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Characterization Wells R-9 and R-9i Geochemistry Report

Los Alamos
NATIONAL LABORATORY

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Groundwater Investigations Focus Area

Cover photo shows a modified Foremost DR-24 dual-rotary drill rig. The DR-24 is one of several drill-rig types being used for drilling, well installation, and well development in support of the Los Alamos National Laboratory Hydrogeologic Workplan. The Hydrogeologic Workplan is jointly funded by the Environmental Restoration Project and Defense Programs to characterize groundwater flow beneath the 43-square-mile area of the Laboratory and to assess the impact of Laboratory activities on groundwater quality. The centerpiece of the Hydrogeologic Workplan is the installation of up to 32 deep wells in the regional aquifer.

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List of Acronyms and Abbreviations

am	amorphous
bgs	below ground surface
°C	(degrees) Celsius
C	colorimetry
CVAA	cold vapor atomic absorption
DCG	derived concentration guideline
DOC	dissolved organic carbon
DOM	dissolved organic matter
DR	dual rotation
E^o	standard electrode potential in volts
Eh	oxidation-reduction potential
EPA	(U.S.) Environmental Protection Agency
ER	Environmental Restoration (Program)
ESP	Environmental Surveillance Program
GEL	General Engineering Laboratory
HE	high explosive
HFO	hydrous ferric oxide
HSA	hollow-stem auger

IC	ion chromatography
ICPMS	inductively coupled argon plasma mass spectrometry
ICPOES	inductively coupled argon plasma optical emission spectroscopy
IRMS	isotope ratio mass spectrometry
ISE	ion selective electrode
JMML	Jemez Mountains meteoric line
J values	estimated values
LANL	Los Alamos National Laboratory
MCL	maximum contaminant level
MDA	minimum detectable activity
MEQ	milliequivalents
µS/cm	microSiemans per centimeter
MWL	(worldwide) meteoric water line
NMWQCC	New Mexico Water Quality Control Commission
NTU	nephelometric turbidity unit
pH	negative $\log_{10}$ activity of the hydrogen ion
ppt	precipitate
psi	pound-force per square inch
SI	saturation index
TA	technical area
TD	total depth
TOC	total organic carbon
TW	test well

Metric to English Conversions

Multiply SI (Metric) Unit	by	To Obtain US Customary Unit
kilometers (km)	0.622	miles (mi)
kilometers (km)	3281	feet (ft)
meters (m)	3.281	feet (ft)
meters (m)	39.37	inches (in.)
centimeters (cm)	0.03281	feet (ft)
centimeters (cm)	0.394	inches (in.)
millimeters (mm)	0.0394	inches (in.)
micrometers or microns (µm)	0.0000394	inches (in.)
square kilometers (km^2)	0.3861	square miles (mi^2)
hectares (ha)	2.5	acres
square meters (m^2)	10.764	square feet (ft^2)
cubic meters (m^3)	35.31	cubic feet (ft^3)
kilograms (kg)	2.2046	pounds (lb)
grams (g)	0.0353	ounces (oz)
grams per cubic centimeter (g/cm^3)	62.422	pounds per cubic foot (lb/ft^3)
milligrams per kilogram (mg/kg)	1	parts per million (ppm)
micrograms per gram (µg/g)	1	parts per million (ppm)
liters (L)	0.26	gallons (gal.)
milligrams per liter (mg/L)	1	parts per million (ppm)
degrees Celsius (°C)	9/5 + 32	degrees Fahrenheit (°F)

CHARACTERIZATION WELLS R-9 AND R-9i GEOCHEMISTRY REPORT

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ABSTRACT

This report provides analytical results for groundwater obtained during four characterization sampling rounds conducted at regional aquifer well R-9 and perched-intermediate well R-9i from February 2000 through September 2001. Well R-9 was sampled on February 28, 2000; September 29, 2000; February 13, 2001; and May 15, 2001. Well R-9i was sampled September 14-15, 2000; February 20-21, 2001; June 11-12, 2001; and September 5-6, 2001. The goal of the characterization efforts at R-9 and R-9i was to assess hydrochemistry and to determine if contaminants existed in the perched zones and regional aquifer in the vicinity of the wells. A geochemical evaluation of the analytical results for the two wells is also presented.

Characterization wells R-9 and R-9i are located in Los Alamos Canyon west of the Los Alamos Canyon weir site within Technical Area (TA)-72, Los Alamos National Laboratory (LANL or the Laboratory). Well R-9i is located 35 feet west of R-9. Wells R-9 and R-9i are downgradient of multiple contaminant source areas that include release sites in the Los Alamos Canyon watershed. Wells R-9 and R-9i were completed on October 18, 1999, and March 11, 2000, respectively.

R-9 is completed with a single-screen well (683.0 to 748.5 ft) with a dedicated submersible pump set in the Santa Fe Group basalt. The regional water table was at a depth of 688 ft at well R-9 during characterization sampling. Well R-9i is completed with a double-screen well (189.1 to 199.5 ft and 269.6 to 280.3 ft) with a Westbay® Instrument, Inc., MP55® monitoring system set in the Cerros del Rio basalt. Perched water tables were at depths of 142 and 264 ft at well R-9i during characterization sampling.

Four rounds of groundwater characterization samples, collected from depths of 198.8 and 278.8 ft in well R-9i and from 741.4 ft in well R-9, were chemically characterized for radionuclides, metals and trace elements, major ions, high explosive (HE) compounds, dissolved organic carbon (DOC), organic compounds, and stable isotopes (H, N, and O). Analytical methods recommended by both the Environmental Protection Agency (EPA) and Environmental Restoration (ER) Project laboratories external to the Laboratory were followed for groundwater (filtered and nonfiltered) samples.

Analytical results for R-9 show that solute concentrations within the regional aquifer, excluding manganese (MCL of 0.05 mg/L), were below maximum contaminant levels (MCLs) established by the EPA. Americium-241, cesium-137, plutonium-238, plutonium-239,240, and strontium-90 generally were not detected in groundwater samples collected from wells R-9 and R-9i. Americium-241, at an activity of 0.0376 ± 0.0285 (3σ) pCi/L (minimum detectable activity [MDA} = 0.0134 pCi/L), was detected, however, in a groundwater sample collected from the upper perched zone at R-9i on the fourth sampling round, September 5, 2001. The derived concentration guideline (DCG) for americium-241, established by the Department of Energy (DOE) is 1.2 pCi/L. These radionuclides, if present, generally adsorb onto aquifer material and migrate in groundwater to a limited extent beneath the alluvium. Activities of uranium-234, uranium-235, and uranium-238 were only detected at concentrations less than 2 pCi/L in wells R-9 and R-9i. Gross alpha and gross beta activities were generally less than 5 pCi/L at well R-9. Measurable gross gamma between 60 and 310 pCi/L at well R-9 was attributed to isotopes within the natural uranium-238, uranium-235, and thorium-232 decay chains.

Groundwater from the regional aquifer in well R-9 is primarily a calcium-sodium-bicarbonate type. This groundwater was found to contain an average of 11.81 pCi/L tritium, 0.00181 milligrams/liter (mg/L)

(1.81 micrograms/L [µg/L]) dissolved uranium, 0.106 mg/L dissolved manganese, 7.1 mg/L dissolved chloride, 0.30 mg/L dissolved fluoride, 6.1 mg/L dissolved sulfate, and 0.6 mg/L nitrate plus nitrite (as N). Nitrate is the dominant nitrogen species present in groundwater collected from well R-9. Perchlorate was only detected in the first sampling round at 0.00165 mg/L (1.65 µg/L), a result only slightly greater than the method detection limit (MDL). Current analytical reporting and detection limits for perchlorate are 0.004 and 0.001 mg/L (4.0 and 1.0 µg/L), respectively, using ion chromatography.

Stable isotope ratios of δD and $\delta^{18}O$ imply that the sampled groundwater at both wells was derived from a local meteoric source consisting of precipitation and surface water. Activities of tritium at well R-9 ranging from 4.84 to 14.68 pCi/L suggest that a component of sampled groundwater is less than 60 years old and postdated the beginning of nuclear testing (based on the cosmogenic baseline of tritium of 1 pCi/L prior to testing). Average results of $\delta^{15}N$ (NO_3) analyses (+4.1‰) suggest that nitrate plus nitrite is derived from both natural and inactive multiple sources (sewage and nitrate derived from treated nitric acid discharges) within upper Los Alamos Canyon.

Perched groundwater in well R-9i is primarily a calcium-sodium-bicarbonate type with similar milliequivalents of calcium and sodium in both the upper and lower perched zones. The upper perched zone was found to contain an average of 200 pCi/L tritium, 0.000293 mg/L (0.293 µg/L) dissolved uranium, 25.1 mg/L dissolved chloride, 0.52 mg/L dissolved fluoride, 1.42 mg/L dissolved iron, 0.83 mg/L dissolved manganese, 0.083 mg/L dissolved nickel, 10.1 mg/L dissolved sulfate, and 0.28 mg/L total Kjeldahl nitrogen. The lower perched zone was found to contain an average of 132 pCi/L tritium, 0.000043 mg/L (0.043 µg/L) dissolved uranium, 18.7 mg/L dissolved chloride, 0.52 mg/L dissolved fluoride, 1.07 mg/L dissolved iron, 0.53 mg/L dissolved manganese, 0.043 mg/L dissolved nickel, 7.32 mg/L dissolved sulfate, and 0.25 mg/L total Kjeldahl nitrogen.

Concentrations of iron and manganese at R-9i exceeded the New Mexico Water Quality Control Commission (NMWQCC) standards for domestic water supply of 1.0 and 0.2 mg/L, respectively. They also exceeded EPA drinking water secondary standards for iron (0.3 mg/L) and manganese (0.05 mg/L). Concentrations of nickel exceeded the EPA standard of 0.1 mg/L in both perched zones for several sampling rounds. We conclude that the source of iron, manganese, and nickel is natural, and that observed concentrations of iron and nickel result from the dissolution and reduction of hydrous ferric oxide, a constituent of the Cerros del Rio basalt. Elevated activities of tritium above cosmogenic baseline (1 pCi/L) suggest that a component of sampled groundwater in well R-9i is less than 60 years old and postdated the beginning of nuclear testing.

Reducing conditions with respect to manganese and iron dominate in both perched zones because of the presence of reductants. Based on chemical data collected at R-9, native groundwater (prior to drilling R-9i), however, was oxidizing with respect to iron and manganese. Nitrate plus nitrite (as N) and perchlorate were less than detection in well R-9i.

Geochemical calculations using the computer program MINTEQA2 were performed to evaluate solute speciation, adsorption/desorption, and mineral equilibrium in assessing groundwater chemistry and refining the geochemical conceptual model for wells R-9 and R-9i. Results suggest that the regional aquifer at well R-9 is undersaturated with respect to amorphous silica phases or volcanic glass, $UO_2(OH)_2$, $CaCO_3$, and $SrCO_3$. Alkalinity (HCO_3^-) provides ligands for complexing with nickel and uranium(VI). Uranium(VI) is calculated to be stable as $UO_2(CO_3)_2^{2-}$ and $UO_2(CO_3)_3^{4-}$ complexes under oxidizing conditions at well R-9. The upper perched zone in well R-9i is in close equilibrium with respect to $FeCO_3$ and $MnCO_3$ and is undersaturated with respect to amorphous silica phases or volcanic glass, $CaCO_3$, $SrCO_3$, and amorphous UO_2.

Reductive dissolution of $Fe(OH)_3$ in the presence of reductants consisting of residual drilling fluids and other chemical reductants may account for elevated concentrations of iron and nickel. This dissolution is hypothesized to enhance desorption of Ni^{2+}. Nickel is a natural trace element concentrated in olivine, a major mineral occurring in the Cerros del Rio basalt. Major cations and anions are calculated to occur as free or uncomplexed solutes. Calculation results agree well with observed mineralogy and groundwater analytical results. Americium is calculated to be stable as $AmCO_3^+$ (87.7%), $Am(CO_3)_2^-$ (8.3%), Am^{3+} (1.0%), and $AmOH^{2+}$ (2.4%) in the upper perched zone at well R-9i. Groundwater is calculated to be undersaturated with respect to $Am(OH)_3$, $Am(OH)_3am$, and $AmOHCO_3$, and transport of americium-241 is inferred to be controlled by adsorption processes at well R-9i.

1.0 INTRODUCTION

This report provides analytical results for four groundwater sampling rounds conducted at characterization wells R-9 and R-9i. The goal of the characterization efforts at R-9 and R-9i was to assess the hydrochemistry and to determine if contaminants are in the perched zones and regional aquifer in the vicinity of the wells. These wells are located in upper Los Alamos Canyon, in TA-72, within the Laboratory (Figure 1.0-1) (Broxton et al. 2001, 71250; Broxton et al. 2001, 71251). Wells R-9 and R-9i were installed by the ER Project as part of groundwater investigations required by the Los Alamos Canyon and Pueblo Canyon Work Plan (LANL 1995, 50290). They also satisfy requirements to install a well in this part of the regional aquifer as part of the "Hydrogeologic Workplan" (LANL 1998, 59599) in support of the Laboratory's "Groundwater Protection Management Program Plan" (LANL 1995, 50124).

Wells R-9 and R-9i were designed primarily to provide geochemical or water quality and hydrogeologic data for the regional aquifer and two perched zones within the Cerros del Rio basalt downgradient of potential release sites in the Los Alamos Canyon watershed (LANL 1995, 50290). Longmire et al. (1996) provides a discussion on the hydrochemistry of upper Los Alamos Canyon prior to the Cerro Grande Fire (Longmire et al. 1996, 54168). A geochemical evaluation of the analytical results for wells R-9 and R-9i is presented in this report.

Hydrogeochemical interpretations are presented using analytical results for groundwater samples collected at wells R-9 and R-9i. Discussion of other hydrogeochemical data collected within the Los Alamos Canyon watershed, however, is deferred until they can be evaluated in the context of sitewide information collected from other ER Project and "Hydrogeologic Workplan" characterization wells (R-7 and R-8). Once all deep groundwater investigations in Los Alamos Canyon are completed, geochemical and hydrogeologic conceptual models for the watershed may be included in a groundwater risk analysis. These models will include an evaluation of potential contaminant transport pathways.

Although R-9 and R-9i are primarily characterization wells, their design and construction also meet the requirements of a Resource Conservation and Recovery Act (RCRA)-compliant monitoring well as described in the EPA document RCRA Groundwater Monitoring: Draft Technical Guidance, November 1992, EPA 1530-R-93-001. Incorporation of these two wells into a Laboratory-wide groundwater monitoring program is planned but will be more specifically determined (e.g., sampling frequency, analytes, etc.) when the results of the R-9 and R-9i characterization activities are comprehensively evaluated in conjunction with other groundwater investigations in the "Hydrogeologic Workplan" (LANL 1998, 59599).

2.0 DRILLING METHODS AND WELL DESIGN

2.1 Drilling Methods

Drilling of R-9 was conducted from September 22, 1997, to February 3, 1998, using air-rotary techniques (Broxton et al. 2001, 71250). Drilling methods included downhole percussion hammers and dual-wall casing to drill open hole, a continuous core system to core open hole, and Holte/Stratex casing advance systems that operated on dual-wall casing and downhole percussion hammers. The borehole was completed to a depth of 771 ft, and the permanent well was installed utilizing a Foremost dual-rotation (DR)-24 drill rig. Well R-9 was completed on October 18, 1999.

R-9i was drilled during the period from March 6 through 9, 2000, using open-hole rotary methods (Broxton et al. 2001, 71251). The borehole was completed to a depth of 322 ft, and the permanent well was installed utilizing a Foremost dual-rotation (DR)-24 drill rig. Well R-9i was completed on March 11, 2000.

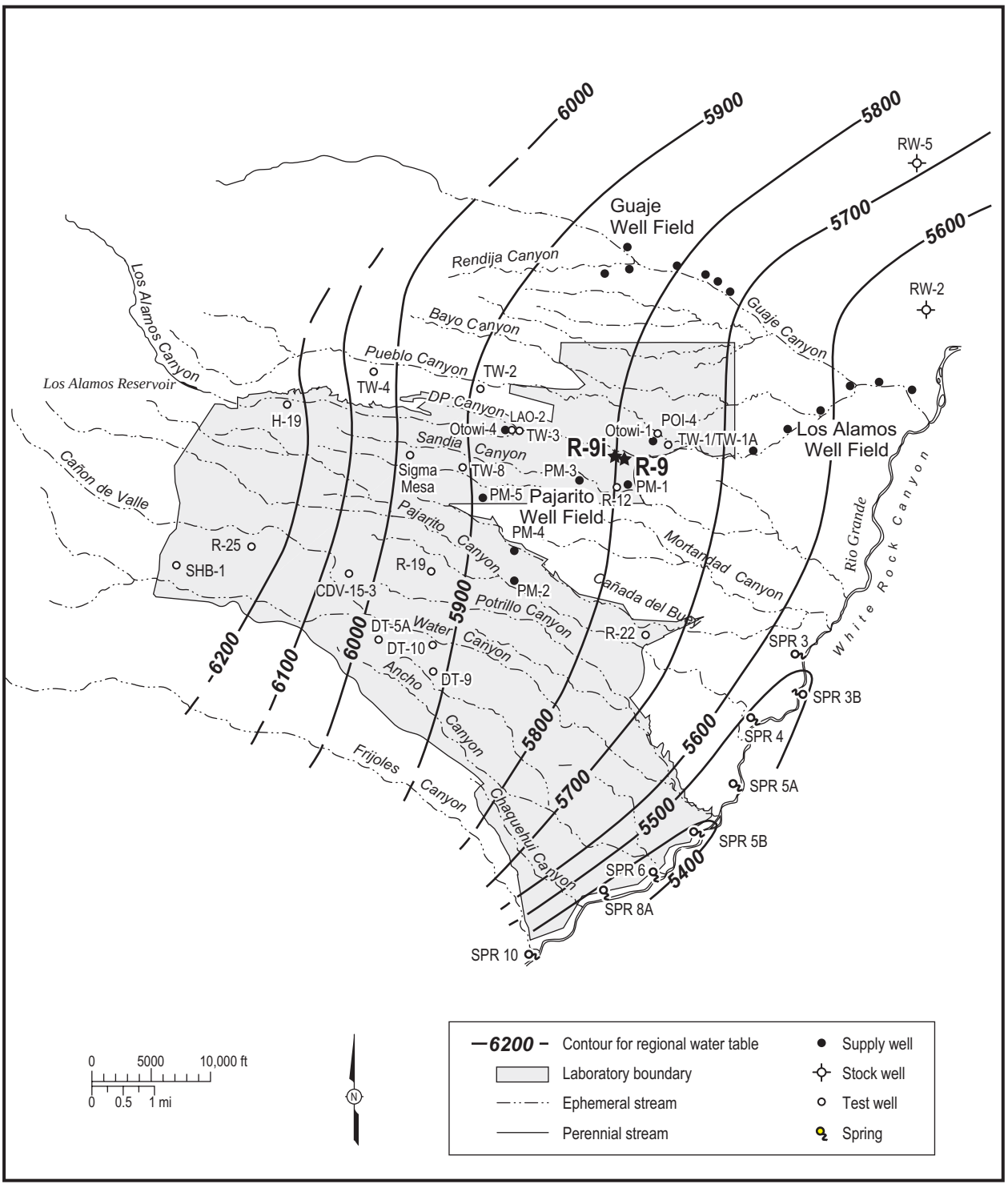

Figure 1.0-1. Locations of wells R-9 and R-9i, selected water supply wells, test wells, and springs near the Rio Grande, and generalized water-level contours for the regional aquifer

The casing-advance (open hole) drilling method was assisted by the use of drilling mud behind the casing for lubrication at R-9i. TORKease® polymer and EZ-MUD® bentonite slurries, mixed with community water obtained from a water line (spout) near the community landfill located at TA-3, were utilized for 100% of the borehole depth. These additives were used to lubricate the outside of the casing system during drilling and to prevent binding the casing string to the borehole wall or another casing string.

2.2 Well Design

Characterization well R-9 was designed as a single-completion well with a wire-wrapped, stainless steel screen. Figure 2.2-1 shows final construction information for well R-9. The screen, with a nominal length of 65.5 ft, is located across the top of the regional zone of saturation. The screen extends from 5 ft above the regional water table to approximately 60.5 ft into saturation. This screen length ensures that the well can continue to function even if the regional water table declines because of extraction of water from nearby supply wells.

A submersible pump was installed in well R-9 by Rio Grande Well Supply of Santa Fe, New Mexico. The pump is a 3-horsepower Grunfos™ Model 10S30-34, 4-in.-outer-diameter, submersible pump that operates on a 460-volt, 3-phase power supply provided by a portable diesel generator. The pump intake was set at 744 ft below the top of the 5-in. well casing (741.4 ft below ground surface [bgs]); this location places the intake approximately 53.4 ft below the static water level in the well. The pump was installed with a check valve and weep hole drilled in the riser pipe at a point near the static water level in the well to allow water to drain from the piping. The pump capacity is approximately 10 gal./min at 700-ft depth.

Before each groundwater sampling event at well R-9, approximately three casing volumes of groundwater were pumped from the well. Field parameters including pH, specific conductance, turbidity, and temperature were recorded during each well sampling event. Development of well R-9 took place after well completion (Broxton et al. 2001, 71250).

Characterization well R-9i was designed as a double-completion well with two wire-wrapped, stainless steel screens from 189.1 to 199.5 ft and 269.6 to 280.3 ft within the Cerros del Rio basalt (Broxton et al. 2001, 71251). Figure 2.2-2 shows final construction information for well R-9i. After well development, the Westbay® MP55 System® for groundwater monitoring was installed in the steel-cased well. Model 2523 MOSDAX® System sampler probe equipment was used to collect groundwater samples from the completed well.

Because of the low-flow (3.8-liters-per-hour) sampling method used at Westbay-constructed wells, no casing volumes of groundwater were pumped from R-9i prior to groundwater sampling events. Field parameters including pH, specific conductance, turbidity, and temperature were recorded during each sampling event.

3.0 HYDROGEOLOGY

3.1 Hydrostratigraphy

The principal hydrogeologic units penetrated in well R-9, in descending order, consist of alluvium, basaltic rocks of the Cerros del Rio volcanic field, older alluvium, the Puye Formation, and Santa Fe Group basalt (Broxton et al. 2001, 71250). Two perched zones of saturation were found, approximately between 180 and 236 ft and 264 and 282 ft in the Cerros del Rio basalt. A massive and unfractured basalt underlying the upper saturated zone appears to be one perching layer. The second perching layer is within the older alluvium that is clay rich (Broxton et al. 2001, 71250). Well R-9i penetrated the alluvium, basaltic rocks of the Cerros del Rio volcanic field, and the older alluvium.

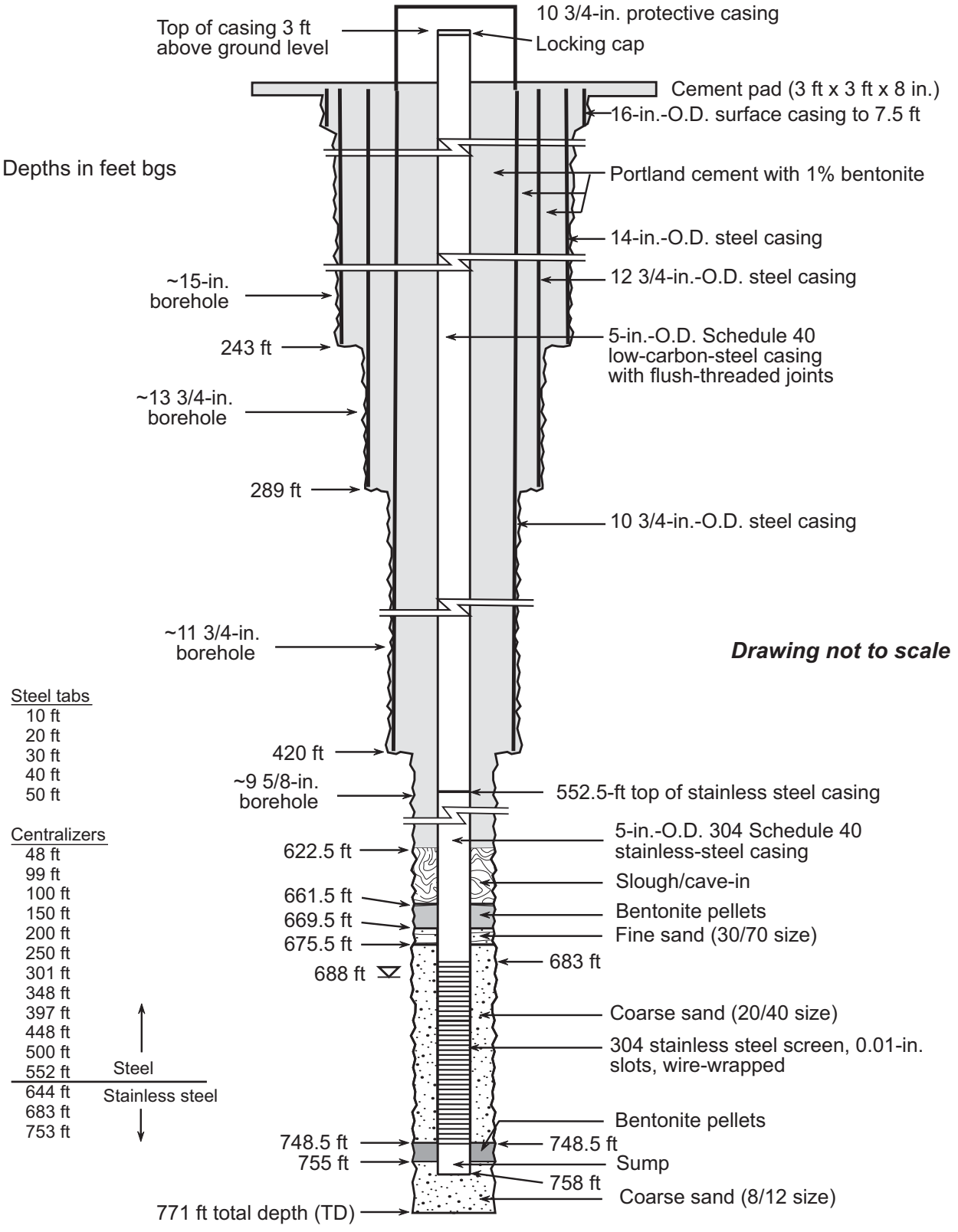

Figure 2.2-1. As-built well completion diagram of R-9 (Broxton et al. 2001, 71250)

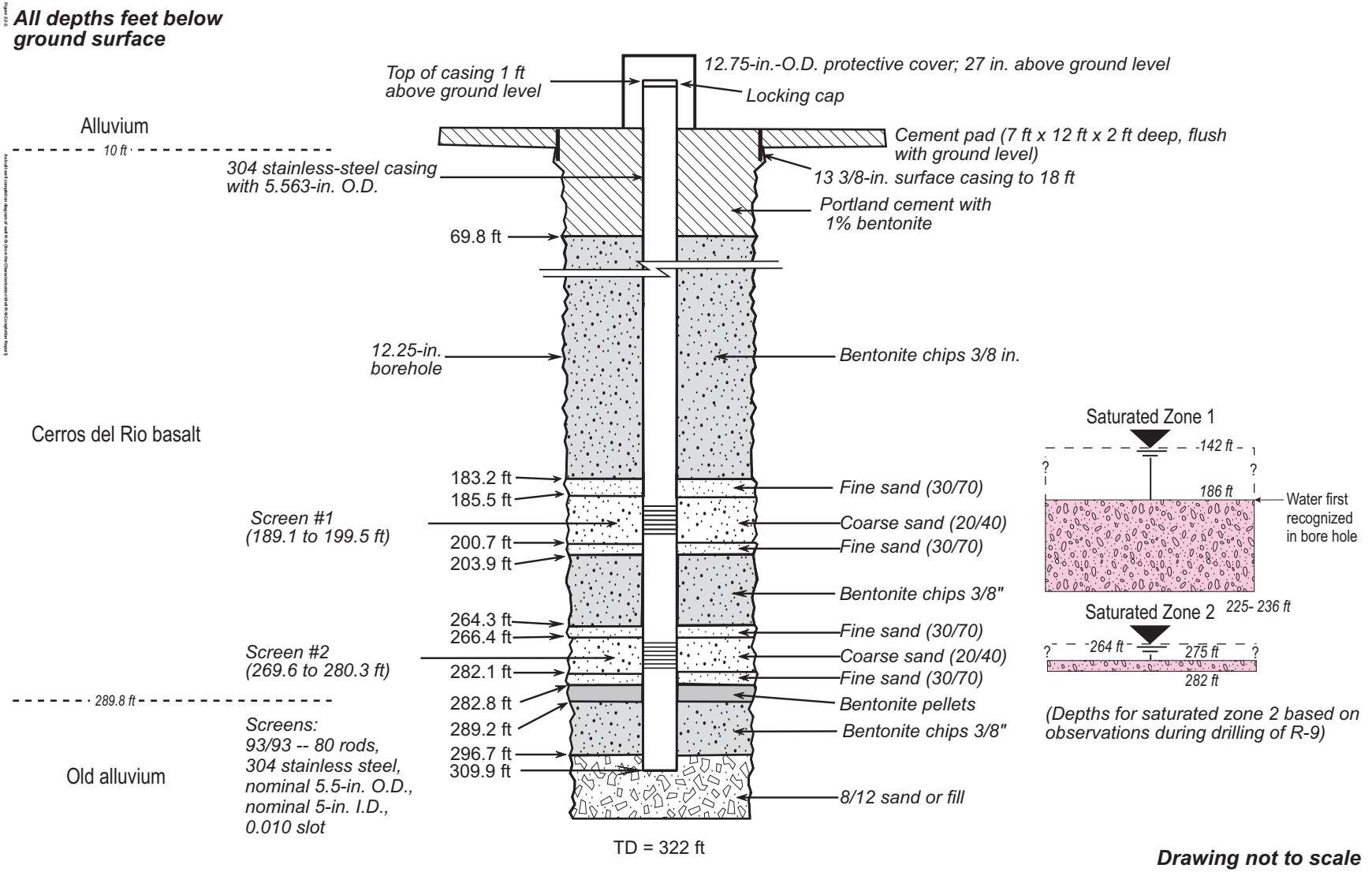

Figure 2.2-2. As-built well completion diagram of well R-9i (from the Characterization Well R-9i Completion Report) (Broxton et al. 2001, 71251)

An injection (slug) test was conducted for screen #1 (upper) in well R-9i. It yielded a value for hydraulic conductivity of 37.07 ft/day using the Bouwer-Rice analytical method (Broxton et al. 2001, 71251). Another injection test, conducted on screen #2 (lower), yielded a value for hydraulic conductivity of 0.79 ft/day using the same analytical method (Broxton et al. 2001, 71251). A 5-hr aquifer pumping test (at a rate of 15 gal./min) was conducted on screen #1 between April 5 and 7, 2000, (Broxton et al. 2001, 71251). From the aquifer performance test, a preliminary transmissivity was calculated as 5 to 10 ft^2/day. No aquifer performance testing was conducted on well R-9.

4.0 FIELD SAMPLING AND ANALYTICAL METHODS

4.1 Field Sampling Methods

Groundwater samples analyzed for inorganic and organic chemicals and radionuclides were collected using a dedicated submersible pump at well R-9 and the Westbay® MP55 system® at R-9i. Temperature, turbidity, pH, and specific conductance were determined on-site from an aliquot collected during field sampling. Both filtered and nonfiltered samples were collected for chemical and radiochemical analyses. Only filtered samples were collected for analyses of isotopic americium, cesium, plutonium, strontium, and uranium during the third and fourth sampling events. Nonfiltered samples were analyzed for gross alpha, gross beta, and gross gamma, which is a conservative approach used to determine if elevated radioactivity is present in the groundwater samples. Groundwater samples were collected for analyses of DOC; total organic carbon (TOC); stable isotopes of hydrogen, oxygen, and nitrogen; major cations and anions; metals; organic compounds; and radionuclides. Aliquots of the samples were filtered through a 0.45-µm Gelman filter and acidified with analytical-grade HNO_3 to a pH of 2.0 or less for metal and radionuclide analyses. DOC samples were filtered with a special 0.45-µm silver filter to eliminate biodegradation of organic solutes. All groundwater samples collected in the field were stored at 4°C until they were analyzed. Groundwater sampling took place approximately four months after completion at well R-9 and six months after completion at R-9i.

4.2 Field Parameters

Field-measured parameters for the groundwater samples, including pH, temperature, specific conductance, and turbidity, are provided in Tables 4.2-1a, 4.2-1b, and 4.2-1c. These parameters were measured at the time of sample collection when groundwater was in contact with the atmosphere. Temperature, specific conductance, and pH were measured with an Orion meter (model 1230); and turbidity was measured with a Hach meter (model 53600-00). Both meters were calibrated daily using buffer solutions (pH 4 and 7) and known standards for turbidity. Field measurements were recorded with daily activity logs submitted to the ER Project and are included with the analytical results. Turbidity generally decreases from the first to the fourth sampling round (Table 4.2-1). Turbidity values for these samples are less than 5 NTUs (Tables 4.2-1a, 4.2-1b, and 4.2-1c) and vary slightly during sampling events. Hydraulic pressure measurements were recorded in the field at well R-9i, which was equipped with the Westbay® MP55 system®. Increasing hydraulic pressure suggests an increase in elevation of the potentiometric surface or water table (Table 4.2-1b and 4.2-1c). Higher hydraulic pressure measurements were recorded in screen # 1 (198.8 ft) than in screen # 2 (278.8 ft) suggesting a vertical downward pressure gradient at well R-9i. Measurements of temperature recorded at well R-9i range from 12.2 to 21.8°C. The lowest measurements were measured in the winter of 2001.

Table 4.2-1a
Field-Measured Parameters for Groundwater Samples Collected at Well R-9

Geologic Unit	**Santa Fe Group basalt**	**Santa Fe Group basalt**	**Santa Fe Group basalt**	**Santa Fe Group basalt**
Depth (ft)	**741.4**	**741.4**	**741.4**	**741.4**
Date sampled (mo/dy/yr)	**02/28/00**	**09/29/00**	**02/13/01**	**05/15/01**
pH (standard units)	7.45	8.03	8.13	7.98
Temperature (°C)	22.7	23.4	23.0	22.8
Specific conductance (µS/cm[a])	239	200	259	255
Turbidity (NTU[b])	2.0	4.2	2.4	2.6

[a] µS/cm = microSiemens per centimeter.
[b] NTU = nephelometric turbidity unit.

Table 4.2-1b
Field-Measured Parameters for Groundwater Samples Collected at Well R-9i, Screen #1

Geologic Unit	**Cerros del Rio basalt**	**Cerros del Rio basalt**	**Cerros del Rio basalt**	**Cerros del Rio basalt**
Depth (ft)	**198.8**	**198.8**	**198.8**	**198.8**
Date sampled (mo/dy/yr)	**09/14/00**	**02/20/01**	**06/11/01**	**09/05/01**
Pressure (psi)[a]	36.24	35.46	38.04	36.97
pH (standard units)	8.04	7.35	6.58	7.22
Temperature (°C)	19.6	12.8	16.2	21.3
Specific conductance (µS/cm)	160	272	268	271
Turbidity (NTU)	3.0	1.2	0.8	Not measured

[a] Pressure is indicated in psi (pound-force per square inch).

Table 4.2-1c
Field-Measured Parameters for Groundwater Samples Collected at Well R-9i, Screen #2

Geologic Unit	**Cerros del Rio basalt**	**Cerros del Rio basalt**	**Cerros del Rio basalt**	**Cerros del Rio basalt**
Depth (ft)	**278.8**	**278.8**	**278.8**	**278.8**
Date sampled (mo/dy/yr)	**09/15/00**	**02/21/01**	**06/12/01**	**09/06/01**
Pressure (psi)	22.39	23.53	25.25	22.87
pH (standard units)	7.50	7.25	7.32	7.18
Temperature (°C)	13.5	12.3	17.2	21.8
Specific conductance (µS/cm)	140	215	192	183
Turbidity (NTU)	1.9	1.4	0.5	1.1

4.3 Analytical and Validation Methods

4.3.1 Analytical Methods

Groundwater samples were analyzed using techniques specified in EPA SW-846 methods including ion chromatography (IC) for bromide, chloride, fluoride, oxalate, nitrate plus nitrite, perchlorate, phosphate, and sulfate. Inductively coupled argon plasma optical emission spectroscopy (ICPOES) was the analytical method for trace elements (aluminum, arsenic, barium, boron, calcium, chromium, cobalt, copper, iron, magnesium, manganese, molybdenum, nickel, potassium, selenium, silicon [silica], silver, sodium, strontium, vanadium, and zinc). Total cyanide was analyzed by colorimetry (C), and mercury was analyzed by cold vapor atomic absorption (CVAA). Ammonium was analyzed by ion selective electrode (ISE). Antimony, beryllium, cadmium, lead, thallium, and uranium were analyzed by inductively coupled argon plasma mass spectrometry (ICPMS). Uranium was also analyzed by kinetic phosphorimetric analysis (KPA) during several sampling rounds. This work was performed by ER-Project-approved subcontractor laboratories including Paragon Analytics, Inc., (IC, C, ISE, CVAA, KPA, and ICPOES methods) and General Engineering Laboratory (GEL) (IC, C, ISE, CVAA, ICPOES, ICPMS methods and perchlorate-IC). Alkalinity was determined in the laboratory (Paragon and GEL) using standard titration techniques. Laboratory blanks were analyzed in accordance with EPA and Laboratory procedures. The precision limits for major ions and trace elements were generally ±10%. DOC fractionation was performed using an XAD-8 column at Huffman Laboratories. (Elution of hydrophobic and hydrophilic organic compounds is based on physical adsorption.)

Tritium activity in groundwater was determined by electrolytic enrichment and direct counting. Radiometric methods included alpha spectrometry for americium, plutonium, and uranium isotopes; gamma spectrometry for cesium-137 and other gamma-emitting isotopes; and gas proportional counting for strontium-90. These analyses were performed by contract laboratories including Severn Trent-Richland Laboratories (radionuclides) (fourth sampling round); Paragon Analytics, Inc., (radionuclides) (first, second, and third sampling rounds); and the University of Miami (low-level tritium).

Stable isotope ratios of oxygen ($\delta^{18}O$) and hydrogen (δD) were analyzed by Geochron Laboratories (Cambridge, Massachusetts) using isotope ratio mass spectroscopy (IRMS). Nitrogen isotope ratios ($\delta^{15}N\text{-}NO_3$) were analyzed by Coastal Science Laboratories, Inc., (Austin, Texas) using IRMS.

Volatile and semivolatile organic compounds, HE compounds, polychlorinated biphenyls, and pesticides were analyzed by high-pressure liquid chromatography and gas chromatography-mass spectrometry. Paragon Analytics, Inc., and GEL performed these organic analyses.

4.3.2 Validation Methods

Data quality validation, performed according to ER-Project standard operation procedures for routine data validation, was done on chemical and radiochemical analytical results for groundwater samples collected from wells R-9 and R-9i and revealed no deficiencies. Groundwater samples were analyzed within required holding times. Laboratory blanks, percent tracer recovery, laboratory duplicate samples, laboratory control samples, internal standards, spike recovery, and analyte concentrations relative to instrument detection and reporting (quantitation) limits were evaluated as part of the validation procedure. Charge balance errors for analytical results were calculated for major and trace ions using the computer program MINTEQA2. Percent charge balance is defined as follows:

(100)[(∑ milliequivalents cations - ∑ milliequivalents anions) divided by
(∑ milliequivalents cations + ∑ milliequivalents anions)].

"Detection" of a chemical in groundwater is defined as finding an analyte concentration that exceeds the instrument detection limit. "Detection" of a radionuclide in groundwater exists if its activity exceeds 3σ (three standard deviations) and the instrument MDA. The 3σ values for every radionuclide are contained in the ER Project database and were included as part of data validation. A nondetect is defined as an analyte concentration that is recorded but is less than the instrument detection limit. The reporting limit is defined as the instrument quantitation limit.

5.0 GROUNDWATER ANALYTICAL RESULTS

This section presents analytical results obtained during four sampling rounds conducted at well R-9 on February 28, 2000, on September 29, 2000, on February 13, 2001, and on May 15, 2001, and conducted at well R-9i on September 14 and 15, 2000, on February 20 and 21, 2001, on June 11 and 12, 2001, and on September 5 and 6, 2001. Analyte suites include major ions, trace elements-trace metals, radionuclides, stable isotopes, organic compounds, and DOC. Analytical results for well R-9 show that contaminant concentrations are below MCLs, excluding manganese with an EPA MCL of 0.05 mg/L, within the regional aquifer at this well location. Concentrations of iron, manganese, and nickel derived from natural sources exceed MCLs established by the EPA for these metals at well R-9i. Concentrations of iron and manganese are also above NMWQCC standards for these two solutes at the well.

5.1 Major Ions, Metals, Radionuclides, Organic Compounds, and Stable Isotopes

5.1.1 Well R-9

Selected results of inorganic and organic analytes measured at well R-9 are provided in Table 5.1-1 and complete analytical results are provided in Appendix A. Groundwater sampled at well R-9 had speciated charge-balance errors, calculated by MINTEQA2, less than ±10%. The positive charge-balance error in Table 5.1-1 indicates excess cations from analytical results, a finding which probably is the result of analytical errors within acceptable instrument precision (< ±10%) associated with ICPOES at Paragon Analytics, Inc., and GEL. Negative charge-balance errors in Table 5.1-1 indicate excess anions from analytical results, a finding which probably is the result of measurement of alkalinity off-site at Paragon Analytics, Inc., and GEL. Distributions of dissolved major ions and silica are shown in Figure 5.1-1. Groundwater at well R-9 is characterized by a calcium-sodium-bicarbonate ionic composition with calculated total dissolved solids (TDS) ranging between 256 and 259 mg/L (Figure 5.1-1). Average concentrations of dissolved chloride, fluoride, nitrate plus nitrite (as N), and sulfate are 7.06, 0.30, 0.63, and 6.10 mg/L, respectively.

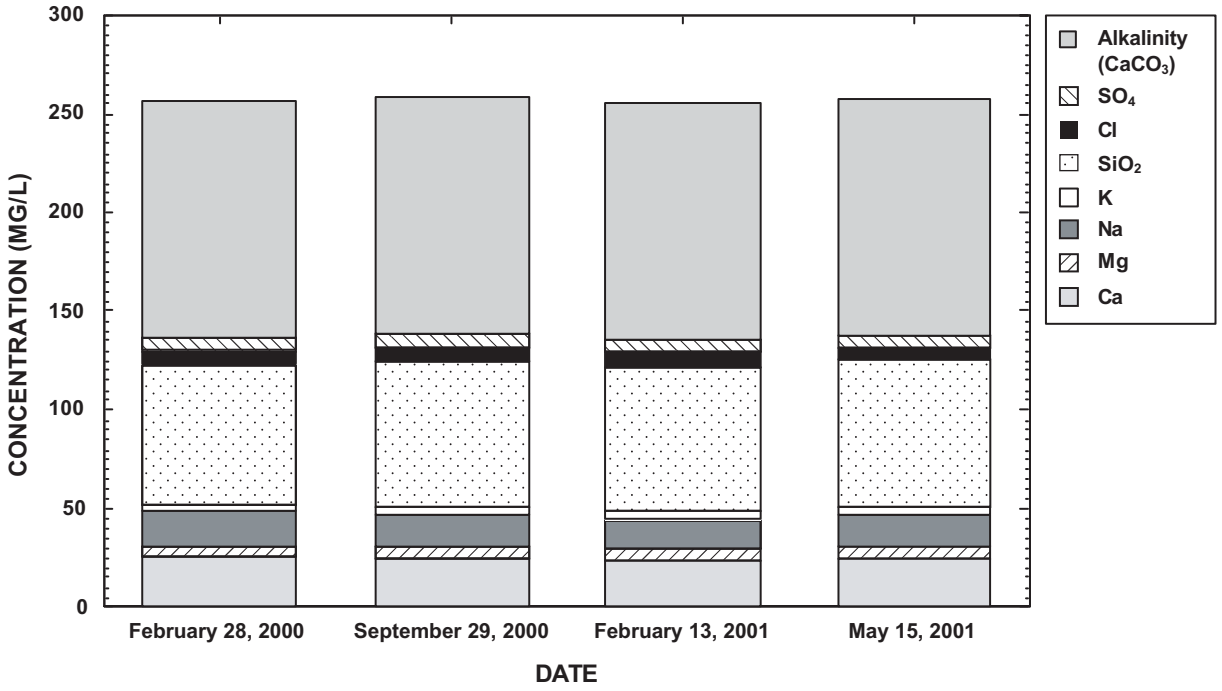

Figure 5.1-1. Major ion chemistry for well R-9 (regional aquifer), upper Los Alamos Canyon

Table 5.1-1
Hydrochemistry of Selected Analytes for Well R-9, Upper Los Alamos Canyon

Depth of Pump Intake (ft)	**741.4**	**741.4**	**741.4**	**741.4**
Geologic Unit	**Santa Fe Group**	**Santa Fe Group**	**Santa Fe Group**	**Santa Fe Group**
Sample Treatment	**Filtered**	**Filtered**	**Filtered**	**Filtered**
Date Sampled (mo/dy/yr)	**02/28/00**	**09/29/00**	**02/13/01**	**05/15/01**
Alkalinity ($CaCO_3$ mg/L)	120	120	120	120
Ca (mg/L)	26.0	25.0	24.0	25.0
Mg (mg/L)	5.6	5.9	5.7	5.8
Na (mg/L)	17.0	16.0	15.0	16.0
K (mg/L)	4.0	3.6	3.8	3.5
Cl (mg/L)	6.86	7.10	7.40	6.90
SiO_2 (mg/L)	70.6	74.5	72.8	74.9
SO_4 (mg/L)	5.79	6.30	6.40	5.90
NH_4 (mg/L)	<0.50, U[a]	<0.50, U	<0.50, U	<0.50, U
B (mg/L)	0.056	0.043	0.039	0.055
Ba (mg/L)	0.099	0.130	0.140	0.140
ClO_4 (mg/L)	0.00165	<0.0028, U	<0.000958, U	<0.00202, U
F (mg/L)	0.31	0.30	0.27	0.32
Fe (mg/L)	0.083	<0.027, U	<0.056, U	<0.053, U
Mn (mg/L)	0.190	0.071	0.080	0.084
Mo (mg/L)	<0.0033, U	<0.0031, U	<0.0045, U	<0.0038, U
Ni (mg/L)	0.0057	0.00095	0.0027	0.0015

Table 5.1-1 (continued)

Depth of Pump Intake (ft)	**741.4**	**741.4**	**741.4**	**741.4**
Geologic Unit	**Santa Fe Group**	**Santa Fe Group**	**Santa Fe Group**	**Santa Fe Group**
Date Sampled (mo/dy/yr)	**02/28/00**	**09/29/00**	**02/13/01**	**05/15/01**
NO_3 + NO_2 (as N) (mg/L)	0.52	0.65	0.68	0.69
Sr (mg/L)	0.16	0.16	0.15	0.16
P (total) (mg/L)	0.051	<0.050, U	<0.016, U	<0.050, U
DOC (mgC/L)	0.67	not reported	not reported	not reported
TOC (mgC/L), NF	26.0	2.7	not reported	not reported
TKN (mg/L)	<0.10, U	0.35	0.18	0.29
U (mg/L)	0.00172	0.00175	0.00185	0.00194
MEQ[b] cations	2.584E-03	2.485E-03	2.379E-03	2.478E-03
MEQ anions	2.546E-03	2.696E-03	2.720E-03	2.676E-03
Charge Balance (%)	+0.74	-4.07	-6.70	-3.84
Am-241 (pCi/L), F[c]	<0.013, U	<0.009, U	<0.009, U	<0.036, U
Cs-137 (pCi/L), F	<-0.5, U	not analyzed	<0.5, U	<0.6, U
Pu-238 (pCi/L), F	<-0.007, U	<0.019, U	<-0.007, U	<0.001, U
Pu-239,240 (pCi/L), F	<0.007, U	<0.017, U	<0.021, U	<0.021, U
Sr-90 (pCi/L), F	<0.04, U	<0.19, U	<0.01, U	<-0.4, U
Tritium (pCi/L), NF[d]	13.98	4.84	13.73	14.68
Gross alpha (pCi/L), NF	1.32	<1.9, U	<2.0, U	<0.7, U
Gross beta (pCi/L), NF	3.55	3.2	<3.4 U	<1.3, U
Gross gamma (pCi/L), NF	not reported	192	237	67
U-234 (pCi/L), F	1.14	1.26	1.31	1.04
U-235 (pCi/L), F	0.049	<0.021, U	<0.053, U	<0.013, U
U-238 (pCi/L), F	0.63	0.56	0.68	0.54
δD (‰), NF	-76	-75	-74	-70
$\delta^{15}N$ (NO_3) (‰), NF	+3.5	+4.6	+4.9	+3.6
$\delta^{18}O$ (‰), NF	-10.5	-10.4	-10.7	-10.6

[a] U = not detected.
[b] MEQ = milliequivalents.
[c] F= filtered.
[d] NF = non filtered.

These solutes are stable as anions and are generally conservative (mobile) in aqueous systems under oxidizing conditions (Langmuir 1997, 56037).

Nitrate is stable under oxidizing conditions and can be reduced to nitrogen gas in the presence of denitrifying bacteria and electron donors such as reduced manganese [Mn(II)] and iron [Fe(II)] and DOC (Langmuir 1997, 56037). Ammonium is less than detection at well R-9 (Table 5.1-1) and is less mobile in groundwater relative to nitrate and nitrite because of cation exchange. Dissolved silica is the second most

abundant solute in the Santa Fe Group basalt between 686 and >710 ft at well R-9 (Broxton et al. 2001, 71250).

Concentrations of perchlorate at well R-9 range from <0.000958 to 0.00165 mg/L (<0.958 to 1.65 µg/L) (Table 5.1-1). The MDL for the IC analysis of perchorate was reported to be 0.001 mg/L by the subcontractor laboratory. The MDL is determined using standard solutions prepared in an ultrapure water matrix. The subcontractor laboratory set a reporting limit of 0.004 mg/L for the method to reflect the effect of real groundwater matrices, which often contain interfering anions. The single detection of perchlorate at well R-9 is only slightly greater than the MDL and less than the reporting limit; therefore, the value should be regarded as having more uncertainty associated with it than a value that is greater than the reporting limit. Perchloric acid ($HClO_4$), however, was used in actinide research conducted at the Laboratory and is a constituent of the treated effluent discharged from former TA-1 and TA-21.

Concentrations of total and dissolved iron were less than detection for three sampling rounds conducted on February 13 and May 5, 2001 (Appendix A), a fact which suggests that groundwater is relatively oxidizing with respect to iron. Concentrations of manganese at well R-9 exceed the EPA secondary standard (0.05 mg/L) and approach the NMWQCC secondary standard of 0.2 mg/L for one sampling round. Concentrations of total and dissolved aluminum were 0.31 and <0.069 mg/L, respectively, during the first sampling event (Appendix A). Concentration differences between total and dissolved aluminum, iron, and manganese decreased during characterization sampling at well R-9, suggesting that suspended material was being removed during pumping. Concentrations of trace elements, including Sb, As, Ba, Be, Cd, Cr, Co, Cu, Pb, Hg, Mo, Ni, Se, Ag, Sr, Tl, U, V, and Zn were within the low-to-moderate microgram/liter range and were less than their respective MCLs in well R-9.

Activities of tritium measured in groundwater samples collected from the regional aquifer at well R-9 averaged 11.81 pCi/L and ranged from 4.84 to 14.68 pCi/L. These values were consistent with the value (14.43 pCi/L) measured during drilling of R-9 (Broxton et al. 2001, 71250). Activities of tritium were generally consistent over time at well R-9 (Table 5.1-1 and Appendix A). Activities of tritium suggested that some of the sampled groundwater was less than 60 years old and postdated the beginning of nuclear testing.

Activities of selected radionuclides measured at well R-9 are provided in Table 5.1-1 and Appendix A. Americium-241, cesium-137, plutonium-238, plutonium-239,240, and strontium-90 were not detected in the groundwater samples collected from well R-9. These radionuclides, if present, adsorb onto aquifer material and migrate in groundwater to a limited extent beneath the alluvium in upper Los Alamos Canyon based on sediment data reported by LANL (ESP 2000, 68661, and ESP 2002, 71301). Gross alpha and gross beta activities were generally less than detection (Table 5.1-1). Measurable gross gamma (67 to 237 pCi/L) was attributed to isotopes within the natural uranium-238, uranium-235, and thorium-232 decay chains (Langmuir 1997, 56037) (Table 5.1-1). Activities of uranium-238, uranium-235, and uranium-234 were less than 1.5 pCi/L in groundwater samples collected from R-9 (Appendix A).

Analyses of $\delta^{18}O$ and δD were performed on groundwater samples collected from wells R-9 and R-9i, and results are shown in Figure 5.1-2. The Jemez Mountains meteoric line (solid) and the worldwide meteoric water line (dashed) are denoted by JMML and MWL, respectively, in Figure 5.1-2. Interpretation of the $\delta^{18}O$ and δD results are similar for the four groundwater samples and borehole samples collected from R-9 and R-9i. The results for wells R-9 and R-9i indicate a meteoric source in which the groundwater samples plot close to both the JMML and MWL (Figure 5.1-2). Isotopic variations in $\delta^{18}O$ and δD are minimal at well R-9, which indicates a long residence time for regional aquifer groundwater and a small amount of local recharge to the regional aquifer at the well site. This finding is also consistent with anion profiles characterized by overall concentration decreases with depth in the saturated perched zones presented by Broxton et al. (2001, 71250) for borehole R-9. Groundwater samples collected from R-9i are

isotopically lighter in $\delta^{18}O$, which suggests that the source of recharge to the perched zones is of a higher elevation relative to that of the regional aquifer at well R-9. There is more isotopic variation in $\delta^{18}O$ and δD for R-9i, which suggests seasonal affects associated with recharge water derived from surface water and alluvial groundwater.

Groundwater samples collected from well R-9 were analyzed for $\delta^{15}N$ (NO_3), with results of +3.5, +4.6, +4.9, and +3.6‰ (Table 5.1-1). These values show some fractionation (enrichment and denitrification of ^{15}N) resulting from a combination of natural nitrate plus nitrite, nitrate derived from dissociated HNO_3, and nitrate from past treated sewage effluents discharged to Los Alamos Canyon. Concentrations of dissolved nitrate plus nitrite (as N) in well R-9 ranged from 0.52 to 0.69 mg/L (Table 5.1-1).

TOC concentrations measured during two sampling events conducted on February 28 and September 29, 2000, were 26.0 and 2.70 mg/L, respectively. The elevated TOC values indicated the presence of residual drilling fluids (EZ-MUD® copolymer) during the first two sampling events conducted at well R-9.

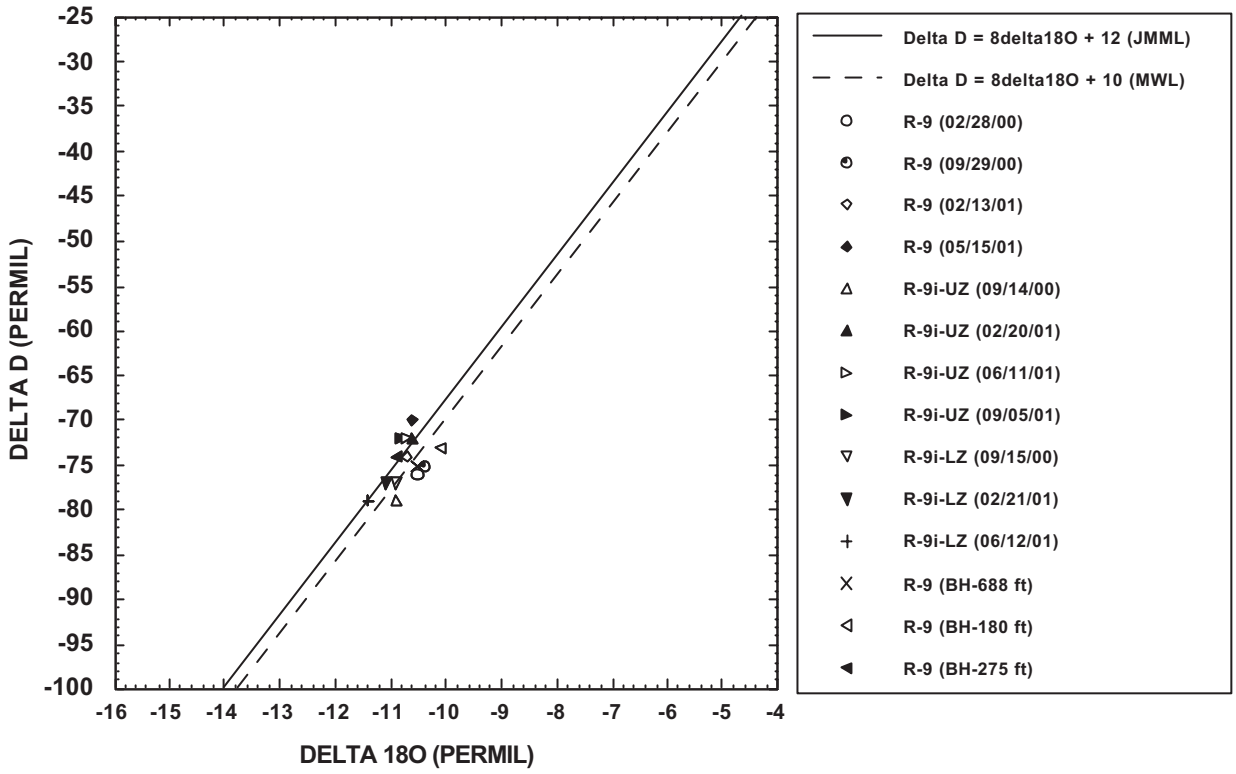

Figure 5.1-2. Stable isotope results for wells R-9 and R-9i in upper Los Alamos Canyon

Volatile and semivolatile organic compounds generally were not detected at well R-9, except for benzene (1.9 µg/L) and toluene (1.1 µg/L) detected during the first sampling round, February 28, 2000. Toluene (12 µg/L) was detected during the second sampling round, September 29, 2000; and toluene (2.5 µg/L) was detected during the third sampling round, February 13, 2000. The occurrence of benzene and toluene (below regulatory limits) at well R-9 could be related to petroleum products because of their co-occurrence, however, ethylbenzene, and xylene isomers were not detected. These other organic compounds are common constituents of gasoline and diesel fuel. HE compounds or their degradation products were not detected at well R-9.

5.1.2 Well R-9i

Selected results of inorganic and organic analytes measured at well R-9i are provided in Tables 5.1-2 and 5.1-3, and complete analytical results are provided in Appendix A. Groundwater sampled at well R-9i (upper perched zone) had speciated charge-balance errors less than ±10%. Positive charge-balance errors in Table 5.1-3 indicate excess cations from analytical results. The negative charge-balance error in Tables 5.1-3 indicates excess anions from analytical results, a finding that probably is the result of measurement of alkalinity off-site at Paragon Analytics, Inc., and GEL.

Table 5.1-2
Hydrochemistry of Selected Analytes for Well R-9i (Lower Zone), Upper Los Alamos Canyon

Depth of Measurement Port (ft)	**278.8**	**278.8**	**278.8**	**278.8**
Geologic Unit	**Cerros del Rio Basalt**	**Cerros del Rio Basalt**	**Cerros del Rio Basalt**	**Cerros del Rio Basalt**
Sample Treatment	**Filtered**	**Filtered**	**Filtered**	**Filtered**
Date Sampled (mo/dy/yr)	**09/15/00**	**02/21/01**	**06/12/01**	**09/06/01**
Alkalinity ($CaCO_3$mg/L), NF[a]	56	71	75	57
Ca (mg/L)	14.0	14.0	13.0	14.4
Mg (mg/L)	4.6	4.5	4.4	4.6
Na (mg/L)	18.0	14.0	13.0	13.8
K (mg/L)	3.7	3.5	3.7	3.5
Cl (mg/L)	22.0	20.0	18.0	14.9
SiO_2 (mg/L)	34.2	32.1	34.2	33.8
SO_4 (mg/L)	7.40	7.50	6.80	7.58
NH_4 (mg/L)	<0.50, U[b]	<0.50, U	<0.10, U	<0.050, U
B (mg/L)	<0.028, U	0.022	<0.016, U	0.025
Ba (mg/L)	0.044	0.045	0.044	0.049
ClO_4 (mg/L)	<0.00104, U	<0.00096, U	<0.000958, U	<0.00202, U
F (mg/L)	0.28	0.27	0.42	0.31
Fe (mg/L)	1.70	0.97	0.91	0.70
Mn (mg/L)	0.520	0.580	0.540	0.487
Mo (mg/L)	0.020	0.013	0.0095	0.011
Ni (mg/L)	0.110	0.028	0.099	0.022
$NO_3 + NO_2$ (as N) (mg/L)	<0.10, U	<0.10, U	<0.05, U	0.02
Sr (mg/L)	0.093	0.087	0.088	0.087
P (total) (mg/L)	<0.050, U	<0.050, U	0.056	0.030
DOC (mgC/L)	3.0	not analyzed	not analyzed	2.3
TOC (mgC/L), NF	4.2	2.4	2.5	2.6
TKN (mg/L)	<0.10	0.32	0.23	0.20
U (mg/L)	0.000068	0.00004	0.00002	<0.000003, U

Table 5.1-2 (continued)

Depth of Measurement Port (ft)	**278.8**	**278.8**	**278.8**	**278.8**
Geologic Unit	**Cerros del Rio Basalt**	**Cerros del Rio Basalt**	**Cerros del Rio Basalt**	**Cerros del Rio Basalt**
Date Sampled (mo/dy/yr)	**09/15/00**	**02/21/01**	**06/12/01**	**09/06/01**
Am-241 (pCi/L), F[c]	**0.049 (0.038)**	<0.026, U	<0.015, U	<0.594, U
Cs-137 (pCi/L), F	<-0.5, U	<0, U	<0.5, U	<2.37, U
Pu-238 (pCi/L), F	<0.006, U	<-0.003, U	<-0.0018, U	-0.001, U
Pu-239,240 (pCi/L), F	<0.0, U	<0.028, U	<0.014, U	-0.001, U
Sr-90 (pCi/L), F	<0.01, U	<-0.5, U	<-0.4, U	<-0.1, U
Tritium (pCi/L), NF	69.4	167	150	130
Gross alpha (pCi/L), NF	<0.25, U	<0.55, U	not analyzed	0.66
Gross beta (pCi/L), NF	3.32	3.4	not analyzed	4.11
Gross gamma (pCi/L), NF	144	<156, U	not analyzed	<10, U
U-234 (pCi/L), F	0.1	<0.028, U	<0.043, U	0.019
U-235 (pCi/L), F	<0.053, U	<-0.001, U	<-0.011, U	<0.002, U
U-238 (pCi/L), F	<0.041, U	<0.02, U	<0.021, U	0.021
δD (‰), NF	-77	-77	-78	-79
$\delta^{15}N$ (NO_3) (‰), NF	Insufficient sample volume[d]	Insufficient sample volume	Insufficient sample volume	Insufficient sample volume
$\delta^{18}O$ (‰), NF	-10.9	-11.1	-11.3	-11.4

[a] NF = non filtered.

[b] U = not detected.

[c] F= filtered.

[d] Nitrate (N) concentrations less than 1 mg/L require a one-gallon sample to measure $\delta^{15}N$.

Table 5.1-3
Hydrochemistry of Selected Analytes for Well R-9i (Upper Zone), Upper Los Alamos Canyon

Depth of Measurement Port (ft)	**198.8**	**198.8**	**198.8**	**198.8**
Geologic Unit	**Cerros del Rio Basalt**	**Cerros del Rio Basalt**	**Cerros del Rio Basalt**	**Cerros del Rio Basalt**
Sample Treatment	**Filtered**	**Filtered**	**Filtered**	**Filtered**
Date Sampled (mo/dy/yr)	**09/14/00**	**02/20/01**	**06/11/01**	**09/05/01**
Alkalinity ($CaCO_3$mg/L), NF[a]	63	82	81	71
Ca (mg/L)	17.0	17.0	17.0	19.4
Mg (mg/L)	5.6	5.8	5.8	6.4
Na (mg/L)	19.0	17.0	17.0	21.0
K (mg/L)	3.9	3.9	4.3	4.2
Cl (mg/L)	24.0	26.0	26.0	25.4
SiO_2 (mg/L)	34.2	30.0	32.1	33.6
SO_4 (mg/L)	9.60	9.80	11.0	10.2

Table 5.1-3 (continued)

Depth of Measurement Port (ft)	198.8	198.8	198.8	198.8
Geologic Unit	**Cerros del Rio Basalt**	**Cerros del Rio Basalt**	**Cerros del Rio Basalt**	**Cerros del Rio Basalt**
Date Sampled (mo/dy/yr)	**09/14/00**	**02/20/01**	**06/11/01**	**09/05/01**
NH_4 (mg/L)	<0.50, U[b]	<0.50, U	<0.10, U	<0.05, U
B (mg/L)	0.056	0.024	<0.025, U	<0.020, U
Ba (mg/L)	0.045	0.063	0.065	0.073
ClO_4 (mg/L)	<0.00104, U	<0.000958, U	<0.000958, U	0.00212
F (mg/L)	0.44	0.56	0.64	0.50
Fe (mg/L)	1.40	2.30	1.00	0.97
Mn (mg/L)	0.52	1.00	0.88	0.92
Mo (mg/L)	0.019	0.021	0.016	0.016
Ni (mg/L)	0.110	0.140	0.044	0.039
$NO_3 + NO_2$ (as N) (mg/L)	<0.10, U	<0.010, U	<0.05, U	<0.69, U
Sr (mg/L)	0.110	0.160	0.110	0.117
P (total) (mg/L)	<0.050, U	<0.064, U	0.056	0.02
DOC (mgC/L)	7.2	not analyzed	not analyzed	3.6
TOC (mgC/L), NF	3.0	4.6	3.2	3.8
TKN (mg/L)	0.40	0.34	0.24	0.29
U (mg/L)	0.000588	0.000086	0.000308	0.000194
MEQ[c] cations	2.280E-03	2.263E-03	2.212E-03	2.547E-03
MEQ anions	2.1256E-03	2.460E-03	2.047E-03	2.196E-03
Charge Balance (%)	+3.52	-4.16	+3.87	+7.39
Am-241 (pCi/L), F[d]	<0.032, U	<0.015, U	<0.026, U	-1.31, U
Cs-137 (pCi/L), F	<-0.5, U	<0.5, U	<-3.8, U	-0.058, U
Pu-238 (pCi/L), F	<-0.005, U	<-0.023, U	<0.001, U	<0.001, U
Pu-239,240 (pCi/L), F	<0.0, U	<0.001, U	<0.0047, U	<0.002, U
Sr-90 (pCi/L), F	<0.16, U	<-0.4, U	<0.6, U	<0.46, U
Tritium (pCi/L), NF	81.4	246	235	239
Gross alpha (pCi/L), NF	<1.0, U	<0.3, U	not analyzed	<1.37, U
Gross beta (pCi/L), NF	3.8	4.0	not analyzed	6.0
Gross gamma (pCi/L), NF	188	306	not analyzed	<56.4, U
U-234 (pCi/L), F	0.28	<0.041, U	0.104	0.124
U-235 (pCi/L), F	<0.045, U	<0.007, U	<0.002, U	<0.009, U
U-238 (pCi/L), F	0.208	<0.07, U	0.072	0.093
7δD (‰), NF	-79	-72	-72	-73
$\delta^{15}N$ (NO_3) (‰), NF	Insufficient sample volume[e]	Insufficient sample volume	Insufficient sample volume	Insufficient sample volume
$\delta^{18}O$ (‰), NF	-10.9	-10.6	-10.7	-10.8

[a] NF = nonfiltered.

[b] U = not detected.

[c] MEQ = milliequivalents.

[d] F= filtered.

[e] Nitrate (N) concentrations less than 1 mg/L require a one-gallon sample to measure $\delta^{15}N$.

Distributions of dissolved major ions and silica are shown in Figures 5.1-3 and 5.1-4. Groundwater at well R-9i is characterized by a calcium-sodium-bicarbonate ionic composition with calculated TDS ranging between 179 and 196 mg/L for the upper perched zone (Figure 5.1-3) and between 152 and 163 mg/L for the lower perched zone (Figure 5.1-4). Average concentrations of dissolved chloride, fluoride, and sulfate are 25.3, 0.53, and 10.15 mg/L, respectively, in the upper perched zone. Elevated concentrations of these solutes suggest that shallow recharge to the upper perched zone has occurred based on similar concentrations of these anions found in surface water and alluvial groundwater in upper Los Alamos Canyon (ESP 2001, 68661, and ESP 2002, 71301). Average concentrations of dissolved chloride, fluoride, and sulfate are 18.7, 0.32, and 7.32 mg/L, respectively, in the lower perched zone. Before the installation of the Westbay® instrumentation at R-9i, the well was left open from March 11 through April 7, 2000, (Broxton et al. 2001, 71251), and mixing of groundwater between the upper and lower perched zones occurred. This mixing masked the native-water chemistry of the lower perched zone, which is characterized by a low hydraulic conductivity. Well R-9i was developed prior to characterization sampling in which a total of 4,465 gallons of groundwater were pumped from the well (Broxton et al. 2001, 71251). Based on differences in activities of tritium observed in the two perched zones and a decrease of TDS in the lower perched zone, it appears that the effects of mixing are probably short-term.

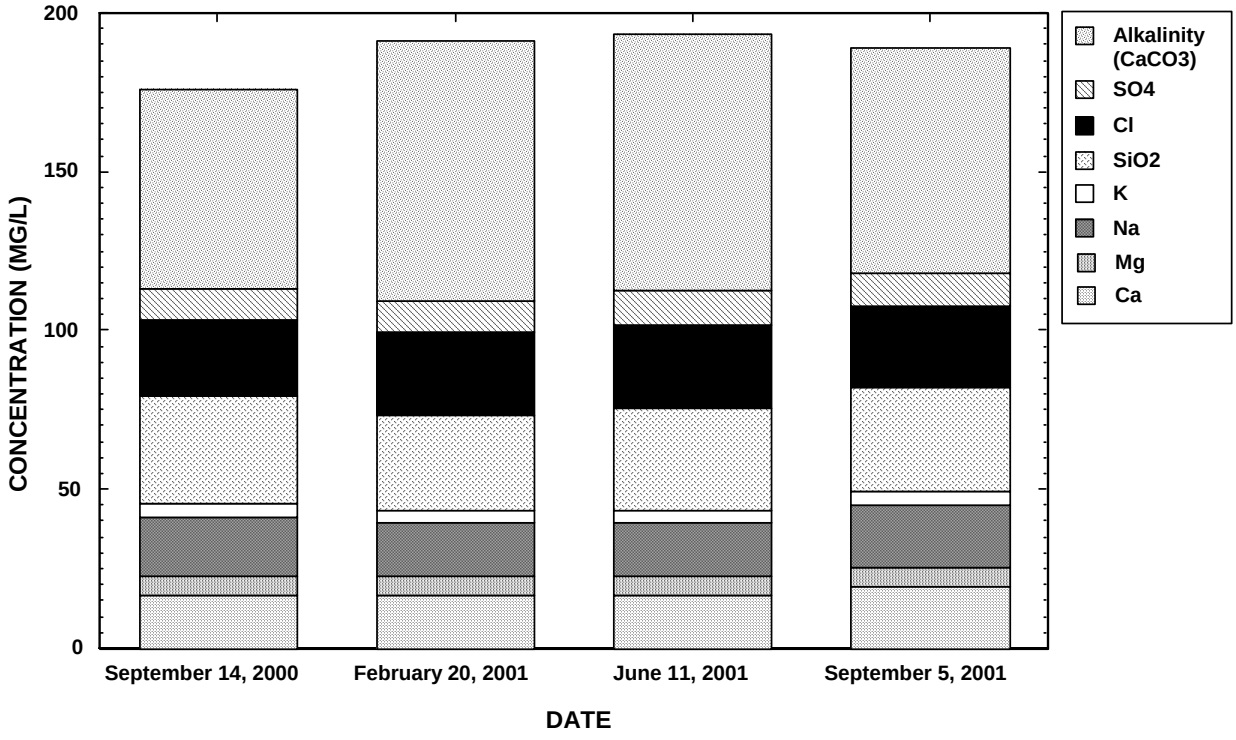

Figure 5.1-3. Major ion chemistry for well R-9i (upper perched zone), upper Los Alamos Canyon

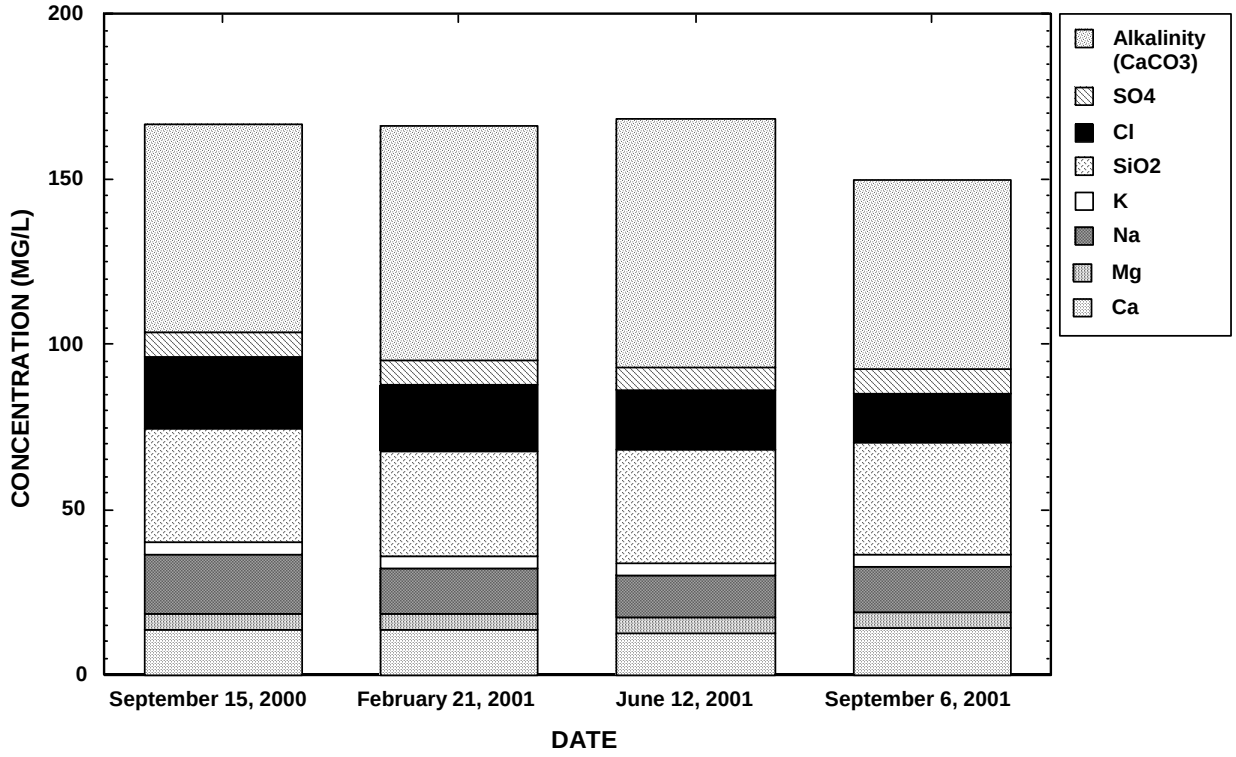

Figure 5.1-4. Major ion chemistry for well R-9i (lower perched zone), upper Los Alamos Canyon

Concentrations of nitrate were generally less than detection (<0.10 mg/L) in well R-9i (Tables 5.1-2 and 5.1-3). Concentrations of perchlorate at well R-9i ranged from <0.000958 to 0.00212 mg/L (<0.958 to 2.12 µg/L) (Tables 5.1-2 and 5.1-3). The MDL for the IC analysis of perchlorate was reported to be 0.001 mg/L by the subcontractor laboratory. The MDL is determined using standard solutions prepared in an ultrapure water matrix. The subcontractor laboratory set a reporting limit of 0.004 mg/L for the method to reflect the effect of real groundwater matrices, which often contain interfering anions.

Concentrations of dissolved iron and manganese ranged from 1.00 to 2.30 mg/L and 0.52 to 1.00 mg/L, respectively, in the upper perched zone at well R-9i. Dissolved concentrations of natural iron and manganese were at or exceeded the NMWQCC secondary standards of 1.0 and 0.2 mg/L for iron and manganese, respectively, during the sampling of R-9i. Concentrations of these two trace metals also exceeded EPA secondary standards for iron (0.3 mg/L) and manganese (0.05 mg/L). There were small differences in concentration between dissolved and total iron and manganese in the upper perched zone (Appendix A). Based on chemical data collected during drilling of R-9 (without fluids), it appears that prior to drilling at well R-9i, perched groundwater was relatively oxidizing with respect to iron and manganese. Based on these current elevated iron and manganese concentrations, the dominant oxidation states of dissolved iron and manganese are probably Fe(II) and Mn(II), and groundwater is reducing with respect to iron and manganese at well R-9i. Under such reducing conditions, $Fe(OH)_3$,α-FeOOH, MnO_2, and MnOOH have increased solubility resulting in elevated concentrations of dissolved iron and manganese (Langmuir 1997, 56037). The reductive dissolution of these solids is represented by the following half-cell (reduction) reactions:

$$Fe(OH)_3 + e^- + 3H^+ = Fe^{2+} + 3H_2O,$$

$$\alpha\text{-}FeOOH + e^- + 3H^+ = Fe^{2+} + 2H_2O,$$

$$MnO_2 + 2e^- + 4H^+ = Mn^{2+} + 2H_2O, \text{ and}$$

$$MnOOH + e^- + 3H^+ = Mn^{2+} + 2H_2O.$$

Oxidized forms of iron and manganese solids are electron acceptors for other oxidizing species (DOC), which are electron donors. Ferric iron within $Fe(OH)_3$ and α-FeOOH, and MN(III) and Mn(IV) within MnOOH and MnO_2, become reduced to Fe(II) and Mn(II), respectively, and dissolution of the solids is greatly enhanced. Electron donors including reactive organic carbon, possibly produced from the Cerro Grande Fire and residual EZ-MUD® copolymer, become oxidized to form organic acids, bicarbonate, carbonic acid, and carbonate, depending on pH. These oxidation-reduction processes are driven by microbial populations, which obtain energy necessary for respiration by first reducing dissolved oxygen to water (highest energy yield) and then by successive reduction of N(V) to N(0), Mn(IV) to Mn(III), Mn(III) to Mn(II), Fe(III) to Fe(II), and S(VI) to S(-II) (lowest energy yield)(Langmuir 1997, 56037).

Concentrations of dissolved nickel range from 0.039 to 0.140 mg/L in the upper perched zone and from 0.010 to 0.110 mg/L in the lower perched zone at well R-9i. Low concentrations of nickel (<0.020 mg/L) are typically observed at the Laboratory and around the Pajarito Plateau (ESP 2002, 71301). The NMWQCC standard for dissolved nickel is 0.2 mg/L, and the highest concentration of dissolved nickel was approximately 70% of the NMWQCC standard. The EPA primary standard for nickel is 0.1 mg/L, and concentrations of nickel at R-9i exceeded the MCL during the first sampling round, September 14-15, 2000, and during the second sampling round, February 20, 2001. Concentrations of nickel were below both the EPA and NMWQCC standards during the third sampling round, June 11-12, 2001, and during the fourth sampling round, September 5-6, 2001.

Nickel is a natural trace element found in olivine ($[Fe,Mg]_2SiO_4$), a constituent of mafic rocks. This trace element has an average worldwide concentration of 160 parts per million in mafic rocks (Krauskopf and Bird 1995, 71477). Concentration of nickel within the Cerros del Rio lavas (11 samples) at R-31 ranged from 35 to 154 ppm (Vaniman et al. 2002, 72615). Abundance of olivine ranged from 2.4 to 8.8 weight percent in the Cerros del Rio basalt characterized at borehole R-9 (Broxton et al. 2001, 71250). One hypothesis for explaining the elevated nickel concentrations in well R-9i is that natural adsorbents such as $Fe(OH)_3$ and α-FeOOH present in the Cerros del Rio basalt dissolved because of the reducing conditions stabilized near the well screens, and nickel desorbed from the dissolving solids. The phases $Fe(OH)_3$ and α-FeOOH initially form from both the oxidation of Fe(II) and dissolution of olivine and glass within altered basalt as shown in the following equations:

$$(Fe,Mg)_2SiO_4 + 1.5O_2 + 4H^+ + 3H_2O = 2Fe(OH)_3 + 2Mg^{2+} + H_4SiO_4 \text{ and}$$

$$(Fe,Mg)_2SiO_4 + 0.5O_2 + 4H^+ + H_2O = \alpha\text{-}2FeOOH + 2Mg^{2+} + H_4SiO_4.$$

Iddingsite ($H_8Mg_9Fe_2Si_3O_{14}$) is another alteration product formed during the hydrolysis and oxidation of olivine, and this phase has been identified at R-9 and R-9i (Broxton et al. 2001, 71250, and Broxton et al. 2001, 71251). Iddingsite consists of a complex mixture of smectite, goethite/hematite, amorphous ferric hydroxide, and chlorite (Deer, Howie, and Zussman 1992, 71476) and occurs in alteration-oxidation zones mantling olivine crystals in the Cerros del Rio basalt (Broxton et al. 2001, 71250, and Broxton et al. 2001, 71251). During drilling of R-9i, organic fluids were introduced for lubricity. They eventually oxidized, forming organic acids. Such oxidation results in reductive dissolution of Fe(III) and Mn(III and IV) solids and consequently, reducing conditions relative to manganese, iron, and sulfur are temporarily established. Desorption of nickel from dissolution of $Fe(OH)_3$ in the presence of organic acids, for

example acetate produced from both the Cerro Grande Fire and oxidation of EZ-MUD® copolymer, is shown by the following equation:

$$8(\equiv Fe^{3+}O^{2-}Ni^{2+}) + 7H^{+} + CH_3COO^{-} = 8Fe^{2+} + 8Ni^{2+} + 2HCO_3^{-} + 4H_2O$$

where:

$8(\equiv Fe^{3+}O^{2-}Ni^{2+})$ is the adsorption surface site containing nickel.

Acetate has been identified as an oxidation product in both surface waters containing ash from the Cerro Grande Fire and in the EZ-MUD® copolymer (Longmire 2002, 72613). Acetate is considered to be one of the electron donors (reducing agents) that enhances reduction of $Fe(OH)_3$ and α-2FeOOH to aqueous Fe(II). Organic acids may have provided reductants to the upper and lower perch zones at well R-9i. This desorption process is discussed in more detail in Section 6, Groundwater Geochemical Calculations.

Figure 5.1-5 shows log molality iron versus log molality nickel for well R-9i. The two solutes correlate with each other, suggesting that dissolution of iron solids is related to elevated concentrations of dissolved nickel. Other natural adsorbents present in the altered Cerros del Rio basalt may include MnO_2 and MnOOH, which dissolve under reducing conditions, releasing nickel to groundwater. Dissolved concentrations of iron and nickel decreased during characterization sampling, a fact suggesting that well R-9i is reequilibrating with the perched groundwater.

Concentrations of dissolved uranium in well R-9i ranged from 0.000086 to 0.00059 mg/L in the upper perched zone and from 0.00002 to 0.000068 mg/L in the lower perched zone. The highest concentration of uranium in the lower perched zone was observed during the first sampling round, September 15, 2000. During drilling of R-9, perched groundwater was encountered at 275 ft, and dissolved uranium concentrations were 0.048 mg/L (Broxton et al. 2001, 71250). Anomalous uranium (18.7 ppm) was also measured on a clay sample collected from 283 ft in borehole R-9, a finding which supports the concept that anthropogenic uranium was present (Broxton et al. 2001, 71250). Chemical reductants such as EZ-MUD® copolymer can reduce U(VI) aqueous species thermodynamically to U(IV) solids (UO_2am, UO_2, $USiO_4$), producing concentrations of dissolved uranium of less than 0.001 mg/L that are similar to those currently observed at R-9i. Mixing of groundwater from the upper perched zone prior to installation of the Westbay® Instruments Inc. MP55 system® could also result in decreasing uranium concentrations in the lower perched zone.

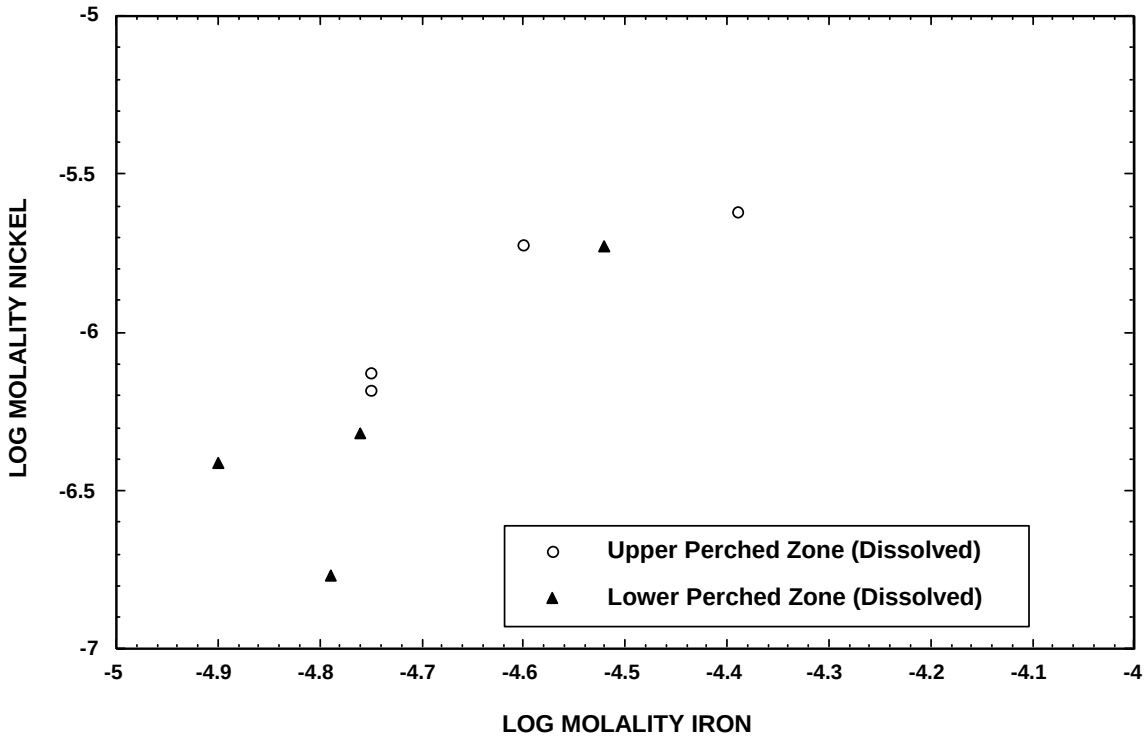

Figure 5.1-5. Log molality iron versus log molality nickel at well R-9i (upper and lower perched zones), upper Los Alamos Canyon

Activities of tritium measured in groundwater samples collected from the upper and lower perched zones at well R-9i ranged from 81.4 to 246 pCi/L and 69.4 to 167 pCi/L, respectively. These values are similar to those (347 pCi/L at 180 ft and 106 pCi/L at 275 ft) measured during drilling of R-9 (Broxton et al. 2001, 71250). Activities of tritium vary over time at well R-9i (Tables 5.1-2 and 5.1-3 and Appendix A). Activities of tritium suggest that most of sampled groundwater is less than 60 years old and postdated the beginning of nuclear testing.

Activities of selected radionuclides measured at well R-9i are provided in Tables 5.1-2 and 5.1-3 and in Appendix A. Americium-241, cesium-137, plutonium-238, plutonium-239,240, and strontium-90 generally were not detected in the groundwater samples collected from well R-9i. Americium-241 was detected, however, at an activity of 0.0376 ± 0.0285 (3σ) pCi/L in a groundwater sample collected from the upper perched zone in the fourth sampling round, September 05, 2001. The DCG for americium-241 established by the DOE for drinking water is 1.2 pCi/L (ESP 2002, 71301). Gross alpha and gross beta activities were generally less than detection (Tables 5.1-2 and 5.1-3). Measurable gross gamma (144 to 306 pCi/L) is attributed to isotopes within the natural uranium-238, uranium-235, and thorium-232 decay chains (Langmuir 1997, 56037) (Table 5.1-1). Activities of uranium-238, uranium-235, and uranium-234 were less than 0.3 pCi/L in groundwater samples collected from R-9i (Appendix A).

Concentrations of TOC measured at well R-9i ranged from 3.0 to 4.6 mg/L in the upper perched zone and from 2.4 to 4.2 mg/L in the lower perched zone. The slightly elevated TOC values might indicate the presence of residual drilling fluids (EZ-MUD® copolymer) and organic-rich ash produced from the Cerro Grande Fire.

Volatile and semivolatile organic compounds generally were not detected at well R-9i, except for 3-nitrotoluene (0.15 µg/L); 2,4-dinitrotoluene (0.5 µg/L); 2-amino-4,6-dinitrotoluene (0.15 µg/L); and RDX

(0.49 µg/L) falsely detected during the first sampling round, September 14 to 15, 2000. Tetryl (2.3 µg/L) was falsely detected during the second sampling round, October 20 to 21, 2000. The reported results for the HE compounds and their degradation products are regarded as false positives for several reasons. The EZ-MUD® drilling agent consists of a polyacrylamide-polyacrylate copolymer that consists of nitro and amino functional groups similar to the functional groups present in the HE compounds and their degradation products. Thus, residual EZ-MUD® constituents may be a significant interferent in the liquid chromatography mass spectrometry method. Further analysis using ultraviolet diode array spectroscopy detection, which provides more accurate identification of eluting compounds, failed to detect any HE compounds or degradation products. Finally, there are no known sources of HE compounds released to upper Los Alamos Canyon, and these compounds have not been detected in surface water and alluvial groundwater in the canyon.

Analysis of the DOC fractionation (also termed “humic substances”), which includes both hydrophobic and hydrophilic fractions, was performed on two groundwater samples collected during the first and fourth rounds from well R-9i (Appendix A). Both fractions contain acid-, neutral-, and base-organic substances. Hydrophobic acids are considered to include humic and fulvic acids (carboxylic acids and phenols), whereas the hydrophobic neutral fraction includes aliphatic organic compounds (Vilks and Bachinski 1996, 71515). Hydrophobic bases include aromatic amines and other nitrogen-containing compounds. The hydrophilic fraction contains low-molecular weight (≤5 carbon atoms) polyelectrolytic and aliphatic acids (acid fraction), aliphatic amines and amino acids (base fraction), and alcohols, esters, aliphatic amides, and carbohydrates (neutral fraction) (Vilks and Bachinski 1996, 71515). These two DOC fractions are naturally occurring in groundwater (Vilks and Bachinski 1996, 71515) with a median concentration of 0.7 mgC/L (Thurman 1985, 71514). Anthropogenic sources including refined petroleum products and high-molecular weight organic compounds are also possible.

A DOC concentration of 7.2 mgC/L was measured in a groundwater sample collected from the upper perched zone at well R-9i on September 14, 2000. This sample contained 3.5 mgC/L hydrophobic fraction consisting of 1.6 mgC/L acid fraction and 1.9 mgC/L neutral fraction with the base fraction less than detection (<0.1 mgC/L). The groundwater also contained 3.7 mgC/L hydrophilic fraction, which consisted of 2.8, 0.3, and 0.6 mgC/L acid, neutral, and base fractions, respectively.

Approximately 33% of the humic and fulvic acids (hydrophobic acid fraction in the upper zone) is calculated to form a complex with calcium. (See Table 6.2-2.) The majority of humic and fulvic acids are stable as noncomplexed anions. Formation of calcium-humate and/or calcium-fulvate complexes does not influence the stability of $CaCO_3$ (calcite) according to MINTEQA2 simulations. The origin of DOC in groundwater at well R-9i includes natural sources, ash from the Cerro Grande Fire, and/or residual fluids from drilling and/or well completion. The neutral and base fractions may consist of residual EZ-MUD® copolymer and aliphatic compounds.

A DOC concentration of 3.0 mgC/L was measured in a groundwater sample collected from the lower perched zone at well R-9i on September 15, 2000. This sample contained 2.0 mgC/L hydrophobic fraction consisting of 0.5 mgC/L acid fraction and 1.5 mgC/L neutral fraction with the base fraction less than detection (<0.1 mgC/L). The groundwater also contained 1.0 mgC/L hydrophilic fraction, which consisted of 0.8 and 0.1 mgC/L acid and neutral fractions, respectively, with the base fraction less than detection (<0.1 mgC/L). The neutral fraction consisted of short chain aliphatic compounds as breakdown products of the EZ-MUD® copolymer.

A DOC concentration of 3.6 mgC/L was measured in a groundwater sample collected from the upper perched zone at well R-9i on September 5, 2001. This sample contained 2.0 mgC/L hydrophobic fraction consisting of 1.2 mgC/L acid fraction and 0.8 mgC/L neutral fraction with the base fraction less than

detection (<0.1 mgC/L). The groundwater also contained 1.6 mgC/L hydrophilic fraction, which consisted of 1.3, 0.1, and 0.2 mgC/L acid, neutral, and base fractions, respectively.

A DOC concentration of 2.3 mgC/L was measured in a groundwater sample collected from the lower perched zone at well R-9i on September 06, 2001. This sample contained 1.4 mgC/L hydrophobic fraction consisting of 0.5 mgC/L acid fraction and 0.9 mgC/L neutral fraction with the base fraction less than detection (<0.1 mgC/L). The groundwater also contained 0.9 mgC/L hydrophilic fraction, which consisted of 0.8 and 0.1 mgC/L neutral and base fractions, respectively, with the base fraction less than detection (<0.1 mgC/L).

5.2 Comparison to Test Well 3 and Monitoring Well POI-4

Total manganese and uranium concentrations at well R-9 exceeded those reported by the Environmental Surveillance Program (ESP)(2002, 71301) for test well (TW) -3 (0.013 mg/L manganese and 0.00054 mg/L uranium) in upper Los Alamos Canyon. TW-3 is completed at the regional water table and provides a comparison for water chemistry with well R-9. Average dissolved manganese and uranium concentrations at well R-9 are 0.106 and 0.00181 mg/L, respectively. Concentrations of manganese at well R-9 exceeded the EPA standard of 0.05 mg/L during the four rounds of sampling (Table 5.1-1, Appendix A).

Concentrations of natural iron, manganese, and nickel at well R-9i exceeded those reported by ESP (2002, 71301) at monitoring well POI-4, completed in the Cerros del Rio basalt in Pueblo Canyon. Total concentrations of iron, manganese, and nickel were 0.057, < 0.002, and <0.020 mg/L, respectively, at POI-4. Concentrations of these three metals at well R-9i exceeded either or both of the EPA and NMWQCC standards of 0.3 mg/L (EPA) and 1.0 mg/L (NMWQCC) for iron; 0.05 (EPA) and 0.2 mg/L (NMWQCC) for manganese; and 0.1 mg/L (EPA) and 0.2 mg/L (NMWQCC) for nickel. Well R-9i, however, is reequilibrating with groundwater, and concentrations of these constituents are generally decreasing. Concentrations of other trace elements and trace metals observed at well R-9i were within concentration ranges for samples collected from POI-4 (ESP 2002, 71301).

6.0 GROUNDWATER GEOCHEMICAL CALCULATIONS

6.1 Computer Program Selection

Geochemical calculations of groundwater samples collected from R-9 and R-9i were conducted to evaluate speciation of solutes (dissolved species) and adsorption/desorption of nickel, and to quantify the state of saturation of solid phases that control groundwater composition under equilibrium conditions. These calculations provided insight into processes that control water/rock interactions, including mineral precipitation and adsorption occurring in both natural and anthropogenic waters. Geochemical calculations of water are conducted to evaluate geochemical processes influencing natural water composition and contaminant chemistry and transport. These calculations were not performed for the lower perched zone at well R-9i because of groundwater mixing between the two saturated zones prior to well construction.

Calculations of solute speciation, PCO_2 gas, adsorption/desorption (surface complexation), and solid-phase saturation indices were made using the computer program MINTEQA2 (Allison et al. 1991, 49930), with single-ion activity coefficients calculated using the Davies equation. MINTEQA2 was developed by Battelle Northwest for the EPA for use at RCRA and Superfund sites. The model is constrained by solute concentrations and involves silicate and iron (oxy)hydroxides-oxides identified by Broxton et al. (2001, 71250) at R-9. MINTEQA2 quantifies possible rock-water and water-atmosphere reactions, but modeling results should be interpreted with caution and are limited by the scope of our understanding of hydrologic

flow conditions (saturated and unsaturated), possible reaction mechanisms, and kinetic constraints in a disequilibrium-dominated system. A source of error in using the computer program is the accuracy of the thermochemical data contained in the database. Errors are greater for trace solutes in which experimental data are inaccurate and/or incomplete including thallium, beryllium, and cadmium. The uranium database contained in MINTEQA2 has been critically evaluated by Grenthe et al. (1992, 71511). There are fewer errors associated with the major ions and with solid phases consisting of carbonate, silicate, and oxyhydroxide minerals (Langmuir 1997, 56037).

6.2 Speciation Calculations

Speciation calculations using the computer program MINTEQA2 (Allison et al. 1991, 49930) were performed to evaluate stable forms of dissolved solutes, which influence mineral precipitation and adsorption reactions occurring in natural and contaminated waters. Fate and transport of natural iron, manganese, and nickel observed at well R-9i are controlled by both aqueous speciation and adsorption/desorption processes. Input files for the calculations are provided in Appendix B. Solutes of importance at well R-9 included major ions, manganese, nickel, and uranium(VI), which are naturally occurring. Results of the speciation calculations are provided in Table 6.2-1.

Table 6.2-1
Results of Speciation Calculations Using MINTEQA2 for Well R-9, Upper Los Alamos Canyon

Solute	Dominant Speciation	Percentage	Sample Date (mo/dy/yr)
Mn(II)	Mn^{2+}	96.4	02/28/00
Mn(II)	Mn^{2+}	96.0	09/29/00
Mn(II)	Mn^{2+}	96.0	02/13/01
Mn(II)	Mn^{2+}	96.1	05/15/01
Ni(II)	$NiCO_3^0$	91.9	02/28/00
Ni(II)	$NiCO_3^0$	95.7	09/29/00
Ni(II)	$NiCO_3^0$	95.6	02/13/01
Ni(II)	$NiCO_3^0$	95.7	05/15/01
U(VI)	$UO_2(CO_3)_2^{2-}$	75.0	02/28/00
U(VI)	$UO_2(CO_3)_3^{4-}$	19.3	02/28/00
U(VI)	$UO_2(CO_3)_2^{2-}$	49.2	09/29/00
U(VI)	$UO_2(CO_3)_3^{4-}$	48.5	09/29/00
U(VI)	$UO_2(CO_3)_2^{2-}$	43.3	02/13/01
U(VI)	$UO_2(CO_3)_3^{4-}$	54.6	02/13/01
U(VI)	$UO_2(CO_3)_2^{2-}$	51.2	05/15/01
U(VI)	$UO_2(CO_3)_3^{4-}$	46.3	05/15/01

Concentrations of dissolved iron at well R-9 were less than detection for the second, third, and fourth sampling rounds conducted on September 29, 2000; February 13, 2001; and May 15, 2001. Consequently, concentrations of this solute were assumed to be half of the detection limit for speciation purposes. Ferrous iron is predicted to be stable as dissolved Fe^{2+}, and the hydrolysis species $FeOH^+$ is a minor component (not shown in Table 6.2-1). The free or uncomplexed Fe^{2+} cation is available for adsorption and precipitation reactions. Uranium(VI) is predicted to be stable as $UO_2(CO_3)_2^{2-}$ and $UO_2(CO_3)_3^{4-}$, and these complexes are semisorbing onto mineral surfaces (Langmuir 1997, 56037). Concentrations of total and dissolved uranium are less than 2 µg/L at well R-9. Manganese is predicted to

be stable as Mn^{2+}, and this species can undergo cation exchange with other divalent cations and surface complexation adsorption with metal (oxy)hydroxides (Langmuir 1997, 56037). Concentrations of natural manganese occur in the regional aquifer, ranging from 0.071 to 0.190 mg/L at well R-9. Major ions consisting of Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Cl^{-}, SO_4^{2-}, and HCO_3^{-} (not shown in Table 6.2-1) are calculated to be stable as free or uncomplexed solutes at well R-9.

Solutes of importance at well R-9i include major ions, iron(II), manganese(II), nickel, and uranium(IV), which are naturally occurring. Results of the speciation calculations are provided in Table 6.2-2. Ferrous iron is predicted to be stable as dissolved Fe^{2+}, and the hydrolysis species $FeOH^{+}$ is a minor component (not shown in Table 6.2-2). The free or uncomplexed Fe^{2+} cation is available for adsorption and precipitation reactions. Nickel is predicted to be stable as $NiCO_3^0$ and Ni^{2+}, and, above pH values greater than 8.5, the free (noncomplex) cation is predicted to adsorb onto negatively-charged surface sites on $Fe(OH)_3$ to a greater extent than the ion pair. Uranium(IV) is predicted to be stable as $U(OH)_4^0$, and this hydrolysis species is semisorbing onto mineral surfaces and enhances the precipitation of UO_2am, UO_2, and $USiO_4$ (Langmuir 1997, 56037). Concentrations of total and dissolved uranium are less than 1 µg/L at well R-9i. Manganese is predicted to be stable as Mn^{2+}. Increasing concentrations of natural manganese occur in the upper and lower perched zones and correlate well with dissolved iron. Major ions consisting of Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Cl^{+}, SO_4^{2-}, and HCO_3^{-} (not shown in Table 6.2-2) are calculated to be stable as free or uncomplexed solutes at well R-9i. Dissolved organic matter (DOM), consisting of humic and fulvic acids (hydrophobic acid fraction), is calculated by MINTEQA2 to include mainly noncomplexed solutes and a calcium-DOM complex (Table 6.2-2). In the fourth sampling round, conducted on September 5, 2001, americium-241 was detected at 0.0376 ± 0.0285 (3σ) pCi/L (1.1E-11 mg/L) in the upper perched zone at well R-9i. Americium is calculated to be stable as $AmCO_3^{+}$ (87.7%), $Am(CO_3)_2^{-}$ (8.3%), Am^{3+} (1.0%), and $AmOH^{2+}$ (2.4%) in the upper perched zone.

Table 6.2-2
Results of Speciation Calculations Using MINTEQA2 for Well R-9i Upper Los Alamos Canyon

Solute	Dominant Speciation	Percentage	Sample Date (mo/dy/yr)
Mn(II)	Mn^{2+}	97.1	09/14/00
Mn(II)	Mn^{2+}	97.3	02/20/01
Mn(II)	Mn^{2+}	97.4	06/11/01
Mn(II)	Mn^{2+}	97.1	09/05/01
Ni(II)	$NiCO_3^0$	93.2	09/14/00
Ni(II)	Ni^{2+}	3.0	09/14/00
Ni(II)	$NiCO_3^0$	84.9	02/20/01
Ni(II)	Ni^{2+}	13.1	02/20/01
Ni(II)	$NiCO_3^0$	43.7	06/11/01
Ni(II)	Ni^{2+}	50.8	06/11/01
Ni(II)	$NiCO_3^0$	81.0	09/05/01
Ni(II)	Ni^{2+}	16.5	09/05/01
U(IV)	$U(OH)_4^0$	100.0	09/14/00
U(IV)	$U(OH)_4^0$	100.0	02/20/01
U(IV)	$U(OH)_4^0$	100.0	06/11/01
U(IV)	$U(OH)_4^0$	100.0	09/05/01
DOM[a]	DOM	65.6	09/14/00
DOM	Mg-DOM	1.8	09/14/00
DOM	Ca-DOM	32.6	09/14/00

[a] DOM = dissolved organic matter.

6.3 Saturation Index Calculations

Solid-solution phase calculations were performed with MINTEQA2 (Allison et al. 1991, 49930) using analytical results obtained from filtered (less than 0.45 µm membrane) groundwater samples collected at well R-9. The purpose of the calculations was to assess the importance of precipitation reactions for controlling the transport of iron, manganese, nickel, uranium, and other solutes at wells R-9 and R-9i. Figure 6.3-1 shows the values of the saturation index (SI) for several key phases for well R-9. The SI is a measure of the degree of saturation, undersaturation, or oversaturation of a solid phase in water (SI = $\log_{10}$ {activity product/solubility product}; at equilibrium SI = 0 ± 0.05) (Langmuir 1997, 56037). Well R-9 groundwater is calculated to be undersaturated with respect to $BaSO_4$ (barite), $FeCO_3$ (siderite), $MnCO_3$ (rhodochrosite), $SrCO_3$ (strontianite), $(UO_2)_2SiO_4 \cdot 2H_2O$ (soddyite), and silica precipitate (Figure 6.3-1). Calculations also show that the groundwater is generally oversaturated with respect to $CaCO_3$ (calcite), $Ca(UO_2)_2(Si_2O_5)_3 \cdot 5H_2O$ (haiweeite), and silica gel (Figure 6.3-1). Calcium carbonate is abundant in the Santa Fe Group basalt at well R-9 (Broxton et al. 2001, 71250).

These results are generally consistent with observed mineralogy (calcium carbonate and absence of strontium carbonate) in the Santa Fe Group basalt at R-9. Calculated $\log_{10}PCO_2$ gas varies from –2.98 to –2.32 atmosphere for the well R-9 groundwater. Variation in the SI values for $FeCO_3$, $CaCO_3$, $SrCO_3$, and PCO_2 gas is the result of differing temperature, carbonate alkalinity, pH, and activities of iron, calcium, and strontium in groundwater at well R-9.

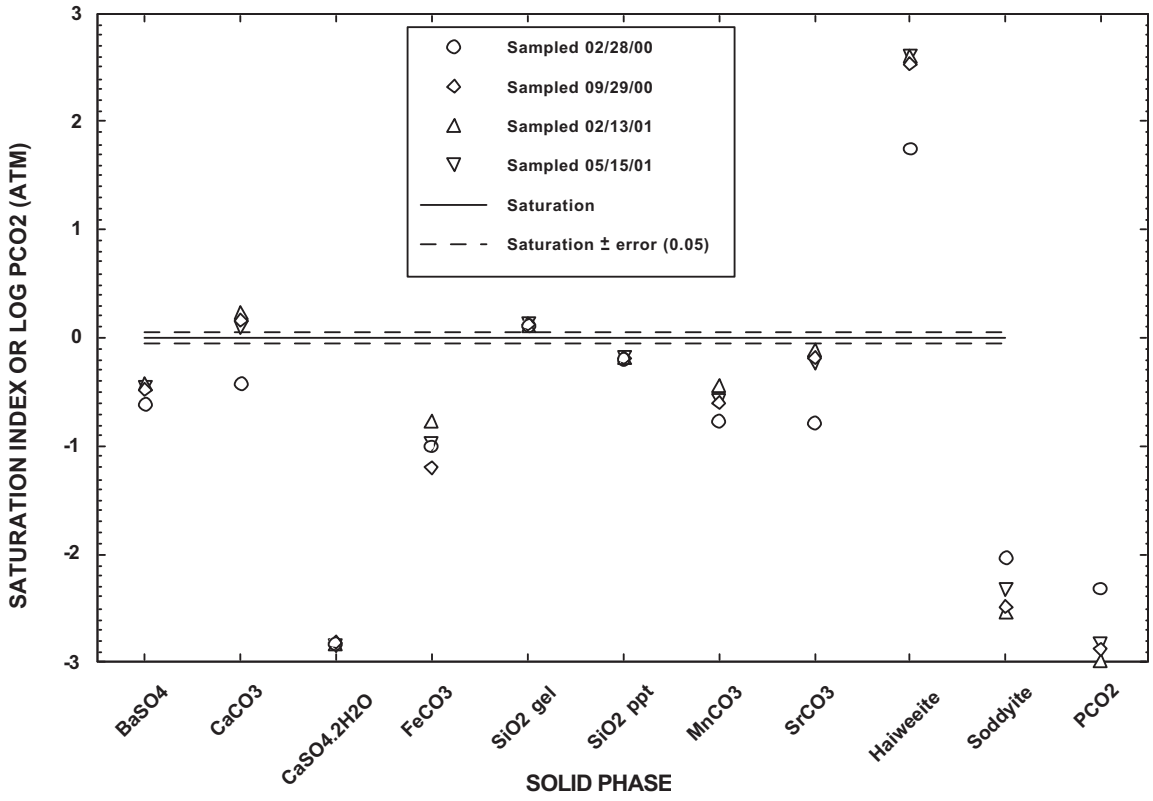

Figure 6.3-1. Results of saturation index calculations using MINTEQA2 for well R-9 (regional aquifer), upper Los Alamos Canyon

Results of mineral saturation calculations for well R-9i (upper perched zone) are shown in Figure 6.3-2. Well R-9i groundwater is calculated to be undersaturated with respect to $CaCO_3$ (calcite), UO_2am, $BaSO_4$, $MnCO_3$, $SrCO_3$, and silica precipitate (Figure 6.3-1). Groundwater is calculated to be both oversaturated and undersaturated with respect to $FeCO_3$, which is controlled by carbonate alkalinity, ferrous iron concentrations, and pH. Calculations also show that the groundwater at well R-9i is oversaturated with respect to $USiO_4$ (coffinite) (Figure 6.3-2). Nickel hydroxide ($Ni(OH)_2$), $NiCO_3$, and Mg_2SiO_4 are not expected to precipitate from solution at well R-9i because groundwater is calculated to be undersaturated with respect to these solid phases. Groundwater is calculated to be undersaturated with respect to $Am(OH)_3$, $Am(OH)_3am$, and $AmOHCO_3$, and transport of americium-241 is inferred to be controlled by adsorption processes at well R-9i.

Calculated $\log_{10}PCO_2$ gas varies from –3.19 to –1.82 atmosphere for the well R-9i groundwater, which is controlled by pH, carbonate alkalinity, and temperature of the perched groundwater. Variation in the SI values for $CaCO_3$ and $SrCO_3$ is the result of differing temperature, carbonate alkalinity, pH, and activities of iron, calcium, and strontium in groundwater at well R-9i.

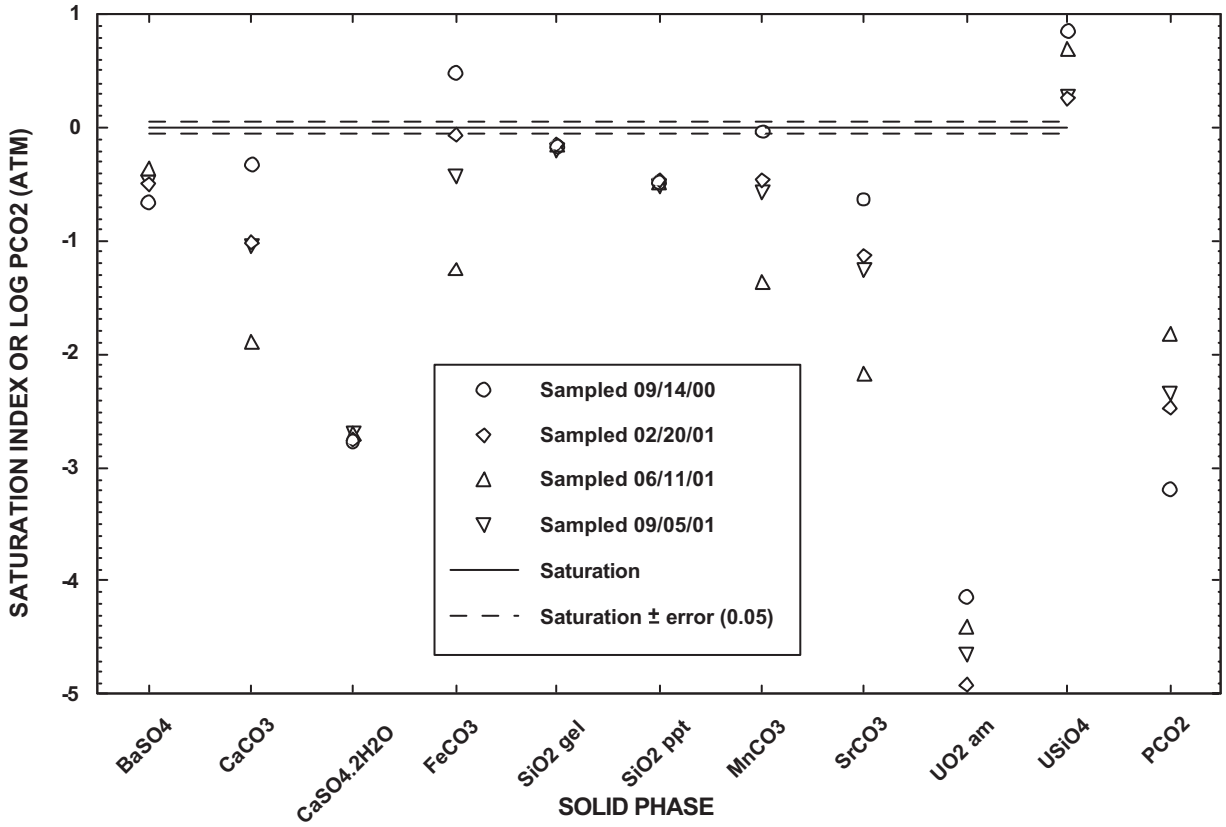

Figure 6.3-2. Results of saturation index calculations using MINTEQA2 for well R-9i (upper perched zone), upper Los Alamos Canyon

6.4 Adsorption/Desorption Calculations

Adsorption/desorption calculations using the computer program MINTEQA2 (Allison et al. 1991, 49930) were performed to evaluate the release of nickel to the upper perched zone in well R-9i. These

calculations are based on the hypothesis that hydrous ferric oxide (HFO) is a natural adsorbent present in the altered Cerros del Rio basalt, which has undergone reductive dissolution. These calculations were not performed for the lower perched zone because of groundwater mixing between the two saturated zones prior to well construction.

Results of the adsorption/desorption calculations are provided in Table 6.4-1. The diffuse double layer adsorption model was used in the calculations. The calculation includes the mass and specific surface area of adsorbent (HFO), high (strong) and low (weak) energy binding sites, aqueous speciation, pH, and Eh (Allison et al. 1991, 49930). Surface complexation (intrinsic) constants for adsorption of nickel by HFO at 25°C are provided below (Allison et al. 1991, 49930):

strong binding site: $Fe\_^{s}OH + Ni^{2+} = Fe\_^{s}OHNi^{2+}$ ($\log K_1^{int} = 0.15$) and

weak binding site: $Fe\_^{w}OH + Ni^{2+} - H^{+} = Fe\_^{w}ONi^{+}$ ($\log K_2^{int} = -2.5$).

Table 6.4-1
Results of Adsorption Calculations Using MINTEQA2 for Well R-9i, Upper Los Alamos Canyon

Parameter	Value	Surface Complex
Concentration of HFO (g/L)	0.0014	Not applicable
Specific surface area (m^2/g)	600	Not applicable
Ionic strength	0.003 molal	Not applicable
pH	8.04	Not applicable
Eh (calculated from Fe^{3+}/Fe^{2+} redox couple) (mV)	-78	Not applicable
Concentration of Ni molal (mg/L)	2.045E-06 (0.120)	Not applicable
Percentage Ni dissolved	97.8	Not applicable
Molality (mg/L)	1.999E-06 (0.118)	Not applicable
Percentage Ni adsorbed	2.2	Not applicable
Molality (mg/L)	4.563E-08 (0.002)	Not applicable
Percentage Ni adsorbed to strong binding site	1.0	$\equiv Fe\_^{s}OHNi^{2+}$
Molality of adsorbed complex (mg/L)	2.074E-08 (0.001)	$\equiv Fe\_^{s}OHNi^{2+}$
Percentage Ni adsorbed to weak binding site	1.2	$\equiv Fe\_^{w}ONi^{+}$
Molality of adsorbed complex (mg/L)	2.489E-08 (0.001)	$\equiv Fe\_^{w}ONi^{+}$
Speciation of dissolved and adsorbed Ni (%)	Ni^{2+} (3.0), $NiCO_3^{0}$ (93.2), $Ni(CO_3)_2^{2-}$ (1.1), $\equiv Fe\_^{s}OHNi^{2+}$ (1.0), $\equiv Fe\_^{w}ONi^{+}$ (1.2)	Not applicable

A provisional Eh of –78mV was calculated with the computer program PHREEQC (Parkhurst and Appelo 1999, 71485) using analytical results for the September 14, 2000, sampling round (Table 5.1-2). The Eh was calculated from the $Fe(OH)_3/Fe^{2+}$ redox couple at pH8.04. However, adsorption calculations are not affected by Eh. For the adsorption/desorption calculations, it is assumed that all of the dissolved iron is from the dissolution of HFO, and total nickel concentrations were used to account for the concentration of this trace element in the aquifer system. Results of the calculations show that 0.118 mg/L nickel is dissolved, which compares very well with the measured 0.110 and 0.120 mg/L of dissolved and total nickel, respectively, at well R-9i. The calculations suggest that the dominant aqueous species of nickel is $NiCO_3^{0}$, and that Ni^{2+} and $Ni(CO_3)_2^{2-}$ are present in small concentrations. Results of the MINTEQA2

calculations support the hypothesis that elevated natural iron and nickel at well R-9i result from the reductive dissolution of HFO followed by desorption of nickel.

7.0 CONCLUSIONS

Four rounds of groundwater characterization samples were collected at well R-9 at a pump intake depth of 741.4 ft. These samples were chemically characterized for radionuclides, metals and trace elements, major ions, HE compounds, dissolved and total organic carbon, organic compounds, and stable isotopes. Americium-241, cesium-137, plutonium-238, plutonium-239,240, and strontium-90 were not detected in the groundwater samples collected from well R-9. Activities of uranium-234, uranium-235, and uranium-238 were detected at concentrations less than 2 pCi/L. Gross alpha and gross beta activities were generally less than detection. Measurable gross gamma was attributed to isotopes within the natural uranium-238, uranium-235, and thorium-232 decay chains.

Groundwater from the regional aquifer in well R-9 is primarily a calcium-sodium-bicarbonate type. This groundwater was found to contain an average of 11.81 pCi/L tritium, 0.00181 mg/L (1.81 µg/L) dissolved uranium, 0.106 mg/L dissolved manganese, 7.1 mg/L dissolved chloride, 0.30 mg/L dissolved fluoride, 6.1 mg/L dissolved sulfate, and 0.6 mg/L nitrate plus nitrite (as N). Concentrations of natural manganese at well R-9 exceeded the EPA secondary standard of 0.05 mg/L. Nitrate was the dominant nitrogen species present in groundwater collected from R-9. Perchlorate was detected only in the first sampling round, at 0.00165 mg/L (1.65 µg/L), which is a J value. Current analytical reporting and detection limits for perchlorate are 0.004 and 0.001 mg/L (4.0 and 1.0 µg/L), respectively, using ion chromatography.

Stable isotope ratios of δD and $\delta^{18}O$ imply that the sampled groundwater at wells R-9 and R-9i was derived from a local meteoric source consisting of precipitation and surface water. Activities of tritium suggest that a component of sampled groundwater is less than 60 years old and postdated the beginning of nuclear testing. Average results of $\delta^{15}N$ (NO_3) analyses (+4.1‰) at well R-9 suggest that nitrate plus nitrite is derived from both natural and inactive multiple sources (sewage and treated nitric acid discharges) within upper Los Alamos Canyon.

Perched groundwater in well R-9i is primarily a calcium-sodium-bicarbonate type with similar milliequivalents of calcium and sodium in both the upper and lower perched zones. The upper perched zone was found to contain an average of 200 pCi/L tritium, 0.000293 mg/L (0.293 µg/L) dissolved uranium, 25.1 mg/L dissolved chloride, 0.52 mg/L dissolved fluoride, 1.42 mg/L dissolved iron, 0.83 mg/L dissolved manganese, 0.083 mg/L dissolved nickel, 10.1 mg/L dissolved sulfate, and 0.28 mg/L total Kjeldahl nitrogen. The lower perched zone was found to contain an average of 132 pCi/L tritium, 0.000293 mg/L (0.043 µg/L) dissolved uranium, 18.7 mg/L dissolved chloride, 0.52 mg/L dissolved fluoride, 1.07 mg/L dissolved iron, 0.53 mg/L dissolved manganese, 0.043 mg/L dissolved nickel, 7.32 mg/L dissolved sulfate, and 0.25 mg/L total Kjeldahl nitrogen.

Concentrations of natural iron and manganese at R-9i exceeded the NMWQCC domestic water supply standards of 1.0 and 0.2 mg/L, respectively, and EPA drinking water secondary standards of manganese (0.05 mg/L) and iron (0.3 mg/L). Based on chemical data collected during drilling of R-9 (without use of drilling fluids), it appears that prior to the drilling of R-9i, perched groundwater within the Cerros del Rio basalt was relatively oxidized with respect to manganese and iron. Reducing conditions with respect to manganese and iron currently dominate in both perched zones. Nitrate plus nitrite (as N) and perchlorate were less than detection in well R-9i. Concentrations of natural nickel exceeded the EPA standard of 0.1 mg/L during the first sampling round, September 14-15, and the second sampling round, February 20, 2001. It is hypothesized that nickel is natural and is from the dissolution and reduction of HFO, a

constituent of the Cerros del Rio basalt. Concentrations of nickel decreased during the characterization sampling to levels below nickel's MCL (0.1 mg/L).

Americium-241, cesium-137, plutonium-238, plutonium-239,240, and strontium-90 generally were not detected in the groundwater samples collected from well R-9i. Americium-241 was detected, however, at an activity of 0.0376 ± 0.0285 (3σ) pCi/L (1.1E -11 mg/L)(MDA = 0.0134 pCi/L) in a groundwater sample collected from the upper perched zone at R-9i on the fourth sampling round, conducted on September 5, 2001. The DCG for americium-241 established by DOE is 1.2 pCi/L (ESP 2002, 71301). Elevated activities of tritium above cosmogenic baseline (1 pCi/L) suggest that a component of sampled groundwater in well R-9i is younger than 60 years old and postdated the beginning of nuclear testing. Stable isotope ratios of δD and $\delta^{18}O$ imply that the sampled groundwater was derived from a local meteoric source, consisting of precipitation and surface water.

Geochemical calculations using the computer program MINTEQA2 were performed to evaluate solute speciation adsorption/desorption and mineral equilibrium in assessing groundwater chemistry and refining the geochemical conceptual model for R-9 and R-9i. Results suggest that the regional aquifer at well R-9 is generally in near equilibrium with $CaCO_3$ and silica (gel), and undersaturated with respect to silica (ppt), $BaSO_4$, $CaSO_4.2H_2O$, $FeCO_3$, $MnCO_3$, $SrCO_3$, and $(UO_2)_2SiO_4 \cdot 2H_2O$. Goundwater was calculated to be oversaturated with respect to $Ca(UO_2)_2(Si_2O_5)_3 \cdot 5H_2O$ at well R-9. Calculations showed that perched groundwater (upper zone) in R-9i was oversaturated with respect to $USiO_4$ and at equilibrium with $MnCO_3$, silica gel, and $FeCO_3$ for at least one or more sampling rounds. This groundwater was generally undersaturated with respect to $BaSO_4$, $CaCO_3$, $CaSO_4 \cdot 2H_2O$, $FeCO_3$, silica (ppt), $MnCO_3$, $SrCO_3$, and amorphous UO_2. Alkalinity (HCO_3^-) provides ligands for complexing with nickel at well R-9i and uranium(VI) at well R-9. Uranium(VI) is calculated to be stable as $UO_2(CO_3)_2^{2-}$, and $UO_2(CO_3)_3^{4-}$ complexes under oxidizing conditions at well R-9. Desorption of natural nickel from HFO accounts for nickel concentration observed at well R-9i. Americium is calculated to be stable as $AmCO_3^+$ (87.7%), $Am(CO_3)_2^-$ (8.3%), Am^{3+} (1.0%), and $AmOH^{2+}$ (2.4%) in the upper perched zone. Groundwater is calculated to be undersaturated with respect to $Am(OH)_3$, $Am(OH)_3am$, and $AmOHCO_3$, and transport of americium-241 is inferred to be controlled by adsorption processes at well R-9i. Calculation results agree well with observed mineralogy and groundwater analytical results.

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B. Hardesty and A. Groffman provided data management.

J. Kofoed and D. Steven collected groundwater samples and recorded field parameters at R-9 and R-9i.

The groundwater integration team, led by C. Nylander, participated in the planning of data collection during the investigation.

B. Enz provided DOE oversight during the investigation.

R. Bohn, D. Broxton, A. Dorries, R. Enz, A. Groffman, E. Louderbough, C. Smith, and J. McCann were reviewers for the document.

C. Schaller was editor for this document. P. Maestas was compositor.

D. Broxton and J. McCann supported this investigation as leaders of the Groundwater Investigations Focus Area.

9.0 REFERENCES

Allison, J. D., D. S. Brown, and K. J. Novo-Gradac, March 1991. "MINTEQA2/PRODEFA2, A Geochemical Assessment Model for Environmental Systems: Version 3.0 User's Manual," EPA/600/3-91/021, Office of Research and Development, Athens, Georgia. (Allison et al. 1991, 49930)

D. Broxton, D. Vaniman, W. Stone, S. McLin, M. Everett, and A. Crowder, May 2001. "Characterization Well R-9i Completion Report," Los Alamos National Laboratory Report LA-13821-MS, Los Alamos, New Mexico. (Broxton et al. 2001, 71251)

D. Broxton, R. Gilkeson, P. Longmire, J. Marin, R. Warren, D. Vaniman, A. Crowder, B. Lowry, D. Rogers, W. Stone, S. McLin, G. WoldeGabriel, D. Daymon, and D. Wycoff, May 2001. "Characterization Well R-9 Completion Report," Los Alamos National Laboratory Report LA-13742-MS, Los Alamos, New Mexico. (Broxton et al. 2001, 71250)

Deer, W. A., R. A. Howie, and J. Zussman, 1992. *An Introduction to The Rock-Forming Minerals, Second Edition*, Longman Scientific & Technical, Essex, England. (Deer et al. 1992, 71476)

ESP (Environmental Surveillance Program), December 2000. "Environmental Surveillance at Los Alamos during 1999," Los Alamos National Laboratory Report LA-13775-ENV, UC902, Los Alamos, New Mexico. (ESP 2000, 68661)

ESP (Environmental Surveillance Program), January 2002. "Environmental Surveillance at Los Alamos during 2000," Los Alamos National Laboratory Report LA-13861-ENV, Los Alamos, New Mexico. (ESP 2002, 71301)

Grenthe, I. et al., eds, 1992. *Chemical Thermodynamics of Uranium*, Chemical Thermodynamics Ser., Amsterdam: Elsevier Science Publ., New York, New York, pp. 1–715. (Grenthe et al. 1992, 71511)

Krauskopf, K. B., and D. K. Bird, 1995. *Introduction to Geochemistry,* McGraw-Hill, New York, New York. (Krauskopf and Bird 1995, 71477)

Langmuir, D., 1997. *Aqueous Environmental Geochemistry,* Prentice-Hall, Inc., Upper Saddle River, New Jersey. (Langmuir 1997, 56037)

LANL (Los Alamos National Laboratory), October 25, 1995. "Groundwater Protection Management Program Plan" (draft), Rev. 2.0, Los Alamos, New Mexico. (LANL 1995, 50124)

LANL (Los Alamos National Laboratory), November 1995. "Task/Site Work Plan for Operable Unit 1049: Los Alamos Canyon and Pueblo Canyon," Los Alamos National Laboratory Report LA-UR-95-2053, Los Alamos, New Mexico. (LANL 1995, 50290)

LANL (Los Alamos National Laboratory), May 22, 1998. "Hydrogeologic Workplan," Los Alamos, New Mexico. (LANL 1998, 59599)

Longmire, P. A., S. Kung, J. M. Boak, A. I. Adams, F. Caporuscio, and R. N. Gray, 1996. "Aqueous Geochemistry of Upper Los Alamos Canyon, Los Alamos, New Mexico," in *New Mexico Geological Society Guidebook*, 47th Field Conference, Jemez Mountains Region, New Mexico, pp. 473–480. (Longmire et al. 1996, 54168)

Longmire, P., Personal Communication from Dale Counce, March 26, 2002. (Longmire 2002, 72613)

Parkhurst, D.L., and C.A.J. Appelo, 1999. "User's Guide to PHREEQC (Version 2)—A Computer Program for Speciation, Batch-Reaction, One-Dimensional Transport, and Inverse Geochemical Calculations," Water-Resources Investigations Report 99-4259, U.S. Geological Survey, Denver, Colorado. (Parkhurst and Appelo 1999, 71485).

Thurman, E. M., 1985. *Organic Geochemistry of Natural Waters*, Martinus Nijhoff/Dr W. Junk Publishers, Boston, Massachusetts, p. 14. (Thurman 1985, 71514)

Vaniman, D., J. Marin, W. Stone, B. Newman, P. Longmire, N. Clayton, R. Lewis, R. Koch, S. McLin, G. WoldeGabriel, D. Counce, D. Rogers, R. Warren, E. Kluk, S. Chipera, D. Larssen, and W. Kopp, February 2002. "Characterization Well R-31 Completion Report," Los Alamos National Laboratory Report LA-13910-MS, Los Alamos, New Mexico. (Vaniman et al. 2002, 72615)

Vilks, P., and D. B. Bachinski, 1996. "Characterization of Organics in Whiteshell Research Area Groundwater and the Implications for Radionuclide Transport," *Applied Geochemistry*, Vol. 11, No. 3, pp. 387–402. (Vilks and Bachinski 1996, 71515)

Appendix A

Groundwater Analytical Results

Table A-1
Regional Well R-9 Screen 1 First Round Sample Results: Data Summary for Inorganic Chemicals

Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects >NMED Groundwater Standard
Field Parameter												
Field Alkalinity (total as $CaCO_3$)	1	741.4	2/28/00	NF[e]	1	1	—[f]	—	—	—	—	—
pH	1	741.4	2/28/00	NF	1	1	7.45	—	>6 & <9	0/1	>6 & <9	0/1
Specific Conductance (µS/cm)	1	741.4	2/28/00	NF	1	1	239	—	—	0/1	—	0/1
Temperature (°C)	1	741.4	2/28/00	NF	1	1	22.7	—	—	0/1	—	0/1
Turbidity (NTU[g])	1	741.4	2/28/00	NF	1	1	2.0	—	—	0/1	—	0/1
Analyte												
Lab Alkalinity (total as $CaCO_3$)	1	741.4	2/28/00	F[h]	1	1	120000	—	—	—	—	—
Aluminum	1	741.4	2/28/00	F	1	0	—	[69]	50	0/1	5000	0/1
Aluminum	1	741.4	2/28/00	NF	1	1	310	—	—	—	—	—
Ammonia (expressed as N)	1	741.4	2/28/00	F	1	0	—	[500]	—	—	—	—
Ammonia (expressed as N)	1	741.4	2/28/00	NF	1	0	—	[500]	—	—	—	—
Antimony	1	741.4	2/28/00	F	1	0		[0.683]	6	0/1	—	—
Antimony	1	741.4	2/28/00	NF	1	1	1.41	—	—	—	—	—
Arsenic	1	741.4	2/28/00	F	1	0	—	[2.3]	50	0/1	100	0/1
Arsenic	1	741.4	2/28/00	NF	1	0	—	[2.3]	—	—	—	—
Barium	1	741.4	2/28/00	F	1	1	99	—	2000	0/1	1000	0/1
Barium	1	741.4	2/28/00	NF	1	1	110	—	—	—	—	—
Beryllium	1	741.4	2/28/00	F	1	1	0.011	—	4	0/1	—	—
Beryllium	1	741.4	2/28/00	NF	1	1	0.018	—	—	—	—	—
Boron	1	741.4	2/28/00	F	1	1	56	—	—	—	750	0/1
Boron	1	741.4	2/28/00	NF	1	1	56	—	—	—	—	—

Table A-1 (continued)

Analyte	Screen	Depth (ft)	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects >NMED Groundwater Standard
Bromide	1	741.4	2/28/00	F	1	0	—	[16]	—	—	—	—
Bromide	1	741.4	2/28/00	NF	1	0	—	[16]	—	—	—	—
Cadmium	1	741.4	2/28/00	F	1	0	—	[0.13]	5	0/1	10	0/1
Cadmium	1	741.4	2/28/00	NF	1	0	—	[0.13]	—	—	—	—
Calcium	1	741.4	2/28/00	F	1	1	26000	—	—	—	—	—
Calcium	1	741.4	2/28/00	NF	1	1	26000	—	—	—	—	—
Chloride	1	741.4	2/28/00	F	1	1	6860	—	250000	0/1	250000	0/1
Chloride	1	741.4	2/28/00	NF	1	1	6510	—	—	—	—	—
Chromium	1	741.4	2/28/00	F	1	0	—	[1.6]	100	0/1	50	0/1
Chromium	1	741.4	2/28/00	NF	1	1	18	—	—	—	—	—
Cobalt	1	741.4	2/28/00	F	1	1	0.52	—	—	—	50	0/1
Cobalt	1	741.4	2/28/00	NF	1	1	0.69	—	—	—	—	—
Copper	1	741.4	2/28/00	F	1	0	—	[0.42]	1300	0/1	1000	0/1
Copper	1	741.4	2/28/00	NF	1	1	2	—	—	—	—	—
Cyanide (total)	1	741.4	2/28/00	NF	1	0	—	[10]	—	—	—	—
Fluoride	1	741.4	2/28/00	F	1	1	309	—	4000	0/1	1600	0/1
Fluoride	1	741.4	2/28/00	NF	1	1	303	—	—	—	—	—
Iron	1	741.4	2/28/00	F	1	1	83	—	300	0/1	1000	0/1
Iron	1	741.4	2/28/00	NF	1	1	12000	—	—	—	—	—
Lead	1	741.4	2/28/00	F	1	0	—	[0.01]	15	0/1	50	0/1
Lead	1	741.4	2/28/00	NF	1	1	9.27	—	—	—	—	—
Magnesium	1	741.4	2/28/00	F	1	1	5600	—	—	—	—	—
Magnesium	1	741.4	2/28/00	NF	1	1	5700	—	—	—	—	—
Manganese	1	741.4	2/28/00	F	1	1	190	—	50	1/1	200	0/1
Manganese	1	741.4	2/28/00	NF	1	1	370	—	—	—	—	—
Mercury	1	741.4	2/28/00	F	1	0	—	[0.011]	2	0/1	—	—
Mercury	1	741.4	2/28/00	NF	1	0	—	[0.011]	—	—	2	0/1

Table A-1 (continued)

Analyte	Screen	Depth (ft)	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects >NMED Groundwater Standard
Molybdenum	1	741.4	2/28/00	F	1	0	—	[3.3]	—	—	—	—
Molybdenum	1	741.4	2/28/00	NF	1	1	4.5	—	—	—	—	—
Nickel	1	741.4	2/28/00	F	1	1	5.7	—	100	0/1	200	0/1
Nickel	1	741.4	2/28/00	NF	1	1	12	—	—	—	—	—
Nitrate + Nitrite (expressed as N)	1	741.4	2/28/00	F	1	1	520	—	10000	0/1	—	—
Nitrate + Nitrite (expressed as N)	1	741.4	2/28/00	NF	1	1	460	—	—	—	—	—
Oxalate	1	741.4	2/28/00	F	1	0	—	[113]	—	—	—	—
Oxalate	1	741.4	2/28/00	NF	1	0	—	[113]	—	—	—	—
Perchlorate	1	741.4	2/28/00	F	1	1	1.65	—	—	—	—	—
Perchlorate	1	741.4	2/28/00	NF	1	0		[1.51]	—	—	—	—
Phosphorus (total)	1	741.4	2/28/00	F	1	1	51	—	—	—	—	—
Phosphorus (total)	1	741.4	2/28/00	NF	1	1	52	—	—	—	—	—
Potassium	1	741.4	2/28/00	F	1	1	4000	—	—	—	—	—
Potassium	1	741.4	2/28/00	NF	1	1	4000	—	—	—	—	—
Selenium	1	741.4	2/28/00	F	1	0	—	[3.8]	50	0/1	50	0/1
Selenium	1	741.4	2/28/00	NF	1	0	—	[3.8]	—	—	—	—
Silica	1	741.4	2/28/00	F	1	1	70620	—	—	—	—	—
Silica	1	741.4	2/28/00	NF	1	1	72760	—	—	—	—	—
Silver	1	741.4	2/28/00	F	1	0	—	[0.64]	100	0/1	50	0/1
Silver	1	741.4	2/28/00	NF	1	0	—	[0.64]	—	—	—	—
Sodium	1	741.4	2/28/00	F	1	1	17000	—	—	—	—	—
Sodium	1	741.4	2/28/00	NF	1	1	18000	—	—	—	—	—
Strontium	1	741.4	2/28/00	F	1	1	160	—	—	—	—	—
Strontium	1	741.4	2/28/00	NF	1	1	160	—	—	—	—	—
Sulfate	1	741.4	2/28/00	F	1	1	5790	—	250000	0/1	600000	0/1
Sulfate	1	741.4	2/28/00	NF	1	1	5670	—	—	—	—	—

Table A-1 (continued)

Analyte	Screen	Depth (ft)	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects >NMED Groundwater Standard
Thallium	1	741.4	2/28/00	F	1	1	0.626	—	2	0/1	—	—
Thallium	1	741.4	2/28/00	NF	1	1	0.489	—	—	—	—	—
Total Kjeldahl Nitrogen	1	741.4	2/28/00	F	1	0	—	[100]	—	—	—	—
Total Kjeldahl Nitrogen	1	741.4	2/28/00	NF	1	1	450	—	—	—	—	—
Uranium (by KPA[i])	1	741.4	2/28/00	F	1	1	1.74	—	—	—	5000	0/1
Uranium (by KPA)	1	741.4	2/28/00	NF	1	1	1.77	—	—	—	—	—
Uranium by (ICPMS[j])	1	741.4	2/28/00	F	1	1	1.72	—	—	—	5000	0/1
Uranium by (ICPMS)	1	741.4	2/28/00	NF	1	1	1.68	—	—	—	—	—
Vanadium	1	741.4	2/28/00	F	1	1	6.9	—	—	—	—	—
Vanadium	1	741.4	2/28/00	NF	1	1	7.9	—	—	—	—	—
Zinc	1	741.4	2/28/00	F	1	0	—	[3.4]	5000	0/1	10000	0/1
Zinc	1	741.4	2/28/00	NF	1	1	9.1	—	—	—	—	—
Stable Isotopes (‰)												
δD	1	741.4	2/28/00	NF	1	1	-76	—	—	—	—	—
$\delta^{15}N$	1	741.4	2/28/00	NF	1	1	+3.5	—	—	—	—	—
$\delta^{18}O$	1	741.4	2/28/00	NF	1	1	-10.5	—	—	—	—	—

[a] Groundwater samples were collected at a depth of 741.4 ft at well R-9.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US E.P.A. secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] NMED = New Mexico Environment Department.

[d] State of New Mexico groundwater standards are from *New Mexico Water Quality Control Commission Regulations, Ground and Surface Water Protection*, 20 NMAC 6.2.

[e] NF = Nonfiltered.

[f] — = Not available or not applicable.

[g] NTU = Nephelometric turbidity unit.

[h] F = Filtered.

[i] KPA = Kinetic phosphorescence analysis.

[j] ICPMS = Inductively coupled plasma mass spectrometry.

Table A-2
Regional Well R-9 Screen 1 First Round Sample Results: Data Summary for Detected Organic Chemicals

Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Benzene	1	741.4	2/28/00	NF[e]	1	1	1.9	5	0/1	10	0/1
Toluene	1	741.4	2/28/00	NF	1	1	1.1	1000	0/1	750	0/1
Dissolved Organic Carbon	1	741.4	2/28/00	F[f]	1	1	670	—[g]	—	—	—
Total Organic Carbon	1	741.4	2/28/00	NF	1	1	26000	—	—	—	—

[a] Groundwater samples were collected at a depth of 741.4 ft at well R-9.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US E.P.A. secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] NMED = New Mexico Environment Department.

[d] State of New Mexico groundwater standards are from *New Mexico Water Quality Control Commission Regulations, Ground and Surface Water Protection*, 20 NMAC 6.2.

[e] NF = Nonfiltered.

[f] F = Filtered.

[g] — = Not available or not applicable.

Table A-3
Regional Well R-9 Screen 1 First Round Sample Results: Data Summary for Radionuclides

Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (pCi/L)	Nondetected Value (pCi/L)	Drinking Water MCL[b] (pCi/L)	Frequency of Detects > Drinking Water MCL
Americium-241	1	741.4	2/28/00	F[c]	1	0	—[d]	[0.013]	—	—
Americium-241	1	741.4	2/28/00	NF[e]	1	0	—	[0.03]	—	—
Cesium-134	1	741.4	2/28/00	F	1	0	—	[0]	—	—
Cesium-134	1	741.4	2/28/00	NF	1	0	—	[0]	—	—
Cesium-137	1	741.4	2/28/00	F	1	0	—	[-0.5]	—	—
Cesium-137	1	741.4	2/28/00	NF	1	0	—	[-0.9]	—	—
Cobalt-60	1	741.4	2/28/00	F	1	0	—	[0.4]	—	—
Cobalt-60	1	741.4	2/28/00	NF	1	0	—	[1.6]	—	—
Europium-152	1	741.4	2/28/00	F	1	0	—	[0.4]	—	—
Europium-152	1	741.4	2/28/00	NF	1	0	—	[0.5]	—	—
Gross Alpha Radiation	1	741.4	2/28/00	F	1	1	1.8	—	15	0/1
Gross Alpha Radiation	1	741.4	2/28/00	NF	1	1	1.32	—	—	—
Gross Beta Radiation	1	741.4	2/28/00	F	1	1	4.5	—	—	—
Gross Beta Radiation	1	741.4	2/28/00	NF	1	1	3.55	—	—	—
Plutonium-238	1	741.4	2/28/00	F	1	0	—	[-0.007]	—	—
Plutonium-238	1	741.4	2/28/00	NF	1	0	—	[0.0084]	—	—
Plutonium-239	1	741.4	2/28/00	F	1	0	—	[0.007]	—	—
Plutonium-239	1	741.4	2/28/00	NF	1	0	—	[-0.005]	—	—
Ruthenium-106	1	741.4	2/28/00	F	1	0	—	[-12]	—	—
Ruthenium-106	1	741.4	2/28/00	NF	1	0	—	[3]	—	—
Sodium-22	1	741.4	2/28/00	F	1	0	—	[0.4]	—	—
Sodium-22	1	741.4	2/28/00	NF	1	0	—	[-0.4]	—	—
Strontium-90	1	741.4	2/28/00	F	1	0	—	[0.04]	8	0/1
Strontium-90	1	741.4	2/28/00	NF	1	0	—	[0.05]	—	—
Tritium	1	741.4	2/28/00	NF	1	1	14	—	20000	0/1
Uranium-234	1	741.4	2/28/00	F	1	1	1.14	—	—	—
Uranium-234	1	741.4	2/28/00	NF	1	1	1.06	—	—	—

Table A-3 (continued)

Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (pCi/L)	Nondetected Value (pCi/L)	Drinking Water MCL[b] (pCi/L)	Frequency of Detects > Drinking Water MCL
Uranium-235	1	741.4	2/28/00	F	1	1	0.049	—	—	—
Uranium-235	1	741.4	2/28/00	NF	1	1	0.034	—	—	—
Uranium-238	1	741.4	2/28/00	F	1	1	0.63	—	—	—
Uranium-238	1	741.4	2/28/00	NF	1	1	0.62	—	—	—

[a] Groundwater samples were collected at a depth of 741.4 ft at well R-9.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US E.P.A. secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] F = Filtered.

[d] — = Not available or not applicable.

[e] NF = Nonfiltered.

Table A-4
Regional Well R-9 Screen 1 Second Round Sample Results: Data Summary for Inorganic Chemicals

Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Field Parameter												
Field Alkalinity (total as $CaCO_3$)	1	741.4	09/29/00	NF[e]	1	1	—[f]	—	—	—	—	—
pH	1	741.4	09/29/00	NF	1	1	8.03	—	>6 & <9	0/1	>6 & <9	0/1
Specific Conductance (µS/cm)	1	741.4	09/29/00	NF	1	1	200	—	—	0/1	—	0/1
Temperature (°C)	1	741.4	09/29/00	NF	1	1	23.4	—	—	0/1	—	0/1
Turbidity (NTU[g])	1	741.4	09/29/00	NF	1	1	4.2	—	—	0/1	—	0/1
Analyte												
Aluminum	1	741.4	09/29/00	F[h]	1	0	—	[7.9]	50	0/1	5000	0/1
Aluminum	1	741.4	09/29/00	NF	1	0	—	[7.9]	—	—	—	—
Ammonia (expressed as N)	1	741.4	09/29/00	F	1	0	—	[500]	—	—	—	—
Ammonia (expressed as N)	1	741.4	09/29/00	NF	1	0	—	[500]	—	—	—	—
Antimony	1	741.4	09/29/00	F	1	0	—	[0.173]	6	0/1	—	—
Antimony	1	741.4	09/29/00	NF	1	0	—	[0.174]	—	—	—	—
Arsenic	1	741.4	09/29/00	F	1	0	—	[3.4]	50	0/1	100	0/1
Arsenic	1	741.4	09/29/00	NF	1	0	—	[3.4]	—	—	—	—
Barium	1	741.4	09/29/00	F	1	1	130	—	2000	0/1	1000	0/1
Barium	1	741.4	09/29/00	NF	1	1	130	—	—	—	—	—
Beryllium	1	741.4	09/29/00	F	1	0	—	[0.01]	4	0/1	—	—
Beryllium	1	741.4	09/29/00	NF	1	0	—	[0.01]	—	—	—	—
Bicarbonate (as $CaCO_3$)	1	741.4	09/29/00	F	1	1	120000	—	—	—	—	—
Bicarbonate (as $CaCO_3$)	1	741.4	09/29/00	NF	1	1	120000	—	—	—	—	—
Boron	1	741.4	09/29/00	F	1	1	43	—	—	—	750	0/1

Table A-4 (continued)

Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Boron	1	741.4	09/29/00	NF	1	1	50	—	—	—	—	—
Bromide	1	741.4	09/29/00	F	1	0	—	[200]	—	—	—	—
Bromide	1	741.4	09/29/00	NF	1	0	—	[200]	—	—	—	—
Cadmium	1	741.4	09/29/00	F	1	0	—	[0.059]	5	0/1	10	0/1
Cadmium	1	741.4	09/29/00	NF	1	0	—	[0.059]	—	—	—	—
Calcium	1	741.4	09/29/00	F	1	1	25000	—	—	—	—	—
Calcium	1	741.4	09/29/00	NF	1	1	25000	—	—	—	—	—
Carbonate (as $CaCO_3$)	1	741.4	09/29/00	F	1	0	—	[20000]	—	—	—	—
Carbonate (as $CaCO_3$)	1	741.4	09/29/00	NF	1	0	—	[20000]	—	—	—	—
Chloride	1	741.4	09/29/00	F	1	1	7100	—	250000	0/1	250000	0/1
Chloride	1	741.4	09/29/00	NF	1	1	7200	—	—	—	—	—
Chromium	1	741.4	09/29/00	F	1	1	2.1	—	100	0/1	50	0/1
Chromium	1	741.4	09/29/00	NF	1	1	3.1	—	—	—	—	—
Cobalt	1	741.4	09/29/00	F	1	0	—	[0.66]	—	—	50	0/1
Cobalt	1	741.4	09/29/00	NF	1	0	—	[0.6]	—	—	—	—
Copper	1	741.4	09/29/00	F	1	1	0.88	—	1300	0/1	1000	0/1
Copper	1	741.4	09/29/00	NF	1	1	5.5	—	—	—	—	—
Cyanide (total)	1	741.4	09/29/00	NF	1	0	—	[10]	—	—	—	—
Fluoride	1	741.4	09/29/00	F	1	1	300	—	4000	0/1	1600	0/1
Fluoride	1	741.4	09/29/00	NF	1	1	300	—	—	—	—	—
Iron	1	741.4	09/29/00	F	1	0	—	[27]	300	0/1	1000	0/1
Iron	1	741.4	09/29/00	NF	1	1	290	—	—	—	—	—
Lead	1	741.4	09/29/00	F	1	0	—	[0.065]	15	0/1	50	0/1
Lead	1	741.4	09/29/00	NF	1	1	1.76	—	—	—	—	—
Magnesium	1	741.4	09/29/00	F	1	1	5900	—	—	—	—	—
Magnesium	1	741.4	09/29/00	NF	1	1	5900	—	—	—	—	—
Manganese	1	741.4	09/29/00	F	1	1	71	—	50	1/1	200	0/1

Table A-4 (continued)

Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Manganese	1	741.4	09/29/00	NF	1	1	75	—	—	—	—	—
Mercury	1	741.4	09/29/00	F	1	0	—	[0.0092]	2	0/1	—	—
Mercury	1	741.4	09/29/00	NF	1	0	—	[0.0092]	—	—	2	0/1
Molybdenum	1	741.4	09/29/00	F	1	0	—	[3.1]	—	—	—	—
Molybdenum	1	741.4	09/29/00	NF	1	0	—	[3.1]	—	—	—	—
Nickel	1	741.4	09/29/00	F	1	1	0.95	—	100	0/1	200	0/1
Nickel	1	741.4	09/29/00	NF	1	1	1.4	—	—	—	—	—
Nitrate + Nitrite (expressed as N)	1	741.4	09/29/00	F	1	1	650	—	10000	0/1	—	—
Nitrate + Nitrite (expressed as N)	1	741.4	09/29/00	NF	1	1	660	—	—	—	—	—
Oxalate	1	741.4	09/29/00	F	1	0	—	[113]	—	—	—	—
Oxalate	1	741.4	09/29/00	NF	1	0	—	[113]	—	—	—	—
Phosphorus (total)	1	741.4	09/29/00	F	1	0	—	[50]	—	—	—	—
Phosphorus (total)	1	741.4	09/29/00	NF	1	0	—	[50]	—	—	—	—
Potassium	1	741.4	09/29/00	F	1	1	3600	—	—	—	—	—
Potassium	1	741.4	09/29/00	NF	1	1	3600	—	—	—	—	—
Selenium	1	741.4	09/29/00	F	1	0	—	[2.6]	50	0/1	50	0/1
Selenium	1	741.4	09/29/00	NF	1	0	—	[2.6]	—	—	—	—
Silica	1	741.4	09/29/00	F	1	1	74550	—	—	—	—	—
Silica	1	741.4	09/29/00	NF	1	1	74550	—	—	—	—	—
Silver	1	741.4	09/29/00	F	1	0	—	[0.45]	100	0/1	50	0/1
Silver	1	741.4	09/29/00	NF	1	0	—	[0.45]	—	—	—	—
Sodium	1	741.4	09/29/00	F	1	1	16000	—	—	—	—	—
Sodium	1	741.4	09/29/00	NF	1	1	16000	—	—	—	—	—
Strontium	1	741.4	09/29/00	F	1	1	160	—	—	—	—	—
Strontium	1	741.4	09/29/00	NF	1	1	160	—	—	—	—	—
Sulfate	1	741.4	09/29/00	F	1	1	6300	—	250000	0/1	600000	0/1
Sulfate	1	741.4	09/29/00	NF	1	1	6300	—	—	—	—	—

Table A-4 (continued)

Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Thallium	1	741.4	09/29/00	F	1	1	0.454	—	2	0/1	—	—
Thallium	1	741.4	09/29/00	NF	1	1	0.404	—	—	—	—	—
Total Kjeldahl Nitrogen	1	741.4	09/29/00	F	1	1	350	—	—	—	—	—
Total Kjeldahl Nitrogen	1	741.4	09/29/00	NF	1	1	750	—	—	—	—	—
Uranium by ICPMS[i]	1	741.4	09/29/00	F	1	1	1.75	—	—	—	—	—
Uranium by ICPMS	1	741.4	09/29/00	NF	1	1	1.71	—	—	—	—	—
Uranium by KPA[j]	1	741.4	09/29/00	F	1	1	1.85	—	—	—	—	—
Uranium by KPA	1	741.4	09/29/00	NF	1	1	1.87	—	—	—	—	—
Vanadium	1	741.4	09/29/00	F	1	1	11	—	—	—	—	—
Vanadium	1	741.4	09/29/00	NF	1	1	11	—	—	—	—	—
Zinc	1	741.4	09/29/00	F	1	0	—	[7.5]	5000	0/1	10000	0/1
Zinc	1	741.4	09/29/00	NF	1	0	—	[12]	—	—	—	—
Stable Isotopes (‰)												
δD	1	741.4	09/29/00	NF	1	1	-75	—	—	—	—	—
$\delta^{15}N$	1	741.4	09/29/00	NF	1	1	+4.6	—	—	—	—	—
$\delta^{18}O$	1	741.4	09/29/00	NF	1	1	-10.4	—	—	—	—	—

[a] Groundwater samples were collected at a depth of 741.4 ft at well R-9.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US E.P.A. secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] NMED = New Mexico Environment Department.

[d] State of New Mexico groundwater standards are from *New Mexico Water Quality Control Commission Regulations, Ground and Surface Water Protection*, 20 NMAC 6.2.

[e] NF = Nonfiltered.

[f] — = Not available or not applicable.

[g] NTU = Nephelometric turbidity unit.

[h] F = Filtered.

[i] ICPMS = Inductively coupled plasma mass spectrometry.

[j] KPA = Kinetic phosphorescence analysis.

Table A-5
Regional Well R-9 Screen 1 Second Round Sample Results: Data Summary for Detected Organic Chemicals

Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Toluene	1	741.4	09/29/00	NF[e]	1	1	12	1000	0/1	750	0/1
Total Organic Carbon	1	741.4	09/29/00	NF	1	1	2700	—[f]	—	—	—

[a] Groundwater samples were collected at a depth of 741.4 ft at well R-9

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US E.P.A. secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] NMED = New Mexico Environment Department.

[d] State of New Mexico groundwater standards are from *New Mexico Water Quality Control Commission Regulations, Ground and Surface Water Protection*, 20 NMAC 6.2.

[e] NF = Nonfiltered.

[f] — = Not available or not applicable.

Table A-6
Regional Well R-9 Screen 1 Second Round Sample Results: Data Summary for Radionuclides

Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (pCi/L)	Nondetected Value (pCi/L)	Drinking Water MCL[b] (pCi/L)	Frequency of Detects > Drinking Water MCL
Americium-241	1	741.4	09/29/00	F[c]	1	0	—[d]	[0.009]	15[e]	0/1
Americium-241	1	741.4	09/29/00	NF[f]	1	0	—	[0.032]	—	—
Gross Alpha Radiation	1	741.4	09/29/00	F	1	0	—	[1.2]	15	0/1
Gross Alpha Radiation	1	741.4	09/29/00	NF	1	0	—	[1.9]	—	—
Gross Beta Radiation	1	741.4	09/29/00	F	1	1	2.9	—	—	—
Gross Beta Radiation	1	741.4	09/29/00	NF	1	1	3.2	—	—	—
Gross Gamma Radiation	1	741.4	09/29/00	F	1	1	132	—	—	—
Gross Gamma Radiation	1	741.4	09/29/00	NF	1	1	192	—	—	—
Plutonium-238	1	741.4	09/29/00	F	1	0	—	[0.019]	15[e]	0/1
Plutonium-238	1	741.4	09/29/00	NF	1	0	—	[0.001]	—	—
Plutonium-239	1	741.4	09/29/00	F	1	0	—	[0.017]	15[e]	0/1
Plutonium-239	1	741.4	09/29/00	NF	1	0	—	[0.02]	—	—
Strontium-90	1	741.4	09/29/00	F	1	0	—	[0.19]	8	0/1
Strontium-90	1	741.4	09/29/00	NF	1	0	—	[0.28]	—	—
Tritium	1	741.4	09/29/00	NF	1	1	4.84	—	20000	0/1
Uranium-234	1	741.4	09/29/00	F	1	1	1.26	—	—	—
Uranium-234	1	741.4	09/29/00	NF	1	1	1.24	—	—	—
Uranium-235	1	741.4	09/29/00	F	1	0	—	[0.021]	—	—
Uranium-235	1	741.4	09/29/00	NF	1	1	0.1	—	—	—
Uranium-238	1	741.4	09/29/00	F	1	1	0.56	—	—	—
Uranium-238	1	741.4	09/29/00	NF	1	1	0.62	—	—	—

[a] Groundwater samples were collected at a depth of 741.4 ft at well R-9.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US E.P.A. secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] F = Filtered.

[d] — = Not available or not applicable.

[e] Based on an MCL of 15 pCi/L (including radium-226, but excluding radon and uranium).

[f] NF = Nonfiltered.

Table A-7
Regional Well R-9 Screen 1 Third Round Sample Results: Data Summary for Inorganic Chemicals

Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Field Parameter												
Field Alkalinity (total as $CaCO_3$)	1	741.4	02/13/01	NF[e]	1	1	—[f]	—	—	—	—	—
pH	1	741.4	02/13/01	NF	1	1	8.13	—	>6 & <9	0/1	>6 & <9	0/1
Specific Conductance (µS/cm)	1	741.4	02/13/01	NF	1	1	259	—	—	0/1	—	0/1
Temperature (°C)	1	741.4	02/13/01	NF	1	1	23	—	—	0/1	—	0/1
Turbidity (NTU[g])	1	741.4	02/13/01	NF	1	1	2.4	—	—	0/1	—	0/1
Analyte												
Lab Alkalinity (total as $CaCO_3$)	1	741.4	02/13/01	F[h]	1	1	120000	—	—	—	—	—
Aluminum	1	741.4	02/13/01	F	1	0	—	[87]	50	0/1	5000	0/1
Aluminum	1	741.4	02/13/01	NF	1	0	—	[71]	—	—	—	—
Ammonia (as N)	1	741.4	02/13/01	F	1	0	—	[500]	—	—	—	—
Antimony	1	741.4	02/13/01	F	1	0	—	[0.153]	6	0/1	—	—
Antimony	1	741.4	02/13/01	NF	1	0	—	[0.622]	—	—	—	—
Arsenic	1	741.4	02/13/01	F	1	1	2.2	—	50	0/1	100	0/1
Arsenic	1	741.4	02/13/01	NF	1	0	—	[1.5]	—	—	—	—
Barium	1	741.4	02/13/01	F	1	1	140	—	2000	0/1	1000	0/1
Barium	1	741.4	02/13/01	NF	1	1	140	—	—	—	—	—
Beryllium	1	741.4	02/13/01	F	1	0	—	[0.015]	4	0/1	—	—
Beryllium	1	741.4	02/13/01	NF	1	0	—	[0.028]	—	—	—	—
Boron	1	741.4	02/13/01	F	1	1	39	—	—	—	750	0/1
Boron	1	741.4	02/13/01	NF	1	1	42	—	—	—	—	—
Bromide	1	741.4	02/13/01	F	1	0	—	[200]	—	—	—	—
Cadmium	1	741.4	02/13/01	F	1	0	—	[0.2]	5	0/1	10	0/1
Cadmium	1	741.4	02/13/01	NF	1	0	—	[0.2]	—	—	—	—

Table A-7 (continued)

Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Calcium	1	741.4	02/13/01	F	1	1	24000	—	—	—	—	—
Calcium	1	741.4	02/13/01	NF	1	1	24000	—	—	—	—	—
Chloride	1	741.4	02/13/01	F	1	1	7400	—	250000	0/1	250000	0/1
Chromium (total)	1	741.4	02/13/01	F	1	1	1.7	—	100	0/1	50	0/1
Chromium (total)	1	741.4	02/13/01	NF	1	1	2.2	—	—	—	—	—
Cobalt	1	741.4	02/13/01	F	1	0	—	[0.4]	—	—	50	0/1
Cobalt	1	741.4	02/13/01	NF	1	0	—	[0.4]	—	—	—	—
Copper	1	741.4	02/13/01	F	1	0	—	[0.34]	1300	0/1	1000	0/1
Copper	1	741.4	02/13/01	NF	1	0	—	[0.34]	—	—	—	—
Cyanide (total)	1	741.4	02/13/01	NF	1	0	—	[10]	—	—	—	—
Fluoride	1	741.4	02/13/01	F	1	1	270	—	4000	0/1	1600	0/1
Iron	1	741.4	02/13/01	F	1	0	—	[56]	300	0/1	1000	0/1
Iron	1	741.4	02/13/01	NF	1	0	—	[140]	—	—	—	—
Lead	1	741.4	02/13/01	F	1	0	—	[0.65]	15	0/1	50	0/1
Lead	1	741.4	02/13/01	NF	1	0	—	[0.65]	—	—	—	—
Magnesium	1	741.4	02/13/01	F	1	1	5700	—	—	—	—	—
Magnesium	1	741.4	02/13/01	NF	1	1	5700	—	—	—	—	—
Manganese	1	741.4	02/13/01	F	1	1	80	—	50	1/1	200	0/1
Manganese	1	741.4	02/13/01	NF	1	1	82	—	—	—	—	—
Mercury	1	741.4	02/13/01	F	1	0	—	[0.016]	2	0/1	—	—
Mercury	1	741.4	02/13/01	NF	1	0	—	[0.016]	—	—	2	0/1
Molybdenum	1	741.4	02/13/01	F	1	0	—	[4.5]	—	—	—	—
Molybdenum	1	741.4	02/13/01	NF	1	1	4.7	—	—	—	—	—
Nickel	1	741.4	02/13/01	F	1	1	2.7	—	100	0/1	200	0/1
Nickel	1	741.4	02/13/01	NF	1	1	2.8	—	—	—	—	—
Nitrate + Nitrite (as N)	1	741.4	02/13/01	F	1	1	680	—	10000	0/1	—	—
Oxalate	1	741.4	02/13/01	F	1	0	—	[190]	—	—	—	—
Perchlorate	1	741.4	02/13/01	F	1	0	—	[0.958]	—	—	—	—

Table A-7 (continued)

Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Phosphorus (total)	1	741.4	02/13/01	F	1	0	—	[16.3]	—	—	—	—
Potassium	1	741.4	02/13/01	F	1	1	3800	—	—	—	—	—
Potassium	1	741.4	02/13/01	NF	1	1	3800	—	—	—	—	—
Selenium	1	741.4	02/13/01	F	1	0	—	[2.5]	50	0/1	50	0/1
Selenium	1	741.4	02/13/01	NF	1	0	—	[2.5]	—	—	—	—
Silica	1	741.4	02/13/01	F	1	1	72760	—	—	—	—	—
Silica	1	741.4	02/13/01	NF	1	1	72760	—	—	—	—	—
Silver	1	741.4	02/13/01	F	1	0	—	[0.48]	100	0/1	50	0/1
Silver	1	741.4	02/13/01	NF	1	0	—	[0.48]	—	—	—	—
Sodium	1	741.4	02/13/01	F	1	1	15000	—	—	—	—	—
Sodium	1	741.4	02/13/01	NF	1	1	15000	—	—	—	—	—
Strontium	1	741.4	02/13/01	F	1	1	150	—	—	—	—	—
Strontium	1	741.4	02/13/01	NF	1	1	150	—	—	—	—	—
Sulfate	1	741.4	02/13/01	F	1	1	6400	—	250000	0/1	600000	0/1
Thallium	1	741.4	02/13/01	F	1	1	0.793	—	2	0/1	—	—
Thallium	1	741.4	02/13/01	NF	1	0	—	[0.077]	—	—	—	—
Total Kjeldahl Nitrogen	1	741.4	02/13/01	F	1	1	180	—	—	—	—	—
Uranium	1	741.4	02/13/01	F	1	1	1.85	—	20	0/1	5000	0/1
Uranium	1	741.4	02/13/01	NF	1	1	1.80	—	—	—	—	—
Vanadium	1	741.4	02/13/01	F	1	1	11	—	—	—	—	—
Vanadium	1	741.4	02/13/01	NF	1	1	9.8	—	—	—	—	—
Zinc	1	741.4	02/13/01	F	1	0	—	[9.8]	5000	0/1	10000	0/1
Zinc	1	741.4	02/13/01	NF	1	0	—	[16]	—	—	—	—

Table A-7 (continued)

Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Stable Isotopes (‰)												
δD	1	741.4	02/13/01	NF	1	1	-74	—	—	—	—	—
$\delta^{15}N$	1	741.4	02/13/01	NF	1	1	+4.9	—	—	—	—	—
$\delta^{18}O$	1	741.4	02/13/01	NF	1	1	-10.7	—	—	—	—	—

[a] Groundwater samples were collected at a depth of 741.4 ft at well R-9.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US E.P.A. secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] NMED = New Mexico Environment Department.

[d] State of New Mexico groundwater standards are from *New Mexico Water Quality Control Commission Regulations, Ground and Surface Water Protection*, 20 NMAC 6.2.

[e] NF = Nonfiltered.

[f] — = Not available or not applicable.

[g] NTU = Nephelometric turbidity unit.

[h] F = Filtered.

Table A-8
Regional Well R-9 Screen 1 Third Round Sample Results: Data Summary for Detected Organic Chemicals

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Toluene	1	741.4	02/13/01	NF[e]	1	1	2.5	—[f]	1000	0/1	750	0/1

[a] Groundwater samples were collected at a depth of 741.4 ft at well R-9.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US E.P.A. secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] NMED = New Mexico Environment Department.

[d] State of New Mexico groundwater standards are from *New Mexico Water Quality Control Commission Regulations, Ground and Surface Water Protection*, 20 NMAC 6.2.

[e] NF = Nonfiltered.

[f] — = Not available or not applicable.

Table A-9
Regional Well R-9 Screen 1 Third Round Sample Results: Data Summary for Radionuclides

Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (pCi/L)	Nondetected Value (pCi/L)	Drinking Water MCL[b] (pCi/L)	Frequency of Detects > Drinking Water MCL
Americium-241	1	741.4	02/13/01	F[c]	1	0	—[d]	[0.009]	15[e]	0/1
Cesium-134	1	741.4	02/13/01	F	1	0	—	[-0.8]	—	—
Cesium-137	1	741.4	02/13/01	F	1	0	—	[0.5]	—	—
Cobalt-60	1	741.4	02/13/01	F	1	0	—	[-0.2]	—	—
Europium-152	1	741.4	02/13/01	F	1	0	—	[1.7]	—	—
Gross Alpha Radiation	1	741.4	02/13/01	NF[f]	1	0	—	[2]	—	—
Gross Beta Radiation	1	741.4	02/13/01	NF	1	0	—	[3.4]	—	—
Gross Gamma Radiation	1	741.4	02/13/01	NF	2	1	237	—	—	—
Plutonium-238	1	741.4	02/13/01	F	1	0	—	[-0.007]	15	0/1
Plutonium-239	1	741.4	02/13/01	F	1	0	—	[0.021]	15	0/1
Ruthenium-106	1	741.4	02/13/01	F	1	0	—	[-6]	—	—
Sodium-22	1	741.4	02/13/01	F	1	0	—	[0.7]	—	—
Strontium-90	1	741.4	02/13/01	F	1	0	—	[0.01]	8	0/1
Tritium	1	741.4	02/13/01	NF	1	1	13.73	—	20000	0/1
Uranium-234	1	741.4	02/13/01	F	1	1	1.31	—	—	—
Uranium-235	1	741.4	02/13/01	F	1	0	—	[0.053]	—	—
Uranium-238	1	741.4	02/13/01	F	1	1	0.68	—	—	—

[a] Groundwater samples were collected at a depth of 741.4 ft at well R-9.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US E.P.A. secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] F = Filtered.

[d] — = Not available or not applicable.

[e] Based on an MCL of 15 pCi/L (including radium-226, but excluding radon and uranium).

[f] NF = Nonfiltered.

Table A-10
Regional Well R-9 Screen 1 Fourth Round Sample Results: Data Summary for Inorganic Chemicals

Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Field Parameter												
Field Alkalinity (total as $CaCO_3$)	1	741.4	05/15/01	NF[e]	1	1	—[f]	—	—	—	—	—
pH	1	741.4	05/15/01	NF	1	1	7.98	—	>6 & <9	0/1	>6 & <9	0/1
Specific Conductance (µS/cm)	1	741.4	05/15/01	NF	1	1	255	—	—	0/1	—	0/1
Temperature (°C)	1	741.4	05/15/01	NF	1	1	22.8	—	—	0/1	—	0/1
Turbidity (NTU[g])	1	741.4	05/15/01	NF	1	1	2.6	—	—	0/1	—	0/1
Analyte												
Lab Alkalinity (total as $CaCO_3$)	1	741.4	05/15/01	F[h]	1	1	120000	—	—	—	—	—
Aluminum	1	741.4	05/15/01	F	1	0	—	[7.6]	50	0/1	5000	0/1
Aluminum	1	741.4	05/15/01	NF	1	0	—	[7.6]	—	—	—	—
Ammonia (as N)	1	741.4	05/15/01	F	1	0	—	[500]	—	—	—	—
Antimony	1	741.4	05/15/01	F	1	0	—	[0.153]	6	0/1	—	—
Antimony	1	741.4	05/15/01	NF	1	0	—	[0.153]	—	—	—	—
Arsenic	1	741.4	05/15/01	F	1	1	2.9	—	50	0/1	100	0/1
Arsenic	1	741.4	05/15/01	NF	1	1	3.4	—	—	—	—	—
Barium	1	741.4	05/15/01	F	1	1	140	—	2000	0/1	1000	0/1
Barium	1	741.4	05/15/01	NF	1	1	130	—	—	—	—	—
Beryllium	1	741.4	05/15/01	F	1	0	—	[0.012]	4	0/1	—	—
Beryllium	1	741.4	05/15/01	NF	1	0	—	[0.012]	—	—	—	—
Boron	1	741.4	05/15/01	F	1	1	55	—	—	—	750	0/1
Boron	1	741.4	05/15/01	NF	1	1	70	—	—	—	—	—
Bromide	1	741.4	05/15/01	F	1	0	—	[200]	—	—	—	—
Cadmium	1	741.4	05/15/01	F	1	0	—	[0.084]	5	0/1	10	0/1
Cadmium	1	741.4	05/15/01	NF	1	0	—	[0.084]	—	—	—	—

Table A-10 (continued)

Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Calcium	1	741.4	05/15/01	F	1	1	25000	—	—	—	—	—
Calcium	1	741.4	05/15/01	NF	1	1	24000	—	—	—	—	—
Chloride	1	741.4	05/15/01	F	1	1	6900	—	250000	0/1	250000	0/1
Chromium (total)	1	741.4	05/15/01	F	1	1	2.0	—	100	0/1	50	0/1
Chromium (total)	1	741.4	05/15/01	NF	1	1	2.4	—	—	—	—	—
Cobalt	1	741.4	05/15/01	F	1	0	—	[0.37]	—	—	50	0/1
Cobalt	1	741.4	05/15/01	NF	1	0	—	[0.37]	—	—	—	—
Copper	1	741.4	05/15/01	F	1	0	—	[0.27]	1300	0/1	1000	0/1
Copper	1	741.4	05/15/01	NF	1	1	14	—	—	—	—	—
Cyanide (total)	1	741.4	05/15/01	NF	1	0	—	[10]	—	—	—	—
Fluoride	1	741.4	05/15/01	F	1	1	320	—	4000	0/1	1600	0/1
Iron	1	741.4	05/15/01	F	1	0	—	[53]	300	0/1	1000	0/1
Iron	1	741.4	05/15/01	NF	1	0	—	[140]	—	—	—	—
Kjeldahl Nitrogen	1	741.4	05/15/01	F	1	1	290	—	—	—	—	—
Lead	1	741.4	05/15/01	F	1	0	—	[1.1]	15	0/1	50	0/1
Lead	1	741.4	05/15/01	NF	1	0	—	[1.1]	—	—	—	—
Magnesium	1	741.4	05/15/01	F	1	1	5800	—	—	—	—	—
Magnesium	1	741.4	05/15/01	NF	1	1	5741	—	—	—	—	—
Manganese	1	741.4	05/15/01	F	1	1	84	—	50	1/1	200	0/1
Manganese	1	741.4	05/15/01	NF	1	1	84	—	—	—	—	—
Mercury	1	741.4	05/15/01	F	1	0	—	[0.033]	2	0/1	—	—
Mercury	1	741.4	05/15/01	NF	1	0	—	[0.033]	—	—	2	0/1
Molybdenum	1	741.4	05/15/01	F	1	0	—	[3.8]	—	—	—	—
Molybdenum	1	741.4	05/15/01	NF	1	0	—	[3.8]	—	—	—	—
Nickel	1	741.4	05/15/01	F	1	1	1.5	—	100	0/1	200	0/1
Nickel	1	741.4	05/15/01	NF	1	1	2.1	—	—	—	—	—
Nitrate + Nitrite (as N)	1	741.4	05/15/01	F	1	1	690	—	10000	0/1	—	—

Table A-10 (continued)

Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Perchlorate	1	741.4	05/15/01	F	1	0	—	[2.02]	—	—	—	—
Phosphorus (as P)	1	741.4	05/15/01	F	1	0	—	[50]	—	—	—	—
Potassium	1	741.4	05/15/01	F	1	1	3500	—	—	—	—	—
Potassium	1	741.4	05/15/01	NF	1	1	3500	—	—	—	—	—
Selenium	1	741.4	05/15/01	F	1	0	—	[1.9]	50	0/1	50	0/1
Selenium	1	741.4	05/15/01	NF	1	0	—	[1.9]	—	—	—	—
Silica	1	741.4	05/15/01	F	1	1	74900	—	—	—	—	—
Silica	1	741.4	05/15/01	NF	1	1	74900	—	—	—	—	—
Silver	1	741.4	05/15/01	F	1	0	—	[0.57]	100	0/1	50	0/1
Silver	1	741.4	05/15/01	NF	1	0	—	[0.57]	—	—	—	—
Sodium	1	741.4	05/15/01	F	1	1	16000	—	—	—	—	—
Sodium	1	741.4	05/15/01	NF	1	1	15000	—	—	—	—	—
Strontium	1	741.4	05/15/01	F	1	1	160	—	—	—	—	—
Strontium	1	741.4	05/15/01	NF	1	1	160	—	—	—	—	—
Sulfate	1	741.4	05/15/01	F	1	1	5900	—	250000	0/1	600000	0/1
Thallium	1	741.4	05/15/01	F	1	1	0.45	—	2	0/1	—	—
Thallium	1	741.4	05/15/01	NF	1	1	1.07	—	—	—	—	—
Uranium	1	741.4	05/15/01	F	1	1	1.94	—	—	—	—	—
Uranium	1	741.4	05/15/01	NF	1	1	1.94	—	—	—	—	—
Vanadium	1	741.4	05/15/01	F	1	1	10	—	—	—	—	—
Vanadium	1	741.4	05/15/01	NF	1	1	11	—	—	—	—	—
Zinc	1	741.4	05/15/01	F	1	0	—	[4.9]	5000	0/1	10000	0/1
Zinc	1	741.4	05/15/01	NF	1	1	15	—	—	—	—	—

Table A-10 (continued)

Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Stable Isotopes (‰)												
δD	1	741.4	05/15/01	NF	1	1	-70	—	—	—	—	—
$\delta^{15}N$	1	741.4	05/15/01	NF	1	1	+3.6	—	—	—	—	—
$\delta^{18}O$	1	741.4	05/15/01	NF	1	1	-10.6	—	—	—	—	—

[a] Groundwater samples were collected at a depth of 741.4 ft at well R-9.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US E.P.A. secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] NMED = New Mexico Environment Department.

[d] State of New Mexico groundwater standards are from *New Mexico Water Quality Control Commission Regulations, Ground and Surface Water Protection*, 20 NMAC 6.2.

[e] NF = Nonfiltered.

[f] — = Not available or not applicable.

[g] NTU = Nephelometric turbidity unit.

[h] F = Filtered.

Table A-11
Regional Well R-9 Screen 1 Fourth Round Sample Results: Data Summary for Detected Organic Chemicals

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
No organic analytes where detected	1	741.4	05/15/01	—[e]	—	—	—	—	—	—	—	—

[a] Groundwater samples were collected at a depth of 741.4 ft at well R-9.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US E.P.A. secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] NMED = New Mexico Environment Department.

[d] State of New Mexico groundwater standards are from *New Mexico Water Quality Control Commission Regulations, Ground and Surface Water Protection*, 20 NMAC 6.2.

[e] — = Not available or not applicable.

Table A-12
Regional Well R-9 Screen 1 Fourth Round Sample Results: Data Summary for Radionuclides

Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (pCi/L)	Nondetected Value (pCi/L)	Drinking Water MCL[b] (pCi/L)	Frequency of Detects > Drinking Water MCL
Americium-241	1	741.4	05/15/01	F[c]	1	0	—[d]	[0.036]	15[e]	0/1
Cesium-134	1	741.4	05/15/01	F	1	0	—	[0.5]	—	—
Cesium-137	1	741.4	05/15/01	F	1	0	—	[0.6]	—	—
Cobalt-60	1	741.4	05/15/01	F	1	0	—	[1.7]	—	—
Europium-152	1	741.4	05/15/01	F	1	0	—	[-18]	—	—
Gross Alpha Radiation	1	741.4	05/15/01	NF[f]	1	0	—	[0.7]	—	—
Gross Beta Radiation	1	741.4	05/15/01	NF	1	0	—	[1.3]	—	—
Gross Gamma Radiation	1	741.4	05/15/01	NF	1	1	67	—	—	—
Plutonium-238	1	741.4	05/15/01	F	1	0	—	[0.001]	15	0/1
Plutonium-239	1	741.4	05/15/01	F	1	0	—	[0.021]	15	0/1
Ruthenium-106	1	741.4	05/15/01	F	1	0	—	[1]	—	—
Sodium-22	1	741.4	05/15/01	F	1	0	—	[-1.5]	—	—
Strontium-90	1	741.4	05/15/01	F	1	0	—	[-0.4]	8	0/1
Tritium	1	741.4	05/15/01	NF	1	1	14.68	—	20000	0/1
Uranium-234	1	741.4	05/15/01	F	1	1	1.04	—	—	—
Uranium-235	1	741.4	05/15/01	F	1	0	—	[0.013]	—	—
Uranium-238	1	741.4	05/15/01	F	1	1	0.54	—	—	—

[a] Groundwater samples were collected at a depth of 741.4 ft at well R-9.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US E.P.A. secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] F = Filtered.

[d] — = Not available or not applicable.

[e] Based on an MCL of 15 pCi/L (including radium-226, but excluding radon and uranium).

[f] NF = Nonfiltered.

Table A-13
Regional Well R-9i Screen 1 First Round Sample Results: Data Summary for Inorganic Chemicals

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Field Parameter												
Field Alkalinity (total as $CaCO_3$)	1	198.8	09/14/00	NF[e]	1	0	—[f]	—	—	—	—	—
pH	1	198.8	09/14/00	NF	1	1	8.04	—	>6 & <9	0/1	>6 & <9	0/1
Specific Conductance (µS/cm)	1	198.8	09/14/00	NF	1	1	160	—	—	0/1	—	0/1
Temperature (°C)	1	198.8	09/14/00	NF	1	1	19.6	—	—	0/1	—	0/1
Turbidity (NTU[g])	1	198.8	09/14/00	NF	1	1	1.9	—	—	0/1	—	0/1
Analyte												
Aluminum	1	198.8	9/14/00	F[h]	1	0	—	[7.9]	50	0/1	5000	0/1
Aluminum	1	198.8	9/14/00	NF	1	0	—	[7.9]	—	—	—	—
Ammonia (expressed as N)	1	198.8	9/14/00	F	1	0	—	[500]	—	—	—	—
Ammonia (expressed as N)	1	198.8	9/14/00	NF	1	0	—	[500]	—	—	—	—
Antimony	1	198.8	9/14/00	F	1	0	—	[0.683]	6	0/1	—	—
Antimony	1	198.8	9/14/00	NF	1	0	—	[0.683]	—	—	—	—
Arsenic	1	198.8	9/14/00	F	1	0	—	[3.4]	50	0/1	100	0/1
Arsenic	1	198.8	9/14/00	NF	1	0	—	[3.4]	—	—	—	—
Barium	1	198.8	9/14/00	F	1	1	45	—	2000	0/1	1000	0/1
Barium	1	198.8	9/14/00	NF	1	1	42	—	—	—	—	—
Beryllium	1	198.8	9/14/00	F	1	1	0.012	—	4	0/1	—	—
Beryllium	1	198.8	9/14/00	NF	1	0	—	[0.01]	—	—	—	—
Bicarbonate	1	198.8	9/14/00	F	1	1	77000	—	—	—	—	—
Bicarbonate	1	198.8	9/14/00	NF	1	1	81000	—	—	—	—	—
Boron	1	198.8	9/14/00	F	1	0	—	[31]	—	—	750	0/1
Boron	1	198.8	9/14/00	NF	1	0	—	[29]	—	—	—	—

Table A-13 (continued)

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Bromide	1	198.8	9/14/00	F	1	0	—	[200]	—	—	—	—
Bromide	1	198.8	9/14/00	NF	1	0	—	[200]	—	—	—	—
Cadmium	1	198.8	9/14/00	F	1	0	—	[0.13]	5	0/1	10	0/1
Cadmium	1	198.8	9/14/00	NF	1	0	—	[0.13]	—	—	—	—
Calcium	1	198.8	9/14/00	F	1	1	17000	—	—	—	—	—
Calcium	1	198.8	9/14/00	NF	1	1	16000	—	—	—	—	—
Carbonate	1	198.8	9/14/00	F	1	0	—	[20000]	—	—	—	—
Carbonate	1	198.8	9/14/00	NF	1	0	—	[20000]	—	—	—	—
Chloride	1	198.8	9/14/00	F	1	1	24000	—	250000	0/1	250000	0/1
Chloride	1	198.8	9/14/00	NF	1	1	23000	—	—	—	—	—
Chromium	1	198.8	9/14/00	F	1	1	1.40	—	100	0/1	50	0/1
Chromium	1	198.8	9/14/00	NF	1	1	0.36	—	—	—	—	—
Cobalt	1	198.8	9/14/00	F	1	1	3.2	—	—	—	50	0/1
Cobalt	1	198.8	9/14/00	NF	1	1	3.7	—	—	—	—	—
Copper	1	198.8	9/14/00	F	1	1	4.5	—	1300	0/1	1000	0/1
Copper	1	198.8	9/14/00	NF	1	1	73	—	—	—	—	—
Cyanide, Total	1	198.8	9/14/00	NF	1	0	—	[10]	—	—	—	—
Fluoride	1	198.8	9/14/00	F	1	1	440	—	4000	0/1	1600	0/1
Fluoride	1	198.8	9/14/00	NF	1	1	430	—	—	—	—	—
Iron	1	198.8	9/14/00	F	1	1	1400	—	300	1/1	1000	1/1
Iron	1	198.8	9/14/00	NF	1	1	890	—	—	—	—	—
Lead	1	198.8	9/14/00	F	1	1	0.14	—	15	0/1	50	0/1
Lead	1	198.8	9/14/00	NF	1	0	—	[0.01]	—	—	—	—
Magnesium	1	198.8	9/14/00	F	1	1	5600	—	—	—	—	—
Magnesium	1	198.8	9/14/00	NF	1	1	5500	—	—	—	—	—
Manganese	1	198.8	9/14/00	F	1	1	520	—	50	1/1	200	1/1
Manganese	1	198.8	9/14/00	NF	1	1	500	—	—	—	—	—

Table A-13 (continued)

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Mercury	1	198.8	9/14/00	F	1	0	—	[0.0092]	2	0/1	—	—
Mercury	1	198.8	9/14/00	NF	1	0	—	[0.0092]	—	—	2	0/1
Molybdenum	1	198.8	9/14/00	F	1	1	19	—	—	—	—	—
Molybdenum	1	198.8	9/14/00	NF	1	1	20	—	—	—	—	—
Nickel	1	198.8	9/14/00	F	1	1	110	—	100	1/1	200	0/1
Nickel	1	198.8	9/14/00	NF	1	1	120	—	—	—	—	—
Nitrate + Nitrite (expressed as N)	1	198.8	9/14/00	F	1	0	—	[100]	10000	0/1	—	—
Nitrate + Nitrite (expressed as N)	1	198.8	9/14/00	NF	1	0	—	[100]	—	—	—	—
Perchlorate	1	198.8	9/14/00	F	1	0	—	[1.04]	—	—	—	—
Perchlorate	1	198.8	9/14/00	NF	1	0	—	[1.04]	—	—	—	—
Phosphorus (total)	1	198.8	9/14/00	F	1	0	—	[50]	—	—	—	—
Phosphorus (total)	1	198.8	9/14/00	NF	1	1	80	—	—	—	—	—
Potassium	1	198.8	9/14/00	F	1	1	3900	—	—	—	—	—
Potassium	1	198.8	9/14/00	NF	1	1	3900	—	—	—	—	—
Selenium	1	198.8	9/14/00	F	1	0	—	[2.6]	50	0/1	50	0/1
Selenium	1	198.8	9/14/00	NF	1	0	—	[2.6]	—	—	—	—
Silica	1	198.8	9/14/00	F	1	1	34286	—	—	—	—	—
Silica	1	198.8	9/14/00	NF	1	1	34286	—	—	—	—	—
Silver	1	198.8	9/14/00	F	1	0	—	[0.45]	100	0/1	50	0/1
Silver	1	198.8	9/14/00	NF	1	0	—	[0.45]	—	—	—	—
Sodium	1	198.8	9/14/00	F	1	1	19000	—	—	—	—	—
Sodium	1	198.8	9/14/00	NF	1	1	19000	—	—	—	—	—
Strontium	1	198.8	9/14/00	F	1	1	110	—	—	—	—	—
Strontium	1	198.8	9/14/00	NF	1	1	100	—	—	—	—	—
Sulfate	1	198.8	9/14/00	F	1	1	9600	—	250000	0/1	600000	0/1
Sulfate	1	198.8	9/14/00	NF	1	1	10000	—	—	—	—	—

Table A-13 (continued)

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Thallium	1	198.8	9/14/00	F	1	0	—	[0.073]	2	0/1	—	—
Thallium	1	198.8	9/14/00	NF	1	0	—	[0.066]	—	—	—	—
Total Kjeldahl Nitrogen	1	198.8	9/14/00	F	1	1	400	—	—	—	—	—
Total Kjeldahl Nitrogen	1	198.8	9/14/00	NF	1	1	310	—	—	—	—	—
Uranium by ICPMS[i]	1	198.8	9/14/00	F	1	1	0.588	—	—	—	—	—
Uranium by ICPMS	1	198.8	9/14/00	NF	1	1	0.641	—	—	—	—	—
Uranium by KPA[j]	1	198.8	9/14/00	F	1	1	0.60	—	—	—	—	—
Uranium by KPA	1	198.8	9/14/00	NF	1	1	0.67	—	—	—	—	—
Vanadium	1	198.8	9/14/00	F	1	1	0.48	—	—	—	—	—
Vanadium	1	198.8	9/14/00	NF	1	1	0.56	—	—	—	—	—
Zinc	1	198.8	9/14/00	F	1	0	—	[11]	5000	0/1	10000	0/1
Zinc	1	198.8	9/14/00	NF	1	1	96	—	—	—	—	—
Stable Isotopes (‰)												
δD	1	198.8	9/14/00	NF	1	1	-79	—	—	—	—	—
$\delta^{18}O$	1	198.8	9/14/00	NF	1	1	-10.9	—	—	—	—	—

[a] R-9i does not extend to the regional aquifer.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US EPA secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] NMED = New Mexico Environment Department.

[d] State of New Mexico groundwater standards are from *New Mexico Water Quality Control Commission Regulations, Ground and Surface Water Protection*, 20 NMAC 6.2.

[e] NF = Nonfiltered.

[f] — = Not available or not applicable.

[g] NTU = Nephelometric turbidity unit.

[h] F = Filtered.

[i] ICPMS = Inductively coupled plasma mass spectrometry.

[j] KPA = Kinetic phosphorescence analysis.

Table A-14
Regional Well R-9i Screen 2 First Round Sample Results: Data Summary for Inorganic Chemicals

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Field Parameter												
Field Alkalinity (total as $CaCO_3$)	2	278.8	09/15/00	NF[e]	0	0	—[f]	—	—	—	—	—
pH	2	278.8	09/15/00	NF	1	1	7.5	—	>6 & <9	0/1	>6 & <9	0/1
Specific Conductance (µS/cm)	2	278.8	09/15/00	NF	1	1	140	—	—	0/1	—	0/1
Temperature (°C)	2	278.8	09/15/00	NF	1	1	13.5	—	—	0/1	—	0/1
Turbidity (NTU[g])	2	278.8	09/15/00	NF	1	1	1.9	—	—	0/1	—	0/1
Analyte												
Aluminum	2	278.8	9/15/00	F[h]	1	0	—	[7.9]	50	0/1	5000	0/1
Aluminum	2	278.8	9/15/00	NF	1	0	—	[7.9]	—	—	—	—
Ammonia (expressed as N)	2	278.8	9/15/00	F	1	0	—	[500]	—	—	—	—
Ammonia (expressed as N)	2	278.8	9/15/00	NF	1	0	—	[500]	—	—	—	—
Antimony	2	278.8	9/15/00	F	1	0	—	[0.683]	6	0/1	—	—
Antimony	2	278.8	9/15/00	NF	1	0	—	[0.683]	—	—	—	—
Arsenic	2	278.8	9/15/00	F	1	0	—	[3.4]	50	0/1	100	0/1
Arsenic	2	278.8	9/15/00	NF	1	0	—	[3.4]	—	—	—	—
Barium	2	278.8	9/15/00	F	1	1	44	—	2000	0/1	1000	0/1
Barium	2	278.8	9/15/00	NF	1	1	46	—	—	—	—	—
Beryllium	2	278.8	9/15/00	F	1	0	—	[0.01]	4	0/1	—	—
Beryllium	2	278.8	9/15/00	NF	1	0	—	[0.01]	—	—	—	—
Bicarbonate	2	278.8	9/15/00	F	1	1	68000	—	—	—	—	—
Bicarbonate	2	278.8	9/15/00	NF	1	1	70000	—	—	—	—	—
Boron	2	278.8	9/15/00	F	1	0	—	[28]	—	—	750	0/1
Boron	2	278.8	9/15/00	NF	1	0	—	[28]	—	—	—	—

Table A-14 (continued)

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Bromide	2	278.8	9/15/00	F	1	0	—	[200]	—	—	—	—
Bromide	2	278.8	9/15/00	NF	1	0	—	[200]	—	—	—	—
Cadmium	2	278.8	9/15/00	F	1	0	—	[0.13]	5	0/1	10	0/1
Cadmium	2	278.8	9/15/00	NF	1	1	0.148	—	—	—	—	—
Calcium	2	278.8	9/15/00	F	1	1	14000	—	—	—	—	—
Calcium	2	278.8	9/15/00	NF	1	1	14000	—	—	—	—	—
Carbonate	2	278.8	9/15/00	F	1	0	—	[20000]	—	—	—	—
Carbonate	2	278.8	9/15/00	NF	1	0	—	[1000]	—	—	—	—
Chloride	2	278.8	9/15/00	F	1	1	22000	—	250000	0/1	250000	0/1
Chloride	2	278.8	9/15/00	NF	1	1	22000	—	—	—	—	—
Chromium	2	278.8	9/15/00	F	1	0	—	[0.33]	100	0/1	50	0/1
Chromium	2	278.8	9/15/00	NF	1	1	7.9	—	—	—	—	—
Cobalt	2	278.8	9/15/00	F	1	1	2.5	—	—	—	50	0/1
Cobalt	2	278.8	9/15/00	NF	1	1	2.8	—	—	—	—	—
Copper	2	278.8	9/15/00	F	1	0	—	[1.2]	1300	0/1	1000	0/1
Copper	2	278.8	9/15/00	NF	1	1	5.2	—	—	—	—	—
Cyanide (total)	2	278.8	9/15/00	NF	1	0	—	[10]	—	—	—	—
Fluoride	2	278.8	9/15/00	F	1	1	280	—	4000	0/1	1600	0/1
Fluoride	2	278.8	9/15/00	NF	1	1	300	—	—	—	—	—
Iron	2	278.8	9/15/00	F	1	1	1700	—	300	1/1	1000	1/1
Iron	2	278.8	9/15/00	NF	1	1	3500	—	—	—	—	—
Lead	2	278.8	9/15/00	F	1	0	—	[0.01]	15	0/1	50	0/1
Lead	2	278.8	9/15/00	NF	1	1	0.211	—	—	—	—	—
Magnesium	2	278.8	9/15/00	F	1	1	4600	—	—	—	—	—
Magnesium	2	278.8	9/15/00	NF	1	1	4600	—	—	—	—	—
Manganese	2	278.8	9/15/00	F	1	1	520	—	50	1/1	200	1/1
Manganese	2	278.8	9/15/00	NF	1	1	520	—	—	—	—	—

Table A-14 (continued)

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Mercury	2	278.8	9/15/00	F	1	0	—	[0.0092]	2	0/1	—	—
Mercury	2	278.8	9/15/00	NF	1	0	—	[0.0092]	—	—	2	0/1
Molybdenum	2	278.8	9/15/00	F	1	1	20	—	—	—	—	—
Molybdenum	2	278.8	9/15/00	NF	1	1	22	—	—	—	—	—
Nickel	2	278.8	9/15/00	F	1	1	110	—	100	1/1	200	0/1
Nickel	2	278.8	9/15/00	NF	1	1	120	—	—	—	—	—
Nitrate + Nitrite (expressed as N)	2	278.8	9/15/00	F	1	0	—	[100]	10000	0/1	—	—
Nitrate + Nitrite (expressed as N)	2	278.8	9/15/00	NF	1	0	—	[100]	—	—	—	—
Nitrogen, Total Kjeldahl (expressed as N)	2	278.8	9/15/00	F	1	0	—	[100]	—	—	—	—
Nitrogen, Total Kjeldahl (expressed as N)	2	278.8	9/15/00	NF	1	0	—	[100]	—	—	—	—
Perchlorate	2	278.8	9/15/00	F	1	0	—	[1.04]	—	—	—	—
Perchlorate	2	278.8	9/15/00	NF	1	0	—	[1.04]	—	—	—	—
Phosphorus (total)	2	278.8	9/15/00	F	1	0	—	[50]	—	—	—	—
Phosphorus (total)	2	278.8	9/15/00	NF	1	1	82	—	—	—	—	—
Potassium	2	278.8	9/15/00	F	1	1	3700	—	—	—	—	—
Potassium	2	278.8	9/15/00	NF	1	1	3700	—	—	—	—	—
Selenium	2	278.8	9/15/00	F	1	0	—	[2.6]	50	0/1	50	0/1
Selenium	2	278.8	9/15/00	NF	1	0	—	[2.6]	—	—	—	—
Silica	2	278.8	9/15/00	F	1	1	34286	—	—	—	—	—
Silica	2	278.8	9/15/00	NF	1	1	34286	—	—	—	—	—
Silver	2	278.8	9/15/00	F	1	0	—	[0.45]	100	0/1	50	0/1
Silver	2	278.8	9/15/00	NF	1	0	—	[0.45]	—	—	—	—
Sodium	2	278.8	9/15/00	F	1	1	18000	—	—	—	—	—

Table A-14 (continued)

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Sodium	2	278.8	9/15/00	NF	1	1	18000	—	—	—	—	—
Strontium	2	278.8	9/15/00	F	1	1	93	—	—	—	—	—
Strontium	2	278.8	9/15/00	NF	1	1	94	—	—	—	—	—
Sulfate	2	278.8	9/15/00	F	1	1	7400	—	250000	0/1	600000	0/1
Sulfate	2	278.8	9/15/00	NF	1	1	7500	—	—	—	—	—
Thallium	2	278.8	9/15/00	F	1	1	0.103	—	2	0/1	—	—
Thallium	2	278.8	9/15/00	NF	1	1	0.125	—	—	—	—	—
Uranium by ICPMS[i]	2	278.8	9/15/00	F	1	1	0.07	—	—	—	—	—
Uranium by ICPMS	2	278.8	9/15/00	NF	1	1	0.06	—	—	—	—	—
Uranium by KPA[j]	2	278.8	9/15/00	F	1	1	0.06	—	—	—	—	—
Uranium by KPA	2	278.8	9/15/00	NF	1	1	0.1	—	—	—	—	—
Vanadium	2	278.8	9/15/00	F	1	0	—	[0.33]	—	—	—	—
Vanadium	2	278.8	9/15/00	NF	1	0	—	[0.33]	—	—	—	—
Zinc	2	278.8	9/15/00	F	1	0	—	[7.1]	5000	0/1	10000	0/1
Zinc	2	278.8	9/15/00	NF	1	0	—	[25]	—	—	—	—
Stable Isotopes (‰)												
δ D	2	278.8	9/15/00	NF	1	1	-77	—	—	—	—	—
δ ^{18}O	2	278.8	9/15/00	NF	1	1	-10.9	—	—	—	—	—

[a] R-9i does not extend to the regional aquifer.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US EPA secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] NMED = New Mexico Environment Department.

[d] State of New Mexico groundwater standards are from *New Mexico Water Quality Control Commission Regulations, Ground and Surface Water Protection*, 20 NMAC 6.2.

[e] NF = Nonfiltered.

[f] — = Not available or not applicable.

[g] NTU = Nephelometric turbidity unit.

[h] F = Filtered.

[i] ICPMS = Inductively coupled plasma mass spectrometry.

[j] KPA = Kinetic phosphorescence analysis.

Table A-15

Regional Well R-9i Screen 1 First Round Sample Results: Data Summary for Detected Organic Chemicals

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Dissolved Organic Carbon	1	198.8	9/14/00	F[e]	1	1	7200	—[f]	—	—	—
Humic Substances, Hydrophilic Acids	1	198.8	9/14/00	F	1	1	2800	—	—	—	—
Humic Substances, Hydrophilic Bases	1	198.8	9/14/00	F	1	1	600	—	—	—	—
Humic Substances, Hydrophilic Neutrals	1	198.8	9/14/00	F	1	1	300	—	—	—	—
Humic Substances, Hydrophilic Total	1	198.8	9/14/00	F	1	1	3700	—	—	—	—
Humic Substances, Hydrophobic Acids	1	198.8	9/14/00	F	1	1	1600	—	—	—	—
Humic Substances, Hydrophobic Bases	1	198.8	9/14/00	F	1	1	0	—	—	—	—
Humic Substances, Hydrophobic Neutrals	1	198.8	9/14/00	F	1	1	1900	—	—	—	—
Humic Substances, Hydrophobic Total	1	198.8	9/14/00	F	1	1	3500	—	—	—	—
Nitrotoluene[3-]	1	198.8	9/14/00	NF[g]	1	1	0.15	—	—	—	—
Total Organic Carbon	1	198.8	9/14/00	NF	1	1	3000	—	—	—	—

[a] R-9i does not extend to the regional aquifer.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US EPA secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] NMED = New Mexico Environment Department.

[d] State of New Mexico groundwater standards are from *New Mexico Water Quality Control Commission Regulations, Ground and Surface Water Protection*, 20 NMAC 6.2.

[e] F = Filtered.

[f] — = Not available or not applicable.

[g] NF = Nonfiltered.

Table A-16

Regional Well R-9i Screen 2 First Round Sample Results: Data Summary for Detected Organic Chemicals

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Amino-4,6-dinitrotoluene[2-]	2	0	9/15/00	NF[e]	1	1	0.15	—[f]	—	—	—
Dinitrotoluene[2,4-]	2	278.8	9/15/00	NF	1	1	0.5	—	—	—	—
Dissolved Organic Carbon	2	278.8	9/15/00	F[g]	1	1	3000	—	—	—	—
Humic Substances, Hydrophilic Acids	2	278.8	9/15/00	F	1	1	800	—	—	—	—
Humic Substances, Hydrophilic Bases	2	278.8	9/15/00	F	1	1	0	—	—	—	—
Humic Substances, Hydrophilic Neutrals	2	278.8	9/15/00	F	1	1	100	—	—	—	—
Humic Substances, Hydrophilic Total	2	278.8	9/15/00	F	1	1	1000	—	—	—	—
Humic Substances, Hydrophobic Acids	2	278.8	9/15/00	F	1	1	500	—	—	—	—
Humic Substances, Hydrophobic Bases	2	278.8	9/15/00	F	1	1	0	—	—	—	—
Humic Substances, Hydrophobic Neutrals	2	278.8	9/15/00	F	1	1	1500	—	—	—	—
Humic Substances, Hydrophobic Total	2	278.8	9/15/00	F	1	1	2000	—	—	—	—
RDX	2	278.8	9/15/00	NF	1	1	0.49	—	—	—	—
Total Organic Carbon	2	278.8	9/15/00	NF	1	1	4200	—	—	—	—

Note: Results for pesticides/PCBs, total organic carbon, semivolatile organic compounds, and volatile organic compounds are pending.

[a] R-9i does not extend to the regional aquifer.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US EPA secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] NMED = New Mexico Environment Department.

[d] State of New Mexico groundwater standards are from *New Mexico Water Quality Control Commission Regulations, Ground and Surface Water Protection*, 20 NMAC 6.2.

[e] NF = Nonfiltered.

[f] — = Not available or not applicable.

[g] F = Filtered.

Table A-17
Regional Well R-9i Screen 1 First Round Sample Results: Data Summary for Radionuclides

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (pCi/L)	Nondetected Value (pCi/L)	Drinking Water MCL[b] (pCi/L)	Frequency of Detects > Drinking Water MCL
Americium-241	1	198.8	9/14/00	F[c]	1	0	—[d]	[0.032]	15[e]	0/1
Americium-241	1	198.8	9/14/00	NF[f]	1	0	—	[0.016]	—	—
Gross Alpha Radiation	1	198.8	9/14/00	F	1	0	—	[-0.1]	15	0/1
Gross Alpha Radiation	1	198.8	9/14/00	NF	1	0	—	[1]	—	—
Gross Beta Radiation	1	198.8	9/14/00	F	1	1	3.2	—	—	—
Gross Beta Radiation	1	198.8	9/14/00	NF	1	1	3.8	—	—	—
Gross Gamma Radiation	1	198.8	9/14/00	F	1	1	159	—	—	—
Gross Gamma Radiation	1	198.8	9/14/00	NF	1	1	188	—	—	—
Plutonium-238	1	198.8	9/14/00	F	1	0	—	[-0.005]	15[e]	0/1
Plutonium-238	1	198.8	9/14/00	NF	1	0	—	[0.01]	—	—
Plutonium-239	1	198.8	9/14/00	F	1	0	—	[0]	15[e]	0/1
Plutonium-239	1	198.8	9/14/00	NF	1	0	—	[0.004]	—	—
Strontium-90	1	198.8	9/14/00	F	1	0	—	[0.16]	8	0/1
Strontium-90	1	198.8	9/14/00	NF	1	0	—	[0.44]	—	—
Tritium	1	198.8	9/14/00	NF	1	1	81.4	—	20000	0/1
Uranium-234	1	198.8	9/14/00	F	1	1	0.28	—	—	—
Uranium-234	1	198.8	9/14/00	NF	1	1	0.47	—	—	—
Uranium-235	1	198.8	9/14/00	F	1	0	—	[0.045]	—	—
Uranium-235	1	198.8	9/14/00	NF	1	1	0.109	—	—	—
Uranium-238	1	198.8	9/14/00	F	1	1	0.208	—	—	—
Uranium-238	1	198.8	9/14/00	NF	1	1	0.238	—	—	—

[a] R-9i does not extend to the regional aquifer.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US EPA secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] F = Filtered.

[d] — = Not available or not applicable.

[e] Based on an MCL of 15 pCi/L (including radium-226, but excluding radon and uranium).

[f] NF = Nonfiltered.

Table A-18
Regional Well R-9i Screen 2 First Round Sample Results: Data Summary for Radionuclides

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (pCi/L)	Nondetected Value (pCi/L)	Drinking Water MCL[b] (pCi/L)	Frequency of Detects > Drinking Water MCL
Americium-241	2	278.8	9/15/00	F[c]	1	1	0.049	—[d]	15[e]	0/1
Americium-241	2	278.8	9/15/00	NF[f]	1	0	—	[0.03]	—	—
Gross Alpha Radiation	2	278.8	9/15/00	F	1	0	—	[0.1]	15	0/1
Gross Alpha Radiation	2	278.8	9/15/00	NF	1	0	—	[0.25]	—	—
Gross Beta Radiation	2	278.8	9/15/00	F	1	1	3.60	—	—	—
Gross Beta Radiation	2	278.8	9/15/00	NF	1	1	3.32	—	—	—
Gross Gamma Radiation	2	278.8	9/15/00	F	1	1	21	—	—	—
Gross Gamma Radiation	2	278.8	9/15/00	NF	1	1	144	—	—	—
Plutonium-238	2	278.8	9/15/00	F	1	0	—	[0.006]	15[e]	0/1
Plutonium-238	2	278.8	9/15/00	NF	1	0	—	[0.002]	—	—
Plutonium-239	2	278.8	9/15/00	F	1	0	—	[0]	15[e]	0/1
Plutonium-239	2	278.8	9/15/00	NF	1	0	—	[0]	—	—
Strontium-90	2	278.8	9/15/00	F	1	0	—	[0.01]	8	0/1
Strontium-90	2	278.8	9/15/00	NF	1	0	—	[0.23]	—	—
Tritium	2	278.8	9/15/00	NF	1	1	69.4	—	20000	0/1
Uranium-234	2	278.8	9/15/00	F	1	1	0.1	—	—	—
Uranium-234	2	278.8	9/15/00	NF	1	1	0.125	—	—	—
Uranium-235	2	278.8	9/15/00	F	1	0	—	[0.053]	—	—
Uranium-235	2	278.8	9/15/00	NF	1	0	—	[0.025]	—	—
Uranium-238	2	278.8	9/15/00	F	1	0	—	[0.041]	—	—
Uranium-238	2	278.8	9/15/00	NF	1	0	—	[0.052]	—	—

[a] R-9i does not extend to the regional aquifer.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US EPA secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] F = Filtered.

[d] — = Not available or not applicable.

[e] Based on an MCL of 15 pCi/L (including radium-226, but excluding radon and uranium).

[f] NF = Nonfiltered.

Table A-19
Regional Well R-9i Screen 1 Second Round Sample Results: Data Summary for Inorganic Chemicals

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Field Parameter												
Field Alkalinity (total as $CaCO_3$)	1	198.8	2/20/01	NF[e]	1	1	—[f]	—	—	—	—	—
pH	1	198.8	2/20/01	NF	1	1	7.35	—	>6 & <9	0/1	>6 & <9	0/1
Specific Conductance (µS/cm)	1	198.8	2/20/01	NF	1	1	272	—	—	0/1	—	0/1
Temperature (°C)	1	198.8	2/20/01	NF	1	1	12.8	—	—	0/1	—	0/1
Turbidity (NTU[g])	1	198.8	2/20/01	NF	1	1	1.2	—	—	0/1	—	0/1
Analyte												
Lab Alkalinity (total as $CaCO_3$)	1	198.8	2/20/01	F[h]	1	1	82000	—	—	—	—	—
Aluminum	1	198.8	2/20/01	F	1	0	—	[43]	50	0/1	5000	0/1
Aluminum	1	198.8	2/20/01	NF	1	0	—	[39]	—	—	—	—
Ammonia (as N)	1	198.8	2/20/01	F	1	0	—	[500]	—	—	—	—
Antimony	1	198.8	2/20/01	F	1	1	0.257	—	6	0/1	—	—
Antimony	1	198.8	2/20/01	NF	1	0	—	[0.153]	—	—	—	—
Arsenic	1	198.8	2/20/01	F	1	0	—	[1.5]	50	0/1	100	0/1
Arsenic	1	198.8	2/20/01	NF	1	0	—	[1.5]	—	—	—	—
Barium	1	198.8	2/20/01	F	1	1	63	—	2000	0/1	1000	0/1
Barium	1	198.8	2/20/01	NF	1	1	64	—	—	—	—	—
Beryllium	1	198.8	2/20/01	F	1	1	0.015	—	4	0/1	—	—
Beryllium	1	198.8	2/20/01	NF	1	1	0.015	—	—	—	—	—
Boron	1	198.8	2/20/01	F	1	1	24	—	—	—	750	0/1
Boron	1	198.8	2/20/01	NF	1	1	26	—	—	—	—	—
Bromide	1	198.8	2/20/01	F	1	0	—	[200]	—	—	—	—
Cadmium	1	198.8	2/20/01	F	1	0	—	[0.2]	5	0/1	10	0/1
Cadmium	1	198.8	2/20/01	NF	1	0	—	[0.2]	—	—	—	—

Table A-19 (continued)

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Calcium	1	198.8	2/20/01	F	1	1	17000	—	—	—	—	—
Calcium	1	198.8	2/20/01	NF	1	1	17000	—	—	—	—	—
Chloride	1	198.8	2/20/01	F	1	1	26000	—	250000	0/1	250000	0/1
Chromium (total)	1	198.8	2/20/01	F	1	1	3	—	100	0/1	50	0/1
Chromium (total)	1	198.8	2/20/01	NF	1	1	1.4	—	—	—	—	—
Cobalt	1	198.8	2/20/01	F	1	1	5.2	—	—	—	50	0/1
Cobalt	1	198.8	2/20/01	NF	1	1	5.0	—	—	—	—	—
Copper	1	198.8	2/20/01	F	1	0	—	[2]	1300	0/1	1000	0/1
Copper	1	198.8	2/20/01	NF	1	0	—	[0.89]	—	—	—	—
Cyanide (total)	1	198.8	2/20/01	NF	1	0	—	[10]	—	—	—	—
Fluoride	1	198.8	2/20/01	F	1	1	560	—	4000	0/1	1600	0/1
Iron	1	198.8	2/20/01	F	1	1	2300	—	300	1/1	1000	1/1
Iron	1	198.8	2/20/01	NF	1	1	2200	—	—	—	—	—
Kjeldahl Nitrogen	1	198.8	2/20/01	F	1	1	340	—	—	—	—	—
Lead	1	198.8	2/20/01	F	1	0	—	[0.65]	15	0/1	50	0/1
Lead	1	198.8	2/20/01	NF	1	0	—	[0.65]	—	—	—	—
Magnesium	1	198.8	2/20/01	F	1	1	5800	—	—	—	—	—
Magnesium	1	198.8	2/20/01	NF	1	1	5800	—	—	—	—	—
Manganese	1	198.8	2/20/01	F	1	1	1000	—	50	1/1	200	1/1
Manganese	1	198.8	2/20/01	NF	1	1	1000	—	—	—	—	—
Mercury	1	198.8	2/20/01	F	1	0	—	[0.016]	2	0/1	—	—
Mercury	1	198.8	2/20/01	NF	1	0	—	[0.016]	—	—	2	0/1
Molybdenum	1	198.8	2/20/01	F	1	1	21	—	—	—	—	—
Molybdenum	1	198.8	2/20/01	NF	1	1	19	—	—	—	—	—
Nickel	1	198.8	2/20/01	F	1	1	140	—	100	1/1	200	0/1
Nickel	1	198.8	2/20/01	NF	1	1	140	—	—	—	—	—
Nitrate + Nitrite (as N)	1	198.8	2/20/01	F	1	0	—	[10]	10000	0/1	—	—

Table A-19 (continued)

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Perchlorate	1	198.8	2/20/01	F	1	0	—	[0.958]	—	—	—	—
Phosphorus (as P)	1	198.8	2/20/01	F	1	0	—	[64.4]	—	—	—	—
Potassium	1	198.8	2/20/01	F	1	1	3900	—	—	—	—	—
Potassium	1	198.8	2/20/01	NF	1	1	3900	—	—	—	—	—
Selenium	1	198.8	2/20/01	F	1	0	—	[2.5]	50	0/1	50	0/1
Selenium	1	198.8	2/20/01	NF	1	0	—	[2.5]	—	—	—	—
Silica	1	198.8	2/20/01	F	1	1	23000	—	—	—	—	—
Silica	1	198.8	2/20/01	NF	1	1	32100	—	—	—	—	—
Silver	1	198.8	2/20/01	F	1	0	—	[0.48]	100	0/1	50	0/1
Silver	1	198.8	2/20/01	NF	1	0	—	[0.48]	—	—	—	—
Sodium	1	198.8	2/20/01	F	1	1	17000	—	—	—	—	—
Sodium	1	198.8	2/20/01	NF	1	1	17000	—	—	—	—	—
Strontium	1	198.8	2/20/01	F	1	1	110	—	—	—	—	—
Strontium	1	198.8	2/20/01	NF	1	1	110	—	—	—	—	—
Sulfate	1	198.8	2/20/01	F	1	1	9800	—	250000	0/1	600000	0/1
Thallium	1	198.8	2/20/01	F	1	1	0.109	—	2	0/1	—	—
Thallium	1	198.8	2/20/01	NF	1	1	0.180	—	—	—	—	—
Uranium	1	198.8	2/20/01	F	1	1	0.086	—	—	—	—	—
Uranium	1	198.8	2/20/01	NF	1	1	0.097	—	—	—	—	—
Vanadium	1	198.8	2/20/01	F	1	1	0.39	—	—	—	—	—
Vanadium	1	198.8	2/20/01	NF	1	1	0.59	—	—	—	—	—
Zinc	1	198.8	2/20/01	F	1	0	—	[9.7]	5000	0/1	10000	0/1
Zinc	1	198.8	2/20/01	NF	1	0	—	[6.8]	—	—	—	—

Table A-19 (continued)

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Stable Isotopes (‰)												
δD	1	198.8	2/20/01	NF	1	1	-72	—	—	—	—	—
$\delta^{18}O$	1	198.8	2/20/01	NF	1	1	-10.6	—	—	—	—	—

[a] R-9i does not extend to the regional aquifer.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US EPA secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] NMED = New Mexico Environment Department.

[d] State of New Mexico groundwater standards are from *New Mexico Water Quality Control Commission Regulations, Ground and Surface Water Protection*, 20 NMAC 6.2.

[e] NF = Nonfiltered.

[f] — = Not available or not applicable.

[g] NTU = Nephelometric turbidity unit.

[h] F = Filtered.

Table A-20
Regional Well R-9i Screen 2 Second Round Sample Results: Data Summary for Inorganic Chemicals

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Field Parameter												
Field Alkalinity (total as $CaCO_3$)	2	278.8	02/21/01	NF[e]	1	1	—[f]	—	—	—	—	—
pH	2	278.8	02/21/01	NF	1	1	7.25	—	>6 & <9	0/1	>6 & <9	0/1
Specific Conductance (µS/cm)	2	278.8	02/21/01	NF	1	1	215	—	—	0/1	—	0/1
Temperature (°C)	2	278.8	02/21/01	NF	1	1	12.3	—	—	0/1	—	0/1
Turbidity (NTU[g])	2	278.8	02/21/01	NF	1	1	1.4	—	—	0/1	—	0/1
Analyte												
Lab Alkalinity (total as $CaCO_3$)	2	278.8	02/21/01	F[h]	1	1	71000	—	—	—	—	—
Aluminum	2	278.8	02/21/01	F	1	0	—	[45]	50	0/1	5000	0/1
Aluminum	2	278.8	02/21/01	NF	1	0	—	[43	—	—	—	—
Ammonia (as N)	2	278.8	02/21/01	F	1	0	—	[500]	—	—	—	—
Antimony	2	278.8	02/21/01	F	1	0	—	[0.171]	6	0/1	—	—
Antimony	2	278.8	02/21/01	NF	1	0	—	[0.193]	—	—	—	—
Arsenic	2	278.8	02/21/01	F	1	0	—	[1.5]	50	0/1	100	0/1
Arsenic	2	278.8	02/21/01	NF	1	0	—	[1.5]	—	—	—	—
Barium	2	278.8	02/21/01	F	1	1	45	—	2000	0/1	1000	0/1
Barium	2	278.8	02/21/01	NF	1	1	47	—	—	—	—	—
Beryllium	2	278.8	02/21/01	F	1	0	—	[0.055]	4	0/1	—	—
Beryllium	2	278.8	02/21/01	NF	1	0	—	[0.052]	—	—	—	—
Boron	2	278.8	02/21/01	F	1	1	22	—	—	—	750	0/1
Boron	2	278.8	02/21/01	NF	1	1	22	—	—	—	—	—
Bromide	2	278.8	02/21/01	F	1	0	—	[200]	—	—	—	—
Cadmium	2	278.8	02/21/01	F	1	0	—	[0.066]	5	0/1	10	0/1
Cadmium	2	278.8	02/21/01	NF	1	0	—	[0.066]	—	—	—	—

Table A-20 (continued)

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Calcium	2	278.8	02/21/01	F	1	1	14000	—	—	—	—	—
Calcium	2	278.8	02/21/01	NF	1	1	14000	—	—	—	—	—
Chloride	2	278.8	02/21/01	F	1	1	20000	—	250000	0/1	250000	0/1
Chromium (total)	2	278.8	02/21/01	F	1	1	1.1	—	100	0/1	50	0/1
Chromium (total)	2	278.8	02/21/01	NF	1	1	11	—	—	—	—	—
Cobalt	2	278.8	02/21/01	F	1	1	1.3	—	—	—	50	0/1
Cobalt	2	278.8	02/21/01	NF	1	1	0.83	—	—	—	—	—
Copper	2	278.8	02/21/01	F	1	0	—	[1.4]	1300	0/1	1000	0/1
Copper	2	278.8	02/21/01	NF	1	1	2.3	—	—	—	—	—
Cyanide (total)	2	278.8	02/21/01	NF	1	0	—	[10]	—	—	—	—
Fluoride	2	278.8	02/21/01	F	1	1	270	—	4000	0/1	1600	0/1
Iron	2	278.8	02/21/01	F	1	1	970	—	300	1/1	1000	0/1
Iron	2	278.8	02/21/01	NF	1	1	1200	—	—	—	—	—
Kjeldahl Nitrogen	2	278.8	02/21/01	F	1	1	320	—	—	—	—	—
Lead	2	278.8	02/21/01	F	1	0	—	[0.123]	15	0/1	50	0/1
Lead	2	278.8	02/21/01	NF	1	0	—	[0.118]	—	—	—	—
Magnesium	2	278.8	02/21/01	F	1	1	4500	—	—	—	—	—
Magnesium	2	278.8	02/21/01	NF	1	1	4500	—	—	—	—	—
Manganese	2	278.8	02/21/01	F	1	1	580	—	50	1/1	200	1/1
Manganese	2	278.8	02/21/01	NF	1	1	590	—	—	—	—	—
Mercury	2	278.8	02/21/01	F	1	0	—	[0.016]	2	0/1	—	—
Mercury	2	278.8	02/21/01	NF	1	0	—	[0.016]	—	—	2	0/1
Molybdenum	2	278.8	02/21/01	F	1	1	13	—	—	—	—	—
Molybdenum	2	278.8	02/21/01	NF	1	1	18	—	—	—	—	—
Nickel	2	278.8	02/21/01	F	1	1	28	—	100	0/1	200	0/1
Nickel	2	278.8	02/21/01	NF	1	1	35	—	—	—	—	—
Nitrate + Nitrite (as N)	2	278.8	02/21/01	F	1	0	—	[100]	10000	0/1	—	—

Table A-20 (continued)

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Oxalate	2	278.8	02/21/01	F	1	0	—	[190]	—	—	—	—
Perchlorate	2	278.8	02/21/01	F	1	0	—	[0.958]	—	—	—	—
Phosphorus (as P)	2	278.8	02/21/01	F	1	0	—	[50]	—	—	—	—
Potassium	2	278.8	02/21/01	F	1	1	3500	—	—	—	—	—
Potassium	2	278.8	02/21/01	NF	1	1	3500	—	—	—	—	—
Selenium	2	278.8	02/21/01	F	1	0	—	[2.5]	50	0/1	50	0/1
Selenium	2	278.8	02/21/01	NF	1	0	—	[2.5]	—	—	—	—
Silica	2	278.8	02/21/01	F	1	1	32100	—	—	—	—	—
Silica	2	278.8	02/21/01	NF	1	1	32100	—	—	—	—	—
Silver	2	278.8	02/21/01	F	1	0	—	[0.53]	100	0/1	50	0/1
Silver	2	278.8	02/21/01	NF	1	0	—	[0.48]	—	—	—	—
Sodium	2	278.8	02/21/01	F	1	1	14000	—	—	—	—	—
Sodium	2	278.8	02/21/01	NF	1	1	14000	—	—	—	—	—
Strontium	2	278.8	02/21/01	F	1	1	87	—	—	—	—	—
Strontium	2	278.8	02/21/01	NF	1	1	87	—	—	—	—	—
Sulfate	2	278.8	02/21/01	F	1	1	7500	—	250000	0/1	600000	0/1
Thallium	2	278.8	02/21/01	F	1	1	0.513	—	2	0/1	—	—
Thallium	2	278.8	02/21/01	NF	1	1	0.445	—	—	—	—	—
Uranium	2	278.8	02/21/01	F	1	1	0.04	—	—	—	—	—
Uranium	2	278.8	02/21/01	NF	1	1	0.047	—	—	—	—	—
Vanadium	2	278.8	02/21/01	F	1	1	0.39	—	—	—	—	—
Vanadium	2	278.8	02/21/01	NF	1	0	—	[0.38]	—	—	—	—
Zinc	2	278.8	02/21/01	F	1	0	—	[4.5]	5000	0/1	10000	0/1
Zinc	2	278.8	02/21/01	NF	1	0	—	[7.3]	—	—	—	—

Table A-20 (continued)

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Stable Isotopes (‰)												
δD	2	278.8	02/21/01	NF	1	1	-77	—	—	—	—	—
$\delta^{18}O$	2	278.8	02/21/01	NF	1	1	-11.1	—	—	—	—	—

[a] R-9i does not extend to the regional aquifer.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US EPA secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] NMED = New Mexico Environment Department.

[d] State of New Mexico groundwater standards are from *New Mexico Water Quality Control Commission Regulations, Ground and Surface Water Protection*, 20 NMAC 6.2.

[e] NF = Nonfiltered.

[f] — = Not available or not applicable.

[g] NTU = Nephelometric turbidity unit.

[h] F = Filtered.

Table A-21

Regional Well R-9i Screen 1 Second Round Sample Results: Data Summary for Detected Organic Chemicals

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Total Organic Carbon	1	198.8	02/20/01	NF[e]	1	1	4600	—[f]	—	—	—	—

[a] R-9i does not extend to the regional aquifer.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US EPA secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] NMED = New Mexico Environment Department.

[d] State of New Mexico groundwater standards are from *New Mexico Water Quality Control Commission Regulations, Ground and Surface Water Protection*, 20 NMAC 6.2.

[e] NF = Nonfiltered.

[f] — = Not available or not applicable.

Table A-22

Regional Well R-9i Screen 2 Second Round Sample Results: Data Summary for Detected Organic Chemicals

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Tetryl	2	278.8	02/21/01	NF[e]	1	1	2.3	—[f]	—	—	—	—
Total Organic Carbon	2	278.8	02/21/01	NF	1	1	2400	—	—	—	—	—

[a] R-9i does not extend to the regional aquifer.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US EPA secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] NMED = New Mexico Environment Department.

[d] State of New Mexico groundwater standards are from *New Mexico Water Quality Control Commission Regulations, Ground and Surface Water Protection*, 20 NMAC 6.2.

[e] NF = Nonfiltered.

[f] — = Not available or not applicable.

Table A-23
Regional Well R-9i Screen 1 Second Round Sample Results: Data Summary for Radionuclides

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (pCi/L)	Nondetected Value (pCi/L)	Drinking Water MCL[b] (pCi/L)	Frequency of Detects > Drinking Water MCL
Americium-241	1	198.8	2/20/01	F[c]	1	0	—[d]	[0.015]	15[e]	0/1
Cesium-134	1	198.8	2/20/01	F	1	0	—	[0.7]	—	—
Cesium-137	1	198.8	2/20/01	F	1	0	—	[0.5]	—	—
Cobalt-60	1	198.8	2/20/01	F	1	0	—	[0.5]	—	—
Europium-152	1	198.8	2/20/01	F	1	0	—	[-0.8]	—	—
Gross Alpha Radiation	1	198.8	2/20/01	NF[f]	1	0	—	[0.3]	—	—
Gross Beta Radiation	1	198.8	2/20/01	NF	1	1	4	—	—	—
Gross Gamma Radiation	1	198.8	2/20/01	NF	1	1	306	—	—	—
Plutonium-238	1	198.8	2/20/01	F	1	0	—	[-0.023]	15[e]	0/1
Plutonium-239	1	198.8	2/20/01	F	1	0	—	[0.001]	15[e]	0/1
Ruthenium-106	1	198.8	2/20/01	F	1	0	—	[-5]	—	—
Sodium-22	1	198.8	2/20/01	F	1	0	—	[-1.8]	—	—
Strontium-90	1	198.8	2/20/01	F	1	0	—	[-0.4]	8	0/1
Tritium	1	198.8	2/20/01	NF	1	1	246	—	20000	0/1
Uranium-234	1	198.8	2/20/01	F	1	0	—	[0.041]	—	—
Uranium-235	1	198.8	2/20/01	F	1	0	—	[0.007]	—	—
Uranium-238	1	198.8	2/20/01	F	1	0	—	[0.07]	—	—

[a] R-9i does not extend to the regional aquifer.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US EPA secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] F = Filtered.

[d] — = Not available or not applicable.

[e] Based on an MCL of 15 pCi/L (including radium-226, but excluding radon and uranium).

[f] NF = Nonfiltered.

Table A-24
Regional Well R-9i Screen 2 Second Round Sample Results: Data Summary for Radionuclides

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (pCi/L)	Nondetected Value (pCi/L)	Drinking Water MCL[b] (pCi/L)	Frequency of Detects > Drinking Water MCL
Americium-241	2	278.8	02/21/01	F[c]	1	0	—[d]	[0.026]	15[e]	0/1
Cesium-134	2	278.8	02/21/01	F	1	0	—	[1.1]	—	—
Cesium-137	2	278.8	02/21/01	F	1	0	—	[0]	—	—
Cobalt-60	2	278.8	02/21/01	F	1	0	—	[0.8]	—	—
Europium-152	2	278.8	02/21/01	F	1	0	—	[5.4]	—	—
Gross Alpha Radiation	2	278.8	02/21/01	NF[f]	1	0	—	[0.55]	—	—
Gross Beta Radiation	2	278.8	02/21/01	NF	1	1	3.4	—	—	—
Gross Gamma Radiation	2	278.8	02/21/01	NF	1	0	—	[156]	—	—
Plutonium-238	2	278.8	02/21/01	F	1	0	—	[-0.003]	15[e]	0/1
Plutonium-239	2	278.8	02/21/01	F	1	0	—	[0.028]	15[e]	0/1
Ruthenium-106	2	278.8	02/21/01	F	1	0	—	[0]	—	—
Sodium-22	2	278.8	02/21/01	F	1	0	—	[0]	—	—
Strontium-90	2	278.8	02/21/01	F	1	0	—	[-0.5]	8	0/1
Tritium	2	278.8	02/21/01	NF	1	1	167	—	20000	0/1
Uranium-234	2	278.8	02/21/01	F	1	0	—	[0.028]	—	—
Uranium-235	2	278.8	02/21/01	F	1	0	—	[-0.001]	—	—
Uranium-238	2	278.8	02/21/01	F	1	0	—	[0.02]	—	—

[a] R-9i does not extend to the regional aquifer.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US EPA secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] F = Filtered.

[d] — = Not available or not applicable.

[e] Based on an MCL of 15 pCi/L (including radium-226, but excluding radon and uranium).

[f] NF = Nonfiltered.

Table A-25
Regional Well R-9i Screen 1 Third Round Sample Results: Data Summary for Inorganic Chemicals

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Field Parameter												
Field Alkalinity (total as $CaCO_3$)	1	198.8	06/11/01	NF[e]	1	1	20000	—[f]	—	—	—	—
pH	1	198.8	06/11/01	NF	1	1	6.58	—	>6 & <9	0/1	>6 & <9	0/1
Specific Conductance (µS/cm)	1	198.8	06/11/01	NF	1	1	268	—	—	0/1	—	0/1
Temperature (°C)	1	198.8	06/11/01	NF	1	1	16.2	—	—	0/1	—	0/1
Turbidity (NTU[g])	1	198.8	06/11/01	NF	1	1	0.8	—	—	0/1	—	0/1
Analyte												
Lab Alkalinity (total as $CaCO_3$)	1	198.8	06/11/01	F[h]	1	1	81000	—	—	—	—	—
Aluminum	1	198.8	06/11/01	F	1	0	—	[7.6]	50	0/1	5000	0/1
Aluminum	1	198.8	06/11/01	NF	1	0	—	[7.6]	—	—	—	—
Ammonia (as N)	1	198.8	06/11/01	F	1	0	—	[100]	—	—	—	—
Antimony	1	198.8	06/11/01	F	1	0	—	[0.153]	6	0/1	—	—
Antimony	1	198.8	06/11/01	NF	1	0	—	[0.153]	—	—	—	—
Arsenic	1	198.8	06/11/01	F	1	0	—	[1.5]	50	0/1	100	0/1
Arsenic	1	198.8	06/11/01	NF	1	0	—	[1.5]	—	—	—	—
Barium	1	198.8	06/11/01	F	1	1	65	—	2000	0/1	1000	0/1
Barium	1	198.8	06/11/01	NF	1	1	65	—	—	—	—	—
Beryllium	1	198.8	06/11/01	F	1	0	—	[0.012]	4	0/1	—	—
Beryllium	1	198.8	06/11/01	NF	1	0	—	[0.074]	—	—	—	—
Boron	1	198.8	06/11/01	F	1	0	—	[25]	—	—	750	0/1
Boron	1	198.8	06/11/01	NF	1	0	—	[20]	—	—	—	—
Bromide	1	198.8	06/11/01	F	1	0	—	[200]	—	—	—	—
Cadmium	1	198.8	06/11/01	F	1	0	—	[0.084]	5	0/1	10	0/1
Cadmium	1	198.8	06/11/01	NF	1	0	—	[0.084]	—	—	—	—

Table A-25 (continued)

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Calcium	1	198.8	06/11/01	F	1	1	17000	—	—	—	—	—
Calcium	1	198.8	06/11/01	NF	1	1	18000	—	—	—	—	—
Chloride	1	198.8	06/11/01	F	1	1	26000	—	250000	0/1	250000	0/1
Chromium (total)	1	198.8	06/11/01	F	1	0	—	[0.25]	100	0/1	50	0/1
Chromium (total)	1	198.8	06/11/01	NF	1	0	—	[0.69]	—	—	—	—
Cobalt	1	198.8	06/11/01	F	1	0	—	[1.7]	—	—	50	0/1
Cobalt	1	198.8	06/11/01	NF	1	0	—	[1.7]	—	—	—	—
Copper	1	198.8	06/11/01	F	1	0	—	[2.6]	1300	0/1	1000	0/1
Copper	1	198.8	06/11/01	NF	1	0	—	[0.36]	—	—	—	—
Cyanide (total)	1	198.8	06/11/01	NF	1	0	—	[10]	—	—	—	—
Fluoride	1	198.8	06/11/01	F	1	1	640	—	4000	0/1	1600	0/1
Iron	1	198.8	06/11/01	F	1	1	1000	—	300	1/1	1000	1/1
Iron	1	198.8	06/11/01	NF	1	1	1100	—	—	—	—	—
Kjeldahl Nitrogen	1	198.8	06/11/01	F	1	1	240	—	—	—	—	—
Lead	1	198.8	06/11/01	F	1	0	—	[1.1]	15	0/1	50	0/1
Lead	1	198.8	06/11/01	NF	1	0	—	[0.037]	—	—	—	—
Magnesium	1	198.8	06/11/01	F	1	1	5800	—	—	—	—	—
Magnesium	1	198.8	06/11/01	NF	1	1	5800	—	—	—	—	—
Manganese	1	198.8	06/11/01	F	1	1	880	—	50	1/1	200	1/1
Manganese	1	198.8	06/11/01	NF	1	1	890	—	—	—	—	—
Mercury	1	198.8	06/11/01	F	1	0	—	[0.033]	2	0/1	—	—
Mercury	1	198.8	06/11/01	NF	1	0	—	[0.033]	—	—	2	0/1
Molybdenum	1	198.8	06/11/01	F	1	1	16	—	—	—	—	—
Molybdenum	1	198.8	06/11/01	NF	1	1	16	—	—	—	—	—
Nickel	1	198.8	06/11/01	F	1	1	44	—	100	0/1	200	0/1
Nickel	1	198.8	06/11/01	NF	1	1	42	—	—	—	—	—
Nitrate + Nitrite (as N)	1	198.8	06/11/01	F	1	0	—	[50]	10000	0/1	—	—

Table A-25 (continued)

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Perchlorate	1	198.8	06/11/01	F	1	0	—	[0.958]	—	—	—	—
Phosphorus (as P)	1	198.8	06/11/01	F	1	1	56	—	—	—	—	—
Potassium	1	198.8	06/11/01	F	1	1	4300	—	—	—	—	—
Potassium	1	198.8	06/11/01	NF	1	1	4300	—	—	—	—	—
Selenium	1	198.8	06/11/01	F	1	0	—	[1.9]	50	0/1	50	0/1
Selenium	1	198.8	06/11/01	NF	1	0	—	[1.9]	—	—	—	—
Silica	1	198.8	06/11/01	F	1	1	32100	—	—	—	—	—
Silica	1	198.8	06/11/01	NF	1	1	32100	—	—	—	—	—
Silver	1	198.8	06/11/01	F	1	0	—	[0.57]	100	0/1	50	0/1
Silver	1	198.8	06/11/01	NF	1	0	—	[0.57]	—	—	—	—
Sodium	1	198.8	06/11/01	F	1	1	17000	—	—	—	—	—
Sodium	1	198.8	06/11/01	NF	1	1	17000	—	—	—	—	—
Strontium	1	198.8	06/11/01	F	1	1	110	—	—	—	—	—
Strontium	1	198.8	06/11/01	NF	1	1	110	—	—	—	—	—
Sulfate	1	198.8	06/11/01	F	1	1	11000	—	250000	0/1	600000	0/1
Thallium	1	198.8	06/11/01	F	1	0	—	[0.077]	2	0/1	—	—
Thallium	1	198.8	06/11/01	NF	1	1	0.41	—	—	—	—	—
Uranium	1	198.8	06/11/01	F	1	1	0.308	—	—	—	—	—
Uranium	1	198.8	06/11/01	NF	1	1	0.243	—	—	—	—	—
Vanadium	1	198.8	06/11/01	F	1	0	—	[0.38]	—	—	—	—
Vanadium	1	198.8	06/11/01	NF	1	0	—	[0.38]	—	—	—	—
Zinc	1	198.8	06/11/01	F	1	1	4	—	5000	0/1	10000	0/1
Zinc	1	198.8	06/11/01	NF	1	0	—	[1.7]	—	—	—	—

Table A-25 (continued)

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Stable Isotopes (‰)							—	—				
δD	1	198.8	06/11/01	NF	1	1	-72	—	—	—	—	—
$\delta^{18}O$	1	198.8	06/11/01	NF	1	1	-10.7	—	—	—	—	—

[a] R-9i does not extend to the regional aquifer.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US EPA secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] NMED = New Mexico Environment Department.

[d] State of New Mexico groundwater standards are from *New Mexico Water Quality Control Commission Regulations, Ground and Surface Water Protection*, 20 NMAC 6.2.

[e] NF = Nonfiltered.

[f] — = Not available or not applicable.

[g] NTU = Nephelometric turbidity unit.

[h] F = Filtered.

Table A-26
Regional Well R-9i Screen 2 Third Round Sample Results: Data Summary for Inorganic Chemicals

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Field Parameter												
Field Alkalinity (total as $CaCO_3$)	2	278.8	06/12/01	NF[e]	1	1	25000	—[f]	—	—	—	—
pH	2	278.8	06/12/01	NF	1	1	7.32	—	>6 & <9	0/1	>6 & <9	0/1
Specific Conductance (µS/cm)	2	278.8	06/12/01	NF	1	1	192	—	—	0/1	—	0/1
Temperature (°C)	2	278.8	06/12/01	NF	1	1	17.2	—	—	0/1	—	0/1
Turbidity (NTU[g])	2	278.8	06/12/01	NF	1	1	0.5	—	—	0/1	—	0/1
Analyte												
Lab Alkalinity (total as $CaCO_3$)	2	278.8	06/12/01	F[h]	1	1	75000	—	—	—	—	—
Aluminum	2	278.8	06/12/01	F	1	0	—	[7.6]	50	0/1	5000	0/1
Aluminum	2	278.8	06/12/01	NF	1	0	—	[13]	—	—	—	—
Ammonia (as N)	2	278.8	06/12/01	F	1	0	—	[100]	—	—	—	—
Antimony	2	278.8	06/12/01	F	1	0	—	[0.522]	6	0/1	—	—
Antimony	2	278.8	06/12/01	NF	1	0	—	[0.38]	—	—	—	—
Arsenic	2	278.8	06/12/01	F	1	0	—	[1.5]	50	0/1	100	0/1
Arsenic	2	278.8	06/12/01	NF	1	0	—	[1.5]	—	—	—	—
Barium	2	278.8	06/12/01	F	1	1	44	—	2000	0/1	1000	0/1
Barium	2	278.8	06/12/01	NF	1	1	44	—	—	—	—	—
Beryllium	2	278.8	06/12/01	F	1	0	—	[0.012]	4	0/1	—	—
Beryllium	2	278.8	06/12/01	NF	1	0	—	[0.012]	—	—	—	—
Boron	2	278.8	06/12/01	F	1	0	—	[16]	—	—	750	0/1
Boron	2	278.8	06/12/01	NF	1	0	—	[26]	—	—	—	—
Bromide	2	278.8	06/12/01	F	1	0	—	[200]	—	—	—	—
Cadmium	2	278.8	06/12/01	F	1	0	—	[0.08]	5	0/1	10	0/1
Cadmium	2	278.8	06/12/01	NF	1	0	—	[0.103]	—	—	—	—

Table A-26 (continued)

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Calcium	2	278.8	06/12/01	F	1	1	13000	—	—	—	—	—
Calcium	2	278.8	06/12/01	NF	1	1	13000	—	—	—	—	—
Chloride	2	278.8	06/12/01	F	1	1	18000	—	250000	0/1	250000	0/1
Chromium (total)	2	278.8	06/12/01	F	1	0	—	[0.46]	100	0/1	50	0/1
Chromium (total)	2	278.8	06/12/01	NF	1	0	—	[1.6]	—	—	—	—
Cobalt	2	278.8	06/12/01	F	1	0	—	[0.45]	—	—	50	0/1
Cobalt	2	278.8	06/12/01	NF	1	0	—	[0.37]	—	—	—	—
Copper	2	278.8	06/12/01	F	1	0	—	[0.27]	1300	0/1	1000	0/1
Copper	2	278.8	06/12/01	NF	1	0	—	[0.27]	—	—	—	—
Cyanide (total)	2	278.8	06/12/01	NF	1	0	—	[10]	—	—	—	—
Fluoride	2	278.8	06/12/01	F	1	1	420	—	4000	0/1	1600	0/1
Iron	2	278.8	06/12/01	F	1	1	910	—	300	1/1	1000	0/1
Iron	2	278.8	06/12/01	NF	1	1	920	—	—	—	—	—
Kjeldahl Nitrogen	2	278.8	06/12/01	F	1	1	230	—	—	—	—	—
Lead	2	278.8	06/12/01	F	1	0	—	[0.037]	15	0/1	50	0/1
Lead	2	278.8	06/12/01	NF	1	0	—	[0.037]	—	—	—	—
Magnesium	2	278.8	06/12/01	F	1	1	4400	—	—	—	—	—
Magnesium	2	278.8	06/12/01	NF	1	1	4400	—	—	—	—	—
Manganese	2	278.8	06/12/01	F	1	1	540	—	50	1/1	200	1/1
Manganese	2	278.8	06/12/01	NF	1	1	540	—	—	—	—	—
Mercury	2	278.8	06/12/01	F	1	0	—	[0.033]	2	0/1	—	—
Mercury	2	278.8	06/12/01	NF	1	0	—	[0.033]	—	—	2	0/1
Molybdenum	2	278.8	06/12/01	F	1	1	9.5	—	—	—	—	—
Molybdenum	2	278.8	06/12/01	NF	1	1	12	—	—	—	—	—
Nickel	2	278.8	06/12/01	F	1	1	9.9	—	100	0/1	200	0/1
Nickel	2	278.8	06/12/01	NF	1	1	11	—	—	—	—	—
Nitrate + Nitrite (as N)	2	278.8	06/12/01	F	1	0	—	[50]	10000	0/1	—	—

Table A-26 (continued)

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Oxalate	2	278.8	06/12/01	F	1	0	—	[190]	—	—	—	—
Perchlorate	2	278.8	06/12/01	F	1	0	—	[0.958]	—	—	—	—
Phosphorus (as P)	2	278.8	06/12/01	F	1	1	56	—	—	—	—	—
Potassium	2	278.8	06/12/01	F	1	1	3700	—	—	—	—	—
Potassium	2	278.8	06/12/01	NF	1	1	3700	—	—	—	—	—
Selenium	2	278.8	06/12/01	F	1	0	—	[1.9]	50	0/1	50	0/1
Selenium	2	278.8	06/12/01	NF	1	0	—	[1.9]	—	—	—	—
Silica	2	278.8	06/12/01	F	1	1	34200	—	—	—	—	—
Silica	2	278.8	06/12/01	NF	1	1	34200	—	—	—	—	—
Silver	2	278.8	06/12/01	F	1	0	—	[0.57]	100	0/1	50	0/1
Silver	2	278.8	06/12/01	NF	1	0	—	[0.57]	—	—	—	—
Sodium	2	278.8	06/12/01	F	1	1	13000	—	—	—	—	—
Sodium	2	278.8	06/12/01	NF	1	1	13000	—	—	—	—	—
Strontium	2	278.8	06/12/01	F	1	1	88	—	—	—	—	—
Strontium	2	278.8	06/12/01	NF	1	1	88	—	—	—	—	—
Sulfate	2	278.8	06/12/01	F	1	1	6800	—	250000	0/1	600000	0/1
Thallium	2	278.8	06/12/01	F	1	0	—	[0.598]	2	0/1	—	—
Thallium	2	278.8	06/12/01	NF	1	0	—	[1.3]	—	—	—	—
Uranium	2	278.8	06/12/01	F	1	1	0.02	—	—	—	—	—
Uranium	2	278.8	06/12/01	NF	1	1	0.022	—	—	—	—	—
Vanadium	2	278.8	06/12/01	F	1	0	—	[0.38]	—	—	—	—
Vanadium	2	278.8	06/12/01	NF	1	0	—	[0.38]	—	—	—	—
Zinc	2	278.8	06/12/01	F	1	0	—	[2.1]	5000	0/1	10000	0/1
Zinc	2	278.8	06/12/01	NF	1	0	—	[2.1]	—	—	—	—

Table A-26 (continued)

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Stable Isotopes (‰)							—	—				
δD	2	278.8	06/12/01	NF	1	1	-78	—	—	—	—	—
$\delta^{18}O$	2	278.8	06/12/01	NF	1	1	-11.3	—	—	—	—	—

[a] R-9i does not extend to the regional aquifer.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US EPA secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] NMED = New Mexico Environment Department.

[d] State of New Mexico groundwater standards are from *New Mexico Water Quality Control Commission Regulations, Ground and Surface Water Protection*, 20 NMAC 6.2.

[e] NF = Nonfiltered.

[f] — = Not available or not applicable.

[g] NTU = Nephelometric turbidity unit.

[h] F = Filtered.

Table A-27

Regional Well R-9i Screen 1 Third Round Sample Results: Data Summary for Detected Organic Chemicals

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Total Organic Carbon	1	198.8	06/11/01	NF[e]	1	1	3200	—[f]	—	—	—	—

[a] R-9i does not extend to the regional aquifer.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US EPA secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] NMED = New Mexico Environment Department.

[d] State of New Mexico groundwater standards are from *New Mexico Water Quality Control Commission Regulations, Ground and Surface Water Protection*, 20 NMAC 6.2.

[e] NF = Nonfiltered.

[f] — = Not available or not applicable.

Table A-28

Regional Well R-9i Screen 2 Third Round Sample Results: Data Summary for Detected Organic Chemicals

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Total Organic Carbon	2	278.8	06/12/01	NF[e]	1	1	2500	—[f]	—	—	—	—

[a] R-9i does not extend to the regional aquifer.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US EPA secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] NMED = New Mexico Environment Department.

[d] State of New Mexico groundwater standards are from *New Mexico Water Quality Control Commission Regulations, Ground and Surface Water Protection*, 20 NMAC 6.2.

[e] NF = Nonfiltered.

[f] — = Not available or not applicable.

Table A-29
Regional Well R-9i Screen 1 Third Round Sample Results: Data Summary for Radionuclides

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (pCi/L)	Nondetected Value (pCi/L)	Drinking Water MCL[b] (pCi/L)	Frequency of Detects > Drinking Water MCL
Americium-241	1	198.8	06/11/01	F[c]	1	0	—[d]	[0.026]	15[e]	0/1
Cesium-134	1	198.8	06/11/01	F	1	0	—	[-4]	—	—
Cesium-137	1	198.8	06/11/01	F	1	0	—	[-3.8]	—	—
Cobalt-60	1	198.8	06/11/01	F	1	0	—	[4.7]	—	—
Europium-152	1	198.8	06/11/01	F	1	0	—	[1]	—	—
Plutonium-238	1	198.8	06/11/01	F	1	0	—	[0.001]	15[e]	0/1
Plutonium-239	1	198.8	06/11/01	F	1	0	—	[0.0047]	15[e]	0/1
Ruthenium-106	1	198.8	06/11/01	F	1	0	—	[19]	—	—
Sodium-22	1	198.8	06/11/01	F	1	0	—	[-1]	—	—
Strontium-90	1	198.8	06/11/01	F	1	0	—	[0.6]	8	0/1
Tritium	1	198.8	06/11/01	NF[f]	1	1	235	—	20000	0/1
Uranium-234	1	198.8	06/11/01	F	1	1	0.104	—	—	—
Uranium-235	1	198.8	06/11/01	F	1	0	—	[0.002]	—	—
Uranium-238	1	198.8	06/11/01	F	1	1	0.072	—	—	—

[a] R-9i does not extend to the regional aquifer.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US EPA secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] F = Filtered.

[d] — = Not available or not applicable.

[e] Based on an MCL of 15 pCi/L (including radium-226, but excluding radon and uranium).

[f] NF = Nonfiltered.

Table A-30
Regional Well R-9i Screen 2 Third Round Sample Results: Data Summary for Radionuclides

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (pCi/L)	Nondetected Value (pCi/L)	Drinking Water MCL[b] (pCi/L)	Frequency of Detects > Drinking Water MCL
Americium-241	2	278.8	06/12/01	F[c]	1	0	—[d]	[0.015]	15[e]	0/1
Cesium-134	2	278.8	06/12/01	F	1	0	—	[-1.1]	—	—
Cesium-137	2	278.8	06/12/01	F	1	0	—	[0.5]	—	—
Cobalt-60	2	278.8	06/12/01	F	1	0	—	[0.5]	—	—
Europium-152	2	278.8	06/12/01	F	1	0	—	[-10]	—	—
Plutonium-238	2	278.8	06/12/01	F	1	0	—	[-0.0018]	15[e]	0/1
Plutonium-239	2	278.8	06/12/01	F	1	0	—	[0.014]	15[e]	0/1
Ruthenium-106	2	278.8	06/12/01	F	1	0	—	[-28]	—	—
Sodium-22	2	278.8	06/12/01	F	1	0	—	[2.6]	—	—
Strontium-90	2	278.8	06/12/01	F	1	0	—	[-0.4]	8	0/1
Tritium	2	278.8	06/12/01	NF[f]	1	1	130	—	20000	0/1
Uranium-234	2	278.8	06/12/01	F	1	0	—	[0.043]	—	—
Uranium-235	2	278.8	06/12/01	F	1	0	—	[-0.011]	—	—
Uranium-238	2	278.8	06/12/01	F	1	0	—	[0.021]	—	—

[a] R-9i does not extend to the regional aquifer.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US EPA secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] F = Filtered.

[d] — = Not available or not applicable.

[e] Based on an MCL of 15 pCi/L (including radium-226, but excluding radon and uranium).

[f] NF = Nonfiltered.

Table A-31
Regional Well R-9i Screen 1 Fourth Round Sample Results: Data Summary for Inorganic Chemicals

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Field Parameter												
Field Alkalinity (total as $CaCO_3$)	1	198.8	9/5/01	NF[e]	1	1	36000	—[f]	—	—	—	—
pH	1	198.8	9/5/01	NF	1	1	7.22	—	>6 & <9	0/1	>6 & <9	0/1
Specific Conductance (µS/cm)	1	198.8	9/5/01	NF	1	1	271	—	—	0/1	—	0/1
Temperature (°C)	1	198.8	9/5/01	NF	1	1	21.3	—	—	0/1	—	0/1
Turbidity (NTU[g])	1	198.8	9/5/01	NF	1	1	—	—	—	0/1	—	0/1
Analyte												
Alkalinity-CO_3+HCO_3	1	198.8	9/5/01	F[h]	1	1	71500	—	—	—	—	—
Aluminum	1	198.8	9/5/01	F	1	0	—	[9.54]	50	0/1	5000	0/1
Aluminum	1	198.8	9/5/01	NF	1	0	—	[9.54]	—	—	—	—
Ammonia	1	198.8	9/5/01	F	1	0	—	[23.5]	—	—	—	—
Antimony	1	198.8	9/5/01	F	1	0	—	[0.752]	6	0/1	—	—
Antimony	1	198.8	9/5/01	NF	1	0	—	[0.174]	—	—	—	—
Arsenic	1	198.8	9/5/01	F	1	0	—	[2.6]	50	0/1	100	0/1
Arsenic	1	198.8	9/5/01	NF	1	0	—	[2.6]	—	—	—	—
Barium	1	198.8	9/5/01	F	1	1	72.6	—	2000	0/1	1000	0/1
Barium	1	198.8	9/5/01	NF	1	1	72.4	—	—	—	—	—
Beryllium	1	198.8	9/5/01	F	1	1	0.013	—	4	0/1	—	—
Beryllium	1	198.8	9/5/01	NF	1	1	0.012	—	—	—	—	—
Boron	1	198.8	9/5/01	F	1	0	—	[20.3]	—	—	750	0/1
Boron	1	198.8	9/5/01	NF	1	0	—	[20.4]	—	—	—	—
Bromide	1	198.8	9/5/01	F	1	0	—	[20]	—	—	—	—
Cadmium	1	198.8	9/5/01	F	1	0	—	[0.017]	5	0/1	10	0/1
Cadmium	1	198.8	9/5/01	NF	1	0	—	[0.017]	—	—	—	—
Calcium	1	198.8	9/5/01	F	1	1	19700	—	—	—	—	—

Table A-31 (continued)

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Calcium	1	198.8	9/5/01	NF	1	1	19400	—	—	—	—	—
Chloride	1	198.8	9/5/01	F	1	1	25400	—	250000	0/1	250000	0/1
Chromium	1	198.8	9/5/01	F	1	1	3.4	—	100	0/1	50	0/1
Chromium	1	198.8	9/5/01	NF	1	1	6.91	—	—	—	—	—
Cobalt	1	198.8	9/5/01	F	1	1	1.39	—	—	—	50	0/1
Cobalt	1	198.8	9/5/01	NF	1	1	1.3	—	—	—	—	—
Copper	1	198.8	9/5/01	F	1	1	1.38	—	1300	0/1	1000	0/1
Copper	1	198.8	9/5/01	NF	1	1	1.3	—	—	—	—	—
Cyanide (Total)	1	198.8	9/5/01	NF	1	1	4.54	—	—	—	—	—
Fluoride	1	198.8	9/5/01	F	1	1	503	—	4000	0/1	1600	0/1
Iron	1	198.8	9/5/01	F	1	1	966	—	300	1/1	1000	0/1
Iron	1	198.8	9/5/01	NF	1	1	999	—	—	—	—	—
Kjeldahl Nitrogen	1	198.8	9/5/01	F	1	1	290	—	—	—	—	—
Lead	1	198.8	9/5/01	F	1	1	0.121	—	15	0/1	50	0/1
Lead	1	198.8	9/5/01	NF	1	0	—	[0.011]	—	—	—	—
Magnesium	1	198.8	9/5/01	F	1	1	6440	—	—	—	—	—
Magnesium	1	198.8	9/5/01	NF	1	1	6350	—	—	—	—	—
Manganese	1	198.8	9/5/01	F	1	1	925	—	50	1/1	200	1/1
Manganese	1	198.8	9/5/01	NF	1	1	932	—	—	—	—	—
Mercury	1	198.8	9/5/01	F	1	0	—	[0.064]	2	0/1	—	—
Mercury	1	198.8	9/5/01	NF	1	0	—	[0.064]	—	—	2	0/1
Molybdenum	1	198.8	9/5/01	F	1	1	15.9	—	—	—	—	—
Molybdenum	1	198.8	9/5/01	NF	1	1	16.2	—	—	—	—	—
Nickel	1	198.8	9/5/01	F	1	1	37.2	—	100	0/1	200	0/1
Nickel	1	198.8	9/5/01	NF	1	1	38.7	—	—	—	—	—
Nitrate-Nitrite as N	1	198.8	9/5/01	F	1	0	—	[6.9]	10000	0/1	—	—
Oxalate	1	198.8	9/5/01	F	1	0	—	[190]	—	—	—	—

Table A-31 (continued)

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Perchlorate	1	198.8	9/5/01	F	1	1	2.12	—	—	—	—	—
Phosphorus (as P)	1	198.8	9/5/01	F	1	1	6.44	—	—	—	—	—
Potassium	1	198.8	9/5/01	F	1	1	4240	—	—	—	—	—
Potassium	1	198.8	9/5/01	NF	1	1	4180	—	—	—	—	—
Selenium	1	198.8	9/5/01	F	1	1	3.72	—	50	0/1	50	0/1
Selenium	1	198.8	9/5/01	NF	1	1	3.52	—	—	—	—	—
Silica	1	198.8	9/5/01	F	1	1	33600	—	—	—	—	—
Silica	1	198.8	9/5/01	NF	1	1	33600	—	—	—	—	—
Silver	1	198.8	9/5/01	F	1	0	—	[0.666]	100	0/1	50	0/1
Silver	1	198.8	9/5/01	NF	1	0	—	[0.666]	—	—	—	—
Sodium	1	198.8	9/5/01	F	1	1	21000	—	—	—	—	—
Sodium	1	198.8	9/5/01	NF	1	1	20800	—	—	—	—	—
Specific Conductance (Lab)	1	198.8	9/5/01	F	1	1	219	—	—	—	—	—
Strontium	1	198.8	9/5/01	F	1	1	117	—	—	—	—	—
Strontium	1	198.8	9/5/01	NF	1	1	116	—	—	—	—	—
Sulfate	1	198.8	9/5/01	F	1	1	10200	—	250000	0/1	600000	0/1
Thallium	1	198.8	9/5/01	F	1	0	—	[0.028]	2	0/1	—	—
Thallium	1	198.8	9/5/01	NF	1	0	—	[0.204.1]	—	—	—	—
Uranium	1	198.8	9/5/01	F	1	1	0.194	—	20	0/1	5000	0/1
Uranium	1	198.8	9/5/01	NF	1	1	0.19	—	—	—	—	—
Vanadium	1	198.8	9/5/01	F	1	1	0.52	—	—	—	—	—
Vanadium	1	198.8	9/5/01	NF	1	0	—	[0.482]	—	—	—	—
Zinc	1	198.8	9/5/01	F	1	1	5.57	—	5000	0/1	10000	0/1
Zinc	1	198.8	9/5/01	NF	1	1	6.3	—	—	—	—	—

Table A-31 (continued)

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Stable Isotopes (‰)												
δD	1	198.8	9/5/01	NF	1	1	-73	—	—	—	—	—
$\delta^{15}N$	1	198.8	9/5/01	NF	1	1	—	BDL[i]	—	—	—	—
$\delta^{18}O$	1	198.8	9/5/01	NF	1	1	-10.8	—	—	—	—	—

[a] R-9i does not extend to the regional aquifer.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US EPA secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] NMED = New Mexico Environment Department.

[d] State of New Mexico groundwater standards are from *New Mexico Water Quality Control Commission Regulations, Ground and Surface Water Protection*, 20 NMAC 6.2.

[e] NF = Nonfiltered.

[f] — = Not available or not applicable.

[g] NTU = Nephelometric turbidity unit.

[h] F = Filtered.

[i] BDL = Below detection limit.

Table A-32
Regional Well R-9i Screen 2 Fourth Round Sample Results: Data Summary for Inorganic Chemicals

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Field Parameter												
Field Alkalinity (total as $CaCO_3$)	2	278.8	9/6/01	NF[e]	1	1	35000	—[f]	—	—	—	—
pH	2	278.8	9/6/01	NF	1	1	7.18	—	>6 & <9	0/1	>6 & <9	0/1
Specific Conductance (µS/cm)	2	278.8	9/6/01	NF	1	1	183	—	—	0/1	—	0/1
Temperature (°C)	2	278.8	9/6/01	NF	1	1	21.8	—	—	0/1	—	0/1
Turbidity (NTU[g])	2	278.8	9/6/01	NF	1	1	1.1	—	—	0/1	—	0/1
Analyte												
Lab Alkalinity (total as $CaCO_3$)	2	278.8	9/6/01	F[h]	1	1	57000	—	—	—	—	—
Aluminum	2	278.8	9/6/01	F	1	0	—	[9.54]	50	0/1	5000	0/1
Aluminum	2	278.8	9/6/01	NF	1	0	—	[9.54]	—	—	—	—
Ammonia (as N)	2	278.8	9/6/01	F	1	0	—	[23.5]	—	—	—	—
Antimony	2	278.8	9/6/01	F	1	0	—	[0.46]	6	0/1	—	—
Antimony	2	278.8	9/6/01	NF	1	0	—	[0.07]	—	—	—	—
Arsenic	2	278.8	9/6/01	F	1	0	—	[2.6]	50	0/1	100	0/1
Arsenic	2	278.8	9/6/01	NF	1	0	—	[2.6]	—	—	—	—
Barium	2	278.8	9/6/01	F	1	1	49.2	—	2000	0/1	1000	0/1
Barium	2	278.8	9/6/01	NF	1	1	48.8	—	—	—	—	—
Beryllium	2	278.8	9/6/01	F	1	1	0.01	—	4	0/1	—	—
Beryllium	2	278.8	9/6/01	NF	1	0	—	[0.003]	—	—	—	—
Boron	2	278.8	9/6/01	F	1	0	—	[25.5]	—	—	750	0/1
Boron	2	278.8	9/6/01	NF	1	0	—	[28.7]	—	—	—	—
Bromide	2	278.8	9/6/01	F	1	0	—	[20]	—	—	—	—
Cadmium	2	278.8	9/6/01	F	1	1	0.04	—	5	0/1	10	0/1
Cadmium	2	278.8	9/6/01	NF	1	1	0.05	—	—	—	—	—

Table A-32 (continued)

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Calcium	2	278.8	9/6/01	F	1	1	14400	—	—	—	—	—
Calcium	2	278.8	9/6/01	NF	1	1	14300	—	—	—	—	—
Chloride	2	278.8	9/6/01	F	1	1	14900	—	250000	0/1	250000	0/1
Chromium (total)	2	278.8	9/6/01	F	1	0	—	[0.57]	100	0/1	50	0/1
Chromium (total)	2	278.8	9/6/01	NF	1	1	3.12	—	—	—	—	—
Cobalt	2	278.8	9/6/01	F	1	0	—	[0.737]	—	—	50	0/1
Cobalt	2	278.8	9/6/01	NF	1	0	—	[0.737]	—	—	—	—
Copper	2	278.8	9/6/01	F	1	0	—	[1.02]	1300	0/1	1000	0/1
Copper	2	278.8	9/6/01	NF	1	1	1.23	—	—	—	—	—
Cyanide (Total)	2	278.8	9/6/01	NF	1	0	—	[2.89]	—	—	—	—
Fluoride	2	278.8	9/6/01	F	1	1	308	—	4000	0/1	1600	0/1
Iron	2	278.8	9/6/01	F	1	1	703	—	300	1/1	1000	0/1
Iron	2	278.8	9/6/01	NF	1	1	706	—	—	—	—	—
Kjeldahl Nitrogen	2	278.8	9/6/01	F	1	1	200	—	—	—	—	—
Lead	2	278.8	9/6/01	F	1	0	—	[0.011]	15	0/1	50	0/1
Lead	2	278.8	9/6/01	NF	1	0	—	[0.011]	—	—	—	—
Magnesium	2	278.8	9/6/01	F	1	1	4600	—	—	—	—	—
Magnesium	2	278.8	9/6/01	NF	1	1	4590	—	—	—	—	—
Manganese	2	278.8	9/6/01	F	1	1	487	—	50	1/1	200	1/1
Manganese	2	278.8	9/6/01	NF	1	1	500	—	—	—	—	—
Mercury	2	278.8	9/6/01	F	1	0	—	[0.064]	2	0/1	—	—
Mercury	2	278.8	9/6/01	NF	1	0	—	[0.064]	—	—	2	0/1
Molybdenum	2	278.8	9/6/01	F	1	1	10.7	—	—	—	—	—
Molybdenum	2	278.8	9/6/01	NF	1	1	10.9	—	—	—	—	—
Nickel	2	278.8	9/6/01	F	1	1	22.3	—	100	0/1	200	0/1
Nickel	2	278.8	9/6/01	NF	1	1	23.5	—	—	—	—	—
Nitrate-Nitrite as N	2	278.8	9/6/01	F	1	1	20	—	10000	0/1	—	—

Table A-32 (continued)

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Phosphorus (as P)	2	278.8	9/6/01	F	1	1	30	—	—	—	—	—
Potassium	2	278.8	9/6/01	F	1	1	3540	—	—	—	—	—
Potassium	2	278.8	9/6/01	NF	1	1	3570	—	—	—	—	—
Selenium	2	278.8	9/6/01	F	1	0	—	[3.49]	50	0/1	50	0/1
Selenium	2	278.8	9/6/01	NF	1	0	—	[3.49]	—	—	—	—
Silica	2	278.8	9/6/01	F	1	1	33800	—	—	—	—	—
Silica	2	278.8	9/6/01	NF	1	1	33800	—	—	—	—	—
Silver	2	278.8	9/6/01	F	1	0	—	[0.666]	100	0/1	50	0/1
Silver	2	278.8	9/6/01	NF	1	0	—	[0.666]	—	—	—	—
Sodium	2	278.8	9/6/01	F	1	1	13800	—	—	—	—	—
Sodium	2	278.8	9/6/01	NF	1	1	14100	—	—	—	—	—
Specific Conductance (Lab)	2	278.8	9/6/01	F	1	1	181	—	—	—	—	—
Strontium	2	278.8	9/6/01	F	1	1	86.6	—	—	—	—	—
Strontium	2	278.8	9/6/01	NF	1	1	86.7	—	—	—	—	—
Sulfate	2	278.8	9/6/01	F	1	1	7580	—	250000	0/1	600000	0/1
Thallium	2	278.8	9/6/01	F	1	0	—	[0.021]	2	0/1	—	—
Thallium	2	278.8	9/6/01	NF	1	0	—	[0.021]	—	—	—	—
Uranium	2	278.8	9/6/01	F	1	0	—	[0.003]	20	0/1	5000	0/1
Uranium	2	278.8	9/6/01	NF	1	0	—	[0.003]	—	—	—	—
Vanadium	2	278.8	9/6/01	F	1	0	—	[0.482]	—	—	—	—
Vanadium	2	278.8	9/6/01	NF	1	1	0.49	—	—	—	—	—
Zinc	2	278.8	9/6/01	F	1	0	—	[2.99]	5000	0/1	10000	0/1
Zinc	2	278.8	9/6/01	NF	1	1	7.38	—	—	—	—	—

Table A-32 (continued)

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Stable Isotopes (‰)												
δD	2	278.8	9/6/01	NF	1	1	-79	—	—	—	—	—
$\delta^{15}N$	2	278.8	9/6/01	NF	1	1	—	BDL[i]	—	—	—	—
$\delta^{18}O$	2	278.8	9/6/01	NF	1	1	-11.4	—	—	—	—	—

[a] R-9i does not extend to the regional aquifer.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US EPA secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] NMED = New Mexico Environment Department.

[d] State of New Mexico groundwater standards are from *New Mexico Water Quality Control Commission Regulations, Ground and Surface Water Protection*, 20 NMAC 6.2.

[e] NF = Nonfiltered.

[f] — = Not available or not applicable.

[g] NTU = Nephelometric turbidity unit.

[h] F = Filtered.

[i] BDL = Below detection limit

Table A-33
Regional Well R-9i Screen 1 Fourth Round Sample Results: Data Summary for Detected Organic Chemicals

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Dissolved Organic Carbon	1	198.8	9/5/01	F[e]	1	1	3600	—[f]	—	—	—	—
Humic Substances, Hydrophilic Acids	1	198.8	9/5/01	F	1	1	1300	—	—	—	—	—
Humic Substances, Hydrophilic Bases	1	198.8	9/5/01	F	1	1	200	—	—	—	—	—
Humic Substances, Hydrophilic Neutrals	1	198.8	9/5/01	F	1	1	100	—	—	—	—	—
Humic Substances, Hydrophilic Total	1	198.8	9/5/01	F	1	1	1600	—	—	—	—	—
Humic Substances, Hydrophobic Acids	1	198.8	9/5/01	F	1	1	1200	—	—	—	—	—
Humic Substances, Hydrophobic Bases	1	198.8	9/5/01	F	1	1	0	—	—	—	—	—
Humic Substances, Hydrophobic Neutrals	1	198.8	9/5/01	F	1	1	800	—	—	—	—	—
Humic Substances, Hydrophobic Total	1	198.8	9/5/01	F	1	1	2000	—	—	—	—	—
Total Organic Carbon	1	198.8	9/5/01	NF[g]	1	1	3810	—	—	—	—	—

[a] R-9i does not extend to the regional aquifer.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US EPA secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] NMED = New Mexico Environment Department.

[d] State of New Mexico groundwater standards are from *New Mexico Water Quality Control Commission Regulations, Ground and Surface Water Protection*, 20 NMAC 6.2.

[e] F = Filtered.

[f] — = Not available or not applicable.

[g] NF = Nonfiltered.

Table A-34

Regional Well R-9i Screen 2 Fourth Round Sample Results: Data Summary for Detected Organic Chemicals

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Dissolved Organic Carbon	2	278.8	9/6/01	F[e]	1	1	2300	—[f]	—	—	—	—
Humic Substances, Hydrophilic Acids	2	278.8	9/6/01	F	1	0	—	[100]	—	—	—	—
Humic Substances, Hydrophilic Bases	2	278.8	9/6/01	F	1	1	100	—	—	—	—	—
Humic Substances, Hydrophilic Neutrals	2	278.8	9/6/01	F	1	1	800	—	—	—	—	—
Humic Substances, Hydrophilic Total	2	278.8	9/6/01	F	1	1	900	—	—	—	—	—
Humic Substances, Hydrophobic Acids	2	278.8	9/6/01	F	1	1	500	—	—	—	—	—
Humic Substances, Hydrophobic Bases	2	278.8	9/6/01	F	1	0	—	[100]	—	—	—	—
Humic Substances, Hydrophobic Neutrals	2	278.8	9/6/01	F	1	1	900	—	—	—	—	—
Humic Substances, Hydrophobic Total	2	278.8	9/6/01	F	1	1	1400	—	—	—	—	—
Total Organic Carbon	2	278.8	9/6/01	NF[g]	1	1	2590	—	—	—	—	—

[a] R-9i does not extend to the regional aquifer.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US EPA secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] NMED = New Mexico Environment Department.

[d] State of New Mexico groundwater standards are from *New Mexico Water Quality Control Commission Regulations, Ground and Surface Water Protection*, 20 NMAC 6.2.

[e] F = Filtered.

[f] — = Not available or not applicable.

[g] NF = Nonfiltered.

Table A-35
Regional Well R-9i Screen 1 Fourth Round Sample Results: Data Summary for Radionuclides

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (pCi/L)	Nondetected Value (pCi/L)	Drinking Water MCL[b] (pCi/L)	Frequency of Detects > Drinking Water MCL
Americium-241	1	198.8	9/5/01	F[c]	2	1	0.0376	—[d]	15[e]	0/2
Americium-241	1	198.8	9/5/01	NF[f]	1	0	—	[-25.30]	—	—
Cesium-134	1	198.8	9/5/01	F	1	0	—	[-1.85]	—	—
Cesium-134	1	198.8	9/5/01	NF	1	0	—	[-1.61]	—	—
Cesium-137	1	198.8	9/5/01	F	1	0	—	[-0.0585]	—	—
Cesium-137	1	198.8	9/5/01	NF	1	0	—	[1.88]	—	—
Cobalt-60	1	198.8	9/5/01	F	1	0	—	[2.36]	—	—
Cobalt-60	1	198.8	9/5/01	NF	1	0	—	[-1.07]	—	—
Europium-152	1	198.8	9/5/01	F	1	0	—	[-0.539]	—	—
Europium-152	1	198.8	9/5/01	NF	1	0	—	[-8.11]	—	—
Gross alpha	1	198.8	9/5/01	NF	1	0	—	[1.37]	—	—
Gross beta	1	198.8	9/5/01	NF	1	1	5.99	—	—	—
Gross gamma	1	198.8	9/5/01	NF	1	0	—	[56.4]	—	—
Lead-212	1	198.8	9/5/01	F	1	0	—	[0.208]	—	—
Plutonium-238	1	198.8	9/5/01	F	1	0	—	[0.00105]	15[e]	0/1
Plutonium-239	1	198.8	9/5/01	F	1	0	—	[0.00158]	15[e]	0/1
Ruthenium-106	1	198.8	9/5/01	F	1	0	—	[5.64]	—	—
Ruthenium-106	1	198.8	9/5/01	NF	1	0	—	[5.22]	—	—
Strontium-90	1	198.8	9/5/01	F	1	0	—	[0.455]	8	0/1
Thallium-208	1	198.8	9/5/01	F	1	0	—	[-2.62]	—	—
Thallium-208	1	198.8	9/5/01	NF	1	0	—	[3.05]	—	—
Thorium-228	1	198.8	9/5/01	F	1	0	—	[0.00676]	15[e]	0/1
Thorium-230	1	198.8	9/5/01	F	1	0	—	[-6.35E-07]	15[e]	0/1
Thorium-232	1	198.8	9/5/01	F	1	0	—	[0.00736]	15[e]	0/1
Tritium	1	198.8	9/5/01	NF	1	1	239	—	20000	0/1
Uranium-234	1	198.8	9/5/01	F	1	1	0.124	—	—	—

Table A-35 (continued)

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (pCi/L)	Nondetected Value (pCi/L)	Drinking Water MCL[b] (pCi/L)	Frequency of Detects > Drinking Water MCL
Uranium-235	1	198.8	9/5/01	F	2	0	—	[0.00877]	—	—
Uranium-235	1	198.8	9/5/01	NF	1	0	—	[-5.1]	—	—
Uranium-238	1	198.8	9/5/01	F	1	1	0.093	—	—	—

[a] R-9i does not extend to the regional aquifer.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US EPA secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] F = Filtered.

[d] — = Not available or not applicable.

[e] Based on an MCL of 15 pCi/L (including radium-226, but excluding radon and uranium).

[f] NF = Nonfiltered.

Table A-36
Regional Well R-9i Screen 2 Fourth Round Sample Results: Data Summary for Radionuclides

Parameter and Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (pCi/L)	Nondetected Value (pCi/L)	Drinking Water MCL[b] (pCi/L)	Frequency of Detects > Drinking Water MCL
Americium-241	2	278.8	9/6/01	F[c]	2	0	—[d]	[0.594]	15[e]	0/2
Cesium-134	2	278.8	9/6/01	F	1	0	—	[0.734]	—	—
Cesium-137	2	278.8	9/6/01	F	1	0	—	[2.37]	—	—
Cobalt-60	2	278.8	9/6/01	F	1	0	—	[2.32]	—	—
Europium-152	2	278.8	9/6/01	F	1	0	—	[-1.63]	—	—
Gross alpha	2	278.8	9/6/01	NF[f]	1	1	0.6640	—	—	—
Gross beta	2	278.8	9/6/01	NF	1	1	4.11	—	—	—
Gross gamma	2	278.8	9/6/01	NF	1	0	—	[10]	—	—
Plutonium-238	2	278.8	9/6/01	F	1	0	—	[-0.00116]	15[e]	0/1
Plutonium-239	2	278.8	9/6/01	F	1	0	—	[-0.000578]	—	—
Ruthenium-106	2	278.8	9/6/01	F	1	0	—	[-3.61]	—	—
Strontium-90	2	278.8	9/6/01	F	1	0	—	[-0.1]	8	0/1
Thorium-228	2	278.8	9/6/01	F	1	0	—	[0.0154]	15[e]	0/1
Thorium-230	2	278.8	9/6/01	F	1	0	—	[-0.00222]	15[e]	0/1
Thorium-232	2	278.8	9/6/01	F	1	0	—	[0.00111]	15[e]	0/1
Tritium	2	278.8	9/6/01	NF	1	1	130	—	20000	0/1
Uranium-234	2	278.8	9/6/01	F	1	1	0.0191	—	—	—
Uranium-235	2	278.8	9/6/01	F	2	0	—	[0.00187]	—	—
Uranium-238	2	278.8	9/6/01	F	1	1	0.0210	—	—	—

[a] R-9i does not extend to the regional aquifer.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US EPA secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] F = Filtered.

[d] — = Not available or not applicable.

[e] Based on an MCL of 15 pCi/L (including radium-226, but excluding radon and uranium).

[f] NF = Nonfiltered.

Appendix B

Geochemical Calculations (Input Files for the Computer Program MINTEQA2)

A description of the input file for the computer program MINTEQA2 (Allison et al. 1991, 49930) is provided below.

Rows one and two (blank) consist of the title for the calculations.

Row three consists of temperature, units of concentration, and calculation of ionic strength.

Row four is blank.

Row five consists of query for charge balance termination (> 30%); alkalinity or inorganic carbon as carbonate; query for oversaturated solids that are not allowed to precipitate excluding infinite and finite phases; maximum number of iterations (40, 100, and 200); selection for calculating activity coefficient (Davies equation); level of output; pH; Eh or pe; and a query for choosing a different file to modify or return to output filename prompt.

Row six is blank.

Row seven contains zeros (not specific to input file).

Row eight is blank.

Rows nine through 25 contains species number, concentration, log base 10 activity, a prompt (y) for refining calculation of activity for each species, and the chemical symbol for each species.

Row 26 is blank.

Row 27 consists of pH input (measured)

Row 28 consists of pH including its species number, pH value, and chemical symbol.

Row 29 includes excluded species for calculation

Row 30 consists of excluded species identification number, log base 10 association constant (K) and delta H (enthalpy) for association constant. Species $U(OH)_5^-$ was excluded from calculations because spectroscopic data did not confirm its occurrence in aqueous solution (Langmuir 1997, 56037).

```
GEOCHEMICAL CALCULATIONS FOR R-9 (02/28/00).

22.70 MG/L   0.000  0.00000E-01
0 0 1 0 3 0 0 0 1 1 0 0 0
0   0   0
    330  0.000E-01   -7.45 y                    /H+1
    140  1.440E+02  -18.60 y                    /TOTAL CARBON, CO3
    150  2.600E+01   -3.19 y                    /Ca+2
    460  5.600E+00   -3.64 y                    /Mg+2
    500  1.700E+01   -3.13 y                    /Na+1
    410  4.000E+00   -3.99 y                    /K+1
    180  6.860E+00   -3.71 y                    /Cl-1
    770  1.130E+02   -2.93 y                    /H4SiO4
    732  5.790E+00   -4.22 y                    /SO4-2
    100  9.900E-02   -6.14 y                    /Ba+2
    270  3.100E-01   -4.79 y                    /F-1
    280  8.300E-02   -5.83 y                    /Fe+2
    470  1.900E-01   -5.46 y                    /Mn+2
    540  4.500E-03   -7.12 y                    /Ni+2
    800  1.600E-01   -5.74 y                    /Sr+2
    893  1.940E-03   -8.14 y                    /UO2+2
    891  1.720E-03   -8.14                      /U+4

  3   1
    330     7.4500     0.0000                   /H+1
  6   1
8913304   -13.1200    30.2450                   /U(OH)5 -1
```

```
GEOCHEMICAL CALCULATIONS FOR R-9 (09/29/00).

23.40 MG/L   0.000  0.00000E-01
0 0 1 0 3 0 0 0 1 1 0 0 0
0   0   0
    330  0.000E-01   -8.03 y                    /H+1
    140  1.440E+02  -18.60 y                    /TOTAL CARBON, CO3
    150  2.500E+01   -3.20 y                    /Ca+2
    460  5.900E+00   -3.61 y                    /Mg+2
    500  1.600E+01   -3.16 y                    /Na+1
    410  3.600E+00   -4.04 y                    /K+1
    180  7.100E+00   -3.70 y                    /Cl-1
    770  1.193E+02   -2.91 y                    /H4SiO4
    732  6.300E+00   -4.18 y                    /SO4-2
    100  1.300E-01   -6.02 y                    /Ba+2
    270  3.000E-01   -4.80 y                    /F-1
    280  1.300E-02   -6.63 y                    /Fe+2
    470  7.100E-02   -5.89 y                    /Mn+2
    540  9.500E-04   -7.79 y                    /Ni+2
    800  1.600E-01   -5.74 y                    /Sr+2
    891  1.750E-03   -8.13 y                    /U+4
    893  1.980E-03   -8.13 y                    /UO2+2

  3   1
    330     8.0300     0.0000                   /H+1
  6   1
8913304   -13.1200    30.2450                   /U(OH)5 -1
```

```
GEOCHEMICAL CALCULATIONS FOR R-9 (02/13/01).

23.00 MG/L   0.000  0.00000E-01
0 0 1 0 3 0 0 0 1 1 0 0 0
0   0   0
    330  0.000E-01   -8.13 y                    /H+1
    140  1.440E+02  -18.60 y                    /TOTAL CARBON, CO3
    150  2.400E+01   -3.22 y                    /Ca+2
    460  5.700E+00   -3.63 y                    /Mg+2
    500  1.500E+01   -3.19 y                    /Na+1
    410  3.800E+00   -4.01 y                    /K+1
    180  7.400E+00   -3.68 y                    /Cl-1
    770  1.164E+02   -2.92 y                    /H4SiO4
    732  6.400E+00   -4.18 y                    /SO4-2
    100  1.400E-01   -5.99 y                    /Ba+2
    270  2.700E-01   -4.85 y                    /F-1
    280  2.800E-02   -6.30 y                    /Fe+2
    470  8.000E-02   -5.84 y                    /Mn+2
    540  2.700E-03   -7.34 y                    /Ni+2
    800  1.500E-01   -5.77 y                    /Sr+2
    891  1.850E-03   -8.11 y                    /U+4
    893  2.090E-03   -8.11 y                    /UO2+2

  3   1
    330     8.1300     0.0000                   /H+1
  6   1
8913304   -13.1200    30.2450                   /U(OH)5 -1
```

```
GEOCHEMICAL CALCULATIONS FOR R-9 (05/15/01).

22.80 MG/L   0.000  0.00000E-01
0 0 1 0 3 0 0 0 1 1 0 0 0
0   0   0
    330  0.000E-01   -7.98 y                    /H+1
    140  1.440E+02  -18.60 y                    /TOTAL CARBON, CO3
    150  2.500E+01   -3.20 y                    /Ca+2
    460  5.800E+00   -3.62 y                    /Mg+2
    500  1.600E+01   -3.16 y                    /Na+1
    410  3.500E+00   -4.05 y                    /K+1
    180  6.900E+00   -3.71 y                    /Cl-1
    770  1.198E+02   -2.90 y                    /H4SiO4
    732  5.900E+00   -4.21 y                    /SO4-2
    100  1.400E-01   -5.99 y                    /Ba+2
    270  3.200E-01   -4.77 y                    /F-1
    280  2.600E-02   -6.33 y                    /Fe+2
    470  8.400E-02   -5.82 y                    /Mn+2
    540  1.500E-03   -7.59 y                    /Ni+2
    800  1.600E-01   -5.74 y                    /Sr+2
    891  1.940E-03   -8.09 y                    /U+4
    893  2.190E-03   -8.09 y                    /UO2+2

  3   1
    330     7.9800     0.0000                   /H+1
  6   1
8913304   -13.1200    30.2450                   /U(OH)5 -1
```

```
GEOCHEMICAL CALCULATIONS FOR R-9i (09/14/00).
REDUCTIVE DISSOLUTION OF FERRIHYDRITE AND DESORPTION OF NICKEL
19.60 MG/L   0.000  0.00000E-01
0 0 1 0 3 0 0 0 1 1 0 0 0
4   1   7
1.400E-03  600.00 0.000 0.000 81
    330  0.000E-01   -8.04 y                    /H+1
    140  7.560E+01  -18.88 y                    /TOTAL CARBON, CO3
      1  0.000E-01    2.80 y                    /E- (ENTERED AS EH)
    150  1.700E+01   -3.37 y                    /Ca+2
    460  5.600E+00   -3.64 y                    /Mg+2
    500  1.900E+01   -3.08 y                    /Na+1
    410  3.900E+00   -4.00 y                    /K+1
    180  2.400E+01   -3.17 y                    /Cl-1
    770  5.474E+01   -3.24 y                    /H4SiO4
    732  9.600E+00   -4.00 y                    /SO4-2
    100  4.500E-02   -6.48 y                    /Ba+2
    270  4.400E-01   -4.64 y                    /F-1
    280  1.400E+00   -4.60 y                    /Fe+2
    281  6.040E-05   -8.97 y                    /Fe+3
    470  5.200E-01   -5.02 y                    /Mn+2
    540  1.200E-01   -5.69 y                    /Ni+2
    800  1.100E-01   -5.90 y                    /Sr+2
    891  5.900E-04   -8.61 y                    /U+4
    813  0.000E-01    0.00 y                    /ADS1PSIo
    811  7.870E-08   -7.10 y                    /ADS1TYP1
    812  3.150E-06   -5.50 y                    /ADS1TYP2

  3   2
      1    -2.7980     0.0000                   /E- (ENTERED AS EH)
    330     8.0400     0.0000                   /H+1
  6   2
8913304   -13.1200    30.2450                   /U(OH)5 -1
    813     0.0000     0.0000                   /ADS1PSIo
```

```
GEOCHEMICAL CALULATIONS FOR R-9i (02/20/01).
UPPER PERCHED ZONE
12.80 MG/L   0.000  0.00000E-01
0 0 1 0 3 0 0 0 1 1 0 0 0
0   0   0
    330  0.000E-01   -7.35 y                    /H+1
    140  9.840E+01   -5.11 y                    /TOTAL CARBON, CO3
    150  1.700E+01   -3.37 y                    /Ca+2
    460  5.800E+00   -3.62 y                    /Mg+2
    500  1.700E+01   -3.13 y                    /Na+1
    410  3.800E+00   -4.01 y                    /K+1
    180  2.600E+01   -3.13 y                    /Cl-1
    770  4.794E+01   -3.30 y                    /H4SiO4
    732  9.800E+00   -3.99 y                    /SO4-2
    100  6.300E-02   -6.34 y                    /Ba+2
    270  5.600E-01   -4.53 y                    /F-1
    280  2.300E+00   -4.39 y                    /Fe+2
    470  1.000E+00   -4.74 y                    /Mn+2
    540  1.400E-01   -5.62 y                    /Ni+2
    800  1.600E-01   -5.74 y                    /Sr+2
    891  8.600E-05   -9.44 y                    /U+4

  3   1
    330     7.3500     0.0000                   /H+1
  6   1
8913304   -13.1200   115.3738                   /U(OH)5-
```

```
GEOCHEMICAL CALCULATIONS FOR R-9i (06/11/01).
UPPER PERCHED ZONE
16.20 MG/L   0.000  0.00000E+00
0 0 1 0 3 0 0 0 1 1 0 0 0
0   0   0
    330  0.000E+00   -6.58 y                    /H+1
    140  9.720E+01  -18.77 y                    /TOTAL CARBON, CO3
    150  1.700E+01   -3.37 y                    /Ca+2
    460  5.800E+00   -3.62 y                    /Mg+2
    500  1.700E+01   -3.13 y                    /Na+1
    410  3.800E+00   -4.01 y                    /K+1
    180  2.600E+01   -3.13 y                    /Cl-1
    770  5.136E+01   -3.27 y                    /H4SiO4
    732  1.100E+01   -3.94 y                    /SO4-2
    100  6.500E-02   -6.32 y                    /Ba+2
    270  6.400E-01   -4.47 y                    /F-1
    280  1.000E+00   -4.75 y                    /Fe+2
    470  8.800E-01   -4.80 y                    /Mn+2
    540  4.400E-02   -6.13 y                    /Ni+2
    800  1.100E-01   -5.90 y                    /Sr+2
    891  3.080E-04   -8.89 y                    /U+4

  3   1
    330     6.5800     0.0000                   /H+1
  6   1
8913304   -13.1200   115.3738                   /U(OH)5-
```

```
GEOCHEMICAL CALCULATIONS FOR R-9I (09/05/01).
UPPER PERCHED ZONE
21.30 MG/L   0.000  0.00000E-01
0 0 1 0 3 0 0 0 1 1 0 0 0
0   0   0
    330  0.000E-01   -7.22 y                    /H+1
    140  8.520E+01  -18.83 y                    /TOTAL CARBON, CO3
    150  1.940E+01   -3.32 y                    /Ca+2
    460  6.300E+00   -3.59 y                    /Mg+2
    500  2.080E+01   -3.04 y                    /Na+1
    410  4.200E+00   -3.97 y                    /K+1
    180  2.540E+01   -3.14 y                    /Cl-1
    770  5.304E+01   -3.26 y                    /H4SiO4
    732  1.020E+01   -3.97 y                    /SO4-2
    100  7.200E-02   -6.28 y                    /Ba+2
    270  5.000E-01   -4.58 y                    /F-1
    280  1.000E+00   -4.75 y                    /Fe+2
    470  9.300E-01   -4.77 y                    /Mn+2
    540  3.900E-02   -6.18 y                    /Ni+2
    800  1.600E-01   -5.74 y                    /Sr+2
    891  1.870E-04   -9.10 y                    /U+4
     40  1.103E-11  -16.34                      /Am+3

  3   1
    330     7.2200     0.0000                   /H+1
  6   1
8913304   -13.1200   115.3738                   /U(OH)5-
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