

# DESCRIPTION OF PIEZOMETERS INSTALLED IN THE MIDDLE RIO GRANDE BASIN AREA, 1997-99, CENTRAL NEW MEXICO

By James R. Bartolino and Dale R. Rankin

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CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
inch	25.40	millimeter
foot	0.3048	meter
mile	1.609	kilometer
acre	4,047	square meter

**Sea level:** In this report, “sea level” refers to the National Geodetic Vertical Datum of 1929—a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

Altitude, as used in this report, refers to distance above sea level.



# Description of Piezometers Installed in the Middle Rio Grande Basin Area, 1997-99, Central New Mexico

By James R. Bartolino and Dale R. Rankin

## ABSTRACT

Since 1993, the Santa Fe Group aquifer system in the Middle Rio Grande Basin, and particularly in the Albuquerque area, has been the focus of studies to further define the extent of the most productive parts of the aquifer and to gain a better understanding of how ground-water levels are changing over time. The U.S. Geological Survey, in cooperation with the New Mexico Office of the State Engineer, installed nine piezometers during 1998-99 at five sites in and near the margin of the Middle Rio Grande Basin in central New Mexico. In addition, the New Mexico Office of the State Engineer installed another nine piezometers at three sites during 1997. These piezometers allow for collection of ground-water-level data in areas for which little information is available. Most of the piezometers were constructed of 2.5-inch-diameter flush-joint polyvinyl chloride (PVC) schedule 80 casing with 10-foot stainless steel screens; the shallow piezometer at the Tomé site has a 40-foot screen, and the single piezometers at the Dome Road and Phoenix Road sites have steel casing with welded joints and a 10- and a 20-foot screen, respectively. Steel casing with a locking lid covers the uppermost 2 feet of the piezometer casing. Drillers' logs and petrophysical logs were collected from the deepest borehole at each site.

## INTRODUCTION

Since 1993, the Santa Fe Group aquifer system in the Middle Rio Grande Basin, particularly in the Albuquerque area, has been the focus of studies to

further define the extent of the most productive parts of the aquifer and to gain a better understanding of how ground-water levels are changing over time (Hawley and Haase (1992); Thorn, McAda, and Kernodle (1993); Kernodle, McAda, and Thorn (1995); McAda (1996); Bartolino (1997); Tiedeman, Kernodle, and McAda (1998). During 1998-99, the U.S. Geological Survey (USGS) in cooperation with the New Mexico Office of the State Engineer (NMOSE) installed nine piezometers at five sites in and near the margins of the Middle Rio Grande Basin in central New Mexico. These piezometers allow for collection of water-level data in areas for which little information is available (fig. 1). The additional water-level data collected will lead to a better understanding of water movement through the Santa Fe Group aquifer system, thus allowing for better management of ground-water resources in the basin.

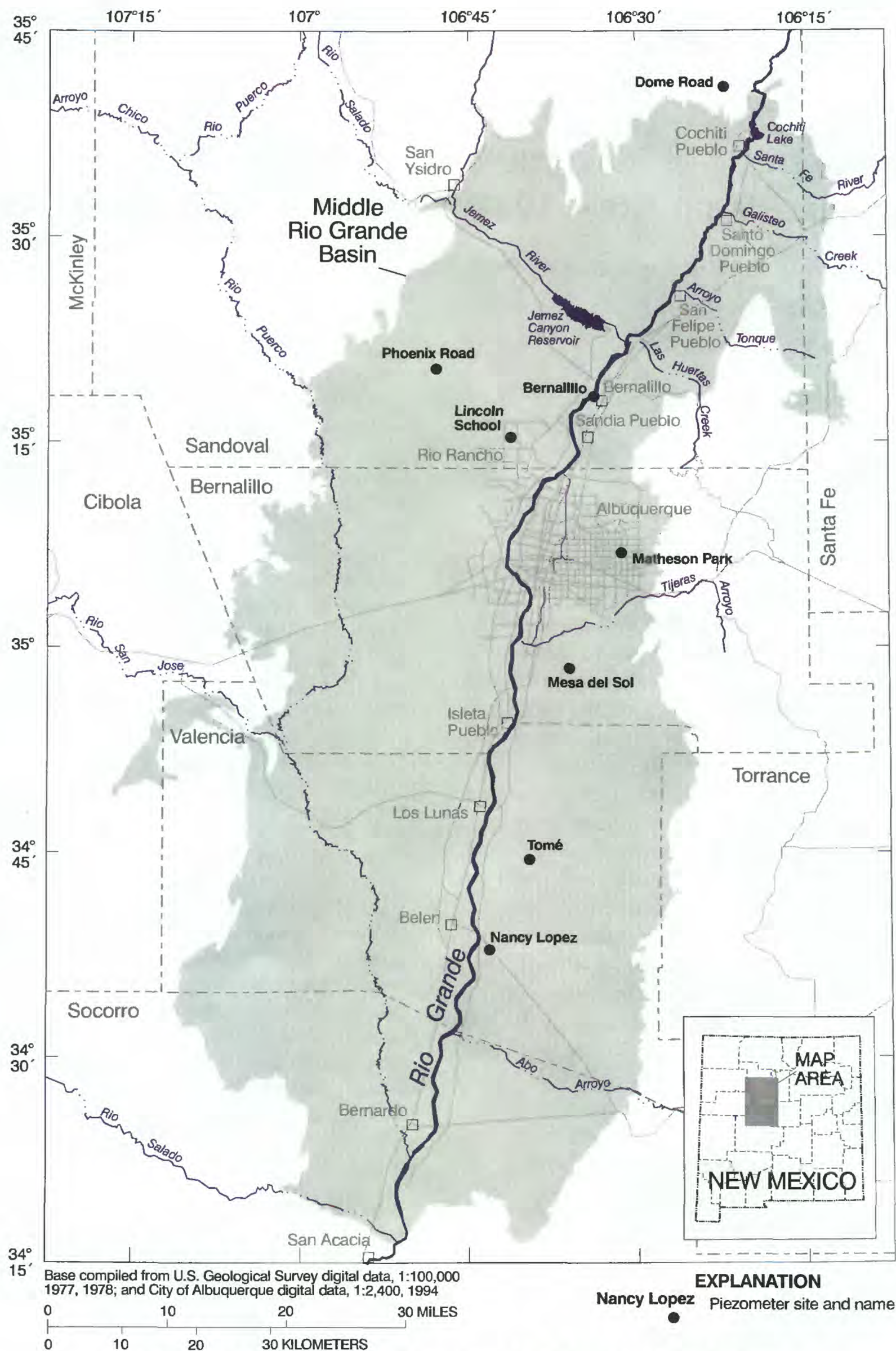
## Purpose and Scope

This report describes the location and construction of nine piezometers that were installed at five sites by the USGS in and near the margins of the Middle Rio Grande Basin in central New Mexico. The report presents piezometer configurations, petrophysical logs, completion diagrams of piezometers, and lithologic logs. Also included are location and construction information and piezometer configurations for nine piezometers installed at three sites in 1997 by the NMOSE.

## Well-Numbering System in New Mexico

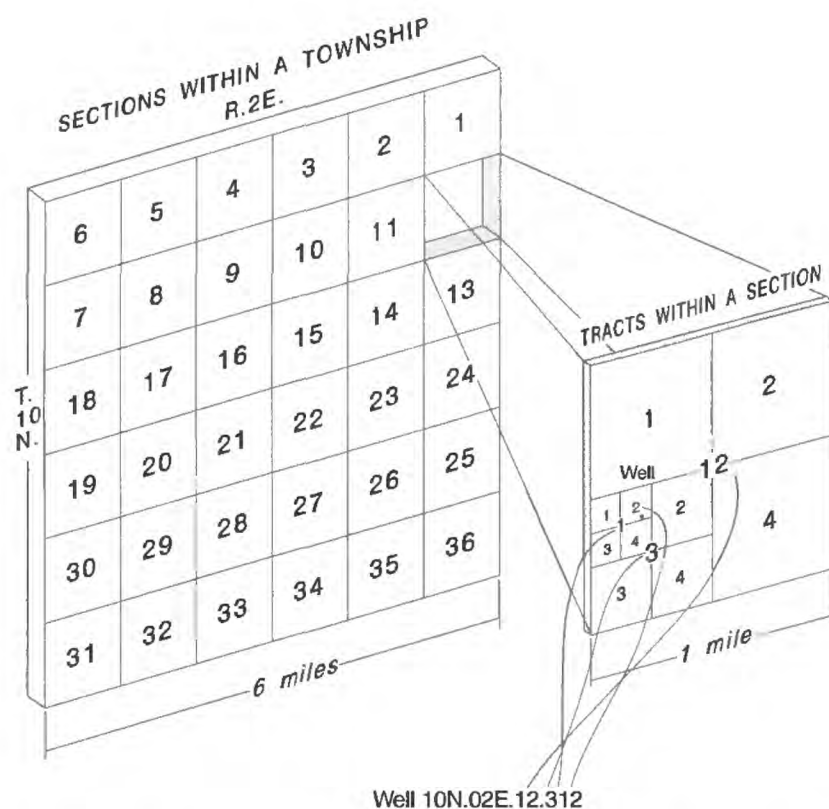
The system of numbering wells in New Mexico is used to designate the location of piezometer sites in this report. The system is based on the common subdivision of public lands into sections (fig. 2).





**Figure 1.** Location of piezometer sites and the Middle Rio Grande Basin.





**Figure 2.** Well-numbering system in New Mexico.

The well number, in addition to designating the well, locates its position to the nearest 10-acre tract in the land network. This number is divided into four segments. The first segment denotes the township north (N.) or south (S.) of the New Mexico base line, the second denotes the range east (E.) or west (W.) of the New Mexico principal meridian, and the third denotes the section. The fourth segment (the section) of the number consists of three digits and denotes the 160-, 40-, and 10-acre tracts, respectively. The section is divided into four quarters numbered 1, 2, 3, and 4 in the normal reading order, for the northwest, northeast, southwest, and southeast quarters. The first digit of the fourth segment denotes the quarter section, which is a tract of 160 acres. Similarly, the quarter section is divided into four 40-acre tracts numbered in the same manner, and the second digit denotes the 40-acre tract. Finally, the 40-acre tract is divided into four 10-acre tracts, and the third digit denotes the 10-acre tract. For example, well 10N.02E.12.312 is in the NE1/4 of the NW1/4 of the SW1/4 of section 12, T. 10 N., R. 02 E. (fig. 2). Letters A, B, C, and so on are added to the fourth segment to designate the second, third, fourth, and succeeding wells in the same 10-acre tract.

## Drilling Method and Piezometer Construction

A three-person crew from the USGS Central Region Drilling Project drilled and constructed the nine piezometers at five sites during 1998-99. A drilling and construction program was established for each site; the primary factors controlling the program were the number of piezometers to be constructed at each site, the estimated depth to water, and the estimated depth of each piezometer. At sites where the depth to water was estimated to be greater than about 600 feet, such as the Dome Road and Phoenix Road sites, the program called for a single-piezometer completion using 4-inch- and 3-inch-diameter steel casing, respectively. At the other three sites where the depth to water was estimated to be less than 200 feet, the program called for multiple-piezometer completions using 2.5-inch-diameter PVC casing. Stainless steel screens (0.020-inch slot size) were used in all piezometers with the exception of the shallow, 40-foot PVC screen (0.010-inch slot size) at the Tomé site. Attached to the bottom of all screens is a 5- or 10-foot section of blank casing (known as a sump) that is capped on the bottom.

Drilling began at each site with the emplacement and subsequent cementing of steel surface casing. At the single-completion sites (Dome Road and Phoenix Road), 8-inch-diameter casing was used, and at the remaining three sites 12-inch-diameter casing was used. One deep borehole was drilled at each site, in which one to three piezometers of varying depths were installed. The USGS collected drill cuttings at 5- to 10-foot intervals for sediment analysis and depositional interpretation by staff of the New Mexico Bureau of Mines and Mineral Resources.

After total depth of the borehole was reached and prior to piezometer completion, the drill string was removed from the borehole and selected petrophysical logs were run. These logs included a caliper log, sonic log, gamma log, neutron log, induction log, and a full set of electric logs including long-short normal, spontaneous-potential, and compensated density log. Every attempt was made to extend all logging tools to the bottom of the borehole. After the logs were evaluated, permeable zones of the aquifer were selected to coincide with the screened intervals.

After the piezometer casing was inserted into the borehole, a tremie pipe (a small-diameter pipe used to conduct material to the bottom of the borehole) was inserted into the borehole beside the casing. If the borehole needed backfilling, bentonite chips were

emplaced using the tremie pipe, over which a primary filter pack (backfill material in the annular space surrounding and immediately above the screen) of 10-20 silica sand was emplaced in the annulus immediately below, above, and adjacent to the screen. The 10-20 silica sand has an intermediate axis between 0.0331 and 0.0787 inch (between 0.841 and 2 millimeters). The amount of 10-20 silica sand used depended on the degree to which the borehole wall caved in (providing for a natural primary filter pack).

For most of the piezometers, several feet of bentonite chips were then emplaced in the borehole above the sand filter pack. For the other piezometers, granular bentonite was emplaced directly over the filter pack. In the single-completion piezometer at Phoenix Road and at the multipiezometer Bernalillo site, the granular bentonite was emplaced to land surface. In the remaining piezometers, the granular bentonite was overlain with cement/bentonite grout that reached land surface.

Before the drill rig moved off site, all piezometers were developed to remove fine-grained material that might have passed through the screen during completion of the piezometers. The shallow water-table piezometers were developed by bailing, and the deeper piezometers were developed with air. Development continued in each piezometer until no fine-grained material was visible. Once all piezometers were installed at each site, a round steel casing protector with a locking lid was cemented into the ground to cover the piezometers at the site. A round steel casing recorder shelter was installed a few feet from the casing protector to house a data logger and power supply. Flexible conduit was buried between the surface casing and recorder shelter so that wiring from pressure transducers could be installed from the piezometer nest to the recorder shelter.

## **Description of Instrumentation Installed**

All piezometers described in this report have been instrumented with pressure transducers to record ground-water levels. At the single-completion sites, the pressure transducer is connected to an electronic data logger. At multipiezometer sites, all transducers are connected to a single data logger. Water-level measurements are recorded at 1-hour intervals. Data are downloaded from the data loggers about every 4-8 weeks and the water level is measured in each

piezometer manually to confirm the accuracy of the pressure transducers.

## **Acknowledgments**

The USGS and NMOSE are appreciative of the following land owners who provided access to the sites: AMREP Corp., City of Rio Rancho, Rio Rancho Public Schools, Rio Grande Utility Corp., Town of Bernalillo, City of Albuquerque, New Mexico State Land Office, and the University of New Mexico. Linda Logan, NMOSE, and Stephanie Moore, USGS, provided technical reviews of this report.

## **DESCRIPTION OF PIEZOMETERS INSTALLED BY THE U.S. GEOLOGICAL SURVEY**

Site and construction information about the nine piezometers installed at five sites by the USGS is listed in table 1 and is discussed in the following five sections. Petrophysical logs, completion diagrams of the piezometers, and lithologic logs are presented in the back of the report (fig. 13). Configuration diagrams for multipiezometer sites also are presented in figures.

### **Bernalillo Site**

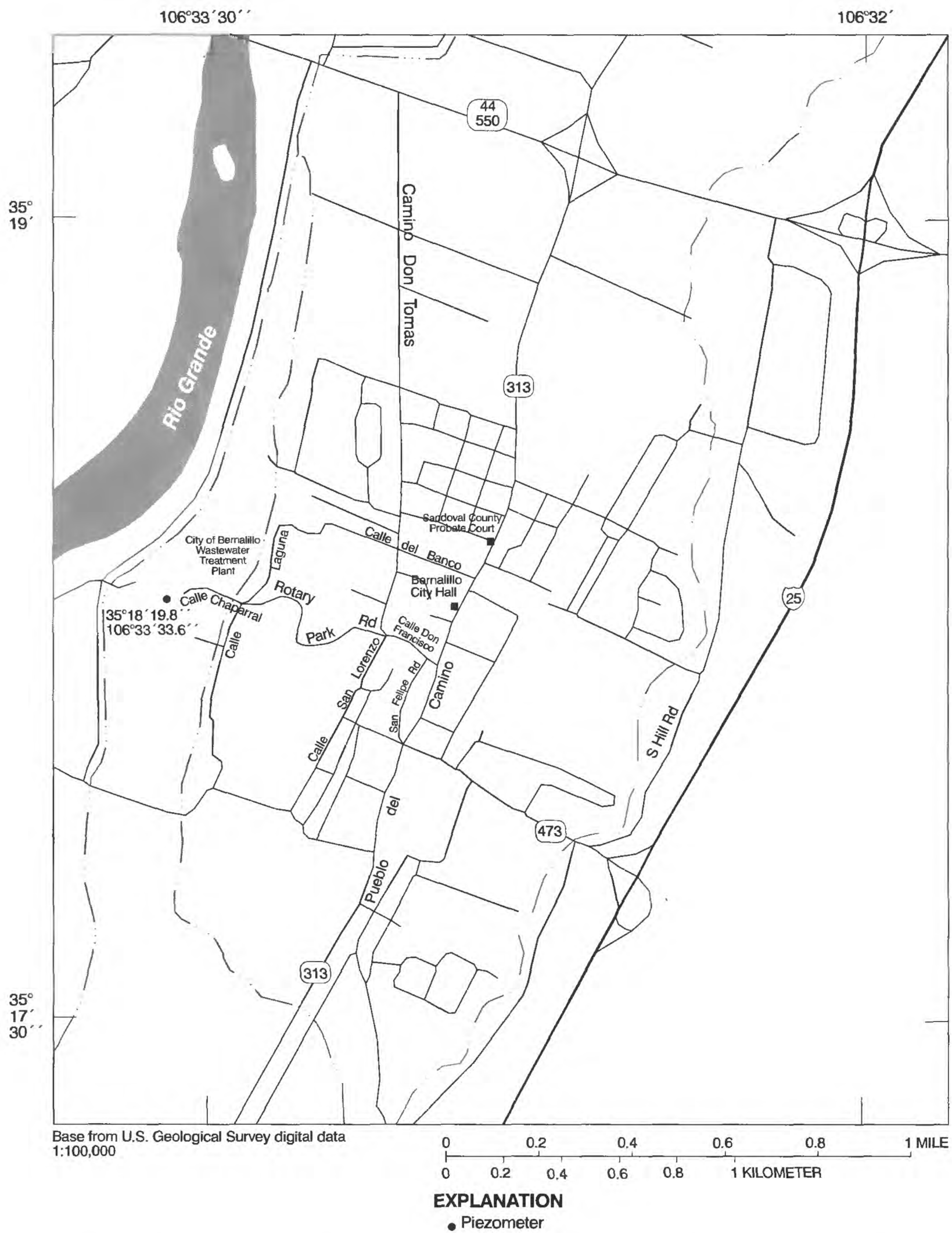
The Bernalillo site is in the town of Bernalillo, approximately 600 feet southeast of the Rio Grande, inside the yard of the wastewater treatment plant (fig. 3). Drilling at the Bernalillo site began on July 30, 1999, and the total depth of 1,255 feet was reached on August 13, 1999. The two piezometers at the site are contained in a 56-foot length of 12-inch-diameter steel surface casing; the configuration of the piezometers is shown in figure 4. Each piezometer consists of 2.5-inch-diameter PVC casing, a 10-foot stainless steel screen, and a 10-foot PVC sump below the screen. The screened intervals were set from 290 to 300 feet and from 1,175 to 1,185 feet below land surface. Petrophysical logs, a completion diagram of the two piezometers, and a lithologic log are shown in figure 13. Site and construction information and initial water-level data are listed in table 1.



**Table 1.** Location, construction information, and initial water-level data for piezometers installed in the Middle Rio Grande Basin area by the U.S. Geological Survey during 1998-99

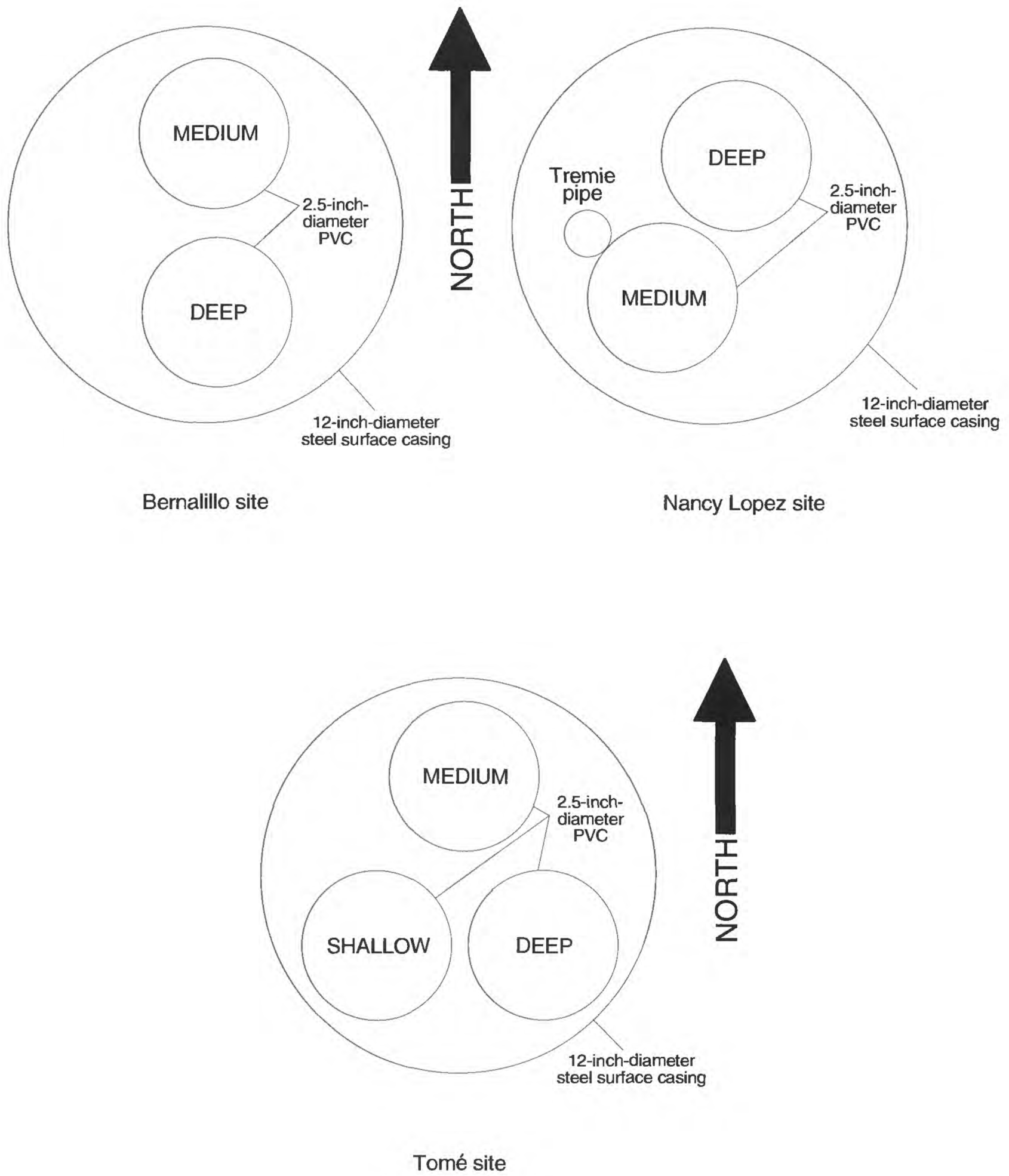
[--do--, ditto]

Site name and piezometer	U.S. Geological Survey site identifier	Piezometer location	Latitude	Longitude	Land- surface elevation (feet)	Date completed	Bore- hole depth (feet)	Screened interval of piezometer (feet)	Initial water level (feet below land surface)	Date water level measured
<b>Bernalillo (figure 3)</b>										
Deep	351821106333901	13N.04E.31.343	35°18'19.8"	106°33'33.6"	5,046	09/02/99	1,255	1,175-1,185	41.04	09/02/99
Medium	351821106333902	--do--	--do--	--do--	--do--	--do--	--do--	290-300	31.99	--Do--
<b>Dome Road (figure 5)</b>	354056106215801	17N.05E.24.344	35°40'57.3"	106°21'56.2"	5,818	10/09/98	1,312	1,280-1,290	592.7	10/09/98
<b>Nancy Lopez (figure 6)</b>										
Deep	343753106430601	05N.03E.28.411	34°37'52.8"	106°43'04.4"	4,925	10/02/98	1,201	1,166-1,176	132.34	10/02/98
Medium	343753106430602	--do--	--do--	--do--	--do--	--do--	--do--	675-685	131.95	--Do--
<b>Phoenix Road (figure 7)</b>	352019106474801	13N.01E.24.313	35°20'21.4"	106°47'46"	6,150	11/24/99	1,685	1,600-1,620	1,184.25	11/24/99
<b>Tomé (figure 8)</b>										
Deep	344431106393401	06N.03E.18.442	34°44'31"	106°39'34"	5,020	08/21/98	1,200	1,185-1,195	194.89	08/21/98
Medium	344431106393402	--do--	--do--	--do--	--do--	--do--	--do--	695-705	194.43	--Do--
Shallow	344431106393403	--do--	--do--	--do--	--do--	--do--	--do--	225-265	193.63	--Do--



**Figure 3.** Location of the Bernalillo piezometer site (see figure 1 for general location of site).





**Figure 4.** Configuration of the piezometers at the Bernalillo, Nancy Lopez, and Tomé sites.

## **Dome Road Site**

The Dome Road site is on the south side of Cochiti Canyon, approximately 3 miles northwest of the town of Cochiti Lake (fig. 5). Drilling at the Dome Road site began on August 22, 1999, and the total depth of 1,312 feet was reached on September 20, 1999. The interval from 1,302 to 1,312 feet was cored; recovery consisted of about 1.5 feet of cobbles. The one piezometer at the site is contained in a 52-foot length of 8-inch-diameter steel surface casing. The piezometer consists of 4-inch-diameter steel casing, a 10-foot stainless steel screen, and a 10-foot steel sump below the screen. The screened interval was set from 1,280 to 1,290 feet below land surface. Petrophysical logs, a completion diagram of piezometers, and a lithologic log are shown in figure 13. Site and construction information and initial water-level data are listed in table 1.

## **Nancy Lopez Site**

The Nancy Lopez site is approximately 2 miles east-southeast of the junction of New Mexico Highway 47 and Highway 304 (fig. 6). Drilling at the Nancy Lopez site began on August 22, 1999, and the total depth of 1,201 feet was reached on August 29, 1999. The two piezometers at the site are contained in a 38-foot length of 12-inch-diameter steel surface casing; the configuration of the piezometers is shown in figure 4. Each piezometer consists of 2.5-inch-diameter PVC casing, a 10-foot stainless steel screen, and a 5-foot PVC sump below the screen. The screened intervals were set from 675 to 685 feet and from 1,166 to 1,176 feet below land surface. The deep piezometer was damaged during installation, and sediment entered the casing. Water-level measurements from this piezometer seem reasonable, however, and the permeability of sediment in the casing does not appear to alter the head in the aquifer adjacent to the screened interval. Petrophysical logs, a completion diagram of the two piezometers, and a lithologic log are shown in figure 13. Site and construction information and initial water-level data are listed in table 1.

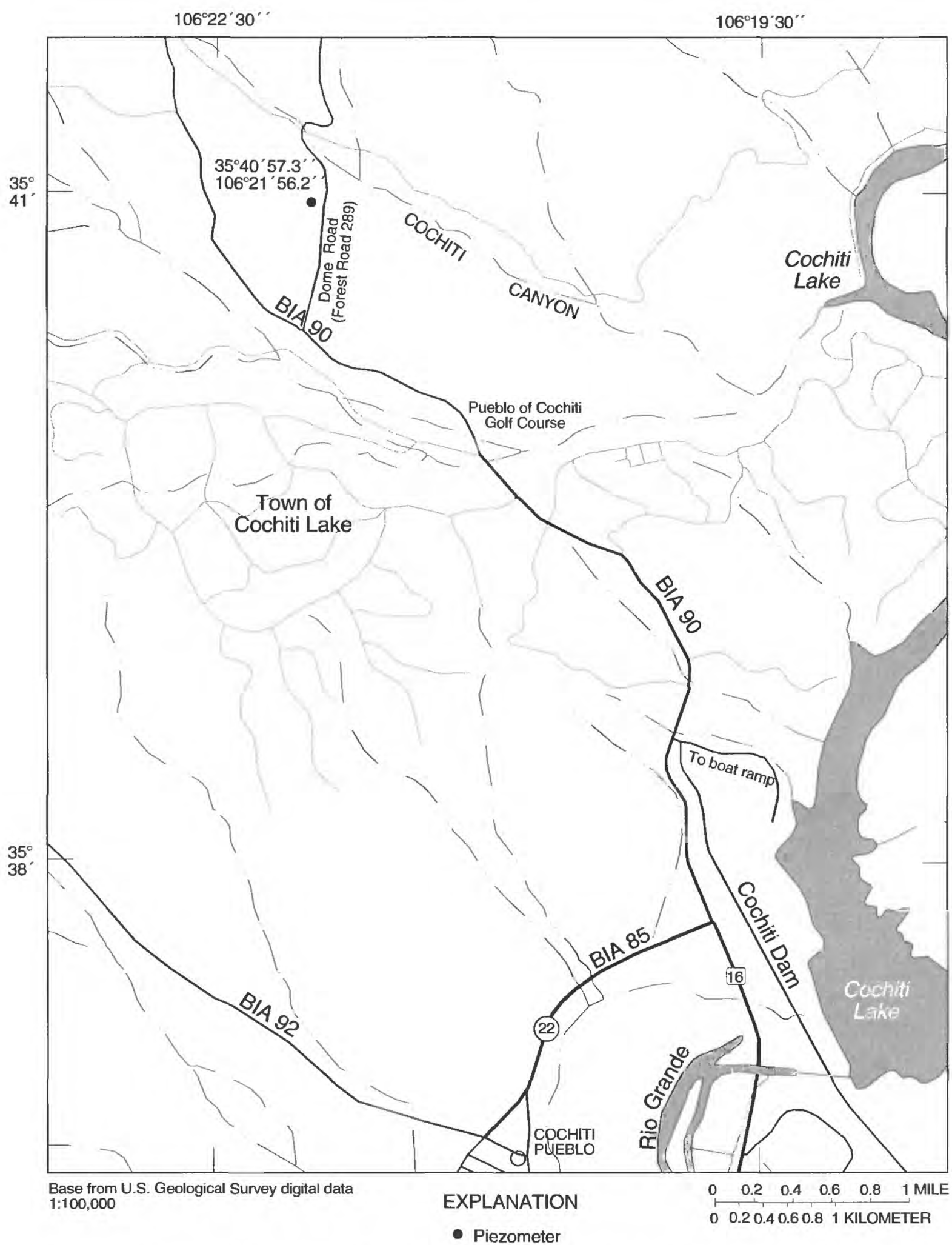
## **Phoenix Road Site**

The Phoenix Road site is near Phoenix Road, approximately 3 miles west of Rainbow Road and the city of Rio Rancho in a grid of currently (2000) unpaved and unnamed streets (fig. 7). Drilling at the Phoenix Road site began on October 16, 1999, and the total depth of 1,685 feet was reached on November 3, 1999. The one piezometer at the site is contained in an 80-foot length of 8-inch-diameter steel surface casing. The piezometer consists of 3-inch-diameter steel casing, a 20-foot stainless steel screen, and a 10-foot steel sump below the screen. The screened interval was set from 1,600 to 1,620 feet below land surface. Petrophysical logs, a completion diagram of piezometers, and a lithologic log are shown in figure 13. Site and construction information and initial water-level data are listed in table 1.

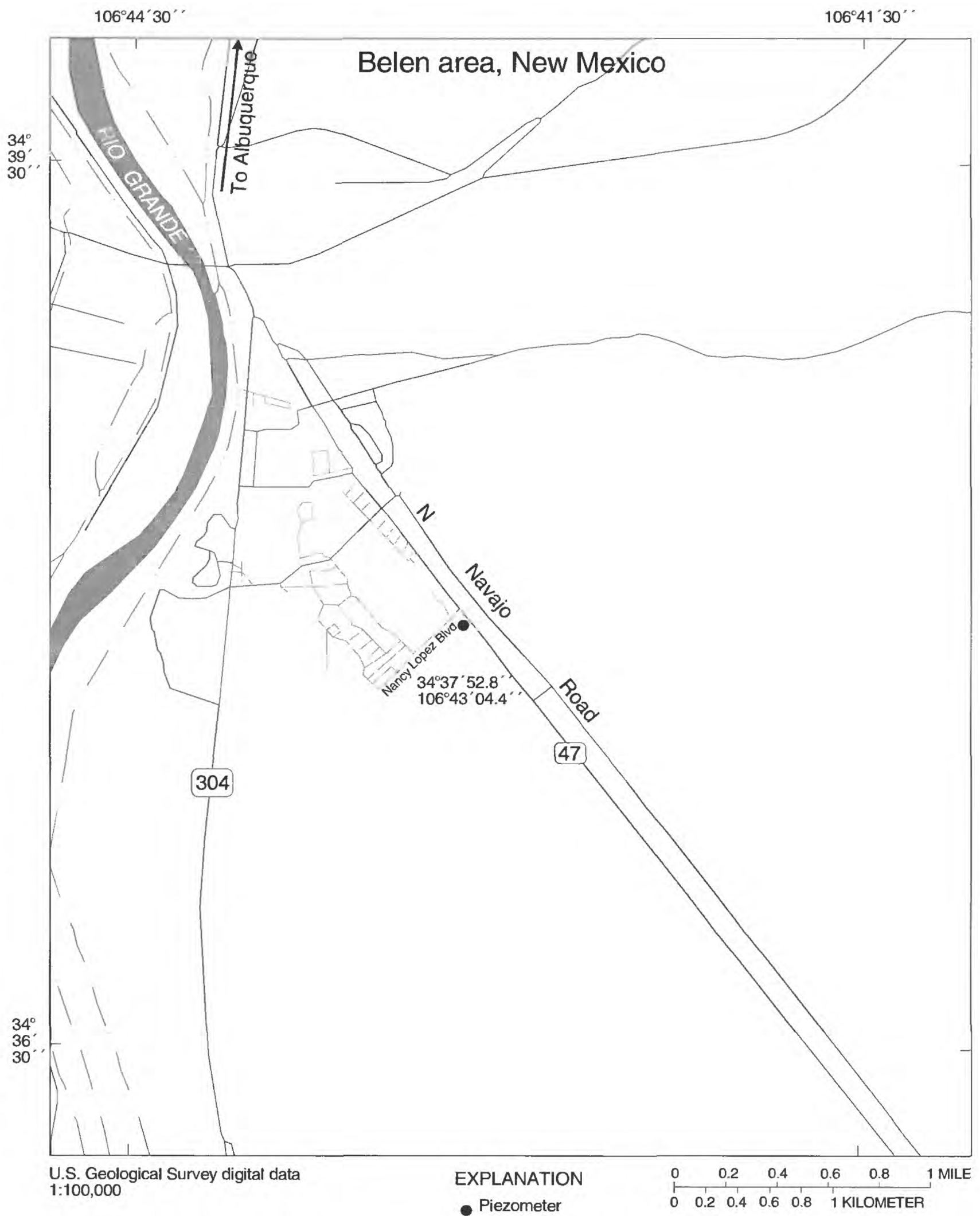
## **Tomé Site**

The Tomé site is approximately 4 miles southeast of the village of Los Lunas, approximately 0.8 mile east of the Manzano Expressway on north Rio del Oro Loop, and approximately 65 feet south of the road (fig. 8). Drilling at the Tomé site began on July 11, 1999, and the total depth of 1,200 feet was reached on July 19, 1999. The three piezometers at the site are contained in a 40-foot length of 12-inch-diameter steel surface casing; the configuration of the piezometers is shown in figure 4. Each piezometer consists of 2.5-inch-diameter PVC casing, a 10-foot stainless steel screen or a 40-foot PVC screen, and a 5- or 10-foot PVC sump below the screen. The screened intervals were set from 225 to 265 feet, 695 to 705 feet, and 1,185 to 1,195 feet below land surface. Petrophysical logs, a completion diagram of the two piezometers, and a lithologic log are shown in figure 13. Site and completion information and initial water-level data are listed in table 1.



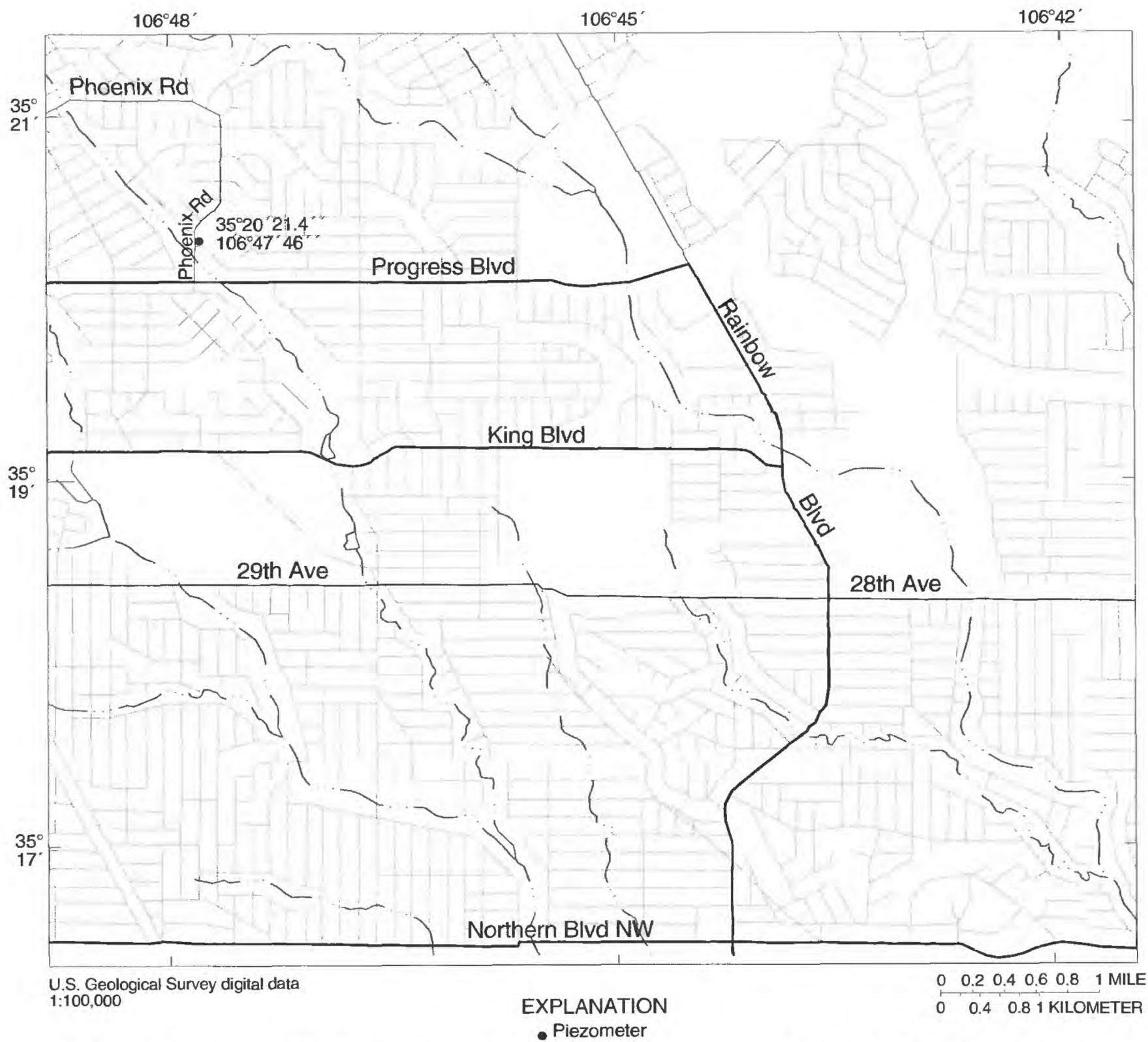


**Figure 5.** Location of the Dome Road piezometer site (see figure 1 for general location of site).

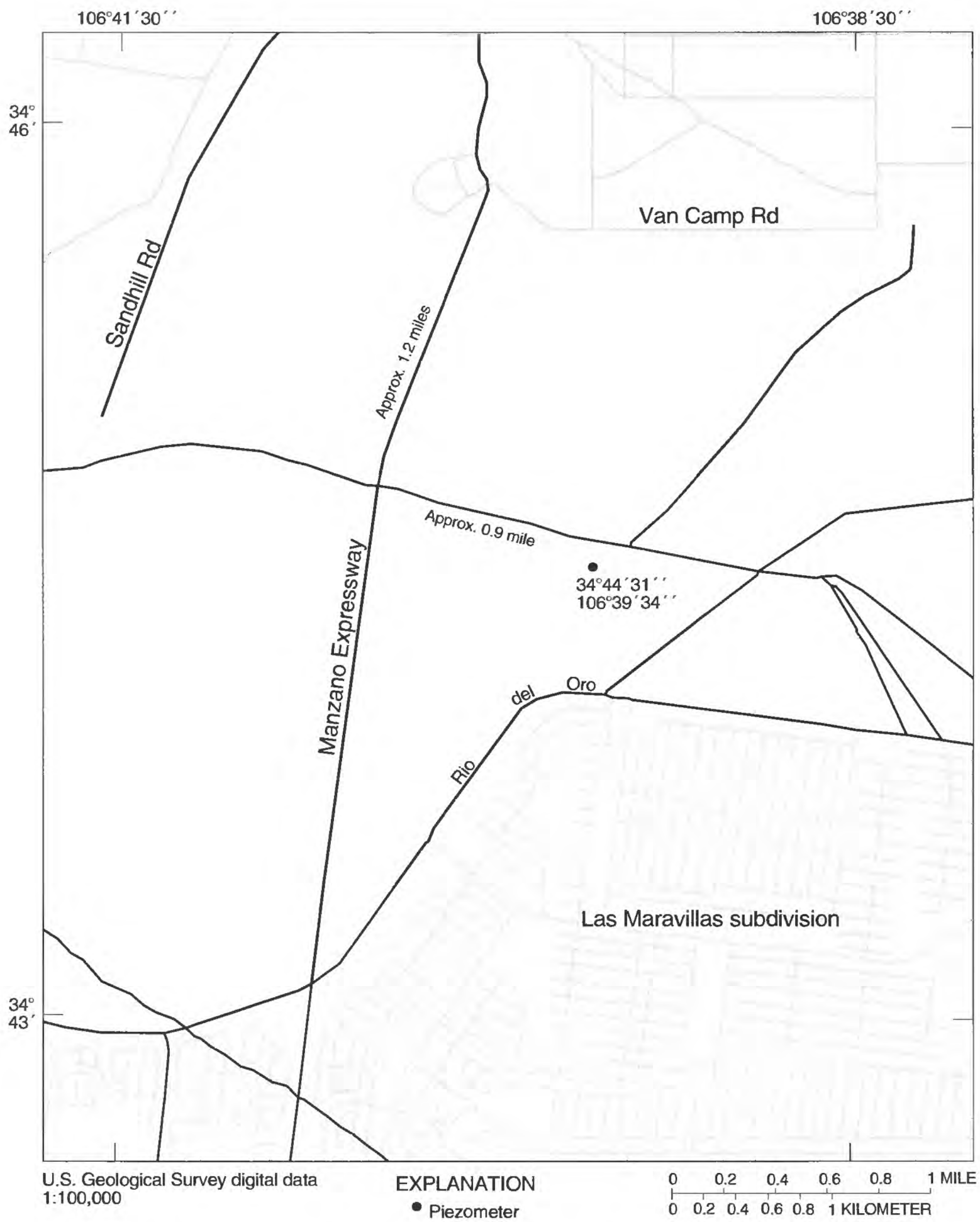


**Figure 6.** Location of the Nancy Lopez piezometer site (see figure 1 for general location of site).





**Figure 7.** Location of the Phoenix Road piezometer site (see figure 1 for general location of site).



**Figure 8.** Location of the Tomé piezometer site (see figure 1 for general location of site).



## DESCRIPTION OF PIEZOMETERS INSTALLED BY THE NEW MEXICO OFFICE OF THE STATE ENGINEER

The nine piezometers installed at three sites by the NMOSE during 1997 are described in the following three sections, and site and construction information is listed in table 2. The USGS was not involved in the installation of these nine piezometers; thus the petrophysical logs, completion diagrams of the piezometers, and lithologic logs are not provided. Each site is described, and configuration diagrams of the piezometers are provided.

### Lincoln School Site

The Lincoln School site is in the city of Rio Rancho in the southwest corner of the grounds of Lincoln Middle School (fig. 9). The piezometers are approximately 52 feet north of Parr Road and 40 feet east of Roswood Drive. The Lincoln School site consists of three piezometers; the screened intervals are from 490 to 590, 810 to 830, and 1,200 to 1,240 feet below land surface. The configuration of the three piezometers is shown in figure 10. Site and construction information and initial water-level data are presented in table 2.

### Matheson Park Site

The Matheson Park site is in the city of Albuquerque in the northeast corner of Matheson Park, south of Candelaria Road and approximately 8 feet east of Dorothy Street (fig. 11). The Matheson Park site consists of three piezometers; the screened intervals are from 600 to 700, 1,020 to 1,040, and 1,460 to 1,500 feet below land surface. The configuration of the piezometers is shown in figure 10. Site and construction information and initial water-level data are listed in table 2.

### Mesa del Sol Site

The Mesa del Sol site is in the city of Albuquerque approximately 4 miles south of the Albuquerque International Airport (fig. 12). The Mesa del Sol site consists of three piezometers; the screened intervals are from 420 to 520, 990 to 1,010, and 1,580 to 1,620 feet below land surface. The configuration of the piezometers is shown in figure 10. Site and

construction information and initial water-level data are listed in table 2.

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**Table 2.** Location, construction information, and initial water-level data for piezometers installed in the Middle Rio Grande Basin area by the New Mexico Office of the State Engineer during 1997

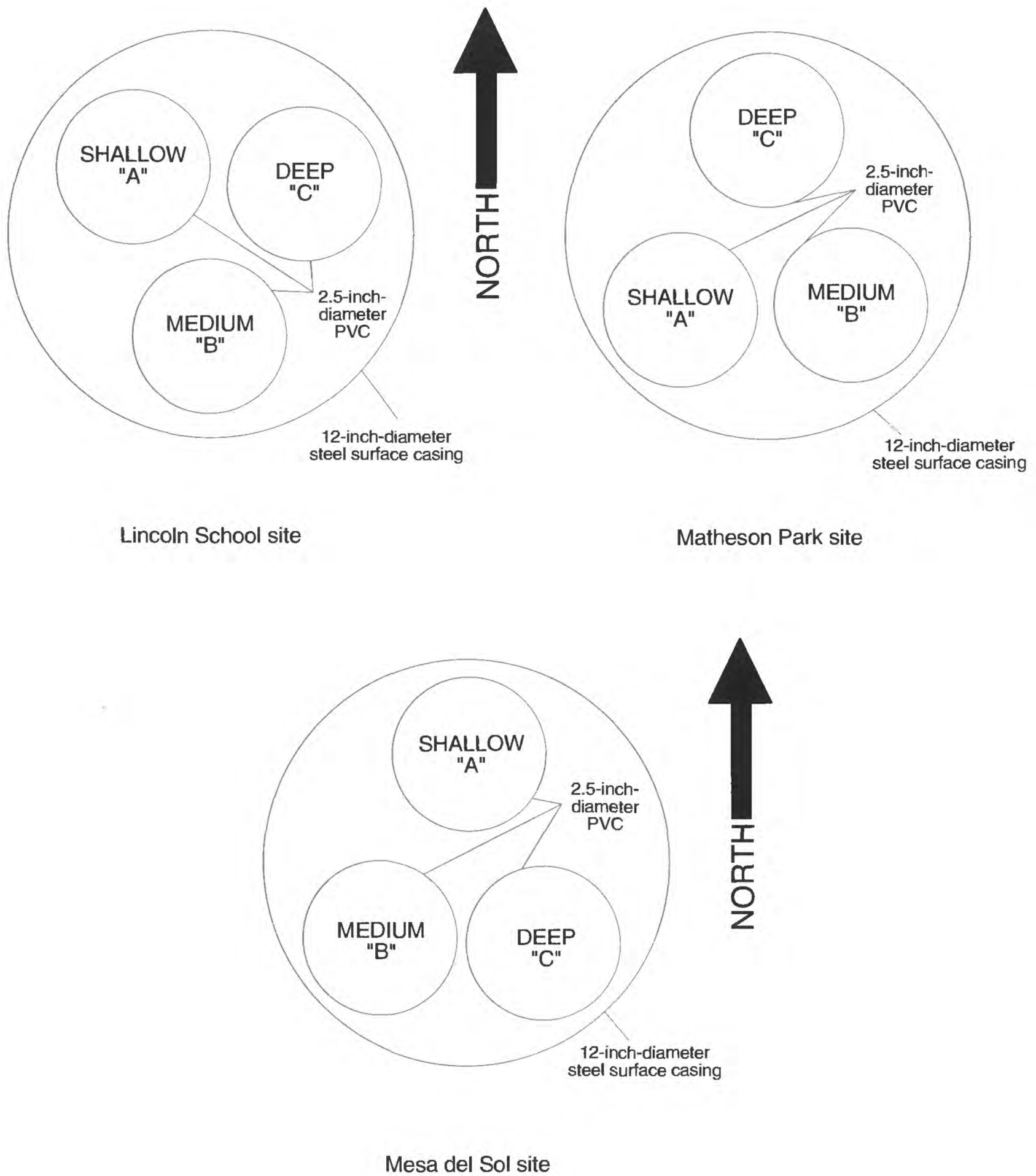
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Site name and piezometer	U.S. Geological Survey site identifier	Piezometer location	Latitude	Longitude	Land- surface elevation (feet)	Date completed	Bore- hole depth (feet)	Screened interval of piezometer (feet)	Initial water level (feet below land surface)	Date water level measured
<b>Lincoln School (figure 9)</b>										
Deep	351515106410401	12N.02E.24.144	35°15'18"	106°41'07"	5,440	09/10/97	1,343	1,200-1,240	493.79	09/10/97
Medium	351515106410402	--do--	--do--	--do--	--do--	--do--	--do--	810-830	493.29	--Do--
Shallow	351515106410403	--do--	--do--	--do--	--do--	--do--	--do--	490-590	485.50	--Do--
<b>Matheson Park (figure 11)</b>										
Deep	350653106311601	10N.04E.09.214	35°06'53"	106°31'18"	5,565	07/18/97	1,630	1,460-1,500	726.88	07/18/97
Medium	350653106311602	--do--	--do--	--do--	--do--	--do--	--do--	1,020-1,040	720.11	--Do--
Shallow	350653106311603	--do--	--do--	--do--	--do--	--do--	--do--	600-700	582.66	--Do--
<b>Mesa del Sol (figure 12)</b>										
Deep	345758106364001	09N.03E.34.231	34°57'58"	106°36'40"	5,300	06/20/97	1,655	1,580-1,620	400.56	06/20/97
Medium	345758106364002	--do--	--do--	--do--	--do--	--do--	--do--	990-1,010	412.48	--Do--
Shallow	345758106364003	--do--	--do--	--do--	--do--	--do--	--do--	420-520	406.76	--Do--





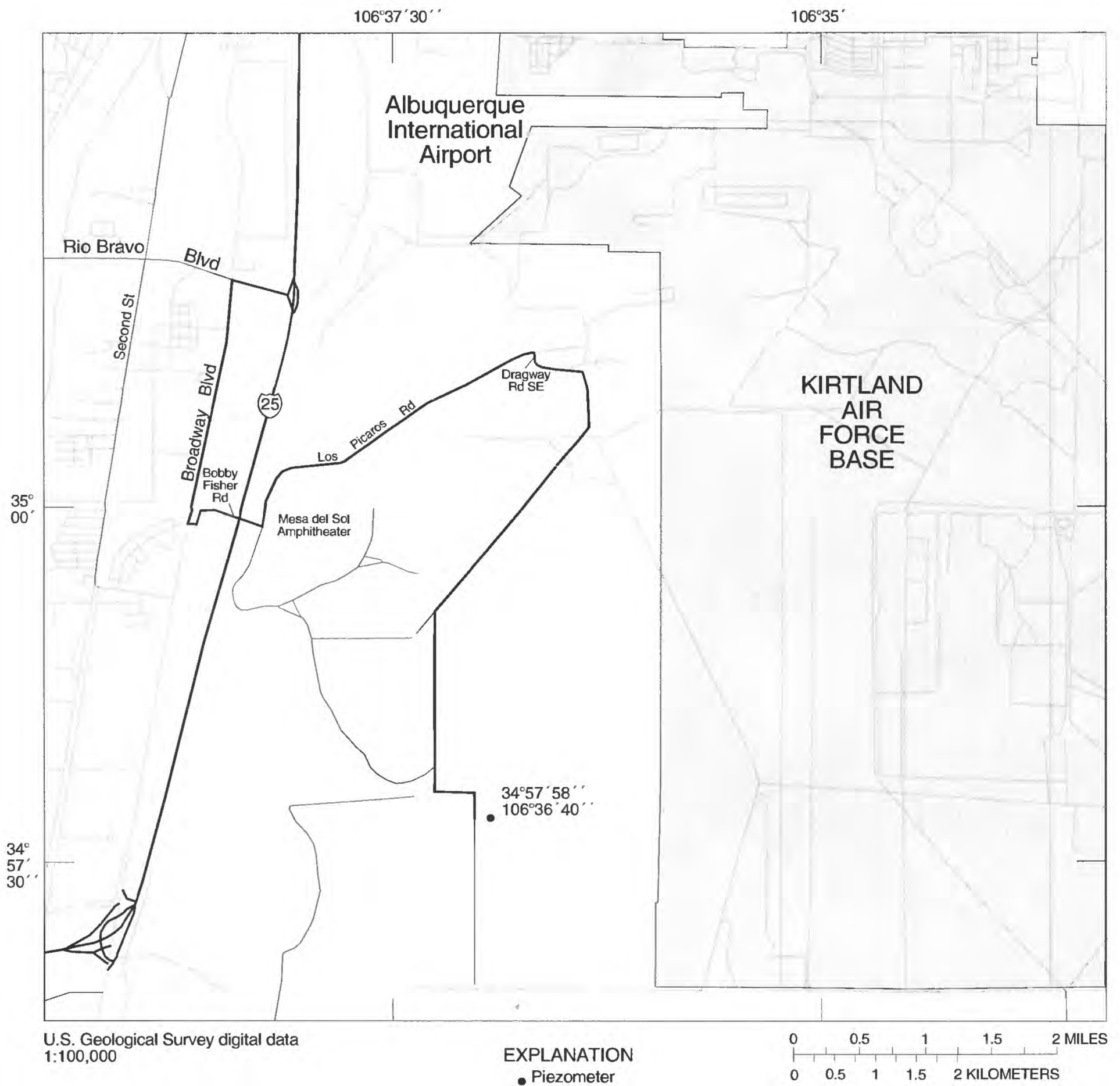
**Figure 9.** Location of the Lincoln School piezometer site (see figure 1 for general location of site).



**Figure 10.** Configuration of the piezometers at the Lincoln School, Matheson Park, and Mesa del Sol sites.

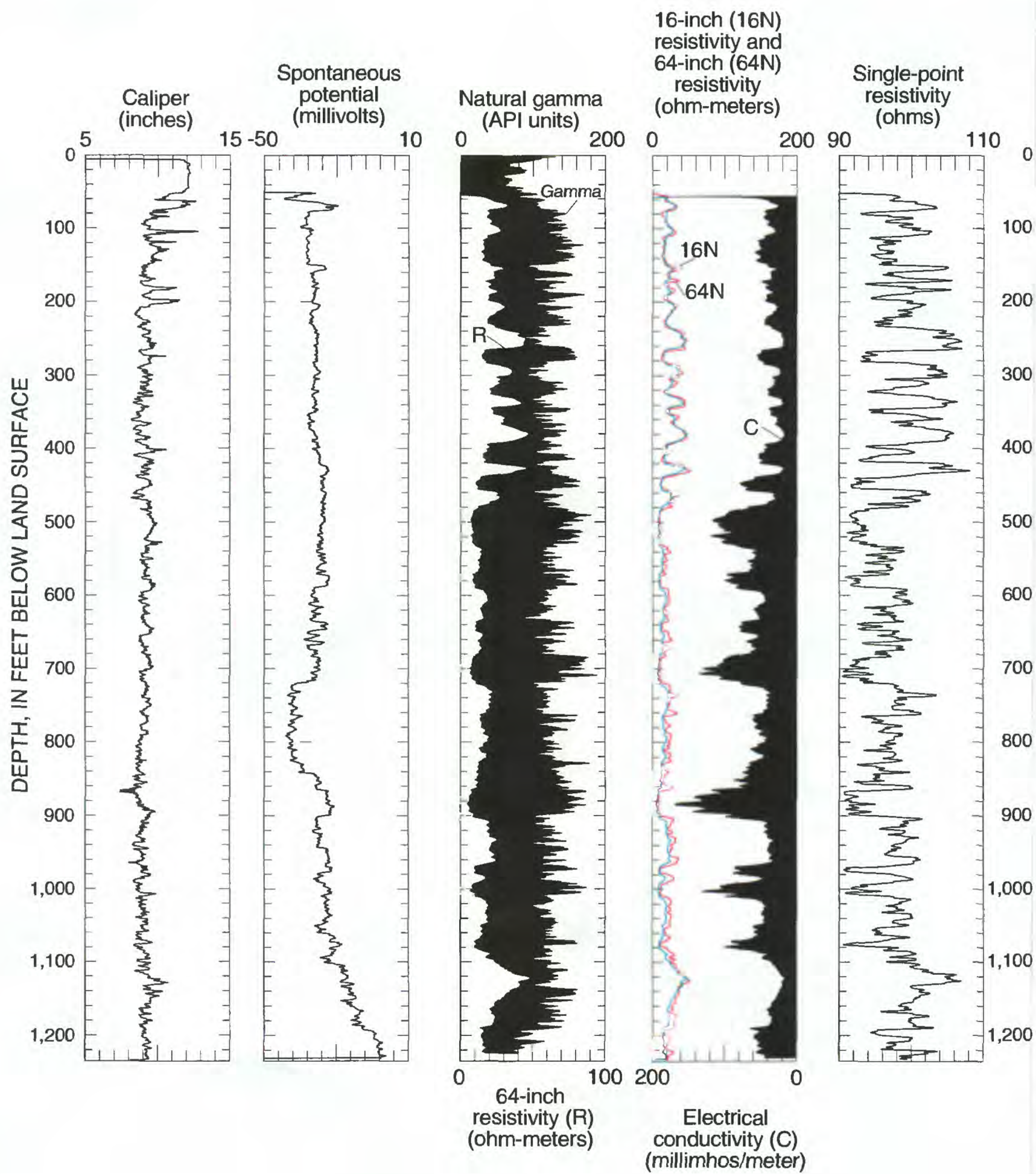






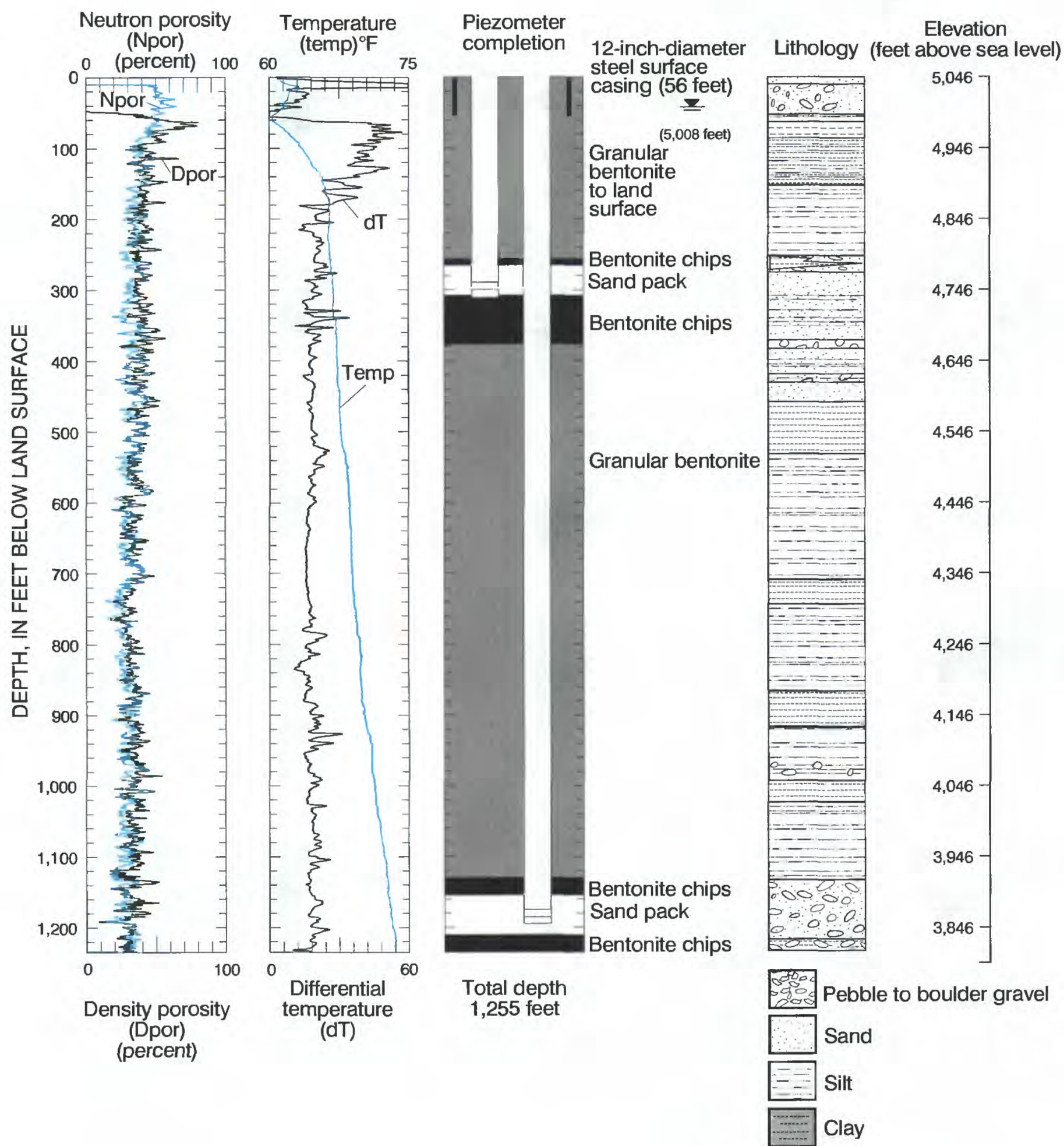
**Figure 12.** Location of the Mesa del Sol piezometer site (see figure 1 for general location of site).

**PETROPHYSICAL LOGS, COMPLETION DIAGRAMS OF  
PIEZOMETERS, AND LITHOLOGIC LOGS**



**Figure 13A.** Petrophysical logs, completion diagram of piezometers, and lithologic log for the Bernalillo site.



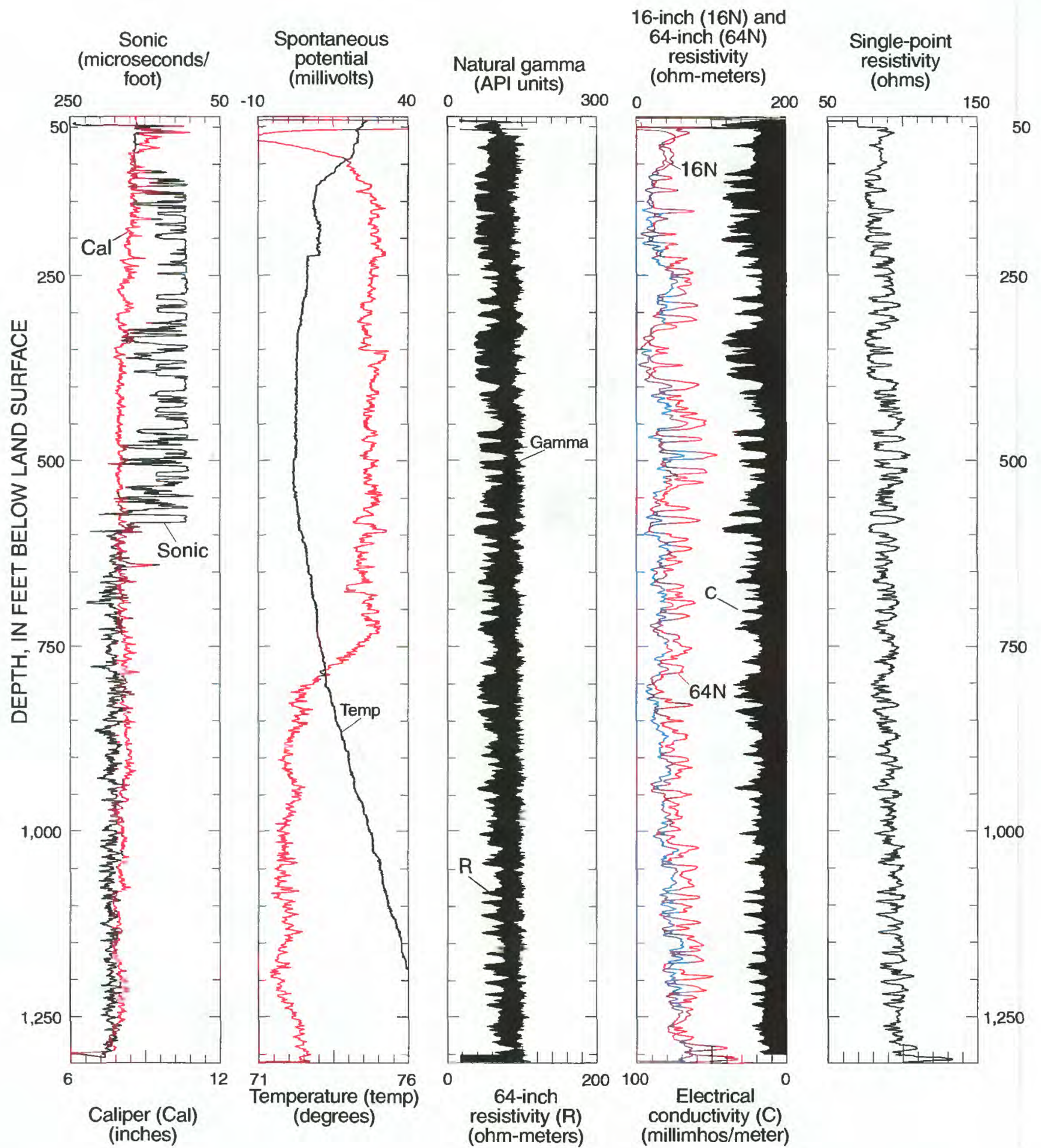


Ground-water level measured September 2, 1999

Geology modified from Jackson and Connell (2000a)

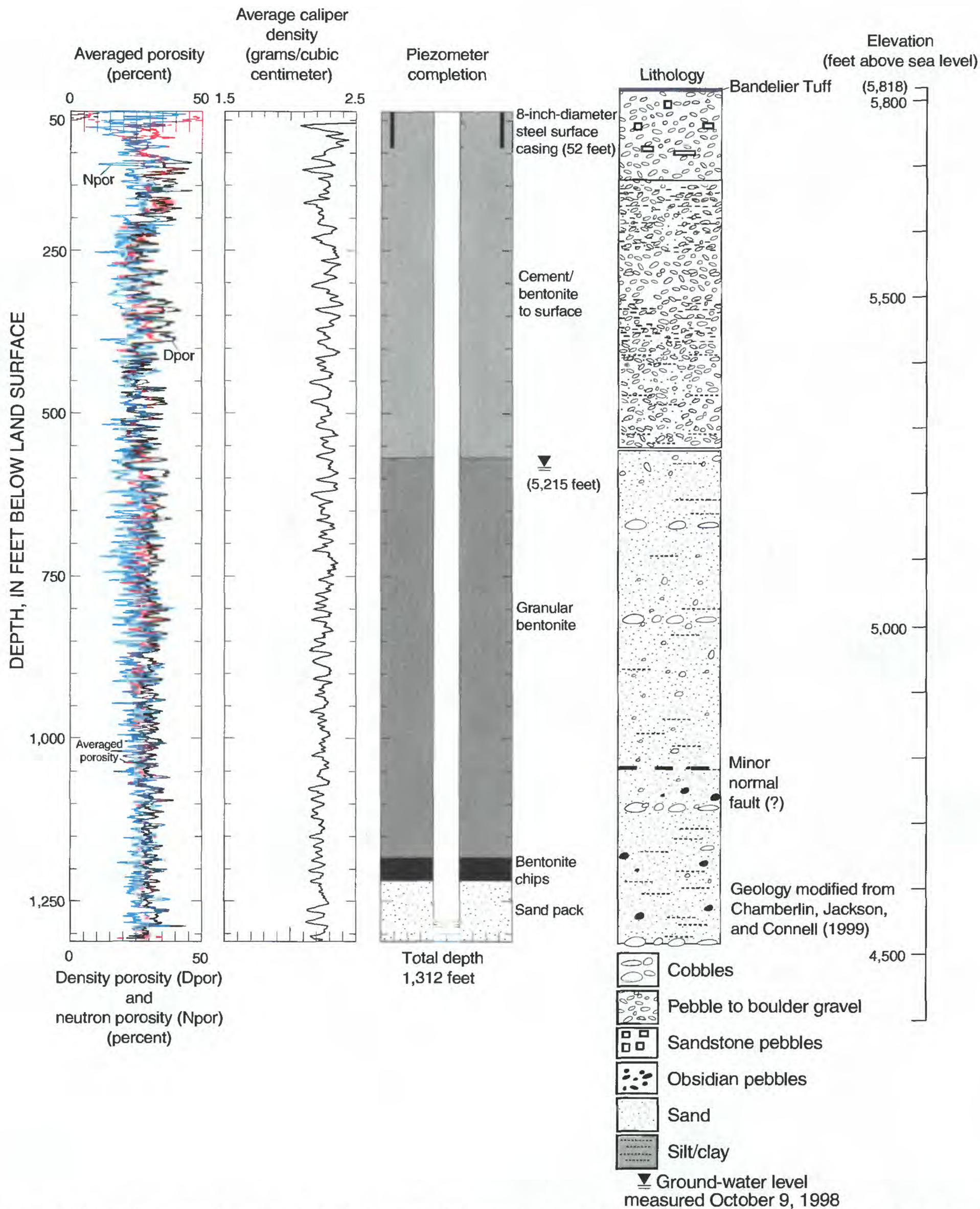
**Figure 13A.** Petrophysical logs, completion diagram of piezometers, and lithologic log for the Bernalillo site--Concluded.





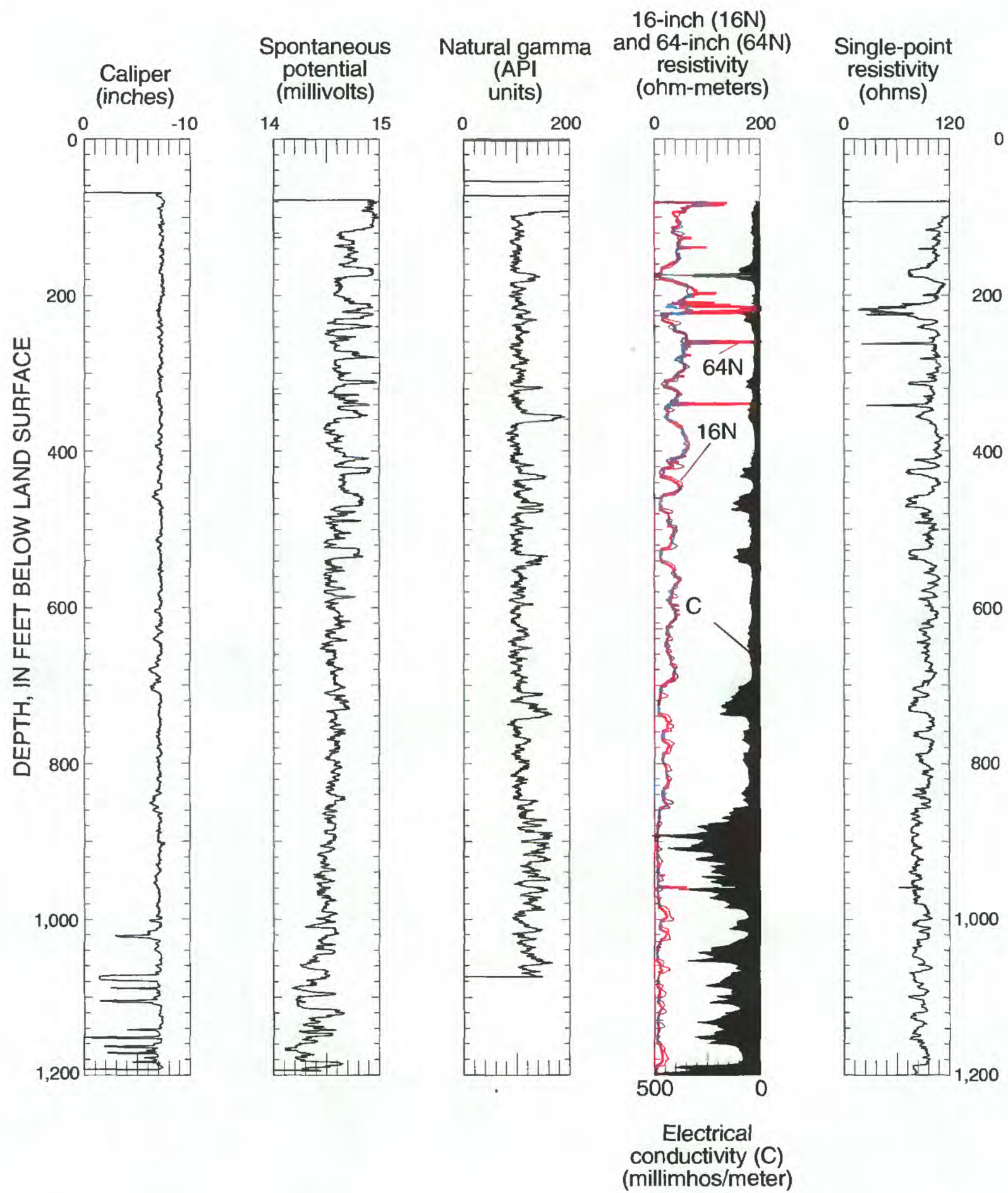
**Figure 13B.** Petrophysical logs, completion diagram of piezometers, and lithologic log for the Dome Road site.





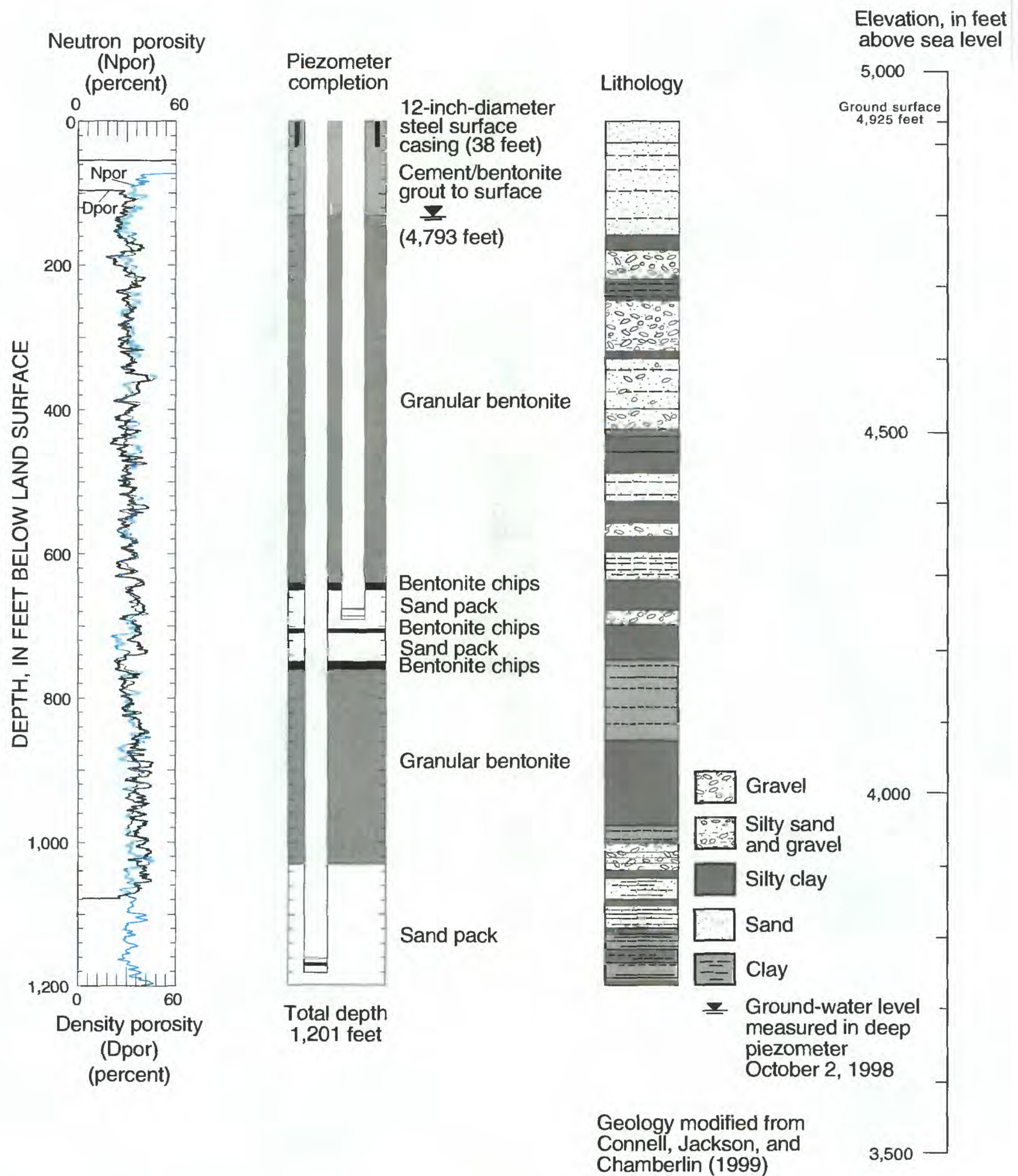
**Figure 13B.** Petrophysical logs, completion diagram of piezometers, and lithologic log for the Dome Road site--Concluded.





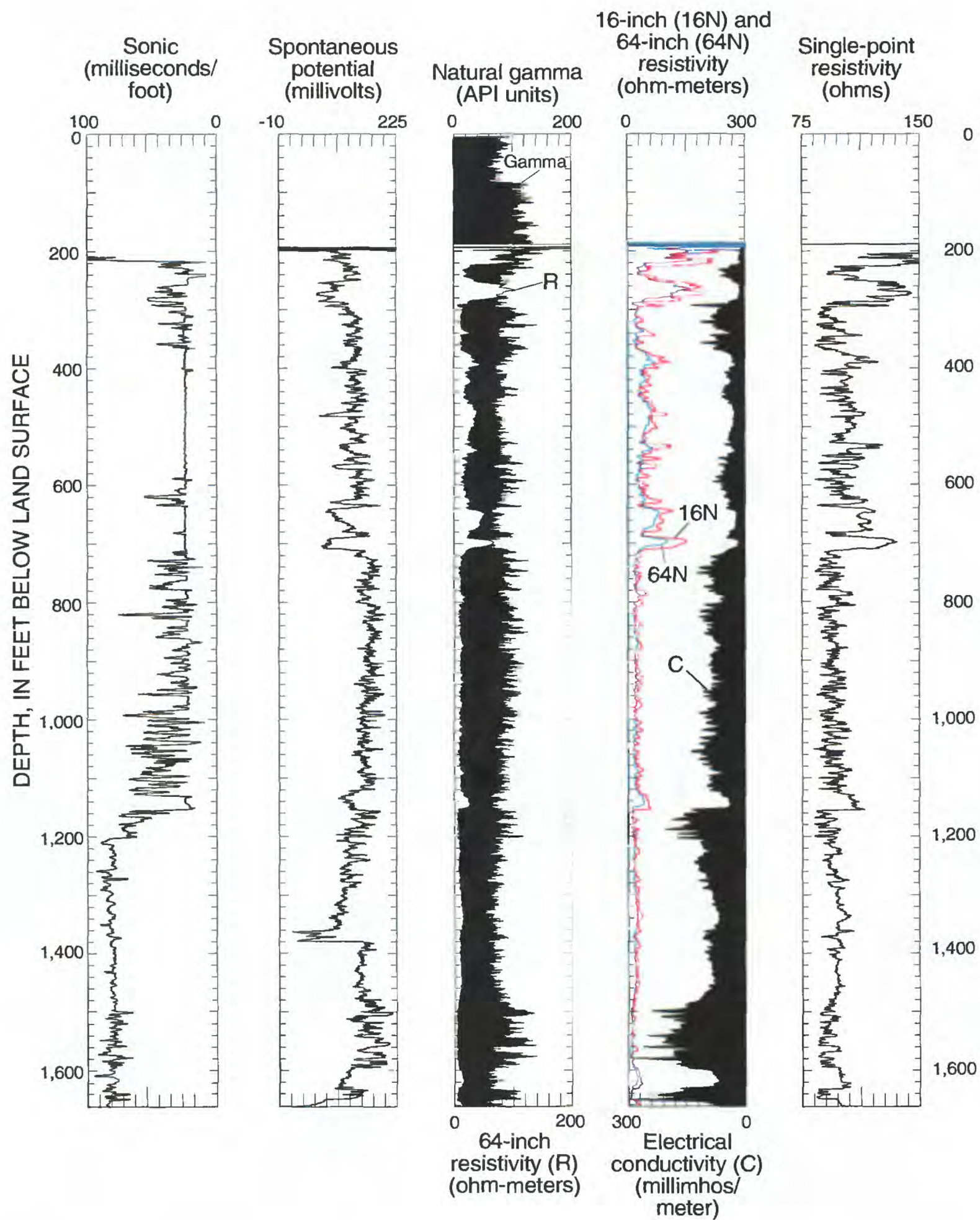
**Figure 13C.** Petrophysical logs, completion diagram of piezometers, and lithologic log for the Nancy Lopez site.





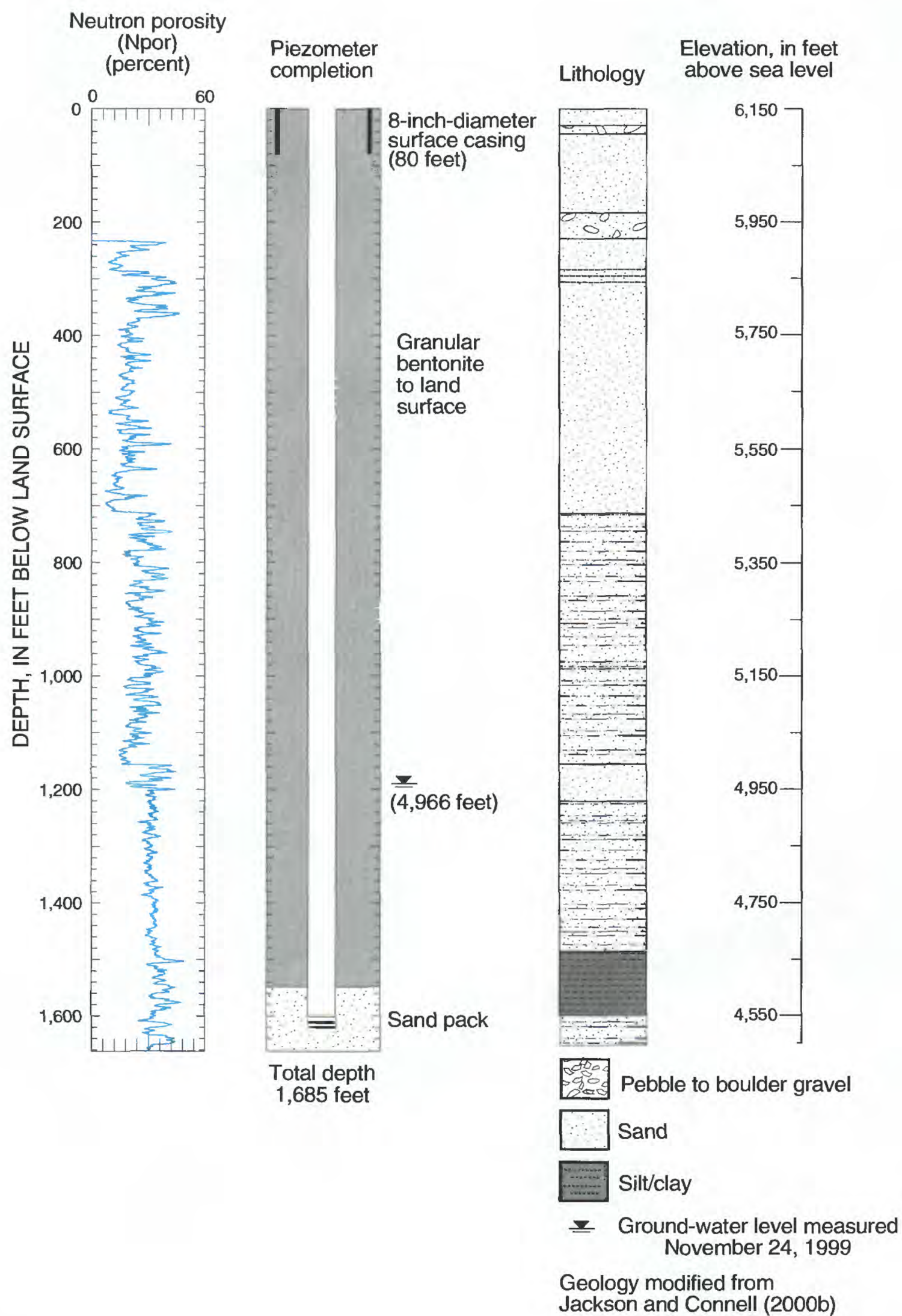
**Figure 13C.** Petrophysical logs, completion diagram of piezometers, and lithologic log for the Nancy Lopez site--Concluded.





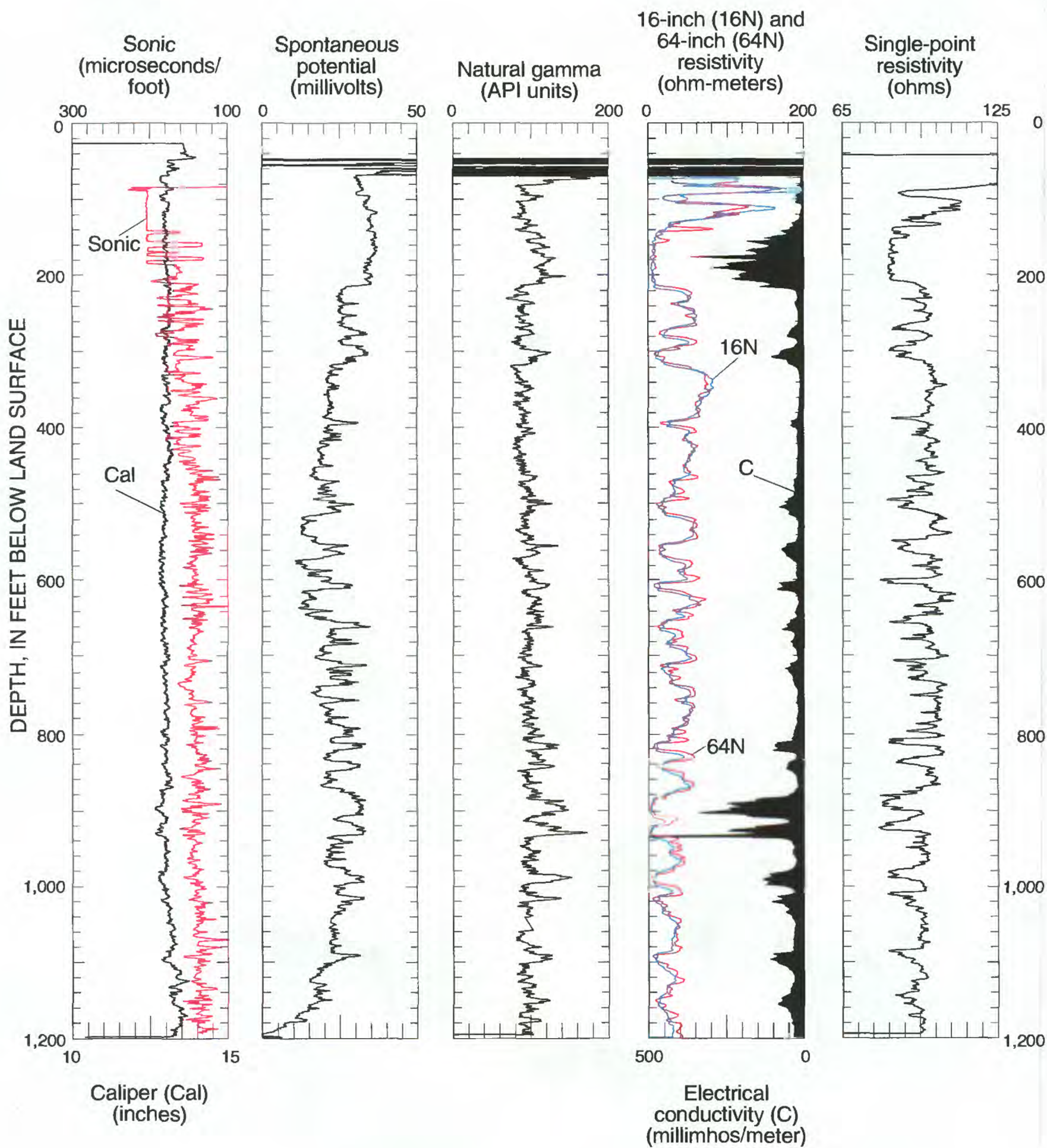
**Figure 13D.** Petrophysical logs, completion diagram of piezometers, and lithologic log for the Phoenix Road site.





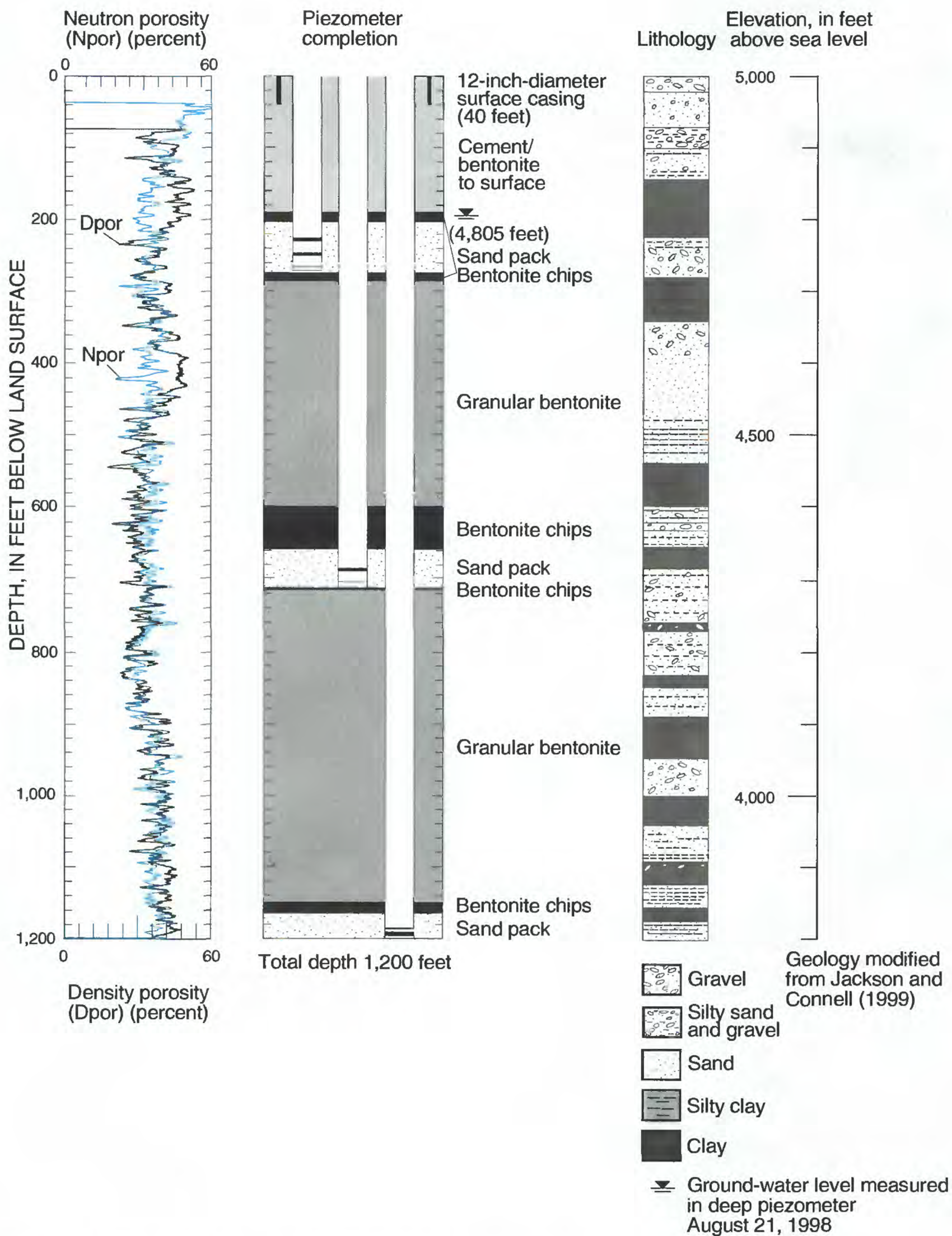
**Figure 13D.** Petrophysical logs, completion diagram of piezometers, and lithologic log for the Phoenix Road site--Concluded.





**Figure 13E.** Petrophysical logs, completion diagram of piezometers, and lithologic log for the Tomé site.





**Figure 13E.** Petrophysical logs, completion diagram of piezometers, and lithologic log for the Torné site--Concluded.