TEXAS WATER DEVELOPMENT BOARD

REPORT 125

WATER RESOURCES OF WARD COUNTY, TEXAS

Ву

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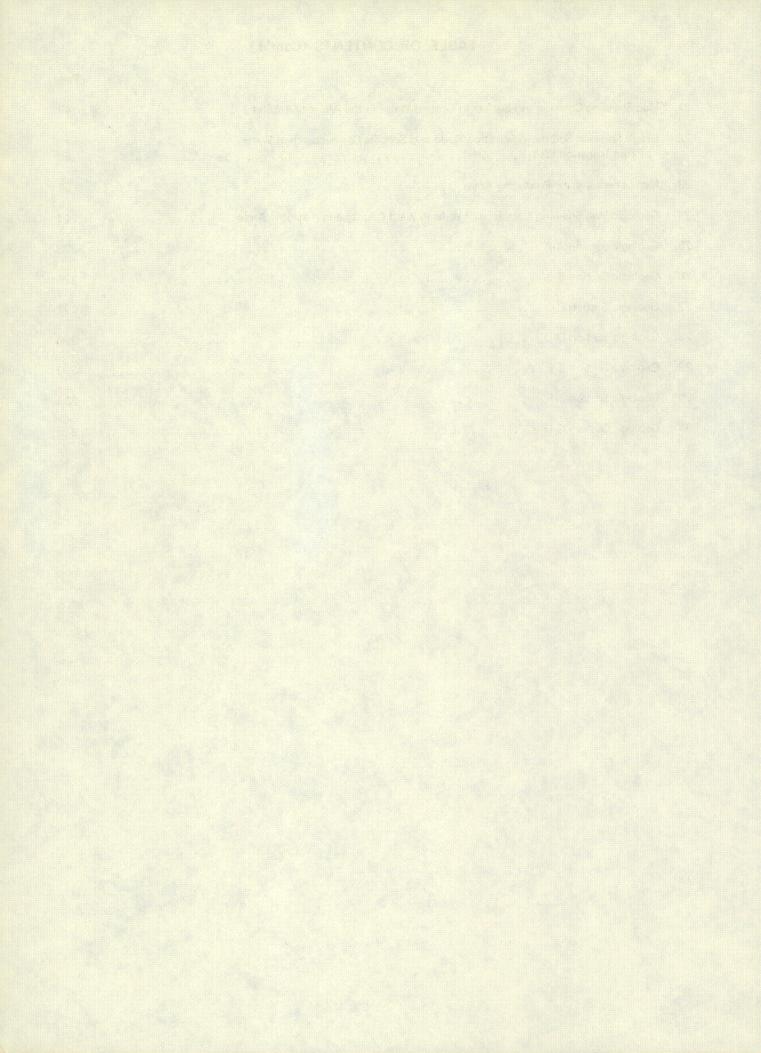
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WATER RESOURCES OF WARD COUNTY, TEXAS

ABSTRACT

Ward County is an area of 827 square miles in the Pecos River Valley of West Texas. The county consists primarily of rolling uplands which are devoted largely to ranching. The Pecos River borders the county on the south and west. The flood plain and terraces along the river are extensively cultivated and irrigated.

During 1967, pumpage of ground water from three aquifers in the county totaled 34,400 acre-feet. Of this amount, 22,600 acre-feet was from the Allurosa aquifer; 2,300 acre-feet was from the Rustler Formation; and 9,500 acre-feet was from the Capitan Limestone. Most of the pumpage, about 20,400 acre-feet, was for industry; and the principal use, 14,600 acre-feet, was for waterflooding oil fields in Ward and adjoining counties.

Water for irrigation is supplied both by pumping wells and diverting flow from the Pecos River. In 1967, pumpage for irrigation was 9,200 acre-feet. During the water year 1967, the three irrigation districts in the county diverted 75,510 acre-feet for irrigation of 9,740 acres. Less than 35,000 acre-feet was actually applied on the cropland, and more than one-half of the water diverted was lost to seepage from canals.

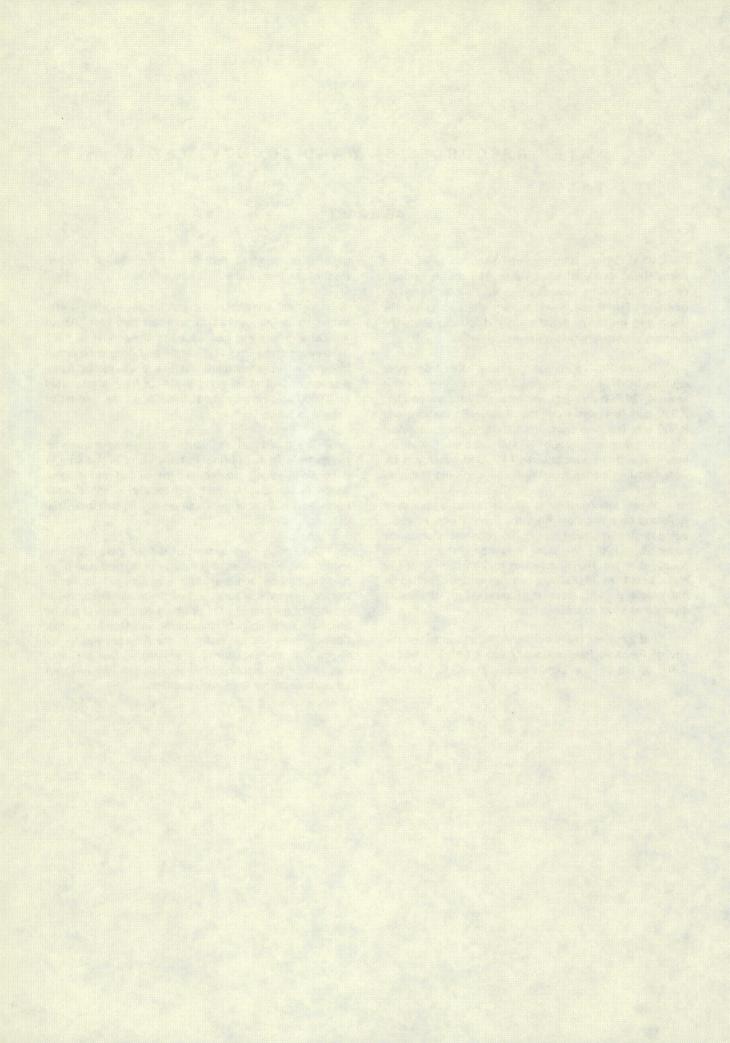
Pumpage for the six cities in Ward County and the city of Pecos in Reeves County was 4,698 acre-feet in 1967. Most of the public-supply wells tap alluvial

deposits in the Monument Draw trough which contains most of the fresh water in the county.

Natural recharge to the Allurosa aquifer is estimated to be about 12,000 acre-feet per year. About 45,000 acre-feet was also added to the aquifer in 1967 by seepage from irrigation canals and deep percolation losses from irrigated fields. Natural discharge by transpiration of vegetation along the Pecos River is estimated at 40,000 acre-feet, or about three times the amount of natural recharge.

The quality of the water in the Allurosa aquifer ranges from fresh to brine. Potable water in this aquifer is confined largely to the eastern half of the county. Water in the Capitan reef and locally in the Rustler Formation is suitable for irrigation and limited industrial use.

Additional development of the Allurosa aquifer is anticipated, with most of the water being obtained from the 10 million acre-feet that is estimated to be in storage. However, a large part of the water in storage is too highly mineralized for drinking purposes and can be used only to irrigate the more salt-tolerant crops. Contamination of the water in the Allurosa aquifer by disposal of oil-field brines in unlined surface pits also may reduce the amount of water that can be developed for purposes other than waterflooding.



WATER RESOURCES OF WARD COUNTY, TEXAS

INTRODUCTION

Purpose and Scope of the Investigation

The investigation of the water resources of Ward County began in the spring of 1967 as a cooperative project of the U.S. Geological Survey and the Texas Water Development Board. The purpose of the investigation was to determine and evaluate the water resources of the county. The results of the investigation are presented in this report, which includes an analytical discussion of the occurrence and availability of the ground-water and surface-water supplies, together with a tabulation of basic data obtained during the investigation.

The scope of the investigation encompassed the collection, compilation, and analysis of data related to ground and surface water, including a determination of the location and extent of the water-bearing formations, the chemical quality of water they contain, the quantity of ground water being withdrawn, and the effects of these withdrawals on the water levels; the hydraulic properties of the principal water-bearing formations; estimates of the quantities of ground water available for development; and the availability and quality of surfacewater supply.

Methods of Investigation

The following methods of investigation were used during the investigation:

- 1. All moderate to large capacity wells and a representative number of small capacity wells (a total of 662 wells) were inventoried. Records of wells are shown in Table 6; locations of wells are shown on Figure 24.
- 2. Electrical, radioactivity, and drillers' logs were collected for correlation and evaluation of subsurface characteristics of the aquifers. Maps showing the depth to and the altitude of the base of the Allurosa aquifer (Figure 9) and top of the Rustler Formation (Figure 7) were drawn. Seven geologic sections were constructed (Figures 25 through 31).
- 3. The quantities of ground water used for public supply, industry, and irrigation were inventoried.

Quantities of water used for domestic supply and livestock were estimated. The quantity of surface water used in the county was compiled from U.S. Geological Survey surface-water records.

- 4. A map was prepared showing the areas of major ground-water withdrawals from the Allurosa aquifer and locations of surface-water diversions (Figure 17).
- 5. The results of six aquifer tests (Table 2) and 95 drawdown or recovery tests (Table 3) were used to evaluate the hydraulic characteristics of the aquifers.
- 6. Water levels in wells were measured and available records of past fluctuations of water levels were compiled (Tables 6 and 7 and Figure 18).
- 7. A map showing depth to water and altitude of water levels in wells tapping the Allurosa aquifer was constructed (Figure 11).
- 8. Climatological records were collected (Figures 2, 3, and 4).
- 9. Chemical analyses of water samples collected from wells during the present and previous investigations (a total of 620 analyses) were compiled (Table 8), and a map showing water quality in the aquifers was prepared (Figure 20).
- 10. A map showing the specific conductance and the concentration of sulfate and chloride in water from wells tapping the Allurosa aquifer and a graph showing the relation of dissolved solids to specific conductance of water from wells and salt-water disposal pits were prepared (Figure 21).
- 11. Chemical analyses of oil-field brines (Table 9) and reported 1961 and 1967 oil-field brine production and disposal data were compiled (Table 5).
- 12. A map was drawn showing areas of oil-field brine production and disposal, locations of sampled disposal pits, and contaminated water wells (Figure 23).
- 13. The hydrologic data were analyzed to determine the quantity and quality of ground water available for development.

Location and Extent of the Area

Ward County is an area of 827 square miles in the Pecos River Valley of West Texas (Figure 1). It is bordered by Loving, Winkler, and Ector Counties on the north, Crane County on the east, and Pecos and Reeves Counties on the south and west. Monahans, the largest town and county seat, is 55 miles southwest of Midland. The estimated populations in 1967 were: Ward County, 12,927; Barstow, 789; Grandfalls, 981; Monahans, 9,476; Pyote, 315; Royalty, 196; and Wickett, 831.

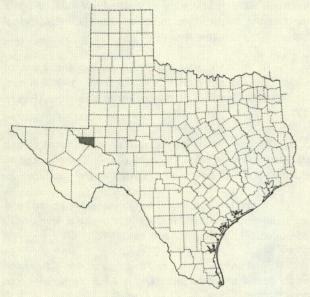


Figure 1.-Location of Ward County

Previous Investigations

The water resources of Ward County were first studied in 1939-40 as part of a joint investigation of the Pecos River basin in New Mexico and Texas by federal and state agencies (U.S. National Resources Planning Board, 1942 and 1942a).

The development of ground water for irrigation in the Pecos-Barstow area in Reeves and Ward Counties during the years 1947-51 was summarized by Hood and Knowles (1952). Ogilbee, Wesselman, and Irelan (1962) included the southwestern part of Ward County in their study of the ground-water resources of Reeves County.

Follett (1954) compiled records of water-level measurements in observation wells in Ward County. As of January 1, 1970, water levels in 25 wells in the county were being measured annually as part of the Texas Water Development Board's observation well program.

A reconnaissance report by Brown and others (1965) provides a generalized evaluation of the ground-water conditions in the Rio Grande basin in Texas, which includes Ward County and most of the adjacent counties.

The water supplies of Barstow, Grandfalls, and Monahans were described by Broadhurst, Sundstrom, and Weaver (1951) in their inventory of the public water supplies of 81 counties in West Texas.

Reports on the ground-water resources of areas adjacent to Ward County are, by county: Crane (Shafer, 1956); Ector (Knowles, 1952); Pecos (Armstrong and McMillion, 1961); Reeves (Knowles and Lang, 1947; Ogilbee, Wesselman, and Irelan, 1962); and Winkler (Garza and Wesselman, 1959).

The geologic formations in Ward County were described by Sellards and others (1932) and Jones (1953). A "Bibliography of Permian Basin geology, west Texas and southeastern New Mexico," published by the West Texas Geological Society in 1967, lists the numerous papers pertaining to the regional geology.

Economic Development

The economy of Ward County is dependent largely upon the production of oil and gas and the irrigation of cropland, but is also supported by income from ranching and the mining of sodium sulfate and sodium chloride brines. The water resources of the county are basic to the economy. All water used for public supply, industry, and domestic supply is pumped from wells. Water for irrigation is supplied by diversion of flow from the Pecos River and from pumping of wells.

Water was instrumental in the founding of the first settlement in Ward County. In 1881, John Thomas Monahan, a surveyor for the Texas and Pacific Railroad, dug and curbed "two natural holes of milky but splendid water in the sands" (Haley and Milton, 1949). The railroad was constructed across the county in the same year, and the town of Trueheart, later renamed Monahans, was established at Monahan's wells.

Irrigation of cropland in the county began in the late 1880's. By 1914, about 16,000 acres were irrigated from canals supplying four projects: the Barstow project, organized in 1890; the Big Valley project, constructed in 1906 and later incorporated with the Grandfalls project; and the Cedarvale project, organized in 1906 (U.S. National Resources Planning Board, 1942). The Barstow, Grandfalls, and Cedarvale projects were subsequently reorganized as Ward County Irrigation District No. 1, and Ward County Water Improvement Districts Nos. 2 and 3, in respective order.

Irrigation from wells started in the vicinity of Barstow shortly after 1900. However, most of the wells in use have been drilled since the end of World War II.

In 1967, 12,760 acres were irrigated in the county. Of this amount, 9,740 acres were irrigated in the districts with surface water, and 3,020 acres were

irrigated from wells both within and outside the districts. The principal crops are cotton, alfalfa, oats, barley, grain, forage sorghum, and pasture grasses.

The discovery of oil in the county on November 2, 1928, was of major importance to the economy. Since that date, nearly 400 million barrels of oil have been produced. In 1966, production of oil and gas amounted to 23.4 million barrels and 20 billion cubic-feet, respectively (Railroad Commission of Texas, 1967). Secondary recovery of oil by the waterflood process, initiated in the county in 1948, has greatly increased oil production but has also put increased demand upon the groundwater resources of the county.

Topography and Drainage

Ward County is in the Pecos Valley section of the Great Plains physiographic province (Fenneman, 1931). More than three-fourths of the surface of the county is rolling uplands. The uplands, which are mantled by caliche and thin sandy soils, are sparsely vegetated with semidesert shrubs and grasses and are devoted largely to ranching. The uplands slope toward the Pecos River and merge with the terraces or lowlands that border the river. The terraces are mantled by fine- to mediumtextured gypsiferous soils that are extensively cultivated in the Barstow and Grandfalls areas. The slope of the terraces, which is to the southeast nearly parallel to the river, ranges from 6 to 8 feet per mile.

A belt of sand dunes, which covers about 50 square miles in northeastern Ward County, is one of the more prominent topographic features of the uplands. In the Monahans Sandhills State Park, near the northeastern corner of the county, the high migrating dunes rise as much as 50 feet above the surrounding land surface. The belt of dunes is a regional feature that extends southeastward from the southeastern corner of New Mexico through parts of Andrews, Winkler, Ward, Ector, Crane, and Upton Counties. Because of the lack of vegetation and the high permeability of the sand, the dunes are an important site of recharge of the underlying ground-water reservoir.

The most prominent feature in western Ward County is the southwest-facing Quito Escarpment that rises 100 to 300 feet above the lowlands bordering the Pecos River to the southwest. The rim of the escarpment forms a topographic divide that extends southeastward from Loving County through Ward County, terminating about 10 miles south of Pyote. Locally, resistant beds of ledge-forming sandstone are exposed in the face of the escarpment below the divide. In other areas, the divide is completely mantled with alluvium and is not easily recognized.

All of Ward County is in the drainage basin of the Pecos River which flows southeastward along the western and southern borders of the county. Surface drainage in the county is largely closed. After periods of heavy precipitation, runoff collects in the swales, sinks, and playas on the upland surface where most of the water is subsequently lost to evapotranspiration. Runoff to the Pecos River by way of the ephemeral streams or draws is small or negligible.

Climate

The climate of Ward County is semiarid and is characterized by a wide range in temperatures and a high rate of evaporation.

The records of the U.S. Weather Bureau at Pecos in Reeves County, which date from 1934, provide the most complete climatological data for Ward County and adjacent areas.

Annual precipitation at Pecos during the period 1935 through 1967 (Figure 2) averaged 9.06 inches. The period maximum, 21.04 inches, occurred in 1941; the period minimum, 2.36 inches, occurred in 1956. Normally about 75 percent of the annual precipitation falls in the 6-month period from May through October (Figure 3). The highest recorded precipitation for one month was 7.41 inches in August 1966.

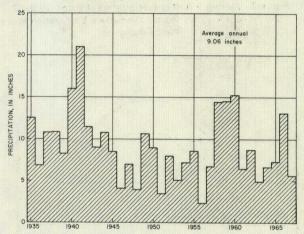
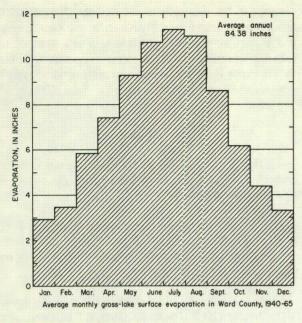


Figure 2.—Annual Precipitation at Pecos, 1935-67

The average annual gross lake-surface evaporation for Ward County is about 84 inches (Kane, 1967), or more than 9 times the average annual precipitation. The evaporation rates are highest during the summer when the soil moisture demand of plants is also large (Figure 3).

For the period 1935 through 1960, the average monthly temperature at Pecos ranged from 44.4° F (6.9°C) in January to 84.1° F (28.9°C) in July (Figure 4). The average daily minimum temperature in January was 27.9° F (-2.3°C); and the recorded extremes were -5° F (-21°C) and 116° F (47°C).



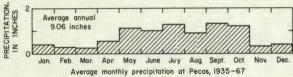


Figure 3.—Average Monthly Precipitation at Pecos 1935-67 and Average Monthly Gross Lake-Surface Evaporation in Ward County

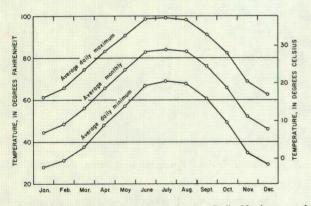


Figure 4.—Average Monthly and Average Daily Maximum and Minimum Temperatures at Pecos, 1935-60

The growing season is about 223 days. The approximate dates for the last and first killing frosts are April 1 and November 10, respectively.

Well-Numbering System

The well-numbering system used in this report was adopted by the Texas Water Development Board for use throughout the State (Figure 5). Under this system, each 1-degree quadrangle in the State is given a number

consisting of two digits; Ward County includes parts of quadrangles 45 and 46. These are the first two digits in the well number. Each 1-degree quadrangle is divided into 7½-minute quadrangles which are given 2-digit numbers from 01 to 64. These are the third and fourth digits of the well number. Each 7½-minute quadrangle is subdivided into 2½-minute quadrangles given a single digit number from 1 to 9. This is the fifth digit of the well number. Finally, each well within a 2½-minute quadrangle is given a 2-digit number in the order in which it was inventoried, starting with 01. These are the last two digits of the well number.

In addition to the seven-digit number, a two-letter prefix is used to designate the county. The prefixes for Ward and adjacent counties are as follows:

COUNTY	PREFIX	COUNTY	PREFIX
Crane	нн.	Reeves	WD
Ector	JH	Ward	YX
Loving	SL	Winkler	ZP
Pecos	US		

Thus, well YX-46-29-601, which is owned by the J. C. Dunagan Estate, is in Ward County (YX), in the 1-degree quadrangle 46, in the 7½-minute quadrangle 29, in the 2½-minute quadrangle 6, and was the first well (01) inventoried in that 2½-minute quadrangle (Figure 5).

Acknowledgments

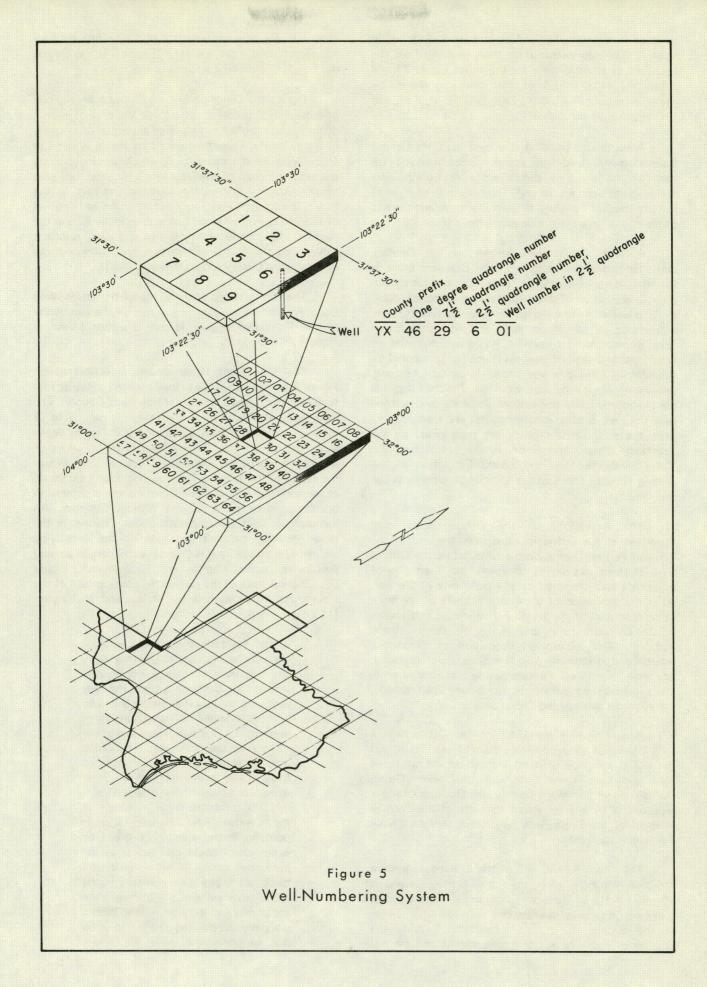
The author is indebted to many ranchers, farmers, and oil company personnel for supplying information about their wells and permitting access to their properties; to the well drillers for logs and other information about water wells; to the local utility companies for power-consumption data; and to the water superintendents of the cities of Grandfalls, Monahans, Pecos, Pyote, and Wickett for data on wells and municipal pumpage.

Considerable information about ground-water conditions in the Monahans and Monument Draw areas was furnished by the Texas Electric Service Company. The Layne-Texas Company and Ed L. Reed, consulting hydrologist, Midland, provided data for two pumping tests included in Table 2.

GEOLOGY AS RELATED TO THE OCCURRENCE OF GROUND WATER

General Stratigraphy and Structure

The geologic units discussed in this report range in age from Permian to Holocene. The thickness, lithology, and water-bearing properties of these units are discussed



in detail in the following section and are summarized in Table 1. The areal extent of the units (outcrops) and the locations of selected wells are shown on Figure 24; the subsurface relationships of the units are shown by geologic sections A-A', B-B', C-C', D-D', E-E', F-F', and G-G (Figures 25 through 31).

A southward-trending structural high, the Central Basin Platform, divides the Permian Basin of west Texas into two smaller basins—the Delaware basin on the west and Midland basin on the east. The eastern third of Ward County overlies the Central Basin Platform, and the rest of the county overlies the Delaware basin (Figure 6).

A large barrier reef known as the Capitan, deposited along the margins of the Delaware basin in Permian (Late Guadalupe) time, caused contemporaneous deposition of three different sequences of rocks: a deep-water marine facies in the Delaware basin, represented by sandstone, shale, and limestone; a reef zone, represented by massive crystalline dolomite or limestone; and shelf or lagoonal deposits, represented by fossiliferous limestone and shale, dolomitic limestone, saline evaporites, and onshore clastics. The shelf deposits are characteristically thin-bedded dolomite or limestone near the reef, grading into evaporites and clastics away from the reef. These deposits are represented by the Grayburg, Queen, and Seven Rivers Formations; the Yates Sandstone; and the Tansill Formation of the Artesia Group. The Capitan Limestone represents the reef deposits.

The formations of the Ochoa Series were deposited in the Delaware basin near the end of the Permian Period. During Castile time, while the Central Basin Platform was slightly above sea level, a sequence of evaporites was deposited on the basin side of the reef. After the deposition of the Castile Formation, the more saline sediments of the Salado Formation were deposited in the Delaware basin and across the Central Basin Platform. This widespread deposition of evaporites, interbedded at intervals with limestone, dolomite, sand, and shale, continued through Salado and Rustler time. The evaporites are overlain by the Dewey Lake redbeds, the youngest rocks of the Ochoa Series.

According to King (1942), "After Ochoa time, a long interval of nondeposition ensued in west Texas, and the region was probably land. Deposition did not begin again until Late Triassic time, when the Dockum Group was laid down." In Ward County, the Dockum Group is represented by the terrestrial deposits of the Tecovas Formation, the Santa Rosa Sandstone, and the Chinle Formation equivalent.

The "basal sandstone" of the Cretaceous System has been recognized along the rim of Quito Escarpment 10 miles north of Barstow. Elsewhere in Ward County, rocks of Cretaceous age have not been identified either at the surface or in the subsurface. Because the Cretaceous rocks have small areal extent and do not

contribute to the water resources of the county, they are not shown on the geologic map (Figure 24) and are not discussed in succeeding sections of this report.

During the Cenozoic Era, which was primarily one of erosion of the older rocks, a thick sequence of alluvial deposits accumulated in two large slumpage depressions in Ward County. These depressions are herein referred to as the Monument Draw trough, which developed along the eastern margin of the Delaware basin, and the Pecos trough, which occupies the south-central part of the basin. The troughs were formed by solution and removal of evaporites in the Ochoa Series, principally salts in the Castile and Salado Formations, and the resultant collapse of the Rustler Formation and younger rocks into the voids (Maley and Huffington, 1953).

The configuration of the slumpage troughs in Ward County is shown by contours drawn on the top of the Rustler Formation (Figure 7) and in sectional view by Figures 25 through 29.

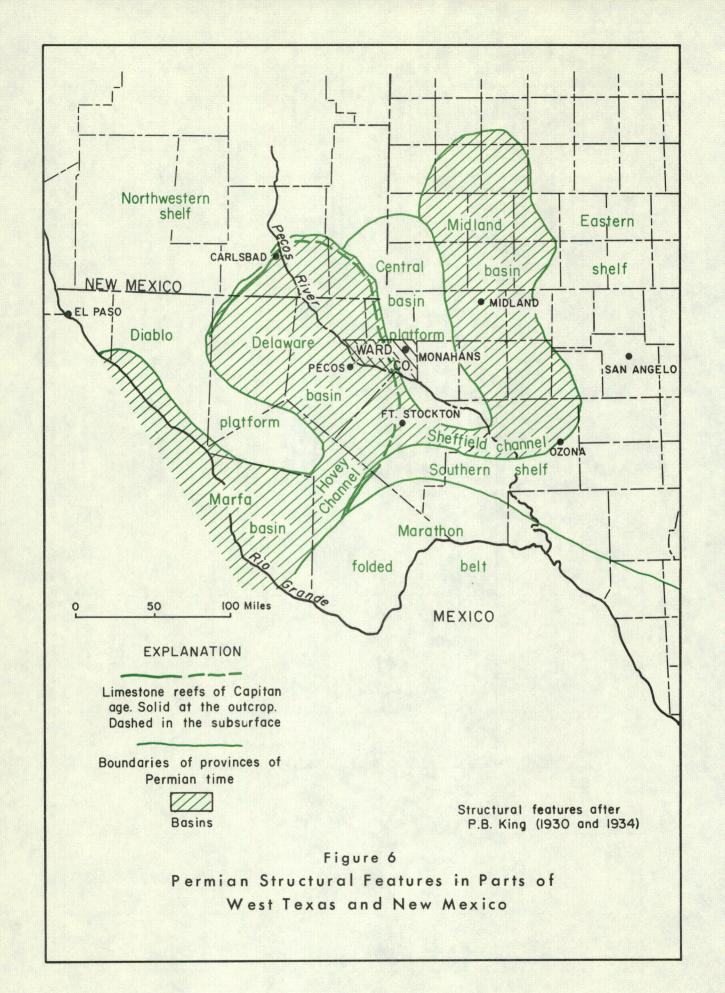
The Monument Draw trough is delineated on Figure 7 by the two sets of closely spaced contours that trend northwestward across central Ward County. The main body of alluvial fill in the trough is about 8 to 12 miles in width and is as much as 1,000 feet in depth along the trough axis. Several tongues of fill, more or less connected to the main body, occupy local sags in the flanks of the trough. The trough is poorly expressed at the surface by Monument Draw, a shallow depression on the uplands of Ward and Winkler Counties. An inconspicuous, in places discontinuous, channel in the draw generally parallels the axis of the underlying trough. The trough itself is aligned nearly parallel to, and overlies the buried Capitan reef (section A-A', Figure 25). The influence of the reef on the development of the trough has been studied by Maley and Huffington (1953), who wrote:

> "...at the time this eastern area (of the Delaware basin) permanently emerged from beneath epicontinental seas in Late Cretaceous time, the beds overlying the Capitan Reef tended to have some slight basinward dip, however small. This basinward increment of dip caused downward-percolating ground waters to move westward toward and over the Capitan Reef front. As suggested by Adams (1944, p. 1623), probable slight warping over the Capitan Reef tended to open fractures in the overlying bedrock by which water could gain access to the evaporite section. The exceptionally thick salt deposits encountered in the reef vicinity were readily soluble in the apparently unsaturated waters. With a gradually accelerated rate of solution due to concentration of subsurface

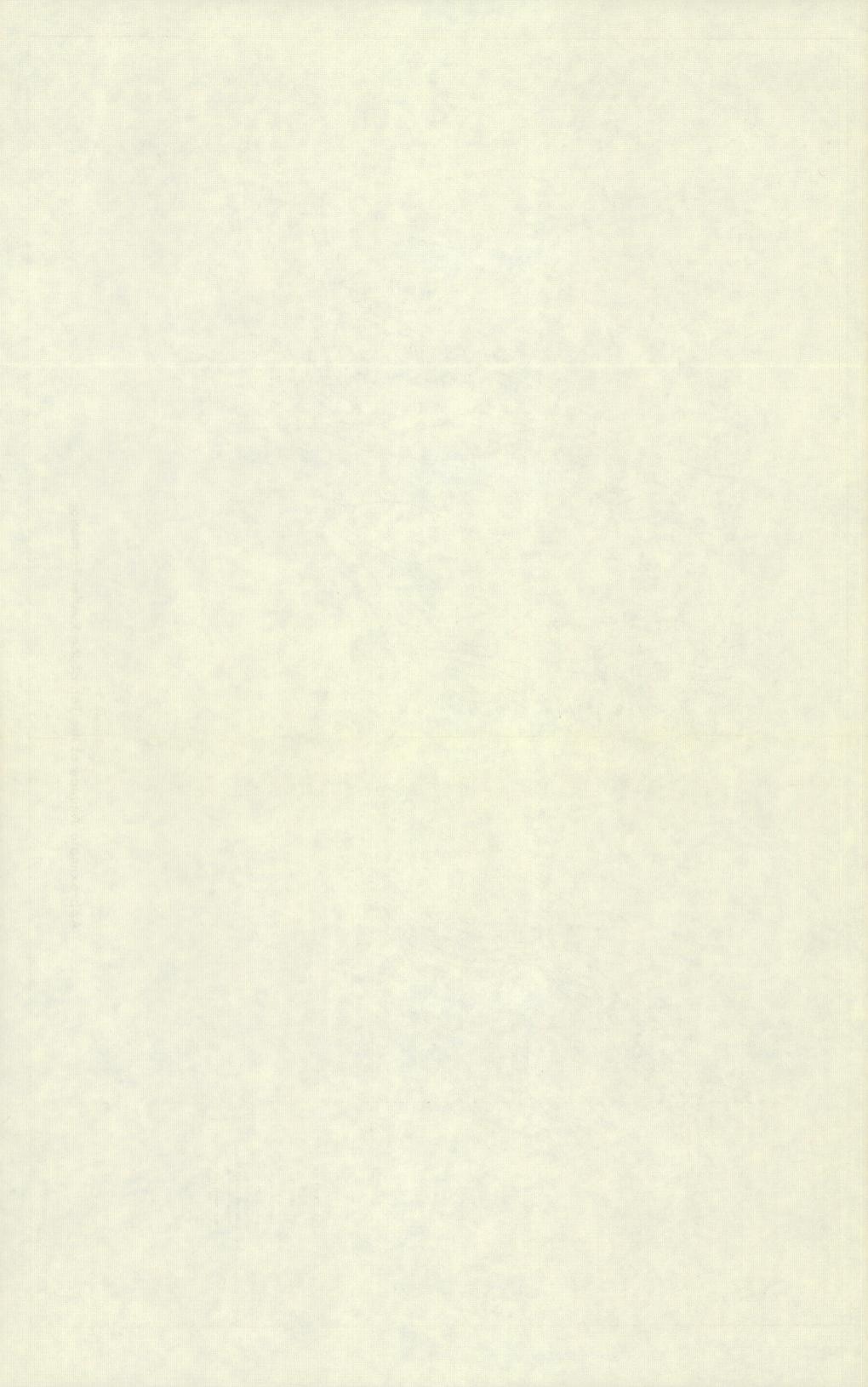
Table 1.—Geologic Units and Their Water-Bearing Characteristics

ERA	SYSTEM	SERIES	GROUP	STRATIGRAPHIC UNIT		APPROXIMATE MAXIMUM THICKNESS (FT)	CHARACTER OF ROCKS	WATER-BEARING CHARACTERISTICS							
	Quaternary			Dune sand		100	Windblown silt and sand.	Principally a recharge facility for underlying for- mations. Supplies small quantities of fresh water to pits and shallow wells. Uppermost unit in the Allurosa aquifer.							
Cenozoic	Quaternary and Tertiary			AII	uvium	1,050	Clay, sand, gravel, and caliche.	Yields small to large quantities of fresh to very saline water, and locally brine. Principal unit in the Allurosa aquifer.							
		# ## 		F	inle ormation quivalent	220	Brick-red to maroon and purple shale and len- ticular beds of fine-grained red or gray sand- stone.	Yields small quantities of fresh to slightly saline water to a few wells in the eastern part of Ward County.							
Mesozoic	Triassic			Dockum		nta Rosa andstone	520	Reddish-brown to gray, medium to coarse- grained micaceous well-cemented sandstone interbedded with red shale and siltstone.	Yields small quantities of fresh to slightly saline water to wells on a structural high that crosses the western half of Ward County. Basal unit in the Allurosa aquifer.						
	Permian	Ochoa		Tecovas Formation and Dewey Lake Redbeds, undif- ferentiated		760	Red shale, siltstone, and very fine-grained sandstone with gypsum and anhydrite cement in the lower part.	Known to yield water to only one well in Ward County.							
				Rustler Formation Salado Formation		500	Anhydrite and dolomite with a basal zone of shale. Locally contains minor amounts of salt and limestone.	Yields moderate to large quantities of moderately to very saline water,							
						1,700	Mostly salt (halite), subordinate amounts of anhydrite, sylvite, and polyhalite.	Water is injected into the formation for recovery of brine used to drill oil and gas wells. Otherwise not known to yield water to wells in Ward County.							
											Cas	tile ormation	2,300	Calcareous anhydrite, halite, and minor amounts of sandstone.	Not known to yield water to wells in Ward County.
Paleozoic		Permian					Tansill Formation	200	Mostly dolomite near the Capitan reef, but grades to anhydrite and salt away from the reef.	Do.					
			Artesia	√ane 1	Yates Sandstone	300	Gray and red sandstone, a few thin beds of dolomite, and red and gray shale.	Yields very saline water and brine in conjunction with oil production.							
		Guadalupe	(Delaware Group in basin)	(Delaware Group in	(Delaware Group in	(Delaware Group in	(Delaware Group in	(Delaware Group in	(Delaware Group in	(Delaware Group in	Lin	Seven Rivers Formation	300	Anhydrite, dolomite, and minor amounts of sandstone and shale.	Yields small to moderate quantities of moderately saline water from flowing oil wells adjacent to the Capitan reef.
				Capitan	Queen Formation	450	Red and gray sandstone interbedded with dolomite and anhydrite.	Yields small amounts of brine from oil wells in the Shipley (Queen) Field east of Royalty.							
						Grayburg Formation	400	Tan and brown dolomite, sandy dolomite interbedded with fine- to medium-grained sandstone.	Yields small quantities of moderately to very saline water to oil wells in southeastern Ward County.						

y The Capitan Limestone (reef facies) has an approximate maximum thickness of 2,000 feet and consists mainly of porous limestone and dolomite, bedded limestone, and reef talus. The formation yields large quantities of moderately to very saline water to wells in Ward County.







drainage, increased amounts of salt were removed, until today there is little or no salt remaining in this narrow belt."

The Pecos trough, separated from the Monument Draw trough to the east by a structural high, underlies western Ward County and extends north to Orla, west to Toyah, and south to Balmorhea in Reeves County. Measured from its eastern rim near Barstow to its western rim near Toyah, the trough is about 30 miles wide; and measured along its north-south axis, the trough is about 75 miles long (Ogilbee, Wesselman, and Irelan, 1962).

The pronounced deformation of the Rustler Formation along the sides of the slumpage troughs in Ward County indicates that faulting has likely occurred. Because the mapping of fault traces was beyond the scope of this report, faults are not shown on the geologic sections and structural maps, which portray only the broad aspects of the present structural trends.

Physical Characteristics and Water-Bearing Properties of the Geologic Units

In the description of the water-bearing properties of geologic units, the yields of wells are described according to the following rating:

DESCRIPTION	YIELD (GALLONS PER MINUTE)
Small	Less than 50
Moderate	50 to 500
Large	More than 500

In general, the chemical quality of the water is classified according to the following:

DESCRIPTION	DISSOLVED-SOLIDS CONTENT (MILLIGRAMS PER LITER)
Fresh	Less than 1,000
Slightly saline	1,000 to 3,000
Moderately saline	3,000 to 10,000
Very saline	10,000 to 35,000
Brine	More than 35,000

Permian System

Guadalupe Series

In the following discussion of formations in the Guadalupe Series, only the Capitan Limestone and its

shelf or back-reef equivalents in the Artesia Group are considered. The fore-reef or basin equivalents in the Delaware Mountain Group, which yield small amounts of brine in conjunction with oil production (Table 9) are not discussed.

Capitan Limestone

The Capitan Limestone, deposited as a reef during Late Guadalupe time, consists of massive, porous limestone and dolomite, bedded limestone, and reef talus. The reef trends north and slightly west through Ward and Winkler Counties into southeastern New Mexico (Figure 6). In Ward County, the reef is approximately 2,000 feet thick and 7 to 10 miles wide; the depth to the crest is about 3,000 feet. The reef interfingers with rocks in the Delaware Mountain Group to the west and rocks in the Artesia Group to the east.

The Capitan Limestone yields large quantities of moderately to very saline water to wells in Ward County. The water is used for secondary recovery of oil in Ward, Crane, and Upton Counties.

Artesia Group

The Artesia Group [Whitehorse Group in previous reports on Pecos County (Armstrong and McMillion, 1961) and Winkler County (Garza and Wesselman, 1959)], the back-reef equivalent of the Capitan Limestone, is divided into five formations—the Grayburg, Queen, Seven Rivers, Yates, and Tansill, in ascending order. On the margin of the reef, the group is composed of dolomite, sandy dolomite, and interbedded sandstone; shelfward the dolomite grades into anhydrite and salt.

Grayburg Formation.—The Grayburg Formation, which is about 400 feet thick, is the lowest unit in the Artesia Group. It consists mostly of tan and brown dolomite, but also contains sandy dolomite interbedded with fine- to medium-grained sandstone; subordinate amounts of anhydrite and bentonite are present. Depths to the top of the formation range from 2,800 to 3,500 feet.

The Grayburg yields small quantities of moderately to very saline water in conjunction with oil production in southeastern Ward County. Moderate quantities of saline water could probably be obtained from wells drilled to the Grayburg near the reef.

Queen Formation.—The Queen Formation, which is approximately 450 feet thick, consists of red and gray sandstone interbedded with dolomite and anhydrite.

The Queen Formation yields small amounts of brine from oil wells in the Shipley (Queen) field east of Royalty.

Seven Rivers Formation.—The Seven Rivers Formation, which is about 300 feet thick, consists of anhydrite, dolomite, and minor amounts of sandstone and shale. Toward the reef, the dolomite content increases and the anhydrite content decreases. Depths to the top of the formation range from about 2,100 to 2,900 feet.

Small to moderate quantities of moderately saline water are produced from flowing oil wells that are completed in the upper part of the formation adjacent to the reef. Part of the produced water is injected into the Yates Sandstone for secondary recovery of oil. Properly constructed water wells tapping the Seven Rivers Formation near the reef would probably yield moderate to large quantities of moderately saline water.

Yates Sandstone.—The Yates Sandstone, a prolific oil-producing formation in Ward County, consists of gray and red sandstone, a few thin beds of dolomite, and red and gray shale. The formation ranges in thickness from about 150 to 300 feet in the county.

The Yates yields very saline water and brine in conjunction with oil production.

Tansill Formation.—The Tansill Formation, which is about 200 feet thick in Ward County, is the youngest formation in the Artesia Group. The rocks are predominantly dolomite near the reef but grade to anhydrite and salt away from the reef. The Tansill is not known to yield water to wells in Ward County.

Ochoa Series

In the order of their deposition, the Ochoa Series consists of the Castile, Salado, and Rustler Formations and the Dewey Lake redbeds. Deposition of the Castile was limited to the Delaware basin; the other three formations are coextensive over both the Delaware basin and Central Basin Platform (Figure 25).

Castile Formation.—The Castile Formation consists of calcareous anhydrite, halite (salt), and minor amounts of sandstone. In the Delaware basin, the Castile is as much as 2,300 feet thick. The formation thins on the west flank of the Capitan reef and is absent on the Central Basin Platform to the east (Figure 25).

The Castile Formation is not known to yield water to wells in the county.

Salado Formation.—The Salado Formation overlies the Castile Formation in the Delaware Basin and overlies the Tansill Formation on the Central Basin Platform. It differs from the Castile Formation in that it consists chiefly of halite and has a subordinate amount of anhydrite. Another important difference is that the Salado contains potash minerals such as sylvite and polyhalite instead of calcite as in the Castile. The Salado

is thickest (1,700 feet, or more) where it supports a structural high in the overlying Rustler Formation in western Ward County, but it is thinner (300 feet, in places) beneath the two slumpage troughs flanking the high (section A-A', Figure 25). The difference in thickness is attributed mainly to post-depositional solution and removal of salt in the Salado by circulating ground water.

In 1967, six plants in the county engaged in the production of brine from the Salado. The brine is produced by injecting water through wells into the salt beds and jetting the salt solution back to the surface. The brine is used to make drilling fluid for drilling oil and gas wells.

Rustler Formation.—The Rustler Formation, which is 200 to 500 feet thick, consists largely of anhydrite and dolomite but has a basal zone of shale. Locally, the Rustler contains minor amounts of salt and limestone. The sharp lithologic break at the contact of the uppermost anhydrite bed in the Rustler with the overlying Dewey Lake redbeds is readily distinguishable on well logs (Figure 8) and has been used to correlate the top of the Rustler in the subsurface (Figure 7). Depths to the top of the Rustler range from 340 feet in the southeastern corner of the county to as much as 1,900 feet in the Monument Draw trough.

The main producing intervals in the Rustler are porous zones in the dolomite and limestone. Porosity ranges from pinpoint to cavernous and is very irregular in extent. As a result, yields from the Rustler range widely; yields as high as 650 gpm (gallons per minute) have been measured, but most wells yield less than 300 gpm. Water from the Rustler in the eastern third of the county is very saline or brine and is used only for secondary recovery of oil. However, near the southcentral edge of the county, five flowing wells yield moderately saline water that has been used successfully for irrigation.

Dewey Lake Redbeds.—The Dewey Lake redbeds, the youngest formation in the Ochoa Series, consists of red siltstone and some gypsum, anhydrite, and red shale. The Dewey Lake is unconformably overlain by the Tecovas Formation of the Triassic Dockum Group. The two formations have similar lithologic and water-bearing characteristics—neither are known to transmit usable quantities of water—and are frequently combined under the general term "Permian-Triassic redbeds." The "redbeds" have not been differentiated on the illustrations in this report.

Triassic System

Dockum Group

The Dockum Group is divided into the Tecovas Formation, the Santa Rosa Sandstone, and the Chinle

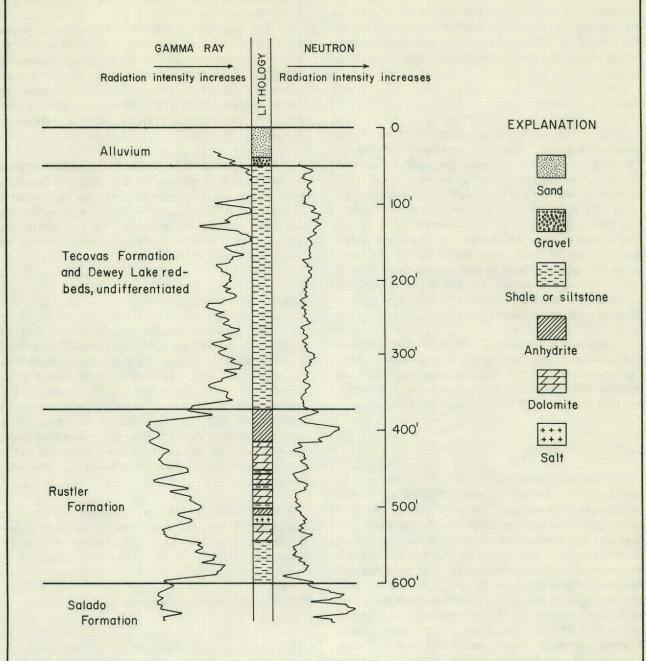


Figure 8

Radioactivity and Driller's Log of the Rustler Formation and Younger Rocks in Southeastern Ward County

Formation equivalent, in ascending order. The Dockum Group is almost the exact equivalent of the Chinle Formation of the Colorado Platform Region (Reeside and others, 1957). Because of local usage, however, Garza and Wesselman (1959) in Winkler County and Armstrong and McMillion (1961) in Pecos County, included only the upper part of the Dockum Group as the equivalent of the Chinle Formation of the type area. The restricted "Chinle Formation equivalent" terminology used in the previous reports is used in this report.

Tecovas Formation

The Tecovas Formation consists of red shale, siltstone, and very fine-grained sandstone. The Tecovas Formation and underlying Dewey Lake redbeds, mapped as one unit in this report, have a combined thickness of as much as 760 feet in the Monument Draw trough. The rocks thin eastward from the trough and are thinnest (less than 300 feet) in the southeastern corner of the county where they are overlain by sand and gravel deposited by the Pecos River. At the surface, the rocks are poorly exposed in the channel of the Pecos River 3 miles south of Grandfalls, but are better exposed in draws and on the sides of benches north of the river 7 to 10 miles southeast of Barstow.

One well in the county (YX-46-39-701) is known to have tapped water-bearing sand or possible crevices in the upper part of the Tecovas Formation near its outcrop. Water from this well, which is now abandoned, was reportedly unfit for livestock and domestic use.

Santa Rosa Sandstone

The Santa Rosa Sandstone consists of reddishbrown to gray, medium- to coarse-grained, micaceous, well-cemented sandstone. The sandstone is typically crossbedded and is interbedded with red shale and siltstone. The Santa Rosa crops out below the rim of Quito Escarpment and is exposed in draws draining the escarpment on the structural high that separates the Pecos and Monument Draw troughs. The rocks are best exposed 12 miles due north of Barstow where 85 feet of ledge-forming sandstone and interbedded shale crop out on the face of Quito Escarpment. A smaller but more accessible outcrop occurs in Rock Quarry Draw, 41/2-miles east of Barstow, where 15 to 20 feet of thick-bedded to massive, crossbedded, hard, red sandtone is exposed in an abandoned guarry. Rock from the quarry has been used to construct several buildings in Barstow, including the old County Court House.

In the Pecos trough west of Quito Escarpment, the Santa Rosa is absent except for local slumpage blocks at the base of the alluvial fill (section E-E', Figure 29). The formation is also absent in the southeastern corner of the county where it has been removed by erosion (section G-G', Figure 31). East from Quito Escarpment,

the Santa Rosa dips gently toward the Monument Draw trough and underlies the surface at shallow depths; but farther east, the rocks plunge into the trough to depths as great as 1,000 feet. The structure is reversed on the east side of the trough where the rocks rise and again assume a fairly level attitude (section C-C', Figure 27).

The thickness of the Santa Rosa generally ranges from 100 to 350 feet, and is maximum (520 feet) in the Monument Draw trough. The Santa Rosa is overlain by the Chinle Formation equivalent or by alluvial deposits where the Chinle is absent. The contact with the overlying sediments is indistinct on most well logs and should be considered approximate where it is shown on the geologic sections (Figure 25 through 31).

The Santa Rosa Sandstone yields small quantities of fresh to slightly saline water to wells on the structural high west of the Monument Draw trough. Wells tapping both the Santa Rosa and overlying alluvial deposits along the margins of the trough and on the platform to the east yield small to large quantities of fresh to very saline water, and locally, brine.

Chinle Formation Equivalent

The Chinle Formation equivalent consists of brick-red to maroon and purple shale and lenticular beds of fine-grained red or gray sandstone and siltstone. The Chinle has not been identified at the surface in Ward County, but it is present in the subsurface in most of the eastern half of the county where it has a maximum thickness of 220 feet. The base of the formation is conformable with the underlying Santa Rosa Sandstone; the top, however, has been subjected to erosion and is overlain with angular unconformity by Cenozoic alluvium.

The Chinle Formation equivalent yields small quantities of fresh to slightly saline water to a few domestic and livestock wells in the eastern third of the county.

Tertiary and Quaternary Systems

Alluvium

Alluvium of Tertiary and Quaternary ages rests unconformably on rocks of Permian and Triassic ages in Ward County. The alluvium consists of clay, sand, gravel, and caliche—material that has been eroded from the older rocks. The lithology and thickness of the beds differ widely within short distances. Normally, the deposits are unconsolidated or poorly cemented. However, patches of indurated caliche and well-cemented gravel conglomerate locally occur on the uplands in the county. The alluvial deposits are thinnest where they wedge out against outcrops of older rocks on the face of

Quito Escarpment, and are thickest (as much as 1,050 feet) in the Pecos and Monument Draw troughs.

In the Monument Draw trough, wells tapping lenses of sand and gravel and beds of well-sorted "quick sand" yield large quantities of fresh to moderately saline water. Along the southern and western perimeters of the county, the very permeable sand and gravel deposits underlying the Pecos River terraces yield large quantities of moderately to very saline water. Small to large quantities of fresh to very saline water and locally brine are pumped from wells tapping alluvial deposits and underlying Santa Rosa Sandstone along the margins of the Monument Draw trough and on the platform east of the trough.

Quaternary System

Dune Sand

Windblown sand deposited as a belt of dunes covers about 50 square miles of northeastern Ward County (Figure 24). Part of the belt consists of high drifting dunes which support scant or no vegetation. Less promiment but more extensive are the low dunes that are partly vegetated and stabilized. The dunes consist of reddish-brown to buff, fine to very fine quartz sand that is intermixed with only minor amounts of silt and clay. The sand has a maximum thickness of about 100 feet in the area of high dunes, but is normally less than 30 feet thick in the area of low dunes.

The water table occurs at shallow depths beneath the high dunes and nearly intersects the surface in the deeper blowouts. Although small quantities of fresh water are obtained from pits and shallow wells in the sand, the dunes are more important as a site of recharge for the underlying formations.

Aquifers

A formation, group of formations, or a part of a formation that is capable of yielding usable quantities of water is termed an aquifer. All ground water used for municipal, domestic, and livestock supplies; a large part of that used by industry; and nearly all the water pumped for irrigation in the county is from the Allurosa aguifer. As defined in this report, the Allurosa aguifer consists of saturated deposits in the Santa Rosa Sandstone, Chinle Formation equivalent, alluvium, and dune sand. The base of the aquifer is identical to the base of the Santa Rosa, or the base of the alluvium where the Santa Rosa is absent. The top of the aquifer is the water table. The aquifer is more than 1,200 feet thick in the Pecos and Monument Draw troughs, but it is much thinner (50 to 300 feet thick) on the platform east of Monument Draw trough, and is discontinuous on the structural high west of the trough. The approximate depth to and the altitude of the base of the aquifer are shown on Figure 9.

The deeper aquifers, such as the Rustler Formation and the Capitan Limestone, are important primarily as a source of saline water for secondary recovery of oil, or as they pertain to the possible contamination of the overlying Allurosa aquifer.

HYDROLOGY

The general principles of ground-water hydrology as they apply to the study area are discussed in the following sections of this report. For additional technical information, the reader is referred to Meinzer (1923a, 1923b), Meinzer and others (1942), Todd (1959), Tolman (1937), and Wisler and Brater (1959); and for nontechnical discussions to Baldwin and McGuinness (1963) and Leopold and Langbein (1960).

Source and Occurrence of Ground Water

The natural source of ground water in Ward County is precipitation in the county and in areas mainly to the north and west. Most of the precipitation is evaporated at the surface or is transpired by vegetation. In normal years, only a small amount runs off into streams. Water that escapes runoff, evaporation, and transpiration migrates slowly downward by gravity through the zone of aeration until it reaches the zone of saturation. In the zone of saturation, all the voids and pore spaces in the rocks are filled with water. The surface of this zone is called the water table, and the water within it is called ground water.

Ground water in Ward County occurs under two conditions—water table, or unconfined; and artesian, or confined. Under water-table conditions, the water will not rise in wells above the level at which it is found in the formation; under artesian conditions, the water rises under pressure to a level above the top of the formation.

The water in the Allurosa aquifer occurs under both water-table and artesian conditions. Normally, the water in the unconsolidated or partially consolidated eclian and alluvial deposits is stored under water-table conditions. Locally, however, water in the deeper alluvial deposits in the Monument Draw and Pecos troughs is confined under slight artesian pressure by overlying, less permeable beds of silt and clay. Artesian conditions are generally observed in wells tapping the consolidated rocks—the Chinle Formation equivalent and Santa Rosa Sandstone—in the lower part of the Allurosa aquifer.

Both the Rustler Formation and Capitan Limestone store water under artesian pressure. The pressure head in the Rustler is sufficient along the south-central edge of the county to cause wells to flow. Well YX-46-32-305, the first to be drilled to the Capitan Limestone (Capitan reef), reportedly had a shut-in pressure of 105 psi (pounds per square inch) at the land surface and flowed 778 gpm when it was drilled in 1953. In 1967, seven wells tapping the Rustler Formation and five wells tapping the Capitan Limestone in Ward County were flowing or had sufficient heads to flow.

Recharge, Movement, and Discharge

The Allurosa aquifer is naturally recharged by infiltration of precipitation, by seepage from streams and depression ponds, and by underflow across the Ward-Loving and Ward-Winkler County lines. The aquifer is also recharged by seepage from irrigation canals and infiltration of irrigation water. The sources and estimated amounts of recharge to the Allurosa aquifer are shown on Figure 10.

Recharge from precipitation and streamflow is intermittent and largely contingent on heavy rainfall. The aquifer is substantially recharged only when storms of long duration or of frequent occurrence saturate the soil so that deep percolation takes place.

The surficial materials in Ward County range widely in their ability to absorb precipitation and transmit it downward to the water table. By far the most favorable site for recharge is the belt of sand dunes that covers the northeastern corner of Ward County. The high permeability of the sand, together with the scarcity of vegetation, permits rapid infiltration of rainfall with minimum evapotranspiration loss. Precipitation that infiltrates to the water table beneath the sand dunes moves southwestwardly towards areas of ground-water withdrawals. Based on the ability of the aquifer to transmit water (coefficient of transmissibility) and the hydraulic gradient, about 2,000 acre-feet of water per year is flowing across the southwestern edge of the sand dunes.

Although sandy soils are prevalent over much of the remainder of the county, they are most always underlain by finer materials that retard the downward percolation of water. The rate of recharge from precipitation is not known, but if it is assumed to be on the order of one-eighth of an inch per year, which is comparable to the less than a quarter of an inch of recharge reported by Theis (1964) for the southern high plains of Texas, then about 5,000 acre-feet per year is being recharged over the remainder of the county.

An estimated 5,000 acre-feet per year of underflow enters Ward County from Loving and Winkler Counties; most of the water flows through alluvial deposits in the Monument Draw and Pecos troughs.

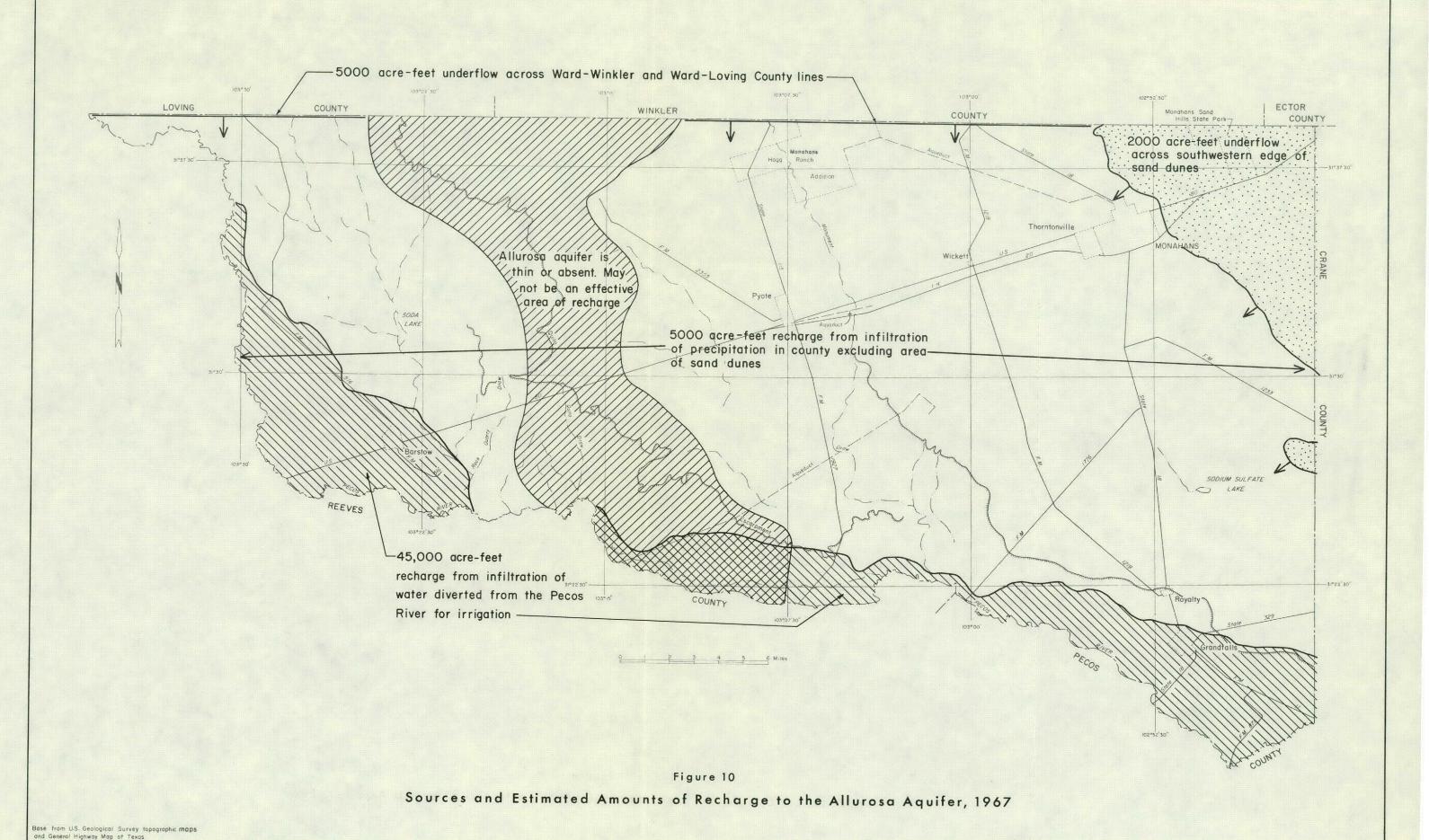
The total amount of natural recharge to the Allurosa aquifer from the sources cited above is estimated to be about 12,000 acre-feet per year.

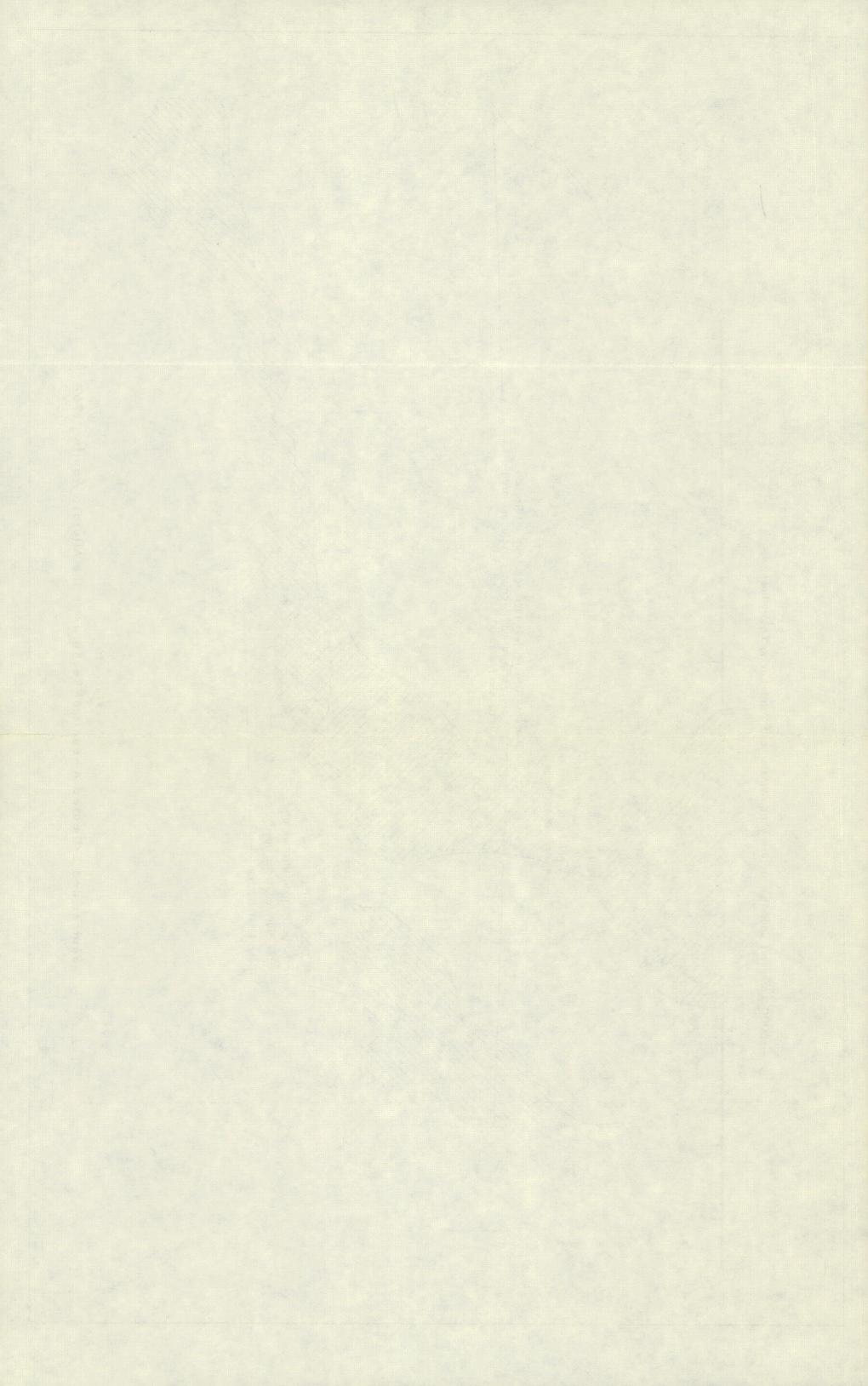
The Allurosa aquifer is also recharged by seepage from irrigation canals and by infiltration of irrigation water applied to the land in excess of the consumptive use of crops. Recharge from these sources occurs mainly within the three irrigation districts in the lowlands bordering the Pecos River and is largely dependent upon the amount of water diverted from the river, which varies widely from year to year. During the water year 1967 (October 1966 through September 1967), the districts diverted 75,510 acre-feet for irrigation of 9,740 acres. According to reports from the districts, 34,739 acre-feet or about 3.6 acre-feet of water per acre was actually applied to the cropland; more than one-half of the total amount of water diverted was lost to seepage from canals. Canal losses ranging from 30 to 72 percent were measured in 1940 during the Pecos River joint investigation (U.S. National Resources Planning Board, 1942) and were summarized as follows:

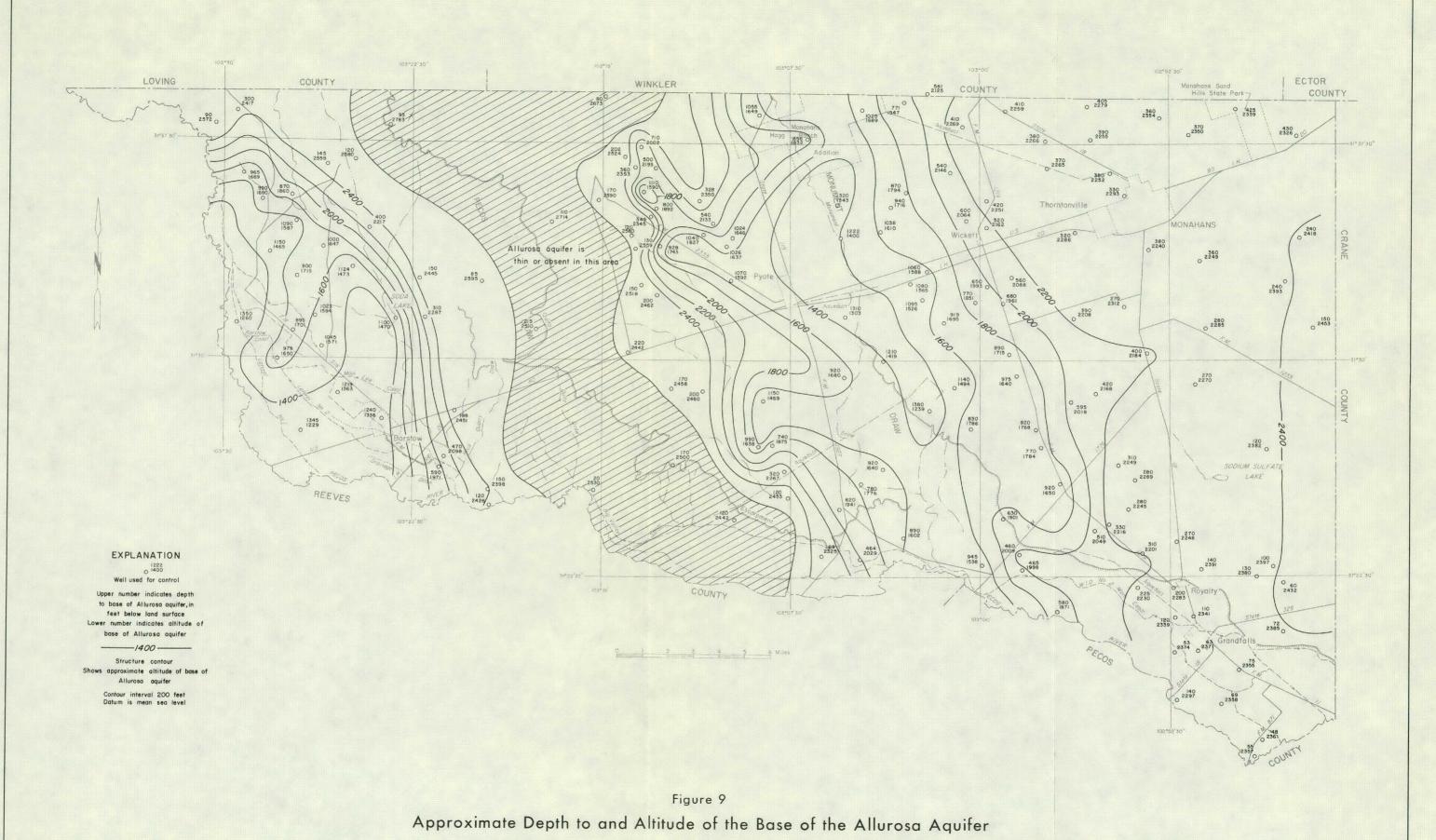
> "... None of the lower [Pecos River] basin ditches is lined to prevent seepage losses. Such losses for all irrigation ditches in Ward County Water Improvement District No. 3 (Cedarvale area) amount to 30 to 32 percent of the water delivered at the headgate. In this area a shallow ditch 8 miles long, constructed almost entirely in caliche, supplies water to irrigate between 100 to 150 acres of land. The ditch has a bottom width of about 10 feet, and the irrigation stream at the headgate is 29 second-feet. In the first 6 miles the loss is 12.5 second-feet, and in the last 2 miles it is 8.5 second-feet, a total loss of 21 second-feet, or 72 percent, in 8 miles of ditch. . . There is so much seepage from this ditch that 24 hours is required to prime it, 24 hours to build up a head, and 60 hours to irrigate an area of 110 acres."

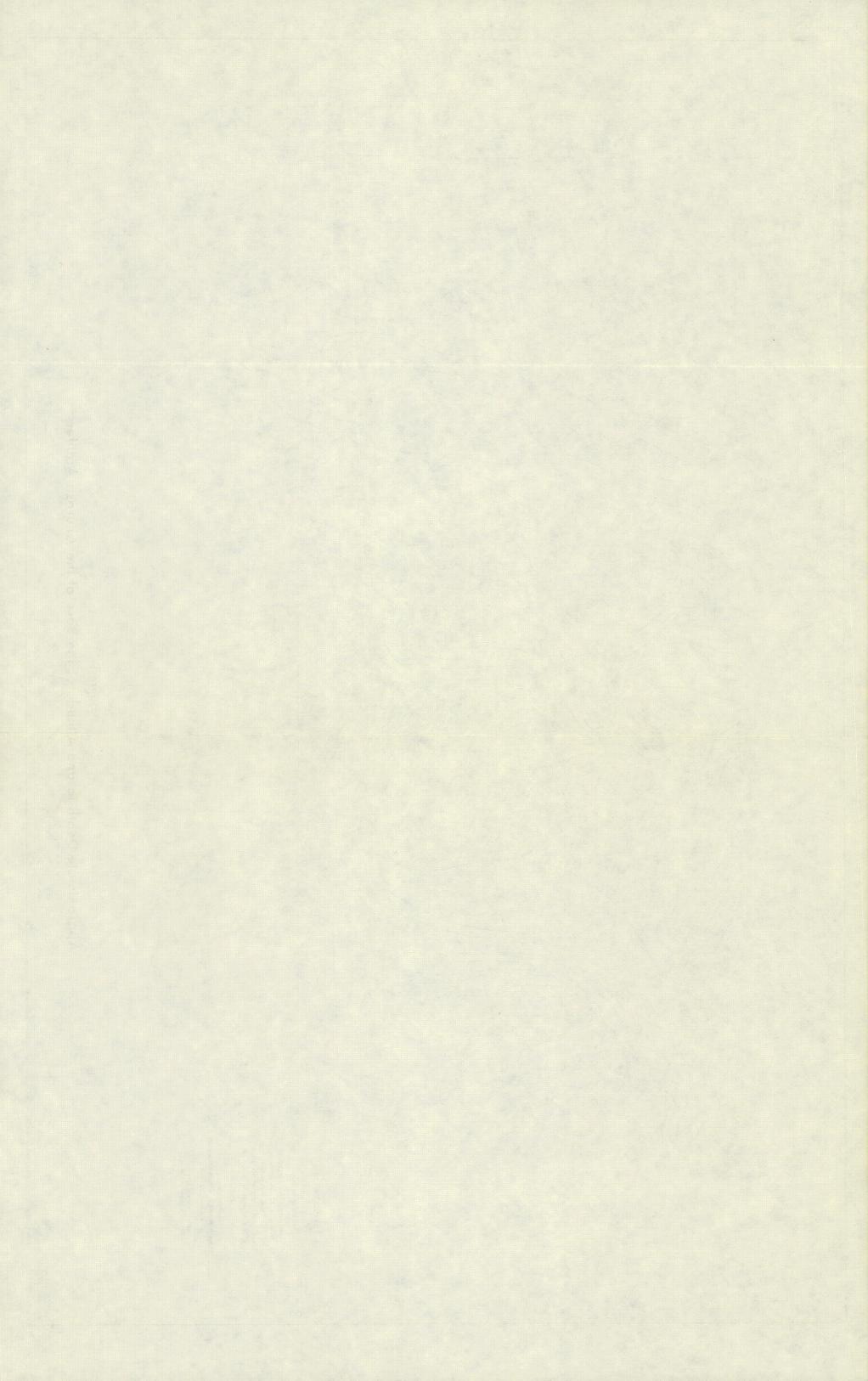
> "In Ward County Water Improvement District No. 2 (Grandfalls area) the seepage loss from irrigation canals is about 30 percent of the total quantity delivered at the headgate. In Big Valley there is an old main irrigation canal constructed along the foothills in porous sand and gravelly soil. Water is delivered at the headgate at the rate of 30 cubic feet per second and of this amount 18 second-feet is lost in 15 miles of canal."

In addition to seepage from canals, approximately 20 percent of the water applied to cropland in irrigation projects in Ward County percolates to the water table. This estimate is based on detailed hydrologic studies conducted during the Pecos River joint investigation (U.S. National Resources Planning Board, 1942). Table









118 (p. 224) of that report shows that the normal consumptive use of water, weighted by type and acreage of crops grown, was 2.81 acre-feet per acre in the Imperial-Zimmerman area near the northern border of Pecos County. In view of the similarity in agricultural practices and hydrologic conditions, the results of this study are believed to be applicable to irrigation projects in Ward County. Accordingly, of the 3.6 acre-feet per acre that was applied in the projects, about 0.8 acre-foot per acre or about 7,700 acre-feet of water was added to the Allurosa aquifer through infiltration of irrigation water during 1967.

The available data suggest that at least 60 percent of the flow that is diverted from the Pecos River eventually percolates to the water table. Accordingly, about 45,000 acre-feet of Pecos River water was added to the Allurosa aguifer during 1967.

The Rustler Formation is recharged naturally by infiltration of precipitation and by seepage from streams at its outcrop in eastern Culberson County (west of the report area). Also, some of the water that enters equivalent formations, which crop out in the Glass Mountains (south of the report area in Pecos and Brewster Counties) may eventually percolate into the Rustler. From the outcrops, the water moves toward the north and east through Pecos and Reeves Counties and enters Ward County as underflow. The quantity of water thus recharged is not known.

In addition to underflow into the county, the Rustler is recharged by injection of salt water through disposal wells within the county. All of the disposal wells are in oil fields on the Central Basin Platform in the eastern third of the county where water in the Rustler is highly mineralized (classed as very saline or brine) and is pumped only for secondary recovery of oil. Based on records of the Texas Water Commission and Texas Water Pollution Control Board (1963), about 18 million barrels, or about 2,300 acre-feet, of oil-field brine was injected into the Rustler Formation during 1961. Data collected from oil companies during the present investigation show that approximately 8 million barrels, or about 1,000 acre-feet, was injected in 1967.

The Capitan Limestone (Capitan reef) is recharged where it crops out in the Guadalupe Mountains in New Mexico and Texas, but probably also receives inflow from its equivalent, the Gilliam Limestone which crops out in the Glass Mountains in Brewster and Pecos Counties. The water moves into Ward County along the trend of the reef shown on Figure 6. The available data are insufficient to determine the amount of water entering the county from these sources.

Ground water in Ward County moves slowly, probably 10 to 500 feet per year, through the aquifers from areas of recharge to areas of discharge, gravity being the motivating force. Initially, the movement is downward in the areas of recharge; thereafter, the water

moves parallel to the slope of the land surface in the alluvial deposits and in the general direction of dip in the consolidated deposits. Exception to the downslope and downdip movement are in the areas where large quantities of water are withdrawn from the aquifers. In those areas, water moves from all directions toward the center of pumping.

The general direction of movement of water in the Allurosa aquifer is shown by the configuration (shape and slope) of the water table, which is contoured on Figure 11. The movement of water is in the direction of decreasing altitude and is at right angles to the contours. Accordingly, water moves toward the southwest from the belt of sand dunes in the northeastern corner of the county; elsewhere, the water moves southward or southeastward in the direction of the Pecos River.

Water in transient storage in the Allurosa aquifer is discharged both naturally and artificially. Natural discharge is by three processes: (1) evapotranspiration, (2) effluent seepage to the Pecos River, and (3) underflow beneath the river into Reeves and Pecos Counties. Water is discharged artificially by pumping of wells (see section on Use of Ground Water) and by seepage into drainage ditches.

Natural discharge by evaporation and transpiration occurs on the lowlands bordering the Pecos River and on the wetlands in and about Soda Lake where the water table is near the land surface. Salt grass, saltcedar, tule, and other salt-tolerant plants are particularly abundant in those areas. Saltcedar, which chokes the banks of the Pecos River, is known to use as much as 5 acre-feet of water per year and to have roots extending to the water table even where it is as much as 50 feet below the land surface.

A program of saltcedar control on the Pecos River downstream from Red Bluff Reservoir was begun by the U.S. Bureau of Reclamation in 1969. As part of this program, the areas of infestation having a density of 10 percent or more were delineated on the flood plain of the river from Mentone (northwest of the report area) in Loving County to the stream-gaging station near Grandfalls. According to Mr. Leon Hill (written communication, 1968), Director of Region 5 of the Bureau of Reclamation:

"The Pecos River flood plain within this reach is quite wide and has poorly defined boundaries. Numerous oxbows, loops, and meanders cause the narrow, deeply incised low-flow channel to have a length at least double that of the flood plain. The heaviest growth occurs either just above the numerous diversion dams or as a heavy growth along the channel. The width of the heavy growth along the channel is approximately equal to

the meander breadth of the river. The remaining portions of the flood plain have less dense infestations, which are probably indicative of the existing lower ground water conditions."

"From a field inspection it was determined that in all probability the phreatophytes have reached their maximum growth and density. It was further estimated that about 15 percent of the infested area was mesquite with the remaining 85 percent saltcedar. Of the 28,270 acres of growth, 83 percent, or 23,450 acres, was considered to have light density (10-35 percent); 11 percent, or 3,120 acres, was considered to have medium density (35-65 percent); and 6 percent or 1,700 acres, was considered to be dense growth (65-100 percent)."

"Using the Blaney method of computing consumptive use, it was determined that the present net consumptive use (precipitation excluded) on the 28,270 acres is 83,130 acrefeet..."

Based on the results of the above study conducted in 1964, approximately 40,000 acre-feet of water is consumed annually by phreatic vegetation along the Pecos River in Ward County.

Discharge of water into the Pecos River via drainage ditches was small or negligible during the current investigation. The only flowing ditch observed drains irrigated land near Barstow. The flow on March 28, 1968, was 310 gpm (.7 cubic-foot per second) measured at a point 300 feet from its confluence with the river, 3% miles southeast of Barstow. The water contained 10,900 mg/l (milligrams per liter) dissolved solids and was therefore classed as very saline.

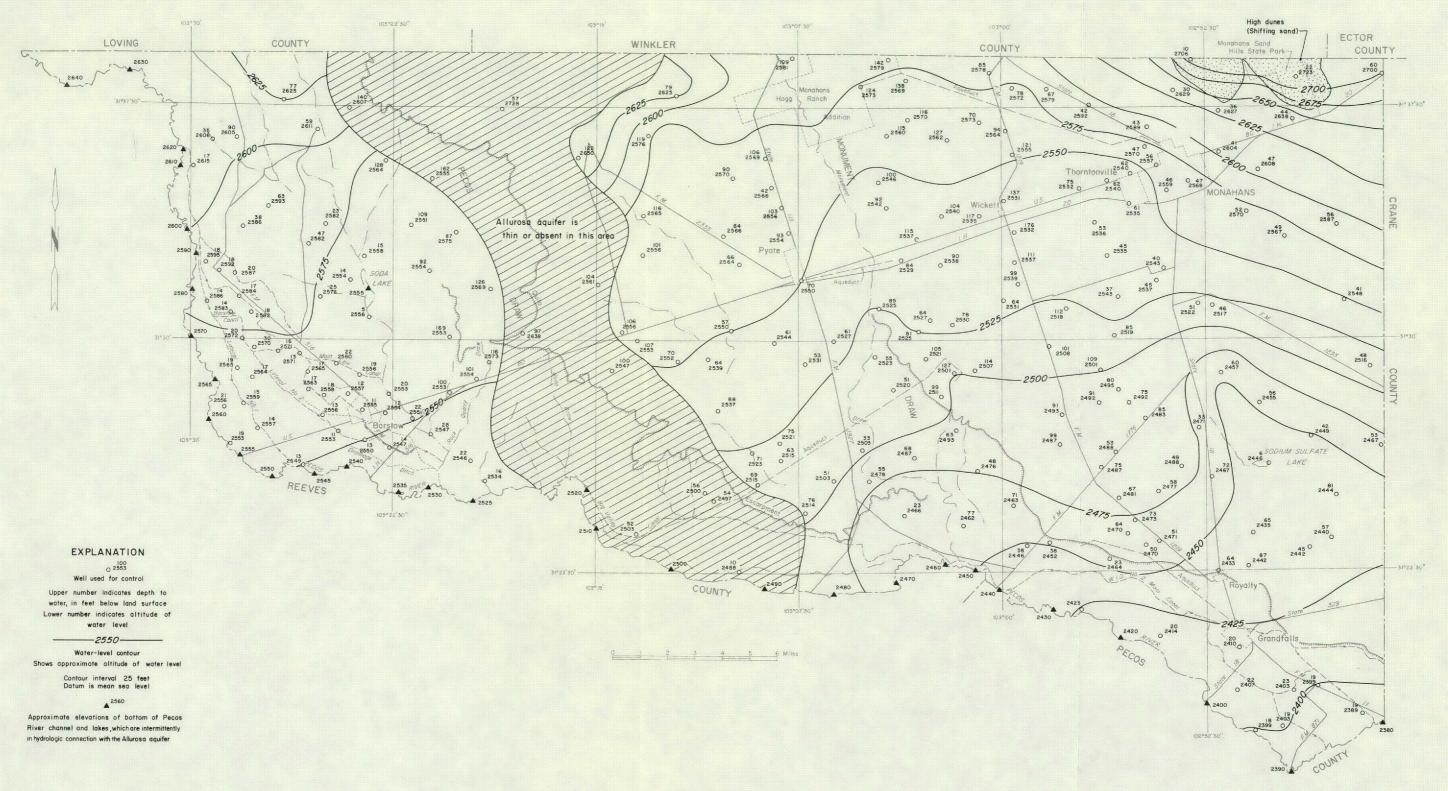
Pecos River Low-Flow and Water-Delivery Studies

A seepage study conducted by the U.S. Geological Survey on May 28-29, 1918, showed that the flow of the Pecos River increased 47.8 cfs (cubic feet per second) or 34,600 acre-feet per year from the New Mexico-Texas State line to Girvin, Texas, during a period of little or no rainfall (Grover, Gray, and Ellsworth, 1922). Of this amount, about 24 cfs (17,400 acre-feet per year) was gained in the reach of river opposite Ward County. Assuming that all of the inflow was effluent seepage from ground water and that both sides of the river contributed equal amounts, about 12 cfs, or approximately 8,700 acre-feet per year, was discharged to the river from the Allurosa aquifer in Ward County.

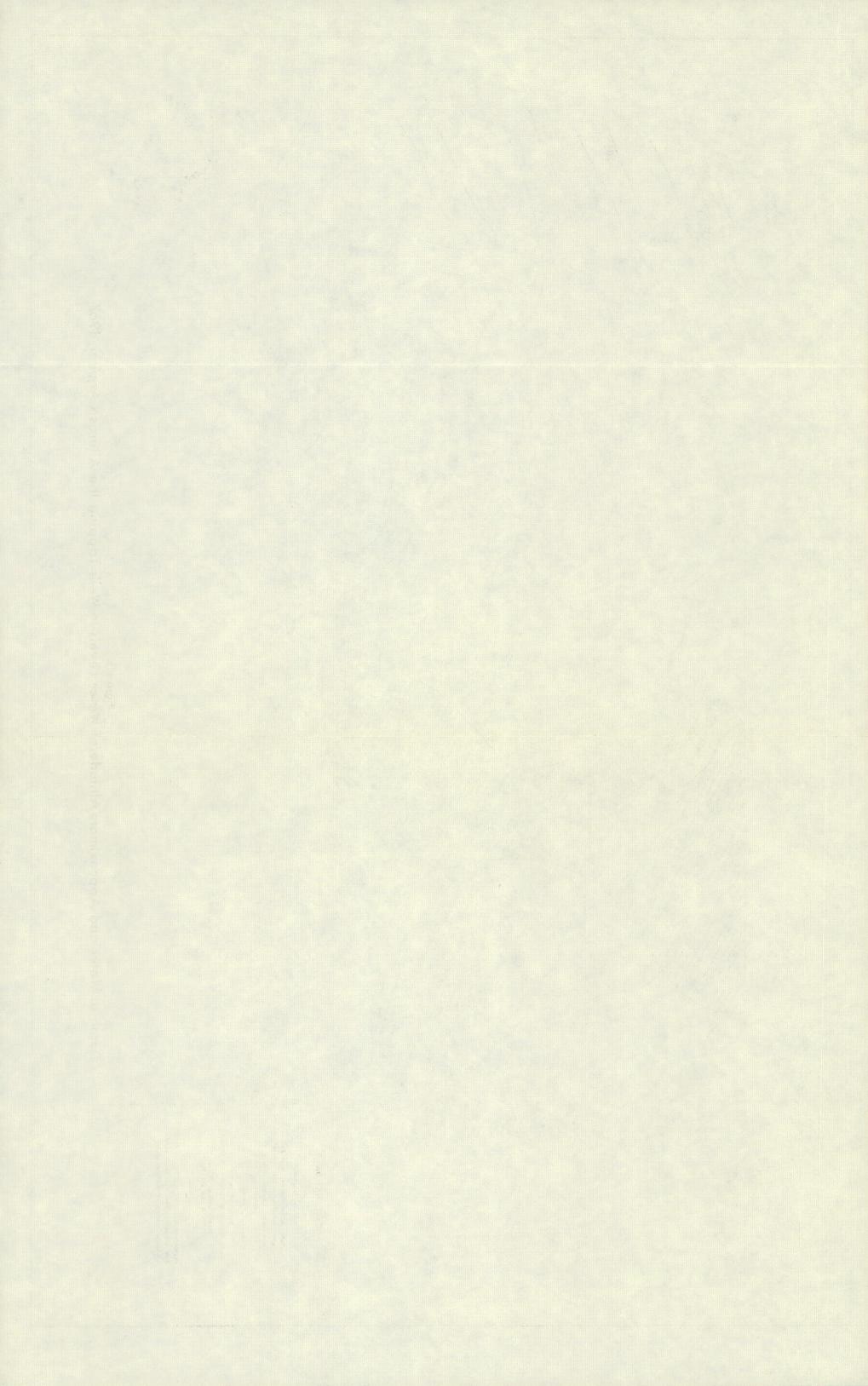
During the Pecos River Joint Investigation, hydrologic studies were made from Red Bluff Reservoir near the New Mexico-Texas State line to Girvin, Texas, a distance of 188 river miles, to determine the sources and amounts of inflow to the river. The studies indicated that ground-water inflow averaged 30,000 acre-feet per year during the period 1905-1939, "...and that in the long run, ground-water inflow and flood inflow occurred in approximately equal proportions" (U.S. National Resources Planning Board, 1942a). Assuming that at least half of the ground-water inflow was gained within the 98-mile reach of river opposite Ward County, and that aguifers on both sides of the river contributed equal amounts, an average of about 7,500 acre-feet per year was discharged to the river from the Allurosa aquifer in Ward County. It should be noted, however, that this study and the seepage study in 1918 were made during periods in which ground-water pumpage and phreatophyte consumption along or near the river were much smaller than in 1967.

Grozier and others (1966) made a water-delivery study February 15 to March 31, 1964, and conducted a low-flow study May 10 to May 12, 1965, to determine the changes in the quantity and quality of flow in the Pecos River for the reach from Red Bluff Reservoir to Girvin, Texas. Figure 12 shows the results of the water-delivery study during which 4,370 acre-feet of water passed the stream-gaging station near Orla, Texas (14.3 miles downstream from Red Bluff Reservoir); 130 acre-feet was diverted from the river; and 1,760 acre-feet passed the stream-gaging station near Girvin. The loss of 2,480 acre-feet of water between the two stations was 57 percent of the flow measured near Orla. This loss was attributed to evaporation, transpiration, and seepage to ground-water aquifers. According to Grozier and others (1966), "... Because the weather was cool and phreatophytes were relatively dormant in February and March, most of the loss was to ground-water aquifers." During this study, about 1,300 acre-feet of water was lost in the reach of river opposite Ward County.

The daily chloride concentration in the Pecos River below Red Bluff Dam near Orla and Pecos River near Girvin for the period February 15 through March 31, 1964, is shown in Figure 12. The figure indicates the chloride content at the sampling station near Orla was markedly uniform during the study, ranging from about 2,900 to 3,000 mg/l. In contrast, the chloride content in the river near Girvin was quite variable, ranging from a high of 7,900 mg/l to a low of 3,780 mg/l. The peak in the chloride content measured on March 7 was likely caused by flushing of salt which had accumulated on the river enbankments during low flow; the peak was followed by a sharp drop in chloride to about 4,100 mg/I when the flushing action was completed. The chloride content gradually increased after most of the released water had passed the sampling station, but it decreased temporarily during a period of refreshment from local runoff.



Depth to Water and Approximate Altitude of Water Levels in Wells Tapping the Allurosa Aquifer, 1967



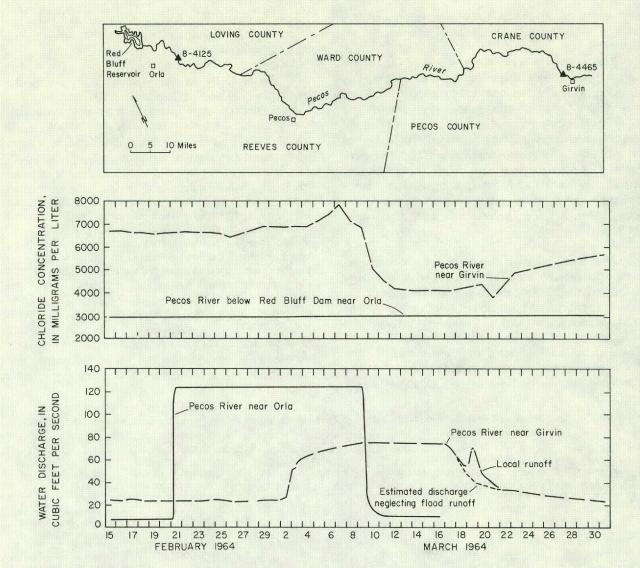


Figure 12.—Hydrograph of Flow and Chloride Concentration in the Pecos River Near Orla and Girvin

During the low-flow study of May 10-12, 1965, the river was dry for about half of its reach along Ward County. Small amounts of flow were measured in reaches of river downstream from Barstow and Grandfalls (Grozier and others, 1966), but most of this water was likely return of flow that had been previously diverted to irrigation projects along the river.

Hydraulic Properties of the Aguifers

Aquifer tests were made in a few wells in Ward County to determine the coefficients of permeability, transmissibility, and storage, which govern the ability of the aquifer to transmit, yield, or store water.

The field coefficient of permeability is the flow of water in gallons per day at the prevailing temperature through a cross section of 1 square foot of the aquifer under a hydraulic gradient of 1 foot per foot.

The coefficient of transmissibility, a similar measure for the entire thickness of the aquifer, is defined as the rate of flow of water in gallons per day at the prevailing water temperature through a vertical strip of the aquifer 1 foot wide extending the full height of the aquifer under a hydraulic gradient of 1 foot per foot. The volume of water that will flow each day through each foot of the aquifer is the product of the coefficient of transmissibility and the hydraulic gradient. The smaller the coefficient of transmissibility, the greater the hydraulic gradient must be for the water to move through the aquifer at a given rate.

The coefficient of storage is the volume of water released from or taken into storage per unit surface area of the aquifer per unit change of the component head normal to that surface. Under water table conditions, the coefficient of storage is practically equal to the specific yield. The specific yield is the quantity of water that a formation will yield under the force of gravity, if it is first saturated and then allowed to drain, the ratio

being expressed in percentage of the volume of this water to the volume of the material drained.

The results of six aquifer tests in Ward County are given in Table 2. Five of the tests were in wells tapping the Allurosa aquifer and one was in a well which had been drilled to test the Rustler Formation. The Layne-Texas Company and Ed L. Reed, Consulting Hydrologist in Midland, Texas, furnished data for two of the tests. All the test data were analyzed by one or more of the following methods: the Theis nonequilibrium method (Theis, 1925), the Cooper and Jacob straight-line method of approximation (Cooper and Jacob, 1946), and the Theis recovery method (Wenzel, 1942).

The coefficients of transmissibility determined from wells tapping the Allurosa aquifer ranged from 11,400 to 240,000 gpd (gallons per day) per foot (Table 2). Field coefficients of permeability ranged from 190 to 2,200 gpd per square foot, but were less than 400 gpd per square foot in four of the five tests. A coefficient of storage of 0.2 was computed from test number 5. The field coefficients of permeability shown were determined by dividing the transmissibility coefficients

by the estimated thickness of sand supplying the water to the well. The sand thicknesses were obtained from a study of drillers' logs or electrical logs.

Figure 13 shows the results of an 81-day aquifer test in Ozark-Mahoning Company's fresh-water well field located 9 miles south-southeast of Monahans. During the wells YX-45-34-503, YX-45-34-505, test, YX-45-34-506 pumped a combined 90 gpm for supply of the company's sodium sulfate plant 2 miles south of the well field. The plant and wells had been shut down for 3 months prior to the test. The graph shows that the water levels were lowered by continued pumping, but that the rate of decline decreased with time as the cone of influence spread out from the pumped wells. Well YX-45-34-505, the nearest to the center of pumping. had the largest decline (8.1 feet) in water level during the test; and correspondingly, well YX-45-34-401, the most distant from the center of pumping, had the smallest decline (3.2 feet). The transmissibilities computed from the drawdown curves in wells YX-45-34-401, YX-45-34-504, and YX-45-34-507 ranged from 11,000 to 11,800 and averaged 11,400 gpd per foot. The average field coefficient of permeability was 285 gpd per square foot.

Table 2.—Coefficients of Permeability and Transmissibility Determined From Pumping Tests of Selected Wells

TEST	WELL PUMPED OR OBSERVED	AQUIFER (WATER-BEARING FORMATION)	TEST COMPLETION DATE	FIELD COEFFICIENT OF PERMEABILITY (GPD PER SQ. FT)	COEFFICIENT OF TRANSMISSIBILITY (GPD PER FT)	REMARKS
1	YX-45-25-317	Rustler Formation	Mar. 20, 1951	670	22,000	4-hour recovery test. Well pumped 600 gpm for 21 hours prior to test.
2	YX-45-33-802	Allurosa aquifer	Aug. 14, 1967	190	34,000	27½-hour recovery test. We pumped 490 gpm for 44½ hours prior to test.
3	YX-45-34-401 503 504 505 506 507	Allurosa aquifer	Oct. 21, 1967	285	11,400	81-day interference test (Figure 13). Wells YX-45-34-503, 505, and 506 pumped a combined 90 gpm during test. Declines in water levels were measured in wells YX-45-34-401, 503, 504, 505, and 507.
4	YX-46-24-701 703 704	Allurosa aquifer	June 8, 1957	280	56,000	24-hour interference test, ¹ / Well YX-46-24-703 pump- ed 500 gpm during test. Declines in water levels were measured in wells YX-46-24-701 and 704.
5	YX-46-29-701 Obs. well 1 Obs. well 2 Obs. well 3 Obs. well 4 Obs. well 5 Obs. well 6 Obs. well 7	Allurosa aquifer	Sept. 24, 1941	2,200	240,000	12-day interference test (Figure 14). Well YX-46-29-701 pumped 1,300 gpm during test. Declines in water levels were measured in pumped well and 7 observation wells, Coefficient of storage = 0.2.
6	YX-46-40-308	Allurosa aquifer	Aug. 12, 1962	390	49,000	3½-hour recovery test. Well pumped 1,050 gpm for 4 hours prior to test.2/

¹ Pumping test conducted by Layne-Texas Co.

^{2/} Pumping test conducted by Ed L. Reed, Consulting Hydrologist, Midland, Texas.

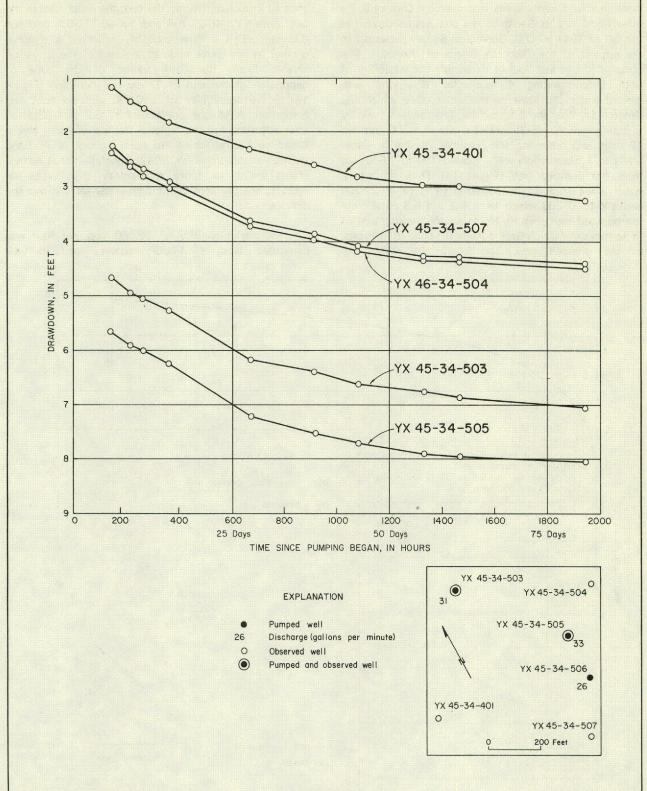


Figure 13
Drawdown of Water Levels in Five Wells Tapping
the Allurosa Aquifer During an 81-Day Period of Pumping

The highest transmissibility in Table 2, 240,000 and per foot, was computed from a 12-day aguifer test made in Ward County Water Improvement District 3, 61/2 miles northwest of Barstow. The test was conducted in the fall of 1941 by U.S. Geological Survey personnel at the request of the District's Board of Directors. The purpose of the test was to determine the feasibility of both supplementing surface-water diversions with ground water and lowering the water table, which was dangerously near the land surface. The test was made by pumping well YX-46-29-701 at a rate of 1,300 gpm for 12 days and observing the resultant decline in water levels in 7 observation wells located 150 to 1,640 feet from the pumped well (Figure 14). During the test, water levels were also measured in wells YX-46-29-704 and YX-46-37-303 which were 1.3 and 5.3 miles from the pumped well. Figure 15 shows the hydrographs of these two wells which were outside the cone of influence of the pumped well. The figure also shows the

hydrographs of observation wells 1 and 7, which were 150 and 1.640 feet from the pumped well and within its cone of influence. During the test, the water level in the two wells (YX-46-29-704 and YX-46-37-303) declined 0.6 foot. This decline probably reflected a regional decline in the water table at the end of the irrigation season. From the configuration of the cone of depression at the end of 12 days of pumping (Figure 14), a transmissibility of 240,000 gpd per foot was computed. A storage coefficient of 0.2 was obtained after adjusting for the regional decline in water levels. Based on the results of this pumping test, J. W. Lang (written communication, 1942) concluded that surface drains would be more satisfactory than wells for relieving the problem of the high water table within the district.

A transmissibility of 22,000 gpd per foot was computed from a 4-hour recovery test in well

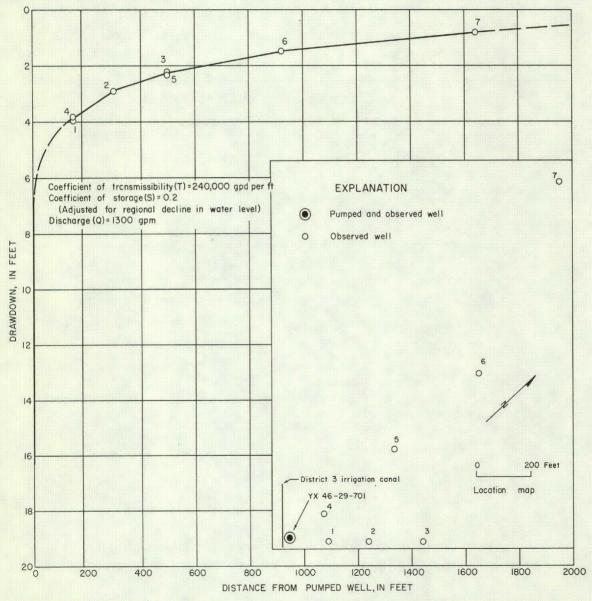
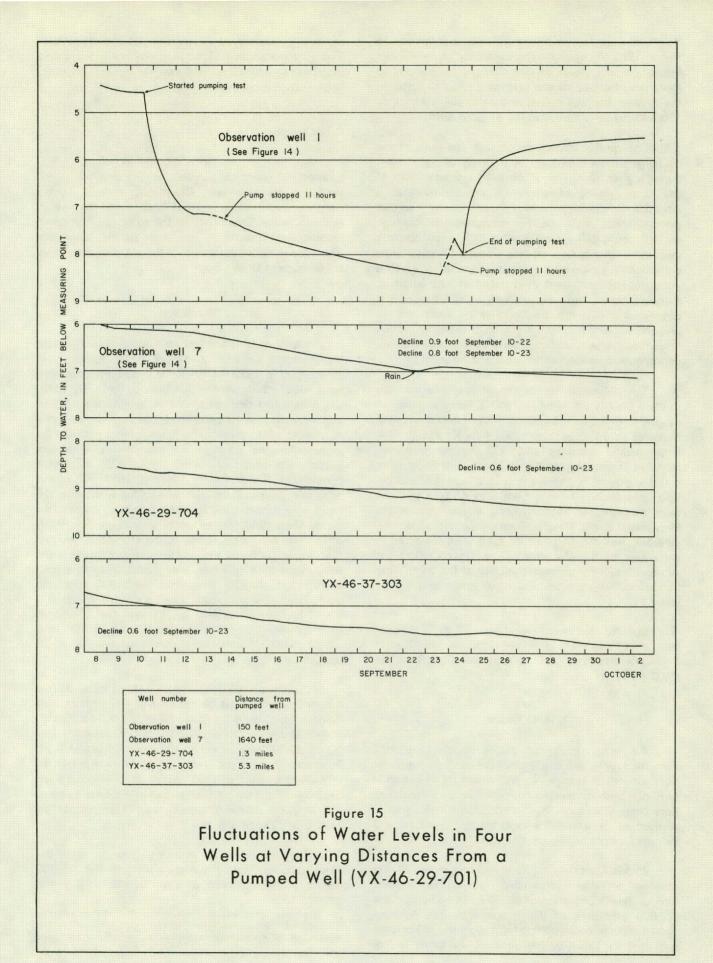


Figure 14.—Relation of Drawdown to Distance From a Well Pumping 1300 gpm for 12 Days



YX-45-25-317. This well was drilled to a depth of 965 feet in 1951 to determine the suitability of the Rustler Formation as a source of water supply for the city of Monahans. Because of the inferior quality of water in the Rustler, the well subsequently was plugged back to 160 feet and was screened in the Allurosa aguifer.

The specific capacity of a well, the ratio of the discharge to the drawdown or recovery of water levels during a given time interval, provides a general index of the water-yielding capability of the aquifer that is capacities vary with tapped. Specific permeabilities; high specific capacities denote high aquifer permeability, and low specific capacities are measured in wells tapping aquifers with low permeability. However, the specific capacity of a well is not a constant inasmuch as it decreases with length of pumping time. Also, the manner in which a well is completed affects the specific capacity. Wells that are properly screened so as to minimize entrance friction losses have larger specific capacities than those that are improperly completed, other factors being equal.

The yields and specific capacities of selected wells in Ward County are listed in Table 3. Specific capacities ranging from 0.3 to 173 gpm per foot of drawdown were measured in 76 wells tapping the Allurosa aquifer. The larger specific capacities (40 to 173 gpm per foot) were recorded in wells tapping the very permeable Pecos River gravel deposits in the Barstow and Grandfalls areas. Specific capacities ranging from 5 to 43 gpm per foot were measured in wells tapping alluvial fill in the Monument Draw trough. Smaller specific capacities, generally less than 5 gpm per foot, were measured in wells east of the Monument Draw trough where the Allurosa aquifer is composed mostly of the Santa Rosa Sandstone, which transmits only small amounts of water.

Specific capacities ranging from 1.7 to 13 gpm per foot were measured in 4 wells tapping the Rustler Formation and from 2.5 to 13 gpm per foot in 8 wells in the Capitan reef.

Use of Water

All water used for public supply, industry, domestic supply, and nearly all of the livestock supply in Ward County is from wells. Water used for irrigation is furnished both by pumping of wells and by diversion of flow from the Pecos River. Part of the water that is pumped in the county is exported for municipal and industrial supply in adjacent counties.

In 1967, a total of 11,208 million gallons (34,400 acre-feet) of water was pumped from aquifers in Ward County, nearly two-thirds or about 7,364 million gallons (22,600 acre-feet), of which was from the Allurosa aquifer. Of the water pumped in the county, 60 percent was used by industry, the principal use being in the

secondary recovery of oil by the waterflood method. Twenty-seven percent of the pumpage was for irrigation of cropland, and 13 percent was for public, domestic, and livestock supply.

Public Supply

In 1967, a total of 1,506 million gallons (4,698 acre-feet) of water was pumped for municipal supply for the cities of Monahans, Grandfalls, Wickett, Pyote, Barstow, and Royalty in Ward County and the city of Pecos in Reeves County. All of the water was from wells tapping the Allurosa aquifer; most of the water was piped from wells completed in the alluvial deposits in the Monument Draw trough.

Monahans

Residents of Monahans were supplied by privately owned wells until a municipal water system was constructed in 1930. In 1943, the system included nine wells, all of which were within the city limits. By 1948, the system had been expanded to include eight of the original wells plus 12 wells which had been drilled half a mile north of the present city limits. In that year, the 20 municipal wells supplied an estimated one million gallons per day of water to 1,825 customers (Broadhurst, Sundstrom, and Weaver, 1951). All of the original municipal wells that were drilled within the city limits were subsequently abandoned because of their low yields. Since 1946, four of the 12 wells in the field north of the city have been leased to the Monahans Country Club for irrigation of golf-course greens; the other eight wells in the field have been abandoned. One of the four wells (YX-45-25-306) reportedly yields 100 gpm; the other wells leased from the city (YX-45-25-307, YX-45-25-310, and YX-45-25-311) and two additional wells owned by the club (YX-45-25-308 and YX-45-25-309) reportedly discharge an average of 70 apm.

Currently (1967), Monahans obtains its municipal supply from the West Monahans and Hogg Ranch well fields. Six wells (YX-45-25-313, YX-45-25-315, YX-45-25-316, YX-45-25-603, YX-45-25-604, and YX-45-25-605) are in use in the West Monahans field. Pumpage from these wells in 1967 amounted to 309,685,000 gallons (950 acre-feet). The combined discharge of the six wells measured by a master meter at the Maxwell pumping station was 800 gpm, or an average of 133 gpm per well.

The four municipal wells which are in use in the Hogg Ranch addition 1/pumped a metered 408,275,000 gallons (1,253 acre-feet) of water in 1967. All of the

^{1/} The Hogg Ranch addition to the city of Monahans includes 18% square miles of range land in Ward and Winkler Counties (boundaries of the addition in Ward County are shown on Figure 24).

Table 3.—Specific Capacities of Selected Wells in Ward County and Adjacent Areas

WELL	DEPTH OF WELL (FT)	CON	TEST IPLETION DATE	LENGTH OF TEST (HOURS)	DISCHARGE (GPM)	DRAWDOWN, D, OR RECOVERY, R (FT)	SPECIFIC CAPACITY (GPM/FT)
				Allurosa aquifer			
YX-45-17-701	403	Apr.	28, 1967	101	53	33 D	1.6
25-304	110		1940	72	75	45 D	1.7*
305	176	Mar.	31, 1965	8	125	55 D	2.3*
321	220	Dec.	16, 1946	8	192	68 D	2.8*
322	221	Nov.	20, 1945	24	160	62 D	2.6*
501	200	May	13, 1967	1	200	88 R	2.3*
507	250	May	24, 1950	24	131	48 D	2.7*
508	275	May	4, 1950	24	147	53 D	2.8*
603	140	Oct.	29, 1953	1	137	50 D	2.7*
707	220		1960	8	34	25 D	1.4*
907	126	May	11, 1967	2	15	54 D	.3
26-701	213	May	16, 1967	14	72	57 D	1.3
33-208	240	Mar.	1967	æ	146	26 D	5.6*
209	352	June	7, 1953	5	800	17 D	47 *
209	352		do	5	1,000	23 D	43 *
214	330	Jan.	6, 1961	4	135	40 D	3.4*
401	250	June	22, 1967	3	555	37 D	15
507	230	June	23, 1967	6	685	34 D	20
515	311	Sept.	1952	24	1,500	40 D	38 *
609	252		1958		131	30 D	4.4*
706	300	June	21, 1967	720	275	114 D	2.4
707	210	June	22, 1967	720	710	112 D	6.3
802	220	Aug.	14, 1967	44	490	21 D	23
805	116		1960	1/2	38	10 D	3.8*
811	220	Feb.	1951	12	400	21 D	19 *
812	140	Aug.	7, 1967	1	295	7.5 D	39
822	135		1960	1/2	51	6 D	8.5*
903	137	July	1966	3	200	35 D	5.7*
908	135		do	4	200	26 D	7.7*
42-505	62	Apr.	27, 1967	10	1,000	20 D	50
46-21-703	228	Feb.	26, 1963	6	175	96 D	1.8*
ZP-46-23-603	400		1956	12	1,040	69 D	15 *
YX-46-23-902	225	Sept.	13, 1967	1	160	21 D	7.6
904	300		do	17	440	32 D	14
24-702	395	June	18, 1959	11	713	86 D	8.3*
703	385	June	8, 1957	6	500	36 D	14 *

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See footnotes at end of table.

Table 3.—Specific Capacities of Selected Wells in Ward County and Adjacent Areas—Continued

WELL	DEPTH OF WELL (FT)	COV	TEST IPLETION DATE	LENGTH OF TEST (HOURS)	DISCHARGE (GPM)	DRAWDOWN, D, OR RECOVERY, R (FT)	SPECIFIC CAPACITY (GPM/FT)
704	392	Apr.	2, 1959	34	1,220	64 D	19 *
704	392	Apr.	14, 1967	2	830	35 D	24
705	387	Feb.	21, 1965	36	1,000	47 D	21 *
705	387	Apr.	17, 1967	1	920	38 D	24
29-701	115	Sept.	23, 1941	300	1,300	16 D	81
705	152	Apr.	23, 1947	72	1,430	16 D	89
804	153		do	1	960	24 D	40
903	190	Jan.	1966	21	410	44 D	9.3*
31-602	200	Sept.	11, 1967	336	240	13 D	18
603	200		do	2	260	25 D	10
604	225		do	2	445	12 D	37
801	300	Nov.	13, 1967	22	380	16 D	24
32-204	425	Dec.	1957	48	1,000	38 D	26 *
204	425	Sept.	26, 1967	1/2	810	25 D	32
401	226	Sept.	9, 1967	126	285	17 D	17
403	400	Sept.	12, 1967	9	500	30 D	17
409	185	Nov.	16, 1967	3/4	207	36 D	5.8
501	182	Jan.	1945	96	280	12 D	23 *
508	425	Sept.	19, 1967	1/2	888	37 D	24
509	385	Aug.	6, 1958	24	838	44 D	19 *
509	385	Sept.	19, 1967	1/2	759	29 D	26
510	259	Sept.	26, 1967	1/2	197	27 D	7.3
511	235		1942	60	190	36 D	5.3*
512	235	July	1943	60	214	13 D	16 *
514	240	Sept.	24, 1945	8	380	85 D	4.5*
514	240	Nov.	16, 1967	2	328	70 D	4.7
603	306		1963	48	1,500	90 D	17 *
604	284	Apr.	1966	134	310	15 D	21
37-110	125	Oct.	19, 1967	14	940	^4 R	67
207	80	Apr.	1940	102	1,400	14 D	100
212	80	Apr.	4, 1940	4	730	1.4 D	52
213	58	Oct.	7, 1940	168	1,200	16 D	75
223	110	Apr.	26, 1947	1	1,125	29 D	39
305	80	Oct.	25, 1967	4	1,450	20 D	73
313	103	June	8, 1940	3	1,270	11 D	115
314	77	Apr.	18, 1947	24	1,675	14 D	120
321	107		1946	168	1,505	30 D	50 *

See footnotes at end of table.

Table 3.—Specific Capacities of Selected Wells in Ward County and Adjacent Areas—Continued

WELL	DEPTH OF WELL (FT)	CON	TEST MPLETION DATE	LENGTH OF TEST (HOURS)	DISCHARGE (GPM)	DRAWDO OF RECOVE (FT	RY, R	SPECIFIC CAPACITY (GPM/FT)
324	105	Nov.	15, 1967	4	740	4.9	D	151
604	95		do	3	1,160	6.7	, D	173
38-104	110	May	21, 1940	3	1,000	23	D	43
39-205	142	Nov.	7, 1967	2	100	14	D	7.1
40-305	250	May	29, 1967	b /	884	34	D	26 *
306	240		do	b /	865	40	D	22 *
307	316		do	b /	656	21	D	31 *
308	256		do	b /	766	33	D	23 *
503	210	Aug.	11, 1967	9∕	870	39	D	22
			R	ustler Formation				
ZP-45-17-802	950	Feb.	15, 1967	1	220	17	D	13 *
YX-45-25-317	₫/965	Mar.	30, 1951	21	600	129	D	4.7
317	₫/965		do	4	600	112	R	5.4
34-703	656	Jan.	1957	5	346	40	D	8.6
46-40-702	1,080	June	1, 1967	83	250	147	D	1.7
			Capitan	Limestone (Capital	n reef)			
YX-46-32-305	3,700	June	28, 1957	5	704 Flow	97	R	7.3*
306	3,950	Feb.	20, 1957	24	288 Flow	113	D	2.5
307	4,100	June	28, 1957	5	640 Flow	88	R	7.3*
308	4,500	Feb.	20, 1957	24	655 Flow	74	D	8.9*
309	4,100	June	28, 1957	5	780 Flow	76	R	10 *
610	4,450	Feb.	20, 1957	24	375 Flow	111	D	3.4
611	4,500	June	28, 1957	5	435 Flow	116	R	3.8*
901	4,421	July	11, 1962	4	1,310 Flow	102	D	13

^{*} Reported data.

^{₫/3} months.

b/ Pumped 60 percent of the time for 42 days.

C/A months

extstyle ext

water was piped 11 miles southeast to the city proper. Yields of 830 and 920 gpm were measured from wells YX-46-24-704 and YX-46-24-705 in April 1967. Yields from the other two wells, YX-46-24-702 and YX-46-24-703, are reportedly of the same magnitude. The four wells tap alluvial deposits in the Monument Draw trough.

Grandfalls

The city of Grandfalls purchased its water system from the L. C. Harrison Water Company in January 1964. At that time, the system was supplied by wells YX-45-33-901, YX-45-33-902, and YX-45-33-903 in a field 4 miles northwest of the city. City well number 1 (YX-45-33-901) was plugged in 1965 after the water became salty (see water analyses in Table 8). City well number 2 (YX-45-33-902) is abandoned and will be plugged. Wells 3 and 4 (YX-45-33-903 and YX-45-33-908) are used only during the summer months when the water demand is greatest.

Most of the municipal supply for Grandfalls is pumped from well number 5 (YX-45-33-812), 6½ miles northwest of the city. This well was originally drilled for Ward County Improvement District No. 2 in 1946, but was not used until it was turned over to the city in 1965.

Wells YX-45-33-903 and YX-45-33-908 reportedly discharge about 200 gpm. During a 1-hour pumping test in August 1967, well YX-45-33-812 pumped 295 gpm and had a drawdown in water level of 7½ feet. In 1967, the three wells pumped 64,211,700 gallons (197 acre-feet).

Wickett

In 1967, the residents of Wickett used 55,436,000 gallons (170 acre-feet) of water supplied from wells YX-46-32-603 and YX-46-32-604. Well YX-46-32-603 discharges 800 gpm; well YX-40-32-604, which is on standby status, pumped 310 gpm during a development test by the driller.

Pyote

The municipal water system of the city of Pyote is leased from the University of Texas. The well field, 3½ miles east of the city, has six wells, of which only three—YX-46-32-501, YX-46-32-513, and YX-46-32-514—are in use. Wells YX-46-32-511 and YX-46-32-512 have been abandoned, and well YX-46-32-515 may be returned to use. All of the wells were drilled in the 1940's to supply the Pyote Air Force Base during World War II. The base was closed after the war, but part of it is now occupied by the West Texas Children's Home, which is connected to the water system.

Yields of the three wells in use range from 260 to 328 gpm. In 1967, the wells supplied 71,457,586 gallons (219 acre-feet) for use in the city and children's home. All of the wells tap alluvial deposits in the Monument Draw trough.

Royalty

Well YX-45-42-102 serves 12 families in Royalty, or about one-fourth of the population; other residents purchase water from the city of Grandfalls or pump their own supply. The well yields an estimated 15 gpm, and in 1967, supplied about 2,700,000 gallons (8.3 acre-feet).

Barstow

Since July 1966, the residents of Barstow have purchased water piped from the city of Pecos. Previous to that time, wells YX-46-38-201 and YX-46-38-202, located 4 miles east of Barstow, supplied the municipal system. Both wells tapped the Santa Rosa Sandstone and neither yielded more than 75 gpm.

In 1967, Barstow used a metered 25,547,000 gallons (78 acre-feet).

Pecos

The water supply for the city of Pecos is piped from two well fields—one in Reeves County and a second in Ward County. The former has been previously described by Ogilbee, Wesselman, and Irelan (1962). The latter is located 6 miles southeast of Pyote and has 4 wells, YX-46-40-305, YX-46-40-306, YX-46-40-307, and YX-46-40-308, all of which tap alluvial deposits in the Monument Draw trough. Yields of three of the wells measured in the spring of 1967 ranged from 766 to 884 gpm and averaged about 790 gpm. In 1967, pumpage from the wells totaled 593,970,600 gallons (1,823 acre-feet).

Industrial Use

Industry pumped 6,661 million gallons (20,435 acre-feet) of water from wells in Ward County in 1967, two-thirds or 4,760 million gallons (14,600 acre-feet) of which was used to waterflood oil fields in Ward and adjoining counties.

Waterflooding

Waterflooding, a method used in the secondary recovery of oil, involves the injection of water to the oil-bearing strata. In some wells, the water is injected by gravity flow; in others, it is injected under pressure

exerted at the well head. (A maximum surface pressure of one-half pound per square inch per foot of well depth has been recommended by the Railroad Commission of Texas.) Once injected, the water raises the pressure in the oil reservoir and displaces the oil, forcing it to flow toward the producing wells.

Water used for waterflooding consists generally of "production" and "extraneous" water mixed in varying proportions. Production water is that which has been separated from the oil-water pumped from the oil wells. Normally, production water is too saline for purposes other than waterflooding; if not injected for secondary recovery, it is disposed of as waste water. Extraneous water is derived from other sources such as water wells and surface-water diversions. Extraneous water may be fresh (although use of fresh water is discouraged), or it may be brine, and may require treatment to be compatible with the fluids and gases in the oil reservoir.

Secondary recovery of oil by the waterflood method began in Ward County in September 1948, when Forest Oil Corporation started a project on a 600-acre lease in the South Ward Field. The practice steadily developed, and by 1955, 32 units were operating. The most recent survey of secondary recovery and pressure maintenance operation in Texas listed 82 units operating in the county as of January 1, 1966, (Texas Petroleum Research Committee, 1967).

In 1967, about 3,100 million gallons (9,500 acre-feet), or nearly 67 percent of the water pumped for waterflooding was from 14 wells tapping the Capitan Limestone (Capitan reef) in Ward County, Part of the water was exported for waterflooding oil fields in neighboring counties.

Fifteen wells, 12 in Ward County and 3 in Winkler County, that tap the Capitan reef are currently (1967) in use in Gulf Oil Corporation's O'Brien water-supply system. The 15 operating wells and 14 unused wells were drilled on a strip of land 1 mile wide extending north from Highway 80 on the west side of Wickett to 1 mile north of the Ward-Winkler County line. O'Brien watersupply well number 1 (YX-46-32-305) was drilled in 1953. At that time, the well flowed 778 gpm and had an artesian head of 242 feet above land surface. In 1957, seven wells in the field were flowing at rates ranging from 288 to 780 gpm. Based on three 24-hour drawdown tests and four 5-hour recovery tests, the specific capacities of these wells ranged from 2.5 to 10 gpm per foot (Table 3). In 1967, three unused wells (YX-46-32-312, YX-46-32-610, and YX-46-32-615) had artesian heads ranging from 21 to 46 feet above land surface. However, all of the producing wells were equipped with pumps and presumably had static water levels near the land surface.

Wells YX-46-32-602 and YX-46-32-901 supply Humble Oil and Refining Company's Wickett water system number 6. Both wells flow, and neither has been equipped with a pump. Well YX-46-32-901 flowed 1,310 gpm during a 4-hour production test in July 1962 and had a specific capacity of 13 gpm per foot. The well had an artesian head of 186 feet above land surface in July 1962; the head had declined to 70 feet above land surface in June 1967.

In 1967, 46 wells tapping the Allurosa aquifer supplied 1,056 million gallons (3,239 acre-feet) of water for secondary-recovery operations in Ward County. Most of the water was injected in the Ward-South and Ward-Estes North Field.

Twelve wells tapping the Rustler Formation pumped 605 million gallons (1,856 acre-feet) for water-flooding in Ward County during 1967. All of the wells are on the structural high east of the Monument Draw trough.

Permian Basin Generating Plant

Texas Electric Service Company's Permian Basin generating plant used a metered 1,110 million gallons of water in 1967. All of the water was from eight wells tapping the Allurosa aquifer. Three wells, YX-45-25-203, YX-45-25-509, and YX-45-25-511, located 1 to 1½ miles east-southeast of the plant, supplied 125 million gallons, and five wells, YX-46-32-204, YX-46-32-508, YX-46-32-509, YX-46-32-510, and YX-46-32-607, located 4½ to 6½ miles west of the plant, supplied 985 million gallons. Water from both well fields was piped to the plant which is located 2½ miles west of Monahans.

Other Uses

Other industrial uses of ground water in Ward County include supplies for three gasoline plants, seven brine-producing plants, Ozark Mahoning Company's sodium sulfate plant, two sand and gravel plants, one bottling plant, highway construction, and drilling rig and oil-field lease supply. In 1967, approximately 790 million gallons (2,420 acre-feet) of ground water was used for these purposes. All of the water was from the Allurosa aquifer.

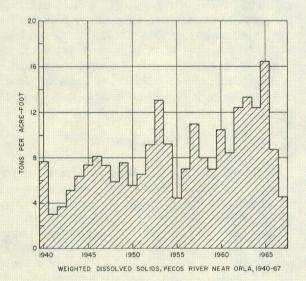
Irrigation

Surface Water

Irrigation of cropland in Ward County began in the late 1880's. Between 1888 and 1906, four irrigation projects were organized on the lowlands bordering the Pecos River, and by 1914, there were 16,060 acres irrigated from canals diverting water from the river (U.S. National Resources Planning Board, 1942).

Water for the irrigation projects in Ward County is stored in Red Bluff Reservoir near the New Mexico-Texas State line. The quantity of water diverted from the Pecos and the quality of the water near Orla varies widely from one year to the next. Figure 16 shows the amounts of water diverted from the Pecos River for irrigation in the county during the period 1940-67. Generally the amounts diverted are declining. For the 19 years of complete record within that period, diversions ranged from 745 acre-feet in 1953 to 138,000 acre-feet in 1943, and averaged 57,000 acre-feet. During the water year 1967 (October 1966 through September 1967), the projects diverted 75,510 acre-feet of water for irrigation of 9,740 acres.

The discharge-weighted average concentrations of dissolved solids in tons per acre-foot in water sampled from the Pecos River near Orla, Texas, 15 miles downstream from Red Bluff Reservoir, is also shown on Figure 16. A ton per acre-foot is the equivalent of 736 milligrams per liter of dissolved solids. In 1967, the released water contained 4.59 tons per acre-foot which was the fourth lowest concentration in the 28 years of record. The general trend in dissolved solids has been upward, however.



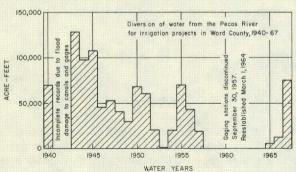


Figure 16.—Weighted Dissolved Solids in the Pecos River Near Orla and Diversion of Water From the Pecos River for Irrigation in Ward County, 1940-67

Ground Water

Irrigation of cropland with water from wells in Ward County began in the vicinity of Barstow shortly after 1900. Wells YX-46-37-102 and YX-46-37-107 are thought to be two of the earliest to be used for irrigation in the county. Both wells are 4½ miles northwest of Barstow; both were drilled in 1908 and were pumped to supplement surface-water supply. Neither of the wells is now in use. Well YX-46-37-305, located three-fourths of a mile east of Barstow, and YX-46-37-207, located 4 miles northwest of Barstow, are two of the oldest wells that remain in use. The former was drilled in 1930 and the latter was drilled before 1930, possibly as early as 1908.

In 1967, 78 wells pumped 9,200 acre-feet of water for irrigation of cropland in Ward County. Of this amount, 8,800 acre-feet was from 76 wells tapping the Allurosa aquifer, and 400 acre-feet was from two wells drilled to the Rustler Formation. Thirty-three of the wells in the Allurosa aquifer are located near Barstow (area A, Figure 17). The two wells in the Rustler Formation are on a farm 10 miles south of Pyote.

Domestic Supply and Livestock Use

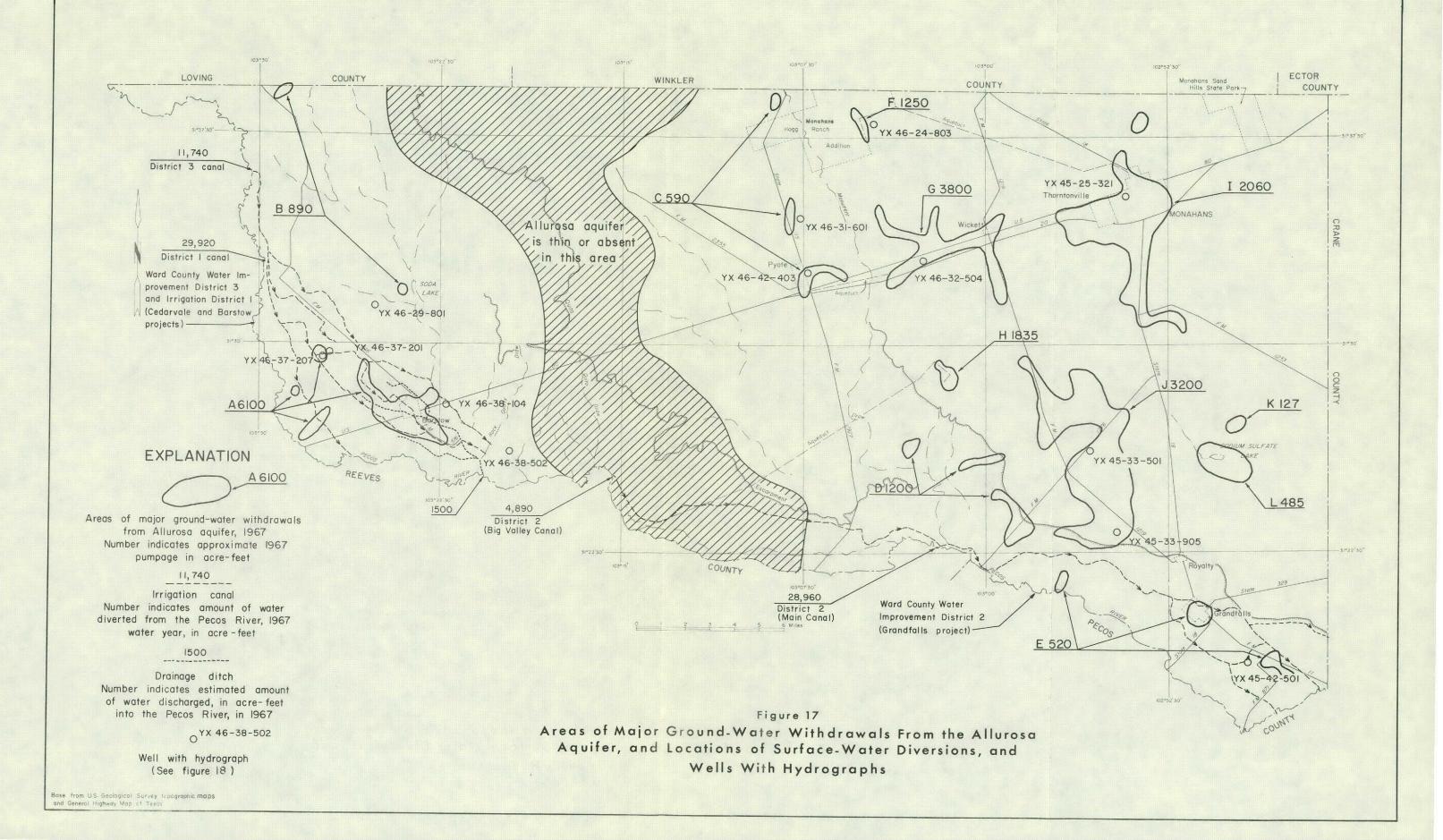
Pumping of ground water for domestic supply and livestock use is relatively small, amounting to only 60 million gallons (164,000 gpd) or 184 acre-feet in 1967. All the water was from the Allurosa aquifer. Most of the livestock wells are equipped with windmills, the yields of which are generally less than 5 gpm. Many of the domestic wells and a few of the livestock wells are equipped with small submergible pumps capable of yielding 10 or 15 gpm.

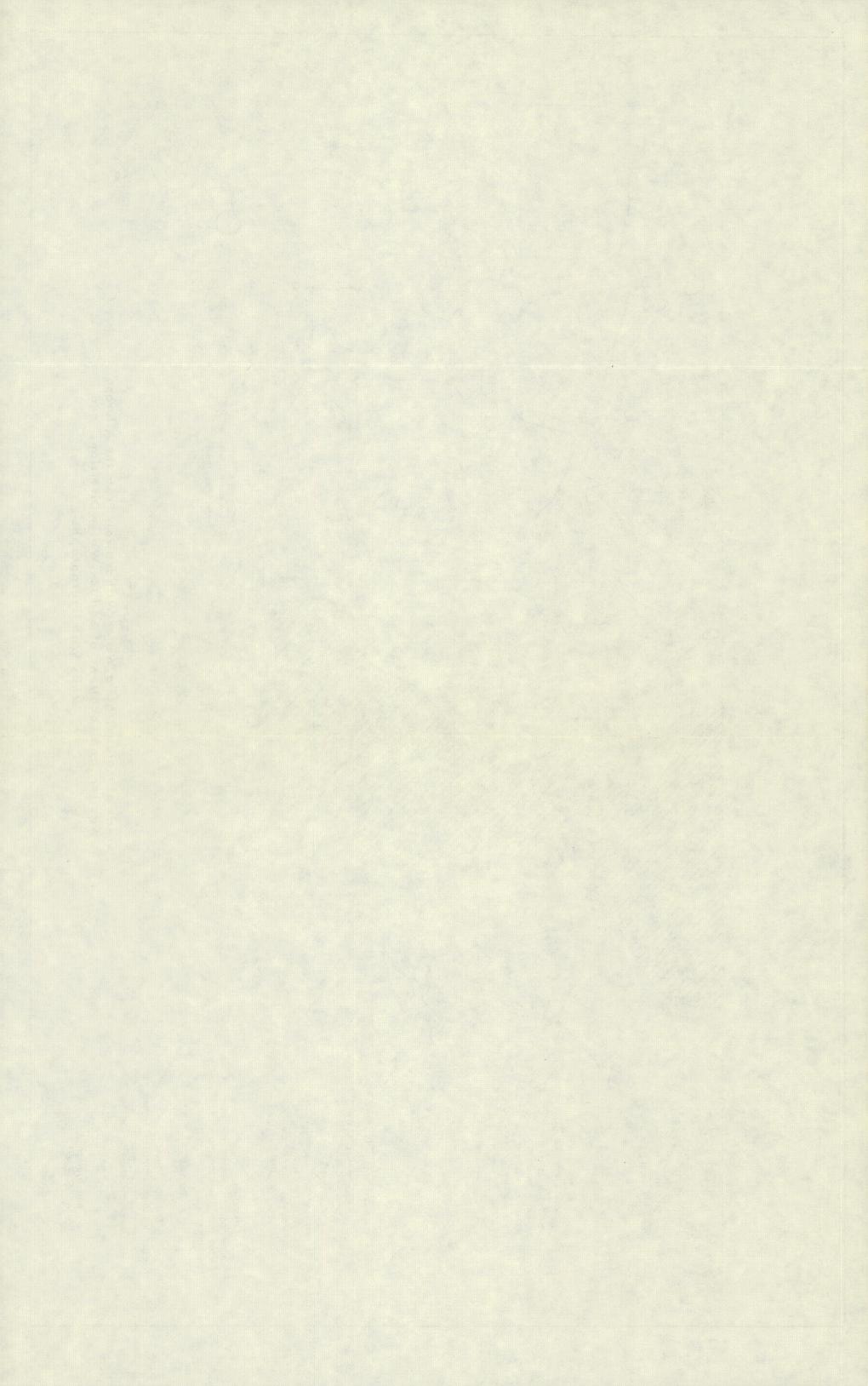
Fluctuations of Water Levels

The fluctuations of water levels in wells depend upon the rate at which water is recharged to an aquifer versus the rate at which it is discharged. When discharge exceeds recharge, the water levels decline; when recharge is greater than discharge, the water levels rise.

Hydrographs showing fluctuations of water levels in 13 wells tapping the Allurosa aquifer are drawn on Figure 18. The locations of wells with hydrographs, the areas and amounts of ground-water withdrawals from the aquifer, and the locations and amounts of surfacewater diversions are shown on Figure 17. The ground-water withdrawals are for the calendar year 1967, and the diversions are for the water year 1967 (October 1966 through September 1967).

The hydrographs of wells near canals supplying the irrigation projects in the county show the largest fluctuations in water levels. The hydrograph of well YX-46-29-701, for example, shows a strong relationship





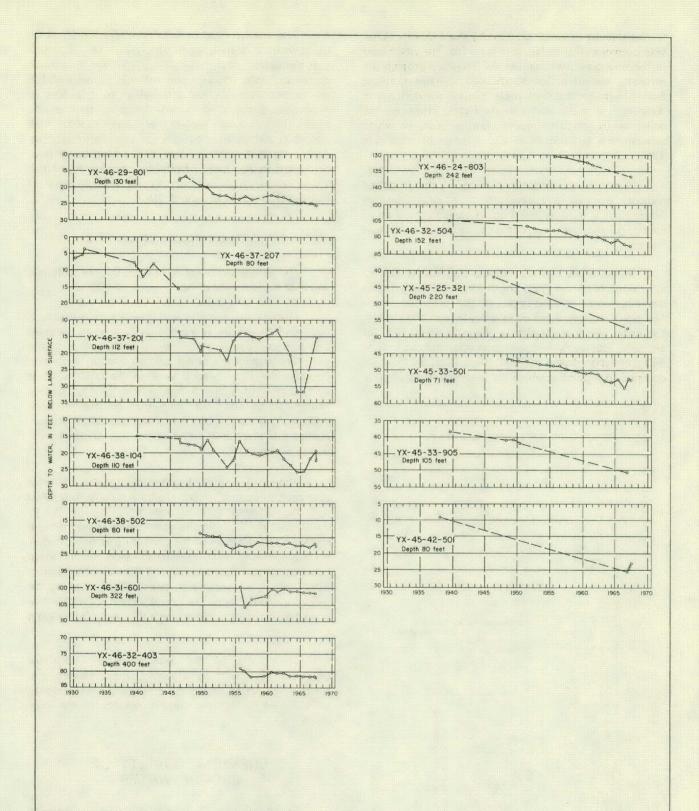
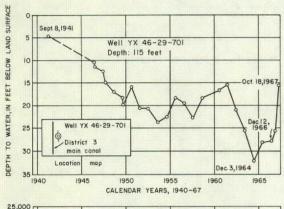


Figure 18
Hydrographs of Wells Tapping the Allurosa Aquifer

to the amount of water diverted by Ward County Water Improvement District No. 3 (Figure 19). The water level in this and other wells within the irrigation projects are generally declining due to reduced recharge resulting from a decrease in surface-water diversions and increased discharge to wells and phreatophytes. However, the water levels partially recover during years in which above-normal amounts of surface water are diverted as in 1967.

Water levels in wells outside of the irrigation projects are generally declining. The larger declines (more than ½ foot per year) are in wells in the areas of major ground-water withdrawals from the Allurosa aquifer.

Water levels in wells tapping the Rustler Formation in parts of the Ward South Field are rising due to the injection of oil-field brine into the formation. In the few wells tapping the Rustler elsewhere in the county, the water levels are declining. Well YX-46-40-701, for example, reportedly had sufficient artesian head to flow 140 gpm when drilled in 1931. Since then, the head has declined to a point at which the well now flows 29 gpm.



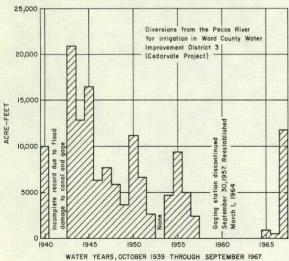


Figure 19.—Hydrograph of Well YX-46-29-701 and Graph Showing Diversion of Water From the Pecos River for Irrigation in Ward County Water Improvement District No. 3

The artesian head in well YX-46-32-305 (Gulf Oil Corporation's O'Brien water-supply well no. 1), which taps the Capitan reef, has declined 253 feet since it was drilled in 1953. This well had a shut-in pressure of 105 psi at the land surface (equivalent to 242 feet of fresh-water head) when drilled. The water level was 11 feet below land surface in June 1967. Well YX-46-32-901 in the Humble Oil and Refining Company's Wickett water system had a shut-in pressure equivalent to 186 feet of fresh-water head in July 1962. The pressure had declined to 29 psi (70 feet of fresh-water head) as of June 8, 1967.

Well Construction

Of the wells inventoried in Ward County, only one was dug; the rest were drilled.

Most of the domestic and livestock wells that have been drilled recently in the county have small diameter casing, 5 to 6 inches, and are cased to the bottom of the well. The casings are either torchslotted or perforated opposite the water-bearing sand. In the older wells, it was common practice to set only a joint of surface casing—10 to 20 feet long—through the surficial deposits, and the rest of the well was completed without casing; this practice resulted in the loss of some wells due to caving.

Municipal, industrial, and irrigation wells are larger in diameter—8 to 20 inches—and are usually completed with large-diameter surface casing which is cemented to the wall of the well. Smaller-sized casing is set from the surface to the bottom of the producing sand. Slotted or perforated casing is set opposite the sand and the space between the perforated casing, and the wall of the well is filled with small-size gravel, pea-sized gravel being the most commonly used. The gravel increases the effective diameter of the well and protects the casing from caving of the sand.

Most wells of the type described above are developed by pumping. However, those tapping the Rustler Formation and Capitan Limestone commonly are acidized to increase the permeability of the limestone.

CHEMICAL QUALITY OF GROUND WATER

Precipitation, in the form of rain or snow, contains only small amounts of mineral matter. Once the water reaches the land surface, however, it dissolves mineral substances from the soil and rocks over and through which it moves. Thus, all ground water naturally contains dissolved minerals, the degree of mineralization determining its suitability for municipal supply, irrigation, and industrial use. The chemical-quality of ground water may be degraded by the activities of man. In some

areas of Ward County, the seepage of oil-field brine and other industrial wastes from unlined surface pits has caused an increase in the mineralization and a change in the chemical character of the ground water.

During this investigation in Ward County, 308 samples of water from wells and earthen pits were collected and analyzed. These analyses and those collected during other investigations are listed in Tables 8 and 9. Table 8 shows 620 analyses of water from wells. Table 9 shows 47 analyses of oil-field brine and other industrial waste water that was placed in pits. The locations of the sampled wells are shown on Figure 24; the sampled pits are shown on Figure 23.

The concentrations of the chemical constituents in the water (Tables 8 and 9) are expressed in milligrams per liter.2/However, it is frequently more convenient for interpretive purposes to compare water in terms of equivalents per liter, which is a measure of the reactive weights of the different constituents. The concentration of an ion in equavalents per liter is determined by multiplying its concentration in milligrams per liter by the reciprocal of the combining weight of the appropriate ions. The chemical character of samples of water from aquifers underlying Ward County is illustrated on Figure 20. Each analysis is represented by a circular diagram subdivided to show the relative proportions of the principal cations and anions present, in terms of percentage of total milliequivalents per liter. The three principal cations-calcium, magnesium, and sodium (including potassium)-are shown in the left half of the circle, being separated from the three principal anionsbicarbonate, sulfate, and chloride (includes nitrate and fluoride) by a vertical line. To make the illustration more easily understood, that part of the diagram showing magnesium and sulfate was made solid.

The specific conductance, sulfate, and chloride concentrations in water from wells tapping the Allurosa aquifer are shown on Figure 21. The depth of the sampled well is also given inasmuch as water from several horizons was analyzed in a few test wells. The figure includes a graph which shows the relation between specific conductance and dissolved solids in water sampled from wells and disposal pits in Ward County. Using this graph, it is possible to estimate the dissolved solids in a sample when only the specific conductance has been determined.

The source and significance of the dissolvedmineral constituents and properties of water in Ward County, summarized in Table 4, was adapted from Doll and others (1963, table 7).

Chemical requirements for industrial uses of water vary according to the industry, but they are fairly rigid where water is used in food, paper, and some chemicalprocess industries. The most common industrial uses of water in Ward County are for cooling, boiler feed, and waterflooding of oil reservoirs. Excessive concentration of dissolved solids are a problem in water used for cooling because they tend to accelerate corrosion (California State Water Pollution Control Board, 1963). The use of water for boiler feed is dependent on very strict limits relative to the dissolved-solids content and silica because of the formation of scale in the boilers. High-pressure systems, operating at a pressure of more than 400 psi, require a dissolved-solids content of 50 mg/l or less and a silica content of not more than 1 mg/l; low-pressure systems, less than 150 psi, can use water having as much as 3,000 mg/l dissolved solids and 40 mg/l silica (Moore, 1940).

According to the U.S. Salinity Laboratory Staff (1954), some of the principal factors that determine the quality of water for irrigation are the concentrations of dissolved solids, sodium, and boron. The relative importance of the dissolved constituents in irrigation water is dependent upon the degree to which they accumulate in the soil. Sodium is a significant factor in evaluating irrigation water because a high SAR (sodium-adsorption ratio) may cause the soil structure to break down. The RSC (residual sodium carbonate) is another factor used in assessing the quality of water for irrigation. According to Wilcox (1955), water containing more than 2.5 me/l (milliequivalents per liter) RSC is not suitable for irrigation, 1.25 to 2.5 me/l is marginal, and less than 1.25 me/l probably is safe.

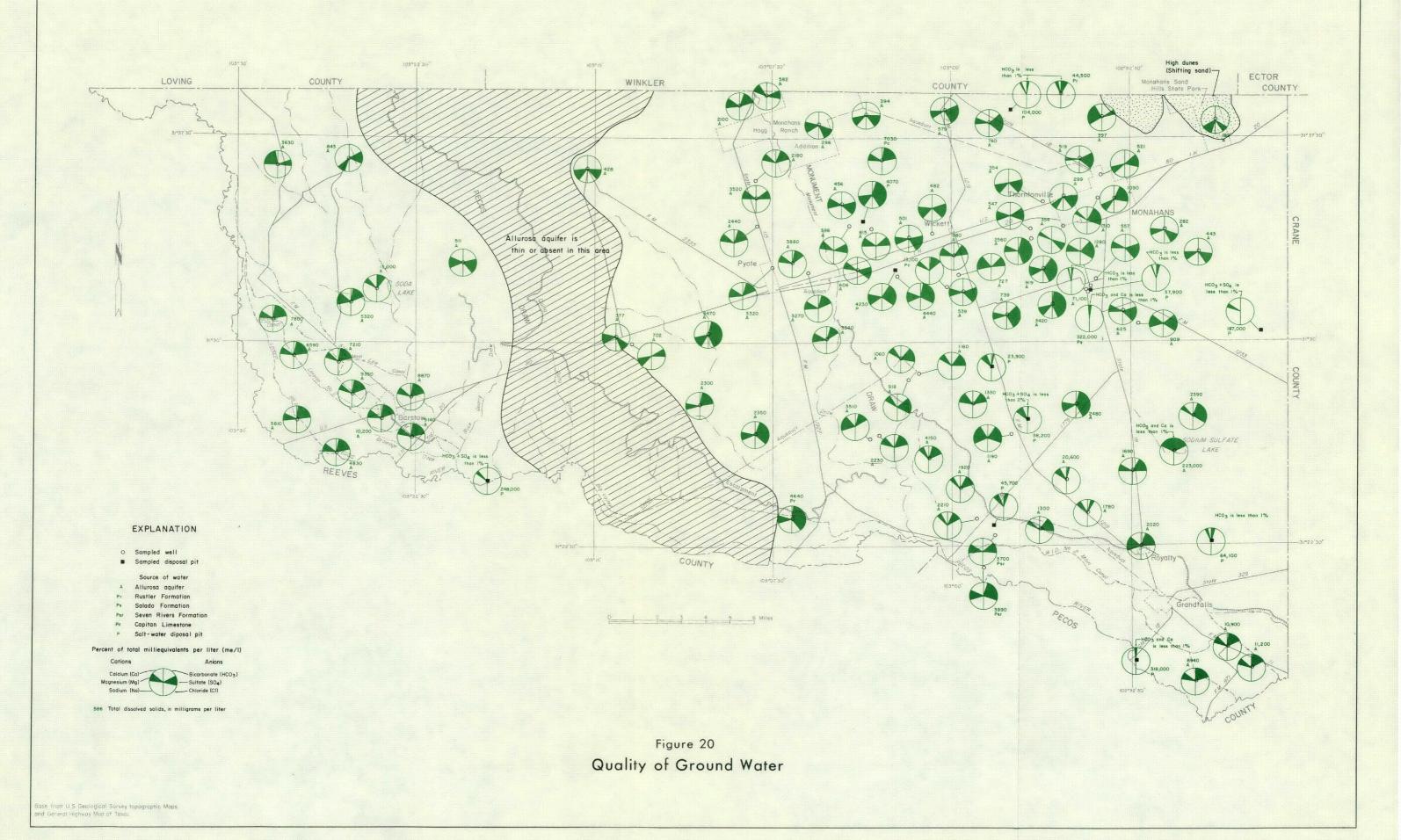
Most state and municipal authorities have adopted the standards set by the U.S. Public Health Service (1962) for drinking water used on common carriers in interstate commerce. The standards are designed to protect the traveling public and are useful in evaluating public water supplies, although they may not be directly applicable in an area such as Ward County where much of the water may exceed the standards for some constituents. According to the standards, in a public water supply, the chemical constituents should not be present in excess of the concentrations shown below except where more suitable supplies are not available.

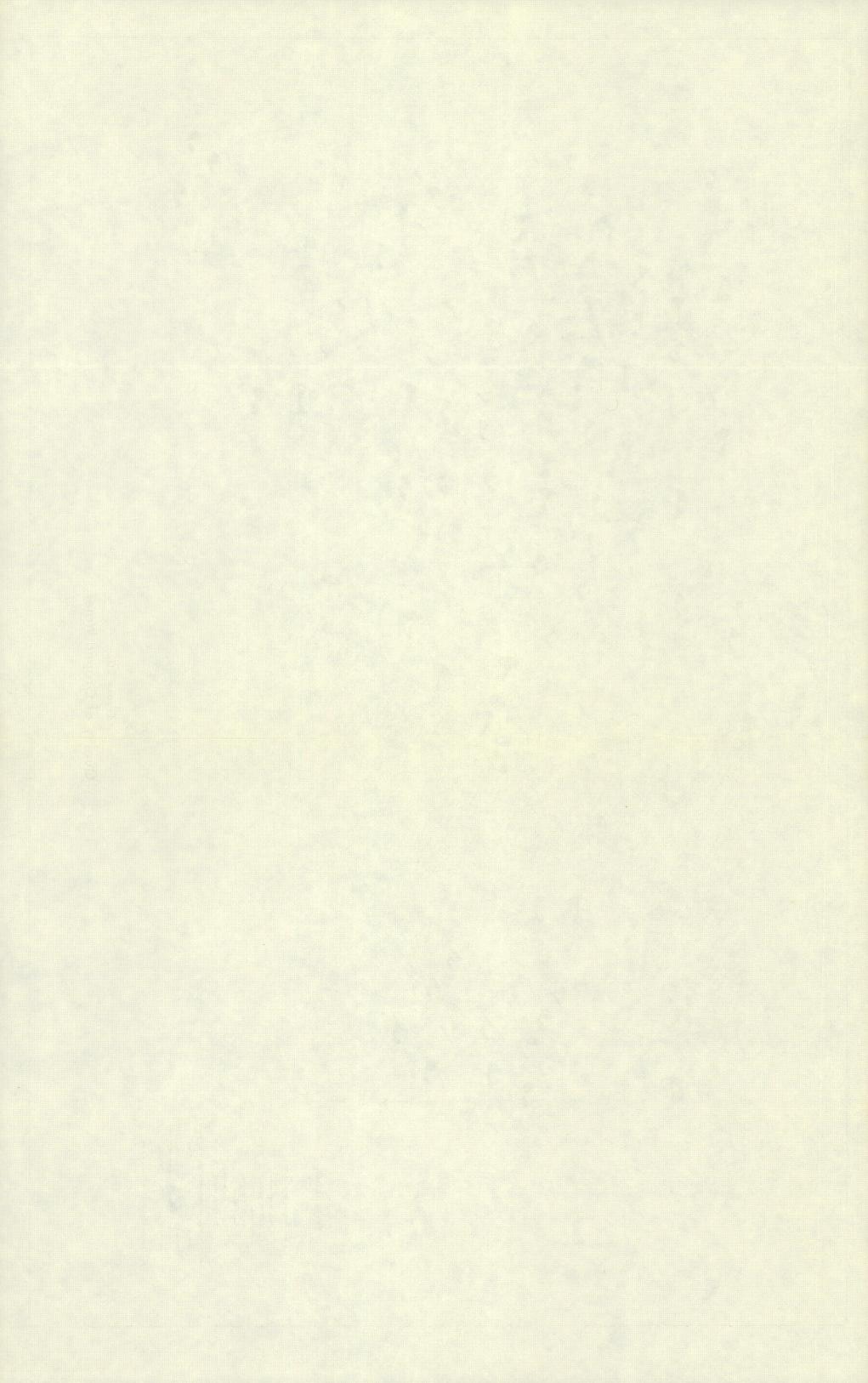
SUBSTANCE	CONCENTRATION (MG/L)
Chloride (CI)	250
Fluoride (F)	1.0*
Iron (Fe)	.3
Nitrate (NO ₃)	45
Sulfate (SO ₄)	250
Dissolved solids	500

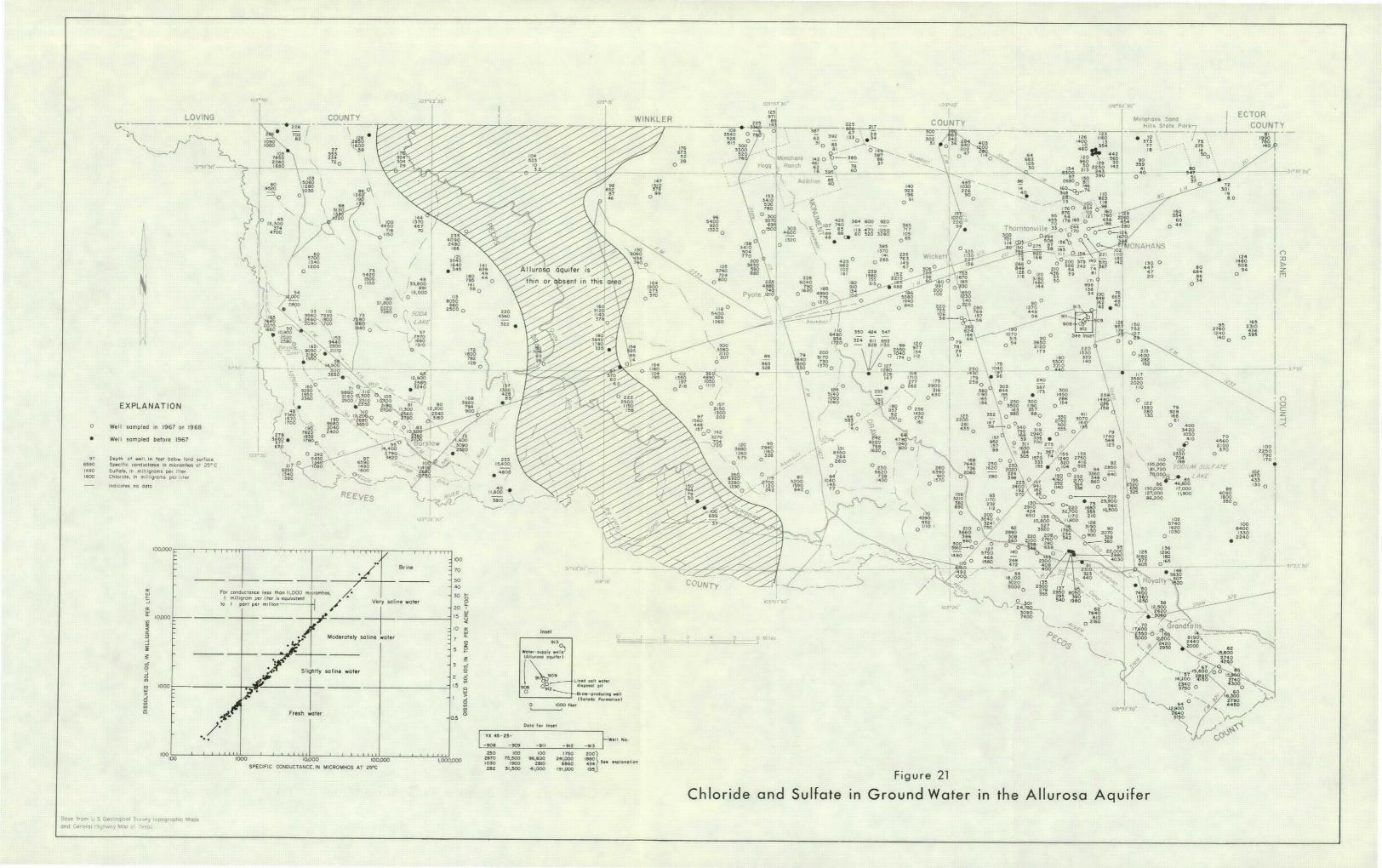
 $^{^*}$ Based on the annual average of maximum daily air temperature of 77° at Midland, Texas, for the period 1931-60.

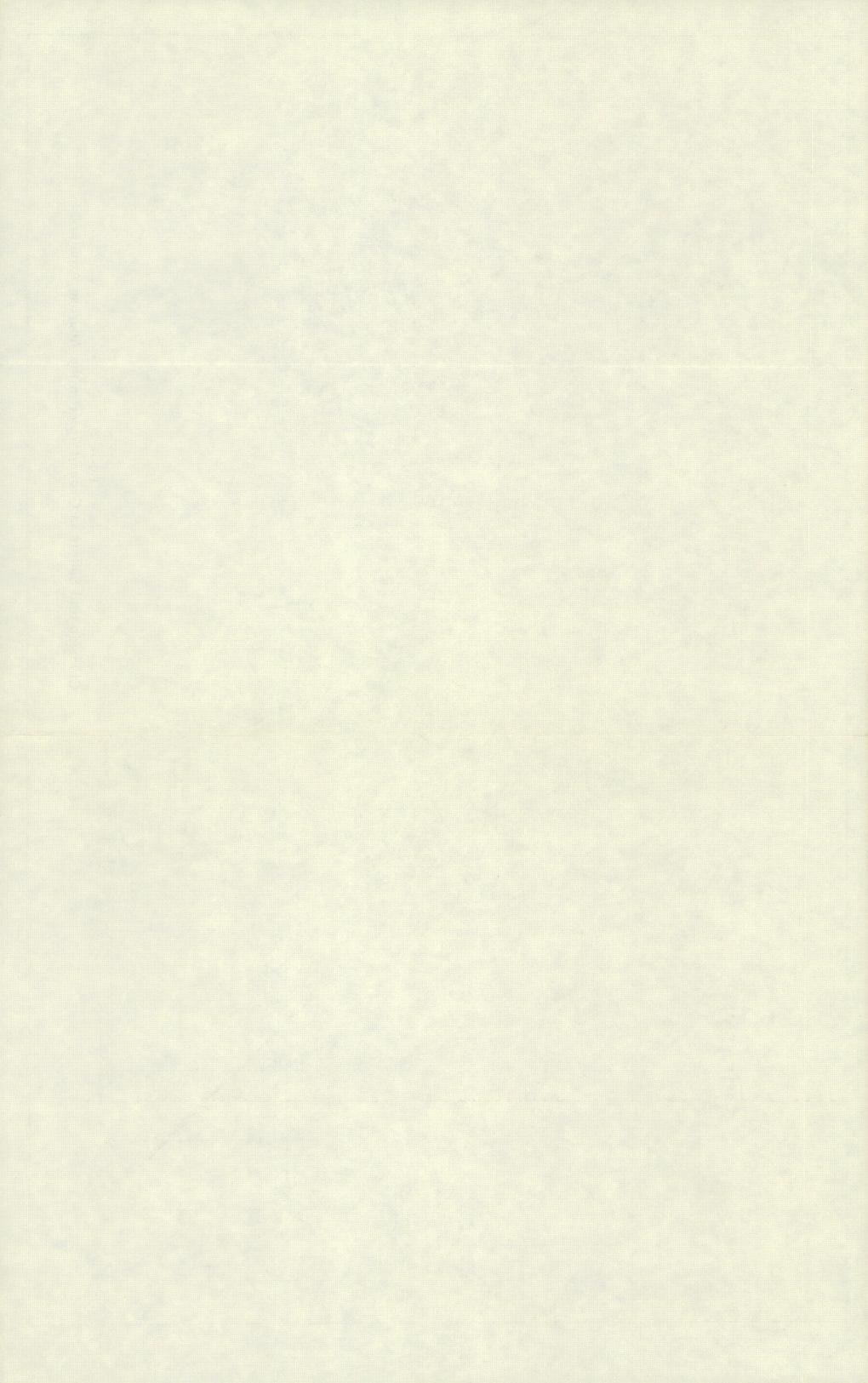
^{2/}Previous to October 1, 1967, laboratories in the U.S. Geological Survey computed dissolved solids as parts per million, which is the unit weight of a substance in a million unit weights of water. Since that date, dissolved solids have been reported as milligrams per liter of water. Except in very saline water or brine, the two can be considered identical.

CONSTITUENT	SOURCE OR CAUSE	SIGNIFICANCE
PROPERTY		
ilica (SiO ₂)	Dissolved from practically all rocks and soils, commonly less than 30 mg/l. High concentrations, as much as 100 mg/l, generally occur in highly alkaline waters.	Forms hard scale in pipes and boilers. Carried over in steam o high pressure boilers to form deposits on blades of turbines Inhibits deterioration of zeolite-type water softeners.
ron (Fe)	Dissolved from practically all rocks and soils. May also be derived from iron pipes, pumps, and other equipment. More than 1 or 2 mg/l of iron in surface waters generally indicates acid wastes from mine drainage or other sources.	On exposure to air, Iron in ground water oxidizes to reddist brown precipitate. More than about 0.3 mg/lstains laundry an utensils reddish-brown. Objectionable for food processing, tet tile processing, beverages, ice manufacture, brewing, and othe processes. U.S. Public Health Service (1962) drinking-wate standards state that iron should not exceed 0.3 mg/l. Large quantities cause unpleasant taste and favor growth of iro bacteria.
alcium (Ca) and nagnesium (Mg)	Dissolved from practically all soils and rocks, but especially from limestone, dolomite, and gypsum. Calcium and magnesium are found in large quantities in some brines. Magnesium is present in large quantities in sea water.	Cause most of the hardness and scale-forming properties or water; soap consuming (see hardness). Waters low in calcium ar magnesium desired in electroplating, tanning, dyeing, and textile manufacturing.
sodium (Na) and sotassium (K)	Dissolved from practically all rocks and soils. Found also in ancient brines, sea water, industrial brines, and sewage.	Large amounts, in combination with chloride, give a salty tast Moderate quantities have little effect on the usefulness of wat for most purposes. Sodium salts may cause foaming in stea boilers and a high sodium content may limit the use of water firrigation.
Bicarbonate (HCO3) and carbonate (CO3)	Action of carbon dioxide in water on carbonate rocks such as limestone and dolomite.	Bicarbonate and carbonate produce alkalinity. Bicarbonates calcium and magnesium decompose in steam boilers and h water facilities to form scale and release corrosive carbon dioxigas. In combination with calcium and magnesium, cause carbo ate hardness.
Sulfate (SO ₄)	Dissolved from rocks and soils containing gypsum, iron sulfides, and other sulfur compounds. Commonly present in mine waters and in some industrial wastes.	Sulfate in water containing calcium forms hard scale in steat boilers. In large amounts, sulfate in combination with other ic gives bitter taste to water. Some calcium sulfate is consider beneficial in the brewing process. U.S. Public Health Serv (1962) drinking-water standards recommend that the sulfacentent should not exceed 250 mg/l.
Chloride (CI)	Dissolved from rocks and soils. Present in sewage and found in large amounts in ancient brines, sea water, and industrial brines.	In large amounts in combination with sodium, gives salty taste drinking water. In large quantities, increases the corrosiveness water. U.S. Public Health Service (1962) drinking-water stydards recommend that the chloride content should not exceed the service of the content should not exceed the content sh
Fluoride (F)	Dissolved in small to minute quantities from most rocks and soils. Added to many waters by fluoridation of municipal supplies.	Fluoride in drinking water reduces the incidence of tooth dec when the water is consumed during the period of enar calcification. However, it may cause mottling of the tee depending on the concentration of fluoride, the age of the chi amount of drinking water consumed, and susceptbility of individual. (Maier, 1950)
Nitrate (NO3)	Decaying organic matter, sewage, fertilizers, and nitrates in soil.	Concentration much greater than the local average may sugg pollution. U.S. Public Health Service (1962) drinking-was standards suggest a limit of 45 mg/l. Waters of high nitr content have been reported to be the cause of methemog binemia (an often fatal disease in infants) and therefore shonot be used in infant feeding. Nitrate has been shown to helpful in reducing inter-crystalline cracking of boiler steel. encourages growth of algae and other organisms which produndesirable tastes and odors.
Dissolved solids	Chiefly mineral constituents dis- solved from rocks and soils. Includes some water of crystalli- zation.	U.S. Public Health Service (1962) drinking-water standa recommend that waters containing more than 500 mg/l dissol- solids not be used if other less mineralized supplies are availal Waters containing more than 1000 mg/l dissolved solids unsuitable for many purposes.
Hardness as CaCO3	In most waters nearly all the hardness is due to calcium and magnesium. All the metallic cations other than the alkali metals also cause hardness.	Consumes soap before a lather will form. Deposits soap curd bathtubs. Hard water forms scale in boilers, water heaters, a pipes. Hardness equivalent to the bicarbonate and carbonate called carbonate hardness. Any hardness in excess of this called non-carbonate hardness. Waters of hardness as much as mg/l are considered soft; 61 to 120 mg/l, moderately hard; to 180 mg/l, hard; more than 180 mg/l, very hard.
Specific conductance (micromhos at 25°C)	Mineral content of the water.	Indicates degree of mineralization. Specific conductance i measure of the capacity of the water to conduct an elec current. Varies with concentration and degree of ionization the constituents.
Hydrogen ion concentration (pH)	Acids, acid-generating salts, and free carbon dioxide lower the pH. Carbonates, bicarbonates, hydroxides, and phosphates, silicates, and borates raise the pH.	A pH of 7.0 indicates neutrality of a solution. Values higher to 7.0 denote increasing alkalinity; values lower than 7.0 indic increasing acidity. pH is a measure of the activity of hydrogen ions. Corrosiveness of water generally increases decreasing pH. However, excessively alkaline waters may a









Of the samples analyzed, 586 were from the Allurosa aquifer, 21 from the Rustler Formation, and 7 from the Capitan Limestone (Table 8). Table 9 includes 47 analyses of water produced with oil and disposed of in earthen pits. The producing horizons ranged in age from Permian to Ordovician. Five of the samples were classed moderately saline, 5 were very saline, and 37 were brine. Most of the water would be unsuitable for use except in waterflood operations.

Although parts of Ward County now yield ground water that has been contaminated, presumably by the disposal of oil-field brine, it is desirable first to summarize the chemical character of the ground water in the various formations where it has not been contaminated. This affords a basis for comparison of the native waters, those whose chemical character is natural to a particular water-bearing zone and locality.

Allurosa Aquifer

The quality of water from wells tapping the Allurosa aquifer varies widely within the county (Figures 20 and 21). The dissolved solids, which influence or limit the general use of water, ranged from 189 to 223,000 mg/l in samples collected during the current investigation. Forty-eight percent of the samples collected from wells during the present or previous investigations had less than 1,000 mg/l dissolved solids and would be classified as fresh. Twenty-three percent of the samples were slightly saline (1,000-3,000 mg/l); 25 percent were moderately saline (3,000-10,000 mg/l); and 4 percent were very saline or brine, containing more than 10,000 mg/l dissolved solids.

In general, water in the dune deposits in the northeastern corner of the county has the least mineralization. The dissolved solids, mostly calcium bicarbonate, normally total less than 500 mg/l (Figure 20). At the other extreme, brine containing more than 100,000 mg/l dissolved solids is pumped from wells tapping alluvial deposits underlying two playas in the county-Sodium Sulfate Lake, which is 3 miles northeast of Royalty, and Soda Lake, which is 3 miles north of Barstow. The brine that has accumulated in the alluvial deposits beneath and bordering Sodium Sulfate Lake is currently being mined by 70 small-capacity wells owned by the Ozark Mahoning Company. All of the wells discharge into the lake where the brine is concentrated by evaporation. From there it is pumped to the company's plant where the sodium sulfate (Glaubers salt) is extracted.

Dissolved solids in water in the alluvial deposits along the Pecos River in the Barstow and Grandfalls areas are principally sodium plus chloride (Figure 20). The total dissolved solids in 12 samples ranged from 5,610 to 11,300 mg/l and averaged 8,400 mg/l.

The principal reservoir of fresh water in the county is in the alluvial deposits which fill the Monument Draw trough. Most of the fresh water is stored east

of a line drawn south along Monument Draw from the Ward-Winkler County line to a point 2 miles southeast of Pyote, where a low escarpment intersects the draw. From there the interface of the fresh water with saline water to the west generally follows this escarpment to a point where deposits containing fresh water wedge out 3 to 4 miles northwest of Royalty.

The quality of water stored in the alluvial deposits in the trough normally deteriorates with depth. Well YX-46-32-206, located 4 miles west of Wickett and 1 mile east of Monument Draw, was drilled to test the quality of water at depths from 324 to 920 feet. An electrical log of this well indicates the base of fresh water to be approximately 500 feet deep and the base of slightly saline water to be about 740 feet deep at that location. Well YX-46-40-203, which was originally drilled to 547 feet, was used to test the quality of water in the alluvium at a location 3 miles southeast of Pyote and 1 mile east of Monument Draw. Partial analyses of water sampled at depths of 424 and 547 feet showed chloride contents of 828 and 1,130 mg/l, respectively.

Fluoride is a problem in water from the Allurosa aquifer. Eighty-nine percent of the samples contained more than 1 mg/l; the average concentration was 2.2 mg/l, which is more than twice the recommended limit.

The hardness of water is commonly recognized by its effect upon soap consumption. Calcium and magnesium—primarily as salts of sulfate and bicarbonate—cause nearly all of the hardness in water from the Allurosa aquifer. Of the samples tested, only 33 contained less than 180 mg/l hardness, which is the lower limit of water classified as very hard.

Much of the water from the Allurosa aquifer that is used for public and domestic supply does not meet the chemical standards established by the U.S. Public Health Service for carriers engaged in interstate commerce. Inasmuch as no other sources of water of suitable quality are readily available, the use of water not fully meeting the standards will likely continue.

Water from the Allurosa aquifer is used extensively for industrial purposes; however, the water is usually treated to reduce the hardness. Nearly all of the compressor stations and gasoline plants use zeolite exchange columns for this purpose. The columns are recharged periodically by flushing with sodium chloride brine. The silica content of the water from the Allurosa aquifer generally is not a problem except when used in boilers. The present trend is toward closed cooling systems in which the water is chemically treated to prevent corrosion and formation of scale. In the closed systems, the water is recycled, which results in considerable reduction in water consumption and pumping costs.

The quality of water for irrigation is commonly judged by a classification proposed by the U.S. Salinity Laboratory Staff (1954). The classification is based on the salinity hazard as measured by the electrical

conductivity of the water and the sodium hazard as measured by the SAR. The relative importance of the dissolved constituents in irrigation water is dependent upon the degree to which they accumulate in the soil—more of the mineral content of the water will accumulate in tight soils than in more permeable soils under similar conditions. Sodium is a significant factor in evaluating the quality of irrigation water because water with a high SAR will cause the soil structure to break down by deflocculating the colloidal soil particles. Consequently, the soil can become plastic, thereby causing poor aeration and low water availability. This possibility is especially true in fine-textured soils.

The SAR value and the conductivity (specific conductance) of samples from 33 irrigation wells tapping

the Allurosa aquifer and one well tapping the Rustler Formation are shown on Figure 22. Fifteen of the samples taken from wells in the Barstow and Grandfalls areas were classed as having very high salinity and sodium hazards. Water of this quality has been used successfully in those areas because of the permeable soils and of the practice of applying quantities of water considerably in excess of the consumptive use of crops in order to maintain a favorable salt balance.

Rustler Formation

The dissolved minerals in water from the Rustler Formation consist mostly of sodium and chloride. Wells tapping the Rustler in the eastern third of the county

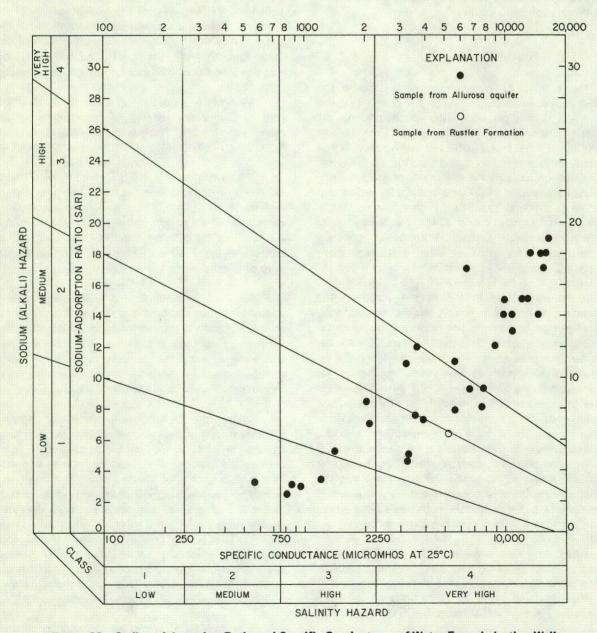


Figure 22.—Sodium-Adsorption Ratio and Specific Conductance of Water From Irrigation Wells

pump very saline water or brine which is used only for secondary recovery of oil. Three wells, located 10 miles south of Pyote, discharge moderately saline water which has been used successfully for irrigation. Elsewhere in the county this aquifer has not been tapped. Consequently, information about the quality of water in the Rustler is lacking over much of the report area.

Capitan Limestone

Fifteen wells tapping the Capitan Limestone in Ward County yield moderately to very saline water, which is used only for secondary recovery of oil. The dissolved solids consist largely of sodium chloride. The main problem in use of this water is the corrosiveness, which requires that the water be treated prior to injection.

GROUND-WATER PROBLEMS

Contamination From Disposal of Oil-Field Brine

The public and domestic water supplies in Ward County are dependent entirely on the ground-water resources of the county. The practice of disposing of oil-field brine through unlined surface pits is a present and potential hazard to the chemical quality of the ground-water supplies in the county.

Brine placed in unlined surface pits either evaporates or seeps into the ground, eventually percolating downward to the water table in a manner similar to that of precipitation on the land surface. Although the average yearly potential evaporation rate from a free water surface in Ward County is about 7 feet, it cannot be depended upon to dispose of the large quantities of brine continuously being produced. Actually, the evaporation rate of the brine is considerably less than that of fresh water because of the presence of oil film on the brine in most of the pits. Furthermore, the evaporation disposes of the water but leaves the salt in the pits as a potential contaminant.

The records of the Texas Water Commission and Texas Water Pollution Control Board (1963) show that 56,586,592 barrels (2,377 million gallons or 7,291 acre-feet) of brine reportedly was produced in Ward County in 1961. Of this amount, 12,053,147 barrels (506 million gallons or 1,553 acre-feet) or about 21 percent of the total was disposed of through unlined surface pits. The rest of the brine was disposed of through injection wells (44,470,254 barrels or 79 percent of the total) or by unknown methods.

A second survey of oil-field brine production and disposal was made by the Texas Water Development Board and Texas Railroad Commission for 1967. The results of the survey, which are not yet published, show

that 87,786,967 barrels (3,687 million gallons or 11,312 acre-feet) of brine was produced in the county in that year. Of this amount, 5,113,244 barrels (215 million gallons or 659 acre-feet) or slightly less than 6 percent of the total amount was disposed of in pits. Most of the brine (82,655,792 barrels) or about 94 percent of the total was injected into wells. The remainder (17,931 barrels) was disposed of by unknown methods. The reported amounts of brine production by oil fields and areas and the amounts and methods of brine disposal in 1961 and 1967 are listed in Table 5. The areas are shown on Figure 23.

The chemical analyses of water sampled from 47 disposal pits are listed in Table 9. The table also shows the rate of discharge into the pits when sampled and the producing horizons. Many of the sampled pits are in oil fields that are being repressurized by waterflooding. Therefore, the analyses of water that is pitted in these fields do not represent the true quality of water in the producing horizons, but rather a mixture of native water which has been diluted by better-quality, extraneous water.

The quality of water that is disposed of in oil fields in Ward County is quite variable as is shown by the chemical analyses in Table 9. Five of the 47 analyses in this table would be classed as moderately saline, five as very saline, and 37 as brine.

The five samples of moderately saline water were from oil- and water-bearing formations that are in hydrologic connection with the Capitan reef. Oil wells which tap these formations near the reef produce relatively small amounts of oil and large quantities of water. Although this water is relatively low in salinity compared to water produced in other oil fields in the county, its disposal in unlined pits is a present and potential source of contamination of fresh water in alluvial deposits beneath the pits.

The analyses of water sampled from well YX-46-32-903 in 1940 and 1967 show the chloride has increased from 370 to 840 mg/l, and the specific conductance has increased from 1,900 to 5,380 (Table 8). The composition and concentrations of the dissolved minerals in the sample that was collected in 1967 are very similar to those in samples taken from pits YX-46-32-6A and 6B (Table 9), which are 0.2 mile north and 0.6 mile northeast of the well. A substantial part of the moderately saline water that has been discharged into these and other pits in this area and into adjacent drainages has presumably infiltrated to the water table. Some of the pitted water likely has spread laterally to enter this and possibly other wells near the pits. Of principal concern is the fact that those oil fields in which the moderately saline water is being pitted generally overlie alluvial deposits in the Monument Draw trough where most of the fresh water in the county is stored.

Table 5.—Reported Brine Production and Disposal in 1961 and 1967

(Quantities Reported in Barrels)

AREA SHOWN ON FIGURE 23	FIELD	YEAR BRINE WAS PRODUCED	SURFACE PITS	DISPOSAL INJECTION WELLS	OTHER METHODS	TOTAL BRINE PRODUCTION
1	Twofreds/Delaware/	1961 1967	151,300 0	0 345,219	33,945 0	185,245 345,219
		Total 1961 Total 1967	151,300 0	0 345,219	33,945	185,245 345,219
2	G-M/Penn./	1961 1967	0	0	0 2,320	0 2,320
		Total 1961 Total 1967	0	0	0 2,320	0 2,320
3	Pruitt, E. /5270 Delaware/	1961 1967	0 33,910	0	0 0	0 33,910
		Total 1961 Total 1967	0 33,910	0	0	0 33,910
4	Monroe	1961 1967	30,641 30,720	0	0	30,641 30,720
		Total 1961 Total 1967	30,641 30,720	0	0	30,641 30,720
5	Quito/Delaware Sand/	1961 1967	203,025 595,713	17,750 0	9,000	229,775 595,713
	Quito, south/Delaware/	1961 1967	0 3,650	0	0	0 3,650
	Quito, west/Delaware/	1961 1967	85,366 208,688	0	0	85,366 208,688
	Regan-Edwards/Delaware, upper/	1961 1967	5,657 26,645	0	0	5,657 26,645
		Total 1961 Total 1967	294,048 834,686	17,750 0	9,000	320,798 834,686
6	Scott/Delaware Sand/	1961 1967	93,313 78,407	0	0	93,313 78,407
		Total 1961 Total 1967	93,313 78,407	0	0	93,313 78,407
7	War-Wink/Cherry Canyon/	1961 1967	0 117,213	0	0	0 117,213
		Total 1961 Total 1967	0 117,213	0	0	0 117,213

Table 5.—Reported Brine Production and Disposal in 1961 and 1967—Continued

AREA SHOWN ON FIGURE 23	FIELD	YEAR BRINE WAS PRODUCED	SURFACE PITS	DISPOSAL INJECTION WELLS	OTHER METHODS	TOTAL BRINE PRODUCTION
8	Quito, East/Delaware/	1961 1967	28,445 32,079	0	0	28,445 32,079
		Total 1961 Total 1967	28,445 32,079	0	0	28,445 32,079
9	Block 17/Lamar Lime/	1961 1967	0 22,078	0	0	0 22,078
	Block 17, SE/Delaware/	1961 1967	25,125 204,681	0 25,550	730 0	25,855 230,231
	Lion	1961 1967	900	0 4,860	0	900 4,860
	Poquito/Delaware/	1961 1967	0 8,323	0	0	0 8,323
		Total 1961 Total 1967	26,025 235,082	0 30,410	730 0	26,755 265,492
10	Wil-John/Delaware Sand/	1961 1967	11,160 -	<u>o</u>	<u>o</u>	11,160
	Wil-John, NW/Delaware Sand	1961 1967	6,825 —	<u>o</u>	0 -	1,825 —
		Total 1961 1967	12,985	0 -	0 -	12,985 —
11	Rhoda Walker	1961 1967	0 2,745	0	0	0 2,745
	Rhoda Walker/5900 Canyon/	1961 1967	0 2,027	0	0	0 2,027
		Total 1961 Total 1967	0 4,772	0	0 0	0 4,772
12	Lockridge/Ellenburger/	1961 1967	0	0 2,200	0	0 2,200
	Lockridge/Wolfcamp/	1961 1967	0	0	0 0	0 0
	Love Lady/6200/	1961 1967	0 7,000	0	0	0 7,000
	Love Lady/6400/	1961 1967	0 16,000	0	0	0 16,000
	Pitzer/Delaware/	1961 1967	0 3,470	0	0	0 3,470

AREA SHOWN ON FIGURE 23	FIELD	YEAR BRINE WAS PRODUCED	SURFACE PITS	DISPOSAL INJECTION WELLS	OTHER METHODS	TOTAL BRINE PRODUCTION
	Pitzer/Ramsey/	1961 1967	0 18,000	0 0	0	0 18,000
	Pitzer, N/Cherry Canyon/	1961 1967	0 11,000	0	0	0 11,000
	Pitzer, S/Delaware/	1961 1967	0 24,662	0 2,900	0	0 27,562
		Total 1961 Total 1967	0 80,132	0 5,100	0	0 85,232
13	Pyote, S/4950 Sand/	1961 1967	808	0	7,471 0	8,279 0
	Pyote, S/6100 Sand/	1961 1967	9,872 44,072	0	0	9,872 44,072
	Pyote, S/6200 Sand/	1961 1967	9,540	<u>o</u>	0 —	9,540 —
	Pyote, S/6450 Sand/	1961 1967	150	0	0	150
		Total 1961 Total 1967	20,370 44,072	0	7,471 0	27,841 44,072
14	Delstrat/Brushy Canyon/	1961 1967	0	45,260 4,334	0	45,260 4,334
		Total 1961 Total 1967	0	45,260 4,334	0	45,260 4,334
15	Magnolia Sealy, W/Brushy Canyon/	1961 1967	0	365 1,297	0	365 1,297
	Magnolia Sealy, W/Yates Dolomite/	1961 1967	0	0 90,128	0	0 90,128
		Total 1961 Total 1967	0	365 91,425	0	365 91,425
16	Pyote, SW/Devonian/	1961 1967	0 630	0 0	0	0 630
		Total 1961 Total 1967	0 630	0	0	0 630
17	Spencer	1961 1967	46,075 32,120	438,200 134,275	0	484,275 166,395
		Total 1961 Total 1967	46,075 32,120	438,200 134,275	0	484,275 166,395

AREA SHOWN ON FIGURE 23	FIELD	YEAR BRINE WAS PRODUCED	SURFACE PITS	DISPOSAL INJECTION WELLS	OTHER METHODS	TOTAL BRINE PRODUCTION
18	Byrd	1961 1967	37,304 39,420	0	0 173	37,304 39,593
		Total 1961 Total 1967	37,304 39,420	0	0 173	37,304 39,593
19	Miller Block B-29/Penn./	1961 1967	3,436 5,554	0 5,127	0	3,436 10,681
	Ward, South	1961 1967	5,888,246 0	11,467,751 8,434,401	0 12,153	17,355,997 8,446,554
	Ward, S./Glorieta/	1961 1967	0	0 5,216	0	0 5,216
	Ward, S./Line/	1961 1967	365,000 -	0 _	0 —	365,000 —
	Ward, S./Penn./	1961 1967	0	0 13,271	0	0 13,271
	Ward, S./8430 Penn./	1961 1967	0 496	0	0	0 496
	Ward, S./Upper Penn. detrital/	1961 1967	0 16,696	0	0 365	0 17,061
	Ward, S./4130 San Andres/	1961 1967	0	0 3,154	0	0 3,154
		Total 1961 Total 1967	6,256,682 22,746	11,467,751 8,461,169	0 12,518	17,724,433 8,496,433
20	Estes, Block 34/Penn./	1961 1967	56,873 0	0 6,022	0	56,873 6,022
	H.S.A./Canyon/	1961 1967	0 10	0	0	0 10
	H.S.A./O'Brien Sand, lower/ (Trans. to Ward-Estes, North)	1961 1967	16,875 0	0	0	16,875 0
	H.S.A./Penn./	1961 1967	0 2,397	0	0	0 2,397
A SHIP STATE	H.S.A./3050 Queen/	1961 1967	0	0 5,468	0	0 5,468
	Hendrick	1961 1967	442,000	0	<u>o</u>	442,000

AREA SHOWN ON FIGURE 23	FIELD	YEAR BRINE WAS PRODUCED	SURFACE PITS	DISPOSAL INJECTION WELLS	OTHER METHODS	TOTAL BRINE PRODUCTION
	Magnolia Sealy	1961 1967	158,278 0	575,445 1,095,449	0	733,723 1,095,449
	Magnolia Sealy, S.	1961 1967	327,853 769,150	543,485 2,303,575	0 0	871,338 3,072,725
	Pyote	1961 1967	0	53,500 40,150	0	53,500 40,150
	Sealy, South/Yates/	1961 1967	36,260 5,140	0 36,932	0	36,260 42,072
	Ward-Estes, north	1961 1967	2,978,080 757,636	23,898,838 64,300,257	0	26,896,918 65,057,893
	Wickett, S./Yates/	1961 1967	23,521 18,250	0 209,015	0	23,521 227,265
		Total 1961 Total 1967	4,059,740 1,552,583	25,071,268 67,996,868	0	29,131,008 69,549,451
21	Monahans/Clearfork/	1961 1967		_ 249,854	_ 0	_ 249,854
	Monahans/Devonian/	1961 1967		_ 8,574		- 8,574
	Monahans/Ellenburger/	1961 1967	-0	185,901	- 0	185,901
	Monahans/Fusselman/	1961 1967	0	765,000 101,146	0	765,000 101,146
	Monahans/Queen Sand/	1961 1967	241 5,250	0 306,620	0	241 311,870
	Monahans/Permian TUBB I/	1961 1967	- 0	705	- 0	_ 705
	Monahans/Permian TUBB II/	1961 1967	- 0	838	- 0	838
	Monahans/Permian TUBB III/	1961 1967	- 0	24,248	_ 0	24,248
43 (1964)	Monahans/Waddell/	1961 1 9 67	0	0 8,510	0	0 8,510
	Monahans, N./Penn./	1961 1967	0 80,300	0	0	80,300

Table 5.—Reported Brine Production and Disposal in 1961 and 1967—Continued

AREA SHOWN ON FIGURE 23	FIELD	YEAR BRINE WAS PRODUCED	SURFACE PITS	DISPOSAL INJECTION WELLS	OTHER METHODS	TOTAL BRINE PRODUCTION
	Triple -S/8725 Penn./	1961 1967	0 19,400	0	0	0 19,400
		Total 1961 Total 1967	241 104,950	765,000 886,396	0	765,241 991,346
22	Wickett/Wolfcamp/	1961 1967	0 15,314	0	0	0 15,314
		Total 1961 Total 1967	0 15,314	0	0	0 15,314
23	C & M/Queen/	1961 1967	0	0 8,395	0	0 8,395
		Total 1961 Total 1967	0	0 8,395	0	0 8,395
24	Monahans, W/Devonian/	1961 1967	0 2,920	0	0	0 2,920
199	Monahans, W/3075 Queen/	1961 1967	0 7,018	0 6,406	0	0 13,424
		Total 1961 Total 1967	0 9,938	0 6,406	0	0 16,344
25	Monahans, S./Queen/	1961 1967	4,372 0	0 156,541	0	4,372 156,541
		Total 1961 Total 1967	4,372 0	0 156,541	0 0	4,372 156,541
26	Janelle/Devonian/	1961 1967	1,824	0 —	0	1,824 -
	Janelle/Wichita Albany/	1961 1967	20,988 7,209	0 636	0	20,988 7,845
	Janelle, SE/Ellenburger/	1961 1967	0	0 15,501	0	0 15,501
	Janelle, SE/TUBB/	1961 1967	0 34,437	0 37,667	0	0 72,104
26	Janelle, SE/Waddell/	1961 1967	0 600	0 9,413	0	0 10,013
		Total 1961 Total 1967	22,812 42, 246	0 63,217	0	22,812 105,463

AREA SHOWN ON FIGURE 23	FIELD	YEAR BRINE WAS PRODUCED	SURFACE PITS	DISPOSAL INJECTION WELLS	OTHER METHODS	TOTAL BRINE PRODUCTION
27	Crawar/TUBB/	1961 1967	76 3,650	0	0	76 3,650
	Crawar/Devonian, north/	1961 1967	8,092 59,392	0	0	8,092 59,392
	Crawar/Ellenburger/	1961 1967	84,140 5,475	0	0	84,140 5,475
	Crawar/Fusselman/	1961 1967	0 74,233	0 20,724	0	0 94,957
	Crawar/Waddell/	1961 1967	2,523 0	0	0	2,523 0
	Crawar, W./Devonian/	1961 1967	0 27,375	0	0	0 27,375
		Total 1961 Total 1967	94,831 170,125	0 20,724	0	94,831 190,849
28	Sand Hills, W./Devonian/	1961 1967	394 0	0 24,365	0	394 24,365
		Total 1961 Total 1967	394 0	0 24,365	0	394 24,365
29	Shipley/3900 Clear Fork/	1961 1967	0 49,275	0 45,220	0	0 94,495
	Shipley/Glorieta/	1961 1967	0 6,242	0 12,109	0	0 18,351
	Shipley/Queen Sand/	1961 1967	249,555 1,204,302	3,262,860 4,258,083	12,045 0	3,524,460 5,462,385
	Shipley/Silurian/	1961 1967		6,000	_ 0	_ 6,000
		Total 1961 Total 1967	249,555 1,259,819	3,262,860 4,321,412	12,045 0	3,524,460 5,581,231
30	Dorr/Queen Sand/	1961 1967	20,680 7,350	0	0	20,680 7,350
		Total 1961 Total 1967	20,680 7,350	0	0	20,680 7,350
31	Pecos Valley High Gravity	1961 1967	434,504 231,846	0 95,920	0	434,504 327,766
		Total 1961 Total 1967	434,504 231,846	0 95,920	0	434,504 327,766

Table 5.—Reported Brine Production and Disposal in 1961 and 1967—Continued

AREA SHOWN ON FIGURE 23	FIELD	YEAR BRINE WAS PRODUCED	SURFACE PITS	DISPOSAL INJECTION WELLS	OTHER METHODS	TOTAL BRINE PRODUCTION
32	Payton	1961 1967	168,830 132,720	3,401,800 0	0 2,920	3,570,630 135,640
	Payton/Devonian/	1961 1967	0 364	0 3,614	0 0	0 3,978
	Payton/Mississippian/	1961 1967	0	0	0 0	0
		Total 1961 Total 1967	168,830 133,084	3,401,800 3,614	0 2,920	3,5 7 0,630 139,618
	County totals	1961 1967	12,053,147 5,113,244	44,470,254 82,655,792	63,191 17,931	56,586,592 87,786,967

Water that is produced in oil fields other than those overlying the Capitan reef normally had a very high mineral content and a high chloride-sulfate ratio. Examination of the specific conductance and chloride-sulfate ratio in water sampled from wells tapping the Allurosa aquifer during the present or previous investigations (Figure 21 and Table 8) indicated that, in addition to YX-46-32-903, 11 other wells have been contaminated, presumably from oil-field brine. The chloride-sulfate ratios exceeded 10 in 6 of the samples indicating those wells are highly contaminated. Six of the contaminated wells are in area 19 on Figure 23. The volume of brine that was pitted in oil fields in that area during 1961 and 1967 totaled 6,256,682 and 22,746 barrels, respectively.

A marked degradation in the chemical quality of ground water apparently has not occurred except locally. It is possible that contamination may be more extensive than is indicated by Figure 23 because of the low velocity of movement of the ground water. Brine that is placed in a pit may not affect the chemical quality of the water in wells nearby for many years. Moreover, in some areas of surface-disposal pits, wells either were not available or were not sampled.

A statewide "no pit" order was issued by the Railroad Commission of Texas effective January 1,1969. As a result of this order, nearly all of the brine is now being injected into disposal or repressurizing wells. However, contamination will continue for some time because of the large amounts of brine already placed in surface pits.

Contamination From Improperly Cased Wells

Improperly or inadequately cased oil and gas wells are potential sources of contamination of the groundwater supplies. The Oil and Gas Division of the Railroad Commission of Texas is responsible for seeing that oil and gas wells are properly constructed, and the Texas Water Development Board furnishes ground-water data to oil operators and to the Railroad Commission in order that all fresh water may be protected. The term "fresh water" is considered by the surface-casing program of the Texas Water Development Board to include water of usable quality. The term "usable" is rather indefinite in that the qualitative limits differ from place to place in the State. In Ward County, the term "water of usable quality" denotes water that may be of satisfactory quality for domestic, livestock, irrigation, or publicsupply purposes or for some restricted industrial purposes. Thus, water of usable quality in Ward County may contain as much as 10,000 mg/l dissolved solids.

The Railroad Commission requires that strata containing usable water be protected by surface casing or new or reconditioned pipe and cement, or by other protective devices. The amount of protection required in

the county differs from place to place, but generally casing and cement is required to a depth of a few tens of feet below the base of the Allurosa aquifer, which is the base of the Santa Rosa Sandstone or base of the alluvium where the Santa Rosa is absent.

One of the larger oil fields in the county, the South Ward Field (in area 19, Figure 23), has field rules requiring a minimum of 450 feet of surface casing. Inasmuch as the base of the Allurosa aquifer is 920 feet below the surface in parts of the field, the minimum surface-casing requirement is deficient by as much as 470 feet. Of principal concern is the fact that many of the oil wells in that area have been converted to injection wells for secondary recovery of oil. Injection of oil-field brines into wells for purposes of either secondary recovery or brine disposal is a potential source of contamination of ground water in other fields in the county in which some of the wells may be inadequately cased.

The locations of four oil tests that were abandoned without being plugged are shown in Figure 23. One of the tests, YX-46-38-601, has been flowing very saline water since 1923 when it was drilled. Another test, located 5 miles northwest of Grandfalls, has flowed oil and salt water for several years. Of principal concern is the fact that this test is about half a mile southwest of well YX-45-33-812, which is the major source of water for residents in Grandfalls. The problem of plugging abandoned oil tests will become more acute with time as many of the older fields in the county are in the late stage of production.

Water in the Allurosa aquifer in the vicinity of the Montex Chemical Plant, 3 miles south of Monahans, has been contaminated, presumably by brine that is produced at the plant. Nine small-capacity wells which tap the Allurosa supply the plant. Three of the wells, YX-45-25-909, 910, and 911, were inventoried during the current investigation. Chemical analyses of water sampled from wells YX-45-25-909 and 911 in 1967 (Table 8 and Figure 21), showed chloride concentrations of 31,500 and 41,000 mg/l, respectively.

The brine well (YX-45-25-912) at the plant, is believed to be the source of the contamination that is evident in the analyses. When inventoried in December 1967, the brine well reportedly had 8 5/8-inch casing from the surface to 92 feet. The surface casing was cemented to the wall of the well. The well had 51/2-inch casing from the surface to 1,008 feet, and had open-hole completion from 1,008 feet to 1,750 feet in the Salado Formation. The brine was produced by injecting water through the 5½-inch casing and jetting the salt back to the surface through tubing inside the 51/2-inch casing. Inasmuch as the base of the Allurosa aquifer is about 270 feet below the land surface at the brine plant, the length of surface casing in the brine well was inadequate to prevent leakage of salt water into the fresh-water sands.

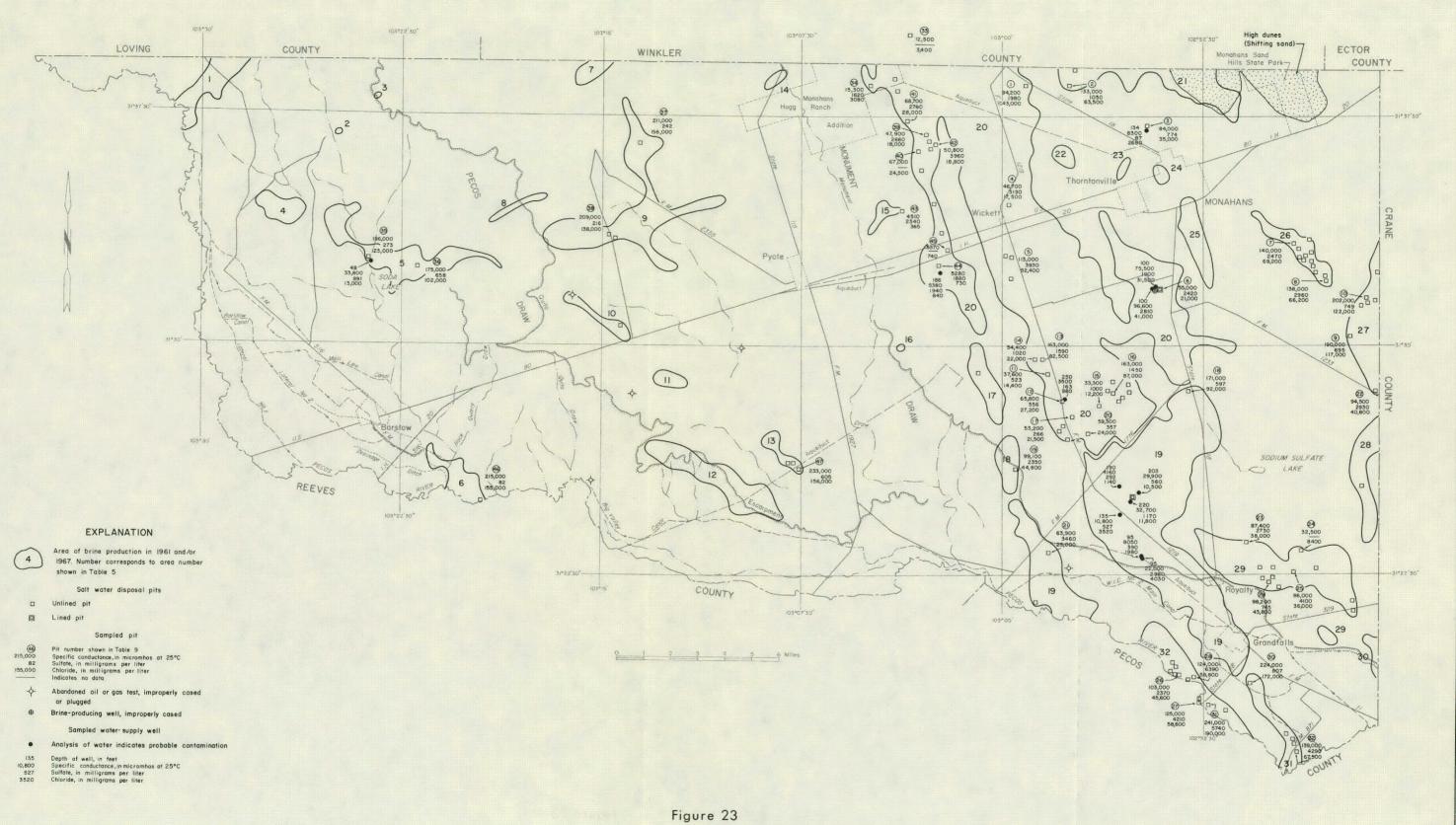
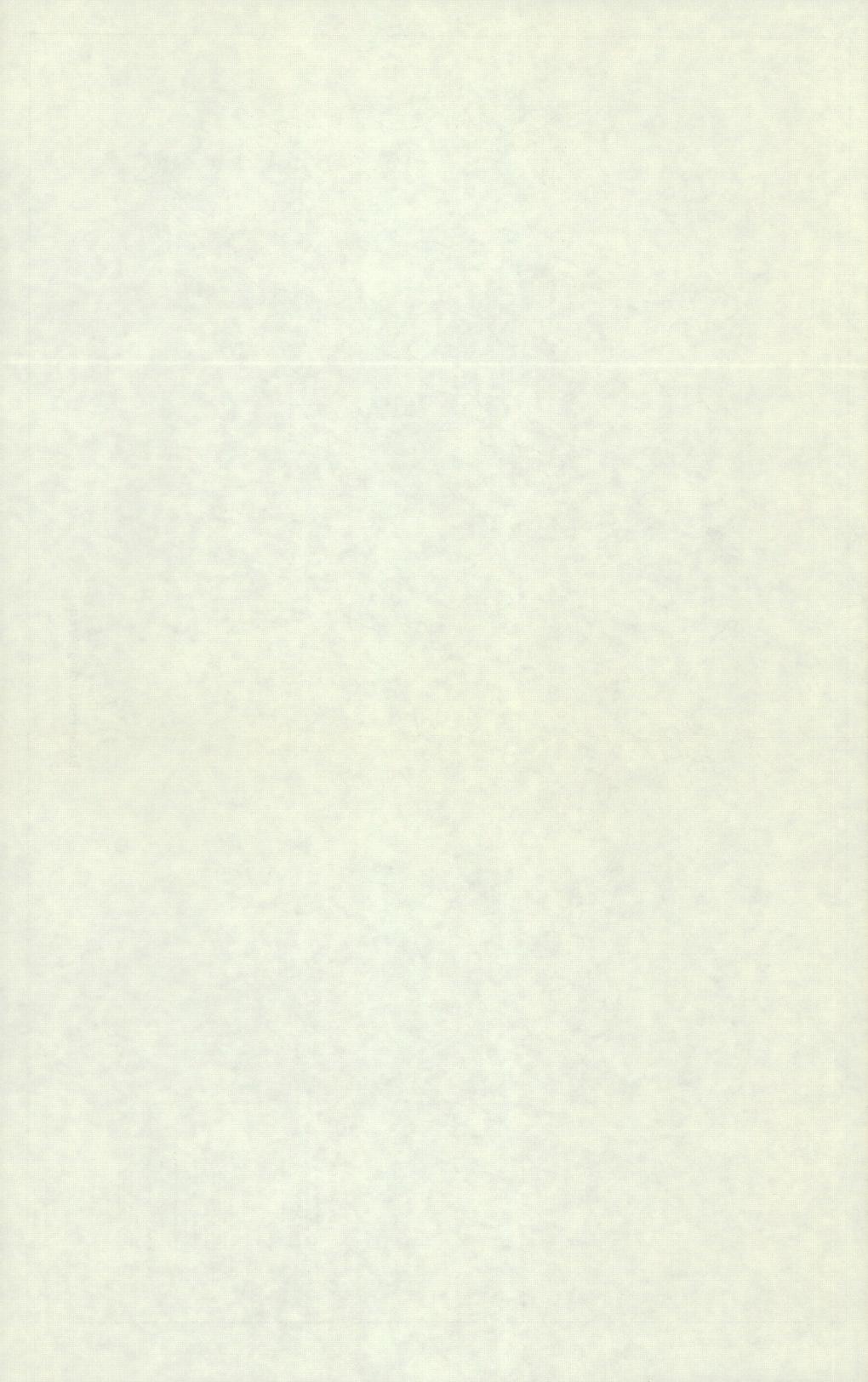


Figure 23
Brine-Producing Areas

Base from U.S. Geological Survey topographic Maps and General Highway Mop of Texas



The owner of the plant was subsequently notified of the contamination problem. On December 12, 1967, he reported that the 5½-inch casing had been cemented from 356 feet to the surface with 140 sacks of cement. It was agreed that water samples should be taken periodically from the supply wells to determine if the source of contamination had been successfully eliminated.

Salt-Water Encroachment

The well fields supplying the cities of Pyote and Pecos are both about 1 mile east of the western boundary of fresh water in the Monument Draw trough. Encroachment of saline water into these well fields could occur in the future, depending upon the rate at which the wells are pumped or additional development that could cause the cone of influence of pumping to intersect the fresh water-saline water boundary. The vertical movement of water of inferior quality that underlies the fresh water body may also be a potential problem.

AVAILABILITY OF GROUND WATER

An estimated 10 million acre-feet of water is stored in the Allurosa aquifer in Ward County. However, much of the water in storage, particularly in the alluvial deposits along the Pecos River, is too highly mineralized for drinking and can be used only to irrigate the more salt-tolerant crops. In addition to the water in storage, the Allurosa aquifer received about 12,000 acre-feet of natural recharge per year, or slightly more than one-half of the total amount pumped from the aquifer in 1967.

The principal supply of fresh water, about 4 million acre-feet, is stored in the alluvial fill in the Monument Draw trough. During 1967, approximately 8,000 acre-feet of water was pumped from these deposits. Additional development is anticipated, most of which will likely be in the area south of Highway 80 and east of Monument Draw on land owned by the University of Texas.

Data are not available to determine the watersupply potential of the other water-bearing formations such as the Rustler Formation and Capitan Limestone. These aquifers are important primarily as a source of saline water for secondary recovery of oil.

SUMMARY AND CONCLUSIONS

Three major aquifers underlie Ward County—the Allurosa aquifer, the Rustler Formation, and the Capitan reef. The Allurosa, the principal aquifer, supplied 22,600 acre-feet of water to wells during 1967. Pumpage from

the Capitan reef and Rustler Formation was 9,500 acre-feet and 2,300 acre-feet, respectively.

Yields from wells in the Allurosa aquifer range from less than 10 gpm to more than 1,500 gpm. The highest yields are obtained from wells tapping alluvial deposits along the Pecos River. Wells tapping the Santa Rosa Sandstone on the structural high that separates the Pecos and Monument Draw troughs are the least productive. Large yields are obtained from wells tapping the Capitan Limestone, and moderate to large yields are pumped from the Rustler Formation.

The quality of water in the Allurosa aquifer varies widely. Water stored in the dune deposits in the northeastern corner of the county has the least mineralization, generally containing less than 500 mg/l dissolved solids. Water in the alluvial deposits along the Pecos River is moderately to very saline. The water is highly mineralized in deposits beneath and bordering Soda Lake and Sodium Sulfate Lake, and in areas where it has been contaminated by oil-field brine. Fresh to slightly saline water can be obtained in most of the remainder of the county.

The water in the Rustler Formation along the south-central edge of the county is suitable for irrigation. Wells tapping the Rustler in the eastern third of the county yield very saline water and brine suitable only for secondary recovery of oil.

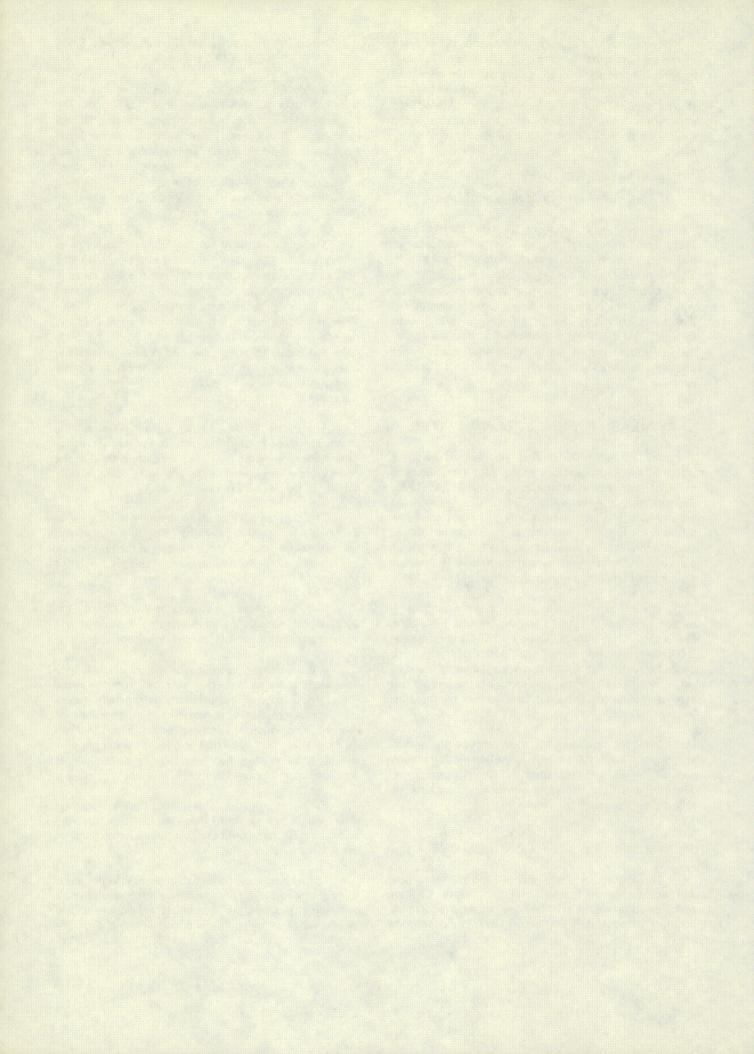
The Capitan reef yields moderately to very saline water which is highly corrosive. For this reason and because of the great depth to the top of the reef (about 3,000 feet), additional development of this aquifer is not anticipated.

The ground-water resources of Ward County are adequate to supply the present rate of demand and support a two or three-fold increase in withdrawals.

The agricultural economy of the county is largely dependent upon surface water diverted from the Pecos River. The supply is undependable, is generally declining, and is practically nonexistent during periods of drought. A program of saltcedar control begun in 1969 may regain as much as 40,000 acre-feet of water per year which was being consumed along the river embankments and flood plain in Ward County.

Lining of irrigation canals would prevent seepage losses which average more than half the flow diverted from the river, but would also greatly reduce recharge of the Allurosa aquifer.

In order to keep abreast of changes in water levels and possible salt-water encroachment into the aquifers, a continuing program of water-level measurement and ground-water sampling for chemical analysis is recommended.



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Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas

All wells drilled unless otherwise noted in Remarks column.

Water level : Reported water levels given in feet; measured water levels given to tenth of a foot and hundreths of a foot in observa-

tion well; R, reported.

Method of lift and type of power: C, cylinder; Cf, centrifugal; E, electric; G, gasoline, butane or Diesel engine; H, hand; J, jet; N, none; Ng, natural

WATER LEVEL

gas; S, submergible; T, turbine; W, windmill. Number indicates horsepower.

Use of water : D, domestic; Ind, industrial; Irr, irrigation; N, none; P, public supply; S, livestock.

Water-bearing unit : A, Allurosa aquifer; Pr, Rustler Formation; Ps, Salado Formation; Pc, Capitan Limestone (reef complex and associated

limestone); Psr, Seven Rivers Formation.

WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	MEAS	E OF	METHOD OF LIFT	USE OF WATER	REMARKS
						Ward Co	unty						
*YX-45-17-701	Cactus Cattle Co.	W. E. (Bud) Tone	1962	403	8	А	2,646	66.7	Apr.	14, 1967	S,E,	Irr S	Irrigated 3 acres of grass and watered 28 head of hogs in 1967. Pumped 53 gpm for 101 hours and had 32.5 feet of drawdown Apr. 24-28 1967.
* 702	H. A. Clements	Layne-Texas Co.	1947	284	4	A	2,650				C,W	S	Drilled as test hole 3-A. Cased to 180 ft, open hole 180 to 284 ft. Base of alluvium at 119 ft. 1
703	do	do	1947	322	10	А	2,650	78.0	Apr.	7, 1967	N	N	Drilled as test hole 3-AB for Texas Electric Service Co. Set and cemented 137 ft of 10 3/4-in. casing. Open hole 137 to 322 ft. Reported pumped 50 gpm and had 54 ft of drawdown.
* 801	Sealy-Smith Foundation		old	64	7	Α	2,634	40.34 41.62	Mar. Dec.	6, 1956 30, 1967	C,W	S	Well W-66 in Pecos River Joint Investi- gation (P. R. J. Inv.) called "Honky Tonk" well. 60 ft of 2-in. column pipe. Measured discharge 3.4 gpm 4-28-67. Current Texas Water Development Board Observation Well. 2/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

		Harris of the Police						WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-17-902	El Paso Nat. Gas. Co.	A. T. Wilhite	1949	129	8	А	2,669	45 R	Mar. 15, 1967	T,E,	Ind	Wells YX-45-17-902, 903, 904, 905, and 906 supply Sealy-Smith Gasoline Plant. Plant well No. 6. Driller's log: sand, surface to 47 ft; red sand, shale and gravel (Triassic) 47-129 ft. Casing perforated 49-129 ft. Reported discharge 15 gpm. Water has gassy taste and odor. Plant employees haul drinking water from Monahans. 1
* 903	do		1954	120	12	Α		47 R	Mar. 15, 1967	T,E, 7 1/2	Ind	Plant well No. 8. Driller's log: sand and sandy clay, surface to 52 ft; redbeds (Triassic) 52-120 ft. Casing perforated 80-115 ft. Reported discharge 10 gpm 3-15-67. Water has gassy taste and odor.
* 904	do	J. D. Cole		126	10	A		53 R	Mar. 15, 1967	T,E, 7 1/2	Ind	Plant well No. 9. Casing perforated 74-113 ft. Gravel packed. Reported draw- down of 27 ft pumping 40 gpm for 1 hour 3-15-67. 1/
* 905	do	Dixon Pump and Equipment Co.	1962	123	8	Α		51 R	Mar. 15, 1967	T,E, 5	Ind	Plant well No. 10. Casing perforated 64-81 and 116-120 ft. Gravel packed. Reported drawdown of 44 ft pumping 39 gpm for 1 hour 3-15-67.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

			1					WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-17-906	El Paso Nat. Gas. Co.	Pete Hill	1949	442	16	A		40 R 80 R	June 2, 1949 Mar. 15, 1967	T,E,	Ind	Plant well No. 2. Casing perforated 50-56 ft. Open hole 67-442 ft. Driller reported no water below 110 ft. Reported draw- down of 70 ft pumping 43 gpm for 1 hour 6-2-49. Drawdown of 34 ft pumping 14 gpm for 1 hour 3-15-67. 1/
907	Sealy-Smith Foundation	Shell Oil Co.	1947	10		A	2,716	9.9 9.6	July 4, 1957 May 17, 1967	N	S	Pit bulldozed 10 foot deep in dune sand. Wel No. H-70 in Winkler County report.
909	do		old	90	7	А	2,659	30.4	Apr. 7, 1967	c,w	S	Called "Bull Well." 60 ft of 2 1/2-in. column pipe.
910	Shell Oil Co.	Sharp Drlg. Co.	1959	850	8	Pr	2,705	180 R	Dec. 17, 1959	S,E, 50	Ind	Sealy-Smith water well No. 1. Open hole 776-850 ft. Supplies water for secondary recovery of oil in the Monahans field.
* 18-701	Sealy-Smith Foundation	Shell Oil Co.	1948	10		A	2,736	13.0 13.0	July 4, 1957 Apr. 8, 1967	N	S	Pit bulldozed in dune sand. Well H-68 in Winkler Co. report.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-18-801	Monahans Sand Hills State Park	R. C. (Dick) Murray	1957	75	8	A		28.0	Apr. 7, 1967	C,W	P	Cased to 44 ft. Casing cemented to wall of well. Open hole 44-75 ft. Driller reported white (eolian) sand, surface to 40 ft; red clay 40-45 ft; red sand 45-50 ft; red clay 50-55 ft; red sand and gravel 55-73 ft; and red clay 73-75 ft. Reported tested at 35 gpm when drilled. Water from shallow sands reported to be gyppy. Water from deeper sands has a very low content of dissolved minerals. 1/
802	do	Shell Oil Co.	1956	63	6	Α	2,745	22.3	Sept. 2, 1967	N	N	Supplied water for drilling Shell Oil Co. Sealy-Smith well A-1. Reported supplied plenty of water for drilling the well. Has not been used since.
* 901	F. L. Williams		1930±	81	6	Α	2,760	60.3	Mar. 22, 1940 Mar. 16, 1967	c,w	\$	Called "Polk Bagley" well. Well W-87 in P.R.J. Inv. 3-inch column pipe. Estimated discharge 36 gpm 3-16-67.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-25-101	H. A. Clements	W. E. (Bud) Tone	1962	485	8	A	2,640	97.1	Apr. 7, 1967	S,E, 7 1/2	D,S	Drilled to replace a well 250 ft deep at this location when the water became salty. Casing cemented from the surface to 135 ft. Open hole 135-485 ft.
102	Gulf Oil Corp.	J. R. Marshall	1934	350	8	A	2,672	134.1	June 23, 1967	N	N	Well W-58 in P. R. J. Inv. Casing perforated 171-195, 265-288, and 312-326 ft. Supplied water for drilling oil tests. 1/
* 103	G. W. O'Brien Est.		1937	157	6	А	2,665	118.2 122.6	May 3, 1940 June 23, 1967	N	N	Well W-58 in P. R. J. Inv. Originally drilled for oil-field supply. Was used for livestock supply until 1965, when column pipe stuck in casing. Reported to have been a strong well.
104	do	Layne-Texas Co.	1947	334	4	А	2,676	121.0	Sept. 27, 1967	N	N	Drilled as test well for Texas Electric Service Co. Cased to 224 ft; open hole 224-334 ft.
105	do	do	do	320	10	A	2,658	93.7	Sept. 27, 1967	N	N	Drilled as test well for Texas Electric Co. Set and cemented 188 ft of 10 3/4-in. casing. Open hole 188-320 feet. 1/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

E T									WATE	R LEVEL			
WEL	L	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-1	25-201	Byron Jackson Co.		1937	95	6	A	2,602	61.6	Apr. 12, 196	7 S,E, 2	Ind	Well W-69 in P. R. J. Inv. formerly supplied Texas-New Mexico pipe- line camp. Cased to 59 ft; open hole 59-95 feet.
*	202	Texas-New Mexico Pipe- line Co.		1937	86	6	А		36 R	Apr. 193	S,E, 2	Ind	Well W-67 in P. R. J. Inv.
	203	Texas Electric Service Co.	Layne-Texas Co.	1947	294	8	A	2,603	62.0	Aug. 30, 196	T,E,	Ind	Company well 29-A. Casing: 10 3/4 in. to 101 ft, cemented; 8 5/8-in. surface to 294 ft; slotted 175-285 ft. Gravel packed. Reported pumped 71 gpm and had 11 ft of drawdown in Aug., 1967. 1/
*	301	L. G. Brine and Water Sales Co.	Harry McMahen	1962	134	6	A		40 R	Oct. 1962	T,E,	Ind	Cased to 90 ft, open hole 90-134 ft. Reported discharge 100 gpm. Water has salty taste.
*	302	R. C. (Dick) Murray	0wner	1958	123	8	А	2,610	52.0	Apr. 13, 1967	S,E,	D	Open hole 100-123 ft. Estimated yield 15 gpm.
	303	W. S. Roberts	E. T. (Gene) Watkins	1948	93	6	А	2,610	21 R 52.2	1948 Apr. 13, 1967		N	Replaced well W-26 in P. R. J. Inv. Cased to 86 ft; open hole 86-93 ft. Reported well was abandoned in 1953 because of the large decline in water level and a deterioration in water quality.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

							•	WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-25-304	Lena Brown (Bronies Grocery Store)	J. J. Harrell	1939	110	8	А		45.4	Apr. 13, 1967	S,E, 1	D	Well W-70 in P. R. J. Inv. Formerly owned by city of Monahans. Open hole 72-110 ft. Reported pumped 75 gpm for 72 hours and had a drawdown of 45 ft in 1940. 1/
305	Monahans Brine Co.	W. E. (Bud) Tone	1965	176	6	А	2,617	46.6	Apr. 12, 1967	S,E	Ind	Casing: 10 3/4-in. surface to 72 ft, cemented; 6-in. to 176 ft; perforated 85-103, and 130-176 ft. Reported pumped 125 gp for 8 hours and had 55 ft drawdown. 1/
306	City of Monahans (Monahans Country Club)	R. C. (Dick) Murray	1954	160	10	A	2,632	43.5	Apr. 12, 1967	T,E, 10	Irr	Casing: 20-in. surface to 65 ft, cemented; 10-in to 160 ft; perforated 65-160 ft. Leased to Monahans Country Club for irrigating golf course Reported discharge 100 gpm.
307	do		1946	150	8	Α	<u></u> -			T,E, 7 1/2	Irr	4-in. column pipe. Reported discharges 70 gpm.
308	Monahans Country Club		1944	150	8	Α			11	T,E, 7 1/2	Irr	Do.
309	do	-	1946	150	8	Α				T,E 5	Irr	
310	City of Monahans (Monahans Country Club)		1946	170	8	A	2,630	45.0	Apr. 12, 1967	T,E, 5	lrr	

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

		T	T					WATE	R LEVEL		I	
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-25-311	City of Monahans (Monahans Country Club)	-	1945	150	8	A			-	T,E, 7 1/2	Irr	
* 312	City of Monahans	Frank Gaylon	1948	149	8	A	2,609	49 R 62.4	Mar. 1948 Λpr. 10, 1967	N	N	Abandoned municipal well No. 3-5. Casing perforated 79-149 ft. Reported discharged 100 gpm in 1964. Decline of 13 feet in water level since 1948 reflects municipal pumping.
* 313	do	do	1948	160	8	A				T,E, 40	P	City well 3-6. Combined discharge of wells YX-45-25-313, 315, 316, 603, 604, 605 in use in city's west Monahans field was 800 gpm (133 gpm/well) in Apr. 67.
* 314	do	do	1948	160	16	A	2,610	63.8	Apr. 10, 1967	N	N	Abandoned city well 3-7.
* 315	City of Monahans	R. C. (Dick) Murray	1952	221	14	A	2,607		-	T,E, 15	Р	City well 3-8. Casing perforated 121-221 ft. Chemical analyses show the quality of water in the west Monahans wellfield has progressively deteriorated.
÷ 316	do	do	1955	165	10	A	2,603	72 R	Oct. 20, 1959	T,E, 20	Р	City well 3-10. Casing: 20-in. to 65 ft, cemented; 10-3/4 in. surface to 165 ft; slotted 65 to 165 ft. Reported tested at 450 gpm when drilled.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL		1	
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-25-317	City of Monahans	J. C. Lewis	1951	160	20	A	2,610	61.2	May 17, 1967	T,E, 10	Irr	Cemetary well. Originally drilled to 965 feet to test the Rustler Formation. Because the water in the Rustler was unsuitable for public supply the well was subsequently plugged back to 160 ft. 1
* 318	Texas & Pacific Railroad	L. F. Buchanan	1937	222	8	A		50 R	Nov. 1937	N	N	Well W-71 in P. R. J. Inv. Formerly supplied locomotives. Casing perforated 142-222 ft. 1/
319	do	T. E. Shutt	1928	200	8	А			1	N	N	Abandoned railroad well. Well W-72 in P. R. J. Inv. <u>1</u> /
320	Paul De Cleva	J. L. Pettit	1967	1,002	7					N		Salt water disposal well. Cased to 810 ft. Casing cemented with 350 sacks. Open hole 810 to 1002 ft in Rustler Formation. Top of Triassic at 120 ft. Top of anhydrite (top of Rustler) at 770 ft. Limestone (main waterbearing zone in Rustler) 810 to 855 ft

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

Г									WATE	R LEVEL		F	
	WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
	YX-45-25-321	City of Monahans	Layne-Texas Co.	1946	220	10	A		42 R 57.6	Dec. 16, 1946 May 17, 1967	N	N	Old T & P R. R. well No. 7. Casing: 18-in., surface to 80 ft; 10 3/4-in. liner, slotted 97-137 and 170-210 ft. Base of alluvium (top of Triassic) at 84 ft on driller's log. Pump- ing test by driller 12-16-16: drawdown of 68 ft pumping 192 gpm for 8 hours. 1/
*	322	do	do	1945	221	10	Α	2,613	55.7	May 17, 1967	T,E, 10	P	Old T & P R. R. well No. 6. Casing: 20-in. surface to 81 ft; 10 3/4-in. to 221 ft; screened 107-117, 127- 149, 163-178, and 187- 211 ft. Base of alluvium at 113 ft. Development test by driller 11-20-45: draw- down of 62 ft. pumping 160 gpm for 24 hours. Current (1967) status: stand-by well for municipal supply. 1/
*	323	John Fitch	John Woodfin	1963	100	9	A				T,E,	Irr	9 5/8-in. casing to 86 ft, cemented; open hole 86-100 ft. 80 ft of 2 1/2-in. column pipe. Reported discharges 25 gpm. Irrigated 3 acres of pasture in 1967.
*	324	City of Monahans		1930	450		A		47.3	Aug. 13, 1967	N	N	Well W-82 in P. R. J. Inv. Old city well No. 3 at Monahans High School. Reported dis- charged 80 gpm in 1941.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

			1	T				WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-25-325	Coca Cola Bottling Co.	Holt Drlg. Co.	1955	126	10	A	2,616	-	-	T,E, 15	Ind	Cased to 90 ft; open hole 90-126 ft. Casing cemented to wall of well to shut out shallow water which is reported to be gyppy.
326	do			130	6	А	2,615	47.0	Aug. 17, 1967	S,E	Ind	
401	Gulf Oil Corp.	S. C. Ingham	1937	407	8	A	2,668	136.1	July 25, 1967	N	N	Well W-105 in P. R. J. Inv. Casing perforated 323-376 ft. Open hole 376-407 ft. 1
* 402	Richardson Oils	W. E. (Bud) Tone	1962	763	10	A	7-	118 R	Aug. 1962	T,E, 10	Ind	University Lands water well No. 3. Casing slotted 180-205 and 220-752 ft. Reported discharge 167 gpm.
* 403	Gulf Oil Corp.	J. D. Cole	1952	325	8	A		131 R	Jan. 1952	S,E,	Ind	O'Brien W. W. No. 22. Casing: 16-in. to 143 ft, cemented with 75 sacks; 8 5/8-in. to 325 ft; perforated 174-185 and 220-322 ft. Gravel- packed with 15 1/2 yards. Metered dis- charge 8-18-67 was 134 gpm. This well and wells YX-46-32-302 and YX-45-33-106 pumped a reported 4,285,008 gal- lons in 1966. The water supplies Gulf Oil Corp's Ward-Estes fresh water system. It is used for drilling oil tests; it supplies the Warren-Monahans Gaso- line Plant, Gulf's Wickett Field Office, several ranch houses and 22 livestock tanks.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

The Televic Learning States	Total design	I delimento manerale					I	WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-25-404	Gulf Oil Corp.	S. C. Ingham	1937	346	10	A	2,668	137.3	Aug. 30, 1967	N .	N	Well W-55 in P. R. J. Inv. formerly supplied city of Wickett. Casing: 10 3/4-in. to 326 ft; 8 5/8-in. 306-346 ft; perforated 326-346 ft. Log shows slight amount of water at 140 ft and in interval 145 to 200 ft. Large show of water in interval 222-234 ft. 1/
* 405	Humble Oil and Refining Co.	Owner	1955	650	8	A	2,646			S,E	Ind	University water well F-3. Casing: 13 3/8-in. to 519 ft; 8 5/8-in. 10-640 ft; perforated 519-640 ft. Open hole 640-650 ft. Reported pumped 200 gpm during a 16 hour development test. Water is used to wash filters at water-flood plant.
406	do	do	1955	624	8	A	2,648	111.1	Sept. 8, 1967	N	N	University water well F-2. Casing: 13-in. to 520 ft; 8 5/8-in. to 624 ft; perforated 499- 624 ft. Reported pumped 133 gpm for 6 hours in 1955.
407	do	do	1955	643	8	А	2,650	113.4	Sept. 8, 1967	N	N	University W. W. No. F-1 formerly supplied water for secondary recovery of oil. Casing perforated 495-643 ft.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
YX-45-25-408	Humble Oil and Refining Co.	Owner	1945	2,753	6		1,945					University F-14 water injection well. Drille as oil test. Plugged back to 1,630 ft in Nov. 1953. Gun-perforated 6 5/8-in. casing 1,375-1,381, 1,420-1,479, 1,490-1,540 and 1,570-1,585 ft in Rustler Formation. Acidized with 14,000 gallons HCl. Swabbed 15 barrels water per hour for 5 hours. Temporarily abandoned in Nov. 1953. Cut and pulled 662 ft of casing. Set plug at 677 ft. Gun-perforated casing 560 to 640 ft in Santa Rosa. Pumped 112 gpm. Converted to injection well for secondary recovery of oil from Yates Sandstone in 1963. 1/
409	Ward County Parks Dept.	R. C. (Dick) Murray	1957	240	8	Α				T,E,	Irr	Casing: 16-in. to 160 ft, cemented; 8 5/8-in to 240 ft; perforated 60 ft in interval 160-240 ft. Set 190 ft of 4-in. column pipe. Reported discharge 100 gpm. Irrigates park lawns and fills swimming pool.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

					T	I			WATE	R LEVEL			
WELL		OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-25-5	501	C. W. Freeman	W. E. (Bud) Tone	1964	200	16	A		53 R	Sept. 1964	T,E, 30	lrr	Set and cemented 86 ft of 16-in. casing. Open hole 86-200 ft. 200 ft of 5-in. column pipe. Discharged 200 gpm 5-13-67. Pumping level 181 ft; 1 hour recovery level, 93 ft. Irrigated 110 acres of grain and alfalfa from this well and YX-45-25-502 in 1966.
* 5	502	do	do	1964	210	12	A		53 R	Dec. 1964	T,E, 30	Irr	Open hole 85-210 ft. Water level was 201 ft below the surface pump- ing 112 gpm 5-13-67. Had been pumping continuously since fall of 1965.
* 5	503	do	do		168	6	А	2,596	60.6	May 13, 1967	T,G	Irr	Open hole 85-168 ft. 160 ft of 4-in. column pipe. 6-in. bowls. Not in use in 1967.
5	504	C. D. Estes	L. B. Russell	1967	212	6	А		50.6 51.9	May 12, 1967 Sept. 26, 1967	S,E, 10	Irr	Set and cemented 70 ft of 8-in. casing set 6 in. to 212 ft; perfo- rated 88-98 and 145- 195 ft opposite sand and gravel. Reported will irrigate 20 acres of nursery stock in 1968.
* 5	505	F. I. Dyer		1938	120	6	A	2,589	43.1 52.7 52.3	May 15, 1941 July 25, 1967 Mar. 29, 1968	C,W	S	Called "Division Well." Open hole 10-120 ft. 60 ft of 3-in. column pipe.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

			T T					WATE	R LEVEL		T	Hardan Branch (1990)
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-25-506	F. I. Dyer		old	90	6	А	2,580	45.4	July 25, 1967	c,w	S	Called "Middle Well." Open hole 10-90 ft. 60 ft of 2 1/2-in. column pipe.
* 507	City of Monahans	Dixon Pump & Equipment Co.	1949	250	8	A		75.3	Aug. 14, 1967	T,E, 25	Р	Gulf Oil Corp., Hutching Camp well No. 3. Casing: 10 3/4-in. to 60 ft, cemented with 60 sacks; 8 5/8-in. to 250 ft; perforated 50-250 ft. Pump test by Gulf Oil 5-24-50: drawdown of 48 ft pumping 131 gpm for 48 hours. 222 ft of column pipe. 12 stage, 8-in. bowls.
* 508	do	Flack & Felton	1948	275	8	A		81 R	May, 1950	T,E,	Р	Gulf Oil Corp., Hutching Camp well No. 1. Casing: 10 3/4-in. to 71 ft, cemented with 85 sacks; 8 5/8-in. to 275 ft; perforated 72- 275 ft. Pump test by Gulf Oil 5-4-50: drawdown of 53 ft pumping 147 gpm for 24 hours.
* 509	Texas Electric Service Co.	Layne-Texas Co.	1947	300	10	A	2,607	74.8	Sept. 26, 1967	T,E,	Ind	Owners well No. 10. Casing: 18-in. to 193 ft, cemented; 10 3/4- in. to 300 ft; perfo- rated 219-300 ft. Gravel packed. 1/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

11.00	100						and the second		R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-25-510	-45-25-510 Texas Electric Service Co. Layne-Texas	Layne-Texas Co.	1947	150	7	A	2,607	45.8 57.0	Mar. 31, 1947 Sept. 26, 1967	N	N	Owner's well No. 10-A drilled and logged to 444 ft. Pump tested open hole to 286 ft. Drawdowns of 64, 82, and 89 ft, pumping 307 304 and 306 gpm respectively. Plugged back to 150 ft and sho casing from 66 to 82 f ft. Tested at 40 gpm with pump set near bottom. Not used since 1/
511	do	do	1947	266	10	Α	2,592	42 R 58.0	May 1947 Aug. 30, 1967	T,E, 20	Ind	Owner's well No. 18 drilled and logged to 324 ft. Plugged back t. 266 ft. Set and cemented 18-in. casing to 32 ft. Set 10 3/4-in. to 263 ft. Perforated 51-159, and 178-263 ft. Gravel packed. Pumping 98 gpm with pumping level at 166 ft 8-30-67. Recovery level 58 ft after shut down 1/2 hour. 1/2
512	do	do	1947	100	10	A	2,590	53.3	Sept. 26, 1967	N	N	Test well No. 28 drilled and logged to 100 ft. Set 46 ft of 10 3/4-in. casing. Open hole 46-100 ft. Bailed 60 gpm when drilled. 1
601	City of Monahans	Frank Gaylon	1948	117	14	А	2,605	46.4	Apr. 10, 1967	N	N	Abandoned city well No 3-2. Casing slotted 79 160 ft.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

				T				WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
YX-45-25-602	City of Monahans	Frank Gaylon	1948	160	14	А				N	N	Abandoned city well No. 3-3. Pump pulled and well capped 4-21-64.
* 603	do	R. C. (Dick) Murray	1953	140	10	А	2,606	53 R	Oct. 29, 1953	T,E, 7 1/2	Р	City well No. 3-9. Top of perforations at 76 ft. Pumping test by Smith Machinery Co., Pecos, Texas: drawdown of 50 ft pumping 137 gpm for 1 hour. 1/
* 604	do	do	1954	156	10	Α	2,602			T,E, 20	Р	City well No. 3-11.
* 605	do	do	1954	154	10	Α	2,599			T,E, 15	P	City well No. 3-12. Reported tested at 400 gpm for 72 hours when drilled.
* 606	Texas Highway Dept.	J. D. Cole	1959	171	6	А	2,606	72.2	May 15, 1967	S,E, 3	Ind	Base of alluvium (top of Triassic) at 89 ft. Driller reported waterbearing sands at 50, 63, 80, and 140 ft. Set and cemented 93 ft of 7-in. casing. Open hole 93-171 ft. Reported discharge 30 gpm. Water used to irrigate lawns and to supply office and motor pool. 1/
* 607	O. R. White	L. W. Pulley	1940	102	6	A	2,607	45.1	May 18, 1967	C,W	N	Well W-81 in P. R. J. Inv. Open hole 85-102 ft. Not used for more than 3 years, but may be used in future. 1/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
YX-45-25-608	P. ε N. Trucking Co.	W. E. (Bud) Tone	1964	176	5	А		47.6	June 21, 1967	S,E, 2	Ind	Open hole 160-176 ft. 132 ft of 1-in. column pipe. Water used to wash trucks.
* 701	F. I. Dyer		old	190	5	А	2,630	112.1	July 25, 1967	c,w	S	Owner's "South Well." Open hole 10-190 ft. 180 ft of 3-in. column pipe.
* 702	Bluford Thornton		old	79	6	А	2,595	64.0	Aug. 30, 1967	c,w	S	Well W-99 in P. R. J. Inv. Water level was 65.7 ft in 1940 with the pump shut down 5 minutes.
703	Cabot Corp. Estes Gaso- line Plt.	O. C. Reynolds	1937	265	12	A	-			T,E, 10	Ind	Owner's No. 1 well. Well W-101 in P. R. J. Inv. Casing: 12 1/2- in. to 228 ft; 10 3/4- in. 160-265 ft; perfo- rated 222-265 ft. 1/
* 704	do	do	1937	260	12	A			-	T,E, 10	Ind	Owner's No. 2 well. Well W-100 in P. R. J. Inv. Casing: 12 1/2- in. to 225 ft; 10 3/4- in. 177 to 260 ft; perforated 219-260 ft.
705	do	J. D. Cole	1955	205	8	А	2,638	99.2	Aug. 30, 1967	T,E, 10	Ind	Owner's No. 3 well. Casing perforated 149- 205 ft. 170 ft of 4-in. column pipe. Well is on stand-by status- seldom used.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

									R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-25-706	Cabot Corp. Estes Gaso- line Plt.	J. C. Cole	1966	280	10	А	2,640	112.2	Aug. 30, 1967	T,E, 20	Ind.	Owner's No. 4 well. Casing perforated 230- 280 ft. Gravel packed. 240 ft of 6-in. column pipe. 8-in. bowls. Reported tested at 525 gpm and had 34 ft of drawdown after 24 hours.
* 707	Transwestern Pipeline Co. Estes Compressor Sta.	Layne-Texas Co.	1960	220	6	A	2,634	104.8	Aug. 30, 1967	T,E,	Ind	Gravel packed. 6 5/8-in. casing to 220 ft, screened 195-215 ft. Development test by driller: 25 ft of drawdown pumping 34 gpm for 8 hours.
* 801	W. A. Estes	Nathe Fielding	1908	186	6	A	2,590	80 R	1908	N	N	Well W-93 in P. R. J. Inv. Called "Bledsoe Well." Abandoned in 1953. Reported water had sulfur taste. 1/
* 802	do	Kerr McGee Co.	1950	180	6	А	2,604	84.7	July 24, 1967	c,w	S	Drilled for rig supply 2-in. column pipe.
* 803	F. I. Dyer		old	90	10	А	2,580	36.7	July 25, 1967	c,W	S	Called "Bitter Well." Water is gyppy.
901	W. B. Morris	E. T. (Gene) Watkins	1944	68	10	A	2,583	39.49 40.66	Feb. 9, 1955 Dec. 30, 1967	N	N	Unused irrigation well. Not pumped since 1959. Current observations well. Reported top of redbeds (Triassic) at 65 ft. Casing perfo- rated 40-68 ft. 2/
902	do		1943	100		А		37.3	Dec. 5, 1959	N	N	Used for irrigation until 1954. Historical observation well. Destroyed.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

		1 Section 1991				1000	14	WATE	R LEVEL		Territoria.	SHORES TO BUILDING THE
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-25-90	D. L. Varnnum	Bishop Smith	1965	100	8	A		40.8	Apr. 27, 1967	T,E,	Irr	Casing perforated 80- 100 ft. Gravel packed. 95 ft of 4-in. column pipe. Pump was sucking air discharging an estimated 75 gpm 5-11-67.
* 90	Hutchings Joint Stock Assoc. (Frank Anthony)		old	76	5	А		60.6	May 11, 1967	c,w	S	Well W-334 in P. R. J. Inv. 3-in. column pipe.
* 90	M. McWorter	Nathe Fielding	1903	167	6	A	2,575	76.6	May 11, 1967	N	N	Well W-90 in P. R. J. Inv. Called "Kethley Well." Formerly used for domestic and live- stock supply. 1/
* 90	6 E. E. Cox	Buster Reed	1956	220	6	А	2,575	83.5	May 11, 1967	S,E,	D	Casing perforated 105- 220 ft. Pump set at 140 ft.
* 90	A. D. Freeman	John Woodfin	1965	126	6	A	2,573	51.2	May 12, 1967	S,E, 2	lrr /	Reported hard red shale at 116 ft (top of Triassic). First water sand at 60 ft (in alluvium). Second water sand at 120 ft (Triassic). Set and cemented 6-in. casing to 70 ft. Open hole 70-126 ft. 108 ft of 2-in. column pipe. Drawdown of 54 ft pumping 15 gpm for 2 hours 5-12-67. Irrigated 2 acres of barley in 1967.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-25-908	C. G. Myers	Buster Reed	1963	250	6	A	2,582	-		S,E	D,S	Water level was 73.9 ft below the surface 6-21-67 with well shut down 1/2 hour. Water reported not suitable for drinkinghas high sulfate content.
* 909	Montex Chemical Co.	do	1963	100	6	A		44.4	June 21, 1967	s,E, 3/4	Ind	Cased to 20 ft, open hole 20-100 ft. Dis- charged 11 gpm 6-21-67. Water has salty taste.
910	do	do	1962	300	6	A	2,582	56.3	June 21, 1967	S,E, 1 1/2	Ind	Cased to 115 ft, open hole 115-300 ft. Dis- charged 15 gpm 6-21-67. Specific conductance of water was 23,300.
* 911	do	do	1963	100	6	А	2,582	44.6	June 21, 1967	S,E, 3/4	Ind	Cased to 20 ft, open hole 20-100 ft. Dis- charged 15 gpm 6-21-67. Water is salty.
* 912	do	Gulf Oil Corp.	1957	1,750	5	Ps	2,582					Reported drilled as formation test in 1957. Set and cemented 8 5/8-in. casing to 92 ft, open hole 1,008-1,750 ft. Converted to injection well for recovering salt from the Salado Formation in 1963.
* 913	George Brown	Buster Reed	1961	200	8	А		44.8	Dec. 9, 1967	S,E,	D	Cased to 70 ft, open hole 70-200 ft.
26-101	Troy Hanson (Hanson Motel)	Frank Gaylon	1950	180	16	A	2,645	40.6	Apr. 8, 1967	T,E,	N	Casing perforated 90- 130 ft. Intends to irrigate pecan trees. Not used in 1967.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

			T .		I			WATE	R LEVEL				
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE MEASUR MENT	RE-	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-26-102	Sealy-Smith Foundation (Vest Ranch)	-	old	90	10	А	2,663	36.4	Apr.	6, 1967	C,W	s	Called "Demster Well." 80 ft of 2 1/2-in. column pipe.
* 103	J. H. Edwards and Sons	Gulf Oil Corp.	1945	150	10	A	2,665	47.3	May 1	5, 1967	S,E,	D,S	Headquarters well. Open hole 125-150 ft. Supplied water for drilling Gulf Oil Corp's. Edwards No. 1- E. oil test. 60 ft of 2-in. column pipe.
* 201	Monahans Sand Hills State Park		1900±	72		A	2,707	44.6	May 16	6, 1940	N	N	Formerly supplied rail- road section house. The section house was moved (now headquarters at Sand Hills Park) and the well was destroyed in 1957.
* 202	Sealy-Smith Foundation		old	80	10	Α	2,682	44.2	May 18	8, 1967	c,w	S	Called "Railroad Well." Reported water is good quality.
* 401	Frank Anthony	John Woodfin	1965	130	6	Α	2,622	51.7	May 15	5, 1967	S,E, 1	D	Ranch headquarters well. Cased to 80 ft, open hole 80-130 ft. Reported tested at 18 gpm (maximum capacity) for 1 1/2 hours when drilled.
* 501	do		old	80	6	Α	2,616	48.7	do	,	c,w	s	Section 18 well.
* 502	J. H. Edwards and Sons	Robinson Drlg. Co.	1954	124	6	A	2,643	56.4	do		c,w	S	Called "4-Section Well." Open hole 109- 124 ft.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-26-701	Lewis Rochester & J. E. Perkins		1955	213	18	А	2,560	44.22 57.90	Feb. 9, 1955 May 16, 1967	Т,G	Irr	Current observation well. Casing perforated 140-213 ft. Irrigated 415 pecan trees in 1967. Drawdown of 57 ft pumping 75 gpm for 14 hours, May 15-16, 1967.
702	702 C. J. Middleton Frank G	Frank Gaylon		933	16	Pr	2,561	45.2	May 12, 1967	N	N	Drilled to test Rustler Formation for irrigation. Bailed sample 5-12-67. Water contained 8,400 mg/l chlorides. Not suitable for irrigation and most other purposes.
* 703	M. E. Bingham		1963	150	5	Α	2,563	46.5	May 11, 1967	S,E, 1	D	Well had been pumping recently when water level was measured.
* 801	W. I. Winter		old	95	8	Α		42.9	do	c,W	S	Wooden tower.
* 901	J. H. Edwards and Sons	Shell Oil Co.	1950	165	6	А	2,589	40.8	do	c,W	S	Supplied water for drilling Shell Oil Co. Janelle Edwards, et. al. No. 1 oil test. Converted to livestock well. Equipped with 50 ft of 2 1/2-in. column pipe. Discharging 2 gpm 5-11-67.
33-101	Standard Oil Co. of Texas	Prince Bros. Drlg. Co.	1936	157	10	А	2,579	79.16 84.99	June 23, 1948 Dec. 30, 1967	N	N	Casing perforated 116- 157 ft. Formerly used for drilling rig supply. Current obser- vation well. 2/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL			The second of th
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-33-102	Gulf Oil Corp.	S. C. Ingham	1937	175	8	A	2,609	95.8 100.8	May 17, 1940 June 26, 1967	N	N	Well W-97 in P. R. J. Inv. Casing perforated 113-175 ft. Formerly supplied drilling rigs. Reportedly jetted 36 gpm from well in 1940.
* 103	Standard Oil Co. of Texas		1936	157	8	A	2,584	90.8	July 24, 1967	T,E, 20	Ind	McFarland water well No. 1. Casing perforated 116-157 ft. Water used to wash filters, engines, and for secondary recovery of oil.
* 104	Petr. Corp. of Texas	Moore & Russell Drlg. Co.	1955	360	10	А		101.2	Aug. 9, 1967	T,E, 15	Ind	Trebol Univ. "C" water well No. 1.
* 105	Sinclair Oil & Gas	Eastland Oil Co.	Before 1955	250		А		77	-	T,E, 7 1/2	Ind	Hathaway water well No. 1. Discharged 72 gpm 7-27-67.
* 106	Gulf Oil Corp.	W. E. (Bud) Tone	1963	303	8	A		95.8	July 25, 1967	S,E, 40	Ind	E. W. Estes water well No. 8. Casing perfo- rated 254-259, and 265- 291 ft. Gravel packed. Reported yield 260 gpm. Pumped for oilfield lease supply and live- stock water.
* 107	Texaco Inc.		1957	250	8	А		102 R	Sept. 1957	T,E, 15	Ind	State of Texas "C & E" water well No. 3. Casing perforated 175- 250 ft. Water used for secondary recovery of oil.
* 108	Bluford Thornton		1941	125	7	А		105.0	Dec. 12, 1967	S,E, 1 1/2	D,S	Ranch headquarters well. Estimated yield 15 gpm.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

Γ									WATE	R LEVEL			
	WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
3	YK-45-33-201	Humble Oil and Refg. Co.		1959	409	7	А	2,567	75.1	July 18, 1967	N	N	American National Bank water well No. 1. Formerly supplied water for secondary recovery of oil.
ş	202	do	W. E. (Bud) Tone	1961	300		Α				T,E, 25	Ind	Louis Richter water well No. 8. Reported tested at 248 gpm when drilled. 1/
Ą	203	do	do	1964	319	10	A		-		T,E, 25	Ind	Louis Richter water well No. 12. Casing perforated 224-319 ft. Gravel packed with 132 yards.
	204	do		1964	308	10	А	2,583	-		T,E, 25	Ind	Louis Richter water well No. 13. Casing perforated 208-308 ft. Reported tested at 575 gpm when drilled. Water level in abandoned well (Richter No. 7) 150 ft north was 91.4 ft below land surface 7-18-67.
*	205	Walsh & Watts Inc.			300		` A	2,600	105.4	July 18, 1967	T,E, 7 1/2	Ind	Louis Richter "C" water well,
*	206	Skelly Oil Co.	J. D. Cole		340	8	Α				T,E, 7 1/2	Ind	Hathaway water well No. 3. Reported tested at 88 gpm when drilled. 1/
*	207	Standard Oil Co. of Texas	Atwood-Clark Drlg. Co.	1954	295	13	A	2,610	104 R 108.6	Feb. 1954 July 24, 1967	N	N	Lucy Adams water well No. 3. Casing perfo- rated 81-144, and 207- 281 ft. Reported draw- downs of 30 and 66 ft. Pumping 170 and 248 gpm in 1954.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL				
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE O MEASURE MENT		METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-33-208	Standard Oil Co. of Texas	W. E. (Bud) Tone	1955	240	13	A	2,612	96 R	Mar.	1967	T,Ng	Ind	Lucy Adams water well No. 4 reported draw- down of 26 ft. Pumping 5000 barrels per day (146 gpm) for 3 months.
* 209	Richardson Oils	Owner	1953	352	10	A		90 R	June	1953	T,E,	Ind	Hathaway water well No. 6. Drilled 20-in. hole to 352 ft; Set 13 3/8-in. casing to 352 ft, slotted 224-352 ft; set 10 3/4-in. casing to 352 ft, slotted 226-351 ft. Placed 840 yds. of gravel between the wall of the well and 10 3/4-in. casing. Reported pumped 800 gpm for 5 hours and had 17 ft of drawdown; pumped 1,000 gpm for 5 hours and had 23 ft drawdown in June 1953. Reported pumped 70 million gallons for secondary recovery operations on the lease in 1966.
210	Harlan Prod. Co.	J. D. Cole	1957	210	8	A	2,575	79.6	Aug. 28,	1967	S,E,	Ind	W. H. Martin water well No. 1. Casing perfo- rated 140-170 ft. Packed with 10 yards of gravel. Set 175 ft of 2-in. column pipe. Used to supply secondary recovery operations through Mar. 1965. Not used since.
211	do	-	1953	127		Α		77 R 80.0	Sept. 18, Aug. 28,		S,E	Ind	Hathaway water well No. 1. Not used since Nov. 1961.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL		l T	
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-33-212	Sinclair Oil & Gas	J. D. Cole	1959	300	8	A	2,583	100.1	Aug. 28, 1967	S,E, 7 1/2	Ind	W. H. Martin water well No. 2. Casing: 10 3/4- in. to 185 ft, cemented; 8 5/8-in. to 300 ft; perforated 190- 300 ft. Reported bailed 60 gpm for 3 hours and had 40 ft drawdown when drilled. 1/
213	do	do	1959	320	10	A	2,585	95.2	do	N	N	W. H. Martin water well No. 1. Set and cemented 10 3/4-in. Cased to 160 ft open hole 160-320 ft. (Pulled 8-in. pro- duction casing).
* 214	do	W. E. (Bud) Tone	1960	330	8	A	2,565	74.1	do	S,E, 10	Ind	W. D. Johnson water well No. 1. Casing: 10 3/4-in. to 194 ft, cemented; 8 5/8-in. to 330 ft; perforated 194-223, and 256-298 ft. Tested by Dixon Pump & Equipment Co., 1-6-61. Drawdown of 40 ft pumping 135 gpm for 4 hours.
* 301	Henry Yates	do	1961	259	8	Α		46.0	July 5, 1967	C,E, 1/3	D	8-in. casing to 112 ft, cemented; open hole 112-259 ft. Set 100 ft of 2 1/2-in. column pipe. Reported discharged 3 gpm. 1/
* 302	W. A. Estes		old	117	6	A	2,560	54.6	July 18, 1967	N	N	Unused livestock well. Well W-94 in P. R. J. Inv.
* 303	Humble Oil & Refining Co.	-	1961	411	7	A				T,E, 10	Ind	American National water well No. 3. Reported discharge 21 gpm. 1/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL			Harrist Charles Charles
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-33-304	Humble Oil & Refining Co.		1961	405	7	А				T,E, 20	Ind	American National water well No. 4. Reported discharge 97 gpm. 1/
* 305	do		1961	400	7	А				T,E, 15	Ind	American National water well No. 5. Reported discharged 107 gpm in Feb. 1967. 1/
* 401	J. C. Cunningham	Clyde Wood	1963	250	12	A	2,586	99.3	June 23, 1967	T,Ng	Irr	Casing perforated 100- 250 ft. Set 220 ft of 8-in. column pipe. Drawdown of 37.4 ft discharging 555 gpm for 3 hours June 22, 1967.
* 402	Pan American Petr. Co.	Noll Drlg. Co.	1961	168	8	A		-		T,E	Ind	Byrd water well No. 1. 40 ft of perforated casing, interval not known. Gravel packed. Set 146 ft of column pipe. Discharged 25 gpm Aug. 22, 1967.
* 501	D. B. Durgin (Bluford Thornton)		1910	71	6	Α	2,541	46.88 52.94	Jan. 3, 1949 Dec. 30, 1967	c,w	S	Called "Shetland Well." Current observation well. $\underline{2}/$
502	Richardson Oils		1934	116	8	Α	2,562	68.27 75.74	Jan. 3, 1949 Dec. 30, 1967	c,w	N	Current observation well. 2/
503	Prince Bros. Drlg. Co.		old	170	5	Α	2,540	51.38	Jan. 24, 1954	N	N	Historical observation well. Obstruction in casing at 50 ft in 1967. Formerly supplied oilfield camp.
504	Standard Oil Co. of Texas		1948	157	9	Α	2,556	60.95 68.85	June 23, 1948 July 21, 1967	N	N	Durgin water well No. 1. Historical observation well. Casing perforated 120-150 ft. 2/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

r			1	1	T .			WATE	R LEVEL		I	
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-33-505	Standard Oil Co. of Texas	-	1948	157	9	A	2,558	61.95 70.10	June 23, 1948 July 21, 1967	T,E, 7 1/2	Ind	Durgin Water well No. 2. Historical observation well. Casing perforated 120-151 ft. Reported discharged 120 gpm in 1942. 2/
506	do		1948	157	9	A		58.83 67.67	June 23, 1948 July 31, 1967	N	N	Durgin water well No. 3. Historical observation well. Casing perforated 119-150 ft. 2/
* 507	Jack Moore	Bishop Smith	1963	230	12	A	2,584	98.0	June 23, 1967	T,G	Irr	Casing perforated 100- 230 ft. Drawdown of 34.3 ft pumping 685 gpm for 6 hours 6-23-67. Reported irri- gated 228 acres of maize and grass from this well and well YX- 45-33-401 in 1967.
508	Humble Oil & Refining Co.		1939	277	6	А	2,576	86.0	July 18, 1967	C,E	D	Louis Richter water well No. 5. Casing perforated 245-276 ft. Supplies lease house and shop. 1/
* 509	Prince Bros. Drlg. Co.	Owner		155	8	А	2,552			T,E, 7 1/2	Ind	Owner's No. 2 well. Casing: 12-in. to 73 ft, cemented; 8-in. to 155 ft; perforated 75- 155 ft. Reported yield 70 gpm.
510	do	do	1935	155	8	А	2,552	70.8	July 21, 1967	N	N	Owner's No. 1 well. Casing perforated 75- 155 ft.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

			Folking of property and the			Te manual i	1,000		WATE	R LEVEL			
WELL		OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-33-	511	Standard Oil Co. of Texas	Jap Harrell		190	10	A	2,550	73 R	Nov. 2, 1950	T,E, 25	Ind	Durgin water well No. 4. Casing perforated 90-184 ft. Gravel packed with 77 yards. Set 160 ft of 6-in. column pipe. Reported discharge 225 gpm. 1/
	512	do	Moore & Russell	1951	220	13	A	2,560	71.8	July 21, 1967	T,E, 25	Ind	Durgin water well No.
*	513	Richardson Oils	M. Z. Zimlock Co.	1937	275	8	А				T,Ng	Ind	Johnson "A" water well No. 2. Casing 8-in. to 208 ft; 6-in. 208-275 ft; perforated. 1/
*	514	do	R. C. (Dick) Murray	1951	223	13	A		70 R	1951	T,E, 30	Ind	W. D. Johnson 'B' water well No. 4. Casing perforated 161-223 ft. Packed with 45 yards of gravel. Set 217 ft of 4-in. column pipe. Reported discharged 240 gpm when drilled.
* !	515	Tidewater 0il Co.	W. E. (Bud) Tone	1952	311	16	A	2,587	90 R	1952	T,E, 10	Ind	W. D. Johnson "B" water well No. 4. Casing perforated 185-305 ft. Packed with 18 yards of gravel. Set 277 ft of 4-in. column pipe. Reported pumped 1,500 gpm for 24 hours and had 40 ft drawdown in 1952.
	601	Humble Oil ε Refg. Co.		1961	440	7	A	2,568	85.1	July 18, 1967	N	N	American National water well No. 6. Unused water-flood supply well.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

	Tell cultural control of			T				WATE	R LEVEL				
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)		E OF URE-	METHOD OF LIFT	USE OF WATER	REMARKS
YX-45-33-602	George R. Bentley			79	6	А	2,504	32.6	Aug.	4, 1967	c,W	S	4-in. column pipe. Discharging 5 gpm when sampled 7-19-67.
603	Standard Oil Co. of Texas	R. C. (Dick) Murray	1952	203	16	A		55 R	Feb.	1952	T,E, 20	Ind	Hardage and Wilson water well No. 1. Casing perforated 70- 90, 107-114, 117-130, 140-166, and 173-196 ft. Reported discharged 150 gpm in 1952.
604	Atlantic Pipe- line Co. Brillhart Sta.	E. T. (Gene) Watkins	1950	135	6	А					J,E	Ind	Company No. 2 well. Casing perforated 117- 120 and 132-135 ft. Reported discharge 18 gpm.
605	C. F. Kolp 0il Co.		old	94	6	А	2,550	67.0 69.5	May July	1, 1940 19, 1967	C,E	Ind	Well W-284 in P. R. J. Inv. Discharged 1/4 gpm 7-19-67.
606	Harlan Prod. Co.			82	6	А	2,537	49.2	July	19, 1967	N	N	Replaced well W-285 in P. R. J. Inv. Bailed water sample 7-19-67.
607	K. S. Green		1932	75	6	А	2,535	58.2	Aug.	28, 1967	N	N	Well W-278 in P. R. J. Inv. Reported "red clay" (redbeds) at 80 ft.
608	Maxwell Oil Co.	Dixon Pump & Equip. Co.	1960	100	6	A	2,564	75 R		1965	T,E,	Ind	F. G. Smith water well No. 1. Set 85 ft of 4-in. column pipe. Reported water is brackish but drinkable.
609	Cities Serv. Co.	C. & H. Drlg. Co.	1956	252	8	А	2,545	48 R		1948	T,E,	Ind	Grimes water well No. 1. Reported pumped 131 gpm and had 30 ft of drawdown in 1958. 1/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

			DATE	DEPTH	CASING	WATER-	ALTI-	ABOVE (+)	R LEVEL	METHOD	USE	
WELL	OWNER	DRILLER	COM- PLET- ED	OF WELL (FT)	DIAM- ETER (IN.)	BEAR- ING UNIT	TUDE OF LAND SURFACE (FT)	OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	OF LIFT	OF WATER	REMARKS
YX-45-33-701	Clayton Hughes	Clyde Word	1964	156	12	А	2,534	71.3	June 2, 1967	T,G	Irr	Casing perforated 60- 166 ft. Set 146 ft of 6-in. column pipe. Irrigated 150 acres of feed from 2 wells in 1967.
702	do	Chas. Miller	1965	153	14	А		53.6	do	T,G	Irr	
703	Paragon Corp.		1958	100	8	A		65 R	1967	T,E, 5	Ind	W. L. Moody water well No. 1. Set 75 ft of 3- in. column pipe.
* 704	Bolin Oil Co.	Owner	1959	200	8	A				T,E, 10	Ind	Wallace water well No. 1. Reported discharges 90 gpm. Water has salty taste.
705	Troy Eiland	K. Kimble Oil Co.	1960	127	16	A		50.8	June 22, 1967	N .	Ind	Drilled to 300 ft in 1960. Well was cleaned out to 127 ft in June 1967. Will supply water for drilling oil tests.
* 706	do		1962	300	16	A	2,484	37.4	Aug. 8, 1967	T,E, 25	Irr	Owner's No. 2 well. Casing perforated 50- 300 ft. Gravel packed. Set 230 ft of 8-in. column pipe. Drawdown of 114 ft pumping 275 gpm for about 30 days in 1967.
* 707	do		1958	210	16	А	2,490	41.8	June 8, 1967	T,G	Irr	Owner's No. 1 well. Drilled to 400 ft. Plugged back to 210 ft. Perforated casing 50- 210 ft. Gravel packed. Drawdown of 112 feet pumping 710 gpm for about 30 days in 1967. Irrigated 160 acres from 2 wells in 1967.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

		1	1	1				WATE	R LEVEL	I		
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-33-70	J. W. Andrews	-	1965	110	8	A		21.2	June 22, 1967	T,G	lrr	Set and cemented 8 5/8-in. casing to 90 ft. Open hole 90-110 ft. Owner reports first water sand was at 18 ft. Water was brackish and had H ₂ S odor. Irrigated 10 acres of garden in 1967.
* 709	Monroe Est.	Sid Richardson	old	62	6	А	2,500	25.3	Aug. 9, 1967	c,W	s	Well W-252 in P. R. J. Inv. Discharged 2 gpm 8-9-67.
710	Bob Randolph	Clyde Word	1962	230	16	A		28 R 32.5	1962 Aug. 9, 1967	T,G	lrr	Casing perforated 35- 350 ft. Gravel packed. Reported discharge 550 gpm. Irrigated 33 acres of sweet sue and coastal bermuda in 1967.
* 71	Bluford Thornton			93	6	А		55.4	Aug. 9, 1967	c,W	S	Discharged 2.4 gpm 8-9-67.
* 71:	Sunset Internat Petr. Corp.	. Ed Henderson	1957	127	9	A	2,490	38.2	Aug. 8, 1967	T,E,	Ind	G. Combs water well No. 1. Casing: 20-in. to 17 ft, cemented; 9 5/8- in. to 126 ft; perfo- rated 21-63, and 105- 114 ft.
* 71	do			2,583		Psr		Flows		N	N	John Miller No. 2 oil well. Flowing an estimated 20 gpm of sulfur water and oil 12-11-67. Oil is skimmed off and water is pitted.
* 80	Standard Oil Co. of Texas	Ingram Bros.	1934	130	8	А				C,E,	Ind	J. E. York water well No. 3. Water used for camp and lease supply. 1/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL					
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	MEAS	TE OF SURE- ENT		METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-33-802	W. E. Anderson	Kennedy & Ham	1952	220	16	Α		35 R 42.5	Aug.	6,	1952 1967	T,E, 30	Ind	Owner's No. 4 well. Casing perforated 40- 220 ft. Gravel packed. Set 90 ft of 10-in. column pipe, and 1 stage 13-in. bowl. Drawdown of 21 ft pumping 460 gpm for 44.5 hours in Aug. 1967.
803	Standard 0il Co. of Texas	Ingram Bros.	1953	95	6	Α	2,548	58.69 67.33	Mar. July	2, 21,	1949 1967	N	N	York water well No. 2. Formerly supplied gasoline plant. Current observation well. 2/
804	do	W. L. Theriac	1934	130	10	Α	2,547	67.25 68.90	Feb. July	7, 21,	1958 1967	N	N	York water well No. 5. Formerly supplied gaso line plant. Historical observation well. 1/
* 805	Atlantic Refining Co.	Frank Gaylon	1950	116	8	A	2,548	71 R			1960	S,E	Ind	W. D. Johnson water well No. 2. Drilled to 130 ft. Set 8 5/8-in. casing to 93 ft; open hole completion. Cleaned out to 116 ft in June 1951. Pumping test by owner in 1960: drawdown of 10 ft pumping 38 gpm for 30 minutes. Pumping level was 80.3 ft discharging 60 gpm 12-11-67. 1/
806	W. D. Johnson	-		115	7	А		64.45 69.99	Dec. Jan.	3, 10,		N	N	Historical observation well. Formerly used for domestic supply. Destroyed in 1956.
807	John Bennett	Blacky Caprito	1932	120	7	Α	2,555	61.31 67.20	Sept. Jan.	2,	1 9 50 1956	N	N	Historical observation well. Has obstruction at 20 ft.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

			T					WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
YX-45-33-808	John Bennett	Blacky Caprito	1932	103	7	А		61.60 61.70	Dec. 3, 1948 Mar. 2, 1949	N	N	Historical observation well. Formerly used for oilfield camp supply. Destroyed.
809	do	Farrell Oil Co.	1930's	116	6	А		58.86 69.65	Dec. 3, 1948 Aug. 6, 1967	N	U	Historical observation well. Not pumped since 1953.
810	Aaron Wilcox		1924	29	6	A	 -	20.04 14.82	Mar. 29, 1940 Dec. 24, 1940	N	N	Well W-255 in P. R. J. Inv. Historical obser- vation well. Formerly used to water live- stock and irrigate garden. Destroyed.
÷ 811	Standard Oil Co. of Texas	Moore & Russell	1951	220	13	А		61.2	July 21, 1967	T,E,	Ind	J. E. York water well No. 6. Set 180 ft of 6-in. column pipe. Reported drawdown of 21 feet pumping 400 gpm for 12 hours in Feb. 1951. Water tastes salty.
* 812	City of Grandfalls	Bradford Drlg. Co.	1946	140	15	А	2,503	28.7 25.9 41.3	Nov. 26, 1946 Nov. 30, 1947 Aug. 7, 1967	T,E, 25	Р	City well No. 5. Casing perforated 68-140 ft. Set 114 ft of 6-in. column pipe. Drawdown of 7.5 ft pumping 295 gpm for 1 hour 8-7-67.
813	W. E. Anderson	Moore & Russell	1947	169	20	Α	2,510	33.2 38.9 46.0	Apr. 30, 1947 July 2, 1949 Aug. 6, 1967	N	U	Owner's No. 1 well. Formerly used for irrigation. Casing perforated 99-159 ft. Reportedly pumped 500 gpm in 1947.
* 814	do	Bradford Drlg. Co.	1948	107	16	A	2,510	33.5 42.0	July 1, 1949 Aug. 6, 1967	T,E, 30	Irr	Owner's No. 2 well. Casing perforated 40- 107 ft. Set 80 ft of column pipe. Two stage 12-in. bowls.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

						and other		WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-33-815	W. E. Anderson		1950	240	16	A	2,510	44.8	Aug. 6, 1967	T,E,	D	Owner's No. 3 well. Casing: 16-in. to 240 ft; 12-in. liner to 240 ft. Top of perfo- rations at 40 ft. Dis- charged 46 gpm 8-13-67.
* 816	Sam Patterson	J. L. Gillette	1936	123	6	А	2,516	40 R	1940	S,E	D	Wcll W-260 in P. R. J. Inv. Formerly supplied Rio Bravo oilfield camp (Olcott water well No. 2). Casing perfo- rated 99-123 ft. 1/
bt 817	Aaron Wilcox	-	1922	25	48	А	2,487	19.3 22.7	Mar. 29, 1940 Aug. 8, 1967	N	U	Well W-254 in P. R. J. Inv. Dug to 35 ft. Curbed to 2 ft. Filled to 28 ft in 1940; 25 ft in 1967. Formerly used for domestic and livestock supply.
818	Forest Oil Corp.		1930's	106	7	А	2,546	61.4 73.4	May 1, 1940 Aug. 8, 1967	N	U	Well W-277 in P. R. J. Inv. Formerly used for oilfield supply.
819	do	Sidwell & Imler	1949	614	10	A	2,534	52.6 64.0	July 5, 1950 Aug. 2, 1967	N	U	A. B. Gordon water well No. 2. Casing perfo- rated 579-614 ft. Reported Gordon water wells 1 and 2 supplied the first secondary recovery operation in Ward County. Well No. 2 has not been used since 1950. 1/
820	do	Wilhite	1950	215	10	A		53 R	Aug. 1950	T,E, 50	Ind	A. B. Gordon water well No. 3. Replaced well No. 2. Casing perfo- rated 50-70, 80-105, 125-140 and 155-215 ft. Reported discharge 350 gpm in 1967. 1/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-33-821	Forest Oil Corp.	Frank Gaylon	1958	208	12	А	2,534	70 R	Mar. 1950	T,E,	Ind	A. B. Gordon water well No. 4. Casing: 20-in. to 45 ft, cemented; 18- in. to 87 ft; 12 3/4- in. to 208 ft; perfo- rated 53 to 208 ft. Reported pumps 11,500 barrels per day (335 gpm). Has pumped continuously since 1958. 1/
* 822	Atlantic Refining Co.	do	1951	135	8	A		-	-	S,E	Ind	W. D. Johnson water well No. 1. Open hole, interval not known. Pumping 70 gpm 12-11-67.
* 901	City of Grandfalls	Boyd Hopkins	1940	95	8	A		43.81	Jan. 2, 1951	N	N	City well No. 1 Well W-263 in P. R. J. Inv. Historical observation well. Casing was perfo- rated 55-95 ft. Well was abandoned and plugged in 1965 when water became salty.
* 902	do		1943	95	8	A		49.5	Apr. 26, 1967	N	N	City well No. 2. Abandoned, due to be plugged.
* 903	do	Tipton Drlg. Co.	1943	137	12	A		-		T,E, 7 1/2	P	City well No. 3. Reported drawdown of 35 ft pumping 200 gpm for 3 hours in July 1966.
904	Standard Oil Co. of Texas	Prince Bros. Drlg. Co.	1937	112	8	A	1-1	40.59 41.43	June 3, 1948 Jan. 2, 1951	N	N	Formerly supplied drilling rigs. Historical observation well. Filled to above water level in 1952.
905	Cities Service, et al.		1930's	105	7	A	2,521	38.06 50.33	Apr. 29, 1940 Apr. 22, 1967	N	N	Well W-265 in P. R. J. Inv. Historical obser- vation well. 2/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-33-906	Buckles & Hostetler			982	7	Pr	2,535	111.2	July 19, 1967	T,E, 20	Ind	Armstrong-Green water well No. 2. Cased to 787 ft, open hole 787- 982 ft in Rustlcr For- mation. Reported dis- charged 160 gpm in 1962
* 907	Handel Hall	John Woodfin	1964	90	5	Α	2,522	51.1	Apr. 26, 1967	S,E, 3/4	D	Casing perforated 65-90 ft.
* 908	City of Grandfalls	Tipton Drlg. Co.	1949	135	8	A				T,E, 7 1/2	Р	City well No. 4. Casing perforated 40-95 ft. Reported drawdown of 26 ft, pumping 200 gpm for 4 1/3 hours in July 1966.
* 909	Cities Service, et al.		old	31	6	А		9.2 11.8	June 6, 1940 Nov. 2, 1950	N	N	Well W-267 in P. R. J. Inv. Filled to 10 ft from surface in 1967. Residents in Grandfalls report that a spring flowed at this location during the early 1900's. The quality of water was reportedly much better than water pumped from wells in the town.
910	Texas & Pacific Oil Co.	Ed Henderson	1955	910	10	Pr	2,543	79.8	Dec. 11, 1967	N	N	James water well No. 1. Cased to 860 ft. Open hole 860-910 ft in Rustler Formation. Reported tested at 390 gpm in 1955.
911	do			128	7	A	2,526	47.2 54.5	May 1, 1940 Apr. 26, 1969	N	N	Well W-274 in P. R. J. Inv. Bailed sample of water 12-11-67.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

									R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-33-912	Forest 0il Corp.	Frank Robinson	1958	1,033	7	Pr	2,530	200 R 130 R	Feb. 1958 Feb. 1967	N	N	A. B. Gordon salt wate disposal well No. 1. Cased to 833 ft, open hole 833-1,033 ft in Rustler Formation 5 1/2-in. tubing. Packer set at 821 ft. Reported 44 million barrels (1,856 million gallons) of salt water was injected between Apr. 1958 and Dec. 31, 1967. Well-head injection pressures ranged from 40 to 95 psi. Well is acidized once or twice a year with 1,500 gallons of 15 percent HCL.
34-101	Chapman Rch.		old	79	5	A	2,511	49.4 55.6	Apr. 23, 1941 June 25, 1967	С,W	S	Well W-335 in P. R. J. Inv. Decline of 6.2 ft in water level since 1941 reflects pumping from Ozark-Mahoning well field 1 mile southeast.
102	do		0-2-11	122	6	Α	2,517	59.8	June 25, 1967	c,w	D,S	Supplies ranch head- quarters.
301	W. I. Winter		old	98	5	Α	2,556	41.2	May 11, 1967	c,w	S	Wooden tower; 2 1/2- in. column pipe. Dis- charged 4 1/2 gpm 5-11-67.
302	do			75	6	Α	2,564	47.5	June 28, 1967	c,w	S	Formerly supplied ranch house which has been abandoned.
401	Jack Richardson	W. E. (Bud) Tone	1950	100	16	A	2,500	44.68 48.66	Feb. 9, 1955 Oct. 21, 1967	N	N	Unused irrigation well. Historical observation well. Casing perforated 60-100 ft. 2/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL				
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE MEASU MEN	IRE-	METHOD OF LIFT	USE OF WATER	REMARKS
+YX-45-34-402	Texas State Highway Dept.	Henderson		155	8	А	2,532	55.13 58.63	Dec. Dec.	4, 1955 8, 1966	C,W	Р	Supplies roadside par Current observation well. Set 147 ft of 3 in. column pipe. 2/
403	Ozark-Mahoning Co.	S. C. Ingham	1937	86	8	A					N	N	Well W-339 in P. R. J Inv. Owner's well No. 216 casing perforated 69-86 ft. 1/
404	Jack Richardson		1950	94	10	Α		45.8	Dec.	5, 1959	N	N	Formerly used for irrigation. Not used since 1955. Casing perforated 60-94 ft.
405	Geo. R. Bentley			150		Α	2,539	70.49 71.34	Mar. Dec. 3	5, 1956 0, 1967	c,w	S	Current observation well. 2/
406	Ozark-Mahoning Co.	S. C. Ingham	1937	85		A	2,450	5.8	June 2	7, 1967	N	N	Owner's well No. 209. Well W-340 in P. R. J Inv. Cribbing to 35 f Perforated casing 35- 58 ft. Well is at eastern edge of Sodium Sulfate Lake. 1
407	do	W. E. (Bud) Tone	1964	110	6	A	2,453				C,E	Ind	Owner's well No. 580. Casing: 10-in. to 10 ft; 6 5/8-in. to 110 ft; perforated 20 to 110 ft. Well is on did crossing Sodium Sulfat Lake and is about 3 ft higher than lake level Pumping 3.6 gpm 10-1-67. Pumping level was 35.6 ft below top of casing. 1/
501	T. C. Barnsley	Delhi-Taylor Oil Corp.	1955	70	12	A	2,491	42.2	June 2	5, 1967	c,W	S	Drilled for rig supply Converted to livestock well in 1964. Replaced well YX-45-34-502 lo- cated 500 ft northwest

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

			1	T				WATE	R LEVEL				
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DAT	TE OF SURE- ENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-34-502	T. C. Barnsley		1940	86	6	A	2,492	39.1 41.8		23, 1941 25, 1967	N	N	Well W-297 in P. R. J. Inv. Abandoned in 1964
503	Ozark Mahoning Co.	R. C. (Dick) Murray	1954	98	8	А		45.2	June	20, 1967	S,E	Ind	Owner's well No. 387. Pumping 31 gpm 9-8-67. 1/
504	do	L. W. Pulley	1946	91	8	A		43 R 45.7	May June	1946 26, 1967	T,E	Ind	Owner's well No. 357. On stand-by status in 1967. Casing perforate 30-91 ft. 17
* 505	do	R. C. (Dick) Murray	1956	400	10	А		46.5	June	26, 1967	S,E	Ind	Owner's well No. 442. Cased to 83 ft; perforated 53-83 ft; open hole 83-400 ft. Drille reported only small seeps (1 quart per minute) from interval 83-400 ft. 1/
506	do	F. C. Ingham	1942	120	8	A					T,E,	Ind	Owner's well No. 312. Casing perforated 41- 95 ft; open hole 95- 120 ft. Driller reported water-bearing sands at intervals 57- 72 and 79-86 ft. Dis- charging 27 gpm 9-8-67. 1/
507	do	-	1949	94	8	A		45.1	June	26, 1967	N	N	Owner's well No. 366. Casing perforated 36- 94 ft. Gravel packed (4 yards). 1/
601	T. C. Barnsley	-	old	100	8	A	2,520	53.5	June	25, 1967	C,W	D,S	2008 10 14 20 P

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

				1					WATE	R LEVEL	T	1	
W	√ ELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45	5-34-602	T. C. Barnsley		1902	100	8	A				S,E 5	S	Well D-18 in Crane County report. Dis- charging 53 gpm 6-25-67. Reported pumped an estimated 55 gpm in June 1961. Water level recovered 10.5 ft with pump shut down for 15 minutes.
*	604	J. H. King	R. C. (Dick) Murray	1	102	6	А				C,W	D	Supplies ranch head- quarters. Open hole 20-102 ft.
*	701	Jess M. Wristen	Dugan	1945	102	6	А	2,500	65.2	July 20, 1967	C,W	S	Replaced well W-292 in P. R. J. Inv. at this location. Casing perfo- rated 62-102 ft.
*	702	Geo. Brandenberg	Texas-Mexico Petr. Co.	1932	136	6	A	2,529	85 R 86.6	Apr. 1940 Aug. 7, 1967	C,E	Ind	Water pumped for lease supply and household use. Reported depend- able supply but water is hard. Discharging 4.8 gpm 7-20-67.
	703	Sinclair Oil & Gas Co.	J. D. Cole	1957	656	10	Pr	2,530	140 R	Jan. 1957	T,E,	1nd	Shipley-Queen water well No. 1. Casing: 13 3/8-in. to 200 ft, cemented; 10 3/4-in. 196-640 ft; open hole 640-656 ft in Rustler Formation. Acidized with 2,000 barrels 15 percent HCl. Reported drawdown of 40 ft pumping 346 gpm for 5 hours in Jan. 1957. Reported pumps 270 gpm in 1967.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL					
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	MEAS	E OF URE-		METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-34-801	Jess M. Wristen	Miles & Beatty	1944	100	5	A	2,497	57.4 56.6	June June	21, 28,	1961 1967	S,E	S	Headquarters well. Casing perforated 60- 100 ft. Pump set at 70 ft. Reported dis- charge 30 gpm.
* 802	do		old	89	6	А	2,525	80.5 80.8	Mar. June	20, 28,	1940 1967	c,w	S	Well W-289 in P. R. J. Inv. Pumping 2.6 gpm 6-28-67.
803	do		1945	70	6	А	2,487	44.8	June	28,	1967	C,W	U	Replaced well W-291 in P. R. J. Inv. Casing perforated 40-70 ft. Reported well has not been used for several years.
* 41-101	lda M. Carr Well No. 1	Ben Glast		2,566	7	Psr		+			1967	N	N	Oil well. Cased to 2,525 ft. Open hole 2,525-2,566 ft in Seven Rivers Formation Flowing 24 gpm of oil and moderately saline water through 2-in. tubing 3-31-68. Oil is skimmed and water is pitted.
* 202	Consolidated P Prod. Co.	Burkholder Drlg. Co.	1960	301	8	A	2,443	20 R			1967	Т,Е	Ind	Viola Myers water well No. 1. Casing: 18-in. to 34 ft, cemented; 8 5/8-in to 301 ft; perforated 90-150 and 280-290 ft. Gravel packed. Set 275 ft of 3-in. column pipe. Reported discharge 50 gpm. Water is brackish.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

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				1				WATE	R LEVEL		The sales	
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-41-203	Porter & Sons Gravel Co.		1960	55	12	A		15.2	Aug. 8, 1967	T,E, 20	Ind	Supplies gravel plant. Driller reported soil and caliche to 5 ft; sand, gravel, and clay 5-65 ft; red beds below 65 ft. Pumping level was 26 ft discharging an estimated 250 gpm for 6 hours 8-7-67. Water level rose to 15.2 ft after well was shut down for 15 hours.
* 301	A. H. Adams, et al.		"1	62	8	Α	2,434	20.4	July 20, 1967	S,E	Ind	Pump disconnected when visited 7-20-67. Bailed sample of water.
302	Harlan Prod. Co.	Ambassador Oil		700	8	Pr	2,458	27.6	Aug. 16, 1967	N	N	Fort Worth National Bank water well No. 1. Drilled to 2,263 ft as oil test. Plugged back to 700 ft. Set 8 5/8-in. casing to 124 ft; open hole 124-700 ft. Log of oil test #8 located 100 ft north. Shows top of red beds (Permian-Triassic) at 40 ft; top of anhydrite (Rustler) at 680 ft; water-bearing oölitic limestone 680-690 ft (Rustler); and top of salt (Salado?) at 825 ft.
* 42-101	Texas Electric Serv. Co.		1937	58	8	A		13.00 20.40	June 12, 1940 May 9, 1967	T,E, 2	N	Well W-301 in P. R. J. Inv. Supplied cooling water for Grandfalls generating plant until it was shut down in 1947.

See footnotes at end of table.

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Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-42-102	R. R. Browning and J. T. Cox		1934	125	8	А	2,497	63.8	Apr. 26, 1967	S,E, 3/4	Р	Well W-271 in P. R. J. Inv. Pumps an estimated 15 gpm. Supplied 12 families in Royalty in 1967.
* 103	W. H. Sloan	E. D. Eaton	1940	146	8	A				N	N	Well W-295 in P. R. J. Inv. Test hole drilled for city of Grandfalls. Driller's log shows surface soil to 2 ft; caliche 2-30 ft; dry sand 30-85 ft; red rock (Permian-Triassic) 85-113 ft; water sand 113-142 ft; and red rock 142-146 ft. Set 146 ft of 8 1/4-in. casing; perforated 117-146 ft. Reported pumping 60 gpm 'would exhaust well.' Water quality deteriorated with time. Well was abandoned and plugged. 1/
* 104	Raymond Hill		1930's	50	6	A	-	27.9 26.9	Mar. 27, 1940 May 10, 1967	N	N	Well W-299 in P. R. J. Inv. Drilled to 78 ft; perforated casing 30- 78 ft. Sanded in to 50 ft in 1967.
* 105	J. J. Kenedy Prod. Co.	Seismograph Crew	1964	70	7	A	2,430	20.3	July 20, 1967	S,E, 5	Ind	Casing perforated 15- 70 ft. Water is injected into well tap- ping the Salado Form- ation for production of brine. Reported tops of Rustler and Salado Formations were at 630 and 850 ft respectively in the brine well (not inventoried).

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL			The page of the figure of the first of the f
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-45-42-106	J. D. Witcher	Lewis	1954	50	7	А		22.5	Aug. 16, 1967	c,w	D	Casing perforated 22-50 ft.
* 401	R. M. Ott, et al.		1936	14		А		9.9	Mar. 5, 1940	N	N	Well W-360 in P. R. J. Inv. formerly used for livestock supply. Destroyed.
402	Geo. Brandenberg	0wner	1966	52	16	A	2,429	22.4	Aug. 29, 1967	Т	Irr	Not used in 1967. Owner reports sand, soil, and caliche to 14 ft; hard pan 14-16 ft; gravel and sand 16-50 ft; red beds (Triassic) 50-52 ft. Casing perforated 20-52 ft. Reported pumped 850 gpm for 25 days in 1966. 1/
501	Chas. W. Potts	Marvin Russell	1938	80	6	А	2,426	9 R 22.54	1938 Nov. 6, 1967	N	N	Unused domestic and livestock well. Casing perforated 50-80 ft. Located 100 ft south of irrigation canal. 2/
502	Raymond Lindsey		old	14		A	S	10.70 9.60	Feb. 2, 1940 Dec. 29, 1942	N	N	Well W-309 in P. R. J. Inv. Dug to 14 ft at a location 50 ft north of irrigation canal. Destroyed. 2/
503	Mrs. E. J. Dorr		old	14		Α		12.0	May 15, 1941	N	N	Well W-310 in P. R. J. Inv. Dug to 14 ft. Destroyed.
504	R. D. Morris	-	1946	65	16	А	2,418	21.60 18.31	Apr. 26, 1967 Nov. 6, 1967	N	N	Unused irrigation well. Casing perforated 22- 65 ft. <u>2</u> /
					The same				MARIE III	85 Cure 100)		

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

									R LEVEL		4			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	MEAS	E OF URE-		METHOD OF LIFT	USE OF WATER	REMARKS
	R. D. Morris		1946	62	16	A	2,418	18.5 18.5	Oct. Nov.	1, 19 6, 19		T,E, 25	lrr	Casing perforated 22-6 ft. Set 56 ft of 8-in. column pipe. Pumped a metered 1,000 gpm for 9 1/2 hours and had 20 ft of drawdown in Apr. 1967. Irrigated 33 acres of bermuda grass in 1967.
* 506	J. D. Witcher	Clyde Word	1966	63	16	A		21.42 17.83	Apr. Nov.	27, 19 6, 19	67	T,E, 30	lrr	Casing perforated 24-6 ft. Set 65 ft of 8-in. column pipe. Discharge 1,100 gpm 4-29-67. Owner reports: Pecos River sand and gravel to about 60 ft with redbeds (Permian- Triassic) below. No water-bearing strata between the base of alluvium and top of Rustler (Permian) in this area. The water from the alluvial de- posits is moderately saline. However, because of the soils it can be used success- fully for irrigation sufficient water and fertilizer are applied
* 507	Eddie Mosley	do	1966	67	12	A		19.28 16.14	Apr. Nov.	27, 19 6, 19	67	T,E, 15	Irr	Casing perforated 20-ft. Discharged 700 gpt 4-29-67. Irrigates 5 acres of oats and barley with well and canal water in 1967.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

	T							WATE	R LEVE		1 1 2 4		The second secon
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DAT MEAS	TE OF SURE- ENT	METHOD OF LIFT	USE OF WATER	REMARKS
YX-45-42-508	John R. Williams	0wner	1966	65	16	А		18.56 15.57		27, 1967 6, 1967	N	N	Drilled for irrigation. Casing perforated 24- 65 ft. Not used in 1967. 2/
* 509	L. E. Wilcox	Clyde Word	1966	64	16	A	2,422	20.13 19.08	July Nov.	19, 1967 6, 1967	T,E, 15	Irr	Casing perforated 23-63 ft. Reported surface soil to 14 ft; and sand and gravel 14-62 ft. Top of redbeds at 62 ft. Set 55 ft of 8-in. column pipe. Irrigated 60 acres of oats and wheat with well and canal water in 1967.
* 510	W. R. Puckett	John H. Tipton	1965	60	15	A		15.1	Oct.	1, 1967	T,E, 15	Irr	Casing perforated 30-60 ft. Set 57 ft of 8-in. column pipe. Pumping 450 gpm 4-27-67. Irrigates 34 acres of grass.
* 511	Chas. W. Potts	A. Bradford	1940	57	6	А		12 R 22.0	May	1940 9, 1967	J,E,	D	Drilled to 80 ft. Cased to 55 ft. Filled to 57 ft in 1967.
512	Carpenter Farms	-	1950	56	16	А		19.35 17.69	May Nov.	6, 1967 6, 1967	N	N	Unused irrigation well. Casing perforated to total depth. $\underline{2}/$
513	A. H. Dunlap		1938	13		А		8.6	Dec.	6, 1940	N	N	Well W-314 in P. R. J. Inv. Dug well. Destroyed.
601	Hal Eudaly, Jr.	John H. Tipton	1949	64	16	Α	2,408	19.18 18.65	May Nov.	9, 1967 6, 1967	7.	N	Unused irrigation well. Casing perforated from surface to total depth. Reported top of redbeds (base of alluvium) at 62 ft. 1/ 2/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

Г		Territoria de la companya della companya della companya de la companya della comp		I	1				WATE	R LEVEL			1	
	WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DAT	TE OF SURE- ENT	METHOD OF LIFT	USE OF WATER	REMARKS
Y	x-45-42-602	Hal Eudaly, Jr.	John H. Tipton	1950	64	16	A		19.8	May	9, 1967	T,G	N	Unused irrigation well. Casing perforated 20- 64 ft. Reported dis- charged 1,650 gpm in 1966. 1/
	603	do	Great Basin Petr. Co.		1,695	5	Pr?	2,412	+1	May	15, 1940	N	N	Well W-312 in P. R. J. Inv. Drilled as oil test "Eudaley No. 1." Flowing 1/4 gpm over top of casing 3-15-40. Destroyed.
	702	Atlantic-Dorr Well No. 3	Sahara-Crandal Oil Co.	1	2,087		?	2,417	18.5	May	9, 1967	N	N	Abandoned oil test. 4 ft of 22-in. casing. Open hole below 4 ft.
	801	F. M. White Well No. 4	Jameson, et al.	1943	4,000		Pc?	2,423				N	N	Oil test. Reported flowing 50-60 gpm when drilled. Water had $\rm H_2S$ odor. Was used to irrigate small garden. Destroyed.
*	802	Signal Oil & Gas Co.		1963	491	8	Pr	2,410	38.8	May	9, 1967	T,E, 7 1/2	Ind	Casing perforated 440-454 ft in Rustler Formation. Acidized with 1,000 barrels 15 percent HCl. Water used for secondary recovery of oil. Has salty taste.
	803	L. E. Wilcox		1938	10		Α	2,422	8.9	May	15, 1941	N	N	Well W-316 in P. R. J. Inv. Destroyed.
*	46-21-701	Mobil Oil Co.	Lang Buchanan	1939	105	6	A	2,715	91.3	Dec.	28, 1942	N	N	Well W-1 in P. R. J. Inv. Formerly used for livestock supply. Filled to above water level in 1967. 1/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

OWNER	DRILLER	DATE	DEPTH					R LEVEL					
	DATECH	COM- PLET- ED	OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	MEAS	TE OF SURE- ENT		METHOD OF LIFT	USE OF WATER	REMARKS
obil Oil Co.	Buffalo Drlg. Co.	1965	286	10	А						T,E,	Ind	Twofreds unit, Tr. 4. Water well No. 1.
do	do	1963	228	10	A	2,720	100 R	Feb.	1	963	T,E, 20	Ind	Twofreds unit, Tr. 8. Water well No. 1. Set 200 ft of 4-in column pipe and 18 stages of 8-in. bowls. Development test, by Dixon Pump and Equipment Co. 2-26-63: drawdown of 96 ft pumping 175 gpm for 6 hours.
. C. Dunagan Est.	Clyde Simmonds	1941	137	7	А	2,695	81.9 86.2	Mar. Oct.	26, 19 4, 19	941	C,W	S	Well W-224 in P. R. J. Inv. Open hole 4-137 ft. Top of redbeds at 18 ft on driller's log. 1/
do	do	1939	97	5	А	2,702	74.1 77.4	Oct. Oct.	25, 19 4, 19	939	C,W	S	Well W-4 in P. R. J. Inv. Casing perforated 91-97 ft.
. W. Anderson Rch.		1939	176	6	А	2,704	79.4	Sept.	28, 1	967	c,w	S	North "Harville Well." Reported seldom used weak supply.
do	Lang Buchanan	1939	176	6	A	2,705	59.7		do		c,w	S	South "Harville Well." Open hole 20-176 ft. Wells are in playa (or sink) on upland surface.
	do C. Dunagan Est. do W. Anderson Rch.	C. Dunagan Est. do do W. Anderson Rch.	Co. do do 1963 C. Dunagan Clyde Simmonds 1941 Est. do do 1939 W. Anderson 1939 Rch.	Co. do do 1963 228 C. Dunagan Clyde Simmonds 1941 137 Est. do do 1939 97 W. Anderson Rch 1939 176	Co. do do 1963 228 10 C. Dunagan Clyde Simmonds 1941 137 7 Est. do do 1939 97 5 W. Anderson Rch.	Co. do do 1963 228 10 A C. Dunagan Clyde Simmonds 1941 137 7 A Est. do do 1939 97 5 A W. Anderson Rch.	C. Dunagan Clyde Simmonds 1941 137 7 A 2,695 Est. do do 1939 97 5 A 2,702 W. Anderson Rch.	C. Dunagan Clyde Simmonds 1941 137 7 A 2,695 81.9 86.2 do do 1939 97 5 A 2,702 74.1 77.4 W. Anderson Rch. 1939 176 6 A 2,704 79.4	C. Dunagan Clyde Simmonds 1941 137 7 A 2,695 81.9 Mar. Est. do do 1939 97 5 A 2,702 74.1 Oct. 77.4 Oct. W. Anderson 1939 176 6 A 2,704 79.4 Sept.	Co. do do 1963 228 10 A 2,720 100 R Feb. 19 C. Dunagan Clyde Simmonds 1941 137 7 A 2,695 81.9 Mar. 26, 19 Est. do do 1939 97 5 A 2,702 74.1 Oct. 4, 19 W. Anderson 1939 176 6 A 2,704 79.4 Sept. 28, 19	C. Dunagan Clyde Simmonds 1941 137 7 A 2,695 81.9 Mar. 26, 1941 86.2 Oct. 4, 1967 do do 1939 97 5 A 2,702 74.1 Oct. 25, 1939 Oct. 4, 1967 W. Anderson Rch 1939 176 6 A 2,704 79.4 Sept. 28, 1967	C. Dunagan Clyde Simmonds 1941 137 7 A 2,695 81.9 Mar. 26, 1941 C,W 86.2 Oct. 4, 1967 C,W do do 1939 97 5 A 2,702 74.1 Oct. 25, 1939 C,W W. Anderson Rch.	C. Dunagan Clyde Simmonds 1941 137 7 A 2,695 81.9 Mar. 26, 1941 C,W S 86.2 Oct. 4, 1967 C,W S Oct. 4, 1967 C,W S W. Anderson Rch.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

		Tall		T				WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-23-902	R. B. Leck	J. D. Cole	1956	225	16	A	2,692	108.25 108.92	Dec. 5, 1959 Dec. 30, 1967	S,E	Irr	Current observation well. Casing perforated 145-225 ft. Set 185 ft of 4-in. column pipe. Drawdown of 21 ft pump-160 gpm for 1 hour 9-13-67. Supplies house, waters stock, and irrigates 4 acres of orchard and 3 acres of pasture in 1967. 2/
* 904	904 do	do	1956	300	16	A	2,687	107.24 109.30	Oct. 7, 1956 Sept. 12, 1967	T,Ng	lrr	Well G-166 in Winkler County report. Historical observation well. Set 185 ft of 8-in. column pipe. Drawdown of 32 ft pumping 440 gpm for 17 hours in Sept. 1967. Reported irrigated 33 acres of feed, 10 acres vegetables, 12 acres alfalfa, and 92 acres of cotton in 1967. 2/
* 905	Fay and Lula Hogg	-	1938	125	6	А	2,690	108.4 109.1 109.2	Aug. 23, 1940 Oct. 16, 1956 Sept. 12, 1967	C,W	S	Well W-41 in P. R. J. Inv. Well G-167 in Winkler County report.
	City of Monahans	Layne-Texas Co.	1957	386	4	A	2,697	117.43 123.89	June 7, 1957 Dec. 14, 1967	N	N	Test hole 2-A. Not completed as water well. Historical observation well. Casing perforated 183-188, 256-261, 280-285, 302-307, 327-332, 352-357, and 376-381 ft.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

			1					WATE	R LEVEL	1 1 1 1 1 1 1 1 1 1		
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-24-702	City of Monahans	Layne-Texas Co.	1959	395	12	A	2,697	119 R	July 1969 June 1957	T,E,	P	City well No. 4-3. Drilled and logged to 404 ft. Plugged back to 395 ft. Set and cemented 20-in. casing to 185 ft. Underreamed to 30-in. hole from 185 to 395 ft. Set 12 3/4-in. casing to 395 ft. Perforated 185-280, 290-340, 350-375 and 378-383 ft. Packed 60 yards of gravel outside 12-in. casing. Pumping tests by driller 6-18-59: drawdown of 125 ft pumping 1,000 gpm for 12 hours. Drawdown of 86 ft pumping 713 gpm for 11 hours. 1/ City well No. 4-1. Dri Drilled and logged to 386 ft. Set 12 3/4-in. casing to 385 ft. Perforated 182-385 ft. Pumping test by driller June 7-8, 1957: drawdown of 35.8 ft pumping 500 gpm for 24 hours. 1/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-24-704	City of Monahans	Layne-Texas Co.	1957	392	12	A	2,694	116 R 121.7	May 1957 Dec. 14, 1967	T,E,	P	City well No. 4-2. Drilled and logged to 519 ft. Plugged back to 392 ft. Set and cement- ed 20-in. casing to 19 ft. Underreamed to 30- in. hole from 191-392 ft; Set 12 3/4-in. casing to 392 ft with shutter screens 200- 290, 294-314 and 324- 384 ft. Packed 65 yards of gravel outside 12- in. casing. Pumping test by driller 4-14- 67: drawdown of 64 ft pumping 1,220 gpm for 34 hours. Well was pumping 830 gpm 4-14- 67. Water level rose 35 ft with well shut down 55 minutes. 1/
* 705	do	Dixon Pump and Equip. Co.	1965	387	14	A		118.3	Apr. 14, 1967	T,E,	P	City well No. 4-4. Drilled and logged to 399 ft. Plugged back to 387 ft. Set and cemented 20-in. casing to 177 ft. Set 14-in. casing to 387 ft with shutter, screens 232-382 ft. Gravel packed. Set 238 ft of 8-in. column pipe and 6 stags 8-in. bowls. Pumping test by driller Feb. 21-22, 1965; drawdown of 47 ft pumping 1,000 gpm for 36 hours. Pumped 920 gpm for 1 hour and had 38.2 ft of drawdown 4-14-67. 1/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

		That ha	1	T				WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-24-706	Fay & Lula Hogg		old	142	6	А		112.4	Aug. 31, 1967	c,w	S	Well W-43 in P. R. J. Inv.
* 801	Gulf Oil Corp.	J. R. Marshall	1938	216	8	A	2,722	144.90 152.85	Mar. 28, 1957 Aug. 31, 1967	N	N	O'Brien water well No. 18. Well W-44 in P. R. J. Inv. Well G-173 in Winkler County report. Casing perforated 164- 216 ft. Driller report- ed water sand 162-211 ftunable to bail water level down. Pump- ed 440 barrels in 2 hours (115 gpm) when drilled. Decline in water level of 7.95 ft since 1957 reflects pumping from city of Monahans Hogg Ranch well field. 1/
* 802	G. W. O'Brien Est. (Jack O'Brien)		1938	149	6	Α	2,707	135.95 137.87	Mar. 6, 1956 Dec. 30, 1967	c,W	S	Well W-45 in P. R. J. Inv. Current observation well. $\underline{2}$ /
803	Texas Elec. Serv. Co.		1955	242	16	А	2,706	130.49 136.70	Mar. 6, 1956 Aug. 31, 1967	N	N	Unused irrigation well. Historical observation well. Decline in water level of 6.33 ft since 1956 reflects pumping from city of Monahans well field. 2/
÷ 804	Al & Sam Ares		1957	225	8	A	2,721	145.3	Aug. 31, 1967	N	N	Magnolia-Sealy water well No. 1. Formerly supplied water for secondary recovery operations. Bailed sample of water from well 12-14-67.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
YX-46-24-805	Geo. Sealy Est.	-	1937	180	7	Α	2,721	142.2	Aug. 31, 1967	C,W	S	Well G-171 in Winkler County report. Well wa formerly used for leas supply by the McQueen and Stout Drlg. Co.
806	Texas Elec. Serv. Co.	Layne-Texas Co.	1955	469		Α	2,696	-		N	N	Drilled and logged to 469 ft as test hole B-3. Not completed as water well. Destroyed.
807	Gulf Oil Corp.			4,500	13	Pc	2,710	66.1	June 7, 1967	N	N	O'Brien water supply well No. A-2.
808	do			4,141	13	Pc	2,708			T,E, 100	Ind	O'Brien water supply well No. A-3.
809	do		1960	4,500	13	Pc	-	70.1	June 7, 1967	N	N	O'Brien water supply well No. A-5. Casing: 20-in. to 526 ft, cemented with 625 sacks; 13 3/8-in. to 1,013 ft; and 9 5/8-in 1,013 to 3,441 ft, cemented with 1,900 sacks. Open hole 3,441 to 4,500 ft in Capitan reef.
810	do		1961	4,500	13	Pc	2,715	-		Cf,E, 7 1/2	l nd	O'Brien water supply well No. A-6. Casing: 20-in. to 519 ft, cemented with 500 sacks; 13 3/8-in. to 1,000 ft; and 9 5/8-in. 1,000-3,445 ft, cemented with 2,100 sacks. Open hole 3,445-4,500 ft in Capitan reef.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

			1	1		Ī		WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
YX-46-24-811	Gulf Oil Corp.		1961	4,500	13	Pc	2,700			T,E,	Ind	O'Brien water supply well No. A-7. Casing: 20-in. to 517 ft, cemented with 500 sacks; 13 3/8-in. to 1,000 ft; and 9 5/8-in. 1,000-3,485 ft, cemented with 1,500 sacks. Open hole 3,485-4,500 ft.
812	do		1961	4,300	13	Pc	2,713	60.0	June 7, 1967	N	N	O'Brien water supply well A-9. Drilled to 4,470 ft; plugged back to 4,300 ft. Casing: 20-in. to 516 ft, cemented with 400 sacks; 13 3/8-in. to 1,000 ft; and 9 5/8-in. 1,000 to 3,425 ft, cemented with 2,100 sacks. Open hole 3,425-4,300 ft.
813	do			4,500	13	Pc	2,718	66.7	do	N	N	O'Brien water supply well No. A-9.
814	do	-	1962	4,400	13	Pc	2,725			T,E,	Ind	O'Brien water supply well No. A-10. Casing: 20-in. to 577 ft, cemented with 450 sacks; 13 3/8-in. to 980 ft; and 9 5/8-in. 980 to 3,531 ft, cemented with 1,805 sacks. Open hole 3,531-4,400 ft.
* 901	do		1936	300	8	A	2,663	85.2	Aug. 31, 1967	N	N	O'Brien water well No. 13. Cased to 121 ft; open hole 121-300 ft. Reported pumped 935 barrels in 24 hours (27 gpm) in Apr. 1936.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

									WATE	R LEVE					HATTER THE THE THE THE THE
	WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DAT MEAS	TE OF SURE- ENT		METHOD OF LIFT	USE OF WATER	REMARKS
Y	X-46-24-902	G. W. O'Brien Est. (Jack O'Brien)		1939	127	5	А	2,700	112.57 111.71	Mar. Dec.	6, 30,	1956 1967	N	N	Current observation well. Well G-176 in Winkler County report.
*	903	Richardson Oils	-	1930's	180	7	А				-2		C,E,	D	Supplies oilfield lease house. Set 160 ft of 2 1/2-in. column pipe. Discharging 4.8 gpm 8-31-67.
*	29-101	J. C. Dunagan Est.		1967	103	4	А	2,695	90.1	Oct.	17,	1963	C,W	S	
*	102	do			45	6	Α	2,632	17.2	Feb.	19,	1967	C,W	S	
*	103	do	Rector 0il Co.	1933	60	6	А	2,641	35.6 34.8	Apr. Oct.			c,w	S	Drilled for rig-supply. Well W-3 in P. R. J. Inv.
*	201	do		old	92	6	А	2,670	58.2	Apr.	19,	1967	S,E, 1/3	D,S	Well W-6 in P. R. J. Inv. South well at ranch headquarters. Casing perforated 90- 92 ft. Discharging 12 gpm 4-19-67.
*	202	do		old	86	8	A	2,670	57.0 58.9	Dec. Oct.	5, 4,	1940 1967	C,W	D,S	Well W-5 in P. R. J. Inv. North well at ranch headquarters. Well was reportedly tested at 50 gpm with- out sucking air.
*	203	do		old	68	8	A	2,649	53.3 54.0	Oct. Mar.			c,w	S	Well W-8 in P. R. J. Inv. Obstacle in casing at 45 ft in 1967.
*	301	do	-	old	144	6	A	2,692	128.4 125.1 128.4	Oct. Jan. Oct.	24, 1	1950	C,W	S	Well W-20 in P. R. J. Inv.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

					T	Π			WATE	R LEVEL			
	WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX	x-46-29-302	J. C. Dunagan Est.	Clyde Simmonds	1941	176	6	A	2,747	136.9 137.3 139.6	Apr. 15, 1941 Jan. 24, 1950 Apr. 20, 1967	c,w	S	Well W-226 in P. R. J. Inv. Well is on Triassic outcrop cover- ed with veneer of wind- blown sand. Reported drill cuttings were "largely fine-grained red sand and deep pur- plish red clay with scattering of small selenite crystals."
*	401	Burkholder Bros.	Holder Water Well Serv.	1966	60	6	А	2,624	37.54	Apr. 20, 1967	C,W	S	Casing perforated 40- 60 ft. Driller reported caliche to 38 ft, clay and gravel 38-46 ft, and sand and gravel 46- 60 ft.
*	402	do	Rector Oil Co.	1933	100	6	A	2,624	29.79 37.94	Nov. 6, 1939 Oct. 17, 1967	N	N	Well W-11 in P. R. J. Inv. Drilled for rigsupply. Converted to livestock well. Abandoned and replaced by well YX-46-29-401 in 1941. Obstacle in casing at 40 ft in 1967. 2/
*	501	John G. Burkholder			75	6	A	2,629	46.6	Apr. 21, 1967	C,W	S	Drilled to replace well W-17 in P. R. J. Inv. which was at this loca- tion. Water level in W-17 was 40.6 ft below land surface in 1940.
	502	C. L. Monroe Est.	Clyde Simmonds	1936	125	6	A	2,642	47.05	Oct. 25, 1939	N	N	Well W-16 in P. R. J. Inv. Historical obser- vation well. Destroyed.
	503	do	-	1929	71	6	A	2,656	59.40 63.32	Nov. 6, 1939 Oct. 17, 1967	N	N	Well W-12 in P. R. J. Inv. Historical obser- vation well. 2/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

										R LEVE					
W	ELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE * OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	MEAS	TE OF SURE- ENT		METHOD OF LIFT	USE OF WATER	REMARKS
YX-46	5-29-504	Hissom Drlg.	0wner	1957	64	6	A	2,605	23.1	Oct.	17,	1967	N	N	Formerly supplied drilling rigs.
	601	J. C. Dunagan Est.		1941	100	6	А	2,640	50.1 52.2	May Aug.	14, 8,	1941 1949	C,W	S	Well W-227 in P. R. J Inv.
	602	Landa Oil Co.		1965	48	6	A	2,573	15.1	Oct.	17,	1967	N	N	Formerly supplied drilling rigs. Bailed sample of water 10-17-67.
•	701	M. I. Vida Farms, Inc.	Lang Buchanan	1940	115	16	A	2,600	4.69 15.66	Sept. Oct.			T,E, 20	==	Well W-174 in P. R. J Inv. Unused irrigation well. Drawdown of 16.: ft pumping 1,300 gpm for 25 days in Sept. 1941. Current obser- vation well. 2/
	702	Ward Co. Irr. Dist. No. 1	C. C. & H. Drlg. Co.	1946	186	16	А	2,592	13.73 20.48	Sept. Dec.	30,	1946 1967	N	N	Dist. well No. 8. Dis charged 1,350 gpm in Oct. 1946. Current ob servation well. 1/2/
	703	U-Bar Land & Cattle Co.		old	9		A	2,604	4.27	Aug.	11,	1941	N	N	Historical observation well. Destroyed.
	704	M. I. Vida Farms, Inc.			54	4	A	2,610	7.90 17.98	Sept. Oct.			N	N	Historical observation well. Well W-182 in P. R. J. Inv. Former Pused for watering livistock. 2/
	705	do	C. C. & H. Drlg.	1946	152	14	A	2,601	15.01 20.70	Oct. Oct.	28, 18,	1946 1967	N	N	Unused irrigation wel Casing perforated 52- 152 ft. Drawdown of 16.2 ft pumping 1,430 gpm for 3 days in 194 2/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

					1		T		WATE	R LEVEL				
WELI	L	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	'	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-2	29-706	Ward Co. Irr. Dist. No. 1	C. C. & H. Drlg.	1946	162	16	А	2,591	11.36 16.80	Sept. 30, Oct. 18,	1946 1967	N	N	Dist. Well No. 9. Casing: 16-in. to 67 ft, perforated liner 51 to 162 ft. Reported pumped 1,650 gpm in 1946. Not used since 1946. 1/2/
*	707	M. I. Vida Farms, Inc.	Leonard Schooler	1947	165		۸	2,607	28.0 19.9	Apr. 24, Oct. 18,		N	N	Unused irrigation well.
*	708	Ward Co. Irr. Dist. No. 1	C. C. & H. Drlg. Co.	1946	195	16	А	2,592	9.24 14.19	Sept. 30, Oct. 18,	1946 1967	N	N	Dist. well No. 10. Historical observation well. Reported discharged 700 gpm in Oct. 1946. 2/
*	709	M. I. Vida Farms, Inc.	Hopper	1926	59	16	А	2,610	14.78	Dec. 5,	1940	N	N	Historical observation well. Destroyed.
	710	do		10	198	16	Α	2,611	26.7 22.3	Apr. 24, Oct. 18,	1967 1967	N	N	Unused irrigation well.
	711	do	C. C. & H. Drlg.	1948	400	16	Α	2,613	26.5	Oct. 18,	1967	N	N	Do.
*	712	do	do	1947	165	16	A	2,600	18.0 14.2	Apr. 24, 0ct. 18,		T,G	Irr	Casing: 20-in. to 80 ft, perforated 15-80 ft; 16-in. liner to 165 ft, perforated 70-165 ft. Irrigated 115 acres of cotton from this well and well YX-46-29-717 in 1966. 1/
	713	do			155	18	A	2,600	26.5 18.5	Apr. 25, 1 Oct. 18, 1	1967 1967	N	N	Unused irrigation well.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

				1				WATE	R LEVEL					
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DAT	E OF SURE-		METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-29-714	M. I. Vida Farms, Inc.	C. C. & H. Drlg. Co.	1948	158	20	А	2,599	23.9 16.4	Apr. Oct.	25, 18,	1967 1967	T,G	Irr	Casing: 20-in. to 69 ft, perforated 10-69 ft; 18-in. perforated liner 59-158 ft. Set 100 ft of 10-in. column pipe with 2 stages of 14-in. bowls. Reported pumped 3 weeks in 1966. Not pumped in 1967.
715	do			150	18	А	2,590	15.4	Mar.	5,	1950	N	N	Unused irrigation well.
716	do			150	18	Α	2,590	16.8		do		N	N	Do.
717	do			150	18	A	2,603	21.8 17.1	Apr. Oct.	24, 18,	1967 1967	T,G	Irr	
* 718	Edith Jenson	Lang Buchanan	1940	50	6	Α	2,597	5.4 14.3	Sept. Oct.	9, 18,	1941 1967	S,E	S	Well W-187 in P. R. J. Inv. Casing perforated 40-50 ft. Irrigates garden and waters live- stock. Not used for drinking.
719	M. I. Vida Farms, Inc.	C. C. & H. Drlg.	1947	360	16	А	2,613	17.5	Oct.	18,	1967	N	N	Unused irrigation well.
720	do	do	1947	180	16	А	2,612	16.9		do		Т	N	Do.
* 721	do		old	18	6	Α	2,597	5.3 15.4	Aug. Oct.	29, 18,	1939 1967	N	N	Unused livestock well. Well W-171 in P. R. J. Inv.
801	R. Burkholder	J. H. Hardaway	1946	130	20	A	2,597	17.70 25.34	Nov. Dec.	25, 1,	1946 1967	N	N N	Drilled for irrigation but reported insufficient supply (400 gpm). Current observation well. 2/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

				1				WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-29-802	O. C. Majors Est.	C. C. & H. Drlg. Co.	1947	162	16	А	2,598	23.6 15.6	Apr. 26, 1967 Oct. 18, 1967	T,G	N	Unused irrigation well. Casing: 20-in. to 38 ft, perforated; 16-in. to 162 ft, perforated 50-162 ft.
803	do	Lang Buchanan		115	6	A	2,596	7.0	Aug. 11, 1941	N	N	Well W-170 in P. R. J. Inv. Owner reported good livestock water from "quicksand" at 115 ft, but supply was weak. Strong supply at 60 ft but quality was bad. Obstruction in casing at 7 ft in 1967.
* 804	do	C. C. & H. Drlg.	1946	153	14	A	2,596	16.9 28.1	Oct. 30, 1946 Apr. 26, 1967	T,G	N	Unused irrigation well. Casing perforated 70-130 ft; open hole 130-153 ft. Reported 48 ft of drawdown pumping 1,550 gpm for 7 hours in 1946. Drawdown of 24.2 ft pumping 960 gpm for 1 hour in Apr. 1947.
* 805	Ralph Burkholder		1930	73	6	A	2,593	16.0 22.7	Oct. 23, 1939 Oct. 18, 1967	c,w	S	Well W-167 in P. R. J. Inv. Reported "small springs of mineralized water 1/2 to 3/4 mile east of well" in 1939.
901	R. W. & J. G. Burkholder		old	23	-	A		18.62	Dec. 28, 1942	N	N	Well W-168 in P. R. J. Inv. Historical obser- vation well. Dug to 23 ft and cribbed 4 ft in diameter. Destroyed.
* 902	B. J. Pevehouse		 	57	4	A	2,561	+0.6 +0.6 4.5	Aug. 8, 1949 Mar. 23, 1950 Apr. 22, 1967	C,W	S	Flowed small quantities of water in 1949 and 1950. Well is near south end of Soda Lake.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-29-903	Atlantic Refg. Co.	Dixon Pump & Equip. Co.	1966	190	9	A	2,569	14 R	Jan. 1966	\$,E 25	Ind	Quito unit water supply well. Casing perforated 140-190 ft. Reported pumped 410 gpm for 21 hours and had 44 ft of drawdown in Jan. 1966. Drawdown of 26 ft pumping 4 million barrels during 18 months in 1966 and 1967. 1/
904	do	Mesa-Noll Drlg. Co.	1965	204	9	Α	2,568	12.6 14.0	Apr. 26, 1967 Oct. 17, 1967	N	N	Casing perforated 170- 204 ft. Reported tested at 400 gpm when drilled.
* 30-101	J. C. Dunagan Est.			235	6	А	2,717	159.2 162.2 162.0	Aug. 8, 1949 Mar. 23, 1950 Oct. 3, 1967	C,W	S	
÷ 201	Anderson Ranch			104	5	A	2,785	56.8	Oct. 2, 1967	C,W	S	"P-lake well." Replaced well W-21 in P. R. J. Inv. at this location. On eastern edge of playa.
* 301	do		old	98	6	Α	2,772	84.7 84.8 85.7	Aug. 22, 1940 June 23, 1961 Sept. 28, 1967	c,w	D,S	South well of two at ranch headquarters. Well W-25 in P. R. J.
* 302	do		old	168	8	A	2,772	85.7 86.5	Aug. 22, 1940 Sept. 28, 1967	C,W	S	North well at ranch headquarters. Well W-24 in P. R. J. Inv.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

				1		ı		WATE	R LEVEL	1	T	
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
YX-46-30-303	Anderson Ranch	R. C. (Dick) Murray	1965	154	5	A	2,772	120.1	Oct. 2, 1967	C,W	S	Drilled to supply water for road construction. Driller's log: hard conglomerate (red sandstone and shale fragments) to 6 ft; caliche 6-21 ft; red rock (Santa Rosa Sandstone) 21-44 ft; sandy clay 44-88 ft; red rock 88-109 ft; red sand (water-bearing) 109-114 ft; red rock and clay breaks 114-154 ft. 1/
* 401	J. C. Dunagan Est.	F. H. Murphy	1937	121	5	Α	2,660	104.8 106.0 109.2	Dec. 5, 1940 Aug. 8, 1949 Oct. 3, 1967	c,w	S	Replaced well W-19 in P. R. J. Inv. at this location.
* 402	Anderson Ranch		old	188	6	Α	2,672	97.3	Oct. 3, 1967	C,W	S	Well W-26 in P. R. J. Inv.
* 403	do	Cactus Drlg. Co.	1954	180	4	A				C,E, 5	D	Drilled for rig supply. Currently supplies oilfield lease house. Discharged 4.6 gpm 10-3-62. Reported good quality of water. Some of the residents of Barstow hauled drinking water from the well before the pipeline to the city of Pecos was completed.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

									WATE	R LEVEL			
WE	ill	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-	-30-501	Anderson Ranch	R. C. (Dick) Murray	1966	141	7	А	<u></u>	99.6	Oct. 3, 1967	c,w	S	Drilled for road con- struction. Log shows: caliche to 18 ft; hard conglomerate shell 18- 34 ft; red rock (Santa Rosa Sandstone) 34-46 ft; red, sandy clay 46- 66 ft; hard sand rock 66-89 ft; red, sandy clay 89-118 ft; redbed with shells 118-126 ft; and red sand and gravel (water-bearing) 126- 141 ft.
	601	Humble Oil & Refg. Co.		1954	975	7	Pr	2,820	261.0	Oct. 2, 1967	N	N	State univ. "AC" water well No. 1. Open hole 749-975 ft in Rustler Formation. Supplied water for drilling oil tests. Reported pumped 25 barrels per hour (18 gpm) when drilled.
*	701	J. C. Dunagan Est.			113	5	Α	2,646	87.2 91.7	Aug. 8, 1949 Oct. 17, 1967	c,w	S	
*	702	John Wilson	Jim Miles	1920	172	6	Α	2,722	162.1 164.5 169.5	Sept. 26, 1939 Jan. 24, 1950 Nov. 14, 1967	c,w	S	Replaced well W-161 in P. R. J. Inv. Open hole 10-172 ft.
*	801	do	Shell Oil Co.	1939	161	4	A	2,735	94.5 96.8	Oct. 8, 1940 Nov. 13, 1967	c,w	S	Owner's "Shell Well." Reported "30 ft of gravel then into rock (Santa Rosa Sandstone)." Tested at 50 gpm when drilled.
*	802	do	Tom Simmonds	1938	220	8	А	2,695	108.7 109.5 126.2	Sept. 26, 1939 Oct. 8, 1940 Oct. 3, 1967	c,w	S	Well W-153 in P. R. J. Inv. Open hole 140- 220 ft. Reported strong supply but gyppy.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

					salt salt is			WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-30-901	Bird S. Hayes Well No. 1	Kenneth Slack	1939	5,088	10	A?	2,710	40.9	Dec. 14, 1967	N	N	Abandoned oil test. Reported cased to 6 ft Left open hole 5-1,100 ft. Bailed water sample 12-14-67.
* 31-101	Anderson Ranch		old	147	5	Α	2,695	119.3	Sept. 28, 1967	c,W	S	Owner's "Oats Well."
301	Paul Walker	-	1953	120	6	А	2,677	101.32 103.38	Mar. 6, 1956 Dec. 6, 1957	N	N	Historical observation well. Filled with trast to about 20 ft from surface in 1967.
302	M. A. Williford	C. O. Richardson	1956	300	16	Α	2,675	104.95 105.94	Mar. 6, 1956 Oct. 30, 1967	Т	N	Current observation well. Not pumped since 1956. $\underline{2}$ /
303	T. B. H. Development Co.		1951	264	14	А		105.8	Sept. 12, 1967	T,G	N	Discharged an estimated 400 gpm in 1956. Irri- gated 50 acres of cotton and grain in 1965. Not used in 1967.
* 304	Jack Baugus		1955	300	12	A		96.4	do	T,E, 40	Irr	Estimated discharged 300 gpm 9-12-67. Irri- gating 80 acres of feed.
* 305	Anderson Ranch		old	96	5	А	2,660	89.8	Sept. 27, 1967	c,w	S	Owner's "Hookedy Well." Pumping 3.3 gpm 9-12- 67. Replaced well W-34 in P. R. J. Inv.
* 306	A. D. Quillin		1927	153	6	Α	2,661	-		c,w	S	Well W-36 in P. R. J. Inv. Drilled for rig- supply. Converted to livestock well.
* 401	Anderson Ranch		1939	130	5	Α	2,681	116.1 115.7	Aug. 15, 1940 Sept. 28, 1967	c,w	S	Owner's "Borax Well." Well W-30 in P. R. J. Inv.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

			T					WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-31-402	Anderson Ranch		1945	164	6	А	2,657	101.2	Sept. 28, 1967	c,w	S	Owner's "Oil Well Mill." Drilled for rig- supply. Converted to livestock well.
* 501	do			105	5	А	2,650	84.3	Sept. 27, 1967	c,w	s	Owner's "County Well No. 1."
* 601	Lucille Smith		1955	322	16	А		99.72 101.65	Mar. 6, 1956 Sept. 12, 1967		N	Casing perforated 167- 302 ft. Reported water is brackish. Current observation well.2/
* 602	N. T. Zachry	Barney Lee	1955	200	12	A	2,659	99.00 103.36	Mar. 6, 1956 Sept. 27, 1967	T,Ng	lrr	Historical observation well. Casing perforated 100-200 ft. Packed with 54 yards of gravel. Set 180 ft of 8-in. column pipe and 12 stages of 8-in. bowls. Pumped 240 gpm for 2 weeks and had 13.2 ft of drawdown in Sept. 1967. Irrigated 28 1/2 acres cotton, 18 acres of feed and 10 acres of grass in 1967. 2/
* 603	Ward County Prec. No. 4	Star Drlg. Co.	1956	200	10	A		82.7	Sept. 11, 1967	T,E, 30	lrr	South well of two used to irrigate park lawns. Set 130 ft of 4-in. column pipe. Drawdown of 25 ft pumping 260 gpm for 2 hours 9-11-67. Reported water is too hard for swimming pool. Water is piped from Pyote city wells for that purpose.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

				П		n 161		WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
* YX-46-31-604	Ward Co. Prec. No. 4	R. C. (Dick) Murray	1962	225	16	A		82.9	Sept. 11, 1967	T,Ng	lrr	Casing perforated 100- 200 ft; 25 ft of blank casing on bottom. Set 185 ft of 6-in. column pipe. Drawdown of 12 ft pumping 445 gpm for 2 hours 9-11-67.
* 605	Lucille Smith		1937	138	6	А	2,658	92.2 92.5	Feb. 23, 1940 Oct. 2, 1967	c,w	s	Well W-35 in P. R. J. Inv.
606	Norman Zachry	-	1965	200	12	A				T,G	N	Unused irrigation well. Reported to have irri- gated 80-90 acres of feed and cotton in 1966.
607	O. G. Lee, et al.	Barney Lee	1956	265	12	А	2,647	92.7	Sept. 27, 1967	Т	N	Drilled to supply water for wetting grade dur- ing construction of Highway 115. Not used since.
* 701	John Wilson	T & P. Railroad	1882	97	120	A	2,640	62.94 66.05	Sept. 26, 1939 Oct. 14, 1967	N La Para	N	Dug to 97 ft in Santa Rosa Sandstone. Sup- plied water for con- struction of railroad. Historical observation well. Well W-141 in P. R. J. Inv. 2
						v ji						

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-31-702	John Wilson		1910	154	5	A	2,662	99.1 101.1 106.3	Sept. 1939 Oct. 8, 1940 Nov. 13, 1967		D,S	Northwest well of two at ranch headquarters. Well W-142 in P. R. J. Inv. Open hole 100-154 ft. Owner reports ranch has 6 windmill wells in use. All are thought to tap Triassic rocks, and most pump only small quantities of water. Shell Oil Co. drilled 108 seismograph holes to depths of 200 ft on the ranch and only 2 holes had sufficient water to supply windmills.
703	do		1905	160	7	A	2,662	100.2 106.5	Oct. 8, 1940 Nov. 13, 1967	c,w	D,S	Southeast well at ranch headquarters. Open hold 100-160 ft.
* 704	do	Texaco Inc. (Seismograph Crew)	1948	160	6	A	2,665	103.5	Nov. 13, 1967	C,W	S	
* 704 * 705	Pat Wilson Well No. 1	Kenneth Slack, et al.	1940	5,052			2,665					Well W-140 in P. R. J. Inv. Drilled to 5052 fr as oil test. Water was sampled at 180 ft (Triassic) and 1060-1064 ft (Rustler). Reported no water sands in interval 180-912 ft. Water from interval above 180 ft contained 3350 mg/l dissolved solids. Water from Rustler Formation contained 7310 mg/l dissolved solved solids.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

				Т				WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-31-706	City of Barstow (Was T & P RR)	W. P. Geaslin	1928	200	10	A	2,664			c,G	N	Formerly used to supply locomotive boilers at Quito station. Casing: 10-in. to 110 ft; 8-in. 100 to 200 ft, perforated 100-160 ft. Reported maximum capacity was 30 gpm. 1/
* 801	Dr. H. B. Johnson		1956	300	12	А		59.6	Nov. 13, 1967	T,G	Ind	Drilled for irrigation. Supplying water for construction of Interstate Highway 20 in 1967. Drawdown of 16 ft pumping 380 gpm for 22 hours in Nov., 1967.
901	do		1956	274	12	А	2,607	54.14 57.86	Dec. 7, 1957 Nov. 13, 1967	N	N	Unused irrigation well. Current observation well. Well YX-46-31-801 had been shut down 38 hours when water level was measured 11-13-67. 2/
* 902	Anderson Ranch		1930	118	7	А	2,630	66.3	Sept. 27, 1967	c,w	S	Well W-134 in P. R. J. Inv. Called "Gyp Well."
32-201	Texas Elec. Serv. Co.		1939	150	6	A	2,686	115.2 116.5	Mar. 4, 1943 Sept. 5, 1967	c,w	N	Well W-47 in P. R. J. Inv. Drilled for rig supply. Converted to livestock well. Not in use in 1967.
202	do	Magnolia Petr. Co.) S	124	7	А	2,678	108.3	Sept. 5, 1967	N	N	Drilled for rig supply.
203	do	-	1955	745	2	Α	2,675	110 R 115.0	1955 Sept. 5, 1967	N	N	Drilled as test hole B-1. Set 2 1/2-in. pipe in 10-in. hole to 280 ft. 1/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

			1	T				WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-32-204	Texas Elec. Serv. Co.	Layne-Texas Co.	1955	425	12	A	2,646	92 R 99.9	Aug. 1958 Sept. 26, 1967	T,E,	Ind	Company Well No. 6. Casing: 20-in. to 193 ft, cemented to wall of well; 12 3/4-in. to 425 ft, screened 215- 415 ft. Underreamed to 30-in. 193-425 ft. Packed 70 yards of gravel between wall of well and 12-in. casing. Set 187 ft of 8-in. column pipe and 9 stages of 10-in. bowls. Pumping test by dril- ler, Dec., 1957: draw- down of 38 ft pumping 1,000 gpm for 48 hours. Drawdown of 25 ft pump- ing 810 gpm for 1/2 hour 9-6-67. 1/
205	do	do	1955	521		А	2,672	′	-	N	N	Drilled and logged to 521 ft as test hole B-4. Not completed as water well.
* 206	do	do	1955	1,010		A	2,646			N	N	Drilled and logged to 1,010 ft as test hole B-6. Water was sampled from intervals 324-364, 544-600, and 879-920 ft. Water levels were 90.1 ft in interval 324-364 ft, and 95.4 ft in interval 879-920 ft. Estimated base of fresh to slightly saline water to be at 740 ft. Top of Triassic (base of alluvium) at 917 ft.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

				T			1	WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-32-207	Gulf Oil Corp.		1959	4,010	13	Pc	2,682			N	N	O'Brien water supply well No. 9. Casing: 20-in. to 539 ft, cemented with 500 sacks; 13 3/8 in. to 1,022 ft; and 9 5/8-in. 1,022-3,496 ft, cemented with 1,850 sacks. Open hole 3,496-4,010 ft in Capitan reef.
* 208	do		1959	4,109	13	Pc	2,692	20.2	June 7, 1967	T,E,	Ind	O'Brien water supply well No. 10. Casing: 20-in. to 520 ft, cemented with 550 sacks; 13 3/8-in. and 9 5/8-in. to 3,447 ft, cemented with 1,805 sacks. Open hole 3,447-4,109 ft.
* 209	do			4,400	13	Pc				T,E, 100	Ind	O'Brien water supply well No. A-4.
* 301	G. W. O'Brien Est. (Jack O'Brien)		1937	140	6	Α	2,689	127.7	Nov. 6, 1967	c,w	s	
* 302	Gulf Oil Corp.	J. D. Cole	1954	365	8	А	2,658	107.6	June 7, 1967	S,E	Ind	O'Brien water supply well No. 23. Casing perforated 170-365 ft. Packed with 18 yards of gravel. Set 323 ft of 4-in. column pipe. Reported pumped 100 barrels in 20 minutes (210 gpm) when drilled. Reported water is used for all oil-field operations other than secondary recovery of oil. Wells tapping the Capitan reef are used for that purpose.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

			1	1			1	WATE	R LEVEL		1	
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
YX-46-32-303	Jack O'Brien	-	1936	130	8	А	2,643	69.9	Sept. 1, 1967	N	N	Drilled for domestic and livestock supply. Not used since 1952. Taps Gulf's fresh-water supply line for domestic use.
304	Gulf Oil Corp.		-260	4,500	13	Pc	2,685	120.8	June 7, 1967	N	N	O'Brien water supply well No. 1. Open hole in Capitan reef.
305	do		1953	3,700	13	Pc	2,661	+242 R +178 R 11.3	Sept. 1953 Sept. 1957 June 8, 1967	N	N	O'Brien water supply well No. 1. Open hole 3,522-3,700 ft. Reported flowed 1,111 barrels per hour (778 gpm) in Sept. 1953. Flowed 12.7 million barrels through 8-24-57. Water was used for secondary recovery of oil.
* 306	do	-		3,950	13	Pc	2,667	+194 R +184 R 1.4	Feb. 19, 1957 June 28, 1957 June 7, 1967	T,E, 125	Ind	O'Brien water supply well No. 3. Reported flowed 10,450 barrels per day with 25 psi well-head pressure in Oct. 1955.
307	do			4,100	13	Pc		+162 R 78.38	June 28, 1957 June 7, 1967	N	N	O'Brien water supply well No. 4. Reported flowed 21,925 barrels per day (640 gpm) with 32 psi well-head pressure 6-13-57. 5 hour shut in pressure head was 70 psi. Specific capacity (5 hour recovery) was 7.3 gpm per ft.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

Г				П	T			T .	WATE	R LEVEL	Linear		
	WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
	x-46-32-308	Gulf Oil Corp.			4,500	13	Pc		+176 R +173 R	Feb. 20, 1957 June 28, 1957	N	N	O'Brien water supply well No. 5. Flowed 22,500 barrels per day (655 gpm) at 44 psi well-head pressure Feb. 19, 1957. Shut in for 24 hours. Pressure head was 76 psi (176 ft). Specific capacity was 8.9 gpm per ft.
	309	do			4,100	13	Pc	2,689	+150 R 31.44	June 28, 1957 June 7, 1967	N	N	O'Brien water supply well No. 6. Reported flowed 26,889 barrels per day (780 gpm) with 32 psi well-head pres- sure. Shut in pressure head (5 hours) was 65 psi. Specific capacity was 10 gpm per ft.
*	310	do		13	4,450	13	Pc	2,689	+194 R	Feb. 19, 1957	T,E, 125	Ind	O'Brien water supply well No. 8.
*	311	do		1960	4,462	13	Pc	2,672	17.5	June 7, 1967	T,E, 100	Ind	O'Brien water supply well No. 11. Casing: 20-in. to 521 ft, cemented with 700 sacks; 13 3/8-in. and 9 5/8-in. to 3,439 ft, cemented with 1,770 sacks. Open hole 3,439 to 4,462 ft in Capitan reef.
	312	do		1960	4,500	13	Pc	2,656	+21	June 8, 1967	N	N	O'Brien water supply well No. 12. Casing: 20-in. to 522 ft, cemented with 600 sacks; 13 3/8-in. to 1,003 ft, and 9 5/8-in. 1,003 to 3,445 ft, cemented with 500 sacks. Open hole 3,445 ft to 4,500 ft.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

			1	T		l l		WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-32-401	J. T. Flowers	Charlie Miller	1967	226	14	А		84.2	Sept. 11, 1967	T,Ng	Irr	Casing perforated 88-166 ft. Packed with 22 yards of gravel. Set 216 ft of 8-in. column pipe and 7 stages of 10-in. bowls. Drawdown of 17 ft pumping 285 gpm for 126 hours in Sept. 1967.
402	J. A. Pebsworth, Jr.	Barney Lee	1955	192	12	А		76.90 79.72	Mar. 6, 1956 Sept. 11, 1967	N	N	Historical observation well. Reported pumped 2 times in 1955 and 1956. Not used since.
* 403	Fitz Sitton	Star Drlg. Co.	1956	400	16	А	2,633	79.12 82.92	Mar. 6, 1956 Dec. 30, 1967	T,Ng	lrr	Current observation well. Reported drilled and cased to 400 ft. Packed with 900 yards of gravel. Set 156 ft of 8-in. column pipe. Drawdown of 29.7 ft pumping 500 gpm for 9 hours 9-15-67. Irrigated 14 acres of feed in 1967. 2/
404	A. J. Staas	Powell Roberts	1955	200	12	А		78.9	Dec. 5, 1959	Т	N	Unused irrigation well. Obstruction in casing at 73 ft in 1967.
* 405	J. A. Pebsworth, Jr.		1910	96	8	А		80.75 83.47	Mar. 6, 1956 Dec. 30, 1967	N	N	Current observation well. Formerly used to water stock and irrigate fruit trees.
* 406	Texas Elec. Serv. Co.		old	107	7	A		91.3	Sept. 5, 1967	N	N	Well W-239 in P. R. J. Inv.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

HARLES DE LES						1000		WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-32-407	L. E. Garrett	Elmo Barnette	1955	303	14	A		114.8	Sept. 12, 1967	N	N	Drilled for irrigatio Not used since 1957. Water reported brackishkilled alfalfa. Bailed sampl 9-12-67.
408	J. T. Flowers	Bill Sprouse	1966	200	12	А		79.9	Sept. 9, 1967	N	N	Drilled for irrigation Perforated casing 100 200 ft. Reported would pump a maximum of 300 gpm. Abandoned and drilled well YX-46-32 401 to replace it.
* 409	John L. Smith	Sprouse Bros.	1963	185	7	A		86.2 85.8	Sept. 14, 1967 Nov. 16, 1967	T,E, 20	Irr	Casing perforated 145 175 ft. Set 140 ft of 4-in. column pipe. Ha drawdown of 35.7 ft pumping 207 gpm for 4 minutes 11-16-67. Irr gated 30 acres of cotton in 1966. Irri- gated 51 acres of gra in 1967.
410	Beverly Reynolds	Elmo Barnette	1955	300		А		115 R	1956	N	N	Reported drawdown of ft pumping an estimate 950 gpm in 1956. Not used since 1961.
411	J. L. Jones	Sprouse Bros.	1964	200	14	А				N	N	Reported irrigated 139 acres of cotton in 1965. Not used since.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

									R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-32-501	Avary & Walker Wtr. Co.	Bill Purcell	1942	182	10	А	-	74 R	1942	T,E,	P	Pyote well No. 1. Drilled to supply Pyote Army Air Force Base (abandoned). Casing: 10 3/4-in. to 136 ft, cemented; 8-in. 111-174 ft, perforated, open hole 174-182 ft. Pumping test by Layne-Texas Co. in Jan. 1945 drawdown of 12 ft pumping 280 gpm for 4 days Pumping 260 gpm 11-16-67. Water is piped to city of Pyote for municipal supply. 1/
502	Texas Elec. Serv. Co.	W. E. (Bud) Tone	1955	148	12	A		88.90 88.98 93.02	Dec. 2, 1955 Dec. 5, 1956 Sept. 14, 1967	N	N	Formerly used for irrigation. Historical observation well.
503	do			160	16	A		92.31	Dec. 7, 1957	N	N	Historical observation well. Abandoned and plugged with concrete
* 504	Texas State Highway Dept.		1937	152	5	A		104.98 112.64	Feb. 23, 1940 Sept. 6, 1967	N	N	Well W-107 in P. R. J Inv. Current obser- vation well. Formerly supplied roadside par Casing perforated 126 165 ft. Open hole 187 195 ft. Sanded in to 152 ft in 1967. 2/
505	Texas Elec. Serv. Co.	J. D. Cole	1951	248	16	А		95.31	Dec. 7, 1957	N	N	Historical observation well. Drilled for irr gation. Reported test at 1,500 gpm and had ft of drawdown. Abandoned and plugged.
506	do		1958	250	16	A		97.40 100.81	Dec. 5, 1959 Dec. 30, 1967	N	N	Formerly used for irrigation. Current observation well. <u>2</u> /

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

			1				I	WATE	R LEVEL		1	
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
YX-46-32-507	Texas Elec. Serv. Co.		old	110	6	Α		107.92	Dec. 8, 1962	N	N	Historical observation well. Obstruction at 40 ft in 1967.
* 508	do	Layne-Texas Co.	1955	426	12	A	2,634	85 R 92.0	1955 Dec. 14, 1967		Ind	Company well No. B-8. Drilled and logged to 426 ft. Set and cemented 20-in. casing to 162 ft. Underreamed hole to 30-in. diameter from 1 162 to 425 ft. Set 12 3/4-in. casing to 425 ft. Set shutter screens 182-230, 270-360 and 380-420 ft. (188 ft total). Gravel packed with 70 yards. Pumped 888 gpm for 1/2 hour and had 37 ft of drawdown 9-19-67. 1/
* 509	do	do	1955	385	12	Α	2,647	101 R 105.4	1955 Dec. 14, 1967		Ind	Company Well No. B-11. Drilled and logged to 390 ft. (Also drilled and logged a test hole to 436 ft, 60 ft east of well). Set and cemented 20-in. casing to 162 ft. Underreamed to 30-in 162-385 ft. Set 12 3/4-in. casing to 385 ft with shutter screens 200-380 ft. Packed 50 yards of gravel outside 12-in. casing. Set 195 ft of 8-in. column pipe and 6 stages of 10-in. bowls. Reported pumped 838 gpm for 24 hours and had 43.5 ft drawdown in Aug. 1958. Pumped 759 gpm for 1/2 hour and had 29 ft drawdown 9-19-67. 1/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-32-510	Texas Elec. Serv. Co.	Layne-Texas Co.	1948	259	10	А	2,652	107 R 114.6	1948 Sept. 26, 1967		Ind	Company Well No. M-3. Drilled and logged to 299 ft. Plugged back to 259 ft. Set and cemented 18-in. casing to 192 ft. Underreamed to 30-in. 195-290 ft. Set 10 3/4-in. to 288 ft, perforated 192-259 ft. Gravel packed. Pumped 197 gpm for 30 minutes and had 27 ft of drawdown 9-26-67. 1/
* 511	Avary & Walker Wtr. Co.	Bill Purcell	1942	235	10	A				N	N	Pyote well No. 2. Well W-321 in P. R. J. Inv. Formerly supplied Pyote Army Air Force Base. Reported pumped 190 gpm for 60 hours and had 36 ft drawdown in 1942. Well caved in beyond repair in Jan. 1945. 1/2
* 512	do	do	1942	235	10	A		71 R	1942	N	N	Pyote well No. 3. Well W-222 in P. R. J. Inv. Reported upper water sands were not cased off. Abandoned and plugged in 1945 because of high chloride and sulfate content in water. 1/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

				1				WATE	R LEVEL			realistation per turb contra a sec
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-32-513	Avary & Walker Wtr. Co.	Bassett Drlg.	1943	241	10	A	2,613	83.9	Nov. 16, 1967	T,E,	P	Pyote well No. 4. Drilled and logged to 241 ft as Pyote Army Airfield No. 4 well. C Casing: 10 3/4-in. to 174 to 241 ft; perforated 174-241 ft. Reported pumped 315 gpm and had 30 ft drawdown. Pumped 370 gpm and had 38 ft drawdown in 1945. Discharged 310 gpm from 4-in. bypass pipe 11-16-67. 1/
* 514	do	Layne-Texas Co.	1945	240	10	A		84.8	do	T,E, 25	P	Pyote well No. 5. Set 18-in. casing to 159 ft, cemented with 200 sacks. Underreamed to 30-in. 159 to 240 ft. Set 10 3/4-in. casing to 240 ft with shutter screens 186-239 ft. Packed 25 yards of gravel between wall of well and 10-in. casing. Driller pumped 380 gpm for 8 hours and had drawdown of 85 ft 9-24-45. Pumped 328 gpm for 2 hours and had 70 ft drawdown 11-16-67. 1/
* 515	do		1949	271	12	A		76 R	1952	T,E, 40	N	Pyote well No. 6. Well was not used in 1967. Reportedly pumps sand. May be used in future.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

	T	Terror de la companya de la company						WATE	R LEVEL		1	
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-32-601	Jack O'Brien	R & R Drlg. Co.	1938	235	6	A		118.6	Sept. 5, 1967	S,E, 20	Ind	Well W-50 in P. R. J. Inv. Formerly supplied Cabot Carbon Plant. Currently (1967) supplies southwestern explosives company plant. Reported to pump 225 gpm.
* 602	Humble Oil & Refg. Co.	Johnn Drlg. Co.	1962	4,460	13	Pc	2,632	+	June 8, 1967	N	Ind	Wickett water system No. 6. Well No. 2. Casing: 13 3/8-in. to 1,211 ft, cemented; 9 5/8-in. 1,211-3,304 ft; open hole 3,304-4,460 ft in Capitan reef. Reported flowed 71,120 barrels per day (2,080 gpm) under 8 psi well-head pressure when drilled.
* 603	City of Wickett	Burkholder Drlg.	1963	306	12	A	2,652	120 R	1963	Т,Е	P	City well No. 1. Driller's log to 180 ft. Sample log 180 to 300 ft. Drilled 24-in. hole to 306 ft. Set 12 3/4-in. casing with packer at 126 ft and shutter screens 206-306 ft. Cemented casing from surface to 126 ft with 310 sacks. Packed annulus from 126-306 ft with 65 yards No. 10. gravel. Tested by Dixon Pump and Equip. Co. Pumped 1,500 gpm for 48 hours and had 90 ft of drawdown. Set 230 ft of 8-in. column pipe and 2 stage 10-in. bowls. Reported pumped 800 gpm in 1967. 1/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

					300			WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
YX-46-32-604	City of Wickett	R. C. (Dick) Murray	1966	284	8	А	2,652	117.2	Sept. 1, 1961	T,E, 15	P	City No. 2 well. On stand-by status. Set and cemented 16-in. casing to 175 ft. Set 8 5/8-in. to 284 ft, perforated 178-284 ft. Gravel packed. Reported drawdown of 15 ft pumping 310 gpm for 134 hours. 1/
* 605	Kent Distribu- tors Inc.		1930	300	6	А		115.9	Sept. 1, 1967	S,E, 5	Ind	Formerly supplied Wickett Refinery which closed in 1961.
606	Texas Elec. Serv. Co.	Layne-Texas Co.	1948	302	10	A	2,644	104.1	Sept. 27, 1967	T	N	Company well No. M-6. Not in use in 1967. Casing: 18 5/8-in to 225 ft. 10 3/4-in to 302 ft. 223 to 302 ft. 1/
* 607	do	do	1948	335	10	А	2,648	106 R	1948	T,E,	Ind	Company well No. M-4. Casing: 18 5/8-in. to 224 ft, cemented; 10 3/4-in. to 335 ft, perforated 248-320 ft. Reported pumped 264 gpm 9-19-67. 1/
* 608	Bluford Thornton			180	6	Α		(6)		c,W	S	Drilled for rig supply. Converted to livestock well.
* 609	Univ. of Texas Well 16-12- B 1	Atlantic Refining Co.	1942	2,911	7	Psr	2,634	+345 R +346 R	Nov. 1942 Nov. 1948	N	N	Oil well producing from the Seven Rivers Formation interval 2,907-2,911 ft. Flowing water and small quantity of oil 12-9-67. Oil is skimmed and water is pitted.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

No. and the second								WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-32-610	Gulf Oil Corp.			4,450	13	Pc	2,644	+217 R +201 R + 46	Feb. 1957 June 1957 June 8, 1967	N	N	O'Brien water supply well No. 2. Reported flowed 15,690 barrels per day at 25 psi well-head pressure in Oct. 1955. Shut-in pressure (24 hours) was 94 psi (217 ft of head) Feb. 19, 1957. Flowed 12,875 barrels per day at 46 psi Feb. 20, 1957. Specific capacity (24 hours) was 3.4 gpm/ft. Flowed 13,229 barrels per day (385 gpm) at 40 psi June 13, 1957. Shut-in pressure (5 hours) was 87 psi June 28, 1957. Specific capacity (5 hours) was 3.5 gpm/ft.
* 611	do			4,500	13	Pc	2,648	+196 R 3.74	June 1957 June 7, 1967	T,E, 100	Ind	O'Brien water supply well No. 7. Reported flowed 14,953 barrels per day (435 gpm) at 34 psi well-head pressure 6-13-57. Shut-in pressure (5 hours) was 85 psi (196 ft of head). Specific capacity (5 hour-recovery) was 3.8 gpm/ft.
* 612	do		1961	4,500	13	Pc	2,649			T,E,	Ind	O'Brien water supply well No. 13. Casing: 20-in. to 533 ft, cemented with 500 sacks; 13 3/8 and 9 5/8-in. to 3,450 ft, cemented with 900 sacks. Open hole 3,450 to 4,500 ft in Capitan reef.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

			T					WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
YX-46-32-613	Gulf Oil Corp.		1961	4,500	13	Pc	2,655	9.3	June 8, 1967	T,E, 100	Ind	O'Brien water supply well No. 14. Casing: 20-in. to 516 ft, cemented with 500 sacks; 13 3/8 and 9 5/8-in. to 3,444 ft, cemented with 1,500 sacks. Open hole 3,444-4,500 ft.
614	do		1961	4,500	13	Pc ;	2,651			N	N	O'Brien water supply well No. 15. Casing: 20-in. to 468 ft, cemented with 500 sacks; 13 3/8 and 9 5/8-in. to 3,460 ft, cemented with 2,100 sacks. Open hole 3,460-4,500 ft.
615	do		1962	4,500	13	Pc	2,645	+23	June 8, 1967	N	N	O'Brien water supply well No. 16. Casing: 20-in. to 516 ft, ce- mented with 475 sacks; 13 3/8 and 9 5/8-in. to 3,470 ft, cemented with 2,100 sacks. Open hole 3,470 to 4,500 ft.
* 701	J. R. Lamothe	Bille Purcel	1943	104	8	A	2,620	70.3	Sept. 9, 1967	N	N	Well W-238 in P. R. J. Inv. Formerly supplied water for wetting run- ways at the Pyote Air Force Base. Reported water was not potable.
* 702	Humble Oil & Refg. Co.		1966	200	6	A				T,G	Ind	State Univ. "D.G." water well No. 1. Casing: 11 1/2-in. to 17 ft; 6 5/8-in. to 200 ft, perforated 157- 187 ft. Pumping a re- ported 50 gpm for rig supply 9-28-67.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

									WATE	R LEVEL			
WELL		OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-32-7	703	John McNeff		old	106	5	А	2,624	72.8	Mar. 12, 1942	N	N	Well W-133 in P. R. J. Inv. Reportedly suppli ed water for wagon yar and livestock. Destroy ed.
* {	801	Bluford Thornton	J. Miles	1939	127	6	A	2,606	78.3 80.4 81.2	June 20, 1940 June 11, 1962 Aug. 11, 1967	J,E,	S	Well W-115 in P. R. J. Inv. Casing perforated 109-127 ft.
* {	802	do	1	old	98	4	А	2,591	59.6 63.6	May 29, 1940 Aug. 11, 1967	c,w	S	Owner's "Old Place Well." Well W-113 in F R. J. Inv.
* {	803	do	J. Miles	1940	110	7	A	2,610	81.2 85.0	Mar. 1, 1943 Oct. 28, 1967	c,w	S	Well W-112 in P. R. J Inv.
*	804	Texas State Hwy. Dept.		1965	207	10	A		76 R 77.2	Mar. 1965 Nov. 7, 1967	S,E	P	Supplies drinking wat and irrigates trees a shrubs at roadside parks.
	901	Humble Oil & Refg. Co.	Johnn Drlg. Co.	1962	4,421	13	Pc	2,610	+186 R + 70	July 11, 1962 June 8, 1967	N	Ind	Wickett water system No. 6, well No. 1. Set and cemented 13 3/8-in casing to 1,284 ft. Set 9 5/8-in. 1,139 to 3,325 ft; open hole 3,325-4,421 ft in Capitan reef. Reported stabilized flowing pressure at 3,300 ft was 1,465 psi dischard ing 45,000 barrels pet day (1,310 gpm) for 4 hours in July 1962. Pressure at 3,300 ft was 1,509 psi with we shut-in for 30 minutes Production index (spec ific capacity) was 1,020 barrels per day per psi or 13 gpm per ft.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

			1					WATE	R LEVEL		Inches	Fig. 19 out made to the last
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-32-902	Bluford Thornton		1947	120	6	Α	2,608	78.4	Aug. 11, 1967	c,W	S	Discharging 3 gpm 8-11-67.
* 903	do	Jim Miles	1939	186	7	A	2,628	89.8	Sept. 6, 1967	c,w	S	Well W-108 in P. R. J. Inv. Discharging 3 gpm 9-6-67. Heavy coating of chemical precipitate on discharge pipe. Comparison of analyses of water sampled from the well in 1940 and 1967 indicates contamination has occurred during intervening time.
37-101	Dan Cooper		1955	300		Α	2,574	16.60 19.01	Feb. 3, 1958 Dec. 1, 1967	Т	N	Unused irrigation well. Current observation well. <u>2</u> /
102	Chester Armstrong		1908	103		A	-	4.11 5.40	Dec. 17, 1930 Dec. 28, 1942	N	N	Well W-188 in P. R. J. Inv. One of first wells used for irrigation in the Barstow area. Dug and cribbed to 12 ft. Drilled 12 to 103 ft. Historical obser- vation well. Destroyed.
* 103	John & Paul Ivey	McMann	1932	- 48	6	Α	2,580	14.08	Feb. 14, 1951	N	N	Well W-193 in P. R. J. Inv. Historical obser- vation well. Obstruc- tion in casing at 10 ft in 1967.
104	Dan Cooper		1955	300	-	Α	2,574	13.86 15.42	Feb. 3, 1958 Dec. 20, 1967	N	N	Unused irrigation well. Historical observation well. 2/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
YX-46-37-105	Floyd Lukins	C. C. & H. Drlg. Co.	1947	220	18	A	2,578	14.25 22.9	Jan. 8, 1950 June 29, 1967	T,Ng	lrr	Casing perforated 120- 220 ft. Set 100 ft of 8-in. column pipe and 2 stages of 10-in. bowls. Reported dis- charge 1,000 gpm. 2/
106	Dan Cooper		1955	300		А	2,577	23.4 21.3	June 21, 1967 Oct. 20, 1967	Т	N	
107	Chester Armstrong		1908	163	10	A		5.0 12.3	Aug. 31, 1939 Oct. 29, 1946	N	N	Well W-190 in P. R. J. Inv. Reported pumped 1,100 gpm in 1946. De- stroyed.
t 108	Ward County Irrigation Dist. No. 1, Well 7		1946	183	16	A		13.9	Sept. 30, 1946	N	N	<u>1</u> /
109	Chester Armstrong	C. C. & H. Drlg. Co.	1949	125	16	А	2,600	26.4 29.6	July 20, 1950 Oct. 26, 1967	T,G	Irr	Casing perforated 20- 125 ft. Irrigating 35 acres of feed in 1967.
* 110	Rayburn Allgood	do	1946	125	20	A	2,588	17.7 20.2	Dec. 16, 1946 Oct. 26, 1967	T,E, 25	Irr	Casing: 20-in. to 52 ft; 16-in. 52 to 113 ft, perforated. Set 60 ft of 10-in. column pipe. Pumping 940 gpm 10-26-67. Water level rose 14 ft with well shut down 14 hours. Thrombined discharge of wells YX-46-37-110, 111, 202, and 207 measured in concrete-line canal was 4,135 gpm in
	- 100			10 (10 (10 (10 (10 (10 (10 (10 (10 (10 (Oct. 1967. Irrigated 378 acres of alfalfa and feed with 4 wells and Red Bluff Reservoi water in 1967. 1/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

		THE THE PARTY NAMED IN						WATE	R LEVEL					
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DAT MEAS	E OF SURE-		METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-37-111	Rayburn Allgood	C. C. & H. Drlg. Co.	1951	160	16	A	2,586	18.6	Oct.	19,	1967	T,E,	Irr	Casing perforated 20- 160 ft. Set 70 ft of 10-in, column pipe.
112	John & Paul Ivey				16	Α	2,584	19.0	Oct.	21,	1967	N	N	Unused irrigation well
113	do				16	А	2,584	18.4		do		N	N	Do.
114	Dan Cooper				16	Α	2,582	18.1		do		N	N	Do.
. 115	do				16	Α	2,581	17.3		do		N	N	Do.
* 201	Ward Co. Irr. Dist. No. 1, Well 5	Coleman & Williams	1946	112	16	Α	2,585	13.19 15.38	Sept. Dec.	30, 19,	946 967	N	N	Current observation well. Casing perforate 16-100 ft. Open hole 104-112 ft. Reported not used since 1954.
* 202	Rayburn Allgood	do	1946	91	16	A	2,587	14.3 19.2	Jan. Oct.	31, 1	947 967	T,E, 25	Irr	Old Ward County Irri- gation District well No. 6. Casing perfo- rated 36-91 ft. Set 60 ft of 10-in. column pipe. 1/
* 203	Ward Co. Irr. Dist. No. 1, Well 2	do	1942	97	16	Α	2,584	15.1	Feb.	12, 1	959	N	N	Historical observation well. Formerly used for irrigation. Aban- doned in Aug. 1950. Casing perforated 41- 97 ft. 1/
* 204	Ward Co. Irr. Dist. No. 1, Well 1	do	1946	71	16	Α	2,584	10.85 13.30	Sept. Oct.			N	N	Casing perforated 17-67 ft. Reported pumped 1,330 gpm in 1946. 1/2/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL				
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT		METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-37-205	Geo. Dinwiddie	Coleman & Williams	1945	71	20	A	2,584	14.67 20.01	Dec. 4, Feb. 12,	1946 1949		Irr	Historical observation well. Casing perforate 17-71 ft. Set 85 ft of 8-in. column pipe. Irrigated 200 acres of alfalfa and grain with 2 wells and canal wate in 1967. Pumping 1,090 gpm 10-23-67. 1/
* 206	R. S. (Bob) Hayes	C. C. & H. Drlg. Co.	1946	110	20	А	2,575	13.83 16.76	Dec. 28,	1946 1967	T,Ng	Irr	Historical observation well. Casing perforate 54-110 ft. Pumped 1,190 gpm and had 30.3 ft of drawdown in Apr. 1947. Pumping 1,080 gpm 3-28-68. Irrigated 80 acres of alfalfa with two wells and canal water. 2/
* 207	Rayburn Allgood		1908?	80	12	A	2,587	5.97 15.32	Dec. 17, Oct. 29,	1930 1946	T,E, 30	Irr	Well W-191 in P. R. J. Inv. Historical observation well. Reported pumped 1,400 gpm for 102 hours and had 14. ft of drawdown in Apr. 1940. Has bee hive in casing in 1967. 2/
* 208	Ward Co. Irr. Dist. No. 1, Well 4	C. C. & H. Drlg. Co.	1945	172	16	А	2,587	12.08 15.87	Dec. 4, Oct. 23,	1946 1967	N	N	Casing perforated 17- 168 ft. <u>2</u> /
209	A. R. Aves	C. Simmonds	old	100	12	A		7.62	Dec. 29,	1942	N	N	Well W-202 in P. R. J. Inv. Historical obser- vation well. Destroyed in 1946.
210	R. S. (Bob) Hayes	3-062 W 3-31K - 113			17 44 7	А	2,576	17.7	Oct. 24,	1967	T,Ng	Irr	
211	R. W. Burkholder		17 <u>11</u>	200	16	А	2,574	18.25 16.97		1959 1967	T,Ng	Irr	Current observation well. 2/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

									R LEVEL				
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	MEAS	E OF URE-	METHOD OF LIFT	USE OF WATER	REMARKS
YX-46-37-212	O. H. Sulivan	Lang Buchanan	1940	80	10	A	2,582	13.2 16.7 16.9	Oct.	28, 1940 29, 1946 23, 1967	J,E, 1/3	D	Well W-198 in P. R. J. Inv. Casing perforated 20-36 and 48-76 ft. Formerly used for irri gation. Pumped 730 gpm for 4 hours and had 14 ft of drawdown in Apr. 1940. Reported water is used for lawn and commodenot suit- able for drinking. 1/
213	Ward Co. Irr. Dist. No. 1, Well 3		1929	58	16	A	2,586	4.52 15.20		17, 1930 23, 1967	N	N	Casing perforated to total depth. Drawdown of 16.1 ft pumping 1,200 gpm for 7 days in 1940. Drawdown of 11.2 ft pumping 790 gp in Apr. 1947. Not pumped since 1960. 1/2/
214	R. W. Burkholder	C. Simmonds	1928	115	8	A	2,575	7.15 16.85		17, 1930 24, 1967	N	N	Well W-214 in P. R. J. Inv. Historical observation well. Casing perforated 10-100 ft; open hole 100-115 ft.
215	Geo. Dinwiddie	Coleman Drlg. Co.	1965	103	16	А	2,583				T,E, 30	Irr	Casing perforated 53- 103 ft. Discharging 1,050 gpm with pumping level at 50.2 ft 10-15-67.
216	0. H. Sullivan	C. C. & H. Drlg. Co.	1946	90	14	А	2,582	15.9 14.9		29, 1946 23, 1967	T,E,	N	Casing perforated 22-90 ft. 1/
217	Geo. Dinwiddie	Austin Jones & Joe Willey	1946	138	16	Α	2,583	14.4 17.0		31, 1947 23, 1967	N	N	Casing perforated 30-138 ft. 1/
218	W. L. (Dub) Fuller		1952	117	20	A	2,584	19.3	Oct.	25, 1967	T,E, 30	N	Casing perforated 57- 117 ft. Reported not pumped since 1957.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
YX-46-37-219	W. L. (Dub) Fuller		1952	121	20	А	2,584	19.1	Oct. 25, 1967	T,E,	N	Casing perforated 60- 121 ft. Not pumped since 1957.
220	H. R. Hudson			90	14	A	2,582	16.4	Oct. 23, 1967	T,E,	N	Casing perforated 55- 90 ft.
221	do		1948	90	16	Α	2,582	16.6	do	T,E,	N	do
* 222	W. H. McGinty	Joe Willey	1946	110	14	Α		14.8	Dec. 16, 1946	T,E, 30	N	Casing perforated 52- 106 ft. 1/
* 223	R. W. Burkholder	C. C. & H. Drlg. Co.	1946	110	20	A	2,580	13.5 17.0	Oct. 28, 1946 Oct. 24, 1967	T,Ng	Irr	Casing perforated 30- 106 ft. Drawdown of 28.8 ft pumping 1,125 gpm for 1 hour 4-26- 47. 1/
224	do	do	1947	200	20	- A	2,578	16.5 17.9	June 26, 1957 Oct. 24, 1967	T,Ng	Irr	Casing perforated 60- 200 ft.
225	Paul Durkel	Schooler Drlg. Co.	1947	133	20	А	2,569	13.0	Oct. 20, 1967	T,G	N	Casing perforated 53- 133 ft. Set 80 ft of 8 in. column pipe and 4 stages of 12-in. bowls Discharged 985 gpm 8- 19-50. Not in use in 1967.
226	E. W. Sweatt Est.	Tom Simmons	1945	110	20	Α	2,584	18.5 20.8	Oct. 28, 1946 Mar. 3, 1948	T,E,	N	Casing perforated 65-
301	Ward Cty. Park Dept.		1956	90	14	Α	2,566	10.9	Oct. 24, 1967	T,E, 15	Irr	Irrigates park lawns in Barstow.
302	W. G. Burkholder	Austin Jones	1947	100	18	A	2,575	14.55 19.43	Jan. 31, 1947 Oct. 25, 1967	N	N	Historical observation well. Casing perforated 50-100 ft. Reported not pumped since 1956. 2/
303	Snyder Nat'l Bank		1940	65	6	А	2,572	7.11 5.66	Feb. 8, 1940 Dec. 29, 1942	N	N	Well W-228 in P. R. J. Inv. Historical observation well. $\underline{2}/$

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVE	L			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	MEA	TE OF SURE- ENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-37-304	George E. Briggs	Coleman Drlg. Co.	1965	81	10	А	2,566				T,E,	Irr	Casing perforated 30-81 ft. Discharged 330 gpm 10-25-67.
* 305	Allgood, Avary, and Cummings	Jim Miles	1930	80	16	A	2,572	5.41 15.83	Dec. Nov.	17, 1930 9, 1967	T,Ng	lrr	Historical observation well. Well W-208 in P. R. J. Inv. Dug to 16 ft and cribbed 5 ft in diameter. Drilled and cased with 9 5/8-in. pipe to 80 ft. Supplie dairy and irrigated alfalfa and cantaloupe in 1933. Pulled 9 5/8-in. casing, Reamed hol to 18-in. and set 16-in. casing to 1947. Pumped 1,450 gpm for 4 1/2 hours and had 19.6 ft of drawdown 10-25-67. Irrigated 62 acres of alfalfa and 20 acres of bermuda grass 2/
306	Paul Durkel	 .	1940	11	8	Α	2,571	9.98 7.67	Mar. Dec.	7, 1940 29, 1942	N	N	Drilled at test hole for recording water levels during P. R. J. Inv. Destroyed. 2/
307	Geo. E. Briggs	Simmons Bros.	1924	85	8	Α	2,570	6.53 13.02	Dec. Oct.	17, 1930 24, 1967	N	N	Well W-205 in P. R. J. Inv. Historical observation well. $\underline{2}$ /
* 308	M. W. Nichols	Jim Miles	1930	85	10	A	2,567	2.03 8.92		17, 1930 29, 1942	Cf,G	N	Well W-211 in P. R. J. Inv. Casing perforated 11-85 ft. Reported pumped 1,150 gpm in 1946. Not used since 1954. 2/
* 309	Barstow Ind. School Dist.	C. C. & H. Drlg. Co.	1950	83	14	А	2,564	11.9	May	11, 1967	T,E, 7 1/2	Irr	Irrigates school lawns. Pumping 330 gpm 5-11- 67.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

					1		1	T	WATE	R LEVEL					
WELL		OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DAT	E OF SURE-		METHOD OF LIFT	USE OF WATER	REMARKS
YX-46-3	37-310	J. H. Reed	C. C. & H Drlg. Co.	1947	112	16	А	2,576	18.6	Oct.	25,	1967	T, E, 50	N	Casing perforated 20- 112 ft.
	311	do	do	1947	149	16	А	2,576	18.8		do		T, E,	N	Casing perforated 66- 149 ft.
*	312	John G. Burkholder	Burkholder Drlg. Co.	1963	90	16	А	2,566	12.5	Nov.	9,	1967	T, E, 15	Irr	Casing perforated 40- 90 ft. Irrigating 5 acres of grass in 1967
*	313	E. W. Sweatt Est.	Grogan	old	103	20	Α	2,580	17.20 22.76	Oct. Oct.	29, 26,	1946 1967	J, E, 1	D	Well W-200 in P. R. J. Inv. Drilled for irrigation. Pumped 1,270 gpm for 3 hours and had Il ft of drawdown 6-8-40. Converted to domestic well. Water is used for all purposes other than drinking.2/
	314	do	Tom Simmons	1945	77	20	Α	2,580	16.8 23.1	Oct. Oct.	29, 26,	1946 1967	T, E, 50	N	Casing perforated 40- 77 ft. Reported pumped 1,675 gpm and had 13.5 ft of drawdown 4-18-47.
*	315	Cox & Evans	Joe Wiley	1946	125	16	A	2,564	8.2 10.7	Nov. Oct.			T, E,	N	Casing perforated 60- 125 ft. Set 60 ft of 10-in. column pipe. Discharged 1,490 gpm 8-17-50. Not pumped in 1967.
	316	John Wilson		1948	128	16	A	2,566	11.9	Oct.	26, 1	967	T, E,	N	Casing perforated 78- 128 ft. Set 60 ft of 10-in. column pipe and two stages of 10-in. bowls. Not pumped since 1965.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL					
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	MEAS	TE OF SURE- ENT		METHOD OF LIFT	USE OF WATER	REMARKS
YX-46-37-317	J. A. Davis	Walker	1961	200	16	А	2,575	22.0	May	10,	1967	T, Ng	Irr	Set 85 ft of 8-in column pipe and 1 stage 10-in, bowl. Irrigated 34 acres of grass in 1967
318	W. L. Fuller	L. B. Coleman	1965	86	12	А	2,566	15.3 13.4	May Oct.		1967 1967	N	N	Casing perforated 46-86 ft.1/
319	Lloyd Smith	do	1964	89	16	А	2,565	14.9 12.3	May Oct.		1967 1967	T, Ng	N	Casing perforated 89 ft. <u>1</u> /
320	Forrest Walker		1955	110	16	Α	2,566	14.3	May	11,	1967	T, Ng	Irr	Irrigated 10 acres of alfalfa in 1967.
* 321	George Briggs	C. C. & H Drlg. Co.	1946	107	20	А	2,570	15.2 12.5	May Oct.		1967 1967	T, E, 40	N	Casing perforated 51- 107 ft. Reported draw- down of 30 ft pumping 1,505 gpm for 7 days in 1946.
322	M. I. Vida Farms Inc.	do	1947	216	16	А	2,582	22.5	Oct.	26,	1967	Т	N	Casing perforated 20- 80 and 70-216 ft.
323	Bob Allgood	do	1950	90	16	Α	2,563	11.8 8.5	June Oct.			T, Ng	ler	Casing perforated 20- 90 ft. Irrigated 24 acres of grass with well and canal water in 1967.
* 324	Barstow School Dist.	A. C. Pump Co.	1963	105	12	Α	2,564	11.1	Oct.	24,	1967	T, E, 15	Irr	Irrigates school lawns. Drawdown of 4.9 ft pumping 740 gpm for 4 hours 11-15-67.
325	Sally Preston	Joe Wiley		119	16	Α	2,568					Т	N	Casing perforated 41- 110 ft.
326	Geo. Briggs	C. C. & H. Drlg. Drlg. Co	1947	100	16	A	2,568	14.2	Oct.	24,	1967	T, E,	N	Casing perforated 30- 100 ft. Not pumped since 1952.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL					
WELL .	OWNER .	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DAT MEAS	E OF URE- NT		METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-37-327	W. E. (Bill) Hollis	Shine Avary	1957	140	16	А	2,573	19.8	Oct.	25, 1	967	T,Ng	N	Irrigated 9 acres of alfalfa in 1967.
328	Shine Avary				16	А	2,564	11.6		do		T,Ng	Irr	
329	do	7			16	Α	2,563	11.2		do		T,Ng	Irr	
330	B. D. Dearing				16	А	2,569	12.4	Oct.	26, 1	967	T,G	N	
331	City of Barstow	Commonwealth	1908	1,100	8	А						-		Well W-213 in P. R. J. Inv. Drilled and logged to 1,100 ft. Reported water was tested tepths of 212, 410, 642, 955, 1,030 and 1,082 ft. None of the water was suitable for domestic use, and the quality of water becamprogressively worse with depth.
k 401	Dan Cooper	Pioneer Canal Co.	1900±	278	6	А	2,573	2.34 22.82	Aug. Feb.	31, 19 12, 19	939	N	N	Well W-195 in P. R. J. Inv. Historical obser- vation well. Destroyed 2/
k 402	W. E. Chapman	F. C. Wheeler	1963	242	16	A	2,568	15.9	Oct.	20, 19	967	T,Ng	lrr	Casing perforated 182-242 ft. Set 185 ft of 10-in. column pipe. Wells YX-46-37-402 and 403 were pumping a combined 1,200 gpm 6-23-67. Reported irrigated 19 acres cotton, 15 acres sweet sue, 22 acres alfalfa, and 264 acres bermuda with 4 wells and canal water in 1967.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL					
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DAT	TE OF SURE- ENT		METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-37-403	W. E. Chapman	F. C. Wheeler	1964	217	16	А	2,568	24.6	Oct.	20, 1	967	T,Ng	Irr	Casing perforated 157-217 ft. Set 185 ft of 10-in. column pipe and 12-in. bowls.
* 404	A. J. Carpenter	Pierce Bros.	1949	300	16	А	2,572	17.39 18.70		29, 1 20, 1		Т	N	Unused irrigation well Casing perforated 17-280 ft. 1/2/
* 501	W. E. Chapman		1961	190	16	А	2,572					T,Ng	Irr	Casing perforated 15- 190 ft. Set 145 ft of 10-in. column pipe. Pumping 670 gpm 6-24- 67.
* 502	do		1961	190	16	Α	2,571	14.0	Oct.	20, 1	967	T,Ng	lrr	Casing perforated 15- 190 ft. Set 150 ft of 10-in. column pipe and 1 stage 14-in. bowl. Pumping 290 gpm 6-22- 67.
503	James P. (Tiny) Goode		1958	100	16	A	2,570	14.0		do		T,G	N	Casing perforated 14- 100 ft. Reported has irrigated 80 acres of grass but has not beer pumped for 2 years.
* 504	Hilton Supply Co.	Walker	1960	97	16	A	2,562	12.7	Nov.	9, 1	967	T,G	Irr	Casing perforated 47- 97 ft. Set 70 ft of 8- in. column pipe. Reported pumps 1,000 gpm and irrigates 80 acres of grass. Also waters livestock.
601	Texas State Highway Dept.	H. Cartis	1949	155	8	A	2,565	11.46	Dec.	9, 19	962	N	N	Historical observation well. Destroyed.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
YX-46-37-602	M. I. Vida Farms, Inc.	E. K. Taylor	1928	80	8	Α	2,563	13.82	Mar. 3, 1950	N	N	Well W-216 in P. R. J. Inv. Historical obser- vation well. Reported to have irrigated "cotton cane, and truck" in the 1940's. Destroyed.
* 603	L. G. Sheppard	Rayford Guffey	1948	150	18	Α	2,563	9.9	Oct. 27, 1967	T,Ng	Irr	Casing perforated 50- 150 ft. Set 38 ft of 8 in. column pipe and 3 stages of 10-in. bowls Irrigated 12 acres of bermuda grass in 1966.
* 604	W. E. Knowles	Blount Bros. Drlg. Co.	1963	95	16	A	2,562	9.7	do	T,E, 50	Irr	Casing perforated 35- 95 ft. Set 40 ft of 10-in. column pipe and one 12-in. bowl. Draw- down of 6.7 ft pumping 1,160 gpm for 3 hours 11-15-67.
605	Jack Wright	Coleman	1962	80	16	А	2,562	8.8	Oct. 24, 1967	T,Ng	Irr	Casing perforated 50-80 ft. Reported pumps 1,100 gpm.
606	Hilton Supply Co.	Walker	1960	94	16	A	2,566	11.8	Oct. 20, 1967	T,Ng	Irr	Casing perforated 44- 94 ft. Set 80 ft of 10 in. column pipe. Reported discharges 1,500 gpm. Irrigated 40 acres of alfalfa in 1967.
607	do		1956	285	16	A	2,564	11.4	Nov. 9, 1967	N	N	Not pumped since 1964.
608	Mrs. Burch Carson	Burkholder Drlg. Co.	1957	110	16	A	2,563		-	N	N	Unused irrigation well

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

F	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1			T				WATE	R LEVEL		T	
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
YX-46-37-609	W. N. Yates	Coleman	1961	60	16	А	2,563	13.2	Oct. 26, 1967	N	N	Casing perforated 30- 60 ft. Reported not used since 1964, but may be used in future.
* 610	do			21	6	Α	2,563	8.9 15.3	Oct. 31, 1939 Oct. 26, 1967	N	N	Well W-215 in P. R. J. Inv. Formerly used for livestock supply.
* 611	Bill Allgood	Shine Avary	1953	100	16	Α	2,561	14.5	Oct. 26, 1967	T,Ng	Irr	Casing perforated 50- 95 ft. Pumping 1,500 gpm 3-31-68.
612	B. & B. Sand & Gravėl Co.			30		Α	2,556	8	do	Cf,E, 25	Ind	Gravel pit. Irrigation drainage ditch empties into pit at north end and drains pit at south end. Water is pumped from pit to wash sand and gravel and to irrigate 20 acres of bermuda grass. Water that drains from the pit flows into the Pecos River 3 miles southeast of Barstow.
38-101	Robert Miller	Coleman Drlg.	1953	100		Α	2,573	21.5	do	Т	N	
* 102	C. E. Swafford	Tom Simmons	old	117	8	A	2,653	94.28 100.34	Sept. 26, 1939 Oct. 26, 1967	N	N	Well W-158 in P. R. J. Inv. Historical obser- vation well. Formerly used for irrigation of truck farm. Reported discharge of 51 gpm would exhaust well in 1939. Well taps Santa Rosa Sandstone.2/
* 103	W. L. Fuller	Lang Buchanan		85	6	Α	2,573	15.4	Apr. 2, 1940	N	N	Well W-209 in P. R. J. Inv. Filled to above water level in 1967.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL				
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE MEASE MEE		METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-38-104	W. L. Fuller	Lang Buchanan	1940	110	12	А	2,574	14.90 22.41		20, 1940 1, 1967		N	Well W-210 in P. R. J. Inv. Current observation well. Casing: 12 1/2-in. to 83 ft, perforated 23-83 ft; 8-in. 83 to 100 ft, perforated. Reported drawdown of 23 ft pumping about 1,000 gpm for 4 hours in May, 1940. Not used since 1957. 2/
* 105	C. E. Swafford	Tom Simmons	1935	108	8	A	2,655	96.01 101.87		26, 1939 26, 1967	C,E	D	Well W-159 in P. R. J. Inv. Historical obser- vation well. Supplies cafe. Water is not used for drinking. 2/
* 106	Avary & Allgood	Schooler	1947	180	16	Α	2,675	19.8	Oct.	25, 1967	T,Ng	Irr	Set 20-in. casing to 48 ft; 16-in. to 180 ft, perforated 20-180 ft. Set 130 ft of 10-in. column pipe and 3 stages of 14-in. bowls.
* 201	City of Barstow Well No. 1	Jim Miles	1930	137	8	А	2,655	95.1 95.8 101.2	Dec. Nov. Nov.	5, 1940 1, 1946 14, 1967	7 1/2	N	Drilled to 117 ft. Deepened to 137 ft in 1955. Taps Santa Rosa Sandstone. Reported pumped 55 gpm in 1948. Well has not been used since July, 1966 when cities of Pecos and Barstow pipe line was completed.
202	City of Barstow Well No. 2	C. C. & H. Drlg. Co.	. 1948	120	8	А					T,E, 10	N	Cased to 15 ft. Open hole 15-120 ft in Santa Rosa Sandstone. Set 110 ft of 4-in. column pipe and 24 stages of 4-in. bowls. Reported discharged 72 gpm in Oct. 1948.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
YX-46-38-20	John H. Wilson		old	232	7	A	2,689	115.0 116.2	Nov. 8, 1940 Nov. 13, 1967	C,W	N	Called "old rock house well." Well W-156 in P R. J. Inv. Open hole 20-232 ft. Owner reports this was one of the first wells to be drilled in Ward County Oldtimers recall that it was drilled with a horse powered rig by a sheep outfit in the middle 1800's. Well taps Santa Rosa Sandstone. Not used since 1963.
* 40	Robert & Ed Miller		1930	13		Α	2,561	11.5	Dec. 29, 1942	N	N	Well W-217 in P. R. J. Inv. Historical obser- vation well. Dug to 13 ft. Destroyed.
4(2 C. B. Reed, et al.		old	25	8	Α	2,565	16.4	Mar. 26, 1941	N	N	Well W-220 in P. R. J. Inv. Dry in 1967.
* 40	Texas State Hwy. Dept.		1967	100	10	A	2,557	11.8	Sept. 27, 1967	T,Ng	Ind	Supplied water for con- struction of Interstate Highway 20 in 1967.
40	4 Robert Miller	Coleman Drlg.	1953	100	16	Α	2,573	21.8	Oct. 26, 1967	T,G,	N	
* 40	5 R. & E. Miller	C. Simmonds	1936	38	6	A	2,564	13.8 19.6	Aug. 30, 1939 Nov. 14, 1967	c,w	N	Well W-218 in P. R. J. Inv. Reported water is unfit for domestic supply.
40	6 Chas. Miller Est.		old	47	6	A	2,575	24.1 28.5	June 21, 1940 Nov. 14, 1967	N	N	Well W-219 in P. R. J. Inv.
* 50	1 L. M. Watson, Jr.	L. Schooler	1947	233	16	А	2,558	11.3	Nov. 14, 1967	N	N	Reported no water sands were found below 100 ft; mostly red clay.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
YX-46-38-502	L. M. Watson, Jr.	Joe Willey	1947	80	16	А	2,568	18.68 22.51	Jan. 23, 1950 Dec. 1, 1967	N	N	Current observation well. Casing perforated to 80 ft. 2/
503	do	-	old	6	36	А	2,558	11.06	Dec. 29, 1942	N	N	Well W-221 in P. R. J. Inv. Historical obser- vation well. Dug to 17 ft. Filled to 6 ft in 1967.
* 504	do	B. W. Helm	1939	15	30	А	2,567	11.7	Aug. 30, 1939	N	N	Well W-222 in P. R. J. Inv. Dug and cribbed to 15 ft. Filled to above water level in 1967.
* 505	Chas. Miller Est.		old	40	6	А	2,550	13.0 16.4	Dec. 12, 1939 Nov. 14, 1967	N	N	Called "E. A. Leffing Well." Well W-223 in P. R. J. Inv.
* 601	C. M. Haughton Well No. 2	Dominion Oil Co. (Arthur Pitts)		4,670	-	Pr	2,550	+		N	N	Well W-230 in P. R. J. Inv. Drilled as oil test. Reported flowed 1,800 gpm from four horizons 700 to 1,200 ft deep in 1923. Flowed 206 gpm 12-19-40, 36 gpm 3-5-64 and 49 gpm 4-19-67. No casing is visible. May have been pulled when well was abandoned.
* 39-101	J. E. Fitzpatric Well No. 1	T. N. Carr, et al.	1938	5,208		A?	2,638	79.5	Mar. 12, 1942	N	N	Abandoned oil test. Casing was pulled. Bailed water sample 10- 5-40. Hole filled to 10 ft in 1967.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

Park Selection				1				WATE	R LEVEL		l griffs	
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-39-102	G. Q. Avary, Sr. & Jr.	Coleman & Huckabee	1959	222	8	А	2,647	92.6 99.5	Apr. 1, 1959 Nov. 11, 1967		S	Open hole 10-222 ft. Reported weak supply well pumps off in strong wind. Water enters well from crevice in red sand- stone (Santa Rosa).
103	do	Earl Ligon	1900	160	5	A	2,660	107.4	Nov. 11, 1967	N	N	Well W-147 in P. R. J. Inv. Well No. 1 at ranch headquarters. Cased to 3 ft, open hole 3 to 160 ft in Santa Rosa Sandstone.
* 104	do	do	1915	164	5	A	2,659	106.1	do	c,w	S	Well No. 2 at ranch headquarters. Open hole 10 to 164 ft.
105	do	Coleman & Huckabee	1950	165	20	A	2,660	104.6 107.2	Mar. 3, 1959 Nov. 11, 1967		Ind	Well No. 3 at ranch headquarters. Open hole 10-165 ft. Driller reported: surface sand to 2 ft, white lime (caliche) 2-20 ft, red rock and red sand rock (Santa Rosa) 20-165 ft. Water is sold for drilling oil tests and for recovery of salt from the Salado Formation.
* 201	do	0wner	1952	102	8	A	2,622	69.5 70.4	Mar. 31, 1948 Nov. 11, 1967	c,w	S	Owner's "Draw" well.
* 202	do	Tom Simmons	1938	157	5	A	2,675	137.4 136.8	Sept. 28, 1939 Nov. 7, 1967	c,w	S	Well W-129 in P. R. J. Inv. Pumping a dribble 11-10-67; reported 3 gpm is maximum.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

			1					WATE	R LEVEL				12 111 11	
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DAT MEAS	TE OF SURE- ENT		METHOD OF LIFT	USE OF WATER	REMARKS
YX-46-39-203	G. Q. Avary, Sr. & Jr.	Coleman & Huckabee	1960	270		A	2,602	63.4	Nov.	11,	1967	T,G	Ind	Drilled for irrigation. Never cased. Used for rig supply in 1967.
* 20 4	do	Uvalde Const. Co.	1942	360	6	A	2,603	62.2 63.5	Mar. Nov.	31, 11,	1959 1967	C,W	S	Replaced well W-130 in P. R. J. Inv. which re- placed a well that was dug in about 1880 at this location.
* 205	Jim Sample	Jack Haley	1964	142	7	А	2,625	88.2	Nov.	10,	1967	s,E, 5	D	Casing perforated 102-142 ft. Set 127 ft of 2 1/2-in. column pipe. Drawdown of 14.2 ft pumping 100 gpm for 2 hours 11-10-67. Well supplies trailer house, fills fish pond, and irrigates garden. The quality of water is exceptionally good for this area.
* 206	G. Q. Avary, Sr. & Jr.		1910	97	6	A	2,626	90.8 89.8	Sept.		1939 1959		S	Well W-128 in P. R. J. Inv. Called "Perrin Well." Chester Rainbow who ranches the Herring spread says this was a site for an old ranch house. Cowboys from adjoining ranches would ride to this well for drinking water because of its good quality.
301	Dr. H. B. Johnson		1956	300	16	A	2,615	57.2 60.7	Dec. Nov.		1959 1967	N	N	Unused irrigation well.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

П									WATE	R LEVEL			
	WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
	YX-46-39-302	McGill-Smith Well No. 1	Owner	1955	1,087	12	Α?	2,615	54.9 62.6	Dec. 2, 1955 Nov. 7, 1967	N	N	Oil test. Driller re- ported: first water at 60 ft; water at 140 ft In sand and gravel. Set 12 3/4-in. casing to 296 ft. Set 10-in. to 500 ft. Top of redbeds (Triassic) at 500 ft.
*	303	J. Duncan		1932	86	7	Α	2,605	62.5 60.6	Sept. 28, 1939 Nov. 10, 1967	c,w	S	Well W-131 in P. R. J. Inv. Open hole 10-86 ft. Water reported slightly gyppy.
	304	E. H. & D. B. Bedell				20	Α	2,611	69.9	Nov. 10, 1967	T,G	Irr	Irrigated 15 to 20 acres of grass in 1967.
*	501	Mrs. Helen Belo	J. Miles	1939	150	10	A	2,556	56.5	do	C,W	N	Well W-232 in P. R. J. Inv. Driller reported: soil and caliche to 20 ft, red sandrock (Santa Rosa Sandstone) 20 to 150 ft. Reported weak well but good water.
*	601	R. M. Lasater		old	82	8	Α	2,594	72.0 71.2	Nov. 20, 1939 Nov. 10, 1967	N	N	Well W-126 in P. R. J. Inv.
*	602	Mrs. Anna Herring	Continental Oil	1959	120	6	Α				C,W	S	Drilled for rig supply converted to livestock well. Reported best water on ranch.
*	603	do	do	1959	119	6	Α	2,578	63.0	Nov. 10, 1967	C,W	S	Drilled for rig supply. Converted to livestock well.
*	604	do	J. Miles	1939	95	8	Α	2,596	76.0 75.1	Nov. 20, 1939 Nov. 10, 1967	C,W	S	Well W-124 in P. R. J. Inv. Southeast well of two at ranch head- quarters.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

			T	1				WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-39-605	Mrs. Anna Herring		1907	86	5	A	2,597	77 · 7 75 · 7	Nov. 20, 1939 Nov. 10, 1967		S	Well W-125 in P. R. J. Inv. Northwest well at ranch headquarters. Water reported gyppy. Drinking water is piped from city of Pecos water line. Hauled water from Pyote prior to its completion in 1966.
* 606	Permian Brine Co.	Owner	1963	260	6	А	2,579	63.8	Nov. 10, 1967	S,E, 1 1/2	Ind	Sandy soil at surface. Reported loose sand and clay stringers to 255 ft, redbed and gravel stringers 255-260 ft, hard rock (Santa Rosa Sandstone) at 260 ft. Set blank casing to 260 ft. Filled casing with gravel to 255 ft. Bailed 66 gpm. Water is used for drilling oil tests and is injected into the Salado Formation for recovery of brine.
607	R. M. Lasater			98	6	А	2,584	68.7	do	N	N	Unused livestock well.
701	W. F. Means	Redman	1940	103	6	А	2,555	53.8 52.3	Oct. 5, 1940 Nov. 11, 1967	N	N	Well W-231 in P. R. J. Inv. Open hole 73-103. Reported water is poor qualitylivestock won't drink it.
* 801	R. M. Lasater	Everts	1938	368	6	A	2,566	60.6	Nov. 10, 1967	N	N	Well W-234 in P. R. J. Inv. Reported good water but weak well. No water in shale from 70 to 368 ft.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

												1	1	
	WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	MEAS	E OF SURE- ENT	METHOD OF LIFT	USE OF WATER	REMARKS
*Y)	K-46-39-802	R. M. Lasater		1908	100	6	A	2,551	53.8	Nov.	10, 196	7 N	N	Well W-235 in P. R. J. Inv. Reported good water but weak well.
	901	Troy Eiland	-		42	6	A	2,498	9.8	Nov.	11, 196	7 C,W	N	Casing perforated to total depth. Well is on the bank of a slough near the Pecos River.
	40-101	D. H. Brewster, Jr.	J. C. Clanton	1956	310	14	А	2,584	53.0	June	2, 196	N	N	Drilled for irrigation. Made a feed crop in 1956. Not used since. Casing perforated 60- 310.
*	102	J. Duncan		1950	110	5	A		4.7			c,w	S	Drilled by county for highway construction. Converted to livestock well. Pumping 5 gpm 6-2-67.
*	103	Bluford Thornton			79	6	Α	2,588	61.0	June	4, 1967	c,w	S	
*	201	do	-	old	106	6	А	2,578	55.3 55.4	June June	18, 1962 2, 1967	c,w	S	Well W-116 in P. R. J. Inv. Owner's "Hog Well."
*	202	do		1945	66	6	A	2,571	49.0 52.0	June June	18, 1962 17, 1967	C,W	S	Well is in a depression and was under water following heavy rains in June 1967.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

F T	T	r	I		Ι			MATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
YX-46-40-203	Marnell & Stewart	Burkholder Drlg. Co.	. 1962	350	14	А	2,622	98.2 100.4	June 15, 1962 Aug. 11, 1967	N	N	City of Pecos test hole No. 4. Drilled and sample-logged to 547 ft. Set 24-in. conductor casing to 3 ft. Set 14-in. to 525 ft with screens 135-150, 343-373, 416-436, 479-489 and 510-525 ft. Progressively plugged back to depths 547, 424, and 350 ft. Water sampled at each interval.
* 204	Lloyd James	0wner	1958	255	10	А	2,626	105.2	Aug. 11, 1967	Т	N	Well was drilled for irrigation but reportedly was never used because of sand problem. City of Pecos test hole No. 2 which was drilled and samplelogged to 536 ft is about 500 ft north of this well. 1/
205	Humble Oil & Refg. Co.		1966	203	6	Α	2,616	93.1	do	N	N	Drilled for rig supply. Casing perforated 160- 190 ft.
* 301	Bluford Thornton		1948	180	6	Α	2,610	93.0 98.6	Sept. 8, 1961 Aug. 17, 1967	c,w	S	
* 302	do	E. T. (Gene) Watkins	1942	175	8	A	2,621	113.6	June 2, 1967	C,W	S	Formerly used for oil- field lease supply (Pan American Petr., Spencer water well No. 1). Casing perforated 173- 175 ft. Set 136 ft of 2 1/2-in. column pipe.
* 303	M. E. Spencer Well No. 5	Pan American Petr. Co.		2,905		Psr			an			Oil well. Sample of water was bled from separator 2-3-51.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

MELL OWNER DATE COMPONER DATE COMPONER CO				T					WATE	R LEVEL			
## 305 City of Pecos Burkholder Drlg. Co. ## 306 City of Pecos Burkholder Drlg. Co. ## 307 City of Pecos Burkholder Drlg. Co. ## 307 City of Pecos Burkholder Drlg. Co. ## 307 T.E. P City well No. 1 (old No. 9). Screened 97-246 ft. Gravel packet Pumping test by driller, May 14, 1963 drawdowns of 30, 45, 50, and 68 ft pumping and 1,569 gpm for 2 hours at each rate. Drawdow of 34 ft pumping and average of 884 gpm for 57 per cent of 57	WELL	OWNER	DRILLER	COM- PLET-	OF WELL	DIAM- ETER	BEAR- ING	TUDE OF LAND SURFACE	ABOVE (+) OR BELOW LAND SUR- FACE DATUM	DATE OF MEASURE-	OF	OF	REMARKS
Drlg. Co. 100 No. 9). Screened 97- 246 ft. Gravel packed Pumping test by driller, May 14, 1963 drawdowns of 30, 45, 50, and 68 ft pumping 825, 1,040, 1,230 and 1,569 gpm for 2 hours at each rate. Drawdow of 34 ft pumping an average of 884 gpm fc 57 per cent of the time (576 hours) in Apr. and May 1967sp cific capacity 26	*YX-46-40-304			1958	238	12	A	2,628	122.72 127.30	Sept. 8, 1961 Dec. 14, 1967	T,G	Irr	Owner estimates well has been pumped 450 hours since Jan. 1965. Not used prior to 1965.
	* 305	City of Pecos		1963	250	14	A	2,618	116 R	Apr. 17, 1967		P	No. 9). Screened 97-246 ft. Gravel packed. Pumping test by driller, May 14, 1963: drawdowns of 30, 45, 50, and 68 ft pumping 825, 1,040, 1,230 and 1,569 gpm for 2 hours at each rate. Drawdown of 34 ft pumping an average of 884 gpm for 57 per cent of the time (576 hours) in Apr. and May 1967specific capacity 26

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-40-306	City of Pecos	Burkholder Drlg. Co.	1963	210	14	A	2,633	125 R	Apr. 10, 1967	T,E,	Р	City well No. 2 (old No. 10). Screened 97-237 ft. Set 208 ft of 8-in. column pipe. Gravel packed. Pumping test by driller, May 13, 1963: drawdowns of 35.5, 44.2, 50, 60, 65, 69, and 75 ft pumping 825, 1,000, 1,120, 1,230, 1,336, 1,438, and 1,569 gpm for 2 hours at each rate. Drawdown of 40 ft pumping 865 gpm for 58 per cen of the time during 42 days in Apr. and May, 1967specific capacity 22 gpm per foot.
* 307	do	F. C. Wheeler	1962	316	14	A	2,633	123 R	Apr. 17, 1967	T,E,	P	City well No. 3 (test well No. 6). Drilled and logged to 510 ft. Plugged back to 316 ft. Screened 127-227 ft, slotted 227-309 ft. Gravel packed. Slots were too large, allowing sand to enter well—installed a desander. Pumping test by Ed Reed & Assoc. July 13, 1962: drawdown of 19.8 ft pumping 350 gpm for 4 hours. Drawdown of 36.5 ft pumping 992 gpm for 2 hours in May 1963 (27 gpm per foot specific capacity). Reported well has been developed.—no longer pumping sand or taking gravel in 1967. 1/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

	r		T					WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-40-308	City of Pecos	F. C. Wheeler	1962	256	14	A	2,628	125 R	Apr. 10, 1967	T,E,	P	City well No. 4 (test well No. 8). Screened 126-251 ft. Gravel packed. Reported drawdowns of 46.3, 53.6, 61.6, 68.6, 74.8, and 78.3 ft pumping 825, 992, 1,120, 1,230, 1,336, and 1,438 gpm for 2 hours at each rate in Aug. 1962. Drawdown of 33 ft pumping an average of 766 gpm for 59 percent of the time in Apr. and May 1967. 1/
* 401	Anna L. Herring			80	6	А	2,554	50.8	June 2, 1967	C,W	S	Pumping 3.7 gpm 6-2-67.
* 402	do	Bert Everts	1939	131	6	А	2,536	33.1	do	C,W	N	Well W-123 in P. R. J. Inv. Reported water is salty. Piping water from city of Pecos line to this location in 1967.
* 501	W. H. Jackson	do	1938	84	6	A	2,553	55.0 54.8	Nov. 17, 1939 Dec. 12, 1967	C,W	S	Well W-242 in P. R. J. Inv. Called "Rock Tank Well." Reported weak supply.
* 502	Transwestern Pipeline Co.	Dixon Pump & Equip. Co.	1966	242	5	A	2,555	50 R	Sept. 26, 1966	T,E,	N	Casing: 14-in. to 180 ft, cemented; 10 3/4-in. to 242 ft, perforated 202-232 ft; 5 1/2-in. to 242 ft, screened 202-232 ft. Pumped 1 week for plant supply. Reported water was brackishtoo much salt for plant's distillation system. Hauling distilled water from plant in Pecos in 1967. 1/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

													A TOUR PROPERTY OF THE PARTY OF
	WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX	-46-40-503	Guy B. Hilton		1964	210	15	A	2,538	48 R	Apr. 1967	T,Ng	Irr	Set 130 ft of 10-in. column pipe. Pumping level was 86.9 ft with well discharging 870 gpm 8-11-67. Reported has pumped nearly continuously for 4 months. Irrigating 32 acres of cotton and 150 acres of feed with 3 wells in 1967.
*	504	do		1964	230	15	Α	2,562		-	T,Ng	Irr	Pumping 780 gpm 8-11-67.
	505	do	J 1	1964	230	15	Α	2,555	68.0	Aug. 11, 1967	T,Ng	Irr	Well not in use in 1967.
*	601	Bluford Thornton	-	Before 1900	66	6	Α	2,556	58.8 61.6 62.6	Oct. 10, 1939 July 12, 1962 Aug. 11, 1967	C,W	S	Called "Blair Well." Well W-122 in P. R. J. Inv.
*	602	Paul Walker	Owner	1963	260	12	A	2,524	48.0	Aug. 15, 1967	T,G	Irr	Waters 20 head of cattle and irrigates 20-40 acres of grass.
									W				
			9.27			259				Project Comments of the Commen	58-11 - 12-11 - 12-11		

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

			T .	1				WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-40-701	Troy Eiland	Owens Oil Co. Bill Tipton	1931	1,100	13	Pr	2,493	+	June 1, 1967	S,E, 3/4	D,S	Well W-237 in P. R. J. Inv. Drilled and logged to 5,005 ft as oil test, W. H. Johnson No. 1. Reported top of Rustler anhydrite at 900 ft, top of dolomite at 1,025 ft. Plugged back to 1,100 ft. Left open hole 20-1,100 ft. Reported flowed 140 gpm in June 1931; 40 gpm, Mar. 1959; and 15 gpm Aug. 1961. Flowing 8 gpm 6-1-67 (well YX-46-40-703 was pumping). Flowing 29 gpm 12-12-67. Water is used for domestic and livestock supply but is not used for drinking. 1/ Cased to 31 ft. Open hole 31-1,080 ft. Reported top of Triassic (base of alluvium) at about 30 ft. Top of Rustler anhydrite at 888 ft. Main producing zone at 1,024 ft. Flowing 200 gpm in 1948 (reported), 150 gpm in Mar. 1959. (estimated) 7 gpm 6-1-67 and 47 gpm 12-12-67 (measured). Drawdown of 147 ft pum pumping 250 gpm for 83 hours in June 1967. Irrigating 171 acres of alfalfa and cotton from 2 wells and Big valley canal (Pecos River water) in 1967. 1/

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

f The state of the			1					WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-40-703	Troy Eiland	Bill Tipton	1948	1,125	13	Pr	2,506	+	Dec. 12, 1967	T,G	Irr	Open hole 30-1,125 ft. Flowing 150 gpm 3-4-59 (estimated), 53 gpm 12-12-67 (measured). Pumping level 270 ft below land surface 6-1-67 with well pumping 650 gpm for 41 hours.
704	Mrs. Helen Belo		old	94	8	Α	2,590	76.1	June 2, 1967	C,W	N	
705	A. G. Riley Est.			1,300	8	Pr	2,507	+.2	June 1, 1967	N .	N	Called "Riley Well." Flowing 16 gpm out of pipe .8 ft above land surface 12-12-67. Formerly used for irri- gation.
* 706	Troy Eiland	Howell & Parker	1948	1,200	8	Pr			do	N	N	Called "Kugle Well." Used for irrigation until 1954. Estimated flowing 30 gpm 6-1-67.
* 801	do	Arthur Pitts Oil Co.	1920	1,680	10	Pr	2,481		do	N	N	Called "Valley Well." Drilled as oil test. Fitz Sitton at Pyote recalls that the well nearly flooded out the area when drilled. Well was flowing an esti- mated 2 ft (about 900 gpm) in 1932. Water was used to irrigate several acres of alfal- fa in 1939. Well was flowing about 1/4 gpm out of a 2 1/2-in. nipple 4 ft above ground level 12-12-67.
802	do	John Woodfin	1960	40	6	A	2,489	22.7	Dec. 12, 1967	c,W	N	Casing perforated 20- 40 ft. Water reported salty.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL					
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DAT MEAS	TE OF SURE- ENT		METHOD OF LIFT	USE OF WATER	REMARKS
*YX-46-40-901	Troy Eiland		1945	110	8	А	2,539	77.4	June	1,	1967	C,W	N	Casing perforated 90- 110 ft.
						Crane Co	ounty							
*HH-45-26-301	J. H. Edwards & Sons	E. T. (Gene) Watkins	1948	90	6	А		66.5	May	11,	1967	C,W	S	
34-603	T. C. Barnsley	Jones	old	466	6	A,Pr		51.5 53.7	Nov. June	1, 25,		N	N	Well D-19 in Crane County report. Drilled to test Rustler For- mation for irrigation. Reported perforated casing in shallow sand (Allurosa aquifer) and left hole open below 100 ft. "Top water was strong 125 gpm; bottom water (Rustler) was salty."
* 39-901	Jess M. Wristen	Jim Miles	1967	55	6	A	2,465	39.9	July	20, 1	967	C,W	S	Casing perforated 35- 55 ft. Reported water is brackish.
					١	Vinkler (County							
*ZP-45-17-401	Sealy-Smith Fdn. (Jess Anthony)	Frank Anthony	1956	300	6	A	2,676	32.7 33.9	Oct. May	8, 1 17, 1	956 967	C,W	D	Well H-81 in Winkler County report. Reporter water sand at 72 ft, redbeds (Triassic) at 90 ft. No water from 90 to 300 ft.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

			T	T				WATE	R LEVEL			1	
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE MEASU MEN	IRE-	METHOD OF LIFT	USE OF WATER	REMARKS
*ZP-45-17-802	Shell Oil Co.	Dixon Pump & Equipment Co.	1967	950	8	Pr	2,685	195.2	May	17, 1967	N	N	Sealy-Smith water well No. 3. Casing: 13 3/8- in. to 133 ft; 8 5/8- in. to 850 ft; open hole 850-950 ft in Rustler Formation. Development tests by driller 2-15-67: draw- down of 17 ft pumping 220 gpm for 1 hour. Drawdown of 8 ft pump- ing 150 gpm. Bailed water sample 5-17-67.
901	do			40	7	A	2,710	28.95 29.94	Oct. Nov. 2	8, 1956 29, 1967	N	N	Well W-75 in Winkler County report. Current observation well. Formerly used for rig supply. 2/
908	Sealy-Smith Foundation	Shell Oil Co.	1948	10	<u>-</u> -	Α	2,716	5.7 8.1		4, 1957 17, 1967	N	S	Pit bulldozed in dune sand. Well H-71 in Winkler County report.
911	Shell Oil Co.	Owner	1962	860	6	Pr					S,E, 50	Ind	Sealy-Smith water well No. 2. Open hole 773- 860 ft in Rustler For- mation. Reported pumpe 9,000 barrels per day (262 gpm) with the pumping level at 300 ft. Water reported to be corrosive. Used for secondary recovery of oil.
18-702	Sealy-Smith Fnd.	Shell Oil Co.	1949	10	100	A	2,734	5	July	4, 1957	N	N	Pit bulldozed in dune sand. Filled with sand to above water table in 1967.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

				1	T T			WATE	R LEVEL			
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
*ZP-45-22-801	L. W. Anderson Rch.	Lang Buchanan	1940	151	6	A	2,783	109.5 109.0 107.6	Aug. 21, 1940 Apr. 1, 1957 Oct. 2, 1967		S	Called "China Well." Well F-43 in Winkler County report. Open hole 3-151 ft. 1/
* 23-601	Jack Baugus	Hamblin	1956	400	12	Α	2,709	113.6 113.8 116.4	Oct. 7, 1956 Feb. 26, 1957 Sept. 14, 1967		Irr	Well G-161 in Winkler County report. Casing perforated 320-400 ft. Set 180 ft of 8-in. column pipe. Reported to have pumped 1,230 gpm for 48 hours during a development test. Pumping 425 gpm 9-14- 67. 1/
* 602	do	do	1956	223	12	А		110.2	Feb. 26, 1957	T,Ng	Irr	Well G-162 in Winkler County report. Casing perforated 163-223 ft.
603	do	do	1956	400	12	A		110.18 117.30	Feb. 26, 1957 Nov. 29, 1967		Irr	Well G-163 in Winkler County report. Casing perforated 320-400 ft. Reported drawdown of 69 ft pumping 1,040 gpm for 12 hours in 1956. Current observation well. 2/
* 701	Anderson Ranch		1938	160	6	A	2,732	78.4 80.7	Sept. 4, 1956 Dec. 16, 1967	C,W	S	Called "Division Well." Well W-23 in P. R. J. Inv. Well F-44 in Winkler County report.
* 801	Phillips Petr. Co.	J. D. Cole	1955	200	10	A	2,760	162.5 164.4	Sept. 21, 1956 Sept. 14, 1967	N	N	Drilled for rig supply. Not used since. Well F-46 in Winkler County report.
901	Mobil Oil Co.			159	8	Á	<u></u>	112.5	Sept. 14, 1967	N	N	Unused rig-supply well.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

								WATE	R LEVEL		1	
WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
ZP-46-23-903	R. J. Milligan	-	1930	144	6	А	2,692	105.14 106.47	Mar. 6, 1956 Sept. 12, 1967	N	N	Well W-39 in P. R. J. Inv. Well G-164 in Winkler County report. Historical observation well. Obstruction in casing at 109 ft in 1967. 2/
* 24-707	Fay and Lula Hogg	Layne-Texas Co.	1957	433	3-1	Α	2,700	110 R	May 1957	N	N	Drilled and logged as test hole 9-A for city of Monahans. 1/
708	City of Monahans	do	1957	402		Α	2,704	117 R	do	N	N	Drilled and logged at test hole 8. 17
815	Gulf Oil Corp.		1962	4,400	13	Pc	2,729			T,E, 100	Ind	O'Brien water supply well No. A-11. Casing: 20-in. to 515 ft, cemented with 550 sacks; 13 3/8 and 9 5/8-in. to 3,526 ft, cemented with 2,200 sacks; open hole 3,526-4,400 ft in Capitan reef.
816	do		1962	4,400	13	Pc	2,715			T,E, 125	Ind	O'Brien water supply well No. A-12. Casing: 20-in. to 515 ft, cemented with 450 sacks; 13 3/8-in. and 9 5/8-in. to 3,496 ft, cemented with 1,900 sacks, open hole 3,496-4,400 ft.

Table 6.--Records of Wells and Test Holes in Ward County and Adjacent Areas--Continued

WELL	OWNER	DRILLER	DATE COM- PLET- ED	DEPTH OF WELL (FT)	CASING DIAM- ETER (IN.)	WATER- BEAR- ING UNIT	ALTI- TUDE OF LAND SURFACE (FT)	WATE ABOVE (+) OR BELOW LAND SUR- FACE DATUM (FT)	DATE OF MEASURE- MENT	METHOD OF LIFT	USE OF WATER	REMARKS
ZP-46-24-817	Gulf Oil Corp.		1962	4,500	13	Pc	2,685			T,E, 125	Ind	O'Brien water supply well. No. A-13. Casing: 20-in. to 522 ft, cemented with 500 sacks; 13 3/8 and 9 5/8-in. to 3,541 ft, cemented with 200 sacks; open hole 3,541-4,500 ft.

^{*} Chemical analyses of water given in Table 8.

^{1/} Log of well in files of Texas Water Development Board.
2/ Additional water-level measurements in Table 7.

Table 7.—Water Levels in Wells in Ward County and Adjacent Areas

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Ward Cou	inty	Dec. 6, 1956	53.01	Dec. 8, 1962	51.12
Well YX-45-	17-801	Dec. 6, 1957	45.73	Dec. 4, 1963	53.01
Owner: Sealy-Smit	h Foundation	May 16, 1967	57.90	Dec. 3, 1964	53,65
Mar. 6, 1956	40.34	Well YX-45-33	3-101	Dec. 6, 1965	52.80
Dec. 6, 1956	40.95	Owner: Standard Oil	Company of Texas	Dec. 8, 1966	55.23
Dec. 7, 1957	40.70	June 23, 1948	79.16	July 21, 1967	52.63
Dec. 5, 1959	41.40	Dec. 7, 1949	79.16	Dec. 30, 1967	52.94
Jan. 18, 1961	40.88	Dec. 2, 1950	79.35	Well YX-45-3	3-502
Dec. 7, 1961	41.24	Jan. 31, 1952	79.51	Owner: Richard	son Oils
Dec. 7, 1962	41.30	Feb. 7, 1953	80.16	Jan. 3, 1949	68.27
Dec. 5, 1963	41.16	Jan. 24, 1954	80.92	Dec. 7, 1949	68.38
Dec. 3, 1964	41.68	Jan. 10, 1955	82.06	Dec. 2, 1950	68.98
Dec. 6, 1965	42.07	Jan. 4, 1956	82.83	Jan. 31, 1952	71.02
Dec. 8, 1966	43.35	Jan. 26, 1957	83.13	Feb. 7, 1953	71.65
Apr. 6, 1967	41.65	Feb. 7, 1958	83.52	Jan. 24, 1954	72.22
Dec. 30, 1967	41.62	Dec. 6, 1959	83.65	Jan. 10, 1955	72.92
Well YX-45-	25-901	Jan. 18, 1961	83,87	Jan. 4, 1956	73.46
Owner: W, B	. Morris	Dec. 6, 1961	83.98	Feb. 7, 1958	74.30
Feb. 9, 1955	39,49	Dec. 8, 1962	82.50	Jan. 18, 1961	74.94
Dec. 4, 1955	38.66	Dec. 4, 2963	84.45	Dec. 6, 1961	74.97
Mar. 5, 1956	38.13	Dec. 3, 1964	84.59	Dec. 8, 1962	75.05
Dec. 6, 1956	38.34	Dec. 6, 1965	84.87	Dec. 4, 1963	76.10
Dec. 6, 1957	37.54	Dec. 8, 1966	84.94	Dec. 3, 1964	70.48
Dec. 5, 1959	37.61	Dec. 30, 1967	84.99	Dec. 6, 1965	75.48
Jan. 18, 1961	37.49	Well YX-45-33	3-501	Dec. 8, 1966	75.42
Dec. 7, 1961	38.25	Owner: D. B. C	Durgin	July 21, 1967	75.78
Dec. 8, 1962	38.75	Jan. 3, 1949	46.88	Dec. 30, 1967	75.74
Dec. 4, 1963	39.26	Dec. 7, 1949	46.95	Well YX-45-3	3-504
Dec. 3, 1964	39,69	Dec. 2, 1950	47.15	Owner: Standard Oil	Co. of Texas
Dec. 6, 1965	40.29	Jan. 31, 1952	47.28	June 23, 1948	60.95
Dec. 8, 1966	40.00	Jan. 24, 1954	48.09	Dec. 2, 1948	61.75
Dec. 30, 1967	40.66	Jan. 10, 1955	48.38	Oct. 2, 1949	61.74
Well YX-45-	26-701	Jan. 4, 1956	48.69	Oct. 3, 1950	61.72
Owner: Lewis Ro		Jan. 26, 1957	48.80	Jan. 31, 1952	66.01
J. E. Perk	44.22	Feb. 7, 1958	49.66	July 21, 1967	68.85
Feb. 9, 1955 Dec. 4, 1955	43.09	Dec. 6, 1959	50.37		
	47.79	Jan. 18, 1961	50.93		
Mar. 5, 1956	47.73	Dec. 6, 1961	50.71		

Table 7.—Water Levels in Wells in Ward County and Adjacent Areas—Continued

DAT		WATER LEVEL	С	PATE	WATER LEVEL	D	ATE	WATER
w	ell YX-45-33-505			Well YX-45-33	3-905	Dec.	3, 1964	72.19
Owner	: Standard Oil Cor	npany	Ov	wner: Cities Serv	vice, et al.	Dec.	6, 1965	72.28
	of Texas		Apr.	29, 1940	38.06	May	13, 1967	71.95
June 23	, 1948	61.95	Dec.	2, 1948	40.70	Dec.	30, 1967	71.34
Dec. 2	, 1948	62.41	Dec.	7, 1949	40.75		Well YX-45-4	2-501
Dec. 7	, 1949	62.92	Dec.	2, 1950	41.68		Owner: Chas. V	V. Potts
Oct. 3	, 1950	62.90	Jan.	2, 1951	41.75		1938	9
July 21	, 1967	70.10	Apr.	22, 1967	50.33	May	19, 1967	25.13
W	lell YX-45-33-506			Well YX-45-3	4-401	July	19, 1967	24 00
Owner:	Standard Oil Con of Texas	npany	(Owner: Jack Ric	hardson	Aug.	16, 1967	24.00
June 23	, 1948	58.83	Feb.	9, 1955	44.68	Oct.	1, 1967	23.20
Dec. 7	, 1949	60.18	Dec.	4, 1955	49.18	Nov.	6, 1967	22.54
Oct. 3	3, 1950	60.31	Dec.	6, 1956	47.87		Well YX-45-4	2-502
July 31	, 1967	67.67	Dec.	6, 1957	45.98		Owner: R. Li	ndsey
W	lell YX-45-33-803		Dec.	5, 1959	45.59	Feb.	2, 1940	10.70
Owner:	Standard Oil Com	npany	June	25, 1967	45.43	Mar.	20, 1940	11.48
	of Texas		Oct.	21, 1967	48.66	Apr.	2, 1940	11.39
	2, 1949	58.69		Well YX-45-3	4-402	May	15, 1940	8.51
	7, 1949	58.68		Owner: Texa Highway Depa		Aug.	29, 1940	9.60
	2, 1950	58.83	Dec.	4, 1955	55,13	Oct.	2, 1940	10.26
	, 1952	60.36	Mar.	5, 1956	56.80	Dec.	6, 1940	11,12
	7, 1953	61.10			54.79	Mar.	27, 1941	12.96
Jan. 24	1, 1954	62.02	Dec.	6, 1956 E. 1050		May	15, 1941	9.93
Jan. 10), 1955	62.77	Dec.	5, 1959	56.09	Dec.	29, 1942	9.60
Jan. 4	1, 1956	63.55	Jan.	18, 1961	54.70		Well YX-45-4	2-504
Jan. 26	5, 1957	63.69	Dec.	6, 1961	58.08		Owner: R. D.	Morris
Feb. 7	7, 1958	63.68	Dec.	8, 1962	54.39	Apr.	26, 1967	21.60
Dec.	5, 1959	64.00	Dec.	4, 1963	57.06	July	19, 1967	20.40
Jan. 18	3, 1961	64.20	Dec.	6, 1965	55.38	Aug.	16, 1967	19.87
Dec.	5, 1961	64.72	Dec.	8, 1966	58.63	Oct.	1, 1967	18.37
Dec. 8	3, 1962	65.14		Well YX-45-3		Nov.	6, 1967	18.31
Dec.	4, 1963	66.84		Owner: Geo. R.			Well YX-45-	42-506
Dec.	3, 1964	69.25	Mar.	5, 1956	70.49		Owner: J. D. V	Vitcher
Dec.	5, 1965	69.62	Dec.	6, 1956	71.25	Apr.	27, 1967	21.42
	3, 1966	67.64	Dec.	6, 1957	71.49	July	19, 1967	19,41
July 2	1, 1967	67.33	Jan.	18, 1961	72.68	Aug.	16, 1967	19.37
			Dec.	6, 1961	71.83	Oct.	1, 1967	17.89
			Dec.	8, 1962	72.64	Nov.	6, 1967	17.83
			Dec.	4, 1963	74.16			

Table 7.—Water Levels in Wells in Ward County and Adjacent Areas—Continued

DATE	WATER LEVEL	DA	те	WATER LEVEL	D	ATE	WATER LEVEL
Well YX-45-4	2-507	v	Vell YX-46-2	3-902		Well YX-46-2	4-803
Owner: Eddie	Mosley		Owner: R, B.	Leck	Owne	r: Texas Electri	c Service Co.
Apr. 27, 1967	19.28	Dec.	5, 1959	108.25	Mar.	6, 1956	130,49
July 19, 1967	17.79	Jan. 1	8, 1961	107.75	Dec.	7, 1957	130.75
Aug. 16, 1967	16.92	Dec.	6, 1961	108.59	Dec.	5, 1959	131.84
Oct. 1, 1967	16.34	Dec.	8, 1962	108.70	Jan.	18, 1961	132,13
Nov. 6, 1967	16.14	Dec.	4, 1963	108.10	Dec.	6, 1961	133.00
Well YX-45-4	42-508	Dec.	3, 1964	108.52	Aug.	31, 1967	136.70
Owner: John R.	. Williams	Dec.	6, 1965	108.69		Well YX-46-2	4-902
Apr. 27, 1967	18,56	Dec.	9, 1966	108.34	Ow	ner: G. W. O'B	rien Estate
July 19, 1967	17.00	Sept. 1	3, 1967	111.22	Mar.	6, 1956	112.57
Aug. 16, 1967	15.90	Dec. 3	0, 1967	108.92	Oct.	15, 1956	112.68
Oct. 1, 1967	15.73	v	Vell YX-46-2	3-904	Dec.	6, 1956	112.73
Nov. 6, 1967	15,57		Owner: R. B.	Leck	Dec.	7, 1957	112.86
Well YX-45-	42-509	Oct.	7, 1956	107.24	Dec.	5, 1959	112.40
Owner: L. E.	Wilcox	Dec.	7, 1957	106.85	Jan,	18, 1961	114.35
July 19, 1967	20.13	Dec.	5, 1959	106.44	Dec.	6, 1961	112.00
Aug. 16, 1967	20.95	Sept. 1	2, 1967	109.30	Dec.	8, 1962	112.24
Oct. 1, 1967	17.93	· ·	Nell YX-46-2	4-701	Dec.	5, 1963	112.05
Nov. 6, 1967	19.08	Owr	ner: City of N	Monahans	Dec.	3, 1964	112.30
Well YX-45-	42-512	June	7, 1957	117,43	Dec.	6, 1965	112.34
Owner: Carpen	ter Farms	Dec.	5, 1959	119.20	Dec.	8, 1966	112.10
May 9, 1967	19.35	Aug. 3	1, 1967	126.71	Aug.	31, 1967	111,88
July 19, 1967	18.70	Dec. 1	4, 1967	123.89	Dec.	30, 1967	111,71
Aug. 16, 1967	18.80	1	Nell YX-46-2	4-802		Well YX-46-2	9-402
Oct. 1, 1967	17.85	Owne	er: G. W. O'B	rien Estate	C	Owner: Burkhol	der Bros.
Nov. 6, 1967	17.69	Mar.	6, 1956	135.95	Nov.	6, 1939	29.79
Well YX-45-	42-601	Dec.	6, 1956	136.10	Dec.	5, 1940	29.50
Owner: Hal Eu	udaly, Jr.	Dec.	7, 1957	136.84	Mar.	25, 1941	29.12
May 9, 1967	19.18	Dec.	5, 1959	136,57	Aug.	8, 1949	32.23
Aug. 16, 1967	19.02	Jan. 1	8, 1961	135.95	Mar.	23, 1950	32,95
Nov. 6, 1967	18.65	Dec.	6, 1961	136.76	Oct.	17, 1967	37.94
		Dec.	8, 1962	137.56		Well YX-46-2	9-503
		Dec.	5, 1963	140.07	0	wner: C. L. Mo	nroe Est.
		Dec.	6, 1965	138.10	Nov.	6, 1939	59.40
		Aug. 3	1, 1967	138.30	Dec.	5, 1940	57.28
		Dec. 3	0, 1967	137.87	Mar.	25, 1941	57.18
					May	13, 1941	57.04
					Aug.	11, 1941	56.99

Table 7.—Water Levels in Wells in Ward County and Adjacent Areas—Continued

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Well YX-46-29-5030	Continued	Well YX-46	-29-702	Aug. 14, 1942	6.82
Mar. 12, 1942	56.23	Owner: W.C.I	.D. No. 1	Dec. 25, 1942	12.77
Aug. 14, 1942	56.41	Sept. 30, 1946	13.73	Oct. 18, 1967	17.98
Dec. 28, 1942	56.50	Dec. 4, 1946	16.77	Well YX-4	6-29-705
Aug. 8, 1949	59.10	Jan. 29, 1947	14.94	Owner: M. I. Vi	da Farms, Inc.
Jan. 24, 1950	59.93	Feb. 8, 1949	18.50	Oct. 28, 1946	15.01
Mar. 23, 1950	59.54	Jan. 23, 1950	21.59	Dec. 4, 1946	16.00
Oct. 17, 1967	63,32	Mar. 3, 1950	20.61	Jan. 29, 1947	17.07
Well YX-46-29-7	701	Feb. 14, 1951	16.90	Mar. 3, 1948	20.08
Owner: M. I. Vida Fa	rms, Inc.	Jan. 29, 1952	18.74	Feb. 8, 1949	21.44
Sept. 8, 1941	4.69	Feb. 4, 1953	21.92	Jan. 23, 1950	22.64
Nov. 2, 1946	10.44	Jan. 23, 1954	24.77	Mar. 3, 1950	23.63
Dec. 4, 1946	11.21	Jan. 8, 1955	24.13	Oct. 18, 1967	20.70
Jan. 29, 1947	12.19	Jan. 5, 1956	20.26	Well YX-4	6-29-706
Mar. 3, 1948	14.87	Jan. 26, 1957	21.71	Owner: W.C	.I.D. No. 1
Feb. 8, 1949	16.80	Feb. 3, 1958	22.73	Sept. 30, 1946	11.36
Jan. 23, 1950	18,28	Feb. 12, 1959	20.03	Dec. 4, 1946	13,42
Mar. 3, 1950	18,82	Jan. 19, 1961	17.99	Jan. 29, 1947	12.67
Feb. 14, 1951	15.50	Dec. 7, 1961	17.52	Feb. 8, 1949	16.67
Jan. 29, 1952	20.35	Dec. 4, 1963	25.45	Jan. 23, 1950	19,57
Feb. 4, 1953	20.62	Dec. 3, 1964	29.34	Mar. 3, 1950	18.50
Jan. 23, 1954	23.74	Dec. 6, 1965	27.48	Feb. 3, 1958	20,72
Jan. 8, 1955	22.43	Dec. 10, 1966	27.82	Feb. 12, 1959	18.56
Jan. 5, 1956	18.09	Apr. 25, 1967	25.23	Oct. 18, 1967	16.80
Jan. 26, 1957	19.40	Oct. 18, 1967	19.78	Well YX-4	6-29-708
Feb. 3, 1958	22.55	Dec. 1, 1967	20.48	Owner: W.C	.I.D. No. 1
Feb. 12, 1959	18.24	Well YX-46	-29-704	Sept. 30, 1946	9.24
Jan. 19, 1961	16.86	Owner: M. I. Vid	a Farms, Inc.	Dec. 4, 1946	10.92
Dec. 7, 1961	15.32	Sept. 19, 1939	7.90	Jan. 29, 1947	10.94
Dec. 9, 1962	20.85	Oct. 19, 1939	6.92	Feb. 8, 1949	15.20
Dec. 4, 1963	25.58	Jan. 8, 1940	11.71	Jan. 23, 1950	18.86
Dec. 3, 1964	32.10	Apr. 30, 1940	10.65	Mar. 3, 1950	17.32
Dec. 6, 1965	27.93	Mar. 26, 1941	17.70	Apr. 25, 1967	20.35
Dec. 10, 1966	28.63	May 14, 1941	13.00	Oct. 18, 1967	14.19
Apr. 25, 1967	25.43	Aug. 11, 1941	8.28	Well YX-4	
Oct. 18, 1967	15.66	Sept. 5, 1941	7.84	Owner: R. E	
		Oct. 2, 1941	9.00	Nov. 25, 1946	17.70
		Mar. 12, 1942	11.22	Dec. 4, 1946	17.40

Table 7.—Water Levels in Wells in Ward County and Adjacent Areas—Continued

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Well YX-46-29-801	I-Continued	Well YX-46-	31-601	Dec. 7, 1961	50.80
Jan. 29, 1947	16.64	Owner: Lucill	e Smith	Dec. 8, 1962	49.89
Jan. 24, 1950	19.26	Mar. 6, 1956	99.72	Dec. 3, 1964	49.93
Mar. 3, 1950	19.29	Dec. 6, 1956	105.93	Dec. 6, 1965	50.15
Feb. 14, 1951	19.81	Dec. 7, 1957	103.35	Dec. 9, 1966	50.03
Jan. 28, 1952	21.85	Dec. 5, 1959	102.55	Nov. 13, 1967	57.86
Feb. 4, 1953	22,39	Jan. 1961	100.43	Well YX-46-	32-402
Jan. 23, 1954	22.36	Dec. 6, 1961	101.28	Owner: J. A. Peb	sworth, Jr.
Jan. 8, 1955	23.23	Dec. 8, 1962	100.20	Mar. 6, 1956	76.90
Jan. 5, 1956	23.42	Dec. 4, 1963	101.15	Dec. 6, 1956	77.67
Jan. 26, 1957	22.63	Dec. 3, 1964	101.08	Dec. 7, 1957	77.85
Feb. 3, 1958	23.61	Dec. 6, 1965	101.24	Dec. 5, 1959	77.84
Jan. 19, 1961	22.17	Dec. 9, 1966	101.45	Sept. 11, 1967	79.72
Dec. 7, 1961	22.80	Sept. 12, 1967	101.65	Well YX-46-	32-403
Dec. 9, 1962	22.95	Well YX-46-	31-602	Owner: Fitz	Sitton
Dec. 4, 1963	23.66	Owner: N. T.	Zachry	Mar. 6, 1956	79.12
Dec. 3, 1964	24.43	Mar. 6, 1956	99.00	Dec. 6, 1956	79.95
Dec. 6, 1965	24.35	Dec. 6, 1956	103.4	Dec. 7, 1957	81.75
Dec. 10, 1966	24.75	Dec. 7, 1957	100.82	Dec. 5, 1959	81.46
Apr. 26, 1967	24.79	Dec. 5, 1959	100.20	Jan. 18, 1961	80.24
Oct. 18, 1967	24.98	Jan. 18, 1961	99.60	Dec. 6, 1961	80.58
Dec. 1, 1967	25.34	Dec. 6, 1961	99.32	Dec. 8, 1962	80.56
Well YX-46-3	31-302	Dec. 8, 1962	99.92	Dec. 4, 1963	81.46
Owner: M. A. V	Williford	Dec. 4, 1963	100.55	Dec. 3, 1964	81.38
Mar. 6, 1956	104.95	Sept. 27, 1967	103.36	Dec. 6, 1965	81.53
Dec. 6, 1956	106.36	Well YX-46-	31-701	Dec. 9, 1966	81.58
Dec. 7, 1957	106.53	Owner: John	Wilson	Sept. 9, 1967	82.84
Dec. 5, 1959	105.91	Sept. 26, 1939	62.94	Dec. 30, 1967	82.92
Jan. 18, 1961	105.23	Mar. 11, 1940	66.43	Well YX-46-	32-405
Dec. 6, 1961	106.74	Oct. 8, 1940	63.81	Owner: J. A. Pet	sworth, Jr.
Dec. 8, 1962	105.20	Dec. 27, 1941	57.98	Mar. 6, 1956	80.75
Dec. 4, 1963	106.43	Oct. 28, 1942	63.06	Dec. 6, 1956	81,59
Dec. 3, 1964	105.63	Nov. 14, 1967	66.05	Dec. 7, 1957	82.28
Dec. 6, 1965	106.00	Well YX-46-	31-901	Dec. 5, 1959	81,97
Dec. 9, 1966	105.69	Owner: Dr. H. I	B. Johnson	Jan. 18, 1961	81.94
Sept. 12, 1967	105.95	Dec. 7, 1957	54.14	Dec. 6, 1961	82.06
Oct. 30, 1967	105.94	Dec. 5, 1959	50.74	Dec. 8, 1962	82.19
		Jan. 18, 1961	50.90	Dec. 4, 1963	82.61

Table 7.—Water Levels in Wells in Ward County and Adjacent Areas—Continued

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Well YX-46-32-405	—Continued	Well YX-46-	37-101	Jan. 29, 1947	13.02
Dec. 3, 1964	83.04	Owner: Dan	Cooper	Feb. 8, 1949	15.76
Dec. 6, 1965	83,20	Feb. 3, 1958	16.60	Jan. 23, 1950	19.15
Dec. 9, 1966	83.33	Dec. 12, 1959	15.64	Mar. 3, 1950	17.86
Sept. 9, 1967	83.77	Jan. 19, 1961	13.07	Feb. 4, 1953	19.05
Dec. 30, 1967	83.47	Dec. 7, 1961	12.81	Jan. 23, 1954	22.20
Well YX-46-3	32-504	Dec. 9, 1962	14.83	Jan. 11, 1955	16.46
Owner: Texa	as State	Dec. 4, 1963	17.94	Jan. 5, 1956	14.00
Highway Dep	artment	Dec. 6, 1965	18.46	Jan. 26, 1957	14.10
Feb. 23, 1940	104.98	Dec. 10, 1966	18.62	Feb. 3, 1958	15.05
Jan. 31, 1952	106.42	June 21, 1967	20.25	Feb. 12, 1959	15.92
Feb. 7, 1953	107.08	Oct. 20, 1967	16.08	Jan. 19, 1961	14.01
Jan. 24, 1954	107.74	Dec. 1, 1967	19.01	Dec. 7, 1961	13.01
Jan. 10, 1955	107.94	Well YX-46-	37-102	Dec. 4, 1963	20.72
Jan. 4, 1956	107.84	Owner: C. Ar	mstrong	Dec. 3, 1964	31.90
Jan. 26, 1957	107.65	Dec. 17, 1930	4.11	Dec. 6, 1965	31.88
Feb. 7, 1958	108,53	Dec. 31, 1931	4.45	Dec. 19, 1967	15.38
Dec. 5, 1959	109.67	Feb. 2, 1932	5.12	Well YX-46-	37-204
Jan. 18, 1961	109.54	Dec. 9, 1939	6.02	Owner: W.C.I.	D. No. 1
Dec. 6, 1961	109.80	June 3, 1940	6.38	Sept. 30, 1946	10.85
Dec. 8, 1962	109.80	Dec. 5, 1940	7.73	Dec. 4, 1946	12.22
Dec. 4, 1963	110.40	Mar. 25, 1941	8.70	Jan. 29, 1947	12,47
Dec. 3, 1964	111.32	Dec. 28, 1942	5.40	Feb 8, 1949	15.66
Dec. 6, 1965	110.77	Well YX-46	-37-104	Jan. 23, 1950	18.26
Dec. 8, 1966	112.00	Owner: Dan	Cooper	Mar. 3, 1950	17.64
Sept. 6, 1967	112.64	Feb. 3, 1958	13.86	Aug. 17, 1950	10.54
Well YX-46-	32-506	Feb. 12, 1959	12.72	Feb. 14, 1951	11.76
Owner: Texas Elect	ric Service Co.	June 21, 1967	17.6	Feb. 4, 1953	19.06
Dec. 5, 1959	97.40	Dec. 20, 1967	15.42	Jan. 23, 1954	21.21
Jan. 18, 1961	97.10	Well YX-46	-37-105	Jan. 11, 1955	21.18
Dec. 6, 1961	97.73	Owner: Floy	d Lukins	Jan. 5, 1956	11.42
Dec. 8, 1962	97.98	Jan. 8, 1950	14.25	Jan. 26, 1957	16.07
Dec. 4, 1963	99.35	July 10, 1950	15.50	Feb. 3, 1958	17.10
Dec. 3, 1964	99.43	Feb. 14, 1951	11.98	Feb. 12, 1959	17.89
Dec. 6, 1965	99.69	June 29, 1967	22,9	Jan. 1961	14.53
Dec. 8, 1966	100.39	Well YX-46	-37-201	Dec. 7, 1961	12.95
Sept. 14, 1967	101.07	Owner: W.C.I	.D. No. 1	Oct. 23, 1967	13.30
Dec. 30, 1967	100.81	Sept. 30, 1946	13.19		
		Dec. 4, 1946	15.32		

Table 7.—Water Levels in Wells in Ward County and Adjacent Areas—Continued

DATE		ATER EVEL	D		WATER LEVEL	D		WATER LEVEL
We	II YX-46-37-206	The Real Property	Jan.	23, 1954	22.35	Feb.	14, 1951	14.56
Owner	: R. S. (Bob) Haye	s the second	Jan.	11, 1955	19.32	Jan.	4, 1956	16.94
Dec. 28,	1946 1	3,83	Jan.	5, 1956	10.62	May	10, 1967	19.15
Dec. 4,	1946 1	4.41	Oct.	23, 1967	15.87	Oct.	25, 1967	19.43
Dec. 9,	1947 1	4.71		Well YX-46-37-211			Well YX-46-37-303	
Mar. 3,	1948 1	5.37	0	wner: R. W. Burkhold	der	Owi	ner: Snyder National E	Bank
Feb. 8,	1949 1	5.51	Dec.	2, 1959	18.25	Feb.	8, 1940	7.11
Dec. 3,	1950 1	6.68	Jan.	19, 1961	16.10	Oct.	19, 1940	5.44
Mar. 3,	1950 1	7.21	Dec.	7, 1961	14.07	Mar.	1, 1941	8.19
Feb. 14,	1951 1	4.68	Dec.	9, 1962	18.52	July	21, 1941	3.16
Jan. 29,	1952 1	6.96	Dec.	4, 1963	18.30	Jan.	1, 1942	5,45
Feb. 4,	1953 2	0.67	Dec.	3, 1964	22.27	July	21, 1942	2.50
Jan. 23,	1954 3	4.18	Dec.	6, 1965	22.07	Dec.	29, 1942	5.66
Jan. 8,	1955	2.72	Dec.	10, 1966	19.00		Well YX-46-37-305	14772
Jan. 4,	1956 1	5.23	Oct.	24, 1967	14.84	Owner:	Allgood, Avary, and Co	ummings
Jan. 26,	1957 1	7.88	Dec.	1, 1967	16.97	Dog	17 1000	E 41
Feb. 3,	1958 1	7.35		Well YX-46-37-213		Dec.	17, 1930	5.41
Feb. 12,	1959 1	7.79		Owner: W.C.I.D. No.	1	Dec.	31, 1931 9, 1939	8.59
Dec. 24,	1967 1	6.76	Dec.	17, 1930	4.52	Dec.	5, 1940	9.71
We	II YX-46-37-207		May	6, 1931	1.30	Mar.	26, 1941	10.18
Ov	vner: R. Allgood		Dec.	9, 1939	5.91	Dec.		
Dec. 17,	1930	5.97	Dec.	5, 1940	8.04		29, 1942	9.61
Dec. 31,	1931	3.98	Dec.	28, 1942	5.63	Nov.	1, 1946	12.13
May 2,	1932	3.12	Jan.	31, 1947	12.28	May	10, 1967	16.03
Dec. 9,	1939	7.21	Oct.	23, 1967	15.20	Nov.	9, 1967 Well YX-46-37-306	15.83
Apr. 10,	1940	8.33		Well YX-46-37-214				
Dec. 5	1940	9.87	C	wner: R. W. Burkhol	der	Man	Owner: Paul Durkel	0.00
Mar. 25,	1941	10.71	Dec.	17, 1930	7.15	Mar.	7, 1940	9.98
Dec. 21,	1942	7.76	May	6, 1931	4.88	Dec.	1, 1940	9.20
Oct. 29	1946	15.32	Dec.	21, 1931	9.10	July Dec.	2, 1941	3.86
W	ell YX-46-37-208		June	6, 1932	4.32	June	16, 1941	6.27
Owr	er: W.C.I.D. No. 1		Nov.	1, 1946	15.54	Dec.	16, 1942 29, 1942	7.67
Dec. 4	1946	12.08	Oct.	24, 1967	16.85	Dec.	Well YX-46-37-307	7.07
Jan. 29	1947	13,32		Well YX-46-37-302			Owner: Geo. E. Brigg	s
Feb. 8	1949	16.28	C	owner: W. G. Burkhol	der	Dec.	17, 1930	6.53
Jan. 23	1950	18.49	Jan.	31, 1947	14.55	May	6, 1931	5.15
Feb. 14	1951	13,06	Mar.	3, 1948	15.22	Dec.	31, 1931	8.23
Feb. 4	1953	20.00	Feb.	8, 1949	15.29	June	1, 1932	5.87

Table 7.—Water Levels in Wells in Ward County and Adjacent Areas—Continued

D		NATER LEVEL	C	DATE	WATER LEVEL	D	ATE	WATER LEVEL
Well	YX-46-37-307-Con	tinued		Well YX-46-37-404	1	Feb.	3, 1958	20.17
Dec.	9, 1939	10.46	(Owner: A. J. Carpen	ter	Feb.	12, 1959	20.87
Dec.	1, 1940	13.54	Aug.	29, 1949	17.39	Jan.	18, 1961	19.84
July	2, 1941	8.07	Sept.	23, 1949	13.08	Dec.	7, 1961	19.26
Oct.	2, 1941	11.62	Jan.	18, 1950	8.31	Dec.	9, 1962	21.94
May	16, 1942	4.00	Oct.	20, 1967	18.70	Dec.	4, 1963	23.69
Dec.	29, 1942	9.00		Well YX-46-38-102	2	Dec.	3, 1964	25.75
Oct.	24, 1967	13.02	1	Owner: C. E. Swaffo	ord	Dec.	6, 1965	25.61
	Well YX-46-37-308		Sept.	26, 1939	94.28	Dec.	10, 1966	21.88
	Owner: M. W. Nichol	s	Aug.	8, 1949	96.67	Nov.	9, 1967	19.16
Dec.	17, 1930	2.03	Jan.	23, 1950	96.94	Dec.	1, 1967	22.14
Dec.	31, 1931	9.90	Mar.	23, 1950	97.03		Well YX-46-38-105	i
Feb.	2, 1932	9.92	Feb.	14, 1951	96,77		Owner: C. E. Swaffo	rd
Dec.	9, 1939	9.21	Jan.	28, 1952	97,30	Sept.	26, 1939	96.01
Jan.	9, 1940	9.93	Feb.	4, 1953	98.27	Dec.	27, 1941	94.28
Aug.	5, 1940	9.36	Jan.	24, 1954	99.35	Dec.	28, 1942	94.62
Mar.	26, 1941	11.22	Jan.	9, 1955	100.10	Oct.	26, 1967	101.87
Dec.	29, 1942	8.92	Jan.	4, 1956	99.98		Well YX-46-38-50	2
	Well YX-46-37-313		Jan.	26, 1957	100.10	(Owner L. M. Watson,	Jr.
Ov	vner: E, W. Sweatt Es	tate	Feb.	3, 1958	100.21	Jan.	23, 1950	18.68
Oct.	29, 1946	17.20	Feb.	12, 1959	100.24	Mar.	1, 1950	18.87
Aug.	29, 1949	11.06	Oct.	26, 1967	100.34	Feb.	14, 1951	18.39
May	10, 1967	24.75		Well YX-46-38-104	4	Jan.	29, 1952	18.60
Oct.	26, 1967	22.76		Owner: W. L. Fulle	er .	Feb.	4, 1953	19.81
	Well YX-46-37-401		May	20, 1940	14.90	Jan.	23, 1954	22.30
	Owner: Dan Cooper		June	5, 1940	14.81	Jan.	10, 1955	23.20
Aug.	31, 1939	2.34	Nov.	2, 1946	15.74	Jan.	5, 1956	22.46
Dec.	9, 1939	1.54	Dec.	4, 1946	15.98	Jan.	26, 1957	22.76
Dec.	5, 1940	2.54	Jan.	30, 1947	16.96	Feb.	3, 1958	22.49
Jan.	18, 1950	8.33	Mar.	3, 1948	17.35	Feb.	12, 1959	21.35
Feb.	14, 1951	9.27	Feb.	8, 1949	17.61	Jan.	18, 1961	21.68
Jan.	29, 1952	13.54	Jan.	18, 1950	18.46	Dec.	7, 1961	21.48
Feb.	4, 1953	19.66	Mar.	3, 1950	18.91	Dec.	9, 1962	21.93
Jan.	23, 1954	24.40	Feb.	14, 1951	16.09	Dec.	4, 1963	21.56
Jan.	8, 1955	25.86	Jan.	29, 1952	19.14	Dec.	3, 1964	22.10
Jan.	5, 1956	22.75	Jan.	23, 1954	24.34	Dec.	6, 1965	22.13
Jan.	26, 1957	18.65	Jan.	9, 1955	22.29	Dec.	10, 1966	22.80
Feb.	3, 1958	22.42	Jan.	5, 1956	16.39	Nov.	14, 1967	21.75
Feb.	12, 1959	22.82	Jan.	26, 1957	19.51	Dec.	1, 1967	22.51

Table 7.—Water Levels in Wells in Ward County and Adjacent Areas—Continued

	DATE	WATER LEVEL	C	PATE	WATER LEVEL	C	DATE	WATER LEVEL
	Well YX-46-40-30	4	Dec.	8, 1962	28.56	Dec.	8, 1962	118.37
	Owner: W. Lochaboy	, Jr.	Dec.	5, 1963	28.85	Dec.	4, 1963	110,11
Sept	. 8, 1961	122.72	Dec.	3, 1964	28.89	Dec.	3, 1964	110.62
June	4, 1967	127.13	Dec.	6, 1965	30.09	Dec.	6, 1965	110,75
Aug	. 11, 1967	129.05	Dec.	8, 1966	29.55	Dec.	9, 1966	110.50
Dec	14, 1967	127.30	May	17, 1967	29.22	Nov.	29, 1967	117.30
	Winkler County		Sept.	2, 1967	29.75		Well ZP-46-23-903	3
	Well ZP-45-17-90		Nov.	29, 1967	29.94		Owner: R. J. Millig	an
(Owner: Shell Oil Com	pany		Well ZP-46-23-603		Mar.	6, 1956	105.14
Oct.	8, 1956	28.95		Owner: Jack Baugu	ıs	Oct.	7, 1956	105.63
Jan.	4, 1958	29.09	Feb.	26, 1957	110.18	Dec.	6, 1956	105,53
Dec	2, 1960	28.95	Feb.	1, 1960	117.73	Dec.	7, 1957	106.06
Dec	. 7, 1961	28.35	Dec.	8, 1961	116.40	Sept.	14, 1967	106.47

Table 8. -- Chemical Analyses of Water From Wells in Ward County and Adjacent Areas

WELL	DEPTH OR PRODUCING INTERVAL (FT)		TE OF LECTION	WATER - BEARING UNIT	SILICA (SiO ₂)			MAGNE - SIUM (Mg)	SODIUM (Na)	POTAS - SIUM (K)	BICAR- BONATE (HCO ₃)	SUL - FATE (SO ₄)	CHLO- RIDE (C1)	FLUO - RIDE (F)	NITRATE (NO)	BORON (B)	DIS- SOLVED SOLIDS	HARD - NESS AS CaCO ₃	PERCENT SODIUM	SODIUM - ADSORP - TION RATIO (SAR)	RESIDUAL SODIUM CARBONATE (RSC)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	pН	TE PE TU °C
X-45-17-701	403	Apr.	28, 1967	A	14		91	20	138	4.9	196	280	114	1,1	0,2	0.21	760	310	49	3.4	0.00	1,200	7.2	2 22
702	284		do	A							200	202	47					272			.00	840	7.4	4 21
801	64	May	16, 1940	A			160	23	* 124		212	423	106		.3		941	494	35			1,420		
801	64	Apr.	28, 1967	A							264	103	30					262			.00	683	7.3	21
902	129	Nov.	2, 1951	A	32	0.07					104		198					274				866	7.7	7
902	129	Sept.	19, 1966	A	52	.44	16	197	* 93		305	243	390				1,140	850				2,250	6.9	
903	120		do	A	48	.09	24	75	* 56		171	50	213				502	370				960	7.4	
904	126		do	A	42	.09	16	148	* 41		98	10	460				765	650				1,400	7.7	7
905	123		do	A	34	.20	8	107	* 66		110	13	354				636	460				1,160	7.9	
906	442	Nov.	2, 1951	A	36	2.3					154		26					146				403	7.4	
906	442	Sept.	19, 1966	A	42	. 04	20	41	* 56	15.	134	30	142				397	220				565	7.5	
18-701	10	Apr.	26, 1957	A	4.2		53	7.5	* 11		96	77	18		1.2		219	162	12	.4		373	7.0) -
801	75	May	14, 1967	A	37	1.1	36	7.6	6.4	2.4	114	14	5.0	.4	24	.06	189	121	10	.3	.00	275	7.1	2
901	81	Mar.	22, 1940	A			163	51	* 166		160	643	126				1,229	616	37			1,750		-
901	81	May	18, 1967	A							130	780	140					690			.00	1,990	7.3	21
25-101	485	Apr.	28, 1967	A							204	226	90					250			.00	1,030	7.4	
103	157	May	3, 1940	A			90	31	* 79		189	226	94		2.5		616	352	33			1,020		-
201	95	Apr.	29, 1941	A			42	5.2	* 16		130	24	19	.8	.0		171	126	21			347		
201	95	Apr.	28, 1967	A	40		62	7.2	20	1.9	130	70	33	.8	.0		299	184	19	.6	.00	455	7.6	
202	86	Feb.	25, 1943	A			38	4.1	* 8.4		134	14	4.0		.0		134	112			<u> </u>			
203	294	Sept.	26, 1967	A	60		58	13	25	3,5	134	87	38	.7	2.5		354	198	21	.8	.00	508	7.4	21
301	134	Apr.	28, 1967	A							118	87	2,680					660			.00	8,300	7.0	21
302	123		do	A	17		104	19	318	4,8	200	454	280	1.8	16		1,310	338	67	7.5	.00	2,060	7.5	21
304	110	Apr.	29, 1941	A	38		68	11	* 16		118	53	67	.7	2,2		314	215	14			534		
304	110	Apr.	13, 1967	A	39	. 02	94	14	48	2.7	136	118	98	.7	39	.10	521	292	26	1.2	.00	823	6.9	
305	176	Aug.	18, 1967	A							124	54	178					296			.00	876	7.5	
306	160	Dec.	18, 1967	A							133	28	13					141			.00	314	7.4	

Table 8. --Chemical Analyses of Water From Wells in Ward County and Adjacent Areas--Continued

WEI	Т	DEPTH OR PRODUCING INTERVAL (FT)	DATE OF COLLECTION	WATER - BEARING UNIT	SILICA (SiO ₂)			MAGNE- SIUM (Mg)	SODIUM (Na)	POTAS - SIUM (K)	BICAR- BONATE (HCO ₃)	SUL - FATE (SO ₄)	CHLO- RIDE (C1)	FLUO- RIDE (F)	NITRATE (NO)	BORON (B)	DIS- SOLVED SOLIDS	HARD - NESS AS CaCO ₃	PERCENT SODIUM	SODIUM - ADSORP - TION RATIO (SAR)	RESIDUAL SODIUM CARBONATE (RSC)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	pН	PI	ER
YX -45	-25-308	150	Feb. 28, 1944	A	34	0.2	58	5	* 19		134	37	41	0.6	3.1		230	165							
	308	150	Apr. 28, 1967	A	34		75	7.0	86	4.2	182	146	76	1.2	.8	.17	519	216	46	2.5	0.00	811	7.2	19	
	312	149	Sept. 16, 1964	A		.36	165	23	* 127		176	310	225			1	937	504					7.5		
	313	160	Sept. 15, 1964	A		.16	229	26	* 159		195	425	302				1,240	680					7.3		
	313	160	Jun. 1, 1967	A		. 04	274	34	* 222		200	620	337	1.2	26		1,610	830					7.4		
	314	160	Dec. 6, 1956	A		.30	65	12	* 75		170	89	91	1.8	6.0		424	215				751	7.9		
	315	221	Jun. 22, 1956	A		.02	46	8	* 43		171	40	46	1.6	2.4		272	148					7.8		
	315	221	Sept. 15, 1964	A	15	.16	83	11	* 62	**	161	121	93				464	254					7.6		
	315	221	Dec. 28, 1966	A			201	25	* 124		190	312	280	1.1	12		1,050	610	-			2,070	7.4		
	315	221	Jun. 1, 1967	A		.04	206	26	* 139		189	357	289	1.2	15		1,130	620					7.6		
	315	221	Jan. 28, 1968	A			248	35	* 235		207	570	367	1.1	14		1,570	760			- 75		7.5		
	316	165	Jan. 5, 1956	A	43	.3	22	5	* 71		195	38	21	1.8	1.3		300	76							
	316	165	Sept. 15, 1964	A	16	.24	93	13	* 48		139	126	104				469	284					7.7		
	316	165	Jun. 1, 1967	A		.16	105	19	* 50		131	188	114	1.0	2.0		544	343					7.5		
	316	165	Jan. 28, 1968	A		.04	149	19	* 75	-	145	244	170	1.3			730	451					7.6		
	317	965	Mar. 30, 1951	Pr	18	.9	1,010	638	13,100	19	116	5,050	19,800	1.7		4.4	39,700	5,140	85			52,000	7.4	23	
	317	160	Apr. 28, 1967	A							244	436	186					512			.00	1,760	7.3	21	
	318	222	Feb. 25, 1943	A			55	9.7	* 97		206	118	65		5.6		452	178							
	322	221	Sept. 16, 1964	A		.16	113	7	* 108		176	180	154				648	312					7.7		
	323	100	May 17, 1967	A							128	112	121					328				834	6.9	21	
	324	450	Apr. 29, 1941	A	36		57	9,1	* 40		145	68	50	1.0	3.5		336	180	32			576			
	325	126	Aug. 17, 1967	A	46		214	34	85	4.2	140	348	275	.8	14		1,090	674	21	1.4	.00	1,670	7.3		
	402	763	Aug. 30, 1967	A	22		96	34	201	5.1	208	185	330	1.5	3.0		980	380	53	4.5	.00	1,670	7.6	23	
	403	325	Aug. 18, 1967	A							178	227	136					362			.00	1,130	7.6	23	
	404	346	Feb. 25, 1943	A			103	3.0	* 86		175	254	112		3.0		674	380							
	405	650	Sept. 8, 1967	A	15		50	21	180	4.3	180	140	225	1.8	.5		727	212	64	5.4	.00		7.9	23	
	501	200	May 13, 1967	A	30		35	6.0	81	3.0	208	54	39	2.5	1.0	.15	354	112	60	3.3	1.17	566	7.4	21	
	502	210	do	A							159	35	30					150			.00	436	7.1	21	
	505	120	May 15, 1941	A			139	49	* 171		145	673	72		.0		1,180	548	40			1,660			
	505	120	Mar. 29, 1968	A	62		272	78	398	34	180	1,480	144		1.4	.69	2,560	1,000	45	5.5	.00	3,180	7.2	21	The Person of the last

Table 8.--Chemical Analyses of Water From Wells in Ward County and Adjacent Areas--Continued

WELL		DEPTH OR PRODUCING INTERVAL (FT)	DATE OF COLLECTION	WATER - BEARING UNIT	SILICA (SiO ₂)			MAGNE - SIUM (Mg)	SODIUM (Na)	POTAS - SIUM (K)	BICAR- BONATE (HCO ₃)	SUL - FATE (SO ₄)	CHLO- RIDE (C1)	FLUO- RIDE (F)	NITRATE (NO)	BORON (B)	DIS - SOLVED SOLIDS	HARD - NESS AS CaCO ₃	PERCENT SODIUM	SODIUM - ADSORP - TION RATIO (SAR)	RESIDUAL SODIUM CARBONATE (RSC)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	рН	P	EM- ERA URE
YX-45-25	-506	90	Mar. 29, 1968	A	45		120	36	97	24	170	448	58	2.3	4.7		919	448	31	2.0	0.00	1,270	7.4	21	7
∌	507	250	Jun. 1, 1967	A		.04	180	60	* 161		156	660	174	1.2	14		1,330	700					8.0		-
a)	508	275	do	A		.04	208	64	* 223		194	820	168	1.5	21		1,600	780					7.9		-
	509	300	Sept. 27, 1967	A							250	114	30					122			1.66	701	7.8		-
	510	150	do	A							119	75	13					87			.21	394	7.5		-
	511	266	Sept. 26, 1967	A	55		66	19	78	7.3	159	126	116	1.2	.2		547	242	40	2.2	.00	849	7.5	21	70
3	603	140	Jun. 12, 1956	A		.16	48	7.0	* 53		165	68	57	2.0	2		319	150					7.7		
3	603	140	Sept. 15, 1964	A	15		82	13	* 60		163	121	93				467	258					7.6		
3	603	140	Jun. 1, 1967	A			67	9	* 67		176	91	72	1.8	8		403	203					7.6		
3/	603	140	Jan. 28, 1968	A		.28	66	9	* 52		150	74	81	1.4	3.5		361	204					7.7		
9	604	156	May 25, 1956	A			24	4	* 59		177	31	25	2.2	1.4		234	78					7.9		
∌/	604	156	Sept. 15, 1964	A	16	.12	67	11	* 51		176	78	70				379	216					7.7		
9	604	156	Jun. 1, 1967	A		.04	102	18	* 63		170	176	107	1.5	4.0		556	330					7.6		
9/	604	156	Jan. 28, 1968	A		.12	84	12	* 124	e Hite	215	193	111	2.5	5.0		638	262					7.7		-
e	605	154	Jun. 1, 1956	A		. 02	25	5	* 62		189	31	36	2.6	1.3		256	85					8.1		
1	605	154	Sept. 15, 1964	A	13		71	17	* 78		185	138	90				500	248					7.6		
e)	605	154	Jun. 1, 1967	A		. 04	106	19	* 99		165	228	121	1.8	16		673	343					7.7		
e)	605	154	Jan. 28, 1968	A		.04	180	28	* 144		160	379	242	1.4	16		1,070	560					7.6		
	606		May 15, 1967					1			320	138	34					95			3.34	896	7.5		
	607		Apr. 29, 1941		28		28	5.2	* 46	750	166	31	12	1.8	1.5		235	91	52			392			
	607		May 18, 1967								184	180	142					284			.00		7.1	21	
	701		Mar. 29, 1968		44		97	24	103	3.6	192	315	54	2.6	1.8		739	340	39	2.4	.00		7.5	22	72
	702	79	May 29, 1940		-		112	33	* 12		332	38	32		105		496	415	6			843			
	702	79	Aug. 30, 1967								314	29	31		89			376			.00		7.3		
	704	260	May 3, 1940		25		72	22	* 83	2.0	203	168	76	1.0	2.2		523	270	40	2.2		876			
	704		Aug. 30, 1967		35	.01	67	18	80	3.8	202	166	66	1.8	2.2	.16	539	241	41	2.2	.00		7.5	22	72
dy	706	280	do	A	20		62	16	+ 94		190	157	56				498	252			.00		7.9	22	
	707	220	Oct. 31, 1960		28	.44	62	16	* 84		207	149	56					213							
	707 801	186	Aug. 30, 1967 Apr. 23, 1941								204	106	58 355				2,340	213			.00		7.6	22	72

Table 8. --Chemical Analyses of Water From Wells in Ward County and Adjacent Areas--Continued

WELL	DEPTH OR PRODUCING INTERVAL (FT)	DATE OF COLLECTION	WATER - BEARING UNIT	SILICA (SiO ₂)		CAL - CIUM (Ca)	MAGNE - SIUM (Mg)	SODIUM (Na)	POTAS - SIUM (K)	BICAR- BONATE (HCO ₃)	SUL- FATE (SO ₄)	CHLO- RIDE (C1)	FLUO- RIDE (F)	NITRATE (NO)	BORON (B)	DIS - SOLVED SOLIDS	HARD - NESS AS CaCO ₃	PERCENT SODIUM		RESIDUAL SODIUM CARBONATE (RSC)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	рН	PE	ERA JRE °F
YX -45-25-802	180	July 24, 196	7 A							192	2,210	440					1,650			0.00	5,300	7.8		
803	90	Mar. 29, 196	8 A	56		592	110	244	63	92	2,120	173		15		3,420	1,930	21	2.4	.00	3,650	7.0	21	70
903	100	May 11, 196	7 A	48		58	15	101	3.8	206	162	62	2.7	3.2	0.19	557	206	51	3.1	.00	848	7.2	21	70
904	76	Apr. 23, 194	1 A			65	12	* 62		289	48	40		3.0		372	212	39			665.			
905	167	do	A			72	19	* 247		279	407	100		2.5		985	258	68			1,520			
906	220	May 11, 196	7 A							266	339	140					160			1.16	1,530	7.5	21	70
907	126	do	A	5.1		69	19	109	3.7	237	178	73	2.9	2.5	.18	625	250	48	3.0	.00	957	7.1	21	70
908	250	Jun. 21, 196	7 A							187	1,030	282					940			.00	2,870	7.6	23	73
909	100	do	A							150	1,900	31,500					4,900			.00	75,500	7.2		
911	100	Dec. 9, 196	7 A	31		1,340	345	25,300	196	196	2,810	41,000				71,100	4,760	92			96,600	7.3	21	70
912	1,750	do	Ps	4.7	3.9	1,000	1,410	121,000	780	122	6,860	191,000			16	322,000	8,290	97			241,000	6.6		
913	200	do	A	52		130	45	224	8.3	286	434	195	2.3	49		1,280	510	48	4.3	.00	1,880	7.2		
26-102	90	May 14, 196	7 A					- ==		74	41	40					147			.00	359	6.8	21	70
103	150	May 15, 196	7 A							174	60	44					215			.00	554	7.0		
201	72	May 16, 194	0 A			36	9.6	* 14		132	19	8.0		25		177	129	19			301			
202	80	May 18, 196	7 A							120	51	37		94			220			.00	547	6.9	21	70
401	130	May 15, 196	7 A	32		44	7.8	39	2.1	179	47	20	1.4	1.2		282	142	37	1.4	.10	447	7.2	21	70
501	80	do	A	39		73	16	49	3.7	240	86	34	1.6	23		443	248	30	1.4	.00	684	7.1	21	70
502	124	do	A	41		150	40	122	4.7	168	508	94	2.5	5.7		1,050	538	33	2.3	.00	1,480	7.0	21	70
701	213	May 16, 196	7 A	41		82	19	201	4.6	248	282	152	2.2	3.0	.35	909	282	60	5.2	.00	1,400	7.3	22	72
702	933	May 12, 196	7 Pr							418	1,950	8,400					6,950				26,600	8.4	21	70
703	150	May 11, 196	7 A							262	107	29			'		172			.85	752	7.2	21	70
801	95	do	A							196	1,240	160					1,100			.00	2,760	7.1	21	70
901	165	do	A							216	436	395					558			.00	2,310	7.0	21	70
33-102	175	May 17, 194) A			78	23	* 71		124	197	96		20		528	289	35			1,040			
cj 103	157	Nov. 11, 196	A A		1.6	62	24	* 127		212	160	137				612	252					7.9		
103	157	Jul. 24, 196	7 A							214	157	99					260		14-	.00	952	7.6	22	72
104	360	Jul. 26, 196	A							196	165	186					368			.00	1,190	7.5	22	72
105	250	Jul. 27, 196	A							197	163	980					1,000			.00	3,500	7.2	22	72
106	303	Jul. 25, 196	A							204	155	71					238			.00	844	7.4	22	72

Table 8. -- Chemical Analyses of Water From Wells in Ward County and Adjacent Areas--Continued

WELL		DEPTH OR PRODUCING INTERVAL (FT)		TE OF LECTION	WATER - BEARING UNIT	SILICA (SiO ₂)			MAGNE - SIUM (Mg)	SODIUM (Na)	POTAS - SIUM (K)	BICAR- BONATE (HCO ₃)	SUL- FATE (SO ₄)	CHLO- RIDE (C1)	FLUO- RIDE (F)	NITRATE (NO)	BORON (B)	DIS - SOLVED SOLIDS	HARD - NESS AS CaCO ₃	PERCENT SOD IUM	SODIUM - ADSORP - TION RATIO (SAR)	RESIDUAL SODIUM CARBONATE (RSC)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	рН	P	EM - ERA URE
YX-45-33	-107	250	Dec.	11, 1967	A							204	179	258					470			0.00	1,430	7.9		-
	108	125	Dec.	12, 1967	A	40	1.2	117	38	302	6.6	254	261	435	2,5	4.5	0.29	1,330	448	59	6.2	.00	2,200	7.5		-
鱼	201	409	Nov.	28, 1959	A			157	59	* 131		131	615	110				1,140						7.0		
덜	202	300	Mar.	16, 1965	A		.60	91	26			210	300	75					332					7.7		
	203	319	Jul.	18, 1967	A							196	336	700					890			.00	2,940	7.5	22	72
	205	300		do	A							144	357	88					332			.00	1,190	7.7	22	72
	206	340	Jul.	24, 1967	A							164	166	59					232			.00	795	7.1	23	73
의	207	295	Nov.	11, 1966	A			122	45	* 87	1 1 200	187	390	179				915	490					7.3		
덜	208	240		do	A		.19	120	44	* 145		183	387	173				959	482					7.3		¦
의	209	352	Jun.	1, 1967	A		.04	47	26			219	147	56					224					7.3		
	212	300	Aug.	28, 1967	A							258	286	154					70			2.8	1,450	8.0		
	214	330		do	A							182	500	555					705			.00	2,750	7.4	22	72
	301	259	Jun.	24, 1967	A							292	256	158					64			3.51	1,480	8.0	21	70
	302	117	Apr.	23, 1941	A			475	142	* 301		164	2,020	110		36		3,170	1,770	27			3,580		21	70
<u>c</u>	303	411	Mar.	6, 1963	A		.28							210										7.3		
	303	411	Jul.	18, 1967	A	38	.16	330	92	282	36	170	1,410	195		7.6	.44	2,480	1,200	33	3.6	.00	3,070	7.4	23	73
cj	304	405	Mar.	6, 1963	A		.12	141													- "			7.3		
ੁ	305	400		do	A		.16	152																7.3		
	401	250	Jun.	23, 1967	A							224		280					262			.00	1,620	7.5	22	72
	402	168	Aug.	18, 1967	A							254	736	2,080					600			.00	7,640	7.5	23	73
	501	71	Apr.	2, 1941	A			172	32	* 135		280	259	154		41		1,030	561	34			1,680			
	501	71	Apr.	2, 1949	A	60		164	36	* 127		272	333	155		55	.58	1,060	558	33			1,570			
	504	157	Sept.	27, 1948	A	52		83	24	* 60		200	155	77		1.2		551	306	30			918			
	505	157	Jul.	21, 1967	A							206	182	85					276			.00	941	8.0		
	507	230	Jun.	22, 1967	A	29	.01	70	22	325	5.3	234	224	398	2.4	3.5	.27	1,190	265	72	8.7	.00				72
	509	155	Jul.	21, 1967	A							200	320	104					360			.00				70
	511	190		do	A							186	292	1,140					960			.00			22	72
c/	513	275	Dec.	5, 1966	A		. 08	90	34			205	367	74					364	Care To				7.5		
cj	514	223		do	A		.46	175	47	Transfer.		212	180	428					630							77.7
	514	223	Jul.	21, 1967	A							204	192	570					632			.00	2,400	7.5	22	72

Table 8.--Chemical Analyses of Water From Wells in Ward County and Adjacent Areas--Continued

WELL	DEPTH OR PRODUCING INTERVAL (FT)	DATE OF COLLECTION	WATER - BEARING UNIT	SILICA (SiO ₂)			MAGNE - SIUM (Mg)	SODIUM (Na)	POTAS - SIUM (K)	BICAR- BONATE (HCO ₃)	SUL - FATE (SO ₄)	CHLO- RIDE (C1)	FLUO- RIDE (F)	NITRATE (NO)	BORON (B)	DIS- SOLVED SOLIDS	HARD - NESS AS CaCO ₃	PERCENT SOD IUM	SODIUM - ADSORP - TION RATIO (SAR)	RESIDUAL SODIUM CARBONATE (RSC)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	pН	PE	M- IRA IRE
YX -45-33-515	311	Aug. 9, 196	7 A							214	184	305					316			0.00	1,630	7.4	22	72
602	79	Jul. 19, 196	7 A							198	568	125					480			.00	1,740	7.6	21	70
603	203	Jul. 24, 196	7 A							180	560	10,500					2,120			27	29,900	7.0		
604	135	Jul. 27, 196	7 A							192	416	505					484			.00	2,750	7.6	23	73
605	94	May 1, 194	0 A			95	31	* 204		199	361	190		1.2		980	365	55		33	1,570			-
605	94	Jul. 19, 196	7 A							100	348	860					840			.00	3,360	7.0	22	72
606	82	do	A									840									2,850			-
607	75	Apr. 2, 194	L A			115	35	* 206		254	355	210		5.0		1,050	431	51			1,680			
609	252	Feb. 12, 195	3 A	8.0		108	25	* 241		240	375	220				1,100								-
609	252	Dec. 9, 196	7 A							212	364	338					520			.00	2,170	7.4		
701	156	Jun. 4, 196	7 A	40		107	40	* 531		260	382	690		2.0		1,920	432	73	11	.00	3,210	7.6		-
704	200	Jun. 2, 196	7 A							250	324	750					490			.00	3,240	7.2		-
706	300	Jun. 21, 196	7 A							256		1,480					1,040			.00	5,910	7.3	22	7:
707	210	Jun. 22, 196	7 A	36		126	40	615	8.2	264	396	860		2.5	.38	2,210	479	73	12	. 00	3,660	7.7	22	72
708	110	do	A							244	492	1,000					800			.00	4,160	7.6		-
709	62	Apr. 2, 1940) A			102	33	* 358		228	281	487		2.0		1,380	390	67			2,460			-
709	62	Aug. 9, 196	7 A							232	308	660					485			.00	2,890	7.7	22	7
711	93	do	A							252	232	112					302		3	.00	1,170	7.5	22	7:
712	127	Aug. 8, 196	7 A							248	468	1,580					740			.00	5,790	7.5		
<i>4,</i>	2,583	Jan. 15, 1962	Psr			361	143	* 833		1,120	799	850				4,110						6.9		-
713	2,583	Dec. 11, 196		13		395	168	646	45	1,070	885	1,020		.5	1.5	3,700		45	6.8	.00	5,280	7.2		-
801		Jul. 21, 196								188	424	650					1,030			.00	2,910	7.5		
802	220	Aug. 13, 196		33		103	27	307	5.6	232	358	348	1.7	3.5	.32	1,300	368	64	7.0	.00		7.6		
805	116	Dec. 11, 1967	A							202	234	342					565			.00		7.4	21	71
811	220	do	A	50		1,080	690	5,580	116	286	1,170	11,800				20,600	5,530	68			32,700	6.8		-
812	140	Jun. 1, 1964			0.06	96	31	* 405		229	262	550	2.2	2.0		1,470	366					7.5		-
y 812	140	Jan. 22, 1965				86	28	* 366		233	261	475	2.5	2.0		1,340	330				2,670	7.7		
y 812	140	Feb. 17, 1966			.06	92	27	* 361		228	227	476	2.3	1.5		1,300	342		17		2,640	7.6		-
y 812	140	Jan. 17, 1967				84	33	* 350		235	248	472	2.6	1.5		1,310	334			7.	2 020	7.6		71
814	107	Jun. 2, 1950) A								338	332									2,030		21	/

Table 8. -- Chemical Analyses of Water From Wells in Ward County and Adjacent Areas -- Continued

	WELL	DEPTH OR PRODUCING INTERVAL (FT)		DATE OF		WATER- BEARING UNIT	SILICA (SiO ₂)		CAL - CIUM (Ca)	MAGNE - SIUM (Mg)	SODI (Na		POTAS - SIUM (K)	BICAR- BONATE (HCO ₃)	SUL - FATE (SO ₄)	CHLO- RIDE (C1)	FLUO- RIDE (F)	NITRATE (NO)	BORON (B)	DIS - SOLVED SOLIDS	HARD - NESS AS CaCO ₃	PERCENT SODIUM	SODIUM - ADSORP - TION RATIO (SAR)	RESIDUAL SODIUM CARBONATE (RSC)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	pН	P	EM - ERA URE
у үх -	45-33-815	240	Au	g. 26,	1963	A			82	24	* 2	63		224	306	269	1.7			1,060	305				2,070	7.5		
	816	123	Ma	r. 29,	1940	A			88	28	* 1	48		234	237	270		3.0		891	499	39		/	1,650			
	816	123	Aug	g. 8,	1967	A	30	0.15	136	41	3	01	6.4	232	408	400	1.8	3.8	0.35	1,440	508	56	5.8	0.00	2,300	7.8		
	817	25	Ma	r. 29,	1940	A										297									1,930			
g, m	821	208	Ma	у 30,	1958	A	14	.16	160	48				176	335	510					596					7.3		
	821	208	Aug	g. 2,	1967	A								220	280	638					570			.00	2,760	7.6		
얼	822	135	Jui	n.	1962	A			690	210	* 6	60		180	350	2,500				4,500						7.7		
	822	135	Dec	e. 11,	1967	A								190	527	3,520					3,100			.00	10,800	7.2		
	901	95	May	15,	1940	A	18	.11	94	40	3	67	9.6	240	324	463	1.7	1.0		1,440	399	67			2,410			
Ь	901	95	Oc 1	18,	1940	A	22	.28	93	35	* 3	71		256	320	454	1.4	2.4		1,420	376					7.0		
Ы	901	95	Aug	g. 26,	1949	A	31	.52	109	33	* 3	45		268	309	437	2.0		77	1,400	408					7.0		
Ы	901	95	Man	19,	1954	A	30	.24	86	35	* 3	49		244	324	412	1.6			1,360	359					7.5		
Ь	901	95	Apr	r. 17,	1961	A		4.5	360	162	* 8	80		205	390	1,980	.8			3,880	1,580				8,050	7.0		
Ы	902	95	Aug	3. 26,	1949	A	40	.5	118	35	* 3	50		250	360	440	2.0			1,470	439							-
Ы	902	95	Jai	n. 30,	1950	A	27	.12	98	37	* 3	54		256	332	433	1.4	.9		1,410	397					7.5		
Ы	902	95	Man	. 19,	1954	A	38	.12	108	40	* 3	40		244	364	422	1.4	.4		1,430	434					7.5		
ы	902	95	Apı	. 17,	1961	A		.14	120	52	* 3	85		244	320	556	1.2	1.9		1,560	515				3,050	7.4		
Ы	902	95	Fel	28,	1966	A			970	328	* 2,3	20		183	2,980	4,030	3.5	15		10,700	3,780				22,000	7.6		
ы	903	137	Apı	. 17,	1961	A		. 04	100	43	* 4	05		235	295	540	1.2	1.4		1,500	430				2,950	7.3		
cj	906	982	Jui	n. 22,	1953	Pr	13	. 02	1,350	692				70	3,580	28,000					6,210					7.5		
cj	906	982	Jui	n. 30,	1955	Pr	10	.36	1,370	1,040				90	5,900	28,700					7,710					7.8		
	906	982	Jul	19,	1967	Pr								74	6,000	39,500					10,000				95,400	6.8		
	907	90	Apı	. 26,	1967	A								252	328	360					420			.00	2,070	7.4	22	72
Ы	908	135	Jur	1. 1,	1964	A		. 04	81	29	* 2	73		232	279	320	2.1	2.0		1,100	322			75		7.8		
Ъ	908	135	Jai	n. 22,	1965	A		.22	73	29	* 3	16		253	278	355	2.3	3.0		1,180	300					8.0		
	909	31	Apı	. 29,	1940	A			96	39	* 3	49		246	323	440		1.0		1,370	400	65			2,310			
	911	128	Dec	. 11,	1967	A	11		103	42	4	99	9.0	138	150	900		.2		1,780	430	71	10	.00		7.0		
덕	912	1,033	Man	6,	1958	Pr	4.5	. 72	1,840	1,420				85	6,050	58,600					10,400					7.9		
	34-101	79	Jui	25,	1967	A								261	166	61			7-		198			, 32		8.2		
	102	122		do		A								298	280	130					134		-	2.20	1,380	8.1		

Table 8.--Chemical Analyses of Water From Wells in Ward County and Adjacent Areas--Continued

WELL	DEPTH OR PRODUCING INTERVAL (FT)	\$1000000000000000000000000000000000000	TE OF LECTION	WATER- BEARING UNIT	SILICA (SiO ₂)			MAGNE - SIUM (Mg)	SODIUM (Na)	POTAS - SIUM (K)	BICAR- BONATE (HCO ₃)	SUL- FATE (SO ₄)	CHLO- RIDE (C1)	FLUO- RIDE (F)	NITRATE (NO)	BORON (B)	DIS - SOLVED SOLIDS	HARD - NESS AS CaCO ₃	PERCENT SODIUM	SODIUM - ADSORP - TION RATIO (SAR)	RESIDUAL SODIUM CARBONATE (RSC)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	рН	P	EM- ERA URE
YX -45 -34 -302	75	Jun.	8, 1967	A							278	572	275					880			0.00	2,260	7.4	22	7
401	100	Nov.	2, 1954	A	62		90	29	* 398		223	704	198	4.0	3.8		1,600	344	72			2,330	7.7		-
402	155	May	13, 1967	A	45		178	52	313	7.9	258	636	325	2.4	2.8		1,690	658	50	5.3	.00	2,520	7.1	21	7
403	86	Apr.	23, 1941	A			32	19,700	* 79,500		114	127,000	86,200				313,000		58			130,000			-
406	85		do	A			416	2,340	* 11,100		286	17,000	11,900				42,900		69			46,800			-
407	110	Oct.	1, 1967	A	7.8	0.23	450	15,200	51,400	4,120	274	81,700	70,000			10	223,000	63,500	62		.00	135,000	6.7	21	7
501	70	Jun.	25, 1967	A							146	2,100	370					1,470			.00	4,560	7.6		-
502	86	Apr.	23, 1941	A									154				1,760					2,150			-
505	400	Jun.	20, 1967	A	61		150	41	582	7.3	216	1,030	410		5.6	.56	2,390	542	70	11	.00	3,420	7.6	21	7
602	100	Jun.	21, 1961	A							212	790	170					690				2,250	7.2	21	7
604	102	Jun.	29, 1967	A							166	433	130					480			.00	1,470	7.3		-
701	102	Jun.	28, 1967	A							216	1,620	1,030					1,600			.00	5,740	7.7		-
702	136	Apr.	22, 1940	A			58	18	* 187		273	180	152				732	219	65			1,300			-
702	136	Jul.	20, 1967	A							276	182	165					230			.00	1,290	7.7	22	7
801	100	Jun.	21, 1961	A							155	1,330	2,240					1,830	33		100	8,400	7.2		-
802	89	Mar.	20, 1940	A			437	130	* 360		140	1,740	340				3,080	1,630	33			3,850		24	7
802	89	Jun.	28, 1967	A							140	1,800	380					1,580			.00	4,090	7.4	22	7
901	55	Jul.	20, 1967	A							234	1,820	1,720					1,800			.00	7,940	7.6	21	7
41-101	2,566	Mar.	31, 1968	Psr	15	.01	470	180	600	29	376	1,630	880		.4	.41	3,990	1,910	40	6.0	.00	5,190	7.6		-
2 02	301	Aug.	7, 1967	A							224	3,090	7,400					3,360			.00	24,100	7.3	21	7
203	55		do	A							248	3,020	5,000					3,600			.00	18,100	7.4	22	7
301	62	Jul.	20, 1967	A							17	810	2,160					1,030			.00	7,640	7.7		-
42 -101	58	Jun.	27, 1940	A			751	292	* 1,920		249	2,620	3,060		8.0		8,780	3,080	58			12,500			-
102	125	Mar	29, 1940	A	40	.18	138	47	375	22	241	504	440	2.3	. 7		1,690	538	61			2,680		22	7
102	125	Apr.	26, 1967	A	44	.12	176	56	435	7.4	238	572	605		6.7	.50	2,020	670	58	7.3	.00	3,160	7.2		
103	146	Apr.	22, 1940	A			221	88	* 889		212	507	1,520				3,330	913	68			5,630	••	22	7
104	50	Mar.	27, 1941	A			348	158	* 1,190		430	1,360	1,650		1.0		4,920	1,520	63			7,400			-
105	70	Jul.	20, 1967	A							200	2,550	5,000					3,720				17,600	7.2		-
106	50	Aug.	16, 1967	A							300	2,420	2,950					2,800			.00	12,200	7.3	21	7
401	14	Mar.	5, 1940	A			720	234	* 1,260		187	2,440	2,000				6,750	2,760	50			9,190			-

Table 8.--Chemical Analyses of Water From Wells in Ward County and Adjacent Areas--Continued

WELL	DEPTH OR PRODUCING INTERVAL (FT)		TE OF LECTION	WATER - BEARING UNIT	SILICA (SiO ₂)			MAGNE - SIUM (Mg)	SODIUM (Na)	POTAS - SIUM (K)	BICAR- BONATE (HCO ₃)	SUL - FATE (SO ₄)	CHLO- RIDE (C1)	FLUO- RIDE (F)	NITRATE (NO)	BORON (B)	DIS- SOLVED SOLIDS	HARD - NESS AS CaCO ₃	PERCENT SODIUM	SODIUM - ADSORP - TION RATIO (SAR)	RESIDUAL SODIUM CARBONATE (RSC)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	рН	P	ERA URE
YX -45 -42 -505	62	Apr.	27, 1967	A	30		855	352	2,540	24	196	2,740	4,250			0.95	10,900	3,580	60	18		15,800	7.1	21	71
506	63	Apr.	29, 1967	A	28		880	356	2,500	24	194	2,740	4,300			. 94	10,900	3,670	60	18		15,900	6.9	21	71
507	67		do	A	28		880	368	2,450	21	196	2,890	4,150			. 92	10,900	3,710	59	17	0.00	15,600	7.2	21	71
509	64	Apr.	27, 1967	A	27		800	298	1,920	29	152	2,640	3,150			. 62	8,940	3,230	56	15	22	12,900	6.8	21	71
510	60		do	A	33		880	358	2,600	24	196	2,790	4,450			1.03	11,200	3,670	60	19		16,300	7.1	21	70
511	57	May	9, 1967	A							166	2,340	3,750					3,840		10.11.20		14,100	6.7	21	70
603	1,695	May	15, 1940	Pr?			1,420	1,040	* 20,800		67	6,100	33,100				62,500	7,800	85			79,800			
801	4,362	Aug.	6, 1943	Pc			766	237	* 641		391	2,410	1,030		0.4		5,280	2,890				6,440		30	68
802	491	Feb.	4, 1958	Pr	8.5	0.34	1,700	981	* 25,300		129	5,450	40,800			30	74,300	8,280					7.4		
46-21-701	105	Dec.	28, 1939	A			612	213	* 1,040		198	2,040	1,680				5,680	2,400	48			7,850			-
702	286	Feb.	3, 1966	A		.30	731	176			119	1,090	1,000					2,550					7.1		
703	228	Mar.	3, 1966	A		.15	233	53			149	702	82					800					7.3		-
801	128	Mar.	19, 1941	A			627	47	* 64		164	1,600	58		21		2,500	1,760	7		1022	2,850			-
802	97	Oct.	25, 1939	A			115	42	* 17		207	227	64				569	460	7			912			
802	97	Oct.	4, 1967	A							208	234	72				4	475			.00	953	7.8		
23-803	176	Aug.	22, 1940	A			148	50	* 400		144	611	488		4.2		1,770		60			2,870			
803	176	Sept.	28, 1967	A							264	52	28					312			.00	673	7.6	21	70
902	225	Sept.	13, 1967	A									780									3,360			
904	300	Oct.	21, 1956	A	48		211	102	* 400		186	531	780	2.6	3.2		2,170	945	48	5.7		3,470	7.5		
904	300	Sept.	13, 1967	A	45		210	102	355	15	184	520	760		4.0	.38	2,100	944	45	5.0	.00	3,300	7.3	22	72
905	125	Aug.	23, 1940	A			60	22	* 109		215	91	146		1.5		535		50			982			
905	125	Sept.	12, 1967	A	36		36	21	136	7.0	217	89	143	3.0	3.5		582	176	61	4.5	. 03	971	7.7		
, <u>n</u> / 24-702	395	Sept.	16, 1964	A		.16	48	16	* 62		193	68	64		-1-		348	186					7.8		
702	395	Jun.	1, 1967	A		.04	52	16	* 49		179	88	42	2.1	7.0		344	197					7.8		
702	395	Jan.	28, 1968	A			56	14	* 47		179	85	40	2.1	2.5		335	198					7.7		
, <u>o</u> 703	385	Sept.	16, 1964	A		.48	49	15	* 64		193	70	63				357	185					7.6		
703	385	Jun.	1, 1967	A		.04	45	18	* 43		168	72	44	2.1	6.0		313	187				616	7.7		
703	385	Jan.	28, 1968	A			52	15	* 59		179	78	60	2.3	3.5		358	191					7.9		
704	392	Oct.	25, 1961	A		.14	56	16	* 75	1	174	77	81	2.3	5.3		399	205				730	7.8		
, <u>p</u> / 704	392	Sant	16, 1964	A		.20	60	19	* 69		185	56	120				415	228					7.5		

Table 8. --Chemical Analyses of Water From Wells in Ward County and Adjacent Areas--Continued

WELL		DEPTH OR PRODUCING INTERVAL (FT)	500000000000000000000000000000000000000	ATE OF	WATER - BEARING UNIT	SILICA (SiO ₂)			MAGNE - SIUM (Mg)	SODIUM (Na)	POTAS - SIUM (K)	BICAR- BONATE (HCO ₃)	SUL- FATE (SO ₄)	CHLO- RIDE (C1)	FLUO- RIDE (F)	NITRATE (NO)	BORON (B)	DIS- SOLVED SOLIDS	HARD - NESS AS CaCO ₃	PERCENT SODIUM	SODIUM - ADSORP - TION RATIO (SAR)	RESIDUAL SODIUM CARBONATE (RSC)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	pН	P	PER
yxx -46-24	4-704	392	Jun.	1, 1967	A		0.04	60	16	* 61		179	83	79	2.3	4.0		393	218					7.4		
by	704	392	Jan.	28, 1968	A		.32	57	17	* 62		177	83	81	2.2	2.0		391	214					7.6		1
Ы	705	387	Dec.	28, 1966	A			58	14	* 54		173	79	67	2.2	3.5		367	206				708	7.9		
Ы	705	387	Jun.	1, 1967	A		.04	47	13	* 34		162	66	29	2.1	6.0		277	173				525	7.8		1
Ы	705	387	Jan.	28, 1968	A			48	13	* 35		162	62	31	2.1	3.5		275	173				1	7.9		
	706	142	Feb.	23, 1940	A									32									537		21	
	706	142	Aug.	31, 1967	A	37		42	15	31	3.6	176	62	16	2.1	.00		296	766	28	1.0	0.00	461	7.8	22	7
	801	217	Mar.	4, 1943	A			48	15	* 16		152	39	34		4.2		231	182							
	802	149	Feb.	23, 1940	A	77		70	16	* 32		200	86	40				344	240	22			598			
	802	149	Aug.	31, 1967	A	52		69	13	35	2.5	188	86	37	2.1	5.0		394	226	25	1.0	.00	587	7.6	22	7
	804	225	Dec.	14, 1967	A	20	.04	44	12	109	2.8	176	67	133	1.6	.00		477	160	59	3.7	.00	826	7.1		
	901	300	Mar.	4, 1943	A			95	24	* 96		209	302	51		.5		662	336							
	903	180	Aug.	31, 1967	A	15		91	18	71	4.2	206	242	36	.8	.00		579	301	34	1.8	.00	863	7.7	21	
29	9-101	103	Oct.	17, 1967	A	34		448	106	634	6.6	184	1,280	1,030		4,5		3,630	1,550	47	7.0	.00	5,060	7.2		1
	102	45		do	A							0.9/	374	4,700		7-			4,040			.00	13,300	4.3		
	103	60	Apr.	19, 1967	A					-5													9,520			
	201	92	Jun.	22, 1961	A							192	400	175					710				1,530	7.3	22	
	201	92	Apr.	19, 1967	A							276	1.89	144					510			.00	1,320	7.2		
	202	86	Oct.	25, 1939	A		77	202	49	* 46		214	364	178				946	706	12			1,510			
	202	86	Oct.	23, 1967	A	47		199	32	25	5.3	270	190	139	.9	72		843	628	8	.4	.00	1,260	7.3		
	203	68	Oct.	25, 1939	A			417	98	* 498		2 02	1,140	830				3,090	1,440	43			4,490			
	203	68	Apr.	19, 1967	A					10 Feb. 10	1	150	1,330	1,020					1,670			.00	5,130	7.2		
	301	144	Oct.	26, 1939	A			108	51	* 116		168	475	71				905	479	35			1,390			
	301	144	Apr.	20, 1967	A							170	467	70					470			.00	1,370	7.5		
	302	176	Apr.	15, 1941	A									38				892					1,240			
	302	176	Oct.	23, 1967	A							188	304	29					338			.00	924	7.2		
	401	60	Apr.	20, 1967	A	- 22						220	1,340	1,200					1,960			.00	5,700	7.2		
	402	40	Dec.	3, 1939	A			268	67	* 1,070		223	1,530	1,060				4,100	944	71			5,660			
	501	75	Apr.	21, 1967	A							212	1,300	1,100					1,580			.00.	5,420	7.2		
	601	100	May	14, 1941	A			601	149	* 181		135	672	1,200		3.5		2,870	2,110	16			4,610			

Table 8. -- Chemical Analyses of Water From Wells in Ward County and Adjacent Areas -- Continued

WELL	DEPTH OR PRODUCING INTERVAL (FT)	DATE OF COLLECTION	WATER - BEARIN UNIT	SILICA (SiO ₂)		MAGNE - SIUM (Mg)	SODIUM (Na)	POTAS - SIUM (K)	BICAR- BONATE (HCO ₃)	SUL - FATE (SO ₄)	CHLO- RIDE (C1)	FLUO- RIDE (F)	NITRATE (NO)	BORON (B)	DIS - SOLVED SOL IDS	HARD - NESS AS CaCO ₃	PERCENT SODIUM	SODIUM - ADSORP - TION RATIO (SAR)	RESIDUAL SODIUM CARBONATE (RSC)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	pН	TH PH TU °C
YX -46 -29 -601	100	Oct. 23, 196	7 A		 				137	716	1,150					1,990			0.00	4,450	7.1	22
602	48	Oct. 17, 196	7 A		 				160	891	13,000					7,040			.00	33,800	7.1	
701	33	May 4, 194	A		 746	269	* 1,270		259	2,460	2,090				6,960	2,970	48			9,560		
701	115	May 7, 194	A		 486	143	* 1,220		213	1,800	1,700				5,450	1,800	59			7,840		
701	115	May 17, 194	A		 476	135	* 1,240		191	1,800	1,700		4.5		5,440	1,740	61			7,930		
702	186	Feb. 194	A	25	 556	197	* 1,000		216	1,840	1,620		3.5	0.49	5,350	2,200	50			7,740		
704	54	Sept. 19, 193	A		 						2,800									12,000		
705	152	Apr. 23, 194	A		 736	228	* 1,260		192	2,310	2,100				6,730	2,770				9,120		
706	162	Feb. 1949	A	24	 650	234	* 1,200		216	2,180	1,950		3.5	.40	6,350	2,580	50			9,050		
708	195	do .	A	23	 660	205	* 1,370		216	2,300	2,050			.69	6,770	2,490	54		-22	9,490		
709	59	Sept. 19, 1939	A		 856	782	* 4,580		366	4,390	7,400				18,200	5,350	65			25,300		
712	165	Apr. 26, 1947	A		 732	192	* 931		170	2,070	1,660		7.0		5,680	2,620				7,640		
718	20	Aug. 22, 1940	A		 						3,550				11,000					14,200		
718	50	do	A		 						2,310				7,490					9,900		
718	50	Oct. 18, 1967	A	18	 816	263	1,500	8.6	196	2,520	2,580				7,800	3,120	51	12	.00	10,900	7.4	
721	18	Sept. 19, 1939	A		 740	235	* 964		229	2,200	1,730				5,980	2,820	43			8,290		
802	162	Jul. 1950	A	34	 692	281	* 1,590		117	2,530	2,550		21	.91	7,760	2,880	55			10,800	7.8	
804	153	Oct. 28, 1946	A		 704	231	* 1,330		196	2,500	2,010				6,870	2,710				9,440		
805	73	Oct. 23, 1939	A		 				150		1,690									7,250		
805	73	Oct. 23, 1967	A	17	 700	165	920	12	134	1,460	1,980		3.0		5,320	2,420	45	8.1	.00	7,580	6.8	21
902	57	Apr. 22, 1967	A		 				192	1,660	1,910					2,360			.00	7,970	7.5	
903	190	Oct. 17, 1967	A	31	 1,100	332	3,880	28	170	2,220	7,280				15,000	4,110	67	26	.00	21,800	7.6	21
30-101	235	Oct. 3, 1967	A		 				40	2,480	166					2,160			.00	4,090	7.4	
201	104	Aug. 21, 1940	A		 						6.0				232					534		21
201	104	Oct. 2, 1967	A		 				312	10	3.2					268			.00	523	7.7	22
301	98	Aug. 22, 1940	A		 75	26	* 20		207	92	46		10		371	294	13			673		
301	98	Jun. 22, 1961	A		 				207	90	37									667	7.6	
301	98	Sept. 28, 1967	A	42	 76	22	32	2.9	210	87	46	2.0	15		428	280	20	.8	.00	652	8.0	
302	168	Aug. 22, 1940	A		 81	25	* 16		207	93	47		7.8		372		10			679		
401	121	Oct. 26, 1939	A		 454	155	* 211		74	1,690	290				2,840	1,770	21	7,		3,480		

Table 8. --Chemical Analyses of Water From Wells in Ward County and Adjacent Areas--Continued

WELL	DEPTH OR PRODUCING INTERVAL (FT)	DATE OF COLLECTION	WATER - BEARING UNIT	SILICA (SiO ₂)			MAGNE - SIUM (Mg)	SODIUM (Na)	POTAS - SIUM (K)	BICAR - BONATE (HCO ₃)	SUL - FATE (SO ₄)	CHLO- RIDE (C1)	FLUO- RIDE (F)	NITRATE (NO)	BORON (B)	DIS - SOLVED SOLIDS	HARD - NESS AS CaCO ₃	PERCENT SOD IUM		RESIDUAL SODIUM CARBONATE (RSC)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	рН	T P T °C
x-46-30-401	121	Jun. 22, 1961	A		0.48					76	1,640	345					1,640				3,540	7.0	
402	188	Aug. 21, 1940	A			321	87	* 150		118	1,160	116		15		1,910		4			2,410		22
403	180	Oct. 3, 1967	A	34		64	26	69	2.6	204	141	58	1.6	15		511	266	36	1.8	0.00	785	7.8	22
501	141	do	A							226	49	44					304			.00	639	7.7	22
701	113	Dec. 14, 1967	A							36	960	2,500					3,940			.00	8,030	5.8	
702	172	Nov. 14, 1967	A							116	782	128					950			.00	1,800	7.3	
801	161	Sept. 26, 1939	A									34									700		
801	161	Dec. 14, 1967	A							296	83	26					314			.00	704	7.9	
802	220	Sept. 26, 1939	A									322									4,360		
901	5,088	Dec. 14, 1967	?	10		56	7.6	36	6.2	200	30	39	.5	2.0		285	171	30	1.2	.00	488	7.1	
31-101	147	Aug. 22. 1940	A			235	47	* 42		150	578	99		7.7		1,080		10			1,530		
101	147	Sept. 28, 1967	A							152	578	99					785			.00	1,510	7.6	
304	300	Sept. 12, 1967	A	41		335	148	690	17	194	695	1,500		2.5	0.31	3,520	1,440	51	7.9	.00	5,570	7.4	-
305	96	Aug. 22, 1940	A			328	126	* 730		220	906	1,280		4.0		3,480		54			5,420		-
305	96	Sept. 27, 1967								176	920	1,320					1,360			.00	5,400	7.8	23
306	153	Feb. 23, 1940				190	83	* 477		218	525	800				2,180	815				3,560		-
306	153	Oct. 2, 1967		50		190	75	446	9.2	214	500	780		4.8		2,180	782	56	7.2	.00	3,410	7.8	-
401	130	Aug. 15, 1940	A			286	54	* 213		150	407	600		7.0		1,640		33			2,730		-
401	130	Mar. 28, 1968	A							148	436	740					1,060			.00	3,060	7.1	2
402	164	do	A							178	273	370					640			.00	1,900	7.4	2:
501	105	do	A							150	724	800					985			.00	3,740	7.3	2
601	322	Jan. 26, 1956	A	31		321	140	568	19	191	668	1,300		.04	.33	3,140	1,380	47	6.7		5,050	7.4	-
602	200	Sept. 11, 1967	A	47		215	90	500	12	212	590	880		2.8	.34	2,440	906	54	7.2	.00	3,830	7.6	22
603	200	do	A									1,320									5,160		-
604	225	Oct. 2, 1967	A							176	740	1,210					1,400			.00	4,880	7.4	22
605	138	Feb. 23, 1940	A									770									3,490		-
605	138	Mar. 26, 1968								210	504	770					760			.00	3,410	7.6	
701	97	Jul. 12, 1940				105	12	* 1.4		271	60	6.0	2.8	24		368					570		-
702	154	Sept. 27, 1939										47									603		
702	154	Dec. 14, 1967		28	1.2	54	19	47	2.9	264	65	14	1.5	15	.20	3 7 7	212	32	1.4	.08	595	7.7	

Table 8. -- Chemical Analyses of Water From Wells in Ward County and Adjacent Areas -- Continued

WEI	ı	DEPTH OR PRODUCING INTERVAL (FT)	DATE OF COLLECTI		WATER - BEARING UNIT		IRON (Fe)		MAGNE - SIUM (Mg)	SODIUM (Na)	POTAS - SIUM (K)	BICAR- BONATE (HCO ₃)	SUL- FATE (SO ₄)	CHLO- RIDE (C1)	FLUO- RIDE (F)	NITRATE (NO)	BORON (B)	DIS - SOLVED SOLIDS	HARD - NESS AS CaCO ₃	PERCENT SODIUM		RESIDUAL SODIUM CARBONATE (RSC)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	pН	P	ERA URI
YX-46	31-704	160	Dec. 14,	1967	A							46	1,140	378					915			0.00	3,120	7.1		
	705	180	Sept. 25,	1940	A			365	126	* 431		49	1,780	335		0.2		3,060		40			3,840			
	705	1,060- 1,064	Oct. 10,	1940	Pr			672	210	* 1,430		82	2,860	1,850		.5		7,060		55			9,420			-
	706	200	Feb. 16,	1940	A			74	30	* 56		240	108	74		20		482	308	28			867		21	1
	801	300	Nov. 13,	1967	A	83		600	158	202	25	125	2,110	207		22		3,470	2,150	17	1.9	.00	3,580	7.2		-
	902	118	Aug. 15,	1940	A	4.9		400	155	* 677		152	1,200	1,180		81		3,770		47			5,690			-
	902	118	Mar. 28,	1968	A							182	926	1,260					1,360			.00	5,400	6.9		-
	32-204	425	Sept. 26,	1967	A	38		47	23	70	5.7	188	85	88	2.6	4.9		456	212	41	2.1	.00	740	7.5	21	7
	206	324- 364	Oct. 7,	1955	A	20						168	118	60					182					8.1		-
	206	879- 920	Oct. 15,	1955	A	25						176	1,050	3,280					1,100				4	7.8		-
	206	544= 600	Oct. 29,	1955	A	15						174	470	520					328					8.3		-
ğ	208	4,109	Oct. 21,	1965	Pc			744	261	* 1,350		517	2,160	2,260				7,030	2,930					6.7		-
	301	140	Jun. 7,	1967	A							160	196	91					365			.00	923	7.2	24	7
	302	365	do		A							178	105	69					216			.00	717	7.6	24	7
, <u>a</u>	306	3,950	Oct. 21,	1965	Pc		0.72	1,170	366	* 5,110		554	2,560	8,800				18,300	4,430					6.7		-
, tj	310	4,450	do		Pc		.80	761	250	* 1,300		517	2,110	2,200				6,900	2,930					6.7		-
	401	226	Sept. 9,	1967	A	51		360	143	810	15	184	790	1,620		2.0	0.42	3,880	1,490	54	9.2	.00	6,040	7.5	22	7
	403	400	Sept. 11,	1967	A	44	.00	345	142	598	16	178	800	1,280		4.5		3,320	1,440	47	6.9	.00.	5,120	7.3	21	7
	405	96	Feb. 23,	1940	A			332	128	* 571		188	836	1,120				3,080	1,360	48			4,800			-
	406	107	Mar. 3,	1943	A			44	21	* 72		228	89	48		6.9		393	196							-
	407	303	Sept. 12,	1967	A									1,320									4,600			-
	409	185	Nov. 16,	1967	A	42		338	132	604	13	192	776	1,270		1.0	.45	3,270	1,390	48	7.1	.00	4,890	7.2	21	7
	501	182	Dec. 14,	1942	A	49	.31	56	18	* 70		204	111	55	2.7	3.4		468	214					7.5	13	5
	501	182	Mar. 1,	1943	A	44	.96	49	17	* 51		196	71	39	2.5	10		380	192					7.7		-
	501	182	Mar. 9,	1948	A	50	. 04	52	21	* 107		218	128	89	3.0	5.3		563	216	52			897	7.5	20	68
	501	182	Sept. 7,	1949	A	54		54	19	* 113		231	124	92	2.8	4.8		577	213	54		100	913	8.0		-
	501	182	Oct. 10,	1950	A	48	.18	54	17	* 115		235	116	92	3.2	3.2		564	204	55			893	8.1		-
	501	182	Oct. 10,	1951	A	51	.09	58	19	* 110		232	124	94	2.4	4.0		576	222	52			949	7.5		-

Table 8.--Chemical Analyses of Water From Wells in Ward County and Adjacent Areas--Continued

WELL	DEPTH OR PRODUCING INTERVAL (FT)		DATE OLLEC		WATER - BEARING UNIT	SILICA (SiO ₂)			MAGNE - SIUM (Mg)		DIUM (Na)	POTAS - SIUM (K)	BICAR- BONATE (HCO ₃)	SUL - FATE (SO ₄)	CHLO- RIDE (C1)	FLUO- RIDE (F)	NITRATE (NO)	BORON (B)	DIS - SOLVED SOLIDS	HARD - NESS AS CaCO ₃	PERCENT SODIUM	SODIUM - ADSORP - TION RATIO (SAR)	RESIDUAL SODIUM CARBONATE (RSC)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	рН	F	EM - PERA TURE
YX-46-32-501	182	Oct.	. 24	, 1952	A	52	0.02	54	20	*	106		232	119	87	2.0	4.7		559	216	51			877	7.7	21	70
501	182	Jun.	. 11	, 1953	A	50	.02	59	20	*	108		234	123	93	3.6	5.1		577	229	51			944	7.4	21	70
501	182	Jan.	. 17	, 1958	A	45	.10	52	16	*	109		238	109	81	2.8	4.0		536	196	55	3.4		840	7.7	18	64
501	182	Sept	t. 9	, 1958	A	50	.16	64	19	*	123		240	136	110	2.8	4.5		627	238	53	3.4		1,020	7.5		
501	182	Aug.	. 21	, 1959	A	49	.03	61	19	*	122		237	134	106	3.0	6.1		617	230	54	3.5		952	7.1	22	72
501	182	Aug.	. 28	, 1961	A	46	.06	60	20	*	121		236	131	109	2.9	4.7		611	232	53	3.4		968	6.9	21	70
501	182	Nov.	. 27	, 1961	A	46	.45	57	18	*	119		231	122	103	3.1	4.8		587	216	54	3.5		933	6.9	20	68
501	182	Sept	t. 17	, 1962	A	47	.06	52	17	*	118		236	111	96	3.2	4.0		564	200	56	3.6		922	7.1		
501	182	Nov.	. 16	, 1967	A	46		59	19		118	4.2	240	134	102	3.0	3.2		606	225	53	3.4	0.00	910	7.5	21	70
504	152	May	3	, 1940	A			100	46	*	354		398	185	488		1.2		1,370	439	64			2,210			
508	425	Sept	t. 27	, 1967	A	39		51	22		118	5.6	204	102	141	2.8	4.4		586	218	53	3.5	.00	962	7.5	22	72
509	385		do		A	40		82	31		155	4.9	204	141	255	2.0	4.1		815	332	50	3.7	.00	1,370	7.4	22	72
510	259	Sept	t. 26	, 1967	A	41	.04	84	30		205	5.6	208	155	315	2.3	4.2		944	333	57	4.9	.00	1,580	7.5	22	72
511	235	Mar.	. 1	, 1943	A	48	.02	58	19	*	66		197	105	58	2.1	9.0		462	222					7.6		1.
512	235	Dec.	. 14	, 1942	A	43	1.2	46	21	*	91		224	101	73	2.7	1.1		489	202					7.4		
512	235	Mar.	. 1	, 1943	A	39	.05	69	33	*	230		231	167	307	2.0	5.3		966	3 08					7.7		
513	241	Mar.	. 9	, 1948	A	50	.04	62	23	*	74		197	130	71	2.8	5.4		515	249	39			801	7.5	20	68
513	241	Sept	t. 7	, 1949	A	52	.00	61	19	ric	88		214	129	72	2.4	5.0		534	230	45			831	7.8		
513	241	Oct.	. 10	, 1950	A	47	.00	68	21	*	90		213	138	88	2.4	4.8		564	256	43			882	7.8	21	70
513	241	Oct.	. 10	, 1951	A	51	.04	67	22	*	84		212	131	85	2.0	5.0		551	258	41			886	7.5	21	70
513	241	Oct.	. 24	, 1952	A	50	.17	66	23	*	89		219	138	85	2.0	5.0		566	259	43			877	7.6	21	70
513	141	Jun.	. 11	, 1953	A	50	.03	65	21	rk	92		217	135	83	2.8	5.5		561	248	44		77	898	7.4		
513	241	Jan.	. 17	, 1958	A	46	.09	68	20	*	96		222	138	88	2.4	5.9		573	252	45	2.7	77	889	7.7	18	64
513	241	Sept	t. 10	, 1958	A	50	.08	68	20	*	98		223	136	91	2.4	6.0		581	252	46	2.7		909	7.8		
513	241	Aug.	. 21	, 1959	A	48	.02	62	19	*	101		218	126	93	2.8	5.4		564	232	49	2.9		874	7.1	22	72
513	241	Aug.	. 28	, 1961	A	46	.20	72	21	*	103		216	147	106	2.6	5.2		609	266	46	2.8		952	6.9	21	70
513	241	Nov.	. 27	, 1961	A	46	.17	68	21	xit	91		202	124	105	2.6	5.0		562	256	44	2.5		896	7.0	21	70
513	241	Sept	t. 17	, 1962	A	49	.08	73	22	*	103		216	148	110	2.5	5.8		619	272	45	2.7		1,000	6.9	21	70
513	241	Nov.	. 16	, 1967	A	47		82	23		104	4.0	218	162	122	2.6	4.0		658	299	43	2.6	.00	991	7.5	21	70
514	240	Mar.	. 9	, 1948	A	50	.04	60	21	o't	72		198	120	67	2.6	5.0		497	236	40			815	8.1	20	68

Table 8.--Chemical Analyses of Water From Wells in Ward County and Adjacent Areas--Continued

WELI	L	DEPTH OR PRODUCING INTERVAL (FT)	DATE OF COLLECTION	WATER - BEARING UNIT	SILICA (SiO ₂)			MAGNE - SIUM (Mg)	SODIUM (Na)	POTAS - SIUM (K)	BICAR- BONATE (HCO ₃)	SUL - FATE (SO ₄)	CHLO- RIDE (C1)	FLUO- RIDE (F)	NITRATE (NO)	BORON (B)	DIS - SOLVED SOL IDS	HARD - NESS AS CaCO ₃	PERCENT SODIUM	SODIUM - ADSORP - TION RATIO (SAR)	RESIDUAL SODIUM CARBONATE (RSC)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	pН	PI	EM- ERA URE °F
YX -46	-32-514	240	Sept. 7, 1949	A	50	0.00	60	19	* 84		210	126	68	2.4	5.1		518	228	44			815	7.7		
	514	240	Oct. 10, 1950	A	47	.00	58	18	* 79		208	113	66	2.4	4.0		489	218	44			771	7.4		
	514	240	Oct. 10, 1951	A	50	.04	58	19	* 78		207	110	69	2.4	5.0		493	222	43			793	7.6	21	70
	514	240	Oct. 24, 1952	A	51	.08	55	19	* 77		209	110	62	2.0	4.3		483	215	44			744	7.8	21	70
	514	240	Jun. 11, 1953	A	49	.03	57	18	* 83		208	114	67	3.2	4.8		498	216	45			785	7.5	21	70
	514	240	Jan. 17, 1958	A	44	.27	58	18	* 78		2 0 5	107	69	2.4	4.7		482	218	44	2.3		754	7.8	18	64
	514	240	Sept. 10, 1958	A	49	.04	63	18	* 87		210	118	82	2.4	4.8		527	231	45	2.5		831	7.7		
	514	240	Sept. 21, 1959	A	47	.09	65	19	* 88		207	123	87	2.7	4.9		539	240	44	2.5		827	7.1	21	70
	514	240	Aug. 28, 1961	A	45	.03	70	20	* 89		200	. 123	105	2.6	4.8		557	256	43	2.4		899	6.9	21	70
	514	240	Nov. 27, 1961	A	48	.69	.73	22	* 105		219	149	110	2.6	5.9		624	272	46	2.8		974	6.9	20	68
	514	240	Sept. 17, 1962	A	47	.00	70	21	* 91		2 02	126	108	2.8	4.0		569	261	43	2.4		936	7.1	21	70
	514	240	Nov. 16, 1967	A	47		78	23	97	3.9	208	152	118	2.6	3.8		627	289	42	2.5	0.00	950	7.5	21	
	515	271	Jan. 17, 1958	A	39	.21	55	24	* 164		221	132	188	2.4	3.5		717	236	60	4.7		1,190	7.8	18	64
	515	271	Sept. 10, 1958	A	41	.28	56	25	* 180		224	138	211	2.4	3.5		767	242	62	5.1		1,290	7.7		
	601	235	Feb. 25, 1943	A			68	20	* 59		206	135	47		4.3		435	252				F-8-407 (4)			
	601	235	Sept. 5, 1967	A	40		71	18	64	4.3	210	149	47	2.0	2.5		501	251	35	1.8	.00	763	7.7		
의,벨	602	4,460	Jul. 13, 1962	Pc		.56	1,110	358	* 4,900		600	2,830	8,130				17,600	4,240					6.9		
Ъ	603	306	Jun. 1, 1966	A		.24	69	18	* 62		179	145	57	1.7	3.0	-	444	249				852	7.7		
	603	306	Sept. 1, 1967	A	35	.09	70	18	62	3.7	188	136	60	2.0	3.2	0.11	482	248	35	1.7	.00		7.7	22	72
	605	300	do	A									50									752			
	607	335	Sept. 27, 1967		27		80	28	210	5.5		206	276	1.9	3.5		940	314	59	5.1	.00	1,550	7.5		72
	608	180	Dec. 9, 1967	A							188	200	105				/	284			.00	991	7.4		
<i>g</i>	609	2,911	Jun. 11, 1951			1.0	530	210			367	1,630	798				4,400								
9,⊻	611	4,500	Oct. 21, 1965	Pc		.68	1,350	361	* 6,240		593	2,780	10,700				21,700					1775	6.7		
	701	104	Mar. 16, 1943				822	432	* 1,370		176	1,720	3,450		3.5		7,880								
	702	200	Sept. 28, 1967		46		368	157	573	15	156	730	1,370		3.0		3,340	1,560	44	6.3	.00		7.6	22	72
	703	106	Feb. 23, 1940										1,070				->					3,970			
ы	801	127	May 29, 1940	15 15			55	26	* 265		251	170	308		4.0		952	244	70			1,170			
9	801	127	Jun. 11, 1962				67	38	* 194		237	310	180	2.5			908	325				1 200			
	801	127	Aug. 11, 1967	A							252	226	147					284			.00	1,280	7.6		

Table 8.--Chemical Analyses of Water From Wells in Ward County and Adjacent Areas--Continued

WELL	DEPTH OR PRODUCING INTERVAL (FT)	100000000000000000000000000000000000000	TE OF		WATER - BEARING UNIT	SILICA (SiO ₂)		MAGNE- SIUM (Mg)	SODIUM (Na)	POTAS - SIUM (K)	BICAR - BONATE (HCO ₃)	SUL - FATE (SO ₄)	CHLO- RIDE (C1)	FLUO- RIDE (F)	NITRATE (NO)	BORON (B)	DIS- SOLVED SOLIDS		PERCENT SODIUM	SODIUM - ADSORP - TION RATIO (SAR)	RESIDUAL SODIUM CARBONATE (RSC)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	pН	P	TEM PERA
YX-46-32-802	98	May	29,	1940	A		 201	61	* 190		212	778	118		18		1,470	752	35			2,070			
802	98	Aug.	11,	1967	A		 				222	1,040	174					1,150			0.00	2,550	7.4	22	7
803	110	Mar.	1,	1943	A		 352	144	* 762		179	823	1,500		0.5		3,670	1,470	53						-
803	110	Mar.	28,	1968	A		 				180	934	1,720					1,720			.00	6,490	7.0		-
804	207	Nov.	17,	1967	A		 				238	146	182					256			.00	1,170	7.8		-
901	4,421	Jun.	8,	1967	Pc	14	 1,090	306	3,220	47	438	2,630	5,550				13,100	3,980	63	22		18,800	6.8	32	9
902	120	Aug.	11,	1967	A		 				228	134	112					244			.00	977	7.7	22	7
903	186	May	29,	1940	A		 						370									1,900			-
903	186	Sept.	6,	1967	A	48	 528	211	532	12	254	1,940	840		4.2		4,440	2,190	34	4.9	.00	5,380	7.2	22	7
37-103	48	Aug.	31,	1939	A		 548	204	* 877		108	1,570	1,700				4,950	2,210	46			7,360			-
108	183	Dec.	4,	1946	A		 582	181	* 1,340		171	2,000	2,050				6,240	2,200	57			8,950			
108	183	Feb.		1949	A	25	 610	204	* 1,470		216	2,130	2,250			0.49	6,800	2,360	58			9,880			ŀ
110	125	Dec.	16,	1946	A		 				109	2,420	2,330									10,300			
110	125	Oct.	19,	1967	A	19	 660	198	1,330	21	192	2,100	2,170			. 52	6,590	2,460	54	12	.00	8,980	7.2	21	
111	160	Oct.	27,	1967	A		 				180	1,950	2,360					2,520			.00	9,290	7.3	21	
201	112	Feb.		1949	A	20	 704	178	* 1,130		156	2,190	1,800		.5	.41	6,100	2,490	50			8,470			
202	91	Apr.	12,	1946	A		 714	197	* 1,030		166	2,200	1,700		3.8		5,930	2,590							
202	91	Sept.	25,	1946	A		 714	216	* 1,200		180	2,290	1,950				6,460	2,670	50						
202	91	Feb.		1949	Α	23	 694	215	* 1,210		188	2,210	1,980		1.0	.64	6,430	2,620	50			9,000			
203	97		do		A	30	 824	229	* 1,530		162	2,320	2,680			.66	7,690	3,000	53			10,900			
204	71		do		A	28	 899	252	* 1,880		160	2,340	3,400			.80	8,870	3,280	55			12,900			
205	71	Oct.	29,	1946	A		 800	266	* 1,430		202	2,490	2,440				7,530	3,090	50			10,400			
205	71	Oct.	23,	1967	A	19	 622	182	1,620	24	174	2,160	2,500			.55	7,210	2,300	60	15	.00	9,880	7.3	21	
206	110	Nov.	1,	1946	A		 700	182	* 952		162	2,170	1,540		2.5		5,630	2,500				7,660			
206	110	Jun.	7,	1967	A	20	 815	205	* 2,190		168	2,680	3,350				9,350	2,880	62	18		13,200	7.0		
207	80	Apr.	15,	1940	A		 636	188	* 994		176	2,160	1,510		5.0		5,530	2,360	48			7,520			
207	80	Aug.	4,	1961	A	21	 670	189	* 1,670		178	2,540	2,340				7,520	2,450	60	15		9,680	6.8	22	
207	80	Oct.	19,	1967	A	20	 664	194	1,540	19	210	2,080	2,430			.72	7,050	2,450	57	14	.00	9,730	7.2		
208	172	Feb.		1949	A	20	 664	212	* 1,320		156	2,190	2,120			.59	6,600	2,530	53		:	9,540			
212	80	Feb.	21,	1940	A		 752	249	* 1,350		210	2,490	2,180				7,130	2,900				10,100			

Table 8. --Chemical Analyses of Water From Wells in Ward County and Adjacent Areas--Continued

WELL	DEPTH OR PRODUCING INTERVAL (FT)	DATE OF COLLECTION	WATER - BEARING UNIT	SILICA (SiO ₂)			MAGNE - SIUM (Mg)	SODIUM (Na)	POTAS - SIUM (K)	BICAR- BONATE (HCO ₃)	SUL - FATE (SO ₄)	CHLO- RIDE (C1)	FLUO- RIDE (F)	NITRATE (NO)		DIS - SOLVED SOLIDS	HARD - NESS AS CaCO ₃	PERCENT SODIUM	SODIUM - ADSORP - TION RATIO (SAR)	RESIDUAL SODIUM CARBONATE (RSC)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	pН	P	EM- ERA URE
YX-46-37-212	80	Apr. 4, 194	0 A			676	257	* 1,280		237	2,510	1,920		12		6,770	2,740	50			9,240			
212	80	Apr. 18, 194	7 A			843	332	* 1,680		226	2,690	2,920				8,570	3,470	-2			11,600			
212	80	Oct. 23, 196	7 A	23		712	260	2,260	24	280	3,260	3,050				9,730	2,850	63	18	0.00	12,900	7.3		
213	58	Sept. 7, 194) A			778	411	* 2,290		259	3,060	3,690		3.6		10,900		58			14,600			
213	58	Feb. 194	9 A	35		820	435	* 2,300		264	3,110	3,830			0.96	10,700	3,840	57			14,900			
214	115	Oct. 21, 193	A O	14	0.04	763	204	* 1,090		116	2,250	1,920		.4		6,320	2,740	47					18	64
215	103	Oct. 23, 196	7 A					1000		220	2,630	2,850					3,120			.00	11,600	7.4	21	70
222	110	Jul. 194	5 A	28		748	272	* 1,400		96	2,510	2,350		26	. 76	7,380	2,980	50			10,300	7.7		
223	110	Sept. 26, 1940	5 A			728	211	* 1,140		164	2,260	1,900				6,320	2,680	48						
226	110	Apr. 23, 194	A A			782	207	* 1,300		170	2,340	2,170				6,880	2,800				9,340			
302	100	Apr. 26, 194	7 A			764	253	* 1,260		230	2,390	2,140				6,920	2,950	48			9,420			
303	65	Apr. 24, 1940	A	-11		830	372	* 2,600		108	2,970	4,300				11,100		61			15,600			
303	65	Jul. 11, 1940	A			748	307	1,910	84	169	2,580	3,240				8,950		56			12,900			
304	81	Oct. 25, 1967	A							176	2,560	2,780			'		3,160			.00	11,300	7.4	21	70
305	80	Sept. 21, 1933	A			695	221	* 1,040		232	2,250	1,680		2.9		6,000	2,640	46					18	64
305	80	Oct. 26, 1967	A	31		824	245	1,920	24	210	2,540	3,180			.59	8,870	3,060	57	15	.00	12,300	7.3		
308	85	Nov. 1, 1946	A			772	165	* 1,400		216	2,420	2,100				6,960	2,600				9,530			
309	83	Oct. 24, 1967	A	21		824	220	1,590	18	182	2,380	2,700				7,840	2,960	54	13	.00	10,900	7.2	21	70
312	90	Nov. 9, 1967	A							244	3,010	4,350					3,960			.00	16,100	7.2		
313	103	Dec. 3, 1940	A			750	214	* 1,070		192	2,310	1,770		23		6,240	2,750	46			8,460			
313	103	May 10, 1967	A	22		725	208	1,620	23	150	2,180	2,700				7,550	2,660	57	14	.00	10,700	6.8		
315	125	Nov. 26, 1946	A			644	211	* 1,040		146	2,290	1,580		12		5,850	2,470	48			7,930			
321	107	Sept. 6, 1946	A			684	209	* 1,030		158	2,240	1,650		10		5,900	2,570	46						
321	107	Aug. 28, 1950	A	29		738	236	* 1,260		103	2,400	2,100		6.5	-74	6,820	2,810	49			9,350	7.9		
324	105	Oct. 24, 1967	A							198	2,700	3,050					3,400			.00	12,000	7.3	21	70
401	278	Jan. 8, 1940	A									710									3,620			
401	278	Oct. 15, 1950	A	26		288	94	* 384		226	777	670		.5		2,350	1,100	43			3,460	7.2		
402	242	Jun. 22, 1967	A							172	1,340	1,080					1,440			.00	5,430	7.3	21	70
403	217	do	A							194	1,340	1,380					1,660			.00	6,290	7.2	21	70
404	300	Sept. 9, 1949	A	40		344	86	* 777	f	198	1,140	1,100		2.5		3,590	1,210	58			5,190	7.1		

Table 8.--Chemical Analyses of Water From Wells in Ward County and Adjacent Areas--Continued

WELL	DEPTH OR PRODUCING INTERVAL (FT)		ATE OF LLECTION	WATER - BEARING UNIT	SILICA (SiO ₂)			MAGNE - SIUM (Mg)	SODIUM (Na)	POTAS - SIUM (K)	BICAR- BONATE (HCO ₃)	SUL - FATE (SO ₄)	CHLO- RIDE (C1)	FLUO- RIDE (F)	NITRATE (NO)	BORON (B)	DIS- SOLVED SOLIDS	HARD - NESS AS CaCO ₃	PERCENT SODIUM	SODIUM - ADSORP - TION RATIO (SAR)	RESIDUAL SODIUM CARBONATE (RSC)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	pН	PI	EM- ERA URE
YX-46-37-501	190	Jun.	22, 1967	A					11 22 1		166	2,040	2,400					2,400			0.00	9,680	7.2	21	70
502	190		do	A	30		640	182	1,030	22	186	1,830	1,780		7.5	0.57	5,610	2,350	49	9.2	.00	7,820	7.4	22	72
504	97	Nov.	9, 1967	A	36		475	174	924	18	224	1,490	1,600		1.0	.48	4,830	1,900	51	9.2	.00	6,590	7.2		
603	150	Aug.	28, 1950	A	20		644	252	* 1,420		110	2,500	2,150		1.5	.46	7,040	2,640	54			9,430	7.5		
604	95	Nov.	15, 1967	A	21		1,010	368	2,050	18	198	2,790	3,820			.77	10,200	4,030	52	14	.00	14,400	7.0	21	70
610	21	Oct.	31, 1939	A									1,710									8,460			
611	100	Mar.	31, 1968	A	25		795	280	1,970	23	208	2,820	3,120		-11	.77	9,140	3,140	58			12,600	7.1	21	70
38-102	117	Dec.	17, 1939	A			356	92	* 166		132	810	480				1,970	1,270	22			2,940			
103	85	Mar.	29, 1940	A			660	184	* 1,020		162	2,230	1,540		5.0		5,720	2,400	48			7,700			
104	85	May	20, 1940	A								,	1,860									8,560			-
105	108	Oct.	26, 1967	A							118	794	900					1,680			.00	3,920	7.0	21	70
106	180	Aug.	28, 1950	A	48		840	302	* 2,130		113	2,500	3,730		6.0	.90	9,620	3,340	58			13,800	7.6		
201	137	Oct.	25, 1930	A	26	0.04	94	29	34	4.3	256	175	35		.9		524	354	18						-
201	137	May	24, 1940	A	28	.12	149	51	76	6.2	216	428	83	1.2	6.4		935	582	23			1,320			-
401	13	Jul.	11, 1940	A			944	321	* 1,540		302	3,090	2,520				8,560		48			11,600			-
403	100	Oct.	26, 1967	A							200	2,680	2,750					3,120			.00	11,400	7.3	21	
405	38	Aug.	30, 1939	A									1,380									7,420			
501	233	Jul.	11, 1949	A									4,800			.82						15,400			-
504	15	Aug.	30, 1939	A									1,650									8,450			
505	40	Dec.	12, 1939	A									3,810									11,600			
601	4,670	Feb.	4, 1926	Pr	18	.49	1,020	406	3,380	96	133	3,150	5,980				14,100	4,230	64						-
601	4,670	Dec.	19, 1940	Pr			939	380	* 3,420		47	3,190	5,670				13,600	3,900	66			19,500			
601	4,670	Mar.	5, 1964	Pr							88		6,900					4,300				20,500	6.9		
39-101	5,208	Oct.	5, 1940	?			90	18	* 421		183	171	627		.8		1,420		75			2,590			
102	222	Mar.	31, 1968	A							42	1,150	158					795			.00	2,500	6.9		
104	164	Dec.	12, 1967	A	43	.01	135	29	62	4.2		104	195	1.0	15		702	456	23	1.3	.00	1,180	7.4		
201	102		do	A							208	197	218					448			.00	1,350	7.0		
202	157		10, 1967								166	1,300	202					1,220				2,150 4,890	7.2		
204	360		11, 1967					-			139	1,050	1,110		11		2 300	1,380	41	4.6	.00	3,270	7.2		
205	142	Nov.	7, 1967	A	47		335	62	345	6.4	144	704	720		11		2,300	1,090	41	4.0	.00	3,270	1.2		

Table 8.--Chemical Analyses of Water From Wells in Ward County and Adjacent Areas--Continued

ī.	VELL	DEPTH OR PRODUCING INTERVAL (FT)		DATE OF DLLECTION	WATER - BEARING UNIT	SILICA (SiO ₂)			MAGNE - SIUM (Mg)	SODIUM (Na)	POTAS - SIUM (K)	BICAR- BONATE (HCO ₃)	SUL - FATE (SO ₄)	CHLO- RIDE (C1)	FLUO- RIDE (F)	NITRATE (NO)	BORON (B)	DIS - SOLVED SOLIDS	HARD - NESS AS CaCO ₃	PERCENT SODIUM	SODIUM - ADSORP - TION RATIO (SAR)	RESIDUAL SODIUM CARBONATE (RSC)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	pН	P	EM- PERA URE
YX-	46-39-206	97	Nov.	7, 1967	A							234	448	157					670			0.00	1,560	7.9		-
	303	86	Mar.	1, 1943	A			410	57	* 126		181	863	238		27		1,900	1,260			.00				-
	501	150	Nov.	28, 1939	A			56	30	* 56		317	79	30				409	263	31			744			-
	601	82		do	A			512	135	* 739		200	1,840	965				4,290	1,830	47			5,820			-
	602	120	Dec.	12, 1967	A							160	1,260	575					1,230			.00	3,880	7.3		-
	603	119		do	A							154	1,120	242					1,130			.00	2,700	7.2		-
	604	95	Nov.	20, 1939	A			262	77	* 347		256	1,080	280				2,170	970	44			2,990			-
	604	95	Nov.	10, 1967	A	30		320	82	318	8.1	206	1,160	328	1.9	1.5		2,350	1,140	38	4.1	.00	2,940	7.2		-
	605	86	Nov.	20, 1939	A									286									2,870			-
	606	260	Nov.	10, 1967	A							142	2,280	1,290					1,620			.00	6,920	7.5		-
	801	367	Nov.	28, 1939	A									53									823			-
	802	100		do	A									37									699			
	40-102	110	Jun.	2, 1967	A							172	1,050	700					1,580			.00	3,990	7.2		
	103	79	Jun.	4, 1967	A							115	1,300	530					1,820			.00	3,640	7.0	21	70
	201	106	Sept	. 28, 1939	A			330	154	* 584		150	773	1,280				3,190	1,460	47			5,180			
	201	106	Jun.	18, 1962	A			450	180	* 740		354	1,160	1,240	3.1			3,950	1,880							
	201	106	Aug.	16, 1967	A							396	1,060	1,060					1,620			.00	5,140	7.4	21	70
	202	66	Jun.	18, 1962	A			98	10	* 4		322	16	9	.4			295	285							-
	202	66	Aug.	16, 1967	A							358	12	4.0					308			.00	583	7.2	21	
	203	547	Jun.	9, 1962	A			244	125	* 660		185	693	1,130				2,940	1,130				3			
	203	424	Jun.	12, 1962	A								611	828					850							-
	203	350	Jun.	15, 1962	A								324						530							
	204	255	Jun.	23, 1962	A			65	36	* 268		237	190	343	2.9			1,020	310							
	301	180	Sept	. 8, 1961	A			70	24	* 122		259	144	122	1.2			610	275							
	301		Jun.		A							290	92	100					290			.00			23	73
	302		Jun.		A							238	316	630					345			.00		7.5		
	303			3, 1951	Psr			1,150	217	* 1,120			2,090	2,130										6.6		
	304			. 8, 1961	A			56	23	* 200		229	250	150	3.5			796	235							
	3 05			27, 1963	A		0.1	60	35	* 277		229	273	309	3.3	2.0		1,070	292					7.7		
	305	250	Aug.	12, 1964	A			66	29	* 278		227	257	310	3.9	5.0		1,060	285	77			2,130	7.7		

Table 8.--Chemical Analyses of Water From Wells in Ward County and Adjacent Areas--Continued

WELL		DEPTH OR PRODUCING INTERVAL (FT)	DATE OF COLLECTION	WATE BEAR UNI	ING (SiO	A IRON (Fe)		MAGNE - SIUM (Mg)	SODIUM (Na)	POTAS - SIUM (K)	BICAR- BONATE (HCO ₃)	SUL- FATE (SO ₄)	CHLO- RIDE (C1)	FLUO- RIDE (F)	NITRATE (NO)	(B)	DIS- SOLVED SOLIDS	HARD - NESS AS CaCO ₃	PERCENT SODIUM	SODIUM - ADSORP - TION RATIO (SAR)	RESIDUAL SODIUM CARBONATE (RSC)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	рН	H	TE PE TU C
YX -46-	40-305	250	Sept. 17, 196	5 A			67	30	* 273		229	266	304	3.5	4.0		1,060	293				2,110	7.5		-
	305	250	Aug. 17, 196	7 A	35	0.01	70	31	287	7.0	236	275	325	3.5	5.2	0.36	1,160	302	67	7.2	0.00	1,880	7.6	22	2
	306	240	Apr. 22, 196	3 A		.16	61	30	* 230		221	268	217	.7	4.0		920	275				1,780	7.7		-
	306	240	Aug. 12, 196	4 A			62	62	* 234		222	270	229	4.1	6.5		945	278				1,900	7.8		
	306	240	Sept. 17, 196	5 A			66	32	* 238		221	279	248	3.5	5.5		981	298				1,940	7.7		-
	307	220	Jul. 2, 196	2 A			46	29			244	329	133					232							•
	307	314	Jul. 5, 196	2 A			62	34			224	342	334					292							
	3 07	316	May 26, 196	3 A		.06	50	27	* 192		226	238	148	3.4	2.5		772	234				1,430	7.5		•
	307	316	Jun. 25, 196	4 A			61	30	* 263		232	273	258	3.7	3.5		1,010	277				2,010	7.7		
	307	316	Sept. 17, 196	5 A			63	31	* 242		232	262	254	3.1	5.0		974	283				1,950	7.8		•
	307	316	Aug. 17, 196	7 A	38	.01	64	31	256	7.0	238	277	262	3.9	5.4	.36	1,060	287	65	6.6	.00	1,710	7.7	22	2
	308	256	Aug. 22, 196	2 A		.04	43	23	* 201		240	259	133	4.0	5.0		786	201				1,440			
	308	256	Nov. 19, 196	3 A			46	22	* 206		245	254	141	4.9	3.5		797	208				1,550	7.9		S. S
	308	256	Jun. 24, 196	4 A			49	23	* 214		239	267	147	4.3	4.0		826	216				1,590	7.9		A STATE OF
	308	256	Sept. 17, 196	5 A			52	22	* 221		242	269	153	4.0	5.5		846	222				1,610	7.9		
	308	256	Aug. 17, 196	7 A	41	.00	52	23	228	5.8	252	274	161	3.9	4.8	.31	918	224	68	6.6	.00	1,430	7.8	22	2
	401	80	Jun. 2, 196	7 A							226	1,590	840					1,560				5,200	7.2	22	2
	402	131	Nov. 14, 193	9 A			360	217	* 1,880		179	1,240	3,150				6,930	1,790	70			11,000			- C.
	402	131	Jun. 2, 196	7 A					1 22		126	244	2,610					410			.00	8,350	7.0	21	L
	501	84	Nov. 28, 193	9 A			78	31	* 273		265	333	250				1,100	322	65		.00	1,890			S. S. S. S.
	501	84	Jun. 2, 196	7 A							318	145	77					250			.21	1,040	7.6	23	3
	502	242	Aug. 10, 196	7 A							152	768	1,620					760			.00	6,220	7.5		
	503	210	Aug. 11, 196	7 A	43		170	83	485	14	252	528	780		3.2	.51	2,230	766	57	7.6	.00	3,560	7.4	21	Ĺ
	504	230	do	А	39		252	117	812	20	194	738	1,430		4.0	.67	3,510	1,110	61	11	.00	5,620	7.4		
	601	66	Oct. 28, 193	9 A							290		715									3,960			
	601	66	Jun. 2, 196	7 A							286	1,040	900					1,140			.00	4,780	7,3		The state of
	602	260	Sept. 27, 196	7 A	30		189	94	1,180	19	312	910	1,570		3.5		4,150	858	74	17	.00	6,390	8.0		- C.
	701	1,100	Aug. 25, 193	9 Pr									348									4,930			The same
	701	1,100	Aug. 16, 196	1 Pr							88	2,640	330					2,520				4,660	6.6	21	No. of Concession,

Table 8. -- Chemical Analyses of Water From Wells in Ward County and Adjacent Areas -- Continued

WELL	DEPTH OR PRODUCING INTERVAL (FT)	DATE OF COLLECTION	WATER BEAR I UNIT	NG (Si	ICA IRO		MAGNE - SIUM (Mg)	SODIUM (Na)	POTAS - SIUM (K)	BICAR- BONATE (HCO ₃)	SUL - FATE (SO ₄)	CHLO- RIDE (C1)	FLUO- RIDE (F)	NITRATE (NO)	BORON (B)	DIS - SOLVED SOLIDS	HARD - NESS AS CaCO ₃	PERCENT SODIUM	SODIUM - ADSORP - TION RATIO (SAR)	RESIDUAL SODIUM CARBONATE (RSC)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	рН	PE	M- ERA IRE °F
YX-46-40-702	1,080	Jun. 1, 19	67 Pr	-						104	2,610	310					2,740			0.00	4,620		27	81
703	1,125	do	Pr	1	.9 -	580	163	* 666		105	2,650	510		0.9		4,640	2,120	41	6.3	.00	5,190	7.1	27	81
706	1,200	do	Pr	-						103	2,640	292		20-16 i			2,600			.00	4,590	7.0	26	79
801	1,680	Dec. 18, 19	32 Pr	2	6 0.1	7 596	271	* 311		93	2,620	338		.6		4,210	2,600							
801	1,680	Aug. 25, 19	39 Pr	-		603	277	* 342		101	2,700	350				4,320	2,640	22			4,980			
801	1,680	Jun. 1, 19	67 Pr	-						22	2,600	322					2,740			.00	4,630	7.2		
901	110	do	A		- -					142	452	1,110					570			.00	4,390	6.7	22	72
		į,			,			7		Crane	County													
нн-45-26-301	90	May 11, 19	67 A	-	- -					214	142	21					216			0.00	707	7.2		
901	55	Jul. 20, 19	67 A		- -					234	1,820	720					1,800			.00	7,940	7.6		
										Winkler	County													
ZP-45-17-401	300	Oct. 8, 19	56 A	4	0	198	24	* 137		210	390	220	0.8	1.2		1,110	592	34	2.5		1,640	7.7		
401	300	May 17, 19	67 A	-						204	376	222					606			0.00	1,640	7.0	21	70
802	950	do	Pr		2.3	1,140	665	14,500	113	ज़्र्य	5,040	23,000				44,500	5,560	84			62,700	4.4	22	72
18-702	10	Oct. 9, 19	56 A	1	.9	38	8.9	* 31		20	87	64	.4	.8		259	132	34	1.2		429	6.7		
46-22-801	151	Aug. 21, 19	40 A	-		56	23	* 12		252	34	8.0		8.2		265		10			497		23	73
801	151	Sept. 20, 19	56 A	5	50	51	19	* 21		243	25	10	1.6	10		309	205	18	0.6		464	7.4		
801	151	Oct. 2, 19	67 A	-								9.1									400			
23-601	400	Sept. 19, 19	67 A	-								720				500/ 44 00					2,820		22	72
602	223	Jan. 25, 19	57 A	4.		211	93	331	14	153	474	740	1.8	4.5	0.31	1,990	910	44	4.8		3,290	7.8		
603	400	Mar. 14, 19	57 A	3	35	75	40	367	10	220	258	492	2.6	3.0	.37	1,390	352	69	8.5		2,310	7.6		
701	160	Mar. 22, 19	40 A	-		64	23	* 42		248	84	30		16		381		26			689			
701	160	Sept. 14, 19	67 A	-								26									673			
801	200	Sept. 21, 19	56 A	4	44 -	50	19	* 122		227	157	75	2.2	7.7		596	203	57	3.7		916	7.7		
903	109	Aug. 22, 19	40 A	-	-	244	114	* 373		150	528	815		2.8		2,120		41			3,540			

Table 8.--Chemical Analyses of Water From Wells in Ward County and Adjacent Areas--Continued

WELL	DEPTH OR PRODUCING INTERVAL (FT)	DATE OF COLLECTION	WATER - BEARING UNIT	SILICA (SiO ₂)		MAGNE - SIUM (Mg)	SODIUM (Na)	POTAS - SIUM (K)	BICAR- BONATE (HCO ₃)	FATE	CHLO- RIDE (C1)	FLUO- RIDE (F)	NITRATE (NO)	(B)	DIS - SOLVED SOLIDS		SODIUM - ADSORP - TION RATIO (SAR)	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	pН	TE PE TU °C	ERA
h ZP-46-24-707	185-205	May 1957	A		 						80					171	 	 			
ы 707	285-305	do	A		 						75					175	 	 			
<u>н</u> 707	412-433	do	A		 						1,140					410	 	 			

- * Sodium and potassium calculated as sodium (Na). Analysis made by the following:

 - aj El Paso Natural Gas Company by Texas State Department of Health
 - g Martin Water Laboratories (Treat-Rite Chemical Company)
 - d Microbiology Service Laboratory
 - e Humble Oil & Refining Company
 - Cities Service Oil Company
 - g Atlantic Refining Company h Layne-Texas Company
 - Southwest Laboratories
 - j/ Pan American Petroleum Corporation

Contains the following:

- ly 3.4 mg/l total acidity as H^{+l}
 1 550 mg/l dissolved hydrogen sulfide (H₂S)
 my 0.06 mg/l Mn
 gy 0.02 mg/l Mn

- oy 0.06 mg/1 Mn

- g 0.06 mg/1 Mn
 g 0.06 mg/1 Mn
 +1
 g 11 mg/1 total acidity as H
 g 425 mg/1 dissolved hydrogen sulfide (H₂S)
 g 500 mg/1 dissolved hydrogen sulfide (H₂S)
 g 370 mg/1 dissolved hydrogen sulfide (H₂S)
 g 340 mg/1 dissolved hydrogen sulfide (H₂S)
 g 600 mg/1 dissolved hydrogen sulfide (H₂S)

PIT NUMBER					May.	RATE OF			CONS	TITUENTS	IN MIL	LIGRAMS	PER L	ITER (MG	/L)	HARD -		SPECIFIC	
SHOWN ON FIGURE 23	ANALYSIS NUMBER	OWNER AND LEASE	PRODUCING HORIZON		DATE OF LECTION	DISCHARGE INTO PIT (GPM)				(Na)		BICAR - BONATE	SUL -	CHLO- RIDE (C1)	DIS- SOLVED SOLIDS	NESS AS CaCO ₃	pH		REMARKS
1	YX -45 -17 -7A	Nortex Oil Co. Texas-Sealy Smith	Yates Sand- stone, Permian	Apr.	28, 1967	not measured					1	28	1,980	43,000		20,800	8.4	94,200	Carbonate 232 mg/1.
2	8 A	Kern County Land Co., Sealy-Smith Fdm.	Pennsylva- nian	May	17, 1967	12	9.4	5,000	975	33,600	196	93	1,050	63,500	104,000	165,000	6.0	133,000	
3	25 - 3A	L & G Brine and Water Sales, Inc.		Apr.	28, 1967	0						128	774	35,000		1,460	6.9	84,000	Pit stores water washed from brine transport trucks and overflow from brine storage tanks.
4	4A	Gulf Oil Corp. G. W. O'Brien		Aug.	18, 1967	not measured		-				500	3,190	17,500		8,800	7.6	46,700	Sampled from tank truck dumping water into caliche pit.
5	4B	Humble Oil & Refining Co., State Univ. "C. J."	Yates Sand- stone, Permian	Dec.	11, 1967	0		75				160	3,930	52,400	17-	23,400	6.8	113,000	
6	9A	Montex Chemical		Dec.	9, 1967	0	9.7	1,390	133	12,800	90	32	2,420	21,000	37,900	4,020	7.0	55,000	Asphalt lined pit at brine plant.
7	26-5A	Gulf Oil Corp. C. W. Edwards, et al.	"Tubb Sand," Permian		do	0						170	2,470	69,200		189,000	8.3	140,000	Carbonate 14 mg/1.
8	8 A	C. L. Norsworthy, Jr., Jack Edwards	"Tubb Sand," Permian	May	15, 1967	.6						268	2,960	66,200		16,800	6.6	138,000	
9		Texaco, Inc. Texaco, et al joint A. V. Winters Fee	Devonian	May	11, 1967	not measured	6.5	19,500	3,500	45,400	964	232	695	117,000	187,000	62,900	6.1	190,000	
10	9в	Edwin L. Cox, Chambers & Kennedy, Edwards "C"	do	Dec.	9, 1967	2						252	749	122,000		65,000	6.2	202,000	
11		Petroleum Corp. of Texas, Trebol Univ. "C"	Yates Sand- stone, Permian	July	25, 1967	34	15	940	772	6,800	137	600	523	14,400	24,200	5,520	7.4	37,600	
12	1F	Sinclair Oil & Gas Co., Hathaway	do	July	27, 1967	10			-5,81			520	556	27,200		12,000	7.2	65,800	
13		Petroleum Corp. of Texas, Trebol Univ. "C"	do	Aug.	15, 1967	22							1,590	82,500				163,000	

.

Table 9.--Chemical Analyses of Oil-Field Brine and Industrial Waste Water Disposed of in Earthen Pits in Ward County and Adjacent Areas--Continued

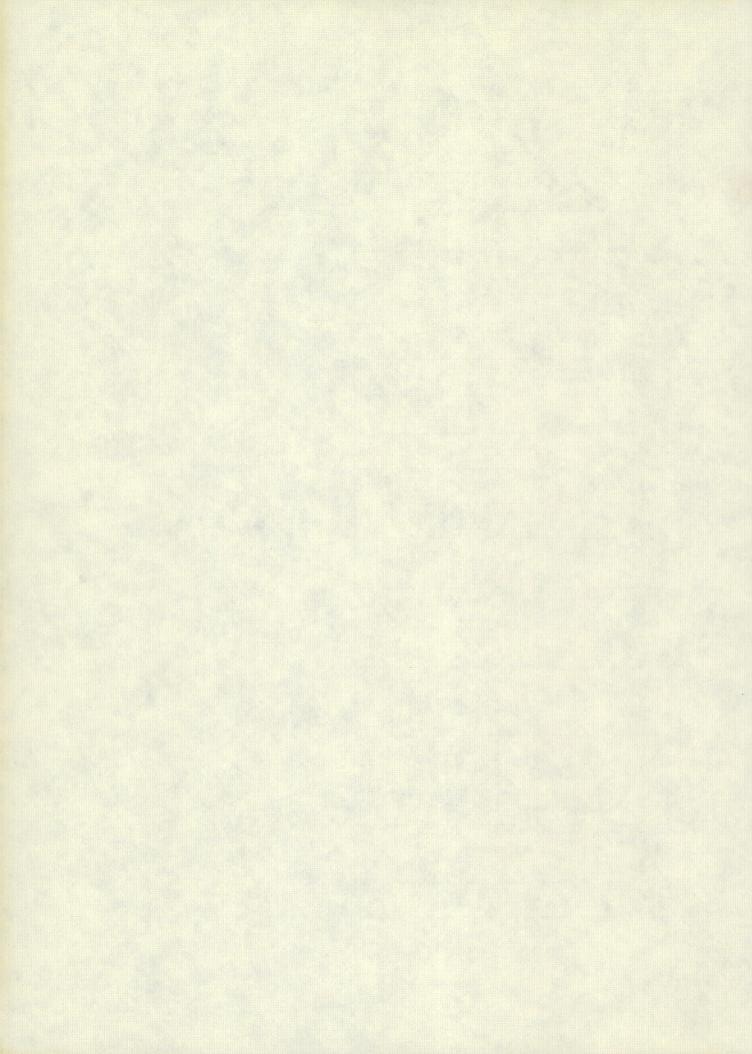
PIT						DAME OF			0000	m T m v D S m o	TN 1/	T TOD ASSO	DID -	TMPD ALC	/T. \	HADD		CDECTETO	
NUMBER	ANALYSIS	OWNER AND LEASE	PRODUCING	D	ATE OF	RATE OF DISCHARGE	STITCA	CAT -	MAGNE -	SODIUM		BICAR -		CHLO-	DIS	HARD - NESS	рН	SPECIFIC CONDUCT-	REMARKS
SHOWN ON FIGURE 23	NUMBER NUMBER	OWNER AND LEASE	HORIZON		LECTION	INTO PIT (GPM)			SIUM (Mg)	(Na)	SIUM (K)	BONATE (HCO ₃)	FATE	RIDE (C1)	SOLVED SOLIDS	AS CaCO ₃	рп	ANCE (MICROMHOS AT 25°C)	
14	YX-45-33-1H	Texaco, Inc., State "C" & "E"	Yates Sand- stone, Permian	Dec.	11, 1967	0						144	1,000	22,000		9,160	7.0	54,400	
15	2A	Humble Oil & Refining Co. Louis Richter	do	July	18, 1967	7						236	1,000	12,200	11	5,400	6.7	33,300	
16	2В	Harlan Production Co., W. L. Martin		July	27, 1967	8						296	1,450	87,000		35,000	6.5	163,000	
17		Harlan Production Co., J. F. Hathaway	do	Aug.	28, 1967	14						376	266	21,500		9,000	7.1	53,200	
18	3A	Paul De Cleva Oil Co., I. Fred	Pennsylva- nian	June	24, 1967	2						61	597	92,000		25,500	4.9	171,000	
19	4A	Pan American Petroleum Co. Byrd	Yates Sand- stone, Permian	Aug.	18, 1967	1/4 to 4							2,350	44,800				99,100	
20	5A	Tidewater Oil Co. W. D. Johnson	do	Aug.	9, 1967	60	12	1,720	1,440	11,000	365	384	357	24,000	39,300	10,200	7.0	59,300	Pit disposal dis- continued and pits destroyed when re- visited Dec. 6, 1967
21	7A	Sunset Inter- national Petro- leum Corp., Combs	do	Dec.	11, 1967	3	26	2,060	1,140	13,400	220	784	3,460	25,000	45,700	9,830	7.1	63,900	
22	34-3A	McCulloch Oil Co. Tubb	Ellenburger Ordovician	Dec.	9, 1967	2						1,280	2,930	40,800		9,600	7.8	94,500	
23		Sohio Petroleum Co., Wristen Bros. "B"	Queen Formation, Permian	June	28, 1967	5						1,390	2,730	38,000		12,600	8.3	87,400	Carbonate 79 mg/l. Seven holes, 4- to 6- feet in diameter blasted in pit botto
24	8A	Sohio Petro- leum Co., Wristen Bros. "E"	do		do	1						224		8,400		7,600	7.2	32,500	
25	8в	Sohio Petro- leum Co., Wristen Bros. "A"	do	Dec.	11, 1967	40	13	1,710	875	21,200	156	125	4,100	36,000	64,100	7,870	7.1	86,000	
26		Adobe Oil Co. Payton Unit, Tract 10	Yates Sand- stone, Permian		do	2 .		1				1,300	2,370	45,600		11,100	7.3	103,000	
27		Luce, W. P. & Ice, Chas. O. J. O. Brictson	do		do	6						874	4,210	58,600		11,000	7.3	125,000	

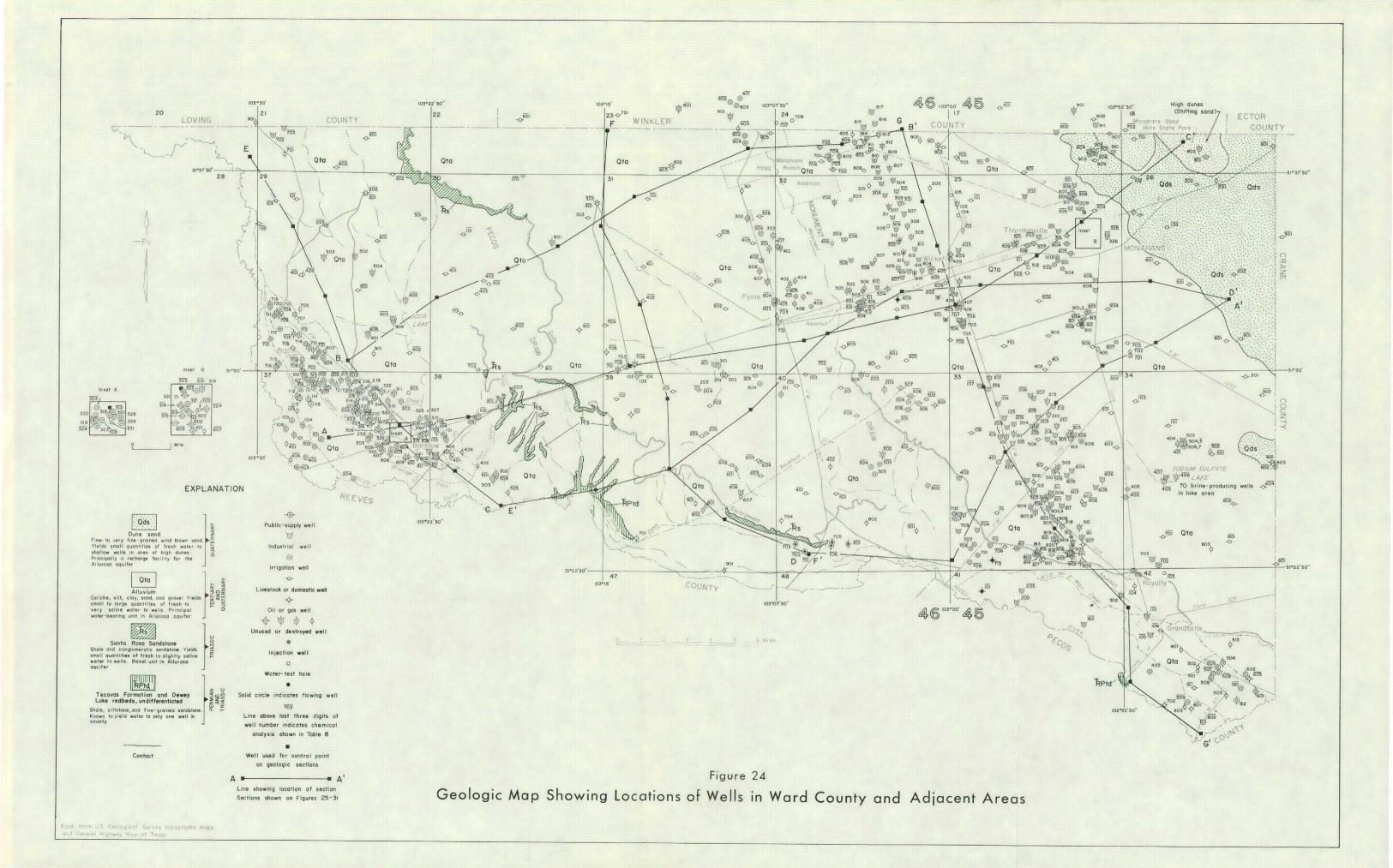
Table 9.--Chemical Analyses of Oil-Field Brine and Industrial Waste Water Disposed of in Earthen Pits in Ward County and Adjacent Areas--Continued

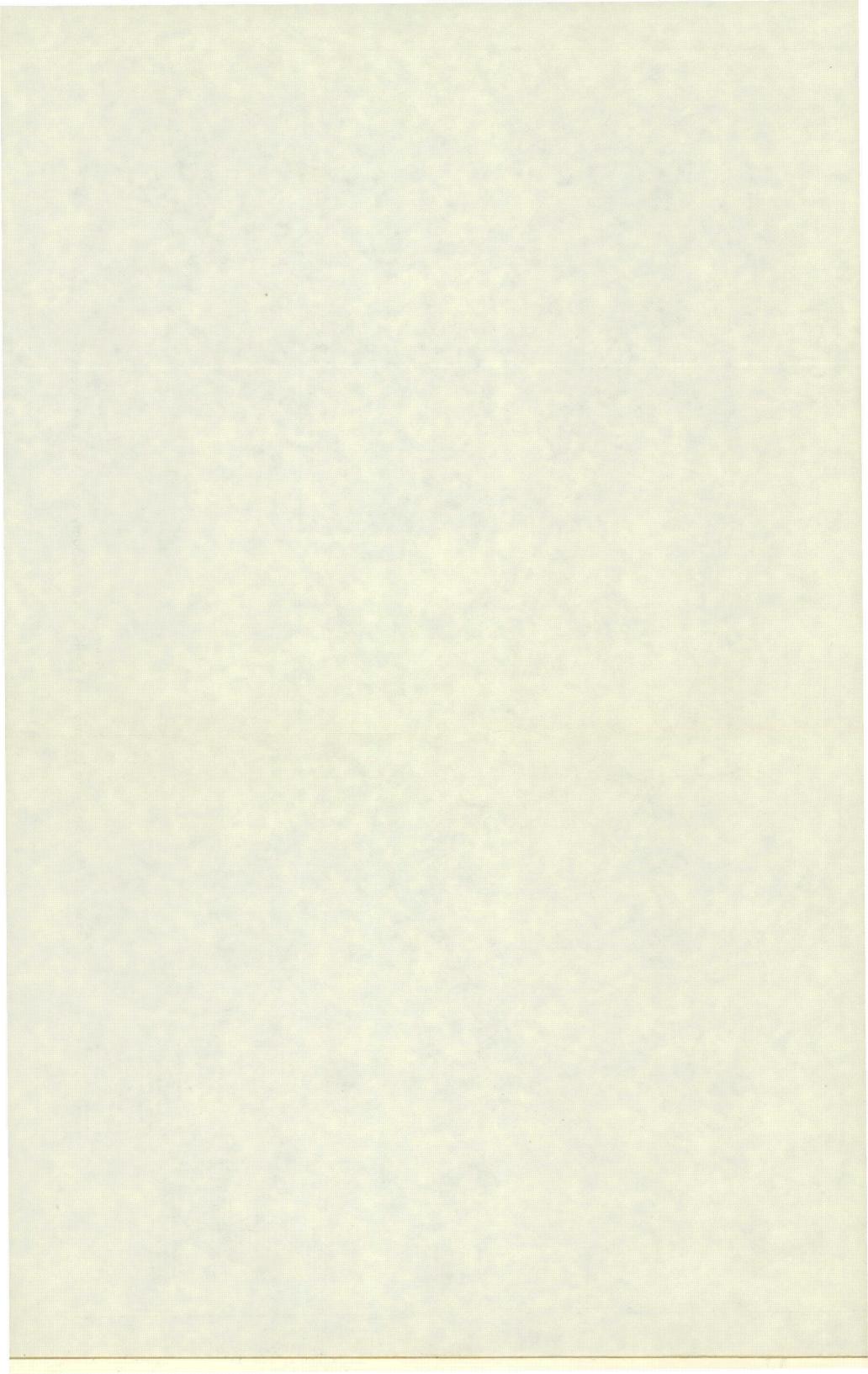
PIT NUMBER						RATE OF			CONS	TITUENTS	IN MIL	LIGRAMS	PER L	ITER (MG	/L)	HARD -		SPECIFIC	
SHOWN ON FIGURE 23	ANALYS IS- NUMBER	OWNER AND LEASE	PRODUCING HORIZON		ATE OF LECTION	DISCHARGE INTO PIT (GPM)			MAGNE- SIUM (Mg)	SODIUM (Na)	POTAS- SIUM (K)	BICAR- BONATE (HCO ₃)	FATE	CHLO- RIDE (C1)	DIS- SOLVED SOLIDS	NESS AS CaCO ₃	F	CONDUCT- ANCE (MICROMHOS AT 25°C)	REMARKS
28	YX -45 -41 -6C	Adobe Oil Co. Payton Unit, Tract 6	Yates Sand- stone, Permian	Dec.	11, 1967	7 3						790	6,390	58,800		12,400	7.2	124,000	
29	42 -1A	Frank Waters Oil Co., Case	Queen Formation, Permian		do	1						97	745	43,800		11,700	7.4	98,200	Water is discharged on ground.
30	4A	H. H. Hawley Oil Co., H. H. Hawley Fee	Yates Sand- stone, Permian	May	9, 1967	0.4					77	47	807	172,000		66,500	5.0	224,000	
31	4в	Luce, W. P. & Ice Chas. O. R. G. Blair	, do	Dec.	11, 1967	9	4.1	1,240	1,620	119,000	318	78	5,740	190,000	318,000	9,760	6.7	241,000	
32		Signal Oil & Gas Co., J. C. Reynolds	do	May	9, 1967	7 4						532	4,290	67,500		18,000	7.1	139,000	
33	ZP-46-24-8A	Kewanee Oil Co. Geo. Sealy Estate	Permian	Sept.	5, 1967	0				4				3,400					Reported pit disposal discontinued July 1962.
34	YX-46-24-8B	Saxet Oil Co. Geo. Sealy Estate	Seven Rivers Formation, Permian	Dec.	7, 1966	not measured							1,620	3,080	9,200		7.0	15,300	Analysis from files of city of Monahans.
35		Landa Oil Co. J. E. Echols	Delaware Mountain Group, Permian	Oct.	17, 1967	1						28	273	123,000	12.	51,600	5.9	196,000	
36		Atlantic Refining Co., Marrow	do	Oct.	27, 1967	24						46	658	102,000		53,200	6.1	175,000	
37	31-1A	Mobil Oil Co. Univ. "B"	do	Sept.	28, 1967	1						16	242	156,000		84,000	5.6	211,000	
38		Texas Oil & Gas Corp., Univ. "A"	do		do	1						16	216	138,000		45,000	6.0	209,000	
39		White Eagle International Inc., G. W. O'Brian, et al.	Yates Sand- stone, Permian	June	7, 1967	22						658	2,660	18,000		7,620	7.4	47,900	
40		Mobil Oil Co., Geo. Sealy Estate "44"	do	Sept.	5, 1967	2								24,500				67,000	
41	2C	Mobil Oil Co., Geo. Sealy Estate	do		do	9		'				228	2,780	28,000		8,150	7.5	68,700	

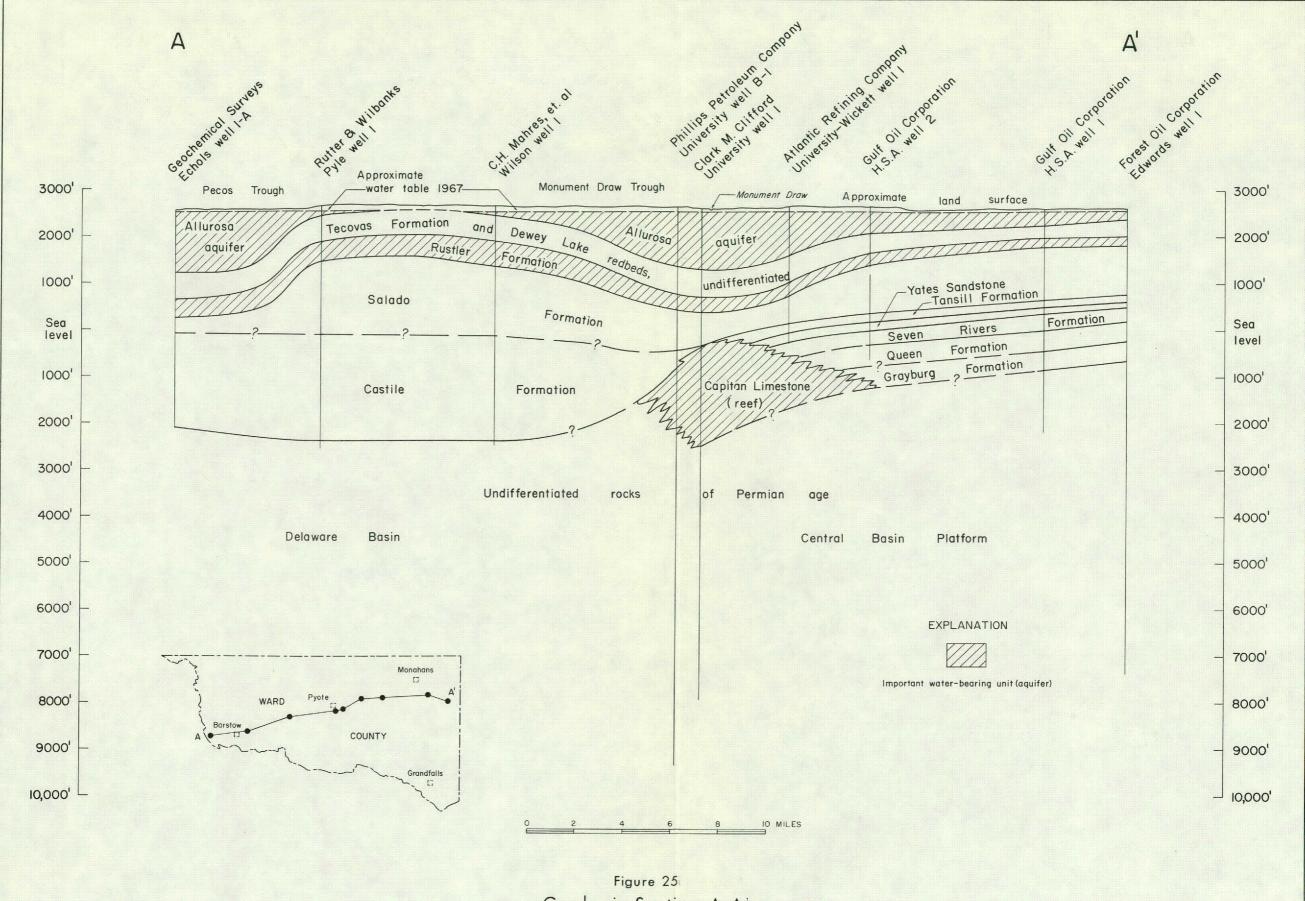
Table 9. -- Chemical Analyses of Oil-Field Brine and Industrial Waste Water Disposed of in Earthen Pits in Ward County and Adjacent Areas -- Continued

PIT NUMBER SHOWN ON FIGURE 23	ANALYSIS NUMBER	OWNER AND LEASE	PRODUCING HORIZON	DATE OF COLLECTION	RATE OF DISCHARGE INTO PIT (GPM)	SILICA (SiO ₂)	CAL- CIUM (Ca)	CONS MAGNE - SIUM (Mg)	TITUENTS SODIUM (Na)		BICAR- BONATE (HCO ₃)	SUL - FATE		DIS- SOLVED SOLIDS	HARD- NESS AS CaCO ₃	pН	SPECIFIC CONDUCT- ANCE (MICROMHOS AT 25°C)	REMARKS
42	YX -46 -32 -3A	White Eagle International Inc., G. W. O'Brien, et al. "B"	Yates Sand- stone, Permian	June 7, 1967	< 0.5					-	318	3,960	18,800		7,380	7.5	50,800	
43	5A	Mobil Oil Co., Geo. Sealy Estate "I"	Yates Sand- stone(?), Permian	Sept. 6, 1967	15	23	670	202	301	15	316	2,340	365	4,070	2,500	7.4	4,510	
44	6A	Atlantic Refining Co., Univ. 16-12	Seven Rivers Formation, Permian	do	16	21	585	209	452	21	674	1,880	730	4,230	2,320	7.4	5,280	
45	6В	Atlantic Refining Co., Univ. 16-12 "C"	do	Sept. 10, 1967	56								740				5,370	
46	38-8A	Continental Oil Co., J. A. Stumpf	Delaware Mountain Group, Permian	Sept. 27, 1967	1	4.2	21,100	3,500	67,500	1,080	23	82	155,000	248,000	67,200	5.8	215,000	
47	39 - 6A	B. B. M. Drilling Co., Epsie Fry	do	Nov. 10, 1967	3						122	605	156,000		57,500	6.7	233,000	

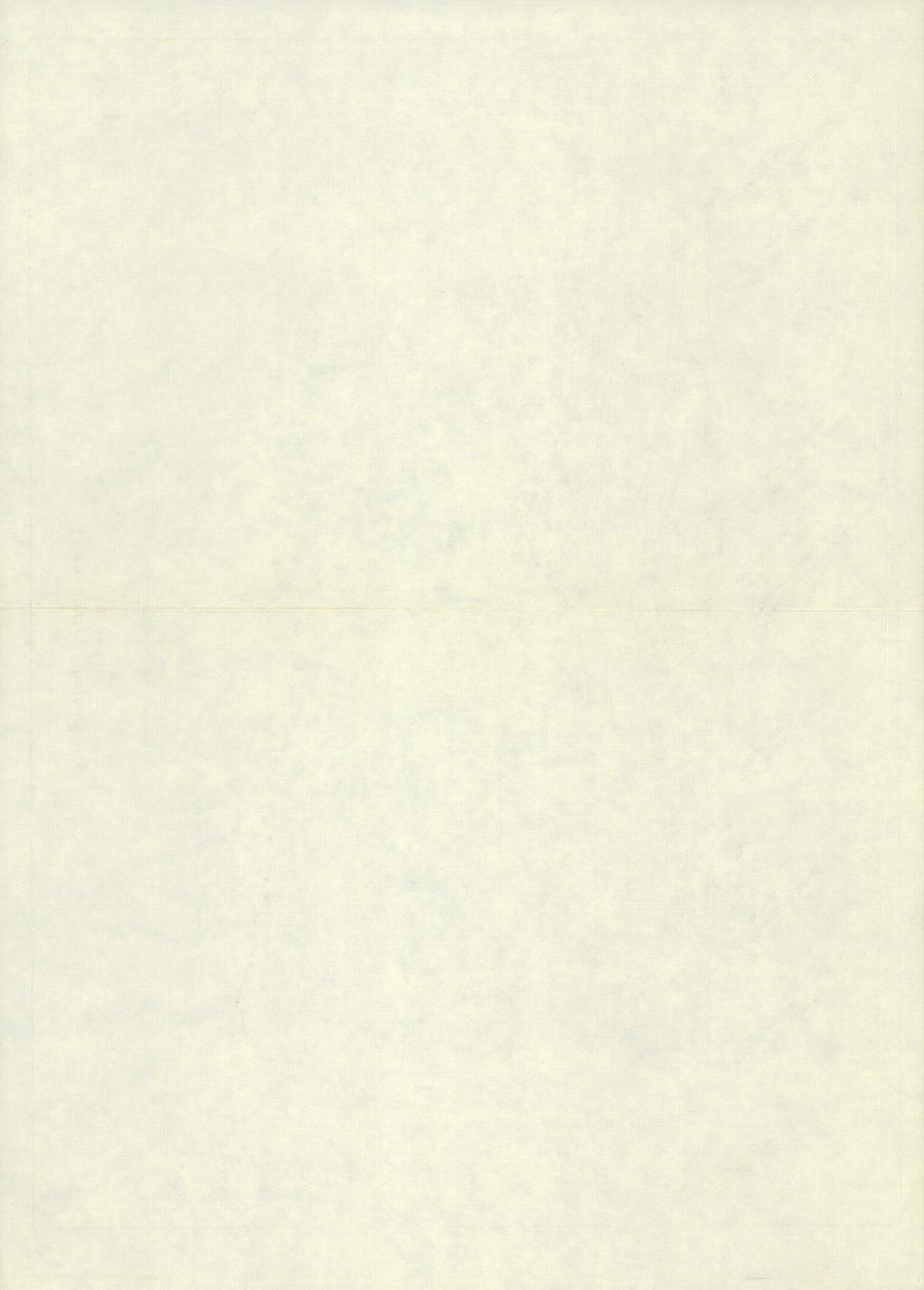


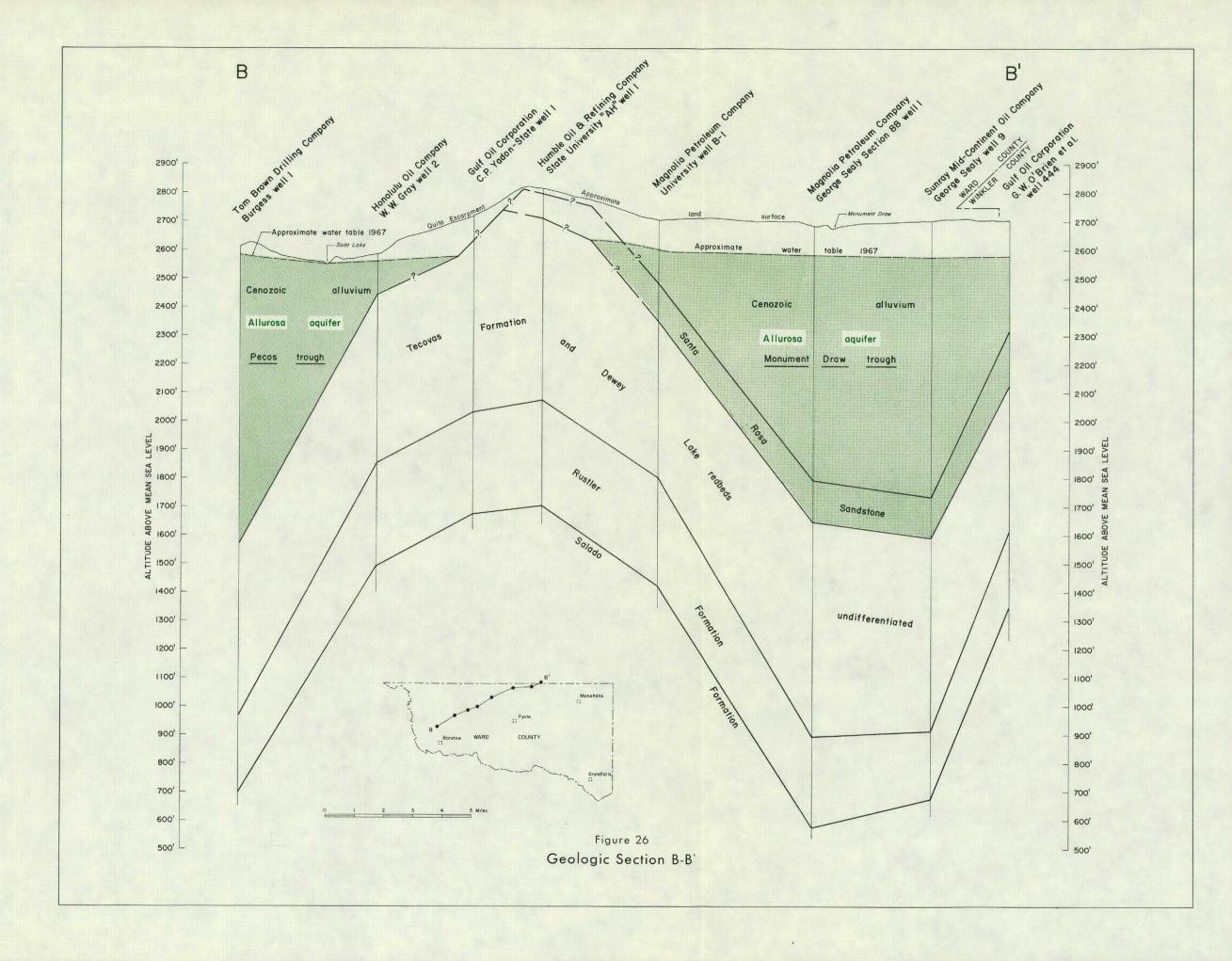


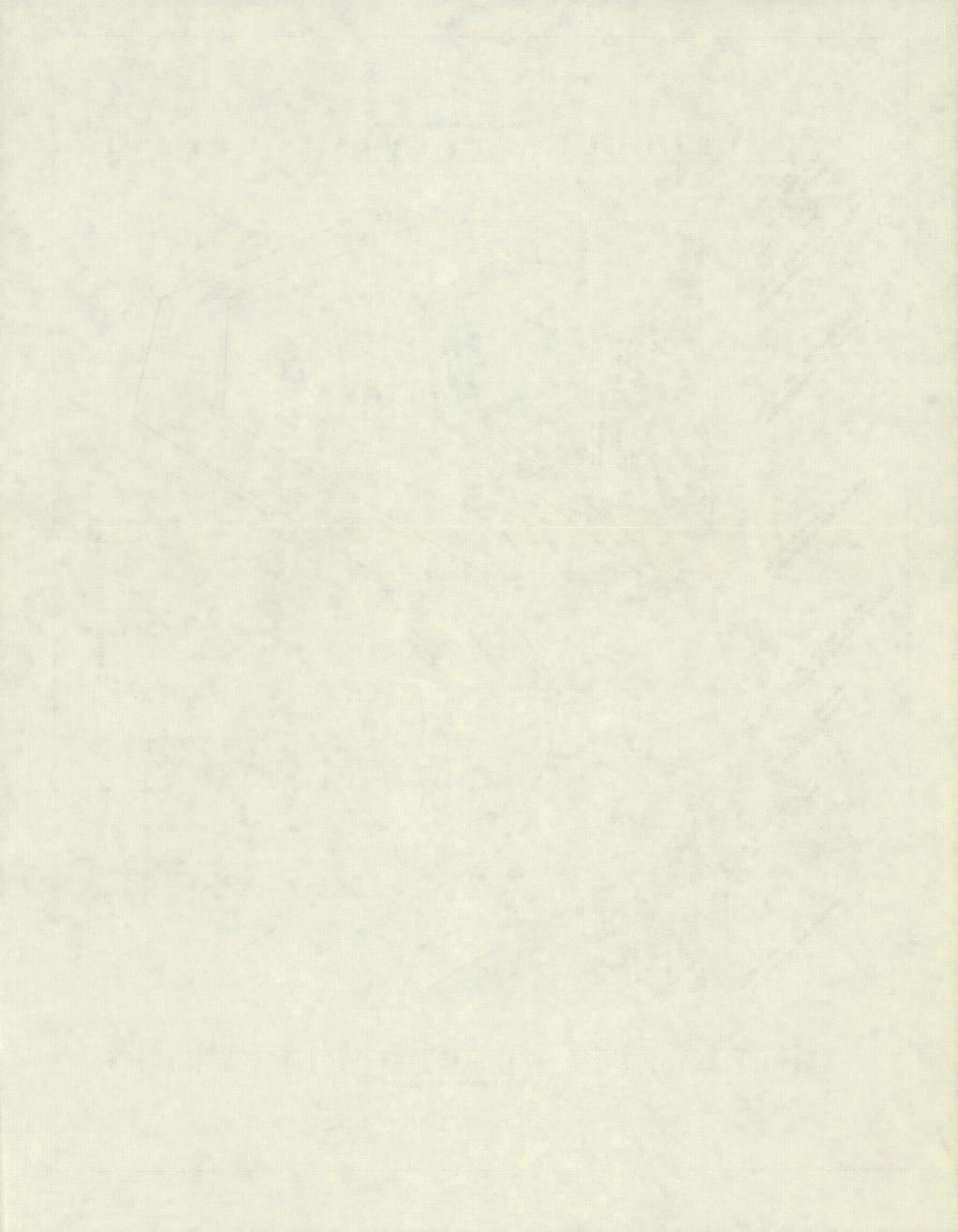


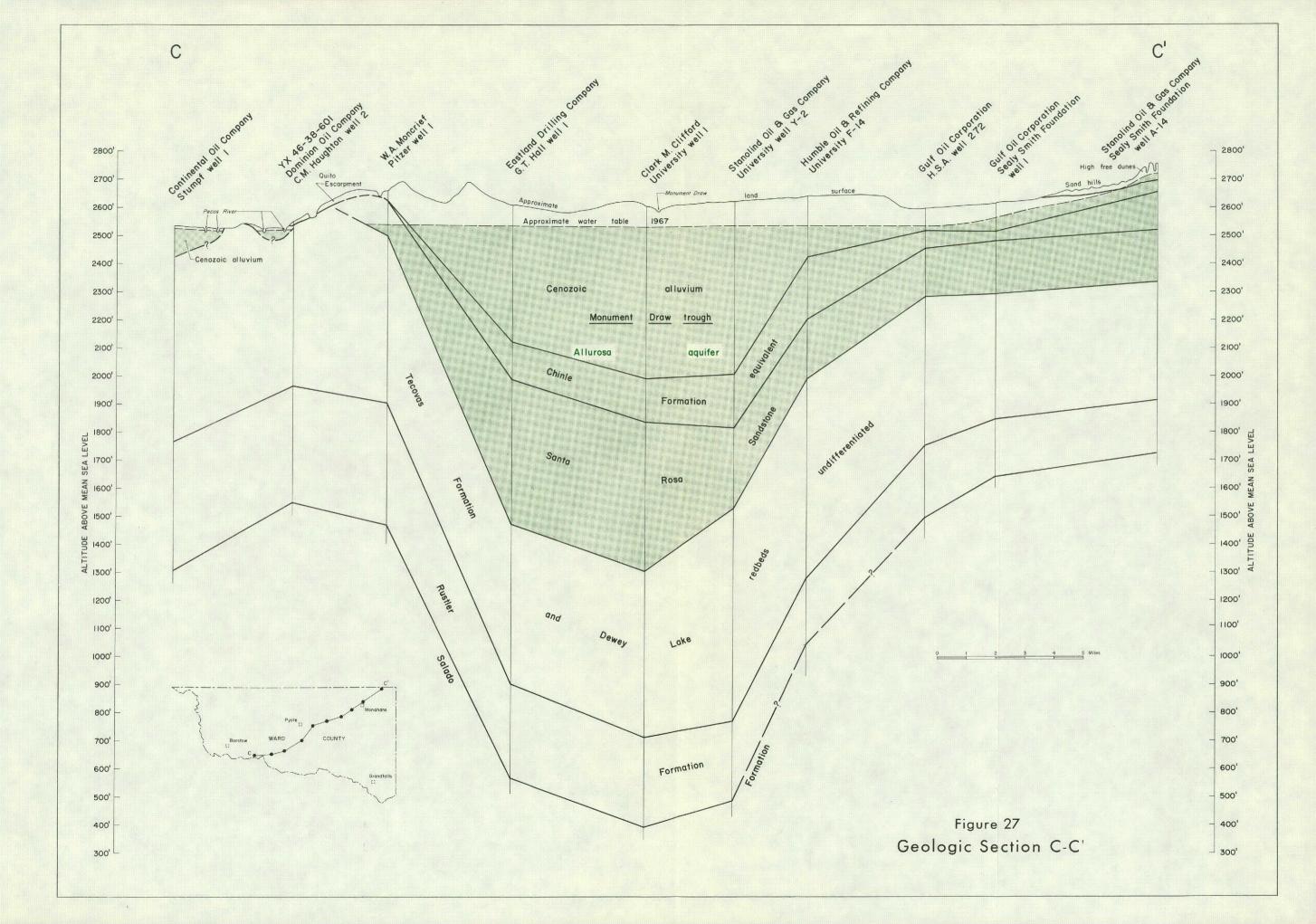


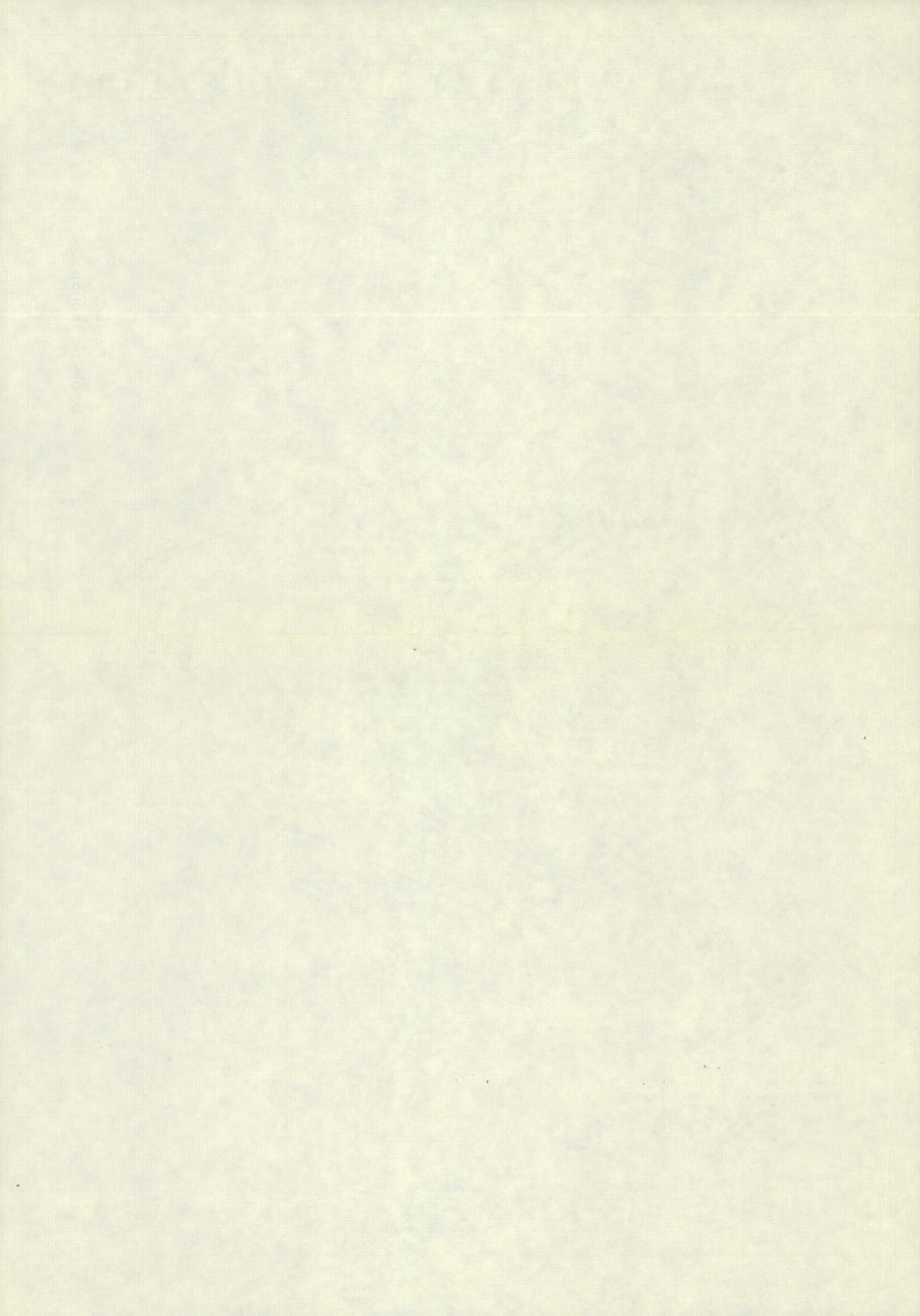
Geologic Section A-A

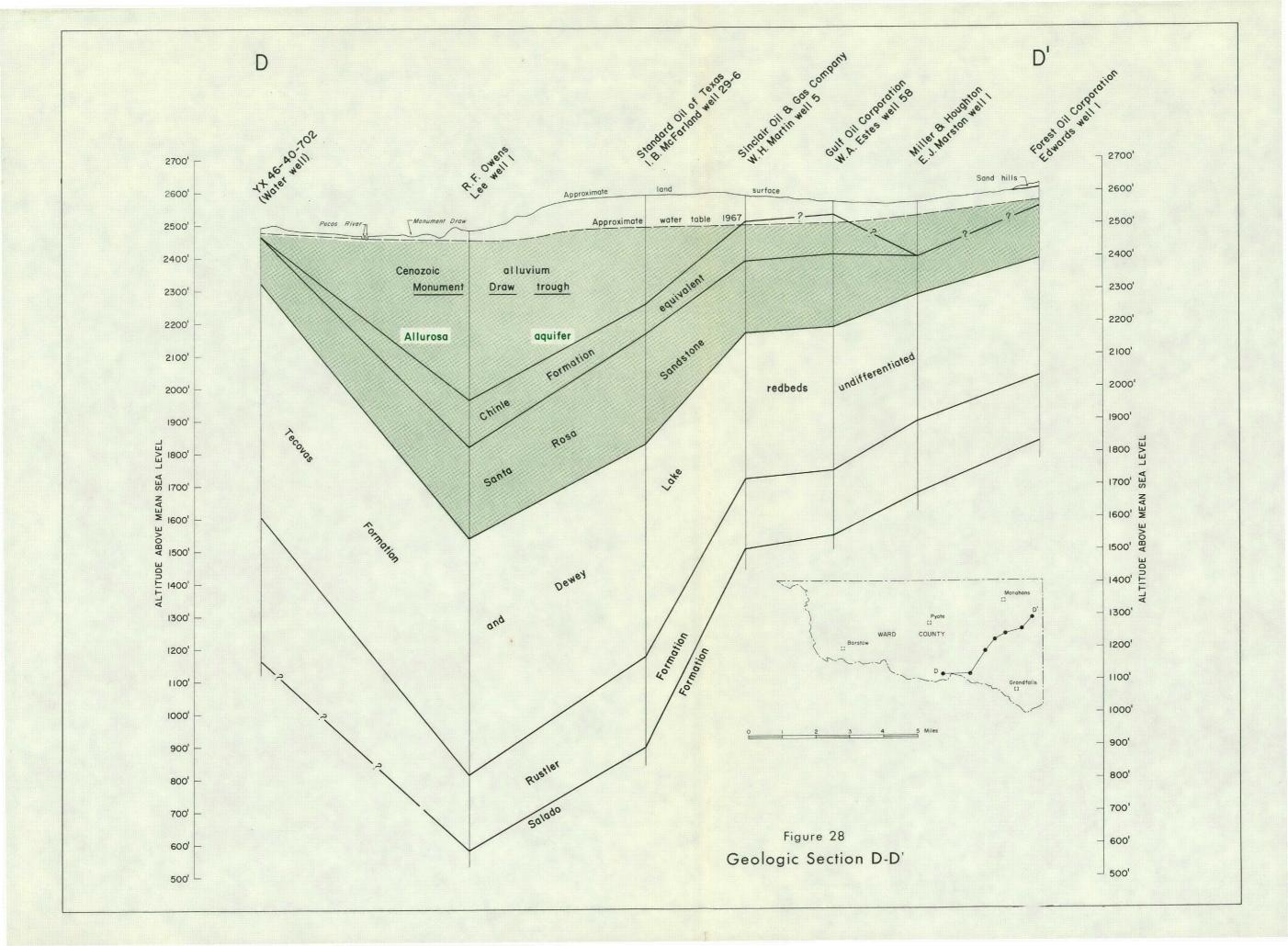


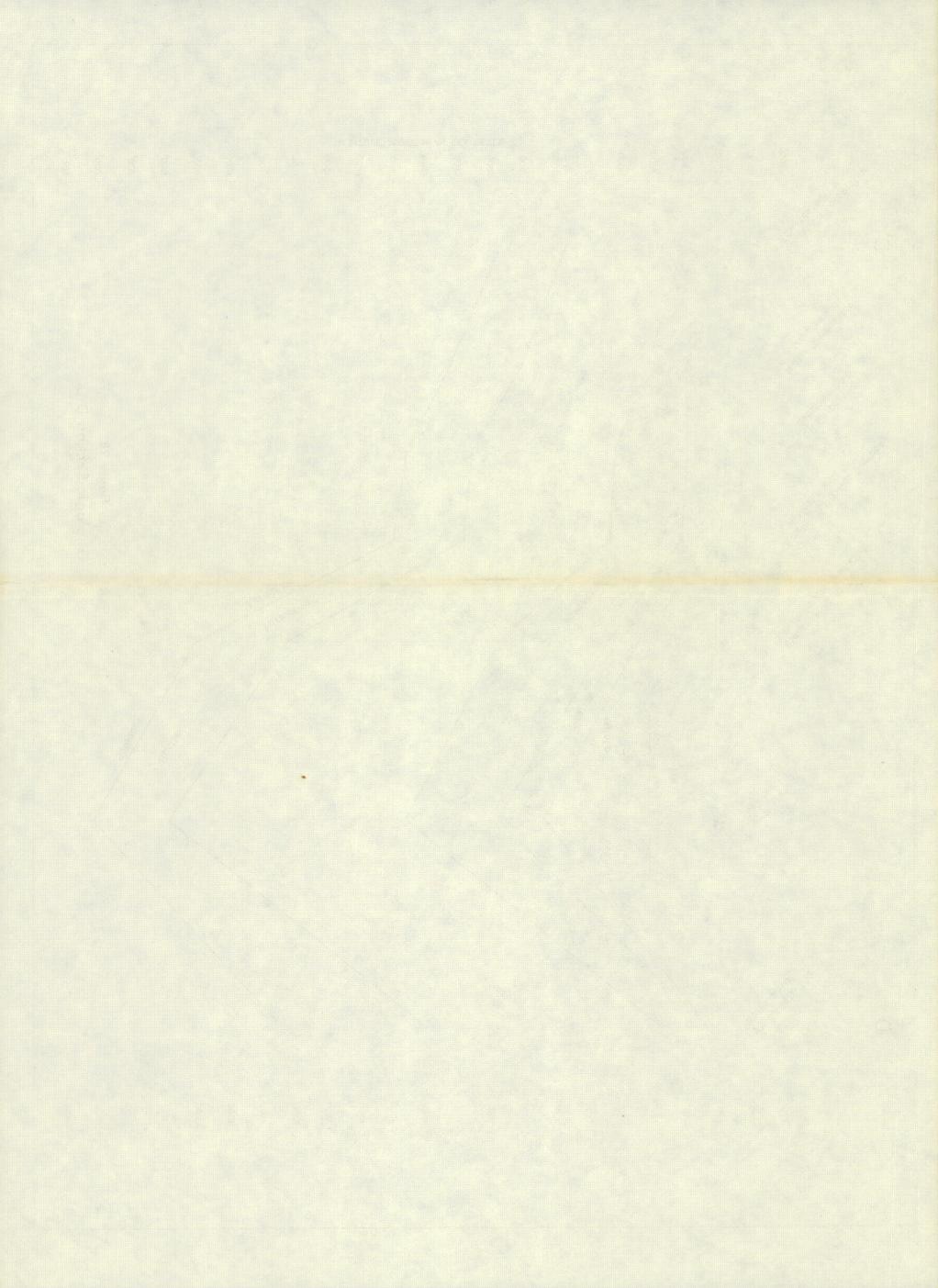












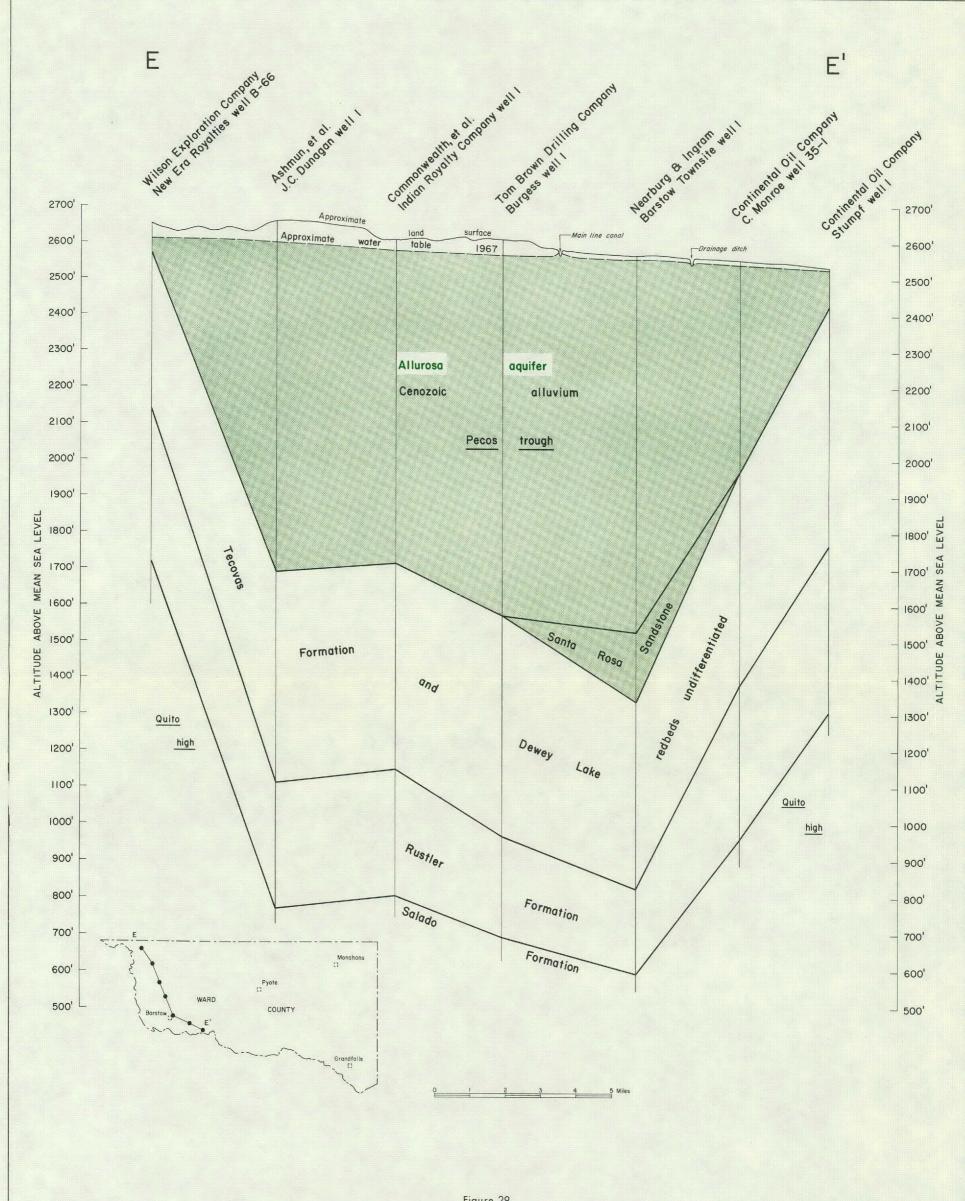


Figure 29
Geologic Section E-E

