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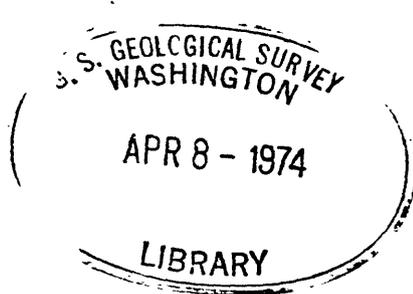
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Test wells drilled at Mockingbird Gap,
Socorro County, N. Mex., June to October 1965

By

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Test wells drilled at Mockingbird Gap,
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Introduction

The Mockingbird Gap area in Socorro County, N. Mex., (fig. 1)

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is in the north-central part of the White Sands Missile Range. Wells in this area yield potable or near-potable water that is used for domestic purposes at several outlying military facilities in the northern part of the Missile Range.

The Mockingbird Gap well in sec. 15, T. 9 S., R. 5 E., (fig. 2)

Figure 2 (caption on next page) belongs near here.

yielded potable water for several years prior to the mid-1950's and was used as a supply well by the Army. By the mid-1950's the yield of the well had declined so much that its use was discontinued, and water was then obtained from the Murray well in sec. 32, T. 8 S., R. 5 E. The yield of the Murray well has declined over the years and during periods of peak use in 1964 and 1965 the yield was insufficient to supply demands of the uprange facilities.

Figure 1.--Mockingbird Gap area, Socorro County, N. Mex., and the
White Sands Missile Range.

2.--Wells in the Mockingbird Gap area, White Sands Missile
Range, N. Mex.

The Mockingbird Gap area is a central water-supply point for much of the uprange area. Funds were allocated by White Sands Missile Range during Fiscal Year 1965 for the drilling of test wells to define the extent of the reservoir tapped by the Murray well and to determine the feasibility of locating a well field in this area. A well site was selected and drilling operations were monitored by the Geological Survey in accordance with provisions of the continuing cooperative agreement between the White Sands Missile Range and the U.S. Geological Survey.

Drilling operations

The occurrence of ground water in the Mockingbird Gap area is described by Weir (1964) and is based on sparse records of the few wells in the area and on the nearby rock outcrops. Figure 3 shows

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Weir's inferred relationships of the rocks and structural conditions in the subsurface in the vicinity of Murray well, which indicates that the Glorieta Sandstone is faulted downward on the south side of an east trending fault at this location and that the source of water to the Murray well is the Glorieta Sandstone.

The site chosen for Mockingbird Gap test well 1 (fig. 2) was based on Weir's interpretation. The test well was expected to penetrate the same general sequence of rock as that in Murray well and to tap water in the Glorieta Sandstone. Information gained from the drilling of Mockingbird Gap test well 1 (tables 1 and 2, and figs. 4 and 6) led to the conclusion that the fault trap was terminated on the west side of the gap by a north trending fault and that the test well had been drilled west of this fault and had not penetrated the aquifer tapped by the Murray well.

Figure 3.--Diagrammatic cross section through Murray well and
MacDonald well 1.

Table 1. --Records of Mockingbird Gap test well 1

Location: SE $\frac{1}{2}$ SW $\frac{1}{2}$ SW $\frac{1}{2}$ sec. 32, T. 8 S., R. 5 E.

Altitude: Land surface altitude 5,070 feet

interpolated from USGS topographic map.

Depth: Drilled to 310 feet, completed at 250 feet.

Date started: June 16, 1965.

Date completed: July 3, 1965 (final bailing test).

Drilling contractor: Perry Drilling Co., Tularosa, New Mexico.

Drilling method: Cable tool rig.

Casing and well record: Drilled to 310 feet with 9 $\frac{1}{2}$ -inch bit, June 16 to June 25, 1965. 6 5/8-inch steel casing installed to a depth of 250 feet June 30, 1965, casing was torch-cut 1/8 X 4-inch slots, 12 slots per foot, from 225 to 250 feet.

Well completion record: Concrete well head set and well retained as observation well.

Summary of drilling: Water entered the well at a depth of about 230 to 235 feet and rose to 181 feet. Drilling was stopped at a depth of 310 feet on June 25. A gamma-ray neutron log of the cased section of the well was made by Lane Wells Company on July 1 (fig. 4).

Figure 4 (caption on next page) belongs near here.

The well was developed by bailing and surging with a bailer. The well was tested for yield by bailing July 3, 1965; 525 gallons of water were bailed from the well and the water level was lowered 51 feet. The water level recovered 23 feet in 45 minutes, an approximate yield of 1.5 gallons per minute. The water obtained from the well is similar to that from Murray well in chemical quality and temperature (table 5).

Figure 4.--Gamma-ray neutron log of Mockingbird Gap test well 1.

Table 1.--Record of Mockingbird Gap test well 1 - Concluded

The water was obtained from unconsolidated fan or bolson deposits overlying mudstone or shale.

Formation logs: Table 2, Sample description, and fig. 4, Gamma-ray neutron log.

Table 2.--Sample description log of Mockingbird Gap test well 1

<u>Material</u>	<u>Depth interval (feet)</u>	
Silt, sandy, tan to orange brown; some granule size gravel-----	0	5
Sand, silty, gravelly, tan, very fine to very coarse, angular to subrounded, poorly sorted; granule gravel is composed of arkose, chert and limestone-----	5	20
Sand, silty, tan, fine to very fine, angular to rounded, poorly sorted; few granule size particles-----	20	45
Sand, silty, gravelly, as in interval 5-20-----	45	55
Sand, silty, as in interval 20-45-----	55	65
Clay, silty, sandy, yellowish tan; some granule to pebble size particles. Wood chips, probably juniper, 10 X 20 X 4 mm in interval 70-75-----	65	80
Clay, tan, and gravel, granule to pebble, rounded to subangular, poorly sorted-----	80	95
Clay, gray with yellow stains, and sandstone, yellow-brown, fine to very fine, mixed composition, angular to subangular, poorly sorted, calcareous cement-----	95	105
Clay, gray, and pebbles, mixed composition, angular to sub- rounded, poorly sorted-----	105	125
Clay, dark gray with yellow streaks and black carbonaceous inclusions; some yellow, friable, very fine sandstone and mixed pebbles-----	125	130

Table 2.--Sample description log of Mockingbird Gap test well 1 - Concluded

<u>Material</u>	<u>Depth interval (feet)</u>	
Silt, clayey, yellowish-tan, and dark gray clay; some pebbles and a piece of pyrite-----	130	140
Silt, clayey, yellowish tan; some pebbles-----	140	145
Sand, silty, tan, fine to very fine, mostly quartz, angular to rounded, poorly sorted; some mixed pebbles-----	145	150
Silt, as in interval 130-140-----	150	155
Sand, silty, tan, fine to very fine, mostly quartz, angular to subangular, poorly sorted; some pebbles and discrete fragments of dark gray clay or shale-----	155	185
Sand, as in interval 155-185, except gray-----	185	210
Sand, as in interval 155-185; some fragments of calcareously cemented sandstone-----	210	225
Gravel, sandy, yellowish-tan, granule to pebble, angular to subrounded, poorly sorted; particles are arkose, limestone, and sandstone (water bearing)-----	225	245
Shale or mudstone, dark gray, and sandstone fragments. Calcite rhombs and pyrite in some samples. Large fragment of black carbonaceous material from 245-250 -----	245	310

The site chosen for Mockingbird Gap test well 2 (fig. 2) was approximately midway between Mockingbird Gap test well 1 and the Murray well. This site was assumed to be east of the inferred north trending fault and should have penetrated the down-faulted sandstone aquifer as shown in figure 3. Information gained from the drilling of this well indicated also that the aquifer tapped by the Murray well was not penetrated (tables 3, 4, and figs 5 and 6).

Table 3.--Record of Mockingbird Gap test well 2

Location: SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{2}$ sec. 32, T. 8 S., R. 5 E.

Altitude: Land surface altitude 5,090 feet

interpolated from USGS topographic map.

Depth: 500 feet.

Date started: September 1, 1965.

Date completed: October 11, 1965 (casing pulled).

Drilling contractor: Perry Drilling Co., Tularosa, New Mexico.

Drilling method: Cable tool rig.

Casing and well record: Drilled to 475 feet with 10-inch bit and 6 5/8-inch blank steel casing installed; well drilled to 500-foot depth with 6-inch tools after casing was installed. Well drilled and cased September 1 to October 7, 1965.

Well completion record: Casing pulled and well abandoned.

Table 4.--Sample description log of Mockingbird Gap test well 2

<u>Material</u>	<u>Depth interval (feet)</u>	
Soil, sandy, gravelly, tan; particles range to 20 mm in diameter and are of mixed composition, well rounded to angular-----	0	5
Gravel, sandy, mixed composition, and tan clay. Particles are as large as 20 mm in diameter, angular to well rounded, and consist of dark gray limestone, feldspars and granite chips, chert and sandstone fragments-----	5	25
Clay, sandy, reddish tan, calcareous, and gravel to 12 mm diameter-----	25	75
Clay, reddish tan, calcareous; some sand to pebble size particles-----	75	170
Clay, yellowish tan, calcareous; some sand to pebble size particles; larger particles are mostly arkose and some limestone-----	170	200
Clay, dark blue gray, noncalcareous, and yellow clay as in interval 170-200; some sand to pebble size particles of arkose and limestone; some gray noncalcareous siltstone fragments in intervals 210-235-----	200	235
Siltstone, gray, slightly calcareous, clay, and a few particles of granite and limestone (water bearing) -----	235	245
Clay, dark blue gray, coherent, with included black organic material and particles from granule to pebble size of mixed composition-----	245	295
Clay, silty, sandy, gray and few granule to pebble size particles of mixed composition. Carbonaceous black material and pyrite in some samples. Material from 245-500 is probably a poorly indurated shale-----	295	500

Summary of drilling:

Water entered the well at a depth of 235 feet and rose to a depth of 222.7 feet. The yield of this water-bearing zone was estimated at about $\frac{1}{2}$ gpm (gallon per minute). Another water-bearing zone having an estimated yield of about $\frac{1}{2}$ gpm was penetrated at about 385 feet. The depth to water after this zone was penetrated was about 240 feet, indicating that the second zone was under less pressure than the first zone. A third water-bearing zone was penetrated at a depth of about 470 feet; the depth to water in the well was about 266.7 feet after this zone was penetrated. Yield of the lower water-bearing zone was estimated to be about 20 gpm by bailing. Drilling could not be continued because the well was caving badly. Blank casing was installed to a depth of 475 feet and the well was drilled with smaller tools to the final depth of 500 feet. A gamma ray neutron log was made by Schlumberger Well Surveying Corporation on October 8, 1965 (fig. 5). None of the water obtained from the well was potable

Figure 5 (caption on next page) belongs near here.

(table 5); the casing was pulled and the well abandoned October 11, 1965.

The source of the water from the three zones was siltstone and sandy clay or shale.

Formation logs: Table 4, Sample description, and fig. 5, Gamma ray neutron log.

Figure 5.--Gamma-ray neutron log of Mockingbird Gap test well 2.

Table 5.--Chemical analyses of water samples from
wells in the Mockingbird Gap area

(Analyses, in parts per million, made by U.S. Geological Survey)

Well	Murray well	Mockingbird Gap test well 1	Mockingbird Gap test well 2	Mockingbird Gap test well 2	Mockingbird Gap test well 2
Sample interval (feet)	all	225 - 250	235 - 255	385±	465 - 470
Date of collection	6-18-64	7-2-65	9-13-65	9-16-65	9-20-65
Silica (SiO ₂)	27	17			10
Iron (Fe)	0.01				
Calcium (Ca)	118	80			41
Magnesium (Mg)	28	22			13
Sodium (Na)					370
Potassium (K)	41	107			
Bicarbonate (HCO ₃)	162	236			129
Carbonate (CO ₃)	0	0			0
Sulfate (SO ₄)	285	278	503	510	622
Chloride (Cl)	45	28	41	100	146
Fluoride (F)	1.0	0.7			1.2
Nitrate (NO ₃)	5.7	0.5			0.0
Dissolved solids					
Calculated	631	649			1,270
Residue on evaporation at 180°C	671	647			
Hardness as CaCO ₃	416	292			158
Noncarbonate hardness as CaCO ₃	277	98			52
Specific conductance (Micromhos at 25°C)	920	974	1,300	1,560	1,880
pH	7.5	8			8.2
Color	2				

Results of test drilling and recommendations for additional work

Figure 6 shows the physical relationship of Mockingbird Gap test

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wells 1 and 2 to Murray well, the depth to water in the wells, and the points at which water first entered the test wells. Mockingbird Gap test wells 1 and 2 did not penetrate the expected sequence of rocks nor did they yield enough potable water to justify drilling of production wells. The dark-gray siltstone and shale in the lower part of both wells suggests that the area is structurally complex or that the structure differs from that postulated by Weir. Additional work and drilling will be needed in this area to define the limits of the aquifer tapped by the Murray well.

The following suggested investigative procedures are based on the information obtained from the test wells:

1. Obtain a gamma-ray neutron log of Murray well the next time the pump is pulled for maintenance work. Comparison of this log with the logs from the test wells may lead to a new interpretation of the conditions under which ground water occurs in this area.

2. Obtain a geophysical survey of the Mockingbird Gap area. The area is much faulted and delineation of the faults now masked by alluvium is needed to delimit the extent of the aquifer tapped by the Murray well.

3. Drill a test well within 50 feet of Murray well to a depth of at least 400 feet to determine whether the Murray well fully penetrates the aquifer it taps, and to determine whether or not water of poor quality underlies the present usable supply.

Figure 6.--Plan and profile sketch of the Mockingbird Gap test wells
and the Murray well.

4. Program at least two additional test wells in the immediate area of the Murray well to determine the attitude of the aquifer beds and the areal extent of the saturated material.

5. Consider additional test drilling on the fan slopes of the igneous rock outcrops at the north end of the San Andres Mountains both on the Jornada del Muerto and Tularosa Basin sides; also in the Oscura Gap area, about five miles northeast of the Murray well.

Reference cited

Weir, J. E., Jr., 1965, Geology and availability of ground water in the northern part of the White Sands Missile Range and vicinity, New Mexico: U.S. Geol. Survey Water-Supply Paper 1801, p. 44.

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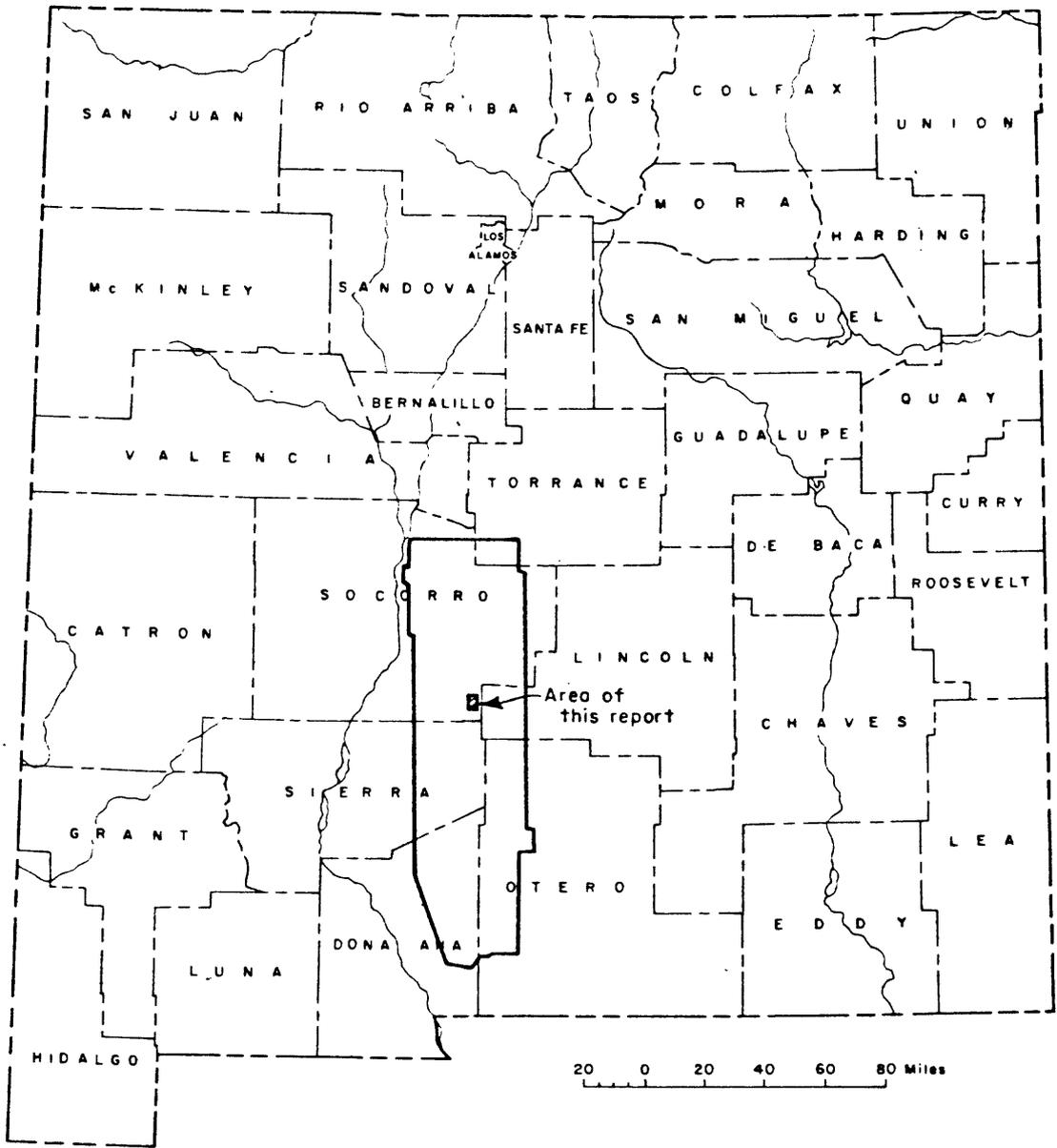
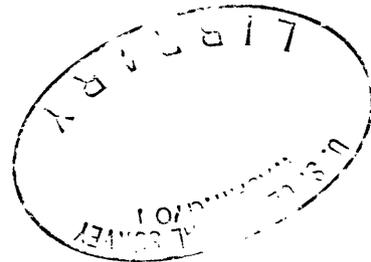
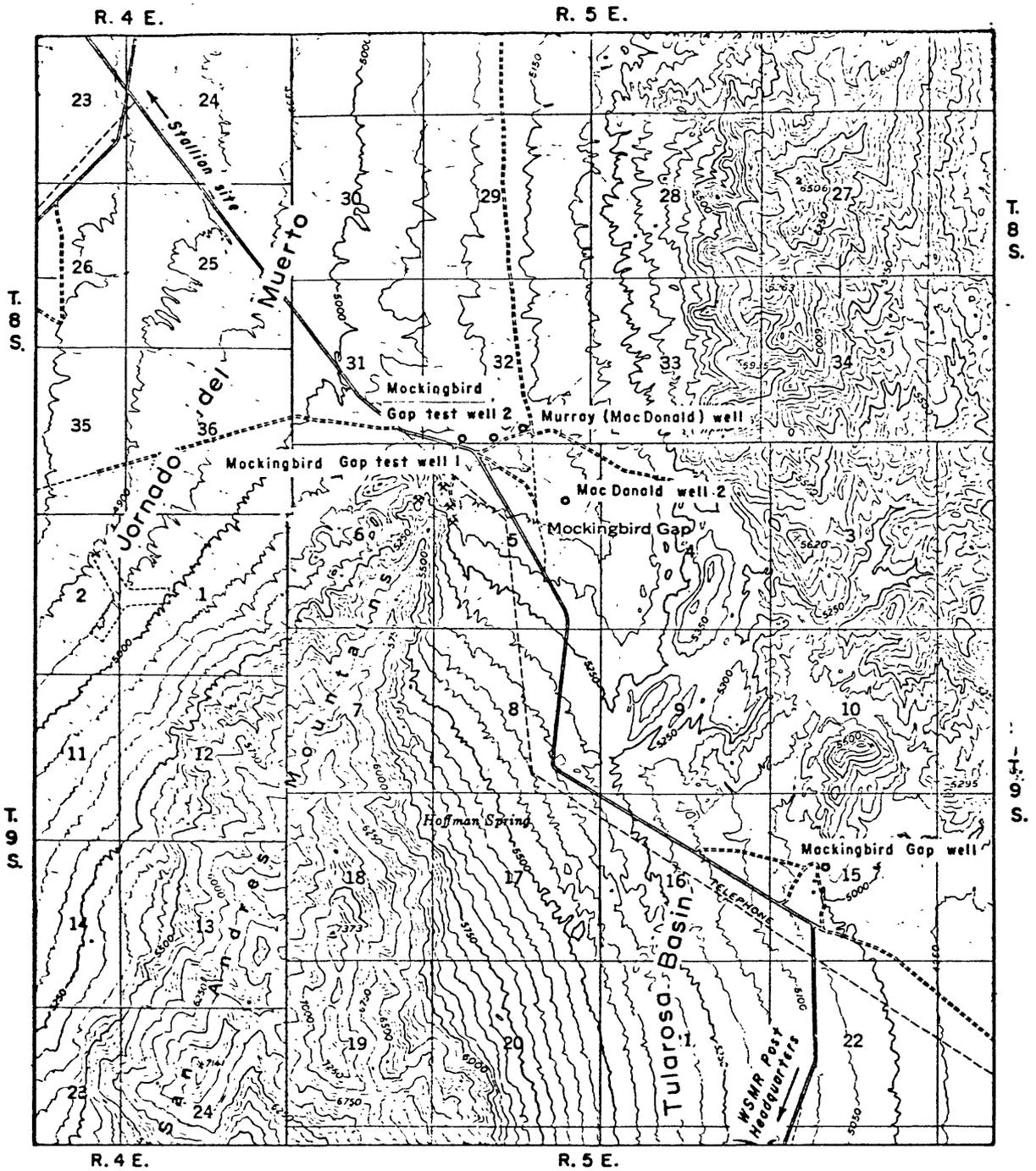


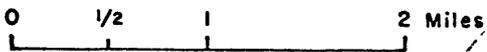
Figure 1.--Mockingbird Gap area, Socorro County, N. Mex.,
and the White Sands Missile Range



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R. 4 E. R. 5 E.
 Topography and base from U.S. Geol. Survey
 Mockingbird Gap Quadrangle, 15-minute
 series, 1948.

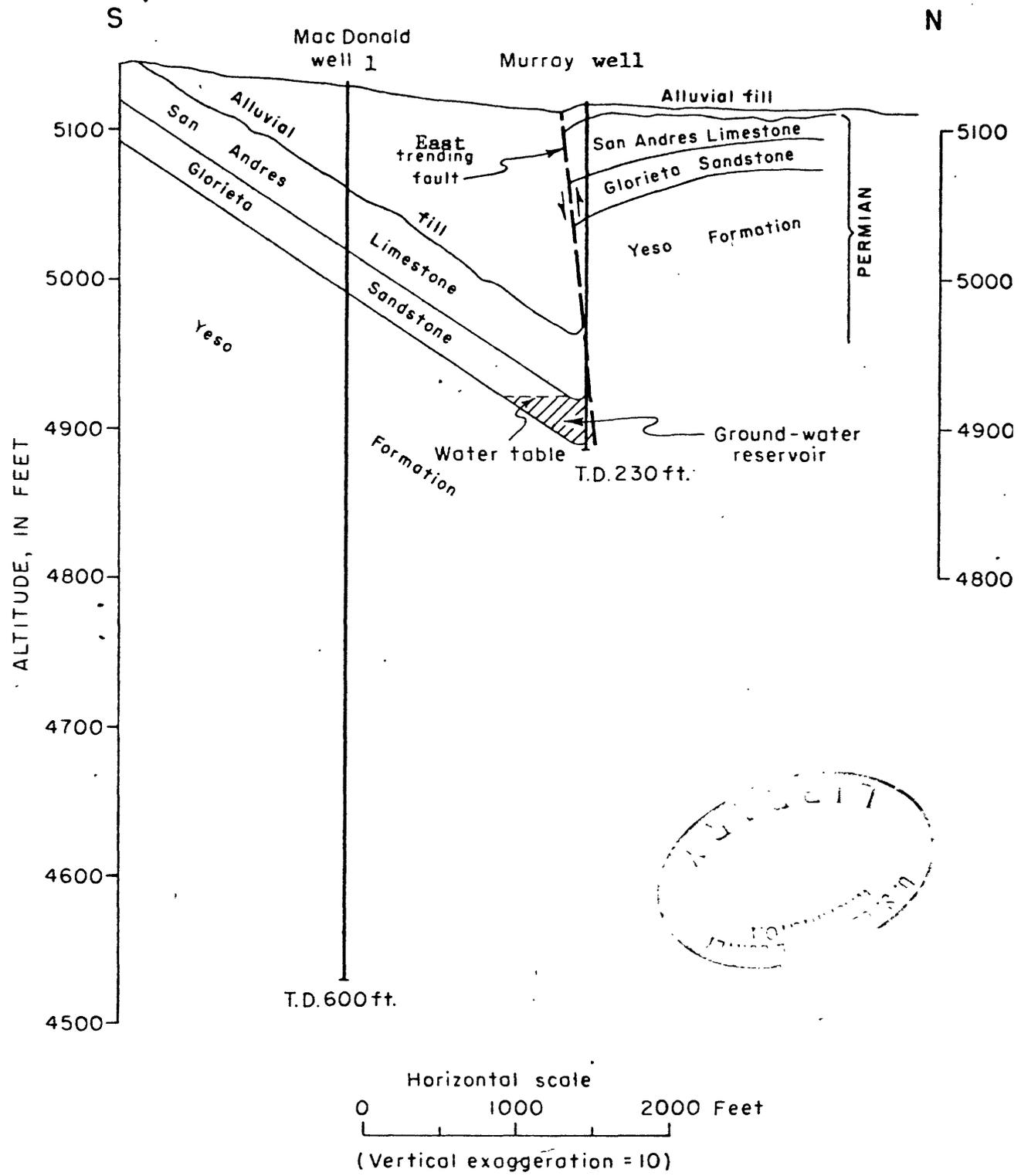


Contour interval 50 feet.
 Datum is mean sea level



Figure 2.--Wells in the Mockingbird Gap area,
 White Sands Missile Range, N. Mex.

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After Weir, 1964

Figure 3.--Diagrammatic cross section through Murray well and MacDonal well 1.

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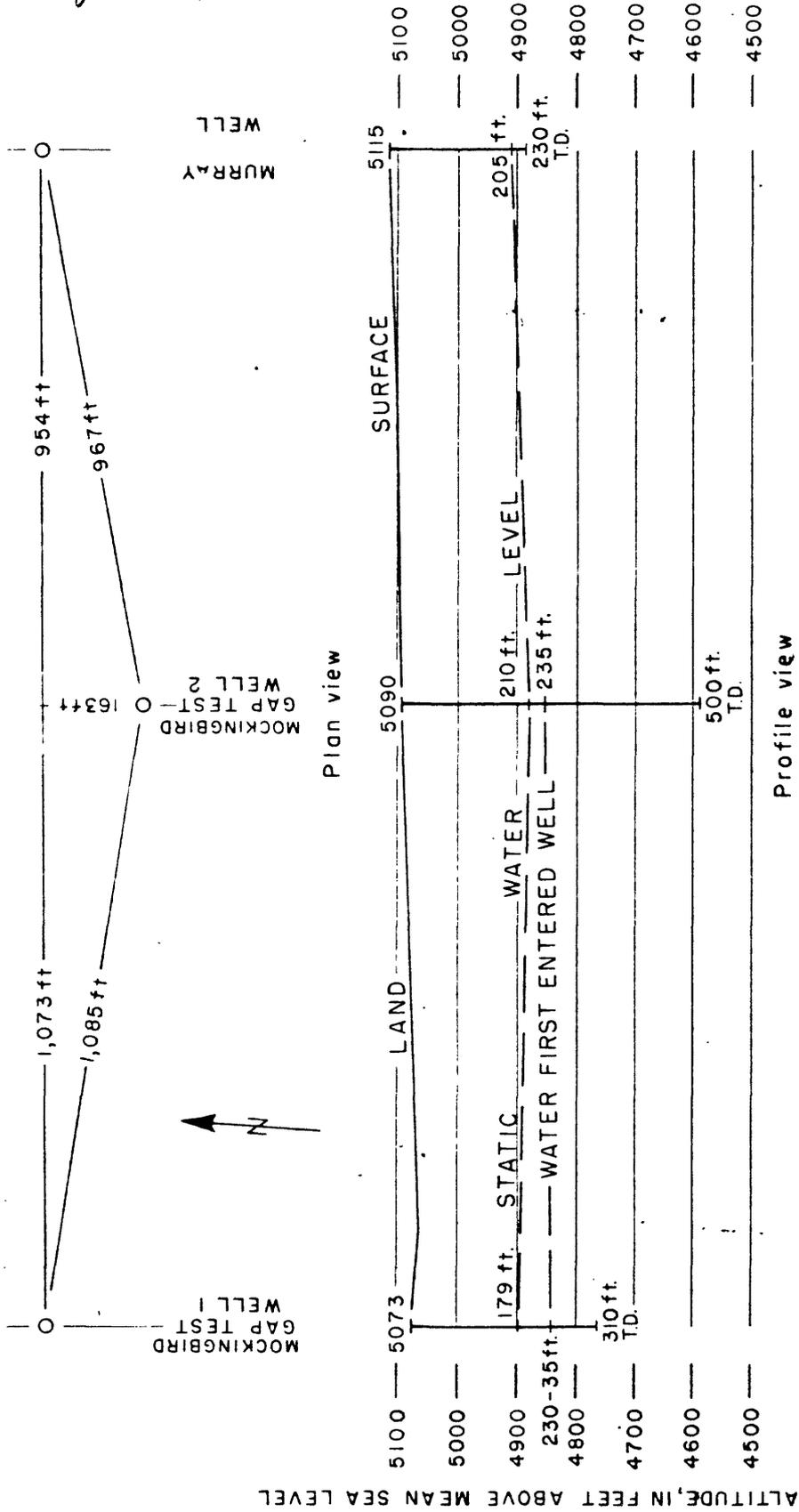


Figure 6.--Plan and profile sketch of the Mockingbird Gap test wells and the Murray well.