STATE OF NEVADA
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
Carson City

Tonopah well field

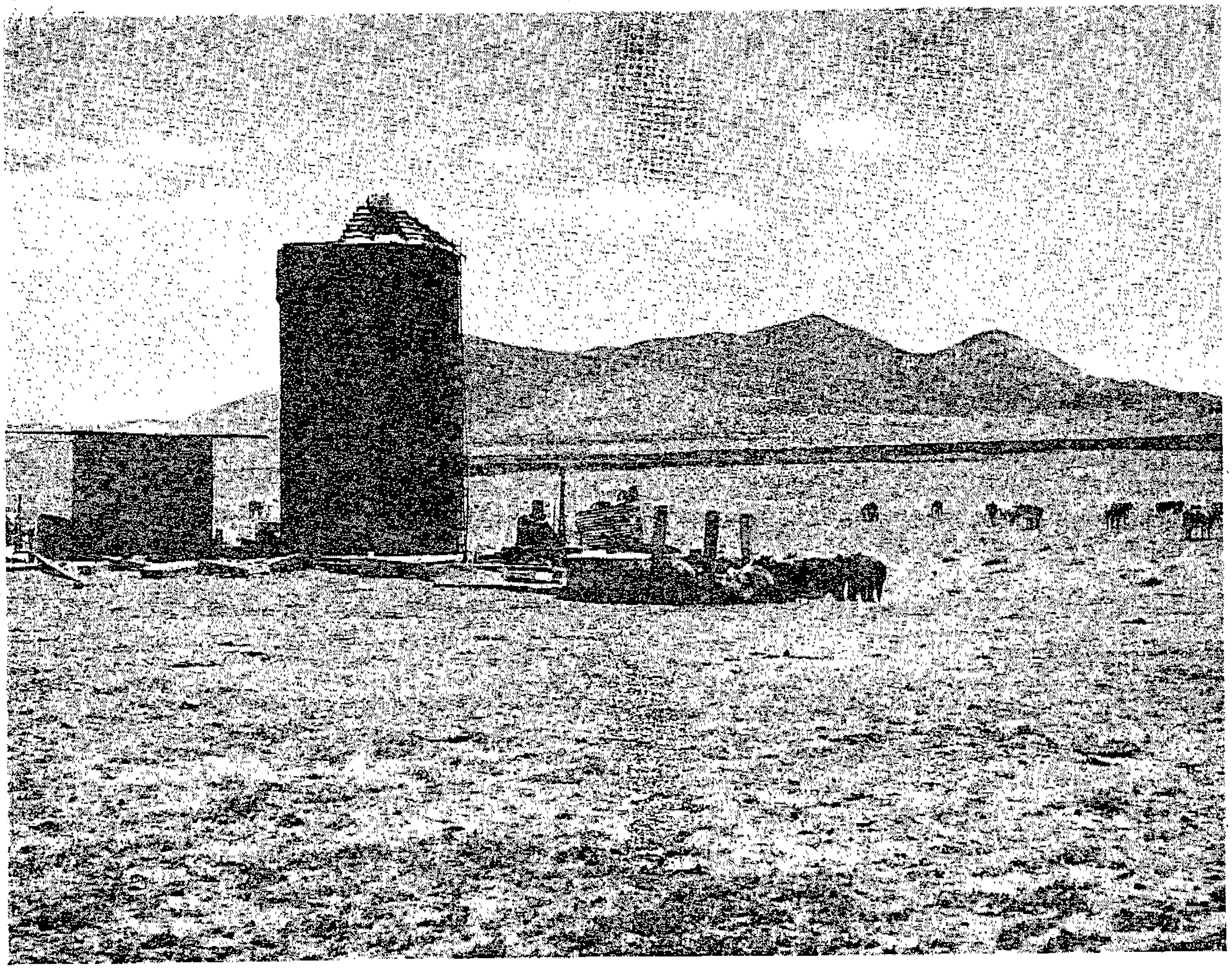
GROUND-WATER RESOURCES – RECONNAISSANCE SERIES
REPORT 12

GROUND–WATER APPRAISAL OF RALSTON AND STONECABIN VALLEYS, NYE COUNTY, NEVADA

By
THOMAS E. EAKIN
Geologist

Price $1.00

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



View northeast of stock well 7/44–36cl in north-central Ralston Valley.
Well is beneath pump at right of high water tank.

COVER PHOTOGRAPH

View southwest of wells 11, 10, and 9 of the Tonopah Municipal Water Company well field, in sec. 8, T. 4 N., R. 44 E. Reported pumping rate of well 11, in right foreground, is 200 gallons a minute; wells 10 and 9, 150 gallons a minute.

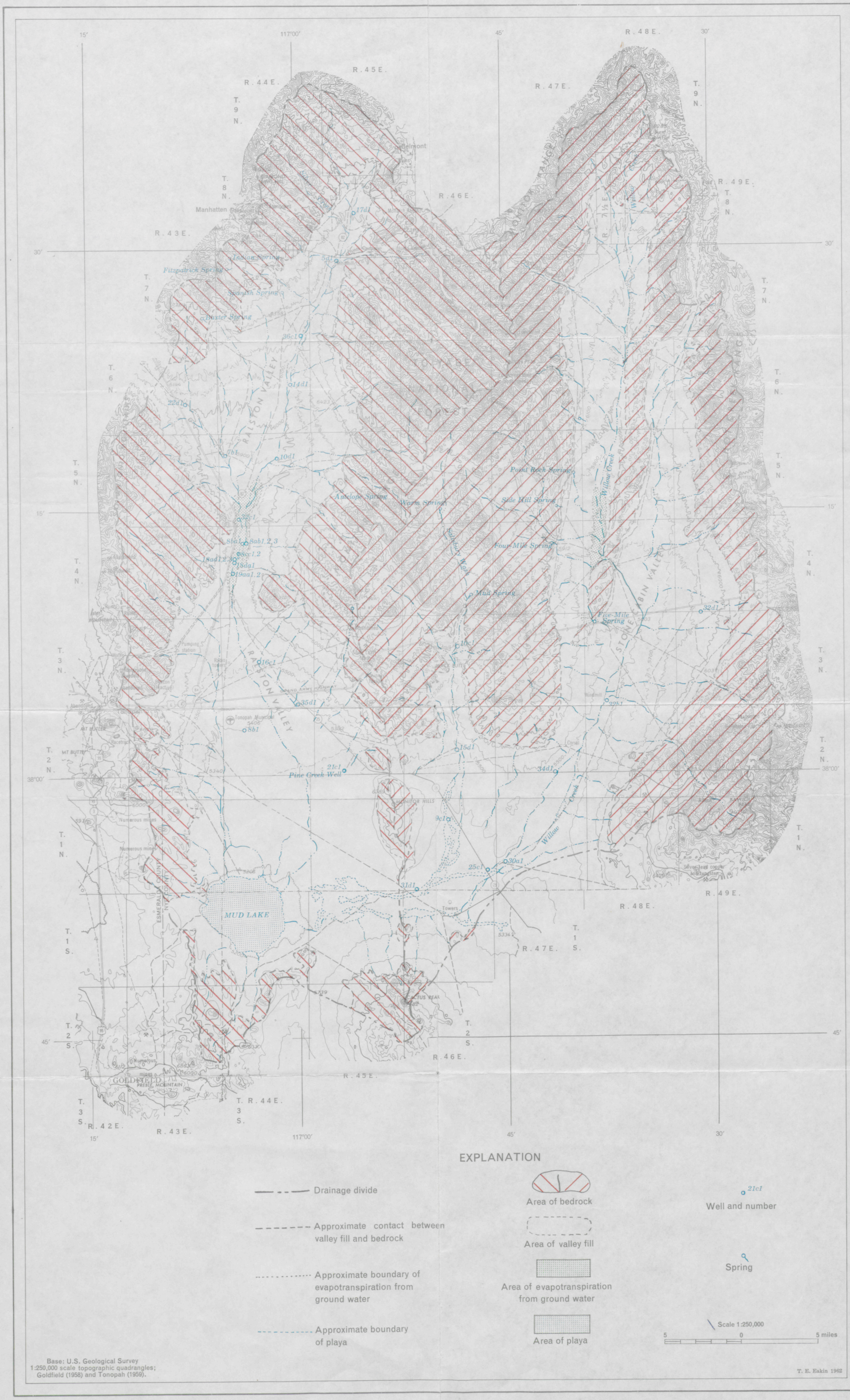


PLATE 1. MAP OF RALSTON AND STONECABIN VALLEYS, NYE COUNTY, NEVADA

SHOWING AREAS OF BEDROCK, VALLEY FILL, PLAYA, AND

BK 12

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FOREWORD

The reconnaissance ground-water study program was initiated by the 1960 legislature and with this report, No. 12, some fourteen valleys have been studied and reports issued setting forth ground-water appraisals together with other basic information.

This report of the ground-water appraisal of Ralston and Stonecabin Valleys was made by Thomas E. Eakin, geologist, U.S. Geological Survey.

This type of study is meeting a definite need in Nevada. As development takes place more detailed studies will be needed. The reconnaissance studies will make available to the State pertinent information that will be valuable to all agencies, both State and Federal.

Hugh A. Shamberger
Director
Department of Conservation
and Natural Resources

October 1962

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GROUND-WATER APPRAISAL OF RALSTON AND STONECABIN VALLEYS,

NYE COUNTY, NEVADA

by
Thomas E. Eakin

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SUMMARY

The results of this reconnaissance of Ralston and Stonecabin Valleys suggest that the average annual recharge to the ground-water reservoir of each valley is about 16,000 acre-feet. The estimated average annual ground-water discharge by evapotranspiration and pumpage is about 2,500 acre-feet from Ralston Valley and about 2,000 acre-feet from Stonecabin Valley.

On the basis of difference between the estimates of recharge and discharge and of hydraulic gradients it is inferred that a considerable part of the total discharge from the valleys occurs by underflow through bedrock to valleys south and west of Mud Lake.

As a tentative estimate of perennial yield the values of discharge by evapotranspiration, about 2,500 and 2,000 acre-feet a year for Ralston and Stonecabin Valleys, respectively, are suggested. These are considered the least maximum quantities that could be developed without reducing appreciably the supply to downstream valleys.

The chemical quality of ground water in the two valleys is represented by only three chemical analyses. To the extent that these analyses are representative of ground water in Ralston and Stonecabin Valleys, the water generally should be suitable for domestic, stock, and irrigation uses. By inference to quality character of somewhat similar areas, it is presumed that the ground water in the valley fill of the two valleys will tend to increase southward in dissolved solids and tend to become a sodium bicarbonate type.

An illustrative example of the magnitude of ground water in storage suggests that about 26 times the estimated average annual ground-water recharge may be in storage in the upper 100 feet of saturated valley fill beneath a 42,000-acre area in Ralston Valley. The relatively large amount of ground water in storage provides a substantial reserve for maintaining potential ground-water requirements during protracted periods of drought.

Present development is largely confined to the well field in Ralston Valley used to supply municipal requirements in Tonopah. The average annual withdrawal for this purpose is reported to be about 50 million gallons of water, or about 150 acre-feet.

The well field is in perhaps the most favorable part of Ralston Valley from the standpoint of shallow depth to water and consequent low pumping lift to land surface. It is the area of natural discharge by evapotranspiration and is favorably situated for the occurrence of water of relatively good quality.

The area of natural discharge by evapotranspiration to the west and north of Stonecabin ranch in Stonecabin Valley similarly is one relatively favorable for ground-water development.

INTRODUCTION

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

Recognizing this need, the State Legislature enacted special legislation (Chapt. 181, Stats. 1960) for beginning a series of reconnaissance studies of the ground-water resources of Nevada. As provided in the legislation, these studies are being made by the U.S. Geological Survey in cooperation with the Nevada Department of Conservation and Natural Resources.

Interest in ground-water resources currently includes many areas and is extending to additional areas almost continuously. Thus, the emphasis of these studies is to provide a general appraisal of the ground-water resources in particular valleys or areas where information is urgently needed, as quickly as possible. For this reason each reconnaissance study is limited severely in time, field work for each area averaging about two weeks.

Additionally, the Department of Conservation and Natural Resources has established a special report series to expedite publication of the results of these reconnaissance studies. Figure 1 shows the areas for which reports have been published in this series. The present report is the twelfth in the reconnaissance series. It describes some of the physical conditions of Ralston and Stonecabin Valleys and includes observations of the interrelation of climate, geology, and hydrology as they are related to the ground-water resources. It includes also a preliminary estimate of the average annual recharge to and discharge from the ground-water reservoir.

The investigation was made under the administrative supervision of Glenn T. Malmberg, Acting District Engineer for Nevada, Ground Water Branch, U. S. Geological Survey.

Location and General Features

Ralston and Stonecabin Valleys, in south-central Nevada, lie within an area enclosed by about latitude 37°50' N. and 38°45' N., and longitude 116°25'

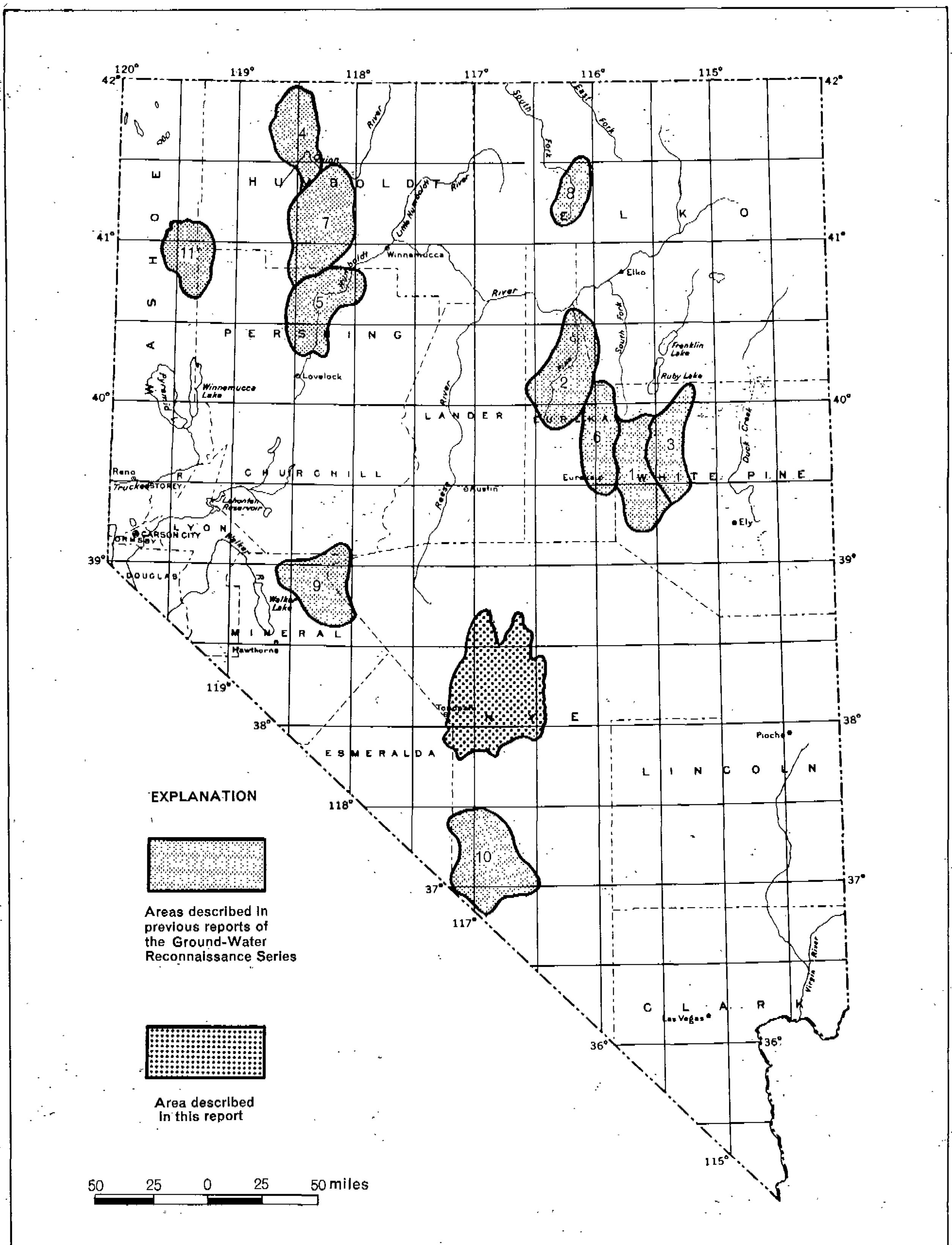

Figure 1. Map of Nevada showing areas described in previous reports of the ground-water reconnaissance series and the area described in this report

and 117°15' W. (pl. 1). The southwest margin of Ralston Valley passes within a mile of the city of Tonopah; Stonecabin Valley is adjacent to Ralston Valley on the east; both valleys are in the northern part of Nye County. Ralston Valley has a drainage area of about 970 square miles, and Stonecabin Valley has a drainage area of about 960 square miles.

Ralston Valley extends about 65 miles northward from Mud Lake at its southern end. Its maximum width is about 20 miles. It is a topographically closed valley, with one exception noted below.

Stonecabin Valley surficially drains to Ralston Valley in the latitude of Mud Lake. The lowest altitude of both valleys is at Mud Lake where the altitude is slightly less than 5,200 feet above sea level.

The highest mountains are in the northernmost parts of the two valleys; an unnamed peak in the Toquima Range, altitude 10,600 feet, is the highest point in Ralston Valley and an unnamed peak in the Monitor Range, altitude 9,600 feet, is the highest point in Stonecabin Valley.

U.S. Highway 6 is the principal access road to both valleys. Nevada State Highway 8A extends northward from U.S. Highway 6 in Ralston Valley and crosses into Big Smoky Valley in T. 6 N., R. 43 E. to connect with U.S. Highway 50 and Austin to the north. State Highway 82, an improved road, provides principal access to the north part of Ralston Valley from its junction with State Highway 8A. State Highway 82 crosses into Monitor Valley near the old mining town of Belmont and connects with U.S. Highway 50 about 80 miles to the north. Graded or unimproved trails provide access to other parts of the two valleys during good weather.

Ralston and Stonecabin Valleys are used principally for livestock range, and only a few active ranches are in the area. The city of Tonopah obtains its water supply from five wells in Ralston Valley from where it is piped about 15 miles to Tonopah. The Tonopah Air Base, south of U.S. Highway 6, was active during World War II. The south end of the area, in the vicinity of Mud Lake, presently is used as a military bombing and gunnery range.

Mining was important in the vicinity of Belmont from about 1865 to 1885. Belmont was the county seat of Nye County from 1867 until the early 1900's when the county seat was moved to Tonopah.

Climate

The climate of south-central Nevada generally is semi-arid in the valleys and sub-humid to humid in the higher parts of the mountains. In the valleys, precipitation and humidity are low and summer temperatures and rates of evaporation are high. Precipitation is irregular, but generally is least on the valley floor and greatest in the higher parts of the mountains. Winter precipitation commonly occurs as snow and summer precipitation usually is localized in high-intensity showers. The temperature range is large, both daily and seasonally. The growing season is of moderate length in the lower parts of the valleys.

Precipitation has been recorded at Belmont and at the Tonopah Air Base (now the municipal airport) within Ralston Valley. Published precipitation records for Stonecabin Valley are not available.

Precipitation at Belmont was recorded during the period 1889-1916. During the 9 full years of record in this period, annual precipitation ranged from 4.32 inches in 1903 to 12.79 inches in 1891. As reported by the U.S. Weather Bureau, the annual precipitation averaged 8.53 inches, based on the 9 complete years of record and 7 years of incomplete record. The altitude of Belmont is listed in Weather Bureau records (Climatic Summary to 1930, Sec. 10-Nevada) as 8,540 feet above sea level, although on the base map for this report the altitude would be interpolated as about 7,500 feet above sea level.

Beginning in 1954, precipitation has been recorded at the Tonopah Airport, sec. 6, T. 2 N., R. 44 E., altitude 5,426 feet above sea level. Previously precipitation was recorded at Tonopah, sec. 35, T. 3 N., R. 42 E., altitude 6,090 feet above sea level. Table 1 lists the annual precipitation at Tonopah for the period 1907-53. Table 2 lists the average monthly and annual precipitation at Tonopah for the period 1941-53 and for Tonopah Airport for 1955-61. Generally it might be expected that precipitation at the airport would average somewhat less than at Tonopah. However, records at both stations have not been maintained simultaneously for comparative purposes. The average annual precipitation at the two stations probably is not greatly different; certainly the difference is far less than the range of annual precipitation at either station. For the period 1907-61 the maximum annual precipitation for both Tonopah and Tonopah Airport was 10.27 inches in 1946 (Tonopah) and the minimum was 1.92 inches in 1927 (Tonopah). The combined average for the two stations for the period 1907-61 was 4.69 inches.

Table 3 lists the average monthly and annual temperature for the period 1941-61 -- the record being combined for Tonopah (until June 1954) and Tonopah Airport (after June 1954). The maximum temperature recorded during this period was 104°F at the airport, July 18, 1960 and the minimum was -12°F, at the airport, January 13, 1955.

Houston (1950, p. 18) lists the growing season in the area as 144 days (May 17 to October 8), based on average data for Tonopah and Goldfield, and for an altitude of about 5,900 feet.

Obviously the growing season may be expected to vary considerably from year to year because of climatic variations. Locally, the growing season will vary from place to place because of variations of topography, orientation, and exposure.

Table 1. -- Annual precipitation, in inches, at Tonopah, Nev. for the period 1907-53

(from published records of the U. S. Weather Bureau)

Date	Precipitation	Date	Precipitation	Date	Precipitation
1907	5.24	1923	4.99	1939	7.26
1908	5.30	1924	4.10	1940	4.56
1909	7.49	1925	5.59	1941	6.29
1910	4.22	1926	2.13	1942	2.19
1911	4.93	1927	1.92	1943	6.56
1912	4.06	1928	2.63	1944	3.49
1913	6.75	1929	3.36	1945	5.73
1914	4.46	1930	4.60	1946	10.27
1915	6.58	1931	6.53	1947	3.66
1916	6.59	1932	3.88	1948	6.11
1917	4.21	1933	2.19	1949	5.85
1918	5.37	1934	3.48	1950	5.08
1919	4.56	1935	3.40	1951	4.99
1920	4.06	1936	5.06	1952	7.89
1921	5.86	1937	4.39	1953	2.91
1922	4.89	1938	7.71		

Table 2. -- Average monthly and annual precipitation, in inches, at Tonopah, Nev. for the period 1941-53 and for Tonopah Airport for 1955-61

(from published records of the U.S. Weather Bureau)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Tonopah	.32	.37	.69	.76	.39	.27	.43	.31	.24	.59	.57	.49	5.46
Tonopah Airport	.23	.16	.15	.23	.51	.08	.51	.55	.34	.28	.25	.14	3.44

Table 3. -- Average monthly and annual temperature, in degrees Fahrenheit, for Tonopah and Tonopah Airport, Nevada, for the period 1941-61

(from published records of the U.S. Weather Bureau)

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
30.3	35.1	39.9	48.7	56.6	65.3	74.1	71.3	64.6	52.2	40.3	33.0	50.9

Physiography and Drainage

Ralston Valley is topographically closed, except for the potential tributary inflow noted below. An ephermeral stream along the axis of Ralston Valley flows southward toward Mud Lake. The stream is fed principally by runoff from the Toquima Range west of Belmont, and from the northwest flank of the Monitor Range, southeast of Belmont. Its channel is well defined to a point about 6 miles north of U.S. Highway 6. South of the point the channel becomes distributary in poorly defined channels leading toward Mud Lake. Runoff rarely reaches Mud Lake because it seeps into the channel bed or evaporates in its southward course.

Most of the runoff generated within the drainage area of Stonecabin Valley apparently is dissipated by evaporation or seepage to the ground-water reservoir. With a sufficient volume and concentration of runoff, streamflow could discharge from the south end of the valley westward to Mud Lake in southern Ralston Valley. Similarly surface flow from Cactus Flat, south of Stonecabin Valley, might flow into the southern part of Stonecabin Valley and thence into Mud Lake. However, this could occur only under the wettest of present-day climatic conditions.

In Stonecabin Valley a bedrock hill extends from the northeast margin of the valley to a short distance south of U.S. Highway 6. The hill trends somewhat west of south, its southern end merging with the southern end of the mountains bounding the west side of the valley. In effect, the ridge divides Stonecabin Valley into an upper and lower part. Overflow from the upper part enters the lower part of the valley through bedrock gaps near Stonecabin and Five-Mile Springs.

GENERAL GEOLOGY

Apparently the oldest rocks in Ralston and Stonecabin Valleys are shale and limestone of early Paleozoic age which occur in the Toquima, Monitor, and Hot Creek Ranges near the northern margin of the project area. Lincoln (1923, p. 160) refers to the occurrence of Ordovician shale and limestone in the Belmont District at the north end of Ralston Valley. Ferguson (1933, p. 13-21) describes shale and limestone ranging in age from Cambrian to Silurian in the Tybo district on the east flank of the Hot Creek Range in the latitude of Twp. 6 N. Lincoln (1923, p. 160) also refers to an intrusive granite in the Belmont district.

The mountains enclosing Ralston and Stonecabin Valleys are composed mostly of Tertiary volcanic rocks, including lava flows, tuffaceous deposits and lesser amounts of intrusive rocks. Nolan (1935) describes the Tertiary rocks of the Tonopah district and Ferguson (1933) describes the Tertiary rocks of the Tybo district. The rocks of those areas probably are representative of the types of Tertiary rocks occuring in Ralston and Stonecabin Valleys. The Paleozoic rocks are intensely faulted and folded; the Tertiary rocks are faulted, but folding is not generally prominent.

Quaternary deposits include surface detritus and sand and gravel along the stream channels in the mountains, fan and stream wash deposits in the valleys, and playa or lacustrine deposits in the Mud Lake area.

The above-described rocks of Ralston and Stonecabin Valleys may be divided into two groups on the basis of the general relation to ground water: bedrock in the mountains and valley fill.

The bedrock in large part includes the Paleozoic and Tertiary rocks. The valley fill includes the Quaternary deposits and underlying Tertiary rocks.

Water-Bearing Properties of the Rocks

Ground water occurs in and is transmitted through some of the Paleozoic rocks in Ralston and Stonecabin Valleys. Generally these rocks are consolidated and have low primary permeability. However, because they have been substantially deformed, weathered, or otherwise altered, locally they may contain secondary openings such as joints and other fractures. Some of the fractures in the limestone have been enlarged by solution, thus increasing the secondary permeability of these rocks. Kral (1951, p. 21, 22) reports that the Highbridge and Belmont shafts in the Belmont district were steadily dewatered by pumping at the rate of about 300 gpm (gallons per minute). The Highbridge shaft was 360 feet deep and the Belmont shaft was somewhat more than 600 feet deep. The reported pumping rate lowered the water level from 50 feet below land surface to a depth that permitted access to the 300-foot level of the Highbridge shaft and the 400-foot level of the Belmont shaft. The pumping dewatered not only the shafts but "many hundreds of feet of old drifts and stopes", according to Kral (1951, p. 21). That the reported pumping rate of 300 gallons per minute readily dewatered these workings suggests that the yield from these shafts would not sustain the 300 gpm rate continuously. Ferguson (1933, p. 56) reports that "abundant flows of water have been encountered" in the Tybo Mine of the Tybo district. He further states that most of the water enters the mine from small fissures in the walls encountered in crosscuts and that in 1929 the flow amounted to 500 gallons a minute. Although this quantity is relatively large in total, the mine has several levels and thousands of feet of drifts and stopes. Accordingly, it may be inferred that the average yield of water from the fractures in these rocks is relatively small.

At Tonopah most of the mine workings apparently were higher than the regional ground-water body. However, the deeper western workings of the Tonopah Extension Mine encountered ground water. According to T. B. Nolan (written communication, 1962) pumpage in the Tonopah Extension amounted to about 2,200 gpm from the 1,880-foot level in 1929. Although this rate is relatively large for a well, it probably represents a rather small unit rate when due regard is given to the surface area of the workings of the Tonopah Extension Mine which are below the non-pumping water level.

The Tertiary rocks in the mountains are fractured largely as a result of faulting. The extent to which the Tertiary rocks of the valley fill are faulted is not known. According to I. J. Winograd (oral communication, 1962) studies in the Yucca Flat area, some 75 miles south of the area of this report, suggest that the Tertiary tuffaceous deposits beneath Yucca Flat are fractured. Regardless of whether the Tertiary rocks have primary permeability or secondary permeability due to fracturing, they probably would transmit water slowly to wells in Ralston and Stonecabin Valleys.

Saturated unconsolidated sand and gravel deposits of Quaternary age probably will yield water freely to wells. However, much of the Quaternary deposits apparently is above the zone of saturation. They have been developed to a moderate extent only at the Tonopah well field in Ralston Valley.

GROUND-WATER APPRAISAL

General Conditions

The ultimate source of most of the ground water in Ralston and Stonecabin Valleys is precipitation within the drainage areas of the valleys. Some of the precipitation on the flanks of the mountains percolates downward to the ground-water reservoir, but most of the recharge to the ground-water reservoir in the valley fill results from the infiltration of runoff from the mountains. An unknown amount of recharge to the ground-water reservoir in the valley fill results from underflow from the rocks of the mountains to the valley fill.

Ground water moves from the recharge areas in the northern parts of Ralston and Stonecabin Valleys toward the topographically low parts of the valleys. The general course of movement is southward toward the Mud Lake area.

Figure 2 shows the approximate slopes of the land surface and water-level profile along the axis of Ralston Valley. The configuration of the water table, or the upper surface of the zone of saturation, conforms generally with the slope of the land surface but commonly has less relief. Thus the depth to water in the valley fill normally increases from the valley axis toward the mountains. The water-level profile along the valley axis shown in figure 2 is somewhat illustrative of this feature. Some modifications result from variations in local hydrogeologic conditions. For example, at the north end of the profile, near Belmont, the water-level is relatively near land surface in the mountain canyons partly because of the concentration of recharge and partly because the cross section of the alluvial deposits probably is small. As the ground water moves into the open valley the depth to water increases probably because of the increasing width and thickness of the valley fill.

A bedrock constriction in the latitude of the Tonopah well field (T. 4 N.) reduces the cross section of the valley fill which in turn reduces the amount of ground water that can be transmitted through the valley fill. This "choke" effect causes the water level to be at or near land surface. As a result some ground water is discharged at and immediately north of the constriction by evaporation and transpiration by phreatophytes. The remaining ground water moves through the constriction as underflow toward the Mud Lake area. Because the cross section of the valley fill increases substantially south of the Tonopah well field, the depth to water also increases. (See figure 2). According to Ball (1907, p. 83), the depth to water at Mud Lake is about 240 feet below the playa.

In Stonecabin Valley the bedrock gap, in sec. 17, T. 4 N., R. 48 E., forms a "choke" on ground-water underflow in a manner similar to the constriction in Ralston Valley near the Tonopah well field. This results in a considerable area of shallow water table upgradient from the gap where ground-water discharge occurs by evaporation and transpiration by phreatophytes. In the lower part of Stonecabin Valley the water level is relatively deep. At well 3/48-32b1 the depth to water is about 110 feet below land surface. South of this well, surface water and ground water moves westward through a gap between the Monitor Hills and the Cactus Range toward Mud Lake. Geologic and hydrologic conditions suggest that some ground water may move from Cactus Flat northwestward to lower Stonecabin Valley and thence westward toward Mud Lake (fig. 3).

Based on the preceding discussion and on the estimated recharge of about 32,000 acre-feet a year to the project area (p.12 to 14), a substantial amount of ground-water discharge might be expected in the Mud Lake area by evapotranspiration. However, this is not the case because the water table is too far below land surface in the Mud Lake area to provide ground-water discharge by evapotranspiration. This then suggests that discharge from the area occurs as underflow through the Paleozoic and (or) Tertiary rocks beneath the topographic divide on the west and south sides of Mud Lake. Available data permit evaluating this discharge only on the basis of potential hydraulic gradients; that is, underflow through the Paleozoic and Tertiary rocks probably occurs from areas of higher water-level altitudes in Ralston and Stonecabin Valleys to areas of lower water-level altitudes to the west and south. Figure 3 shows apparent water-level gradients between selected points in the southern part of Ralston and Stonecabin Valleys, Alkali Springs Valley, and Clayton Valley to the west, and Stonewall Flat to the south. The absence of necessary data on geologic conditions in this area precludes direct evaluation of the magnitude of possible bedrock underflow. The indicated gradients do suggest possible directions of movement, and the differences between the estimates of ground-water recharge and discharge in the valleys suggests the possible magnitude of underflow through bedrock. The accuracy of the underflow estimates, of course, depend upon the accuracy of the estimates of recharge and discharge within each valley.

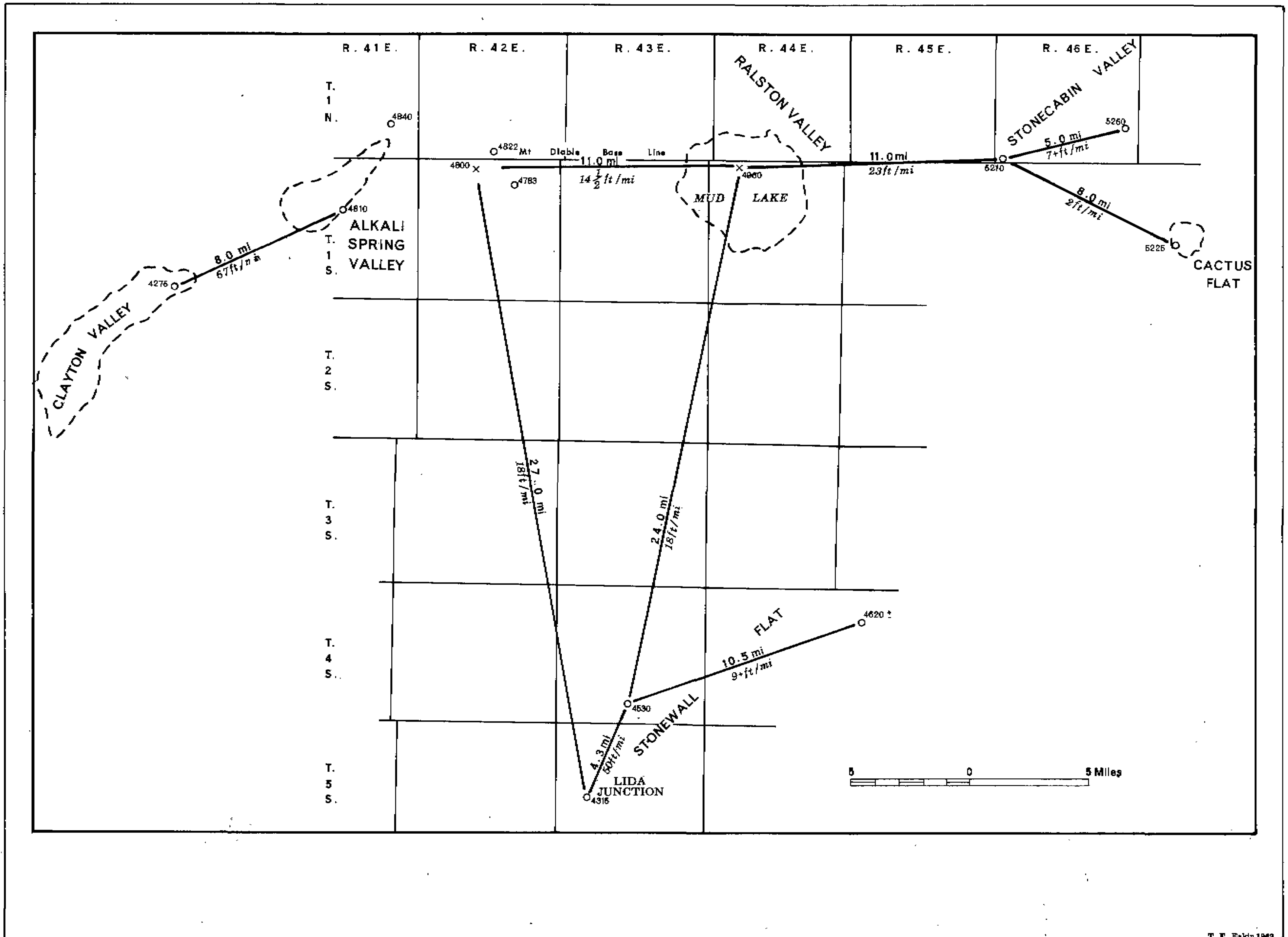

Figure 3. SKETCH MAP showing water-level altitudes and apparent water-level gradients in the vicinity of Mud Lake.

Estimated Average Annual Recharge

An estimate may be made of the average annual recharge to the ground water reservoir as a percentage of the average annual precipitation within the valley (Eakin and others, 1951, p. 79-81). A brief description of the method follows: Zones in which the average precipitation ranges between specified limits are delineated on a map, and a percentage of the precipitation is assigned to each zone which represents the possible average recharge from the average annual precipitation on that zone. The degree of reliability of the estimate so obtained, of course, is related to the degree to which the values approximate the actual precipitation, and the degree to which the assumed percentages represent the actual percentage of recharge. Neither of these factors is known precisely enough to assure a high degree of reliability for any one valley. However, the method is useful for reconnaissance estimates.

The precipitation map of Nevada (Hardman and Mason, 1949, p. 10) has been adjusted by Hardman (oral communication, 1962) on the basis of topographic base maps at a scale of 1:250,000 now available and which are the base for plate 1 of this report. The division between the zones of less than 8 inches and 8 to 12 inches of precipitation was delineated at the 6,000-foot contour, between 8 to 12 inches and 12 to 15 inches at the 7,000-foot contour, between 12 to 15 inches and 15 to 20 inches at the 8,000-foot contour, and between 15 to 20 inches and more than 20 inches at the 9,000-foot contour.

The average precipitation assumed for the respective zones, beginning with the zone of 8 to 12 inches of precipitation, is 10 inches (0.83 foot), 13.5 inches (1.12 feet), 17.5 inches (1.46 feet), and 21 inches (1.75 feet).

The estimates of recharge, as a percentage of the average precipitation for each zone are as follows: 8 to 12 inches, 1 percent; 12 to 15 inches, 7 percent; 15 to 20 inches, 15 percent; and more than 20 inches, 25 percent.

Tables 4 and 5 summarize the computation of recharge for Ralston and Stonecabin Valleys, respectively. The estimated recharge (column 5) for each zone is obtained by multiplying the figures in columns 2, 3, and 4. Thus for the zone receiving more than 20 inches of precipitation in Ralston Valley, the computed recharge is 1,400 acres x 1.75 feet x 0.25 (percent), or about 600 acre-feet. The average annual recharge to the ground-water reservoirs in the valley fill, so estimated, is about 16,000 acre-feet each for Ralston and Stonecabin Valleys.

Table 4. -- Estimated average annual ground-water recharge from precipitation in Ralston Valley.

Precipitation zone (inches)	Approximate area of zone (acres)	Average annual precipitation (feet)	Percent recharged	Estimated recharge (acre-feet) (2x3x4 ÷ 100)
20+	1,400	1.75	25	600
15-20	26,600	1.46	15	5,800
12-15	105,000	1.12	7	8,200
8-12	219,000	.83	1	1,800
8-	269,000	.5	--	--
	621,000 (970 sq. mi.)		Estimated average annual recharge (rounded)	16,000

Table 5. -- Estimated average annual ground-water recharge from precipitation in Stonecabin Valley.

Precipitation zone (inches)	Approximate area of zone (acres)	Average annual precipitation (feet)	Percent recharged	Estimated recharge (acre-feet) (2x3x4 ÷ 100)
20+	3,000	1.75	25	1,300
15-20	25,000	1.46	15	5,500
12-15	89,000	1.12	7	7,000
8-12	266,000	.83	1	2,200
8-	230,000	.5	--	--
	613,000 (960 sq. mi.)		Estimated average annual recharge (rounded)	16,000

Estimated Average Annual Discharge

Some ground-water is discharged from Ralston and Stonecabin Valleys by transpiration of water-loving vegetation (phreatophytes) and by evaporation, and some ground water is pumped from Ralston Valley and exported out of the valley for public-supply use in Tonopah. However, a larger amount of ground water may be discharging by underflow through bedrock from the Mud Lake area. Based on the potential hydraulic gradients, underflow from the Mud Lake area probably moves southward to Stonewall Flat and westward toward Clayton Valley.

An accurate estimate of underflow through bedrock in the Mud Lake area cannot be made with the presently available data. However, to the extent that the estimates of recharge, discharge by evapotranspiration and pumpage from the Tonopah well field closely represent actual ground-water recharge to and discharge from the valley, the difference between these estimates suggests the possible magnitude of underflow through bedrock from the valley.

Table 6 summarizes the estimated average annual discharge from Ralston and Stonecabin Valleys resulting from evaporation, transpiration, and pumping.

Studies by Lee (1912) and White (1932) made in the Great Basin and Young and Blaney (1942) made in southern California, form the basis for the estimate of discharge by evapotranspiration used in table 6. The rate of use was assigned on the basis of vegetative types, density and depth to the water table.

Table 6.--Estimated average annual discharge by evapotranspiration and pumpage from Ralston and Stonecabin Valleys.

Methods of ground-water discharge	Estimated rate of ground-water use (feet per year)	Area (acres)	Approximate discharge in acre-feet per year
Evapotranspiration in Ralston Valley: principally by mixed greasewood, rabbitbrush, salt grass, and related phreatophytes; depth to water 2 to 30 feet, average about 10 feet.	0.5	5,000	2,500
Pumpage from Ralston Valley for city of Tonopah. Average annual pumpage about 50 million gallons			150
Evapotranspiration in Stonecabin Valley: principally by mixed greasewood, rabbitbrush, salt grass, and related phreatophytes; depth to water 0 to 30 feet, average about 10 feet.	0.5	3,000	1,500
Discharge of springs at Stonecabin ranch, Stonecabin Valley, estimated average about 2/3 cfs.			500
Estimated pumpage for stockwater from wells in valley fill.			25
Estimated discharge by evapotranspiration and pumpage from ground-water reservoirs in Ralston and Stonecabin Valleys, rounded --			4,700

The estimated average annual recharge to Ralston and Stonecabin Valleys are about 13,000 and 14,000 acre-feet more than the estimated discharge listed in table 6. If these estimates are correct, about 27,000 acre-feet of underflow is discharging through the bedrock from the Mud Lake area. This may be roughly checked by a calculation of transmissibility through a section of the valley fill applying appropriate figures that may approximate actual conditions. The formula Q = 0.00112 TIW provides the basis for the computation where Q = the quantity of underflow, 0.00112 converts gallons per day to acre-feet per year, T = the coefficient of transmissibility 1/ of the water-bearing deposits, I = the ground-water gradient, and W = the width of the section through which the ground water moves. The above terms are given in the following units: Q, in acre-feet per year; W, in miles; I, in feet per mile; and T, in gallons per day per foot times 0.00112.

In Ralston Valley, the width of the valley fill between the bedrock hills in the southern part of T. 4 N. is about 3 miles, the water-level gradient is estimated to be about 40 feet per mile, and the coefficient of transmissibility is assumed to be 50,000 gallons per day per foot. Substituting the above values in the formula, the underflow through the section in Ralston Valley is about 6,700 acre-feet per year.

The width of a north-trending section between the Monitor Hills and the Cactus Range in Stonecabin Valley is about 5 miles wide; the hydraulic gradient is on the order of 25 feet per mile, and the coefficient of transmissibility is assumed to be 50,000 gallons per day per foot. These values suggest an underflow of about 7,000 acre-feet per year through the section in Stonecabin Valley. The underflow toward Mud Lake by the method of differences of recharge and discharge within the valleys is about 27,000 acre-feet a year and by the method of computation of underflow by the Q = TIW method is about 14,000 acre-feet a year. Both values seem somewhat high to represent the underflow through bedrock to areas south and west of Mud Lake. However, together with possible hydraulic gradients in these directions, they lend support to the concept that underflow from Mud Lake occurs to the south or west or both. Because data are not adequate for precise determination of the factors used in the two sets of computations, both the estimates of underflow and recharge may not represent actual conditions. Although the estimates of discharge also are based on inadequate data, it is believed that the values obtained have a somewhat higher order of reliability in these reconnaissance estimates.

1/ The transmissibility may be expressed in terms of gallons per day through a strip of the aquifer 1 foot wide extending the full height of the aquifer under unit hydraulic gradient, or through a section of the aquifer 1 mile wide under a hydraulic gradient of 1 foot per mile.

Perennial Yield

The perennial yield of a ground-water system is limited ultimately by the average annual recharge to and discharge from the aquifer system. It is the upper limit of the amount of water that can be withdrawn for an indefinite period of time from an aquifer system without causing a continuing depletion of storage. The average recharge from precipitation and the average discharge by evapotranspiration, discharge to streams, and underflow from a valley are measures of the natural inflow and outflow from the aquifer system.

In an estimate of perennial yield, consideration should be given to the effects that ground-water development by wells may have on the natural circulation of ground water. Development by wells may or may not induce recharge in addition to that received under natural conditions. Part of the water discharged by wells may re-enter the ground-water reservoir by downward percolation, especially if the water is used for irrigation. Ground water discharged by wells usually is offset eventually by a reduction of the natural discharge. In practice, however, it is difficult to offset fully the discharge by wells by an equal decrease in the natural discharge, except when the water table has been lowered to a level that eliminates both underground outflow and evapotranspiration in the area of natural discharge. The numerous pertinent factors are so complex that, in effect, specific determination of perennial yield of a valley requires a very extensive investigation, based in part on data that can be obtained economically only after there has been substantial development of ground water for several years.

The apparent substantial amount of ground-water underflow moving southward and westward out of the drainage basin further complicates the evaluation of perennial yield. Pumping from wells might not salvage much of this discharge unless the wells were drilled so as to intercept the discharge and unless pumping resulted in the removal of a substantial part of the ground water in storage at the south end of the area. To accomplish the required lowering of water levels in the valley fill, pumping lifts probably would have to be considerably in excess of present-day economic pumping lifts for irrigation. Accordingly, the preliminary estimates of perennial yield are limited to the estimated average annual evapotranspiration of ground water. For Ralston Valley, the preliminary estimate of perennial yield is about 2,500 acre-feet, and for Stonecabin Valley, the preliminary estimate is about 2,000 acre-feet, which includes the spring discharge at Stonecabin ranch and Five-Mile Springs. The extent to which the yields could be increased above these amounts would be related largely to the amount of discharge by underflow through bedrock from the two valleys that could be salvaged. In any event, on a continuing basis, it could not exceed the estimated average annual recharge of about 32,000 acre-feet for both valleys.

If the discharge by underflow from Ralston and Stonecabin Valleys is reduced substantially by pumping, the amount of water available for use in the downstream valleys eventually will be reduced accordingly. For this area, and for other similar areas of Nevada, consideration must be given to the limitations that should be placed on local development in hydrologically interconnected valleys. For Ralston and Stonecabin Valleys the preliminary estimates of perennial yield described are considered to be the minimum quantities that could be developed without causing any appreciable reduction of the supply in the downstream valleys.

Storage

A considerable amount of ground water is stored in the valley fill of Ralston and Stonecabin Valleys. It is many times the volume of the average annual recharge to and discharge from the ground-water reservoirs of the two valleys. Present data do not permit a precise determination of the amount of ground water in storage. However, an idea of the magnitude of the water in storage that can be developed by wells is indicated by the following computation. The surface area of the valley fill lying below the 6,000-foot contour north of T. 3 N. in Ralston Valley is about 42,000 acres. If it is assumed that this area approximately represents the area beneath which a reasonably thick section of the valley fill is saturated with ground water, and if a value of 10 percent is assumed as the specific yield (drainable pore space) of the saturated deposits, then about 4,200 acre-feet of water is available in storage for each saturated foot of valley fill. On this basis, the amount of available water in storage in the upper 100 feet of saturated valley fill would be 420,000 acre-feet or about 26 times the estimated average annual recharge to the ground-water reservoir in Ralston Valley. A similar relationship occurs in Stonecabin Valley. In addition, an unknown amount of ground water is stored in the bedrock of the two valleys.

The principal point to be recognized is that ground water in storage provides a reserve for maintaining an adequate supply for pumping during protracted periods of drought, or for temporary periods of high demand under emergency conditions. This reserve, in effect, increases the reliability of ground water as a dependable source of supply and is an important asset in semiarid regions where surface water supplies vary widely from year to year.

One method of determining storage capacity and perennial yield of a given area involves the collection and analysis of data on artificial withdrawals by wells. Commonly too, the analysis is complicated by the fact that part of the ground water pumped is returned to the ground-water reservoir. However, in Ralston Valley most of the ground water pumped by the Tonopah Municipal Water Co. is used outside of the valley, in Tonopah. This situation is favorable for a small scale study of the effect of pumping on the ground-water system.

Chemical Quality

The chemical quality of ground water in interior valleys usually varies considerably as the water moves through the ground-water system. In general, the concentration of dissolved chemical constituents is low in the areas of recharge. As the water moves toward areas of discharge it is in contact with rock materials of different solubilities. The extent to which the water dissolves chemical constituents from the rock materials is governed in large part by the solubility, volume, and distribution of the different rock materials, the time the water is in contact with the rocks, and the temperature and pressure in the ground-water system. In the areas of natural discharge, the ground water is evaporated or transpired, processes which tend to concentrate dissolved chemical constituents in the remaining ground water.

Table 7 gives the analyses of water from two wells in Ralston Valley and one spring in Stonecabin Valley. For reference U.S. Public Health Standards also are shown in the table for the same constituents. Salty ground water was encountered at about 800 feet in a well drilled at the Tonopah Airbase during the war, according to an unconfirmed report. Other than the inference that the salty water probably was unsatisfactory for domestic purposes no particular interpretation can be made of this information. The concentration of the constituents determined in water from the three samples are substantially below the limits set by the U.S. Public Health Service for drinking water.

Generally, the analyses indicate suitability for irrigation of the type usually found in this region of Nevada. It may be noted that computations of the Sodium-adsorption ratio places the water in the medium salinity hazard category according to the classification of the U.S. Salinity Laboratory (U.S. Department of Agriculture, 1954, p. 79, 80)-- that is, the water can be used if a moderate amount of leaching occurs, and plants with a moderate salt tolerance can be grownin most cases without special practices for salinity control. Boron in small quantities is essential to plant growth but is toxic to crops only slightly above optimum concentrations. No boron was found in the analyses of water from spring 4/48-17 or well 7/44-36c1.

The analyses indicate that ground water in Ralston and Stonecabin Valleys generally is suitable for stock purposes.

Table 7.--Chemical analysis of the three water samples from Ralson and Stonecabin Valleys, and U.S. Public Health Service, drinking water standards.

(Constituents in parts per million)

Location	Silica	Iron	Calcium	Magnesium	Sodium	Potassium	Bicarbonate	Sulfate	Chloride	Fluoride	Nitrate	Phosphate
4/44-8ba1	60	0.01	43	2.4	25	7.4	137	34	13	.3	11	.20
4/48-17 1/	80	--	23	2.1	36	7.8	130	19	13	0.5	2.4	--
7/44-36c1 1/	57	--	39	5.4	32	5.8	154	37	14	0.1	2.5	--
U.S. Public Health Service 2/	--	.3	--	--	--	--	--	250	250	1.3 3/	45 4/	--

1/ Boron - 0.0 ppm. These analyses are subject to revision.

2/ Drinking water standards announced by U.S. Public Health Service: Title 42, part 72, paragraph 72.205 of Federal Register p. 2154, dated March 6, 1962.

3/ Recommended control limit for upper concentration ranges from 0.8 to 1.7 ppm varying according to annual average maximum daily air temperature. Value given in this table is for approximate maximum daily temperature for Tonopah.

4/ In areas in which the nitrate content of water is known to exceed 45 ppm, the public should be warned of the potential dangers of using the water for infant feeding.

The analysis, location of the well from which the sample was taken, and the gross conditions of ground-water occurrence and movement suggest that ground water north of the Tonopah well field may be proportionally high of calcium (Ca). However, southward, toward Mud Lake, the proportion of sodium (Na) probably increases as would the dissolved solids concentration. Southward from near Belmont to Mud Lake the general character of ground water would be expected to change from a calcium bicarbonate type to a sodium bicarbonate type. This characteristic has been identified in part in other areas where ground water circulates through Tertiary volcanic rocks either in adjacent mountains or where they underlie the valley floor.

Development

Ground water presently is developed only to a minor extent in Ralston and Stonecabin Valleys. Pumpage from the well field in Ralston Valley for public supply in Tonopah is the principal development. Spring discharge is used on Stonecabin ranch and, to a lesser extent, at Five-Mile Spring in Stonecabin Valley, for meadow irrigation. A few residents at Belmont use water from a small spring. Stock water is supplied from a number of springs in the mountains and about 20 wells distributed throughout Ralston and Stonecabin Valleys.

Water supply for Tonopah: The public water supply for the city of Tonopah is provided by the Tonopah Municipal Water Company from wells in the northwest quarter of T. 4 N., R. 44 E., on Ralston Valley. A brief account of the early period of development is well-described by Meinzer (1917, p. 125) and is quoted as follows:

> "Ten 14-inch wells were originally sunk at intervals of about 100 feet in an east-west line across the flood plain at right angles to the axis of the valley. On the rock, which was struck 55 feet below the surface, there is said to be a 10-foot bed of clay, above which there is clay, sand, and the gravel from which the water is derived. The water table was originally 8 feet below the surface, but in 1913 it was a few feet lower. The yield seems gradually to have declined, more likely by clogging of the wells than by diminution of the supply, until in 1913 it was only a few thousand gallons an hour.
>
> "Two large wells have been sunk in the same locality, one 8 by 12 feet by 45 feet deep, the other 5 by 6 feet by 60 feet deep. They are pumped with centrifugal pumps and contribute largely to the supply. An infiltration ditch, discharging by gravity, furnished about 9,000 gallons an hour until it was damaged by a flood in the fall of 1913.
>
> "Recently three wells were sunk somewhat less than 100 feet apart along an east-west line at the axis of the valley

4,400 feet north of the pumping plant, where the water table is only about 5 feet below the surface and ground water is being discharged through soil and vegetation. These wells are 12 inches in diameter and range in depth from 46 to 51 feet. They pass through about 4 feet of gray silt loam and then chiefly through clean sand and gravel to the bottom, where bowlders (boulders) were struck. They are lined to the bottom with No. 12 double stovepipe casing with small perforations. A yield of 100 gallons a minute is reported by Mr. M. P. Shepard, foreman of the pumping plant, to have been obtained in a test of one of these wells with a drawdown of 20 feet, and a yield of 150 gallons a minute with a drawdown of 25 feet. With larger perforations the yield would probably have been greater.

"A test well 65 feet deep, 2 miles farther up the valley, struck water at a depth of about 5 feet and passed chiefly through clean gravel to the bottom, where bowlders (boulders) were encountered. Mr. Shepard reports that this well was pumped 8 hours at the rate of 50 gallons a minute with a drawdown of only 16 inches.

"The supply in this valley is apparently a definitely limited underflow, but larger quantities could doubtless be recovered by a more widely distributed system of wells, which would get the water that now escapes toward the south."

In about 1920, two more wells were drilled north of the then existing wells, according to Mr. E. Mayfield, the present manager of the water company. Unsuccessful attempts to develop water south of the well field also were made, according to Mr. Mayfield. These included a 1,500-foot test south of present U.S. Highway 6, and two or three shallower tests between the Highway and the well field. Specific locations of these tests were not ascertained.

When the Tonopah Air Base was being established during World War II, an effort was made to develop a water supply on the base, which is just south of U.S. Highway 6. A well was drilled to a reported depth of 1,200 feet. Saline water reportedly was encountered at about 800 feet, but was cased off and drilling was continued. At a depth of about 1,200 feet the tools became stuck in the hole, attempts to free them were unsuccessful, and drilling was terminated.

To provide the necessary water supply for the air base, four wells were drilled in 1943 north of the then existing well field. The locations of the wells are shown in figure 4. Table 9 gives additional information of individual wells. Reported annual pumpage of ground water from the well field through 1946 is given in table 8. Since that time annual pumpage reportedly has remained about the same. The peak annual pumpage during 1943-45 reflects

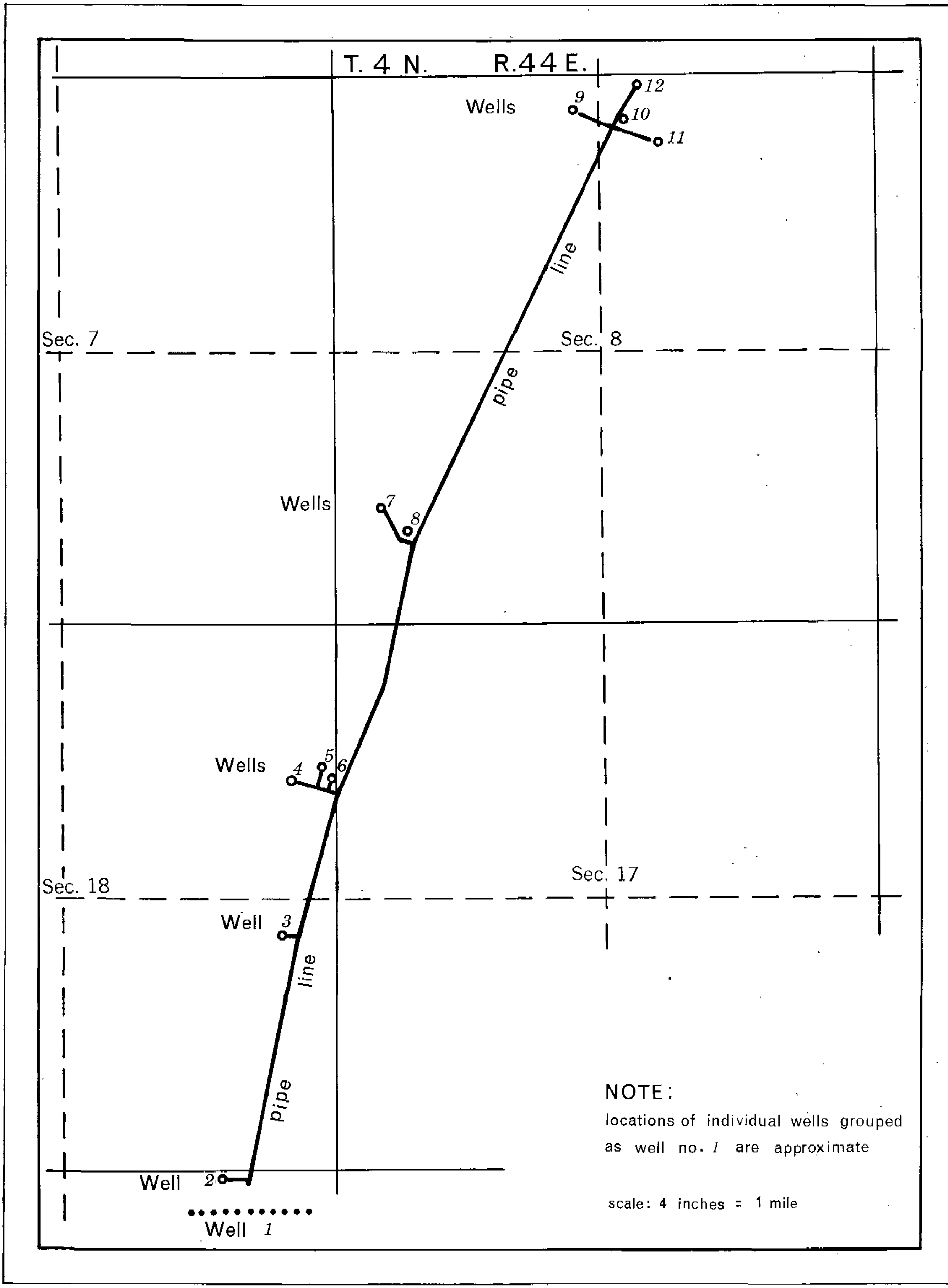

Figure 4. SKETCH MAP

showing locations of wells in the well field of the Tonopah municipal water company, Ralston Valley.

the substantial demand for water by the air base and the related concurrent increase in water use in Tonopah.

The present water supply for Tonopah is obtained principally from wells 9 to 12 and infrequently from well 8.

Table 8.-- Reported annual pumpage of ground water from the Tonopah well field, 1911-46.

Year	Pumpage Million gallons	Year	Pumpage Million gallons
1911	73	1931	27
12	114	32	25
13	128	33	26
14	115	34	26
15	106	35	30
16	102	36	30
17	90	37	31
18	122	38	26
19	123	39	27+
20	122	40	26
21	116	41	28
22	126	42	53
23	89	43	a 109
24	54	44	a 238
25	54	45	a 169
26	48	46	49
27	48	..	...
28	40	..	...
29	38 1/2	..	...
30	30	..	...

a. Includes pumpage for Tonopah Air Base, 1943-1945.

PROPOSALS FOR ADDITIONAL GROUND-WATER STUDIES

In compliance with the request of Hugh A. Shamberger, Director, Department of Conservation and Natural Resources, State of Nevada, suggestions for special studies that are listed below are recommended for obtaining needed basic data and for obtaining a better understanding of the factors that influence or control ground water in Ralston and Stonecabin Valleys and similar areas in Nevada. These studies are separate from the normal areal investigations that commonly are needed after the development of ground water in a given area becomes substantial.

1. An investigation could be made of the effects of pumpage on the ground-water regimen in the vicinity of the well field in Ralston Valley. Although pumpage in this area is small and the effects on the aquifer system also small, the export of the water pumped to Tonopah which is outside of Ralston Valley, provides an environment in which recycling of pumped water is not a complicating factor. Meinzer (1917, p. 125) noted a minor decline in water level in the area in 1913. And a measurable decline should be possible, especially during a succession of "dry" years. However, recovery of water levels in whole or in part apparently occurs during years of favorable conditions of recharge. Demonstration of this relationship by adequate data in Nevada would prove a useful reference not only for this area but for other areas in the State. The investigation would include the study of the storage capacity of the sediments within the zone of water-level flunctuations and the overlying deposits and the use of ground water by phreatophytes.

2. An investigation could be made of the geologic and hydrologic factors that control the discharge of ground water from the Mud Lake area by underflow to the south and west. The resulting information may have little direct economic value in Ralston and Stonecabin Valley, but it would be of substantial value to the State in that the knowledge and understanding gained would be most pertinent to the yield of the basins south and west of Mud Lake.

In some areas in the central and southern part of Nevada, much or all of the ground water is discharged through bedrock from one topographically closed valley to another. In a number of valleys the valley fill is virtually unsaturated. A study to determine the direction, rate, and quantity of ground water being discharged under these conditions within the Nevada Test Site is presently being made by the Geological Survey at the request of the Atomic Energy Commission. The situation in Ralston and Stonecabin Valleys provides a hydrologic environment intermediate between that of valleys where most of the recharge to ground water drains downward from the valley fill into the bedrock and the hydrologically closed valleys where the valley fill is saturated and the entire discharge of ground water is from the valley fill in areas of evapotranspiration.

The investigation first should be directed toward obtaining a better definition of the shape of the water table in the valley fill in the vicinity of Mud Lake. If the results confirm the present hypothesis, the next phase of the study should be directed toward determination of the pattern of ground-water flow in the valley fill toward the bedrock. Subject to the results of the second phase, the third and final phase of the investigation would be directed toward obtaining information on the direction, rate, and quantity of movement of ground water through the bedrock to the adjacent valleys.

The investigation should also include detailed studies of geology, structure, hydrology, hydraulics, and chemical quality of water. It is evident that this study would require substantial funds, experienced personnel and specialized equipment.

DESIGNATION OF WELLS

The wells in this report are designated by a single numbering system. The number assigned to the well is both an identification number and a location number. It is referenced to the Mount Diablo base line and meridian established by the General Land Office.

A typical number usually consists of three units. The first unit is the township north of the Mount Diablo base line. The second unit, a number separated by a slant line from the first, is the range east of the Mount Diablo meridian. The third unit, separated from the second by a dash, is the number of the section in the township. The section number is followed by one or two lower case letters, the first of which designates the quarter section, the second, the quarter-quarter section, and finally, a number designating the order in which the well was recorded in the smallest subdivision of the section. The letters a, b, c, and d designate, respectively, the northeast, northwest, southwest, and southeast quarters and quarter-quarters of the section.

For example, well number 4/44-8ba1 indicates the first well recorded in the northeast quarter of the northwest quarter of sec. 8, T. 4 N., R. 44 E.

Owing to limitation of space, wells on plate 1 and figure 4 are indentified only by the section number, quarter section and quarter-quarter section letters and serial number. The township in which the well is located can be ascertained by the township and range numbers shown at the margin of plate 1 and figure 4.

Wells listed in tables 9 and 10 are shown either on plate 1 or figure 4.

Table 9.--Records of selected wells in Ralston Valley.

2/44-8b1. Owner, not determined. Well dry at 264 feet.

2/45-21c1. Owner, Frank Arcularius. Drilled stock well; depth 325 feet, casing diameter 8 inches. Equipped with cylinder pump, windmill, and diesel engine.

3/44-16c1. Owner, Jack Cornell. Drilled stock well; depth 540 feet, casing diameter 5 3/4 inches. Depth to water below land surface, 480 feet May 18, 1947. Temperature of water reported as 72°F. Driller's log:

Material	Thickness (feet)	Depth (feet)
Soft gravel; no layers of different formation	540	540

3/44-35d1. Owners, formerly Warren C. and Donald B. Hunt. Drilled stock well; depth unknown, casing diameter 10 inches. Equipped with a cylinder pump and gas engine. Measuring point, top of casing, 0.1 foot below concrete floor, which is 0.2 foot above land surface. Depth to water below land surface; 377.9 feet, November 9, 1956; 379 ± feet, October 22, 1957; 377.43 feet, September 2, 1958; 384.15 feet, September 14, 1959; and 383.20 feet, December 1, 1960.

4/44-8ab1. Owner's well 10. Owner, Tonopah Municipal Water Company. Drilled public supply well; casing diameter 12 inches, depth 63 feet. Equipped with turbine, and 7.5 HP electric motor. Approximate pumping rate 150 gpm. Measuring point, bottom of pump base at 4-by 4-inch access hole in concrete base, about 2 feet above land surface. Depth to water, 13.7 feet below measuring point (pump off 2 minutes), June 18, 1962.

4/44-8ab2. Owner's well 11. Owner, Tonopah Municipal Water Company. Drilled public supply well; depth 80 feet, casing diameter 14 inches. Equipped with turbine, and 7.5 H.P. electric motor. Approximate pumping rate 200 gpm. Measuring point, bottom of pump base at 4-by 4-inch access hole in concrete base, about 2 feet above land surface. Depth to water below measuring point: 13.92 feet, May 12, 1948; 10.7 feet (pump off 3 days), June 18, 1962.

4/44-8ab3. Owner's well 12. Owner, Tonopah Municipal Water Company. Drilled public supply well; depth 60 feet, casing diameter 14 inches. Equipped with turbine and 7.5 H.P. electric motor. Approximate pumping rate 200 gpm.

4/44-8ba1. Owner's well 9. Owner, Tonopah Municipal Water Company. Drilled public supply well; depth 65 feet, casing diameter 14 inches. Equipped with turbine and 5 H.P. electric motor. Approximate pumping rate 150 gpm. Measuring point, bottom of pump base at 4-by 4-inch access hole in concrete base, about 2 feet above land surface. Depth to water below measuring point: 10.1 feet, May 12, 1948; 10.8 feet (pump off 5 minutes), June 18, 1962.

4/44-8cc1. Owner's well 7. Owner, Tonopah Municipal Water Company. Drilled public supply well, used for standby; depth about 38 feet, casing diameter 8 inches. Equipped with turbine and 3 H.P. electric motor. Measuring point, top of casing. Depth to water below measuring point 8.18 feet, May 12, 1948.

4/44-8cc2. Owner's well 8. Owner, Tonopah Municipal Water Company. Drilled public supply well used for standby; depth 38 feet, casing diameter 8 inches. Equipped with turbine and 3 H.P. electric motor. Approximate pumping rate 125 gpm.

4/44-18ad1. Owner's well 4. Owner, Tonopah Municipal Water Company. Drilled unused public supply well; depth 46 to 51 feet, casing diameter 12 inches.

4/44-18ad2. Owner's well 5. Owner, Tonopah Municipal Water Company. Drilled unused public supply well; depth 47 feet, casing diameter 12 inches. Equipped with turbine and 3 H.P. electric motor. Depth to water below measuring point 10.9 feet, May 12, 1948.

4/44-18ad3. Owner's well 6. Owner, Tonopah Municipal Water Company. Drilled unused public supply well; depth 47 (?) feet, casing diameter 12 inches.

4/44-18da1. Owner's well 3. Owner, Tonopah Municipal Water Company. Dug unused public supply well; depth 60 feet, diameter 5-by 6-foot shaft.

4/44-19aa1. Owner's well 1. Owner, Tonopah Municipal Water Company. Consists of an east-west line of ten 14-inch wells, spaced about 100 feet apart. Depth of wells about 55 feet. Initial depth to water about 8 feet below land surface.

4/44-19aa2. Owner's well 2. Owner, Tonopah Municipal Water Company. Dug unused public supply well; depth 45 feet, diameter 8-by 12-foot shaft. Pumped with a centrifugal pump, yielding about 9,000 gallons per hour until destroyed by flood in 1913.

5/44-7b1. Owner, Frank Arcularius. Dug stock well; depth unknown, diameter 4 by 4 feet. Equipped with piston pump and gasoline engine. Measuring point top of concrete and wood cribbing which is 1 foot above land surface. Depth to water below land surface, 70.83 feet, June 16, 1962.

5/44-10dl. Owner's Blair well. Owner, Lawrence Parman. Drilled stock well; depth about 80 feet, casing diameter 6 inches. Equipped with pump jack and gasoline engine. Reported depth to water, 80 feet.

5/44-32cl. Owner, not determined. Dug unused well; depth 18 feet. Measuring point, top of tie cribbing on south side of well which is at land surface.

Water levels, in feet, below land surface

	Water Level		Water Level		Water Level
May 12, 1948	12.17	Sept. 9, 1952	12.62	Aug. 30, 1956	12.54
March 30, 1949	12.50	Sept. 18, 1953	12.75	Oct. 22, 1957	12.47
March 24, 1950	12.40	March 16, 1954	12.19	Sept. 2, 1958	12.78
Sept. 19, 1950	12.75	Sept. 10, 1954	12.59	Sept. 14, 1959	12.65
March 12, 1951	12.34	March 3, 1955	11.98	Dec. 1, 1960	12.50
Sept. 11, 1951	12.85	Sept. 13, 1955	12.48	June 18, 1962	12.02
March 26, 1952	12.36	March 23, 1956	11.85		

6/43-22dl. Owner, Frank Arcularius. Drilled stock well; depth 320 feet, casing diameter 8 inches. Equipped with turbine pump. Approximate. depth to water below land surface, 227 feet, February 16, 1950. Temperature of water reported at 46°F. Driller's log:

Material	Thickness (feet)	Depth (feet)
Soil	12	12
Lava, soft, red	308	320
Total depth		320

6/44-14dl. Owner, Lawrence Parman. Drilled stock well; depth 260 feet, casing diameter 8 inches. Equipped with gear pump and gasoline engine. Depth to water below land surface, 192 feet, November 4, 1948. Temperature of water reported as 50°F. Driller's log:

Material	Thickness (feet)	Depth (feet)
Silt, white ash	30	30
Boulders	10	40
Sand, hard packed with boulders	60	100
Gravel, cemented	125	225
Sand, loose	5	230
Silt	25	255
Sand, loose	5	260
Total depth		260

7/44-36c1. Owner, Frank Arcularius. Drilled stock well; depth 240 feet, casing diameter 6 inches. Equipped with a pump jack and gasoline engine. Depth to water below land surface 182 feet October 20, 1948. Temperature of water reported as 50°F. Driller's log:

Material	Thickness (feet)	Depth (feet)
Silt, white ash	30	30
Ash, white, with boulders	70	100
Silt, white ash	90	190
Sand, loose	5	195
Silt	40	235
Sand, loose	5	240
Total depth		240

7/45-5d1. Owner, Lawrence Parman. Drilled stock well; depth about 250 feet. Equipped with pump jack and tractor power take off. Reported depth to water about 200 feet, June 18, 1962.

8/45-17d1 (projected). Owner, Frank Arcularius. Drilled stock well; depth 260 feet, casing diameter 14 inches. Equipped with turbine pump and tractor engine. Measuring point, top of 1-inch hole in pump base which is at land surface. Depth to water below land surface: 200 feet, September 28, 1949; 214.75 feet, June 18, 1962. Temperature of water reported as 52°F. Driller's log:

Material	Thickness (feet)	Depth (feet)
Sand	50	50
Sand, hard	155	205
Gravel	3	208
Sand, hard	12	220
Gravel	5	225
Sand, hard	15	240
Gravel	2	242
Sand, hard	16	258
Gravel	2	260
Total depth		260

Table 10.--Records of selected wells in Stonecabin Valley.

1/46-9cl. Owner, formerly John J. Casey. Drilled stock well; depth 184 feet, casing diameter 6 inches. Equipped with cylinder pump and windmill. Measuring point, top of pump pipe which is 4.7 feet above land surface. Depth to water below measuring point, 134.64 feet, May 22, 1956; 132.89 feet, June 19, 1962. Driller's log:

Material	Thickness (feet)	Depth (feet)
Sand, clay	31	31
Gravel, sand	31	62
Clay, hard	28	90
Sand, gravel	35	125
Clay, hard	11	136
Sand, fine	13	149
Clay	4	153
Sand, gravel	13	166
Gravel	18	184
Total depth		184

1/46-25cl. Owner, not determined. Drilled construction well; depth not determined, casing diameter 8 inches. Equipped with electric submersible pump. Measuring point, lower edge of 1 1/2 inch measuring pipe which is 3 feet above land surface. Depth to water below measuring point, 110.07 feet, June 19, 1962.

1/46-31dl. Owner, formerly John J. Casey. Drilled stock well; depth 117 feet; casing diameter 6 inches. Equipped with cylinder pump and windmill. Depth to water below land surface, 90 feet, May 22, 1956. Driller's log:

Material	Thickness (feet)	Depth (feet)
Clay, sand, gravel	14	14
Gravel, clean	103	117
Total depth		117

1/47-30al. Owner, formerly John J. Casey. Drilled stock well; depth not determined; casing diameter 14 inches. Equipped with cylinder pump and windmill. Measuring point, top of concrete curb which is 5 feet above land surface. Depth to water below measuring point, 107.1 feet, May 22, 1956.

2/46-15dl. Owner, Frank Arculárius.. Drilled stock well; depth 325 feet; casing diameter 8 inches. Equipped with gear drive cylinder pump and diesel engine.

2/47-34d1. Owner, formerly John J. Casey. Drilled abandoned well.

3/46-10c1. Owner, not determined. Dug and drilled stock well; depth of well not determined; casing diameter 8 inches. Equipped with cylinder pump and windmill. Measuring point, top of wood curbing which is at land surface. Depth to water below measuring point, 28.9 feet, June 20, 1962.

3/48-32b1. Owner, formerly John J. Casey. Drilled stock well; depth 150 feet; casing diameter 6 inches. Equipped with cylinder pump and windmill. Measuring point, top of lower edge of notch in casing which is 1 foot above land surface. Depth to water below measuring point 110.91 feet, June 20, 1962. Driller's log:

Material	Thickness (feet)	Depth (feet)
Clay - hardpan	25	25
Sand, coarse	50	75
Clay	40	115
Sand and gravel	35	150
Total depth		150

4/49-32d1. Owner, formerly John J. Casey. Drilled stock well; depth 380 feet; casing diameter 6 inches. Equipped with gear pump and gasoline engine. Depth to water below land surface, 325 feet, May 20, 1952. Temperature of water reported as 52°F. Driller's log:

Material	Thickness (feet)	Depth (feet)
Sand, yellow	135	135
Sand, dark yellow	115	250
Sand, light yellow	90	340
Gravel	10	350
Clay	10	360
Sand and gravel	20	380
Total depth		380

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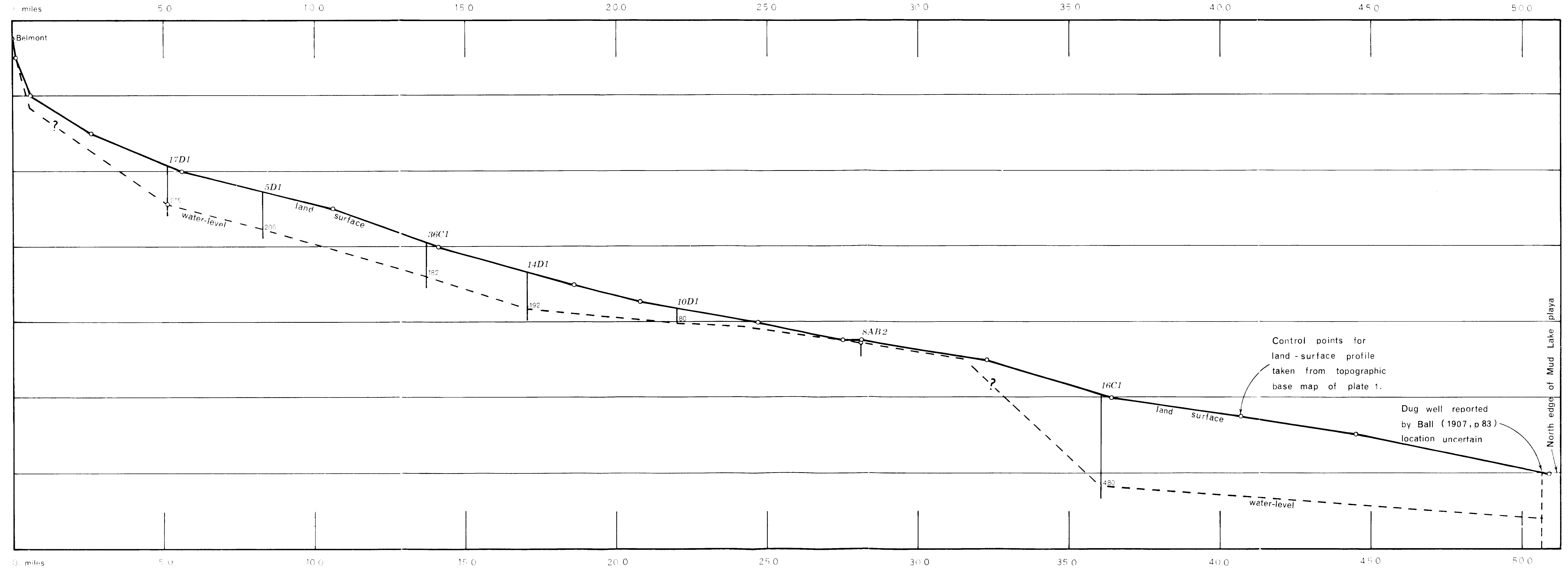

EXPLANATION

Circle in well indicates measured water-level; for other wells, water-levels are reported.

17D1 well and number

T. E. Eakin 1962

Figure 2. GENERALIZED PROFILE OF WATER LEVEL AND LAND SURFACE ALONG THE AXIS OF RALSTON VALLEY