TEXAS DEPARTMENT OF WATER RESOURCES

REPORT 218

OCCURRENCE AND QUALITY OF GROUND WATER IN BAYLOR COUNTY, TEXAS

By

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FOREWORD

Effective September 1, 1977, Texas three water resources agencies, the Texas Water Rights Commission, the Texas Water Development Board, and the Texas Water Quality Board, were consolidated to form the Texas Department of Water Resources. A number of publications prepared under the auspices of the predecessor agencies are being published by the TDWR. To effect as little delay as possible in production of these publications, references to these predecessor agencies will not be altered except on their covers and title pages.

Harvey Davis
Executive Director

FOREWORD

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TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd.)

TABLE OF CONTENTS (Cont'd.)

TABLES

TABLE OF CONTENTS (Cont'd.)

Page

FIGURES

OCCURRENCE AND QUALITY OF GROUND WATER IN BAYLOR COUNTY, TEXAS

ABSTRACT

Baylor County lies within the drainage basins of the Brazos and Red Rivers in north-central Texas, covering an area of about 857 square miles. Permian rocks of the Wichita and Clear Fork Groups, dipping gently to the northwest, are found at the surface within the county except where they are overlain by erratic deposits of Pleistocene and Recent alluvium of the Quaternary System.

Small amounts of poor quality ground water, generally used for domestic and livestock supplies, are produced in Baylor County from local zones of generally low permeability at or near the outcrop of the rocks of the Wichita and Clear Fork Groups.

Small to moderate quantities of fresh to slightly saline ground water are produced in the county from Recent alluvial deposits. About 17 percent of the wells inventoried produce from this aquifer. The water from this formation is used mostly for irrigation, domestic, and livestock purposes. About 200 acre-feet per year is pumped for irrigation uses from the Recent alluvium in the county. Water quality is generally good in this aquifer. However, there are some local problems that are probably caused by poor quality water flowing in adjacent streams.

The Seymour Formation of Pleistocene age is the major source of ground water in Baylor County. Nearly 80 percent of the wells inventoried produce or have produced small to moderate quantities of fresh to slightly saline water from the Seymour aquifer. Only small quantities of water are usually available from this aquifer. However, in parts of a 73 square-mile area extending from the city of Seymour west to the Knox County line and lying between the Brazos and Wichita Rivers, wells can sustain yields up to 500 gallons per minute and provide water for irrigation, municipal, industrial, domestic, and livestock purposes. In this area, the potential yield of the Seymour is about 10,100 acre-feet per year and the estimated total pumpage is about 5,000 acre-feet per year; thus, an estimated 5,100 acre-feet should be available for development annually. Because of an extremely thin saturated thickness over much of the area, however, only an estimated 1,500 acre-feet per year is actually available for economical future development. About 730 acre-feet was pumped for public supply by the city of Seymour in 1969, and about 3,770 acre-feet was used for irrigation. Water quality is generally good in the Seymour Formation. More than 90 percent of the wells sampled produce water with less than 3,000 milligrams per liter dissolved solids.

There are some indications of very local contamination of ground water by oil-field brines in the Permian and Quaternary rocks in the county, but there were no traces of extensive alteration of the native quality of water by this source. Chloride content ranged from 5 to 3,240 milligrams per liter, and 65 samples contained more than the 250 milligrams per liter recommended. Many of these, however, are not thought to be contaminated, but to contain high natural concentrations. There is some evidence of contamination of ground water from biological waste sources in all aquifers. Forty-five wells produce water containing concentrations of nitrate higher than the recommended 45 milligrams per liter. The nitrate content of samples ranged from < 0.4 to 781 milligrams per liter.

Methods of disposal of oil-field brines may have caused some damage to water quality in the past, but only in local occurrences. In 1961, 12,027,319 barrels of salt water was reported produced with oil and gas in the county. Of this amount, 96.99 percent was reported returned to the subsurface through injection and disposal wells, 0.85 percent was reported placed into surface pits, and 2.16 percent was reported disposed of by other methods. In 1967, 10,258,360 barrels of salt water was reported produced with oil and gas in the county. Of this amount, 99.96 percent was reported injected into the subsurface, and 0.04 percent was reported disposed of by miscellaneous methods. No salt water was reported placed in surface pits for disposal in 1967.

OCCURRENCE AND QUALITY OF GROUND WATER IN BAYLOR COUNTY, TEXAS

INTRODUCTION

Purpose and Scope

This investigation is one of several ground-water studies that have been conducted by the staff of the Texas Water Development Board in north-central Texas to meet a growing need for more detailed and accurate ground-water information in this area. The Board recognizes the significance of ground water to this region and is aware of the vital need for obtaining detailed and accurate information on the depth of occurrence of usable-quality water as the basis for providing adequate and equitable protection for those water supplies. Several towns with municipal water supplies in north-central Texas, including Seymour the county seat of Baylor County, are served by ground water or have water wells as a standby supply. 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, Brown, Coleman, Jones, Montague, Shackelford, Stephens, Throckmorton, and Young Counties have been published by the Board, and reports for Taylor and Wilbarger Counties are being prepared for publication.

The present study was initiated in September 1968, to gather and compile all available data on the occurrence, quantity, quality, and availability of ground water in Baylor County; to evaluate the data; and to prepare a report for publication by the Board.

The scope of the study included determination of the location, extent, and hydrologic parameters of fresh water-bearing strata and the quantity and quality of all ground water used or available for use within the county. The surface and shallow subsurface geology as it relates to the depth and occurrence of ground water was studied; the methods and amounts of oil-field brine disposal and the chemical character of the brines were compiled; and the effects on water quality that may have been caused by surface or subsurface disposal of oil-field brines, inadequate surface casing, or improperly plugged wells in the county were included.

Methods of Investigation

This study included an inventory of all wells producing water for municipal, irrigation, and industrial use; a representative number of wells supplying water for livestock and domestic usage; and many springs in Baylor County. This inventory consisted of locating the wells accurately and compiling information on the well depth, depth to water in wells, geologic formations in which the wells are completed, methods of well construction, uses of the water produced, and the pumping capacity of the wells. A total of 529 water wells and springs were inventoried.

In conjunction with this inventory, 183 water samples were collected from wells and springs for chemical analysis by the laboratory of the Texas State Department of Health. A study of these analyses was made in an attempt to determine the native chemical characteristics of the ground water or at least the normal ranges of chemical constituents. Areas of possible contamination were located using these ranges and by comparing the analyses made in conjunction with this study with chemical analyses made in the past.

U.S. Geological Survey topographic maps were used to determine surface elevations for each well and spring. These elevations were helpful in comparing the depth to water in one well to that in another, and to determine the aquifer.

Surface and subsurface geologic information, with special emphasis on its relation to the occurrence of ground water, was gathered. This included geologic maps, electrical logs of oil and gas tests, drillers' logs of water wells and test holes, and other pertinent data. Also, nineteen geologic test holes were drilled and logged in the Seymour Formation.

Three pumping tests were conducted on irrigation wells that produce from the Seymour Formation. Power-yield tests, to determine the amount of water produced for each unit of power used, were conducted on several wells with different sizes and types of pumps. Electrical-use data were collected for each irrigation well that was powered by electricity.

A study was made of oil-field brine disposal practices within the county and of available information on areas and amounts of brine production and disposal in an attempt to identify possible connections with present or potential contamination of ground water. Locations were determined for salt-water disposal wells used within the county.

Irrigation pumpage was estimated from electrical-use data collected in the power-yield tests. Domestic and livestock pumpage was estimated. Municipal pumpage was obtained from the city of Seymour. These pumpage data were used in conjunction with data collected in a low-flow study of part of the Brazos River within the county to determine figures for recharge, discharge, and storage of ground water within the Seymour Formation in Baylor County.

The data from the water-well inventory, the chemical analyses of ground water and oil-field brines, the inventory of salt-water production and disposal for the years 1961 and 1967 conducted by the Railroad Commission of Texas, and the ground-water pumpage were tabulated. Climatological data significant to the occurrence and use of water in the county were compiled, including precipitation, lake-surface evaporation, and temperature range.

Previous Investigations

C. H. Gordon (1913) reported on the geology and underground waters of the Wichita region (Wichita Falls). His report includes general reference to the occurrence and quality of ground water in Baylor County.

A study of the alluvial deposits of the Brazos River from Knox City to Waco, Texas, discusses in some detail the deposits of the Seymour Formation in Baylor County (Stricklin, 1961).

General information on the geology and ground water in Baylor County and the surrounding north-central Texas area is contained in reconnaissance investigations of ground-water resources of the Red River basin (Baker and others, 1963) and the Brazos River basin (Cronin and others, 1963).

From 1955 until 1960, the U.S. Geological Survey maintained a yearly observation well program in Baylor County. Since 1960, this program has been managed by the Texas Water Development Board (formerly the Texas Water Commission). Much of the data collected within this program has been incorporated into this report. At the present time, six wells are measured annually.

Several publications on the general geology of the north-central Texas area include some data pertinent to Baylor County and are included in the selected references of this report.

Well-Numbering System

The numbers assigned to wells and springs in this report conform to the statewide well-numbering system used by the Texas Water Development Board. Each well and spring is assigned a number to facilitate record keeping and locating the well within the State. This system is based on division of the State into quadrangles formed by degrees of latitude and longitude, and repeated divisions of these quadrangles into smaller ones as illustrated in Figure 1.

The largest quadrangle, a 1-degree quadrangle, is divided into sixty-four 7½-minute quadrangles, each of which is further divided into nine 2½-minute quadrangles. Each 1-degree quadrangle in the State has been assigned a number for identification. The 7½-minute quadrangles are numbered consecutively from left to right beginning in the upper left hand corner of the 1-degree quadrangle, and the 2½-minute quadrangles within the 7½-minute quadrangle are similarly numbered. The first two digits of a well number identify the 1-degree quadrangle, the third and fourth digits identify the 7½-minute quadrangle, the fifth digit identifies the 2½-minute quadrangle, and the last two digits designate the order in which the well was inventoried within the 2½-minute quadrangle. In addition to the seven-digit well number, a 2-letter prefix is used to identify the county. The prefix for Baylor County is AU, and the county lies within the 1-degree quadrangles numbered 20 and 21 that are shown on Figure 1.

Acknowledgements

Appreciation is expressed to the many farmers, ranchers, water well drillers, oil operators, businessmen, and other individuals who generously provided information or cooperated in the collection of data for this report.

Appreciation is also expressed to the personnel of the city of Seymour; the Agricultural Stabilization and Conservation County Committee; the County Commissioner's Court; the U.S. Soil Conservation

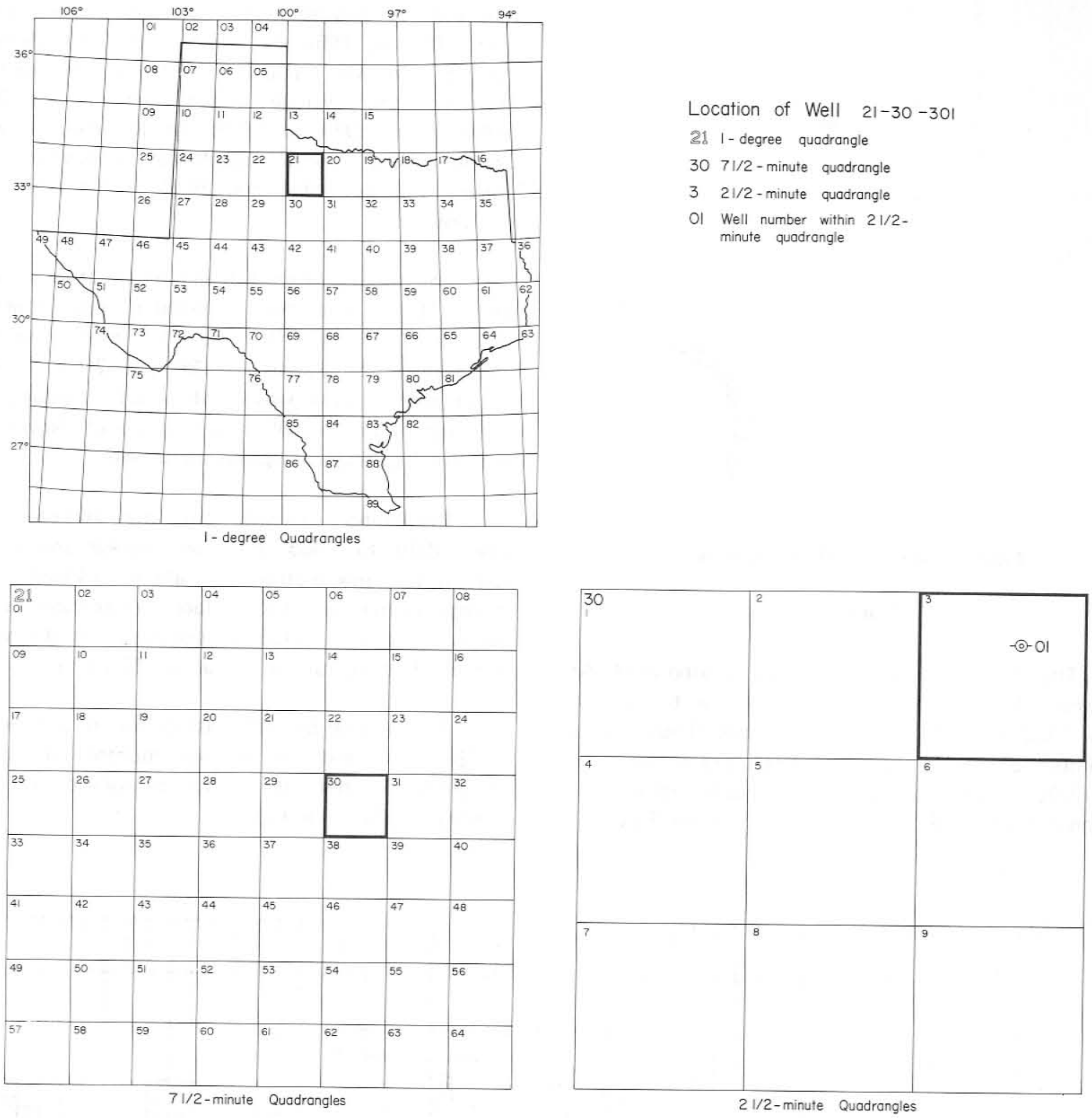


Figure 1.—Well-Numbering System

Service; the Railroad Commission of Texas; the Texas State Department of Health; the Texas Highway Department; the B-K Electric Cooperative; and other private, local, county, state, and federal agencies that furnished information.

GEOGRAPHY

Location

Baylor County lies in north-central Texas within the Osage Plains Section of the Central Lowlands Physiographic Province. The county has an area of about 857 square miles and lies generally between 98°56′ and 99°28′ west longitude and 33°23′ and 33°51′ north latitude. It is bounded on the north by Wilbarger County, on the east by Archer County, on the south by Throckmorton County, and on the west by Knox and Foard Counties (Figure 2). Seymour, the county seat, lies approximately in the center of the county and is located 51 miles west-southwest of Wichita Falls, 137 miles northwest of Fort Worth, and 100 miles north-northeast of Abilene.

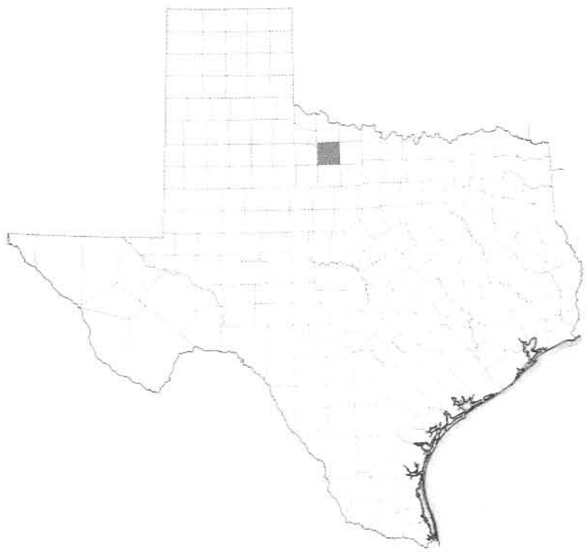


Figure 2.—Location of Baylor County

Climate

The climate in Baylor County is subhumid. At Seymour the average annual rainfall for the period from 1923 to 1969 was 25.57 inches. There was a maximum of 46.16 inches in 1941 and a minimum of 13.05 inches in 1928. The yearly rainfall at Seymour from 1923 to 1969 is shown on Figure 3.

At Dundee, in Archer County about 23 miles northeast of Seymour, the average annual rainfall from 1923 to 1969 was 25.06 inches. At Olney, in Young County about 35 miles southeast of Seymour, the average annual rainfall was 24.98 inches from 1944 to 1969. At Munday, in Knox County about 22 miles southwest of Seymour, the average annual rainfall was 24.53 inches from 1913 to 1969.

The average annual mean temperature is about 64°F (18°C). The mean maximum temperature for July is 98°F (37°C) and the mean minimum temperature for January is 28°F (−2°C). There is an annual growing season of about 213 days, with the first frost in fall occurring about November 3 and the last frost in spring about April 3.

Evaporation records for the 26-year period from 1940 to 1965 show an average annual gross lake-surface evaporation of about 76 inches. The average annual net lake-surface evaporation (average annual gross lake-surface evaporation less the average annual effective rainfall) is about 52 inches.

The average monthly distribution of precipitation at Seymour and the average monthly distribution of gross and net lake-surface evaporation in Baylor County are shown on Figure 4.

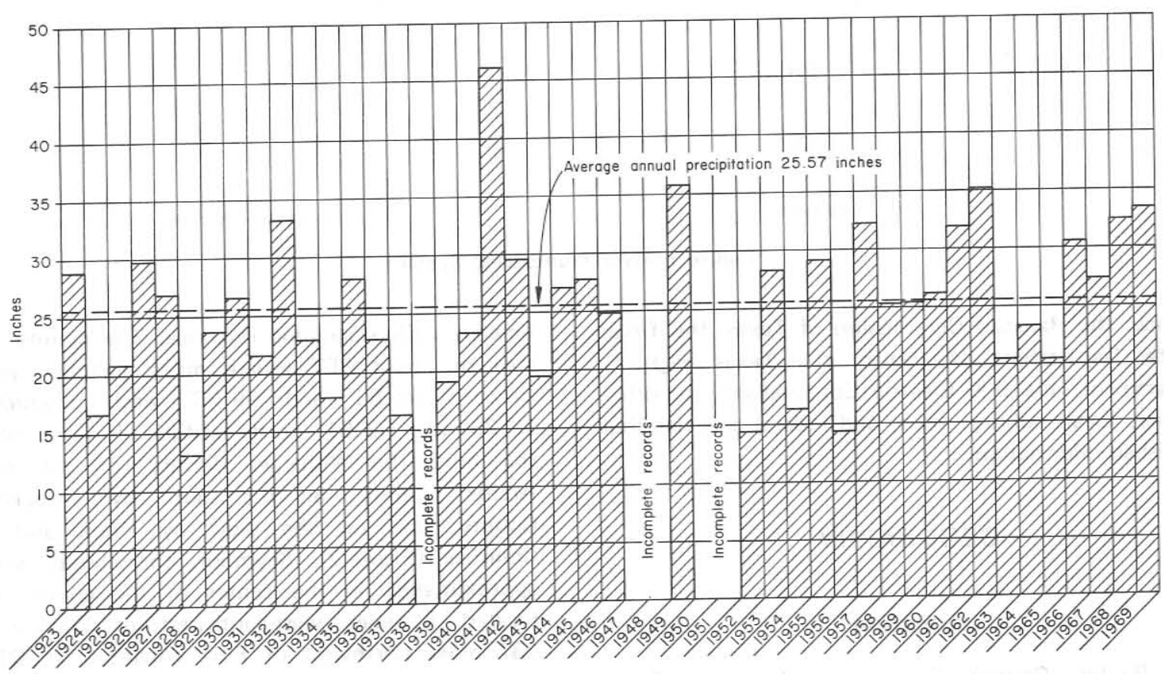


Figure 3.—Annual Precipitation at Seymour, 1923-1969
(From records of U.S. Weather Service)

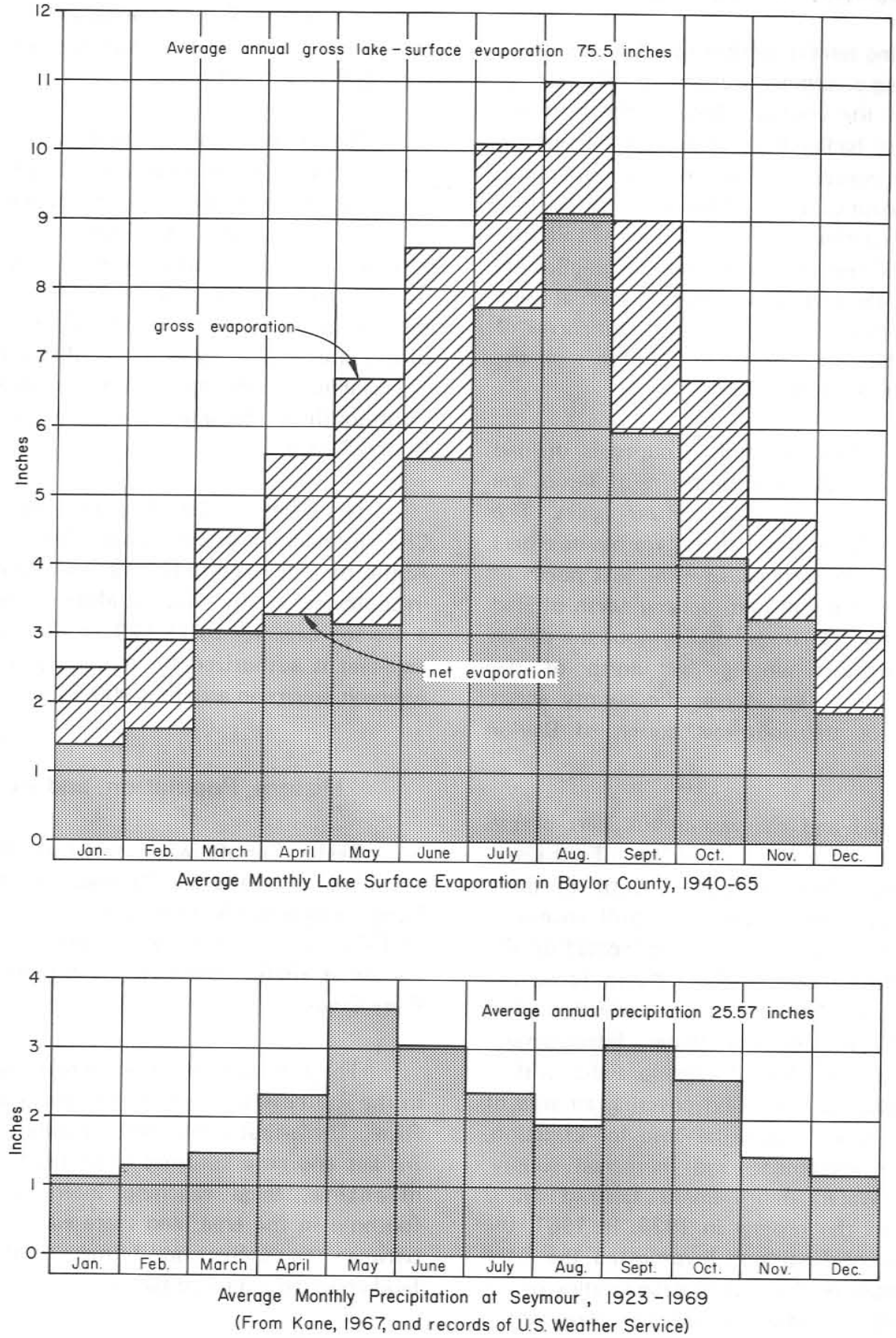


Figure 4

Average Monthly Precipitation at Seymour and Average Monthly Lake-Surface Evaporation in Baylor, County

Topography and Drainage

A gently rolling terrain, broken by a few low-lying, north-south trending escarpments generally characterizes the topography of the county. Much of the northern one-third consists of badlands developed on the outcrop of the relatively incompetent, thin-bedded sandstones, siltstones, and claystones of the Permian by the Wichita River and its tributaries. The total relief within the county is about 450 feet, with elevations ranging from a low of less than 1,050 feet above mean sea level at Lake Diversion on the Wichita River in the northeast corner of the county to a high of more than 1,500 feet on the Baylor-Throckmorton County line.

Surface-water flow in Baylor County is divided between two of the major drainage basins of Texas, the Red River basin and the Brazos River basin. The drainage divide which separates these two basins enters Baylor County on the west county line just north of U.S. Highway 82 and trends east, passing north of Red Springs and Seymour. Northeast of Seymour the divide turns to the southeast passing just north of the community of Westover and leaves the county about four miles north of the southeast corner of Baylor County.

The north half and the east-central part of the county are drained by the Wichita and North Fork Little Wichita Rivers and their tributaries. Both of these streams flow generally eastward to their confluence with the Red River. Two major reservoirs are located on the Wichita River in Baylor County. Lake Kemp, located in the north-central part of the county was constructed in 1923 by the Wichita County Water Improvement District No. 1 and the city of Wichita Falls, with a capacity of 461,800 acre-feet and covering an area of 20,620 acres. The water was to be used for irrigation, electrical power development, and municipal supply. Wichita County Water Improvement District No. 2 bought interests in the project in 1923. In 1961, the U.S. Army Corps of Engineers investigated the Lake Kemp Dam and reported that due to deterioration of the spillway and outlet works the existing lake was a potential hazard to the valley below the dam. Major reconstruction was indicated and eventually approved in 1970. Modification and reconstruction of the dam will increase the storage capacity of the reservoir to 567,900 acre-feet and the surface area to 24,720 acres.

Lake Diversion is located in the northeast corner of Baylor County and the northwest corner of Archer County, about 20 miles downstream from Lake Kemp, and was built as a part of the same project. Water is released from Lake Kemp to maintain the desired height in Lake Diversion for discharge to the irrigation canals. Lake Diversion has a capacity of 40,000 acre-feet. Wichita County Water Improvement District No. 1 transferred its interest in the project to the city of Wichita Falls in 1961.

The southern part of the county is drained by the Brazos River and its tributaries. The flow is generally southeast where it leaves the county just south and east of the community of Round Timber. The main tributaries of the Brazos River in Baylor County are Millers Creek, which flows from Throckmorton County through the southwest corner of the county into the Brazos about nine miles south of Seymour, and Deep Creek, which flows from about the center of the county south-southeast to enter the river just northwest of Round Timber.

The cities of Haskell, Goree, Munday, and Knox City, formed the North Central Texas Municipal Water Authority and voted to build a reservoir on Millers Creek in southwest Baylor County. Millers Creek Reservoir has a storage capacity of 25,520 acre-feet of which 3,500 acre-feet is authorized for municipal use annually. The reservoir covers an area of 1,900 acres.

History, Population, and Economy

Baylor County was created in 1858 from Fannin County and named for Dr. Henry W. Baylor, a Texas Ranger surgeon. The first surveys of the area were made in 1853, when the county was still an Indian stronghold. As late as 1870, Indians were still hunting buffalo along Pony Creek.

The first attempt at settlement was made in 1855 in the southeastern part of the county along the Brazos River. These first farmer-settlers were driven out by the Indians and none returned until 1874 and 1875. In the meantime, large ranching interests had secured a foothold in the area, and there was a constant struggle between the ranchers and farmers until 1881, when the feud ended in a pitched battle.

In 1879 the county was organized, with the city of Seymour (formerly called Oregon City) as the county seat. The county has been served by three weekly newspapers; The Seymour Cresset (in 1880), The Seymour Scimeter (1881-1886), and The Baylor County Banner (1895 to present).

The discovery of oil in 1906 brought a renewed influx of settlers. In 1880, the county had a population of 715. This had risen to 3,052 in 1900. The oil boom and allied industry brought it to 8,411 in 1910. The population has gradually decreased since then and was

5,893 in 1960. The population of Seymour, the county seat and only incorporated city, was 2,029 in 1910 and rose steadily to 3,789 in 1960.

The highway system in Baylor County includes U.S. Highway 82, 183, 277, and 283; State Highway 199 and several paved farm to market roads. The county is served by the Fort Worth and Denver Railroad. Seymour has a class two airport, but the nearest scheduled airline service is at Wichita Falls.

The economy of Baylor County depends primarily on agriculture, with the production of cotton, grains, and beef cattle predominating. Estimated farm income in 1968 was $8,155,000. The central, west-central, southwest, and southeast parts of the county are generally devoted to farming. Most of the northern part of the county is ranch country.

There is some manufacturing in Seymour, but the major industry in the county is oil and gas production. In 1968, 1,243,837 barrels of oil was produced in the county, and the total production, as of January 1, 1969, was 43,423,029 barrels. There is also some production of sand and gravel within the county. In 1967, the mineral value of the county was estimated at $5,294,630.

GENERAL GEOLOGY

Geologic History

Throughout most of geologic time, from the Cambrian Period through the Permian Period, Baylor County and the surrounding north-central Texas area was covered by shallow seas. Much of the earlier periods—Cambrian, Ordovician-Silurian, and Mississippian—is characterized by typical marine deposits of limestone and black shales. These deposits represent relatively long periods of deposition and stable environments. The Pennsylvanian and Permian Periods, however, are characterized by continued rapid transgression and regression of shallow epicontinental seas, leaving a thick sequence of relatively thin-bedded deposits of almost every type of depositional environment from shallow-shelf, through deltaic, fluvial, and continental. At the end of the Paleozoic, the depositional record is broken by a major erosional unconformity which has formed an extensive peneplain that represents much of the present surface topography.

During the Pleistocene Epoch, much of Baylor County and the area to the west and southwest was the site of an extensive outwash plain receiving sediments from a source area to the west. These sediments likely covered most or all of Baylor County at one time. This cycle of deposition is thought to have been initiated and controlled by climatic cycles caused by the advance and retreat of Pleistocene glaciation.

The deposition of this alluvial plain was followed by a renewed cycle of erosion during the Recent Epoch which cut through the outwash deposits leaving remnants that cap the divides of the present drainage system. Associated with the present drainage network, alluvial sediments have been deposited along the floodplain of the larger streams. Often, where the older Pleistocene deposits have been reworked, the two alluvial deposits are interconnected.

Stratigraphy of Water-Bearing Formations

Subsurface rocks in Baylor County range in age from Cambrian to Quaternary. Rocks of the Wichita and Clear Fork Groups of the Permian System and scattered deposits of Pleistocene and Recent alluvium of the Quaternary System outcrop within the county. The general lithology of the rock units are given in Table 1, and the stratigraphic relationships are shown on the geologic sections (Figures 18, 19, and 20).

Ordovician-Silurian and Mississippian Systems

These early and middle Paleozoic Systems are represented in the subsurface by thick massive deposits of marine limestone with some dolomite. Some shales and other clastics are interbedded with the limestone. In Baylor County, the water contained in these rocks is very saline.

Pennsylvanian System

The Pennsylvanian System is present in the subsurface in Baylor County. Surface outcrops are present to the east and southeast of the county. The Pennsylvanian is represented by thin to massive interbedded marine limestones, shales, sandstones, and conglomerates laid down by rapid transgressions and regressions of shallow epicontinental seas. Many of the marine formations have been extensively eroded and are cut by channel deposits of shale, sand, and gravel. On and near the outcrop, many of the Pennsylvanian deposits produce small to moderate amounts of fresh to moderately saline ground water from local permeable zones. In Baylor County, however, these rocks produce only saline water.

BAYLOR COUNTY

Table 1.—Stratigraphic Units and Their Water-Bearing Properties

SYSTEM	SERIES	STRATIGRAPHIC UNITS	APPROXIMATE THICKNESS (FEET)	PREDOMINANT CHARACTER OF ROCKS	WATER-BEARING CHARACTERISTICS
Quaternary	Recent	Alluvium	30	Cross-bedded, lenticular deposits of gravel, sand, silt, and clay along rivers and major tributaries.	Yields fresh to slightly saline water in small quantities to wells.
	Pleistocene	Seymour Formation	60	Cross-bedded, lenticular deposits of gravel, sand, silt, and clay on the interstream divides. Usually contains a basal unit of sand and gravel. Often has deposits of secondary caliche near the surface.	Yields fresh to slightly saline water in small to moderate quantities to wells.
Permian	Leonard	Clear Fork Group	300	Thin-bedded sandstones, and claystones, with a few thin limestones and dolomites.	Yields fresh to moderately saline water in small quantities to wells in the outcrop.
		Wichita Group	1,100	Thin limestones, fine-grained sandstones, siltstones and claystones. Some massive limestone and thin shales near the top of the group.	Do.
---?---?---					
Pennsylvanian		Cisco Group	1,400	Thin limestone beds, massive shales, and channel-fill sandstones.	Not known to yield usable quality water in Baylor County.
		Canyon Group	1,500	Massive to thin limestone beds interbedded with massive shales and thin lenticular sandstones.	Do.
		Strawn Group	1,500	Thick units of shale, limestone, and sandstone.	Do.
		Bend Group	200	Thick shale units with some sand and conglomerate.	Do.
Mississippian			300	Massive limestone and shale.	Do.
Ordovician-Silurian		Ellenburger Group	—	Massive limestone.	Do.

Permian System

The Permian System is represented in Baylor County by rocks of the Wichita and Clear Fork Groups. The Wichita outcrops in the eastern two-thirds of the county and the Clear Fork in the western third. These beds dip gently to the west-northwest at about 20 to 40 feet per mile.

The Wichita Group consists of thin limestones, shales, siltstones, and sandstones, with some massive limestones and thin shales near the top of the group. To the south of Baylor County, this group is characterized by well-developed limestone beds interbedded with massive deposits of red and gray shale. Because of the persistence of these limestone beds, they have been used as markers or boundaries in delineating formations within the group. In places, these beds have also been cut by channel deposits of shale, sand, and gravel. In Baylor County and northward, however, the limestones are replaced by deposits of shale, siltstone, and sandstone making it difficult, if not impossible, to delineate the formations.

On or near the outcrop of these beds in Baylor County, small amounts of fresh to moderately saline ground water are produced from erratic local zones of low permeability. In the subsurface, especially in the western part of the county, these rocks produce only brines and may also produce some hydrocarbons.

The Clear Fork Group is generally made up of thin-bedded red siltstones, shales, and sandstones broken by thin erratic lenses of dolomite and calcareous shale. However, in Baylor County, much of the shale which is present as massive beds in the counties to the southwest has been replaced by redbed deposits of sandstone and siltstone. Some anhydrite is found in the subsurface, but it has generally been leached out on the surface exposures.

Small amounts of fresh to moderately saline water are produced from local erratic zones of low permeability at or near the outcrop of rocks of the Clear Fork Group in the county. Down dip these rocks produce only brines.

Quaternary System

The Quaternary System is represented by alluvial deposits of Pleistocene and Recent age. The Pleistocene sediments, named the Seymour Formation for outcrops in Baylor County, consist of interbedded alluvial gravels, sands, silts, and clays laid down by streams in a sheet deposit. These sediments were deposited on a highly eroded surface developed in the underlying Permian rocks and dip very slightly to the southeast (Figures 21 and 22). Recent erosion by the present stream network has reduced the Seymour to patches capping the stream divides. These older deposits often interfinger with more recent alluvial deposits. To the west of Baylor County, the formation contains a thin bed of volcanic ash debris which has been found over much of west and north-central Texas and has been dated as Pleistocene. The formation also contains bones of Pleistocene reptiles and mammals.

Though the Seymour is generally heterogeneous, there is a preponderance of coarser materials at the base, which adds to the water-bearing capability. These rocks produce small to moderate amounts of fresh to slightly saline water in Baylor County.

The Recent alluvium consists of scattered deposits of gravel, sand, silt, and clay developed in and near the floodplains of the rivers and their major tributaries. The alluvium dips generally downstream and toward the river. Many of the sediments which make up these Recent deposits were probably derived from the older Seymour Formation. The Recent alluvium produces small to moderate amounts of fresh to slightly saline water in Baylor County.

Regional Structure

The principal buried structural features affecting the attitude of strata in north-central Texas are illustrated on Figure 5. These structures include the Bend flexure, Red River uplift, Muenster arch, Fort Worth basin, eastern Midland shelf, Concho arch, and the Concho shelf.

Baylor County is on the northern extension of the Concho shelf and is bounded on the north by the Red River uplift. On the Concho shelf, the rocks of Pennsylvanian and Permian age form a westward-dipping homocline. Rock formations underlying the county dip west-northwest at about 40 feet per mile, excluding the channel-fill sandstones that occur in the Pennsylvanian and Permian rocks and the surficial deposits of Quaternary alluvium.

GENERAL GROUND-WATER HYDROLOGY

Ground-water occurrence in north-central Texas and Baylor County is erratic, the aquifers are small in extent and discontinuous, and the yields, in general, are small (less than 100 gallons per minute) to moderate (100 to 1,000 gallons per minute). However, ground

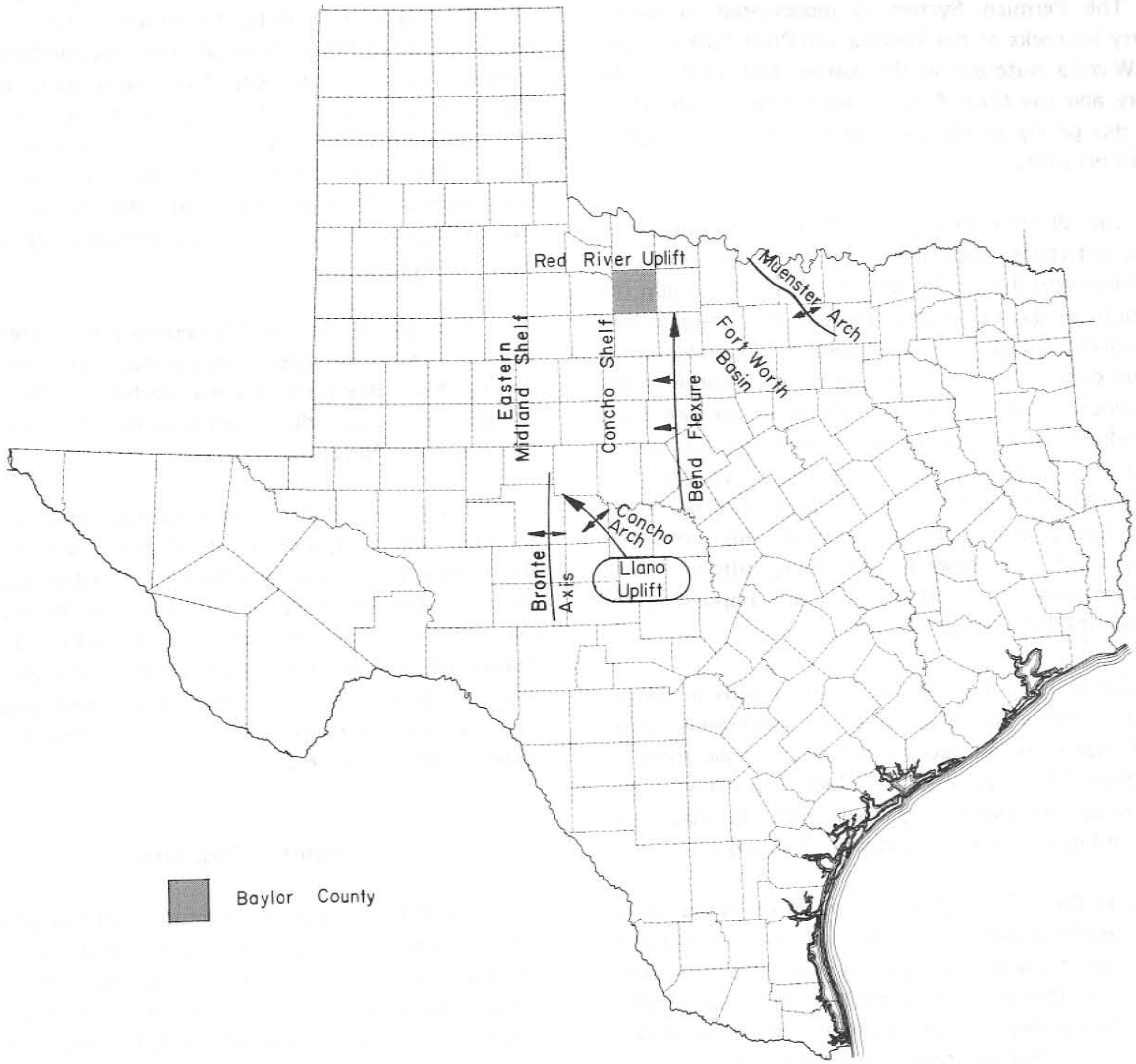


Figure 5.—Major Structural Features in North-Central Texas

water in this area conforms to the same fundamental principles of occurrence as that in other areas of the world.

Hydrologic Cycle

The hydrologic cycle is the sum total of processes and movements of the earth's moisture from the sea, through the atmosphere, to the land, and eventually, with numerous delays en route, back to the sea. All water occurring in Baylor County is derived from precipitation. The water available for use—whether from direct precipitation, streamflow, water from wells, or spring discharge—is captured in transit, and after its use and reuse, is returned to the hydrologic cycle. This cycle is graphically illustrated in Figure 6, which shows the continuing movement of water from the oceans through evaporation to precipitation and its return either directly or ultimately to the ocean.

Source and Occurrence of Ground Water

The ultimate source of all ground water is precipitation, either on the outcrop of the aquifer or through seepage or leakage from rocks above the aquifer. That small portion of the total precipitation which seeps

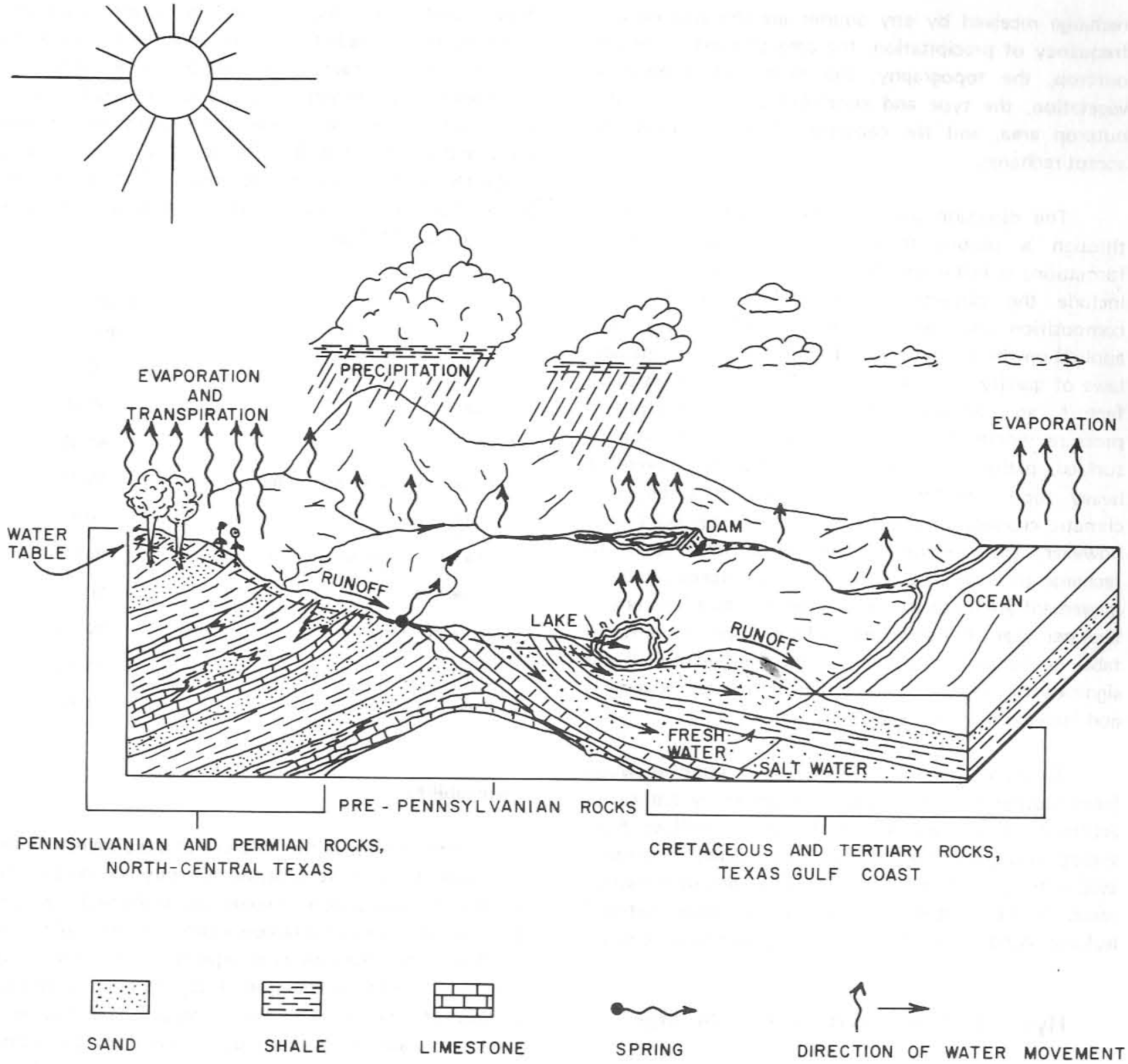


Figure 6.—The Hydrologic Cycle

down through the soil mantle and reaches the water table (the top of the zone within which the voids or pore spaces of the rock material which makes up the aquifer are saturated) is called ground water.

Ground water is said to occur under either water-table (unconfined) or artesian (confined) conditions. Under water-table conditions, the top of the saturated zone is exposed to only the pressure of the atmosphere. When a well taps a water-table aquifer, the water will not rise above the point at which it is encountered. Artesian conditions exist when the aquifer is bounded by an impervious bed and the water is under hydrostatic pressure. When a well taps an artesian aquifer, the water will stand at some point above the top of the aquifer and if the land surface at the well is sufficiently lower than the land surface at the aquifer's outcrop area, the water will flow.

Recharge, Movement, and Discharge of Ground Water

Recharge is the process by which water is added to an underground water-bearing formation (aquifer), whether by direct precipitation on the outcrop, or by subsequent seepage from surface streams, lakes, or overlying rocks. Factors which control the amount of recharge received by any aquifer are the amount and frequency of precipitation, the area and extent of the outcrop, the topography, the type and amount of vegetation, the type and condition of the soil in the outcrop area, and the capacity of the formation to accept recharge.

The direction and rate of movement of water through a porous medium, such as any geologic formation, is influenced by a variety of factors which include the physical nature of the formation—its composition and configuraton; the external pressures applied on the formation; and the fundamental physical laws of gravity and momentum. Also included in these factors are surface tension, friction, atmospheric pressure where the formation encounters the earth's surface, paths of differential permeability, effects of heavy local withdrawal or injection of water, and climatic changes affecting rates of recharge. Generally, however, ground-water movement is from areas of recharge to areas of discharge, and the normal rates of movement are on the order of a few feet to a few tens of feet per year. The steepening of the slope of the water table or piezometric surface around a pumped well will significantly increase the rate of ground-water movement and increase the flow toward the well.

Discharge is any process which removes water from storage within an aquifer whether by natural or artificial means. Natural discharge is outflow from springs and seeps, the baseflow (underflow) to streams, evaporation, transpiration by plants whose root systems reach the water table, and loss through interformational leakage. Artificial discharge is usually pumpage by wells.

Hydraulic Characteristics of an Aquifer

The capacity of an aquifer to hold, transmit, or to yield water to wells depends on several factors which include not only the lithology and grain size of the sediments, but also the porosity and permeability and the coefficients of transmissibility and storage. Also, these factors will vary not only from aquifer to aquifer, but from place to place within an aquifer. Therefore, an aquifer may be more productive in some areas than in others.

Porosity

Porosity is a measure of the volume of pore space within a sediment expressed as a percentage of the total volume of the sediment. It will vary not only with the shape and size of the particles which comprise an aquifer, but also with the sorting of grain sizes and types, and with the amount of compaction and cementation the sediments have undergone. Generally deeper aquifers have undergone a greater degree of compaction and cementation and will generally have a lower porosity than shallow aquifers with similar shapes, sizes, and sorting of grains. The porosity of sedimentary materials ranges from zero to greater than 50 percent. Some representative ranges are given in the following table (Todd, 1959, p. 16):

MATERIAL	POROSITY (percent)
Soils	50-60
Clay	45-55
Silt	40-50
Medium to coarse mixed sand	35-40
Uniform sand	30-40
Fine to medium mixed sand	30-35
Gravel	30-40
Gravel and sand	20-35
Sandstone	10-20
Shale	1-10

Permeability

Permeability is the measure of a sediment's ability to transmit water. It depends not only on the size and number of pore spaces or voids within the sediment, but also on the degree of interconnection of these voids. The coefficient of permeability is expressed as the number of gallons of water moving in 1 day through a vertical section of the aquifer 1 foot square and having a hydraulic gradient of 1 foot per foot or 45 degree slope. Meinzer (1942, p. 453) states that personnel of the United States Geological Survey have measured, in the hydrologic laboratory, coefficients of permeabilities of natural earth materials ranging from about 0.0002 to about 90,000 gpd/ft^2 (gallons per day per square feet).

Transmissibility

The coefficient of transmissibility is defined as the number of gallons of water that will move in 1 day through a vertical strip of the aquifer 1 foot wide and extending the full saturated thickness of the aquifer, at a hydraulic gradient of 1 foot per foot or a slope of 45 degrees. Thus, the coefficient of transmissibility is the coefficient of permeability applied over the entire saturated thickness of an aquifer.

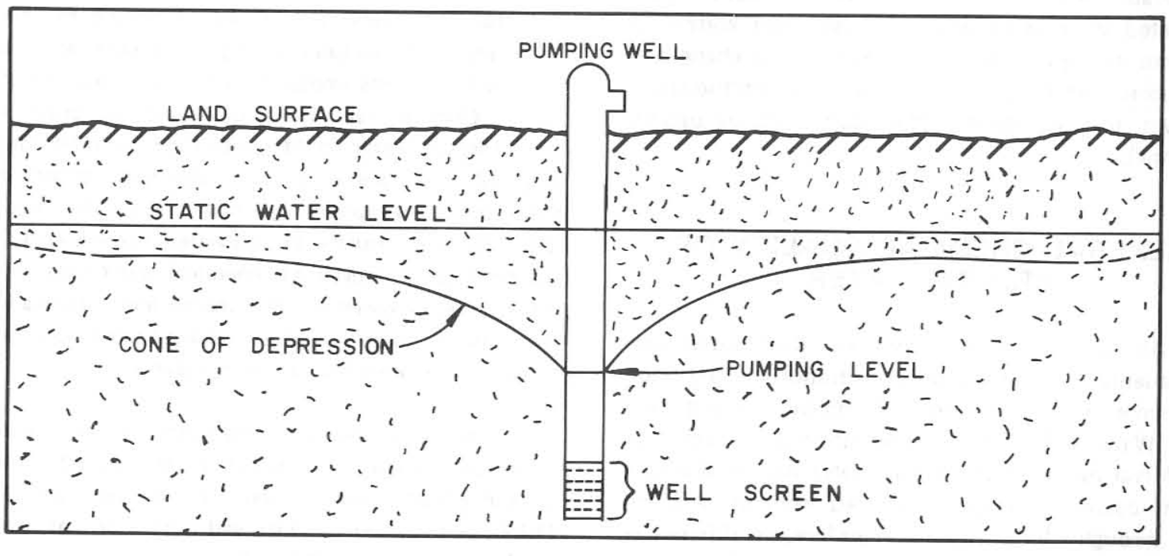
Storage

The coefficient of storage is a measure of the capacity of an aquifer to yield water. It is defined as the volume of water that is released from or taken into storage by an aquifer per unit surface area of the aquifer per unit change in the component of the head normal to that surface (Todd, 1959, p. 31).

Under artesian conditions, water is yielded due to compression of the sediments and expansion of the water when the piezometric surface is lowered. Under water-table conditions, the yield is due to the influence of gravity and the coefficient of storage is equal to the specific yield. Because of the vast change in pressure needed to produce large amounts of water under artesian conditions, the coefficient of storage is generally much smaller than in aquifers under water-table conditions. Because of these differences, a well pumping from an artesian aquifer will produce a large cone of depression in the piezometric surface in a very short period of time, whereas a well pumping from a water-table aquifer will develop a much smaller cone of depression in the water-table over a much longer period of time. Although no definite limits have been established, Ferris and others (1962) place the range of coefficients of storage for artesian aquifers from about 0.00001 to 0.001 and for water-table aquifers from about 0.05 to 0.30.

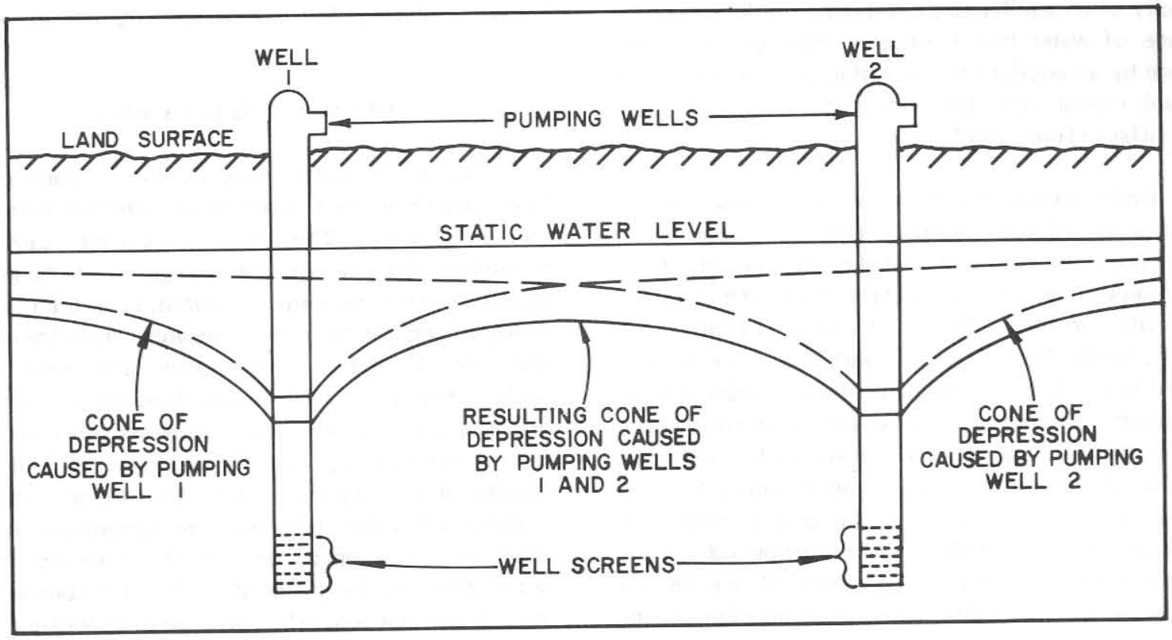
Changes in Water Levels

Changes in water levels are due to many causes. Some are of regional significance, whereas others are extremely local. The more significant causes of water-level fluctuations are changes in recharge and discharge. When recharge is reduced, as in the case of a drought, some of the water discharged from the aquifer must be withdrawn from storage and water levels decline. The water levels may be lowered sufficiently to dry up springs or shallow wells. However, when adequate rainfall resumes, the volume of water drained from storage in the aquifer during the drought may be replaced and water levels will rise accordingly. When a water well is pumped, water levels in the vicinity are drawn down in the shape of an inverted cone with its apex at the pumped well. This cone of depression in the water table is illustrated in the following diagram.



The development of this cone depends on the aquifer's coefficients of transmissibility and storage, and on the rate of pumping. As pumping continues, the cone expands and continues to do so until it intercepts a source of replenishment capable of supplying sufficient water to satisfy the pumping demand. This source of replenishment can be either intercepted natural discharge or induced recharge. If the quantity of water received from these sources is sufficient to compensate for the water pumped, the growth of the cone will cease and a balance between recharge and discharge is achieved. In areas where recharge or salvageable natural discharge is less than the amount of water pumped from wells, water is removed from storage in the aquifer to supply the deficiency and water levels will continue to decline.

Where intensive development has taken place in ground-water reservoirs, each well superimposes its own individual cone of depression on the cone of neighboring wells. This results in the development of a regional cone of depression. When the cone of one well overlaps the cone of another, interference occurs and an additional lowering of water levels occurs as the wells compete for water by expanding their cones of depression. The amount or extent of interference between cones of depression depends on the rate of pumping from each well, the spacing between wells, and the hydraulic characteristics of the aquifer in which the wells are completed. The effects of interference between pumping wells are illustrated in the following diagram.



Water levels in some wells, especially those completed in artesian aquifers, have been known to fluctuate in response to such phenomena as changes in barometric pressure, tidal force, and earthquakes. However, the magnitude of the fluctuations are usually very small.

GENERAL CHEMICAL QUALITY OF GROUND WATER

All ground water contains dissolved-mineral constituents. The type and concentration depend upon the source, movement, and environment of the ground water. Water derived from precipitation is relatively free of mineral matter, but because water has considerable solvent power, it dissolves minerals from the soil and rocks through which it passes. Therefore, the differences in chemical character of ground water reflect, in a general way, the nature of the geologic formations and the soils that have been in contact with the water. The concentration of dissolved solids generally increases with depth, especially where the movement of the water is restricted. Rocks deposited under marine conditions will contain brackish or highly mineralized water unless flushing by fresh water has been accomplished. This flushing action will occur in the outcrop area and a limited distance downdip, depending in part upon the permeability of the rocks.

The chemical quality of ground water that has not been artificially altered is relatively constant, as is the temperature of ground water, which makes it highly desirable for many uses. Included among the factors determining the suitability of ground water as a supply are the limitations imposed by the intended use of the water. Criteria have been developed to cover most categories of water quality, including bacterial content, physical characteristics, and chemical constituents. Water-quality problems associated with the first two categories can usually be alleviated economically, but the removal of undesirable chemical constituents can be difficult and expensive. The source and significance of the principal dissolved-mineral constituents occurring in ground water are summarized in Table 2.

For many purposes the dissolved-solids content constitutes a major limitation of the use of water. A general classification of water by Winslow and Kister (1956, p. 5) based on dissolved-solids content, in mg/l (milligrams per liter), is as follows:

DESCRIPTION	DISSOLVED-SOLIDS CONTENTS (mg/l)
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

Table 2.—Source and Significance of Dissolved-Mineral Constituents and Properties of Water

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. More than 1 or 2 mg/l of iron in surface waters generally indicates acid wastes from mine drainage or other sources.	On exposure to air, iron in ground water oxidizes to 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 ancient 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 mine waters and 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. Some calcium sulfate is considered beneficial in the brewing process. 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 ancient 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 susceptbility of the individual. (Maier, 1950)
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. Nitrate has been 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.
Dissolved solids	Chiefly mineral constituents dissolved from rocks and soils. Includes some water of crystallization.	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. Waters containing more than 1000 mg/l dissolved solids are unsuitable for many purposes.
Hardness as $CaCO_3$	In most waters nearly all the hardness is due to calcium and magnesium. All the metallic cations other than the alkali metals also cause hardness.	Consumes soap before a lather will form. Deposits soap curd 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 as much as 60 ppm are considered soft; 61 to 120 mg/l, moderately hard; 121 to 180 mg/l, hard; more than 180 mg/l, very hard.
Specific conductance (micromhos at 25°C)	Mineral content of the water.	Indicates degree of mineralization. Specific conductance 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, and 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.

Relationship of Water Quality to Use

Irrigation

The suitability of water for irrigation purposes depends not only on the chemical quality of the water, but also on soil composition and texture, irrigation practices, types of crops grown, climate, and drainage. In consideration of the quality of water for irrigation, both the concentration and composition of the dissolved constituents are important. The chemical characteristics that seem to be most important in evaluating the quality of water for irrigation are: (1) the relative proportion of sodium to the other cations (called the percent sodium), (2) the sodium-adsorption ratio, (3) the total concentration of soluble salts (usually expressed as the specific conductance), (4) the amount of residual sodium carbonate, and (5) the concentration of boron.

The U.S. Salinity Laboratory Staff (1954, p. 69-82) proposed a system of classification that is commonly used for judging the suitability of water for irrigation use. As shown in Figure 7, the classification is based on plotting the salinity hazard as measured by the electrical conductivity (specific conductance) against the sodium hazard as measured by the sodium-adsorption ratio (SAR). The SAR is used to express the relative activity of sodium ions in exchange reactions with soil and is defined by the equation:

$$SAR = \frac{Na^{+}}{\sqrt{\frac{Ca^{++} + Mg^{++}}{2}}},$$

where Na^{+}, Ca^{++}, and Mg^{++} represent the concentrations in milliequivalent per liter (me/l) of the respective ions.

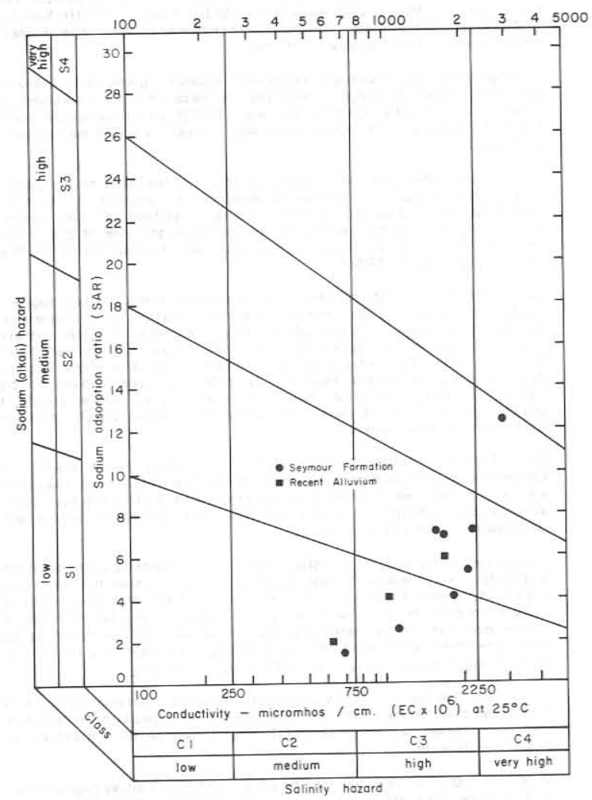


Figure 7.–Classification of Irrigation Waters Showing Quality of Water From Representative Irrigation Wells in Baylor County (After U.S. Salinity Laboratory Staff, 1954, p. 80)

In general, water with low salinity and sodium hazards is suitable for all crops. Water with a high salinity or sodium hazard is unsuitable for continuous irrigation of crops, except those which have a high salinity tolerance and only then under certain ideal soil and drainage conditions. The percent sodium and sodium-adsorption ratio are used to express the relative amount of sodium ions in the water as compared to the amount of calcium and magnesium ions. When water with a high SAR and percent sodium is placed upon soils which are tight and do not drain well, the sodium ions in the water will replace calcium and magnesium ions in the soil. The resulting sodium compounds tend to make the soil highly plastic and will hinder tilling operations and lower the permeability of the soil.

High concentrations of dissolved solids in irrigation water disrupt the osmotic exchange of water between plants and the soil solution (the soil and the water contained in it). This osmotic exchange usually occurs when soil water, with a relatively low concentration of dissolved solids, moves into the root system of a plant to a relatively high concentration of dissolved solids within the plant. When the concentration of dissolved solids in the soil becomes too high, the osmotic exchange may reverse and the plants may lose water, wilt, and die. Also, high concentrations of some ions are toxic to plants. Chloride and sulfate are probably the most injurious that are often found in high concentrations in ground water.

The residual sodium carbonate (RSC) factor is used in assessing the quality of water for irrigation because excessive sodium carbonate concentrations cause soils to break down and lose their permeability, resisting the movement of air and water. Alkali soils will develop and the soil will lose its ability to support plant life.

Wilcox (1955, p. 11) gives the following limits for RSC for irrigation waters: above 2.6 me/l (milliequivalents per liter) is not suitable for irrigation, 1.25 to 2.6 me/l is marginal, and water containing less than 1.25 me/l is probably safe.

Boron in irrigation water is essential to plant growth, but only in very small amounts. A deficiency of boron may seriously injure plants. On the other hand, concentrations as low as 1 mg/l may harm plants which are sensitive to boron. As an example, lemons show definite and, at times, economically important injury when irrigated with water containing 1 mg/l of boron, while alfalfa will make maximum growth with water containing 1 to 2 mg/l boron. The following table is often used as a guide in rating irrigation water in relation to boron.

Permissible Limits for Boron of Several Classes of Irrigation Water

CLASSES OF WATER		SENSITIVE CROPS (mg/l)	SEMITOLERANT CROPS (mg/l)	TOLERANT CROPS (mg/l)
RATING	GRADE			
1	Excellent	0.33	0.67	1.00
2	Good	0.33 to 0.67	0.67 to 1.33	1.00 to 2.00
3	Permissible	0.67 to 1.00	1.33 to 2.00	2.00 to 3.00
4	Doubtful	1.00 to 1.25	2.00 to 2.50	3.00 to 3.75
5	Unsuitable	> 1.25	> 2.50	> 3.75

Under most normal conditions of irrigation, however, it is not the quality of the irrigation water that directly affects the growing plants. It is the chemical quality and characteristics of the soil solution. The soil solution always contains a higher concentration of minerals than irrigation water, generally four to eight times as much. In tight soils and fields with poor drainage, application of irrigation water with high or even moderate salinity and sodium hazards will increase the mineral concentration of the soil solution. Sandy soils with relatively high permeabilities and good drainage will allow the excess mineral content to be flushed or leached out by application of large amounts of water. Because of this, water of very poor quality may be used for irrigation if the soil conditions are right and care is taken to select crops with high tolerances for the minerals contained in the water.

Industrial

Ground water used for industry may be classified into four principal categories: cooling water, boiler water, process water, and water used for secondary recovery of oil by water injection.

Although cooling water is usually selected on the basis of its temperature and source of supply, its chemical quality is also significant. Any characteristic that may adversely affect the heat-exchange surface is undesirable. Substances such as magnesium, calcium, iron, and silica may cause the formation of scale. Another objectionable feature that may be found in cooling water is corrosiveness caused by calcium and magnesium chlorides, sodium chloride in the presence of magnesium, acids, oxygen, and carbon dioxide.

Boiler water used for production of steam requires high quality-of-water standards, since extreme temperature and pressure conditions intensify the problems of corrosion and incrustation. Under these conditions, the presence of silica is particularly undesirable as it forms a hard scale or incrustation.

Water coming in contact with, or incorporated into, manufactured products is termed "process water" and is subject to a wide range of quality requirements. These requirements involve physical, biological, and chemical factors. Water used in the manufacture of textiles must be low in dissolved-solids content and free of iron and manganese, which could cause staining. The beverage industry normally requires water free of iron, manganese, and organic substances.

Water used for injection in the secondary recovery of oil is generally that water taken from the oil reservoir. However, this water—usually brine—must generally be supplemented in order to meet the requirements of volume. Careful control must be exercised over the injected water with regard to suspended solids, dissolved gases, microbiological growths, and mineral constituents. Suspended solids in the water, of course, can cause plugging of the reservoir. Hydrogen sulfide, carbon dioxide, and oxygen all have corrosive effects on well equipment, and oxygen reacting with the metallic ions, primarily iron (Fe^{+++}), will cause plugging of the reservoir. Organisms such as iron bacteria, algae, and fungi have an effect of plugging the reservoir or pumping equipment, and the sulfate reducers have a corrosive effect.

Insofar as the mineral constituents are concerned, iron and manganese are undesirable as they cause plugging in injection wells. Sulfates are of interest from a standpoint of deposition. Water that is high in sulfate should not be mixed with water containing appreciable amounts of barium, because this would result in formation of barium sulfate with a very low solubility. The pH value is also significant when corrosion control and the solubilities of calcium carbonate and iron are considered. The higher the pH, the more difficult it is to maintain iron in solution and to keep calcium scale from forming.

Public Supply

The U.S. Public Health Service has established standards for drinking water to be used on common carriers engaged in interstate commerce. The standards are designed primarily to protect the traveling public and are often used to evaluate public water supplies. According to these standards, chemical constituents should not be present in the water supply in excess of the listed concentrations except where more suitable supplies are not available. Some of the standards adopted by the U.S. Public Health Service (1962, p. 7-8) are as follows:

SUBSTANCE	CONCENTRATION (mg/l)
Chloride (Cl)	250
Fluoride (F)	(*)
Iron (Fe)	.3
Manganese (Mn)	.05
Nitrate (NO_3)	45
Sulfate (SO_4)	250
Dissolved solids	500

* When fluoride is present naturally in drinking water, the concentration should not average more than the appropriate upper limit shown in the following table:

ANNUAL AVERAGE OF MAXIMUM DAILY AIR TEMPERATURES (°F)	RECOMMENDED CONTROL LIMITS OF FLUORIDE CONCENTRATIONS (mg/l)		
	LOWER	OPTIMUM	UPPER
50.0 to 53.7	0.9	1.2	1.7
53.8 to 58.3	.8	1.1	1.5
58.4 to 63.8	.8	1.0	1.3
63.9 to 70.6	.7	.9	1.2
70.7 to 79.2	.7	.8	1.0
79.3 to 90.5	.6	.7	.8

Water having concentrations of chemical constituents in excess of the recommended limits may be objectionable for many reasons. According to Maxcy (1950, p. 271), water containing nitrate in excess of 45 mg/l has been related to the incidence of infant cyanosis (methemoglobinemia or "blue baby" disease). A high nitrate concentration is often, but not always, indicative of pollution from organic matter, commonly human or livestock wastes. Iron and manganese in excessive concentrations cause reddish-brown or dark-gray precipitates, which stain clothing and plumbing fixtures. Sulfate in water in excess of 250 mg/l may produce a laxative effect, and water containing chloride exceeding 250 mg/l may have a salty taste. Fluoride in concentrations of about 1 mg/l may reduce the incidence of tooth decay, but excessive concentrations may cause teeth to become mottled (Dean, Arnold, and Elvove, 1942, p. 1155-1159).

Hardness in water is caused principally by calcium and magnesium. Excessive hardness causes increased consumption of soap and induces the formation of scale in hot water heaters and water pipes. The following table shows the commonly accepted standards and classifications of water hardness:

HARDNESS RANGE (mg/l)	CLASSIFICATION
60 or less	Soft
61 to 120	Moderately hard
121 to 180	Hard
More than 180	Very hard

Changes in Chemical Quality

One of the major assets of ground-water supplies is the general uniformity of chemical quality and temperature. The increased demands on an aquifer caused by heavy pumpage, however, may impose new hydrologic conditions on the aquifer which in turn may bring about alteration of the chemical quality of the water produced. This can be dramatically illustrated by the aquifers along the Texas Gulf Coast. The Gulf Coast aquifer consists of several hundred feet of interbedded sands, silts, and shales which dip generally south beneath the Gulf. Under normal conditions, the hydrostatic pressure of fresh water being added to the aquifer's outcrop area keeps the salt water, which occurs far down dip beneath the Gulf, pushed back and an interface is formed between the two waters. Heavy pumpage along the coast, however, will often sufficiently lower the hydrostatic pressure so that salt water may invade the zones that formerly contained fresh water. This type of problem is often found in coastal aquifers.

Water stratification within an aquifer may also cause a problem. Often water quality may vary vertically within an aquifer, and usually the poorer quality water will be found lower in the formation. Heavy development and pumping of an aquifer with this type of stratification may bring drastic changes in the quality of water produced as the amount of good or at least better quality water is reduced and more and more of the poorer quality water is brought into the wells.

Ground-water aquifers are also in danger of pollution from other sources, especially from man's activities. This is true of all aquifers, but especially of shallow water-table aquifers. Municipal and domestic sewage systems (including septic tanks), the wastes from barnyards and feedlots, industrial wastes, and oil-field brine that is improperly disposed of can enter into ground water and render it unfit for most uses.

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 the blending of poor and good quality waters, and addition of chemicals. The limiting factor in treatment is cost. Each water may require a different treatment method which should be designed for that particular water and its intended use. However, once a treatment is established it probably will not have to be changed as the chemical characteristics of uncontaminated ground water remain fairly constant.

OCCURRENCE AND QUALITY OF GROUND WATER

In Baylor County, fresh to moderately saline water is produced from rocks of the Permian and Quaternary Systems. Brines are produced from formations ranging from Cambrian to Permian in age, and are used in secondary recovery and pressure-maintenance oil-field operations. The chemical quality of these brines is discussed later.

Permian rocks of the Wichita and Clear Fork Groups outcrop throughout Baylor County, except in local areas where they are covered by Quaternary alluvial deposits of the Pleistocene and Recent Epochs. Small amounts of ground water are found within shallow, erratic zones of low permeability on or near the outcrop of the Permian rocks, and small to moderate amounts of good quality water are produced from the alluvial sands and gravels of Quaternary age.

During this study, 529 wells, springs, and test holes were inventoried. Seven wells that were inventoried produce or have produced brine from rocks of Permian, Pennsylvanian, and Cambrian ages. Twenty-one test holes were drilled for geologic data. Nine of these test holes were cored and used as observation wells in conducting pumping tests. Electric logs of 12 oil tests (Table 11) were used to construct the geologic cross sections. The largest number (97 percent) of wells were developed in rocks of Quaternary age. The remaining 3 percent of the wells were developed in rocks of the Permian or the Permian in combination with the Quaternary alluvium. There were 228 irrigation wells, 114 domestic and livestock wells, 20 public supply wells, and 10 industrial wells in use. The locations of wells, springs, and test holes are shown on Figure 16.

Water samples were collected for chemical analysis from 183 wells and springs in Baylor County. These analyses are shown on Table 8. There was a wide variety in the chemical quality of water from wells. The following table shows the number of samples falling within various ranges:

RANGE IN DISSOLVED SOLIDS (mg/l)	NUMBER OF ANALYSES	PERCENT OF TOTAL ANALYSES
500 or less	22	12.02
501 to 1,000	72	39.35
1,001 to 1,500	47	25.68
1,501 to 2,000	22	12.02
2,001 to 3,000	8	4.37
Over 3,000	12	6.56

The dissolved solids content of these samples ranged from 240 to 7,870 mg/l. The wide variation in the chemical quality is also reflected in the concentrations of the principal chemical constituents in the samples. The following table gives the ranges in concentration of the principal ions present in ground water:

CHEMICAL CONSTITUENT	MAXIMUM CONCEN-TRATION (mg/l)	MINIMUM CONCEN-TRATION (mg/l)
Silica	98	4
Calcium	680	6
Magnesium	500	5
Sodium	2,040	12
Bicarbonate	1,760	20
Sulfate	1,660	7
Chloride	3,240	5
Fluoride	8.0	< .1
Nitrate	781	< .4

Wells high in dissolved solids and chlorides are possibly contaminated by oil-field brines. Wells high in nitrates are possibly contaminated with biological wastes. The location of wells sampled, well depth, and the chloride, sulfate, and dissolved-solids contents are shown on Figure 8.

Permian System

Wichita Group

Rocks of the Wichita Group cover about the eastern two-thirds of Baylor County, except in areas where they are overlain by Quaternary alluvial deposits. These rocks dip westward beneath the overlying Clear Fork Group.

Four wells were inventoried which produce or have produced small amounts of fresh to moderately saline water from rocks of the Wichita Group in the county. This water is found in erratic, discontinuous zones of generally low permeability at or near the outcrop.

Water samples were collected during the course of this study from two of the four wells completed in rocks of the Wichita Group. A previous analysis was available on well 21-40-501. A comparison of these three analyses shows that the water produced from these rocks is of poor quality. The water is high in chlorides, sulfates, and dissolved solids. One well, 21-40-524, completed in the Wichita Group and the Recent alluvium, has water that is of much better quality than the water from wells penetrating only the Wichita Group. This is indicated in the following table:

WELL	DISSOLVED SOLIDS (mg/l)	CHLORIDE (mg/l)	SULFATE (mg/l)	NITRATE (mg/l)
WICHITA GROUP				
21-37-905	2,480	356	1,100	184.8
38-203	4,270	2,040	530	42
40-501	5,075	1,355	1,384	—
RECENT ALLUVIUM AND WICHITA GROUP				
21-40-524	750	75	106	23.0

The relatively high nitrate concentration of water from wells 21-37-905 and 21-38-203 indicates the possibility of biological contamination. Well 21-38-203 is possibly contaminated by either a septic tank or from a nearby barnyard. The nitrate content in water from well 21-37-905 appears to be a natural occurrence since no houses or barnyards are nearby.

The high chloride concentration of water from well 21-38-203 is a possible indication of contamination from oil-field brines. Since water from well 21-40-501 contained as high a concentration of sulfate as of chloride, it is likely the high concentrations are due to natural mineralization which is common in areas of Permian outcrop. This would probably also explain the high sulfate content of water from well 21-37-905.

Water from only one well (21-38-203) is being used at the present time, but all wells have been used in the past for domestic and livestock supplies.

Three of the wells inventoried, which produce water from the Wichita Group, were hand dug and cased with rock or concrete. Well 21-40-501 was reported drilled and cased with small diameter steel oil-field casing. The wells are equipped with windmills or small jet electric pumps which produce less than 10 gpm (gallons per minute).

Clear Fork Group

The Clear Fork Group outcrops in the western third of Baylor County and yields small amounts of water from local zones of generally low permeability at or near the outcrop. During this study, three wells were inventoried which produce water from rocks of this group. Five other wells were found which produce commingled waters from these rocks and the Seymour Formation.

Samples were collected from each of the wells that produce water exclusively from the rocks of the Clear Fork Group. Two of these wells (21-21-924 and 21-30-119) produce water of fairly good quality, but the third well contained poor quality water. The following table lists the concentrations of several predominant minerals for the three samples:

WELL	DISSOLVED SOLIDS (mg/l)	CHLORIDE (mg/l)	SULFATE (mg/l)	NITRATE (mg/l)
21-21-924	396	208	7	18.0
29-311	3,510	1,010	500	781.0
30-119	580	58	86	< .4

The high chloride content of well 21-29-311 indicates the possibility of contamination. The extremely high concentration of nitrate in this well (781 mg/l) is possibly the result of pollution from a nearby septic tank or other source of biological waste.

Samples were collected for chemical analysis for the five wells which produce or have produced water from rocks of the Clear Fork Group and the Seymour Formation. These analyses show this water to be of poor quality as indicated by the following table:

WELL	DISSOLVED SOLIDS (mg/l)	CHLORIDE (mg/l)	SULFATE (mg/l)	NITRATE (mg/l)
21-29-202	1,560	290	189	322.3
802	4,830	1,920	600	570
902	3,820	1,590	570	231.0
30-126	1,230	170	201	12.0
701	4,250	1,270	700	496

The high chlorides and dissolved solids of three of the wells may be due to contamination by oil-field brines. The extremely high nitrate concentration in four of the wells is possibly due to waters from nearby septic tanks and barnyards. Most of these wells are hand dug and lined with either fieldstone or concrete.

Seven of the eight wells completed in the Clear Fork and the Clear Fork and Seymour are in use or have been used in the past for domestic or livestock supply. Four wells (21-29-202, 21-29-902, 21-30-126, and 21-30-701) are still in use. Water from wells which contain high chloride and nitrate concentrations should probably not be used for domestic and livestock supply. Water from well 21-30-126 is used to supply the Baylor County Precinct 1 road barn, and is probably of good enough quality for almost any use.

Quaternary System

Pleistocene Series

The Pleistocene Series of rocks is represented in Baylor County by the deposits of the Seymour Formation, which are found in irregular patches capping some of the stream divides within the county and the surrounding area. These deposits are especially well developed in an area just north and northwest of the city of Seymour between the Wichita and Brazos Rivers. Most of the wells that produce water from the Seymour Formation in the county are found within this area.

A total of 387 wells and springs were inventoried which produce or have produced water from the Seymour Formation. Eighty-three wells were unused at the time of this study. Of the remaining 304 wells, the use of water was as follows: domestic and livestock, 73; public supply, 20; industrial, 6; and irrigation, 205.

Chemical analyses were conducted on samples collected from 113 wells and springs during this study. Previous analyses also were available on samples from twelve wells. The ranges in dissolved-solids content of the water samples are as follows:

RANGE IN DISSOLVED SOLIDS (mg/l)	NUMBER OF ANALYSES	PERCENT OF TOTAL ANALYSES	CUMULATIVE PERCENT
500 or less	13	11.50	11.50
501 to 1,000	47	41.60	53.10
1,001 to 1,500	33	29.20	82.30
1,501 to 2,000	12	10.62	92.92
2,001 to 3,000	4	3.54	96.46
Over 3,000	4	3.54	100.00

The dissolved-solids concentrations ranged from 304 to 7,800 mg/l which indicates the quality of water within the Seymour is variable, but generally is fresh to slightly saline since more than 96 percent of the analyses contain less than 3,000 mg/l dissolved solids.

There are some wide variations in the ranges of the principal chemical constituents as shown in the following table:

CHEMICAL CONSTITUENT	RANGE IN MG/L
Silica	7 to 98
Calcium	11 to 360
Magnesium	7 to 500
Sodium	21 to 2,040
Bicarbonate	196 to 1,220
Sulfate	16 to 1,660
Chloride	5 to 3,110
Fluoride	.2 to 8.0
Nitrate	< .4 to 525
Boron	.1 to 2.7

Many of the samples contain higher concentrations of chloride, sulfate, and nitrate than is recommended by the U.S. Public Health Service (1962, p. 7-8). Thirty-eight samples contain chloride concentrations higher than 250 mg/l, twenty-five contain sulfate concentrations higher than 250 mg/l, and thirty-six contain nitrate concentrations higher than the recommended 45 mg/l.

Although salt-water contamination does not seem to have been extensive in the Seymour Formation, water from a few of the wells which contain high concentrations of chloride possibly have been contaminated by oil-field brines, or other contaminants. Chloride and dissolved-solids concentrations of these wells are shown below:

WELL	CHLORIDE (mg/l)	DISSOLVED SOLIDS (mg/l)
21-22-910	3,110	7,800
30-907	1,450	3,060
803	2,300	6,200

Possible pollution from septic tanks, and the outwash from barnyards and small feedlots does seem to be a problem. Of the 36 samples which contained concentrations of nitrate higher than the recommended 45 mg/l, the following 16 contained more than 100 mg/l:

WELL	NITRATE CONCENTRATION (mg/l)
21-21-602	143.0
701	110.0
925	420.0
22-710	197.4
849	273.0
904	525
29-305	122.3
801	483
30-108	110.0
115	273
116	210
601	156.0
607	202
31-102	210
803	270
39-202	416.0

Water from several of these wells is still used for domestic supplies.

Analyses made prior to this investigation indicate that the chemical quality of Seymour water generally has remained fairly constant. However, a comparison of analyses from wells 21-22-901, 21-30-601, and 21-40-520 indicates susbstantial improvement in chloride and dissolved-solids content as indicated by the following table:

WELL	CHLORIDE CONTENT (mg/l)		DISSOLVED-SOLIDS CONTENT (mg/l)	
	PREVIOUS ANALYSIS	RECENT ANALYSIS	PREVIOUS ANALYSIS	RECENT ANALYSIS
21-22-901	2,000	560	–	–
30-601	640	387	2,540	1,520
40-520	401	37	1,318	710

Except for a few wells which are possibly contaminated, water from the Seymour Formation is generally of acceptable quality for use in domestic, livestock, and public supplies.

Because the quality standards of water for different industrial purposes vary so widely depending on the particular needs of the industry using the water, no definite general statement may be made about the use of water from the Seymour Formation for industrial use. However, the quality as indicated by chemical analyses of samples would be suitable for many industrial uses.

The major use of water from the Seymour Formation is for irrigation. In Baylor County, the crops most often irrigated include cotton, maize, wheat, and some coastal bermuda. In judging the suitability of water for irrigation, several factors of water quality, soil type, and topography must be taken into consideration.

As discussed previously, the water-quality factors which affect the use of water for irrigation are the salinity hazard, the sodium hazard, the residual sodium carbonate hazard, and the boron hazard.

The ranges of specific conductance (the measure of salinity hazard) of the water samples collected from wells producing from the Seymour Formation are shown in the following table:

SPECIFIC CONDUCTANCE RANGE (micromhos at 25°C)	NUMBER OF ANALYSES	PERCENT OF TOTAL ANALYSES	CUMULATIVE PERCENT
Less than 250	0	0	0
250 to 750	11	9.73	9.73

SPECIFIC CONDUCTANCE RANGE (micromhos at 25°C)	NUMBER OF ANALYSES	PERCENT OF TOTAL ANALYSES	CUMULATIVE PERCENT
750 to 2,250	80	70.80	80.53
Over 2,250	22	19.47	100.00

Over 90 percent of the analyses are classified as high or very high salinity hazard. Because of this, much of the water produced from the Seymour would not normally be used for irrigation. However, since most of the soils have excellent permeability and drainage, and the crops irrigated in the area are generally very salt tolerant, problems arising from use of these waters have not occurred.

The SAR ranges from a low of 0.7 to a high of 18.6, and averages 5.0. Only one analysis is above the medium range.

RSC calculations were made on 22 water samples from irrigation wells producing from the Seymour. These calculations range from 0 to 2.98 me/l (milliequivalents per liter) and average about 0.75 me/l. This RSC range and the excellent soil conditions generally found within the area indicate little if any problem because of residual sodium.

The boron concentrations in samples of water from 31 wells completed in the Seymour Formation are shown in Table 3. The ranges in boron concentrations of these samples are as follows:

RANGE IN BORON CONCENTRATION (mg/l)	NUMBER OF ANALYSES	PERCENT OF TOTAL ANALYSES
0 to 1.0	26	83.87
1.1 to 2.0	3	9.68
2.1 to 3.0	2	6.45

Since more than 80 percent have 1.0 mg/l boron or less, a comparison with the chart of permissible limits of boron concentration in irrigation waters indicates that most of the water produced from the Seymour in the county rates good to excellent except for crops extremely sensitive to boron.

Recent Series

The Recent Series of rocks is represented in Baylor County by alluvial deposits along and near the floodplains of the major streams. These sediments, usually consisting of interfingering or discontinuous beds of gravel, sand, silt, and clay, are especially well developed along the main stem of the Brazos River.

Eighty-nine wells were inventoried during this investigation which produce or have produced water from the Recent alluvium in Baylor County. Twenty-seven of these wells were not in use during this study. The remaining 62 wells supplied water for domestic and livestock (36 wells), industrial (3 wells), and irrigation (23 wells) purposes.

Water samples were collected for chemical analysis from 55 wells during this study. One sample was bailed from a test hole. Three previous analyses were available for comparison with present water quality. A study of these analyses shows some variation of water quality within the Recent alluvium, but this would be expected because of the erratic nature of its occurrence and generally poor quality of water in the adjacent streams.

The dissolved-solids content of the samples ranged from 240 to 7,870 mg/l. The number of analyses falling within certain ranges of dissolved solids is shown in the following table:

RANGE IN DISSOLVED SOLIDS (mg/l)	NUMBER OF ANALYSES	PERCENT OF TOTAL ANALYSES	CUMULATIVE PERCENT
500 or less	8	14.29	14.29
501 to 1,000	22	39.28	53.57
1,001 to 1,500	13	23.21	76.78
1,501 to 2,000	8	14.29	91.07

Table 3.—Iron and Boron Concentrations in Water From Selected Wells and Springs

Analyses are in milligrams per liter.

WELL	IRON (Fe)	BORON (B)
Permian—Wichita		
21-38-203	0.02	1.2
Permian—Clear Fork		
21-30-119	1.10	0.4
Seymour, Formation and Permian—Clear Fork, Co-Mingled		
21-29-802	0.02	2.3
902	.04	.5
30-126	.04	1.7
701	.04	1.3
Seymour Formation		
21-21-702	18.50	0.6
925	.04	.6
22-710	.10	.9
730	.10	.7
819	—	1.0
849	.10	1.9
903	—	1.1
29-205	.10	1.5
302	—	.46
303	—	.3
312	.20	.9
316	.16	.8
801	.22	2.7
901	.20	2.6
30-120	—	.4
Seymour Formation—Continued		
121	—	.1
123	—	.5
124	.13	.5
125	.22	.5
261	.02	.7
302	.01	.8
304	.04	—
369	.06	.2
370	.84	.5
371	.04	.6
601	.02	.83
606	.16	.5
607	.16	.6
801	.13	.4
31-101	.58	.3
102	.06	.7
804	.02	.3
40-520	.4	—
Recent Alluvium		
21-29-101	—	1.0
501	—	.8
503	0.06	.6
30-608	.16	1.5
908	.1	—
40-510	9.80	.21
527	.6	—

RANGE IN DISSOLVED SOLIDS (mg/l)	NUMBER OF ANALYSES	PERCENT OF TOTAL ANALYSES	CUMULATIVE PERCENT
2,001 to 3,000	2	3.57	94.64
Over 3,000	3	5.36	100.00

Nearly 95 percent of the water samples contain 3,000 mg/l or less of dissolved solids, which would be classified as fresh to slightly saline.

The wide variations in the ranges of the principal chemical constituents are as follows:

Silica	8 to 64
Calcium	13 to 536
Magnesium	9 to 380
Sodium	30 to 1,910
Bicarbonate	198 to 1,760
Sulfate	13 to 1,535
Chloride	9 to 3,240
Fluoride	.5 to 2.8
Nitrate	< .4 to 546.0
Boron	.2 to 1.5

Several samples contained higher concentrations of chloride, sulfate, and nitrate than is recommended by the U.S. Public Health Service (1962, p. 7-8). Nineteen samples contained chloride concentrations in excess of 250 mg/l, 10 contained sulfate concentrations higher than 250 mg/l, and 11 contained nitrate concentrations higher than 45 mg/l. Five wells which produce water with especially high concentrations of chloride may possibly have been contaminated by oil-field brines or other sources of chloride. The dissolved-solids, chloride, and sulfate concentrations of water from these wells are shown in the following table:

WELL	DISSOLVED SOLIDS (mg/l)	CHLORIDE (mg/l)	SULFATE (mg/l)
21-38-302	7,870	3,240	1,010
39-311	1,730	700	125
313	1,940	680	270
501	4,010	1,620	943
40-201	1,970	630	133

The water in the Brazos River is often quite high in chlorides, and may have contributed poor quality water to some wells (especially well 21-38-302). Also in the north-central Texas area, water may contain high chlorides from natural sources, especially on or near the outcrop of some of the Permian rock formations. When this natural occurrence of high chlorides is found, however, it is usually associated with equally high or higher concentrations of sulfates derived from the many deposits of gypsum common to this area. Because of this, samples which contained very high concentrations of sulfate were not considered to be contaminated unless they also contained concentrations of chloride much higher than the sulfate content. From the analyses of the samples taken, salt-water contamination apparently has occurred only in a few very local areas in the Recent alluvium in the county.

The high nitrate concentrations in several samples are thought to be an indication of possible biological contamination. These pollution problems are very local in extent and may have been caused by effluent from septic tanks and the outwash from barnyards and small feedlots. The following wells contained water with nitrate concentrations in excess of 100 mg/l:

WELL	NITRATE CONCENTRATION (mg/l)
21-29-101	114
501	147
38-301	158
39-201	121
40-104	110
106	105
532	546

Three of the wells are still used as domestic supplies.

Comparisons of three previous chemical analyses with three recent analyses indicate that water quality has deteriorated slightly in two instances and improved in one.

A comparison of two samples from well 21-39-201 shows an increase in concentrations of calcium, 6 to 93 mg/l; magnesium, 69 to 84 mg/l; sodium, 12 to 57 mg/l; bicarbonate, 287 to 510 mg/l; and chloride, 33 to 99 mg/l. The sulfate content decreased slightly from 41 to 39 mg/l.

A previous chemical analysis of water from well 21-40-527 when compared with a recent analysis from well 21-40-526, about 150 feet away, shows an increase in sodium, 79 to 318 mg/l; bicarbonate, 437 to 520 mg/l; chloride, 130 to 256 mg/l; nitrate, 4.3 to 20 mg/l; and dissolved-solids, 839 to 1,130 mg/l. Calcium decreased from 139 to 56 mg/l and silica, magnesium, and sulfate decreased slightly.

A previous partial chemical analysis of water from well 21-30-908 contained 32 mg/l sulfate and 2,020 mg/l chloride, indicating possible brine contamination. A recent analysis on well 21-30-903, which is located about 75 feet away, indicates the possibility of some abatement of the problem since the chloride concentration was only 708 mg/l.

Except in the few previously mentioned cases which show indications of possible pollution or contamination, the chemical analyses of water from wells developed in the Recent alluvium indicate the water is generally of acceptable quality for use in domestic, livestock, and public supplies.

Because the quality standards of water for different industrial purposes vary so widely, depending on the particular needs of the industry using the water, no definite general statements may be made about the use of water from the Recent alluvium deposits in industry. However, the native water quality indicates the water to be suitable for many industrial uses.

Much of the water produced from the Recent alluvium in the county, is used for irrigation, mostly for coastal bermuda grass and feed grains. The same water-quality factors which are normally used to determine the suitability of water for irrigation use also apply to water of the Recent alluvium.

The specific conductance of 56 samples of water from the Recent alluvium ranged from 393 to 10,250 micromhos at 25°C. The following table shows the number and percentage of analyses within certain range groups:

SPECIFIC CONDUCTANCE RANGE (micromhos at 25°C)	NUMBER OF ANALYSES	PERCENT OF TOTAL ANALYSES	CUMULATIVE PERCENT
Less than 250	0	0	0
250 to 750	6	10.71	10.71
750 to 2,250	36	64.29	75.00
Over 2,250	14	25.00	100.00

As shown on Figure 7, nearly 90 percent of the samples fall within a high or very high salinity hazard class. Normally, the high or very high salinity hazard would make the use of this water for irrigation questionable. However, the generally sandy soils, with high permeability and excellent drainage, and the choice of crops, with relatively high salt tolerance, reduces the salinity hazard.

The range in SAR is from 0.3 to 11.3, with an average of 4.2. This range of SAR is within the low to medium class of sodium hazard on the classification chart.

Residual sodium carbonate calculations were made on five samples taken from irrigation wells producing from the alluvium. These calculations ranged from 0 to 3.32 me/l and averaged about 1.80 me/l. Because of the excellent soil conditions where this water is used, this range would probably not cause any problems.

The boron concentrations from five analyses ranged from 0.2 to 1.5 mg/l and averaged about 0.8 mg/l (Table 3). Water with these concentrations would be of little danger except for crops which are highly sensitive to boron.

AVAILABILITY OF GROUND WATER

In Baylor County, only the Seymour Formation and the Recent alluvial deposits contain water in sufficient quantities to warrant development.

Seymour Formation

The Seymour Formation is the principal ground-water source in the county, providing much of the water for domestic, livestock, industrial, irrigation, and municipal uses.

Extent of the Aquifer

The formation consists of alluvial gravels, sands, silts, and clays which are interbedded in discontinuous beds and lenses. The upper portion of the formation is generally characterized by secondary accumulations of caliche. The formation outcrops in broken, isolated patches on the stream divides in Baylor County. Most of these areas are small in extent and contain only limited amounts of ground water. About 73 square miles of the Seymour Formation that outcrops in and around the city of Seymour and north and westward to the Knox County line lying between the Brazos and Wichita Rivers is currently the most extensively developed area in the county. Also, the Seymour reaches its greatest saturated thickness here, thereby giving this area the greatest potential for future development in the county. Generally, the following discussions will concern this large area. The approximate altitude of the base of the Seymour Formation in this area is shown on Figure 9. The thickness of the Seymour varies from zero at the edge to a maximum of about 60 feet. There is a maximum saturated thickness of more than 25 feet.

Source and Occurrence of Ground Water

The source of ground water in the Seymour Formation is precipitation falling on the outcrop. The amount (or the percentage of the total yearly precipitation) that is contributed to the aquifer depends on several factors, such as amount, type, and intensity of precipitation; type of soil; climate; topography; and amount and type of vegetative cover. The ground water in storage within the Seymour Formation is found in the pore spaces or voids between the rock particles which make up the formation. These voids are interconnected and the water in storage is under atmospheric pressure. Thus, except possibly in a few local erratic areas where zones of relatively impermeable clay may confine the aquifer, water in the Seymour Formation occurs under water-table (unconfined) conditions.

Only a relatively small part of the annual precipitation actually enters the Seymour Formation as recharge. Most of the rainfall runs off to streams, or evaporates. Much of the portion that enters the ground is either retained in the soil zone and used by vegetation or is evaporated.

Calculations of recharge and discharge for the Seymour Formation in conjunction with this study indicate that about 10.2 percent of the annual precipitation that falls on the outcrop enters the soil and flows under the force of gravity through the interconnected voids within the formation and reaches storage in the aquifer. With the average annual rainfall of 25.57 inches, this means that about 2.6 inches of water is taken into storage yearly.

Recharge, Movement, and Discharge of Ground Water

Recharge is the amount of water taken into storage in an aquifer from outside sources. In the case of the Seymour Formation, a water-table aquifer, it is that portion of the annual precipitation that is taken into the soil and moves downward by gravity flow until it reaches the water table. Recharge varies locally within the Seymour outcrop area.

The normal movement of ground water is from areas of recharge toward points of discharge. This movement takes place under the influence of the force of gravity. Within the Seymour Formation in Baylor County, the general movement of ground water is to the south and southeast following the general slope of the land surface and the slope of the underlying surface upon which the formation rests. There is some drainage along the northern edge of the outcrop toward the north. This normal flow is usually modified by pumpage of wells and in cases of heavy pumpage, water flows from all directions toward the pumped wells.

Within a porous medium such as the Seymour Formation, the rate of ground-water movement depends on the porosity and the permeability. In sand, the rate of movement has been measured at from 10 to 15 feet per year and in coarse gravels at about 20 or more feet per year. In a mixture of sand and gravel, like the Seymour, the rate may be about 20 feet per year.

Discharge from the Seymour consists of natural discharge and pumpage by wells. The natural discharge includes the flow from springs and seeps, underflow or leakage to another aquifer, baseflow to streams, and evapotranspiration. Springs and seeps occur along most of the edge of the Seymour outcrop. Most of the larger springs are located on the south edge of the outcrop along the Brazos River just west of the city of Seymour. In a shallow water-table aquifer, such as the Seymour, the flow of the springs depends on the amount of water in storage, thus their flow varies in direct relationship to the amount of rainfall. Many of the smaller springs, especially those along the north edge of the outcrop, have been known to dry up during extended droughts. Many of those on the south side along the Brazos River, however, have never been known to cease flowing.

Leakage or loss of water by the Seymour to the underlying Permian rocks is probably very small, because of the relative impermeability of the sandstones, siltstones, and claystones which make up the Permian. Local instances of leakage are indicated, however, along the southern edge of the Seymour outcrop, where the Seymour is in hydrologic contact with the Recent alluvial deposits along the north side of the Brazos River. Much of the water that flows from springs and seeps along this same stretch is also taken up by these Recent deposits. Most of the natural discharge of the Seymour Formation, except that lost to evapotranspiration, is first discharged into the Recent alluvium and then into the Brazos River.

Evaporation and transpiration are often very significant factors in ground-water discharge. This is especially true in shallow water-table aquifers such as the Seymour Formation. The average annual gross lake surface evaporation of about 75 inches per year and the relatively shallow water table, generally less than 20 feet below the ground surface, indicate a large loss to evaporation during the hot summer months. Evaporation losses from shallow water-table aquifers have been estimated at more than an acre-foot per acre per year in some studies (Hammond, 1969, p. 14). A significant amount of water is also lost each year through transpiration by plants. The amount of water lost depends upon the types of plants, climatic conditions, topography, and soil conditions in the area. Most of the area of Seymour outcrop has been cleared for cultivation, though a few small areas are still covered with mesquite growth. Much of the outcrop area of the Recent alluvium, however, is covered with mesquite and salt cedar. These two plants, called phreatophytes because they usually obtain most of their water from the zone of saturation, are especially obnoxious because they consume large amounts of ground water and have no economic value.

An attempt was made to estimate the recharge rate and the total recharge to the Seymour Formation in the county by calculating the amount of natural discharge (spring flow) and pumpage for 1969. In February 1970, a low-flow study was conducted along the Brazos River from the Knox County line to the bridge at the city of Seymour. Flow measurements were taken at five sites along this stretch of the river. The study was conducted during the winter because evaporation and transpiration losses would be at a minimum, and any gains in flow in the river would approximate the natural discharge of the Seymour Formation across the sections between each two measurements. The following table shows the flows, in cubic feet per second (ft^3/s), at each site; the gain in flow, in ft^3/s for each section; and the yearly discharge, in acre-feet, which this gain would represent.

MEASURING SITE	FLOW (ft^3/s)	FLOW SECTION	NET GAIN IN FLOW (ft^3/s)	YEARLY DISCHARGE REPRESENTED BY NET GAIN (acre-feet)
1	34.6	—	—	—
2	34.7	A-B	0.1	72.4
3	35.2	B-C	.5	362.5
4	37.8	C-D	2.6	1,882.5
5	38.7	D-E	.9	651.6

On the map showing the altitude of the water table during the winter of 1969-70 (Figure 11), flow lines were drawn at right angles to the water-table contours from flow-measurement sites 2 and 3 and from sites 4 and 5 to where they intersected on the ground-water divide which runs east and west parallel to the river. The two areas delineated by these flow lines represent flow channels within the Seymour Formation. The natural discharge of each area is equal to the amount of water added to the river from that area minus any evapotranspiration losses. In computing the southward movement of ground water from the two flow channels to the Brazos River, any corresponding northward drainage from areas across the river was considered negligible. Since the measurements were taken when evapotranspiration was essentially zero, the yearly discharge represented by the net gain in flow is equal to the natural discharge or rejected recharge for each respective area. By estimating the total pumpage within each area and adding it to the natural discharge, the total discharge for each flow channel may be calculated.

If there was no rise or decline of the water table from winter 1968-69 to winter 1969-70 (Figures 10 and 11), then the total discharge for each area would be equal to total recharge. However, during this period there was a general rise in the water table of about 0.5 foot which would make the total recharge greater than the total discharge. The recharge rate in 1969, in inches of water, can be calculated by dividing the total recharge of each flow channel by its surface area. These calculations are summarized in the following table:

FLOW CHANNEL	AREA (acres)	TOTAL RECHARGE IN 1969 (acre-feet)	RECHARGE RATE IN 1969 (inches)	PERCENT OF 1969 TOTAL
1	3,629	605	2.0	5.8
2	8,163	3,401	5.0	14.5

The average recharge rate is about 3.15 inches for 1969. This would represent about 10.2 percent of the total 1969 precipitation. Applied over the entire area of the large outcrop of Seymour between the Brazos and Wichita Rivers (about 73 square miles) this would represent a total recharge of 13,500 acre-feet for 1969. If the same percentage of the average annual rainfall is assumed to be taken into the aquifer, then about 2.6 inches would be added to storage. Thus, under normal rainfall conditions, recharge to the Seymour Formation in the area between the Brazos and Wichita Rivers would equal about 10,100 acre-feet per year.

Hydraulic Characteristics of the Aquifer

In an attempt to derive the hydraulic characteristics (porosity, permeability, transmissibility, and storage) of the Seymour Formation, three aquifer tests were conducted using irrigation wells that produce from the formation. The results of these tests are given in Table 4. Measurements of porosity were not obtained for the Seymour Formation; however, since the water-producing zones generally consist of gravel with a sand matrix, an average porosity of about 20 percent can be assumed (Meinzer, 1923a, p. 11).

Coefficients of transmissibility and storage were calculated using the nonequilibrium method (Cooper and Jacob, 1946, p. 256-534) and pumpage and drawdown figures obtained from the aquifer tests. At each test site, three observation wells were drilled and cased to facilitate these calculations. Coefficients of permeability were derived from each calculated transmissibility by dividing the transmissibilities by the saturated thicknesses. The transmissibilities ranged from about 24,200 gpd (gallons per day) per foot in well 21-30-302 to almost 80,600 gpd per foot in well 21-21-941. The average coefficient of transmissibility was about 50,100 gpd per foot. The permeabilities ranged from about 790 to 2,000 gpd per square foot. The average coefficient of permeability was about 1,370 gpd per square foot. The average coefficient of storage was about 0.11, and the range from 0.03 to 0.30. Under water-table conditions, such as in the Seymour Formation, the coefficient of storage is equal to the specific yield.

History of Development

Most of the well development in the Seymour Formation has occurred since 1900, although a few livestock and domestic supply wells were reported drilled in Baylor County before that time. It has been reported by "oldtimers" in the county and in other areas where the Seymour Formation is well developed that there were only small amounts of water available from the Seymour 40 or 50 years ago. Through the years, domestic and livestock supplies have been developed over almost all of the Seymour outcrop areas within the county. At the present time, most of the domestic and livestock wells and all of the irrigation, public supply, and industrial wells are developed on that part of the Seymour Formation which extends from the city of Seymour, west to the Knox County line between the Brazos and Wichita Rivers.

Records of 387 wells and springs which produce water from the Seymour Formation in the county were collected during the course of this study. Of these, 205 were used for irrigation, 20 for public supply, 6 for industrial supply, and 73 for domestic and livestock supply. Eighty-three wells were not in use and either abandoned or destroyed. An attempt was made to inventory all irrigation, municipal, and industrial wells and a selected number of livestock and domestic wells in order to provide adequate well coverage.

The total estimated pumpage of ground water from the Seymour Formation during 1969 was about 5,000 acre-feet or 4.5 mgd (million gallons per day). The irrigation pumpage from the Seymour aquifer was about 3,770 acre-feet or 3.4 mgd in 1969, which

Table 4.—Results of Aquifer Tests Conducted on Selected Wells Penetrating the Seymour Formation

WELL	TYPE OF WELL	DATE TEST STARTED	SATURATED THICKNESS AT END OF TEST (feet)	FIELD CO-EFFICIENT OF PERMEABILITY (gpd/ft²)	COEFFICIENT OF TRANS-MISSIBILITY (gpd/ft)	COEFFICIENT OF STORAGE	YIELD (gpm)	DRAWDOWN (feet)
21-21-920	Pumped	Apr. 27,1970	35.4	1,874	66,352	—	470	6.6
939	Observation	do	38.0	1,774	67,435	—	—	4.0
940	do	do	39.1	1,866	72,900	0.18	—	3.4
941	do	do	40.2	2,004	80,571	.16	—	2.3
Averages[1] for aquifer test number 1				1,880	71,800	0.17		
21-22-903	Pumped	July 21, 1969	29.7	1,674	49,736	—	211	10.8
911	Observation	do	35.7	1,248	44,563	0.04	—	4.8
912	do	do	36.7	1,264	46,420	.06	—	3.8
913	do	do	37.7	1,070	40,365	.08	—	2.8
Averages[1] for aquifer test number 2				1,310	45,300	0.06		
21-30-302	Pumped	July 14, 1970	30.6	791	24,221	—	189	11.9
385	Observation	do	37.6	954	35,896	0.04	—	4.9
386	do	do	37.3	955	35,640	.30	—	3.7
387	do	do	40.0	937	37,491	.03	—	2.5
Averages[1] for aquifer test number 3				910	33,300	0.12		
Averages[1] for all tests				1,370	50,100	0.11		

[1] Permeability and transmissibility averages rounded to three significant figures.

represents nearly 75 percent of the total ground-water pumpage.

The estimated pumpage of ground water by use from the Seymour Formation in 1969 is shown below:

USE	PUMPAGE MILLION GALLONS PER DAY	ACRE-FEET PER YEAR
Irrigation	3.37	3,770
Industry	.14	150
Public supply	.65	730
Rural domestic and livestock	.31	350
Total*	4.47	5,000

*Figures are approximate because some pumpage is based on estimated values.

A few irrigation wells were developed in Baylor County as early as 1950, and several were inventoried which were reported drilled in 1951, 1952, 1953, and 1954. Due to the extended severe drought from the early 1950's until 1957, more than 100 irrigation wells were drilled in the county during 1955, 1956, and 1957. Development continued from 1957 until the present, though at a much slower rate. In 1952, there were about 10 irrigation wells in use in the county and the number has increased to the present 205. Possibly a total of about 300 wells produce or have produced water for irrigation from the Seymour Formation in the county but many have been abandoned or replaced by new wells.

The amount of water pumped for irrigation has varied considerably through the years, first because of increased development, but since 1956, mostly in response to the amount of rainfall. The following table shows the total estimated pumpage of irrigation water from the Seymour from 1952 through 1969:

YEAR	PUMPAGE (acre-feet)
1952	60
1953	390
1954	650
1955	880
1956	3,130
1957	2,180
1958	1,380
1959	2,750
1960	2,740
1961	1,550
1962	2,990
1963	3,580
1964	5,060
1965	4,990
1966	4,850
1967	3,850
1968	2,100
1969	3,770
Total	46,900

The total pumpage figures were calculated by applying production figures from power-yield tests conducted during this investigation (Table 5) to figures for power consumption by irrigation wells collected from electric power cooperatives. The amount of irrigation pumpage is not expected to vary significantly in the future, except in response to precipitation variations.

The city of Seymour has obtained its municipal water supply for many years from wells tapping the Seymour Formation. There were at least six wells in use in 1948, when two new wells were drilled. In 1949, one of these wells was abandoned. Because of water shortages and drastically lowered water levels during the drought of 1951-57, the city began a search for a more extensive water supply. Test holes were drilled on several tracts near the city in an attempt to develop an adequate supply. During 1956, two additional wells were drilled within the city. In 1959, the city leased the water rights on about 200 acres of land located just north of town and five wells were drilled, and in 1965, an additional six wells were drilled on the lease. In 1969, the city of Seymour was operating 19 public-supply wells. This includes one well used for irrigation in the city park, and one well from which the city sells water to Sun Oil Company for waterflooding. One hundred and eleven acre-feet of water was used by Sun in 1969.

Pumpage of water for municipal usage has remained fairly constant over the last 15 years as is illustrated by the following table:

YEAR	PUMPAGE (acre-feet)
1955	450
1956	820
1957	640
1958	610
1959	500
1960	670
1961	580
1962	590
1963	640
1964	680
1965	680
1966	630
1967	660
1968	670
1969	730
Total	9,550

This represents an average annual pumpage of about 640 acre-feet of water for public supply from the Seymour

Table 5.—Results of Power-Yield Tests Conducted on Selected Irrigation Wells

WELL	OWNER	TYPE OF PUMP[1]	PUMP HORSE-POWER	YIELD IN GALLONS PER MINUTE	GALLONS PER KILOWATT HOUR	KILOWATT HOURS PER HOUR
21-22-729	Westley T. Cockroft	T	7.5	155	1,788.5	5.2
809	Franklin Coufal, Jr.	T	7.5	230	2,437.5	3.2
810	do	T	5	190	2,850.0	4.0
844	Florence B. Parker, et al.	T	5	290	4,848.0	3.6
845	do	T	7.5	235	3,057.0	4.6
903	do	T	5	211	3,436.7	3.7
30-117	Emmet Golden, et al.	S	5	60	782.6	4.6
222	Billy W. Golden	T	7.5	65	894.5	4.4
254	Mrs. Denton Powell	T	4.5	100	1,000.0	6.0
302	T. C. Griffin	T	10	189	1,898.1	6.0
329	Emitt Golden & Company	T	10	50	567.6	5.3
337	Bill Elliston	T	15	180	437.8	24.7
339	Lee Wayne McQuire	T	15	210	1,072.3	11.8
341	do	T, Cf	5, 10	195	1,063.6	11.0

[1] T, turbine; S, submersible; Cf, centrifugal.

Formation in the county. This aquifer is the sole source of water for the city of Seymour. Monthly variations in pumpage for 1969 are shown on the following table:

MONTH	PUMPAGE (acre-feet)
January	42.4
February	37.4
March	36.5
April	51.4
May	56.3
June	71.5
July	133.4
August	128.4
September	43.1
October	39.5
November	51.7
December	36.4
Total for 1969	728.0

The municipal use of water from the Seymour Formation in the county should remain relatively constant in the future.

Most of the industrial usage of water from the Seymour Formation in Baylor County is confined to small capacity wells supplying small businesses such as service stations and cotton gins. In the past, when the cotton gins were operated by steam power, much more water was used by this industry. Some of the first wells dug in the county were used to supply water for cotton gins. Other industrial operations in the county use only small amounts of water estimated to be about 40 acre-feet in 1969.

Prior to 1900 water from the Seymour Formation had been used for domestic and livestock supplies. In 1969, an estimated 350 acre-feet of water was used for these purposes. Before urbanization reduced the number of people living in the rural areas of the county, a much larger amount of water was probably used each year for domestic and livestock supplies. Pumpage of water from the Seymour Formation in the county for domestic and livestock use will probably remain relatively constant in the future.

Changes in Water Levels

The normal changes in the depth to the water table (water level) within the Seymour Formation are cyclic in nature. There are two major cycles which may be observed. The first cycle, shown by the hydrographs in Figure 12, includes the seasonal changes from month to month. A monthly water-level measurement program was conducted during 1969 and early 1970, and measurements in selected observation wells were used to construct the hydrographs. The hydrographs show, as might be expected, relatively high water levels during the winter and early spring months, caused by decline in pumping, higher fall and winter precipitation, and lowered evapotranspiration; and a decline of water levels in the summer as a result of less rainfall, increased pumping, and high evapotranspiration.

The second cycle, illustrated by the hydrographs of yearly water-level measurements in Figure 13, is irregular due to long-term periods of high rainfall or drought which generally vary in length and intensity. This cycle is also emphasized by pumpage of ground water, especially for irrigation, because of increased need for water in times of drought. A program of yearly measurements of water levels in selected irrigation wells completed in the Seymour aquifer was initiated in the 1950's by the U.S. Geological Survey. This program is now administered by the Texas Water Development Board. Measurements are made in January when the water table should be at its highest.

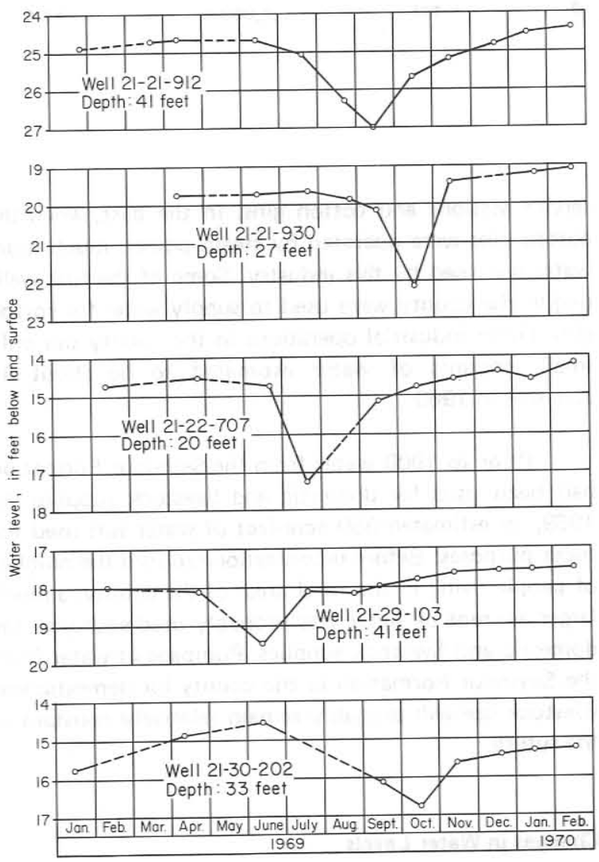


Figure 12.—Hydrographs of Water Levels in Monthly Observation Wells in the Seymour Formation, January 1969-February 1970

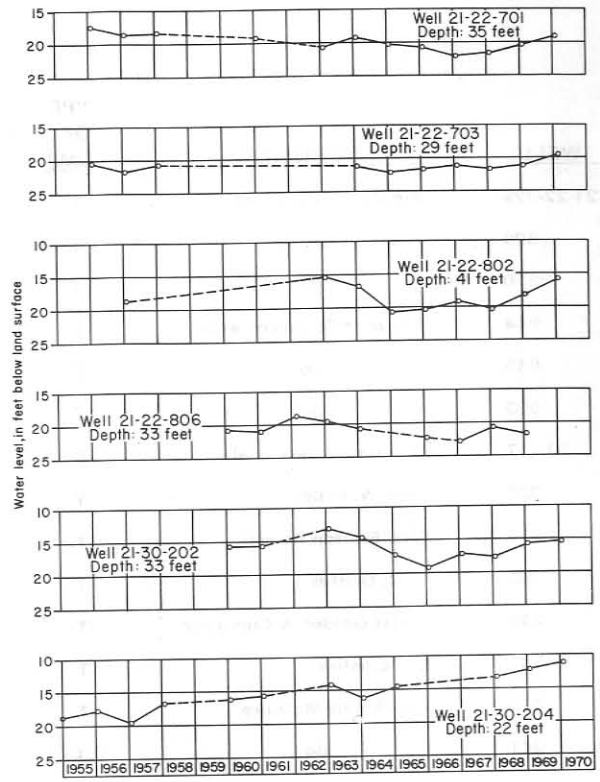


Figure 13.—Hydrographs of Water Levels in Yearly Observation Wells in the Seymour Formation, 1955-70

When a well is pumped and ground water is removed from an aquifer, a depression shaped like an inverted cone is formed in the water-table surface surrounding the pumped well. If several closely spaced wells pump water from the same aquifer, their cones of depression may overlap causing additional lowering of water levels in the area.

Prolonged heavy pumpage causes the water levels in the Seymour Formation to decline rapidly due in part to the thin saturated thickness and limited extent of the aquifer. However, the shallow aquifer is overlain by sandy soil with high permeability which allows rapid infiltration of precipitation. Thus, the Seymour water levels rise in response to the rapid infiltration more quickly than those in deeper aquifers with less permeable overburdens. Because of this rapid recharge to the aquifer, only an extended drought would seriously reduce the amount of water available from the Seymour Formation.

Well Construction

Most of the older wells in the county are hand dug and cased with concrete rings (31 or 42 inches in diameter) or lined with field stone. Most of the dug wells are used for domestic, livestock, and some industrial supplies. However, a few have been reworked or deepened, cased with steel casing, and gravel packed for irrigation use. Some of the older wells of the city of Seymour are large-diameter wells that were hand dug.

Most of the wells developed recently in the county were drilled with rotary rigs known as "bucket rigs." Usually a large hole about 24 to 36 inches in diameter is drilled and the well is cased with steel casing and gravel packed. Occasionally large diameter galvanized culvert is substituted for the steel casing. Major wells used to supply irrigation or municipal water are usually cased with 12-inch, 14-inch, 16-inch, or 18-inch steel casing, while wells supplying water for domestic, livestock, or other purposes are often cased with steel casing that is 6, 8 or 10 inches in diameter. This steel casing is usually torch slotted about 5 to 15 feet above the total depth. A few wells are cased with thin gauge galvanized metal casing or plastic well casing. Several wells which are equipped with centrifugal pumps have a pump pit around the wellhead to place the pump about 7 to 12 feet below the ground surface.

Most of the wells inventoried in the county have pumps powered by electricity, although a few irrigation pumps are powered with butane gas engines.

Most of the domestic, livestock, and industrial supply wells in the county are equipped with small (1/3 or 1/2 horsepower) jet pumps, which generally produce less than 25 gpm.

The larger capacity wells, for irrigation and municipal supply, are equipped with turbine or centrifugal pumps. These large pumps are generally powered with 1 to 15 horsepower motors. A few of the wells are equipped with 1-1/2 to 3 horsepower submersible pumps. These major wells produce from less than 50 gpm to more than 500 gpm, with the average being about 200 gpm.

Availability of Ground Water for Future Development

An estimated 116,000 acre-feet of water was in storage within the Seymour aquifer at the end of 1969. This figure was calculated using the areal extent of the main water-bearing portion of the Seymour Formation, an estimated average saturated thickness of 12.5 feet, and an average porosity of 20 percent. A part of the water in storage, however, cannot be withdrawn because of molecular forces which bind it to the rock surfaces within the aquifer. Generally, at least in a water-table aquifer such as the Seymour, the specific yield (or storage coefficient) is used as a measure of the amount of water available within an aquifer. By substituting the average specific yield of 14 percent for the 20 percent porosity, it was calculated that it would theoretically be possible to develop 81,000 acre-feet of water from the Seymour Formation in the county. Pumping this amount would be impractical, however, because in dewatering the aquifer (mining the ground water), the capacities and efficiencies of wells producing from the aquifer would be lowered drastically, and perhaps even the general chemical quality of the water would be adversely affected.

The potential yield of an aquifer is defined as the amount of ground water that can be continuously withdrawn from an aquifer without creating abnormally low water levels or exceeding the recharge rate. Thus, the potential yield for the Seymour Formation in the area between the Brazos and Wichita Rivers north and west of the city of Seymour is equal to the total recharge for a year of average rainfall (25.57 inches). This average recharge was calculated at about 10,100 acre-feet per year.

The amount of ground water available for future development would therefore be the potential yield less the average pumpage from the aquifer. Using 5,000 acre-feet per year as the average pumpage, the water available for future development from the Seymour aquifer is about 5,100 acre-feet per year.

An attempt was made to locate areas where at least a part of this 5,100 acre-feet might be economically developed, either by pumping more water from existing wells, or through drilling of new wells. The physical nature of the aquifer generally lends itself to extensive development only where the saturated thickness exceeds 15 feet. Therefore, these areas on the saturated thickness map of the Seymour Formation in west-central Baylor County (Figure 14) were examined closely. Using the average recharge rate, the amount of recharge was calculated for each area with 15 feet or more saturated thickness. If the recharge was higher than the estimated pumpage, the area was designated as favorable for future development; if the pumpage exceeded the recharge, the area was considered not favorable for future development. The areas of future development shown on Figure 14 were calculated to be able to produce about 1,500 acre-feet more water than was produced in 1969. Because of the shallow water table and the large areas with very thin saturated intervals in the Seymour

aquifer, much of the remainder of the 5,100 acre-feet of water calculated as available for future development is probably impossible or at least impractical to develop. Much of the 3,600 acre-feet difference is lost to evaporation and to seeps and springs along the margins of the aquifer where the saturated thickness is inadequate to sustain the large yields required for irrigation use.

Conservation of Ground Water

Because of its shallow water table and limited areal and vertical extent, the Seymour aquifer in Baylor County is especially sensitive to both overdraft and water-quality contamination. Good, well thought-out conservation measures, however, can maintain the Seymour aquifer in its present state as an adequate source of relatively good quality water for irrigation, municipal, industrial, domestic, and livestock supplies.

Care should be taken to maintain the pumpage within the potential yield of the aquifer. Special consideration should also be used in the spacing of any new or replacement wells in order to avoid interference between the cones of depression. Care should also be used in equipping wells. Large capacity pumps should be avoided.

Because of the relative ease with which contaminants may reach the shallow water table of the Seymour Formation, special care should be taken in the handling and disposal of water, such as oil-field brine or sewage, which might cause deterioration of water quality.

Recent Alluvium

In Baylor County, the Recent alluvium consists of deposits of gravel, sand, silt, and clay along the floodplains of the major streams. These deposits are best developed along the Brazos River. These sediments occur on both sides of the river, but the two most extensive and well-developed areas are found on the north side, one near Round Timber in the southeast part of the county and the second about 3.5 miles southwest of Red Springs along the Knox County line in the west-central part of the county. The width of the outcrop of the Recent alluvium along the Brazos River varies from a minimum of a few hundred feet to a maximum of about 2.5 miles. The thickness of the deposits ranges from zero at the edge of the outcrop up to about 30 feet. The saturated thickness ranges from zero to about 15 feet. The Recent alluvium generally provides small amounts of ground water to wells for domestic, livestock, and irrigation purposes.

The primary source of water in the Recent alluvium is rainfall on the outcrop and underflow and spring and seep flow from the Seymour Formation. Just west of the city of Seymour, a relatively large amount of water is contributed to the Recent alluvium from the Seymour Formation where the two aquifers are in hydrologic contact.

Ground water within the alluvium occurs under water-table conditions similar to those found in the Seymour Formation. The ground water occurs in the basal portions of the sediments.

Recharge to the Recent alluvium is probably about equal to that of the Seymour Formation since the surface conditions of soil type, topography, and climate are very similar. The rate of recharge computed for the Seymour aquifer is about 10.2 percent of the yearly precipitation, which would be about 2.6 inches. It is estimated that about 3,000 acre-feet of water is received by the Recent alluvium from the Seymour aquifer along the stretch of the Brazos River west from Seymour to the Knox County line. Most of this 3,000 acre-feet of water, however, is lost as spring flow and underflow.

The movement of ground water within the alluvium is generally toward points of discharge along the river. Flow rates are probably less than those of the Seymour Formation, because of the lower hydraulic gradient.

Discharge of ground water from the Recent alluvium consists of evaporation, transpiration by plants, base flow to the river, springflow and pumpage to wells. Evapotranspiration is probably very high because of the shallow water table and the dense growths of mesquite and salt-cedar on the outcrop.

The porosity and permeability of the Recent alluvial deposits are probably in the same range as those of the Seymour Formation, since the two sediments are very similar in composition. The transmissibility is lower because of the reduced saturated thickness. The specific yield is probably also within the same range as that of the Seymour.

A total of 89 wells which produce or have produced water from rocks of the Recent alluvium were inventoried during this study. Twenty-seven have been abandoned or were unused. Of those in use, 36 supplied livestock and domestic water, 3 supplied industrial water, and 23 supplied irrigation water.

Probably the first wells in the county were developed in the Recent alluvial deposits near Round Timber, the site of the first settlement in the county. These wells were developed for domestic and livestock supplies. The first industrial supply well in the county was developed at Round Timber about 1900 to supply water for a cotton gin. Wells are found throughout most of the outcrop area of these sediments along the Brazos River. Several irrigation wells which produce from this aquifer have been in use in the county since 1957. The first wells drilled to produce irrigation water from the Recent alluvium were drilled on the Knox County line in the west-central part of the county. Several new irrigation wells were drilled in 1966 and 1967 near Round Timber. The following table gives the approximate pumpage of water for irrigation from the Recent alluvial deposits from 1957 to 1969:

YEAR	PUMPAGE (acre-feet)
1957	50
1958	20
1959	40
1960	20
1961	10
1962	20
1963	50
1964	40
1965	70
1966	160
1967	150
1968	110
1969	120
Total	860

Most of the irrigation wells completed in these sediments have relatively small yields. Usually several wells are pumped into the same line (a manifold system) or into a central tank. Most of the water pumped from these wells is used to irrigate coastal bermuda grass and feed grains. The total pumpage of water from the Recent alluvium for all purposes, is probably about 200 acre-feet per year.

No comparative measurements are available to show the changes in the water levels of wells completed in the Recent alluvium in Baylor County. It can be assumed, however, because of the shallow water table and unconsolidated sediments, that the aquifer will generally follow the same cycles of water-level fluctuations as the Seymour aquifer. Where these deposits are in hydrologic contact with the Seymour Formation, lowering of the water table in the Seymour lessens the amount of water received by the Recent alluvium and should cause a corresponding lowering of water levels.

Most of the older wells completed in the rocks of the Recent alluvium are hand dug and lined either with field stone or large diameter concrete rings (generally 31 or 42 inches in diameter). The newer wells, including most of the irrigation-supply wells, are drilled with a rotary rig and cased with steel oil-field casing (usually 10 to 18 inches in diameter). Most of the irrigation wells are gravel packed. Wells for domestic and livestock supply are equipped with small jet pumps powered with 1/3 or 1/2 horsepower electric motors or windmills. These pumps generally supply less than 10 gpm. Most of the irrigation wells are equipped with centrifugal pumps powered with 1, 1-1/2, or 2 horsepower electric motors. The capacity of these wells ranges from about 25 to 75 gpm. Usually the irrigation wells pump into a central tank, from which water is delivered to the field by a large-capacity centrifugal pump.

No attempt was made to calculate either the amount of water in storage within this aquifer or the quantity of water available for development. There are probably areas within the outcrop of the Recent alluvium in the county where small groups of wells similar to those already developed could be drilled and used to supply irrigation water on a relatively small scale. Location of these areas could be accomplished by an extensive test drilling program. Most areas where the thickness of the alluvium exceeds 15 feet should provide sufficient quantities of water for domestic or livestock uses.

Because of the relatively thin saturated thickness, careful planning would be required in locating and equipping wells for irrigation supplies. Wells should be spaced so as to minimize interference. Also, small-capacity pumps should be used to minimize drawdown. Because of the relatively limited supply of water available from this aquifer, overpumping and overdevelopment should be avoided.

SURFACE-CASING RECOMMENDATIONS FOR WATER-QUALITY PROTECTION

The Texas Water Development Board recommends to oil and gas operators and the Railroad Commission of Texas the depth to which usable quality ground water should be protected in drilling for oil and gas. The authority for participation by the Board in this surface-casing program is derived from rules promulgated by the Railroad Commission under authority given that agency by statutes dealing with the regulation of drilling and production activities of the petroleum industry.

Statewide Rule 13 (formerly Rule 12a) of the Railroad Commission requires that operators obtain a letter from the Texas Water Development Board recommending the depth to which fresh-water strata should be protected when drilling in a new lease or area, if the lease or area is not covered by field rules or lease recommendations. Railroad Commission Rule 8 (formerly Rule 20) requires that all fresh-water strata be protected in drilling or production activities.

In carrying out its duties under Rule 13, the Texas Water Development Board maintains technical data files upon which to base fresh water protection recommendations in all areas of the State, and prepares these recommendations for operators contemplating drilling oil or gas tests. The recommended depth to which ground water of usable quality should be protected in a given area is based on all pertinent information available to the surface casing staff at the time the recommendation is given. Recommended depths in any one area may therefore be revised from time to time as additional subsurface information becomes available.

Known depths of wells producing usable water, or depths of wells which formerly produce water of usable quality, such as domestic, municipal, industrial, livestock, or irrigation wells, are of primary value in determining the depth of usable water. Electric or gamma-ray neutron logs run on oil and gas tests are used in many areas to determine the depth to the base of usable quality ground water. Surface elevation is given special consideration when a recommendation is given in an area that has moderate to high surface relief, as is common to portions of Baylor County. This consideration is imperative when the slope of the land surface does not conform to the dip of the underlying rocks, because of the danger that poor quality water will cause contamination of surface and ground water by moving along the dip of the beds of fresh water zones or to points of discharge in stream channels. All of this information is interpreted in the light of the available knowledge of the geology and ground-water hydrology available on the area involved.

OIL-FIELD BRINE PRODUCTION AND DISPOSAL

Quantity and Distribution of Produced Brine

During 1962, the Railroad Commission of Texas, the Texas Water Pollution Control Board, and the Texas Water Commission cooperated in the collection and tabulation of information submitted by oil and gas operators concerning the 1961 oil-field brine production and disposal in Texas. The Railroad Commission of Texas and the Texas Water Development Board have cooperated in a similar collection and tabulation of the 1967 oil-field brine production and disposal in the State. Table 10 is a summary of the brine production in 1961 and 1967 by oil fields, grouped by arbitrarily defined producing areas. The location and extent of the brine-producing areas in the county and the amount of brine production and method of disposal in each area for 1967 are shown on Figure 17.

The total production of oil-field brines reported for 1967 (10,258,360 barrels) was about 85 percent of the total reported for 1961 (12,027,319 barrels). In 1961, 102,270 barrels or 0.85 percent of the total production was reported disposed of into open, unlined surface-disposal pits. However, no salt water was reported placed into pits for disposal in 1967. This drop is probably due to the no-pit order issued by the Railroad Commission in 1965. In 1961, 11,665,118 barrels or 96.99 percent of the total production of salt water was reported injected into wells for disposal. This includes both pressure maintenance wells and salt-water disposal wells. In 1967, 10,254,710 barrels or 99.96 percent of the total reported production was disposed by injection. In 1961, 259,931 barrels or 2.16 percent of the total reported brine production was disposed of by other miscellaneous methods, such as dumping into surface drainageways or on road and lease surfaces. In 1967, however, miscellaneous disposal was reported for only 3,650 barrels or 0.04 percent of the total brine production.

There have been some significant changes in the distribution of brine production and in the methods of its disposal in the county since 1961 as shown on Figure 17. Four of the areas (areas 3, 8, 10, and 12) ceased producing brine after 1961. In 1961, some brine was being disposed in open-surface pits in areas 1, 2, 9, 12, 13, and 14. In 1967, however, disposal of brine in surface pits had reportedly ceased in all areas. All areas were disposing brine by injection into the subsurface or by other miscellaneous methods.

Chemical Quality of Produced Brine

Chemical analyses of some oil-field brines from various producing zones in Baylor County are tabulated in Table 9. These analyses show the same ions present in the brines that are present in samples from water wells used for domestic and livestock supplies (Table 8). However, the sodium, magnesium, calcium, and chloride ions are present in much greater concentration in the brines.

Table 8 presents chemical analyses in milligrams per liter, which is the preferred metric system unit. Table 9 presents similar data (from Laxon and others, 1960 and B J Service, 1960), but in ppm (parts per million) by weight. Parts per million may be considered equal to milligrams per liter at concentrations less than about 7,000 ppm. At higher concentrations the units are not directly interchangeable, as conversion must take into account the greater differences in density of saline waters.

In the brine samples in Table 9, the sodium concentration ranges from 36,000 to 56,000 ppm. The chloride concentration ranges from 50,500 to 125,050 ppm. The concentration of magnesium ranges from 1,232 to 2,930 ppm. The range in calcium concentration is from 6,190 to 18,390 ppm, and the range in dissolved solids is from 105,000 to more than 202,000 ppm.

ALTERATION OF NATIVE QUALITY OF GROUND WATER

Alteration of the chemical quality of ground and surface water, as evidenced by the chemical analyses of water, has occurred locally in Baylor County. Although a study of the contamination of surface water was not included in the scope of this report, it is impossible to ignore the interrelationship of ground and surface water. Alteration of the chemical quality of surface water may affect the quality of ground water by downward percolation of the altered water, and alteration of ground-water quality may affect surface water by outflow from springs and by contribution to the base flow of streams.

The alteration of the chemical quality of ground water may be due to both natural and artificial means. Natural alteration occurs when water dissolves minerals from the rocks over which it flows or through which it percolates. In Baylor County, natural alteration is evidenced by high sulfate concentration (from anhydrite) and high bicarbonate concentration (from limestone and dolomite).

Artificial alteration of the quality of ground water may be either biological or chemical. Biological contamination is usually evidenced by a high nitrate concentration in the water and is usually due to poor well construction and to location of water wells near septic tanks, livestock feedlots, and barnyards. Several wells in the county seem to be contaminated by one or more of these causes.

Alteration of the chemical quality of ground water may also be associated with the operations of the oil and gas industry. Brine produced with oil and gas may comingle with usable-quality water in several ways. Brines placed in shallow surface pits for disposal may contaminate ground water by downward seepage or percolation. Overflow of brines from surface pits may contaminate surface water. Saline water may move up the bore holes of improperly plugged or cased wells into shallow fresh-water zones, due to natural pressure and the pressure of secondary-recovery injection. Ground-water quality may also be altered by lateral and vertical movement of injection fluids from improperly constructed municipal and industrial waste-disposal wells.

Figure 15 shows diagrams of the chemical analyses of water from some apparently contaminated wells, native quality or apparently unaltered ground water, and a typical oil-field brine. The diagrams illustrate the chemical similarity between a typical oil-field brine and water from wells which have been apparently contaminated by brine. Only a small amount of brine entering a water supply is necessary to change significantly the chemical character of the water. There are only a few indications of apparent contamination in the county probably because efforts have been made and are being made by many petroleum operators to avoid contamination of the soil, surface water, and ground water, especially by curtailing the use of open, unlined surface pits as a means of brine disposal. The locations of wells, apparently contaminated by oil-field brines, are shown on Figure 17.

SUMMARY AND CONCLUSIONS

Approximately 1,500 acre-feet of ground water is available annually for future development from the Seymour aquifer in Baylor County. This is equal to about 1.4 million gallons per day. Development of this additional water would raise the pumpage about 30 percent from 5,000 to 6,500 acre-feet per year. Another 3,600 acre-feet per year was calculated as available, but is impractical to produce because of the thin saturated thickness over much of the outcrop area and the high loss to evaporation.

About 50 percent of the water available from the Seymour Formation is pumped at the present time, mostly for irrigation purposes (about 3,770

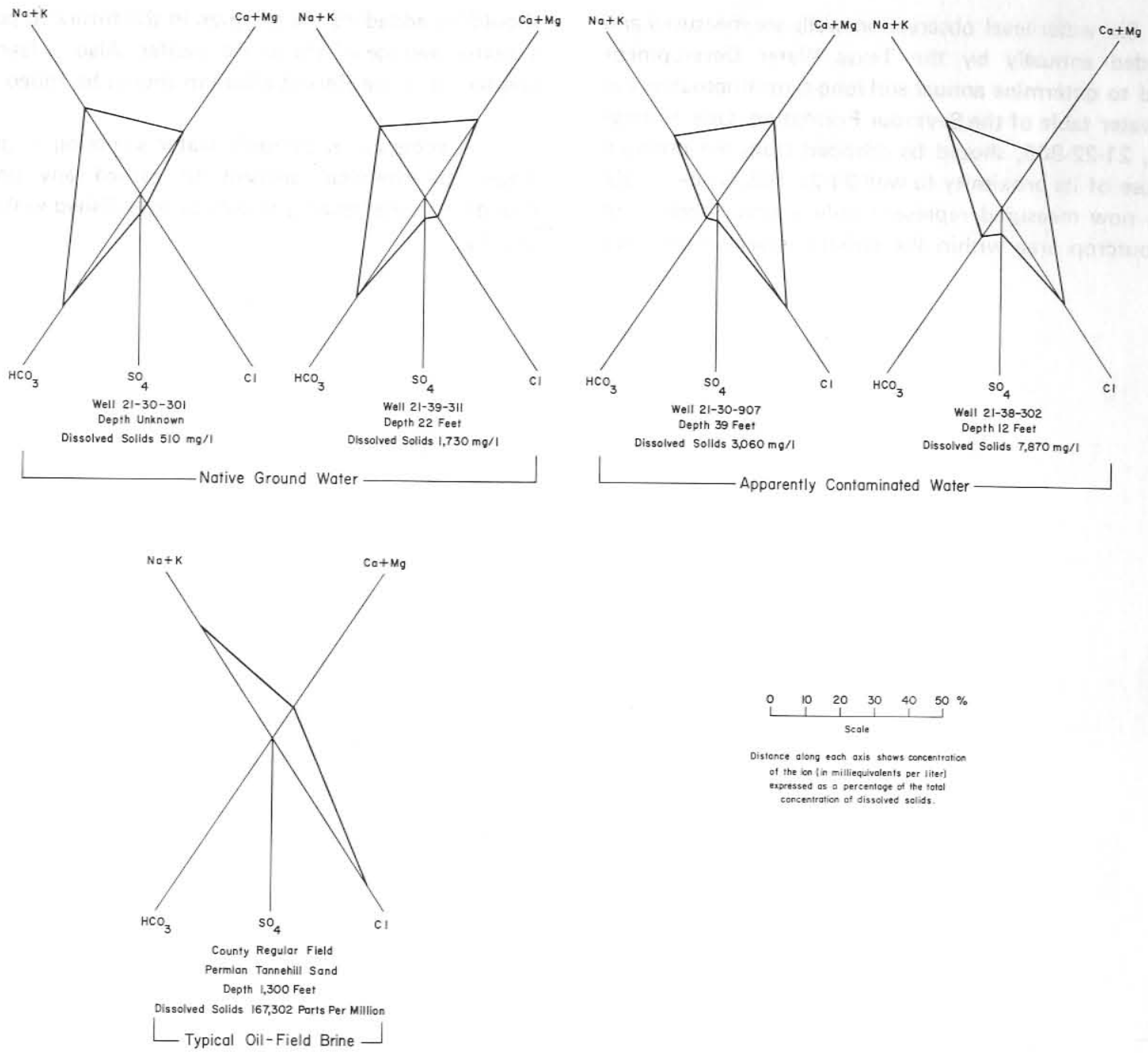


Figure 15.—Diagrams of Chemical Analyses of Ground Water From the Seymour Formation and a Typical Oil-Field Brine

acre-feet per year) and municipal uses (about 730 acre-feet per year).

There is a possibility of development of limited supplies of ground water for irrigation purposes from the Recent alluvium along the Brazos River within the county. Special care must be taken in equipping and spacing the wells, however, since the aquifer has limited areal and vertical extent and could easily be overdeveloped.

Contamination of ground-water supplies with oil-field brines has not been an extensive problem within the Seymour Formation and Recent alluvium because of the Railroad Commission of Texas order banning surface-disposal pits. However, the water-producing formations in the county have some problems with possible contamination caused by biological wastes. Many of these problems could be avoided in the future by more careful location of water wells with respect to septic tanks, barnyards, and other sources of organic material; better construction of wells, especially in sealing in the top; and more careful location and construction of septic tanks.

Any future development of water from the Seymour Formation should be preceded by a complete program of test drilling and test pumping of wells to determine local aquifer characteristics. The wells should be drilled at optimum spacing to avoid interference between cones of depression, and they should equipped with pumps selected to provide only the amounts of water which the aquifer can safely produce.

Six water-level observation wells are measured and recorded annually by the Texas Water Development Board to determine annual and long-term fluctuations in the water table of the Seymour Formation. One of these wells, 21-22-806, should be dropped from the program because of its proximity to well 21-22-703. Since the six wells now measured represent only a small portion of the outcrop area within the county, several new wells should be added to the program in the future to provide a better average of the entire aquifer. Also, a few wells completed in the Recent alluvium should be added.

A program of periodic water sampling of ground water for chemical analysis to record any possible changes in water quality should be established within the county.

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Table 6. -- Records of Water Wells and Springs

Water-bearing unit : Qal, Recent alluvium; Qs, Seymour Formation; Pw, Wichita Group; Pcf, Clear Fork Group; PPcs, Cisco Group; PPcn, Canyon Group; C, Cambrian.

Water levels : Reported water levels given in feet; measured water levels given in feet and tenths.

Method of lift and type of power: B, bucket or bailer; C, Cylinder; Cf, centrifugal; E, electric; G, natural gas, butane, or gasoline; H, hand; J, jet; N, none; 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.

All wells are drilled unless otherwise noted in remarks.

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
20-25-401	American Petrofina Company of Texas	Cosden Petroleum Company	1961	946	10-3/4 7 3	242 957 875	Pw	1,175	846 846	Oct. 19, 1963 Nov. 15, 1969	C, E	Ind	Converted oil test used in waterflooding operation.
* 33-703	Mrs. J. L. Hargraves	--	--	27	36	--	Qal	1,256	20.5	Nov. 7, 1968	C, W	N	Dug well. Windmill broken.
* 21-21-601	Travis J. Peacock	Donald J. Peacock	--	36	42 31	--	Qs	1,310	27.6 26.9	Feb. 13, 1969 Jan. 21, 1970	J, E	D, S	Dug well. Springs and seeps along bluff nearby.
* 602	do	--	--	43	30	--	Qs	1,322	26.5	Feb. 13, 1969	C, W	N	Dug well. Wind mill broken.
* 701	Henry P. Arledge	--	1954	25	36	--	Qs	1,403	19.2 18.9	Feb. 11, 1969 Jan. 21, 1970	C, W	S	Dug well.
* 702	do	--	1943	28	36	--	Qs	1,409	21.0 20.6	Feb. 11, 1969 Jan. 21, 1970	C, W	S	Do.
703	do	--	--	Spring	--	--	Qs	1,388	(+)	--	Flows	N	Spring flows 25+ gpm.
* 801	Herman Yungman	--	--	56	30	--	Qs	1,358	27.1 26.8 26.9 25.3 24.7 25.2	Jan. 23, 1969 Apr. 23, 1969 July 18, 1969 Oct. 15, 1969 Mar. 17, 1970 May 13, 1970	C, W J, E	S	Dug well. Used as monthly observation well in this study.
* 802	Henry P. Arledge	--	1939	25	24	--	Qs	1,351	17.1 17.4	Feb. 11, 1969 Jan. 21, 1970	J, E	D, S	Dug well.
* 803	do	--	--	19	31	--	Qs	1,387	10.0 10.0 10.5 10.8 8.3 7.0	Feb. 12, 1969 Apr. 23, 1969 July 18, 1969 Sept. 15, 1969 Dec. 18, 1969 May 13, 1970	C, W	N	Dug well. Windmill broken. Used as monthly observation well in this study.
804	do	Lewis Barnes	1969	49	--	--	Qs	1,391	15.0	July 7, 1969	N	N	Core test drilled for this report. Base of Seymour at 22 feet. Very little water in Seymour. No water in Permian clay and siltstone.[1]
* 901	Trula Burkhalter	Les Jameson	1956	33	10	--	Qs	1,354	19.5 21.5 21.2 20.8	Apr. 19, 1956 Jan. 14, 1961 Feb. 4, 1969 Jan. 21, 1970	Cf, E 1-1/2	Irr	Well reported drilled one foot into redbeds. Yield reported 50 gpm. Yield drops to 30 gpm after pumping several days.
* 902	Elizabeth Hertel	--	--	28	31	--	Qs	1,356	21.8 22.3 24.8 21.6 21.2 24.4	Jan. 2, 1969 Apr. 11, 1969 July 18, 1969 Sept. 15, 1969 Dec. 18, 1969 May 13, 1970	J, E	S	Dug well. Used as monthly observation well in this study.
903	do	--	--	29	31	--	Qs	1,359	27.3	Jan. 2, 1969	J, E	S	Dug well.

See footnotes at end of table.

Table 6. -- Records of Water Wells and Springs -- 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
21-21-904	Elizabeth Hertel	--	--	37	30	--	Qs	1,363	23.8 23.6	Jan. 23, 1969 Jan. 21, 1970	C, W	N	Dug well. Windmill broken.
905	Edwin R. Brom	Les Jameson	1956	36	20	40	Qs	1,356	25.5	Jan. 23, 1969	Sub, E 2-1/2	Irr	Reported drilled to 40 feet. Reported drilled 1 foot into redbeds. Gravel packed.
906	do	do	1956	34	13	37	Qs	1,356	25.3 25.0	do Jan. 21, 1970	T, E 3	Irr	Reported drilled to 37 feet. Reported drilled 1 foot into redbeds. Gravel packed.
907	do	do	1956	42	13	42	Qs	1,357	--	--	T, E 2	N	Caved. Reported drilled 1 foot into redbeds. Formerly used as an irrigation supply. Gravel packed.
908	do	do	1956	42	13	42	Qs	1,358	26.8 23.3 26.5 26.0	Jan. 14, 1956 Apr. 19, 1956 Jan. 23, 1969 Jan. 21, 1970	T, E 2	Irr	Reported drilled 43 feet, 1 foot into redbeds. Gravel packed.
909	Dudley B. Myers	Dudley B. Myers	1955	33	24	--	Qs	1,353	22.8 22.8	Jan. 23, 1969 Jan. 21, 1970	Cf, E 1	Irr	Dug well. Dug to redbeds. When pumped with well 21-21-910, reported to make about 250 gpm.
* 910	do	do	1956	39	24	--	Qs	1,353	23.6 23.4	Jan. 23, 1969 Jan. 21, 1970	T, E 5	Irr	Dug well. Dug to redbeds. See well 21-21-909.
911	do	Les Jameson	1957	42	12	--	Qs	1,354	--	--	Sub, E 2	Irr	Reported to pump 100 gpm. Gravel packed.
912	do	do	1960	41	12	--	Qs	1,354	24.9 24.7 25.1 27.0 24.8 23.9	Jan. 23, 1969 Mar. 20, 1969 July 18, 1969 Sept. 15, 1969 Dec. 18, 1969 May 13, 1970	Cf, E 1-1/2	Irr	Used as monthly observation well in this study. Reported to make 75 gpm. Gravel packed.
913	Trula Burkhalter	do	1956	35	12	--	Qs	1,354	20	July 11, 1960	Cf, E 1	Irr	Reported to pump 50 gpm.
914	do	Dale Heard	1958	32	17	--	Qs	1,354	--	--	Cf, E 1	Irr	Reported to pump 100 gpm.
915	do	Les Jameson	1959	34	21	--	Qs	1,352	21.0	Feb. 4, 1969	Cf, E 1	Irr	Reported to pump 60 gpm.
* 916	do	do	1956	33	12	33	Qs	1,352	--	--	Cf, E 1	Irr	Reported to pump 90 gpm.
* 917	Riley P. Henson	--	--	28	31	--	Qs	1,342	16.4 15.4	Feb. 4, 1969 Jan. 21, 1970	J, E 1-1/3	S, Irr	Dug well. Pumps into central tank with wells 21-21-933 and 21-21-934, distributed by centrifugal pump for irrigation. Reported to pump about 45 gpm.
918	Rex Howell	Les Jameson	1956	43	15	--	Qs	1,353	21.6 20.5 21.9 21.0	Feb. 5, 1969 Apr. 27, 1970 Apr. 29, 1970 Apr. 30, 1970	T, G	Irr	Reported to pump 600 gpm when drilled. Used as observation well in pumping test of well 21-21-920. Gravel packed.
919	do	do	1955	44	12	--	Qs	1,353	22.6	Feb. 5, 1969	T, E 3	Irr	Pumping rate 125 gpm, measured Apr. 26, 1970. Reported to pump 150 gpm. Gravel packed.
* 920	do	do	1956	44	13	--	Qs	1,353	22.0 28.4 22.6	Apr. 27, 1970 Apr. 29, 1970 Apr. 30, 1970	T, G	Irr	Reported to pump 700 gpm when drilled. Used as pumping well for pumping test in this study. Three observation wells drilled nearby. Pumped at about 465 gpm for 48 hours. Gravel packed.[2]
921	James H. Waldron and Benjamin C. Moore	do	--	38	15	--	Qs	1,352	21.1 21.1	Feb. 5, 1969 Jan. 21, 1970	Cf, E 1	Irr	Gravel packed.

See footnotes at end of table.

Table 6. -- Records of Water Wells and Springs -- 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
21-21-922	James H. Waldron and Benjamin C. Moore	Les Jameson	--	38	15	--	Qs	1,352	20.9 21.0	Feb. 5, 1969 Jan. 21, 1970	N	N	Drilled and cased for irrigation supply. Not equipped yet. Gravel packed.
923	W. C. Hertel	--	--	23	31	--	Qs	1,370	15.0 14.0	Feb. 11, 1969 Jan. 21, 1970	J, E	D, S	Dug well.
* 924	Travis J. Peacock	--	1946	100	--	--	Pcf	1,323	32.8	Apr. 9, 1969	N	N	Base of Seymour Formation reported at 10 feet. No water in Seymour. Water reported salty when drilled. Windmill broken. Drilled for livestock supply.
* 925	Trula Burkhalter	--	1933	24	31	--	Qs	1,352	21.3 20.9	Feb. 26, 1969 Jan. 21, 1970	J, E	D, S	Dug well.
926	do	Les Jameson	--	26	14	--	Qs	1,353	20.1 20.4 20.5 20.8 20.1 20.1	Feb. 27, 1969 Mar. 20, 1969 June 13, 1969 Oct. 15, 1969 Jan. 15, 1970 May 13, 1970	N	N	Used as monthly observation well in this study. Formerly used as irrigation supply. Gravel packed.
927	do	do	1956	25	18	--	Qs	1,353	12.9	Apr. 19, 1956	N	N	Silted up in 1967 flood. Formerly used as an irrigation supply. Gravel packed.
928	do	do	1956	28	--	--	Qs	1,353	--	--	N	N	Do.
929	Clifford Heard	Dale Heard	1959	38	13	--	Qs	1,348	21.7	Apr. 10, 1969	T, G	Irr	Reported to pump 100 gpm. Owner uses tractor motor to run pump. Gravel packed.
930	do	do	1958	27	13	--	Qs	1,346	19.7 20.1 22.1 19.1 19.0 19.0	do Sept. 16, 1969 Oct. 15, 1969 Feb. 18, 1970 Apr. 15, 1970 May 13, 1970	T, E 3	Irr	Well reported to have pumped 400 gpm when first drilled; 200 gpm now. Used as monthly observation well in this study. Gravel packed.
931	W. T. Ward	Les Jameson	1964	40	21	--	Qs	1,348	21.9	Apr. 9, 1969	T, E 3	Irr	Reported to pump about 140 gpm. Gravel packed.
932	do	do	1964	39	21	--	Qs	1,348	20.7	do	T, E 3	Irr	Reported to pump about 160 gpm. Gravel packed.
933	Riley P. Henson	Ernest Knesek	1969	31	18	31	Qs	1,336	18.5 18.0	do Apr. 10, 1969	J, E 2	Irr	Water-level measurement taken three hours after pumping 50 gpm for one hour. Pumps into central tank. Water distributed from tank by 7-1/2 horsepower electric centrifugal pump.
934	do	do	1969	29	--	--	Qs	1,337	--	--	J, E 1/2	Irr	Pumps into central tank. Water distributed from tank by 7-1/2 horsepower electric centrifugal pump. Reported to pump 30 gpm.
935	J. C. Wright, Jr.	Les Jameson	1959	37	13	--	Qs	1,354	22.9	June 18, 1969	T, E 3	Irr	Reported to pump 150 gpm. Gravel packed.
936	do	do	1959	42	13	42	Qs	1,354	23.0	June 26, 1969	Sub, E 5	Irr	Reported to pump 200 gpm. Gravel packed.
937	do	do	1961	42	12	42	Qs	1,354	--	--	Sub, E 1-1/2	Irr	Reported to pump 90 gpm. Gravel packed.
938	do	do	1964	38	8	38	Qs	1,354	21.8	June 18, 1969	J, E	D, S	Gravel packed.

See footnotes at end of table.

Table 6. -- Records of Water Wells and Springs -- 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
21-21-939	Rex Howell	Lewis Barnes	1969	44	3	44	Qs	1,353	24.5 21.5 21.1 21.6 25.6 22.2	July 11, 1969 Nov. 14, 1969 Feb. 18, 1970 Apr. 27, 1970 Apr. 29, 1970 Apr. 30, 1970	N	N	Drilled and cased as observation well for pumping test in this study. Water reported by driller at 21 feet. Base of Seymour at 42 feet. Casing pulled after completion of pumping test.1/ 2/
940	do	do	1969	44	3	44	Qs	1,353	24.3 21.7 21.1 21.6 25.0 22.4	July 11, 1969 Nov. 14, 1969 Feb. 18, 1970 Apr. 27, 1970 Apr. 29, 1970 Apr. 30, 1970	N	N	Do.
941	do	do	1969	43	3	43	Qs	1,353	24.0 21.4 20.8 21.6 23.9 22.0	July 11, 1969 Nov. 14, 1969 Feb. 18, 1970 Apr. 26, 1970 Apr. 29, 1970 Apr. 30, 1970	N	N	Drilled and cased as observation well for pumping test in this study. Water reported by driller at 21 feet. Base of Seymour at 42.5 feet. Casing pulled after completion of pumping test.1/ 2/
942	G. C. Laney	do	1969	27	--	--	Qs	1,353	--	--	N	N	Core test. Base of Seymour at 21.0 feet. Little or no water in Seymour.1/
* 22-401	Wallace L. Malone	Les Jameson	1967	32	15	32	Qs	1,311	23.5 22.7	Feb. 12, 1969 Jan. 22, 1970	J, E	D, S	Old dug well equipped with windmill is about 15 feet north of this well.
* 402	Ruby E. Nichols	--	--	35	31	--	Qs	1,314	20.9 20.9 21.2 21.2 21.4	Feb. 12, 1969 Apr. 23, 1969 June 13, 1969 July 18, 1969 Oct. 15, 1969	C, W J, E	D, S	Dug well. Used as monthly observation well in this study.
* 403	do	--	1949	29	13	--	Qs	1,319	25.9 25.1	Feb. 12, 1969 Jan. 22, 1970	C, W	N	Windmill broken. Formerly used as a livestock supply.
* 404	do	--	--	40	31	--	Qs	1,321	28.2 28.0	Feb. 12, 1969 Jan. 22, 1970	J, E	D, S	Dug well.
405	do	--	--	32	13	--	Qs	1,322	30.3 31.5	Feb. 12, 1969 Jan. 22, 1970	N	N	Formerly used as a livestock supply.
406	Wallace L. Malone	--	--	Spring	--	--	Qs	1,280	(+)	--	Flows	N	Spring flows about 10 gpm.
407	do	--	--	Spring	--	--	Qs	1,285	(+)	--	Flows	N	Spring flows about 15 gpm from two cuts in bluff.
408	do	--	--	Spring	--	--	Qs	1,285	(+)	--	Flows	N	Do.
501	Glen Miller	--	--	33	34	33	Qs	1,341	9.9	June 30, 1969	C, W	N	Dug well. Formerly used as domestic and livestock supply.
701	J. G. Campbell	Les Jameson	1955	35	12	36	Qs	1,342	17.4 19.2 22.1 21.6 19.2	Jan. 5, 1956 Jan. 14, 1961 Jan. 21, 1967 Jan. 18, 1968 May 13, 1970	T, E 5	Irr	Yearly observation well. Reported to pump about 200 gpm. Gravel packed.
702	Jess L. Compton	do	1957	40	14	--	Qs	1,337	--	--	T, E 5	Irr	Gravel packed.1/
703	Edward Haisler	Edward Haisler	1954	29	40	--	Qs	1,328	21.4 20.3 19.2 19.4 21.0	Apr. 10, 1969 Apr. 20, 1969 June 13, 1969 Apr. 15, 1970 May 13, 1970	Cf, E 1-1/2	Irr	Dug well. Yearly observation well. Reported to pump 75 gpm.

See footnotes at end of table.

Table 6. -- Records of Water Wells and Springs -- 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
* 21-22-704	Cora Morris estate	Les Jameson	1959	28	13	--	Qs	1,312	16.0 20.1 18.6 15.2 15.3 15.3	Feb. 11, 1969 Aug. 25, 1969 Sept. 16, 1969 Feb. 18, 1970 Apr. 23, 1970 May 12, 1970	Cf, E 3	Irr	Used as monthly observation well in this study. Reported tested by driller at 400 gpm. Reported to pump 125 gpm.
705	do	do	1959	31	12	--	Qs	1,313	14.0	Feb. 11, 1969	T, G	Irr	Reported tested at 400 gpm by driller. Reported to pump 275 gpm. Gravel packed.
706	do	do	1959	31	12	--	Qs	1,315	18.7	do	T, G	Irr	Do.
707	do	do	1964	20	12	--	Qs	1,330	14.7 15.2 14.8 14.2 14.1 14.0 14.0	do Sept. 15, 1969 Oct. 15, 1969 Feb. 18, 1970 Mar. 25, 1970 Apr. 15, 1970 May 13, 1970	Cf, E 1	Irr	Reported to pump 35 gpm. Used as monthly observation well in this study. Gravel packed.
708	do	do	1964	20	12	--	Qs	1,330	14.3	Feb. 11, 1969	Cf, E 1	Irr	Reported to pump 35 gpm. Gravel packed.
* 709	do	do	1964	22	8	--	Qs	1,331	14.3	do	Cf, E 1	Irr	Do.
* 710	Mrs. R. E. Morris	--	--	32	31	--	Qs	1,328	14.0	do	J, E	D, S	Dug well.
* 711	Heirs of J. E. Morris	--	--	22	31	--	Qs	1,333	16.0 13.5	Feb. 12, 1969 Jan. 21, 1970	J, E	D, S	Do.
712	do	--	--	27	31	--	Qs	1,338	26.9 26.3	Feb. 12, 1969 Jan. 22, 1970	N	N	Dug well. Formerly used as a domestic and livestock supply.
713	do	--	--	21	31	--	Qs	1,333	16.2	Feb. 12, 1969	C, W	N	Dug well. Windmill broken. Formerly used as a domestic and livestock supply.
714	Mattie Morris estate	--	--	26	30	--	Qs	1,363	11.2 10.8 9.4 8.7 8.6 8.6	do July 18, 1969 Jan. 15, 1970 Mar. 25, 1970 Apr. 15, 1970 May 13, 1970	N	N	Dug well. Used as monthly observation well in this study.
* 715	Heirs of J. E. Morris	--	--	26	36	--	Qs	1,355	13.5 12.4	Feb. 12, 1969 Jan. 22, 1970	B, H	D, S	Dug well.
* 716	George R. Malone	--	--	32	30	--	Qs	1,309	12.8	Apr. 10, 1969	J, E	D, S	Do.
717	J. G. Campbell	Les Jameson	1957	35	12	--	Qs	1,337	19.7	Apr. 2, 1969	T, E 5	Irr	Gravel packed.
718	do	do	1959	36	12	--	Qs	1,345	20.0	do	T, E 3	Irr	Do.
719	James E. Doss	-- Covey	1956	40	12	--	Qs	1,337	21.0	do	T, E 5	Irr	Do.
* 720	do	Les Jameson	1962	39	15	--	Qs	1,337	21.5 22.3 19.4 19.2 19.2	do Aug. 25, 1969 Feb. 17, 1970 Apr. 15, 1970 May 13, 1970	Cf, E 1	Irr	Used as monthly observation well in this study. Gravel packed.
721	do	-- Covey	1954	36	15	--	Qs	1,334	--	--	T, E 5	Irr	Gravel packed.

See footnotes at end of table.

Table 6. -- Records of Water Wells and Springs -- 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			
21-22-722	James E. Doss	-- Covey	1956	40	15	--	Qs	1,334	20.3	Apr. 2, 1969	T, E 5	Irr	Gravel packed.
723	do	do	1956	40	12	--	Qs	1,333	19.0	do	Cf, E 1	Irr	Do.
724	do	do	1954	35	12	--	Qs	1,337	19.7	do	T, E 2	Irr	Do.
725	Paulene Laney	Dickerson and Combs	--	36	12	36	Qs	1,331	21.5	Apr. 20, 1956	T, G	Irr	Base of Seymour reported at 34 feet. Reported to pump about 200 gpm. Casing slotted 21 to 36 feet. Gravel packed.
726	do	do	1953	41	12	43	Qs	1,334	26.7 26.2	Apr. 20, 1956 Feb. 11, 1969	T, G	Irr	Base of Seymour reported at 41 feet. Reported to pump about 200 gpm. Casing slotted 28 to 43 feet. Gravel packed.
727	W. T. Ward	Les Jameson	1965	41	14	--	Qs	1,345	21.0	Apr. 24, 1969	Sub, E 2	Irr	Gravel packed.
728	Edward Haisler	Edward Haisler	1953	32	42	--	Qs	1,331	22.2 21.0	Jan. 13, 1961 Apr. 10, 1969	T, E 3	Irr	Reported to pump 175 gpm. Gravel packed.
729	Westley T. Cockroft	Buster Tolson	1953	33	18	--	Qs	1,326	19.1	Apr. 24, 1969	T, E 7-1/2	Irr	Reported to pump 300 gpm. Gravel packed.
* 730	C. R. Morris	--	--	23	31	--	Qs	1,341	18.5	Nov. 21, 1969	N	N	Dug well. Formerly used as a domestic and livestock supply.
801	Carl B. Chapman	Doris Dickerson	1951	36	14	36	Qs	1,307	15.6 15.5 19.0 17.3 12.5 12.4 11.0 11.2	Feb. 27, 1969 Mar. 20, 1969 Aug. 25, 1969 Sept. 16, 1969 Dec. 18, 1969 Jan. 15, 1970 Apr. 15, 1970 May 13, 1970	T, E 5	Irr	Reported to pump 200 gpm. Used as monthly observation well in this study. Gravel packed.
802	Charles W. Hatter, et al.	-- Smelley	1953	41	14	--	Qs	1,300	18.7 20.6 20.4 15.3 14.0 13.4 13.4	Jan. 12, 1957 Jan. 14, 1965 Jan. 19, 1966 Apr. 23, 1969 June 17, 1969 Apr. 15, 1970 May 13, 1970	T, E 10	Irr	Reported to pump 400 gpm. Yearly observation well, and monthly observation well in this study. Gravel packed.
* 803	D. A. Chapman, Jr.	D. A. Chapman, Sr.	1941	36	36	--	Qs	1,302	--	--	N	N	Dug well. Abandoned, partially caved. Formerly used for irrigation supply.
* 804	do	Les Jameson	1959	41	13	41	Qs	1,302	--	--	T, G	Irr	Reported tested at 400 gpm. Reported to pump 350 gpm in 1961 and 250 gpm in 1969. Gravel packed.
805	Burrell Lee, Jr.	J. R. Rea	1955	36	14	--	Qs	1,304	13.2 14.2	Jan. 12, 1958 Jan. 14, 1960	N	N	Well destroyed 1961. Reported to have pumped 150 gpm.
806	Edward J. Haisler	Edward J. Haisler	1955	33	18	33	Qs	1,324	21.0 19.0 22.3 22.8 19.9	do Feb. 21, 1962 Jan. 19, 1966 Jan. 20, 1967 Oct. 20, 1969	T, G	Irr	Yearly observation well. Reported to pump 250 gpm. Gravel packed.
807	Burrell Lee, Jr.	Lewis Barnes	1969	55	--	--	Qs	1,308	--	--	N	N	Core test drilled for this report. Base of Seymour at 22 feet. Very little water in Seymour. No water in Permian clay and siltstone.[1]

See footnotes at end of table.

Table 6. -- Records of Water Wells and Springs -- 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
21-22-809	Franklin Coufal, Jr.	--	1955	35	15	35	Qs	1,299	14.9 14.2	Jan. 21, 1969 Jan. 21, 1970	T, E 10	Irr	Reported to pump about 300 gpm. Gravel packed.
* 810	do	--	1956	38	12	38	Qs	1,302	12.8	Jan. 21, 1969	T, E 5	Irr	Reported to pump about 225 gpm. Pumped 190 gpm during power-yield test on July 24, 1969. Gravel packed.
811	Frank Coufal, Sr.	--	1955	31	15	--	Qs	1,304	12.7 11.0	do Jan. 21, 1970	T, G	Irr	Reported to pump about 250 gpm.
* 812	do	Frank Coufal, Sr.	1954	38	12	--	Qs	1,305	--	--	T, E 5	Irr	Do.
* 813	do	--	1956	--	12	--	Qs	1,306	13.9	Jan. 21, 1969	T, E 7-1/2	Irr	Pumped 230 gpm during power-yield test on July 16, 1969.
* 814	do	--	1958	45	15	--	Qs	1,315	23.7 23.2	Feb. 27, 1969 Jan. 21, 1970	T, E 5	Irr	Estimated to pump about 200 gpm.
* 815	do	--	1961	43	15	--	Qs	1,315	23.7 23.1	Feb. 27, 1969 Jan. 21, 1970	T, E 5	Irr	Do.
* 816	Burrell Lee, Jr.	Burrell Lee, Jr.	--	29	13	--	Qs	1,317	17	Jan. 22, 1969	J, E	D, S	--
* 817	do	J. R. Rea	1955	33	12	--	Qs	1,305	12.7 11.2	do Jan. 21, 1970	T, E 5	Irr	Reported to pump 200 gpm. Gravel packed.
818	do	Les Jameson	1956	33	12	--	Qs	1,305	--	--	T, E 5	Irr	Reported to pump 250 gpm. Gravel packed.
* 819	do	do	1956	33	12	--	Qs	1,305	--	--	T, E 5	Irr	Do.
* 820	do	--	--	17	30	--	Qs	1,305	13.3 11.7	Jan. 22, 1969 Jan. 21, 1970	C, W	N	Dug well.
821	N. P. Mitchell	Les Jameson	1961	33	--	--	Qs	1,320	--	--	N	N	Caved in. Formerly used as irrigation supply.
822	do	Buster Tolson	1957	33	15	--	Qs	1,322	21.1 20.1	Jan. 23, 1969 Jan. 21, 1970	T, E 3	Irr	Two 1-1/2 horsepower motors with pumps.
823	do	do	1957	35	13	--	Qs	1,323	21.4	Jan. 23, 1969	T, E 3	Irr	Do.
824	do	Dale Heard	1957	34	13	--	Qs	1,323	20.4	do	T, E 3	Irr	Do.
825	Wallace L. Malone	Les Jameson	1966	31	15	--	Qs	1,308	15.8	Feb. 12, 1969	T, E 7-1/2	Irr	Reported to pump 300 gpm. Gravel packed.
826	do	do	1966	31	15	--	Qs	1,312	--	--	T, E 2	Irr	Reported to pump 125 gpm. Gravel packed.
827	Anton Fojtik	Doris Dickerson	1952	37	14	--	Qs	1,308	--	--	T, G	Irr	Gravel packed.1/
828	do	do	1952	37	14	--	Qs	1,307	--	--	T, E 2	Irr	Gravel packed.
829	Carl B. Chapman	Les Jameson	1957	37	13	--	Qs	1,307	--	--	T, G 15	Irr	Reported to pump 200 gpm. Gravel packed.
830	do	Frank Coufal, Sr.	1957	37	13	37	Qs	1,306	--	--	T, G	Irr	Reported to pump 150 gpm. Gravel packed.
831	do	Les Jameson	--	38	15	38	Qs	1,306	15.1	Feb. 27, 1969	N	N	Drilled for irrigation supply. Gravel packed.

See footnotes at end of table.

Table 6. -- Records of Water Wells and Springs -- 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
	21-22-832	T. E. Craddock	Les Jameson	1960	42	13	42	Qs	1,311	16.1	Feb. 27, 1969	T, E 5	Irr	Reported to pump 400 gpm. Gravel packed.
	833	do	J. M. Rea	1956	37	13	37	Qs	1,310	16.3	do	T, E 5	Irr	Reported to pump 225 gpm. Gravel packed.
*	834	do	do	1956	37	13	37	Qs	1,309	16.1	do	T, E 5	Irr	Do.
	835	Frank Coufal, Sr.	--	1954	44	14	44	Qs	1,316	23.3	do	T, G	N	Formerly used as an irrigation supply. Gravel packed.
	836	Anton Fojtik	J. M. Rea	1956	37	14	--	Qs	1,308	15.4	Apr. 20, 1956	T, G	Irr	Gravel packed.
	837	Lem Bellows estate	--	1956	--	14	--	Qs	1,301	--	--	T, E 15	Irr	Do.
	838	do	Gower Drilling Company	1952	36	14	36	Qs	1,301	17.2 15.5 14.1	Jan. 14, 1960 Feb. 21, 1962 Mar. 13, 1969	T, E 15	Irr	Gravel packed.
	839	Edward Haisler	Edward Haisler	1957	34	18	34	Qs	1,326	21.0 21.0 21.0	Jan. 14, 1960 Jan. 13, 1961 Apr. 10, 1969	T, G	Irr	Reported to pump 250 gpm. Gravel packed.
*	840	Charles W. Hatter, et al.	Les Jameson	--	42	14	--	Qs	1,305	19.0	Apr. 23, 1969	J, E Cf, E 1-1/2	D, S Irr	Reported to pump 75 gpm. Gravel packed.
	841	D. A. Chapman, Jr.	do	1967	37	12	37	Qs	1,302	13.9	do	C, W Cf, E 5	Irr	Dug well; drilled deeper, cased, and gravel packed. Reported to pump 250 gpm.
	842	M. E. Birdwell, et al.	Franklin Coufal, Jr.	1957	37	14	37	Qs	1,306	13.2	Apr. 29, 1969	T, E 5	Irr	Gravel packed.
	843	L. Estes Miller	Les Jameson (Covey)	1956	42	13	42	Qs	1,299	14.6	do	T, E 5	Irr	Redbeds reported at 41 feet. Reported to pump 200 gpm in 1956 and 160 gpm in 1969. Gravel packed.
	844	Florence B. Parker, et al.	Les Jameson	1967	38	16	38	Qs	1,301	--	--	T, E 5	Irr	Pump is flush with casing, unable to measure. Reported to pump 300 gpm. Pumped 290 gpm during power-yield test on July 24, 1969. Gravel packed.
	845	do	do	1956	40	13	40	Qs	1,301	16.9	Apr. 29, 1969	T, E 7-1/2	Irr	Reported to pump 400 gpm in 1956 and 225 gpm in 1969. Pumped 235 gpm during power-yield test on July 24, 1969. Gravel packed.
	846	Glen Miller	--	--	27	39	27	Qs	1,350	5.6	June 26, 1969	C, W	N	Dug well. Windmill broken.
	847	S. E. Williamson	James M. Rea	1962	33	16	36	Qs	1,312	12.8	Nov. 24, 1969	T, E 7-1/2	Irr	Reported to pump 300 gpm. Gravel packed.
	848	do	do	1962	33	16	36	Qs	1,311	12.8	do	T, E 5	Irr	Reported to pump 250 gpm. Gravel packed.
*	849	do	--	--	30	31	--	Qs	1,322	--	--	C, H	N	Dug well.
*	901	Earley W. Samsill	Earley W. Samsill	1928	17	31	--	Qs	1,317	11.5 4.1	Jan. 13, 1961 Apr. 24, 1969	J, E	D, S	Do.
*	902	do	--	--	26	48	--	Qs	1,320	12	1943	N	N	Dug well. Reported filled and abandoned in 1961.
*	903	Florence B. Parker, et al.	Les Jameson	1957	34	12	--	Qs	1,301	16.3 17.2 34.2 19.0	Jan. 22, 1969 July 21, 1969 July 29, 1969 July 30, 1969	T, E 5	Irr	Used as pumping well for pumping test in this study. Pumped 211 gpm for eight days. Gravel packed.[2]

See footnotes at end of table.

Table 6. -- Records of Water Wells and Springs -- 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
* 21-22-904	Earley W. Samsill	--	--	33	31	--	Qs	1,318	6.0 10.9 9.3 6.1 4.1 5.5 5.8	Apr. 23, 1969 Aug. 25, 1969 Sept. 16, 1969 Nov. 14, 1969 Mar. 26, 1970 Apr. 15, 1970 May 13, 1970	C, W	D, S	Dug well. Reported dug out to 33 feet in 1941. Used as monthly observation well in this study.
* 905	do	--	--	28	30	--	Qs	1,324	21.5	Apr. 24, 1969	C, W	S	Dug well.
906	L. Estes Miller	Les Jameson	1959	40	13	40	Qs	1,300	17.0	Apr. 29, 1969	T, E 3	Irr	Reported to pump about 160 gpm. Gravel packed.
907	Joe E. Gaines	--	1956	31	14	31	Qs	1,298	17.7	June 19, 1969	T, E 3	Irr	Gravel packed.
908	do	--	1956	--	14	--	Qs	1,298	--	--	T, E 3	Irr	Do.
909	Glen Miller	--	--	--	36	--	Qs	1,302	13.3	June 26, 1969	J, E	D, S	Dug well.
* 910	do	--	--	Spring	--	--	Qs	1,346	(+)	--	Flows	N	Spring flowing about 2 gpm. Water flows from Permian sandstone, but source is Seymour alluvial deposits overlying the older rocks.
911	Burrell Lee, Jr.	Lewis Barnes	1969	41	3	41	Qs	1,301	20 21.5 18.1 17.3 22.9 19.1	June 26, 1969 July 11, 1969 July 16, 1969 July 21, 1969 July 29, 1969 July 30, 1969	N	N	Drilled and cased as observation well for pumping test in this study. Base of Seymour at 40.5 feet. Casing pulled after pump test.[1]
912	do	do	1969	42	3	42	Qs	1,301	20 18.7 17.8 17.0 19.8 18.7	June 26, 1969 July 11, 1969 July 16, 1969 July 21, 1969 July 29, 1969 July 30, 1969	N	N	Do.
913	do	do	1969	41	3	41	Qs	1,301	20 18.4 17.7 17.1 20.0 18.8	June 27, 1969 July 11, 1969 July 16, 1969 July 21, 1969 July 29, 1969 July 30, 1969	N	N	Do.
* 29-101	Chester Blankenship	--	1955	34	42 16	--	Qal	1,308	21.0	June 19, 1969	J, E Cf, E 10	S, Irr	On manifold system with well 21-29-105. Reported yield of 2 wells was 150 gpm.
* 103	Henry P. Arledge	--	--	41	36	--	Qs	1,408	18.0 19.5 18.2 17.6 17.5 17.6 17.5	Feb. 12, 1969 June 13, 1969 Aug. 29, 1969 Jan. 15, 1970 Mar. 17, 1970 Apr. 15, 1970 May 13, 1970	J, E	S	Dug well. Used as monthly observation well in this study.
* 104	J. W. Elkins	--	--	18	31	--	Qs	1,404	13.8 13.1	Feb. 25, 1969 Jan. 21, 1970	J, E	D, S	Dug well.
105	Chester Blankenship	--	1955	26	42 16	--	Qal	1,308	20.2	June 19, 1969	Cf, E 10	Irr	On manifold system with well 21-29-101. Reported yield of two wells was 150 gpm.

See footnotes at end of table.

Table 6. -- Records of Water Wells and Springs -- 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
21-29-106	Dr. C. M. Randall, Jr.	--	1957	34	32 15	--	Qal	1,306	15.2	June 19, 1969	Cf, E 10	Irr	On manifold system with well 21-29-107. Reported yield of 2 wells was 150 gpm.
107	do	--	1957	35	32 15	--	Qal	1,306	21.7	do	Cf, E 10	Irr	On manifold system with well 21-29-106. Reported yield of 2 wells was 150 gpm. Gravel packed.
108	do	Les Jameson	1966	23	15	--	Qal	1,306	11.5	do	T, E 1-1/2	Irr	Reported to pump about 60 gpm. Gravel packed.
109	do	do	1966	21	15	--	Qal	1,306	9.6	do	T, E 1-1/2	Irr	Do.
110	A. K. Boyd	do	1956	25	12	25	Qal	1,306	10.3	Nov. 21, 1969	T, E 1-1/2	Irr	Unused irrigation well. Well silted up. Reported to have pumped about 75 gpm. Gravel packed.
* 201	Charles E. Plunckett	do	1966	30	15	30	Qs	1,342	23.5 23.0	Jan. 23, 1969 Jan. 21, 1970	J, E	D, S	--
* 202	Henry F. Moore	--	1903	100	6	--	Qs, Pcf	1,402	16.3	Feb. 13, 1969	J, E	D, S	Reported very little water from Seymour.
* 203	L. D. Offutt	--	--	33	42	--	Qs	1,396	23.0 22.1	Feb. 25, 1969 Jan. 21, 1970	J, E	D, S	Dug well.
* 204	A. B. Martin, Jr.	--	--	23	42	--	Qal	1,300	13.1	Sept. 16, 1969	J, E	D, S	Do.
* 205	Ed M. Compton	--	--	36	31	--	Qs	1,340	25.7	do	J, E	D, S	Dug well. Water reported to leave mineral deposits on containers.
301	Albert Hrncirik	Buster Tolson	1956	11	12	--	Qs	1,313	4.9	Sept. 17, 1969	N	N	No pump at this date. Occasionally used for irrigation supply.
* 302	Chester Cox	Les Jameson	1951	28	14	--	Qs	1,318	20.3	June 26, 1969	Cf, E 3/4	Irr	Base of Seymour reported at 27 feet. Reported to pump about 35 gpm.
* 303	do	--	1951	27	--	--	Qs	1,318	--	--	Cf, E 1-1/2	Irr	Base of Seymour reported at 27 feet. Reported to pump about 75 gpm.
304	Mattie Morris estate	--	--	29	31	--	Qs	1,380	23.9 25.1 23.1 23.4	Feb. 12, 1969 Apr. 11, 1969 Jan. 15, 1970 May 13, 1970	N	N	Dug well. Used as monthly observation well in this study.
* 305	Red Springs Gin	--	1910	34	31	--	Qs	1,393	23.5 25.0 21.5 21.2 21.1 21.2	Feb. 26, 1969 Oct. 16, 1969 Jan. 15, 1970 Mar. 17, 1970 Apr. 15, 1970 May 13, 1970	J, E	Ind	Dug well. Used as monthly observation well in this study.
* 306	Mike Parker	Mike Parker	1948	19	31	--	Qs	1,369	12.7 11.8	Feb. 25, 1969 Jan. 21, 1970	C, E	D, S	Dug well.
307	B. J. West & W. H. King	Les Jameson	1956	24	31	--	Qs	1,317	17.2	Apr. 8, 1969	T, E 1-1/2	Irr	Reported to pump about 80 gpm.
308	do	do	1956	25	31	--	Qs	1,317	--	--	N	N	Caved. Formerly used as irrigation supply. Reported to have pumped about 80 gpm.
309	do	do	1956	20	30	--	Qs	1,315	12.0	Apr. 8, 1969	T, E 1-1/2	Irr	Reported to pump about 75 gpm.
* 310	Chester Cox	--	--	29	24	--	Qs	1,329	25.1	June 26, 1969	J, E	D, S	Dug well. Water from well reported to have corroded pipes.
* 311	Clyde Chapman	--	--	47	60	--	Pcf	1,350	36.4	June 20, 1969	C, W	N	Dug well. Windmill broken.

See footnotes at end of table.

Table 6. -- Records of Water Wells and Springs -- 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
* 21-29-312	Albert Hrncirik	Buster Tolson	--	11	42	--	Qs	1,309	3.0	Sept. 17, 1969	T, E 1-1/2	D, S Irr	Dug well. Reported to pump about 60 gpm.
313	do	do	--	14	12	--	Qs	1,308	4.0	do	T, E 1-1/2	Irr	Reported to pump about 60 gpm.
314	do	do	--	13	15	--	Qs	1,304	5.5	do	N	N	No pump at this date. Occasionally used as irrigation supply. Reported to pump about 50 gpm.
315	do	--	--	21	10-3/8	--	Qs	1,308	13.9	do	T, E 1-1/2	Irr	Reported to pump about 60 gpm. Gravel packed.
* 316	James H. Waldron	Les Jameson	1957	23	9	--	Qs	1,321	15.7	Nov. 20, 1969	J, E	D, S	Gravel packed.
317	Walter E. Malone	--	--	Spring	--	--	Qs	1,300	(+)	--	Flows	N	Spring flows about 5 gpm from bluff just above Brazos River.
318	Clyde Chapman	Lewis Barnes	1969	106	--	--	Qs	1,396	20	July 8, 1969	N	N	Core test drilled for this report. Base of Seymour at 24.5 feet. Very little water in Seymour. No water in Permian clay, siltstone, and sandstone.1/
319	do	Clyde Chapman	--	25	8	--	Qs	1,396	21.8	do	Cf, E 1-1/3	Irr	Used to water orchard. Gravel packed.
* 501	A. B. Martin, Jr.	Ernest Knesek	1969	17	--	--	Qal	1,297	13.5	Sept. 16, 1969	N	N	Reported 4.5 feet of good sand and gravel. Owner plans to case and equip with windmill for livestock supply.
502	do	do	1969	18	--	--	Qal	1,295	12.5	do	N	N	Owner reports about 6 feet of good sand and gravel; plans to develop as an irrigation well.
* 503	W. C. and W. H. Hertel	Egenbacher	1955	31	31 16	-- --	Qal	1,325	20.6	Nov. 19, 1969	Cf, E	Irr	Measured yield of 72 gpm. Gravel packed.
601	Burrell Lee, Jr.	Lewis Barnes	1969	32	--	--	Qs	1,353	--	--	N	N	Core test. Base of Seymour at 30.5 feet. Very little water in Seymour.1/
701	Baylor County	--	--	Spring	--	--	Qs	1,385	(+)	--	Flows	N	Spring on county road at Knox County line.
* 801	Tom McMorris	Jim Redman	1952	33	30	--	Qs	--	17.2	July 10, 1969	J, E	D, S	Dug well.
* 802	Roy Butler	--	--	36	31	--	Qs, Pcf	1,437	8.6	Nov. 19, 1969	J, E	N	Chloride analysis in 1966 showed 5,300 mg/1.
* 901	Carl Snyder	--	--	14	36	--	Qs	1,389	0.2	Nov. 26, 1969	N	N	Dug well. Several seeps and mineral deposits around well, in field, and in ditch along county road.
* 902	Flint Bibb	--	--	44	--	--	Qs, Pcf	1,401	6.5	do	J, E	D, S	Dug well. Owner reports that water taste has recently become unpalatable.
30-101	Burt Meers	-- Smelly	1955	38	31 16	-- 38	Qs	1,338	23.5 22.1 20.3	Jan. 5, 1956 Feb. 21, 1961 Feb. 18, 1970	N	N	Well silted up to 22 feet. Reported to pump 90 gpm.
102	do	do	1957	34	31 14	-- 34	Qs	1,338	23.7 23.9	Jan. 12, 1958 Feb. 14, 1961	N	N	Well silted up above water table. Reported to pump 50 gpm when used as irrigation supply.
103	M. M. Busby	J. M. Rea	1955	38	15	39	Qs	1,339	26.3 26.1	Jan. 22, 1969 Jan. 22, 1970	T, E 1-1/2	Irr	Reported to pump about 60 gpm. Base of Seymour reported at 38 feet. Gravel packed.
104	do	Les Jameson	1956	34	15	--	Qs	1,336	22.6	Jan. 22, 1969	T, E 3	Irr	Reported to pump about 125 gpm. Gravel packed.
105	do	do	1956	34	13	--	Qs	1,336	23.2 23.6	do Jan. 22, 1970	T, E 2	Irr	Reported to pump about 90 gpm. Gravel packed.

See footnotes at end of table.

Table 6. -- Records of Water Wells and Springs -- 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
21-30-106	Billy W. Golden	Les Jameson	1968	36	14	--	Qs	1,335	26.1 26.3 27.8 27.3 25.7 26.5 26.6	Jan. 27, 1969 Mar. 20, 1969 Sept. 16, 1969 Oct. 16, 1969 Jan. 15, 1970 Apr. 15, 1970 May 13, 1970	Sub, E 5	Irr	Reported to pump about 130 gpm. Used as monthly observation well in this study. Gravel packed.
107	do	do	1968	36	12	--	Qs	1,336	26.5	Jan. 27, 1969	T, E 3	Irr	Reported to pump about 225 gpm. Gravel packed.
* 108	Mattie Morris estate	--	--	21	40	--	Qs	1,376	16.2	Feb. 12, 1969	J, E	D, S	Dug well.
* 109	J. Frank Studer	--	--	24	31	--	Qs	1,303	10.3 9.3	Feb. 25, 1969 Jan. 22, 1970	C, E	D, S	Do.
110	Charles Montgomery	--	1958	40	10	--	Qs	1,361	9.2 9.7 8.7 8.7	Apr. 9, 1969 Dec. 18, 1969 Mar. 17, 1970 May 13, 1970	T, E 1-1/2	Irr	Reported to pump about 50 gpm. Used as a monthly observation well in this study.
111	do	--	1958	40	31	--	Qs	1,361	--	--	T, E 1-1/2	N	Well caved or silted up. Formerly used as an irrigation supply.
112	do	--	1958	40	10	--	Qs	1,361	--	--	T, E 1-1/2	N	Do.
113	do	--	1958	40	--	--	Qs	1,362	--	--	N	N	Do.
114	do	--	1965	40	--	--	Qs	1,371	--	--	N	N	Do.
* 115	J. G. Campbell	Les Jameson	1957	40	12	--	Qs	1,373	--	--	J, E	D, S	Do.
* 116	do	--	--	33	31	--	Qs	1,373	17.9 17.1	Apr. 9, 1969 Jan. 22, 1970	J, E	D, S	Dug well.
117	Emmet Golden, et al.	Les Jameson	1969	34	16	--	Qs	1,333	21.7	July 9, 1969	Sub, E 5	Irr	Pumped 60 gpm through sprinkler system during power-yield test on July 23, 1969. Gravel packed.1/
118	Orville Moody	--	--	22	38	22	Qs	1,361	15.9	Sept. 16, 1969	J, E 1/3	Irr	--
* 119	Baylor County Precinct 1	Les Jameson	--	18	8	--	Pcf	1,345	6.5	do	J, E	Ind	Gravel packed.
* 120	G. and L. Oil Company	--	--	36	31	--	Qs	1,351	28.7	Sept. 19, 1969	C, W Sub, E	Ind	Used to supply county equipment barn. Gravel packed.
* 121	Hancock Truck Stop	--	--	18	31	--	Qs	1,357	12.5	Oct. 1, 1969	J, E	Ind	Dug well. Service station and cafe water supply.
122	Delmer F. Styles	Delmer F. Styles	1957	20	14	--	Qs	1,302	--	--	T, E 1-1/2	Irr	Do.
* 123	Walter E. Malone	--	--	20	32	--	Qs	1,295	10.8	Oct. 1, 1969	C, W	S	Dug well. Reported to pump about 50 gpm.
* 124	do	--	1930	25	31	--	Qs	1,308	19.7	Oct. 16, 1969	C, W	S	Dug well.
* 125	Delmer F. Styles	--	--	21	31	--	Qs	1,306	13.4	do	N	N	Do.
* 126	James H. Waldron	--	--	51	31	--	Qs, Pcf	1,358	11.7	Nov. 20, 1969	J, E	D, S	Dug well. Formerly used as domestic, livestock, and irrigation well.
127	do	Les Jameson	1957	25	8	--	Qs	1,318	17.7	do	Cf, E	Irr	On manifold system with 21-30-128. Reported to pump about 50 gpm. Gravel packed.
128	do	do	1957	26	6	--	Qs	1,317	17.1	do	Cf, E	Irr	Do.

See footnotes at end of table.

Table 6. -- Records of Water Wells and Springs inued

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
21-30-129	James H. Waldron	Les Jameson	1957	22	4	--	Qs	1,318	16.9	Nov. 20, 1969	N	N	Formerly used as irrigation supply. Gravel packed.
130	do	do	1957	25	8	--	Qs	1,318	17.1	do	N	N	Do.
131	Mike Parker	Lewis Barnes	1969	40	--	--	Qs	1,332	--	--	N	N	Core test drilled for this study. Base of Seymour at 16 feet. No water in Seymour or in Permian clay and siltstone.1/
132	Baylor County Precinct 1	do	1969	35	--	--	Qs	1,345	--	--	N	N	Core test drilled for this study. Base of Seymour at 10.5 feet. Very little water in Seymour, and Permian clay and siltstone.1/
133	Delmer F. Styles	--	--	Spring	--	--	Qs	1,288	(+)	--	Cf, E 2	Irr	--
201	Walter E. Malone	--	--	Spring	--	--	Qs	1,290	(+)	--	Flows	S	Spring flows 10 to 15 gpm.
202	Mrs. Nick Mitchell	Les Jameson	1959	33	14	33	Qs	1,297	15.8 14.9 14.9 15.1	Jan. 14, 1960 Mar. 20, 1969 Apr. 15, 1970 May 13, 1970	T, E 10	Irr	Reported tested by driller at 800 gpm. Reported to pump 300 gpm. Yearly observation well, and monthly observation well in this study. Gravel packed.
203	W. T. Cockroft	-- Smelley	1953	23	14	--	Qs	1,287	11.8 7.8	Jan. 12, 1957 Apr. 24, 1969	T, E 3	Irr	Reported to pump about 200 gpm.
204	Burrell Lee, Jr.	--	1951	22	15	--	Qs	1,287	18.6 19.8 10.4 10.8 10.1 10.2	Jan. 5, 1955 Jan. 12, 1957 Nov. 14, 1969 Dec. 18, 1969 Apr. 15, 1970 May 13, 1970	Cf, E 1-1/2	Irr	Reported to yield about 75 gpm. Yearly observation well, and monthly observation well in this study.
205	do	--	1951	23	14	--	Qs	1,292	24.7 22.3	Jan. 12, 1956 Jan. 14, 1960	J, E Cf, E	D, S Irr	Reported to pump about 60 gpm.
206	do	--	1951	22	15	--	Qs	1,288	13.9 14.6	Jan. 22, 1969 Jan. 22, 1970	Cf, E 5	Irr	Reported to pump about 200 gpm.
207	Wilburn F. Redwine	Les Jameson	1965	25	9	--	Qs	1,286	--	--	Cf, E 4-1/2	Irr	Reported to pump about 100 gpm.
208	Westley T. Cockroft	--	1953	23	14	--	Qs	1,287	7.9	Apr. 24, 1969	T, E 2	Irr	Reported to pump about 175 gpm.
209	do	--	1953	23	13	--	Qs	1,288	12.4	do	Cf, E 2	Irr	Reported to pump about 125 gpm.
210	do	--	1953	24	14	--	Qs	1,288	11.4	do	Cf, E 1	Irr	Reported to pump about 100 gpm.
211	do	--	1953	23	14	--	Qs	1,287	11.2	do	Cf, E 1-1/2	Irr	Reported to pump about 115 gpm.
212	do	--	1953	22	13	--	Qs	1,288	7.4 7.9	do Jan. 22, 1970	T, E 2	Irr	Reported to pump about 175 gpm. Gravel packed.
213	Burrell Lee, Jr.	--	--	25	15	--	Qs	1,290	16.3 15.9 15.9 15.9 12.4	Jan. 14, 1960 Jan. 14, 1961 Jan. 22, 1969 Mar. 20, 1969 Jan. 22, 1970	Cf, E 7-1/2	Irr	Reported to pump about 250 gpm.
* 214	do	--	--	Spring	--	--	Qs	1,268	(+)	--	Flows	S	Estimated to flow about 25 gpm on Jan. 22, 1969. Owner reports flow varies with rainfall, but has never stopped completely.

See footnotes at end of table.

Table 6. -- Records of Water Wells and Springs -- 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
* 21-30-215	E. G. (Bill) Glover	Les Jameson	1956	42	12	42	Qs	1,306	--	--	J, E	D, S	Old dug well; deepened, cased and gravel packed inside of old concrete culvert.
216	do	do	1957	41	12	42	Qs	1,306	22.4 21.9	Jan. 22, 1969 Jan. 22, 1970	T, E 5	Irr	Owner reports it pumps about 290 gpm. Reported tested by U.S. Geological Survey at 300 gpm. Base of Seymour reported at 41 feet. Gravel packed.
217	do	do	1956	32	12	33	Qs	1,303	15.0 14.2	Jan. 22, 1969 Jan. 22, 1970	T, E 5	Irr	Owner reports yield of about 290 gpm. Reported tested by U.S. Geological Survey at 400 gpm. Base of Seymour reported at 31 feet. Gravel packed.
218	do	do	1959	44	12	44	Qs	1,307	21.0	Jan. 22, 1969	T, E 5	Irr	Owner reports yield of about 290 gpm. Reported tested by U.S. Geological Survey at 300 gpm. Base of Seymour reported at 40 feet. Gravel packed.
219	N. P. Mitchell	Dale Heard	1960	42	12	--	Qs	1,312	25.0 24.0	Jan. 23, 1969 Jan. 22, 1970	T, E 3	Irr	Reported to pump about 200 gpm. A five horsepower centrifugal pump is used to maintain sprinkler pressure. Gravel packed.
* 220	do	Buster Tolson	1958	32	13	--	Qs	1,326	26.0	Jan. 23, 1969	N	N	Formerly used as irrigation supply.
221	do	do	1958	30	13	--	Qs	1,326	22.9	do	T, E 2	Irr	Reported to pump about 90 gpm.
222	Billy W. Golden	Les Jameson	1968	33	14	--	Qs	1,329	21.3	Jan. 27, 1969	T, E 7-1/2	Irr	Pumped 65 gpm into sprinkler system during power-yield test on July 23, 1969.
223	O. C. Roden	--	1956	24	13	--	Qs	1,304	14.7	Feb. 5, 1969	Cf, E 1-1/2	Irr	Reported to pump about 75 gpm.
224	do	--	1956	25	--	--	Qs	1,304	--	--	N	N	Sand washed in and partially filled casing. Formerly used as irrigation supply. Reported to have pumped about 75 gpm.
225	do	Frank Coufal, Sr.	--	35	--	--	Qs	1,306	--	--	T, E 5	Irr	Reported to pump about 150 gpm.
226	do	--	--	36	15	--	Qs	1,304	21.2	Apr. 25, 1969	T, E 3	Irr	Reported to pump about 125 gpm. Gravel packed.
227	do	--	--	--	--	--	Qs	1,306	--	--	Cf, E 3	Irr	Reported to pump about 200 gpm.
228	do	Frank Coufal, Sr.	1957	38	15	--	Qs	1,307	22.7 22.3	Jan. 28, 1969 Jan. 22, 1970	T, E 5	Irr	Reported to pump about 225 gpm. Gravel packed.
229	O. C. Roden	--	1963	37	13	--	Qs	1,306	20.0 19.6	Jan. 28, 1969 Jan. 22, 1970	T, E 5	Irr	Reported to pump about 250 gpm. Gravel packed.
230	do	Frank Coufal, Sr.	1957	39	12	--	Qs	1,304	16.7 16.2	Jan. 28, 1969 Jan. 22, 1970	T, E 5	Irr	Reported to pump about 230 gpm. Gravel packed.
231	do	--	--	39	15	--	Qs	1,303	15.1 14.5	Jan. 28, 1969 Jan. 22, 1970	T, E 10	Irr	Reported to pump about 300 gpm. Gravel packed.
232	Richard Cox	--	1965	39	15	--	Qs	1,303	23.9	Jan. 28, 1969	T, E 10	Irr	Do.
233	O. C. Roden	--	1963	37	--	--	Qs	1,305	--	--	T, E 2	Irr	Reported to pump about 120 gpm.
234	do	--	1956	37	12	--	Qs	1,302	22.6	Jan. 28, 1969	T, E 3	Irr	Reported to pump about 150 gpm.
235	do	--	--	35	13	--	Qs	1,304	20.2	Apr. 28, 1969	T, E 3	Irr	Do.

See footnotes at end of table.

Table 6. -- Records of Water Wells and Springs -- 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
21-30-236	O. C. Roden	--	--	26	15	--	Qs	1,303	14.8	Feb. 5, 1969	Cf, E 1	Irr	Reported to pump about 50 gpm.
237	do	--	--	25	13	--	Qs	1,303	15.9	do	Cf, E 1	Irr	Do.
* 238	do	--	--	30	13	--	Qs	1,305	19.1	do	Cf, E 1-1/2	Irr	Reported to pump about 60 gpm.
* 239	H. W. Fell, Jr.	--	--	15	13	--	Qs	1,285	9.4 9.2	Feb. 26, 1969 Jan. 22, 1970	J, E	Ind	Used to supply veterinarian's office.
* 240	Fell & Fell	--	--	25	21	--	Qs	1,282	17.2 15.9	Feb. 26, 1969 Jan. 22, 1970	J, E	S	Dug well.
* 241	H. W. Fell, Sr.	Les Jameson	1967	25	8	--	Qs	1,282	--	--	J, E	D	--
* 242	H. W. Fell, Jr.	do	1967	25	42	--	Qs	1,282	--	--	J, E	D, S	--
243	Fell & Fell	--	--	--	41	--	Qs	1,284	9.0	Feb. 26, 1969	T, E 1-1/2	Irr	Dug well. Reported to pump about 75 gpm.
244	do	Les Jameson	1967	20	15	--	Qs	1,283	7.4	do	T, E 1-1/2	Irr	Reported to pump about 50 gpm. Gravel packed.
245	do	--	--	--	--	--	Qs	1,283	--	--	N	N	Dug well. Destroyed. Formerly used as irrigation supply.
246	do	--	--	18	41	--	Qs	1,284	8.3 7.6	Feb. 26, 1969 Jan. 22, 1970	T, E 1-1/2	Irr	Dug well. Reported to pump about 60 gpm.
247	do	--	--	--	--	--	Qs	1,283	--	--	N	N	Dug well. Destroyed. Formerly used as irrigation supply.
248	do	Les Jameson	1967	26	14	--	Qs	1,282	--	--	T, E 5	Irr	Pumps into tank. Water distributed from tank to sprinkler system by 20 horsepower centrifugal pump. Reported to pump about 200 gpm. Gravel packed.
249	do	--	--	22	--	--	Qs	1,281	14.3	Feb. 25, 1969	T, E 1-1/2	Irr	Reported to pump about 60 gpm.
* 250	Orville Barrett	--	--	19	16	--	Qs	1,291	10.2	Apr. 2, 1969	N	N	Formerly used as an irrigation supply.
251	do	--	--	--	7	--	Qs	1,291	--	--	J, E 1-1/2	N	Do.
252	do	--	--	27	31	--	Qs	1,293	25.3 23.8	Apr. 2, 1969 Jan. 22, 1970	J, E	D, S	Dug well.
253	Mrs. Denton Powell	Les Jameson	1965	32	18	--	Qs	1,295	14.6	Apr. 9, 1969	T, E 7-1/2	Irr	Reported to pump about 300 gpm. Gravel packed.
254	do	do	1958	22	--	--	Qs	1,290	10.4	Apr. 24, 1969	T, E 4-1/2	Irr	Reported to pump about 185 gpm. Pumped 100 gpm into sprinkler system during power-yield test on July 24, 1969.
255	Raymond Brown	--	1954	24	--	--	Qs	1,285	12.9	Apr. 9, 1969	Cf, E 2	Irr	Reported to pump about 120 gpm.
256	O. C. Roden	--	1956	38	15	--	Qs	1,305	20.0	Apr. 28, 1969	T, E 3	Irr	Reported to pump about 150 gpm. Gravel packed.
257	Morris J. Christian	Les Jameson	1956	32	14	--	Qs	1,293	14.5	June 18, 1969	T, E 7-1/2	Irr	Reported to pump about 275 gpm. Gravel packed.

See footnotes at end of table.

Table 6. -- Records of Water Wells and Springs -- 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
21-30-258	Morris J. Christian	Les Jameson	1956	30	16	--	Qs	1,293	12.7	June 18, 1969	Cf, E 10	Irr	Reported to pump about 275 gpm. Gravel packed.
259	W. T. Cockroft	-- Smelley	--	19	13	--	Qs	1,295	11.5	Sept. 17, 1969	Cf, E 1-1/2	Irr	Reported to pump about 60 gpm.
260	Wilburn F. Redwine	Les Jameson	1966	26	16	--	Qs	1,286	12.0	Sept. 29, 1969	Cf, E 2	Irr	Reported slightly sanded up. Reported to pump about 75 gpm.
* 261	do	--	--	22	42	--	Qs	1,287	12.6	do	J, E	D, S	Dug well.
262	Glenn Cooper	--	--	Spring	--	--	Qs	1,267	(+)	--	Flows	N	Spring flows about 15 gpm.
263	Walter E. Malone	--	--	Spring	--	--	Qs	1,290	(+)	--	Flows	S	Do.
264	Burrell Lee, Jr.	Lewis Barnes	1969	21	--	--	Qs	1,287	13	July 2, 1969	N	N	Core test drilled for this report. Base of Seymour at 20 feet.[1]
265	Jack King	Les Jameson	1968	25	--	--	Qs	1,286	--	--	Cf, E	Irr	Reported to pump about 45 gpm. Gravel packed.
* 301	City of Seymour	John Kale	1959	--	--	--	Qs	1,283	12.3	Dec. 2, 1968	T, E 7-1/2	P	Reported to pump about 300 gpm. Gravel packed.
* 302	T. C. Griffin	-- Smelley	1952	45	14	--	Qs	1,300	20.1 21.6	July 14, 1969 July 18, 1969	T, E 10	Irr	Used as pumping well in pumping test for this study. Three observation holes drilled nearby. Pumped 189 gpm for three days. Gravel packed.[2]
303	do	-- Colby	1957	47	12	--	Qs	1,301	26.5 20.9 21.2	Jan. 27, 1957 June 18, 1969 July 14, 1969	N	N	Well abandoned. Former irrigation supply. Gravel packed.
* 304	City of Seymour	--	1924	37	--	--	Qs	1,294	17.0	July 2, 1968	T, E 10	P	Reported to pump about 250 gpm.
* 305	do	W. E. Turner	1948	42	18	42	Qs	1,284	18.5	do	T, E 10	P	Reported to pump about 400 gpm. Base of Seymour at 42 feet. Gravel packed.[1]
306	do	J. P. (Buster) Tolson	1957	45	16	45	Qs	1,282	33.0 17.8	1957 July 2, 1968	T, E 3	P	Reported to pump about 85 gpm. Base of Seymour at 43 feet. Gravel packed.[1]
307	Mrs. Mamie Coates	Mr. Coates	1954	20	51	--	Qs	1,288	12.5	Feb. 11, 1970	T, E 2	Irr	Dug well. Reported to pump 60 gpm.
* 308	B. E. Keck	--	--	38	7	--	Qs	1,297	19.4	Nov. 22, 1968	J, E	P	Used to supply a motel and trailer park.
309	City of Seymour	--	--	--	--	--	Qs	1,291	18.3	July 2, 1968	T, E 15	P	Reported to pump about 300 gpm.
310	do	W. E. Turner	1948	42	18	43	Qs	1,289	18.3	do	T, E 10	P	Reported to pump about 385 gpm. Base of Seymour at 42 feet.[1]
311	do	--	--	40	--	--	Qs	1,388	17.7	do	T, E 7-1/2	P	Reported to pump about 140 gpm.
312	do	--	--	40	--	--	Qs	1,286	19.5	do	T, E 7-1/2	P	Reported to pump about 240 gpm.
313	do	--	--	42	12	--	Qs	1,282	16.6	do	T, E 5	P	Reported to pump about 180 gpm.
* 314	do	J. P. (Buster) Tolson	1956	39	24	39	Qs	1,281	12.0 14.5	1956 July 2, 1960	T, E 3	P	Reported to pump about 100 gpm. Gravel packed.[1]
315	do	do	1956	49	24	49	Qs	1,285	13 17.1	Aug. 31, 1956 July 2, 1968	T, E 3	P	Reported to pump about 140 gpm. Base of Seymour at 46 feet.[1]

See footnotes at end of table.

Table 6. -- Records of Water Wells and Springs -- 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
21-30-316	City of Seymour	John Kale	1959	--	--	--	Qs	1,291	--	--	N	N	Reported tested by driller at 200 gpm. Drilled for use as public supply, but not used yet. Gravel packed.
317	do	do	1959	--	--	--	Qs	1,283	11.1 11.6	Dec. 2, 1968 Jan. 6, 1970	T, E 7-1/2	P	Reported to pump about 225 gpm. Gravel packed.
318	do	do	1959	--	--	--	Qs	1,285	11.8 11.2	Dec. 2, 1968 Jan. 6, 1970	T, E 5	P	Reported to pump about 175 gpm. Gravel packed.
319	do	do	1959	--	--	--	Qs	1,289	14.5 10.0	Dec. 2 1968 Jan. 6, 1970	T, E 5	P	Reported to pump about 200 gpm. Gravel packed.
320	do	do	1965	37	13	38	Qs	1,291	--	--	N	N	Reported tested by driller at 200 gpm. Drilled for public supply, but not used yet. Gravel packed.
* 321	do	do	1965	37	13	38	Qs	1,292	--	--	T, E 40	P	The City of Seymour is selling water from this well to Sun Oil Company for waterflooding. Reported to pump about 200 gpm. Gravel packed.
* 322	do	do	1965	30	13	31	Qs	1,295	12.0 13.3	Dec. 2, 1968 Jan. 6, 1970	T, E 7-1/2	P	Reported to pump about 200 gpm. Gravel packed.
323	do	do	1965	28	13	29	Qs	1,293	11.0 12.0	Dec. 2, 1968 Jan. 6, 1970	T, E 7-1/2	P	Do.
324	do	do	1965	28	13	29	Qs	1,292	11.6 12.0	Dec. 2, 1968 Jan 6, 1970	T, E 7-1/2	P	Reported to pump about 300 gpm. Gravel packed.
325	do	do	1965	28	13	30	Qs	1,292	10.8 10.5	Dec. 2, 1968 Jan. 6, 1970	T, E 7-1/2	P	Reported to pump about 200 gpm. Gravel packed.
326	do	--	--	25	--	--	Qs	1,270	--	--	T, E	Irr	City park well. Reported to pump about 125 gpm.
327	Emitt Golden & Company	Buster Tolson	1958	44	13	--	Qs	1,296	21.9 22.0	Jan. 28, 1969 Jan. 22, 1970	T, E 7-1/2	Irr	Reported to pump about 300 gpm. Gravel packed.
328	do	Les Jameson	1966	45	13	--	Qs	1,297	18.8	Jan. 28, 1969	T, E 7-1/2	Irr	Reported to pump about 250 gpm. Gravel packed.
329	do	Buster Tolson	1958	45	13	--	Qs	1,297	28.0	Jan. 22, 1970	T, E 10	Irr	Reported to pump about 250 gpm. Pumped 50 gpm into sprinkler system during power-yield test on July 25, 1969. Gravel packed.
330	do	do	1958	40	15	--	Qs	1,296	22.3 22.6	Jan. 28, 1969 Jan. 22, 1970	T, E 7-1/2	Irr	Reported to pump about 225 gpm. Gravel packed.
331	Ed Hajek	Eddie Joe Orsak, et al.	1964	36	18	--	Qs	1,296	17.5	Mar. 13, 1969	T, G	Irr	Reported to pump about 100 gpm. Gravel packed.
332	do	Franklin Coufal, et al.	--	41	14	--	Qs	1,296	21.8 21.8 25.3 24.0 21.5 21.6 21.7	do Mar. 20, 1969 Aug. 25, 1969 Sept. 16, 1969 June 13, 1969 Apr. 15, 1970 May 15, 1970	T, G	Irr	Reported to pump about 200 gpm. Used as monthly water-level observation well in this study. Gravel packed.
333	do	do	--	40	13	--	Qs	1,296	18.5	Mar. 13, 1969	T, G	Irr	Reported to pump about 200 gpm. Gravel packed.
334	T. C. Griffin	Buster Tolson	1960	46	13	--	Qs	1,298	24.4	Apr. 3, 1969	T, E 10	Irr	Do.
335	do	Les Jameson	1955	--	--	--	Qs	1,301	--	--	T, E 3	Irr	Reported to pump about 135 gpm. Gravel packed.

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
21-30-336	T. C. Griffin	Les Jameson	1965	48	13	--	Qs	1,303	25.0	Apr. 3, 1969	T, G	Irr	Reported to pump about 250 gpm. Gravel packed.
337	Bill Elliston	--	1965	32	31	--	Qs	1,293	16.1	do	T, E 15	Irr	Pumped about 180 gpm into sprinkler system during power-yield test on July 25, 1969. Gravel packed.
338	do	Les Jameson	1965	31	31	--	Qs	1,292	16.0	do	T, E 5	Irr	Reported to pump about 175 gpm. Gravel packed.
339	Lee Wayne McGuire	do	1963	49	13	--	Qs	1,304	24.0	Apr. 11, 1969	T, E 15	Irr	Reported to pump about 300 gpm. Pumped about 210 gpm into sprinkler system during power-yield test on July 25, 1969. Gravel packed.
340	do	Lee Wayne McGuire, et al.	1964	48	36	--	Qs	1,305	26.0	do	N	N	Formerly used as irrigation supply. Reported to have pumped about 100 gpm.
341	do	Les Jameson	1967	49	17	--	Qs	1,291	21.0 23.5 22.5 21.3 21.1	do Sept. 16, 1969 Oct. 16, 1969 Mar. 26, 1970 May 13, 1970	T, E 5	Irr	Reported to pump 200 gpm. Water pressure on sprinkler system maintained by 10 horsepower centrifugal pump. Pumped about 195 gpm into sprinkler system during power-yield test on July 25, 1969. Used as monthly water-level observation well in this study. Gravel packed.
342	do	do	1967	43	42	--	Qs	1,291	19.3	do	N	N	Drilled for irrigation supply, but never used. Gravel packed.
343	Henry P. Arledge	do	1944	20	8	--	Qs	1,286	11.0	Apr. 23, 1969	T, E 1-1/2	Irr	Reported to pump about 75 gpm into central tank. Water distributed through sprinkler system by 10 horsepower centrifugal pump. Gravel packed.
344	do	do	1944	21	8	--	Qs	1,284	12.3	do	T, E 1	Irr	Reported to pump about 50 gpm. See well 21-30-343. Gravel packed.
345	do	do	1944	24	8	--	Qs	1,287	15.0	do	Cf, E 3	Irr	Reported to pump about 140 gpm. See well 21-30-343. Gravel packed.
346	do	do	1945	24	8	--	Qs	1,288	18.5	do	N	N	Formerly used as irrigation supply.
347	do	do	1946	20	8	--	Qs	1,283	11.2	do	Cf, E 3	Irr	Reported to pump about 125 gpm. See well 21-30-343. Gravel packed.
348	do	do	--	22	8	--	Qs	1,285	--	--	T, E 1	Irr	Reported to pump about 45 gpm. Old dug well with windmill nearby.
349	Turner Standlee	do	1956	53	14	--	Qs	1,307	--	--	T, E 5	Irr	Reported to pump about 225 gpm. Gravel packed.
350	do	do	1954	52	15	--	Qs	1,304	--	--	T, E 5	Irr	Reported to pump about 275 gpm. Gravel packed.
351	Arthur Lee Harris	--	1965	--	15	--	Qs	1,299	--	--	T, E 15	Irr	Reported to pump about 350 gpm.
352	do	--	1968	--	11	--	Qs	1,297	--	--	T, E 5	Irr	Reported to pump about 225 gpm. Gravel packed.
353	do	Les Jameson	1956	48	13	--	Qs	1,302	--	--	T, E 5	Irr	Reported to pump about 425 gpm. Gravel packed.
354	do	do	1955	48	13	--	Qs	1,302	--	--	T, E 3	Irr	Reported to pump about 250 gpm. Gravel packed.
355	Olaf Shipman	do	1956	40	13	--	Qs	1,300	--	--	T, G	Irr	Tested with Hoffmeter on July 24, 1969, pumped 480 gpm. Gravel packed.
356	do	do	1955	40	14	--	Qs	1,301	19.5	July 30, 1969	T, E 3	Irr	Reported to pump about 130 gpm. Gravel packed.

See footnotes at end of table.

Table 6. -- Records of Water Wells and Springs -- 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
21-30-357	E. L. Pechacek	Buster Tolson	1963	19	19	--	Qs	1,290	11.4	June 19, 1969	Cf, E 1-1/2	Irr	Used mostly to water small orchard.
358	do	do	1963	19	12	--	Qs	1,290	9.3	do	T, E 2	Irr	Pumps about 100 gpm into tank. Water distributed through sprinkler system by 3 horsepower centrifugal pump.
359	do	Ernest Knesek	1964	29	10	--	Qs	1,293	13.4	do	T, E 3	Irr	Reported to pump about 125 gpm.
360	do	do	1964	30	42 13	--	Qs	1,291	14.1	do	Cf, E 1-1/2	Irr	Reported to pump about 75 gpm.
361	do	do	1964	28	10	--	Qs	1,290	--	do	T, E 5	Irr	Reported to pump about 200 gpm. Gravel packed.
362	do	do	1964	22	12	--	Qs	1,287	11.5	do	T, E 1-1/2	Irr	Reported to pump about 75 gpm. Gravel packed.
363	L. W. Hobbs	--	1964	25	15	--	Qs	1,294	10.1	do	N	N	Formerly used as irrigation supply.
364	Dr. C. M. Randall, Jr.	--	1968	19	16	--	Qal	1,257	7.5	do	Cf, E 1-1/2	Irr	Reported to pump about 60 gpm. Gravel packed.
365	do	--	1968	19	12	--	Qal	1,257	7.8	do	Cf, E 1-1/2	Irr	Do.
366	do	--	1968	16	16	--	Qal	1,257	5.8	do	Cf, E 1-1/2	Irr	Do.
367	do	--	1968	18	12	--	Qal	1,257	5.6	do	Cf, E 1-1/2	Irr	Do.
368	Farmer's Co-op Association Gin	-- Ponder	1954	32	8	31	Qs	1,292	24.4	Oct. 16, 1969	J, E 1	Ind	Supplies water for cotton gin. Reported to pump about 25 gpm.
* 369	Bill Elliston	Les Jameson	1969	33	16	39	Qs	1,291	22.4 17.1	June 10, 1969 Nov. 19, 1969	Sub, E 3	D, S	Test pumped by driller at 160 gpm. Gravel packed.1/
* 370	Don McDermitt	do	1969	42	16	42	Qs	1,296	19.0	June 23, 1969	J, E	Ind	Supplies water for tractor sales and service shop. Tested by driller at 240 gpm. Gravel packed.1/
* 371	T. C. Griffin	Buster Tolson	1962	46	12	46	Qs	1,298	--	--	J, E	D, S	Gravel packed.
372	M. A. "Shorty" Doyle	--	--	31	31	--	Qs	1,296	19.7	Nov. 25, 1969	Cf, E 1-1/2	Irr	Dug well. Reported to pump about 60 gpm.
373	do	-- Smelley	1956	42	13	42	Qs	1,297	17.6	do	T, G	Irr	Reported to pump about 150 gpm. Gravel packed.
374	Royce D. Standlee	Les Jameson	1956	34	31	--	Qs	1,293	17.7	Nov. 24, 1969	Cf, E 1-1/2	Irr	Reported to pump about 75 gpm. Gravel packed.
375	do	-- Smelley	1955	42	12	--	Qs	1,296	--	--	T, G	Irr	Well reported buttomed on hard rock, driller unable to penetrate with bucket rig. Possibly Lueders limestone. Reported to pump about 150 gpm. Gravel packed.
376	do	--	1954	32	42	--	Qs	1,296	21.0	Nov. 24, 1969	Cf, E 5	Irr	Dug well. Reported to pump about 100 gpm.
377	Westley Hrncirik	Ernest Knesek	1968	38	16	38	Qs	1,297	18.4	Nov. 25, 1969	Cf, E 1-1/2	Irr	Reported to pump about 75 gpm. Gravel packed.
378	William H. Hertel	do	1969	32	15	--	Qs	1,291	15.9	Nov. 19, 1969	Cf, E 2	Irr	Do.

See footnotes at end of table.

Table 6. -- Records of Water Wells and Springs -- 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
21-30-379	William H. Hertel	Les Jameson	1951	32	45	--	Qs	1,291	--	Nov. 19, 1969	N	N	Well sanded up. Formerly used as an irrigation supply.
380	Bill Elliston	--	1956	35	31 12	-- --	Qs	1,294	14.7	Nov. 18, 1969	Cf, E 10	Irr	Reported to pump about 200 gpm. Gravel packed.
381	Leonard Kunkel	Buster Tolson	1966	25	41 8	-- 25	Qal	1,264	5.2	Feb. 20, 1970	T, E 1-1/2	Irr	Reported to pump 60 gpm. Tested about 50 gpm.
382	do	Leonard Kunkel	1966	15	41 6	-- 23	Qal	1,263	5.1	do	N	N	Dug well. Dug to redbeds at 23 feet. Silted up and caved. Reported to have pumped 45 gpm. Formerly used as an irrigation supply.
383	City of Seymour	--	--	Spring	--	--	Qs	1,303	(+)	--	Flows	N	Spring in ditch beside gravel city street. Flows about 10 gpm from base of Seymour.
384	Buck Wallace	--	--	Spring	--	--	Qs	1,280	(+)	--	Flows	N	Spring flows about 5 gpm.
385	T. C. Griffin	Lewis Barnes	1969	45	3	45	Qs	1,299	19.7 19.9 24.8 21.3	July 11, 1969 July 14, 1969 July 17, 1969 July 18, 1969	N	N	Drilled and cased as observation well for pumping test of well 21-30-302 for this study. Base of Seymour at 42.5 feet. Casing pulled after pumping test. Water from sand and gravel.1/ 2/
386	do	do	1969	44	3	44	Qs	1,299	20 20.1 20.2 23.9 21.6	July 2, 1969 July 11, 1969 July 14, 1969 July 17, 1969 July 18, 1969	N	N	Do.
387	do	do	1969	45	3	45	Qs	1,299	20 20.4 20.4 22.9 21.8	July 2, 1969 July 11, 1969 July 14, 1969 July 17, 1969 July 18, 1969	N	N	Do.
388	B. E. Keck	do	1969	41	--	--	Qs	1,297	--	--	N	N	Core test drilled for this study. Base of Seymour at 40 feet. Water mostly from fine-grained pack sand.1/
401	Ernest Knesek	Buster Tolson	1959	43	31	--	Qs	1,368	29.3	Apr. 25, 1969	N	N	Formerly used as an irrigation supply.
402	do	Ernest Knesek	1964	41	31	--	Qs	1,368	30.0	do	N	N	Do.
* 403	Morris Cockrell	do	1964	25	12	--	Qs	1,374	18.0	July 9, 1969	Cf, E	D	--
501	Ernest Knesek	do	1955	8	40	--	Qs	1,342	2.2	Apr. 25, 1969	Cf, E 1	Irr	Reported to pump about 50 gpm.
502	do	do	1955	12	13	--	Qs	1,340	1.9	do	N	N	Formerly used as an irrigation supply.
503	do	do	1955	10	9	--	Qs	1,340	.50	do	N	N	Do.
504	do	do	1955	11	15	--	Qs	1,340	1.0	do	N	N	Do.
505	do	--	1955	10	60	--	Qs	1,340	.40	do	N	N	Dug well. Formerly used as an irrigation supply.
506	do	Ernest Knesek	1964	43	31	--	Qs	1,366	30.6	do	N	N	Formerly used as an irrigation supply.
507	do	do	1964	36	42	--	Qs	1,366	30.9	do	N	N	Do.
508	do	do	1964	36	40	--	Qs	1,365	26.2	do	T, E 2	Irr	Reported to pump about 90 gpm.
* 509	do	do	--	40	--	--	Qs	1,365	--	--	J, E	D, S	Old dug well, bailed down to redbeds about 1941.
510	Jerry Butler	--	--	31	38	--	Qs	1,360	23.8	July 3, 1969	J, E	D	Dug well. Owner reports water-level decline due to irrigation wells north of this well.

See footnotes at end of table.

Table 6. -- Records of Water Wells and Springs -- 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
21-30-511	Ernest Knesek	Lewis Barnes	1969	43	--	--	Qs	1,366	--	--	N	N	Core test drilled for this report. Base of Seymour at 42.5 feet. Very little water in Seymour.1/
* 601	Emil Simaichl	--	1915	25	17	--	Qs	1,365	17.8	July 10, 1969	C, W	D, S	Dug well.
602	Seymour Country Club	Ernest Knesek	1952	23	42	--	Qs	1,340	17.7	July 9, 1969	Cf, E	Irr	Dug well. Used to irrigate greens on golf course.
603	State of Texas	--	--	Spring	--	--	Qs	1,332	(+)	--	Flows	N	Seeps and springs along both sides of U.S. 277 and Fort Worth and Denver Railroad right of way.
* 604	Jessie Hajek	Jessie Hajek	1951	25	44	--	Qs	1,337	14.9	July 2, 1969	J, E	D	Dug well.
605	Rudolph Kohut	--	--	22	42	--	Qs	1,352	20.8	Nov. 18, 1969	N	N	Dug well. Formerly used as domestic and livestock supply.
* 606	do	--	1955	14	30	--	Qs	1,340	9.1	do	J, E 1-1/2	Irr	Dug well. Reported to pump about 20 gpm.
* 607	Jerry E. Mocek	--	--	29	42	--	Qs	1,354	18.2	Nov. 25, 1969	J, E	D, S	Dug well.
* 608	Baylor Livestock Company	Buster Tolson	1962	22	42 15	-- --	Qal	1,272	10.8	do	J, E	Ind	Dug well. Feedlot supply well.
* 701	Gertie Moore	--	--	53	31	--	Qs, Pcf	1,412	11.8	Nov. 19, 1969	J, E	D, S	Dug well. Another house well equipped with jet motor is located just across county road from this well.
* 801	Dannie Portwood Fancher	--	--	Spring	--	--	Qs	1,318	(+)	--	J, E	D, S	Several springs and seeps along bluff. Used since first settlement of county.
802	Crown Central Petroleum Corporation	C. Y. Gorman Drilling Company	1956	1,538	7 4-1/2	1,361 1,538	PPcs	1,345	--	--	C, G 30	Ind	Produces from Saddle Creek Sand (Pennsylvanian). Used to waterflood Tannehill sand (Permian). Produces about 22,000 gallons per day.
803	do	do	1963	1,505	4-1/2	1,452	PPcs	1,342	--	--	C, E 20	Ind	Do.
804	Skelly Oil Company	Rimes Well Service	1968	1,512	5-1/2 4	1,373 1,512	Pw	1,441	--	--	C, E 20	Ind	Reported to produce water from the Tannehill sand for waterflooding purposes. Reported to pump about 9 gpm. Water Reported to contain 90,000 ppm chlorides.
* 901	Vernon Teague	--	--	22	31	--	Qal	1,245	20.1	Dec. 18, 1968	C, E	S	Dug well.
* 902	Frank Allen	--	--	29	31	--	Qal	1,253	26.9	Dec. 12, 1968	C, W	S	Do.
* 903	C. M. Randall, Sr., et al.	--	--	14	31	--	Qal	1,249	11.3	Dec. 17, 1968	C, W	S	Dug well. Just east of this well is an unused drilled well with 13-inch galvanized casing. Depth is 15.9 feet. Water level is 10.7 feet below land surface. A 20-inch core of massive white limestone is nearby; probably Lueders Formation of Permian.
* 904	Dr. C. M. Randall, Jr., et al.	Les Jameson	--	20	8	--	Qs	1,318	--	--	J, E	D, S	Well and pump covered with dirt to prevent freezing.
905	Frank Allen	--	--	Spring	--	--	Qs	1,310	(+)	--	Flows	N	Spring in old gravel pits, flows about 15 gpm.
906	do	--	--	Spring	--	--	Qs	1,310	(+)	--	Flows	N	Spring in old gravel pit, flows about 10 gpm.
* 907	Joe Hajek	--	--	39	47	--	Qs	1,340	21.0	July 2, 1969	J, E	D	Dug well.
* 908	Howard Smulcher	Howard Smulcher	1967	28	19	--	Qal	1,253	20.8	May 19, 1970	Cf	Ind	Used in waterflood operation.

See footnotes at end of table.

Table 6. -- Records of Water Wells and Springs -- 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
* 21-31-101	Adolph E. Wirz	--	--	20	30	--	Qs	1,357	2.3	Nov. 23, 1969	C, W	D, S	Dug well. Damp spots, seeps and white mineral deposits (probably sulfates) all around field near well.
* 102	David Wirz	--	--	64	42	--	Qs	1,365	5.5	do	J, E	D, S	Dug well. Water from sand and gravel at 15 to 25 feet. Well dug until hit limestone bed at 64 feet; probably Lueders Formation of Permian.
* 401	Ernest Hrncirik	--	--	20	31 22	-- --	Qs	1,374	9.8	Dec. 12, 1968	C, W	S	--
402	Henry Peek	--	--	Spring	--	--	Qs	1,355	(+)	--	Flows	N	Spring flows about 10 gpm.
403	State of Texas	--	--	Spring	--	--	Qs	1,334	(+)	--	Flows	N	Spring flows about 10 gpm in ditch on north side of Highway 199.
* 801	C. C. Sanders	--	1936	31	42	--	Qs	1,332	24.7	Nov. 22, 1968	C, W	D, S	Dug well. Blow sand at surface. Dug to solid limestone bed.
* 803	Mrs. Barbara Novac	--	--	11	100	--	Qs	1,318	4.1	Feb. 20, 1970	J, E	D, S	Dug well. Reported to have become salty in last few years.
* 804	Carter H. Taylor	--	1920	41	50	--	Qs	1,365	11.6	do	J, E	D, S	Dug well. Another well was dug about 15 feet to the northwest and has been used as a cistern.
32-201	Skelly Oil Company	Schultz and Brannan	1960	4,250	11 7	63 2,801	PPcn	1,270	--	--	N	N	Formerly used to supply salt water for water-flooding. Re-entry of oil-test. Produced from Canyon reef (Pennsylvanian).
37-501	H. G. Williams	Horn Drilling Company	1964	1,550	5 2	-- 1,490	Pw	1,400	--	--	C, E 5	Ind	Salt water supply well for secondary recovery of oil. Reported to pump about 5 gpm.
601	Oakland Corporation	Kuehn and Roberts	1958	6,880	13 10 7	243 3,004 6,788	C	1,383	--	--	S, E 150	Ind	Supplies water for use in waterflood operation. Reported to pump about 300 gpm.
* 905	Portwood Ranch and Company	--	--	24	96	--	Pw	1,327	19.9	Nov. 22, 1968	C, W	N	Dug well. Windmill broken.
38-201	Henry Seydler	--	1930	72	36	--	Pw	1,360	31.9	July 9, 1969	C, W	N	Do.
* 203	Ignac Hostas	--	--	52	38	--	Pw	1,334	2.2	June 20, 1969	J, E	D, S	Dug well. Reported contaminated by salt water in 1966. Investigated by Railroad Commission of Texas.
* 301	Vernon Teague	--	1888	31	42	--	Qal	1,245	26.5	Dec. 17, 1968	J, E	D, S	Dug well.
* 302	do	--	--	12	31	--	Qal	1,227	9.9	Dec. 18, 1968	C, W	N	Dug well. Windmill broken.
* 39-101	do	Les Jameson	--	35	12	--	Qal	1,248	22.7	do	T, E 3	Irr, S	Drilled for use as irrigation supply. Estimated to pump about 100 gpm.
* 102	Joe Glover	Joe Glover and Buster Tolson	1960	8	8	--	Qal	1,225	15.5	do	J, E	S	Water level is pumping level. Two pumps on this well. Two other shallow wells nearby, not used now.
* 201	Charles T. Porter	--	--	16	31	--	Qal	1,212	10.6	Nov. 28, 1968	J, E	D, S Ind	Dug well. Windmill tower still over well. Well used as a supply for a small feedlot operation.
* 202	Horace E. James	J. A. and Bill Warren	1950	20	31	--	Qs	1,315	15.1	Dec. 13, 1968	J, E	D, S	Dug well.
* 203	Mrs. I. J. Wehmeyer	do	1936	19	31	--	Qal	1,272	5.1	do	N	N	Dug well. Formerly domestic and livestock supply.
* 301	Jim Welch	--	--	20	40	--	Qal	1,208	13.7	Nov. 14, 1968	J, E	N	Do.

See footnotes at end of table.

Table 6. -- Records of Water Wells and Springs -- 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
*	21-39-302	Charles T. Porter	Les Jameson	1967	21	16	--	Qal	1,220	13.7	Nov. 21, 1968	J, E 1-1/2	Irr, S	One of 6 wells which pump into central distribution line. The 6 wells are reported to pump a total of about 400 gpm. Gravel packed.
	303	do	do	1967	22	13	--	Qal	1,219	14.0	do	J, E 1-1/2	Irr, S	Do.
	304	do	do	1967	22	13	--	Qal	1,219	14.5	do	J, E 1-1/2	Irr, S	Do.
	305	do	do	1967	23	13	--	Qal	1,220	15.1	do	J, E	Irr, S	Do.
	306	do	do	1967	24	13	--	Qal	1,221	15.0	do	J, E	Irr, S	Do.
	307	do	do	1967	22	13	--	Qal	1,219	13.8	do	J, E	Irr, S	Do.
	308	Lincoln Burns estate	--	--	16	30	--	Qal	1,201	10.2	do	C, W	N	Dug well. Windmill broken. Formerly used as livestock supply.
*	309	do	--	--	13	31	--	Qal	1,208	9.8	do	C, W	S	Dug well near large gravel pits with 20 to 25 feet of medium to coarse gravel.
*	310	Mrs. Mabel Johnson	--	--	25	31	--	Qal	1,202	12.5	do	J, E	D, S	Dug well.
*	311	do	--	--	22	24	--	Qal	1,223	16.7	do	C, W	N	Dug well. Windmill broken. Formerly used as livestock supply.
*	312	John Bess Fancher	--	--	15	48	--	Qal	1,204	12.0	Dec. 11, 1968	C, W	S	Dug well.
*	313	do	--	--	14	31	--	Qal	1,201	11.3	do	J, E	S	Do.
*	314	do	--	--	14	28	--	Qal	1,197	9.4	do	C, W	S	Do.
*	501	Mack Russell	Mack Russell	1960	26	6	--	Qal	1,218	17.7	Dec. 17, 1968	C, W	N	Well, hand augered. Windmill broken. Formerly used as livestock supply.
*	502	do	do	1967	16	6	--	Qal	1,213	14.1	do	C, W	S	Well, hand augered.
*	503	do	do	--	9	31	--	Qal	1,207	8.5	do	N	N	Dug well, for livestock supply. Well partially caved and washed in.
*	601	Jettie Howe Russell	Seismograph Crew	1955	16	5	--	Qs	1,292	15.2	Dec. 12, 1968	C, W	S	Windmill pumps well dry in high wind.
*	602	Ralph Howe	Ralph Howe	1963	15	30	--	Qs	1,281	10.0	do	J, E	D, S	Seymour gravels well cemented. Well dug and blasted with dynamite.
*	603	Mildred R. Lunsford	--	--	15	52	--	Qs	1,290	12.0	do	J, E	D, S	Do.
	604	do	--	--	Spring	--	--	Qs	1,260	(+)	--	Flows	N	Spring flowing at an estimated 15 gpm from cracks, crevices, and seams of about 15 to 20 feet of well-cemented Seymour gravels.
*	40-101	John A. Young, Jr.	--	--	17	40	--	Qal	1,200	11.9	Nov. 8, 1968	J, E	S	Dug well.
*	102	Portwood Ranch and Company	--	--	35	48	--	Qal	1,226	32.2	Nov. 13, 1968	C, W	S	Do.
*	103	Myrton Couch	--	1915	13	36	--	Qal	1,203	7.1	do	J, E C, W	D, S	Dug well. Another well equipped with a windmill is just east of this well.
*	104	Bobby Morris	--	--	20	36	--	Qal	1,198	14.5	Nov. 14, 1968	J, E	D, S	Dug well. Windmill tower still over well.
*	105	Mrs. S. S. Knox	Henry Welch	1955	20	36	--	Qal	1,196	--	--	C, H	D, S	Dug well.
*	106	do	do	--	19	36	--	Qal	1,202	12.4	Nov. 19, 1968	C, W	S	Do.

See footnotes at end of table.

Table 6. -- Records of Water Wells and Springs -- 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
* 21-40-107	Mrs. S. S. Knox	Henry Welch	1950	16	36	--	Qal	1,190	13.0	Nov. 19, 1968	C, W	S	Dug well.
* 108	Paul Brock	Bill Guthrie	1959	22	10	--	Qal	1,205	15.1	Nov. 20, 1968	J, E	D, S	--
* 109	do	--	--	25	30	--	Qal	1,203	17.7	do	J, E	N	Dug well. New house well (21-40-108) drilled because this well started to produce gas. Formerly used as domestic and livestock supply.
110	do	Paul Brock	--	12	36	--	Qal	1,196	6.5	do	N	N	Dug well. Partially silted up. Formerly used as livestock supply.
* 111	Bobby Brock	Bobby Brock	1958	15	42	--	Qal	1,203	11.1	do	J, E	D, S	Dug well.
* 112	Paul Brock	do	1958	16	31	--	Qal	1,204	11.2	do	C, W	S	Do.
* 113	Lincoln Burns estate	--	--	12	36	--	Qal	1,197	5.2	Nov. 21, 1968	C, W	N	Dug well. Windmill broken. Formerly used as livestock supply.
* 114	do	Ernest Knesek	--	24	7	--	Qal	1,210	18.4	do	J, E	S	--
115	Rudolph A. Hrncirik	--	--	17	34	--	Qal	1,247	12.4	do	N	N	Dug well. Formerly used as domestic and livestock supply.
* 116	do	--	--	40	36	--	Qal	1,238	31.8	do	C, W	D, S	Dug well.
* 201	Sam Portwood	Buster Tolson	--	31	15	--	Qal	1,214	24.7	Nov. 14, 1968	N	N	Formerly used as domestic and livestock supply.
* 401	Portwood Ranch and Company	--	--	--	7	--	Qal	1,181	9.1	Nov. 8, 1968	C, W	S	Old dug well; deepened, cased, and gravel packed.
* 402	Sam Portwood	J. B. Guthrie	1955	17	6	--	Qal	1,193	13.2	Nov. 14, 1968	C, W	S	--
* 403	Ernest Hrncirik	--	--	8	30	--	Qal	1,178	6.8	do	C, W	S	Dug well.
404	do	--	--	--	48	--	Qal	1,177	6.9	do	N	N	Dug well. Formerly used as domestic and livestock supply.
* 502	Portwood Ranch and Company	--	--	30	36	--	Qs	1,237	15.9	Nov. 7, 1968	C, W	S	Dug well.
* 503	do	--	--	31	42	--	Qs	1,273	11.0	do	C, W	S	Do.
* 504	do	--	--	33	30	--	Qs	1,267	26.9	do	N	N	Dug well. Windmill tower over well. Formerly used as livestock supply.
* 505	do	--	--	33	45	--	Qs	1,258	16.7	do	J, E	D, S	Dug well. Two jet pumps. Supplies several houses.
* 506	do	--	--	20	36	--	Qal	1,192	13.9	Nov. 8, 1968	C, W	N	Dug well. Windmill broken. Formerly used as livestock supply.
507	do	Ernest Knesek	1967	26	10	--	Qal	1,192	14.1	do	J, E 1-1/2	Irr	Reported to pump about 75 gpm. Pumps into earth tank. Water distributed through sprinkler system. Gravel packed.
508	do	do	1967	25	10	--	Qal	1,193	13.7	do	N	N	Drilled as an irrigation supply. Not yet equipped when inventoried. Gravel packed.
509	do	do	1967	26	10	--	Qal	1,194	13.4	do	N	N	Do.
* 510	do	do	1967	24	10	--	Qal	1,195	13.9	do	N	N	Drilled as an irrigation supply. Gravel packed.
511	do	Les Jameson	1967	24	17	--	Qal	1,192	11.6	do	N	N	Do.
512	do	do	1967	23	15	--	Qal	1,190	11.4	do	N	N	Do.

See footnotes at end of table.

Table 6. -- Records of Water Wells and Springs -- 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
21-40-513	Portwood Ranch and Company	Les Jameson	1967	24	15	--	Qal	1,190	11.1	Nov. 8, 1968	N	N	Drilled as an irrigation supply. Gravel packed.
514	do	do	1967	24	15	--	Qal	1,191	11.3	do	N	N	Do.
* 515	do	do	1967	24	17	--	Qal	1,191	11.4	do	N	N	Do.
516	do	do	1967	24	15	--	Qal	1,192	10.9	do	J, E 2	Irr	Reported to pump about 90 gpm. Pumps into earthen tank. Water distributed through sprinkler system by 10 horsepower centrifugal pump. Gravel packed.
517	do	do	1967	26	17	--	Qal	1,192	11.0	do	J, E 2	Irr	Do.
* 518	do	--	--	19	30	--	Qs	1,245	10.2	do	J, E	D, S	Dug well.
519	do	--	--	26	36	--	Qs	1,240	6.5	do	N	N	Dug well. Formerly used as domestic and livestock supply.
* 520	do	--	--	22	30	--	Qs	1,267	14.6	Nov. 13, 1968	C, W	S	Dug well.
* 521	do	--	--	34	36	--	Qal	1,197	29.2	Nov. 8, 1968	C, W	N	Dug well. Windmill broken. Formerly used as domestic and livestock supply.
* 522	Sam Portwood	--	--	19	31	--	Qal	1,199	14.6	Nov. 14, 1968	J, E	D, S	Dug well. Two jet pumps on well. Supplies two households.
* 523	do	Buster Tolson	--	33	13	--	Qal	1,206	15.4	do	J, E	D, S	--
* 524	do	--	1936	52	42	--	Qal, Pw	1,222	41.8	do	C, W	N	Dug well. Windmill broken. Formerly used as domestic and livestock supply.
* 525	G. H. Brock	--	1947	15	31	--	Qs	1,260	7.9	Nov. 20, 1968	J, E	N	Dug well. Formerly used as domestic and livestock supply.
* 526	J. B. Guthrie	--	--	36	36	--	Qal	1,213	28.3	Nov. 14, 1968	J, E	D, S	Dug well.
* 527	do	--	1923	28	48	--	Qal	1,203	18.9	do	C, W	S	Dug well. Originally supplied water to cotton gin. Gin no longer here.
* 528	Ernest Hrncirik	Ernest Knesek	--	21	15	--	Qal	1,187	9.4	do	J, E	D, S	--
* 529	Jim Welch	--	--	24	30	--	Qs	1,251	15.3	Nov. 13, 1968	J, E	D, S	Dug well. New well drilled about 15 feet south of this well. New well: depth, 23 feet; water level, 14.7 feet below land surface; cased with 13-inch oil field casing.
* 530	do	--	1917	44	36	--	Qs	1,247	34.8	do	C, W	N	Dug well. Windmill broken. Formerly used as domestic and livestock supply.
531	Mrs. Valerie Trevis	--	--	28	36	--	Qal	1,209	21.7	Nov. 19, 1968	J, E	N	Dug well. Formerly used as domestic and livestock supply.
* 532	do	--	--	29	36	--	Qal	1,211	23.9	do	N	D, S	Dug well. Replacement pump not installed when inventoried.
* 601	Portwood Ranch and Company	--	--	28	30	--	Qs	1,268	16.0	Nov. 7, 1968	J, E	N	Dug well. Formerly used to irrigate small orchard.
* 804	Don Buckalew	--	1952	28	5	--	Qal	1,190	--	--	S, E	D, S	--
* 810	do	--	--	25	30	--	Qal	1,198	20.1	Nov. 6, 1968	N	N	Dug well. Formerly used as domestic and livestock supply.

See footnotes at end of table.

Table 6. -- Records of Water Wells and Springs -- 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
					DIAM-ETER (in.)	DEPTH (ft)			BELOW LAND-SURFACE DATUM (ft)	DATE OF MEASUREMENT			
21-40-811	Portwood Ranch and Company	--	--	32	30	--	Qal	1,200	23.5	Nov. 7, 1968	C, W	S	Dug well. Another old dug well just south of this well not inventoried.
* 812	Jim Welch	--	--	28	36	--	Qal	1,210	26.2	Nov. 13, 1968	J, E	S	Dug well. Formerly also used as domestic supply.

* For chemical analyses of water, see Table 8.
1/ For drillers' logs of wells, see Table 7.
2/ For results of pumping tests of wells, see Table 4.

Table 7.—Drillers' Logs of Water Wells

Well 21-21-804

Owner: Henry P. Arledge
Driller: Lewis Barnes

	THICKNESS (FEET)	DEPTH (FEET)
Topsoil, brown, moist, sandy	2.5	2.5
Caliche, tan, slightly sandy with some red staining	9.5	12.0
Clay, silty, red-stained, slightly sandy	3.0	15.0
Sand, fine-grained, saturated, reddish-brown, some gravel stringers	2.0	17.0
Clay, hard, red, silty, slightly moist	2.0	19.0
Sand, medium-grained, with 40% clay, quartz sand, rounded	2.0	21.0
Gravel, medium to coarse-grained, rounded	1.0	22.0
Permian, claystone, red, hard, very dry, greenish-blue oxidation halos from 1/2 inch to 6 inches diameter, flaking	27.0	49.0

Well 21-21-939

Owner: Rex Howell
Driller: Lewis Barnes

	THICKNESS (FEET)	DEPTH (FEET)
Topsoil, sandy, dark-brown, moist, some silt	2.0	2.0
Clay, silty, light-brown, sand pebbles	6.5	8.5
Sand, fine-grained, tan, stained, some clay	2.0	10.5
Caliche, tan, some gravel, stained, some silt	3.5	14.0
Sand, medium-grained, stained red, some caliche, quartz sand, rounded	5.0	19.0
Clay, silty, calcareous, red	1.0	20.0
Sand, medium- to coarse-grained, red	1.0	21.0
Clay, sandy, medium-grained, red, moist	1.0	22.0
Sand, coarse gravel, medium-grained sand, stained red	7.0	29.0
Sand, medium-grained, subrounded quartz, stained red	5.5	34.5
Gravel, fine- to medium-grained, clay, sandy stringers present, rounded	5.0	39.5
Gravel, fine- to coarse-grained, rounded, light and dark minerals	2.5	42.0
Permian, hard red clay, oxidation halos, very dry	1.5	43.5

Well 21-21-940

Owner: Rex Howell
Driller: Lewis Barnes

	THICKNESS (FEET)	DEPTH (FEET)
Topsoil, brown, sandy, moist	2.0	2.0
Clay, silty, gray-tan, with some sand pebbles	7.0	9.0
Caliche, some staining, clay, silty	2.5	11.5
Sand, fine-grained, tan-red, some medium gravel, some clay stringers	7.5	19.0
Clay, stained red grading to tan, silty	3.0	22.0
Sand, tan, medium-grained, with some gravel pebbles	6.0	28.0
Gravel, coarse- to fine-grained, subrounded, light and dark minerals	4.0	32.0
Sand, fine- to coarse-grained, with gravel pebbles, stained, red, rounded	6.0	38.0
Gravel, coarse-grained, also finer-sized intermixed, stained red, light and dark minerals	4.5	42.5
Permian, hard red clay, oxidation halos, dry	1.5	44.0

Well 21-21-941

Owner: Rex Howell
Driller: Lewis Barnes

	THICKNESS (FEET)	DEPTH (FEET)
Topsoil, dark-brown, sandy, moist	2.0	2.0
Silty, tan-gray, some pebbles	6.0	8.0
Caliche, tan, some gravel-sized pebbles, clay, silty	5.0	13.0
Sand, fine- to medium-grained, quartz, stained red, some caliche, some gravel stringers	12.0	25.0
Gravel, fine- to medium-grained, rounded with some clay stringers and some large gravel pebbles	5.0	30.0
Sand, medium- to fine-grained, with gravel stringers, rounded, light and dark minerals	4.0	34.0
Reworked Permian, hard red clay, and sandstone layered	1.0	35.0
Gravel, medium- to coarse-grained, rounded light and dark minerals	7.5	42.5
Permian, red clay, hard-dry, oxidation halos	.5	43.0

Table 7.—Drillers' Logs of Water Wells—Continued

	THICKNESS (FEET)	DEPTH (FEET)
Well 21-21-942		
Owner: G. C. Laney Driller: Lewis Barnes		
Topsoil, brown, moist, sandy	2.0	2.0
Clay, silty, small pebbles, dry, light-brown	2.0	4.0
Clay, sandy, fine-grained, dry, some silt reddish-brown	5.0	9.0
Caliche, sandy, tan, some staining, iron staining	3.0	12.0
Sand, fine-grained, 30% clay, red, moist quartz sand	1.5	13.5
Sand, fine- to medium-grained, with 50% gravel medium- to coarse-grained, rounded	7.5	21.0
Permian, mudstone-red, oxidation halos very dry and hard	5.5	26.5
Well 21-22-702		
Owner: Jess L. Compton Driller: Les Jameson		
Sand and gravel	20.0	20.0
Clay	1.0	21.0
Sand and gravel	18.0	39.0
Coarse gravel; redbeds last few inches	1.0	40.0
Well 21-22-807		
Owner: Burrell Lee, Jr. Driller: Lewis Barnes		
Topsoil, dark-brown, slightly moist, sandy	2.0	2.0
Clay, tannish, brown, dry, silty, some caliche present	3.0	5.0
Sand, fine-grained, very dirty—red 40%-60% clay, rounded, dry	5.0	10.0
Clay, 30%-50% sand, fine-grained, red, dry	10.0	20.0
Sand and gravel, fine- to coarse-grained, sand and gravel, Permian pebbles, dirty with about 20% clay	2.0	22.0
Permian, siltstone, red, hard, compacted dry, weathered clay also present in various amounts, layered, some sand pebbles present in small amounts, oxidation halos, blue-green, from 1/16 to 1/3 inch	33.0	55.0

	THICKNESS (FEET)	DEPTH (FEET)
Well 21-22-827		
Owner: Anton Fojtik Driller: Doris Dickerson		
Caliche	13.0	13.0
Sand and gravel	23.0	36.0
Redbeds	3.0	39.0
Well 21-22-911		
Owner: Burrell Lee, Jr. Driller: Lewis Barnes		
Topsoil, dark-brown, sandy, moist	2.0	2.0
Clay, sandy, tan, some staining with about 25% silt	8.0	10.0
Caliche, some staining, silty clay	1.0	11.0
Sand, staining, very dirty, 30%-50% clay, fine-grained sand, quartz, rounded	2.5	13.5
Sand, fine-grained, red, 10% clay	8.0	21.5
Sand, medium-grained, rounded, light and dark minerals, with some gravel pebbles	11.5	32.0
Sand, medium- to coarse-grained, 30% gravel, all sizes of grains	4.0	36.0
Gravel, medium- to coarse-grained, rounded, small amounts of clay and sand	4.5	40.5
Permian, clay, red, dry, oxidation halos	0.5	41.0
Well 21-22-912		
Owner: Burrell Lee, Jr. Driller: Lewis Barnes		
Topsoil, dark-brown, sandy, moist	2.0	2.0
Clay, silty, light-brown-tan with pebbles, 20% fine-grained sand	8.0	10.0
Sand, 30%-50% clay, stained red, tan, fine- to medium-grained	5.5	15.5
Sand, stained red, fine-grained, rounded quartz	8.5	24.0
Sand, fine- to medium-grained, with fine-grained gravel stringers, light and dark minerals, rounded	4.0	28.0
Gravel, medium- to coarse-grained, rounded, light and dark minerals	3.0	31.0
Sand, medium- to coarse-grained, stained red, light and dark minerals, rounded	3.0	34.0

Table 7.—Drillers' Logs of Water Wells—Continued

	THICKNESS (FEET)	DEPTH (FEET)
Well 21-22-912—Continued		
Sand and gravel, medium- to coarse-grained, rounded, clay stringers	6.5	40.5
Permian, clay, red, oxidation halos, dry, very compacted	1.5	42.0
Well 21-22-913		
Owner: Burrell Lee, Jr. Driller: Lewis Barnes		
Topsoil, dark-brown, moist sandy	2.0	2.0
Clay, sandy, dry, tan-gray green, caliche present	8.0	10.0
Clay, 30% to 50% sand, some caliche, stained red	6.0	16.0
Sand, 10% to 15% clay, red, rounded medium- to coarse-grained, with gravel stringers	4.0	20.0
Sand, medium- to coarse-grained, red, rounded, clean, with a few gravel stringers	7.0	27.0
Sand, red, rounded, fine-grained, layered clay and gravel stringers, quartz sand	9.0	36.0
Gravel, medium- to coarse-grained, stained red light and dark minerals, rounded	4.5	40.5
Permian, clay, dark-red, very hard, oxidation halos present, silty	0.5	41.0
Well 21-29-318		
Owner: Clyde Chapman Driller: Lewis Barnes		
Topsoil, sandy, fine-grained, 70% slightly moist clay, 30% light-brown	2.0	2.0
Clay, very sandy, stained red, dry caliche, fine-grained sand	10.0	12.0
Sand, fine-grained, dry, quartz, calcareous sand pebbles 20% clay-red	3.0	15.0
Sand and gravel, fine- to coarse-grained, rounded, all minerals—10% clay, red staining	9.5	24.5
Permian, siltstone, weathered, soft 1/8 inch-1/2 inch oxidation halos-grains visible under hand lens, red	0.5	25.0
Permian, siltstone, very dry, hard, layered, red and tan banding. A few pebbles present, oxidation halos 1/8 inch-6 inches in diameter	56.0	81.0
Permian, sandstone, medium-grained, compacted non-calcareous cement, dry, dark blackish-red color	1.5	82.5
Permian, siltstone, with some fine-grained sand, tan and red banding	23.5	106.0

	THICKNESS (FEET)	DEPTH (FEET)
Well 21-29-601		
Owner: Burrell Lee, Jr. Driller: Lewis Barnes		
Topsoil, sandy, light-brown, moist	2.0	2.0
Clay, sandy fine-grained, 20%-40% reddish-brown, slightly moist, caliche in various amounts	13.0	15.0
Sand, fine-grained, very dry, rounded quartz, 10%-30% clay reddish-brown, caliche from 18-20 feet, consolidated sand at 22.0-22.5 feet	8.0	23.0
Sand, fine- to medium-grained, red, very dry rounded, light and dark minerals	5.0	28.0
Sand and gravel, fine- and medium-grained, dry, 20% clay sized particles	2.5	30.5
Permian, siltstone, red, hard, some clay-sized particles, some oxidation halos	1.5	32.0
Well 21-30-117		
Owner: Emitt Golden, et al. Driller: Les Jameson		
Topsoil	7.0	7.0
Caliche and sand	17.0	24.0
Sand and gravel	9.0	33.0
Redbeds	1.0	34.0
Well 21-30-131		
Owner: Mike Parker Driller: Lewis Barnes		
Topsoil, dark-brown, moist	2.0	2.0
Clay, some silt, reddish-brown, dry	7.0	9.0
Caliche, sandy, fine-grained, clay, tan with red staining	2.0	11.0
Sand, fine-grained, with about 35% clay	2.0	13.0
Sand and gravel, sand-medium to coarse, gravel—fine to medium, base of Seymour at 16 feet	3.0	16.0
Siltstone and mudstone, some clay, hard red, oxidation halos, some stratification, Permian, Clear Fork	24.0	40.0
Well 21-30-132		
Owner: Baylor County Precinct 1 Driller: Lewis Barnes		
Topsoil, light-brown, sandy, moist	2.0	2.0
Clay, with about 10% fine-grained sand, dark-brown, slightly moist	4.0	6.0

Table 7.—Drillers' Logs of Water Wells—Continued

	THICKNESS (FEET)	DEPTH (FEET)
Well 21-30-132—Continued		
Caliche, white to tan, with silt and sand pebbles, medium-grained, iron stained, base of Seymour at 10.5 feet	4.5	10.5
Siltstone and mudstone, blue-green, with some clay, dry, flaking, some red and tan staining, Permian, Clear Fork	24.5	35.0
Well 21-30-264		
Owner: Burrell Lee, Jr. Driller: Lewis Barnes		
Topsoil, dark-brown, sandy, moist	2.0	2.0
Clay, with some silt and sand, brown, 10% caliche	9.0	11.0
Sand, fine-grained, with about 30% clay, water at 13 feet	3.0	14.0
Gravel, fine- to medium-grained, with about 20% sand, base of Seymour at 20 feet	6.0	20.0
Mudstone, tan, very hard, with oxidation halos, Permian	1.0	21.0
Well 21-30-305		
Owner: City of Seymour Driller: W. E. Turner		
Topsoil	3.0	3.0
Red pack sand	6.0	9.0
Red sand with clay balls	9.0	18.0
White sand and gravel	7.0	25.0
Red sand and pea gravel	11.0	36.0
Red, coarse sand	6.0	42.0
Red sandrock, redbeds	2.0	44.0
Well 21-30-306		
Owner: City of Seymour Driller: J. P. "Buster" Tolson		
Topsoil	4.0	4.0
Red clay	6.0	10.0
Caliche or white clay	2.0	12.0
Sandy clay—red	3.0	15.0
Sugar sands with some gravel	5.0	20.0
Clay, sand, and gravel	5.0	25.0
Fine sand, some gravel	3.0	28.0
Dry coarse gravel, some clay, water at 33 feet	5.0	33.0

	THICKNESS (FEET)	DEPTH (FEET)
Well 21-30-306—Continued		
Coarse gravel and sand (looks very good)	10.0	43.0
Blue clay	1.0	44.0
Well 21-30-310		
Owner: City of Seymour Driller: W. E. Turner		
Topsoil	3.0	3.0
Joint clay and pack sand	9.0	12.0
Dry sand and gravel	8.0	20.0
Fine sand and gravel	5.0	25.0
Red, coarse sand and gravel	9.0	34.0
Coarse, white sand	2.0	36.0
Coarse, white sand and coarse gravel	6.0	42.0
Red sand	1.0	43.0
Well 21-30-314		
Owner: City of Seymour Driller: J. P. "Buster" Tolson		
Topsoil	5.0	5.0
Red, sandy clay	8.0	13.0
White sand	5.0	18.0
Red gravel with some clay	1.0	19.0
Sand and gravel, water at 25 feet	6.0	25.0
Gravel and sand	8.0	33.0
Soft sand rock	2.0	35.0
Red clay	2.0	37.0
Blue clay	2.0	39.0
Well 21-30-315		
Owner: City of Seymour Driller: J. P. "Buster" Tolson		
Topsoil	6.0	6.0
Red clay soil	6.0	12.0
Fine river sand	13.0	25.0
Hard, red clay with some rock	3.0	28.0
Fine sand	4.0	32.0
Gravel and sand, water at 34 feet	2.0	34.0
Coarse gravel, very little sand	12.0	46.0
Rock, some gravel	2.0	48.0
Blue shale	1.0	49.0

Table 7.—Drillers' Logs of Water Wells—Continued

	THICKNESS (FEET)	DEPTH (FEET)
Well 21-30-369		
Owner: Bill Elliston Driller: Les Jameson		
Topsoil, sandy loam	5.0	5.0
Red sand	18.0	23.0
Sand and fine gravel, white	5.0	28.0
Red clay	3.0	31.0
Sand and coarse gravel	7.0	38.0
Redbeds	1.0	39.0
Well 21-30-370		
Owner: Don McDermitt Driller: Les Jameson		
Topsoil, sandy loam	6.0	6.0
Red sand	14.0	20.0
Quick sand	6.0	26.0
Water sand, fine	6.0	32.0
Coarse sand	5.0	37.0
Sand and gravel	4.0	41.0
Redbeds	1.0	42.0
Well 21-30-385		
Owner: T. C. Griffin Driller: Lewis Barnes		
Topsoil, sandy, light-brown, moist, fine-grained sand	2.0	2.0
Clay, sandy, fine-grained, dry, caliche present in small amounts	8.0	10.0
Sand, 30% to 50% clay, reddish-brown, fine-grained, dry, quartz	14.0	24.0
Gravel, medium- to fine-grained, rounded, all minerals present, 30% sand, medium- to coarse-grained, saturated	13.0	37.0
Gravel, fine- to coarse-grained, rounded, all minerals present, small amounts of sand intermixed	5.5	42.5
Permian, siltstone, red, hard, very dry	2.0	44.5
Well 21-30-386		
Owner: T. C. Griffin Driller: Lewis Barnes		
Topsoil, light-brown, sandy, moist	2.0	2.0
Clay, sandy, red-tan, with caliche present in various amounts, dry	10.0	12.0
Well 21-30-386—Continued		
Sand, 30% to 50% clay, fine-grained, quartz, reddish-brown, dry, cemented pebble throughout this section	8.0	20.0
Sand, medium- to coarse-grained, 10% to 30% gravel, no clay in section, rounded gravel	12.0	32.0
Gravel, coarse- to medium-grained, rounded, all minerals	9.0	41.0
Permian, mudstone, very hard, bluish-red, dry	3.0	44.0
Well 21-30-387		
Owner: T. C. Griffin Driller: Lewis Barnes		
Topsoil, dark-brown, sandy, moist	2.0	2.0
Clay, sandy, fine-grained, red, dry, caliche in varying amounts, cemented pebbles throughout section	20.0	22.0
Sand, fine- to medium-grained, quartz, rounded, with some fine-grained gravel	10.0	32.0
Sand, medium- to coarse-grained, with 30% to 50% gravel, fine- to medium-grained, all minerals, rounded	8.0	40.0
Gravel, medium- to coarse-grained, rounded, all minerals	2.5	42.5
Permian, hard, dry, reddish-blue mudstone, some silt in section	2.5	45.0
Well 21-30-388		
Owner: B. E. Keck Driller: Lewis Barnes		
Topsoil, dark-brown, sandy, moist clay, light-brown, sandy, 10% to 40% caliche, iron-stained from 8 feet to 9 feet	2.0	2.0
Clay, silty, reddish-brown, small amounts of caliche	8.0	18.0
Sand, fine-grained, red, moist, dirty, saturated, 20% clay	2.0	20.0
Sand and gravel, medium- to fine-grained saturated, clean	20.0	40.0
Permian, mudstone, blue, very hard and dry, stratified	1.0	41.0
Well 21-30-511		
Owner: Ernest Knesek Driller: Lewis Barnes		
Topsoil, light-brown, sandy, fine-grained, moist	2.0	2.0

Table 7.—Drillers' Logs of Water Wells—Continued

	THICKNESS (FEET)	DEPTH (FEET)
Well 21-30-511—Continued		
Clay, silty, some sand pebbles, slightly moist, reddish-brown	5.0	7.0
Clay, sandy, fine-grained, dry, reddish-brown, quartz sand	2.0	9.0
Sand, dirty, 30%-50% clay, dry, reddish-brown, quartz rounded, fine-grained	6.0	15.0
Caliche, sandy, fine-grained, tan, reddish-brown, 50% sand and 50% caliche	2.0	17.0
Sand, fine - to medium-grained, tan, reddish-brown, 90% quartz, slightly moist, rounded, some gravel, medium-grained	9.0	26.0
Sand and gravel, fine - to medium-grained, rounded, all minerals, dry	10.0	36.0
Gravel, fine - to coarse-grained, saturated, rounded, all minerals, very clean; last few inches of Permian-weathered, soft, red, dry, reddish-brown, siltstone, with small amounts of clay	6.5	42.5

Table 8.–Chemical Analyses of Water From Wells and Springs

(Analyses given in milligrams per million except percent sodium, specific conductance, pH, sodium adsorption ratio, and residual sodium carbonate.)

Analyses by Texas State Department of Health unless indicated by footnote.

WELL	OWNER	DEPTH OF WELL (ft)	DATE OF COLLECTION	SILICA (SiO_2)	CALCIUM (Ca)	MAGNESIUM (Mg)	SODIUM (Na)	BICARBONATE (HCO_3)	SULFATE (SO_4)	CHLORIDE (Cl)	FLUORIDE (F)	NITRATE (NO_3)	DISSOLVED SOLIDS	TOTAL HARDNESS AS $CaCO_3$	PERCENT SODIUM	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	pH	SODIUM ADSORPTION RATIO (SAR)	RESIDUAL SODIUM CARBONATE (RSC)
								Permian, Wichita Group - Pw											
21-37-905	Portwood Ranch and Company	24	Nov. 22, 1968	16	408	135	165	232	1,100	356	1.4	184.8	2,480	1,580	19.0	2,970	7.6	1.8	--
38-203	Ignac Hostas	52	Feb. 20, 1970	16	220	252	988	381	530	2,040	2.0	42	4,270	1,590	63.6	6,223	7.8	10.6	--
								Seymour Formation and Permian, Clear Fork Group - Qs, Pcf											
21-29-202	Henry F. Moore	100	Feb. 13, 1969	31	101	56	344	425	189	290	4.6	322.3	1,560	483	61.0	2,290	7.6	6.8	--
802	Roy Butler	36	Nov. 19, 1969	24	263	284	1,033	279	600	1,920	3.2	570	4,830	1,820	55.1	6,630	7.5	10.5	--
902	Flint Bibb	44	Dec. 26, 1969	17	680	182	397	312	570	1,590	.7	231.0	3,820	2,450	25.6	5,380	7.2	3.4	--
30-126	James H. Waldron	51	Nov. 20, 1969	22	64	45	339	760	201	170	2.8	12.0	1,230	347	67.7	1,830	8.1	7.9	--
701	Gertie Moore	53	Nov. 19, 1969	20	157	198	1,073	680	700	1,270	4.6	496	4,250	1,210	65.7	5,750	7.4	13.3	--
								Recent Alluvium and Permian, Wichita Group - Qal, Pw											
21-40-524	Sam Portwood	52	Nov. 14, 1968	23	41	50	170	530	106	75	1.3	23.0	750	306	54.7	1,147	7.7	4.2	--
								Permian, Clear Fork Group - Pcf											
21-21-924	Travis J. Peacock	100	Apr. 9, 1969	4	14	5	130	20	7	208	< .1	18.0	396	55	83.7	772	6.6	2.5	--
29-311	Clyde Chapman	47	June 20, 1969	20	269	169	660	200	500	1,010	1.1	781.0	3,510	1,370	51.4	4,700	7.5	7.8	--
30-119	Baylor County Precinct 1	18	Sept. 16, 1969	20	62	41	95	442	86	58	1.8	< .4	580	325	39.0	932	7.5	2.3	--
								Seymour Formation - Qs											
21-21-601	Travis J. Peacock	36	Feb. 13, 1969	30	102	63	247	459	266	241	1.5	86.0	1,260	520	51.1	1,800	7.7	4.7	--
602	do	43	do	32	73	48	256	700	96	108	1.3	143.0	1,100	381	59.4	1,630	7.7	5.7	--
701	Henry P. Arledge	25	Feb. 11, 1969	34	48	26	246	456	112	135	2.4	110.0	940	225	70.4	1,440	8.0	7.1	--
702	do	28	do	32	96	45	256	420	173	248	1.5	95.0	1,170	425	56.3	1,780	7.6	5.3	--
801	Herman Yungman	56	Jan. 23, 1969	35	37	40	422	550	138	378	.8	44.0	1,370	256	78.2	2,180	8.3	11.5	--
802	Henry P. Arledge	25	Feb. 11, 1969	22	100	35	34	478	23	26	1.0	3.5	480	392	15.7	683	7.9	.7	--
803	do	19	Feb. 12, 1969	23	21	20	290	570	84	134	8.0	30.5	890	136	82.3	1,470	7.9	11.0	--
901	Trula Burkhalter	33	Feb. 4, 1969	24	73	110	188	467	189	308	2.4	29.0	1,150	640	39.1	1,920	7.6	3.2	0
902	Elizabeth Hertel	28	Jan. 23, 1969	25	48	67	90	459	54	81	2.7	34.0	630	395	33.3	1,041	7.6	2.0	--
910	Dudley B. Myers	39	do	25	57	38	180	438	96	138	1.6	35.5	790	298	57.0	1,240	7.8	4.6	1.23

See footnotes at end of table.

Table 8. – Chemical Analyses of Water From Wells and Springs – Continued

WELL	OWNER	DEPTH OF WELL (ft)	DATE OF COLLECTION	SILICA (SiO_2)	CAL-CIUM (Ca)	MAGNE-SIUM (Mg)	SODIUM (Na)	BICAR-BONATE (HCO_3)	SUL-FATE (SO_4)	CHLO-RIDE (Cl)	FLUO-RIDE (F)	NI-TRATE (NO_3)	DIS-SOLVED SOLIDS	TOTAL HARDNESS AS $CaCO_3$	PERCENT SODIUM	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	pH	SODIUM ADSORP-TION RATIO (SAR)	RESIDUAL SODIUM CARBON-ATE (RSC)
									Seymour Formation - Qs - Continued										
21-21-916	Truła Burkhalter	33	Feb. 4, 1969	20	94	74	137	520	99	225	1.1	< 0.4	910	540	36.0	1,550	7.3	2.6	0
917	Riley P. Henson	28	Apr. 11, 1969	28	67	78	410	530	296	451	.9	6.5	1,600	490	64.3	2,500	7.9	8.0	--
917	do	28	Apr. 23, 1969	25	56	69	399	530	283	408	2.4	9.0	1,510	425	66.8	2,380	7.8	8.4	--
920	Rex Howell	44	Apr. 27, 1970	27	86	78	243	504	160	304	1.7	42	1,190	540	49.7	1,880	7.6	4.6	0
920	do	44	Apr. 29, 1970	26	86	78	229	498	150	297	1.4	42	1,150	540	48.2	1,840	7.5	4.3	0
925	Truła Burkhalter	24	Feb. 26, 1969	26	177	84	185	395	255	178	1.5	420.0	1,520	790	32.0	2,060	7.4	2.7	--
22-401	Wallace L. Malone	32	Feb. 12, 1969	27	70	68	175	520	192	129	2.2	31.0	950	456	45.5	1,510	7.7	3.6	--
402	Ruby E. Nichols	35	Feb. 12, 1969	24	116	55	328	520	299	339	1.1	37.0	1,460	510	58.1	2,270	7.6	6.2	--
403	do	29	do	37	80	46	131	560	68	105	.9	17.5	760	390	42.3	1,220	7.7	2.9	--
404	do	40	do	28	59	48	331	650	170	256	2.0	29.0	1,240	346	67.5	1,990	7.6	7.7	--
704	Cora Morris estate	28	Feb. 11, 1969	25	50	112	303	710	191	284	3.8	27.5	1,350	590	53.0	2,120	7.7	5.4	.02
709	do	22	do	27	55	53	171	490	94	149	2.3	38.5	830	356	51.1	1,360	7.6	3.9	.95
710	Mrs. R. E. Morris	33	do	32	91	136	341	690	169	422	3.2	197.4	1,730	790	48.1	2,560	7.7	5.2	--
711	Heirs of J. E. Morris	22	Feb. 12, 1969	30	42	58	540	970	249	312	4.8	25.0	1,740	344	77.5	2,630	7.7	12.7	--
715	do	26	do	28	44	35	166	450	89	72	2.4	38.5	700	254	59.0	1,134	7.3	4.6	--
716	George R. Malone	32	Feb. 25, 1969	31	52	80	340	680	228	231	4.3	66.0	1,370	457	62.0	2,120	7.7	6.9	--
720	James E. Doss	39	Apr. 2, 1969	7	62	84	328	268	282	520	2.0	< .4	1,420	500	58.8	2,340	7.8	6.4	--
730	C. R. Morris	23	Nov. 21, 1969	19	88	64	248	484	198	287	2.0	5.5	1,150	483	51.6	1,750	7.9	4.8	--
1/ 803	D. A. Chapman, Jr.	36	Oct. 1943	--	56	94	141	554	98	177	--	33	872	526	--	--	--	--	--
1/ 804	do	41	Jan. 20, 1959	--	73	81	260	499	260	284	--	--	1,457	--	--	--	--	--	--
1/ 804	do	41	Aug. 8, 1961	31	45	58	269	540	164	205	--	42	1,080	351	63.0	1,760	7.3	6.2	--
810	Franklin Coufal, Jr.	38	Feb. 27, 1969	28	50	62	236	550	113	210	2.6	23.5	1,000	378	57.6	1,630	7.7	5.3	1.49
812	Frank Coufal, Sr.	38	Jan. 21, 1969	38	69	79	130	493	119	164	2.1	22.0	870	497	36.3	1,390	7.8	2.5	0
813	do	--	do	30	76	96	189	540	214	212	2.5	28.0	1,110	590	41.2	1,750	7.7	3.4	0
814	do	45	do	25	36	24	136	411	54	42	2.2	38.5	560	188	61.2	865	7.6	4.3	2.98
815	do	43	do	27	64	49	222	479	127	190	1.9	35.5	950	360	57.3	1,540	7.6	5.1	.66
816	Burrell Lee, Jr.	29	Jan. 22, 1969	24	43	37	255	530	129	148	2.1	34.0	930	259	68.1	1,490	7.8	6.9	--
2/ 817	do	33	--	--	50	40	325	540	53	295	--	--	1,315	--	71.0	1,900	8.4	8.0	--
2/ 819	do	33	--	--	58	68	222	585	144	117	--	--	1,194	--	52.8	1,850	8.0	4.6	--
819	do	33	July 2, 1969	21	47	65	330	580	187	274	3.3	37.5	1,250	385	64.8	1,950	7.8	7.3	1.84
820	do	--	Jan. 22, 1969	57	102	76	254	1,220	15	98	1.8	14.4	1,220	570	44.4	1,950	7.5	4.1	--
834	T. E. Craddock	37	Mar. 1956	98	11	7	230	196	147	124	.6	62	780	58	88.5	1,085	8.5	4.1	2.07

See footnotes at end of table.

Table 8. -- Chemical Analyses of Water From Wells and Springs -- Continued

WELL	OWNER	DEPTH OF WELL (ft)	DATE OF COLLECTION	SILICA (SiO_2)	CAL-CIUM (Ca)	MAGNE-SIUM (Mg)	SODIUM (Na)	BICAR-BONATE (HCO_3)	SUL-FATE (SO_4)	CHLO-RIDE (Cl)	FLUO-RIDE (F)	NI-TRATE (NO_3)	DIS-SOLVED SOLIDS	TOTAL HARDNESS AS $CaCO_3$	PERCENT SODIUM	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	pH	SODIUM ADSORP-TION RATIO (SAR)	RESIDUAL SODIUM CARBON-ATE (RSC)
							Seymour Formation - Qs -- Continued												
21-22-840	Charles W. Hatter, et al.	42	Apr. 23, 1969	31	97	100	580	700	429	640	1.1	< 0.4	2,220	650	66.1	3,350	7.5	9.9	0
849	S. E. Williamson	30	Nov. 24, 1969	19	38	15	537	620	154	313	.7	273.0	1,660	156	87.6	2,380	8.0	18.6	--
1/ 901	Earley W. Samsill	17	Oct. 1943	--	--	--	--	357	--	2,000	--	--	--	--	--	--	--	--	--
901	do	17	Apr. 24, 1969	16	61	78	890	740	890	560	4.6	13.0	2,880	474	80.2	3,950	7.9	1.8	--
1/ 902	do	26	Oct. 1943	--	--	--	--	677	--	600	--	--	--	--	--	--	--	--	--
2/ 903	Florence B. Parker, et al.	34	--	--	80	181	506	450	710	433	--	--	2,363	--	63.6	2,800	7.9	9.0	--
903	do	34	Jan. 22, 1969	28	82	99	474	610	458	454	2.7	41.5	1,940	610	93.2	2,920	7.7	12.4	0
903	do	34	July 27, 1969	24	82	99	530	620	550	454	2.6	30.5	2,080	610	65.0	2,980	7.9	9.3	0
904	Earley W. Samsill	33	Apr. 23, 1969	23	207	186	810	540	940	840	.9	525	3,800	1,280	57.8	4,860	7.5	9.8	--
905	do	28	Apr. 24, 1969	17	98	107	382	680	550	239	2.5	75.0	1,810	690	54.8	2,520	7.7	6.3	--
910	Glen Miller	Spring	June 20, 1969	19	195	407	2,040	580	1,660	3,110	5.9	51.0	7,800	2,160	67.3	9,850	7.8	1.9	--
29-103	Henry P. Arledge	41	Feb. 12, 1969	37	77	39	258	465	186	203	1.6	65.0	1,100	351	61.5	1,700	7.8	6.0	--
104	J. W. Elkins	18	Feb. 25, 1969	30	56	33	172	448	94	77	2.9	95.0	780	278	57.3	1,159	7.6	4.5	--
201	Charles E. Pluncket	30	Jan. 23, 1969	30	119	87	239	325	252	426	1.1	38.0	1,350	660	49.1	2,160	7.5	4.1	--
203	L. D. Offutt	33	Feb. 13, 1969	43	92	35	233	342	164	265	1.0	64.0	1,070	372	57.7	1,660	7.6	5.3	--
205	Ed M. Compton	36	Sept. 16, 1969	31	193	148	446	700	420	730	1.2	38.5	2,350	1,090	46.9	3,460	7.8	5.9	--
1/ 302	Chester Cox	28	Aug. 8, 1961	24	70	33	130.2	424	101	62	1.1	51	681	310	46.0	1,090	7.1	3.1	--
303	do	27	June 26, 1969	22	58	31	73	332	60	32	1.2	56.0	496	273	36.2	752	7.7	1.9	0
305	Red Springs Gin	34	Feb. 26, 1969	28	79	44	115	438	81	69	1.7	122.3	760	379	40.0	1,136	7.4	2.6	--
306	Mike Parker	19	Feb. 25, 1969	30	36	21	206	510	79	38	2.5	80.0	740	176	72.0	1,102	7.7	6.7	--
310	Chester Cox	29	June 26, 1969	27	96	76	334	540	284	351	.9	25.5	1,460	550	56.8	2,180	7.8	6.2	--
312	Albert Hrncirik	11	Sept. 17, 1969	20	84	60	189	620	194	107	.9	3.5	960	456	46.8	1,470	7.9	4.0	.09
316	James H. Waldron	23	Nov. 20, 1969	22	72	47	259	403	255	228	2.0	3.6	1,090	375	59.9	1,700	7.6	5.8	--
801	Tom McMorris	33	Nov. 19, 1969	21	82	54	476	482	273	305	1.7	483	1,930	427	70.4	2,600	7.8	9.9	--
901	Carl Snyder, Jr.	14	Nov. 26, 1969	19	33	42	613	450	197	710	2.5	13.5	1,850	258	83.5	3,040	7.6	16.5	--
30-108	Mattie Morris estate	21	Feb. 12, 1969	18	65	49	466	510	216	462	2.4	110.0	1,640	367	73.4	2,540	7.9	10.5	--
109	J. Frank Studer	24	Feb. 25, 1969	24	55	33	107	458	48	36	1.2	35.5	570	273	46.2	899	7.6	2.8	--
115	J. G. Campbell	40	Apr. 9, 1969	31	84	69	184	530	125	91	3.6	273	1,120	494	44.7	1,570	7.9	3.6	--
116	do	33	do	25	129	143	410	590	710	313	2.5	210	2,230	410	49.4	2,980	7.7	5.9	--
120	G. and L. Oil Company	36	Sept. 19, 1969	25	73	24	177	499	84	104	.6	25.5	760	282	57.4	1,200	7.8	4.6	--
121	Hancock Truck Stop	18	Oct. 1, 1969	20	64	27	24	315	39	7	.9	20.0	357	270	15.8	559	7.4	6.2	--
123	Walter E. Malone	20	do	20	35	43	113	449	53	30	1.5	51.0	570	267	47.6	900	7.9	3.0	--

See footnotes at end of table.

Table 8. -- Chemical Analyses of Water From Wells and Springs -- Continued

WELL	OWNER	DEPTH OF WELL (ft)	DATE OF COLLECTION	SILICA (SiO_2)	CAL-CIUM (Ca)	MAGNE-SIUM (Mg)	SODIUM (Na)	BICAR-BONATE (HCO_3)	SUL-FATE (SO_4)	CHLO-RIDE (Cl)	FLUO-RIDE (F)	NI-TRATE (NO_3)	DIS-SOLVED SOLIDS	TOTAL HARDNESS AS $CaCO_3$	PERCENT SODIUM	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	pH	SODIUM ADSORP-TION RATIO (SAR)	RESIDUAL SODIUM CARBON-ATE (RSC)
								Seymour Formation - Qs -- Continued											
21-30-124	Walter E. Malone	25	Oct. 16, 1969	20	63	30	126	379	84	65	1.0	92.0	670	283	48.6	1,010	7.6	3.2	--
125	Delmer F. Styles	21	do	21	57	37	96	400	120	27	1.0	< .4	560	296	41.0	854	7.2	2.4	--
214	Burrell Lee, Jr.	Spring	June 12, 1969	21	44	56	98	487	57	40	1.5	29.0	590	340	38.4	940	7.8	2.3	--
215	E. G. (Bill) Glover	42	Jan. 22, 1969	22	57	29	41	327	28	17	1.0	39.5	396	262	25.6	634	7.5	1.1	--
220	N. P. Mitchell	32	Jan. 23, 1969	27	53	33	106	421	45	70	2.3	11.0	550	269	46.1	897	7.6	2.8	--
238	O. C. Roden	30	Feb. 5, 1969	24	45	45	290	495	178	189	2.9	80.0	1,100	298	67.9	1,700	7.7	7.3	2.17
239	H. W. Fell, Jr.	15	Feb. 26, 1969	22	53	31	146	440	73	73	1.4	42.5	660	263	54.6	1,062	7.8	3.9	--
241	H. W. Fell, Sr.	25	do	23	46	35	130	449	69	50	1.8	28.0	600	259	52.3	954	7.6	3.5	--
242	H. W. Fell, Jr.	25	do	22	43	39	131	462	73	51	2.0	29.0	620	267	51.6	976	7.8	3.5	--
250	Orville Barrett	19	Apr. 24, 1969	20	47	40	52	366	44	18	.5	29.0	431	280	29.0	685	7.9	1.4	--
261	Wilburn F. Redwine	22	Sept. 29, 1969	21	44	54	118	570	52	29	1.5	18.0	620	331	43.4	984	7.6	2.8	--
301	City of Seymour	--	Dec. 19, 1968	24	45	17	117	410	47	22	1.9	32.5	510	184	58.1	791	7.8	3.8	--
1/ 302	T. C. Griffin	45	Jan. 13, 1961	30	71	62	436.2	540	394	350	--	42	1,580	432	68.0	2,580	7.7	9.0	--
302	do	45	June 30, 1969	26	70	53	329	550	294	208	2.0	34.0	1,290	390	64.2	1,900	7.6	7.2	1.16
1/ 304	City of Seymour	37	Oct. 1943	14	68	33	126	387	79	84	1.1	60	656	305	--	--	7.9	--	--
305	do	42	Dec. 19, 1968	25	57	31	56	336	45	26	1.5	42.5	450	273	31.0	705	7.7	1.5	--
308	B. E. Keck	38	Nov. 22, 1968	24	89	35	109	348	68	157	1.5	28.5	680	365	39.4	1,129	7.4	2.5	--
314	City of Seymour	39	Dec. 19, 1969	25	65	38	87	399	64	50	1.4	59.0	590	318	37.4	907	7.7	2.1	--
321	do	37	Dec. 20, 1968	22	76	23	180	462	108	104	.6	44.0	790	283	58.0	1,230	7.7	4.7	--
322	do	30	do	22	56	17	32	278	24	5	.7	22.0	316	209	24.7	490	7.6	1.0	--
369	Bill Elliston	33	Nov. 19, 1969	19	78	27	62	365	57	38	1.7	24.0	486	307	29.2	766	7.7	1.8	--
370	Don McDermitt	42	do	22	118	72	192	479	197	262	1.6	33.5	1,140	590	40.8	1,795	7.4	3.4	--
371	T. C. Griffin	46	Nov. 21, 1969	21	136	73	228	467	216	351	1.8	4.0	1,260	640	43.1	2,000	7.4	3.9	--
403	Morris Cockrell	25	July 9, 1969	21	42	46	416	373	255	387	3.1	65.0	1,420	295	75.4	2,060	8.0	10.5	--
509	Ernest Knesek	40	Apr. 25, 1969	21	77	21	178	373	121	143	.8	42.5	790	277	58.3	1,240	7.5	4.7	--
1/ 601	Emil Simaichl	25	Mar. 14, 1950	31	154	76	602.0	543	524	640	1.4	129	2,540	696	--	3,810	7.6	--	--
601	do	25	July 10, 1969	21	72	80	340	295	312	387	2.2	156.0	1,520	510	59.3	2,260	8.0	6.6	--
604	Jessie Hajek	25	July 2, 1969	21	31	54	154	484	96	51	4.1	74.0	720	299	52.8	1,102	7.9	3.9	--
606	Rudolph Kohut	14	Nov. 18, 1969	25	42	37	104	428	57	24	2.8	33.5	540	257	46.5	834	7.8	2.8	1.89
607	Jerry C. Mocek	29	Nov. 26, 1969	26	129	75	195	373	170	285	2.2	202	1,270	630	39.6	1,900	7.4	3.3	--
801	Dannie Portwood Fancher	Spring	Nov. 25, 1969	22	105	40	173	366	125	232	.7	59	940	430	45.9	1,500	7.5	3.6	--

See footnotes at end of table.

Table 8. -- Chemical Analyses of Water From Wells and Springs -- Continued

WELL	OWNER	DEPTH OF WELL (ft)	DATE OF COLLECTION	SILICA (SiO_2)	CAL-CIUM (Ca)	MAGNE-SIUM (Mg)	SODIUM (Na)	BICAR-BONATE (HCO_3)	SUL-FATE (SO_4)	CHLO-RIDE (Cl)	FLUO-RIDE (F)	NI-TRATE (NO_3)	DIS-SOLVED SOLIDS	TOTAL HARDNESS AS $CaCO_3$	PERCENT SODIUM	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	pH	SODIUM ADSORP-TION RATIO (SAR)	RESIDUAL SODIUM CARBON-ATE (RSC)
								Seymour Formation - Qs -- Continued											
21-30-904	Dr. C. M. Randall, Jr. et al.	20	Dec. 17, 1968	36	120	144	194	970	44	357	0.9	< 0.4	1,380	913	31.6	2,230	7.6	2.8	--
907	Joe Hajek	39	July 2, 1969	26	222	248	550	538	271	1,450	2.7	71.0	3,060	1,570	43.3	4,770	7.9	6.1	--
31-101	Adolph E. Wirz	20	Nov. 24, 1969	18	44	40	153	590	74	32	1.9	< .4	650	274	53.4	1,017	7.8	3.9	--
102	David Wirz	64	do	19	46	55	402	690	201	181	3.0	210	1,460	341	71.6	2,050	7.8	9.4	--
401	Ernest Hrncirik	20	Dec. 12, 1968	28	62	59	60	506	46	40	1.2	1.0	550	400	25.0	883	7.6	1.3	--
801	C. C. Sanders	31	Nov. 22, 1968	25	86	57	196	640	140	116	1.9	40.0	980	449	48.6	1,500	7.6	4.0	--
803	Mrs. Barbara Novac	11	Feb. 20, 1970	16	360	500	1,040	404	1,510	2,300	1.2	270	6,200	2,970	--	7,570	7.5	--	--
804	Carter H. Taylor	41	do	17	81	64	108	418	59	141	1.5	99	780	467	--	1,290	7.6	--	--
39-202	Horace E. James	20	Dec. 13, 1968	36	169	92	133	510	95	188	1.2	416.0	1,380	800	26.5	1,940	7.4	2.0	--
601	Jettie Howe Russell	16	Dec. 12, 1968	20	56	29	50	349	24	19	1.5	29.0	401	261	30.0	635	7.8	1.4	--
602	Ralph Howe	15	do	16	47	30	48	331	24	24	1.3	13.5	368	242	30.2	605	7.8	1.3	--
603	Mildred R. Lunsford	15	do	17	94	18	58	322	36	56	.6	79.0	520	311	28.7	812	7.7	1.4	--
40-502	Portwood Ranch and Company	30	Nov. 7, 1968	27	88	22	56	412	41	20	.2	22.0	479	311	28.1	738	7.8	1.4	--
503	do	31	do	28	143	45	87	484	125	109	.8	37.5	810	540	25.8	1,290	7.7	1.6	--
504	do	33	do	34	123	41	200	630	133	142	.7	36.0	1,020	475	47.8	1,570	7.4	4.0	--
505	do	33	do	27	60	48	41	416	34	24	1.1	23.0	463	347	20.3	737	7.7	1.0	--
518	do	19	Nov. 8, 1968	29	63	16	21	268	16	12	.5	13.5	304	223	17.3	479	7.3	6.2	--
1/ 520	do	22	Oct. 9, 1906	28	82	54	323	414	173	401	--	40	1,318	--	--	--	--	--	--
520	do	22	Nov. 13, 1968	28	41	48	165	640	53	37	3.5	16.5	710	299	55.0	1,082	7.7	4.2	--
525	F. H. Brock	15	Nov. 20, 1968	18	94	57	570	570	311	630	3.2	27.5	1,990	470	72.4	3,110	7.6	1.1	--
529	Jim Welch	24	Nov. 13, 1968	27	44	27	110	427	43	21	4.0	36.0	530	219	52.1	825	8.4	3.2	--
530	do	44	do	34	90	32	58	510	25	31	1.1	< .4	520	355	26.2	880	7.3	1.3	--
601	Portwood Ranch and Company	28	Nov. 7, 1968	32	113	63	157	610	89	184	1.1	15.5	960	540	38.6	1,510	7.4	2.9	--
								Recent Alluvium - Qal											
20-33-703	Mrs. J. L. Hargraves	27	Nov. 7, 1968	32	188	46	340	590	32	630	.5	< .4	1,560	660	53.0	2,540	7.4	5.8	--
21-29-101	Chester Blankenship	34	June 19, 1969	24	35	31	190	466	96	49	1.9	114.0	770	216	65.4	1,148	7.8	5.6	3.32
204	A. B. Martin, Jr.	23	Sept. 16, 1969	24	44	31	80	365	44	24	1.0	38.5	466	237	41.8	727	7.7	2.2	--
501	do	17	do	31	129	77	214	395	233	298	.6	147.0	1,320	640	42.0	2,000	7.5	3.6	--
503	W. C. and W. H. Hertel	31	Nov. 19, 1969	21	44	29	151	400	65	87	.7	57.0	650	230	58.3	1,015	7.8	4.3	1.96
30-608	Baylor Livestock Company	22	Nov. 25, 1969	21	61	65	228	670	186	117	2.1	< .4	1,010	420	53.9	1,570	7.6	4.8	--

See footnotes at end of table.

Table 8. – Chemical Analyses of Water From Wells and Springs – Continued

WELL	OWNER	DEPTH OF WELL (ft)	DATE OF COLLECTION	SILICA (SiO_2)	CAL-CIUM (Ca)	MAGNE-SIUM (Mg)	SODIUM (Na)	BICAR-BONATE (HCO_3)	SUL-FATE (SO_4)	CHLO-RIDE (Cl)	FLUO-RIDE (F)	NI-TRATE (NO_3)	DIS-SOLVED SOLIDS	TOTAL HARDNESS AS $CaCO_3$	PERCENT SODIUM	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	pH	SODIUM ADSORP-TION RATIO (SAR)	RESIDUAL SODIUM CARBON-ATE (RSC)
								Recent Alluvium - Qal – Continued											
21-30-901	Vernon Teague	22	Dec. 18, 1968	21	389	347	1,049	560	1,535	1,811	1.9	26.0	5,460	2,398	48.7	6,920	7.4	9.3	--
902	Frank Allen	29	Dec. 12, 1968	22	41	39	109	426	56	45	.6	34.0	560	262	48.0	889	7.5	2.9	--
903	C. M. Randall, Sr. et al.	14	Dec. 17, 1968	20	111	360	435	422	41	708	.7	11.5	1,890	426	68.9	2,680	7.7	9.2	--
1/ 908	Howard Smulcer	28	Nov. 8, 1967	--	--	--	--	--	32	2,020	--	--	--	1,040	--	--	7.2	--	--
38-301	Vernon Teague	31	Dec. 17, 1968	17	93	92	150	401	163	224	.7	158.4	1,100	611	34.7	1,700	7.6	2.6	--
302	do	12	Dec. 18, 1968	25	434	380	1,910	1,760	1,010	3,240	1.5	< .4	7,870	2,650	61.0	10,250	7.9	11.3	--
39-101	do	35	do	15	43	63	181	600	217	39	2.4	6.5	860	367	52.0	1,300	7.8	4.1	--
102	Joe Glover	20	do	15	64	36	164	530	121	58	2.3	4.4	730	307	53.8	1,080	7.6	4.1	--
1/ 201	Charles T. Porter	16	--	--	6	69	12	287	41	33	--	--	--	--	--	--	--	--	--
201	do	16	Nov. 21, 1968	22	93	84	57	510	39	99	.7	121.0	770	580	17.7	1,190	8.1	1.0	--
203	Mrs. I. J. Wehmeyer	19	Dec. 13, 1968	21	109	50	224	630	180	178	1.6	8.6	1,080	481	50.4	1,700	7.7	2.0	--
301	Jim Welch	20	Nov. 14, 1968	18	71	17	33	282	19	47	.7	< .4	345	247	23.0	638	7.0	.9	--
302	C. T. Porter	21	Nov. 21, 1968	8	39	68	267	418	118	347	.7	< .4	1,050	375	61.0	1,760	8.1	6.0	0
309	Lincoln Burns estate	13	do	9	59	23	92	411	45	40	1.1	< .4	471	243	45.2	791	7.6	2.6	--
310	Mrs. Mabel Johnson	25	do	14	22	17	172	490	59	17	2.8	15.0	560	125	75.0	873	8.0	6.7	--
311	do	22	do	20	95	73	462	484	125	700	1.5	14.0	1,730	540	65.1	2,840	7.6	8.7	--
312	John Bess Fancher	15	Dec. 11, 1968	16	78	58	104	600	94	37	1.2	5.0	690	436	34.1	1,090	8.1	2.2	--
313	do	14	do	20	134	133	395	600	270	680	1.2	15.5	1,940	880	49.3	3,050	7.5	5.8	--
314	do	14	do	14	149	103	268	660	401	304	2.1	< .4	1,570	798	42.2	2,330	7.6	4.1	--
501	Mack Russell	26	Dec. 17, 1968	10	536	161	631	227	943	1,620	1.2	< .4	4,010	2,000	41.0	5,520	6.9	6.1	--
502	do	16	do	17	162	67	109	442	253	208	.9	< .4	1,030	680	26.0	1,620	7.3	1.8	--
503	do	9	do	64	171	35	271	1,120	43	195	2.1	< .4	1,216	570	32.1	2,200	7.6	2.8	--
40-101	John A. Young, Jr.	17	Nov. 8, 1968	23	82	28	86	417	37	56	.7	55.0	570	320	36.8	893	7.5	2.0	--
102	Portwood Ranch and Company	35	Nov. 13, 1968	18	59	46	30	398	21	20	.9	22.0	413	338	16.0	677	7.7	0.7	--
103	Myrton Couch	13	Nov. 13, 1968	15	49	42	75	400	46	39	.7	26.5	491	296	35.5	791	7.8	2.0	--
104	Bobby Morris	20	Nov. 14, 1968	23	102	62	322	510	200	345	1.3	110.0	1,420	510	57.8	2,110	7.6	6.2	--
105	Mrs. S. S. Knox	20	Nov. 19, 1968	16	73	85	340	600	335	254	2.3	75.0	1,480	530	58.1	2,190	8.0	6.4	--
106	do	19	do	21	44	60	153	450	104	81	1.5	105.0	790	358	48.2	1,230	7.8	3.5	--
107	do	16	do	18	264	79	388	398	610	590	1.6	< .4	2,150	980	46.2	3,070	7.5	5.4	--
108	Paul Brock	22	Nov. 20, 1968	18	74	66	194	490	128	221	1.1	39.0	980	458	47.4	1,620	7.5	3.9	--
109	do	25	do	16	79	66	208	490	161	228	1.1	29.5	1,030	467	49.2	1,690	7.5	4.2	--
111	Bobby Brock	15	do	21	113	89	310	660	264	379	1.1	20.0	1,520	650	51.0	2,340	7.6	5.2	--

See footnotes at end of table.

Table 8. – Chemical Analyses of Water From Wells and Springs – Continued

WELL	OWNER	DEPTH OF WELL (ft)	DATE OF COLLECTION	SILICA (SiO_2)	CAL-CIUM (Ca)	MAGNE-SIUM (Mg)	SODIUM (Na)	BICAR-BONATE (HCO_3)	SUL-FATE (SO_4)	CHLO-RIDE (Cl)	FLUO-RIDE (F)	NI-TRATE (NO_3)	DIS-SOLVED SOLIDS	TOTAL HARDNESS AS $CaCO_3$	PERCENT SODIUM	SPECIFIC CONDUCTANCE (MICROMHOS AT 25°C)	pH	SODIUM ADSORP-TION RATIO (SAR)	RESIDUAL SODIUM CARBON-ATE (RSC)
								Recent Alluvium - Qal - Continued											
21-40-112	Paul Brock	16	Nov. 20, 1968	20	136	144	580	770	660	620	1.4	4.0	2,540	930	57.7	3,540	7.6	6.3	--
113	Lincoln Burns estate	12	Nov. 21, 1968	20	54	63	87	610	45	24	1.3	2.5	600	393	32.4	959	7.8	1.9	--
114	do	24	do	18	62	36	110	439	60	66	.7	23.5	590	303	44.2	963	7.6	2.8	--
116	Rudolph A. Hrncirik	40	do	18	42	9	247	442	76	115	1.6	88.0	810	143	79.0	1,270	8.1	9.0	--
201	Sam Portwood	31	Nov. 14, 1968	15	154	124	416	1,010	133	630	.8	< .4	1,970	900	50.2	3,050	7.9	6.1	--
401	Portwood Ranch and Company	--	Nov. 13, 1968	16	87	41	142	415	190	100	.9	39.0	820	388	44.3	1,210	7.6	3.1	--
402	Sam Portwood	17	Nov. 14, 1968	21	56	30	94	407	59	43	.8	15.0	520	263	44.0	815	7.6	2.5	--
403	Ernest Hrncirik	8	do	15	164	99	246	488	157	540	1.1	15.5	1,480	815	40.0	2,460	7.6	3.8	--
506	Portwood Ranch and Company	20	Nov. 8, 1968	18	56	61	147	740	38	36	1.1	17.0	740	389	45.2	1,155	7.8	3.3	--
510	do	24	do	10	13	12	62	198	13	24	.9	< .4	240	82	61.4	393	7.8	.3	1.60
515	do	24	do	9	38	33	70	411	22	9	.7	< .4	384	231	40.0	634	7.8	2.0	2.13
521	do	34	do	22	65	65	128	510	90	132	.8	17.0	770	432	39.2	1,220	7.5	2.7	--
522	Sam Portwood	19	Nov. 14, 1968	9	63	51	137	530	131	60	1.5	18.5	730	367	44.8	1,131	7.8	3.1	--
523	do	33	do	24	64	59	66	462	80	42	1.5	15.5	580	402	26.2	911	7.5	1.4	--
526	J. B. Guthrie	36	do	21	56	33	318	520	166	256	2.8	20.0	1,130	275	71.5	1,750	7.6	8.3	--
1/ 527	do	28	Oct. 6, 1906	24	139	51	79	437	172	130	--	4.3	839	--	--	--	--	--	--
528	Ernest Hrncirik	21	Nov. 14, 1968	14	124	34	19	520	20	17	.7	7.0	492	447	8.5	810	7.8	.4	--
532	Mrs. Valerie Trevis	29	Nov. 19, 1968	20	236	114	194	610	199	208	.7	546.0	1,820	1,010	29.0	2,470	7.4	2.6	--
804	Don Buckalew	28	Sept. 19, 1967	20	30	55	147	640	50	19	1.8	24	660	302	52.0	1,020	7.9	3.7	--
810	do	25	Nov. 6, 1968	20	95	112	154	890	120	106	.9	42.0	1,090	700	32.4	1,640	7.8	2.5	--
812	Jim Welch	28	Nov. 13, 1968	22	79	45	147	500	69	134	1.1	28.5	770	384	46.0	1,260	7.7	3.3	--

1/ Analyses by U.S. Geological Survey Laboratory.
2/ Analyses by Midwestern University.

Table 9.—Chemical Analyses of Oil-Field Brines

(Analyses are in parts per million except pH.)

Data from Laxson and others, 1960 and BJ Service, Inc., 1960

PRODUCING ZONE	FIELD	AVERAGE DEPTH OF WELL	IRON (Fe)	CALCIUM (Ca)	MAGNESIUM (Mg)	SODIUM (Na)	BICARBONATE (HCO_3)	SULFATE (SO_4)	CHLORIDE (Cl)	DIS-SOLVED SOLIDS	pH
					PERMIAN SYSTEM						
Camp Colorado lime	Regular	—	—	11,360	2,050	55,000	23	250	109,800	187,800	6.9
Tannehill sand	FCR (Tannehill)	—	34	7,635	2,066	44,144	31	64	92,196	149,170	5.5
Do.	Regular	1,293	28	7,588	1,974	41,800	16	67	83,515	134,960	6.72
Do.	do	1,222	5	7,870	2,048	41,340	27	54	83,465	134,804	6.81
Do.	do	1,303	78	8,510	2,024	40,630	38	52	83,425	134,679	6.14
Do.	do	1,329	—	7,363	1,908	40,935	60	102	81,605	131,973	6.45
Do.	do	1,300	43	10,000	1,510	52,400	109	240	103,000	167,302	6.4
Do.	do	1,330	—	9,088	1,908	46,000	20	188	92,350	149,444	5.5
Do.	do	1,500	—	7,480	2,930	46,370	46	0	93,500	150,280	6.38
Do.	do	—	—	10,250	2,040	36,000	30	200	103,200	178,200	6.6
					PENNSYLVANIAN SYSTEM						
Canyon	—	946	4.2	6,190	1,232	—	79	50	50,500	105,000	7.1
Do.	Regular (Saddle Creek)	1,500	45	8,200	1,920	47,600	98	78	94,000	151,944	6.5
Do.	do	1,500	40	7,640	1,320	48,300	109	12	92,000	149,422	6.5
Do.	Seymour # 1	2,560	—	7,520	1,728	39,890	125	444	79,500	—	6.8
Strawn	do	4,700	—	17,050	2,271	56,000	11	28	123,100	—	—
Caddo	do	5,100	—	18,390	2,691	55,050	0	69	125,050	—	—
					CAMBRIAN SYSTEM						
—	Fritz	6,880	33.0	15,400	2,440	47,700	12	292	114,000	202,000	5.7

Table 10.—Reported Oil-Field Brine Production and Disposal in 1961 and 1967

(Quantities reported in barrels)

Production and method of disposal taken from Railroad Commission of Texas 1961 and 1967 salt-water production and disposal questionnaires.

AREA SHOWN ON FIGURE 17,	FIELD[1]	BRINE PRODUCTION		DISPOSAL INTO PITS		INJECTION INTO WELLS		MISCELLANEOUS	
		1961	1967	1961	1967	1961	1967	1961	1967
1	Glenda-Janis (1,600 Tannehill)	48,285	119,455	0	0	48,285	119,455	0	0
	County regular	678,944	85,775	10,996	0	667,948	85,775	0	0
	Area Total	727,229	205,230	10,996	0	716,233	205,230	0	0
2	Bomarton (Tannehill "A")	1,800	15,577	315	0	1,485	15,577	0	0
	Bomarton (Tannehill "C")	140,596	262,766	1,269	0	139,327	262,766	0	0
	Bomarton (Tannehill "D")	750	0	0	0	750	0	0	0
	F. C. R. Tannehill	230,494	35,000	0	0	203,494	35,000	0	0
	Fritz (Tannehill, Upper)	50,006	124,879	0	0	50,006	124,879	0	0
	County regular	5,348,859	6,572,041	72,105	0	5,162,823	6,568,391	113,931	3,650
	Area Total	5,745,505	7,010,263	73,689	0	5,557,885	7,006,613	113,931	3,650
3	County regular	83,585	0	0	0	83,585	0	0	0
	Area Total	83,585	0	0	0	83,585	0	0	0
4	Seymour, North (5,000 Strawn)	4,500	5,400	0	0	4,500	5,400	0	0
	Area Total	4,500	5,400	0	0	4,500	5,400	0	0
5	Seymour (Caddo)	146,000	0	0	0	0	0	146,000	0
	Seymour Pool	1,058,181	911,334	0	0	1,058,181	911,334	0	0
	Seymour (Strawn)	104,286	0	0	0	104,286	0	0	0
	Seymour, East (Strawn)	510,000	556,122	0	0	510,000	556,122	0	0
	Area Total	1,818,467	1,467,456	0	0	1,672,467	1,467,456	146,000	0
6	Rendham Mississippi	906,620	0	0	0	906,620	0	0	0
	Rendham, North (Mississippi)	3,000	7,765	0	0	3,000	7,765	0	0
	Rendham, Northwest (Mississippi)	0	54,750	0	0	0	54,750	0	0
	Area Total	909,620	62,515	0	0	909,620	62,515	0	0

Table 10.—Reported Oil-Field Brine Production and Disposal in 1961 and 1967—Continued

AREA SHOWN ON FIGURE 17,	FIELD[1]	BRINE PRODUCTION		DISPOSAL INTO PITS		INJECTION INTO WELLS		MISCELLANEOUS	
		1961	1967	1961	1967	1961	1967	1961	1967
7	Rendham	0	30,000	0	0	0	30,000	0	0
	Rendham Pool	860,720	398,580	0	0	860,720	398,580	0	0
	Area Total	860,720	428,580	0	0	860,720	428,580	0	0
8	Freeport (Caddo Lime)	18,080	0	0	0	18,080	0	0	0
	Freeport (Mississippi Lime)	237,250	0	0	0	237,250	0	0	0
	Area Total	255,330	0	0	0	255,330	0	0	0
9	Parkey (Caddo)	2,555	52,891	2,555	0	0	52,891	0	0
	Area Total	2,555	52,891	2,555	0	0	52,891	0	0
10	Westover, Northeast (Mississippi)	20,000	0	0	0	20,000	0	0	0
	Area Total	20,000	0	0	0	20,000	0	0	0
11	Darnell (5,030 Conglomerate)	0	36,500	0	0	0	36,500	0	0
	Lilly D (Caddo) & Lilly D (Mississippi)	28,000	0	0	0	28,000	0	0	0
	Westover, East (Caddo)	33,708	32,850	0	0	33,708	32,850	0	0
	Area Total	61,708	69,350	0	0	61,708	69,350	0	0
12	County regular	120	0	120	0	0	0	0	0
	Area Total	120	0	120	0	0	0	0	0
13	U.C.S.L. (Mississippian)	0	259,200	0	0	0	259,200	0	0
	County regular	46,300	363,600	2,500	0	43,800	363,600	0	0
	Area Total	46,300	622,800	2,500	0	43,800	622,800	0	0
14	Doggie (Lower Gunsight)	127,750	0	0	0	127,750	0	0	0
	Westover (Upper Gunsight)	85,775	0	0	0	85,775	0	0	0
	Y-B (Gunsight Upper)	7,300	0	7,300	0	0	0	0	0
	County regular	1,270,855	333,875	5,110	0	1,265,745	333,875	0	0
	Area Total	1,491,680	333,875	12,410	0	1,479,270	333,875	0	0
	County Total	12,027,319	10,258,360	102,270	0	11,665,118	10,254,710	259,931	3,650
	Percent of Total	100.0%	100.0%	0.85%	0.0%	96.99%	99.96%	2.16%	0.04%

[1] Oil or gas fields as assigned by the Railroad Commission of Texas.

Table 11.—Oil and Gas Tests Selected as Data-Control Points

WELL	OPERATOR	LEASE AND WELL	SURVEY	DATE OF ELECTRICAL LOG
20-09-701	Tom B. Medders	Waggoner "C" # 1	Sec. 10, H&TC	June 11, 1955
17-401	Amis & Starr	Cowan # 1	Sec. 93, T&NO	July 21, 1964
25-701	Burk Royalty Co.	Elledge-Furr Unit # 1	TE&L	Mar. 25, 1961
21-21-301	Pure Oil Co.	W. T. Waggoner, est. "A" # 1	Sec. 156, Blk. A, BBB&C	Oct. 17, 1955
22-502	do	W. T. Waggoner, est. "E" # 1	Sec. 1, H&TB	June 27, 1957
23-601	S. D. Johnson, et al.	Ballerstedt # 1	Sec. 21, T&NO	Dec. 27, 1950
24-501	Kewanee Oil Co.	Poth # 1	Sec. 88, T&NO	July 11, 1956
31-802	E. B. Clark, et al.	C. M. Taylor # 1	Sec. 9, H&TC	July 16, 1951
32-501	Bobby M. Burns, Trustee	Longley # 1	Sec. 228, T&NO	June 25, 1957
37-201	Continental Oil Co.	J. H. Thomas # 1	Sec. 13, Blk. 1, D&WRR	Jan. 20, 1951
38-202	American Liberty Oil Co.	Criswell # 1	Sec. 97, T&NO	May 19, 1949
39-605	A. R. Dillard, et al.	U.C.S.L. # 2	U.C.S.L.	Dec. 12, 1959