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STATE OF NEVADA
OFFICE OF THE STATE ENGINEER

WATER RESOURCES BULLETIN No. 8

GROUND WATER IN WHITE RIVER VALLEY, WHITE PINE, NYE, AND LINCOLN COUNTIES, NEVADA

By
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FOREWORD

This report is the eighth in the series of Nevada Water Resources Bulletins prepared by the U. S. Geological Survey, in cooperation with the Office of the State Engineer.

Ground-water investigations on a State-wide basis were begun July 1, 1945 as the result of increasing interest in the development of additional water supplies in Nevada. The development of additional water in the State must come, to a considerable extent, from ground-water resources because surface water has been almost entirely appropriated.

The reports resulting from these investigations form a basis for the proper understanding of the occurrence, source, movement, and disposal of ground water in the ground-water reservoirs in the State. They also include estimates for the amount of water that may be potentially developed from the ground-water reservoirs. Such information is necessary for the conservation of our ground-water resources and at the same time permits full and intelligent development of the potential water available. Under natural conditions, much ground water is used to support native phreatophyte vegetation (plants that depend upon ground water to supply their needs), and in evaporation from soil and from free-water surfaces. The water so lost may be salvaged in part by withdrawals from wells and thereby be utilized for higher beneficial use.

The cooperative program is under the supervision of Hugh A. Shamberger, Assistant State Engineer of Nevada, and Thomas W. Robinson, District Engineer, Ground Water Branch, U. S. Geological Survey.

ALFRED MERRITT SMITH,
State Engineer.

November 14, 1949.

ABSTRACT

White River Valley, in east-central Nevada, is a semiarid intermontane trough in the central part of the Great Basin, at the upper end of a long, narrow tongue of the Colorado River drainage basin. The sparse population is principally engaged in agriculture. The water supply is derived from large springs which annually discharge about 40,000 acre-feet of water and from White River, which annually discharges about 2,000 acre-feet. The only two irrigation wells in the valley were pumped to supplement the surface-water supply in 1947. Nearly 4,200 acres of land are now irrigated. The main purpose of this investigation was to obtain an estimate of the amount of ground water in the valley available for irrigation.

The principal water-bearing beds are in the alluvial apron and river-bed deposits which underlie the valley lowland. These aquifers consist of moderately to highly permeable sand and gravel deposits interbedded with silt and clay. The igneous and sedimentary bedrocks of the mountains that surround the valley are relatively impermeable and are a barrier to movement of ground water, except for parts of the Pogonip and Nevada limestones of Paleozoic age. These limestones are cavernous and are believed to transmit large quantities of water. Water issuing from Preston Big Springs and Lund, Hot Creek, and some other large springs is probably supplied from these limestones. Some water transmitted from the mountainous recharge areas by these limestone aquifers may also recharge the ground-water reservoir of the valley fill.

The ultimate source of the ground water is from precipitation within the watersheds of White River and Jakes Valleys. Most of the precipitation is lost by evaporation and transpiration before it percolates into the ground-water reservoir. Estimates based on the available precipitation data, and on studies of recharge in somewhat comparable areas, indicate that the annual ground-water recharge is about 53,000 acre-feet. This water moves underground toward the axis of the valley where about 34,000 acre-feet is discharged from the valley by evapo-transpiration. The remainder flows out of the valley on the surface or as underflow.

On the basis of the amount of ground water now lost by transpiration and evaporation, the depth to the water table, and the water-bearing characteristics of the ground-water reservoir, it is estimated that about 19,000 acre-feet of water of suitable quality is annually available for irrigation by pumping. Also, 11,000 acre-feet of water discharged by Hot Creek Spring may be made available for irrigation by diverting the water, either by ditch or by low-lift pumping. Artificial recharge to the ground-water reservoir also may be feasible to conserve part of the winter discharge of the large springs, and it may be desirable if future development of pumping for irrigation materially lowers the water table in the vicinity of Preston and Lund. That artificial recharge can be accomplished effectively is demonstrated in part by substantial losses of water from ditches to the ground-water reservoir.

This report contains tables giving climatological data, available discharge records of springs and streams, analyses of the waters of three large springs, and records for most of the wells and the principal springs in the valley. Illustrations showing the drainage area, areal distribution and nature of the water-bearing formations, water-table contours, the extent of the recharge and transpiration areas, and the area of irrigated lands are also presented.

A reconnaissance report on land classification by Howard G. Mason, Nevada Agricultural Experiment Station, is included.

GROUND WATER IN WHITE RIVER VALLEY, IN WHITE PINE, NYE, AND LINCOLN COUNTIES, NEVADA

By G. B. Maxey and T. E. Eakin

INTRODUCTION

White River Valley lies in the southwest part of White Pine County, the northeast part of Nye County, and the northwest corner of Lincoln County, in east-central Nevada (see fig. 1). Preston and Lund, the principal communities in the valley, are centers for farming and stock-raising activities, the only important industries in the valley. These towns are about 35 miles southwest of Ely, the county seat of White Pine County. They are reached from Ely by U. S. Highway 6, which cuts southwest across the north end of the valley, and by Nevada State Highway 38, which traverses the valley from its intersection with U. S. Highway 6 southward through Preston and Lund. Nevada State Highway 38A connects Lund with Hiko to the south in Lincoln County. The population of the valley in 1940 was about 850 and was believed to be about the same in 1948.

The principal water supply for White River Valley is obtained from several large springs, and from White River, Water Creek, and Ellison Creek, the only perennial streams. Water from these sources has been sufficient to irrigate the cultivated land in the valley since it was first settled in the early 1860's, except during periods of drought. Many wells have been drilled since about 1925 to obtain water for stock and domestic use. Also, a few irrigation wells, of which two were used during 1947, have been drilled during the last 10 years to supplement irrigation supplies from the springs and streams. All the arable land in the valley is not being cultivated, and further farming activity depends in part upon utilization of the ground water that may be developed by wells.

The feasibility of developing ground water by wells for irrigation has long been discussed by residents in the valley and by county, State, and Federal officials, but detailed studies of the ground-water conditions have never been made. The U. S.

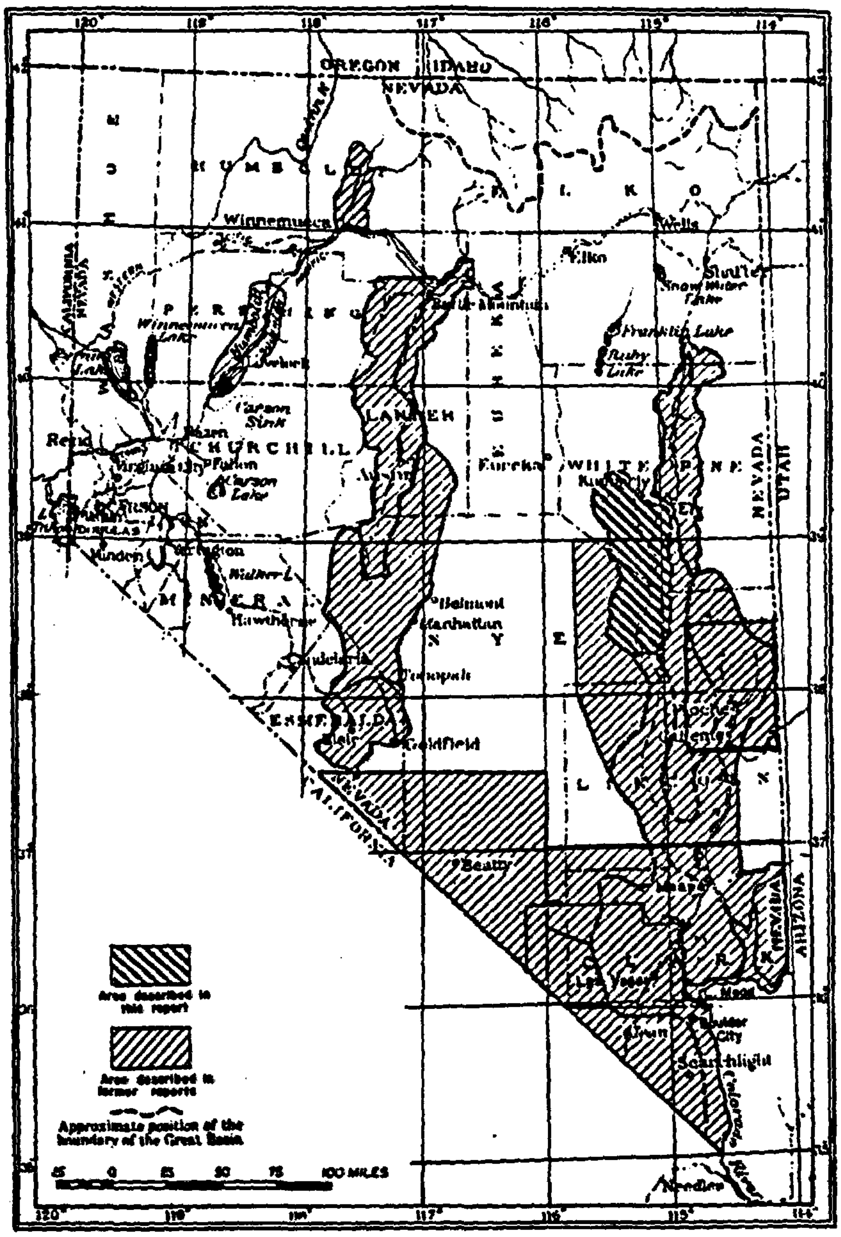

FIGURE 1.—Map of Nevada showing areas covered by published ground-water reports and by the present report.

Geological Survey,[1] White Pine County,[2] the Nevada State Agricultural Experiment Station,[3] the Bureau of Agricultural E nomics of the U. S. Department of Agriculture,[4] and the S Conservation Service[5] made brief ground-water investigations in the valley prior to the present study. The reports of these investigations contain general information that was of considerable help to the present study and they have been consulted freely.

The purpose of the present investigation was to determine, by means of geologic and hydrologic studies, the source, movement, and quality of the ground water and the amount that could be developed by wells without exceeding the safe yield. In addition, this report begins the systematic collection of hydrologic data which may be used for evaluation of the ground-water resources from time to time as development progresses.

An inventory of 98 wells and 12 springs has been made since the study was started in July 1947. This inventory is shown in Tables 6, 7, 8, 9, and 10. All available well and spring records have been studied and the total discharge from wells and springs has been determined. Estimates were made of the discharge of ground water by evaporation and transpiration in areas where the water table is at or near the land surface, and of outflow from the valley. The quality and temperature of the ground water studied. A reconnaissance map showing the general geology of the valley was prepared and the relations between geologic and ground-water conditions studied. All available and reliable well logs have been compiled and are presented in Table Water levels are being measured periodically in 12 selected obs vation wells.

The cooperation of the well owners in White River Valley in allowing their wells to be used for measurements and tests was invaluable to the investigation and is hereby acknowledged. Two local well drillers, Dennis Smith and J. D. Hill, kindly furnished numerous well logs and other data for wells that they have

[1]Carpenter, Everett, Ground water in southeastern Nevada: U. S. Geol. Survey Water-Supply Paper 365, 86 pp., 1915.

[2]Well data files, office of the County Clerk, White Pine County, Nevada, 1913–1948.

[3]Hardman, George, and Miller, M. R., The quality of the waters of southeastern Nevada, drainage basins and water resources: Univ. Nevada, Agr. Exper. Sta. Bull. 136, p. 37, 1934.

[4]Water facilities area plan for upper White River sub-area of the Virgin River area, Nevada: U. S. Dept. Agr., Bur. Agr. Econ., 57 pp., 1942.

[5]Better land use in the White Pine Soil Conservation District: U. S. Dept. Agr., Soil Cons. Service, pp. 26–30, 1943.

drilled in the valley. The writers wish to thank William Helphinstine, White Pine County Agricultural Agent; the officials of White Pine County; the Soil Conservation Service; the Bureau of Land Management; the State Department of Highways, and the Office of the State Engineer, all of whom assisted by making available valuable data. F. W. Millard and Son, consulting engineers in Ely, Nevada, assisted by contributing data. Grateful appreciation is extended to the writers' colleagues on the Geological Survey who reviewed the report and offered much helpful criticism.

The investigation has been under the general supervision of T. W. Robinson, District Engineer in Nevada for the Ground Water Branch, U. S. Geological Survey.

LOCATION AND GENERAL FEATURES

White River Valley, as defined in this report, includes about 1,620 square miles of the White River drainage basin lying north of the line of low bedrock hills extending eastward from Troy Peak and about 8 miles south of the Adams-McGill reservoir. The valley, which is about 70 miles long and ranges in width from 20 to 30 miles, comprises the north part of the White River drainage area between 114°53′ and 115°27′ west longitude and between 38°15′ and 39°17′ north latitude (see pl. 1). That part of the White River drainage basin lying south of this area, locally referred to as White River Wash, is not included in the present investigation.

The valley is in the central part of the Great Basin section of the Basin and Range physiographic province. It is at the north end of a long tongue of the Colorado River drainage basin. Although it is not an enclosed basin with interior drainage, it possesses many of the features of the intermontane basins of the Great Basin section. It is an elongate lowland filled to an undetermined depth with unconsolidated deposits of gravel, sand, silt, and clay. The lowland is bounded by high, northerly trending, more or less parallel mountain ranges composed of well-indurated sedimentary and igneous rocks. The broad river channel which occupies the valley floor is physiographically analogous to the playa lakes usually found in the intermontane basins. An alluvial apron, consisting of coalescing alluvial fans which head in the canyons of the mountains, extends to the river channel. Thus the valley lowland consists of the river channel and the alluvial apron. As in the intermontane basins nearby, the boundary of this valley lowland is roughly the same as the contact between the alluvial apron and the bedrock of the mountainous areas.

The valley lies between the Egan Range on the east and a chain of mountain ranges consisting of the White Pine Mountains, the Horse Range, and the Grant Range on the west. The northern boundary of the valley is a range of low hills that extends southwest from Kimberly to a point about 4 miles northwest of Baldy Mountain and forms a topographic divide between White River and Jakes Valleys. The east side of the valley is nearly straight and trends almost due north. The west side of the valley is irregular, especially in the south part.

The valley lowland which is about 4 miles wide at the north end, just south of Dark Peak, gradually increases to a width of about 10 miles in the vicinity of Preston. From Preston south for a distance of 10 miles it ranges in width from 8 to 10 miles. A large reentrant on the west side of the valley, locally referred to as The Cove, extends west at this point toward the Horse Range. This broader segment of the valley is about 14 miles wide and continues southward about 8 miles, where spurs of the Grant and Egan Ranges extend toward the axis of the valley and reduce its width to about 8 miles. Southward from here the valley widens to more than 15 miles and then narrows to about 6 miles at the south boundary of the area. The floor of the valley lowland slopes southward from an altitude of about 6,000 feet, 8 miles north of Preston, to an altitude of about 5,100 feet at the south end. The valley lowland has been moderately dissected by White River and its tributaries. Excavation of the broad river channel with its marginal terraces cut in the sediments of the alluvial apron probably took place during the Pleistocene epoch, when the climate was more humid than at present. Carpenter[1] states "during the humid Pleistocene epoch * * * a stream of considerable magnitude carved a channel through the valley from Preston to the head of Muddy Valley." The Muddy Valley is tributary to the Colorado River.

The Egan Range is a persistently high mountain mass from 5 to 10 miles wide that extends north along the east side of the White River Valley from a point about 10 miles south of Sunnyside to Kimberly, a distance of about 65 miles. It reaches altitudes of about 8,500 feet east of Sunnyside, about 10,000 feet

[1]Carpenter, Everett, Ground water in southeastern Nevada: U. S. Geol. Survey Water-Supply Paper 365, p. 54, 1915.

east of Lund, and 10,929 feet at Ward South Summit, the highest peak near the north end of the range. Its crest is the main drainage divide between White River Valley and Steptoe and Cave Valleys. The range is lower south of Sunnyside and is separated by low passes from some low unnamed mountains which are the northward extension of the Pahroc Range.

A low ridge of unnamed hills extends across the north end of the valley from Kimberly southwesterly toward Baldy Mountain, thus connecting the Egan Range and the White Pine Mountains. These hills form a topographic divide between White River and Jakes Valleys and reach altitudes ranging from about 6,800 to 8,000 feet.

The White Pine Mountains bound the northwest part of White River Valley. They extend north from U. S. Highway 6 at Currant Summit beyond the north end of the valley, where they bound Jakes Valley on the west. This range is the highest in the vicinity of White River Valley. The highest peak, Currant Mountain, reaches an altitude of 11,493 feet. The altitude exceeds 9,000 feet throughout most of the length of the range. The White Pine Mountains are drained by White River and its tributary, Ellison Creek, both perennial streams.

The Horse Range reaches an altitude of 8,000 feet but averages considerably lower. It extends south about 10 miles from Currant Summit along the west side of White River Valley to the north end of the Grant Range.

The Grant Range extends south from the Horse Range beyond the south border of the valley. The north end of the range is low, with an average altitude of about 7,500 feet. The main part of the range rises southward and near the south end it reaches 11,268 feet above sea level at Troy Peak.

DRAINAGE

White River Valley is drained by White River and its tributaries. The river and its principal tributary, Ellison Creek, head in the White Pine Mountains. They converge near U. S. Highway 6 at the Rosevear Ranch, where the river crosses the contact of the bedrock and the valley fill and enters the valley lowland. During the summer water flows in the river channel as far south as Lund before it is entirely depleted by irrigation diversions and by evaporation and infiltration. During the winter months water usually flows to a point about 15 miles south of the Adams-McGill reservoir, about 50 miles south of Lund, where it sinks into the old river bed.

White River and Ellison Creek were measured just above their confluence near U. S. Highway 6 during the period of low flow on December 22, 1947. The discharge of the river was 1.66 second-feet and that of Ellison Creek was 0.43 second-foot, making the total discharge below the confluence 2.09 second-feet. Measurements of these streams have been made from time to time by the State Engineer's office since 1908. During 1914 a gaging station was maintained on White River, above Preston, by the U. S. Geological Survey from late May until early September. All these measurements are shown in Table 1.

As shown by the table, the maximum measured discharge of White River below its confluence with Ellison Creek was 44 second-feet in 1914 and, the minimum was 1.85 on September 10, 1937. It is reported that the river has discharged as much as 75 second-feet during the spring runoff period. Most of the water in White River is used for irrigation by farmers in the area adjacent to U. S. Highway 6. The maximum flow reaching the valley lowland near Preston during the irrigation season is about 4 second-feet and the average flow is about 2 second-feet.

TABLE 1

Discharge of White River, White Pine County, Nevada[1]

Data from water-supply card of State Engineer of Nevada

Point of measurement for the following five measurements unknown, but believed to be between McQuean Ranch and Rosevear Ranch.

Date	Place	Discharge (sec.-ft.)
August 1908	3 miles below spring	9.0
September 1908	At spring	2.0
June 1908	At spring	7.0
June 1908	4 miles downstream from spring	8.5
May 7, 1913	300 feet west of school and below most diversions	.30

Data from U. S. Geological Survey, Water Resources Division

Location—Approximately in sec. 4, T. 12 N., R. 61 E., M.D.M., 250 feet above the north- and south-side dividing flume, about 3 miles northwest of Preston. Staff gage was installed in 1913 at Preston, above all diversions for the district, but there are several small diversions for ranches in the neighborhood of Barnes. Observations discontinued September 4, 1914. Measurements in second-feet.

1914	May	June	July	Aug.	Sept.
1	...	14	5	1.0	0.3
2	...	17	4	1.0	.4
3	...	17	3.5	.9	.7
4	...	17	4	1.1	Dry
5	...	17	4	1.3	
6	...	18	4.5	1.5	
7	...	19	4	1.7	
8	...	18	4	1.9	
9	...	18	4	.9	
10	...	17	5	1.1	
11	...	16	5.5	1.3	
12	...	15	4	1.5	
13	...	14	4.5	1.9	
14	...	13	4.0	2.3	
15	...	13	3.5	1.9	
16	...	13	2.7	1.5	
17	...	12	2.4	1.6	
18	...	11	3	1.5	
19	...	7	2	1.5	
20	...	7	1.4	1.5	
21	...	7	1.7	1.2	
22	...	7	2.0	.9	
23	...	7	2.3	.8	
24	...	7	2.3	.7	
25	...	15	2.4	.4	
26	...	24	2.4	.2	
27	12	10	2.4	.2	
28	11	5.5	4	.2	
29	11	6	14	.2	
30	11	6	4	.2	
31	12	—	2.4	.2	

Data from water-supply card of State Engineer of Nevada

Date	Place	Discharge (sec.-ft.)
Oct. 16, 1914	300 feet west of school and below most diversions	0.7
July 8, 1915	Midland Trail Bridge at McQuean Ranch	3.6
June 24, 1916	Above gaging station	4.2
May 27, 1918	At bridge on Midland Trail	3.84

Data from Water Commissioner Reports to State Engineer of Nevada
(Unless stated, point of measurement is unknown)

Date	Place	Discharge (sec.-ft.)
May 18, 1924		6.74
May 20		6.21
May 21		6.21
June 2		5.35

[1]Data compiled by F. N. Dondero, Office Engineer, Office of the State Engineer of Nevada, from records of the Office of the State Engineer of Nevada, and from publications of the U. S. Geological Survey, Water Resources Division.

Date	Place	Discharge (sec.-ft.)
June 7		3.90
June 12		3.74
June 20		3.28
July 11		2.45
July 30		1.49
May 2, 1927		5.62
May 2		6.21
June 24		2.73
May 15, 1928		3.72
June 5		2.70
June 20		2.23
June 1932		6.50
July 11, 1932		3.06
June 2, 1933,	White River above all diversions except that of A. Lee	8.01
June 8,	White River above all diversions except that of A. Lee	9.33
June 18,	White River above all diversions except that of A. Lee	6.83
June 23,	White River above all diversions except that of A. Lee	5.38
July 12,	White River above all diversions except that of A. Lee	3.35
July 17,	White River above all diversions except that of A. Lee	3.23
May 5, 1935,	White River above all diversions except that of A. Lee	[2]10.78
Apr. 29, 1936,	White River at Berryman-Rosevear diversion	[3]13.31
May 2,	White River above all diversions except that of A. Lee	20.91
May 5,	White River above all diversions except that of A. Lee	17.40
May 7,	White River above all diversions except that of A. Lee	14.80
May 12,	White River above all diversions except that of A. Lee	10.50
May 16,	White River above all diversions except that of A. Lee	9.25
May 19,	White River above all diversions except that of A. Lee	3.20
May 23,	White River above all diversions except that of A. Lee	4.65
May 26,	White River above all diversions except that of A. Lee	5.30
May 30,	White River above all diversions except that of A. Lee	5.11
June 2,	White River above all diversions except that of A. Lee	7.88
June 5,	White River above all diversions except that of A. Lee	8.10
June 9,	White River above all diversions except that of A. Lee	5.01
June 16,	White River above all diversions except that of A. Lee	4.08
June 19,	White River above all diversions except that of A. Lee	3.80
June 23,	White River above all diversions except that of A. Lee	3.60
June 27,	White River above all diversions except that of A. Lee	3.35
July 2, 1937,	Measurement made above McQuean Ranch diversion	6.15
July 7,	Measurement made above McQuean Ranch diversion	5.30
July 12,	Measurement made above McQuean Ranch diversion	4.61
July 15,	Measurement made above McQuean Ranch diversion	4.22
July 19,	Measurement made above McQuean Ranch diversion	4.28
July 23,	Measurement made above McQuean Ranch diversion	4.00
July 29,	Measurement made above McQuean Ranch diversion	4.00
June 24, 1943,	White River above all diversions except that of A. Lee	[4]4.05

Water Creek, in Water Canyon, is the only other perennial stream in the valley. Throughout the year water flows in its channel from the springs at its head to a point a few miles southwest of the mouth of Water Canyon. The discharge of Water Creek is carried in an irrigation ditch to the Peacock Ranch about 5 miles north of Lund. The measured discharge of Water Creek at the mouth of Water Canyon was 0.89 second-foot on December 22, 1947. It is reported that the creek discharges about 3 second-feet at this point during the spring runoff period from April to June and that about 1 second-foot flows continuously during the low runoff period from September to April.

The intermittent streams in the smaller canyons of the mountains discharge water for only short periods during the spring runoff and when flash floods occur.

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[2]Measurement by F. N. Dondero.
[3]Measurement by H. A. Shamburger, Assistant State Engineer of Nevada.
[4]Measurement by A. M. Smith, State Engineer of Nevada, and F. N. Dondero.

CLIMATE

The climate of eastern Nevada is arid to semiarid owing to the low precipitation and high rate of evaporation. The areal distribution of precipitation is irregular, but the existing records and the vegetative cover indicate that the greatest precipitation occurs on the higher mountain slopes and that the driest areas are in the lower parts of the valleys. The temperature ranges considerably both diurnally and seasonally.

PRECIPITATION

The accompanying Figure 2 and Tables 2, 3, 4, and 5, based on records of the U. S. Weather Bureau and the Nevada Cooperative Snow Surveys, show the average monthly precipitation, the annual precipitation, and the cumulative departure from the average annual precipitation for 59 years (1888 to 1947) at McGill, for 34 years at Adaven (Sharp), and for 17 years at Kimberly. They also show the monthly and annual precipitation at Sunnyside and Currant. Sunnyside is in White River Valley and Kimberly, McGill, Adaven (Sharp), and Currant are in adjacent valleys. Kimberly, the highest U. S. Weather Bureau Station in Nevada in 1948, is near the drainage divide at the north end of White River Valley; McGill is in Steptoe Valley; Adaven is in Garden Valley, and Currant is in Railroad Valley. The last two stations are at altitudes respectively slightly higher and slightly lower than the average altitude of the floor of White River Valley. Probably the average precipitation at the two stations approximates closely that in White River Valley. The amount of precipitation to be expected at higher altitudes is indicated by the record of the Kimberly station. Snowfall at higher altitudes during the winter months is also indicated by one snow-survey course at Murry Summit, altitude 7,250 feet, established in 1936 by the Nevada Cooperative Snow Surveys. Comparison of the precipitation at Kimberly with that of the lower surrounding stations shows an increase with altitude.

Precipitation at each station varies greatly from year to year, as shown in Table 2. At McGill it has ranged between 5.58 inches and 18.01 inches, at Adaven (Sharp) between 5.19 and 23.55 inches, and at Kimberly between 6.86 inches and 19.95 inches. For the most part the seasonal variation is regional, but there are some local variations, as in 1931, when precipitation at McGill and Kimberly was respectively about 3 and 4 inches below normal and at Adaven (Sharp) 2 inches above normal.

The cumulative departure from average annual precipitation at McGill, Kimberly, and Adaven (Sharp) is shown in Figure 2. Such graphs are of particular interest in studies of ground-water conditions because they portray long-term deficiencies and excesses of precipitation and because changes of storage in ground-water reservoirs usually reflect these deficiencies and excesses. The cumulative departure graphs show that at McGill the period 1890 to 1900 was one of above-normal precipitation and that the period 1900 to 1910 was about normal. The trend was then downward to 1915, generally upward until 1923, and then downward until 1935. Since 1935 it has averaged about normal. The graphs for Adaven (Sharp) and Kimberly cannot be compared directly with that for McGill because they do not cover the same period, but the trend was generally downward during the first part of the records, until 1935, and then upward.

Precipitation is distributed rather evenly through the year at McGill and Kimberly but not so evenly at Adaven (Sharp), Sunnyside, and Currant, although commonly the months of highest and lowest precipitation are the same. Generally less than 20 percent of the annual precipitation occurs during June, July, and August, the driest period of the year, in the form of afternoon showers and cloudbursts. About 60 percent occurs as snow between December and May.

TEMPERATURE

Long-period temperature records are available for two climatological stations, McGill and Adaven (Sharp). These records are summarized in Table 5, where the average, minimum, and average maximum temperatures for the period of record at each station are listed. The highest temperature of record at McGill was 104° F.; at Adaven (Sharp), it was 105° F. The lowest temperature of record at McGill was —27° F.; at Adaven (Sharp), it was —22° F.

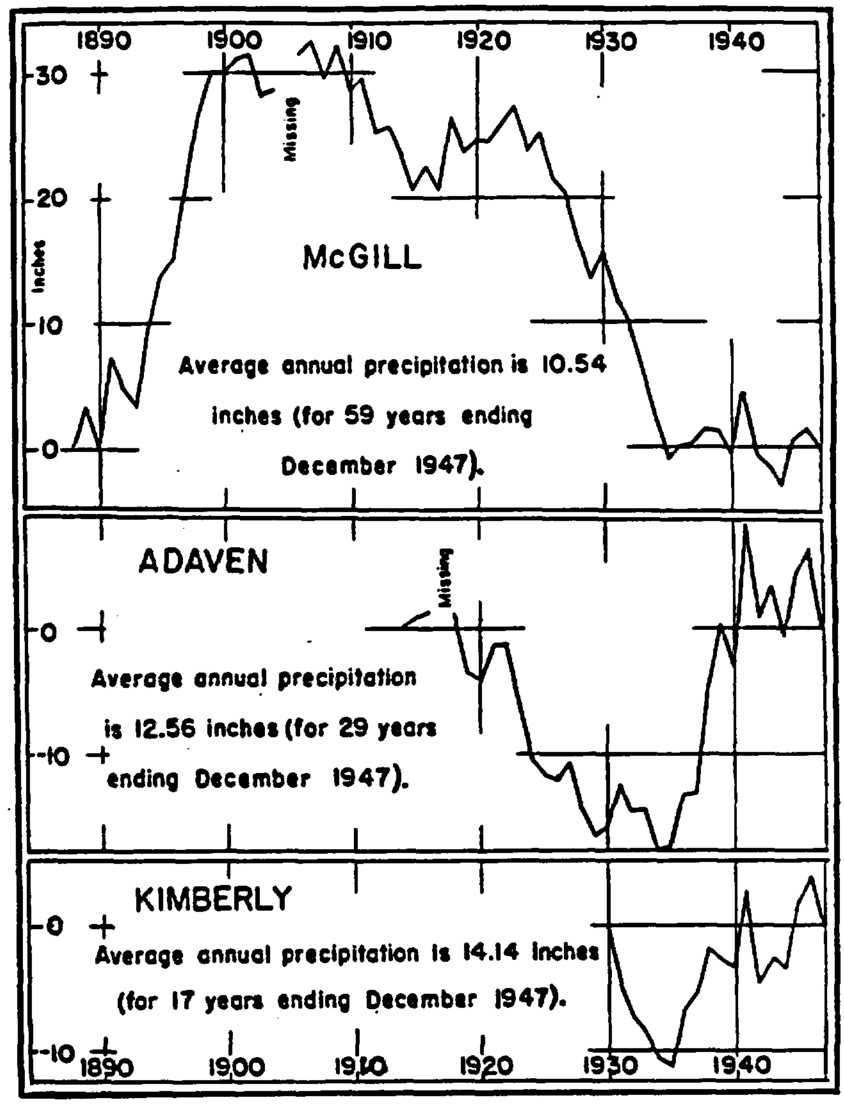

FIGURE 2—Graphs showing cumulative departure from average annual precipitation at three stations in eastern Nevada.

TABLE 2

Annual Precipitation, in inches, at McGill, Kimberly, and Adaven (Sharp), Nevada

(Records from U. S. Weather Bureau)

Year	McGill[1]	Adaven[3]	Year	McGill[1]	Kimberly[2]	Adaven[3]
1888	10.38	------	1920	11.39	------	12.10
1889	13.54	------	1921	10.53	------	15.43
1890	7.18	------	1922	11.87	------	12.66
1891	13.01	------	1923	11.92	------	8.34
1892	7.89	------	1924	7.04	------	7.47
1893	9.14	------	1925	11.82	------	11.38
1894	16.71	------	1926	7.11	------	12.22
1895	14.77	------	1927	9.36	------	13.75
1896	11.82	------	1928	6.56	------	9.15
1897	17.20	------	1929	7.56	------	10.41
1898	15.06	------	1930	12.78	------	13.16
1899	14.35	------	1931	6.81	9.63	15.32
1900	10.47	------	1932	8.44	11.26	10.44
1901	11.51	------	1933	6.89	13.01	12.66
1902	10.91	------	1934	7.01	12.15	9.29
1903	7.30	------	1935	7.06	13.45	12.79
1904	11.00	------	1936	11.48	18.70	16.82
1905	------	------	1937	10.90	15.46	12.74
1906	13.43	------	1938	11.68	17.53	21.32
1907	11.77	------	1939	10.39	13.33	18.94
1908	7.45	------	1940	8.53	13.63	9.65
1909	13.15	------	1941	15.36	19.95	23.56
1910	7.01	------	1942	5.53	6.36	5.19
1911	11.40	------	1943	9.95	18.48	14.93
1912	6.15	------	1944	8.59	13.12	8.71
1913	11.19	------	1945	14.35	19.45	17.43
1914	8.63	------	1946	11.15	16.14	14.28
1915	7.44	13.44	1947	9.12	10.25	6.51
1916	12.36	13.03	Ave.	10.54	14.14	12.58
1917	8.67	------				
1918	16.21	------	1931–1947			
1919	7.94	7.47	Ave.	9.60	14.14	13.48

[1]Altitude 6,340 feet; location, sec. 28, T. 18 N., R. 64 E.
[2]Altitude 7,250 feet; location, sec. 3, T. 16 N., R. 62 E.
[3]Altitude 6,250 feet; location, sec. 16, T. 3 N., R. 57 E.

TABLE 3

Average monthly and annual precipitation, in inches, at five stations in eastern Nevada

(Records from U. S. Weather Bureau)

Name of Station	Length of record (years)	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Adaven[1] (Sharp)	31	1.32	1.52	1.45	1.11	0.89	0.37	0.91	1.40	0.41	1.13	0.75	1.27	12.56
Currant[2]	5	.33	.39	1.40	.95	.38	.54	.13	.59	.36	.90	.73	.44	7.14
Kimberly[3]	17	1.60	1.85	1.56	1.49	.91	.67	.90	.94	.78	1.05	.88	1.51	14.14
McGill[4]	59	.94	.92	1.10	1.11	1.23	.63	.66	1.02	.63	.82	.66	.82	10.54
Sunnyside[5]	[6]6	.81	.86	2.28	.34	.93	.30	.77	.34	.46	.33	.33	1.39	9.17

[1]Altitude 6,250 feet; location, sec. 16, T. 3 N., R. 57 E.
[2]Altitude 5,183 feet; location, sec. 8, T. 10 N., R. 58 E.
[3]Altitude 7,250 feet; location, sec. 8, T. 16 N., R. 62 E.
[4]Altitude 6,340 feet; location, sec. 28, T. 18 N., R. 64 E.
[5]Altitude 5,334 feet; location, sec. 29, T. 7 N., R. 62 E.
[6]Incomplete record.

TABLE 4

Depth and water content of snow, in inches, at Murry Summit, Nevada[1]

Year	Date	Snow	Water	Date	Snow	Water
1937	Mar. 1	25.0	6.4	Apr. 1	12.8	5.1
1938	Feb. 28	13.8	2.8	Apr. 1	6.4	2.3
1939	Mar. 3	15.1	2.3	No survey		
1940	Mar. 2	11.1	3.2	Apr. 1	8.1	.4
1941	Mar. 1	12.3	4.3	Apr. 1	8.3	4.3
1942	Mar. 2	15.0	3.8	Apr. 2	7.7	2.8
1943	Mar. 1	14.3	5.0	Apr. 1	.0	.0
1944	Mar. 1	22.0	5.3	Apr. 1	14.9	5.6
1945	Mar. 1	15.5	4.9	Apr. 4	16.9	5.8
1946	Mar. 4	11.7	3.4	Apr. 2	12.1	3.0
1947	Feb. 27	10.3	4.3	Apr. 2	.0	.0
1948	Feb. 27	5.3	1.5	Mar. 29	14.3	4.2
Average		14.3	3.9	Average	8.9	3.1

Miscellaneous measurements—

Date	Snow	Water	Date	Snow	Water
Jan. 2, 1937	22.2	2.9	Jan. 2, 1942	11.8	2.0
Feb. 1, 1937	25.1	4.8	Feb. 2, 1942	12.9	3.2
Jan. 3, 1938	5.1	.7	Feb. 1, 1943	16.5	3.7
Jan. 31, 1938	6.1	.9	Jan. 3, 1944	12.9	2.1
Feb. 2, 1939	14.7	2.4	Feb. 1, 1944	13.1	2.9
Jan. 1, 1940	.0	.0	Jan. 2, 1945	13.1	3.0
Feb. 2, 1940	9.7	2.4	Feb. 1, 1945	14.6	3.4
Jan. 3, 1941	8.2	.5	Jan. 2, 1946	9.8	1.8
Feb. 1, 1941	12.8	2.9	Feb. 1, 1946	13.9	2.6

[1]Established August 12, 1936 by E. Hill and C. Elges. Located on Nevada National Forest in sec. 25, T. 16 N., R. 62 E. Elevation 7,250 feet. Course revised in 1947 to 10 samples at 100 feet. Surveys by District Forest Ranger, Ely, Nevada. Data from reports of the Nevada Cooperative Snow Surveys.

TABLE 5

Average, average maximum, and average minimum monthly and annual temperature, in degrees Farenheit, at McGill and Adaven (Sharp), Nevada

(Records from U. S. Weather Bureau)

McGill, Altitude 6,340 feet
(Location: sec. 28, T. 18 N., R. 64 E., in Steptoe Valley, about 40 miles air line northeast of Lund.)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year	Length of record (years)
Average	25.5	29.0	34.8	43.0	51.0	60.1	67.4	64.5	56.3	45.7	35.5	27.2	45.0	50
Average maximum	39.4	42.7	50.7	59.8	69.5	80.4	88.4	86.5	77.8	64.7	52.0	41.2	62.8	27
Average minimum	15.9	19.9	25.5	32.1	39.5	48.6	56.6	54.2	44.9	34.1	24.3	17.0	34.4	27

Adaven (Sharp), Altitude 6,250 feet
(Location: sec. 16, T. 3 N., R. 57 E., in White River drainage area, about 58 miles air line southwest of Lund.)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year	Length of record (years)
Average	29.1	31.8	37.9	45.1	55.3	63.2	70.2	68.2	60.1	49.0	39.0	31.1	48.3	26
Average maximum	42.0	44.3	52.3	61.0	70.5	80.5	87.5	85.6	77.1	64.4	54.0	44.2	63.6	26
Average minimum	15.7	18.5	23.4	29.2	36.9	44.6	52.9	51.1	43.6	33.6	24.0	18.0	32.6	26

According to the records of the U. S. Weather Bureau, the frost-free growing period at McGill has ranged from 27 da in 1891 (July 12 to August 8) to 150 days in 1933 (May 13 to October 20) and has averaged 120 days (May 31 to September 20) during a 50-year period of record. The frost-free growing period at Adaven has ranged from 87 days in 1925 (June 22 to September 17) to 155 days in 1922 (May 29 to October 29) and has averaged 121 days (June 1 to September 29) during a 33-year period of record. Inasmuch as the altitudes of these stations are from 300 to 1,200 feet above the floor of White River Valley, the growing season there is probably a little longer. The growing period in White River Valley is usually satisfactory for the growth of hay and other frost-resistant or rapidly maturing crops.

VEGETATION

Between altitudes of 6,000 to 9,000 feet the highlands that border White River Valley commonly are covered by a vigorous growth of juniper (mostly *Juniperus utahensis*) and piñon pine (*Pinus monophylla* and *Pinus edulis*), associated with sagebrush (*Artemisia tridentata*), blackbrush (*Coleogyne ramosissima*), little rabbit brush (*Chrysothamnus stenophyllus*), and other typical members of the Northern Desert Shrub plant association. Small growths of white fir (*Abies concolor*) and other large evergreens are commonly found in well-shaded mountain canyons between altitudes of 7,500 and 11,000 feet, but slopes well timbered with trees of this type are not to be found.

The alluvial apron and the valley floor are commonly cover by sagebrush, little rabbit brush, and associated shrubs, except places where the water table is near the land surface.

Growths of rabbit brush (*Chrysothamnus graveolens*), salt grass (*Distichlis spicata*), greasewood (*Sarcobatus vermiculatus*), and other phreatophytes—plants that habitually obtain their water supply from the zone of saturation either directly or through the capillary fringe—are commonly found where the water table is near the land surface. Phreatophytes transpire large quantities of ground water during their growing season. Determination of the use of water by phreatophytes is an important and necessary factor in estimating the discharge of ground water and the amount of ground water available in the desert valleys and basins of Nevada. Large areas in White River Valley are covered by phreatophytes. These are in the channel of White River south of Lund, including most of the Wilson Meadows, and in the eastern part of The Cove. An unusual phreatophyte, locally referred to as "swamp cedar," grows in small areas west of White River, especially in sec. 33, T. 11 N., R. 61 E. This tree has been tentatively identified as a variety of the Rocky Mountain juniper (*Juniperus scopulorum*) or possibly a hybrid between the Rocky Mountain juniper and the western or Utah juniper (*Juniperus utahensis*).[1] It also grows in Spring Valley, about 30 miles east of White River Valley, in marshlands and other places where the water table is near the land surface. These are the only two localities where the writers have observed this phreatophyte.

The mapped area of phreatophytes as shown on Plate 1 closely conforms to the area in which the water table is within 10 feet of the land surface in White River Valley.

GEOLOGY AND WATER-BEARING CHARACTERISTICS OF THE ROCKS

GENERAL RELATIONS

The rocks of White River Valley may be divided into two general groups on the basis of their age, origin, occurrence, and influence on the occurrence and movements of ground water. These groups are: (1) The older sedimentary and igneous rocks in the mountains and foothills; and (2) the lake beds and alluvial deposits of the valley.

OLDER SEDIMENTARY AND IGNEOUS ROCKS

The stratigraphy of the older sedimentary rocks in White River Valley has been studied in detail only in the Robinson mining district in the vicinity of Ely, Ruth, and Kimberly, adjacent to the northeast part of the valley. Reconnaisance studies have been made, also, in Cave Valley on the east side of the Egan Range. Only reconnaisance studies, mostly conducted during the present investigation, have been made in other parts of the valley. However, these reconnaisance studies indicate that the general stratigraphic sequence of the older rocks is similar to that in the Robinson district and in Cave Valley. The center stratigraphic column in Figure 3 shows the general relations in the Robinson district and in Cave Valley. Columns that diagramatically illustrate the Paleozoic stratigraphy in the Eureka and Pioche mining districts, the areas closest to the Robinson district and White River Valley in which detailed geologic studies have been made, are shown, also, in Figure 3.

[1]Personal correspondence with Robert L. Brown, Regional Nursery Division, Pacific Coast Region, Soil Cons. Service, Dec. 22, 1947.

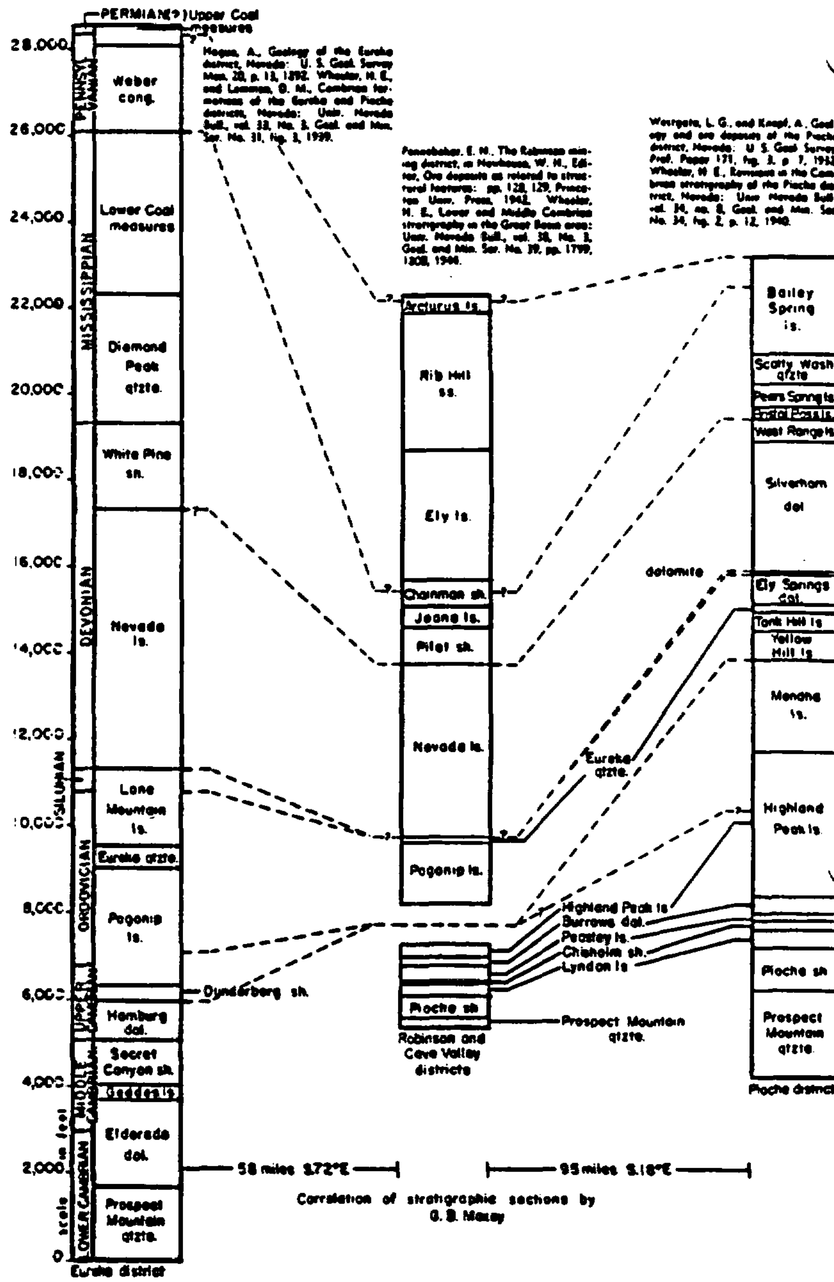

FIGURE 3—Diagrammatic correlation of Paleozoic stratigraphic columns in the Eureka, Pioche, and Robinson mining districts, and Cave Valley, Nevada.

Rocks of Paleozoic age form the main bulk of the ranges adjacent to White River Valley. Rocks of Devonian to Pennsylvanian age crop out in the north part of the Egan Range, on the drainage divide and in the foothills at the north end of the valley, and in the foothills along the west side of the valley as far south as The Cove. Farther south, rocks in the mountains along both sides of the valley are commonly older and belong to formations of Cambrian to Devonian age. Rocks of Ordovician and Devonian age crop out along the crests of the White Pine and Grant Ranges and rocks of later Paleozoic age form the lower parts of the east sides of these ranges. Rocks of early Paleozoic age form a few small isolated hills or buttes north of Moon River Spring in the south end of the valley.

Detailed lithologic descriptions of the formations as they appear in the Robinson, Patterson, Pioche, and Eureka mining districts are available in papers by Westgate and Knopf,[1] Wheeler and Lemmon,[2] Wheeler,[3] Hague,[4] and Pennebaker,[5] and therefore are not given in this report.

In summary, most formations in the mountains adjacent to White River Valley consist of well-indurated shale, sandstone, quartzite, dolomite, and limestone. Limestone and dolomite are the predominant rock types. They are commonly noncavernous, even where jointed and faulted, but parts of two formations, the Pogonip and Nevada limestones, are moderately cavernous.

Extrusive rocks are exposed in a large area in the foothills in the northwest and west parts of the valley. These rocks also crop out over small areas in the northeast and southeast parts of the valley. They commonly consist of rhyolite, andesite, and minor flows of basalt. The extrusive rocks are associated with intrusive porphyries and quartz monzonite in the vicinity of Shingle Pass in the south part of the Egan Range, in the Robinson mining district, and on the west slopes of the White Pine and

[1]Westgate, L. G., and Knopf, A., Geology and ore deposits of the Pioche district, Nevada: U. S. Geol. Survey Prof. Paper 171, 1932.

[2]Wheeler, H. E., and Lemmon, D. M., Cambrian formations of the Eureka and Pioche districts, Nevada: Univ. Nevada Bull., vol. 33, no. 3, Geol. and Min. Ser. No. 31, 1939.

[3]Wheeler, H. E., Revisions in the Cambrian stratigraphy of the Pioche district, Nevada: Univ. Nevada Bull., vol. 34, no. 8, Geol. and Min. Ser. No. 34, 1940.

Lower and Middle Cambrian stratigraphy in the Great Basin area: Univ. Nevada Bull., vol. 38, no. 3, Geol. and Min. Ser. No. 39, pp. 1708–1800, May 1944.

[4]Hague, A., Geology of the Eureka district, Nevada: U. S. Geol. Survey Mon. 20, 1892.

[5]Pennebaker, E. N., The Robinson mining district, in Newhouse (Editor), Ore deposits as related to structural features: pp. 128–136, 1942.

Grant Ranges. The porphyries and monzonites in the Robinson mining district intruded Pennsylvanian and possibly Permian rocks and were cut by the extrusive rocks. All the flow rocks adjacent to and in White River Valley are stratigraphically overlain by the Tertiary and Quaternary lacustrine and alluvial sediments. Similar flow rocks cut through limestones of Pennsylvanian age and are covered by the Panaca formation of Pliocene age[6] in the Pioche district. This stratigraphic relationship is common in other nearby areas. Therefore, the age of the flows is tentatively assigned to the Tertiary period because they occupy a position similar to that of the Tertiary(?) flows of the Pioche and other nearby districts where detailed studies have been made.

The Tertiary(?) flow rocks commonly are dense and therefore not highly permeable. They are considerably jointed, and in some areas individual flows are separated by thin sedimentary beds.

The physical characteristics of most of the older sedimentary rocks and of the igneous rocks indicate that they are not good water-bearing formations and that little water could be developed from wells penetrating them. Primarily they are barriers to movement of ground water on either side of the valley. They may partly impede ground-water movement at the north end of White River Valley. Thus, so far as ground-water movements are concerned, the valley is isolated from adjoining valleys on the east and west but probably receives some ground water from Jakes Valley to the north. The moderately cavernous parts of the Pogonip and Nevada limestones are probably good aquifers that store and transmit large quantities of water where they are beneath the regional water table. Small quantities of water probably percolate into joints and along faults in the other formations and in the igneous rocks and eventually seep into the alluvial deposits or come to the surface as small springs.

TERTIARY AND QUATERNARY ALLUVIAL AND LACUSTRINE DEPOSITS

The alluvial deposits of gravel, sand, silt, and clay that make up the valley fill contain the most productive aquifers and yield all the water discharged from wells and by soil evaporation and transpiration from plants in White River Valley. These deposits occur over most of the valley lowland. The contact between the alluvial and lacustrine deposits and the older rocks (see pl. 1) is

[6] Phoenix, D. A., Geology and ground water in the Meadow Valley Wash drainage area, Nevada, above the vicinity of Caliente: State of Nevada, Office of the State Engineer, Water Resources Bull., No. 7, pp. 32–38, 1948.

higher in the north part of the valley than in the south part. The maximum altitude of the contact is about 7,000 feet and the average altitude is about 6,000 feet. The alluvial and lacustrine deposits range in thickness from a featheredge to a maximum of at least 1,300 feet. According to the log of the White Pine County test well (12/62-5D1) drilled to a depth of 1,300 feet, the well ended in alluvial or lacustrine materials. This well has been destroyed and it is now impossible to check the depth. Another county test well (12/61-13D1) was drilled to a depth of 560 feet and ended in lacustrine deposits. All other known wells in the valley are reported or known to be shallower than these test wells. Thus the maximum thickness of the alluvial and lacustrine deposits in White River Valley is apparently more than 1,300 feet. These sediments in White River Valley may be grouped into the following four units on the basis of their age, origin, and distribution: (1) The older lacustrine deposits of possible middle to late Tertiary age; (2) the alluvial-fan deposits, formed probably during the late Tertiary and in the Quaternary period; (3) the Pleistocene river deposits; (4) deposits of Recent age which occur commonly in the bottoms of the washes and on the valley floor. These units are not differentiated on Plate 1 because detailed geologic mapping was not within the scope of this investigation.

The older lacustrine deposits crop out near the Adams-McGill reservoir in the south part of White River Valley. They consist of fine sand, silt, clay, containing considerable limey materials, most of which is probably caliche. The beds are horizontal and apparently have not been disturbed by faulting or folding. The altitude of the top of the beds near the reservoir is about 5,350 feet. Outcrops of these deposits have not been identified in the north part of the valley as they have been covered by sediments deposited during later geologic time. In the vicinity of Preston and Lund, it appears that the fine-grained materials penetrated by wells below a depth of about 150 feet, and an altitude of about 5,450 feet, are part of these lacustrine sediments. The lithology and stratigraphic position of these sediments closely resemble other lacustrine sediments studied in nearby areas, such as the Panaca formation[7] in the Pioche district and parts of the Humboldt formation along the Humboldt River. Therefore, it is believed likely that they were deposited since middle Tertiary time and before the close of the Pliocene epoch.

[7]Phoenix, D. A., op. cit. p. 34.

The lithology of the alluvial-fan deposits is well known from numerous exposures along the higher parts of the alluvial a and from several logs of wells drilled in the central part of valley. Near the mountains, in the upper part of the alluvial apron, they commonly consist of massive to thin beds of coarse, angular, poorly assorted gravel and sand. These beds are of local derivation and of relatively high permeability. They dip away from the mountains at angles of 8° to 15°. Lower down on the alluvial apron the beds become more sandy and silty and dip at lower angles. The beds of coarser materials become thinner and interfinger with thick lenses of silt and clay along the toe of the apron in the central part of the valley. Deposition of the materials in the alluvial apron may have been contemporaneous with that of the lacustrine deposits and probably continued through early Pleistocene time. The apron was dissected during late Pleistocene (?) time but later it became a depositional area and deposition is continuing along channels incised in it.

The character and position of these sediments is of much significance in the occurrence of ground water in the valley. Nearly all the relatively heavy precipitation in the mountains is on areas tributary to the outcrops of the gravels. That fraction of the precipitation not lost by evaporation or transpiration recharges the ground-water reservoir either by percolation in the soil mantle and the underlying rocks thence into the valley fill; or by runoff on the surface of the alluvial fans and thence into the valley fill.

The toes of the alluvial fans are truncated by the old cha of White River. The old river bed and its tributaries are defined by escarpments throughout the length of White River Valley. The confluence of the old White River channel and the large tributary, Jakes Wash, is just south of Preston. The main river channel extended northwesterly into the White Pine Mountains, whereas Jakes Wash drained the north and northwestern parts of the Egan Range. Thus the present drainage pattern was established at least in late Pleistocene time. These old channels range from a quarter to half a mile in width. The old channel is about 1½ miles wide south from its confluence with Jakes Wash to Lund. South of Lund to the south end of White River Valley it averages about three-quarters of a mile wide.

The base of the escarpments marginal to the old river channel marks the contact of the river deposits with the alluvial-fan materials. The river deposits consist of beds and lenses of well-sorted to poorly sorted, well-rounded gravel with some sand and

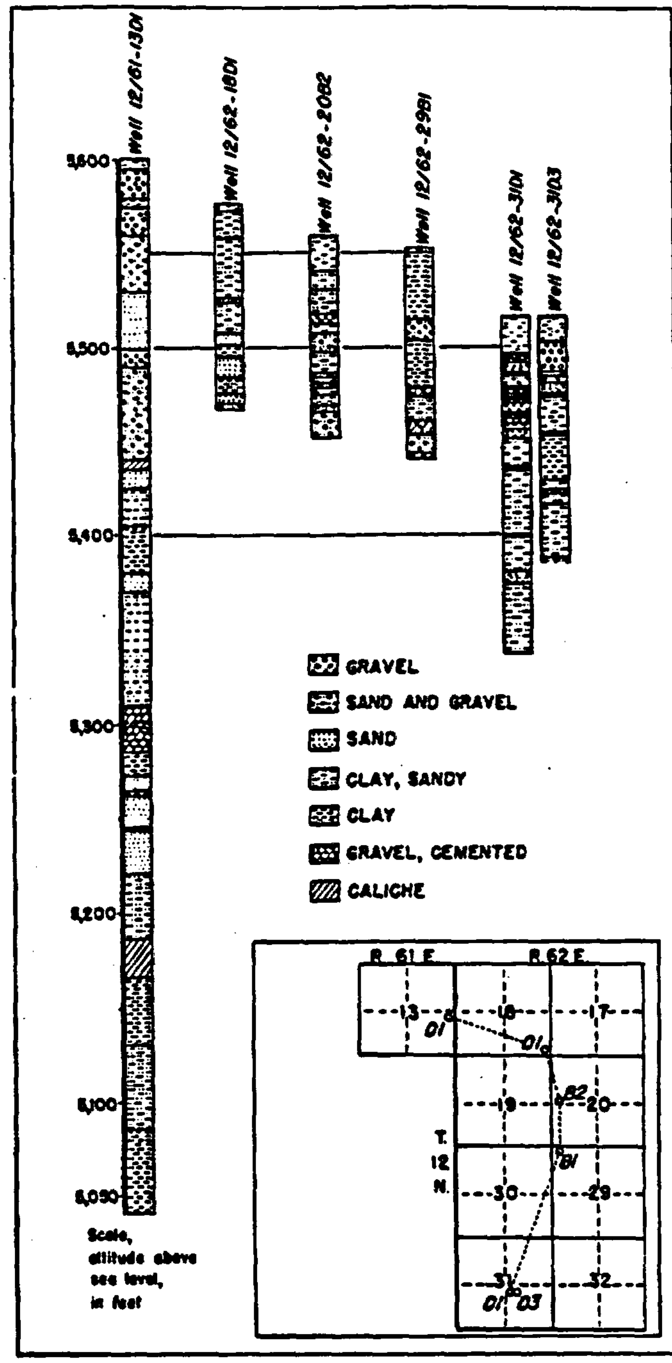

FIGURE 4—Selected logs of wells in White River Valley, Nevada.

silt. The thickness of these deposits may be as much as 150 feet in some places and probably averages about 50 feet. The river gravels were deposited by White River principally during late Pleistocene time. The well-sorted sands and gravels form highly permeable aquifers that are among the most productive in White River Valley.

Alluvial deposits of Recent age, consisting of silt and clay with some sand and gravel, occur locally in most of the large washes in White River Valley. These deposits commonly are thin and lie above the regional water table, but in a few places they may extend below the water table and may prove to be important water-bearing beds. Figure 4 shows, graphically, the logs of several wells in the valley.

GROUND WATER

OCCURRENCE

All the ground water obtained from wells in White River Valley is drawn from the sand and gravel deposits of the valley fill. Most of it is taken from the highly permeable gravels and sands deposited in the old channels of White River along the axis of the valley. The river gravels of the old channels are in contact with the truncated lower ends of the alluvial apron and are more or less interconnected with the sand and gravel deposits of the alluvial apron. The river deposits probably average 50 feet in thickness. They are underlain, in part, by alluvial-apron sediments that also contain water-bearing sand and gravel lenses. Logs of wells drilled in the vicinity of Preston and Lund show that the alluvial-apron sediments may be about 120 feet thick and are underlain by less permeable lacustrine sediments of Tertiary age (see fig. 4). Thus the known productive water-bearing beds in White River Valley occur in the alluvial apron and the river-channel deposits ranging in depth from about 15 to 150 feet, depending upon the topographic location. The river gravels are commonly thinner and underlie smaller areas in the south part of the valley from Emigrant Springs to Hot Creek Ranch. Important water-bearing beds may occur only in the alluvial fans in the south part of the valley because there the relatively impermeable lacustrine sediments are near the surface or crop out nearly everywhere along the axis of the valley.

Springs in the valley fill yield large quantities of water. Most of them, such as Emigrant, Butterfield, and Flag Springs (see pl. 1) occur on the lower part of the alluvial apron. They are probably gravity springs, and most of the water that issues from them comes to the surface along the outcrop area of the relatively permeable water-bearing beds which overlie impermeable beds in the alluvial-fan deposits. Commonly the water table is near the surface in the vicinity of and downstream from the spring sites.

Arnoldson, Nicholas, Cold, and Preston Big Springs issue from the valley fill in the vicinity of Preston. The water table in the immediate vicinity of the springs, as shown by measurements of the water level in several nearby wells, is at least 60 feet beneath the land surface. Thus the water issuing from the springs is under artesian head. The following discussion is offered as a tentative explanation of the possible origin of these springs: Prior to the deposition of the valley fill, large springs issued from bedrock aquifers in the vicinity of the present site of Preston. During the deposition of the Tertiary lacustrine sediments the water issuing from the springs was under sufficient head to continue rising through the lake deposits. The large springs flowed with sufficient velocity to allow selective deposition of only the sandy or coarser particles at the spring sites. Thus relatively permeable channels were maintained through the lacustrine sediments, as they were deposited, the head at all times being sufficient to cause discharge at the spring orifices. Deposition of lacustrine sediments gradually gave way to deposition of fan sediments. Channels through these fan sediments probably were maintained by a process similar to that described above, and were isolated from the surrounding alluvial-fan sediments by deposition of wind-blown silt and clay which became fixed in the moist vegetated areas around the spring orifices. These inferences may be substantiated in part by the reported presence of thick zones of clay and silt around Preston Big Spring.[1]

Caliche does not crop out in the vicinity of the springs. There is no surficial evidence that the springs ever deposited sufficient quantities of calcareous material to form "pipes" or channels. Partial analyses by D. E. White,[2] Geologist, U. S. Geological Survey, show that the water from the springs does not deposit calcareous material at present. Leakage to the valley fill from the spring conduits is possible. However, on the basis of the assumptions made in the foregoing paragraphs, the spring conduits are enclosed by relatively impermeable sediments. These sediments would prevent lateral percolation of appreciable quantities of water. Further, the water table is deep in the immediate

[1]Oral communication from Soil Conservation Service, Ely, Nevada.
[2]Oral communication.

vicinity of the springs. Substantial losses through the conduit walls would be expected to result in a ground-water level at or near the level of the spring orifices.

Ground water also occurs in the bedrock in and adjacent to White River Valley. Large quantities of water are discharged from Lund Spring, which issues from limestone near the southeast corner of Lund, and at Hot Creek Spring near Hot Creek Ranch in the south part of the valley. Lund Spring apparently flows out of crevices in cavernous limestone (Nevada(?) limestone), and Hot Creek Spring flows out of a highly faulted, cavernous part of the Pogonip(?) limestone. Several other smaller springs issue from bedrock, the most important being Moon River Spring about 3 miles southwest of Hot Creek Spring. In the mountainous areas numerous small springs issue from bedrock or from alluvium near bedrock. Many of them are intermittent and cease flowing during the dry part of the year and in periods of drought. Only small quantities of water occur in bedrock formations other than the Nevada and Pogonip limestones because the other rocks are relatively impermeable.

SPRINGS

The location and physical characteristics of the largest and most important springs in White River Valley are shown on Plate 1 and in Tables 6, 7, and 8. Most of the larger springs are thermal,[3] that is, the temperature of the water that issues from them is more than 10° F. higher than the average annual air temperatures in the valley. This higher temperature is inferred to indicate that some or all of the water that issues from the springs circulates to considerable depth following infiltration in the recharge area. The temperature of the water does not necessarily indicate the depth to which it circulates, because in the Great Basin the temperature gradient of the earth ranges considerably from place to place. The depth to which water circulates probably varies in the different spring systems. The time required for the water to circulate probably varies also in the different spring systems. The temperature of water issuing from spring systems is controlled by: (1) Rock temperature, (2) depth of circulation, (3) length of the system, and (4) time required for circulation. Thus the temperature of water issuing from a spring system is the resultant effect of the several factors. For example, the higher temperature of the water from Mormon

[3] Stearns, N. D., Stearns, H. T., and Waring, G. A., Thermal springs in the United States: U. S. Geol. Survey Water-Supply Paper 679-B, p. 61, 1937.

Spring does not necessarily show that it circulates more deeply than the waters of lower temperature from Preston Big or Cold Springs. Reconnaissance study of the geology of the recharge areas and the boundaries of the drainage area of the valley indicates that the water discharged from springs originates as precipitation within the drainage boundaries of White River and Jakes Valleys.

TABLE 6

Principal springs in White River Valley, Nevada

Number and location	Name and owner[1]	Geology	Temperature (°F.)	Discharge: Date of measurement	Discharge: Second-feet	Remarks
		NYE COUNTY				
6/60-25B1	Moon River Spring—Don Hutchings	Issues from valley alluvium adjacent to hill of Paleozoic limestone	92		[2]2	
6/61-18A1	Hot Creek Spring—Whipple Bros.	Issues from valley alluvium adjacent to hill of Paleozoic limestone	92	4- 6-35	15.34	Measured by F. W. Millard and Son. Analysis.
7/62-28B1	Butterfield Springs—Whipple Bros.	Issues from two orifices along lower slopes of alluvial fan			[2]2.5	
7/62-32D1	Flag Springs—Hendrix Bros.	Issues from several orifices along lower slopes of alluvial fan			[2]2.5	
9/61-32D1	Mormon Spring—Don Eldridge	Issues from valley alluvium about 1 mile east of bedrock hills	100		4.22	Recorded from Water-Supply Paper 679-B, p. 165.
9/62-19D1	Emigrant Springs—Don Eldridge	Issues from several orifices along lower slopes of alluvial fan	67		[2]3	
		WHITE PINE COUNTY				
11/62-4A1	Lund Spring—Lund Irrigation Company and others	Issues from alluvium about 25 feet from surface contact with bedrock (limestone)	66	10 27 10	5.36	Measurement by Office of Nevada State Engineer.
				3-16-35	9.34	Measurement by Scott and Titus for Lund Irrigation Co. Spring orifice lowered.
				3-16-35	10.19	Measurement by Scott and Titus for Lund Irrigation Co. Spring orifice lowered.
				3- 6-36	6.39	Measurement by Office of Nevada State Engineer.

TABLE 6, WHITE PINE COUNTY—*Continued*

Number and location	Name and owner[1]	Geology	Temperature (°F.)	Discharge: Date of measurement	Discharge: Second-feet	Remarks
				1-23-37	7.22	Measurement by C. H. Wainwright for Lund Irrigation Co.
				5-17-44	8.14	Measurement by Office of Nevada State Engineer.
				5- 9-47	9.49	Measurement by Office of Nevada State Engineer.
12/61-2A1	Preston Big Spring—Preston and Lund Irrigation Companies	Issues from valley alluvium, probably through a conduit, and is under artesian pressure		5- 8-47	8.64	Measurement by Office of Nevada State Engineer.
			For other measurements see Table 7			
12/61-12B1	Cold Spring—Lund Irrigation Co.	Issues from valley alluvium, probably through a conduit, and is under artesian pressure	70	5- 9-47	1.74	Measurement by Office of Nevada State Engineer.
			For other measurements see Table 7			
12/61-12D1	Nicholas Spring—Lund Irrigation Co.	Issues from valley alluvium, probably through a conduit, and is under artesian pressure	71	5- 9-47	2.50	Measurement by Office of Nevada State Engineer.
			For other measurements see Table 7			
12/61-12D2	Arnoldson Spring—Preston Irrigation Co.	Issues from valley alluvium, probably through a conduit, and is under artesian pressure	72	5- 9-47	3.08	Measurement by Office of Nevada State Engineer.
			For other measurements see Table 7			
13/60-33A1	Williams Hot Spring—Jesse Gardner	Issues from fracture in interbedded sandstone, gravel, and limestone near exposures of Tertiary(?) flow rocks	124	......	.11±	Record in Water-Supply Paper 679, p. 163.
			128	12-16-47	[2].3±	

[1]Springs are numbered by the same system as that described on page 54 for numbering wells. [2]Estimated.

TABLE 7

Discharge, in second-feet, of Preston Big, Arnoldson, Cold, and Nicholas Springs, White River Valley, Nevada[1]

(Measurements by the Office of the State Engineer of Nevada except as noted)

Date	Preston Big Spring	Arnoldson Spring	Cold Spring	Nicholas Spring
Oct. 27, 1910	6.21	3.14	1.03	2.28
1913	7.96	3.66		
Aug. 16, 1913	[2]7.60			
Oct. 16, 1914	[2]7.00			
June 24, 1916	[2]8.00			
1922	....	3.52		
May 7, 1935	7.10	3.25	1.31	2.63
Aug. 13	7.21			
Mar. 6, 1936	8.48	3.86	1.34	2.68
Mar. 29	....	3.85	1.40	2.65
Mar. 30	8.10	3.85	1.40	2.65
Apr. 7	8.31	3.83	1.41	2.75
Apr. 29	8.39	3.80	1.44	2.74
May 2	8.29			
May 5	8.18	3.80	1.38	2.70
May 7	8.20	3.82	1.38	2.70
May 12	8.03	3.82	1.39	2.70
May 16	8.28	3.82	1.44	2.70
May 19	8.34	3.82	1.39	2.70
May 23	8.25	3.82	1.38	2.70
May 26	8.57	3.82	1.30	2.70
May 30	8.50	3.82	1.34	2.70
June 2	8.52	3.82	1.49	2.70
June 5	8.42	3.82	1.40	2.70
June 9	8.31	3.82	1.40	2.70
June 16	8.54	3.82	1.40	2.70
June 19	8.40	3.82	1.38	2.70
June 23	8.50	3.82	1.41	2.70
June 27	8.48	3.82	1.37	2.70
July 7	8.73	3.82	1.38	2.70
July 12	8.40	3.82	1.38	2.70
July 18	8.67	.....	1.38	
July 19	8.52	3.82	1.40	2.70
July 26	8.50	3.82	1.38	2.70
Aug. 4	8.53	3.82	1.39	2.70
Aug. 15	8.30	3.82	1.39	2.70
Aug. 25	8.43	3.82	1.40	2.70
May 14, 1937	8.50			
Apr. 16, 1939	8.34			
Sept. 5	8.71			
Dec. 1	8.23			
Mar. 24, 1941	8.34			
June 13	8.39	3.73		
Apr. 16, 1943	9.04			
May 17, 1944	8.97	3.73		
July 27, 1946	8.58			
May 9, 1947	8.64	3.07	1.74	2.51

[1]Compiled by F. N. Dondero, Office Engineer, Office of the State Engineer of Nevada, from records of the Office of the State Engineer of Nevada.

[2]Measurement by the U. S. Geological Survey, Water Resources Division.

SOURCE AND AMOUNT OF RECHARGE

As has been mentioned previously, the area enclosed by the drainage boundary of White River Valley can be considered an enclosed ground-water basin, except that it probably receives some underflow from Jakes Valley to the north and loses water by surface flow and underflow at the south end. There are no large areas of natural discharge in Jakes Valley. The valley is topographically separated from White River Valley by an alluvial divide at the head of Jakes Wash. It is believed that ground water moves south from Jakes Valley into White River Valley in the vicinity of Jakes Wash. Thus the ultimate source of the ground water is believed to be the precipitation within the White River Valley drainage boundary and the drainage boundary of Jakes Valley. However, only a small part of the water that falls as rain and snow on the drainage area reaches the ground-water reservoir. Large quantities are lost by transpiration and evaporation before the water has deeply penetrated the soil and rocks. An appreciable fraction of the precipitation probably never reaches the soil but falls on trees and other vegetation and evaporates following storms.

The average annual amount of recharge to ground water in White River Valley can be estimated from the precipitation and from the results of recharge studies in comparable areas. This requires a determination or estimate of average annual precipitation for the drainage area, from which the recharge is calculated as a percentage. An estimate for the precipitation in the White River Valley was made from a precipitation map[4] for the State of Nevada in which zones of average range of precipitation are designated. The zones are divided into the following ranges: less than 8 inches; 8 to 12 inches; 12 to 15 inches; 15 to 20 inches; and over 20 inches. The amount of water from the successive zones that reaches the ground-water reservoir is estimated as, 0, 3, 7, 15, and 25 percent of the precipitation in the respective zones. The percentages are adapted for this area from preliminary recharge studies in east-central Nevada. These studies consisted of estimating the ground-water discharge by natural losses from 13 valleys in east-central Nevada. The recharge for each valley was also estimated, using the rainfall-zone map as a basis. The recharge estimates were then balanced

[4]Hardman, George. Nevada precipitation and acreages of land by rainfall zones. Univ. Nevada Agr. Exper. Sta., mimeographed report and map. 10 pp., June 1936.

by trial-and-error with the discharge estimates. They also compare favorably with percentages determined in Las Vegas Valley[5] by means of precipitation gages maintained at different altitudes in the Spring Mountains. The average annual ground-water recharge estimated on this basis is about 40,000 acre-feet for White River Valley, and about 13,000 acre-feet for Jakes Valley. This represents an approximation of the total recharge to ground water. The amount of ground water available to wells is estimated to be about 55 percent of the total recharge. (See page 46.)

MOVEMENT

Water from precipitation that enters the ground-water reservoir moves toward the axis of the valley. This is shown by the difference in altitude of the water levels in wells and mines high in the recharge areas and in wells in the lower part of the valley. For example, the altitude of the water level in the Alpha Mine near Kimberly is approximately 6,100 feet, the altitude of the water level in the Jakes Wash well (14/61–9C1, unsurveyed) is about 5,800 feet, and the altitude of the water table in the vicinity of Preston and Lund, as determined from measurements in many wells, ranges from 5,550 to 5,500 feet. Thus the slope of the water table and movement of the ground water are toward the valley axis.

The slope, and hence the movement of the ground water, and the shape of the water table in the vicinity of Lund and Preston are shown by water-level contours on Plate 2. The main ditch from Lund Spring extends north for about 1 mile to the north part of Lund. Most of the spring water is carried through this ditch for about 9 months of the year. During the remaining 3 months most of the spring discharge is diverted to the natural channel, which extends west from the spring. A ground-water ridge extends west from the north part of Lund, indicating that water in the main ditch recharges the ground-water reservoir in that vicinity. A smaller inflection of the water-level contours suggest ground-water recharge from the natural channel of Lund Spring, and from the tributary irrigation ditches in the area. White River and the main ditches from the springs near Preston also apparently contribute water to the ground-water reservoir. However, the water-level contours outside the immediate vicinity

[5]Maxey, G. B., and Robinson, T. W., Ground water in Las Vegas, Pahrump, and Indian Spring Valleys, Nevada (A summary): State of Nevada, Office of the State Engineer Water Resources Bull. No. 6, p. 10, 1947.

of Lund are not controlled closely enough by wells to show definitely that contributions from the river and springs occur. The inference is supported, however, by measurements of losses between given points along the ditch from Nicholas, Cold, and Preston Big Springs. The discharge above and below a half-mile reach of the ditch immediately south of Preston was measured in April 1948 and found to be about 6.7 second-feet at the upper end of the reach and 6.0 second-feet at the lower end. Evaporation and transpiration were negligible and there were no diversions in this reach of the ditch. Thus these measurements indicate that about 0.7 second-foot percolated into the ground in that distance.

The southerly slope of the water table, and the resulting southerly movement of ground water throughout the length of the valley, is shown by measurements of the altitude of the water table. The southerly slope of the water table west of Lund is about 15 feet to the mile (see pl. 2). Measurements in the stretch along the river, south of latitude 38°15′ N., show that the slope of the water table steepens sharply. In February 1948 the water table was at the land surface at the south end of the area of transpiration in the southeast part of sec. 25, T. 5 N., R. 60 E. Five miles southeast of this point, the water level in the White River well (SW¼ sec. 36, T. 4 N., R. 61 E.), not shown on Plate 1, was 90 feet below land surface. Two miles farther southeast, in the Esplin well (SW¼ sec. 8, T. 3 N., R. 62 E.), not shown on Plate 1, the water level was about 220 below land surface. The land surface in this area has a gradient of about 30 feet a mile. The slope of the water table, then, is about 48 feet a mile for the 5-mile segment between sec. 25, T. 5 N., R. 60 E., and the White River well; between the White River well and the Esplin well the slope of the water table is on the order of magnitude of 95 feet a mile. Thus the data indicate that there is underflow to the south, out of the area, beneath White River channel.

DISCHARGE

Ground water is discharged within White River Valley by several large springs and by wells. All available records of the discharge of springs and wells were compiled as a part of the ground-water inventory. Most of these records are shown in Tables 6, 7, and 9. The estimated discharge of ground water from springs and wells, based on these records and on measurements made during the current investigation, was 40,000 and

400 acre-feet of water, respectively, for 1947. The annual discharge from springs in previous years of record was about the same, but only about 180 acre-feet of water was discharged annually from wells between 1930 and 1940, and before 1930 the amount was probably less than 100 acre-feet.

All the water discharged within the valley by springs and wells is accounted for in the discharge inventory discussed in the following paragraphs, because this water is ultimately discharged from the valley by evapo-transpiration of areas of irrigated plants and native phreatophytes, by underflow, and by stream flow.

Ground water is discharged from White River Valley by two processes: (1) Evapo-transpiration, which includes evaporation from the soil and from free-water surfaces and transpiration by both native phreatophytes and cultivated plants, and (2) underground and surface outflow at the south end of the valley.

The scope of this investigation did not include detailed studies of evapo-transpiration rates in White River Valley. Therefore, estimates of the rates of evapo-transpiration[6] are based on data obtained from studies made in other parts of the West, especially those made by Lee[7] and White[8] in the Great Basin. These estimates were adapted to the climatic and hydrologic conditions of White River Valley and compare favorably with the values of consumptive use estimated by Piper, Robinson, and Park[9] in the Harney Basin, Oregon.

On this basis the annual consumptive use of alfalfa, cereals, and meadow hay, the chief cultivated crops in the valley, is estimated to be 1.25 feet. This estimate is substantiated in part by

[6] Evapo-transpiration here includes evaporation from free-water surfaces and "consumptive use," which is considered as the sum of the amount of water used by vegetative growth of a given area in transpiration or building of plant tissue and that evaporated from adjacent soil, in any specified time. The quantity is expressed as acre-feet per acre per year. Consumptive use is not equivalent to duty of water. Duty of water is the amount of water applied to crops and includes consumptive use, unavoidable losses such as percolation beyond the reach of plant roots, and some waste necessary to irrigate a given tract properly.

[7] Lee, C. H., An intensive study of the water resources of a part of Owens Valley, California: U. S. Geol. Survey Water-Supply Paper 294, 135 pp., 1912.

[8] White, W. N., A method of estimating ground-water supplies based on discharge of plants and evaporation from soil: U. S. Geol. Survey Water-Supply Paper 659-A, 105 pp., 1932.

[9] Piper, A. M., Robinson, T. W., and Park, C. F., Jr., Geology and groundwater resources of the Harney Basin, Oregon: U. S. Geol. Survey Water-Supply Paper 841, 189 pp., 1939.

data from studies made near Chino, California, by Blaney, Taylor, and Young.[10]

It is believed that most phreatophytes discharge only small, probably negligible amounts of water from the ground-water reservoir where the water table is more than 15 feet below the land surface. Salt grass, the most common phreatophyte in the area of transpiration apparently does not grow where the water table is more than 10 feet below the land surface and grows densely only where the water table is within 6 feet of the surface. In White River Valley few other phreatophytes grow even where the water table is within 15 feet of the land surface, and it is believed that they discharge very little water. Therefore, allowing for the distribution of phreatophytes and on the basis described in the preceding paragraph, it is estimated that the annual rate of evapo-transpiration is 0.8 foot in the area of transpiration in White River Valley. This estimate includes allowances for plant density, depth to the water table, and evaporation from small tracts of free-water surfaces.

The transpiration area (see pl. 1) comprises about 36,000 acres lying between the banks of White River channel and extending south from Lund to the south end of the valley. The area of irrigated land on which alfalfa, cereals, and meadow hay are grown is about 4,000 acres. Most of this land is in the vicinity of Preston and Lund and only small tracts lie in other parts of the valley (see pl. 1).

The estimated total annual discharge by evapo-transpiration is given below:

	Annual rate of discharge (feet)	Area (acres)	Annual discharge (acre-feet)
Native phreatophytes	0.8	36,000	28,800
Cultivated plants	1.25	4,000	5,000
Total discharge (approximate)			34,000

The quantity of water discharged by stream flow from the south end of White River Valley was estimated in February 1948 to be about 3 second-feet. Observations made during 1947 and 1948 indicate that the discharge might average 3 second-feet during the 6 months of the year when there is little irrigation in the valley. Possibly 1.5 second-feet flows during the early

[10] Blaney, H. F., Taylor, C. A., and Young, A. A., Rainfall penetration and consumptive use of water in Santa Ana River Valley and coastal plains: California Dept. Public Works, Water Resources Div. Bull. 33, pp. 85, 86, 1930.

spring and fall, and no water is discharged by the stream during the 3 summer months. From these data it is estimated that the average annual discharge by streams from White River Valley into White River Wash is about 1,500 acre-feet.

Ground water is also discharged from the south end of the valley as underflow in White River Wash. It is possible to estimate this discharge by subtracting from the total recharge to White River Valley the combined discharge by evaporation and stream flow. The total recharge, assuming that the Jakes Valley drainage basin is tributary to White River Valley, is estimated to be 53,000 acre-feet, and discharge by evapo-transpiration and streams totals about 35,500 acre-feet. On this basis it is estimated that as much as 17,500 acre-feet of water leaves the valley as underflow. Of course, all errors in other factors are thrown into this figure.

Evaluation of ground-water discharge by underflow at the south end of White River Valley cannot be made by other methods because the thickness and permeability of the water-bearing materials in that area are unknown.

Hot Creek Spring annually discharges 11,000 acre-feet of water. Of this amount about 4,000 acre-feet may be accounted for by evapo-transpiration losses between the spring orifice and the south end of the valley. It is recognized that not all of this 4,000 acre-feet loss is supplied by Hot Creek Spring, as there is substantial underflow from White River and the springs to the north. Also, about 700 acre-feet of water from Hot Creek Spring probably is discharged from the valley as stream flow. According to these figures not less than 6,300 acre-feet of water from Hot Creek Spring alone must leave the valley as underflow. Consequently, the estimate of 17,500 acre-feet for the entire underflow out of the valley is believed not to be unreasonable.

The estimated total annual discharge of ground water from White River Valley is summarized below:

Process	Acre-feet
Evapo-transpiration	34,000
Underflow from south end of valley	17,500
Stream flow from south end of valley	1,500
Total discharge	53,000

UTILIZATION

Present — The principal use of the ground-water discharge from wells and springs is for irrigation in the vicinity of Lund and Preston and, to a lesser extent, near Emigrant Springs, Sunnyside, and Hot Creek Ranch. Wells and springs are also the principal source of water for domestic use and stockwatering throughout the valley.

The consumptive use of water in the irrigated areas is estimated to be about 5,000 acre-feet. The remaining 35,400 acre-feet of the 40,400 acre-feet of water discharged by wells and springs flows into the area of transpiration or returns by downward percolation to the ground-water reservoir in the valley lowland, from which it is later discharged by evapo-transpiration or by underflow out of the area. An indeterminate part of this 35,400 acre-feet of water is put to some beneficial use[11] to irrigate meadow pasture and to water stock.

Potential—Much of the water that is now discharged from the valley by evapo-transpiration, underflow, and stream flow can be utilized for irrigation by improving present methods of irrigation and by pumping water from the ground-water reservoir.

Hot Creek Spring annually discharges about 11,000 acre-feet of water, only a small part of which is used beneficially. The remainder flows into the Adams-McGill reservoir, thence south into White River Wash. Most of this water is lost by evaporation, transpiration, and percolation in the gravels of the wash. The discharge of this spring probably could be put to greater beneficial use on land of fair quality northwest of the spring. This can be accomplished either by construction of a new ditch or by low-lift pumping.

It is possible that as much as 12,000 acre-feet of ground water can be recovered annually by pumping from wells along the lower part of the alluvial fans and in the river channel in White Pine County. Probably 7,000 acre-feet can be recovered annually by wells in the part of the valley in Nye County. It is believed that such a withdrawal would not exceed the safe yield of the ground-water reservoir in the valley. Thus, about 30,000 acre-feet of ground water—19,000 from wells and 11,000 from Hot Creek Spring—is believed to be recoverable from the 53,000 acre-feet annually discharged from the valley by evapo-transpiration, underflow, and stream flow.

Artificial recharge to the ground-water reservoir is the practice of spreading surface water on areas of highly permeable sand

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[11] "Beneficial use" is here construed to mean use involving a reasonable duty of water and may include natural losses between the point of diversion and the point of application.

and gravel connected with the aquifers. This may be done during periods in which there is little or no use of the surface-water supply. Water spreading in many places, notably in southern California, has resulted in considerable conservation of water otherwise lost for beneficial use. It is unlikely that water spreading would prove feasible in White River Valley at present, because it would tend to increase the losses from evaporation and transpiration from the present areas with a shallow water table. However, should heavy pumping materially lower the water table in the vicinity of Preston and Lund, some relief may be afforded by water spreading in areas north and east of Preston. Water for such artificial recharge might be available from the winter discharge of Preston Big, Arnoldson, Cold, and Nicholas Springs, only part of which is now used. Further, unused winter discharge from Lund Spring might also be utilized for the same purpose in the vicinity of Lund.

QUALITY OF WATER

Chemical analyses of the waters from three springs in White River Valley are shown in Table 8. The analyses show that the waters discharged by these springs are moderately hard but low in mineral content. The water would be satisfactory for stockwatering, domestic, and irrigation use.

TABLE 8

Chemical analyses of the waters from three springs in White River Valley, Nevada

(Analyses in parts per million)

	Spring (Name, Number, and Location)		
Chemical constituents	Lund Spring[1] 11/62-4A1	Butterfield Springs[2] 7/62-28B1	Hot Creek Spring[1] 6/61-18A1
Silica (SiO_2)	13	46	32
Iron and Aluminum (Fe and Al)	..	0.3	
Calcium (Ca)	56	40	58
Magnesium (Mg)	24	23	22
Sodium and potassium (Na and K)	3.7	2	32
Bicarbonate (HCO_3)	276	178	294
Sulfate (SO_4)	13	27	45
Chloride (Cl)	3.0	18	12
Nitrate (NO_3)	3.2	----	0.3
Boron (B)	0.02	----	0.04
Dissolved solids	252	283	346
Hardness (as $CaCO_3$) Total	238	194	235
Specific conductance ($K \times 10^6$ at 25° C.)	445	---	564

[1]Analyses by Salt Lake City Laboratory of the U. S. Geological Survey. Samples collected May 27, 1949.

[2]Analysis by W. B. Adams (from chemical analyses of municipal water supplies, bottled mineral waters, and hot springs of Nevada: Univ. Nevada, Dept. Food and Drugs, Public Service Div., p. 16, 1944).

It is believed that most of the waters from wells and springs in White River Valley are comparable in quality to the waters of the three springs mentioned above. Water from wells ranging from 20 to 80 feet in depth is used for domestic purposes throughout the valley and apparently is of satisfactory quality, for no objections to it were mentioned by the present local residents.

CONSTRUCTION OF WELLS

Wells with larger capacities would result from improved methods of well construction and development in White River Valley. Most of the wells in the valley are equipped either with perforated casing in which slots have been cut by the driller with a cutting torch before placing in the well, or with casing perforated with a casing ripper after the casing has been placed in the well. No wells have been equipped with well screens, nor have any been gravel-packed. Most of the wells only partially penetrate the water-bearing beds. So far as is known none of the irrigation wells have been fully developed by surging or other methods.

The slot area in the perforated casings in the wells range from about 1 to perhaps 10 percent of the surface area of the perforated parts of the casings, and the slots are relatively large openings that commonly allow both the coarse and the fine material of the water-bearing beds to enter the well. The width of the slots in perforated casing is the same or larger on the outside than it is on the inside of the casing, and the walls of the slots are rough and irregular. Thus, when the well is pumped much of the water-bearing material in the immediate vicinity of the well is drawn into the well and discharged through the pump. The beds overlying the water-bearing materials may be left unsupported and may collapse and clog the openings or crush the casing. The passage of the sand and gravel through the pump causes excessive wear on the working parts of the pump. The small proportion of slot area—the openings through which water must pass in order to enter the well—results in considerable loss in head through the screen—"screen loss"—and in lower specific capacity (yield per unit of drawdown) of the well. "Screen loss" also results from clogging in the rough, irregular slots.

Ideally a well as a hydraulic structure should be so designed as to admit with a minimum loss of head as much water as the water-bearing material can yield. That is, the permeability of the well structure should be as much as or greater than that of the water-bearing material. As the permeability of most aquifers is distributed about evenly throughout each square foot so, also, should the permeability of the well structure be distributed about evenly for each square foot of casing opposite the water-bearing material. Under such conditions, when the permeability of the well structure is as great as or greater than that of the water-bearing material, the maximum specific capacity can be obtained.

Ordinarily most of the loss of head in a well structure occurs where the water enters the casing. Thus to minimize the head loss or "screen loss" of a well structure it is desirable to provide sufficient openings in the well casing of such a size and distribution as to equal or yield in capacity the openings in the adjacent material. This may be done best by use of well screens and, where necessary, gravel packing.

Well screens commonly used for irrigation wells are designed with areas of slot openings that range from about 20 to 50 percent of the surface area of the screen. The percentage of slot area depends on the type of screen and the size of the slot openings. Commonly, samples of water-bearing materials are analyzed and the size of the slot opening is selected so that most of the fine-grained materials in the aquifer are removed during development of the well before the permanent pump is installed. The coarser materials are thus left in place, forming a wall of relatively permeable gravel and coarse sand around the well. The slots are wider on the inside of the screen so that particles will easily pass through the slots once they enter them. Thus the well-screen slots may be expected to remain open. These features of well screens result in larger yields and longer-lived wells.

Gravel-packed wells are constructed with a layer of gravel placed around the well casing or screen. The size of the gravel is selected so that the materials of the water-bearing beds will not pass through the gravels and into the well when water is pumped from it. The gravel-packed well is especially useful when the materials of the water-bearing beds are uniformly fine-grained. As the gravel pack reduces "screen loss" and prevents caving of the overlying beds, the gravel-packed well is commonly efficient and long-lived.

Complete penetration of the water-bearing beds by wells will also result in larger yields for each foot of drawdown. Many wells, regardless of how they are cased, will probably yield considerably more water if they are properly developed prior to the installation of the permanent pump.

SUMMARY OF GROUND-WATER CONDITIONS

From the foregoing discussion the following conclusions may be drawn:

(1) The only source of ground water in White River Valley is precipitation on the tributary slopes of the Egan Range, White Pine Mountains, and Horse and Grant Ranges. Only a small part of this precipitation recharges the ground-water reservoir. Estimates based on the available precipitation data indicate that the annual recharge is approximately 53,000 acre-feet.

(2) Discharge of ground water from the valley occurs by transpiration from native and cultivated plants, evaporation, and surface and underground outflow. Estimates based on detailed data from other areas similar to White River Valley show that annual losses from evapo-transpiration are about 34,000 acre-feet. Stream flow and underflow from the south end of the valley are estimated to total about 19,000 acre-feet.

(3) About 12,000 acre-feet of ground water in White River Valley is estimated to be available by pumping in White Pine County, and 7,000 in Nye County. About 11,000 acre-feet may be made available by diverting the discharge of Hot Creek Spring.

(4) Artificial recharge to the ground-water reservoir may result in recovery of the wasted part of the winter discharge of the springs, if the water table is materially lowered by increased pumping in the vicinity of Preston and Lund.

(5) Logs and performance of wells drilled in the vicinity of Preston and Lund show that aquifers suitable for development of large-capacity wells are locally present in this area at depths ranging from 15 to 150 feet. Information from well records in other parts of the valley is either not available or inconclusive. However, surficial geologic and hydrologic evidence suggests that relatively permeable water-bearing beds may be present in the old river channel and on the lower parts of the alluvial fans. At favorable topographic locations, successful large-capacity wells could be developed from such aquifers.

RECONNAISSANCE LAND CLASSIFICATION

Development of ground water is expected to be initially for irrigation use in White River Valley. Because of this the Office of the State Engineer requested the Nevada Agricultural Experiment Station to make a land classification reconnaissance in the general area of potential ground-water development in White River Valley. The report by Howard G. Mason to Alfred Merritt Smith, State Engineer, is quoted below:

"This survey was made in cooperation with the Nevada State Engineer and the Ground Water Branch of the U. S. Geological Survey. Its purpose is to indicate the location and approximate extent of potential agricultural land available for development by pumping from the ground waters in upper White River Valley.

"The land was classified on the basis of a field inspection of the surface and soil profile, where exposed, and the native vegetation. No laboratory work was done on the soils. Measurements were made by speedometer readings or pacing. The map was constructed on a base supplied by the Ground Water Branch. Ground control was limited, in part, to the topographic features present on the base map.

"The survey was limited to areas estimated to have ground water possibly available within a feasible pumping lift. This land was classified into three broad groups. Class I land is land which is considered to be definitely suitable for development so far as soil and topography are concerned. Class II land appears less definitely suitable, or is an intermixture of suitable and unsuitable land which was difficult to separate by this type of survey. Class III includes lands which were considered definitely unsuitable for development by the use of pumped water. The chief reason for placing lands in the lower grades was the expense involved in effecting complete reclamation by the use of pumped water.

"The land inspected is designated in four tracts for purposes of convenient description. Tract 1 is located on the floor of the main drainage way just east and northeast of Preston. This body of land has a deep, uniform, and permeable soil, free from harmful quantities of alkali or an excessive amount of calcium. The northern one-third of the tract has a rather uneven surface, and indications of some alkali in the subsoil. Tract 1 includes a gross area of about 2,500 acres.

"Tract 2 lies on the west side of the valley, beginning just south of the area irrigated by the Lund Spring, extending south into T. 8 N., R. 61 E., and including a small area south of Mormon Spring. This tract includes approximately 25,000 acres of mostly rather low-grade land. The bodies of what appeared to be good land were too small and irregular to be readily segregated by this type of survey. The major soil type is a dense clay which would be rather difficult to reclaim. Scattered over the tract are many irregular, more or less sandy areas. The most favorable sites for development are probably along the border between the sandy and clay soils. It is rather doubtful if many of these can

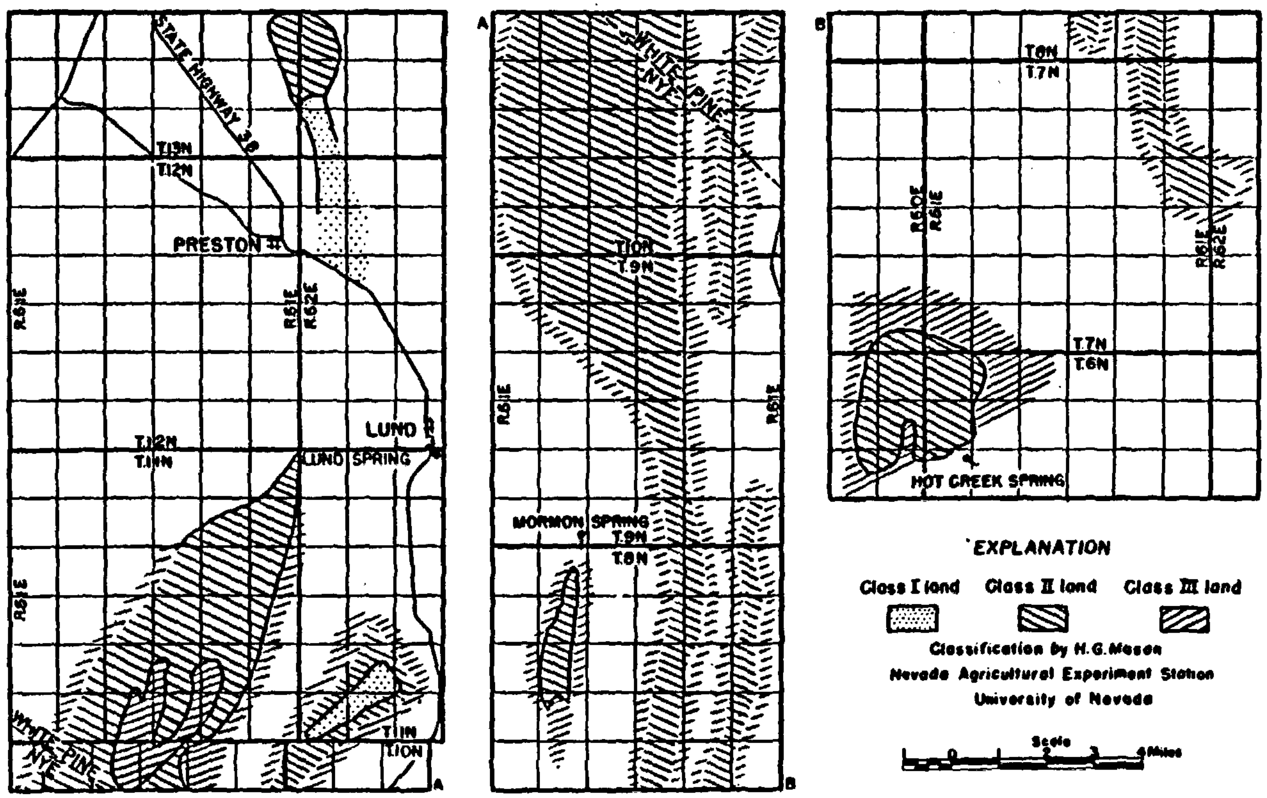


FIGURE 5—Reconnaissance classification of land in White River Valley, Nevada.

be found which are large enough to be economically feasible. Several hundred acres in the north part of T. 10 and in the sou part of T. 11 were placed in Class III because of the accumu tion of an excessive amount of alkali.

"Tract 3 is located along the east side of the valley, south of Lund. It is on the toe of the alluvial slope from the Egan Range, and is possibly the most promising section of the valley. The soils generally are deep, permeable, and of medium texture. The best sites are located on gentle slopes, covered with a heavy growth of sage and rabbit brush, at an elevation of 10 feet or more above the transpiration area on the valley floor. There is a gross area of about 5,000 acres in Tract 3.

"Tract 4 includes land to the north and west which may be irrigated by gravity diversion of Hot Creek Spring, or by a low, pumping lift of these waters. The north and west boundaries of this tract was arbitrarily drawn to include about 3,500 acres. The same kind of land extends considerably farther north and west. This land lies well for irrigation, and in a compact body. The soil is medium to fine in texture, and highly calcareous. At a depth of from two to three feet the soil is so filled with lime concretions as to be impossible to bore with a soil augur. It is rather difficult to forecast how productive this land may be under irrigation. It will probably be much more productive at first than the land now being irrigated from Hot Creek Spring. The soil probably will respond rather well to applications of phosphate.

"A total area of approximately 36,000 acres was examined ar classified as shown on Figure 5, page 52. Perhaps tw thirds of this land is of doubtful value for development by the use of pumped water. From the remainder, however, it should be possible to select sufficient reasonably good land on which to use all of the ground water which may be economically recovered in the area.

"HOWARD G. MASON,
"Nevada Agricultural Experiment Station."

WELL RECORDS

The following tables present the records of 98 wells in the valley. Table 9 shows the number, location, owner, type, diameter, and depth of each well. It also contains a list of all available measurements of the water levels in the wells, the principal use of water withdrawn from each well, and the type of pump and power used at each well. This table lists most of the known wells in the valley as of March 1948, and a few other wells, now destroyed, whose records have proved valuable in various phases of the investigation. All the wells in the table are shown on Plate 1 or Plate 2. Table 10 presents the 13 available logs and casing records for wells in the valley, and Figure 4 shows 6 of the logs graphically.

The wells and springs are identified by a numbering system based on the Mt. Diablo base and meridian network of surveys by the General Land Office. This numbering system also serves to locate the well or spring in the township, range, and section. The first unit, consisting of one or two numerals, is the township, and the second unit, consisting of two numerals, is the range; the entire area is in the northeast quadrant of the Mt. Diablo base and meridian, and the abreviations "N." and "E." are not used. The last unit, separated by a dash, shows the section, quarter section, and individual well number. Each section has been divided into four equal parts, each of which has been assigned a letter. Beginning with the northeast quarter, the letters have been assigned in a counterclockwise direction. Thus, the northeast quarter is A, the northwest quarter is B, the southwest quarter is C, and the southeast quarter is D. The first well recorded in a given quarter section is designated by the numeral 1, the second is designated by 2, and so forth. Thus, the first well located in the southeast quarter of section 31, Township 12 N., Range 62 E. would be numbered 12/62–31D1, the second well located would be numbered 12/62–31D2, and so forth. On Plates 1 and 2, only that part of the number designating the quarter section and the order in which the well or spring was recorded is shown.

TABLE 9

Record of Wells in White River Valley, Nevada

(Type of well—B, bored; Dg, dug; Dr, drilled. Use of water—D, domestic; I, irrigation; N, not used; S, Stock; O, observation. Type of pump—C, cylinder; T, turbine; J, jet. Type of power—WM, windmill; F, fuel oil, gasoline, or diesel engine; H, horse; E, electric; W, water.)

Well number and location	Owner	Type of well and year completed	Diameter (inches)[1]	Depth (feet)	Measuring Point: Altitude above mean sea level datum (feet)	Measuring Point: Above (+) or below (—) land-surface (feet)	Measuring Point: Description	Water Level: Below measuring point (feet)	Water Level: Date	Use	Type of pump and power	Remarks
NYE COUNTY												
5/59-32C1	Paris	Dr	6			+1.0	Bottom of hole in casing	9.01	2-27-48	S	C, WM	
8/60-28A1	Don Eldridge	Dr	6	142		+2.5	Top of casing	118.70	2-27-48	S	C, F, WM	
9/60-1A1	Ernest Gubler	Dg	36	40		.0	Top of casing	36.12	2-27-48	S	C, WM	
9/61-7B1	Lloyd Sorenson	Dg	48	43		.0	Top edge of iron manhole	31.1	9-15-45	S	C, H	
								31.00	10- 1-47			
								30.86	2-27-48			
10/60-13C1	Carter Bros. and others	Dr	6			+.5	Top of iron plate on casing	54.62	10- 1-47	S	C, WM	
								55.19	2-27-48			
10/60-13C2	Carter Bros. and others	Dr, 1946	6							S	C, F	
10/60-24D1	Dan Clark	Dg	48	55		+.5	Top of 2- by 4-inch upright	39.73	10- 1-47	S	C, H	
								42.27	2-27-48			
10/60-36B1	Bureau of Land Management	Dr	8			+.5	Top of casing	42.07	10- 1-47	S	J, F	Well cleaned. New pump installed Nov. 1947.
								41.90	2-27-48			
10/61-11D1		Dr	6			+.5	Top of iron place on casing	5.26	10- 8-47	S	C, WM	
10/61-26B1	Carter Bros.	Dr	6			+.5	Bottom of hole in pump base	9.40	10-16-47	S	C, WM	
10/61-34A1	Don Eldridge	Dr	4			+2.5	Bottom of hole in pump base	8.56	10-16-47	S	C, WM	
WHITE PINE COUNTY												
11/61-16D1	Carter Bros. and others	Dr, 1948	6	82		+2.0	Top of casing	29.61	2-26-48	S	C, WM	
11/61-32B1	Carter Bros. and others	Dg	34	48		+1.0	Top of casing and concrete curb	40.44	7-25-47	S	C, WM	
								40.60	10-29-47			
11/61-35A1		Dr	6			+0.5	Bottom of hole in pump base	13.02	9- 9-47	S	C, WM	
								13.10	10-30-47			
11/61-35D1		Dg	66	17.1		+3.0	Top of wood curb	16.90	8-15-45	S	C, WM	
11/62-4B1	Latter Day Saints Church	Dg	60	55		+1.5	Top of 3- by 12-inch plank well cover	48.31	7-23-47	I	C, WM	
								44.99	3-29-48			
11/62-5A1	Vern Whipple	Dg	36	36		+1.5	Top of concrete curb	34.26	7-23-47	S	C, WM	
								31.97	3-29-48			
11/62-5D1		Dr	6	30		+1.5	Top of casing	7.60	7-23-47	S	C, WM	
								4.67	3-29-48			
11/62-6A1		Dg	26	10	5,507.16	+3.0	Top of casing	8.04	7-25-47	S	C, WM	
11/62-6D1		Dr	6	12	5,490.95	+.5	Top of iron plate on casing	6.64	10- 8-47	S	C, WM	
11/62-6D2		Dr	6		5,489.74	+1.0	Top of casing	5.17	10- 8-47	S	C, WM	
11/62-7B1	Ernest Gubler	Dr	6			+1.0	Top of iron plate on casing	19.40	9- 9-47	S	C, WM	
11/62-17C1	George Fawcett	Dg	60	15		+1.0	Top of plank well cover	10.50	7-23-47	S	C, WM	
								8.08	3-29-48			
11/62-19C1		Dr	6			+1.0	Top of iron plate on casing	5.20	10- 8-47	S	C, WM	
11/62-33D1	Merrill Gubler	Dr, 1948	14	130		.0	Land surface	7	3-31-48			Casing pulled, well abandoned. Log.
12/60-11A1	Nevin Munson	Dg	48	20.5		+2.0	Top of 8- by 8-inch timber cribbing	18.10	12- 1-47	N		
12/61-2C1	Lloyd Oxborrow	Dr	10.8	170			Flowing		7-17-47	I		
12/61-12D1	Mrs. Berinson	Dg	48	69.5	5,618.28	+.5	Top of plank cover	64.83	7-18-47	N	C, WM	
								65.52	10-28-47			
12/61-12D2	H. Whitlock and others	Dg	60	70						D	C, W	

[1]The maximum width of square or rectangular dug wells is given in place of diameter. Diameter is given for top of casing or at land surface.

TABLE 9—*Continued*

Well number and location	Owner	Type of well and year completed	Diameter (inches)[1]	Depth (feet)	Measuring point			Water level		Use	Type of pump and power	Remarks
					Altitude above mean sea level datum (feet)	Above (+) or below (−) land-surface (feet)	Description	Below measuring point (feet)	Date			
12/61-12D3	Preston School	Dr	6	——	——			——	——	N		
12/61-12D4	Lowell Peterson	Dr	6	——	——	+.5	Bottom of hole in pump base	61.24 61.67	10- 1-47 10-28-47	N	C, H	
12/61-12D5	Lowell Peterson	Dr	——	——	——	——	——	——	——	D	J, E	
12/61-13A1	John Dennis	Dg	48	72	5,616.65	+.5	Top of plank cover	67.13 68.20 67.20	7-28-47 10-28-47 11-24-47	D	C, WM	
12/61-13D1	Lowell Peterson	Dr, 1919	12	184	——	—2.0	Top of casing	56.27	12-12-47	N	—	Log. Reported depth 560 feet.
12/61-13D2	Lowell Peterson	Dr, 1919	——	——	——	——	——	——	——	——	—	Destroyed.
12/61-34A1	Bureau of Land Management	Dr	7	——	——	+1.5	Top of casing	59.56 59.80 60.00	7-15-47 10-29-47 3-29-48	S	C, WM	
12/62-5D1		Dr, 1916	72	1,800	——	——	——			—	—	Log. Well destroyed.
12/62-17D1	Peacock Bros.	Dr	6	——	——	+1.5	Bottom of hole in pump base	58.45 58.74	9-30-47 10-28-47	S	C, WM	
12/62-17D2	Eugene Peacock	Dr, 1947	6	74	——	——	——	——	——	S	C, WM	Log.
12/62-18D1	U. S. Geological Survey	Dr, 1947	6	108	——	+.5	Top of casing	51.23 44.41	12-18-47 3-30-48	O	—	Log.
12/62-19B1	Mrs. Berinson	Dr	6	54	5,574.29	+1.0	Top of iron plate on casing	43.57 44.55 44.62	7-17-47 10- 8-47 11-24-47	S	C, WM	
12/62-20B1	A. N. Carter	Dg	60	32	5,560.61	.0	Top of 2- by 2-inch plank cover	29.06 29.76 30.28	7-22-47 11-24-47 3-30-48	N	C, WM	
12/62-20B2	W. M. Reid	Dr, 1948	16	107	——	+1.0	Top of casing	36.44 36.52	1- 5-48 3-30-48	I	T, F	Log.
12/62-20C1	A. N. Carter	Dg	72	31	——	.0	Top of concrete curb	29.46 30.65	12-18-47 3-30-48	N		
12/62-20D1	A. N. Carter	Dg	48	34	5,556.14	+.5	Top of 2- by 12-inch plank cover	28.88 28.85	7-17-47 11-25-47	S	C, WM	
12/62-28B1	Dellie Terry	Dr	6	60	5,575.96	+1.0	Bottom of hole in pump base	43.77	12-12-47	D	C, WM	
12/62-28C1	Dellie Terry	Dr	6	——	5,556.13	+1.0	Bottom of hole in pump base	44.75	10- 8-47	S	C, WM	
12/62-28C2	Joe Vance	Dg	24	33	5,554.01	+1.5	Top of casing	37.12 24.54	7-22-47 12-12-47	S	C, WM	
12/62-29A1	James Oxborrow	Dr	6		5,546.79	+.5	Top of casing	20.66	7-17-47	S	C, WM	
12/62-29B1	Kenneth Gubler	Dr	14	112	5,552.5	+.5	Lower lip of pump discharge pipe	30.84	7-17-47	I	T, F	Log.
12/62-29D1	Dellie Terry	Dr	6	50	5,537.72	+.5	Bottom of hole in pump base	15.26 14.80	10- 8-47 12-12-47	S	C, WM	
12/62-29D2	James Oxborrow	Dr	6	——	5,538.08	.0	Bottom of hole in pump base	16.69 16.70	10- 8-47 12-12-47	S	C, WM	
12/62-29D3		Dg	60	16	5,533.10	+1.5	Top of concrete curb	12.29 13.89	7-22-47 ——	S	C, WM	
12/62-30A1	Leland Hendrix	Dr	6	——	——	——	——	——	——	S	C, WM	
12/62-30A2	Peacock Bros.	Dr	6	——	5,546.69	.0	Bottom of hole in pump base	27.02	9-30-47	S	C, WM	
12/62-30B1	Peacock Bros.	Dr	6	——	5,558.40	+0.5	Bottom of hole in pump base	37.75 35.83	9- 9-47 11-25-47	S	C, WM	
12/62-30B2	Peacock Bros.	Dr	6	——	5,545.33	+.5	Bottom of hole in pump base	26.83	9-30-47	S	C, WM	
12/62-30C1	Peacock Bros.	Dr	6	50	——	+1.0	Bottom of hole in pump base	22.94	9-30-47	S	C, WM	
12/62-30D1	W. A. Reed	Dg	48	——	5,531.66	.0	Top of concrete curb	15.06	7-16-47	S	C, WM	
12/62-30D2		Dr	6	32	5,537.48	+1.0	Top of casing	20.50	7-22-47	S	C, WM	

[1]The maximum width of square or rectangular dug wells is given in place of diameter. Diameter is given for top of casing or at land surface.

Well number and location	Owner	Type of well and year completed	Diameter (inches)[1]	Depth (feet)	Measuring point: Altitude above mean sea level datum (feet)	Measuring point: Above (+) or below (−) land-surface (feet)	Measuring point: Description	Water level: Below measuring point (feet)	Water level: Date	Use	Type of pump and power	Remarks
2/61-12D3	Preston School	Dr	6	......	....	......	....	——	——	N		
2/61-12D4	Lowell Peterson	Dr	6	......	....	+.5	Bottom of hole in pump base	61.24 61.67	10- 1-47 10-28-47	N	C, H	
2/61-12D5	Lowell Peterson	Dr	....	......	....	——	....	......	——	D	J, E	
2/61-13A1	John Dennis	Dg	48	72	5,616.65	+.5	Top of plank cover	67.13 68.20 67.20	7-28-47 10-28-47 11-24-47	D	C, WM	
2/61-13D1	Lowell Peterson	Dr, 1919	12	184	....	−2.0	Top of casing	56.27	12-12-47	N	—	Log. Reported depth 560 feet.
2/61-13D2	Lowell Peterson	Dr, 1919	....	......	....	——	....	——	——	—	—	Destroyed.
2/61-31A1	Bureau of Land Management	Dr	7	.. ...	....	+1.5	Top of casing	59.56 59.80	7-15-47 10-29-47	S	C, WM	
2/62-5D1		Dr, 1916	7½	1,300	....	......	....	60.00	3-29-48	—	—	Log. Well destroyed.
2/62-17D1	Peacock Bros.	Dr	6	......	....	+1.5	Bottom of hole in pump base	58.45 58.74	9-30-47 10-28-47	S	C, WM	
2/62-17D2	Eugene Peacock	Dr, 1947	6	74	....	——	....	......	——	S	C, WM	Log.
2/62-18D1	U. S. Geological Survey	Dr, 1947	6	108	....	+.5	Top of casing	51.23 44.41	12-18-47 3-30-48	O	—	Log.
2/62-19B1	Mrs. Berinson	Dr	6	54	5,574.29	+1.0	Top of iron plate on casing	43.57 44.55 44.62	7-17-47 10- 8-47 11-24-47	S	C, WM	
2/62-20B1	A. N. Carter	Dg	60	32	5,560.61	.0	Top of 2- by 2-inch plank cover	29.06 29.76 30.28	7-22-47 11-24-47 3-30-48	N	C, WM	
/62-20B2	W. M. Reid	Dr, 1948	16	107	....	+1.0	Top of casing	36.44 36.52	1- 5-48 3-30-48	I	T, F	Log.
/62-20C1	A. N. Carter	Dg	72	31	....	.0	Top of concrete curb	29.46 30.65	12-18-47 3-30-48	N		
/62-20D1	A. N. Carter	Dg	48	34	5,556.14	+.5	Top of 2- by 12-inch plank cover	28.88 28.85	7-17-47 11-25-47	S	C, WM	
/62-28B1	Delile Terry	Dr	6	60	5,575.96	+1.0	Bottom of hole in pump base	43.77	12-12-47	D	C, WM	
/62-28C1	Delile Terry	Dr	6	......	5,556.12	+1.0	Bottom of hole in pump base	44.75	10- 8-47	S	C, WM	
/62-28C2	Joe Vance	Dg	24	33	5,554.01	+1.5	Top of casing	27.12 24.54	7-22-47 12-12-47	S	C, WM	
/62-29A1	James Oxborrow	Dr	6	.	5,546.79	+.5	Top of casing	20.66	7-17-47	S	C, WM	
/62-29B1	Kenneth Gubler	Dr	14	112	5,552.5	+.5	Lower lip of pump discharge pipe	30.84	7-17-47	I	T, F	Log.
/62-29D1	Delile Terry	Dr	6	50	5,537.72	+.5	Bottom of hole in pump base	15.26 14.80	10- 8-47 12-12-47	S	C, WM	
/62-29D2	James Oxborrow	Dr	6	.. ...	5,538.08	.0	Bottom of hole in pump base	16.69 16.70	10- 8-47 12-12-47	S	C, WM	
/62-29D3		Dg	60	16	5,533.10	+1.5	Top of concrete curb	12.29 13.89	7-22-47 ——	S	C, WM	
/62-30A1	Leland Hendrix	Dr	6	......	....	......	....	——	——	S	C, WM	
/62-30A2	Peacock Bros.	Dr	6	.....	5,546.69	.0	Bottom of hole in pump base	27.02	9-30-47	S	C, WM	
/62-30B1	Peacock Bros.	Dr	6	......	5,558.40	+0.5	Bottom of hole in pump base	27.75 25.83	9- 9-47 11-25-47	S	C, WM	
/62-30B2	Peacock Bros.	Dr	6	.....	5,545.33	+.5	Bottom of hole in pump base	26.83	9-30-47	S	C, WM	
/62-30C1	Peacock Bros.	Dr	6	50	....	+1.0	Bottom of hole in pump base	22.94	9-30-47	S	C, WM	
/62-30D1	W. A. Reed	Dg	48	.....	5,531.66	.0	Top of concrete curb	15.06	7-16-47	S	C, WM	
/62-30D2		Dr	6	32	5,537.48	+1.0	Top of casing	20.50	7-22-47	S	C, WM	

[1]The maximum width of square or rectangular dug wells is given in place of diameter. Diameter is given for top of casing or at land surface.

Well number and location	Owner	Type of well and year completed	Diameter (inches)[1]	Depth (feet)	Measuring point: Altitude above mean sea level datum (feet)	Measuring point: Above (+) or below (—) land-surface (feet)	Measuring point: Description	Water level: Below measuring point (feet)	Water level: Date	Use	Type of pump and power	Remarks
12/62-30D3		Dr	6	......	5,535.38	+.5	Top of casing	13.66	7-22-47	S	C, WM	
12/62-30D4	Peacock Bros.	Dr	6	......	5,535.73	+1.0	Bottom of hole in pump base	13.92	9-30-47	S	C, WM	
12/62-31A1	Milton Gardner	Dg	48	15	....	+1.0	Top of plank cover at pump base	10.50	7-18-47	S	C, WM	
								11.20	11-30-47			
12/62-31A2		Dg	48	18	5,520.48	+.5	Top of plank cover	13.80	7-25-47	S	C, WM	
								13.77	10-29-47			
12/62-31D1	Carter Bros.	Dr, 1941	16	178	5,517.87	+1.5	Top of hole in pump base	13.53	9-15-45	I	T, F	Log. 6-inch hole 65 to 178 feet in Feb. 1948; 6-inch casing pulled.
								13.88	7-16-47			
								14.66	10-29-47			
								14.58	12- 2-47			
								13.42	2-18-48			
12/62-31D2	Carter Bros.	Dg	48	16	5,516.75	+.5	Top of plank cover	12.95	7-18-47	S	C, WM	
								13.10	10-29-47			
								12.28	12- 2-48			
12/62-31D3	Carter Bros.	Dr, 1948	16	128	5,516.28	+1.0	Top of casing	12.30	2-18-48	I	T, F	Log.
12/62-32A1	Carter Bros.	Dr	6	......	5,530.70	+.5	Bottom of hole in pump base	9.64	12-12-47	S	C, WM	
12/62-32B1	Cannon Gardner	Dr	6	......	5,526.57	+.5	Bottom of hole in pump base	7.58	9-30-47	S	C, WM	
12/62-32B2	Cannon Gardner	B, 1948	8	12	....	+.5	Top of casing	7.05	1-22-48	S	C, WM	
12/62-32C1	Cannon Gardner	Dr	4	......	....	+.5	Bottom of hole in pump base	6.05	10-29-47	S	C, WM	
12/62-33A1	G. M. Reid	Dg	60	48	5,594.03	+1.5	Top of 2- by 4-inch curb	41.91	7-23-47	S	C, WM	
								41.96	11- 6-47			
12/62-33A2	Cliff Peacock	Dr	6	......	5,593.35	+.5	Hole in pump base	40.80	7-23-47	S	C, WM	
12/62-33A3	Maurice Oxborrow	Dg	48	46	5,590.65	+1.5	Top of concrete curb	37.04	7-23-47	S	C, WM	
								36.60	11- 6-47			
12/62-33A4	Clinton Scow	Dr	6	58	5,593.47	+.5	Top of casing	39.12	7-23-47	N	C, WM	
								38.80	11- 6-47			
12/62-33A5	Wayne Gardner	Dg	48	31	5,578.95	+.5	Top of edge of iron manhole	20.38	7-23-47	D	C, WM	
								19.89	11- 6-47			
12/62-33A6	Vance McKenzie	Dg	......	......	5,598.13	+0.5	Top of plank well cover	39.82	7-23-47	D	J, E	
								40.40	11- 6-47			
12/62-33A7	Lorraine Hendrix	Dg	48	35	5,591.83	+2.0	Top of manhole	32.71	7-23-47	S	C, WM	
								32.73	11-20-47			
12/62-33A8	Loren O'Donnell	Dr	6	......	5,594.18	+.5	Top of casing	33.08	7-23-47	S	C, WM	
								33.07	11-20-47			
12/62-33A9	Milton Gardner	Dg	48	23	5,562.99	.0	Top of concrete curb	16.69	7-23-47	N	C, WM	
12/62-33B1		Dr	6	......	5,527.48	+1.0	Top of iron plate on casing	7.71	9-30-47	S	C, WM	
								5.97	11-20-47			
12/62-33B2		Dr	6	......	5,533.30	.0	Top of iron plate on casing	10.07	10- 9-47	S	C, WM	
								9.18	11-20-47			
12/62-33B3	Dellie Terry	Dr	6	......	5,533.00	+.5	Top of iron plate on casing	7.32	10-13-47	S	C, WM	
								7.37	11-20-47			
12/62-33C1		Dg	24	9.5	5,543.43	+2.5	Top of casing	8.54	7-23-47	S	C, WM	
12/62-33C2		Dr	6	14.5	....	+2.0	Top of casing	3.72	10-29-47	S	C, WM	
12/62-33D1	Doyle Wakely	Dr	6	......	....	+.5	Top of casing	24.00	7-23-47	D	C, WM	
12/62-33D2	Leland Hendrix	Dr	6	......	....	......	....	......	....	D	J, E	
12/62-33D3	Wilfred Terry	Dr	5⅝	225	....	+.5	Edge of lower lip of 1-inch ell	6.75	7-23-47	D	C, WM	
12/62-33D4	Dellie Terry	Dr	6	......	5,556.17	.0	Top of iron plate on casing	......	....	D	C, WM	
12/62-33D5	Ervin Hendrix	Dr, 1947	6	......	....	—3.5	Top of casing	6.50	12-11-47	D	......	
12/62-33D6	Ervin Hendrix	Dr	6	......	....	+1.0	Top of casing	13.55	12-11-47	N	......	
12/62-33D7	Vance Smith	Dr, 1948	6	99	....	+1.5	Top of casing	8.57	2-22-48	D	......	Log.
13/61-9C1	William Wieser	Dr, 1948	6	190	....	+1.0	Top of casing	......	....	D	C, WM	Log.
13/61-25A1	Bureau of Land Management	Dg	72	36.5	....	.0	Top of wood crib	35.32	12-12-47	N	......	
								35.26	1- 5-48			
								35.07	3-29-48			
14/59-26A1	Jesse Gardner	B	36	60	....	......	....	......	....	D	C, WM	
14/61-9C1	Bureau of Land Management, Jakes Wash well	Dr, 1938	6	365	6,150 (Estimated)		Land surface	350±	1938	S	C, WM	Water level reported by driller.
14/62-31B1	Bureau of Land Management	Dr, 1938	6	185	....	+5.5	Top of casing—dry at	182 ft.	7-25-47	N	......	Log. Abandoned.
14/62-31B2	Bureau of Land Management	Dr, 1938	6	145	....	......	Land surface—dry at	145 ft.	1938	N	......	Log. Abandoned.

[1]The maximum width of square or rectangular dug wells is given in place of diameter. Diameter is given for top of casing or at land surface.

TABLE 10

Logs and casing records of wells in White River Valley, Nevada

11/62-33D1. Merrill Gubler. Diameter, 14 inches to 130 feet. Casing pulled and well abandoned. Driller's log.

Material	Thickness (feet)	Depth (feet)
Clay	11	11
Gravel; water rose 4 feet in casing	2	13
Cemented gravel	3	16
Soft clay	19	35
Cemented gravel	5	40
Clay, some gravel	59	99
"Hardpan" (lime)	3	102
Yellow clay	3	105
"Hardpan" (lime)	2	107
Blue clay	0.5	107.5
Yellow clay	18.5	126
"Hardpan" (lime)	4	130
Yellow clay	....	130
Total depth	....	130

12/61-13D1. Lowell Peterson. Diameter, 12 inches to 20 feet, 9⅝ inches from 20 to 117 feet, 7⅝ inches from 117 to 487 feet; uncased from 487 to 560 feet. Driller's log from county records. Well abandoned.

Material	Thickness (feet)	Depth (feet)
Soil	5	5
Gravel	15	20
Clay, yellow	5	25
Gravel	15	40
Gravel and sand	30	70
(Water level 70 feet below land surface)		
Sand	30	100
Gravel	10	110
Sand and gravel	50	160
"Rock"	5	165
Sand	10	175
Clay and sand	20	195
Clay, yellow	25	220
(Water level 65 feet below land surface)		
Sand	10	230
Sand and clay, yellow	40	270
Clay and sand, white	10	280
Clay and sand, yellow	10	290
Gravel, cemented	25	315
Clay, "gumbo," yellow to white	13	328
Sand, fine, black	7	335
Clay, yellow	3	338
Sand, fine, black	10	348
Sand, dark	7	355
Clay, yellow	1	356
Sand, dark	2	358
Sand	22	380
Sand to mud, yellow	5	385
Sand to mud, white	30	415
"Talc," white	20	435
Mud, white, soft	15	450
Mud, gray, soft	5	455
Clay, pink, soft	5	460
Clay, yellow, soft	10	470
Clay and sand, gray, soft	45	515
"Gumbo," gray, soft	20	535
Clay, yellow, soft	25	560
Total depth	....	560

12/62-5D1. Data of uncertain value. Diameter, 7⅝ inches to 1.226 feet. Driller's log from county records. Well destroyed.

Material	Thickness (feet)	Depth (feet)
Gravel	45	45
Soft muddy formation	7	52
Gravel (water struck at 115 feet)	123	175
Sand	65	240
Gravel, hard	8	248
Sand	32	280
"Hard streak"	10	290
Gravel	No record	
Sand and gravel	No record	
Sand and gravel	110	500
Clay and gravel	40	540
Clay, little sand	460	1,300
Total depth	....	1,300

12/62-17D2. Eugene Peacock. Diameter, 6 inches to 74 feet; casing perforated with 5/16- by 3-inch slots, four to the round, one round to the foot. Driller's log.

Material	Thickness (feet)	Depth (feet)
Clay and gravel	6	6
Clay, sandy	10	16
Sand and gravel	5	21
Clay, sandy, cemented	3	24
Clay, sandy	3	27
Clay, sandy, cemented	12	39
Clay, sandy, soft; little water	22	61
Clay, sandy, cemented	6	67
"Hardpan" (lime)	1	68
Sand and gravel; water	6	74
Total depth	....	74

12/62-18D1. U. S. Geological Survey. Test well drilled by Lund Irrigation District. Land-surface altitude, 5,577 feet. Diameter, 6 inches to 105 feet; open end, not perforated. Driller's log.

Material	Thickness (feet)	Depth (feet)
Top soil	3	3
Clay, sandy, cemented	15	18
Clay, sandy, soft, wet	13	31
Clay, sandy, cemented	4	35
Clay, sandy, soft	14	49
"Hardpan"	1	50
Clay, sandy, soft	17	67
Sand, fine	6	73
(Water rose 19 feet)		
Clay, soft	7	80
Sand, coarse, water	11	91
Clay, soft	8	99
Sand, coarse	6	105
Clay, sandy, soft	3	108
Total depth	....	108

12/62-20B2. W. M. Reid. Irrigation well; diameter, 16 inches to 107 feet; casing perforated with Mills Knife ¼ by 3-inch slots, 13 to the round, 51 rounds on 1 foot centers. Driller's log.

Material	Thickness (feet)	Depth (feet)
Soil, black	19	19
Gravel and clay, cemented	10	29
Clay, sandy	9	38
Clay, sandy, cemented	4	42
Gravel, coarse, and sand	5	47
(Water level rose 10 feet to 32 feet)		
Clay, gravelly, cemented	5	52
Sand and gravel; water	10	62
Clay, sandy, cemented	11	73
Sand and gravel; water	2	75
Clay and gravel	2	77
Sand and gravel; water	2	79
Clay and gravel	3	82
Clay, yellow	7	89
Clay, sandy, cemented	3	92
Sand and coarse gravel; water	15	107
Total depth	....	107

12/62-29B1. Kenneth Gubler. Land-surface altitude, 5,553 feet. Irrigation well; diameter, 14 inches to 112 feet; yield, about 1,100 gallons a minute. Log from Soil Conservation Service.

Material	Thickness (feet)	Depth (feet)
Soil, black	2	2
Clay, yellow	36	38
Gravel and sand; water	12	50
Clay, yellow	25	75
Sand and gravel, hard, cemented	5	80
Clay, sandy, yellow	12	92
Sand and gravel, hard, cemented	8	100
Gravel and sand; water	10	110
Clay, blue	2	112
Total depth	....	112

12/62-31D1. Carter Bros. Land-surface altitude 5,516 feet. Irrigation well; diameter, 16 inches to 65 feet, 6 inches from 65 to 178 feet; 16-inch casing perforated with ⅛- to ¼-inch slots, about two per linear foot from 13 to 60 feet; 6-inch casing removed from well. Yield, about 500 gallons a minute. Driller's log.

Material	Thickness (feet)	Depth (feet)
Soil, clay; water at 12 feet	18	18
Clay	1	19
Gravel, cemented	5	24
Gravel; water	5	29
Clay	2	31
Sand and gravel	6	37
"Lime-cemented" material	1	38
Clay	2	40
Sand and gravel	3	43
"Cemented lime"	1	44
Clay	2	46
Gravel	5	51
"Cemented lime"	1	52
Clay	2	54
Gravel	3	57
Clay	3	60
Gravel	5	65
Clay, sandy	15	80
Sand and gravel	1	81
Clay, sandy	35	116
"Hardpan"	1	117
Clay, sandy	19	136
Sand and gravel, "muck"; water	6	142
Clay, sandy	36	178
Total depth	....	178

12/62-31D3. Carter Bros. Land-surface altitude 5,515 feet. Irrigation well; diameter, 16 inches to 128 feet; 94 feet of 16-inch casing; perforated from 12 to 30 feet, 31 to 36 feet, and 40 to 44 feet with ½- by 3-inch slots, 13 to the round with rounds on 8-inch centers. Driller's log.

Material	Thickness (feet)	Depth (feet)
Black soil	13	13
Boulder gravel, sand and small gravel; water	16	29
Clay, sandy	3	32
Sand and gravel; water	3	35
Clay and gravel	6	41
Sand and gravel; water	2	43
Clay, sandy	19	62
"Hardpan" (lime)	1	63
White clay	24	87
Clay, sandy, cemented	5	92
Sand, black, coarse- to medium-grained; water	2	94
Clay, sandy, cemented	6	100
Clay, sandy, yellow	28	128
Gravel, coarse, and sand	—	128
Total depth	—	128

12/62-33D7. Vance Smith. Diameter, 6 inches to 99 feet; 6-inch casing to 87 feet, perforated with 5/16- by 3-inch slots from 67 to 87 feet. Driller's log.

Material	Thickness (feet)	Depth (feet)
Clay	18	18
"Hardpan" (lime)	4	22
Clay	32	54
"Hardpan" (lime); little water	2	56
Clay	43	99
Gravel; water level in casing rose 91 feet	—	99
Total depth	—	99

13/61-9C1. William Wieser. Diameter, 6 inches. Driller's log.

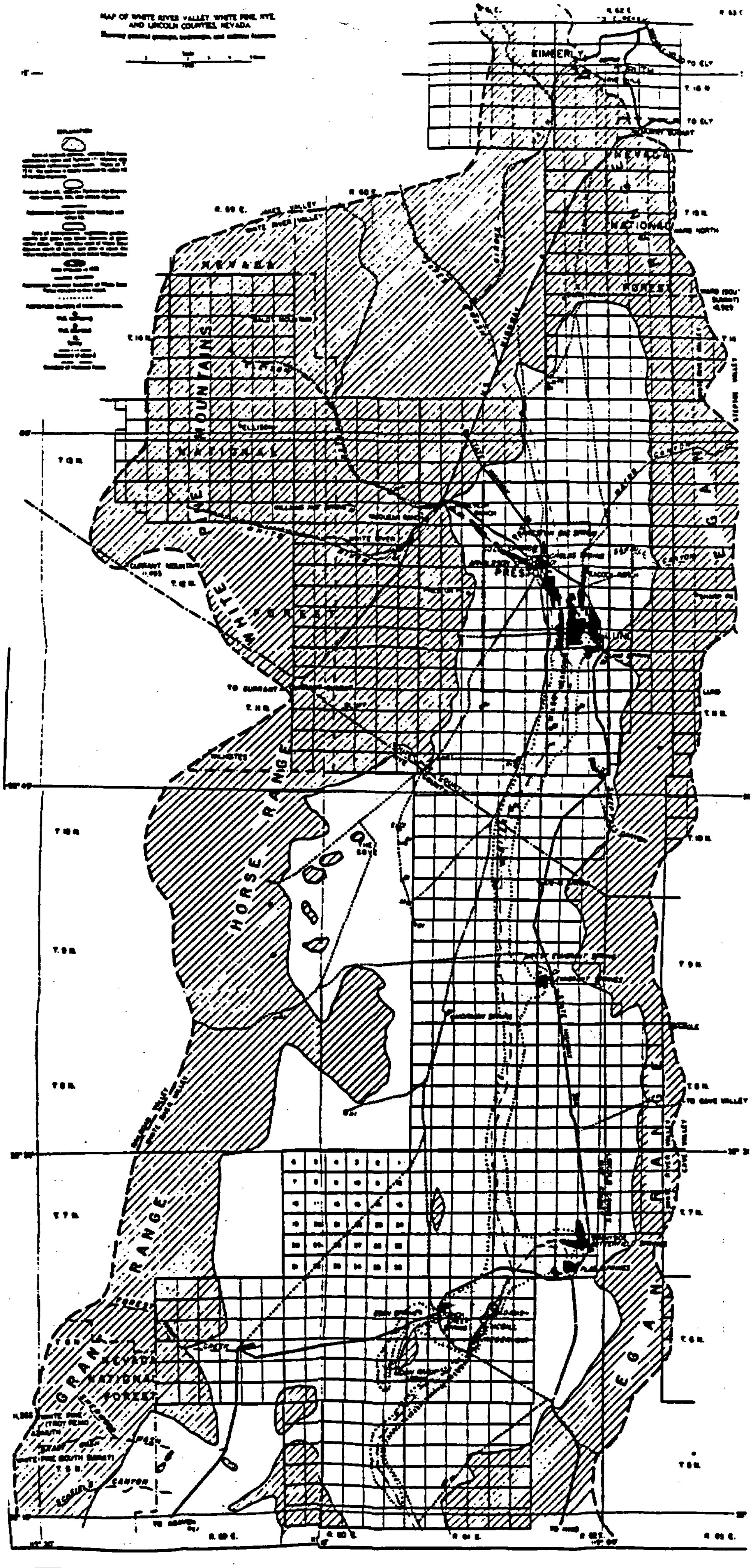
Material	Thickness (feet)	Depth (feet)
Soil	2	2
White rhyolite	78	80
Decomposed rhyolite and silt; little water	10	90
White rhyolite	90	180
Decomposed rhyolite and silt; little water	1	181
White rhyolite	8	189
Brown "loose" sand; water level rose 121 feet	1	190
Total depth	—	190

14/62-31B1. Bureau of Land Management. Diameter, 6 inches; 169 feet of casing. Driller's log.

Material	Thickness (feet)	Depth (feet)
"Earth" and gravel	3	3
Sandstone, hard, white	27	30
Sandstone, soft, white, and clay	3	33
Sandstone, hard, brown	13	46
Sandstone, hard, white	28	74
Sandstone, hard, brown	18	92
Sandstone, "medium," white	10	102
Sandstone, "medium," brown, and clay	42	144
Clay and sand, soft, brown	17	161
Sandstone, "medium," white	9	170
Sandstone, hard, white ("Water indications" at 185 feet)	15	185
Total depth	—	185

14/62-31B2. Bureau of Land Management. Diameter. 6 inches. Well abandoned.

Material	Thickness (feet)	Depth (feet)
"Earth" and gravel	5	5
Sandstone, hard, brown	35	40
Clay, brown	3	43
Sand and gravel; "seepage water"	37	80
Sand, black, and clay	15	95
Sand, fine	6	101
Sand, black, and clay	27	128
Limestone, "medium," white	10	138
Clay, gravel to "limestone"	7	145
(Lost shoe in hole; well abandoned)		
Total depth	—	145



MAP OF WHITE RIVER VALLEY, WHITE PINE, NYE, AND LINCOLN COUNTIES, NEVADA
KIMBERLY
TO ELY
NEVADA
NATIONAL
FOREST
WHITE
MOUNTAINS
NATIONAL
FOREST
PRESTON
LUND
HORSE
RANGE
TO CAVE VALLEY
GRANT
RANGE
NEVADA
NATIONAL
FOREST
EGAN
RANGE

U.S. GEOLOGICAL SURVEY STATE ENGINEER OF NEVADA WATER RESOURCES BULLETIN 8, PLATE 2