**CONVERSION FACTORS**

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

<table>
<thead>
<tr>
<th>Multiply inch-pound units</th>
<th>by</th>
<th>To obtain metric units</th>
</tr>
</thead>
<tbody>
<tr>
<td>inch</td>
<td>25.40</td>
<td>millimeter</td>
</tr>
<tr>
<td>foot</td>
<td>0.3048</td>
<td>meter</td>
</tr>
<tr>
<td>mile</td>
<td>1.609</td>
<td>kilometer</td>
</tr>
<tr>
<td>cubic inch</td>
<td>16.39</td>
<td>cubic centimeter</td>
</tr>
</tbody>
</table>
TEST WELLS T27 AND T28,
WHITE SANDS MISSILE RANGE,
DOÑA ANA COUNTY, NEW MEXICO

By Robert G. Myers and Karen M. Pinckley

ABSTRACT

Two test wells, T27 and T28, were drilled at White Sands Missile Range in south-central New Mexico as part of a joint military training program sponsored by the U.S. Army in February and March 1983. Test wells T27 and T28 were drilled as observation wells in the vicinity of the Liquid Propellant Storage Area. Information obtained from these wells includes lithologic logs, driller's logs, and borehole-geophysical logs from the cased wells.

INTRODUCTION

Two test wells, T27 and T28 (fig. 1; table 1), were drilled at White Sands Missile Range in south-central New Mexico as part of a joint military training program sponsored by the U.S. Army in February and March 1983. The participants of the program were members of the U.S. Army (active) from White Sands Missile Range, New Mexico, and Fort Knox, Kentucky, and U.S. Army (reserve) from Missoula, Montana, and Bismarck, North Dakota. The U.S. Geological Survey assisted White Sands Missile Range in site selection, borehole-geophysical logging, analysis of well cuttings, and compilation of the lithologic logs. The hydraulic-rotary drilling method was used to drill the test wells. This study was done in cooperation with the U.S. Department of the Army, White Sands Missile Range, Engineering and Housing Directorate.

To date (December 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 test well T27 was estimated from U.S. Geological Survey borehole-geophysical logs.
Figure 1.—Location of test wells T27 and T28, White Sands Missile Range.
Lithologic logs in this report were prepared by the U.S. Geological Survey from cutting samples collected by the U.S. Army. The following list defines the terms used to describe the grain size of the detritus:

<table>
<thead>
<tr>
<th>Description</th>
<th>Size in millimeters</th>
<th>Size in inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pebbles</td>
<td>4-64</td>
<td>0.15-2.5</td>
</tr>
<tr>
<td>Granules</td>
<td>2-4</td>
<td>0.08-0.15</td>
</tr>
<tr>
<td>Very coarse sand</td>
<td>1.0-2.0</td>
<td>0.04-0.08</td>
</tr>
<tr>
<td>Coarse sand</td>
<td>0.5-1.0</td>
<td>0.02-0.04</td>
</tr>
<tr>
<td>Medium sand</td>
<td>0.25-0.5</td>
<td>0.01-0.02</td>
</tr>
<tr>
<td>Fine sand</td>
<td>0.125-0.25</td>
<td>0.005-0.01</td>
</tr>
<tr>
<td>Very fine sand</td>
<td>0.0625-0.125</td>
<td>0.0025-0.005</td>
</tr>
<tr>
<td>Silt</td>
<td>0.004-0.0625</td>
<td>0.00015-0.0025</td>
</tr>
<tr>
<td>Clay</td>
<td>less than 0.004</td>
<td>less than 0.00015</td>
</tr>
</tbody>
</table>

Rounding was determined from comparison with the grain models in the Manual of Field Geology (Compton, 1962). The degree of roundness can range from very angular to well rounded. Sorting is the degree to which grains in a sample approach the same size. This value can range from very well sorted (grains all the same size) to very poorly sorted (a wide range of grain sizes with no dominant grain sizes). The colors and any accompanying code numbers in the lithologic descriptions refer to the colors from the Rock-Color Chart (Goddard, 1948) prepared by the Rock-Color Chart Committee and distributed by the Geological Society of America.
Table 1. Well records of test wells T27 and T28

<table>
<thead>
<tr>
<th>Well name</th>
<th>Location</th>
<th>Date drilled</th>
<th>Water level below land surface (feet)</th>
<th>Drilled depth (feet)</th>
<th>Finished depth (feet)</th>
<th>Slotted interval, depth below land surface (feet)</th>
<th>Casing diameter (inches)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>T27</td>
<td>22S.05E.22.141</td>
<td>02-83</td>
<td>163±</td>
<td>263±</td>
<td>250</td>
<td>170-250</td>
<td>4 (PVC)</td>
<td>No cap on bottom of casing</td>
</tr>
<tr>
<td>T28</td>
<td>22S.05E.22.122</td>
<td>03-83</td>
<td>—</td>
<td>300</td>
<td>100±</td>
<td>160-300</td>
<td>4 (PVC)</td>
<td>Caved above water table; casing broken at about 77 feet below land surface.</td>
</tr>
</tbody>
</table>

TEST WELL T27

Test well T27 (fig. 1) was drilled as an observation well in February 1983 (table 1). The main purpose of the well is to monitor water levels and water quality in the vicinity of the Liquid Propellant Storage Area. The well penetrated Quaternary alluvium and bolson fill composed of interbedded silty clay and clay with some sand and silt. A lithologic log prepared by the U.S. Geological Survey from analysis of the well cuttings collected by the U.S. Army is shown in table 2.

T27 was drilled with a 7 7/8-inch-diameter wing bit to a depth of 263 feet and completed at a depth of 250 feet. A driller's log for T27 is shown in table 3. The well was drilled with organic-polymer drilling fluid. The well was completed with 250 feet of 4-inch-inside-diameter PVC casing with a slotted interval from 170 feet to 250 feet. The bottom of the well is uncapped. Borehole-geophysical logs made in the cased well are shown in figure 2. The depth to water below land surface of about 163 feet was estimated from the borehole-geophysical logs.
Table 2. Lithologic log for test well T27 (22S.05E.22.141)

<table>
<thead>
<tr>
<th>Lithology</th>
<th>Thickness (feet)</th>
<th>Depth interval below land surface (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay, moderate-brown (5YR 4/4), with about 50 percent caliche.</td>
<td>5</td>
<td>0-5</td>
</tr>
<tr>
<td>Clay, moderate-reddish-brown (10R 4/6), with about 20 percent caliche.</td>
<td>5</td>
<td>5-10</td>
</tr>
<tr>
<td>Clay, moderate-yellowish-brown (10YR 5/4), with a little silt and caliche.</td>
<td>5</td>
<td>10-15</td>
</tr>
<tr>
<td>Clay, moderate-yellowish-brown (10YR 5/4), with massive caliche.</td>
<td>10</td>
<td>15-25</td>
</tr>
<tr>
<td>Clay, moderate-brown (5YR 4/4) and moderate-reddish-brown (10R 4/6),</td>
<td>5</td>
<td>35-40</td>
</tr>
<tr>
<td>with a little silt and massive caliche.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clay, moderate-brown (5YR 4/4), with a little silt.</td>
<td>5</td>
<td>40-45</td>
</tr>
<tr>
<td>Clay, moderate-brown (5YR 4/4), with pockets of very fine black sand and some moderate-reddish-brown (10R 4/6) clay.</td>
<td>5</td>
<td>45-50</td>
</tr>
<tr>
<td>Clay, moderate-brown (5YR 4/4), with caliche.</td>
<td>15</td>
<td>50-65</td>
</tr>
<tr>
<td>Clay, silty, moderate-reddish-brown (10R 4/6) and moderate-yellowish-brown (10YR 5/4), with a little caliche.</td>
<td>25</td>
<td>65-90</td>
</tr>
<tr>
<td>Clay, very hard, moderate-brown (5YR 4/4), with caliche.</td>
<td>5</td>
<td>90-95</td>
</tr>
<tr>
<td>Clay, silty, moderate-brown (5YR 4/4), with a little caliche.</td>
<td>5</td>
<td>95-100</td>
</tr>
</tbody>
</table>
Table 2. Lithologic log for test well T27 (22S.05E.22.141) - Continued

<table>
<thead>
<tr>
<th>Lithology</th>
<th>Thickness (feet)</th>
<th>Depth interval below land surface (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay, silty, moderate-brown (5YR 4/4) and moderate-reddish-brown (10R 4/6).</td>
<td>15</td>
<td>100-115</td>
</tr>
<tr>
<td>Clay, silty, light-brown (5YR 5/6) and moderate-reddish-brown (10R 4/6), with much caliche.</td>
<td>5</td>
<td>115-120</td>
</tr>
<tr>
<td>Clay, moderate-brown (5YR 4/4), with a little silt and caliche.</td>
<td>30</td>
<td>120-150</td>
</tr>
<tr>
<td>Clay, silty, moderate-brown (5YR 4/4), with moderate-reddish-brown (10R 4/6) clay and much caliche.</td>
<td>5</td>
<td>150-155</td>
</tr>
<tr>
<td>Clay, moderate-brown (5YR 4/4), very hard, with caliche.</td>
<td>5</td>
<td>155-160</td>
</tr>
<tr>
<td>Clay, silty, moderate-brown (5YR 4/4), with bits of caliche.</td>
<td>5</td>
<td>160-165</td>
</tr>
<tr>
<td>Clay, moderate-brown (5YR 4/4), with caliche.</td>
<td>10</td>
<td>165-175</td>
</tr>
<tr>
<td>Clay, silty, moderate-brown (5YR 4/4) and moderate-reddish-brown (10R 4/6), with some caliche.</td>
<td>10</td>
<td>175-185</td>
</tr>
<tr>
<td>Clay, silty, light-brown (5YR 5/6), with very hard moderate-brown (5YR 4/4) clay and much caliche.</td>
<td>5</td>
<td>185-190</td>
</tr>
<tr>
<td>Clay, silty, light-brown (5YR 5/6) and moderate-reddish-brown (10R 4/6), with caliche.</td>
<td>20</td>
<td>190-210</td>
</tr>
<tr>
<td>Lithology</td>
<td>Thickness (feet)</td>
<td>Depth interval below land surface (feet)</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>------------------</td>
<td>-----------------------------------------</td>
</tr>
<tr>
<td>Silt, moderate-reddish-brown (10R 4/6), with very fine to fine-grained,</td>
<td>10</td>
<td>210-220</td>
</tr>
<tr>
<td>well-rounded quartz sand and caliche.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clay and silty clay, moderate-brown (5YR 4/4) and some moderate-reddish-</td>
<td>15</td>
<td>220-235</td>
</tr>
<tr>
<td>brown (10R 4/6), with caliche.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clay, moderate-brown (5YR 4/4), with a little very fine, greenish quartz</td>
<td>5</td>
<td>235-240</td>
</tr>
<tr>
<td>sand and caliche.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clay and silty clay, moderate-brown (5YR 4/4) and moderate-reddish-brown</td>
<td>20</td>
<td>240-260</td>
</tr>
<tr>
<td>(10R 4/6), with much massive caliche.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 3. Driller's log for test well T27 (22S.05E.22.141)

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

Date drilling started: 2-28-1983

<table>
<thead>
<tr>
<th>Hour</th>
<th>Date</th>
<th>Lithology</th>
<th>Depth below land surface (feet)</th>
<th>Marsh-funnel viscosity</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1100</td>
<td>02-28</td>
<td>Top soil</td>
<td>0</td>
<td>64</td>
<td>Started kelly in</td>
</tr>
<tr>
<td>1115</td>
<td>02-28</td>
<td>Clay</td>
<td>10</td>
<td>64</td>
<td>Normal drilling</td>
</tr>
<tr>
<td>1117</td>
<td>02-28</td>
<td>Clay</td>
<td>20</td>
<td>64</td>
<td>Added 20' section</td>
</tr>
<tr>
<td>1120</td>
<td>02-28</td>
<td>Clay</td>
<td>30</td>
<td>64</td>
<td>Normal drilling</td>
</tr>
<tr>
<td>1150</td>
<td>02-28</td>
<td>Clay</td>
<td>40</td>
<td>64</td>
<td>Added 20' section</td>
</tr>
<tr>
<td>1155</td>
<td>02-28</td>
<td>Clay</td>
<td>50</td>
<td>56</td>
<td>Normal drilling</td>
</tr>
<tr>
<td>1210</td>
<td>02-28</td>
<td>Clay and gravel</td>
<td>60</td>
<td>56</td>
<td>Added 20' section</td>
</tr>
<tr>
<td>1215</td>
<td>02-28</td>
<td>Clay and gravel</td>
<td>70</td>
<td>56</td>
<td>Normal drilling</td>
</tr>
<tr>
<td>1220</td>
<td>02-28</td>
<td>Clay and gravel</td>
<td>80</td>
<td>56</td>
<td>Added 20' section</td>
</tr>
<tr>
<td>1225</td>
<td>02-28</td>
<td>Clay and sand</td>
<td>90</td>
<td>45</td>
<td>Normal drilling</td>
</tr>
<tr>
<td>1235</td>
<td>02-28</td>
<td>Clay and sand</td>
<td>100</td>
<td>45</td>
<td>Added 20' section</td>
</tr>
<tr>
<td>1304</td>
<td>02-28</td>
<td>Silt</td>
<td>110</td>
<td>45</td>
<td>Few cuttings</td>
</tr>
<tr>
<td>1308</td>
<td>02-28</td>
<td>Gravel</td>
<td>115</td>
<td>45</td>
<td>Logged</td>
</tr>
<tr>
<td>1311</td>
<td>02-28</td>
<td>Silt and clay</td>
<td>120</td>
<td>45</td>
<td>Added 20' section</td>
</tr>
<tr>
<td>1315</td>
<td>02-28</td>
<td>Clay</td>
<td>130</td>
<td>36</td>
<td>Normal drilling</td>
</tr>
<tr>
<td>1322</td>
<td>02-28</td>
<td>Clay</td>
<td>140</td>
<td>36</td>
<td>Added 20' section</td>
</tr>
<tr>
<td>1324</td>
<td>02-28</td>
<td>Clay</td>
<td>150</td>
<td>36</td>
<td>Normal drilling</td>
</tr>
<tr>
<td>1335</td>
<td>02-28</td>
<td>Clay</td>
<td>160</td>
<td>36</td>
<td>Added 20' section</td>
</tr>
<tr>
<td>1343</td>
<td>02-28</td>
<td>Clay</td>
<td>170</td>
<td>36</td>
<td>Normal drilling</td>
</tr>
<tr>
<td>1350</td>
<td>02-28</td>
<td>Silt and clay</td>
<td>180</td>
<td>36</td>
<td>Added 20' section</td>
</tr>
<tr>
<td>1356</td>
<td>02-28</td>
<td>Silt and clay</td>
<td>190</td>
<td>36</td>
<td>Normal drilling</td>
</tr>
<tr>
<td>1402</td>
<td>02-28</td>
<td>Silt and clay</td>
<td>200</td>
<td>36</td>
<td>Added 20' section</td>
</tr>
<tr>
<td>1411</td>
<td>02-28</td>
<td>Silt and clay</td>
<td>210</td>
<td>36</td>
<td>Normal drilling</td>
</tr>
<tr>
<td>1420</td>
<td>02-28</td>
<td>Silt and clay</td>
<td>220</td>
<td>36</td>
<td>Added 20' section</td>
</tr>
<tr>
<td>1425</td>
<td>02-28</td>
<td>Silt and clay</td>
<td>230</td>
<td>36</td>
<td>Normal drilling</td>
</tr>
<tr>
<td>1442</td>
<td>02-28</td>
<td>Silt and clay</td>
<td>240</td>
<td>36</td>
<td>Added 20' section</td>
</tr>
<tr>
<td>1446</td>
<td>02-28</td>
<td>Silt and clay</td>
<td>250</td>
<td>36</td>
<td>Normal drilling</td>
</tr>
<tr>
<td>1450</td>
<td>02-28</td>
<td>Silt and clay</td>
<td>260</td>
<td>36</td>
<td>Done drilling</td>
</tr>
<tr>
<td>1600</td>
<td>02-28</td>
<td>Silt and clay</td>
<td>263</td>
<td>36</td>
<td>Reamed hole, began pulling steel</td>
</tr>
</tbody>
</table>
Figure 2.--Gamma, neutron, and caliper logs for test well T77 (22S.05E.22.141) with casing.
TEST WELL T28

Test well T28 (fig. 1) was drilled as an observation well in March 1983 (table 1). The main purpose of the well is to monitor water levels and water quality in the vicinity of the Liquid Propellant Storage Area. The well penetrated Quaternary alluvium and bolson fill composed of interbedded clay, silt, sand and gravel. A lithologic log prepared by the U.S. Geological Survey from analysis of the well cuttings collected by the U.S. Army is shown in table 4.

T28 was drilled with a 9 7/8-inch-diameter wing bit to a depth of 300 feet and completed at a depth of 300 feet. A driller's log for T28 is shown in table 5. The well was drilled with a bentonite drilling fluid. The well was completed with 300 feet of 4-inch-inside-diameter PVC casing with a slotted interval from 160 feet to 300 feet. The bottom of the well is uncapped. A caliper log made in the cased well is shown in figure 3. The casing is separated at about 77 feet below land surface (fig. 3). A dummy probe was used to break through the bridge in the casing at 80 feet below land surface. The probe was spudded to about 100 feet below land surface and could not go beyond that depth. The finished well depth is above the water table.

CALIPER

Figure 3.--Caliper log for test well T28 (22S.05E.22.122) with casing.
### Table 4. Lithologic log for test well T28 (22S.05E.22.122)

<table>
<thead>
<tr>
<th>Lithology</th>
<th>Thickness (feet)</th>
<th>Depth interval below land surface (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay, moderate-brown (5YR 4/4), with a little silt and some very coarse grained sand and granules consisting of subrounded quartz, feldspar, granite, and purple igneous rock; contains massive caliche and biotite flakes.</td>
<td>15</td>
<td>0-15</td>
</tr>
<tr>
<td>Clay, moderate-brown (5YR 3/4), with granules of subrounded quartz, granite, feldspar, and purple igneous rock; much fine-grained, well-rounded quartz sand from 25-30 feet; caliche and biotite throughout.</td>
<td>15</td>
<td>15-30</td>
</tr>
<tr>
<td>Sand, fine-grained, quartz, moderately well-rounded, with bits of hard, moderate-brown (5YR 4/4) clay and soft caliche; a little rounded, coarse-grained quartz.</td>
<td>5</td>
<td>30-35</td>
</tr>
<tr>
<td>Clay, moderate-brown (5YR 4/4), with much massive caliche.</td>
<td>5</td>
<td>35-40</td>
</tr>
<tr>
<td>Sand, fine- to medium-grained, quartz, subrounded, with some subrounded, coarse-grained sand consisting of quartz, chert, feldspar, and moderate-reddish-orange (10K 6/6) igneous rock; also bits of hard, moderate-brown (5YR 4/4) clay and moderate-orange-pink (10R 7/4) caliche.</td>
<td>10</td>
<td>40-50</td>
</tr>
<tr>
<td>Pebbles, subrounded to well-rounded, quartz, feldspar, and chert with a little moderate-brown (5YR 4/4) clay and hard caliche; poorly sorted.</td>
<td>5</td>
<td>50-55</td>
</tr>
<tr>
<td>Clay, moderate-brown (5YR 4/4), with very coarse grained sand to granules of quartz, chert, and feldspar; medium- to coarse-grained sand from 60-65 feet.</td>
<td>15</td>
<td>55-70</td>
</tr>
</tbody>
</table>
Table 4. Lithologic log for test well T28 (22S.05E.22.122) - Continued

<table>
<thead>
<tr>
<th>Lithology</th>
<th>Thickness (feet)</th>
<th>Depth interval below land surface (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand, medium- to very coarse grained, with a few granules consisting of</td>
<td>5</td>
<td>70-75</td>
</tr>
<tr>
<td>well-rounded quartz with a little chert, purple (5RP) igneous rock, and</td>
<td></td>
<td></td>
</tr>
<tr>
<td>granite; contains caliche; poorly sorted.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Granules, subrounded to well-rounded; composed mostly of quartz with some</td>
<td>5</td>
<td>75-80</td>
</tr>
<tr>
<td>brown (5YR) and purple (5RP) igneous rock and a little granite and caliche.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clay, silty, pale-yellowish-brown (10YR 6/2), with a few subrounded</td>
<td>15</td>
<td>80-95</td>
</tr>
<tr>
<td>granules of quartz, and igneous rocks with massive pinkish-gray (5YR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8/1) caliche.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clay, pale- (10YR 6/2) to moderate-yellowish-brown (10YR 5/4), with a few</td>
<td>10</td>
<td>95-105</td>
</tr>
<tr>
<td>granules and some caliche.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clay, moderate-yellowish-brown (10YR 5/4), with caliche.</td>
<td>25</td>
<td>105-130</td>
</tr>
<tr>
<td>Clay, silty, yellowish-brown (10YR 5/4), with caliche.</td>
<td>5</td>
<td>130-135</td>
</tr>
<tr>
<td>Clay with silt, moderate-brown (5YR 4/4), and much rounded quartz grains</td>
<td>5</td>
<td>135-140</td>
</tr>
<tr>
<td>ranging in size from fine to coarse grained with scattered granules;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>some fine-grained sand is cemented with pinkish-gray (5YR 8/1) caliche;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>feldspar, chert, and igneous rocks are present in small amounts.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand, fine- to medium-grained, quartz, rounded, cemented (very hard)</td>
<td>5</td>
<td>140-145</td>
</tr>
<tr>
<td>with caliche; a few subrounded granules of quartz, chert, and feldspar are</td>
<td></td>
<td></td>
</tr>
<tr>
<td>present.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lithology</td>
<td>Thickness (feet)</td>
<td>Depth interval below land surface (feet)</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>------------------</td>
<td>-----------------------------------------</td>
</tr>
<tr>
<td>Caliche, massive, with fine- to medium-grained, well-rounded quartz sand cemented within; a few subrounded quartz and igneous granules and a little moderate-brown (5YR 4/4) clay are present from 155-160 feet.</td>
<td>15</td>
<td>145-160</td>
</tr>
<tr>
<td>Sand, fine-grained, well-rounded, quartz, and pale-yellowish-brown (10YR 6/2) clay with some medium-grained sand and granules, mostly consisting of well-rounded quartz, and caliche; very poorly sorted.</td>
<td>5</td>
<td>160-165</td>
</tr>
<tr>
<td>Clay and silty clay, moderate-brown (5YR 4/4), with much caliche and fine- to medium-grained quartz sand from 165-170 feet.</td>
<td>15</td>
<td>165-180</td>
</tr>
<tr>
<td>Clay, moderate-yellowish-brown (10YR 5/4), with fine-grained sand and caliche.</td>
<td>10</td>
<td>180-190</td>
</tr>
<tr>
<td>Clay, silty, pale- (10YR 6/2) to moderate-yellowish-brown (10YR 5/4), with much massive caliche.</td>
<td>10</td>
<td>190-200</td>
</tr>
<tr>
<td>Clay, silty, moderate-yellowish-brown (10YR 5/4), with fine- to medium-grained sand and much caliche.</td>
<td>10</td>
<td>200-210</td>
</tr>
<tr>
<td>Clay, silty, moderate-yellowish-brown (10YR 5/4), with much caliche.</td>
<td>5</td>
<td>210-215</td>
</tr>
<tr>
<td>Clay, moderate-yellowish-brown (10YR 5/4), with much caliche; some fine- to coarse-grained sand from 220-225 feet.</td>
<td>10</td>
<td>215-225</td>
</tr>
<tr>
<td>Lithology</td>
<td>Thickness (feet)</td>
<td>Depth interval below land surface (feet)</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Clay silty, moderate-yellowish-brown (10YR 5/4), with caliche; some fine-grained sand from 225-230 feet.</td>
<td>10</td>
<td>225-235</td>
</tr>
<tr>
<td>Clay, moderate-brown (5YR 4/4), with a little silt and caliche.</td>
<td>25</td>
<td>235-260</td>
</tr>
<tr>
<td>Clay, silty, moderate-brown (5YR 4/4), with large chunks of carbonate-cemented fine-grained sublitharenite and bits of caliche; interval from 270-275 feet contains much fine-grained quartz sand.</td>
<td>15</td>
<td>260-275</td>
</tr>
</tbody>
</table>
Table 5. Driller's log for test well T28 (22S.05E.22.122)

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

Date drilling started: 3-1-1983

<table>
<thead>
<tr>
<th>Hour</th>
<th>Date</th>
<th>Lithology</th>
<th>Depth below land surface (feet)</th>
<th>Marsh-funnel viscosity</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1300</td>
<td>03-01</td>
<td>Silt, large sand, and clay</td>
<td>10</td>
<td>36</td>
<td>Spud in</td>
</tr>
<tr>
<td>1328</td>
<td>03-01</td>
<td>Caliche, silt, and coarse sand</td>
<td>20</td>
<td>32</td>
<td>Normal drilling, added 20' steel</td>
</tr>
<tr>
<td>1340</td>
<td>03-01</td>
<td>Small gravel</td>
<td>25-26</td>
<td>32</td>
<td>1 foot</td>
</tr>
<tr>
<td>1403</td>
<td>03-01</td>
<td>Red to white clay and small gravel</td>
<td>40</td>
<td>34</td>
<td>Added bentonite (2), normal drilling</td>
</tr>
<tr>
<td>1425</td>
<td>03-01</td>
<td>Silt, clay, and small gravel</td>
<td>42-50</td>
<td>31</td>
<td>10 feet, normal drilling</td>
</tr>
<tr>
<td>1450</td>
<td>03-01</td>
<td>Silt, clay, sand, and small gravel</td>
<td>60</td>
<td>31</td>
<td>Normal drilling</td>
</tr>
<tr>
<td>1500</td>
<td>03-01</td>
<td>Silt, clay, sand, and small gravel</td>
<td>70</td>
<td>28</td>
<td>Added 500 gal. water, normal drilling</td>
</tr>
<tr>
<td>1505</td>
<td>03-01</td>
<td>Coarse sand, clay, silt, and gravel</td>
<td>80</td>
<td>27</td>
<td>Normal drilling</td>
</tr>
<tr>
<td>1525</td>
<td>03-01</td>
<td>Small gravel, clay, and silt</td>
<td>90</td>
<td>27</td>
<td>Normal drilling</td>
</tr>
<tr>
<td>1535</td>
<td>03-01</td>
<td>Red and white clay, small gravel, and silt</td>
<td>100</td>
<td>26</td>
<td>Normal drilling</td>
</tr>
<tr>
<td>Hour</td>
<td>Date</td>
<td>Lithology</td>
<td>Depth below land surface (feet)</td>
<td>Marsh-funnel viscosity</td>
<td>Remarks</td>
</tr>
<tr>
<td>-------</td>
<td>------</td>
<td>----------------------------------</td>
<td>---------------------------------</td>
<td>------------------------</td>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>1545</td>
<td>03-01</td>
<td>Red clay, sand, silt, small gravel</td>
<td>110</td>
<td>26</td>
<td>105'-107' gravel, normal drilling</td>
</tr>
<tr>
<td>1555</td>
<td>03-01</td>
<td>Red clay, sand, and silt</td>
<td>123</td>
<td>26</td>
<td>Normal drilling</td>
</tr>
<tr>
<td>1600</td>
<td>03-01</td>
<td>--</td>
<td>123</td>
<td>26</td>
<td>Bit clogged</td>
</tr>
<tr>
<td>1605</td>
<td>03-01</td>
<td>--</td>
<td>123</td>
<td>--</td>
<td>Pulled steel</td>
</tr>
<tr>
<td>1655</td>
<td>03-01</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>Disconnected bit to wash</td>
</tr>
<tr>
<td>1740</td>
<td>03-01</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>Reconnected bit</td>
</tr>
<tr>
<td>1745</td>
<td>03-01</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>Trip back into hole</td>
</tr>
<tr>
<td>1855</td>
<td>03-01</td>
<td>Clay, sand, silt</td>
<td>125</td>
<td>35</td>
<td>Started drilling, added 5 bags of mud</td>
</tr>
<tr>
<td>1905</td>
<td>03-01</td>
<td>Clay, sand, silt</td>
<td>130</td>
<td>35</td>
<td>Normal drilling</td>
</tr>
<tr>
<td>1925</td>
<td>03-01</td>
<td>Clay, sand, silt</td>
<td>140</td>
<td>35</td>
<td>Normal drilling, added 20' steel</td>
</tr>
<tr>
<td>1945</td>
<td>03-01</td>
<td>Clay, sand, silt</td>
<td>150</td>
<td>35</td>
<td>Normal drilling</td>
</tr>
<tr>
<td>2005</td>
<td>03-01</td>
<td>Clay, sand, silt</td>
<td>160</td>
<td>35</td>
<td>Added 20' steel</td>
</tr>
<tr>
<td>2028</td>
<td>03-01</td>
<td>Clay, sand, silt</td>
<td>170</td>
<td>38</td>
<td>Normal drilling</td>
</tr>
</tbody>
</table>
Table 5. **Driller's log for test well T28 (22S.05E.22.122) — Continued**

<table>
<thead>
<tr>
<th>Hour</th>
<th>Date</th>
<th>Lithology</th>
<th>Depth below land surface (feet)</th>
<th>Marsh-funnel viscosity</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>2055</td>
<td>03-01</td>
<td>Sand, clay, silt</td>
<td>180</td>
<td>38</td>
<td>Added 20' steel</td>
</tr>
<tr>
<td>2100</td>
<td>03-01</td>
<td>Sand, clay, silt</td>
<td>190</td>
<td>39</td>
<td>Normal drilling</td>
</tr>
<tr>
<td>2110</td>
<td>03-01</td>
<td>Sand, clay, silt</td>
<td>200</td>
<td>39</td>
<td>Added 20' steel</td>
</tr>
<tr>
<td>2142</td>
<td>03-01</td>
<td>Clay and silt</td>
<td>210</td>
<td>42</td>
<td>Normal drilling</td>
</tr>
<tr>
<td>2153</td>
<td>03-01</td>
<td>Clay and silt</td>
<td>220</td>
<td>42</td>
<td>Added 20' steel</td>
</tr>
<tr>
<td>2255</td>
<td>03-01</td>
<td>Clay and silt</td>
<td>230</td>
<td>43</td>
<td>Normal drilling</td>
</tr>
<tr>
<td>2300</td>
<td>03-01</td>
<td>Clay and silt</td>
<td>240</td>
<td>43</td>
<td>Added 20' steel</td>
</tr>
<tr>
<td>2316</td>
<td>03-01</td>
<td>Clay and silt</td>
<td>250</td>
<td>43</td>
<td>Normal drilling</td>
</tr>
<tr>
<td>2322</td>
<td>03-01</td>
<td>Clay and silt</td>
<td>260</td>
<td>40</td>
<td>Added 20' steel</td>
</tr>
<tr>
<td>2345</td>
<td>03-01</td>
<td>Clay and silt</td>
<td>270</td>
<td>40</td>
<td>Normal drilling</td>
</tr>
<tr>
<td>0002</td>
<td>03-02</td>
<td>Clay and silt</td>
<td>280</td>
<td>40</td>
<td>Normal drilling</td>
</tr>
<tr>
<td>0020</td>
<td>03-02</td>
<td>Clay and silt</td>
<td>290</td>
<td>40</td>
<td>Normal drilling</td>
</tr>
<tr>
<td>0040</td>
<td>03-02</td>
<td>Clay and silt</td>
<td>300</td>
<td>40</td>
<td>Circulating on bottom</td>
</tr>
</tbody>
</table>
### Table 5. Driller's log for test well T28 (22S.05E.22.122) - Concluded

<table>
<thead>
<tr>
<th>Hour</th>
<th>Date</th>
<th>Lithology</th>
<th>Depth below land surface (feet)</th>
<th>Marsh-funnel viscosity</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>0125</td>
<td>03-02</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>Started tripping out</td>
</tr>
<tr>
<td>0210</td>
<td>03-02</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>Take off bit, set up for casing</td>
</tr>
<tr>
<td>0255</td>
<td>03-02</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>Started putting 4&quot; PVC in hole</td>
</tr>
<tr>
<td>0515</td>
<td>03-02</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>Finished casing, started to put steel down hole</td>
</tr>
<tr>
<td>0555</td>
<td>03-02</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>Aux. cable undone from fixed end</td>
</tr>
<tr>
<td>0615</td>
<td>03-02</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>Started putting steel in hole</td>
</tr>
<tr>
<td>0640</td>
<td>03-02</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>Ready to develop</td>
</tr>
<tr>
<td>0820</td>
<td>03-02</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>Pull steel, steel caught in casing</td>
</tr>
</tbody>
</table>
REFERENCES
