# TEST WELLS T21, T22, AND T25, WHITE SANDS MISSILE RANGE, DOÑA ANA COUNTY, NEW MEXICO

By R. G. MYERS

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Prepared in cooperation with

WHITE SANDS MISSILE RANGE

U.S. GEOLOGICAL SURVEY

OPEN-FILE REPORT 83-771


Albuquerque, New Mexico

1983

UNITED STATES DEPARTMENT OF THE INTERIOR

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GEOLOGICAL SURVEY

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## CONVERSION FACTORS

In this report, measurements are given in inch-pound units only. The following table contains factors for converting to metric units.

| Multiply inch-pound units | By | To obtain metric units |
|---|---|---|
| foot | 0.3048 | meter |
| inch | 25.40 | millimeter |
| cubic inch | 16.387 | cubic centimeter |

National Geodetic Vertical Datum of 1929 (NGVD of 1929): A geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called "Mean Sea Level." NGVD of 1929 is referred to as sea level in this report.

# TEST WELLS T21, T22, AND T25, WHITE SANDS MISSILE RANGE, DOÑA ANA COUNTY, NEW MEXICO

By R.G. Myers

## ABSTRACT

Three test wells, T21, T22, and T25, were drilled at White Sands Missile Range in south-central New Mexico as part of a joint military program sponsored by the U.S. Army in September 1982. T21 and T22 were drilled as observation wells for two old landfills. T25 was drilled as an exploratory hole to obtain lithologic and borehole-geophysical data in the vicinity of the proposed replacement well for Supply Well 15. Information obtained from these wells includes borehole-geophysical and driller's logs.

## INTRODUCTION

Three test wells, T21, T22, and T25, (fig. 1; table 1) were drilled at White Sands Missile Range in south-central New Mexico as part of a joint military program sponsored by the U.S. Army in September 1982. The instructors were members of the U.S. Navy from Point Hueneme, California, and the trainees were members of the U.S. Air Force from Hurlburt Field at Eglin Air Force Base, Florida; members of the U.S. Army from Fort Campbell and Fort Knox, Kentucky, and Fort Bragg, North Carolina; and a civilian from the Facilities Engineering Directorate of White Sands Missile Range (Eckles, 1982). One week of classroom training was followed by three weeks of drilling training. The U.S. Geological Survey assisted White Sands Missile Range in site selection and borehole-geophysical logging. The hydraulic-rotary drilling method was used to drill the test wells. This study was done in cooperation with the Department of the Army, White Sands Missile Range, Facilities Engineering Directorate.

To date (May 1983), none of these wells have been developed. Therefore, there are no chemical analyses of water samples available. Depth to water below land surface in the test wells was estimated from U.S. Geological Survey borehole-geophysical logs.

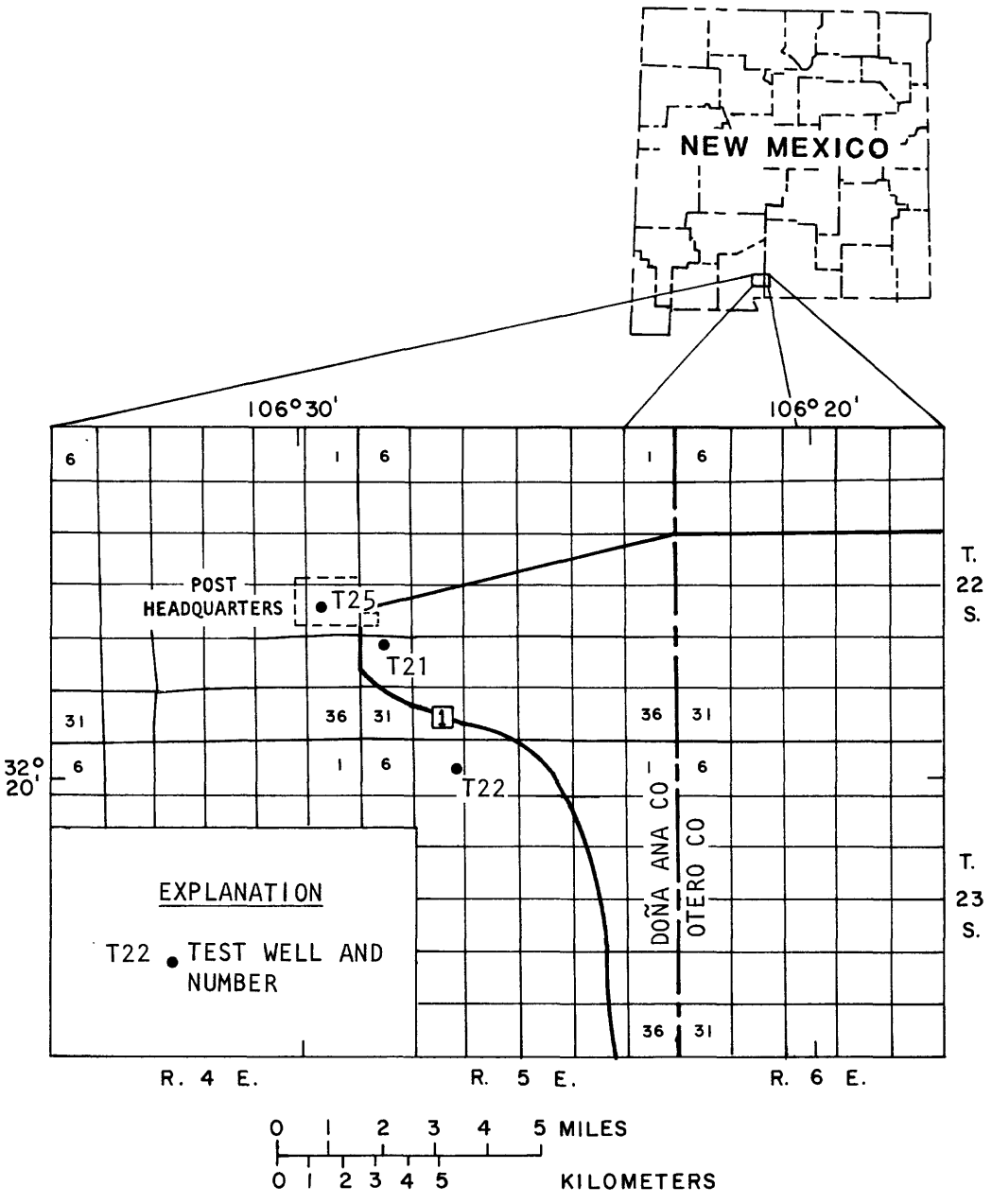



Figure 1.--Locations of test wells T21, T22, and T25, White Sands Missile Range, New Mexico.

Table 1.--Well records of test wells T21, T22, and T25, White Sands Missile Range, New Mexico

| Well name | Location | Date drilled | Water level below land surface (feet) | Drilled depth (feet) | Finished depth (feet) | Slot or screen interval (depth below land surface) (feet) | Casing diameter (inches) | Use |
|---|---|---|---|---|---|---|---|---|
| T21 | 22S.05E.30.122 | 09/82 | 315± | 500 | Reported: 420<br>Measured: 379 | Reported: 380-400 | 4 PVC | Observation |
| T22 | 23S.05E.05.144 | 09/82 | 197± | 1120 | 260 | Slot: 80-240 | Steel: 8=0-80 ft 6=80-260 ft | Observation |
| T25 | 22S.04E.24.144a | 09/82 | --- | 760 | --- | --- | | Exploratory (abandoned) |
| T25 | 22S.04E.24.144b | 09/82 | 438± | 945 | --- | --- | Surface casing set only | Exploratory (about 6 ft north of T25 (.144a)) |

## TEST WELL T21

Test well T21 (fig. 1) was drilled as an observation well in September 1982 (table 1). The main purpose of the well is to monitor the migration of any possible contamination from an old, buried landfill south of the well site. The well penetrated interbedded clay, silt, sand, and gravel in the Quaternary alluvium and bolson fill. A driller's log for T21 is shown in table 2.

T21 was drilled to a depth of 500 feet and completed at a reported depth of 420 feet. The well was drilled with a bentonite drilling fluid. The measured depth of T21 in February 1983 was 379 feet. The well was completed with 420 feet of 4-inch-outside-diameter PVC casing with a reported screened interval from 380 feet to 400 feet. The well was gravel packed to within about 20 feet of land surface. Borehole-geophysical logs made in the cased well are shown in figure 2. The depth to water below land surface of about 315 feet was estimated from the borehole-geophysical logs.

Table 2.--Driller's log for test well T21 (22S.05E.30.122)

[All information taken directly from field notes provided by White Sands Missile Range]

Date drilling started: 9/7/82

| Hour | Date | Formation | Depth (feet) | Marsh-funnel viscosity | Remarks |
|---|---|---|---|---|---|
| 0821 | 09-07 | Sand | 5 | 30 | |
| 0827 | 09-07 | Sand | 10 | 30 | |
| 0833 | 09-07 | Slightly larger sand | 15 | 29 | |
| 0840 | 09-07 | Sand | 20 | 32 | |
| 0845 | 09-07 | --- | -- | -- | 1 1100 lb. collar, length=20' |
| 0943 | 09-07 | Sand | 25 | 34 | |
| 0945 | 09-07 | Sand | 30 | 35 | |
| 0952 | 09-07 | Sand | 35 | 35 | |
| 0954 | 09-07 | Sand | 40 | 35 | |
| 0959 | 09-07 | --- | -- | -- | 1 1100 lb. collar, length=20' |
| 1013 | 09-07 | Sand | 45 | 42 | |
| 1015 | 09-07 | Sand | 50 | 36 | |
| 1018 | 09-07 | Sand | 55 | 34 | |
| 1022 | 09-07 | Sand/rock | 60 | 34 | |
| 1024 | 09-07 | --- | -- | -- | 20' steel added |
| 1058 | 09-07 | Sand/rock | 65 | 35 | |
| 1100 | 09-07 | Sand/rock | 70 | 35 | |
| 1105 | 09-07 | Sand/rock | 75 | 32 | |
| 1110 | 09-07 | Sand/rock | 80 | 32 | |
| 1129 | 09-07 | --- | -- | -- | 20' steel added |
| 1136 | 09-07 | Sand/rock | 85 | 34 | |
| 1140 | 09-07 | Sand/rock | 90 | 33 | |
| 1144 | 09-07 | Sand/rock | 95 | 33 | |
| 1146 | 09-07 | Rock/sand | 100 | 35 | |
| 1155 | 09-07 | Sand/rock | --- | -- | 20' steel added |
| 1202 | 09-07 | Rock/sand | 105 | 33 | |
| 1204 | 09-07 | Rock/sand | 110 | 33 | |
| 1206 | 09-07 | Rock/sand | 115 | 36 | |

Table 2.--Driller's log for test well T21 (22S.05E.30.122) - Continued

| Hour | Date | Formation | Depth (feet) | Marsh-funnel viscosity | Remarks |
|---|---|---|---|---|---|
| 1209 | 09-07 | Sand/rock | 120 | 33 | |
| 1225 | 09-07 | Sand/rock | --- | -- | 20' steel added |
| 1240 | 09-07 | Sand/rock | 125 | 36 | |
| 1244 | 09-07 | Sand/rock | 130 | 36 | |
| 1247 | 09-07 | Sand/rock | 135 | 36 | |
| 1250 | 09-07 | Sand/rock | 140 | 34 | |
| 1300 | 09-07 | --- | --- | -- | 20' steel added |
| 1313 | 09-07 | Sand/rock | 145 | 34 | |
| 1318 | 09-07 | Gravel/sand | 150 | 35 | |
| 1323 | 09-07 | Gravel/sand | 155 | 35 | |
| 1330 | 09-07 | Gravel/sand | 160 | 36 | |
| 1354 | 09-07 | --- | --- | -- | 20' steel added |
| 1358 | 09-07 | Gravel/sand | 165 | 35 | |
| 1406 | 09-07 | Gravel/sand | 170 | 35 | |
| 1410 | 09-07 | Gravel/sand | 175 | 35 | |
| 1415 | 09-07 | Gravel/sand | 180 | 35 | |
| 1420 | 09-07 | --- | --- | -- | 20' steel added |
| 1430 | 09-07 | Gravel/sand | 185 | 32 | |
| 1439 | 09-07 | Gravel/sand | 190 | 33 | |
| 1442 | 09-07 | Gravel/sand | 195 | 34 | |
| 1452 | 09-07 | Gravel/sand | 200 | 33 | |
| 1500 | 09-07 | Gravel/sand | --- | -- | 20' steel added |
| 1508 | 09-07 | Gravel/sand | 205 | 36 | |
| 1518 | 09-07 | Gravel/sand | 210 | 36 | |
| 1525 | 09-07 | Gravel/sand | 215 | 38 | |
| 1530 | 09-07 | Sand | 220 | 34 | |
| 1541 | 09-07 | Sand | --- | -- | 20' steel added |
| 1551 | 09-07 | Sand/gravel | 225 | 32 | |
| 1600 | 09-07 | Sand/gravel | 230 | 33 | |
| 1610 | 09-07 | Sand/gravel | 235 | 35 | |
| 1615 | 09-07 | Clay/sand/gravel | 240 | 34 | |
| 1625 | 09-07 | Sand | --- | -- | 20' steel added |
| 1645 | 09-07 | Sand/little gravel | 245 | 32 | |
| 1655 | 09-07 | Sand | 250 | 33 | |
| 1700 | 09-07 | Sand | 255 | 35 | |

Table 2.--Driller's log for test well T21 (22S.05E.30.122) - Continued

| Hour | Date | Formation | Depth (feet) | Marsh-funnel viscosity | Remarks |
|---|---|---|---|---|---|
| 1705 | 09-07 | Sand | 260 | 33 | |
| 1716 | 09-07 | --- | --- | -- | 20' steel added |
| 1730 | 09-07 | Sand/gravel | 265 | 35 | |
| 1740 | 09-07 | Sand/clay/gravel | 270 | 35 | |
| 1750 | 09-07 | Sand/clay/gravel | 275 | 35 | |
| 1800 | 09-07 | Sand/clay/gravel | 280 | 34 | |
| 1810 | 09-07 | --- | --- | -- | 20' steel added |
| 1827 | 09-07 | Sand and gravel | 285 | 35 | |
| 1900 | 09-07 | Sand and gravel | 290 | 36 | |
| 1907 | 09-07 | Hit rock (s.s.) fm. for 5'; sand,gravel | 295 | 35 | |
| 1915 | 19-07 | Sand/gravel | 300 | 36 | |
| 1924 | 09-07 | --- | --- | -- | 20' steel added |
| 1933 | 09-07 | Sand and clay | 305 | 38 | |
| 1940 | 09-07 | Clay and sand | 310 | 38 | |
| 1945 | 09-07 | Clay and sand | 315 | 38 | |
| 1951 | 09-07 | Clay/sand | 320 | 39 | Added 200 gal. water |
| 2000 | 09-07 | --- | --- | -- | 20' steel added |
| 2017 | 09-07 | Hard sand-sandstone | 325 | 38 | |
| 2045 | 09-07 | Clay/gravel, sandstone | 330 | 38 | |
| 2058 | 09-07 | Clay/gravel, sandstone | 335 | 36 | |
| 2106 | 09-07 | Silt/sand, clay/gravel | 340 | 39 | |
| 2120 | 09-07 | --- | --- | -- | 20' steel added |
| 2140 | 09-07 | Sand/gravel | 345 | 38 | |
| 2145 | 09-07 | Sand/gravel | 350 | 38 | |
| 2152 | 09-07 | Sand/gravel | 355 | 37 | |
| 2156 | 09-07 | Sand/gravel | 360 | 35 | 20' steel added |
| 0023 | 09-08 | Sand/shale | 365 | 39 | |
| 0034 | 09-08 | Sand and bits of clay | 370 | 37 | |
| 0037 | 09-08 | Sand/clay bits | 375 | 37 | |
| 0100 | 09-08 | Sand/clay | 380 | 37 | 20' steel added |
| 0105 | 09-08 | Sand/clay | 385 | 37 | |
| 0120 | | | | 39 | |
| 0130 | 09-08 | Sand/clay | 390 | 39 | |

Table 2.--Driller's log for test well T21 (22S.05E.30.122) - Concluded

| Hour | Date | Formation | Depth (feet) | Marsh-funnel viscosity | Remarks |
|---|---|---|---|---|---|
| 0134 | 09-08 | Clay with sand | 395 | 39 | |
| 0140 | 09-08 | Clay with sand | 400 | 43 | |
| 0147 | 09-08 | --- | --- | 43 | 20' steel added |
| 0205 | 09-08 | Sand/bits of clay | 405 | 40 | |
| 0217 | 09-08 | Sand/bits of clay | 410 | 43 | |
| 0221 | 09-08 | Sand/bits of clay | 415 | 43 | |
| 0230 | 09-08 | Sand/bits of clay | 420 | 44 | |
| 0233 | 09-08 | --- | --- | -- | 20' steel added |
| 0300 | 09-08 | Sand/clay | 425 | 45 | |
| 0306 | 09-08 | Sand/clay | 430 | 45 | |
| 0313 | 09-08 | Sand/clay bits | 435 | 45 | |
| 0318 | 09-08 | Sand/clay bits | 440 | 45 | |
| 0325 | 09-08 | --- | --- | -- | 20' steel added |
| 0337 | 09-08 | Sand/clay bits | 445 | 47 | |
| 0345 | 09-08 | Sand/ bits of clay | 450 | 45 | |
| 0355 | 09-08 | Sand | 455 | 45 | |
| 0400 | 09-08 | Sand | 460 | 45 | 20' steel added |
| 0420 | 09-08 | Sand | 465 | 45 | |
| 0425 | 09-08 | Sand/bits of clay | 470 | 45 | |
| 0432 | 09-08 | Sand/bits of clay | 475 | 55 | |
| 0505 | 09-08 | Sand/bits of clay | 480 | 44 | |
| 0520 | 09-08 | --- | --- | -- | 20' steel added |
| 0550 | 09-08 | Sandy clay bits | 485 | 44 | |
| 0557 | 09-08 | Sand/clay bits | 490 | 44 | |
| 0601 | 09-08 | Sand/clay | 495 | 50 | |
| 0615 | 09-08 | Sand/clay | 500 | 50 | |
| 0620 | | tripping out | | | |

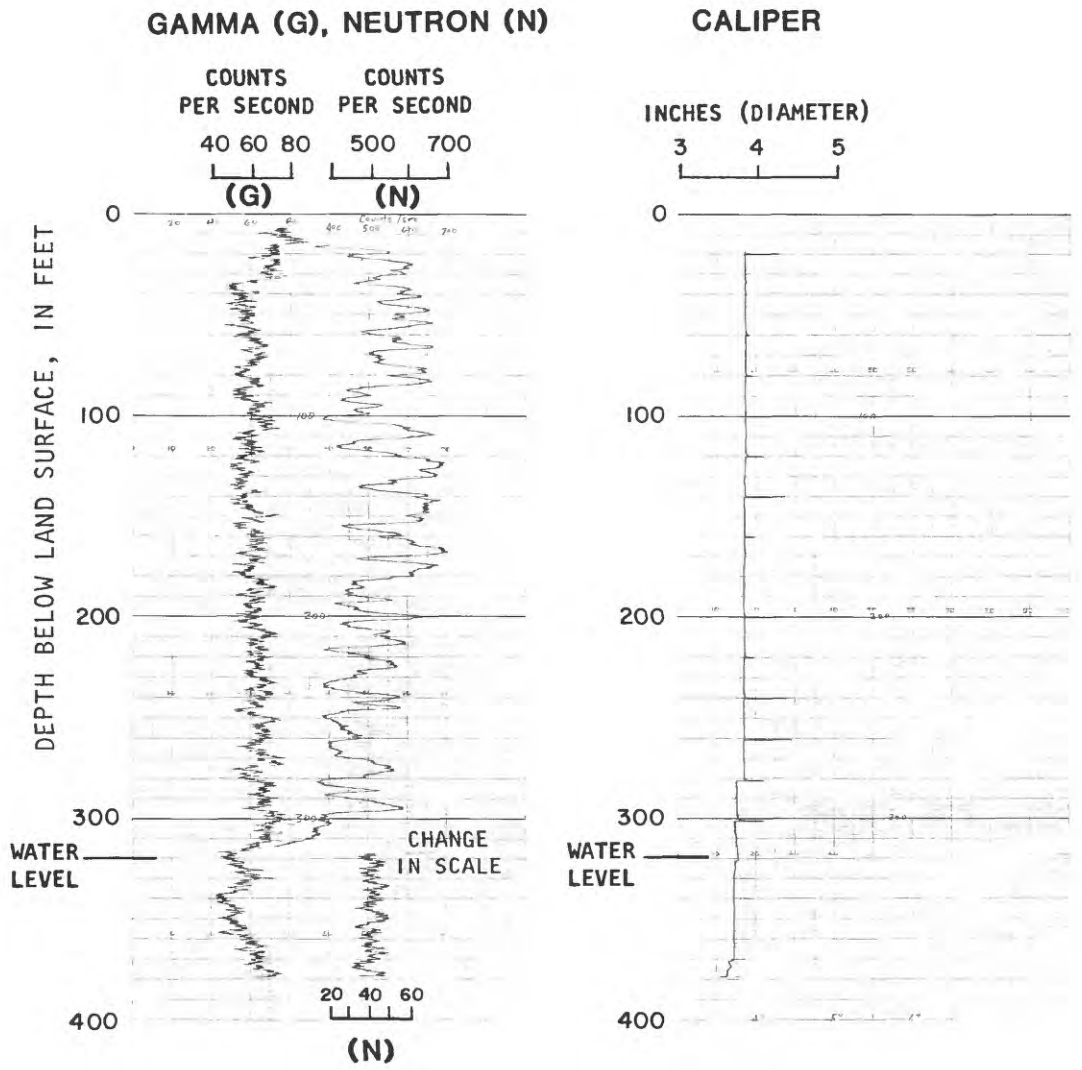



Figure 2.--Gamma, neutron, and caliper logs for test well T21 (22S.05E.30.122) with casing.

## TEST WELL T22

Test well T22 (fig. 1) was drilled as an observation well in September 1982 (table 1). The main purpose of the well is to monitor the migration of any possible contamination from a landfill located north of the well site. Though the current direction of ground-water flow is toward the east, ground-water withdrawals from the proposed well field in the Soledad Canyon area (Wilson and Myers, 1981) to the south of T22 could eventually change the configuration of the freshwater surface and the direction of ground-water flow. The well penetrated interbedded clay, silt, sand, and gravel in the Quaternary alluvium and bolson fill. Some of the lower material may be similar to piedmont-slope deposits that are exposed along the nearby mountain front to the west of the well site. A driller's log for T22 is shown in table 3.

T22 was drilled to a depth of 1,110 feet and casing was installed to a depth of 260 feet. The well was drilled with organic-polymer drilling fluid and reamed with organic-polymer and bentonite drilling fluids. The well was completed with 8-inch-diameter blank steel casing to a depth of 80 feet; 6-inch-diameter slotted steel casing from a depth of 80 to 240 feet below land surface; and 6-inch-diameter blank steel casing from 240 to 260 feet below land surface. This well was scheduled to be completed at a greater depth, but continual caving prevented this. The caving may have been due to the decomposition of the organic-polymer drilling fluid. The caliper log of test well T22 (fig. 3) shows a badly washed-out hole as compared to test well T25 (fig. 4), which was drilled with a bentonite drilling fluid. The well was gravel packed to within about 80 feet of land surface. Borehole-geophysical logs made in the uncased hole for T22 are shown in figure 3. The depth to water below land surface of about 197 feet was estimated from the borehole-geophysical logs.

The driller's log for T22 (table 3) reported bedrock at 1,070 feet below land surface, but bedrock was probably not encountered in T22. No change in lithology was reported from 540 feet to 1,000 feet. The driller's log also indicates that between 400 feet and 1,040 feet, one length of drill stem (20 feet) was added every 30 to 60 minutes. From 1,040 feet to 1,110 feet the time was gradually increased from 1 hour and 13 minutes to 1 hour and 50 minutes per length of drill stem. The teeth on the rollers of the bit were worn smooth when the hole was completed. If bedrock had been encountered with a worn bit, it is not likely that the drillers would have continued to drill at their reported speed. Cutting-sample volumes usually were between 0.015 and 0.125 cubic inch. The few rock fragments obtained from the bottom of the hole were subangular to subrounded and smaller than 0.06 inch in diameter, indicating an unconsolidated material and not bedrock.

Table 3.--Driller's log for test well T22 (23S.05E.05.144)

[All information taken directly from field notes provided by White Sands Missile Range]

Date drilling started: 9/8/82

| Hour | Date | Formation | Depth (feet) | Marsh-funnel viscosity | Remarks |
|---|---|---|---|---|---|
| 1900 | 09-08 | Sand | 5 | 37 | |
| 1910 | 09-08 | Sand | 10 | 41 | |
| 1920 | 09-08 | Sand | 15 | 34 | |
| 1935 | 09-08 | Sand | 20 | 32 | |
| 2010 | 09-08 | --- | -- | -- | Added 20' collar, 1100 lbs. |
| 2015 | 09-08 | Sand | 25 | 33 | |
| 2020 | 09-08 | Coarse sand | 30 | 34 | |
| 2025 | 09-08 | Quartz/clay/sand/gravel | 35 | 33 | |
| 2030 | 09-08 | Coarse sand | 40 | 33 | |
| 2040 | 09-08 | --- | -- | -- | Added 20' collar, 1100 lbs. |
| 2055 | 09-08 | Qtz, coarse gravel | 45 | 34 | |
| 2100 | 09-08 | Fine sand | 50 | 34 | |
| 2104 | 09-08 | Fine sand | 55 | 35 | |
| 2110 | 09-08 | Sand | 60 | 34 | |
| 2125 | 09-08 | --- | -- | -- | Added 20' steel |
| 2150 | 09-08 | Fine sand | 65 | 33 | |
| 2155 | 09-08 | Fine sand | 70 | 34 | |
| 2200 | 09-08 | Fine sand | 75 | 33 | |
| 2210 | 09-08 | Fine sand/clay | 80 | 34 | |
| 2215 | 09-08 | --- | -- | -- | Added 20' steel, cave in |
| 2225 | 09-08 | Fine sand | 85 | 33 | |
| 2230 | 09-08 | Coarse gravel, qtz | 90 | 32 | |
| 2232 | 09-08 | Sand | 95 | 33 | |
| 2240 | 09-08 | Sand/clay/gravel/qtz | 100 | 34 | |
| 2305 | 09-08 | --- | --- | -- | Added 20' steel |
| 2310 | 09-08 | Coarse sand | 105 | 34 | |
| 2315 | 09-08 | Coarse sand | 110 | 34 | |
| 2323 | 09-08 | Quartzite gravel | 115 | 34 | |
| 2333 | 09-08 | Quartzite sand/gravel | 120 | 34 | Added 20' steel |

Table 3.--Driller's log for test well T22 (23S.05E.05.144) - Continued

| Hour | Date | Formation | Depth (feet) | Marsh-funnel viscosity | Remarks |
|---|---|---|---|---|---|
| 0100 | 09-09 | Quartzite sand/gravel | 125 | 34 | |
| 0115 | 09-09 | Quartzite sand/gravel | 130 | 34 | |
| 0117 | 09-09 | Quartzite sand/gravel | 135 | 34 | |
| 0120 | 09-09 | Quartzite sand/gravel | 140 | 33 | Added 20' steel |
| 0135 | 09-09 | Quartzite sand/gravel | 145 | 33 | |
| 0137 | 09-09 | Quartzite sand/gravel | 150 | 33 | |
| 0200 | 09-09 | Clay and fine sand | 155 | 34 | |
| 0220 | 09-09 | Clay | 160 | 34 | Added 20' steel |
| 0300 | 09-09 | Clay | 165 | 31 | |
| 0320 | 09-09 | Clay | 170 | 32 | |
| 0333 | 09-09 | Clay | 175 | 33 | |
| 0345 | 09-09 | Clay | 180 | 34 | Added 20' steel |
| 0440 | 09-09 | Clay | 185 | 33 | |
| 0443 | 09-09 | Clay | 190 | 33 | |
| 0445 | 09-09 | Clay | 195 | 34 | Sample |
| 0510 | 09-09 | Clay | 200 | 33 | Added 20' steel |
| 0520 | 09-09 | Clay | 205 | 33 | Sample |
| 0530 | 09-09 | Clay | 210 | 32 | |
| 0556 | 09-09 | Clay | 215 | 32 | |
| 0610 | 09-09 | Clay | 220 | 32 | Added 20' steel |
| 0615 | 09-09 | Clay | 225 | 32 | |
| 0645 | 09-09 | Clay | 230 | 33.5 | |
| 0650 | 09-09 | Clay | 235 | 32 | |
| 0700 | 09-09 | Clay | 240 | 33 | Added 20' steel |
| 0705 | 09-09 | Clay | 245 | 33 | |
| 0730 | 09-09 | Clay | 250 | 33 | |
| 0735 | 09-09 | Clay | 255 | 34 | |
| 0745 | 09-09 | Clay | 260 | 34 | Added 20' steel |
| 0750 | 09-09 | Clay | 265 | 32 | |
| 0755 | 09-09 | Clay | 270 | 34 | |
| 0800 | 09-09 | Clay | 275 | 34 | |
| 0805 | 09-09 | Clay | 280 | 34 | Added 20' steel |
| 0815 | 09-09 | Clay | 285 | 35 | |
| 0827 | 09-09 | Clay | 290 | 35 | |
| 0831 | 09-09 | Clay | 295 | 35 | |

Table 3.--Driller's log for test well T22 (23S.05E.05.144) - Continued

| Hour | Date | Formation | Depth (feet) | Marsh-funnel viscosity | Remarks |
|---|---|---|---|---|---|
| 0835 | 09-09 | Clay | 300 | 35 | Added 20' steel |
| 0849 | 09-09 | Clay | 305 | 34 | |
| 0900 | 09-09 | Clay | 310 | 34 | |
| 0905 | 09-09 | Clay | 315 | 34 | |
| 0906 | 09-09 | Clay/gravel | 320 | 33 | Added 20' steel |
| 0912 | 09-09 | Clay/gravel | 325 | 34 | |
| 0926 | 09-09 | Clay/gravel | 330 | 34 | |
| 0932 | 09-09 | Clay/gravel | 335 | 34 | |
| 0945 | 09-09 | Clay | 340 | 34 | Added 20' steel |
| 1006 | 09-09 | Clay | 345 | 34 | |
| 1017 | 09-09 | Clay | 350 | 34 | |
| 1022 | 09-09 | Clay | 355 | 34 | |
| 1026 | 09-09 | Clay | 360 | 34 | Added 20 steel |
| 1100 | 09-09 | Clay | 365 | 33 | |
| 1101 | 09-09 | Clay | 370 | 34 | |
| 1104 | 09-09 | Clay | 375 | 34 | |
| 1109 | 09-09 | Clay | 380 | 33 | Added 20' steel |
| 1129 | 09-09 | Clay | 385 | 34 | |
| 1132 | 09-09 | Clay | 390 | 34 | |
| 1135 | 09-09 | Clay | 395 | 33 | |
| 1139 | 09-09 | Clay | 400 | 33 | Added 20' steel |
| 1205 | 09-09 | Clay | 405 | 33 | |
| 1210 | 09-09 | Clay | 410 | 33 | |
| 1212 | 09-09 | Clay | 415 | 34 | |
| 1215 | 09-09 | Clay | 420 | 34 | Added 20' steel |
| 1238 | 09-09 | Clay | 425 | 34 | |
| 1242 | 09-09 | Clay | 430 | 34 | |
| 1244 | 09-09 | Clay | 435 | 34 | |
| 1246 | 09-09 | Clay | 440 | 33 | Added 20' steel |
| 1305 | 09-09 | Clay | 445 | 33 | |
| 1311 | 09-09 | Clay | 450 | 33 | |
| 1314 | 09-09 | Clay | 455 | 34 | |
| 1325 | 09-09 | Clay | 460 | 33 | Added 20' steel |
| 1345 | 09-09 | Clay | 465 | 33 | |
| 1348 | 09-09 | Clay | 470 | 33 | |

Table 3.--Driller's log for test well T22 (23S.05E.05.144) - Continued

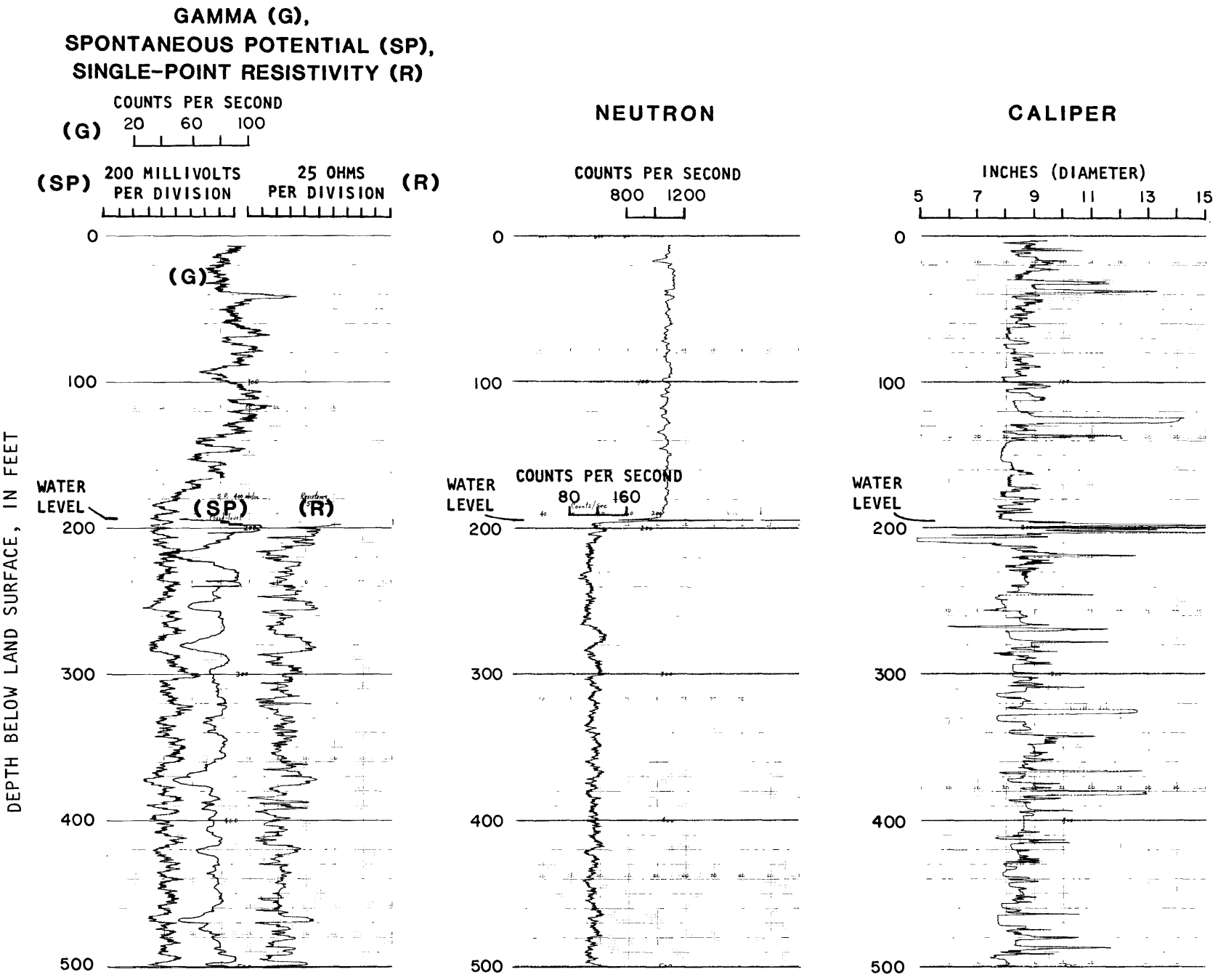
| Hour | Date | Formation | Depth (feet) | Marsh-funnel viscosity | Remarks |
|---|---|---|---|---|---|
| 1350 | 09-09 | Clay | 475 | 33 | |
| 1355 | 09-09 | Clay | 480 | 33 | Added 20'steel |
| 1412 | 09-09 | Clay | 485 | 33 | |
| 1417 | 09-09 | Clay | 490 | 33 | |
| 1421 | 09-09 | Clay | 495 | 33 | |
| 1426 | 09-09 | Clay | 500 | 33 | Added 20' steel |
| 1440 | 09-09 | Clay | 505 | 33 | |
| 1446 | 09-09 | Clay | 510 | 33 | |
| 1451 | 09-09 | Clay | 515 | 33 | |
| 1454 | 09-09 | Clay | 520 | 33 | |
| 1505 | 09-09 | Clay | 525 | 33 | |
| 1515 | 09-09 | Clay | 530 | 33 | |
| 1520 | 09-09 | Clay | 535 | 33 | |
| 1525 | 09-09 | Clay | 540 | 33 | Added 20' steel |
| 1622 | 09-09 | Silt | 545 | 30.5 | Added 300 gal. water |
| 1630 | 09-09 | Silt | 550 | 31 | |
| ---- | 09-09 | --- | 555 | -- | |
| 1727 | 09-09 | Silt | 560 | 33 | Added 20' steel |
| 1745 | 09-09 | Silt | 570 | 31 | Added Revert |
| 1810 | 09-09 | Silt | 580 | 32 | Added 20' steel |
| 1849 | 09-09 | Silt | 590 | 33 | |
| 1925 | 09-09 | Silt | 600 | 32 | Added 20' steel |
| 2010 | 09-09 | Silt | 610 | 32 | |
| 2018 | 09-09 | Silt | 620 | 32 | |
| 2025 | 09-09 | --- | --- | -- | Added 20' steel |
| 2032 | 09-09 | Silt | 630 | 32 | |
| 2040 | 09-09 | Silt | 640 | 32 | |
| 2050 | 09-09 | --- | --- | -- | Added 20' steel |
| 2100 | 09-09 | Silt | 650 | 32 | |
| 2110 | 09-09 | Silt | 660 | 32 | |
| 2135 | 09-09 | --- | --- | -- | Added 20' steel |
| 2212 | 09-09 | Silt | 670 | 33 | |
| 2224 | 09-09 | Silt | 680 | 33 | |
| 2315 | 09-09 | --- | 680 | -- | Added 20' steel |
| 2325 | 09-09 | Silt | 690 | 31 | |

Table 3.--Driller's log for test well T22 (23S.05E.05.144) - Continued

| Hour | Date | Formation | Depth (feet) | Marsh-funnel viscosity | Remarks |
|---|---|---|---|---|---|
| 2335 | 09-09 | Silt | 700 | 31 | Added 20' steel |
| 2345 | 09-09 | Silt | 705 | 30 | Well mud warm |
| 2359 | 09-09 | Silt | 710 | 31 | |
| 0015 | 09-10 | Silt | 715 | 32 | |
| 0025 | 09-10 | Silt | 720 | 33 | Added 20' steel |
| 0104 | 09-10 | Silt | 730 | 31 | |
| 0113 | 09-10 | Silt | 740 | 31 | Added 20' steel |
| 0129 | 09-10 | Silt | 750 | 32 | |
| 0140 | 09-10 | Silt | 760 | 31 | Added 20' steel |
| 0208 | 09-10 | Silt | 770 | 32 | |
| 0215 | 09-10 | Silt | 780 | 32 | Added 20' steel |
| 0237 | 09-10 | Silt | 790 | 33 | |
| 0257 | 09-10 | Silt | 800 | 32 | Added 20' steel |
| 0321 | 09-10 | Silt | 810 | 32 | |
| 0330 | 09-10 | Silt | 820 | 32 | Added 20' steel |
| 0355 | 09-10 | Silt | 830 | 32 | |
| 0403 | 09-10 | Silt | 840 | 30 | Added 20' steel |
| 0440 | 09-10 | Silt | 850 | 31 | |
| 0457 | 09-10 | Silt | 860 | 32 | Added 20' steel |
| 0515 | 09-10 | Silt | 870 | 33 | |
| 0535 | 09-10 | Silt | 880 | 33 | Added 20' steel |
| 0610 | 09-10 | Silt | 890 | 33 | |
| 0630 | 09-10 | Silt | 900 | 32 | Added 20' steel |
| 0653 | 09-10 | Silt | 910 | 32 | |
| 0727 | 09-10 | silt | 920 | 31 | Added 20' steel |
| 0742 | 09-10 | Silt | 925 | 32 | |
| 0759 | 09-10 | Silt | 930 | 32 | Added 200 gal. water |
| 0810 | 09-10 | Silt | 940 | 32 | Added 20' steel |
| 0844 | 09-10 | Silt | 950 | 32 | Still warm |
| 0855 | 09-10 | Silt | 960 | 30 | Added 20' steel |
| 0925 | 09-10 | Silt | 970 | 31 | |
| 0940 | 09-10 | Silt | 980 | 32 | Added 20' steel |
| 1011 | 09-10 | Silt | 990 | 32 | |
| 1032 | 09-10 | Silt | 1000 | 29 | Added 20' steel |

Table 3.--Driller's log for test well T22 (23S.05E.05.144) - Concluded

| Hour | Date | Formation | Depth (feet) | Marsh-funnel viscosity | Remarks |
|---|---|---|---|---|---|
| 1151 | 09-10 | Bed qtz | 1010 | 29 | |
| 1225 | 09-10 | Silt | 1020 | 31 | Added 20' steel |
| 1302 | 09-10 | Qtz shale | 1030 | 30 | |
| 1325 | 09-10 | Shale | 1040 | 30 | Added 20' steel |
| 1406 | 09-10 | Shale | 1050 | 32 | Slow drilling |
| 1438 | 09-10 | Shale | 1060 | 31 | Added 20' steel |
| 1529 | 09-10 | Shale, consol. tuff | 1070 | -- | Hit bedrock |
| 1547 | 09-10 | Silt | 1080 | 29 | |
| 1610 | 09-10 | --- | ---- | 29 | Added 20' steel |
| 1650 | 09-10 | Clay rock, gravel | 1090 | 31 | Added 50 gal. water |
| 1740 | 09-10 | Bedrock, gravel | 1100 | 31 | |
| 1800 | 09-10 | --- | ---- | -- | Added 20' steel |
| 1820 | 09-10 | Bedrock | 1110 | 30 | Added 200 gal. water, circulated for 1 hour. |
| 1920 | 09-10 | --- | --- | --- | Tripping out |
| 2300 | 09-10 | --- | --- | -- | Tripping out complete, electrolog start time. |
| 0550 | 09-11 | --- | --- | 29 | Started reaming with 14 3/4" bit. |
| 0650 | 09-11 | --- | 10 | 32 | |
| 0708 | 09-11 | --- | 20 | 34 | |
| 0725 | 09-11 | --- | -- | 34 | Added 20' steel |


GAMMA (G),
SPONTANEOUS POTENTIAL (SP),
SINGLE-POINT RESISTIVITY (R)
COUNTS PER SECOND
(G) 20 60 100
(SP) 200 MILLIVOLTS PER DIVISION
25 OHMS PER DIVISION (R)
NEUTRON
COUNTS PER SECOND
800 1200
CALIPER
INCHES (DIAMETER)
5 7 9 11 13 15
DEPTH BELOW LAND SURFACE, IN FEET
WATER LEVEL
(G)
(SP)
(R)
COUNTS PER SECOND
80 160
0
100
200
300
400
500

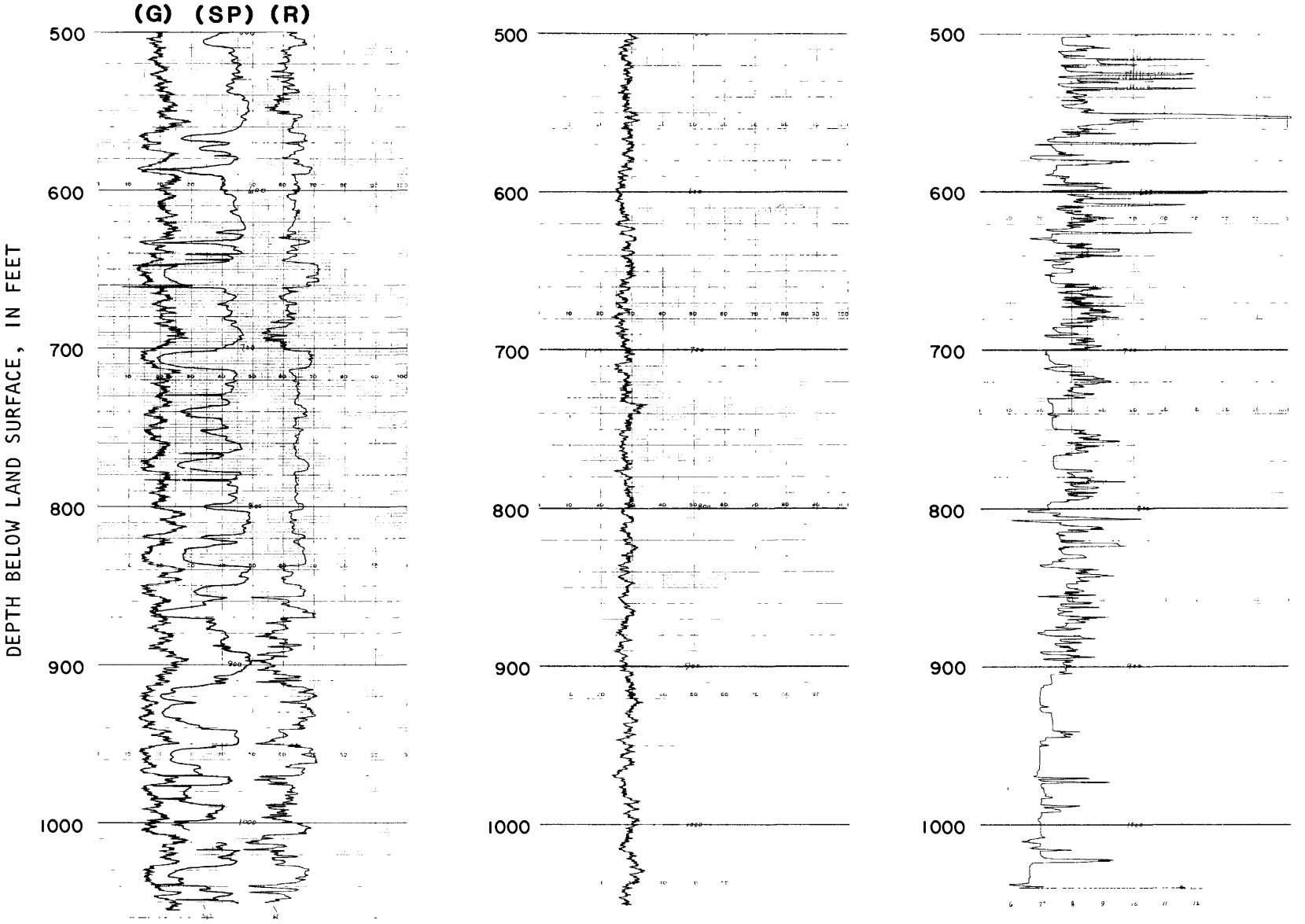



Figure 3.--Borehole-geophysical logs for test well T22 (23S.05E.5.144).

## TEST WELL T25

Test well T25 (fig. 1) was drilled in September 1982 as an exploratory hole to obtain lithologic and borehole-geophysical data of the Quaternary alluvium and bolson fill in the vicinity of the the proposed replacement well for Supply Well 15 (table 1). The well penetrated interbedded clay, silt, sand, and gravel. Driller's logs for two holes drilled at site T25 are shown in tables 4 and 5.

The first hole (22S.04E.24.144a) at site T25 (table 4) was drilled to a depth of about 760 feet before the bit broke off and was lost in the hole. A new hole (22S.04E.24.144b) was started about 6 feet north of the previous hole. The new hole intersected the old hole at about 500 feet in depth according to the driller's log (table 5). The log indicates that the drilling continued down the old hole, went through the bit left in the old hole at 750 feet, and continued on to a depth of 945 feet. The well was drilled with a bentonite drilling fluid. The hole was left uncased except for some surface casing that was installed in order to allow the possibility of obtaining some geothermal information at a later date. Borehole-geophysical logs for T25 are shown in figure 4. The depth to water below land surface of about 438 feet was estimated from the borehole-geophysical logs.

Table 4.--Driller's log for test well T25 (22S.04E.24.144a)

[All information taken directly from field notes provided by White Sands Missile Range]

Date drilling started: 9/16/82

| Hour | Date | Formation | Depth (feet) | Marsh-funnel viscosity | Remarks |
|---|---|---|---|---|---|
| 1950 | 09-16 | --- | -- | -- | |
| 2009 | 09-16 | Sand | 10 | 27 | |
| 2040 | 09-16 | Sand | 20 | 27 | |
| 2400 | 09-17 | --- | -- | 35 | Added 20' collar |
| 0013 | 09-17 | Sand | 30 | 52 | |
| 0020 | 09-17 | Sand | 40 | 38 | |
| 0030 | 09-17 | --- | -- | -- | Added 20' collar |
| 0043 | 09-17 | Sand | 50 | 36 | |
| 0045 | 09-17 | Sand | 60 | 38 | |
| 0100 | 09-17 | --- | -- | -- | Added steel |
| 0110 | 09-17 | Sand | 70 | 37 | |
| 0119 | 09-17 | Sand | 80 | 42 | |
| 0125 | 09-17 | --- | -- | -- | Added 20' steel |
| 0138 | 09-17 | Sand | 90 | 46 | |
| 0145 | 09-17 | Sand | 100 | 44 | |
| 0151 | 09-17 | --- | --- | -- | Added 20' steel |
| 0207 | 09-17 | Sand | 110 | 47 | |
| 0212 | 09-17 | --- | 115 | -- | Had to stop drilling; mud pump mag hot on L/bank |
| 0255 | 09-17 | --- | --- | -- | Started drilling again, replaced spring in stat valve |
| 0305 | 09-17 | Sand | 120 | 46 | |
| 0308 | 09-17 | --- | --- | -- | Added 20' steel |
| 0324 | 09-17 | Sand | 130 | 46 | |
| 0336 | 09-17 | Rock and sand | 140 | 47 | |
| 0345 | 09-17 | --- | --- | -- | Added 20' steel |
| 0402 | 09-17 | Sand | 150 | 36 | |

Table 4.--Driller's log for test well T25 (22S.04E.24.144a) - Continued

| Hour | Date | Formation | Depth (feet) | Marsh-funnel viscosity | Remarks |
|---|---|---|---|---|---|
| 0408 | 09-17 | Sand | 160 | 39 | |
| 0420 | 09-17 | --- | -- | -- | Added 20' steel |
| 0438 | 09-17 | Sand and clay | 170 | 42 | |
| 0450 | 09-17 | Sand | 180 | 42 | |
| 0456 | 09-17 | --- | --- | -- | Added 20' steel |
| 0520 | 09-17 | Sand and rock | 190 | 44 | |
| 0532 | 09-17 | Sand and rock | 200 | 44 | |
| 0540 | 09-17 | --- | --- | -- | Added 20' steel |
| 0555 | 09-17 | Sand and rock | 210 | 44 | |
| 0610 | 09-17 | Sand, rock, and clay | 220 | 50 | |
| 0615 | 09-17 | --- | --- | -- | Added steel |
| 0630 | 09-17 | Sand and rock | 230 | 38 | |
| 0640 | 09-17 | Sand and rock | 240 | 40 | |
| 0645 | 09-17 | --- | --- | -- | Added 20' steel |
| 0703 | 09-17 | Sand and rock | 250 | 43 | |
| 0715 | 09-17 | Sand and rock | 260 | 46 | |
| 0720 | 09-17 | --- | --- | -- | Added 20' steel |
| 0737 | 09-17 | Sand and rock | 270 | 38 | |
| 0750 | 09-17 | Sand and rock | 280 | 41 | |
| ---- | 09-17 | --- | --- | -- | added 20' steel |
| ---- | 09-17 | --- | 290 | -- | |
| 0840 | 09-17 | --- | --- | -- | Broke the kelly out, pulled drill stem to effect repairs. |
| 1655 | 09-17 | --- | 290 | -- | Repaired, steel back in ground |
| 1702 | 09-17 | Sand | 290 | 32 | |
| 1713 | 09-17 | Sand | 300 | 34 | Changed steel |
| 1750 | 09-17 | Sand | 310 | 43 | |
| 1805 | 09-17 | Sand | 320 | 42 | Added steel |
| 1833 | 09-17 | Sand | 330 | 45 | |
| 1845 | 09-17 | Sand | 340 | 46 | Added steel |
| 1900 | 09-17 | Sand | 350 | 48 | |
| 1905 | 09-17 | Sand | 360 | 48 | Added steel |
| 1947 | 09-17 | Sand | 370 | 46 | |

Table 4.--Driller's log for test well T25 (22S.04E.24.144a) - Continued

| Hour | Date | Formation | Depth (feet) | Marsh-funnel viscosity | Remarks |
|---|---|---|---|---|---|
| 2008 | 09-17 | Sand | 380 | 47 | Added steel |
| 2020 | 09-17 | Sand | 390 | 40 | |
| 2035 | 09-17 | Sand and clay | 400 | 45 | Added steel |
| 2120 | 09-17 | Sand and clay | 410 | 40 | |
| 2130 | 09-17 | Sand and clay | 420 | 45 | Added steel |
| 2200 | 09-17 | Sand | 430 | 43 | |
| 2125 | 09-17 | Sand | 440 | 45 | Added steel |
| 2300 | 09-17 | Sand | 450 | 47 | |
| 2312 | 09-17 | Sand | 460 | 45 | Added steel |
| 2341 | 09-17 | Sand | 470 | 49 | |
| 2354 | 09-17 | Sand | 480 | 52 | Added steel |
| 0018 | 09-18 | Sand and clay | 490 | 51 | |
| 0036 | 09-18 | Sand and clay | 500 | 53 | Added steel |
| 0101 | 09-18 | Sand and clay | 510 | 46 | |
| 0108 | 09-18 | Sand and clay | 520 | 48 | Added steel |
| 0128 | 09-18 | Sand and clay | 530 | 48 | |
| 0139 | 09-18 | Sand | 540 | 57 | Added steel |
| 0202 | 09-18 | Sand | 550 | 40 | |
| 0215 | 09-18 | Sand | 560 | 42 | Added steel |
| 0246 | 09-18 | Sand | 570 | 39 | |
| 0255 | 09-18 | Sand | 580 | 39 | Added steel |
| 0334 | 09-18 | Sand and clay | 590 | 44 | |
| 0344 | 09-18 | Sand and clay | 600 | 44 | Added steel |
| 0412 | 09-18 | Sand and clay | 610 | 40 | |
| 0429 | 09-18 | Sand and clay | 620 | 45 | Added steel |
| 0454 | 09-18 | Sand | 630 | 37 | |
| 0502 | 09-18 | Sand and clay | 640 | 38 | Added steel |
| 0521 | 09-18 | Sand | 650 | 39 | |
| 0543 | 09-18 | Sand | 660 | 39 | Added steel |
| 0622 | 09-18 | Sand | 670 | 45 | |
| 0642 | 09-18 | Sand | 680 | 42 | Added steel |
| 0717 | 09-18 | Sand and gravel | 690 | 39 | |
| 0955 | 09-18 | --- | 700 | 45 | Added steel |
| 1045 | 09-18 | Sand and gravel | 710 | 50 | |
| 1100 | 09-18 | Sand and gravel | 720 | 45 | |

Table 4.--Driller's log for test well T25 (22S.04E.24.144a) - Concluded

| Hour | Date | Formation | Depth (feet) | Marsh-funnel viscosity | Remarks |
|---|---|---|---|---|---|
| 1110 | 09-18 | --- | --- | 39 | Added 20' steel |
| 1124 | 09-18 | Sand and gravel | 730 | 42 | |
| 1135 | 09-18 | Sand and gravel | 740 | 44 | |
| 1145 | 09-18 | --- | --- | 44 | Added 20' steel |
| 1236 | 09-18 | --- | 750 | 41 | Mud gun valve broken, circulation only |
| 1445 | 09-18 | --- | | 29 | New valve installed, cleaned mud pits-new mud |
| 1500 | 09-18 | --- | 750 | 32 | Continued drilling, good circulation |
| 1600 | 09-18 | --- | 760 | | |
| 1630 | 09-18 | --- | --- | -- | Pulled all steel to inspect bit |
| | | | Bit broken--lost hole. | | |

Table 5.--Driller's log for test well T25 (22S.04E.24.144b)

[All information taken directly from field notes provided by White Sands Missile Range]

Date drilling started: 9/18/82

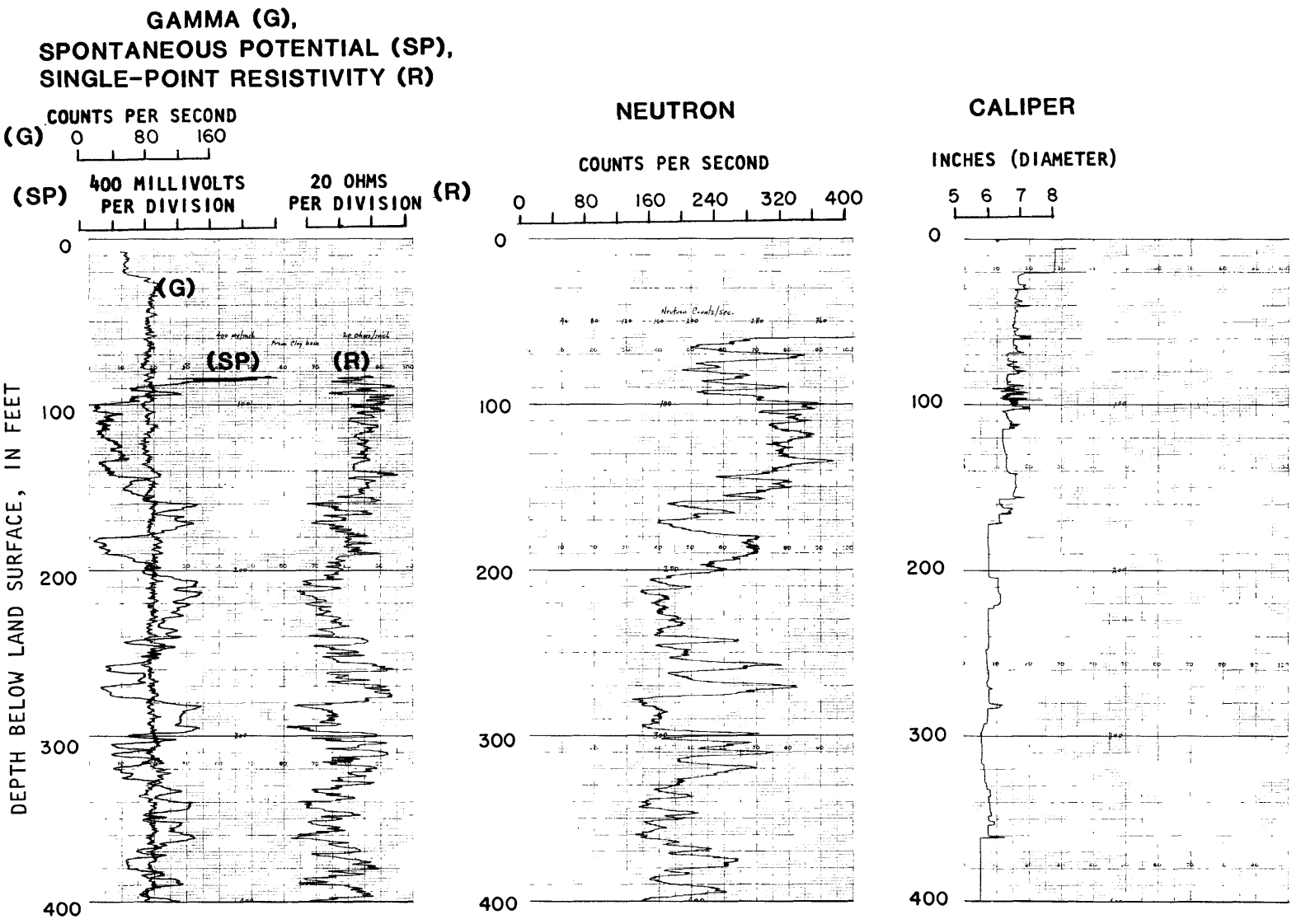
| Hour | Date | Formation | Depth (feet) | Marsh-funnel viscosity | Remarks |
|---|---|---|---|---|---|
| 2020 | 09-18 | --- | --- | 33 | Started drilling |
| 2030 | 09-18 | Sand | 10 | 28 | |
| 2045 | 09-18 | Sand | 20 | 29 | 20' steel collar |
| 2205 | 09-18 | Sand | 30 | 30 | |
| 2210 | 09-18 | Sand | 40 | 31 | Added 20' steel |
| 2238 | 09-18 | Sand | 50 | 31 | |
| 2250 | 09-18 | Sand | 60 | 32 | Added 20' steel |
| 0015 | 09-19 | Sand | 80 | 35 | Added 20' steel |
| 0045 | 09-19 | Sand | 90 | 35 | |
| 0050 | 09-19 | Sand | 100 | 35 | Added 20' steel |
| 0106 | 09-19 | Sand | 110 | 36 | |
| 0115 | 09-19 | Sand | 120 | 37 | Added 20' steel |
| 0148 | 09-19 | Sand | 140 | 37 | Added 20' steel |
| 0215 | 09-19 | Sand | 160 | 38 | Added 20' steel |
| 0256 | 09-19 | Sand | 180 | 38 | Added 20' steel |
| 0329 | 09-19 | Sand | 200 | 35 | Added 20' steel |
| 0354 | 09-19 | Sand/clay | 220 | 38 | Added 20' steel |
| 0424 | 09-19 | Sand/clay | 240 | 37 | Added 20' steel |
| 0502 | 09-19 | Sand/clay | 260 | 41 | Added 20' steel |
| 0531 | 09-19 | Sand/clay | 280 | 36 | Added 20' steel |
| 0602 | 09-19 | Sand | 300 | 36 | Added 20' steel |
| 0636 | 09-19 | Sand | 320 | 35 | Added 20' steel |
| 0701 | 09-19 | Sand | 340 | 40 | Added 20' steel |
| 0721 | 09-19 | Sand | 340 | 42 | Pulled steel, mud pump down for rebuild |
| 1040 | 09-19 | --- | --- | -- | Dropping steel in hole, mud pump repaired |
| 1135 | 09-19 | --- | 350 | 29 | Drilling |

Table 5.--Driller's log for test well T25 (22S.04E.24.144b) - Continued

| Hour | Date | Formation | Depth (feet) | Marsh-funnel viscosity | Remarks |
|---|---|---|---|---|---|
| 1205 | 09-19 | Sand | 360 | 31 | Repaired hoist cable |
| 1255 | 09-19 | --- | --- | 31 | Added 20' steel |
| 1310 | 09-19 | Sand | 370 | 31 | |
| 1335 | 09-19 | Sand | 380 | 31 | Added 20' steel |
| 1415 | 09-19 | Sand | 390 | 32 | |
| 1355 | 09-19 | Sand | 400 | 34 | |
| 1425 | 09-19 | --- | --- | 33 | Added 20' steel |
| 1455 | 09-19 | Sand | 410 | 34 | |
| 1500 | 09-19 | Sand | 420 | 32 | |
| 1510 | 09-19 | --- | --- | 32 | Added 20' steel |
| 1544 | 09-19 | Sand | 430 | 32 | |
| 1600 | 09-19 | Sand | 440 | 32 | Added 20' steel |
| 1626 | 09-19 | Sand | 450 | 29 | |
| 1647 | 09-19 | Sand | 460 | 31 | Added 20' steel |
| 1655 | 09-19 | Sand | 470 | 31 | |
| 1700 | 09-19 | Sand | 480 | 31 | Added 20' steel |
| 1703 | 09-19 | Sand | 500 | 31 | Met other hole Added 20' steel |
| 1705 | 09-19 | --- | 520 | 31 | Added 20' steel |
| 1709 | 09-19 | --- | 540 | 31 | Added 20' steel |
| 1711 | 09-19 | --- | 560 | 31 | Added 20' steel |
| 1715 | 09-19 | --- | 580 | -- | Added 20' steel |
| 1722 | 09-19 | --- | 600 | 33 | Added 20' steel |
| 1726 | 09-19 | --- | 620 | 33 | Added 20' steel |
| 1730 | 09-19 | --- | 640 | 33 | Added 20' steel |
| 1735 | 09-19 | --- | 660 | 33 | Added 20' steel |
| 1744 | 09-19 | --- | 680 | 35 | Added 20' steel |
| 1750 | 09-19 | --- | 700 | 35 | Added 20' steel |
| 1805 | 09-19 | --- | 720 | 34 | Added 20' steel |
| 1825 | 09-19 | --- | 740 | 34 | Added 20' steel |
| 1837 | 09-19 | Sand | 750 | 33 | Hit old bit |
| 1855 | 09-19 | Sand | 760 | 33 | Added 20' steel |
| 1900 | 09-19 | --- | --- | -- | Down, broke aux. cable |

Table 5.--Driller's log for test well T25 (22S.04E.24.144b) - Concluded

| Hour | Date | Formation | Depth (feet) | Marsh-funnel viscosity | Remarks |
|---|---|---|---|---|---|
| 1945 | 09-19 | --- | 760 | -- | Drilling again |
| 2012 | 09-19 | Sand | 770 | 31 | |
| 2027 | 09-19 | Sand | 780 | 31 | Added 20' steel |
| 2045 | 09-19 | Sand | 790 | 35 | |
| 2055 | 09-19 | Sand | 800 | 35 | Added 20' steel |
| 2115 | 09-19 | Sand | 810 | 34 | |
| 2130 | 09-19 | Sand | 820 | 35 | Added 20' steel |
| 2207 | 09-19 | Sand | 830 | 34 | |
| 2215 | 09-19 | Sand | 840 | 35 | Added 20' steel |
| 2300 | 09-19 | Sand | 850 | 41 | |
| 2315 | 09-19 | Sand | 860 | 29 | Added 20' steel |
| 2340 | 09-19 | --- | 870 | 35 | |
| 0004 | 09-20 | Sand | 880 | 36 | Added 20' steel |
| 0040 | 09-20 | Sand/clay | 890 | 40 | |
| 0115 | 09-20 | Sand/clay | 900 | 35 | Added 20' steel, down 15 min. due to mud gun valve |
| 0200 | 09-20 | Sand/ clay | 910 | 35 | |
| 0234 | 09-20 | Sand | 920 | 37 | Added 20' steel |
| 0325 | 09-20 | Sand | 930 | 41 | |
| 0412 | 09-20 | Sand | 940 | 43 | Added 20' steel, fixed break on tongs, prime mud pump |
| 0745 | 09-20 | --- | 945 | -- | Penetration stopped, circulation only; mud pump on/off valve not working; must use master clutch to stop mud |
| | | Hole completed at 945' | | | |


GAMMA (G),
SPONTANEOUS POTENTIAL (SP),
SINGLE-POINT RESISTIVITY (R)
COUNTS PER SECOND
(G) 0 80 160
(SP) 400 MILLIVOLTS PER DIVISION
20 OHMS PER DIVISION (R)
(G)
(SP)
(R)
DEPTH BELOW LAND SURFACE, IN FEET
0
100
200
300
400
NEUTRON
COUNTS PER SECOND
0 80 160 240 320 400
CALIPER
INCHES (DIAMETER)
5 6 7 8

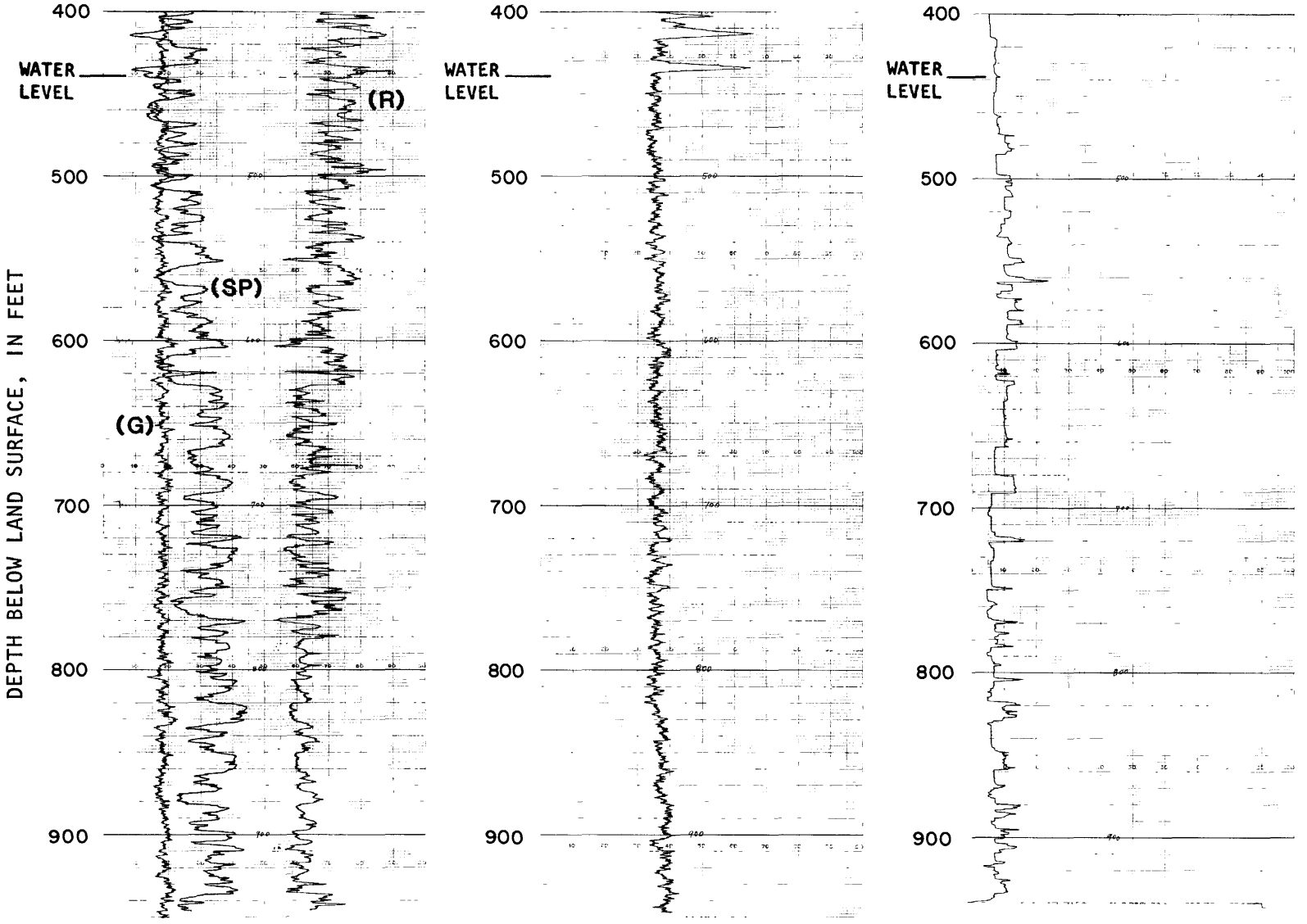



Figure 4.--Borehole-geophysical logs for test well T25 (22S.04E.24.144b).

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Eckles, Jim, 1982, Finding water a fine art at WSMR: Missile Ranger, White Sands Missile Range, New Mexico, v. 34, no. 37, p. 8.

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