UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Water Resources Division

WATER-RESOURCES RECONNAISSANCE OF ASHFORD MILL AND EMIGRANT RANGER STATION, DEATH VALLEY NATIONAL MONUMENT, CALIFORNIA

Prepared in cooperation with the
National Park Service
U.S. Department of the Interior

ADMINISTRATIVE REPORT
For U.S. Government use only

Sacramento, California
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Revised February 1966

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INTRODUCTION

In January 1964 the U.S. Geological Survey, at the request of the National Park Service, made a reconnaissance ground-water investigation of the Ashford Mill and Emigrant Ranger Station areas (fig. 1) in Death Valley National Monument to assist the development of water supplies for camping areas and public-service facilities.

The purpose of this report is to furnish specific information concerning the probable water supply in these two areas. The scope includes (1) a brief description of the geologic features, (2) a collection of available water analyses, (3) a brief description of wells and springs, and (4) a selection of sites for test wells. Chemical analyses are listed in table 1.

The fieldwork and preparation of this report were under the supervision of Fred Kunkel, district geologist for California, U.S. Geological Survey, Ground Water Branch. The Ashford Mill and Emigrant Ranger Station areas were visited during the course of fieldwork with Garland Moore, Park Engineer, U.S. Park Service.

ASHFORD MILL AREA

General Features

The ruins of Ashford Mill are in the southern part of Death Valley National Monument (fig. 1). In the vicinity of Ashford Mill the valley is an elongated trough, or graben, the floor of which is about 150 feet below sea level. The altitude of the Black Mountains, east of the area, is about 4,000 feet above sea level. The Amargosa River flows south from Beatty, Nev. (fig. 1), and makes a U-bend near Saratoga Spring. From Saratoga Spring it flows northward and occupies the bottom of the trough, about 1,000 feet southwest of Ashford Mill. Ground-water underflow in the area probably closely parallels the surface-drainage system.

The Black Mountains are carved from the basement complex (fig. 2), which consists of quartizite, schist, and gneiss. The valley area is underlain by volcanic rocks, continental deposits, and alluvial-fan and wash deposits. The volcanic rocks are predominantly basalt. The continental deposits are semiconsolidated to consolidated and consist of gravel, sand, silt, and clay. The alluvial-fan and wash deposits are unconsolidated to semiconsolidated and consist of gravel, sand, silt, and clay. Lake deposits probably occur in the subsurface but do not crop out in the area. The basement complex and the volcanic rocks are, for the most part, impermeable. Ground water occurs within these units only in joints. The continental deposits are poorly permeable. The alluvial-fan and wash deposits are permeable and where saturated would yield water to wells.

Hydrologic and quality-of-water data in the vicinity of Ashford Mill are meager. The only chemical analysis available for the report area is that of water from one small spring in the Black Mountains (fig. 2 and table 1). Several chemical analyses of water from wells and springs outside the study area are given in table 1 because they indicate the probable quality of water in the alluvial-fan and wash deposits beneath Ashford Mill. The location of these wells and springs, outside the Ashford Mill area, is shown on figure 1.

The water from Saratoga Spring (table 1) contains 3,100 ppm (parts per million) dissolved solids, and 3.1 ppm fluoride. The water from Gravel well (fig. 1) contains 1,860 ppm dissolved solids. This water does not meet the drinking water-standards set by the U.S. Public Health Service (1962, p. 8 and 32-34). In addition, Malmberg and Eakin (1964) report fluoride in ground water on the upper Amargosa River drainage in Nevada in excess of standards allowed by the U.S. Public Health Service (1962, p. 8). Water from Shortys and Bennetts wells (table 1) is potable, probably because the water is derived from the creek in Hanaupah Canyon. The creek in Hanaupah Canyon heads in the high peaks, which have altitudes of more than 9,000 feet above sea level. The creek is reported by park rangers to flow most of the year. The analysis of water from Virgin Spring (table 1) in the Black Mountains indicates that sulfate and total dissolved solids exceed Public Health Service standards (1962, p. 32-34). However, the water is more nearly potable than the water from Saratoga Spring and Gravel well.

Virgin and Rhodes Springs have been developed and used as water supplies during mining and prospecting activities in the past. Virgin Spring is a pool of water in a prospect tunnel in the basement complex. There is no observable flow in the tunnel. It is doubtful if Virgin Spring can be developed to yield more than 1 or 2 gallons per minute. Rhodes Spring is at the contact of the basement complex and the alluvial-fan and wash deposits. Because the flow of Rhodes Spring is diverted into a water-distribution system, the quantity could not be determined. Bradbury well (fig. 2) is an old dug well that has caved in. However, trees and other vegetation in the vicinity of the well indicate that the water table probably is at shallow depth.

Proposed Test Drilling

To test for potable water in the vicinity of Ashford Mill, it is suggested that a well be drilled about $1\frac{1}{2}$ miles west of Bradbury well at the site shown on figure 2. A bail test by the driller and a chemical analysis of the water obtained will determine if the quantity and quality of the water are satisfactory for local needs. The well should be drilled to the basement complex, which at this site may be less than 100 but not more than 150 feet below land surface. If the quantity of the water from the well is not sufficient or if the quality is unsatisfactory, water can be obtained from Virgin and Rhodes Springs. It is doubtful if potable water can be obtained from a well in the alluvial-fan and wash deposits beneath Ashford Mill.

[illegible]

EMIGRANT RANGER STATION AREA

General Features

Emigrant Ranger Station is in the western part of Death Valley National Monument (fig. 1). The ranger station is on an alluvial fan between Tucki and Cottonwood Mountains. Emigrant Canyon has a drainage area of about 75 square miles; about half of the drainage area is at altitudes of 5,000 to 6,000 feet above sea level (fig. 1).

The basement complex which forms the core of Tucki Mountain (fig. 3) consists of quartzite and granitic rocks. Continental deposits which form the west flank of Tucki Mountain and overlie the basement complex consist of semiconsolidated gravel, sand, silt, and clay, locally interbedded with volcanic rocks and limestone breccia. Alluvial-fan and wash deposits that overlie the continental deposits and basement complex are composed of unconsolidated to semiconsolidated gravel, sand, silt, and clay. The basement complex is, for the most part, impermeable but may contain small amounts of ground water in joints. The continental deposits are poorly permeable. The alluvial-fan and wash deposits are permeable and where saturated would yield water to wells.

There are several seeps and springs in Emigrant Canyon (fig. 3). The chemical analysis of water from Emigrant Spring (table 1) indicates that the water is potable. The water in other springs, which are shown on figure 3 for which there are no chemical analyses, probably is similar in quality.

Most of the seeps and springs in Emigrant Canyon have been developed or used as water supplies during mining and prospecting activities in the past. At the present time the flow from Emigrant Spring is piped to Emigrant Ranger Station. There are several seeps from joints in volcanic rocks about 50 yards north of Emigrant Spring. These seeps probably could be developed to yield 1 or 2 gallons per minute. Upper Emigrant Spring, which is a series of seeps in the alluvium in the bottom of a small tributary, probably could be developed to yield several gallons per minute. Malapi, Burro, and Canyon Springs are seeps from joints in the basement complex and the continental deposits. The flow from the springs in the vicinity of Malapi Spring was not measured. However, the combined flow is estimated to be 5-10 gallons per minute.

Proposed Test Drilling

It is probable that ground water, derived from seeps and springs, moves through the alluvial-fan and wash deposits that veneer the bottom of Emigrant Canyon. The underlying basement complex and the continental deposits probably impede the downward movement of water. Ground-water underflow from Emigrant Canyon and other canyons that drain Tucki and Cottonwood Mountains probably moves into the alluvial-fan and wash deposits beneath Emigrant Ranger Station. One test well should be drilled near the ranger station to determine the quantity and quality of ground water in the alluvial-fan and wash deposits, which are probably less than 200 feet thick at this site. If the quantity and quality of ground water at the station are not satisfactory, the alluvial-fan and wash deposits should be tested at the two sites shown in Emigrant Canyon (fig. 3). The alluvial-fan and wash deposits in Emigrant Canyon are probably less than 30 feet thick, consequently, test wells need not exceed this depth.

If the quantity and quality of water at the test sites are unsatisfactory, it is suggested that Upper Emigrant Spring be developed for a water supply by drilling a shallow well below the spring. However, large withdrawals from the well would lower the water table, and the seeps would not be available for use by the wildlife.

REFERENCES CITED

Malmberg, G. T., and Eakin, T. E., 1964, Relation of fluoride content to recharge and movement of ground water in Oasis Valley, Southern Nevada: Art. 163 in U.S. Geol. Survey Prof. Paper 475-D, p. D189-D191.

U.S. Public Health Service, 1962, Drinking Water Standards: Public Health Service Pub., no. 956, 61 p.

APPENDIX

RESULTS OF TEST DRILLING

During the period April through June 1965, which was subsequent to the preparation of this report, the Park Service by contract with the Effinger Drilling and Pump Service of Las Vegas, Nev., drilled and tested 5 wells--2 in the Ashford Mill area and 3 in the Emigrant Ranger Station area. This appendix summarizes the results of that drilling and testing program.

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[illegible]

[illegible]

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[illegible]

[illegible]

Ashford Mill Area

The first test well in the Ashford Mill area was drilled in Rhodes Wash at the proposed site shown in figure 2. That well, drilled to a depth of 45 feet, entered consolidated rock at 36 feet and was dry.

Test well 2 (21N/3E-28B1), whose location is shown in figure 4, was drilled to a depth of 275 feet. The static water level on May 27, 1965, prior to test pumping was 164.2 feet below top of casing, which is 3 feet above land-surface datum. During test pumping at a rate of 150 gpm, on May 27 and 28, 1965, the water level was 202.4 feet below top of casing, indicating a drawdown of 38.2 feet and a specific capacity of 3.9 gpm per foot of drawdown.

Log of Ashford Mill test well 2
(Well 21N/3E-28B1)

Material	Thickness (feet)	Depth (feet)
Well drilled as open hole to 275 feet, then cased with 10-inch open-bottom casing without a driving shoe. Casing perforated from 170 to 210 and from 235 to 245 feet.		
Gravel and sand	33	33
Conglomerate (or fanglomerate), hard	129	162
Gravel and sand, poorly cemented. Water	31	193
Conglomerate (or fanglomerate), hard	43	236
Gravel and sand, poorly cemented. Water	5	241
Conglomerate (or fanglomerate), hard	34	275

The chemical analysis of the water from test well 2 (table 1) shows that the pumped water is not potable. Also, on the basis of the geologic and hydrologic reconnaissance of the area, further test drilling is not suggested. As an alternative, we suggest that the Park Service explore the feasibility of desalinization of the nonpotable supply.

[illegible]

[illegible]

[illegible]

[illegible]

Emigrant Ranger Station Area

The sites of the three test wells drilled in the Emigrant Ranger Station area are shown in figure 3. Wells 1 and 2, drilled at the mouth of Emigrant Canyon, encountered bedrock at depths of 44 feet and 121 feet and were dry. No further testing in the immediate area of these two wells is suggested.

Well 3, drilled at the site of the Emigrant Ranger Station, was in alluvial deposits for its entire depth of 285 feet. This well encountered no water. If the well were drilled deeper, water might be found. The depth to water and the probable yield of the well cannot be predicted. However, because the alluvium in the area is cemented, the yield, if any, probably would be low. Therefore, further test drilling is not suggested.

Logs of Emigrant Ranger Station test wells

Material	Thickness (feet)	Depth (feet)
Test well 1. Drilled as open hole to 50 feet. Well was dry and was backfilled.		
Gravel, sand, and silt of igneous, metamorphic, and sedimentary rock	44	44
Metamorphic rock	6	50
Test well 2. Drilled as open hole to 123 feet. Well was dry and was backfilled.		
Alluvium	121	121
Consolidated rock	2	123
Test well 3. Drilled to 285 feet, 12-inch casing to 64 feet, no water encountered.		
Alluvium	58	58
Alluvium, cemented	227	285

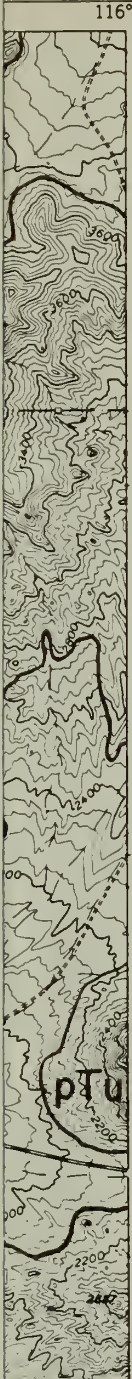
Labo

Well	Dissolved solids: Residue at 180°C	Hardness as $CaCO_3$	Noncarbonate hardness as $CaCO_3$	Percent sodium	Specific conductance (micromhos at 25°C)	pH	Laboratory and Laboratory number
Virgin		482				8.0	CDPH-23506
Sarato		222				8.0	CDPH- 6400
Midway		451				8.1	CDPH- 6389
Stove	4,530	820	508	74	7,300	8.0	USGS-45504
H Spring (		146				7.9	CDPH- 6394
Emigra		170				7.7	CDPH- 6399
Gravel		495				7.7	CDPH- 5376
Mesqui		127				7.9	CDPH- 6391
Shorty		268				8.3	CDPH- 5500
Bennet						7.9	CDPH- 5498
Texas		160				8.4	CDPH- 6392
Nevare		185				8.1	CDPH-20503
Burro	-	281	0	31	639	7.7	USGS-49331
Ashfor test (21N	-	785	562	85	10,700	7.6	USGS-4956

Table 1.--Chemical analyses of water in Death Valley National Monument

Laboratory: CDPH, California Department of Public Health; USGS, U.S. Geological Survey.

Well or spring name	Date of collection	Depth of well (feet)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids: Calculated (Sum of determined constituents)	Dissolved solids: Residue at 180°C	Hardness as $CaCO_3$	Noncarbonate hardness as $CaCO_3$	Percent sodium	Specific conductance (micromhos at 25°C)	pH	Laboratory and Laboratory number
			All concentrations expressed in parts per million (ppm)																				
Virgin Spring	3-6-64			0.04	84	67	120	6.2	438	0	346	26	0.6	0.2		920		482				8.0	CDPH-23506
Saratoga Spring	9-2-63			.00	35	33	955	32	406	--	1,050	647	3.1	2.7		3,100		222				8.0	CDPH- 6400
Midway well	8-15-63	10		3.4	67	69	225	45	745	--	247	74	3.3	.4		1,200		451				8.1	CDPH- 6389
Stove Pipe Wells Hotel	1-23-64	110	64		96	141	1,220	86	380	0	605	1,840	2.1	7.9	13	4,260	4,530	820	508	74	7,300	8.0	USGS-45504
Spring at Thorndike Camp	8-29-63			.08	54	3.1	10	2	187	--	5.4	4.6	.2	.0		200		146				7.9	CDPH- 6394
Emigrant Spring	8-29-63			.03	32	22	28	2.0	203	--	19	21	.3	5.7		270		170				7.7	CDPH- 6399
Gravel well	12-28-60	22		9.5	91	66	469	14	171	--	214	--	.2	--		1,860		495				7.7	CDPH- 5376
Mesquite Spring	8-15-63			.02	29	13	235	13	426	--	170	82	3.3	.0		850		127				7.9	CDPH- 6391
Shortys well	12-28-60	18		.8	53	33	115	4.8	176	--	117	--	.3	--		638		268				8.3	CDPH- 5500
Bennetts well	12-28-60	18		4.3	51	21	45	1.2	134	--	85	62	.5	.0		385						7.9	CDPH- 5498
Texas Spring	8-21-63			.05	34	18	148	11	322	--	155	36	3.8	.0		640		160				8.4	CDPH- 6392
Nevares Springs	6-5-63			.17	42	20	148	11	333	--	174	38	2.6	.0		705		185				8.1	CDPH-20503
Burro Spring	5-3-65		48	-	43	32	50	3.1	343	0	50	27	.3	11	.3	408	-	281	0	31	639	7.7	USGS-49331
Ashford Mill test well 2 (21N/3E-28B1)	6-14-65	275	49	-	187	77	160	55	272	0	1,440	2,880	3.0	6.5	12	7,000	-	785	562	85	10,700	7.6	USGS-49566



EXPLANATION

Qal

Alluvial-fan and wash deposits of Quaternary age

Predominantly unconsolidated to semiconsolidated gravel, sand, silt, and clay

QTc

Continental deposits of Quaternary and Tertiary age

Semiconsolidated to consolidated gravel, sand, silt, and clay

Tv

Volcanic rocks of Tertiary age

Predominantly basalt

pTu

Basement complex of pre-Tertiary age

Predominantly quartzite, schist, and gneiss

Geologic contact

Spring

Well

Test well, proposed site

APPROXIMATE MEAN DECLINATION, 1952

QUADRANGLE LOCATION

AREA

Geology by M. G. Croft, 1964

FIGURE 2. RECONNAISSANCE GEOLOGIC MAP OF ASHFORD MILL AREA DEATH VALLEY NATIONAL MONUMENT, CALIFORNIA

Base is northwestern part of U.S. Geological Survey Confidence Hills topographic quadrangle map

Geology by M. G. Croft, 1964

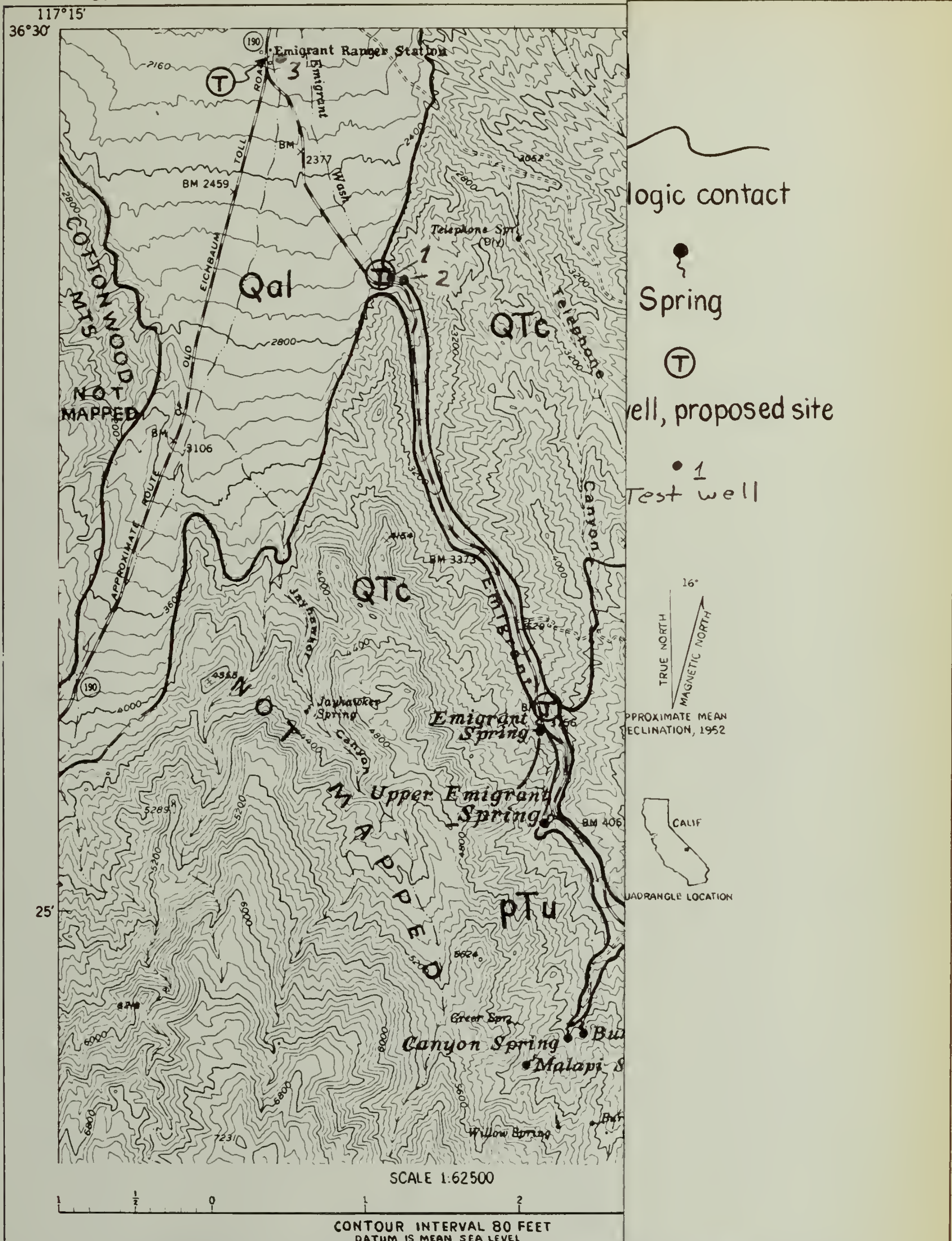


FIGURE 3. RECONNAISSAN ATION AREA
DEATH VALLEY

Base is northwestern part of U. S. Geological Survey
Emigrant Canyon topographic quadrangle map

Geology by M. G. Croft, 1964

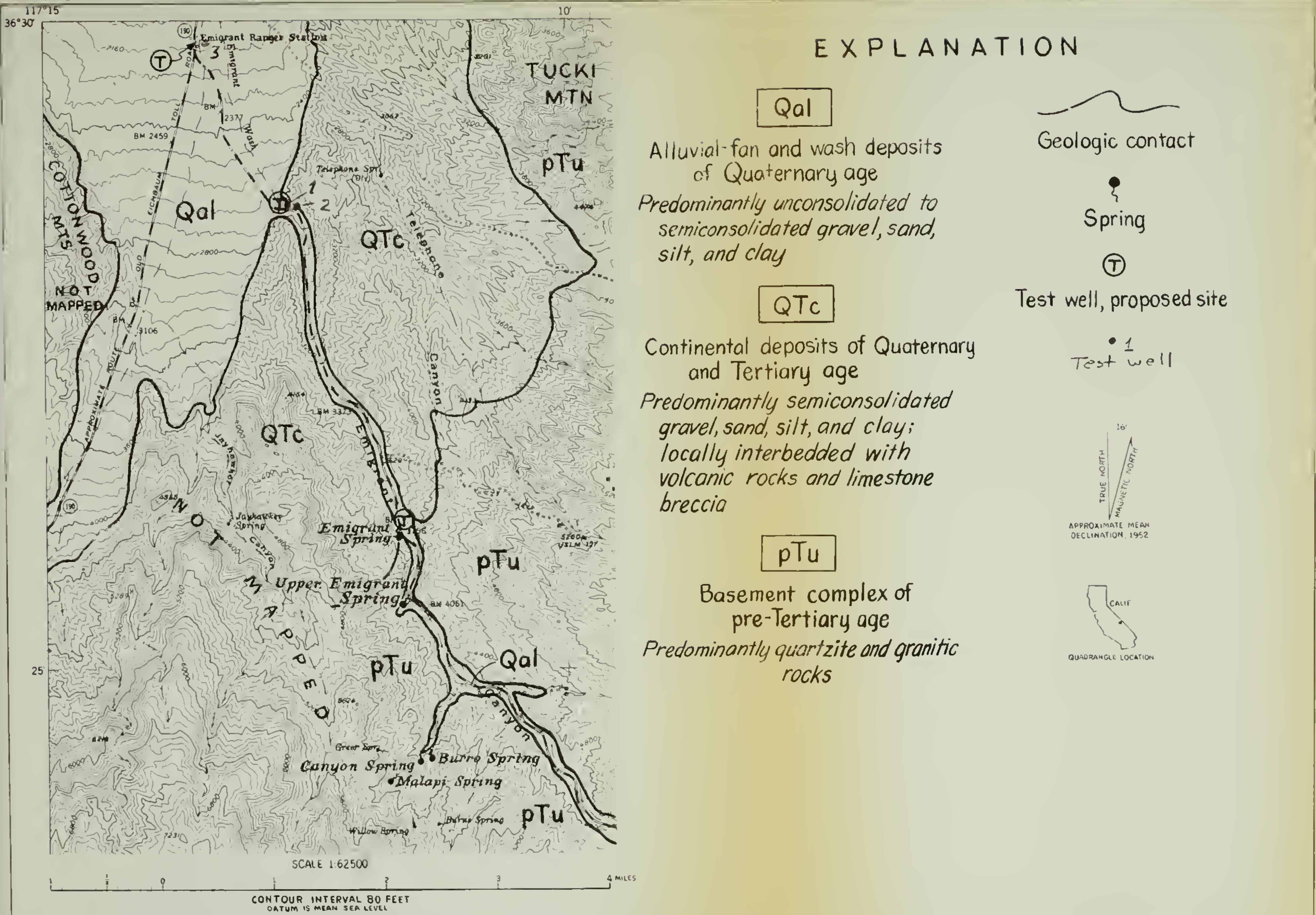
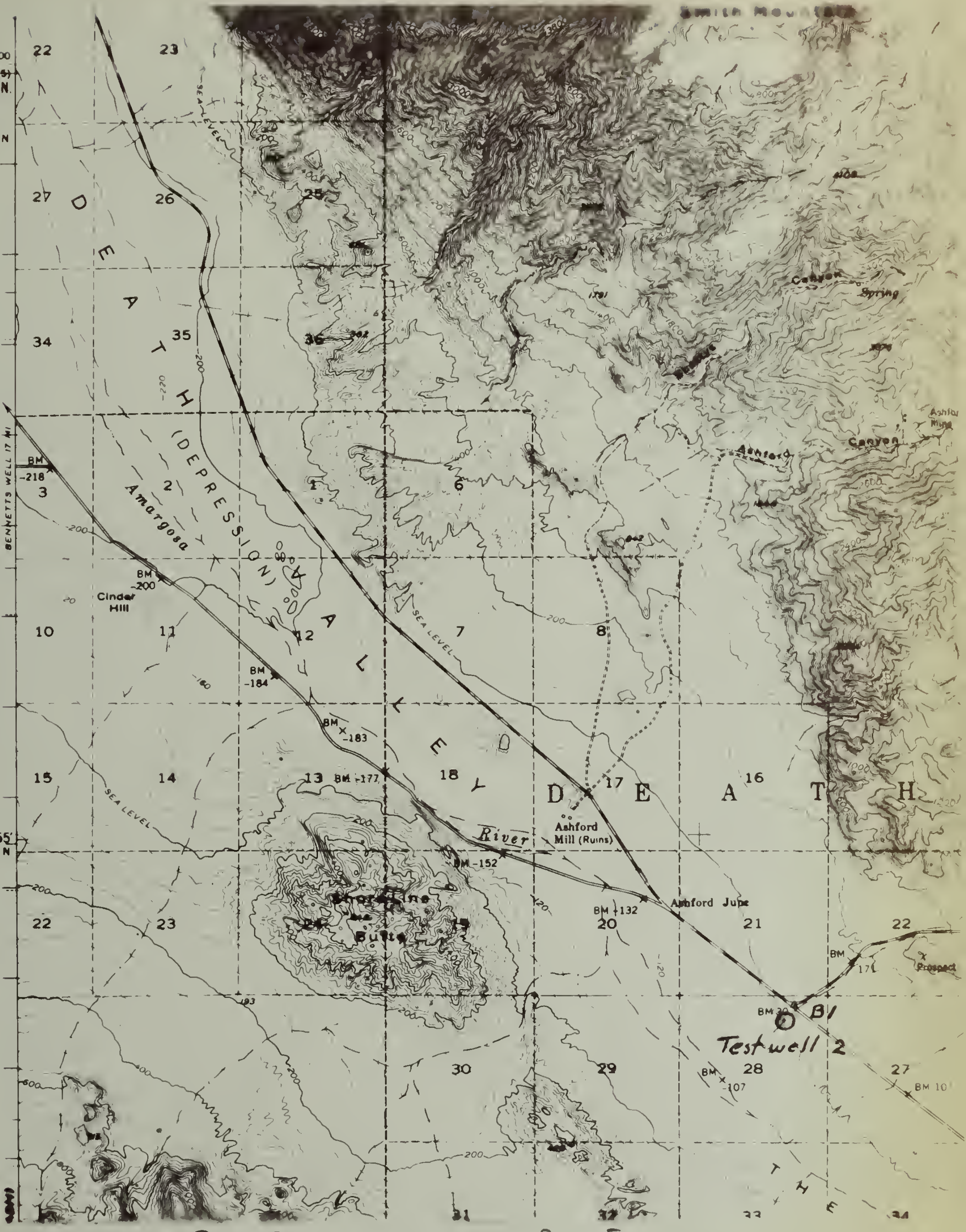


FIGURE 3. RECONNAISSANCE GEOLOGIC MAP OF EMIGRANT RANGER STATION AREA DEATH VALLEY NATIONAL MONUMENT, CALIFORNIA

Base is northwestern part of U. S. Geological Survey Emigrant Canyon topographic quadrangle map

Geology by M. G. Croft, 1964



NORTHWESTERN PART OF CONFIDENCE HILLS QUADRANGLE
SHOWING SITE OF ASHFORD MILL TEST WELL 2