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**DEVELOPMENT OF GROUND WATER FOR IRRIGATION IN
THE DELL CITY AREA, HUDSPETH COUNTY, TEXAS**

BY

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UNITED STATES GEOLOGICAL SURVEY

**PREPARED COOPERATIVELY BY THE GEOLOGICAL SURVEY,
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PURPOSE OF THE INVESTIGATION

Prior to 1947, ground water in the Dell City area of Hudspeth County, Tex., was used only for watering livestock and for supplying ranch headquarters. During the three years from 1947 through 1949 there was a rapid development of ground water for irrigation. In 1949 32 wells were used, out of a total of 78 that have been drilled, and 6,000 acres were irrigated. The purpose of the investigation described in this report is to determine, insofar as practicable, the source, direction of movement, quantity, and quality of the ground water in the Dell City area. The investigation was made as a part of the cooperative ground-water investigations in Texas by the United States Geological Survey and the Texas State Board of Water Engineers.

LOCATION AND EXTENT OF AREA

The Dell City irrigation area is in the northeastern part of Hudspeth County. Dell City, which is approximately the center of the present development, is about 13 miles north of U. S. Highway 62, 16 miles west of the Hudspeth-Culbertson County line, and 75 miles east of El Paso. (See index map on pl. 1.) Approximately 40,000 acres of irrigable land lie in the general area west of the Salt Lakes between U. S. Highway 62 and the New Mexico line. There is irrigable land across the State line in New Mexico; however, this report does not discuss the ground-water development in that area.

ACKNOWLEDGMENTS

Reports by King 1/ have been consulted freely for information concerning the geology of the region and his geologic map was used in this report with some minor additions and revisions based on new information from drillers logs of recently drilled wells. Appreciation is expressed to the well drillers, well owners, farmers, and ranchers who so generously supplied information used in this report.

1/ King, P. B., Permian of west Texas and southeastern New Mexico: Am. Assoc. Petroleum Geologists Bull., vol. 26, pp. 535-763, 1942; Geology of the southern Guadalupe Mountains, Tex., U. S. Geol. Survey Prof. Paper 215, 1948.

SURFACE FEATURES AND DRAINAGE

The land surface of the irrigated area surrounding Dell City is an outwash plain that is bordered on the east by the Salt Basin and on the north, west, and south by limestone uplands. The Salt Basin is a depression about 150 miles in length and 5 to 15 miles in width, which lies between Sierra Diablo and Diablo Plateau on the west and the Delaware and Guadalupe Mountains on the east. According to King ^{2/} the basin floor is probably the bottom of a lake or succession of lakes that filled the lowest part of the Salt Basin in Pleistocene time. Old beaches are clearly shown on aerial photographs; they lie about 40 feet above the lowest points on the floor of the basin. The alkali flats, locally known as salt lakes, are among the most conspicuous features of the basin floor.

The Guadalupe Mountains form the most prominent land feature of the region. Guadalupe Peak, which lies about 25 miles southeast of Dell City, is the highest point in Texas, 8,751 feet above sea level. Igneous intrusives make up the Cornudas Mountains and Sierra Tinaja Pinta, which lie west of the outwash plain. The Wilcox Hills, which are composed of limestone, and an igneous intrusion locally known as Round Hill, stand about 150 feet above the plain itself.

Salt Basin is a closed basin. The Sacramento River drains approximately 1,300 square miles north and west of the area. It flows only after heavy rains, except in its extreme northern reaches. It is reported that flows from the river seldom reach the Salt Basin. The remainder of the streams that drain into the Basin are intermittent and, like the Sacramento River, carry water only after heavy rains.

CLIMATE

The climate of the region is typical of the arid Southwest. The winters are comparatively short and mild. Throughout the other seasons of the year temperatures are relatively high. The annual rainfall is small. At the Salt Flat emergency air field the annual precipitation averaged about 9 inches for a 10-year period (table 1). Rainfall probably is greater in the mountainous areas to the north and east than at Dell City. Figure 1 shows graphically the monthly temperature, precipitation, and rates of evaporation from a free-water surface at the Agriculture College, Las Cruces, N. Mex., which is 100 miles northwest of Dell City. The figure shows also the average monthly precipitation at the Salt Flat emergency air field. The potential annual evaporation is, on the average, 9 times greater than the annual precipitation. The greater part of the precipitation occurs during the summer, when the temperature is high; consequently evaporation and transpiration dissipate most of the water that reaches the ground in the Dell City area.

^{2/} King, P. B., op. cit., Prof. Paper 215, pp. 137-157, 1948.

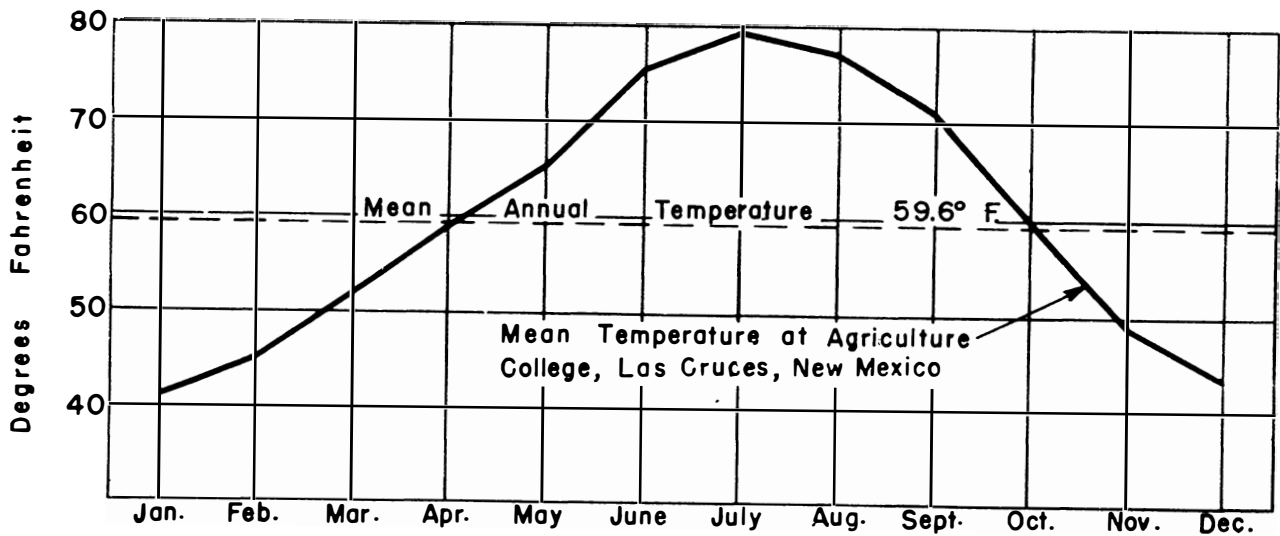
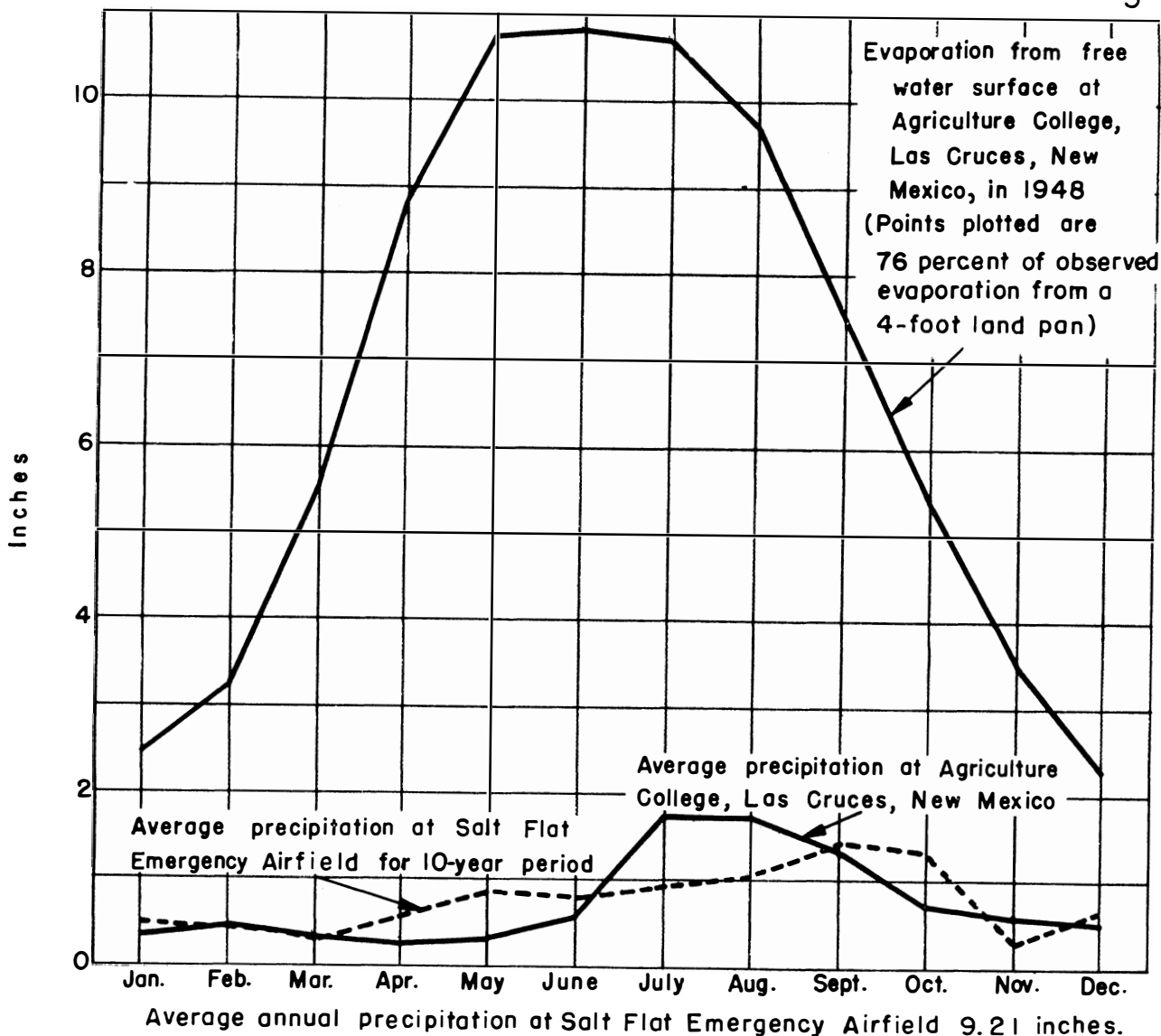


FIGURE I.-Graphs showing evaporation, precipitation, and temperature near the Dell City area.

Table 1. Monthly and annual precipitation, in inches, at Salt Flat Station, Dell City area, Hudspeth County, Texas

From U. S. Weather Bureau Publications

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1940	-	-	0.14	0.30	1.81	1.70	1.01	1.83	0.19	1.86	0.48	0.25	<u>1/</u>
1941	.04	1.38	1.04	2.59	1.35	-	1.95	1.95	4.66	2.80	.12	.78	<u>1/</u>
1942	.07	.12	.02	1.27	.22	2.04	.67	.33	.25	1.01	.02	1.18	7.20
1943	.00	-	.02	.11	.79	1.16	-	.13	.30	-	.87	1.46	<u>1/</u> 4.84
1944	.44	1.01	-	.64	.64	.16	-	1.27	2.22	.11	-	-	<u>1/</u> 6.49
1945	.45	.00	.75	.00	.00	.21	.38	.23	.27	3.06	.00	.06	5.41
1946	1.07	.00	.11	.00	.99	.12	.99	.67	1.50	1.18	.24	.45	7.32
1947	.58	-	.26	.07	1.64	.01	.32	1.37	.70	.92	.42	.35	<u>1/</u> 6.70
1948	-	-	-	-	-	.93	1.18	1.98	.03	.22	.00	.55	4.89
1949	1.17	.07	.00	.22	.55	.56	1.37	.64	4.52	-	-	-	-
Average	.48	.43	.29	.58	.89	.76	.98	1.04	1.46	1.39	.27	.64	<u>2/</u> 9.21

1/ Record incomplete.

2/ Sum of average monthly precipitations.

GEOLOGY

Areal Geology

The rocks that crop out in the area are shown on plate 1. The principal water-bearing formation is the Bone Spring limestone of the Leonard series of Permian age. The Bone Spring limestone was divided by King 3/ into three members, which are, in ascending order: the black limestone member, the Victorio Peak gray member, and the Cutoff shaly member. Following is King's description of the Bone Spring limestone, as it occurs in the Guadalupe Mountains where it attains a thickness of several thousand feet.

The Bone Spring is composed almost entirely of limestone beds, as contrasted with the dominantly sandy strata of the Delaware Mountain group which overlies it. In the Delaware Mountains and extending as far north as Bone Canyon, the exposed parts of the formation are black, cherty limestone in thin beds, with partings and a few members of shaly limestone and siliceous shale. North of Bone Canyon in the Guadalupe Mountains, the upper part of the black limestone is replaced by a thick-bedded gray limestone, the Victorio Peak gray member, which also forms the capping stratum of the Sierra Diablo. Between the main mass of limestones and the sandstone of the Delaware Mountain group is a small thickness of interbedded limestone and shale, which forms the Cutoff shaly member and its probable equivalents.

3/ King, P. B., op. cit., Prof. Paper 215, pp. 12-14, 1948.

The part of the Bone Spring that crops out in the Dell City irrigation area is a gray thick-bedded dolomitic limestone and is probably the Victorio Peak gray member. Dolomitic limestone, chert, and calcareous sand have been collected from wells drilled in the area.

An igneous intrusive of Tertiary age stands near the east edge of the irrigated area, and an igneous sill has been reported in three wells about half a mile south of the intrusive.

Undifferentiated alluvial deposits of Pleistocene and Recent age that consist of silty loam, sand, and gravel cover the Bone Spring in most of the irrigation area. Drillers' logs indicate that these deposits range in thickness from about 5 feet to 150 feet throughout most of the developed area. The floor of the Salt Basin is clay and unconsolidated gypsum of Pleistocene age, probably deposited in a former shallow lake.

Geologic Structure

The cross sections on plate 1 show the general geologic structure in the Dell City area. The east-west cross section shows the Bone Spring limestone beneath the alluvial fill and the deep structural trough of the Salt Basin which is filled with alluvium. The depth of the fill in the Basin has not been determined, but a well immediately east of a north-south fault or fault zone along the east side of the irrigated area did not reach bedrock at a depth of approximately 300 feet. According to Baker, ^{4/} a well about 30 miles southeast of Dell City did not completely penetrate the alluvial material at a depth of 1,620 feet.

The north-south cross section shows an old erosional surface covered with alluvium and a fault at the south side of the irrigated area. This fault trends northwest-southeast, and logs of wells drilled near it indicate a displacement of less than 100 feet.

OCCURRENCE OF GROUND WATER

The rock that make up the outer crust of the earth contain water in the small openings, called voids and interstices, between the mineral grains. The number, size, shape, and arrangement of these interstices depend upon the character of the rocks. They range in size from very small openings in clay and consolidated rocks to large caverns in some limestones. The interstices are generally connected so that water may percolate from one to another. The rate of movement of ground water is controlled in part by the size of the interstices in the water-bearing medium.

In the Dell City area a number of drillers have reported caverns and other places in the limestone where they could get no cuttings from the hole, indicating a limestone with relatively large openings along joints and bedding planes--openings that probably have been enlarged by the solution of the limestone by ground water as it moved through the formation. The drillers also report

^{4/} Baker, C. L., Structural geology of Trans-Pecos Texas: Texas Univ. Bull. 3401, p. 171, 1935.

honeycomb limestone and soft porous limestone, probably a result of the same action. The erratic distribution of these solution channels and other openings introduces an element of chance into the prospecting for water in the area underlain by limestone. The erratic distribution of openings in the Bone Spring limestone is attested by the fact that, of the wells drilled for irrigation, more than 50 percent failed to penetrate a zone in the limestone capable of delivering quantities of water to the wells sufficient for practicable irrigation.

The porosity of a rock is the percentage of the total volume of the rock that is occupied by openings. A rock containing small openings may have a high porosity but water will not move through it easily, whereas a coarse-grained or cavernous rock, which may have a lower porosity, may yield water to wells more readily. The alluvial material thus far penetrated in wells drilled east of the north-south fault consists of interbedded clay and fine-grained sand, and, although its porosity may be very high, it does not transmit water to wells in sufficient quantities to produce large yields.

The altitude of the piezometric surface in the Dell City area has been determined by instrumental leveling. Contrary to normal expectation, the water surface in the Bone Spring limestone has an almost uniform elevation of about 3,625 feet above sea level throughout the entire irrigated area. This is a limiting factor in the development of the area because, as the land surface rises westward, the depth to water becomes proportionately greater until pumping lifts are too great for economical use of the water. The relatively level surface of the water may result from damming action caused by the abrupt change in the character of the water-bearing material and a consequent change in permeability at the north-south fault line along the east side of the area, or from some other structural feature not disclosed by this investigation.

Recharge to the Ground-Water Reservoir

The extent of the area supplying natural recharge to the irrigated area is not known. The Bone Spring limestone crops out for a long distance along the Sacramento River. The Sacramento River, which drains an area of about 1,300 square miles, loses most of its water before reaching the Salt Flats, and it is believed that seepage from the river is the chief source of recharge to the ground-water reservoir. Some direct penetration of rainfall and seepage along the smaller intermittent streams also probably contributes to the recharge.

Natural Discharge from the Ground-Water Reservoir

East of the north-south fault, where the water is in alluvium, the water table slopes eastward toward the salt lakes at the rate of about 4 feet per mile. The relatively steep slope of the water table east of the fault indicates that the lakes are the principal area of discharge of the

ground-water reservoir. The lake floor has an altitude of 3,616 feet at a point just east of the irrigated area and is nearly level over its entire 37,000 acres. During the summers of 1948 and 1949, water stood from 3 to 3.5 feet below the lake bed in a narrow ditch along U. S. Highway 62. Water from this depth is brought to the surface by capillary action and is discharged by evaporation. Evaporation from a free-water surface in this region is about 80 inches a year (fig. 1). Consequently, the discharge by evaporation of capillary water from the surface of the lake floor is great, although probably less than evaporation from a free water surface. Water occasionally collects in the lakes after unusually heavy rains, but the water table is below the land surface most of the time.

DEVELOPMENT OF GROUND WATER

Prior to 1947 the only use of ground water in the area was for ranch headquarters and livestock. During the three-year period 1947-49, inclusive, 78 wells were drilled for the purpose of irrigation. However, only 32 of the wells, which have yields that range from 350 to 3,000 gallons a minute and average about 1,400 gallons a minute, were used for irrigation in 1949. Three wells had not been tested, and the other 43, which had yields reported to range from 200 to 600 gallons a minute, were not used. Tests on eight of the production wells showed an average specific capacity of 100 gallons a minute per foot of drawdown. About 2,500 acres were irrigated in 1948 and about 6,000 acres in 1949. Feed crops were planted on approximately 500 acres each year, and cotton was grown on the remainder of the acreage. It is estimated that about 18,000 acre-feet of water or about 3 acre-feet per acre was used in 1949.

FLUCTUATION OF WATER LEVELS

Measurements of the depths to water in wells in the Dell City area have been made periodically since March 1948. These measurements are shown in table 4 on pages 34-37. A comparison of the water levels in 11 wells that were measured in March 1948 and again in February 1949 shows an average net decline of 0.4 foot. A comparison of the water levels in 13 wells that were measured in February 1949 and again in February 1950 shows an average net decline of 0.36 foot.

QUALITY OF WATER

The chemical analyses of water from 20 wells and 1 spring in the Dell City area are tabulated in table 5, page 38.

The principal use of water in this area is for irrigation. The analyses show that the water is of satisfactory quality for the watering of most crops. The water in the shallow alluvial deposits in the eastern part of the area is more highly mineralized than the water in the Bone Spring limestone. Analyses of water from the deeper alluvial deposits are not available.

The following classification 5/ has often been used as a guide in evaluating irrigation waters:

Water class	Conductance (Micromhos at 25°C.)	Salt content		Sodium (percent)	Boron (ppm)
		Total (ppm)	Per acre-ft. (tons)		
Class 1 ¹	1,000	700	1	60	0.5
Class 2 ²	1,000-3,000	700-2,000	1-3	60-75	.5-2.0
Class 3 ³	3,000	2,000	3	75	2.0

1. Excellent to good, suitable for most plants under most conditions.
2. Good to injurious, the higher concentrations probably harmful to the more sensitive crops.
3. Injurious to unsatisfactory, probably harmful to most crops and unsatisfactory for all but the most tolerant. If a water falls in class 3 on any basis -- that is, conductance, salt content, percentage of sodium, or boron content, it should be classed as unsuitable under most conditions. Should the salts present be largely sulfates, the values for salt content in each class can be raised 50 percent.

The concentration of sulfate, which on the average is about 750 parts per million, is about 500 parts per million above the standard set by the U. S. Public Health Service 6/ for public consumption on interstate carriers. All water contained dissolved solids -- in excess of the limits of 1,000 parts per million recommended for an acceptable municipal supply. The water may have an objectionable taste and may cause temporary intestinal disturbance. A very small percentage of the water pumped in the Dell City area is used for domestic purposes.

CONCLUSIONS

The performance of some of the larger irrigation wells in the Dell City area during the 3-year period 1947-49 indicates that the underground reservoir in the Bone Spring limestone is large. As yet there has been no serious decline of water levels in wells, but sufficient data are not available to estimate the maximum practicable rate of withdrawal from the ground-water reservoir. Most of the water that lies at or just below the present lake floor east of the irrigated area is probably supplied by overflow or seepage from the adjacent limestone reservoir. The large average annual loss by evaporation from the lake floor under natural conditions is probably a measure of the average annual recharge to the limestone reservoir; it has not been estimated.

5/ Magistad, O. C., and Christiansen, J. E., Saline soils: U. S. Dept. Agr. Cir. 707, 1944.

6/ Public Health Service drinking water standards: Public Health Service, vol. 61, pp. 371-384, 1946.

The data obtained during this investigation suggest possibilities for further expansion, although development of the area has been hampered by the fact that a rather large percentage of the wells yield insufficient quantities of water for large-scale irrigation. However, many of the unsatisfactory wells were drilled outside the area most suitable for irrigation, which appears to be limited on the east by the lake beds and on the west by the indefinite line beyond which the depth to water is too great for economical pumping.

A large number of the wells that have comparatively low yields did not penetrate the most permeable rocks, characterized by solution channels that permit almost unrestricted underground flow. Some wells of low yield are within a few hundred feet of wells having sufficient yields for successful irrigation. It is believed that treatment with acid might increase the percentage of successful wells. There is also a possibility of increasing the yield of some wells by drilling deeper. No information is available regarding the permeability of lower beds or the quality of water that might be obtained from them.

Table 2. Records of wells in Dell City area, Hudspeth County, Texas

Method of lift: C, cylinder; E, electric; G, gasoline or butane; H, hand; O, oil or Diesel; T, tubine; W, windmill. Number indicates horsepower.

Use of water: D, domestic; Irr, irrigation; N, not used; S, stock.

Well	Distance from Dell City	Owner	Driller	Date completed	Altitude of measuring point (ft.)
1	10 miles west	W. A. Stroman	--	Old	--
2	8 $\frac{1}{2}$ miles southwest	do.	--	1948	4,106 ^a
3	5 $\frac{1}{2}$ miles west	do.	--	Old	--
4	3 $\frac{1}{4}$ miles northwest	Catholic Church	Mountain Drilling Co.	1949	--
5	2 miles northwest	Donald C. Bennett	Hays Bros.	1949	--
6	2 miles west	do.	Evel Ross	1948	3,779.45
7	1 mile west	do.	Hays Bros.	1948	3,758.43
8	1 $\frac{1}{4}$ miles west	James P. Williams	Evel Ross	1948	3,754.98
9	do.	do.	Mountain Drilling Co.	1948	3,754.18
10	1 mile west	do.	Jordon Drilling Co.	1947	3,760.02
11	2 miles southwest	F. W. Dodson	Evel Ross	1948	3,781.65
12	2 $\frac{1}{2}$ miles southwest	E. L. Stone	do.	1948	3,766.33
13	4 $\frac{1}{2}$ miles southwest	R. L. Merrill	--	Old	3,768.0
14	do.	do.	Mountain Drilling Co.	1948	3,784.16
15	2 $\frac{1}{2}$ miles south	Jess Tillery	D. C. Slater	1949	--
16	2 $\frac{1}{4}$ miles south	do.	do.	1949	--
17	1 $\frac{1}{4}$ miles southwest	do.	do.	1949	--

a/ Water level reported by driller or owner.

Table 2. Principal water-bearing formation is the Bone Spring limestone unless otherwise noted in remarks. All wells drilled unless otherwise noted.

Well	Height of measuring point above ground (ft.)	Depth of well (ft.)	Diameter of well (in.)	Water level		Method of lift	Use of water	Remarks
				Below land surface (ft.)	Date of measurement			
1	--	550	8	a/530.0	Feb. 10, 1949	C,W	S	
2	--	600	8	a/500.0	do.	C,W	S	
3	--	350	8	a/320.0	do.	C,W	S	
4	1.3	750	16	182.0	Aug. 16, 1949	None	N	
5	--	420	--	a/160.0	1949	None	N	
6	0.0	350	--	154.9	Feb. 3, 1949	None	N	See log.
7	--	200	16	--	--	T,O	Irr	Casing: 20 feet.
8	0.4	230	16	129.9	Feb. 3, 1949	T,G, 80	Irr	Yield 860 gallons a minute, Aug. 26, 1948.
9	--	187	16	a/128.0	Nov. 11, 1948	T,G, 80	Irr	Casing: 52 feet. See log.
10	1.0	237	16	133.7	Mar. 12, 1948	T,G, 100	Irr	Casing: 50 feet. Drawdown 13 feet after pumping 8 days at 1,500 gallons a minute, measured Aug. 26, 1948.
11	0.0	361	18, 12	156.2	do.	None	N	
12	0.7	275	16	140.7	Feb. 3, 1949	None	N	Casing: 14 feet. Yield reported 600 gallons a minute when tested. See log.
13	0.5	--	7	142.0	Dec. 9, 1948	None	N	
14	0.5	500	16	158.2	Nov. 8, 1948	C,W	D	See log.
15	--	185	20	--	--	None	N	Abandoned.
16	0.0	250	20	78.3	Nov. 29, 1949	None	N	To be used for irrigation. See log.
17	0.0	300	20	81.5	do.	None	N	Drawdown reported 15 feet while pumping 1,500 gallons a minute. Will be used for irrigation. See log.

Table 2. Records of wells in Dell City area, Hudspeth County -- Continued

Well	Distance from Dell City	Owner	Driller	Date completed	Altitude of measuring point (ft.)
18	1 $\frac{1}{4}$ miles southwest	Byron Jordon	Jordon Drilling Co.	1948	--
19	do.	do.	do.	1948	--
20	1 mile west	Donald C. Bennett	Hays Bros.	1949	--
21	$\frac{1}{2}$ mile west	James P. Williams	Mountain Drilling Co.	1948	3,719.92
22	$\frac{1}{2}$ mile northwest	Donald C. Bennett	W. E. Hellyer	1948	3,712.60
23	1 mile northwest	do.	Mountain Drilling Co.	1948	3,732.11
24	1 $\frac{1}{4}$ miles northwest	do.	W. E. Hellyer	1948	3,735.92
25	1 $\frac{1}{4}$ miles northwest	D. I. Leatherman	Jordon Drilling Co.	1947	3,744.97
26	do.	do.	Mountain Drilling Co.	1948	3,744.76
27	1 $\frac{1}{2}$ miles northwest	J. A. Donathan	Hays Bros.	1949	--
28	do.	do.	do.	1949	--
29	2 $\frac{1}{4}$ miles northwest	M. R. and G. J. Collier	Leslie Carter	1949	3,729±
30	3 $\frac{3}{4}$ miles north	James Napier	-- Nordyke	1947	3,713.01
31	3 $\frac{1}{2}$ miles north	do.	--	Old	3,702.34
32	do.	do.	--	1949	--

Table 2 -- Continued

Well	Height of measuring point above ground (ft.)	Depth of well (ft.)	Diameter of well (in.)	Water level		Method of lift	Use of water	Remarks
				Below land surface (ft.)	Date of measurement			
18	0.0	--	--	92.6	Sept. 23, 1949	None	N	
19	0.0	--	--	86.8	do.	None	N	
20	1.0	200	16	129.4	do.	T	N	Casing: 15 feet.
21	0.6	250	16	94.1	Mar. 12, 1948	T,G	Irr	Drawdown 21 feet while pumping 1,250 gallons a minute, measured Aug. 26, 1948. Temp. 68° F.
22	0.8	304	18	87.0	Feb. 3, 1949	None	N	
23	1.2	250	18	106.2	do.	None	D,S	Casing: 120 feet.
24	1.5	200	18	109.6	do.	T,G	Irr	Drawdown 8 feet after pumping 3 hours at 1,100 gallons a minute, measured Aug. 26, 1948.
25	0.0	248	18	119.9	do.	None	N	Casing: 40 feet. See log.
26	1.2	390	18	118.5	do.	None	N	Casing: 15 feet. See log.
27	--	322	--	a/110.0	Nov. 29, 1949	None	N	Yield reported 400 gallons a minute. See log.
28	--	225	--	a/106.0	do.	None	N	Well not completed when visited. See log.
29	--	304	16	a/104.0	Feb. 3, 1949	T,O	Irr	Casing: 60 feet. Drawdown reported 45 feet while pumping 1,500 gallons a minute. See log.
30	0.0	280	16	87.9	Mar. 11, 1948	None	N	Drawdown 20 feet after pumping one hour at 350 gallons a minute, measured Aug. 26, 1948. Well not used in 1949.
31	2.0	--	6	75.2	do.	None	N	
32	--	250	16	a/ 80.0	Nov. 29, 1949	T,G	Irr	

Table 2. Records of wells in Dell City area, Hudspeth County -- Continued

Well	Distance from Dell City	Owner	Driller	Date completed	Altitude of measuring point (ft.)
33	1 $\frac{1}{2}$ miles north	Geo. S. McConnell	Evel Ross	1949	3,714
34	do.	do.	Jordon Drilling Co.	1948	3,713.96
35	1 mile north	J. P. Williams and F. W. Dodson	Evel Ross	1949	--
36	$\frac{3}{4}$ mile north	do.	Mountain Drilling Co.	1949	--
37	$\frac{1}{4}$ mile north	C. W. Voyles	Frank Gentry	1948	3,703.63
38	In Dell City	do.	Mountain Drilling Co.	1948	3,699.69
39	do.	do.	--	1948	3,700.21
40	$\frac{1}{4}$ mile south	do.	Evel Ross	1948	3,698.56
41	$\frac{1}{2}$ mile south	do.	do.	1949	--
42	$\frac{3}{4}$ mile southeast	do.	Jordon Drilling Co.	1947	3,688.42
43	1 $\frac{1}{4}$ miles southeast	S. L. and N. R. Hays	Evel Ross	1948	3,675.83
44	1 mile south	do.	Hays Bros.	1949	3,692.19
45	do.	do.	do.	1948	--
46	do.	do.	do.	1949	--

Table 2 -- Continued

Well	Height of measuring point above ground (ft.)	Depth of well (ft.)	Diameter of well (in.)	Water level		Method of lift	Use of water	Remarks
				Below land surface (ft.)	Date of measurement			
33	--	230	16	a/ 90.0	Mar. 1949	T,O	Irr	Casing: 145 feet. Wells 33 and 34 are 20 feet apart and are affected by mutual interference. Drawdown reported by Soil Conservation Service 44 feet when both wells are pumping.
34	1.1	255	20	87.9	Feb. 3, 1949	T,O	Irr	Casing: 80 feet. Drawdown 20 feet after pumping 4 months at 1,300 gallons a minute; measured by Soil Conservation Service. See log.
35	--	260	16	--	--	None	N	
36	--	260±	16	--	--	T	N	
37	--	--	6	--	--	--	--	Test hole.
38	0.5	175	16	75.7	Sept. 28, 1948	None	N	Casing: 175 feet. See log.
39	1.5	238	16	77.7	Aug. 13, 1948	C,W	D,S	Casing: 220 feet. See log.
40	0.0	240	--	75.8	Feb. 3, 1949	None	N	See log.
41	--	230	16	--	--	None	N	Casing: 20 feet. Drawdown reported 20 feet while pumping 1,800 gallons a minute. Will be used for irrigation.
42	0.9	220	16	62.5	Mar. 1, 1948	T,G	Irr	Casing: 120 feet. Drawdown 5 feet after pumping 3 months at 1,800 gallons a minute; measured Aug. 26, 1948. Temp. 68° F.
43	0.0	235	--	51.2	Feb. 3, 1949	None	N	See log.
44	0.0	245	16	68.7	Nov. 28, 1949	T,O, 220	Irr	Casing: 15 feet. Pump set at 110 feet. See log.
45	0.0	268	16	69.6	Sept. 23, 1949	T,O, 120	Irr	Casing: 15 feet. Pump set at 150 feet.
46	--	285	16	--	--	T,O	Irr	Casing: 15 feet. Pump set at 110 feet.

Table 2. Records of wells in Dell City area, Hudspeth County -- Continued

Well	Distance from Dell City	Owner	Driller	Date completed	Altitude of measuring point (ft.)
47	1 mile south	S. L. and N. R. Hays	Hays Bros.	1949	--
48	1½ miles south	do.	Mountain Drilling Co.	1948	3,682.86
49	2¼ miles south	do.	Jim Folk	1948	3,681.69
50	2¼ miles southeast	do.	do.	1948	3,665.32
51	2 miles southeast	R. L. Merrill	Mountain Drilling Co.	1948	3,664.02
52	do.	do.	do.	1948	3,662.16
53	do.	do.	do.	Old	3,654.96
54	1½ miles southeast	Frank Gentry	do.	1948	3,662.01
55	1¼ miles southeast	do.	Frank Gentry	1948	3,664.18
56	do.	do.	do.	1948	3,668.40
57	1 mile southeast	do.	do.	1948	--
58	1 mile east	do.	do.	1948	3,672.58
59	do.	do.	do.	1948	3,672.59
60	do.	do.	do.	1948	3,673.00
61	do.	do.	do.	1948	--

Table 2 -- Continued

Well	Height of measuring point above ground (ft.)	Depth of well (ft.)	Diameter of well (in.)	Water level		Method of lift	Use of water	Remarks
				Below land surface (ft.)	Date of measurement.			
47	--	250	16	--	--	T,O	Irr	Casing: 15 feet. Pump set at 110 feet. Wells 44, 45, 46, and 47 are in a line about 50 feet apart; pumping level reported 105 feet when all wells are pumping at approximately 1,500 gallons a minute each.
48	1.0	200	16	58.0	Feb. 3, 1949	T,O, 200	Irr	Yield reported 1,800 gallons a minute.
49	1.5	300	--	57.6	Nov. 18, 1948	C	D	See log.
50	0.0	270	--	41.2	do.	None	N	Do.
51	0.0	230	--	39.5	do.	None	N	Do.
52	0.0	250	16	37.5	do.	T,G, 140	Irr	Casing: 20 feet.
53	1.0	--	6	30.8	do.	None	N	Water-bearing formation unknown.
54	0.0	205	--	37.7	Feb. 3, 1949	None	N	Casing: 20 feet. See log.
55	0.0	165	--	40.2	do.	None	N	
56	0.0	250	18	44.3	Nov. 18, 1948	T,G, 140	Irr	Casing: 80 feet. Draw-down reported 40 feet while pumping 2,400 gallons a minute.
57	--	250	--	a/ 45.0	--	None	N	
58	1.0	201	18	47.6	Feb. 3, 1949	T,G, 100	Irr	Casing: 68 feet. Draw-down 22 feet.
59	1.0	187	18	47.7	do.	T,G, 100	Irr	Casing: 68 feet. Draw-down 24 feet. Combined yield of wells 58, and 59 4,500 gallons a minute; measured Aug. 26, 1948.
60	1.0	201	7	47.5	Mar. 3, 1948	C,W	D,S	Casing: 80 feet. See log.
61	--	278	--	--	--	--	N	Abandoned.

Table 2. Records of wells in Dell City area, Hudspeth County -- Continued

Well	Distance from Dell City	Owner	Driller	Date completed	Altitude of measuring point (ft.)
62	2 $\frac{1}{2}$ miles northeast	A. M. Stone	W. E. Hellyer	1949	--
63	do.	do.	do.	1949	--
64	3 miles northeast	do.	do.	1949	--
65	3 $\frac{1}{4}$ miles northeast	Dr. Beloe Stone	do.	1949	--
66	2 $\frac{1}{4}$ miles northeast	C. W. Voyles and R. L. Merrill	--	1947	3,652.89
67	do.	do.	Mountain Drilling Co.	1947	3,652.41
68	2 $\frac{3}{4}$ miles northeast	do.	-- Nordyke	1947	3,651.48
69	2 $\frac{1}{2}$ miles east	Wayne Chandler	do.	1947	3,650.19
70	3 $\frac{3}{4}$ miles southeast	Guitar Estate	do.	1947	3,639.29
71	3 $\frac{1}{2}$ miles southeast	B. F. Jarvis	--	--	3,645.04
72	do.	do.	W. E. Hellyer	1948	3,645.75
73	3 $\frac{1}{4}$ miles southeast	do.	do.	1948	3,645.28
74	3 miles east	James Napier	-- Nordyke	1948	3,645.95
75	3 $\frac{1}{8}$ miles east	C. W. Voyles	Mountain Drilling Co.	1948	3,644.89
76	3 miles northeast	Roy Keeney	--	--	3,653.20
77	3 $\frac{1}{4}$ miles northeast	do.	--	1948	3,650.55
78	4 $\frac{3}{4}$ miles northeast	E. O. Brownfield	-- Nordyke	1948	3,646.85

Table 2 -- Continued

Well	Height of measuring point above ground (ft.)	Depth of well (ft.)	Diameter of well (in.)	Water level		Method of lift	Use of water	Remarks
				Below land surface (ft.)	Date of measurement			
62	--	140	16	a/44.0	Sept. 8, 1949	T,O	Irr	Casing: 37 feet. Yield reported 1,800 gallons a minute.
63	--	240	16	a/44.0	do.	T,O	Irr	Do.
64	--	425	--	a/39.0	do.	None	N	Yield reported 150 gallons a minute.
65	--	240	16	a/40.0	do.	None	N	Casing: 12 feet. Yield reported 600 gallons a minute. See log.
66	1.0	250	16	29.2	Mar. 2, 1948	T,G	Irr	Casing: 250 feet. Draw-down 37 feet at a reported yield of 700 gallons a minute.
67	1.5	250	16	27.3	do.	T,G	Irr	Casing: 70 feet. Draw-down 41 feet while pumping 620 gallons a minute; measured Sept. 2, 1948.
68	2.5	250	16	25.4	Feb. 3, 1949	None	N	Casing: 250 feet.
69	0.8	200+	16	25.8	do.	T,G	Irr	Casing: 200 feet. Yield reported 800 gallons a minute.
70	0.5	100	16	18.8	Aug. 12, 1948	T,G	D,S	Casing: 100 feet, perforated 70 feet. Water-bearing formation, alluvium.
71	1.0	300	16	21.0	Aug. 6, 1948	T,G	Irr	Casing: 25 feet.
72	0.8	150	16	21.1	Feb. 3, 1949	None	N	Do.
73	0.0	150	16	21.9	do.	None	N	Do.
74	0.9	300	16	21.5	Mar. 11, 1948	T,G	Irr	Casing: 300 feet, perforated. Yield estimated 350 gallons a minute.
75	1.3	118	16	19.9	do.	None	N	Water-bearing formation, unknown.
76	3.5	200	16	25.8	do.	C,W	D,S	Do.
77	0.8	200	16	25.6	do.	T,G	Irr	
78	0.9	250	14	22.7	Nov. 8, 1948	None	N	Casing: 100 feet.

Table 2. Records of wells in Dell City area, Hudspeth County -- Continued

Well	Distance from Dell City	Owner	Driller	Date completed	Altitude of measuring point (ft.)
79	4 $\frac{1}{2}$ miles northeast	E. O. Brownfield	-- Nordyke	1948	3,650.21
80	4 $\frac{1}{4}$ miles northeast	do.	Evel Ross	1949	--
81	5 miles northeast	do.	do.	1948	3,669.69
82	do.	do.	do.	1949	3,669.50
83	5 $\frac{1}{2}$ miles northeast	do.	--	Old	3,648.90
84	4 $\frac{1}{2}$ miles northeast	C. W. List	--	--	3,644.25
85	do.	do.	--	1947	3,644.42
86	do.	V. C. Snodgrass	H. H. Leonard	1949	--
87	5 $\frac{1}{2}$ miles east	C. W. Voyles and R. W. Merrill	--	Old	3,629.83
88	8 $\frac{3}{4}$ miles northeast	Crow Springs	--	--	3,625 $\frac{1}{2}$

Table 2 -- Continued

Well	Height of measuring point above ground (ft.)	Depth of well (ft.)	Diameter of well (in.)	Water level		Method of lift	Use of water	Remarks
				Below land surface (ft.)	Date of measurement			
79	1.9	250	14	25.7	Sept. 28, 1948	T,0	Irr	Casing: 165 feet. Yield 620 gallons a minute, measured, Sept. 28, 1948
80	--	145	14	a/51.0	Sept. 23, 1949	C	D	Casing: 15 feet. Yield reported 30 gallons a minute.
81	0.4	154	20	46.2	Mar. 7, 1949	T,0	Irr	Casing: 8 feet. Pump set at 90 feet. Draw-down 28 feet after pumping several days at 2,900 gallons a minute; measured Sept. 28, 1948. See log.
82	0.0	145	20	47.9	Sept. 22, 1949	T,0	Irr	Casing: 8 feet. Well 82 is 20 feet from well 81, when both wells are pumping mutual interference reduces their yields.
83	1.7	35±	6	23.6	Nov. 17, 1948	C,W	S	Water-bearing formation unknown.
84	--	--	6	--	--	C,W	D,S	Water-bearing formation, alluvium.
85	1.4	163	16	19.3	Feb. 3, 1949	T,G	Irr	Casing: 163 feet, perforated. Yield estimated 400 gallons a minute. Water-bearing formation, alluvium.
86	--	225	15½	a/20.0	Nov. 29, 1949	None	N	Casing: 169 feet. Yield reported 200 gallons a minute. Water-bearing formation, alluvium. See log.
87	2.8	30	6	10.0	Feb. 4, 1949	None	N	Water-bearing formation, alluvium.
88	--	Spring	--	--	--	Flows	S	Spring reported to flow steadily at about 3 gallons a minute. Used as watering place for many years.

Table 2. Records of wells in Dell City area, Hudspeth County -- Continued

Well	Distance from Dell City	Owner	Driller	Date completed	Altitude of measuring point (ft.)
89	13 $\frac{1}{4}$ miles east	H. Lewis	--	Old	--
90	do.	-- Hunter	--	Old	3,671 \pm
91	16 $\frac{1}{2}$ miles southeast	Ed Hammack	H. H. Virdell	1941	--
92	19 $\frac{1}{2}$ miles southeast	Mrs. L. D. Hammack	-- Ellison	1943	--
93	17 $\frac{1}{2}$ miles southeast	do.	--	1905	3,638 \pm
94	16 $\frac{1}{4}$ miles southeast	Ed Hammack	-- Ellison	1943	--
95	15 miles southeast	do.	Mountain Drilling Co.	1949	--
96	do.	do.	--	--	3,650 \pm
97	do.	do.	--	Old	--
98	11 $\frac{1}{2}$ miles southeast	do.	Pure Oil Co.	1949	--
99	11 miles southeast	do.	--	Old	--
100	15 miles southeast	State of Texas	--	--	3,626.58
101	14 $\frac{3}{4}$ miles southeast	Ed Hammack	--	--	3,709.15
102	10 $\frac{1}{2}$ miles southeast	Guitar Estate	--	Old	3,653.21
103	7 miles southeast	do.	--	--	3,638.9
104	12 miles south	Henry McLaughlin	H. H. Virdell	1948	3,988.5
105	11 miles southwest	E. C. Mowry No. 1	A. R. Jones	1945	4,050 \pm

Table 2 -- Continued

Well	Height of measuring point above ground (ft.)	Depth of well (ft.)	Diameter of well (in.)	Water level		Method of lift	Use of water	Remarks
				Below land surface (ft.)	Date of measurement			
89	0.0	27±	36	25.0	Sept. 29, 1948	None	N	Water-bearing formation, alluvium. Dug.
90	0.8	60	--	50.0	do.	C,W	S	Old Eclipse well. Water bitter. Water-bearing formation, alluvium.
91	--	200	6	a/185.0	Nov. 28, 1949	C,W	S	Water-bearing formation unknown.
92	--	100	6	a/ 85.0	do.	C,W	S	Casing: 100 feet. Water-bearing formation, unknown.
93	1.0	24	36	22.8	Sept. 29, 1948	None	N	Dug. Water-bearing formation, alluvium.
94	--	100	6	a/ 85.0	--	C,W	S	Water-bearing formation, unknown.
95	0.6	300	16	56.0	Aug. 25, 1949	T,G	Irr	Yield reported 500 gallons a minute. Water-bearing formation, unknown.
96	0.0	40	6	33.0	Sept. 29, 1948	C,W	S,D	Water-bearing formation, alluvium.
97	--	24	--	a/20.0	Nov. 28, 1949	None	N	Water-bearing formation, alluvium.
98	--	49	--	a/22.0	do.	C,W	S	Do.
99	0.0	12	--	10.5	do.	C,W	S	Dug. Old Lightning well. Water has "bad odor", and stock will not drink it if other water is available. Water-bearing formation, alluvium.
100	3.0	15	--	9.0	Dec. 4, 1948	C,H	--	Dug. State roadside park. Water-bearing formation, alluvium.
101	0.5	--	4	89.1	Oct. 27, 1948	C,E	D	
102	1.8	60	6	33.0	Sept. 29, 1948	C,W	S	Water-bearing formation, alluvium.
103	1.8	40	6	16.6	do.	C,W	S	Do.
104	2.0	450	8	367.5	Nov. 29, 1949	C,W	D,S	
105	--	4,518	12½, to 4½	--	--	None	N	Oil test. See log.

Table 2. Records of wells in Dell City area, Hudspeth County -- Continued

Well	Distance from Dell City	Owner	Driller	Date completed	Altitude of measuring point (ft.)
106	10 $\frac{1}{2}$ miles southwest	Wm. Melbreth	Presley Hurt	1908	--
107	13 miles southwest	do.	--	1911	--
108	15 miles southwest	Lilliam Applegate	--	Old	4,170 \pm
109	11 miles southwest	A. R. Jensen	--	Old	4,180 \pm
110	4 miles northeast	Lloyd Snodgrass	H. H. Leonard	1949	--
111	4 miles east	H. H. Leonard	do.	1949	--
112	4 miles southeast	do.	do.	1949	--

a/ Water level reported by driller or owner.

Table 2 -- Continued

Well	Height of measuring point above ground (ft.)	Depth of well (ft.)	Diameter of well (in.)	Water level		Method of lift	Use of water	Remarks
				Below land surface (ft.)	Date of measurement			
106	--	553	8	a/400.0	Jan. 15, 1950	C,W	S	
107	--	460	8	a/450.0	do.	C,W	S	
108	--	920	8	a/600.0	Feb. 10, 1949	C,W	D,S	Casing: 20 feet.
109	--	720	8	a/700.0	do.	C,W	S	
110	--	225	15½	a/ 20.0	Jan. 4, 1950	T,G	Irr	Casing: 169 feet, perforated. See log.
111	--	231	16, to 12½	a/ 18.0	do.	T,G	Irr	Casing: 231 feet, perforated. Drawdown reported 7 feet while pumping 2,000 gallons a minute. See log.
112	--	225	16, to 12½	a/ 18.0	do.	--	--	Casing: 225 feet, perforated. Well not developed when visited. Water-bearing formation alluvium. See log.

Table 3. Drillers' logs, Dell City area, Hudspeth County, Texas

Thickness (feet)		Depth (feet)		Thickness (feet)		Depth (feet)	
<u>Well 6</u>							
Donald C. Bennett, 2 miles west of Dell City. Driller, Evel Ross.							
Alluvium	135	135	Packsand	70	350		
Limestone	145	280					
<u>Well 9</u>							
James P. Williams, 1½ miles west of Dell City. Driller, Mountain Drilling Co.							
Soil	4	4	Gravel	5	75		
Gravel	6	10	Limestone	65	140		
Adobe	10	20	Gravel	2	142		
Gravel	32	52	Limestone, broken ..	45	187		
Limestone, broken	18	70					
<u>Well 12</u>							
E. L. Stone, 2½ miles southwest of Dell City. Driller, Evel Ross.							
Topsoil	14	14	Conglomerate	20	120		
Gravel, dry	6	20	Conglomerate, cemented	40	160		
Conglomerate	25	45	Red sandy limestone,				
Gravel	15	60	some gravel, water				
Conglomerate	25	85	rose to 138 feet ..	105	265		
Gravel	15	100	Gray limestone	10	275		
<u>Well 14</u>							
R. L. Merrill, 4½ miles southwest of Dell City. Driller, Mountain Drilling Co.							
Soil	7	7	Water rose to 150				
Soil and gravel	18	25	feet				
Yellow sand, clay			Yellowish-brown				
breaks	60	85	limestone,				
Gray limestone	140	195	broken	285	500		
Gray sandy limestone ...	20	215					

Table 3. Drillers' logs, Dell City area, Hudspeth County -- Continued

Thickness (feet)		Depth (feet)	Thickness (feet)		Depth (feet)
<u>Well 16</u>					
Jess Tillery, $2\frac{1}{4}$ miles south of Dell City. Driller, D. C. Slater.					
Alluvium	90	90	Sand, loose	20	240
Limestone, first water			Limestone and shells	10	250
90 feet, more water					
120 feet	130	220			
<u>Well 17</u>					
Jess Tillery, $1\frac{3}{4}$ miles southwest of Dell City. Driller, D. C. Slater.					
Soil and gravel	30	30	Limestone, water from		
Red mud	70	100	185 to 300 feet ...	200	300
<u>Well 25</u>					
D. I. Leatherman, $1\frac{3}{4}$ miles northwest of Dell City. Driller, Jordon Drilling Co.					
Soil	6	6	Limestone, dry cavern		
Gravel	12	18	at 110 feet, soft		
Sand and shale	72	90	limestone, 6 or 7		
			feet at 145 feet,		
			water rose to 110		
			feet	158	248
<u>Well 26</u>					
D. I. Leatherman, $1\frac{1}{4}$ miles northwest of Dell City. Driller, Mountain Drilling Co.					
Soil and gravel	39	39	Limestone, water		
Limestone	2	41	between 140 and		
Clay and limestone	19	60	150 feet	330	390

Table 3. Drillers' logs, Dell City area, Hudspeth County -- Continued

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
<u>Well 27</u>					
J. A. Donathan, $1\frac{1}{2}$ miles northwest of Dell City. Driller, Hays Bros.					
Soil and gravel	10	10	Medium-grained		
Clay, sand and gravel ...	40	50	limestone	63	268
Red clay	53	103	Honeycomb limestone ..	3	271
Limestone	27	130	No cuttings, probably		
Quicksand	5	135	crevices	19	290
Sandstone	15	150	Limestone and shale .	15	305
Limestone	35	185	Yellow clay	5	310
Soft porous limestone ...	20	205	Gravel	10	320
			Limestone	2	322
<u>Well 29, partial log</u>					
M. R. and G. J. Collier, $2\frac{1}{4}$ miles northwest of Dell City. Driller, Leslie Carter.					
Soil and gravel.....	65	65	Limestone, numerous crevices		
Limestone	60	125	filled with sand and fos-		
Sand and gravel	7	132	siliferous material ...	118	250
			TOTAL DEPTH		304
<u>Well 28</u>					
J. A. Donathan, $1\frac{1}{2}$ miles northwest of Dell City. Driller, Hays Bros.					
Soil and gravel	40	40	Soft limestone, some		
Clay.....	65	105	clay	7	185
Gravel, sand, and clay .	20	125	Clay, sand, and chalk.	7	192
Clay and sand	10	135	Sandstone	8	200
Clay and gravel	10	145	Limestone "quicksand"	10	210
Clay, sand, and gravel .	31	176	Sandstone	12	222
Soft porous rock	2	178	Limestone	3	225
<u>Well 34</u>					
George S. McConnell, $1\frac{1}{2}$ miles north of Dell City. Driller, Jordan Drilling Co.					
Topsoil	9	9	Sand and gravel, water		
Gravel and caliche	41	50	rose to 87 feet	20	130
Hard limestone	45	95	Medium hard limestone .	70	200
Honeycomb limestone	15	110	(Continued on next page)		

Table 3. Drillers' logs, Dell City area, Hudspeth County -- Continued

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
<u>Well 34 -- Continued</u>					
Honeycomb limestone	40	240	Flint rock	-	255
White quicksand	15	255			
<u>Well 38</u>					
C. W. Voyles, in Dell City. Driller, Mountain Drilling Co.					
Soil and gravel	50	50	Sand, water	15	153
Clay and caliche	30	80	Hard limestone	22	175
Hard limestone	10	90			
Soft sandy limestone, some water	48	138			
<u>Well 39</u>					
C. W. Voyles, in Dell City. Log by J. A. Donathan from memory.					
Soil and gravel	90	90	Honeycomb limestone, rusty	68	238
Limestone, water	60	150			
Soft sandy limestone, water	20	170			
<u>Well 40</u>					
C. W. Voyles, $\frac{1}{4}$ mile south of Dell City. Driller, Evel Ross.					
Soil and gravel	50	50	Soft rust colored lime- stone, water at 170 ft.	35	200
Caliche	40	90			
Medium to hard lime- stone, water	25	115	Honeycomb limestone, water	10	210
Soft sandy limestone	22	137			
Packsand	13	150	Rusty-colored lime- stone	10	220
Medium hard limestone ...	15	165	Gravel, dry	20	240
<u>Well 43</u>					
S. L. and N. R. Hays, $1\frac{1}{4}$ miles southwest of Dell City. Driller, Evel Ross.					
Soil and alluvium	60	60	Hard limestone	50	235
Sandy gray limestone ...	125	185			

Table 3. Drillers' logs, Dell City area, Hudspeth County -- Continued

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
<u>Well 44</u>					
S. L. and N. R. Hays, 1 mile south of Dell City. Driller, Hays Bros.					
Alluvium	20	20	Sand	7	240
Gravel and clay	55	75	Hard limestone ...	5	245
Limestone, soft zones	158	233			
<u>Well 49</u>					
S. L. and N. R. Hays, $2\frac{1}{4}$ miles south of Dell City. Driller, Jim Folk.					
Soil and gravel	6	6	Brown limestone..	110	180
Brown limestone	54	60	Broken sandy lime-		
Yellow sand, some water ...	10	70	stone	15	195
			Brown limestone .	105	300
<u>Well 50</u>					
S. L. and N. R. Hays, $2\frac{1}{4}$ miles southeast of Dell City. Driller, Jim Folk.					
Soil and gravel	20	20	Brown limestone, water		
Brown limestone	25	45	at 60 feet	233	270
Yellow clay	2	47			
<u>Well 51</u>					
R. L. Merrill, 2 miles southeast of Dell City. Driller, Mountain Drilling Co.					
Soil	10	10	Sandy limestone ...	13	178
Gravel	15	25	Sand, water	2	180
Adobe	15	40	Broken limestone ..	10	190
Gravel	5	45	Hard limestone	8	198
Hard limestone	4	49	Sandy brown lime-		
Broken sandy limestone ...	116	165	stone	12	210
			Sandy yellow		
			limestone	20	230

Table 3. Drillers' logs, Dell City area, Hudspeth County -- Continued

	Thickness (feet)	Depth (feet)		Thickness (feet)	Depth (feet)
<u>Well 54</u>					
Frank Gentry, $1\frac{1}{2}$ miles southeast of Dell City. Driller, Mountain Drilling Co.					
Soil	20	20	Gray limestone, water		
Gravel and clay.....	30	50	between 185 feet and		
Sandy limestone	5	55	195 feet in soft		
Limestone	10	65	limestone	130	205
Sandy red limestone	10	75			
<u>Well 60</u>					
Frank Gentry, 1 mile east of Dell City. Driller, Frank Gentry.					
Soil, gravel and sand ...	68	68	Hard limestone,		
Gray limestone	52	120	"flinty"	52	180
Honeycomb limestone			Honeycomb limestone,		
water	8	128	water	7	187
			Limestone	14	201
<u>Well 65</u>					
Beloe Stone, $3\frac{1}{4}$ miles northeast of Dell City. Driller, W. E. Hellyer.					
Alluvium	12	12	Gray sandstone	30	120
Gray limestone	78	90	Gray limestone	120	240
<u>Well 81</u>					
E. O. Brownfield, 5 miles northeast of Dell City. Driller, Evel Ross.					
Soil	8	8	Packsand, water	86	154
Limestone	90	98			
<u>Well 86</u>					
V. C. Snodgrass, $4\frac{1}{2}$ miles east of Dell City. Driller, H. H. Leonard.					
Soil	1	1	Sand	10	75
Gypsum	24	25	Shale	23	98
White sand, water	15	40	Sand	12	110
Broken limestone	8	48	White clay	30	140
Yellow clay	17	65	Red clay.....	9	149
Sand	10	75	(Continued on next page)		

Table 3. Drillers' logs, Dell City area, Hudspeth County -- Continued

Thickness (feet)		Depth (feet)		Thickness (feet)		Depth (feet)	
<u>Well 86 - Continued</u>							
Sand	5	154	White clay	10	185		
White clay	16	170	Sand	10	195		
Hard sand	5	175	White clay	30	225		
<u>Well 105, partial log</u>							
E. C. Mowry No. 1, 11 miles southwest of Dell City. Driller, A. R. Jones.							
Surface	6	6	Gray shale with lime				
Lime	30	36	shells	11	1,252		
Brown and yellow lime ..	26	62	Lime, probably crevices	16	1,268		
Hard gray lime	306	368	Lime	50	1,318		
Lime with yellow shale, breaks	26	394	Lime, probably crevices	5	1,323		
Hard lime	16	410	Dark gray lime	324	1,647		
Lime	4	414	Dark gray lime with				
Yellow lime and shells	6	420	chert	16	1,663		
Lime	37	457	Gray lime, fresh water	11	1,672		
Sandy lime, one bailer fresh water per hour	8	465	Dark gray lime with occasional chert ..	108	1,780		
Sandy lime	7	472	Dark shale	4	1,784		
Sandy lime and chert ..	10	482	Dark gray lime, cherty	39	1,813		
Sandy lime, 3 bailers fresh water per hour	8	490	Lime with black shale streaks	7	1,820		
Cherty lime	70	560	Dark gray lime, cherty	40	1,860		
Gray lime	8	568	Dark gray lime and				
Yellow lime	7	575	shale streaks	25	1,885		
Dark lime	15	590	Gray lime	9	1,894		
Light and dark lime, more water	117	707	Lime with black shale streaks	36	1,930		
Blue shale	5	712	Sandy blue shale	9	1,939		
Lime	53	765	Lime with blue shale .	9	1,948		
Hard lime	30	795	Sandy blue shale with some red shale	8	1,956		
Lime	110	905	Red and green shale ..	7	1,963		
Hard gray lime	140	1,045	Maroon shale, various colors quartz and				
Lime with shale breaks	15	1,060	sand	159	2,122		
Hard gray lime and anhydrite	107	1,167	Cherty lime and sand, water	47	2,169		
Lime	12	1,179	Gray and yellow lime, cherty	9	2,178		
Lime and anhydrite	33	1,212	TOTAL DEPTH		4,518		
Hard gray lime	13	1,225					
Lime with shale breaks	12	1,237					
Hard lime	4	1,241					

Table 3. Drillers' logs, Dell City area, Hudspeth County -- Continued

Thickness (feet)		Depth (feet)		Thickness (feet)		Depth (feet)	
<u>Well 110</u>							
Lloyd Snodgrass, 4 miles northeast of Dell City. Driller, H. H. Leonard.							
Soil	1	1	Broken limestone	8	188		
Gypsum	24	25	Hard limestone	17	205		
Sand, water	10	35	Sand	7	212		
Yellow clay	130	165	Yellow clay	13	225		
Hard limestone	15	180					
<u>Well 111</u>							
H. H. Leonard, 4 miles east of Dell City. Driller, H. H. Leonard.							
Soil	1	1	Clay	24	156		
Gypsum	26	27	Sand and gravel	13	169		
Sand, water	10	37	Red shale	22	191		
Clay.....	81	118	Broken limestone ...	30	221		
Sand and gravel	14	132	Hard brown limestone	10	231		
<u>Well 112</u>							
H. M. Leonard, 4 miles southeast of Dell City. Driller, H. H. Leonard.							
Soil	1	1	Sand and gravel	7	125		
Gypsum	19	20	Clay	30	155		
Sand, water	10	30	Sand and gravel	65	220		
Clay	88	118	Clay	5	225		

Table 4. Water levels in wells in the Dell City area, Hudspeth County, Texas
Depth to water, in feet, below land surface datum.

<u>Well 6</u>		<u>Well 12</u>	
Donald C. Bennett, 2 miles west of Dell City.		E. L. Stone, 2 $\frac{1}{2}$ miles southwest of Dell City.	
Nov. 8, 1948	155.39	Nov. 12, 1948	141.15
Feb. 3, 1949	154.89	Feb. 3, 1949	140.65
Nov. 24	156.08	Nov. 24	141.50
Jan. 3, 1950	155.32	Jan. 3, 1950	140.99
Feb. 21	155.26	Feb. 21	140.99
<u>Well 8</u>		<u>Well 14</u>	
James P. Williams, 1 $\frac{1}{4}$ miles west of Dell City.		R. L. Merrill, 4 $\frac{1}{2}$ miles southwest of Dell City.	
Nov. 12, 1948	130.45	Nov. 8, 1948	158.15
Feb. 3, 1949	129.92	Feb. 3, 1949	157.91
Sept. 23	133.75	Nov. 24	158.79
Jan. 3, 1950	130.84	Jan. 3, 1950	158.31
		Feb. 21	158.36
<u>Well 10</u>		<u>Well 21</u>	
James P. Williams, 1 mile west of Dell City.		James P. Williams, $\frac{1}{2}$ mile west of Dell City.	
Mar. 12, 1948	133.70	Mar. 12, 1948	94.10
Aug. 10	a/149.10	Aug. 12	104.50
Aug. 26	140.02	Aug. 13	95.85
Sept. 29	136.27	Aug. 18	95.75
Feb. 3, 1949	137.14	Aug. 26	a/117.07
		Feb. 3, 1949	94.40
<u>Well 11</u>		<u>Well 24</u>	
F. W. Dodson, 2 miles southwest of Dell City.		Donald C. Bennett, 1 $\frac{1}{4}$ miles northwest of Dell City.	
Mar. 12, 1948	156.23	Aug. 12, 1948	111.15
Aug. 26	157.50	Aug. 18	a/119.40
Nov. 12	157.35	Feb. 3, 1949	109.62
Feb. 3, 1949	156.94	Nov. 23	110.84
Aug. 12	159.39		
Nov. 24	157.98		
Jan. 3, 1950	157.45		
Feb. 21	157.28		

a/ Well pumping.

Table 4. Water levels in wells in the Dell City area, Hudspeth County --
Continued

<u>Well 25</u>		<u>Well 38</u>	
D. I. Leatherman, $1\frac{3}{4}$ miles northwest of Dell City.		C. W. Voyles, in Dell City.	
Aug. 10, 1948	120.81	Mar. 11, 1948	73.75
Aug. 26	121.25	Aug. 17	76.70
Feb. 3, 1949	119.87	Sept. 28	75.72
Aug. 12	123.72	Feb. 3, 1949	76.72
Nov. 23	121.08	Aug. 16	79.42
Jan. 3, 1950	120.46	Nov. 24	75.98
Feb. 21	120.33	Jan. 3, 1950	75.40
		Feb. 21	75.23
<hr/>		<hr/>	
<u>Well 30</u>		<u>Well 42</u>	
James Napier, $3\frac{3}{4}$ miles north of Dell City.		C. W. Voyles, $\frac{3}{4}$ mile southeast of Dell City.	
Mar. 11, 1948	87.85	Mar. 1, 1948	62.50
Aug. 12	90.80	Aug. 8	a/67.90
Aug. 27	a/110.6	Sept. 28	63.47
Nov. 8	88.79	Feb. 3, 1949	62.83
Feb. 3, 1949	88.23	Aug. 18	a/73.00
Aug. 12	90.67		
Sept. 22	90.65		
Nov. 23	89.39		
<hr/>		<hr/>	
<u>Well 34</u>		<u>Well 48</u>	
George S. McConnell, $1\frac{1}{2}$ miles north of Dell City.		S. L. and N. R. Hays, $1\frac{1}{2}$ miles south of Dell City.	
Aug. 14, 1948	a/108.20	Aug. 17, 1948	59.12
Nov. 8	88.60	Feb. 3, 1949	58.03
Feb. 3, 1949	87.86	Jan. 5, 1950	58.61
Nov. 24	90.36	Feb. 21	58.37
Jan. 3, 1950	89.34		
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a/ Well pumping.

Table 4. Water levels in wells in the Dell City area, Hudspeth County --
Continued

Well 50

S. L. and N. R. Hays, $2\frac{1}{4}$ miles
southeast of Dell City.

Nov. 18, 1948	41.24
Feb. 3, 1949	41.05
Jan. 3, 1950	41.47
Feb. 21	41.49

Well 58

Frank Gentry, 1 mile east of Dell
City.

Aug. 5, 1948	<u>a/74.00</u>
Aug. 8	52.45
Nov. 8	49.11
Feb. 3, 1949	47.64
Sept. 22	51.67
Nov. 24	48.74
Jan. 3, 1950	48.22
Feb. 21	48.02

Well 67

Voyles and Merrill, $2\frac{1}{4}$ miles
northeast of Dell City.

Mar. 2, 1948	27.29
Aug. 6	31.50
Sept. 2	<u>a/72.20</u>
Feb. 3, 1949	27.72
Nov. 24	28.35
Jan. 3, 1950	27.97
Feb. 21	27.96

Well 68

Voyles and Merrill, $2\frac{3}{4}$ miles north-
east of Dell City.

Aug. 12, 1948	25.00
Feb. 3, 1949	25.42
Nov. 24	26.34
Jan. 3, 1950	25.93
Feb. 21	25.96

Well 74

James Napier, 3 miles east of Dell
City.

Mar. 11, 1948	21.50
Aug. 12	22.05
Oct. 26	22.10
Feb. 3, 1949	21.86

Well 75

C. W. Voyles, $3\frac{1}{2}$ miles east of Dell
City.

Mar. 11, 1948	19.91
Aug. 12	20.35
Feb. 3, 1949	20.17
Nov. 24	20.91
Jan. 3, 1950	20.68
Feb. 21	20.52

Well 77

Roy Keeney, $3\frac{1}{4}$ miles northeast of
Dell City.

Mar. 11, 1948	25.63
Aug. 5	26.50
Feb. 3, 1949	26.36
Nov. 11	27.91
Jan. 3, 1950	26.79
Feb. 21	26.83

a/ Well pumping.

Table 4. Water levels in wells in the Dell City area, Hudspeth County --
Continued

<u>Well 81</u>		<u>Well 87</u>	
E. O. Brownfield, 5 miles north- east of Dell City.		Voyles and Merrill, 5½ miles east of Dell City.	
Aug. 12, 1948	<u>a/74.98</u>	Nov. 8, 1948	10.30
Sept. 28	46.45	Feb. 4, 1949	9.95
Feb. 3, 1949	46.15	Nov. 24	9.11
Sept. 22	47.53		
Jan. 3, 1950	46.54		
Feb. 21	46.51		

a/ Well pumping.

Table 5. Analyses of water from wells in Dell City area, Hudspeth County, Texas
(Analyses given are in parts per million except specific conductance, pH, and percent sodium)

Well	Owner	Depth of well (ft.)	Date of collection	Specific conductance (Micromhos at 25° C)	pH	Silica (SiO ₂)	Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na + K)	Bicarbonate (HCO ₃)	Sulfate (SO ₄)	Chloride (Cl)	Nitrate (NO ₃)	Boron (B)	Dissolved solids	Total hardness as CaCO ₃	Percent sodium
9	James P. Williams	210	Aug. 9, 1949	2,480	7.5	14	254	99	192	236	845	268	8.5	0.54	1,800	1,040	28
1/11	F. W. Dodson	361	Mar. 12, 1948	2,870	-	19	204	95	300	254	619	495	.5	-	1,860	900	42
21	James P. Williams	250	do.	1,780	-	18	190	90	105	248	663	125	1.8	-	1,320	844	21
1/25	D. I. Leatherman	390	Mar. 11, 1948	1,750	-	18	170	90	99	252	608	118	3.8	-	1,230	794	21
30	James Napier	280	Aug. 17, 1948	1,560	-	15	207	89	25	214	663	45	9.8	-	1,160	884	6
2/33	Geo. S. McConnell	230	Aug. 9, 1949	8,180	7.1	12	602	436	998	79	1,160	1,350	256	-	6,850	3,300	40
34	do.	256	Aug. 6, 1948	1,470	-	16	213	79	25	260	624	32	2.8	-	1,120	856	6
34	do.	256	Aug. 9, 1949	1,480	7.8	-	-	-	-	254	-	35	-	.26	-	-	-
1/38	C. W. Voyles	175	Mar. 11, 1948	1,900	-	20	192	101	104	196	775	105	5.0	-	1,400	894	20
38	do.	175	Aug. 12, 1948	1,820	-	19	228	96	61	244	737	90	3.2	-	1,350	964	12
42	do.	220	Mar. 12, 1948	1,720	-	-	216	86	54	208	695	82	1.2	-	1,240	892	12
42	do.	220	Aug. 5, 1948	2,460	-	19	189	92	175	150	609	335	1.2	-	1,490	850	31
42	do.	220	Aug. 9, 1949	2,590	7.2	15	235	82	246	278	649	392	1.5	.43	1,760	924	37
48	S.L. and N.R. Hays	200	Aug. 5, 1948	2,620	-	19	187	73	239	176	537	412	1.8	-	1,560	766	40
1/58	Frank Gentry	201	Mar. 3, 1948	2,210	-	22	144	150	156	280	801	178	1.2	-	1,590	976	26
59	do.	187	Aug. 5, 1948	2,050	-	19	251	97	89	248	798	130	2.2	-	1,510	1,030	16
59	do.	187	Aug. 9, 1949	2,180	7.3	15	250	107	130	253	854	175	3.8	.24	1,660	1,060	21
69	Wayne C. Chandler	200 ⁺	Aug. 6, 1948	1,710	-	18	237	86	44	262	724	50	2.5	-	1,290	945	9
74	James Napier	300	Aug. 5, 1948	1,970	-	23	229	95	98	254	738	140	1.8	-	1,450	962	18
77	Roy Keeney	200	Mar. 11, 1948	2,030	-	22	242	100	115	268	867	100	2.5	-	1,580	1,020	20
81	E. O. Brownfield	150	Aug. 12, 1948	1,520	-	16	212	71	56	224	683	28	9.8	-	1,190	821	13
87	Voyles and Merrill	30	Dec. 9, 1948	3,470	-	52	322	231	205	208	1,530	305	7.0	.53	2,750	1,750	20
88	Crow Springs	-	Nov. 28, 1948	1,660	-	13	202	86	49	266	569	108	1.2	.54	1,160	858	11
90	-- Hunter	60	Sept. 29, 1948	7,900	-	16	670	298	900	96	2,440	1,470	200	-	6,040	2,900	40
102	Guitar Estate	60	Dec. 9, 1948	3,410	-	22	254	113	325	260	701	600	20	-	2,160	1,100	39
103	do.	40	do.	3,740	-	21	244	115	412	200	867	645	3.2	.48	2,410	1,080	45
104	Henry McLaughlin	450	do.	2,950	-	13	392	156	147	202	1,510	142	1.8	-	2,460	1,620	16

1/ Sampled by bailing from the hole. All others sampled while pumping.

2/ Sampled after pumping 2 minutes.