STATE OF NEVADA
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF WATER RESOURCES
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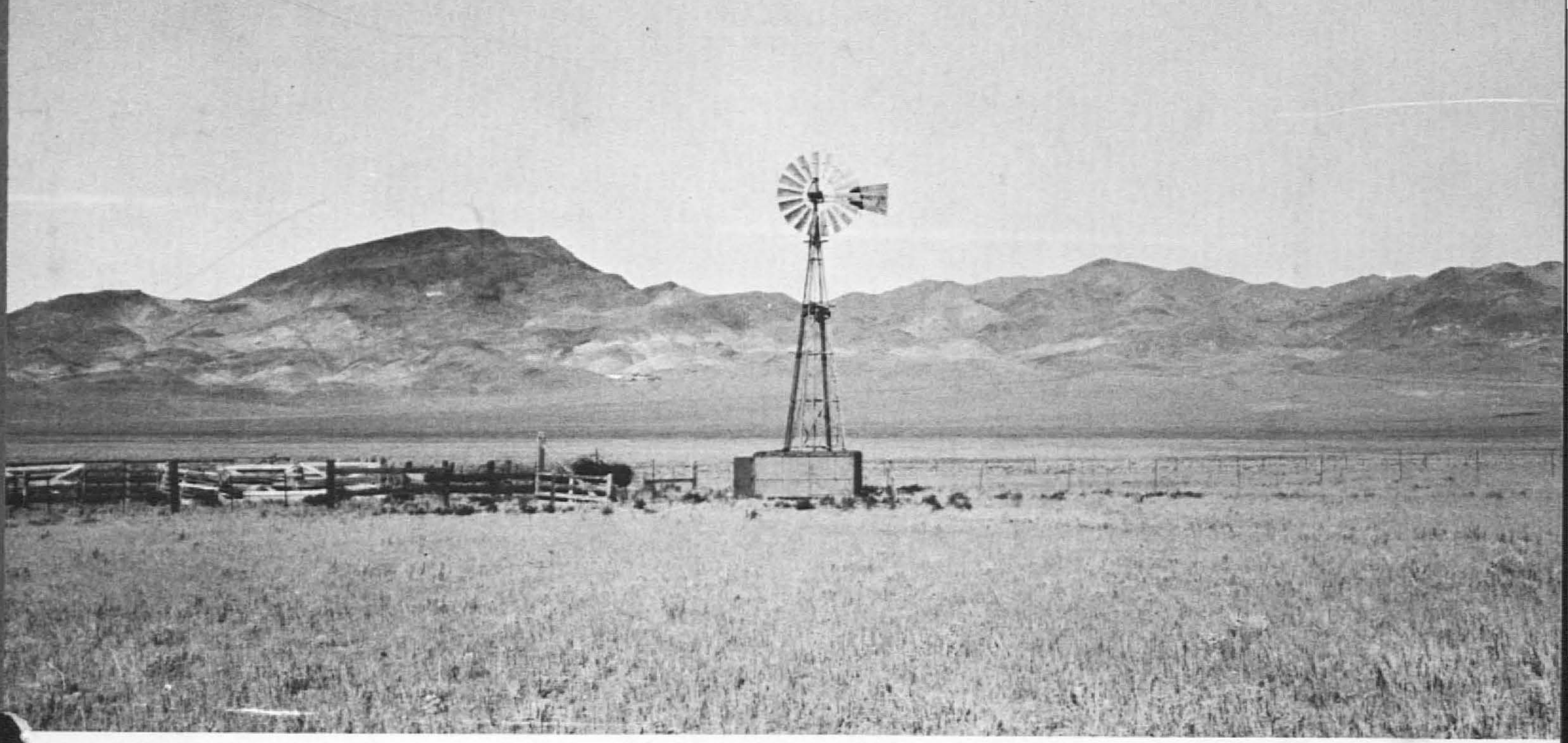

Well 29/29–14b, Seven Troughs Range in background.

WATER RESOURCES–RECONNAISSANCE SERIES

REPORT 55

WATER–RESOURCES APPRAISAL OF THE GRANITE SPRINGS VALLEY AREA, PERSHING, CHURCHILL, AND LYON COUNTIES, NEVADA

By
J. R. Harrill

Prepared cooperatively by the
Geological Survey, U.S. Department of the Interior

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Hydrologist

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FOREWORD

The program of reconnaissance water-resources studies was authorized by the 1960 Legislature to be carried on by Division of Water Resources of the Department of Conservation and Natural Resources in cooperation with the U.S. Geological Survey.

This report is the 55th in the series to be prepared by the staff of the Nevada District Office of the U.S. Geological Survey. These 55 reports describe the hydrology of 189 valleys.

The reconnaissance surveys make available pertinent information of great and immediate value to many State and Federal agencies, the State cooperating agency, and the public. As development takes place in any area, demands for more detailed information will arise, and studies to supply such information will be undertaken. In the meantime, these reconnaissance studies are timely and adequately meet the immediate needs for information on the water resources of the areas covered by the reports.

Roland D. Westergard
Roland D. Westergard
State Engineer

1971

Division of Water Resources

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WATER-RESOURCES APPRAISAL OF THE GRANITE SPRINGS VALLEY AREA, PERSHING, CHURCHILL, AND LYON COUNTIES, NEVADA

By J. R. Harrill

INTRODUCTION

Purpose and Scope of the Study

Ground-water development in Nevada has shown a substantial increase in recent years. A part of this increase is due to the effort to bring new land into cultivation. The increasing interest in ground-water development has created a substantial demand for information on ground-water resources throughout the State.

Recognizing this need, the State Legislature enacted special legislation (Chapter 181, Statutes of 1960) for beginning a series of reconnaissance studies of the ground-water resources of Nevada. As provided in the legislation, these studies are being made by the U.S. Geological Survey in cooperation with the Nevada Department of Conservation and Natural Resources. This is the 55th report prepared as part of the reconnaissance studies (fig. 1).

During the course of the earlier ground-water studies, little information on surface-water resources was presented. Later the reconnaissance series was broadened to include preliminary quantitative evaluations of the surface-water resources in the valleys studied.

The objectives of the reconnaissance studies and this report are to (1) describe the hydrologic environment, (2) appraise the source, occurrence, movement, and chemical quality of water in the area, (3) estimate average annual recharge to and discharge from the ground-water reservoir, (4) provide preliminary estimates of perennial yield and transitional storage reserve, and (5) estimate present and evaluate potential development in the area.

Field work for this report was done in November 1969.

Analog Model Simulation

Electrical analog models are scaled-down versions of the aquifer flow system constructed from suitable electronic components. Electrical flow through a model and water flow through an aquifer are defined by congruent laws.

A steady-state electrical analog model of part of the study area was built to simulate the interrelation of recharge, discharge, hydraulic gradients, transmissivity, and boundary conditions of the valley-fill reservoir under natural conditions. The model was constructed from conductive paper at the same scale as plate 1, and provided a two-dimensional analysis of the flow system. Evaluation of modeled results provided information used to help define the flow system, to estimate average transmissivity, and to check the compatability of recharge and discharge estimates with hydraulic gradients measured in the field. These results are discussed in the appropriate sections of the text.

Location and General Features

The area covered by this report is in west-central Nevada. It is centered about 60 miles northeast of Reno and about 25 miles west of Lovelock, as shown on plate 1.

The area covered about 1,540 square miles and is composed of four valleys, which are shown on plate 1. From north to south these valleys are: (1) Kumiva Valley; (2) Granite Springs Valley, which includes tributary Sage Hen Wash and Sage Valley; (3) Fireball Valley, which is also called North Valley; and (4) Bradys Hot Springs Area. Bradys Hot Springs Area is composed of two valley segments. The north segment receives surface inflow from Fireball Valley and drains through a bedrock constriction to the southern segment which extends south to Fernley, Nevada. The study area includes only the north part of this segment, the boundary is drawn across the approximate center of the Fernley Sink, a shallow lake about 5 miles northeast of Fernley.

Location and names of mountain ranges and principal roads are shown on plate 1.

Previous Work

Previous work is limited largely to studies of the geology and mineral deposits of the area. Tatlock (1969) compiled a preliminary geologic map of Pershing County. Lincoln (1923) described the geology and history of several mining districts in the area of study. Shamberger (written commun., 1969) compiled a history of the Seven Troughs Mining District which includes information about water supplies. No hydrologic studies have been made of the area; however, several well sites and springs were canvassed by Z. F. Zdenek of the U.S. Geological Survey in 1960 and 1961. Adjacent Lovelock Valley and Black Rock Desert have been studied at reconnaissance level by Robinson and Fredericks (1946), Everett and Rush (1965), Eakin and Lamke (1966), and Sinclair (1963). Reconnaissance studies of adjacent parts of the Carson and Truckee River drainages are in progress as of 1970.

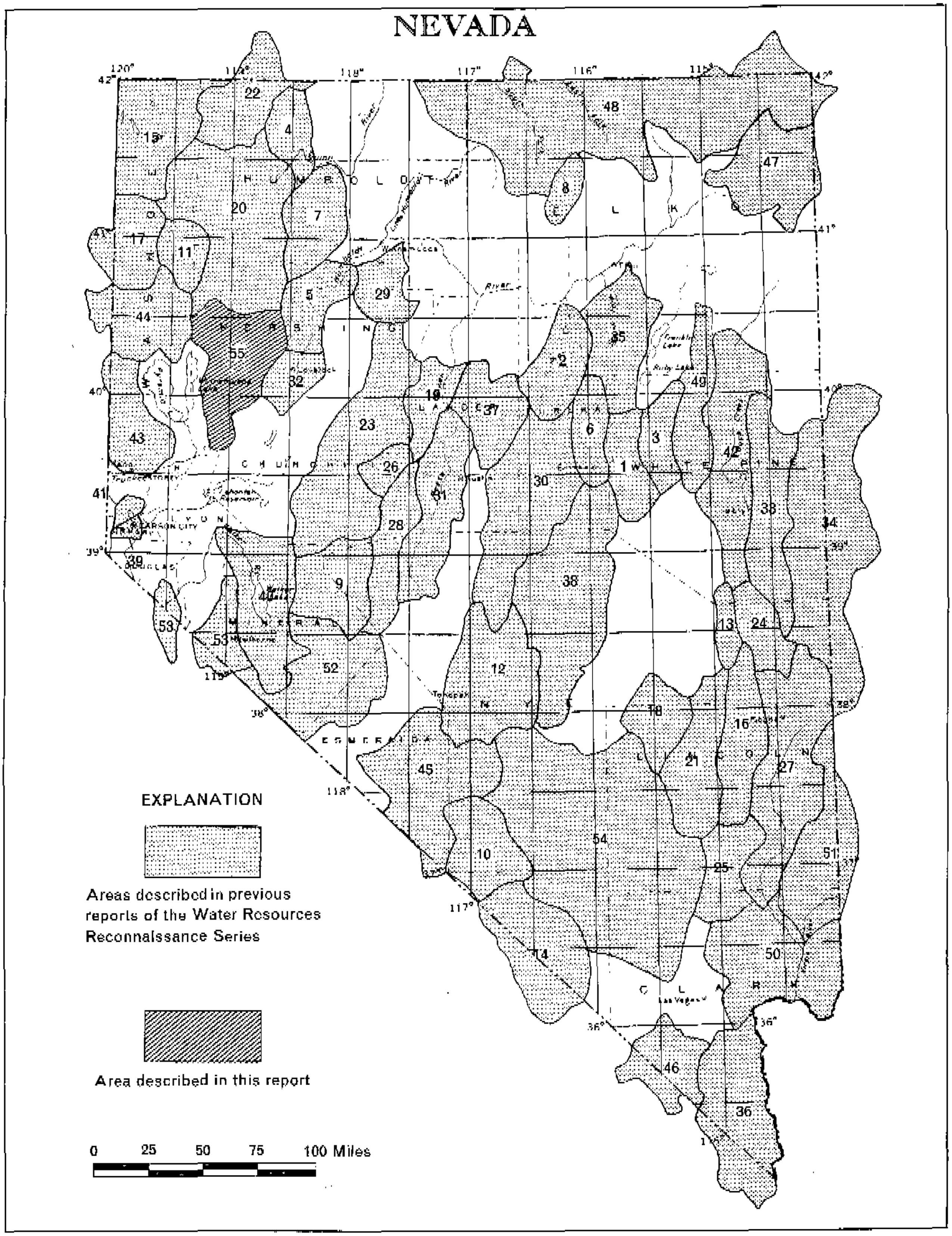

Figure 1.—Area described in this report and others in previous reports of the Water Resources Reconnaissance Series

Numbering System for Hydrologic Sites

The numbering system for hydrologic sites in this report is based on the rectangular subdivision of the public lands, referenced to the Mount Diablo base line and meridian. It consists of three units: The first is the township north (N) of the base line; the second unit, separated from the first by a slant, is the range east (E) of the meridian; the third unit, separated from the second by a dash, designates the section number. The section number is followed by a letter that indicates the quarter section and quarter-quarter section where applicable, the letters a, b, c, and d designate the northeast, northwest, southwest, and southeast quarters, respecively. For example, well 24/26-12bb is the well recorded in the NW¼ of the NW¼ section 12, T. 24 N., R. 26 E., Mount Diablo base line and meridian.

Because of limitation of space, wells and springs are identified on plate 1 only by section number, quarter section or quarter-quarter section letters. Township and range numbers are shown along the margins of the area on plate 1.

HYDROLOGIC ENVIRONMENT

Physiography and Drainage

Valleys in the study area are structural depressions which have been partly filled by debris from the surrounding mountains. Kumiva Valley and Granite Springs Valley are topographically closed basins; Fireball Valley and Bradys Hot Springs Area are not.

Principal landforms in the valleys are alluvial aprons which border the mountains, are composed of coalescing alluvial fans and pediments, and slope toward the center or low part of the valley which typically contains a playa. Sand dunes formed by fine materials blown from the playa commonly border parts of the playa. In most of the area, the apron has not been deeply dissected by the present day ephemeral stream channels which carry intermittent runoff from the mountains toward the playa.

All drainage in the two closed valleys is toward the playas. Fireball Valley drains to Bradys Hot Springs Area which in turn drains to a shallow lake along the southern boundary of the area. The drainage network is shown on plate 1.

Lithologic Units

Lithologic units in the report area are divided into two major groups on the basis of their hydrologic properties. These are (1) unconsolidated deposits, which form the valley fill, are highly porous, and commonly transmit water readily; and (2) consolidated rocks which occur in the mountains and at depth beneath the valley fill, commonly have low porosities and permeabilities, and except where highly fractured or altered by other secondary features, do not readily transmit appreciable quantities of water.

The four principal lithologic units used in this report are described in table 1. Distribution of the units listed in table 1 is shown on plate 1.

Climate

Climate in the study area ranges from arid in the valleys to subhumid in the higher mountains. Precipitation and humidity generally are low and summer temperatures and evaporation are high. Precipitation varies widely in amount but is generally least on the valley floor and greatest in the mountains. Snow is common during the winter months but a significant winter snowpack does not accumulate in the mountains during most years

Table 1.--Principal lithologic units

System	Series		Unit designation	Estimated thickness (feet)	Lithology	Occurrence	General hydrologic properties
QUATERNARY	Holocene	VALLEY FILL	Playa deposits	0-100±	Silt, clay, and evaporites, includes some eolian deposits.	As shown on plate 1.	High interstitial porosity and low permeability. Do not yield water readily to wells.
	Pleistocene and Holocene		Alluvium	0-1,000±	Alluvial and colluvial deposits of sand, gravel, silt, and clay. Materials range from well sorted to poorly sorted and form lenticular deposits. Younger surficial deposits along ephemeral channels and in the central parts of the valleys are unconsolidated. Older deposits exposed on dissected fans and at depth may be partly consolidated in localized areas.	As shown on plate 1.	Sand and gravel deposits moderately to highly permeable and may yield large quantities of water to wells. Fine-grained sand, silt, and clay are less capable of yielding water to wells.
TERTIARY		CONSOLIDATED ROCKS	Volcanic and sedimentary rocks	--	Volcanic rocks, rhyolite, andesite, and basalt. Sedimentary rocks, typically fine-grained sediments include some sandstone.	As shown on plate 1.	Do not readily transmit water. In some areas volcanic rocks may transmit significant quantities of water along fractures or zones between flows. Sediments may transmit significant quantities of water where they are highly fractured.
JURASSIC AND CRETACEOUS			Granitic and metamorphic rocks	--	Granitic rocks, principally granodiorite; metamorphic rocks, principally shale, phyllite, quartzite, and limestone.	As shown on plate 1.	Granitic rocks have virtually no interstitial porosity and permeability, may transmit small quantities of water through near-surface fractures and weathered zones. Metamorphic rocks commonly have low interstitial porosities and permeabilities, may transmit some water through areas where fractures have not been sealed by secondary minerals or where solution features have developed in the carbonate rocks.

because of their comparatively low altitudes and relief. Localized thunderstorms provide most of the summer precipitation.

Table 2 lists the average monthly and annual precipitation at 13 stations in and adjacent to the area. Location of the stations is shown on plate 1.

Freeze data published by the U.S. Weather Bureau for Fernley, Lovelock, Lovelock FAA Airport, and Pahute Meadows Ranch are listed in table 3. They may be used to estimate the approximate length of the growing season in the study area, which is determined largely by temperature and varies with the type of crop grown. For example, a crop which experiences a killing frost at 28°F should have a growing season of 150 to 170 days in the study, whereas crops which are killed by the first 32°F freeze should have growing seasons of only 130 to 150 days.

The growing season at Lovelock FAA Airport is shorter than at Lovelock. This difference may be due to thermal inversions which are common in closed valleys in Nevada. Similar conditions may exist in Granite Springs Valley and Kumiva Valley where the areas with the longest growing seasons may be on the slopes of the apron.

Table 2.--Average monthly and annual precipitation, in inches, at 14 stations in west-central Nevada

Location[1]	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1 Brown	.68	.59	.33	.45	.27	.22	.06	.07	.08	.38	.20	.50	3.83
2 Fernley	.80	.59	.39	.38	.59	.26	.22	.27	.24	.26	.39	.58	4.97
3 Gerlach	.71	.64	.46	.47	.63	.54	.14	.16	.24	.44	.51	.75	5.69
4 Hot Springs	.62	.43	.23	.34	.26	.25	.09	.07	.04	.12	.37	.47	3.29
5 Jungo	.40	.41	.16	.30	.31	.24	.06	.22	.40	.40	.32	.53	3.75
6 Lovelock	.65	.55	.46	.40	.49	.43	.16	.18	.30	.40	.40	.45	4.87
7 Lovelock FAA Airport	.39	.37	.33	.37	.73	.48	.18	.25	.36	.28	.48	.33	4.55
8 Majuba Mountain	--	--	--	--	--	--	--	--	--	--	--	--	10.8
9 Nixon	.81	.82	.58	.56	.57	.62	.23	.22	.34	.60	68	.77	6.80
10 Pahute Meadows Ranch	.74	.36	.33	.43	.47	.84	.20	.31	.43	.09	1.27	.71	6.18
11 Sand Pass	.95	.84	.57	.45	.53	.49	.19	.12	.31	.47	.58	.94	6.44
12 Soldiers Meadow	.88	.32	.22	.58	.68	1.26	.05	.44	.24	.19	.99	.88	6.73
13 Sulphur	.64	.53	.34	.39	.51	.34	.11	.11	.32	.56	.41	.61	4.88

[1]	Altitude	Location Section	Location Township	Location Range	Period of record	Remarks
1	3,929	18	25 N.	30 E.	1870-1893	Some months missing
2	4,150	11	20 N.	24 E.	1870-1951, 1954-68	
3	3,940	14	32 N.	23 E.	1913-57, 1963-68	1952-57 records for Empire, Nev.
4	4,072	12	22 N.	26 E.	1870-1899, 1901	Some months missing
5	4,165	10	35 N.	32 E.	1915-25	
6	3,977	27	27 N.	31 E.	1891-1966, 1968	
7	3,900	1	25 N.	30 E.	1948-68	
8	6,000	31	33 N.	31 E.	1963-67	Storage gage; long-term average may be lower than 4-year average
9	3,900	1	22 N.	23 E.	1928-53, 1962-68	Some months missing
10	4,375	7	39 N.	29 E.	1963-68	Some months missing
11	4,198	30	28 N.	20 E.	1913-63, 1966-68	Some months missing
12	4,550	7	40 N.	25 E.	1963-66	Some months missing
13	4,044		35 N.	29 E.	1914-46, 1948-53	Some months missing

Table 3.--Longest period, in days, in which temperatures did not go below the indicated values at four stations in west-central Nevada

	Fernley[1]			Lovelock[2]			Lovelock FAA Airport[3]			Pahute Meadows Ranch[4]		
Year	24°F	28°F	32°F	24°F	28°F	32°F	24°F	28°F	32°F	24°F	28°F	32°F
1950	144	144	134	227	145	135	144	114	110	--	--	--
1951	203	186	144	202	194	144	188	187	131	--	--	--
1952	201	125	124	225	202	197	202	184	90	--	--	--
1953	--	--	--	220	180	159	178	156	131	--	--	--
1954	--	--	--	207	175	116	139	104	102	--	--	--
1955	183	183	128	183	180	134	181	152	124	--	--	--
1956	201	191	181	204	203	152	203	154	152	--	--	--
1957	214	171	140	193	162	126	205	172	139	--	--	--
1958	153	151	150	181	152	149	172	150	139	--	--	--
1959	201	161	147	201	195	147	165	121	108	--	--	--
1960	174	145	144	181	145	143	145	124	91	--	--	--
1961	207	182	148	185	158	135	170	148	133	--	--	--
1962	222	168	139	238	191	151	190	139	121	--	--	--
1963	187	179	151	193	179	179	183	179	154	--	--	--
1964	164	136	112	192	171	164	202	197	116	181	164	164
1965	164	137	129	235	137	129	187	134	128	134	127	123
1966	170	170	167	170	170	167	170	166	146	--	--	121
1967	168	146	106	--	--	--	167	145	143	183	166	--
1968	169	146	130	--	--	130	169	130	129	156	155	129
Average	184	160	140	202	173	148	177	150	126	164	153	134

1. Altitude 4,150 feet.
2. Altitude 3,977 feet.
3. Altitude 3,900 feet.
4. Altitude 4,375 feet.

VALLEY-FILL RESERVOIR

Extent and Boundaries

The alluvial deposits of the valleys, as shown on plate 1, form the valley-fill reservoirs which are the principal source of ground water in the area. There is insufficient information available to adequately evaluate the thickness of the valley fill. The deepest well in the area is at the southern end of Granite Springs Valley (24/26-12b) and is 600 feet deep. It was bottomed in soft blue clay. The reservoirs beneath the valley floors probably are as much as 1,000 feet thick near the centers of all valleys except Fireball Valley. Valley-fill deposits in Fireball Valley probably are less than 1,000 feet thick.

External hydraulic boundaries are formed by the consolidated rocks that underlie and form the sides of the valley-fill reservoirs (pl. 1). These boundaries are leaky to varying degrees, depending on the type of rocks and the degree of structural deformation

Transmissivities and Storage Coefficients

Transmissivity is a measure of capacity of an aquifer system to transmit ground water. The storage coefficient in a heterogeneous valley-fill reservoir is a measure of the amount of water that will drain by gravity. When utilized together in certain types of mathematical or analog models, the transmissivity and storage coefficient can be used to define the distribution and amount of water-level decline that would result under certain conditions of pumping and boundary conditions.

Average transmissivity values were approximated for Granite Springs Valley and Kumiva Valley by constructing a steady-state electrical analog model, based on the distribution of recharge and discharge as estimated in this report, and the measured water-level altitudes in wells. Best agreement between the actual and model water-level altitudes in central Granite Springs Valley was obtained when a transmissivity of about 30,000 gallons per day per foot was used in the model. Best agreement in Kumiva Valley and Sage Valley was obtained when transmissivity values of 10,000 to 15,000 gallons per day were used in the model. These average values are first approximations which suggest probable transmissivity values for large areas of the valley fill. Values for actual wells are affected by local conditions and may vary significantly from the average values.

A valley-fill reservoir under long-term pumping conditions generally functions as an unconfined aquifer or water-bearing zone; under such conditions, the storage coefficient may be nearly equal to the specific yield. The coefficient of storage of the valley fill is estimated from well logs and field observations to be at least 0.1, which is equivalent to a specific yield of 10 percent.

Source, Occurrence, and Flow of Ground Water

Virtually all ground water in the valley-fill reservoirs is derived from the infiltration of precipitation that falls within the basins. Most deep infiltration is from runoff and occurs on the slopes of the alluvial apron; however, some deep infiltration also occurs in the mountains where percolating water moves along bedrock fractures to the zone of saturation.

Ground water occurs in the saturated part of the valley fill where it occupies the interstices present in the granular clastic deposits and chemical precipitates. It is generally at shallow depths in areas of ground-water discharge near the centers of the valleys, but may be several hundred feet below land surface along the upper margins of the valleys. Figure 2 shows approximate depths to water in the fall of 1969.

Ground water moves from areas of high hydraulic head to areas of lower hydraulic head. The rate of movement depends on the hydraulic gradient and the permeability and porosity of the material through which water is moving. Typical rates range from several feet per year to several hundred feet per year. The horizontal movement of ground water in the valley fill is parallel to the slope of the water surface. A downward component of movement occurs in areas of recharge and an upward component occurs in areas of evapotranspiration. The general directions of ground-water movement may be inferred from plate 1, which shows point values of approximate altitudes of fall water levels in 1969. Insufficient information is available to draw water-level contours.

Most ground water in Kumiva Valley probably moves as underflow to Granite Springs Valley. Ground water in Granite Springs Valley moves from the mountains and tributary areas toward the playa and phreatophyte areas shown on plate 1. Ground water in Fireball Valley probably moves as underflow to Bradys Hot Springs Area. Ground water in Bradys Hot Springs Area moves toward the discharge area shown on plate 1. There is some underflow into Bradys Hot Springs Area from the Fernley Area (see p. 22).

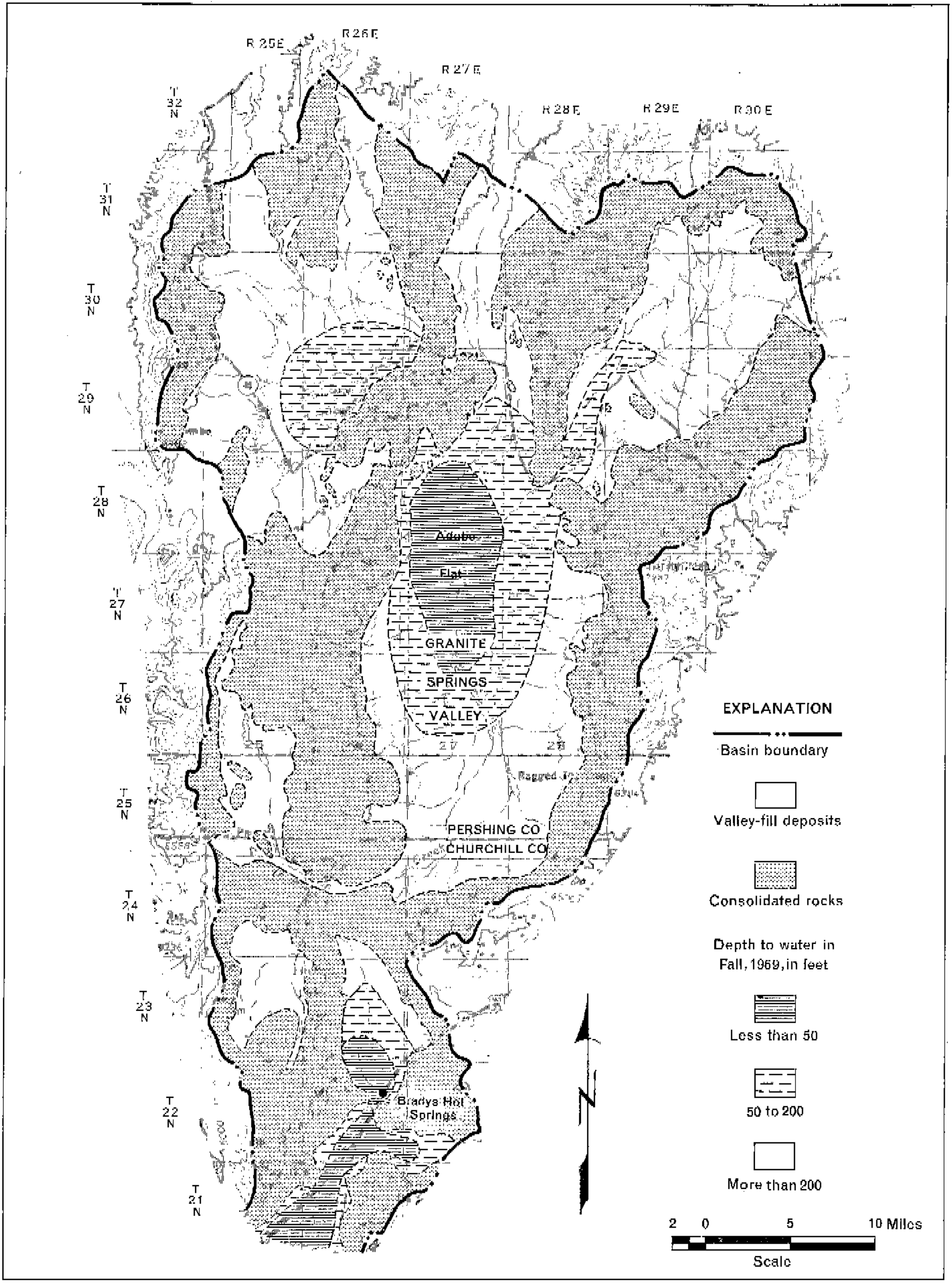

Figure 2.— Approximate depth to water, Fall 1969

INFLOW TO THE VALLEY-FILL RESERVOIR

Inflow to the valley-fill reservoir is from precipitation, runoff, inflow from outside the area (to Bradys Hot Springs Area), and from infiltration of ground water through consolidated rocks and alluvium.

Precipitation

Precipitation, falling as snow or rain, is the principal source of water entering the hydrologic systems of the study area. Part of the precipitation is evaporated directly from vegetation or the ground surface, part runs off as surface flow, part infiltrates to shallow depths where it replenishes soil moisture, and part eventually infiltrates to the zone of saturation where it recharges the ground-water system.

The precipitation pattern in Nevada is related principally to the topography (Hardman, 1936); stations at higher altitudes generally receive more precipitation than those at lower altitudes. However, this general relation may be considerably modified by local conditions. The valley floors of the report area generally receive less than 8 inches of precipitation per year.

Estimates of average precipitation in the four areas are summarized by altitude zones in table 6. The estimates are based on the precipitation-altitude relation shown by Hardman's (1936) map, as revised in 1964, and on the precipitation data listed in table 3.

Runoff

By T. L. Katzer

Available Records

There are no continuous recording or nonrecording gaging stations within the project area. The only perennial stream is in Stonehouse Canyon in the northeast corner of the project area. Flow there was estimated to be 1 cfs (cubic foot per second) on Dec. 22, 1969, and 0.1 cfs on Feb. 26, 1970. The estimate in December was made one day after a heavy rainstorm. The stream is ephemeral in its lower reaches.

Streamflow Characteristics

Of the 508 square miles of area above 5,000 feet altitude, only 5.7 square miles are above 7,000 feet. The highest peak in the area is 8,226 feet and is in the Selenite Range in the northwestern part of the report area. Even though the mountains are moderately high, the area is very dry. Runoff is dependent primarily on high intensity precipitation rather than on snowmelt.

The runoff record of Newark Valley tributary near Hamilton, Nevada, (partial-record station) is presented in table 4 to show the distribution of runoff that can be expected from the ephemeral streams in the report area. All of the runoff recorded at the Newark gage is the result of summer thunderstorm activity or high intensity precipitation on a snowpack. Generally, storms are not severe or extensive enough to produce a lasting snowpack, and much of the snow will sublimate or melt and evaporate prior to runoff.

Estimated Runoff

Because no records of streamflow are available for the project area, the amount of runoff from the mountain blocks that reaches the alluvial-bedrock contact must be calculated by indirect methods (Moore, 1968). The amount of runoff crossing the 5,000-foot altitude was estimated from a regional altitude-runoff relation, which was refined by measuring the channel geometry of several ephemeral streams at the alluvial-bedrock contact. Table 5 shows the estimated runoff from the mountain blocks to each of the valleys within the project area.

Recharge from Precipitation

On the valley floors, where precipitation is small, little water infiltrates directly to the ground-water reservoir. Much of the precipitation is evaporated and transpired after infiltration, and some adds to soil moisture. Greater precipitation in the mountains provides most of the recharge. Some of the water reaches the ground-water reservoir by infiltration of runoff on the alluvial apron and the valley floor and some by lateral underflow from the consolidated rocks.

A method described by Eakin and others (1951, p. 79-81) is used to estimate the average annual recharge from precipitation. The method assumes that a percentage of the average annual precipitation becomes ground-water recharge. The estimated average annual recharge for the four valleys listed in table 6 is about 1 percent of the estimated total precipitation. A range of 3 to 7 percent is typical of the amounts usually calculated by this method for the desert basins of Nevada. Thus, the estimated recharge may seem low when compared to other valleys, but may be reasonable for this area because of the usual lack of a winter snowpack on most of the mountains. Even so, the estimated recharge is more than the estimated runoff at the mountain front, which if true, would suggest that much of the recharge must occur in the mountain blocks.

Table 4.-- Record of runoff for Newark Valley tributary near Hamilton, Nevada, water years 1963-69

Month	1963		1964		1965		1966		1967		1968		1969	
	Acre-feet	Days of flow	Acre-feet	Days of flow	Acre-feet	Days of flow	Acre-feet	Days of flow	Acre-feet	Days of flow	Acre-feet	Days of flow	Acre-feet	Days of flow
October	--	--	0.6	1	--	--	--	--	--	--	--	--	--	--
November	--	--	--	--	--	--	--	--	--	--	--	--	--	--
December	--	--	--	--	--	--	--	--	--	--	--	--	--	--
January	--	--	--	--	--	--	--	--	--	--	--	--	0.2	1
February	--	--	--	--	--	--	0.2	1	0.8	3	--	--	0.2	1
March	--	--	--	--	--	--	25	10	--	--	--	--	605	15
April	--	--	--	--	--	--	--	--	--	--	--	--	44	17
May	--	--	--	--	--	--	--	--	0.2	1	--	--	--	--
June	2.4	2	0.6	2	--	--	--	--	0.4	1	--	--	--	--
July	--	--	--	--	0.4	1	0.3	2	0.2	1	48	1	--	--
August	1.2	2	--	--	18	6	--	--	--	--	12	3	113	4
September	0.4	2	--	--	3	1	--	--	4.2	3	5	1	--	--
Total	4.0	6	1.2	3	21.4	8	25.5	13	5.8	9	65	5	762	38

Table 5.--Estimated average annual runoff

Hydrographic area	Area above 5,000 feet altitude (acres)	Estimated runoff (acre-feet per year)
Kumiva Valley	75,200	610
Granite Springs Valley	213,000	1,800
Fireball Valley	20,600	160
Bradys Hot Springs Area	16,300	110

Table 6.--Estimated average annual precipitation and ground-water recharge

Precipitation zone (altitude in feet)	Area (acres)	Estimated annual precipitation			Estimated recharge from precipitation	
		Range (inches)	Average (feet)	Average (acre-feet)	Percentage of precipitation	Acre-feet per year
KUMIVA VALLEY						
Above 7,500	200	15-20	1.5	300	15	50
6,500-7,500	3,300	12-15	1.1	3,600	7	250
5,500-6,500	30,000	8-12	.8	24,000	3	720
Below 5,500	181,000	<8	.5	90,000	Minor	--
Total (rounded)	214,000			120,000		1,000
GRANITE SPRINGS VALLEY						
Above 7,500	390	15-20	1.5	580	15	90
6,500-7,500	9,700	12-15	1.1	11,000	7	770
5,500-6,500	108,000	8-12	.8	86,000	3	2,600
Below 5,500	508,000	<8	.5	254,000	Minor	--
Total (rounded)	626,000			350,000		3,500
FIREBALL VALLEY						
Above 6,500	620	12-15	1.1	680	7	50
5,500-6,500	6,700	8-12	.8	5,400	3	160
Below 5,500	30,500	<8	.5	15,000	Minor	--
Total (rounded)	37,800			21,000		200
BRADYS HOT SPRING AREA						
Above 6,500	230	12-15	1.1	250	7	20
5,500-6,500	5,700	8-12	.8	4,600	3	140
Below 5,500	108,000	<8	.5	54,000	Minor	--
Total (rounded)	114,000			59,000		160

Inflow from the Fernley Area

Surface Inflow

The southern boundary of Bradys Hot Springs Area is drawn across the Fernley Sink, a shallow lake, supported primarily by surface inflow from the Fernley Area, but may be supported to a small extent by ground-water seepage. The lake area fluctuates in response to variations in surface inflow. Surface inflow to Bradys Hot Springs Area is estimated to be about equal to the net evaporation from the surface of the lake. Surface inflow from Bradys Hot Springs Area to the lake is very small.

The lake area shown on plate 1 is the same as that on the Army Map Service 1:250,000-scale, Reno map. For purposes of estimating evaporation, the effective area of the lake, due to seasonal fluctuations, is considered to be about two-thirds of the area shown on the map, or about 1,100 acres. Average annual net evaporation from the lake is about 3.6 feet, based on an annual evaporation rate of 4 feet per year minus an average annual precipitation of about 5 inches. Thus, the estimated average annual surface-water inflow to Bradys Hot Springs Area is about 4,000 acre-feet per year.

Subsurface Inflow

A hydraulic gradient from the Fernley Area to parts of Bradys Hot Springs Area is inferred from land-surface altitudes shown on the Two Tips, Nev., 15-minute topographic quadrangle, and from field observations that indicate a static ground-water surface within a few feet of land surface in the wet-playa areas. Water levels beneath the playa in the southern segment of Bradys Hot Springs Area range from altitudes of about 4,010 feet near the edge of the lake to about 4,040 feet at the abandoned salt evaporators at the north end of the playa. Water levels in the Fernley Area, about 1½ to 2 miles south of the boundary, are at altitudes of 4,040 to 4,060 feet. Thus, a hydraulic gradient of 5 to 10 feet per mile presumably exists between parts of the Fernley area and much of the discharge area in the southern segment of Bradys Hot Springs Area. Transmissivity of the valley-fill deposits in this area is not known. The yield-drawdown data for well 21/26-18b (see table 11 at the end of the report) suggests a low transmissivity. Field observations and the general geologic setting also suggest a low to moderate transmissivity for deposits in the central part of the valley. However, permeable deposits may be present along the sides of the valley and permeable zones in the volcanic bedrock may transmit some water northward. This possibility may explain in part the seepage area in secs. 13 and 18, T. 21 N., Rs. 25 and 26 E.

For purposes of computation, transmissivity of deposits in the center of the valley is assumed to be 20,000 gpd per foot and transmissivity along the margins of the valley is assumed to be 50,000 gpd per foot. Assuming an average gradient of 7 feet per mile, a width of 3 miles for the low transmissivity deposits, and a width of 1 mile for the marginal deposits, subsurface inflow from the Fernley Area is computed roughly to be 1,000 acre-feet per year. This first approximation of the subsurface inflow would be low, if significant flow occurs through permeable zones in the volcanic rocks bordering the valley.

OUTFLOW FROM THE VALLEY-FILL RESERVOIR

Evapotranspiration

Natural evapotranspiration of ground water occurs where the saturated part of the valley fill is at shallow depth. Discharge is accomplished principally in three ways: (1) by evapotranspiration in areas of phreatophytes; (2) by direct evaporation from bare soil; and (3) by evapotranspiration of spring discharge where the water level intersects the land surface.

The principal phreatophyte in the area shown on plate 1 is greasewood. Some shadscale is included in local areas in Granite Springs Valley and some saltgrass and saltbush is included in local areas in Bradys Hot Springs Area. Greasewood also grows as a xerophyte in much of Bradys Hot Springs Area and Fireball Valley and in parts of Granite Springs Valley. An example of this is in the vicinity of well 23/26-4c (depth to water 291 feet) where greasewood is a significant part of the surrounding vegetation. The greasewood mapped as a phreatophyte was restricted to areas where depth to water was about 50 feet or less.

The area of tules and saltgrass in the Bradys Hot Springs Area is supported largely by spring discharge and seepage near the bedrock-alluvial contact on the west side of the valley.

Estimates of the natural evapotranspiration of ground water are given in table 7. These estimates are based on rates of consumption of ground water, as described by Lee (1912), White (1932), Young and Blaney (1942), Houston (1950), and Robinson (1965). Little information is available concerning the rate at which ground water is evaporated from bare soil on playas. Depth to water below playas in Bradys Hot Springs Area is less than 10 feet, and the surface typically has a porous, fluffy texture. Depth to water beneath the Granite Springs Valley playa probably is slightly greater than 10 feet, because no saltgrass was observed along the margin of the playa. The southern end of the Granite Springs Valley playa has a slightly fluffy texture; however, the northern end has a firmer surface. An estimated average rate of evaporation of ground water of 0.1 foot per year is used for both the Bradys Hot Springs Area and the Granite Springs Valley playas. This rate may be slightly high in Granite Springs Valley and slightly low in Bradys Hot Springs Area.

The playa in Kumiva Valley is where minimum depth to water probably exceeds 50 feet. Consequently, it does not discharge ground water.

Table 7.--Estimated evapotranspiration of ground water[1]

Phreatophyte assemblage or type surface	Areal density	Approximate depth to water (feet)	Area (acres)	Annual evapotranspiration	
				Acre-feet per acre	Acre-feet
		GRANITE SPRINGS VALLEY			
Greasewood	Low to moderate	10-50	12,300	0.2	2,500
Greasewood and shadscale[2]	Low	40-50+	9,000	.05	450
Playa	--	10-15	14,200	.1	1,400
Total (rounded)			35,500		4,400
		BRADYS HOT SPRINGS AREA			
Principally greasewood[2] includes some saltgrass and saltbush in local areas	Low to moderate	5-50+	7,200	.2	1,500
Tules, saltgrass, and bare soil	Moderate to low	<5	700	1.25	900
Playa	--	<10	6,300	.1	630
Total (rounded)			14,200		3,000

1. No ground water is discharged by evapotranspiration in Fireball and Kumiva Valleys.

2. Assemblage may include some greasewood growing as xerophytes.

Springs

Exposures of granitic rocks in Kumiva and Granite Springs Valleys typically contain small perched springs which flow at rates up to several gallons per minute. In Kumiva Valley most of these springs have been developed for stock purposes, thereby reducing the need to drill and maintain stock wells in the valley.

The major springs in Granite Springs Valley are in the Seven Troughs Range. Porters Spring (29/28-5b), on the west side of the Seven Troughs Range, flowed about 15 gallons per minute in November 1969. The water is used for domestic and mining purposes. On the east side of the Seven Troughs Range, springs in Burnt, Seven Troughs, and Stonehouse Canyons were developed for water supplies by miners in the early 1900's. Estimated flow in Stonehouse Canyon was about 45 gallons per minute on Feb. 27, 1970.

Bradys Hot Springs Area has few perched springs in the mountains; however, rising ground water along the edges of the playa results in numerous small springs and seepage areas. Local seepage at the bedrock-alluvial contact along the east side of the playa in sec. 7, T. 21 N., R. 26 E., results in an annual discharge of about 900 acre-feet per year. There was no flow at Bradys Hot Springs (22/26-12c) in November 1969. However, prior to attempts to develop hot water and steam by drilling wells in the vicinity of the springs, there was flow of several gallons per minute. During cold weather, "steam" can be observed rising from the ground in the vicinity of the springs.

Ground-Water Development

Ground-water development in the study area is very small. In 1969 pumpage was limited to stock-water withdrawals and did not exceed 10 acre-feet in any of the areas.

Spring discharge used for stock and domestic purposes probably was less than 50 acre-feet in both Kumiva and Granite Springs Valleys, and less than 30 acre-feet in Bradys Hot Springs Area.

There was no withdrawal of water from the steam wells in Bradys Hot Springs Area in 1969. However, in past years significant quantities of water were withdrawn to develop the wells and to supply a swimming pool and other facilities located near the springs. In June 1960, one of the steam wells reportedly flowed at a rate of 600 gpm. Total withdrawal of ground water by steam wells prior to 1969 may have been several thousand acre-feet. Withdrawals of this magnitude probably are sufficient to cause flow to cease at the springs. If the steam wells remain unused for a sufficient period of time, natural spring discharge should resume.

GROUND-WATER BUDGETS

For natural conditions and over the long term, assuming that long-term climatic conditions remain reasonably constant, ground-water inflow to and outflow from an area are about equal. Thus, a ground-water budget can be used (1) to compare the estimates of natural inflow to and outflow from each valley, (2) to determine the magnitude of errors in the two estimates, provided that one or more of the elements are not estimated by difference, and (3) to select a value that, within the limits of accuracy of this reconnaissance, represents both inflow and outflow. This value in turn is utilized in a following section of the report to estimate the perennial yield of each area. Table 8 presents ground-water budgets for each area and shows the reconnaissance values selected to represent both inflow and outflow.

For Kumiva and Fireball Valleys, outflow is assumed to equal the estimated recharge, because no direct estimates of discharge were made. For Granite Springs Valley, even though some of the estimated ground-water discharge may include consumption by greasewood which may be sustained primarily by soil moisture (table 7), the estimated value of recharge agrees remarkably well with that of discharge.

A large imbalance exists between estimated inflow and outflow for Bradys Hot Springs Area. The estimated outflow is more than twice the estimated inflow. The imbalance is due either to errors in the estimates or to unresolved hydrologic factors which include the following possibilities: (1) There may be additional ground-water inflow from the Fernley Area; (2) the estimated discharge may be high. As indicated in table 7, some greasewood mapped as consuming ground water may be sustained primarily by soil moisture (the maximum reduction in outflow due to this factor is 20 percent or less); (3) the estimated recharge may be low. Prevailing winds in the area are easterly, and there is a possibility that moisture picked up over Pyramid Lake may result in higher precipitation in Fireball Valley and parts of Bradys Hot Springs Area and Sage Hen Wash than would otherwise be expected. The only data to substantiate this possibility is that average annual precipitation at Nixon (table 3) is significantly higher than at other stations at comparable altitudes. Precipitation data would have to be collected in the areas listed above to prove or disprove this possibility; and (4) there may be some subsurface inflow from parts of Granite Springs Valley. Most of Sage Hen Wash is separated from the main part of Granite Springs Valley by granitic rocks which compose the Shawave Mountains and probably do not readily transmit ground water. Some of the ground water presumably moving southward beneath Sage Hen Wash may continue to flow southward into Bradys Hot

Table 8.--Preliminary ground-water budgets

[All estimates in acre-feet per year and rounded]

Budget elements	Kumiva Valley	Granite Springs Valley	Fireball Valley	Bradys Hot Springs Area
INFLOW				
Ground-water recharge from precipitation (table 6)	1,000	3,500	200	160
Subsurface inflow (p.)				
From valleys in the study area	--	[a]1,000	--	[b]200
From Fernley Area	--	--	--	1,000
Total (rounded) (1)	1,000	4,500	200	1,400
NATURAL OUTFLOW				
Evapotranspiration (table 7)	--	4,400	--	3,000
Subsurface outflow (p.)	[c]1,000	--	[c]200	--
Total (rounded) (2)	1,000	4,400	200	3,000
IMBALANCE				
Excess of outflow over inflow (2) - (1)	(d)	-100	(d)	1,600
VALUES SELECTED TO REPRESENT INFLOW AND NATURAL OUTFLOW	1,000	4,500	200	2,500

a. From Kumiva Valley.
b. From Fireball Valley.
c. Assumed to be the same as the estimated recharge.
d. Imbalance is 0 because subsurface outflow was determined by difference.

Springs Area rather than to flow eastward and then northward to the Granite Springs Valley discharge area. Water-level data must be obtained before this possibility can be proved or disproved. Until this problem is resolved, an interim value of 2,500 acre-feet per year was selected in table 8, because the existing estimate of outflow is considered no more accurate than the estimate of inflow.

CHEMICAL QUALITY OF WATER

Ten water samples were collected and analyzed as part of the present study to make a generalized appraisal of the suitability of the water for use and to help define potential water-quality problems. These analyses are listed in table 9 along with four others made prior to this study.

Types of Water

For purposes of this report, waters are classified on the basis of their dominant anion and cation. All water samples from the Bradys Hot Springs Area were sodium chloride waters. Analyses from Granite Springs Valley included calcium bicarbonate, sodium bicabonate, and sodium chloride waters. The samples from Kumiva Valley are calcium bicarbonate or sodium bicarbonate waters.

Suitability for Use

Based on the meager data in table 9, all water samples from Granite Springs and Kumiva Valleys were of suitable quality for irrigation and domestic use. Water from beneath the Granite Springs Valley playa probably has a higher dissolved-solids content and may not be suitable for irrigation or domestic purposes. No samples of this water were obtained during this study. All water samples from Bradys Hot Springs Area exceeded limits recommended as drinking water standards by the U.S. Public Health Service (1962) and had high or very high salinity and sodium hazards in regard to irrigation use. No samples were obtained upgradient from the discharge area in the northern part of T. 23 N., R. 26 E. (pl. 1). Water quality in this part of the area may be significantly better than that indicated by the analyses in table 9. For more specific information regarding the suitability of water for use, the reader is referred to the following published references:

Type of use	Reference
Agricultural	U.S. Salinity Laboratory (1954) Scofield (1936) McKee and Wolf (1963) Wilcox (1955) Bernstein (1964)
Domestic	U.S. Public Health Service (1962)

The bacteriological quality of drinking water is important but is outside the scope of this report. If any doubt exists regarding the acceptability of a drinking-water supply, contact the Nevada Bureau of Environmental Health, Carson City.

THE AVAILABLE GROUND-WATER SUPPLY

The available ground-water supply of the four valleys in the study area consists of two interrelated entities: (1) the perennial yield, or the maximum amount of natural discharge that economically and legally can be salvaged over the long-term by pumping; and (2) the transitional storage reserve (defined below).

Perennial Yield

In Granite Springs Valley and Bradys Hot Springs Area, most of the ground-water evapotranspiration could be salvaged by properly located wells; however, in Bradys Hot Springs Area, water quality might be a limiting factor for agricultural use. In Kumiva and Fireball Valleys, where subsurface outflow is the sole means of discharge, the amount of salvable discharge is difficult to determine. The possibility of salvaging all or part of the outflow by pumping is uncertain. For the purpose of this reconnaissance it is assumed that the subsurface geohydrologic controls might permit salvage of about half the outflow by partly dewatering the valley-fill reservoir. Thus, the estimated perennial yield of the four valleys is as follows:

Kumiva Valley	500	acre-feet per year
Granite Springs Valley	4,500	do.
Fireball Valley	100	do.
Bradys Hot Springs Area	2,500	do.

Perennial yield for Granite Springs Valley includes inflow from Kumiva Valley and perennial yield for Bradys Hot Springs Area includes inflow from Fireball Valley. If the tributary areas were fully developed, the estimated maximum amount of water available on a sustained basis would be about 500 acre-feet per year in Kumiva Valley, 4,000 acre-feet per year in Granite Springs Valley, 100 acre-feet per year in Fireball Valley, and 2,400 acre-feet per year in Bradys Hot Springs Area. The yield of the Bradys Hot Springs Area would also be increased by the amount of any surface and subsurface inflow induced by development.

Transitional Storage Reserve

Transitional storage reserve has been defined by Worts (1967) as the quantity of water in storage in a particular ground-water reservoir that can be extracted and beneficially used during the transition period between natural equilibrium conditions and the new equilibrium conditions under the perennial yield concept of ground-water development. In the arid environment of the Great Basin, the transitional storage reserve of such a reservoir is the amount of stored water

Table 9.--Partial and detailed chemical analyses of water from wells, springs, and seeps

[Partial field-office and detailed laboratory analyses by the U.S. Geological Survey]

					Milligrams per liter (upper number) and milliequivalents per liter (lower number)1/										Factors affecting suitability for irrigation2/			
Location	Source	Date sampled	Temperature °F	Temperature °C	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) plus potassium (K)3/	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Hardness as $CaCO_3$	Specific conductance (micromhos per cm at 25°C)	pH (lab. determination)	Salinity hazard	Sodium-adsorption ratio (SAR)	Sodium hazard	Residual sodium carbonate (RSC)
									BRADYS HOT SPRINGS AREA								
21/26-7ad	Spring	11-13-69	60	15½	94 4.69	48 3.97	1,095 47.59	213 3.49	258 5.37	1,680 47.39	433 8.66	6,400	8.2	Very high	23	Very high	0.00(S)
21/26-18b5/	Marsh	4-23-59	65	18½	160 7.98	108 8.88	(5)	215 3.52	313 6.52	2,100 59.22	845 16.90	6,950	7.5	Very high	18	Very high	0.00(S)
22/26-12c5/	Steam well	6- 2-60	--	--	53 2.64	1.2 .10	(5)	162 2.66	377 7.85	978 29.58	138 3.76	4,090	7.3	Very high	29	Very high	0.00(S)
22/26-35a	Spring	11-12-69	--	--	122 6.09	13 1.04	2,320 101.05	188 3.08	89 1.85	3,660 103.25	357 7.13	12,000	7.7	Unsuitable	54	Very high	0.00(S)
22/27-30c5/	Well	10- 6-61	65	18½	165 8.23	14 1.17	(5)	138 2.26	--	4,430 124.97	469 9.38	13,200	7.5	Unsuitable	54	Very high	0.00(S)
23/26-33ac	Well	11-13-69	55	13	15 0.75	5 0.45	--	226 3.70	--	330 9.31	60 1.20	1,800	8.0	High	--	--	2.50(M)
									GRANITE SPRINGS VALLEY								
26/27-25b	Well	11-18-69	64	18	35 1.75	4 0.37	--	136 2.23	--	46 1.30	106 2.12	510	8.2	Low	--	--	0.11(S)
28/28-8cd	Well	11-19-69	--	--	15 0.75	3 0.27	--	108 1.77	--	91 2.57	51 1.02	510	7.9	Low	--	--	0.75(S)
29/28-5b5/	Spring	11-20-69	64	18	24 1.20	11 0.92	30 1.29	110 1.80	26 0.54	38 1.07	106 2.12	420	8.1	Low	1.3	Low	0.00(S)
29/29-6d5/	Well	9-14-61	69	20½	46 2.30	4.1 0.34	(5)	99 1.62	61 1.27	38 1.07	132 2.64	423	7.6	Low	1.0	Low	0.00(S)
30/29-19c5/	Spring	11-20-69	--	--	82 4.09	6 0.51	49 2.11	124 2.03	142 2.96	61 1.72	230 4.60	780	8.2	Medium	1.4	Low	0.00(S)
									KUMIVA VALLEY								
28/26-32ad	Spring	11-14-69	--	--	60 2.99	12 1.01	47 2.04	231 3.79	43 0.90	48 1.35	200 4.00	600	8.1	Low	1.4	Low	0.00(S)
29/24-11b	Spring	11-14-69	--	--	44 2.20	18 1.44	--	240 3.93	--	44 1.24	182 3.64	630	8.1	Low	--	--	0.29(S)
30/24-15cb	Spring	11-14-69	47	8½	32 1.50	5 0.40	--	128 2.10	--	20 0.56	100 2.00	330	8.2	Low	--	--	0.10(S)

1. Milligrams per liter and milliequivalents per liter are metric units of measure that are virtually identical to parts per million and equivalents per million, respectively, for all waters having a specific conductance less than about 10,000 micromhos. The metric system of measurement is receiving increased use throughout the United States because of its value as an international form of scientific communication. Therefore, the U.S. Geological Survey recently has adopted the system for reporting all water-quality data.

2. Salinity hazard is based on specific conductance (in micromhos) as follows: 0-750, low hazard (water suitable for almost all applications); 750-1,500, medium (can be detrimental to sensitive crops); 1,500-3,000, high (can be detrimental to many crops); 3,000-7,500, very high (should be used only for tolerant plants on permeable soils); >7,500, unsuitable. Sodium-adsorption ratio (SAR) provides an indication of what effect an irrigation water will have on soil-drainage characteristics. SAR is calculated as follows, using milliequivalents per liter: $SAR = Na/\sqrt{(Ca + Mg)/2}$. Sodium hazard is based on an empirical relation between salinity hazard and sodium-adsorption ratio. Residual sodium carbonate (expressed in milliequivalents per liter) is tentatively related to suitability for irrigation as follows: safe (S), 0-1.25; marginal (M), 1.26-2.50; unsuitable (U), >2.50. The several factors should be used as general indicators only, because the suitability of a water for irrigation also depends on climate, type of soil, drainage characteristics, plant type, and amount of water applied. These and other aspects of water quality for irrigation are discussed by the National Technical Advisory Committee (1968, p. 143-177), and the U.S. Salinity Laboratory Staff (1954).

3. Computed as the milliequivalent-per-liter difference between the determined negative and positive ions; expressed as sodium. Computation assumes that concentrations of undetermined ions--especially nitrate--are small.

4. All carbonate values 0 mg/l.

5. Detailed analyses; additional determinations listed below.

	Milligrams per liter (upper number) and milliequivalents per liter (lower number)1/										
Location	Silica (SiO_2)	Aluminum (Al)	Iron (Fe)	Sodium (Na)	Potassium (K)	Lithium (Li)	Fluoride (F)	Nitrate (NO_3)	Phosphate (PO_4)	Boron (B)	Dissolved-solids content6/
21/26-18b7/	33	a 0.55	a 0.00	1,190 51.76	78 2.00	0.71 .10	1.4 .07	0.3 0	0.06	6.5	4,100
22/26-12c8/	242	a 0.52	a 0.08	780 33.93	63 1.66	1.8 .26	7.6 .40	0.4 .01	.22	6.8	2,600
22/27-30c	--	--	--	2,710 117.88	47 160	--	--	--	--	--	--
29/28-5b	--	--	--	--	--	--	--		--	--	--
29/29-6d	70	--	0.01	27 1.17	9.8 0.25	--	0.3 .02	3.1 .05	--	0.1	308
30/29-19c	--	--	--	--	--	--	--		--	--	--

6. Computed sum, with bicarbonate expressed as carbonate.
7. Manganese 0.00 mg/l.
8. Manganese, copper, lead, zinc 0.00 mg/l; arsenic 0.15 mg/l.
a. In solution when analyzed.

Using the above equation and the estimates for Granite Springs Valley as an example (transitional storage reserve, 890,000 acre-feet; perennial yield, 4,500 acre-feet) and using a pumping rate (Q) equal to the perennial yield in accordance with the general intent of Nevada Water Law, the time (t) to deplete the transitional storage reserve is computed to be roughly 400 years. At the end of that time, the transitional storage reserve would be exhausted, subject to the assumptions previously described.

What is not shown by the example is that in the first year virtually all the pumpage would be derived from storage, and very little, if any, would be derived from the salvage of natural discharge. On the other hand, during the last year of the period, nearly all pumpage would be derived from salvage of natural discharge and virtually none from the storage reserve.

During the period of depletion, the ground-water flow net would be substantially modified. The estimated recharge of 4,500 acre-feet per year that originally flowed from around the sides of the valley to areas of natural discharge would ultimately flow directly to pumping wells.

To meet the needs of an emergency or other special purpose requiring ground-water pumpage in excess of perennial yield for specified period of time, the transitional storage reserve could be depleted at a more rapid rate than in the example given. The above equation can be used to compute the time required to exhaust the storage reserve for any selected pumping rate in excess of the perennial yield. However, once the transitional storage reserve was exhausted, the pumping rate should be reduced to the perennial yield as soon as possible. Pumpage in excess of the perennial yield would result in an overdraft, and pumping lifts would continue to increase and stored water would continue to be depleted until some undesired result occurred.

SELECTED WELL DATA AND WELL LOGS

Selected well data are listed in table 11 and selected drillers' logs of wells are listed in table 12. Most of the well data and logs are from the files of the Nevada State Engineer. Because of the sparse development in the area, these tables include most of the information available.

Table 11.--Records of selected wells

Owner: BLM, Bureau of Land Management
Use: C, construction; S, stock
Depth to water: In feet below land
surface; R, reported
Remarks: SLN, log number in the files
of the Nevada State Engineer

Location number	Owner or name	Year drilled	Depth (feet)	Diameter (inches)	Use	Yield (gpm)/ and drawdown (feet)	Land surface altitude (feet)	Depth to water: Date	Depth to water: Depth (feet)	Remarks
				BRADYS HOT SPRINGS AREA						
21/26-18b	Industrial Construction	1964	320	8	C	225/296	4,030±	10-10-64	4 R	Well abandoned, probably destroyed
22/26-12c	Magma Energy Co.	--	--	--	--	--	4,120±	--	--	Geothermal area1/
22/27-20c	--	--	35	--	S	--	4,120	11-12-69	33.82	
-32b	--	--	--	--	S	--	4,220	--	130 R	
23/26-4a	Springer Hot Spring well	--	--	8	S	--	4,335	11-13-69	291.3	
-33a	--	--	34	43	S	--	4,088	11-13-69	25.35	
				GRANITE SPRINGS VALLEY						
24/26-13b	Telephone well	1942	600	6	S	4/	4,550	11-13-69	287.0	SLN 397
26/27-25b	W. ragged top well #1	1939	266	8	S	10/	4,030	3-16-39	211 R	SLN 307
28/25-8c	--	--	--	10	S	--	3,930	11-19-69	114.76	
29/29-6d	Vernon well #2	--	--	10	S	--	4,300	11-20-69	181.1	
-14b	Seven Troughs well	--	--	8	S	--	4,540	11-19-69	414.5	
30/30-7b	Circle L Ranch	--	--	5	S	--	4,500	11-19-69	275.5	
				KUMIVA VALLEY						
30/24-23a	Cowles Bros.	1951	56	8	S	--	--	10-28-51	11.5R	SLN 1312
30/25-5c	BLM	--	--	6	S	--	4,700	--	278	
30/26-18c	--	--	--	3	S	--	4,530	--	296	

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1. Four completed steam wells in this area. Depths range from 500 feet to 1,200 feet. Wells reported to yield in excess of 1 cfs hot water when allowed to flow. Five abandoned wells also in the same area.

Table 12.--Drillers' logs of selected wells

21/26-18b Industrial Construction

Material	Thickness (feet)	Depth (feet)
Clay, brown	6	6
Clay, brown and gravel (water)	9	15
Gravel	5	20
Clay, brown, and gravel	10	30
Malpai, black[1]	8	38
Gravel, black malpai, and brown clay	17	55
Malpai and gravel	19	74
Clay, brown, and gravel	4	78
Sand, gray, and gravel	30	108
Gravel, sand, and clay	5	113
Malpai and boulders	10	123
Gravel, sand, and clay	7	130
Malpai, black, and clay	30	160
Clay, brown, and sand	2	162
Malpai, black, and boulders	2	164
Malpai, black, and clay	3	167
Malpai and blue clay	29	196
Clay, brown	34	230
Clay, black	5	235
Clay, black, and layer rock	65	300
Clay, black	1	301
Malpai and black clay	19	320

24/26-12b Telephone well

Material	Thickness (feet)	Depth (feet)
Sandy clay, gray, hard	20	20
Sandy clay, gray, medium	48	68
Sandy clay, yellow, medium	10	78
Clay, blue, soft	26	104
Clay, green, soft	48	152
Clay, brown, soft	16	168
Clay, green, soft	33	201
Clay, blue, soft	157	358
Clay, black, soft. Water at 375	43	401
Clay, black, soft	170	571
Clay, blue, soft	29	600

26/27-25b W. Ragged Top Well No. 1

Material	Thickness (feet)	Depth (feet)
Sandy clay	120	120
Quicksand	8	128
Sandy clay	69	197
Sand, coarse (in water)	14	211
Sandy clay	6	217
Gravel, coarse	2	219
Sand	47	266

30/24-23a Cowles Bros.

Material	Thickness (feet)	Depth (feet)
Topsoil, water in sand	14	14
Granite soil	8	22
Granite sand, waterbearing	2	24
Granite rock, some soft places of an inch or two might be some water	32	56

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1. Malpai probably means basalt pebbles.

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LIST OF PREVIOUSLY PUBLISHED REPORTS IN THIS SERIES

(See fig. 1)

Report no.	Valley or area
1	Newark (out of print)
2	Pine (out of print)
3	Long (out of print)
4	Pine Forest (out of print)
5	Imlay area (out of print)
6	Diamond (out of print)
7	Desert (out of print)
8	Independence (out of print)
9	Gabbs (out of print)
10	Sarcobatus and Oasis (out of print)
11	Hualapai Flat
12	Ralston and Stone Cabin
13	Cave
14	Amargosa Desert, Mercury, Rock, Fortymile Canyon, Crater Flat, and Oasis
15	Sage Hen, Guano, Swan Lake, Massacre Lake, Long, Macy Flat, Coleman, Mosquito, Warner, and Surprise
16	Dry Lake and Delamar
17	Duck Lake
18	Garden and Coal
19	Middle Reese and Antelope
20	Black Rock Desert, Granite Basin, High Rock Lake, Mud Meadow, and Summit Lake
22	Pueblo, Continental Lake, Virgin, and Gridley Lake
23	Dixie, Stingaree, Fairview, Pleasant, Eastgate, Jersey and Cowkick
24	Lake
25	Coyote Spring, Kane Springs, and Muddy River Springs
26	Edwards Creek
27	Lower Meadow, Patterson, Spring (near Panaca), Rose, Panaca, Eagle, Clover, and Dry
28	Smith Creek and Ione
29	Grass (near Winnemucca)
30	Monitor, Antelope, Kobeh, and Stevens Basin (out of print)
31	Upper Reese
32	Lovelock
33	Spring (near Ely; out of print)
34	Snake, Hamlin, Antelope, Pleasant, and Ferguson Desert (out of print)
35	South Fork, Huntington, and Dixie Creek-Tenmile Creek (out of print)
36	Eldorado, Piute, and Colorado River (out of print)
37	Grass (near Austin) and Carico Lake (out of print)
38	Hot Creek, Little Smoky, and Little Fish Lake (out of print)
39	Eagle (Carson City)
40	Walker Lake and Rawhide Flats
41	Washoe
42	Steptoe
43	Honey Lake, Warm Springs, Newcomb Lake, Cold Spring, Dry, Lemmon, Red Rock, Spanish Springs, Bedell Flat, Sun and Antelope
44	Smoke Creek Desert, San Emidio Desert, Pilgrim Flat, Painters Flat, Skedaddle Creek, Dry (near Sand Pass), and Sano (out of print)

Report no.	Valley or area
45	Clayton, Stonewell Flat, Alkali Spring, Oriental Wash, Lida, and Grapevine Canyon
46	Mesquite, Ivanpah, Jean Lake, and Hidden
47	Thousand Springs and Grouse Creek
48	Little Owyhee River, South Fork Owyhee River, Independence, Owyhee River, Bruneau River, Jarbidge River, Salmon Falls Creek, and Goose Creek
49	Butte
50	Lower Moapa, Black Mountains, Garnet, Hidden, California Wash, Gold Butte, and Greasewood
51	Virgin River, Tule Desert, and Escalante Desert
52	Columbus Salt March, Soda Spring Valley
53	Antelope Valley, East Walker
54	Nevada Test Site

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

STATE OF NEVADA
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF WATER RESOURCES

VALLEY-FILL

QUATERNARY	Holocene	▨ Playa deposits in areas of deep ground water	☐ Playa deposits in areas of shallow ground water
	Pleistocene and Holocene	☐ Alluvium	

CONSOLIDATED ROCKS

▨ Volcanic and sedimentary rocks

▨ Granitic and metamorphic rocks

- - - - Contact

—··— Basin boundary

PHREATOPHYTE AREAS

🟩 Greasewood, includes some salt grass and salt bush in Brady's Hot Springs area

🟩 Greasewood and shadscale

🟩 Tules and salt grass

▨ Discharging playa

▨ Shallow lake

● Spring

(water-level altitude) 4120 ○ 30c (Location)
Well and number

0 5 10 miles
Scale

SUMMARY

The Granite Springs Valley Area covers about 1,540 square miles. It consists of four sparsely populated valleys in west-central Nevada. The valleys are surrounded by mountains of low to moderate relief which generally do not accumulate any significant winter snowpack. Consequently, the area is comparatively dry; runoff from the mountains and recharge to the valley-fill, ground-water reservoir is low.

Cattle grazing and mining are the principal industries. There have been no attempts at farming. Samples of well and spring waters from Kumiva Valley and Granite Springs Valley were generally chemically suitable for irrigation and domestic use, but samples from Bradys Hot Springs Area were more highly mineralized.

The tabulation below summarizes most of the estimated hydrologic quantities for the area.

PRELIMINARY ESTIMATES OF HYDROLOGIC ELEMENTS
(All water quantities are average annual volumes, in acre-feet, except where noted)

ITEM	AREA			
	KUMIVA VALLEY	GRANITE SPRINGS VALLEY	FIREBALL VALLEY	BRADYS HOT SPRINGS AREA
Area (square miles)	333	967	58	178
Minimum altitude of valley floor (feet)	4,400	3,850	4,600	4,010
Surficial drainage	None	None	To Bradys Hot Springs Area	To lake at south boundary of area
Subsurface drainage	To Granite Springs Valley	None	do.	None
Inflow from outside the area	None	None	None	From Fernley Area
HYDROLOGIC ESTIMATES				
Precipitation	121,000	346,000	21,000	59,000
Runoff	610	1,800	160	110
Surface inflow from Fernley Area	--	--	--	a 4,000
Recharge from precipitation	1,000	3,500	200	160
Intervalley leakage				
Kumiva Valley to Granite Springs Valley	--	1,000	--	--
Fireball Valley to Bradys Hot Springs Area	--	--	--	220
Fernley Area to Bradys Hot Springs Area	--	--	--	1,000
Evapotranspiration of ground water	Trace	4,400	Trace	3,000
Reconnaissance value of ground-water inflow and outflow	1,000	4,500	200	2,500
Perennial yield	500	4,500	100	2,500
Transitional storage reserve1/	450,000	890,000	50,000	150,000

a. Average annual net evaporation from lake at southern end of area.

1. Estimated total quantity available for use on a one-time basis.

MAP NUMBER	STATION NAME	APPROXIMATE ALTITUDE	MEASURED AVERAGE ANNUAL PRECIP. (INCHES)
1	Brown	3929	3.83
2	Fernley	4150	4.97
3	Gerlach	3940	5.69
4	Hot Springs	4072	3.29
5	Jungo	4165	3.75
6	Lovelock	3977	4.87
7	Lovelock FAA airport	3900	4.55
8	Majuba Mtn.	6000	10.80
9	Nixon	3900	6.80
10	Pahute Meadows Ranch	4375	6.18
11	Sand Pass	4198	6.44
12	Soldiers Meadow	4550	6.73
13	Sulphur	4044	4.88

Base from Army Map Service-1:250,000 series;
Reno (1957), Lovelock (1955).
Cartography by C. Bosch

Pershing County geology adapted from Tatlock (1969),
remaining geology by J. R. Harrill (1969)

PLATE 1.—HYDROGEOLOGY OF THE GRANITE SPRINGS VALLEY AREA, PERSHING, CHURCHILL, AND LYON COUNTIES, NEVADA