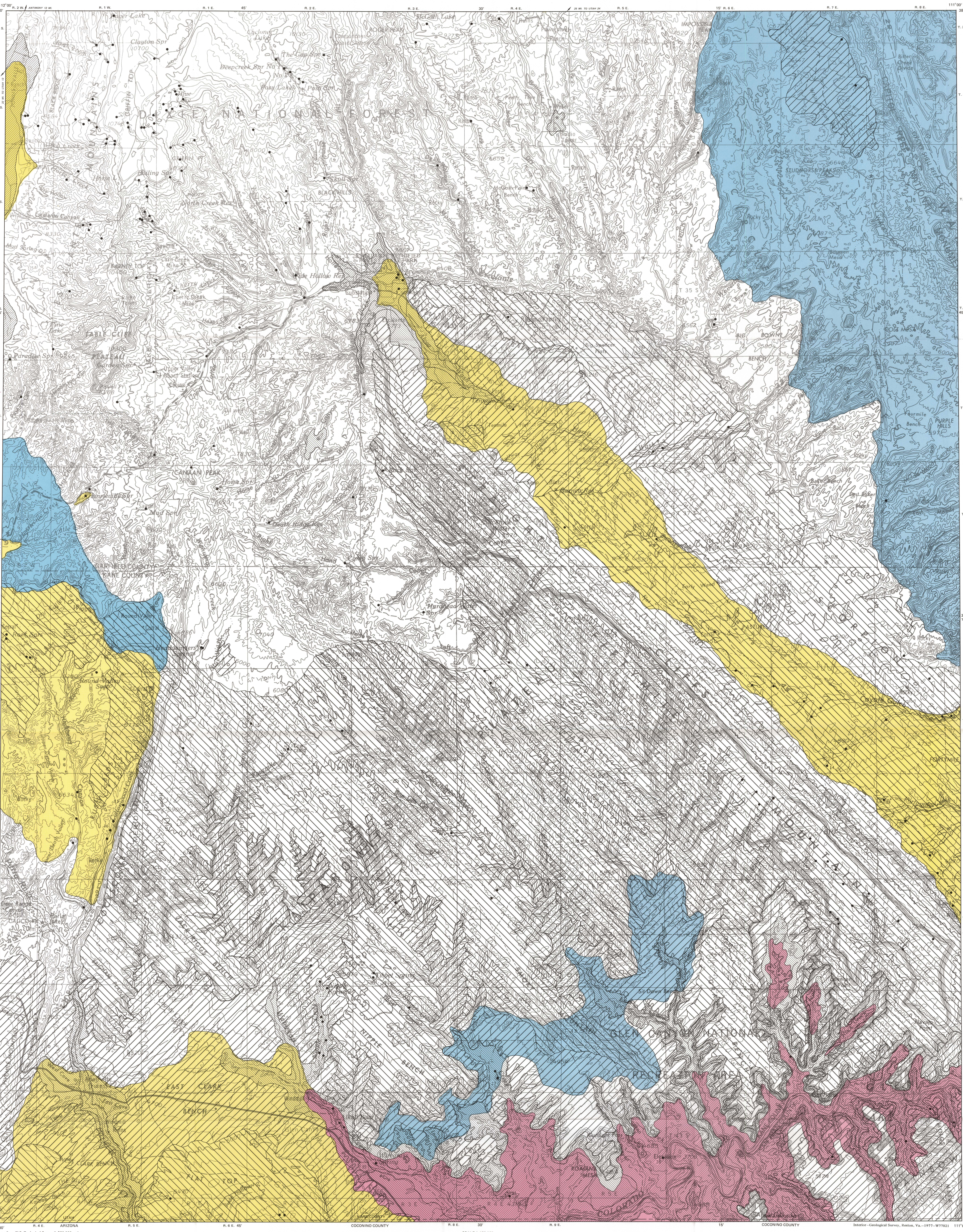
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

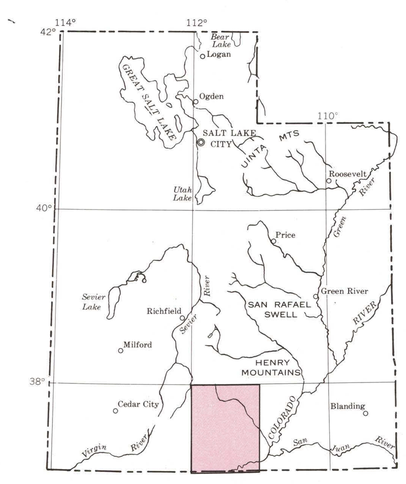
MISCELLANEOUS INVESTIGATIONS SERIES
MAP I-1033-B



Base from U.S. Geological Survey 1:250,000 series: Escalante, Utah; Arizona, 1956 (revised 1970)

SCALE 1:125,000

CONTOUR INTERVAL 200 FEET (60 METERS)
DATUM IS MEAN SEA LEVEL



INDEX MAP OF UTAH

MAP SHOWING GENERAL AVAILABILITY OF GROUND WATER IN THE KAIPAROWITS COAL-BASIN AREA, UTAH

By
Don Price
1977

EXPLANATION

Yields of properly constructed wells and water levels in those wells should be within the ranges shown. More detailed information about potential yields of wells and depths of ground water is available from the U.S. Geological Survey, Salt Lake City, Utah

EXPECTED SUSTAINED YIELDS OF INDIVIDUAL WELLS, IN GALLONS (LITERS) PER MINUTE

- 1 to 5 (4 to 20)
- 5 to 50 (20 to 190)
- 50 to 500 (190 to 1,900)
- 500 to 1,000 (1,900 to 3,800) Locally more than 1,000 (3,800)

Spring
Number identifies spring in accompanying table. Number of "tails" indicates number of springs at same site

EXPECTED DEPTH TO GROUND WATER, IN FEET (METERS) BELOW LAND SURFACE

- Less than 100 (30)
- 100 to 200 (30 to 60)
- 200 to 500 (60 to 150)
- 500 to 1,000 (150 to 300) Locally more than 1,000 (300)
- Less than 100 (30) to more than 1,000 (300)
  Less than 100 (30) along deeply incised streams; more than 1,000 (300) on higher plateaus and benches

INTRODUCTION

This is one of a series of maps that describe the geology and related natural resources of the Kaiparowits coal-basin area, Utah. The map is based partly on records of water wells, springs, and coal and petroleum-exploration holes, partly on unpublished reports of field evaluations of prospective stock-water well sites by personnel of the U.S. Geological Survey, and partly on a 6-day field reconnaissance by the writer in parts of the mapped area.

Most of the data used to compile the map were collected by the U.S. Geological Survey in cooperation with State, local, and other Federal agencies. Published sources of data include Phoenix (1963), Iorns, Hembree, and Phoenix (1964), Cooley (1965), Feltis (1966), Goode (1966, 1969), and the final environmental impact statement for the proposed Kaiparowits power project (U.S. Bureau of Land Management, 1976).

Few data about the availability or depth of ground water could be obtained for large areas in the Kaiparowits coal basin. In those areas, expected yields of individual wells are inferred from the geology as compiled by Stokes (1964) and Hackman and Wyant (1973), and depths of ground water in wells are inferred largely from the local topography.

El Paso Natural Gas Co., Resources Co., Kaiser Engineers, and Southern California Edison Co. provided specific information regarding the availability and depth of ground water in their exploratory holes on the Kaiparowits Plateau. The cooperation of those firms is gratefully acknowledged.

GENERAL HYDROLOGIC PROPERTIES OF THE ROCKS

Rocks ranging in age from Permian to Holocene are exposed in the Kaiparowits coal-basin area (Hackman and Wyant, 1973). They consist chiefly of sedimentary rocks—mostly interbedded sandstone, siltstone, shale, conglomerate, and limestone strata—in aggregate a thickness of several thousand feet. On the Aquarius Plateau, the sedimentary rocks are capped by volcanic rocks; but throughout the remainder of the area they are mantled locally by unconsolidated sedimentary deposits—mostly stream-valley alluvium, terrace gravels, and dune sand. Ground water occurs at varying depths in all the sedimentary and volcanic rocks; stream-valley alluvium contains ground water locally, but the terrace gravels and dune sands are largely unsaturated.

The rocks, where saturated, transmit the water to wells and springs at varying rates depending largely on their permeability or hydraulic conductivity. The stream-valley alluvium is moderately to highly permeable and transmits water readily to wells and springs. In most places, however, the alluvium is discontinuous and too thin to yield more than 50 gallons (190 liters) per minute on a sustained basis to wells.

In the upper Escalante River basin (in the vicinity of the community of Escalante) and in Johns Valley (in the northwestern corner of the map), individual wells tapping the alluvium could yield up to 500 gallons (1,900 liters) per minute of water.

The volcanic rocks are also moderately to highly permeable; they yield water to numerous springs on the Aquarius Plateau, and water seeping from these rocks helps to support the flow of the Escalante River. The volcanic rocks are not known to be tapped by wells within the area. Based on well records for adjacent areas, however, most wells that tap these rocks could yield up to 50 gallons (190 liters) per minute of water; and some wells, ideally located, could yield much more than 50 gallons (190 liters) per minute. In the upper Fremont River valley just to the north, for example, volcanic rocks yield more than 1,000 gallons (3,800 liters) per minute of water to wells and springs (Bjorklund, 1969, p. 44-46).

The sedimentary rocks that underlie most of the area are as a whole poorly permeable and transmit water slowly to wells and springs (except where those rocks are intensely faulted or fractured). Because of the great thickness and extent of the sedimentary rocks, however, they contain most of the ground water available for development in the area. Most of these rocks, where saturated, could yield 5 to 50 gallons (20 to 190 liters) per minute of water to individual wells. In those areas underlain by thick (more than 100 feet (30 meters)) saturated sections of sandstone, individual wells could yield 50 to more than 1,000 gallons (190 to 3,800 liters) per minute of water.

The Navajo Sandstone, where it lies at or near the land surface around the margins of the Kaiparowits Plateau, is the best source of ground water for large sustained withdrawals by wells. In these areas, saturated sections of the formation are several hundred to more than 1,000 feet (300 meters) thick; and where faulted or fractured, can yield more than 1,000 gallons (3,800 liters) per minute to individual wells 16 inches (40 centimeters) or more in diameter. Several such wells that tap the Navajo south of the Kaiparowits Plateau reportedly have been pumped at rates of 1,000 to about 1,600 gallons (3,800 to 6,060 liters) per minute.

The Navajo Sandstone, where it underlies the Kaiparowits Plateau, probably is fully saturated and could also support large continuous withdrawals of water by wells. However, the wells would have to be drilled to depths of 2,000 to 4,000 feet (610 to 1,220 meters) just to reach the top of the formation. This may not be economically feasible (1976 economic conditions). Therefore, the yield ranges shown on this map for the Kaiparowits Plateau are yields that can be expected from wells tapping less productive sandstone aquifers that overlie the Navajo.

EXPECTED YIELDS OF WELLS

The yield of a well not only depends on the hydrologic properties of the rocks tapped by the well, it also depends on the depth and diameter of the well, and on the size, depth, and type of pump placed in the well. The minimum expected yields of individual wells shown on this map assume that the wells are at least 6 inches (15 centimeters) in diameter; fully penetrate the aquifer; either have no casing, perforated casing, or well screens opposite the aquifer; and are equipped with optimal pumping equipment. The yields shown are those that could be sustained indefinitely by pumping. In many parts of the Kaiparowits coal-basin area, individual wells may obtain yields larger than those shown. These larger yields, however, probably would not be sustained indefinitely because of limitations of either storage capacity in the aquifer or the rate of natural recharge to the aquifer. For example, some of the larger canyons (such as Wahweap Creek canyon) contain saturated highly permeable alluvial deposits locally that could yield up to 100 gallons (380 liters) per minute of water to a well for short periods of pumping, but recharge (from less permeable bedrock) to the alluvium is too slow to sustain such withdrawal rates indefinitely.

EXPECTED DEPTH TO GROUND WATER

The ranges of expected depth to ground water shown on this map are based on measured and reported depths of water in wells (mostly in the vicinity of the communities of Escalante, Boulder, and Glen Canyon) and on reported depths to water in coal-exploration holes (mostly in the central part of the Kaiparowits Plateau). Ground-water-level data are not available for large areas in the Kaiparowits coal basin. In those areas, the expected depths to water are inferred from the general geology, topography, and from information in unpublished reports of field investigations of prospective stock-water well sites.

The depths shown, in most cases, represent the depth to the top of the main zone of saturation (the regional water table). In some areas, including the Kaiparowits Plateau, perched ground-water bodies are at varying levels above the main zone of saturation. These perched ground-water bodies support the flow of such springs as Nipple and Tibbet Springs on Nipple Bench. Although wells tapping such shallow perched aquifers could produce enough water for domestic and stock supply, they probably could not produce large sustained supplies.

SPRINGS

Most of the springs shown on this map were located from U.S. Geological Survey topographic maps and the U.S. Bureau of Land Management Kanab District grazing map. Most of the springs are in the head-water areas of the Escalante River. Numerous springs once discharged from the walls of Glen Canyon (Cooley, 1965), but most of those springs are now inundated by Lake Powell. Yields of most springs range from less than 1 to about 20 gallons (4 to 80 liters) per minute, but several springs discharge more than 100 gallons (380 liters) per minute (see accompanying table).

GROUND-WATER QUALITY

The general chemical quality of ground water in the Kaiparowits coal-basin area is shown in another map in this series (Price, 1977). According to that map, much of the ground water (including springflow) may be too saline to drink. This is also indicated by the accompanying table showing records of selected springs. Therefore, water from springs and newly drilled wells should be analyzed and treated, if necessary, prior to use for domestic supply. This is especially true in low-altitude areas where shale and siltstone are the dominant lithologies.

REFERENCES CITED

Bjorklund, L. J., 1969, Reconnaissance of the ground-water resources of the upper Fremont River Valley, Wayne County, Utah: Utah Dept. Nat. Resources Tech. Pub. 22, 54 p.

Cooley, M. E., 1965, Stratigraphic sections and records of springs in the Glen Canyon region of Utah and Arizona: Museum Northern Arizona Tech. Ser. 6, 140 p.

Feltis, R. D., 1966, Water from bedrock in the Colorado Plateau of Utah: Utah State Engineer Tech. Pub. 15, 82 p.

Goode, H. D., 1966, Second reconnaissance of the water resources in western Kane County, Utah: Utah Geol. and Mineral Survey Water-Resources Bull. 8, 44 p.

——— 1969, Reconnaissance appraisal of the water resources near Escalante, Garfield County, Utah: Utah Geol. and Mineral Survey Water-Resources Bull. 11, 38 p.

Hackman, R. J., and Wyant, D. G., 1973, Geology, structure, and uranium deposits of the Escalante quadrangle, Utah and Arizona: U.S. Geol. Survey Misc. Geol Inv. Map I-744, scale 1:250,000.

Iorns, W. V., Hembree, C. H., and Phoenix, D. A., 1964, Water resources of the Upper Colorado River Basin—Basic data: U.S. Geol. Survey Prof. Paper 442, 1036 p.

Phoenix, D. A., 1963, Geology of the Lees Ferry area, Coconino County, Arizona: U.S. Geol. Survey Bull. 1137, 86 p.

Price, Don, 1977, Map showing general chemical quality of ground water in the Kaiparowits coal-basin area, Utah: U.S. Geol. Survey Misc. Geol. Inv. Map I-1033-A, scale 1:125,000.

Stokes, W. L., ed., 1964, Geologic map of Utah: Utah Univ., scale 1:250,000.

U.S. Bureau of Land Management, 1976, Final environmental impact statement, proposed Kaiparowits power project, Chaper II (Description of the environment): U.S. Dept. Interior, 445 p.

U.S. Public Health Service, 1962, Drinking water standards: U.S. Public Health Service Pub. 956, 61 p.

RECORDS OF SELECTED SPRINGS

Altitude: Altitude of spring interpolated from U.S. Geological Survey topographic maps.
Geologic source: Qa, alluvium; Kwa, Wahweap Sandstone; Ksc, Straight Cliffs Formation; Jm, Morrison Formation; Jse, Summerville Formation and Entrada Sandstone, undivided; Je, Entrada Sandstone; Jca, Carmel Formation; JTRn, Navajo Sandstone (see Hackman and Wyant, 1973, for description of geologic units).
Springflow: Rate - e, estimated; m, measured. Dissolved solids - maximum allowable limit recommended by the U.S. Public Health Service (1962, p. 7) for drinking water is 500 mg/1 (milligrams per liter); concentrations of specific mineral constituents available from data sources indicated in last column.

Map No.	Name	Altitude, feet (meters)	Geologic source	Springflow: Rate, gallons (liters) per minute	Springflow: Temperature (°C)	Springflow: Dissolved solids (mg/1)	Springflow: Date	Springflow: Source of data
1	Unnamed	7,100 (2,164)	Ksc	30m (110)	–	–	8-12-67	Goode (1969).
2	Death Hollow Spurter	5,790 (1,765)	JTRn	10e (38)	16.5	231	8-16-67	Do.
3	Escalante Falls	6,075 (1,852)	Ksc	50e (190)	10.0	465	8-15-67	Do.
4	Pine Creek 2	5,720 (1,743)	Jca(?)	100e (380)	11.0	3,960	8-20-67	Do.
5	Escalante 2	5,740 (1,750)	Qa	450e (1,700)	11.0	637	8-21-67	Do.
6	Harris Wash 2	4,950 (1,509)	JTRn	2-3e (7.6-11)	–	–	8-14-67	Do.
7	Unnamed	6,600 (2,012)	Ksc	200e (760)	14.0	352	8-12-64	Goode (1966).
8	Round Valley	6,165 (1,879)	Jca(?)	0.25m (0.9)	16.0	[1] 310	5-28-74	([2])
9	Headquarters	6,020 (1,835)	Qa	0.3m (1.1)	13.0	1,780	5-29-74	([2])
10	Cat Well	4,860 (1,481)	JTRn(?)	1e (3.8)	–	"potable"	–	([3])
11	Unnamed	5,730 (1,746)	Kwa	2e (7.6)	11.0	1,650	5-29-74	([2])
12	Tommy Water	5,640 (1,719)	Kwa	15m (57)	11.5	921	5-29-74	([2])
13	Fourmile Water	5,640 (1,719)	Kwa	15m (57)	–	823	5-29-74	([2])
14	Cottonwood	4,350 (1,326)	Jse(?)	2e (7.6)	–	"potable"?	--	([3])
15	Pump Canyon	5,300 (1,615)	JTRn	15e (57)	15.0	141	5-29-74	([2])
16	Unnamed	5,160 (1,573)	JTRn	58m (220)	15.5	199	7-20-64	Goode (1966).
17	Drip Tank	4,910 (1,497)	Ksc	15e (57)	–	531	5-30-74	([2])
18	Fortymile	4,415 (1,346)	Je(?)	3-4e (11-15)	–	"potable"	--	([3])
19	Wesses Canyon	4,840 (1,475)	Ksc	5e (19)	–	1,230	5-14-74	([2])
20	Tibbet	4,680 (1,426)	Ksc	1e (3.8)	–	1,140	5-30-74	([2])
21	Fiftymile	4,450 (1,356)	Jse(?)	0.25m (0.9)	–	"unpotable"	--	([3])
22	Nipple	4,750 (1,448)	Ksc	1e (3.8)	–	578	5-30-74	([2])
23	Unnamed	3,840 (1,170)	Jm	0.5e (1.9)	–	1,750	5-30-74	([2])
24	Alkali	3,910 (1,192)	Qa	450e (1,700)	–	2,140	5-31-74	([2])
25	Castle Rock	3,640 (1,109)	Je	0.5e (1.9)	–	232	12-5-58	Iorns, Hembree, and Phoenix (1964).[4]
26	Unnamed	3,300 (1,006)	JTRn	50e (190)	–	346	4-21-59	Do.

[1] Estimated from specific conductance as measured by portable conductance meter.
[2] From files of U.S. Geological Survey, Salt Lake City, Utah.
[3] Estimated discharge and notation regarding potability from U.S. Bureau of Land Management (U.S. Gardner, oral commun., June 18, 1976).
[4] Spring area inundated by Lake Powell.

For sale by Branch of Distribution, U.S. Geological Survey, Box 25286, Federal Center, Denver, CO 80225