WATER RESOURCES OF THE SANTA YSABEL AND MESA GRANDE INDIAN RESERVATIONS, SAN DIEGO COUNTY, CALIFORNIA

By John R. Freckleton

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JAMES G. WATT, Secretary

GEOLOGICAL SURVEY

Doyle G. Frederick, Acting Director

For additional information write to:

District Chief
Water Resources Division
U.S. Geological Survey
345 Middlefield Road
Menlo Park, Calif. 94025

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CONVERSION FACTORS

For those readers who may prefer metric units rather than inch-pound units, the conversion factors for the terms used in this report are listed below:

Multiply	By	To obtain
acre	0.004047	km^2 (square kilometer)
acre-foot	0.001233	hm^3 (cubic hectometer)
ft (foot)	0.3048	m (meter)
ft^3/s (cubic foot per second)	0.02832	m^3/s (cubic meter per second)
gal/min (gallon per minute)	0.06309	L/s (liter per second)
(gal/min)/ft (gallon per minute per foot)	0.2070	(L/s)/m (liter per second per meter)
inch	25.4	mm (millimeter)
mi (mile)	1.609	km (kilometer)
mi^2 (square mile)	2.590	km^2 (square kilometer)
μmho (micromho)	1.000	μS (microsiemens)

Abbreviations used:
- lsd - land surface datum
- mg/L - milligram per liter
- μg/L - microgram per liter
- μmho/cm at 25°C - micromho per centimeter at 25 degrees Célsius
- DD - drawdown in feet
- °C - degree Celsius

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.

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ABSTRACT

The Santa Ysabel (consisting of three tracts) and Mesa Grande Indian Reservations are in north-central San Diego County, Calif. On both reservations fractured and weathered igneous and metamorphic rocks and alluvium are water bearing; however, no wells are known to derive their water entirely from alluvium. Well yields range from 2.5 to 250 gallons per minute. Springs occur where saturated fractured or weathered material intersects the land surface. Spring discharge ranged from 0 gallon per minute (November 1979) to 9.4 gallons per minute (November 1979). Few data are available for the surface-water characteristics of the study area. One-time measurements of discharge at selected stream sites were made in late November 1979 and late May 1980; discharges ranged from less than 0.01 cubic foot per second to an estimated 3 cubic feet per second. Further study of the surface-water systems would provide a basis for estimating their development potential.

The existing water-supply development on the Santa Ysabel Indian Reservation is adequate for the present residents. The Mesa Grande reservation was unoccupied in 1952, was reportedly unoccupied in November 1979, and has no developed water supply. Additional water can be developed for both reservations from the igneous and metamorphic rock, from presently undeveloped springs, and from perennial reaches of the larger streams. Except for excessive iron and sodium at some ground-water sites and excessive sodium at a few surface-water sites, the water is of suitable quality for domestic and agricultural use.

INTRODUCTION

The Santa Ysabel Indian Reservation consists of three separate tracts (fig. 1). Tracts One and Two are occupied by the Mesa Grande Band, and Tract Three is occupied by the Santa Ysabel Band. The land supports limited timbering, cattle and horse raising, and agriculture. The Mesa Grande Indian Reservation is a single unit about three-quarters of a mile west of Santa Ysabel Tract Two. It was used for cattle grazing in 1952 (Olmsted, 1953).

According to the U.S. Bureau of Indian Affairs "Tribal Information and Directory" (1979), the 1979 resident population of Santa Ysabel Tract Three was 167 and the combined resident population of Tracts One and Two was 33. Mesa Grande Indian Reservation was reportedly unoccupied in November 1979. The water-resources information for the Mesa Grande reservation was obtained mainly from Olmsted (1953).

Purpose and Scope

The purpose of this study was to collect and analyze hydrologic data and to evaluate water resources for the Santa Ysabel and Mesa Grande Indian Reservations. Done in cooperation with the U.S. Bureau of Indian Affairs, this study supplies information that can be used by the Bureau of Indian Affairs in the formulation of plans that may improve the economy and living conditions on the reservations.

The scope included canvassing all accessible wells and springs on the reservations, sampling water for analysis, and collecting hydrologic data on streams. Additional hydrologic data were also obtained from government agencies and local residents. A geologic map showing locations of wells, springs, precipitation station, and stream data sites was compiled. This report summarizes the data collected and the findings of the study.

Previous Work and Acknowledgments

Published reports and maps pertaining to the study area are listed in the "References" section of this report. They include data on geology, precipitation, wells, and springs. Agencies contributing unpublished data to this study are the U.S. Bureau of Indian Affairs, U.S. Indian Health Service, California Department of Water Resources, and the U.S. Geological Survey. The assistance given by the U.S. Bureau of Indian Affairs and the U.S. Indian Health Service is gratefully acknowledged as is the help and cooperation of the individual well and spring owners.

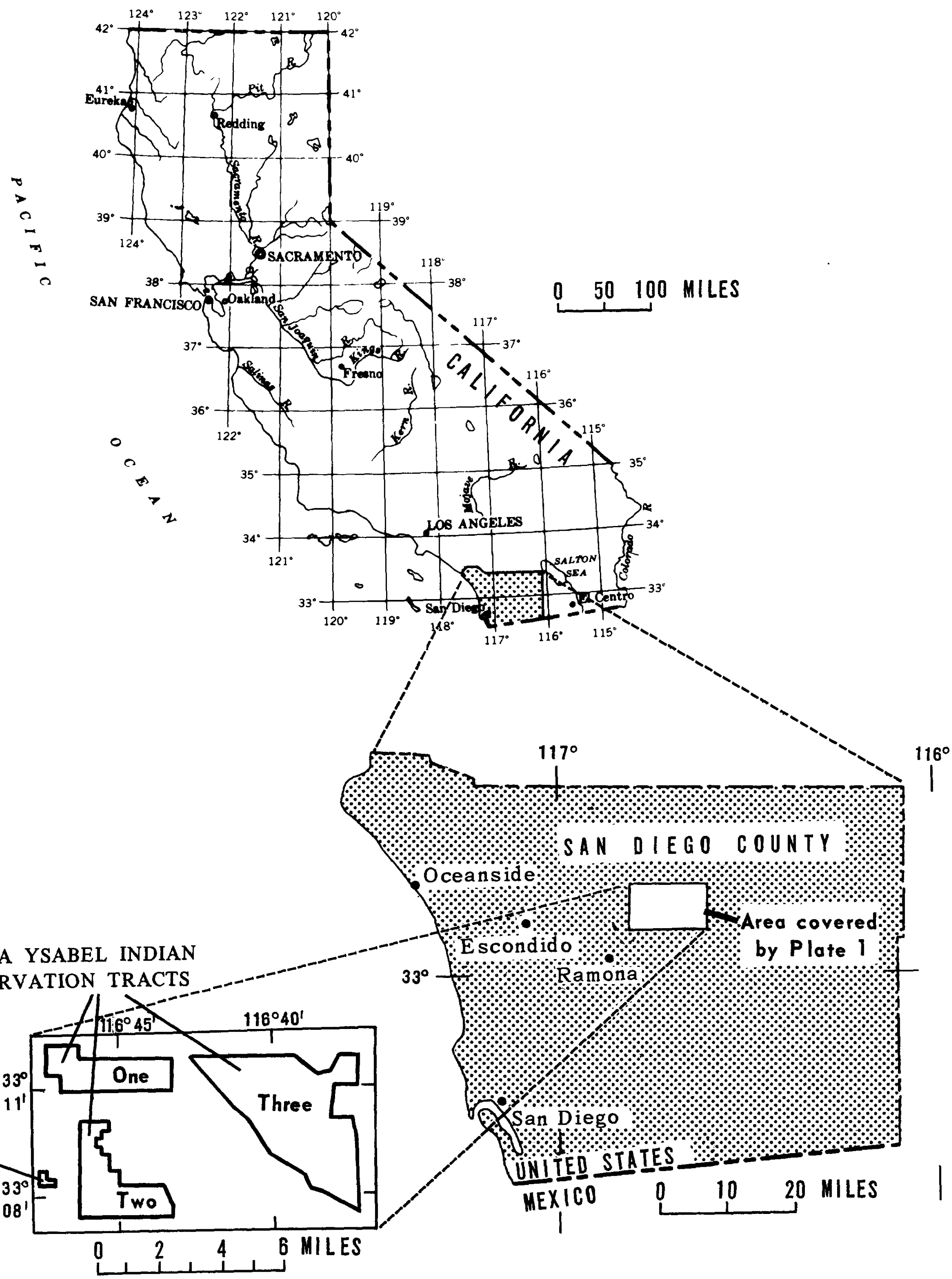
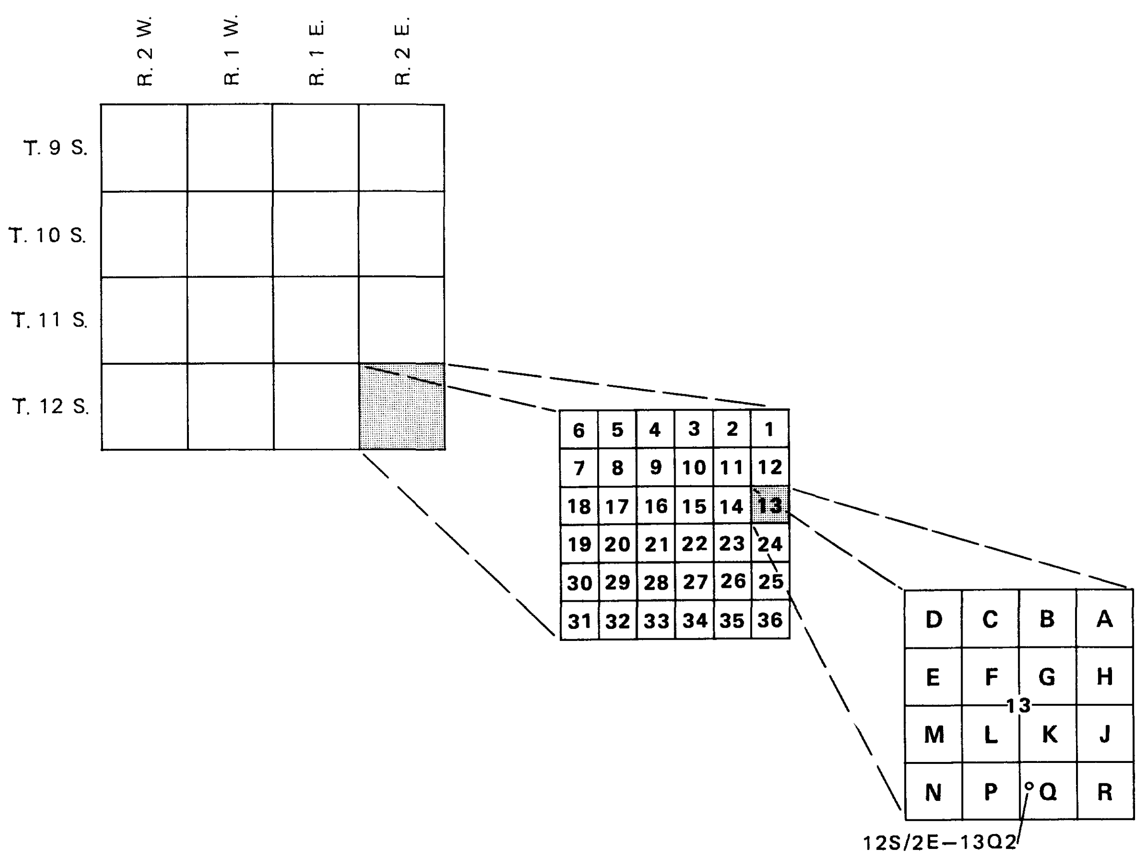


FIGURE 1.--Index map.

Well-, Spring-, and Stream Site-Numbering Systems

Wells and springs are numbered according to their location in the rectangular system for the subdivision of public land. The part of the number preceding the slash (as in 12S/2E-13Q2) indicates the township (T. 12 S.); the number after the slash indicates the range (R. 2 E.); the number after the dash indicates the section (sec. 13); the letter after the section number indicates the 40-acre subdivision of the section according to the lettered diagram below. The final digit is a serial number for wells in each 40-acre subdivision. The area lies entirely in the southeast quadrant of the San Bernardino base line and meridian. Springs are numbered similarly except that an S is placed between the 40-acre subdivision letter and the final digit. Stream data-collection sites are numbered sequentially (as in site 1).



LOCATIONS AND GENERAL FEATURES

Santa Ysabel and Mesa Grande Indian Reservations are near the southwest corner of California in north-central San Diego County (fig. 1) about 40 mi northeast of San Diego. Major road access to the reservations from the north and south is provided by State Highway 79. Access from the east is by State Highway 78 and from the west by State Highways 76 and 78 (pl. 1).

The total acreage of Santa Ysabel Indian Reservation, Tracts One, Two, and Three as of September 30, 1978, was about 15,520 acres or about 24 mi^2, and that of the Mesa Grande Indian Reservation was 120 acres or about 0.2 mi^2 (U.S. Bureau of Indian Affairs, 1979). Tract One is a strip about 4 mi long and about 1 to 1½ mi wide. It includes all of secs. 25, 26, and 27, and parts of secs. 21 and 28, T. 11 S., R. 2 E. (pl. 1). The area of Tract One is about 2,720 acres or 4.25 mi^2. Tract Two is a roughly L-shaped area that includes all or parts of secs. 3, 10, 11, 13, 14, and 15, T. 12 S., R. 2 E. (pl. 1). Its area is about 3,200 acres or 5 mi^2. The largest of the three tracts of the Santa Ysabel Indian Reservation is Tract Three. It includes all or parts of secs. 25-30 and 32-35, T. 11 S., R. 3 E., and all or parts of secs. 1-4, 10-14, and 24, T. 12 S., R. 3 E. (pl. 1). It has an irregular shape and an area of about 9,600 acres or 15 mi^2.

The 120 acres which compose the Mesa Grande Indian Reservation are the E½SE¼ sec. 8 and the SW¼SW¼ sec. 9., T. 12 S., R. 2 E. (pl. 1).

The reservations are in heavily forested and mountainous terrain, having a relief of nearly 3,000 ft on Santa Ysabel Tract Three. A number of grassland flats and flats along creeks provide grazing for horses and cattle.

Precipitation

Precipitation data have not been collected within the area of this report since 1922. Table 1, reproduced from Olmsted (1953), gives 14 years of record for a station at Mesa Grande (pl. 1).

The 14-year average annual precipitation was about 31 inches for the years 1908-09 through 1921-22, and the annual total ranged from about 19 inches in 1917-18 to about 48 inches in 1915-16 (Olmsted, 1953). A contour map showing lines of equal precipitation prepared by Rantz (1969) indicates that the Santa Ysabel Indian Reservation has an average annual precipitation of somewhat over 30 inches, and the Mesa Grande Indian Reservation has about 25 inches.

About 85 percent of the average annual precipitation, partly snow, occurs in the months of November through April. The remainder occurs mostly as scattered summer thundershowers, which, on occasion, are locally intense. In many years, however, the summer rainfall is insignificant.

TABLE 1. - Average monthly precipitation, in inches, at Mesa Grande, Calif.

[From Olmsted, 1953]

Month	Mesa Grande 1909-22 average
January	5.70
February	5.26
March	2.44
April	1.57
May	.14
June	.13
July	.24
August	.35
September	1.60
October	1.85
November	4.11
December	7.84
Average yearly total	31.23

Geology

Geologic information for the area (pl. 1) is derived primarily from mapping of the Santa Ysabel quadrangle by Merriam (1958) at a scale of 1:62,500. Plate 1 also includes geology mapped by Weber (1963, pl. 1) at a scale of 1:125,000 and by Olmsted (1953, pl. 2) at a scale of 1:24,000. The geologic unit descriptions and general water-bearing properties (Description of Map Units, pl. 1) are taken from these sources.

Most of the area of this report is underlain by igneous and metamorphic rocks of Triassic(?) to Cretaceous age. These rocks include the Julian Schist, Mixed Rocks of Merriam (1958), San Marcos Gabbro, and Lakeview Mountain Tonalite. In many areas these rocks are weathered to depths of a few feet to more than 70 ft. In most of the study area a thin soil zone (2 to 10 ft thick) has formed over the rocks.

Alluvium of Quaternary age occurs in limited extent on both reservations (pl. 1). On Santa Ysabel Indian Reservation the major alluviated areas border Scholder Creek on Tract One and Carrizo Creek on Tract Three, and minor alluviated areas border unnamed creeks of the Bloomdale Creek drainage on Tract Two. A narrow band of alluvium borders Scholder Creek on the Mesa Grande Indian Reservation.

The Elsinore fault parallels the southwest border of Santa Ysabel Tract Three. An unnamed fault extends into the northeast part of the tract and another unnamed fault is in the west-central part. The north end of a northwest-trending fault extends into the southeast part of Tract One.

GROUND WATER

Ground water in the report area originates from precipitation that infiltrates the soil and moves downward into the fractures and weathered zones in the igneous and metamorphic rocks. Some ground water enters these rocks from underflow along the alluviated reaches of the streams. The ground water then moves toward the lower altitudes to emerge as spring flow where the fractures or saturated weathered material intersect the land surface. Inspection of plate 1 indicates that a number of springs may be fault related, such as spring 12S/3E-11MS1 near the Elsinore fault, or contact related, such as several springs in sec. 2, T. 12 S., R. 3 E., near the contact between the Mixed Rocks of Merriam (1958) and the Lakeview Mountain Tonalite.

All the wells on the Indian lands obtain water principally from fractured and weathered igneous and metamorphic rocks. Ground-water storage in the fractures and weathered zones is dependent on precipitation. Thus, in dry seasons and prolonged droughts, spring flow from these zones diminishes and water levels in wells decline.

The occurrence of water in the unweathered igneous and metamorphic rock is erratic. These rocks yield water to wells only where highly fractured. If a well is to be drilled into these rocks, the more favorable locations would be where the rock is highly fractured in low-lying sites where drainage from the surrounding area would provide a greater quantity of recharge.

No wells on these Indian lands are known to obtain water exclusively from the alluvium. The alluvium along Scholder Creek on Tract One, however, undoubtedly would yield enough water for domestic supplies for a number of residents. Possibly the small alluvial deposits along some of the other streams also would yield enough water for small domestic supplies.

Data on wells and springs are presented in tables 2 and 3. Pumping-test results and drillers' logs for a number of wells are given in tables 4 and 5 respectively. Well and spring locations are plotted on plate 1.

Water levels in wells in late 1979 and early 1980 ranged from 31.5 ft below land surface datum in well 12S/3E-4R1 to flowing water from well 11S/2E-28R1. Well yields ranged from a maximum of 250 gal/min from well 12S/3E-4R1, to 2.5 gal/min from well 12S/2E-13Q2. Pumping-test results for well 12S/3E-4R1, pumped at 94 gal/min, and well 12S/2E-13Q2, pumped at 2.5 gal/min, indicate specific capacities of 1.90 and 0.02 respectively--the extremes of values for those wells which have available data (table 2).

Spring discharge in November 1979 ranged from a maximum of 9.4 gal/min from spring 12S/3E-2RS1 to 0.0 for a number of known springs (table 3).

TABLE 2. - Well data

State well number: The official State well number assigned to the well. All numbers based on San Bernardino base line and meridian.

Date of observation: Date the well was visited and the data collected.

Owner or user: The owner or user of the well.

Year completed: Year the well drilling was completed.

Depth of well: Depth in feet measured or reported on date shown.

Type and diameter: The type of well indicates how the well was drilled: Ar, air rotary; D, drilled; and Dug. Diameter is the outside diameter of the well casing, in inches, at land surface.

Type of pump and power: The type of pump is indicated thus: J, jet; L, lift; N, none; and S, submersible. The type of power is indicated thus: E, electric; G, gasoline; N, none; and W, wind.

Yield: Yield in gallons per minute.

Use: The use of the well is indicated thus: Com, community; Des, destroyed; Dom, domestic; I, irrigation; S, stock; T, test; and Un, unused.

Measuring point: The point from which the water level is measured. It also shows the distance of the measuring point, in feet, above land-surface datum, or, if negative, below land-surface datum. The measuring points are indicated thus: Bp, bottom of pool; N, no access; and Tc, hole in top of casing cover.

Altitude of lsd: The altitude of land-surface datum is the altitude, in feet, of the ground adjacent to the well, as interpolated from the topographic base maps having contour intervals of 20 and 40 feet.

Water level below lsd: The water level below land-surface datum is the depth to water, in feet, after the distance between land-surface datum and measuring point has been subtracted from the measurement. F indicates well flowing.

Other data: The other data are indicated by the following symbols: C, chemical analysis of water; L, driller's log; and PT, pumping test.

State well number	Date of observation	Owner or user	Year completed	Depth of well (feet)	Type and diameter (inches)	Type of pump and power	Yield (gal/min)	Use	Measuring point: Description	Measuring point: Distance above lsd (feet)	Altitude of lsd (feet)	Water level below lsd (feet)	Other data
11S/2E-21L1	11-29-79	Lachusa	1977	500	Ar 6-5/8	S E	5	Dom	Tc	1.3	3,660	2.03	C,L,PT
11S/2E-25M1	5-29-80	Gomez	1976	311	Ar 6	N N	--	Un	N	--	3,840	--	L
11S/2E-25N1	Not visited.	M.G.I.B.[1]	--	--	--	--	--	--	--	--	3,810	--	--
11S/2E-25N2	5-20-80	do.	1977	547	Ar 6-5/8	S E	60	Com	Tc	1.29	3,760	F	C,L,PT
11S/2E-26M1	5-29-80	Angel	1976	235	Ar 6-5/8	J G	6	Dom	Tc	.6	3,910	6.6	C,L
11S/2E-28C1	5-28-80	Pena	--	--	6-5/8	S E	--	Dom	N	--	3,140	--	C
11S/2E-28C2	Not visited.	Soto	--	--	--	--	--	--	--	--	3,190	--	--
11S/2E-28G1	11-04-52	--	1941	20	D --	N N	--	T	--	--	3,240	--	--
	11-29-79	--	--	--	--	--	--	Des	--	--	--	--	--
11S/2E-28G2	11-04-52	--	1941	20	D --	N N	--	T	--	--	3,240	--	--
	11-29-79	--	--	--	--	--	--	Des	--	--	--	--	--
11S/2E-28J1	5-28-80	Lachusa	--	--	8	J G	--	Dom	N	--	3,290	--	C
11S/2E-28K1	5-20-80	M.G.I.B.[1]	1977	545	Ar 6-5/8	S E	25	Com	Tc	2.08	3,150	7.92	C,L
11S/2E-28K2	5-20-80	do.	1978	490	Ar 6-5/8	--	13.5	Un	--	--	3,150	--	L,PT
11S/2E-28R1	11-03-52	LaChappa	1941	53	D 8-5/8	L G	4	Dom	Tc	.0	3,300	[2]26.4	L
	11-29-79	do.	--	--	--	--	--	Un	--	--	--	F	--
11S/3E-19Q1	5-20-80	Paipa	1976	137	Ar 6-5/8	S E	15	Dom	Tc	2.0	2,760	5.0	L,PT
11S/3E-25H1	5-28-80	Romic	--	--	6-5/8	J G	--	Dom	Tc	2.4	3,800	6.9	C
11S/3E-25L1	5-28-80	Leo	--	--	6-5/8	S E	--	Dom	N	--	3,960	--	C
11S/3E-29D1	5-20-80	Beresford	1941	80	8-5/8	L W	10	Dom	N	--	2,830	--	L
11S/3E-29D2	5-20-80	--	--	--	--	--	--	Un	--	--	2,880	--	--
11S/3E-35J1	5-20-80	King	--	155	6-5/8	J G	--	Dom,S	Tc	1.17	4,820	22.58	C
11S/4E-30G1	9-12-65	--	--	4	[3]120	N N	--	Un	Bp	-4.0	3,680	3.5	--
	11-26-79	--	--	--	[3]180	--	--	--	Bp	--	--	1.8	C
12S/2E-3B1	5-20-80	Ortega	--	--	6-5/8	J G	--	Dom	Tc	1.25	3,280	9.7	C
12S/2E-3B2	5-20-80	M.G.I.B.[1]	--	--	6-5/8	S E	--	Com	N	--	3,310	--	C
12S/2E-10G4	11-12-52	J. Valle	--	70	24	--	--	Dom,S	--	--	2,935	F[2]	--
12S/2E-13Q1	11-06-52	C. Ponchetti	1935[4]	--	Dug 36	L W	--	Dom,S,I	Tc	1.0	2,870	16.62	C
	5-28-80	do.	--	--	--	--	--	Un	--	--	--	12.0	--
12S/2E-13Q2	5-28-80	do.	1976	150	Ar 6-5/8	J G	2.5	Dom	N	--	2,840	--	C,L,PT
12S/3E-2R1	11-27-79	S.Y.I.R.[5]	--	--	--	--	--	Des	--	--	4,740	--	--
12S/3E-4R1	5-20-80	do.	1974	230	8	S E	250	Com	Tc	.5	3,260	31.5	C,PT
12S/3E-10B1	5-20-80	do.	--	--	--	--	--	Des	--	--	3,550	--	--
12S/3E-10H1	5-20-80	do.	1974	150	6	S E	&40	Com	Tc	1.0	3,590	9.5	C,PT

[1]Mesa Grande Indian Band.
[2]Measured 11-5-52.
[3]Well is a dug out spring. Diameter is pool diameter when measured.
[4]Reported.
[5]Santa Ysabel Indian Reservation.

TABLE 3. - Spring data

Owner or name: The apparent owner or user on the date indicated. In some cases, the local name of the spring is given.

Date measured: The date the spring discharge was measured.

Discharge: Discharge, in gallons per minute; D, Dry; F, Flowing; N, Negligible.

Method measured: O, Estimated; I, Bucket; N, Not measured; R, Reported.

Water use: H, Domestic; S, Stock supply; U, Unused.

Improvements: 0, None; 1, Trough; 2, Concrete well; 3, Rock dam; 4, Rock well; 5, Dug out; 6, Earth reservoir; 7, Stone reservoir; 8, Pipe; 9, Stone well.

Chemical analyses: C, Indicates one analysis in which the major chemical constituents were determined in order to permit an anion-cation equation balance.

Altitude of lsd: Altitude of land-surface datum, in feet. Land-surface datum is an arbitrary plane closely approximating land surface.

State No.	Owner or name	Date measured	Discharge (gal/min)	Method measured	Water use	Improvements	Chemical analyses	Altitude of lsd (ft)
11S/2E-21KS1	Santa Ysabel Indian Reservation.	11-04-52	<1	O	H	7,8	C	3,620
		11-29-79	D	--	--	Destroyed	--	--
11S/2E-21KS2	do.	11-04-52	<1	O	S	0	--	3,620
		11-29-79	D	--	--	Destroyed	--	--
11S/2E-21KS3	do.	11-04-52	<1	O	U	0	--	3,590
		11-29-79	<1	O	U	8	--	--
11S/2E-21LS1	Lachusa	Not visited	--	--	--	--	--	3,680
11S/2E-21RS1	Santa Ysabel Indian Reservation.	11-04-52	D	--	U	7,8	--	3,420
		11-29-79	D	--	U	7,8	--	--
11S/2E-25NS1	Maxey	11-06-52	<1	O	S	1,7,8	C	3,770
		05-20-80	--	N	S	1,7,8	--	--
11S/2E-26AS1	Quail Spring	11-03-52	.25	I	S	7,8	C	3,710
		11-29-79	.33	I	S	7,8	C	--
11S/2E-26ES1	Santa Ysabel Indian Reservation.	11-03-52	<1	O	S	9	--	3,920
		11-29-79	<1	O	S	1,8	--	--

11S/2E-26ES2	do.	11-29-79	<1	O	U	0	--	3,880
11S/2E-27HS1	do.	11-03-52	N	O	S	6	--	3,920
		11-29-79	F	O	S	6	--	--
11S/2E-27HS2	do.	11-03-52	N	O	S	6	--	3,920
		11-29-79	F	O	S	6	--	--
11S/2E-27JS1	do.	11-03-52	N	O	U	0	--	3,975
		11-29-79	D	--	U	0	--	--
11S/2E-27NS1	Jim Lloyd	11-06-52	<1	O	S	5,8	--	3,300
11S/2E-28QS1	Santa Ysabel Indian Reservation.	11-03-52	D	--	U	4	--	3,230
11S/2E-28QS2	do.	11-07-52	1	O	S	1,2,8	--	3,180
11S/3E-25MS1	--	11-27-79	1	O	U	0	--	3,800
11S/3E-33MS1	Santa Ysabel Indian Reservation.	04-26-67	<1	O	U	0	--	3,160
		11-28-79	<1	O	U	0	--	--
11S/3E-34ES1	do.	11-28-79	<1	O	U	0	--	4,280
11S/3E-34KS1	do.	04-26-67	1	O	U	0	--	4,310
		11-27-79	4.5	I	U	0	--	--
11S/3E-34PS1	do.	11-27-79	D	--	U	0	--	4,380
11S/3E-34PS2	do.	11-27-79	.31	I	U	0	--	4,390
11S/3E-35CS1	do.	04-26-67	D	R	U	0	--	4,320
		11-28-79	D	--	U	7	--	--
11S/3E-35JS1	King	05-20-80	F	O	H,S	8	C	4,840
12S/2E-3BS1	Ortega	11-05-52	--	N	H	8,9	--	3,320
		05-20-80	.13	I	U	8	C	--
12S/2E-3BS2	Santa Ysabel Indian Reservation.	11-05-52	2.5	I	H	7	C	3,250
12S/2E-3BS3	do.	11-05-52	<1	O	S	9	--	3,265
12S/2E-3BS4	do.	11-06-52	1.5	O	S	3	--	3,260
12S/2E-3BS5	Stella Gordon (nee Pena)	11-06-52	1	R	H	3	--	3,240
12S/2E-3PS1	Santa Ysabel Indian Reservation.	11-05-52	5	O	S	7	--	2,860
		11-24-79	D	--	--	0	--	--
12S/2E-10GS1	Juvencio Valle	11-05-52	D	--	H	7,8	--	2,960
12S/2E-10GS2	do.	11-05-52	D	--	H,S	4	--	2,935
12S/2E-10GS3	do.	11-05-52	.33	I	S	7	C	2,900
12S/2E-10HS1	Santa Ysabel Indian Reservation.	11-05-52	1	O	U	0	--	2,930
12S/2E-10HS2	do.	11-05-52	<1	O	--	0	--	2,870

TABLE 3.--Spring data--Continued

State No.	Owner or name	Date measured	Discharge (gal/min)	Method measured	Water use	Improve-ments	Chemical analyses	Altitude of lsd (ft)
12S/2E-10HS3	Santa Ysabel Indian Reservation.	11-05-52	1	0	--	0	--	2,940
12S/3E-1DS1	do.	04-26-67	2	0	S	7,8	--	4,760
		11-27-79	.13	I	U	7,8	C	--
12S/3E-1ES1	do.	04-26-67	2	0	U	0	--	4,800
		11-27-79	D	--	U	0	--	--
12S/3E-1ES2	do.	04-26-67	1	0	U	0	--	4,800
		11-27-79	D	I	U	3	--	--
12S/3E-2FS1	do.	04-26-67	3	0	U	0	--	4,700
		11-28-79	D	--	U	0	--	--
12S/3E-2FS2	do.	11-28-79	<1	0	U	0	--	4,760
12S/3E-2KS1	do.	11-27-79	.14	I	U	0	--	4,760
12S/3E-2LS1	do.	04-26-67	1	0	U	0	--	4,770
		11-28-79	<1	0	S	0	--	--
12S/3E-2LS2	do.	05-20-80	--	N	H,S	7,8	--	4,820
12S/3E-2RS1	do.	11-28-79	9.4	I	U	0	--	4,650
12S/3E-11BS1	do.	11-27-79	.4	I	U	3	--	4,540
12S/3E-11FS1	do.	11-28-79	<1	0	U	0	--	4,080
12S/3E-11FS2	do.	11-28-79	2	I	U	3	--	4,160
12S/3E-11MS1	do.	11-28-79	1	0	U	0	--	3,600
12S/3E-11NS1	do.	11-28-79	<1	0	U	3	--	3,520
12S/3E-12DS1	do.	11-28-79	5	0	U	0	--	4,630
12S/3E-13ES1	Reed	Not visited	--	--	--	--	--	3,950
12S/3E-24AS1	Santa Ysabel Indian Reservation.	Not visited	--	--	--	--	--	3,920
12S/4E-19DS1	do.	Not visited	--	--	--	--	--	3,920

TABLE 4. - Selected pumping-test results

Length of test: Time of measurement, in minutes, after pump was started.

Static water level: Depth to water, in feet below land-surface datum, prior to start of test.

Yield: Yield of the well, in gallons per minute, for drawdown indicated.

Drawdown: Difference, in feet, between the static and pumping water levels. (Pumping water level is the sum of the static water level plus drawdown)

Specific capacity: Yield, in gallons per minute per foot of drawdown. In a fully efficient and fully penetrating well, specific capacity directly reflects aquifer transmissivity. A declining specific capacity, with time, indicates a deteriorating well condition with respect to hydraulic efficiency, such as plugged well perforations, well sanding, or a declining water level in the aquifer. An increasing specific capacity indicates continuing development of the aquifer near the well. For a given amount of available drawdown, a well with a large specific capacity will have a greater yield than a well with a small specific capacity.

State well No.	Date	Length of test (minutes)	Static water level (ft)	Yield (gal/min)	Drawdown (ft)	Specific capacity [(gal/min)/ ft of DD]
11S/2E-21L1	1-24-78	1,440	13	15	82	0.18
11S/2E-25N2	12-19-77	1,440	25	30	23	1.30
11S/2E-28K2	7- 6-78	1,440	29	15	391	.04
11S/3E-19Q1	1976	360	6	15	30.7	.49
12S/2E-13Q2	1976	360	11.3	2.5	128.7	.02
12S/3E-4R1	9- 5-74	1,320	26.5	94	49.5	1.90
12S/3E-10H1	8- 5-74	1,440	28	37.5	60	.62

TABLE 5. - Drillers' logs

Material	Thickness (feet)	Depth (feet)
11S/2E-21L1. Drilled by Butler Drilling Co. in November 1977. 6-5/8-inch casing 0-40 feet. Altitude about 3,660 feet.		
Topsoil	4	4
Granite, decomposed, red	14	18
Granite, decomposed, blue	9	27
Granite, slightly broken, blue	28	55
Granite, solid, blue	20	75
Fracture, broken	1	76
Granite, solid, blue	39	115
Strata, broken	11	126
Granite, solid, blue	42	168
Fracture, broken	2	170
Granite, solid, blue	120	290
Granite, solid, very hard, gray	210	500
11S/2E-25M1. Drilled by Rex Anderson Corp. in December 1976. 6-inch casing 0-25 feet 7 inches. Altitude about 3,840 feet.		
Soil	5	5
Granite, decomposed	25	30
Granite, broken	20	50
Granite, hard	24	74
Fracture	1	75
Granite, hard	16	91
Fracture	1	92
Granite, hard	20	112
Fracture	1	113
Granite, hard	31	144
Fracture	1	145
Granite, hard	29	174
Fracture	1	175
Granite, hard	30	205
Fracture	1	206
Granite, hard	105	311

TABLE 5. - Drillers' logs--Continued

Material	Thickness (feet)	Depth (feet)
11S/2E-25N2. Drilled by Butler Drilling Co. in October 1977. 6-5/8-inch casing 0-37 feet. Altitude about 3,760 feet.		
Topsoil and small rocks	10	10
Granite, decomposed and rocks	8	18
Strata, broken rock	2	20
Granite, decomposed, firm	7	27
Granite, hard, blue	63	90
Strata, broken	2	92
Granite, solid, blue	28	120
Granite, broken	5	125
Granite, solid	70	195
Granite, broken	5	200
Granite, solid	40	240
Granite, broken	10	250
Granite, solid	66	316
Strata, broken	1	317
Granite, solid	101	418
Granite, slightly broken	12	430
Granite, solid	100	530
Granite, slightly broken	5	535
Strata, broken	1	536
Granite, slightly broken	9	545
Strata, broken	1	546
Granite, slightly broken	1	547

TABLE 5. - Drillers' logs--Continued

Material	Thickness (feet)	Depth (feet)
11S/2E-26M1. Drilled by Rex Anderson Corp. in December 1976. 6-inch casing 0-29 feet 7 inches. Altitude about 3,910 feet.		
Soil	6	6
Granite, soft	19	25
Fracture	2	27
Granite, hard	19	46
Fracture	1	47
Granite, hard	1	48
Fracture	2	50
Granite, hard	19	69
Fracture	1	70
Granite, hard	16	86
Fractured heavily	16	102
Granite, soft	6	108
Granite, hard	48	156
Fracture	1	157
Granite, hard	22	179
Fracture	1	180
Granite, hard	9	189
Fracture, 6 gal/min	1	190
Granite, hard	45	235
11S/2E-28K1. Drilled by Butler Drilling Co. in November 1977. 6-5/8-inch casing 0-38 feet. Altitude about 3,160 feet.		
Topsoil	5	5
Granite, decomposed	14	19
Granite, soft	4	23
Granite, decomposed	4	27
Granite, blue	13	40
Fracture, 3-inch	0	40
Granite, solid, gray	40	80
Rock, very broken	5	85
Granite, slightly broken	25	110
Granite, solid, gray	175	285
Granite, slightly broken, white-gray	30	315
Granite, solid, very hard, light-gray	195	510
Granite, slightly softer, gray	35	545

TABLE 5. - Drillers' logs--Continued

Material	Thickness (feet)	Depth (feet)
11S/2E-28K2. Drilled by Butler Drilling Co. in January 1978. 6-5/8-inch casing 2-37 feet. Altitude about 3,160 feet.		
Topsoil	7	7
Granite, decomposed, soft	29	36
Granite, solid	156	192
Strata, fractured	3	195
Granite, solid	295	490
11S/2E-28R1. Drilled by Arthur A. King in November 1941. 8-5/8-inch casing 0-53 feet, perforated 15 to 33 feet. Altitude about 3,300 feet.		
Topsoil	3	3
Sand, loose, gravel and clay	12	15
Gravel, coarse	11	26
Sand, fine	7	33
Granite, decomposed	20	53
11S/3E-19Q1. Drilled by Trunnell Wells and Pumps in May 1976. 6-5/8-inch casing 0-137 feet, perforated 35 to 137 feet. Altitude about 2,760 feet.		
Topsoil, small rocks	2	2
Granite, decomposed, soft	6	8
Granite, decomposed, fractured	8	16
Granite, soft	50	66
Fractured	2	68
Granite, soft	8	76
Fractured	7	83
Granite, soft	35	118
Quartz, clay	3	121
Granite, soft	12	133
Fractured, very	4	137

TABLE 5. - Drillers' logs--Continued

Material	Thickness (feet)	Depth (feet)
11S/3E-29D1. Drilled by Arthur A. King in April 1941. 8-5/8-inch casing 0-74 feet, perforated 18 to 72 feet. Altitude about 3,020 feet.		
Soil, sandy	10	10
Granite, decomposed	64	74
Granite, hard	6	80
12S/2E-13Q2. Drilled by Trunnell Wells and Pumps in May 1976. 6-5/8-inch casing 0-150 feet, perforated 25 to 35 feet. Altitude about 2,840 feet.		
Topsoil	2	2
Clay	3	5
Sand	11	16
Granite, decomposed	5	21
Granite	9	30
Fracture	1	31
Granite, no fractures	119	150

SURFACE WATER

Few data are available on streamflow characteristics in the area of this study; there are no long-term data. One-time measurements (table 6) made in late November 1979 and late May 1980, however, give some notion of the magnitude of flow in some of the larger streams (pl. 1). The November measurements are representative of the dry season in 1979.

Santa Ysabel Tract Three is drained by Carrizo, Matagual, and Santa Ysabel Creeks. Carrizo Creek, a tributary to Lake Henshaw (about 2 mi northwest of the report area), flows northwestward, mostly through a deep, V-shaped canyon in the middle of the tract. The upper reaches of Carrizo Creek are perennial where the flow is sustained by numerous small springs. Measurements at sites 6 and 8 are of discharges from springs (not shown on pl. 1) in the upper Carrizo drainage area, and measurement at site 5 was on the main stem of the creek at a point downstream from most of the springs. The lower reaches of Carrizo Creek are dry in some years (William S. Bigelow, U.S. Indian Health Service, oral commun., 1980). On November 26, 1979, however, at site 3 the flow was 0.85 ft^3/s.

TABLE 6. - Physical characteristics of water and flow data at surface-water sites

Site No. (see pl. 1)	Location (township/range-section)	Date of measurement	Physical characteristics measurements: Specific conductance (µmho/cm at 25°C)	Temperature (°C)	pH (units)	Flow rate (ft^3/s)
1	11S/2E-28	11-29-79	380	10.0	--	0.01
2[1]	11S/3E-8	11-26-79	340	12.0	8.1	.26
3	11S/3E-19	11-26-79	255	9.0	7.9	.85
4	11S/3E-26	11-27-79	240	10.0	7.4	.18
5	11S/3E-34	11-27-79	170	7.5	--	.37
6	11S/3E-36	11-27-79	98	10.5	--	<.01
7	12S/2E-13	5-28-80	320	18.0	--	[2]2
8	12S/3E-1	11-27-79	140	8.5	--	<.01
9	12S/3E-11	11-28-79	210	8.5	--	.25
10	12S/3E-13	5-28-80	280	10.5	7.5	[2]3
11	12S/3E-16	11-28-79	280	10.0	--	1.5

[1]Matagual Creek below bridge on Highway 79. (Not on pl. 1.)
[2]Estimated.

Matagual Creek flows northwesterly into Lake Henshaw and drains the northern part of Santa Ysabel Tract Three. Only a short reach of the headwaters of this stream is on the tract. The flow of Matagual Creek downstream from the tract is partly controlled by three reservoirs, but it is free flowing within the tract. The discharge at the northern boundary of the tract (site 4) November 27, 1979, was 0.18 ft^3/s.

Santa Ysabel Creek, the largest measured stream in the report area, drains the southern part of Santa Ysabel Tract Three and flows southwestward into Santa Ysabel Valley. It is perennial and spring fed in the upper reaches along the southern boundary of the tract. Measurements at sites 9 and 10 are of streamflow which originated as spring discharge into this drainage; that at site 11 (1.5 ft^3/s) is discharge of the main stem.

Tract Two, except for a small part of the easternmost extent, is drained by Bloomdale Creek. This stream flows southward through fairly open valleys in its upper reaches, but through a deep, V-shaped canyon in its lower reaches within the tract. It is perennial, but no data are available on its other flow characteristics.

The southeastern part of Tract One is drained by Bloomdale Creek and its tributaries; the western part is drained by Scholder Creek. In this reach Scholder Creek is a perennial stream (William S. Bigelow, U.S. Indian Health Service, oral commun., 1980) that flows southwestward through a fairly open valley. The discharge at site 1 November 9, 1979, was 0.01 ft^3/s.

The Mesa Grande Indian Reservation is drained by Scholder Creek which is reported to be dry (Olmsted, 1953) at times in the reach which crosses the reservation. Additional flow data are not available on this reach of this stream.

Further study of the surface-water systems would provide a basis for estimating their development potential.

WATER QUALITY

Except for excessive iron and sodium at some sites, the ground water from all the wells and springs sampled for chemical analysis is of suitable quality for drinking. Thirteen of the nineteen samples (table 7) analyzed for iron, contain iron in excess of the U.S. Environmental Protection Agency (1977) criterion for drinking water of 300 μg/L. The 300 μg/L limit is based on aesthetic rather than toxicological reasons. Water in well 11S/2E-28K1 contains a concentration about 45 times higher than the recommended maximum; others contain from about 5 to 20 times the recommended maximum. These high iron concentrations may make the water unpalatable, and it can stain plumbing fixtures and laundered clothes; but they are not toxic.

Sodium in excess of 20 mg/L, which occurs in 10 samples, may be a hazard to the health of those who must restrict sodium in their diet (U.S. Environmental Protection Agency, 1978, p. 121).

TABLE 7. - Analyses of water from selected wells and springs

STATE WELL NO.	DATE OF SAMPLE	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	TEMPERATURE (DEG C)	HARDNESS (MG/L AS CACO3)	HARDNESS, NONCARBONATE (MG/L CACO3)	CALCIUM DISSOLVED (MG/L AS CA)	MAGNESIUM, DISSOLVED (MG/L AS MG)	SODIUM, DISSOLVED (MG/L AS NA)	SODIUM PERCENT
011S002E21KS1S	52-11-04	489	7.8	--	240	6	42	33	16	13
011S002E21L01S	79-11-29	340	--	14.0	140	26	33	13	17	30
011S002E25N01S	80-05-20	235	6.7	16.0	70	0	17	6.8	15	29
011S002E25NS1S	52-11-06	191	7.0	--	56	0	14	5.1	17	38
011S002E26AS1S	52-11-03	175	7.1	--	40	0	11	3.1	21	51
	79-11-29	210	--	6.5	38	4	8.8	3.8	19	62
011S002E26M01S	80-05-29	330	7.3	--	100	18	27	8.6	19	28
011S002E28C01S	80-05-28	340	6.8	15.0	100	2	27	8.3	21	30
011S002E28J01S	80-05-28	320	6.7	15.0	85	15	19	9.2	28	41
011S002E28K01S	80-05-20	395	6.5	17.0	100	34	25	10	24	32
011S003E25H01S	80-05-28	260	6.8	12.5	65	0	19	4.3	20	39
011S003E25L01S	80-05-28	200	6.3	12.0	52	0	15	3.6	18	42
011S003E35J01S	80-05-20	128	6.5	14.5	30	7	10	1.3	8.1	36
011S003E35JS1S	80-05-20	93	6.4	15.0	16	0	5.0	.8	7.9	51
011S004E30G01S	79-11-26	280	8.2	9.0	72	0	20	5.4	26	51
012S002E03B01S	80-05-20	190	6.5	19.5	46	13	10	5.0	10	31
012S002E03BS1S	80-05-20	240	6.2	17.0	48	0	11	5.1	11	32
012S002E03B02S	80-05-20	175	6.7	16.0	63	34	16	5.5	20	40
012S002E03BS2S	52-11-05	188	7.9	--	69	1	25	1.5	13	29
012S002E10GS3S	52-11-05	268	7.5	--	89	0	20	9.4	22	34
012S002E13Q01S	52-11-06	342	7.7	--	96	0	27	6.9	32	41
012S002E13Q02S	80-05-28	385	6.4	19.0	110	9	24	12	28	35
012S003E01DS1S	79-11-27	130	--	12.0	30	0	8.8	1.9	11	51
012S003E04R01S	80-05-20	480	7.0	18.0	120	2	29	12	34	37
012S003E10H01S	80-05-20	440	6.5	15.0	110	14	28	9.8	31	37

TABLE 7. - Analyses of water from selected wells and springs--Continued

STATE WELL NO.	DATE OF SAMPLE	SODIUM AD-SORP-TION RATIO[1]	POTAS-SIUM DIS-SOLVED (MG/L AS NA)	POTAS-SIUM, DIS-SOLVED (MG/L AS K)	BICAR-BONATE (MG/L AS HCO3)	CAR-BONATE (MG/L AS CO3)	ALKA-LINITY (MG/L AS CACO3)	SULFATE DIS-SOLVED (MG/L AS SO4)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL)	FLUO-RIDE, DIS-SOLVED (MG/L AS F)
011S002E21KS1S	52-11-04	.4	--	.7	286	0	235	--	17	--
011S002E21L01S	79-11-29	.6	21	3.9	--	--	110	47	19	.1
011S002E25N01S	80-05-20	.8	--	6.1	--	--	79	13	13	.3
011S002E25NS1S	52-11-06	1.0	--	3.5	72	0	59	--	14	--
011S002E26AS1S	52-11-03	1.4	--	2.8	61	0	50	--	17	--
	79-11-29	1.3	22	2.8	--	--	34	15	26	.1
011S002E26M01S	80-05-29	.8	--	2.3	--	--	85	26	19	.1
011S002E28C01S	80-05-28	.9	--	3.6	--	--	100	24	15	.2
011S002E28J01S	80-05-28	1.3	--	1.8	--	--	70	31	35	.1
011S002E28K01S	80-05-20	1.0	--	5.4	--	--	70	45	29	.2
011S003E25H01S	80-05-28	1.1	--	3.0	--	--	80	2.2	15	.1
011S003E25L01S	80-05-28	1.1	--	.7	--	--	64	2.3	13	.2
011S003E35J01S	80-05-20	.6	--	1.2	--	--	23	2.6	7.7	.1
011S003E35JS1S	80-05-20	.9	--	.8	--	--	16	4.1	9.2	.1
011S004E30G01S	79-11-26	1.3	29	2.7	--	--	110	2.9	16	.1
012S002E03B01S	80-05-20	.6	--	2.1	--	--	33	26	8.9	.2
012S002E03BS1S	80-05-20	.7	--	2.2	--	--	62	8.4	13	.2
012S002E03B02S	80-05-20	1.1	--	1.2	--	--	29	27	9.4	.2
012S002E03BS2S	52-11-05	.7	--	1.5	83	0	68	--	7.8	--
012S002E10GS3S	52-11-05	1.0	--	4.1	118	0	97	--	10	--
012S002E13Q01S	52-11-06	1.4	--	4.1	134	0	110	--	28	--
012S002E13Q02S	80-05-28	1.2	--	3.1	--	--	100	18	14	.1
012S003E01DS1S	79-11-27	.9	12	.5	--	--	37	3.5	11	.1
012S003E04R01S	80-05-20	1.3	--	5.4	--	--	120	46	24	.5
012S003E10H01S	80-05-20	1.3	--	2.4	--	--	96	33	28	.3

[1]The 1952 values are calculated.

TABLE 7. - Analyses of water from selected wells and springs--Continued

STATE WELL NO.	DATE OF SAMPLE	SILICA, DIS-SOLVED (MG/L AS SIO2)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L)	SOLIDS, DIS-SOLVED (TONS PER AC-FT)	NITRO-GEN, NITRATE TOTAL (MG/L AS NO3)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N)	PHOS-PHORUS, ORTHO, DIS-SOLVED (MG/L AS P)	PHOS-PHATE, ORTHO, DIS-SOLVED (MG/L AS PO4)	BORON, DIS-SOLVED (UG/L AS B)	IRON, DIS-SOLVED (UG/L AS FE)
011S002E21KS1S	52-11-04	--	--	--	.60	--	--	--	60	--
011S002E21L01S	79-11-29	46	248	.34	--	.02	.01	.03	10	2600
011S002E25N01S	80-05-20	55	176	.24	--	.01	.00	.00	10	2000
011S002E25NS1S	52-11-06	--	--	--	1.9	--	--	--	460	--
011S002E26AS1S	52-11-03	--	--	--	.40	--	--	--	370	--
	79-11-29	35	133	.18	--	.01	.01	.03	10	1700
011S002E26M01S	80-05-29	23	177	.24	--	.07	.00	.00	20	340
011S002E28C01S	80-05-28	44	207	.28	--	.02	.00	.00	60	4100
011S002E28J01S	80-05-28	49	216	.29	--	.01	.00	.00	30	1000
011S002E28K01S	80-05-20	45	240	.33	--	.02	.03	.09	20	14000
011S003E25H01S	80-05-28	46	161	.22	--	.13	.00	.00	10	2800
011S003E25L01S	80-05-28	44	139	.19	--	.40	.01	.03	9	2200
011S003E35J01S	80-05-20	31	90	.12	--	3.3	.00	.00	7	40
011S003E35JS1S	80-05-20	33	72	.10	--	.31	.01	.03	9	20
011S004E30G01S	79-11-26	38	179	.24	--	.46	.01	.03	30	60
012S002E03B01S	80-05-20	49	133	.18	--	.11	.03	.09	2	1700
012S002E03BS1S	80-05-20	49	137	.19	--	.01	.72	2.2	10	110
012S002E03B02S	80-05-20	54	158	.21	--	.17	.03	.09	20	6300
012S002E03BS2S	52-11-05	--	--	--	3.2	--	--	--	280	--
012S002E10GS3S	52-11-05	--	--	--	2.4	--	--	--	50	--
012S002E13Q01S	52-11-06	--	--	--	.40	--	--	--	60	--
012S002E13Q02S	80-05-28	42	235	.32	--	7.5	.01	.03	20	<10
012S003E01DS1S	79-11-27	40	99	.13	--	.03	.04	.12	9	30
012S003E04R01S	80-05-20	48	275	.37	--	.19	.00	.00	60	3000
012S003E10H01S	80-05-20	52	257	.35	--	2.9	.03	.09	0	2400

About half the sampled ground water is classified as soft (hardness, as calcium carbonate, less than 75 mg/L); the rest ranges from moderately hard (75 to 150 mg/L) to hard (150 to 300 mg/L). All the ground water sampled is suitable for irrigation.

Water having a pH close to neutral (7.0) is desirable to avoid corrosion of metal. The pH of the sampled ground water ranges from 6.2 to 8.2. The extremes of this range may be slightly corrosive to some metals.

All the surface water analyzed (table 8) is generally suitable chemically for both drinking and irrigation supplies. A few samples, however, contained an excessive concentration of sodium. Physical characteristics of the water at the 11 surface-water sites are presented in table 6.

PRESENT WATER-SUPPLY DEVELOPMENT

At the time of his visit in 1952, Olmsted (1953) reported that Scholder Creek on the Mesa Grande Indian Reservation (pl. 1) was not flowing and there was no water development of any kind.

Residents of Santa Ysabel Indian Reservation Tract Three are supplied their water needs by community system wells 12S/3E-4R1 and 10H1, and a number of individual wells and developed springs (tables 1 and 2 and pl. 1). No water from the major creeks on Tract Three is utilized for domestic purposes; however, cattle and horses were observed drinking from Carrizo Creek near spring 11S/3E-34KS1.

Three main community water systems serve the Mesa Grande Indian Band on Tracts One and Two of the Santa Ysabel Indian Reservation. Water for these systems is provided by wells 11S/2E-25N2 and 11S/2E-28K1 on Tract One and 12S/2E-3B2 on Tract Two (pl. 1). Another community well, 12S/2E-3B1, is used on Tract Two, and a new community well, 11S/2E-28K2, on Tract One is awaiting the installation of power lines. A number of individual wells and developed springs serve those residents not served by the community systems (see tables 1 and 2 and pl. 1).

Scholder Creek on Tract One supplies water for cattle. At the present time (1980) the existing ground-water development is adequately meeting the needs of the residents for both domestic and stock purposes. Depending on the practicality, convenience improvements such as additional hookups to the community systems and conversion from gasoline powered to electric powered pumps could be made.

TABLE 8. - Analyses of water from selected surface-water sites

[Results are shown in milligrams per liter (mg/L) except for iron and boron which are shown in micrograms per liter (μg/L), and percent sodium]

	Site 1 11-29-79	Site 2[1] 11-26-79	Site 3 11-26-79	Site 4 11-27-79	Site 5 11-27-79	Site 9 11-28-79	Site 10 5-28-79	Site 11 11-28-79
Hardness as $CaCO_3$ (Ca,Mg).	140	94	70	68	40	53	72	86
Noncarbonate hardness	27	0	0	0	0	0	2	7
Calcium, dissolved	30	27	18	19	11	14	20	23
Magnesium, dissolved	15	6.5	6.1	4.9	3.1	4.4	5.3	7.0
Sodium, dissolved	24	29	22	19	14	17	14	23
Percent sodium	40	47	50	45	50	49	29	45
Sodium-adsorption-ratio (SAR).	.9	1.3	1.1	1.0	1.0	1.0	.7	1.1
Sodium plus potassium, dissolved.	26	31	25	21	16	19	--	26
Potassium, dissolved	1.9	2.3	2.7	2.2	2.2	2.3	2.1	2.9
Alkalinity, total as $CaCO_3$.	110	120	80	89	55	60	70	79
Sulfate, dissolved	48	12	18	3.7	5.0	17	18	26
Chloride, dissolved	30	22	18	17	12	16	15	18
Fluoride, dissolved	.1	.2	.1	.1	.1	.1	.1	.2
Silica, dissolved	36	31	42	39	38	39	29	40
Dissolved solids, sum of constituents.	251	204	175	159	119	146	146	188
Dissolved solids, tons per acre-foot.	.34	.28	.24	.22	.16	.20	.20	.26
Nitrite plus nitrate, dissolved as N.	.02	.33	.01	.21	.13	.01	.03	.01
Phosphorus, dissolved orthophosphate as P.	.01	.21	.04	.08	.08	.01	.01	.05
Phosphate, ortho, dissolved (PO_4).	.03	.64	.12	.25	.25	.03	.03	.15
Boron, dissolved as B	20	30	20	30	20	20	30	30
Iron, dissolved as Fe	160	10	100	50	190	160	130	190

[1]Matagual Creek at Bridge on Highway 79. Not on plate 1.

POTENTIAL FOR FUTURE WATER-SUPPLY DEVELOPMENT

Ground water for small domestic and stock supplies can be developed in most areas of the reservations from the igneous and metamorphic rock. Water for limited irrigation or light industrial use (25 to 200 gal/min) might be obtained in favorable locations that are topographically low and near the larger faults where fracturing has been most extensive. The alluvium along Scholder Creek on Tract One might also supply water for limited irrigation. Additional water can be developed from the many springs that are not now developed to their full potential. The upper, perennial reaches of Carrizo, Matagual, and Santa Ysabel Creeks have potential for development of limited irrigation supplies and for domestic supplies where not constrained by downstream water rights.

SUMMARY

On both the Santa Ysabel and Mesa Grande Reservations, fractured and weathered igneous and metamorphic rocks, as well as alluvium are water bearing; however, no wells are known to derive their water entirely from alluvium. Well yields range from 2.5 to 250 gal/min. Spring discharge ranges from 0.0 to 9.4 gal/min.

Few data are available for the surface-water characteristics of the study area. One-time measurements were made in late November 1979 and late May 1980; the discharge ranged from less than 0.01 ft^3/s at sites 6 and 8 to an estimated 3 ft^3/s at site 10. Further study of the surface-water systems would provide a basis for estimating their development potential.

Average annual precipitation is somewhat over 30 inches for most of Santa Ysabel Indian Reservation, and about 25 inches for Mesa Grande Indian Reservation. Precipitation is adequate to support perennial streams and springs; it supplies the recharge to water-bearing formations.

Except for excessive iron and sodium at some ground-water sites and excessive sodium at a few surface-water sites, the water is of suitable chemical quality for domestic and agricultural use.

The existing water-supply development on the Santa Ysabel Indian Reservation is adequate to serve the present residents. The Mesa Grande reservation was unoccupied and had no water-supply development in 1952 (Olmsted, 1953) and was reportedly unoccupied in November 1979.

Additional water can be developed from the fractured igneous and metamorphic rock, from presently undeveloped springs, and from perennial reaches of the larger streams if not constrained by downstream water rights.

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