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HYDROLOGIC RECONNAISSANCE OF DEEP CREEK VALLEY, TOOELE AND JUAB COUNTIES, UTAH, AND ELKO AND WHITE PINE COUNTIES, NEVADA

by

J. W. Hood and K. M. Waddell, Hydrologists
U. S. Geological Survey

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CONTENTS

CONTENTS–Continued

ILLUSTRATIONS

TABLES

TABLES--Continued

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ABSTRACT

Deep Creek valley is a north-trending depression that lies astride the Utah-Nevada State line and extends about 30 miles southward from T. 7 S. in Utah (T. 27 N. in Nevada) to T. 12 S. (T. 22 N.) in the southern Deep Creek Mountains. The drainage basin contains about 281,000 acres. The known ground-water reservoir in the valley is in unconsolidated rocks of Tertiary and Quaternary age and underlies at least 32,000 acres.

The source of water in Deep Creek valley is an estimated 290,000 acre-feet of average annual precipitation. Nearly half of this amount falls on the lowlands of the drainage basin, below an altitude of about 6,500 feet, and does little more than sustain soil moisture. Most runoff and ground-water recharge to the valley, therefore, is derived from precipitation on the drainage basin above 6,500 feet. The estimated average annual runoff from the uplands is 28,000 acre-feet. Part of the surface water is discharged by evapotranspiration in the uplands and valley, part recharges the ground-water reservoir, and a small part flows out of the valley. The valley is drained by Deep Creek through a narrow gorge that leads to the Great Salt Lake Desert. The estimated annual outflow from the valley, including some discharge from springs and seepage areas, is 2,000 acre-feet, or about 0.7 percent of the estimated volume of average annual precipitation in the drainage basin.

The estimated average annual recharge to and discharge from the ground-water reservoir is 17,000 acre-feet of water. Ground water is discharged from Deep Creek valley by evapotranspiration, by wells, and by outflow from springs and seepage areas. About 15,000 acre-feet of water is discharged by evapotranspiration, about 600 acre-feet by pumping from wells, and about 1,000 acre-feet by surface outflow from springs and seepage areas.

The amount of ground water available for salvage from nonbeneficial discharge in Deep Creek valley is estimated to be about 4,000 acre-feet. Additional withdrawals by wells in excess of 4,000 acre-feet would be from storage and would result in declines of water levels. If 100 feet of saturated deposits in the ground-water reservoir were dewatered, the estimated volume of water that could be recovered would be 320,000 acre-feet.

The water in Deep Creek valley is of suitable chemical quality for domestic, stock, and irrigation purposes. The range in the concentration of dissolved solids is 38-562 mg/l (milligrams per liter). Samples from streams contained 38-397 mg/l. Ground-water samples contained 118-562 mg/l, but only 6 of the 19 ground-water samples contained in excess of 300 mg/l of dissolved solids. All but two samples were of the calcium and (or) magnesium bicarbonate type.

Agricultural use of water began in Deep Creek valley before 1860, and to date (1967) the main use of water has been for irrigation of pasture and forage crops. The Utah State Engineer's hydrographic survey of the valley in 1963 indicated that about 3,780 acres in Utah and an estimated minimum of about 370 acres in Nevada were being irrigated with water from streams, springs, and wells. Of the total of about 4,200 acres, about 350 acres were being supplied with water from wells. Water from the valley also was being diverted to about 100 acres of land outside the valley.

Because existing stream and spring supplies appear to be fully appropriated, future additional development would have to depend on water from wells. Terrain and possibly soil conditions appear to limit total development of irrigable lands in the valley to a maximum of about 20,000 acres. A full development of that magnitude, based on pumping of wells, would require removal of ground water from storage and therefore a lowering of water levels.

INTRODUCTION

This report, the fourth in a series by the U. S. Geological Survey in cooperation with the Utah Department of Natural Resources, Division of Water Rights, describes water resources of the western basins of Utah. Its purpose is to present available hydrologic data on Deep Creek valley, to provide an evaluation of the potential water-resource development of the valley, and to identify needed studies that would help provide an understanding of the valley's water supply.

The reconnaissance of Deep Creek valley was made during 1966-67 and consisted largely of a study of all available data for climate, geology, streams, wells, springs, and water use. These data were supplemented with field data collected during a total of about 1 week in December 1966 and late summer 1967. The fieldwork included rapid examination of land forms, vegetation, geology, and distribution and use of water. Geological data were supplemented with the interpretation of data from aerial photographs. Some of the water sources in the Deep Creek valley drainage basin in Utah were sampled during the summer and fall of 1966 and analyzed for chemical content under a cooperative program with the Utah Geological and Mineralogical Survey.

Data on stream discharge, records of wells and selected springs, selected drillers' logs, and chemical analyses are presented in tables 10-16, and locations of wells, springs, and surface-water data sites are shown on plate 1.

Deep Creek valley lies astride the Utah-Nevada State line (fig. 1). Ibapah, in Deep Creek valley, Utah, is 186 road miles southwest of Salt Lake City, via Wendover, Utah, and 416 road miles east-northeast of Carson City, via Ely, Nev. The nearest main route of travel is U. S. Highway alternate 50, 26 miles north of Ibapah.

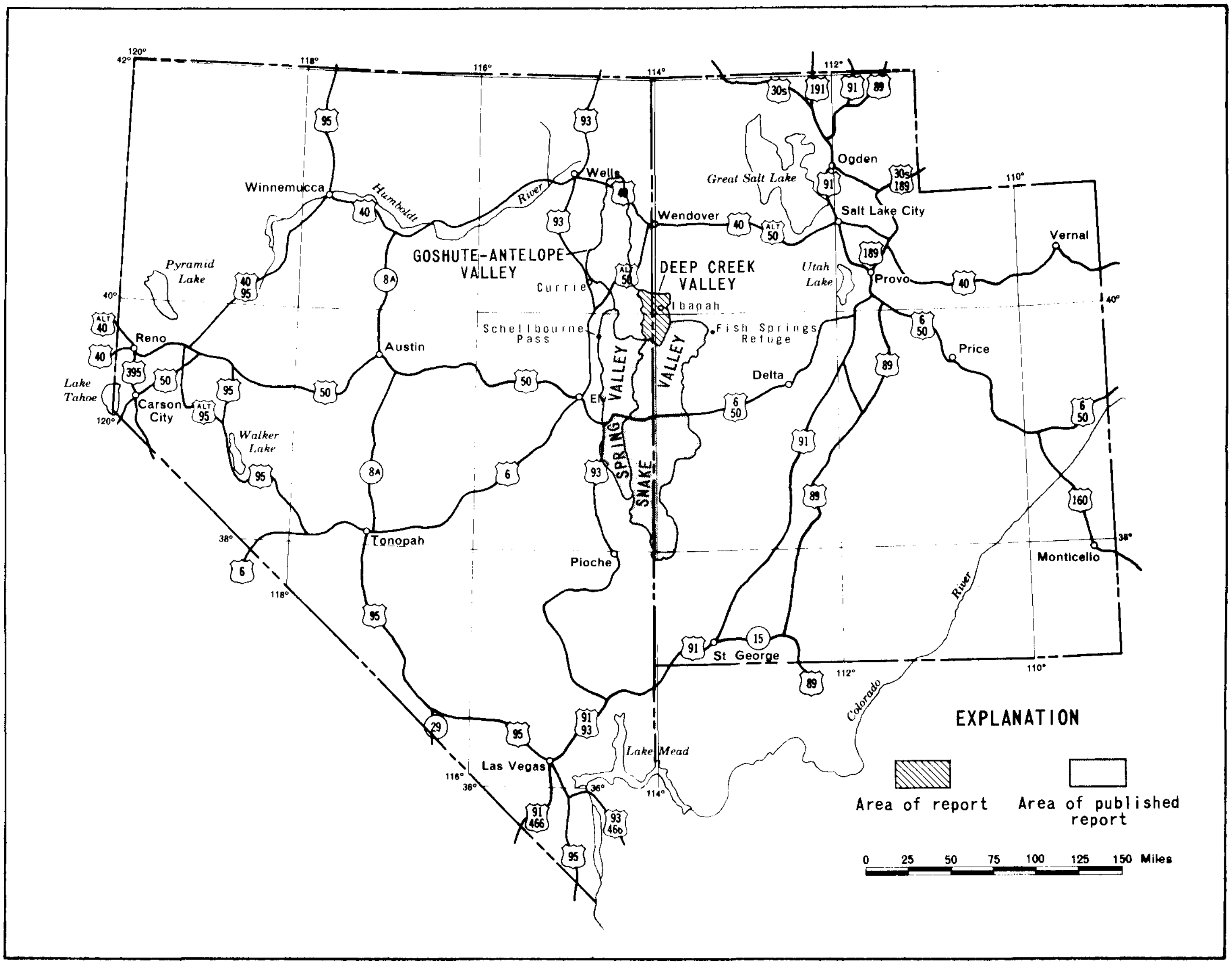


Figure 1.—Location of report area in Utah and Nevada and other nearby areas previously studied.

Deep Creek valley drainage basin lies north and west of the crest of the Deep Creek Mountains and comprises about 281,000 acres (440 square miles). The basin extends about 30 miles south from T. 7 S. in Utah (T. 27 N. in Nevada) to T. 12 S. in Utah (T. 22 N. in Nevada) and about 15 miles west from R. 18 W. in Utah to R. 69 E. in Nevada (fig. 1).

Deep Creek valley is remote and sparsely populated. Ibapah is the only town (fig. 1); and, according to the 1960 census, had a population of 213. The Goshute Indian Reservation covers approximately the southern one-third of the drainage basin and contains the village of Goshute. Access could not be obtained to the reservation during the investigation, and consequently collection of hydrologic data in the field was limited to areas outside the reservation. Farms are scattered along the valley from the Goshute Indian Reservation to the north end of the valley. A few ranches and mine properties are the only other points of resident population.

Few published sources of information about water in Deep Creek valley are available. Meinzer (field notes in files of U. S. Geological Survey, 1908-09) noted a few individual hydrologic data for the valley. The U. S. Geological Survey has measured streamflow in the valley since 1958 (U. S. Geological Survey, 1961-66) and has measured water levels in observation wells since 1962. The U. S. Weather Bureau (1963a and b) and Hardman (1936, map revised 1965) have compiled maps showing annual precipitation; and Bagley, Jeppson, and Milligan (1964) included the Utah part of the valley in their analysis of water yields in Utah. The water resources of adjacent areas are described by Eakin, Maxey, and Robinson (1949)--Goshute-Antelope Valley, Nev.; by Rush and Kazmi (1965)–Spring Valley, Nev.; and by Hood and Rush (1965)–Snake Valley, Utah and Nev. Figure 1 shows the location of these adjacent areas.

Sources of geologic data are more abundant. The main sources consulted were Nolan (1935), Heylmun (1965), and Stokes (1964). These and other sources are given in the list of selected references.

See the appendix for a description of the system of numbering wells and springs and the use of metric units in this report.

PHYSIOGRAPHY

The Deep Creek valley drainage basin is in the Great Basin section of the Basin and Range physiographic province (Fenneman, 1931, 1946), and it drains to the southwestern side of the Great Salt Lake Desert (pl. 1). Deep Creek valley is bounded on the east and south by the Deep Creek Mountains, on the west by the Goshute Mountains, and on the north by low hills and upland flats.

The Deep Creek Mountains, which separate Deep Creek valley from Snake Valley to the southeast, are high and very steep. Haystack Peak has an altitude of 12,101 feet, and the mountains have fairly extensive areas above 10,000 feet. The southwestern end of the J-shaped range has peaks that are above 8,000 feet. The Goshute Mountains, which separate Deep Creek valley from Antelope Valley to the west, are low in relation to the Deep Creek Mountains and reach a maximum altitude of only 7,005 feet within the drainage basin. The drainage divide between Deep Creek valley and the Great Salt Lake Desert crosses peaks that reach 6,000-6,600 feet, except at Ochre Mountain which reaches 7,541 feet.

The east side of the drainage basin slopes more steeply toward the valley than the west side. Level areas in the drainage basin are scarce and are restricted mainly to the valley flat surrounding Deep Creek and its largest tributaries. The entire valley gives a visual impression of recent uplift and currently active erosion.

Deep Creek and part of lower Spring Creek flow in a flood plain or valley flat that has been cut into the adjacent slopes and in places is bounded by low bluffs. The bed of Deep Creek ranges in altitude from about 6,400 feet at the mouth of Johnson Canyon to about 5,100 feet at the head of the gorge that leads out of the valley.

The shapes of the mountains are due partly to geologic structure and partly to the types of rock that are exposed. In the Deep Creek Mountains, the rocks are complexly folded and faulted and have been intruded by masses of granitoid rocks. The present height of the Deep Creek Mountains is due mainly to movement along north-trending faults; but in the mountain area, rocks resistant to erosion stand high above the valley, as at Haystack Peak (pl. 1). The sharp ridges and asymmetric shapes of the mountains in the southern part of the drainage basin are due mainly to differential erosion among the fault blocks and thrust plates.

The rolling uplands and moderate slopes along much of the western drainage divide are due to erosion of the extrusive volcanic rocks that cap part of the uplands. Where the volcanic rocks are faulted, however, and where sedimentary rocks and agglomerate of Tertiary age are exposed, rugged badlands of low relief have resulted from both structural movement and differential erosion.

Debris eroded from the mountains has been deposited in large alluvial fans on the eastern and southern sides of the valley. The fans coalesce laterally and form an undulating slope or alluvial apron. Parts of the alluvial apron are missing on some steep slopes, either because they were removed by later erosion, or possibly because they were never deposited on the steep slopes.

Deep Creek, the master stream in the valley, heads in the Deep Creek Mountains and flows northward. Most flow in the upper part of Deep Creek is from Fifteenmile, Steve's, and Sam's Creeks which head near Haystack Peak. Tributaries along the east side of Deep Creek are short, straight, and steep; tributaries from the west side drain large areas and have dendritic patterns. Although geologic structure influences the drainage pattern throughout the drainage basin, the influence is particularly striking in the vicinity of Spring Creek (Round Valley Creek), the largest western tributary to Deep Creek. Spring Creek heads at a large spring less than 1 mile west of Deep Creek, flows northwestward to Round Valley, thence flows northeastward, and joins Deep Creek near Ibapah, about 16 miles downstream from the headspring (pl. 1).

Water in Deep Creek flows out of the valley through a narrow gorge cut in consolidated rocks, and thence flows north-northeastward to the Great Salt Lake Desert.

CLIMATE

Because of the wide range of altitudes in the Deep Creek valley drainage basin, parts of the basin are semiarid, whereas the uppermost slopes of the Deep Creek Mountains are humid to subalpine. The availability of climatologic data is summarized in table 1, and the locations of climatologic stations are shown in figure 2. Ibapah is the only station in Deep Creek valley itself, but that station has a long record. Most of the stations are at relatively low altitudes (4,237-5,280 feet), but records are available for two storage gages in Nevada at medium (6,590 feet) to high altitudes (8,150 feet). Useful regional interpretations of climatic data are also available, such as the Nevada precipitation map by Hardman (1965), the paper by Peck and Brown (1962) who produced the isohyetal maps of Utah (U. S. Weather Bureau, 1963a and b), and the tables of freezing-temperature probabilities by Ashcroft and Derksen (1963, p. 20-21).

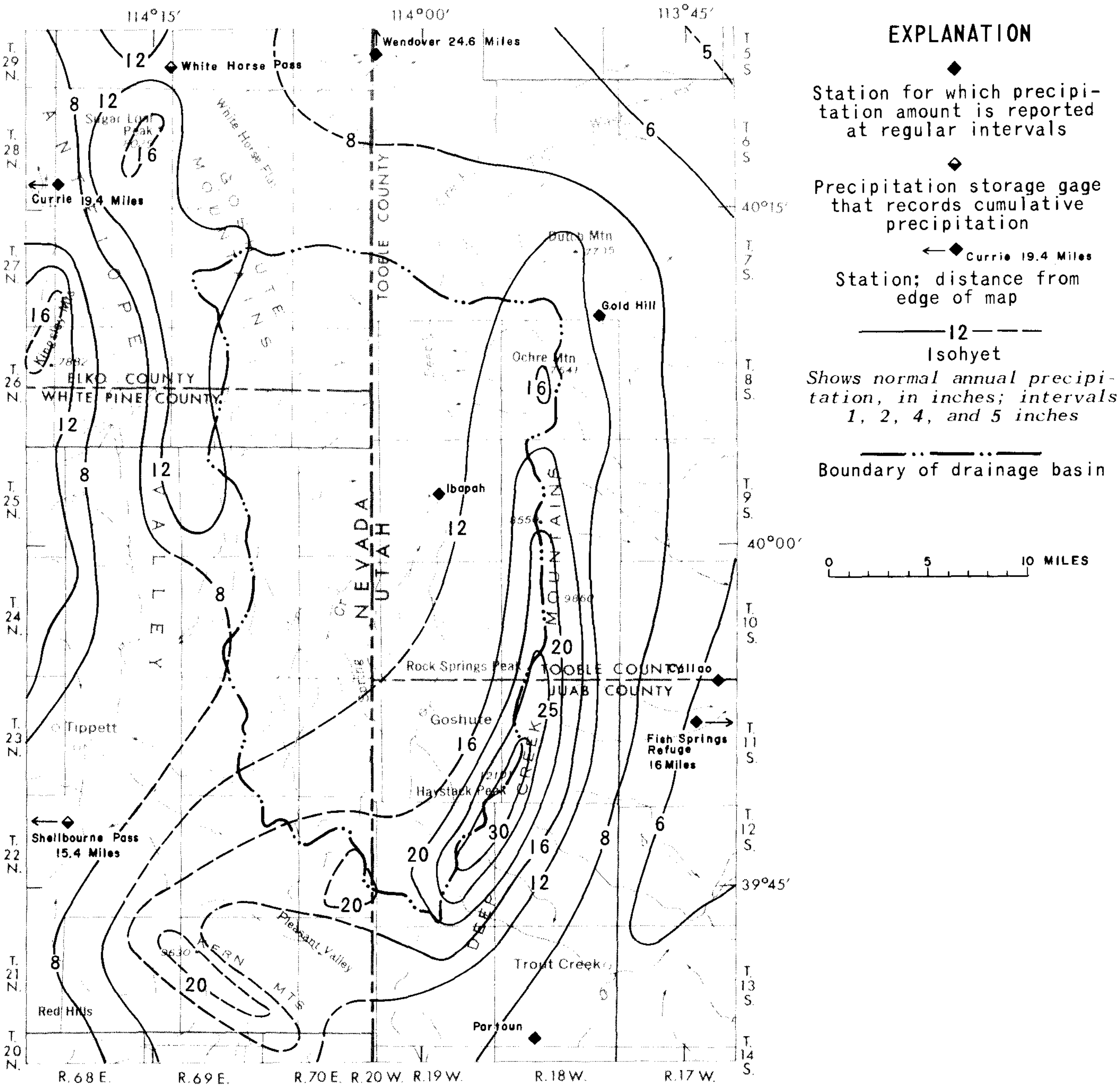
Average annual precipitation in Deep Creek valley is about 8 inches in the western part of the drainage basin and is more than 30 inches in the highest part of the Deep Creek Mountains

(fig. 2). The isohyets are derived from the U. S. Weather Bureau (1963a) and from Hardman (1965). The authors adjusted the isohyetal-line positions along the State line to reconcile the two map sources. The adjustments, particularly in the area between Ibapah and the Elko-White Pine County line, appear to be confirmed by vegetation densities, which generally adjust to available precipitation.

Table 1.--Stations at which climatologic data have been collected in and near the Deep Creek valley drainage basin, as of January 1967

(Data published by U. S. Weather Bureau (1937, 1951-66, 1957 and 1965; U. S. Environmental Science Services Administration (1967); P, precipitation, T, temperature, E, evaporation)

Station	Location		Altitude (feet)	Type and period of record (years)	Remarks
	Latitude	Longitude			
				Utah	
Callao	39°54′	113°43′	4,330	P, 28; T, 4	In Snake Valley, at south edge of Great Salt Lake Desert.
Fish Springs Refuge	39°50′	113°24′	4,350	P, 6; T, 6; E, 4	In Fish Springs Flat, at south edge of Great Salt Lake Desert; National Wildlife Refuge.
Gold Hill	40°10′	113°50′	5,210	P, 1; T, 1	In northern foothills of Deep Creek Mountains. Station established in April 1966.
Ibapah	40°02′	113°59′	5,280	P, 63; T, 63	In Deep Creek valley. Station established 1903. Record intermittent. Precipitation record interrupted 1911-13 inclusive. Temperature record intermittent 1906-13 and interrupted 1942-46 inclusive.
Partoun	39°39′	113°53′	4,750	P, 16; T, 16	In Snake Valley.
Wendover WB AP	40°44′	114°02′	4,237	P, 55; T, 50	At west edge of Great Salt Lake Desert. Detailed data for station available from U. S. Weather Bureau.
				Nevada	
Currie Highway Station	40°16′	114°45′	5,820	P, 5; T, 5	In pass between Goshute and Steptoe Valleys.
Shellbourne Pass	39°48′	114°35′	8,150	P, 13	Storage gage. Between Spring and Steptoe Valleys.
White Horse Pass	40°21′	114°14′	6,590	P, 12	Storage gage; intermittent record. Between Great Salt Lake Desert and Antelope Valley.



Base adapted from U.S. Geological Survey State Base Maps: Utah (1959) and Nevada (1965)

Isohyets from U.S. Weather Bureau (1963a) for Utah; Nevada, after Hardman (1965); adjustments and modifications (dashed lines) by J. W. Hood, 1967

Figure 2.--Isohyetal map of the Deep Creek valley drainage basin and vicinity showing locations of climatologic stations listed in table 1.

The distribution of annual average precipitation in the Deep Creek valley drainage basin does not exactly follow the general principal that lands at lower altitudes receive less precipitation than those at higher altitudes. The storms that deliver most of the precipitation to Deep Creek valley come from the west but are not much affected by the relatively low Goshute Mountains. On crossing the valley, however, the flowing air begins to rise several miles west of the steep, high Deep Creek Mountains. Thus, because the valley is close to the base of the Deep Creek Mountains, the southern part of the valley receives as much or more precipitation as do the uplands to the northwest of the valley and as do parts of the Goshute Mountains. For example, the long-term average annual precipiation at Ibapah (altitude 5,280 feet) is 11.13 inches, whereas the estimated average annual precipitation at White Horse Pass (altitude 6,590 feet), based on adjustment of a short-term record, is about 10.5 inches.

Most precipitation in the high mountains falls as snow during the winter and spring and as rain from local summer storms. In the lowlands of the valley, April and May are the wettest months, as indicated by the graph (fig. 3) of monthly precipitation at Ibapah. (See table 2.) Recorded annual precipitation varies greatly at most of the stations in the area. Ibapah, for example, received only 3.20 inches in 1953, but received 27.02 inches in 1941. Callao, on the east side of the Deep Creek Mountains, received 0.94 inch of precipitation in 1953 and 9.03 inches in 1945. Wendover received 1.77 inches of precipitation in 1926 and 10.13 inches in 1941. The long-term trend of precipitation is illustrated by the cumulative departure from average annual precipitation curves for Ibapah and Wendover (fig. 4).

Table 2.—Average monthly and annual precipitation, in inches, at stations in and near the Deep Creek valley drainage basin

For basic data, see U.S. Weather Bureau (1951-66) and U.S. Environmental Science Services Administration (1967). Numbers in parentheses show period of record in years. Annual total is sum of monthly averages. See figure 2 for station locations.

	Callao	Currie Highway Station	Fish Springs Refuge	Ibapah	Partoun	Shellbourne[1] Pass	White Horse Pass	Wendover WB AP Complete record	Wendover WB AP 1931-60 normal
January	0.33(28)	0.21(5)	0.16(6)	0.68(57)	0.30(16)	0.91(13)	-	0.28(55)	0.32
February	.27(28)	.48(5)	.55(6)	.94(57)	.38(16)	1.01(13)	-	.32(55)	.30
March	.35(28)	.43(5)	.66(6)	1.04(57)	.43(16)	1.23(13)	-	.35(55)	.39
April	.50(28)	.52(5)	.74(6)	1.21(59)	.56(17)	1.31(13)	-	.48(55)	.51
May	.55(28)	.65(5)	.96(6)	1.57(58)	.74(17)	1.42(12)	-	.65(55)	.66
June	.56(29)	1.44(5)	.90(6)	.98(58)	.68(17)	.78(12)	-	.57(56)	.46
July	.25(29)	.61(5)	.47(7)	.80(58)	.43(17)	.68(12)	-	.31(56)	.31
August	.50(29)	.79(5)	.52(7)	1.02(57)	.50(17)	1.05(12)	-	.33(56)	.36
September	.35(29)	.51(5)	.72(7)	.63(55)	.37(17)	.80(12)	-	.37(56)	.32
October	.36(29)	.37(5)	.43(7)	.94(56)	.31(17)	.61(13)	-	.43(56)	.46
November	.39(28)	.40(5)	.52(7)	.64(56)	.46(17)	.85(13)	-	.27(56)	.29
December	.26(29)	.79(5)	.47(7)	.68(56)	.37(17)	1.02(13)	-	.33(56)	.29
Annual	4.67	7.20	7.10	11.13	5.53	11.67	8[2]	4.69	4.67

[1] Monthly averages based on monthly totals prorated from storage gage records.

[2] Based on 15 measurements of accumulated precipitation in storage gage during 1954 and 1957-65. The long-term average annual precipitation is about 10.5 inches based on a comparable 11-year record at Ibapah.

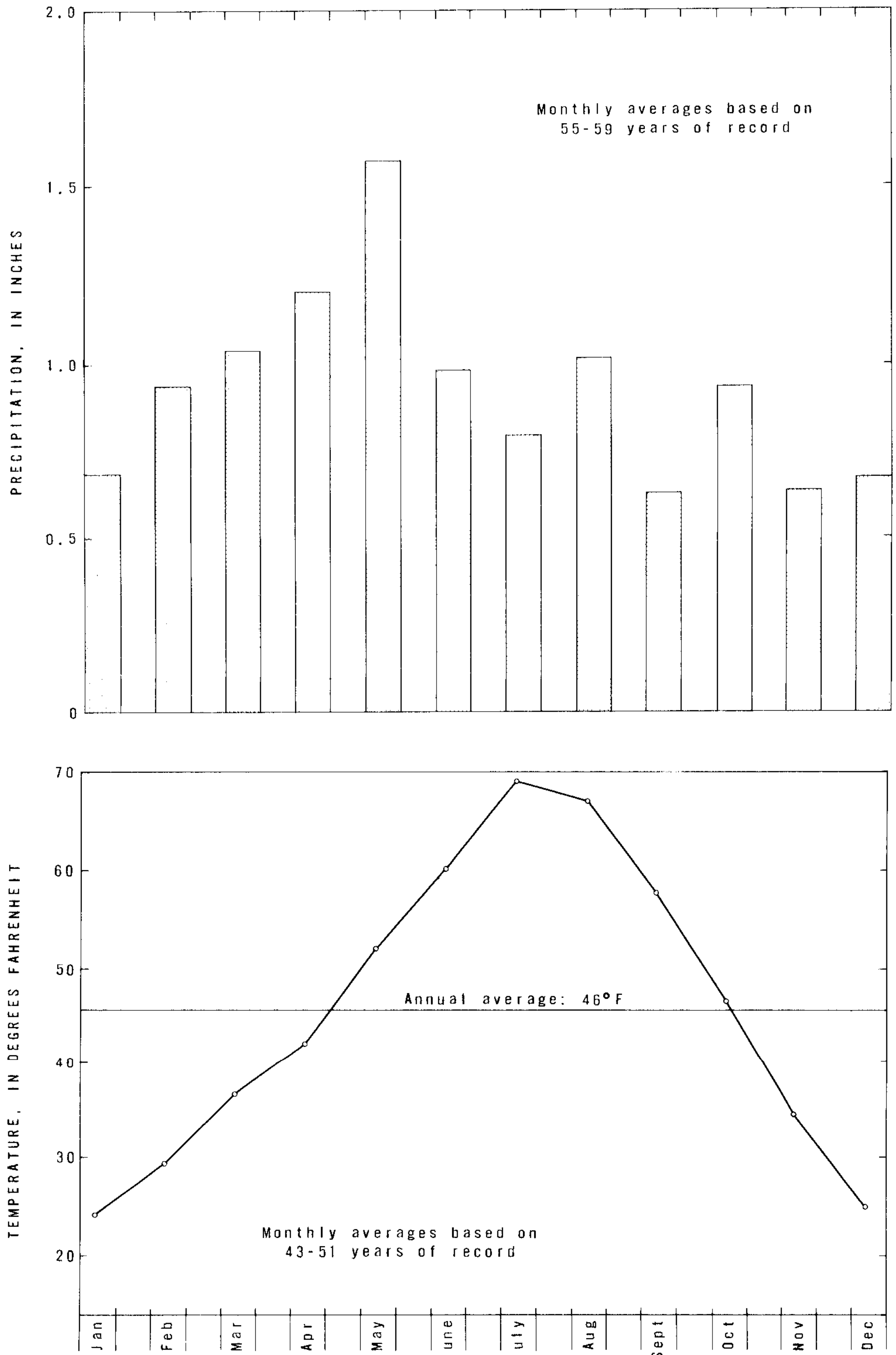


Figure 3.—Average monthly precipitation and temperature at Ibapah.

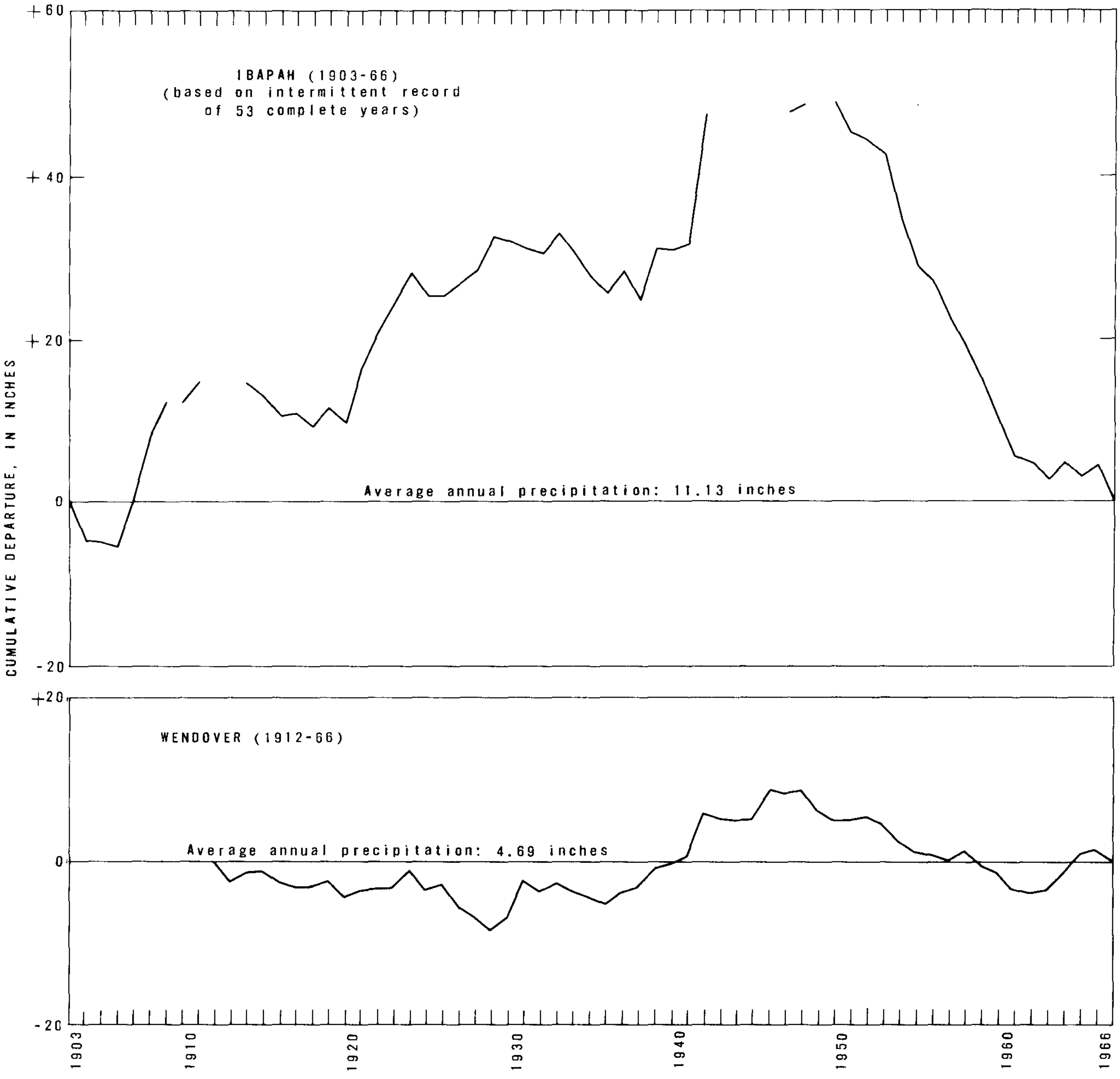


Figure 4.—Cumulative departure from average annual precipitation at Ibapah and Wendover.

The average annual air temperature at Ibapah is 46°F (8°C). Temperatures on the alluvial slopes above the valley bottom may be several degrees warmer. The coldest average monthly temperature at Ibapah is 25°F (-4°C) in January and the warmest is 69°F (21°C) in July. Average monthly minimum and maximum temperatures at Ibapah range from 9°F (-13°C) in January to 91°F (33°C) in July, and extremes range from -39°F (-39°C) to 106°F (41°C).

The length of the growing season is of particular importance in agricultural practice and is defined as the number of days between the last killing frost in the spring and the first killing frost in the fall. Because the definition of killing frost differs with the type of crop, the U. S. Weather Bureau publishes freeze data that include the number of days between the last spring minimum and the first fall minimum temperatures of 32°F (0°C), 28°F (-2°C), and 24°F (-4°C). A summary of these data for the period 1950-66 is shown in table 3 for three stations in and near the Deep Creek valley drainage basin. The growing season in Deep Creek valley is considerably shorter than in adjacent valleys to the north and east. Crops experiencing a killing frost of 28°F (-2°C) have an average growing season of 95 days. However, because the Ibapah station is on the floor of the valley, where the cold air settles, it may be inferred that the growing season on adjacent slopes is somewhat longer.

Table 3.--Number of days between the last spring minimum and the first fall minimum temperature at three stations in and near the Deep Creek valley drainage basin, 1950-66

(Data from U.S. Weather Bureau (1951-66); U.S. Environmental Science Service Administration, (1967). Year of occurrence given in parentheses.)

	Ibapah	Partoun	Wendover
Number of days between the last spring and the first fall temperatures of:			
32°F (0°C) or below			
Average	66	123	183
Maximum	115 (1955)	193 (1952)	204 (1957)
Minimum	9 (1956)	85 (1962)	133 (1965)
28°F (-2°C)			
Average	95	150	220
Maximum	130 (1955)	207 (1952)	242 (1962)
Minimum	63 (1960)	112 (1962)	202 (1956)
24°F (-4°C) or below			
Average	128	166	237
Maximum	176 (1963)	220 (1952)	260 (1962)
Minimum	95 (1950)	131 (1959, 1965)	216 (1950)

The quantity of water that is evaporated from the Deep Creek valley drainage basin under natural conditions cannot be estimated accurately from the available records. Of greater importance to this hydrologic reconnaissance is an estimate of the potential evapotranspiration. This estimate, based on the essentially continuous long-term record of temperatures at Ibapah, is given in the section on potential evapotranspiration.

GEOLOGY

The Deep Creek valley drainage basin is a structural basin of the basin and range type. It was formed by the deformation of consolidated Tertiary and older rocks and is partly filled with unconsolidated or semiconsolidated rocks of Tertiary and Quaternary age. The unconsolidated deposits form the main ground-water reservoir in the valley.

Rocks ranging in age from Precambrian to Permian and from early Tertiary to Holocene (Recent) are exposed or have been penetrated by wells in the basin. The pre-Tertiary rocks consist of consolidated metasedimentary and sedimentary rocks. The consolidated rocks of Tertiary age include both igneous and sedimentary rocks, including appreciable quantities of pyroclastics. The detritus that forms the unconsolidated rocks was derived from the older rocks as the result of weathering processes, including glaciation of the high mountain areas during the Pleistocene Epoch.

The geology shown on plate 1 is based on existing maps, on photogeology, and on a small amount of field checking. The geology in Utah is based on work by Stokes (1964). The geology in the western and northern parts of the drainage basin in Nevada was mapped by photogeologic methods, and the geology in the southern part of the area in Nevada is simplified after sources reported by the Intermountain Association of Petroleum Geologists-Eastern Nevada Geological Society (1960).

For the purpose of this report, geologic units having similar water-bearing characteristics were mapped as single units in order to emphasize the relation of geology to hydrology. Plate 1 shows the distribution of the major rock units and table 4 gives a general description of their lithology and water-bearing characteristics.

WATER RESOURCES

Volume of precipitation

All water in Deep Creek valley is derived from precipitation within the drainage basin. The average annual precipitation ranges from 8 to 30 inches (see "Climate"), and the distribution is shown on the isohyetal map in figure 2.

The volume of precipitation on the valley was estimated from figure 2. The area between each pair of isohyetal lines within the drainage basin was measured with a planimeter, and the area obtained was multiplied by the average or weighted average of the values for the two

Table 4.--Lithology and water-bearing characteristics of rocks in the Deep Creek valley drainage basin

[See pl. 1 for locations of units described]

Age	Lithologic unit	Character of material	Water-bearing properties
Pleistocene(?) and Holocene	Alluvium	Mainly clay and silt, but includes some sand and coarser deposits. Channel fill confined mainly to bottom of Deep Creek valley and mouths of largest tributaries.	Generally low in permeability. Most of these deposits are saturated at or near the land surface and capillary rise conveys ground water to the land surface where the water is discharged by evapotranspiration.
Pleistocene	Glacial outwash	Fine- to coarse-grained deposits in small patches in highest parts of Deep Creek Mountains (not shown on pl. 1) and in about 6 square miles at the foot of the mountains south of the Tooele-Juab County line.	Permeability probably is high in part of the deposits. Outwash at base of mountains is an important recharge area because of the coarseness of some of the deposits and the availability of recharge from perennial streams.
	Alluvium and colluvium	Alluvial fans and aprons along the bases of the high mountain ranges. Coarse-grained gravel and sand interbedded with some silt or clay; sorting near heads of fans is poor but increases downslope and grain size decreases. May underlie young channel fill in the valley. On gentler slopes and in stream valleys on west side of drainage basin deposits are fine to coarse grained. Old channel fill in some tributaries contains interbeds of silt similar to loess which is being dissected.	Coarse-grained deposits in upper slopes of alluvial fans and aprons are the main recharge area for ground water in Deep Creek valley, and have moderate to high permeability. Deposits in lower slopes and probable equivalents that underlie the valley have moderate permeability. Silt similar to loess in tributary channels has low permeability and inhibits recharge along those channels. This unit, together with part of the channel fill in the main valley and probably the youngest part of the sedimentary rocks of Tertiary age, is the main water-bearing formation in Deep Creek valley.
Eocene(?) to Pliocene(?)	Consolidated and semi-consolidated sedimentary rocks and interbedded pyroclastics	Basal red conglomerate, White Sage Formation of Eocene age, claystone, siltstone, sandstone, conglomerate, shale, limestone, and tuff. Contains abundant pyroclastic interbeds in middle part, of Miocene and Pliocene(?) age. Intercalated with extrusive igneous rocks (Tv on pl. 1). Section is structurally distorted and degree of distortion increases downward in section.	Generally low in permeability, but uppermost part of section estimated to be moderate in permeability. Uppermost part is dry on west side of drainage basin but may be part of the section that yields water to wells in Deep Creek valley.
Oligocene to Pliocene(?)	Extrusive igneous rocks and associated pyroclastics	Includes rocks of rhyolitic, andesitic, and basaltic(?) composition. Includes small areas of associated intrusive rocks. In the subsurface, part of these rocks intercalated with sedimentary rocks of Tertiary age (Tu on pl. 1).	Generally low in permeability. Some "lava" locally may have moderate to high permeability. See log of well 26/70-20cl. These rocks are the source of some springs and where saturated probably would yield water to wells.
Late Eocene(?) or Oligocene(?)	Intrusive igneous rocks	Massive intrusion of granitoid rock that now forms the highest peaks in the southern Deep Creek Mountains.	Low in permeability except along joints and fault zones. Inhibits ground-water recharge and therefore enhances runoff from an area where precipitation is greatest in Deep Creek valley drainage basin.
Middle Cambrian to Permian	Consolidated sedimentary and metasedimentary rocks	Siltstone, shale, sandstone, conglomerate, limestone, dolomite, and quartzite.	Bulk permeability is low, but absorbs and transmits some ground-water recharge to valley because of secondary permeability. Repeated fracturing by faulting and folding of the sedimentary section has developed secondary openings which in the carbonate rocks have been enlarged to cavernous zones by solution. Evidence of solution is seen in such locations as the large spring, (C-11-19)19caa-S1, and the oil test, 26/70-20cl. In the oil test permeability at depth in the carbonate rocks is evident from the recovery of reportedly fresh water from drill-stem tests.
Precambrian and Early Cambrian	Consolidated sedimentary and metasedimentary rocks	Mainly argillite and quartzite, includes some sandstone and shale. Lies adjacent to intrusive granitoid rocks. Quartzites are extensively jointed in some locations.	Low in permeability, except along joints and fault zones. Inhibits ground-water recharge and enhances runoff from area of high precipitation.

bounding lines. Averages were weighted downward where the shape of the land surface causes a nonuniform distribution of precipitation. The following summary gives the estimated quantities of precipitation for the various intervals.

Isohyetal interval (inches)	Area (acres)	Volume of precipitation (acre-feet)
Less than 8	200	100
8-12	161,000	134,000
12-16	80,200	89,700
16-20	23,400	33,900
20-25	10,700	19,800
25-30	4,000	9,000
More than 30	1,200	3,100
Totals (rounded)	281,000	290,000

Much of the basin receives small quantities of precipitation, and therefore nearly half of the precipitation does little more than sustain soil moisture in the lowlands. A more detailed analysis of the precipitation distribution is given in the discussion on estimating average annual recharge.

Surface water

General conditions

A part of the precipitation that falls on the mountains of the Deep Creek valley drainage basin runs off as streamflow. On the upper slopes of the valley, much streamflow is lost by infiltration and by evapotranspiration in areas of native and cultivated vegetation. Part of the runoff reaches Deep and Spring Creeks in the valley, where most of the water is diverted for the irrigation of farm and pasture lands. A small amount of surface water intermittently flows out of the valley in Deep Creek.

Most runoff in the drainage basin results from two sources—snowmelt during late winter, spring, and early summer and summer thunderstorms. The melting of snow in the valley produces runoff in Deep Creek during February, March, or April of most years. (See crest-stage gage record in fig. 5.) Snowmelt in the mountains begins generally about the middle of May, and high runoff continues into July. (See records for Sam's, Steve's, and Fifteenmile Creeks in fig. 5.) Floodflow from thunderstorms may occur during the period July-October.

The perennial streams in the Deep Creek valley drainage basin are Deep, Spring, Sam's, Steve's, and Fifteenmile Creeks. Water in these streams is derived directly or indirectly from precipitation mainly at high altitudes; and together with the intermittent flow in other mountain streams, water in the perennial streams constitutes the principal source of surface water for irrigation and ground-water recharge to the valley. Spring Creek is directly sustained by the

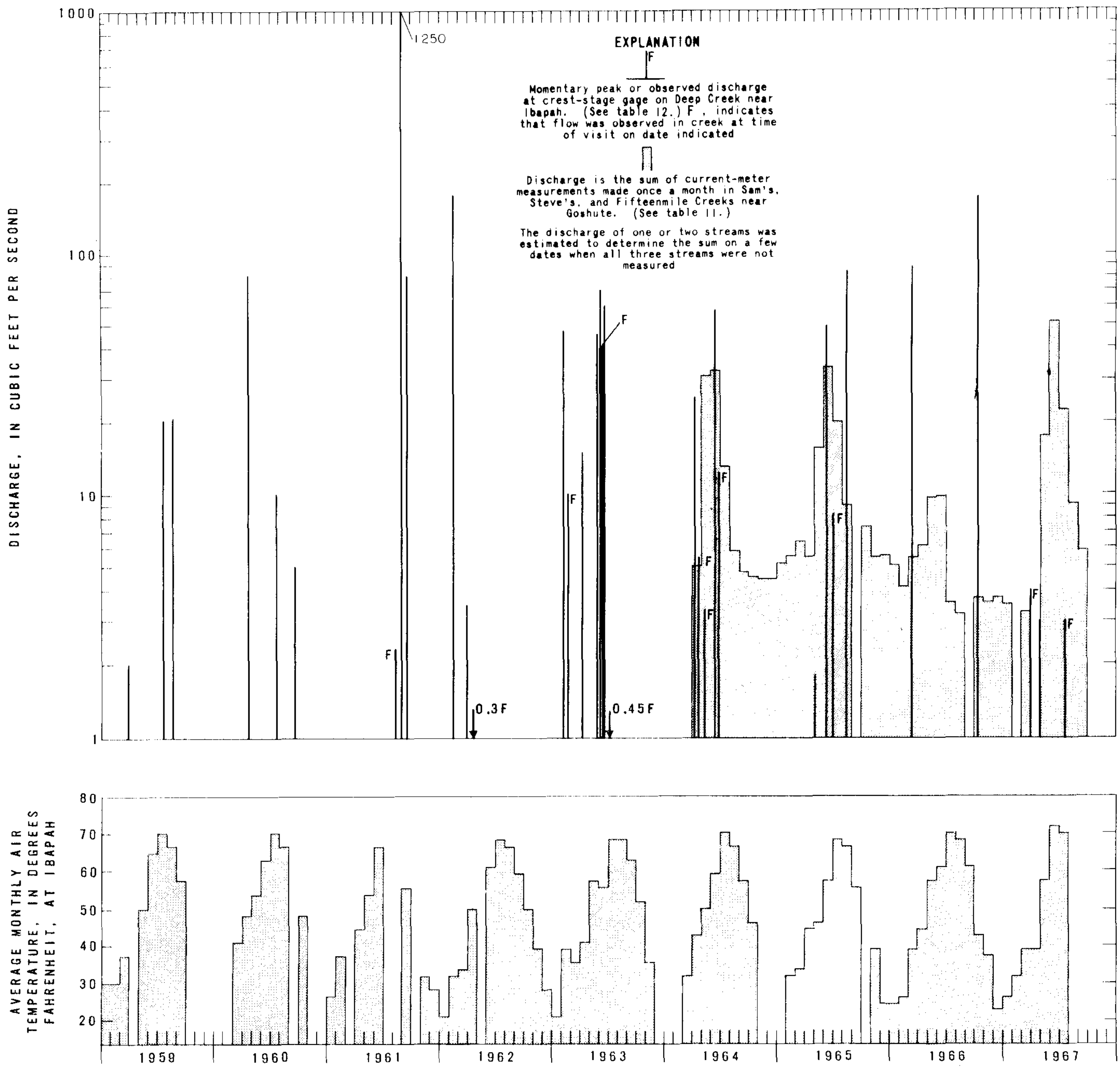


Figure 5.—Discharge of Deep Creek at crest-stage gage 10-1728.95 Deep Creek near Ibapah, the sum of the discharges of Sam's, Steve's, and Fifteenmile Creeks near Goshute, and the monthly average air temperature at Ibapah.

discharge of a large spring, (C-11-19)19caa-S1, at the south end of the valley; and the flow of Deep Creek at Ibapah is augmented by the discharge of numerous springs in the valley. (See pl. 1.) Sam's, Steve's, and Fifteenmile Creeks all head in the highest parts of the Deep Creek Mountains and are tributary to Deep Creek.

Available records of flow

Sites at which data for flow of surface water have been obtained in the Deep Creek valley drainage basin are shown in figure 1 and are described in table 10. These sites include gaging station 10-1728.93, Deep Creek near Goshute, where a daily record of streamflow has been obtained since the gage was installed in April 1964 (table 5); four sites where flows are measured at intervals of about 1 month (table 11); two crest-stage gages north of Deep Creek valley, where momentary peak gage heights are measured (table 12); and seven other sites, where miscellaneous measurements and estimates were made (table 10).

Table 5.—Summary of mean monthly and mean annual streamflow and annual runoff at gaging station 10-1728.93 Deep Creek near Goshute, 1964-67 (See U. S. Geological Survey, 1964-67)

Location: Lat 39°53'00", long 113°59'50", in SW¼NW¼ sec. 9, T. 11 S., R. 19 W., on left bank 60 ft upstream from masonry diversion structure, three-quarters of a mile north of Goshute, 1.4 miles south of Goshute Indian Reservation boundary, and 10½ miles south of Ibapah.

Drainage area: 43 sq mi, approximately.

Records available: April 1964 to September 1967.

Gage: Water-stage recorder. Altitude of gage is 6,100 ft (from topographic map).

Extremes: Maximum discharge, 32 cfs June 21, 1967 (gage height, 2.52 ft).

Remarks: Records good. Results of discharge measurements, in cubic feet per second, made above diversions on three perennial tributary streams upstream from station, and on ditch carrying return flow from Steve's Creek and Sam's Creek, entering 50 ft below station, are in table 11.

Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Mean annual streamflow (cfs)	Annual runoff (acre-feet)
1964	-	-	-	-	-	-	0.55	4.70	11.3	2.33	0.75	0.5	-	-
1965	0.25	0.11	0.21	1.26	0.14	0.01	.05	3.47	12.4	4.08	3.31	2.65	2.33	1,680
1966	2.04	1.86	1.21	.36	.99	1.25	1.33	2.78	.26	0	0	0	1.01	729
1967	0	0	0	0	0	0	0	.74	13.5	5.08	2.27	1.67	1.94	1,400
Average	.76	.66	.47	.54	.38	.42	.48	2.92	9.36	2.87	1.58	1.20	1.8	1,300

Records from the gaging station 10-1728.93 and from the four sites on the streams and ditch tributary to Deep Creek are generally indicative of the quantity of streamflow in the vicinity of Goshute, although flows at the gaging station are affected by upstream diversions.

The crest-stage gages on Deep and Bar Creeks are located so that when flow is recorded at both sites, precipitation is known to have occurred in the northeastern part of Deep Creek valley. When flow is recorded only at the Deep Creek crest-stage gage, the precipitation that caused it is known to have occurred at some point in Deep Creek valley other than the northeastern part.

Runoff

The amount of surface-water runoff that reaches Deep Creek valley from the adjacent uplands cannot be computed directly, because adequate records are not available. An estimate of the average annual runoff in the Utah part of the drainage basin was made from the isogram worksheets described by Bagley, Jeppson, and Milligan (1964, p. 54-56). For the purpose of this study, the runoff in the Nevada part of the drainage basin was estimated by extrapolating isolines of mean annual runoff from the Utah part into Nevada. The extrapolation was based mainly on altitude zones, but it was generally adjusted to account for the effects of the shape and orientation of the mountains on distribution of precipitation.

The estimated average annual runoff from the uplands is 28,000 acre-feet of water (table 6); about 22,000 acre-feet runs off uplands in Utah, and about 6,000 acre-feet runs off uplands in Nevada. About 17,000 of the estimated 28,000 acre-feet of upland runoff infiltrates the ground (see section on recharge) and 11,000 acre-feet flows to the valley as surface water. About half of this surface water reaches the valley in Sam's, Steve's, and Fifteenmile Creeks, and the other half reaches the valley as snowmelt in intermittent streams and as flow in ephemeral streams after thunderstorms.

Table 6.—Estimated average annual runoff from the uplands of the Deep Creek valley drainage basin

Interval between lines of equal runoff (inches)	Runoff (inches)	Area (acres)	Total runoff (acre-feet) (rounded)
1-2	1.5	13,850	1,700
2-4	3	9,190	2,300
4-8	6	19,160	9,600
8-12	10	10,750	9,000
More than 12	13	5,470	5,900
Total (rounded)		58,000	28,000

Outflow from the valley

The estimated average annual surface-water outflow from Deep Creek valley is about 2,000 acre-feet; about 1,000 acre-feet is upland runoff and 1,000 acre-feet is spring discharge, principally along the main channel of Deep Creek. This 2,000 acre-feet represents about 0.7 percent of the annual precipitation on the drainage basin.

Most streamflow is consumed in Deep Creek valley; but after thunderstorms, during periods of peak snowmelt, and during some winters, water flows out of the valley and northward to the Great Salt Lake Desert. Thunderstorms produce large ephemeral flows of a few hours duration; about 1,250 cfs (cubic feet per second) of water flowed past the crest-stage gage on Deep Creek as a result of a thunderstorm in August 1961. Melting snow and ice in the valley also cause a few large peak flows, but the flow is of slightly greater duration than flow from thunderstorms. Average winter outflow generally is on the order of 1 cfs but may be of several months duration in wet years.

Ground water

Source

Ground water in Deep Creek valley is derived entirely from precipitation that falls on the drainage basin, mostly on lands above 6,500 feet. Some of this water is lost directly by evapotranspiration, some infiltrates the consolidated rocks, and some collects in streams that discharge onto the adjacent permeable alluvial aprons. Of the water that infiltrates the rocks, much is lost by evapotranspiration after infiltration and a part eventually reaches the ground-water reservoir in the valley.

Only a small part of the precipitation that falls on lands below 6,500 feet reaches the ground-water reservoir, because the amount of precipitation is generally small and much of the water that infiltrates the soil is held in the soil and subsequently discharged by evapotranspiration. Precipitation on lands below 6,500 feet does recharge the ground-water reservoir when water from intense local storms falls on coarse-grained alluvium (Qag and Qgo on pl. 1), but recharge is least or nonexistent when water falls on fine-grained deposits (Qal and Tu on pl. 1).

Estimated average annual recharge

The annual ground-water recharge to Deep Creek valley was estimated by using a method described by Hood and Waddell (1968, p. 22). This method assumes that a fixed percentage of the average annual precipitation on the drainage basin enters the ground-water reservoir in the valley, and relates the quantity of recharge to the sum of quantities of water originating from precipitation in several isohyetal intervals. The amounts of precipitation were obtained for the isohyetal intervals shown in figure 2 by means of a planimeter, and the percentage of recharge

from each of the isohyetal intervals was estimated on the basis of variations in geology and topography. Recharge percentage values are smallest where small quantities of precipitation fell on unconsolidated or semiconsolidated rocks with gentle slopes. Recharge percentages are greater in areas of moderate to high altitude—6,500-9,000 feet—where much of the Deep Creek Mountains is underlain by consolidated sedimentary rocks. The steep surface of these rocks rapidly delivers surface water to the permeable alluvial aprons at the edge of the valley. These rocks, moreover, may absorb a part of the precipitation which then percolates downdip through fractures and solution openings in the rocks and directly recharges the ground-water reservoir in Deep Creek valley. The largest recharge percentages are assigned to the highest parts of the Deep Creek Mountains--9,000-12,000 feet—where precipitation is greatest, the slope of the land surface is greatest, the soils are thin or missing, and the underlying rock is essentially impermeable. This area delivers surface water to recharge areas at the edge of the valley with the least initial loss.

The estimated average annual recharge to Deep Creek valley (table 7) is 17,000 acre-feet, or about 6 percent of the estimated 290,000 acre-feet of average annual precipitation on the drainage basin.

Table 7.—Estimated volumes of precipitation and ground-water recharge in the Deep Creek valley drainage basin

(Areas of precipitation zones measured from geologic and isohyetal maps, pl. 1 and fig. 2. Estimates of average annual precipitation are weighted for steeply sloping mountain areas.)

Precipitation zone (inches)	Area (acres)	Estimated annual precipitation		Estimated annual recharge	
		Feet	Acre-feet	Percentage of precipitation	Acre-feet
		Areas of Quaternary and Tertiary rocks			
8-12	131,000	0.83	109,000	0	0
12-16	55,900	1.13	63,000	3	1,900
16-20	2,000	1.46	2,900	8	200
20-25	1,000	1.83	1,800	12	200
Subtotal (rounded)	190,000		177,000		2,300
		Areas of Precambrian and Paleozoic consolidated rocks			
Less than 8	200	0.63	130	1	0
8-12	29,800	.83	25,000	2	500
12-13[1]	3,600	1.04	3,700	5	200
12-16	20,700	1.13	23,000	10	2,300
16-20	21,400	1.46	31,000	15	4,700
20-25	9,700	1.83	18,000	20	3,600
25-30	4,000	2.25	9,000	25	2,200
More than 30	1,200	2.61	3,100	30	900
Subtotal (rounded)	91,000		113,000		14,400
Total	281,000		290,000		17,000

[1] Estimated range of precipitation for northwestern part of drainage basin inside 12-16-inch isohyetal interval.

Occurrence and movement

Most of the ground water in Deep Creek valley is under artesian (confined) conditions. Drillers' logs of wells in the valley indicate that the permeable, water-bearing beds are intercalated with thick beds of clay (table 14). Thus, in most wells the water level is above the top of the permeable bed in which the water is found. Most wells in the valley are, therefore, artesian; but only three wells in the valley were known to flow in 1967. (See pl. 1 and table 13.) A few wells tap water under water-table (unconfined) conditions. Such conditions probably are prevalent beneath the alluvial fans adjacent to the valley, but the extent of water-table conditions is not known.

Artesian conditions in the valley are also indicated by the occurrence of springs which yield water that is warmer than the average annual air temperature. Water from Chadman Spring, (C-9-19)13cbc-S1, along the edge of the valley, and water from spring (C-9-19)33adc-S1 in the valley bottom have temperatures of 53° and 58°F (12° and 14°C), respectively, well above the average annual air temperatures of 46°F (8°C) at Ibapah. The relatively high temperature of the spring water indicates that the water probably is discharged from water-bearing beds several hundred feet below the land surface. Similar temperatures of water from shallow wells near the springs may indicate that a part of the well water is upward leakage from deep sources.

A reliable contour map of the ground-water surface in Deep Creek valley cannot be constructed because of the scarcity of well data away from the axis of the valley. Altitudes of the water surface in the wells indicate that the ground-water surface slopes generally northward in the same direction as the valley floor. In general, the ground water moves from the edges of the valley toward the axis and thence northward. The gradient of the ground-water surface along the axis of the valley is about 100 feet per mile, from the south end of the valley to the vicinity of Ibapah. The gradient of the ground-water surface is about 20 feet per mile from Ibapah to the north end of the valley. Although the gentler gradient in the northern part of the valley may be partly related to a thicker aquifer, the available data indicate that the gradient of the ground-water surface north of Ibapah is related to continuous ground-water discharge along the axis of the valley by evapotranspiration and springs.

Ground water in the consolidated rocks in the adjacent mountains can be inferred to move toward the valley because many of the consolidated rocks dip into the valley and because several springs discharge from bedrock. For example, spring (C-11-19)19caa-S1 issues from limestone and sustains the base flow of Spring Creek.

Information on water in the rocks beneath the valley is available only from the Gulf Refining Co. oil test 26/70-2cl. The water level in consolidated carbonate rocks encountered in this test is inferred from drill-stem test data to be about 800 feet below the land surface. The inferred altitude of that water level is 4,700 feet, which is below that of water levels in wells in the valley; but it is above the water level in well (C-7-19)9acc-1 and above the altitude of the floor of the Great Salt Lake Desert, both north of Deep Creek valley. Because there is no other potential discharge area for the deep-seated water in the consolidated rocks in Deep Creek valley, water that passes through the consolidated rocks moves to the area of the Great Salt Lake Desert. The amount of water moving in the rocks probably is small.

Storage

The subsurface geologic conditions within the Deep Creek valley drainage basin are not well enough known to provide an estimate of ground-water storage in the entire valley. An estimate was made for the valley flat and the immediately adjacent area, however, based on conditions inferred from water-level fluctuations and well logs.

Under natural conditions a ground-water system is in dynamic equilibrium; long-term average annual recharge and discharge are equal, and the amount of ground water in transient storage remains nearly constant. Withdrawal of water from wells in Deep Creek valley has not appreciably altered the natural balance. Comparison of water-level changes in observation wells with annual precipitation (fig. 6) shows that the ground-water levels generally follow precipitation changes.

Recoverable water in storage in the unconsolidated rocks is that part of the stored water that will drain by gravity from the ground-water reservoir as water levels are lowered and that water released when artesian head is lowered. In a water-table aquifer, the quantity of recoverable water is computed as the product of the specific yield of the ground-water reservoir, the saturated thickness, and the area.

Beds of permeable material in the unconsolidated rocks beneath Deep Creek valley have estimated specific yields of 20-30 percent, but the permeable beds are intercalated with thick beds of clay and amount to only about 20 percent of the saturated section. Because the clays are partly sandy and all the clay will yield some water by compaction, the maximum specific yield is estimated to be 10 percent for the entire saturated section. The valley flat and immediately adjacent areas of unconsolidated materials total about 50 square miles, or 32,000 acres. If 100 feet of saturated deposits in this area were dewatered, the estimated volume of water that would be recovered would be:

$$32{,}000 \times 0.1 \times 100 = 320{,}000 \text{ acre-feet}$$

or nearly 20 times the estimated average annual ground-water recharge. The storage figure of 320,000 acre-feet may be greater or smaller than the actual amount, because the ground-water reservoir may be more or less extensive than estimated.

Discharge

Ground water is known to discharge in Deep Creek valley by evapotranspiration, by pumpage from wells, and by outflow of unused spring discharge.

Evapotranspiration

Evapotranspiration in Deep Creek valley includes transpiration of water by both native and cultivated plants, evaporation from open bodies of water, and evaporation of water from the soil.

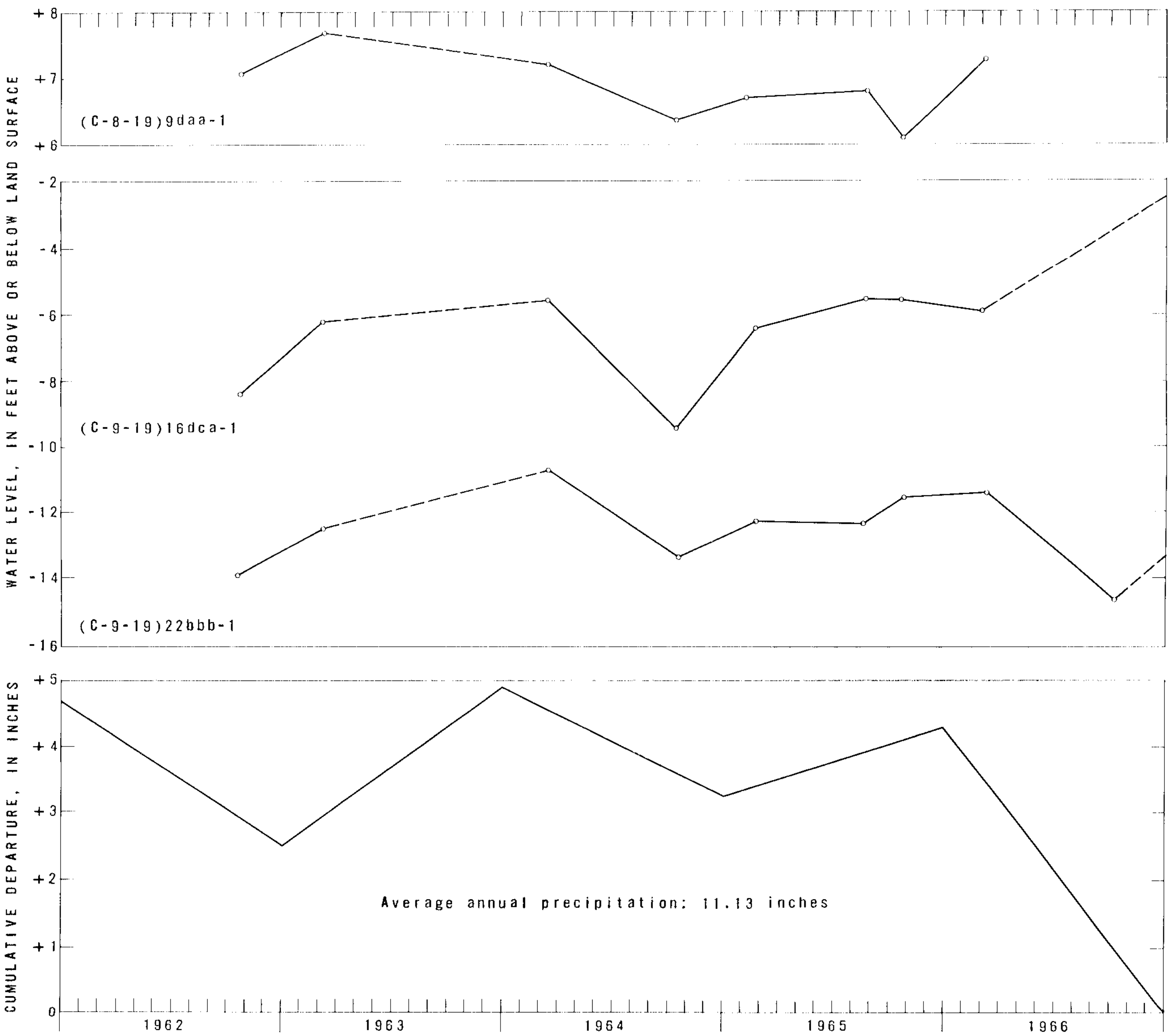


Figure 6.—Hydrographs of water levels in observation wells in Deep Creek valley and the cumulative departure from the 1903-66 average annual precipitation at Ibapah, 1962-66.

Potential evapotranspiration.—The actual rate of transpiration by native and cultivated plants and evaporation from soils in Deep Creek valley is limited by the quantity of water available. The potential evapotranspiration (PE) in the valley is a measure of the quantity of water that would be used if water were continuously available and is a function of several natural factors.

Cruff and Thompson (1967, p. M15-16, M26-27), in comparing six methods for estimating potential evapotranspiration, found that the most practical of the methods was the Blaney-Criddle method because it produced reasonable results from readily available climatological data. The method is expressed by the following equation:

$$PE = K \times \frac{T \times p}{100}$$

where K is an empirical comsumptive-use coefficient, which Cruff and Thompson indicate is about 0.85 for the year for arid areas similar to Deep Creek valley; T is the mean monthly temperature, and p is the monthly percentage of total daytime hours in the year. The monthly percentage of daytime hours may be obtained from Criddle, Harris, and Willardson (1962, p. 38).

Computation using temperature data for Ibapah indicates that the potential annual evapotranspiration is on the order of 40 inches, or nearly four times the average annual precipitation at Ibapah.

Estimated evapotranspiration.—The general area in Deep Creek valley in which significant quantities of ground water are discharged by evapotranspiration is shown on plate 1. The area is subdivided into two parts, the bottom land and the lower slopes of the valley immediately adjacent to the bottom land, including the lower slope of the alluvial apron along the Deep Creek Mountains. Within the general area, an estimated 15,000 acre-feet of ground water is discharged from about 20,000 acres (table 8). The actual evapotranspiration, therefore, is about 90 percent of the estimated ground-water recharge and averages about 20 percent of the estimated potential evapotranspiration.

Ground-water discharge by evapotranspiration is greatest in the bottom land, or valley flat along Deep and lower Spring Creeks. An estimated 12,000 acre-feet of ground water is discharged where the depth to water is from 0 to 5 feet and where spring water supplements the streamflow that is diverted for the irrigation of crop and pasture lands. The total rate of water discharge in parts of the bottom lands approaches the estimated potential evapotranspiration of about 40 inches per year and locally may exceed that figure.

Within the bottom land, native and irrigated meadows are watered by ground-water subirrigation. In addition to meadowgrasses and other crops, ground water is transpired by native phreatophytes including rabbitbrush (*Chrysothamnus nauseousus*), greasewood (*Sarcobatus vermiculatus*), localized dense stands of willow (*Salix* sp.), and a few groves of trees at ranches and farmsteads.

Evaporation in the bottom land includes evaporation from the soil where the water table is very shallow and from three small reservoirs, all of which store flow from springs. One

reservoir, on the Goshute Indian Reservation southwest of Ibapah, stores water diverted from Spring Creek, but it is often dry. The other two reservoirs are north of Ibapah and are shallow areas that are extremely wet or flooded during a part of the year. Evaporation from the valley is greatest in these wet areas and in irrigated fields.

An estimated 3,000 acre-feet of ground water is discharged by phreatophytes in the area of sloping land adjacent to the bottom land. The phreatophytes are greasewood and rabbitbrush. Greasewood is relatively widespread where the depth to water does not exceed about 50 feet. Some vigorous, large plants grow in moderate to dense stands adjacent to the bottom land, but most greasewood cover is moderate to sparse depending on the depth to water and soil conditions. Rabbitbrush is generally restricted to small areas of dense growth where the depth to water is less than about 20 feet.

Table 8.—Estimated average annual ground-water discharge by evapotranspiration in Deep Creek valley

Terrain and phreatophytes	Area (acres)	Depth to water (feet)	Average annual evapotranspiration	
			Acre-feet per acre	Acre-feet (rounded)
Valley bottom land. Wet meadows irrigated with flow from springs, areas of meadowgrass, patches of willow, small areas of dense mixed phreatophytes other than meadowgrass, storage ponds, and other areas of standing water	5,860	0-5	2	12,000
Slopes adjacent to bottom land and lower slope of alluvial apron along Deep Creek Mountains. Mainly greasewood with local concentrations of rabbitbrush. Greasewood is sparse in areas of deep water levels. Both greasewood and rabbitbrush are dense and vigorous in some areas adjacent to bottom land where water levels are shallow	13,800	5-50	.25	3,000
Totals (rounded)	20,000			15,000

Pumpage

Deep Creek valley contains 22 water wells in use (pl. 1). Only three wells are specifically intended for irrigation, whereas most are used for domestic and stock supplies and some are used incidentally for irrigation of small tracts. The three irrigation wells are south of Ibapah, and water from them is applied to lands totaling about 350 acres. The withdrawal of water from wells is estimated to be about 50 acre-feet per year for domestic and stock use and about 500 acre-feet for irrigation, or a rounded total of 600 acre-feet of water per year.

Outflow of unconsumed spring discharge

Water that flows from Deep Creek valley is a combination of runoff from surface sources and discharge from springs and seepage areas. A total of about 2,000 acre-feet of water flows from the valley, and about 1,000 acre-feet is estimated to be discharge from springs and seepage areas.

Ground-water budget

The average annual quantity of water recharged to and discharged from the ground-water reservoir in Deep Creek valley is estimated to be 17,000 acre-feet. The quantities involved in the ground-water budget are summarized in table 9. The indicated balance of recharge and discharge is only approximate, but it shows that the order of magnitude is correct.

Table 9.—Ground-water budget for Deep Creek valley

Item	Estimated quantity of water, in acre-feet per year
Recharge (table 7)	17,000
Discharge:	
Evapotranspiration (table 8)	15,000
Pumpage from wells (p. 24)	600
Outflow from springs and seepage areas (above)	1,000
Total (rounded)	17,000

Perennial yield

The perennial yield of a ground-water reservoir is the maximum amount of water of suitable quality that can be withdrawn economically each year for an indefinite period of years. The perennial yield cannot exceed the natural discharge; moreover, the yield will be limited to the amount of natural discharge that can economically be salvaged for beneficial use.

The maximum amount of ground water available for salvage in Deep Creek valley is the estimated evapotranspiration plus surface outflow from springs and seepage areas, which amounts to about 16,000 acre-feet. About 12,000 acre-feet of this water is now used for beneficial purposes. A part of the remaining 4,000 acre-feet of water might be salvaged by lowering water levels in the valley, but salvage of even this amount by pumping a planned network of wells would lower water levels and thereby affect supplies now being used beneficially in the valley bottom land. The existing water supply might be extended, however, by increasing the efficiency of water management.

Chemical quality of water

The concentration of dissolved solids in water in the Deep Creek valley drainage basin ranges from 38 to 562 mg/l (milligrams per liter) (tables 15 and 16). The principal chemical constituents in water from all but two sources are calcium and (or) magnesium, and bicarbonate. The water containing the lowest concentrations of dissolved solids is from perennial mountain streams in the southeastern part of the basin, and the water containing the highest concentration of dissolved solids is from well (C-9-19)9add-1, about 1½ miles north of Ibapah (pl. 1).

Mountains

The concentrations of dissolved solids in water from three streams in the Deep Creek Mountains are 38, 40, and 58 mg/l (table 15). The only mountain spring sampled was Cold Spring, (C-10-18)7bdc-S1, and on August 15, 1966, the water contained 229 mg/l of dissolved solids. The principal chemical constituents are calcium and bicarbonate in water from the streams and magnesium and bicarbonate in water from the spring. The low concentration of dissolved solids in water from the streams is typical of streams in western basins where the water is derived principally from high-altitude snowmelt.

Valley

The concentration of dissolved solids in ground water in the valley ranges from 118 to 562 mg/l (table 16). Water from two stream sites, Deep Creek and Middle Fork Deep Creek (see pl. 1), contained 397 and 281 mg/l of dissolved solids (table 15). The principal chemical constituents in water from all but two sources in the valley are calcium and (or) magnesium and bicarbonate.

The chemical composition of the ground water in the valley suggests that dolomitic rocks are the principal source of dissolved minerals in the water. In most of the water, the concentration of calcium (measured in equivalents per million) approximates that of magnesium, and the concentration of calcium plus magnesium approximates that of bicarbonate (fig. 7). These relations are true especially for water issuing from springs along the north-trending fault scarp in T. 9 S., R. 19 W. (pl. 1). The water from the springs along the fault is of uniform chemical composition.

Chemical quality of ground water in relation to sources of recharge

Comparison of the chemical composition of the ground water in Deep Creek valley with that of water from springs and streams issuing from the Deep Creek Mountains indicates that much of the ground water in the valley is derived from the perennial streams that head in the southern part of the basin. The concentration of dissolved solids in water issuing from springs along the western slopes of the Deep Creek Mountains ranges from 229 to 302 mg/l as compared to the range of 38 to 58 mg/l in water from Sam's, Steve's, and Fifteenmile Creeks in the

southeastern part of the basin. Several wells and a spring along Deep and Spring Creeks yield water containing less than 200 mg/l of dissolved solids; thus the more likely source of recharge would be the perennial streams rather than ground water that is moving westward from the Deep Creek Mountains.

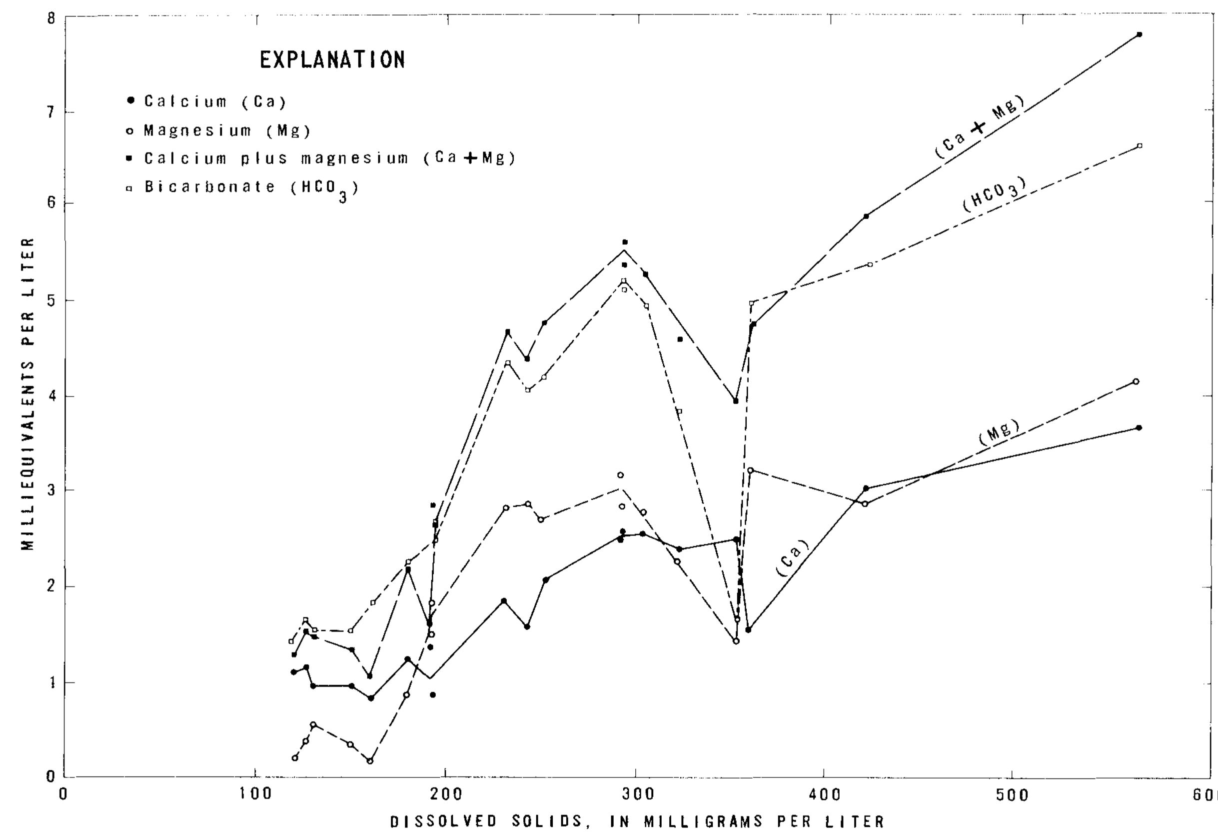


Figure 7.—Relation of concentrations of calcium, magnesium, and bicarbonate to concentration of dissolved solids in ground water in the Deep Creek valley drainage basin.

Domestic supplies

Most of the water supplies used for domestic purposes in Deep Creek valley is derived from wells or springs. Some surface water on the Goshute Indian Reservation in the southern part of the valley is used for domestic supply.

Much of the water in Deep Creek valley contains more than 180 mg/l of hardness as calcium carbonate ($CaCO_3$) and is classed as very hard by the U. S. Geological Survey.

The water from only one source exceeds 500 mg/l of dissolved solids, the maximum limit recommended by the U. S. Public Health Service (1962) for drinking-water standards. The concentrations of sulfate, chloride, fluoride, nitrate, and iron plus manganese were below the recommended maximum limits in samples from all sources.

Irrigation supplies

The suitability of water for irrigation depends primarily upon the concentration of dissolved solids, the relative proportions and concentration of some of the ions in solution, and the characteristics of the soil upon which the water is applied. In this report, the suitability of water for irrigation is judged by the classification developed by the U. S. Salinity Laboratory Staff (1954, p. 79-81). Water from all sources that were sampled in the drainage basin is generally suitable for irrigation.

All the water sampled in the drainage basin has a low-sodium hazard and most has either a low- or a medium-salinity hazard. Water from one well, (C-9-19)9add-1, had a high-salinity hazard.

The maximum amount of residual sodium carbonate present in water from any source was 0.75 epm (equivalents per million). According to the U. S. Salinity Laboratory Staff (1954, p. 81) water containing less than 1.25 epm probably is safe for use in irrigation.

Boron concentrations determined in water from all sampled sources were less than the suggested lower limit of tolerance of 0.33 mg/l for the most sensitive crops (U. S. Salinity Lab. Staff, 1954, p. 81).

LAND USE AND DEVELOPMENT

All but about 5,000 acres of the 281,000 acres in the Deep Creek valley drainage basin are native range used for grazing of livestock. According to maps of the U. S. Bureau of Land Management (1954, 1955, 1961, 1964), about 6 percent (17,000 acres) of the 281,000 acres is privately owned land; about 30 percent (about 85,000 acres) in the southern end of the drainage basin, is in the Goshute Indian Reservation; and the remaining 64 percent is partly public domain administered by the U. S. Bureau of Land Management and partly State-owned land.

Of the privately owned land, nearly 60 percent is in or adjacent to the valley bottom land of Deep and Spring Creeks and an additional 10-15 percent is on adjacent slopes. Only about 3 percent of the privately owned land is in Nevada and is in the bottom land of Spring Creek. About one-third of the Goshute Indian Reservation is in Utah, and the Utah part of the reservation surrounds small areas of privately owned land amounting to about 3,100 acres.

Past and present development

Settlement of Deep Creek valley by white men began about 1860 when the Pony Express route was established. A station was opened north of the present site of Ibapah, and by 1866 there was considerable travel along the Overland Stage route (Nolan, 1935, p. 3). Diversion of streamflow in the area undoubtedly began with the first full-time residents because the remoteness of the area made garden tracts and fodder production for through animal traffic a practical necessity. Emmons (1877, p. 474), during the period 1867-73, noted that considerable agricultural land had been occupied by Mormon settlers in the valley.

An organized irrigation system began in 1929 with the formation of the West Deep Creek Irrigation and Power Co. This distribution company delivered water to 1,100 acres of land, according to Richards, Davis, and Griffin (no date).

In 1963, the Utah State Engineer made a hydrographic survey of the valley preparatory to an adjudication of water rights. The maps prepared show that nearly 4,200 acres of land was irrigated by water from streams, springs, and wells in the Deep Creek valley drainage basin. This total includes an estimated minimum of 370 acres in the bottom land of Spring Creek in Nevada. About 100 additional acres was at the edge of the Great Salt Lake Desert northeast of Deep Creek valley; and nearly 700 acres had formerly been irrigated, but in 1963 was "dry" or fallow and no longer was provided with water. Based on the hydrographic survey maps, the following uses are indicated for irrigated land:

Crop or land status	Acres
Pasture, both grass and "brush"	1,990
Hay fields (mainly timothy, *Phleum pratense*)	1,410
Alfalfa (*Medicago sativa*)	230
Small grains and other crops	90
Fallow (plowed)	60
Estimated area of irrigated land in Nevada, type of crop not determined (probable minimum)	370
Subtotal	4,150
Formerly irrigated land now without water supply	690
Land irrigated outside of basin with water from Deep Creek	100
Total (rounded)	5,000

Nearly 600 acres of the total 5,000 acres indicated in the table is above the valley bottom land and in some years is irrigated by surface water alone or by wells and surface water. More than half of the 600 acres was not in use in 1963.

The Goshute Indian Reservation in the southern part of the valley consists mainly of grazing lands, but includes about 1,200 acres that has been irrigated from Deep and Spring Creeks. In 1963, the quantity of tilled land around the village of Goshute was small and in 1966-67 still appeared to be small. Most of the actively irrigated land in the reservation is probably along Spring Creek from about the center of T. 24 N., R. 70 E., in Nevada northeastward to the reservation boundary at the north edge of T. 24 N. A substantial part of the flow of Deep and Spring Creeks reportedly is diverted to lands on the reservation during each year.

Potential development

The amount of agricultural development in Deep Creek valley appears to be definitely limited. The amount of water available is limited and much of the land is steeply sloping or otherwise uneven. Soil conditions were not studied during this reconnaissance, but they might further restrict the area considered suitable for farming.

Supplies of water from streams and springs appear to be fully appropriated. Future additional development, thus would depend on water from wells. The bottom land and the adjacent potentially irrigable areas are estimated to amount to about 20,000 acres. If the total land irrigated were only one-half of this amount, the quantity of water needed annually would amount to about 30,000 acre-feet, at a rate of 3 acre-feet per acre, including crop requirements and conveyance and other losses. The withdrawal of enough water from wells to compensate for the difference between the available supplies from streams and springs (an estimated 20,000 acre-feet or less) and 30,000 acre-feet of water would result in the removal of ground water from storage and a consequent lowering of water levels in the valley.

Lowering of water levels in the valley would partly dry up existing subirrigated meadows and probably would diminish the flow of springs and streams in the bottom land. Thus, the existing hydrologic regimen would be altered. As noted in the section on perennial yield, somewhat less than 4,000 acre-feet of additional water might be withdrawn from wells and thus salvaged from loss by evapotranspiration with minimum adverse effect on the existing supplies if the spacing of wells was carefully planned.

PROPOSALS FOR ADDITIONAL STUDIES

Because landownership and development appear to be stable, a detailed appraisal of the water resources of the Deep Creek valley drainage basin does not appear to be needed immediately. When a detailed study is needed, it will require several specific kinds of work including:

1. Detailed geologic mapping is needed along the western border of the drainage basin and in the areas of rocks of Tertiary and Quaternary age in the valley. Studies should include not only distribution and structure of the rocks, but tests of the rocks should be made to determine hydrologic properties. Test holes need to be drilled in the valley to aid in geologic interpretations and to provide hydrologic data where no existing source of information is available.

2. Streamflow in 1967 was the most important source of water in the valley, and further study of that source of water is needed. Recording gages should be installed (1) at the north end of Deep Creek valley, either at the entrance or within the gorge that leads out of the valley, and (2) on Deep Creek in Johnson Canyon above all diversions, in order to measure the intermittent flow from the southern mountain area, and (3) on Spring Creek above all diversions, in order to measure the magnitude and fluctuation of spring discharge that sustains the creek. Partial-record stations are needed on major intermittent streams to aid in the evaluation of ephemeral runoff. Sets of miscellaneous measurements need to be made during the snowmelt period and during summer and fall low-water periods on the perennial and intermittent streams to determine streamflow losses across the alluvial fans.

3. A detailed inventory of ground-water sources is needed, particularly in the upland areas. An inventory of springs in the mountains and in the valley, including chemical analyses of the water, is of particular importance. Wells should be tested to determine aquifer coefficients.

4. The diversion and delivery of water in the existing water distribution system should be analyzed in order to provide part of the data needed for a firm water budget.

5. Supplemental data needed for a detailed study of the hydrology including recording precipitation gages and thermographs at locations in the northern and western parts of the valley and precipitation storage gages in the high mountains and on the remote western border.

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APPENDIX

WELL- AND SPRING-NUMBERING SYSTEM

In this report the number assigned to a well or spring is both an identification number and a location number. The number is based on the common method of subdividing Federal Lands of the western United States. In Utah, the numbers are referenced to the Salt Lake Base Line and Meridian, and in Nevada to the Mount Diablo Base Line and Meridian.

Utah is divided into four quadrants by the Salt Lake Base Line and Meridian (see fig. 8). These quadrants are designated by the uppercase letters A, B, C, and D, thus: A, for the northeast quadrant; B, for the northwest; C, for the southwest; and D, for the southeast quadrant. Numbers designating the township and range respectively, follow the quadrant letter, and the three are enclosed in parentheses. The number after the parentheses designates the section, and the lowercase letters give the location of the well within the section. The first letter indicates the quarter section, which is generally a tract of 160 acres; the second letter indicates the 40-acre tract, and the third letter indicates the 10-acre tract. The number that follows the letters indicates the serial number of the well or spring within the 10-acre tract. Thus, well (C-8-19)9daa-1, in Tooele County, is in the NE¼NE¼SE¼ sec. 9, T. 8 S., R. 19 W., and is the first well constructed or visited in that tract.

When the serial (final) number is preceded by an "S" the number designates a spring; for example, Secret Spring is (C-9-19)12bdd-S1 (table 13). In this report, when no serial number is suffixed to a location for a 10-acre tract, the number designates the location of a surface-water data or sampling site; for example, see (C-8-19)34caa, Deep Creek at temporary diversion dam (tables 10 and 15 and pl. 1).

A typical Nevada number consists of three elements. The first is the township north of the Mount Diablo Base Line; and the second element, separated from the first by a slant line, is the range east of the Mount Diablo Meridian. The third element, separated from the second by a dash, is the section in the township, and the section number is followed by a lowercase letter that indicates the quarter section; finally the letter is followed by a number that indicates the order in which the well was recorded in the quarter section. The letters a, b, c, and d, respectively, designate the northeast, northwest, southwest, and southeast quarters of the section.

USE OF METRIC UNITS

In this report, the units which indicate concentrations of dissolved solids and individual ions determined by chemical analysis and the temperatures of water are reported in metric units rather than English units. This change has been made a part of a gradual change to the metric system that is in general use by the scientific community. The change is intended to promote greater uniformity in reporting of data.

Concentrations of chemical constituents are reported in milligrams per liter (mg/l). For concentrations less than 7,000 mg/l the numbers reported are the same as for concentrations in parts per million (ppm), the units used in earlier reports in this series.

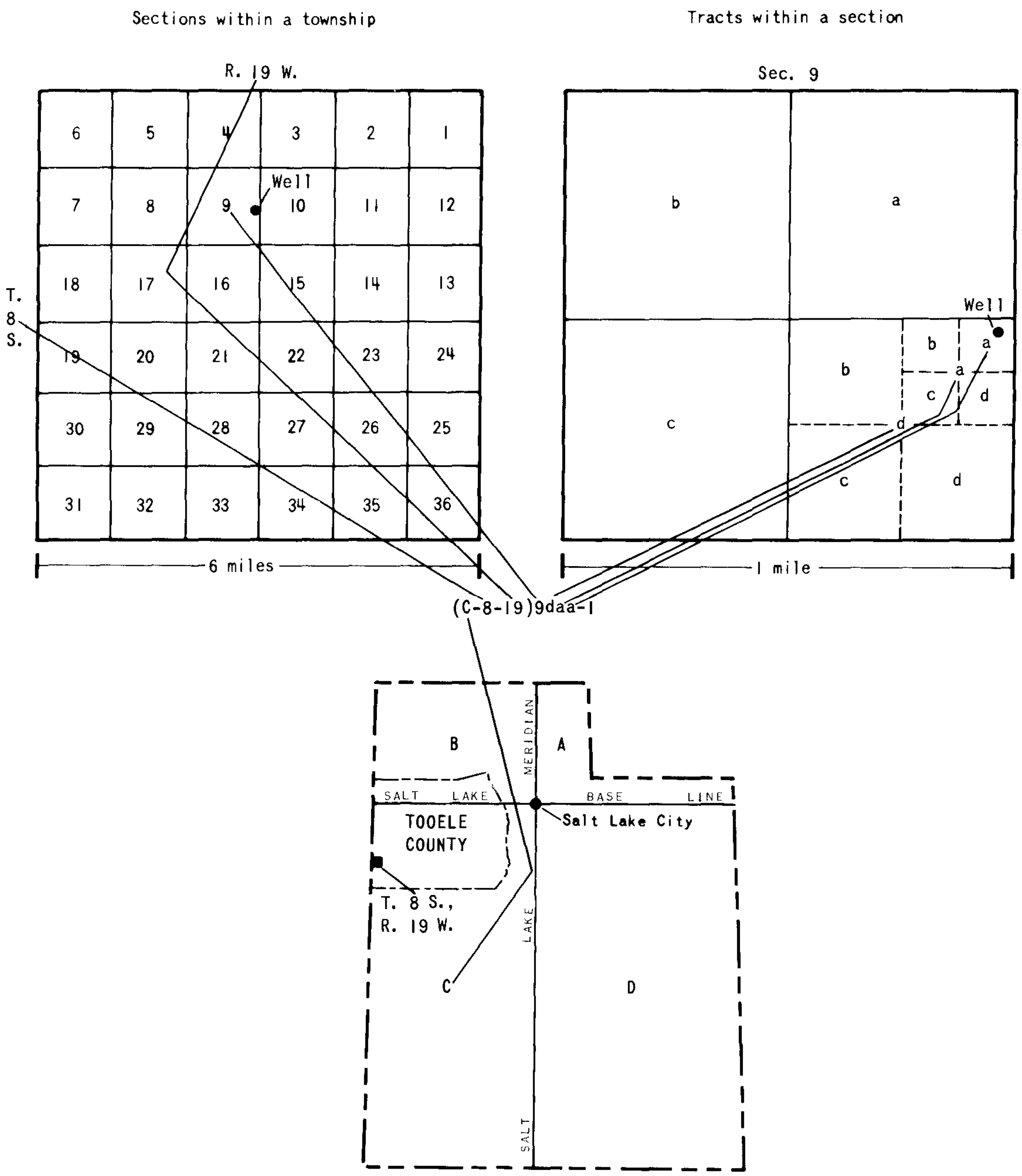

Figure 8.—Well- and spring-numbering system used in Utah.

Water temperature is reported in degrees Celsius (centigrade or °C), but the customary English unit of degrees Fahrenheit (°F) follows in parentheses in the text. Air temperature is reported in °F, but the equivalent temperature in °C follows in parentheses in the text for easier comparison with water temperature in tables. The reporting of temperatures in both metric and English units is done to assist those readers who are not familiar with the Celsius temperature scale. The following conversion table will also help to clarify the relation between degrees Fahrenheit and degrees Celsius:

TEMPERATURE-CONVERSION TABLE

For conversion of temperature in degrees Celsius (°C) to degrees Fahrenheit (°F). Conversions are based on the equation, $°F = 1.8°C + 32$; Temperatures in °F are rounded to nearest degree. Underscored equivalent temperatures are exact equivalents. For temperature conversions beyond the limits of the table, use the equation given, and for converting from °F to °C, use $°C = 0.5556\,(°F - 32)$. The equations say, in effect, that from the freezing point (0°C, 32°F) the temperature rises (or falls) 5°C for every rise (or fall) of 9°F.

°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F
-20	-4	-10	14	0	32	10	50	20	68	30	86	40	104
-19	-2	-9	16	+1	34	11	52	21	70	31	88	41	106
-18	0	-8	18	2	36	12	54	22	72	32	90	42	108
-17	+1	-7	19	3	37	13	55	23	73	33	91	43	109
-16	3	-6	21	4	39	14	57	24	75	34	93	44	111
-15	5	-5	23	5	41	15	59	25	77	35	95	45	113
-14	7	-4	25	6	43	16	61	26	79	36	97	46	115
-13	9	-3	27	7	45	17	63	27	81	37	99	47	117
-12	10	-2	28	8	46	18	64	28	82	38	100	48	118
-11	12	-1	30	9	48	19	66	29	84	39	102	49	120

BASIC DATA

Table 10.--Discharge of streams at sites in the Deep Creek valley drainage basin

Site location: See appendix for description of location-numbering system.
Stream and site description: Number is U.S. Geological Survey station number.
Discharge: Measured, unless indicated by e, estimated.

Site location	Stream and site description	Approximate drainage area (square miles)	Date	Discharge (cfs)	Remarks and other data available
(C-7-19)3aac	10-1729. Bar Creek near Ibapah	12	-	See remarks	Crest-stage gage on road to Gold Hill, north of Deep Creek valley. Concurrent flood peaks at this station and station 10-1728.95 indicate runoff in Deep Creek from precipitation in north end of Deep Creek valley. See table 12 for separate listing of discharge measurements and estimates.
3abb	10-1728.95 Deep Creek near Ibapah	460	-	do	Crest-stage gage at bridge on road to Gold Hill, north of Deep Creek valley. Indicates peak flow or lack of flow from Deep Creek valley. See table 12 for separate listing of discharge measurements and estimates.
(C-8-19)4bcd	Deep Creek at bridge at north end of Deep Creek valley	-	1-19-67	0	
			2-21-67	25.0	Current-meter measurement. Water contained pieces of ice from thaw.
			5- 2-67	6.01	Current-meter measurement.
34caa	Deep Creek at temporary diversion dam	-	2-17-66	2e	Temperature is 18°C. See chemical analysis in table 15.
(C-9-19)21acc	Middle Fork Deep Creek, south of county road, southwest of Ibapah	-	8-16-66	3e	Temperature is 19°C. See chemical analysis in table 15.
21bdc	Spring Creek, south of county road, southwest of Ibapah	-	8-16-66	0	
		-	1-19-67	5.74	Current-meter measurement 150 feet above junction with parallel streams.
21dab	East Fork of Deep Creek above diversions, south of Ibapah	-	1-19-67	2.07	Current-meter measurement.
			2-21-67	2.75	Do.
21dcb	Middle Fork Deep Creek 0.5 mile south of county road, southwest of Ibapah	-	2-21-67	1.5	Do.
29baa	Spring Creek at ranch road crossing	-	2-21-67	9.38	Do.
(C-11-19)9bcb	Ditch at junction with Deep Creek	-	-	See remarks	Mouth of ditch is 50 feet below station 10-1728.93. Water is return flow of irrigation diversions from Sam's and Steve's Creeks. See table 11 for separate listing of discharge measurements.
9bcb	10-1728.93 Deep Creek near Goshute	43	-	do	Gaging station. See table 5 for summary of record. Flow at this station is affected by diversions from Sam's, Steve's, and Fifteenmile Creeks which supply the base flow at this station.
15adc	Sam's Creek above diversions	-	-	do	See table 11 for separate listing of discharge measurements. See chemical analysis in table 15.
15ccc	Steve's Creek above diversions	-	-	do	Do.
28bad	Fifteenmile Creek above diversions	7.8	-	do	Do.

Table 11.–Records of miscellaneous streamflow measurements near Goshute

(Discharge, in cubic feet per second)

Water year	October		November		December		January		February		March		April		May		June		July		August		September	
	Day	Discharge	Day	Discharge	Day	Discharge	Day	Discharge	Day	Discharge	Day	Discharge	Day	Discharge	Day	Discharge	Day	Discharge	Day	Discharge	Day	Discharge	Day	Discharge
												FIFTEENMILE CREEK												
1964	-	-	-	-	-	-	-	-	-	-	-	-	23	3.29	14	8.12	5 17	8.14 15.6	16	5.86	18	3.18	15	2.68
1965	6	2.80	5	2.71	2 30	2.86 2.21	27	3.48	25	3.82	25	3.66	21	3.37	10 20	3.49 7.39	2 15	10.2 14.5	19	7.16	19	4.89	-	-
1966	14	3.99	16	3.69	6	3.60	4	3.08	3	2.83	29	3.80	29	3.52	19	5.33	1 28	4.17 2.75	27	1.90	16	1.79	-	-
1967	4	2.26	8	2.40	14	2.77	19	2.36	-	-	29	2.24	-	-	2 23	3.21 7.35	20	23.5	18	8.16	23	4.16	20	3.39
												SAM'S CREEK												
1964	-	-	-	-	-	-	-	-	-	-	-	-	22	0.42	14	2.65	5 17	4.01 11.2	16	3.23	18	0.74	15	0.36
1965	6	0.35	5	0.42	2 30	1/0.40 1/.26	27	1/0.44	25	1/0.56	25	0.91	21	.93	10 20	1.38 5.02	2	8.60	19	7.82	19	.88	-	-
1966	14	1.00	16	.47	6	.25	4	.29	3	0	3 29	.17 .30	5	1.14	19	2.38	1 28	3.70 1.18	27	.37	16	.36	-	-
1967	4	.34	8	.30	14	.30	19	.21	-	-	29	.22	-	-	2 23	.77 6.92	20	19.2	18	7.75	23	2.26	20	.57
												STEVE'S CREEK												
1964	-	-	-	-	-	-	-	-	-	-	-	-	22	1.24	14	20.9	5 17	7.30 7.13	16	4.09	18	1.83	15	1.69
1965	6	1.37	5	1.33	2 30	1.22 1/.88	27	1/1.17	25	1.15	25	1.76	21	1.18	10	1.60	2 15	3.82 6.69	19	4.78	19	3.23	-	-
1966	14	2.31	16	1.71	6	1.63	4	1.65	3	1.31	2 29	1.49 1.24	29	1.42	19	1.98	1 28	1.91 1.53	27	1.27	16	1.03	-	-
1967	4	1.08	8	.84	14	.64	19	.96	-	-	29	.83	-	-	2 23	.93 3.16	20	8.46	18	6.61	23	2.74	20	1.86
												DITCH AT JUNCTION WITH DEEP CREEK												
1964	-	-	-	-	-	-	-	-	-	-	-	-	23	0.55	14	1.61	5 17	6.40 8.45	-	-	18	0	15	0.12
1965	6	0.44	-	-	2	0.57	27	0.92	25	0.64	25	0	21	1.06	10 20	1.56 5.06	2 15 29	7.50 5.20 1.82	19	6.33	19	.90	15	2.40
1966	14	1.98	16	1.23	6	1.20	4	1.15	3	.95	2 29	1.16 .66	29	1.06	19	1.72	1 28	1.76 1.52	27	.50	-	-	-	-
1967	4	.76	8	.22	14	.33	19	.37	21	.99	29	.37	-	-	2 23	.47 4.86	20	9.50	18	4.56	23	1.55	20	.40

1/ Stage-discharge relation affected by ice.

Table 12.—Discharges obtained from crest-stage gage records for Deep Creek near Ibapah (10-1728.95) and Bar Creek near Ibapah (10-1729.), 1959-67

Discharge: Measured unless indicated by e, estimated.

Inspection date	DEEP CREEK		BAR CREEK		Remarks
	Probable date of peak	Discharge (cfs)	Probable date of peak	Discharge (cfs)	
Dec. 8, 1958	-	-	-	-	Stations established.
Mar. 4, 1959	-	0	-	0	
Apr. 2	-	2e	-	0	
July 21	-	0	-	0	
Aug. 6	July 24, 1959	20	July 24, 1959	15	
Aug. 20	-	0	-	0	
Aug. 25	Aug. 20	21e	Aug. 20	80e	
Sept. 15	-	0	-	10-15e	
Oct. 12	-	0	-	0	
Apr. 26, 1960	Apr. 23, 1960	81	-	0	
June 2	-	0	-	0	
July 6	-	0	June 10, 1960	120	
Aug. 4	See remarks	10e	Aug. 1	5e	Peak occurred during previous week.
Aug. 30	-	0	-	0	
Sept. 20	See remarks	5e	Sept. 2	1-5	Peak occurred during previous week.
Aug. 8, 1961	-	0	-	0	
Aug. 15	Aug. 15, 1961	2.32	-	0	Current-meter measurement.
Aug. 30	Aug. 25	1,250	Aug. 25, 1961	2,690	Peak discharge determined indirectly by slope-area method.
Sept. 27	Sept.18	80	Sept.18	120	From rating curve.
Oct. 25	-	0	-	0	
Feb. 15, 1962	Feb. 14, 1962	175	-	0	
Apr. 2	Mar. 30	3.5e	-	0	
Apr. 19	Apr. 19	.3e	-	0	
Oct. 17	-	0	-	0	
Feb. 19, 1963	Feb. 9, 1963	47	-	0	
	Feb. 19	9.96	-	0	Current-meter measurement.
Apr. 23	See remarks	15e	-	0	Date of peak unknown.
May 14	-	0	-	0	
May 29	May 25	45	-	0	
June 13	June 10	70	June 10, 1963	41e	
	June 13	40e	-	-	
July 9	June 16	60	-	0	
	July 9	.45e	-	-	
Aug. 29	-	0	-	2e	
Sept. 19	-	0	Sept. 5	40e	
Nov. 13	-	0	-	0	
Apr. 22, 1964	Apr. 5 to Apr. 10, 1964	25e	-	0	
	Apr. 22	5.50	-	-	Current-meter measurement.
May 14	May 14	3e	-	0	
June 23	June 17	57e	June 17, 1964	8e	
	June 23	12.3	-	-	
Aug. 18	-	0	-	0	
May 10, 1965	See remarks	1.8e	-	0	Date of peak unknown.
June 29	June 10, 1965	50e	June 26, 1965	24e	
	June 29	8.4e	-	-	
Aug. 19	Aug. 17	84e	Aug. 17	75e	
May 19, 1966	Mar. 10, 1966	88	-	0	
July 27	-	0	-	0	
Oct. 11	Oct. 2	173e	Oct. 2, 1966	187e	
Nov. 7	-	0	-	0	
Mar. 29, 1967	Mar. 29, 1967	4	-	0	Flowing.
May 2	May 2	3	-	0	
May 23	-	See remarks	-	0	Same flow since May 2, 1967.
July 18	July 18	3e	June 13-14, 1967	14.2	
Aug. 22	-	-	-	0	
Sept. 20	-	0	-	2e	

Table 13.—Records of selected wells and spring in and near the Deep Creek valley drainage basin

Location No.: See appendix for description of well- and spring-numbering system.
State Engineer No.: A, application number; C, claim number; WDR, well driller's report number.
Type of well: C, cable tool; D, dug; H, hydraulic rotary; J, jetted; Z, drilled, but method not known.
Depth of well: Reported by owner or driller.
Water-bearing zone: Character of material - C, conglomerate; D, dolomite; G, gravel; L, limestone; S, sand; U, unconsolidated sediments (sand, gravel, and clay).
Water level: Measured depths given in tenths of feet; reported depths given in feet; F, flows.
Method of lift and type of power: First letter - C, centrifugal pump; F, flows; J, jet pump; N, none; P, piston pump (plunger or cylinder); T, turbine pump. Second letter - E, electric; D, diesel; G, gasoline. Number in parenthese indicates horsepower.
Well performance: Yield - B, bailed (rate reported by driller); E, estimated; M, measured; R, reported by driller, owner, or operator.
Use of water: H, domestic; I, irrigation, S, stock; U, unused.
Remarks and other data available: C, chemical analysis in table 16; H, hydrograph of water levels in figure 6; L, driller's log of well in table 14; Perf., casing perforated; Temp., temperature of water in degrees Celsius (see appendix for explanation of conversion to degrees Fahrenheit).

Location	Owner or name	State Engineer No.	Year drilled	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing zone: Depth to top (feet)	Water-bearing zone: Thickness (feet)	Water-bearing zone: Character of material	Altitude above sea level (feet)	Water level: Above(+) or below(-) land-surface datum (feet)	Water level: Date of measurement	Method of lift and type of power	Well performance: Yield (gpm)	Well performance: Drawdown (feet)	Use of water	Remarks and other data available
UTAH																	
(C-7-19)																	
9acc-1	U.S. Bureau of Land Management	A-13071	1935	C	605	6	565	40	S,G	4,990	-500	3-13-35	P,G (5)	20R	-	S	In canyon of Deep Creek between Deep Creek valley and Great Salt Lake Desert. Cased to 605 ft, perforated. L.
11bca-1	do	A-33777	1961	C	300	-	-	-	-	5,050	-	-	N	-	-	U	North of Deep Creek valley. Reported dry and abandoned. Known as Oswald well. L.
(C-8-19)																	
9daa-1	Jay Hicks	A-18189 WDR-4803	1946	C	306	6	54 101 195	2 5 111	G G,S C	5,130	+7.1	10-24-62	F	40E	-	H,I,S	Cased to 203 ft. Perf. 190-203 ft. C,H,L.
34baa-1	W. H. Parrish	C-21062	1885	J	350	2	-	-	-	5,175	-	-	F	5.7M	-	H,S	Temp. 12. C.
(C-9-19)																	
1cdc-S1	North Spring	-	-	-	-	-	-	-	G(?)	5,490	-	-	-	1.1M	-	S	Spring improved by U.S. Bureau of Land Management. C.
3bac-1	F. F. Snively	A-31138	-	-	43	6	-	-	-	5,190	-	-	-	-	-	S	
9add-1	S. H. Nicholes	A-16160 WDR-4738	1946	C	535	6	367	10	S,G	5,230	-16	7- 1-46	C,E	2E	-	H,S	Cased to 392 ft. Perf. 367-392 ft. Temp. 11. C,L.
12bdd-S1	Secret Spring	-	-	-	-	-	-	-	G(?)	5,470	-	-	-	1.1M	-	S	Spring improved by U.S. Bureau of Land Management. Temp. 15. C.
13cbc-S1	Chadman Spring	-	-	-	-	-	-	-	G(?)	5,530	-	-	-	1.0M	-	S	Spring improved by U.S. Bureau of Land Management. Temp. 14. C.
15ccb-1	Earl Hall	A-17966 WDR-4807	1946	C	65	6	55	10	S,G	5,280	-14	7-27-46	-	-	-	H,I,S	Cased to 65 ft. Perf. 55-65 ft. L.
16dca-1	Mrs. Wade Parrish	A-25966 WDR-11700	1955	C	58	6	37 50	5 5	G G	5,270	-8.3	10-24-62	-	-	-	H,S	Cased to 58 ft. Perf. 40-55 ft. H,L.
16dda-1	W. P. Calloway	A-26216 WDR-11978	1955	C	70	6	50 65	5 5	G G	5,280	-14	9-23-55	C,E	20M	-	H,I,S	Well equipped with two pumps. Cased to 70 ft. Perf. 50-70 ft. Temp. 12. C,L.
16ddc-1	R. P. Bateman	-	-	-	-	-	-	-	-	-	-	-	P,G	5M	-	H,S	Temp. 10. C.
21dac-1	Kenneth Snively	A-26327 WDR-11977	1955	C	50	6	40	10	G	5,290	-2	9-25-55	-	40R	13	H,I,S	Cased to 50 ft. Perf. 40-50 ft. L.
21dcc-1	F. F. Snively	A-17727 WDR-4681	1946	C	70	6	46 56	4 14	S,G S,G	5,300	-14	7-24-46	-	17M	-	H,S	Cased to 70 ft. Perf. 50-70 ft. Temp. 12. C,L.
22bac-1	Ibapah Cemetery	A-25937 WDR-11128	1954	C	100	6	27 50 64	1 2 2	S S S	5,315	-15	9- 8-54	P,G	50R	4	I	Cased to 70 ft. Perf. 50-70 ft. Temp. 11. C,L.
22bbb-1	Mathew Chastian	-	-	D	-	-	-	-	-	5,290	-13.9	10-24-62	N	-	-	U	H.
23daa-S1	Christiansen Spring	-	-	-	-	-	-	-	-	5,595	-	-	-	10E	-	H,S	Temp. 13. C.
23dbc-S1	Greasewood Spring	-	-	-	-	-	-	-	-	5,570	-	-	-	7.1M	-	S	Spring improved by U.S. Bureau of Land Management. Temp. 12. C.
27bdd-1	S. W. Cook	-	-	D	45	36	-	-	-	5,360	-	-	P,E	3E	-	H,S	Cased to 45 ft. Temp. 11. C.
33adc-S1	Unnamed spring	-	-	-	-	-	-	-	-	5,390	-	-	-	-	-	I,S	Large seepage area at apparent head of Middle Fork Deep Creek; at west side of 50-ft diameter pool. Temp. 12. C.
34bad-1	S. W. Cook	A-31637	1960	C	147	12	24 55 112 120 143	2 2 5 3 4	G G G G S,G	5,400	F	8-20-60	T,G	380R 20M	37	I,S	Cased to 147 ft. Perf. 112-117, 120-123, 143-147 ft. Yield and drawdown reported after 8 hours of pumping. Temp. 12. C,L.
35ccd-1	Goshute Day School	-	1956	Z	80	-	-	-	-	5,500	-	-	T?,D	-	-	H	C.
(C-10-18)																	
7bdc-S1	Cold Spring	A-8932-1	-	-	-	-	-	-	-	7,100	-	-	-	10E	-	S	2½ x 3-ft pond; no improvements. Temp. 9. C.
(C-10-19)																	
4aaa-S1	Goshute Indian Reservation	-	-	-	-	-	-	-	-	5,500	-	-	N	-	-	I,S?	In Deep Creek bottom, 0.1 mile west of road.
22bbd-1	W. A. Weaver	A-17529 WDR-4459	1946	C	114	6	78 87 107	4 13 7	G G G	5,800	-71	8-20-46	T?,G	60M	-	H	Cased to 114 ft. Perf. 74-114 ft. Water reported to be corrosive. Temp. 13. C,L.
22bcd-1	do	A-23505 WDR-11125	1954	C	130	12	86 107 115	14 3 15	G,S S U	5,790	-74	7-15-54	-	800R	8	H,I,S	Cased to 130 ft. Perf. 74-124 ft. L.
22caa-1	C. M. Hibbard	A-14871 WDR-2837	1942	Z	131	4	120	11	S,G	5,800	-85	7- 4-42	-	5B	0	S	Drilled in old 95-ft dug well. Cased to 131 ft, open end. L.
22cda-1	Merlin Johnson	A-25959	1961	C	195	12	-	-	G	5,850	-130	8-26-61	-	300R	8	I	Cased to 195 ft. Perf. 130-195 ft. Yield and drawdown measured after 6 hours of pumping. L.
(C-11-19)																	
19caa-S1	Goshute Indian Reservation	-	-	-		-	-	-	L(?)	6,350	-	-	-	-	-	I,S	Spring at head of Spring Creek. Flow from mountains north-northwestward to join Round Valley Creek. Apparently discharges several cubic feet per second.

Table 13.--Continued

Location	Owner or name	State Engineer No.	Year drilled	Type of well	Depth of well (feet)	Diameter of well (inches)	Water-bearing zone: Depth to top (feet)	Water-bearing zone: Thickness (feet)	Water-bearing zone: Character of material	Altitude above sea level (feet)	Water level: Above(+) or below(-) land-surface datum (feet)	Water level: Date of measurement	Method of lift and type of power	Well performance: Yield (gpm)	Well performance: Drawdown (feet)	Use of water	Remarks and other data available
									NEVADA								
23/69-13d1	Goshute Indian Reservation	-	-	Z	-	-	-	-	-	6,000	-	-	C	-	-	S	Windmill appears to have been inoperative for years.
24/69-27b1	do	-	-		-	-		-	-	5,810	-	-	-	-	-	S	
25/70-6d1	U.S. Bureau of Land Management	8135	1964	C	210	-		-	-	5,710	-	-	N	-	-	U	Well reported as dry hole. L.
8d1	do	8218	1964	C	240	-	-	-	-	5,700	-	-	N	-	-	U	Do.
34c1	S. P. Sheldon	-	-	Z	100 200	-		-	-	5,460	-		J,E	-	-	H,S	Well equipped with two pumps. C.
26/70-20c1	U.S. Bureau of Land Management	-	1954	H	4,502	-	3,540 4,135	135 215	D D	5,504	-780 (See remarks)	-	N	-	-	U	Oil test. Gulf Refining Co. No. 1D, Dennison-Federal lease. Driller reported "fresh" water in zones tested. Water level in deeper zone is approximated from drill-stem test data. L.

Table 14.--Drillers' logs of selected wells in and near the Deep Creek valley drainage basin

Altitudes are in feet above sea level for land surface at well.
Thickness in feet.
Depth in feet below land surface.

UTAH

Material	Thickness	Depth
(C-7-19)9acc-1. Log by H. M. Robinson. Alt. 4,990 ft.		
Clay, sandy	30	30
Clay, brown, sandy	89	119
Clay and gravel layers	376	495
Sand, coarse; some water	25	520
Sand, fine, and gravel; water bearing	15	535
Clay, sandy	30	565
Sand and fine gravel; water bearing	40	605
(C-7-19)11bca-1. Log reported by U.S. Bureau of Land Management Alt. 5,050 ft.		
Silt, white	9	9
Lime rock	11	20
Shale, red, sandy	240	260
Gravel, white, cemented	25	285
Lime rock, decomposed	15	300
(C-8-19)9daa-1. Log by J. F. O'Brien. Alt. 5,130 ft.		
Clay, black	54	54
Gravel	2	56
Clay, black	24	80
Gravel and sand	6	86
Clay, black	15	101
Gravel and sandy clay	5	106
Clay, brown, sandy	65	171
Hardpan and sandstone	8	179
Clay, brown	5	184
Hardpan	5	189
Clay, brown	6	195
Conglomerate	111	306
(C-9-19)9add-1. Log by J. F. O'Brien. Alt. 5,230 ft.		
Earth and rock	20	20
Clay, brown	65	85
Sand and clay, brown	98	183
Hardpan	4	187
Clay, brown	80	267
Clay, white	23	290
Hardpan	6	296
Clay, white	24	320
Hardpan	5	325
Clay, brown	30	355
Hardpan	12	367
Sand and pea-size gravel	10	377
Clay, brown	158	535
(C-9-19)15ccb-1. Log by J. F. O'Brien. Alt. 5,280 ft.		
Earth and gravel; water at 56 ft.	56	56
Sand and gravel	9	65
(C-9-19)16dda-1. Log by J. F. O'Brien. Alt. 5,280 ft.		
Topsoil	4	4
Boulders	11	15
Gravel, coarse, and sand	19	34
Clay	3	37
Gravel	5	42
Clay	8	50
Gravel; water bearing	5	55
Clay	10	65
Gravel	5	70
(C-9-19)21dac-1. Log by J. F. O'Brien. Alt. 5,290 ft.		
Clay	12	12
Gravel and clay	6	18
Hardpan	3	21
Clay	19	40
Gravel; water bearing	10	50
(C-9-19)21dcc-1. Log by J. F. O'Brien. Alt. 5,300 ft.		
Clay, brown, hard	46	46
Sand and gravel	4	50
Clay, brown	6	56
Sand and gravel	14	70
(C-9-19)22bac-1. Log by J. F. O'Brien. Alt. 5,315 ft.		
Overburden	5	5
Gravel	7	12
Clay, brown, and gravel	15	27
Sand; water rose to 15 ft	1	28
Clay, brown, and gravel	22	50
Sand, coarse	2	52
Clay, brown, and gravel	12	64
Sand, coarse	2	66
Clay, brown	34	100
(C-9-19)34bad-1. Log by J. F. O'Brien. Alt. 5,400 ft.		
Clay, brown	19	19
Conglomerate	5	24
Gravel, coarse	2	26
Clay, white	29	55
Gravel, pea-size	2	57
Clay, brown, sandy	43	100
(C-9-19)34bad-1 - Continued		
Gravel and clay	5	105
Sand, brown, hard	7	112
Gravel, pea-size	5	117
Clay, brown, sandy, hard	3	120
Gravel, pea-size	3	123
Clay, white	17	140
Hardpan	3	143
Sand and gravel	4	147
(C-10-19)22bbd-1. Log by J. F. O'Brien. Alt. 5,800 ft.		
Earth and rock	30	30
Clay, sandy	40	70
Gravel; water bearing at 78 ft.	12	82
Clay	5	87
Gravel	13	100
Clay	7	107
Gravel, good	7	114
(C-10-19)22bcd-1. Log by J. F. O'Brien. Alt. 5,790 ft.		
Overburden	12	12
Boulders	12	24
Clay, brown, and gravel	16	40
Boulders	5	45
Clay, brown, and gravel	41	86
Gravel and sand	14	100
Clay, sandy	7	107
Sand, coarse	3	110
Clay, sandy	5	115
Sand, clay, and gravel	15	130
(C-10-19)22caa-1. Log by C. W. Anderson. Alt. 5,800 ft.		
Old dug well	95	95
Muck, sandy	25	120
Sand and gravel	11	131
(C-10-19)22cda-1. Log by J. F. O'Brien. Alt. 5,850 ft.		
Topsoil	5	5
Boulders	40	45
Clay, brown, and gravel	93	138
Gravel, pea-size; water bearing	2	140
Clay, brown, and gravel	7	147
Gravel, coarse and some clay	13	160
Clay, brown, sandy	10	170
Clay and gravel	5	175
Clay, brown, sandy	10	185
Gravel, very coarse	2	187
Clay, brown, sandy	8	195

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Material	Thickness	Depth
25/70-6d1. Log by F. J. Schuh Alt. 5,710 ft.		
Clay, gray, and some gravel	150	150
Clay, brown, and lava rock	60	210
25/70-8d1. Log by F. J. Schuh Alt. 5,700 ft.		
(Slope) wash	10	10
Clay and gravel	175	185
"Lime fault"	55	240
26/70-20c1. Log by Gulf Refining Co. Alt. 5,504 ft.		
Sandstone, silty, with interbedded volcanic ash and red and brown shale	790	790
26/70-20c1. - Continued		
Lava, gray, black, and brown, with few interbeds of volcanic ash and sandstone	960	1,750
Shale, bentonitic, light gray to gray green. Two 20-foot lava sections and two quartz sands	465	2,215
Top of Permian Gerster-Phosphoria		
Limestone, brown-gray, fine crystalline with brown chert, some silty and sandy zones	1,030	3,245
Siltstone, gray to black, limy, with chert beds	85	3,330
26/70-20c1 - Continued		
Limestone, dark gray, silty, fossil fragments, chert	20	3,350
Shale, black, silty, with interbedded dolomite, dark brown to black, very fine crystalline, cherty	190	3,540
Dolomite, brown, fine crystalline, cherty with some silty zones	320	3,860
Limestone, brown-gray, fine to medium crystalline, cherty	170	4,030
Dolomite, brown, very fine to fine crystalline, with considerable silt and sandy interbeds	472	4,502

Table 15.—Chemical analyses of water from selected streams in the Deep Creek valley drainage basin

Discharge: Measured unless indicated by e, estimated.
Dissolved solids: Residue on evaporation at 180°C.

Location	Name	Date of collection	Discharge (cfs)	Milligrams per liter																Sodium-adsorption ratio	Specific conductance (micromhos/cm at 25°C)	pH
				Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Phosphate (PO_4)	Boron (B)	Dissolved solids	Hardness as $CaCO_3$	Noncarbonate hardness as $CaCO_3$			
(C-8-19) 34caa	Deep Creek	8-17-66	2e	27	42	33	40	6.6	254	0	62	36	0.5	1.1	0.23	0.14	397	240	32	1.1	602	7.8
(C-9-19) 21acc	Middle Fork Deep Creek	8-16-66	3e	30	20	30	26	3.7	210	0	30	18	.4	.4	-	.10	281	172	0	.9	421	8.1
(C-11-19) 15adc	Sam's Creek	6-28-66	3.5	7.6	4.8	1.6	3.0	.6	27	0	1.9	1.1	.2	.1	-	.05	38	18	0	.3	53	7.0
		10- 4-66	.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	60	-
15ccc	Steve's Creek	6-28-66	1.8	9.2	7.6	1.2	3.7	.6	34	0	3.1	2.2	.2	.0	-	.05	40	24	0	.3	65	7.2
		10- 4-66	1.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	70	-
28bad	Fifteenmile Creek	6-28-66	4.0	13	7.2	2.9	5.4	1.0	39	0	6.6	2.2	.2	.0	-	.06	58	30	0	.4	89	7.2
		10- 4-66	2.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	97	-

Table 16.—Chemical analyses of water from selected wells and springs in the Deep Creek valley drainage basin

Discharge: Measured unless indicated by e, estimated.
Dissolved solids: Residue on evaporation at 180°C.

Location	Date of collection	Temperature (°C)	Discharge (gpm)	Silica (SiO_2)	Iron (Fe)1/	Manganese (Mn)1/	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Phosphate (PO_4)	Boron (B)	Copper (Cu)1/	Lead (Pb)1/	Zinc (Zn)1/	Lithium (Li)	Strontium (Sr)	Bromide (Br)	Iodide (I)	Dissolved solids	Hardness as $CaCO_3$	Noncarbonate hardness as $CaCO_3$	Percent sodium	Sodium-adsorption ratio	Specific conductance (micromhos/cm at 25°C)	pH
				Milligrams per liter																												
UTAH																																
(C-8-19)																																
9daa-1	6-28-66	13	20e	21	-	-	46	27	27	2.0	234	0	28	46	0.2	0.1	-	0.04	-	-	-	-	-	-	-	322	228	36	20	0.8	552	8.2
34baa-1	8-17-66	12	5.7	33	0.00	0.00	18	22	8.3	4.9	150	0	9.6	14	.2	1.4	0.11	.06	0.01	0.00	0.00	0.00	0.31	0.1	0.00	193	134	11	11	.3	293	7.5
(C-9-19)																																
1cdc-S1	8-17-66	-	1.1	13	-	-	51	34	8.2	.5	312	0	8.2	10	.1	.2	.00	.04	-	-	-	-	-	.1	.00	292	268	12	6	.2	511	7.7
9add-1	8-17-66	11	2e	34	-	-	74	50	54	3.4	404	0	59	72	.4	2.7	.00	.11	-	-	-	-	-	.4	.00	562	390	59	23	1.2	909	7.9
12bdd-S1	8-17-66	15	1.1	13	-	-	50	38	8.8	.4	322	0	9.9	12	.1	.1	.01	.05	-	-	-	-	-	-	-	290	282	18	6	.2	525	7.7
13cbc-S1	8-17-66	14	1.0	14	-	-	51	34	7.3	1.5	304	0	8.6	10	.1	.4	.08	.05	-	-	-	-	-	.1	.00	302	264	15	6	.2	495	7.9
16ddc-1	8-17-66	10	5.0	30	.00	.00	60	35	38	2.5	326	0	35	48	.3	.1	.31	.10	.01	.01	.02	.02	30	.2	.00	420	292	25	22	1.0	698	7.7
16dda-1	8-16-66	12	20	26	.01	.00	26	11	14	1.6	135	0	4.2	13	.2	.5	.17	.05	.00	.01	.00	.01	.18	.1	.00	179	108	0	22	.6	278	7.6
21dcc-1	8-16-66	12	17	24	.01	.00	23	4.6	10	1.3	99	0	5.2	7.0	.2	.3	.00	.04	.00	.01	.02	.01	.10	.0	.00	127	77	0	22	.5	192	7.4
22bac-1	8-16-66	11	10	26	.05	.00	18	6.7	9.9	1.1	93	0	6.0	6.5	.2	.4	.13	05	.01	.01	.04	.01	.11	.0	.00	131	73	0	22	.5	186	7.4
23daa-S1	8-16-66	13	10e	10	.00	.00	41	33	6.5	.9	254	0	6.9	16	.1	2.8	.00	.03	.00	.00	.00	.00	.11	.1	.00	250	236	28	6	.2	444	7.9
26dbc-S1	8-15-66	12	7.1	12	.00	.00	30	35	6.1	1.0	248	0	8.5	8.0	.0	2.5	.08	.02	.00	.00	.00	.00	.11	.0	.00	243	219	16	6	.2	414	7.8
27bdd-1	8-15-66	11	3e	37	.00	.00	30	39	38	4.4	304	0	23	26	.4	4.3	.08	.15	.00	.00	.00	.02	.23	.1	.00	359	236	0	25	1.1	575	7.9
33adc-S1	8-16-66	12	-	22	.06	.00	22	2.2	9.8	1.0	85	0	4.7	7.0	.2	.8	.13	.05	.01	.01	.03	00	.09	.0	.00	118	63	0	25	.5	173	7.2
34bad-1	8-15-66	12	20	25	.01	.00	19	4.3	12	1.1	92	0	6.2	7.5	.2	.8	.06	.04	.00	.00	.02	.00	.10	.0	.00	149	66	0	28	.6	183	7.5
34ccd-1	8-15-66	-	-	30	-	-	26	18	9.6	1.7	162	0	8.4	10	.2	2.2	-	.04	-	-	-	-	-	-	-	193	140	8	13	.4	299	7.7
(C-10-18)																																
7bdc-S1	8-15-66	9	10e	7.7	.00	.00	37	34	5.1	.8	268	0	5.8	6.5	.1	2.6	.04	.05	.00	.00	.01	.00	.10	.2	.00	229	232	12	5	.1	426	7.7
(C-10-19)																																
22bbd-1	8-15-66	13	60	20	.00	.01	50	18	23	1.6	102	0	13	102	.2	4.2	.04	.04	.00	.01	.03	.00	.21	.4	.00	351	196	112	20	.7	528	7.5
NEVADA																																
25/70-34c1	8-16-66	-	-	21	-	-	18	1.8	34	1.4	110	0	12	14	0.4	1.4	-	0.03	-	-	-	-	-	-	-	161	53	0	58	2.0	249	7.6

1/ Samples were filtered and acidified at time of collection.

PUBLICATIONS OF THE UTAH DEPARTMENT OF NATURAL RESOURCES, DIVISION OF WATER RIGHTS

(*)—Out of Print

TECHNICAL PUBLICATIONS

No. 1. Underground leakage from artesian wells in the Flowell area, near Fillmore, Utah, by Penn Livingston and G. B. Maxey, U.S. Geological Survey, 1944.

No. 2. The Ogden Valley artesian reservoir, Weber County, Utah, by H. E. Thomas, U.S. Geological Survey, 1945.

*No. 3. Ground water in Pavant Valley, Millard County, Utah, by P. E. Dennis, G. B. Maxey, and H. E. Thomas, U.S. Geological Survey, 1946.

*No. 4. Ground water in Tooele Valley, Tooele County, Utah, by H. E. Thomas, U.S. Geological Survey, in Utah State Eng. 25th Bienn. Rept., p. 91-238, pls. 1-6, 1946.

*No. 5. Ground water in the East Shore area, Utah: Part I, Bountiful District, Davis County, Utah, by H. E. Thomas and W. B. Nelson, U.S. Geological Survey, in Utah State Eng. 26th Bienn. Rept., p. 53-206, pls. 1-2, 1948.

*No. 6. Ground water in the Escalante Valley, Beaver, Iron, and Washington Counties, Utah, by P. F. Fix, W. B. Nelson, B. E. Lofgren, and R. G. Butler, U.S. Geological Survey, in Utah State Eng. 27th Bienn. Rept., p. 107-210, pls. 1-10, 1950.

No. 7. Status of development of selected ground-water basins in Utah, by H. E. Thomas, W. B. Nelson, B. E. Lofgren, and R. G. Butler, U.S. Geological Survey, 1952.

*No. 8. Consumptive use of water and irrigation requirements of crops in Utah, by C. O. Roskelly and Wayne D. Criddle, 1952.

No. 8. (Revised) Consumptive use and water requirements for Utah, by W. D. Criddle, K. Harris, and L. S. Willardson, 1962.

No. 9. Progress report on selected ground water basins in Utah, by H. A. Waite, W. B. Nelson, and others, U.S. Geological Survey, 1954.

No. 10. A compilation of chemical quality data for ground and surface waters in Utah, by J. G. Connor, C. G. Mitchell, and others, U.S. Geological Survey, 1958.

No. 11. Ground water in northern Utah Valley, Utah: A progress report for the period 1948-1963, by R. M. Cordova and Seymour Subitzky, U.S. Geological Survey, 1965.

No. 12. Reevaluation of the ground-water resources of Tooele Valley, Utah, by Joseph S. Gates, U.S. Geological Survey, 1965.

*No. 13. Ground-water resources of selected basins in southwestern Utah, by G. W. Sandberg, U.S. Geological Survey, 1966.

No. 14. Water-resources appraisal of the Snake Valley area, Utah and Nevada, by J. W. Hood and F. E. Rush, U.S. Geological Survey, 1966.

No. 15. Water from bedrock in the Colorado Plateau of Utah, by R. D. Feltis, U.S. Geological Survey, 1966.

No. 16. Ground-water conditions in Cedar Valley, Utah County, Utah, by R. D. Feltis, U.S. Geological Survey, 1967.

No. 17. Ground-water resources of northern Juab Valley, Utah, by L. J. Bjorklund, U.S. Geological Survey, 1968.

No. 18. Hydrologic reconnaissance of Skull Valley, Tooele County, Utah, by J. W. Hood and K. M. Waddell, U.S. Geological Survey, 1968.

No. 19. Appraisal of the quality of surface water in the Sevier Lake basin, Utah, by D. C. Hahl and J. C. Mundorff, U. S. Geological Survey, 1968.

No. 20. Extensions of streamflow records in Utah, by J. K. Reid, L. E. Carroon, and G. E. Pyper, U. S. Geological Survey, 1969.

No. 21. Summary of maximum discharges in Utah streams, by G. L. Whitaker, U. S. Geological Survey, 1969.

No. 22. Reconnaissance of the ground-water resources of the upper Fremont River Valley, Wayne County, Utah, by L. J. Bjorklund, U. S. Geological Survey, 1969.

No. 23. Hydrologic reconnaissance of Rush Valley, Tooele County, Utah, by J. W. Hood, Don Price, and K. M. Waddell, U. S. Geological Survey, 1969.

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No. 1. Ground water in the Jordan Valley, Salt Lake County, Utah, by Ted Arnow, U.S. Geological Survey, 1965.

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No. 1. Records and water-level measurements of selected wells and chemical analyses of ground water, East Shore area, Davis, Weber, and Box Elder Counties, Utah, by R. E. Smith, U.S. Geological Survey, 1961.

No. 2. Records of selected wells and springs, selected drillers' logs of wells, and chemical analyses of ground and surface waters, northern Utah Valley, Utah County, Utah, by Seymour Subitzky, U.S. Geological Survey, 1962.

No. 3. Ground-water data, central Sevier Valley, parts of Sanpete, Sevier, and Piute Counties, Utah, by C. H. Carpenter and R. A. Young, U.S. Geological Survey, 1963.

No. 4. Selected hydrologic data, Jordan Valley, Salt Lake County, Utah, by I. W. Marine and Don Price, U.S. Geological Survey, 1963.

No. 5. Selected hydrologic data, Pavant Valley, Millard County, Utah, by R. W. Mower, U.S. Geological Survey, 1963.

*No. 6. Ground-water data, parts of Washington, Iron, Beaver, and Millard Counties, Utah, by G. W. Sandberg, U.S. Geological Survey, 1963.

No. 7. Selected hydrologic data, Tooele Valley, Tooele County, Utah, by J. S. Gates, U.S. Geological Survey, 1963.

No. 8. Selected hydrologic data, upper Sevier River basin, Utah, by C. H. Carpenter, G. B. Robinson, Jr., and L. J. Bjorklund, U.S. Geological Survey, 1964.

No. 9. Ground-water data, Sevier Desert, Utah, by R. W. Mower and R. D. Feltis, U.S. Geological Survey, 1964.

No. 10. Quality of surface water in the Sevier Lake basin, Utah, by D. C. Hahl and R. E. Cabell, U.S. Geological Survey, 1965.

No. 11. Hydrologic and climatologic data, collected through 1964, Salt Lake County, Utah by W. V. Iorns, R. W. Mower, and C. A. Horr, U.S. Geological Survey, 1966.

No. 12. Hydrologic and climatologic data, 1965, Salt Lake County, Utah, by W. V. Iorns, R. W. Mower, and C. A. Horr, U.S. Geological Survey, 1966.

No. 13. Hydrologic and climatologic data, 1966, Salt Lake County, Utah, by A. G. Hely, R. W. Mower, and C. A. Horr, U.S. Geological Survey, 1967.

No. 14. Selected hydrologic data, San Pitch River drainage basin, Utah, by G. B. Robinson, Jr., U.S. Geological Survey, 1968.

No. 15. Hydrologic and climatologic data. 1967, Salt Lake County, Utah, by A. G. Hely, R. W. Mower, and C. A. Horr, U.S. Geological Survey, 1968.

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*No. 1. Plan of work for the Sevier River Basin (Sec. 6, P.L. 566), U.S. Department of Agriculture, 1960.

No. 2. Water production from oil wells in Utah, by Jerry Tuttle, Utah State Engineer's Office, 1960.

No. 3. Ground-water areas and well logs, central Sevier Valley, Utah, by R. A. Young, U.S. Geological Survey, 1960.

*No. 4. Ground-water investigations in Utah in 1960 and reports published by the U.S. Geological Survey or the Utah State Engineer prior to 1960, by H. D. Goode, U.S. Geological Survey, 1960.

No. 5. Developing ground water in the central Sevier Valley, Utah, by R. A. Young and C. H. Carpenter, U.S. Geological Survey, 1961.

*No. 6. Work outline and report outline for Sevier River basin survey, (Sec. 6, P.L. 566), U.S. Department of Agriculture, 1961.

No. 7. Relation of the deep and shallow artesian aquifers near Lynndyl, Utah, by R. W. Mower, U.S. Geological Survey, 1961.

No. 8. Projected 1975 municipal water-use requirements, Davis County, Utah, by Utah State Engineer's Office, 1962.

No. 9. Projected 1975 municipal water-use requirements, Weber County, Utah, by Utah State Engineer's Office, 1962.

No. 10. Effects on the shallow artesian aquifer of withdrawing water from the deep artesian aquifer near Sugarville, Millard County, Utah, by R. W. Mower, U.S. Geological Survey, 1963.

No. 11. Amendments to plan of work and work outline for the Sevier River basin (Sec. 6, P.L. 566), U.S. Department of Agriculture, 1964.

No. 12. Test drilling in the upper Sevier River drainage basin, Garfield and Piute Counties, Utah, by R. D. Feltis and G. B. Robinson, Jr., U.S. Geological Survey, 1963.

No. 13. Water requirements of lower Jordan River, Utah, by Karl Harris, Irrigation Engineer, Agricultural Research Service, Phoenix, Arizona, prepared under informal cooperation approved by Mr. William W. Donnan, Chief, Southwest Branch (Riverside, California) Soil and Water Conservation Research Division, Agricultural Research Service, U.S.D.A. and by Wayne D. Criddle, State Engineer, State of Utah, Salt Lake City, Utah, 1964.

*No. 14. Consumptive use of water by native vegetation and irrigated crops in the Virgin River area of Utah, by Wayne D. Criddle, Jay M. Bagley, R. Keith Higginson, and David W. Hendricks, through cooperation of Utah Agricultural Experiment Station, Agricultural Research Service, Soil and Water Conservation Branch, Western Soil and Water Management Section, Utah Water and Power Board, and Utah State Engineer, Salt Lake City, Utah, 1964.

No. 15. Ground-water conditions and related water-administration problems in Cedar City Valley, Iron County, Utah, February, 1966, by Jack A. Barnett and Francis T. Mayo, Utah State Engineer's Office.

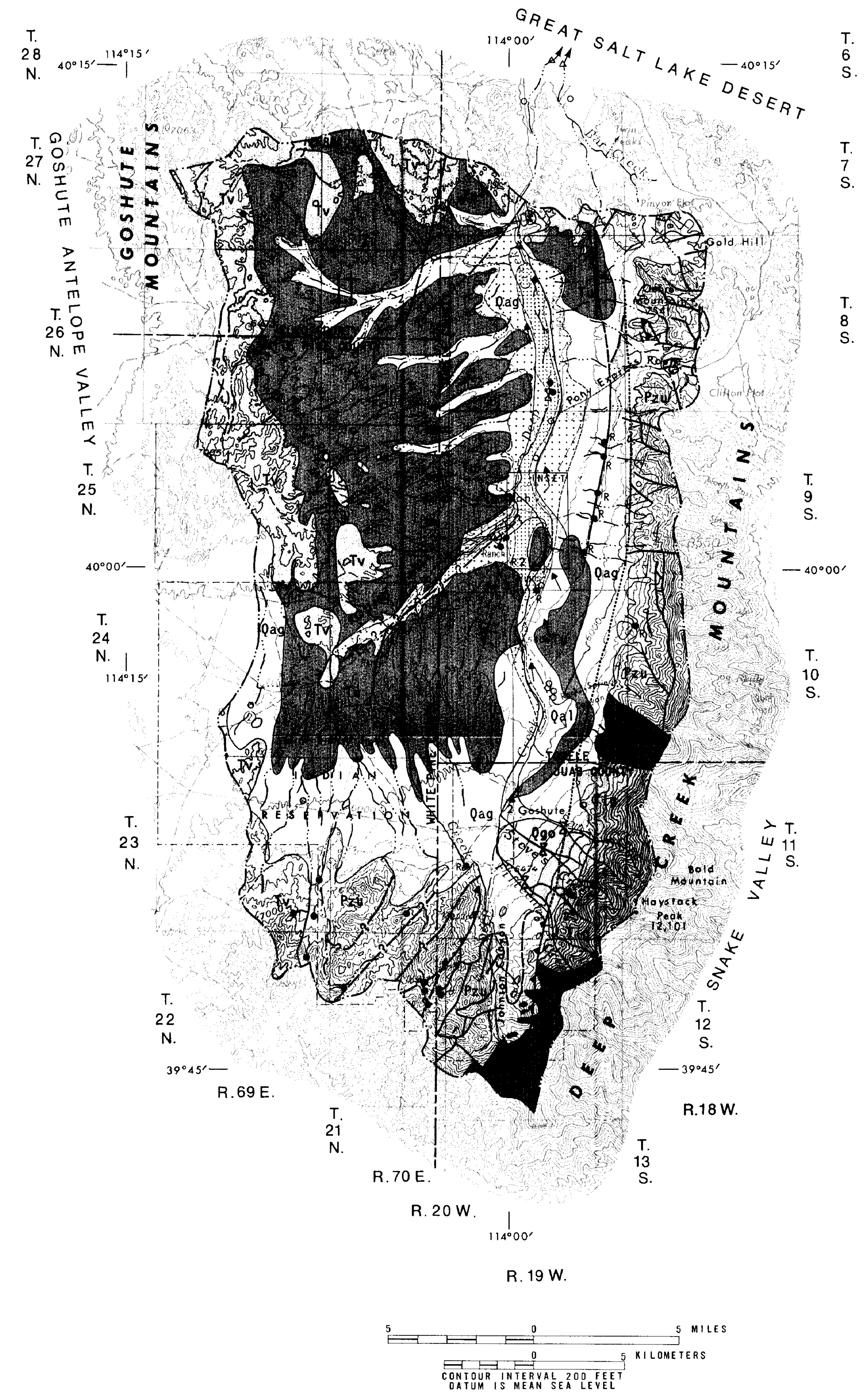
No. 16. Summary of water well drilling activities in Utah, 1960 through 1965, compiled by Utah State Engineer's Office, 1966.

No. 17. Bibliography of U.S. Geological Survey Water Resources Reports for Utah, compiled by Olive A. Keller, U.S. Geological Survey, 1966.

No. 18. The effect of pumping large-discharge wells on the ground-water reservoir in southern Utah Valley, Utah County, Utah, by R. M. Cordova and R. W. Mower, U.S. Geological Survey, 1967.

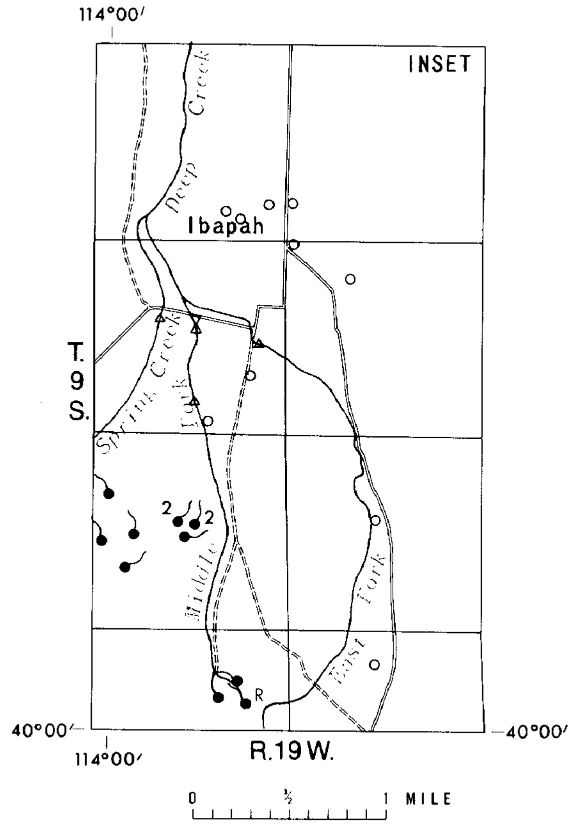
No. 19. Ground-water hydrology of southern Cache Valley, Utah, by L. P. Beer, 1967.

No. 20. Fluvial sediment in Utah, 1905-65, A data compilation, by J. C. Mundorff, U. S. Geological Survey, 1968.

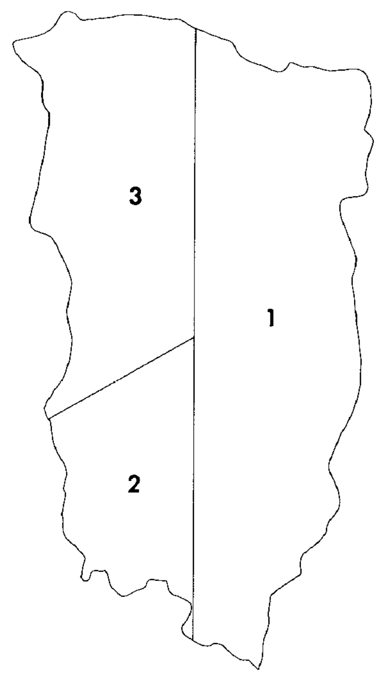


Generalized geology and hydrology

Base from U.S. Geological Survey 1:250,000 (AMS) series: Utah and Nevada: Tooele (1962), Delta (1962), Elko (1962), and Ely (1962)



Inset shows locations of wells, springs, and surface-water sites in vicinity of Ibapah



Geology was compiled by J. W. Hood from the following sources:

1. After Stokes (1964).
2. After Intermountain Association of Petroleum Geologists-Eastern Nevada Geological Society (1960).
3. Reconnaissance photogeology with little field checking by J. W. Hood, 1966-67.

Hydrology by J. W. Hood, 1966-67

EXPLANATION

GEOLOGY

Cenozoic — QUATERNARY

Qal — Alluvium
Mainly clay and silt, but contains some sand and coarser deposits; low permeability

Qgo — Glacial outwash
Permeability probably is high in part; a part of the recharge area

Qag — Alluvium and colluvium
Along margins of the Deep Creek Mountains, the deposits are mostly coarse grained and are the main recharge area; in gentler slopes and near streams on the west side of the drainage basin, deposits are fine to coarse grained and contain interbeds of silt similar to loess; main water-bearing unit in valley; low to high permeability

Cenozoic — TERTIARY

Tu — Consolidated and semiconsolidated sedimentary rocks and interbedded pyroclastics
Siltstone, claystone, conglomerate, limestone, and tuff; permeability probably low to moderate; may yield water to wells in valley

Tv — Extrusive igneous rocks and associated pyroclastics
Permeability is low, although some "lava' may have high permeability locally

Tig — Intrusive igneous rock
Generally low permeability, but may transmit water through joints and fractures; enhances runoff

Paleozoic — MIDDLE CAMBRIAN to PERMIAN

Pzu — Consolidated sedimentary and metasedimentary rocks
Consolidated siltstone, shale, sandstone, conglomerate, limestone, dolomite, and quartzite; low bulk permeability, but high secondary permeability along joints, shattered zones, and cavernous zones in carbonate rocks; a part of the recharge area

Precambrian and Paleozoic — PRECAMBRIAN and LOWER CAMBRIAN

€lu/p€u — Consolidated sedimentary and metasedimentary rocks
€lu, *undivided, includes quartzite and some sandstone and shale;* p€u, *undivided, consists mainly of argillite and quartzite. Both have low permeability, but may transmit water through joints and fractures; enhances runoff*

Approximate contact

Fault
Dashed where inferred; dotted where concealed

Thrust fault
Barbs on side of thrust sheet

Anticline
Showing trace of axial plane

Syncline
Showing trace of axial plane

Dip and strike of beds

HYDROLOGY

Direction of ground-water movement
Dashed where inferred

Spring
R, *record in table 13*

Nonflowing *Flowing*
Well
(see table 13)

Gaging station
(see table 5)

Partial record or miscellaneous discharge data site
(see tables 10, 11, and 12)

Site sampled for chemical analysis of surface water (see table 15)
Estimates of discharge in table 10

Number by symbol indicates more than one data site at location shown

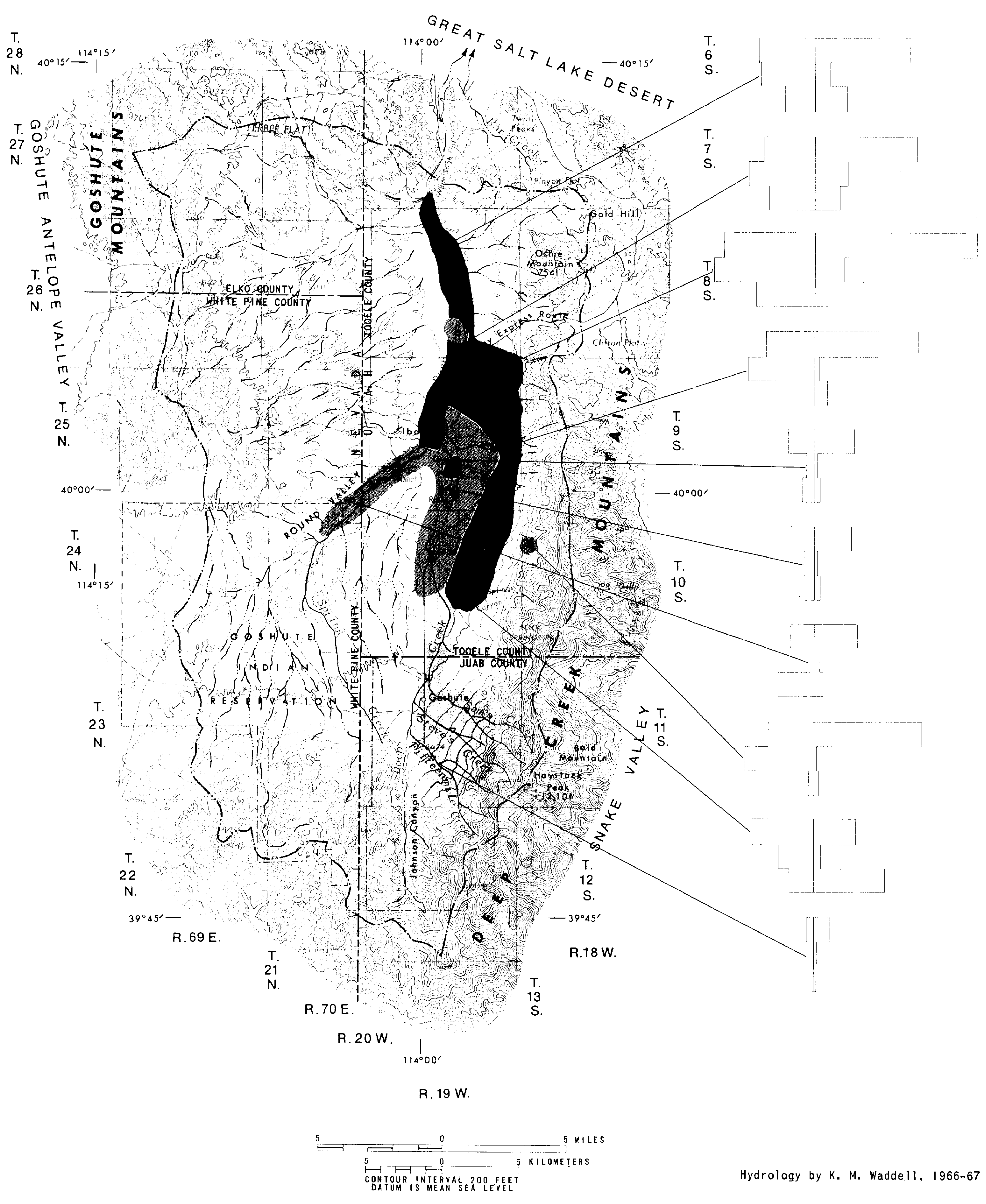
Boundary of drainage basin

AREAS OF EVAPOTRANSPIRATION
(see table 8)

Boundary of evapotranspiration area

Bottom land
General depth to water is 0-5 feet. Large rates of discharge from areas of native and cultivated grasses, phreatophytes, and small areas of open water

Slopes adjacent to bottom land
General depth to water is 5-50 feet. Mainly greasewood with local concentrations of rabbitbrush



Generalized distribution of dissolved solids in ground and surface waters and the chemical character of representative water samples

Hydrology by K. M. Waddell, 1966-67

EXPLANATION

CHEMICAL QUALITY OF WATER

Concentration of dissolved solids, in milligrams per liter

Streams

Less than 100

Wells, springs, and streams

100-250

250-500

500-750

No data available

Calcium (Ca) — *Bicarbonate (HCO_3)*
Magnesium (Mg) — *Sulfate (SO_4)*
Sodium (Na) + potassium (K) — *Chloride (Cl)*

5 4 3 2 1 0 1 2 3 4 5
MILLIEQUIVALENTS PER LITER

Bar diagrams showing concentrations of cations and anions, in milliequivalents per liter, for representative analyses of water

HYDROLOGY

Well
Chemical analysis in table 16

Spring
Chemical analysis in table 16

Stream sampling site
Chemical analysis in table 15

Boundary of drainage basin

HYDROGEOLOGIC MAPS OF THE DEEP CREEK VALLEY DRAINAGE BASIN, TOOELE AND JUAB COUNTIES, UTAH, AND ELKO AND WHITE PINE COUNTIES, NEVADA