

***TEST WELLS SF-1A, 1B, 1C, AND SF-2A, 2B, 2C,
SANTA FE COUNTY, NEW MEXICO***

By Donald L. Hart , Jr.

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CONVERSION FACTORS

In this report, measurements are given in inch-pound units only (except for grain size). The following table contains factors for converting to metric units. To convert millimeters (mm) to inches, multiply by 0.03937.

<u>Multiply inch-pound units</u>	<u>By</u>	<u>To obtain metric units</u>
inch	25.40	millimeter
foot	0.3048	meter
mile	1.609	kilometer
acre	0.004047	square kilometer

Degrees Fahrenheit (°F) can be converted to degrees Celsius (°C) as follows:

$$^{\circ}\text{F} = (1.8 \times ^{\circ}\text{C}) + 32$$

TEST WELLS

SF-1A, 1B, 1C, AND SF-2A, 2B, 2C,

SANTA FE COUNTY, NEW MEXICO

By Donald L. Hart, Jr.

ABSTRACT

Two well nests, SF-1 and SF-2, were drilled in Santa Fe County, New Mexico, to monitor the hydraulic head within selected zones of the aquifer. Each well nest consists of three piezometers of shallow, middle, and deep completion within the aquifer. Each set of wells was drilled to a depth of about 2,000 feet before actual construction of the piezometers. Each piezometer was completed using either 5 or 10 feet of wire-wrapped screen. These piezometers were constructed as part of a larger ongoing program with the Santa Fe Metropolitan Water Board and New Mexico State Engineer Office to establish a regional observation-well network and to better define the groundwater flow system in the vicinity of Santa Fe and the Santa Fe well fields.

INTRODUCTION

Two well nests, SF-1 and SF-2 (fig. 1), were drilled in Santa Fe County, New Mexico, as part of the hydrologic investigations being conducted by the U.S. Geological Survey in cooperation with the Santa Fe Metropolitan Water Board and the New Mexico State Engineer Office. Well nest SF-1 was drilled in the southern part of the city of Santa Fe, and well nest SF-2 was drilled near the western edge of the Buckman well field in the vicinity of Buckman Road and the Rio Grande. The wells were drilled using standard hydraulic-rotary drilling methods. Personnel from the U.S. Geological Survey or New Mexico State Engineer Office were on site to log well cuttings, obtain geophysical logs, and sample the wells for water quality. In the future, aquifer characteristics may be better defined by using the well nests as observation wells for the nearby production wells that already exist.

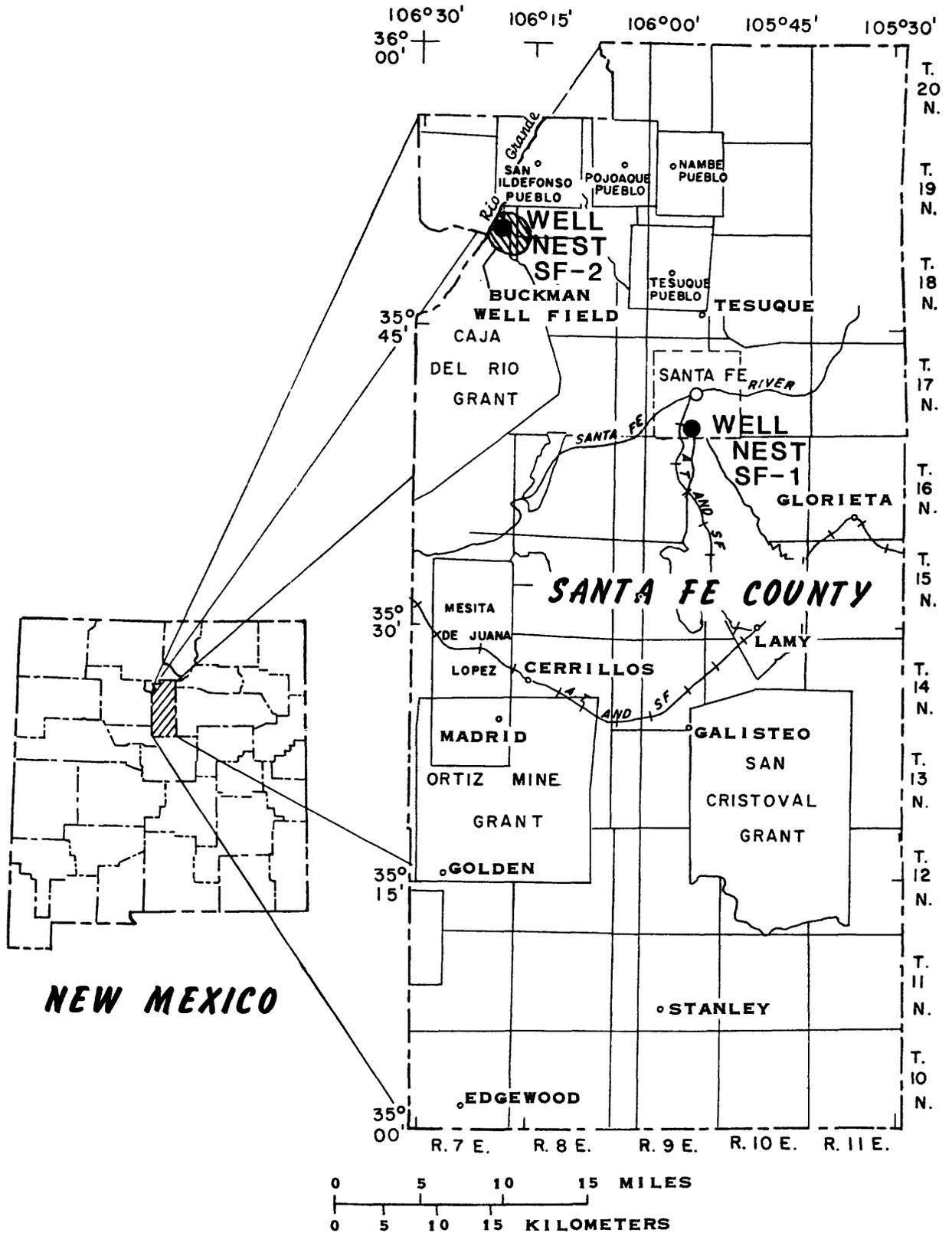


Figure 1.--Location of Santa Fe County, New Mexico, and well nests SF-1 and SF-2.

The well nests described in this report are in land-grant areas and were located using the New Mexico Coordinate System. For convenience, the sites also have been located using a common land-grid well-numbering system projected to the land-grant areas (fig. 2). This system of numbering wells in New Mexico is based on the common subdivision of public lands into sections. The well number, in addition to designating the well, locates its position to the nearest 10-acre tract in the land network. The number is divided by periods into four segments. The first segment denotes the township (T.) north (N.) or south (S.) of the New Mexico Base Line; the second segment denotes the range (R.) east (E.) or west (W.) of the New Mexico Principal Meridian; and the third segment denotes the section (sec.). The fourth segment consists of three digits that denote the 160-, 40-, or 10-acre tract, respectively, in which the well is located. For this purpose, the section is divided into four quarters, numbered 1, 2, 3, and 4, for the northwest, northeast, southwest, and southeast quarters, respectively. The first digit of the fourth segment gives the quarter section, which is a tract of 160 acres. Similarly, the 160-acre tract is divided into four 40-acre tracts denoted by the second digit and numbered in the same manner. Finally, the 40-acre tract is divided into four 10-acre tracts that are denoted by the third digit. In the remainder of the report, the common land-grid system will be used. Thus, well nest SF-1 X=585,500, Y=1,696,400 is in T. 17 N., R. 09 E., sec. 35.131, and well nest SF-2 X=525,500, Y=1,758,600 is in T. 19 N., R. 07 E., sec. 36.311.

Shown in table 1 are water-level information and construction details of the two well nests. The three piezometers completed at the site designated SF-1 were completed inside a single 6-inch casing (fig. 3). The three piezometers completed at the site designated SF-2 were completed as individual holes about 15 feet apart (fig. 4).

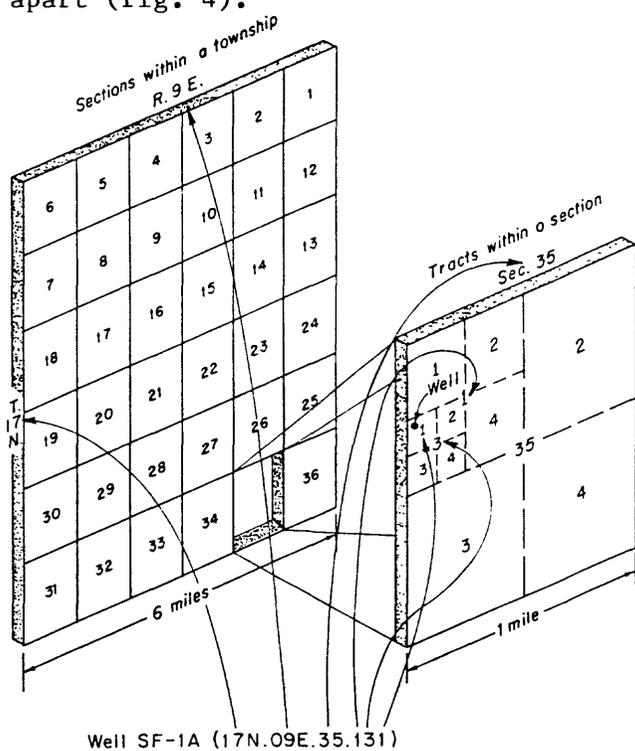


Figure 2.--Well-numbering system in New Mexico.

Table 1.—Records for well nests SF-1 and SF-2

Well name and location	Date water level meas- ured	Water level below land surface (feet)	Drilled depth (feet)	Finished depth (feet)	Screened interval depth below land surface (feet)	Casing diameter (inches)
SF-1A						
17N.9E.35.131A	9/26/86	82.4	2,020	1,952	1,917-1,922	2.0
	3/02/87	81.1				
	5/27/87	81.5				
	6/01/87	81.6				
SF-1B						
17N.9E.35.131B	9/26/86	181.7	2,020	1,060	1,025-1,030	2.0
	3/02/87	184.2				
	5/27/87	184.6				
	6/01/87	185.6				
SF-1C						
17N.9E.35.131C	9/26/86	252.1	2,020	780	669-674	2.0
	3/02/87	259.4				
	5/27/87	260.6				
	6/01/87	262.4				
SF-2A						
19N.7E.36.311A	10/02/86	Flowing ¹	2,000	1,872	1,850-1,860	4.5
	3/04/87	+129.8				
	5/27/87	+84.4				
	6/01/87	+136.6				
SF-2B						
19N.7E.36.311B	10/02/86	152.2	860	824	802-812	4.5
	3/02/87	71.5				
	5/27/87	86.4				
	6/01/87	143.3				
SF-2C						
19N.7E.36.311C	10/02/86	152.17	380	356	324-334	4.5
	3/02/87	81.4				
	5/27/87	92.1				
	6/01/87	149.4				

¹Water levels in well SF-2A are in feet above land surface.

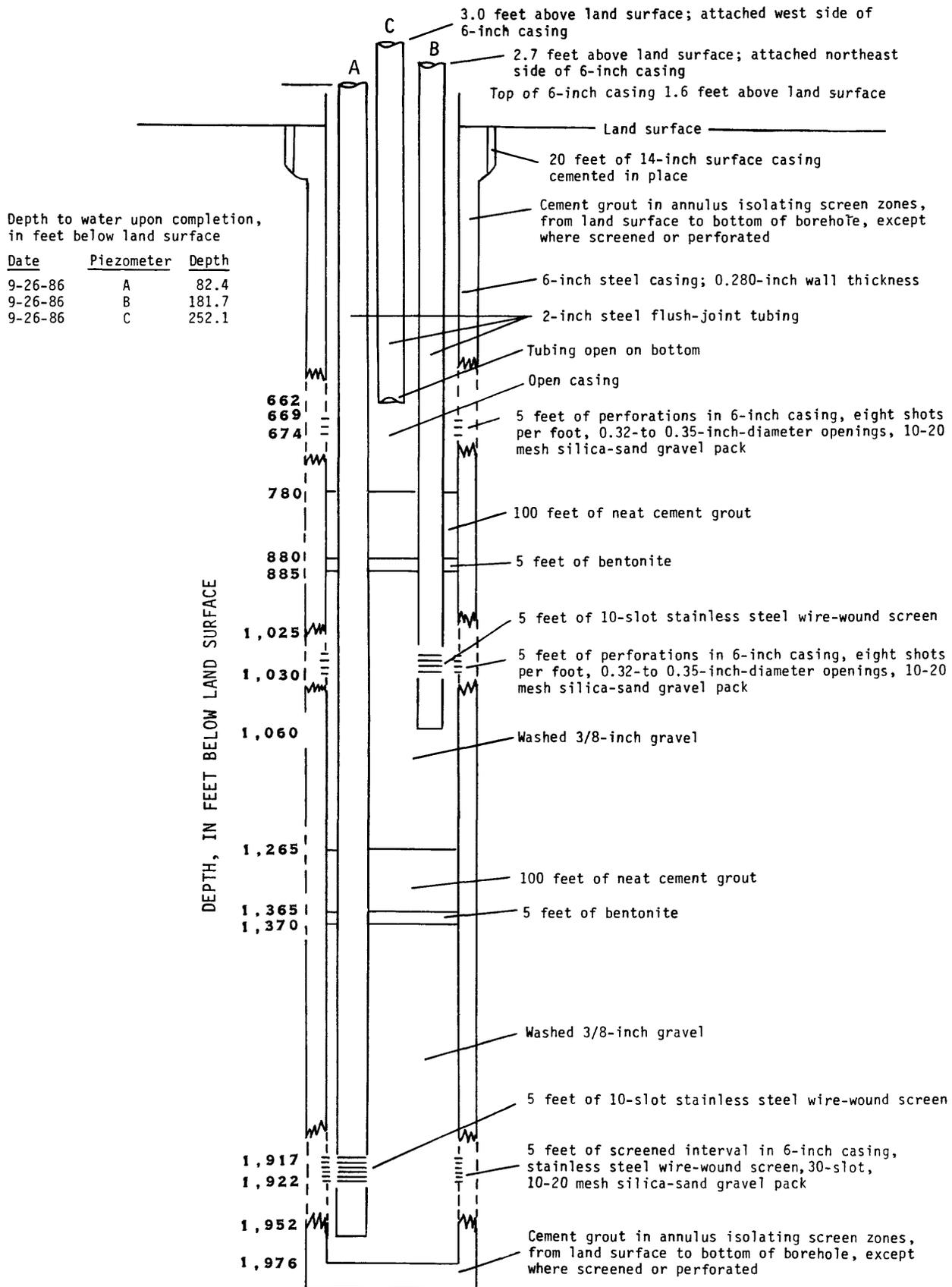


Figure 3.--Construction details for well nest SF-1 (17N.09E.35.131).

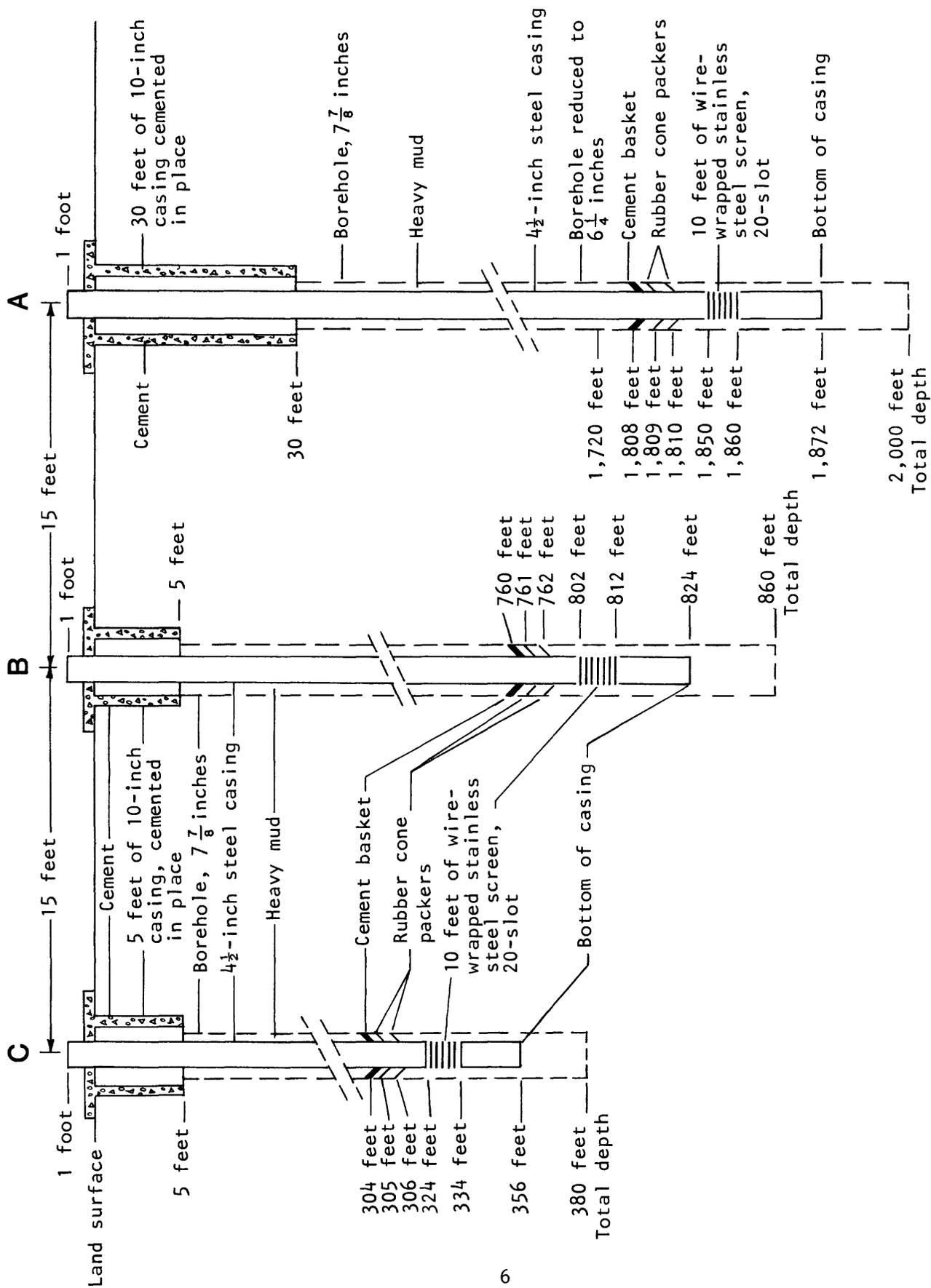


Figure 4.--Construction details for well nest SF-2 (19N.07E.36.311).

WELL NESTS SF-1 AND SF-2

Both SF-1 and SF-2 well nests are designed to monitor the potentiometric head at three different depths in the aquifer so that the vertical hydraulic gradients within the aquifer can be determined. In addition, lithologic data were collected (tables 2 and 3), geophysical logs were run in the boreholes (figs. 5 and 6), and water samples were collected from water-bearing zones at each site for chemical analysis (table 4).

Lithologic logs in this report were prepared from well cuttings with depths adjusted to the geophysical logs run after the drilling was completed. The term sorting in the lithologic logs refers to the uniformity of the size of the sand or gravel in the sample, and the angularity or roundness refers to the shape of the individual grains. These characteristics were described by visual inspection in the field. The color descriptions and accompanying code numbers refer to the colors from the Rock-Color Chart (National Research Council, 1948). Colors were matched to damp borehole cuttings. The following list defines the terms used to describe the grain size of the detritus:

Description	Size (millimeters)	Size (inches)
Pebbles	4.0 - 64	0.16 - 2.5
Granules	2.0 - 4.0	0.08 - 0.16
Very coarse sand	1.0 - 2.0	0.04 - 0.08
Coarse sand	0.5 - 1.0	0.02 - 0.04
Medium sand	0.25 - 0.5	0.01 - 0.02
Fine sand	0.125 - 0.25	0.005 - 0.01
Very fine sand	0.0625 - 0.125	0.0025 - 0.005
Silt	0.004 - 0.0625	0.00015 - 0.0025
Clay	less than 0.004	less than 0.00015

Table 2.—Lithologic log for test well SF-1A (17N.09E.35.131A)

[Modified from samples described by Maryann Wasiolek,
New Mexico State Engineer Office; mm = millimeter]

Interval, in feet below land surface	Description of formation cuttings
0-100	Sand, medium to very coarse, quartz; very fine subangular to fine pebble gravel of quartz, granite, dark mafics, and minor sandstones interbedded with 10% pinkish-tan, sandy clays.
100-130	Sand, coarse, fairly well sorted to fine, subangular pebble gravel, of quartz, granite, mafics, and shale; 30% red-brown sticky clay and some fine sandstone.
130-310	Sand, medium to very coarse, and very fine to fine pebble gravel; red-brown sandy clay with beds of clean, very coarse subrounded quartz and granite; trace of red-tan silt and white clay.
310-320	Gravel, fine pebble, averaging 5 mm, of quartz, granite, feldspars, and metamorphics, with 5% light-brown silt (5 YR 6/4).
320-390	Clay and sand, medium, some fine angular pebble gravel of siliceous volcanics, quartz, and granite; some bright-yellow and white clay balls from 370 to 390 feet. Increase in gravel in the lower part of the sampled interval.
390-400	Clay, white-tan, sticky; plus very coarse subangular sand and fine pebble gravel of volcanics, quartz, mafics, and granite.
400-480	Clay, silty, tan, sticky; 10-30% coarse, subrounded quartz and subrounded quartz sand and subangular, very fine gravel.
480-540	Clay, pale-reddish-brown (10 R 5/4), sticky; interbedded with lenses of very coarse sand to very fine pebble gravel as above, but including some limy shales and quartzite. Tan clay, 510-540 feet, with white clay balls 520-530 feet. Some 10- to 13-mm pebble fragments 520-540 feet.

Table 2.—Lithologic log for test well SF-1A (17N.09E.35.131A)—Continued

Interval, in feet below land surface	Description of formation cuttings
540-560	Clay, red-brown, sticky, with 15% fine angular pebble gravel as above.
560-580	Sand, very coarse, and very fine, subrounded pebble gravel of quartz, granite, volcanics, and metamorphics interbedded with sticky pale-reddish-brown (10 R 5/4) clay and minor bright-green clay. Some pebble fragments to 10 mm also present.
580-590	Gravel, very fine pebble, subrounded as above with 15% tan silt and red-brown clay.
590-600	Clay, red-brown, sticky, with 15% 10-mm pebble gravel as above and minor white clay.
600-620	Sand, very coarse; and gravel, very fine, subrounded pebbles of quartz granite, volcanics, and metamorphics, interbedded with sticky, pale-reddish-brown (10 R 5/4) clay.
620-660	Clay, red-brown, sticky, with 10-mm pebble gravel as above and minor white clay.
660-680	Sand, very coarse; very fine, subrounded pebble gravel, with pale-reddish-brown (10 R 5/4) clay.
680-700	Clay, silty, pale-reddish-brown (10 R 5/4), sticky; some coarse sand.
700-750	Silt, clayey, tan, sticky; red-brown clay, with 25% very fine to fine, angular pebble gravel of quartz, volcanics, granite, and minor limy shales. Few pebbles to 10 mm.
750-790	Silt, tan; red-brown clay plus 40% very fine to medium, angular, pebble gravel as above. Most gravels are 3 mm with some to 10 mm.
790-840	Silt, tan; red-brown clay plus 10% fine to medium pebble gravel to 12 mm including some dark volcanics; 50% gravel 800-810 feet.

Table 2.--Lithologic log for test well SF-1A (17N.09E.35.131A)--Continued

Interval, in feet below land surface	Description of formation cuttings
840-870	Clay, silty, red-brown, sticky; 50% very coarse sand to fine pebble gravel (as above), mostly 2-6 mm in size. Minor 10-mm gravel.
870-900	Gravel, very fine to medium, 3 mm and 10 mm the dominant sizes; 40% tan silt and red-brown clay.
900-970	Silt, light-brown (5 YR 6/4), sticky, clayey; 5-25% very coarse sand and very fine pebble gravel lenses.
970-1,000	Gravel, fine to medium, angular pebble gravel; mostly 6-9 mm of all above-mentioned types interbedded with tan, sticky, clayey silt.
1,000-1,010	Clay, pale-reddish-brown (10 R 5/4), sticky clay with tan silt; 25-35% fine to medium, angular pebble gravel of which the large fragments are dark volcanics.
1,010-1,030	Gravel, fine, subangular pebble gravel of quartz and granite; 30% tan, silty clay.
1,030-1,100	Silt, clayey, red-brown with some tan; 25-40% very fine to medium pebble gravel of granite, quartz, metamorphics, minor quartzite, and limy shales. Largest gravels are dark volcanics.
1,100-1,160	Clay, silty, red-brown, sticky, with alternating beds of red-tan; 5-25% very fine to medium pebble gravel as above.
1,160-1,180	Gravel, very fine to medium, subangular pebble (as above); 50% red-tan, sticky, silty clay.
1,180-1,490	Silt, sandy, clayey, tan-red, with an average 15% lenses of alternating medium to very coarse quartz sand and fine to medium pebble gravel. Minor white clay. Gravels contain much dark, angular volcanic material.
1,490-1,590	Silt, sandy, clayey, tan-red, with about 25% lenses of very fine to medium, angular pebble gravel of quartz, siliceous volcanics, granite, and metamorphics.

Table 2.--Lithologic log for test well SF-1A (17N.09E.35.131A)--Concluded

Interval, in feet below land surface	Description of formation cuttings
1,590-1,600	Clay, silty, sticky, solid tan-red; in balled masses with some medium to fine sand and 5% subangular 10- to 12-mm medium pebble gravel.
1,600-1,700	Silt, clayey, sandy, light-brown (5 YR 6/4); with lenses of very coarse sand to medium pebble gravel of mostly highly angular granite, quartz, and some siliceous volcanics. Gravel sizes are concentrated in 1 mm, 3 mm, and some larger pieces 8-10 mm.
1,700-1,720	Silt, sandy, clayey, tan-red; plus lenses of coarse to very coarse sand and very fine pebble gravel of mostly subangular granite and quartz in sizes 1 mm and 3 mm.
1,720-1,800	Clay, sandy, silty, pale-red (10 R 6/2); with 20% lenses of poorly sorted coarse sand to fine, subangular pebble gravel.
1,800-1,830	Clay, sandy, silty, red-brown; alternating with 20% interbedded lenses of fairly well sorted, very coarse sands and fine pebble gravel of granite, quartz, and siliceous volcanics.
1,830-1,910	Clay, sandy, moderate-reddish-brown (10 R 4/6), very stiff; plus 10-20% lenses of poorly sorted, very coarse sand to fine pebble gravel, as above, and minor white clay.
1,910-1,920	Clay, sandy, silty, pale-reddish-brown (10 R 5/4); plus 30% lenses of poorly sorted, very coarse sand and fine pebble gravel, mainly 1 mm and 7 mm of quartz, granite, and metamorphics.
1,920-1,990	Clay, sandy, silty, pale-brown (5 YR 5/2), sticky, stiff; with up to 10% lenses of fairly well sorted, coarse to very coarse sand and very fine pebble gravel of quartz, granite, metamorphics, and quartzite.
1,990-2,020	Clay, silty, sandy, medium-dark-gray (N 4), sticky; with minor sorted coarse to very coarse, subangular pebble gravel.

Table 3.--Lithologic log for test well SF-2A (19N.07E.36.311A)

[Samples described by Donald L. Hart, Jr.,
U.S. Geological Survey; mm = millimeter]

Interval, in feet below land surface	Description of formation cuttings
0-40	Sand, medium to very coarse, granules and pebbles to 15 mm, grayish-orange-pink (10 R 8/2).
40-60	Sand, medium to very coarse, granules and pebbles to 15 mm, and clay, grayish-orange-pink (10 R 8/2).
60-70	Clay, some fine to very coarse sand, and trace of granules, grayish-orange (10 YR 7/4).
70-160	Clay, silty, grayish-pink (5 YR 8/2).
160-180	Clay, trace of medium to very coarse sand, grayish-orange-pink (10 R 8/2).
180-210	Clay, grayish-orange (10 YR 7/4).
210-230	Clay and medium to very coarse sand, granules and pebbles to 8 mm, dark-yellowish-orange (10 YR 6/6).
230-250	Clay and medium to very coarse sand, grayish-orange-pink (10 R 8/2).
250-290	Sand, medium to very coarse, with interbedded clay, grayish-orange-pink (10 R 8/2).
290-340	Sand, medium to very coarse, granules and pebbles to 8 mm, with few thin interbedded clays, pale-brown (5 YR 5/2).
340-380	Sand, medium to very coarse, and clay, grayish-brown (5 YR 5/2).
380-410	Clay and trace of medium to coarse sand, pale-yellowish-brown (10 YR 6/2).
410-500	Sand, medium to very coarse, granules and pebbles to 15 mm, and interbedded clays, light-brown (5 YR 5/6).
500-510	Clay, light-brown (5 YR 5/6).

Table 3.—Lithologic log for test well SF-2A (19N.07E.36.311A)—Continued

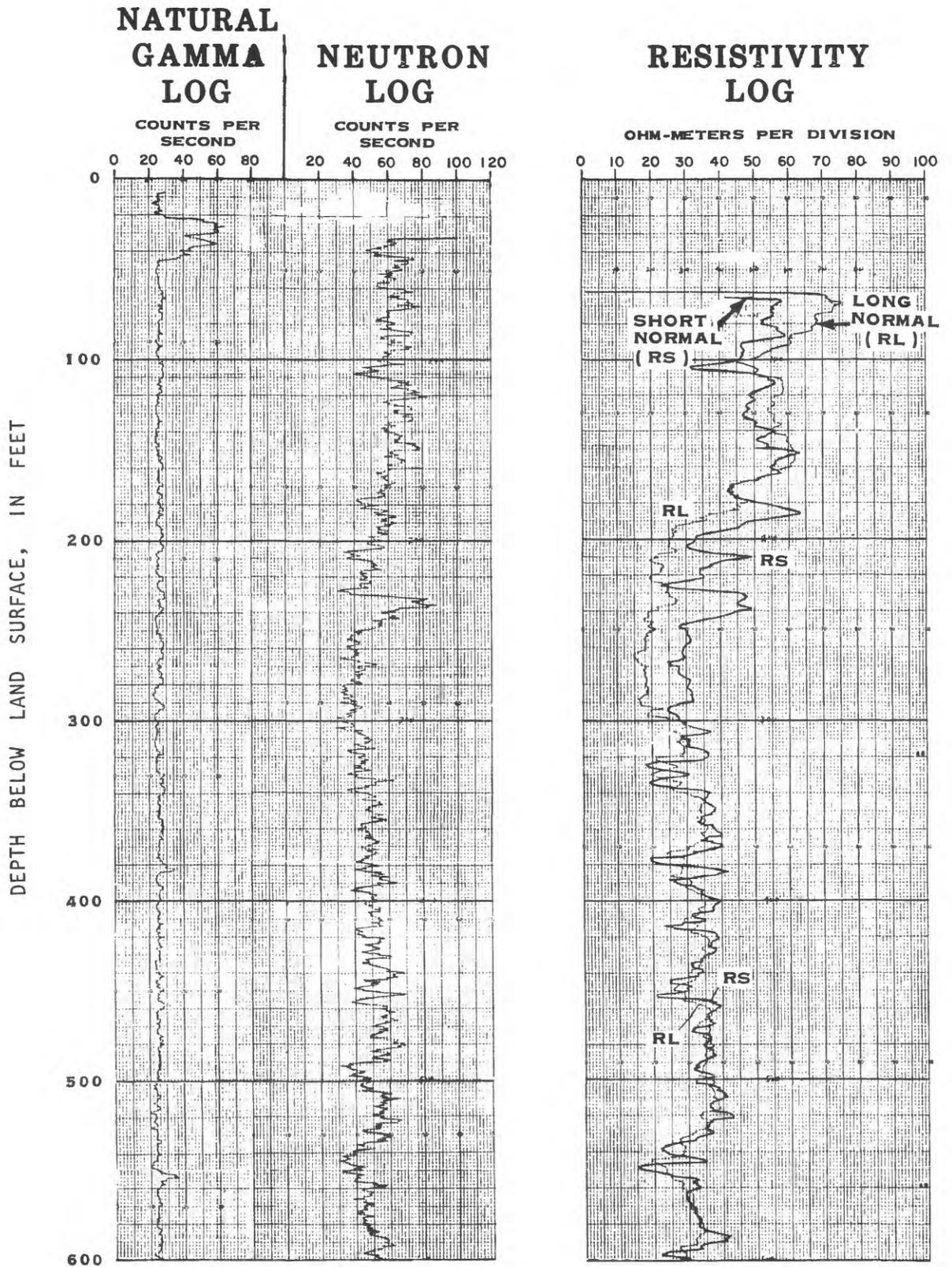
Interval, in feet below land surface	Description of formation cuttings
510-550	Granules and pebbles to 15 mm, pale-red (10 R 6/2).
550-620	Clay and silt, moderate-brown (5 YR 4/4).
620-630	Sand, fine to coarse, moderate-yellowish-brown (10 YR 5/4).
630-670	Clay with a few interbedded very fine to medium sands, moderate-yellowish-brown (10 YR 5/4).
670-690	Sand, fine to very coarse, granules and pebbles to 15 mm, moderate-brown (5 YR 4/4).
690-800	Clay and silt, with interbedded very fine to medium sands, moderate-brown (5 YR 4/4).
800-810	Sand, fine to medium, moderate-brown (5 YR 4/4).
810-990	Clay and silt, trace of fine sand, moderate-brown (5 YR 4/4).
990-1,020	Sand, very fine to fine, light-brown (5 YR 5/6).
1,020-1,040	Clay and silt, moderate-yellowish-brown (10 YR 5/4).
1,040-1,090	Sand, very fine to very coarse, with interbedded clay, moderate-yellowish-brown (10 YR 5/4).
1,090-1,100	Clay and silt, pale-yellowish-brown (10 YR 6/2).
1,100-1,120	Sand, fine to coarse, pale-yellowish-brown (10 YR 6/2).
1,120-1,140	Clay, pale-yellowish-brown (10 YR 6/2).
1,140-1,160	Sand, medium to very coarse, granules and pebbles to 8 mm, moderate-yellowish-brown (10 YR 5/4).
1,160-1,180	Sand, medium to very coarse, and silt, moderate-yellowish-brown (10 YR 5/4).
1,180-1,210	Sand, coarse to very coarse, granules and pebbles to 8 mm, pale-reddish-brown (10 R 5/4).

Table 3.--Lithologic log for test well SF-2A (19N.07E.36.311A)--Continued

Interval, in feet below land surface	Description of formation cuttings
1,210-1,230	Sand, very fine to medium, and silt, moderate-yellowish-brown (10 YR 5/4).
1,230-1,250	Sand, medium to very coarse, trace of granules, light-brown (5 YR 5/6).
1,250-1,290	Clay and silt, trace of fine to medium sand, moderate-yellowish-brown (10 YR 5/4).
1,290-1,370	Sand, medium to very coarse, granules and pebbles to 8 mm, trace of interbedded clay, moderate-yellowish-brown (10 YR 5/4).
1,370-1,450	Clay and silt, few interbedded fine to medium sands, moderate-reddish-brown (10 R 4/6).
1,450-1,480	Sand, fine to coarse, moderate-reddish-brown (10 R 4/6).
1,480-1,490	Clay and silt, moderate-reddish-brown (10 R 4/6).
1,490-1,500	Sand, fine to coarse, moderate-reddish-brown (10 R 4/6).
1,500-1,540	Clay, trace of fine to coarse sand, moderate-reddish-brown (10 R 4/6).
1,540-1,580	Sand, fine to medium, trace of clay, grayish-red (10 R 4/2).
1,580-1,640	Clay, pale-yellowish-green (10 Y 8/2), and very fine to coarse, moderate-yellowish-brown (10 YR 5/4) interbedded sand.
1,640-1,680	Sand, fine to coarse, moderate-yellowish-brown, some interbedded clay (10 YR 5/4).
1,680-1,710	Clay, sandy, moderate-brown (5 YR 4/4).
1,710-1,740	Clay, moderate-brown (5 YR 4/4).
1,740-1,760	Sand, coarse to very coarse, trace of granules and pebbles to 8 mm, moderate-reddish-orange (10 R 6/6).

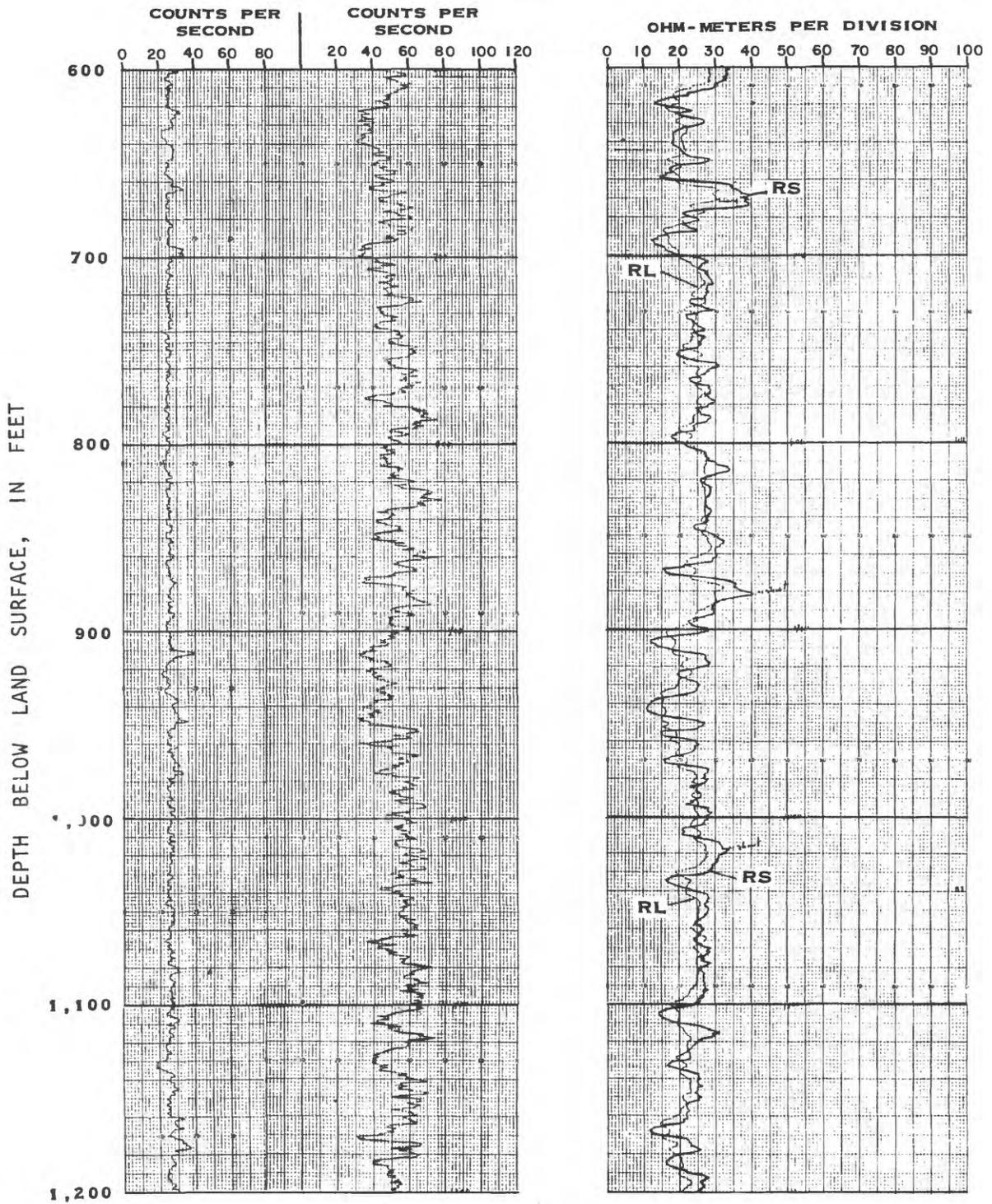
Table 3.—Lithologic log for test well SF-2A (19N.07E.36.311A)—Concluded

Interval, in feet below land surface	Description of formation cuttings
1,760-1,780	Clay and silt, moderate-reddish-orange (10 R 6/6).
1,780-1,820	Sand, coarse to very coarse, and interbedded clay, moderate-reddish-orange (10 R 6/6).
1,820-1,840	Clay, sandy, moderate-brown (5 YR 4/4).
1,840-1,860	Sand, fine to coarse, silty, moderate-yellowish- brown (10 YR 5/4).
1,860-2,000	Clay, silty, and interbedded fine to very coarse sand, moderate-yellowish-brown (10 YR 5/4).



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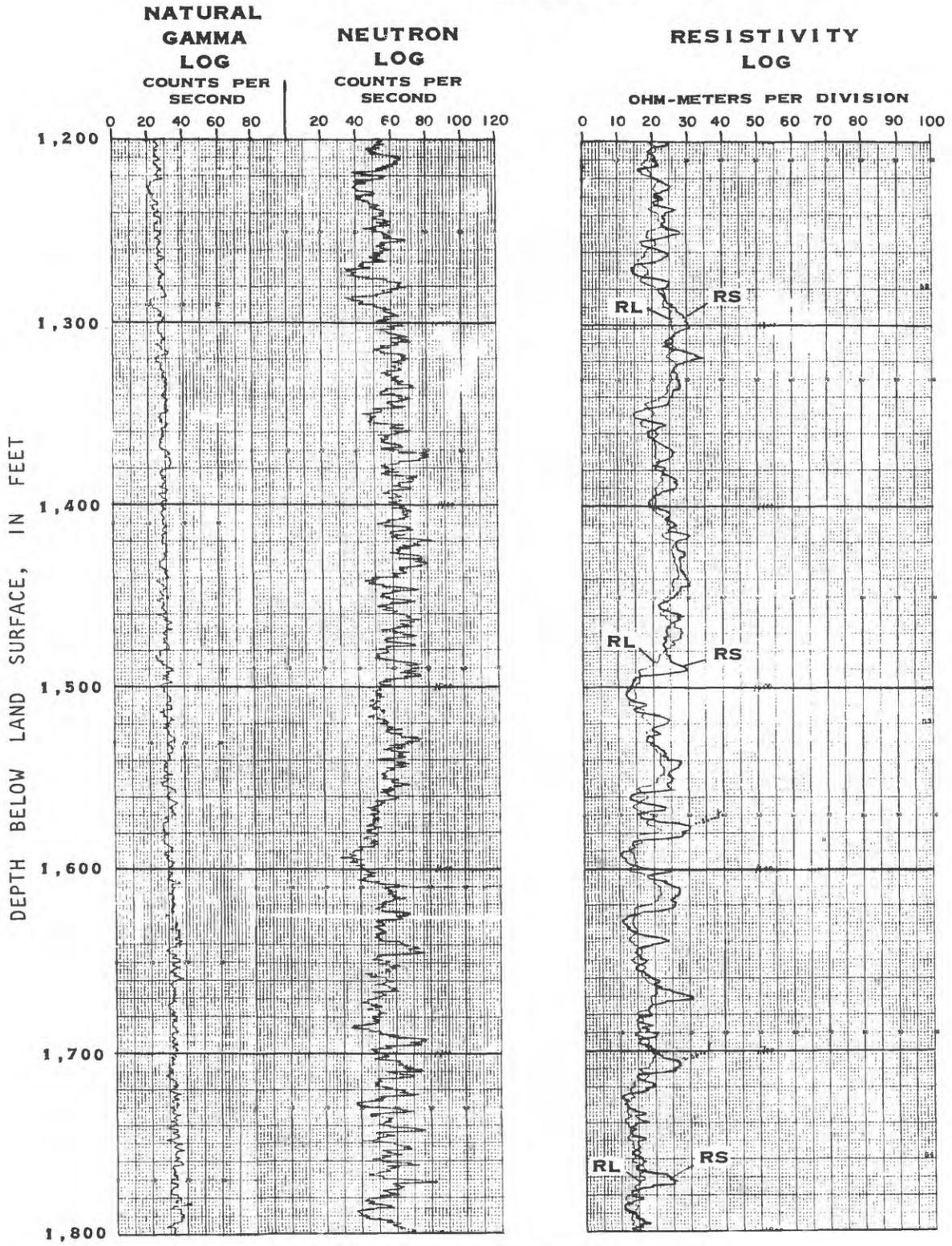
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Figure 5.--Geophysical logs for test well SF-1A (17N.09E.35.131A).

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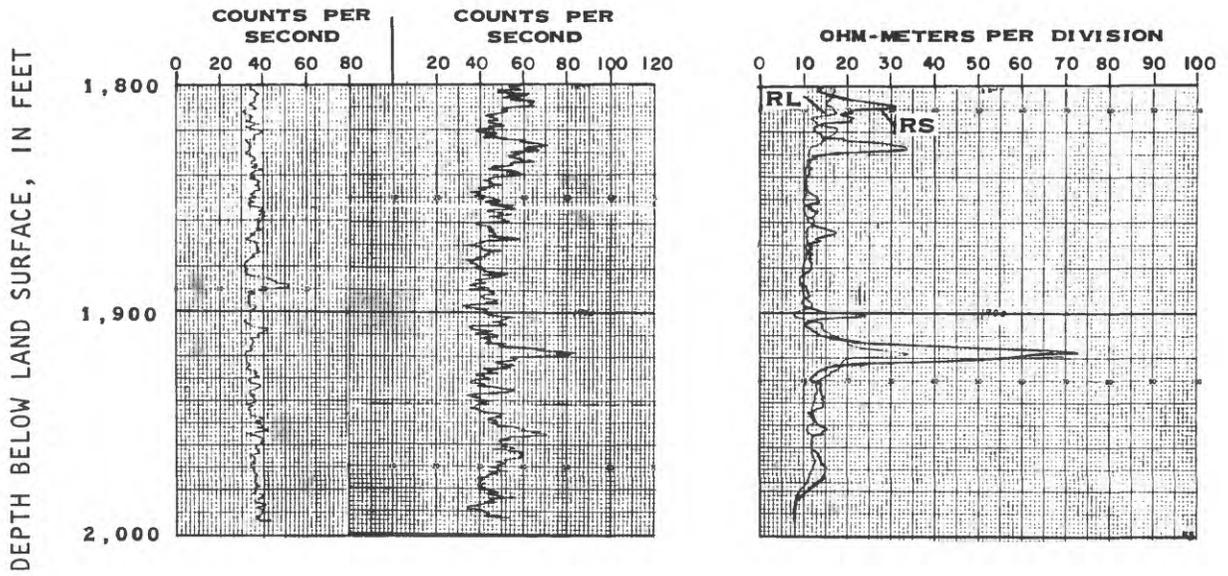
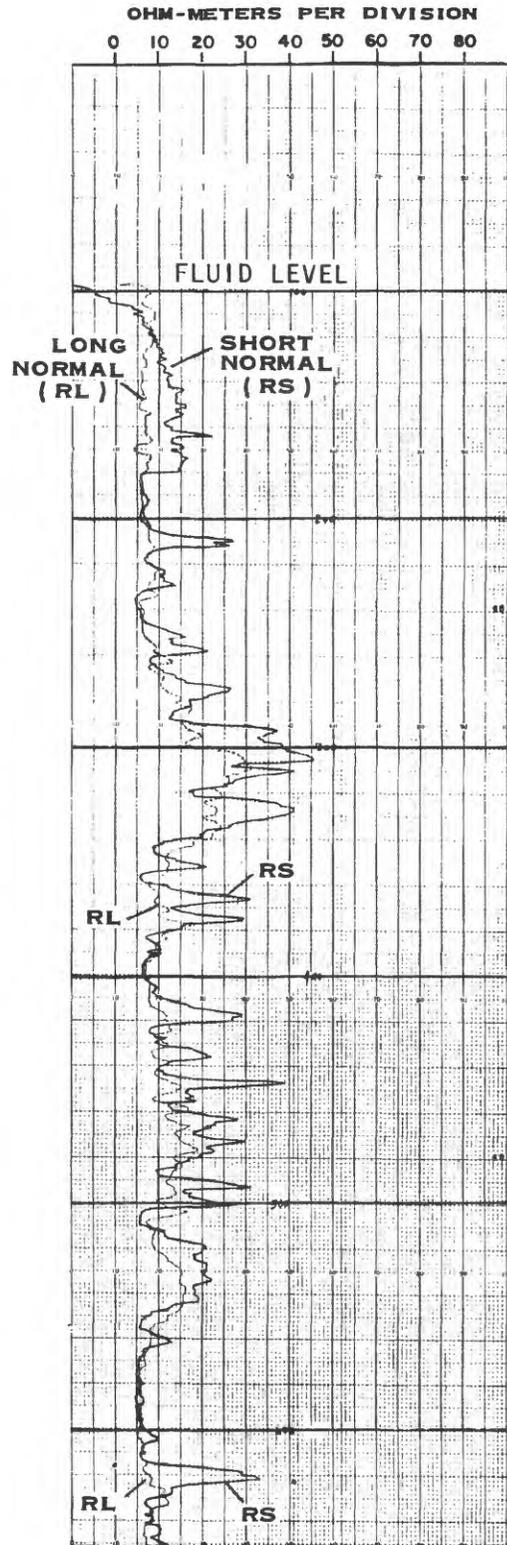
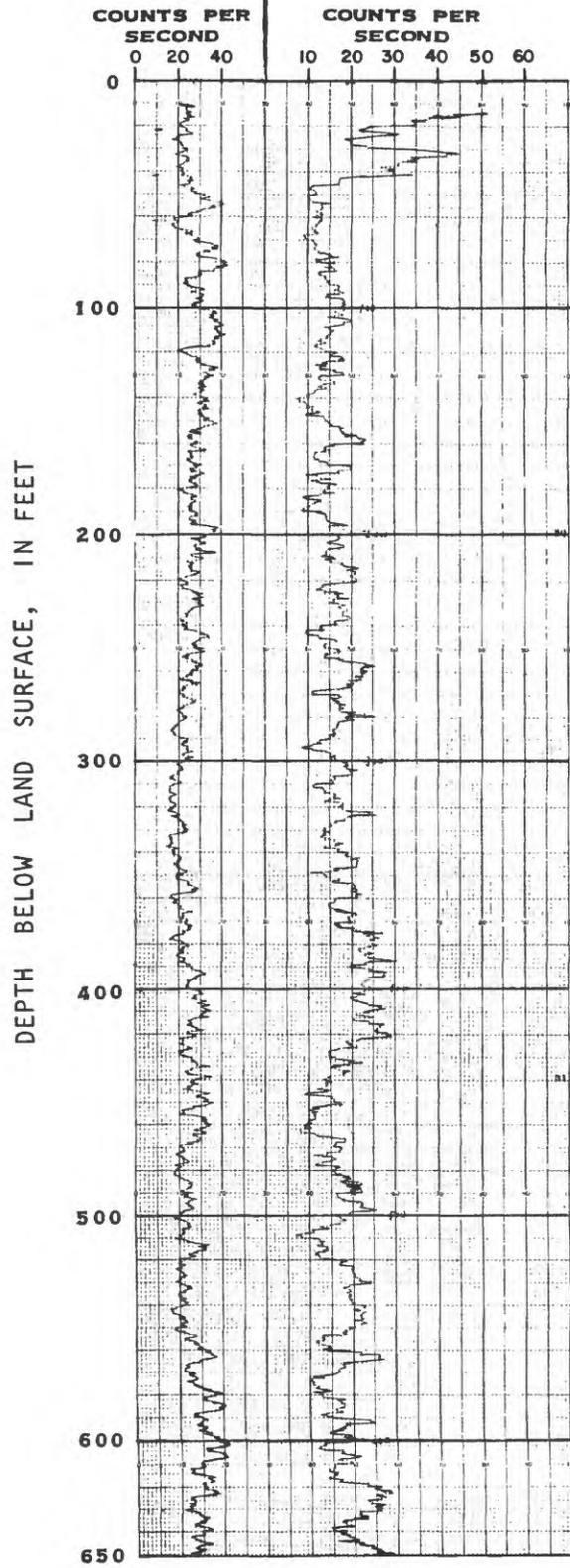


Figure 5.--Geophysical logs for test well SF-1A (17N.09E.35.131A) --Concluded.

NATURAL GAMMA LOG

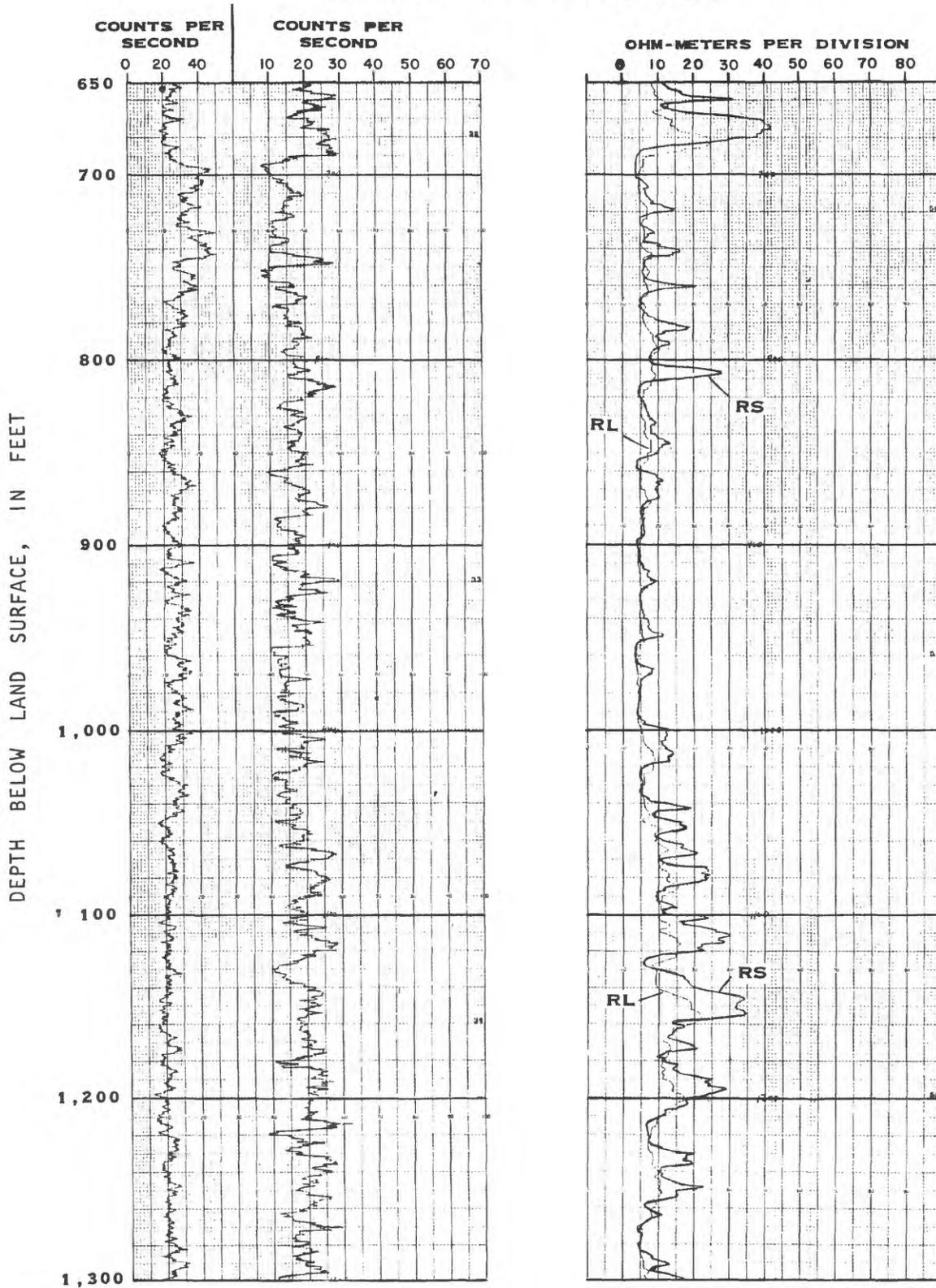
NEUTRON LOG

RESISTIVITY LOG



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Figure 6.--Geophysical logs for test well SF-2A (19N.07E.36.311A).

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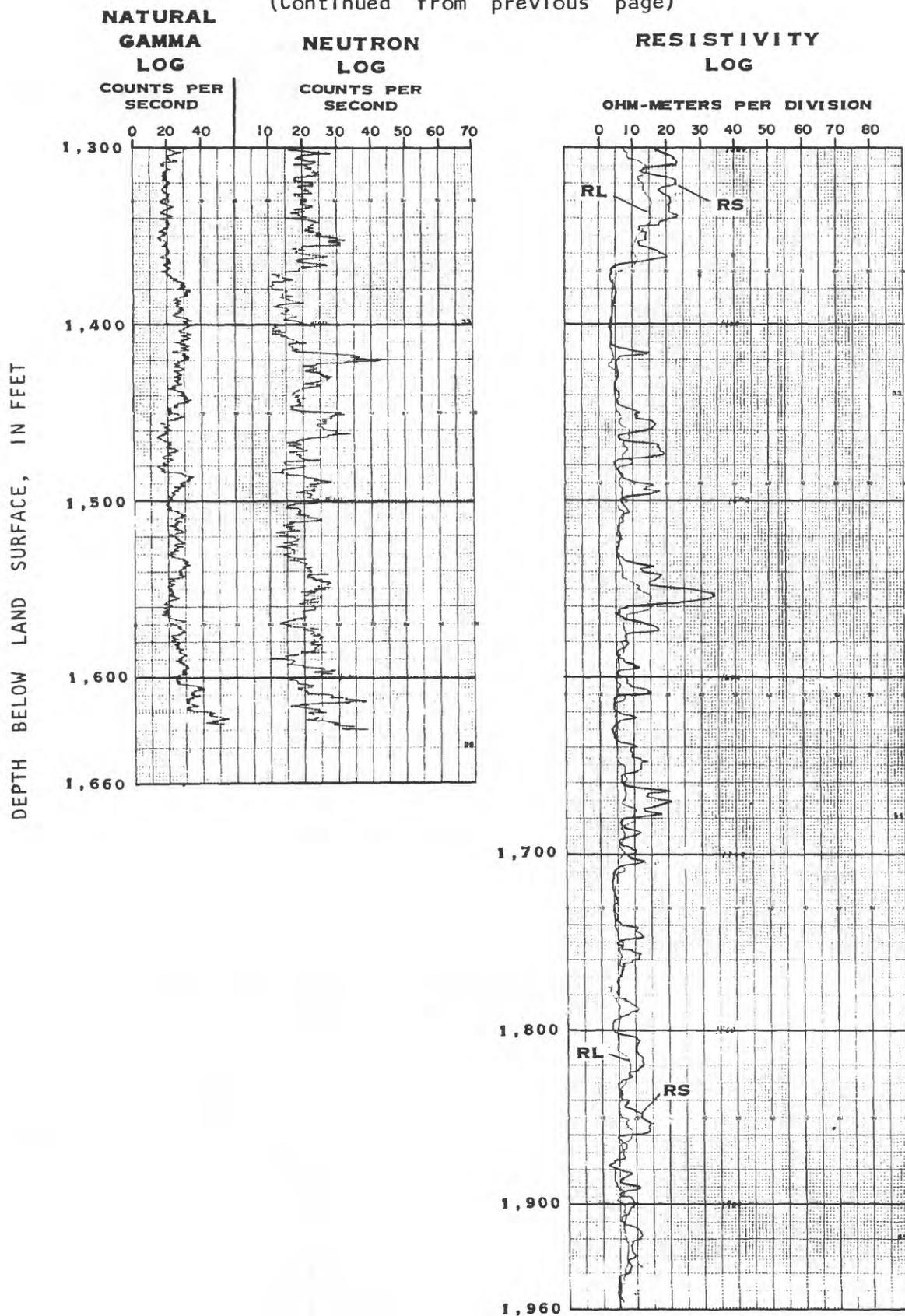


Figure 6.--Geophysical logs for test well SF-2A (19N.07E.36.311A) --Concluded.

Table 4.—Analyses of water samples from well nests SF-1 and SF-2

[cm, centimeter; deg. C, degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; CaCO₃, calcium carbonate; Ca, calcium; Mg, magnesium; Na, sodium; K, potassium; SO₄, sulfate; Cl, chloride; F, fluoride; SiO₂, silica; NO₂, nitrite; NO₃, nitrate; N, nitrogen; Fe, iron; Mn, manganese]

Constituent or property	SF-1A	SF-1C	SF-2A	SF-2B	SF-2C
Specific conductance (microsiemens per cm at 25 deg. C)	417	750	1,349	900	309
pH (laboratory) (units)	9.29	8.52	9.2	8.8	8.5
Water temperature (deg. C)	-	-	22.5	20.0	18.0
Hardness, total (mg/L as CaCO ₃)	6.0	21	61	61	39
Alkalinity (mg/L as CaCO ₃)	169	130	580	382	129
Dissolved solids (mg/L)	250	450	810	489	209
Calcium, dissolved (mg/L as Ca)	2.1	8.5	20	19	15
Magnesium, dissolved (mg/L as Mg)	.07	.20	2.8	3.2	.39
Sodium, dissolved (mg/L as Na)	90	150	309	170	63
Sodium, percent	97	92	90	85	76
Sodium-adsorption ratio	17	14	17	10	4
Potassium, dissolved (mg/L as K)	1.3	5.8	7.6	5.1	2.3
Sulfate, dissolved (mg/L as SO ₄)	26	100	48	26	20
Chloride, dissolved (mg/L as Cl)	8.8	86	55	4.6	9.4
Fluoride, dissolved (mg/L as F)	1.7	1.6	.43	.40	.30
Silica, dissolved (mg/L as SiO ₂)	17	20	17	28	21
NO ₂ +NO ₃ as N, dissolved (mg/L as N)	.10	.46	.35	.98	2.7
Iron, dissolved (µg/L as Fe)	36	53	30	14	58
Manganese, dissolved (µg/L as Mn)	4	8	489	3	2
Date sampled	9/16/86	9/16/86	7/27/86	7/27/86	7/28/86

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