TEXAS DEPARTMENT OF WATER RESOURCES

REPORT 240

OCCURRENCE, QUALITY, AND QUANTITY OF GROUND WATER IN WILBARGER COUNTY, TEXAS

By

Robert D. Price, Geologist
Texas Department of Water Resources

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OCCURRENCE, QUALITY, AND QUANTITY OF GROUND WATER IN WILBARGER COUNTY, TEXAS

ABSTRACT

Wilbarger County, 954 square miles in area, is located in extreme north-central Texas and entirely within the Osage section of the Central Lowlands physiographic province. The area lies within the Red River drainage basin with the Red River forming its north boundary and the Pease River dissecting the county and flowing northeast through the central part of the county. Vernon, the county seat, is the largest city with a 1970 population of 11,454. The climate of the area is a subhumid, warm-temperate, continental type. The mean annual rainfall at Vernon (1935-70) is 25.04 inches.

The water needs of the county are supplied almost entirely from ground water. The water-bearing units listed in their order of importance are: the Seymour Formation, Quaternary alluvium deposits, and the rocks of the Permian System. The Seymour Formation and Quaternary alluvium deposits are hydrologically connected and usually function as a single aquifer. The yields of the wells range from small to moderate. The quality of their ground waters ranges from fresh to very saline. Ground waters of the Clear Fork Group of Permian age are of small yields and are usually highly mineralized. The San Angelo Formation of Permian age reliably yields fresh to slightly saline ground water in small quantities.

Ground water in Wilbarger County is used for municipal, irrigation, rural domestic, livestock, and industrial purposes. In 1970, about 6,000 acre-feet was pumped. Of this, about 4,000 acre-feet (65 percent) was for municipal supply; 2,000 acre-feet (33 percent) was for irrigation; 150 acre-feet (2 percent) for rural domestic and livestock use; and 9 acre-feet (less than 1 percent) for industrial purposes.

An estimated 266,000 acre-feet of ground water is in transient storage in the Seymour Formation in the Odell-Fargo area, and an additional 101,000 acre-feet is estimated to be in storage in this aquifer in the Lockett area. The estimated quantity of water available for annual withdrawal by wells in these areas is 5,000 acre-feet and 3,500 acre-feet, respectively. Large-scale development will reduce the streamflow of the region which is partly sustained by natural ground-water discharge.

The native ground water in the principal aquifer in the county, although very hard, is of good quality. Water from this aquifer is suitable for public supplies, irrigation, livestock, and limited industrial uses.

OCCURRENCE, QUALITY, AND QUANTITY OF GROUND WATER IN WILBARGER COUNTY, TEXAS

INTRODUCTION

Location

Wilbarger County, having an areal extent of approximately 954 square miles, is located in extreme north-central Texas (Figure 1). The north boundary, which is also the line between the States of Texas and Oklahoma, parallels the Red River (Figure 5). The county is bounded on the west by Foard and Hardeman Counties. Wichita County and Baylor County are located on the east and south, respectively. The county is located approximately between 98° 57′ and 99° 28′ west longitude and 33° 50′ and 34° 28′ north latitude. Vernon, the county seat, is centrally located within the county at the junction of U.S. Highways 70, 183, and 283, approximately 50 miles northwest of Wichita Falls, Texas.

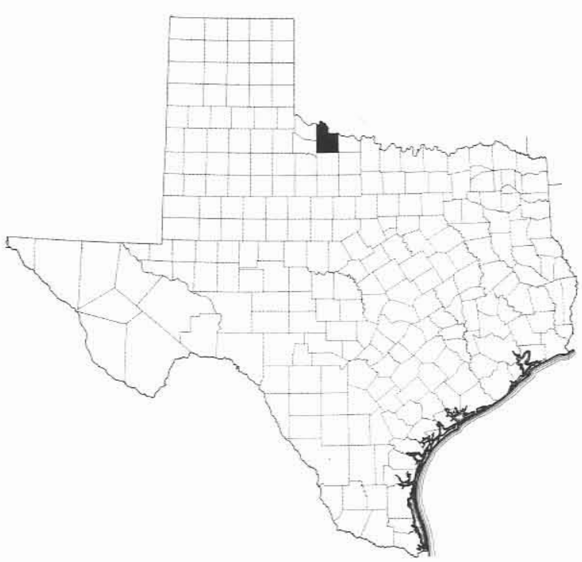

Figure 1.—Map of Texas Showing Location of Wilbarger County

Purpose and Scope

The Texas Water Development Board recognizes the significance of ground water in the north-central Texas region and has conducted several investigations in order to meet a growing need for more accurate and detailed ground-water information in this area. This investigation is one of the studies within the subject region.

Several towns with municipal water supplies in north-central Texas are served by ground water or use wells on a standby basis. In addition to meeting municipal needs for water in the area, ground water is often the sole source supplying domestic, farm, and ranch needs.

Reports from the results of investigations in Archer, Baylor, Brown, Coleman, Jones, Montague, Shackelford, Stephens, Taylor, Throckmorton, and Young Counties have been or are being published by the Board.

The specific purpose of this study was to determine the occurrence, quality, and quantity of the ground-water resources of Wilbarger County. Special emphasis was placed on determining the sources of water suitable for municipal, industrial, irrigation, domestic, and livestock use. Areas and possible sources of present or potential ground-water contamination were delineated.

The scope of this project included the collection, compilation, and analysis of data pertaining to the distribution and quality of ground water in Wilbarger County, and the presentation of these data, results of analyses, and conclusions in report form.

Methods of Investigation

An inventory was made of all municipal, industrial, and irrigation wells, plus all springs, as well as a representative selection of domestic and livestock wells. A total of 973 wells, springs, and test holes were inventoried in the period September 1969 to June 1971 (Table 4). Water levels were measured in all wells where possible. Information was gathered, when available, on well depths, well construction, date drilled, driller, water-yielding formations, and water-production quantities. Surface elevations of all wells inventoried were determined from topographic maps and electric log well records.

Water samples were collected for chemical analysis from 464 selected wells, springs, or test holes during this study. These analyses, as well as 109 analyses performed by commercial or private laboratories, are listed in Table 8.

Surface and subsurface geologic data were collected and compiled, placing special emphasis on their relationship to ground water. To supplement the available data, in the period October 5-22, 1970, the Texas Water Development Board drilled 10 test holes to better determine the configuration of the base of the Seymour Formation northeast of Odell.

Additional data were collected and compiled on apparent and potential ground-water contamination, oil-field brine disposal, climate, and areas of ground-water recharge and discharge.

Previous Investigations

Prior to this investigation, several general geological reports relating to the area had been published and these are cited in the selected references.

Gordon (1913) conducted a regional reconnaissance investigation of the geology and underground waters of 13 counties in north-central Texas. A brief discussion of conditions in Wilbarger County is included in this water-supply paper.

Follett, Sundstrom, and White (1944) made a fairly detailed study of the ground-water resources in the vicinity of Vernon. Their report includes records of 221 wells and 161 chemical analyses of ground water. Also included is a brief description of the geology of the county and its relationship to the occurrence of ground water, and data on aquifer characteristics and pumpage.

Willis and Knowles (1953) conducted a very detailed investigation of the ground-water resources of the Odell sand hills in northern Wilbarger County. With financial assistance from the city of Vernon, 70 test holes were drilled during that study to determine accurately the aquifer's character and thickness. Included in the report are records of 110 wells and 42 chemical analyses of water. Also presented is a discussion of the relationship of the geology to the occurrence of ground water, results of aquifer pumping tests, hydrologic maps, and estimates of the amount of ground water in storage.

In 1956, Follett compiled records of water-level measurements in Foard and Wilbarger Counties. This report includes historical water-level data on 76 observation wells in Wilbarger County, and hydrographs of 11 selected wells within the county.

Baker, Long, Reeves, and Wood (1963) completed a regional reconnaissance investigation of the ground-water resources of the Red River, Sulphur River, and Cypress Creek basins in Texas. Wilbarger County is located within the Red River basin.

An investigation of ground- and surface-water contamination near Harrold in Wilbarger County was made by Fink (1965), and Stearman (1960) conducted a reconnaissance investigation of alleged contamination of irrigation wells near Lockett in west-central Wilbarger County.

Two unpublished reports have been written concerning water-quality problems within the subject county. Davis in 1963 conducted a regional reconnaissance study of oil-field brine conditions in the Red River basin of Texas.[1] This report dealt primarily with natural pollution, such as salt springs, as well as the control of man-made pollution caused by industrial and municipal wastes. An investigation was made during 1968 on the nitrate content in ground water of the Seymour Formation in the Lockett area of Wilbarger County.[2] This study was made at the request of the Red River Authority of Texas.

Pertinent water-well data from all of the above reports have been selectively incorporated into the present report. These and the new well inventory data together comprise a large body of documentation for the areas of major water-well development in the county (Tables 4-8 and Figure 34).

[1] Davis, J. R., 1963, "Salinity alleviation study of oil-field brine conditions in the Red River basin of Texas." Unpublished, Texas Water Commission file report.

[2] Hill, Robert, 1968, "Miscellaneous paper on nitrate content in ground water of the Seymour Formation, in the Pease River Valley, Wilbarger County, Texas." Unpublished, Texas Water Commission file report.

Well-Numbering System

The system used in the numbering of wells and springs in this report is one developed and adopted by the Texas Water Development Board (Figure 2). It is based on latitude and longitude and is presently in use throughout the State. The system is based on the assignment of a seven-digit number to each well. The State is divided into quadrangles formed by degrees of latitude and longitude, and these are repeatedly subdivided into smaller quadrangles as follows:

1. The largest, 1-degree quadrangles, are each given a two-digit number from 01 to 89. Thus, the origin of the first two digits of a well number.

2. Each 1-degree quadrangle is further subdivided into 64 7½-minute quadrangles which are each assigned a two-digit number from 01 to 64. These two digits are the third and fourth digits of a well number.

3. Lastly, each 7½-minute quadrangle is subdivided into nine 2½-minute quadrangles which are numbered one to nine. This number is the fifth digit of the well number. Within these 2½-minute quadrangles, each well is assigned a two-digit number in sequence beginning with 01. These are the last two digits of the well number.

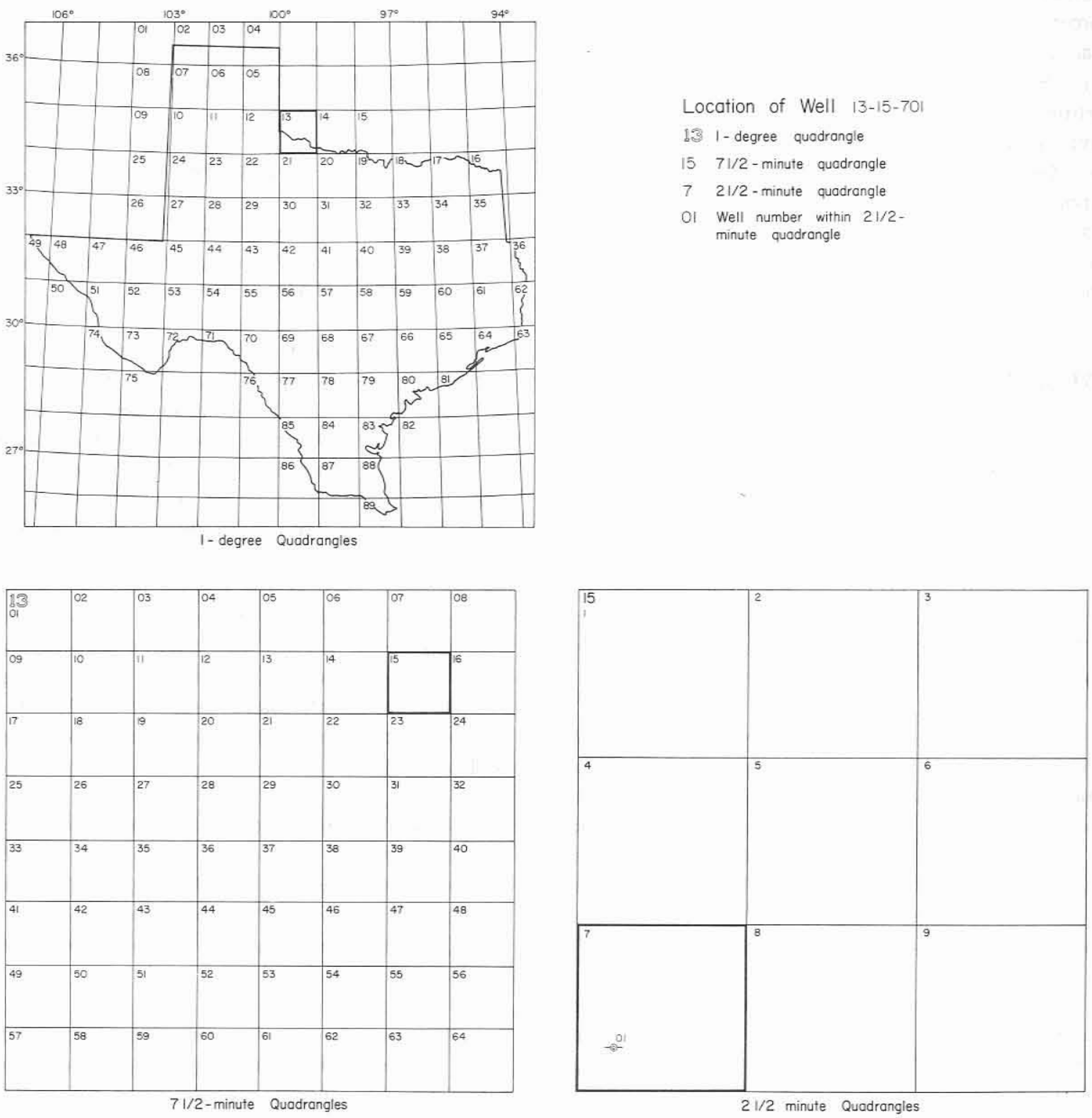

Figure 2.—Well-Numbering System

On the well-location map in this report (Figure 34), the 1-degree quadrangles are shown with large open-block numerals. The 7½-minute quadrangles are labeled in their northwest corners, and the last three digits of each well number are shown at the well site.

Acknowledgements

The author is indebted to the many landowners, farmers, water well drillers, oil operators, and municipal officials for permitting access to their wells, aiding in the collection of well data, and for granting permission to test their wells. Appreciation is also extended to the various governmental agencies, especially to Mr. Perry Barnes, manager, U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service, Wilbarger County Committee; Mr. Norman Drake (deceased), former county agent, Wilbarger County; Messrs. Frank L. Dunkin and John Adams, U.S. Department of Agriculture, Soil Conservation Service; and representatives of the U.S. Geological Survey, the State Department of Highways and Public Transportation, and the State Health Department. Special recognition is extended to the Southwest Rural Electric Association, Incorporated, of Tipton, Oklahoma, for providing data pertinent to this study.

WILBARGER COUNTY GEOGRAPHY

Topography and Drainage

Wilbarger County is located entirely within the Osage section of the Central Lowlands physiographic province. Topographically, the county is an eastward-sloping plain with surface elevations ranging from 1,480 feet in the northwest to about 1,040 feet in the southeast.

The northern two-thirds of the county, dissected by the wide flat valleys of the Pease River and its tributaries, is dominantly gently rolling farm lands composed of sandy to moderately sandy soils, mixed soils, or bottomland soils. The southern one-third, as well as a small area immediately north of Vernon, has hilly topography with mainly shale- and clay-derived soils and is used mainly for ranching operations.

Two prominent eastward-facing escarpments which trend northeast are formed by Permian dolomite and limestone beds. One such escarpment is formed by the Merkel Dolomite Member of the Choza Formation which crops out in the northwest part of the county (Figure 5). A similar, but less prominent one is formed across the southeastern one-third of the county by the outcropping Lueders Formation.

Wilbarger County is located entirely within the Red River drainage basin. The northern two-thirds is drained by the Red River, its minor tributary Wanderers Creek, and the Pease River and its tributaries which flow northeastward into the Red River. The southern one-third of the county is drained by the eastward-flowing Beaver Creek and its tributaries which flow into the Wichita River in Wichita County.

Santa Rosa Lake, located on Beaver Creek in south-central Wilbarger County, is the only sizeable surface reservoir within the county. This lake is owned by the W. T. Waggoner estate, covers approximately 1,500 acres, and is used for oil-field operations, domestic water supply, and irrigation. The estimated total storage capacity of the lake is 11,570 acre-feet.

History

Wilbarger County, formed in 1858 from Bexar Territory, was named for Josiah and Mathias Wilbarger who were early-day Austin settlers.

Among the first and most distinguished pioneers of the area were Judge J. Doan, C. F. Doan, and W. B. Worsham. The R2 ranch, with headquarters at Big Spring (near the present Hillcrest Country Club in northwest Vernon), was established by Mr. Worsham in 1879. Cowboys in this section of Texas gathered at the ranch to receive news from their homes in the east. The Doan brothers, in the meantime, built a store in the northeast part of the county near the cattle trail which crossed the Red River into Indian Territory. This store was known as "Doan's Store" and the cattle crossing became known as "Doan's Crossing". Several hundred thousand head of cattle, on their way to northern markets, made this crossing between 1880 and 1890.

Rapid settlement of the area occurred following the establishment of a mail route from Seymour to Doan's Store, and on October 10, 1881, Wilbarger County was organized. Many of the early settlers to the county were from Arkansas, Georgia, North Carolina, Ohio, and Virginia.

Vernon, the county seat, was incorporated in 1889. Originally the name Eagle Flat was chosen as its name; however, it was changed when the Post Office Department objected.

Oil was first discovered in Wilbarger County in 1908, and the first well was completed in November of that year.

Population

The 1970 federal census gave Wilbarger County a total population of 15,355. Vernon, the county seat, had an official population of 11,454. Statistics regarding other towns, communities, or cities were reported merely as Divisions and include the rural areas surrounding the area. The population of the county Divisions are as follows: Lockett, 1,742; Fargo-Odell, 1,082; and Harrold-Oklaunion, 1,079.

According to the 1960 population census, 68.4 percent was urban, 16.3 rural non-farm, and 15.3 percent rural farm. Data were not available to make a 1970 comparison.

The population density in 1970 was 16.1 persons per square mile compared to 18.6 in 1960.

Climate and Weather

The climate of Wilbarger County could be termed moderate More specifically, it has a subhumid, warm-temperate, continental type of climate. This is reflected by the records of precipitation, temperature, and evaporation within the area (Figures 3 and 4).

Records furnished by the U.S. Weather Service at Vernon, for the 36-year period from 1935 through 1970, are included in this report (Figure 3). A comparison of these data and other observations is as follows:

1. The mean annual rainfall at Vernon (1935-70) is 25.04 inches.

2. The maximum officially recorded yearly rainfall of 48.71 inches was recorded in 1941.

3. The minimum officially recorded rainfall was 13.26 inches in 1956.

4. Available data at Vernon indicate that in the spring, May received the maximum average monthly rainfall which amounted to 4.53 inches, and in the fall, September with 2.81 inches had the greatest average monthly amount (Figure 4).

According to the Texas Almanac for 1970-71, the temperature at Vernon varies from a mean maximum of 98°F during July to a mean maximum of 29°F for January, with a mean annual temperature of about 68°F. For the period of record, the temperature range at Vernon is from a minimum of −7°F to a maximum of 119°F. The same source states that the approximate dates for the first and last killing frosts are November 7 and March 31, giving the county a growing season of 221 days.

Data for the period from 1940-65 compiled by Kane (1967) reflect that the average annual gross lake-surface evaporation depth in Wilbarger County is approximately 72 inches; however, the average net lake-surface evaporation depth is only about 48 inches (Figure 4).

Economy

The principal factors determining the economy of Wilbarger County, listed in their order of importance, are: the extraction of minerals, agriculture, and small industry.

The most important influence on the county's economy is the production of oil and gas. Since the initial discovery well in 1908, approximately 4,000 producing wells have been drilled on an estimated 600 leases scattered throughout the county. Over 212.9 million barrels of oil was produced from 1908 to 1973 (Texas Almanac for 1974-75). A total of 4.3 million barrels was produced in 1972. Natural gas liquids, sand and gravel, and limestone production make up the balance of the mineral extractions. The total value of all 1971 mineral production was approximately $14.9 million.

Agriculture is the secondary source of income. Both farming and ranching play major roles. Based on information furnished by the Wilbarger County Building Committee for 1960, approximately 40.3 percent of the county's 610,560 acres was under cultivation and 59.7 percent was used in ranching operations. The principal crops grown were hay (mostly alfalfa), cotton, wheat, grain sorghums, oats, and guar. The value of all crops sold in 1968 was approximately $7.6 million. In 1968, there were an estimated 45,000 head of cattle, 2,700 head of hogs, and 500 head of sheep in Wilbarger County. The total 1968 value for the sales of livestock and their products was approximately $5.2 million.

Most of the small industries of the county are located in Vernon and they are mainly associated with agriculture. These include cotton gins, a guar mill, grain elevators, feed and seed establishments, cattle feedlots, a meat-packing plant, and shipping. Other small industries

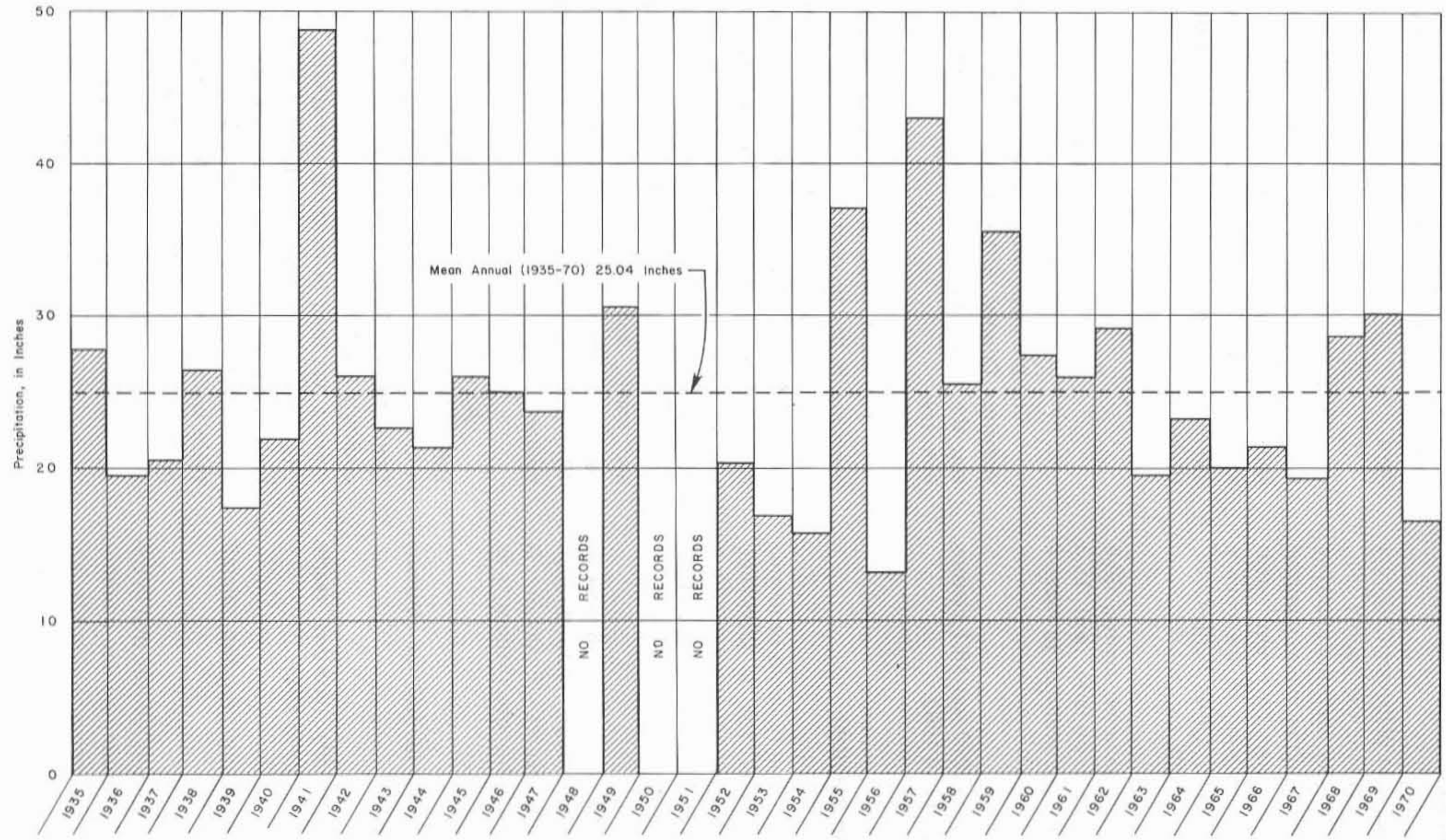

Figure 3
Annual Precipitation at Vernon, 1935-70
(From Records of National Weather Service)

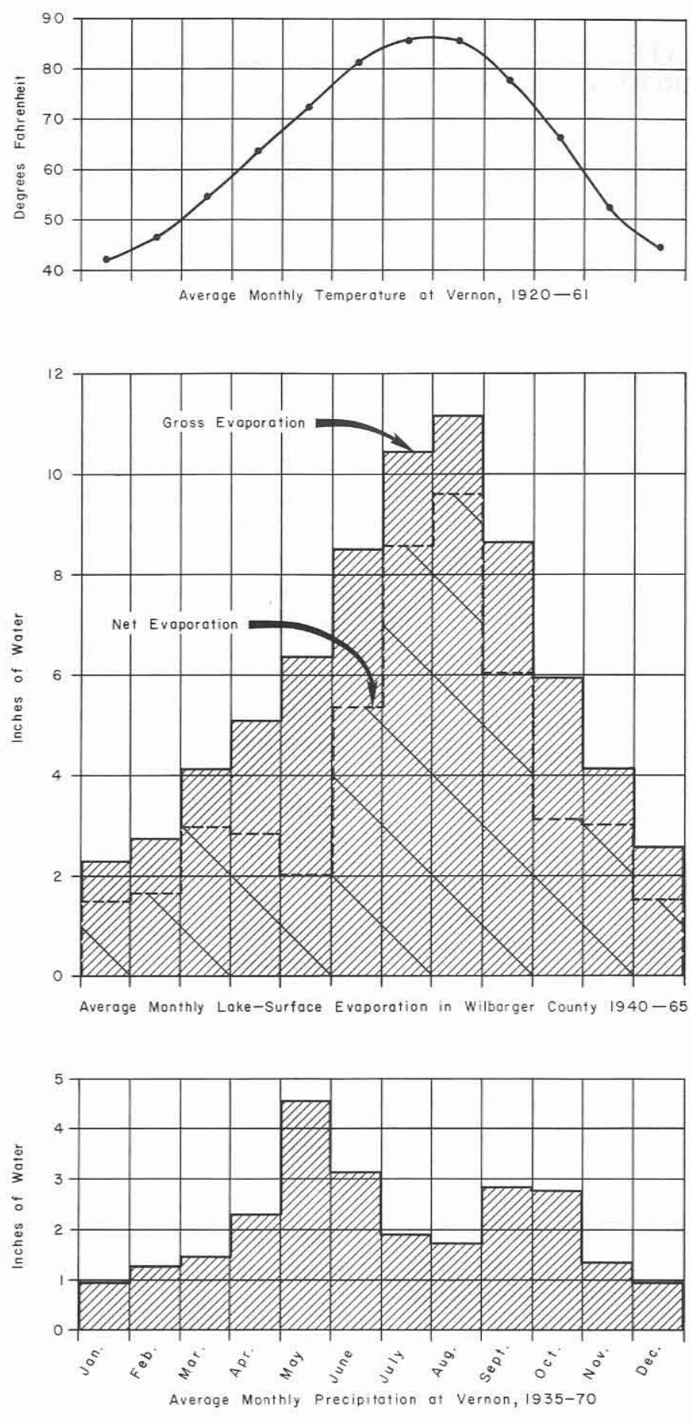

Figure 4

Average Monthly Precipitation, Lake-Surface Evaporation, and Temperature (From Records of National Weather Service, and Kane, 1967) are clothing, athletic supply, and mattress manufacturers and soft drink processors.

GEOLOGY AS RELATED TO THE OCCURRENCE OF GROUND WATER

General Geology

Geologic History

Geologically, the history of Wilbarger County is complicated in that the northern two-thirds of the county lies within the Hardeman (eastern Palo Duro) basin and the southern one-third is within the Baylor syncline. The two areas are separated by the Red River arch (Figure 9).

Much of the following information on geologic history is taken from Laing (1963).

During Cambrian time, structurally high areas existed in the vicinity of the present Red River arch (Figures 6, 7, and 8). Cambrian sediments were not deposited on the extremely high areas; however, Lower Ellenburger beds of Upper Cambrian age are present north and south of the arch.

Ordovician age rocks are known to have been laid down in Wilbarger County and to the north in Oklahoma. Slight fluctuation of the seas is evidenced by several disconformities in the Upper Ellenburger and a thinning of the Lower Simpson beds.

Silurian and Devonian age sediments are also known to have been deposited in areas to the north; however, it is not known if deposition occurred in Wilbarger County.

At the close of Devonian time, the Acadian orogeny caused retreat of the seas and the area was subjected to widespread erosion until early Mississippian time. This removed all of the Devonian, Silurian (if ever present), and much of the Ordovician sediments from the Wilbarger County area. Remnants of these units remain in other areas of the present Hardeman basin.

After the Acadian uplift, Mississippian seas advanced and deposited marine limestones and shales. The Mississippian period was followed by an erosional period which removed most of the Mississippian sediments from the Red River arch, while lower areas and areas to the north and south retained these sediments.

Deposition was resumed with the advance of Morrowan seas and the area north of the Red River arch received sediments.

The Wichita orogeny, at the close of Morrow time, raised the Wichita Mountains and thus formed the Hardeman basin. The previously deposited Mississippian and Morrowan rocks were removed from the mountains during this period of erosion.

Following this, deposition was continued, with minor movements in the Wichita Mountains and the Red River arch, throughout Strawn and most of Canyon times.

The Arbuckle orogeny began during Canyon time and continued until late Cisco time when Pontotoc conglomerates were deposited to the north of Wilbarger County. This movement further depressed the associated basin. The Red River arch was buried during this time within the subject county. Subsidence continued throughout late Pennsylvanian and Permian times and sediments deposited onlapped the Wichita Mountains.

Final movement of the area was regional tilting of the Permian deposits, causing a slight elevating of the Wichita Mountains and subjecting the surface beds to erosion from that time until present. This movement established the regional dip on the Permian beds as it exists today.

During the Triassic and Jurassic periods, the area was emergent and there was a time of continental uplift and erosion.

In contrast to the two preceeding periods, the Cretaceous represents a time of advancement of the seas. During this time, there was a southeastward tilting of the Texas gulf coast region with the associated reversal of the drainage systems.

The previously deposited Cretaceous beds were then removed from Wilbarger County and surrounding areas during the Cenozoic Era.

The Larimide orogeny caused the Rocky Mountain region to be elevated during this time and this was the source area for material in the Ogallala Formation which was later reworked and deposited by streams as the Seymour Formation of Wilbarger County and surrounding areas.

Stratigraphy

Exposed at the surface and underlying Wilbarger County, rocks representing various geologic systems are present (Figures 5, 6, 7, and 8). The systems, listed in order from oldest to youngest, are: Precambrian, Cambrian, Ordovician, Mississippian, Pennsylvanian, Permian, and Quaternary. The general lithology of the various units, and their stratigraphic relationships are shown on the geologic sections (Figures 6, 7, and 8). These rocks are composed mainly of limestones, dolomites, shales, and clastics which, for the most part, were deposited in epicontinental seas of relative shallow depth. The sequence of deposition of rock types indicates that there were repeated transgressions and regressions of the seas. Since the pre-Permian rocks produce ground waters of a brine quality (total dissolved solids greater than 35,000 ppm), no further discussion will be made on these units. See Table 9 for the chemical character of brines in the various pre-Permian strata.

The oldest rocks exposed at the surface in Wilbarger County belong to three groups of the Permian System. Listed in order from oldest to youngest, they are: the Wichita, Clear Fork, and Pease River Groups. These units are overlain, throughout much of the county, by younger Quaternary deposits of the Seymour Formation or stream alluvium (Figure 5). The geologic formations and their water-bearing properties are summarized in Table 1, and their stratigraphic relationships and structural attitude are illustrated in Figures 6, 7, and 8.

At their maximum extent, shallow Permian seas were very widespread throughout Texas (Eardley, 1951, pl. 9). The seas extended from the southwest, out of Mexico, over the north-central Texas area including Wilbarger County, over all of West Texas and into the neighboring States of New Mexico and Oklahoma, and as far north as Kansas (Sellards et al., 1932, p. 185-186).

During the time in which the Wichita Group was deposited, a landmass was postulated to have been east and southeast of the Wilbarger County area. Dominately marine shales and shelf limestones were deposited in shallow seas covering areas immediately south of Wilbarger County. During this time, a delta apparently was forming in the vicinity of the Arbuckle and Wichita Mountains of Oklahoma. This caused a gradual northward change in the lithology of the Wichita Group with sandy sediments becoming more prominent in a limestone and a marginal marine red bed sequence (Stafford, 1960, p. 278). This condition existed just south of the Red River in the Wilbarger County area.

Deposition of the Clear Fork Group, composed of thin, poorly-developed limestones and dolomites, interbedded with red beds and, locally, anhydrite, suggests that the seas were becoming more restricted and the climate more arid.

The Pease River Group, of Upper Permian age, is marked by an increase in nonmarine clastics at the beginning of its deposition. These clastics are postulated to be a deltaic deposit due to their cross-bedded and conglomeratic character. This increase in nonmarine clastics, accompanied by a marked erosional unconformity between the San Angelo Formation and the underlying Clear Fork Group, indicates a renewed uplift of the source area, believed to have been east of the north-central Texas area. Later deposition of thick beds of evaporites, interfingered with red beds, thin limestones, and dolomitic limestones, suggests a much more restricted sea and an even more arid climate.

Unconformably overlying the rocks of Permian age within Wilbarger County are semi-consolidated and unconsolidated deposits of clay, sand, and gravel of Quaternary age. These are the principal water-bearing beds of the area.

The geologic record between the Permian System and the Quaternary System is not recorded in the rock sequence of the subject area. However, Van Siclen (1957, p. 56-57), states that prior to Pleistocene time, the Wilbarger County and surrounding area was eroded to a nearly flat plain which had a gentle slope to the east. During this time, all sediments younger than Permian were removed.

In Pleistocene time, streams thought to have been well established for quite some time were depositing sediments over a large area of north-central Texas. These sediments are believed to have been transported from the west. They are referred to as the Seymour Formation and formed a near continuous sheet-type deposit over wide areas and probably covered most of the entire area of Wilbarger County at one time. Deposition of the sediments was thought to have been controlled by repeated cycles of terrestial alluviation and erosion caused principally by climatic changes associated with the advance and retreat of glacial ice sheets. These were located in the northern United States and in Canada (Van Siclen, 1957, p. 46-60).

Seymour deposits were subjected to erosion during Recent time and they now are present as scattered patches capping interstream areas. The existing valleys of major streams now contain unconsolidated alluvial deposits, probably of Pleistocene to Recent age, which were in part derived from the eroded Seymour Formation. Terrace deposits are found along both the Red River and Pease River. These remnants from earlier levels of the rivers consist of gravel, sand, and silt of a more recent origin than the Seymour Formation found at higher elevations. Ground water of poor quality is found in these deposits.

Table 1.—Geologic Units and Their Water-Bearing Properties in Wilbarger County

System	Series	Group	Formation	Approximate maximum thickness (feet)	Lithologic character	Water-bearing characteristics
Quaternary	Recent to Pleistocene		Alluvium	60	Alluvial cross-bedded gravel, sandstone, fine silt, and sandy clay occurring as erratic deposits in the stream valleys of the Red River, Pease River, and their major tributaries. Wind-blown deposits of fine sand, and alluvial terrace deposits of silt, sandstone, and gravel, are also present along these streams.	Yields fresh to very saline water in small to moderate quantities to wells mainly along rivers and their major tributaries.
Quaternary	Recent to Pleistocene		Seymour	112	Contains alluvial, fine-grained, white and light tan to red sand and silt; reddish-orange and gray clay; white to buff nodules of caliche (usually near surface). Lower portion of the formation is generally cross-bedded, interstratified lenses of orange clay, sand, and coarse gravels or conglomerates which are made up of well rounded pebbles of quartz, quartzite, igneous crystalline rocks, bone fragments, petrified wood, scattered water-worn Cretaceous fossils, and cobbles and pebbles of limestone. Volcanic ash is present in the outcrop north of Doans.	Yields fresh to very saline water (mostly fresh to slightly saline) in small to moderate quantities to wells in the northern two-thirds of the county.
Permian	Guadalupe	Pease River	San Angelo	210	Cross-bedded deltaic sandstone, red to greenish-gray to pink, usually well consolidated, medium-grained, sub-angular to well rounded, occurs near top of the formation; lower portion contains clay balls, sandstone as above interbedded with cherty conglomerate, gypsum nodules, streaks of "satin spar" gypsum, and red and green shale and clay.	Yields fresh to slightly saline water in small quantities to wells in the northwest part of the county.
Permian	Leonard	Clear Fork	Choza Vale Arroyo	1,350	The persistent, blue to gray, Merkel Dolomite Member of the Choza Formation is present near the top of this group. The remainder of the group consists of red to reddish-brown or gray gypsiferous shale, thin stringers of dolomite, anhydrite or gypsum, and limestone, and a few thin lentils of shaley sandstone.	Yields fresh to very saline water in small quantities to a few scattered wells in the east-central and west-central parts of the county.
Permian	Leonard	Wichita	Lueders and older formations	670	Massive to thin beds of blue, gray to buff, fossiliferous limestone interbedded with argillaceous limestone and black, gray to greenish-gray shale; grades into dolomite westward in the subsurface.	Not known to yield useable quality water to wells in Wilbarger County.

Yield of wells: Small, less than 100 gpm (gallons per minute); moderate, 100-1,000 gpm; large, more than 1,000 gpm.

Quality of water as ppm (parts per million) dissolved solids: fresh, less than 1,000 ppm; slightly saline, 1,000 to 3,000 ppm; moderately saline, 3,000 to 10,000 ppm; very saline, 10,000 to 35,000 ppm; brine, greater than 35,000 ppm.

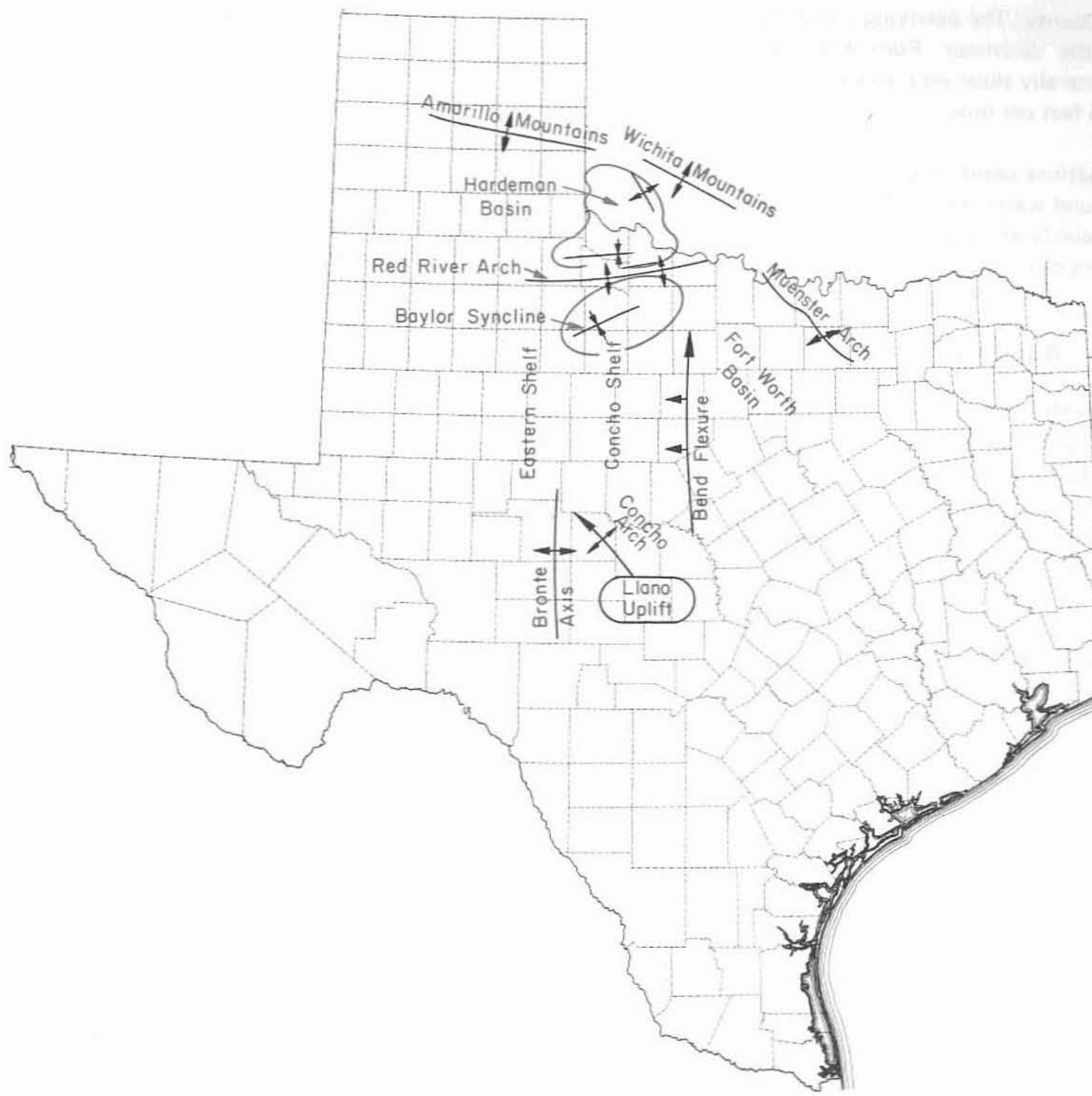

Figure 9.--Major Structural Features in North-Central Texas

Structure

The major subsurface structural features of Wilbarger County and vicinity include the Wichita Mountains of Oklahoma, the Red River arch, the Hardeman basin, and the Baylor syncline. The locations of these structural features are shown on Figure 9.

Wilbarger County is located mainly within the Hardeman basin. The Red River arch trends east-west across the south one-third of the county. A small part of the county south of the Red River arch lies within the Baylor syncline.

The Red River arch has existed since Cambrian time. Movement occurred several times until burial of the feature near the close of Cisco time.

Depressing of the Hardeman basin, at the close of Morrowan time, occurred coincident with the raising of the Wichita Mountains during the Wichita orogeny. The basin was further depressed by the Arbuckle orogeny during Canyon and Cisco time (Laing, 1963, p. 214).

The Baylor syncline was formed during early Pennsylvanian time contemporaneous with the Bend flexure (Farris et al., 1963, p. 12).

During Permian time, regional tilting, combined with filling of the Midland basin, formed the present dip on post-Atoka strata within north-central Texas (Figures 6, 7, and 8).

This west-northwest dip of approximately 25 feet per mile is reflected in the exposed Permian beds of

Wilbarger County. The overlying surficial deposits which comprise the Seymour Formation and Quaternary alluvium generally slope very gently to the east-southeast at about 15 feet per mile.

Formations significant to the occurrence of usable quality ground water within Wilbarger County have not been appreciably affected by any of the major structural deformations other than tilting as described above.

Aquifers and Aquicludes

An aquifer is a permeable, water-bearing geologic formation, part of a formation, or group of formations (Meinzer, 1923, p. 30). An aquiclude is a relatively impermeable or an impermeable body of rock, which may contain water but is incapable of transmitting an appreciable quanity. The Permian rocks that crop out in Wilbarger County generally function as aquicludes, either yielding no water to wells or yielding only small amounts, while the Seymour Formation and Quaternary alluvium are more permeable and serve as aquifers.

The lithology, approximate thicknesses, and water-bearing properties of the geologic units are summarized in Table 1. Figure 5 shows the areal extent of the outcrops of the various units. The subsurface position, the thickness of the geologic units, and the lithology as indicated by electric logs of wells are further shown on Figures 6, 7, and 8.

Pre-Permian Systems

Ground water of fresh to moderately saline quality is not known to occur below the rocks of the Permian System within Wilbarger County. Since this report is concerned primarily with usable quality ground water, no detailed discussion will be made of the pre-Permian rock units. Table 9 indicates the chemical character of brines that are produced with oil from various zones, and the geologic sections (Figures 6, 7, and 8) show stratigraphic relationships of the older units for comparison and correlation with previous north-central Texas ground-water studies.

Permian System

There are three groups of this system represented within Wilbarger County and, listed from the oldest to the youngest, they are the Wichita, the Clear Fork, and the Pease River Groups.

Wichita Group

The oldest rocks exposed within the study area are formations of the upper part of the Wichita Group. The Lueders, which is the uppermost formation of this group, is also the best exposed in Wilbarger County, and is generally composed of three members, the Paint Rock Limestone, the Maybelle Limestone, and the Lake Kemp Limestone which is the youngest. The Lueders was originally described by Garrett et al. (1930), and consists of alternating thick beds of medium-light to light-gray limestones and blue, gray to greenish gray, and black shales (Stafford, 1960, p. 276).

The Wichita Group is about 670 feet thick in Wilbarger County (Table 1). The group crops out in the extreme southeastern corner of Wilbarger County (Figure 5), and its beds dip to the west-northwest at about 25 feet per mile.

Usable ground water is not known to occur in the Wichita Group in Wilbarger County. However, if usable quality water does exist, it most probably would be associated with local fracturing and solution channels very near the drainage systems in the outcrop of the Lueders Formation. Water would possibly be highly mineralized and well yields unreliable.

Clear Fork Group

Lying conformably upon the Wichita Group is the Clear Fork Group, composed of the Arroyo, Vale, and Choza Formations. These units crop out, or subcrop beneath surficial deposits of Quaternary age, in a belt approximately 24 miles wide, trending slightly northeast-southwest (Figure 5).

The represented thickness of the Clear Fork is approximately 1,350 feet. The beds dip west-northwest at approximately 25 feet per mile. They consist mainly of white to cream-colored, buff and brown, thin-bedded to shaley limestones, interbedded with marls and dolomite near the base. There is a gradation upward into red to reddish-brown or gray nonmarine shales and blue to gray dolomites (Farris et al., 1963, p. 19).

Water-bearing strata of the Clear Fork Group consists of fractured limestones and dolomites which are locally permeable (Table 1). These beds yield fresh to very saline waters in small quantities to a few wells within Wilbarger County.

Pease River Group

The Pease River is the youngest and uppermost group of the Permian System. Its formations, listed in ascending order are: the San Angelo, Flowerpot, Blaine, and Dog Creek. Within Wilbarger County, only the San Angelo is represented and it rests unconformably upon the Clear Fork Group (Figure 5). This formation was named by Cummins and Lerch (1891, p. 73-77, 321-325). The unit consists of a nonmarine series of cross-bedded deltaic sandstones, conglomerates of chert and quartz pebbles, and red to green shales (Table 1). The approximate thickness is 210 feet.

The San Angelo is exposed above the prominent escarpment formed by the underlying Merkel Dolomite Member of the Choza Formation in the northwest part of the county. It dips to the west-northwest at the rate of about 25 feet per mile. The formation is overlain by younger Quaternary age rocks throughout much of its extent in the county (Figure 5).

This formation is one of the more reliable minor sources of ground water and yields water in small quantities to wells in the extreme northwestern part of Wilbarger County (Tables 4 and 8, and Figure 34). The quality of water ranges from fresh to slightly saline. The downdip limit of usable quality water within the formation is unknown; however, water suitable for domestic and livestock use is known to be present as far west as the county line.

Quaternary System

Rocks of the Quaternary System occur as isolated patches covering an estimated 50 percent of the surface of Wilbarger County (Figure 5). They are separated from the underlying Permian beds by a marked erosional unconformity and generally slope very gently to the east-southeast (Figures 6, 7, and 8).

The rocks of this age, which include the Seymour Formation, stream terrace deposits, and flood-plain alluvium, contain most of the ground water in the county. The water quality ranges from fresh to very saline. Most of the water, however, is fresh to slightly saline. Well yields range from small to moderate (Tables 4 and 8 and Figure 34).

Seymour Formation

The Seymour Formation was named by Cummins (1893, p. 181-190). The unit generally caps the interstream areas or divides between the major streams and consists of alluvial deposits of clay, silt, sand, caliche, gravel, and conglomerate. The thickness of the formation varies from 0 to 112 feet.

The formation is the major ground-water source in Wilbarger County. Figure 5 shows the location and extent of the Seymour Formation within the investigated area. The quality of ground water found within the Seymour ranges from fresh to very saline. The well yields range from small to moderate (Table 2).

Although individual beds of the Seymour are discontinuous, except for isolated areas, a fairly consistant development of sand, gravel, and conglomerate is usually present near its base. This basal unit is best developed in the Odell-Fargo area in northern Wilbarger County and in the Lockett area in the west-central part of the county (Figure 5). Almost all of the higher yield wells in this formation derive their water from this basal zone.

The heterogeneous distribution of the various units of the Seymour Formation indicates that it was deposited by branching streams. This formation and the Ogallala Formation of the High Plains area of Texas are lithologically similar and are thought to have been deposited under similar environmental conditions. However, it was suggested by Gordon (1913, p. 30) that the source area for the Seymour was the Tertiary beds which outcrop along the Llano Estacado to the northwest rather than the uplift of the Rocky Mountains from which the Ogallala was derived.

It is believed by Van Siclen (1957, p. 47-60) that following the removal of all post-Permian sediments, Pleistocene streams deposited sediments, originating from the west, over a large area of north-central Texas. Deposition was thought to have been controlled by repeated cycles of terrestial alluviation and erosion caused by climatic changes associated with the advance and retreat of glacial ice sheets in the northern United States.

Terrace Deposits

The flood plains of both the Red River and Pease River are fairly wide, and remnants of previous river terraces are preserved to heights of approximately 50 feet above the present streams. These terrace deposits consist of clay, silt, sand, and gravel of Pleistocene to Recent origin. They are younger than the Seymour Formation, which is found at a higher level, and older than the sediments which cover the flood plains of the present river valleys.

The thickness of the terrace deposits varies greatly due to the irregularity of the surface upon which they were deposited. In general, their thickness ranges from approximately 35 to 60 feet.

The areal extent of the terrace deposits is difficult to map and, therefore, they are combined with other Quaternary alluvium on the geologic map (Figure 5).

The area between the communities of Doans and Fargo, and between the eastern limit of the Seymour Formation (in the Odell-Fargo area) and the present flood plain of the Red River (east of Fargo), is thought to be occupied by terrace deposits. Extensive irrigation development is present in this locality.

These deposits, as well as the Recent flood-plain alluvium, yield fresh to very saline water to wells in small to moderate quantities.

Recent Alluvium

Within Wilbarger County, alluvial flood-plain deposits are present in a band approximately 1 to 2 miles wide along the Red River, the Pease River, and its tributaries (Figure 5). They are composed of silt, sand, and gravel and rest unconformably in contact with terrace deposits, the Seymour Formation, or underlying beds of Permian age.

It appears that these deposits were derived, for the most part, from terrace deposits or the Seymour Formation and were transported to their present position by existing streams. These sediments were erratically deposited and are very discontinuous. Porosities and permeabilities of the deposits vary greatly and, therefore, the yields of the wells also have a wide range.

The most favorable areas for ground-water development are in oxbows of former streambeds due to the presence of more permeable deposits. Small areas of irrigation have been developed on these alluvial deposits.

The Recent flood-plain alluvium and the older, terrace deposits are grouped together as Quaternary alluvium on the geologic map (Figure 5). The Quaternary alluvium provides a reliable source of ground water in Wilbarger County. The quality ranges from fresh to very saline and the waters are often high in sulfate and chloride content (Table 8). Yields of wells range from small to moderate.

GROUND-WATER HYDROLOGY

General Principles of Occurrence

The occurrence of ground water in north-central Texas as well as in Wilbarger County is erratic, the aquifers are limited and discontinuous, and the yields, in general, are small (less than 100 gpm) to moderate (100 to 1,000 gpm). Even though these conditions exist, the ground-water occurrences conform to the same fundamental principles as those in any other area.

Hydrologic Cycle

The water available for use by man—whether as rain, streamflow, water from wells, or spring discharge—is captured in transit, and after its use and reuse, is returned to the hydrologic cycle from which it came. This cycle is illustrated in Figure 10. Graphically, this figure shows the continuing movement of water from the oceans through evaporation to precipitation and its return, either directly or indirectly, to the ocean.

Definition of Ground Water and Related Terms

Ground water is that part of the returning water which has entered the subsurface and filled the void spaces of the porous rocks which are within the zone of saturation. The source of all fresh ground water is precipitation; however, only a small percentage of the precipitation actually becomes ground water.

As water moves downward under gravity through porous rocks, it first enters the *zone of areation*, an unsaturated zone in which the voids contain both air and water, and later it enters the *zone of saturation* where all of the pore spaces are filled with water. The upper surface of the zone of saturation is called the *water table,* and the water below the water table is termed *ground water.* Occasionally, water in its downward movement encounters impermeable beds above the normal water table and is trapped, forming what is referred to as a *perched water table.*

Water-table conditions exist where the upper surface of the zone of saturation is unconfined and is under atmospheric pressure. When water-bearing formations dip below non-porous beds in the subsurface, the water is under pressure and is confined. Waters under these conditions are said to be under artesian conditions.

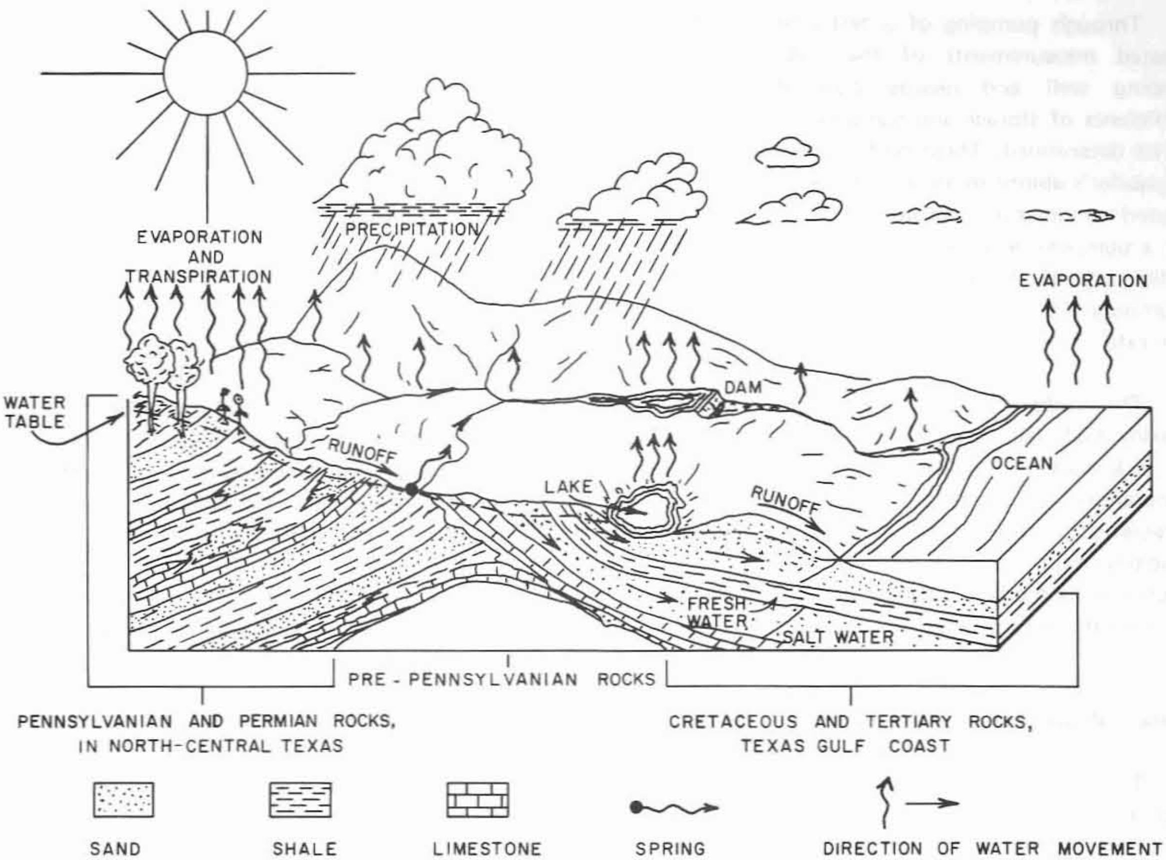

Figure 10.—The Hydrologic Cycle

The water table commonly has essentially the same configuration as that of the regional topography but in subdued form. In a specified aquifer, elevations of the water table, measured in existing wells, can be used to determine the shape of the water table, the direction of ground-water movement, and the hydraulic gradient under which the ground water moves. By mapping the subsurface elevations of water levels in existing wells, one can also determine the direction of ground-water movement and the hydraulic gradient in an artesian aquifer. In contrast to that of water-table conditions, the surface actually mapped under artesian conditions is a pressure (piezometric) surface, or an imaginary surface representing the elevation to which the water rises when the confined aquifer is penetrated. If the piezometric surface of an artesian aquifer is higher than the land surface, water will flow to the surface from wells penetrating the aquifer.

The storage capacity of the pores of a water-bearing formation is important in calculating the amounts of water stored in an aquifer. A measure of the storage capacity is the *coefficient of storage*, which is the volume of water, per unit of surface area, that will be taken into, or released from, storage when the water table or piezometric surface is raised or lowered by 1 foot (after Theis, 1938, p. 394). The term *specific yield* is used under water-table conditions and is defined as the ratio of the volume of water yielded to the volume of the aquifer which was dewatered (after Stearns, 1928, p. 144). Coefficients of storage in artesian aquifers are very small in comparison to those of water-table aquifers since artesian storage is dependent upon the elastic properties of the aquifer.

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 unit hydraulic gradient.

The *coefficient of transmissivity* is a measure of an aquifer's ability to transmit water and it is important in computing the amount of water available on a continuous basis. It is defined as the amount of water, in gallons per day, which will flow through a vertical column of aquifer 1 foot wide under a 45-degree slope or gradient (after Theis, 1938, p. 889-902). Given a known hydraulic gradient and the coefficient of transmissivity, one can calculate the amounts of water passing through specific portions of an aquifer.

Through pumping of a test well and the use of repeated measurements of the water levels in the pumping well and nearby observation wells, the coefficients of storage and transmissivity for an aquifer can be determined. These coefficients are a measure of the aquifer's ability to store and transmit water and can be used to determine proper well spacing, the effects that a pumping well may have on another well, and to predict water-level drawdowns at various distances from a pumping well after a specified time of pumping at a given rate.

The yield in gallons per minute per foot of drawdown of water level is a well pumping at a constant rate is known as the *specific capacity* of a well. This measurement is another indication of the hydraulic characteristics of a water-bearing formation. Specific capacities must be used with caution since they are affected by methods of well completion and they change with the rate and the length of pumping.

Source and Occurrence of Ground Water

The source of ground water in Wilbarger County is precipitation; however, only a small portion of the precipitation which falls actually reaches the water table (Figure 10).

Water occurs and is stored in pores or voids between the rock particles. The two fundamental rock characteristics which are important in the occurrence of ground water are *porosity,* or the ratio of the volume of void space to the total rock volume expressed as a percentage, and *permeability*, which is the ability of a porous material to transmit water. The porosity of a rock is dependant upon the shape, size, sorting, and the amount of cementation of the grains. Clays, silts, and soils, which are fine-grained, commonly have high porosity ranging from 40 to 60 percent and are capable of storing large quantities of water; however, much of their water is not readily transmitted because of the small size of the voids and low permeabilities.

The upper portion of the Seymour Formation generally is composed of fine-grained, well cemented sediments, and contains much stored water but does not readily transmit this water. The basal part of the Seymour is usually composed of relatively uniform sands which may have porosities ranging from 30 to 40 percent and sands and gravels which commonly have porosities which range from 20 to 35 percent. The important difference between these materials and those generally found in the upper part of the Seymour is that the basal portion of the formation has greater permeability and is more capable of transmitting the water. It is for this reason that greater volumes of water are produced from the basal part of the formation.

The water is unconfined in the Seymour and is, therefore, said to be under water-table conditions. In most areas, the level of the water table is above the basal sands and gravels.

The source of ground water available to Quaternary alluvium deposits is mostly through direct precipitation; however, since the Seymour Formation is hydrologically connected with the Quaternary alluvium deposits in most areas of Wilbarger County, some of the ground water in the alluvium is derived by underflow from the Seymour. The ground water in the Quaternary alluvium deposits, as in the Seymour, is unconfined and under water-table conditions.

Ground water occurring locally in the pre-San Angelo Permian aquicludes is derived in part by infiltration of stream runoff, and by interformational leakage in those areas where Quaternary age deposits directly overlie the Permian rocks. The water occurring in the pre-San Angelo Permian aquicludes is believed to be confined to locally permeable zones containing fractures and solution channels at or near the outcrop, and the areas most favorable for well development are near existing drainage systems. The water found within these rocks is, for the most part, under artesian conditions.

Some of the ground water within the San Angelo Formation of Permian age is derived from precipitation falling on its limited outcrop area, and much of it is derived by interformational drainage from the Quaternary age rocks which overlie the formation over much of its extent in the northwest part of the county. The less highly mineralized waters within the San Angelo Formation are usually found near the east edge of its outcrop, although other, local areas near drainage systems may also contain better quality waters. Higher yield wells should be found in areas of locally higher permeabilities. The waters of this formation may be under either water-table or artesian conditions, as part of the formation dips beneath impermeable beds in the subsurface.

Recharge, Movement, and Discharge of Ground Water

Replenishment of water to an underground water-bearing unit, or recharge, is mainly by natural means. The controlling factors for recharge are the intensity and the amount of precipitation. Precipitation, in the form of rain, sleet or snow, and the seepage from lakes or streams on an aquifer's outcrop, aid in natural recharge. The rechargeability of an aquifer depends upon the type of topography, the amount and kind of vegetative cover, the condition of the soils, and the permeability of the rocks involved. Minor amounts of artificial recharge may be accomplished by running water over an aquifer's permeable outcrop or by pumping water into the water-bearing unit, through wells.

The source of all water in storage in the Seymour Formation, as well as the source of recharge to it, is direct precipitation on its outcrop area.

The rate of recharge to the Seymour is probably greatest in Wilbarger County within the Odell-Fargo and Lockett areas (Figure 5). Here the topography is gently rolling and much of the surface is composed of highly permeable sand which readily permits the water to infiltrate the soil zone and percolate to the water table.

In most of the other areas of Seymour occurrence, the surface is nearly flat, has been cleared of trees, and is in cultivation. Even though some of the soils are fairly tight, the farm practices of terracing, contour plowing, and deep plowing allow the soils to receive considerable precipitation which may percolate downward to the water table.

The actual amount of recharge to a ground-water zone resulting from the infiltration of precipitation can be calculated by using water-level records from several wells over a period of years and comparing the rises of water levels with the precipitation. Records of water levels in the Seymour Formation prior to irrigation pumpage within Wilbarger County are too few and too short to be used for reliable calculations of recharge; however, a tentative estimate can be made by comparing calculations of recharge made by Preston (1978) in Baylor County which borders Wilbarger County on the south. The Seymour Formation deposits of Wilbarger County are geologically similar to those of Baylor County; therefore, a direct comparison can be made giving a fairly reliable estimate. In Baylor County, the recharge to the Seymour Formation in 1969 was found to be about 10.2 percent of the year's precipitation. At Vernon, the mean annual rainfall (1935-70) is 25.04 inches, and 10.2 percent of this would be 2.55 inches or 0.21 foot per year.

Assuming an average recharge rate of 2.55 inches per unit area per year as representative of the Seymour Formation in Wilbarger County, the following volumes of water are estimated to be recharged to the major Seymour areas in the county:

Area	Approximate average annual recharge, in acre-feet
Odell-Fargo	15,000
Lockett	10,500
Total	25,500

It must be emphasized that the above estimates are based on conditions within Baylor County during 1969 only, and that the actual amount of recharge will vary from year to year according to the intensity and amount of rainfall.

Recharge to the Quaternary alluvium is mainly from precipitation; however, much recharge is derived also by underflow from the Seymour Formation where they are directly in contact. Additional recharge to the Quaternary alluvium takes place by the infiltration of stream runoff and floodwaters that result from precipitation upstream. Recharge from stream runoff is usually temporary since most of this recharge is bank storage only. These waters flow back into the streams after the runoff recedes. However, during flooding, the waters often cover the entire flood plain, and at this time considerable recharge takes place.

Recharge to the Permian water-bearing strata also is dependent on the rainfall. Much of the recharge is from the streams which cross their outcrop. Interformational leakage from the overlying Quaternary deposits provides additional recharge (Figure 5), and precipitation directly on the outcrop area provides some recharge. Information is lacking to determine the amounts of recharge.

The San Angelo Formation of Permian age is believed to derive some of its recharge from the overlying Seymour Formation in extreme northwest Wilbarger County.

The movement of ground water from areas of recharge to areas of discharge is generally very slow. The governing factors which determine the rate of movement are the permeability of the aquifer and the hydraulic gradient. With low permeability (for example, 10 gallons per day per square foot) and a very low gradient of much less than 1 degree, the rate of flow would be less than 1 foot per day. Under conditions of high permeability and gradient, field tests have indicated flow rates greater than 100 feet per day. Todd (1959, p. 53) states, however, that the normal range is from 5 feet per year to 5 feet per day. Artificial discharge through pumping wells can alter the direction of movement and the natural rate of flow of ground water. In most areas of north-central Texas, ground-water movement is not constant in rate or direction. This is due to the wide variance in the lithology, extent, porosity, permeability, and structure of the water-bearing units.

The movement of ground water is down gradient, from the high to low elevations, at right angles to the contours which denote the configuration of the water table for a given aquifer. Ground-water movement is in general toward the major streams or their tributaries.

Ground-water movement within the Seymour Formation in the Odell-Fargo area of northern Wilbarger County is dominated by two ground-water highs which are located in the central part of the area (Figure 23). Movement away from these highs is south and southeastward into Wildcat and Salt Creeks; eastward into Quaternary alluvium of the Red River; north, northwest, and northeastward into alluvium of the Red River; and also northwest into Wanderers Creek. Another ground-water high is located near the northwest county line within this same area. Movement away from this high is northward into Quaternary alluvium of the Red River and northeastward into Wanderers Creek. Some ground-water movement from the Seymour Formation is into areas of well withdrawal from the San Angelo Formation. The Seymour overlies this formation in northwest Wilbarger County.

Within the Lockett area of west-central Wilbarger County, ground-water movement in the Seymour Formation is dominated by a northeast-trending regional high, and movement is generally northwest or northward into Quaternary alluvium along the Pease River, and southeast or eastward from this regional high into Paradise Creek (Figure 20).

Along the Pease River and Paradise Creek, ground water moves through the Quaternary alluvium deposits into the drainage system, then downstream toward the Red River.

Within other, minor occurrences of the Seymour Formation between Vernon and the east line of the county, ground-water movement is mostly northerly into the Quaternary alluvium along the Pease River or its tributaries. Movement is then through these deposits downstream along the Pease River or the Red River east-southeastward out of the county. Minor movement in the Seymour is southerly into the drainage system of Beaver Creek.

Ground-water movement within the Permian strata is mainly down-dip toward pumping wells. Minor movement from the San Angelo Formation is eastward into the tributaries of the Pease River.

Discharge is the process by which water is continuously being removed from an aquifer. As in the case of recharge, the discharge of water from a water-bearing unit is also by natural and artificial means. Natural discharge occurs as flow from springs, effluent seepage, interformational leakage, transpiration by plants, and by evaporation. Artifically, water is discharged through wells by pumping.

Natural ground-water discharge from several areas of the Seymour Formation is evident by seeps or springs which flow from the formation near its outer edges. Some spring waters flow directly onto the surface of exposed Permian beds, where they may evaporate, while others infiltrate into the Quaternary alluvium deposits.

Discharge by effluent seepage is that water which flows out of the zone of saturation and into a stream whose surface is lower than the water table. If a stream or part of a stream receives water from the zone of saturation, it is said to be "effluent" with respect to ground water.

The Red River; its tributary, Wanderers Creek; the Pease River, its tributary Paradise Creek, and possibly others are, for the most part, effluent streams. Quaternary alluvium covers the flood plains of most of these streams, and effluent discharge from the alluvium contributes to their flow.

Normally, effluent streamflow can be measured and the data used to calculate recharge rates. However, due to drought conditions which caused streamflow capture by irrigators, this information could not be readily obtained during the period of study.

Where one aquifer is in contact with another, ground water can move from the one having the higher head into the one having a lower head. This has been referred to as interformational leakage. An undertermined amount of ground water is discharged into the Permian rocks where they subcrop beneath the Seymour Formation or Quaternary alluvium. This condition definitely exists in the Odell-Fargo area of northern Wilbarger County where the San Angelo Formation subcrops beneath the Seymour.

Transpiration is the process by which water is discharged into the atmosphere by growing plants. Water taken into plant roots may be obtained from the belt of soil moisture, from the zone of saturation, or from the capillary fringe.

Calculation of the amount of transpiration for an area involves many varables which are difficult, if not impossible to measure. In areas where deep-rooted plants such as alfalfa are able to draw water directly from the zone of saturation, transpiration may be a major factor in the discharge of ground water.

If the water table is very near the land surface, ground water may be discharged into the air by evaporation. The main factor governing the rate of evaporation is the depth to the water table. Other factors are temperature, wind velocity, humidity, and type of soils. Since the water table within the study area is, for the most part, fairly deep, evaporation is probably small.

Pumpage is a form of artificial discharge. The actual amount of pumpage will be discussed in a later section of this report.

Even though the direction of ground-water movement and the areas of discharge are essentially as previously described, it should be pointed out that all of the streams are not perennial streams or those which are supported by ground-water discharge. Many of the tributaries of the major drainage system are wet-weather streams only. These streams do not receive ground-water flow because it is intercepted. Part of it is intercepted by vegetation which has extended its roots down to the water table. Additional water evaporates from seeps, springs, marshes, and from the streams themselves. Much of the natural discharge is also intercepted by pumpage.

In summary, the amount of water available on a long-term basis is limited by recharge. If recharge does not equal discharge the aquifer will be progressively drained. If recharge is greater than discharge, then water will be taken into storage and progressively fill the aquifer.

Based on the mean annual rainfall at Vernon, it is believed that approximately 25,500 acre-feet of ground water is available annually from the Seymour Formation in the Odell-Fargo and Lockett areas. This assumes that all of the natural discharge will be captured. Theoretically, essentially all of the natural discharge can be intercepted by pumping wells; however, this would reduce the flow of the streams as has been the case in some parts of the State.

Hydraulic Properties of the Aquifers

Aquifer tests on the Seymour Formation were previously conducted by the U.S. Geological Survey on six wells in Wilbarger County to determine the coefficients of storage and transmissibility. The results of these tests are shown on Table 2. The measured yields of the wells ranged from 93 to 430 gpm (gallons per minute).

The data in Table 2 were analyzed by one or more of the following methods: the non-equilibrium method (Theis, 1935, p. 519-524), the Cooper and Jacob straight-line method of approximation (Cooper and Jacob, 1946, p. 526-534), and the Theis recovery formula (Wenzel, 1942, p. 94-97). The thicknesses of the aquifers were determined by a study of drillers' logs.

The coefficients of storage for the Seymour Formation within Wilbarger County ranged from 0.014 to 0.23. Based on these figures, an average coefficient of storage of 0.14 was determined and later used to calculate the amount of water in storage.

The coefficients of transmissivity determined from pumped wells tapping the Seymour Formation in Wilbarger County ranged from 19,300 to 59,900 gpd/ft.

Only 11 specific capacity tests were run during the period of this study on wells yielding water from the Seymour Formation (Table 2). The specific capacities of these wells ranged from 5.3 to 40.8 gpm/ft. The U.S. Geological Survey had previously run specific capacity tests on six wells in the Seymour and these ranged from 4.4 to 142 gpm/ft.

Additional well performance tests were run on irrigation wells pumping from the Seymour, and the measured yields on these ranged from 35 to 295 gpm (Table 2).

Additional specific capacities of Seymour and Quaternary alluvium wells were reported by water well drillers and they are listed in Table 2. The specific capacities reported for 10 irrigation wells producing from the Quaternary alluvium ranged from 5.0 to 70.0 gpm/ft.

Wells producing from the Seymour Formation or Quaternary alluvium have various saturated thicknesses (Table 2). Wells near the center of the Odell-Fargo area usually have saturated thicknesses greater than 20 feet, as shown in Figure 29. The larger-yield wells have near, or in excess of, 60 feet of saturated thicknesses with a maximum thickness of 85 feet. Saturated thicknesses within the Lockett area range from 4 to 57 feet (Figure 28). Other occurrences of the Seymour Formation have lesser amounts of saturated thickness; however, data are inadequate to show the saturated thickness in these areas.

Table 2.—Aquifer Coefficients of Storage and Transmissivity, and Well Specific Capacities and Yields

Well	Aquifer	Saturated thickness (feet)	Date test began	Specific capacity (gpm/ft)	Coefficient of storage	Coefficient of transmissivity (gpd/ft)	Yield (gpm)	Remarks
13-37-906	Seymour Formation	36.4	Apr. 29, 1967	9.4	—	—	205	Well performance test by driller, Layne-Western Company, Inc.
907	do	44.1	do	14.0	—	—	205	Do.
38-401	do	42.3	Apr. 2, 1967	15.0	—	—	205	Do.
402	do	45.2	Mar. 22, 1967	10.6	—	—	205	Do.
403	do	45.5	Apr. 5, 1967	15.1	—	—	205	Do.
404	do	26.6	Apr. 2, 1967	6.9	—	—	50	Do.
702	do	70.0	July 10, 1970	6.1	—	—	274	Well performance test by Texas Water Development Board.
703	do	48.3	Apr. 18, 1967	7.7	—	—	172	Well performance test by driller, Layne-Western Company, Inc.
704	do	47.9	Apr. 17, 1967	13.7	—	—	205	Do.
705	do	57.5	Apr. 13, 1967	7.6	—	—	207	Do.
706	do	61.7	Apr. 15, 1967	7.4	—	—	205	Do.
707	do	45.7	Apr. 11, 1967	25.2	—	—	205	Do.
708	do	48.7	Apr. 19, 1967	11.8	—	—	205	Do.
709	do	39.5	Apr. 9, 1967	9.6	—	—	203	Do.
710	do	37.9	Mar. 29, 1967	11.1	—	—	205	Do.
711	do	65.0	July 23, 1969	8.1	—	—	100	Do.
712	do	70.2	July 16, 1969	6.4	—	—	175	Do.
45-507	do	—	July 14, 1970	—	—	—	37	Well performance test by Texas Water Development Board.
509	do	—	July 16, 1970	40.8	—	—	251	Do.
603	do	—	do	—	—	—	126	Do.
604	do	—	July 14, 1970	—	—	—	295	Do.
606	do	—	July 16, 1970	5.3	—	—	126	Do.
607	do	—	July 14, 1970	—	—	—	188	Do.
609	do	37	Oct. 20, 1969	4.3	—	—	120	Well performance test by driller, Robert Dale.

Table 2.—Aquifer Coefficients of Storage and Transmissivity, and Well Specific Capacities and Yields—Continued

Well	Aquifer	Saturated thickness (feet)	Date test began	Specific capacity (gpm/ft)	Coefficient of storage	Coefficient of transmissivity (gpd/ft)	Yield (gpm)	Remarks
13-45-611	Seymour Formation	63	July 16, 1955	10.3	–	–	380	Well performance test by driller, Robert Dale.
616	do	40.5	June 6, 1955	6.5	–	–	265	Do.
622	do	38	Jan. 25, 1969	25.0	–	–	550	Do.
803	do	–	July 14, 1970	–	–	–	177	Well performance test by Texas Water Development Board.
804	do	–	do	–	–	–	172	Do.
807	do	–	do	–	–	–	90	Do.
46-108, 109	do	–	July 23, 1970	–	–	–	217*	Do.
111, 112	do	–	do	–	–	–	183*	Do.
114	do	67.6	July 10, 1970	6.1	–	–	274	Do.
121	do	–	July 16, 1970	–	–	–	137	Do.
122	do	–	do	–	–	–	137	Do.
123	do	–	July 21, 1970	6.0	–	–	220	Do.
124	do	33.4	do	12.4	–	–	221	Do.
128	do	31	Oct. 14, 1970	26.0	–	–	450	Well performance test by driller, Robert Dale.
207	do	–	July 10, 1970	–	–	–	144	Well performance test by Texas Water Development Board.
210	do	–	July 21, 1970	–	–	–	193	Do.
214	do	–	July 23, 1970	–	–	–	170	Do.
219	do	–	July 21, 1970	–	–	–	146	Do.
220	do	–	July 23, 1970	–	–	–	178	Do.
221	do	–	do	–	–	–	178	Do.
228	do	–	July 10, 1970	10.3	–	–	144	Do.
230	do	29	Apr. 14, 1967	12.5	–	–	250	Well performance test by driller, Robert Dale.
232	do	34	Dec. 1, 1970	8.9	–	–	250	Do.
233	do	28	Apr. 28, 1971	4.0	–	–	100	Do.

Table 2.—Aquifer Coefficients of Storage and Transmissivity, and Well Specific Capacities and Yields—Continued

Well	Aquifer	Saturated thickness (feet)	Date test began	Specific capacity (gpm/ft)	Coefficient of storage	Coefficient of transmissivity (gpd/ft)	Yield (gpm)	Remarks
13-46-401	Seymour Formation	73	Sept. 9, 1963	9.4	—	—	300	Well performance test by driller, D. L. McDonald.
402	do	71	June 13, 1953	7.3	—	—	300	Do.
403	do	74.5	June 3, 1953	8.2	—	—	300	Do.
404	do	62	1953	5.5	—	—	210	Do.
405	do	83	do	10.0	—	—	300	Do.
406	do	76	do	7.7	—	—	300	Do.
407	do	74	May 24, 1953	12.3	—	—	320	Do.
408	do	77	1953	8.3	—	—	300	Do.
421	do	—	July 21, 1970	—	—	—	220	Well performance test by Texas Water Development Board.
422	do	—	July 16, 1970	—	—	—	266	Do.
428	do	—	do	—	—	—	132	Do.
430	do	57	June 13, 1967	6.0	—	—	250	Well performance test by driller, Robert Dale.
501	do	79	1953	6.1	—	—	300	Well performance test by driller, D. L. McDonald.
502	do	76	do	7.3	—	—	300	Do.
503	do	74	June 24, 1953	13.6	—	—	300	Do.
507	do	70 ±	Feb. 5, 1952	17.0	—	40,100	430	Aquifer test by U.S. Geological Survey.
511	do	61	Apr. 2, 1969	9.6	—	—	250	Well performance test by driller, McDonald Drilling Company, Inc.
512	do	58	Apr. 20, 1969	5.4	—	—	200	Do.
514	do	—	Aug. 5, 1970	—	—	—	94	Well performance test by Texas Water Development Board.
515	do	53.2	July 21, 1970	5.4	—	—	213	Do.
516	do	—	do	—	—	—	229	Do.
601	Quaternary alluvium	—	Mar. 3, 1960	40.0	—	—	603	Well performance test by driller, Robert Dale.
602	do	—	1956	53.6	—	—	750	Do.

Table 2.—Aquifer Coefficients of Storage and Transmissivity, and Well Specific Capacities and Yields—Continued

Well	Aquifer	Saturated thickness (feet)	Date test began	Specific capacity (gpm/ft)	Coefficient of storage	Coefficient of transmissivity (gpd/ft)	Yield (gpm)	Remarks
13-46-605	Quaternary alluvium	—	June 6, 1967	29.2	—	—	350	Well performance test by driller, Robert Dale.
606	do	34	Mar. 12, 1969	62.5	—	—	500	Well performance test by driller, Lee Hopper.
616	do	43	May 29, 1971	11.7	—	—	350	Well performance test by driller, Robert Dale.
902	do	24	Jan. 21, 1971	30	—	—	30	Do.
54-516	do	15	Mar. 30, 1971	70.0	—	—	350	Do.
712	Seymour Formation	—	July 22, 1970	—	—	—	110	Well performance test by Texas Water Development Board.
725	do	18	Aug. 28, 1970	6.9	—	—	125	Well performance test by driller, Robert Dale.
726	do	29	Jan. 10, 1967	43.8	—	—	350	Do.
727	do	27	Mar. 23, 1971	8.3	—	—	100	Do.
730	do	14	Apr. 4, 1971	5.5	—	—	60	Do.
731	do	14.4	May 13, 1971	10.0	—	—	140	Do.
804	do	—	Oct. 23, 1943	—	—	—	257	Well performance test by U.S. Geological Survey.
805	do	—	Oct. 12, 1943	—	—	—	411	Do.
806	do	—	Oct. 23, 1943	—	—	—	273	Do.
808	do	20 ±	Oct. 11, 1943	44.0	—	59,900	408	Aquifer test by U.S. Geological Survey.
817	do	—	Nov. 7, 1943	16.4	—	26,700	162	Do.
—	do	20-30	do	—	0.10	34,400	162	Observation well for aquifer test on well 13-54-817, above.
—	do	20-30	do	—	.23	54,600	162	Do.
820	do	—	do	—	.014	19,700	162	Aquifer test by U.S. Geological Survey.
838	do	14.2	Apr. 3, 1969	25.0	—	—	200	Well performance test by driller, Robert Dale.
839	do	12	Mar. 14, 1968	25.0	—	—	300	Do.
849	do	18	Feb. 18, 1970	8.3	—	—	125	Do.
903	do	20-30	Oct. 11, 1943	11.0	—	19,300	93	Aquifer test by U.S. Geological Survey.
906	Quaternary alluvium	14	June 21, 1965	5.0	—	—	20	Well performance test by driller, Don Hopper.

Table 2.—Aquifer Coefficients of Storage and Transmissivity, and Well Specific Capacities and Yields—Continued

Well	Aquifer	Saturated thickness (feet)	Date test began	Specific capacity (gpm/ft)	Coefficient of storage	Coefficient of transmissivity (gpd/ft)	Yield (gpm)	Remarks
13-61-334	Seymour Formation	13	Apr. 11, 1967	10.0	—	—	100	Well performance test by driller, Robert Dale.
336	do	—	July 9, 1970	—	—	—	56	Well performance test by Texas Water Development Board.
418	do	—	July 17, 1970	—	—	—	100	Do.
419	do	—	July 11, 1956	16.1	—	—	209	Well performance test by driller, Robert Dale.
425	do	—	July 17, 1970	—	—	—	63	Well performance test by Texas Water Development Board.
515 } 568 }	do	—	July 22, 1970	—	—	—	86*	Do.
552 } 553 }	do	—	June 10, 1970	—	—	—	94*	Do.
562 } 563 }	do	—	July 22, 1970	—	—	—	91*	Do.
621	do	—	July 17, 1970	—	—	—	81	Do.
623	do	—	do	—	—	—	119	Do.
639	do	—	do	—	—	—	139	Do.
648	do	9	Aug. 30, 1970	10	—	—	50	Well performance test by driller, Robert Dale.
702	do	—	July 21, 1960	142	—	—	384	Well performance test by U.S. Geological Survey.
703	do	33.5	May 5, 1955	29.2	—	—	350	Well performance test by driller, Robert Dale.
812	do	14.6	June 9, 1970	24.6	—	—	123	Well performance test by Texas Water Development Board.
824	do	23	Mar. 2, 1967	16.7	—	—	350	Well performance test by driller, Robert Dale.
829	do	18	Aug. 16, 1965	5.0	—	—	50	Well performance test by driller, Hopper Drilling Company.
830	do	—	June 10, 1970	—	—	—	177	Well performance test by Texas Water Development Board.
831	do	—	June 9, 1970	—	—	—	121	Do.
833	do	15	July 10, 1967	20.6	—	—	310	Well performance test by driller, Robert Dale.

Table 2.—Aquifer Coefficients of Storage and Transmissivity, and Well Specific Capacities and Yields—Continued

Well	Aquifer	Saturated thickness (feet)	Date test began	Specific capacity (gpm/ft)	Coefficient of storage	Coefficient of transmissivity (gpd/ft)	Yield (gpm)	Remarks
13-61-834	Seymour Formation	—	June 11, 1970	—	—	—	137	Well performance test by Texas Water Development Board.
835	do	—	July 22, 1970	—	—	—	136	Do.
836	do	—	June 11, 1970	—	—	—	180	Do.
841	do	24	Sept. 5, 1970	13.6	—	—	150	Do.
845	do	17	Mar. 25, 1968	3.3	—	—	50	Well performance test by driller, Robert Dale.
901	do	13	July 1, 1967	4.0	—	—	40	Do.
911	do	—	June 11, 1970	—	—	—	59	Well performance test by Texas Water Development Board.
62-155	do	12	July 28, 1970	3.9	—	—	35	Well performance test by driller, Robert Dale.
159	do	12.5	Apr. 15, 1971	6.7	—	—	600	Do.
220	do	19.5	July 22, 1970	16.6	—	—	202	Well performance test by Texas Water Development Board.
226	do	17	Apr. 22, 1969	16.1	—	—	225	Well performance test by driller, Robert Dale.
234	do	21	May 6, 1970	8.6	—	—	120	Do.
236	do	12	Jan. 18, 1966	9.1	—	—	100	Do.
237	do	13	Jan. 30, 1966	15.0	—	—	150	Do.
245	do	8	Apr. 19, 1970	7.5	—	—	60	Do.
246	do	6.5	Apr. 27, 1967	16.7	—	—	100	Do.
302	Quaternary alluvium	11	June 18, 1965	7.5	—	—	30	Well performance test by driller, Don Hopper.
303	do	17	June 25, 1965	8.0	—	—	40	Do.
414	Seymour Formation	—	July 9, 1970	6.5	—	—	35	Well performance test by Texas Water Development Board.
425	do	—	July 29, 1970	—	—	—	212	Do.
427	do	12	Mar. 29, 1967	28.6	—	—	200	Well performance test by driller, Robert Dale.
428	do	9	May 16, 1967	19.5	—	—	175	Do.
433	do	13	June 26, 1970	13.6	—	—	150	Do.

Table 2.—Aquifer Coefficients of Storage and Transmissivity, and Well Specific Capacities and Yields—Continued

Well	Aquifer	Saturated thickness (feet)	Date test began	Specific capacity (gpm/ft)	Coefficient of storage	Coefficient of transmissivity (gpd/ft)	Yield (gpm)	Remarks
—	Seymour Formation	—	Nov. 14, 1951	4.4	—	19,600	165	Aquifer test by U.S. Geological Survey on test hole 63, 3 miles north-northwest of White City, location shown on Figure 31.
—	do	65 ±	do	—	0.02	21,000	165	Aquifer-test observation well located 100 feet north of test hole 63 mentioned above.
—	do	65 ±	do	—	.015	20,800	165	Aquifer-test observation well located 100 feet south of test hole 63 mentioned above.

Fluctuations of Water Levels

Locally, the depth to water in wells indicates the position of the water table under water-table conditions, or of the piezometric surface under artesian conditions. When there is an absence of withdrawal, or the influence due to pumping is nil, the depth-to-water measurement is termed a *static water level*. When the measurement is made in a pumping well, the water level is termed a *pumping level*. Changes in water levels reflect changes in the amount of ground water stored in a given aquifer. The changes may be on a local or on a regional basis. Regional changes over a long period of time reflect a change in the recharge-discharge relationship.

Often water-level fluctuations of a minor nature are reflections of earthquakes, tidal forces and, most commonly, changes in atmospheric pressure.

The most significant water-level changes are the result of heavy pumping. Depending on the reservoir characteristics of an aquifer and the rates of withdrawal, cones of depression of various sizes are formed around the well bores of pumping wells. These cones are formed by the drawdown of the water table or the piezometric surface and are in the shape of an inverted cone having its apex at the pumped well (Figure 11, well A). These cones will expand until they encounter a source of replenishment equal to the discharge rate. If a cone does not encounter an adequate source of replenishment, it will continue to expand until it encounters the cone of depression of another pumping well, as is the case in highly developed irrigation areas, and may combine with it and form a large regional cone of depression in the piezometric surface or the water table.

CHEMICAL CHARACTER OF GROUND WATER

Only small amounts of mineral matter are present in precipitation, whether it is in the form of sleet, snow

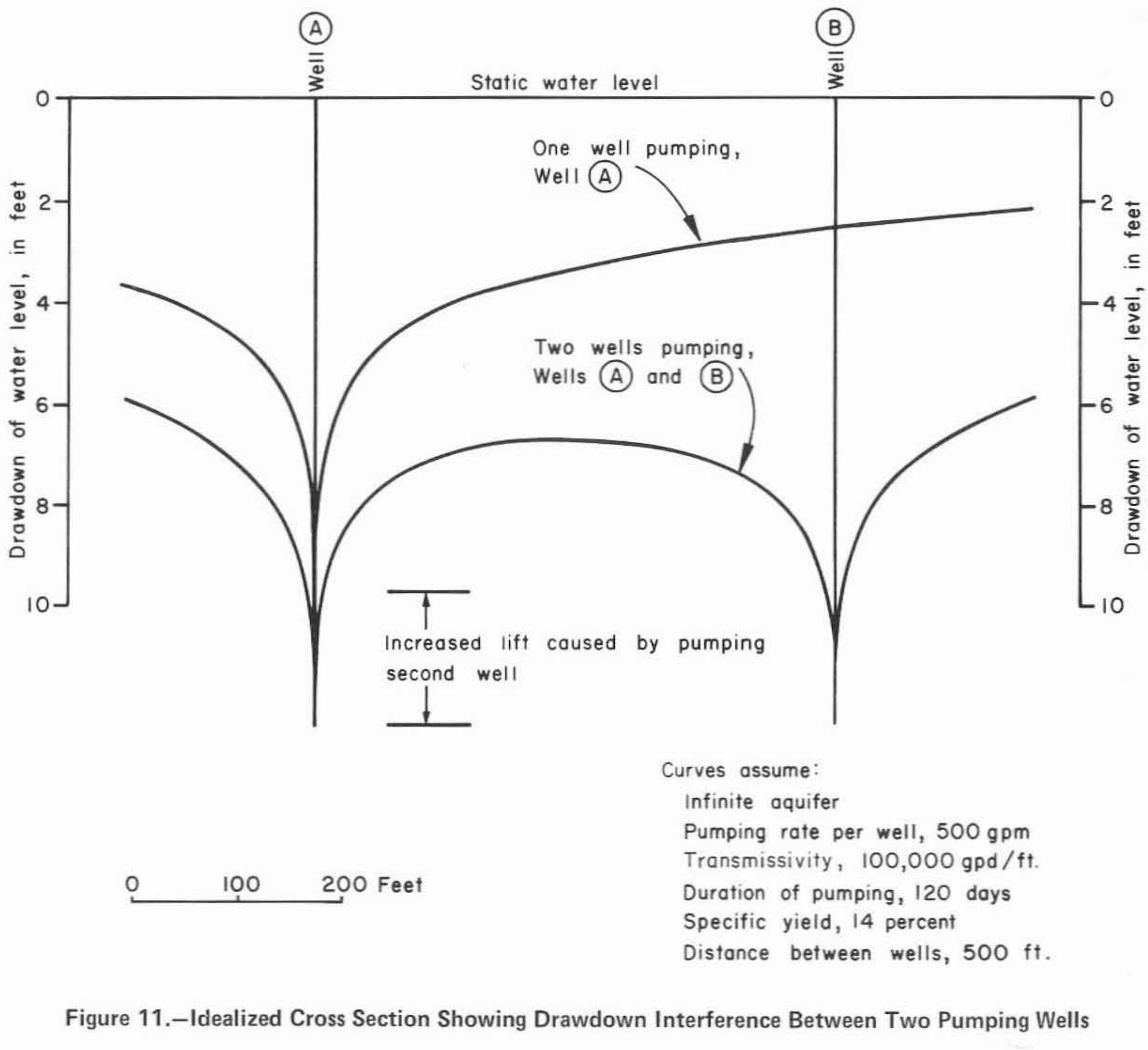

Figure 11.—Idealized Cross Section Showing Drawdown Interference Between Two Pumping Wells

or rain. However, upon reaching the land surface, water dissolves minerals from the soils and rocks through which it moves and takes the mineral substances into solution, thus changing its chemical composition. This accounts for the wide differences in the chemical quality of ground water. In general, the concentration of dissolved solids increases with the depth of the aquifer.

In addition to natural factors, ground water is often subjected to contamination from various other sources that are connected with human activities. Contamination may result from the improper disposal of sewage or industrial wastes. It also may result from disposal of brine, which is produced with hydrocarbons, or by leakage from abandoned or producing oil wells.

The mineral concentrations indicated by 573 chemical analyses of water samples from wells and springs in the county are reported in Table 8. Wells which were sampled are widely scattered and the analyses should represent the full range in chemical quality that may be expected. The wells from which a water sample was collected are shown on the well-location map (Figure 34) by a bar over the well number.

Table 3, which is adapted from Doll and others (1963), lists the principal mineral constituents found in natural water and discusses their source, significance, and physical properties. Hem (1959) gives a detailed, technical discussion of water quality. The discussion which follows lists some of the more important quality factors in water and is primarily derived from these two sources.

Dissolved Solids

The dissolved-solids content of a water sample indicates the total quantity of dissolved mineral matter that is present. This is determined by evaporating a known quantity of water for 1 hour at 180°C and weighing the residue.

The dissolved-solids content is usually the main factor which limits or determines the use of water. Winslow and Kister (1956, p. 5) used an excellent and very applicable general classification of waters which is based on the dissolved-solids concentration in ppm (parts per million). The classification is as follows:

Description	Dissolved-solids content (ppm)
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

In recent years most laboratories have begun reporting analysis in mg/l (milligrams per liter) instead of ppm. These units, for practical purposes, are identical until the dissolved-solids concentration of natural water exceeds about 7,000 mg/l. The constituent concentrations in this report are given in mg/l, except for the oil-field brines for which chemical analyses were originally reported in ppm. Most of the analyses of ground water in this report are below 7,000 mg/l and therefore the units are interchangeable. For the more highly mineralized waters, a density correction would be necessary in conversion using the following formula:

$$\text{Parts per million} = \frac{\text{milligrams per liter}}{\text{specific gravity of the water}}$$

The dissolved-solids content of ground water collected from the Seymour Formation of Wilbarger County ranged from 178 to 11,700 mg/l. Based on the Winslow and Kister classification, this water would be termed fresh to very saline.

Within the Odell-Fargo area, 89 percent of the samples collected were fresh water, containing less than 1,000 mg/l dissolved solids. There were 12 samples in this area which would be termed slightly saline. Only two samples (wells 13-46-507 and 617) were moderately saline and their dissolved-solids concentrations were 3,140 and 4,150 mg/l, respectively.

Seymour ground water in the Lockett area is of poorer quality than in the Odell-Fargo area. Of the wells sampled, 78 percent contained fresh water, 21 percent contained slightly saline water, and the water from well 13-61-701 was very saline, containing 11,700 mg/l dissolved solids.

In other areas of Seymour ground water, slightly over one-half of the sampled waters were fresh and the balance were slightly to moderately saline.

The range in concentration of dissolved solids in Quaternary alluvium ground water was from 345 (well 13-56-507) to 20,900 mg/l (well 13-57-402). Approximately 30 percent of the sampled waters were fresh, 53 percent were slightly to moderately saline, and the waters from three wells (13-62-527, 13-64-604, and 14-57-402) were very saline. The dissolved-solids concentrations of these waters were 16,100, 27,900, and 20,900 mg/l, respectively.

Ground-water samples from Permian rocks contained from 280 to 17,000 mg/l dissolved solids and would be classed as fresh to very saline.

Table 3.—Source and Significance of Dissolved-Mineral Constituents and Properties of Water (Adapted from Doll and others, 1963, p. 39-43)

Constituent or property	Source or cause	Significance
Silica (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 of high pressure boilers to form deposits on blades of turbines. Inhibits deterioration of zeolite-type water softeners.
Iron (Fe)	Dissolved from practically all rocks and soils. May also be derived from iron pipes, pumps, and other equipment.	On exposure to air, iron in ground water oxidizes to reddish-brown precipitate. More than about 0.3 mg/l stains laundry and utensils reddish-brown. Objectionable for food processing, textile processing, beverages, ice manufacture, brewing, and other processes. U.S. Public Health Service (1962) drinking water standards state that iron should not exceed 0.3 mg/l. Larger quantities cause unpleasant taste and favor growth of iron bacteria.
Calcium (Ca) and Magnesium (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 of water; soap consuming (see hardness). Waters low in calcium and magnesium desired in electroplating, tanning, dyeing, and in textile manufacturing.
Sodium (Na) and Potassium (K)	Dissolved from practically all rocks and soils. Found also in oil-field brines, sea water, industrial brines, and sewage.	Large amounts, in combination with chloride, give a salty taste. Moderate quantities have little effect on the usefulness of water for most purposes. Sodium salts may cause foaming in steam boilers and a high sodium content may limit the use of water for irrigation.
Bicarbonate (HCO_3) and Carbonate (CO_3)	Action of carbon dioxide in water on carbonate rocks such as limestone and dolomite.	Bicarbonate and carbonate produce alkalinity. Bicarbonates of calcium and magnesium decompose in steam boilers and hot water facilities to form scale and release corrosive carbon dioxide gas. In combination with calcium and magnesium, cause carbonate hardness.
Sulfate (SO_4)	Dissolved from rocks and soils containing gypsum, iron sulfides, and other sulfur compounds. Commonly present in some industrial wastes.	Sulfate in water containing calcium forms hard scale in steam boilers. In large amounts, sulfate in combination with other ions gives bitter taste to water. U.S. Public Health Service (1962) drinking water standards recommend that the sulfate content should not exceed 250 mg/l.
Chloride (Cl)	Dissolved from rocks and soils. Present in sewage and found in large amounts in oil-field brines, sea water, and industrial brines.	In large amounts in combination with sodium, gives salty taste to drinking water. In large quantities, increases the corrosiveness of water. U.S. Public Health Service (1962) drinking water standards recommend that the chloride content should not exceed 250 mg/l.
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 decay when the water is consumed during the period of enamel calcification. However, it may cause mottling of the teeth, depending on the concentration of fluoride, the age of the child, amount of drinking water consumed, and susceptibility of the individual (Maier, 1950, p. 1120-1132).
Nitrate (NO_3)	Decaying organic matter, sewage, fertilizers, and nitrates in soil.	Concentration much greater than the local average may suggest pollution. U.S. Public Health Service (1962) drinking water standards suggest a limit of 45 mg/l. Waters of high nitrate content have been reported to be the cause of methemoglobinemia (an often fatal disease in infants) and therefore should not be used in infant feeding (Maxcy, 1950, p. 271). Nitrate shown to be helpful in reducing inter-crystalline cracking of boiler steel. It encourages growth of algae and other organisms which produce undesirable tastes and odors.
Boron (B)	A minor constituent of rocks and of natural waters.	An excessive boron content will make water unsuitable for irrigation. Wilcox (1955, p. 11) indicated that a boron concentration of as much as 1.0 mg/l is permissible for irrigating sensitive crops; as much as 2.0 mg/l for semitolerant crops; and as much as 3.0 mg/l for tolerant crops. Crops sensitive to boron include most deciduous fruit and nut trees and navy beans; semitolerant crops include most small grains, potatoes and some other vegetables, and cotton; and tolerant crops include alfalfa, most root vegetables, and the date palm.

Table 3.—Source and Significance of Dissolved-Mineral Constituents and Properties of Water (Adapted from Doll and others, 1963, p. 39-43)—Continued

Constituent or property	Source or cause	Significance
Dissolved solids	Chiefly mineral constituents dissolved from rocks and soils.	U.S. Public Health Service (1962) drinking water standards recommend that waters containing more than 500 mg/l dissolved solids not be used if other, less mineralized supplies are available. For many purposes the dissolved-solids content is a major limitation on the use of water. A general classification of water based on dissolved-solids content, in ppm, is as follows (Winslow and Kister, 1956, p. 5): Waters containing less than 1,000 ppm of dissolved solids are considered fresh; 1,000 to 3,000 ppm slightly saline; 3,000 to 10,000 ppm, moderately saline; 10,000 to 35,000 ppm, very saline; and more than 35,000 ppm, brine.
Hardness as $CaCO_3$	In most waters nearly all the hardness is due to calcium and magnesium. All of the metallic cations other than the alkali metals also cause hardness.	Consumes soap before a lather will form. Deposits soap curd on bathtubs. Hard water forms scale in boilers, water heaters, and pipes. Hardness equivalent to the bicarbonate and carbonate is called carbonate hardness. Any hardness in excess of this is called non-carbonate hardness. Waters of hardness up to 60 mg/l are considered soft; 61 to 120 mg/l, moderately hard; 121 to 180 mg/l, hard; more than 180 mg/l, very hard.
Sodium-adsorption ratio (SAR)	Sodium in water.	A ratio for soil extracts and irrigation waters used to express the relative activity of sodium ions in exchange reactions with soil (U.S. Salinity Laboratory Staff, 1954, p. 72, 156). Defined by the following equation: $$SAR = \frac{Na^+}{\sqrt{\frac{Ca^{++} + Mg^{++}}{2}}},$$ where Na^+, Ca^{++}, and Mg^{++} represent the concentrations in milliequivalents per liter (me/l) of the respective ions.
Residual sodium carbonate (RSC)	Sodium and carbonate or bicarbonate in water.	As calcium and magnesium precipitate as carbonates in the soil, the relative proportion of sodium in the water is increased (Eaton, 1950, p. 123-133). Defined by the following equation: $$RSC = (CO_3^{--} + HCO_3^{-}) - (Ca^{++} + Mg^{++})$$ where CO_3^{--}, HCO_3^{-}, Ca^{++}, and Mg^{++} represent the concentrations in milliequivalents per liter (me/l) of the respective ions.
Specific conductance (micromhos at 25°C)	Mineral content of the water.	Indicates degree of mineralization. Specific conductance is a measure of the capacity of the water to conduct an electric current. Varies with concentration and degree of ionization of the constituents.
Hydrogen ion concentration (pH)	Acids, acid-generating salts, and free carbon dioxide lower the pH. Carbonates, bicarbonates, hydroxides, phosphates, silicates, and borates raise the pH.	A pH of 7.0 indicates neutrality of a solution. Values higher than 7.0 denote increasing alkalinity; values lower than 7.0 indicate increasing acidity. pH is a measure of the activity of the hydrogen ions. Corrosiveness of water generally increases with decreasing pH. However, excessively alkaline waters may also attack metals.

Hardness

The characteristic of water known as hardness is caused almost entirely by the compounds of calcium and magnesium. Hard water contains these compounds in abundance whereas soft water does not.

A classification, based on the amount of calcium carbonate or its equivalent that would be formed if the water were evaporated, was devised by the U.S. Geological Survey and is listed in the following table:

Hardness range (mg/l)	Class
0 to 60	Soft
61 to 120	Moderately hard
121 to 180	Hard
More than 180	Very hard

In Wilbarger County, 97 percent of the waters from the Seymour Formation were very hard; however, they ranged from moderately hard to very hard. The hardness of water from this aquifer ranged from 91 to 4,380 mg/l.

As in the case of water from the Seymour, water from the Quaternary alluvium deposits is predominately very hard. The water in one sample was moderately hard, and two samples contained hard water. Hardness ranged from 96 to 16,000 mg/l.

All of the samples collected from Permian rocks were very hard water. The hardness ranged from 221 to 9,200 mg/l.

Iron

Iron in comparatively small amounts is present in most ground waters. It is derived primarily from the soils and sediments through which the water passes.

Upon exposure to air, water containing small amounts of iron leaves a reddish residue or stain. For this reason, ground waters having excessive amounts of iron (greater than 0.3 mg/l) are objectionable for some industrial and domestic uses.

There is very little difference in the iron content of ground water in the various Seymour Formation areas in Wilbarger County. Of 39 samples, 18 or 46 percent contained greater than the recommended upper limit; the iron content ranged from no detected amount (well 13-37-910) to 84 mg/l (well 13-46-515).

The iron content was determined on only one sample from the Quaternary alluvium deposits. Water from well 13-62-521 contained 0.4 mg/l which is above the recommended limit.

The iron content was not determined in water from the Permian rocks.

Sodium and Potassium

Sodium and potassium are alkali metals that are found in all natural waters; however, only sodium is generally found in significant quantities.

Sodium is the most abundant cation in sea water, where its average concentration is about 10,000 mg/l. For this reason, some ground waters that contain excessively high concentrations of sodium, associated with excessively high amounts of chloride, may have been altered by sea water.

When these constituents are present in moderate quantities, they have little effect on the use of water for other than certain industrial uses. Water containing high concentrations of sodium salts may cause soil damage, and therefore, could be detrimental for irrigation use.

The sodium content ranged from 17 to 2,780 mg/l in water from the Seymour Formation, from 50 to 5,500 mg/l in water from the Quaternary alluvium deposits, and from 15 to 2,900 mg/l in water from Permian water-bearing units. The potassium content in these same waters ranged from 0.6 to 38 mg/l, less than 1 to 54 mg/l, and less than 1 to 14 mg/l, respectively.

Carbonate and Bicarbonate

Bicarbonate anions occur in natural waters as the result of dissolved carbon dioxide. Waters containing carbon dioxide dissolve limestones and dolomites when they come into contact with them. This releases carbonate which is changed to bicarbonate by part of the dissolved carbon dioxide. The bicarbonate concentration in water is in general a measure of its alkalinity.

High concentrations of sodium bicarbonate cause foaming in industrial boilers and may also be objectionable in irrigation waters.

Wilbarger County ground waters have a bicarbonate content which ranges from 0 to 880 mg/l in the Seymour Formation, from 83 to 851 mg/l in the Quaternary alluvium deposits, and from 229 to 640 mg/l in Permian water-bearing units.

Sulfate

Sulfate may be dissolved in water which passes through anhydrite or gypsum. It also may be derived from rocks, such as black shale, which contain the mineral pyrite. Within Wilbarger County, it would be derived from rocks of Permian age which characteristically contain anhydrite and gypsum.

Sulfate, in combination with high calcium and magnesium concentrations, contributes to the formation of boiler scale and usually increases the cost of water softening.

Approximately 91 percent of the water samples analyzed from the Seymour Formation contained less than the upper limit of 250 mg/l recommended for public supplies. The sulfate content of all samples ranged from 3 to 1,940 mg/l. Nine Seymour water samples contained sulfate concentrations in excess of 750 mg/l and those waters may have a laxative effect.

The range of sulfate content in waters collected from Quaternary alluvium deposits was from 9 to 1,670 mg/l. Thirty-three samples, or 49 percent, contained less than the recommended upper limit while approximately 23 percent contained sulfate in concentrations exceeding 750 mg/l.

The sulfate content of water from wells in the Permian water-bearing units ranged from 16 to 1,930 mg/l. Approximately 68 percent of the samples contained less than the recommended upper limit for sulfate. Water from only one well (13-63-201) would tend to have a laxative effect because of high sulfate content.

Chloride

Common table salt consists of chloride in combination with sodium. Both of these constituents are generally present in all ground waters and they are present in varying quantities in waters collected from wells in Wilbarger County. Chloride occurs as the most abundant ion found in sea water where its average content is about 19,000 mg/l. Normally, the regional chloride content of an aquifer is relatively low and, therefore, the presence of abnormally high amounts associated with high sodium is suggestive of possible contamination by salt water. This is generally derived from oil-field brines; however, some water-bearing units may contain naturally high chloride concentrations.

The usability of water for various purposes may be determined in part by the amount of chloride. Small amounts have little effect on the usefullness of water, but in concentrations of several hundred mg/l, in combination with sodium it gives water a salty taste and, therefore, is undesirable for domestic use. There are also limitations on this constituent in water which is used for industrial and irrigational purposes. These limitations will be discussed in a later section of this report.

The chloride content of ground water collected and analyzed from the Seymour Formation of Wilbarger County ranged from 2 to 7,100 mg/l. The following tabulation gives a more complete breakdown of the chloride content of the Seymour Formation waters:

Range in chloride content (mg/l)	Number of analyses	Percent of total analyses
0 to 250	379	78
251 to 500	61	13
501 to 1,000	27	6
Over 1,000	15	3

Approximately 90 percent of the analyzed Seymour samples within the Odell-Fargo area contained water with less than 250 mg/l, the suggested upper limit for chloride in drinking water (U.S. Public Health Service, 1962, p. 7 and 8). In the Lockett area, 74 percent of the samples were below the suggested upper limit, and 70 percent of the ground waters of other areas of the Seymour Formation were of acceptable quality.

Samples of water collected and analyzed from Quaternary alluvium deposits contained chloride concentrations which ranged from 13 to 17,800 mg/l. A more complete breakdown of the chloride content of waters from these deposits is as follows:

Range in chloride content (mg/l)	Number of analyses	Percent of total analyses
0 to 250	29	39
251 to 500	16	21
501 to 1,000	14	19
Over 1,000	16	21

Chloride concentration range of ground water from rocks of Permian age was from 8 to 10,700 mg/l. Of the analyzed samples, 69 percent contained less than the suggested upper limit for this constituent. Approximately 19 percent of the samples had a chloride content greater than 1,000 mg/l.

Fluoride

Fluoride, present in only small amounts in ground water, is derived mainly from fluorite and other fluoride-bearing minerals of igneous rocks. The principal effect of fluoride in drinking water is on the dental health of children. The constituent is beneficial or detrimental depending on the concentration. While small quantities are beneficial in lessening tooth decay, if waters containing too much fluoride are used by children up to 12 years of age over prolonged periods of time, it may contribute to a permanent dental defect known as fluorosis, or mottling of the teeth.

The fluoride concentrations recommended by the U.S. Public Health Service (1962, p. 7, 8) are based on climatic factors that affect the amount of water consumed—for Wilbarger County the recommended lower limit is 0.7 mg/l, the optimum concentration is 0.8 mg/l, and the upper limit is 1.0 mg/l.

Within the Seymour Formation in Wilbarger County, the fluoride content ranged from 0.1 to 7.0 mg/l (Table 8). The average fluoride content of 423 samples collected from the Seymour Formation was 1.1 mg/l. A summary of fluoride content in the Seymour Formation samples analyzed is as follows:

Range in fluoride content (mg/l)	Number of analyses	Percent of total analyses
0 to 0.7	115	27
0.8 to 1.0	114	27
Over 1.0	194	46

The range in fluoride content from 67 samples collected from Quaternary alluvium deposits was from 0.3 to 4.3 mg/l. Approximately 49 percent of the samples contained less fluoride than the recommended upper limit.

Waters from the Permian rocks had a fluoride content which ranged from 0.4 to 2.4 mg/l, with 56 percent of the analyzed waters falling below the constituent's recommended upper limit.

Nitrate

The nitrate content of ground waters varies greatly and may be derived from several sources. In Wilbarger County, the ground water in the Seymour Formation, in particular, locally contains higher than normal nitrate concentrations.

The harmful effects of excessive nitrate will be discussed in a later part of this section. It should be kept in mind, however, that any water containing nitrate in excess of 45 mg/l is not recommended for human consumption (Table 3).

Nitrate concentrations within Seymour Formation ground waters ranged from less than 0.4 to 552 mg/l. The following tabulation gives a more complete breakdown of the nitrate content of these waters:

Range in nitrate content (mg/l)	Number of analyses	Percent of total analyses
0 to 45	266	59
45 to 100	164	36
101 to 220	22	5
Over 220	2	.5

The range in nitrate content varies among the areas of Seymour occurrence. In the Odell-Fargo area, 86 percent of the analyzed samples were below 45 mg/l, the recommended upper limit for public water supplies (U.S. Public Health Service, 1962). Within the Lockett area, only 47 percent of the sampled waters would be considered by this standard to be safe for drinking. In the other areas underlain by the Seymour Formation, approximately 51 percent of the waters analyzed would be considered safe for human consumption.

Adults can tolerate much more nitrate in drinking water than babies, but prolonged illness and even death can occur when the nitrate concentration is high enough and the water is consumed over a long enough period of time. Burden (1961) concluded that the average lethal dose for a 140-pound adult is between 80 and 300 milligrams of nitrate per kilogram (2.205 pounds) of body weight. Or in other words, death is most likely to occur when 80 to 300 mg/l of the body weight is nitrate. Burden (1961) recommended a maximum limit for nitrate in livestock water of 220 mg/l, and concluded that there should be concern for animals when the nitrate content reaches 100 mg/l.

There are several explanations for the high nitrate concentrations in ground water in the Seymour Formation. Within the Odell-Fargo and Lockett areas of Wilbarger County, the main crop grown is alfalfa. In the root zone of these plants, nitrogen-fixing bacteria take nitrogen from the soil air and fix it in the soil as nitrate. Alfalfa has been grown over much of the area since the late 1940's and this crop has contributed much nitrate to the soil. Through leaching, some of the nitrate may reach the zone of saturation.

In addition, much fertilization is necessary in this area for the optimum growth of alfalfa, the extensive use of fertilizers that contain nitrate may have added additional nitrate to the ground water as well as to the soils in the area of cultivation. Research to date has not been conclusive enough to fully evaluate the effects of fertilizers on ground water. The Texas A&M Water Resources Institute is conducting research on this subject in some counties of north-central Texas.

It has been suggested that the leaching of soil and humus in old mesquite groves which have been converted to farmlands is the cause of high nitrate content in ground water in certain broad areas of California (Huberty et al., 1945, p. 14-15). Another explanation for high nitrate is that it may be due to the leaching of nitrate from grasslands after they were put into cultivation. Nitrogen, bound in organic form, is believed to be highest in soils under grass vegetation and decreases rapidly when these lands are placed in cultivation. One or both of these explanations may be the cause of some of the high nitrate content in waters from the Seymour Formation, since much of the area was formerly in grassland or covered by mesquite groves.

Many of the well waters that contain excessive amounts of nitrate are possibly contaminated due to the effects of sewage from nearby septic tanks or animal wastes from barnyards. This would account not only for high concentrations of nitrate but would also be an explanation for part of the increase in chloride concentration as the two are associated (Hem, 1959, p. 18). It is felt that improper disposal of sewage from populated areas has added much nitrate to the ground water in some parts of the county. Also, a cattle feedlot operation north of the city of Vernon is thought to have contributed additional nitrate to the water in the Seymour Formation.

Determinations of nitrate content in 70 samples collected from Quaternary alluvium ground water are given in Table 8. A sample from well 13-64-609 contained more than the recommended upper limit of 45 mg/l, and that sample contained 90 mg/l. The lowest nitrate concentration in the alluvium ground water was less than 0.4 mg/l.

Permian age rocks contained ground waters having a range in nitrate content from less than 0.4 to 187 mg/l. A total of 12 (75 percent) out of 16 samples of these waters had less than the recommended upper limit for nitrate content.

Boron

Boron, necessary for crop growth, is not known to affect the use of water for purposes other than irrigation. Excessive amounts of boron are highly toxic to plants and render water unsuitable for irrigation. A boron concentration as high as 1.0 mg/l is permissible for irrigation of sensitive crops such as deciduous fruit and nut trees; as high as 2.0 mg/l for semi-tolerant crops such as most small grains, cotton, potatoes, and other vegetables; and as high as 3.0 mg/l for tolerant crops such as alfalfa and most root vegetables.

The boron content of 376 samples from selected wells in the Seymour Formation ranged from 0.1 to 3.2 mg/l. A tabulation of the boron content of Seymour Formation waters is as follows:

Range in boron content (mg/l)	Number of analyses	Percent of total analyses
0 to 0.4	290	77
0.5 to 1.0	71	19
1.1 to 2.0	12	3
2.1 to 3.0	1	.3
Over 3.0	2	.5

Samples collected from 66 wells yielding water from Quaternary alluvium deposits had a boron content ranging from 0.2 to 3.8 mg/l. Approximately 83 percent of these samples would be suitable for irrigating sensitive crops, 95 percent would be suitable for semi-tolerant crops, and 98 percent would be suitable for tolerant crops (alfalfa and most root vegetables). Only the water from well 13-62-302 would not be suitable for irrigation due to toxic effects and it had a boron content of 3.8 mg/l.

All but one of 13 analyzed water samples from the Permian rocks would be suitable for irrigating sensitive crops. The water from well 13-63-201 would be suitable only for tolerant crops since its boron content was 2.3 mg/l.

The main crops grown in Wilbarger County are cotton, grain sorghums, oats, wheat, alfalfa, and guar. Almost all of these crops can tolerate a boron content up to 3.0 mg/l. Therefore, most irrigation waters from the water-bearing formations of the county can be used without concern for toxicity due to boron.

Suitability for Drinking and Livestock Use

The degree and type of mineralization of ground water affect its suitability for municipal, livestock, irrigation, and industrial uses. Several criteria for water quality requirements have been developed through the years which serve as guidelines in determining the suitability of water for various uses. Subjects covered by the guidelines are bacterial content; physical characteristics, including color, taste, odor, turbidity, and temperature; and lastly, the chemical constituents. Economically, water-quality problems associated with the first two subjects can usually be alleviated. The neutralization or removal of most of the unwanted chemical constituents is usually difficult and often costly.

In 1962, the U.S. Public Health Service set forth recommended standards for drinking water to be used on interstate carriers and these were designed to protect the traveling public from digestive upsets. These standards are useful in evaluating public and domestic water supplies, even though they may not be directly applicable to Wilbarger County where some of the water exceeds the standards for some constituents. As set out in the standards, in a public water supply, the chemical constituents should not exceed the concentrations shown in the following table, except in those areas where more suitable supplies are not available:

Substance	Concentration (mg/l)
Chloride (Cl)	250
Fluoride (F)	1.0*
Iron (Fe)	.3
Magnesium (Mg)	125
Manganese (Mn)	.05
Nitrate (NO_3)	45
Sulfate (SO_4)	250
Total dissolved solids (A dissolved-solids content as much as 1,000 mg/l may be permitted if less mineralized water is not available.)	500

*Upper limit based on the annual average maximum daily air temperature of 76.8°F for Wilbarger County. The recommended control limits of fluoride concentrations are: lower, 0.7; optimum, 0.8; and upper, 1.0 mg/l.

Many areas of north-central Texas do not have and cannot obtain municipal and domestic water supplies which meet the recommended standards; however, supplies which do not meet these standards have been used for long periods of time without any apparent ill effects to the user. It is not generally recommended that water used for drinking purposes contain more than a maximum of 2,000 mg/l dissolved solids; however, water containing somewhat higher mineral concentrations has been used where water of better quality was not available.

Water having concentrations of chemical constituents in excess of the U.S. Public Health Service's standards may be objectionable for many reasons. Brief explanations for these objections as well as the significance of each constituent are made in Table 3. More detailed discussions and the ranges in concentration of chemical constituents within the various water-bearing units of Wilbarger County can be found in preceding parts of this section.

Smith et al. (1942, p. 15) stated that some livestock have been known to survive on water containing much as 10,000 ppm dissolved solids, although water of considerably better quality is necessary for maximum growth and reproduction. Burden (1961) stated that there should be concern for livestock when the nitrate content of their drinking water is as great as 100 mg/l and he further recommended an upper limit of 220 mg/l for waters used for livestock consumption.

Suitability for Irrigation Use

The quality of irrigation waters is important to the results which can be expected from their use. The results, however, are greatly influenced by the climate, soils, management practices, crops grown, drainage, and the quantity of water available.

The primary factors which determine the quality of water used for irrigation are:

(1) the salinity hazard or the total salt concentration,

(2) the sodium hazard or the proportion of sodium and its relationship to other cations,

(3) the boron hazard or the concentration of boron or other toxic elements and under certain conditions,

(4) the carbonate and bicarbonate ions hazard which is a consideration of the bicarbonate content in relationship to calcium and magnesium (U.S. Salinity Laboratory Staff, 1954, p. 69-82; Wilcox, 1955, p. 11-12; Lyerly and Longenecker, 1957, p. 13-15).

In most waters, the salt concentration is not high enough to impair or retard the growth of plants. It is the salt accumulation in the soil which causes saline conditions that are injurious to plants. However, as the salt concentration in irrigation waters increases, the salinity hazard or the tendency of salts to accumulate in the soil also increases.

The U.S. Salinity Laboratory Staff (1954, p. 69-82) designed the classification chart shown in Figure 13 which is an excellent guide in estimating the relative salinity hazard of irrigation waters. It is based in part on various salinity classes which are determined by the conductivity in micromhos per centimeter at 25°C which is shown on most chemical analyses (Table 8). The salinity-hazard classes are shown on the horizontal scale of Figure 13 and a discussion of them follows (Lyerly and Longenecker, 1957, p. 13-14):

(C1) Low-salinity water—can be used for irrigation of most crops on most soils and there is little or no soil salinity developed. Care must be exercised only in soils having extremely low permeability.

(C2) Medium-salinity water—can be used if moderate leaching occurs. Plants with moderate salt tolerance can usually be grown without special salinity control practices.

(C3) High-salinity water—cannot be used on soils with restricted drainage. If used, plants with good salt tolerance should be selected, adequate drainage should be provided, and special management for salinity control should be practiced.

(C4) Very high-salinity water—not ordinarily suitable for irrigation. If used, the water must be applied in excess amounts to provide leaching and it must be used on permeable soils with adequate drainage. Crops must be highly salt tolerant.

Physical conditions of the soil are markedly affected by an increase in exchangeable sodium. For that reason it is necessary to consider the sodium hazard of irrigation water. Accumulations of sodium in the soil may be injurious to plants sensitive to sodium. The total salt concentration, as well as the sodium-adsorption ration (SAR), influence the sodium hazard. A high SAR is the cause of soil structure breakdown. Soils tend to form a hard crust and become impermeable to water and air movement. This usually results in crop damage, cultivation difficulties, and drainage problems (Hem, 1959, p. 247). Table 3 shows the equation for calculating the SAR, and Table 8 gives the SAR values which have been calculated for most of the water samples in Wilbarger County. Using these SAR values and the conductivity, the sodium hazard can be determined from Figure 13. The sodium-hazard classes as shown on the vertical scale of Figure 13 are as follows (Lyerly and Longenecker, 1957, p. 14-15):

(S1) Low-sodium water—can be used on almost all soils with little danger of developing harmful levels of exchangeable sodium; the water could be injurious on certain soils to some stone-fruit trees and other sodium-sensitive crops.

(S2) Medium-sodium water—recommended to be used on coarse-textured or organic soils having good permeability. In the absence of gypsum in the soil, this water will present an appreciable sodium hazard in fine-textured soils with high cation-exchange capacity under low-leaching conditions.

(S3) High-sodium water—will require special management as it may produce harmful levels of exchangeable sodium in most soils; however, this is not the case in gypsiferous soils. Organic additions, high leaching, and good drainage are needed.

(S4) Very high-sodium water—usually unsatisfactory for irrigation. Exceptions are at low and possibly medium salinity, where the solution of calcium from the soil or the use of gypsum or other additives may make the use of this water feasible.

Under most conditions, irrigation waters having a percent sodium (Table 8) of less than 60 and a low bicarbonate content are probably satisfactory. The sodium hazard becomes progressively greater as the percent sodium increases above 60.

Excessive boron content will render water unsuitable for irrigation. A previous section of this report discusses the sensitivity of various crops, the boron limits for these crops, as well as the boron ranges for the various aquifers of Wilbarger County. Table 8 lists the boron content, where determined, of waters sampled from various aquifers within the county.

Following irrigation, the soil dries and the soil solution becomes progressively more concentrated. This condition creates a tendency for the less soluble compounds to precipitate from solution. Both calcium and magnesium carbonate, being less soluble than sodium carbonate, may precipitate with drying. This precipitation results in an increase in the proportion of sodium in solution. The bicarbonate ion is the source of carbonate which makes the precipitation possible.

The conditions favoring precipitation and the extent to which calcium and magnesium carbonates will precipitate are not fully understood. However, waters containing 1.25-2.5 me/l (milliequivalents per liter) of residual sodium carbonate (RSC) are considered marginal and those containing greater than 2.5 me/l probably are unsafe for irrigation use. The equation for calculating RSC is contained in Table 3, and RSC values for ground waters in Wilbarger County are shown in Table 8.

A widely used system for determining the quality of irrigation waters is that shown in Figure 13 which is based on the salinity hazard as measured by the specific conductance and the sodium (alkali) hazard as measured by the SAR (U.S. Salinity Laboratory Staff, 1954, p. 69-82). Plots of representative Seymour Formation waters are shown on Figure 13. All but 40 of the 321 samples of Seymour ground water fall within salinity-hazard classes C2 and C3 and sodium-hazard

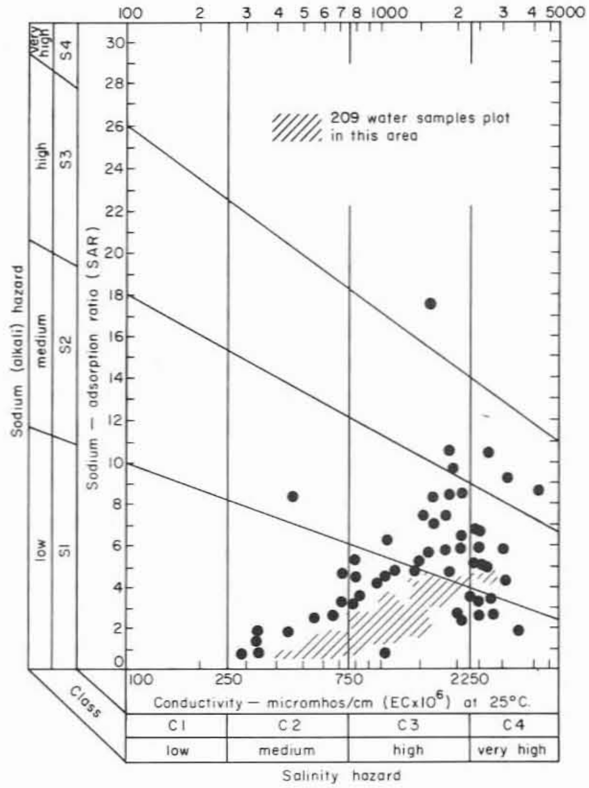

Figure 13.—Classification of Seymour Formation Waters for Irrigation

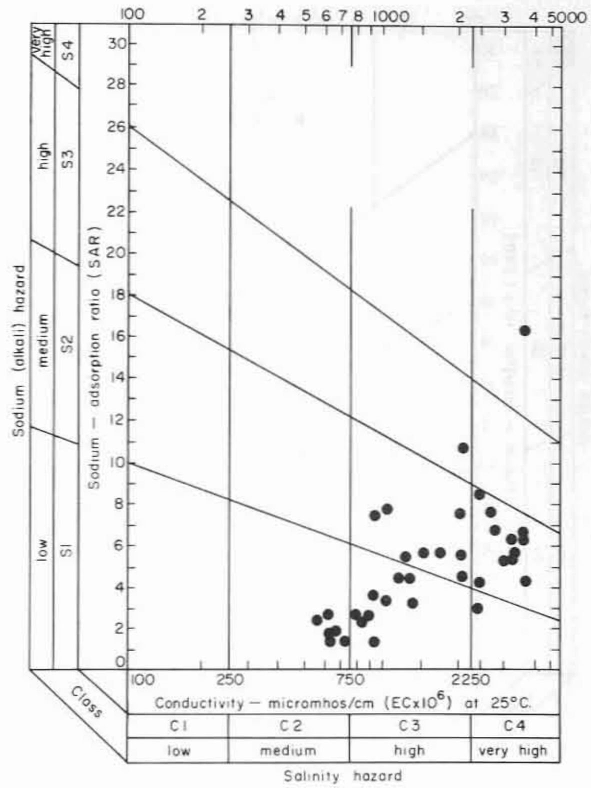

Figure 14.—Classification of Waters From the Quaternary Alluvium for Irrigation

class S1. The importance of these classes has been discussed previously.

Of 344 Seymour samples for which percent sodium was calculated, 329 (96 percent) had a percent sodium of 60 or less and 15 samples had a percent sodium greater than 60.

Quaternary alluvium waters are plotted on Figure 14 to indicate their suitability for irrigation. All but two of the samples of Quaternary alluvium water fall within salinity-hazard classes C2, C3, and C4, and sodium-hazard classes S1 and S2. An additional six samples had a conductivity greater than 5,000 and consequently could not be plotted on the diagram.

Out of a total of 45 samples of Quaternary alluvium waters analyzed, 33 or 73 percent had a calculated percent sodium of 60 or less. Irrigation waters with a percent sodium of 60 or less and having a low bicarbonate content are usually satisfactory. When the percentage is greater than 60, the sodium hazard becomes progressively greater. A total of 12 samples of Quaternary alluvium waters had a percent sodium greater than 60.

Plots of representative waters from Permian rocks are shown on Figure 15 to indicate their suitability for irrigation. All but three of the water samples shown fall within salinity-hazard class C3 and sodium-hazard class S1. An additional four samples had a conductivity greater than 5,000, thus preventing the plotting of these samples on the chart. These waters are not considered suitable for irrigational purposes. The rest of the waters are suitable for irrigational use under certain conditions.

Most of the waters from Permian rocks are classed as high salinity hazard (C3) waters and cannot be used on soils with restricted drainage. If used, plants with good salt tolerance should be selected, adequate drainage should be provided, and special management for salinity control should be practiced. The waters typically have a low sodium hazard and can be used with little danger of developing harmful levels of exchangeable sodium on almost all soils.

Out of a total of 16 samples of water from Permian rocks on which the percent sodium calculations were made, 14 or 87 percent had a percent sodium of 60 or less. Only the samples from wells 13-63-201 and 13-64-601 had a percent sodium greater than 60.

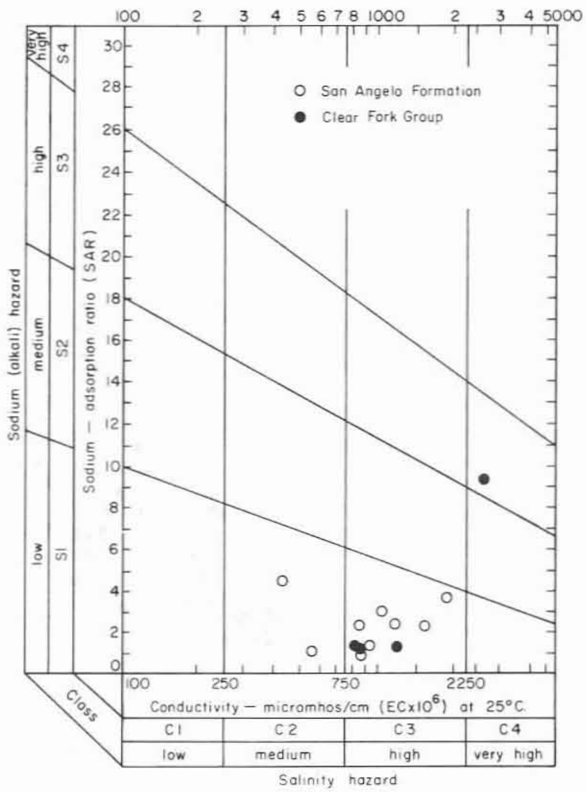

Figure 15.—Classification of Waters From the Permian Rocks for Irrigation

Suitability for Industrial Use

The water-quality requirements for an industrial water supply are determined by the type of industry. The main concern to many industries is that the water selected for its supply does not contain corrosive or scale-forming constituents. Both magnesium and calcium affect the hardness and are of a major concern in any water to be used in boilers. Excessive amounts of silica and iron cause scale deposits which reduce the efficiency of many industrial processes. The water quality must be rigidly controlled where the water is used in the processing of food, paper, or some chemical-process industries. Mineral impurities affect color, taste, odor, and turbidity; therefore, water with a high content of dissolved solids is usually avoided.

Treatment of Water

Water that does not meet the requirements of a municipal or industrial user commonly can be treated by various methods so that it will become usable. Treatment methods include softening, aeration, filtration, cooling, dilution or blending of poor and good quality waters, and the addition of chemicals. The limiting factor in treatment is economics. Each water may require different treatment and the treatment should be designed for that particular water. However, once treatment is established it probably will not have to be changed as the chemical characteristics of uncontaminated ground water remain fairly constant.

Historical Changes in Water Quality

The quality of water derived from the various formations in Wilbarger County varies greatly (Table 8 and Figure 12). Even with this exhibited wide range in quality, some of the waters sampled during this study appear to have been altered.

Both natural and artificial means contribute to the alteration of the chemical quality of ground water. Natural alteration occurs when water dissolves minerals from the rocks through which it percolates or over which it flows. In Wilbarger County natural alteration is evidenced by the locally high concentrations of sulfate which was derived from gypsum and anhydrite, as well as by the high concentrations of bicarbonate which was derived from dolomite and limestone. This is particularly true in the case of waters found in the rocks of Permian age. High sulfate concentrations are also common in water obtained from Quaternary alluvium wells. These deposits are often recharged by overflow waters of the Red and Pease Rivers which flow over beds of gypsum and anhydrite west of Wilbarger County.

Artificial alteration of ground-water quality may be by biological or chemical means. The positioning of wells near, or downslope from, septic tanks and livestock feedlots or barnyards may result in biological contamination. The presence of an abnormally high nitrate concentration in the water locally is usually suggestive of biological contamination.

Alteration of ground water by chemical means may be associated with the production of oil and gas, or may result from improperly constructed industrial waste-disposal wells. Produced brines as a potential source of ground-water contamination will be discussed in a later section of this report.

The locations of several wells and one spring which show evidence of contamination are shown on Figure 32. This illustration also shows several areas of vegetative-kill, which are apparently the result of discharge of oil-field brine onto the surface or overflow of brine from surface disposal pits.

Figure 16 contains a series of radial-pattern diagrams which illustrate the relative concentrations of

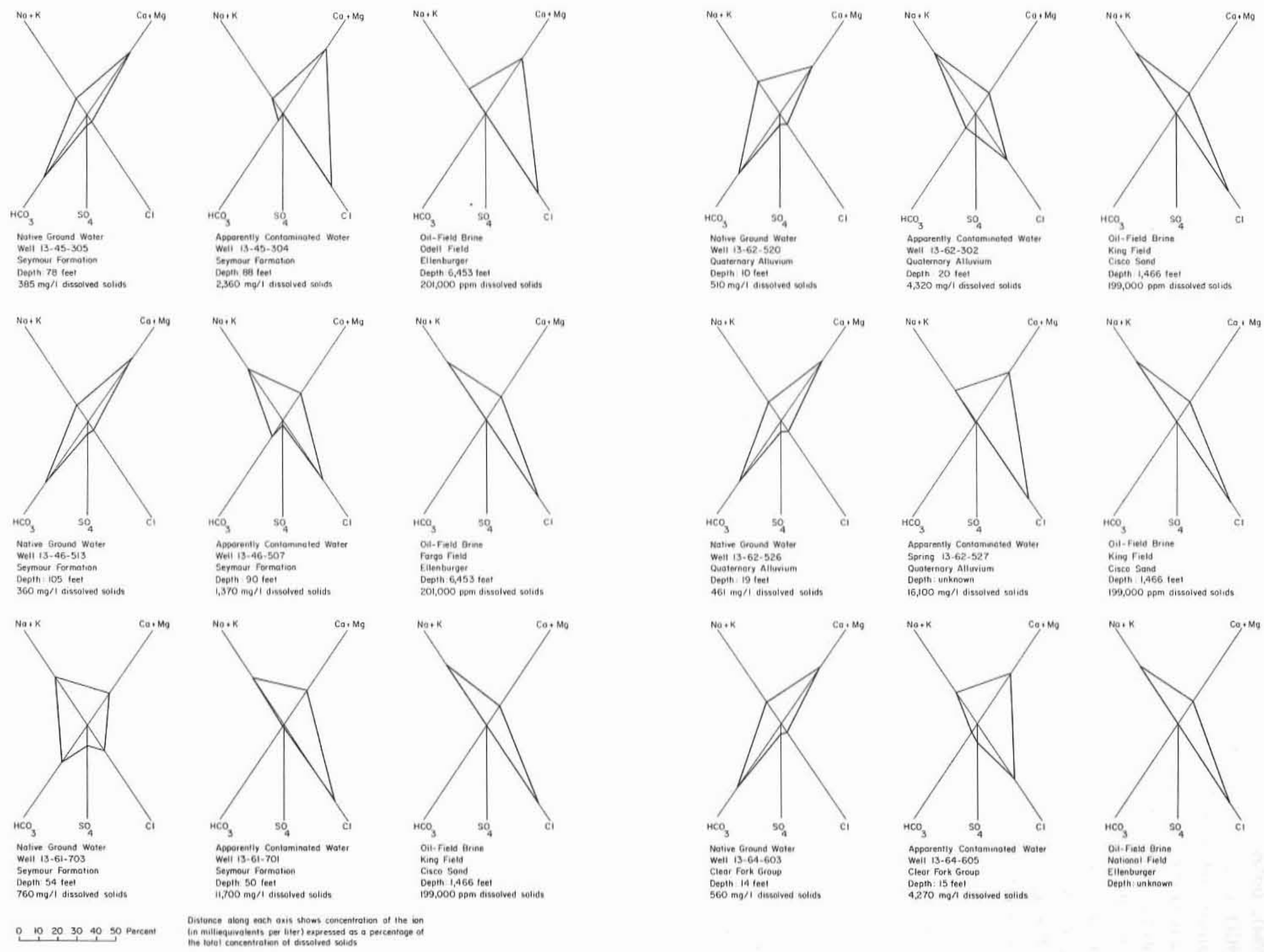

Figure 16

Diagrams of Chemical Analyses of Ground Water and Typical Oil-Field Brine dissolved minerals in native ground water, in water from selected apparently contaminated wells, and in a typical oil-field brine which was produced with oil or gas at a nearby location. The percent of each major chemical constituent—calcium (Ca), magnesium (Mg), chloride (Cl), sodium (Na), potassium (K), sulfate (SO_4), and bicarbonate (HCO_3)—is plotted on radial coordinates and the plots connected. The shape of the patterns thus illustrates the similarities and differences between the chemical analyses. Although several indications of apparent contamination are still evident in Wilbarger County, efforts have been and are being made by the Texas Railroad Commission and the many petroleum operators to eliminate contamination of the surface water, soil, and ground water.

Changes in native-quality water have occurred in some areas underlain by the Seymour Formation. Historical quality data, when present, are included in Table 8 to indicate the location and the amount of change which has occurred. A total of 43 wells sampled for chemical analysis in earlier investigations in 1943, 1949, 1951 through 1953, 1955, 1960, 1961, and 1967 were resampled during this investigation. Seven of the recent samples showed essentially no change in chemical quality, and 18 exhibited slight improvement in overall quality. Twelve samples showed only slight to moderate deterioration, and six exhibited significant worsening of quality (Table 8). Several wells are thought to have been altered due to the presence of oil-field brines as the ground water contained an abnormally high content of chloride and dissolved solids as well as sodium (Table 8 and Figure 16). The dissolved-solids and chloride content of apparently contaminated water from 23 wells and one spring are as follows:

Well	Dissolved solids (mg/l)	Chloride (mg/l)	Aquifer
13-45-304	2,360	1,390	Seymour Formation
46-118	1,320	700	Do.
128	1,070	530	Do.
427	1,230	640	Do.
507	1,370	650	Do.
55-101	4,270	1,440	Do.
401	3,850	1,160	Do.
402	4,740	1,890	Do.
403	4,960	1,950	Do.
404	6,200	2,040	Do.
56-501	2,540	1,510	Do.
61-104	7,300	2,970	Quaternary alluvium
105	5,750	3,150	Do.
337	6,900	2,680	Do.
701	11,700	7,100	Seymour Formation
62-302	4,320	1,550	Quaternary alluvium
527 (Spring)	16,100	10,400	Do.
63-201	6,700	2,150	Clear Fork Group
64-604	27,900	17,800	Quaternary alluvium
605	4,270	1,880	Clear Fork Group
14-49-702	3,410	1,610	Seymour Formation
57-101	17,000	10,700	Clear Fork Group
401	9,600	5,900	Quaternary alluvium
402	20,900	12,900	Do.

Many wells contain water in which the nitrate concentrations are greater than the upper limit recommended for drinking purposes (Table 8 and Figure 12). Most of these wells are in the Lockett area, and the probable causes of their high nitrate content have been previously discussed.

WELL DEVELOPMENT

History of Well Development in Wilbarger County

The earliest settlers of the county probably lived near springs and obtained their water supplies from flows near the base of terrace or Seymour deposits along the Red or Pease Rivers. As the county became more populated, early domestic and livestock supplies were obtained from hand-dug wells, and later many sand-point wells were driven to tap the underlying deposits of sand and gravel. The oldest inventoried domestic well (13-61-201) was hand dug in 1897. The majority of the 188 domestic or livestock wells inventoried during this or previous studies were drilled. There was no set pattern to their development which has been irregularly spaced throughout the years.

In 1972, a total of 110 public supply wells were known and had been inventoried. Follett et al. (1944, p. 5) reported that the first county public water system was constructed in 1890, within the city of Vernon. This privately owned system, consisting of one 16-foot well, provided water to the business district and was abandoned in 1895. Vernon's first municipally owned waterworks was reported to have been started in 1909. This consisted of a manifold-type system of hand-driven sand points which tapped the Seymour Formation and was powered by a cylinder pump. This system was abandoned about 1923 after the development of a well field located about two miles northeast of Vernon near the site of the present municipal swimming pool.

Yields of "swimming pool" wells were low, and eventually these were replaced by several well fields located in or near the city of Vernon. The fields are known as the Old North Station (11 wells), South Pumping Station (5 wells), Schmoker (10 wells), and the Southwest Field (8 wells). These well fields were developed in the Seymour Formation from 1931 through 1949. Twenty-two of the 34 wells are still in use; however, they are used only at peak pumping periods during the summer months.

Seven municipal wells, located in the western part of Vernon and developed from 1926 through 1950, supplied water to that part of town. Only one of these wells (13-54-810) is still being used for municipal supply.

In the early 1940's when the Victory Airfield was in operation, the city of Vernon operated a 27-well field which was located approximately 5 miles south of town on Paradise Creek. These wells pumped from Quaternary alluvium deposits. Later these wells were used by the Vernon State Hospital, and they also provided water for the Waggoner Ranch for a short time.

The development of Vernon's Odell well field began in 1953 with the drilling of 12 municipal wells (Table 4 and Figure 34). Additional drilling in 1958, 1961, and 1969 brought the total well count to 15. Since the completion of this well field, it has provided all of the municipal supply for the city except at peak pumpage periods during the summer months when wells in the Vernon area are pumped.

The city of Vernon has purchased additional acreage 2½ miles north of the Odell well field and plans to develop wells there for municipal purposes.

The total number of public-supply wells being operated by the city of Vernon during the summer of 1971 was 38 and they were distributed as follows: Vernon area, 23 wells; Odell area, 15 wells.

The Round Timber municipal well field, in the northern tip of the county, was initially developed during 1967 by the city of Altus, Oklahoma. At that time, 14 wells were completed. In 1969, two additional wells were drilled, making a total of 16 wells all of which are producing from the Seymour Formation.

The Red River Authority of Texas has recently installed a rural water system to provide water for the immediate area around Lockett. The Lockett water system is supplied by three municipal wells. Wells 13-61-619 and 620 were drilled during 1969 and well 13-61-648 was drilled in 1970.

In addition to the public supply wells previously discussed, four other wells are presently being used or have been used for municipal purposes. These are wells 13-45-204, 13-55-906, 13-61-647, and 13-64-602. These wells were developed during the period from 1930 to 1964. Water from well 13-45-204 is used as a municipal supply for the public school in Odell. Two wells are used at rural churches, and well 13-64-602 was formerly used at a restaurant and gas station.

The development and use of ground water for industrial purposes within Wilbarger County has been very limited. A total of 18 industrial wells which produce water from the Clear Fork Group, Seymour Formation, or Quaternary alluvium were inventoried during this investigation. The first recorded industrial well was drilled in 1914 (well 13-46-701); however, five of the wells inventoried were reported as "old" and several of these could have been dug or drilled prior to 1914. Well 13-61-715, drilled in 1965, was the most recently developed industrial well. The following tabulation reflects the development history of all the industrial wells:

Year drilled	Number of industrial wells drilled	Percent of total
"Old" or before 1915	6	33.4
1916-50	4	22.2
1951-60	4	22.2
1961-71	4	22.2

Of these 18 industrial wells, water from 8 was used in the operation of cotton gins, 5 for the drilling of oil-field tests or in waterflood operations, 1 for an animal clinic, 2 for a service station, 1 for the Lockett fire department, and 1 well is pumped to lower the water level at a grain elevator.

Prior to 1943, the use of ground water for irrigation within Wilbarger County was conducted on a very small scale. Follett et al. (1944, p. 15-31) reported that there were probably not more than 24 irrigation wells in use prior to 1943, and several of these have since been destroyed. Most of the wells were located in the Rayland area of west-central Wilbarger County. The first recorded irrigation development in the Odell area was in 1943; however, most of the development began in the 1950's.

During this investigation, a total of 608 irrigation wells were inventoried. Of these, 537 were producing from the Seymour Formation, 70 were producing from Quaternary alluvium, and 1 was producing from the Clear Fork Group. A breakdown of the development of irrigation wells within the county is as follows:

Year	Number of irrigation wells drilled	Percent of total
1943 or before	8	1.3
1944-50	6	1.0
1951-60	271	44.6
1961-70	317	52.1
1971	6	1.0

Of the 608 irrigation wells inventoried, 173 are located in the Odell-Fargo area and 435 are in the Lockett area.

Well Construction

Of the 925 wells developed in the Seymour Formation, Quaternary alluvium deposits, and the Permian rocks, a few were hand dug; however, most were drilled. Well depths range from 10 to 125 feet.

The majority of the dug wells are used for domestic or livestock purposes. They are generally about 3 to 4 feet in diameter and lined with native stone, brick, or concrete rings. The more recently drilled domestic and livestock wells are cased with small-diameter (5 to 18 inches) galvanized sheetmetal or steel casing. The galvanized metal casing is perforated opposite the water-bearing zones, and steel casing is generally torch-slotted.

Industrial, irrigation, and public supply wells are larger in diameter, 5 to 30 inches, and usually cased to the bottom. In most wells, the hole is reamed to 36 inches, and prior to the setting of the casing, a Layne shutter or Doerr well screen is set, or the casing is torch-slotted opposite the water-bearing zones. Following the setting of the casing on bottom, the hole outside the casing is then filled with small pea-sized gravel. The casing in public supply wells which have been in use for many years is generally not cemented, and surface casing was not installed. In more recently completed public supply wells, a large-diameter casing, 34-36 inches, is set to a maximum depth of 50 feet and cemented to the surface. The production casing is usually 10 to 13 inches in diameter and a well screen is installed opposite the water-bearing strata. In some instances, where centrifugal pumps are used, a sump or pit, 12 to 15 feet in depth, is constructed of concrete rings or a rectangular pit is walled with concrete. This is done to house the pump and reduce the height of lift.

Most of the wells are developed by pumping.

Yields of Wells

The measured yields of 6 test holes and public supply wells on which aquifer tests were previously conducted by the U.S. Geological Survey ranged from 93 to 430 gpm. These tests are listed in Table 2.

Performance tests were conducted during this study on 56 irrigation wells and yields ranged from 35 to 295 gpm (Table 2). This table also contains yield data on all types of wells on which reports were filed by well drillers. Yields ranging from 35 to 600 gpm were reported on wells pumping from the Seymour Formation. Wells deriving their water from Quaternary alluvium deposits were reported to yield from 20 to 750 gpm. One well completed in the Clear Fork Group was reported to yield 15 gpm.

Yields reported by well owners contacted are as follows: Seymour Formation, 3 to 800 gpm; Quaternary alluvium deposits, 10 to 1,000 gpm; and Permian rocks, 15 gpm to "strong".

Pump Types and Energy Sources

Most domestic and livestock wells in Wilbarger County are equipped with jet pumps with the next most popular type being the centrifugal pump. Other wells have submersible pumps. The windmills are equipped with cylinders. The power or energy source of these pumps is generally electricity with the size of the motors ranging from one-third to slightly over 1 horsepower. The ½-horsepower motor is the most common size in use.

Public supply and industrial wells are generally equipped with a vertical turbine-type pump. A few are submersible, jet, or centrifugal-type pumps. Of the wells presently in use in this category, all are powered by electricity with a 10-horsepower motor being the most common size. The motors range from 5 to 30 horsepower.

Of the 608 irrigation wells presently in use which are not of the manifold type, 71 percent are equipped with vertical turbine pumps, 21 percent with centrifugal pumps, and 8 percent with submersible pumps. The principal power source is electricity with 82 percent of the pumps equipped with electric motors ranging in size from 2 to 50 horsepower. Eighty-three pumps are equipped with internal combustion engines which use liquified petroleum fuel.

The manifold irrigation systems presently in use are equipped with centrifugal pumps, and over 70 percent of these pumps are powered by electric motors which range in size from 1 to 40 horsepower. The remainder of the manifold systems are powered by butane or propane.

GROUND-WATER PUMPAGE AND UTILIZATION

Figure 17 graphically shows the estimated amounts of ground water pumped from the water-bearing units of Wilbarger County for irrigation, municipal, industrial, and domestic and livestock purposes. Methods used to obtain these estimates are described briefly below.

The quantity of ground water used for irrigation was estimated from power and yield tests. The following procedure was used to estimate this pumpage: (1) the annual number of kilowatt-hours supplied to the irrigated farms was obtained from the power companies and electrical cooperatives, (2) power and yield tests were conducted on selected irrigation wells to determine the average number of gallons produced per kilowatt-hour, (3) the average number of gallons produced per kilowatt-hour was multiplied by the total kilowatt-hours obtained from the power companies and electrical cooperatives to determine the approximate annual irrigation pumpage, and (4) additional pumpage was added to account for those irrigation wells powered by butane and propane fuels. In addition, data for some of the early years shown on Figure 17 were obtained from previous publications.

Data on the amounts of ground water used for municipal and for industrial purposes were compiled largely from the returns of mailed questionnaires, which have been sent by the Texas Water Development Board's staff annually to the various industries and municipalities.

Estimates of rural domestic and livestock ground-water usage were obtained by multiplying the average amount of water a person uses by the rural population, and multiplying the average amount of water each type of livestock animal uses by the population of each animal type. Rural population and animal census data for 1970 were furnished by the Wilbarger County Program Building Committee. The domestic and livestock ground-water usage is thought not to have varied greatly from year to year in the report area.

Irrigation Pumpage

During this investigation, 608 wells were inventoried which were producing or had produced water for irrigation in Wilbarger County. Tabulation of these wells by water-bearing units is: Seymour Formation, 537 wells; Quaternary alluvium deposits, 70 wells; and Clear Fork Group, 1 well. Pumpage from these irrigation wells represents about 33 percent of the total 1970 ground-water pumpage in the county.

Most of the water is applied by sprinkler systems to the various crops. The principal irrigated crop is alfalfa, followed by cotton and Coastal Bermuda grass.

Irrigation pumpage from all water-bearing zones is estimated at 17,000 acre-feet for the period 1943 through 1970. The 1970 irrigation pumpage is estimated at 2,000 acre-feet. Of this pumpage, 84 percent was obtained from the Seymour Formation, 15 percent from Quaternary alluvium deposits, and less than 1 percent from the Clear Fork Group.

Areas of irrigation pumpage from the Seymour Formation were mainly in the Odell-Fargo area and the Lockett area. Most of the Quaternary alluvium deposits irrigation pumpage was east of Fargo. Irrigation pumpage in other areas is very small and there are no large concentrations of wells.

Municipal Pumpage

During 1970, approximately 4,000 acre-feet or 65 percent of the total ground-water pumpage of Wilbarger County was for public supplies (Figure 17). The estimated pumpage for this use for the period from 1943 through 1970 was 53,000 acre-feet. Almost all of this pumpage was from the Seymour Formation.

Public Water Supply—Vernon, Texas

The city of Vernon is the largest consumer of ground water for municipal needs in Wilbarger County. The city's 1970 public supply pumpage from 38 active

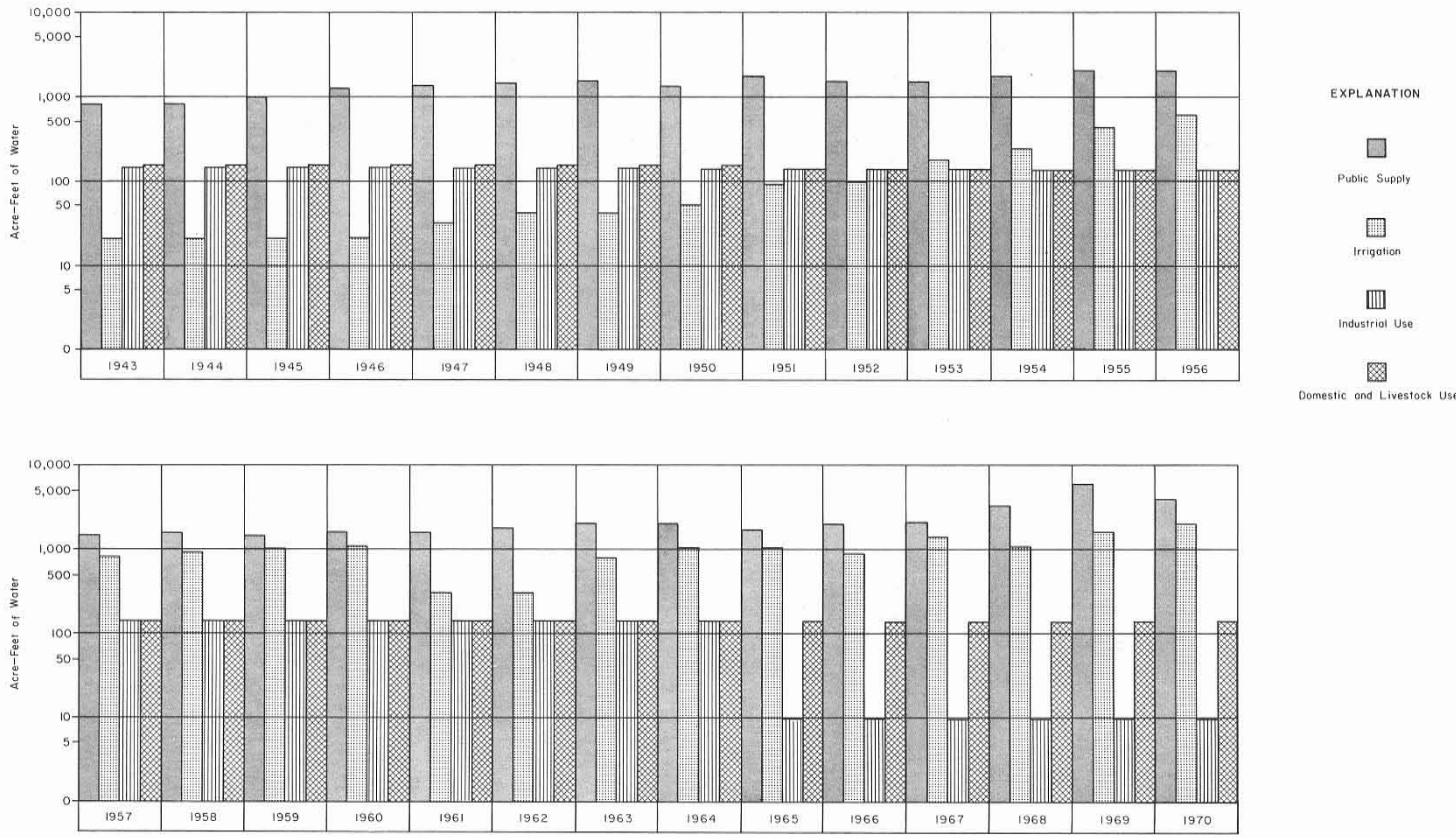

Figure 17

Estimated Pumpage of Ground Water in Wilbarger County, 1943-70 wells was 2,900 acre-feet, and the estimated total pumpage from 1943 through 1970 was 47,000 acre-feet.

Public Water Supply—Altus, Oklahoma

Altus, Oklahoma is the second largest municipal consumer of ground water in Wilbarger County. This city secures most of its public supply from its 16-well Round Timber field located in the extreme northern part of the county (Figure 34). The 1970 pumpage from this field was 1,100 acre-feet, and the total pumpage from 1968 through 1970 was 3,900 acre-feet. This field produces from the Seymour Formation.

Rural Water Districts

As of 1972, there were four rural water districts in operation in Wilbarger County. These are the Harrold, Lockett, Northside, and Thirsty Water Supply Corporations. The city of Electra supplies water to the Harrold water system. The Lockett water system obtains water from 3 wells in the Lockett area developed in the Seymour Formation. The 1970 pumpage, as well as the total pumpage through 1970, was 33 acre-feet. The city of Vernon supplies water to the Northside water system, and this use is included with Vernon's total water use. The Thirsty water system supplied water to the Farmers Valley area and the water is pumped from 1 well located in Hardeman County.

Several privately owned, small capacity public supply wells were inventoried during the study. These systems collectively pumped an estimated 2 acre-feet in 1970 and have pumped about 1,800 acre-feet from 1943 through 1970.

Industrial Water Use

In 1970, an estimated 9 acre-feet of ground water was pumped in Wilbarger County for industrial uses (Figure 17). This is 0.2 of 1 percent of the total ground water pumped in 1970. During the period from 1943 through 1970, the total pumpage from 21 wells (16 inventoried during study and 5 known to have been destroyed) is estimated at 3,300 acre-feet.

Domestic and Livestock Use

A reliable estimate of rural ground-water usage for domestic and livestock purposes is difficult to make; however, the 1970 pumpage was about 150 acre-feet. Pumpage for the period from 1943 through 1970 is estimated to have been about 4,200 acre-feet.

AVAILABILITY OF GROUND WATER

Seymour Formation and Quaternary Alluvium

The principal aquifers in Wilbarger County are the Seymour Formation and the Quaternary alluvium deposits. These geologic units generally are in hydrologic contact with each other and may be considered to be a single hydrologic unit. Both units provide water for all uses. The Seymour Formation is the major source of water for public supply and irrigation uses.

The extent of these aquifers and their geologic characteristics are discussed in the geology section of this report. Table 1 lists the lithologic characteristics of the water-bearing units.

Changes in Water Levels

Historical water-level data in Wilbarger County are scarce prior to 1943; however, many older residents of the county report that prior to irrigation or public-supply development, there was a gradual rise in water levels. This is supported by data, presented in an early ground-water investigation by Follett et al. (1944, p. 9-10), for 9 wells in the Rayland area in northeast Foard County. From 1936 and to 1943 the average rise in water levels measured in these wells was 0.3 foot per year.

Between 1890 and 1895, the city of Vernon reportedly obtained a municipal supply from a shallow (16 feet) well which was located in the central part of the city. The water level in this area was less than 16 feet in depth during that period of time. On January 8, 1971, the water levels in wells near this original well were about 25 feet below land surface. This shows that in this area of heavy pumping there has been a substantial decline in water levels.

Figure 18 is a water-table map showing the water levels in the Seymour Formation and Quaternary alluvium in the Lockett area during the fall of 1943. Figures 19 and 20 are water-table maps for the area during the fall and winter of 1969-70 and 1970-71, respectively. The maximum measured decline in water level was 21.04 feet in well 13-61-534, from October 1943 to March 1970. The average decline in water levels within the Lockett area for the period from October

1943 through January 1971 was 0.45 foot per year. These data exclude areas of formerly heavily pumped public supply wells near Vernon; these wells are used only during the summer months and water levels in the areas involved are generally rising due to recharge.

The configuration of the water table in the Seymour Formation in the Odell-Fargo area during the summer of 1951 is reflected on Figure 21. Figures 22 and 23 show the water levels for the Seymour Formation and Quaternary alluvium deposits during the fall and winter of 1969-70 and 1970-71, respectively. Data on these maps reflect that locally in areas of non-pumpage there may be slight rises in water levels reflecting recharge; however, within the subject area there was a general decline in water levels. The maximum measured decline was 29.12 feet in well 13-46-402, from January 1954 to January 1971. Including data in the city of Vernon's Odell well field, the average 1951-70 decline in water levels in the Odell-Fargo area was 0.94 foot per year. Within the Odell well field, 1970-71 water-level declines were generally about 1.5 feet; however, well 13-46-404 reflected a decline of 6.09 feet during that time.

The hydrographs shown on Figure 24 are records of Seymour Formation or Quaternary alluvium water-level fluctuations recorded monthly during the period of field investigation, from November 1969 through January 1971. Figure 25 contains long-term hydrographs of 22 observation wells in which water levels are measured annually. The hydrographs, in general, reflect noticeable changes in water levels which correspond to changes in rainfall and public supply or irrigation pumpage.

Peak water levels generally occur during January and June (Figure 24). The high water levels in January reflect rises during the fall and early winter when there is much less pumpage than in the irrigation season. The high water levels in June probably reflect increased rainfall during May, which is normally the month of highest rainfall (Figure 4). A general decline is reflected in water levels to a seasonal low in the growing season and hot summer months of July and August; the marked water-level declines during this period are caused primarily by irrigation pumpage.

In summary, water levels fluctuate in response to precipitation, cultivation practices, and pumpage. A change in water level indicates a change in the amount of water in storage. Water levels have generally declined in both the Lockett and Odell-Fargo areas of Wilbarger County with development of irrigation and public supply wells; therefore, the amount of ground water in storage has decreased.

Ground-water data collected in the Lockett area during 1943 (Follett et al., 1944) were not sufficient to construct a reliable saturated thickness map of the Seymour Formation. Therefore, it was impossible to accurately calculate the amount of water in storage at that time. The total amount of ground water in storage as of January 1971 is calculated to have been approximately 101,000 acre-feet.

A conservative estimate of the amount of ground water in storage in 1952 in the Odell sand hills was 225,000 acre-feet within the 70 square miles investigated by Willis and Knowles (1953). This would have been an average of 3,200 acre-feet per square mile. During this investigation, the area underlain by the Seymour Formation was determined to be about 112 square miles. Using this area and 3,200 acre-feet per square mile as previously determined, there would have been on the order of 358,000 acre-feet of ground water in storage in the Seymour Formation in the Odell-Fargo area in 1952. By comparison, much more reliable data indicate that there was approximately 266,000 acre-feet of ground water in storage within the Seymour Formation in this area as of January 1971. The available data are not considered adequate to make calculations for the other areas of Seymour Formation or Quaternary alluvium deposits.

Theoretical Effects of Pumpage

Pumping wells can have widespread effects on water levels in an aquifer such as the Seymour Formation. Water levels in the immediate vicinity of the wells decline as water is removed from aquifer storage. The amount of decline is greatest at the pumped well and becomes progressively less with distance from the well, thus forming a "cone of depression" in the water table with the apex of the cone being at the pumped well (Figure 11).

Continued pumping removes more water from storage causing the cone of depression to expand. Expansion of the cone will continue until it intercepts some source of replenishment. This replenishment may be from a stream, from the percolation of precipitation from the surface, from another aquifer in contact with the pumped aquifer, or until the cone intercepts any source of replenishment that is adequate for the pumping rate.

Factors which determine the extent of the cone of depression are the aquifer's transmissivity and storage coefficients, the pumping rate, and the length of time the well is pumped.

Figure 26 shows the theoretical declines in the water table, derived from the non-equilibrium formula of Theis (1935), at various times and distances from a well pumping from the Seymour Formation at a constant rate. Most of the curves shown on Figure 26 are based on the aquifer characteristics determined by the U.S. Geological Survey from aquifer tests (Table 2). The upper set of curves, however, was constructed using assumed aquifer coefficients to illustrate the theoretical drawdowns in areas where the transmissivities and the pumping rates are likely to be less than in the tested areas.

Figure 26 shows that the greatest amount of drawdown occurs in the first few days of pumping and that the water levels are affected at relatively large distances from the pumping well. Under the conditions assumed in the lower set of curves on Figure 26, water levels are affected up to 1 mile in all directions from the pumping well after 30 days. The drawdown as shown on Figure 26 is directly proportional to the rate of pumping; therefore, the effects of different pumping rates can be determined. For example, if the assumed pumping rate is 400 gpm instead of 200 gpm the drawdown would be twice that indicated. Or, if the assumed pumping rate is only 100 gpm then the drawdown would only be one-half that indicated.

Figure 27 illustrates the theoretical drawdown that would occur at various distances from a pumped well after 1 day of pumping at various rates. Identical aquifer characteristics were used to construct this figure and the center set of curves on Figure 26.

The amount of interference that will theoretically occur between two or more pumping wells and the effects of well interference on water levels are shown by the distance-drawdown graphs of Figure 26. When wells that produce from the same water-bearing formation are too closely spaced, the cones of depression overlap and interference between wells is the result. When this condition exists, the pumping of one well lowers the water level in nearby wells. The drawdown at any point in the area of influence caused by the discharge of several wells is equal to the sum of the drawdown caused by each well. This is important in that wells spaced too closely will result in lower pumping levels and a decline in the yield of each well as it competes for water. Assume that two wells are spaced 100 feet apart, are each pumping 150 gpm, and that the aquifer characteristics at these wells are the same as those used to construct the center set of distance-drawdown graphs shown on Figure 26. The graphs show that after 4 days the drawdown in each well caused by its own pumping is 7.1 feet. The water level 100 feet away from a pumping well would be 1.9 feet. Thus, the total drawdown in each well would be 7.1 feet caused by its own pumping plus the 1.9 feet of interference caused by the pumping of the other well, or 9.0 feet. From this it can be seen that the curves are useful to demonstrate the extent of the cone of depression, the effect of pumping on water levels with time, and also the effects of well spacing.

Basic assumptions were made in the construction of the graphs. It was assumed that all water pumped is withdrawn from storage. It was further assumed that the aquifer has infinite areal extent, is homogeneous and isotropic, and has a uniform thickness.

The assumed conditions of homogenity and infinite aquifer extent do not actually occur in nature. The Seymour of Wilbarger County has a limited extent, and consists of sand, gravel, and clay of varied permeability and porosity. The aquifer also varies from place to place in the amount of saturated thickness. Boundary conditions caused by the physical limits of the aquifer or by changes in its permeability and saturated thickness will result in greater drawdowns than those illustrated by the graphs.

The curves presented on Figures 26 and 27 are not applicable to all parts of the Seymour Formation and should, therefore, be used with caution except where aquifer characteristics are the same as those assumed in construction of the graphs. The graphs, however, are based on aquifer characteristics determined from actual aquifer tests. It is thought that the transmissivities used to construct these curves probably encompass the range of actual transmissivities which will be encountered in most of those areas in which the Seymour is productive.

Ground Water Available for Development

Several hydrologic and economic factors determine the amount of water available for development from the water-bearing units of Wilbarger County. The major hydrologic factors are the rate of recharge to the aquifer, the ability of the aquifer to transmit water, and the volume of water in storage. The main economic factors are the number and the cost of wells required to produce the maximum amount of water.

The amount of ground water in transient storage within an aquifer can be determined by the areal extent of the water-bearing unit, its saturated thickness, and its storage coefficient. Reliable calculations of the amount of ground water in storage within the Quaternary alluvium deposits of Wilbarger County are not possible due to the lack of data. Data are sufficient, however, to make fairly reliable calculations for the major areas of the Seymour Formation within the county.

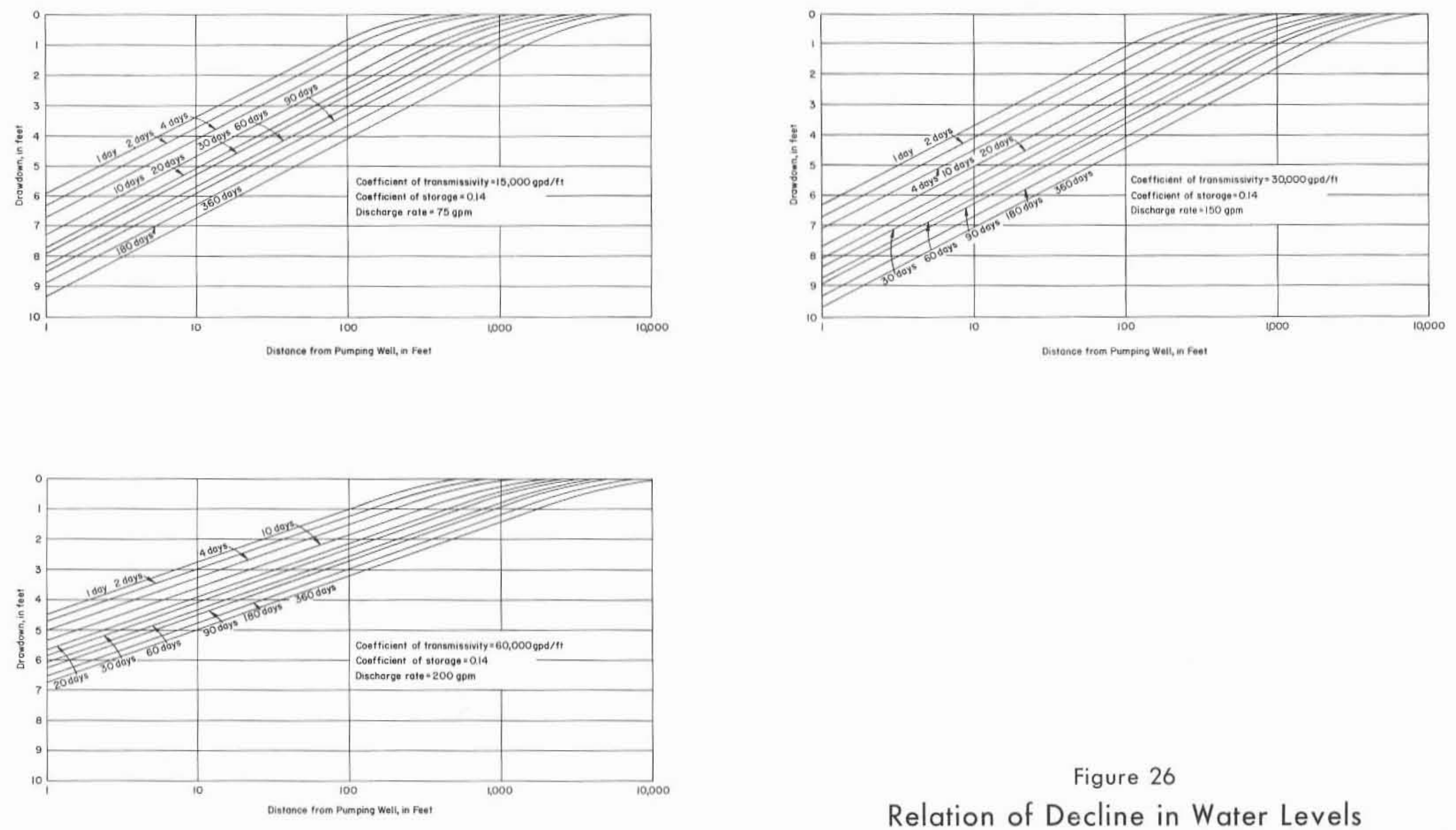

Figure 26

Relation of Decline in Water Levels
in the Seymour Formation to Time and Distance,
for Various Transmissivities and Discharge Rates

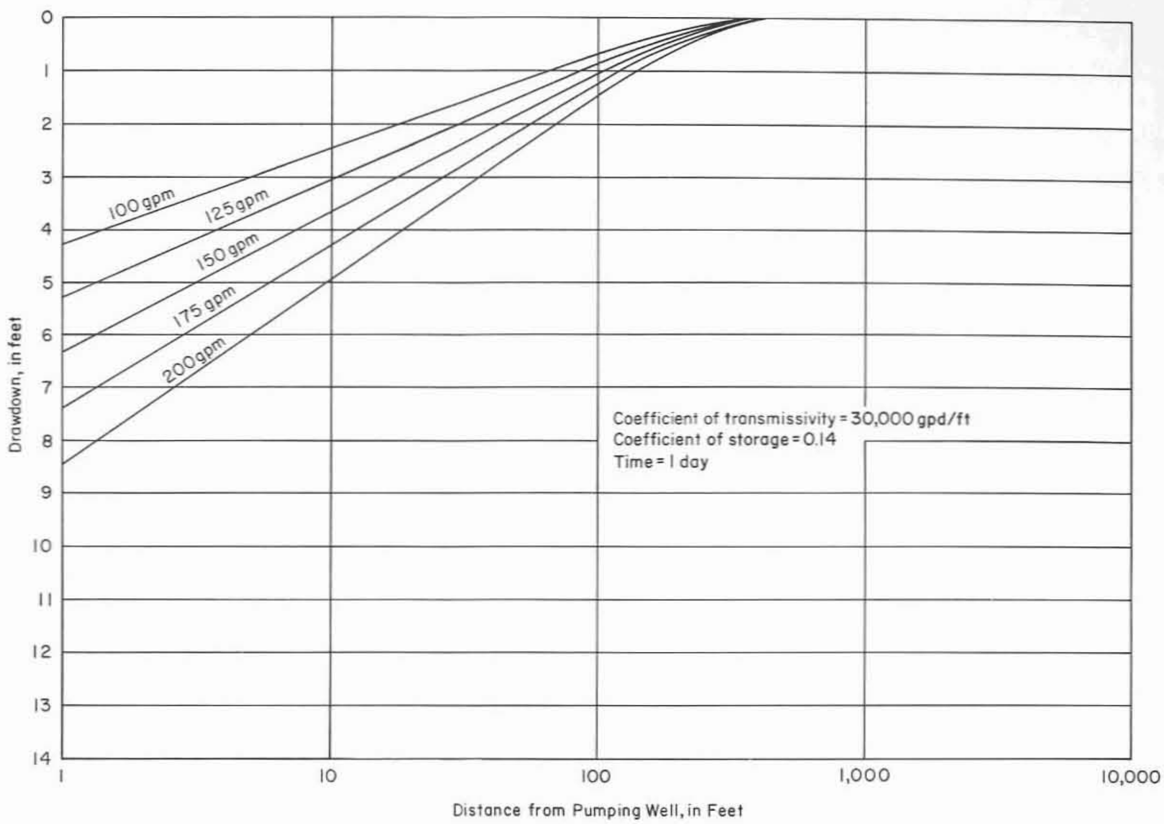

Figure 27.—Relation of Decline in Water Levels in the Seymour Formation to Discharge Rate and Distance

The Seymour Formation in Wilbarger County occurs as several isolated deposits (Figure 5). The largest and most important of these are located in the Odell-Fargo and Lockett areas. Both of these areas presently have irrigation and public supply developments. The Odell-Fargo area has the greatest saturated thickness and has the greatest potential for future development. Care should be given to the spacing of new wells, however, as the water levels are presently declining in areas where wells are concentrated. The Lockett area has been producing ground water for many years and several localities do not have sufficient saturated thickness for additional development; however, the southeast one-third of this area possibly still contains some areas suitable for future irrigation development.

Saturated thickness maps of the Odell-Fargo and Lockett areas (Figures 28 and 29) were prepared from information on the water-table maps of the Seymour Formation and Quaternary alluvium deposits for the fall and winter of 1970-71 (Figures 20 and 23) and two contour maps showing the base of the same geological units (Figures 30 and 31). The greatest saturated thickness in the Odell-Fargo area is about 5 miles northeast of the community of Odell where it reaches a maximum thickness of 85 feet. Several localities have greater than 50 feet of saturated thickness. In the Lockett area, the maximum saturated thickness is about 57 feet and it is located in the extreme southwestern part of the area.

The data derived from six aquifer tests conducted on wells pumping from the Seymour Formation indicated an average coefficient of storage of 14 percent. If the average coefficient of storage of 14 percent is representative, then about 266,000 acre-feet of water is theoretically available in transient storage in the Odell-Fargo area, as of 1971, in the Seymour Formation only. An estimated 101,000 acre-feet of ground water remains in storage in the formation within the Lockett area. Other areas underlain by the Seymour Formation contain lesser amounts of ground water in storage; however, data are not sufficient to assign meaningful storage values to them.

The amount of ground water that can be developed, is limited by the amount of recharge to the aquifer. During years of drought, discharge can exceed recharge with the deficit being pumped from storage. This condition can exist only temporarily, or until the supply in storage is exhausted. Fortunately droughts are

eventually interrupted by years in which precipitation is normal or above normal. During these periods, recharge normally exceeds discharge and ground water previously removed from storage is either partly or completely replaced.

Willis and Knowles (1953, p. 29) estimated that about 10,000 acre-feet of water per year was being discharged from seeps and springs around the edge of the Odell sand hills and by evapotranspiration. This was for a 70-square-mile area. The present study encompassed an area of about 112 square miles of Seymour extent and the natural discharge for this area would have been larger. Flow-net calculations indicate that the natural discharge for the greater area would be about 15,000 acre-feet per year. Willis and Knowles (1953, p. 29) further stated that their estimated natural discharge was approximately equal to the average annual recharge and was equivalent to about 2 inches per year over the entire area. As discussed earlier, average recharge to the Seymour Formation was estimated in the present study to be about 2.55 inches per year, which for the Odell-Fargo area amounts to about 15,000 acre-feet per year. During 1970, however, a dryer than average year, the recharge rate to the area was only about 10,000 acre-feet. Rainfall during 1970 was only 16.75 inches which is much less than the mean annual rainfall of 25.04 inches.

Using the same average recharge rate per unit area as used in the Odell-Fargo area, the average recharge in the Lockett area (slightly less than 78 square miles) would be about 10,500 acre-feet annually.

Theoretically, the amount of ground water available for development on a yearly basis is the average annual recharge. It would be impossible to intercept all of this water. To do this would require capture by wells of all natural discharge. Natural discharge, in part, supports vegetation growth and streamflow. It is possible to capture enough of this discharge during the summer months, however, to reduce all of the local streamflow.

The second largest use of water is for irrigation which is confined mainly to the spring and summer months. Municipal pumpage is year-round. Year-round pumping for irrigation is both uneconomical and unnecessary. During the fall and winter months, much natural discharge would not be captured.

With an average of 15,000 acre-feet per year recharged to the Odell-Fargo area, it seems reasonable to assume that one-third of this, or about 45 acre-feet per square mile (5,000 acre-feet) per year could be pumped without unduly lowering the water table if wells were adequately spaced and the individual areas were not overdeveloped. The 1970 pumpage was approximately 4,800 acre-feet; however, the wells are closely spaced and there is local overdevelopment. The result is that much of the available water is not being obtained in some areas, and yet there is a decline in water levels over most of the irrigation and public supply pumpage areas.

Within the Lockett area, about 7,000 acre-feet is recharged during dry years with an average recharge rate of about 10,500 acre-feet annually. Assuming that capturing of one-third of the average annual recharge were possible, then about 3,500 acre-feet annually would not be an unrealistic withdrawal rate. This assumes that the irrigation areas would not be overdeveloped and that about 45 acre-feet per square mile per year would be withdrawn. This is not the case and, as a result, the northwestern two-thirds of the Lockett area is now nearing depletion as a source of water in the quantities needed for irrigation and public supply.

To dewater the Odell-Fargo and Lockett areas completely would be impractical because the yields of wells fall off rapidly as the saturated thickness of the aquifer is greatly reduced. This is presently happening in the Lockett area. Complete dewatering would also require constant, year-round pumpage. This is not economically feasible, nor is there a need for major pumpage during the fall and winter months except for municipal purposes.

Maximum development of water supplies from the Seymour Formation in Wilbarger County would require numerous low-capacity wells as is the case, at present, in the Lockett area. The saturated thickness is relatively thin over much of the area (Figures 28 and 29) and in these areas the formation will not produce large quantities of water from single wells. Only in the thickest saturated zones are wells expected to yield as much as 200 gpm.

Some of the areas of Seymour occurrence in Wilbarger County have a very small extent as well as very little saturated thickness. In such areas the aquifer may not be able to sustain withdrawals by wells during droughts of long duration.

Possible Areas of Future Development

The results of this investigation revealed that, as a general rule, the most desirable areas for development of Seymour ground-water supply coincide with those areas of greatest saturated thickness (Figures 28 and 29). In these areas, the basal sands and gravels that are thickest and most permeable are generally associated with the structural lows or "valleys" in the underlying Permian erosional surface upon which these sediments were deposited (Figures 30 and 31). It appears that the most promising areas of future development should normally be where the saturated thickness exceeds 30 feet. It should be pointed out that apparently reliable irrigation wells have been developed in areas having less than 30 feet of saturated thickness. In times of drought, excessive pumping may result in failure of wells in areas of little saturated thickness.

Within the Odell-Fargo area, there are several areas in which the saturated thickness is greater than 30 feet. The most favorable location lies approximately 5 miles northeast of Odell where the saturated thickness reaches a maximum of 85 feet. However, any additional development will further lower the water table.

The saturated thickness is 20 feet or less over most of the northwest two-thirds of the Lockett area, and this locality is near depletion for irrigational or public-supply uses. Several areas in the southeast one-third of the Lockett area have an indicated saturated thickness of 30 feet or more. Further development may be possible in these areas, but care should be used to locate new wells beyond the radius of influence of existing wells, and withdrawal rates should be limited to about 45 acre-feet per year per square mile to prevent a further lowering of the water table.

Permian Rocks

The Clear Fork Group and San Angelo Formation of the Pease River Group provide ground water mainly for domestic and livestock uses. The yields of wells are small and not generally dependable. The quality of the water ranges from fresh to very saline in the Clear Fork Group, and from fresh to slightly saline in the San Angelo Formation.

Table 1 lists the lithologic characteristics of these Permian water-bearing rocks, and additional discussion of them can be found in the geology section of this report.

Changes in Water Levels

Historical water-level data are available for only 2 wells that pump ground water from the Permian rocks, wells 13-64-603 and 14-57-101. Both of these produce from the Clear Fork Group. The water levels of each well were measured in July of 1964 and again in June of 1971. Well 13-64-603 exhibited a net rise of 3.68 feet and well 14-57-101 reflected a net decline of 0.61 foot during this period (Table 4 and Figure 34). Based on these few data, it appears that there are no significant declines in water levels and that in at least one case, there is local recharge to the water-bearing zone. It should be pointed out, however, that these are summer water levels and there may have been pumping prior to measurements.

Availability of Ground Water for Future Development

Areas of possible future development of ground water from the Clear Fork Group are most promising along the creeks which cross the outcrop (Figure 5). In general, wells drilled closest to the updip limits of the individual water-bearing beds could be expected to encounter the fresher quality water. The ground water, however, varies in quality from location to location. Most waters derived from the Clear Fork Group would be suitable only for livestock use. Any wells developed would be of questionable reliability, and their yields should vary but generally be less than 50 gpm.

Low-yield wells of fair reliability can probably be drilled in the San Angelo Formation in most of the area where it occurs.

PRODUCTION AND DISPOSAL OF OIL-FIELD BRINE

Areas, Methods, and Quantity of Disposal

In 1962 and again in 1968, the Railroad Commission of Texas, the Texas Water Quality Board (formerly the Texas Water Pollution Control Board), the Texas Water Commission (in 1962), and the Texas Water Development Board (in 1968) cooperated in the statewide collection and tabulation of information submitted by oil and gas operators concerning the 1961 and the 1967 oil-field brine production and the methods used for its disposal. A summary of these inventories, as they pertain to Wilbarger County, is presented in Table 10.

Figure 32 delineates the areas of brine disposal, and shows the quantities and methods of disposal, within Wilbarger County.

Areas of disposal, listed numerically 1 through 27 on Figure 32, were determined by outlining the areas of greatest concentration of producing oil and gas wells. No attempt is made in this presentation to separate individual oil or gas fields; however, care was taken not to include parts of a field in more than one area. Statistics on brine disposal for individual oil and gas fields for the years 1961 and 1967 are tabulated in Table 10 by area.

The methods of disposal are by injection into wells, disposal in surface pits, and miscellaneous methods. Waters listed as injected are those which are injected into the subsurface through the salt-water injection wells of a waterflood operation, through salt-water disposal wells, or those injected into a non-producing subsurface zone of a presently producing oil well. Waters listed under pits are those which are placed into open surface disposal pits. Miscellaneous disposal includes any other method, mainly through hauling by trucks to salt-water disposal wells or waterflood injection wells.

Table 10 shows that total brine production in the county increased from 1961 to 1967 but the total quantity of brine disposed of in surface pits decreased. As of January 1, 1968, disposal of brine into pits had been discontinued in areas 1 through 9, 11 through 13, and 15 through 21, and 23 through 27. Disposal into pits had been drastically reduced in areas 10 and 22. Pit disposal in area 14 was reduced by only about 21 percent. In areas 6 and 19, wells that produced brine in 1961 had been plugged by 1967. The alternate method of disposal, in most cases where pit disposal was reduced, has been by injection.

The total reported brine production in Wilbarger County in 1961 was 25,303,214 barrels compared to 35,650,538 barrels produced in 1967. The amount disposed of in pits during 1961 was 234,744 barrels or 0.9 percent of the total as compared to 15,315 barrels or 0.1 percent of the total in 1967. Disposal by injection into wells in 1961 was 24,857,606 barrels (98.2 percent) and in 1967 was 35,549,907 barrels (99.7 percent). Miscellaneous disposal in 1961 and 1967 was 210,864 barrels and 85,316 barrels, respectively. This was 0.9 percent of the total in 1961 and 0.2 percent of the total in 1967. For a comparison of the various methods of disposal by area and field for the years 1961 and 1967, see Figure 32 and Table 10.

Chemical Quality of Produced Brines

Table 9 is a tabulation of the chemical analyses of some oil-field brines in Wilbarger County, which were obtained by commercial sources (Laxson et al., 1960). These brines have, for the most part, the same ions present that are present in waters from wells used for municipal, industrial, irrigation, and livestock supplies. However, the calcium, magnesium, sodium, and chloride ions are present in much greater concentrations in the brines.

The concentration ranges for various ions in the tabulated brines are as follows:

Ion	Concentration range (ppm)
Calcium (Ca)	11,000 to 22,398
Magnesium (Mg)	1,850 to 3,040
Sodium (Na)	49,420 to 60,370
Chloride (Cl)	103,950 to 134,200

Produced Brine as a Potential Source of Ground-Water Contamination

Ground water can be subjected to contamination from various sources, and one potential source of contamination is the improper disposal of oil-field brines. Prior to the advent of the statewide no-pit order promulgated by the Texas Railroad Commission, which became effective January 1, 1969, there was possibly considerable ground-water pollution caused by the disposal of brines in open, unlined surface disposal pits. Even though much of the water content of the brines in these pits evaporated, if soil conditions were conductive there was considerable percolation of the brines downward to the water table which resulted in contamination of the native ground water. Occasional overflow of brines from these surface pits may have contaminated surface waters. When brine mixes with native ground water, there is usually a marked increase in the ground water's content of chloride and sodium ions. Such an increase is reflected in the chemical analyses of some of the waters in Wilbarger County (Figure 16 and Table 8). Figure 32 depicts the location of several wells in Wilbarger County in which the ground-water supply is apparently contaminated.

Contamination may also result when there is leakage from old, abandoned and improperly plugged oil tests, or improperly cased producing oil wells. In cases such as these, the brines move up the bore hole of improperly plugged or cased wells into the shallow, fresh-water zones, due to both natural pressure and the pressure created by secondary recovery injection operations. The Texas Railroad Commission now has limited funds available for plugging abandoned oil and gas wells or tests which may be leaking brines to the surface or subsurface, or to require plugging of these holes by those responsible. Much work has been done by the Texas Railroad Commission and oil operators to alleviate contamination problems resulting from brine produced with oil and gas.

OTHER GROUND-WATER PROBLEMS

Areas of Vegetative Kill and Possible Causes

Vegetative-kill areas in Wilbarger County are probably the result of two distinct causes: those resulting from brine disposal by the oil and gas industry and those associated with natural seepage. Since drainage may be poor in the immediate vicinity of natural seeps, these areas may become waterlogged during times of much rainfall.

Vegetative-kill areas associated with brine disposal can result from brine being discharged directly onto the surface, overflow of surface disposal pits, and less obvious sources of brine such as improperly plugged oil tests and leaking producing oil wells or leaking pipelines. Figure 32 shows the location of most of the vegetative-kill areas in Wilbarger County. Photographs of typical kill areas which are the apparent result of brine disposal are shown on Figure 33. Fortunately, most of the brine-related kill areas occur where usable quality ground water is not known to have existed.

In areas where natural drainage is poor and where the water table is near the land surface, waterlogged areas may develop. Land which becomes waterlogged is of little value for agricultural use. Water-loving vegetation grows on these sites, and transpiration by this foliage and direct evaporation from the damp soil result in the loss of large quantities of water to the atmosphere. The soil of such areas, in time, becomes highly charged with the mineral residues from these waters and white spots will form on the land (Hem, 1959, p. 243). This condition is thought to exist in a few areas southeast of the community of White City and also south of Fargo. These seeps are located at or near the geological contact of the Seymour Formation or Quaternary alluvium deposits with the underlying beds.

Future Water-Level Declines Northeast of Odell

Geological data available prior to this investigation suggested that there may have been a former channel of the Red River in the area northeast of Odell (Willis and Knowles, 1953, p. 11). For this reason, the Texas Water Development Board drilled 10 test holes during the period October 5-22, 1970. These tests ranged in depth from 45 to 110 feet and they were selectively placed in an effort to locate this channel. Additional test-hole data were also secured from all available sources in an effort to further delineate the channel. Drillers' logs of these tests are presented in Table 5, and their locations are shown on Figure 34.

Data presented on Figure 31 reflect two and possibly more buried channels exist. However, test drilling to date has not revealed definite outlets from these channels to the river. Two marked lows at the base of the aquifer are shown on the subject map. One is an east-trending low located about three-fourths of a mile north of Farm Road 91. About 4 miles northeast of Odell, the feature reaches a minimum of about 1,270 feet above sea level. Its lowest known elevation is reached approximately 7 miles northeast of Odell where the elevation is 1,239 feet. Another structural low, trending northeast, is located 2¼ miles north of Farm Road 91. The lowest elevation is located about 4 miles northeast of Odell on the Mock Ranch. This is the location of the city of Altus well field. The elevation at the base of the aquifer in this area is 1,257 feet.

Because these lows at the base of the aquifer exist, it would be possible to sufficiently lower the water levels in these areas to reverse the directions of ground-water flow and draw in poorer quality water from the Red River and its associated flood-plain alluvium. Care should be taken so as not to reduce the water levels below the elevation at which the river is flowing or the elevation it reaches during flood stage. The present river elevation (1971) is approximately 1,285 feet above mean sea level at a point 2 miles north of Odell. If water levels in the aquifer decline below this level, the gradient of the water table will be reversed and very poor quality water from the river will enter the aquifer.

Water levels during the fall and winter of 1970-71 were at about 1,335 feet (4 miles northeast of Odell), and there is no danger of reversal of the water-table gradient for several years. It should be pointed out, however, that water levels are at present dropping at an average rate of about 0.94 foot per year in areas of irrigation. In the area of municipal pumpage southeast of Odell, the water levels are dropping about 1.5 feet per year. The water levels may drop more rapidly with development of the city of Vernon's planned new well field 2½ miles northeast of Odell.

SUMMARY AND CONCLUSIONS

The Seymour Formation is the most reliable source of usable quality ground water in Wilbarger County. This formation yields mostly fresh water; however, the quality ranges from fresh to very saline. The wells yield small to moderate quantities. The waters derived from the Seymour Formation are used for all purposes and it is the main public-supply source for the county.

A. Vegetative-kill area in creek 7 miles south of Vernon, within confines of an oil field and down gradient from a producing well. View is northwest.

B. Vegetative-kill area within oil field 7 miles south of Vernon. Partial cause is leaking pipeline shown in foreground. View is northeast.

Figure 33.—Views of Vegetative-Kill Areas

C. Vegetative-kill area in producing oil field 4 miles southeast of Harrold. Spillage is possibly from pipeline or producing oil well. View is north.

D. Grayback area, where hydrocarbons and salt water have spilled into drainageway. Many such vegetative-kill areas are present in this vicinity. View is southwest.

Figure 33.—Views of Vegetative-Kill Areas—Continued

Quaternary alluvium deposits, which are usually hydrologically connected with the Seymour, are the second most reliable ground-water source. Wells in these deposits yield small to moderate quantities of fresh to very saline water which is used for all purposes. The water pumped from the Quaternary alluvium is in many areas higher in mineral content than that of the Seymour Formation, and in these areas its use is limited to irrigation and livestock use.

Some of the rocks of Permian age also contain small supplies of ground water. The Clear Fork Group generally contains highly mineralized water suitable mainly for livestock purposes. The well yields are small and unpredictable. The San Angelo Formation reliably yields small quantities of fresh to slightly saline water which is used primarily for domestic and livestock purposes.

The Seymour Formation is a major water-supply source in two main areas. The Odell-Fargo area, located in the extreme northern part of the county, covers approximately 112 square miles. The Lockett area, which covers about 78 square miles, is located in the west-central part of the county.

Using a storage coefficient of 14 percent, there was estimated to be 266,000 acre-feet of ground water in transient storage in the Odell-Fargo area in 1971. Approximately 101,000 acre-feet was present in the Lockett area.

Based on 10.2 percent of the mean annual rainfall of 25.04 inches at Vernon, the average annual recharge to the Seymour Formation is estimated to be 2.55 inches or 0.21 foot. This would be 134 acre-feet per year per square mile, or 15,000 acre-feet for the Odell-Fargo area and 10,500 acre-feet for the Lockett area. These would also be the amounts of average annual natural discharge from the respective areas, providing there was no interception by pumping wells. It is not possible to intercept all of the natural discharge, however, and a more realistic figure of the quantity of water available for withdrawal by wells would be 45 acre-feet per year per square mile, or 5,000 acre-feet per year in the Odell-Fargo area and 3,500 acre-feet per year in the Lockett area. Many of the areas of irrigation and public-supply pumpage are overdeveloped, ground water is being withdrawn at a much faster rate, and as a result the amount of water in storage in these areas is being reduced. This results, locally, in declining water levels.

The average water-level decline for the period from 1951 through January 1971 in irrigation areas within the Odell-Fargo area was 0.94 foot per year. In areas of public-supply pumpage the water levels were dropping at about 1.5 feet per year during this same period. In the Lockett area, water levels in irrigation areas declined an average of 0.45 foot per year during the period from 1943 through January 1971.

During 1970, approximately 4,000 acre-feet or 65 percent of the total ground-water pumpage of Wilbarger County was for municipal supplies. The total estimated pumpage for this purpose for the period from 1943 through 1970 was 53,000 acre-feet. Almost all of this pumpage was from the Seymour Formation. The cities of Vernon, Texas and Altus, Oklahoma were the principal users.

Irrigation pumpage represented 33 percent of the total 1970 ground-water pumpage of the county. Total irrigation pumpage from all water-bearing zones during that year was 2,000 acre-feet; of this total, 84 percent was from the Seymour Formation, 15 percent from Quaternary alluvium deposits, and less than 1 percent from the Clear Fork Group. A conservative estimate of irrigation use for the period from 1943 through 1970 was 17,000 acre-feet.

In 1970, only about 9 acre-feet of ground water was used for industrial purposes. During the period from 1943 through 1970, an estimated 3,300 acre-feet was used for this purpose.

Livestock and domestic pumpage was estimated to have been about 150 acre-feet during 1970. Pumpage from 1943 through 1970 was conservatively estimated at 4,200 acre-feet.

Alteration of native-quality ground water in several wells in Wilbarger County has resulted, presumably, from the disposal of oil-field brines into unlined surface pits or from abandoned oil or gas tests which are leaking. Most contamination sources should have been eliminated by the Texas Railroad Commission's statewide no-pit order. However, since the effects of contamination may continue for long periods of time, it would be advisable to set up a program for periodic resampling of selected wells for chemical analysis, to check the amount and extent of the contamination.

In order to further evaluate the future effects of heavy irrigation and municipal pumpage from the various water-bearing zones, a network of 44 observation wells has been established in Wilbarger County, and water levels in these wells are planned to be measured and recorded annually by personnel of the Texas Water Development Board.

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Table 4.--Records of Water Wells, Springs, and Selected Test Holes

Water levels : Reported water levels are given to the nearest foot; measured water levels are given to the nearest tenth or hundredth of a foot.
Method of lift and type of power: C, cylinder; E, electric; G, gasoline, butane, or natural gas; Cf, centrifugal; H, hand or hand pump; J, jet; N, none; R, reciprocating; Sub, submersible; 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 : Qal, Quaternary alluvium; Qs, Seymour Formation; Pprsa, San Angelo Formation; Pcf, Clear Fork Group.
Altitude of land surface : Altitudes were determined principally from U.S. Geological Survey topographic maps; a few altitudes were surveyed.

	Well	Owner	Driller	Date completed	Depth of well (ft)	Casing		Water bearing unit	Altitude of land surface (ft)	Water level		Method of lift	Use of water	Remarks
						Diameter (in.)	Depth (ft)			Below land-surface datum (ft)	Date of measurement			
*	13-37-701	Cecil Ayres	--	--	Spring	--	--	Qs	1,332	(+)	Feb. 20, 1970	Flows	N	Water flows from outcrop of Seymour Formation. Estimated flow greater than 50 gpm (gallons per minute).
	901	Mrs. A. F. Winston	M. Heydrick	1954	72	--	--	Qs	1,347	25.17 23.42 29.03	June 22, 1960 Jan. 17, 1963 Jan. 22, 1967	N	N	Destroyed. Former irrigation well. Yield reported 400 gpm. 4/
	902	do	Robert Dale	1967	73	14	73	Qs	1,347	30	July 10, 1967	T, E, 40	Irr	Yield reported 250 gpm. Well has been purchased by the city of Vernon for future public supply. 1/
*	903	do	do	1967	73	14	73	Qs	1,348	30.38 31.86 31.66	Dec. 17, 1969 Jan. 13, 1970 Jan. 7, 1971	T, E, 10	Irr	Yield reported 250 gpm. Well has been purchased by the city of Vernon for future public supply. Well formerly pumped into well 13-37-902. 1/ 4/
*	904	Kenneth R. Neel	do	1966	67	14	67	Qs	1,348	24.30	Jan. 29, 1970	T, E, 20	Irr	Yield reported 350 gpm. 1/
*	905	do	--	--	Spring	--	--	Qs	1,298	(+)	do	Flows	N	Water seeps from contact of Seymour Formation.
	906	City of Altus, Oklahoma	Layne Western Co.	1967	72	34 12	12 72	Qs	1,360	34	Apr. 29, 1967	T, E, 7-1/2	P	1/ 2/
	907	do	do	1967	75	34 12	12 75	Qs	1,350	29	do	T, E, 7-1/2	P	1/ 2/
	908	do	do	1969	48	5	48	Qs	1,360	36	Apr. 1969	N	N	Used by city of Altus as an observation well.
*	909	do	do	1964	80	1-1/4	80	Qs	1,350	30 33	July 1965 Sept. 16, 1968	N	N	Used by city of Altus as an observation well. 1/
*	910	do	do	1964	38	5	38	Qs	1,292	11 10	July 1965 Sept. 16, 1968	N	N	Do.
	911	City of Vernon	Texas Water Development Board	1970	60	--	--	Qs	1,348	21.1	Oct. 22, 1970	N	N	Test hole. 1/ 3/
	912	do	do	1970	72	--	--	Qs	1,347	24.8	do	N	N	Do.
*	913	Charles Tallant	do	1970	55	--	--	Qs	1,338	16.98	Nov. 3, 1970	N	N	Do.
	38-401	City of Altus, Oklahoma	Layne-Western Co.	1967	77	34 12	12 77	Qs	1,320	33	Apr. 2, 1967	T, E, 7-1/2	P	1/ 2/
	402	do	do	1967	82	34 12	12 82	Qs	1,320	36	Mar. 22, 1967	T, E, 7-1/2	P	1/ 2/
	403	do	do	1967	87	34 12	12 87	Qs	1,319	40	Apr. 5, 1967	T, E, 7-1/2	P	1/ 2/
	404	do	do	1967	58	34 12	12 58	Qs	1,305	29	Apr. 2, 1967	T, E, 3	P	1/ 2/
	405	do	do	1964	70	1-1/4	70	Qs	1,310	33 33	July 1965 Sept. 16, 1968	N	N	Used by city of Altus as an observation well. 1/

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
* 13-38-701	Mrs. Elwyn Bingham	W. E. Turner	1949	112	7	112	Qs	1,372	24.20 26.85 21.08 29.60 34.40	Feb. 2, 1952 Jan. 7, 1954 Jan. 14, 1965 Jan. 13, 1970 Jan. 7, 1971	J, E	D, S	Well 9 of Bull. 5301. 6/ Well A-9 of Bull. 5614. 4/ 7/
* 702	do	Robert Dale	1967	114	14	114	Qs	1,372	31 30.06 38.97	Mar. 26, 1967 Jan. 29, 1970 July 10, 1970	T, E, 30	Irr	1/ 2/
703	City of Altus, Oklahoma	Layne-Western Co.	1967	67	34 12	12 67	Qs	1,340	17	Apr. 18, 1967	T, E, 7-1/2	P	1/ 2/
704	do	do	1967	72	34 12	12 72	Qs	1,350	22	Apr. 17, 1967	T, E, 7-1/2	P	1/ 2/
705	do	do	1967	80	34 12	12 80	Qs	1,349	21	Apr. 13, 1967	T, E, 5	P	1/ 2/
706	do	do	1967	88	34 12	12 88	Qs	1,345	24	Apr. 15, 1967	T, E, 5	P	1/ 2/
707	do	do	1967	72	34 12	12 72	Qs	1,310	24	Apr. 11, 1967	T, E, 15	P	1/ 2/
708	do	do	1967	80	34 12	12 80	Qs	1,315	29	Apr. 19, 1967	T, E, 7-1/2	P	1/ 2/
709	do	do	1967	76	34 12	12 76	Qs	1,335	35	Apr. 9, 1967	T, E, 5	P	1/ 2/
710	do	do	1967	77	36 12	12 77	Qs	1,340	37	Mar. 29, 1967	T, E, 5	P	1/ 2/
711	do	do	1969	90	34 12	12 90	Qs	1,356	25	July 23, 1969	T, E, 7-1/2	P	1/ 2/
712	do	do	1969	93	34 12	12 93	Qs	1,355	22	July 16, 1969	T, E, 7-1/2	P	1/ 2/
713	do	do	1964	70	1-1/4	70	Qs	1,359	30 32	July 1965 Sept. 16, 1968	N	N	Used by city of Altus as an observation well. 1/
714	do	do	1964	90	1-1/4	90	Qs	1,323	40 42	July 1965 Sept. 16, 1968	N	N	Do.
715	do	do	1964	60	1-1/4	60	Qs	1,299	19 20	July 1965 Sept. 16, 1968	N	N	Do.
716	Mrs. Elwin Bingham	Robert Dale	1966	69	--	--	Qs	1,365	--	--	N	N	Test hole. 1/
717	do	do	1966	73	--	--	Qs	1,364	--	--	N	N	Do.
718	do	do	1967	69	--	--	Qs	1,364	--	--	N	N	Do.
719	do	do	1967	72	--	--	Qs	1,361	--	--	N	N	Do.
720	do	do	1966	101	--	--	Qs	1,370	--	--	N	N	Do.
721	do	do	1966	89	--	--	Qs	1,372	--	--	N	N	Do.
722	Frank McDougal	do	1967	85	--	--	Qs	1,367	--	--	N	N	Do.
723	do	do	1967	99	--	--	Qs	1,375	--	--	N	N	Do.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
13-38-724	Frank McDougal	Robert Dale	1967	104	--	--	Qs	1,369	--	--	N	N	Test hole. 1/
* 801	W. S. Fitzgerald	W. E. Turner	--	113	6	113	Qs	1,368	28.99 31.84 33.94 36.12 35.51	Feb. 1, 1952 Jan. 14, 1957 Jan. 14, 1965 Feb. 14, 1970 Jan. 7, 1971	J, E	D, S	Well 12 of Bull. 5301. 6/ Well B-12 of Bull. 5614. 4/ 7/
802	Jake C. Riggins	Robert Dale	1969	81	14	81	Qs	1,328	21.47	Jan. 27, 1970	T, E, 20	Irr	Yield reported 350 gpm. 1/
* 803	W. Neal Fitzgerald	Texas Water Development Board	1970	110	--	--	Qs	1,366	23.34	Nov. 2, 1970	N	N	Test hole. 1/
804	do.	do.	1970	45	--	--	Qs	1,371	20.8	Oct. 22, 1970	N	N	Do.
* 805	J. R. Watts	Robert Dale	1954	86	14	86	Qs	1,328	45	June 11, 1971	T, E, 25	Irr	Water reported from sand and gravel with base at 86 feet. Yield reported 350 gpm.
806	do	do	1966	70	14	70	Qs	1,329	45	do	T, E, 10	Irr	Yield reported 300 gpm. Water reported from sand and gravel. This well pumps into well 13-38-805.
807	do	do	1969	59	14	59	Qs	1,310	24.94	do	N	N	Unused irrigation well. Water reported from sand and gravel with base at 58 feet.
* 808	do	--	--	Spring	--	--	Qs	1,300	(+)	do	Flows	N	--
* 45-102	Gordon K. Haynes	do	1951	60	14	60	Qs	1,388	31.65 31.30	Feb. 17, 1970 Feb. 1, 1971	T, G, 100	Irr	Yield reported 150 gpm. Water reported from 10 to 12 feet of sand and gravel.
* 103	John W. Ayres	do	1950	45	6	45	Qs	1,370	35.61	Feb. 20, 1970	J, E	D, S	Water reported from sand and gravel.
104	Mrs. Ida Berngen	do	1955	17	--	--	Qs	1,371	--	--	N	N	Destroyed. Formerly a three-well manifold system used for irrigation.
105	do	do	1957	79	14	79	Qs	1,367	13.62 22.84 23.33	Apr. 21, 1960 Feb. 4, 1970 Feb. 1, 1971	T, G, 50	Irr	Yield reported 800 gpm.
201	J. W. Collins	do	1957	64	14	64	Qs	1,331	13 19.17 19.66	Mar. 4, 1959 Feb. 5, 1970 Feb. 1, 1971	T, G, 30	Irr	Yield reported 560 gpm. Water reported from sand and gravel with base at 63 feet.
* 202	Hugh Rape	--	--	55	6	55	Qs	1,352	21.61 22.59	Feb. 18, 1970 Feb. 2, 1971	J, E	D, S	Water reported from sand and gravel.
* 203	Robert Dale	W. E. Turner	--	84	7	84	Qs	1,351	--	--	N	N	Unused domestic well. Well 28 of Bull. 5301. 6/
* 204	Chillicothe Independent School District	B. B. Thrash	1954	80	6	80	Qs	1,353	40	June 11, 1971	J, E, 2	P	--
* 205	Chickasha Cotton Oil Co.	do	1952	60	6	60	Qs	1,342	35	do	J, E, 1	Ind	Used at a cotton gin. Yield reported strong.
* 301	Kenneth R. Neel	Robert Dale	1965	67	14	67	Qs	1,346	27.80	Jan. 29, 1970	T, E, 20	Irr	--
302	Fred S. Hanna	do	1953	88	16	88	Qs	1,368	20.59 20.43 22.47	Feb. 5, 1970 Feb. 13, 1970 Jan. 7, 1971	N	N	Unused irrigation well. Yield reported 400 gpm. Water reported from sand and gravel. 4/

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diam-eter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
13-45-303	Fred S. Hanna	Robert Dale	1960	88	14	88	Qs	1,367	20.91	Feb. 5, 1970	T, E, 30	Irr	Water reported from sand and gravel at 69 to 86 feet with red beds at 86 feet.
* 304	do	do	1954	88	14	88	Qs	1,368	21.02	do	T, E, 7-1/2	Irr	Water reported from sand and gravel at 69 to 86 feet with red beds at 86 feet. Yield reported 280 gpm. This well pumps into well 13-45-303.
* 305	do	do	1962	78	6	78	Qs	1,371	20.84	do	J, E	S	Water reported from sand and gravel.
* 306	Mrs. Florence Fain	--	--	29	6	29	Qs	1,367	11.9 19.30	July 18, 1951 Feb. 18, 1970	N	N	Unused domestic and stock well. Well 23 of Bull. 5301. 6/
* 307	Charles Tallant	--	--	65	6	65	Qs	1,360	32.49	Oct. 22, 1970	C, W	S	Water reported from sand and gravel.
* 308	do	Texas Water Development Board	1970	62	5	62	Qs	1,340	17.21	do	N	N	Test hole to be used as a stock well. 1/ 3/
309	do	do	1970	90	--	--	Qs	1,362	--	--	N	N	Test hole. 1/ 3/
* 310	do	do	1970	60	--	--	Qs	1,340	17.75	Nov. 3, 1970	N	N	Do.
* 311	Charles R. Tallant	Robert Dale	1970	90	6	90	Qs	1,370	23.50	do	J, E, 1/2	S	Water reported from sand and gravel with base at 90 feet.
312	Mrs. J. W. Brock	do	1970	58	6	58	Qs	1,367	19 21.40	Dec. 18, 1970 Feb. 2, 1971	J, E, 1/2	D	1/
* 402	Mary Touchstone Estate	do	1958	63	14	63	Qs	1,352	13.78 15.91 14.41 14.84	May 11, 1960 May 8, 1965 Jan. 13, 1970 Jan. 7, 1971	N	N	Unused irrigation well. Water reported from sand and gravel. 4/
* 403	Benjamin H. Smith, Jr.	Lee Hopper	1967	68	14	68	Qs	1,350	13.22 14.55	Feb. 11, 1970 Feb. 1, 1971	T, G, 230	Irr	Yield reported 750 gpm. Water reported from sand and gravel at 63 to 66 feet. Red beds reported at 66 feet.
* 404	George Moffitt	Robert Dale	1955	45	12	45	Qs	1,362	15.17	June 9, 1971	J, E, 1/2	D	--
406	Mary Touchstone Estate	do	1957	63	12	63	Qs	1,353	12.98 14.05	May 11, 1960 Dec. 3, 1969	T, E, 45	Irr	Water reported from sand and gravel with base at approximately 61 feet.
501	Sutton Estate	Robert Dale	1958	74	14	74	Qs	1,349	14 20.68 21.49	Apr. 2, 1958 Feb. 11, 1970 Feb. 1, 1971	T, G, 260	Irr	Yield reported 600 gpm. Water reported from sand and gravel.
* 502	Allen R. Knight	do	1958	66	14	66	Qs	1,334	13 11.91	Feb. 30, 1958 Feb. 4, 1970	T, G, 30	Irr	Yield reported 550 gpm.
* 503	Mrs. Myrtle J. Collins	do	1956	52	14	52	Qs	1,339	5.00 5.93	May 11, 1960 Dec. 4, 1969	T, E, 25	Irr	Yield reported 300 gpm. Water reported from sand and gravel at 29 to 51 feet. Red beds reported at 51 feet.
* 504	do	L. E. Stamps	1955	60	14	60	Qs	1,354	16.04 19.27 15.15 20.25 22.06	Jan. 9, 1956 Jan. 14, 1957 Jan. 17, 1963 Jan. 13, 1970 Jan. 7, 1971	N	N	Unused irrigation well. Yield reported 75 gpm. Water reported from sand and gravel. 4/
505	do	do	1954	50	14	50	Qs	1,340	5.70	Dec. 4, 1969	T, E, 5	Irr	Yield reported 200 gpm. Water reported from sand and gravel at 29 to 49 feet. Red beds reported at 49 feet.
506	do	Robert Dale	1960	60	14	60	Qs	1,332	3.67 8.70 10.30	May 11, 1960 Dec. 3, 1969 Feb. 1, 1971	T, E, 10	Irr	Yield reported 250 gpm. 1/

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
* 13-45-507	Mrs. Myrtle J. Collins	B. B. Thrash	1957	61	14	61	Qs	1,363	16.90 23.55	May 11, 1960 Dec. 3, 1969	T, E, 7-1/2	Irr	Water reported from sand and gravel at 30 feet and from sand with some gravel at 55 to 60 feet. 2/
508	do	do	1957	61	16	61	Qs	1,365	12.39 19.48	May 11, 1960 Dec. 4, 1969	T, E, 7-1/2	Irr	Yield reported 200 gpm. Water reported from sand and gravel at 30 feet and from sand with some gravel at 55 to 60 feet.
* 509	Mrs. M. J. Moore	Robert Dale	1962	37	16	37	Qs	1,380	22.81 26.27	Feb. 18, 1970 Feb. 1, 1971	Sub, E, 20	Irr	Water reported from sand and gravel. 2/
* 601	Mrs. L. E. McConnell	Bill Turner	1950	59	6	59	Qs	1,394	12.20 12.52 16.97 28.43	Feb. 27, 1951 July 18, 1951 Jan. 8, 1955 Jan. 29, 1970	Cf, E, 5	D	Well 56 of Bull. 5301. 6/ Well C-56 of Bull. 5614. 7/
602	do	do	1950	65	--	--	Qs	1,400	18.33 19.99 21.78 23.10	Feb. 27, 1951 Feb. 9, 1952 Jan. 8, 1953 Jan. 8, 1955	N	N	Destroyed irrigation well. 4/ Well 55 of Bull. 5301. 6/ Well C-55 of Bull. 5614. 7/
603	do	--	1952	70	16	70	Qs	1,399	21.65 21.43 27.57 35.53 39.91	Jan. 8, 1953 Jan. 4, 1958 Jan. 14, 1965 Jan. 14, 1970 Jan. 7, 1971	T, E, 30	Irr	Water reported from sand and gravel with base at 66 feet. 2/ 4/ Well C-55a of Bull. 5614. 7/
* 604	W. R. Moore, Jr.	Robert Dale	1959	67	14	67	Qs	1,390	13.20 26.34	Sept. 30, 1960 Jan. 29, 1970	T, E, 50	Irr	Water reported from sand and gravel with base at 66 feet. Red beds reported at 66 feet. 2/
605	Mrs. L. E. McConnell	Bill Turner	1954	50	16	50	Qs	1,410	25.91 28.59 33.69 40.16 42.18	Jan. 8, 1951 Feb. 18, 1960 Jan. 18, 1960 Jan. 14, 1970 Jan. 7, 1971	T, G	Irr	--
* 606	do	Robert Dale	1968	66	16	66	Qs	1,398	30 33.70	1968 Jan. 14, 1970	T, E, 30	Irr	Water reported from sand and gravel. 2/
* 607	W. R. Moore, Jr.	do	1965	69	14	69	Qs	1,385	24.87	Jan. 29, 1970	T, E, 30	Irr	2/
* 608	Mrs. L. E. McConnell	--	--	65	8	65	Qs	1,391	36.93	do	J, E, 1/2	N	Unused domestic well. Well 57 of Bull. 5301. 6/
609	Bert Presley	Robert Dale	1969	73	14	73	Qs	1,392	31 29.77 33.61	Sept. 9, 1969 Feb. 4, 1970 Feb. 1, 1971	T, E, 15	Irr	1/
* 610	do	do	1963	72	14	72	Qs	1,395	29.02	Feb. 4, 1970	T, E, 25	Irr	--
611	H. Leroy Conner	do	1955	96	14	96	Qs	1,422	30 40.32	July 20, 1955 Feb. 4, 1970	T, G, 50	Irr	1/ 2/
* 612	Bert Presley	--	--	51	6	51	Qs	1,412	25.39 40.26	July 18, 1951 Feb. 4, 1970	J, E, 1/2	D	Well 88 of Bull. 5301. 6/
613	E. H. Worley	Robert Dale	1965	70	14	70	Qs	1,390	25.51	do	T, E, 20	Irr	Yield reported 175 gpm.
* 614	do	do	1965	70	14	70	Qs	1,400	24.09	do	T, E, 20	Irr	Yield reported 250 gpm.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
* 13-45-615	E. H. Worley	Robert Dale	1967	70	14	70	Qs	1,405	40.68 34.98	Feb. 4, 1970 Feb. 1, 1971	T, E, 15	Irr	Yield reported 200 gpm.
* 616	Benjamin H. Smith, Jr.	do	1955	70	14	70	Qs	1,421	29 37.32 38.80	June 6, 1955 Feb. 11, 1970 Feb. 1, 1971	N	N	Unused irrigation well. 1/ 2/
* 617	Nelson Johnston	Bill Turner	1936	33	6	--	Qs	1,378	13.3 19.26 20.30	July 18, 1951 Feb. 17, 1970 Feb. 1, 1971	N	N	Unused stock well. Original depth reported 67 feet; sanded up to 33 feet. Water reported from sand and gravel at 59 to 66 feet. Red beds reported at 66 feet. Well 31 of Bull. 5301. 6/
618	C. C. Lamb	Robert Dale	1961	97	14	97	Qs	1,419	48.34	Feb. 18, 1970	T, G	Irr	Yield reported 300 gpm. Water reported from sand and gravel.
619	Ray C. Morgan	do	1963	72	14	72	Qs	1,405	36.16	Feb. 11, 1970	T, G, 30	Irr	Yield reported 400 gpm.
620	do	do	1969	72	14	72	Qs	1,401	34.08	do	T, G, 30	Irr	Yield reported 300 gpm.
621	do	do	1968	65	14	65	Qs	1,396	26.56	do	T, E, 30	Irr	Yield reported 550 gpm. 1/
622	do	do	1969	66	14	54	Qs	1,395	24 25.32 29.50	Jan. 25, 1969 Feb. 11, 1970 Feb. 2, 1971	T, E, 30	Irr	1/ 2/
* 623	Leon Morgan	do	1958	57	6	57	Qs	1,401	--	--	Cf, E, 1	D	--
* 624	Warren King	do	1968	75	14	75	Qs	1,404	34 37.39	1968 Feb. 11, 1970	T, E, 30	Irr	Yield reported 400 gpm. Water reported from sand and gravel at 50 to 74 feet. Red beds reported at 74 feet.
625	do	do	1968	75	14	75	Qs	1,400	36 36.42	1968 Feb. 11, 1970	T, E, 30	Irr	Yield reported 400 gpm. Water reported from sand and gravel at 30 to 74 feet. Red beds reported at 74 feet.
* 701	Marvin Sherman	Vernon Pump Service	1967	50	7	50	Pprsa	1,362	15	June 9, 1971	J, E, 3/4	D	--
* 702	John W. Ayres	Robert Dale	1950	50	6	50	Qs	1,360	25.48	Feb. 18, 1970	J, E, 1/2	D, S	Water reported from sand and gravel.
* 703	Marvin Sherman	Lee Hopper	1967	30	7	30	Pprsa	1,370	10	June 9, 1971	Cf, G	S, Irr	Five-well manifold system with all wells the same depth, completed the same, and pumped with a common pump and motor. Yield reported 80 gpm. Water reported from gravel.
801	John W. Ayres	Robert Dale	1956	40	14	30	Qs	1,380	17 22.33	Aug. 17, 1956 Feb. 18, 1970	N	N	Unused irrigation well. Yield reported 340 gpm but fell off rapidly. Water reported from sand and gravel.
* 802	W. C. Dunn	L. E. Stamps	1955	61	16	61	Qs	1,399	43.21	Dec. 4, 1969	T, E, 10	Irr	Yield reported 250 gpm. Water reported from sand and gravel at 33 to 60 feet. Red beds reported at 60 feet.
* 803	A. S. Tooley	Robert Dale	1954	51	16	51	Qs	1,386	26.12	Dec. 16, 1969	T, E, 10	Irr	2/
* 804	do	do	1955	45	16	45	Qs	1,384	26 23.99	May 17, 1955 Dec. 16, 1969	T, E, 10	Irr	Water reported from sand and gravel. 2/

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
13-45-805	W. C. Dunn	Robert Dale	1966	61	16	61	Qs	1,400	41.59	Dec. 4, 1969	T, E, 20	Irr	Yield reported 200 gpm. Water reported from sand and gravel.
806	do	do	1962	45	6	45	Qs	1,391	33.76	do	J, E, 1/3	D	Water reported from sand and gravel.
807	A. S. Tooley	do	1953	52	16	52	Qs	1,384	24.91	Dec. 16, 1969	T, E, 10	Irr	Water reported from sand and gravel. 2/
* 808	do	do	1954	46	16	46	Qs	1,389	33.04	do	T, E, 10	Irr	Yield reported 300 gpm. Water reported from sand and gravel.
809	do	do	1960	44	16	44	Qs	1,389	32.31 36.24 37.35	Dec. 16, 1969 Jan. 13, 1970 Jan. 7, 1971	N	N	Unused irrigation well. Yield reported 150 gpm. Water reported from sand and gravel.
* 810	Walter H. Obenhaus	do	1959	50	14	50	Qs	1,395	37.86 37.18	Feb. 17, 1970 Feb. 1, 1971	Cf, E, 2	D, S, Irr	Yield reported 25 gpm.
* 811	do	L. E. Stamps	1957	52	16	52	Qs	1,406	38.09	Feb. 17, 1970	Cf, E, 2	Irr	Yield reported 25 gpm. Water reported from 8 feet of sand and gravel.
812	do	Lee Hopper	1963	55	14	55	Qs	1,406	39.99	do	Cf, E, 2	Irr	Yield reported 25 gpm. Water reported from 5 feet of sand and gravel.
* 813	do	Robert Dale	1956	40	6	40	Pprsa	1,419	21.04	do	J, E, 1/2	D, S	Yield reported strong. Water reported from "broken shale".
814	John W. Ayres	--	1956	61	14	61	Qs	1,391	38.27 38.83	Feb. 20, 1970 Feb. 1, 1971	T, G	Irr	Yield reported 245 gpm. Water reported from 24 feet of sand and gravel with base at 60 feet. Red beds reported at 60 feet.
* 815	do	--	--	50	8	50	Qs	1,383	5.02 7.14	Feb. 18, 1970 Feb. 1, 1971	W, C	S	Yield reported weak. Water reported from 2 to 3 feet of sand and gravel.
* 816	Bessy W. Clancy Estate	--	--	35	--	--	Pprsa	1,420	17.85	June 9, 1971	R, E, 1/3	D, S	Dug well. Yield reported strong. Water reported from clay.
* 901	State of Texas	--	--	Spring	--	--	Qs	1,315	(+)	Sept. 30, 1970	Flows	N	Yield less than 1 gpm. Water seeps from well-cemented coarse gravel and friable sand.
* 902	M. K. Berry	--	--	40	8	40	Qs	1,335	16.46	Nov. 19, 1970	J, E, 1/2	D, S	Yield reported weak. Water reported from sand and gravel.
46-101	Mrs. A. F. Winston	Robert Dale	1960	86	14	86	Qs	1,358	22.21	Dec. 16, 1969	T, E, 30	Irr	Yield reported 400 gpm. Water reported from sand and gravel at 65 to 85 feet. Well has been purchased by the city of Vernon for a future public supply source.
* 102	do	John Kale	1957	82	14	82	Qs	1,358	12.20 14.88 11.05 22.11	Jan. 4, 1958 June 22, 1960 Jan. 17, 1963 Dec. 16, 1969	T, E, 30	Irr	Yield reported 300 gpm. Water reported from 11 feet of basal gravel. Well has been purchased by the city of Vernon for a future public supply source.
103	do	Mr. Myatt	1955	84	16	84	Qs	1,357	13.27 9.03 20.25 20.13 20.86	Jan. 7, 1956 Feb. 12, 1961 Dec. 16, 1969 Jan. 13, 1970 Jan. 7, 1971	T, G	Irr	Yield reported 300 gpm. Water reported from mostly sand with some gravel. Well has been purchased by the city of Vernon for a future public supply source. 4/

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
13-46-104	Mrs. A. F. Winston	John Kale	1955	84	16	84	Qs	1,356	12.22 14.41 6.80 14.95 19.32 18.92 15.25	Jan. 7, 1956 June 22, 1960 Jan. 18, 1966 Jan. 22, 1967 Dec. 16, 1969 Jan. 13, 1970 Jan. 7, 1971	T, G	Irr	Yield reported 500 gpm. Water reported from 18 feet of basal gravel. Well has been purchased by the city of Vernon for a future public supply source. 4/
105	do	do	1957	89	14	89	Qs	1,360	6.50 11.02 6.93 5.02 16.84	Jan. 4, 1958 June 22, 1960 Feb. 22, 1962 Jan. 17, 1963 Jan. 16, 1969	T, E, 30	Irr	Yield reported 600 gpm. Water reported from 30 feet of basal gravel. Well has been purchased by the city of Vernon for a future public supply source.
106	do	do	1955	92	16	92	Qs	1,366	12.98 9.75 20.14 19.38 19.77 20.24	Jan. 7, 1956 Jan. 17, 1963 Jan. 22, 1967 Dec. 16, 1969 Jan. 13, 1970 Jan. 7, 1971	T, E, 40	Irr	Yield reported 600 gpm. Water reported from 20 feet of basal gravel. Well has been purchased by the city of Vernon for a future public supply source. 4/
107	I. W. Boyd	--	--	33	8	33	Qs	1,388	19.45 23.29 22.07 24.19 21.97	July 19, 1951 Jan. 8, 1955 Jan. 7, 1956 Jan. 14, 1957 Jan. 17, 1963	C, W	N	Unused domestic and stock well. Well 38 of Bull. 5301. 6/ Well A-38 of Bull. 5614. 7/
* 108	Jake C. Riggins	Lee Hopper	1967	58	14	58	Qs	1,380	21.51 24.12	Jan. 27, 1970 Feb. 2, 1971	Sub, E, 5	Irr	Well pumps into well 13-46-109. 2/
109	do	do	1966	56	14	56	Qs	1,370	16.84	Jan. 27, 1970	T, E, 20	Irr	Water reported from sand and gravel at 43 to 55 feet. Red beds reported at 55 feet. Well 13-46-108 pumps into this well. 2/
110	do	do	1965	72	14	72	Qs	1,385	32.39	do	N	N	Unused irrigation well. Yield reported 300 gpm. Water reported from sand and gravel at 59 to 71 feet. Red beds reported at 71 feet.
111	do	Jim Rae	1965	78	14	78	Qs	1,390	32.42	do	T, E, 25	Irr	Water reported from sand and gravel at 65 to 77 feet. Red Beds reported at 77 feet. Well 13-46-112 pumps into this well. 2/
* 112	do	Lee Hopper	1965	78	14	78	Qs	1,392	33.46	do	Sub, E, 5	Irr	Water reported from sand and gravel at 65 to 77 feet. Red beds reported at 77 feet. This well pumps into well 13-46-111. 2/
113	do	Robert Dale	1969	78	14	78	Qs	1,388	35	do	N	N	Unused irrigation well. Yield reported 275 gpm. Water reported from sand and gravel.
* 114	Mrs. Elwyn Bingham	do	1967	108	14	108	Qs	1,372	33 29.01 33.14	Dec. 24, 1967 Jan. 29, 1970 Feb. 3, 1971	T, E, 30	Irr	1/ 2/
* 115	Kenneth R. Neel	do	1965	68	14	68	Qs	1,359	26.14	Jan. 29, 1970	T, E, 10	Irr	Yield reported 150 gpm.
* 116	W. C. Bellar	do	1964	78	14	78	Qs	1,411	36.84 39.49	Feb. 4, 1970 Feb. 2, 1971	T, E, 20	Irr	Yield reported 100 gpm. Water reported from sand and gravel at 71 to 76 feet. Red beds reported at 76 feet.
117	do	do	1969	80	14	80	Qs	1,410	37 37.85	May 1969 Feb. 4, 1970	T, E, 5	Irr	Yield reported 200 gpm. 1/
* 118	Sumner Estate	do	1968	83	14	83	Qs	1,400	33.61	do	T, E, 15	Irr	Yield reported 300 gpm. Water reported from 8 feet of sand and gravel with base at 81 feet. Red beds reported at 81 feet.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing		Water bearing unit	Altitude of land surface (ft)	Water level		Method of lift	Use of water	Remarks
					Diameter (in.)	Depth (ft)			Below land-surface datum (ft)	Date of measurement			
13-46-119	Mrs. J. B. North	Jim Rae	1965	66	14	66	Qs	1,390	32.91	Feb. 4, 1970	T, E, 7-1/2	Irr	Yield reported 200 gpm. Water reported from sand and gravel at 54 to 66 feet. Red beds reported at 66 feet.
* 120	do	Robert Dale	1963	66	14	66	Qs	1,388	23.61	do	T, E, 25	Irr	Yield reported 200 gpm. Water reported from sand and gravel at 62 to 65 feet. Red beds reported at 65 feet.
* 121	Sumner Estate	do	1957	64	14	64	Qs	1,381	33.50	Jan. 30, 1970	T, E, 30	Irr	Water reported from sand and gravel at 50 to 63 feet. Red beds reported at 63 feet. 2/
122	do	do	1968	88	14	88	Qs	1,382	31.45	do	T, E, 30	Irr	Water reported from sand and gravel at 74 to 87 feet. Red beds reported at 87 feet. 2/
* 123	Mrs. M. E. Forester	do	1965	66	14	66	Qs	1,386	16 19.57	1965 Feb. 3, 1970	T, E, 25	Irr	Water reported from sand and gravel at 52 to 65 feet. Red beds reported at 65 feet. 2/
* 124	do	do	1962	62	14	62	Qs	1,386	23 28.56 32.75	1962 Feb. 3, 1970 Feb. 2, 1971	T, E, 30	Irr	1/ 2/
125	City of Vernon	do	1968	95	14	95	Qs	1,365	30 29.00	Dec. 30, 1968 Sept. 17, 1970	N	N	Unused irrigation well, planned for future use as a public supply source. 1/ 2/ 3/
* 126	do	Texas Water Development Board	1970	105	--	--	Qs	1,370	29.4	Oct. 22, 1970	N	N	Test hole. 1/ 3/
* 127	Grady E. Bingham	do	1970	87		--	Qs	1,368	21.37	Nov. 2, 1970	N	N	Do.
* 128	G. K. Martin	Robert Dale	1970	64	14	64	Qs	1,391	27.61	Nov. 10, 1970	T, E, 20	Irr	1/ 2/
130	Mrs. Elwyn Bingham	do	1966	81	--	--	Qs	1,367	--	--	N	N	Test hole. 1/
131	Charles Tallant	do	1968	69	--	--	Qs	1,362	--	--	N	N	Do.
* 201	W. S. Fitzgerald	B. B. Thrash	1957	100	18	100	Qs	1,363	20.28 21.99 23.64	Apr. 4, 1960 Feb. 5, 1970 Jan. 7, 1971	T, G	Irr	Yield reported 350 gpm.
202	Cleve Hamilton	--	--	25	--	--	Qs	1,362	16.88 20.95 18.24 20.29 16.20 16.20	Feb. 1, 1952 Jan. 7, 1954 Jan. 7, 1956 Jan. 14, 1957 Jan. 4, 1958 Jan. 17, 1963	N	N	Abandoned stock well. Well 40 of Bull. 5301. 6/ Well B-40 of Bull. 5614. 7/
* 203	T. R. Olive Estate	Robert Dale	1957	52	14	52	Qs	1,359	23.97 31.01 31.83	Apr. 6, 1960 Jan. 30, 1970 Feb. 2, 1971	T, E, 15	Irr	Yield reported 202 gpm. Water reported from sand and gravel with base at 51 feet. Red beds reported at 51 feet.
204	do	do	1957	52	14	52	Qs	1,361	26.75 32.76	Apr. 6, 1960 Jan. 30, 1970	T, E, 15	Irr	Yield reported 202 gpm. Water reported from sand and gravel with base at 51 feet. Red beds reported at 51 feet.
205	R. H. Newsom	do	1956	70	14	70	Qs	1,372	28.26 29.92 37.72 38.38 38.99	Jan. 4, 1958 Jan. 14, 1964 Jan. 18, 1966 Jan. 14, 1970 Jan. 7, 1971	T, E, 20	Irr	Yield reported 318 gpm. Water reported from sand and gravel at 28 to 70 feet. Red beds reported at 70 feet. 4/
* 206	do	Bill Turner	1948	86	8	86	Qs	1,377	30.7 29.48 31.80 39.70	Aug. 8, 1951 Jan. 8, 1953 Jan. 14, 1957 Feb. 20, 1970	J, E, 1/2	D, S	Water reported from sand and gravel. Well 74 of Bull. 5301. 6/ Well B-74 of Bull. 5614. 7/

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diam-eter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
* 13-46-207	Grady W. Stowe	Robert Dale	1956	56	14	56	Qs	1,371	19.48 31.64	Apr. 4, 1960 Feb. 3, 1970	T, E, 20	Irr	Red beds reported at 54 feet. 2/
208	Sumner Estate	do	1956	59	14	59	Qs	1,376	18.13 33.65	Apr. 4, 1960 Feb. 4, 1970	T, E, 30	Irr	Yield reported 450 gpm. Water reported from sand and gravel at 44 to 57 feet. Red beds reported at 57 feet.
* 209	Leonard L. Woodard	do	1955	68	16	68	Qs	1,372	18.60 20.50 26.80 34.52 37.65	Jan. 7, 1956 Feb. 18, 1960 Jan. 18, 1966 Jan. 14, 1970 Jan. 7, 1971	T, E, 25	Irr	Yield reported 700 gpm. 4/
* 210	Jake C. Riggins	Loyd Stamps	1956	81	14	81	Qs	1,388	30.21 44.88 47.17	Apr. 4, 1960 Jan. 27, 1970 Feb. 2, 1971	Sub, E, 25	Irr	Water reported from sand and gravel at 65 to 80 feet. Red beds reported at 80 feet. 2/
211	R. H. Newsom	Robert Dale	1964	73	14	73	Qs	1,373	34.89	Jan. 14, 1970	T, E, 20	Irr	Yield reported 300 gpm. Water reported from sand and gravel.
* 212	Jake C. Riggins	do	1969	79	14	79	Qs	1,331	23.78 25.52	Jan. 27, 1970 Feb. 2, 1971	N	N	Unused irrigation well. Yield reported 200 gpm. 1/
* 213	do	--	--	Spring	--	--	Qs	1,290	(+)	Jan. 27, 1970	Flows	S	Estimated flow 30 gpm.
* 214	C. M. Clarkson	Jim Rae	1965	64	14	64	Qs	1,364	23.74	do	T, E, 15	Irr	Water reported from sand and gravel at 43 to 63 feet. Red beds reported at 63 feet. 2/
* 215	Jake C. Riggins	Lee Hopper	1966	62	12	62	Qs	1,370	26.59 28.41	do Feb. 2, 1971	T, E, 10	Irr	Yield reported 250 gpm. Water reported from sand and gravel at 49 to 61 feet. Red beds reported at 61 feet.
216	do	Jim Rae	1965	55	14	55	Qs	1,373	27.21	Jan. 27, 1970	T, E, 15	Irr	Yield reported 300 gpm. Water reported from sand and gravel at 43.5 to 53.5 feet. Red beds reported at 53.5 feet.
217	do	Robert Dale	1966	60	14	60	Qs	1,381	27	do	T, E, 7-1/2	Irr	Yield reported 300 gpm. 1/
* 218	do	do	1960	62	14	62	Qs	1,379	34.78 37.57	do Feb. 2, 1971	T, E, 30	Irr	Yield reported 600 gpm. Water reported from sand and gravel at 39 to 61 feet. Red beds reported at 61 feet.
* 219	do	do	1966	98	14	98	Qs	1,396	56.01	Jan. 27, 1970	T, E, 20	Irr	Well originally 100 feet deep, plugged back to 98 feet. Water reported from sand and gravel at 85 to 100 feet. Red beds reported at 100 feet. 2/
220	do	do	1964	82	14	82	Qs	1,385	44.40	Jan. 29, 1970	T, E, 25	Irr	Water reported from sand and gravel. Red beds reported at 81 feet. 2/
221	do	do	1964	80	14	80	Qs	1,379	45	Jan. 27, 1970	T, E, 25	Irr	Water reported from sand and gravel. Red beds reported at 79 feet. 2/
222	do	do	1966	94	14	94	Qs	1,392	49.34	do	T, E, 25	Irr	Yield reported 400 gpm. Water reported from sand and gravel at 85 to 95 feet. Red beds reported at 95 feet.
223	do	Lee Hopper	1967	82	14	82	Qs	1,384	45	do	N	N	Unused irrigation well. Water reported from sand and gravel at 73 to 81 feet. Red beds reported at 81 feet.
* 224	Sumner Estate	Robert Dale	1965	67	14	67	Qs	1,388	53.14	Feb. 5, 1970	T, E, 25	Irr	Yield reported 400 gpm. 1/

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
* 13-46-225	Sumner Estate	Robert Dale	1965	65	14	65	Qs	1,379	24.26	Feb. 5, 1970	T, E, 20	Irr	Yield reported 300 gpm. Water reported at 58 to 65 feet. Red beds reported at 65 feet.
* 226	William S. Fitzgerald	Bill Turner	--	65	6	65	Qs	1,358	--	--	Cf, E, 1/2	D, S	--
227	do	B. B. Thrash	1955	90	6	90	Qs	1,358	24.48	Feb. 5, 1970	J, E, 1/2	D, S	--
* 228	Grady W. Stowe	Robert Dale	1969	71	14	71	Qs	1,371	35 34.93	Mar. 30, 1969 Feb. 3, 1970	T, E, 20	Irr	Red beds reported at 69 feet. 2/
229	Leonard L. Woodward	do	1962	70	14	70	Qs	1,374	36.45	do	T, E, 20	Irr	Yield reported 200 gpm. Water reported from sand and gravel at 60 to 69 feet. Red beds reported at 69 feet.
230	Sumner Estate	do	1967	68	12	66	Qs	1,379	33 36.44	Apr. 14, 1967 Feb. 4, 1970	T, E, 7-1/2	Irr	1/ 2/
231	North Side High School	--	1958	100	--	--	Qs	1,364	--	--	--	S	Formerly an industrial well used at the now abandoned missile base.
232	Sumner Estate	Robert Dale	1970	80	14	80	Qs	1,379	43	Dec. 1, 1970	T, E, 7	Irr	1/ 2/
233	Bill Graf	do	1971	90	14	90	Qs	1,396	59	Apr. 28, 1971	--	Irr	1/ 2/
234	William S. Fitzgerald	B. B. Thrash	1957	93	--	--	Qs	1,362	22	Feb. 1957	N	N	Test hole. 1/
235	do	do	1957	105	--	--	Qs	1,366	19	do	N	N	Do.
236	do	do	1957	103	--	--	Qs	1,364	20	do	N	N	Do.
237	do	do	1957	100	--	--	Qs	1,359	--	--	N	N	Do.
* 301	Jake C. Riggins	--	--	Spring	--	--	Qs	1,285	(+)	Jan. 27, 1970	Flows	N	--
302	T. R. Olive Estate	Robert Dale	1962	78	14	78	Qs	1,364	32.16 34.94	Jan. 30, 1970 Feb. 2, 1971	T, G, 50	Irr	Water reported from sand and gravel at 48 to 76 feet. Red beds reported at 76 feet.
* 303	Troy A. Chapman	--	--	Spring	--	--	Qs	1,280	(+)	Nov. 6, 1970	Flows	N	Flows from base of cross-bedded Permian sandstone; water is believed derived by leakage from the Seymour Formation into the sandstone.
* 304	Ross Estate	--	--	Spring	--	--	Qs	1,290	(+)	Nov. 10, 1970	Flows	N	Spring no. 77 of Bull. 5301. 6/
* 305	do	W. T. Roland	1942	15	6	15	Qs	1,245	--	--	J, E, 1/3	D	Hand augered.
* 306	Joe Emmett	--	--	23	--	--	Qs	1,290	18.63	June 17, 1971	J, E, 1/3	D	Dug well.
* 307	J. R. Watts	Robert Dale	1967	60	6	60	Qs	1,370	45	June 11, 1967	J, E, 1/2	D	Yield reported strong.
401	City of Vernon	D. L. McDonald	1953	110	24 10	40 110	Qs	1,408	32 31.56 33.21 32.41 33.01	1953 Jan. 6, 1954 Jan. 8, 1955 Jan. 8, 1956 Jan. 4, 1958	N	N	Unused public supply well, caved. 1/ 2/ Well C-127 of Bull. 5614. 7/

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diam-eter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
13-46-402	City of Vernon	D. L. McDonald	1953	100	24 10	50 100	Qs	1,410	24 24.68 28.05 26.02 30.36 48.08 55.30 53.80	Jan. 8, 1953 Jan. 6, 1954 Jan. 14, 1957 Jan. 4, 1958 Jan. 17, 1963 Jan. 16, 1969 Jan. 14, 1970 Jan. 7, 1971	N	N	Unused public well. Yield reported 190 gpm. 1/ 2/ 4/ Well C-110 of Bull. 5614. 7/
403	do	do	1953	95	24 10	43 95	Qs	1,404	16 17.52 21.00 25.10 20.70 22.35 39.64 41.96	1953 Jan. 6, 1954 Jan. 9, 1956 Jan. 14, 1957 Jan. 4, 1958 Jan. 17, 1963 Jan. 15, 1970 Feb. 2, 1971	T, E, 20	P	Yield reported 110 gpm. 1/ 2/ Well C-118 of Bull. 5614. 7/
* 404	do	do	1953	91	24 10	50 87	Qs	1,395	20 15.82 19.27 19.23 20.54 37.69 43.78	1953 Jan. 6, 1954 Jan. 8, 1956 Jan. 4, 1958 Jan. 17, 1963 Jan. 14, 1970 Jan. 8, 1971	T, E, 20	P	Yield reported 210 gpm. 1/ 2/ 4/ Well C-119 of Bull. 5614. 7/
405	do	do	1953	105	24 10	50 105	Qs	1,400	17 15.15 27.44 25.52 19.30 37.91 42.22	1953 Jan. 6, 1954 Jan. 14, 1957 Feb. 22, 1962 Jan. 17, 1963 Jan. 13, 1970 Feb. 2, 1971	T, E, 20	P	Yield reported 200 gpm. 1/ 2/ Well C-126 of Bull. 5614. 7/
406	do	do	1953	97	24 10	40 97	Qs	1,392	14 13.76 16.34 21.78 18.26 33.81	1953 Jan. 6, 1954 Jan. 9, 1956 Feb. 22, 1962 Jan. 17, 1963 Jan. 13, 1970	T, E, 20	P	Yield reported 260 gpm. 1/ 2/ Well C-120 of Bull. 5614. 7/
407	do	do	1953	95	24 10	42 95	Qs	1,392	16 15.55 18.93 18.95 23.31 36.10 41.80	1953 Jan. 6, 1954 Jan. 9, 1956 Jan. 4, 1958 Jan. 17, 1963 Jan. 13, 1970 Feb. 3, 1971	T, E, 20	P	Well C-121 of Bull. 5614. 1/ 2/ 7/
408	do	do	1953	90	24 10	44 90	Qs	1,384	8 11.78 12.28 15.25 13.34 29.46 33.97	1953 Jan. 6, 1954 Jan. 4, 1958 Jan. 29, 1960 Feb. 2, 1961 Jan. 14, 1970 Feb. 3, 1971	T, E, 20	P	Well C-120 of Bull. 5614. 1/ 2/ 7/
* 409	Fred J. Halencak	Bill Turner	1949	105	6	95	Qs	1,391	10.7 19.28 26.73 37.76 38.96 42.85	July 19, 1951 Jan. 8, 1956 Jan. 14, 1957 Dec. 3, 1969 Jan. 13, 1970 Jan. 8, 1971	J, E, 1/2	D, S	Well 66 of Bull. 5301. 6/ Well C-66 of Bull. 5614. 4/ 7/

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
13-46-410	Mrs. N. L. Goodwin	Robert Dale	1956	60	14	60	Qs	1,411	19.65 40	Sept. 30, 1960 Feb. 11, 1970	T, G	N	Unused irrigation well. Yield reported 165 gpm. Water reported from sand and gravel with base at 59 feet. Red beds reported at 59 feet.
411	J. R. White Estate	do	1959	46	12	46	Qs	1,419	17.29 26.77	Sept. 30, 1960 Feb. 11, 1970	T, G	Irr	Yield reported 75 gpm. Water reported from sand and gravel with base at 45 feet. Red beds reported at 45 feet.
412	do	do	1960	46	12	46	Qs	1,418	26.48 27.32	Feb. 11, 1970 Feb. 2, 1971	T, G	Irr	Do.
413	City of Vernon	Layne-Arkansas	1961	102	24 13	50 96	Qs	1,413	55.23 56.28	Jan. 14, 1970 Feb. 2, 1971	T, E, 30	P	Yield reported 300 gpm. 1/
414	do	do	1961	107	24 13	51 103	Qs	1,408	70.31 71.15	Jan. 15, 1970 Feb. 2, 1971	T, E, 30	P	Do.
* 415	do	Herman Winters	1958	112	26 13	50 113	Qs	1,427	69.20 70.72	Jan. 15, 1970 Feb. 2, 1971	T, E, 30	P	Do.
416	do	do	1958	105	26 13	50 103	Qs	1,424	33 51.13 53.76	Mar. 4, 1958 Dec. 12, 1969 Feb. 2, 1971	T, E, 30	P	Do.
* 417	Jake C. Riggins	Robert Dale	1965	98	14	98	Qs	1,400	35.14	Jan. 27, 1970	T, E, 30	Irr	Yield reported 500 gpm. Water reported from sand and gravel at 71 to 97 feet. Red beds reported at 97 feet.
418	do	do	1968	91	14	91	Qs	1,402	38.81	do	T, E, 20	Irr	Yield reported 400 gpm. 1/
* 419	Sumner Estate	do	1968	86	14	86	Qs	1,413	49.00	Feb. 5, 1970	T, E, 25	Irr	Yield reported 300 gpm. Water reported from sand and gravel at 74 to 84 feet. Red beds reported at 84 feet.
420	do	do	1954	88	16 10	88 88	Qs	1,411	24.30 44.11	Jan. 4, 1958 Feb. 5, 1970	T, G, 65	Irr	Yield reported 200 gpm. Water reported from sand and gravel.
* 421	do	do	1964	90	14	90	Qs	1,385	36.50 40.15	Feb. 5, 1970 Feb. 2, 1971	T, E, 30	Irr	Water reported from sand and gravel. 2/
422	Roy D. Wilson, Jr.	do	1964	89	14	89	Qs	1,384	30.54	Jan. 30, 1970	T, E, 25	Irr	Water reported from sand and gravel at 84 to 88 feet. Red beds reported at 88 feet. 2/
* 423	J. R. White Estate	Olin Oil Company	1947	49	8	49	Qs	1,420	36.82 37.60	Feb. 11, 1970 Feb. 2, 1971	J, E, 1/2	S	Yield reported 70 gpm. Water reported from sand and gravel at 28 to 49 feet. Red beds reported at 49 feet.
* 424	C. C. Lamb	--	--	98	6	98	Qs	1,418	46.92	Feb. 18, 1970	J, E, 1/2	D	Water reported from sand and gravel.
425	Ray C. Morgan	Robert Dale	1966	71	14	71	Qs	1,400	32.81	Feb. 11, 1970	T, G, 30	Irr	Yield reported 400 gpm.
* 426	Leon Morgan	Bill Turner	1950	70	6	70	Qs	1,402	41.14	do	N	N	Unused domestic and stock well. Originally a dug well. Well 53 of Bull. 5301. 6/
* 427	Sumner Estate	Robert Dale	1970	71	14	71	Qs	1,390	34.64	Nov. 10, 1970	N	Irr	Yield measured 370 gpm. Water reported from sand and gravel at 58 to 69 feet. Red beds reported at 69 feet. Pump on order when well was inventoried.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
13-46-428	Mrs. F. B. Elliott	Lee Hopper	1966	91	12	91	Qs	1,400	38.81	Feb. 11, 1970	T, E, 15	Irr	2/
429	Bert Dockery	Robert Dale	1965	100	14	100	Qs	1,399	--	--	T, E, 30	Irr	Yield reported 750 gpm. Water reported from sand and gravel. Well 13-46-430 pumps into this well.
* 430	do	do	1967	99	14	99	Qs	1,400	38	June 13, 1967	T, E, 10	Irr	1/ 2/
432	City of Vernon	--	1958	102	--	--	Qs	1,400	--	--	N	N	Test hole. 1/
* 501	do	D. L. McDonald	1953	103	24 10	42 103	Qs	1,395	19 20.87 24.35 27.88 24.62 27.40 42.70	1953 Jan. 6, 1954 Jan. 8, 1955 Jan. 14, 1957 Jan. 4, 1958 Feb. 22, 1962 Jan. 13, 1970	T, E, 20	P	Yield reported 200 gpm. 1/ 2/ 4/ Well D-123 of Bull. 5614. 7/
502	do	do	1953	102	24 10	50 102	Qs	1,394	21 23.03 25.95 29.65 26.66 43.30 49.55	1953 Jan. 6, 1954 Jan. 9, 1956 Jan. 14, 1957 Jan. 4, 1958 Dec. 12, 1969 Feb. 3, 1971	T, E, 20	P	Well D-124 of Bull. 5614. 1/ 2/ 7/
* 503	do	do	1953	112	24 10	50 112	Qs	1,400	33 32.94 36.05 35.90 37.35 51.75 55.54	1953 Jan. 6, 1954 Jan. 9, 1956 Jan. 4, 1958 Jan. 17, 1963 Dec. 12, 1969 Feb. 3, 1971	T, E, 20	P	Well D-125 of Bull. 5614. 1/ 2/ 7/
* 504	do	W. E. Turner	1951	120	6	120	Qs	1,409	42.14 47.02 51.82 57.60 68.29	Feb. 1, 1952 Jan. 9, 1956 Jan. 14, 1965 Jan. 13, 1970 Jan. 7, 1971	N	N	Unused public supply well. 4/ Well 70 of Bull. 5301. 6/ Well D-70 of Bull. 5614. 7/
505	do	D. L. McDonald	--	120	6	120	Qs	1,408	42.5 35.78 34.85 45.95 54.71	Feb. 1, 1952 Jan. 14, 1957 Jan. 14, 1964 Jan. 13, 1970 Jan. 7, 1971	C, W	S	Well D-70a of Bull. 5614. 4/ 7/
* 506	Jake C. Riggins	Bill Turner	1951	103	6	103	Qs	1,385	27.50 23.11 38.34	Jan. 31, 1952 Jan. 8, 1953 Jan. 27, 1970	N	N	Former observation well. Water reported from sand and gravel at 83 to 102 feet. Red beds reported at 102 feet. 4/ Well 71 of Bull. 5301. 6/ Well D-71 of Bull. 5614. 7/
* 507	do	do	1951	92	18	92	Qs	1,384	21.77 23.14 25.20 37.75	Jan. 31, 1952 Jan. 8, 1953 Jan. 8, 1956 Jan. 27, 1970	T, G, 50	Irr	Yield reported 600 gpm. 1/ 2/ Well 72 of Bull. 5301. 6/ Well D-72 of Bull. 5614. 7/
* 508	Bill Dodson	--	--	94	6	94	Qs	1,390	40.50 46.17 44.89 51.62 53.79	Aug. 16, 1951 Jan. 14, 1957 Jan. 17, 1963 Jan. 14, 1970 Jan. 7, 1971	-, W	N	Unused stock well. 4/ Well 81 of Bull. 5301. 6/ Well D-81 of Bull. 5614. 7/

See footnotes at end of table.

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
13-46-509	Anderson Estate	--	--	65	6	65	Qs	1,418	35.56 39.38 45.25 45.16 45.93	Feb. 2, 1952 Jan. 4, 1958 Jan. 21, 1968 Jan. 13, 1970 Jan. 7, 1971	C, N	N	Unused stock well. 4/ Well 93 of Bull. 5301. 6/ Well D-93 of Bull. 5614. 7/
* 510	do	--	--	16	--	--	Qs	1,299	11.84 15.35 14.34 15.13	Aug. 16, 1951 Jan. 8, 1953 Jan. 7, 1954 Jan. 8, 1955	N	N	Destroyed. Formerly a dug stock well.
511	City of Vernon	McDonald Drilling Company, Inc.	1969	116	20 13	54 115	Qs	1,397	50 52.62 61.32	Apr. 1969 Dec. 12, 1969 Feb. 3, 1971	T, E, 20	P	1/ 2/
512	do	do	1969	101	20 13	36 101	Qs	1,393	36 36.32 37.27	Apr. 20, 1969 Dec. 12, 1969 Feb. 3, 1971	T, E, 20	P	1/ 2/
* 513	Bill Dodson	Carl Bradford	1966	105	6	105	Qs	1,390	43.00	Dec. 17, 1969	J, E	D, S	Yield reported greater than 20 gpm. Water reported from sand and gravel. Red beds reported at 105 feet.
* 514	Donald Riggins	Jim Rae	1963	65	10	65	Qs	1,409	39.25 39.54	Jan. 27, 1970 Feb. 2, 1971	T, E, 7-1/2	Irr	Water reported from sand and gravel. 2/
* 515	Jake C. Riggins	Robert Dale	1968	95	14	95	Qs	1,385	40.11 38.44	Jan. 27, 1970 Feb. 2, 1971	T, E, 25	Irr	1/ 2/
* 516	Sumner Estate	do	1969	94	14	94	Qs	1,395	43.80	Feb. 5, 1970	T, E, 25	Irr	Water reported from sand and gravel at 80 to 92 feet. Red beds reported at 92 feet. 2/
* 517	B. Goodpasture	Carl Bradford	1943	50	14	50	Qs	1,360	14.94 28.32	July 18, 1951 June 10, 1971	Sub, E, 1-1/2	Irr	Well had been recently pumped when water level was measured on June 10, 1971. Water is used to irrigate football field and lawn at Northside Independent School. Water reported from sand and some gravel. Well 97 of Bull. 5301. 6/
518	Jake C. Riggins	Robert Dale	1971	96	--	--	Qs	1,385	--	--	N	N	Test hole. 1/
519	City of Vernon	--	1958	125	--	--	Qs	1,440	--	--	N	N	Do.
* 601	Cathern Pierce	Robert Dale	1957	61	14	61	Qal	1,217	26.82 35.17	Mar. 31, 1960 Nov. 4, 1970	T, G, 60	Irr	Water reported from gravel at 42 to 60 feet. Red beds reported at 60 feet. 2/
* 602	Troy A. Chapman	do	1956	47	14	47	Qal	1,195	11 9.25 18.32	Aug. 1, 1956 Mar. 31, 1960 Nov. 5, 1970	T, E, 30	Irr	Yield reported 500 gpm. Water reported from sand and gravel. 2/
* 603	do	M. L. Myatt	1956	51	14	51	Qal	1,201	11.78 21.48	Mar. 31, 1960 Nov. 11, 1970	N	N	Unused irrigation well. Yield reported 450 gpm. Water reported from gravel at 31 to 49 feet.
* 604	M. K. Berry	Robert Dale	1956	40	14	40	Qal	1,184	4.02 10.48	Mar. 3, 1960 Nov. 11, 1970	T, G, 40	Irr	Yield reported 580 gpm.
* 605	E. Howard Heath	do	1967	45	14	45	Qal	1,198	16 12.02	June 6, 1967 Nov. 4, 1970	T, E, 40	Irr, S	1/ 2/
606	do	Lee Hopper	1969	54	14	54	Qal	1,207	18 15.38 15.45	Mar. 12, 1969 Nov. 4, 1970 Jan. 7, 1971	T, B	Irr	1/ 2/
* 607	Winburn Smith	Bill Lantz	1950	58	12	58	Qs	1,272	20.95	Nov. 4, 1970	J, E, 1/2	D	Yield reported weak. Water reported from sand or gravel at 28 and 47 feet. Red beds reported at 58 feet.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
* 13-46-608	Horace B. Coffee	--	1940	26	--	--	Qs	1,245	14.65	Nov. 4, 1970	N	N	Dug domestic well, unused. Water reported from sand and some gravel at approximately 16 feet.
* 609	Cathern Pierce	--	--	31	--	--	Qs	1,224	21.34 25.87	July 8, 1951 Nov. 4, 1970	J, E, 1/3	D	Dug well. Well 100 of Bull. 5301. 6/
* 610	Troy A. Chapman	Robert Dale	1965	44	14	44	Qal	1,192	15.30 14.50	Nov. 5, 1970 Jan. 7, 1971	T, E, 30	Irr	Yield reported 1,000 gpm. Water reported from coarse sand and small gravel. Red beds reported at 43 feet.
* 611	do	do	1965	55	14	55	Qal	1,196	19.13	Nov. 5, 1970	T, E, 30	Irr	Yield reported 756 gpm. Water reported from coarse sand and small gravel. Red beds reported at 54 feet.
612	do	do	1968	46	14	46	Qal	1,190	14.97	do	T, G, 30	Irr	Yield reported 450 gpm. 1/
* 613	do	do	1968	61	14	61	Qal	1,202	27.15	do	T, E, 30	Irr	Yield reported 400 gpm. 1/
* 614	do	do	1968	55	16	55	Qal	1,197	17.04 16.09	do Jan. 7, 1971	T, E, 30	Irr	Yield reported 450 gpm. Water reported from coarse sand and small gravel. Red beds reported at 54 feet.
* 615	do	do	1969	63	14	63	Qal	1,209	23.55	Nov. 5, 1970	T, E, 15	Irr	Yield reported 300 gpm. 1/
616	Cathern Pierce	do	1971	63	14	63	Qal	1,213	34.24	June 17, 1971	T, G, 79	Irr	1/ 2/
* 617	Fargo Gin	--	--	24	-- 2-1/2	-- 24	Qs	1,250	12.97	do	N	N	Unused industrial well. Dug well to 14 feet. Caved from 14 to 24 feet. Yield reported strong.
701	J. R. White Gin	--	1914	28	--	--	Pcf	1,360	16.24	Feb. 17, 1970	J, E, 1/2	Ind	Dug well. Yield reported weak. Water reported from "birds-eye clay".
* 702	do	--	--	28	--	--	Pcf	1,359	16	do	Sub, E, 1/2	Ind	Dug well. Yield reported weak. Water reported from "birds-eye clay".
* 801	Jake C. Riggins	Lee Hopper	1965	50	6	50	Qs	1,400	33.76	Jan. 27, 1970	J, E, 1/2	D, S	Yield reported 75 gpm. Water reported from sand and gravel at 36 to 49 feet. Red beds reported at 49 feet.
802	do	Bill Turner	--	57	6	57	Qs	1,405	38.2 40.04	July 19, 1951 Jan. 29, 1970	J, E, 1	D	Yield reported 100 gpm. Well 106 of Bull. 5301. 6/
* 901	G. C. Crisp	--	1936	32	--	--	Qs	1,225	18	June 17, 1971	J, E, 1/2	D	Dug well.
902	Clyde Crisp	Robert Dale	1971	38	5	38	Qal	1,189	12	Jan. 21, 1971	--	S	1/ 2/
47-101	Ross Estate	do	1956	50	14	50	Qal	1,208	8.36 10.88	June 21, 1960 Nov. 10, 1970	T, E	Irr	Yield reported 500 gpm.
* 102	Jack Slappey	Myatt Brothers	1952	40	6	40	Qal	1,206	5 7.12	June 21, 1960 Nov. 6, 1970	Cf, E, 15	Irr	Yield reported 400 gpm. Four-well manifold system with all holes the same depth and completed the same, and pumped by a common pump and motor.
* 103	Ray C. Morgan	M. L. Myatt	1969	44	14	44	Qal	1,208	8.03	Feb. 12, 1970	T, G, 30	Irr	Yield reported 590 gpm. Water reported from sand and gravel at 36 to 44 feet. Red beds reported at 44 feet.

See footnotes at end of table.

	Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
	13 47-104	Ray C. Morgan	M. L. Myatt	1970	52	14	52	Qal	1,208	7.45	Feb. 12, 1970	T, -, 30	N	Unused irrigation well. Yield reported 750 gpm. Water reported from sand and gravel at 40 to 52 feet. Red beds reported at 52 feet.
*	105	Royce Eiland	Royce Eiland	--	15	2	15	Qal	1,199	7	Nov. 6, 1970	J, E, 1/3	D, S	Driven sandpoint. Yield reported good. Water reported from sand and gravel.
	106	do	Robert Dale	1967	41	6	41	Qal	1,202	8.03	do	Cf, E, 15	Irr	Yield reported greater than 300 gpm. Two-well manifold system with both holes the same depth and completed the same, pumped by a common pump and motor. 1/
	107	Ross Estate	do	1965	46-48	6	48	Qal	1,203	10	Nov. 10, 1970	Cf, G	Irr	Yield reported 500 gpm. Three-well manifold system with the holes ranging in depth from 46 to 48 feet and completed the same, pumped by a common pump and motor.
	401	Johnson and Ekern	do	1959	42	6	42	Qal	1,194	7 8	Feb. 1959 June 10, 1971	Cf, E, 25	Irr	Yield reported 450 gpm. Four-well manifold system with all holes the same depth and completed the same, pumped by a common pump and motor.
	402	do	Bill Lance and Robert Dale	1947	42	6 8	42 42	Qal	1,191	5 8	Apr. 1947 June 10, 1971	Cf, E, 25	Irr	Yield reported 600 gpm. Four-well manifold system with two holes cased with 6-inch and two holes cased with 8-inch casing. All holes are completed the same and pumped with a common pump and motor.
	403	R. J. Adams	--	1954	31	--	--	Qal	1,188	5	Mar. 31, 1960	N	N	Destroyed. Formerly a three-well manifold system used for irrigation; yield reported 350 gpm.
	404	Fred McLaughlin	Robert Dale	1970	45	14	45	Qal	1,199	7.54	Nov. 4, 1970	T, G, 40	Irr	Yield reported 450 gpm. 1/
*	405	do	do	1968	40	6	40	Qal	1,202	8.71	do	J, E, 1/2	D	Water reported from coarse sand and gravel with base at 40 feet. Red beds reported at 40 feet.
*	406	Mrs. H. D. Williamson	M. L. Myatt	1970	38	14	38	Qal	1,180	10.61	do	T, -	Irr	Yield reported 800 gpm. Equipment being installed. Water reported from sand and gravel at 10 to 38 feet. Red beds reported at 38 feet.
*	407	do	do	1970	38	14	38	Qal	1,185	11.12	do	T, -	Irr	Yield reported 800 gpm. Equipment being installed. Water reported from sand and gravel at 10.5 to 38 feet. Red beds reported at 38 feet.
*	408	Johnson and Ekern	Robert Dale	1967	41	6	41	Qal	1,194	8	June 10, 1971	Cf, E, 25	Irr	Yield reported 600 gpm. Four-well manifold system with all holes the same depth and completed the same, pumped by a common pump and motor.
*	409	do	Lee Hopper	1969	42	6	42	Qal	1,189	8	do	Cf, E, 25	Irr	Yield reported 700 gpm. Four-well manifold system with all holes the same depth and completed the same, pumped by a common pump and motor.
*	410	do	Robert Dale	1967	31	6	31	Qal	1,188	8	do	Cf, E, 25	Irr	Yield reported 500 gpm. Four-well manifold system with all holes the same depth and completed the same, pumped by a common pump and motor.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
13-47-411	Johnson and Ekern	Robert Dale	1967	42	6	42	Qal	1,184	8	June 10, 1971	Cf, E, 25	Irr	Yield reported 600 gpm. Four-well manifold system with all holes the same depth and completed the same, pumped by a common pump and motor.
* 701	J. C. Parker	Lee Hopper	1964	40	14	40	Qal	1,178	9.85 9.90	Nov. 10, 1970 Jan. 7, 1971	T, G	Irr	Yield reported 650 gpm. Water reported from gravel at 9 to 39 feet. Red beds reported at 39 feet. 4/
* 702	do	do	1964	39	6	39	Qal	1,183	8.00	Nov. 10, 1970	Cf, G	Irr	Yield reported 300 gpm. Two-well manifold system with both holes the same depth and completed the same, pumped by a common pump and motor.
* 703	Horace B. Coffee	W. F. Lantz	1965	35	12	35	Qal	1,179	9.40	Nov. 4, 1970	Cf, G	S, Irr	Yield reported 160 gpm. Water reported from sand and gravel at 8 to 35 feet. Red beds reported at 35 feet.
704	John D. Alexander	--	1962	38	--	--	Qal	1,177	10	Nov. 5, 1970	N	N	Destroyed. Formerly a two-well manifold system used for irrigation, with yield reported 700 gpm.
* 705	do	M. L. Myatt	1970	35	16	35	Qal	1,176	9.94	do	T, G, 60	Irr	Yield reported 700 gpm. 1/
706	James Sullivan	Robert Dale	1964	35	6	35	Qal	1,179	7.39	Nov. 6, 1970	Cf, G	Irr	Yield reported 300 gpm. Two-well manifold system with both holes the same depth and completed the same, pumped by a common pump and motor. 1/
* 707	do	--	--	16	2	16	Qal	1,190	--	--	C, W	S	Driven sandpoint. Water reported from sand and gravel.
* 708	Charles S. White	Robert Dale	1964	42	18 14	32 42	Qal	1,179	14.50	Nov. 11, 1970	T, G	Irr	Yield reported 400 gpm. Water reported from sand and gravel at 12 to 42 feet. Red beds at 42 feet.
709	Lee A. Roberson	do	1968	28	6	28	Qal	1,177	7.48	do	Cf, E, 20	Irr	Yield reported 560 gpm. Four-well manifold system with all holes the same depth and completed the same, pumped by a common pump and motor.
* 710	do	do	1965	28	6	28	Qal	1,176	7.68	do	N	N	Unused stock well. Water reported from sand and gravel.
711	do	do	1965	28	6	28	Qal	1,177	7.81	do	Cf, E, 15	Irr	Yield reported 300 gpm. Four-well manifold system with all holes the same depth and completed the same, pumped by a common pump and motor.
* 712	do	do	1970	28	6	28	Qal	1,178	7.51	do	Cf, E, 5	Irr	Yield reported 85 gpm. Water reported from sand and gravel.
* 713	do	do	1970	29	6	29	Qal	1,179	9.27	do	J, - 1/3	N	Unused domestic well. Water reported from sand and gravel.
* 714	Wiley Thomas	do	1965	32	5	29	Qal	1,171	10.30	June 10, 1971	J, E, 3/4	D	Not used for human consumption.
* 53-108	J. F. Calvert	--	--	Spring	--	--	Pprsa	1,450	(+)	Nov. 3, 1970	Flows	--	Flows from gravel at base of the San Angelo Formation. Yield estimated greater than 5 gpm.
* 109	Lonnie Ross	Carl Bradford	1968	45	5	45	Pprsa	1,449	20.12	June 9, 1971	J, E, 1/2	D, S	Yield reported strong.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
* 13-53-110	Flynn Estate	--	1924	15	6	15	Pprsa	1,414	11.53	June 9, 1971	J, E, 1/2	D	Yield reported strong.
* 402	Luke Graf	--	--	26	--	--	Pcf	1,368	25.48	Nov. 3, 1970	J, E, 1/3	S	Dug well.
* 501	W. L. Quisenberry	W. L. Quisenberry et al.	1967	13	--	--	Qal	1,320	10.87	do	N	N	Dug well. Unused domestic well. Water reported from fine gravel.
* 502	Cleve E. Pursley	--	--	12	--	--	Qal	1,329	8.74	do	N	N	Dug well. Unused industrial well. Formerly supplied water for the Farmers Valley Gin. Water reported from sand and gravel.
* 503	do	--	--	24	--	--	Pcf	1,325	12.58	Nov. 6, 1970	J, E, 1/3	S, D	Dug well. Yield reported weak.
* 54-501	City of Vernon	Cap Huddleston	--	20	--	--	Qs	1,199	3.74 8.31 10.83 13.26 10.00 12.37 8.00 3.88 4	Oct. 14, 1943 Feb. 9, 1952 Jan. 9, 1953 Jan. 7, 1955 Jan. 8, 1956 Jan. 15, 1957 Jan. 3, 1958 Jan. 17, 1962 Dec. 10, 1969	N	N	Dug well. Unused public supply well, last used in 1939. Well 150 of Vernon rept. 5/ Well G-150 of Bull. 5614. 7/
502	do	do	--	16	--	--	Qs	1,199	3.78 7.68 4	Oct. 14, 1943 Feb. 27, 1951 Dec. 10, 1969	T, E, 3	P	Dug well. Well now used only occasionally to fill the city swimming pool.
503	do	do	--	16	--	--	Qs	1,199	3.21 6.84 4	Oct. 14, 1943 Feb. 27, 1951 Dec. 10, 1969	N	N	Dug well. Unused public supply well, last used in 1939.
504	do	do	--	18	--	--	Qs	1,199	3.24 6.23 4	Oct. 17, 1943 Feb. 9, 1952 Dec. 10, 1969	N	N	Do.
505	do	do	--	18	--	--	Qs	1,199	2.87 4	Oct. 17, 1943 Dec. 10, 1969	N	N	Do.
506	do	do	--	18	--	--	Qs	1,199	2.82 4	Oct. 17, 1943 Dec. 10, 1969	N	N	Do.
507	do	do	--	18	--	--	Qs	1,199	3.03 3.52	Oct. 17, 1943 Dec. 10, 1969	T, E, 5	P	Dug well. Well now used only occasionally to fill the city swimming pool.
508	do	do	--	18	--	--	Qs	1,199	2.79 4	Oct. 14, 1943 Dec. 10, 1969	N	N	Dug well. Unused public supply well, last used in 1939.
509	do	do	--	18	--	--	Qs	1,199	2.74 4	Oct. 17, 1943 Dec. 10, 1969	N	N	Do.
* 510	do	--	--	Spring	--	--	Qs	1,196	(+)	Dec. 10, 1969	Flows	N	Flows northward from approximately the base of the Seymour Formation.
511	Benjamin H. Smith, Jr.	Robert Dale	1966	28	5	28	Qal	1,191	6	Feb. 12, 1970	Cf, G, 26	Irr	Yield reported 90 gpm. Water reported from sand and gravel at 17 to 27 feet. Red beds reported at 27 feet. Four-well manifold system with all holes the same depth and completed the same, pumped by a common pump and motor.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
* 13-54-512	Johnson and Ekern	Robert Dale	1967	31	6	31	Qal	1,197	12	June 10, 1971	Cf, E, 25	Irr	Yield reported 400 gpm. Six-well manifold system with all holes the same depth and completed the same, pumped by a common pump and motor.
* 513	do	do	1967	31	6	31	Qal	1,199	12	do	Cf, E, 25	Irr	Yield reported 600 gpm. Four-well manifold system with all holes the same depth and completed the same, pumped by a common pump and motor.
514	do	Lee Hopper	1969	31	6	31	Qal	1,195	12	do	Cf, E, 25	Irr	Yield reported 700 gpm. Four-well manifold system with all holes the same depth and completed the same, pumped by a common pump and motor.
* 515	Benjamin H. Smith, Jr.	do	1968	30	6	30	Qal	1,197	7.01	Feb. 12, 1970	Cf, G, 26	Irr	Yield reported 80 gpm. Water reported from sand and gravel at 19 to 29 feet. Red beds reported at 29 feet. Five-well manifold system with all holes the same depth and completed the same, pumped by a common pump and motor.
* 516	Hillcrest Country Club	Lee Hopper and Robert Dale	1968	29	5	29	Qal	1,190	12 11.67	Mar. 30, 1971 June 22, 1971	Cf, E, 40	Irr	Originally a five-well manifold system drilled in 1968. System was redrilled by R. Dale in 1971 and only four holes were redrilled with all holes being the same depth and completed the same, pumped by a common pump and motor. 1/ 2/
* 701	Mrs. Cora King	L. E. Stamps	1960	55	10	55	Qs	1,246	18.74 28.15	July 8, 1960 Dec. 2, 1970	T, E, 10	Irr	Yield reported 160 gpm. Water reported from gravel from 33 to 53 feet. Red beds reported at 53 feet.
* 702	do	do	1958	55	14	55	Qs	1,247	19.96 25.44	July 8, 1960 Dec. 2, 1970	T, E, 30	Irr	Yield reported 400 gpm. Water reported from sand and gravel with base at 53 feet.
703	Donna Moore	Robert Dale	1960	64	14	64	Qs	1,235	14.99	Mar. 10, 1970	T, G, 30	Irr	--
704	do	--	before 1943	42	12	42	Qs	1,234	18.55	do	T, G, 20	Irr	Water reported from sand and gravel at 15 to 42 feet. Red beds reported at 42 feet. Well 109 of Vernon rept. 5/
* 705	do	--	--	14	4	14	Qs	1,236	10.79	Nov. 2, 1943	Cf, E, 1/3	D, S	Well 110 of Vernon rept. 5/
706	Willie Kieschnik, Jr.	L. E. Stamps	1958	35	48 16	15 35	Qs	1,242	21.58	Mar. 24, 1970	Cf, E, 2	Irr	Yield reported 100 gpm. This well and well 13-54-707 were in a two-well manifold system until Feb. 1970; wells are now pumped separately.
* 707	do	do	1958	35	48 16	15 35	Qs	1,241	22.29	do	Cf, E, 2	Irr	Yield reported 100 gpm. This well and well 13-54-706 were in a two-well manifold system until Feb. 1970; wells are now pumped separately.
708	Donna Moore	Robert Dale	1953	41	14	41	Qs	1,250	28.19	do	T, E, 15	Irr	Yield reported 100 gpm. Water reported from sand and gravel at 33 to 41 feet. Red beds reported at 41 feet.
709	Willie Kieschnick, Sr.	do	1959	35	14	35	Qs	1,250	22.07	do	T, E, 10	Irr	Yield reported 100 gpm. Water reported from sand and gravel at 27 to 35 feet. Red beds reported at 35 feet.
710	do	L. E. Stamps	1960	33	8	33	Qs	1,241	--	--	Cf, E, 30	N	Destroyed irrigation manifold system. Now sanded up. Yield reported 200 gpm. Water reported from sand and gravel at 21 to 32 feet. Red beds reported at 32 feet.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
* 13-54-711	Willie Kieschnick, Jr.	Robert Dale	1969	37	6	37	Qs	1,250	28.93	Mar. 24, 1970	Sub, E, 3/4	S	Yield reported 30 gpm. Water reported at 29 to 36 feet. Red beds reported at 36 feet.
* 712	Willie Kieschnick, Sr.	do	1963	46	14	46	Qs	1,249	27.58	do	T, E, 15	Irr	Water reported from sand and gravel at 12.5 to 45 feet. Red beds reported at 45 feet. Well 13-54-713 pumps into this well. 2/
713	do	L. E. Stamps	1956	39	14	39	Qs	1,248	26.29	do	T, E, 10	Irr	Yield reported 75 gpm. Water reported from sand and gravel at 27 to 38 feet. Red beds reported at 38 feet. This well pumps into well 13-54-712.
* 714	Albert C. Graf	do	1956	38	14	38	Qs	1,251	24.81	Apr. 3, 1970	T, E, 5	Irr	Yield reported 65 gpm. Water reported from sand and gravel.
* 715	do	Jim Rae	1960	40	16	40	Qs	1,242	20.38	do	T, E, 20	Irr	Yield reported 290 gpm. Water reported from sand and gravel.
* 716	Curtis A. Graf	Robert Dale	1968	54	14	54	Qs	1,250	25.87	do	T, E, 15	Irr	Yield reported 345 gpm. 1/
* 717	Albert C. Graf	do	1966	38	14	38	Qs	1,254	24.35	do	T, E, 10	Irr	Yield reported 160 gpm. Water reported from sand and gravel.
* 718	Joe Frank Lowe	do	1967	56	14	56	Qs	1,248	49.49	July 29, 1970	T, E, 25	Irr	The water-level measurement shown was obtained while well was pumping. Yield reported 400 gpm. 1/
* 719	Otto J. Obenhaus, Jr.	do	1962	42	14	42	Qs	1,244	27.33	Dec. 9, 1970	T, E, 10	Irr	Yield reported 25 gpm. Water reported from sand and gravel at 17 to 40 feet. Red beds reported at 40 feet.
* 720	do	L. E. Stamps	1956	42	14	42	Qs	1,250	31.64	do	Cf, E, 5	Irr	Yield reported 25 gpm. Water reported from sand and gravel.
* 721	do	Robert Dale	1964	42	14	42	Qs	1,250	32.69	do	T, E, 10	Irr	Yield reported 20 gpm. Water reported from sand and gravel. Well 13-54-722 pumps into this well.
* 722	do	do	1965	42	14	42	Qs	1,250	37.40	do	Cf, E, 3	Irr	Yield reported 10 gpm. Water reported from sand and gravel. This well pumps into well 13-54-721.
* 723	do	do	1965	42	6	42	Qs	1,250	28	do	J, E, 1/3	D, S	Yield reported weak. Water reported from sand and gravel.
724	Mrs. Jack Orr	L. E. Stamps	1959	41	14	41	Qs	1,238	24.89	do	T, -	N	Unused irrigation well. Yield reported 25 gpm. Water reported from sand and gravel.
725	Dr. J. P. Eaton	Robert Dale	1970	52	14	52	Qs	1,251	27	Aug. 28, 1970	Sub, E, 5	Irr	1/ 2/
726	Maurice Oliver	do	1967	51	14	51	Qs	1,242	18	Jan. 10, 1967	T, E, 15	Irr	1/ 2/
727	Frank Kock	do	1971	58	14	58	Qs	1,255	27	Mar. 23, 1971	T, E	Irr	1/ 2/
728	do	Lee Hopper	1969	40	6	40	Qs	1,258	--	--	Sub, E	Irr	--
* 729	Myrtle Welch	--	1965	45	6	45	Qs	1,237	24.5	Apr. 11, 1967	J, E, 1/3	D	--
730	Albert C. Graf	Robert Dale	1971	46	14	46	Qs	1,255	29	Apr. 4, 1971	Sub, E, 1	Irr	1/ 2/

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
13-54-731	Arthur Schultz	Robert Dale	1971	42	14	42	Qs	1,246	25	May 13, 1971	T, E	Irr	1/ 2/
801	City of Vernon	Bill Turner	1948	42	18	42	Qs	1,231	32 29.70 24.36 21.65 17.31 16.34 15.72 18.33 20.03	May 17, 1949 Jan. 9, 1952 Jan. 8, 1956 Jan. 15, 1957 Jan. 5, 1958 Jan. 29, 1960 Jan. 18, 1963 Dec. 10, 1969 Feb. 5, 1971	T, E, 5	P	Yield reported 225 gpm. Water reported from sand and gravel. Well G-330 of Bull. 5614. 7/
802	do	H. E. Reed	1939	38	18	38	Qs	1,230	31 30.97 30.82 31.77 28.57	May 17, 1949 Feb. 27, 1951 Jan. 7, 1953 Jan. 6, 1954 Jan. 8, 1955	N	N	Unused public supply well, capped with cement. Yield reported 300 gpm. Water reported from sand and gravel. Well G-329 of Bull. 5614. 7/
803	do	do	1947	44	18	44	Qs	1,229	27 26.49 23.65 18.92 17.81 21.27 21.39	May 17, 1949 Jan. 8, 1956 Jan. 15, 1957 Jan. 5, 1958 Jan. 29, 1960 Dec. 9, 1969 Feb. 5, 1971	T, E, 5	P	Yield reported 225 gpm. Water reported from sand and gravel.
* 804	do	do	1940	42	18	42	Qs	1,230	22 20.47 31.98 24.26 17.79 20.16 20.91	Apr. 11, 1941 Nov. 10, 1943 Jan. 6, 1954 Jan. 17, 1957 Jan. 29, 1960 Dec. 9, 1969 Feb. 5, 1971	T, E, 5	P	Yield reported 257 gpm. Water reported from sand and gravel at 22 to 41 feet. Red beds reported at 41 feet. Well 146 of Vernon rept. 5/ Well G-146 of Bull. 5614. 7/
* 805	do	Tom Chance and H. E. Reed	1939	45	18	45	Qs	1,231	22 18.73 32.36 22.76 16.70 20.73 22.97	Apr. 11, 1941 Oct. 11, 1943 Jan. 6, 1954 Jan. 15, 1957 Jan. 18, 1963 Dec. 10, 1969 Feb. 5, 1971	T, E, 15	P	Yield reported 300 gpm. Water reported from sand and gravel at 22 to 41 feet. Well 145 of Vernon rept. 5/ Well G-145 of Bull. 5614. 7/
* 806	do	H. E. Reed	1940	41	18	41	Qs	1,232	22 16.43 31.40 24.93 15.43 18.59 24.56	Apr. 11, 1941 Oct. 23, 1943 Feb. 9, 1952 Jan. 8, 1956 Jan. 18, 1963 Dec. 10, 1969 Feb. 5, 1971	T, E, 5	P	Yield reported 150 gpm. Water reported from sand and gravel at 22 to 41 feet. Red beds reported at 41 feet. Well 143 of Vernon rept. 5/ Well G-143 of Bull. 5614. 7/
807	do	Bill Turner	1947	45	18	45	Qs	1,231	27.03 22.60 17.73 16.59 30.06	Jan. 8, 1956 Jan. 15, 1957 Jan. 5, 1958 Jan. 18, 1963 Dec. 10, 1969	T, E, 5	P	Yield reported 165 gpm. Water reported from sand and gravel.
* 808	do	H. E. Reed	1946	41	18	41	Qs	1,231	31 32.92 33.23 24.18 17.12 20.67	May 17, 1949 Feb. 9, 1952 Jan. 6, 1954 Jan. 15, 1957 Jan. 18, 1963 Feb. 5, 1971	T, E, 5	P	Yield reported 225 gpm. Water reported from sand and gravel. 2/ Well G-328 of Bull. 5614. 7/

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diam-eter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
13-54-809	City of Vernon	Bill Turner	1947	45	18	45	Qs	1,232	24.78 22.54 18.31 16.8 16.00 20	Jan. 8, 1956 Jan. 15, 1957 Jan. 5, 1958 Jan. 29, 1960 Jan. 18, 1963 Dec. 10, 1969	T, E, 5	P	Yield reported 150 gpm. Water reported from sand and gravel.
* 810	do	do	1950	45	18	45	Qs	1,227	27.01 32.42 17.46 19.32 20.60 19.70 20.88	Feb. 27, 1951 Jan. 6, 1954 Jan. 18, 1963 Jan. 18, 1966 Jan. 21, 1967 Jan. 13, 1970 Jan. 8, 1971	T, E, 10	P	Well G-325 of Bull. 5614. 4/ 7/
811	do	H. E. Reed	1946	41	18	41	Qs	1,224	31 24.99 32.12 25.53 17.50 24	May 17, 1949 Feb. 27, 1951 Jan. 6, 1954 Jan. 15, 1957 Jan. 30, 1961 Dec. 10, 1969	N	N	Unused public supply well. Yield reported 117 gpm. Well G-326 of Bull. 5614. 7/
812	do	do	1946	43	18	43	Qs	1,224	31 25.08 21.45 18.34 24.04	May 17, 1949 Jan. 15, 1957 Jan. 4, 1958 Jan. 30, 1961 Dec. 10, 1969	J, E, 1/3	D	Former public supply well. Yield reported 65 gpm. Well G-327 of Bull. 5614. 7/
813	do	Bill Turner	1948	41	18	41	Qs	1,221	30 24.25 28.26 29.74	May 17, 1949 Feb. 27, 1951 Jan. 7, 1953 Jan. 6, 1954	N	N	Unused public supply well, capped with cement. Yield reported 225 gpm. Well G-324 of Bull. 5614. 7/
814	do	do	1948	44	--	--	Qs	1,215	26 31.26 33.00 31.75 27.75 19.09	May 17, 1949 Feb. 27, 1951 Jan. 8, 1953 Jan. 8, 1955 Jan. 15, 1957 Jan. 18, 1963	N	N	Destroyed public supply well. Yield reported 81 gpm. Well G-323 of Bull. 5614. 7/
815	do	Layne-Texas Co.	1926	43	--	--	Qs	1,214	30 31.00 31.22 31.71	May 17, 1949 Feb. 27, 1951 Jan. 8, 1953 Jan. 6, 1954	N	N	Destroyed public supply well. Yield reported 117 gpm. Well G-322 of Bull. 5614. 7/
816	do	do	1925	40	--	--	Qs	1,213	32.92 33.25 32.05 28.44 22.31 18.99	Feb. 27, 1951 Jan. 6, 1954 Jan. 8, 1955 Jan. 15, 1957 Jan. 29, 1960 Jan. 18, 1963	N	N	Destroyed public supply well. Well 160 of Vernon rept. 5/ Well G-160 of Bull. 5614. 7/
* 817	do	do	1926	39	--	--	Qs	1,216	27.93 33.14 33.27 29.00 27.40 18.39	Apr. 11, 1941 Feb. 27, 1951 Jan. 8, 1953 Jan. 8, 1956 Jan. 15, 1957 Jan. 18, 1963	N	N	Destroyed public supply well. Yield reported 150 gpm. 1/ 2/ Well 163 of Vernon rept. 5/ Well G-163 of Bull. 5614. 7/
818	do	do	1925	44	18	44	Qs	1,217	27.10 32.68 34.53 27.42 16.72 20.91 19.57	Oct. 30, 1943 Feb. 27, 1951 Jan. 6, 1954 Jan. 15, 1957 Jan. 18, 1963 Jan. 13, 1970 Feb. 5, 1971	T, E, 3	P	Yield reported 150 gpm. Well 164 of Vernon rept. 5/ Well G-164 of Bull. 5614. 7/

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diam-eter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
* 13-54-819	City of Vernon	Layne-Texas Co.	1925	46	18	46	Qs	1,218	27.91 33.55 34.18 32.00 27.58 20.09 20.67	Apr. 11, 1941 Feb. 27, 1951 Jan. 8, 1953 Jan. 8, 1955 Jan. 15, 1957 Dec. 9, 1969 Feb. 5, 1971	T, E, 5	P	Yield reported 175 gpm. Well 165 of Vernon rept. 5/ Well G-165 of Bull. 5614. 7/
820	do	H. E. Reed	1945	43	--	--	Qs	1,214	28 35.21 30.04 28.52 22.10 19.37	May 17, 1949 Feb. 27, 1951 Jan. 8, 1956 Jan. 15, 1957 Jan. 29, 1960 Jan. 18, 1963	N	N	Destroyed public supply well. Yield reported 98 gpm. 2/ Well G-321 of Bull. 5614. 7/
* 821	do	Layne-Texas Co.	1926	46	18	46	Qs	1,218	22 29.24 36.73 32.83 23.16 19.63 23.39	Apr. 11, 1941 Nov. 12, 1943 Feb. 27, 1951 Jan. 8, 1956 Jan. 30, 1961 Dec. 10, 1969 Feb. 5, 1971	T, E, 5	P	Yield reported 180 gpm. Water reported from sand and gravel at 22 to 44 feet. Well 166 of Vernon rept. 5/ Well G-166 of Bull. 5614. 7/
* 822	Burke Estate	do	1933	43	18	43	Qs	1,220	28.51 25.73 33.63 20	Apr. 11, 1941 Oct. 14, 1943 Jan. 8, 1953 Dec. 10, 1969	J, E	D	Former public supply well for city of Vernon. Yield reported 150 gpm. Water reported from sand and gravel at 22 to 43 feet. Well 167 of Vernon rept. 5/ Well G-167 of Bull. 5614. 7/
823	City of Vernon	H. E. Reed	1947	44	18	44	Qs	1,252	26 34.92 32.06 29.14 27.43 33.10 33.51	May 17, 1949 Jan. 6, 1954 Jan. 8, 1955 Jan. 5, 1958 Jan. 18, 1963 Dec. 10, 1969 Feb. 4, 1971	T, E, 5	P	Yield reported 225 gpm. Water reported from sand and gravel. Well G-332 of Bull. 5614. 7/
824	do	City of Vernon	1945	40	18	40	Qs	1,253	35.93 33.44 32.27 31.61 28.17 33	Jan. 6, 1954 Jan. 8, 1955 Jan. 15, 1957 Jan. 5, 1958 Jan. 18, 1963 Dec. 10, 1969	T, E, 5	P	Yield reported 100 gpm. Well G-333 of Bull. 5614. 7/
825	do	do	1945	40	1/2 18	-- 40	Qs	1,251	29.93 33.47 25.53 28.60 31.22 30.67 30.97	Feb. 27, 1951 Jan. 6, 1954 Jan. 18, 1963 Jan. 14, 1965 Jan. 14, 1969 Jan. 13, 1970 Jan. 8, 1971	N	N	Unused public supply well. Yield reported 100 gpm. Water reported from sand and gravel. 4/ Well G-331 of Bull. 5614. 7/
* 826	do	Bill Turner	1946	46	18	46	Qs	1,251	26 28.93 28.55 25.21 31.07	May 17, 1949 Jan. 15, 1957 Jan. 5, 1958 Jan. 18, 1963 Dec. 10, 1969	T, E, 7-1/2	P	Yield reported 300 gpm. Water reported from sand and gravel.
827	do	do	1947	45	18	45	Qs	1,253	26 29.82 28.48 26.19 25.50 31.02 31.50	May 17, 1949 Jan. 8, 1956 Jan. 5, 1958 Jan. 29, 1960 Jan. 18, 1963 Dec. 9, 1969 Feb. 4, 1971	T, E, 7-1/2	P	Do.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diam-eter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
* 13-54-828	City of Vernon	H. E. Reed	1947	38	18	38	Qs	1,252	26 25.35 21.84 22.70 21.72 22	May 17, 1949 Jan. 15, 1957 Jan. 29, 1960 Jan. 30, 1961 Jan. 18, 1963 Dec. 9, 1969	T, E, 5	P	Yield reported 225 gpm. Water reported from sand and gravel.
829	do	do	1946	41	18	41	Qs	1,251	26 27.63 28.17 24.97 25.70 31	May 1949 Feb. 27, 1951 Jan. 15, 1957 Jan. 29, 1960 Jan. 18, 1963 Dec. 10, 1969	T, E, 3	P	Yield reported 200 gpm. Water reported from sand and gravel.
* 830	do	Bill Turner	1949	41	18	41	Qs	1,254	22.96 24.40 22.50 24.10 19.90 30.90 30.52	Feb. 9, 1952 Jan. 8, 1955 Jan. 8, 1956 Jan. 15, 1957 Jan. 29, 1960 Dec. 9, 1969 Feb. 4, 1971	T, E, 5	P	Yield reported 150 gpm. Water reported from sand and gravel. Well G-334 of Bull. 5614. 7/
831	R. L. More, Jr.	Tom Chance	--	43	--	--	Qs	1,241	17.29 22.48 23.14 17.49 20.40 29	Nov. 2, 1943 Feb. 28, 1951 Jan. 7, 1955 Jan. 3, 1958 Jan. 17, 1963 June 22, 1971	J, E, 2	D, Irr	Dug well. Water reported from sand and gravel at 20 to 42 feet. Red beds reported at 42 feet. Well 133 of Vernon rept. 5/
* 832	do	do	--	38	120	9	Qs	1,242	17.42 23.20 21.29 17.74 19.19 26.60	Nov. 2, 1943 Feb. 10, 1952 Jan. 7, 1956 Jan. 3, 1958 May 25, 1960 June 22, 1971	J, E, 2	D, Irr	Dug well. Water reported from sand and gravel at 20 to 42 feet. Red beds reported at 42 feet. Well 114 of Vernon rept. 5/
833	Martha Wilhelm	Robert Dale	1958	29	2	29	Qs	1,258	26	Apr. 16, 1970	Cf, G	N	Unused irrigation manifold system. Yield reported weak. There are 12 wells in the system, all the same depth and completed the same, pumped by a common pump and motor. Water reported from sand and gravel.
* 834	City of Vernon	Layne-Texas Co.	1927	44	18	44	Qs	1,220	30	May 17, 1949	N	N	Former public supply well, capped with cement. Yield reported 65 gpm. Well 154 of Vernon rept. 5/
835	do	Tom Chance	1938	28	--	--	Qs	1,232	22.25 16.50 19.90 20.72 21.10	Apr. 11, 1941 Oct. 12, 1943 Dec. 10, 1969 Jan. 13, 1970 Jan. 8, 1971	N	N	Dug well. Unused irrigation well. Yield reported 200 gpm. Water reported from sand and gravel. 4/ Well 144 of Vernon rept. 5/
836	Fred Schmoker	Robert Dale	1966	41	14	41	Qs	1,232	20.70	Dec. 10, 1969	Cf, E	Irr	--
* 837	Mrs. F. B. Elliott	Lee Hopper	1969	45	16	45	Qs	1,251	26.67	Feb. 19, 1970	T, E, 25	Irr	Yield reported 200 gpm.
838	do	Robert Dale	1969	46	14	46	Qs	1,252	28 28.01	Apr. 3, 1969 Feb. 19, 1970	T, E, 10	Irr	1/ 2/
839	Harold Star	do	1968	47	14	47	Qs	1,252	28 26.82	Mar. 14, 1968 Feb. 19, 1970	T, E, 15	Irr	1/ 2/
* 840	Curtis R. Renfro	L. E. Stamps	1955	32	14	32	Qs	1,234	21.05	Mar. 5, 1970	T, E, 7-1/2	Irr	Water reported from sand and gravel at 20 to 31 feet. Red beds reported at 31 feet.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
* 13-54-841	Curtis R. Renfro	L. E. Stamps	1955	32	14	32	Qs	1,236	22.94	Mar. 5, 1970	T, E, 7-1/2	Irr	Water reported from sand and gravel at 20 to 31 feet. Red beds reported at 31 feet.
* 842	do	do	1955	32	14	32	Qs	1,234	20.61	do	T, E, 7-1/2	Irr	Do.
* 843	do	do	1955	32	14	32	Qs	1,237	19.94	do	T, E, 7-1/2	Irr	Do.
844	do	do	1955	32	14	32	Qs	1,238	20.80	do	N	N	Unused irrigation well. Water reported from sand and gravel at 20 to 31 feet. Red beds reported at 31 feet.
* 845	Martha Wilhelm	Robert Dale	1955	32	16	32	Qs	1,252	25.89	Apr. 16, 1970	T, E, 10	Irr	Yield reported greater than 75 gpm. Water reported from sand and gravel.
846	J. H. Pettit et al.	Lough Brothers	1928	42	18	42	Qs	1,221	18.46 20.15	Nov. 1, 1943 Dec. 9, 1970	T, E, 5	Irr	Yield reported 150 gpm. Water reported from sand and gravel with base at 42 feet. Former public supply well for the city of Vernon. Well 152 of Vernon rept. 5/
847	do	Robert Dale	1965	45	14	45	Qs	1,221	20.17	do	T, E, 5	Irr	Yield reported 150 gpm. Water reported from sand and gravel. This well pumps into well 13-54-848.
* 848	do	Layne-Texas Co.	1926	46	18	46	Qs	1,222	16 20 20.78	1929 1943 Dec. 9, 1970	T, E, 5	Irr	Yield reported greater than 50 gpm. Former public supply well for city of Vernon. 1/ Well 153 of Vernon rept. 5/
849	Wilbarger County Hospital	Robert Dale	1970	48	14	48	Qs	1,224	17	Feb. 14, 1970	Sub, E, 10	Irr	1/ 2/
* 850	Texas Department of Mental Health and Mental Retardation	--	1956	47	14	47	Qs	1,234	18	1969	T, E, 15	Irr	Water reported from gravel.
851	Frank Kock	Lee Hopper	1969	35	--	--	Qs	1,259	--	--	--	Irr	One well of four-well collector system.
852	do	do	1969	35	--	--	Qs	1,260	--	--	--	Irr	Do.
853	do	do	1969	40	--	--	Qs	1,261	--	--	--	Irr	Do.
854	do	Robert Dale	1970	33	14	33	Qs	1,264	25	Mar. 5, 1970	Cf, E, 2	Irr	Yield reported 25 gpm. One well of a four-well collector system. 1/
855	Kampgrounds of America	do	1951	42	14	42	Qs	1,220	--	--	T, E, 10	Irr	--
901	City of Vernon	H. E. Reed	1935	57	18	57	Qs	1,232	25 28.47 39.52 26.52 23.98 25	Apr. 11, 1941 Oct. 13, 1943 Jan. 8, 1955 Jan. 29, 1960 Jan. 18, 1963 Dec. 10, 1969	T, E, 5	P	Yield reported 98 gpm. Water reported from sand and gravel. Well 173 of Vernon rept. 5/ Well G-173 of Bull. 5614. 7/
902	do	do	1931	48	18	48	Qs	1,230	25 32.26 39.30 41.20 37.86 29.29	Apr. 1941 Oct. 14, 1943 Feb. 27, 1951 Jan. 7, 1953 Jan. 8, 1956 Jan. 29, 1960	N	N	Destroyed public supply well. Yield reported 175 gpm. Water reported from sand and gravel at 25 to 48 feet. Well 174 of Vernon rept. 5/ Well G-174 of Bull. 5614. 7/

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

	Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
*	13-54-903	City of Vernon	H. E. Reed	1931	49	18	49	Qs	1,224	25 28.21 36.54 28.97 22.94 24.19 24.14 24.69	Apr. 11, 1941 Oct. 11, 1943 Jan. 8, 1955 Jan. 3, 1958 Jan. 15, 1964 Dec. 10, 1969 Jan. 13, 1970 Jan. 8, 1971	T, E, 5	P	Yield reported 160 gpm. Water reported from sand and gravel at 25 to 48 feet. 2/ 4/ Well 171 of Vernon rept. 5/ Well G-171 of Bull. 5614. 7/
*	904	do	do	1932	55	18	55	Qs	1,229	25 29.52 38.91 35.28 27.27 25	Apr. 11, 1941 Oct. 14, 1943 Feb. 10, 1952 Jan. 8, 1956 Jan. 29, 1960 Dec. 10, 1969	T, E, 5	P	Yield reported 180 gpm. Water reported from sand and gravel. Well 172 of Vernon rept. 5/ Well G-172 of Bull. 5614. 7/
*	905	do	City of Vernon	1946	53	18	53	Qs	1,229	32 36.55 37.62 26.84 24.84 24.58 25.76 25.87	May 17, 1949 Feb. 27, 1951 Jan. 8, 1955 Jan. 29, 1960 Jan. 15, 1964 Dec. 9, 1969 Jan. 13, 1970 Feb. 5, 1971	T, E, 5	P	Yield reported 200 gpm. Water reported from sand and gravel. 4/ Well G-320 of Bull. 5614. 7/
*	906	Dr. James J. Muirhead	Don Hopper	1965	25	6	25	Qs	1,210	11 15.00	June 21, 1965 July 31, 1970	N	N	Unused irrigation well. 1/ 2/
	907	Dr. J. J. Slaugenhop	Robert Dale	1969	35	14	35	Qs	1,202	15	Mar. 30, 1969	T, E, 5	Irr	Yield reported 100 gpm. This is one well of a two-well collector system. 1/
	908	do	do	1969	43	14	43	Qs	1,210	20	Mar. 31, 1969	T, E, 5	Irr	Do.
*	909	Dr. J. D. Hoover	Lee Hopper	1963	20	6	20	Qal	1,185	7.43	June 15, 1971	Cf, E, 1	Irr	Yield reported 50 gpm. Four-well manifold system with all holes the same depth and completed the same, pumped by a common pump and motor.
*	910	do	L. E. Stamps	--	20	6	20	Qal	1,192	11.87	do	J, E, 3/4	D	--
*	55-101	E. B. Schur	E. B. Schur	1942	50	5	50	Qs	1,250	32.24	June 10, 1971	J, E, 1/2	Irr	Yield reported weak.
*	102	J. B. Halford	Dan Magness	1912	38	--	--	Qs	1,220	25.10	do	J, E, 3/4	D, S	Dub well. Yield reported strong.
*	103	Vera Hendrix	F. F. Thomas	1940	25	--	--	Qs	1,190	21.94	do	J, E, 1/2	D, S	Dug well. Yield reported good.
*	401	Charles V. Schur	--	--	25	36	25	Qal	1,169	14.29	June 15, 1971	J, E, 1/2	S	Dug well. Yield reported strong.
*	402	Johnson and Ekern	Robert Dale	1966	25	6	25	Qs	1,230	8	1966	Cf, E, 20	Irr	Yield reported 600 gpm. Water reported from sand and gravel. Four-well manifold system with all holes the same depth and completed the same, pumped by a common pump and motor.
*	403	do	Lee Hopper	1967	30	6	30	Qs	1,220	--	--	Cf, E, 25	Irr	Yield reported 600 gpm. Six-well manifold system with all holes the same depth and completed the same, pumped by a common pump and motor.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
* 13-55-404	Johnson and Ekern	Lee Hopper	1969	31	6	31	Qs	1,223	--	--	Cf, G, 40	Irr	Yield reported 700 gpm. Water reported from sand and gravel. Four-well manifold system with all holes the same depth and completed the same.
* 501	Wilbert A. Kieschnick	Robert Dale	1963	21	6	21	Qal	1,142	8.56	Feb. 5, 1970	Cf, G	Irr	Yield reported 200 gpm. This well and 13-55-502 are on a manifold system and pumped by a common pump and motor.
502	do	do	1963	22	6	22	Qal	1,143	8.59	do	Cf, G	Irr	Yield reported 180 gpm. This well and 13-55-501 are on a manifold system and pumped by a common pump and motor.
* 503	do	--	--	Spring	--	--	Qal	1,140	(+)	do	Flows	N	--
* 504	do	L. E. Stamps	1957	48	6	48	Qs	1,224	35.84	do	J, E, 1/3	N	Unused domestic well. Yield reported weak. Water reported from sand and gravel. Red beds reported at 47 feet.
* 505	J. A. Dixon Estate	--	1910	28	1	28	Qs	1,187	--	--	C, W	S	Hand-driven sandpoint. Yield reported good. Water reported from sand at 22 to 26 feet. Well 195 of Vernon rept. 5/
* 506	do	Dea Millspaugh	1970	23	6	23	Qs	1,170	13.79	Dec. 1, 1970	J, E, 1/2	S, D	Yield reported good. Water reported from sand and gravel at 21 to 23 feet.
* 507	do	--	--	35	--	--	Qs	1,187	29.99	do	J, E, 1/3	D	Dug well.
* 508	Leroy Hobratschk	Lee Hopper	1966	25	12	25	Qs	1,170	19.12	June 16, 1971	Cf, E, 3	Irr	Yield reported 45 gpm. Water reported from sand and gravel.
* 509	A. A. Hingst	--	--	60	6	60	Qs	1,222	16.64	do	C, W	S	--
* 510	A. C. Borger	A. E. Janek	1942	38	--	--	Qs	1,180	18.20 20	Nov. 4, 1943 June 24, 1971	J, E, 3/4	D, S	Water reported from sand and gravel below 26 feet. Well 196 of Vernon rept. 5/
* 601	Earl J. King	Mr. Vanick	--	26	--	--	Qs	1,172	22.71	June 23, 1971	J, E, 1/3	D	Dug well. Yield reported strong. Well 198 of Vernon rept. 5/
* 602	do	--	--	Spring	--	--	Qs	1,150	(+)	do	Flows	S	Flows from contact of Seymour Formation. Yield estimated 3 gpm.
* 603	Mrs. H. Y. Pitts	Carl Bradford	1969	25	6	25	Qs	1,162	20	do	J, E, 1/3	D	Yield reported fair.
* 701	Earl Graf	--	--	38	--	--	Qs	1,192	33	Dec. 1, 1970	J, E, 1/3	D	Dug well. Yield reported good.
* 702	M. L. Sharp	--	1961	30	6	30	Qs	1,198	14.54	June 23, 1971	J, E, 3/4	Ind	Yield reported 50 gpm. Water reported from 6 to 8 feet of sand and gravel.
* 703	Johnson and Ekern	Robert Dale	1960	35	8	35	Qs	1,181	--	--	Sub, E	S	--
* 801	J. A. Dixon Estate	--	--	24	--	--	Qs	1,180	3.59 5.72	Nov. 3, 1943 Dec. 1, 1970	J, E, 1/2	D	Yield reported good. Well 194 of Vernon rept. 5/
* 802	Mrs. W. S. Bourland	--	--	15	60	15	Qs	1,205	13.30 13.36	Nov. 3, 1943 June 24, 1971	N	N	Unused domestic well. Water reported from sand. Well 192 of Vernon rept. 5/
* 56-401	Clarence C. Freeling	--	1942	65	--	--	Qs	1,200	63	Dec. 4, 1970	J, E, 1/3	D, S	Dug well. Yield reported weak. Water reported from sand at 61.5 to 63 feet. Red beds reported at 63 feet.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
* 13-56-402	Mrs. W. H. Gfeller	--	1936	26	--	--	Qs	1,223	21.36	June 24, 1971	J, E, 1/3	D, S	Dug well. Yield reported fair. Water reported from gravel.
* 403	Jimmy Koontz	Pat Waggoner	1964	86	8	86	Qs	1,221	67.55	June 23, 1971	Sub, E, 1/2	D, S	Yield reported greater than 100 gpm.
* 501	M. A. Gillis	Amarillo Drilling & Septic Co.	1970	55	18	55	Qs	1,194	33.84	Dec. 3, 1970	N	D, S	Well being completed in Dec. 1970. Water reported from sand and gravel at 31 to 52 feet. Red beds reported at 52 feet.
* 502	do	--	1945	65	--	--	Qs	1,191	34	do	J, E, 1/2	D, S	Dug well. Yield reported strong.
* 503	E. L. Gooch	--	1959	62	--	--	Qs	1,201	30	do	J, E, 1/3	D	Yield reported strong. Water reported from sand and gravel at 35 to 60 feet. Red beds reported at 60 feet.
* 504	Clarence C. Freeling	--	--	28	2	28	Qal	1,120	8	Dec. 4, 1970	Cf, E, 1/3	S	Driven sandpoint. Water reported from sand and gravel.
505	do	Robert Dale	1960	28	6	28	Qal	1,119	8.13	do	Cf, E, 20	Irr	Yield reported 400 gpm. Water reported at 7 to 28 feet. Red beds reported at 28 feet. Six-well manifold system with all holes the same depth and completed the same, pumped by a common pump and motor.
* 506	Bobby Gene Arnold	Carl Bradford	1966	65	5	65	Qs	1,200	48.73	Dec. 10, 1970	J, E, 1/3	D, S	Yield reported strong. Water reported from sand and gravel.
* 507	R. B. Arnold Estate	Lee Hopper	1968	26	5	26	Qal	1,118	5.61	do	Cf, G	Irr	Yield reported 400 gpm. Water reported from sand and gravel at 4 to 24 feet. Red beds reported at 24 feet. Five-well manifold system with all holes the same depth and completed the same, pumped by a common pump and motor.
* 601	E. L. Kieschnick	Anton Vonic	1951	32	--	--	Qs	1,166	--	--	J, E, 1/3	D, S	Dug well. Yield reported good.
* 602	Leonard R. Payton	--	--	Spring	--	--	Qs	1,130	(+)	Dec. 10, 1970	Flows	S	Flows from Seymour Formation.
* 603	Toney Mayer	--	--	25	--	--	Qs	1,145	13.28	June 23, 1971	J, E, 1/2	D, S	Yield reported weak.
* 701	Charles Tirey	Lee Hopper	1964	37	12	37	Qs	1,240	26.09 25.08 25.13 25.09	Nov. 20, 1969 Dec. 16, 1969 Jan. 13, 1970 Feb. 12, 1971	N	N	Unused domestic well. Yield reported good. Water reported from sand and gravel at 19.5 to 39.5 feet. Red beds reported at 39.5 feet. 4/
* 702	H. J. Shelnutt	--	--	33	--	--	Qs	1,235	31.60	June 25, 1971	Cf, E, 1/3	D, S	Dug well. Yield reported strong.
801	Mrs. John Carmichael	--	--	34	--	--	Qs	1,191	24.71 26.02 26.06 25.59	Nov. 20, 1969 Dec. 16, 1969 Jan. 13, 1970 Jan. 7, 1971	C, E	S	Dug well. Yield reported weak. 4/
* 802	do	H. K. McCracken	1966	36	30	36	Qs	1,191	23.65	Nov. 20, 1969	J, E, 1/2	D	Yield reported fair. Water reported from sand and gravel at 17 to 24 feet. Red beds reported at 24 feet.
* 803	Mrs. J. R. Kubala	Amarillo Drilling and Septic Co.	1968	38	24	38	Qs	1,232	23.33	June 25, 1971	J, E, 3/4	D	Yield reported strong. Water reported from sand with base at 36 feet. Red beds reported at 36 feet.
* 804	W. B. Houtchens	do	1965	25	36	25	Qs	1,176	16	June 24, 1971	J, E, 1/2	D, S	Yield reported strong.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
* 13-56-805	Elliott Producers Gin	--	1958	24	--	--	Qs	1,198	14.70	June 23, 1971	J, E, 1/3	Ind, D	Dug well. Yield reported strong.
* 806	Mrs. G. C. Schuman	Amarillo Drilling and Septic Co.	1966	26	36	26	Qs	1,204	14.40	do	J, E, 1/3	D	Yield reported strong.
* 901	Leslie Moore	do	1966	29	30	29	Qs	1,155	11.39	Dec. 3, 1970	Cf, E, 2	Irr	Yield reported 75 gpm. Water reported from sand and gravel at 11 to 26 feet. Red beds reported at 26 feet. One of five wells on a collector system. 4/
902	do	do	1970	26	18 16	10 26	Qs	1,160	11.21	do	N	N	Unused irrigation well. Yield reported 50 gpm. Water reported from sand and gravel at 10 to 22 feet. Red beds reported at 22 feet. One of five wells on a collector system.
* 903	do	do	1966	29	24	29	Qs	1,160	12.90 12.60	do Jan. 7, 1971	Cf, E, 2	Irr	Yield reported 50 gpm. Water reported from sand and gravel at 12.5 to 25.5 feet. Red beds reported at 25.5 feet. One of five wells on a collector system.
904	do	do	1966	29	24	29	Qs	1,164	14.1	Dec. 3, 1970	Cf, E, 2	Irr	Yield reported 50 gpm. Water reported from sand and gravel at 12 to 25 feet. Red beds reported at 25 feet. One of five wells in a collector system.
* 905	do	do	1969	29	24	29	Qs	1,165	17.58	do	N	N	Unused irrigation well. Yield reported 50 gpm. Water reported from sand and gravel at 11.7 to 24.7 feet. Red beds reported at 24.7 feet. One of five wells on a collector system.
* 906	Immanuel Luthern Church	Erwin Schoppa	1935	30	--	--	Qs	1,226	18.35	June 25, 1971	J, E, 1/3	D, P	Dug well. Yield reported strong. Water not used for human consumption.
* 907	Albert Jokel	Albert Jokel	1931	35	--	--	Qs	1,189	12.90	June 24, 1971	Cf, E, 1	D, S	Dug well. Yield reported weak.
* 908	Leon Raschke	--	--	20	--	--	Qs	1,209	17	June 23, 1971	J, E	D, S	Dug well. Yield reported weak.
* 909	Albert Lowke	--	1956	20	--	--	Qs	1,210	15.74	June 24, 1971	J, E, 1/2	D, S	Dug well. Yield reported good.
* 61-101	Leon G. Lehman	Robert Dale	1968	31	14	31	Qs	1,261	17.35	Apr. 8, 1970	Cf, G, 25	Irr	Yield reported 150 to 175 gpm. Water reported from sand and gravel.
102	Edward L. Lehman, Jr.	do	1960	30	8	30	Qal	1,258	10	Apr. 1, 1970	Cf, E, 15	Irr	Yield reported 100 gpm. This well, 13-61-103, and 13-61-104 are on a manifold system and are pumped by a common pump and motor.
103	do	do	1960	30	8	30	Qal	1,258	9.94	do	Cf, E, 15	Irr	Yield reported 100 gpm. This well, 13-61-102, and 13-61-104 are on a manifold system and are pumped by a common pump and motor.
* 104	do	Pat Waggoner	1958	30	13	30	Qal	1,258	10	do	Cf, E, 15	Irr	Yield reported 150 gpm. This well, 13-61-102, and 13-61-103 are on a manifold system and are pumped by a common pump and motor. 1/
* 105	Leon G. Lehman	L. E. Stamps	1957	38	16	38	Qal	1,259	13.65	Apr. 8, 1970	N	N	Unused irrigation well. Yield reported greater than 175 gpm. Water reported from sand and gravel.
* 106	do	Robert Dale	1965	25	6	25	Qs	1,275	17.14	do	J, E, 1/2	D	Water reported from sand and gravel.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
* 13-61-201	C. Glenn Cato	Houston Waggoner	1897	21	--	--	Qs	1,269	19 10.16 16.76 17.80 17.50	1897 Oct. 27, 1943 Jan. 16, 1957 Feb. 23, 1962 Jan. 17, 1963	C, W	N	Dug well. Unused domestic and stock well, dry in July 1970. Water reported from sand and gravel with base at 21 feet. Red beds at 21 feet. Well 16 of Vernon rept. 5/
202	E. A. Woolf	Robert Dale	1961	46	14	46	Qs	1,271	27.03	Nov. 19, 1969	T, E, 5	Irr	Yield reported 75 to 100 gpm. Water reported from sand and gravel. This well and three others are on a collector system.
* 203	T. J. McGill Estate	--	1966	50	16	50	Qs	1,281	--	--	T, E, 15	Irr	--
* 204	Edward L. Lehman, Jr.	L. E. Stamps	1958	32	14	30	Qal	1,256	16.70 10.38 11.05	Apr. 12, 1967 Apr. 1, 1970 Feb. 3, 1971	Cf, E, 20	Irr	Yield reported 200 gpm. This well and 13-61-205 are on a manifold system and are pumped by a common pump and motor. 1/
205	do	Robert Dale	1960	30	8	30	Qal	1,255	11.14	Apr. 1, 1970	Cf, E, 20	Irr	Yield reported 200 gpm. This well and 13-61-204 are on a manifold system and are pumped by a common pump and motor.
* 206	do	do	1964	30	8	30	Qal	1,259	12.89	do	Cf, E, 10	Irr	Yield reported 100 gpm. 1/
* 207	do	Carl Bradford	1964	30	6	30	Qal	1,253	13.30	do	J, E, 3/4	S	Yield reported 50 gpm. Water reported from sand and gravel.
208	do	do	1964	30	6	30	Qal	1,251	10.02	do	J, E, 3/4	S	Do.
* 209	do	Pat Waggoner	1956	32	16	32	Qs	1,260	12.22	do	Cf, E, 20	Irr	Yield reported 50 gpm. Water reported from sand and gravel. This well, 13-61-210, and 13-61-551 are on a manifold system and are pumped by a common pump and motor.
* 210	do	L. E. Stamps	1956	32	14	32	Qs	1,260	13.19	do	Cf, E, 20	Irr	Yield reported 50 gpm. Water reported from sand and gravel. This well, 13-61-209, and 13-61-551 are on a manifold system and are pumped by a common pump and motor.
* 211	C. Glenn Cato	--	--	39	12	39	Qs	1,269	--	--	J, E, 1/2	D	Water reported from sand and gravel.
212	--	--	1951	36	--	--	Qs	1,270	--	--	N	N	Test Hole. 1/
* 301	E. A. Woolf	L. E. Stamps	1955	41	14	41	Qs	1,268	29.42 29.64	Dec. 11, 1970 Jan. 8, 1971	T, E, 5	S, Irr	Yield reported 150 gpm. One of four wells on a collector system. 4/
302	Glenn Cato	do	1957	39	14	39	Qs	1,272	28.76 31.56	Jan. 12, 1970 Jan. 8, 1971	Cf, E, 2	Irr	Yield reported 80 gpm. One of four wells on a collector system.
303	E. A. Woolf	Robert Dale	1967	40	14	40	Qs	1,269	31.65	Nov. 19, 1969	T, E, 7-1/2	Irr	Yield reported 100 to 150 gpm. Water reported from sand and gravel.
304	do	do	1961	40	14	40	Qs	1,271	27.90	do	T, G, 32	Irr	Yield reported 200 gpm. Water reported from sand and gravel.
* 305	Albert C. Graf	Jim Rae	1961	38	16	38	Qs	1,262	29.34	Apr. 3, 1970	T, E, 5	Irr	Yield reported 90 gpm. Water reported from sand and gravel. One of four wells on a collector system.
306	do	L. E. Stamps	1960	40	16	40	Qs	1,260	29.67	do	Sub, E, 3	Irr	Yield reported 125 gpm. Water reported from sand and gravel. One of four wells on a collector system.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
13-61-307	Albert C. Graf	Robert Dale	1965	36	14	36	Qs	1,255	26.88	Apr. 3, 1970	T, E, 5	Irr	Yield reported 70 gpm. Water reported from sand and gravel. One of four wells on a collector system.
308	do	do	1964	37	14	37	Qs	1,255	28.69	do	Cf, E, 2	Irr	Yield reported 60 gpm. Water reported from sand and gravel. One of four wells on a collector system.
309	do	do	1965	40	14	40	Qs	1,265	28.44	do	T, E, 15	Irr	Yield reported 110 gpm. Water reported from sand and gravel. Well 13-61-310 pumps into this well.
* 310	do	do	1964	42	14	42	Qs	1,265	28.56	do	Sub, E, 2	Irr	Yield reported 90 gpm. Water reported from sand and gravel. This well pumps into 13-61-309.
311	do	do	1965	37	14	37	Qs	1,252	19.62 24.47	Apr. 8, 1970 Feb. 3, 1971	N	N	Unused irrigation well. Yield reported 70 gpm. Water reported from sand and gravel.
312	do	do	1965	37	14	37	Qs	1,256	25.62	Apr. 8, 1970	N	N	Do.
* 313	Curtis A. Graf	do	1963	41	14	41	Qs	1,264	28.17	Apr. 3, 1970	T, E, 5	Irr	Yield reported 100 gpm. Water reported from sand and gravel. One of four wells on a collector system.
314	do	do	1964	41	14	41	Qs	1,265	27.73 28.53	do Feb. 3, 1971	Cf, E, 2	Irr	Yield reported 50 gpm. Water reported from sand and gravel. One of four wells on a collector system.
315	do	do	1965	39	16	39	Qs	1,266	27.35	Apr. 3, 1970	Cf, E, 2	Irr	Yield reported 100 gpm. Water reported from sand and gravel. One of four wells on a collector system.
* 316	do	do	1965	41	14	41	Qs	1,265	27.02	do	T, E, 3	Irr	Yield reported 75 gpm. Water reported from sand and gravel. One of four wells on a collector system.
* 317	Herbert K. Haseloff	do	1955	48	14	48	Qs	1,268	29.42	Apr. 9, 1970	T, E, 25	Irr	Yield reported 110 gpm. Water reported from sand and gravel. Well 13-61-318 pumps into this well.
318	do	do	1955	48	14	48	Qs	1,268	29.12	do	T, E, 5	Irr	Yield reported 110 gpm. Water reported from sand and gravel. This well pumps into well 13-61-317.
* 319	A. J. Lambert	L. E. Stamps	1955	42	16	42	Qs	1,267	--	--	T, E, 5	Irr	Yield reported greater than 50 gpm. Water reported from sand and gravel. One of four wells on a collector system.
* 320	do	do	1956	42	16	42	Qs	1,268	--	--	T, E, 5	Irr	Do.
321	do	Robert Dale	1961	42	14	42	Qs	1,267	34.80	June 10, 1970	Cf, E, 2	Irr	Water level measured during pumping. Yield reported greater than 50 gpm. Water reported from sand and gravel. One of four wells on a collector system.
* 322	do	do	1969	44	14	44	Qs	1,265	27	Apr. 2, 1969	T, E, 5	Irr	Yield reported greater than 50 gpm. One of four wells on a collector system. 1/
323	Mrs. C. H. Cato	do	1953	26	6	26	Qal	1,239	14.61	July 2, 1970	Cf, E, 15	N	Unused irrigation four-well manifold system with all holes the same depth and completed the same, pumped by a common pump and motor. Yield reported 520 gpm. 1/
* 324	Fagan Miller	do	1956	31	8	31	Qs	1,235	--	--	Cf, E, 10	Irr	Yield reported 80 gpm. Four-well manifold system with all holes the same depth and completed the same, pumped by a common pump and motor.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
* 13-61-325	Fagan Miller	Robert Dale	1956	27	8	27	Qal	1,230	--	--	Cf, E, 15	Irr	Yield reported 125 gpm. Four-well manifold system with all holes the same depth and completed the same, pumped by a common pump and motor. Water reported from sand and gravel.
* 326	J. W. Jackson, Jr.	do	1965	27	6	27	Qs	1,250	20.09	June 8, 1971	Cf, E, 5	Irr	Yield reported 100 gpm. Three-well manifold system with all holes the same depth and completed the same, pumped by a common pump and motor. Water reported from sand and gravel.
327	E. C. Michels	do	1967	43	18	43	Qs	1,267	29.51	Feb. 3, 1971	Cf, E, 3	Irr	Yield reported 125 gpm. Water reported from sand and gravel. One of five wells on a manifold system.
328	do	do	1967	45	18	45	Qs	1,267	28.80	July 2, 1970	Cf, E, 2	Irr	Water level measured during pumping. Yield reported 150 gpm. Water reported from sand and gravel. One of five wells on a manifold system.
* 329	do	do	1966	47	18	47	Qs	1,267	26.66	do	Cf, E, 2	Irr	Water level measured during pumping. Yield reported 175 gpm. Water reported from sand and gravel. One of five wells on a manifold system.
330	do	do	1966	49	18	49	Qs	1,266	33.01	do	Cf, E, 2	Irr	Water level measured during pumping. Yield reported 200 gpm. Water reported from sand and gravel. One of five wells on a manifold system.
331	do	do	1966	51	18	51	Qs	1,266	33.77	do	Cf, E, 2	Irr	Water level measured during pumping. Yield reported 225 gpm. Water reported from sand and gravel. One of five wells on a manifold system.
332	C. Glenn Cato	do	1967	43	18	43	Qs	1,266	31.53	do	T, E, 5	Irr	Yield reported weak. Water reported from sand and gravel. One of four wells on a manifold system.
* 333	do	do	1967	43	18	43	Qs	1,267	24.00	Apr. 11, 1967	T, E, 5	Irr	Yield reported 100 gpm. One of four wells on a manifold system. 1/
* 334	do	do	1967	44	14	44	Qs	1,268	25 32.36	do July 2, 1970	Cf, E, 2	Irr	The July 2, 1970 water level was measured during pumping. One of four wells on a manifold system. 1/ 2/
* 335	Carl A. Rumage	--	1940's	36	6	36	Qs	1,269	31	do	J, E, 1/3	D, S	Yield reported fair. Water reported from sand and gravel.
* 336	do	Robert Dale	1966	39	14	39	Qs	1,263	27.20	Feb. 3, 1971	T, E, 15	Irr	Water reported from sand and gravel at 27 to 37 feet. Red beds reported at 37 feet. 2/
* 337	do	do	1969	24	6	24	Qal	1,228	8.23	July 2, 1970	Cf, E, 20	Irr	Yield reported 330 gpm. Four-well manifold system with all holes the same depth and completed the same, pumped by a common pump and motor. Water reported from sand and gravel at 10 to 21 feet. Red beds reported at 21 feet.
338	James B. Jansa	L. E. Stamps	1960	34	16	34	Qs	1,287	23.51	Feb. 4, 1971	Cf, E, 2	Irr	Yield reported 50 gpm. Water reported from sand and gravel. One of four wells on a collector system.
339	do	do	1960	34	14	34	Qs	1,287	31.06	Dec. 2, 1970	Cf, E, 2	Irr	Water level measured during pumping. Yield reported 50 gpm. Water reported from sand and gravel. One of four wells on a collector system.
340	do	do	1960	34	14	34	Qs	1,287	25.44	do	Cf, E, 2	Irr	Do.
* 341	do	do	1960	34	14	34	Qs	1,287	24.48	do	Cf, E, 2	Irr	Do.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
* 13-61-342	J. W. Jackson, Jr.	L. E. Stamps and Robert Dale	1963	31	14	31	Qs	1,238	17.27	June 8, 1971	Cf, E, 7-1/2	Irr	Yield reported 150 gpm. Three-well manifold system with all holes the same depth and completed the same, pumped by a common pump and motor. Water reported from sand and gravel.
343	--	--	1951	37	--	--	Qs	1,284	--	--	N	N	Test hole. 1/
344	--	--	1951	36	--	--	Qs	1,272	--	--	N	N	Do.
345	--	--	1951	25	--	--	Qs	1,263	--	--	N	N	Do.
413	Leon G. Lehman	Pat Waggoner	1955	30	16	30	Qs	1,277	17.91	Apr. 8, 1970	Cf, G	Irr	Water reported from sand and gravel. This well, 13-61-427, and 13-61-428 are a three-well manifold system, pumped by a common pump and motor. Yield for system reported 350 gpm.
414	do	do	1956	31	16	31	Qs	1,260	17.78	do	Cf, G, 25	Irr	Yield reported at 150 gpm.
* 415	Tom R. Locke	Robert Dale	1956	36	16	36	Qs	1,323	22 27.3	May 22, 1956 June 3, 1970	Cf, G, 32	N	Unused irrigation well. Yield reported 40 gpm. This well and 13-61-419 are two-well manifold system, pumped by a common pump and motor. 1/ Well 4 of Contamination Rept. 8. 9/
417	Sam Judd, Jr.	L. E. Stamps	1959	49	14	49	Qs	1,297	36.98 26.44	July 29, 1960 July 15, 1970	T, -	N	Unused irrigation well. The July 29, 1960 water level was measured during pumping. Yield reported 120 gpm. Water reported at 16 to 47 feet. Red beds reported at 47 feet.
418	Henry W. Karcher	do	1955	42	14	42	Qs	1,301	15 31.18 24.69	1956 July 18, 1960 Mar. 26, 1970	T, G	Irr	Water reported from sand and gravel at 15 to 38 feet. Red beds reported at 38 feet. 2/
419	Tom R. Locke	Robert Dale	1956	35	16	34	Qs	1,325	22 21.89 21.72 27.28	July 11, 1956 Mar. 10, 1960 July 14, 1960 June 3, 1970	Cf, G, 40	N	Unused irrigation well. Yield reported 40 gpm. This well and 13-61-415 are a two-well manifold system, pumped by a common pump and motor. 1/ 2/
* 420	E. A. Woolf	L. E. Stamps	1956	28	13	28	Qs	1,258	17.08	Nov. 14, 1969	Cf, G	Irr, S	Yield reported very weak. Water reported from sand and gravel. This well and 13-61-421 are a two-well manifold system, pumped by a common pump and motor.
421	do	do	1956	27	12	27	Qs	1,258	15.12	do	Cf, G	Irr, S	Yield reported very weak. Water reported from sand and gravel. This well and 13-61-420 are a two-well manifold system, pumped by a common pump and motor.
* 422	C. A. Schmoker	do	1958	56	16	56	Qs	1,308	33.68 32.82 32.02 27.99	Nov. 18, 1969 Dec. 15, 1969 Jan. 12, 1970 Jan. 8, 1971	T, E, 15	Irr	Yield reported 300 gpm. Water reported from sand and gravel. 4/
423	do	do	1955	67	14	67	Qs	1,310	53.00 39.66	July 29, 1960 Nov. 18, 1969	T, G, 40	Irr	The July 29, 1960 water level was measured during pumping. Yield reported 150 gpm. Water reported from sand and gravel.
424	Mrs. Carl Schultz	do	1955	42	14	42	Qs	1,297	27.35	July 15, 1970	T, G	N	Unused irrigation well. Yield reported 60 gpm. Water reported from sand and gravel.
* 425	Henry W. Karcher	Robert Dale	1968	51	18 14	39 51	Qs	1,298	27 25.29 25.11	Mar. 26, 1968 Mar. 26, 1970 Feb. 3, 1971	T, E, 7-1/2	Irr	1/ 2/

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
* 13-61-426	Leon G. Lehman	Robert Dale	1965	28	14	28	Qs	1,268	20.07 20.92	Apr. 8, 1970 Feb. 3, 1971	Cf, E, 10	Irr	Yield reported greater than 150 gpm. Water reported from sand and gravel.
427	do	Pat Waggoner	1955	31	16	31	Qs	1,278	17.90 19.41	Apr. 8, 1970 Feb. 3, 1971	Cf, G	Irr	Water reported from sand and gravel. This well, 13-61-428, and 13-61-413 are a three-well manifold system, pumped by a common pump and motor. Yield of system reported 350 gpm.
* 428	do	do	1955	30	16	30	Qs	1,277	17.91	Apr. 8, 1970	Cf, G	Irr	Water reported from sand and gravel. This well, 13-61-427, and 13-61-413 are a three-well manifold system, pumped by a common pump and motor. Yield of system reported 350 gpm.
* 501	Edward L. Lehman, Jr.	Jim Rae	1958	43	14	43	Qs	1,293	24.25 28.33	July 22, 1960 Apr. 2, 1970	Sub, E, 3; Cf, E, 5	Irr	Yield reported weak. Water reported from 12 feet of clayey basal gravel. One of six wells on a manifold system.
502	Edgar Schoppa	Robert Dale	1955	39	14	39	Qs	1,294	--	--	T, G	N	Unused irrigation well.
* 503	Emma Schulz	L. E. Stamps	1956	56	14	56	Qs	1,288	21.90 31.55	July 22, 1960 June 3, 1970	T, G, 32	Irr	Yield reported 235 gpm. Water reported from sand and gravel with base at 54 feet.
* 504	Willie Kieschnick	--	1912	20	--	--	Qs	1,288	13.01 16.70 20.14 21.48 23.37	Oct. 29, 1943 Feb. 10, 1952 Jan. 7, 1955 Jan. 16, 1957 Jan. 17, 1963	N	N	Dug domestic and stock well, destroyed.
505	do	Robert Dale	1966	51	14	51	Qs	1,291	17.38 32.94	Jan. 3, 1958 Mar. 10, 1970	Cf, E, 2	Irr	Yield reported 50 gpm. Water reported from sand and gravel at 41 to 50 feet. Red beds reported at 50 feet.
* 506	T. J. McGill Estate	do	1955	54	16	54	Qs	1,285	--	--	T, G	Irr	Yield reported 600 gpm. 1/
* 507	do	do	1956	46	16	46	Qs	1,284	32.03	Mar. 4, 1970	Sub, E, 2	D, Irr	This well pumps into 13-61-203.
508	J. F. Shivers	do	1956	33	7	33	Qs	1,304	23	June 2, 1970	Cf, G	N	Unused irrigation manifold system with four wells of same depth and completed the same, pumped by a common pump and motor. Yield reported 100 gpm. Water reported from basal gravel at 20 to 32 feet. Red beds reported at 32 feet.
509	Clois R. Cobb	do	1955	38	16	38	Qs	1,305	17 24.09	Jan. 15, 1955 Mar. 24, 1970	T, G, 35	Irr	Yield reported 250 gpm. 1/
* 510	T. J. McGill Estate	do	1955	38	16	38	Qs	1,307	18.84 27.51	July 12, 1960 Mar. 9, 1970	T, E, 15	Irr	Yield reported 300 gpm. Water reported from sand and gravel.
* 511	do	do	1956	40	16	40	Qs	1,308	15 25.32	Feb. 28, 1956 Mar. 9, 1970	T, E, 5	Irr	Yield reported 200 gpm. 1/
512	Bill Smith	L. E. Stamps	1959	37	30 14	24 37	Qs	1,316	22.74 28.62	July 14, 1960 Apr. 10, 1970	(2 pumps) Cf, E, 1/2	Irr	Yield reported 80 gpm. One of four wells on a collector system.
* 513	C. A. Schmoker	do	1955	29	16	29	Qs	1,314	16.10 17.79 15.60 16.86 24.25	Jan. 6, 1956 Jan. 16, 1957 Jan. 3, 1958 May 25, 1960 Nov. 14, 1969	T, E, 10	Irr	Yield reported 135 gpm. Water reported from sand and gravel.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
* 13-61-514	Bill Smith	L. E. Stamps	1958	37	30 14	16 37	Qs	1,315	19.71 24.59	July 14, 1960 Apr. 10, 1970	(2 pumps) Cf, E, 1/2	Irr	Yield reported 80 gpm. Water reported from sand and gravel. One of two wells on a manifold system.
* 515	Homer W. Custer	do	1955	36	14	36	Qs	1,319	20.27 27.50	July 15, 1960 June 3, 1970	Sub, E, 2	Irr	Yield reported 50 gpm. 1/ Well 5 of Contamination Rept. 8. 9/ This well pumps into well 13-61-568.
516	Dan R. Nowlin	Robert Dale	1957	39	14	39	Qs	1,320	28.14	do	Cf, E, 5	Irr	Yield reported 50 gpm. This well pumps into 13-61-567.
* 517	Walter Gaebler	do	1959	40	14	40	Qs	1,316	17.45 24.78	July 18, 1960 Mar. 27, 1970	T, G	Irr	Yield reported 75 gpm. Water reported from sand and gravel with base at 40 feet.
* 518	W. Claude Bildstein	L. E. Stamps	1959	50	14	50	Qs	1,318	19.06 30.09	July 12, 1960 Mar. 24, 1970	T, E, 20	Irr	Yield reported 240 gpm. Water reported from sand and gravel with base at 49 feet. Well 13-61-519 pumps into this well.
519	do	do	1959	50	14	50	Qs	1,319	21.69 32.81	July 12, 1960 Mar. 24, 1970	T, E, 5	Irr	Yield reported 200 gpm. This well pumps into 13-61-518.
* 520	C. A. Schmoker	do	1955	36	6	36	Qs	1,314	27.10	Nov. 14, 1969	J, E, 1/2	D	Water reported from sand and gravel.
521	do	Robert Dale	1965	36	13	36	Qs	1,315	28.19 27.42	do Feb. 3, 1971	Cf, E, 2	Irr	Yield reported 50 gpm. Water reported from sand and gravel at 22 to 34 feet. This well pumps into 13-61-513.
522	do	do	1969	30	14	30	Qs	1,313	25.02	Nov. 14, 1969	Cf, E, 2	Irr	Yield reported 35 gpm. Water reported from sand and gravel. This well pumps into 13-61-513.
* 523	T. J. McGill Estate	--	--	--	6	--	Qs	1,289	33 31.52	1968 Mar. 4, 1970	J, E, 1	D, S	--
524	John Lingnau	Robert Dale	1961	35	14	35	Qs	1,282	26.88	Mar. 9, 1970	T, G	D	Yield reported weak. Water reported from sand and gravel at 23 to 35 feet. Red beds reported at 35 feet.
525	do	do	1959	32	14	32	Qs	1,283	23.53	do	T, -, 5	N	Unused irrigation well. Yield reported weak. Water reported from sand and gravel at 20 to 31 feet. Red beds reported at 31 feet.
526	do	do	1963	32	24 12	3 32	Qs	1,283	28.31	do	N	N	Unused irrigation well. Yield reported weak. Water reported from sand and gravel at 22 to 31 feet. Red beds reported at 31 feet.
* 527	do	Pat Waggoner	1955	37	6	37	Qs	1,281	--	--	J, E, 1	D, S	Water reported from sand and gravel at 25 to 36 feet. Red beds reported at 36 feet.
* 528	Alvin Lingnau	Robert Dale	1969	34	48 6	4 34	Qs	1,306	27.10	Mar. 9, 1970	J, E, 3/4	D	Yield reported 500 gpm. Water reported from sand and gravel at 18 to 33 feet. Red beds reported at 33 feet.
* 529	M. E. Lingnau	do	1959	38	14	38	Qs	1,307	17 26.71	Sept. 15, 1960 Mar. 9, 1970	T, G, 50	Irr	Yield reported 500 gpm. Water reported from sand and gravel.
530	T. J. McGill Estate	do	1965	35	14	35	Qs	1,314	30.63 30.33	do Feb. 4, 1971	Sub, E, 2	Irr	Yield reported 75 gpm.
* 531	do	do	1950	31	14	31	Qs	1,309	26.78	Mar. 9, 1970	T, E, 15	Irr	Water reported from sand and gravel.
532	do	do	1965	31	14	31	Qs	1,308	28.13	do	Cf, E, 3	Irr	--

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
13-61-533	T. J. McGill Estate	Robert Dale	1955	28	--	--	Qs	1,314	--	--	N	N	Destroyed irrigation well.
* 534	do	--	--	35	--	--	Qs	1,305	10.14 31.18	Oct. 28, 1943 Mar. 9, 1970	W, C, J, E	S	Well 86 of Vernon rept. 5/
* 535	Willie Kieschnick	L. E. Stamps	1956	51	14	51	Qs	1,291	33.01	Mar. 10, 1970	T, E, 10	Irr	Yield reported 75 gpm. Water reported from sand and gravel at 41 to 50 feet. Red beds reported at 50 feet. Well 13-61-505 pumps into this well.
536	do	do	1958	43	14	43	Qs	1,287	32.13	do	T, G, 15	Irr	Yield reported 100 gpm. Water reported from sand and gravel at 36 to 42 feet. Red beds reported at 42 feet.
* 537	do	Robert Dale	1964	58	6	58	Qs	1,288	35.33 38.01	do Feb. 3, 1971	Cf, E, 1/3	D, S	Yield reported 75 gpm. Water reported from sand and gravel at 42 to 57 feet. Red beds reported at 57 feet.
538	Clois R. Cobb	do	1963	41	14	41	Qs	1,308	27.39	Mar. 24, 1970	T, G, 30	Irr	Yield reported 170 gpm. Water reported from sand and gravel at 22 to 40 feet. Red beds reported at 40 feet.
* 539	Edward K. Obenhaus	L. E. Stamps	1960	45	14	45	Qs	1,281	30 28.14	do Feb. 3, 1971	T, E, 10	Irr	--
540	do	do	1965	45	16	45	Qs	1,281	30 38.34	Mar. 24, 1970 do	Cf, E, 3	Irr	The measured water level (38.34 feet) was obtained during pumping.
541	do	do	1963	45	14	45	Qs	1,281	30	do	Sub, E, 1-1/2	Irr	--
* 542	do	Robert Dale	1964	45	14	45	Qs	1,280	30 33.87	do do	Cf, E, 1-1/2	Irr	The measured water level (33.87 feet) was obtained during pumping.
543	do	do	1964	45	14	45	Qs	1,280	30	do	Sub, E, 3	Irr	--
544	Edward L. Lehman, Jr.	do	1959	43	8	43	Qs	1,293	28	Apr. 2, 1970	Cf, E, 5	Irr	Yield reported weak. Water reported from 12 feet of clayey basal gravel. One of six wells on a collector system. One of five wells on a manifold system, pumped by a common pump and motor.
545	do	do	1959	43	6	43	Qs	1,293	28	do	Cf, E, 5	Irr	Do.
546	do	do	1959	43	6	43	Qs	1,292	28	do	Cf, E, 5	Irr	Do.
547	do	do	1959	43	8	43	Qs	1,291	28	do	Cf, E, 5	Irr	Do.
548	do	do	1963	43	14	43	Qs	1,290	26.30 25.14	do Feb. 3, 1971	Sub, E, 1/2	Irr	Yield reported 30 gpm. One of six wells on a collector system.
* 549	do	L. E. Stamps	1958	40	6	40	Qs	1,280	26	Apr. 1, 1970	J, E, 1/2	D, S	Water reported from sand and gravel.
550	do	Robert Dale	1964	40	6	40	Qs	1,279	26.40	do	J, E, 1/2	D	Yield reported 50 gpm. Water reported from sand and gravel.
* 551	do	L. E. Stamps	1956	32	16	32	Qs	1,260	18.6 12.7	Apr. 12, 1967 Apr. 1, 1970	Cf, E, 20	Irr	Yield reported 50 gpm. This well, 13-61-209, and 13-61-210 are on a three-well manifold system, pumped by a common pump and motor. Water reported from sand and gravel.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
13-61-552	Mrs. Minnie Beasley	Robert Dale	1960	43	14	43	Qs	1,321	21.61 32.75	July 17, 1960 Mar. 27, 1970	T, E, 10	Irr	Water reported from sand and gravel with base at 42 feet. Red beds reported at 42 feet. 2/
* 553	do	do	1965	54	14	54	Qs	1,322	32.10	do	T, E, 10	Irr	2/
* 554	Leon G. Lehman	do	1958	38	16	38	Qs	1,284	22.25	Apr. 8, 1970	T, G	Irr	Yield reported 275 gpm. Water reported from sand and gravel.
* 555	Martin H. Schulz	do	1965	51	14	51	Qs	1,299	25.17	do	T, G	Irr	Yield reported 140 gpm. Water reported from sand and gravel.
556	Bill Smith	Carl Bradford	1965	39	12	39	Qs	1,315	24.58	Apr. 10, 1970	Cf, E, 1/2	Irr	Yield reported 40 gpm. Water reported from sand and gravel. One of two wells on a collector system.
* 557	do	Robert Dale	1961	37	48 16	24 37	Qs	1,316	28.48	do	Cf, E, 1/2	Irr	Yield reported 80 gpm. Water reported from sand and gravel. One of five wells on a collector system.
558	do	do	1961	37	48 16	24 37	Qs	1,317	28.54	do	Cf, E, 1/2	Irr	Yield reported weak. Water reported from sand and gravel. One of five wells on a collector system.
559	do	Carl Bradford	1965	39	12	39	Qs	1,317	26.28	do	Cf, E, 1/2	Irr	Yield reported 40 gpm. Water reported from sand and gravel. One of five wells on a collector system.
* 560	do	do	1965	39	12	39	Qs	1,319	27.69	do	Cf, E, 1/2	Irr	Do.
* 561	J. F. Shivers	Robert Dale	1959	32	6	32	Qs	1,305	10	June 2, 1970	J, E, 1/2	D	Yield reported 50 gpm. Water reported from sand and gravel at 17 to 31 feet. Red beds reported at 31 feet.
562	Dan R. Nowlin	do	1961	39	14	39	Qs	1,319	30.50	do	T, E, 5	Irr	This well pumps into 13-61-563. 2/
* 563	do	do	1960	39	16	39	Qs	1,320	21.54 28.71	July 15, 1960 June 2, 1970	T, E, 10	Irr	Well 13-61-562 pumps into this well. 2/
* 564	Robert M. Gaebler	do	1961	50	14	50	Qs	1,319	32.15	June 3, 1970	T, E, 15	Irr	Yield reported 250 gpm. Water reported from sand and gravel.
565	do	do	1960	50	14	50	Qs	1,318	30.82	do	Cf, E, 2	Irr	Yield reported 125 gpm. Water reported from sand and gravel.
* 566	do	do	1961	50	14	50	Qs	1,318	32.49	do	T, E, 5	Irr	Do.
567	Dan R. Nowlin	do	1963	39	14	39	Qs	1,318	--	--	T, G	Irr	Yield reported 150 gpm. Well 13-61-516 pumps into this well.
* 568	Homer W. Custer	do	1963	39	14	39	Qs	1,320	26	June 2, 1970	T, E, 10	Irr	Well 13-61-515 pumps into this well. 2/
569	do	do	1964	34	14	34	Qs	1,319	25.17	June 3, 1970	Cf, E, 1-1/2	Irr	Yield reported 50 gpm. One of five wells on a collector system.
570	do	do	1964	32	16	32	Qs	1,318	26.00	do	Cf, E, 1-1/2	Irr	Yield reported 30 gpm. One of five wells on a collector system.
571	do	do	1964	32	16	32	Qs	1,318	26.86	do	Cf, E, 1	Irr	Yield reported 40 gpm. One of five wells on a collector system.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
13-61-572	Homer W. Custer	Robert Dale	1964	32	14	32	Qs	1,318	24.30	June 3, 1970	Cf, E, 1-1/2	Irr	Yield reported 75 gpm. One of five wells on a collector system.
* 573	do	do	1960	32	30 14	15 32	Qs	1,318	24.58	do	Cf, E, 1/2	Irr	Yield reported 30 gpm. One of five wells on a collector system.
574	Mrs. E. P. Streit	L. E. Stamps	1958	54	14	54	Qs	1,288	31.63	June 4, 1970	T, G, 30	Irr	Yield reported 75 gpm. Water reported from tight gravel with clay layers at 23 to 53 feet. Red beds reported at 53 feet.
575	do	do	1959	54	14	54	Qs	1,288	32.51	do	T, G, 58	Irr	Yield reported 165 gpm. Water reported from loose gravel at 48 to 53 feet. Red beds reported at 53 feet.
* 576	do	Robert Dale	1965	56	14	56	Qs	1,284	30.59	do	T, E, 10	Irr	Yield reported 150 gpm. Water reported from tight gravel with clay layers at 19 to 55 feet. Red beds at 55 feet.
577	T. J. McGill Estate	--	--	40	14	40	Qs	1,318	29.18 30.83	July 30, 1970 Feb. 4, 1971	T, E, 15	N	Unused irrigation well.
* 578	Martha Graf	Jim Rae	1964	43	16	43	Qs	1,318	30	1968	T, E, 10	Irr	Yield reported 125 gpm. Water reported from sand and gravel at 26 to 40 feet. Red beds reported at 40 feet. Well 13-61-579 pumps into this well.
* 579	do	Lee Hopper	1968	44	8	44	Qs	1,318	--	--	Sub, E, 5	Irr	Yield reported 100 gpm. Water reported from sand and gravel at 10 to 40 feet. Red beds reported at 40 feet. This well pumps into 13-61-578.
* 580	O. G. Hamilton	Robert Dale	1966	44	18	44	Qs	1,315	31.98	June 8, 1971	N	N	Unused irrigation well. Yield reported less than 75 gpm. Water reported from sand and gravel at 24 to 44 feet. Red beds reported at 44 feet. This well formerly pumped into 13-61-581.
581	do	do	1966	48	18	48	Qs	1,316	32.52	do	T, -	N	Unused irrigation well. Yield reported 75 gpm. Water reported from sand and gravel at 24 to 48 feet. Red beds reported at 48 feet. Well 13-61-580 formerly pumped into this well.
* 582	Lockett High School	--	--	--	--	--	Qs	1,314	--	--	J, E	N	Unused public supply well.
601	E. A. Woolf	L. E. Stamps	1955	40	14	40	Qs	1,300	28.61 26.92 32.09 29.41 32.40	Jan. 6, 1956 Jan. 17, 1963 Jan. 18, 1966 Jan. 12, 1970 Jan. 8, 1971	T, E, 3	Irr	Yield reported 50 gpm. 4/
602	do	do	1953	40	14	40	Qs	1,299	30.45 27.70 35.02 33.79 34.15	Jan. 7, 1954 Jan. 3, 1958 Jan. 14, 1965 Jan. 12, 1970 Jan. 8, 1971	T, G	Irr	Yield reported 75 gpm. 4/
603	Mrs. John Kretschmer	--	1953	53	14	53	Qs	1,302	31.50 32.04 31.20	Jan. 7, 1954 Jan. 16, 1957 Jan. 3, 1958	N	N	Unused irrigation well. Well F-68a of Bull. 5614. 7/
604	do	L. E. Stamps	1959	45	14	45	Qs	1,302	26.00 34.61	July 11, 1960 June 18, 1971	N	N	Unused irrigation well.
605	Mrs. M. V. McNairy	Robert Dale	1958	40	14	40	Qs	1,297	17 16.25 29	Jan. 18, 1958 July 11, 1960 Mar. 26, 1970	T, E, 20	Irr	Yield reported 200 gpm. Water reported from sand and gravel.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

	Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
	13-61-606	Mrs. M. V. McNairy	Robert Dale	1958	43	14	43	Qs	1,297	16.35 29 31.98	July 11, 1960 Mar. 26, 1970 do	Cf, E, 2	Irr	The water level measured on Mar. 26, 1970 (31.98 feet) was obtained during pumping. Yield reported 100 gpm. Water reported from sand and gravel with base at 42 feet. Red beds reported at 42 feet.
	607	E. H. Richie, Jr.	Jim Rae	1956	48	14	48	Qs	1,308	20.74 29.29 29.65	July 12, 1960 Apr. 16, 1970 Feb. 4, 1971	T, G, 30	Irr	Yield reported 300 gpm. Water reported from sand and gravel.
*	608	Karl Schoppa, W. E. Turner, and Robert Dale	Karl Schoppa, W. E. Turner, and Robert Dale	1940	46	18	46	Qs	1,313	11.87 24.50 32.11	Oct. 28, 1943 July 12, 1960 Apr. 16, 1970	T, E, 10	Irr	Owner hand-dug well to 28 feet. W. E. Turner and Robert Dale deepened well to 46 feet. Yield reported 140 gpm. Well 82 of Vernon rept. 5/
*	609	Paul Schoppa	L. E. Stamps	1956	51	16	51	Qs	1,312	24.26 32.35	July 13, 1960 Apr. 16, 1970	T, E, 15	Irr	Yield reported 260 gpm. Water reported from sand and gravel.
*	610	Homer Haseloff	do	1959	43	16	43	Qs	1,308	20.99	July 13, 1960	T, E, 10	Irr	Yield reported 110 gpm. Water reported from 10 feet of water sand. This well pumps into 13-61-627.
*	611	T. J. McGill Estate	--	1930	30	4	30	Qs	1,294	15.40 19.85	Oct. 29, 1943 Mar. 4, 1970	Cf, E, 1/3	D	Originally a dug well. Well 17 of Vernon rept. 5/
	612	Edward K. Obenhaus	Robert Dale	1967	51	14	51	Qs	1,316	29.82	Mar. 24, 1970	Cf, E, 3	Irr	Yield reported 100 gpm.
*	613	do	do	1961	51	14	51	Qs	1,317	28.81	do	T, E, 10	Irr	Do.
	614	do	do	1966	51	14	51	Qs	1,317	31 29.84	June 29, 1966 Mar. 24, 1970	Cf, E, 2	Irr	Yield reported 40 gpm. 1/
*	615	Bethal T. Juvenal	L. E. Stamps	1960	36	14	36	Qs	1,297	29	Mar. 26, 1970	T, G	Irr	Yield reported 75 gpm. Water reported from 6 to 8 feet of sand and gravel. Well 13-61-616 pumps into this well.
	616	do	do	1959	40	14	40	Qs	1,296	29.16	do	T, E, 10	Irr	Yield reported 50 gpm. Water reported from 6 to 8 feet of sand and gravel. This well pumps into 13-61-615.
*	617	Mrs. M. V. McNairy	Robert Dale	1968	44	14	44	Qs	1,298	29	do	T, E, 5	Irr	Yield reported 150 gpm. Water reported from sand and gravel.
*	618	do	do	1968	44	14	44	Qs	1,296	27 35.92	do do	Cf, E, 2	Irr	The measured water level (35.92 feet) was obtained during pumping. Yield reported 75 gpm. Water reported from sand and gravel at 22 to 43 feet. Red beds reported at 43 feet.
	619	Lockett Water District	E. B. Dyer Drilling Co.	1969	50	16 9	25 50	Qs	1,301	29	Apr. 10, 1969	T, E, 5	P	Yield reported 40 gpm. 1/
	620	do	do	1969	50	16 9	25 50	Qs	1,300	29	do	T, E, 5	P	Do.
*	621	Ed A. Haseloff	Robert Dale	1960	40	14	40	Qs	1,305	15 26.12	Mar. 23, 1959 Apr. 16, 1970	T, E, 10	Irr	1/ 2/
*	622	do	L. E. Stamps	1948	36	12	36	Qs	1,305	25.59	do	N	N	Unused irrigation well. Water reported from sand and gravel.
*	623	do	Robert Dale	1963	42	14	42	Qs	1,307	26.22 26.98	do Feb. 4, 1971	T, E, 10	Irr	Water reported from sand and gravel. 2/

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
13-61-624	Eddie Schoppa	Robert Dale	1955	37	14	37	Qs	1,317	16 29.14 30.74	1955 June 4, 1970 Feb. 4, 1971	N	N	Unused irrigation well. Yield reported 30 gpm. 1/
* 625	Karl Karcher	Carl Bradford	1968	--	6	--	Qs	1,295	--	--	Cf, E, 1/2	N	Unused industrial well. Yield reported 50 gpm.
* 626	do	Robert Dale	1960	--	6	--	Qs	1,295	--	--	Cf, E, 3/4	Ind	Yield reported 50 gpm.
627	Homer Haseloff	L. E. Stamps	1959	43	14	43	Qs	1,308	23.40 33.12	July 13, 1960 June 9, 1970	Cf, E, 3	Irr	The June 9, 1970 water level was measured during pumping. Yield reported 110 gpm. Water reported from 12 feet of sand.
628	Hattie Haseloff	Robert Dale	1953	37	--	--	Qs	1,310	--	--	N	N	Destroyed irrigation well. Yield reported 100 gpm.
629	Lily Mae Allred	--	1953	--	7	--	Qs	1,294	--	--	N	N	Unused irrigation well.
* 630	do	--	1953	--	7	--	Qs	1,294	26.64	June 10, 1970	N	N	Do.
631	do	--	1953	--	7	--	Qs	1,293	25.18	do	N	N	Do.
632	do	--	1953	--	7	--	Qs	1,291	25.76	do	N	N	Do.
633	do	--	1953	--	7	--	Qs	1,291	25.60	do	N	N	Do.
634	do	--	1953	--	7	--	Qs	1,291	25.22	do	N	N	Do.
635	do	--	1953	--	7	--	Qs	1,291	24.92	do	N	N	Do.
636	Jennie L. Foerster	L. E. Stamps	1959	34	14	34	Qs	1,289	24 28.23	July 2, 1970 do	Cf, E, 2	Irr	Measured water level (28.23 feet) was obtained during pumping. Yield reported 65 gpm. Water reported from sand and gravel. One of two wells on a collector system.
* 637	do	Loyd E. Stamps	1959	34	14	34	Qs	1,289	24 28.84	do do	Cf, E, 3	Irr	Measured water level (28.84 feet) was obtained during pumping. Yield reported 65 gpm. Water reported from sand and gravel. One of two wells on a collector system.
638	E. A. Woolf	do	1956	31	8	31	Qs	1,289	24	do	N	N	Unused irrigation manifold system. Four wells of same depth and completed the same, pumped by a common pump and motor. Yield of system reported less than 100 gpm. Water reported from sand and gravel.
* 639	Myrtle Darsey	Robert Dale	1958	43	14	43	Qs	1,301	30.54 28.64	July 3, 1970 Feb. 4, 1971	T, E, 20	Irr	Water reported from sand and gravel. 2/
* 640	do	L. E. Stamps	1962	45	16	45	Qs	1,307	30	July 3, 1970	T, E, 15	Irr	Water reported from sand and gravel. Well 13-61-641 pumps into this well.
641	do	Robert Dale	1965	45	14	45	Qs	1,307	29.25	Feb. 4, 1971	Cf, E, 3	Irr	Yield reported 150 gpm. Water reported from sand and gravel. This well pumps into well 13-61-640.
* 642	do	L. E. Stamps	1960	46	14	46	Qs	1,307	29.04	July 3, 1970	Cf, E, 2	N	Unused irrigation well. Yield reported 125 gpm. Water reported from sand and gravel.
* 643	Mrs. V. H. Weekley	do	1959	34	14	34	Qs	1,287	--	--	T, E, 15	Irr	Yield reported 50 gpm. Water reported from sand and gravel. Well 13-61-644 pumps into this well.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
13-61-644	Mrs. V. H. Weekley	L. E. Stamps	1959	34	14	34	Qs	1,288	24.45	Dec. 2, 1970	Cf, E, 2	Irr	Yield reported 50 gpm. Water reported from sand and gravel. This well pumps into well 13-61-643.
* 645	do	--	1920	20?	1	20?	Qs	1,298	16	Oct. 29, 1943	Cf, E	D, S	Yield reported weak. Water reported from sand and gravel at 16 to 20 feet. Well 18 of Vernon rept. 5/
* 646	Five-in-One Gin	--	--	40	6	40	Qs	1,319	32.66	June 25, 1971	N	N	Unused industrial well.
* 647	Zion Lutheran Church	Robert Dale	1964	37	6	37	Qs	1,309	28.01	do	J, E, 1/2	P	Yield reported weak. Water reported from sand and gravel.
648	Lockett Water District	do	1970	45	14	45	Qs	1,298	30	Aug. 29, 1970	Sub, E, 2	P	1/ 2/
* 701	Jeff Matysek	L. E. Stamps	1955	50	16	50	Qs	1,336	19.42 30.98	July 7, 1960 June 9, 1971	N	N	Unused irrigation well. Yield reported 420 gpm. Well 1 of Contamination Rept. 8. 9/
* 702	Charlie Joe Matysek	do	1956	50	16	50	Qs	1,335	19.39 19.73 30.43	Mar. 10, 1960 July 21, 1960 June 4, 1970	T, G, 40	Irr	Yield reported 300 gpm. Water reported from sand and gravel at 22 to 50 feet. Well 3 of Contamination Rept. 8. 9/
* 703	Frank Granot	Robert Dale	1955	54	14	54	Qs	1,338	20 23.26 35.13 35.10	May 5, 1955 July 18, 1960 June 9, 1970 Feb. 3, 1971	T, E, 30	Irr	Yield reported 300 gpm. 1/
* 704	Edward K. Obenhaus	do	1966	40	14	40	Qs	1,328	18.15 26.30	July 18, 1960 Mar. 24, 1970	T, E, 15	Irr	Yield reported 250 gpm.
705	do	do	1968	40	14	40	Qs	1,329	28.27	do	T, E, 5	Irr	Yield reported 150 gpm.
* 706	Henry L. Williams	do	1967	50	6	50	Qs	1,333	30	June 2, 1970	J, E, 3/4	D	Yield reported strong. Water reported from sand and gravel.
* 707	Oliver C. Holland	do	1968	56	14	56	Qs	1,342	31 33.66 31.92	July 24, 1968 June 3, 1970 Feb. 3, 1971	T, E, 20	Irr	Yield reported 300 gpm. 1/
* 708	do	L. E. Stamps	1956	52	16	52	Qs	1,346	24.48 30.25	July 21, 1960 June 3, 1970	T, E, 25	Irr	Yield reported 300 gpm. Water reported from sand and gravel at 28 to 52 feet. Red beds reported at 52 feet.
* 709	Tom R. Locke	Jim Rae	1965	46	16	46	Qs	1,327	33.92	do	T, E, 10	Irr	Yield reported 150 gpm. Water reported from sand and gravel at 22 to 46 feet. Red beds reported at 46 feet.
710	do	do	1965	48	14	48	Qs	1,327	35.53	do	T, G, 40	Irr	Yield reported 150 gpm.
* 711	Mrs. Velma C. Harvel	Robert Dale	1959	36	14	38	Qs	1,328	21.93 28.64 28.71	Mar. 10, 1960 July 30, 1970 Feb. 3, 1971	Cf, G	N	One well of an unused irrigation two-well manifold system. Yield of system reported 300 gpm. Both wells pumped by a common pump and motor. Well 6 of Contamination Rept. 8. 9/
712	do	do	1959	38	84 14	15 38	Qs	1,327	18 20.75	June 10, 1959 July 14, 1960	Cf, G	N	On manifold system with well 13-61-711.
* 713	Medders Petroleum Co.	do	1965	42	7	42	Qs	1,334	33.90	June 9, 1971	N	N	Water quality observation well. Water reported from sand and gravel.
* 714	Alfred C. Matysek	Carl Bradford	1968	29	6	29	Qs	1,331	19	do	J, E, 1/2	D	Yield reported good. Water reported from gravel.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
* 13-61-715	Medders Petroleum Co.	Robert Dale	1965	40	7	40	Qs	1,337	30.44	June 9, 1971	N	N	Unused industrial well. Formerly used as water source in an oil-field water flooding operation.
* 716	Jeff Matysek	--	1959	50	6	50	Qs	1,335	31	do	J, E, 1/3	D	Well 2 of Contamination Rept. 8. 9/
* 717	Emma Main	Tom Chance	1943	30	--	--	Qs	1,337	4.1 19.94	Oct. 21, 1943 Mar. 9, 1960	N	N	Destroyed industrial well. Formerly used as water source during development of an oil field. Well 91 of Vernon rept. 5/ Well 7 of Contamination Rept. 8. 9/
* 801	F. E. Nerlin	Albert Vanek	1943	18	--	--	Qs	1,331	10.74 13.20 17.14	Jan. 25, 1943 Feb. 10, 1952 Jan. 9, 1953	N	N	Dug domestic and stock well, destroyed. Water reported from sand and gravel at 10 to 18 feet. Well 92 of Vernon rept. 5/
802	Schmoker Estate	L. E. Stamps	1956	47	14	47	Qs	1,330	20.27	July 12, 1960	N	N	Unused irrigation well. Yield reported 45 gpm. Water reported from sand and gravel at 32 to 38 feet. Red beds reported at 38 feet.
803	do	do	1956	51	16	51	Qs	1,324	19.41 29.34	do Mar. 10, 1970	T, G, 18	Irr	Yield reported 50 gpm. Water reported from sand and gravel.
804	do	do	1959	46	14	46	Qs	1,323	19.98 29.5	July 12, 1960 Mar. 10, 1970	T, G	N	Unused irrigation well. Yield reported 100 gpm. Water reported from sand and gravel at 36 to 42 feet. Red beds reported at 42 feet.
* 805	Peggy Harris	Robert Dale	1955	44	14	44	Qs	1,323	19 19.56	May 17, 1955 June 1, 1960	T, E, 15	Irr	Yield reported 138 gpm. Water reported from sand and gravel with base at 42 feet. Red beds reported at 42 feet. Well 8 of Contamination Rept. 8. 9/
806	Mary Ann Lanigan	do	1959	47	14	47	Qs	1,322	21 19.35 31.73 31.39	Apr. 1959 July 18, 1960 June 9, 1970 Feb. 4, 1971	T, E, 25	Irr	Yield reported 350 gpm. Water reported from sand and gravel at 34 to 46 feet. Red beds reported at 46 feet.
* 807	E. G. Boman	L. V. Parkhill	1936	28	--	--	Qs	1,320	8.81 12.45 14.95	Oct. 22, 1943 Feb. 26, 1951 Feb. 10, 1952	N	N	Dug domestic and stock well, destroyed. Water reported from sand. Red beds reported at 28 feet. Well 80 of Vernon rept. 5/
* 808	J. F. Shivers	H. L. Myatt	1952	47	18	47	Qs	1,326	19.85 33.65	July 12, 1960 June 2, 1970	T, E, 30	Irr	Yield reported 400 gpm. Water reported from sand and gravel at 27 to 46 feet. Red beds reported at 46 feet.
* 809	Dr. Dan R. Nowlin et al.	L. E. Stamps	1956	50	14	50	Qs	1,330	17 28.10	Feb. 28, 1956 Apr. 2, 1970	T, E, 30	Irr	Yield reported 600 gpm. Water reported from sand and gravel. Well 13-61-823 pumps into this well.
810	T. S. Haney	Robert Dale	1959	44	12	44	Qs	1,337	16 16.85 29.98	Mar. 28, 1960 July 18, 1960 Dec. 2, 1970	T, G	Irr	Yield reported 530 gpm. Water reported from sand and gravel.
811	Bill Smith	L. E. Stamps	1956	34	14	34	Qs	1,328	14.80 22.81	July 18, 1960 Apr. 10, 1970	Cf, E, 1	Irr	Water reported from sand and gravel with base at 34 feet. Red beds reported at 34 feet. One of five wells on a collector system. System yield reported 200 gpm.
* 812	Walter E. Foerster, Jr.	Robert Dale	1966	51	14	51	Qs	1,326	31.72 33.41	Nov. 18, 1969 Feb. 3, 1971	T, E, 15	Irr	1/ 2/
* 813	do	do	1951	34	6	34	Qs	1,318	15.12 15.07 15.24 16.27	Nov. 18, 1969 Dec. 15, 1969 Jan. 12, 1970 Jan. 8, 1971	J, E, 1/3	D, S	Water reported from sand and gravel. 4/

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
13-61-814	Schmoker Estate	Robert Dale	1964	48	14	48	Qs	1,327	33.01	Mar. 10, 1970	T, G, 45	Irr	Yield reported 150 gpm. Water reported from sand and gravel at 39 to 47 feet. Red beds reported at 47 feet.
815	Edward K. Obenhaus	--	1966	55	16	55	Qs	1,331	32.26	Mar. 24, 1970	T, G, 35	Irr	Yield reported 400 gpm. Wells 13-61-816 and 817 pump into this well.
816	do	--	1966	55	12	55	Qs	1,332	32.2	do	Cf, E, 2	Irr	Yield reported 25 to 30 gpm. This well pumps into 13-61-815.
* 817	do	Robert Dale	1968	55	14	55	Qs	1,333	30.50	do	T, E, 5	Irr	Yield reported 250 gpm. This well pumps into 13-61-815.
818	Thomas M. Lanigan, Jr.	do	1967	45	14	45	Qs	1,332	28 34.00	do do	Cf, E, 3	Irr	The measured water level (34.00 feet) was obtained during pumping. Yield reported 100 gpm.
* 819	do	do	1966	45	14	45	Qs	1,336	34	do	T, E, 10	Irr	--
* 820	Cleve Ryan	Carl Bradford	1967	60	6	60	Qs	1,340	45.82	Apr. 2, 1970	J, E, 1/2	D, S	Yield reported strong. Water reported from sand and gravel.
* 821	Edward L. Lehman, Jr.	Robert Dale	1968	52	14	52	Qs	1,328	30.85	do	T, E, 20	Irr	Yield reported 200 gpm. Water reported from sand and gravel.
822	do	do	1968	52	14	52	Qs	1,329	32.81	do	T, E, 20	Irr	Yield reported 225 gpm. Water reported from sand and gravel.
* 823	Dr. Dan R. Nowlin	do	1967	54	14	54	Qs	1,331	27.5 28.72 31.49	Apr. 12, 1967 Apr. 2, 1970 Feb. 3, 1971	T, E, 10	Irr	Yield reported 300 gpm. This well pumps into 13-61-809.
* 824	Walter T. Gaebler	do	1967	59	14	59	Qs	1,331	31	Mar. 2, 1967	Sub, E, 10	Irr	1/ 2/
* 825	Bill Smith	L. E. Stamps	1956	36	16	36	Qs	1,329	22.55 24.70	Apr. 10, 1970 Feb. 4, 1971	Cf, E, 1	Irr	Water reported from sand and gravel with base at 34 feet. Red beds reported at 34 feet. One of five wells on a collector system.
826	do	do	1956	34	16	34	Qs	1,329	22.86	do	Cf, E, 1	Irr	Do.
827	do	do	1956	34	14	34	Qs	1,328	22.74	do	Cf, E, 1	Irr	Do.
828	do	do	1956	34	16	34	Qs	1,328	23.18	do	Cf, E, 1	Irr	Do.
829	do	Hopper Drilling Co.	1965	41	12	40	Qs	1,328	22	Aug. 16, 1965	N	N	Unused irrigation well. 1/ 2/
* 830	Peggy Harris	Robert Dale	1958	47	14	47	Qs	1,325	--	--	T, E, 25	Irr	Water reported from sand and gravel. 2/
* 831	Mary Ann Lanigan	do	1957	49	14	49	Qs	1,322	18.52	July 13, 1960	T, E, 15	Irr	Do.
* 832	J. F. Shivers	do	1967	53	14	53	Qs	1,324	31.24 32.38	June 2, 1970 Feb. 4, 1971	T, E, 10	Irr	Yield reported 350 gpm. Water reported from sand and gravel at 41 to 48 feet. Red beds reported at 48 feet.
833	do	do	1967	53	14	53	Qs	1,326	32 33.84	July 10, 1967 June 2, 1970	T, E, 5	Irr	Yield reported 300 gpm. 1/ 2/
* 834	Hub Colley et al.	do	1967	57	14	57	Qs	1,330	30 33	Feb. 27, 1967 June 2, 1970	T, E, 15	Irr	1/ 2/

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
* 13-61-835	Hub Colley et al.	L. E. Stamps	1957	54	14	54	Qs	1,335	33	June 2, 1970	T, E, 15	Irr	Water reported from approximately 20 feet of sand and gravel. 2/
* 836	do	Robert Dale	1968	59	14	59	Qs	1,330	33	Sept. 10, 1968	T, E, 20	Irr	1/ 2/
* 837	Henry L. Williams	L. E. Stamps	1958	51	16	51	Qs	1,335	17 29.02	1958 June 2, 1970	T, G	Irr	Yield reported 450 gpm. Water reported from sand and gravel.
* 838	Hub Colley et al.	do	1963	54	6	54	Qs	1,330	33	June 11, 1970	J, E, 3/4	D	Yield reported strong.
* 839	C. Glenn Cato	Robert Dale	1968	45	14	45	Qs	1,331	26	Aug. 29, 1968	T, E, 3	Irr	Yield reported 150 gpm. One of two wells on a collector system. 1/
840	do	do	1968	46	14	46	Qs	1,332	26	May 16, 1968	T, E, 5	Irr	Yield reported 250 gpm. Water reported from sand and gravel. One of two wells on a collector system.
841	Edward L. Lehman, Jr.	do	1970	58	14	58	Qs	1,331	30 34.10	Sept. 3, 1970 Dec. 2, 1970	T, E, 10	Irr	1/ 2/
842	W. T. Waggoner Estate	do	1964	65	14	65	Qs	1,328	--	--	T, E, 20	S	Water reported from sand and gravel.
* 843	Alfred C. Matysek	do	1963	52	14	52	Qs	1,336	37	June 9, 1971	T, G	Irr	Yield reported 500 gpm. Water reported from gravel at 36 to 52 feet. Red beds reported at 52 feet.
* 844	do	do	1965	39	14	39	Qs	1,334	27	do	T, E, 15	Irr	Yield reported 450 gpm. Water reported at 34 to 39 feet. Red beds reported at 39 feet.
845	Arthur Piper	do	1968	53	6	53	Qs	1,335	34	Mar. 25, 1968	Sub, E, 3/4	Irr	1/ 2/
* 846	H. R. Box	Pat Waggoner	1961	35	--	--	Qs	1,325	14	June 9, 1971	J, E, 1/2	D, S	Yield reported good. Water reported from sand and gravel at 24 to 34 feet. Red beds reported at 34 feet.
* 847	Ernest Bergt	Robert Dale	1964	24	6	24	Qs	1,305	8	June 10, 1971	J, E, 1/2	D	Water reported from red rock.
* 901	Edward K. Obenhaus	do	1967	47	14	47	Qs	1,330	31 30.90	July 6, 1967 Mar. 24, 1970	J, E, 1/2; Cf, E, 2	D	1/ 2/
902	do	do	1966	45	14	45	Qs	1,322	28.82 30.01	do Feb. 4, 1971	Cf, E, 2	Irr	Yield reported 75 to 80 gpm. This well pumps into 13-61-905.
903	do	do	1963	47	14	47	Qs	1,322	29.58	Mar. 24, 1970	T, E, 3	Irr	Yield reported 65 gpm. This well pumps into 13-61-905
* 904	do	do	1963	48	14	48	Qs	1,322	32.14	do	T, E, 3	Irr	Yield reported 150 to 175 gpm. This well pumps into 13-61-905.
905	do	do	1961	47	14	47	Qs	1,323	30.95	do	T, E, 10	Irr	Yield reported 100 to 125 gpm. Wells 13-61-902, 903, and 904 pump into this well.
906	do	do	1964	48	14	48	Qs	1,324	32.27	do	T, E, 3	Irr	Yield reported 100 gpm. This well pumps into 13-61-908.
* 907	do	do	1966	49	6	49	Qs	1,325	33.27	do	Sub, E, 1-1/2	Irr	Yield reported 45 gpm. This well pumps into 13-61-908.
908	do	do	1963	49	14	49	Qs	1,326	34.81	do	T, E, 10	Irr	Yield reported 150 gpm. Wells 13-61-906, 907, 909, and 910 pump into this well.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
13-61-909	Edward K. Obenhaus	Robert Dale	1966	50	6	50	Qs	1,328	37.61	Mar. 24, 1970	Sub, E, 2-1/2	Irr	Yield reported 40 gpm. This well pumps into 13-61-908.
* 910	do	do	1966	50	14	50	Qs	1,330	38.71	do	Sub, E, 2-1/2	Irr	Do.
* 911	Henry Teague	do	1963	44	14	44	Qs	1,323	--	--	T, E, 7-1/2	Irr	Water reported from sand and gravel. 2/
* 912	Jack Carter	do	1963	47	16	47	Qs	1,322	31.52 31.78	July 3, 1970 Feb. 4, 1971	T, E, 20	Irr, S	Yield reported 175 gpm. Water reported from sand and gravel with base at 45 feet. Red beds reported at 45 feet.
* 913	Henry C. Streit	--	--	34	--	--	Qs	1,271	19.47	June 25, 1971	J, E, 1/2	S	Dug well. Yield reported weak.
* 62-101	Curtis A. Graf	Robert Dale	1959	40	14	40	Qs	1,245	16 23.94	Mar. 12, 1959 Apr. 3, 1970	T, E, 3	Irr	Yield reported 100 gpm. Water reported from sand and gravel. One of four wells on a collector system.
* 102	Willie Kieschnick, Jr.	--	1954	47	16	47	Qs	1,248	17.11 14.58 19.30 26.84 28.75	Jan. 7, 1955 Jan. 2, 1958 Jan. 15, 1964 Jan. 12, 1970 Jan. 8, 1971	T, E, 15	Irr	Yield reported 400 gpm. 4/
103	Edgar N. Schoppa	L. E. Stamps	1957	37	14	37	Qs	1,250	31.80 22.42	July 27, 1960 Apr. 9, 1970	T, E, 10	N	Unused irrigation well. Yield reported weak. Water reported from sand and 3 or 4 feet of gravel.
104	do	do	1957	37	14	37	Qs	1,248	32.90 23.28	July 27, 1960 Apr. 9, 1970	Sub, E, 1-1/2	N	Unused irrigation well. Yield reported weak. Water reported from mostly sand with base at 36 feet.
105	C. A. Schmoker	Robert Dale	1955	29	16	29	Qs	1,268	20.50 18.00 20.40 25.03 28.23 29.85 25.30	Jan. 7, 1956 Feb. 23, 1962 Jan. 15, 1964 Jan. 18, 1966 Jan. 20, 1968 Jan. 15, 1969 Jan. 12, 1970	Cf, E, 2	Irr	4/
* 106	do	do	1955	27	16	27	Qs	1,265	20.73 22.28 18.97 18.27 18.40 26.39 24.32	Jan. 7, 1956 Jan. 15, 1957 May 26, 1960 Feb. 22, 1962 Jan. 17, 1963 Nov. 13, 1969 Jan. 12, 1970	Cf, E, 1	Irr	Yield reported 40 gpm. Water reported from 5 to 6 feet of sand and gravel.
107	do	do	1955	28	16	28	Qs	1,263	20.46 21.98 17.99 26.08	Jan. 7, 1956 Jan. 15, 1957 Feb. 22, 1962 Nov. 13, 1969	Cf, E, 1	Irr	Yield reported 40 gpm. Water reported from sand and gravel.
108	Joe Frank Lowe	L. E. Stamps	1957	39	14	39	Qs	1,264	15.86 31.46	May 13, 1960 July 29, 1970	Cf, E, 3	Irr	Yield reported 70 gpm. Water reported from sand and gravel. One of two wells on a collector system.
109	do	do	1957	38	14	38	Qs	1,262	33.39	do	Cf, E, 3	Irr	Yield reported 70 gpm. Water reported from sand and gravel. One of three wells on a collector system.
110	W. F. McKee	--	--	20	--	--	Qs	1,271	14.9	Oct. 29, 1943	N	N	Destroyed domestic and stock well. Well 27 of Vernon rept. 5/

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
13-62-111	W. F. McKee	Tom Chance	--	24	--	--	Qs	1,271	14.69 19.16 19.67 19.44 17.46	Oct. 29, 1943 Feb. 26, 1951 Jan. 7, 1954 Jan. 15, 1957 Jan. 2, 1958	N	N	Destroyed domestic well. Well 26 of Vernon rept. 5/
* 112	do	do	--	58	--	--	Qs	1,271	14.83 20.02 19.90 17.70	Oct. 29, 1943 Jan. 7, 1955 Jan. 7, 1956 Jan. 2, 1958	N	N	Destroyed domestic and stock well. Red beds reported at 38 feet. Well 25 of Vernon rept. 5/
113	Lockett Seed Co.	--	1953	40	16	40	Qs	1,282	24.74 23.96 21.61	Jan. 7, 1954 Jan. 7, 1956 Jan. 2, 1958	N	N	Unused irrigation well.
* 114	F. S. Lockett Estate	Robert Dale	1953	36	16	36	Qs	1,279	16.30 23.49	May 31, 1960 Nov. 14, 1969	T, G, 50	Irr	Yield reported 150 gpm. Water reported from sand and gravel.
* 115	do	do	1953	47	18	47	Qs	1,284	28.25 29.05 24.15 25.58 30.72 31.79 31.50 31.98	Jan. 7, 1954 Jan. 15, 1957 Jan. 2, 1958 Feb. 23, 1962 Jan. 18, 1966 Jan. 20, 1968 Jan. 12, 1970 Jan. 8, 1971	T, G, 50	Irr	Yield reported 250 gpm. Water reported from sand and gravel at 34 to 43 feet. 4/
* 116	Karl Haseloff	do	1958	37	14	37	Qs	1,277	11 13.25 20.56	Feb. 18, 1958 May 31, 1960 Apr. 9, 1970	T, E, 15	Irr	Yield reported 150 gpm.
* 117	Arnold H. Kiesling	--	1902	32	--	--	Qs	1,282	10.71 18.44 11.82 22.42 23.18	Oct. 19, 1943 Jan. 7, 1955 Jan. 17, 1963 Jan. 12, 1970 Jan. 8, 1971	N	N	Unused domestic and stock well. 4/ Well 42 of Vernon rept. 5/ Well F-42 of Bull. 5614. 7/
118	Karl Haseloff	W. E. Turner	1951	34	--	--	Qs	1,277	13.42	Feb. 28, 1951	N	N	Destroyed irrigation two-well manifold system. Water reported from sand with base at 32 feet. Red beds reported at 32 feet.
* 119	do	do	1951	35	16	35	Qs	1,283	14.34 17.21 13.48	do Jan. 7, 1955 May 31, 1960	T, G	N	Unused irrigation well, filled with sand. Water reported from sand and gravel. Red beds reported at 33 feet. Well F-286 of Bull. 5614. 7/
120	Hattie Haseloff	Robert Dale	1954	37	--	--	Qs	1,284	19.61	Jan. 7, 1955	N	N	Destroyed irrigation well, never used. Well F-28d of Bull. 5614. 7/
121	F. S. Lockett Estate	do	1958	33	16	33	Qs	1,287	13 25.44 25.09 25.30	Oct. 15, 1958 Nov. 17, 1969 Jan. 12, 1970 Jan. 8, 1971	T, G, 50	N	Unused irrigation well. Yield reported 150 gpm. 4/
122	C. A. Schmoker	do	1966	28	16	28	Qs	1,266	21.81 21.80 21.65 22.84	Nov. 13, 1969 Dec. 15, 1969 Jan. 12, 1970 Jan. 8, 1971	Cf, E, 1	Irr	Yield reported 40 gpm. Water reported from sand and gravel. 4/
123	Lockett Seed Co.	do	1962	40	16	40	Qs	1,291	26.24	Nov. 18, 1969	T, E, 25	Ind	Well is used by city of Lockett Fire Department. Yield reported 250 gpm.
* 124	do	Fred Turner	1948	34	14	34	Qs	1,284	25.66	Nov. 17, 1969	T, E, 3	Irr	Yield reported 110 gpm. Water reported from sand and gravel. This well pumps into 13-62-125.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

	Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
*	13-62-125	Lockett Seed Co.	L. E. Stamps	1957	34	14	34	Qs	1,285	--	--	T, E, 15	Irr	Yield reported 240 gpm. Water reported from sand and gravel. Well 13-62-124 pumps into this well.
	126	Curtis A. Graf	Robert Dale	1966	42	14	42	Qs	1,250	21 23.10 26.04	Jan. 21, 1966 Apr. 3, 1970 Feb. 3, 1971	Cf, E, 2	Irr	Yield reported 100 gpm. One of four wells on a collector system. 1
	127	Lockett Seed Co.	Tom Chance	--	38	--	--	Qs	1,291	37	Nov. 18, 1969	N	N	Dug industrial well, unused. Red beds reported at 38 feet. Well 30 of Vernon rept. 5
	128	Cody Austin	L. E. Stamps	1956	46	14	46	Qs	1,246	24.29	Mar. 24, 1970	T, G, 35	Irr	Yield reported 200 gpm. Water reported from sand and gravel at 34 to 45 feet. Red beds reported at 45 feet.
	129	Curtis A. Graf	do	1957	45	14	45	Qs	1,247	23.35	Apr. 3, 1970	T, E, 3	Irr	Yield reported 100 gpm. Water reported from sand and gravel. One of four wells on a collector system.
	130	do	Robert Dale	1966	43	14	43	Qs	1,250	23.62	Apr. 3, 1970	T, E, 5	Irr	Yield reported 100 gpm. Water reported from sand and gravel. One of four wells on a collector system.
	131	Edgar N. Schoppa	do	1963	37	14	37	Qs	1,248	24.37	Apr. 9, 1970	T, E, 10	N	Unused irrigation well. Yield reported weak. Water reported from sand and gravel.
	132	Karl Haseloff	do	1955	38	16	38	Qs	1,277	21	do	T, E, 15	Irr	Yield reported 150 gpm. Water reported from sand and gravel.
	133	Robert Dale	do	1969	44	14	44	Qs	1,254	--	--	Cf, E, 2-1/2	Irr	Yield reported 70 gpm. 1
	134	do	do	1967	48	18	48	Qs	1,255	--	--	Sub, E, 2	Irr	Yield reported 50 gpm. 1
*	135	Ed A. Haseloff	L. E. Stamps	1950	37	16	37	Qs	1,280	21.11	Apr. 9, 1970	Cf, G	Irr	Four-well manifold system with all wells the same depth and completed the same, pumped by a common pump and motor. Yield for system reported 110 gpm. Water reported from sand and gravel.
	136	Robert Dale	Robert Dale	1964	50	14	50	Qs	1,251	--	--	Sub, E, 3	Irr	Yield reported 75 to 80 gpm. 1
	137	Hattie Haseloff	do	1960	33	7	33	Qs	1,281	--	--	Cf, G, 100	Irr	Four-well manifold system with all wells the same depth and completed the same, pumped by a common pump and motor. Yield for system reported 310 gpm.
*	138	A. J. Lambert	L. E. Stamps	1954	52	16	52	Qs	1,260	28	1954	Sub, E, 2	Irr	Water reported from sand and gravel with base at 44 feet. Red beds reported at 44 feet.
*	139	do	do	1956	46	14	46	Qs	1,257	13 28	1956 June 10, 1970	T, E, 5	Irr	Yield reported 150 gpm. Water reported from sand and small gravel at 13 to 46 feet. Red beds reported at [illegible] feet. One of four wells on a collector system.
*	140	do	do	1957	42	16	42	Qs	1,256	13 28	1957 June 10, 1970	T, E, 5	Irr	Yield reported 150 gpm. Water reported from sand and gravel with base at 42 feet. Red beds reported at 42 feet. One of four wells on a collector system.
*	141	do	Robert Dale	1959	39	14	39	Qs	1,255	28.02	do	N	N	Unused irrigation well. Yield reported 150 gpm. Water reported from sand and gravel at 15 to 39 feet. Red beds reported at 39 feet.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
* 13-62-142	A. J. Lambert	Robert Dale	1968	45	14	45	Qs	1,253	24 28	Mar. 15, 1968 June 10, 1970	T, E, 3	Irr	Yield reported 100 gpm. One of four wells on a collector system. 1/
* 143	do	do	1968	45	14	45	Qs	1,252	24 28	Mar. 15, 1968 June 10, 1970	T, E, 3	Irr	Yield reported 150 gpm. One of four wells on a collector system. 1/
* 144	do	Bill Turner	1939	29	6	29	Qs	1,276	11.78 22.99 23.87	Nov. 1, 1943 June 10, 1970 Feb. 3, 1971	N	N	Unused domestic well. Originally a dug well; has been reworked. Well 31 of Vernon rept. 5/
145	do	L. E. Stamps	1955	20	--	--	Qs	1,266	--	--	N	N	Test hole. 1/
146	do	do	1955	24	--	--	Qs	1,252	--	--	N	N	Do.
* 147	J. E. Lockett	Robert Dale	1962	39	14	39	Qs	1,289	16	Mar. 10, 1962	T, G	Irr	Water reported from sand and gravel with base at 38 feet. Red beds reported at 38 feet.
* 148	Mrs. C. H. Cato	do	1955	34	14	34	Qs	1,290	28.54	July 3, 1970	Cf, -, 2	N	Unused irrigation well. Water reported from sand and gravel.
* 149	Charles H. Graf	do	1963	28	14	28	Qs	1,268	--	--	T, E, 15	Irr	Yield reported 175 gpm. Water reported from sand and gravel at 23 to 31 feet. Red beds reported at 31 feet.
* 150	do	do	1968	40	14	40	Qs	1,276	24	June 28, 1968	T, E, 7-1/2	Irr	Yield reported 100 gpm. 1/
151	do	do	1968	37	14	37	Qs	1,275	23	do	T, E, 7-1/2	Irr	Yield reported 50 gpm.
* 152	Joe Frank Lowe	do	1962	38	18	38	Qs	1,265	34.14 25.30	July 29, 1970 Feb. 4, 1971	Cf, E, 5	Irr	The July 29, 1970 water level was measured during pumping. Yield reported 70 gpm. Water reported from sand and gravel. One of three wells on a collector system.
* 153	Dr. James J. Muirhead	Lee Hopper	1966	42	12	42	Qs	1,278	23.53	Sept. 22, 1970	T, E, 10	Irr	Yield reported 200 gpm. Water reported from sand and gravel.
154	James Sullivan	Robert Dale	1959	34	6	34	Qs	1,269	--	--	N	N	Unused irrigation manifold system, containing four wells of same depth and completed the same which were pumped by a common pump and motor.
* 155	do	do	1970	39	14	39	Qs	1,270	23 24.57	July 27, 1970 Nov. 12, 1970	Sub, E, 3/4	Irr	1/ 2/
156	F. S. Lockett Estate	Bill Turner	1957	41	16	41	Qs	1,287	32.70	Nov. 17, 1969	N	N	Unused irrigation well. Yield reported weak. Water reported from sand and gravel.
* 157	Hunter Hopson	--	1961	44	8	44	Qs	1,291	35.9	Apr. 11, 1967	J, E	D	--
* 158	H. & S. Dehydrating Plant	--	1955	36	--	--	Qs	1,281	27.0	do	J, E	D	Dug well.
159	Cody Austin	Robert Dale	1971	47	16	47	Qs	1,248	32	Apr. 15, 1971	Sub, E, 1	Irr	1/ 2/
* 160	C. A. Schmoker	--	1951	35	--	--	Qs	1,262	--	--	T, E	D	--
* 201	Johnny Fluhmann	Robert Dale	1959	43	14	43	Qs	1,265	20.34 32.34	May 13, 1960 June 15, 1971	T, E, 10	Irr	Yield reported 50 gpm. Water reported from sand and gravel.
* 202	Frank E. Lowe	L. E. Stamps	1959	42	14	42	Qs	1,264	19.82 34.63 30.34	May 13, 1960 July 29, 1970 Feb. 4, 1971	T, E, 5	Irr	Water reported from gravel at 27 to 41 feet. This well pumps into 13-62-227.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
* 13-62-203	Frank Kaluza	--	1926	27	36	27	Qs	1,263	11.63 22.58 20.40 23.12 18.50 20.57	Oct. 18, 1943 Jan. 7, 1954 Jan. 7, 1956 Jan. 15, 1957 Jan. 2, 1958 Jan. 17, 1963	N	N	Dug domestic and stock well, unused. Well 123 of Vernon rept. 5/ Well G-123 of Bull. 5614. 7/
204	do	--	1926	22	--	--	Qs	1,262	12.00 21.90 18.10 20.47	Oct. 18, 1943 Jan. 7, 1955 Jan. 2, 1958 Jan. 17, 1963	C, W	N	Dug domestic and stock well, unused. Well 124 of Vernon rept. 5/ Well G-124 of Bull. 5614. 7/
205	L. E. Stamps	L. E. Stamps	1957	39	12	39	Qs	1,256	20.04 27.48	May 5, 1960 June 15, 1971	T, G, 30	Irr	Yield reported 120 gpm. 1/
206	L. D. Lemon	do	1959	20	7	20	Qs	1,253	11.38	Mar. 24, 1970	N	N	Unused irrigation well. One of two wells formerly on a manifold system. Yield of the system reported 75 gpm. Water reported from sand and gravel at 14 to 19 feet. Red beds reported at 19 feet.
* 207	Frank E. Lowe	do	1958	41	14	41	Qs	1,264	15.14	May 13, 1960	T, G, 60	Irr	Water reported from Seymour Formation at 21 to 40 feet. Red beds reported at 40 feet. Well 13-62-228 pumps into this well.
* 208	Ernest P. Streit	do	1960	29	8	29	Qs	1,265	--	--	Cf, E, 2	Irr	Three-well manifold system with all holes the same depth and completed the same, pumped by a common pump and motor. Yield for system reported 50 gpm. Water reported from sand and gravel with base at 27.5 feet. Three of five wells on a collector system.
209	Dr. James J. Muirhead	L. E. Stamps	1956	40	14	40	Qs	1,277	9.79 22.01	May 31, 1960 Sept. 22, 1970	T, -	N	Unused irrigation well. Yield reported 500 gpm. Water reported from sand and gravel at 25 to 39 feet.
* 210	Marshall Nixon	--	1927	40	--	--	Qs	1,270	7.55	Oct. 20, 1943	N	N	Destroyed stock well. Water level was measured during pumping. Water reported from sand and gravel at 35 to 40 feet. Well 41 of Vernon rept. 5/
* 211	do	--	1961	40	6	40	Qs	1,270	25.82 25.51 25.28 26.36	Nov. 21, 1969 Dec. 15, 1969 Jan. 12, 1970 Jan. 8, 1971	J, E, 1/3	S	4/
212	do	Robert Dale	1965	41	14	41	Qs	1,267	21.58	Nov. 21, 1969	T, G	Irr	Yield reported 350 gpm. Water reported from sand and gravel at approximately 30 to 40 feet.
213	do	do	1961	41	14	41	Qs	1,264	25.10	do	T, G, 32	Irr	Yield reported 100 gpm. Water reported from sand and gravel at 30 to 40 feet. Well 13-62-214 pumps into this well.
* 214	do	Jim Rae	1964	41	14	41	Qs	1,265	27.42	do	Cf, E, 2	Irr	Yield reported 80 gpm. Water reported from sand and gravel. This well pumps into well 13-62-213.
* 215	Henry S. Ramsey	Robert Dale	1959	30	6	30	Qs	1,235	12.45	do	J, E, 1/2	D, S	Water reported from alluvial material with base at 28 feet.
216	do	Lee Hopper	1969	28	6	28	Qs	1,237	11.30 11.01 11.02 15.14	do Dec. 15, 1969 Jan. 12, 1970 Jan. 8, 1971	N	N	Unused stock well. Water reported from small gravel. 4/

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

	Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
	13-62-217	L. D. Lemon	Robert Dale	1965	41	14	41	Qs	1,254	21.70	Mar. 24, 1970	T, G, 40	Irr	Yield reported 150 gpm. Water reported from sand and gravel at 31 to 40 feet. Red beds reported at 40 feet.
*	218	do	L. E. Stamps	1960	33	16	33	Qs	1,250	14.74	do	N	N	Unused irrigation well. One of two wells formerly on a manifold system. Yield for system reported 75 gpm. Water reported from sand and gravel at 14 to 19 feet. Red beds reported at 19 feet.
	219	Mrs. Carrie May Oliver	Robert Dale	1956	36	14	36	Qs	1,276	21.73	do	Cf, -, 2	N	Unused irrigation well.
*	220	Norman Drake	do	1967	44	14 --	36 44	Qs	1,265	20 19.50	Feb. 14, 1967 Mar. 24, 1970	T, E, 10	Irr	1/ 2/
*	221	Charles H. Graf	--	--	28	6	28	Qs	1,270	23.91	July 28, 1970	J, E, 1/2	D	Yield reported fair. Water reported from sand and gravel.
*	222	do	Robert Dale	1964	30	6	30	Qs	1,268	28.17	do	J, E, 1/3	S	Yield reported 75 gpm. Water reported from sand and gravel at 25 to 29 feet. Red beds at 29 feet.
*	223	Ernest P. Streit	L. E. Stamps	1962	29	6	29	Qs	1,264	23.79 27.70	do Feb. 4, 1971	J, E, 1/2	S	Yield reported fair. Water reported from sand and gravel.
	224	do	do	1960	30	8	30	Qs	1,264	--	--	Cf, E, 2	Irr	Yield reported 50 gpm. Water reported from sand and gravel with base at 27.5 feet. One of five wells on a collector system.
	225	do	Robert Dale	1964	34	14	34	Qs	1,261	28.39	July 28, 1970	Cf, E, 2	Irr	Yield reported 30 gpm. Water reported from sand and gravel. One of five wells on a collector system.
	226	Frank E. Lowe	do	1969	48	14	48	Qs	1,264	28 18.50	Apr. 22, 1969 July 29, 1970	T, E, 25	Irr	The July 29, 1970 water level shown may be anomalous as wells 13-62-202 and 227 had recently pumped into this well. 1/ 2/
	227	do	do	1961	45	14	45	Qs	1,264	32.08	do	Cf, E, 3	Irr	Yield reported 150 gpm. Water reported from sand and gravel. This well pumps into 13-62-226.
	228	do	L. E. Stamps	1966	41	14	41	Qs	1,264	--	--	T, G, 30	Irr	Yield reported 200 gpm. Water reported from sand and gravel. This well pumps into well 13-62-207.
	229	Dr. James J. Muirhead	Hopper Drilling Co.	1966	42	12	42	Qs	1,276	20 22.34	Mar. 3, 1966 Sept. 22, 1970	Sub, E, 5	Irr	1/
*	230	do	do	1967	42	8	42	Qs	1,277	22.77	do	Sub, E, 7-1/2	Irr	Water reported from sand and gravel.
	231	do	do	1966	42	12	42	Qs	1,277	21.11	do	Sub, E, 7-1/2	Irr	Yield reported 250 gpm. Water reported from sand and gravel.
	232	do	do	1966	42	10	42	Qs	1,278	20 21.40	Mar. 3, 1966 Sept. 22, 1970	Sub, E, 5	Irr	1/ 2/
*	233	do	Lee Hopper	1966	42	6	42	Qs	1,276	22.99	do	J, E, 1/2	D	Water reported from sand and gravel.
	234	Marshall Nixon	Robert Dale	1970	47	14	47	Qs	1,266	23 23.44	May 2, 1970 Dec. 11, 1970	T, E, 15	Irr	Well 13-62-235 pumps into this well. 1/ 2/
	235	do	do	1970	45	14	45	Qs	1,267	22	do	Cf, E, 2	Irr	This well pumps into 13-62-234. 1/
*	236	Robert E. Matus	Robert Dale	1966	37	14	37	Qs	1,281	21 32.94	Jan. 18, 1966 June 8, 1971	Cf, E, 2	Irr	The June 8, 1971 water level was measured during pumping. This well pumps into 13-62-237. 1/ 2/

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
13-62-237	Robert E. Matus	Robert Dale	1966	39	14	39	Qs	1,282	23	Jan. 30, 1966	T, E, 10	Irr	Well 13-62-236 pumps into this well. 1/ 2/
* 238	Bradford Hancock	L. E. Stamps	1959	27	6	27	Qs	1,264	--	--	J, E, 1/2	S	Yield reported weak. Water reported from sand and gravel.
239	do	Robert Dale	1963	30	6	30	Qs	1,266	--	--	J, E, 1	Irr	Water reported from sand and gravel.
240	do	do	1965	30	16	30	Qs	1,266	--	--	Cf, E, 1	Irr	Yield reported greater than 100 gpm. Water reported from sand and gravel.
* 241	do	do	1964	46	14	46	Qs	1,266	--	--	T, E, 15	Irr	Yield reported 150 gpm. Water reported from sand and gravel. Well 13-62-242 pumps into this well.
242	do	do	1966	46	16	46	Qs	1,265	29	1966	Cf, E, 1	Irr	Yield reported 100 gpm. This well pumps into 13-62-241. 1/
* 243	Johnny Fluhmann	Pat Waggoner	1963	44	6	44	Qs	1,266	31.54	June 15, 1971	J, E, 1/2	D	Yield reported weak. Water reported from sand and gravel with base at 34 feet. Red beds reported at 34 feet.
* 244	L. E. Stamps	--	--	39	--	--	Qs	1,256	28	do	J, E, 1/2	D	Water reported from sand and gravel.
245	Curtis Schwearts	Robert Dale	1970	41	14	41	Qs	1,264	29	Apr. 16, 1970	Sub, E, 3/4	D	1/ 2/
246	Frank Kock	do	1967	35	14	35	Qs	1,259	26	Apr. 27, 1967	Cf, E, 2	Irr	1/ 2/
* 301	James Sullivan	--	--	14	--	--	Qs	1,213	8.30 5.00 9.62 10.85 10.08 7.71 10.09	Oct. 19, 1943 Feb. 28, 1951 Jan. 7, 1954 Jan. 15, 1957 Jan. 14, 1965 Jan. 12, 1970 Jan. 8, 1971	N	N	Dug domestic and stock well, unused. 4/ Well 126 of Vernon rept. 5/ Well G-126 of Bull. 5614. 7/
* 302	Dr. James J. Muirhead	Don Hopper	1965	20	8	20	Qal	1,200	9 12.74	June 18, 1965 July 31, 1970	N	N	Unused irrigation well. 1/ 2/
303	do	do	1965	29	8	29	Qal	1,200	12 13.32	June 25, 1965 July 31, 1970	J, E, 1/2	Irr, D	1/ 2/
* 401	A. W. Lowe	L. E. Stamps	1957	39	14	39	Qs	1,293	16.92 24	May 18, 1960 June 10, 1970	T, G, 15	Irr	Yield reported 45 to 50 gpm.
402	C. Glenn Cato	do	1958	41	14	41	Qs	1,294	16.50 26.67	July 11, 1960 July 3, 1970	T, E, 15	Irr	Yield reported 120 gpm. Water reported from sand and gravel with base at 39 or 40 feet. Well 13-62-431 pumps into this well.
* 403	J. E. Lockett	do	1957	39	14	39	Qs	1,289	29.20 27	July 18, 1960 June 10, 1970	T, G	Irr	Yield reported 235 gpm. Water reported from 15 feet of sand and gravel.
404	F. W. Schmoker	do	1957	40	14	40	Qs	1,288	12 10.98 22.77	1957 July 18, 1960 Mar. 11, 1970	T, G, 40	Irr	Yield reported 200 gpm. Water reported from sand and gravel at 28 to 38 feet. Red beds reported at 38 feet.
405	do	do	1956	38	14	38	Qs	1,288	12.78 25.34	May 16, 1960 Mar. 11, 1970	N	N	Unused irrigation well. Yield reported 30 gpm. Water reported from sand and gravel at 32 to 36 feet. Red beds reported at 36 feet.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
* 13-62-406	F. W. Schmoker	L. E. Stamps	1956	38	14	38	Qs	1,289	24.43	Mar. 11, 1970	N	N	Unused irrigation well. Yield reported 30 gpm. Water reported from sand and gravel at 26 to 37 feet.
407	do	do	1957	43	14	43	Qs	1,292	26.55 27.17	Mar. 10, 1970 Feb. 4, 1971	T, E, 3	Irr	Yield reported 50 gpm. Water reported from sand and gravel at 31 to 42 feet. Red beds reported at 42 feet. This well pumps into 13-62-417.
408	do	do	1957	43	12	43	Qs	1,293	16.12 26.60	May 16, 1960 Mar. 10, 1970	T, E, 3	Irr	Yield reported 50 gpm. Water reported from sand and gravel at 31 to 42 feet. Red beds reported at 42 feet. This well pumps into 13-62-417.
* 409	do	Robert Dale	1954	42	12	42	Qs	1,289	12.35 22.93	May 16, 1960 Mar. 10, 1970	T, E, 3	Irr	Yield reported 50 gpm. Water reported from sand and gravel at 30 to 41 feet. Red beds reported at 41 feet. One of four wells on a collector system.
410	do	L. E. Stamps	1958	42	14	42	Qs	1,290	12.62 22.91	May 16, 1960 Mar. 10, 1970	T, E, 3	Irr	Yield reported 20 gpm. Water reported from sand and gravel at 30 to 41 feet. Red beds reported at 41 feet. One of four wells on a collector system.
411	do	Robert Dale	1954	40	16	40	Qs	1,291	13.50 23.48	May 16, 1960 Mar. 10, 1970	T, E, 3	Irr	Yield reported 20 gpm. Water reported from sand and gravel at 24 to 40 feet. Red beds reported at 40 feet. One of four wells on a collector system.
412	do	do	1954	39	16	39	Qs	1,291	13.59 23.21 24.36	May 16, 1960 Mar. 10, 1970 Feb. 4, 1971	T, E, 3	Irr	Yield reported 50 gpm. Water reported from sand and gravel at 23 to 38 feet. Red beds reported at 38 feet. One of four wells on a collector system.
* 413	Roy C. Hofmann	do	1957	40	14	40	Qs	1,298	16 15.02 25.99 28.53	Mar. 16, 1957 May 17, 1960 Apr. 9, 1970 Feb. 4, 1971	T, E, 15	Irr	Water reported from sand and gravel with base at 39 feet.
* 414	August F. Schwarz	L. E. Stamps	1956	41	14	41	Qs	1,296	12.98 22.72 23.24	May 17, 1960 Apr. 9, 1970 Feb. 4, 1971	T, E, 10	Irr	Water reported from 8 feet of basal gravel. Red beds reported at 38 feet. 2/
* 415	William C. Haseloff	Tom Chance	--	30	--	--	Qs	1,269	22.97 20.68 20.67 22.16	Nov. 18, 1969 Dec. 15, 1969 Jan. 12, 1970 Jan. 8, 1971	N	N	Dug domestic well, unused. Yield reported very weak. Water reported at 17 and 25 feet. 4/
* 416	do	Robert Dale	1961	30	6	30	Qal	1,256	13.37	Nov. 18, 1969	J, E, 1	D, S	Yield reported 30 gpm. Water reported at 9, 17, and 25 feet.
417	F. W. Schmoker	do	1966	46	16	46	Qs	1,294	26.41	Mar. 10, 1970	T, G, 27	Irr	Yield reported 30 gpm. Water reported from sand and gravel at 42.5 to 45 feet. Red beds reported at 45 feet. Wells 13-62-407 and 408 pump into this well.
* 418	do	L. E. Stamps	1956	39	14	39	Qs	1,289	20.94 28.66	Mar. 11, 1970 Feb. 4, 1971	N	N	Unused irrigation well. Yield reported 200 gpm. Water reported from sand and gravel at 33 to 38 feet. Red beds reported at 38 feet.
419	do	Robert Dale	1961	39	16	39	Qs	1,290	26.48	Mar. 10, 1970	T, G, 27	Irr	Yield reported 75 gpm. Water reported from sand and gravel at 32 to 38 feet. Red beds reported at 38 feet. Well 13-62-420 pumps into this well.
420	do	do	1961	39	16	39	Qs	1,289	24.38	do	T, G, 27	Irr	Yield reported 30 gpm. Water reported from partially cemented sand and gravel at 32 to 38 feet. Red beds reported at 38 feet. This well pumps into 13-62-419.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
* 13-62-421	F. W. Schmoker	L. E. Stamps	1959	42	16	42	Qs	1,286	21.67 22.55	Mar. 11, 1970 Feb. 4, 1971	N	N	Unused irrigation well. Yield reported 150 gpm. Water reported from sand and gravel at 33 to 41 feet. Red beds reported at 41 feet.
422	Albert C. Graf	Robert Dale	1968	47	16	47	Qs	1,296	30.05 39.50	Apr. 3, 1970 Feb. 4, 1971	T, E, 20	Irr	Yield reported 225 gpm. Well 13-62-423 pumps into this well. 1/
* 423	do	do	1969	47	16	47	Qs	1,295	28.78	Apr. 3, 1970	T, E, 10	Irr	Yield reported 190 gpm. This well pumps into 13-62-422. 1/
* 424	Roy C. Hofmann	do	1967	60	14	60	Qs	1,298	30.84	Apr. 9, 1970	T, E, 25	Irr	Yield reported 260 gpm. 1/
* 425	do	do	1957	40	14	40	Qs	1,294	28.10 28.82	do Feb. 4, 1971	T, E, 25	Irr	Water reported from sand and gravel. 2/
* 426	R. W. Lowe	do	1964	35	14	35	Qs	1,292	24	June 10, 1970	T, G	Irr	Yield reported 45 to 50 gpm.
427	do	do	1967	44	14	44	Qs	1,292	28 24 26.83	Mar. 29, 1967 June 10, 1970 Feb. 4, 1971	T, E, 10	Irr	1/ 2/
* 428	J. E. Lockett	do	1967	42	14	42	Qs	1,292	28	May 16, 1967	T, E, 10	Irr	1/ 2/
429	Mrs. C. H. Cato	do	1957	47	16	47	Qs	1,292	34.10	July 3, 1970	T, E, 15	Irr	Water reported from sand and gravel.
430	do	do	1957	45	14	45	Qs	1,293	33.72	do	T, E, 15	Irr	Do.
* 431	C. Glenn Cato	Loyd E. Stamps	1958	41	14	41	Qs	1,294	31.19 29.72	do Feb. 4, 1971	Cf, E, 2	Irr	Yield reported 120 gpm. Water reported from sand and gravel with base at 39 or 40 feet. This well pumps into 13-62-402.
* 432	do	Robert Dale	1963	45	14	45	Qs	1,294	34	July 3, 1970	T, E, 20	Irr	Water reported from sand and gravel. Well 13-62-433 pumps into this well.
* 433	do	do	1967	44	18 14	32 44	Qs	1,295	27 31.57 29.75	June 26, 1967 July 3, 1970 Feb. 4, 1971	Cf, E, 3	Irr	This well pumps into 13-62-432. 1/ 2/
* 434	C. S. Schmoker	L. E. Stamps	--	38	--	--	Qs	1,285	--	--	J, E	D	--
501	Henry S. Ramsey	--	1940's	21	6	21	Qal	1,218	2.88	Jan. 26, 1970	N	N	Unused public supply well. Dug well. Formerly used at Victory Airfield and by Vernon State Hospital.
* 502	H. A. Carpenter	--	--	11	--	--	Qal	1,243	8.08 2.95 9.45	Oct. 20, 1943 Feb. 26, 1951 Jan. 7, 1951	N	N	Destroyed dug well. Former domestic and stock well. Well 54 of Vernon rept. 5/ Well G-54 of Bull. 5614. 7/
503	Henry S. Ramsey	--	1940's	21	6	21	Qal	1,220	2.70	Jan. 26, 1970	N	N	Unused public supply well. Dug well. Formerly used at Victory Airfield and by Vernon State Hospital.
504	do	--	1940's	21	6	21	Qal	1,220	1.78	do	N	N	Do.
505	do	--	1940's	21	6	21	Qal	1,221	1.82	do	N	N	Do.
506	do	--	1940's	21	6	21	Qal	1,222	2.05	do	N	N	Do.
507	do	--	1940's	21	6	21	Qal	1,225	2.70	do	N	N	Do.
508	do	--	1940's	21	6	21	Qal	1,224	2.80	do	N	N	Do.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
13-62-509	Henry S. Ramsey	--	1940's	21	6	21	Qal	1,223	1.54	Jan. 26, 1970	N	N	Unused public supply well. Dug well. Formerly used at Victory Airfield and by Vernon State Hospital.
510	do	--	1940's	21	6	21	Qal	1,223	2.55	do	N	N	Do.
511	do	--	1940's	21	6	21	Qal	1,224	0.80	do	N	N	Do.
512	do	--	1940's	21	6	21	Qal	1,224	2	do	N	N	Do.
513	do	--	1940's	21	6	21	Qal	1,225	1.98	do	N	N	Do.
514	do	--	1940's	21	6	21	Qal	1,224	2.25	do	N	N	Do.
* 515	do	--	1940's	22	6	22	Qal	1,225	3.86	do	N	N	Do.
516	do	--	1940's	21	--	--	Qal	1,226	2	do	N	N	Do.
517	do	--	1940's	21	6	21	Qal	1,225	3.76	do	N	N	Do.
518	do	--	1940's	21	6	21	Qal	1,226	5.04	do	N	N	Do.
519	do	--	1922	19	50	19	Qal	1,224	9.89	Oct. 30, 1943	N	N	Unused public supply and industrial well. Dug well. Formerly used as a water supply for development of an oil field. Later used as a public supply well for the Waggoner Ranch. Well 51 of Vernon rept. 5/
520	do	--	1922	10	50	10	Qal	1,223	13.90 6.47	do Jan. 26, 1970	Cf, E, 10; J, E, 1-1/2	D	Dug well. Formerly used as a water supply for development of an oil field. Later used as a public supply well for the Waggoner Ranch. Well 50 of Vernon rept. 5/
* 521	do	--	1922	18	50	18	Qal	1,220	13.68 3.58	Oct. 30, 1943 Jan. 26, 1970	N	N	Unused public supply and industrial well. Dug well. Formerly used as a water supply for development of an oil field. Later used as a public supply well for the Waggoner Ranch. Well 48 of Vernon rept. 5/
522	do	--	1940's	21	6	21	Qal	1,221	2.68	do	N	N	Unused public supply well. Dug well. Formerly used at Victory Airfield and by Vernon State Hospital.
523	do	--	1940's	21	6	21	Qal	1,222	2.32	do	N	N	Do.
524	do	--	1940's	17	6	17	Qal	1,220	3.03	do	N	N	Do.
525	do	--	1940's	21	6	21	Qal	1,221	1.10	do	N	N	Do.
* 526	do	--	1940's	19	6	19	Qal	1,218	2.00 3.90	do Feb. 4, 1971	N	N	Do.
* 527	A. G. Graf	--	--	Spring	--	--	Qal	1,220	(+)	--	Flows	N	Flows from sand. Estimated flow 10 gpm.
* 528	do	Lee Hopper	1965	32	10	32	Qal	1,232	23.75	July 30, 1970	Cf, E, 10	Irr	Yield reported 100 gpm. Water reported from gravel with base at 28 feet. Red beds reported at 28 feet. One well of a two-well manifold system which is pumped by a common pump and motor.
529	do	do	1965	31	10	31	Qal	1,231	19.08	do	Cf, E, 10	Irr	Yield reported 100 gpm. Water reported from a gravel with base at 27 feet. Red beds reported at 27 feet. One well of a two-well manifold system which is pumped by a common pump and motor.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
* 13-62-530	Vernon State Hospital	City of Vernon	1943	23	18	23	Qal	1,219	15.89	Oct. 9, 1943	N	N	Unused public supply well. Formerly used for Victory Airfield and owned by the city of Vernon. Yield reported 225 gpm. Water reported from gravel at 12.5 to 22.5 feet. Well 46 of Vernon rept. 5/
531	do	do	1943	22	18	22	Qal	1,220	18.50	do	N	N	Unused public supply well. Formerly used for Victory Airfield and owned by the city of Vernon. Yield reported 150 to 175 gpm. Water reported from gravel at 18 to 22 feet. Well 47 of Vernon rept. 5/
* 701	Mrs. F. A. Caperton	Tom Chance	1953	28	16	28	Qal	1,255	4.35 14.76	July 7, 1960 June 22, 1971	Cf, G	N	Unused irrigation manifold system. Four wells of same depth and completed the same, pumped by a common pump and motor. Yield for system reported 250 gpm. Water reported from 12 feet of dirty sand and gravel with base at 27 feet.
* 702	Lee A. Roberson	Robert Dale	1968	29	6	29	Qal	1,255	11.04	Nov. 11, 1970	Cf, E, 2	Irr	Yield reported 60 gpm. 1/
703	do	do	1968	28	6	28	Qal	1,255	11.02	do	Cf, E, 2	Irr	Yield reported 50 gpm. 1/
* 63-201	Woodrow Tacker	Jimmy Kuntz	1970	30	6	30	Pcf	1,220	8.52	June 24, 1971	J, E, 1/3	S	Yield reported weak. Water reported from "joint clay" at 14 feet and also near bottom of hole.
301	Paschal King	--	--	20	--	--	Qal	1,231	20.39 13.88	Oct. 14, 1961 June 23, 1971	Cf, E, 1/2	D, S	Dug well. Yield reported good. Water reported from sand and gravel. Formerly used at school and gin in Oklaunion.
* 302	Houston Belew	Robert Dale	1970	26	6	26	Qs	1,241	17.15	June 24, 1971	J, E, 1/2	S	Yield reported weak. Water reported from gravel at 23 to 25 feet. Red beds reported at 25 feet.
401	O. E. Carpenter	O. E. Carpenter	--	28	--	--	Pcf	1,210	18	--	N	N	Destroyed dug well. Former domestic and stock well. Water level reported when dug. Yield reported weak. Water reported at 18 feet in clay joints. Water reported unfit for human or livestock consumption.
* 64-301	Sam Kelly Estate	Sam Kelly	1914	36	--	--	Qs	1,216	16.60	June 25, 1971	C, W	S	Dug well. Yield reported 3 gpm. Water reported unfit for human consumption.
302	Leon Raschke	--	--	19	--	--	Qs	1,220	13.10	June 23, 1971	Cf, G	S	Dug well. Yield reported weak.
* 601	Wilbarger Elevators, Inc.	--	1960	20	14	20	Pcf	1,232	8 10.96	Jan. 30, 1961 June 23, 1971	N	N	Unused industrial well. Water reported from gypsum at 6 to 20 feet. Well used only to reduce water level in grain elevator.
* 602	Mrs. Charles Tirey	--	1930	22	--	--	Qal	1,208	15 10.6	Jan. 30, 1961 July 8, 1964	N	N	Destroyed well. Former public supply well. Well 7 of Rept. LD-0365. 8/
* 603	Mary E. Prince Estate	--	--	14	--	--	Pcf	1,203	10.2 13.88	do June 23, 1971	C, W	S	Dug well. Well 5 of Rept. LD-0365. 8/
* 604	Charles Tirey	--	--	27	--	--	Qal	1,200	9.6	Jan. 8, 1964	N	N	Destroyed well. Former stock well. Well 6 of Rept. LD-0365. 8/
* 605	State Highway Department	--	--	15	--	--	Pcf	1,212	8.6	July 8, 1964	N	N	Destroyed dug well. Former domestic well. Well 9 of Rept. LD-0365. 8/
* 14-49-401	Ed Sefcik	Robert Dale	1963	30	5	30	Qs	1,100	16.40	Dec. 3, 1970	Cf, E, 3/4	D, S	Yield reported good. Water reported from sand and gravel at 12 to 29 feet. Red beds reported at 29 feet.

See footnotes at end of table.

Table 4.--Records of Water Wells, Springs, and Selected Test Holes--Continued

Well	Owner	Driller	Date completed	Depth of well (ft)	Casing: Diameter (in.)	Casing: Depth (ft)	Water bearing unit	Altitude of land surface (ft)	Water level: Below land-surface datum (ft)	Water level: Date of measurement	Method of lift	Use of water	Remarks
* 14-49-402	Ed Sefcik	Amarillo Drilling & Septic Co.	1967	38	30	38	Qs	1,104	24.86	Dec. 3, 1970	Cf, E, 15	Irr	Yield reported 125 gpm. Water reported from sand and gravel at 18 to 35 feet. Red beds reported at 35 feet.
* 403	do	do	1970	36	18	36	Qs	1,105	19.40	do	T, G	Irr	Yield reported 125 gpm. Water reported from sand and gravel with base at 34 feet. Red beds reported at 34 feet.
* 404	Marvin C. Schoppa	Howard Goodnight	1950	35	--	--	Qs	1,134	28.45	June 24, 1971	Cf, E, 1/3	D, S	Dug well. Yield reported weak.
* 701	H. M. Tarelton	Robert Dale	1969	33	6	33	Qs	1,118	17.02	do	J, E, 1/3	D	Yield reported good. Water reported from sand and gravel.
* 702	Wilbarger County	--	--	22	--	--	Qs	1,138	11.20	June 23, 1971	N	N	Dug stock well, unused.
* 801	John Turner Farms	--	1961	40	14	40	Qs	1,102	24.07 24.29	Dec. 3, 1970 Jan. 7, 1971	Sub, E, 3	D, S, Irr	Yield reported 90 gpm. Water reported from sand and gravel at 18 to 38 feet. Red beds reported at 38 feet. 4/
* 802	do	--	--	Spring	--	--	Qs	1,100	(+)	--	Flows	N	Flows from contact of Seymour Formation. Yield estimated 10 gpm.
* 57-101	T. H. Parmelly Estate	--	--	20	--	--	Pcf	1,202	12.8 12.19	July 7, 1964 June 24, 1971	N	N	Dug well. Unused domestic and stock well. Well 4 of Rept. LD-0365. 8/
* 401	J. P. Holliman	--	before 1940	15	--	--	Qal	1,187	2.25	July 7, 1964	N	N	Dug well. Destroyed domestic and stock well. Well 1 of Rept. LD-0365. 8/
* 402	do	--	before 1930	--	--	--	Qal	1,181	--	--	N	N	Dug well. Reported was flowing on July 7, 1964. Destroyed stock well. Well 2 of Rept. LD-0365. 8/
21-05-201	Mrs. Walter Southhall	Pat Waggoner	1954	36	14	36	Qal	1,283	6.30 5.84	July 18, 1960 June 9, 1971	N	N	One well of an unused irrigation two-well manifold system, formerly pumped by a common pump and motor. Water reported from sand and gravel.
* 202	do	do	1954	32	14	32	Qal	1,283	5.55 5.84	July 18, 1960 June 9, 1971	N	N	Formerly used on irrigation manifold system with well 21-05-201. Water reported from sand and gravel at 11 to 29 feet. Red beds reported at 29 feet.
203	W. T. Waggoner Estate	do	1956	20	--	--	Qal	1,279	15	1956	N	N	Destroyed stock well. Yield reported 125 gpm. Water reported from gravel at 16 to 20 feet. Water reported unfit for human consumption.
501	do	--	1936	20	--	--	Qal	1,255	15	1936	N	N	Destroyed domestic well. Yield reported 10 to 15 gpm. Water reported from alluvium with base at 20 feet.

* For chemical analyses of water, see Table 8.
1/ For drillers' logs of wells, see Table 5.
2/ For results of pumping tests, measured yields, and specific capacities of wells, see Table 2.
3/ Electric logs in files of Texas Water Development Board, Austin, Texas.
4/ Observation well; historical water-level measurements in files of Texas Water Development Board, Austin, Texas.
5/ Texas Board of Water Engineers duplicated report, Ground-Water Resources in the Vicinity of Vernon, Texas, 1944.
6/ Texas Board of Water Engineers Bulletin 5301, Ground-Water Resources of the Odell Sand Hills, Wilbarger County, Texas, 1953.
7/ Texas Board of Water Engineers Bulletin 5614, Records of Water-Level Measurements in Foard and Wilbarger Counties, Texas, 1956.
8/ Texas Water Commission Report LD-0365, Investigation of Ground- and Surface-Water Contamination Near Harrold, Wilbarger County, Texas, 1965.
9/ Texas Board of Water Engineers Contamination Report 8, A Reconnaissance Investigation of Alleged Contamination of Irrigation Wells Near Lockett, Wilbarger County, Texas, 1960.

Table 5.—Drillers' Logs of Water Wells and Selected Test Holes

	Thickness (feet)	Depth (feet)
Well 13-37-902		
Owner: Mrs. A. F. Winston Driller: Robert Dale		
Soil and clay	18	18
Fine sand	30	48
Pack sand	6	54
Fine to medium sand	8	62
Medium to coarse sand and few gravel	8	70
Red bed	3	73
Well 13-37-903		
Owner: Mrs. A. F. Winston Driller: Robert Dale		
Soil and sandy clay	19	19
Fine sand	19	38
Fine to medium sand	4	42
Fine sand	6	48
Pack sand	7	55
Fine to medium water sand	7	62
Medium to coarse sand and few gravel	7	69
Cemented sand and gravel	.5	69.5
Red bed	3.5	73
Well 13-37-904		
Owner: Kenneth R. Neel Driller: Robert Dale		
Soil and clay	10	10
Fine sand	45	55
Medium to coarse sand and few gravel	10	65
Red bed	2	67
Well 13-37-906		
Owner: City of Altus, Oklahoma Driller: Layne-Western Co.		
Fine sand	20	20
Clay	29	49
Medium to fine sand and gravel	13	62
Fine to coarse sand and gravel	10	72
Red shale	—	72
Well 13-37-907		
Owner: City of Altus, Oklahoma Driller: Layne-Western Co.		
Fine to medium red sand	16	16
Clayey fine red sand	12	28
Slightly clayey fine to medium sand	7	35
Fine to coarse sand and gravel	40	75
Red shale	—	75
Well 13-37-909		
Owner: City of Altus, Oklahoma Driller: Layne-Western Co.		
Fine to medium red clayey sand	20	20
Fine to medium coarse red sand	24	44
Hard streak	2	46
Fine to coarse sand and fine gravel, tan	14	60
Fine to coarse sand and fine to medium coarse gravel, tan	13	73
Red bed (water from 63 to 73 feet)	7	80
Well 13-37-910		
Owner: City of Altus, Oklahoma Driller: Layne-Western Co.		
Fine to medium red sand	5	5
Gray and red clay	3	8
Fine to medium tan sand	2	10
Fine to coarse tan sand	5	15
Fine to coarse sand and fine to coarse gravel, tan	5	20
Fine to coarse sand and gravel, tan	5	25
Coarse sand and gravel with some very coarse gravel, tan	6	31
Hard streak	1	32
Red bed	6	38
Well 13-37-911		
Owner: City of Vernon Driller: Texas Water Development Board		
Soil, sandy, light brown to tan, very fine grained	2.5	2.5
Sand, light brown to tan, fine grained	16	18.5

Table 5.—Drillers' Logs of Water Wells and Selected Test Holes—Continued

Well 13-37-911—Continued

	Thickness (feet)	Depth (feet)
Clayey sand, dark brown, medium-grained, with streaks of white well-cemented sand	3	21.5
Unknown lithology	4	25.5
Sand, white to tan, medium- to coarse-grained	4.5	30
Clayey sand, red, very fine-grained	15	45
Sand, tan, coarse- to very coarse-grained	5	50
Gravely sand, tan, white, various colored	6	56
Shale, red and gray	2	58
Sand, red, medium-grained, (Permian?)	2	60

Well 13-37-912

Owner: City of Vernon
Driller: Texas Water Development Board

	Thickness (feet)	Depth (feet)
Soil, sandy, light tan, very fine-grained	2	2
Sand, tan, fine- to medium-grained	8.5	10.5
Sand, tan, medium-grained, with red clay streaks	5.5	16
Sand, tan, fine- to medium-grained with gray shale streak	1	17
Sand, tan, fine- to medium-grained	4	21
Sand, tan, fine- to medium-grained, with dark brown clay specks	4	25
Sand, tan, fine- to medium-grained	4	29
Sand, as above, with white to gray shaley sand streaks, tight	1	30
Sand, tan, fine- to medium-grained	6	36
Clayey sand, tan to red, fine-grained	8	44
Clay, red, semi-blocky	1	45
Sand, tan, medium-grained, with few granules and pebbles of gravel to 12 mm	5	50
Sand, tan, medium- to coarse-grained, with few chunks of red clay	1	51
Sand, as above, with scattered gravel granules and pebbles to 7 mm	2	53
Sand, tan, medium- to coarse-grained	1	54
Clayey sand, tan, medium- to coarse-grained, with red clay	3	57

Well 13-37-912—Continued

	Thickness (feet)	Depth (feet)
Clayey sand, as above, with gravel granules and pebbles to 50 mm	2	59
Gravely sand, tan, coarse-grained, granules and pebbles, up to 60 mm	11	70
Shale, red, blocky	3	73

Well 13-37-913

Owner: Charles Tallant
Driller: Texas Water Development Board

	Thickness (feet)	Depth (feet)
Soil, sandy, light brown to tan, medium-grained	5	5
Sand, tan, medium- to coarse-grained, some gravel granules to 4 mm	5	10
Clayey sand, light orange, medium-grained, clay, light orange	5	15
Sandy clay, light orange, with sand, very fine- to medium-grained	15	30
Clayey sand, tan to light orange, fine-grained, isolated gravels, variously colored, granules to 4 mm	10	40
Sand, tan, coarse-grained	5	45
Gravel, white, red, orange, fine, mainly quartz, some limestone and dolomite, granules to 4 mm	5	50
Shale, red and gray, blocky	5	55

Well 13-38-401

Owner: City of Altus, Oklahoma
Driller: Layne-Western Co.

	Thickness (feet)	Depth (feet)
Fine sand	7	7
Fine sand with clay	28	35
Sandy clay	2	37
Fine to coarse sand	8	45
Clay	1	46
Fine to coarse sand and gravel	8	54
Cemented sand and gravel	2	56
Fine to coarse sand and gravel	21	77
Shale	—	77

Well 13-38-402

Owner: City of Altus, Oklahoma
Driller: Layne-Western Co.

	Thickness (feet)	Depth (feet)
Sandy silt and clay	15	15
Cemented sand	17	32

Table 5.—Drillers' Logs of Water Wells and Selected Test Holes—Continued

	Thickness (feet)	Depth (feet)
Well 13-38-402—Continued		
Clay	2	34
Fine to coarse sand	23	57
Clay	5	62
Medium to coarse sand and gravel	20	82
Red shale	—	82

Well 13-38-403

Owner: City of Altus, Oklahoma
Driller: Layne-Western Co.

	Thickness (feet)	Depth (feet)
Sandy silt and clay	37	37
Fine to coarse sand	22.5	59.5
Sandy clay	8.5	68
Fine to coarse sand and gravel	8	76
Cemented sand and gravel	6	82
Medium to coarse sand and gravel	5	87
Red shale	—	87

Well 13-38-404

Owner: City of Altus, Oklahoma
Driller: Layne-Western Co.

	Thickness (feet)	Depth (feet)
Fine sand	20	20
Fine to medium sand and gravel	10	30
Sandy red clay	4	34
Fine to coarse sand and gravel	11	45
Sandy gray clay	5	50
Medium to coarse sand and gravel with red clay lenses	8	58
Red shale	—	58

Well 13-38-405

Owner: City of Altus, Oklahoma
Driller: Layne-Western Co.

	Thickness (feet)	Depth (feet)
Fine to medium red clayey sand	29	29
Red clay	3	32
Fine to coarse sand, tan with cemented streaks	8	40
Fine to coarse sand and fine gravel, tan	8	48
Sandy red bed	10	58
Well 13-38-405—Continued		
Red sandstone and some shale	8	66
Red sandstone (very hard)	4	70

Well 13-38-702

Owner: Mrs. Elwyn Bingham
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil	3	3
Gray clay	11	14
Fine sand, red	20	34
Clay, red	5	39
Fine sand, red	15	54
Clay	10	64
Fine sand, red	4	68
Pack sand and sandrock	28	96
Medium sand and few gravel	11	107
Gravel	2	109
Red bed	5	114

Well 13-38-703

Owner: City of Altus, Oklahoma
Driller: Layne-Western Co.

	Thickness (feet)	Depth (feet)
Fine to medium red sand	10	10
Clayey fine to medium sand	20	30
Clayey fine red sand	13	43
White clay	1	44
Fine to coarse sand with fine gravel, tan	23	67
Red shale	—	67

Well 13-38-704

Owner: City of Altus, Oklahoma
Driller: Layne-Western Co.

	Thickness (feet)	Depth (feet)
Fine to medium red sand	10	10
Clayey red sand	9	19
Fine to coarse red sand	23	42
Clayey fine sand	6	48
Fine to coarse sand and fine gravel	24	72
Red shale	—	72

Table 5.—Drillers' Logs of Water Wells and Selected Test Holes—Continued

	Thickness (feet)	Depth (feet)
Well 13-38-705		
Owner: City of Altus, Oklahoma Driller: Layne-Western Co.		
Fine to medium red sand	6	6
Fine clayey tan sand	50	56
Fine to coarse tan sand	24	80
Red shale	—	80
Well 13-38-706		
Owner: City of Altus, Oklahoma Driller: Layne-Western Co.		
Fine to medium sand	10	10
Clayey fine to medium tan sand	27	37
Sandy gray clay	20	57
Fine to coarse tan sand	10	67
Red clay	1	68
Fine to coarse sand and gravel, tan	20	88
Red shale	—	88
Well 13-38-707		
Owner: City of Altus, Oklahoma Driller: Layne-Western Co.		
Sandy clay	20	20
Fine to coarse sand and gravel	22	42
Clay	1	43
Fine to coarse sand and gravel	29	72
Red shale	—	72
Well 13-38-708		
Owner: City of Altus, Oklahoma Driller: Layne-Western Co.		
Dune sand	6	6
Sandy clay	29	35
Fine to medium sand and gravel	45	80
Red shale	—	80
Well 13-38-709		
Owner: City of Altus, Oklahoma Driller: Layne-Western Co.		
Loose fine sand	7	7
Fine to coarse sand and gravel	43	50
Well 13-38-709—Continued		
Cemented sand and gravel	2	52
Medium to coarse sand and gravel	20	72
Cemented sand and very coarse gravel	4	76
Red shale	—	76
Well 13-38-710		
Owner: City of Altus, Oklahoma Driller: Layne-Western Co.		
Loose fine sand	8	8
Sandy clay	12	20
Fine to medium sand, fine gravel	40	60
Gray clay	2	62
Cemented sand and gravel	8	70
Fine to coarse sand and gravel	7	77
Red shale	—	77
Well 13-38-711		
Owner: City of Altus, Oklahoma Driller: Layne-Western Co.		
Sandy soil	2	2
Sandy gray clay	14	16
Fine to coarse sand	9	25
Brown and red clay	35	60
Fine to coarse sand	20	80
Coarse sand and gravel	9.5	89.5
Red shale	—	89.5
Well 13-38-712		
Owner: City of Altus, Oklahoma Driller: Layne-Western Co.		
Sandy soil	3	3
Gray clay	4	7
Fine red sand	6	13
Brown clay	9	22
Fine sand	4	26
Red clay	6	32
Fine sand	20	52
Gray clay	5	57

Table 5.—Drillers' Logs of Water Wells and Selected Test Holes—Continued

	Thickness (feet)	Depth (feet)
Well 13-38-712—Continued		
Medium to coarse sand	22	79
Fine sand	4	83
Coarse gravel	9.5	92.5
Red shale	—	92.5
Well 13-38-713		
Owner: City of Altus, Oklahoma Driller: Layne-Western Co.		
Fine to medium red sand	10	10
Fine to medium tan to red sand	11	21
Fine to medium red sand	11	32
Very sandy red clay	3	35
Fine to medium red sand	9	44
Very sandy gray to tan clay	11	55
Fine to coarse tan sand	7	62
Hard streak	1	63
Red bed	7	70
Well 13-38-714		
Owner: City of Altus, Oklahoma Driller: Layne-Western Co.		
Fine to medium clayey sand, red	21	21
Fine to medium sand, tan	4	25
Fine to medium clayey sand, red	15	40
Hard cemented streak	1	41
Fine to coarse tan sand	14	55
Fine to coarse sand and some fine gravel with cemented streaks	10	65
Fine to coarse sand and fine tan gravel with cemented streaks	8	73
Red shaley sandstone	12	85
Red bed	5	90
Well 13-38-715		
Owner: City of Altus, Oklahoma Driller: Layne-Western Co.		
Fine to medium clayey sand	20	20
Fine to coarse sand and fine gravel, tan	7	27
Hard cemented streak	1	28

	Thickness (feet)	Depth (feet)
Well 13-38-715—Continued		
Fine to coarse tan sand with some cemented streaks	17	45
Hard cemented fine to coarse sand and gravel, tan	10	55
Red bed	5	60
Well 13-38-716		
Owner: Mrs. Elwyn Bingham Driller: Robert Dale		
Soil	5	5
Clay	9	14
Fine sand	5	19
Clay	13	32
Fine sand	14	46
Fine sand, clay layers	10	56
Sand rock	2	58
Fine water sand	4	62
Cemented sand and gravel	1	63
Fine sand	4	67
Sand rock	1	68
Red bed	1	69
Well 13-38-717		
Owner: Mrs. Elwyn Bingham Driller: Robert Dale		
Top soil	3	3
Clay	12	15
Fine sand	5	20
Clay	15	35
Fine sand	10	45
Pack sand	10	55
Sand rock	1	56
Fine sand	4	60
Medium sand	2	62
Clay	10	72
Red bed	1	73

Well 13-38-718

Owner: Mrs. Elwyn Bingham
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Top soil	25	25
Fine sand and clay layers	20	45
Fine sand	11	56
Cemented sand and gravel	3	59
Sand rock and clay	4	63
Red bed	6	69

Well 13-38-719

Owner: Mrs. Elwyn Bingham
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Unknown lithology	52	52
Fine water sand	7	59
Clay layers	12	71
Red bed	1	72

Well 13-38-720

Owner: Mrs. Elwyn Bingham
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil	3	3
Sandy clay	13	16
Fine sand	21	37
Clay	9	46
Fine sand	20	66
Sand rock	1	67
Fine sand	3	70
Clay	1	71
Fine to medium sand	10	81
Medium to coarse sand and few gravel	5	86
Cemented sand and gravel	0.5	86.5
Fine to medium sand	2.5	89
Sand rock	0.5	89.5
Medium to coarse sand and gravel	0.5	90
Fine sand	4	94
Coarse sand and gravel	6	100
Red bed	1	101

Well 13-38-721

Owner: Mrs. Elwyn Bingham
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil	3	3
Sandy clay	16	19
Fine sand	16	35
Clay	13	48
Pack sand and clay layers	14	62
Fine water sand	6	68
Clay	1	69
Fine water sand	9	78
Fine to medium sand	6	84
Cemented sand and gravel	0.5	84.5
Medium to coarse sand and gravel	3.5	88
Red bed	1	89

Well 13-38-722

Owner: Frank McDougal
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Fine sand	18	18
Fine sand and clay layers	9	27
Fine water sand and clay layers	22	49
Clay	10	59
Fine sand	8	67
Sand rock	11.5	78.5
Fine sand	5.5	84
Red bed	1	85

Well 13-38-723

Owner: Frank McDougal
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Fine sand and clay layers	27	27
Unknown lithology	51	78
Fine water sand	6	84
Sand rock	1	85
Fine sand	1	86
Sand rock	0.5	86.5
Fine to medium sand	3.5	90

Table 5.—Drillers' Logs of Water Wells and Selected Test Holes—Continued

	Thickness (feet)	Depth (feet)
Well 13-38-723—Continued		
Medium to coarse sànd and gravel, tight	3	93
Cemented sand and gravel	1	94
Fine to medium sand and gravel with clay layers	4	98
Red bed	1	99

Well 13-38-724

Owner: Frank McDougal
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Unknown lithology	25	25
Fine sand	12	37
Fine sand and clay layers	29	66
Sand rock	2	68
Fine sand and clay layers	14	82
Fine sand with sand rock layers	5	87
Fine water sand	6	93
Unknown lithology	10	103
Red bed	1	104

Well 13-38-802

Owner: Jake C. Riggins
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil and sandy clay	26	26
Clay	22	48
Fine sand with clay layers	10	58
Fine to medium sand	4	62
Sand rock	1	63
Pack sand	8	71
Cemented sand and gravel	0.5	71.5
Medium to coarse sand and few gravel	4.5	76
Red bed	5	81

Well 13-38-803

Owner: W. Neal Fitzgerald
Driller: Texas Water Development Board

	Thickness (feet)	Depth (feet)
Soil, sandy, light brown, fine- to medium-grained	3	3
Sand, light orange, medium-grained	12	15
Clayey sand, orange, fine-grained	4.5	19.5

Well 13-38-803—Continued

	Thickness (feet)	Depth (feet)
Sand, orange, fine- to medium-grained	3	22.5
Sandy clay, orange, blocky, with orange sand, fine- to medium-grained, tight	3	25.5
Sand, red to orange, fine-grained	4	29.5
Sand, as above, slightly clayey	4	33.5
Sand, light-gray to light tan, medium-grained	9	42.5
Sand, light orange, tan to light buff, very fine- to fine-grained	12	54.5
Shaley sand, light red to pink, very fine-grained	3	57.5
Caliche, white, finely crystalline, pin-point porosity	1	58.5
Sand, white, very fine- to medium-grained, well-cemented	4.5	63
Clayey sand, pink, very fine- to fine-grained, with clay, light orange	7	70
Caliche, white, finely crystalline, slightly porous with clayey sand, as above	10	80
Sand, tan and red to orange, coarse- to very coarse-grained, with few granules and pebbles 4 to 15 mm	7	87
Sand, tan, coarse- to very coarse-grained	8	95
Sand, as above, with granules of gravel to 4 mm	5	100
Clayey sand, light orange, fine-grained, with granules of gravel up to 3 mm	4	104
Shale, red, blocky	3	107
Clayey sand, red, fine-grained, (Permian?)	3	110

Well 13-38-804

Owner: W. Neal Fitzgerald
Driller: Texas Water Development Board

	Thickness (feet)	Depth (feet)
Soil, sandy, light brown, fine-grained	5	5
Sand, light tan, fine- to medium-grained	3.5	8.5
Clayey sand, tan, very fine- to fine-grained, few rust colored streaks	3	11.5
Sand, rust and tan mottled, fine- to medium-grained	12.5	24
Clayey sand, light red to tan, fine-grained, with red clay	1	25

Table 5.—Drillers' Logs of Water Wells and Selected Test Holes—Continued

	Thickness (feet)	Depth (feet)
Well 13-38-804—Continued		
Sand, rust, fine- to medium grained	14	39
Shale, red, blocky	6	45

Well 13-45-308

Owner: Charles Tallant
Driller: Texas Water Development Board

	Thickness (feet)	Depth (feet)
Soil, sandy, white to tan, fine-grained	2	2
Sand, tan, fine-grained	3	5
Sand, as above, with red clay streaks	1.5	6.5
Sand, as above, with caliche nodules	1	7.5
Sand, tan fine-grained	15.5	23
Sand, orange, very fine-grained, with clay and dolomite and limestone particles, fine grained	2	25
Sand, orange, fine- to medium-grained	8	33
Sand, tan to orange, medium- to coarse-grained, with fine gravel to 4 mm	4	37
Sand, tan to orange, fine-grained, with clay layers	4	41
Sand, tan to orange, coarse-grained, fine gravel 2 to 4 mm	6	47
Sand and gravel, as above, with orange clay streaks	2	49
Sand, tan to orange, coarse- to very coarse-grained, with small gravels 2 to 4 mm	2	51
Gravel, various colored, pebbles 26 to 50 mm	3	54
Shale, red and gray	6	60
Gravel, various colors, fine (2-4 mm), well-cemented (Permian?)	2	62

Well 13-45-309

Owner: Charles Tallant
Driller: Texas Water Development Board

	Thickness (feet)	Depth (feet)
Soil, sandy, brown, fine-grained	5	5
Sand, as above, with dark brown shale streaks	5	10
Sand, light tan to white fine- to coarse-grained, with streaks of caliche and dark brown shale	20	30
Sand, white, fine- to medium-grained, well cemented	10	40
Well 13-45-309—Continued		
Sand, light orange, fine- to medium-grained, with orange shale streaks	30	70
Sand, light orange and white, very coarse-grained, with gravel pebbles 4 to 10 mm	6	76
Shale, red and gray, blocky	10	86
Sand, light red to various colored, fine- to medium-grained, with red clay streaks	4	90

Well 13-45-310

Owner: Charles Tallant
Driller: Texas Water Development Board

	Thickness (feet)	Depth (feet)
Soil, sandy, brown, medium-grained	5	5
Clayey sand, tan, very fine- to medium-grained	15	20
Sand, white to light gray, fine-grained, cemented with caliche	5	25
Sandy caliche, white to tan, finely crystalline, with sand, as above	5	30
Clayey sand, light red to orange, fine-grained, with orange clay	10	40
Sand, tan, very coarse-grained, few gravel granules of dolomite and limestone to 2 mm	5	45
Sand, as above, with few gravel granules to 4 mm	5	50
Gravel, various colored quartz, limestone and dolomite granules and pebbles 1 to 20 mm, with sand, as above	5	55
Shale, red and gray, blocky	5	60

Well 13-45-312

Owner: Mrs. J. W. Brock
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil and loose clay	54	54
Medium sand	2	56
Red bed	2	58

Well 13-45-506

Owner: Sam H. Tooley
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil and clay	27	27
Fine sand	11	38
Medium to coarse sand and few gravel	11	49

Table 5.—Drillers' Logs of Water Wells and Selected Test Holes—Continued

	Thickness (feet)	Depth (feet)
Well 13-45-506—Continued		
Coarse sand and gravel	8	57
Red bed	3	60

Well 13-45-609

Owner: Bert Presley
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Top soil and clay	16	16
Sand	29	45
Medium to coarse sand and gravel	13	58
Fine to medium sand	4	62
Medium to coarse sand and gravel	6	68
Red bed	5	73

Well 13-45-611

Owner: H. Leroy Conner
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Sandy soil	3	3
Sandy clay	32	35
Fine sand	30	65
Fine sand and small gravel	10	75
Sand and gravel	18	93
Red bed	2.5	95.5

Well 13-45-616

Owner: Benjamin H. Smith, Jr.
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Sandy soil	3	3
Sandy shale	15	18
Fine red sand	6	24
Clay	3	27
Fine sand silt	8	35
Fine water sand	12	47
Sugar sand	13	60
Sand rock	2	62
Fine water sand	5.5	67.5
Coarse sand and gravel	1.5	69
Red bed	1	70

Well 13-45-621

Owner: Ray C. Morgan
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil and clay	23	23
Fine sand	6	29
Medium to coarse sand with clay layers	9	38
Clay	6	44
Fine sand	5	49
Medium to coarse sand and few gravel	12	61
Red bed	4	65

Well 13-45-622

Owner: Ray C. Morgan
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil	4	4
Clay	17	21
Fine sand	11	32
Fine sand with clay layers	9	41
Fine to medium sand	7	48
Medium sand and few gravel	5	53
Coarse sand and gravel	9	62
Red bed	2	64

Well 13-46-114

Owner: Mrs. Elwyn Bingham
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil	4	4
Clay	24	28
Pack sand	38	66
Clay	2	68
Fine sand, red	10	78
Fine sand	11	89
Sand rock, hard	1	90
Medium to coarse sand and few gravel	1	91
Coarse sand and gravel	14	105
Red bed	2	107

Table 5.—Drillers' Logs of Water Wells and Selected Test Holes—Continued

Well 13-46-117

Owner: W. C. Bellar
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil and sandy clay	30	30
Clay	5	35
Fine sand with clay layers	19	54
Fine to medium sand	4	58
Fine sand and clay layers	6	64
Medium to coarse sand	10	74
Medium to coarse sand and few gravel	2	76
Red bed	4	80

Well 13-46-124

Owner: Mrs. M. E. Forester
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Top soil	4	4
Sandy clay	14	18
Fine sand	19	37
Medium to fine water sand	4	41
Fine sand with clay layers	5	46
Pack sand	5	51
Soft sand rock	4	55
Medium to coarse sand and gravel	7	62
Red bed	—	62

Well 13-46-125

Owner: City of Vernon
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil and sandy clay	22	22
Fine sand and clay layers	16	38
Fine sand with 6 inches to 1 foot sand rock layers, hard	18	56
Fine water sand and clay layers	3	59
Fine water sand	15	74
Medium to coarse sand and few gravel	4	78
Medium to coarse sand	8	86
Medium to coarse sand and few gravel	8	94
Sand rock, hard	1	95
Red bed	—	95

Well 13-46-126

Owner: City of Vernon
Driller: Texas Water Development Board

	Thickness (feet)	Depth (feet)
Soil, sandy, light brown very fine-grained	2.5	2.5
Sand, light brown, fine- to medium-grained	39	41.5
Sand, light orange, fine-grained, with clay streaks	4	45.5
Sand, light orange, fine-grained	6	51.5
Sand, light tan, medium- to coarse-grained	4	55.5
Sand, light orange, coarse- to very coarse-grained, with gravel 2 to 12 mm	12	67.5
Gravel, various colored, pebbles 6 to 12 mm, with sand as above	2	69.5
Sand, light orange, coarse- to very coarse-grained, with gravel 6 to 12 mm	4	73.5
Gravel, various colored, with pebbles up to 27 mm, with sand as above, and water worn bi-valve fossils	6.5	80
Gravel, various colored, granules 2 to 4 mm, with thin light red shale breaks	5	85
Clay, light orange to brown, with various colored granules of gravel 2 to 4 mm	5	90
Gravel, various colored, with granules and pebbles 2 to 24 mm, with sand, orange, very coarse grained, and clay balls	3	93
Gravel, various colored, granules, pebbles and cobbles 2 to 65 mm, with sand, orange, very coarse-grained	6	99
Shale, red, blocky	4	103
Sand, dark red and various colored, very coarse-grained (Permian?)	2	105

Well 13-46-127

Owner: Grady E. Bingham
Driller: Texas Water Development Board

	Thickness (feet)	Depth (feet)
Soil, sandy, light brown, fine-grained	3.5	3.5
Sand, light tan, fine-grained	2.5	6
Clayey sand, light tan, fine-grained	4	10
Sand, light tan to white, fine-grained	4	14
Sand, as above, with dark brown clay layers	4	18

	Thickness (feet)	Depth (feet)
Well 13-46-127—Continued		
Sand, tan to orange, medium-grained	4	22
Sand, as above, with tight clayey sand layers	7	29
Sandy clay, orange, with gray sand, fine-grained, tight	3	32
Clayey sand, light orange, fine-grained	1	33
Clay, orange	3	36
Sandy clay, orange, fine-grained	1	37
Sand, red to dark orange, fine-grained	4	41
Sand, as above, with orange clay streaks	1	42
Sand, light tan, medium-grained	4	46
Sandy clay, light tan to orange, fine-grained, with iron nodules	3	49
Sand, tan, medium-grained	8	57
Sand, tan, medium- to coarse-grained, with gravel granules to 4 mm	1	58
Sand, tan, medium- to coarse-grained	8	66
Sand, tan, medium- to coarse-grained, with gravel granules and pebbles 2 to 20 mm	14	80
Gravel, various colored, with pebbles 4 to 35 mm	3	83
Sand, tan, coarse-grained, with gravel pebbles to 40 mm	2	85
Shale, red, blocky	2	87
Well 13-46-128		
Owner: G. K. Martin Driller: Robert Dale		
Soil and clay	9	9
Fine sand	19	28
Fine sand and clay layers	7	35
Clay	4	39
Sand rock	3	42
Fine sand	3	45
Fine to medium (sand?)	5	50
Medium to coarse (sand?)	3	53
Medium to coarse sand and gravel	7	60
Red bed	4	64
Well 13-46-130		
Owner: Mrs. Elwyn Bingham Driller: Robert Dale		
Top soil	4	4
Sandy clay	8	12
Fine sand	2	14
Clay	5	19
Fine sand	7	26
Clay	8	34
Fine sand	8	42
Sand rock	1	43
Fine sand with clay layers	3	46
Clay	7	53
Sand rock	0.5	53.5
Fine sand	12.5	66
Fine to medium sand	2	68
Medium coarse sand and few gravel	6	74
Fine sand	2	76
Medium to coarse sand and few gravel	4	80
Red bed	1	81
Well 13-46-131		
Owner: Charles Tallant Driller: Robert Dale		
Fine sand	14	14
Clay	8	22
Fine sand	6	28
Fine sand with clay layers	10	38
Fine water sand	17	55
Six-inch sand rock layers	5	60
Fine sand	0.5	60.5
Medium to poor sand	3.5	64
Coarse sand and gravel	2	66
Red bed	3	69
Well 13-46-212		
Owner: Jake C. Riggins Driller: Robert Dale		
Soil and sandy clay	38	38
Clay	18	56

Table 5.—Drillers' Logs of Water Wells and Selected Test Holes—Continued

	Thickness (feet)	Depth (feet)
Well 13-46-212—Continued		
Fine sand	12	68
Medium to coarse sand	8	76
Red bed	3	79
Well 13-46-217		
Owner: Jake C. Riggins Driller: Robert Dale		
Soil	3	3
Sandy clay	24	27
Fine sand	8	35
Fine to medium sand, hard	7	42
Sand rock, hard	2	44
Medium sand and gravel	4	48
Coarse sand and small gravel	6	54
Sand rock	5	59
Red bed	1	60
Well 13-46-224		
Owner: Sumner Estate Driller: Robert Dale		
Soil and clay	17	17
Fine sand with clay layers	21	38
Fine to medium sand with clay layers	9	47
Pack sand	3	50
Sand rock, hard	1	51
Pack sand	4	55
Medium to coarse sand and gravel	9	64
Red bed	3	67
Well 13-46-230		
Owner: Sumner Estate Driller: Robert Dale		
Soil	3	3
Clay	14	17
Fine sand	17	34
Pack sand	5	39
Medium sand	5	44
Fine sand	5	49
Well 13-46-230—Continued		
Sand rock	1	50
Medium sand	4	54
Coarse sand	2	56
Coarse sand and small gravel	6	62
Red bed	6	68
Well 13-46-232		
Owner: Sumner Estate Driller: Robert Dale		
Top soil	3	3
Sandy clay	21	24
Fine sand and clay layers	26	50
Sand rock	2	52
Fine sand	13	65
Fine to medium sand and few gravel	12	77
Red bed	3	80
Well 13-46-233		
Owner: Bill Graf Driller: Robert Dale		
Soil	5	5
Fine sand with clay layers	67	72
Sand rock	3	75
Clay	7	82
Fine to medium sand and few gravel	5	87
Red bed	3	90
Well 13-46-234		
Owner: William S. Fitzgerald Driller: B. B. Thrash		
Top soil and quicksand, fine, white	20	20
Unknown lithology	10	30
Red clay	8	38
Blue caliche	6	44
Red and blue clay	11	55
Sand rock	20	75
Water-bearing blue and gray clay	5	80

Table 5.—Drillers' Logs of Water Wells and Selected Test Holes—Continued

	Thickness (feet)	Depth (feet)
Well 13-46-234—Continued		
Water-bearing caliche	2	82
Fine gravel and sand	3	85
Gravel, average 3/8 to 1/4 inch diameter	8	93
Red bed	–	93
Well 13-46-235		
Owner: William S. Fitzgerald Driller: B. B. Thrash		
Top soil and quicksand	22	22
Unknown lithology	3	25
Red clay	7	32
Caliche	4	36
Unknown lithology	1	37
Sand rock	3	40
Red sand rock, some clay	2	42
Sand rock and sand	15	57
Blue clay and caliche	1	58
Red clay	3	61
Red and blue clay	4	65
Water-bearing clay	3	68
Sand rock	5	73
Through hard rock	10	83
Gravel	2	85
Gravel and sand rock	10	95
Sand rock	10	105
Red bed	–	105
Well 13-46-236		
Owner: William S. Fitzgerald Driller: B. B. Thrash		
Top soil and quicksand	25	25
Unknown lithology	5	30
Red caliche	4	34
Blue caliche, soft	4	38
Blue clay	2	40
Sand rock	8	48
Water clay	2	50

	Thickness (feet)	Depth (feet)
Well 13-46-236—Continued		
Sand rock	10	60
Clay balls	4	64
Gravel	2	66
Sand rock, trace gravel	4	70
Water sand, some gravel	33	103
Red bed	–	103
Well 13-46-237		
Owner: William S. Fitzgerald Driller: B. B. Thrash		
Top soil and quicksand	26	26
Unknown lithology	1	27
Blue clay	10	37
Fine sand	5	42
Water-bearing sand and clay	15	57
Blue clay	1	58
Sand rock	4	62
Sand	10	72
Coarse sand	28	100
Red bed	–	100
Well 13-46-401		
Owner: City of Vernon Driller: D. L. McDonald		
Unknown lithology	8	8
Red clay and sand	32	40
Coarse sand and fine gravel	34	74
Sandstone	1	75
Sand, gravel, and clay balls	22	97
Clay with streaks of sand and gravel	8	105
Red clay (water from 40 to 105 feet)	5	110
Well 13-46-402		
Owner: City of Vernon Driller: D. L. McDonald		
Top sand and clay streaks	20	20
Soft sand	20	40
Sand and fine gravel	20	60

Table 5.—Drillers' Logs of Water Wells and Selected Test Holes—Continued

	Thickness (feet)	Depth (feet)
Well 13-46-402—Continued		
Sand, gravel, and clay balls	35	95
Red bed (water from 20 to 95 feet)	5	100
Well 13-46-403		
Owner: City of Vernon Driller: D. L. McDonald		
Sand and clay streaks	10	10
Sandy clay	10	20
Sand and clay streaks	20	40
Sand and clay balls	10	50
Sand, gravel, and clay balls	40	90
Red bed	5	95
Well 13-46-404		
Owner: City of Vernon Driller: D. L. McDonald		
Top sand and clay	10	10
Sand and clay	20	30
Sand	40	70
Sand and gravel	12	82
Red clay (water from 30 to 82 feet)	9	91
Well 13-46-405		
Owner: City of Vernon Driller: D. L. McDonald		
Top sand and clay	10	10
Sand and clay	30	40
Sand	20	60
Sand, gravel, and clay balls	30	90
Sand and red clay	10	100
Red clay	5	105
Well 13-46-406		
Owner: City of Vernon Driller: D. L. McDonald		
Top sand and clay streaks	10	10
Sand and sandy clay streaks	10	20
Sandy clay	10	30
Sand and sandy clay streaks	20	50

	Thickness (feet)	Depth (feet)
Well 13-46-406—Continued		
Sand and fine gravel	20	70
Sand, fine gravel, and clay balls	20	90
Red bed	7	97
Well 13-46-407		
Owner: City of Vernon Driller: D. L. McDonald		
Top sand and clay	10	10
Sandy clay	10	20
Sand and clay streaks	30	50
Coarse sand and fine gravel	20	70
Sand, gravel, and clay balls	20	90
Red clay (water from 20 to 90 feet)	5	95
Well 13-46-408		
Owner: City of Vernon Driller: D. L. McDonald		
Sand and clay streaks	20	20
Sand and clay balls	40	60
Sand and clay balls, hard	10	70
Cemented sand and gravel	1	71
Sand, fine gravel, and clay balls	14	85
Red clay	5	90
Well 13-46-413		
Owner: City of Vernon Driller: Layne-Arkansas		
Red sand	12	12
Sand and clay	6	18
Sand	1	19
Muddy sand and clay	15	34
Sand	7	41
Sand and clay	8	49
Sand	2	51
Sand and clay	4	55
Sand	2	57
Sand, gravel and clay	3	60
Fine sand	8	68

Table 5.—Drillers' Logs of Water Wells and Selected Test Holes—Continued

	Thickness (feet)	Depth (feet)
Well 13-46-413—Continued		
Coarse sand	8	76
Coarse sand and gravel	18	94
Clay and gravel	2	96
Red bed	6	102

Well 13-46-414

Owner: City of Vernon
Driller: Layne-Arkansas

	Thickness (feet)	Depth (feet)
Red sand	9	9
Sandy clay	8	17
Red sand	5	22
Red sandy clay	38	60
Sand	7	67
Sand, cored	1	68
Sand, dirty	9	77
Sand, cut good	3	80
Sand, cored	2	82
Sand, good	1	83
Coarse gravel	7	90
Sand, cored	1	91
Sand and fine gravel	12	103
Red bed	4	107

Well 13-46-415

Owner: City of Vernon
Driller: Herman Winters

	Thickness (feet)	Depth (feet)
Sand	9	9
Clay	4	13
Sand, packed	14	27
Sandy clay	17	44
Sand, fine	21	65
Fine to medium sand	12	77
Medium to fair sand and gravel	3	80
Good to extra good coarse sand and gravel (clay streaks 109 to 112 feet)	32	112
Red bed	1	113

Well 13-46-416

Owner: City of Vernon
Driller: Herman Winters

	Thickness (feet)	Depth (feet)
Sandy clay	15	15
Fine sand with clay streaks	19	34
Fine to medium sand	27	61
Clay streaks	3	64
Sand, medium	9	73
Sand, medium to fair	12	85
Coarse sand and gravel	13	98
Coarse sand and gravel with clay balls	2.5	100.5
Red bed	4.5	105

Well 13-46-418

Owner: Jake C. Riggins
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil	4	4
Sandy clay	14	18
Fine sand	4	22
Clay	2	24
Fine sand	13	37
Clay and rock	1	38
Fine sand	10	48
Fine sand with clay layers	8	56
Sand rock	1	57
Fine and medium sand and few gravel	16	73
Sand rock	3	76
Fine and medium sand and gravel with cemented layers	14	90
Red bed	1	91

Well 13-46-430

Owner: Bert Dockery
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil	4	4
Clay	18	22
Fine sand	9	31

Table 5.—Drillers' Logs of Water Wells and Selected Test Holes—Continued

	Thickness (feet)	Depth (feet)
Well 13-46-430—Continued		
Silt sand	20	51
Clay	5	56
Fine sand	6	62
Pack sand	3	65
Fine sand	9	74
Fine to medium sand	4	78
Medium to coarse sand	8	86
Medium to coarse sand and few gravel	6	92
Coarse sand and gravel	3	95
Red bed	4	99

Well 13-46-432

Owner: City of Vernon
Driller: —

	Thickness (feet)	Depth (feet)
Silty sand	22	22
Clay	9	31
Sand with clay streaks	17	48
Sand, fine to medium	13	61
Sand, medium to fair	13	74
Sand, medium to good	24	98
Red bed	4	102

Well 13-46-501

Owner: City of Vernon
Driller: D. L. McDonald

	Thickness (feet)	Depth (feet)
Top sand	4	4
Clayey sand	16	20
Blue sandy clay	10	30
Soft sand	10	40
Sand and clay balls	10	50
Sand, gravel, and clay balls	26	76
Sand rock	1	77
Sand, gravel, and clay balls	21	98
Red clay (water from 30 to 98 feet)	5	103

Well 13-46-502

Owner: City of Vernon
Driller: D. L. McDonald

	Thickness (feet)	Depth (feet)
Top sand	5	5
Red sand and clay streaks	15	20
Sand and clay streaks	10	30
Sand and fine gravel	10	40
Sand, gravel, and clay balls	57	97
Red clay (water from 20 to 97 feet)	5	102

Well 13-46-503

Owner: City of Vernon
Driller: D. L. McDonald

	Thickness (feet)	Depth (feet)
Sand	10	10
Red clayey sand	10	20
Red sandy clay	20	40
Red clayey sand	10	50
Sand, gravel, and clay balls	57	107
Red bed (water from 50 to 107 feet)	5	112

Well 13-46-507

Owner: Jake C. Riggins
Driller: Bill Turner

	Thickness (feet)	Depth (feet)
Soil	3	3
Sand, red, fine- to coarse-grained	9	12
Sand, yellow, fine- to coarse-grained	3	15
Sand, brown, fine- to coarse-grain	15	30
Sandy, white, fine- to very coarse-grained	20	50
Sand, white and pink, fine- to coarse-grained, hard	10	60
Sand, white, fine- to very coarse-grained, and layers of hard sand	19	79
Sand, hard, white	3	82
Gravel, pebbles, and medium- to very coarse-grained sand	8	90
Shale, hard, red	2	92

Table 5.—Drillers' Logs of Water Wells and Selected Test Holes—Continued

Well 13-46-511

Owner: City of Vernon
Driller: McDonald Drlg. Co., Inc.

	Thickness (feet)	Depth (feet)
Loose sand	12	12
Clay and sand	34	46
Sand, clay streaks	31	77
Sand	10	87
Sand, gravel, clay streaks	20	107
Sand, a little clay	4	111
Red clay	5	116

Well 13-46-512

Owner: City of Vernon
Driller: McDonald Drlg. Co., Inc.

	Thickness (feet)	Depth (feet)
Top soil and clay	4	4
Clay	16	20
Clay, streaks of sand rock	13	33
Clay, sand streaks	4	37
Sand, clay streaks	17	54
Clay	6	60
Sand and clay	5	65
Sand, some gravel, clay streaks	12	77
Sand, gravel, and clay streaks	17	94
Red clay	7	101

Well 13-46-515

Owner: Jake C. Riggins
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Sandy medium loam	4	4
Sand soil	4	8
Sandy clay	20	28
Fine sand and clay layers	10	38
Fine to medium water sand	8	46
Sand rock	1	47
Fine to medium sand (pack)	4	51
Clay	3	54
Fine sand	18	72
Pack sand	1	73
Medium to coarse sand and gravel	17	90

Well 13-46-515—Continued

	Thickness (feet)	Depth (feet)
Medium to coarse sand and more gravel	4	94
Red bed	1	95

Well 13-46-518

Owner: Jake C. Riggins
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Top soil	3	3
Clay	18	21
Fine sand with clay	17	38
Fine to medium white sand	4	42
Pack sand	4	46
Fine to medium white sand	11.5	57.5
Medium to coarse sand and gravel	5.5	63
Fine sand	5	68
Sand rock	0.5	68.5
Fine sand	17.5	86
Fine to medium sand	4	90
Medium to coarse sand	5	95
Red bed	1	96

Well 13-46-519

Owner: City of Vernon
Driller: —

	Thickness (feet)	Depth (feet)
Sand	14	14
Sandy clay	14	28
Sand, packed	6	34
Clay	14	48
Clay, medium to hard	19	67
Sandy clay	5	72
Sand, firm to medium	47.5	119.5
Red bed	5.5	125

Well 13-46-605

Owner: E. Howard Heath
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil	4	4
Clay	12	16

Table 5.—Drillers' Logs of Water Wells and Selected Test Holes—Continued

	Thickness (feet)	Depth (feet)
Well 13-46-605—Continued		
Fine to medium sand	18	34
Coarse sand and gravel	6	40
Red bed	5	45

Well 13-46-606

Owner: E. Howard Heath
Driller: Lee Hopper

	Thickness (feet)	Depth (feet)
Top soil sand	5	5
Fine sand, loose	23	28
Coarse sand	10	38
Coarse sand, loose	7	45
Coarse sand and gravel, loose	7	52
Red bed	2	54

Well 13-46-612

Owner: Troy A. Chapman
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil and clay	6	6
Fine sand	2	8
Clay	4	12
Fine sand and clay layers	9	21
Clay	5	26
Fine sand and clay layers	8	34
Fine to medium sand and few gravel	4	38
Mostly gravel	4	42
Red beds	4	46

Well 13-46-613

Owner: Troy A. Chapman
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil and clay	13	13
Fine sand and clay layers	8	21
"Rotten" clay	10	31
Fine sand	7	38
Medium to coarse sand and small gravel	16	54
Coarse sand and gravel	3	57
Red beds	4	61

Well 13-46-615

Owner: Troy A. Chapman
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Top soil and clay	14	14
Fine sand and clay layers	4	18
Riverbed clay	16	34
Fine to medium sand and clay layers	8	42
Medium to coarse sand and few gravel	6	48
Fine to medium sand and few gravel	6	54
Medium to coarse sand and few gravel	5	59
Red bed	4	63

Well 13-46-616

Owner: Cathern Pierce
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil	4	4
Clay	12	16
Sand rock	5	21
Fine sand and clay layers	37	58
Medium to coarse sand and few gravel	2	60
Red bed	3	63

Well 13-46-902

Owner: Clyde Crisp
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil and clay	8	8
Fine sand	22	30
Coarse sand and gravel	6	36
Red bed	2	38

Well 13-47-106

Owner: Royce Eiland
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil	2	2
Fine to medium coarse sand and gravel	37	39
Red bed	2	41

Table 5.—Drillers' Logs of Water Wells and Selected Test Holes—Continued

Well 13-47-404

Owner: Fred McLaughlin
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil and clay	6	6
Sand	4	10
Clay	5	15
Fine sand	10	25
Medium to coarse sand and few gravel	5	30
Medium to coarse sand and small gravel	11	41
Red bed	4	45

Well 13-47-705

Owner: John D. Alexander
Driller: M. L. Myatt

	Thickness (feet)	Depth (feet)
Soil	6	6
Fine sand, water at 10 feet	4	10
Coarse water sand	15	25
Coarse sand and good gravel, water	10	35
Red beds	—	35

Well 13-47-706

Owner: James Sullivan
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil and clay	4	4
Fine sand	14	18
Medium sand	4	22
Medium to coarse sand	6	28
Medium to coarse sand and gravel	7	35
Red bed	—	35

Well 13-54-516

Owner: Hillcrest Country Club
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Sandy soil	2	2
Fine sand	18	20
Medium to coarse sand and gravel	7	27
Red bed	2	29

Well 13-54-716

Owner: Curtis A. Graf
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil	3	3
Soil and clay	15	18
Fine sand	20	38
Medium to coarse sand and few gravel	3	41
Fine sand	2	43
Medium to coarse sand and gravel	8	51
Red bed	3	54

Well 13-54-718

Owner: Joe Frank Lowe
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Top soil and clay	8	8
River sand	42	50
Coarse sand and gravel	6	56
Red beds	—	56

Well 13-54-725

Owner: Dr. J. P. Eaton
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Top soil	4	4
Clay	14	18
Fine sand	6	24
Fine sand with clay layers	1	25
Sand rock	7	32
Fine to medium sand	6	38
Fine sand and few gravel	2	40
Coarse sand and gravel	2	42
Clay	1	43
Coarse sand and gravel	2	45
Red bed	7	52

Well 13-54-726

Owner: Maurice Oliver
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil	3	3
Clay	14	17

Table 5.—Drillers' Logs of Water Wells and Selected Test Holes—Continued

	Thickness (feet)	Depth (feet)
Well 13-54-726—Continued		
Gravel	3	20
Clay	20	40
Coarse sand and gravel	7	47
Red bed	4	51
Well 13-54-727		
Owner: Frank Kock Driller: Robert Dale		
Soil	4	4
Clay	20	24
Very fine red sand	30	54
Red bed	4	58
Well 13-54-730		
Owner: Albert C. Graf Driller: Robert Dale		
Soil	4	4
Sandy clay	21	25
Clay	5	30
Fine sand	3	33
Fine to medium sand with few gravel	10	43
Red bed	3	46
Well 13-54-731		
Owner: Arthur Schultz Driller: Robert Dale		
Soil	3	3
Clay	5	8
Sandy clay	10	18
Fine sand	4	22
Fine to medium sand	10	32
Medium to coarse sand and few gravel	7	39
Red bed	3	42
Well 13-54-817		
Owner: City of Vernon Driller: Layne-Texas Co.		
Soil	2	2
Silty sand	8	10

	Thickness (feet)	Depth (feet)
Well 13-54-817—Continued		
Coarse-grained sand	6	16
Rock	0.5	16.5
Fine-grained sand	1	17.5
Shale	0.5	18
Sandy shale	2	20
White sand	8	28
Rock	1	29
Silty sand	5	34
Fine sand, boulders, and clay	5	39
Well 13-54-838		
Owner: Mrs. F. B. Elliott Driller: Robert Dale		
Soil and clay	18	18
Medium and coarse sand	4	22
Clay	3	25
Coarse sand and clay layers	3	28
Medium to coarse sand and gravel	14	42
Red bed	4	46
Well 13-54-839		
Owner: Harold Star Driller: Robert Dale		
Soil	3	3
Sandy clay	17	20
Fine sand	3	23
Coarse sand and small gravel	5	28
Clay	1	29
Medium to coarse sand and gravel	11	40
Red bed(?)	5	45
Well 13-54-848		
Owner: J. H. Pettit, et al. Driller: Layne-Texas Co.		
Soil	16	16
Sand and gravel	6	22
Clay	0.5	22.5
Sand and gravel	22.5	45
Clay(red beds)	1	46

	Thickness (feet)	Depth (feet)
Well 13-54-849		
Owner: Wilbarger County Hospital Driller: Robert Dale		
Soil and clay	17	17
Fine sand	6	23
Fine sand with clay layers (6 inches)	5	28
Fine to medium sand, few gravel	7	35
Red bed	13	48
Well 13-54-854		
Owner: Frank Kock Driller: Robert Dale		
Top soil and clay	18	18
Medium to coarse sand	2	20
Coarse sand and gravel	10	30
Red bed	3	33
Well 13-54-906		
Owner: Dr. James J. Muirhead Driller: Don Hopper		
Top soil, sand and clay	10	10
Joint clay	10	20
River sand	5	25
Red bed	—	25
Well 13-54-907		
Owner: Dr. J. J. Slaugenhop Driller: Robert Dale		
Soil and clay	17	17
Fine to medium sand	3	20
Medium to coarse sand and few gravel	7	27
Coarse sand and gravel	3	30
Red beds	5	35
Well 13-54-908		
Owner: Dr. J. J. Slaugenhop Driller: Robert Dale		
Soil and clay	23	23
Soft clay and fine sand	2	25
Soft clay with gravel layers 6 to 18 inches thick	7	32

	Thickness (feet)	Depth (feet)
Well 13-54-908—Continued		
Fine to medium sand	1	33
Medium to coarse sand and few gravel	6	39
Red bed	4	43
Well 13-61-104		
Owner: Edward L. Lehman, Jr. Driller: Pat Waggoner		
Soil	10	10
Sand	8	18
Unknown lithology	4	22
Gravel	8	30
Red bed	—	30
Well 13-61-204		
Owner: Edward L. Lehman, Jr. Driller: L. E. Stamps		
Top soil	6	6
Dirty sand	5	11
Fine water sand	8	19
Coarse water sand and gravel	10	29
Red bed	1	30
Well 13-61-206		
Owner: Edward L. Lehman, Jr. Driller: Robert Dale		
Top soil	5	5
Sand	3	8
Clay	5	13
Sand, water	12.5	25.5
Gravel	4.5	30
Red bed	—	30
Well 13-61-212		
Owner: — Driller: —		
Fine sand	10	10
Sandy, clay	3	13
Coarse sand	5	18
Coarse sand and gravel	1	19

	Thickness (feet)	Depth (feet)
Well 13-61-212—Continued		
Coarse sand	9	28
Gravel	3	31
Shale and sand	3	34
Red bed	2	36

Well 13-61-322

Owner: A. J. Lambert
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil and clay	16	16
Fine sand with clay layers	15	31
Fine to medium sand	2	33
Fine to medium to coarse sand and few gravel	7	40
Red bed	4	44

Well 13-61-323

Owner: Mrs. C. H. Cato
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil and subsoil	5	5
Clay	6	11
Fine sand with clay layers	4	15
Coarse to medium sand with clay layers	9	24
Red beds	2	26

Well 13-61-333

Owner: C. Glenn Cato
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Top soil and unknown lithology	16	16
Coarse sand and gravel	12	28
Fine to medium sand	4	32
Medium to coarse sand and few gravel	2	34
Fine sand and few gravel	4	38
Medium to coarse sand and few gravel	4	42
Sand rock	0.5	42.5
Red bed	0.5	43

Well 13-61-334

Owner: C. Glenn Cato
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil	3	3
Clay, red and gray	19	22
Sand rock	1	23
Fine sand	11	34
Medium sand and few gravel	4	38
Red bed	6	44

Well 13-61-343

Owner: –
Driller: –

	Thickness (feet)	Depth (feet)
Fine sand	18	18
Coarse sand	10	28
Pea gravel, coarse sand	4	32
Gravel	2	34
Shale and sand	1	35
Red bed	2	37

Well 13-61-344

Owner: –
Driller: –

	Thickness (feet)	Depth (feet)
Fine sand	7	7
Sandy clay	12	19
Coarse sand	12	31
Pea gravel	2	33
Red shale and coarse sand	1	34
Red bed	2	36

Well 13-61-345

Owner: –
Driller: –

	Thickness (feet)	Depth (feet)
Fine sand	11	11
Sandy clay	1	12
Coarse sand	9	21
Pea gravel	2	23
Red bed	2	25

Table 5.—Drillers' Logs of Water Wells and Selected Test Holes—Continued

	Thickness (feet)	Depth (feet)
Well 13-61-415		
Owner: Tom R. Locke Driller: Robert Dale		
Soil	3	3
Soft red clay	11	14
Fine sand, white	13	27
Sand and small gravel	3	30
Gravel, loose	5	35
Red bed	1	36
Well 13-61-419		
Owner: Tom R. Locke Driller: Robert Dale		
Soil	3	3
Sandy clay	15	18
Coarse sand and large gravel, clean	15	33
Red bed(?)	2	35
Well 13-61-425		
Owner: Henry W. Karcher Driller: Robert Dale		
Soil and sandy clay	15	15
Medium sand and fine gravel with clay layers 4 to 6 inches	20	35
Coarse sand and gravel	10	45
Red bed	5	50
Well 13-61-506		
Owner: T. J. McGill Estate Driller: Robert Dale		
Top soil	18	18
Good coarse white sand and coarse gravel	36	54
Red bed	–	54
Well 13-61-509		
Owner: Clois R. Cobb Driller: Robert Dale		
Top soil	5	5
Clay	10	15
Well 13-61-509—Continued		
Sand and gravel	20	35
Red bed	3	38
Well 13-61-511		
Owner: T. J. McGill Estate Driller: Robert Dale		
Soil	2.5	2.5
Sandy soil	7.5	10
Fine sand	5	15
Water sand and gravel	15	30
Gravel	8	38
Red bed	2	40
Well 13-61-515		
Owner: Homer W. Custer Driller: L. E. Stamps		
Rock sand	4	4
Clay	16	20
Sand, gravel, dirty	6	26
Good gravel	4	30
Small gravel	5	35
Red bed	1	36
Well 13-61-614		
Owner: Edward K. Obenhaus Driller: Robert Dale		
Soil	3	3
Clay	25	28
Fine red sand	13	41
Medium sand	1	42
Medium to coarse sand	3	45
Red bed	5	50
Well 13-61-619		
Owner: Lockett Water District Driller: E. B. Dyer Drilling Co.		
Sand and clay, half and half	25	25
Fairly coarse sand and few gravel	18	43
Red bed	7	50

Well 13-61-620

Owner: Lockett Water District
Driller: E. B. Dyer Drilling Co.

	Thickness (feet)	Depth (feet)
Sand and clay, half and half	25	25
Fairly coarse sand and few gravel	18	43
Red bed	7	50

Well 13-61-621

Owner: Ed. A. Haseloff
Driller: L. E. Stamps

	Thickness (feet)	Depth (feet)
Soil	5	5
Sandy clay and clay	4	9
Sand	5	14
Gravel	5	19
Clay	2	21
Clay, sand, and tight sand	18	39
Red bed	1	40

Well 13-61-624

Owner: Eddie Schoppa
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Top soil	2	2
Caliche	6	8
Fine sand, mixed caliche layers	6	14
Sand and gravel	12	26
Pea gravel	11	37
Red bed	—	37

Well 13-61-648

Owner: Red River Authority of Texas
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil and clay	16	16
Fine sand	2	18
Clay	1	19
Fine sand	5	24
Fine sand and clay layers	8	32
Medium and coarse sand, few gravel, with clay layers	7	39
Red bed	6	45

Well 13-61-703

Owner: Frank Granot
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Top soil	3	3
Fine sand and clay	11	14
Clay	4	18
Fine water sand	9	27
Tight dirty sand and gravel	5	32
Coarse sand and gravel	18	50
Coarse sand, clean and loose	3.5	53.5
Red bed	—	53.5

Well 13-61-707

Owner: Oliver C. Holland
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil and clay	15	15
Fine sand	11	26
Clay	1	27
Fine to medium sand	4	31
Coarse sand and gravel	5	36
Clay with cemented sand and gravel layers	2	38
Coarse sand and gravel	14	52
Red bed	4	56

Well 13-61-812

Owner: Walter E. Foerster, Jr.
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil and clay	17	17
Fine sand	9	26
Clay	1	27
Fine sand	6	33
Medium to coarse sand and gravel	8	41
Coarse sand and gravel	6	47
Red bed	4	51

Well 13-61-824

Owner: Walter T. Gaebler
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil	3	3
Sandy clay	24	27

	Thickness (feet)	Depth (feet)
Well 13-61-824—Continued		
Clay	3	30
Fine sand and clay layers	11	41
Medium sand	7	48
Medium and coarse sand and few gravel	6	54
Red bed	3	57
Well 13-61-829		
Owner: Bill Smith Driller: Hopper Drilling Co.		
Top soil	10	10
Red clay and sand	10	20
Blue clay and sand	10	30
Sand and gravel	10	40
Red bed	1	41
Well 13-61-833		
Owner: J. F. Shivers Driller: Robert Dale		
Soil	3	3
Clay	15	18
Fine sand with clay layers	10	28
Medium to coarse sand	13	41
Coarse sand and few gravel	7	48
Red bed	5	53
Well 13-61-834		
Owner: Hub Colley, et al. Driller: Robert Dale		
Sandy soil	3	3
Sandy clay	16	19
Fine sand with clay layers	8	27
Fine to medium sand	4	31
Medium sand	3	34
Medium to coarse sand and small gravel	13	47
Clay	1	48
Coarse sand and gravel	4	52
Red bed	5	57

	Thickness (feet)	Depth (feet)
Well 13-61-836		
Owner: Hub Colley, et al. Driller: Robert Dale		
Soil and clay	22	22
Fine sand	4	26
Medium to coarse sand and few gravel	7	33
Coarse sand and gravel	3	36
Coarse sand and more gravel	4	40
Coarse sand and lot of gravel	14	54
Red bed	5	59
Well 13-61-839		
Owner: C. Glenn Cato Driller: Robert Dale		
Top soil and clay	19	19
Fine to medium sand	3	22
Pack sand	4	26
Medium to coarse sand and few gravel	3	29
Fine to medium sand with clay layers	5	34
Medium to coarse sand and few gravel	6	40
Red bed	5	45
Well 13-61-841		
Owner: Edward L. Lehman, Jr. Driller: Robert Dale		
Top soil and clay	16	16
Fine sand	12	28
Sand rock	2	30
Fine to medium sand	6	36
Clay	2	38
Fine sand	10	48
Medium to coarse sand and few gravel	6	54
Red bed	4	58
Well 13-61-845		
Owner: Arthur Piper Driller: Robert Dale		
Soil	4	4
Clay	17	21

Table 5.—Drillers' Logs of Water Wells and Selected Test Holes—Continued

	Thickness (feet)	Depth (feet)
Well 13-61-845—Continued		
Fine red sand	20	41
Medium to coarse sand with clay layers	3	44
Coarse sand and gravel	7	51
Red bed	2	53
Well 13-61-901		
Owner: Edward K. Obenhaus Driller: Robert Dale		
Soil	4	4
Clay	14	18
Sand	2	20
Clay	11	31
Fine sand	13	44
Red bed	3	47
Well 13-62-126		
Owner: Curtis A. Graf Driller: Robert Dale		
Soil and clay	18	18
Fine to medium to coarse sand and very few gravel	19	37
Red bed	5	42
Well 13-62-133		
Owner: Robert Dale Driller: Robert Dale		
Sand and sandy clay	19	19
Fine sand	11	30
Fine, medium, and some coarse sand	12	42
Red bed	2	44
Well 13-62-134		
Owner: Robert Dale Driller: Robert Dale		
Soil	3	3
Blue clay	3	6
Sandy clay	9	15
Medium to sandy gravel	11	26
Red sand	16	42
Well 13-62-134—Continued		
Fine to medium sand	3	45
Medium to coarse sand and few gravel	5	50
Red bed	3	53
Well 13-62-136		
Owner: Robert Dale Driller: Robert Dale		
Soil	4	4
Blue clay	4	8
Sandy clay	7	15
Medium to coarse sand	9	24
Fine to medium sand	14	38
Coarse sand	4	42
Coarse sand and few gravel	6	48
Red bed	2	50
Well 13-62-142		
Owner: A. J. Lambert Driller: Robert Dale		
Top soil	14	14
Dry sand	12	26
Fine sand	2	28
Fine red sand	6	34
Medium coarse sand, a little tight	5	39
Clay and cement, tight gravel	1	40
Good gravel	4	44
Red bed	1	45
Well 13-62-143		
Owner: A. J. Lambert Driller: Robert Dale		
Top soil and clay	13	13
Coarse sand and gravel	3	16
Clay	4	20
Very fine sand	4	24
Red fine sand	2	26
White fine sand	8	34
Fine to medium sand and few gravel	4	38

Table 5.—Drillers' Logs of Water Wells and Selected Test Holes—Continued

	Thickness (feet)	Depth (feet)
Well 13-62-143—Continued		
Coarse sand and gravel	3	41
Red bed	4	45

Well 13-62-145

Owner: A. J. Lambert
Driller: L. E. Stamps

	Thickness (feet)	Depth (feet)
Top soil	2	2
Caliche	5	7
Sugar sand	6	13
Water sand	2	15
Tight gravel	5	20
Red bed	—	20

Well 13-62-146

Owner: A. J. Lambert
Driller: L. E. Stamps

	Thickness (feet)	Depth (feet)
Top soil	3	3
Caliche	4	7
Dry water sand	5	12
Sandy clay	3	15
Water sand	5	20
Red bed	4	24

Well 13-62-150

Owner: Charles H. Graf
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Unknown lithology	28	28
Good bright gravel	7	35
Red bed	5	40

Well 13-62-155

Owner: James Sullivan
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil and clay	16	16
Sandy clay	9	25
Sand rock	1	26
Fine to medium sand with a few gravel	9	35
Red bed	4	39

Well 13-62-159

Owner: Cody Austin
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil	6	6
Sandy clay	15	21
Fine sand	10	31
Fine to medium sand	13	44
Red bed	3	47

Well 13-62-205

Owner: L. E. Stamps
Driller: L. E. Stamps

	Thickness (feet)	Depth (feet)
Sand and shale	30	30
Sand and gravel, water	7	37
Red bed	2	39

Well 13-62-220

Owner: Norman Drake
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil	4	4
Clay	13	17
Fine sand	9	26
Medium to coarse sand	5	31
Coarse sand and large gravel	8	39
Red bed	3	42

Well 13-62-226

Owner: Frank E. Lowe
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil	4	4
Clay	18	22
Fine sand	10	32
Coarse sand and gravel	7	39
Fine sand	2	41
Coarse sand and gravel	4	45
Red bed	3	48

Well 13-62-229

Owner: Dr. James J. Muirhead
Driller: Hopper Drilling Co.

	Thickness (feet)	Depth (feet)
Top soil	3	3
Sand and soil	7	10

	Thickness (feet)	Depth (feet)
Well 13-62-229—Continued		
Sand and clay	8	18
Water sand	10	28
Water sand	5	33
Gravel	8	41
Red bed	1	42

Well 13-62-232

Owner: Dr. James J. Muirhead
Driller: Hopper Drilling Co.

	Thickness (feet)	Depth (feet)
Top soil	4	4
Sandy clay	6	10
Sandy clay	10	20
Water sand	11	31
Gravel	10	41
Red bed	1	42

Well 13-62-234

Owner: Marshal Nixon
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil and clay	12	12
Sandy clay	11	23
Fine sand with clay layers	8	31
Fine to medium sand	10	41
Coarse sand and gravel	3	44
Red bed	3	47

Well 13-62-235

Owner: Marshal Nixon
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil and sandy clay	24	24
Fine to medium sand	9	33
Medium to coarse sand	3	36
Medium to coarse sand and gravel	5	41
Red bed	4	45

Well 13-62-236

Owner: Robert E. Matus
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil	3	3
Clay	14	17
Well 13-62-236—Continued		
Fine sand	6	23
Sand rock, hard	2	25
Fine to medium sand and very few gravel	8	33
Red bed	4	37

Well 13-62-237

Owner: Robert E. Matus
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil	3	3
Clay	13	16
Sandy clay	6	22
Fine to medium sand	9	31
Medium to coarse sand	3	34
Coarse gravel	2	36
Red bed	3	39

Well 13-62-242

Owner: Bradford Hancock
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil	3	3
Sandy clay	24	27
Fine to medium sand	6	33
Medium to coarse sand and few gravel, with 4 to 6 inch tight layers	11	44
Red beds	2	46

Well 13-62-245

Owner: Curtis Schwearts
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil and clay	16	16
Fine sand	9	25
Fine to medium sand	5	30
Fine to medium sand and few gravel	7	37
Red bed	4	41

Well 13-62-246

Owner: Frank Kock
Driller: Robert Dale

	Thickness (feet)	Depth (feet)
Soil	4	4
Clay	12	16

	Thickness (feet)	Depth (feet)
Well 13-62-246—Continued		
Fine to medium sand	14	30
Coarse sand and large gravel	2	32
Red bed	3	35
Well 13-62-302		
Owner: Dr. James J. Muirhead Driller: Don Hopper		
Top soil and clay	10	10
Joint clay	10	20
Red bed	–	20
Well 13-62-303		
Owner: Dr. James J. Muirhead Driller: Don Hopper		
Top soil and sand	10	10
Red clay	10	20
Yellow clay and gravel	9	29
Red bed	–	29
Well 13-62-422		
Owner: Albert C. Graf Driller: Robert Dale		
Top soil and sand, clay	4	4
Clay	23	27
Fine sand with clay layers	4	31
Coarse sand, small gravel	3	34
Clay	1	35
Coarse sand, small gravel, little clay	5	40
Cemented sand and gravel	1	41
Medium coarse sand, small gravel	1	42
Coarse sand and gravel	4	46
Red bed	1	47
Well 13-62-423		
Owner: Albert C. Graf Driller: Robert Dale		
Top soil	15	15
Clay	15	30
Medium coarse sand and trace gravel	3	33

	Thickness (feet)	Depth (feet)
Well 13-62-423—Continued		
Cemented sand and gravel	0.5	33.5
Medium coarse sand and gravel with layers clay	2.5	36
Coarse sand and gravel	2	38
Medium coarse sand and gravel	0.5	38.5
Coarse sand and gravel	2.5	41
Red bed	6	47
Well 13-62-424		
Owner: Roy C. Hoffmann Driller: Robert Dale		
Soil and clay	18	18
Fine to medium sand	14	32
Sand rock, hard	2	34
Fine to medium sand	8	42
Medium to coarse sand and gravel	8	50
Cemented sand and gravel	1	51
Coarse sand and boulders	4	55
Red bed	5	60
Well 13-62-427		
Owner: A. W. Lowe Driller: Robert Dale		
Soil	3	3
Clay	13	16
Clay with fine sand layers	6	22
Medium sand	6	28
Medium to coarse sand and gravel	12	40
Red bed	3	43
Well 13-62-428		
Owner: J. E. Lockett Driller: Robert Dale		
Soil	4	4
Clay, sandy	14	18
Fine to medium sand	11	29
Medium sand with clay layers	7	36
Coarse sand and gravel	1	37
Red bed	4	41

Table 5.—Drillers' Logs of Water Wells and Selected Test Holes—Continued

	Thickness (feet)	Depth (feet)
Well 13-62-433		
Owner: C. Glenn Cato Driller: Robert Dale		
Soil	4	4
Gray clay	13	17
Fine to medium sand, red	11	28
Clay	5	33
Coarse sand and gravel	7	40
Red bed	4	44
Well 13-62-702		
Owner: Lee A. Roberson Driller: Robert Dale		
Soil	4	4
Clay	10	14
Well 13-62-702—Continued		
Creek wash with clay layers	13	27
Red bed	2	29
Well 13-62-703		
Owner: Lee A. Roberson Driller: Robert Dale		
Soil	4	4
Clay	8	12
Creek wash with clay layers	14	26
Red bed	2	28

Table 6.—Drillers' Logs of Geophysical Shot Holes Used for Supplementary Data Control in the Lockett Area

Data from files of U.S. Geological Survey. See Figure 30 for location of these geophysical shot holes.

	Thickness (feet)	Depth (feet)
Shot Hole 2		
Altitude 1,312 feet		
Sandy clay	12	12
Sand	6	18
Gravel	7	25
Shale	27	52
Shot Hole 3		
Altitude 1,321 feet		
Sandy clay	17	17
Sand and gravel	12	29
Shale	21	50
Shot Hole 4		
Altitude 1,324 feet		
Sand	30	30
Gravel and sand	22	52
Shale	3	55
Shot Hole 10		
Altitude 1,312 feet		
Sandy clay	21	21
Gravel and sand	20	41
Shale	30	71
Shot Hole 14		
Altitude 1,300 feet		
Sandy clay	22	22
Sand and gravel	14	36
Shale	24	60
Shot Hole 15		
Altitude 1,311 feet		
Sand	17	17
Sand and gravel	28	45
Shale	25	70
Shot Hole 21		
Altitude 1,307 feet		
Sandy clay	26	26
Sand	9	35
Sand and gravel	8	43
Shale	17	60
Shot Hole 27		
Altitude 1,294 feet		
Sandy clay	16	16
Sand and gravel	25	41
Shale	29	70
Shot Hole 34		
Altitude 1,291 feet		
Sandy clay	14	14
Sand and gravel	21	35
Shale	35	70
Shot Hole 97		
Altitude 1,237 feet		
Sandy clay	21	21
Gravel and sand	7	28
Shale	12	40

Table 6.—Drillers' Logs of Geophysical Shot Holes Used for Supplementary Data Control in the Lockett Area—Continued

	Thickness (feet)	Depth (feet)
Shot Hole 102		
Altitude 1,293 feet		
Sandy clay	14	14
Sand	4	18
Shale	32	50
Shot Hole 103		
Altitude 1,316 feet		
Sand and clay	25	25
Sand and gravel	10	35
Shale	15	50
Shot Hole 104		
Altitude 1,319 feet		
Sandy clay	8	8
Sand and gravel	11	19
Shale	31	30
Shot Hole 109		
Altitude 1,319 feet		
Sandy clay	18	18
Sand and gravel	26	44
Shale	26	70
Shot Hole 110		
Altitude 1,305 feet		
Sandy clay	16	16
Sand and gravel	28	44
Shale	26	70
Shot Hole 115		
Altitude 1,309 feet		
Sandy clay	24	24
Sand and gravel	14	38
Shale	52	90

	Thickness (feet)	Depth (feet)
Shot Hole 121		
Altitude 1,303 feet		
Sandy clay	11	11
Sand and gravel	17	28
Shale	42	70
Shot Hole 122		
Altitude 1,304 feet		
Sandy clay	20	20
Sand and gravel	23	43
Shale	27	70
Shot Hole 128		
Altitude 1,298 feet		
Sand	30	30
Sand and gravel	20	50
Shale	20	70
Shot Hole 133		
Altitude 1,298 feet		
Sand	29	29
Sand and gravel	13	42
Shale	28	70
Shot Hole 202		
Altitude 1,313 feet		
Sandy clay	17	17
Gravel	12	29
Shale	32	61
Shot Hole 203		
Altitude 1,325 feet		
Sand	25	25
Gravel	15	40
Shale	30	70

Table 6.—Drillers' Logs of Geophysical Shot Holes Used for Supplementary Data Control in the Lockett Area—Continued

	Thickness (feet)	Depth (feet)
Shot Hole 210		
Altitude 1,313 feet		
Sandy clay	12	12
Sand and gravel	21	33
Shale	37	70
Shot Hole 215		
Altitude 1,306 feet		
Sandy clay	14	14
Sand and gravel	27	41
Shale	29	70
Shot Hole 222		
Altitude 1,299 feet		
Sand	28	28
Sand and gravel	17	45
Shale	25	70
Shot Hole 233		
Altitude 1,286 feet		
Sandy clay	29	29
Shale	41	70
Shot Hole 234		
Altitude 1,289 feet		
Sandy clay	12	12
Sand and gravel	29	41
Shale	29	70
Shot Hole 310		
Altitude 1,305 feet		
Sand and gravel	39	39
Shale	51	90

	Thickness (feet)	Depth (feet)
Shot Hole 315		
Altitude 1,306 feet		
Sandy clay and gravel	46	46
Shale	44	90
Shot Hole 403		
Altitude 1,309 feet		
Sand and gravel	38	38
Shale	52	90
Shot Hole 790		
Altitude 1,230 feet		
Sand	25	25
Shale	25	50
Shot Hole 802		
Altitude 1,286 feet		
Sandy clay	13	13
Sand and gravel	6	19
Shale	31	50
Shot Hole 803		
Altitude 1,314 feet		
Sand	23	23
Gravel	5	28
Shale	5	33
Shot Hole 804		
Altitude 1,318 feet		
Sandy clay	14	14
Sand	10	24
Sand and gravel	12	36
Shale	14	50

Table 6.—Drillers' Logs of Geophysical Shot Holes Used for Supplementary Data Control in the Lockett Area—Continued

	Thickness (feet)	Depth (feet)
Shot Hole 808		
Altitude 1,322 feet		
Sandy clay	26	26
Sand and gravel	17	43
Shale	17	60
Shot Hole 809		
Altitude 1,317 feet		
Sandy clay	9	9
Sand and gravel	30	39
Shale	31	70
Shot Hole 810A		
Altitude 1,315 feet		
Sand and gravel	38	38
Shale	52	90
Shot Hole 815		
Altitude 1,305 feet		
Sandy clay	24	24
Sand and gravel	24	38
Shale	33	70
Shot Hole 821		
Altitude 1,301 feet		
Sandy clay	16	16
Sand and gravel	25	41
Shale	29	70
Shot Hole 833		
Altitude 1,301 feet		
Sandy clay	29	29
Sand and gravel	15	44
Shale	26	70
Shot Hole 897		
Altitude 1,253 feet		
Sandy shale	20	20
Shale	50	70
Shot Hole 902		
Altitude 1,300 feet		
Sandy clay	15	15
Gravel	12	27
Shale	24	51
Shot Hole 903		
Altitude 1,318 feet		
Sand	30	30
Gravel	10	40
Shale	10	50
Shot Hole 904		
Altitude 1,321 feet		
Sandy clay	21	21
Sand	6	27
Gravel and sand	16	43
Shale	10	53
Shot Hole 909		
Altitude 1,325 feet		
Sandy clay	21	21
Sand and gravel	24	45
Shale	25	70
Shot Hole 915		
Altitude 1,309 feet		
Sandy clay	26	26
Sand and gravel	14	40
Shale	30	70

Table 6.—Drillers' Logs of Geophysical Shot Holes Used for Supplementary Data Control in the Lockett Area—Continued

	Thickness (feet)	Depth (feet)
Shot Hole 921		
Altitude 1,305 feet		
Sandy clay	26	26
Sand and gravel	15	41
Shale	29	70
Shot Hole 922		
Altitude 1,304 feet		
Sandy clay	24	24
Sand and gravel	19	43
Shale	27	70
Shot Hole 933		
Altitude 1,295 feet		
Sand	20	20
Sand	13	33
Shale	37	70
Shot Hole 997		
Altitude 1,239 feet		
Sandy clay	13	13
Shale	57	70
Shot Hole 1002		
Altitude 1,311 feet		
Sandy clay	19	19
Gravel	12	31
Shale	29	60
Shot Hole 1010		
Altitude 1,313 feet		
Sandy clay	18	18
Gravel and sand	26	44
Shale	26	70
Shot Hole 1015		
Altitude 1,308 feet		
Sand	40	40
Shale	30	70
Shot Hole 1027		
Altitude 1,296 feet		
Sandy clay	11	11
Sand and gravel	27	38
Shale	32	70
Shot Hole 1033		
Altitude 1,294 feet		
Sandy clay	18	18
Sand	11	29
Shale	41	70
Shot Hole 1034		
Altitude 1,291 feet		
Sandy clay	24	24
Sand and gravel	15	39
Shale	31	70
Shot Hole 1102		
Altitude 1,314 feet		
Sandy clay	17	17
Sand and gravel	16	33
Shale	18	51
Shot Hole 1110		
Altitude 1,246 feet		
Sandy shale	20	20
Shale	40	60

Table 6.—Drillers' Logs of Geophysical Shot Holes Used for Supplementary Data Control in the Lockett Area—Continued

	Thickness (feet)	Depth (feet)
Shot Hole 1111		
Altitude 1,277 feet		
Sandy clay	35	35
Shale	35	70
Shot Hole 1112		
Altitude 1,287 feet		
Sand	35	35
Sand and gravel	11	46
Shale	24	70
Shot Hole 1115		
Altitude 1,303 feet		
Sandy clay	13	13
Sand and gravel	30	43
Shale	27	70
Shot Hole 1133		
Altitude 1,281 feet		
Sandy clay	38	38
Shale	32	70
Shot Hole 1134		
Altitude 1,288 feet		
Sandy clay	13	13
Sand and gravel	23	36
Shale	34	70
Shot Hole 1210		
Altitude 1,310 feet		
Sandy clay	21	21
Sand and gravel	17	38
Shale	52	90
Shot Hole 1215		
Altitude 1,307 feet		
Sand and gravel	40	40
Shale	50	90
Shot Hole 1303		
Altitude 1,315 feet		
Sand and gravel	39	39
Shale	51	90
Shot Hole 1403		
Altitude 1,315 feet		
Sand and gravel	34	34
Shale	56	90
Shot Hole 1410		
Altitude 1,308 feet		
Sand and gravel	38	38
Shale	52	90
Shot Hole 1415		
Altitude 1,309 feet		
Sand	10	10
Clay	18	28
Sand and gravel	15	43
Shale	47	90
Shot Hole 8110		
Altitude 1,253 feet		
Sand	28	28
Shale	32	60

Table 6.—Drillers' Logs of Geophysical Shot Holes Used for Supplementary Data Control in the Lockett Area—Continued

	Thickness (feet)	Depth (feet)
Shot Hole 8111		
Altitude 1,279 feet		
Sandy clay	37	37
Shale	33	70
Shot Hole 8112		
Altitude 1,284 feet		
Sandy clay	29	29
Sand and gravel	12	41
Shale	29	70
Shot Hole 9110		
Altitude 1,244 feet		
Sandy shale	18	18
Shale	42	60
Shot Hole 9111		
Altitude 1,270 feet		
Sandy shale	30	30
Shale	40	70
Shot Hole 9112		
Altitude 1,284 feet		
Sandy clay	34	34
Sand and gravel	11	45
Shale	25	70
Shot Hole 10,112		
Altitude 1,282 feet		
Sandy clay	41	41
Shale	29	70
Shot Hole 11,112		
Altitude 1,270 feet		
Sand	28	28
Shale	42	70

Table 7.—Drillers' Logs of Test Holes Used for Supplementary Data Control in the Odell-Fargo Area

Data are from Texas Board of Water Engineers Bulletin 5301 (Willis and Knowles, 1953), except that land-surface altitudes are determined from U.S. Geological Survey topographic maps. See Figures 21 and 31 for location of these test holes.

Test Hole 2

Altitude 1,344 feet
Owner: Mrs. John Minarik

	Thickness (feet)	Depth (feet)
Sand, fine- to medium-grained	38	38
Clay, sandy	2	40
Caliche, hard, sandy	8	48
Shale, hard, red, silty, and hard red shale	3	51

Test Hole 3

Altitude 1,363 feet
Owner: State of Texas

	Thickness (feet)	Depth (feet)
Sand, fine- to medium-grained	12	12
Sand, medium- to very coarse-grained	17	29
Shale, hard, red and gray	14	43

Test Hole 4

Altitude 1,365 feet
Owner: Wilbarger County

	Thickness (feet)	Depth (feet)
Sand, fine- to medium-grained	24	24
Clay, sandy, red and white	14	38
Sand, medium- to coarse-grained	26	64
Sand, fine- to medium-grained, and clay	10	74
Sand, coarse- to very coarse-grained, granules 2 to 4 mm, and pebbles 5 to 10 mm	18	92
Sand, very coarse-grained, and granules 2 to 4 mm	10	102
Gravel, pebbles 2 to 20 mm, and very coarse-grained sand	4	106
Shale, hard, red	1	107

Test Hole 5

Altitude 1,349 feet
Owner: J. F. Watson

	Thickness (feet)	Depth (feet)
Sand, fine- to medium-grained	40	40
Caliche, hard, sandy	3	43
Sand, medium- to very coarse-grained	15	58

Test Hole 5—Continued

	Thickness (feet)	Depth (feet)
Sand, very coarse-grained, granules 2 to 4 mm, and pebbles 5 to 10 mm	13	71
Shale, hard, gray and red	1	72

Test Hole 6

Altitude 1,349 feet
Owner: Wilbarger County

	Thickness (feet)	Depth (feet)
Sand, fine- to medium-grained	15	15
Sand, medium- to very coarse-grained	41	56
Sand, very coarse-grained, granules 2 to 4 mm, and pebbles 5 to 10 mm	9	65
Shale, hard, red	1	66

Test Hole 7

Altitude 1,360 feet
Owner: Wilbarger County

	Thickness (feet)	Depth (feet)
Sand, fine- to coarse-grained	24	24
Caliche, hard, white and yellow	16	40
Sand, coarse- to very coarse-grained	2	42
Clay, sandy, gray	2	44
Caliche, hard, sandy	4	48
Sand, coarse- to very coarse-grained, granules 2 to 4 mm, and pebbles 5 to 10 mm	24	72
Shale, hard, red	1	73

Test Hole 8

Altitude 1,368 feet
Owner: Wilbarger County

	Thickness (feet)	Depth (feet)
Sand, fine- to medium-grained, and clay, sandy	82	82
Sand, very coarse-grained, granules 2 to 4 mm, and pebbles 4 to 12 mm	5	87
Shale, hard, red	5	92

Test Hole 10

Altitude 1,376 feet
Owner: State of Texas

	Thickness (feet)	Depth (feet)
Sand, fine- to medium-grained	67	67
Caliche, hard, sandy	11	78

Table 7.—Drillers' Logs of Test Holes Used for Supplementary Data Control in the Odell-Fargo Area—Continued

	Thickness (feet)	Depth (feet)
Test Hole 10—Continued		
Sand, very coarse-grained, granules 2 to 4 mm, pebbles 5 to 10 mm	8	86
Gravel, pebbles 5 to 15 mm, and granules 2 to 4 mm	5	91
Shale, hard, red	1	92
Test Hole 11		
Altitude 1,363 feet Owner: State of Texas		
Sand, fine- to coarse-grained	32	32
Clay, sandy, red and white	10	42
Sand, fine- to coarse-grained	10	52
Sand, fine- to medium-grained	10	62
Clay, sandy, red and white	12	74
Sand, fine- to medium-grained	6	80
Sand, coarse- to very coarse-grained	7	87
Gravel, very coarse-grained, sand, granules 2 to 4 mm, and pebbles 5 to 15 mm	5	92
Sand, coarse- to very coarse-grained, granules 2 to 4 mm	18	110
Gravel, granules 2 to 4 mm, pebbles 5 to 10 mm, and very coarse-grained sand	5	115
Shale, hard, red	2	117
Test Hole 13		
Altitude 1,331 feet Owner: C. D. Watts et al.		
Sand, fine- to medium-grained	16	16
Clay, sandy	10	26
Sand, fine- to coarse-grained	20	46
Clay, sandy, red	25	71
Sand, medium- to very coarse-grained	16	87
Gravel, pebbles 5 to 12 mm, granules 2 to 4 mm, and very coarse-grained sand	5	92
Sand, coarse- to very coarse-grained	6	98
Gravel, granules 2 to 4 mm, pebbles 5 to 10 mm, and very coarse-grained sand	5	103
Shale, red	1	104

	Thickness (feet)	Depth (feet)
Test Hole 17		
Altitude 1,319 feet Owner: Wilbarger County		
Sand, fine- to coarse-grained	13	13
Clay, sandy white	3	16
Caliche, sandy	5	21
Clay, sandy, brown	22	43
Sand, medium- to very coarse-grained	13	56
Gravel, granules 2 to 4 mm, pebbles 5 to 10 mm, and very coarse-grained sand	6	62
Sandstone, hard, red	8	70
Test Hole 18		
Altitude 1,349 feet Owner: State of Texas		
Sand, fine- to coarse-grained	18	18
Clay, sandy, white and gray	14	32
Sand, fine- to medium-grained	11	43
Caliche, hard, sandy, and sandy clay	13	56
Sand, medium- to very coarse-grained, and granules 2 to 4 mm	14	70
Sand, coarse- to very coarse-grained, granules 2 to 4 mm, and pebbles 5 to 6 mm	3	73
Sandstone, hard, red	1	74
Test Hole 19		
Altitude 1,374 feet Owner: State of Texas		
Sand, fine- to medium-grained, and clay, sandy	68	68
Gravel, granules 2 to 4 mm, pebbles 5 to 10 mm, and very coarse-grained sand	3	71
Shale, hard, red	1	72
Test Hole 21		
Altitude 1,367 feet Owner: State of Texas		
Sand, fine- to medium-grained	18	18
Caliche, hard, sandy	2	20

Table 7.—Drillers' Logs of Test Holes Used for Supplementary Data Control in the Odell-Fargo Area—Continued

	Thickness (feet)	Depth (feet)
Test Hole 21—Continued		
Clay, sandy, white	2	22
Sand, fine- to medium-grained	6	28
Gravel, granules 2 to 4 mm, and pebbles 5 to 20 mm	2	30
Shale, hard, red	7	37
Test Hole 22		
Altitude 1,362 feet Owner: State of Texas		
Sand, fine- to medium-grained	8	8
Caliche, hard, sandy	5	13
Sand, fine- to medium-grained	7	20
Clay, sandy	5	25
Shale, hard, red	1	26
Test Hole 24		
Altitude 1,369 feet Owner: State of Texas		
Sand, fine- to medium-grained	76	76
Gravel, pebbles 5 to 10 mm, granules 2 to 4 mm, and very coarse-grained sand	10	86
Gravel, pebbles 5 to 25 mm, and granules 2 to 4 mm	6	92
Shale, hard, red, silty	1	93
Test Hole 25		
Altitude 1,368 feet Owner: Wilbarger County		
Sand, fine- to medium-grained	32	32
Sand, medium- to very coarse-grained	24	56
Gravel, pebbles 5 to 10 mm, and granules 2 to 4 mm	1	57
Shale, hard, red	1	58
Test Hole 26		
Altitude 1,352 feet Owner: State of Texas		
Sand, fine- to medium-grained	39	39
Clay, sandy, brown	2	41

	Thickness (feet)	Depth (feet)
Test Hole 26—Continued		
Sand, medium- to coarse-grained	4	45
Clay, sandy, brown	2	47
Sand, medium- to coarse-grained	12	59
Sand, coarse- to very coarse-grained, and granules 2 to 4 mm	4	63
Shale, hard, red	1	64
Test Hole 29		
Altitude 1,372 feet Owner: State of Texas		
Sand, fine- to medium-grained	48	48
Clay, brown, silty and sandy	14	62
Clay, gray	8	70
Clay, brown, silty	5	75
Gravel, pebbles 5 to 20 mm, granules 2 to 4 mm, and very coarse-grained sand	6	81
Shale, hard, red	1	82
Test Hole 32		
Altitude 1,375 feet Owner: Wilbarger County		
Sand, fine- to medium-grained, fossils	5	5
Caliche, sandy	30	35
Sand, hard, red, fine- to medium-grained	17	52
Sand, medium- to coarse-grained, fossils	15	67
Shale, hard, red	1	68
Test Hole 34		
Altitude 1,392 feet Owner: Wilbarger County		
Sand, fine- to medium-grained	6	6
Clay, gray, sandy	4	10
Sand, fine- to medium-grained	2	12
Clay, white and red, sandy	7	19
Sand, fine- to medium-grained	3	22
Clay, white and red, sandy	8	30

Table 7.—Drillers' Logs of Test Holes Used for Supplementary Data Control in the Odell-Fargo Area—Continued

	Thickness (feet)	Depth (feet)
Test Hole 34—Continued		
Sand, fine- to coarse-grained, and granules 2 to 4 mm	2	32
Shale, hard, red	1	33
Test Hole 35		
Altitude 1,377 feet Owner: Wilbarger County		
Sand, fine- to medium-grained	41	41
Sand, medium- to very coarse-grained, and granules 2 to 4 mm	11	52
Shale, hard, red	1	53
Test Hole 36		
Altitude 1,390 feet Owner: W. F. Shelton		
Sand, fine- to medium-grained	13	13
Clay, brown and gray	7	20
Sand, fine- to medium-grained	9	29
Clay, red, silty	8	37
Clay, white and yellow, sandy	12	49
Sand, medium- to coarse-grained	7	56
Sand, coarse- to very coarse-grained, granules 2 to 4 mm, and pebbles 5 to 8 mm	2	58
Shale, hard, red	1	59
Test Hole 37		
Altitude 1,388 feet Owner: Wilbarger County		
Sand, fine- to medium-grained	54	54
Sand, fine- to medium-grained cemented with red clay, hard	13	67
Caliche, hard, sandy	4	71
Shale, hard, red	3	74
Test Hole 39		
Altitude 1,367 feet Owner: Wilbarger County		
Sand, fine- to medium-grained	5	5
Clay, brown and gray, sandy	24	29

	Thickness (feet)	Depth (feet)
Test Hole 39—Continued		
Caliche and clay, sandy	10	39
Gravel, granules 2 to 4 mm, pebbles 5 to 20 mm, and very coarse-grained sand	8	47
Shale, hard, red	1	48
Test Hole 41		
Altitude 1,360 feet Owner: State of Texas		
Sand, fine- to medium-grained, and sandy clay	18	18
Clay, red and white sandy	14	32
Sand, coarse- to very coarse-grained	6	38
Gravel, granules 2 to 4 mm, pebbles 5 to 15 mm, and very coarse-grained sand	9	47
Sahle, red, sandy	5	52
Test Hole 43		
Altitude 1,328 feet Owner: Cleve Hamilton		
Soil	3	3
Clay, sandy	7	10
Caliche, sandy	2	12
Sand, fine-grained	2	14
Sandstone, and shale, hard, red	3	17
Test Hole 46		
Altitude 1,366 feet Owner: Wilbarger County		
Sand, fine- to medium-grained	22	22
Sand, medium- to very coarse-grained, granules 2 to 4 mm	28	50
Gravel, pebbles 5 to 20 mm, granules 2 to 4 mm, and coarse- to very coarse-grained sand	9	59
Shale, hard, red	1	60

Table 7.—Drillers' Logs of Test Holes Used for Supplementary Data Control in the Odell-Fargo Area—Continued

Test Hole 47

Altitude 1,360 feet
Owner: Wilbarger County

	Thickness (feet)	Depth (feet)
Sand, fine- to very coarse-grained	32	32
Sand, medium- to very coarse-grained, granules 2 to 4 mm	13	45
Gravel, pebbles 5 to 10 mm, granules 2 to 4 mm, coarse- to very coarse-grained sand	15	60
Gravel, pebbles 5 to 25 mm, granules 2 to 4 mm	5	65
Shale, hard, red	7	72

Test Hole 48

Altitude 1,370 feet
Owner: State of Texas

	Thickness (feet)	Depth (feet)
Sand, fine- to medium-grained	7	7
Clay, red and gray, sandy	6	13
Caliche, hard, sandy	6	19
Sand, fine- to coarse-grained	5	24
Clay, red	2	26
Sand, coarse- to very coarse-grained	13	39
Sandstone cemented with red clay	3	42
Sand, medium- to very coarse-grained	8	50
Caliche	1	51
Gravel, pebbles 5 to 25 mm, granules 2 to 4 mm	16	67
Shale, hard, red	1	68

Test Hole 49

Altitude 1,360 feet
Owner: State of Texas

	Thickness (feet)	Depth (feet)
Sand, fine-grained and clay, sandy	25	25
Caliche, sandy	5	30
Sandstone and sandy shale, hard, red and gray	15	45

Test Hole 50

Altitude 1,390 feet
Owner: Wilbarger County

	Thickness (feet)	Depth (feet)
Sand, fine- to coarse-grained	40	40
Sand, coarse- to very coarse-grained	9	49
Gravel, granules 2 to 4 mm, very coarse-grained sand, and pebbles 5 to 6 mm	3	52
Sand, coarse- to very coarse-grained	10	62
Sand, very coarse-grained, and granules 2 to 4 mm	4	66
Gravel, very coarse-grained sand, granules 2 to 4 mm	4	66
Gravel, very coarse-grained sand, granules 2 to 4 mm, and pebbles 5 to 10 mm	4	70
Shale, hard, red	1	71

Test Hole 51

Altitude 1,390 feet
Owner: Wilbarger County

	Thickness (feet)	Depth (feet)
Sand, fine- to medium-grained	12	12
Sand, coarse- to very coarse-grained	51	63
Gravel, granules 2 to 4 mm, pebbles 5 to 20 mm, and very coarse-grained sand	11	74
Shale, hard, red	1	75

Test Hole 52

Altitude 1,408 feet
Owner: J. O. Henry

	Thickness (feet)	Depth (feet)
Sand, fine- to medium-grained	15	15
Clay, white and red, sandy	5	20
Sand, medium- to very coarse-grained, and granules 2 to 4 mm	42	62
Shale, hard, red	1	63

Test Hole 54

Altitude 1,411 feet
Owner: Wilbarger County

	Thickness (feet)	Depth (feet)
Sand, fine- to medium-grained	50	50
Caliche, sandy, soft	10	60

Table 7.—Drillers' Logs of Test Holes Used for Supplementary Data Control in the Odell-Fargo Area—Continued

	Thickness (feet)	Depth (feet)
Test Hole 54—Continued		
Sand, coarse- to very coarse-grained	10	70
Gravel, granules 2 to 4 mm, and pebbles 5 to 10 mm	8	78
Shale, hard, red	1	79
Test Hole 58		
Altitude 1,400 feet Owner: Wilbarger County		
Sand, fine- to medium-grained	27	27
Clay, white and red, sandy	25	52
Gravel, pebbles 5 to 12 mm, and very coarse-grained sand	15	67
Shale, hard, red	1	68
Test Hole 59		
Altitude 1,388 feet Owner: State of Texas		
Sand, fine- to medium-grained	24	24
Clay, red, sandy	3	27
Caliche, hard, sandy	3	30
Sand, coarse- to very coarse-grained, granules 2 to 4 mm, and pebbles 5 to 8 mm	16	46
Gravel, pebbles 5 to 25 mm, granules 2 to 4 mm	4	50
Shale, hard, red	1	51
Test Hole 60		
Altitude 1,388 feet Owner: State of Texas		
Sand, fine- to medium-grained	25	25
Sand, coarse- to very coarse-grained, granules 2 to 4 mm, and pebbles 5 to 8 mm	9	34
Gravel, pebbles 6 to 12 mm, and very coarse-grained sand	3	37
Sand, very coarse-grained	4	41
Gravel, pebbles 5 to 25 mm, granules 2 to 4 mm	10	51
Shale, hard, red	1	52

	Thickness (feet)	Depth (feet)
Test Hole 61		
Altitude 1,411 feet Owner: Wilbarger County		
Sand, fine- to medium-grained	20	20
Clay, red, sandy	19	39
Sand, very coarse-grained, granules 2 to 4 mm, and pebbles 5 to 8 mm	19	58
Gravel, pebbles 5 to 13 mm, and very coarse-grained sand	8	66
Gravel, pebbles 8 to 20 mm	10	76
Shale, hard, red	1	77
Test Hole 62		
Altitude 1,420 feet Owner: Wilbarger County		
Sand, fine- to medium-grained	24	24
Clay, red, sandy	4	28
Sand, coarse-grained	18	46
Sand, very coarse-grained, granules 2 to 4 mm, and pebbles 5 to 8 mm	40	86
Gravel, pebbles 8 to 20 mm	6	92
Sand, very coarse-grained, and granules 2 to 4 mm	6	98
Gravel, pebbles 5 to 10 mm	7	105
Shale, hard, red	1	106
Test Hole 63		
Altitude 1,410 feet Owner: Leon Brooks		
Soil	3	3
Sand, red, fine-grained	12	15
Sand, blue, fine-grained	5	20
Sand, red and blue, fine-grained	5	25
Sand, red, fine-grained	5	30
Sand, red, and caliche	5	35
Sand, red, coarse-grained, and clay	5	40
Sand, red, fine-grained	5	45
Sand, white, coarse-grained	10	55

Table 7.—Drillers' Logs of Test Holes Used for Supplementary Data Control in the Odell-Fargo Area—Continued

	Thickness (feet)	Depth (feet)
Test Hole 63—Continued		
Sand, white, coarse-grained, fine-grained gravel, and clay	5	60
Sand, white, coarse-grained and fine-grained gravel	15	75
Sand, red, yellow and blue, coarse-grained, and fine-grained gravel	7	82
Shale, red	1	83
Test Hole 64		
Altitude 1,399 feet Owner: Wilbarger County		
Sand, fine- to medium-grained	30	30
Gravel, granules 2 to 4 mm, pebbles 5 to 15 mm, and very coarse-grained sand	5	35
Sand, very coarse-grained	33	68
Sand, very coarse-grained, granules 2 to 4 mm, and pebbles 5 to 8 mm	22	90
Shale, hard, red	2	92
Test Hole 65		
Altitude 1,394 feet Owner: Wilbarger County		
Sand, fine- to coarse-grained, and sandy clay	62	62
Gravel, granules 2 to 4 mm, pebbles 5 to 20 mm, and very coarse-grained sand	16	78
Sand, very coarse-grained	8	86
Gravel, granules 2 to 4 mm, pebbles 5 to 20 mm, and very coarse-grained sand	4	90
Shale, hard, red	2	92
Test Hole 67		
Altitude 1,398 feet Owner: Wilbarger County		
Sand, fine- to medium-grained	18	18
Clay, sandy	5	23
Sand, fine- to very coarse-grained	7	30
Clay, sandy	13	43
Caliche, hard, sandy	3	46
Test Hole 67—Continued		
Sand, medium- to very coarse-grained, granules 2 to 4 mm, and pebbles 5 to 10 mm	19	65
Caliche and clay, sandy	18	83
Gravel, pebbles 5 to 25 mm, granules 2 to 4 mm, and very coarse-grained sand	22	105
Shale, hard, red	4	109
Test Hole 72		
Altitude 1,385 feet Owner: Mrs. V. K. McCaleb		
Soil	3	3
Sand, red, fine- to coarse-grained	9	12
Sand, yellow, fine- to coarse-grained	3	15
Sand, brown, fine- to coarse-grained	15	30
Sand, white, fine- to very coarse-grained, and granules 2 to 4 mm	20	50
Sand, white and pink, fine- to coarse-grained, hard	10	60
Sand, white, fine- to very coarse-grained, granules 2 to 4 mm, and layers of hard sand	19	79
Sand, hard, white	3	82
Gravel, granules 2 to 4 mm, pebbles 5 to 40 mm, and medium- to very coarse-grained sand	8	90
Shale, hard, red	2	92
Test Hole 73		
Altitude 1,384 feet Owner: State of Texas		
Sand, fine- to medium-grained	20	20
Clay, white, silty	28	48
Sand, coarse- to very coarse-grained, granules 2 to 4 mm	39	87
Gravel, pebbles 5 to 15 mm, granules 2 to 4 mm	4	91
Shale, hard, red	1	92

Table 7.—Drillers' Logs of Test Holes Used for Supplementary Data Control in the Odell-Fargo Area—Continued

	Thickness (feet)	Depth (feet)
Test Hole 75		
Altitude 1,370 feet Owner: Wilbarger County		
Sand, fine- to medium-grained	30	30
Sand, coarse- to very coarse-grained, granules 2 to 4 mm	36	66
Gravel, pebbles 5 to 15 mm, and granules 2 to 4 mm	4	70
Sand, coarse- to very coarse-grained, and granules 2 to 4 mm	6	76
Gravel, pebbles 5 to 15 mm, granules 2 to 4 mm	8	84
Shale, hard, red	2	86
Test Hole 76		
Altitude 1,315 feet Owner: Wilbarger County		
Sand, fine- to medium-grained	4	4
Clay, black peat	4	8
Clay, gray	6	14
Sand, coarse- to very coarse-grained	1	15
Shale, hard, red	1	16
Test Hole 80		
Altitude 1,395 feet Owner: State of Texas		
Sand, fine- to medium-grained	23	23
Clay, sandy	9	32
Sand, fine- to coarse-grained	5	37
Clay, red, silty, and sandy	14	51
Sand, coarse- to very coarse-grained, and granules 2 to 4 mm	19	70
Clay, red, silty	2	72
Sand, very coarse-grained, granules 2 to 4 mm	6	78
Gravel, granules 2 to 4 mm, pebbles 5 to 8 mm, and very coarse-grained sand	3	81
Clay, red	1	82
Sand, medium- to very coarse-grained	24	106
Test Hole 80—Continued		
Gravel, pebbles 5 to 15 mm, granules 2 to 4 mm, and very coarse-grained sand	6	112
Shale, hard, red	1	113
Test Hole 82		
Altitude 1,420 feet Owner: Wilbarger County		
Sand, fine- to medium-grained	25	25
Clay, sandy, brown	18	43
Sand, medium- to coarse-grained	15	58
Sand, coarse- to very coarse-grained, granules 2 to 4 mm, pebbles 5 to 6 mm	8	66
Sand, coarse- to very coarse-grained	16	82
Shale, hard, red	1	83
Test Hole 83		
Altitude 1,399 feet Owner: Wilbarger County		
Sand, fine- to medium-grained	52	52
Sand, coarse- to very coarse-grained, and granules 2 to 4 mm	7	59
Gravel, granules 2 to 4 mm, and pebbles 5 to 20 mm	2	61
Shale, hard, red	3	64
Test Hole 85		
Altitude 1,399 feet Owner: Wilbarger County		
Sand, fine- to medium-grained	7	7
Clay, gray and red, sandy	20	27
Sand, medium- to coarse-grained	31	58
Clay, red, sandy	3	61
Sand, medium- to very coarse-grained	5	66
Sand, very coarse-grained and granules 2 to 4 mm	22	88
Gravel, pebbles 8 to 20 mm, granules 2 to 4 mm, and very coarse-grained sand	5	93
Shale, hard, red	1	94

Table 7.—Drillers' Logs of Test Holes Used for Supplementary Data Control in the Odell-Fargo Area—Continued

	Thickness (feet)	Depth (feet)
Test Hole 86		
Altitude 1,421 feet Owner: Wilbarger County		
Sand, fine- to medium-grained	12	12
Clay, red, sandy	45	57
Sand, medium- to very coarse-grained	22	79
Sand, coarse- to very coarse-grained, granules 2 to 4 mm, and pebbles 5 to 10 mm	7	86
Gravel, pebbles 5 to 12 mm, graunules 2 to 4 mm	9	95
Sand, very coarse-grained	10	105
Gravel, pebbles 5 to 25 mm, granules 2 to 4 mm	4	109
Shale, hard, red	1	110
Test Hole 87		
Altitude 1,423 feet Owner: Wilbarger County		
Sand, fine- to medium-grained	35	35
Clay, red, sandy	9	44
Sand, fine- to coarse-grained	39	83
Gravel, pebbles 5 to 10 mm, granules 2 to 4 mm, and very coarse-grained sand	18	101
Sandstone	4	105
Shale, hard, red	1	106
Test Hole 89		
Altitude 1,416 feet Owner: State of Texas		
Sand, fine- to medium-grained	10	10
Clay, red and gray, sandy	11	21
Sand, fine- to coarse-grained	14	35
Sand, coarse- to very coarse-grained, granules 2 to 4 mm, and pebbles 5 to 8 mm	6	41
Shale, hard, red	1	42
Test Hole 90		
Altitude 1,422 feet Owner: Wilbarger County		
Sand, fine- to medium-grained	20	20
Clay, red, sandy	5	25
Sand, fine- to medium-grained, hard	12	37
Clay, red, sandy	9	46
Sand, coarse- to very coarse-grained	24	70
Sand, very coarse-grained, granules 2 to 4 mm, and pebbles 5 to 10 mm	5	75
Shale, hard, red	1	76
Test Hole 91		
Altitude 1,412 feet Owner: Wilbarger County		
Sand, fine- to medium-grained	33	33
Sand, medium- to very coarse-grained	19	52
Clay, red, sandy	2	54
Sand, coarse- to very coarse-grained, granules 2 to 4 mm, and pebbles 5 to 8 mm	6	60
Gravel, pebbles 8 to 20 mm, granules 2 to 4 mm, and very coarse-grained sand	3	63
Shale, hard, red	1	64
Test Hole 92		
Altitude 1,405 feet Owner: Wilbarger County		
Sand, fine- to medium-grained	12	12
Clay, sandy, and fine-grained sand	40	52
Sand, coarse- to very coarse-grained	3	55
Gravel, granules 2 to 4 mm, pebbles 5 to 20 mm, and very coarse-grained sand	10	65
Shale, hard, red	7	72

Table 7.—Drillers' Logs of Test Holes Used for Supplementary Data Control in the Odell-Fargo Area—Continued

	Thickness (feet)	Depth (feet)
Test Hole 94		
Altitude 1,399 feet		
Owner: Wilbarger County		
Sand, fine- to medium-grained, and layers of sandy clay	28	28
Caliche, sandy	4	32
Sand, fine- to medium-grained	9	41
Sand, coarse- to very coarse-grained, granules 2 to 4 mm, and pebbles 5 to 12 mm	15	56
Sand, coarse- to very coarse-grained	3	59
Clay, red, sandy	3	62
Gravel, granules 2 to 4 mm, pebbles 5 to 20 mm, and very coarse-grained sand	7	69
Shale, hard, red	1	70
Test Hole 95		
Altitude 1,380 feet		
Owner: State of Texas		
Sand, fine- to medium-grained	10	10
Sand, coarse- to very coarse-grained, and granules 2 to 4 mm	40	50
Gravel, pebbles 5 to 15 mm, and granules 2 to 4 mm	9	59
Shale, hard, red	1	60
Test Hole 98		
Altitude 1,328 feet		
Owner: Wilbarger County		
Sand, fine- to medium-grained	12	12
Shale, hard, red	1	13
Test Hole 99		
Altitude 1,261 feet		
Owner: Wilbarger County		
Sand, fine- to very coarse-grained	10	10
Clay, red, sandy	8	18
Sand, fine- to medium-grained	7	25
Shale, hard, red	1	26

	Thickness (feet)	Depth (feet)
Test Hole 101		
Altitude 1,317 feet		
Owner: State of Texas		
Sand, fine- to medium-grained, and sandy clay	10	10
Shale, hard, red	5	15
Test Hole 103		
Altitude 1,379 feet		
Owner: Wilbarger County		
Sand, fine- to coarse-grained	20	20
Sand, coarse- to very coarse-grained, granules 2 to 4 mm, and pebbles 5 to 10 mm	5	25
Shale, hard, red	1	26
Test Hole 104		
Altitude 1,406 feet		
Owner: Wilbarger County		
Sand, fine- to medium-grained	10	10
Clay, gray and red, sandy	22	32
Gravel, granules 2 to 4 mm, pebbles 5 to 15 mm, and very coarse-grained sand	13	45
Sand, very coarse-grained	2	47
Shale, hard, red	5	52
Test Hole 105		
Altitude 1,411 feet		
Owner: Wilbarger County		
Sand, fine- to medium-grained	28	28
Sand, fine- to medium-grained, and thin layers of caliche	10	38
Clay, soft red	4	42
Sand, coarse- to very coarse-grained and granules 2 to 4 mm	8	50
Gravel, granules 2 to 4 mm, and pebbles 5 to 6 mm	8	58
Shale, hard, red	5	63

Table 7.—Drillers' Logs of Test Holes Used for Supplementary Data Control in the Odell-Fargo Area—Continued

Test Hole 107

Altitude 1,415 feet
Owner: Wilbarger County

	Thickness (feet)	Depth (feet)
Sand, fine- to medium-grained	6	6
Clay, sandy	8	14
Sand, medium-grained, and clay	8	22
Clay, red, sandy	14	36
Sand, fine- to medium-grained, and clay	12	48
Shale, hard, red	1	49

Test Hole 109

Altitude 1,411 feet
Owner: Wilbarger County

	Thickness (feet)	Depth (feet)
Sand, fine- to medium-grained	15	15
Clay, red, sandy	5	20
Caliche, hard, sandy	5	25
Sand, medium- to very coarse-grained	5	30
Caliche, hard, sandy	3	33
Shale, hard, red	1	34

Table 8.--Chemical Analyses of Water From Wells and Springs

(Analyses are in milligrams per liter except percent sodium, specific conductance, pH, SAR, and RSC.)

Water-Bearing Unit: Qal, Quaternary alluvium; Qs, Seymour Formation; Pprsa, San Angelo Formation; Pcf, Clear Fork Group.
Analyses performed by Texas Department of Health except where indicated by footnote.

Well	Water-bearing unit	Depth of well (ft)	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids	Hardness as $CaCO_3$	Percent sodium	Sodium adsorption ratio (SAR)	Residual sodium carbonate (RSC)	Specific conductance (Micromhos at 25° C)	pH
Seymour Formation and Quaternary Alluvium																						
13-37-701	Qs	Spring	Feb. 20, 1970	6	--	65	29	25	1	334	41	9	0.8	5	0.1	346	283	16.2	0.65	0.00	575	7.8
903	Qs	73	Dec. 17, 1969	17	4.6	52	18	21	< 1	234	21	7	.6	25	.1	279	201	18.6	.65	.00	441	7.7
904	Qs	67	Jan. 29, 1970	17	--	48	26	28	< 1	260	27	15	.6	27	.1	317	225	21.2	.81	.00	515	7.7
905	Qs	Spring	do	24	--	70	31	51	5	378	47	32	.8	5.3	.1	452	303	26.9	1.28	.15	715	7.8
1/ 909	Qs	80	July 12, 1964	17.2	.60	59	18	39	--	280	37	20	.3	32	--	266	244	--	--	--	--	7.42
1/ 910	Qs	38	July 8, 1964	12	.00	82	12	62	--	344	28	45	.1	10	--	372	252	--	--	--	--	7.40
913	Qs	55	Nov. 3, 1970	24	--	41	36	54	< 1	348	40	10	.9	29	.2	406	251	31.7	1.47	.69	630	7.6
2/ 38-701	Qs	112	Apr. 11, 1951	--	--	74	19	* 14	--	254	24	41	--	2.8	--	332	262	11	--	--	556	--
			Jan. 29, 1970	20	--	64	18	17	< 1	248	19	26	.7	12	.1	299	232	14.1	.50	.00	496	7.7
702	Qs	114	July 10, 1970	21	--	71	16	23	< 1	253	19	13	.7	46	.2	334	242	16.8	.63	.00	534	7.5
3/ 801	Qs	113	Aug. 17, 1951	22	--	74	20	* 14	--	259	32	34	--	5	--	365	266	10	--	--	578	8.1
803	Qs	110	Nov. 2, 1970	18	--	71	13	44	< 1	283	45	15	.5	29	.1	375	233	29.1	1.25	.00	587	7.8
805	Qs	86	June 11, 1971	21	--	71	18	27	< 1	260	33	33	.4	17	.1	348	251	--	--	--	555	7.4
808	Qs	Spring	do	28	--	78	21	24	< 1	311	30	23	.4	8	.2	365	284	--	--	-	570	7.5
45-102	Qs	60	Feb. 17, 1970	16	--	96	24	35	< 1	248	134	15	1.0	70	.1	510	340	18.2	.82	.00	740	7.6
103	Qs	45	Feb. 20, 1970	18	--	67	21	21	1	275	38	9	.5	26	.1	337	255	15.4	.58	.00	527	8.0
202	Qs	55	Feb. 18, 1970	18	--	56	27	25	2	262	41	6	.8	40	.2	345	250	17.9	.69	.00	542	7.5
2/ 203	Qs	84	Apr. 11, 1951	--	--	82	31	* 75	--	331	85	88	--	13	--	566	332	33	--	--	941	--
204	Qs	80	June 11, 1971	22	--	71	25	57	< 1	303	63	45	.5	28	.2	461	278	--	--	--	705	7.8
205	Qs	60	do	19	--	70	31	49	4	284	68	65	.4	11	.3	457	302	--	--	--	732	7.6
301	Qs	67	Jan. 29, 1970	19	--	50	25	30	3	271	27	16	.6	23	.1	327	230	21.9	.85	.00	515	8.1
304	Qs	88	Feb. 5, 1970	21	--	458	151	183	6	206	24	1,390	.5	22	.5	2,360	1,770	18.4	1.90	.00	3,750	7.3
305	Qs	78	do	24	--	70	22	32	2	294	32	18	.7	39	.1	385	267	20.6	.85	.00	602	7.5
306	Qs	29	Feb. 18, 1970	40	--	81	26	23	3	270	27	42	.6	61	.2	437	311	14.1	.58	.00	673	7.8
307	Qs	65	Oct. 22, 1970	20	--	62	20	27	< 1	289	21	12	.8	26	.1	331	239	19.8	.76	.00	525	7.6
308	Qs	62	do	19	--	58	21	41	< 1	293	26	17	.6	40	.1	367	233	27.8	1.17	.14	577	7.8
310	Qs	60	Nov. 3, 1970	20	--	71	39	26	2	293	50	51	.6	35	.2	439	339	14.3	.61	.00	714	7.2
311	Qs	90	do	19	.16	77	16	22	< 1	250	30	13	.4	63	.1	363	260	15.7	.60	.00	567	7.7
402	Qs	63	Dec. 3, 1969	1	--	129	151	413	5	46	990	530	.7	< .4	1.2	2,240	940	48.8	5.85	.00	3,110	7.0
403	Qs	68	Feb. 11, 1970	18	--	227	101	207	3	338	740	247	1.4	27	.8	1,740	980	31.4	2.87	.00	2,300	7.6
404	Qs	45	June 9, 1971	19	--	71	45	117	< 1	420	108	94	1.4	37	.4	700	362	--	--	--	1,085	7.3
502	Qs	66	Feb. 4, 1970	21	--	79	28	59	2	305	70	67	.5	30	.3	510	312	29.2	1.46	.00	803	7.6

See footnotes at end of table.

Table 8.--Chemical Analyses of Water From Wells and Springs--Continued

Well	Water-bearing unit	Depth of well (ft)	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids	Hardness as $CaCO_3$	Percent sodium	Sodium adsorption ratio (SAR)	Residual sodium carbonate (RSC)	Specific conductance (Micromhos at 25° C)	pH
								Seymour Formation and Quaternary Alluvium--Continued														
13-45-503	Qs	52	Dec. 3, 1969	18	--	77	31	91	< 1	378	86	64	0.8	25	0.3	580	320	38.3	2.22	0.00	917	7.6
504	Qs	60	Dec. 4, 1969	21	--	54	42	143	< 1	467	95	93	2.0	< .4	.4	680	307	50.3	3.54	1.52	1,099	7.4
507	Qs	61	Dec. 3, 1969	18	--	47	23	105	< 1	392	52	28	1.3	28	.4	495	213	51.8	3.13	2.16	770	8.2
509	Qs	37	Feb. 18, 1970	21	--	76	32	35	2	329	36	24	.9	31	.2	420	320	19.4	.86	.00	718	7.1
2/ 601	Qs	59	Jan. 20, 1959	--	--	75	21	* 30	--	291	30	17	--	55	--	396	274	19	--	--	609	--
			Jan. 29, 1970	19	--	73	19	27	4	250	31	17	.6	68	.1	382	260	18.4	.73	.00	575	7.6
604	Qs	67	do	18	--	67	19	33	1	281	32	15	.7	42	.2	366	243	22.6	.91	.00	572	7.6
606	Qs	66	do	18	--	59	18	18	1	220	22	10	.6	53	.1	308	220	15.3	.53	.00	466	7.8
607	Qs	69	Jan. 29, 1970	16	4.2	53	18	24	< 1	240	22	9	.7	25	.1	286	206	20.0	.72	.00	463	7.7
3/ 608	Qs	65	Aug. 13, 1951	19	--	68	20	* 18	--	248	29	16	--	30	--	373	252	10	--	--	593	7.8
			Jan. 29, 1970	10	--	48	21	26	5	206	36	17	.5	43	.1	308	205	21.3	.78	.00	482	8.1
610	Qs	72	Feb. 4, 1970	39	--	27	12	49	27	277	10	11	.4	< .4	.1	311	120	47.1	1.95	2.15	450	7.6
612	Qs	51	do	7	--	52	16	26	3	244	20	7	.8	23	.1	275	195	22.2	.79	.10	445	7.8
614	Qs	70	do	18	--	65	17	26	1	256	28	7	.4	43	.1	331	231	19.7	.74	.00	532	7.6
615	Qs	70	do	9	--	32	12	23	< 1	168	20	6	.4	11	.1	196	128	28.1	.88	.20	343	8.1
616	Qs	70	Feb. 11, 1970	14	--	37	7	19	< 1	187	4	4	.7	< .4	.1	178	121	25.5	.75	.64	293	7.1
617	Qs	33	Feb. 17, 1970	7	--	29	9	29	7	172	< 4	21	.3	8.3	.4	195	108	37.3	1.23	.67	346	7.3
623	Qs	57	Feb. 11, 1970	20	--	94	27	39	2	309	27	75	.5	42	.1	479	344	19.9	.92	.00	802	7.4
624	Qs	75	do	17	--	50	13	20	2	193	24	9	.5	33	.1	264	179	20.0	.67	.00	414	7.7
702	Qs	50	Feb. 18, 1970	21	--	46	27	54	2	298	42	23	1.1	24	.3	388	225	34.4	1.57	.42	608	8.4
4/ 802	Qs	61	Apr. 5, 1960	--	--	34	32	40	--	366	14	28	--	--	--	514	--	--	--	--	780	8.2
			Dec. 4, 1969	17	.30	74	33	55	1	370	52	30	.7	41.5	.3	487	321	27.2	1.34	.00	770	7.6
803	Qs	51	Apr. 15, 1970	21	--	63	22	29	< 1	295	28	12	.6	29	.2	350	249	20.5	.81	.00	559	7.5
804	Qs	45	do	22	--	62	21	33	< 1	284	32	12	.7	37	.1	360	242	22.7	.91	.00	555	7.5
808	Qs	46	Dec. 16, 1969	20	--	73	19	40	1	338	36	19	1.1	< .4	.2	375	260	25.0	1.07	.34	674	7.2
810	Qs	50	Feb. 17, 1970	19	--	64	30	45	2	325	51	19	1.0	33	.8	424	283	25.6	1.16	.00	663	7.9
811	Qs	52	do	19	--	51	27	26	2	273	24	6	.8	44	.2	334	239	19.0	.72	.00	520	8.2
815	Qs	50	Feb. 18, 1970	18	--	77	32	35	1	309	42	44	.6	40	.2	442	325	19.1	.85	.00	728	7.7
901	Qs	Spring	Sept. 30, 1970	1	--	205	93	308	5	171	1,270	88	1.5	< .4	2.7	2,060	900	42.7	4.47	.00	2,460	7.0
902	Qs	40	Nov. 19, 1970	15	--	79	38	61	< 1	310	128	36	1.0	62	.6	570	352	27.5	1.42	.00	857	8.1
46-102	Qs	82	Dec. 16, 1969	20	.65	64	22	26	1	256	30	28	.6	29	.2	347	253	18.2	.70	.00	555	7.6
108	Qs	58	Jan. 27, 1970	15	--	56	21	25	1	232	24	9	.7	68	.1	334	224	19.5	.72	.00	502	7.5
112	Qs	78	do	10	--	47	15	23	4	212	20	11	.5	20	.1	255	177	22.4	.77	.00	410	7.4
114	Qs	108	July 10, 1970	21	--	67	16	23	< 1	253	23	15	.8	30	.2	320	234	17.5	.65	.00	514	7.3
115	Qs	68	Jan. 29, 1970	22	--	49	31	25	3	266	22	8	.9	64	.1	356	249	18.0	.69	.00	536	8.0

See footnotes at end of table.

Table 8.--Chemical Analyses of Water From Wells and Springs--Continued

Well	Water-bearing unit	Depth of well (ft)	Date of collection	Silica (SiO_2)	Iron (Fe)	Cal-cium (Ca)	Magne-sium (Mg)	Sodium (Na)	Potas-sium (K)	Bicar-bonate (HCO_3)	Sul-fate (SO_4)	Chlo-ride (Cl)	Fluo-ride (F)	Ni-trate (NO_3)	Boron (B)	Dis-solved solids	Hard-ness as $CaCO_3$	Per-cent so-dium	Sodium adsorp-tion ratio (SAR)	Residual sodium carbon-ate (RSC)	Specific conduct-ance (Micromhos at 25° C)	pH
								Seymour Formation and Quaternary Alluvium--Continued														
13-46-116	Qs	78	Feb. 4, 1970	19	--	65	14	24	2	212	39	17	0.5	39	0.1	324	220	19.4	0.71	0.00	506	7.3
118	Qs	83	do	18	--	175	42	252	4	163	22	700	.6	27	.2	1,320	610	47.3	4.44	.00	2,270	7.5
120	Qs	66	do	18	--	63	15	21	4	242	24	17	.7	20	.1	302	219	17.4	.62	.00	475	7.4
121	Qs	64	Jan. 30, 1970	22	--	75	19	31	4	294	31	28	.7	21	.1	377	267	20.2	.83	.00	588	7.5
123	Qs	66	Feb. 3, 1970	22	--	64	18	22	1	262	21	13	.5	25	.1	316	231	17.4	.64	.00	520	7.6
124	Qs	62	do	22	--	79	20	26	2	294	32	23	.5	30	.9	380	279	16.7	.67	.00	602	7.6
126	Qs	105	Oct. 22, 1970	16	--	77	18	68	< 1	196	88	35	.5	147	.1	550	268	35.7	1.81	.00	791	7.6
127	Qs	87	Nov. 2, 1970	20	--	35	10	121	< 1	349	83	14	.8	7	.1	463	129	67.1	4.63	3.14	712	7.7
128	Qs	64	Nov. 10, 1970	19	--	87	18	288	1	182	14	530	.6	22	.2	1,070	292	68.2	7.32	.00	1,900	7.5
201	Qs	100	July 10, 1970	23	--	81	16	23	< 1	277	25	31	.6	16	.2	352	269	15.5	.60	.00	576	7.5
203	Qs	52	Feb. 4, 1970	7	--	68	23	44	2	326	28	33	.8	16	.2	382	264	26.5	1.17	.06	632	7.6
3/ 206	Qs	86	Aug. 10, 1951 Feb. 20, 1970	-- 24	-- --	-- 81	-- 26	-- 60	-- 2	278 278	-- 66	94 99	-- .3	-- 13	-- .3	-- 510	304 308	-- 29.9	-- 1.50	-- .00	868 833	7.5 7.5
4/ 207	Qs	56	Dec. 8, 1956	--	--	121	--	* 107	--	330	67	98	--	--	--	759	--	--	--	--	--	8.63
209	Qs	68	Feb. 3, 1970	18	--	70	21	35	1	279	35	33	.5	27	.2	378	261	22.8	.95	.00	620	7.8
210	Qs	81	Jan. 27, 1970	18	6.0	77	20	31	2	301	30	21	.7	39	.2	387	274	19.9	.82	.00	610	7.9
212	Qs	79	do	4	--	40	24	50	1	256	41	43	.4	< .4	.1	329	198	35.6	1.56	.24	588	7.8
213	Qs	Spring	do	10	--	67	46	65	4	448	63	45	.6	< .4	.2	520	359	28.2	1.49	.17	827	8.0
214	Qs	64	do	20	--	65	16	30	2	264	22	14	1.2	37	.2	337	229	22.0	.85	.00	535	7.9
215	Qs	62	do	19	.22	70	19	24	2	266	24	21	1.2	31	.2	342	252	17.0	.65	.00	548	7.6
218	Qs	62	do	19	.10	65	17	31	2	257	28	19	1.8	31	.2	340	231	22.5	.88	.00	537	7.7
219	Qs	98	do	13	6.4	60	21	42	2	256	40	40	.4	18	.3	362	236	27.8	1.18	.00	583	7.4
224	Qs	67	Feb. 5, 1970	17	--	73	24	62	3	284	55	86	.3	6.7	.3	467	280	32.5	1.61	.00	772	7.7
225	Qs	65	do	20	--	78	20	46	2	318	44	29	.7	31	.2	427	275	26.9	1.22	.00	670	7.7
226	Qs	65	do	20	--	75	24	29	2	315	27	10	.8	67	.2	410	288	18.2	.75	.00	625	7.6
228	Qs	71	Feb. 3, 1970	16	4.4	72	23	41	2	273	42	49	.4	37	.3	416	275	24.5	1.07	.00	680	7.5
301	Qs	Spring	Jan. 27, 1970	15	--	61	40	77	2	417	51	53	1.2	15	.3	520	316	34.7	1.89	.53	849	7.9
303	Qs	Spring	Nov. 6, 1970	28	--	153	79	103	3	880	97	76	1.5	< .4	.4	970	710	24.1	1.68	.28	1,490	7.4
3/ 304	Qs	Spring	Feb. 28, 1951 Nov. 10, 1970	9.9 23	-- --	62 72	35 27	* 37 44	-- < 1	334 350	39 40	41 28	-- .6	10 27	-- .2	421 434	298 294	-- 24.6	-- 1.11	-- .00	-- 692	-- 7.3
305	Qs	15	do	25	--	62	46	125	< 1	468	92	79	2.1	30	.6	690	345	44.2	2.94	.79	1,084	7.7
306	Qs	23	June 17, 1971	28	--	68	43	66	< 1	465	53	21	1.0	21	.3	530	348	--	--	--	802	7.8
307	Qs	60	June 11, 1971	19	--	48	37	61	< 1	316	52	24	.9	62	.2	459	274	--	--	--	705	7.5
404	Qs	91	Dec. 12, 1969	19	.30	66	19	32	1	268	25	20	.6	37	.1	352	241	22.1	.88	.00	560	7.4

See footnotes at end of table.

Table 8.--Chemical Analyses of Water From Wells and Springs--Continued

Well	Water-bearing unit	Depth of well (ft)	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids	Hardness as $CaCO_3$	Percent sodium	Sodium adsorption ratio (SAR)	Residual sodium carbonate (RSC)	Specific conductance (Micromhos at 25° C)	pH
								Seymour Formation and Quaternary Alluvium--Continued														
3/ 13-46-409	Qs	95	Aug. 7, 1951	26	--	70	28	* 61	--	311	62	68	--	8.5	--	470	290	31	--	--	840	7.5
		105	Dec. 3, 1969	19	--	67	22	57	2	307	50	39	0.4	25.5	0.3	433	257	32.6	1.55	0.00	691	8.0
415	Qs	113	Dec. 12, 1969	20	< 0.02	59	14	23	< 1	222	24	13	.3	34	.1	296	207	19.3	.69	.00	475	7.6
417	Qs	98	Jan. 27, 1970	15	7.8	57	24	52	2	282	49	43	.2	14	.2	395	241	31.7	1.44	.00	642	7.8
419	Qs	86	Feb. 5, 1970	18	--	58	21	32	2	271	31	18	.2	27	.2	340	233	23.1	.92	.00	545	7.8
421	Qs	90	do	20	--	81	19	45	3	336	38	22	.5	34	.2	428	280	25.8	1.17	.00	680	7.7
423	Qs	49	Feb. 11, 1970	17	--	78	16	26	2	262	27	12	.5	74	.1	382	260	17.9	.70	.00	580	7.5
424	Qs	98	Feb. 18, 1970	21	--	59	11	20	2	233	16	2	.2	33	.1	279	191	18.2	.62	.00	422	7.6
2/ 426	Qs	70	Apr. 11, 1951	--	--	74	21	* 14	--	265	30	24	--	25	--	350	271	10	--	--	619	--
			Feb. 11, 1970	2	--	16	9	40	3	98	12	50	.2	< .4	.1	180	76	53.3	1.98	.09	343	7.3
427	Qs	71	Nov. 6, 1970	23	--	169	41	225	2	171	21	640	.7	21	.1	1,230	590	45.4	4.03	.00	2,190	7.3
430	Qs	99	June 16, 1971	21	--	65	20	37	< 1	288	30	14	.4	42	.2	371	246	--	--	--	570	7.6
501	Qs	103	Dec. 12, 1969	14	.06	67	18	35	1	293	27	11	.6	38.5	.2	357	242	23.8	.97	.00	565	8.0
3/ 503	Qs	107	July 28, 1960	16	--	66	17	* 40	--	265	31	30	.5	35	--	374	234	27	--	--	606	6.9
3/ 5/ 504	Qs	120	Feb. 8, 1952	--	--	--	--	--	--	66	--	159	--	--	--	--	--	--	--	--	760	7.2
3/ 5/ 506	Qs	103	do	--	--	--	--	--	--	75	--	146	--	--	--	--	--	--	--	--	728	7.7
			Jan. 27, 1970	< 1	--	27	9	66	38	620	5	37	.1	< .4	.1	560	107	57.4	2.78	8.01	1,090	7.3
3/ 6/ 507	Qs	92	Feb. 2, 1952	29	--	378	83	* 692	--	246	50	1,780	--	17	--	3,140	1,280	54	--	--	5,860	7.5
3/ 6/			Feb. 7, 1952	30	--	332	73	* 666	--	176	53	1,680	--	15	--	2,940	1,130	56	--	--	5,530	7.5
			Aug. 19, 1971	25	--	128	22	354	7	273	36	650	.4	18	.4	1,370	414	--	--	--	2,370	7.1
3/ 508	Qs	94	Aug. 16, 1951	4.3	--	19	7.2	* 45	--	98	3	62	--	5	--	209	77	56	--	--	376	7.8
3/ 510	Qs	16	do	--	--	--	--	--	--	358	--	14	--	--	--	--	276	--	--	--	693	7.7
513	Qs	105	Dec. 17, 1969	17	--	69	19	29	1	264	33	21	.8	40	.1	360	250	20.3	.80	.00	568	7.5
514	Qs	65	Jan. 27, 1970	20	1.7	75	15	32	2	290	30	9	.7	37	.4	364	249	21.7	.87	.00	570	7.2
515	Qs	95	do	5	84	30	9	126	4	198	34	138	.4	35	.1	447	115	70.5	5.11	.95	785	7.7
516	Qs	94	Feb. 5, 1970	20	--	67	20	44	3	281	36	32	.4	37	.2	397	251	27.6	1.21	.00	638	7.5
4/ 517	Qs	50	Apr. 5, 1960	--	--	112	0	26	--	317	19	11	--	--	--	509	--	--	--	--	760	3.6
			June 10, 1971	19	--	75	19	42	< 1	296	25	34	.8	44	.2	405	268	--	--	--	640	7.9
601	Qal	61	June 17, 1971	19	--	63	34	130	< 1	401	119	66	1.4	41	.7	670	300	--	--	--	1,000	7.8
602	Qal	47	Nov. 5, 1970	15	--	165	80	430	2	404	740	419	1.1	< .4	.7	2,050	740	55.8	6.87	.00	2,820	7.6
603	Qal	51	Nov. 10, 1970	14	--	97	49	148	< 1	336	130	242	1.0	22	.7	870	444	42.0	3.06	.00	1,440	7.6
604	Qal	40	Nov. 11, 1970	21	--	202	114	382	< 1	387	468	700	1.0	14	.9	2,090	970	46.1	5.33	.00	3,120	7.5
605	Qal	45	Nov. 4, 1970	15	--	78	44	190	2	530	170	133	1.0	< .4	.6	890	378	52.3	4.26	7.13	1,400	7.9
607	Qs	58	do	16	--	58	29	79	< 1	336	82	24	1.7	54	.6	510	265	39.2	2.10	.20	777	7.6
608	Qs	26	do	23	--	108	63	315	< 1	570	344	255	1.7	50	1.1	1,440	530	56.4	5.95	.80	2,090	7.6
609	Qs	31	do	17	--	130	52	242	< 1	426	347	190	1.7	90	.8	1,280	540	49.5	4.54	.00	1,850	7.2
			June 17, 1971	15	--	322	78	343	< 1	295	1,030	394	1.5	45	1.3	2,370	1,130	--	--	--	2,900	7.7

See footnotes at end of table.

Table 8.--Chemical Analyses of Water From Wells and Springs--Continued

Well	Water-bearing unit	Depth of well (ft)	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids	Hardness as $CaCO_3$	Percent sodium	Sodium adsorption ratio (SAR)	Residual sodium carbonate (RSC)	Specific conductance (Micromhos at 25° C)	pH
								Seymour Formation and Quaternary Alluvium--Continued														
13-46-610	Qal	44	Nov. 5, 1970	19	--	172	85	265	< 1	316	130	690	0.8	5	0.5	1,520	780	42.5	4.13	0.00	2,550	7.5
611	Qal	55	do	20	--	137	65	250	22	471	96	476	.6	20	.6	1,320	610	47.3	4.42	.00	2,150	7.3
613	Qal	61	do	26	--	57	38	134	< 1	422	92	82	.8	31	.5	670	300	49.4	3.37	.93	1,032	8.3
614	Qal	55	do	12	--	87	53	271	2	421	370	213	1.3	< .4	.6	1,220	436	57.5	5.64	.00	1,840	7.9
615	Qal	63	do	17	--	50	26	127	< 1	383	93	55	1.2	33	.5	590	233	54.3	3.62	1.63	917	7.8
617	Qs	24	June 17, 1971	15	--	630	136	550	6	318	1,940	680	1.4	35	3.2	4,150	2,140	--	--	--	4,680	7.4
801	Qs	50	Jan. 27, 1970	20	--	74	15	31	5	260	27	15	.5	65	.1	381	246	21.7	.87	.00	580	7.6
901	Qs	32	June 17, 1971	21	--	66	15	29	< 1	250	26	15	.4	39	.1	334	228	--	--	--	518	7.8
4/ 47-102	Qal	40	May 7, 1955 Nov. 6, 1970	-- 8	-- --	160 30	-- 38	* 104 87	-- 10	439 314	37 42	133 87	-- .6	-- 3.5	-- .3	897 461	-- 233	-- 44.8	-- 2.48	-- .49	-- 800	-- 7.2
103	Qal	44	Feb. 12, 1970	19	--	376	100	1,050	7	365	1,110	1,570	.9	< .4	1.2	4,410	1,350	62.9	12.46	.00	5,990	7.4
105	Qal	15	Nov. 6, 1970	8	--	324	70	490	25	306	580	970	.8	3.5	.4	2,620	1,100	49.2	6.43	.00	3,840	7.2
405	Qal	40	Nov. 4, 1970	17	--	64	31	100	--	393	68	83	.8	< .4	.4	560	289	42.9	2.55	.67	901	7.8
406	Qal	38	do	1	--	163	111	358	3	83	204	1,000	.5	< .4	.4	1,880	860	47.4	5.30	.00	3,170	7.2
407	Qal	38	do	1	--	31	45	198	< 1	224	183	226	.6	< .4	.5	800	265	61.9	5.28	.00	1,340	7.6
408	Qal	41	June 10, 1971	22	--	187	52	370	3	360	485	495	1.1	< .4	.6	1,790	680	--	--	--	2,550	7.7
409	Qal	42	do	23	--	174	52	278	3	368	425	379	.8	< .4	.6	1,520	650	--	--	--	2,200	7.8
410	Qal	31	do	22	--	154	48	269	5	340	372	363	1.0	< .4	.4	1,400	580	--	--	--	2,090	7.6
701	Qal	40	Nov. 10, 1970	2	--	37	40	399	6	112	483	387	.7	4.5	.4	1,420	254	77.3	10.87	.00	2,190	7.1
702	Qal	39	do	12	--	57	15	57	12	176	51	98	.7	5.5	.2	396	205	37.7	1.73	.00	683	7.2
703	Qal	35	Nov. 4, 1970	19	--	83	29	233	3	351	236	227	1.0	5	.3	1,010	327	60.7	5.60	.00	1,570	8.0
705	Qal	35	Nov. 5, 1970	1	--	72	47	339	3	195	560	280	1.0	< .4	.6	1,400	376	66.2	7.59	.00	2,050	7.8
707	Qal	16	Nov. 6, 1970	24	--	121	39	422	4	410	540	350	1.2	< .4	.6	1,700	463	66.5	8.52	.00	2,430	7.5
708	Qal	42	Nov. 11, 1970	5	--	101	88	434	2	305	650	463	.8	< .4	1.0	1,890	610	60.6	7.63	.00	2,740	7.7
710	Qal	28	do	1	--	16	13	167	< 1	168	84	174	.9	< .4	.2	540	96	79.2	7.43	.85	964	7.9
712	Qal	28	do	18	--	88	20	176	2	305	129	215	.8	7	.3	810	303	55.8	4.39	.00	1,320	7.8
713	Qal	29	do	6	--	35	15	72	< 1	215	35	74	1.6	3.5	.2	349	152	50.6	2.53	.48	610	7.7
714	Qal	32	June 10, 1971	21	--	184	107	580	3	510	890	560	1.1	6	1.5	2,600	900	--	--	--	3,500	7.4
53-501	Qal	13	Nov. 3, 1970	21	--	235	141	430	12	680	950	439	.9	4.5	1.5	2,570	1,170	44.5	5.47	.00	3,430	7.3
502	Qal	12	do	16	--	197	123	217	< 1	333	790	259	1.8	9	1.4	1,780	1,000	32.2	3.00	.00	2,340	7.6
3/ 54-501	Qs	20	Oct. 14, 1943	--	--	--	--	--	--	376	32	40	--	--	--	--	--	--	--	--	--	--
510	Qs	Spring	Dec. 10, 1969	11	--	50	23	63	12	342	45	30	.7	< .4	.3	403	222	38.4	1.85	1.17	665	7.6
512	Qal	31	June 10, 1971	20	--	730	158	1,350	8	415	1,530	2,500	1.0	< .4	.7	6,500	2,470	--	--	--	8,002	7.4
513	Qal	31	do	20	--	480	135	760	5	409	1,220	1,280	1.1	< .4	1.3	4,100	1,760	--	--	--	5,230	7.6

See footnotes at end of table.

Table 8.--Chemical Analyses of Water From Wells and Springs--Continued

Well	Water-bearing unit	Depth of well (ft)	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids	Hardness as $CaCO_3$	Percent sodium	Sodium adsorption ratio (SAR)	Residual sodium carbonate (RSC)	Specific conductance (Micromhos at 25° C)	pH
								Seymour Formation and Quaternary Alluvium--Continued														
13-54-515	Qal	30	Feb. 12, 1970	12	--	106	39	56	2	292	212	54	2.6	< 0.4	0.5	630	426	22.2	1.18	0.00	940	7.6
516	Qal	29	June 22, 1971	16	--	207	119	418	3	443	930	396	1.8	< .4	1.2	2,310	1,010	--	--	--	3,000	7.2
701	Qs	55	Dec. 2, 1970	17	--	46	23	61	< 1	299	38	24	1.2	26	.2	383	209	38.8	1.83	.72	610	7.3
702	Qs	55	do	23	--	71	30	46	< 1	294	45	41	.6	57	.1	459	303	24.7	1.14	.00	722	8.0
3/ 705	Qs	14	Nov. 22, 1943	--	--	--	--	--	--	376	60	39	--	--	--	--	--	--	--	--	--	--
			Mar. 10, 1970	24	--	57	25	64	< 1	304	50	33	1.4	39	.2	442	244	36.3	1.8	.10	695	7.7
707	Qs	35	Mar. 24, 1970	16	--	67	48	106	< 1	344	95	118	1.5	70	.4	690	364	38.8	2.41	.00	1,088	7.6
711	Qs	37	do	20	--	51	39	94	< 1	343	76	51	1.7	70	.3	570	288	41.5	2.40	.00	878	7.8
712	Qs	46	do	20	--	73	41	109	< 1	361	74	115	1.5	63	.3	680	352	40.3	2.53	.00	1,071	7.6
714	Qs	38	Apr. 11, 1967	22	--	64	33	58	--	312	43	32	1.1	100	--	510	295	--	--	--	766	7.6
			Apr. 3, 1970	17	--	66	27	55	< 1	331	37	24	1.3	78	.2	468	277	30.1	1.44	.00	710	7.7
715	Qs	40	do	26	--	101	59	95	2	447	110	119	1.1	60	.3	790	497	29.4	1.86	.00	1,210	7.6
716	Qs	54	do	20	--	53	24	59	< 1	293	43	27	1.6	56	.2	428	233	35.6	1.69	.15	679	7.6
717	Qs	38	do	22	--	86	37	40	< 1	409	36	31	1.0	41	.3	495	367	19.3	.91	.00	784	7.2
718	Qs	56	July 29, 1970	23	--	59	29	59	< 1	304	44	25	1.3	68	.3	457	265	32.8	1.59	.00	705	7.4
719	Qs	42	Dec. 9, 1970	23	--	84	46	93	< 1	399	78	102	1.1	56	.4	680	398	33.8	2.04	.00	1,062	7.4
720	Qs	42	do	21	--	77	47	98	< 1	395	76	97	1.4	71	.4	680	388	35.5	2.17	.00	1,085	7.5
721	Qs	42	do	21	--	65	40	98	< 1	398	63	68	1.5	58	.4	610	326	39.4	2.35	.00	963	7.7
723	Qs	42	do	20	--	87	52	92	< 1	409	90	78	1.6	117	.5	740	430	31.8	1.93	.00	1,114	7.6
729	Qs	45	Apr. 11, 1967	24	--	76	54	125	--	401	116	92	1.3	141	--	830	412	--	--	--	1,250	7.6
3/ 804	Qs	41	Oct. 23, 1943	27	0.04	56	42	* 75	--	333	53	49	1.6	87	--	555	312	--	--	--	--	--
		42	Apr. 13, 1967	12	--	50	34	31	--	281	30	19	1.1	48	--	364	265	--	--	--	575	7.7
			Dec. 9, 1969	20	.68	67	31	45	< 1	357	36	26	1.4	31	.3	432	295	24.7	1.13	.00	690	7.6
3/ 3/ 805	Qs	41	Apr. 11, 1941	--	--	60	41	* 78	--	326	59	73	--	68	--	561	318	--	--	--	--	--
			Oct. 11, 1943	--	--	80	44	* 91	--	317	88	129	1.1	52	--	641	382	--	--	--	--	--
3/ 806	Qs	41	Oct. 23, 1943	--	--	59	38	* 62	--	303	51	45	--	--	--	504	303	--	--	--	--	--
808	Qs	41	June 8, 1949	29	.16	65	37	67	--	336	57	53	1.3	62	--	534	314	--	--	--	--	--
			Apr. 13, 1967	21	--	56	46	49	--	344	49	35	1.3	78	--	500	330	--	--	--	790	7.6
810	Qs	45	Dec. 9, 1969	8	.64	63	40	66	--	376	52	40	1.2	60	--	520	323	30.8	1.60	.00	824	7.3
3/ 817	Qs	42	Apr. 11, 1941	20	.02	73	49	* 78	--	324	93	63	1.1	122	--	659	384	--	--	--	--	--
3/ 819	Qs	44	Oct. 11, 1943	23	.05	75	42	* 46	--	306	59	58	1.3	76	--	602	360	--	--	--	--	--
		46	Dec. 9, 1969	19	1.16	128	80	92	1	373	137	169	1.2	176	.4	990	649	23.5	1.56	.00	1,540	--
3/ 821	Qs	43	Oct. 11, 1943	--	--	83	46	* 79	--	314	67	74	--	168	--	672	396	--	--	--	--	--
3/ 822	Qs	43	Apr. 11, 1943	--	--	72	32	* 39	--	305	37	36	1.1	64	--	431	310	--	--	--	--	--
826	Qs	46	June 8, 1949	65	1.3	57	25	55	--	275	37	36	1.1	62	--	430	245	--	--	--	--	--
3/ 828	Qs	38	Jan. 30, 1961	25	.01 7/	59	24	56	1	282	36	40	.9	58	--	411	246	33	1.6	--	711	7.6
			Dec. 9, 1969	19	.16	59	25	52	< 1	294	37	30	1.0	47	.2	415	251	31.3	1.44	.00	660	7.8

See footnotes at end of table.

Table 8.--Chemical Analyses of Water From Wells and Springs--Continued

Well	Water-bearing unit	Depth of well (ft)	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids	Hardness as $CaCO_3$	Percent sodium	Sodium adsorption ratio (SAR)	Residual sodium carbonate (RSC)	Specific conductance (Micromhos at 25° C)	pH
										Seymour Formation and Quaternary Alluvium--Continued												
13-54-830	Qs	41	Dec. 9, 1969	20	0.88	68	28	68	< 1	290	52	61	1.2	60	0.2	500	286	33.9	1.74	0.00	797	7.6
3/ 832	Qs	38	Nov. 22, 1943 June 22, 1971	-- 23	-- --	-- 69	-- 27	-- 54	-- < 1	306 311	35 53	33 30	-- .8	-- 49	-- .2	-- 459	-- 287	-- --	-- --	-- --	-- 695	-- 7.8
3/ 834	Qs	44	Nov. 2, 1943	--	--	73	50	* 95	--	375	79	69	--	134	--	685	388	--	--	--	--	--
837	Qs	45	Feb. 19, 1970	78	--	6	< 1	77	18	0	36	35	.6	< .4	.1	328	17	90.8	8.10	1.18	464	10.5
840	Qs	32	Mar. 5, 1970	21	--	59	36	63	1	309	60	47	1.1	73	.2	510	296	31.8	1.61	.00	778	7.7
841	Qs	32	do	22	--	61	33	61	< 1	300	56	38	1.1	78	.2	498	288	31.7	1.57	.00	768	7.6
842	Qs	32	do	22	--	67	42	50	1	351	52	43	.9	53	.2	500	340	24.1	1.17	.00	793	7.5
843	Qs	32	do	22	--	56	27	46	< 1	296	36	24	.9	48	.2	406	252	28.7	1.27	.00	635	7.8
845	Qs	32	Apr. 16, 1970	26	--	65	38	50	< 1	361	37	32	1.0	62	.2	489	318	25.4	1.22	.00	747	7.3
3/ 848	Qs	46	Nov. 2, 1943 Dec. 9, 1970	20 24	.04 --	82 96	49 60	* 97 75	-- < 1	375 453	91 100	81 71	1.3 1.0	116 77	-- .4	722 730	406 487	-- 25.1	-- 1.48	-- .00	-- 1,130	-- 7.2
850	Qs	47	June 22, 1971	25	--	76	49	92	< 1	450	69	80	1.2	46	.4	660	392	--	--	--	1,020	7.5
3/ 901	Qs	48	Oct. 30, 1943	20	.02	79	37	* 75	--	324	60	65	1.3	110	--	607	349	--	--	--	--	--
3/ 903	Qs	48	Oct. 13, 1943	--	--	82	37	* 96	--	325	69	88	--	127	--	679	356	--	--	--	--	--
3/ 3/ 904	Qs	48	Apr. 11, 1941 Oct. 30, 1943	-- --	-- --	75 75	30 24	* 63 * 53	-- --	294 275	49 51	53 49	-- 1.0	100 62	-- --	547 451	310 285	-- --	-- --	-- --	-- --	-- --
3/ 905	Qs	53	Jan. 30, 1961 Apr. 13, 1967 Dec. 9, 1969	27 25 21	.01 -- 1.32	73 78 82	33 37 32	58 64 61	.6 -- < 1	324 364 345	56 61 61	57 60 61	.8 .9 1.2	50 55 50	-- -- .2	431 560 540	318 347 339	28 -- 28.1	-- -- 1.44	-- -- .00	829 884 845	7.9 7.5 7.6
906	Qal	25	July 31, 1970	13	--	76	94	680	2	730	550	650	1.4	< .4	2.9	2,430	580	72.0	12.34	.50	3,510	7.5
909	Qal	20	June 15, 1971	8	--	50	45	225	< 1	329	126	288	.8	< .4	.7	910	311	--	--	--	1,550	7.0
910	Qal	20	do	23	--	55	51	141	< 1	483	101	92	1.4	27	.7	730	347	--	--	--	1,120	7.6
55-101	Qs	50	June 10, 1971	16	--	399	131	930	3	194	1,230	1,440	.9	26	3.1	4,270	1,540	--	--	--	5,650	7.4
102	Qs	38	do	13	--	48	19	227	< 1	378	236	83	1.5	30	1.2	840	197	--	--	--	1,270	7.7
103	Qs	25	do	16	--	203	121	309	< 1	451	530	530	.8	4	.7	1,940	1,010	--	--	--	2,720	7.7
401	Qal	25	June 15, 1971	22	--	445	61	820	3	471	1,070	1,160	1.1	37	1.6	3,850	1,360	--	--	--	4,920	7.6
402	Qs	25	June 10, 1971	19	--	540	125	990	7	339	1,000	1,890	.8	5	.6	4,740	1,860	--	--	--	6,300	7.5
403	Qs	30	do	22	--	600	133	990	7	404	1,060	1,950	.9	< .4	.7	4,960	2,050	--	--	--	6,500	7.4
404	Qs	31	do	23	--	730	156	1,280	9	378	950	2,840	.8	4	.6	6,200	2,480	--	--	--	8,005	7.3
4/ 501	Qal	21	Aug. 15, 1956	--	--	--	--	* 792	--	472	1,070	760	--	--	--	3,436	--	--	--	--	--	--
503	Qal	Spring	Feb. 5, 1970	6	--	100	51	810	< 1	390	930	640	1.1	26	1.0	2,760	462	79.2	16.35	.00	3,820	7.7
504	Qs	48	do	3	--	65	29	370	9	277	378	327	.5	14	.5	1,330	282	74.1	9.58	.00	1,970	7.5
3/ 505	Qs	28	Nov. 3, 1943 Dec. 1, 1970	-- 15	-- --	-- 48	-- 55	-- 207	-- < 1	581 510	260 158	176 84	-- 2.1	-- 51	-- .9	-- 900	-- 345	-- 56.6	-- 4.84	-- 2.57	-- 1,350	-- 8.8
506	Qs	23	do	13	--	44	31	145	2	434	81	43	1.4	61	.8	630	238	57.0	4.08	2.36	988	7.8

See footnotes at end of table.

Table 8.--Chemical Analyses of Water From Wells and Springs--Continued

Well	Water-bearing unit	Depth of well (ft)	Date of collection	Silica (SiO_2)	Iron (Fe)	Cal-cium (Ca)	Magne-sium (Mg)	Sodium (Na)	Potas-sium (K)	Bicar-bonate (HCO_3)	Sul-fate (SO_4)	Chlo-ride (Cl)	Fluo-ride (F)	Ni-trate (NO_3)	Boron (B)	Dis-solved solids	Hard-ness as $CaCO_3$	Per-cent so-dium	Sodium adsorp-tion ratio (SAR)	Residual sodium carbon-ate (RSC)	Specific conduct-ance (Micromhos at 25° C)	pH
								Seymour Formation and Quaternary Alluvium--Continued														
13-55-507	Qs	35	Dec. 1, 1970	13	--	42	29	94	< 1	371	50	18	1.4	56	0.5	485	223	47.8	2.73	1.62	756	7.7
508	Qs	25	June 16, 1971	13	--	94	51	296	< 1	310	282	400	1.2	2	.8	1,290	444	--	--	--	1,990	7.6
509	Qs	60	do	13	--	176	101	530	< 1	293	540	850	1.0	47	.9	2,400	860	--	--	--	3,530	7.5
3/ 510	Qs	38	Nov. 4, 1943 June 24, 1971	-- 16	-- --	-- 39	-- 33	-- 110	-- < 1	367 354	70 72	40 36	-- 1.2	-- 60	-- .5	-- 540	-- 236	-- --	-- --	-- --	-- 834	-- 7.5
601	Qs	26	June 23, 1971	14	--	35	45	61	1	342	44	27	1.1	42	.4	438	272	--	--	--	709	7.7
3/ 602	Qs	Spring	Nov. 4, 1943 June 23, 1971	-- 15	-- --	-- 35	-- 46	-- 61	-- < 1	398 333	60 53	52 28	-- 1.1	-- 49	-- .4	-- 452	-- 278	-- --	-- --	-- --	-- 705	-- 7.9
603	Qs	25	do	14	--	44	55	107	1	473	69	44	1.5	46	.6	620	337	--	--	--	974	7.6
701	Qs	38	Dec. 1, 1970	16	--	93	85	210	< 1	390	224	327	1.0	20	.6	1,170	580	44.0	3.79	.00	1,840	7.4
702	Qs	30	June 23, 1971	19	--	54	34	47	1	281	37	23	.8	95	.2	449	277	--	--	--	682	7.2
703	Qs	35	June 10, 1971	30	--	111	62	124	< 1	540	120	128	.9	67	.7	910	530	--	--	--	1,370	7.6
3/ 801	Qs	24	Nov. 3, 1943 Dec. 1, 1970	-- 17	-- --	-- 52	-- 38	-- 143	-- < 1	520 492	110 95	100 40	-- 2.0	-- 36	-- 1.4	-- 670	-- 287	-- 52.0	-- 3.67	-- 2.33	-- 1,008	-- 7.8
3/ 802	Qs	15	Nov. 3, 1943	--	--	--	--	--	--	396	135	96	--	--	--	--	--	--	--	--	--	--
56-401	Qs	65	Dec. 4, 1970	13	--	38	25	118	< 1	333	53	23	1.3	130	.4	570	198	56.5	3.65	1.51	818	7.8
402	Qs	26	June 24, 1971	17	--	75	43	66	< 1	299	77	87	.8	65	.3	580	364	--	--	--	929	7.3
403	Qs	86	June 23, 1971	15	--	53	22	141	< 1	325	113	90	.8	24	.3	620	223	--	--	--	965	7.2
501	Qs	55	Dec. 3, 1970	--	--	194	108	610	3	124	57	1,510	1.0	< .4	.2	2,540	930	58.8	8.69	.00	4,320	7.0
502	Qs	65	do	19	--	40	20	188	< 1	471	73	64	1.6	57	.7	700	184	68.9	6.02	4.04	1,080	7.6
503	Qs	62	do	20	--	66	24	276	< 1	415	208	200	1.2	50	.5	1,050	263	69.6	7.42	1.55	1,640	7.7
504	Qal	28	Dec. 4, 1970	15	--	151	43	305	3	451	371	319	1.4	< .4	.7	1,430	560	54.5	5.63	.00	2,120	7.3
506	Qs	65	Dec. 10, 1970	14	--	40	13	127	< 1	322	79	54	.6	18	.2	500	152	64.5	4.48	2.24	800	7.6
507	Qal	26	do	7	--	41	14	66	< 1	214	49	46	.3	17	.2	345	160	47.5	2.28	.30	580	7.1
601	Qs	32	do	14	--	36	36	47	< 1	298	30	5	1.0	74	.2	390	239	30.0	1.32	.11	607	8.0
602	Qs	Spring	do	14	--	38	18	73	< 1	320	27	7	1.0	37	.2	372	167	48.7	2.45	1.90	575	7.9
603	Qs	25	June 23, 1971	19	--	40	27	107	< 1	389	46	24	1.2	41	.5	496	211	--	--	--	770	7.7
701	Qs	37	Nov. 20, 1969	15	--	63	26	137	--	407	84	93	1.2	15.5	--	640	263	53.1	3.67	1.43	1,024	7.6
702	Qs	33	June 25, 1971	17	--	90	57	196	< 1	404	154	250	1.5	62	.5	1,030	459	--	--	--	1,600	7.6
802	Qs	36	Nov. 20, 1969	16	--	66	66	496	--	560	342	496	1.2	32	--	1,760	425	71.7	10.45	.70	2,685	7.5
803	Qs	38	June 25, 1971	19	--	64	25	142	< 1	379	72	107	.9	42	.4	660	264	--	--	--	1,026	7.4
804	Qs	25	June 24, 1971	35	--	125	117	760	< 1	740	520	860	1.7	70	1.6	2,850	790	--	--	--	4,070	7.5
805	Qs	24	June 23, 1971	23	--	68	39	106	2	395	75	98	1.1	23	.4	630	330	--	--	--	1,006	7.5
806	Qs	26	do	23	--	63	45	126	1	426	79	84	1.8	62	.4	690	342	--	--	--	1,194	7.5
901	Qs	29	Dec. 3, 1970	17	--	52	48	358	< 1	620	192	231	3.0	77	1.1	1,280	326	70.5	8.62	3.58	1,950	7.9

See footnotes at end of table.

Table 8.--Chemical Analyses of Water From Wells and Springs--Continued

Well	Water-bearing unit	Depth of well (ft)	Date of collection	Silica (SiO_2)	Iron (Fe)	Cal-cium (Ca)	Magne-sium (Mg)	Sodium (Na)	Potas-sium (K)	Bicar-bonate (HCO_3)	Sul-fate (SO_4)	Chlo-ride (Cl)	Fluo-ride (F)	Ni-trate (NO_3)	Boron (B)	Dis-solved solids	Hard-ness as $CaCO_3$	Per-cent so-dium	Sodium adsorp-tion ratio (SAR)	Residual sodium carbon-ate (RSC)	Specific conduct-ance (Micromhos at 25° C)	pH
Seymour Formation and Quaternary Alluvium--Continued																						
13-56-903	Qs	29	Dec. 3, 1970	16	--	39	36	384	< 1	660	189	207	4.0	65	1.2	1,270	247	77.2	10.64	5.83	1,930	7.8
905	Qs	28	do	14	--	14	13	386	< 1	710	105	115	7.0	43	1.9	1,070	91	90.2	17.61	10.46	1,650	8.6
906	Qs	30	June 25, 1971	25	--	133	86	200	< 1	498	140	309	1.7	134	.6	1,270	690	--	--	--	2,000	7.4
907	Qs	35	June 24, 1971	17	--	63	41	308	< 1	459	163	167	2.3	270	.8	1,260	328	--	--	--	1,810	7.9
908	Qs	20	June 23, 1971	24	--	61	37	211	< 1	423	117	157	3.8	68	.4	890	303	--	--	--	1,390	7.8
909	Qs	20	June 24, 1971	22	--	82	43	478	< 1	510	232	510	2.7	41	.9	1,660	382	--	--	--	2,530	7.8
61-101	Qs	31	Apr. 8, 1970	18	--	109	55	209	1	344	205	283	.9	77	.4	1,130	500	47.6	4.07	.00	--	7.7
104	Qal	30	Apr. 1, 1970	15	--	680	169	1,690	7	204	1,670	2,970	1.9	< .4	1.3	7,300	2,380	60.6	15.04	.00	8,790	7.3
105	Qal	38	Apr. 8, 1970	7	--	74	141	1,780	54	840	21	3,150	.3	3	.7	5,750	760	83.5	28.07	.00	8,420	7.6
106	Qs	25	do	22	--	153	94	220	< 1	316	287	436	1.0	121	.4	1,490	770	38.3	3.44	.00	2,250	7.5
201	Qs	21	Oct. 27, 1943	--	--	--	--	--	--	418	68	67	--	--	--	--	--	--	--	--	--	--
203	Qs	50	Mar. 4, 1970	26	--	130	58	100	2	351	105	261	.7	24	.3	880	570	27.7	1.83	.00	1,490	7.6
204	Qal	32	Apr. 12, 1967	19	--	230	183	401	--	453	680	820	1.9	8	--	2,570	1,330	--	--	--	3,830	7.3
			Apr. 1, 1970	5	--	444	260	940	7	93	1,150	2,140	2.1	< .4	.7	5,000	2,180	48.4	8.77	.00	6,600	7.3
206	Qal	30	do	2	--	208	149	493	4	54	740	1,000	1.2	3	.8	2,630	1,130	48.6	6.36	.00	3,760	7.4
207	Qal	30	do	15	--	210	156	478	2	447	1,210	405	2.6	< .4	1.6	2,700	1,170	47.1	6.09	.00	3,400	7.8
209	Qs	32	do	40	--	104	77	217	< 1	366	197	334	1.1	80	.6	1,230	580	45.1	3.94	.00	1,910	8.0
211	Qs	39	July 10, 1970	25	--	103	57	104	< 1	296	103	225	1.1	50	.4	810	491	31.6	2.05	.00	1,380	7.8
301	Qs	41	Nov. 19, 1969	24	--	82	63	95	--	304	65	222	1.0	31	--	730	463	30.9	1.92	.00	1,260	7.8
305	Qs	38	Apr. 3, 1970	20	--	56	26	58	2	310	31	35	1.3	42	.2	423	248	33.6	1.59	.12	690	7.5
310	Qs	42	do	22	--	59	32	77	2	320	36	69	1.7	63	.3	520	280	37.5	2.01	.00	789	7.7
313	Qs	41	do	22	--	63	29	48	2	333	30	27	1.6	31	.2	418	279	27.3	1.26	.00	699	7.3
316	Qs	41	do	21	--	55	26	52	2	305	27	27	1.3	51	.2	412	246	31.3	1.43	.09	655	7.3
317	Qs	48	Apr. 10, 1970	21	--	63	28	40	< 1	299	26	28	1.2	54	.2	408	274	24.2	1.06	.00	645	7.6
319	Qs	42	June 10, 1970	28	--	118	65	112	< 1	382	84	256	.9	31	.4	880	560	30.2	2.05	.00	1,470	7.5
320	Qs	42	do	26	--	113	58	114	< 1	406	85	214	.9	47	.3	860	520	32.2	2.17	.00	1,380	7.5
322	Qs	44	do	27	--	113	70	96	< 1	317	85	257	1.2	60	.3	870	570	26.9	1.76	.00	1,470	7.6
324	Qs	31	June 17, 1971	22	--	52	33	75	< 1	306	53	40	1.2	70	.3	496	268	--	--	--	768	7.4
325	Qal	27	do	23	--	295	196	520	4	510	730	1,020	2.1	< .4	.6	3,240	1,550	--	--	--	4,200	7.5
326	Qs	27	June 8, 1971	22	--	80	74	137	< 1	570	101	148	1.6	16	.5	860	500	--	--	--	1,370	7.6
329	Qs	47	July 2, 1970	25	--	103	51	89	< 1	318	76	190	1.2	48	.3	740	469	29.1	1.78	.00	1,240	7.6
333	Qs	43	do	25	--	111	74	94	< 1	354	86	258	1.1	39	1.4	860	580	26.0	1.69	.00	1,470	7.7
334	Qs	44	do	27	--	123	74	93	< 1	331	72	288	1.4	49	.3	890	610	24.9	1.64	.00	1,540	7.7
335	Qs	36	do	28	--	135	107	161	< 1	362	133	365	1.5	220	.3	1,330	780	30.9	2.50	.00	2,040	7.8

See footnotes at end of table.

Table 8.--Chemical Analyses of Water From Wells and Springs--Continued

Well	Water-bearing unit	Depth of well (ft)	Date of collection	Silica (SiO_2)	Iron (Fe)	Cal-cium (Ca)	Magne-sium (Mg)	Sodium (Na)	Potas-sium (K)	Bicar-bonate (HCO_3)	Sul-fate (SO_4)	Chlo-ride (Cl)	Fluo-ride (F)	Ni-trate (NO_3)	Boron (B)	Dis-solved solids	Hard-ness as $CaCO_3$	Per-cent so-dium	Sodium adsorp-tion ratio (SAR)	Residual sodium carbon-ate (RSC)	Specific conduct-ance (Micromhos at 25° C)	pH
								Seymour Formation and Quaternary Alluvium--Continued														
13-61-336	Qs	39	July 2, 1970	25	--	107	72	108	< 1	379	84	233	1.6	80	0.5	900	560	29.4	1.98	0.00	1,490	7.5
337	Qal	24	July 9, 1970	21	--	650	168	1,560	8	397	1,610	2,680	1.9	< .4	1.0	6,900	2,310	59.4	14.07	.00	8,890	7.4
341	Qs	34	Dec. 2, 1970	24	--	107	49	115	< 1	375	77	208	.9	37	.2	800	471	34.7	2.30	.00	1,330	7.8
342	Qal	31	June 8, 1971	17	--	153	106	268	4	464	446	399	2.0	< .4	.7	1,620	820	--	--	--	2,390	7.8
415	Qs	36	Mar. 10, 1960	--	--	--	--	--	--	474	--	194	--	--	--	--	344	--	--	--	1,520	7.4
			June 3, 1970	31	--	109	55	167	2	540	88	193	1.0	64	.4	980	500	42.1	3.25	.00	1,550	7.4
420	Qs	28	Nov. 14, 1969	18	--	72	45	98	--	389	112	64	1.4	56	--	660	363	37.0	2.24	.00	1,010	7.7
422	Qs	56	Nov. 18, 1969	20	0.58	69	34	155	1	432	108	109	2.4	33.5	.5	740	314	51.8	3.81	.80	1,173	7.6
425	Qs	51	Mar. 26, 1970	20	--	76	42	115	1	355	94	130	1.0	71	.3	720	362	40.9	2.63	.00	1,100	7.6
426	Qs	28	Apr. 8, 1970	22	--	135	60	230	1	328	247	369	.9	50	.5	1,280	580	46.1	4.13	.00	2,030	7.6
428	Qs	30	do	22	--	90	37	136	1	376	96	125	.8	88	.3	780	378	43.9	3.04	.00	1,220	7.7
501	Qs	43	Apr. 2, 1970	31	--	94	51	118	< 1	381	85	191	1.0	28	.3	790	443	36.8	2.45	.00	1,290	7.7
503	Qs	56	June 3, 1970	23	--	109	52	127	< 1	338	111	228	.8	45	.4	860	488	36.1	2.50	.00	1,440	7.4
3/ 504	Qs	20	Oct. 29, 1943	--	--	--	--	--	--	388	110	219	--	--	--	--	--	--	--	--	--	--
506	Qs	54	Mar. 4, 1970	26	--	141	52	138	2	354	113	314	.7	24	.3	990	570	34.6	2.52	.00	1,650	7.5
507	Qs	46	do	22	--	119	58	86	2	290	96	256	.8	29	.2	810	540	25.8	1.61	.00	1,360	7.5
510	Qs	38	Mar. 6, 1970	26	--	148	67	205	5	407	173	391	.9	30	.4	1,250	640	40.9	3.51	.00	2,000	7.4
511	Qs	40	do	25	--	142	66	200	3	400	155	384	.8	32	.4	1,210	630	41.0	3.48	.00	1,930	7.4
513	Qs	29	Nov. 14, 1969	29	--	83	36	99	--	398	60	79	.6	84.5	--	670	355	37.8	2.29	.00	1,025	7.4
514	Qs	37	Apr. 10, 1970	19	--	74	25	112	3	383	47	96	.9	48	.3	610	288	45.9	2.88	.52	985	7.5
4/ 8/ 515	Qs	36	Mar. 24, 1955	--	--	138	--	* 160	--	430	85	164	--	--	--	989	--	--	--	--	--	7.7
			Sept. 4, 1959	--	--	253	136	422	--	447	307	1,009	--	--	--	2,574	--	--	--	--	--	--
			Mar. 10, 1960	28	--	158	89	* 280	--	441	214	540	--	27	--	1,550	760	44	--	--	2,750	7.2
			June 3, 1970	29	--	180	94	311	1	530	225	540	.8	9	.7	1,730	835	44.7	4.68	.00	2,650	7.4
517	Qs	40	June 9, 1970	27	--	129	57	175	< 1	420	131	296	.8	28	.4	1,050	560	40.6	3.22	.00	1,730	7.2
518	Qs	50	Mar. 24, 1970	27	--	151	58	235	2	417	206	405	.8	28	.5	1,320	620	45.2	4.10	.00	2,060	7.2
520	Qs	36	Nov. 14, 1969	25	--	80	43	83	--	368	65	85	.5	92	--	660	378	32.4	1.86	.00	1,013	7.7
523	Qs	--	Mar. 4, 1970	25	--	111	45	132	2	283	122	250	.9	40	.3	870	462	38.3	2.67	.00	1,450	7.7
527	Qs	37	Mar. 9, 1970	24	--	88	50	83	1	327	84	152	.9	37	.3	680	426	29.7	1.75	.00	1,110	7.5
528	Qs	34	do	25	--	208	94	184	3	326	208	570	.7	36	.4	1,490	910	30.6	2.65	.00	2,360	7.4
529	Qs	38	do	25	--	188	89	147	2	355	139	500	.7	< .4	.4	1,270	840	27.7	2.21	.00	2,110	7.4
			June 8, 1971	25	--	176	90	150	< 1	322	136	474	.6	42	.3	1,250	810	--	--	--	2,170	7.5
531	Qs	31	Mar. 6, 1970	26	--	153	67	138	4	338	117	368	.6	37	.6	1,080	660	31.3	2.33	.00	1,761	7.5
534	Qs	35	Oct. 28, 1943	--	--	--	--	--	--	372	150	262	--	--	--	--	--	--	--	--	--	--
			Mar. 9, 1970	22	--	132	55	218	3	375	187	351	.8	37	.4	1,190	560	46.1	4.03	.00	1,880	7.5
535	Qs	51	Mar. 10, 1970	25	< .02	114	40	154	1	373	128	207	.6	67	.3	920	451	42.6	3.15	.00	1,480	7.6

See footnotes at end of table.

Table 8.--Chemical Analyses of Water From Wells and Springs--Continued

Well	Water-bearing unit	Depth of well (ft)	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids	Hardness as $CaCO_3$	Percent sodium	Sodium adsorption ratio (SAR)	Residual sodium carbonate (RSC)	Specific conductance (Micromhos at 25° C)	pH
								Seymour Formation and Quaternary Alluvium--Continued														
13-61-537	Qs	58	Mar. 10, 1970	23	--	151	53	196	3	386	155	359	0.6	42	0.3	1,170	600	41.6	3.48	0.00	1,880	7.4
539	Qs	45	Mar. 24, 1970	19	--	91	52	90	1	317	106	164	1.1	42	.4	720	441	30.8	1.87	.00	1,160	7.8
542	Qs	45	do	19	--	108	61	123	1	343	142	240	1.1	39	.5	900	520	34.0	2.34	.00	1,450	7.5
549	Qs	40	Apr. 12, 1967 Apr. 1, 1970	20 24	-- --	96 115	58 65	125 137	-- < 1	355 382	97 117	226 245	1.3 1.1	63 60	-- .5	860 950	478 560	-- 34.9	-- 2.52	-- .00	1,450 1,570	7.6 7.6
551	Qs	32	Apr. 12, 1967	20	--	85	63	150	--	346	131	232	1.3	63	--	920	470	--	--	--	1,550	7.5
553	Qs	54	Mar. 27, 1970	33	--	115	43	208	< 1	397	122	266	1.0	88	.4	1,070	467	49.2	4.18	.00	1,700	7.2
554	Qs	38	Apr. 8, 1970	27	--	107	47	176	20	455	141	213	1.0	80	.4	1,040	462	45.3	3.56	.00	1,590	7.5
555	Qs	51	do	25	--	98	49	121	2	433	88	168	1.1	42	.4	810	448	36.9	2.48	.00	1,300	7.6
557	Qs	37	Apr. 10, 1970	36	--	132	49	179	< 1	329	91	344	1.0	94	.4	1,090	530	42.2	3.37	.00	1,750	7.5
560	Qs	39	do	25	--	110	49	148	3	378	96	240	1.0	43	.3	900	476	40.4	2.96	.00	1,500	7.6
561	Qs	32	June 2, 1970	25	--	97	42	184	< 1	412	114	218	.8	35	.4	920	415	49.2	3.94	.00	1,510	7.5
563	Qs	39	do	27	--	140	55	193	2	484	133	294	.7	28	.4	1,110	580	42.1	3.50	.00	1,770	7.5
564	Qs	50	June 3, 1970	25	--	114	42	205	< 1	393	108	296	.8	39	.4	1,020	459	49.3	4.16	.00	1,700	7.3
566	Qs	50	do	24	--	119	43	205	< 1	392	140	297	.9	34	.4	1,060	475	48.4	4.09	.00	1,730	7.7
568	Qs	39	do	28	--	213	73	330	2	531	236	550	.7	74	.6	1,770	840	46.2	4.97	.00	2,670	7.5
8/ 573	Qs	32	Aug. 12, 1960 June 2, 1970	-- 27	-- --	90 101	43 41	117 134	-- 1	357 426	118 85	171 164	-- 1.5	-- 43	-- .3	896 810	-- 422	-- 41.3	-- 2.89	-- .00	-- 1,290	-- 7.7
576	Qs	56	June 4, 1970	23	--	100	47	95	< 1	309	97	169	1.0	58	.4	740	445	31.7	1.96	.00	1,200	7.3
578	Qs	43	July 30, 1970	28	--	91	39	133	< 1	416	77	152	1.1	49	.4	780	388	42.8	2.95	.00	1,220	7.5
579	Qs	44	do	29	--	92	37	126	< 1	416	76	141	1.2	48	.4	760	381	41.9	2.81	.00	1,160	7.4
580	Qs	44	June 8, 1971	15	--	97	52	92	< 1	260	51	271	.6	15	.3	720	454	--	--	--	1,250	7.6
582	Qs	--	Apr. 12, 1967	25	--	186	87	324	--	451	260	610	1.1	14	--	1,730	820	--	--	--	2,850	7.2
608	Qs	46	July 20, 1953 Apr. 16, 1970	-- 25	-- --	56 140	46 43	* 94 133	-- 2	287 378	48 113	178 264	-- .7	-- 20	-- .3	660 930	-- 530	38.5 35.5	-- 2.53	-- .00	-- 1,530	8.0 7.4
609	Qs	51	do	30	--	101	36	85	2	316	75	145	.7	39	.2	670	400	31.5	1.84	.00	1,090	7.4
610	Qs	43	June 9, 1970	28	--	103	46	82	< 1	316	69	170	1.0	61	.2	720	446	28.5	1.69	.00	1,163	7.5
3/ 611	Qs	30	Oct. 10, 1943 Mar. 4, 1970	-- 24	-- --	-- 128	-- 47	-- 109	-- 1	318 295	100 102	158 244	-- .8	-- 88	-- .3	-- 890	-- 510	-- 31.7	-- 2.10	-- .00	-- 1,450	-- 7.7
613	Qs	51	Mar. 24, 1970	24	--	136	40	154	1	346	150	291	.6	13	.4	980	500	39.9	2.98	.00	1,560	7.3
615	Qs	36	Mar. 26, 1970	21	--	65	28	47	1	290	34	40	1.3	64	.2	444	280	26.8	1.23	.00	740	7.6
617	Qs	44	do	22	--	66	29	57	< 1	300	38	41	1.1	84	.2	486	285	30.4	1.47	.00	745	7.6
618	Qs	44	do	22	--	68	33	63	< 1	307	52	55	1.1	81	.2	530	306	31.1	1.58	.00	806	7.6
621	Qs	40	Apr. 16, 1970	25	--	80	36	52	< 1	367	34	61	.8	41	.2	510	347	24.6	1.21	.00	826	7.6
622	Qs	36	do	26	--	105	42	64	2	305	58	168	.7	28	.2	640	435	24.3	1.34	.00	1,067	7.5

See footnotes at end of table.

Table 8.--Chemical Analyses of Water From Wells and Springs--Continued

Well	Water-bearing unit	Depth of well (ft)	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids	Hardness as $CaCO_3$	Percent sodium	Sodium adsorption ratio (SAR)	Residual sodium carbonate (RSC)	Specific conductance (Micromhos at 25° C)	pH
								Seymour Formation and Quaternary Alluvium--Continued														
13-61-623	Qs	42	Apr. 16, 1970	24	--	85	34	44	< 1	253	33	99	0.8	90	0.1	530	353	21.5	1.03	0.00	853	7.5
625	Qs	--	June 8, 1970	23	--	91	32	37	1	388	26	37	.7	41	.2	480	360	18.4	.85	.00	762	7.4
626	Qs	--	June 9, 1970	24	--	105	37	51	< 1	377	26	102	.7	41	.2	570	416	21.0	1.08	.00	965	7.4
630	Qs	--	June 10, 1970	16	--	58	31	57	1	296	41	48	.8	49	.1	448	272	31.3	1.50	.00	729	7.5
637	Qs	34	July 2, 1970	25	--	75	40	82	< 1	372	39	86	1.6	75	.3	610	349	33.8	1.91	.00	956	7.9
639	Qs	43	July 3, 1970	27	--	74	36	72	< 1	321	43	89	1.3	55	.3	560	335	31.7	1.70	.00	907	7.5
640	Qs	45	do	27	--	132	72	111	< 1	368	69	322	.9	27	.3	940	620	27.8	1.93	.00	1,650	7.4
642	Qs	46	do	16	--	68	39	98	< 1	289	81	151	.7	11	.2	610	331	39.2	2.34	.00	1,024	7.5
643	Qs	34	Dec. 2, 1970	24	--	102	48	85	< 1	351	72	167	1.2	36	.2	710	454	28.9	1.73	.00	1,165	7.8
645	Qs	20	Oct. 29, 1943	--	--	--	--	--	--	287	24	38	--	--	--	--	--	--	--	--	--	--
			Apr. 12, 1967	27	--	72	42	63	--	292	45	124	1.5	43	--	560	353	--	--	--	936	7.4
646	Qs	40	June 25, 1971	24	--	174	66	141	3	337	309	269	.5	53	.2	1,210	710	--	--	--	1,760	7.5
647	Qs	37	do	23	--	70	21	52	< 1	305	33	29	.4	46	.2	424	260	--	--	--	658	7.5
[8] 701	Qs	50	Aug. 7, 1959	--	--	159	105	356	--	418	129	797	--	--	--	1,964	--	--	--	--	--	--
[3]			Mar. 10, 1960	29	--	440	242	* 1,250	--	368	158	3,080	--	--	--	5,380	2,090	56	12	--	9,470	6.9
			June 9, 1971	22	--	1,140	371	2,780	11	238	174	7,100	1.7	24	.5	11,700	4,380	--	--	--	> 12,000	7.1
[8] 702	Qs	50	Aug. 6, 1959	--	--	62	39	110	--	440	63	91	--	--	--	805	--	--	--	--	--	--
[3]			Mar. 10, 1960	--	--	48	33	* 120	--	426	58	70	--	--	--	571	256	50	3.3	--	967	7.1
[8]			July 28, 1960	--	--	55	36	89	--	347	72	83	--	--	--	682	--	--	--	--	--	--
			June 4, 1971	26	--	103	62	204	3	409	104	330	1.2	48	.5	1,080	510	--	--	--	1,750	7.7
703	Qs	54	June 9, 1970	28	--	25	47	181	2	365	130	144	1.6	19	.4	760	257	60.5	4.90	.84	1,196	8.3
704	Qs	40	Mar. 24, 1970	27	--	120	63	198	2	466	109	302	1.7	75	.4	1,130	560	43.5	3.64	.00	1,780	7.4
706	Qs	50	June 2, 1970	27	--	80	40	188	1	471	123	163	1.6	27	.5	880	365	52.8	4.27	.42	1,400	7.6
707	Qs	56	June 3, 1970	29	--	59	34	134	1	451	66	79	1.7	29	.3	660	288	50.4	3.44	1.65	1,040	7.7
708	Qs	52	do	29	--	83	51	238	2	500	196	216	1.5	27	.5	1,090	415	55.5	5.08	.00	1,700	7.6
709	Qs	46	do	30	--	86	49	159	< 1	481	78	157	1.3	64	.3	860	419	45.3	3.39	.00	1,390	7.5
[3] 711	Qs	36	Mar. 10, 1960	--	--	--	--	--	--	477	--	268	--	--	--	--	456	--	--	--	1,830	7.3
			July 30, 1970	27	--	68	41	129	2	510	72	94	1.4	< .4	.4	690	340	45.2	3.04	1.55	1,087	7.5
713	Qs	42	June 9, 1971	27	--	95	66	336	2	338	153	560	1.1	32	.4	1,440	510	--	--	--	2,310	7.9
714	Qs	29	do	25	--	90	49	127	3	450	106	126	1.6	57	.3	810	428	--	--	--	1,250	7.9
715	Qs	40	do	20	--	67	36	170	4	489	14	192	1.4	< .4	.3	740	316	--	--	--	1,250	7.8
[8] 716	Qs	50	Aug. 17, 1959	--	--	165	109	319	--	410	130	769	--	--	--	1,903	--	--	--	--	--	--
[3]			Mar. 10, 1960	--	--	--	--	--	--	401	--	1,220	--	--	--	--	1,310	--	--	--	4,450	7.0
			June 9, 1971	22	--	102	56	204	2	462	124	278	1.6	38	.4	1,060	487	--	--	--	1,690	7.8
[3] 717	Qs	30	Oct. 21, 1943	24	1.0	68	43	* 139	--	491	92	96	2.1	112	--	718	346	--	--	--	--	--
[3] 801	Qs	18	Oct. 25, 1943	--	--	--	--	--	--	467	44	74	--	--	--	--	--	--	--	--	--	--
805	Qs	44	Nov. 28, 1955	24	--	64	55	* 253	--	278	175	365	--	12	--	1,080	385	59	5.6	--	2,050	8.2
			June 2, 1970	29	--	297	89	335	2	473	344	750	.8	12	.7	2,080	1,110	39.7	4.37	.00	3,150	7.5

See footnotes at end of table.

Table 8.--Chemical Analyses of Water From Wells and Springs--Continued

Well	Water-bearing unit	Depth of well (ft)	Date of collection	Silica (SiO_2)	Iron (Fe)	Cal-cium (Ca)	Magne-sium (Mg)	Sodium (Na)	Potas-sium (K)	Bicar-bonate (HCO_3)	Sul-fate (SO_4)	Chlo-ride (Cl)	Fluo-ride (F)	Ni-trate (NO_3)	Boron (B)	Dis-solved solids	Hard-ness as $CaCO_3$	Per-cent so-dium	Sodium adsorp-tion ratio (SAR)	Residual sodium carbon-ate (RSC)	Specific conduct-ance (Micromhos at 25° C)	pH
								Seymour Formation and Quaternary Alluvium--Continued														
13-61-807	Qs	28	Oct. 22, 1943	--	--	--	--	--	--	334	120	287	--	--	--	--	--	--	--	--	--	--
808	Qs	47	May 14, 1953	--	--	186	79	* 460	--	51.2	293	550	--	--	--	2,115	--	56.0	--	--	--	7.2
			June 2, 1970	31	--	92	44	254	1	530	157	255	0.9	14	0.5	1,110	410	57.4	5.46	0.42	1,700	7.8
809	Qs	50	Apr. 1, 1970	24	--	76	48	118	3	381	60	179	1.5	37	.4	730	387	39.9	2.61	.00	1,200	7.8
812	Qs	51	Nov. 18, 1969	22	--	69	45	305	--	540	195	257	1.1	13.5	--	1,170	360	64.9	7.00	1.71	1,845	7.9
813	Qs	34	do	24	--	117	56	141	--	307	55	348	.8	26.5	--	920	520	36.9	2.68	.00	1,640	7.4
817	Qs	55	Mar. 24, 1970	6	--	95	64	351	7	530	121	540	1.3	< .4	.5	1,460	500	60.3	6.82	.00	2,410	7.3
819	Qs	45	do	28	--	147	105	590	4	510	580	770	1.8	12	.9	2,490	800	61.7	9.11	.00	3,450	7.4
820	Qs	60	Apr. 2, 1970	26	--	113	51	351	4	510	238	415	.9	21	.5	1,470	491	60.9	6.90	.00	2,300	7.6
821	Qs	52	June 2, 1970	29	--	112	63	244	2	540	203	268	1.0	48	.5	1,240	540	49.6	4.57	.00	1,910	7.4
823	Qs	54	Apr. 12, 1967	26	--	76	49	228	--	495	157	200	1.5	18	--	1,000	394	--	--	--	1,600	7.5
			Apr. 1, 1970	26	--	51	28	159	< 1	464	83	72	1.9	20	.4	670	241	59.0	4.46	2.78	1,049	7.5
824	Qs	59	Mar. 27, 1970	29	--	168	103	220	4	467	121	570	1.1	17	.4	1,460	840	36.1	3.29	.00	2,410	7.5
825	Qs	36	Apr. 10, 1970	25	--	99	36	104	3	421	84	137	1.1	1.5	.2	700	393	36.4	2.27	.00	1,126	7.5
830	Qs	47	June 2, 1970	28	--	169	96	324	2	540	296	540	1.1	21	.7	1,740	820	46.3	4.93	.00	2,650	7.6
831	Qs	49	do	28	--	190	97	284	2	479	192	610	.9	9	.6	1,650	870	41.4	4.17	.00	2,670	7.3
832	Qs	53	do	5	--	26	44	296	3	530	19	324	.4	< .4	.4	980	245	72.5	8.24	3.82	1,730	7.5
834	Qs	57	do	31	--	126	78	291	1	520	177	437	1.1	20	.7	1,420	640	49.9	5.02	.00	2,300	7.6
835	Qs	54	do	27	--	77	44	375	1	560	238	324	1.0	17	.6	1,380	373	68.6	8.45	1.72	2,120	7.7
836	Qs	59	do	29	--	105	54	323	1	530	218	352	1.2	25	.6	1,370	487	59.1	6.37	.00	2,130	8.1
837	Qs	51	do	31	--	137	88	362	3	530	302	500	1.2	29	.7	1,710	710	52.7	5.92	.00	2,650	7.6
838	Qs	54	June 11, 1970	28	--	100	63	229	2	520	149	290	1.2	31	.5	1,150	510	49.4	4.41	.00	1,770	7.5
839	Qs	45	July 22, 1970	31	--	90	42	221	< 1	487	172	199	1.1	46	.4	1,040	396	54.8	4.83	.07	1,640	7.7
843	Qs	52	June 9, 1971	31	--	128	74	253	< 1	510	237	368	1.1	21	.5	1,360	630	--	--	--	2,080	7.6
844	Qs	39	do	30	--	120	91	413	1	540	323	580	1.2	15	.6	1,840	670	--	--	--	2,770	7.8
846	Qs	35	do	24	--	72	47	176	< 1	540	136	113	.7	32	.4	870	372	--	--	--	1,300	7.7
847	Qs	24	do	21	--	64	37	118	< 1	470	85	39	.8	42	.4	640	312	--	--	--	961	8.0
901	Qs	47	Mar. 24, 1970	27	--	236	107	269	3	333	349	710	1.1	38	.7	1,900	1,030	36.2	3.65	.00	2,850	7.2
904	Qs	48	do	31	--	112	46	158	2	390	167	224	1.0	30	.3	960	469	42.3	3.17	.00	1,500	7.4
907	Qs	49	do	26	--	156	62	176	2	336	206	380	1.0	24	.5	1,200	640	37.2	3.01	.00	1,870	7.5
910	Qs	50	do	25	--	139	45	66	2	293	68	240	1.1	20	.2	750	530	21.2	1.24	.00	1,250	7.3
911	Qs	44	June 2, 1970	35	--	165	68	276	1	407	234	487	1.0	43	.5	1,510	690	46.4	4.57	.00	2,380	7.4
912	Qs	47	July 3, 1970	35	--	70	53	268	< 1	362	210	327	1.1	23	.5	1,170	390	59.9	5.89	.00	1,870	7.2
913	Qs	34	June 25, 1971	17	--	87	134	520	< 1	700	455	520	2.3	190	.7	2,270	770	--	--	--	3,250	7.8

See footnotes at end of table.

Table 8.--Chemical Analyses of Water From Wells and Springs--Continued

Well	Water-bearing unit	Depth of well (ft)	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids	Hardness as $CaCO_3$	Percent sodium	Sodium adsorption ratio (SAR)	Residual sodium carbonate (RSC)	Specific conductance (Micromhos at 25° C)	pH
								Seymour Formation and Quaternary Alluvium--Continued														
13-62-101	Qs	40	Apr. 3, 1970	24	--	77	55	144	2	580	16	176	1.3	< 0.4	0.6	780	418	42.8	3.06	1.09	1,300	7.6
102	Qs	47	Mar. 24, 1970	22	--	73	44	100	< 1	384	79	111	1.3	29	.3	650	363	37.4	2.28	.00	1,055	8.0
106	Qs	27	Nov. 13, 1969	24	--	69	27	53	--	306	41	37	1.2	60	--	462	285	28.8	1.36	.00	719	7.7
3/ 112	Qs	58	Oct. 29, 1943	--	--	--	--	--	--	402	210	183	--	--	--	--	--	--	--	--	--	--
4/ 114	Qs	36	Apr. 1, 1960	--	--	114	8	* 64	--	372	67	64	--	--	--	689	--	29.8	1.5	--	1,080	8.0
115	Qs	47	Nov. 18, 1969	21	--	88	39	73	--	356	69	64	2.5	98	--	630	380	29.5	1.63	.00	960	7.4
116	Qs	37	Apr. 10, 1970	24	--	79	47	95	2	445	60	84	1.3	60	.4	670	393	34.4	2.08	.00	1,067	7.5
3/ 117	Qs	32	Oct. 19, 1943	--	--	--	--	--	--	189	68	125	--	--	--	--	--	--	--	--	--	--
			Nov. 18, 1969	21	--	75	23	69	--	354	48	50	.8	30	--	491	281	34.8	1.79	.19	785	7.5
3/ 119	Qs	35	Apr. 10, 1951	--	--	72	35	* 78	--	341	55	68	--	75	--	586	324	34	--	--	961	--
3/ 124	Qs	34	Nov. 28, 1955	28	--	62	31	74	2.1	326	50	49	1.2	58	.26	506	281	--	--	--	839	7.6
125	Qs	34	Nov. 18, 1969	22	--	92	50	102	--	350	93	92	1.4	178.5	--	800	436	33.8	2.13	.00	1,190	7.6
135	Qs	37	Apr. 9, 1970	25	--	60	28	78	< 1	321	46	37	1.6	88	.2	520	265	39.0	2.08	.00	798	7.6
138	Qs	52	June 10, 1970	22	--	77	44	96	< 1	340	64	110	1.1	92	.4	670	374	35.9	2.17	.00	1,060	7.7
139	Qs	46	do	24	--	77	40	105	< 1	362	88	92	1.2	80	.4	690	355	39.2	2.43	.00	1,048	7.5
140	Qs	42	do	23	--	73	37	100	< 1	403	65	85	1.6	6.5	.4	590	334	39.3	2.37	.00	1,004	7.2
141	Qs	39	do	24	--	72	46	102	< 1	404	100	64	1.2	9.2	.5	700	369	37.6	2.31	.00	1,041	7.4
142	Qs	45	do	23	--	73	36	113	< 1	397	69	94	1.2	39	.4	640	331	42.6	2.70	.00	1,023	7.6
143	Qs	45	do	22	--	70	36	137	< 1	406	75	106	1.3	54	.4	700	325	47.8	3.30	.17	1,115	7.6
144	Qs	29	do	23	--	79	55	79	< 1	331	60	68	1.1	119	.3	650	365	32.1	1.81	.00	975	7.4
147	Qs	39	do	27	--	83	32	94	< 1	364	61	85	1.1	60	.3	620	340	37.5	2.21	.00	984	7.5
148	Qs	34	July 3, 1970	22	--	78	35	59	< 1	365	39	32	1.1	100	.2	550	340	27.4	1.39	.00	835	7.5
149	Qs	28	July 28, 1970	24	--	59	23	37	< 1	265	24	29	1.1	40	.2	367	243	25.1	1.05	.00	595	7.8
150	Qs	40	do	25	--	56	30	35	< 1	277	26	26	1.0	49	.2	384	262	22.6	.95	.00	607	7.4
152	Qs	38	July 29, 1970	23	--	61	26	41	< 1	289	29	25	.9	44	.2	392	258	25.6	1.10	.00	613	7.4
153	Qs	42	Sept. 22, 1970	118	--	173	23	38	< 1	281	38	39	.9	42	.2	410	277	22.9	.99	.00	654	7.5
155	Qs	39	Nov. 12, 1970	25	--	89	37	104	< 1	368	67	119	1.1	66	.3	690	376	37.6	2.33	.00	1,090	8.0
157	Qs	44	Feb. 8, 1967	--	0.08	77	36	58	--	323	56	43	1.2	95	--	690	342	--	--	--	950	7.5
158	Qs	36	Feb. 20, 1967	--	.40	60	47	63	--	306	48	53	1.5	130	--	710	344	--	--	--	1,010	7.6
160	Qs	35	do	--	.04	51	25	54	--	277	50	36	1.2	33	--	530	233	--	--	--	716	7.8
201	Qs	43	June 15, 1971	24	--	65	36	50	2	323	34	32	1.3	82	.1	485	309	--	--	--	751	7.2
202	Qs	42	July 29, 1970	23	--	66	36	62	< 1	340	44	49	1.4	58	.3	510	311	30.3	1.53	.00	795	7.4
3/ 203	Qs	27	Oct. 18, 1943	--	--	--	--	--	--	328	44	90	--	--	--	--	--	--	--	--	--	--
207	Qs	41	July 29, 1970	25	--	60	31	43	< 1	306	36	27	1.4	49	.2	422	276	25.4	1.13	.00	658	7.4

See footnotes at end of table.

Table 8.--Chemical Analyses of Water From Wells and Springs--Continued

Well	Water-bearing unit	Depth of well (ft)	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids	Hardness as $CaCO_3$	Percent sodium	Sodium adsorption ratio (SAR)	Residual sodium carbonate (RSC)	Specific conductance (Micromhos at 25° C)	pH
Seymour Formation and Quaternary Alluvium--Continued																						
13-62-208	Qs	29	July 28, 1970	25	--	73	29	39	< 1	315	34	34	0.9	49	0.2	439	303	21.7	0.97	0.00	698	7.4
3/ 210	Qs	40	Oct. 20, 1943	--	--	--	--	--	--	342	48	63	--	--	--	--	--	--	--	--	--	--
211	Qs	40	Nov. 21, 1969	19	--	47	23	57	--	282	31	26	1.7	28.5	--	383	215	36.7	1.70	.33	619	7.4
214	Qs	41	Nov. 20, 1969	21	--	60	33	64	--	311	49	55	1.6	40	--	477	284	32.8	1.64	.00	761	7.4
215	Qs	30	Nov. 21, 1969	19	--	58	36	50	--	377	41	22	.8	18.5	--	431	294	27.0	1.27	.30	696	7.3
218	Qs	33	Mar. 24, 1970	7	--	40	20	82	6	332	7	52	.7	3	.3	381	184	49.2	2.62	1.77	681	7.2
220	Qs	44	do	21	< 0.02	51	31	42	< 1	289	36	27	1.6	37	.2	389	254	26.6	1.16	.00	619	7.7
221	Qs	28	July 28, 1970	25	--	85	29	47	< 1	348	44	40	.8	49	.2	491	333	23.4	1.12	.00	778	7.5
222	Qs	30	do	25	--	73	29	35	< 1	323	25	39	1.0	48	.2	434	301	20.3	.88	.00	675	7.5
223	Qs	29	do	23	--	67	29	53	< 1	298	42	32	1.2	76	.2	470	285	28.9	1.37	.00	726	7.6
230	Qs	42	Sept. 22, 1970	21	--	64	30	57	< 1	307	43	51	1.0	46	.3	464	285	30.4	1.47	.00	740	7.9
233	Qs	42	do	19	--	81	26	44	< 1	257	56	45	.9	74	.2	472	308	23.7	1.09	.00	742	7.6
236	Qs	37	June 8, 1971	21	--	68	22	39	< 1	275	26	45	.9	23	.1	380	258	--	--	--	610	7.9
238	Qs	27	June 15, 1971	20	--	63	43	64	< 1	458	36	28	1.2	11	.4	491	336	--	--	--	783	7.4
241	Qs	46	do	23	--	60	32	67	< 1	338	43	51	1.3	38	.3	481	281	--	--	--	736	7.7
243	Qs	44	do	23	--	68	34	41	< 1	317	36	31	1.0	67	.2	457	311	--	--	--	715	7.5
244	Qs	39	do	23	--	70	35	63	< 1	317	41	58	1.0	81	.4	530	318	--	--	--	827	7.6
3/ 301	Qs	14	Oct. 19, 1943	--	--	--	--	--	--	425	64	48	--	--	--	--	--	--	--	--	--	--
			Nov. 13, 1969	12	--	45	30	102	18	484	38	27	1.4	< .4	.6	510	236	48.5	2.90	3.22	801	7.7
302	Qal	20	July 31, 1970	11	--	74	172	1,280	< 1	770	810	1,550	1.6	44	3.8	4,320	890	75.6	18.55	.00	6,040	7.7
401	Qs	39	June 10, 1970	23	--	67	27	44	< 1	301	30	25	1.0	64	.1	429	277	25.9	1.16	.00	669	7.5
403	Qs	39	do	26	--	81	36	87	< 1	378	65	81	1.1	43	.3	610	353	34.9	2.02	.00	978	7.5
406	Qs	38	Mar. 11, 1970	15	--	68	16	26	5	290	13	27	.5	8.3	.1	322	235	19.2	.73	.06	541	7.4
409	Qs	42	Mar. 9, 1970	18	--	53	19	47	1	278	30	18	1.9	25	.2	350	209	32.7	1.40	.38	562	7.6
413	Qs	40	Apr. 9, 1970	21	--	57	22	39	< 1	304	23	12	1.2	31	.2	355	234	26.5	1.10	.30	570	7.7
414	Qs	41	do	22	--	83	39	79	< 1	378	55	78	1.1	93	.2	640	365	32.1	1.81	.00	984	7.4
415	Qs	30	Nov. 18, 1969	20	--	84	46	136	--	550	108	75	.9	25.5	--	770	398	42.6	2.96	1.09	1,190	7.8
416	Qal	30	do	19	--	47	33	63	--	344	33	29	1.0	29	--	423	253	35.3	1.74	.58	696	7.5
418	Qs	39	Mar. 11, 1970	20	--	60	21	63	1	326	47	21	1.0	29	.2	423	235	36.7	1.77	.64	667	7.5
421	Qs	42	do	20	--	64	22	94	< 1	340	51	55	1.0	58	.3	530	251	44.9	2.58	.58	834	7.6
423	Qs	47	Apr. 3, 1970	19	--	65	22	83	2	323	40	41	1.1	94	.3	530	254	41.5	2.26	.22	800	7.5
424	Qs	60	Apr. 9, 1970	13	--	59	23	76	< 1	278	58	51	1.1	69	.3	487	243	40.4	2.12	.00	773	7.5
425	Qs	40	do	25	--	77	27	44	< 1	348	35	26	1.0	54	.1	460	304	24.0	1.10	.00	705	7.5
426	Qs	35	June 10, 1970	24	--	78	29	37	< 1	314	29	30	1.1	70	.2	452	315	20.3	.90	.00	702	7.5

See footnotes at end of table.

Table 8.--Chemical Analyses of Water From Wells and Springs--Continued

Well	Water-bearing unit	Depth of well (ft)	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids	Hardness as $CaCO_3$	Percent sodium	Sodium adsorption ratio (SAR)	Residual sodium carbonate (RSC)	Specific conductance (Micromhos at 25° C)	pH
							Seymour Formation and Quaternary Alluvium--Continued															
13-62-428	Qs	42	June 10, 1970	24	--	98	42	59	3	420	57	40	0.9	104	0.2	640	419	23.5	1.26	0.00	970	7.4
431	Qs	41	July 3, 1970	25	--	71	33	57	< 1	311	50	48	1.3	64	.2	500	314	28.4	1.41	.00	798	7.6
432	Qs	45	do	27	--	71	37	77	< 1	383	47	65	1.1	42	.3	560	328	33.7	1.84	.00	894	7.4
433	Qs	44	do	27	--	73	37	85	< 1	375	52	72	1.2	56	.3	590	334	35.5	2.01	.00	935	7.6
434	Qs	38	Apr. 12, 1967	19	--	56	26	72	--	301	51	38	1.3	73	--	484	247	--	--	--	750	7.6
502	Qal	11	Oct. 20, 1943	--	--	--	--	--	--	851	600	770	--	--	--	--	--	--	--	--	--	--
515	Qal	22	Jan. 26, 1970	14	--	43	40	50	--	381	31	16	1.1	11	--	393	231	28.4	1.31	.80	650	7.7
520	Qal	10	do	15	--	47	40	89	< 1	428	52	44	1.3	11	.4	510	283	40.6	2.30	1.37	835	7.9
521	Qal	18	Oct. 30, 1943	13	0.40	42	39	* 90	--	395	54	43	1.7	20	--	500	266	--	--	--	--	--
526	Qal	19	Jan. 26, 1970	13	--	60	46	50	< 1	414	47	40	.8	< .4	.3	461	338	24.2	1.17	.02	770	7.8
527	Qal	Spring	July 30, 1970	30	--	1,710	1,160	2,680	< 1	383	9	10,400	.8	< .4	.9	16,100	9,100	39.1	12.24	.00	>12,000	6.8
528	Qal	32	do	17	--	212	207	351	< 1	355	56	1,240	1.8	21	.8	2,280	1,380	35.6	4.11	.00	3,930	7.3
530	Qal	23	Oct. 9, 1943	--	--	90	105	* 526	--	566	418	610	--	50	--	2,080	656	--	--	--	--	--
701	Qal	28	June 22, 1971	14	--	21	24	240	< 1	550	107	68	4.3	15	1.0	760	153	--	--	--	1,176	7.6
702	Qal	29	Nov. 11, 1970	14	--	21	23	216	< 1	498	100	64	3.3	20	.7	710	145	76.4	7.81	5.26	1,128	7.4
63-301	Qal	20	June 23, 1971	11	--	137	107	620	< 1	220	424	1,050	1.2	< .4	.6	2,460	780	--	--	--	3,800	7.0
302	Qs	26	June 24, 1971	13	--	241	210	1,090	< 1	451	1,120	1,520	1.7	104	1.6	4,520	1,470	--	--	--	6,010	7.7
64-301	Qs	36	June 25, 1971	23	--	159	163	461	< 1	340	321	670	4.0	552	.8	2,520	1,070	--	--	--	3,640	7.4
602	Qal	22	July 8, 1964	16	--	69	37	40	--	451	16	13	.8	< .4	--	414	324	--	--	--	734	7.6
604	Qal	27	do	20	--	3,300	1,880	4,510	--	192	270	17,800	1.0	< .4	--	27,900	16,000	--	--	--	>12,000	7.0
14-49-401	Qs	30	Dec. 3, 1970	16	--	35	25	99	< 1	345	45	26	.6	56	.3	473	193	52.8	3.11	1.81	734	7.6
402	Qs	38	do	19	--	64	49	36	< 1	337	39	60	.5	48	.4	482	364	17.9	.83	.00	795	7.9
403	Qs	36	do	15	--	55	34	52	< 1	296	35	40	.4	60	.2	437	276	28.9	1.35	.00	697	7.5
404	Qs	35	June 24, 1971	16	--	25	29	184	< 1	447	89	72	1.6	43	.5	680	180	--	--	--	1,050	7.8
701	Qs	33	do	23	--	67	53	164	< 1	470	123	145	.9	42	.4	850	386	--	--	--	1,310	7.6
702	Qs	22	June 23, 1971	22	--	257	131	830	5	379	372	1,610	.4	< .4	.6	3,410	1,180	--	--	--	5,008	7.5
801	Qs	40	Dec. 3, 1970	20	--	80	79	188	< 1	510	131	241	1.1	39	.5	1,030	530	43.7	3.56	.00	1,660	7.6
802	Qs	Spring	do	16	--	75	62	225	< 1	540	123	260	.7	4	.5	1,030	444	52.4	4.65	.00	1,690	7.9
57-401	Qal	15	July 7, 1964	16	--	970	409	2,120	--	295	27	5,900	.7	< .4	--	9,600	4,100	--	--	--	>12,000	7.0
402	Qal	--	do	15	--	1,860	464	5,500	--	234	67	12,900	.8	< .4	--	20,900	6,600	--	--	--	>12,000	7.3
21-05-202	Qal	32	June 9, 1971	16	--	70	100	530	< 1	494	409	620	3.8	3	1.3	2,000	590	--	--	--	3,020	7.9

See footnotes at end of table.

Table 8.--Chemical Analyses of Water From Wells and Springs--Continued

Well	Water-bearing unit	Depth of well (ft)	Date of collection	Silica (SiO_2)	Iron (Fe)	Cal-cium (Ca)	Magne-sium (Mg)	Sodium (Na)	Potas-sium (K)	Bicar-bonate (HCO_3)	Sul-fate (SO_4)	Chlo-ride (Cl)	Fluo-ride (F)	Ni-trate (NO_3)	Boron (B)	Dis-solved solids	Hard-ness as $CaCO_3$	Per-cent so-dium	Sodium adsorp-tion ratio (SAR)	Residual sodium carbon-ate (RSC)	Specific conduct-ance (Micromhos at 25° C)	pH
										Permian Rocks												
13-45-701	Pprsa	50	June 9, 1971	23	--	61	46	127	1	384	169	67	2.2	38	0.6	720	343	44.6	2.99	0.00	1,080	7.6
703	Pprsa	30	do	29	--	81	64	117	1	482	221	51	1.8	17	.7	820	466	35.2	2.35	.00	1,198	7.5
813	Pprsa	40	Feb. 17, 1970	16	--	128	68	192	4	290	128	452	.6	14	.8	1,150	600	40.9	3.40	.00	1,940	7.5
816	Pprsa	35	June 9, 1971	16	--	59	25	38	< 1	267	39	18	.7	50	.2	377	251	24.6	1.04	.00	588	7.8
46-702	Pcf	28	Feb. 17, 1970	18	--	96	34	48	< 1	362	47	45	.6	95	.4	560	381	21.6	1.08	.00	864	8.0
53-108	Pprsa	Spring	Nov. 3, 1970	20	--	65	55	68	< 1	468	100	32	.9	12	.5	580	390	27.6	1.50	.00	898	8.2
109	Pprsa	45	June 9, 1971	25	--	54	21	15	< 1	250	16	8	1.0	17	.1	280	221	12.8	1.49	.00	444	7.5
110	Pprsa	15	do	21	--	41	60	89	< 1	483	61	23	2.3	50	.6	580	347	35.8	2.08	.99	894	7.8
402	Pcf	26	Nov. 3, 1970	17	--	153	81	129	< 1	371	419	160	.8	13	.7	1,160	710	28.2	2.10	.00	1,660	7.4
503	Pcf	24	Nov. 6, 1970	17	--	103	80	94	< 1	339	374	85	1.5	18	.5	940	590	25.7	1.68	.00	1,330	7.3
63-201	Pcf	30	June 24, 1971	17	--	325	278	1,650	< 1	383	1,930	2,150	2.0	187	2.3	6,700	1,960	64.7	16.19	.00	8,230	7.5
64-601	Pcf	20	June 23, 1971	17	--	96	78	510	< 1	640	452	469	1.1	32	.9	1,970	560	66.4	9.34	.00	2,870	7.5
603	Pcf	14	July 8, 1964	24	--	93	40	56	--	560	24	38	.7	< .4	--	570	395	22.5	1.99	1.26	964	7.9
			June 23, 1971	20	--	96	34	57	14	500	50	40	.4	< .4	.2	560	379	23.8	1.28	.67	872	7.5
605	Pcf	15	July 8, 1964	22	--	380	339	650	--	500	750	1,880	1.0	< .4	--	4,270	2,340	37.7	5.85	.00	6,750	7.3
14-57-101	Pcf	20	July 7, 1964	34	--	2,000	1,020	2,900	--	229	171	10,700	2.4	< .4	--	17,000	9,200	40.6	1.31	1.92	>12,000	6.8

1/ Analysis by Layne Western Company.
2/ Analysis by U.S. Bureau of Reclamation.
3/ Analysis by U.S. Geological Survey.
4/ Analysis by Midwestern University (Wichita Falls, Texas) and U.S. Department of Agriculture.
5/ Contains no bromide or iodide.
6/ Contains 5± mg/l bromide and no iodide.
7/ Iron in solution.
8/ Analysis by Texas Agricultural Experiment Station.
* Concentration includes both sodium (Na) and potassium (K).

Table 9.—Chemical Analyses of Oil-Field Brines

(Analyses are in parts per million except pH.)

After Rowland Laxson et al., 1960, Resistivities and chemical analyses of formation waters from the west-central Texas area: West Central Texas Section of the Society of Petroleum Engineers of A.I.M.E.

Producing zone	Field[1]	Average well depth (feet)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	pH
				PERMIAN SYSTEM					
Permian	Consolidated	—	12,545	2,069	54,800	0	231	112,495	6.7
				PENNSYLVANIAN SYSTEM					
Cisco	King	1,466	12,410	2,734	60,370	179	241	122,700	6.7
Do.	East Castle-berry	2,888	13,330	1,996	52,830	27	314	110,750	4.4
Do.	Fargo	3,280-3,330	16,450	2,174	55,795	17	137	121,350	4.1
Canyon	Rock Crossing	3,000	13,295	2,279	50,500	39	334	107,900	6.6
Do.	Harrold	3,200	12,840	1,850	49,420	56	394	103,950	5.7
Strawn	Consolidated	3,750	17,400	2,600	54,100	11	233	121,650	6.6
Do.	Fargo	5,200	11,000	1,961	51,500	0	402	104,350	3.2
Caddo	Consolidated	4,000	18,275	2,765	55,700	15	117	126,150	6.6
Do.	Harrold	4,200	20,005	3,040	53,450	25	137	126,600	4.5
Bend	National	4,478	22,398	2,987	55,800	0	115	134,200	3.5
				MISSISSIPPIAN SYSTEM					
Mississippian Lime	Bugscuffle	6,000	15,905	2,644	57,300	101	124	124,200	6.5
Mississippian Conglomerate	do	6,300	16,620	1,914	59,150	56	69	126,700	6.3
				ORDOVICIAN SYSTEM					
Ellenburger	Rock Crossing	3,800	16,995	2,381	55,550	8	269	122,400	4.1
Do.	Potts	4,993	16,130	2,351	55,610	13	276	120,800	6.9
Do.	O'dell	6,453	17,225	2,836	56,070	52	247	125,000	8.0

[1] Oil and gas fields as assigned by the Railroad Commission of Texas.

Table 10.—Reported Oil-Field Brine Production and Disposal in 1961 and 1967,

(Quantities reported in barrels)

Area[1]	Field[2]	Brine production 1961	Brine production 1967	Disposal into pits 1961	Disposal into pits 1967	Injection into wells 1961	Injection into wells 1967	Miscellaneous disposal 1961	Miscellaneous disposal 1967
1	Odell	70,203	18,980	0	0	70,203	18,980	0	0
	Odell Ellenburger	43,579	7,665	0	0	43,579	7,665	0	0
	Odell, West (Chappel)	0	33,441	0	0	0	33,441	0	0
	Odell, West (Ellenburger)	0	136,175	0	0	0	136,175	0	0
	Area Total	113,782	196,261	0	0	113,782	196,261	0	0
2	Fargo	126,071	0	50	0	125,841	0	180	0
	Fargo (Canyon 3900')	0	8,863	0	0	0	8,863	0	0
	Fargo (Canyon 4200')	0	60,862	0	0	0	60,862	0	0
	Fargo (Canyon 4400')	0	7,379	0	0	0	7,379	0	0
	Fargo (Cisco 3200')	0	43,754	0	0	0	43,754	0	0
	Fargo (Cisco 3700')	97,437	53,962	0	0	97,437	53,962	0	0
	Fargo, West (Strawn Conglomerate)	12,555	0	0	0	11,443	0	1,112	0
	Sumner (Mississippi)	0	730	0	0	0	730	0	0
	Sumner (Strawn)	0	730	0	0	0	730	0	0
	West Fargo	0	4,728	0	0	0	4,728	0	0
	Area Total	236,063	181,008	50	0	234,721	181,008	1,292	0
3	Schmoker (Conglomerate)	55,150	239,400	200	0	54,950	239,400	0	0
	Area Total	55,150	239,400	200	0	54,950	239,400	0	0
4	County Regular	1,030	2,160	0	0	1,030	2,160	0	0
	Area Total	1,030	2,160	0	0	1,030	2,160	0	0
5	Tolbert	70,750	14,600	70,750	0	0	14,600	0	0
	Area Total	70,750	14,600	70,750	0	0	14,600	0	0
6	Bugscuffle (Strawn)	1,309	0	0	0	1,309	0	0	0
	Area Total	1,309	0	0	0	1,309	0	0	0
7	Main (Canyon)	182,500	298,000	0	0	182,500	298,000	0	0
	Main (2600' Sand)	6,205	4,300	0	0	6,205	4,300	0	0
	Area Total	188,705	302,300	0	0	188,705	302,300	0	0
8	Lockett	0	3,650	0	0	0	3,650	0	0
	Lockett (Cisco)	0	10,950	0	0	0	10,950	0	0
	County Regular	17,000	0	0	0	17,000	0	0	0
	Area Total	17,000	14,600	0	0	17,000	14,600	0	0
9	Blackman (1400' Sand)	730	0	0	0	0	0	730	0
	Blackman (1600' Sand)	3,650	5,475	0	0	3,650	5,475	0	0
	King	2,555	27,375	0	0	2,555	27,375	0	0

Table 10.—Reported Oil-Field Brine Production and Disposal in 1961 and 1967—Continued

Area[1]	Field[2]	Brine production 1961	Brine production 1967	Disposal into pits 1961	Disposal into pits 1967	Injection into wells 1961	Injection into wells 1967	Miscellaneous disposal 1961	Miscellaneous disposal 1967
	King, North (1600' Sand)	155,125	126,290	0	0	155,125	126,290	0	0
	Streit (Lower Dyson)	18,250	72,367	0	0	18,250	72,367	0	0
	County Regular	8,760	61,685	1,460	0	7,300	61,685	0	0
	Area Total	189,070	293,192	1,460	0	186,880	293,192	730	0
10	Wolfson—1700'	10,950	0	0	0	10,950	0	0	0
	County Regular	3,709,040	1,794,653	3,890	45	3,705,150	1,794,608	0	0
	Area Total	3,719,990	1,794,653	3,890	45	3,716,100	1,794,608	0	0
11	Castleberry, East (Cisco)	24,645	273,013	0	0	24,645	273,013	0	0
	Zacaweista (Cisco "AA")	7,300	0	0	0	7,300	0	0	0
	County Regular	336,317	130,640	27,400	0	100,375	130,640	208,542	0
	Area Total	368,262	403,653	27,400	0	132,320	403,653	208,542	0
12	W. C. (Castleberry)	41,850	0	0	0	41,850	0	0	0
	W. C., East (Canyon Sand)	10,950	36,500	0	0	10,950	36,500	0	0
	County Regular	0	118,280	0	0	0	118,280	0	0
	Area Total	52,800	154,780	0	0	52,800	154,780	0	0
13	National (Caddo)	7,300	0	0	0	7,300	0	0	0
	National (Canyon Lime)	54,750	47,450	0	0	54,750	47,450	0	0
	National (Ellenburger)	22,200	21,900	0	0	21,900	21,900	300	0
	Area Total	84,250	69,350	0	0	83,950	69,350	300	0
14	K-D (2000' Canyon Sand)	18,250	0	0	0	18,250	0	0	0
	Pounds (Dyson Upper)	1,825	0	0	0	1,825	0	0	0
	Rogers-McCrary	66,470	87,150	0	0	66,470	87,150	0	0
	County Regular	595,320	549,065	13,795	10,950	581,525	538,115	0	0
	Area Total	681,865	636,215	13,795	10,950	668,070	625,265	0	0
15	Sauder-Dyson	109,125	322,000	0	0	109,125	322,000	0	0
	County Regular	537,157	554,235	13,687	0	523,470	554,235	0	0
	Area Total	646,282	876,235	13,687	0	632,595	876,235	0	0
16	County Regular	773,405	760,030	0	0	773,405	757,150	0	2,880
	Area Total	773,405	760,030	0	0	773,405	757,150	0	2,880
17	Cullum (1900' Gunsite)	15,000	73,390	0	0	15,000	73,390	0	0
	Electra (Ellenburger)	6,570	0	0	0	6,570	0	0	0
	Sumner (2100' Cisco Sand)	25,185	0	0	0	25,185	0	0	0
	County Regular	784,040	4,516,401	6,845	0	777,195	4,515,345	0	1,056
	Area Total	830,795	4,589,791	6,845	0	823,950	4,588,735	0	1,056
18	S and K (Caddo)	618	67,525	618	0	0	67,525	0	0
	County Regular	27,090	73,000	1,500	0	25,590	36,500	0	36,500
	Area Total	27,708	140,525	2,118	0	25,590	104,025	0	36,500

Table 10.—Reported Oil-Field Brine Production and Disposal in 1961 and 1967—Continued

Area[1]	Field[2]	Brine production 1961	Brine production 1967	Disposal into pits 1961	Disposal into pits 1967	Injection into wells 1961	Injection into wells 1967	Miscellaneous disposal 1961	Miscellaneous disposal 1967
19	County Regular	7,300	0	7,300	0	0	0	0	0
	Area Total	7,300	0	7,300	0	0	0	0	0
20	Dill, East (Dyson)	3,600	0	0	0	3,600	0	0	0
	County Regular	39,775	24,090	4,775	0	35,000	24,090	0	0
	Area Total	43,375	24,090	4,775	0	38,600	24,090	0	0
21	Zacaweista (Ellenburger)	15,500	0	15,500	0	0	0	0	0
	County Regular	469,116	1,937,936	0	0	469,116	1,937,936	0	0
	Area Total	484,616	1,937,936	15,500	0	469,116	1,937,936	0	0
22	D-K (Upper Dyson)	54,750	0	0	0	54,750	0	0	0
	Dubann (2430' Sand)	200,750	0	0	0	200,750	0	0	0
	Grayback (Ellenburger)	3,698,943	850,873	2,800	0	3,696,143	850,873	0	0
	Grayback (Strawn)	8,030	0	0	0	8,030	0	0	0
	Grayback, East (Strawn)	0	93,597	0	0	0	93,597	0	0
	Grayback, Southeast (Strawn)	5,948	4,745	548	0	5,400	4,745	0	0
	Rock Crossing (Canyon Lime)	467,200	161,312	0	0	467,200	161,312	0	0
	Rock Crossing (Ellenburger)	500,901	0	0	0	500,901	0	0	0
	Waggoner Milham (Cisco Sand)	45,075	1,246,895	0	0	45,075	1,246,895	0	0
	Wood-Milham	0	3,650	0	0	0	3,650	0	0
	Wood-Milham (Cisco)	672,695	1,822,080	0	0	672,695	1,822,080	0	0
	County Regular	6,243,447	15,861,570	32,826	4,320	6,210,621	15,813,450	0	43,800
	Area Total	11,897,739	20,044,722	36,174	4,320	11,861,565	19,996,602	0	43,800
23	Baker Properties-Cambron (Dyson Sand)	23,500	3,600	0	0	23,500	3,600	0	0
	Buck Baker (2400' Sand)	13,500	7,300	0	0	13,500	7,300	0	0
	Dublin-Kiel (1900' Dyson Sand)	26,380	88,000	0	0	26,380	88,000	0	0
	Grayback, East (Milham)	69,350	377,750	0	0	69,350	377,750	0	0
	Kiel (Dyson)	109,500	0	0	0	109,500	0	0	0
	L. P. (Milham)	2,520	0	0	0	2,520	0	0	0
	Modine (Milham)	18,000	0	0	0	18,000	0	0	0
	Wilson (Milham)	23,725	21,900	0	0	23,725	21,900	0	0
	County Regular	3,624,919	1,815,346	9,300	0	3,615,619	1,815,346	0	0
	Area Total	3,911,394	2,313,896	9,300	0	3,902,094	2,313,896	0	0
24	H-W (Caddo)	25,550	0	0	0	25,550	0	0	0
	Paradise (Caddo)	191,600	227,090	3,650	0	187,950	227,090	0	0
	County Regular	14,312	0	0	0	14,312	0	0	0
	Area Total	231,462	227,090	3,650	0	227,812	227,090	0	0
25	TT (Ellenburger)	21,170	7,200	0	0	21,170	7,200	0	0
	Area Total	21,170	7,200	0	0	21,170	7,200	0	0

Table 10.—Reported Oil-Field Brine Production and Disposal in 1961 and 1967—Continued

Area[1]	Field[2]	Brine production 1961	Brine production 1967	Disposal into pits 1961	Disposal into pits 1967	Injection into wells 1961	Injection into wells 1967	Miscellaneous disposal 1961	Miscellaneous disposal 1967
26	K and S (Dyson)	9,125	0	0	0	9,125	0	0	0
	County Regular	224,475	255,500	0	0	224,475	255,500	0	0
	Area Total	233,600	255,500	0	0	233,600	255,500	0	0
27	Ancell (Ellenburger)	52,195	0	0	0	52,195	0	0	0
	Billie Joe (Caddo)	47,200	0	0	0	47,200	0	0	0
	Billie Joe (Palo Pinto)	192	0	0	0	192	0	0	0
	Consolidated Pool	92,480	74,941	17,850	0	74,630	74,941	0	0
	Potts (Ellenburger)	60,000	21,600	0	0	60,000	21,600	0	0
	County Regular	162,275	74,810	0	0	162,275	73,730	0	1,080
	Area Total	414,342	171,351	17,850	0	396,492	170,271	0	1,080
	County Total	25,303,214	35,650,538	234,744	15,315	24,857,606	35,549,907	210,864	85,316
	Percent of Total	100%	100%	0.9%	0.1%	98.2%	99.7%	0.9%	0.2%

[1] Area as shown in Figure 32.
[2] Oil and gas fields as assigned by the Railroad Commission of Texas.

Table 11.—Oil and Gas Tests Selected as Data-Control Points in Wilbarger County and Adjacent Areas

Well	Operator	Lease name and operator's well number	County	Survey location
13-37-914	Sunray MidContinent Oil	C. F. Mock No. 2	Wilbarger	Section 21, Block 11, H&TCRR Survey, A-142
44-603	Humble Oil	Dodson No. 1	Hardeman	NE/4 Section 49, Block 10, H&TCRR Survey, A-44
45-405	Humble Oil	Ray McClintock No. 1	Wilbarger	SE/4 Section 22, Block 10, H&TCRR Survey, A-910
46-129	Tom B. Medders	C. H. Riggins No. 1	do	NW/4 Section 14, Block 11, H&TCRR Survey, A-809
431	Bolin Oil and Humphrey Oil	Goodwin No. 1	do	NW/4 Section 11, Block 15, H&TCRR Survey, A-454
54-401	Pan American Petroleum Company	W. L. Hammonds No. 1	do	SE/4 Section 1, Block 16, H&TCRR Survey, A-399
55-405	Blackwood and Nichols	Claude Ayres No. 1	do	Section 26, Block 12, H&TCRR Survey, A-656
61-583	Texaco Inc. (formerly Bolin Oil, et al.)	Lillie Cobb No. 1	do	NW/4 Section 10, Block 9, H&TCRR Survey, A-1038
718	B. B. Burke	Cato No. 1	Foard	SW/4 Section 20, Block 8, H&TCRR Survey
914	Fain and McGaha	Streit No. 1	Wilbarger	SW/4 Section 7, Block 9, H&TCRR Survey
64-101	The Texas Company	H. F. Hauser No. 1	do	Wm. Alston Survey, A-571
14-49-703	British American	F. L. Kirt No. 1	do	Tract 103, Waggoner Colony Subdivision
901	Fain and McGaha	Powell and Vanderwoude No. 1	Wichita	Tract 239, Waggoner Colony Subdivision
20-09-101	Cox Drilling Company	Ancell No. 2	Wilbarger	SE/4 Section 3, Block 7, H&TCRR Survey
21-05-601	Continental Oil Company	W. T. Waggoner Est. No. 1	do	NW/4 Section 39, Block 1, H&TCRR Survey, A-47
06-301	Socony Mobil	W. T. Waggoner Est. No. 1-A	do	SE/4 Section 23, Block 2, H&TCRR Survey, A-138
07-601	Fain and McGaha	Waggoner No. 1-D	do	NW/4 Section 11, Block 4, H&TCRR Survey, A-91
08-701	The Texas Company	Waggoner Est. No. 1	do	SW/4 Section 2, Block 17, H&TCRR Survey, A-1597
14-101	H. H. and R. Operating Account	W. T. Waggoner Est. No. 1	do	NW/4 Section 33, Block 1, H&TCRR Survey, A-52
21-301	Pure Oil Company	W. T. Waggoner Est. No. 1-A	Baylor	NW/4 Section 156, Block A, BBB&CRR Survey, A-1408