SUMMARY OF WATER-SUPPLY STUDIES IN YOSEMITE NATIONAL PARK, CALIFORNIA JULY 1970 THROUGH DECEMBER 1972

U.S. GEOLOGICAL SURVEY

Administrative Report for
U.S. Government Use Only

Prepared in cooperation with
the National Park Service

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CONVERSION FACTORS

Factors for converting English units to the International System of Units (SI) are given below to four significant figures. However, in the text the metric equivalents are shown only to the number of significant figures consistent with the values for the English units.

English	*Multipy by:*	*Metric (SI)*
acre	0.4047	ha (hectare)
acre-ft (acre-foot)	1,234	m^3 (cubic meter)
ft (foot)	0.3048	m (meter)
ft/d (feet per day)	0.3048	m/d (meters per day)
ft^3/s (cubic feet per second)	0.02832	m^3/s (cubic meters per second)
gal (gallon)	0.003785	m^3 (cubic meter)
gal/d (gallons per day)	0.003785	m^3/d (cubic meters per day)
gal/min (gallons per minute)	0.06309	l/s (liters per second)
(gal/min)/ft (gallons per minute per foot)	0.207	l/s/m (liters per second per meter)
in (inch)	2.540 25.40	cm (centimeter) mm (millimeter)
mi (mile)	1.609	km (kilometer)

SUMMARY OF WATER-SUPPLY STUDIES IN YOSEMITE NATIONAL PARK, CALIFORNIA, JULY 1970 THROUGH DECEMBER 1972

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ABSTRACT

During water-supply studies in Yosemite National Park, surface-water supplies from small streams were monitored, using low-flow gages, to supplement regular data collection at gaging stations on the Merced River. Ground water from unconsolidated deposits and fractures in consolidated rocks has been explored. Water levels in wells show minor seasonal fluctuations, but in general, the aquifers remain nearly full throughout the year. The chemical quality of surface and ground water is good for almost all uses.

Water-supply reconnaissance studies have been made for sites at Glacier Point, Yosemite Valley, Big Meadow, El Portal, and Badger Pass.

INTRODUCTION

The objective of the water-resources program of the National Park Service in Yosemite National Park is an overall appraisal of water-resources potentials for Yosemite to permit an evaluation of the water sources for use. The scope of the work done by Geological Survey personnel from July 1970 through December 1972 included (1) data collection for an overall appraisal of water resources in the park, (2) appraisal of sites for water-supply development, and (3) measurements of low flow in small streams and ground-water fluctuations in wells.

Survey personnel have made several brief water-supply investigations in the park since 1962. Most of the work was directed toward development of small water supplies for specific areas. The earlier work included studies in the Foresta, Big Meadow, Badger Pass, Bridalveil campground, and White Wolf areas. Several water wells were drilled in conjunction with or as a result of the studies.

The Survey maintains several gaging stations on the Tuolumne and Merced Rivers inside the park and at sites downstream from the eastern border of the park. Water stage and discharge, and results of water-quality analyses are published in water-supply papers and annual data reports.

Analyses of the quality of both surface- and ground-water samples have been made to determine chemical constituents dissolved in the water. Data on suspended sediment in streams and water temperature also has been collected. Some of the data, such as the streamflow data, are published by the Survey; some are available only in office records.

Park Service personnel have always been helpful in implementing studies in the park by members of the Geological Survey staff. Of special help during the work reported here were William R. Jones, Chief Naturalist; Herbert Ewing, Mather District Ranger; Robert Dunnagan, Supervisory Park Ranger; and Whalen Fairchild, Chief of Maintenance Management.

WATER-RESOURCES APPRAISAL

Work began on a water-resources appraisal study in Yosemite National Park during July through October 1970. The park includes many areas where visitor use requires developed water supplies; these areas plus projected user areas were emphasized in the study (fig. 1).

Surface Water

The Merced River is the largest stream in the developed part of the park. About one-half mile downstream from the mouth of Illilouette Creek at a site near Happy Isles, water is diverted from the Merced River to supply users in Yosemite Valley.

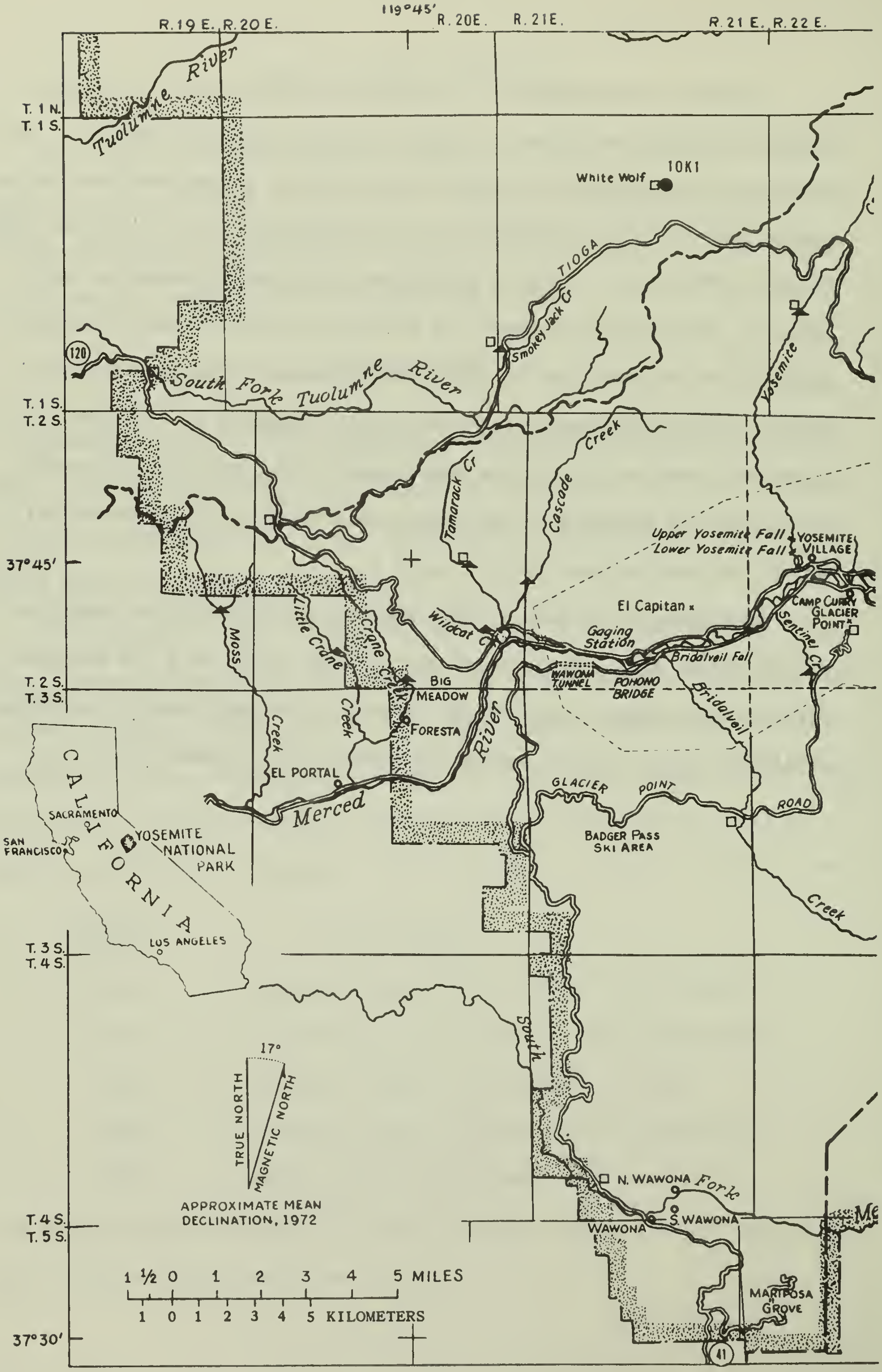
Surface-water supplies have been developed in various places in the park. In some areas where the prospects for ground-water development are marginal, there are small streams that might supply water. However, the reliability of the streams as water sources during late summer has not been established. In 1970 a program was started to obtain low-flow data at selected sites on small streams. The five sites selected initially were:

Station number	Station name
11-2647	Porcupine Creek at Porcupine Flat Campground
2657	Yosemite Creek at Yosemite Creek Campground
2662	Sentinel Creek near Yosemite Village
2667	Tamarack Creek at Tamarack Creek Campground
2794	Smoky Jack Creek at Smoky Jack Campground

Five more stations were added in 1971 to supply additional information in the vicinity of Big Meadow (see p. 42).

Discharge measurements of low flows at the selected sites can be related to concurrent flows at nearby continuous gaging stations. The low-flow characteristics of long-term records at gaging stations can be transferred to obtain estimates of the characteristics at low-flow sites (Riggs, 1973, p. 14). When a sufficient correlative record has been obtained, the relation between the five low-flow sites and recording gages on the Merced River at Happy Isles, Pohono Bridge, and Briceburg (about 15 miles downstream from the eastern boundary of the park) will be examined. Results of low-flow measurements are listed under low-flow partial-record stations in the annual data reports of the Geological Survey and are included here in table 1.

Measurements are made at the low-flow sites during the snow-free months of the year. Peak demand in the park occurs on a few weekends during late summer. Low-flow data indicate the magnitude of discharge available in the streams during the times of peak demand for water.


119°45'
R.19 E.
R.20 E.
R. 20E.
R. 21E.
R.21 E.
R.22 E.
T. 1 N.
T. 1 S.
Tuolumne River
White Wolf
10K1
TIOGA
Smokey Jack Cr
Yosemite
120
South Fork Tuolumne River
T. 1 S.
T. 2 S.
Tamarack Cr
Cascade Creek
Upper Yosemite Fall
Lower Yosemite Fall
YOSEMITE VILLAGE
37°45'
El Capitan
CAMP CURRY
GLACIER POINT
Sentinel Cr
Wildcat Cr
Gaging Station
Bridalveil Fall
Little Crane Creek
Crane Creek
Moss Creek
WAWONA TUNNEL
POHONO BRIDGE
Bridalveil
T. 2 S.
T. 3 S.
BIG MEADOW
FORESTA
River
EL PORTAL
Merced
GLACIER POINT ROAD
BADGER PASS SKI AREA
Creek
CALIFORNIA
SACRAMENTO
SAN FRANCISCO
YOSEMITE NATIONAL PARK
LOS ANGELES
T. 3 S.
T. 4 S.
South
17°
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 1972
N. WAWONA
Fork
S. WAWONA
WAWONA
Me
T. 4 S.
T. 5 S.
1 ½ 0 1 2 3 4 5 MILES
1 0 1 2 3 4 5 KILOMETERS
MARIPOSA GROVE
37°30'
41

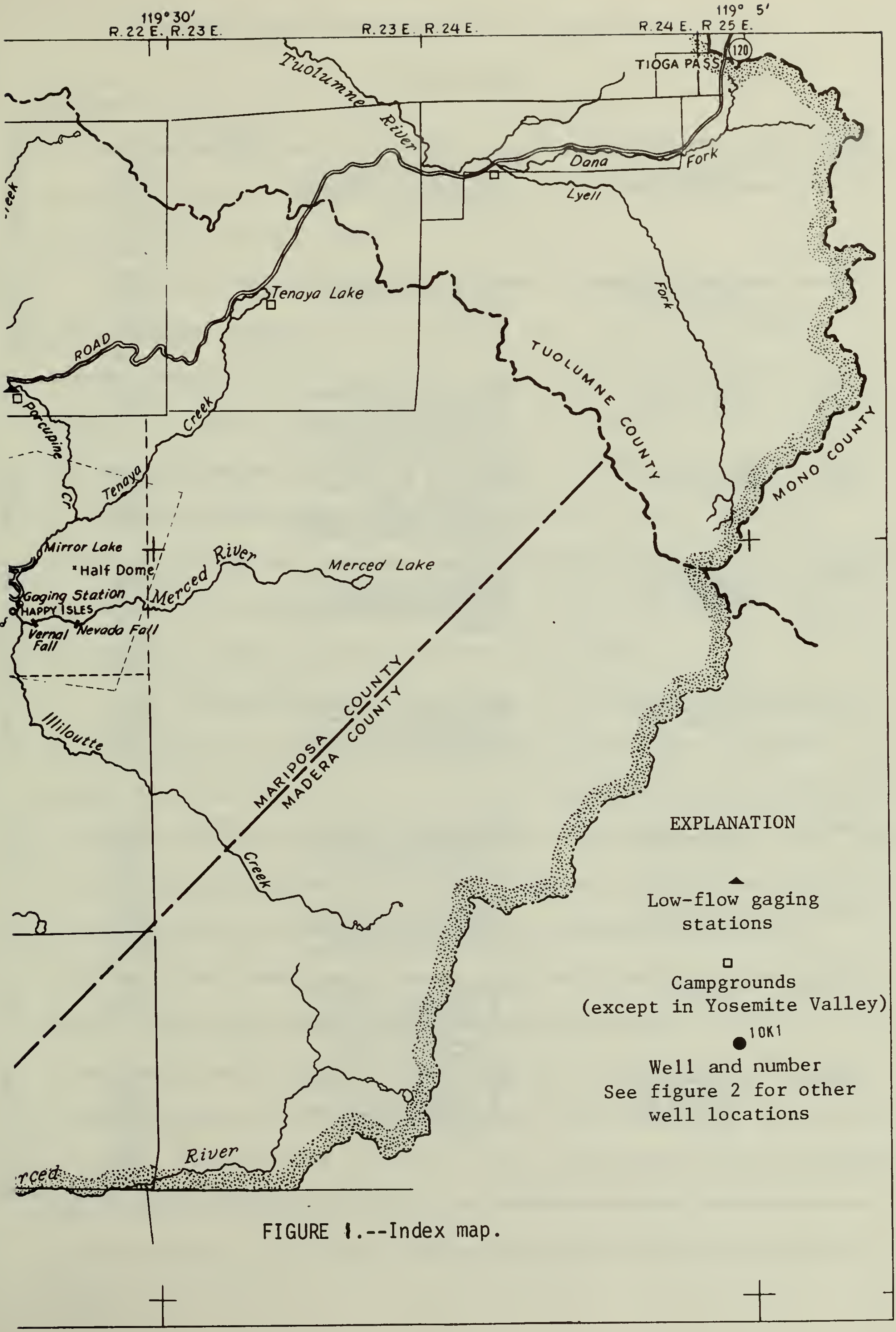


FIGURE 1.--Index map.

Table 1.--*Discharge at low-flow partial-record stations*

Station number	Station name	Location	Drainage area (sq mi)	Measurements	
				Date	Discharge ft^3/s
11-2647.00	Porcupine Creek at Porcupine Flat Campgrounds, near Yosemite Village	NE¼SW¼ sec.33, T.1 S., R.22 E., at Porcupine Flat Campgrounds, 1,500 ft downstream from highway bridge, and 4.1 miles northeast of Yosemite Village.	3.60	8-19-70 9-2-70 9-16-70 8-11-71 9-7-71 9-21-71 7-6-72 8-22-72 10-4-72	0.16 .02 .03 1.48 .35 .06 2.66 .02 .22
11-2657.00	Yosemite Creek at Yosemite Creek Campgrounds, near Yosemite Village	SW¼NE¼ sec.30, T.1 S., R.22 E., at Yosemite Creek Campgrounds, 5.6 miles north of Yosemite Village.	18.5	8-19-70 9-2-70 9-16-70 8-11-71 9-7-71 9-21-71 7-6-72 10-4-72	.55 .06 .002 1.80 3.68 .05 10.6 .58
11-2662.00	Sentinel Creek near Yosemite Village	Unsurveyed, T.2 S., R.22 E., Mariposa County, in Yosemite National Park, 200 ft downstream from Deer Meadows, 1.3 miles southeast of Glacier Point Hotel, and 2.3 miles south of Yosemite Village.	1.40	8-12-71 6-27-72 7-6-72	.015 .43 .12
11-2666.00	Cascade Creek near El Portal	NW¼SW¼ sec.19, T.2 S., R.21 E., Mariposa County, in Yosemite National Park, 200 ft upstream from unnamed tributary, 6.2 miles northeast of El Portal, and 6.5 miles west of Yosemite Village.	10.3	8-12-71 9-7-71 9-22-71 7-5-72 8-23-72 10-4-72	.51 .20 .13 1.51 .09 .12
11-2667.00	Tamarack Creek at Tamarack Flat Campground, near El Portal	NE¼NW¼ sec.23, T.2 S., R.20 E., at culvert on Big Oak Flat Road at Tamarack Flat Campground, 5.7 miles northeast of El Portal, and 8.2 miles west of Yosemite Village.	4.31	8-18-70 9-2-70 9-16-70 10-6-70 10-15-70 8-12-71 9-7-71 9-22-71 7-5-72 8-23-72 10-4-72	.41 .21 .17 .16 .15 .75 .41 .21 1.55 .21 .20
11-2668.00	Wildcat Creek near El Portal	SE¼SW¼ sec.25, T.2 S., R.20 E., Mariposa County, in Yosemite National Park, upstream from highway bridge, and 4.9 miles northeast of El Portal.	1.24	8-10-71 9-8-71 9-22-71 7-6-72 8-23-72 10-5-72	.15 .12 .08 .05 .03 .07
11-2669.00	Crane Creek above diversion dam, near El Portal	SE¼SW¼ sec.34, T.2 S., R.20 E., Mariposa County, in Yosemite National Park, 40 ft upstream from head of diversion ditch, and 2.8 miles northeast of El Portal.	8.10	8-11-71 9-7-71 9-21-71 7-5-72 8-22-72 10-5-72	1.29 .95 .56 1.07 .24 .27
11-2670.00	Little Crane Creek near El Portal	NW¼NE¼ sec.32, T.2 S., R.20 E., Mariposa County, in Stanislaus National Forest, upstream from Little Nellie Falls, and 3.2 miles north of El Portal.	1.31	8-10-71 9-7-71 9-21-71 7-5-72 8-22-72 10-4-72	.19 .22 .15 .25 .07 .11
11-2671.00	Moss Creek near El Portal	SE¼NW¼ sec.25, T.2 S., R.19 E., Mariposa County, in Stanislaus National Forest, 120 ft downstream from road crossing, 300 ft downstream from unnamed tributary, and 4.7 miles northwest of El Portal.	4.45	8-10-71 9-7-71 9-21-71 7-5-72	.79 .74 .40 .65
11-2794.00	Smoky Jack Creek at Smoky Jack Campground, near Yosemite Village	NW¼NW¼ sec.31, T.1 S., R.21 E., 12 ft downstream from culvert on Tioga Road, 8.5 miles northeast of Yosemite Village, and 10.6 miles northeast of El Portal.	4.15	8-18-70 9-2-70 9-16-70 10-6-70 10-15-70 8-11-71 9-7-71 9-21-71 7-6-72 8-22-72 10-4-72	.15 .08 .04 .04 .05 .15 .18 .06 .83 .08 .07

Ground Water

Ground water is used as a source for water supplies in many parts of the Sierra Nevada. Yields from wells usually are small and sometimes are subject to considerable seasonal fluctuation.

Rocks that form the aquifers in Yosemite National Park consist of unconsolidated deposits and consolidated rocks. The unconsolidated deposits include alluvium, composed mainly of water-laid sedimentary material in the full range of grain sizes from boulders to clay, and till deposited during various periods of glaciation. The consolidated rocks are igneous granitic rocks (granite, granodiorite, quartz monzonite) locally fractured, and residuum (deeply weathered granitic rock, in place, not eroded, colloquially called "decomposed granite"). Metamorphic rocks are not significant as aquifer materials in the park.

Wells in the Yosemite area generally are constructed either in (1) alluvium and residuum, or (2) consolidated rock where fractured. Wells constructed in alluvium and residuum usually are cased to their full depth with perforations in the casing opposite water-yielding zones. Wells in alluvium and residuum almost always yield water though quantities may be small because of the character and scant thickness of saturated material in many small meadow areas. The consolidated rock, except for water in fractures, can be considered non-water-bearing. Wells in consolidated rock usually are cased from the surface down to the depth where unweathered rock is encountered, and obtain water from fractures in the rock. Estimation of the prospect for a well in hard rock is speculative because the yield is dependent on the number and size of fractures intercepted and on there being sufficient water stored in the fracture system.

Wells have been drilled in several localities in the park. In 1963, R. H. Dale (written commun., May 10, 1966) examined more than 20 privately owned wells in the Foresta subdivision and two in the adjacent Big Meadow area. Four test wells were drilled to consolidated rock in Big Meadow during autumn 1964 during a ground-water study by the U.S. Bureau of Reclamation (1965).

In 1968, three test wells were drilled in the park at sites selected by Survey personnel. The sites are at the Badger Pass ski area, near Bridalveil Campground, and at White Wolf (H. T. Mitten, written commun., April 9, 1969). Each of the wells was drilled into consolidated rock and most of the water obtained is from fractures.

The measured or reported yields of all the foregoing wells are in the range from 1 to 25 gal/min (0.06 to 1.6 l/s).

Periodic water-level measurements in selected wells in the park indicate that the water level is near or above land surface during most of the year (table 2).

Table 2.--*Water levels in wells*

[All wells owned by U.S. National Park Service. Water level, in feet, below or above (+) land surface.]

Date	Water level
Well 1S/21E-10K1	
Aug. 29, 1968	9.4
July 18, 1972	+.4
Aug. 22	1.0
Oct. 4	.5
Well 2S/20E-3F2	
March 9, 1965	2.2
July 18, 1972	4.0
Aug. 22	5.8
Oct. 5	4.9
Well 2S/20E-3F3	
March 9, 1965	1.4
July 18, 1972	4.2
Aug. 22	5.8
Oct. 5	4.4
Well 2S/22E-19J1	
Jan. 19, 1972	flowing
June 27	flowing
July 18	flowing
Aug. 21	flowing
Oct. 5	2.2
April 19, 1973	flowing
Well 2S/22E-19Q1	
Feb. 4, 1971	8.2
July 18, 1972	8.9
Aug. 21	10.1
Oct. 5	10.1
Well 3S/21E-22E1	
July 3, 1968	0.8
June 27, 1972	flowing
July 18	flowing
Aug. 21	flowing
Oct. 3	flowing
Well 3S/21E-24E1	
Aug. 10, 1968	1.9
June 27, 1972	-
July 18	2.3
Aug. 21	2.8
Oct. 3	2.5

Sites for ground-water development (proven and prospective) include:

- Aspen Valley
- Big Meadow
- Bridalveil Campground
- Crane Flat
- Dana Meadows
- Eagle Peak Meadows
- El Capitan Meadow
- Empire Meadow
- Foresta
- Gin Flat
- Glen Aulin
- Half Moon Meadow
- Harden Lake area
- Hole Creek Meadow
- Kerrick Meadow
- Kibbie Lake area
- Laurel Lake area
- Leidig Meadow
- Long Meadow
- Lost Bear Meadow
- McGurk Meadow
- McSwain Meadows
- Miguel Meadow
- Mono Meadow
- Monroe Meadows
- Pate Valley
- Peregoy Meadow
- Pleasant Valley
- Porcupine Flat
- Pothole Meadows
- Ribbon Meadow
- Rogers Meadow
- Smith Meadow
- Smoky Jack Campground
- Snow Flat
- Starr King Meadow
- Tamarack Flat
- Thompson Canyon
- Tilden Canyon
- Tiltill Valley
- Tuolumne Meadows
- Turner Meadows
- Wawona area
- Westfall Meadows
- White Wolf
- Yosemite Creek Campgrounds
- Yosemite Valley

Field examination of the sites[1] is incomplete and will be continued as future work schedules permit.

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[1] Most of the sites are not shown on the maps in this report. Site names were taken from Geological Survey 15-minute topographic quadrangle maps and Park Service maps.

Water Quality

Water samples were collected for chemical analysis at selected springs and stream sites near campgrounds and gaging stations (table 3) from July 1970 to December 1972. The largest concentration of dissolved solids in any sample was 46 mg/l (milligrams per liter). None of the dissolved constituents in any sample exceeded recommended limits for potable use. Total organic carbon in the samples from pond 2 at Tioga Pass (7.0 mg/l) and from Smoky Jack Creek below the campground (3.0 mg/l) are the highest in the group, but are within the range of values for surface-water samples from Pacific Coast areas described by Helms (1970, p. 8). None of the samples were analyzed for bacterial content. The analyses in table 3 should not be construed to qualify the water for use as a public water supply.

Many water samples from streams, springs, and wells in Yosemite have been collected by the Geological Survey and other agencies under the auspices of various programs. The results of analyses are available in agency files and a wide variety of previous and concurrent publications. No attempt has been made to incorporate analyses other than those for samples collected during the work described in this report.

Table 3.--*Results of chemical analyses*

Analyses by U.S. Geological Survey

Sampling site	Date of collection	Water temperature (°C)	Concentration, in milligrams per liter																Percent sodium	Specific conductance (micromhos at 25°C)	pH	Total organic carbon (TOC) (mg/l)
			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 (sum)	Hardness as $CaCO_3$	Noncarbonate hardness as $CaCO_3$				
U.S. Public Health Service drinking-water standards (1962)				0.3							250	250	>0.9	45		500						
STREAMS																						
Merced River water-supply diversion near Happy Isles	9-9-70	13.0	3.9	0.01	1.9	0.0	1.9	0.2	6	0	0.0	2.4	0.0	0.1	0.05	13	4	0	44	23	6.7	3.0
Porcupine Creek above campground	9-10-70	9.0	7.7	.02	1.5	.0	1.8	.4	8	0	.0	.3	.0	.0	.02	16	4	0	50	18	6.2	.5
below campground	9-10-70	9.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.5
Yosemite Creek above west campground	9-10-70	12.0	6.2	.00	1.8	.0	1.3	.6	8	0	.0	.3	.0	.2	.05	14	4	0	35	17	6.0	1.5
east campground collection box	9-10-70	10.0	17.0	.03	4.6	.4	3.4	.9	23	0	1.0	.2	.0	.0	.02	39	13	0	35	43	6.5	2.0
below campground	9-10-70	12.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	.5
Sentinel Creek at low-flow gage	9-9-70	11.5	7.9	.00	2.4	.1	1.6	.5	9	0	2.0	.3	.0	.2	.07	20	6	0	33	24	6.2	2.0
Merced River south of east end of Leidig Meadow	2-3-71	5.0	7.0	--	2.0	.0	2.1	.6	8	0	1.0	2.2	.1	.0	.11	20	5	0	48	24	6.2	--
Tamarack Creek above campground	9-11-70	12.5	11.0	.00	12.0	.1	2.0	.3	38	0	1.0	.2	.0	.0	.07	46	30	0	13	70	7.7	1.5
below campground	9-11-70	14.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.0
Smoky Jack Creek above campground	9-11-70	11.0	11.0	.00	8.3	.2	2.0	.3	28	0	1.0	.1	.0	.1	.01	37	22	0	17	51	7.2	.5
below campground	9-11-70	13.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.0
Tioga Pass diversion to tank	9-8-70	8.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	.0
holding tank	9-8-70	11.0	9.0	.00	3.0	.1	2.3	.2	9	0	1.0	2.6	.0	.0	.02	22	8	1	37	31	6.4	--
pond 2	9-8-70	14.5	7.3	.01	1.8	.0	2.1	1.1	8	0	2.0	.4	.0	.2	.12	19	4	0	43	25	6.0	7.0

Table 3.--Continued

									SPRINGS												
Happy Isles east spring	9-9-70	7.0	9.4	.0	2.1	.1	2.0	1.0	10	0	1.0	1.0	.1	.0	.07	22	6	0	39	26	6.4
west spring	9-9-70	6.8	9.4	.0	2.2	.2	2.0	1.1	12	0	1.0	.9	.0	.0	.08	23	6	0	36	27	6.8
Iron Spring	2-4-71	7.0	31	.10	3.3	.0	2.4	.9	12	0	1.0	1.6	.2	.0	.09	27	8	0	36	31	6.4
Bear Spring (100 yards east of Fern Spring)	9-8-70	8.0	12.0	.0	3.9	.4	2.8	.8	19	0	1.0	.2	.0	.0	.00	30	11	0	33	39	6.5
Fern Spring	9-8-70	--	13.0	.0	2.6	.2	2.2	.7	15	0	2.0	.3	.1	.1	.00	28	8	0	37	27	6.5
									WELLS												
Well 2S/22E-19J1	10-22-71	--	19	.12	3.1	.6	2.8	2.0	34	0	.3	.7	.5	.04	.06	46	10	0	32	36	7.0
Do.	2-3-72	8.4	19	.01	2.7	.7	2.1	2.5	20	0	1.5	.7	.2	.05	.00	39	10	0	26	33	8.5
Well 2S/22E-19Q1	2-3-71	9.3	17	.19	3.5	.0	3.6	1.5	17	0	.0	1.2	.2	.0	.09	35	8	0	43	41	5.8
Do.	2-4-71	9.0	17	.12	3.5	.0	3.6	1.6	17	0	.0	.8	.1	.0	.09	35	8	0	43	40	6.0

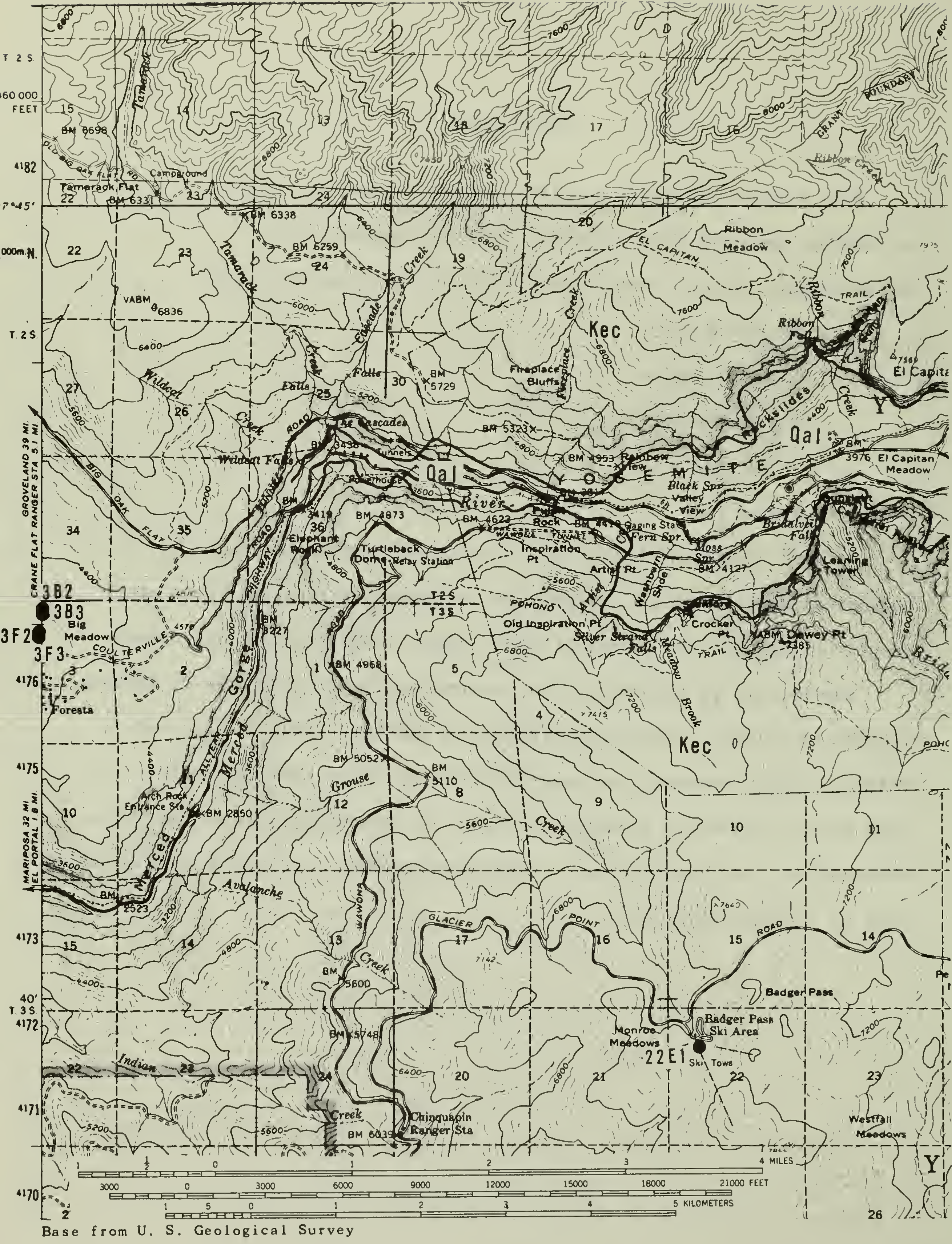
SITE STUDIES

Site studies for water supplies were undertaken at five local areas in Yosemite National Park from July 1970 to December 1972. In approximate chronological order of study, the localities are:

Glacier Point
Yosemite Valley
Big Meadow
El Portal
Badger Pass

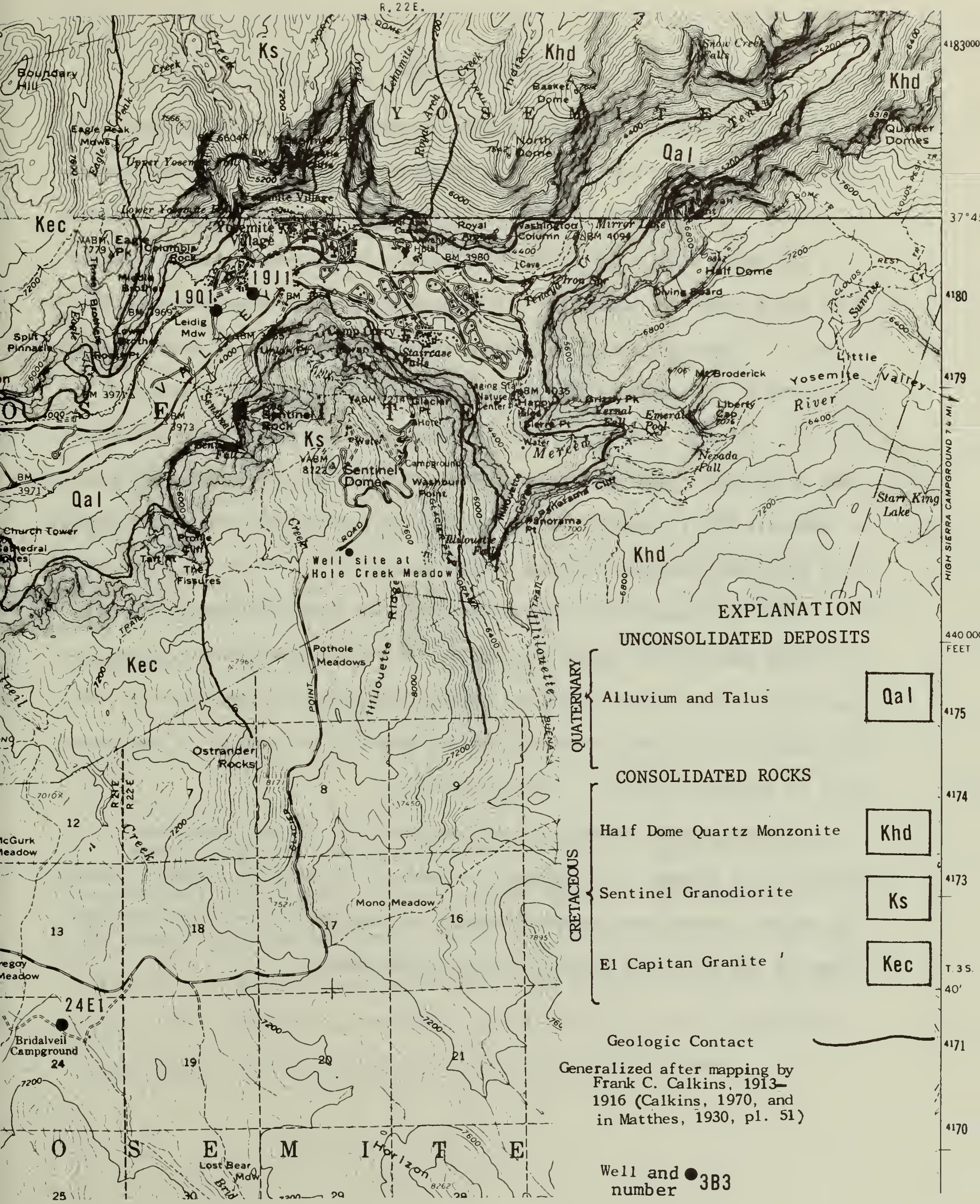
In each locality, the National Park Service requested that the Geological Survey examine the area and recommend exploration for a water supply or evaluate the potential water supply available for development.

Discussions of geology in this report are based on mapping of bedrock geology by Frank C. Calkins in 1913-16 (*in* Matthes, 1930, pl. 51, and Calkins, 1970), Matthes' own work in the same volume (Matthes, 1930), work by the California Division of Mines and Geology (1967), and on field observation. For convenience, a simplified geologic map based on Calkins' work is included (fig. 2).



Base from U. S. Geological Survey
15-min. topographic quadrangle
maps, Yosemite, 1956, and Hetch
Hetchy Reservoir, 1956.

FIGURE 2.--Generalized geologic map of



osemite Valley and vicinity.

Glacier Point

The water supply for Glacier Point is obtained from two sources. During early summer, water from a collection gallery in Hole Creek Meadow is gravity-fed to a 420,000-gal ($1,590 \ m^3$) storage tank about a quarter of a mile west of Glacier Point Campground. In midsummer when the supply from the gallery is inadequate, it is augmented with water from a pond formed by a masonry dam on an unnamed stream about half a mile southwest of Union Point. The water flows by gravity from the pond to a 10,000-gal ($38 \ m^3$) storage tank at Union Point and is pumped uphill to a storage tank at Glacier Point Campground. The two water sources reportedly provided an adequate water supply for the Glacier Point Hotel and campground through July 1969 when the hotel burned to the ground.

Field reconnaissance of several of the local meadows was carried out to verify the geology mapped by Calkins (1970) and to examine the fracture and joint system. The fractured Sentinel Granodiorite (fig. 2) was examined for water seeps and springs where it is exposed on the south wall of Yosemite Valley.

A sledge hammer seismic survey was conducted in the Hole Creek Meadow in an attempt to determine the depth to consolidated rock. However, the seismic survey was rendered useless because of refraction through the pipes of the collector gallery buried in the meadow.

The existing water system at Glacier Point could be improved by making some changes at Hole Creek Meadow. The gallery in the meadow could be buried deeper, and both the trunkline to the reservoir and the reservoir itself could be enlarged. Another gallery could be installed in Deer Creek Meadow which is larger than Hole Creek Meadow. With data from a low-flow gage on Deer Creek, an estimate can be made of summer and fall yields from a gallery system in Deer Creek Meadow.

Stream water could be diverted to the Glacier Point area from Sentinel Creek but diversion would reduce the flow over Sentinel Falls.

The possibility of obtaining ground water was considered and a prospective site for a test well was selected (fig. 2). Data are not available to predict the depth or yield of a well at the site; drilling a well at the proposed site will be highly speculative. The principal purpose of the well will be to obtain information on the character and extent of the fractures in the underlying rocks.

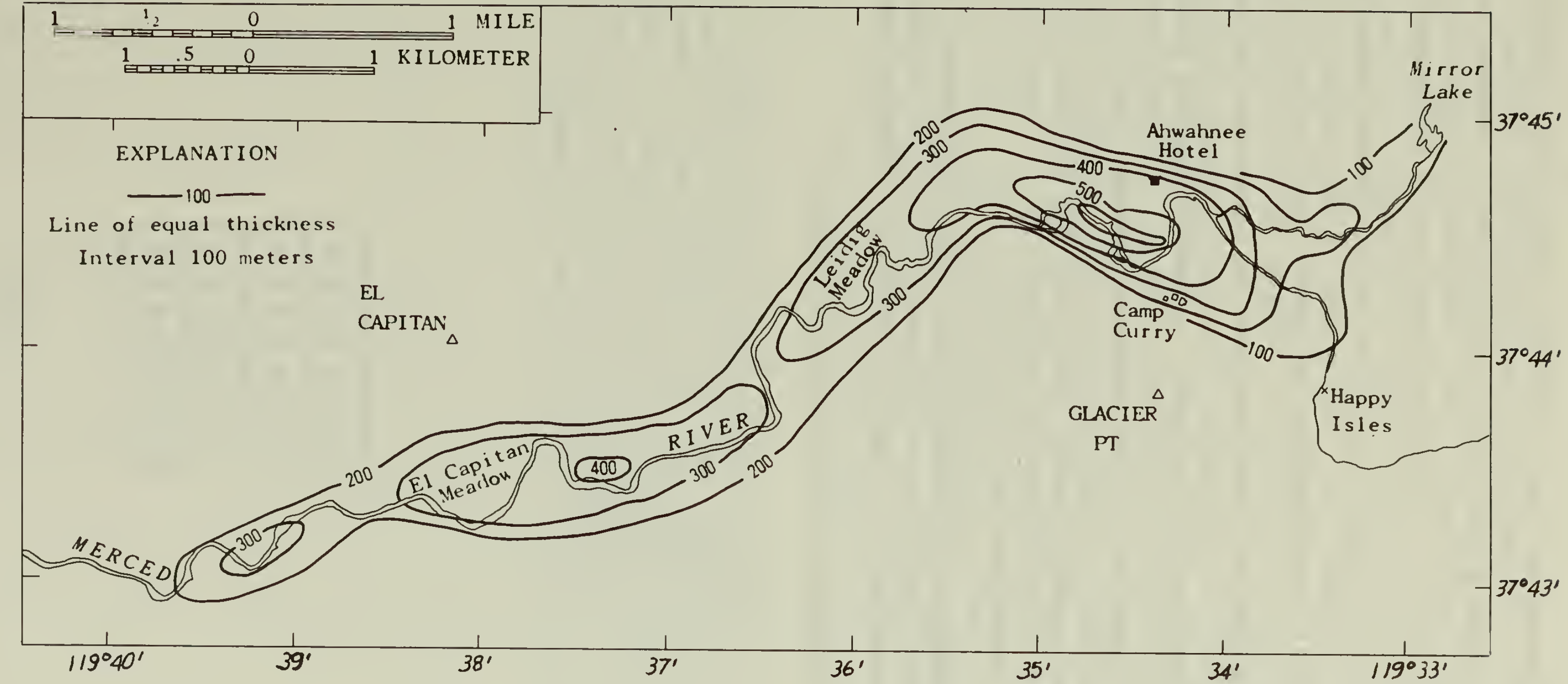
Yosemite Valley

Most of the water supply for Yosemite Valley is diverted from the Merced River at Happy Isles about one-half mile (0.8 km) downstream from the mouth of Illilouette Creek. The supply is augmented when needed by flow from two springs about one-quarter mile (0.4 km) southwest of Happy Isles. During dry years the demand may, at times, equal or exceed the supply because no storage facility is built into the system.

A potential source of water in Yosemite Valley is ground water in the unconsolidated deposits that compose the floor of the valley. Matthes (1930, p. 103) estimated the depth of valley fill at not less than 300 ft (91 m). Subsequent seismic exploration in the mid-1930's (Gutenberg and others, 1956) suggested a far greater depth, locally exceeding 2,000 ft (609 m) (fig. 3). Test drilling has verified that the valley fill is deeper than Matthes' original estimate.

The relation between the depth of the unconsolidated deposits (fig. 3) and the consolidated rocks adjacent to Yosemite Valley (Calkins, 1970 and fig. 2) is obvious and logical. The valley transects three major rock units; from east to west, the massive Half Dome Quartz Monzonite of Cretaceous age, the extensively jointed Sentinel Granodiorite of Cretaceous age, and the massive El Capitan Granite of Cretaceous age. Where the Sentinel Granodiorite is inferred to underlie the valley, the unconsolidated deposits are deepest, indicating that glacial scour differentially exploited adjacent rock units of differing strength characteristics, incising deeply into the weakest, jointed rock. Such geologic data can be used to speculate qualitatively about the depth of unconsolidated deposits in valleys and meadows in other parts of the park.

The unconsolidated deposits that fill the valley include alluvial, glacial, proglacial, fluvial, and lacustrine sedimentary deposits laid down over consolidated rock. Analysis of similar deposits by Morris and Johnson (1966), suggested that specific yield of alluvium in Yosemite Valley is 15 to 25 percent and hydraulic conductivity is about 13 to 26 ft/d (4.0 to 7.9 m/d).



After Gutenberg and others, 1956

FIGURE 3.--Thickness of unconsolidated deposits in Yosemite Valley.

The ground-water level in the valley probably remains close to land surface throughout the year. Properly managed, the quantity of water in the aquifer system formed by the unconsolidated deposits in the valley should be ample for a considerable water-supply development.

In addition to water within the unconsolidated deposits, water also may be available from fractures in rocks. The Sentinel Granodiorite (fig. 2) is extensively fractured and its occurrence and contacts in the subsurface can be easily inferred. A steeply dipping fracture pattern approximately parallel to the length of Yosemite Valley is crossed by several other steeply dipping fractures. Any of these fractures could form conduits for underflow into the valley.

Reconnaissance of Yosemite Valley during the summer and fall of 1970 led to the selection of a test well site in a forested area at the northeast end of Leidig Meadow (well 2S/22E-19Q1, fig. 2).

Test Well 2S/22E-19Q1[a]

Drilling on test well 2S/22E-19Q1 started in December 1970. A reverse-circulation drill rig (Burnham, 1963) was utilized to provide easier development and accurate logging of the well. The drill was unable to penetrate boulders encountered at 259 ft (78.9 m). Caving of very fine-grained sand and silt below a depth of about 55 ft (16 m) prompted completion of the well at 56 ft (17 m) at the base of a fine- to coarse-grained sand (table 4). Following completion of the well, a temporary pump was installed and the well was pumped and surged until clear water was obtained. Four satellite observation wells were jetted to a depth of about 10 ft (3 m) below land surface. The directions and distances from the test well to the observation wells are listed in figure 5.

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[a] Wells are identified according to their location in the rectangular system for the subdivision of public lands. The identification consists of the township number, north or south; the range number, east or west; and the section number. A section is further divided into sixteen 40-acre (16.2 ha tracts lettered consecutively (except I and O) as shown in the diagram. Within the 40-acre (16.2 ha) tract, wells are sequentially numbered. All wells in the study area are referenced to Mount Diablo base line and meridian.

D	C	B	A
E	F	G	H
M	L	K	J
N	P	Q	R

A graphic log based on information supplied by the driller is presented in figure 4. A generalized lithologic log of the well based on grab samples taken at a spacing interval of 5 ft (1 m) is presented in table 4. Analyses of particle sizes for two drillers' grab samples are presented in table 5. Table 6 gives the correlation between descriptions of particulate matter (table 4) and particle-size ranges (table 5).

Test pumping of well 2E/22E-19Q1 was started on February 2, 1971. Drawdown reached a maximum after about 200 minutes of pumping at 65 gal/min (4.1 l/s) (fig. 5), indicating that the cone of influence of the pumped well intercepted a quantity of water equal to the discharge of the pump. The principal source of recharge probably is the Merced River; ample quantities of water were available for recharge at the time of the test.

The specific capacity of the well was about 4 (gal/min)/ft of drawdown (0.83 l/s/m) during the test. The driller estimated that the well could sustain a discharge of 60-65 gal/min (3.8 to 4.1 l/s). Verification of sustained yield will depend on the results of pumping at the end of a dry season.

Water samples for chemical analysis (table 3) were collected at the well during test pumping. In addition, a water sample was taken from the Merced River during the test pumping for comparison. Analyses of water samples from the well and river indicate that the water is similar and of excellent chemical quality. Bicarbonate is the dominant anion with calcium the dominant cation.

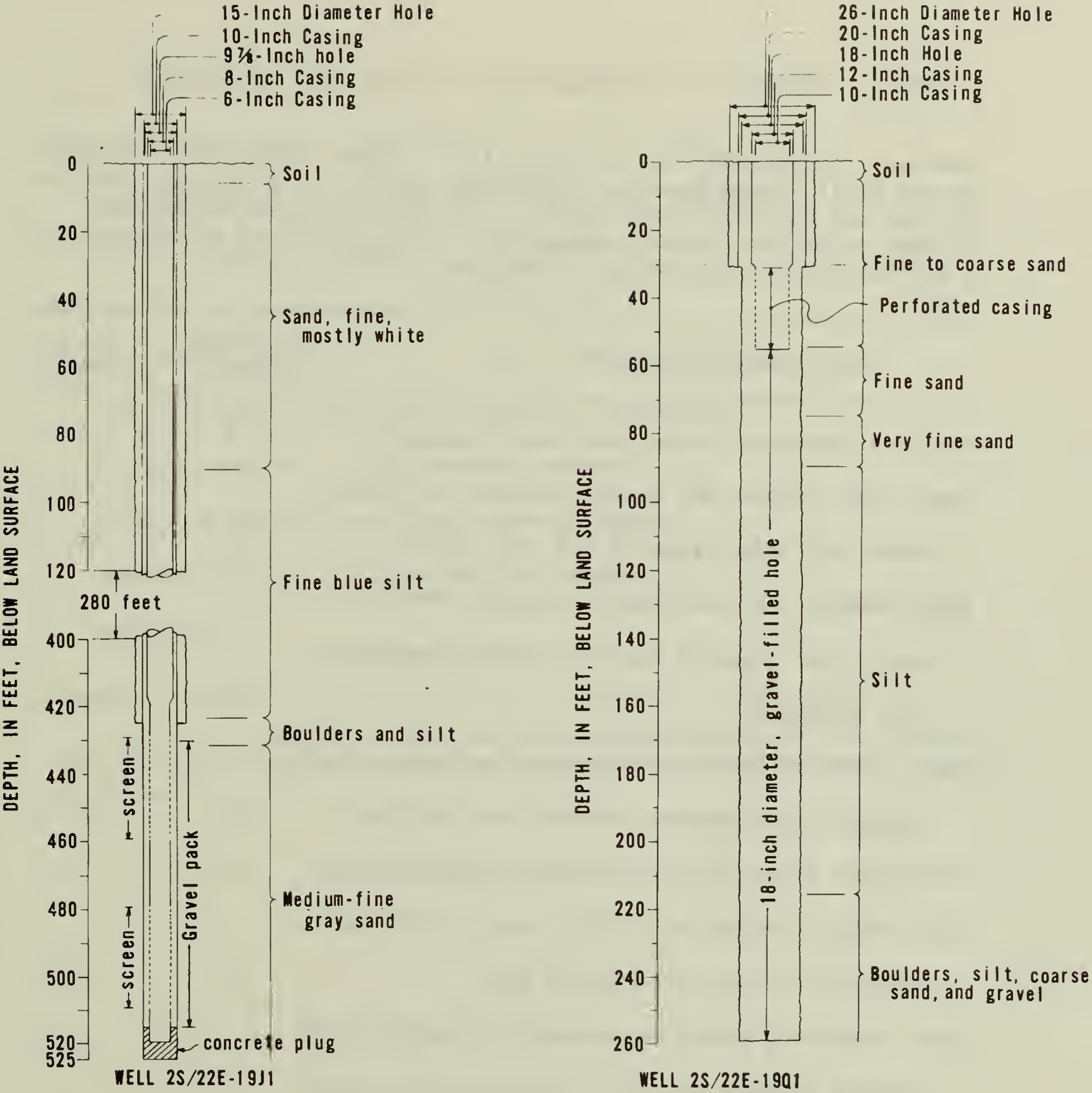

FIGURE 4.--Diagrammatic logs of test wells in Yosemite Valley.

Table 4.--*Generalized lithologic log of test well 2S/22E-19Q1*

Test well 2S/22E-19Q1 was drilled with a reverse circulation hydraulic rotary drill during December 1970-February 1971. The well was cased to 56 feet and backfilled with gravel. The casing is perforated from 32 feet to 56 feet below land surface. The water level in the well was 8.21 feet below land surface on February 4, 1971.

Lithologic Description	Thickness (feet)	Depth (feet)
Top soil, moderate brown, with wood fragments	5	5
Sand, very coarse- and coarse-grained, yellowish-gray, with sand granules and fine pebbles	35	40
Sand, medium- to fine-grained, light brownish-gray, with granules and fine pebbles,weathered rock fragments	1	[a]41
Sand, fine- to coarse-grained, yellowish-gray, with weathered and rounded granules and pebbles	14	55
Sand, very fine- to fine-grained, yellowish-gray	10	65
Sand, very fine-grained, light gray, with large subhedral to euhedral biotite mica	10	75
Sand, weathered granitic, coarse- and very coarse-grained rounded grains, light olive-gray, with large subhedral to euhedral biotite mica	5	80
Sand, very fine- to medium-grained, and silt, light gray, (sand becoming finer with depth)	15	95
Silt, light gray	121	216
Rock fragments, granitic gravel and light gray silt	5	221

Table 4.--Continued

Silt, light gray, and granitic rock fragments	6	227
Sand, coarse-grained, light gray, and silt. Sand is composed of quartz and orthoclase; to a lesser extent plagioclase, biotite and amphibole	2	229
Silt, light gray, granitic rock fragments	6	235
Rock fragments, granitic, very coarse-grained sand to coarse pebbles, light gray, and silt, with some rounded pebbles. Rock fragments composed of quartz, orthoclase and plagioclase feldspar, euhedral biotite mica and varying amounts of amphibole.	24	259

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a. At a depth of 41 feet below land surface the driller changed from hydraulic rotary drilling to reverse-circulation hydraulic rotary drilling.

Table 5.--*Particle-size analyses of samples from test well 2S/22E-19Q1*

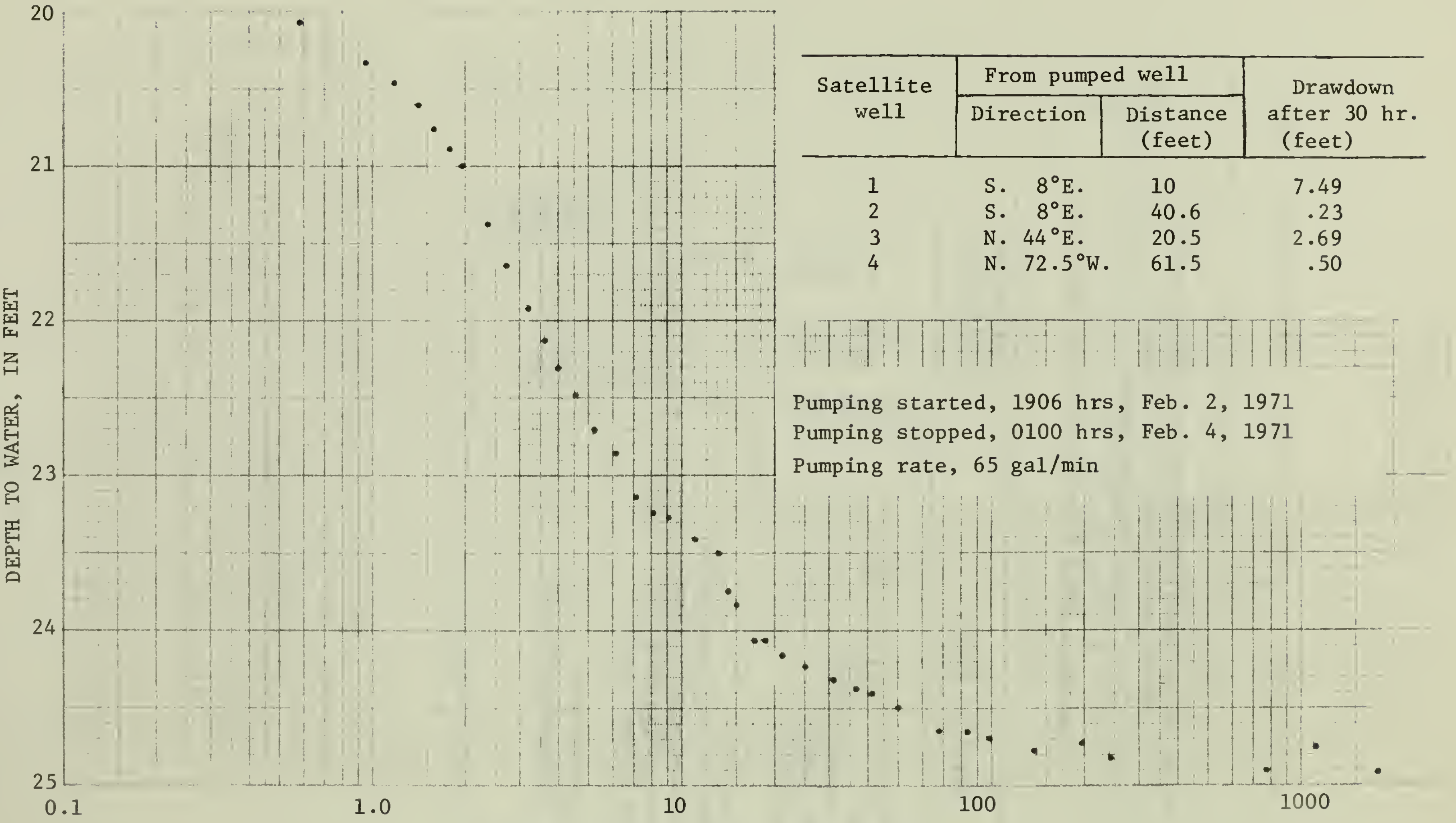
(Methods of analysis: B, bottom withdrawal tube; C, chemically dispersed; N, in native water; P, pipet; S, sieve; V, visual accumulation tube; W, in distilled water)

Sample depth, below land surface (feet)	Particle size: Percent finer than size (in millimeters) indicated													Method of analysis
	0.002	0.004	0.008	0.016	0.031	0.062	0.125	0.250	0.500	1.00	2.00	4.00	8.00	
50						0.4	1.3	9.6	28.9	57.8	74.5	88.4	97.1	S
200	4	5	10	44	92	99.7	99.9	100						SPWC

Table 6.--*Classification of particulate matter by mean grain size*

[modified after Compton, 1962, p. 213]

Particle size	Size range (millimeters)
Boulder	>256
Cobble	64 - 256
Very coarse pebble	32 - 64
Coarse pebble	16 - 32
Medium pebble	8 - 16
Fine pebble	4 - 8
Granule or very fine pebble	2 - 4
Very coarse-grained sand	1 - 2
Coarse-grained sand	.5 - 1
Medium-grained sand	.25 - .5
Fine-grained sand	.125 - .25
Very fine-grained sand	.062 - .125
Silt	.004 - .062
Clay	<.004



Satellite well	From pumped well		Drawdown after 30 hr. (feet)
	Direction	Distance (feet)	
1	S. 8°E.	10	7.49
2	S. 8°E.	40.6	.23
3	N. 44°E.	20.5	2.69
4	N. 72.5°W.	61.5	.50

Pumping started, 1906 hrs, Feb. 2, 1971
Pumping stopped, 0100 hrs, Feb. 4, 1971
Pumping rate, 65 gal/min

FIGURE 5.--Drawdown in test well 2S/22E-19Q1.

Test Well 2S/22E-19J1

Following completion and testing of well 2S/22E-19Q1, a second well was drilled to a depth of 1,015 ft (309 m) at a site about one-half mile east of 19Q1. The new site was selected east of Yosemite Creek near its confluence with the Merced River (fig. 2).

A standard hydraulic-rotary drill was used to combat the caving problems experienced in the first well. Drilling proceeded smoothly until large boulders were intercepted at a depth of about 900 ft (274 m). The last 105 ft (32 m) at the bottom of the hole were extremely difficult to drill due to the presence of boulders and because of caving problems. Ultimately caving choked the hole; while trying to redrill, the driller lost the string of tools below about 600 ft (183 m). The hole was redrilled to about 520 ft (158 m) using reverse circulation and the silt layer which extends to a depth of 425 ft (130 m) was cemented off.

A graphic log of test well 2S/22E-19J1, based on drillers' data (fig. 4), and a generalized lithologic log of the well based on grab samples taken at 5-foot (2 m) intervals (table 7) show the general characteristics of the section and construction of the well. Particle-size analysis for 11 grab samples and one bottom-hole core sample are presented in table 8. See table 6 for correlation between particulate matter (table 7) and the particle-size ranges (table 8).

Table 7.--*Generalized lithologic log of test well 2S/22E-19J1*

Test well 2S/22E-19J1 was drilled during the winter through the summer of 1971. The well was drilled to a depth of 1,015 feet using a hydraulic rotary drill. Due to caving, the hole was cased to a depth of 520 feet. Sixty feet of well screen was distributed in 10-foot sections in the bottom 92 feet of the hole. On January 19, 1972, the well was flowing about 50 gallons per minute. On June 12, 1972, the well was flowing about 200 gallons per minute.

Lithologic Description	Thickness (feet)	Depth (feet)
Top soil, moderate brown	5	5
Sand, coarse-grained, with very coarse-grained sand, yellowish-gray, salt and pepper	15	20
Sand, medium-grained, yellowish-gray, salt and pepper	40	60
Sand, very fine-grained, yellowish-gray, salt and pepper	25	85
Sand, very fine-grained, and silt, light gray	95	180
Silt, light gray	70	250
Sand, very fine-grained, light brownish-gray	45	295
Silt, light gray	130	425
Sand, coarse-grained, light gray	10	435
Sand, very fine-grained, and silt with some medium-grained sand, light gray	5	440
Sand, medium-grained and fine-grained, with some coarse-grained sand, light gray	10	450
Sand, medium- and fine-grained, light gray	20	470
Sand, coarse-grained, with some very fine-grained sand, light gray	30	500

Table 7.--Continued

Sand, very fine-grained, and coarse-grained sand, light gray	30	530
Sand, fine-grained and very fine-grained, light gray	5	535
Sand, fine-grained with some coarse-grained sand, light gray	10	545
Sand, very fine-grained, and silt, with some medium-grained sand, light gray, greater than 1 percent subhedral to euhedral biotite mica	25	570
Sand, coarse-grained, with some very fine-grained sand, light gray	15	585
Sand, very fine-grained, with some coarse-grained sand, light gray, lenses with greater than 1 percent subhedral to euhedral biotite mica	90	675
Sand, coarse-grained, with some very fine-grained sand, light gray	10	685
Sand, very fine-grained, with some coarse-grained sand, light gray	25	710
Sand, coarse-grained, with some very fine-grained sand, light gray	25	735
Sand, very fine-grained, with a trace of coarse-grained sand, light gray	10	745
Sand, very fine-grained, with a trace of medium-grained sand, light gray	5	750
Sand, medium-grained, light gray	15	765
Sand, coarse-grained, with a trace of very fine-grained sand, light gray	5	770

Table 7.--Continued

Sand, coarse-grained, with some very fine-grained sand, light gray	65	835
Sand, very fine-grained, with a trace of coarse-grained sand, light gray	5	840
Sand, very fine-grained, and silt, light gray	20	860
Sand, very fine-grained, with some silt and a trace of coarse-grained sand, light gray	5	865
Sand, coarse-grained, with some very fine-grained sand, light gray	30	895
Sand, fine-grained, with some very fine-grained sand, light gray	5	900
Sand, fine- and coarse-grained; light gray, less than 1 percent weathered biotite mica	10	910
Sand, medium- and fine-grained, light gray, less than 1 percent weathered biotite mica	25	935
Sand, medium, light gray, less than 1 percent weathered biotite mica	20	955
Sand, medium-grained, with some fine-grained sand, light gray	5	960
Sand, medium coarse- to very fine-grained, light gray	10	970
Sand, fine- and very fine-grained, with some coarse-grained sand, light gray, less than 1 percent weathered biotite mica, 2-4 percent unweathered biotite mica	10	980

Table 7.--Continued

Sand, medium- to fine-grained, with some coarse-grained sand, light gray, less than 1 percent weathered biotite mica	5	985
Sand, very fine- and coarse-grained, light gray, less than 1 percent weathered biotite mica, 2-4 percent unweathered biotite mica	20	1005
Not sampled (rock fragments)	10	1015

Table 8.—*Particle-size analyses of samples from test well 2S/22E-19J1*

(Methods of analysis: B, bottom withdrawal tube; C, chemically dispersed; N, in native water; P, pipet; S, sieve; V, visual accumulation tube; W, in distilled water)

Sample depth, below land surface (feet)	Particle size													Method of analysis
	Percent finer than size (in millimeters) indicated													
	0.002	0.004	0.008	0.016	0.031	0.062	0.125	0.250	0.500	1.00	2.00	4.00	8.00	
15	--	--	--	--	--	0.2	0.6	5.5	34.4	74.0	94.0	99.7	100	SBWC
50	0	0	0	0	1	3	15	72	88	92	100			SBWC
325	5.9	6.0	9.0	42.5	84.6	93.6	98.0	99.3	99.6	100	--			SPWC
450	.5	.5	1.5	3.1	3.9	4.3	5.8	13.1	56.0	99.7	100			SPWC
500	1	1	2	3	3	4	6	14	25	86	100			SPWC
600	.2	.3	.6	1.1	1.4	1.7	8.5	51.4	84.3	99.5	100			SPWC
a 614	.5	.6	1.0	1.6	2.3	8.3	67.2	89.2	96.3	98.4	100			SPWC
615	1	1	2	3	3	4	32	35	59	96	100			SBWC
700	1	1	2	3	5	8.1	26.0	69.2	93.1	99.5	100			SPWC
800	1.0	1.0	1.3	2.5	4.9	10.2	21.9	40.2	53.8	99.6	100			SPWC
900	1	2	3	7	26	50.4	55.8	71.7	93.8	99.8	100			SPWC
1,000	.6	.7	1.2	2.1	3.5	4.4	6.9	16.6	42.4	99.7	100			SPWC

a. Sample obtained as a bottom-hole core.

Of particular interest in table 8 are the analyses of samples from 614 and 615 feet (187 m) below land surface. Although essentially from the same stratigraphic horizon, they show marked percentage differences in finer fractions. The differences between the two samples give a qualitative comparison between core samples and samples from the discharge of a hydraulic rotary drill using drilling mud.

Petrographic analysis of a thin-section made from the core sample from 614 feet (187 m) (H. W. Oliver, written commun., May 7, 1971) yielded the following results:

Estimated percentage	Minerals
85	Quartz - clear; grains are sharp-edged, but possess ~ 10 percent rounding.
9	Plagioclase - albite twinning. $>An_{20}$ ~ 1/5 of surfaces show alteration.
3	Microcline - pericline twinning; n < balsam, about same amount of alteration as the plagioclase.
2	Hornblende - small cleavage fragments; typically green.
1	Biotite - anhedral.
trace	Apatite - classic acicular crystals.
trace	Sphene (?) - typical high relief, but golden in color; slightly pleochroic.
trace	Opaques - blobs.

The density of the sample in place is 1.98 grams per cubic centimeter.

Well 19J1 was completed to 520 ft (158 m) with 60 ft (18 m) of well screen (6-inch [15 cm] Johnson screen, 0.020, stainless steel) distributed in 10-foot (3 m) sections in the bottom 92 ft (28 m) of the hole (fig. 4). According to information supplied by the manufacturer, the maximum capacity of the screen at recommended velocity of water is about 750 gal/min (47 l/s).

A pump was installed to test the well in January 1972. Two satellite observation wells were jetted to a depth of 11 ft (3 m) at sites about 30 ft (9 m) from the pumped well. After 700 minutes of pumping at 850 gal/min (54 l/s), the water level in the pumped well was about 92 ft (28 m) below the measuring point (fig. 6). Prior to the test, the well was flowing and the static water level could not be measured. However, if 92 ft (28 m) is used as the minimum drawdown, then the maximum specific capacity of the well does not exceed about 9 (gal/min)/ft of drawdown (1.9 l/s/m). Under artesian conditions where yield is proportional to drawdown--theoretically a yield of 1,200 gal/min (76 l/s) could be obtained with 150 ft (46 m) of drawdown and 2,000 gal/min (126 l/s) with 220 ft (67 m). The theoretical yields cannot be attained by installing a larger pump because the aquifer section penetrated by the well is not of uniform character throughout its thickness, and the screen in the test well is designed to operate efficiently at about 750 gal/min (47 l/s).

During test pumping, the water level in the satellite wells showed no fluctuation in response to extraction of water from the confined part of the section. The lack of response indicates that the silt separating the shallow and deep parts of the section functions as an effective confining bed.

Two water samples were collected from well 19J1. One sample was collected when the well was completed; the other during testing of the well. The results of analysis (table 3) indicate that the water is of excellent chemical quality and similar to that taken from well 2S/22E-19Q1.

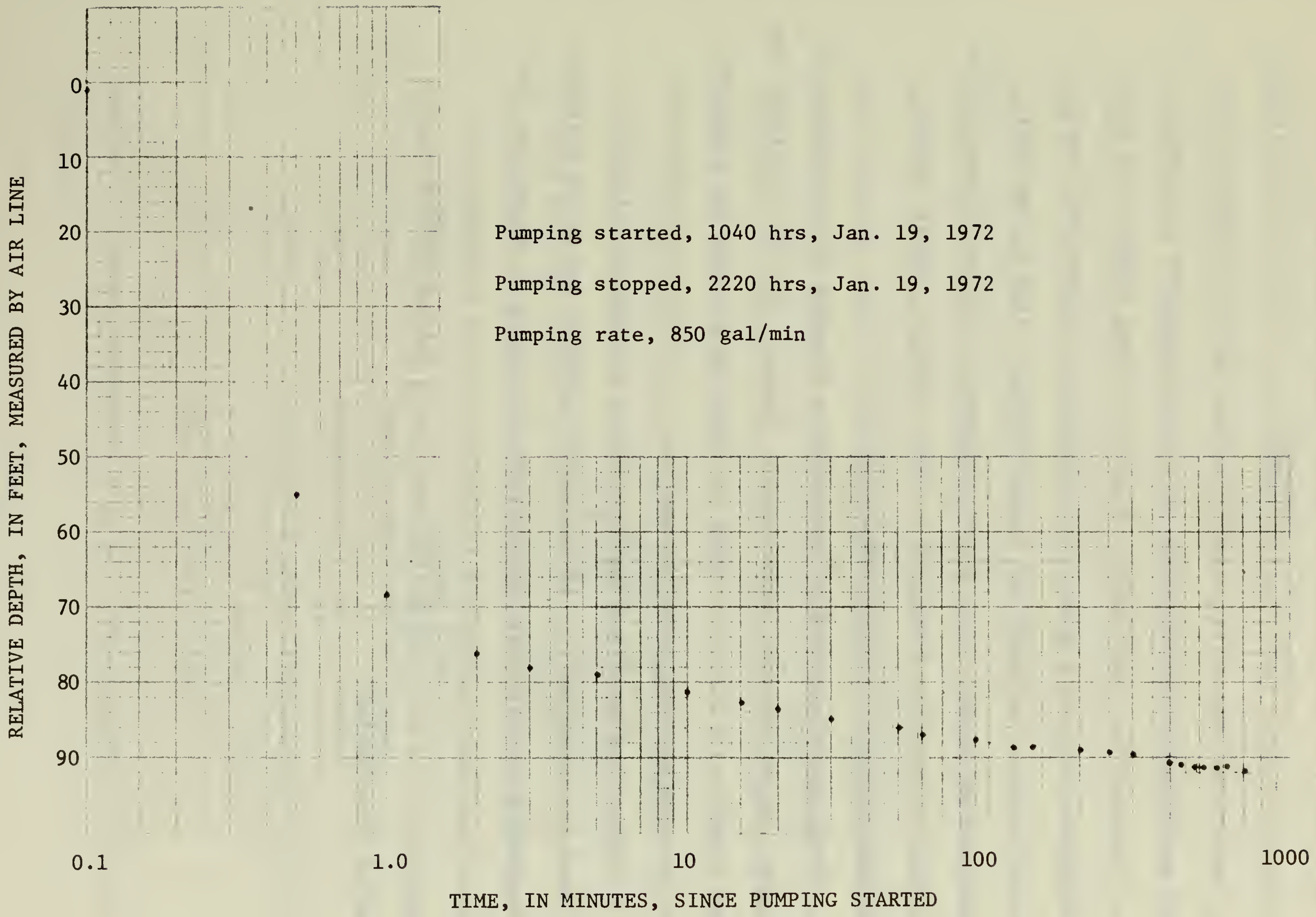


FIGURE 6.--Drawdown in test well 2S/22E-19J1.

As a result of the information gained from the test wells, it is reasonable to predict that a well at either site, drilled to consolidated rock, constructed with larger capacity screen, will yield substantially larger quantities of water than the test wells. Eastward in Yosemite Valley the depth to consolidated rock should be even greater than it is at either test well site (fig. 3); consequently, a greater well depth, screened interval, and yield can be anticipated. Sites for new wells probably can be selected close to the alinement of planned changes in the water distribution system (Metcalf and Eddy, 1970, p. 33-69), thereby minimizing additional pipeline construction.

Simultaneous operation of deep wells in Yosemite Valley probably will induce mutual interference between wells. However, the data available from single pumped wells above and below the confining silt are not sufficient to define with any confidence the magnitude of prospective interference. The quality of the results of aquifer testing in Yosemite Valley is inhibited by characteristics of the aquifer material and by the existence of boundaries to the system formed by the side walls of the valley. The physical constraints probably will always leave the interpreter of aquifer-test data with substantial doubt as to the validity of results obtained from testing.

Big Meadow

A program to evaluate water sources for a proposed 5 million gal/d (19,000 m^3/d) requirement in the Big Meadow area (fig. 1) was requested by the Park Service (Gerard S. Witucki, oral commun., May 27, 1971). The water-supply requirement was for a proposed user area in Big Meadow to include housing facilities and parking, and staging facilities so that park visitors could stay at Big Meadow and visit Yosemite Valley by bus. Preliminary review of available data indicated that the required supply could not be obtained within the area of Big Meadow. Therefore, the area under consideration was expanded to include a radius of 6 mi (9.7 km) from Big Meadow (Dustin Augenbaugh, oral commun., June 15, 1971).

The Merced River and six creeks were considered as potential sources of surface water within a 6-mile (9.7 km) radius of Big Meadow. A low-flow gage was established on Tamarack Creek in 1970; five new low-flow gages were installed during August 1971 at the following sites:

Station number	Station name
11-2666	Cascade Creek near El Portal
2668	Wildcat Creek near El Portal
2669	Crane Creek above diversion dam near El Portal
2670	Little Crane Creek near El Portal
2671	Moss Creek near El Portal

Results of discharge measurements at all low-flow gages are included in table 1.

The largest source of water within the prescribed 6-mi (9.7 km) radius from Big Meadow is the Merced River. The minimum discharge of record at the gaging station on the Merced River at Pohono Bridge was 3.3 ft^3/s (0.092 m^3/s) on September 29 and October 1, 1924. Except for this occurrence, low flows at Pohono Bridge during the period of record since 1916 have been more than 8 ft^3/s (0.2 m^3/s).

There are two localities in the Big Meadow area where potential ground-water development can be considered. The meadow itself overlies a ground-water reservoir, and the accumulated unconsolidated deposits at the Cascades are a small aquifer that could be tapped (fig. 2).

Big Meadow is a small basin, less than 200 acres (80 ha), in granitic consolidated rock cut by glacial action. The unconsolidated deposits in Big Meadow are composed of glacial till overlain by alluvium (R. H. Dale, written commun., May 4, 1966). The consolidated rock is a massive granodiorite usually described as nonwater-bearing though some water probably can be obtained if fractures in the rocks are found in the subsurface. Underneath the meadow, the depth to the consolidated rock is irregular and ranges from near surface to about 90 ft (27 m). The glacial till overlying the consolidated rock consists of boulders, sand, silt, and clay. It is poorly sorted and yields only small quantities of water to wells. Wells in glacial till in the Foresta subdivision yielded 1 to 5 gal/min (0.06 to 0.32 l/s). The alluvium consists of well-sorted medium to coarse sand in the banks of Crane Creek; it becomes finer and less well-sorted away from the creek. The thickness of the alluvium probably is less than 50 ft (15 m) over an area of about 70 acres (28 ha) and thins to zero elsewhere. The water-bearing properties of the alluvium are better than those of the glacial till. Test wells in alluvium in Big Meadow, drilled by the U.S. Bureau of Reclamation in 1964, yielded about 20 gal/min (1.3 l/s). The usable ground-water storage capacity in the alluvium in Big Meadow is conservatively estimated at about 70 acre-ft (86,380 m^3) of water. This is based on estimated saturated thickness of 20 ft (6 m) over an area of 70 acres (28 ha), and an estimated specific yield of 5 percent.

Unconsolidated deposits overlying the consolidated rocks along the north bank of the Merced River near the Cascades (fig. 2) are described as postglacial alluvial fans consisting mostly of coarse rock waste (Matthes, 1930, pl. 29). Interstitial space in the unconsolidated deposits probably is filled with the sand and silt exposed on the surface at the Cascades picnic ground. The thickness of the deposits is estimated at less than 50 ft (15 m). Because of the character of the unconsolidated deposits, well drilling would be difficult and yields of wells probably would be small. The water table can be expected to fluctuate with river stage and inflow from the Cascades.

In summary, the only available water source that would meet a 5 million gal/d (19,000 m^3/d) requirement for the Big Meadow area during most years is the Merced River. The combined low flow of six small streams in the area was about 0.8 million gal/d (3,000 m^3/d) in the fall of 1972. The estimated ground-water storage capacity in Big Meadow is not sufficient for the supply required. Total yield from wells in the meadow probably would not exceed 0.2-0.3 million gal/d (760 to 1,100 m^3/d). Wells near the Cascades cannot be expected to produce sufficient quantities of water to increase the supply significantly. A 5 million gal/d water supply for Big Meadow can be obtained by storage of water during the wet season for use during dry periods.

El Portal

A prospective site for a water well was examined at El Portal on October 13, 1972, in response to a request by Gerard S. Witucki (oral commun., Aug. 29, 1972).

The Merced River canyon at El Portal is narrow, and the river flows along the south side of Highway 140 in a channel choked with boulders. North of the highway, El Portal (fig. 1) is on a low terrace above an old stream channel. The material exposed at the surface north of the highway includes outcrops of the granitic consolidated rock and unconsolidated deposits composed of materials ranging in size from silt to boulders. About 1 mi (1.6 km) downstream from El Portal, a gravel mine is being operated on a gravel bar adjacent to the present-day river channel.

The following summarizes comments by the driller after test drilling in the El Portal area (Bill Belknap, oral commun., May 24, 1973).

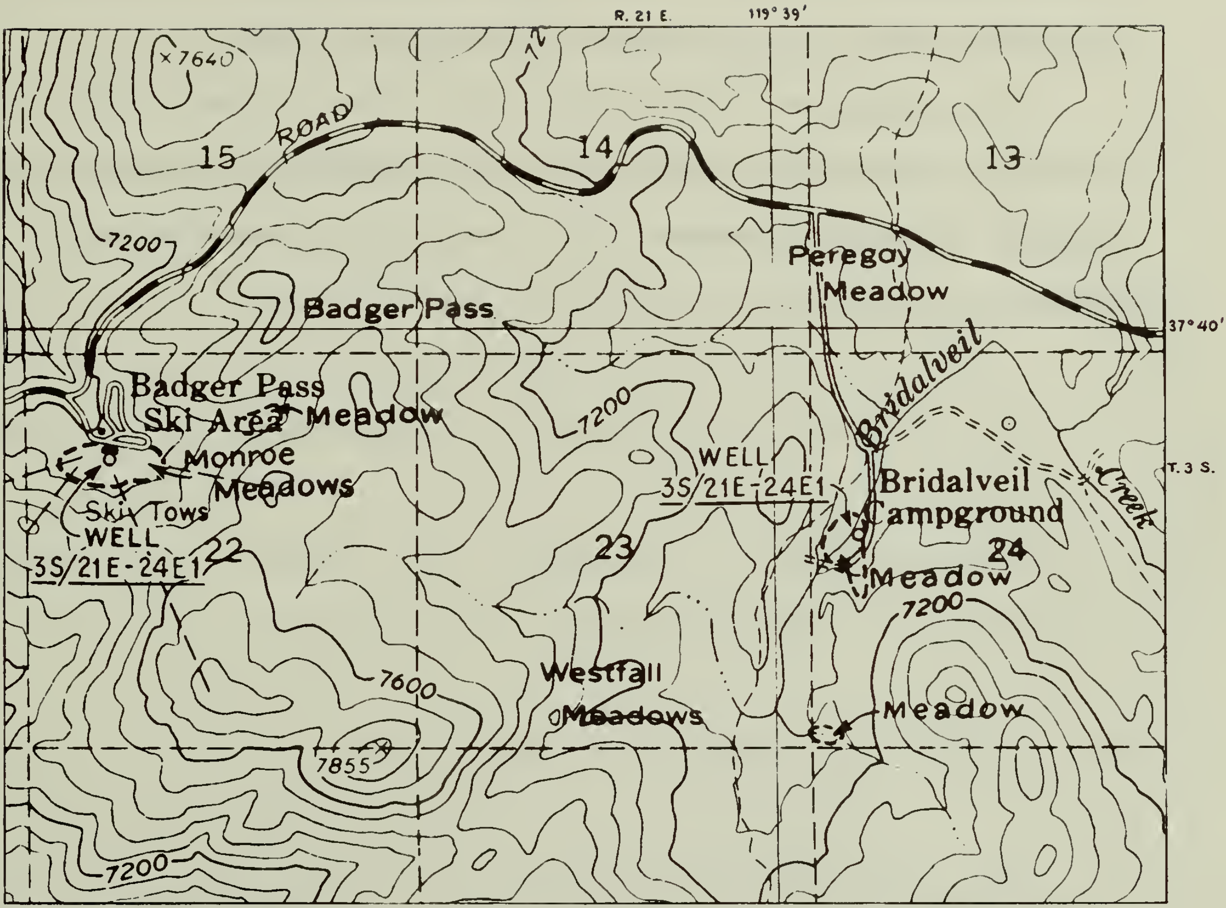
1. Four test holes were drilled near a store beside the highway at El Portal. None of the test holes yielded sufficient water to warrant development.
2. A test hole was drilled at a site about a half-mile (0.8 km) downstream from El Portal, about 600 ft (185 m) north of the bridge where the road crosses the river. Unconsolidated deposits consisting of silt, sand, and gravel, were encountered to a depth of 55 ft (17 m). The test hole was drilled in consolidated rock to a depth of about 150 ft (46 m); the part of the hole in consolidated rock (below 55 ft) did not yield water. A well was constructed to a depth of 55 ft (17 m), with a 14-in (36 cm) screen at the bottom. After surging and cleaning, the well was test-pumped at about 75 gal/min (4.7 l/s).

Badger Pass

In response to a request (Gerard S. Witucki, oral commun., November 7 and 13, 1972), data on file were reviewed to evaluate water sources for a 100,000 gal/d (380 m^3/d) supply at the Badger Pass ski area.

Prior to 1968, the water supply at the Badger Pass ski area (fig. 7) was obtained from a buried collector-pipe system in Monroe Meadows and from two springs in the vicinity (H. T. Mitten, written commun., 1965). In 1968 a well was drilled near the ski lodge at a site recommended by Mitten.

Collectively, surface- and ground-water sources in the immediate vicinity can be expected to yield about 50,000 gal/d (190 m^3/d). The collector-pipe system in Monroe Meadows yielded about 6 gal/min (0.38 l/s) during a test on January 4, 1961. A new collector-pipe system installed in the small meadow about 1,000 ft (300 m) east of Monroe Meadows could yield on the order of 15 gal/min (0.95 l/s). Well 3S/21E-22E1, at the lodge, yielded more than 15 gal/min (0.95 l/s) in 1968 and the two springs tapped prior to 1968 together yielded about 6 gal/min (0.38 l/s) To obtain more than 50,000 gal/d (190 m^3/d), sources farther from the ski area will have to be explored.



Base from U.S. Geological Survey
Yosemite, 1:62,500, 1956

0 ½ 1 MILE

0 .5 1 KILOMETER

CONTOUR INTERVAL 80 FEET
DATUM IS MEAN SEA LEVEL

FIGURE 7.--Badger Pass ski area and Bridalveil campground.

Bridalveil Creek is the only surface-water source of sufficient size within a radius of 2 to 3 mi (3.2 to 4.8 km) from the Badger Pass ski area. Unfortunately, diversion of water from Bridalveil Creek will have a detrimental effect on the esthetics of Bridalveil Falls.

Field reconnaissance undoubtedly would produce several prospective sites for ground-water development. Sites at Bridalveil campground, McGurk, Peregoy, and Westfall Meadows (fig. 2) probably could be selected for test drilling.

REFERENCES CITED

Burnham, W. L., 1963, Reverse-circulation drilling, an improved tool for production wells and exploratory holes: U.S. Geol. Survey open-file rept., 10 p.

California Division of Mines and Geology, 1967, Geologic map of California, Mariposa sheet: 2 pl.

Calkins, F. C., 1970, Map of bedrock geology of Yosemite Valley, California: U.S. Geol. Survey open-file map.

Compton, R. R., 1962, Manual of field geology: New York, John Wiley & Sons, Inc., 378 p.

Gutenberg, Beno, Buwalda, J. P., and Sharp, R. P., 1956, Seismic explorations on the floor of Yosemite Valley, California: Geol. Soc. America Bull., v. 67, p. 1051-1078.

Matthes, F. E., 1930, Geologic history of the Yosemite Valley: U.S. Geol. Survey Prof. Paper 160, 137 p.

Morris, D. A., and Johnson, A. I., 1966, Summary of hydrologic and physical properties of rock and soil materials, as analyzed by the Hydrologic Laboratory of the U.S. Geological Survey, 1948-60: U.S. Geol. Survey open-file rept., 60 p.

Metcalf and Eddy, Engineers, 1970, Report on improvements and additions to water and sewage systems at Yosemite Valley, Yosemite National Park, California: Rept. for Natl. Park Service, December 1970, 175 p.

Riggs, H. C., 1973, Regional analyses of streamflow characteristics: U.S. Geol. Survey Techniques Water-Resources Inv., book 4, chap. B3, 15 p.

U.S. Bureau of Reclamation, 1965, Ground-water geology and resources potential of Big Meadow, Yosemite National Park, California: U.S. Bur. of Reclamation Adm. Rept. for Natl. Park Service, 16 p.