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RECONNAISSANCE OF GROUND WATER IN PLAYAS VALLEY, HIDALGO COUNTY, NEW MEXICO

By

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United States Geological Survey

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OF
GROUND WATER IN PLAYAS VALLEY, HIDALGO COUNTY, NEW MEXICO

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ABSTRACT

Playas Valley is a north-trending intermontane valley in the Basin and Range province of southwestern New Mexico. A reconnaissance investigation of the area was made by the U. S. Geological Survey in cooperation with the State Engineer of New Mexico to determine the availability of water throughout the valley. The area investigated is 925 square miles in southern Hidalgo County, comprising Tps. 26-34 S., Rs. 16-18 W. It includes the Playas Valley Underground Water Basin, 515 square miles in extent.

The rolling plain of the valley floor is bordered by the Big and Little Hatchet Mountains on the east and the Animas and Pyramid Mountains on the west. An inconspicuous alluvial divide extends across the valley from Gillespie Mountain on the west to a point just north of Hatchet Gap on the east and separates upper (southern) from lower (northern) Playas Valley. Surface runoff in upper Playas Valley collects along the east side of the valley in an almost flat area that drains northward to Hatchet Gap, then eastward into Hachita Valley; lower Playas Valley drains toward ephemeral Playas Lake about 2 miles south of a line of the Southern Pacific Co. and is a closed basin topographically.

Until recently, the arid to semiarid climate has discouraged farming. In 1948, however, successful irrigation with ground water began in secs. 16 and 21, T. 30 S., R. 16 W. In late 1955 and early 1956, a series of test holes and two irrigation wells were drilled on the U-Bar Ranch property in the southern part of upper Playas Valley to provide data for an evaluation of the ground-water resources. Conversion of 20 to 35 sections of the U-Bar Ranch property into irrigated farmland was contemplated. The area was surveyed and some of the land was sold or placed under purchase option. The Playas Valley Underground Water Basin was declared on February 23, 1956, by order of the State Engineer of New Mexico. Protest hearings, arising from applications to appropriate ground water in the valley, virtually halted further development in 1956. The protests were withdrawn in February 1957 and development of additional lands probably will be resumed.

Playas Valley is a sediment-filled trough created by block faulting. Much of the valley fill, which is composed of detritus of unknown thickness accumulated from the erosion of the surrounding highlands, is saturated with ground water. The water table lies about 200 feet below the land surface at the southern end of the valley and only a few feet below the surface near Playas Lake. From near the Mexican border to the vicinity of Hatchet Gap, the water table slopes at a gradient of about 7 feet per mile. The gradient flattens near Playas Lake. Wells yield water under artesian pressure in parts of the valley, and flowing wells have been drilled along the west side of Playas Lake and at Las Cienegas.

Recharge to the body of ground water in Playas Valley is derived from precipitation on the valley and its drainage area. Recharge is only a small percentage of the total precipitation because of losses by evapotranspiration and runoff and because of the relatively small area of intake.

Part of the ground water is discharged by seeps and springs along the west side of Playas Lake. Phreatophytes along the west side of the lake also remove ground water. Additional water may leave the valley through Hatchet Gap, the gap between the Animas and Pyramid Mountains, and the gap between the Coyote Hills and Pyramid Mountains.

The water in Playas Valley is generally suitable in chemical quality for stock and domestic use and for irrigation, although boron in the northern lake area may be injurious to crops most sensitive to boron. In 8 of 12 samples the concentration of fluoride was greater than the recommended maximum in water for domestic use. Most of the samples analyzed are classed as sodium bicarbonate water.

Irrigation wells in Tps. 30, 31, and 32 S., R. 16 W., discharge the greatest amounts of ground water of any wells in the valley. Water levels in irrigation wells near Hatchet Gap have declined about 2 feet per year since pumping began in 1948. Water levels in some stock and domestic wells declined 7 to 8 feet from 1913 to 1956. Apparently, annual pumpage from the main body of ground water in the valley exceeds annual recharge; and, as the natural discharge probably has not decreased, the ground water is at present pumped from storage. Maximum long-term utilization of the supply will require proper spacing of wells and other conservative practices.

INTRODUCTION

Playas Valley is in southeastern Hidalgo County in the southwest corner of New Mexico. The arid north-trending intermontane valley is about 50 miles long and averages 12 miles wide. The area investigated includes most of this valley and all of the Playas Valley Underground Basin (pl. 1 and fig. 1). The center of the valley is about 60 miles southwest of Deming, N. Mex., and about 45 miles south-southeast of Lordsburg, N. Mex., the county seat of Hidalgo County. Access to the area is by State Highways 9 and 81, and by a line of the Southern Pacific Co. which crosses the northern part of the valley.

The principal use of land in the area has been for grazing, although some gardens have been cultivated and, since 1948, an appreciable amount of irrigation has been developed in upper (southern) Playas Valley. Recent interest in the possibility of irrigation in the valley culminated in the subdivision of a part of the U-Bar Ranch into farm tracts. The State Engineer of New Mexico declared the Playas Valley Underground Water Basin on February 23, 1956, for the protection of water rights and the regulation of the use of ground water in accordance with State law.

Acknowledgments and Previous Investigations

Many logs, locations and elevations of wells, and other miscellaneous data were provided by Mr. L. T. Putnam and the staff of the State Engineer Office in Deming; their assistance in the collection of data is gratefully acknowledged. The helpful information provided by residents of the valley, the technical data supplied by Mr. George Witte, engineer for the U-Bar Ranch, and Mr. Kenneth Reim, geologist for the Diamond A Ranch, are greatly appreciated. Mr. R. T. Zeller, associate geologist, New Mexico Bureau of Mines and Mineral Resources, supplied information on the areal geology. Mr. J. R. Willett, formerly of the Geological Survey, assembled a part of the field data from March 1953 to December 1954.

Previous investigations in the area are notably those of Schwennesen (1918), Lasky (1947), Lindgren, Graton, and Gordon (1910), and Darton (1928, 1933). The work of Schwennesen included a comprehensive areal report on the ground-water resources of the Animas, Playas, Hachita, and San Luis basins in southern Hidalgo County. Darton briefly described the structure and rocks of the mountains adjacent to Playas Valley. Lasky reported on the mineral deposits of the area, as did Lindgren, Graton, and Gordon.

Purpose and Scope of the Investigation

This investigation was made to determine the availability of water throughout the Playas Valley. As development of ground water continues, it will be of increasing importance to the residents of the valley, and to the State Engineer Office, to have available records of the changes in water level in the reservoir upon which to base future decisions concerning use and development of ground water in the valley. Furthermore, quantitative studies will be required to evaluate the effects of pumping upon the water supply.

This report evaluates information obtained from a program of periodic measurement of water levels in selected observation wells established in 1948, and information obtained from several visits to the area by the writer in the fall and winter of 1955 and the spring and summer of 1956. Water levels were measured, wherever possible, in wells in the lower part of the valley. Information on file concerning wells in the upper part of the valley and in the mountains adjacent to the valley was incorporated in the well tables, but not all of these wells were visited during the investigation.

The valley floor and the lower slopes of the alluvial fans bordering the valley floor were studied in detail. This part of the valley is approximately the area included in the Playas Valley Underground Water Basin. Elevations of wells were established by spirit level in the vicinities of Hatchet Gap and Playas Lake and at several wells north of the area included in topographic maps by personnel of the State Engineer Office at Deming.

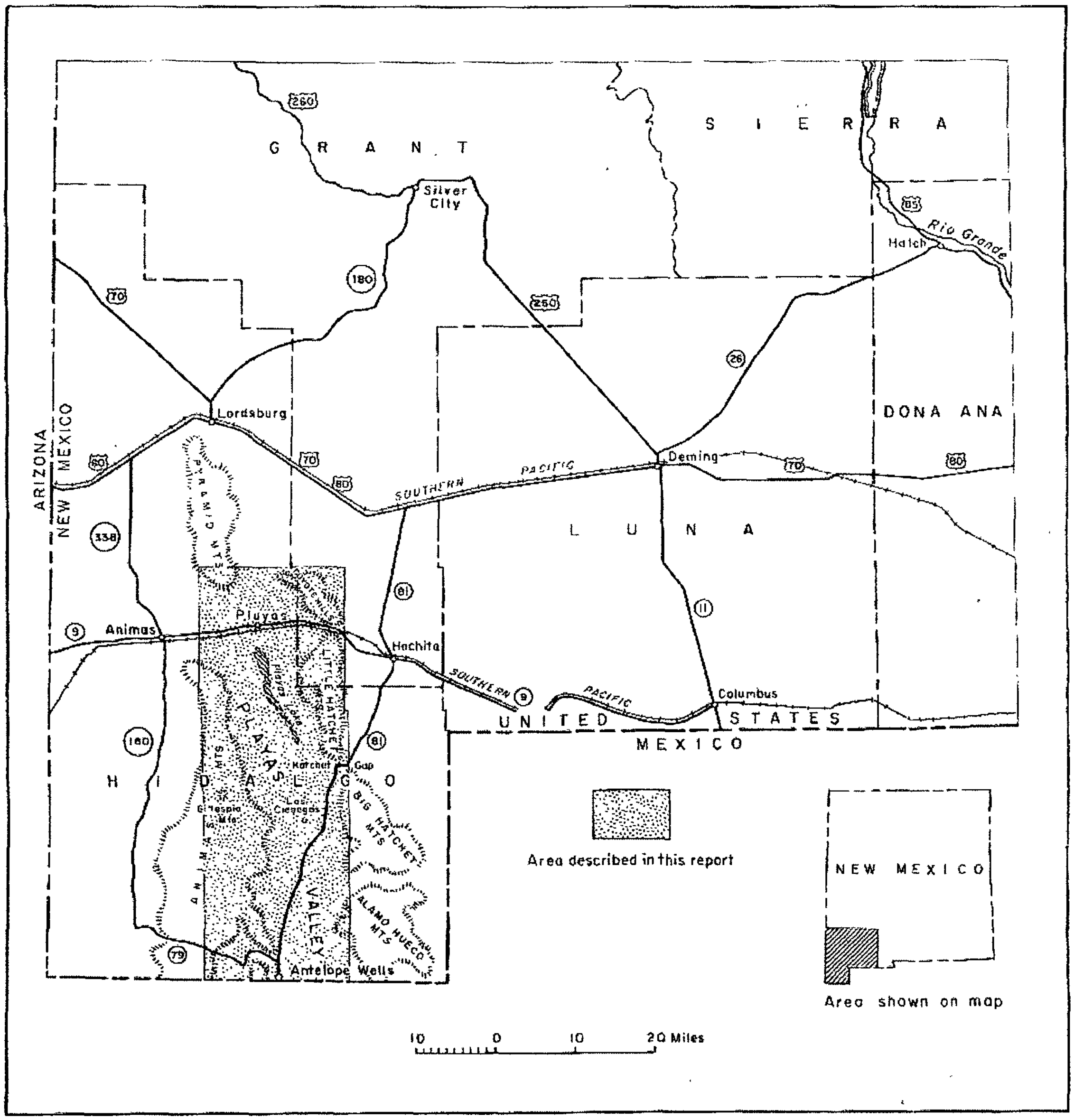

FIGURE 1. Map showing location of Playas Valley in New Mexico.

The investigation was made under the direct supervision of E. D. Gordon and the general direction of C. S. Conover, formerly District Engineer, Albuquerque, N. Mex., and A. N. Sayre, formerly Chief of the Ground Water Branch of the Geological Survey.

Well-Numbering System

The system of numbering wells used herein is based on the common subdivision of public lands into sections. By means of it the well number, in addition to designating the well, locates its position to the nearest 10-acre tract in the land net. Figure 2 illustrates the method of numbering the tracts within a section. The number is divided by periods into four segments. The first segment denotes the township north or south of the New Mexico base line; the second denotes the range east or west of the New Mexico principal meridian; and the third denotes the section. In a county such as Hidalgo, which lies entirely within one quadrant of the principal meridian and base line, the direction north or south of the base line or east or west of the meridian is not given. Hidalgo County lies entirely in the southwest quadrant. The fourth segment of the number, which consists of three digits, denotes the particular

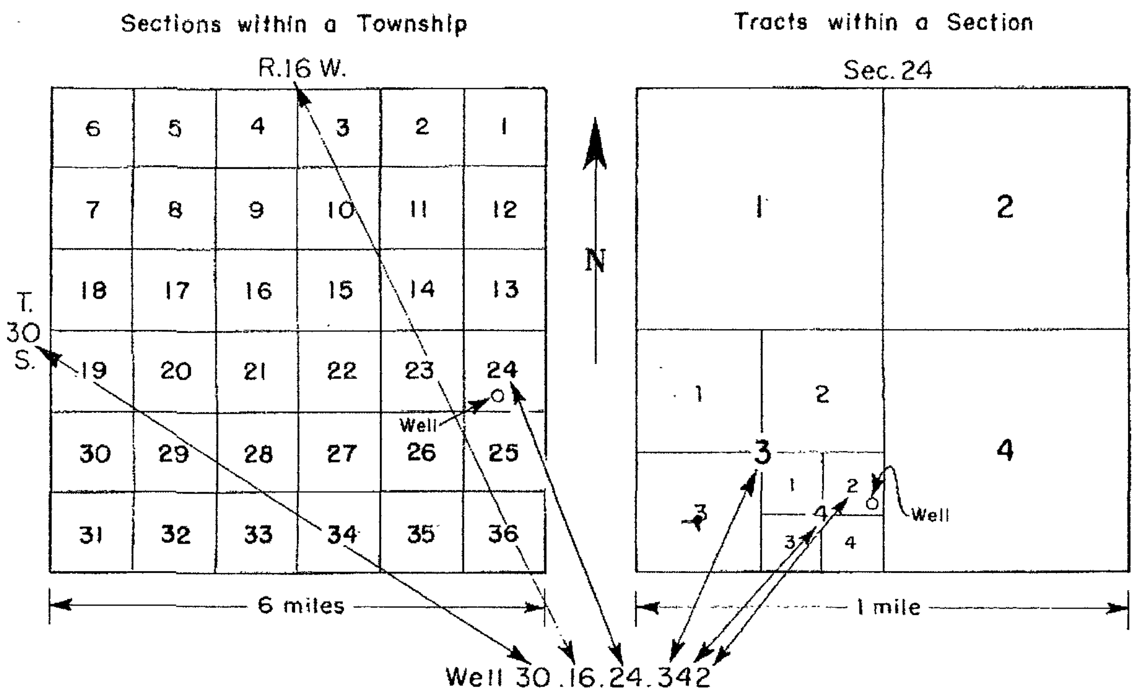

FIGURE 2. System of numbering wells in New Mexico.

10-acre tract in which the well is situated. For this purpose the section is divided into four quarters, numbered 1, 2, 3, and 4, for the northwest, northeast, southwest, and southeast quarters, respectively. The first digit of the fourth segment gives the quarter section, which is usually a tract of 160 acres. The quarter section is divided similarly into four 40-acre tracts numbered in the same manner, and the second digit denotes the 40-acre tract. Finally, the 40-acre tract is divided into four 10-acre tracts, and the third digit denotes the 10-acre tract. Thus, well 30.16.24.342 in Hidalgo County is in the NE¼SE¼SW¼ sec. 24, T. 30 S., R. 16 W. If a well cannot be located accurately within a 10-acre tract, a zero is used as the third digit, and if it cannot be located accurately within a 40-acre tract, zeros are used for both the second and third digits. If the well cannot be located more closely than the section, the fourth segment of the well number is omitted. When it becomes possible to locate more accurately a well in whose number zeros have been used, the proper digits are substituted for the zeros. Letters (a, b, c, etc.) are added to the last segment to designate the second, third, fourth, and succeeding wells listed in the same 10-acre tract.

GEOGRAPHY

Location and Extent of the Area

The area investigated includes about 925 square miles within Tps. 26-34 S., Rs. 16-18 W., of southern Hidalgo County, in southwestern New Mexico (fig 1.). The area of the declared ground-water basin, about 515 square miles, is included in the approximately 600-square-mile lowland part of the valley. The lowland valley and its area of drainage includes about 940 square miles, and extends south of Antelope Wells into Mexico for about 2 miles. The Mexican settlement across the international border from Antelope Wells has the greatest concentration of population in the valley at the present time. For convenience, wells, ranches, and easily identified physiographic features are generally referred to in locating points in the valley. Playas, on a line of the Southern Pacific Co. between Animas and Hachita in the lower Playas Valley, and Hatchet Gap, between the Big and Little Hatchet Mountains on the east side of the valley, are two such points. Playas is about 17 miles west of Hachita and 11 miles east of Animas. By road, Hatchet Gap is about 17 miles southwest of Hachita, 75 miles southwest of Deming, and about 65 miles southeast of Lordsburg. Topographic maps of the Playas Valley as far north as T. 26 S. are available.

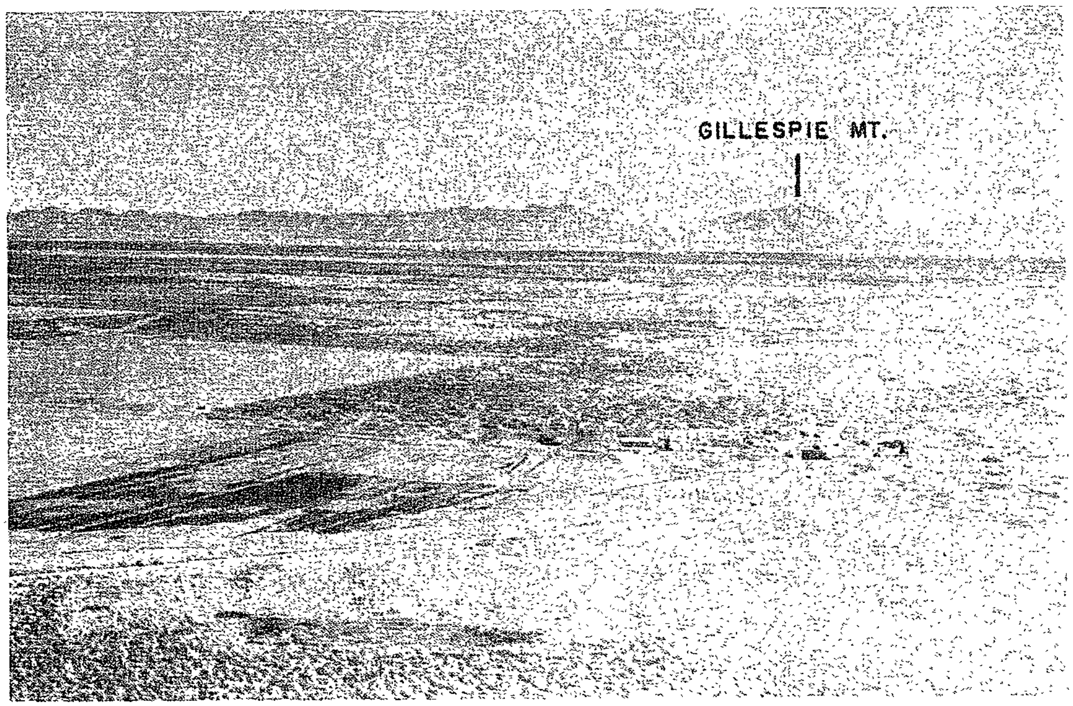

FIGURE 3. View westward across Playas Valley, from Hatchet Gap, N. Mex. Animas Mountains are in background; farm land of Everhart Ranch is in foreground.

Topography and Drainage

Playas Valley, typical of intermontane valleys in the Basin and Range province, lies between two north-trending chains of mountains—the Animas and Pyramid Mountains on the west and the Big and Little Hatchet Mountains on the east. The Animas Valley lies immediately west of the Animas Mountains and Hachita Valley lies immediately east of the Big and Little Hatchet Mountains (fig. 1). Low divides formed by alluvial fans adjacent to smaller mountains and hills close the north and south ends of Playas Valley between these two mountain chains. A low alluvial divide extending from Gillespie Mountain to a point just north of Hatchet Gap separates the Playas Valley into an upper (southern) and a lower (northern) drainage basin (fig. 3). The intermontane valley is a gently rolling plain flanked by fans and alluvial slopes extending from the surrounding mountains. In general, the fans along the west side of the valley are larger and gentler in slope than the fans along the east side. The alluvial fans in the lower valley extend to the edge of Playas Lake along the length of the lake.

Big Hatchet Peak, 8,366 feet above sea level, is the highest mountain in the area; its summit is about 4,090 feet above the bed of Playas Lake, the lowest point in the area (altitude 4,276 feet). The altitude of the valley is about 4,650 feet near the Mexican border, about 4,300 feet at Hatchet Gap. The valley floor slopes steadily downward to the north from the Mexican border to the vicinity of Walnut Wells (altitude 4,450 feet), then less steeply downward to Hatchet Gap. North of the inconspicuous alluvial divide separating the upper and lower valleys, the valley floor slopes gently toward Playas Lake. The flat valley floor is widest (about 3½ miles) just west of Hatchet Gap and near Walnut Wells. The divide separating the upper and lower valleys appears to be a continuation of the alluvial fan from Gillespie Mountain, which extends across the valley to the fan north and west of Hatchet Gap. The principal low points in the highlands surrounding the valley are Hatchet Gap (altitude 4,300 feet) between the Big and Little Hatchet Mountains, the gap (altitude 4,500 feet) separating the Animas and Pyramid Mountains west of Playas, and the gap (altitude 4,675 feet) separating the Little Hatchet Mountains and the Coyote Hills east of Playas. State Highway 81 enters the valley through Hatchet Gap; State Highway 9 and the Southern Pacific Co. railroad pass through the gaps east and west of Playas.

Drainage in upper Playas Valley is toward Hatchet Gap. Surface water from the Whitewater Mountains and the southern part of the Animas Mountains collects in several washes which enter the western side of the upper valley in Tps. 32, 33, and 34 S. These washes drain southeastward through the Animas Mountains until their channels cross the higher slopes of the alluvial fans. From these slopes the washes drain east-

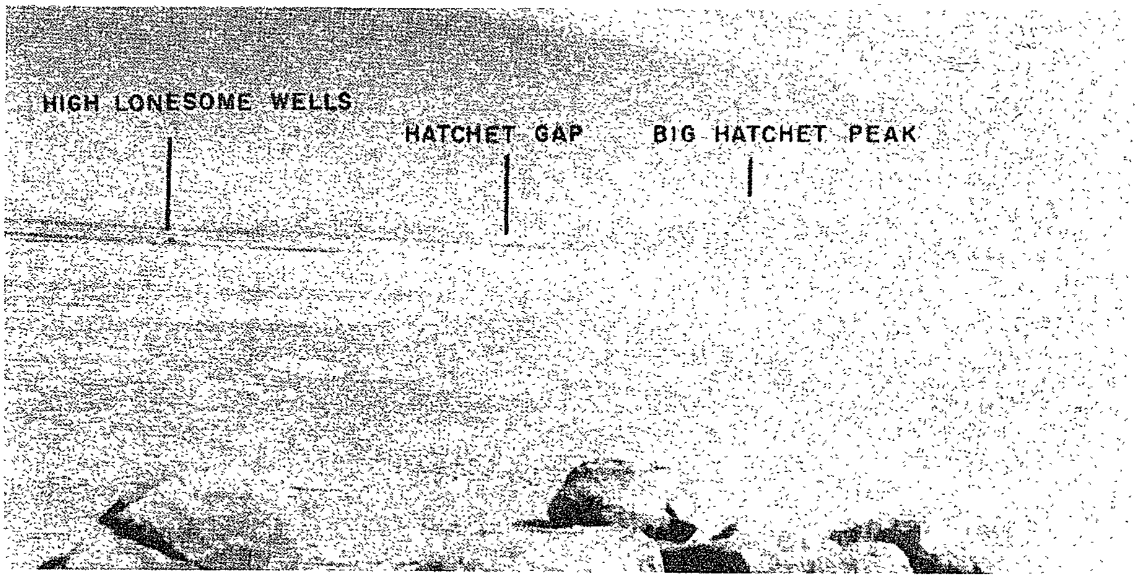

FIGURE 4. View northward from NW¼NW¼NE¼ sec. 4, T. 34 S., R. 17 W., of central valley plain of upper Playas Valley in New Mexico. Little and Big Hatchet Mountains are to east.

ward and northward. Sheet flow predominates as the channels become less distinct near the valley floor. Drainage from the southwestern part of the valley crosses the valley axis near Las Cienegas as sheet flow and joins the northward drainage from the Alamo Hueco and Big Hatchet Mountains along the east side of the valley. Drainage along the east side of the valley follows a shallow, indistinct course northward to Hatchet Gap, through which water flows during times of exceptionally heavy precipitation. The stream channels of the mountain canyons become indistinct along the fan slopes; drainage on the valley floor follows no clearly cut channel but occurs as sheet flow up to, and sometimes through, Hatchet Gap (fig. 4).

Drainage in lower Playas Valley is toward Playas Lake (fig. 5). Axial stream channels open into the north and south ends of the flat playa-lake bed. These channels are short, steep-walled gullies that rapidly decrease in depth away from the lake. Steep-walled gullies also enter the lake on the west side near the Thompson and Whitmire flowing wells, but most of the drainage channels entering the lake are continuations of the shallow channels along the lower surfaces of the fan slopes. Water entering the lake remains there until it evaporates. The length of time during which water stands on the playa is dependent upon the amount of precipitation; during most of the period of this investigation, the lake bed was dry. The bed is a mixture of clay and silt which, when dry, is dark brown, mottled in places by the chemical residues from the evaporated water, and cracked in polygonal patterns to a depth of about 6 inches. The lake bed is nearly flat throughout its length but rises a few inches to a foot where deposits from distributary channels have built small deltas. A hole 12 feet deep was augered at the NE cor. sec. 5, T. 28 S., R. 17 W., and penetrated only clay. Water stood in the hole at about 4 feet beneath the surface of the lake. Springs and seeps discharge along the west side of the lake near several wells that tap water under artesian pressure. Saltcedars grow along the west side of the southern part of the lake and cottonwoods grow along the west bank between the Whitmire and Thompson wells.

A pronounced topographic rise, or bluff, a few yards from the lake bed, surrounds most of the lake area. This bluff is best seen near the Tubbs and Whitmire wells, where it is about 10 feet high. Above the bluff, the gentle slopes of the alluvial fans begin. Dune sand crops out in patches along the east side of Playas Lake. Schwennesen (1918) interpreted the bluffs and sand dunes bordering Playas Lake to be remnants of features associated with an ancient, much larger lake.

Climate

Playas Valley is an arid to semiarid intermontane basin which receives an average precipitation of about 10 inches per year. In recent years, however, the precipitation has been several inches below average. The average annual precipitation reported by the weather station at Hachita, 17 miles east of the axis of Playas Valley, is 10.41 inches and this probably is representative of the precipitation received in the

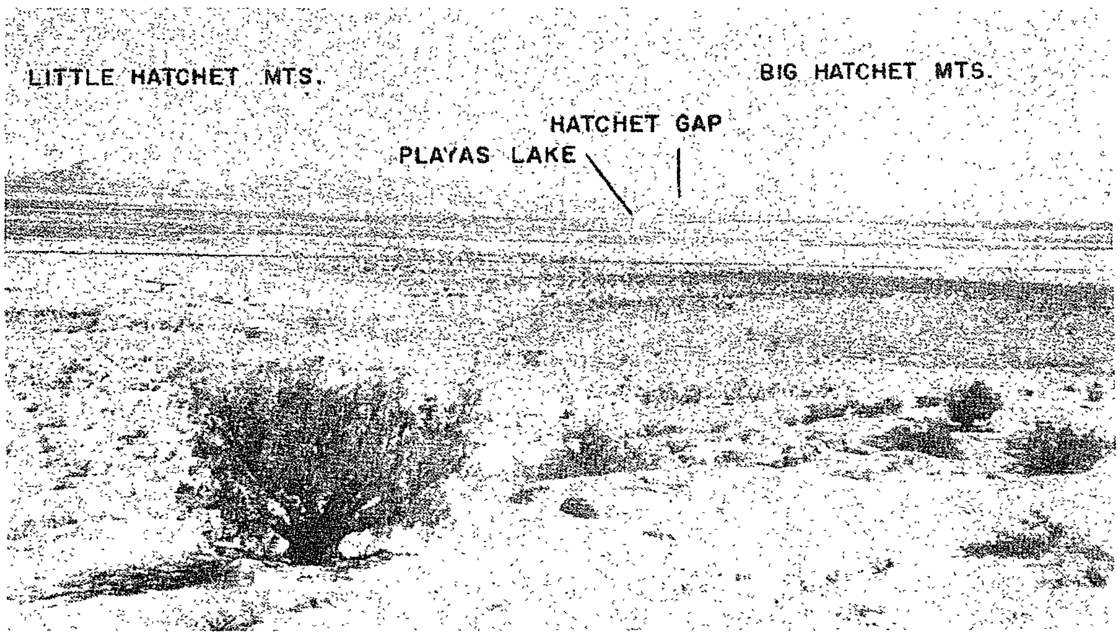

FIGURE 5. View southeastward from NW1/4 sec. 15, T. 27 S., R. 18 W., of lower Playas Valley in New Mexico.

valley. A graph of precipitation at Hachita (fig. 6) shows the distribution by months for the period 1948-55, inclusive. Annual precipitation totals and departures from the long-term average are listed in the table below. No total precipitation for the years 1949 and 1950 is included because some monthly records were not obtainable, but the long-term average for these months was included as an estimate in the construction of the bar graph (fig. 6). In the 6-year period 1951 through 1956 a total deficiency in precipitation of 16.76 inches was recorded, indicating an average annual deficiency of 2.79 inches for the period, or about 27 percent of the 10.41-inch average. The mountains adjacent to the valley probably receive 1 to 5 inches more precipitation per year than the valley floor. As indicated by figure 6, precipitation usually is greatest during July, August, and September, when intense thundershowers of relatively short duration are common.

Records of the U. S. Weather Bureau show that the average annual temperature at Hachita is about 60°F. The lowest temperature of record is −6°F (January 29, 1948) and the highest is 108°F (June 28, 1930). The growing season normally extends from early April through October; the average date for the last killing frost is April 9, and the average date for the first killing frost is November 7. Humidity is generally low in the valley; evaporativity, estimated from records at Florida pan-evaporation station about 80 miles east, is approximately 100 inches a year. High winds are common in the spring.

Precipitation and estimated irrigated acreage and pumpage in Playas Valley, Hidalgo County, N. Mex.

Year	Precipitation at Hachita, N. Mex.		Acres irrigated	Pumpage (acre-feet)
	Precipitation (inches)	Departure (inches)*		
1948	10.55	+0.14	300	600
1949	—	—	1,000	1,600
1950	—	—	1,250	2,400
1951	8.88	−1.53	1,300	2,600
1952	e 8.37	−2.04	1,300	2,500
1953	8.34	−2.07	1,350	2,900
1954	10.34	− .07	900	1,500
1955	6.37	−4.04	1,270	2,200
1956	3.40	−7.01	1,590	2,900

e Estimated;
* Departure from normal plus (+), when above normal; minus (−), when below normal.

Culture

Exploitation of mineral resources in the Little Hatchet Mountains brought many people to Hachita near the turn of the century, but Playas Valley seems to have been bypassed by the miners. Early settlement in the Playas Valley is recorded by a number of

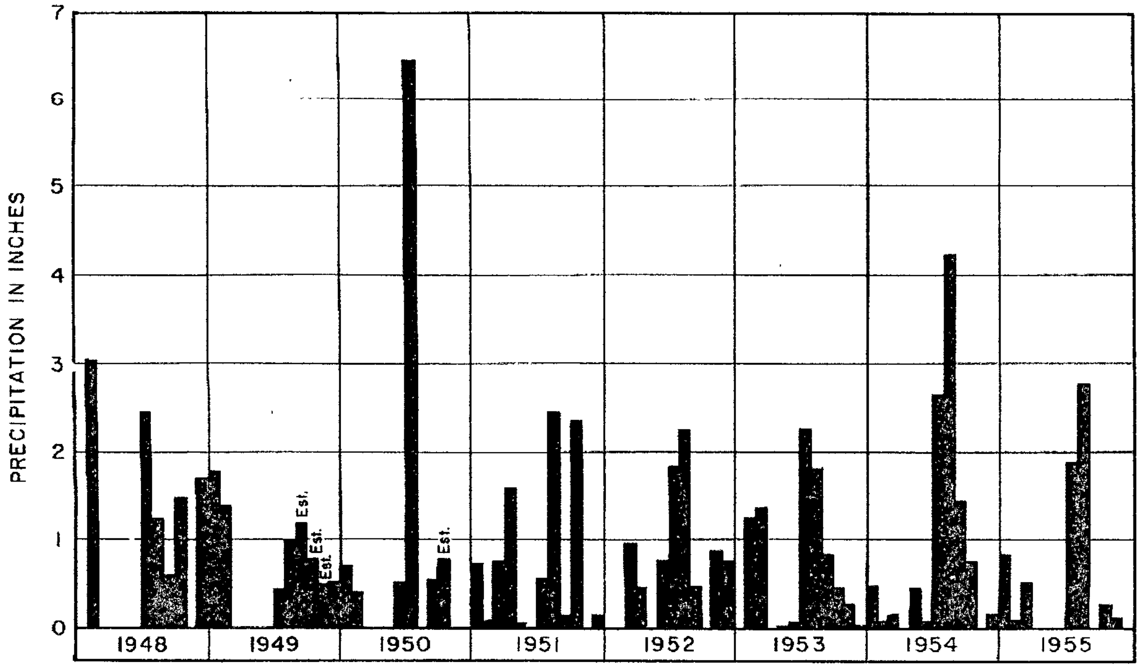

FIGURE 6. Graph of precipitation at Hachita, Grant County, N. Mex.

writers; in 1913 several families had settled in the vicinity of Pothook and Playas, on a rail line of the Southern Pacific Co., and also west of Hatchet Gap, according to Schwennesen (1918). Early settlers in the valley became ranchers. Feed crops were raised and some garden plots were cultivated. From the early part of the century until 1948 no significant farming operations developed, and the land was used principally for grazing. Farming began in 1948 west of Hatchet Gap in secs. 16 and 21, T. 30 S., R. 16 W. Wells for irrigation were drilled, and the acreage under cultivation has increased since that time. Electricity is supplied to the valley by the Columbus Electric Cooperative, and several irrigation pumps are driven by electric motors. A transmission line of the El Paso Natural Gas Co. crosses the lower valley about $3\frac{1}{2}$ miles north of Playas, but no service spur line to the irrigated area near Hatchet Gap has been constructed. Some irrigation-pump engines in the valley are powered by liquefied petroleum gas.

The population of the valley in recent years probably has not exceeded 150. The nearest school is at Hachita, about 20 miles from the irrigated area. Hachita is also the most convenient railway shipping point for the irrigated area of the valley and the nearest source of supply for foodstuff and general merchandise.

In 1955 the U-Bar Ranch was purchased by persons who believed that the area included in and adjoining T. 32 S., R. 16 W., could be successfully developed into irrigated farms. An exploratory program of drilling for water in quantities adequate for irrigation was begun—test irrigation wells 31.16.28.333 (fig. 7) and 32.16.32.333 were drilled and equipped with turbine pumps, about 35 sections of land were surveyed, and about 20 sections sold or optioned. The State Engineer declared the Playas Valley Underground Water Basin on February 23, 1956. Most of the applications for appropriation of underground water were protested, and the resulting protest hearings before the State Engineer in the spring of 1956 prevented further development of ground water until the protests were resolved. The protests filed by the Diamond A Ranch were withdrawn in February 1957, and development of irrigated lands probably will be resumed.

GEOLOGY

Stratigraphy

Rocks of Precambrian to Recent age are exposed in the mountains bordering Playas Valley and have been described by several geologists. Schwennesen (1918) mentioned the general types of rocks exposed in the area, Darton (1928, 1933) described briefly the rocks and general structure of the mountain ranges bordering

Playas Valley, and Lasky (1947) described in detail the geology of the Little Hatchet Mountains. Several aspects of the geology of the area are presented in the Fourth Field Conference Guidebook of the New Mexico Geological Society (Kottlowski, 1953).

Rocks of Paleozoic age are exposed in the Big Hatchet Mountains and in the northern tip of the Animas Mountains. Sandstone and limestone of Cambrian to Silurian age and shale of Devonian age crop out in the northern end of the Big Hatchet Mountains, just south of Hatchet Gap (Darton, 1928, p. 9-15). Limestone with some interbedded shale, of Carboniferous age, crops out in the central and southern parts of the Big Hatchet Mountains and at the north end of the Animas Mountains.

Rocks of Mesozoic age are exposed in the Little Hatchet Mountains, in the west-central Animas Mountains, in the Coyote Hills, and in the hills between the Big Hatchet Mountains and the Alamo Hueco Mountains. They are mostly sandstone but include some limestone, shale, and rocks of volcanic origin. Lasky (1947, p. 1) assigns these strata to the Lower Cretaceous, which in the Little Hatchet Mountains includes a section 17,000 to 21,000 feet thick. The sedimentary rocks in this section are the last marine sequence of consequence; they are overlain by a complicated series of igneous intrusives and extrusives.

Late Cretaceous or early Tertiary igneous intrusive rocks crop out in the Little Hatchet Mountains. Tertiary flows and pyroclastic rocks once extended over most of the area and, in places, were a thousand feet or more thick. Faulting has exposed underlying older rocks in many places in the mountains, but the extrusive-rock cover has been removed by erosion only in the higher parts of the mountains.

Quaternary rocks consist of basalt flows and valley fill. The basalt flows are much less in evidence in Playas Valley than in Animas Valley where several square miles west of Animas are covered by basalt flows. The basalt is probably Pleistocene in age (Lasky, 1947, p. 37). The valley fill is probably the product of more than one sequence of erosion (Lasky, 1947, p. 37, 38) and may range in age from Pliocene to Recent. The material filling the valley was eroded from the adjacent highlands and consists of gravel, sand, silt, clay, and mixtures thereof, in lenses and interstratified beds. Most of the valley fill has been derived from igneous rocks. Its thickness ranges from zero along the contact of the mountain bedrock and the alluvial slope to more than a thousand feet in the valley floor. Probably no wells have penetrated the full thickness of detritus on the valley floor. The 904-foot Stout Brothers well (32.16.14.324) penetrated several layers of hard rock, according to the driller's log, but these layers are probably beds of indurated valley fill rather than bedrock. Wells 31.16.28.333, 32.16.32.333, and 33.17.13.311 were drilled respectively 914 feet, 1,000 feet, and 998 feet deep in the valley fill. On the alluvial slopes about a quarter of a mile west of the Ringbone well, an oil-test well is reported to have penetrated limestone bedrock only a few feet beneath the surface, and a stock well drilled about 3 miles east of Young's ranch in sec. 5, T. 31 S., R. 17 W. is reported to have penetrated bedrock at a depth of about 60 feet.

FIGURE 7. U-Bar Ranch irrigation well (31.16.28.333) in upper Playas Valley in New Mexico. Big Hatchet Peak is in background.

Geologic History

An exhaustive geologic history of the area, derived from the full sequence of rocks exposed in the mountains bordering Playas Valley, is beyond the scope of this report and unnecessary to an understanding of the ground-water resources of the valley. The ground water is in permeable beds of the valley fill, and an understanding of the general structure and mode of formation of the valley fill is more germane to the problem than a detailed description of the rocks that border the valley. The following statements concerning the geologic history of Playas Valley are inferred from the history of the Little Hatchet Mountains presented by Lasky (1947, p. 51-53).

After Late Cretaceous or Early Tertiary folding and faulting, igneous intrusion emplaced dikes and sills, and was followed by igneous extrusion that covered the area with a blanket of flows and pyroclastic rocks several hundred feet thick. Extrusion continued, perhaps through Tertiary (Miocene?) time, and was followed by another period of deformation, which was characterized principally by faulting. As the igneous activity began to die out, some movement began along old faults and other planes of weakness. Probably by late Pliocene or early Pleistocene time the major basin faulting was completed, and the igneous activity ceased after the expulsion of the youngest basalt flows. Sedimentary debris eroded from the bordering uplifted masses began to fill the trough created by the downdropping of the central fault block, and subsequent erosion of the highlands carved the present topography. Movement along the faults has probably continued into Recent time.

Geologic Structure

Except in the instance of the Little Hatchet Mountains, the detailed structure of the mountain ranges bordering Playas Valley is not known. In general, the structural relations within the mountain ranges are of less interest, insofar as movement of ground water is concerned, than the structure of the basin. Playas Valley is underlain by a tilted, downdropped block bordered by relatively uplifted fault-block mountains. These basin faults are alined with the scarp faces of the bordering mountains, which trend north-south and may represent either a continuous fault along the whole mountain front or a series of alined shorter faults. Whether the basin faulting began at the same time as the Cretaceous and Tertiary faulting in the Little Hatchet Mountains is not known. From the discontinuity of the Tertiary flows, it must be assumed that at least some movement occurred along the major faults in Quaternary time. The movement probably continued into Recent time and rejuvenated the drainage on the fan and mountain slopes (Lasky, 1947, p. 53). The greatest movement uplifted the Hatchet Mountains, in which Precambrian rocks are exposed. The Animas, Pyramid, and Alamo Hueco Mountains were uplifted less because, insofar as is known, only upper Paleozoic or younger rocks are exposed in these mountains. It is believed that the bedrock structure has little effect on the movement of ground water in the valley fill. Contours on the water table (pl. 1) do not indicate any detectable influence on movement of ground water by folding or faulting.

Bolson Deposition

The processes of bolson deposition that produced the valley fill in Playas Valley are active in the area today. It seems likely that these same processes will eventually cause the filling of Playas Lake and the development of external drainage from the lower valley through Hatchet Gap, unless future faulting alters the drainage system. Bolson deposition, stated simply, is the accumulation of erosional debris from adjacent mountains in a closed valley or lowland. Wind and weather erode the rocks of the hills and mountains and the resulting particles are transported by gravity, water, and wind to the valley floor. Sheet and stream flood are probably the most effective agents of such deposition. Bolson deposition is characterized by variations in particle size, and rounding and sorting produced by repeated transport and deposition of the material.

The materials in transport from the mountains to the valley floor form the slopes of the alluvial fans that flank the valley. Formation of a slope begins with deposition of talus material at the mouths of canyons opening into the valley. These fan-shaped deposits increase in size outward toward the valley floor, upward toward the source in the mountains, and laterally toward the adjacent fans. Eventually, the fans coalesce to form continuous alluvial aprons sloping away from the mountains. Leaching and redeposition of carbonate minerals produce a calichelike conglomerate along the fan slopes, streams wash clay into the playa lakes and low places, and the wind blows sand and finer particles into dunes along the lake shores and on the fan slopes.

Stream-laid deposits underlie the slopes bordering the valley. Although no streams in the area flow perennially, the ephemeral streams may carry considerable loads of sediments after heavy precipitation. The nature of these loads and the distances they are carried depend upon the quantity of water in the stream, the steepness of the gradient, the shape of the stream channel, and the shape, size, and weight of the particles transported. Ephemeral streams cut and abandon channels, form bars and cutbanks, and, in general, perform the usual functions of stream deposition and erosion. However, their active life is short in comparison with that of perennial streams and much more violent as the result of their direct dependence upon precipitation. The wind carries particles from the beds of dry streams and lakes, and from recently plowed fields, until its velocity is decreased by an obstruction such as a clump of mesquite. When the velocity is decreased, the particles in transport are dropped and a mound of the material is formed. Examples of wind-laid deposits in the Playas Valley are the sand dunes among the mesquite clumps northwest of Hatchet Gap and the dunes along the east side of Playas Lake.

The finest particles carried by the ephemeral streams accumulate in the playa lakes which are common in the closed basins of the Basin and Range province. Water from the streams collects and evaporates in the playas, leaving a sheet of silt and clay that contains not only the particles carried in suspension by the water but the dissolved minerals as well. The playa lake beds typically are stained by the deposited minerals and by products of the reaction of mineral and vegetal matter.

An examination of the drillers' logs of wells (table 1) in the Playas Valley reveals that sand, gravel, silt, and clay, at places intermixed, lie in beds of various thicknesses. Individual beds probably are not extensive areally, as beds between wells could not be correlated with the available logs. The well logs are too few to delineate the local extent of any of the more prominent beds. Clay beds 60 feet or more in thickness were penetrated in some of the deep test wells drilled on the U-Bar Ranch in the upper valley. The sorting of the fill generally is poor, although individual beds composed of well-sorted material are not uncommon. In general, the fill is a heterogeneous mixture of materials of various particle sizes bedded in lenses and discontinuous layers.

GROUND WATER

Occurrence

Ground water in the Playas Valley is obtained from the permeable sediments of the valley fill. All wells on which information was obtained are completed in the valley fill, with the possible exception of some on the east side of the valley near Ringbone well. The ground water contained in these sediments, insofar as is known, is derived entirely from precipitation on the drainage area of the basin. The water reaching the ground-water body is probably a very small part of the total precipitation; however, the ground-water body in the Playas Valley is believed to be continuous throughout the valley. Because of the wide range in permeability of the bolson deposits, ground water occurs under both artesian and water-table conditions.

Ground water tapped by most wells in the valley is under water-table conditions. The depth to water along the valley axis ranges from about 4 to 200 feet and, in general, decreases toward Playas Lake. The shape of the water table resembles to some extent the topography of the valley. The water table is cupped downward toward the axis of the valley, although in the upper valley its axis lies east of the valley axis. The water table flattens near Playas Lake. The difference in elevation between the water beneath the fan slopes and the water beneath the valley floor suggests that water under artesian pressure may be present at depth along the valley axis. However, confining beds as well as aquifers tend to lens out. The consequent leakage between permeable beds separated by discontinuous confining beds reduces artesian pressure, and there is little, if any, artesian effect in most wells of moderate depths.

Ground water is obtained from sand and gravel interbedded with clay and beds of silt. Consolidated rock (probably conglomerate) is reported in some well logs, but its areal distribution could not be determined from the available information. It seems unlikely, however, that consolidated rock forms a continuous bed within the valley fill. From an examination of recent well logs (table 1) and those reported by Schwennesen (1918, pl. 8, p. 110), it is believed that the whole of the valley is underlain by thick but generally discontinuous beds of clay and silt and lenses of clay and silt intermixed with gravel and sand. If the underlying beds of clay and silt were continuous, artesian pressures could prevail throughout the valley floor and artesian wells such as those at Las Cienegas and Whitmire might be common.

The artesian wells at Las Cienegas and along the west side of Playas Lake are believed to be the result of water moving down a fan slope and being trapped in an aquifer by underlying and overlying beds having less permeability. These conditions are local, inasmuch as wells drilled a few miles away appear to tap unconfined water. (See pl. 1, also Schwennesen, 1918, p. 114-115.) The two wells at Las Cienegas are about 100 feet deep and, so far as is known, have flowed continuously since they were drilled near the turn of the century. The two wells are now connected so that they discharge about 10 gpm (gallons per minute) through a common outlet about 10 feet above the ground. The flow was not appreciably different in 1956 from that reported in 1913 (6.2 gpm), although it may vary somewhat from time to time.

The wells along the west side of Playas Lake are probably similar to those at Las Cienegas, but their histories are not so well known. Schwennesen reported 10 springs along the west side of the lake in the area between Lane Ranch and Tubbs. As these springs are no longer in evidence, except for small seeps, it is possible that irrigation wells have intercepted water that formerly discharged as spring flow. The well called Artesian, near the south end of Playas Lake, may have been developed from one of the springs reported by Schwennesen. The water in Artesian well stands at about the level of the land surface in a 3-foot concrete liner that rises above the ground about 1 foot and extends beneath the land surface about 10 feet. A windmill lifts water into a circular steel storage tank. Tubbs, the northernmost flowing well along the west side of the lake, is similar to Artesian in that it opens into two fieldstone cribs about 3 feet in diameter in which the water stands at about ground level or slightly above. At Tubbs the discharge flows by gravity through buried pipes to a partly buried storage tank and several watering troughs. The water from Whitmire and

Thompson wells also is distributed by underground pipes to watering troughs and storage tanks. The artesian head at both wells is about 8 feet above the land surface, but the altitude of the land surface at Whitmire is about 2 feet above that at Thompson.

Between Thompson and Whitmire are several seeps, or indications of former seeps. When the area was visited in the spring of 1956, most of these seeps were moist but, with one exception, were not flowing. The exception was a seep not far south of Thompson well, which discharged a little water onto the clay of the lake bed. Remains of fenced enclosures indicate that several seeps or springs along the west side of the lake formerly may have flowed enough water for stock use. One of these is at Whitmire well, where a concrete box and ditch draining toward the lake remain; northwest of the well and the nearby abandoned ranch house, and about halfway between Whitmire and Thompson, are the remnants of wooden cribbing and a ditch. Both of these springs are now dry, as is the spring north of Las Cienegas mentioned by Schwennesen. These seeps and springs may discharge artesian water from the same aquifer as that tapped by the wells, or they may result from the intersection of the water table and the land surface in the bluff along the west side of the lake. The springs at the U-Bar Ranch headquarters, at the southeast edge of the valley, and Cottonwood Spring, at the east side of the valley east of Playas Lake, are probably caused by ground water meeting a barrier of bedrock as the water moves down a canyon through a relatively thin sheet of unconsolidated alluvium flooring the canyon. The barrier impounds the ground water and forces it to discharge at the surface as a spring. It is significant that the canyons drain a considerable area above these springs, and perhaps the relatively small discharge in proportion to the drainage area is indicative of the small amount of precipitation that reaches the ground-water body in this area.

The depth to water at specific localities in the valley may be inferred from the depths to water listed on plate 1 and the elevation of the land surface. The flowing wells at Las Cienegas and along the west side of Playas Lake represent local artesian conditions and should not be used as a guide to the general depth to water in this particular locality. (See tables 2 and 3 and pl. 1.)

Known depths to water in wells in the valley range from about 4 feet in the bed of Playas Lake to more than 360 feet in a well in sec. 5, T. 31 S., R. 17 W. In general, depths to water decrease toward the lake. The depth to water at the Diamond A Ranch Antelope well near the Mexican border is 226 feet; near Hatchet Gap it is about 45 feet; and at Playas, along the railroad, it is about 65 feet. Water from flowing wells along the west side of Playas Lake, as at Whitmire, is under a head of about 8 feet or less; and water from flowing wells at Las Cienegas is under a head of about 10 feet. The static level of water in the irrigation wells near Hatchet Gap ranges from about 40 to 60 feet. Farther south, in T. 32 S., the depth to water in irrigation wells ranges from about 75 to 100 feet and increases with distance southward.

The difference in water levels in water-table and artesian wells may be about 5 feet, as at Tubbs, or more than 40 feet, as at Las Cienegas. The flowing wells mentioned above are not the only wells tapping water under artesian head. U-Bar Ranch irrigation well 31.16.28.333 probably taps artesian water as there is a pronounced difference in water level between the deep irrigation well and a shallow stock well nearby. It is to be expected that some wells in a bolson fill will penetrate strata bearing water under artesian head, and it is difficult to distinguish between wells that derive a part of their yield from artesian aquifers and wells that derive their entire yield from unconfined aquifers.

The hydrographs in figure 8 indicate two principal types of behavior of water levels in wells in the Playas Valley. The first type is the steady decline shown by the hydrographs of wells 32.17.13.243 and 32.17.23.434, which may be attributed to a decrease in ground-water storage as the result of drought. The second type is a fluctuation such as is shown by the hydrographs of wells 30.16.11.331 and 30.16.29.422, reflecting decline during the pumping season and recovery after the season is over.

Movement

Ground water in Playas Valley moves toward Hatchet Gap, and to and probably beyond Playas. The water table at Antelope Wells near the Mexican border is at an altitude of about 4,460 feet, at Hatchet Gap about 4,260 feet, and at Playas about 4,250 feet. These figures may serve to orient one quickly as to the general direction of ground-water movement, but the contours on the water table (pl. 1) should be examined for a clearer picture of the direction of movement.

A trough in the water table is indicated by a southward bow of the contours between Hatchet Gap and Antelope Wells (pl. 1). This trough extends northward from the south-central part of the valley near the Mexican border to the east side of the valley near Hatchet Gap. Along the western side of the axis of the trough, near Old Walnut Well, the contours flatten or bow eastward, perhaps indicating eastward-moving recharge from the area northwest of Culberson Ranch. A similar, more pronounced eastward bow of the contours is indicated in the area between Gillespie Mountain, in the Animas Mountains at the west side of the valley, and Hatchet Gap at the east side. The axial trough of the water table in the southern end of the valley is near the center of the valley, and in the vicinity of Hatchet Gap it is close to the east side, similar to the topographic axis. This trough is an

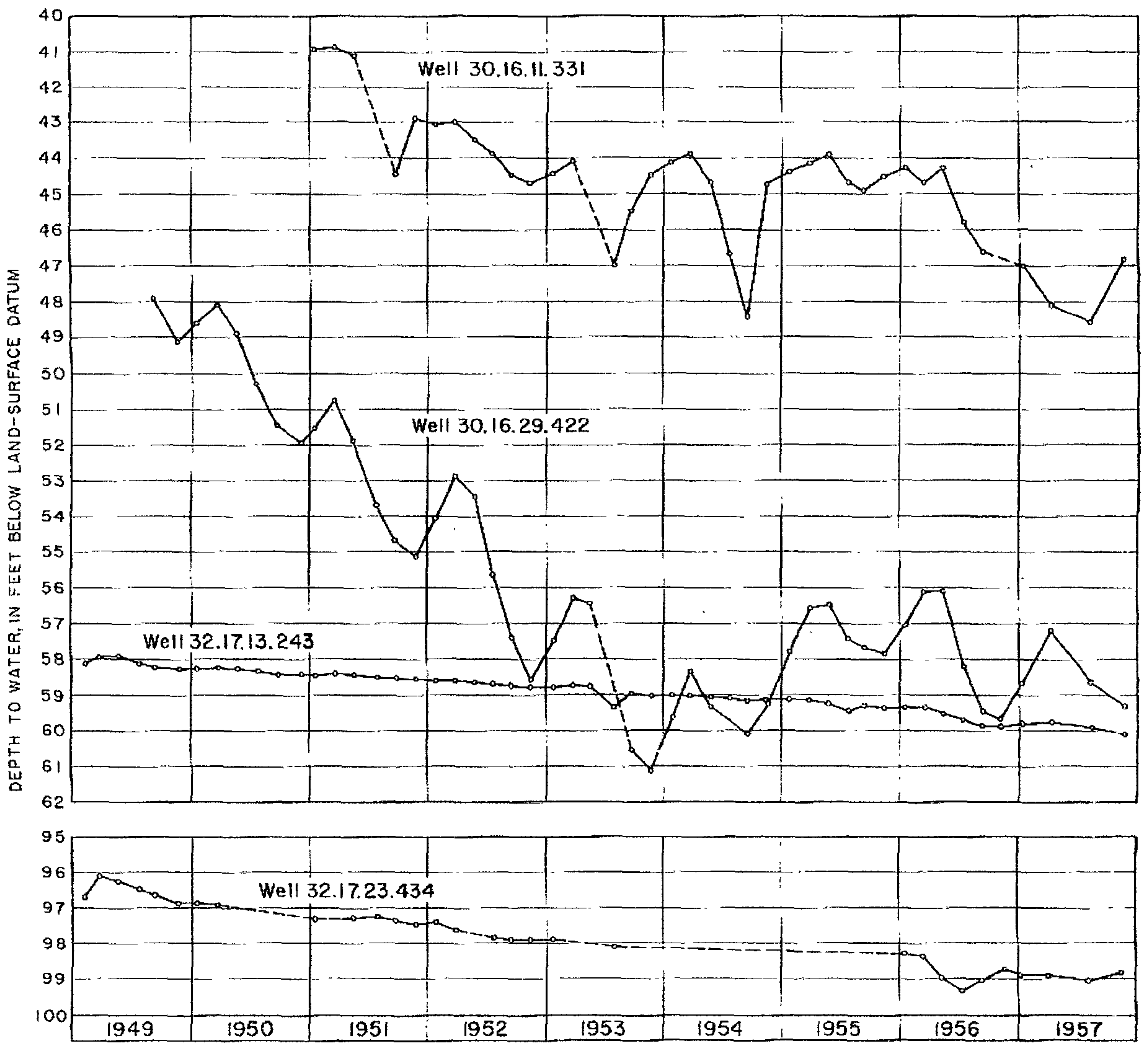

FIGURE 8. *Fluctuations of water levels in observation wells in Playas Valley in New Mexico.*

indication, perhaps, of more permeable sediments, probably an accumulation of old stream deposits, through which the ground water moves freely. From the shape of the contours, it can be seen that ground water moves down the alluvial slopes flanking the upper valley and then northward toward Hatchet Gap.

Ground water probably moves through Hatchet Gap (Schwennesen, 1918, p. 122; Lasky, 1947, p. 10) over a subsurface dam of bedrock beneath the unconsolidated valley fill. The water table of Playas Valley is considerably above that of Hachita Valley near the gap; nevertheless, it is likely that little water moves through the gap. Probably most of the water moves past Hatchet Gap northward toward Playas Lake, and some moves through Hatchet Gap only when the water table is high enough for water to spill over the bedrock dam.

The 4,260-foot contour near Hatchet Gap does not extend southward along the valley axis as does the 4,280-foot contour, possibly indicating the effects of pumping in the irrigated area. If pumping has removed enough water to cause the 4,260-foot contour to retreat toward Hatchet Gap, a ground-water divide may exist near Hatchet Gap, further preventing much ground water from flowing through the gap.

In the lower valley, water-table contours indicate movement of ground water toward the lake and Playas. It is possible that ground water moves from the vicinity of Playas northwestward into Animas Valley, or northward into the Lordsburg Valley, but the available data do not confirm such movement. The altitude of the water table near Playas is about 4,250 feet. The altitude of water levels at the O'Neal and Adams wells and at Antelope (pl. 1) is about the same as that at Playas.

The water table must be nearly flat in the vicinity of Playas, and the direction of ground-water movement cannot be determined with accuracy until more water-level measurements are available. The few wells that exist are widely spaced; hence the direction of ground-water movement must be inferred from the general difference in elevation between the water table in Playas Valley and that in the adjacent Animas Valley.

Contours on the water table in Animas Valley (Reeder, 1957) and water-level measurements near Playas indicate the possibility of ground-water movement on a line striking about N. 70° W. from Playas to the Animas Valley. If the valley fill in the gap between the Animas and Pyramid Mountains is thick, water may move between the Animas and Playas Valleys; if the valley fill is thin, the bedrock may form a dam preventing movement of water between the two valleys.

High water levels in two windmill wells a few yards apart in sec. 27, T. 25 S., R. 17 W., indicate that ground water does not move northward between the Pyramid Mountains and Coyote Hills. If these wells tap the main zone of saturation, there is a ground-water divide near Lone Hill well which coincides roughly with the topographic divide between Playas Valley and Lordsburg Valley. However, it is possible that these two wells tap perched water above the main zone of saturation and that water does move northward into Lordsburg Valley.

The existence of a ground-water divide would indicate that lower Playas Valley is a closed ground-water basin as well as a closed topographic basin. A closed ground-water basin would account for the flatness of the water table throughout the northern part of the valley. However, if ground water is continuing to move northward past Playas Lake, the flatness of the water table could be the result of an increase in permeability and/or thickness of the aquifer. Available well logs do not suggest an increase in permeability. If the permeability is slight, the flatness of the water table might indicate instead that the quantity of water moving past Playas Lake is very small.

Ground water moves upward along the west edge of Playas Lake to discharge through seeps and flowing wells. Also, because the water table is only about 4 feet beneath the surface of the lake bed, water may evaporate from the capillary fringe extending upward from the water table. (See Meinzer, 1923a, p. 31-38.) Each of the cottonwood trees and other large phreatophytic plants along the west side of the lake use several hundred gallons of water per day during the summer, so that the aggregate discharge by transpiration may be considerable.

Recharge and Discharge

Very little, if any, water percolates downward to the water table from lakes or the flat parts of the valley floor, because fine materials form a relatively impermeable clay pan beneath these areas. The upper parts of the alluvial slopes are formed by coarse particles that may offer a relatively permeable route for recharge to the water table. However, relatively impermeable caliche exposed in some places along the side slopes of the valley undoubtedly impedes downward movement of water. Part of the water from heavy precipitation runs off directly through Hatchet Gap and is not available for recharge in Playas Valley.

Recharge is greatest during periods of heavy precipitation, but before recharge can be effective the soil moisture must be replenished and demands of vegetation met. A part of the precipitation is returned to the atmosphere by evapotranspiration. Soil moisture in excess of evapotranspiration requirements eventually moves downward and reaches the water table as recharge. However, precipitation is greatest during the summer when the demand by vegetation is high; and because of the narrow width of the intake areas, the high velocity and irregularity of the surface flow, and the impounding of water on clay pans, recharge to the water table is probably a very small percentage of the total precipitation.

W. N. White (1931, p. 69-80) estimated the ground-water recharge in the Mimbres Valley in Luna County, N. Mex., from seepage runs, records of streamflow, and observations on soil permeability. He pointed out that the principal area of recharge was the permeable bed of the Mimbres River and a belt of porous sand and gravel along the upper reaches of the fans near the mountains. The Mimbres and Playas Valleys are similar in many respects, the principal difference between the two being the greater area of the Mimbres Valley. Also, the Mimbres Valley has a better defined principal drain—the Mimbres River and its tributaries—than has the Playas Valley, although the drainage network of washes which enters the southwest corner of the upper valley from the Animas Mountains may correspond in some measure to the drainage system of the Mimbres River. White (p. 76-80) estimated that 30 to 50 percent of the flow of the Mimbres River was absorbed, the quantity depending upon the velocity and type of flow, and he considered 40 percent to be a fair average. On this basis, the recharge to the Mimbres ground-water basin from a drainage area of about 900 square miles was estimated to be 10,000 to 11,000 acre-feet per year, about 2 percent of the rainfall in the area.

Probably the streams of Playas Valley do not cross as much permeable area of intake, proportionately, as do those of Mimbres Valley because they do not form as efficient a drainage system. In Playas Valley, the mountain drainage follows the gullies entrenched in the fan slopes and dissipates as sheet flow a short distance from the mountains. The principal areas of recharge are probably the gullies along the upper reaches of the fan slopes. The water in these gullies is moving rapidly and has little opportunity to sink in, even though the channel is porous; the water that reaches the flat areas penetrates the fine underlying materials with difficulty, and the quantity of water reaching the water table is believed therefore to be only a small part of the total flow.

The nature of the precipitation obviously affects the amount of recharge. Runoff from a slowly melting snow or gently falling rain will be in contact with the porous and permeable deposits for a relatively long time and therefore will result in increased recharge. As mentioned previously, however, much of the precipitation is in the form of short thundershowers of local extent, which concentrate relatively large quantities of water in small areas. This water drains quickly down the slopes and collects in the flat areas of the valley, where the rate of downward percolation is low and the rate of evaporation is high.

If the ground-water reservoir in Playas Valley were recharged at a rate equal to that in Mimbres Valley as estimated by White, the recharge as computed on the basis of the smaller area would be about 27 percent of 10,000 to 11,000 acre-feet per year, or about 3,000 acre-feet per year. The highlands surrounding Playas Valley are more mountainous than those adjacent to Mimbres Valley, so some allowance should be made for increased precipitation in the mountains. The greater precipitation in the higher mountains near Playas Valley may not result in proportionately greater recharge to the valley proper, however, because there will be increased interception of water by plants, which are more abundant on the higher slopes. Nevertheless, increased precipitation in the mountains should increase the overall recharge to perhaps about 1 percent of total precipitation on the drainage area of the Playas Valley, as compared with the 0.8 percent that is estimated for Mimbres Valley.

If 1 percent of the precipitation becomes ground water, in a year of average precipitation the annual recharge should be 5,000 acre-feet. Recharge in such an amount probably occurs only in years of normal or above normal precipitation. In dry years there may be no recharge. Over a long period an intermediate figure of 2,500 acre-feet per year may be a good estimate for average annual recharge to the entire valley. The upper Playas Valley constitutes about half the total area and therefore may receive about half the recharge, or about 1,250 acre-feet per year. Annual recharge should approximate closely the amount of water moving each year past a line across the valley. The effective width of the upper valley is about 8 miles and the gradient of the water table is about 8 feet per mile. If a T of 70,000 gpd per foot as determined for well 31.16.28.333 is considered to be average for the valley fill, the annual recharge to the valley should be about 5,000 acre-feet. However, if the T of 20,000 gpd per foot as computed from the average specific capacities of 17 wells is used, a figure of 1,400 acre-feet per year is obtained. This figure is more nearly in agreement with the estimates of recharge from precipitation and indicates that the T computed from the aquifer test data for well 31.16.28.333 probably is too high an average for the valley fill.

Springs and seeps along the west side of Playas Lake in the lower valley discharge ground water. The flow of some springs and seeps, as reported in 1913, has diminished or ceased. Several springs along the west side of Playas Lake reported by Schwennesen and one at Las Cienegas in upper Playas Valley no longer flow. Some ground water may move through Hatchet Gap into Hachita Valley, some through the gap between the Animas and Pyramid Mountains along the railroad into the Animas Valley, and some northward between the Pyramid Mountains and Coyote Hills into Lordsburg Valley. The quantity of water discharged through these gaps is unknown. If the discharge at Playas Lake represents most of the natural discharge of the lower valley, the lower estimates of recharge are probably more nearly correct than the higher.

Phreatophytes grow in a narrow strip along the west side of Playas Lake. Cottonwood trees are the most conspicuous, but saltcedars, grasses, and other water-loving plants are numerous. To compute the use of water by these plants would require a detailed inventory of the amount and types of vegetation. The amount of water used by these plants might be on the order of 3 acre-feet per acre per year, as in the Safford Valley of Arizona (Gatewood and others, 1950, p. 2), but probably is less, as the opportunities for removal of ground water by plants are not nearly so good in Playas Valley as in the Safford Valley, because the soil in the Playas Valley near the lake is tighter. A tight soil decreases the amount of water available to plants. Surface water in the lake supplies a part of the vegetation's requirements during years of normal and above normal precipitation. A consumptive use of about 2 acre-feet per acre per year by phreatophytes near the lake bed in an area of about 35 acres may be a fair estimate. On this basis, the phreatophytes near the lake use about 70 acre-feet of water per year. About 70 operating windmills in the valley withdraw water from the main ground-water body. These windmills pump an estimated aggregate of 70 to 100 acre-feet per year for stock and domestic use; domestic use accounts for not more than 5 acre-feet of this. Flowing wells and springs supply about 8 to 12 acre-feet per year.

The water table is about 4 feet below the lake bed, and ground water presumably could move to the surface by capillarity and there evaporate directly. However, such a process should result in deposition of a crust of minerals by the evaporating water. No crust of minerals was observed on the surface of the lake bed. The lack of a salt crust indicates that the net movement of water is downward, not upward. This in turn indicates that water must move beneath the lake toward points of discharge on or beyond the margins of the lake.

Probably the principal discharge from the ground-water body within Playas Valley is by pumping in the irrigated area of the upper valley. The number of acres cultivated and the quantity of water pumped each year for the period of record are estimated in the table on page 7. About 16,000 acre-feet of water was pumped in the period 1948-55, inclusive. The amount of water pumped each year depends upon the acreage irrigated, the type of crop, and the amount of precipitation during the growing season.

Well Construction and Characteristics

About a hundred operating stock and domestic wells are listed in the well records (table 3). Most of these are drilled wells about 6 inches in diameter, but some are dug or bored wells 2 feet or more in diameter. The drilled wells generally have steel casing to their full depth. Most of the stock and domestic wells are equipped with windmills which, in conjunction with storage tanks, provide dependable supplies of water. Many of the windmill wells have been in existence for so many years that the records of construction have long since disappeared, and little can be ascertained concerning the depth of the well or the depth at which water-bearing beds were penetrated during drilling. The average yield of the windmill wells is probably about 1 gpm. The windmill wells on the ranches are usually named and serve as landmarks. The diameter of the windmill rotor may be taken as an approximate indication of the depth to water, although this criterion is not infallible; a larger rotor generally indicates a greater depth to water.

Ten test holes were drilled on the U-Bar Ranch in the upper (southern) valley to establish the availability of water for irrigation and to determine the lithology of the valley fill. The first five wells were drilled in June 1955 with a seismic shothole drill rig. A driller's log was kept of each. (See table 1.) The holes ranged in depth from 291 to 450 feet. The last five wells were drilled with a larger rotary drill unit, and more detailed logs were kept by Messrs. Witte and Reim. These holes, drilled from October through December 1955, ranged in depth from 181 to 998 feet. None of the holes were cased and most of them caved within a short time. All the test holes were reported to have been completed in valley fill. Subsequent to the test drilling, two irrigation wells (31.16.28.333 and 32.16.32.333) were drilled and equipped with turbine pumps. These wells are 914 and 1,000 feet deep, respectively.

Most irrigation wells in the Playas Valley are drilled and are cased to full depth, generally with slot-perforated steel casing They range in diameter from 8 to 18 inches. The irrigation wells near Hatchet Gap are about 100 to 360 feet deep (table 2); those drilled by the U-Bar Ranch are 900 feet deep or more, and wells drilled recently on the U-Bar Ranch irrigation tract are about 400 feet deep. Vertical turbine pumps are used on all the irrigation wells. They are powered by direct-coupled electric motors or by drive-shaft-coupled combustion engines fueled with liquefied petroleum gas, gasoline, or similar conventional fuel.

The yields and drawdowns of some wells are listed in table 4. Because of factors relating to the construction of the individual wells and of the heterogeneity of the aquifers, the size of the pump is not necessarily consistent with the yield. The specific capacity, which is the number of gallons of water per minute yielded per foot of drawdown, is a convenient factor to use in comparing wells. The specific capacities of several wells in the valley are listed in table 4. Most of the estimated discharges used in computing specific capacities were determined by the trajectory method, in which the velocity of the water leaving the discharge pipe is estimated from the distance the water drops in a given horizontal distance; the discharge is then obtained from a nomograph. This method is reasonably accurate if the discharge pipe is full and the flow is not excessively turbulent, but it is by no means as accurate as methods that require the use of weirs or current meters. The specific capacities of irrigation wells in the valley range from 6 to 41 gpm per foot of drawdown and are probably less now than in 1948 when pumping began. The average specific capacity, computed from all data obtained since 1948, is about 23 gpm per foot of drawdown.

Most of the irrigation wells for which a specific capacity can be computed are in a small area near Hatchet Gap. The specific capacities computed from data obtained in the early years of pumping (1948-52) are higher than those computed from data collected in 1955 and 1956. This may be the result of a decline in water level effected by pumping, which would reduce the yield of the wells. Also, the perforations in the well casing may have become partly clogged with encrusting minerals or particles washed in from the aquifer. Such clogging would decrease the yield of the well in relation to the drawdown. The average discharge of irrigation wells is about 800 gpm, the yields ranging from about 200 to 1,700 gpm. Table 5 lists the data from pumping tests of the U-Bar Ranch irrigation wells.

Water-Level Fluctuations and Effects of Pumping

The water levels in wells fluctuate from year to year and during the year. The hydrographs (fig. 8) of well 32.17.13.243, an unused stock well, and well 32.17.23.434, an unused irrigation well—both distant from the center of irrigation pumping—show a decline of water levels between 0.2 and 0.3 foot per year for the period of record (1949-57). The change in water levels in these wells is mostly a gentle, nearly constant year-to-year lowering. An average of water-level declines computed from recent depths to water in wells near those measured in 1913 and those reported by

Schwennesen indicated a lowering of about 7 to 8 feet during the period 1913 to 1956. The hydrographs (fig. 8) of well 30.16.11.331, an irrigation well near the center of pumping, and well 30.16.29.422, an unused irrigation well also near the center of pumping, show declines in water levels of more than 4 feet a year during several years and net changes of 2 feet or more in some years. The irrigation wells near Hatchet Gap follow the trend of wells 30.16.11.333 and 30.16.29.422, in that the declines in water level when water is pumped for irrigation and the high water-level measurement recorded, generally in January or March, change from year to year. The amount of water-level decline in individual wells during the pumping season depends upon the characteristics of the well and the use made of the well; the year-to-year change in water level is generally dependent upon the amount of water pumped for irrigation. The average change in water level in individual wells from year to year, generally a decline, may be obtained from the summary of annual water levels and water-level change from 1949 to 1956 included in table 6. These data indicate that from 1949 to 1954 the average annual change in water level was a decline of about 2 feet. In 1954 and 1955 the water levels rose in most wells, as indicated by the measurements made in January 1954, 1955, and 1956. The net rise in water levels in these 2 years was the result of reduced pumping from individual wells because of a decrease in the acreage irrigated and also because favorable seasonal rains diminished the need for application of water.

Water levels have declined about 8 feet in some wells since the measurements in 1913 by Schwennesen. The decline does not imply that the water table has been lowered 8 feet throughout the valley. It is simply an average of declines and rises computed from recent measurements of water levels in wells near those measured by Schwennesen. The change in water level may be relatively local, reflecting the removal of water by one or more wells in a small area. In general, however, it does indicate that the water table has not risen since 1913 and suggests that it has declined perhaps several feet since that time. The decline may be attributed to pumping, although the water levels were measured in stock wells, which generally are beyond the effects of recent irrigation pumping, so that the decline from pumping should be of little significance so far as the change for the 43-year period is concerned. It is more likely that the lowering is the effect of drought. The steady year-to-year decline in water levels shown by hydrographs of wells 32.17.13.243 and 32.17.23.434 is perhaps an indication of the rate of decline of the water table as the result of drought. The average annual lowering of water level indicated by these hydrographs is about 0.2 to 0.3 foot, or about 1 foot to $1\frac{1}{2}$ feet in 5 years. If this rate of decline has been continuous since 1913, the expected lowering would be 8 to 13 feet for the 43-year period 1913 to 1956. It is questionable, however, whether the water table has declined steadily since 1913, even though the recorded average lowering is in agreement with the rate indicated by the recent hydrographs. No water levels are recorded for the intervening years, and the rate of change may have varied from time to time. Some water levels measured by Schwennesen (1918) are recorded in table 3. These water levels were measured in wells in the same general area as the present wells, although they are not necessarily the same wells. Some idea of the change in the water level can be obtained by comparing the recent and past measurements. Where a substantial rise in water level appears, the present well may be a deeper well tapping artesian water.

Fluctuations of water levels cannot be correlated with the available precipitation data (figs. 6 and 8). The hydrographs show the fluctuation of water levels caused by seasonal pumping, however. Water levels decline during the summer as long as pumping continues, and rise during the winter after pumping stops in the fall. The annual declines shown in table 6 are net declines based on measurements in January.

Because water is being pumped from storage, a lowering of water levels may be expected each year; water levels usually will not recover from seasonal pumping to the previous year's high. Water levels to determine annual changes are measured in January at a time when most of the seasonal recovery has occurred. The highest water levels indicated on the hydrographs usually occur in March rather than in January; however, the recovery from January to March is generally at a rather slow, nearly uniform rate. Thus, the net or annual change in water levels computed from January measurements is essentially as accurate as one computed from the highs for each year.

Pumping changes the shape of the water table. When a pump is operated a gradient in the water table is established, and water drains into the well from the surrounding saturated materials to replace water discharged by the pump. As pumping continues, water continues to drain from the saturated materials, and a cone of depression appears in the water table surrounding the well. When pumping is stopped, the water level rises in the well as water moves into the cone of depression from the surrounding area. Hydrographs showing fluctuations of water levels in wells near the center of pumping are included in figure 8.

Well 30.16.11.331 is an irrigation well on the northeast edge of the area of irrigation pumping. The well is pumped somewhat sporadically; it was pumped very little in 1955 but was being pumped in the late fall of 1956. The hydrograph of this well (fig. 8) illustrates the seasonal fluctuation and the progressive decline of water level from year to year as the well is pumped. During 1955, when the well was pumped but little, the decline during the growing season was probably caused by the pumping of nearby wells. In 1953 the water level was lowest in July and then recovered, indicating discontinuance of pumping early in the season.

Well 30.16.29.422 is an unused irrigation well in the pumped area. The hydrograph illustrates the year-to-year decline in the water table in the area of concentrated pumping. The water level in this well recovers each year until about March, when pumping for irrigation begins, and then declines as the result of pumping from nearby wells. When pumping stops, the water level begins to recover and continues to rise until the next pumping season begins. From 1949 to 1953 the highest water level in this well each year was below the high point of the previous year. In 1954 and 1955, the acreage irrigated in the valley was reduced, precipitation was relatively heavy during the growing season, and much less water was pumped. Consequently, the water levels in early 1955 and 1956 rose above the levels of the previous years, but still were not as high as in 1949, prior to beginning of heavy pumping in the irrigated area. The general trend of the water level in well 30.16.29.422 may be expected to continue downward as long as the present, or a greater, rate of pumping is maintained. Seasonal fluctuations and departures from the general trend of decline may be expected as the rate of pumping changes.

The hydrograph of well 32.17.13.243 shows a steady decline in water level. This well is an unused stock well remote from the main irrigated area. The seasonal declines in 1953, 1955, and 1956 are probably the effects of pumping from wells about a mile away. The overall decline is probably caused largely by drought.

The hydrograph of well 32.17.23.434, an unused irrigation well remote from the main area of pumping, shows a trend in water-level decline similar to that of well 32.17.13.243. The record is incomplete where the line is dashed, because the well was equipped with a pump for some time and measurements could not be made during that period. The seasonal decline recorded in 1956 is probably caused by pumping from the same wells that affect well 32.17.13.243.

Most farmers are interested in knowing how much the water level will decline in their wells each year as pumping continues, because the cost of pumping increases as the depth to water increases. To predict these declines, a continuing program of water-level measurement will be needed to evaluate seasonal and annual fluctuations after the basin has been developed. The administrative policy of the State Engineer of New Mexico is to allow development of 1,600 acres of land at a water-duty rate of 3 acre-feet per year in each strip of half a township across the valley. This arrangement is designed to permit maximum freedom in choice of land used with minimum interference between pumped wells. It is essentially a system of well spacing based upon the effects of decline of water levels in wells along the axis of the valley, and it is based on the assumption that water levels will decline to the economic limit in 40 years.

The drawdown in wells may be large during the early years of development. However, after the development is complete and the quantity of water pumped is about the same each year, the annual declines in water levels should decrease. This rate of decline, ideally, is a logarithmic function of time, if there is no recharge. That is, in the tenth year the expected lowering would be one-tenth of the first year's lowering. However, the Playas Valley is long and narrow, and when the pumping effects extend to the valley walls, the rate of decline will be greater than before. It will therefore be of value to the residents of the valley to maintain a continuing program of water-level measurements.

Aquifer Tests

During their investigation of the water resources of the Playas Valley, Messrs. Reim and Witte made aquifer tests on two irrigation test wells drilled by the U-Bar Ranch. On December 15, 1955, well 31.16.28.333 (Reim, 1956, p. 42-45) was pumped for 12 hours and 26 minutes at a reported rate of 1,285 gpm and for 11 minutes at 1,466 gpm. On March 1, 1956, Mr. Witte pumped well 32.16.32.333 at a rate of 1,500 gpm for 8 hours and 35 minutes. The discharge was measured with an 8-inch flow meter during both tests.

Water levels during the test in well 31.16.28.333 were measured in the pumped well, in a windmill-equipped well 458 feet south of the pumped well, and in an intermediately located shothole test well. The shothole was uncased and contained an obstruction at a depth of about 20 feet; the measurements of water level in this hole were therefore regarded as unreliable. Water levels were measured in the pumped well with an electrical device. The device failed and consequently the plot of the drawdown is unusable. The measurements of water level in the windmill-equipped observation well, though few in number, were satisfactory, but this well did not penetrate the full sequence of sediments penetrated by the pumped well. In the test of well 32.16.32.333, only the drawdown of the pumped well was recorded. Barometric fluctuations were recorded during the test of well 31.16.28.333, but the available information is not sufficient to determine the barometric efficiency of the well. It is believed, however, that drawing smooth curves through the plot points compensated for any slight barometric fluctuations that may have occurred.

The data from each test were analyzed by the Theis nonequilibrium formula. By use of a value of Δs obtained from a graphic plot, this formula may be stated as $T=264Q/\Delta s$, in which T is the coefficient of transmissibility, in gallons per day per foot; Q is the discharge, in gallons per minute; and Δs is the change in water level per log cycle of time, taken from a plot of water-level change versus time, in which time is plotted on a logarithmic scale against water level on an arithmetic scale. An analysis of data from both tests suggests a T of 70,000 to 80,000 gpd per foot.

An average specific capacity for the wells listed in table 4 is about 23 gpm per foot of drawdown which, multiplied by a factor of 1,100 to 1,300 (Theis and others, 1954), indicates a T of 20,000 to 33,000 gpd per foot. A more nearly accurate value for T for the aquifers in the valley fill may lie between the extremes of the values determined from the aquifer tests and values estimated on the basis of specific capacity, and may be about 50,000 gpd per foot. A longer aquifer test and more and better observation wells would probably yield more reliable data for computing the T. In bolson deposits, the likelihood of penetrating aquifers that are heterogeneous is more nearly the rule than the exception, so that the application of the Theis formula, which is based on movement of water in a homogeneous aquifer, is seldom valid.

Chemical Quality

Most of the ground water in Playas Valley is suitable for irrigation, according to the classification of the Department of Agriculture given in Agriculture Handbook 60 (U. S. Salinity Laboratory Staff, 1954, p. 79-82, fig. 25). Data from 13 sources are plotted in figure 9. The Agriculture Handbook contains a detailed explanation of the construction and use of the diagram, which relates sodium-adsorption ratio and conductivity to sodium (alkali) and salinity hazards, respectively. This system of classifying irrigation waters is based on the assumption that the water will be used under average conditions with respect to soil texture and rate of water infiltration, drainage, quantity of water used, climate, and salt tolerance of crop. Any large deviation from one or more of these conditions may make some ordinarily satisfactory waters unsafe to use. Different types of soil underlie different parts of Playas Valley, and a soil analysis should be a prerequisite to farming.

According to the classification diagram (fig. 9), most of the waters analyzed have a low alkali hazard and a medium salinity hazard. Ground water in the valley is suitable for growing plants having a moderate tolerance for salt. There should be little danger of developing high concentrations of exchangeable sodium in the soil from irrigation with ground water in Playas Valley; however, peach and similar trees and other sodium-sensitive plants may accumulate injurious concentrations of sodium.

Alkali soils may be formed by irrigating with water high in "residual sodium carbonate." The residual sodium carbonate (U. S. Salinity Laboratory Staff, 1954, p. 81) is above the recommended limit of 2.5 epm (equivalents per million) in water samples from wells 27.17.7.422 and 30.16.14 233, and near the limit in the sample from 28.17.33.244. Samples from wells 27.17.8.300, 27.17.30.200, and 27.18.13.200 (analyses reported by Schwennesen) also were above the recommended limit. Of the 31 analyses in table 7 in which the residual sodium carbonate could be calculated or estimated, the 5 samples enumerated above were classed as unfit, 14 were marginal, and 12 were safe for irrigation use. Soil additives, such as gypsum, should allow the marginal waters to be used safely on well-drained, permeable soils.

Water from well 27.17.7.422 near the playa lake contains an appreciable quantity of boron, 1.2 ppm (parts per million), which will affect most boron-sensitive crops. The concentration of boron probably increases toward the lake. The mineral constituents and physical properties of samples from several wells are listed in the table of chemical analyses (table 7).

Water obtained from some wells in Playas Valley is soft, but the hardness and dissolved-solids content increase toward the northern and eastern parts of the valley. The concentrations of dissolved solids range from about 150 ppm in the southern part of the valley to about 6,900 in the northern part. Hardness as $CaCO_3$ ranges from about 10 to 1,400 ppm, increasing northward. The pH ranges from about 7.4 to 9.2.

Water of the sodium bicarbonate type is the most common; calcium magnesium bicarbonate, calcium sulfate, and sodium sulfate waters are less common. The sulfate content of the water in the valley is generally less than 80 ppm but increases to more than 4,000 ppm in Schwennesen well 201 in the northeastern part of the valley. Water from well 27.16.5.334, in the northern part of Playas Valley, contains 675 ppm of sulfate but is used for watering stock. In general, it appears that most of the water moving down the valley contains sodium bicarbonate and that sulfate is contributed to the ground-water reservoir by water entering the valley from the east side near the Little Hatchet Mountains.

Analyses in table 7 do not report all the constituents necessary to classify water as fit or unfit for human consumption in accordance with recommended standards of the U. S. Public Health Service (1946). However, the fluoride concentration in 8 of the 12 samples in which the concentration was determined is more than 1.5 ppm, the maximum concentration acceptable for public water supplies. Drinking water containing fluoride in excess of 1.5 ppm causes mottling of the enamel of children's teeth if used while the teeth are forming. The first three analyses in table 7 list sulfate in excess of the recommended maximum of 250 ppm. Water from these sources is considered very hard, and it may produce a laxative effect if drunk by persons unaccustomed to it. The concentration of dissolved solids was in excess of the optimum 500 ppm in 4 of the samples but in excess of 1,000 ppm in only 1 of the 4 samples. Dissolved solids may impart a bad

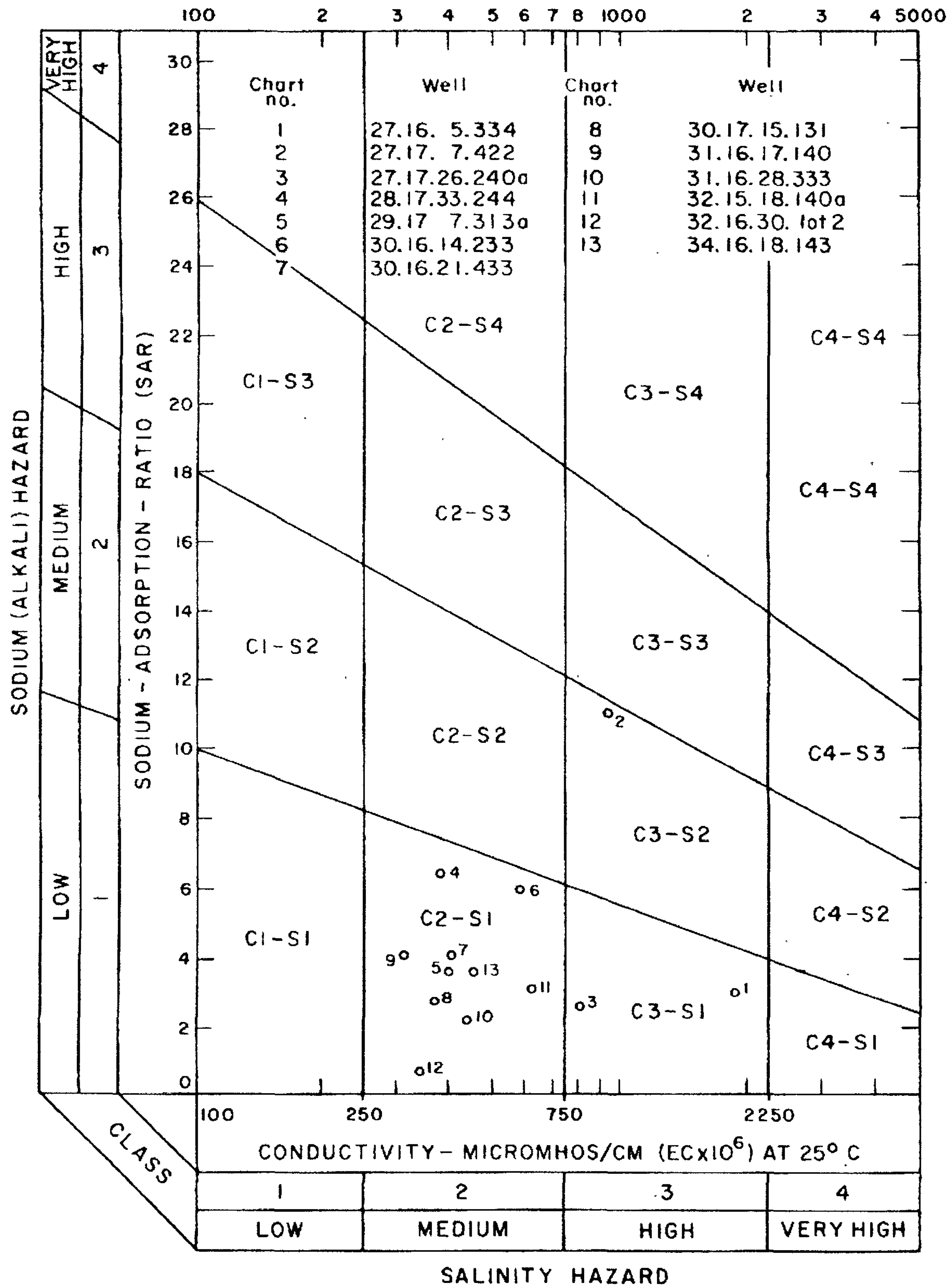

FIGURE 9. Classification of well waters for irrigation in Playas Valley in New Mexico. (After USDA Agriculture Handbook 60, p. 80.)

taste to water but a concentration of 1,000 ppm is permissible if water of better quality is not available. So far as is known, no bacterial count has been made of any domestic water supply in the valley. The content of lead, arsenic, or other elements, similarly injurious to human beings in small concentrations, was not determined. However, wells in the valley have supplied water for domestic use for many years without known deleterious effects upon the users.

The high concentration of silica in most waters from the Playas Valley would cause scale to form in pipes and boilers. Calcium carbonate scale also may form from some waters, but most waters are suitable, or adaptable by softening and pH adjustment, for industrial use.

SUMMARY

Ground water in quantity and quality suitable for irrigation is available in Playas Valley. Successful irrigation wells have been drilled in Tps. 30-32 S., Rs. 16-17 W. Twenty-six such wells have been constructed, of which 21 are equipped for operation. During the period 1948 to 1956 about 19,200 acre-feet of water—about 2,100 acre-feet per year—was pumped from these wells and used to irrigate an average of 1,140 acres per year.

Recharge to upper Playas Valley is estimated to be about 1,250 acre-feet annually which is about half of the annual withdrawal by pumping. Water levels are declining—the January 1957 decline ranged from 0.39 foot to 2.68 feet. It is believed that the pumping has not yet reduced the natural discharge of ground water; consequently, the water pumped is mostly from storage and water levels will continue to decline if the present pumping rate is maintained. The life of the ground-water supply can be prolonged by proper well spacing, efficient operation of pumping plants, and effective use of the pumped water; the State Engineer is responsible for administering rights to the use of water within the declared basin in such a way as to promote these objectives.

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TABLES

Table 1. Drillers' logs of wells in the Playas Valley area, Hidalgo County, N. Mex.

Drillers' logs of water wells listed in table 1 were furnished by the driller or owner. The name of the driller and additional data on the wells are given in table 2. Wording of logs has been slightly modified for uniformity of presentation.

Material	Thickness (feet)	Depth (feet)
30.16.7.333 Bobby H. Killian		
Clay	12	12
Gravel	5	17
Clay	4	21
Gravel	4	25
Clay	5	30
Gravel (water-bearing stratum)	45	75
Sand	25	100
30.16.14.233 M. T. Everhart, Jr.		
Fill	6	6
Gravel	6	12
Clay	23	35
Sand and gravel (water-bearing stratum)	23	58
Rock	3	61
Clay, caliche and rock	15	76
Sand and gravel (water-bearing stratum)	4	80
Clay	8	88
Rock	3	91
Clay	7	98
Limestone	3	101
Clay	13	114
Gravel and sand (water-bearing stratum)	3	117
Clay	4	121
30.16.21.444 A. C. Gillespie		
Top soil	5	5
Clay	15	20
Gravel	6	26
Clay	9	35
Gravel	10	45
Clay	10	55
Sand	5	60
Clay	9	69
Gravel	4	73
Clay	17	90
Gravel	8	98
Clay	4	102
Gravel	9	111
Clay	9	120
Gravel	4	124
Clay	7	131
Gravel	8	139
Clay	1	140
Gravel	4	144
Clay	2	146
Gravel	9	155
Clay	16	171
Gravel	5	176
Clay	21	197
Gravel	7	204
Clay	11	215
31.16.28.333a U-Bar Ranch		
Top soil	14	14
Clay, gravel	66	80
Gravel	50	130
Clay	620	750
Soft gravel	130	880
Large gravel, rock	34	914
31.16.28.333b U-Bar Ranch (Test well 3)*		
Top soil	6	6
Sand, gravel, and clay streaks	49	55
Water sand and gravel	130	185
Coarse water sand and gravel with interbedded clay streaks, sands are eight to ten feet in thickness	40	225
Coarse water sands with streaks of gravel	125	350
Coarse water sands and gravel with interbedded clay streaks. Sands are from ten to twenty feet in thickness, and the clay streaks are four to five feet in thickness	100	450

*Driller's comment: This test looks to be excellent for irrigation water.

Material	Thickness (feet)	Depth (feet)
32.16.14.324 Glen R. and Boyd Stout		
Soil	14	14
Clay	1	15
Caliche	25	40
Clay	85	125
Sand and gravel	5	130
Clay	125	255
Sand and gravel	5	260
Clay	80	340
Conglomerate	87	427
Hard white sandstone	5	432
Conglomerate	43	475
Hard rib	4	479
Conglomerate	101	580
Hard rib	10	590
Sandrock	28	618
Conglomerate	62	680
Clay	30	710
Clay and gravel conglomerate	25	735
Sand	10	745
Hard rock	30	775
Clay and gravel conglomerate	17	792
Clay and sandstone streaks	112	904
32.16.15.300 U-Bar Ranch (Test well 2)*		
Top soil	6	6
Clay and gravel	59	65
Water sand and loose gravel	54	119

Table 1. Drillers' logs of wells in the Playas Valley area, Hidalgo County, N. Mex. (continued)

Material	Thickness (feet)	Depth (feet)
32.16.15.300 U-Bar Ranch (Test well 2)* (continued)		
Water sand, gravel with interbedded clay streaks	36	155
Water sand and gravel	136	291

*Driller's comment: Circulation lost at 155 feet, regained and lost at 291 feet. No cuttings recovered. This test appears to be excellent for irrigation water.

Material	Thickness (feet)	Depth (feet)
32.16.29.132 J. O. Nelson		
Top soil	3	3
Sandrock	2	5
Brown shale	3	8
Sandrock	2	10
Brown shale	30	40
Gray shale	10	50
Brown shale	37	87
Sand and gravel	2	89
Red shale	9	98
Sand and gravel	29	127
Sand and gravel	24	151
Red shale	8	159
Sand and gravel	12	171
Red shale	7	178
Sand and gravel	12	190
Red shale	65	255
Sand and gravel	15	270
Red shale	5	275
Sand and gravel	10	285
Red shale	5	290
Sand and gravel	10	300
Red shale	20	320
Sand and gravel	18	338
Red shale	5	343
Sand and gravel	17	360
Red shale	8	368
Sand and shale	18	386
Sand and gravel	4	390
Red shale	2	392
32.16.30.312 U-Bar Ranch (Test well 1)*		
Top soil	8	8
Clay and gravel stringers	32	40
Good water sands	20	60
Five to six foot sands with interbedded two and three foot clay stringers	130	190
Clay and gravel	40	230
Porous water sands and gravel	57	287
Rock	1	288
Coarse water sand and river-bed gravel	137	425
Sands appear to be same type as above, but finer and a little tighter	25	450

*Driller's comment: Water abundant in this area for irrigation, and a good ten-inch well could be produced here.

Material	Thickness (feet)	Depth (feet)
32.16.32.333 U-Bar Ranch		
Top soil	6	6
Clay	79	85
32.16.32.333 U-Bar Ranch (continued)		
Sand and gravel	5	90
Clay	20	110
Sand (water)	10	120
Clay	20	140
Sand and gravel (water)	5	145
Clay	26	171
Sand and gravel (water)	19	190
Clay	6	196
Gravel	16	212
Clay	54	266
Gravel and sand	14	280
Clay	21	301
Gravel and sand	14	315
Clay	67	382
Gravel and sand	13	395
Clay	20	415
Sand and gravel	15	430
Clay	25	455
Sand and gravel	5	460
Conglomerate	540	1,000
32.17.23.434 R. M. Timberlake*		
Sandy soil	22	22
Clay and gravel	19	41
Fine gravel and sand	37	78
Sand and little clay	15	93
Sand and fine gravel, water level at 100 feet	14	107
Clay and sand	16	123
Clay and small gravel	16	139
Gravel and water	3	142
Clay and sand	12	154
Coarse gravel and sand	9	163
Gravel and clay	24	187
Coarse gravel and sand	8	195
Clay and sand	45	240
Gravel, sand, and a little clay	60	300
Sand and gravel with some clay separations	53	353

*Drilling company reports that pump was set at 150 feet and pumped 600 to 700 gpm.

Material	Thickness (feet)	Depth (feet)
33.16.5.400 U-Bar Ranch (Test well 4)		
Top soil	8	8
Clay and gravel beds	32	40
Water sands and gravel	114	154
Water sands, gravel with interbedded clay stringers	21	175
Water sands and gravel	30	205
Clay streak interbedded with gravel	13	218
Water sands and gravel	177	395
Sand, gravel and some loose rocks with thin layers of clay	30	425

Table 1. Drillers' logs of wells in the Playas Valley area, Hidalgo County, N. Mex. (continued)

33.16.6.422 U-Bar Ranch (Test well 5-A)

Samples described by George Witte and K. M. Reim

Material	Thickness (feet)	Depth (feet)
Surface soil	5	5
Buff clay with medium to coarse sand, trace of fine gravel	2	7
Coarse sand with fine gravel, some quartz fragments, no clay	10	17
Buff clay with medium to coarse sand	10	27
Medium to coarse sand with dark brown clay	20	47
Buff clay with medium and coarse sand	20	67
Medium to coarse sand with some clay	38	105
Very coarse sand and fine gravel, excellent sorting	10	115
Buff clay with little medium sand	10	125
Medium to coarse sand with trace of buff clay (quartz particles mixed with volcanic material)	30	155
Fine gravel with some clay	10	165
Buff clay with fine gravel and coarse sand (this zone may have permeable streaks of gravel)	40	205
Fine to medium gravel with streaks of coarse sand and buff clay. Coarser gravels are at 245 to 285, 305 to 335, 335 to 365 feet	395	600

33.16.19.200 U-Bar Ranch (Test well 2-A)

Samples described by K. M. Reim

Material	Thickness (feet)	Depth (feet)
Top soil	12	12
Dark brown clay with very coarse volcanic sand	15	27
Light buff clay with some coarse volcanic sand	3	30
Coarse quartz sand with some volcanic sand, no clay, sorting good	3	33
Light buff clay with some volcanic sand	10	43
Coarse quartz sand with fine volcanic gravel, trace of clay	9	52
Buff clay with little sand	14	66
Fine to medium volcanic gravel	1	67
Buff clay with medium sand	11	78
Buff clay with few very thin sand stringers (trace of sand at 76 to 108, 118 to 128 feet)	72	150
Medium to fine volcanic gravel and coarse sand (some quartz) with thin buff clay stringers	7	157
Buff clay with very thin sand stringers	30	187
Fine volcanic gravel with buff clay stringers	7	194
Buff clay with very thin sand stringers	33	227
Fine volcanic gravel with clay stringers	5	232
Fine black gravel and coarse volcanic sand with clay stringers	20	252
Buff clay with trace of sand	10	262
Coarse volcanic sand and fine gravel with little to no clay	22	284

33.16.19.200 U-Bar Ranch (Test well 2-A) (continued)

Material	Thickness (feet)	Depth (feet)
Buff clay and coarse volcanic sand	26	310
Medium volcanic gravel	20	330
Coarse volcanic sand and fine gravel (coarser gravel at depth) interbedded with thin beds of buff clay	70	400
Fine and medium volcanic gravel	15	415
Fine volcanic gravel and coarse sand interbedded with thin buff clay beds (hard drilling at 436 to 448, 494 to 497 feet—white siliceous material)	92	507
Interbedded buff clay and coarse volcanic sand	48	555
Fine volcanic gravel and coarse sand interbedded with thin buff clay beds. Lost circulation for a short period of time at 556 feet. The volcanic sand and gravel is composed essentially of fragments of andesite, latite, rhyolite, and tuff	21	576

33.16.21.342 U-Bar Ranch (Test well 1-A)

Samples described by K. M. Reim

Material	Thickness (feet)	Depth (feet)
Medium to fine quartz sand with some limestone (or caliche) fragments	30	30
Coarse volcanic gravel	5	35
Coarse volcanic gravel with some thin buff clay beds	28	63
Fine volcanic gravel with black cobbles (very slow drilling rate)	5	68
Coarse volcanic sand and some fine gravel interbedded with buff clay	12	80
Coarse volcanic sand and fine gravel with trace of clay	5	85
Coarse volcanic sand and fine gravel with buff clay	10	95
Medium to fine volcanic gravel and coarse sand with trace to no clay; 100 to 115 feet contains coarser gravel	50	145
Medium to very coarse volcanic sand with few very thin buff clay beds; coarser sand at 160 to 165 feet with less clay (an increase of quartz particles). The volcanic sand and gravel is composed essentially of fragments of andesite, latite, rhyolite and tuff	36	181

33.17.8.220 R. M. Timberlake*

Material	Thickness (feet)	Depth (feet)
Soil	9	9
Rock embedded in red clay	136	145
Sand, gravel, and rock	27	172

*Driller's comment: Principal water-bearing material from 149 to 172 feet is composed of sand, gravel, and rock.

Table 1. Drillers' logs of wells in the Playas Valley area, Hidalgo County, N. Mex. (continued)

Material	Thickness (feet)	Depth (feet)
33.17.13.311 U-Bar Ranch (Test well 3-A)		
Samples described by K. M. Reim		
Quartz sand and volcanic gravel	7	7
Medium quartz sand with some volcanic sand, sorting good	4	11
Fine volcanic gravel and coarse quartz sand	20	31
Medium to fine volcanic gravel with some clay at 31 to 41 feet	30	61
Buff clay	39	100
Coarse sand and fine gravel with some buff clay	4	104
Fine gravel and coarse sand with some buff clay	22	126
Buff clay and coarse gravel	4	130
Fine and medium gravel interbedded with very thin buff clay	20	150
Buff clay with some coarse sand	37	187
Light reddish brown clay with some coarse sand	3	190
Medium and fine gravel with thin reddish clay beds	10	200
Fine gravel and coarse sand interbedded with reddish clay	20	220
Medium gravel to coarse sand with some clay	30	250
Light reddish clay interbedded with some sand and gravel	28	278
Fine and medium gravel and coarse sand with trace of clay	10	288
Buff clay with little sand	7	295
Very coarse sand interbedded with buff clay	20	315
Buff clay with little sand	30	345
Buff clay interbedded with coarse sand and fine gravel	30	375
Fine gravel and coarse sand	10	385
Medium and fine gravel with trace of clay, sorting good	10	395
Coarse sand and fine gravel, coarser gravel at 415 to 425 feet, sorting good	60	455
Coarse sand and fine gravel interbedded with buff clay	15	470
Coarse sand and fine gravel	17	487
Dark buff clay with some sand	3	490
Coarse sand and some fine gravel with a trace of clay	15	505
Fine and some medium gravel, cuttings primarily chips of several types of highly siliceous volcanic rock (areas of hard drilling), some thin buff clay stringers, clay at 535 to 545 feet	100	605
Medium rounded to sub-rounded gravel (lost circulation at this interval)	3	608
Fine and some medium gravel, with some thin buff clay stringers, clay at 695 to 705, 715 to 724 feet	166	774
Samples not available for logging	27	801
33.17.13.311 U-Bar Ranch (Test well 3-A) (continued)		
Brown clay with some coarse sand	9	810
Fine gravel with brown clay	10	820
Brown clay with medium to coarse sand	20	840
Very coarse sand with brown clay	10	850
Brown clay with some coarse volcanic sand	20	870
Very fine gravel and some clay	10	880
Brown clay with little medium to coarse sand	20	900
Coarse sand and fine gravel with little clay	10	910
Brown clay and some coarse sand	10	920
Very coarse sand with some brown clay streaks	20	940
Brown clay and little coarse sand	58	998
34.16.7.100 U-Bar Ranch (Test well 5)*		
Top soil	8	8
Clay streaks and gravel	32	40
Water sands and gravel	184	224
Clay and gravel	6	230
Water sands and gravel	95	325
Water sands, gravel and loose boulders	125	450

*Driller's comment: The test appears to qualify for a good irrigation water well.

Material	Thickness (feet)	Depth (feet)
34.17.12.240 U-Bar Ranch (Test well 4-A)		
Samples described by K. M. Reim		
Top soil, brown clay and fine volcanic gravel (a few limestone fragments)	9	9
Red clay and some coarse sand	11	20
Fine and some medium volcanic gravel with some red clay	10	30
Ashbrown clay with some coarse sand	34	64
Buff clay and fine gravel	7	71
Medium volcanic gravel (dia. 1 + cm.) and some buff clay (lost circulation)	10	81
Buff clay with little medium sand	40	121
Fine volcanic gravel with little clay (lost circulation)	9	130
Buff clay	15	145
Buff clay with thin streaks of very fine gravel	10	155
Buff clay with trace of medium sand	5	160
Buff clay with some fine gravel	35	195
Fine volcanic gravel with buff clay; clay predominates from 125 to 220 feet. This entire section is probably not very permeable	75	270
Coarse and medium volcanic sand with some streaks of fine gravel. Fine volcanic gravel at 330 to 340 feet (few clay streaks less than 1 foot thick between 480 to 660 feet). Clay in sand in samples 480 to 510 and 600 to 630 feet	390	660
Coarse sand with fine gravel. Red clay streaks probably not exceeding 1 foot. Lost circulation several times	140	800

Table 2. Records of irrigation wells in Playas Valley, Hidalgo County, N. Mex.

EXPLANATION

Well-location number: See figure 2 for system used. Asterisk (*) indicates chemical analysis given in table 7.

Altitude: Altitude refers to general land surface near the well. Altitude to tenth of a foot was determined by spirit level; altitude to an even foot interpolated from U. S. Geological Survey topographic maps.

Depth of well: M, measured: otherwise, reported.

Method of lift and power: L. cylinder or plunger pump; T, vertical turbine pump; e, electric; h, hand; i, internal combustion engine.

Use of water: D, domestic; I, irrigation; U, unused or abandoned.

Water level: Measured water levels are given to tenth or hundredth of a foot; reported water levels are given to an even foot; P, well pumping at time of measurement.

Remarks: Wells at the approximate location of those measured by Schwennesen in 1913 (Water-Supply Paper 422) are noted with the well number used by Schwennesen, the depth to water in feet below land surface, and the date of measurement. Example: S-300, WL 59, 12-7-13. A well thus marked may be, but is not necessarily, the well measured in 1913. The notation "temp. 68° F" indicates the temperature of the water pumped from the well at the discharge pipe.

Well location	Owner	Driller	Date completed	Altitude above sea level (feet)	Depth of well (feet)	Diameter of well (inches)	Method of lift and power	Use of water	Size of discharge pipe (inches)	Water level: Below land-surface datum (feet)	Water level: Date of measurement	Measuring point: Description	Measuring point: Height above or below (—) land-surface datum (feet)	Remarks
30.16. 7.333	Bobby H. Killian	J. H. Wright	1949	4,376	100	12	T	I	6	54.77 54.46	12-15-55 3-28-56	West of two holes in pump base north side	1.10	No motor on pump.
11.323	Aubrey Dans	do.	1951	4,312.1	100	12	T	I	6	44.02 43.34	9-27-55 3-27-56	Top of casing	.60	Do.
11.331	S. M. Smith	—	—	4,314.6	107	12	Te	I	6	40.94 44.70	1-15-51 3-12-56	do.	.55	S-269, WL 34, 12-12-13; 3 dry 6-inch casings nearby.
14.211a	M. T. Everhart, Jr.	J. H. Wright	1954	4,307.5	116	18	Ti	I	8	40.34 39.26	5-27-54 3-12-56	do.	1.50	Well enlarged from 16 to 18 inches March 1956. Temp. 68° F.
14.233*	do.	do.	1949	4,312.7	122	14	Ti	I	8	69.4P 43.53	7-26-49 3-12-56	Bottom edge of 1-inch round hole in casing	.62	—
[illegible]44	J. W. Hill	Morrison Bros.	1950	4,319.6	80?	16	Te	I	10	40.24 41.45	5-19-50 3-27-56	Top of casing	.30	—
16.344	A. C. Gillespie	Fred Boggs	1948	4,324	150	16	Ti	I	8	36.60 40.81	7-30-48 3-27-56	do.	.73	—
18.433	J. H. Wright	J. H. Wright	1954	4,377	115	—	Ti	I	8	58.59 —	12-15-55 —	¾-inch hole in pump base	.50	—
20.333	W. C. Bennett	M. R. Little	1955	4,375	—	16	Ti	I	8	44.47 43.93	11- 3-55 3-27-56	Top of casing	1.20	—
21.412	A. C. Gillespie	Morrison Bros.	1948	4,328.1	200	14	Te	I	6	37.39 46.73	7-30-48 3-12-56	do.	.50	Temp. 69° F.
21.433*	do.	do.	1948	4,332	160	16	Ti	I	8	68.6P 50.98	9-28-48 3-27-56	do.	—	Do.

Table 2. Records of irrigation wells in Playas Valley, Hidalgo County, N. Mex. (continued)

Well location	Owner	Driller	Date completed	Altitude above sea level (*feet*)	Depth of well (*feet*)	Diameter of well (*inches*)	Method of lift and power	Use of water	Size of discharge pipe (*inches*)	Water level		Measuring point		Remarks
										Below land-surface datum (*feet*)	Date of measurement	Description	Height above or below (—) land-surface datum (*feet*)	
30.16.21.444	A. C. Gillespie	J. H. Wright	1956	4,331.3	215	16	Ti	I	10	— 52 68	— 3-27-56	Top of casing	0.50	Temp. 68° F.
28.233	G. A. Sundquist	Morrison Bros.	1948	4,335	170	16	Ti	I	8	41.29 —	11-23-48 —	—	—	Do.
28.334	do.	do.	1949	4,345	170	16	Te	I	6	49.46 55.79	7-26-49 3-12-56	Top of casing	1.50	—
28.424	do.	J. H. Wright	1949	4,339	209	16	Ti	I	8	60.01 57.21	1-29-54 1-16-56	do.	.30	Temp. 69° F.
28.433	do.	Morrison Bros.	1948	4,344	360	.14	Te	I	8	— —	— —	—	—	Temp. 68° F.
28 444	do.	do.	1949	4,341	250	16	Te	I	8	44.03 58.63	3-23-49 1-16-56	Top of casing	.90	Do.
29.422	R. K. Myers	do.	1948	4,348	160	16	Lh	D	—	43.97 56.14	7-30-48 3-12-56	do.	.50	Unused irrigation well equipped with cylinder pump.
31.16.22.433	Doak Heard	do.	1955	4,397	200	16	—	U	—	71.02 70.93	9-22-55 3-28-56	do.	—.30	Only 36 feet of surface casing.
28.333*	U-Bar Ranch	Jack Myles	1955	4,403	914	16	Ti	I	10	30.71 45.42	9-12-55 12-13-55	do.	.90	Temp. 77° F. An uncased 450-foot test hole between this well and nearby windmill well has caved.
32.16.14.324	Glen R. and Boyd Stout	Jim McBee	1956	4,455	904	16	—	U	—	— —	— —	--	—	Casing pulled, well caved. Reportedly produced 300 gpm with test pump Temp. 71° F.
19.Lot 4	C. O. Freeman	J. H. Wright and S. E. McConnaughey	1954	4,487	192	12	Te	ID	6	79.03 78.53	7-30-53 12-17-55	Top of casing	.75	Temp 70° F.
29.132	J. O. Nelson	J. W. Hill	1956	4,482	392	13	—	—	—	77.22 78.49	6- 7-56 8- 8-56	do.	1.00	No equipment.
30.Lot 2*	Claude Edwards	Jim McBee	1951	4,491	150	16	Te	I	8	85.73 85.11	3-12-56 3-27-56	Hole inside pump shell	1.00	—
32.333	U-Bar Ranch	do.	1956	4,517	1,000	22	Ti	I	10	— 103.70	— 3-29-56	Top of casing	.80	—
32.17.23.434	R. M. Timberlake	H. S. Call	1948	4,507	162M	12	--	U	—	99.35 98.39	11-23-48 3-12-56	do.	--	No equipment. Reportedly drilled to 353 feet.

Table 3. Records of nonirrigation wells and springs in Playas Valley, Hidalgo County, N. Mex.

EXPLANATION

Well-location number: See figure 2 for system used. Asterisk (*) indicates chemical analysis given in table 7.

Owner or name: Entry followed by (D) or (U) is name of well owned by Diamond A Ranch or U-Bar Ranch, respectively.

Altitude: Altitude refers to general land surface near the well. Altitude to tenth of a foot was determined by spirit level; altitude to an even foot interpolated from U. S. Geological Survey topographic map.

Depth of well: M, measured; otherwise, reported.

Method of lift and power: J, jet pump; L, cylinder or plunger pump; e, electric; i, internal combustion engine; w, wind.

Use of water: D, domestic; Ind, industrial; S, stock; T, test well not necessarily cased or developed; U, unused or abandoned.

Water level: Measured water levels are given to tenth or hundredth of a foot; reported water levels are given to an even foot; P, pumping at time of measurement.

Remarks: Wells at the approximate location of those measured by Schwennesen in 1913 (Water-Supply Paper 422) are noted with the well number used by Schwennesen, the depth to water in feet below land surface, and the date of measurement. Example: S-300, WL 59, 12-7-13. A well thus marked may be, but is not necessarily, the well measured in 1913. The notation "temp. 68°F" indicates the temperature of the water pumped from the well at the discharge pipe.

Well location	Owner or name	Driller	Date completed	Altitude above sea level (feet)	Depth of well (feet)	Diameter of well (inches)	Method of lift and power	Use of water	Size of discharge pipe (inches)	Water level: Above (+) or below land-surface datum (feet)	Water level: Date of measurement	Measuring point: Description	Measuring point: Height above or below (—) land-surface datum (feet)	Remarks
26.17.10.111	Lone Hill (D)	Tillar Casaras	1927	4,371	186	6	Lw	S	2	—	—	—	—	—
14.240	O'Neal (D)	A. E. Mahres	1941	4,418.3	198	6	Lw	S	2	173.56 174.1P	12-16-55 5-24-56	Top of casing	1.10	—
28.420	Baker (D)	J. A. Cason	1923	4,321	175	—	Lw	S	2	—	—	—	—	May be dug well; unused well to northeast (420a) S-201, WL 58, 10-8-13.
28.420a	do.	—	—	4,320.7	161M	—	—	US	—	74.88	5-24-56	Top of concrete slab	.60	May be dug well, covered with concrete surface slab.
33.130	Briggs Place (D)	Joe Eicks	1925	4,322	162	5	Lw	DS	2	—	—	—	—	Surface casing holds spill water from pump, S-203, WL 75, 10-8-13.
26.18. 8.143	—	—	—	4,900	—	6	Lw	S	3½	—	—	—	—	Obstruction at 162 feet.
23.122	West Baker (D)	A. E. Mahres	1936	4,583.8	400	6	Lw	S	3½	334.40 336.7P	12-16-55 9-15-56	½-inch hole in casing	.90	—
34.432	Joe Heaston	—	—	4,471	—	8	Lw	DS	—	—	—	—	—	Obstruction at 26 feet.
27.16. 3.333	Diamond A Ranch	—	—	4,700	172M	6	—	US	—	67.35	9-20-56	Top of casing	—	No equipment.
5.334*	Mangold (D)	—	1941	4,536.1	60	6	Lw	S	2	36.90 38.0P	12-15-55 5-23-56	do.	1.40	S-205, WL 24, 10-4-13.
6.133	Diamond A Ranch	—	—	4,500	124M	6	—	US	—	98.67 98.38	2-17-55 11-19-56	do.	.27	No equipment; abandoned homestead.
8.143	Flanagan (D)	—	—	4,531.2	60	6	Lw	S	2¼	30.47 33.9P	12-15-55 6- 5-56	do.	.70	S-207, WL 17, 10-5-13.

Table 3. Records of nonirrigation wells and springs in Playas Valley, Hidalgo County, N. Mex. (continued)

Well location	Owner or name	Driller	Date completed	Altitude above sea level (feet)	Depth of well (feet)	Diameter of well (inches)	Method of lift and power	Use of water	Size of discharge pipe (inches)	Water level: Above (+) or below land-surface datum (feet)	Water level: Date of measurement	Measuring point: Description	Measuring point: Height above or below (—) land-surface datum (feet)	Remarks
27.16.10.133	Huntley (D)	—	—	4,611.1	46	6	Lw	S	1½	37.92 38.40	12-15-55 6- 5-56	Top of casing	1.80	
15.334	Ringbone (D)	—	—	4,688.9	60	6	Lw	S	2	41.95 45.40	12-19-55 6- 5-56	do.	.40	Temp. 68°F. Unused dry dug well 15 feet south. Plugged oil test (?) northwest a quarter of a mile.
24.220	Diamond A Ranch	Youngblood	1948	4,712	750	12	—	U	—	—	—	—	—	—
28.242	Mrs Livingston	—	—	4,900	21	—	Lw	S	—	16.24	2-16-55	Top of pump-column support clamps	.60	Dug well, called "Dug Out Well." Temp. 67°F.
29.140	do.	—	—	4,700	—	—	Lw	S	—	57.92	2-16-55	Top of barrel supporting pump column	2.31	Dug well.
36.300	M. G. Fowles	National Mine	—	4,850	—	—		DInd	—	—	—	—	—	Dug well (mine shaft); water unsuitable for culinary use, suitable for milling use.
27.17. 7.422*	Southern Pacific	—	—	4,315.8	82	6	Lw	D	1¼	68.16 73.9P	12-15-55 6- 6-56	Top of concrete curb	.50	S-213, WL 76, 10-7-53.
8.210	Playas (D)	—	—	4,305.8	115	5	Lw	S	1½	45.00 65.9P	12-15-55 6- 6-56	do.	—	Casing rusted and collapsed; measurements approximate.
8.311	Southern Pacific	—	—	4,311.4	168	—	Le	D	2	63.34 63.76	3-14-55 6- 6-56	Top of concrete base	1.00	Standby well equipped with pump jack; S-216, WL 66, 10-7-13.
8.313	Whites Place (D)	J. A. Cason	1922	4,309	128	5	Lw	DS	1½	—	—	—	—	Obstruction at 20 feet; S-217, WL 54, 10-7-13.
26.240	McDonald (D)	Joe Bicks	1926	4,435	240	—	L	US	3	—	—	—	—	Northeast well of 2.
26.240a	do.	do.	1926	4,433.7	208	5	Lw	S	2	165.89	12-16-55	Top of casing	.50	—
30.234	Adams (I)	A. E. Mahres	1932	4,289.4	52	5	Lw	S	2¼	36.22 34.5P	12-15-55 5-18-56	Top of steel pipe clamps	.50	S-227, WL 42, 10-2-56.
27.18. 2.333	Rubens No. 1a (State land)	—	1954	4,435	1,400	12	—	T	—	—	—	Bottom of ⅜-inch plug	6.00	Oil test; mud at about 98 feet.
5.334	V. A. Peterson	—	—	4,470	—	8	Lw	DS	2	234.3P 234.3P	3-14-55 11- 2-55	Top of casing	1.50	—
12.314	Rubens No. 1 (State land)	—	1950	4,378.8	1,085	12	—	T	—	133.84	6- 7-56	Bottom edge of 2½-inch pipe	.60	Oil test.

Table 3. Records of nonirrigation wells and springs in Playas Valley, Hidalgo County, N. Mex. (continued)

27.18.18.421	Southern Pacific	—	—	4,495.3	800	—	—	UD	—	248 05 248 10	3-14-55 11-19-56	Top edge of wooden cribbing	—	Uncased, unused well S-97; no measurement in 1913.
26.233	H. G. Adams	—	1914	4,434.0	280	6	Lw	DS	2	187 75 186.18	3-14-55 5-31-56	Top of casing	0.50	Measured 3-14-55 by electric-contact device.
34.311	do.	C. Dickerson	1950	4,584.4	386	8	Li	S	2	330.15 330.10	3-14-55 5-31-56	Top of steel plate	1.00	Drilled to 406 feet, believed caved to 386 feet; equipped with pump jack.
28.16. 9.311	Mrs. Livingston	Jim and Frank Wright	—	4,756	52M	8	Lw	DS	2	18.77 16.28	2-14-55 12- 2-55	Top of casing	1.00	Northernmost of 3 wells.
9.311a	do.	—	—	4,756	22M	—	Lw	DS	—	17.22	4- 5-55	Joint in pump column	2.10	Easternmost of 3 wells.
9.311b	do.	—	—	4,756	20M	6	Lw	DS	—	14.91	4- 5-55	Top of casing	1.70	Westernmost of 3 wells.
21.233	Federal land	Little Hatchet Mining Company	—	4,950	12M	—	—	—	—	7.65	4- 5-55	Top of concrete base	.90	Dug out spring equipped with centrifugal pump.
24.232	Mrs. Garland Livingston	—	—	4,820	20M	—	Lw	S	—	12.15	2- 7-56	Top of barrel over casing	1.10	Dug well; temp. 61°F.
33.111	Sim Smith	—	—	4,773	—	—	—	U	—	6.50 7.75	12-22-55 6- 1-56	Top of wooden cribbing	.50	S-230, WL 0, 1913. Boxed-in spring (Cottonwood Spring); temp. 60°F.
33.231	do.	—	—	4,860	50	6	Lw	DS	2½	38.12	12-19-55	Top of casing	1.00	S-231; no measurement in 1913; temp. 66°F.
28.17. 5.424	Diamond A Ranch	—	—	4,277	19	6	—	U	—	3.56 3.86	5-29-56 5-19-56	Top edge of gate valve	4.00	—
8.213	Tubbs (D)	A. E. Mahres	1932	4,277.6	—	5	—	S	—	.53	5-18-56	Top of casing	—	South well of 2 flowing wells.
10.440	Camp Grounds (D)	Joe Eicks	1927	4,390	150	5	Lw	DS	2	—	—	—	—	Obstruction at 30 feet.
28.130	Thompson	J. A. Cason	1923	4,282.6	80	—	—	S	2½	+11.53 + 7.2	3-20-50 6- 2-56	Top of 2½-inch pipe elbow	1.80	Flowing well, discharging 6-2-56.
33.244*	Whitmire (D)	do.	1923	4,285.0	150	—	—	S	—	+ 7.6 + 7.6	3-20-56 5-23-56	Top edge 1¼-inch pipe coupling on rock well curb	1.50	Flowing well S-237, WL 0, 10-1-13.
28.18. 1.411	U. S. Government	—	1910	4,394.1	135	6	Lw	S	3	112.57 112.33	9-14-55 5-31-56	Top of casing	.30	Reportedly not cased.
29.16.20.110	Gold Hill (D)	Joe Eicks	1927	4,402.5	195	6	Lw	S	3	137.8P	6- 1-56	do.	.30	Temp. 73°F.
22.220	Sim Smith	—	—	4,725	50	36	Lw	S	2	35.63	12-19-55	do.	1.80	Dug well; temp. 65°F.
31.422	Herbert Young	—	—	4,297	—	6	Lw	S	3	32.7P	6- 2-56	do.	.60	S-240, WL 30, 9-30-13. Unused dry well 300 feet northwest of Lane Ranch.
32.311	do.	—	—	4,298.5	—	8	Lw	S	3	30.33	6- 2-56	do.	1.50	S-241, WL 22, 9-30-13. Dry casing 150 feet east of Lane Ranch.
29.17. 1.220	Sunny Slope (D)	A. E. Mahres	1932	4,462.6	244	5	Lw	S	2½	187.02 183.8P	1-17-56 6- 1-56	do.	.90	Temp. 73°F.

Table 3. Records of nonirrigation wells and springs in Playas Valley, Hidalgo County, N. Mex. (continued)

Well location	Owner or name	Driller	Date completed	Altitude above sea level (feet)	Depth of well (feet)	Diameter of well (inches)	Method of lift and power	Use of water	Size of discharge pipe (inches)	Water level: Above (+) or below land-surface datum (feet)	Water level: Date of measurement	Measuring point: Description	Measuring point: Height above or below (—) land-surface datum (feet)	Remarks
29.17. 3.133	—	—	—	4,289.2	80M	6	—	U	—	3.71	5-31-56	Top of casing	1.20	Unused open casing; S-243, WL 0, 10-1-13.
7.313	Double Mills (D)	Joe Eicks	1925	4,495.1	214	5	—	US	—	191.02 189.22	12-14-55 5-18-56	do.	.50	Southwest well of 2, unequipped.
7.313a*	do.	do.	1925	4,494.3	218	5	Lw	DS	3	190.57 190.8P	12-14-55 6- 7-56	do.	1.00	Northeast well of 2.
10.244	Willow Tree (D)	Lewis Ellison	1929	4,285.0	250	6	Lw	S	3	20.0P 21.6P	3-20-55 6- 1-56	do.	1.00	S-242, WL 26, 12-17-13.
15.330	Lakeview (D)	J. A. Cason	1923	4,362.6	192	5	Lw	S	3	57.97 57.4P	12-19-55 5-31-56	do.	1.00	—
25.320	Artesian (D)	A. E. Mahres	1932	4,289.1	—	36	Lw	S	2	.00 + .25	12-19-55 5-18-56	Top of concrete curb	1.00	S-250, WL 20, 12-16-13.
33.310	Jack's Defeat (D)	Joe Eicks	1925	4,487	220	5	Lw	S	3	—	—	—	—	Obstruction at 19 feet; temp. 74°F.
29.18.15.324	Baldy Well (D)	—	1938	4,710.3	430	6	Lw	S	2½	406 0P	5-28-56	Top of casing	.75	Temp. 72°F.
35.422	Parker Ranch (D)	—	—	4,740	—	72	Lw	S	2½	14.39 15.4P	5- 9-56 5-18-56	Top of pipe clamps	1.00	Dug well more than 26 feet deep.
30.16. 3.444	Sim Smith	—	1930	4,317.9	59M	4	—	UDS	—	55.60 55.50	9-17-54 12-15-55	Top of casing	.50	8-inch surface casing, 4-inch liner 4 feet below top of casing West well of 2. S-257, WL 48, 9-29-13.
3.444a	do.	—	1944	4,318	150	8	Lw	DS	2	—	—	—	—	East well of 2.
5.433	Burt's Well	A. E. Mahres	1942	4,307.6	64	6	Lw	S	3	27.46 27.23	9-27-55 12-15-55	Top of casing	.90	S-259, WL 24, 8-19-13.
7.333a	Bobby H. Killian	—	—	4,376	—	6	Lw	S	3	54.81	12-15-55	Top edge of upper pipe clamps	.90	—
12.134	M. T. Everhart, Jr.	—	—	4,301.1	82M	6	Lw	DS	2	45.26 45.44	1-24-55 9-27-55	Top of casing	.90	S-272, WL 19, 8-18-13.
12.314	do.	—	—	4,301.4	—	6	Lw	S	—	45.01 43.88	1-24-55 9-27-55	do.	—	Temp. 69°F. S-273, WL 39, 9-23-13.
18.433a	J. H. Wright	—	—	4,375	—	6	Lw	D	1½	54.40	4-26-56	do.	.30	Irrigation well 300 feet southwest.
27.330	Benton Place (D)	J. A. Cason	1923	4,340	130	6	Lw	S	2	60.62 60.5P	12-15-55 5-21-56	Bottom of pipe clamps	—	S-286, WL 41, 12-12-13.
28.444a	G. A. Sandquist	J. H. Wright	1956	4,341	84	6	Je	D	—	58.46	1-19-56	Top of casing	.50	—

Table 3. Records of nonirrigation wells and springs in Playas Valley, Hidalgo County, N. Mex. (continued)

30.16.34.240	Doak Heard	—	—	4,370	135	5	Lw	S	3	73.10 74.59	1-27-55 12-16-55	Top edge of steel cover plate	0.40	S-287, WL 60, 12-13-13.
30.17.15.131*	Red Hill (D)	Joe Eicks	1925	4,520	235	6	Lw	S	3	200.32	12-13-55	Top of casing	.50	—
36.124	Sand Bar (D)	J. A. Cason	1922	4,490	200	6	Lw	S	3	—	—	—	—	Two wells, temp. 60°F. in northwest well.
30.18.18.000	Upshaw (D)	—	—	5,187	15	—	—	—	—	—	—	—	—	Dug well with gallery at bottom.
31.16.14.110	Doak Heard	—	—	4,398	—	5	Lw	S	3	87.34 88.08	1-27-55 12-16-55	Top of casing	.30	Well may be in southwest corner of sec. 11.
17.140*	Las Cienegas (D)	—	1904	4,376	102	5⅝	—	DS	3	+10	12-13-55	Discharge pipe	—	Two flowing wells with single discharge pipe. S-294.
28.333a	U-Bar Ranch	—	—	4,403	65	6	Lw	S	2½	52.42 54.94	12-13-55 4-25-56	Top of casing	.32	Temp. 67°F. Well south of new irrigation well. Windmill removed December 1955.
34.420	Doak Heard	—	—	4,420	130	6	Lw	S	2	79.77	4-25-56	do.	1.00	South well of 2; water reported soft.
34.420a	do.	—	—	4,420	160	6	Lwe	DS	2	92.57 79.84	9-22-55 4-25-56	do.	.40	North well of 2, equipped with pump jack. S-295, WL 84, 12-10-13.
31.17. 5.233	Herbert Young	Harry Young	1914	4,728	140	5⅝	Lw	DS	2½	122.94 124.71	1-24-55 12-16-55	do	1.20	Northeast well of 3; water reported hard.
5.233a	do.	Jim Ham	1945	4,728	160	5⅝	Lw	DS	2½	123.34 125.25	1-24-55 12-16-55	Top of steel cover plate	.90	Center well of 3; water reported hard.
5.233b	do	Art Myers	1938	4,728	300	5⅝	Lw	DS	2	300 365	1-24-55 12-16-55	do.	.45	Southwest well of 3; water reported soft; measurement approximate.
32.15.18.140a*	Whitewater Wells (U)	—	—	4,526	—	6	Lw	S	2	154.93	12-2-55	Crack in steel cover plate	.50	South well of 2.
32.16. 3.214	New Wells (U)	—	—	4,408	70	6	Lw	S	2	59.91 62	7-29-54 11-20-55	Top of casing	1.00	S-297, WL 54, 12-10-13.
15.300	U-Bar Ranch	Myles and Depauw Drilling Co.	1955	4,437	291	—	—	T	—	—	—	—	—	Uncased seismic shot-hole test, well caved.
17.234	Diamond A Ranch	—	—	4,465	106M	6	—	U	—	64.06	9- 5-56	Top of casing	.75	S-300, WL 59, 12-7-13.
18.322	New Walnut Well (D)	A. E. Mahres	1942	4,467	91	6	Lw	S	1½	58.52	7-28-54	do.	.90	Temp. 69°F. S-302, WL 56, 12-9-13.
22.121	Arvil Bell	—	—	4,443	105	6	Lw	US	—	71.55 71.89	12-16-55 3-29-56	do.	1.20	North well of 2; no rotor. S-303. WL 63. 12-9-13.
22.121a	do.	—	—	4,443	80	6	Lw	S	3	70.4 76.8P	11-20-55 3-29-56	do.	.80	South well of 2, called Gilberts Wells.
29.121	J. O. Nelson	—	—	4,477	162	6	Lw	S	2½	86.30	12-17-56	do.	.40	Temp. 67°F. S-304, WL 71, 12-7-13.
30.312	do.	Myles and Depauw Drilling Co.	1955	4,492	450	—	—	T	—	86.6 86.53	11-20-55 12-17-55	Land surface	—	Uncased seismic shot-hole test well; caved; only few inches of water in hole.

Table 3. Records of nonirrigation wells and springs in Playas Valley, Hidalgo County, N. Mex. (continued)

Well location	Owner or name	Driller	Date completed	Altitude above sea level (feet)	Depth of well (feet)	Diameter of well (inches)	Method of lift and power	Use of water	Size of discharge pipe (inches)	Water level: Above (+) or below land-surface datum (feet)	Water level: Date of measurement	Measuring point: Description	Measuring point: Height above or below (—) land-surface datum (feet)	Remarks
32.17. 1.422	Steen Place (D)	J. A. Cason	1922	4,443	118	5⅝	Lw	S	3	—	—	—	—	Temp. 67°F.
13.243	Old Walnut Well (D)	—	—	4,469	62	6	—	US	—	58.13 59.38	2- 4-49 3-12-56	Top of casing	1.00	S-306, WL 56, 12-9-13.
14.133	R. M. Timberlake	—	—	4,533	—	6	Lw	S	2	140.34 147.92	7-28-54 12-21-55	do.	.70	—
23.224	do.	—	—	4,490	—	6	Lw	S	2	83.64 84.16	7-28-54 9-27-55	do.	1.40	Temp. 67°F. S-307, WL 72, 12-9-13.
27.222	Mrs. J. C. Frye	Bob Malone	1925	4,525	194	8	Lw	D	2	—	—	—	—	Owner reports water level at 124 feet.
29.330	State land	—	—	4,683	—	6	Lw	S	2	37.15	9-26-55	Top of wooden block	1.30	—
33.16. 4.240	Bull Pasture (U)	—	—	4,574	170	6	Lw	S	3	152.6P 152.7P	9-21-55 3-29-56	Top of casing	.70	—
5.400	U-Bar Ranch	Myles and Depauw Drilling Co.	1955	4,550	425	—	—	T	—	—	—	—	—	Uncased seismic shot-hole test well.
6.212	Lookout Wells (U)	—	—	4,518	—	6	Lw	S	2	101.84 103.64	9- 9-55 4-24-56	Top of casing	1.20	West well of 2. Temp. 71°F
6.422	U-Bar Ranch	—	1955	4,528	600	6½	—	T	—	111	1- 6-56	Land surface	—	Uncased test well.
13.120	do.	—	—	4,787	130	6	Lw	DS	2	—	—	—	—	U-Bar Ranch headquarters, large spring north of well. S-309, WL 0, 12-7-13.
18.440	McDauw's Wells (U)	—	—	4,587	170	8	Lw	S	3	161 164.0P	11-19-55 5-21-56	Top of casing	1.80	South well of 2.
19.200	U-Bar Ranch	—	1955	4,607	576	6¼	—	T	—	—	—	Land surface	—	Uncased test well.
21.342	do.	—	1955	4,681	181	4¾	—	T	—	—	—	—	—	Do.
32.310	Haskins Wells (U)	—	—	4,635	—	5⅝	Lw	S	3	205.85 209.3P	12-19-55 4-27-56	Top of casing	1.20	Southeast well of 2.
35.441	Eagle Mountain (U)	—	—	4,787	144	—	Lw	S	3	101 98.5P	11-18-55 12-19-55	do.	—	South well of 2.
33.17. 3.144	Lard Place (D)	Joe Eicks	1927	4,560	140	6	Lw	DS	2	134.10 134.2P	11-19-55 12-19-55	do.	.25	Temp. 69°F. S-311, WL 125, 12-8-13.
8.220	R. M. Timberlake	W. C. Wright	—	4,595	172	6	Lw	S	2	148.73	12-19-55	do.	.70	Well cleaned April-May 1956; casing perforated 149-172 feet.
13.311	U-Bar Ranch	Simpson	1955	4,602	998	6¼	—	T	—	163.95	12-19-55	Land surface	—	Uncased test well.

Table 3. Records of nonirrigation wells and springs in Playas Valley, Hidalgo County, N. Mex. (continued)

33.17.22.340	High Lonesome (D)	—	—	4,659	350	5⅝	Lw	S	2½	—	—	—	—	North well of 2. Temp. 73°F. S-312, WL 136, 12-6-13.
22.340a	do	A. E. Mahres	1939	4,659	403	6	Lw	S	3½	—	—	—	—	South windmill well of 2.
33.18. 8.211	Spillsbury (D)	—	1936	5,200	288	8	Lw	S	—	49.6P	5-26-56	Top of casing	1.40	Water level in unused well 50 feet south is 20.6 feet.
17.411	Rock Ridge (D)	—	—	5,112	72M	5	Lw	S	2½	38.2P	5-26-56	do.	.80	Dry, unused well 25 feet south.
18.124	Lynch Place (D)	—	—	5,251	210	—	Lw	DS	2	—	—	—	—	—
22.333	Joyce (D)	—	—	5,025	337	6	Lw	S	—	213.2P	5-26-56	Top of steel cover plate	.60	—
30.313	Little Lynch (D)	—	—	5,225	100	6	Lw	S	2	41.18 42.5P	12-30-55 5-26-56	Top of casing	.72	—
33.19.36.242	Eakin Place (D)	—	—	5,225	140	6	Lw	S	2	90.6P	5-26-56	do.	.56	—
34.16. 7.100	U-Bar Ranch	Myles and Depauw Drilling Co.	1955	4,638	450	—	—	T	—	—		—	—	Uncased seismic shot-hole test well.
18.143*	Antelope Wells (U)	—	—	4,662	211	6	Lw	DS	3	201.04	3-29-56	Hole in flange of steel cover	.10	West well of 2, S-313, WL 173+, 12-3-13.
34.17. 4.110	Thicket Well (D)	Joe Eicks	1927	4,755	50	60	Lw	S	4	21.30	12-19-55	Top of corrugated steel casing	.70	Dug well.
5.240	Granite Well (D)	Boone	1953	4,765	83	10	Lw	S	2	16.07	12-30-55	Top of steel cover plate	.50	Temp. 65°F.
12.240	U-Bar Ranch	Simpson	1955	4,645	800	6¼	—	T	—	186.3	12-17-55	Land surface	—	Uncased test well.
14.321	Antelope Well (D)	A. E. Mahres	1934	4,688	285	5⅝	Lw	S	2	227.0 226.25	11-19-55 12-19-55	Top of casing	.30	—
24.113	Dipping Tank (U)	—	—	4,660	—	6	—	US	3	183.3 183.53	11-18-55 12-19-55	do.	.50	—
34.18. 1.110	Culberson (D)	—	—	4,888	240	5⅝	Lw	DS	3	225	1936	—	—	Two windmill wells; surface casing holds spill water. 1936 water level reported by ranch officials.
9.242	Bass Flat (D)	—	—	5,080	640	—	Li	S	—	—	—	Top of casing	1.00	Water level below 500 feet; equipped with pump jack.

Table 4. Yield, drawdown, and specific capacity of irrigation wells in Playas Valley, Hidalgo County, N. Mex.

(Yield: E, estimated; M, measured; R, reported. Pumping level: S, pumping for short time.)

Location number	Yield		Nonpumping level		Pumping level		Drawdown below nonpumping level (ft)	Specific capacity (*gpm per ft*)
	Rate (*gpm*)	Date of measurement	Water level (*ft*)	Date of measurement	Water level (*ft*)	Date of measurement		
30.16.14.211	800E	Mar. 16, 1951	39	Jan. 15, 1951	65	Mar. 15, 1951	26	31
14.211a	500E	Aug. 8, 1956	42	Apr. 26, 1956	68	Aug. 8, 1956	26	19
14.233	800R	July 26, 1949	39	Jan. 16, 1950	69	July 26, 1949	30	27
16.344	1050M	July 30, 1948	37	July 30, 1948	73	July 30, 1948	36	29
18.433	200E	Aug. 8, 1956	59	Dec. 15, 1955	90	Aug. 7, 1956	31	6
21.412	600E	Jan. 24, 1956	48	Jan. 24, 1956	69S	Jan. 24, 1956	21	28
21.433	1150M	Sept. 28, 1948	40	Nov. 23, 1948	69	Sept. 28, 1948	29	40
21.444	800E	Aug. 7, 1956	53	Mar. 27, 1956	94	Aug. 7, 1956	41	20
28.334	540M	Sept. 3, 1949	49	July 26, 1949	66	Sept. 3, 1949	17	32
28.424	650E	Aug. 7, 1956	58	Jan. 24, 1956	108	Aug. 7, 1956	50	13
28.444	590E	Aug. 7, 1956	58	Feb. 8, 1955	93	Aug. 7, 1956	35	17
31.16.28.333	1280R	Dec. 15, 1955	45	Dec. 15, 1955	121	Dec. 16, 1955	76	17
32.16.19.Lot 4	470M	July 14, 1955	79	Dec. 17, 1955	109	July 14, 1955	30	16
19.Lot 4	540E	Aug. 8, 1956	79	Dec. 17, 1955	110	July 14, 1955	31	17
30.Lot 2	650M	May 24, 1952	85	Mar. 27, 1952	101	Mar. 27, 1952	16	41
32.333	1500R	Mar. 1, 1956	105	Mar. 1, 1956	192	Mar. 2, 1956	87	17
32.333	1700E	Mar. 19, 1956	105	Mar. 18, 1956	174S	Mar. 19, 1956	69	25

Table 5. Aquifer-test data for U-Bar Ranch wells 31.16.28.333 and 32.16.32.333, Hidalgo County, N. Mex.

Well 31.16.28.333; tested by G. C. Witte, assisted by K. M. Reim, for Mr. O. P. Leonard, owner. Pumping rate maintained at 1,285 gpm for 12 hrs. 26 min. Throttle opened on pump motor at 8:22 p.m. December 15 and discharge averaged 1,465 gpm for 11 min. Discharge measured with an 8-inch-diameter flow meter.

Time	Water levels: Pumped well measuring point is 1.1 feet above land-surface datum	Water levels: Observation well measuring point is 0.4 foot above land-surface datum	Remarks
Dec. 15, 1955			
7:10 a.m.	46.51	—	—
33	—	52.7	—
56	—	—	Pumping started.
8:11	68.9	—	—
23	72.9	—	Water temperature, 73° F.
32	75.9	—	—
44	80.3	—	Pumping rate, 1,285 gpm.
53	83.5	—	—
9:01	83.8	—	—
17	83.7	—	—
35	85.1	—	—
56	87.7	—	—
10:03	—	53.6	—
25	88.4	—	—
42	93.0	—	—
11:23	—	53.9	—
33	92.6	—	—
45	93.4	—	—
12:01 p.m.	93.4	—	—
24	—	54.05	—
37	93.1	—	—
1:35	121.8	—	—
2:02	121.8	—	—
11	—	54.3	—
26	121.6	—	—
3:03	—	54.7	—
05	121.8	—	—
Dec. 15, 1955 (continued)			
3:58 p.m.	121.8	—	—
4:02	—	54.5	—
5:05	122.0	—	—
15	—	54.5	—
6:02	122.1	—	—
15	—	54.5	—
7:11	122.1	—	—
17	—	54.8	—
8:06	122.1	—	Water temperature, 73° F.
09	—	54.8	—
22	—	—	Pumping rate increased to 1,450 gpm.
26	121.8	—	—
33	121.7	—	Pump stopped.
52	53.6	—	Recovery measurements.
9:07	52.6	—	—
20	52.4	—	—
37	51.9	—	—
45	—	54.6	—
10:06	51.4	—	—
52	50.7	—	—
11:00	—	54.4	—
50	50.1	—	—
55	—	54.4	—
Dec. 16, 1955			
9:40 a.m.	48.3	—	—
10:35	—	53.8	—
Dec. 17, 1955			
3:45 p.m.	47.0	—	—

Table 5. Aquifer-test data for U-Bar Ranch wells 31.16.28.333 and 32.16.32.333, Hidalgo County, N. Mex. (continued)

Well 32.16.32.333; tested by G. C. Witte on or about March 1, 1956, for Mr. O. P. Leonard, owner. Discharge measured with flow meter. Upper 400 feet of well cased with blank pipe, lower part of well uncased at the time the test was made. Average pumping rate about 1,500 gpm.

Time	Water levels	Remarks	Time	Water levels	Remarks
6:30 p.m.	104.8	Pumping started.	8:00 p.m.	188.3	—
32	110.0	—	35	188.7	—
38	140.0	—	9:45	188.5	Water temperature, 71° F.
40	158.0	—	10:37	190.2	—
48	183.8	—	11:40	190.8	—
55	183.2	—	12:40 a.m.	190.8	—
7:00	—	Water temperature, 71° F.	1:35	191.5	—
05	185.0	—	3:00	191.8	—
25	187.8	—	05	—	Pumping stopped.
45	188.3	—	7:30	106.0	—

le 6. Annual water levels and changes of water levels from 1949 to 1957 in Playas Valley, Hidalgo County, N. Mex.

Water levels																					Highest		Lowest		Record	
ry 1951		January 1952			January 1953			January 1954			January 1955			January 1956			January 1957									
Day	Change 1950-51	Level	Day	Change 1951-52	Level	Day	Change 1952-53	Level	Day	Change 1953-54	Level	Day	Change 1954-55	Level	Day	Change 1955-56	Level	Day	Change 1956-57	Change 1949-57	Level	Year	Level	Year	Began	Year missing
15	—	43.07	26	— 2.13	44.46	23	— 1.39	44.15	29	+0.31	44.41	24	—0.26	44.32	16	+0.09	47.00	22	— 2.68	—	40.94	51	47.00	57	51	—
15	—5.67	48.27	26	— 9.29	42.18	23	+ 6.09	41.69	29	+ .49	(hi)	—	—	--	—	—	—	-	—	—	32.12	49	48.27	52	49	—
											40.30	24	—	39.58	16	+ .72	a59.15	22	—19.57	—	39.58	56	40.50	55	55	—
15	—3.77	61.43	26	—19.15	46.77	23	+14.66	51.42	29	—4.65	46.26	24	+5.16	43.79	16	+2.47	(a)	—	—	—	b38.51	50	61.43	52	50	57
15	—	38.27	26	— .35	38.97	23	— .70	40.51	29	—1.54	40.19	24	+ .32	—	—	—	41.95	22	—	—	37.92	51	41.95	57	51	56
15	+ .01	(f)																		—	35.06	49	36.80	50	49	—
					45.31	23	—	47.43	29	—2.12	46.29	24	+1.14	47.19	16	— .90	48.65	22	— 1.46	—	45.32	53	48.65	57	53	—
15	—4.21	(i)																		—	44.24	49	51.84	51	49	—
—	—	—	—	—	—	—	—	61.12	29	—	57.93	24	+3.19	57.27	16	+ .66	59.73	22	— 2.46	—	48.03	50	61.12	54	50	51-53
								60.01	29	—	56.79	24	+3.22	57.21	16	— .42	59.65	22	— 2.44	—	56.79	55	60.01	54	54	—
15	—2.94	54.06	26	— 2.52	57.47	23	— 3.41	59.61	29	—2.14	57.80	24	+1.81	57.04	16	+ .76	58.65	22	— 1.61	—14.80	43.85	49	59.61	54	49	—
								78.66	29	—	78.60	24	+ .06	78.48	16	+ .12	78.87	22	— .39	—	78.48	55	78.87	57	54	—
								85.51	29	—	85.63	24	— .12	85.59	16	+ .04	86.10	22	— .50	—	85.51	54	86.10	57	54	—
15	— .18	58.60	26	— .17	58.80	23	— .20	59.01	29	— .21	59.13	24	— .12	59.38	16	— .25	59.84	22	— .46	— 1.71	58.13	49	59.84	57	49	—
15	— .42	97.40	26	— .10	97.91	23	— .51	—	—	—	—	—	—	98.29	16	—	98.93	22	— .64	— 2.23	96.70	49	98.93	57	49	54-55

Table 6. Annual water levels and changes of water levels from 1949 to 1957 in Playas Valley, Hidalgo County, N. Mex.

ll location	Name	Water levels: February 1949 Level	February 1949 Day	January 1950 Level	January 1950 Day	Change 1949-50	January 1951 Level	January 1951 Day	Change 1950-51	January 1952 Level	January 1952 Day	Change 1951-52	January 1953 Level	January 1953 Day	Change 1952-53	January 1954 Level	January 1954 Day	Change 1953-54	January 1955 Level	January 1955 Day	Change 1954-55	January 1956 Level	January 1956 Day	Change 1955-56
6.11.331	Sim Smith						40.94	15	—	43.07	26	— 2.13	44.46	23	— 1.39	44.15	29	+0.31	44.41	24	—0.26	44.32	16	+0.09
14.211	M. T. Everhart, Jr.	32.12	4	33.31	16	—1.19	38.98	15	—5.67	48.27	26	— 9.29	42.18	23	+ 6.09	41.69	29	+ .49	(hi)	—	—	--	—	—
14.211a	do.																		40.30	24	—	39.58	16	+ .72
14.233	do.			b38.51	16	—	42.28	15	—3.77	61.43	26	—19.15	46.77	23	+14.66	51.42	29	—4.65	46.26	24	+5.16	43.79	16	+2.47
16.244	J. W. Hill						37.92	15	—	38.27	26	— .35	38.97	23	— .70	40.51	29	—1.54	40.19	24	+ .32	—	—	—
16.344	A. C. Gillespie	35.06	4	36.80	16	—1.74	36.79	15	+ .01	(i)														
21.412	do.												45.31	23	—	47.43	29	—2.12	46.29	24	+1.14	47.19	16	— .90
27.3[illegible]	Victoria Land & Cattle Co.	44.24	4	48.63	16	—4.39	52.84	15	—4.21	(i)														
28.334	G. A. Sundquist			48.03	16	—	—	—	—	—	—	—	—	—	—	61.12	29	—	57.93	24	+3.19	57.27	16	+ .66
28.424	do.															60.01	29	—	56.79	24	+3.22	57.21	16	— .42
29.422	R. K. Myers	43.85	4	48.60	16	—4.75	51.54	15	—2.94	54.06	26	— 2.52	57.47	23	— 3.41	59.61	29	—2.14	57.80	24	+1.81	57.04	16	+ .76
;.19.Lot 4	C. O. Freeman															78.66	29	—	78.60	24	+ .06	78.48	16	+ .12
30.Lot 2	C. C. Edwards															85.51	29	—	85.63	24	— .12	85.59	16	+ .04
'.13.243	Victoria Land & Cattle Co.	58.13	4	58.25	16	— .12	58.43	15	— .18	58.60	26	— .17	58.80	23	— .20	59.01	29	— .21	59.13	24	— .12	59.38	16	— .25
23.434	Mr. Timberlake	96.70	4	96.88	16	— .18	97.30	15	— .42	97.40	26	— .10	97.91	23	— .51	—	—	—	—	—	—	98.29	16	—

.. Pumping.
›. Pumped recently.
ι. Well destroyed, filled, or caved.
Measurement discontinued.

Table 7. Chemical analyses of water from wells in Playas Valley, Hidalgo County, N. Mex.

(Analyses by U. S. Geological Survey except those reported by Schwennesen in Water-Supply Paper 422, which were made by the New Mexico Experiment Station. Chemical constituents are in parts per million.)

EXPLANATION

Location number: See figure 2 for system used. The three digits in parentheses identify samples analyzed by New Mexico Experiment Station (Schwennesen, 1918). These numbers included also in tables 2 and 3 (Remarks column). The location given by Schwennesen does not always correspond with the location given in this report because the land survey had not been completed at the time of his report.

Owner or name: The owner or name reported by Schwennesen is included with the analyses from Water-Supply Paper 422. Entry followed by (D) or (U) is name of well owned by Diamond A Ranch or U-Bar Ranch, respectively.

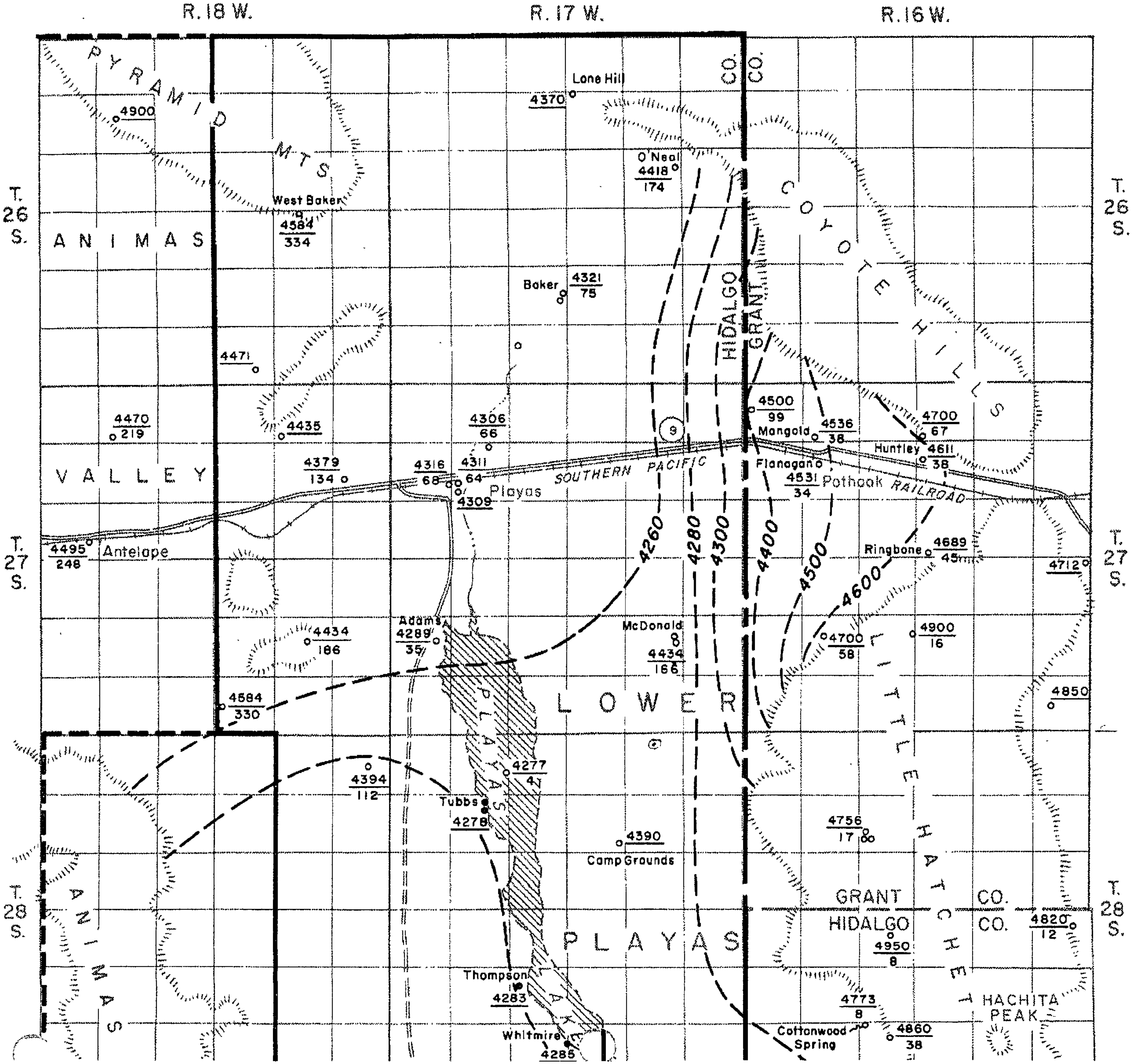
Dissolved solids: Recent analyses report the sum of the determined constituents, analyses from Water-Supply Paper 422 report a residue on evaporation.

Sodium-adsorption ratio (SAR): For those analyses in which sodium is not reported, the SAR was determined by estimating sodium as the difference of the equivalents of hardness and the sum of the equivalents of determined anions. The SAR was then determined from a nomograph on page 73, U. S. Department of Agriculture, Agriculture Handbook 60. SAR not computed for 1913 analyses.

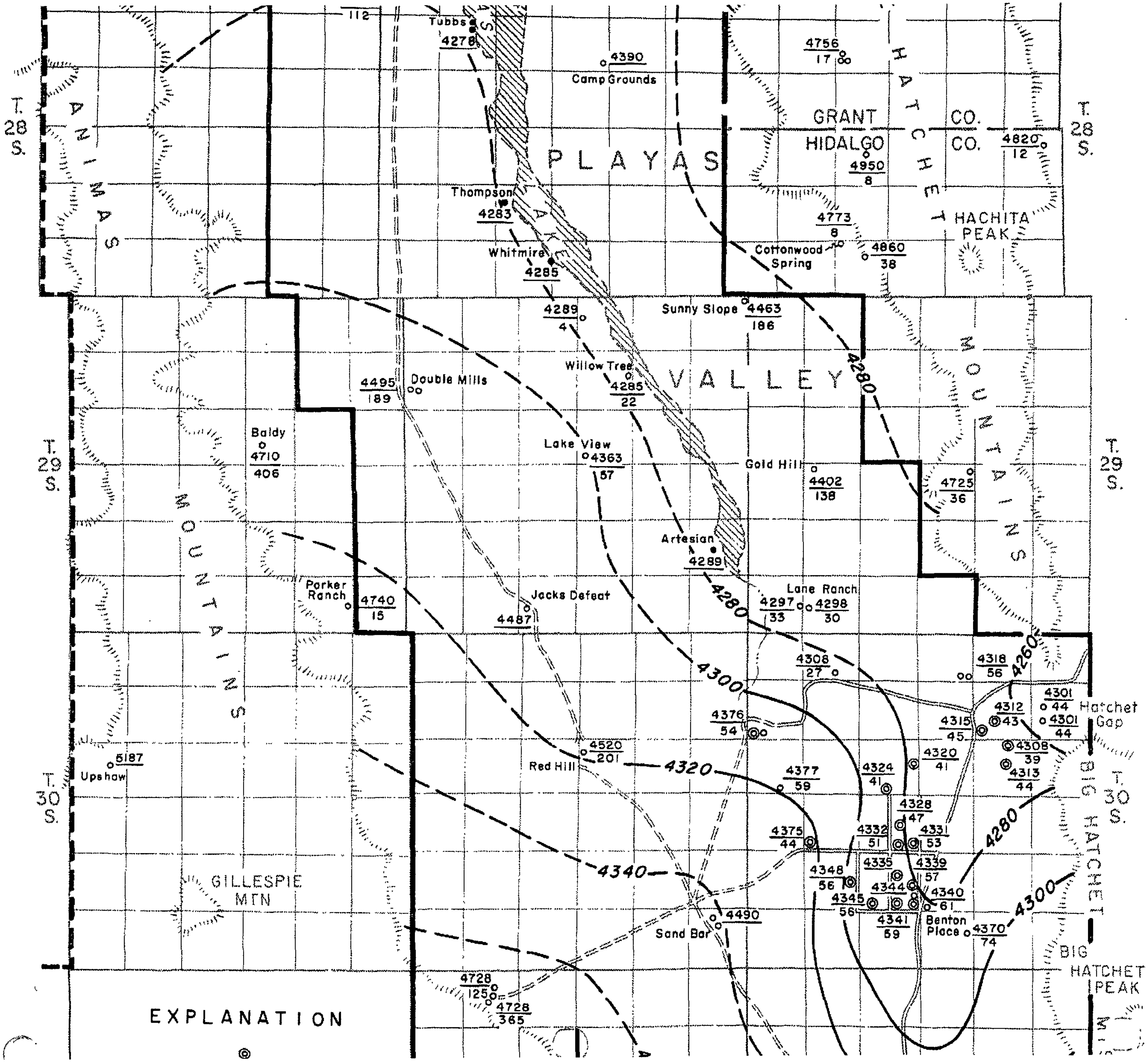
Well location	Owner or name	Date of collection	Temperature (°F)	Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids		Hardness as $CaCO_3$		Percent sodium	Sodium adsorption ratio (SAR)	Specific conductance (micromhos at 25°C)	pH
															Parts per million	Tons per acre-foot	Calcium, magnesium	Non-carbonate				
26.17.28.4(201)	Victoria Land and Cattle Co.	10/ 8/13	—	—	439	66	1,579	393	0	4,072	167	—	—	—	6,913	—	1,400	—	—	—	—	—
27.16. 5.334	Mangold (D)	6/ 7/56	—	—	—	—	—	300	0	675	93	1.5	—	—	—	—	670	424	—	3.2	1,880	7.4
8 1(205)	G. Livingstone	10/ 4/13	—	—	130	57	98	332	0	392	63	—	—	—	955	—	560	—	—	—	—	—
27.17. 7.422	Southern Pacific Co.	6/ 7/56	72	50	21	1.4	187	265	0	116	79	4.0	4.8	1.2	594	0.81	58	0	87	11	948	7.9
8.3(218)	F. S. Cooper	10/ 4/13	—	—	22	9.1	106	272	0	72	17	—	—	—	421	—	92	—	—	—	—	—
21.3(225)	R. E. Croom	10/ 5/13	—	—	40	21	74	275	0	70	35	—	—	—	430	—	186	—	—	—	—	—
26 240a	McDonald (D)	6/ 7/56	—	—	—	—	—	235	0	125	60	1.4	—	—	—	—	218	26	—	2.6	799	7.6
30.2(227)	Wm. Adams	10/ 2/13	—	—	18	6.9	142	316	0	79	29	—	—	—	501	—	73	—	—	—	—	—
27.18.13.2(228)	B. B. Baker	10/ 6/13	—	—	20	8.6	130	281	0	77	40	—	—	—	476	—	85	—	—	—	—	—
28 17. 5.4(237)	Whitmire (D)	10/ 1/13	—	—	30	13	61	221	0	59	12	—	—	—	370	—	128	—	—	—	—	—
33 244	do.	6/ 7/56	83	39	8.3	2.1	80	186	0	35	6.0	1.8	1.5	.95	268	.36	29	0	86	6.5	391	8.2
29.16.32.3(241)	A. F. Lane	9/30/13	—	—	18	9.1	86	158	16	72	29	—	—	—	357	—	81	—	—	—	—	—
29.17. 7.313a	Double Mills (D)	6/ 7/56	74	34	19	3.6	67	180	0	33	15	1.0	3.7	—	266	.36	62	0	70	3.7	403	7.6
14.3(246)	J. R. Hobbs	12/17/13	—	—	20	7.1	59	193	0	32	12	—	—	—	308	—	79	—	—	—	—	—
36.4(256)	—	9/30/13	—	—	19	13	45	152	0	54	12	—	—	—	276	—	101	—	—	—	—	—
30 16 7 3(265)	A. S. Lewis	12/16/13	—	—	21	6.1	55	177	0	33	12	—	—	—	253	—	77	—	—	—	—	—
12.3(273)	South Hatchet Wells	9/23/13	—	—	20	7.4	101	209	0	84	29	—	—	—	437	—	80	—	—	—	—	—

Table 7. Chemical analyses of water from wells in Playas Valley, Hidalgo County, N. Mex. (continued)

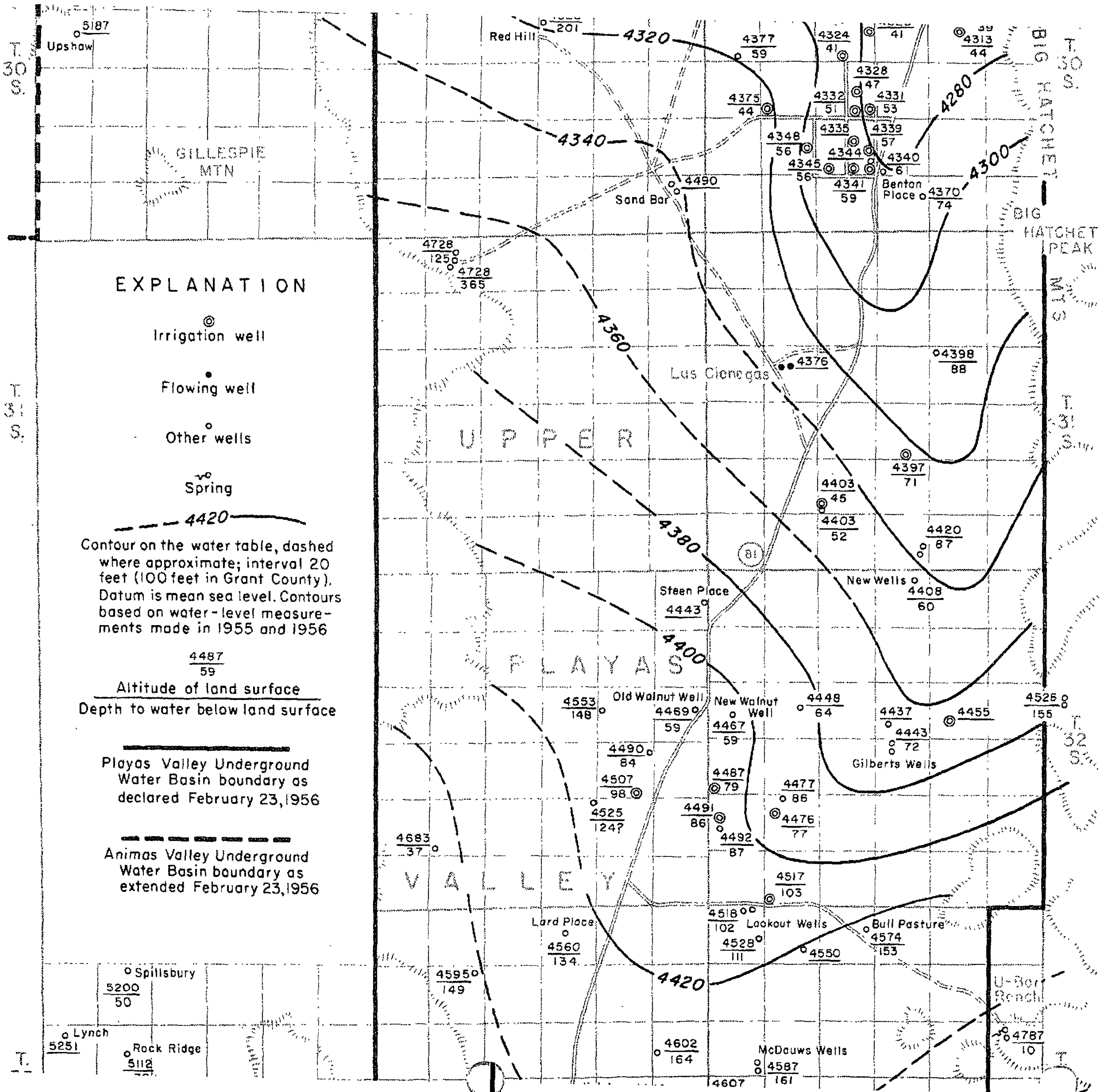
Well location	Owner or name	Date of collection	Temperature (°F)	Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids: Parts per million	Dissolved solids: Tons per acre-foot	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Percent sodium	Sodium adsorption ratio (SAR)	Specific conductance (micromhos at 25°C)	pH
30.16.14.233	M. T. Everhart	9/21/53	—	62	20	3.4	114	282	0	49	12	3.6	3.3	—	406	0.55	64	0	79	6.0	588	—
21.433	Myers Brothers	9/21/53	—	57	20	2.8	74	197	0	35	8	4.4	1.2	—	299	.41	62	0	72	4.1	415	—
21.433	do.	6/29/56	64	—	—	—	—	186	0	—	15	—	—	0.23	—	—	—	—	—	—	443	
30.17.15.131	Red Hill (D)	6/ 7/56	79	—	—	—	—	166	0	37	7.0	2.4	—	.84	—	—	67	0	—	2.9	368	7.8
31.16.17.1(294)	Ojo de las Cienegas	12/11/13	—	—	13	7.1	44	133	0	29	12	—	—	—	243	—	62	—	—	—	—	—
17.140	Las Cienegas (D)	3/29/56	—	—	—	—	—	142	0	28	7.0	2.4	—	—	—	—	33	0	—	4.1	317	
28.333	U-Bar Ranch	9/ 7/55	77	—	—	—	—	123	41	—	12	—	—	—	—	—	11	0	—	—	435	9.2
32.15.18.140a	Whitewater Wells (U)	1/28/52	65	—	—	—	89	283	0	64	23	1.6	—	—	—	—	142	—	58	3.2	625	—
32.16. 3.2(297)	New Wells	12/10/13	—	—	24	20	37	193	0	41	16	—	—	—	295	—	142	—	—	—	—	—
22.1(303)	Gilbert Wells	12/ 9/13	—	—	41	16	40	216	0	35	26	—	—	—	340	—	168	—	—	—	—	—
30.Lot 2	C. C. Edwards	11/23/53	—	38	41	6.4	19	129	0	28	21	.6	5.9	—	223	.30	129	24	24	.7	348	—
30.Lot 2	do.	6/29/56	65	—	—	—	—	126	0	—	6.5	—	—	.26	—	—	—	—	—	—	279	7.9
32.17.13.2(306)	Walnut Wells	12/ 9/13	—	—	31	8.6	28	160	0	20	16	—	—	—	200	—	113	—	—	—	—	—
33.17.33.4(312)	High Lonesome Wells	12/ 6/13	—	—	26	5.1	5.3	101	0	4.1	7.2	—	—	—	144	—	86	—	—	—	—	—
34.16.18.143	Antelope Wells (U)	3/29/56	—	36	25	4.0	75	179	0	62	15	3.6	2.1	—	311	.42	79	0	67	3.7	460	7.9
18.3(313)	Antelope Wells	12/ 3/13	—	—	17	2.6	62	139	0	48	17	—	—	—	254	—	53	—	—	—	—	—



R. 18 W.
R. 17 W.
R. 16 W.
T. 26 S.
T. 27 S.
T. 28 S.
PYRAMID MTS.
ANIMAS VALLEY
COYOTE HILLS
LOWER PLAYAS
LITTLE HATCHET
PLAYAS LAKE
HACHITA PEAK
HIDALGO CO.
GRANT CO.
SOUTHERN PACIFIC RAILROAD
Lone Hill
O'Neal
West Baker
Baker
Playas
Antelope
Mangold
Flanagan
Huntley
Pothook
Ringbone
Adams
McDonald
Tubbs
Camp Grounds
Thompson
Whitmire
Cottonwood Spring
4260
4280
4300
4400
4500
4600



PLAYAS
LAKE
VALLEY
ANIMAS
MOUNTAINS
HATCHET
MOUNTAINS
HACHITA PEAK
BIG HATCHET
BIG HATCHET PEAK
GILLESPIE MTN
GRANT CO.
HIDALGO CO.
T. 28 S.
T. 29 S.
T. 30 S.
Tubbs
Camp Grounds
Thompson
Whitmire
Cottonwood Spring
Sunny Slope
Willow Tree
Double Mills
Baldy
Lake View
Gold Hill
Artesian
Parker Ranch
Jacks Defeat
Lane Ranch
Hatchet Gap
Red Hill
Upshaw
Sand Bar
Benton Place
4280
4260
4300
4320
4340
EXPLANATION


EXPLANATION
Irrigation well
Flowing well
Other wells
Spring
4420
Contour on the water table, dashed where approximate; interval 20 feet (100 feet in Grant County). Datum is mean sea level. Contours based on water-level measurements made in 1955 and 1956
4487
59
Altitude of land surface
Depth to water below land surface
Playas Valley Underground Water Basin boundary as declared February 23, 1956
Animas Valley Underground Water Basin boundary as extended February 23, 1956
T. 30 S.
T. 31 S.
T. 32 S.
Upshaw
5187
GILLESPIE MTN
Red Hill
201
4320
4340
4360
4380
4400
4420
4300
4280
Sand Bar
4490
Benton Place
BIG HATCHET MTS
BIG HATCHET PEAK
Las Cienegas
4376
UPPER PLAYAS VALLEY
Steen Place
4443
New Wells
Old Walnut Well
New Walnut Well
Gilberts Wells
Lord Place
Lookout Wells
Bull Pasture
U-Bar Ranch
McDauws Wells
Spillsbury
5200
50
Lynch
5251
Rock Ridge
5112
81

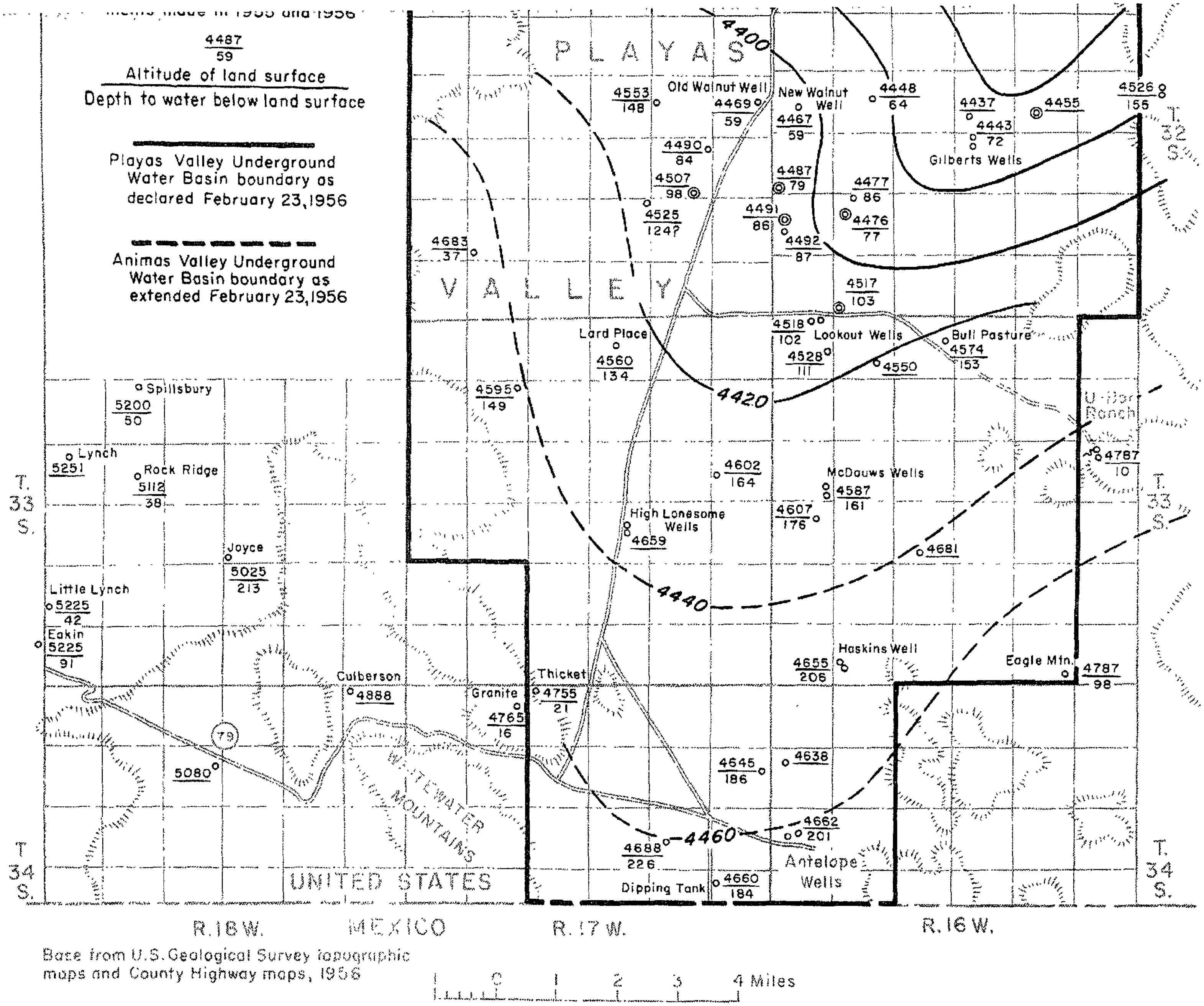


PLATE 1

Map of Playas Valley, Hidalgo County, N. Mex., showing boundaries of declared underground water basin, locations of wells, contours of the water table, and depth to water, 1955-56.

Robert Holder

From: Steve Finch [sfinch@shomaker.com]
Sent: Friday, November 02, 2007 6:30 PM
To: rholder@dahughes.net
Cc: 'Donaldson, Gerald R'
Subject: NMOCD requirements for exploration in T32S R17W
Attachments: Doty well table.pdf

Robert:

There is an excellent report on the Animas Basin describing the geology and hydrogeology that was prepared by the New Mexico Water Resources Research Institute. The report is titled Trans-International Boundary Aquifers in Southwestern New Mexico, dated March 2000. It was prepared for the EPA and International Boundary and Water Commission – U. S. Section. I have a paper copy, and Chapter 7 has most of what you need. There is also a report prepared by the New Mexico Office of the State Engineer: Doty, G. C., 1960, Reconnaissance of ground water in Playas Valley, Hidalgo County, New Mexico: New Mexico State Engineer Technical Report 15. The Doty report has water well data in tables and shown on maps. The nearest water wells to T32S R17W section 26 are in Sections 23 and 27. Attached is a copy of the well data for the area from Doty. The primary aquifer is the basin fill (alluvium and Upper Gila Conglomerate) and appears to be less than 700 ft thick in the area.

Let me know if you need more information or if you have questions.

Steven T. Finch, Jr.
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Table 3. Records of nonirrigation wells and springs in Playas Valley, Hidalgo County, N. Mex. (continued)

Well location	Owner or name	Driller	Date completed	Altitude above sea level (feet)	Depth of well (feet)	Diameter of well (inches)	Method of lift and power	Use of water	Size of discharge pipe (inches)	Water level: Above (+) or below land-surface datum (feet)	Water level: Date of measurement	Measuring point: Description	Measuring point: Height above or below (—) land-surface datum (feet)	Remarks
32 17. 1.422	Steen Place (D)	J. A. Cason	1922	4,443	118	5⅝	Lw	S	3	—	—	—	—	Temp. 67°F.
13.243	Old Walnut Well (D)	—	—	4,469	62	6	—	US	—	58.13 59.38	2-4-49 3-12-56	Top of casing	1.00	S-306, WL 56, 12-9-13.
14.133	R M Timberlake	—	—	4,553	—	6	Lw	S	2	140.34 147.92	7-28-54 12-21-55	do.	.70	—
23.224	do.	—	—	4,490	—	6	Lw	S	2	83.64 84.16	7-28-54 9-27-55	do.	1.40	Temp. 67°F, S-307, WL 72, 12-9-13.
27.222	Mrs. J. C. Frye	Bob Malone	1925	4,525	194	8	Lw	D	2	—	—	—	—	Owner reports water level at 124 feet.
29.330	State land	—	—	4,683	—	6	Lw	S	2	37.15	9-26-55	Top of wooden block	1.30	—
33.16. 4.240	Bull Pasture (U)	—	—	4,574	170	6	Lw	S	3	132.6P 132.7P	9-21-55 3-29-56	Top of casing	.70	—
5.400	U-Bar Ranch	Myles and Depauw Drilling Co.	1955	4,550	425	—	—	T	—	—	—		—	Uncased seismic shot-hole test well.
6.212	Lookout Wells (U)	—	—	4,518	—	6	Lw	S	2	101.84 103.64	9-9-55 4-21-56	Top of casing	1.20	West well of 2 Temp. 71°F.
6.422	U-Bar Ranch	—	1955	4,528	600	6½	—	T	—	111	1-6-56	Land surface	—	Uncased test well
13.120	do.	—	—	4,787	130	6	Lw	DS	2	—		-	—	U-Bar Ranch headquarters, large spring north of well. S-309, WL 0, 12-7-13.
18.440	McDauw's Wells (U)	—	—	4,587	170	8	Lw	S	3	161 164.0P	11-19-55 5-21-56	Top of casing	1.80	South well of 2
19.200	U-Bar Ranch	—	1955	4,607	576	6¼	—	T	—	—	—	Land surface	—	Uncased test well.
21.342	do.	—	1955	4,681	181	4¾	—	T	—	—	—	—	—	Do.
32.310	Haskins Wells (U)	—	—	4,655	—	5⅝	Lw	S	3	205.85 209.3P	12-19-55 4-27-56	Top of casing	1.20	Southeast well of 2.
35.441	Eagle Mountain (U)	—	—	4,787	144	—	Lw	S	3	101 93.5P	11-18-55 12-19-55	do.	—	South well of 2.
33 17. 3.144	Lard Place (D)	Joe Eicks	1927	4,560	140	6	Lw	DS	2	134.10 134.2P	11-19-55 12-19-55	do.	.25	Temp. 69°F. S-311, WL 125, 12-8-13.
8.220	R. M. Timberlake	W. C. Wright	—	4,595	172	6	Lw	S	2	148.73	12-19-55	do	.70	Well cleaned April-May 1956; casing perforated 149-172 feet
13.311	U-Bar Ranch	Simpson	1955	4,602	998	6¼	—	T	—	163.95	12-19-55	Land surface	—	Uncased test well.