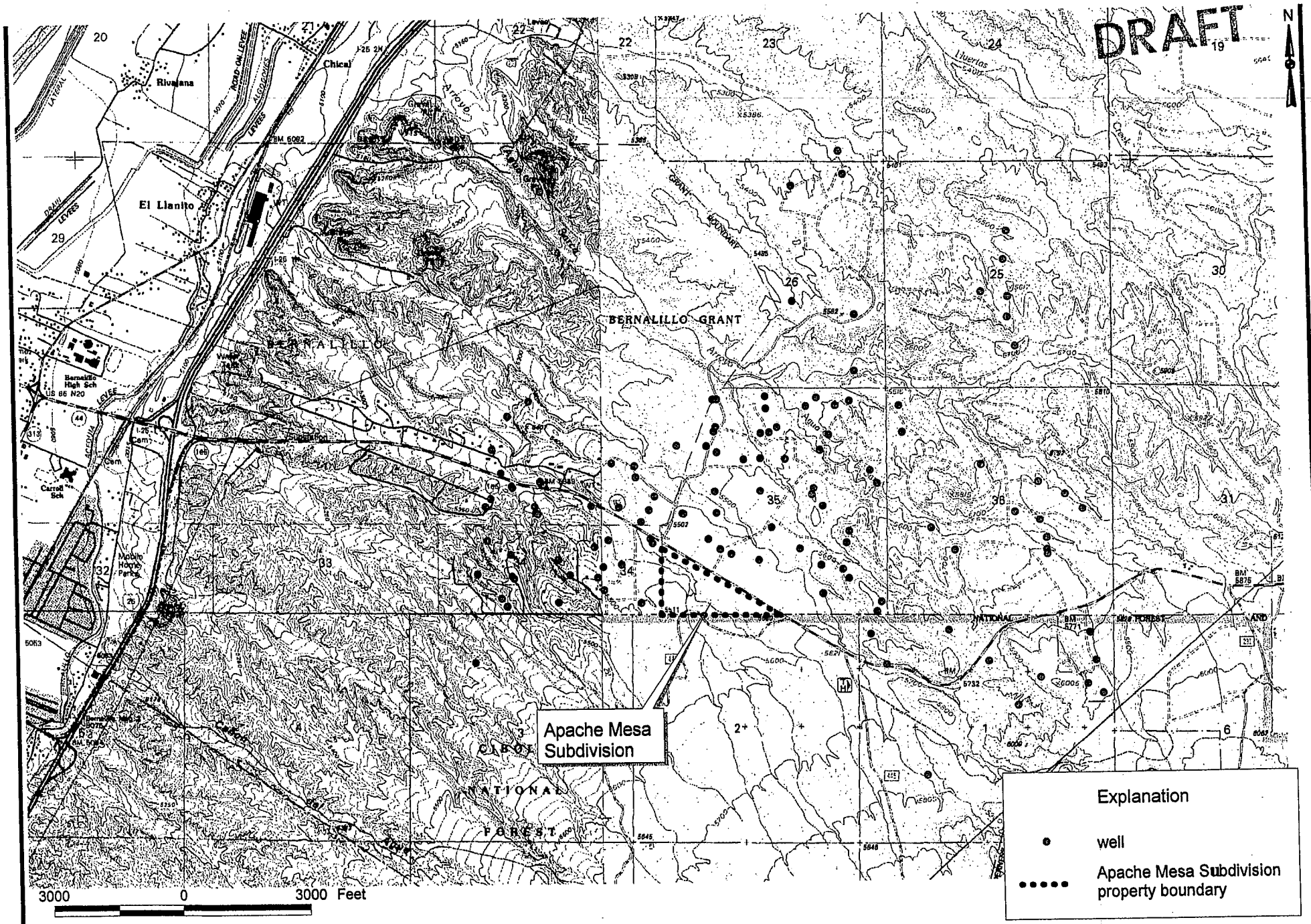

Figure 1. Topographic map of the Apache Mesa Subdivision and surrounding area, showing wells within a one-mile radius of the subdivision, southern Sandoval County, New Mexico.

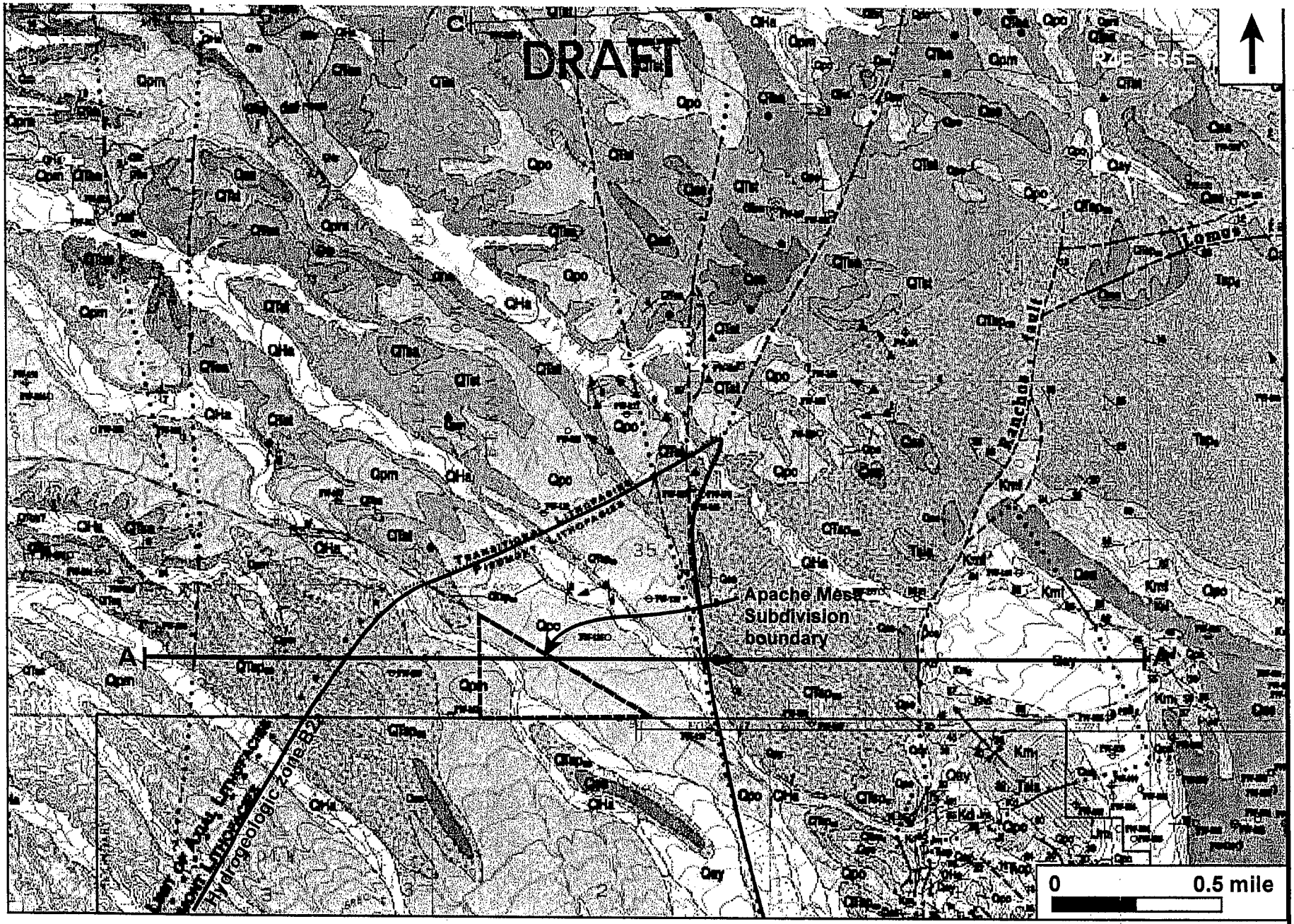

Figure 2. Geologic map of the Apache Mesa Subdivision and surrounding area (Connell et al., 1999) showing line of section and hydrogeologic zone B2a of Johnson (2000), southern Sandoval County, New Mexico. See Figure 3 for explanation of map units.

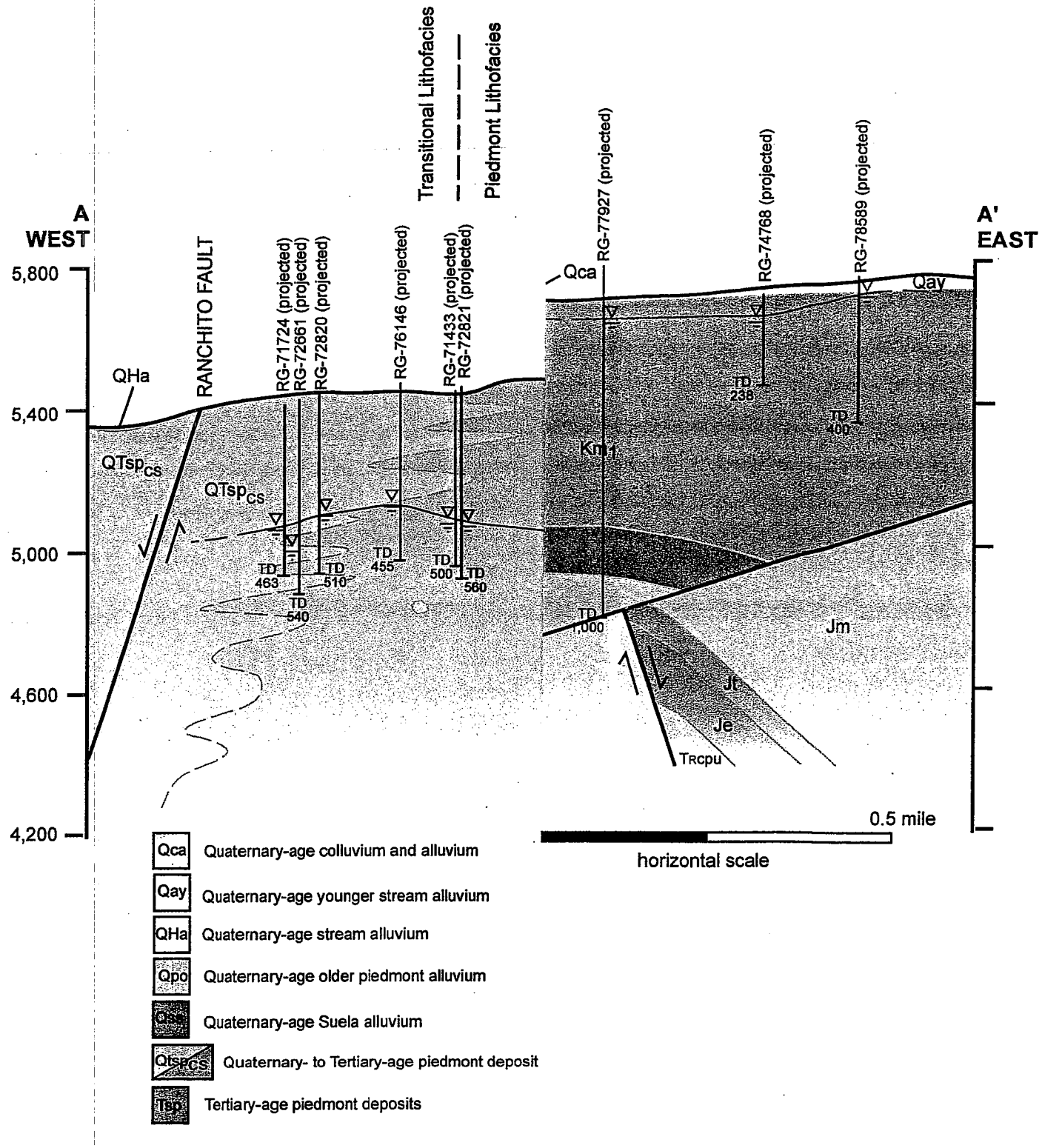

Figure 3. West-e:ction.

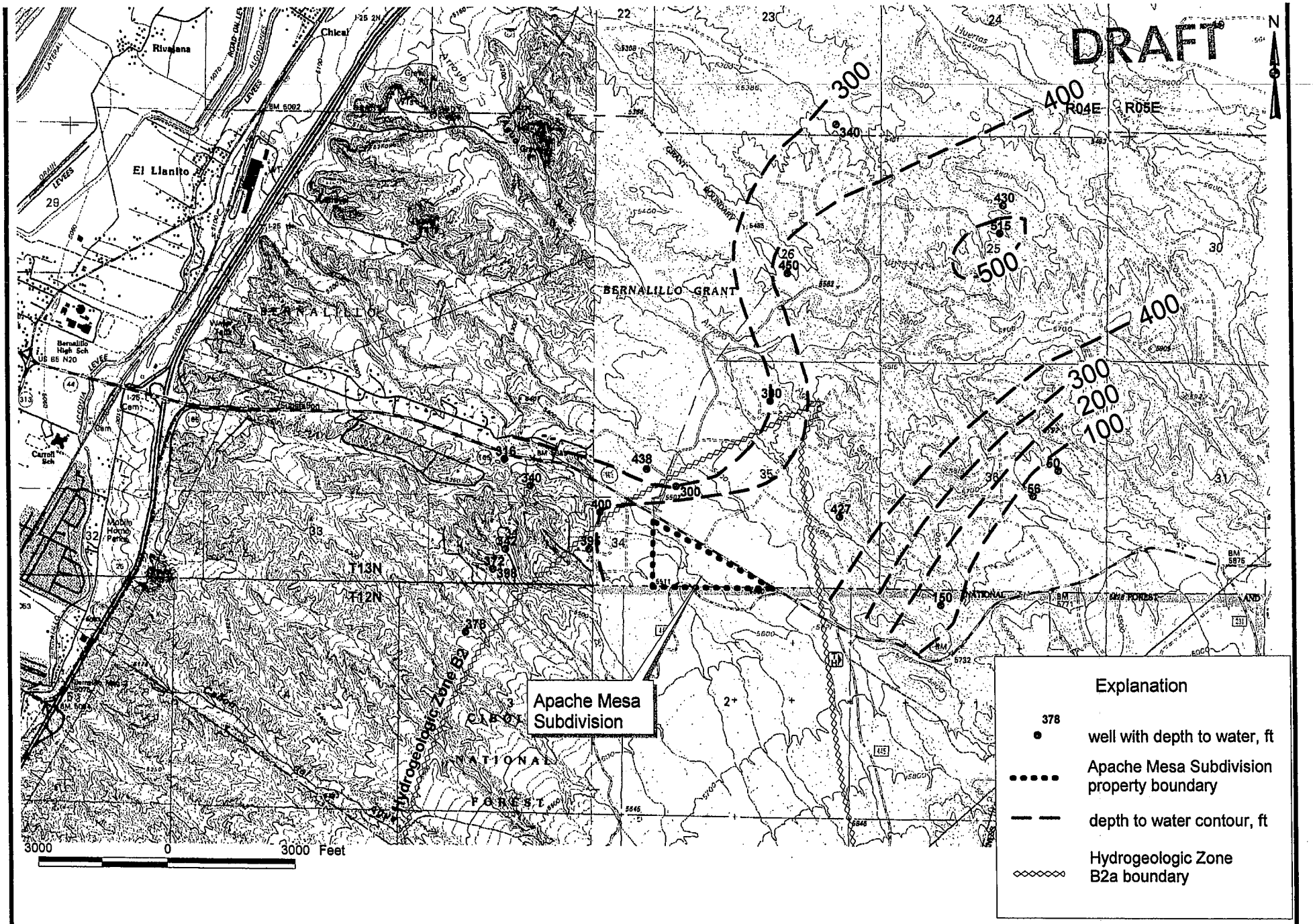

Figure 4. Map showing depth to ground-water contours and hydrogeologic zone B2a of Johnson (2000), Apache Mesa Subdivision and surrounding area, southern Sandoval County, New Mexico.

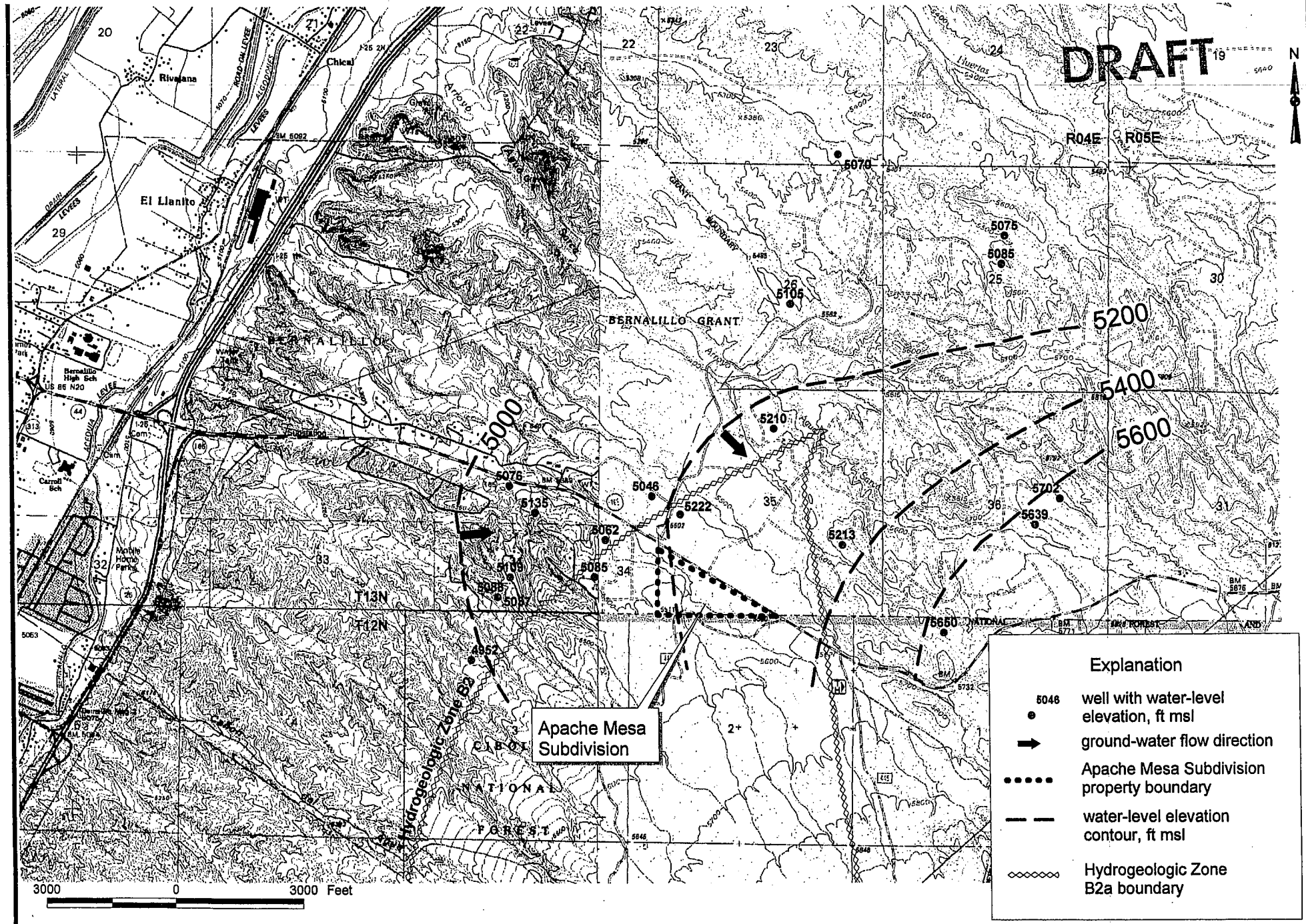

Figure 5. Map showing ground-water elevation contours and hydrogeologic zone B2a of Johnson (2000), Apache Mesa Subdivision and surrounding area, southern Sandoval County, New Mexico.

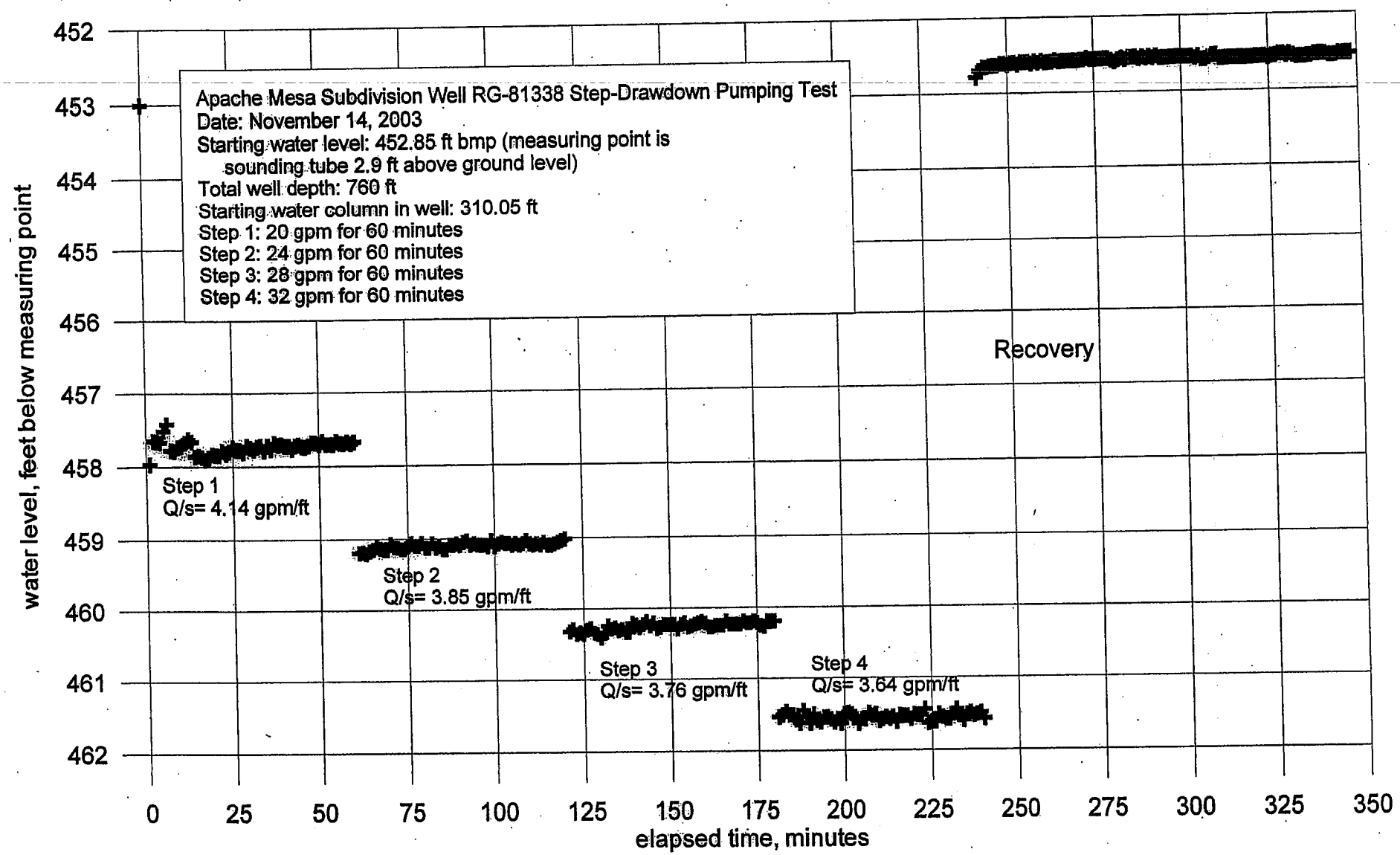

Figure 6. Plot of drawdown and recovery data from the step-drawdown pumping test performed on well RG-81338 on November 14, 2003, Apache Mesa Subdivision, southern Sandoval County, New Mexico.

DRAFT

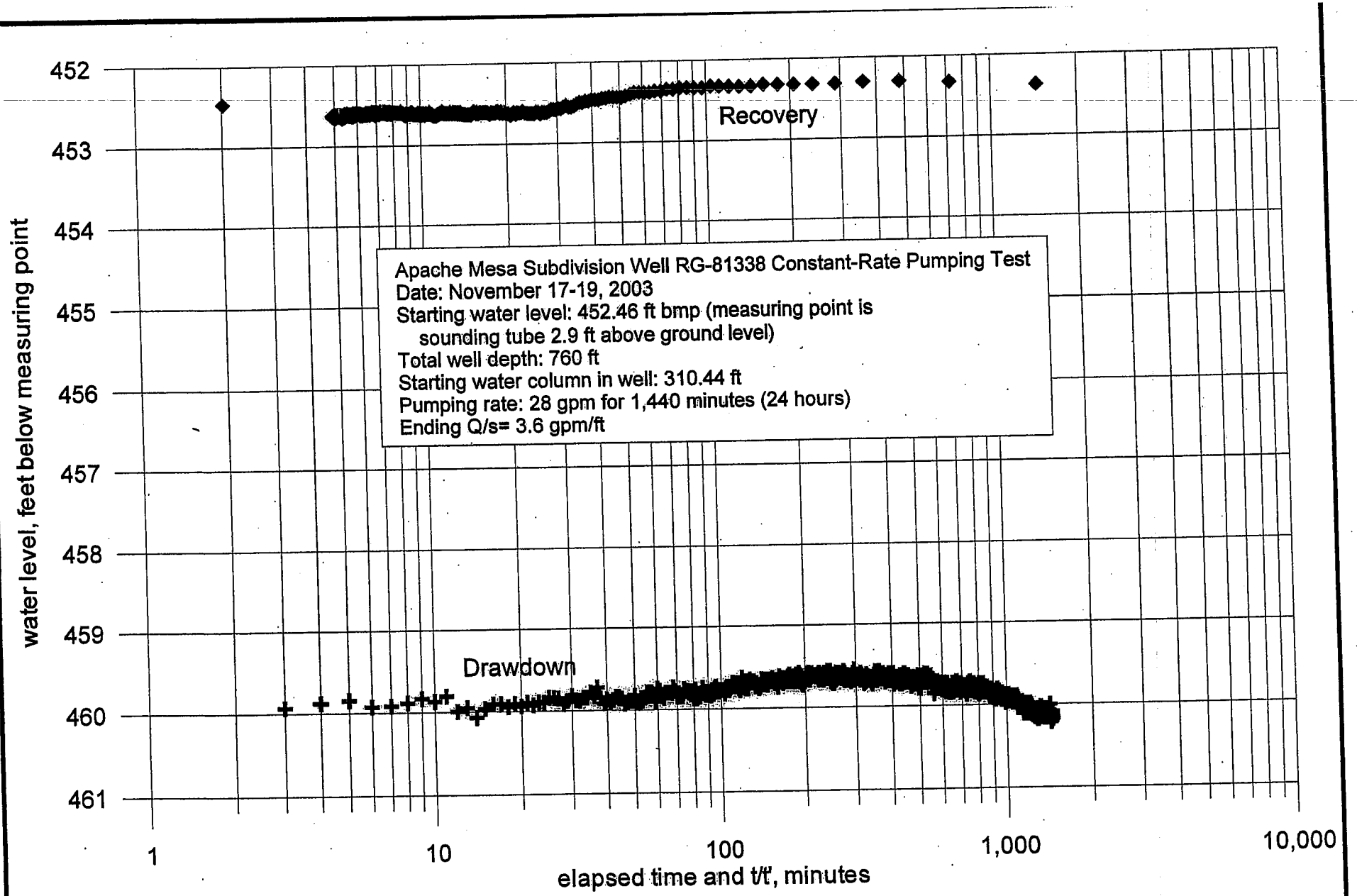

Figure 7. Semi-logarithmic plot of drawdown and recovery data from the 24-hour constant-rate pumping test performed on well RG-81338 between November 17 and 19, 2003, Apache Mesa Subdivision, southern Sandoval County, New Mexico.

DRAFT

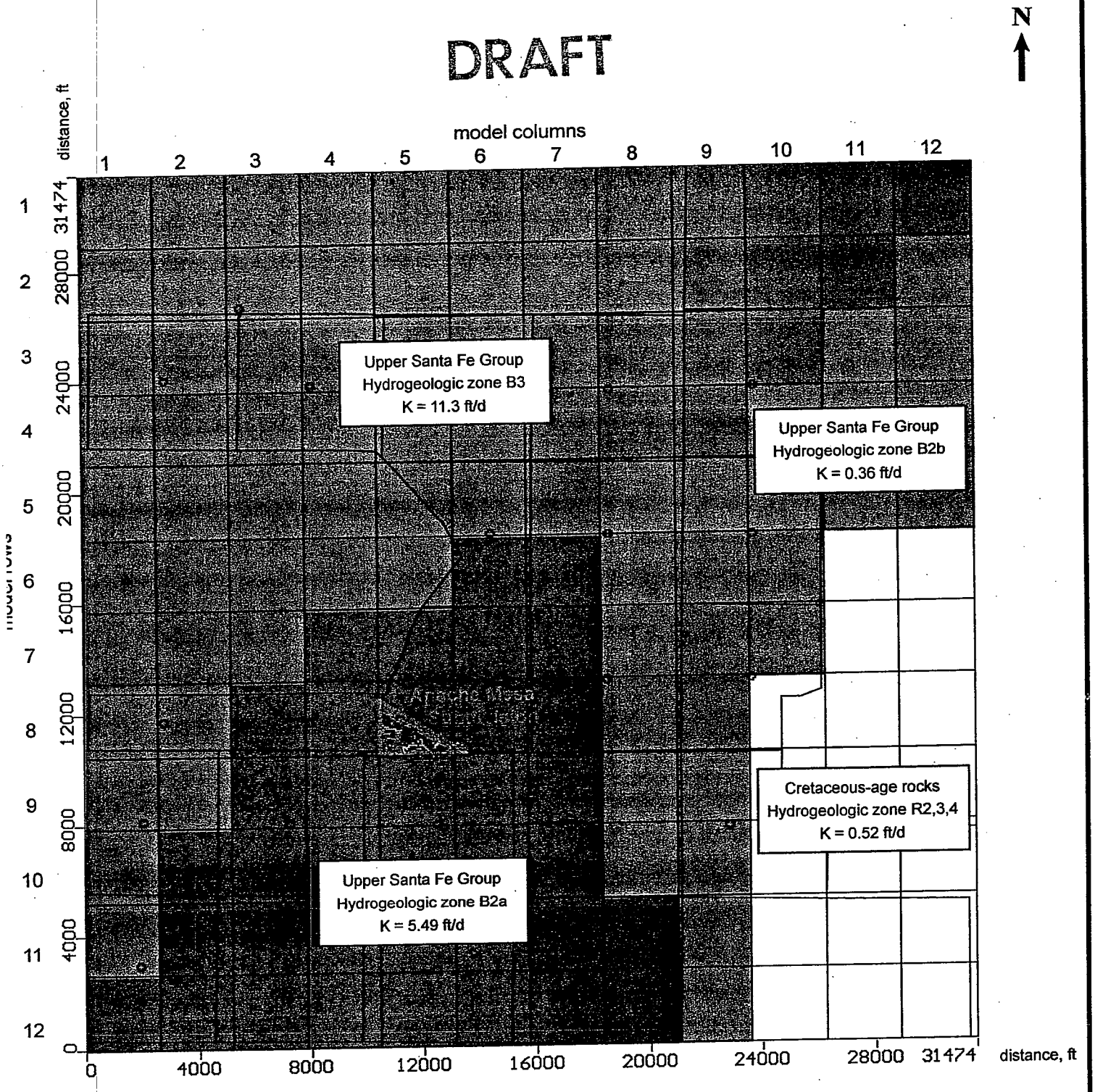

Figure 8. Ground-water flow model grid and domains with varying hydraulic properties, Apache Mesa Subdivision, southern Sandoval County, New Mexico.

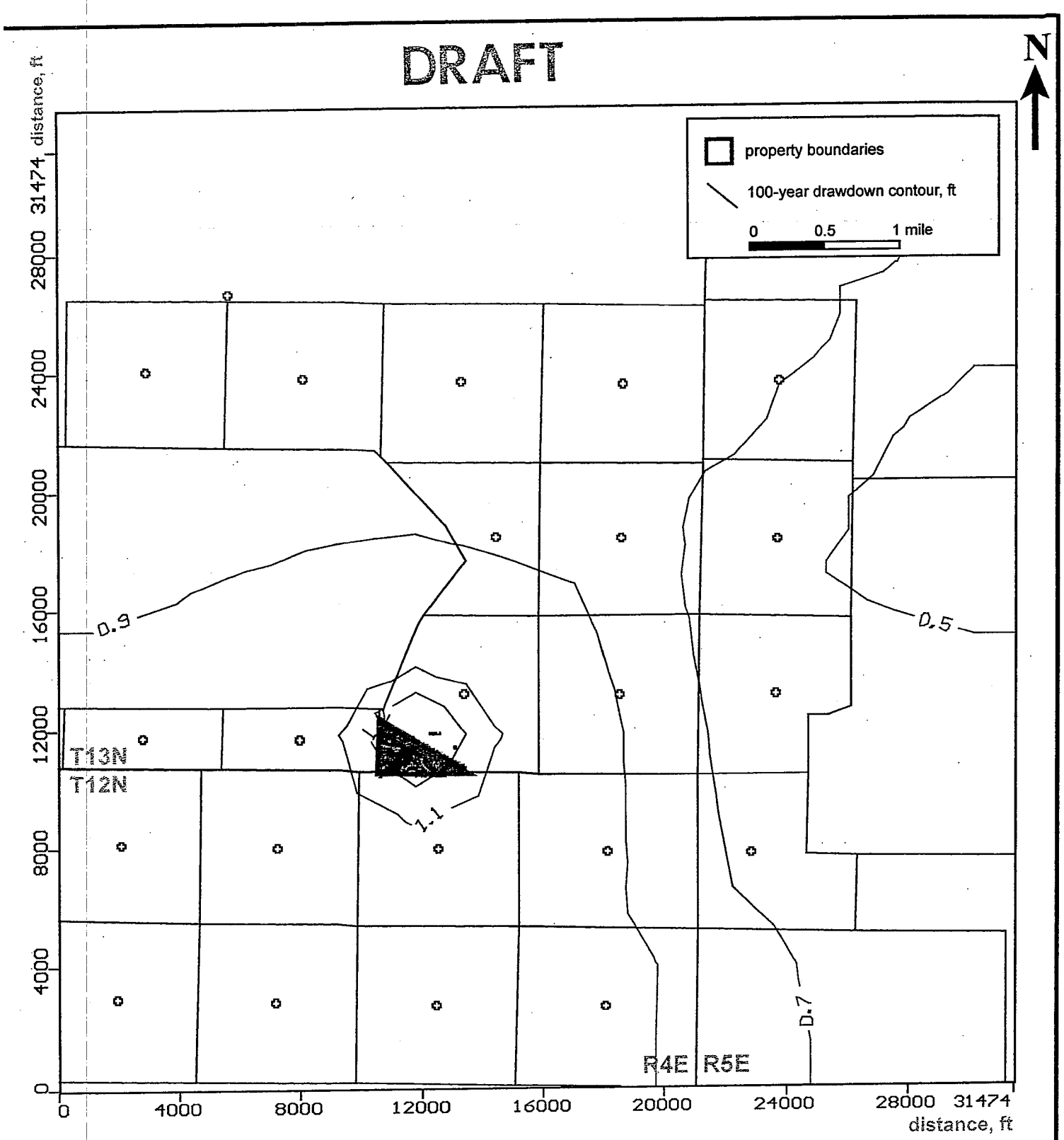

Figure 9. Ground-water flow model grid showing estimated 100-year drawdown, Apache Mesa Subdivision, southern Sandoval County, New Mexico.

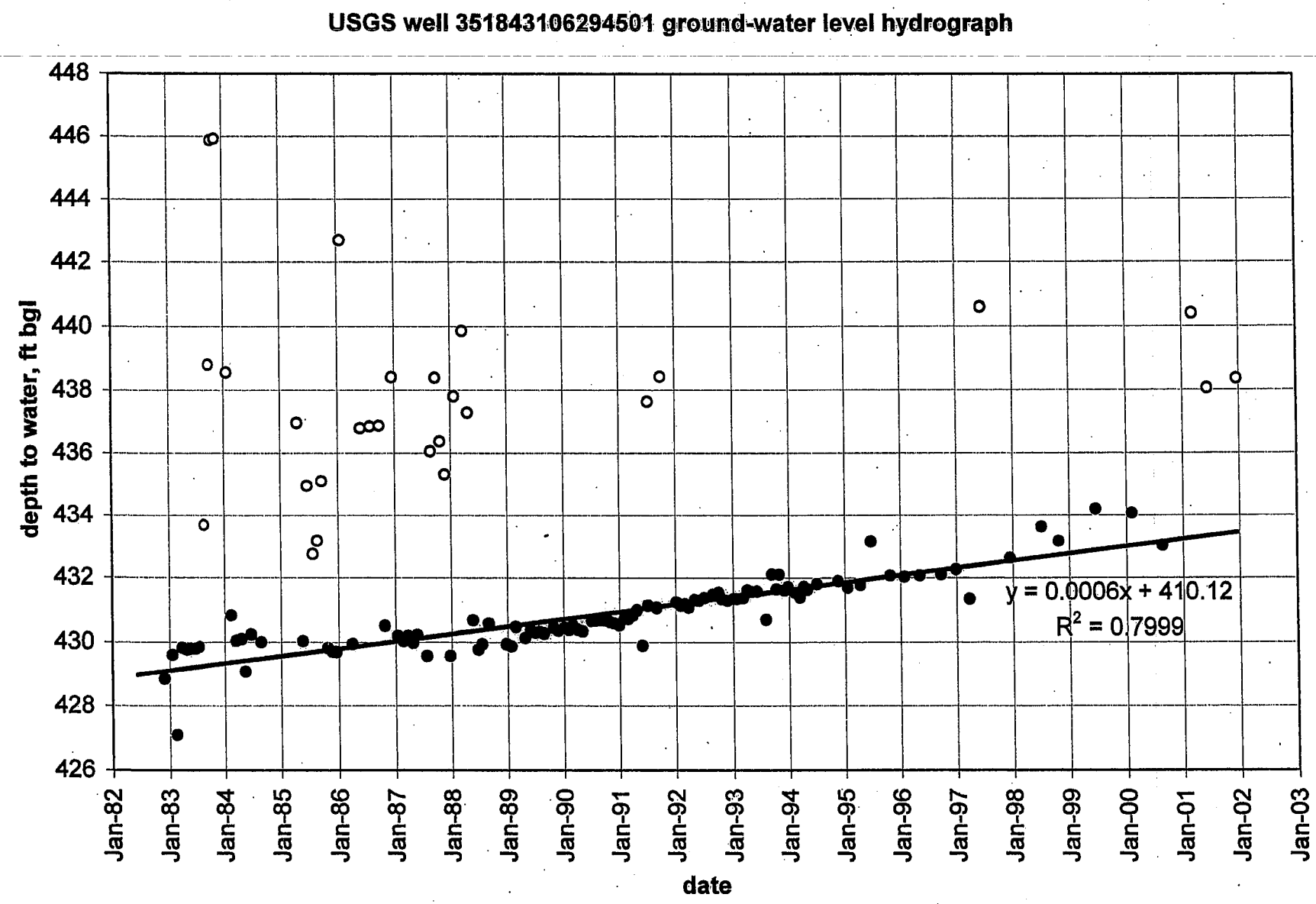

Figure 10. Ground-water hydrograph from well within one mile of the Apache Mesa Subdivision.

DRAFT

APPENDICES

Appendix A.

Well record and well completion diagram for well RG-81338 in the Apache Mesa Subdivision

JOHN SHOMAKER & ASSOCIATES, INC.
2703-B Broadbent Parkway NE Albuq. NM 87107

Borehole Logging Form

Client: Mark Goodwin and Associates	Project: Apache Mesa Subdivision	Hole: RG-81338	1 of 1
Site: Apache Mesa Subdivision, near Placitas, southern Sandoval County, New Mexico		Date: October 30, 2003	
Geologist: JTL	Contractor: Murray Drilling Company	Map: Bernalillo exit 240, east on Highway 165, RG-81338 on south side of highway west of Town of Placitas	
Drill Method: direct mud rotary drilling	Rig: mud rotary		
Notes: JTL not on site for drilling, drilled to TD at 9:00, JTL logged cuttings at 12:00	Bit size: 7-7/8-inch tricone		
Elevation, ft	Land Surface: 5505 ft amsl	TOC: 2.9 ft agl	

Depth, ft	Thickness, ft		Description
0-180	180		red-brown sandy gravel; gravel is subangular to subrounded, granitic composition; coarse sand is subrounded
180-240	60		red-brown gravely clay; 40 to 50 percent gravel is subangular to subrounded, granitic composition
240-460	220		grayish-red gravely sand; 10 percent gravel is subangular to subrounded, granitic composition; very coarse sand is subangular
460-470	10		brown sandy clay; fine sand is subrounded, about 70 percent quartz, 30 percent feldspar
470-760	290		grayish-red sand; very fine to medium sand is moderately sorted, subrounded, about 70 percent quartz, 30 percent feldspar
			T.D. 760 feet

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well APACHE MESA LLC SKIP KRUZICH Owner's Well No. _____

Street or Post Office Address P.O. BOX 14798

City and State ALBUQUERQUE NM 87191

Well was drilled under Permit No. RG 81338 and is located in the:

a. _____ ¼ _____ ¼ _____ ¼ _____ ¼ of Section 35 Township 13N Range 04E N.M.P.M.

b. Tract No. _____ of Map No. _____ of the _____

c. Lot No. _____ of Block No. _____ of the _____

Subdivision, recorded in SANDAVOL County.

d. X= 426778 (3603996) feet, Y= 1567661 (3908300) feet, N.M. Coordinate System CENTRAL Zone in the NON-GRANT Grant.

U.S.G.S. QUAD MAP:

(B) Drilling Contractor MURRAY DRILLING CO License No. WD-672

Address P.O. BOX 1567 BERNALILLO NM 87004 867-9500

Drilling Began 10/27/03 Completed 11/1/03 Type tools ROTARY Size of hole 7 7/8 in.

Elevation of land surface or _____ at well is + 2 ft. Total depth of well 760 ft.

Completed well is [X] shallow [ ] artesian. Depth to water upon completion of well 446 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
680	760	80	SMALL GRAVEL LARGE SAND	+/- 12

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
5	PVC	GLUE	+2	760	762	CLOSED	610	760

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
0	760	7 7/8	14		MUD PUMP

Section 5. PLUGGING RECORD

Plugging Contractor _____

Address _____

Plugging Method _____

Date Well Plugged _____

Plugging approved by:

_____

State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received

Quad _____ FWL _____ FSL _____

File No. _____ Use _____ Location No. _____

Section 6. LOG OF HOLE

Depth in Feet From	To	Thickness in Feet	Color and Type of Material Encountered
0	80	80	GRAVEL & RED SAND
80	90	10	RED SAND SMALL GRAVEL
90	100	10	GRAVEL, RED SAND & CLAY
100	130	30	RED CLAY & SAND
130	440	110	SAND & GRAVEL
440	460	20	SAND & TAN CLAY
460	680	220	SMALL GRAVEL & SAND
680	760	80	SMALL GRAVEL LARGE SAND

Section 7. REMARKS AND ADDITIONAL INFORMATION

ndersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above bed hole.

Tim Murray 1/6/03
Driller

RUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office e State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is l, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section 5 need be completed.

Appendix B.

Selected drawdown and recovery measurements taken during the 24-hour constant-rate pumping test at well RG-81338

Selected 24-hour constant rate aquifer pumping test measurements

Apache Mesa Subdivision test well RG-81338 pumping rate 28 gpm						
Automated measurements with transducer and datalogger						
Measuring point is top of sounding tube, 2.9 ft above ground level						
Date	Time	Elapsed time, min	t/t'	Water level, ft bmp	Drawdown, ft	notes
11/17/2003	10:30:00	0		452.46	0	pump on
11/17/2003	10:31:00	1		459.89	7.43	
11/17/2003	10:32:00	2		459.91	7.45	
11/17/2003	10:33:00	3		459.93	7.47	
11/17/2003	10:34:00	4		459.88	7.42	
11/17/2003	10:35:00	5		459.85	7.39	
11/17/2003	10:36:00	6		459.93	7.47	
11/17/2003	10:37:00	7		459.92	7.46	
11/17/2003	10:38:00	8		459.88	7.42	
11/17/2003	10:39:00	9		459.83	7.37	
11/17/2003	10:40:00	10		459.87	7.41	
11/17/2003	10:45:00	15		459.96	7.50	
11/17/2003	10:50:00	20		459.94	7.48	
11/17/2003	10:55:00	25		459.84	7.38	
11/17/2003	11:00:00	30		459.82	7.36	
11/17/2003	11:05:00	35		459.78	7.32	
11/17/2003	11:10:00	40		459.87	7.41	
11/17/2003	11:15:00	45		459.86	7.40	
11/17/2003	11:20:00	50		459.83	7.37	
11/17/2003	11:25:00	55		459.79	7.33	
11/17/2003	11:30:00	60		459.75	7.29	
11/17/2003	11:35:00	65		459.8	7.34	
11/17/2003	11:40:00	70		459.84	7.38	
11/17/2003	11:45:00	75		459.78	7.32	
11/17/2003	11:50:00	80		459.87	7.41	
11/17/2003	11:55:00	85		459.81	7.35	
11/17/2003	12:00:00	90		459.83	7.37	
11/17/2003	12:05:00	95		459.75	7.29	
11/17/2003	12:10:00	100		459.78	7.32	
11/17/2003	12:20:00	110		459.69	7.23	
11/17/2003	12:30:00	120		459.72	7.26	
11/17/2003	12:40:00	130		459.68	7.22	
11/17/2003	12:50:00	140		459.65	7.19	
11/17/2003	13:00:00	150		459.68	7.22	
11/17/2003	13:10:00	160		459.75	7.29	
11/17/2003	13:20:00	170		459.64	7.18	
11/17/2003	13:30:00	180		459.64	7.18	
11/17/2003	13:40:00	190		459.58	7.12	
11/17/2003	13:50:00	200		459.65	7.19	
11/17/2003	14:40:00	250		459.63	7.17	
11/17/2003	15:30:00	300		459.66	7.20	
11/17/2003	16:20:00	350		459.58	7.12	
11/17/2003	17:10:00	400		459.63	7.17	
11/17/2003	18:00:00	450		459.68	7.22	
11/17/2003	18:50:00	500		459.72	7.26	

11/17/2003	19:40:00	550		459.68	7.22	
11/17/2003	20:30:00	600		459.77	7.31	
11/17/2003	21:20:00	650		459.78	7.32	
11/17/2003	22:10:00	700		459.8	7.34	
11/17/2003	23:00:00	750		459.81	7.35	
11/17/2003	23:50:00	800		459.78	7.32	
11/18/2003	0:40:00	850		459.83	7.37	
11/18/2003	1:30:00	900		459.85	7.39	
11/18/2003	2:20:00	950		459.88	7.42	
11/18/2003	3:10:00	1000		459.94	7.48	
11/18/2003	4:50:00	1100		459.98	7.52	
11/18/2003	6:30:00	1200		459.99	7.53	
11/18/2003	8:10:00	1300		460.1	7.64	
11/18/2003	9:50:00	1400		460.12	7.66	
11/18/2003	10:26:00	1440		460.18	7.72	pump off
11/18/2003	10:27:00	1	1441	452.38	-0.08	recovery
11/18/2003	10:28:00	2	721	452.33	-0.13	
11/18/2003	10:29:00	3	481	452.31	-0.15	
11/18/2003	10:30:00	4	361	452.31	-0.15	
11/18/2003	10:31:00	5	289	452.32	-0.14	
11/18/2003	10:32:00	6	241	452.32	-0.14	
11/18/2003	10:33:00	7	206.714	452.32	-0.14	
11/18/2003	10:34:00	8	181	452.32	-0.14	
11/18/2003	10:35:00	9	161	452.32	-0.14	
11/18/2003	10:36:00	10	145	452.33	-0.13	
11/18/2003	10:41:00	15	97	452.35	-0.11	
11/18/2003	10:46:00	20	73	452.36	-0.10	
11/18/2003	10:51:00	25	58.6	452.39	-0.07	
11/18/2003	10:56:00	30	49	452.44	-0.02	
11/18/2003	11:01:00	35	42.1429	452.48	0.02	
11/18/2003	11:06:00	40	37	452.51	0.05	
11/18/2003	11:11:00	45	33	452.56	0.10	
11/18/2003	11:16:00	50	29.8	452.59	0.13	
11/18/2003	11:21:00	55	27.1818	452.62	0.16	
11/18/2003	11:26:00	60	25	452.63	0.17	
11/18/2003	11:31:00	65	23.1538	452.62	0.16	
11/18/2003	11:36:00	70	21.5714	452.63	0.17	
11/18/2003	11:41:00	75	20.2	452.63	0.17	
11/18/2003	11:46:00	80	19	452.62	0.16	
11/18/2003	11:51:00	85	17.9412	452.61	0.15	
11/18/2003	11:56:00	90	17	452.6	0.14	
11/18/2003	12:01:00	95	16.1579	452.6	0.14	
11/18/2003	12:06:00	100	15.4	452.59	0.13	
11/18/2003	13:46:00	200	8.2	452.59	0.13	
11/18/2003	15:26:00	300	5.8	452.63	0.17	
11/19/2003	9:54:00	1042	2.02564	452.47	0.01	

Appendix C.

Laboratory report for water-quality analyses and chain-of-custody forms, and NMED/DWB drinking water standards.

Hall Environmental Analysis Laboratory

COVER LETTER

December 05, 2003

Roger Peery
John Shomaker & Assoc.
2703-D Broadbent Pkwy NE
Albuquerque, NM 87107
TEL: (505) 280-1994
FAX (505) 345-9920

RE: Placitas/Apache

Order No.: 0311131

Dear Roger Peery:

Hall Environmental Analysis Laboratory received 1 sample on 11/18/2003 for the analyses presented in the following report.

These were analyzed according to EPA procedures or equivalent.

Reporting limits are determined by EPA methodology. No determination of compounds below these (denoted by the ND or < sign) has been made.

Please don't hesitate to contact HEAL for any additional information or clarifications.

Sincerely,

Andy Freeman, Business Manager
Nancy McDuffie, Laboratory Manager

Hall Environmental Analysis Laboratory

Date: *05-Dec-03*

CLIENT: John Shomaker & Assoc.
Lab Order: 0311131
Project: Placitas/Apache
Lab ID: 0311131-01

Client Sample ID: Placitas
Collection Date: 11/18/2003 9:05:00 AM
Matrix: AQUEOUS

Analyses	Result	Limit	Qual	Units	DF	Date Analyzed
EPA METHOD 300.0: ANIONS						Analyst: **BDH**
Fluoride	0.33	0.10		mg/L	1	11/18/2003 4:55:49 PM
Chloride	35	0.10		mg/L	1	11/18/2003 4:55:49 PM
Nitrogen, Nitrite (As N)	ND	0.10		mg/L	1	11/18/2003 4:55:49 PM
Nitrogen, Nitrate (As N)	0.16	0.10		mg/L	1	11/18/2003 4:55:49 PM
Sulfate	73	0.50		mg/L	1	11/18/2003 4:55:49 PM
EPA METHOD 310.1: ALKALINITY						Analyst: **MAP**
Alkalinity, Total (As CaCO3)	230	4.0		mg/L CaCO3	2	12/1/2003
Carbonate	ND	4.0		mg/L CaCO3	2	12/1/2003
Bicarbonate	230	4.0		mg/L CaCO3	2	12/1/2003
EPA METHOD 7470: MERCURY						Analyst: **MAP**
Mercury	ND	0.00040		mg/L	2	12/2/2003
EPA METHOD 6010C: DISSOLVED METALS						Analyst: **NMO**
Aluminum	ND	0.020		mg/L	1	11/20/2003 2:49:20 PM
Barium	0.072	0.0020		mg/L	1	11/20/2003 2:49:20 PM
Beryllium	ND	0.0030		mg/L	1	11/20/2003 2:49:20 PM
Cadmium	ND	0.0020		mg/L	1	11/20/2003 2:49:20 PM
Calcium	68	1.0		mg/L	1	11/20/2003 2:49:20 PM
Chromium	ND	0.0060		mg/L	1	11/20/2003 2:49:20 PM
Copper	ND	0.0060		mg/L	1	11/20/2003 2:49:20 PM
Iron	ND	0.020		mg/L	1	11/20/2003 2:49:20 PM
Lead	ND	0.0050		mg/L	1	11/20/2003 2:49:20 PM
Magnesium	6.2	1.0		mg/L	1	11/20/2003 2:49:20 PM
Manganese	0.0020	0.0020		mg/L	1	11/20/2003 2:49:20 PM
Nickel	ND	0.010		mg/L	1	11/20/2003 2:49:20 PM
Silver	ND	0.0050		mg/L	1	11/20/2003 2:49:20 PM
Sodium	52	1.0		mg/L	1	11/20/2003 2:49:20 PM
Zinc	0.12	0.050		mg/L	1	11/20/2003 2:49:20 PM
EPA METHOD 150.1: PH						Analyst: **MAP**
pH	7.70	0.010		pH units	1	12/1/2003
EPA METHOD 160.1: TDS						Analyst: **MAP**
Total Dissolved Solids	430	1.0		mg/L	1	11/24/2003
EPA METHOD 180.1: TURBIDITY						Analyst: **MAP**
Turbidity	ND	0.50		NTU	1	11/18/2003

Nephelometric Turbidity Units

Qualifiers:

ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
B - Analyte detected in the associated Method Blank
* - Value exceeds Maximum Contaminant Level
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
E - Value above quantitation range

ENERGY LABORATORIES, INC. *2393 Salt Creek Highway (82601)* P.O. Box 3258 * Casper, WY 82602
Toll Free 888.235.0515 * 307.235.0515 * Fax 307.234.1639 * casper@energylab.com

LABORATORY ANALYTICAL REPORT

Client: Hall Environmental
Project: Placitas/Apache
Lab ID: C03110650-001
Client Sample ID: Placitas 0311131-01

Report Date: 12/04/03
Collection Date: 11/18/03 09:05
Date Received: 11/19/03
Matrix: Aqueous

Analyses	Result	Units	Qual	RL	MCL/ QCL	Method	Analysis Date / By
NON-METALS							
Cyanide, Total Automated	ND	mg/L		0.005		E335.3	11/21/03 13:40 eli-b
PHYSICAL PROPERTIES							
Color	ND	c.u.		5.0		A2120 B	11/19/03 14:45 jl
Odor	NOO	T.O.N.	Threshold odor number	1.00		A2150 B	11/20/03 11:30 / jl
pH	7.67	s.u.		0.01		A4500-H B	11/19/03 14:45 / jl
Surfactants, MBAS	ND	mg/L		1.0		A5540 C	11/19/03 14:45 / jl
METALS - DISSOLVED							
Antimony	ND	mg/L		0.001		E200.8	11/22/03 01:32 / smd
Arsenic	0.011	mg/L		0.001		E200.8	11/22/03 01:32 / smd
Selenium	0.003	mg/L		0.001		E200.8	11/22/03 01:32 / smd
Thallium	ND	mg/L		0.001		E200.8	11/22/03 01:32 / smd

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

QA/QC Summary Report

Client: Hall Environmental
Project: Placitas/Apache

Report Date: 12/04/03
Work Order: C03110650

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A2120 B								Batch: R28728	
Sample ID: MBLK	Method Blank							11/19/03 14:45	
Color	ND	c.u.	5.00						
Sample ID: C03110650-001ADUP	Sample Duplicate							11/19/03 14:45	
Color	ND	c.u.	5.00				0	10	
Method: A2150 B								Batch: R28747	
Sample ID: MBLK	Method Blank							11/20/03 11:30	
Odor	NOO	T.O.N.	1.00						
Sample ID: C03110650-001ADUP	Sample Duplicate							11/20/03 11:30	
Odor	NOO	T.O.N.	1.00				0	20	
Method: A4500-H B								Batch: R28728	
Sample ID: MBLK	Method Blank							11/19/03 14:45	
pH	5.81	s.u.	0.0100						
Sample ID: C03110650-001ADUP	Sample Duplicate							11/19/03 14:45	
pH	7.71	s.u.	0.0100				0.6	10	
Method: A5540 C								Batch: R28728	
Sample ID: MBLK	Method Blank							11/19/03 14:45	
Surfactants, MBAS	ND	mg/L	1.00						
Sample ID: C03110650-001ADUP	Sample Duplicate							11/19/03 14:45	
Surfactants, MBAS	ND	mg/L	1.00				0	20	
Sample ID: C03110476-001ADUP	Sample Duplicate							11/19/03 14:45	
Surfactants, MBAS	0.425	mg/L	1.00				0	20	
Method: E200.8								Batch: R28832	
Sample ID: LRB	Method Blank							11/21/03 21:50	
Antimony	0.0000470	mg/L	0.00100						
Arsenic	ND	mg/L	0.00100						
Selenium	ND	mg/L	0.00100						
Thallium	ND	mg/L	0.00100						

Qualifiers: RL - Analyte reporting limit.

ND - Not detected a he reporting limit.

QA/QC Summary Report

Client: Hall Environmental
Project: Placitas/Apache

Report Date: 12/04/03
Work Order: C03110650

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
								Batch: B_A2003-11-21_4_CN__01	
Method: E335.3									
Sample ID: B03110933-001FMS	Matrix Spike							11/21/03 13:22	
Cyanide, Total Automated	0.112	mg/L	0.00500	112	80	120			
Sample ID: MBLK-3	Method Blank							11/21/03 10:45	
Cyanide, Total Automated	ND	mg/L	0.00500						
Sample ID: B03110933-001FMSD	Matrix Spike Duplicate							11/21/03 13:24	
Cyanide, Total Automated	0.114	mg/L	0.00500	114	80	120	1.9	10	

Qualifiers: RL - Analyte reporting limit.

ND - Not detected a he reporting limit.

Date: *05-Dec-03*

Hall Environmental Analysis Laboratory

CLIENT: John Shomaker & Assoc.
Work Order: 0311131
Project: Placitas/Apache

QC SUMMARY REPORT
Method Blank

Sample ID: **MB 111803** Batch ID: **R10145** Test Code: **E300** Units: **mg/L** Analysis Date: **11/18/2003 11:33:10 A** Prep Date:
Client ID: Run ID: **LC_031118A** SeqNo: **227630**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Fluoride	ND	0.10									
Chloride	ND	0.10									
Nitrogen, Nitrite (As N)	ND	0.10									
Nitrogen, Nitrate (As N)	ND	0.10									
Sulfate	ND	0.50									

Sample ID: **MBLK** Batch ID: **R10218** Test Code: **E310.1** Units: **mg/L CaCO3** Analysis Date: **12/1/2003** Prep Date:
Client ID: Run ID: **WC_031201B** SeqNo: **229379**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity, Total (As CaCO3)	ND	2.0									
Carbonate	ND	2.0									
Bicarbonate	ND	2.0									

Sample ID: **MB-4760** Batch ID: **4760** Test Code: **SW7470** Units: **mg/L** Analysis Date: **12/2/2003** Prep Date: **12/2/2003**
Client ID: Run ID: **MI-LA254_031202A** SeqNo: **229697**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	ND	0.00020									

Sample ID: **MB-4772** Batch ID: **4772** Test Code: **SW7470** Units: **mg/L** Analysis Date: **12/4/2003** Prep Date: **12/3/2003**
Client ID: Run ID: **MI-LA254_031204A** SeqNo: **230381**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	ND	0.00020									

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank

CLIENT: John Shomaker & Assoc.
Work Order: 0311131
Project: Placitas/Apache

QC SUMMARY REPORT
Method Blank

Sample ID: **MBLK** Batch ID: **R10170** Test Code: **SW6010A** Units: **mg/L** Analysis Date: **11/20/2003 2:09:52 PM** Prep Date:
Client ID: Run ID: **ICP_031120B** SeqNo: **228268**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aluminum	ND	0.020									
Barium	ND	0.0020									
Beryllium	ND	0.0030									
Cadmium	ND	0.0020									
Calcium	0.2634	1.0									J
Chromium	ND	0.0060									
Copper	ND	0.0060									
Iron	ND	0.020									
Lead	ND	0.0050									
Magnesium	0.2086	1.0									J
Manganese	ND	0.0020									
Nickel	0.0002292	0.010									J
Silver	ND	0.0050									
Sodium	0.2184	1.0									J
Zinc	0.005876	0.050									J

Sample ID: **MB-4703** Batch ID: **4703** Test Code: **E160.1** Units: **mg/L** Analysis Date: **11/24/2003** Prep Date: **11/21/2003**
Client ID: Run ID: **WC_031124C** SeqNo: **228600**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total Dissolved Solids	ND	1.0									

Sample ID: **MBLK** Batch ID: **R10144** Test Code: **E180.1** Units: **NTU** Analysis Date: **11/18/2003** Prep Date:
Client ID: Run ID: **WC_031118A** SeqNo: **227622**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Turbidity	0.06	0.50									J

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank

Date: *05-Dec-03*

Hall Environmental Analysis Laboratory

CLIENT: John Shomaker & Assoc.
Work Order: 0311131
Project: Placitas/Apache

QC SUMMARY REPORT
Sample Duplicate

Sample ID: **0311131-01A** Batch ID: **R10144** Test Code: **E180.1** Units: **NTU** Analysis Date: **11/18/2003** Prep Date:
Client ID: **Placitas** Run ID: **WC_031118A** SeqNo: **227625**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Turbidity	0.04	0.50	0	0	0	0	0	0.05	0	20	J

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank

1

Hall Environmental Analysis Laboratory

Date: *05-Dec-03*

CLIENT: John Shomaker & Assoc.
Work Order: 0311131
Project: Placitas/Apache

QC SUMMARY REPORT
Laboratory Control Spike - generic

Sample ID: **LCS 111803** Batch ID: **R10145** Test Code: **E300** Units: **mg/L** Analysis Date: **11/18/2003 11:49:54 A** Prep Date:
Client ID: Run ID: **LC_031118A** SeqNo: **227631**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Fluoride	0.4767	0.10	0.5	0	95.3	90	110	0			
Chloride	4.698	0.10	5	0	94.0	90	110	0			
Nitrogen, Nitrite (As N)	0.904	0.10	1	0	90.4	90	110	0			
Nitrogen, Nitrate (As N)	2.331	0.10	2.5	0	93.2	90	110	0			
Sulfate	9.4	0.50	10	0	94.0	90	110	0			

Sample ID: **LCS-4760** Batch ID: **4760** Test Code: **SW7470** Units: **mg/L** Analysis Date: **12/2/2003** Prep Date: **12/2/2003**
Client ID: Run ID: **MI-LA254_031202A** SeqNo: **229698**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	0.004754	0.00020	0.005	0	95.1	75.2	134	0			

Sample ID: **LCSD-4760** Batch ID: **4760** Test Code: **SW7470** Units: **mg/L** Analysis Date: **12/2/2003** Prep Date: **12/2/2003**
Client ID: Run ID: **MI-LA254_031202A** SeqNo: **229699**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	0.005068	0.00020	0.005	0	101	75.2	134	0.004754	6.39	0	

Sample ID: **LCS-4772** Batch ID: **4772** Test Code: **SW7470** Units: **mg/L** Analysis Date: **12/4/2003** Prep Date: **12/3/2003**
Client ID: Run ID: **MI-LA254_031204A** SeqNo: **230382**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	0.004491	0.00020	0.005	0	89.8	75.2	134	0			

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank

CLIENT: John Shomaker & Assoc.
Work Order: 0311131
Project: Placitas/Apache

QC SUMMARY REPORT
Laboratory Control Spike Duplicate

Sample ID: **LCSD-4772** Batch ID: **4772** Test Code: **SW7470** Units: **mg/L** Analysis Date: **12/4/2003** Prep Date: **12/3/2003**
Client ID: Run ID: **MI-LA254_031204A** SeqNo: **230383**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	0.005345	0.00020	0.005	0	107	75.2	134	0.004491	17.4	0	

Sample ID: **LCS** Batch ID: **R10170** Test Code: **SW6010A** Units: **mg/L** Analysis Date: **11/20/2003 2:11:31 PM** Prep Date:
Client ID: Run ID: **ICP_031120B** SeqNo: **228269**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aluminum	0.4865	0.020	0.5	0	97.3	80	120	0			
Barium	0.4554	0.0020	0.5	0	91.1	80	120	0			
Beryllium	0.4774	0.0030	0.5	0	95.5	80	120	0			
Cadmium	0.4693	0.0020	0.5	0	93.9	80	120	0			
Calcium	48.13	1.0	50	0.2634	95.7	80	120	0			
Chromium	0.4653	0.0060	0.5	0	93.1	80	120	0			
Copper	0.469	0.0060	0.5	0	93.8	80	120	0			
Iron	0.4671	0.020	0.5	0	93.4	80	120	0			
Lead	0.4628	0.0050	0.5	0	92.6	80	120	0			
Magnesium	47.19	1.0	50	0.2086	94.0	80	120	0			
Manganese	0.4741	0.0020	0.5	0	94.8	80	120	0			
Nickel	0.444	0.010	0.5	0.0002292	88.8	80	120	0			
Silver	0.4563	0.0050	0.5	0	91.3	80	120	0			
Sodium	46.99	1.0	50	0.2184	93.5	80	120	0			
Zinc	0.4654	0.050	0.5	0.005876	91.9	80	120	0			

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank

CLIENT: John Shomaker & Assoc.
Work Order: 0311131
Project: Placitas/Apache

QC SUMMARY REPORT
Laboratory Control Spike Duplicate

Sample ID: **LCSD** Batch ID: **R10170** Test Code: **SW6010A** Units: **mg/L** Analysis Date: **11/20/2003 2:15:26 PM** Prep Date:
Client ID: Run ID: **ICP_031120B** SeqNo: **228270**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aluminum	0.4788	0.020	0.5	0	95.8	80	120	0.4865	1.59	20	
Barium	0.4479	0.0020	0.5	0	89.6	80	120	0.4554	1.66	20	
Beryllium	0.4732	0.0030	0.5	0	94.6	80	120	0.4774	0.890	20	
Cadmium	0.4603	0.0020	0.5	0	92.1	80	120	0.4693	1.95	20	
Calcium	47.07	1.0	50	0.2634	93.6	80	120	48.13	2.22	20	
Chromium	0.4566	0.0060	0.5	0	91.3	80	120	0.4653	1.89	20	
Copper	0.4612	0.0060	0.5	0	92.2	80	120	0.469	1.67	20	
Iron	0.4598	0.020	0.5	0	92.0	80	120	0.4671	1.57	20	
Lead	0.4472	0.0050	0.5	0	89.4	80	120	0.4628	3.43	20	
Magnesium	44.99	1.0	50	0.2086	89.6	80	120	47.19	4.77	20	
Manganese	0.4654	0.0020	0.5	0	93.1	80	120	0.4741	1.85	20	
Nickel	0.4366	0.010	0.5	0.0002292	87.3	80	120	0.444	1.68	20	
Silver	0.4493	0.0050	0.5	0	89.9	80	120	0.4563	1.55	20	
Sodium	47.27	1.0	50	0.2184	94.1	80	120	46.99	0.594	20	
Zinc	0.4574	0.050	0.5	0.005876	90.3	80	120	0.4654	1.74	20	

Sample ID: **LCS-4703** Batch ID: **4703** Test Code: **E160.1** Units: **mg/L** Analysis Date: **11/24/2003** Prep Date: **11/21/2003**
Client ID: Run ID: **WC_031124C** SeqNo: **228601**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total Dissolved Solids	950	1.0	1000	0	95.0	80	120	0			

Sample ID: **LCS1** Batch ID: **R10144** Test Code: **E180.1** Units: **NTU** Analysis Date: **11/18/2003** Prep Date:
Client ID: Run ID: **WC_031118A** SeqNo: **227623**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Turbidity	43.6	0.50	42	0.06	104	90	110	0			

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank

CLIENT: John Shomaker & Assoc.
Work Order: 0311131
Project: Placitas/Apache

QC SUMMARY REPORT
Laboratory Control Spike - High

Sample ID: **LCS2** Batch ID: **R10144** Test Code: **E180.1** Units: **NTU** Analysis Date: **11/18/2003** Prep Date:
Client ID: Run ID: **WC_031118A** SeqNo: **227624**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Turbidity	584	0.50	584	0.06	100	90	110	0			

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank

Hall Environmental Analysis Laboratory

Sample Receipt Checklist

Client Name SHO

Date and Time Received: 11/18/2003

Work Order Number 0311131

Received by AT

Checklist completed by _____ 11/18/03
Signature | Date

Matrix

Carrier name Client drop-off

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐	
Custody seals intact on shipping container/cooler?	Yes ☐	No ☐	Not Present ☐	Not Shipped ☑
Custody seals intact on sample bottles?	Yes ☐	No ☐	N/A ☑	
Chain of custody present?	Yes ☑	No ☐		
Chain of custody signed when relinquished and received?	Yes ☑	No ☐		
Chain of custody agrees with sample labels?	Yes ☑	No ☐		
Samples in proper container/bottle?	Yes ☑	No ☐		
Sample containers intact?	Yes ☑	No ☐		
Sufficient sample volume for indicated test?	Yes ☑	No ☐		
All samples received within holding time?	Yes ☑	No ☐		
Water - VOA vials have zero headspace?	No VOA vials submitted ☑	Yes ☐	No ☐	
Water - pH acceptable upon receipt?	Yes ☐	No ☐	N/A ☑	
Container/Temp Blank temperature?	2°	*4° C ± 2 Acceptable* If given sufficient time to cool.		

COMMENTS:

Client contacted _____ Date contacted: _____ Person contacted _____

Contacted by: _____ Regarding _____

Comments: _____

Corrective Action _____

CHAIN-OF-CUSTODY RECORD

NELAC ☐ USACE ☐

Other:

Client: JSAI

Project Name: Placitas / Apache

Address: 2703 Broadbent Pkwy
Suite D
Albuquerque NM 87107

Project #:

Project Manager: RLP

Phone #: (505) 345-3407

Sampler: JTL

Fax #: (505) 345-9920

Sample Temperature: 2°C

Date	Time	Matrix	Sample I.D. No.	Number/Volume	Preservative $HgCl_2$	Preservative HNO_3	Preservative	HEAL No.
11/18/03	9:05	aqv.	Placitas	1 / 500 mL		✓		0311131-1
				1 / 125 mL			HNO3 ✓	
				1 / 250 mL			NaOH	
				1 / 1L			H2SO4	
				1 / 500mL			None	

Date: 11/18/03 Time: 12:20 Relinquished By: (Signature) Received By: (Signature) 11/18/03 Time 1225

Date: Time: Relinquished By: (Signature) Received By: (Signature)

Remarks: diss. Metals preserved in lab

AT 11/18/03

HALL ENVIRONMENTAL ANALYSIS LABORATORY
4901 Hawkins NE, Suite D
Albuquerque, New Mexico 87109
Tel. 505.345.3975 Fax 505.345.4107
www.hallenvironmental.com

ANALYSIS REQUEST

BTEX + MTBE + TMB's (8021)	BTEX + MTBE + TPH (Gasoline Only)	TPH Method 8015B (Gas/Diesel)	TPH (Method 418.1)	EDB (Method 504.1)	EDC (Method 8021)	8310 (PNA or PAH)	RCRA 8 Metals	Anions (F, Cl, NO_3, NO_2, PO_4, SO_4)	8081 Pesticides / PCB's (8082)	8260B (VOA)	8270 (Semi-VOA)	See Attached List	+ dissolved Metals			Air Bubbles or Headspace (Y or N)
												X	X			

Appendix D.

Summary of wells within a one-mile radius of the Apache Mesa Subdivision that are on file with the NMOSE.

Appendix D: Wells on file with the NMOSE that are known to be completed within a one-mile radius of the Apache Mesa Subdivision

NMOSE File no.	Use	Div	Owner	Well Number	Source	Tws	Rng	Sec	q	q	q	Begin date	Finish date	Well depth	Depth to water	Land surface elevation, ft amsl	Model row	Model column
RG 28434	DOM	3	LANNY J. AND DEBORAH L. LARSON	RG 28434	Shallow	12N	04E	1	0	0	0	4/16/1977	4/19/1977	320	60		9	8
RG 77927	DOM	3	STEVE & JACKIE WREGE	RG 77927	Shallow	12N	04E	1	1	2	4	8/19/2002	8/30/2002	1000	150	5720	9	10
RG 06594	DOM	3	TERRY & J. SHANNON JACKSON	RG 06594	Shallow	12N	04E	1				10/16/1961	10/20/1961	124	40		9	12
RG 51123 CLW	DOM	3	WILLIAM LEVIN	RG 51123 CLW	Shallow	12N	04E	1	0	0	0			94	58		9	12
RG 54195	DOM	3	JOHN BRALY	RG 54195	Shallow	12N	04E	1	2	3	3	8/12/1991	8/15/1991	463	278	5750	10	11
RG 60465	DOM	3	MICHAEL L. OJEDA	RG 60465	Shallow	12N	04E	1	2	3	2	10/19/1994	10/21/1994	320	200	5900	10	11
RG 01916	DOM	3	RICHARD LAWRENCE	RG 01916	Shallow	12N	04E	1	2	4	2	5/2/1958	5/5/1958	100	50	5890	10	12
RG 02007	DOM	3	B. M. ADAMS	RG 02007	Shallow	12N	04E	1	2	4	2	5/5/1958	5/9/1958	110	65	5890	10	12
RG 60497	DOM	3	JOHN B. ARANGO	RG 60497	Shallow	12N	04E	1	3	1	4	10/6/1994	10/6/1994	210	12	5760	11	9
				RG 54556 X	Shallow	12N	04E	1	1	1	1	12/3/1991	12/23/1991	830	504	5670		
RG 54556	MDW	16.737	ORVILE H. (TRUSTEE) UTRUP	RG 54556	Shallow	12N	04E	2	2	2	2	9/5/1991	9/8/1991	684		5740	9	8
RG 79076	DOM	3	KEVIN S. ALBERT	RG 79076	Shallow	13N	04E	25	3	2	2	11/7/2002	11/26/2002	690	430	5520	3	10
RG 55077	DOM	3	EDWARD ALLEN	RG 55077	Shallow	13N	04E	25	4	1	1	4/20/1992	6/28/1992	210	110	5560	3	11
RG 73262		0	JAMES E. BURKE	RG 73262	Shallow	13N	04E	25	4	1	1	6/5/2000	6/12/2000	700	515	5560	3	11
RG 18159	DOM	3	EQUITY MANGEMENT COMPANY	RG 18159	Shallow	13N	04E	25	0	0	0	9/13/1971	12/8/1971	490	335		4	11
RG 63688	DOM	3	MARY SLOAN	RG 63688	Shallow	13N	04E	26	2	1	1	1/10/1996	1/12/1996	590	470	5400	1	7
RG 72500	MUL	3	LAURIE PATTERSON	RG 72500	Shallow	13N	04E	26	2	2	1	8/23/2002	11/5/2002	650	340	5410	1	8
RG 04209	DOM	3	LONNIE BROWN	RG 04209	Shallow	13N	04E	26				2/22/1960	2/23/1960	100	23		3	8
RG 49802	MDW	115	LA MESA WATER CO-OP	RG 49802	Shallow	13N	04E	26	4	4		2/13/1989	2/24/1989	690	305	5590	4	8
RG 49516	IND	359	M.T. INVESTMENT CO.	RG 49516	Shallow	13N	04E	27	1	2	4	8/8/1989	8/11/1989	521	172	5250	1	2
RG 42562	MUL	80	DELASHE CORPORATION	RG 42562	Shallow	13N	04E	34	1	2		9/10/1984	9/14/1984	612	306	5350	5	2
RG 68625	DOM	3	VICTORIA M. URBAN	RG 68625	Shallow	13N	04E	34	1	2		10/30/1997	10/31/1997	420	183	5370	5	2
RG 72847		0	SKY MOUNTAINLLC	RG 72847	Shallow	13N	04E	34				9/20/1999	9/29/1999	600	354		6	1
RG 22598	DOM	3	JERRY BERGLUND	RG 22598	Shallow	13N	04E	34	0	0	0	3/10/1973	3/25/1973	419	368		6	2
RG 54168	DOM	3	STEPHEN ESPARZA	RG 54168	Shallow	13N	04E	34	1	3	3	7/16/1991	7/19/1991	478	310	5350	6	2
RG 54585	DOM	3	JEANNE VASTA	RG 54585	Shallow	13N	04E	34	1	3	3	11/18/1991	11/22/1991	435	239	5350	6	2
RG 71724		0	SKY MOUNTAIN, LOC	RG 71724	Shallow	13N	04E	34	1	4	3	4/1/1999	4/13/1999	463	316	5390	6	2
RG 34902	DOM	3	JOHN EBERLY	RG 34902	Shallow	13N	04E	34	0	0	0	10/8/1980	10/10/1980	530	385		6	4
RG 50833	DOM	3	DARREL BUFFINGTON	RG 50833	Shallow	13N	04E	34	0	0	0	5/22/1989	5/26/1989	555	395		6	4
RG 79271		0	DAVE HARPER	RG 79271	Shallow	13N	04E	34				12/27/2002	1/3/2003	500	390		6	4
RG 54846	DOM	3	DAVE PAFFETT	RG 54846	Shallow	13N	04E	34	3	1	2	2/9/1992	2/13/1992	490	297	5390	7	1
RG 58850	DOM	3	TERESA MALDONADO	RG 58850	Shallow	13N	04E	34	3	1	2	2/7/1994	2/11/1994	440	320	5350	7	1
RG 68922	MUL	3	LARRY MOORE	RG 68922	Shallow	13N	04E	34	3	1	4	12/2/1997	12/4/1997	500	200	5380	7	1
RG 38051	DOM	3	THOMAS J. ASH	RG 38051	Shallow	13N	04E	34	0	0	0	6/7/1982	6/19/1982	703	481		7	2
RG 72820	DOM	3	DAVID BOLTON	RG 72820	Shallow	13N	04E	34	3	4	1	3/15/2000	3/22/2000	510	342	5450	7	2
RG 76146	DOM	3	TREVOR REED	RG 76146	Shallow	13N	04E	34	3	2	2	10/24/2001	11/20/2001	455	340	5420	7	2
RG 40388	DOM	3	DON BOOTH	RG 40388	Shallow	13N	04E	34	0	0	0	9/22/1983	9/26/1983	452	370		7	3
RG 72215		0	DAVID BOLTON	RG 72215	Shallow	13N	04E	34	4	1	2	12/27/1999	12/31/1999	540	378	5410	7	3
RG 55692	MUL	3	TEVOR REED	RG 55692	Shallow	13N	04E	34	4	2		7/20/1992	7/21/1992	590	375	5480	7	4
RG 58580	MUL	3	DANIEL J. TALLON	RG 58580	Shallow	13N	04E	34	4	2	4	11/29/1993	12/5/1993	600	435	5500	7	4
RG 67149	MUL	3	DAVID C. BOLTON	RG 67149	Shallow	13N	04E	34	4	2	2	7/1/1997	7/9/1997	575	300	5480	7	4
RG 73907	DOM	3	MALTESE KROSS CORPORATION	RG 73907	Shallow	13N	04E	34	4	2	1	7/13/2000	7/19/2000	601	314	5460	7	4
RG 18782	DOM	3	ROBERT D. THOMPSON	RG 18782	Shallow	13N	04E	34	3	3	0	11/1/1971	11/15/1971	427	296	5450	8	1
RG 43849	COM	3	ALICE WOLF	RG 43849	Shallow	13N	04E	34	0	0	0	7/15/1985	7/17/1985	530	393		8	2
RG 72661	MUL	3	GAIL ANDREWS	RG 72661	Shallow	13N	04E	34	3	4	3	8/23/1999	8/25/1999	540	398	5460	8	2
RG 70264	DOM	3	CANDICE MCGUIRE	RG 70264	Shallow	13N	04E	34				7/21/1998	7/21/1998	400	221		8	3
RG 71433	DOM	3	CHARLES N. & ARLENE Y. ATWOOD	RG 71433	Shallow	13N	04E	34	4	3	3	3/29/1999	3/31/1999	500	372	5490	8	3
RG 72821	DOM	3	DAVID BOLTON	RG 72821	Shallow	13N	04E	34	4	3	1	9/6/2000	9/8/2000	560	395	5450	8	3
RG 11802	DOM	3	JAMES P. SWANN	RG 11802	Shallow	13N	04E	34	4	4	1	9/21/1964	10/10/1964	520	450	5460	8	4
RG 43031	DOM	3	DELONGCHAMP MICHAEL	RG 43031	Shallow	13N	04E	34	0	0	0	3/15/1985	3/18/1985	535	388		8	4
RG 44347	DOM	3	O.H. MILLS	RG 44347	Shallow	13N	04E	34	4	4	4	10/10/1985	10/10/1985	603	443	5500	8	4
RG 58560	DOM	3	MORGAN REED	RG 58560	Shallow	13N	04E	34	4	4	1			520	400	5460	8	4
RG 32283	DOM	3	ORVILE C. III MCCALLISTER	RG 32283	Shallow	13N	04E	35	0	0	0	4/17/1979	4/20/1979	621	440		5	5
RG 46599	DOM	3	GLEN MANTYCH	RG 46599	Shallow	13N	04E	35	0	0	0	10/26/1986	10/31/1986	625	500		5	5
RG 54634	DOM	3	BARBARA HASELDEN	RG 54634	Shallow	13N	04E	35	1	2	3	11/23/1991	12/5/1991	560	457	5480	5	5
RG 57191	DOM	3	DON MOON	RG 57191	Shallow	13N	04E	35	1	1	4	5/3/1993	5/7/1993	620	410	5470	5	5

RG 48759	MUL	3	BRAD & CONNIE GREER	RG 48759	Shallow	13N	04E	35	0	0	0	2/8/1988	2/13/1988	565	325			5	6
RG 53424	DOM	3	LOS VECINOS WATER SYSTEM	RG 53424	Shallow	13N	04E	35	1	2	4	3/8/1991	3/10/1991	660	410	5570		5	6
RG 59797	DOM	3	KIM WROBLEWSKI	RG 59797	Shallow	13N	04E	35	2	2	3	6/27/1994	6/30/1994	603	340	5520		5	6
RG 60701	DOM	3	MAX E. OR DIANE J. SATCHELL	RG 60701	Shallow	13N	04E	35	1	2	2	12/12/1900	12/14/1994	580	324	5440		5	6
RG 48073	DOM	3	JAMES E. GREEN	RG 48073	Shallow	13N	04E	35	0	0	0	8/26/1987	9/1/1987	545	430			5	7
RG 64580	DOM	3	SAM JONES	RG 64580	Shallow	13N	04E	35	2	1		8/1/1996	8/4/1996	560	318			5	7
RG 39211	DOM	3	JACK ROBERTS	RG 39211	Shallow	13N	04E	35	0	0	0	1/22/1983	1/23/1983	600	470			5	8
RG 54920	DOM	3	CHRISTINE DESMOND	RG 54920	Shallow	13N	04E	35	2	1	4	2/24/1992	2/26/1992	585	260	5500		5	8
RG 65209	SAN	3	DONALD & SHIRLEY CATES	RG 65209	Shallow	13N	04E	35	2	2	1	9/27/1996	10/2/1996	595	390	5480		5	8
RG 44484	DOM	3	HAROLD BOWERS	RG 44484	Shallow	13N	04E	35	0	0	0	10/21/1985	10/8/1985	850	700			6	5
RG 48424	MDW	1.05	HOMESTEADS EAST WATER COOP	RG 48424	Shallow	13N	04E	35	1	3	1	11/16/1987	11/20/1987	601	345	5460		6	5
RG 62805	DOM	3	DEL PACKWOOD	RG 62805	Shallow	13N	04E	35	1	3	4	9/18/1995	9/19/1995	620	410	5500		6	5
RG 70146	DOM	0	BOB AND MADELINE NASBY	RG 70146	Shallow	13N	04E	35	1	3	2	12/10/1998	12/21/1998	610	447	5480		6	5
RG 37344	DOM	3	O.D. MAES	RG 37344	Shallow	13N	04E	35	0	0	0	12/29/1981	1/8/1982	600	460			6	6
RG 58464	DOM	3	CHUCK T. SCHAKEL	RG 58464	Shallow	13N	04E	35	1	3	3	4/7/1994	4/10/1994	475	260	5460		6	6
RG 70482	MUL	3	ROBERT J. THORNTON	RG 70482	Shallow	13N	04E	35	1	4	2	8/19/1998	8/25/1998	598	435	5470		6	6
RG 37165	DOM	3	HERB SCHMIDT	RG 37165	Shallow	13N	04E	35	0	0	0	11/17/1981	11/25/1981	770	326			6	7
RG 45102	DOM	0	JOHN BORKERT	RG 45102	Shallow	13N	04E	35	2	3	2	3/11/1986	3/12/1986	181	90	5500		6	7
RG 72458	DOM	3	TED MOSER	RG 72458	Shallow	13N	04E	35	2	3	1	2/21/2000	3/3/2000	605	300	5530		6	7
RG 75056	DOM	3	SHAWN & PATRICIA WALLWORK	RG 75056	Shallow	13N	04E	35	2	3		2/23/2001	3/10/2001	600	450	5480		6	7
RG 44733	DOM	3	JAMES A. & BETSY K. HORKOVICH	RG 44733	Shallow	13N	04E	35	0	0	0	10/29/1985	11/8/1985	580	450			6	8
RG 67590	DOM	3	STEVEN K. KINNEY	RG 67590	Shallow	13N	04E	35	3	1	1	6/13/1997	6/19/1997	720	388	5500		7	5
RG 68855	MUL	3	PAUL GABALDON	RG 68855	Shallow	13N	04E	35	3	1	2	12/22/1997	1/7/1998	738	448	5480		7	5
RG 72457		0	PHILLIP BAXTER	RG 72457	Shallow	13N	04E	35	3	1	4	11/17/1999	11/30/1999	605	300	5520		7	5
RG 81338		0	APACHE MESA LLC	RG 81338	Shallow	13N	04E	35				10/27/2003	11/1/2003	760	445			7	5
RG 63457	DOM	3	JAMES R. OR ANNE LYNCH	RG 63457	Shallow	13N	04E	35	3	2	4	11/9/1995	11/15/1995	650	480	5540		7	6
RG 36424	DOM	3	MASON R. HISE	RG 36424	Shallow	13N	04E	35	0	0	0	4/16/1981	4/25/1981	650	385			7	7
RG 53108	DOM	3	DONALD DUSZYNSKI	RG 53108	Shallow	13N	04E	35	4	1	2	10/16/1990	10/19/1990	570	410	5560		7	7
RG 49616	DOM	3	BAYARD ROBERTS	RG 49616	Shallow	13N	04E	35	0	0	0	7/21/1988	8/5/1988	700	485			7	8
RG 43248 CL	W DOM	3	MEL HARRISON	RG 43248 CLW	Shallow	13N	04E	35	3	3	1	3/5/1985	3/7/1985	390	240	5500		8	5
RG 32505	DOM	3	MARK BARON	RG 32505 X	Shallow	13N	04E	35	3	4	1	12/6/1993	12/10/1993	633	490	5540		8	6
RG 58639	DOM	3	DOROTHY JACKMAN	RG 58639	Shallow	13N	04E	35	3	4	2	1/13/1994	1/19/1994	96	23	5530		8	6
RG 44638	MUL	3	JON & NANCY MELVILLE	RG 44638	Shallow	13N	04E	35	0	0	0	10/16/1985	10/28/1985	700	450			8	7
RG 52641	DOM	3	WAYNE BRUMMETT	RG 52641	Shallow	13N	04E	35	0	0	0	7/17/1990	7/18/1990	630	300			8	7
RG 40042	DOM	3	GENE & DIANA WATSON	RG 40042	Shallow	13N	04E	35	0	0	0	8/30/1983	9/10/1983	842	490			8	8
RG 56592	MUL	3	JON MC CALLISTER	RG 56592	Shallow	13N	04E	35	4	4	4	3/2/1993	3/5/1993	675	478	5700		8	8
RG 64202	DOM	3	PHYLLIS KNIGHT	RG 64202	Shallow	13N	04E	35	4	4	4	3/20/1996	3/27/1996	560	320	5700		8	8
RG 77710	DOM	3	JESSE W. SUMMERS	RG 77710	Shallow	13N	04E	35	4	4	1	9/4/2002	9/8/2002	660	427	5600		8	8
RG 10032	NOT	0	RANCHOS DE PLACITAS SANITATION	RG 10032	Shallow	13N	04E	36	1	1	3	1/22/1964	2/13/1964	501	132	5560		5	9
RG 59333	SAN	3	JOHN MCCALLISTER	RG 59333	Shallow	13N	04E	36	1	1	1	4/14/1994	4/16/1994	596	335	5520		5	9
RG 05100	DOM	3	N. J. EICH	RG 05100	Shallow	13N	04E	36				8/21/1960	9/1/1960	225	180			6	10
RG 05104	DOM	3	JOHN OREB JR.	RG 05104	Shallow	13N	04E	36				3/25/1961	3/28/1961	212	160			6	11
RG 67635	MUL	3	HOMEOWNERS' ASSOCIATION CORRAL	RG 67635	Shallow	13N	04E	36	3	1	4	6/9/1997	6/22/1997	370	30	5610		7	9
RG 05692	DOM	3	U.C. LUFT	RG 05692	Shallow	13N	04E	36				3/29/1961	4/6/1961	140	50			7	10
RG 05589	DOM	3	MRS. C. R. SEBASTIAN	RG 05589	Shallow	13N	04E	36				3/2/1961	3/20/1961	178	140			7	11
RG 59899	DOM	3	RONALD & PENNY PATTON	RG 59899	Shallow	13N	04E	36	4	1	1	7/5/1900	7/6/1994	440	39	5690		7	11
RG 69946		3	KAYEMAN, INC.	RG 69946	Shallow	13N	04E	36	4	1	4	7/21/1998	7/23/1998	280	45	5700		7	11
RG 74768	DOM	3	ABRAHAM J. AND JANET E. GOLDBE	RG 74768	Shallow	13N	04E	36	4	1	4	10/16/2000	10/24/2000	238	56	5700		7	11
RG 78589	DOM	3	RICHARD A. & JUDY WILSON	RG 78589	Shallow	13N	04E	36	4	2	1	12/11/2002	12/12/2002	400	50	5700		7	12

Appendix D: 100-year drawdowns in wells within a one-mile radius of Apache Mesa Subdivision as a result of pumping subdivision wells

Wells on file with the NMOSE known to be completed	Model observation well	Township	Range	Section	100-yr drawdown
Apache Mesa Subdivision wells, RG-43248	o40	13N	4E	35	1.36
RG-43031, RG-58560, RG-11802, RG-44347	o39	13N	4E	34	1.09
RG-67590, RG-68855, RG-72457, RG-81338	o28	13N	4E	35	1.06
RG-58639, RG-32505	o41	13N	4E	35	1.11
RG-73907, RG-67149, RG-55692, RG-58580	o27	13N	4E	34	0.99
RG-63457	o29	13N	4E	35	1.01
RG-72821, RG-70264, RG-71433	o38	13N	4E	34	0.97
RG-44638, RG-52641	o42	13N	4E	35	1.02
RG-53108, RG-36424	o30	13N	4E	35	0.96
RG-40388, RG-72215	o26	13N	4E	34	0.94
RG-44484, RG-70146, RG-62805, RG-48424	o18	13N	4E	35	0.93
RG-37344, RG-70482, RG-58464	o19	13N	4E	35	0.92
RG-43849, RG-72661	o37	13N	4E	34	0.93
RG-34902, RG-50833, RG-79271	o17	13N	4E	34	0.92
RG-45102, RG-72458, RG-75056, RG-37165	o20	13N	4E	35	0.89
RG-54556, RG-28434	o44	12N	4E	1	0.84
RG-18782	o36	13N	4E	34	0.92
RG-77710, RG-40042, RG-56592, RG-64202	o43	13N	4E	35	0.83
RG-76146, RG-38051, RG-72820	o25	13N	4E	34	0.92
RG-49616	o31	13N	4E	35	0.79
RG-58850, RG-54846	o24	13N	4E	34	0.91
RG-60497	o49	12N	4E	1	0.76
RG-60701, RG-48759, RG-53424, RG-59797	o11	13N	4E	35	0.86
RG-54634, RG-46599, RG-32283, RG-57191	o10	13N	4E	35	0.88
RG-71724, RG-22598, RG-54168, RG-54585	o16	13N	4E	34	0.89
RG-48073, RG-64580	o12	13N	4E	35	0.84
RG-44773	o21	13N	4E	35	0.76
RG-72847	o15	13N	4E	34	0.89
RG-68625, RG-42562	o9	13N	4E	34	0.87
RG-77927	o45	12N	4E	1	0.62
RG-67635	o32	13N	4E	36	0.61
RG-65209, RG-39211, RG-54920	o13	13N	4E	35	0.75
RG-60465	o48	12N	4E	1	0.62
RG-2007, RG-1916	o47	12N	4E	1	0.60
RG-6594, RG-51123	o46	12N	4E	1	0.58
RG-5692	o33	13N	4E	36	0.52
RG-49802	o8	13N	4E	26	0.77
RG-59333, RG-10032	o14	13N	4E	36	0.64
RG-59899, RG-5569, RG-69946, RG-74768	o34	13N	4E	36	0.52
RG-5100	o22	13N	4E	36	0.50
RG-49516	o1	13N	4E	27	0.81
RG-4209	o4	13N	4E	26	0.76
RG-78589	o35	13N	4E	36	0.51
RG-63688	o2	13N	4E	26	0.76
RG-5104	o23	13N	4E	36	0.49
RG-72500	o3	13N	4E	26	0.75
RG-79076	o5	13N	4E	25	0.72
RG-18159	o7	13N	4E	25	0.51
RG-55077, RG-73262	o6	13N	4E	25	0.62