UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Water Resources Division

WATER-RESOURCES RECONNAISSANCE IN THE GENERAL GRANT GROVE AREA KINGS CANYON NATIONAL PARK, CALIFORNIA

Prepared in cooperation with the
National Park Service
Department of the Interior

ADMINISTRATIVE REPORT
For U.S. Government use only

Menlo Park, California
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WATER-RESOURCES RECONNAISSANCE IN THE GENERAL GRANT GROVE AREA

KINGS CANYON NATIONAL PARK, CALIFORNIA

By R. A. LeBlanc

ABSTRACT

Further development of water supplies in the General Grant Grove area probably will depend primarily on pumpage from ground water. Ten prospective test-well sites are recommended to be explored by drilling to establish ground-water yields, monitor water levels, and determine the best sites for production wells.

INTRODUCTION

In September and October 1969, the U.S. Geological Survey, in cooperation with the National Park Service, made a comprehensive reconnaissance of water resources in the northern part of the General Grant Grove Section of Kings Canyon National Park in California (fig. 1).

This report was prepared by the U.S. Geological Survey, Water Resources Division, under the general supervision of R. Stanley Lord, district chief for California, and under the immediate direction of Willard W. Dean, chief of the Sacramento subdistrict office. Mr. Jerry A. Eubanks, chief park maintenance engineer, Mr. Richard C. Riegelhuth, park biologist, Mr. Vincent M. Hefti, supervisory park ranger, and other park personnel provided assistance and information during the field investigation.

Purpose and Scope

The purpose of the reconnaissance was to evaluate water resources available for further development. In scope the project includes: (1) mapping of meadows and seeps, (2) canvassing of wells and springs, (3) measuring of well, spring, and stream discharge, (4) describing the water-bearing properties of decomposed granodiorite and fractured bedrock and, (5) suggesting prospective sites for additional water supplies.

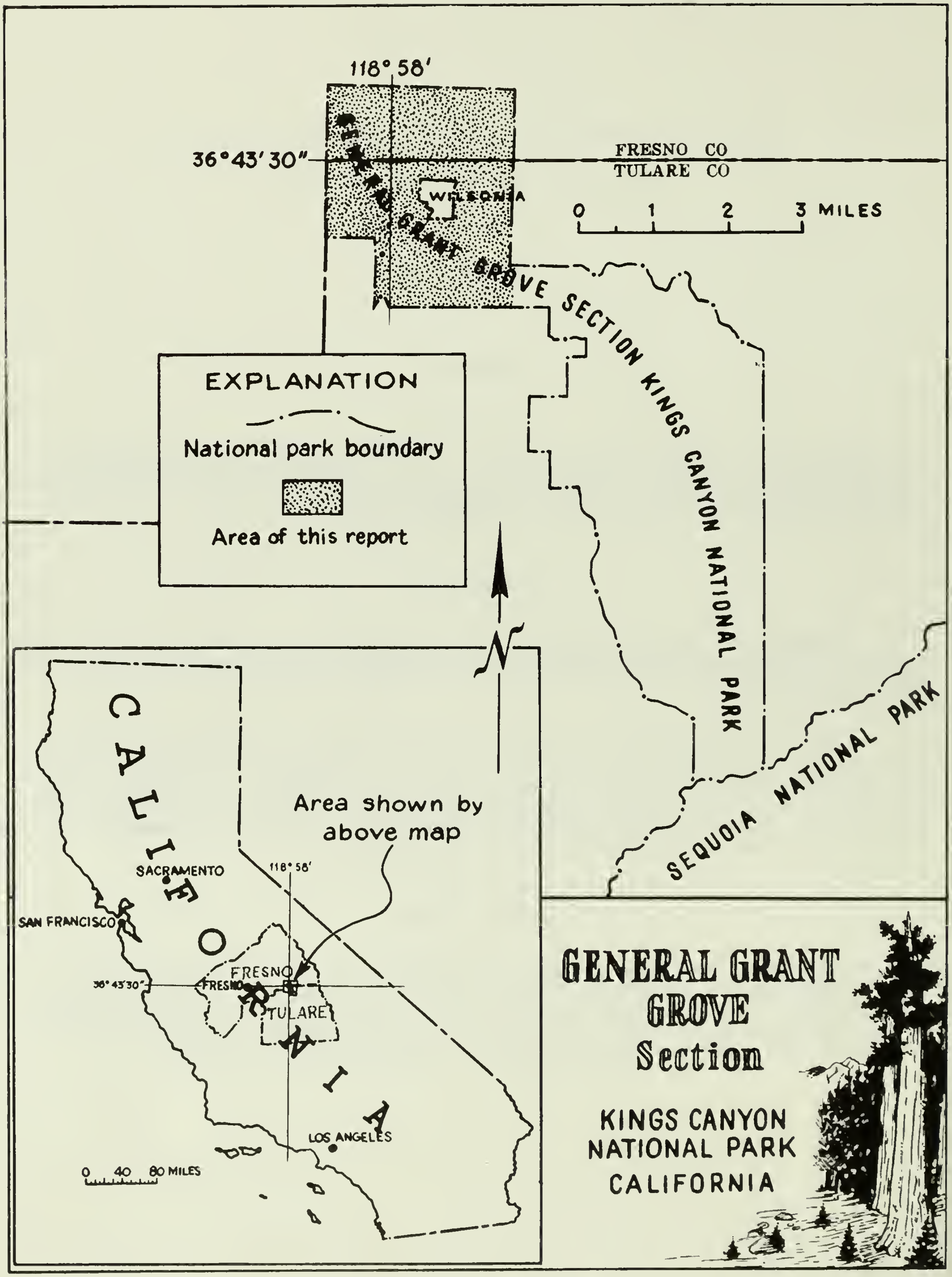

FIGURE 1.—Index map.

Location and Features

The General Grant Grove Section of Kings Canyon National Park is about 50 miles east of Fresno (fig. 1) on State Highway 180. This report covers the northern 7 square miles of the General Grant Grove Section on the western slope of the Sierra Nevada. Altitude ranges from about 5,400 feet, where Sequoia Creek crosses the park boundary, to 7,761 feet on Park Ridge.

The area (fig. 3) lies mainly on the western slope of the southern part of Park Ridge. The forested slopes of the ridge are sufficiently weathered that a residual mantle covers most of the area, except where bedrock is exposed on steep slopes. Three significant perennial streams are found within the General Grant Grove Section; Abbott, Mill Flat, and Sequoia Creeks. These streams are deeply incised in that part of the park west of Highway 180.

Climate

Warm and dry summers in Grant Grove are typical of the west slope of the Sierra Nevada. Occasional summer thunderstorms occur, but more than 90 percent of the precipitation, mostly snow, occurs during the winter from November through April. Winters are cold with night temperatures occasionally falling to -21°C (Celsius) or -6°F (Fahrenheit).

The average annual precipitation at Grant Grove during 1941-69 was 42.1 inches. Annual precipitation varied considerably (fig. 2) with a range from 15.1 to 61.8 inches. Precipitation is equivalent to an average annual water input of 3.5 acre-feet per acre. The quantities of ground and surface water available for use vary with fluctuations in precipitation.

Weather records are available at Giant Forest for the period 1920-69 and are available at Grant Grove for 1941-69. The 1941-69 records at both stations are similar. The records from Giant Forest (fig. 2), 16 air miles southeast of Grant Grove, indicate that average annual precipitation during the period of 1922-35 was lower than during the period of record at Grant Grove of 1941-69. The two stations are at about the same altitude. Average annual precipitation at Giant Forest during 1922-35 was 36.7 inches, 5.4 inches less than for the period 1941-69 at Grant Grove. A similar extended period of low precipitation could occur at Grant Grove sometime in the future. A sequence of several years of below-average precipitation such as 1923-25, 1928-29, or 1959-61 would impose serious strain on supplies.

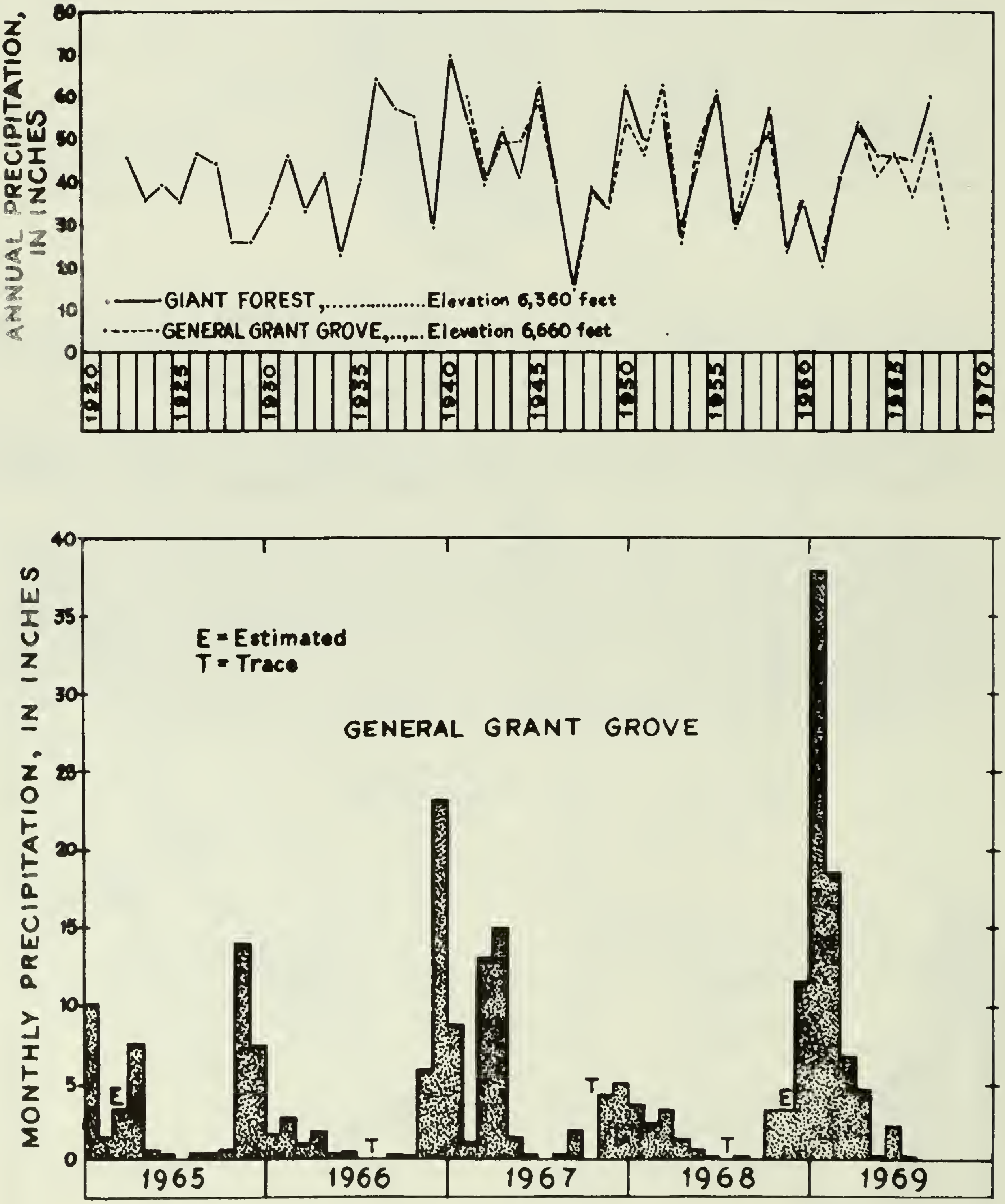

FIGURE 2.—Precipitation graphs.

WATER RESOURCES

Watershed Characteristics

The most significant watershed characteristics that affect water resources of the study area are slope of the land surface, vegetative cover, and the underlying rocks. Hill slopes range from about 30 to 40 percent, and meadow slopes range from about 3 to 30 percent. The hills and ridges have a variable forest cover of mixed conifers with a few black oaks. In draws, particularly in areas of flat slope, there are willows, azaleas, and other shrubs. In meadows, there is a transition from grass along the forest edge, to herbaceous broad leaves, and to grass-like reeds, bracken, fern, and moss where the water table is near or at land surface. Willows commonly grow in the moist areas of meadows.

The entire study area is underlain by granitic bedrock, probably all granodiorite (California Div. Mines and Geology, 1966). The granitic rocks are overlain by decomposed granitic rock and some soil. Mountain soils are thin, and decomposed granodiorite according to drillers' logs ranges from 10 to 120 feet in thickness. The lesser thicknesses of decomposed granodiorite occur on ridges, hill slopes, and in the steeper sloping meadows.

Beneath the decomposed granodiorite lies fractured but unweathered bedrock. Fractures decrease rapidly with depth but may remain sufficiently open for water to flow at depths greater than 100 feet below the surface. Because fractures are the principal control of topography (California Dept. Water Resources, 1968, p. 57), they should be more numerous beneath draws and meadows than on ridges or hill slopes. Drillers' logs in the area indicate fractures occurring at depths ranging from 12 to 68 feet below land surface; this range is limited by the depths of existing wells in the area. Fractures can be expected below the 68-foot depth.

Surface Water

Eight small headwater streams radiating from Park Ridge carry perennial or seasonal surface runoff from the study area. Of these only four, Abbott, Mill Flat, Sequoia, and Mill Creeks (fig. 3) are readily accessible to existing park facilities. The flow of one or more of these four streams might be utilized as a future source of water supply if it is determined that low-flow runoff is dependable during a dry year.

During collection of other data, 23 low-flow measurements were made at selected sites (fig. 3) on Abbott, Mill Flat, Sequoia, and Mill Creeks during late September and early October of 1969. The measurements were made volumetrically using a bucket and stopwatch. Results listed in table 2 are considered reasonably accurate. Two measurements were made of the flow in Bearskin Creek on the east side of Park Ridge.

Streamflow records on other high-altitude streams in the Sierra Nevada indicate that minimum flows during a year usually occur during late September or early October, the period of data collection for this study in 1969. However, 1969 was a year of extremely high precipitation, deep snowpack, and summer and fall streamflow near the greatest of record. As an index of runoff conditions, the average discharge of the Kaweah River near Three Rivers was 150 cfs (cubic feet per second) in September 1969. The only greater September average discharge at this location since 1903 was 206 cfs in 1906. In contrast, the September discharge during the dry year of 1924 averaged 12.6 cfs, 1928 was 14.6 cfs, 1931 was 18.1 cfs, and 1934 was 14.0 cfs. Many other September averages are in the range of 20 to 40 cfs. Kaweah River runoff is a crude index to conditions in the Grant Grove area, however, it is certain that the data in table 1 represent wet-year conditions.

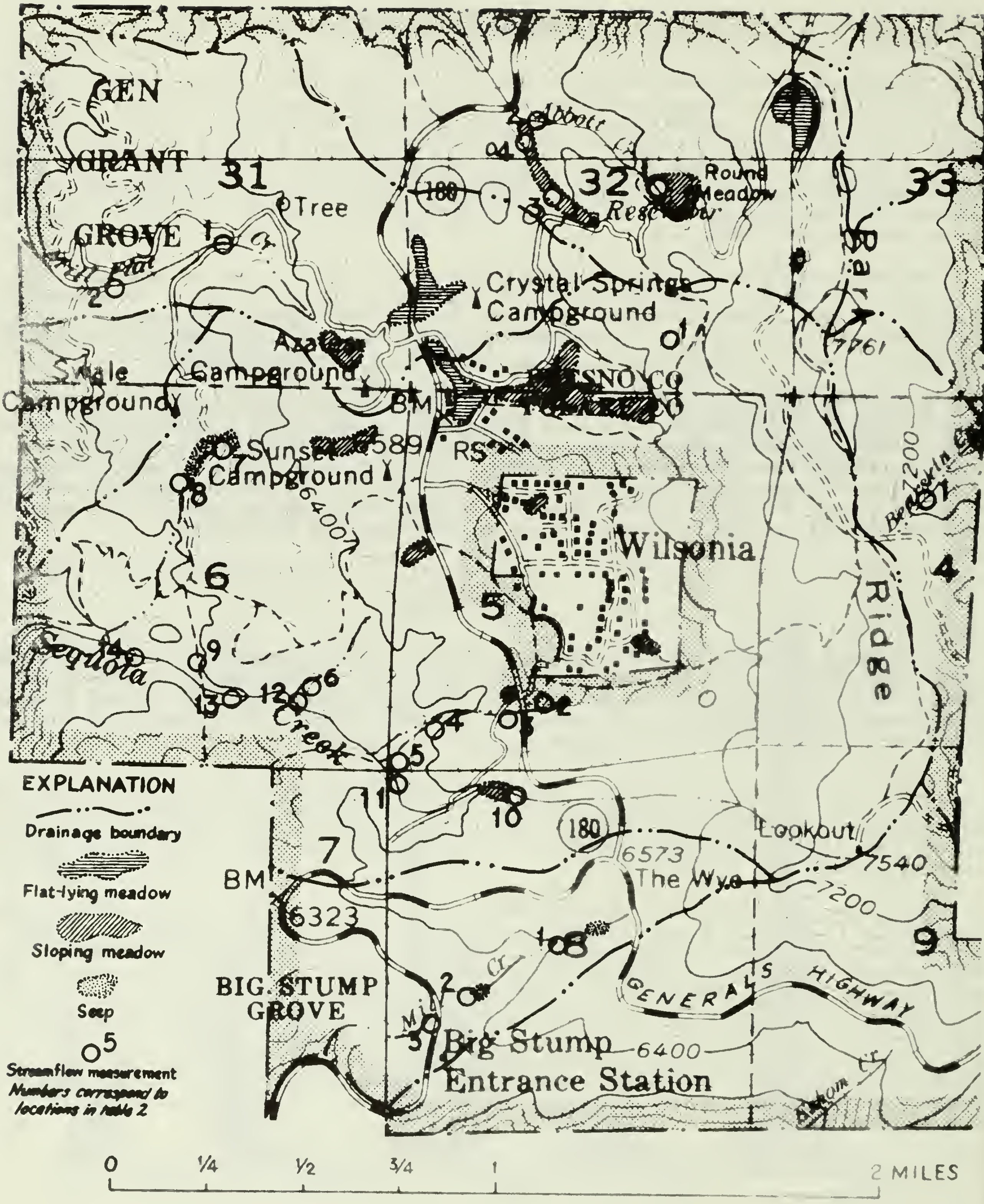

FIGURE 3.—Drainage areas, meadows, seeps, and streamflow measurement sites.

Table 1.--Streamflow measurements

Location	Discharge (gpm)	Temperature (°C)	Date
Abbott Creek			
1.	60		9-28-69
2.	77		9-29-69
a3.	15		9-29-69
a4.	30		9-29-69
Mill Flat Creek			
1.	15		10- 5-69
2.	21	9.0	10- 5-69
Sequoia Creek			
a1.	3		9-30-69
a2.	0		9-30-69
a3.	4		9-30-69
a4.	16		9-30-69
a5.	20		9-30-69
a6.	4		9-30-69
a7.	6	6.8	10- 5-69
a8.	12	8.6	10- 5-69
a9.	15		9-30-69
10.	11	12.8	9-29-69
11.	12		9-30-69
12.	45		9-30-69
13.	110	10.4	9-30-69
14.	204		9-30-69
Mill Creek			
1.	2		9-29-69
2.	5	10.0	10- 5-69
3.	5		10- 5-69
Bearskin Creek			
1.	0		10- 2-69
2.	90	7.4	10- 2-69

a. Site on a tributary to the named creek.

The low flow of Mill Flat and Mill Creeks was so small even in the wet 1969 year that probably these streams could not be used. Sequoia and Bearskin Creeks, and possibly Abbott Creek, appear worthy of additional investigation under dry-year conditions. The low flow of all these streams during late summer and early fall is base flow derived from springs and seeps from ground water. Any development of additional wells in upstream aquifers could diminish the base flow, especially during dry years. Samples of water for chemical analysis were not collected at stream sites, but the chemical quality of the water probably is similar to the quality of water in springs that contribute to the base flow (see p. 8).

Ground Water

Ground water probably can be found in the study area wherever decomposed or fractured granitic rocks or sedimentary deposits are present to form an adequate aquifer. Precipitation is ample to recharge the ground-water body, but the capacity of subsurface storage is nearly impossible to predict. In general, the meadow areas represent the most predictable and the largest, volume for volume, ground-water storage units. However, neither storage nor yield can be predicted in the fractured rocks.

Meadow and seep areas are shown in figure 3. The meadows are open grassy areas, generally greater than 4 acres in extent, in the Grant Grove area. All probably are underlain by unconsolidated sedimentary fill and decomposed granitic rock overlying fresh granitic rock. The thickness of the unconsolidated material probably is greater beneath the flatter-lying meadows. The flatter-lying meadows are assumed to be underlain by unconsolidated material to a depth of about 50 feet, whereas, the steeper meadows probably are underlain by a thickness of about 30 feet. The estimates are based on the logs of two wells (Dale, 1964, p. 13 and 16) drilled in meadows in the steeper-slope group where the thickness of unconsolidated material was 20 to 30 feet, and on the opinion that the material probably is appreciably thicker in the flatter meadow areas.

The flatter meadows have a total area of 16 acres and the steeper meadows a total area of 38 acres. Assuming that the deposits beneath the meadows have an average specific yield of 25 percent, ground-water storage capacity for all the meadow areas (fig. 3) is estimated at about 500 acre-feet. If 10 percent of the stored ground water beneath the meadows can be extracted, then wells must be developed that are collectively capable of withdrawing about 50 acre-feet of ground water annually. This quantity is conservative because extractions probably will induce additional recharge from surface water, reduce natural discharge of ground water, and probably will permit movement of ground water into the unconsolidated material from water-filled fractures in granitic rocks of the surrounding slopes. The estimate of ground-water storage or of extractable water does not include water that is available from seeps.

Ground water does not occur solely in the unconsolidated material in the study area. The probability of finding water in fractures in the granitic rocks is high. However, depths, yields of wells, and the quantity of water available in storage cannot be predicted. Seeps (fig. 3) are small area, mostly less than 1 acre in extent, where ground water is near or at the surface. The availability of water in the seep areas is obvious, however, the quantity available cannot be predicted.

During the field investigation, 14 springs were canvassed (fig. 4, app. 1). Of these, two in Wilsonia and eight within the park were being used for water supply. Discharge from the springs ranged from 1 to 36 gpm (gallons per minute), the latter figure for the combined flow of two springs. The sum of the measured flows from springs is 76 gpm. Flows of individual springs are listed in table 2.

Chemical analyses of water samples from springs, 14S/28E-5H1 and 14S/28E-8L1, are in appendix 2. Total dissolved solids are 23 and 33 mg/l (milligrams per liter), respectively. In terms of salinity and dissolved-mineral constituents, the water is well within drinking water standards (Dept. Public Health, 1962). The concentration of iron in water from spring 14S/28E-8L1 might limit use of the water for laundry because of staining. The recommended limit for iron and manganese together is 0.3 mg/l (Hem, 1959, p. 238).

A selective canvass was made in Wilsonia where nine wells, six owned by the Park Service, were canvassed. Two other wells, 14S/28E-32H1, and 14S/28E-32K1, were canvassed for a total of 11 wells (app. 1). The average depth of the canvassed wells is 36 feet, but one driller's log of a well in Wilsonia lists a depth of 120 feet bottomed in decomposed granodiorite. The well corresponding to this driller's log was not identified during the field canvass.

Water levels ranged from 1 foot above to 35 feet below land surface. Deeper levels were measured in wells on ridges or hill slopes. A water-level contour map was not prepared.

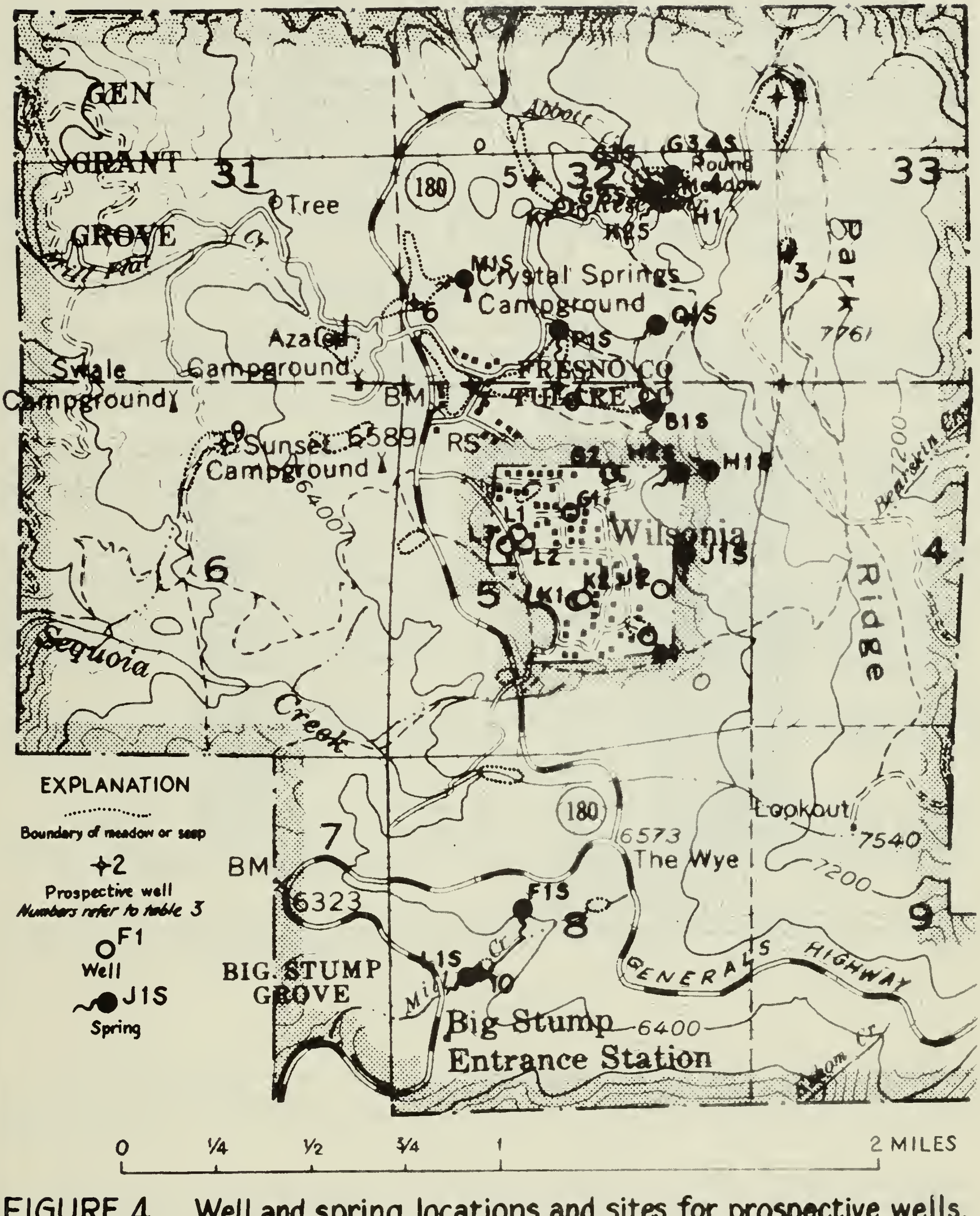

FIGURE 4.—Well and spring locations, and sites for prospective wells.

Pumping tests in 1964 for wells 13S/28E-32H1 and 32K1 indicated that they could be pumped at sustained yields of about 75 gpm and 40 gpm (Dale, 1966, p. 15 and 17). A pump was not available at well 13S/28E-32H1 during fieldwork in 1969, however, all flowing water from the well was diverted to a single channel and measured at 72 gpm; the reported flow in 1964 was about 25 gpm. With a suitable pump, a discharge greater than 72 gpm could be expected. Well 13S/28E-32K1 (table 2) was pumped on October 1, 1969 at 60 gpm for 19 minutes with 1.6 feet of drawdown. According to Davis and Turk (1969, p. 5) only 10 percent of wells drilled in weathered or unweathered crystalline rock can be expected to yield such quantities of water. Reports on drillers' logs indicate yields from 15 to 75 gpm for wells in Wilsonia.

The chemical quality of water from wells (app. 2) is within the drinking water standards. The total dissolved solids are low, ranging from 36 to 58 milligrams per liter.

Table 2.--Spring- and well-flow measurements

(See appendix 1 for well- and spring-numbering system)

Spring or well number	Flow (gpm)	Temperature (°C)	Date
13S/28E-32G1S } 13S/28E-32G2S }	36	7.0	9-28-69
13S/28E-32G3S	2	6.2	9-28-69
13S/28E-32G4S	3		9-28-69
13S/28E-32H1	72	6	9-28-69
13S/28E-32K1	a60	8.4	10- 1-69
13S/28E-32K2S	1		9-28-69
13S/28E-32M1S	1.5	8.4	10- 1-69
13S/28E-32P1S	0		9-30-69
13S/28E-32Q1S	1		9-30-69
14S/28E- 5B1S	10	7.4	9-27-69
14S/28E- 5H1S	12	7.8	9-27-69
14S/28E- 5H1S	b3		9-29-69
14S/28E- 5J1S	1		9-29-69
14S/28E- 8F1S	1	10.0	9-29-69
14S/28E- 8L1S	5	9.0	10- 5-69

a. Pumped discharge.
b. Reported discharge.

PROPOSED PROGRAM FOR DRILLING TEST WELLS

A well drilling and testing program is proposed to provide data on yields of wells in the unconsolidated material in the meadow areas, and the bedrock. The information obtained will aid evaluation of the prospective ground-water supply for future planning and development in the study area. In addition, the information may supplement other studies by the Park Service that are concerned with the ecological effects of development.

A general plan for drilling should include wells drilled to bedrock at sites in the meadows and test pumped as necessary to determine the yield characteristics of the unconsolidated material at each site. After testing, the wells can be deepened or offset and drilled into underlying bedrock to obtain yield information for the fractured rocks if water-bearing fractures are found. Wells at seeps or any other sites outside of the meadows probably will be drilled in bedrock through most of their depth. Wells at these sites will provide data on fractured bedrock providing that water-bearing fractures are found.

Wells in the unconsolidated material should be drilled to bedrock to insure taking full advantage of the saturated section. Depths in the unconsolidated material probably will range from about 20 to 50 feet, but may be deeper. Wells drilled into bedrock have no limits on depth, but as a general guide, probably should be drilled to depths of at least 100 feet below the top of bedrock and probably should not exceed about 300 feet below the top of bedrock.

Testing at each new well should include thorough cleaning and development of the well, followed by test pumping to obtain discharge and drawdown data and measurements of recovery after pumping is stopped. Where other wells or springs are nearby, data should be obtained on water-level fluctuations and changes in discharge from springs during test pumping.

Each meadow and seep is a potential site for one or more wells. Because they are underlain by unconsolidated material, the meadows probably are the best sites for wells. The flatter-lying meadows probably have the thickest section of unconsolidated material, and the best prospective sites are in the three flat-lying meadows shown in figure 3. If fractured granitic rocks underlie the meadows, the fractures can be expected to be water filled as the overlying unconsolidated material is saturated and receives ample annual precipitation for recharge.

There is no indication of appreciable saturated thickness of unconsolidated material at the seeps, but the presence of water does indicate water-bearing material near the surface probably underlain at shallow depth by impermeable bedrock. If the sites at seeps are test drilled, water might be obtained from fractures, if present, in the bedrock.

If sites for wells must be selected away from the meadows and seeps, they should be chosen at the lowest practicable altitude. This practice combined with selection of sites in or near drainage channels or streams should provide the best opportunity to drill into decomposed rock or water-bearing fractures in bedrock.

Ten sites where successful wells probably can be drilled are listed in table 3. In addition to hydrologic considerations, each site was selected with regard for its position relative to the development of user areas in the park.

FUTURE DATA COLLECTION

A continuing program of data collection should be instituted during a period to include one or preferably two successive years of low precipitation. The program should be reviewed for changes annually, but should not be discontinued or drastically curtailed until data are obtained during dry years.

Water-level data should be obtained from wells in the area. Regular monthly measurements during the snow-free months probably will be sufficient. As new wells are drilled, they should be added to the list for regular depth-to-water measurements. When dry years occur, some test pumping should be planned to establish yield and drawdown data under least favorable circumstances. A limited number of low-flow measurements should be planned for streams in the study area, principally in Sequoia Creek. If use of surface water is planned, the low-flow measurements will provide data to estimate the size and reliability of the supply.

Table 3.--Prospective well sites

Site number	Distance from corner of section			Description
	Miles	Corner	Section	
1	0.09 North .17 West	Southeast	31	In a small meadow on the north side of Azalea Campground.
2	.74 North .00 East	Southwest	33	Near the center of a flat-lying open meadow. The site is upgradient from the storage reservoir in section 32.
3	.34 North .03 East	Southwest	33	A seep on Park Ridge Road.
4	.51 North .28 West	Southeast	32	In the northeast corner of Round Meadow, about 75 feet west of the only large clump of conifers in the meadow. This site is above the storage reservoir in the section, however, a well at this location could have possible adverse effects on flows from springs, 13S/28E-32G3S, 32G4S, and well 13S/28E-32H1.
5	.53 North .64 West	Southeast	32	The site is in the center of the meadow about 100 feet down-gradient from a change in slope and about 300 feet lower in altitude than the storage reser-voir in the same section.
6	.21 North .96 West	Southeast	32	In a large area of willows, east of Highway 180 and southwest of Crystal Campground.
7	.90 North .75 West	Southeast	5	In a large area of willows, 550 feet northeast of bench mark, elevation 6,589 feet, near the main park facilities.
8	.90 North .51 West	Southeast	5	In the meadow southeast of Crystal Campground, near a low wooden barrier.
9	.83 North .43 West	Southeast	6	In a seep south of Swale Campground, a small grassy area with azaleas, located east of the dirt road.
10	.37 North .72 West	Southeast	8	In a seep 50 feet northeast of spring 14S/28E-8L1S.

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Appendix 1.--*Description of wells and springs*

[Boxhead explanations are abstracted from U.S. Geological Survey "Instructions for Using the Punch-Card System for the Storage and Retrieval of Ground-Water Data"]

State well number: The wells are identified according to their location in the rectangular system for the subdivision of public land. The identification consists of the township number, north or south; the range number, east or west; and the section number. The section is further subdivided into sixteen 40-acre tracts lettered consecutively (excepting I and O), beginning with A in the northeast corner of the section and progressing in a sinusoidal manner to R in the southeast corner. Wells within the 40-acre tract are numbered sequentially. The base line and meridian are indicated by the final letter, as follows: H, Humboldt; M, Mount Diablo; S, San Bernardino.
Spring number: Springs are numbered similarly. However the letter S is added after the 40-acre tract letter to differentiate the spring from a well.

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

Ownership:

- C County
- F Federal Government
- M City, town, or unincorporated village
- N Corporation or company, churches, lodges, and other nonprofit, nongovernment groups
- P Private
- S State agency
- W Water district.

Use of water:

- A Air conditioning
- B Bottling
- C Commercial
- D Dewatering
- E Power generation
- F Fire protection
- H Domestic
- I Irrigation
- M Medicinal
- N Industrial, including mining
- P Public supply
- R Recreation
- S Stock supply
- T Institutional
- U Unused
- V Repressurization
- W Recharge
- X Desalination, public supply
- Y Desalination, other use
- Z Other.

Use of well:

- A Anode
- D Drainage
- G Seismic hole
- H Heat reservoir
- O Observation
- P Oil or gas
- R Recharge
- T Test hole
- U Unused
- W Withdraw water
- X Waste disposal
- Z Destroyed.

Well data: In tabulation below, C, complete data; N, no data; P, partial data. Complete physical data include depth, diameter, and finish. Complete geologic data include lithology and aquifer thickness. Complete water-level data include altitude of land-surface datum, in feet above mean sea level; water level, in feet above(+) or below land-surface datum; and date of measurement. Complete yield data include rate of pumping and drawdown.

Code symbol	1	2	3	4	5	6	7	8	9	0
Physical	C	C	P	C	C	P	C	C	P	P
Geologic	C	C	P	C	C	N	C	N	P	N
Water level	C	C	C	N	N	P	P	C	C	N
Yield	C	N	C	C	N	P	C	N	N	P

Chemical analyses:

- C Complete
- G Dissolved gases
- J Conductance and chloride
- K Conductance
- L Chloride
- M Multiple (complete and one or more partials)
- P Partial
- R Radiochemical (plus partial or complete chemical)
- S Special (tritium, carbon-14, and all other special determinations)
- T Trace elements (spectrographic).

Log data:

- A Drilling-time
- B Casing-collar
- C Caliper (diameter) survey
- D Driller's
- E Electric
- F Fluid-conductivity or fluid-resistivity
- G Geologist or sample
- H Magnetic
- I Induction
- J Gamma-ray
- K Dipmeter or directional (inclinometer) survey
- L Laterolog
- M Microlog
- N Neutron
- O Microlaterolog
- P Photographic
- Q Radioactive-tracer
- R Radiation (includes both neutron and gamma-ray)
- S Sonic
- T Temperature
- U Temperature and fluid-conductivity (resistivity)
- V Fluid-velocity
- W Electric and radiation
- X Electric, radiation, caliper, and fluid-velocity
- Y Electric, radiation, and sample (or driller's)
- Z Electric, radiation, temperature, and fluid-conductivity.

Depth of well: Depth, in feet below land-surface datum, as reported by owner, driller, or others, or as measured by the Geological Survey.

Depth cased: Length of casing, in feet below land-surface datum, to the top of the first perforations.

Diameter: Inside diameter of the well, in inches; nominal inside diameter, in inches, of the innermost casing at the surface for drilled cased wells

Well finish:

- C Porous concrete
- F Gravel wall, perforated or slotted casing
- G Gravel wall, commercial screen
- H Horizontal gallery or collector
- O Open end
- P Perforated or slotted casing
- S Screen
- T Sand point
- W Walled or shored
- X Open hole in aquifer (generally cased to aquifer)
- Z Other.

Method drilled:

- A Rotary
- B Bored or augered
- C Cable-tool
- D Dug
- H Hydraulic-rotary
- J Jetted
- P Air percussion
- R Reverse-rotary
- T Trenching
- V Driven
- W Drive-wash
- Z Other.

Lift type:

- A Air
- B Bucket
- C Centrifugal
- J Jet
- L Multiple (centrifugal)
- M Multiple (turbine)
- N None
- P Piston
- R Rotary
- S Submergible
- T Turbine
- Z Other.

Power:

- 1 Hand
- 2 Natural gas engine
  - A 0-20 hp
  - B >20-50
  - C >50-100
  - D>100-200
  - E >200
- 3 Gasoline engine
  - F 0-5 hp
  - G >5-20
  - H >20-50
  - J >50-100
  - K >100-200
  - L >200
- 4 Diesel engine
  - M 0-50 hp
  - N >50-150
  - P>150-400
  - Q>400-750
  - R >750
- 5 Electric motor
  - S 0-1 hp
  - T >1-5
  - U >5-15
  - V>15-100
  - W >100
- 6 Wind
- 7 LP gas engine (propane or butane)
  - A 0-20 hp
  - B >20-50
  - C >50-100
  - D>100-200
  - E >200
- 8 Other.

Altitude of lsd: Altitude of land-surface datum, in feet, above mean sea level. Land-surface datum is an arbitrary plane closely approximating land surface at the time of the first measurement and used as the plane of reference for all subsequent measurements.

Water level: Depth to water, in feet, above(+) or below land-surface datum.

Date measured: Month and year of the water-level measurement; other data given generally apply for this date.

Yield of well (or spring): Yield, in gallons per minute; drawdown, in feet.

State well number	Owner or user	Ownership	Use of water	Use of well	Well data	Chemical analyses	Log data	Depth of well (feet below lsd)	Depth cased (feet below lsd)	Diameter (inches)	Well finish	Method drilled	Year drilled	Lift type	Power	Altitude of lsd (feet)	Water level (feet below lsd)	Date measured	Yield: Gallons per minute	Yield: Drawdown (feet)
13S/28E-32G1S	Natl. Park Service	F	P													6,950		10- 2-69	a36	
13S/28E-32G2S	Do	F	P													6,950				
13S/28E-32G3S	do	F	P													7,040		9-28-69	2	
13S/28E-32G4S	do	F	U													7,043		9-28-69	3	
13S/28E-32H1	do	W	P	W	1	C	D	32		6		C	1964	N		6,970	F	10- 5-64	72	
13S/28E-32K1	do	F	P	W	1	C	D	32		6		C	1964	J	3	6,800	7	10- 1-69	60	2
13S/28E-32K2S	do	F	U													6,970		9-28-69	0	
13S/28E-32M1S	do	F	P													6,600		10- 1-69	2	
13S/28E-32P1S	do	F	U													6,700		9-30-69	0	
13S/28E-32Q1S	do	F	U													6,880		9-30-69	0	
14S/28E- 5B1S	do	F	P													6,828		9-27-69	10	
14S/28E- 5G1	do	F	H	W	9			32		8				J	S	6,600	10	9-26-69		
14S/28E- 5G2	do	F	H	W	9			35		7				T	S	6,660	13	9-26-69		
14S/28E- 5H1S	Do	F	P			C										6,940		9-27-69	12	
14S/28E- 5H2S	Masonic Lodge	P	H													6,860		9-29-69	b3	
14S/28E- 5J1S	Natl. Park Service	F	H													6,840		9-29-69	1	
14S/28E- 5J2	Do	F	U	U	9			36		8				N		6,700	6	9-26-69		
14S/28E- 5K1	do	F	U	U	9			40		8				P	1	6,560	36	9-26-69		
14S/28E- 5K2	Do	F	H	W	2		D	31		8		C	1955	J	5	6,565				
14S/28E- 5L1	Wilsonia Lodge	P	P	W	0	C		43		8		C	1943	T	T	6,565				
14S/28E- 5L2	Kings Canyon Lodge	P	H	W	0	C		40				C		J	T	6,550	8	9-30-69		
14S/28E- 5L3	Tulare County	C	H	W	9			33		8		C		T	S	6,560	8	9-27-69		
14S/28E- 5Q1	Natl. Park Service	F	H	W	9			45		8		C		T	S	6,600	23	9-26-69		
14S/28E- 8F1S	Do	F	H													6,423		9-29-69	1	
14S/28E- 8L1S	Do	F	U			C										6,220		10- 5-69	5	

a. Flow for springs 13S/28E-32G1S and 32G2S.
b. Reported yield.

Appendix 2.--Chemical analyses of water

Values for dissolved solids indicate the residue on evaporation at 180°C, except those preceded by the letter "b," which have been calculated (sum of determined constituents).

State well or spring number	Date of collection	Depth of well (feet)	Water temperature (°C)	Results in milligrams per liter: 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	Hardness as $CaCO_3$	Noncarbonate hardness as $CaCO_3$	Percent sodium	Specific conductance (micromhos at 25°C)	pH	Laboratory and sample number
U.S. Public Health Service drinking-water standards (1962)					0.3							250	250		45		500						
13S/28E-32H1	10- 5-64	32	5.5	24		6.4	0.4	4	1.5	28	0	0.0	0.2	0.0	0	0.0	51	18	0	30	55	6.3	47751
13S/28E-32K1	11-24-64	32		28		5.8	.6	5	1.8	29	0	1.0	1.1	.0	1	.0	58	17	0	35		6.7	48181
14S/28E- 5H1S	9-27-69		7.8	15	.01	.9	.0	2	.4	8	0	.0	.4	.0	0	.0	b23	2	0	64	18	6.0	59321
14S/28E- 5L1	9-27-69	43	9.0	30	.03	4.0	.2	6	.6	25	0	.0	1.4	.1	1	.0	b55	11	0	50	48	6.5	59319
14S/28E- 5L2	9-30-69	40		18	.1	2.6	.2	4	1.1	17	0	1.0	1.2	.1	0	.0	b36	8	0	49	38	6.5	39320
14S/28E- 8L1S	10- 5-69		9.0	20	.3	2.0	.2	3	.5	14	0	.0	.4	.0	0	.0	b33	6	0	52	29	6.0	59318

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