GROUND-WATER RESOURCES OF RUSK COUNTY, TEXAS

By W.M. Sandeen

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METRIC CONVERSIONS

For those readers interested in using the metric system, the metric equivalents of inch-pound units of measurements are given in parentheses. The inch-pound units of measurements used in this report may be converted to metric units by the following factors:

From	Multiply by	To obtain
acre	0.4047	hectare
acre-foot	0.001233	cubic hectometer (hm^3)
barrel	0.1590	cubic meter (m^3)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
foot	0.3048	meter (m)
foot per day (ft/d)	0.3048	meter per day (m/d)
foot per mile (ft/mi)	0.189	meter per kilometer (m/km)
foot squared per day (ft^2/d)	0.0929	meter squared per day (m^2/d)
gallon per day (gal/d)	0.003785	cubic meter per day (m^3/d)
gallon per minute (gal/min)	0.06308	liter per second (L/s)
	0.003785	cubic meter per minute (m^3/min)
inch	25.4	millimeter (mm)
micromhos per centimeter at 25° Celsius	1.00	microsiemens per centimeter at 25° Celsius
mile	1.609	kilometer (km)
million gallon per day (Mgal/d)	0.04381	cubic meter per second (m^3/s)
	3,785	cubic meter per day (m^3/d)
square mile	2.590	square kilometer (km^2)

Temperature data in this report are in degrees Celsius (°C) and may be converted to degrees Fahrenheit (°F) by the following formula:

$$°F = 1.8(°C) + 32.$$

DEFINITIONS OF TERMS

In this report certain technical terms, including some that are subject to different interpretations, are used. For convenience and clarification, these terms are defined as follows:

Acre-foot - The volume of water required to cover 1 acre to a depth of 1 foot ($43,560\ ft^3$ or 325,851 gallons).

Acre-foot per year - One (1) acre-foot per year equals 892.13 gal/d.

Aquifer - A formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs.

Aquifer test, pumping test - The test consists of the measurement, at specific intervals, of the discharge and water level of the well being pumped and the water levels in nearby observation wells. Formulas have been developed to show the relationship of the yield of a well, the shape and extent of the cone of depression, and the properties of the aquifer such as the specific yield, porosity, hydraulic conductivity, transmissivity, and storage coefficient.

Artesian aquifer, confined aquifer - Artesian (confined) water occurs where an aquifer is overlain by rock of lower hydraulic conductivity (e.g., clay) that confines the water under pressure greater than atmospheric. The water level in an artesian well will rise above the level at which it was first encountered in the well. The well may or may not flow.

Barrel - A volume of 42 gallons.

Brine - Water containing more than 35,000 mg/L (milligrams per liter) dissolved solids (Winslow and Kister, 1956, p. 5).

Cone of depression - Depression of the water table or potentiometric surface surrounding a discharging well or group of wells (usually shaped like an inverted cone).

Dip of rocks, attitude of beds - The angle or amount of slope at which a bed is inclined from the horizontal; direction also is expressed (for example, 1 degree southeast or 90 ft/mi southeast).

Drawdown - The lowering of the water table or potentiometric surface caused by pumping (or artesian flow). In most instances, it is the difference, in feet, between the static level and the pumping level.

Electric log - A graph showing the variation in relationship between the electrical properties of the rocks and their fluid contents penetrated in a well. The electrical properties are natural potentials and resistivities to induced electrical currents, some of which are modified by the presence of the drilling mud.

Freshwater - Water containing less than 1,000 mg/L dissolved solids (Winslow and Kister, 1956, p. 5).

Ground water - Water in the ground that is in the saturated zone from which wells, springs, and seeps are supplied.

Head, static - The height above a standard datum of the surface of a column of water (or other liquid) that can be supported by the static pressure at a given point.

Hydraulic conductivity - The rate of flow of a unit volume of water in unit time at the prevailing kinematic viscosity through a cross section of unit area, measured at right angles to the direction of flow, under a hydraulic gradient of unit change in head over unit length of flow path. Formerly called field coefficient of permeability.

Hydraulic gradient - The change in static head per unit of distance in a given direction.

Moderately saline water - Water containing 3,000 to 10,000 mg/L dissolved solids (Winslow and Kister, 1956, p. 5).

National Geodetic Vertical Datum of 1929 (NGVD of 1929) - A geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called mean sea level.

Potentiometric surface - A surface which represents the static head. As related to an aquifer, it is defined by the levels to which water will rise in tightly cased wells. The water table is a particular potentiometric surface.

Slightly saline water - Water containing 1,000 to 3,000 mg/L dissolved solids (Winslow and Kister, 1956, p. 5).

Specific capacity - The rate of discharge of water from a well divided by the drawdown of water level in the well. It generally is expressed in gallons per minute per foot of drawdown for a specified period after discharge ceases.

Specific yield - The quantity of water that an aquifer will yield by gravity if it is first saturated and then allowed to drain; the ratio expressed in percentage of the volume of water drained to volume of the aquifer drained.

Storage coefficient - The volume of water an aquifer releases from or takes into storage per unit of surface area of the aquifer per unit change in the component of head normal to that surface.

Transmissivity - The rate at which water of the prevailing kinematic viscosity is transmitted through a unit width of the aquifer under a unit hydraulic gradient. It is the product of the hydraulic conductivity and the saturated thickness of the aquifer. Formerly called coefficient of transmissibility.

Very saline water - Water containing 10,000 to 35,000 mg/L dissolved solids (Winslow and Kister, 1956, p. 5).

Water level; static level or hydrostatic level - In an unconfined aquifer, the distance from the land surface to the water table. In a confined (artesian) aquifer, the level to which the water will rise either above or below land surface.

Water table - The water table is that surface in an unconfined water body at which the pressure is atmospheric. It is defined by the levels at which water stands in wells that penetrate the water body just far enought to hold standing water. In wells which penetrate to greater depths, the water level will stand above or below the water table if an upward or downward component of ground-water flow exists.

Yield - The rate of discharge, commonly expressed as gallons per minute, gallons per day, or gallons per hour. In this report, yields are classified as small, less than 50 gal/min; moderate, 50 to 250 gal/min; and large, more than 250 gal/min.

GROUND-WATER RESOURCES OF

RUSK COUNTY, TEXAS

By

W. M. Sandeen

ABSTRACT

Fresh to slightly saline water is available in most parts of Rusk County, which is located in the Piney Woods region of northeast Texas. The Wilcox aquifer, which underlies the entire county, was the source of most of the ground water withdrawn during 1980. Other units capable of yielding fresh ground water are the Carrizo, Queen City, and Sparta aquifers and the Reklaw Formation.

About 5.4 million gallons per day (20,440 cubic meters per day) of ground water was used for all purposes during 1980. Of this amount, about 78 percent was used for public supply, 10 percent for mining, 8 percent for industrial purposes, and 4 percent for rural domestic use. Water levels have declined extensively at the city of Henderson, which used about 38 percent of all ground water consumed in Rusk County.

Generally, the ground water is of acceptable quality. Water in some of the near-surface beds and some of the deeper sands in the Wilcox aquifer may have become mineralized because of oilfield operations. Ground-water contamination by oilfield brines at Henderson Oil Field has been documented. Two separate instances of streamflow contamination at Striker Creek and Henderson Oil Field have been documented.

Moderate amounts of ground water are available for development. The amount that is available perennially is not known, but it is greater than that being withdrawn. Assuming a hydraulic gradient of about 8 feet per mile (1.5 meters per kilometer), at least 12 million gallons per day (45,420 cubic meters per day) of fresh ground water is being transmitted through the Wilcox and about 3 million gallons per day (11,350 cubic meters per day) through the Carrizo. About 20 million acre-feet (24,660 cubic hectometers) of freshwater is available from storage in the Wilcox and about 4 million acre-feet (4,930 cubic hectometers) from storage in the Carrizo. Additional amounts of slightly saline water are available from the major aquifers. Smaller but undetermined amounts of fresh ground water are available from the Sparta and Queen City aquifers and from the Reklaw Formation. Properly constructed wells in the Wilcox and Carrizo aquifers can be expected to yield more than 500 gallons per minute (32 liters per second) if the wells are properly spaced. Development of additional resources around the city of Henderson and the Mount Enterprise Fault System should be considered cautiously because of the probability of saltwater encroachment. Ground water in other parts of the county is practically undeveloped.

Some mineralization of ground water is due to natural causes. Other mineralization of ground water is due to contamination. A program needs to be initiated to determine the extent and cause of mineralization that has taken place in freshwater sands. Water-quality data is needed at Henderson in order to monitor saltwater encroachment.

INTRODUCTION

Location and Extent of Area

Rusk County, located in the Piney Woods region of northeast Texas, is bordered by Gregg and Harrison Counties on the north, Panola and Shelby Counties on the east, Nacogdoches County on the south, and Cherokee and Smith Counties on the west (fig. 1). The city of Henderson, the county seat and largest city in the county, is about 135 miles (217 km) east of Dallas and about 75 miles (121 km) west of Shreveport, Louisiana. Rusk County has an area of 939 square miles (2,432 km^2). Altitude of the land surface ranges from 227 feet (69 m) near the Sabine River to 709 feet (216 m) near the town of Mount Enterprise.

Purpose and Scope

This is a report of a detailed investigation of the ground-water resources of Rusk County begun during 1979 by the U.S. Geological Survey in cooperation with the Texas Department of Water Resources. After about 5 months of initial work, the project was deferred for lack of funds. The project was resumed during 1981, which made it necessary to update the 1979 data including 1981 water levels.

The purpose of the investigation was to determine the occurrence, availability, dependability, quality, and quantity of ground water present in the county. Special emphasis was placed upon describing the quantity and quality of ground water suitable for public supply and industrial use.

The investigation included: Determining the extent of sands containing freshwater; documenting the chemical quality of the water; estimating the quantities of water being withdrawn; determining the effects of withdrawals on ground-water levels; estimating the hydraulic characteristics of the water-bearing sands; rating the area on the basis of ground-water availability; and determining the potential sources of contamination.

Methods of Investigation

Field data for this report were collected during March through June, 1979, and during March through July, 1981. Data from older reports were included, the earliest of which was written in 1932, shortly after the discovery of East Texas Oil Field. Basic information, including depths of wells, water levels, methods of well construction, type of lift, yield characteristics, and use of water was collected for 365 wells. In addition, water samples were collected for chemical analysis. All relevant information previously collected by the Texas Department of Water Resources and the Geological Survey was used.

Basic data used in describing the hydrologic characteristics and features of the various aquifers in this report are derived from the field inventory of existing water wells, drillers' logs of representative wells, measurement of water levels in these wells, collection and analysis of water samples from the wells, and aquifer tests. The well inventories are compiled in table 1, drillers' logs in table 2, water levels in table 3, and water-quality analyses in tables 4a and 4b (supplemental information).

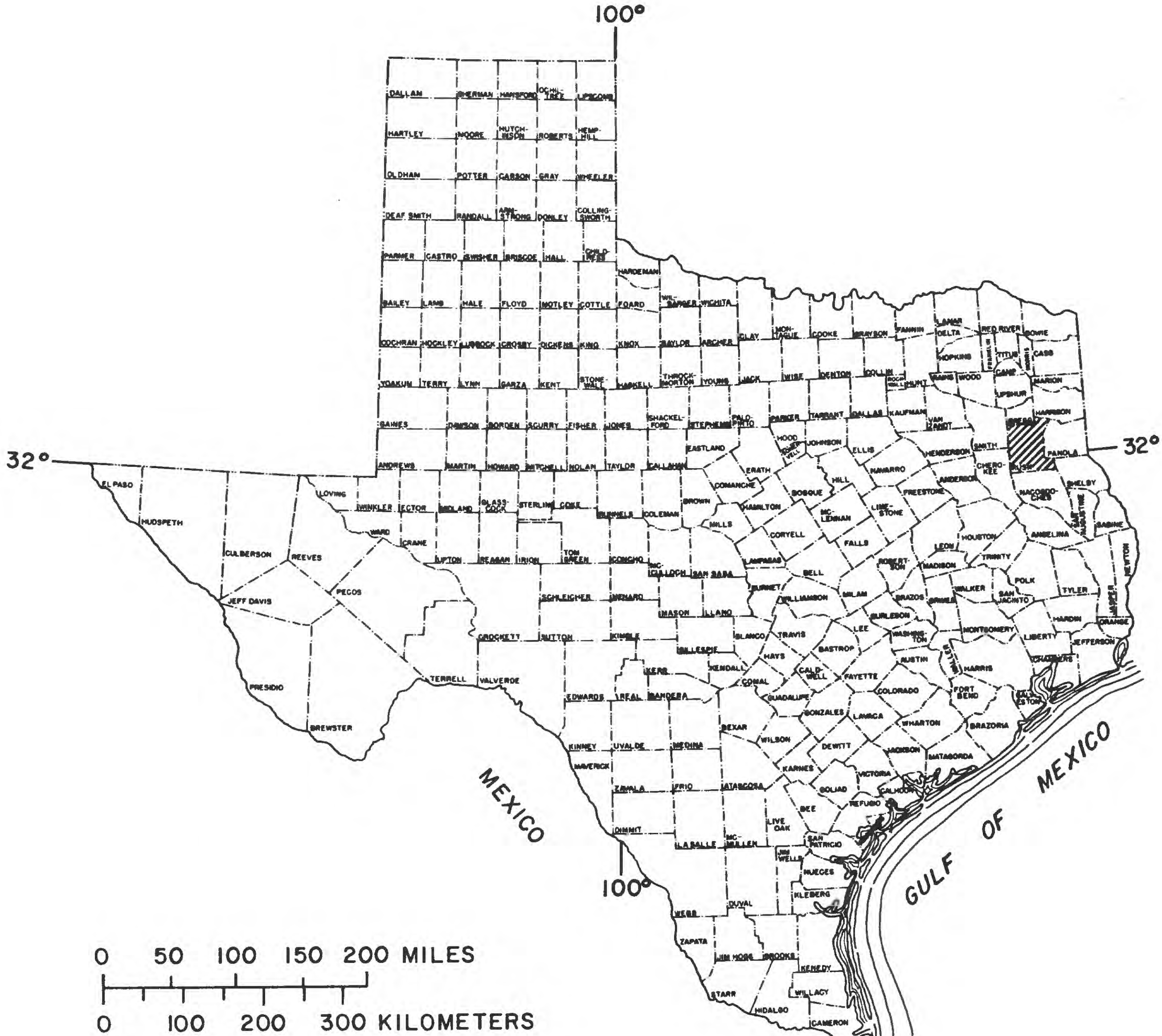


Figure 1.-Location of Rusk County

Most data relating to the quantity of ground water withdrawn for public supply and industrial uses were obtained from records of the Texas Department of Water Resources. Some quantities were estimated on the basis of the number of users and normal rates of use.

The map of the geologic units is from the Geologic Atlas of Texas, which was prepared by the University of Texas, Bureau of Economic Geology (1965, 1968). Electric logs of oil, gas, and water wells commonly were used for control in preparation of the geologic sections and for maps showing the altitudes of aquifers, the base of fresh and slightly saline water, and approximate thickness of sands containing freshwater. Additional subsurface information was provided by drillers' logs of wells. In some instances, projections of fault blocks from the surface to the subsurface were made to show relationships existing along the Mount Enterprise Fault Zone.

Representative results of aquifer tests from previously published data in adjacent counties were analyzed by the Theis nonequilibrium method as modified by Cooper and Jacob (1946) and the Theis recovery method (Wenzel, 1942). Data relating to secondary recovery, saltwater production, surface casing, and oil production in oil and gas fields were acquired from records of the Railroad Commission of Texas and the East Texas Salt Water Disposal Company.

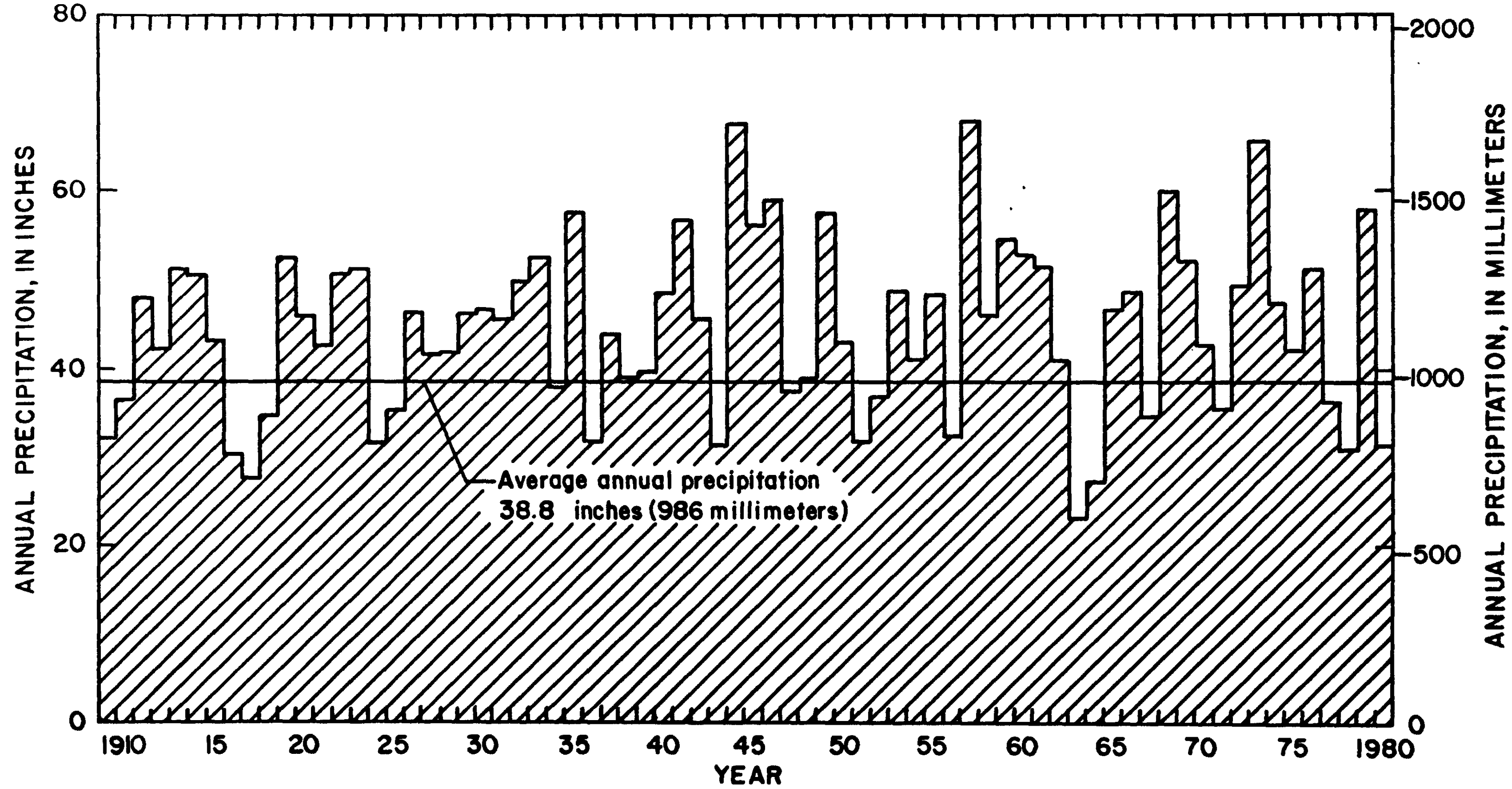
Altitudes not previously determined were interpolated from available Geological Survey 7-1/2 and 15-minute topographic maps having a contour interval ranging between 10 feet (3 m) and 20 feet (6 m) in the study area.

Physiography, Drainage, and Climate

Rusk County is in the West Gulf Coastal Plain physiographic province (Fenneman, 1939) and a part of the Piney Woods region of East Texas. The most prominent physiographic feature is the Mount Enterprise Fault System, which extends along an east-west axis across the southern part of the county. The system forms a series of hills, some of which attain an altitude in excess of 600 feet (183 m), extending from due east of Mount Enterprise to near Reklaw, where the system is somewhat offset to the north. The land surface slopes away from these high ridges, generally to the north and to the south, interrupting a regional surface sloping in an easterly and southerly direction. Substantial growths of pine and hardwood occur throughout much of the county.

Springs commonly are found at higher and intermediate altitudes. Streams in the northeastern part of the county drain to the Sabine River whereas those in the southwestern part drain to the Neches River. Striker Creek and Bowles Creek drain into the Striker Creek Lake, Beaver Run and Tiawichi Creek into Lake Cherokee, and Martin Creek into Martin Lake.

Rusk County has a warm, semihumid climate. Annual precipitation at Henderson for 1909-80 ranged from 23 inches (584 mm) during 1963 to 68 inches (1,727 mm) during 1957 and averaged 38.8 inches (986 mm) as shown in figure 2. According to the National Oceanic and Atmospheric Administration, the monthly precipitation at Henderson for 1941-70 ranged from 2.81 inches (71 mm) during July to 5.79 inches (147 mm) during May and averaged 3.94 inches (100 mm) as shown in figure 3.



From records of National Oceanic
and Atmospheric Administration

Figure 2.-Annual precipitation at Henderson, 1909-80

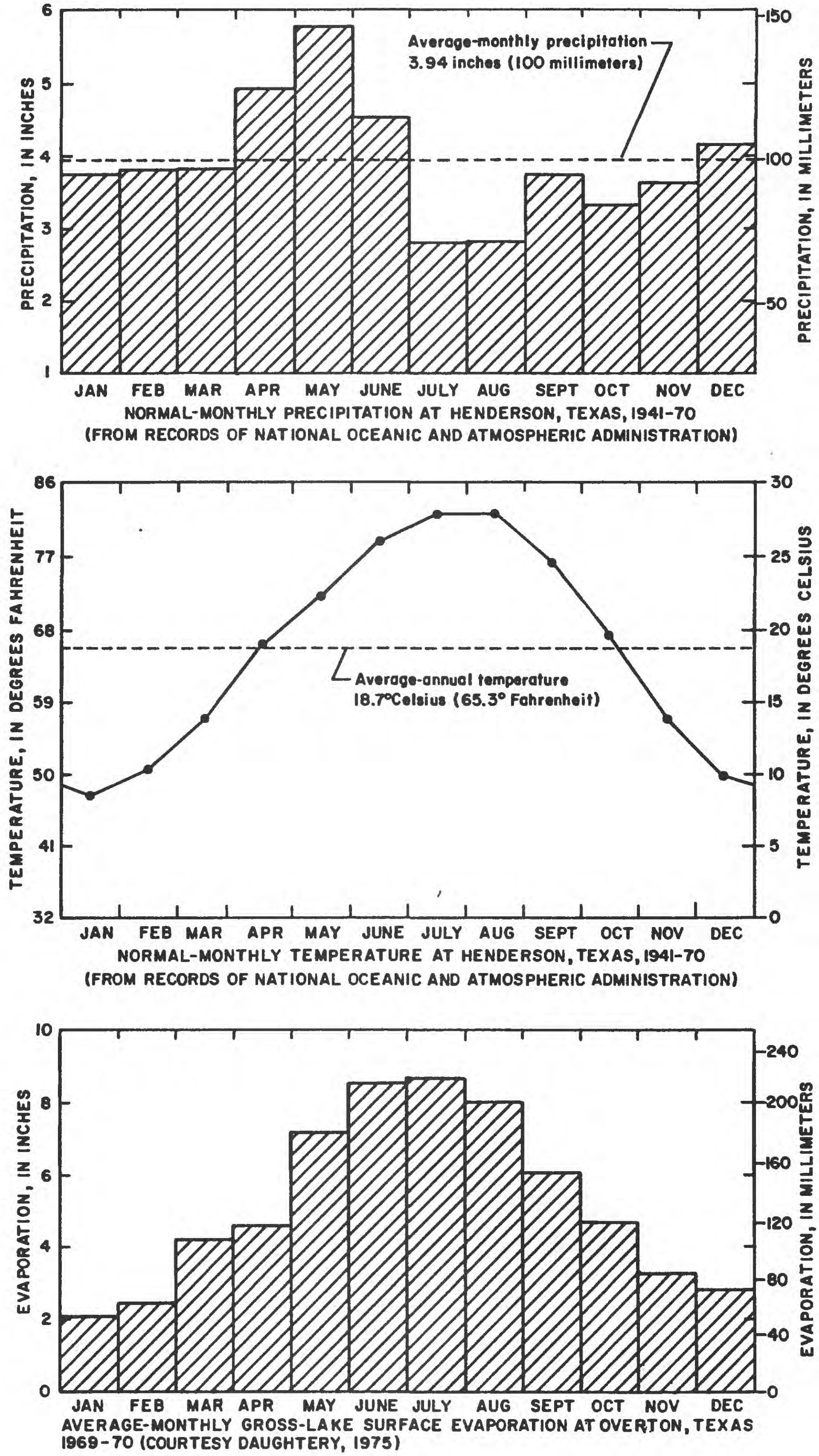


Figure 3.-Average-monthly precipitation and temperature at Henderson and average-monthly gross-lake surface evaporation at Overton

The average-annual temperature at Henderson (fig. 3) is 18.7°C (65.3°F). Dates of the first and last freezes are about November 14 and February 20; the average growing season lasts about 250 days. The average-annual gross-lake surface evaporation for 1969 and 1970 at Overton was 66.6 inches (1,692 mm) according to Dougherty (1975).

Economic Development

During 1980, oil and gas, lignite leasing, lumbering, agriculture, and clay products provided the main sources of income for Rusk County. Until 1930, lumbering and agriculture provided the mainstay for the economy of the area. The beginning of the oil and gas industry in the county occurred during 1929 when "Dad" Joiner (fig. 4) started his No. 3 Daisy Bradford well in northwest Rusk County. The well was completed during 1930 as the first discovery well for East Texas Oil Field (Rusk, Gregg, Upshur, and Smith Counties). The location of this field and others are shown in figure 5. Since that time, oil and gas and the processing of petroleum and related products have been the most significant industry.

Completion of the No. 3 Daisy Bradford, however, came at an awkward time, just before the height of the depression. Independents drilled hundreds of wells, many of which were on town lot spacing. So much crude was produced from East Texas that the price of oil fell to 10 cents a barrel. When riots started, Governor Ross Sterling called out the National Guard to preserve order. It also was at this time that he appointed E. O. Thompson to the Texas Railroad Commission and delegated to him the responsibility of regulating oil and gas production in Texas.

By 1980, East Texas Oil Field had produced over 4.622 billion barrels (734,898,000 m^3) of oil and was responsible for making Rusk County rank among the larger oil producing counties in Texas. The field also had produced substantial quantities of saltwater. According to a 1961 oilfield-brine disposal inventory prepared by the Texas Water Commission and Texas Water Pollution Control Board (1963), 156.7 million barrels (24,915,300 m^3) of saltwater were produced that year. This was an average of 0.427 million barrels (67,890 m^3) a day, 99 percent of which was disposed of through injection wells.

Population

Rusk County has a population of 41,382 according to the Bureau of Census (1980). Henderson, the county seat, has a population of 11,473. Populations of other towns are: Overton, 2,430; Tatum, 1,614; New London, 942; and Mount Enterprise, 485. The 1980 census also shows that 2,543 of the people living in Kilgore (Gregg and Rusk Counties) reside in Rusk County.

Previous Investigations

Deussen (1914) mentioned the existence of several springs and water wells in his study of the southeastern part of the Texas Coastal Plain including more than 20 Texas counties. Turner (1932) compiled a report on ground water in East Texas Oil Field that covered parts of Gregg, Rusk, Smith, and Upshur

C. M. (Dad) Joiner (1), Dr. Lloyd (2), H. L. Hunt (3), and drilling crew

Figure 4.-C.M. (Dad) Joiner, Dr. Lloyd, H. L. Hunt, and drilling crew of No. 3 Daisy Bradford, discovery well of East Texas Oil Field (1930). Photo courtesy of YOUTH SPEAKS

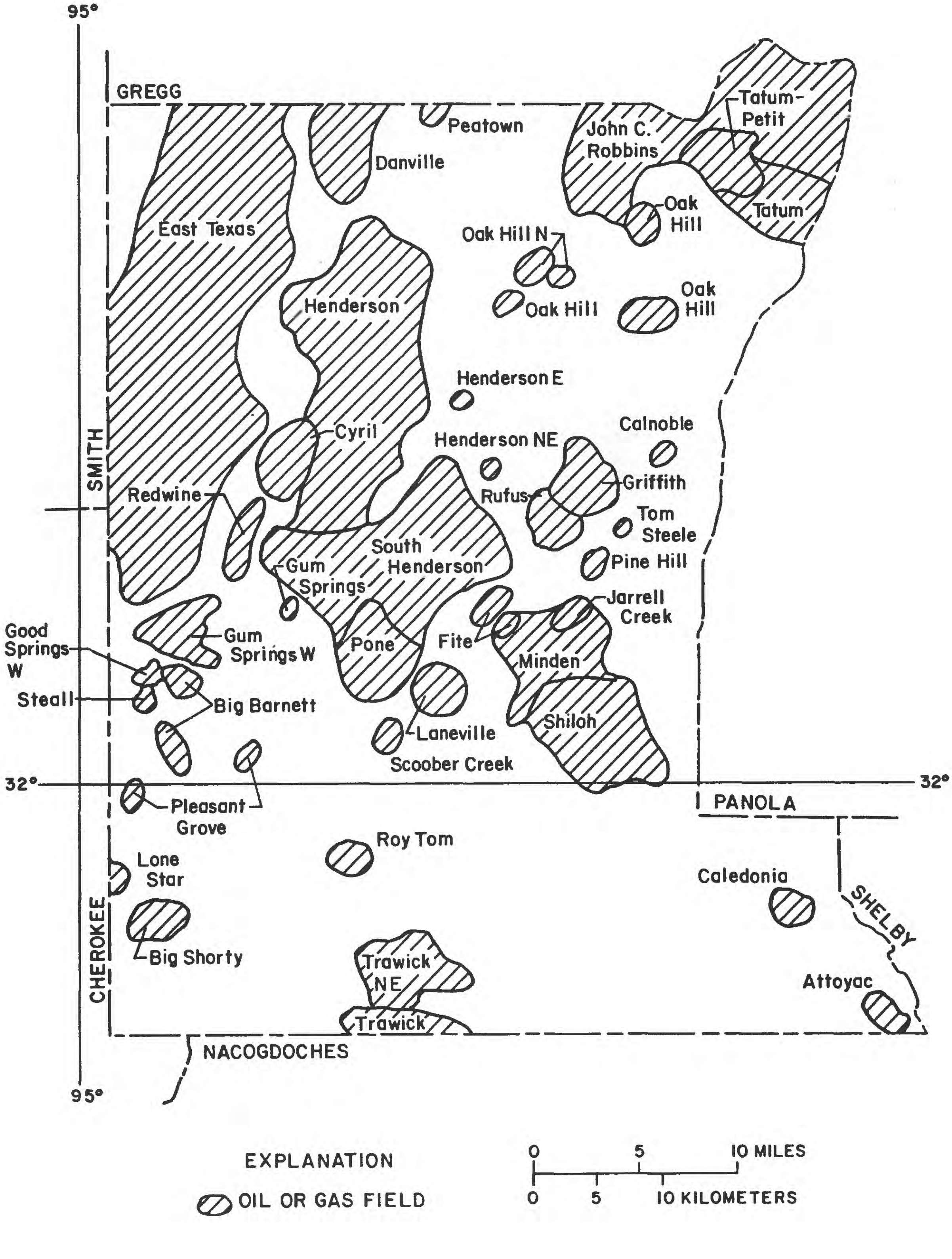


Figure 5.-Location of significant oil and gas fields

Counties. He concluded that saltwater contamination of the freshwater-bearing zones probably had not occurred at that time. Turner suggested that the possibility of bacteriological contamination of ground water existed and recommended that all "abandoned oil wells that yield a flow of saltwater should be plugged." He also recommended that special attention be given to setting "surface casing." Lyle (1937) presented a comprehensive inventory of about 406 wells, drillers' logs, and water analyses and included a location map of Rusk County. During this same period, a number of test holes were drilled using Works Progress Administration (WPA) labor. Follett (1943) augmented Lyle's data by publishing an inventory of about 160 old and new wells in the northwestern part of Rusk County.

Baker, Peckham, Dillard, and Souders (1963) made a reconnaissance of the ground-water resources of the Neches River basin that included Rusk County. In another report, Baker, Dillard, Souders, and Peckham (1963) made a reconnaissance of the ground-water resources of the Sabine River that included a part of Rusk County. Between 1937 and 1940, water levels were measured in a number of shallow observation wells near Henderson but were previously unpublished. About 1972, the Texas Department of Water Resources (TDWR), formerly the Texas Water Development Board (TWDB), established a group of observation wells in Rusk County. Water levels were measured periodically and water samples from representative wells were analyzed for chemical constituents.

Reports discussing the ground-water resources of counties adjacent to Rusk County include: Smith County (Dillard, 1963); Gregg and Upshur Counties (Broom, 1969); Angelina and Nacogdoches Counties (W. F. Guyton and Associates, 1970); and Anderson, Cherokee, Freestone, and Henderson Counties (W. F. Guyton and Associates, 1972).

In addition to the ground-water investigations, a reconnaissance of water quality of surface water in the Neches River basin was made by Hughes and Leifeste (1967). Their study includes data on the Striker Creek drainage basin, which is nearly centered along the county line of the west side of Rusk County. Approximately two-thirds of the watershed is in East Texas Oil Field.

Well-Numbering System

The local well-numbering system used in this report is the system adopted by the Texas Department of Water Resources for use throughout the State. Under this system, each 1-degree quadrangle in the State is given a number consisting of two digits. These are the first two digits in the well number. Each 1-degree quadrangle is divided into 7-1/2-minute quadrangles that are given two-digit numbers from 01 to 64. These are the third and fourth digits of the well number. Each 7-1/2-minute quadrangle is subdivided into 2-1/2-minute quadrangles and given single-digit numbers from 1 to 9. This is the fifth digit of the well number. Each well within a 2-1/2-minute quadrangle is given a two-digit number in the order in which it was inventoried. These are the last two digits of the well number. The well location on a map is shown by listing only the last three digits of the well number adjacent to the well location. The second two digits are shown in the northwest corner of each 7-1/2-minute quadrangle, and the first two digits are shown by the large double-line numbers.

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

County	Prefix	County	Prefix
Cherokee	DJ	Panola	UL
Gregg	KU	Rusk	WR
Harrison	LK	Shelby	XB
Nacogdoches	TX	Smith	XH

For example, well WR-35-50-801, which supplies water for the city of Henderson, is in Rusk County (WR) in the 1-degree quadrangle (35), in the 7-1/2-minute quadrangle (50), in the 2-1/2-minute quadrangle (8), and was the first well (01) inventoried in that 2-1/2-minute quadrangle (fig. 6). Well numbers used by Lyle (1937) and Follett (1943) and the corresponding numbers used in this report are given in table 5 ("old number"). The location of wells, springs, and selected test holes used in this report are shown in figure 7.

The Geological Survey's national site identification system uses the latitude-longitude coordinate system. The combination of the 6-digit latitude number, the 7-digit longitude number, and a 2-digit sequence number forms a 15-digit site identification number. For example, the first site at latitude 32°15'42" and longitude 94°34'23" gives a site-identification number of 321542094342301. A cross reference between the local and national systems for the wells in this report are given in table 5.

Acknowledgments

The author expresses his appreciation to the many land owners, well owners, and industrial and municipal officials for their cooperation and for allowing access to their properties. Particular appreciation is expressed to Jack Cook, Water Superintendent, City of Henderson; Bob Lomax, Manager, Elderville Water Supply Corporation; John Seifert, W. F. Guyton and Associates; Jack Waldron, Layne-Texas Company; Jackie Murray; Rick Hornsby, Exxon Coal USA, Inc.; and Casey Clawson, Henderson Clay Products.

GEOLOGIC FRAMEWORK AND PHYSICAL CHARACTERISTICS OF THE GEOLOGIC UNITS

Rusk County is in an area affected by several regional structural features--the Sabine Uplift, Mount Enterprise Fault System, and East Texas Embayment (fig. 8). Geologic units, ranging in age from Paleocene and Eocene (Wilcox Group) through the Holocene (alluvium), crop out at the surface as shown in figure 9. Beds of the Carrizo Sand, which crop out over about a third of the county, are slightly more extensive than those of the older Wilcox Group. A description of the geologic units and their water-bearing characteristics is given in table 6. Stratigraphic and structural relationships in the subsurface are shown on the geologic sections (fig. 10-12).

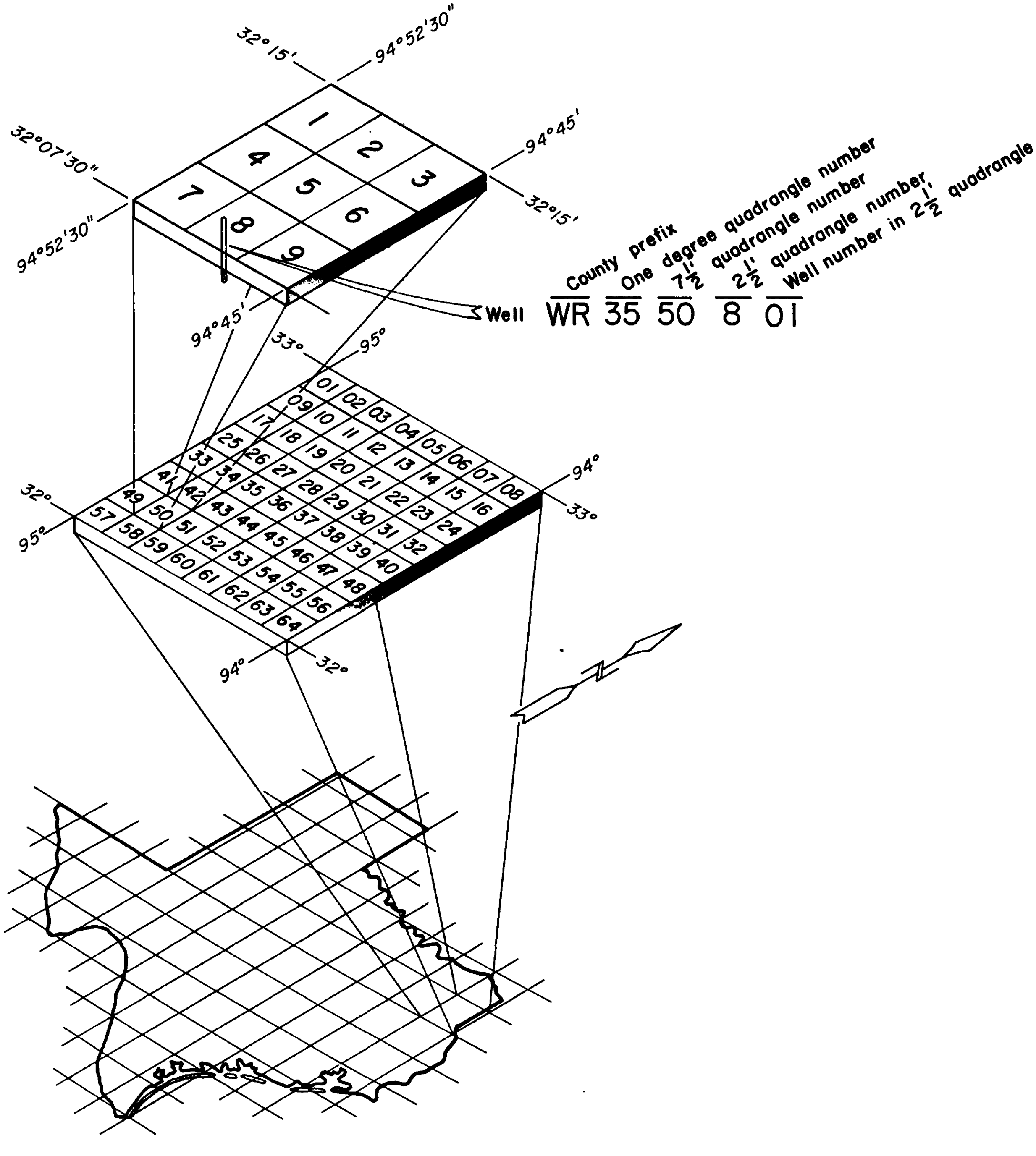


Figure 6.-Well-numbering system

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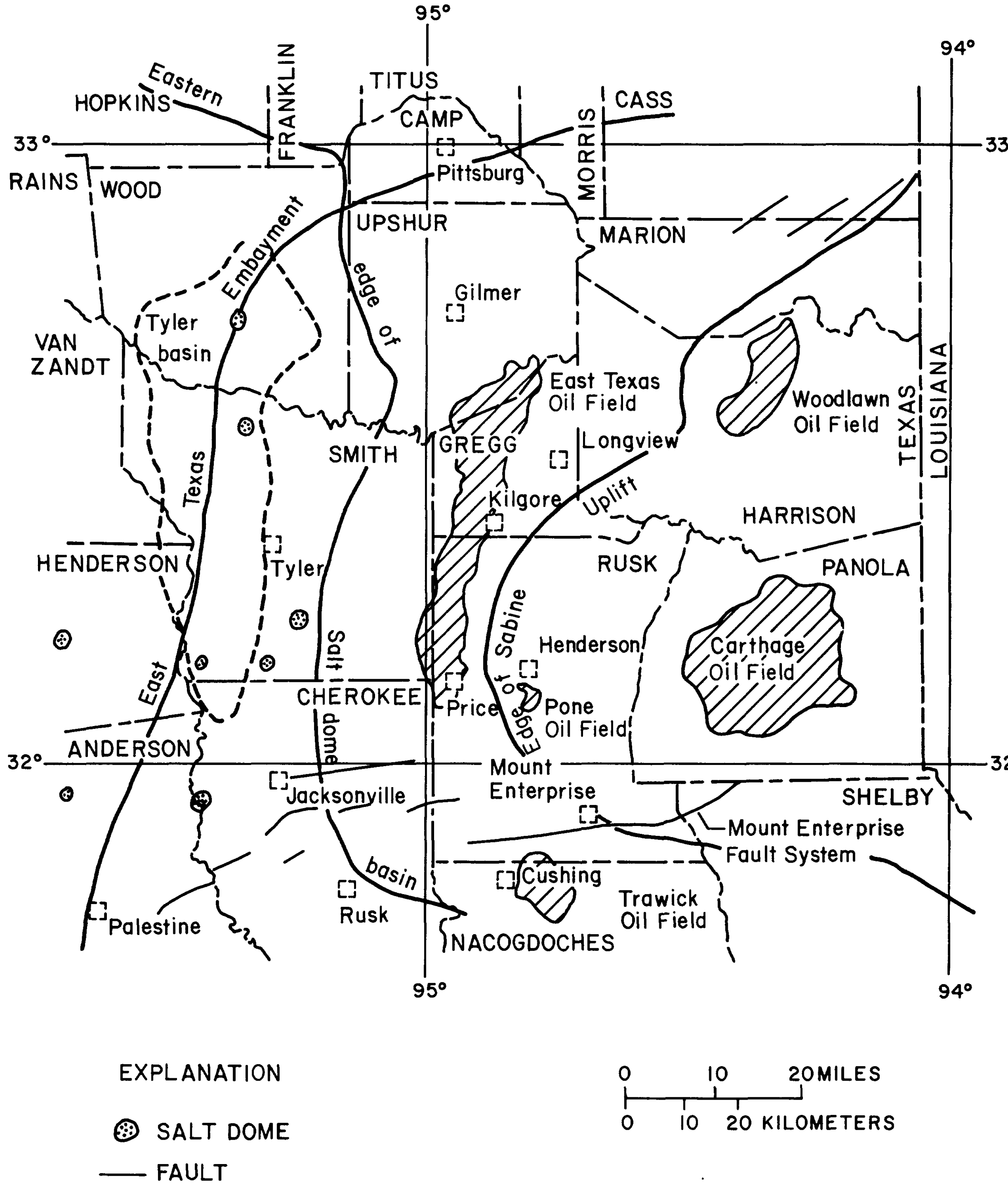

Base from U.S. Geological Survey
State base map, 1:500,000

Modified from Fisher, (1965), Sellards and
Hendricks, (1946), and Nichols, (1964)

Figure 8.-Location of principal geologic structual features in East Texas

page 20 follows

Table 5.--Cross reference of well numbers in Rusk County

Old number	New number	Site identification	Old number	New Number	Site identification	Old number	New number	Site identification
4	WR-35-41-101	322038094581701	248	WR-35-50-703	320910094505001	567	WR-37-10-101	315101094503301
7	WR-35-41-401	321859094585701	251	WR-35-50-701	320855094522401	571	WR-37-02-803	315234094493701
14	WR-35-41-708	321633094581101	255	WR-35-50-702	320925094491801	575	WR-37-02-401	315510094501401
16	WR-35-41-705	321632094583702	260	WR-35-50-403	321120094414601	576	WR-37-02-501	315707094492401
17	WR-35-41-707	321631094583401	289	WR-35-49-509	321143094552501	577	WR-37-02-601	315718094471501
22a	WR-35-41-706	321524094584601	294	WR-35-49-304	321352094540301	578	WR-37-02-602	315712094472401
31	WR-35-41-510	321751094564301	299a	WR-35-41-810	321501094560301	579	WR-37-02-604	315520094472901
31a	WR-35-41-509	321752094565101	310	WR-35-49-101	321448094583201	583	WR-37-03-701	315255094444401
32	WR-35-41-505	321844094565301	313	WR-35-49-103	321408094582001	585	WR-37-11-203	325204094422801
40	WR-35-41-202	322100094555601	315	WR-35-49-102	321413094573001	588	WR-37-02-603	315710094450401
47a	WR-35-41-308	322000094540001	316a	WR-35-49-205	321415094562501	589	WR-37-03-401	315714094440001
50	WR-35-41-508	321939094552101	327	WR-35-49-303	321338094545901	590	WR-37-03-402	315620094432001
62	WR-35-41-902	321625094540701	336a	WR-35-49-510	321146094564401	593	WR-37-03-503	315520094413401
70	WR-35-41-903	321539094163601	343	WR-35-57-803	320115094564601	594	WR-37-03-504	315507094410201
75	WR-35-41-904	321609094531401	367	WR-35-57-504	320302094563901	596	WR-37-03-901	325430094394101
80	WR-35-42-402	321750094500201	369	WR-35-57-601	320310094532501	598	WR-37-11-301	325051094385501
82	WR-35-42-403	321941094500401	375	WR-35-57-301	320647094541701	607	WR-37-04-402	325708094352201
88	WR-35-41-201	322125094554001	384	WR-35-49-807	320910094553701	608	WR-37-04-201	325740094333501
90	WR-35-42-601	321952094472901	393	WR-35-49-604	321022094523901	609	WR-37-04-301	325802094315501
92	WR-35-42-501	321811094475601	398	WR-35-49-902	320852094525301	619	WR-37-12-201	315055094332501
100	WR-35-42-904	321703094454301	402	WR-35-59-402	320410094441801	621	WR-37-12-303	325054094304501
103	WR-35-42-602	321757094453701	409	WR-35-50-805	320701094484401	629	WR-35-41-304	322140094542201
108	WR-35-43-401	321826094442801	415	WR-35-50-910	320908094440201	631	WR-35-41-309	322113094542901
111	WR-35-42-303	322147094452901	416	WR-35-50-901	320852094470701	634	WR-35-41-307	322020094534301
114	WR-35-42-302	322036094461501	420	WR-35-50-911	320816094461501	642	WR-35-41-507	321951094553401
126	WR-35-43-801	321651094411101	423	WR-35-58-302	320522094451801	652	WR-35-41-703	321632094583701
130	WR-35-43-901	321628094382001	426	WR-35-59-501	320440094415501	653	WR-35-41-803	321616094554301
132	WR-35-44-702	321718094370501	427	WR-35-59-603	320414094392101	654	WR-35-41-802	321617094554201
136	WR-35-44-403	321856094361501	429	WR-35-59-302	320510094392601	656	WR-35-49-203	321457094555801
140	WR-35-44-503	321954094344801	433	WR-35-59-203	320654094404201	658	WR-35-49-201	321427094562101
146	WR-35-44-302	322015094302501	434	WR-35-51-902	320911093383601	661	WR-35-41-704	321532094580001
151	WR-35-44-604	321904094322501	505	WR-35-59-904	320222094383201	669	WR-35-49-208	321321094550101
152	WR-35-44-605	321836094316801	507	WR-35-60-701	320138094362001	671	WR-35-49-209	321309094551501
165	WR-35-51-903	320844094381101	519	WR-35-59-701	320224094433501	682	WR-35-49-503	321217094561801
168	WR-35-52-702	320946094372401	524	WR-37-03-101	315950094443101	684	WR-35-49-504	321222094571101
175	WR-35-51-603	321055094394701	528	WR-35-58-801	320200094480501	694	WR-35-49-508	321126094562201
176	WR-35-51-503	321044094411402	532	WR-37-02-102	315756094502701	697	WR-35-49-507	321048094550901
177	WR-35-51-802	320908094421202	534	WR-37-02-206	315915094484901	698	WR-35-49-603	321045094533401
179	WR-35-50-913	320930094450201	535	WR-37-02-101	315929094502301	704	WR-35-49-506	321049094561501
179a	WR-35-50-912	320928094450801	536	WR-35-58-702	320154094510101	711	WR-35-49-505	321036094570001
183	WR-35-51-102	321413094424001	538	WR-35-58-701	320154094515801	722	WR-35-49-402	321105094575301
185	WR-35-50-303	321319094454701	547	WR-37-01-103	315949094583701	730	WR-35-49-403	321004094574801
187	WR-35-59-203	320654094404201	548	WR-37-01-202	315959094561701	736	WR-35-49-808	320954094553801
191	WR-35-50-205	321309094474601	549	WR-37-01-203	315754094551501	742	WR-35-49-801	320809094562901
206	WR-35-50-601	321007094470401	551	WR-37-01-401	315728094584301	752	WR-35-49-702	320858094581801
218	WR-35-50-404	321032094502001	558	WR-37-01-701	315438094574201	758	WR-35-50-902	320908094470201
224	WR-35-50-101	321452094512801	559	WR-37-01-803	315402094561201	760	WR-35-50-803	320851094480901
225	WR-35-50-102	321339094505901	563	WR-37-01-601	315513094533201	761	WR-35-50-804	320833094473401
230	WR-35-50-103	321253094515801	564	WR-37-01-901	315322094542301	762	WR-35-50-903	320902094470501
240a	WR-35-50-402	321117094504901	565	WR-37-09-201	315114094553801			

Table 6.--Geologic units and their water-bearing properties in Rusk County

System	Series	Group	Unit	Approximate range in thickness (feet)	Composition	Water-bearing properties
Quaternary	Holocene		Alluvium	0-35	Sand, silt, clay, and some gravel.	May yield small quantities of water to shallow dug wells.
	Pleistocene		Terrace deposits	0-30	Sand, silt, and clay.	Not known to yield water to wells.
Tertiary	Eocene	Claiborne	Sparta Sand	0-100	Interbedded sand, clay, and silt.	Feeds springs; may yield some water to dug wells.
			Weches Formation	0-50	Glauconite, glauconitic clay and sand. Secondary deposits of limestone in outcrop.	Not known to yield water to wells in Rusk County.
			Queen City Sand	0-130	Sand, silt, clay, and some lignite.	Yields small to moderate quantities of freshwater.
			Reklaw Formation	0-130	Glauconitic clay, some sand, weathers to a red clayey soil, limonite seams, iron concretions.	Yields small quantities of water to wells.
			Carrizo Sand	0-135	Grey to white. Often massive sand, clay lenses; may be predominantly clayey.	Yields large to moderate quantities of freshwater. In hydrologic continuity with the Wilcox.
		Wilcox		625-1,550	Thin, sometimes massive beds of sand; clay and lignite. Beds often discontinuous.	Yields large to moderate quantities of fresh to slightly saline water.
	Paleocene	Midway		850-1,000	Calcareous clay and minor amounts of limestone, silt, and glauconitic clay.	Not known to yield water to wells in Rusk County; upper sand may contain some slightly saline water.

The Sabine Uplift (fig. 8) is a structurally complicated area in northeast Texas and northwest Louisiana. The western boundary extends into Rusk County. Sands, red beds, and shales of the Cretaceous Woodbine Formation were deposited over this uplift and later eroded. East Texas Oil Field, a stratigraphic trap, produces oil from the Woodbine at a depth of about 3,650 feet (1,112 m). About 20-25 miles (32-40 km) west of the eastern edge of East Texas Oil Field lies the nadir of the East Texas Embayment, into which the Woodbine thickens. Such features were at times instrumental in controlling the deposition of the Wilcox.

The Mount Enterprise Fault System trends east-west across southern Rusk County. The Queen City Sand, Weches Formation, and Sparta Sand are preserved in the downthrown side of this system. Eaton (1956, p. 83) notes that there was moderate movement along this system in Midway time, considerable movement during Claiborne time, and a marked movement during post-Claiborne time. An earthquake of 7 on the Richter scale was reported at Rusk (Cherokee County), during 1891 but is questioned by von Hake (1977). Collins, Hobday, and Kreitler (1980, p. 16) suggest that the event may have been seismic. They use releveling data to conclude that the system has been active during the past 30 years.

Further information on the geologic relationships existing in this area is available from Sellards, Adkins, and Plummer (1932) and from Kreitler and others (1980). For a generalized regional appraisal relating to the structural and depositional altitude of the Wilcox Group, the reader is referred to Jones and others (1976).

Midway Group

The Midway Group, mostly marine in origin, is composed chiefly of calcareous clay, which locally may contain thin stringers of limestone and glauconitic sand. In places, the unit is silty and slightly sandy in the uppermost part of the section.

The altitude of the top of the Midway, which coincides with the base of the Wilcox Group (fig. 13), ranges from about 300 feet (91 m) below sea level in the northeastern part of the county to about 1,600 feet (488 m) below sea level in the southwestern part of the county. In the northern part of the county, the beds dip at a rate of about 30 ft/mi (5.7 m/km) to the west. In the southern part of the county, they dip about 50 ft/mi (9.5 m/km) to the southwest.

The Midway Group is not known to yield water to wells in the area. Nevertheless, the unit is hydrologically significant because the Midway Group forms the basal confining unit for the overlying Wilcox Group. There is also a sand body about 30 feet (9m) thick within the uppermost 200 ft (61 m) that may contain small amounts of slightly saline water. In a few instances the base of slightly saline water has been picked at the base of this sand bed from electric logs.

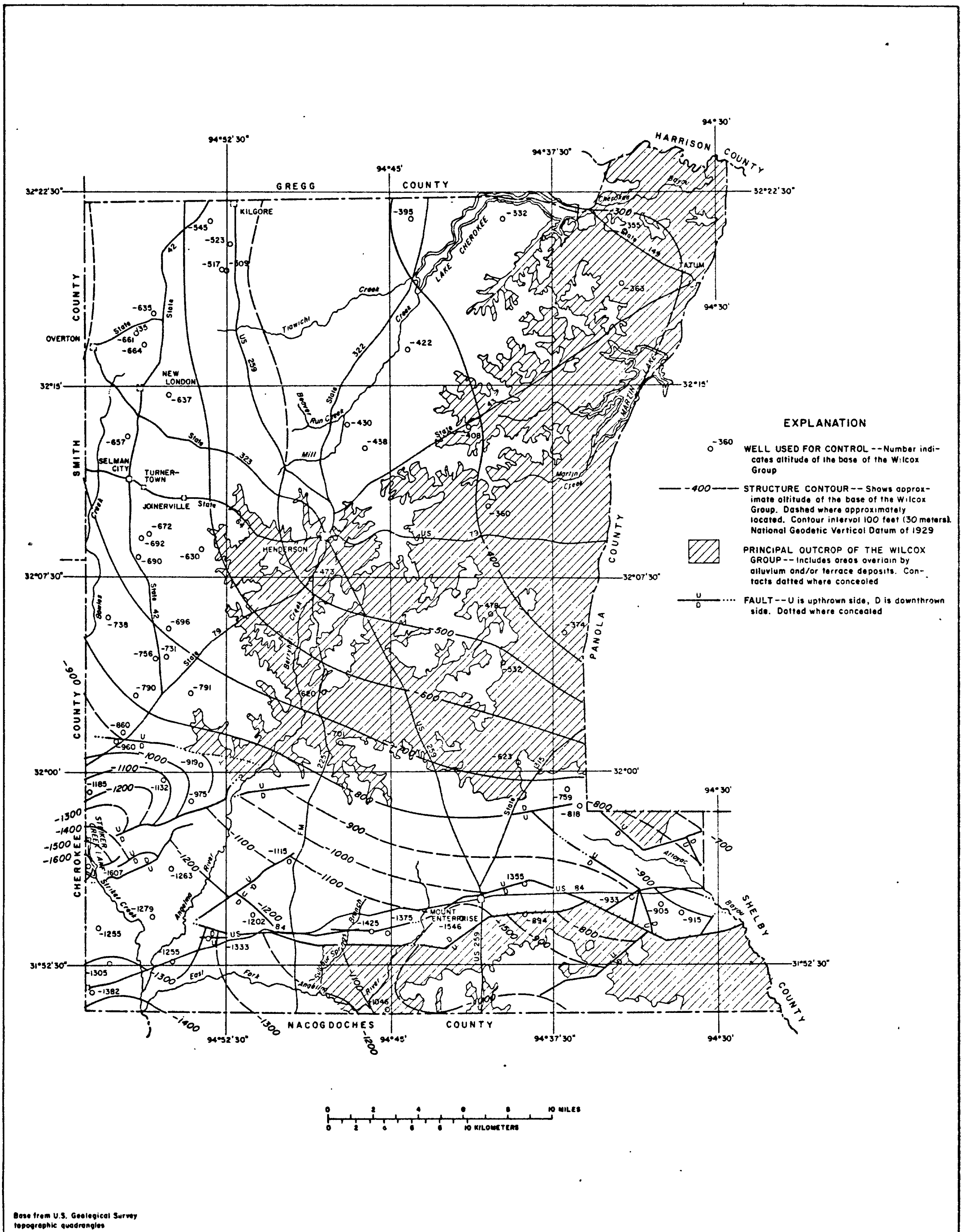

Figure 13.-Approximate altitude of the base of the Wilcox Group

Wilcox Group

The Wilcox Group is exposed on the surface in northeastern and east-central Rusk County and comformably overlies the Midway. It consists mainly of thin, but sometimes massive beds of sand, silt, and clay with minor amounts of lignite and secondary deposits of limonite. Typically, the sands are gray, fine grained and silty. Often the beds are fluvial and deltaic in nature. Due to facies changes, individual beds often are difficult to correlate from well to well. However, some beds of coarse grained sand attain a thickness of nearly 200 feet or 61 m (well WR-35-59-901). Other beds cannot be correlated from well to well as is clearly shown in the geologic sections (fig. 10-12).

The altitude of the top of the Wilcox Group is depicted in figure 14. Except where interrupted by the Mount Enterprise Fault System, these beds dip at the rate of about 30 ft/mi (5.7 m/km) in a direction away from the Sabine Uplift.

Carrizo Sand

The Carrizo Sand uncomformably overlies the Wilcox Group and crops out more extensively than any other geologic unit in the county. It attains a maximum thickness of about 135 feet (41 m). Surface exposures usually are reddish in color and often cross bedded. In the subsurface the Carrizo is a massive, fine- to medium-grained white quartz sand. It also contains a few clay lenses, but rarely is predominantly clay. In electrical logs, the Carrizo is distinguished from the overlying Reklaw and underlying Wilcox by a markedly higher resistivity. In places, however, the contacts are difficult to pick. As does the Wilcox Group, the Carrizo Sand dips away from the Sabine Uplift into the East Texas Embayment at a rate of about 30 ft/mi (5.7 m/km) except where interrupted by the Mount Enterprise Fault System.

Reklaw Formation

The Reklaw Formation conformably overlies the Carrizo Sand. The Reklaw attains a maximum thickness of about 130 feet (40 m) and is exposed primarily in the northern part of the county and north of the Mount Enterprise Fault System. The formation consists of glauconitic clay and minor amounts of sand and lignite. The basal part of the Reklaw contains a silty, glauconitic fine grained quartz sand that is often difficult to distinguish from the underlying Carrizo using electric logs. In the outcrop, the Reklaw forms a red clay soil characterized by limonite seams and iron concretions, easily distinguished from the underlying gray sandy soil of the Carrizo.

Queen City Sand

The Queen City Sand, which overlies the Reklaw Formation, consists mostly of alternating beds of very fine to fine grained quartz sand and clay. The Queen City Sand crops out over an area of about 100 square miles (259 km^2) and attains a maximum thickness of about 130 feet (40 m) where overlain by the Weches Formation. The maximum thickness occurs mainly in the downdropped blocks associated with the Mount Enterprise Fault System. Elsewhere, the

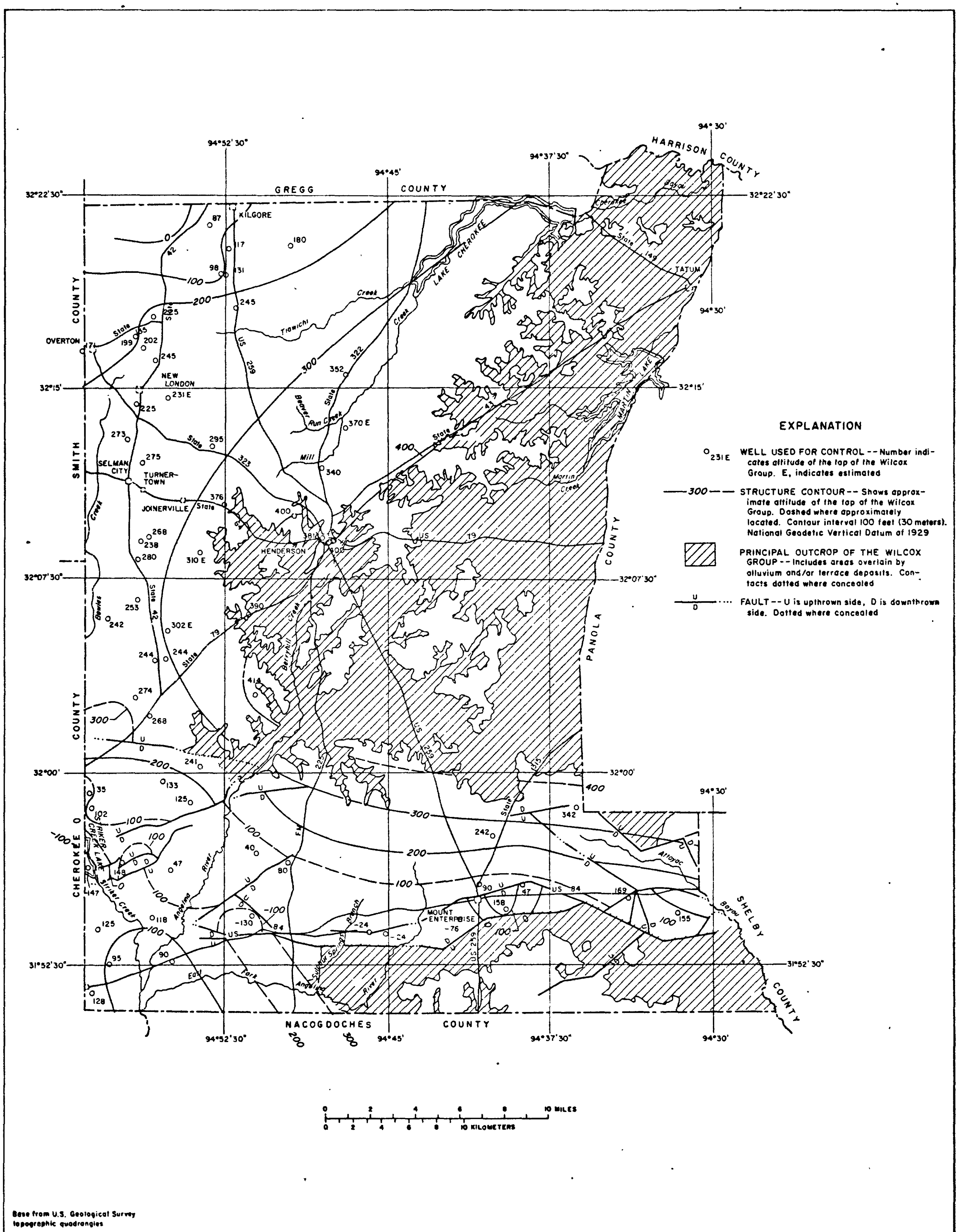

Figure 14.-Approximate altitude of the top of the Wilcox Group

Queen City is eroded and relatively thin. There is not enough control to adequately map the Queen City Sand.

Weches Formation

The Weches Formation, consisting of interbedded glauconitic clay and sand, crops out as scattered outliers in the Mount Enterprise Fault System area. The Weches attains a maximum thickness of about 50 feet (15 m), but is not known to yield water to wells in Rusk County.

Sparta Sand

The Sparta Sand consists of fine sand and sandy clay and silt, attains a thickness of about 100 feet (30 m), and is exposed only in the area of the Mount Enterprise Fault System. Numerous springs issue from the contact of the Sparta with the underlying Weches. The formation yields small quantities of freshwater to wells in adjacent counties. Springs issuing from the Sparta yield moderate quantities of ground water to the base flow of small streams in southern Rusk County.

Terrace Deposits and Alluvium

Terrace deposits, probably of Pleistocene age, are present at several places along the Sabine and Angelina Rivers. These beds are remnants of a formerly more extensive surface that has been largely removed by erosion. The terrace deposits are in continuity with the underlying Eocene beds but are considered hydrologically insignificant.

Alluvium is present in and around the flood plains of the principal streams (fig. 9). These deposits, consisting of fine sand, silt, clay, and possibly gravel, have an estimated maximum thickness of about 35 feet (10 m). Alluvial deposits are capable of yielding at least small amounts of water to wells. At least one well in Rusk County is completed in the alluvium.

HYDROLOGIC UNITS

In order to simplify the discussion of hydrology in the area, the following previously described geologic units are designated as aquifers in Rusk County: Wilcox Group, Carrizo Sand, Queen City Sand, and Sparta Sand. The other geologic units are designated as confining beds and are: Midway Group, Reklaw Formation, and Weches Formation. A number of dug wells tap the thin basal sand of the Reklaw.

Wilcox Aquifer

Broom (1969) noted that the Carrizo and Wilcox have similar hydrologic properties and are in hydrologic continuity in Gregg County. Consequently, he considered them to function as a single aquifer. W. F. Guyton and Associates

(1970, 1972) considered the two aquifers to be separate units in Cherokee and Nacogdoches Counties. In this report, the Carrizo and Wilcox are treated as two distinct aquifers.

The Wilcox aquifer is present throughout Rusk County and is the most significant hydrologic unit. Substantial withdrawals occur from the middle and lower sands at Henderson and in the area of East Texas Oil Field. Many of the upper sands in the Wilcox are thin, fine grained and silty. By contrast, the lower beds are sometimes massive and coarse grained. Often individual beds are discontinuous.

The quality of water in the Wilcox varies both vertically and laterally from fresh to slightly saline. In rare instances, the water may be moderately saline. In places, the shallower sands may not necessarily contain the best quality water.

The thickness of freshwater-bearing sands in the Wilcox is shown in figure 15. The thickness of sands containing freshwater are based on the interpretation of electric logs. The thickness ranges from about 170 feet (52 m) to about 400 feet (122 m). The altitude of the freshwater is shown in figure 16a and the base of the slightly saline water is shown in figure 16b.

Carrizo Aquifer

Another significant water-bearing unit is the Carrizo aquifer, which is present in about 70 percent of the county. In places, however, the Carrizo sands may be interbedded with clay as shown in figure 17, which shows ground water seeping from the Carrizo sands at the Ross clay pit of Henderson Clay Products north of the city of Henderson.

The Carrizo aquifer has an average sand thickness of about 80 feet (24 m) in the subsurface and 50 feet (15 m) in the outcrop area. However, a sand thickness map was not constructed because data were inadequate.

Other Aquifers

Only a few small-capacity wells draw water from the Queen City aquifer because of its near surface occurrence and small aerial extent. Except for a few isolated exposures in the northwestern part of Rusk County, the Queen City is present only in downdropped blocks associated with the Mount Enterprise Fault System. The Sparta is present only in the area along the Mount Enterprise Fault System. The Sparta is not an important aquifer in Rusk County. Both the Queen City and Sparta feed numerous small springs in Rusk County.

GROUND-WATER HYDROLOGY

Source and Occurrence

Precipitation is the source of all fresh ground water. Most precipitation on the land surface runs off, is consumed by evaporation, or is stored in the soil, later to be evaporated or transpired. A part of the water infiltrates through the pores of the soil and subsoil to the zone of saturation by the

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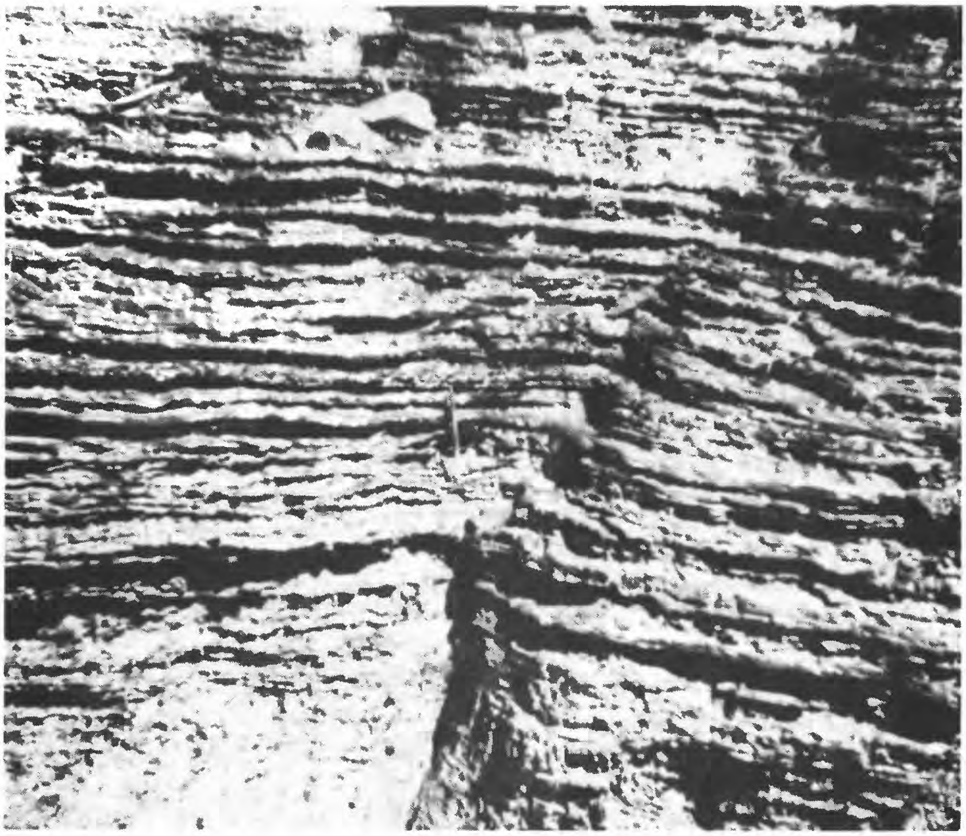

Figure 17.-Ground water seeping from sand layers in the Carrizo aquifer at the Ross clay pit north of the city of Henderson

forces of gravity and molecular attraction. The zone of saturation is the zone below the water table where the interstices are filled with fluid.

Ground water in the area occurs under water-table and artesian conditions. Under water-table conditions the water is unconfined. When tapped by a well, the unconfined water does not rise above the zone of saturation in the aquifer. Under artesian conditions, the water is confined. When tapped by a well, the confined water rises, due to hydrostatic pressure, above the level at which it is first encountered.

Fresh ground water occurs throughout Rusk County and often in at least several water-bearing sands. The most prolific water-producing zones are the artesian sands of the Wilcox, which are developed for municipal and industrial purposes. All significant withdrawals are from the artesian part of the Carrizo and Wilcox aquifers. Less productive shallow wells that tap the first saturated sand below the land surface are often used for stock and domestic purposes. Water in these beds usually occurs under water-table conditions at a depth of less than 50 feet (15 m) below land surface. Detailed information on individual wells is given in table 1.

Recharge, Movement, and Discharge of Ground Water

Recharge, the addition of water to an aquifer by natural or artificial processes, occurs mainly from the infiltration of rainfall into the outcrop. Recharge also may occur by percolation of water from streams and ponded areas. There is a large potential for recharge in Rusk County because the Wilcox and Carrizo crop out in about 60 percent of the area. Although the actual rate of recharge is not known, it probably is less than 1 inch (25.4 mm) per year.

Ground water moves slowly through the aquifers under the force of gravity from areas of recharge to areas of discharge. The movement under water-table conditions is lateral to discharge areas which, under natural conditions, are topographically lower than the recharge area. The movement under artesian conditions is toward areas of lower pressure head, normally downdip in the aquifer. Water then moves vertically upward into the lower pressured shallow material. Natural discharge also may occur through a seep or spring; artificial discharge may occur through a well. The rate of movement in the aquifers, either laterally or vertically, is dependent on the hydraulic gradient and conductivity of the material. Rates of movement probably are a few hundred feet per year.

The direction of movement in Rusk County in the water-table parts of the aquifers generally is toward the streams. The direction of movement in the artesian parts of the principal aquifers, the Carrizo and Wilcox, is from the outcrop toward the southeast and locally, toward the cones of depression at Henderson, East Texas Oil Field, and Tatum as shown in the potentiometric-surface map for the Wilcox (fig. 18).

Hydraulic Characteristics of the Aquifers

The importance of an aquifer as a source of water depends upon "its ability to store and transmit water" according to Ferris and others (1962, p. 70).

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These characteristics are expressed in terms of storage coefficient and transmissivity.

No aquifer tests were conducted in Rusk County because of a lack of controlled conditions. Aquifer tests, however, have been performed using wells completed in the Wilcox, Carrizo, and Queen City aquifers in Cherokee County (W. F. Guyton and Associates, 1972), Gregg County (Broom, 1969), and Nacogdoches County (W. F. Guyton and Associates, 1970). The test data were analyzed either by the Theis nonequilibrium method (Theis, 1935) or the modified Theis recovery method (Wenzel, 1942, p. 95). The results are given in table 7.

To estimate the expected range of transmissivities of the Wilcox and Carrizo aquifers in Rusk County, the following assumptions were made:

1. The hydraulic conductivities of the sands in the three adjacent counties (table 7) are representative of the sands in these same aquifers in Rusk County;
2. The sands opposite the screen are similar to the unscreened sands; and
3. The thickness of sands containing freshwater ranges from about 100 to 370 feet (30 to 113 m) for the Wilcox aquifer.

Based on these assumptions, the transmissivities of the Wilcox aquifer would range from 270-13,500 ft^2/d (25-1,720 m^2/d); and based on a maximum sand thickness of 100 feet in the Carrizo aquifer, the estimated maximum transmissivity is 6,400 ft^2/d (595 m^2/d).

Downdip from the outcrops where the Wilcox and Carrizo aquifers are under artesian conditions, the storage coefficients range from about 0.00006 to 0.0007, as indicated in table 7. Although no data are available for the area, the storage coefficients for the aquifers under water-table conditions would be expected to range from 0.1 to 0.2

The transmissivities and storage coefficients must be known to predict the drawdown of water levels caused by pumping a well or group of wells. The theoretical relationship of drawdown to transmissivity and distance is shown in figure 19. Calculations of drawdown are made on the basis of a group of wells pumping 1 Mgal/d (3,785 m^3/d) continuously for 1 year from an extensive aquifer.

The relationship of drawdown to time and distance caused by a well or group of wells pumping 1 Mgal/d (3,785 m^3/d) from an artesian aquifer of infinite extent having a storage coefficient of 0.0001 and a transmissivity of 10,000 ft^2/d (930 m^2/d) is shown in figure 20. The rate of drawdown decreases with time, but the water level declines indefinitely until a source of recharge is intercepted to offset the withdrawal and establish equilibrium in the aquifer. Because the drawdown is directly proportional to the rate of withdrawal, the drawdown for other than 1 Mgal/d (3,785 m^3/d) can be determined by multiplying the drawdown value shown in figure 20 by the proper multiple or fraction of 1,000,000.

Note that figures 19 and 20 show that the drawdown caused by the pumping well is greatest near the well and decreases as distance from the pumping well increases. This is the practical reason for properly spacing wells; mutual interference is decreased and consequently, pumping costs are reduced.

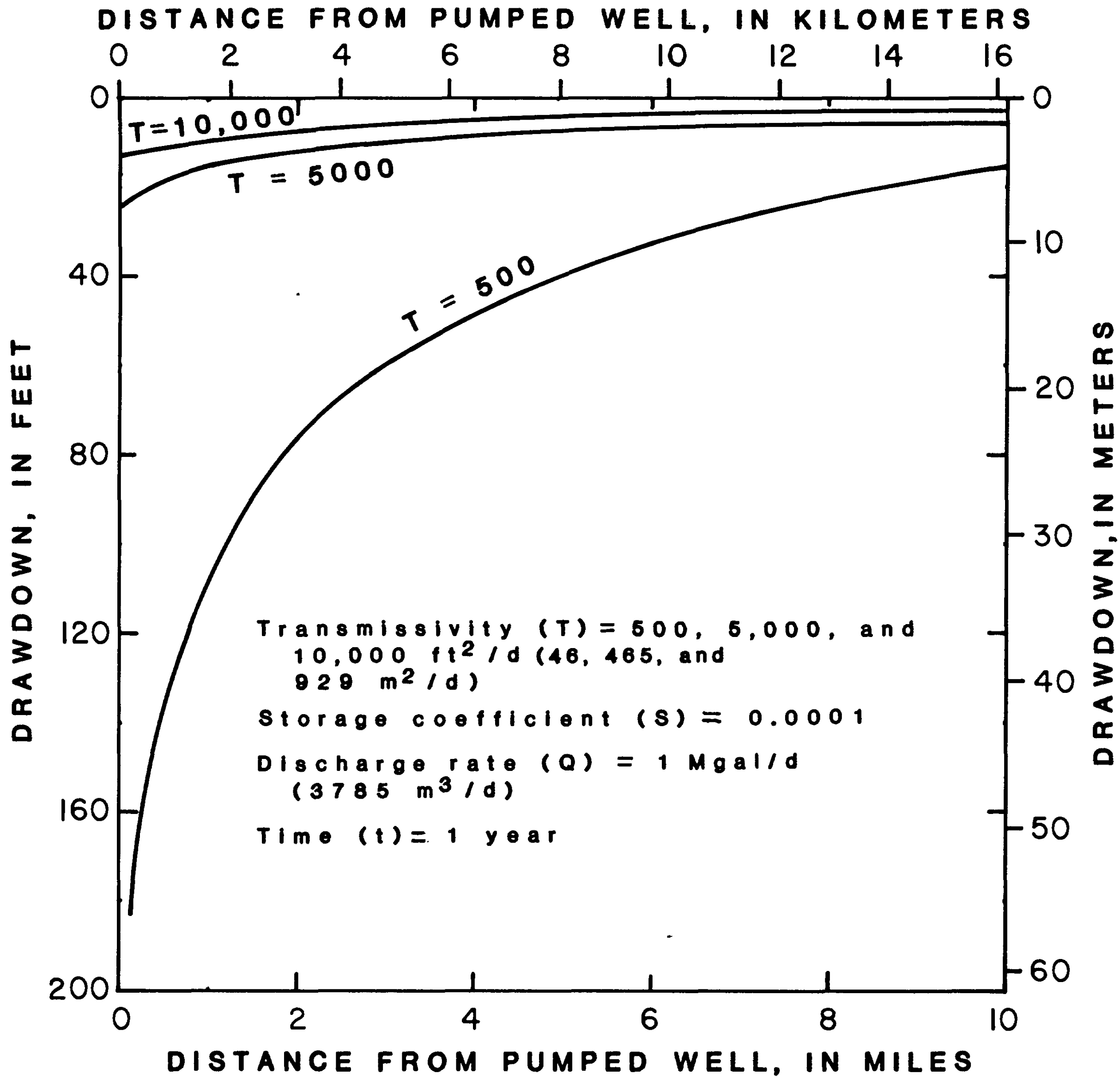

Figure 19.–Relationship of drawdown to transmissivity and distance

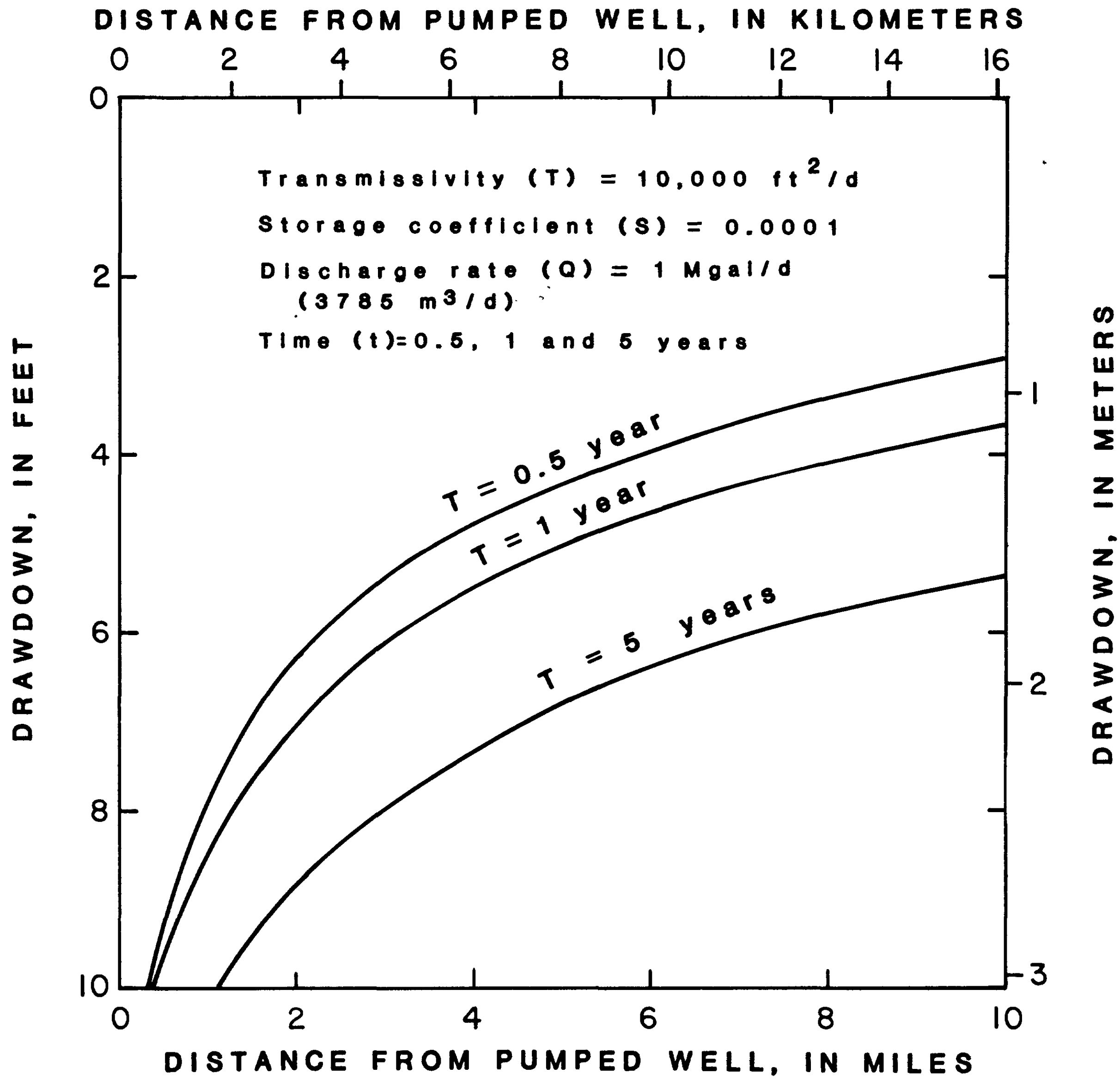

Figure 20.–Relationship of drawdown to time and distance as a result of pumping under artesian conditions

Table 7.--Results of aquifer tests in Cherokee, Gregg, and Nacogdoches Counties[1/]

County prefixes: DJ - Cherokee; KU - Gregg; TX - Nacogdoches

Well	Sand thickness of pumped well (feet)	Discharge (gallons per minute)	Specific capacity (gallons per minute per foot of drawdown)	Hydraulic conductivity (feet per day)	Storage coefficient	Remarks
			Carrizo aquifer			
DJ-37-01-401	75	343	5.4	19.4	--	Recovered for 24 hours.
402	60	350	5.4	25.5	--	Do.
	75	350	--	22	0.0001	Drawdown of observation well DJ-37-01-401.
09-101	2/52	43	4.5	28.4	--	Recovered for 2 hours.
33-202	2/70	102	1.2	63.8	--	Do.
38-06-603	80	692	13.1	31.0	--	Do.
604	90	621	10.3	18.9	--	Recovered for 12 hours.
15-102	2/36	36	2.1	15.7	--	Recovered for 2 hours.
502	101	473	7.1	20.6	--	Recovered for 24.5 hours.
			Queen City aquifer			
DJ-38-32-903	2/45	50	1.8	9.0	--	Recovered for 2 hours.
			Carrizo-Wilcox aquifer			
KU-35-26-705	64	--	--	11.4	.00006	Drawdown of observation well.
706	105	300	2.8	5.7	--	Drawdown of pumped well.
708	75	100	--	5.5	--	Recovered for 5 months.
			Wilcox aquifer			
DJ-34-64-402	90	63	6.1	19.4	--	Recovered for 2 hours.
37-09-102	2/94	75	7.1	18.2	--	--
38-08-105	90	102	7.4	36.4	--	--
TX-37-10-403	55	110	1.0	2.7	--	Recovered for 2 hours.
11-901	50	85	1.6	6.7	--	--
13-402	30	123	1.0	5.0	--	--
	2/30	123	--	5.0	.0007	Drawdown of observation well TX-37-13-401.
404	58	180	3.6	13.4	--	Recovered for 2 hours.

1/ Modified from Broom (1969) and W. F. Guyton and Associates (1970, 1972).
2/ Length of screen.

QUALITY OF GROUND WATER

Chemical constituents found in ground water originate principally from the soil and rocks through which the water has passed. Consequently, the chemical character of the water reflects, in a general way, the nature of the geologic formations that have been in contact with the water. Usually ground water in confined aquifers is free from contamination by organic matter. Sometimes, however, ground water in unconfined aquifers may become contaminated when contaminated water percolates from the land surface.

Those factors determining the suitability of water for a particular use are the quality of the water and the limitations imposed by the use. Important criteria used in establishing limitations are bacterial content, temperature, color, taste, odor, and concentration of chemical constituents in the water. Pesticides, if present, also may be a factor in limiting use. A general listing of sources and the significance of dissolved mineral constituents and properties are presented in table 8 (supplemental information).

Wells in Rusk County for which water-quality data are available are listed in table 1. Results of these analyses, showing the source and amount of dissolved constituents are listed in table 4a. Data for certain metals and trace elements are listed in table 4b. The analyses included those made by the Geological Survey, other government agencies, and commercial laboratories.

Three samples of ground water were analyzed for pesticides. Water from springs WR-35-57-403 (Big Springs) and WR-37-02-904 (Sulfur Springs) and from well WR-37-03-202 (Mount Enterprise) was analyzed for 28 insecticides and herbicides. None of these water samples contained pesticides in excess of the suggested limits.

For many purposes, the dissolved-solids concentration places a major limitation on the use of ground water. A general classification of water based on the dissolved-solids concentration is as follows (modified after Winslow and Kister, 1956, p. 5):

Description	Dissolved-solids concentration (milligrams per liter)
Fresh	Less than 1,000
Slightly saline	1,000 - 3,000
Moderately saline	3,000 - 10,000
Very saline	10,000 - 35,000
Brine	More than 35,000

Water-Quality Criteria and Standards

The Federal Water Pollution Control Act Amendment of 1972 requires that the U.S. Environmental Protection Agency (EPA) publish criteria accurately reflecting the latest scientific knowledge. The law requires that these criteria consider the kind and extent of all identifiable effects upon health and welfare that may result from the presence of any pollutants. Moreover, these criteria should be set forth for all bodies of water including ground water. During 1973, the Environmental Protection Agency published criteria relating to the protection of human health and desired species of aquatic plants (National Academy of Sciences, National Academy of Engineering, 1973). During 1976, the Environmental Protection Agency revised the earlier rules (U.S. Environmental Protection Agency, 1977a).

The Environmental Protection Agency's "Quality Criteria for Water, 1976," discusses more than 50 constituents commonly occurring in water. It sets the recommended limits, presents the reason for selecting a given criteria, and cites references relating to these standards. Rules for the primary drinking water regulations were published in the Federal Register (U.S. Environmental Protection Agency, 1976) and became effective July 3, 1979. Rules for the National secondary drinking water regulations were published in the Federal Register (U.S. Environmental Protection Agency, 1979) and became effective January 19, 1981. Although concentrations of chemical constituents exceeding the recommended limits are objectionable, these limits may sometimes be changed in areas where suitable water is not otherwise available, provided that health and public welfare are adequately protected (U.S. Environmental Protection Agency, 1979).

Aquifers and Geologic Units

Chemical analyses showing the concentrations of dissolved constituents in water from 158 wells and 2 springs are listed in table 4a. About 68 percent of these wells tap the Wilcox aquifer, 18 percent the Carrizo aquifer, and 1 percent the combined Carrizo and Wilcox aquifers. Another 13 percent tap the basal sands of the Reklaw Formation, which are hydraulically connected to the underlying Carrizo. Electric logs are available for many additional wells and are useful in delineating variation in water salinity.

The dissolved-solids concentrations of water from representative wells from the various units are shown in figure 21. Some of the wells inventoried in previous investigations could be relocated only approximately.

Chemical quality of ground water based on electric logs indicates that sand containing slightly saline water sometimes overlies freshwater sands. In places, even the shallow sands yield slightly mineralized water. Water from 28 shallow wells less than 75 feet (23 m) deep, had concentrations of more than 1,000 mg/L (milligrams per liter) dissolved solids according to Lyle (1937, p. 72-86). Water from nine of these wells had dissolved-solids concentrations exceeding 3,000 mg/L. Partial analyses of water from two of these wells, WR-35-57-803 and WR-35-60-701, are listed in table 4a.

Midway Group

Some electric logs indicate that slightly saline water occasionally is present in a sand about 100 feet (30 m) below the top of the Midway. Where this occurs, the base of slightly saline water is picked at the base of this unit. The presence of this sand also is noted by the Texas Department of Water Resources, which may require use of surface casing to protect the sand from contamination by oil and gas production. The Midway, however, does not yield water to wells in Rusk County.

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Wilcox Aquifer

Water from 107 wells tapping the Wilcox generally was of a sodium bicarbonate type. A calcium magnesium chloride sulfate type of water occurs in several shallow wells (generally less than 300 feet or 91 m deep), such as WR-35-51-903 and WR-35-52-701. Both types of water in the Wilcox are described in Rusk County by Henry, Basciano, and Duex (1980).

Concentrations of dissolved solids in the 107 samples analyzed ranged from 49 mg/L (in a 200-foot or 61-m deep well) to 3,430 mg/L in one well tapping a basal Wilcox sand. Only eight samples exceeded concentrations of 1,000 mg/L dissolved solids. The electric logs shown in the cross sections (figs. 10-12) also indicate that some of the sand beds in the lower part of the Wilcox aquifer contain better quality water than the overlying beds. One example of water-quality zonation in the Wilcox aquifer is illustrated at WR-35-50-804, a test hole drilled for the city of Henderson in 1942. Analyses of water from the well show:

Interval sampled (feet)	Dissolved-solids concentration (milligrams per liter)
246-257	292
493-504	1,116
600-611	945
683-694	795

Analyses of water samples collected from well WR-35-50-801, owned by the city of Henderson, show that dissolved-solids concentrations increased from 249 to 328 mg/L between 1941 and 1983. This well is located between the cone of depression at Henderson and Henderson Oil Field. It is also only half a mile due east of well WR-35-50-804.

Carrizo Aquifer

Water from each of 31 wells and springs in the Carrizo was analyzed. Most of the wells were less than 100 feet (30 m) deep. The water usually was of a calcium magnesium chloride sulfate type, although sodium and bicarbonate ions were predominant in a few analyses. Only three samples exceeded 1,000 mg/L dissolved-solids concentration.

Spring WR-35-57-406 (Big Springs), once used for public supply, issues from the Carrizo Sand. Water from the spring contained 60 µg/L (micrograms per liter) of chromium and 28 µg/L of lead (see table 4b). The concentration of chromium exceeds the recommended limit of 50 µg/L for public supply use. In 1983, water from Big Springs was reported to be used by some local residents for washing automobiles.

Analyses of water from well WR-35-41-703, tapping the Carrizo-Wilcox, show that the concentration of dissolved solids has increased from 140 to 546 µg/L between 1941 and 1983. This city of Overton well is located along the west side of East Texas Oil Field near the source of Bowles Creek.

Other Aquifers and Geologic Units

Only one analysis of water from a well tapping the Queen City is listed in table 4a, and the analysis may or may not be representative of water in the aquifer. No analyses of water from the Sparta Sand are included in this report.

Results of analyses of water from 15 wells tapping the Reklaw Formation are listed. Water from two of these wells contained more than 1,000 mg/L dissolved solids. Two of these wells yielded water with relatively high sulfate concentrations. Analyses also are included in table 4a for two samples collected from wells tapping unknown water-bearing sands.

Contamination and Protection of Ground Water

Rusk County is a substantial, but declining oil-producing county. During 1980, it produced 14,900,000 barrels (2,370,000 m^3) of oil, down from about 21,164,311 barrels (3,365,000 m^3) of oil during 1973. Much of this crude was withdrawn from the East Texas Oil Field, which had a cumulative production of 4.622 billion barrels (734,900,000 m^3) of oil through 1980. The number of producing wells peaked at 25,987 during November 1939 according to the Railroad Commission of Texas. According to the East Texas Salt Water Disposal Company (1958), by January 1, 1958, 29,806 wells had been drilled in the field. At that time there were 19,684 producing wells.

During 1981, pressure-maintenance programs used fresh and slightly saline water from the Wilcox aquifer for oilfield water flooding at a number of oil fields in the area. These include the following fields as shown in figure 5 (and pay zones): East Texas (Woodbine), Pone (basal Pettit), Shiloh (upper Pettit), Tatum (Pettit and lower Pettit), Henderson (Pettit and Travis Peak), and East Henderson (Travis Peak).

Surface Casing

An act of the Texas Legislature, passed in 1899, requires that oil and gas wells be cased to prevent ground water above the producing zone from entering oil and gas wells. Later, acts of 1919, 1931, 1932, and 1935, gave broad powers to the Railroad Commission to prevent oil, gas, and water from escaping from the original strata in which they are confined into another strata.

Originally, the Railroad Commission determined where surface casing should be set. Later, the Texas Department of Water Resources and its predecessors was given the authority to make recommendations concerning the protection of usable water. Water containing dissolved-solids concentrations of less than 3,000 mg/L is recommended for protection by use of surface casing or cement. Recommendation for protection of more highly mineralized water may be made if the water is being used for beneficial purposes.

The depth to the base of sands containing fresh to slightly saline water (in those fields for which field rules exist) and the amount of required cemented surface casing, according to published rules of the Railroad Commission of Texas are shown in figure 22. A recent statewide ruling of the Railroad Commission of Texas in June 1979 relating to the drilling, producing, and

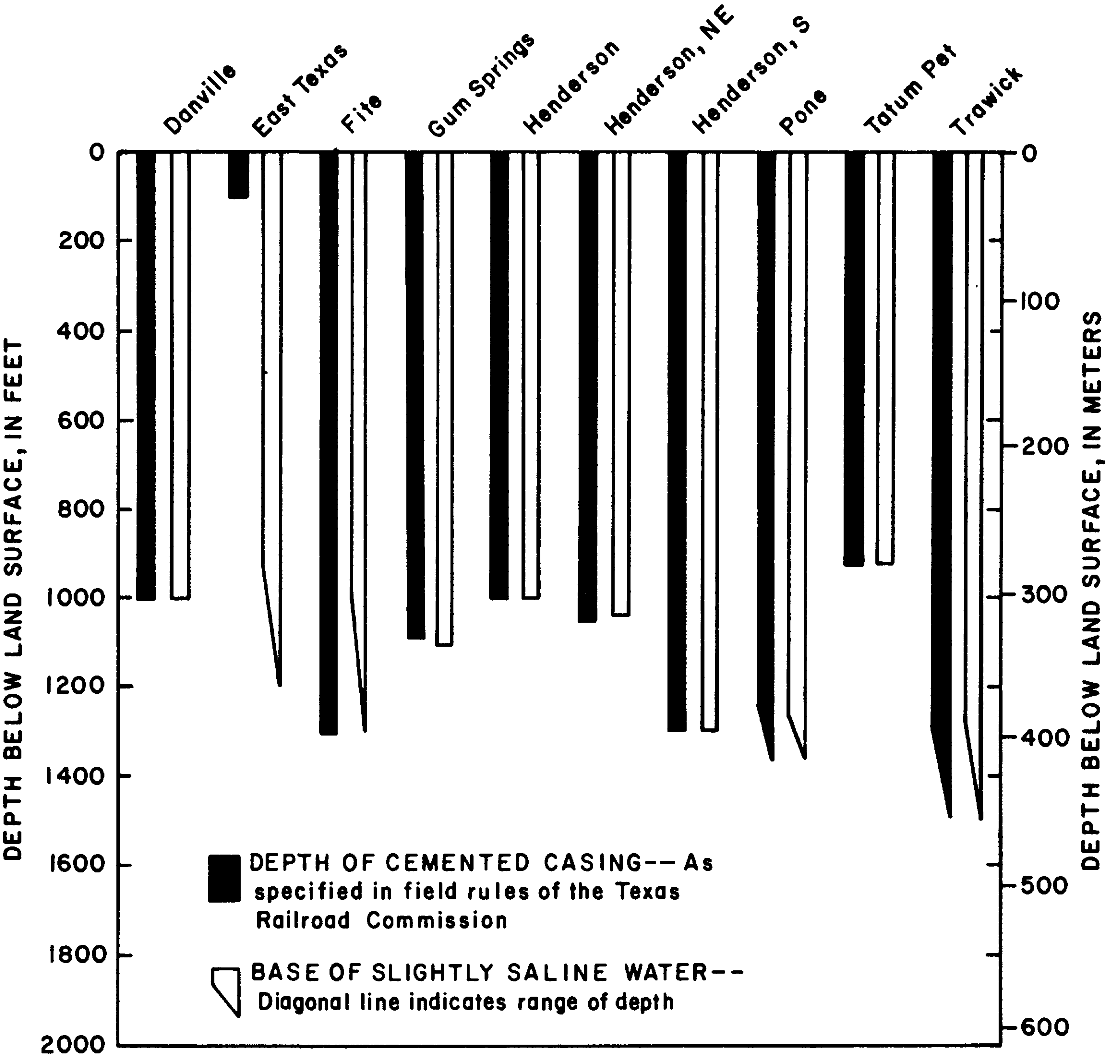

Figure 22.-Relationship between surface-casing requirements and the base of fresh to slightly saline water, Rusk County

plugging of any oil, gas, or geothermal well requires the protection of usable water both above and below the surface. Also, the Texas Department of Water Resources requires that all fresh and slightly saline water sands be protected. However, according to the original field rules in 1932 for East Texas (Woodbine) Oil Field, the base of usable water is not adequately protected.

Disposal of Saltwater

Considerable amounts of brine are produced in Rusk County in connection with the production of oil. If mishandled in improperly cased or plugged oil wells or tests holes, these brines can move upward from the underlying higher pressured saltwater-bearing formations into zones of fresh and slightly saline water. To prevent this, the Railroad Commission requires that brine be disposed of in ways that will not contaminate freshwater.

Between January 1, 1969, (when the Railroad Commission established a rule prohibiting the use of open pits for disposal of oilfield brine) and 1981, nearly all of the brine produced in Rusk County was disposed of through injection wells. Currently (1982), this is particularly true in the area around East Texas Oil Field where the additional water is needed to maintain reservoir pressure for secondary recovery.

Large quantities of saltwater have been produced from East Texas Oil Field. During some years, the production of saltwater almost equaled the production of oil. The amounts (daily average) of saltwater that were produced, injected, and otherwise diverted for selected years are shown in table 9.

A study of saltwater disposal (Railroad Commission of Texas, 1952, p. 91) showed that during October 1935, East Texas Oil Field had been producing about 15,000 barrels (2,385 m^3) of saltwater per day. By 1938, water production had increased to about 100,000 barrels (15,900 m^3) per day. During this period, saltwater was pumped into natural drainage systems. Saltwater was first reinjected into the subsurface during June 1938. By 1942, saltwater production had increased to 439,000 barrels (69,800 m^3) per day. This was equivalent to about 18.44 Mgal/d (69,800 m^3/d), of which 18.4 percent was being reinjected into the producing Woodbine sands. About 15 Mgal/d (56,780 m^3/d) was being otherwise diverted, probably into surface pits and into the natural drainage system.

During 1961, the total brine production for East Texas Oil Field was estimated to be 155,193,391 barrels (24,675,000 m^3). About 99 percent was disposed of through injection wells. About 0.2 percent, 0.4 Mgal/d (1,500 m^3/d) was disposed of through open surface pits, while another 0.7 percent, 0.12 Mgal/d (450 m^3/d) was disposed of by unknown methods. (See Texas Water Commission and the Texas Water Pollution Control Board, 1963.)

Contamination

One case of oilfield brine contamination has been documented at Henderson Field in Rusk County by Burnitt (1963). Contamination was found in an 85-foot (140-m) deep water well (WR-35-50-204) and at three stream sites along the Beaver Run and Cherokee Bayou drainage areas. Leakage occurred from unlined

Table 9.--Saltwater production and disposal, East Texas Oil Field

(Figures modified from East Texas Salt Water Disposal Co., 1958, and Texas Water Commission and Texas Water Pollution Control Board, 1963)

Year	Saltwater produced (daily average)		Saltwater injected (daily average)		Saltwater otherwise diverted (daily average)	
	Barrels	Million gallons	Barrels	Million gallons	Barrels	Million gallons
1935	15,000	0.63	0	0	15,000	0.63
1938	100,000	4.20	610	.03	100,000	4.17
1942	439,000	18.44	81,000	3.40	358,000	15.04
1950	643,000	27.00	466,000	19.57	177,000	7.43
1961	433,000	18.19	429,000	18.02	4,000	0.17

NOTE: Figures may vary slightly due to rounding procedures.

surface pits, formerly used for storing oilfield brines. Analyses of water collected from the contaminated well show relatively high amounts of calcium, sodium, chloride, and total dissolved solids, and a relatively low pH. The first sample was collected after 1 minute of pumping; the second sample after 5 hours of pumping. During this period, the total dissolved solids increased from 1,870 to 2,475 mg/L; the pH declined from 6.5 to 5.6. Water collected from one stream site contained 50 mg/L of dissolved solids. Water collected from the three contaminated stream sites had dissolved-solids concentrations of 116,880, 6,684, and 6,609 mg/L.

Hughes and Leifeste (1967) completed a reconnaissance of water quality of surface water in the Neches River basin. Their study includes data on Striker Creek Lake and the Striker Creek drainage basin, which also includes the Bowles Creek watershed. Water samples were collected during low flows from 24 sites in the Striker Creek basin during March and June 1964. Hughes and Leifeste (1967, p. A21) reported that some earthen pits were still used to store oilfield brine. They also observed oil wastes along the banks of water courses, which indicated that there had been brine spills. "In addition to deliberate dumping," reported Hughes and Leifeste, "brine also reaches streams as a result of leaks in collection systems, breaks in pipelines, overflow of storage tanks, and other accidents incidental to the handling of large volumes of waste water." The following are conclusions they reached:

1. Bowles Creek and its tributaries are the source of most of the salinity;
2. Many streams carry acid water with the pH as low as 3.2;
3. Sodium and chloride are the principal dissolved constituents;
4. Sulfate concentrations generally are low throughout the area;
5. Where acid water occurs outside the oilfield area, sulfate is the principal anion; and
6. High chloride water was not found outside the oilfield area.

DEVELOPMENT AND USE OF GROUND WATER

History of Development

Prior to about 1920, nearly all the water used in Rusk County came from shallow wells dug into the Wilcox and Carrizo aquifers. Numerous springs (there may be as many as several hundred) also provide water throughout much of the area. Brune (1981, p. 390-394) in "Springs of Texas" lists 43 springs of historical interest. Many of these are located along the Mount Enterprise Fault Zone. Stockman Springs (WR-37-03-403), west of Mount Enterprise, is located along the East Fork of the Angelina River. Brune reports that in 1833, Henry Stockman received a land grant which included the springs now named after him. He also relates that Stockman, along with a yoke of oxen, drowned in the springs. Other springs such as Sulphur Springs (WR-37-02-904) are of similar extent.

The discovery of East Texas Oil Field in 1930 created an immediate demand for water to be used for industrial purposes. Almost all of this withdrawal was from the Carrizo and Wilcox aquifers. Turner (1932, p. 6) estimated that about 16.2 Mgal/d (61,317 m^3/d) was being withdrawn for oilfield operations in Rusk and Gregg Counties. The cities of Kilgore (Gregg and Rusk Counties) and Longview (Gregg County) at first used water from the Sabine River. By 1934, concentrations of oilfield brines and industrial wastes became so high during low flow in the Sabine River that these cities located other sources of drinking water. For a while Longview diverted creek water for drinking, but now (1982) uses water from Lake Cherokee (Rusk and Gregg Counties). Kilgore withdraws ground water from well fields in Smith County.

When Lyle (1937) inventoried 406 wells in Rusk County, only 15 were classified as industrial, 8 as public supply, and 16 as "oilfield" use. Most of the larger-capacity wells were concentrated around East Texas Oil Field and the city of Henderson. Elsewhere, shallow-dug wells were used for domestic and stock purposes.

Much of the industrial use of ground water is related to the production of oil and gas with most of the withdrawals concentrated in East Texas Oil Field. Follett (1943) inventoried those industrial wells in the northwestern part of the county. During 1981, water levels were measured in some of the same wells he visited.

Shallow wells continued to be used rather extensively in the area until the late 1960's and early 1970's. By then, a number of rural water-supply corporations were organized under the auspices of the Farmers Home Administration. During 1981, there were 24 active water-supply corporations serving residents of Rusk County. These systems, together with the municipalities of Henderson, Overton, New London, and Tatum, supply about 90 percent of the water used for domestic and stock purposes.

Use of Water

Withdrawals of ground water during 1960, 1970, and 1980 are summarized by use in table 10. During 1980, all significant withdrawals of ground water, about 4.6 Mgal/d (17,411 m^3/d), were from the Wilcox aquifer. Of this amount, about 94 percent was freshwater. Numerous springs, creeks, and ponds supply the water needs for livestock. Surface water is used for some public supply and industrial purposes. The Elderville Water-Supply Corporation obtains water from Lake Cherokee through the City of Longview; Texas Utilities Generating Company uses Martin Lake as a source of cooling water at their generating plant.

Municipal Use

Estimates of municipal use of ground water are listed in table 11. Of the 4.20 Mgal/d (15,900 m^3/d) of ground water used for public supply, 3.23 Mgal/d (12,230 m^3/d) of water was used by the five municipalities listed in table 11. The City of Henderson, the largest single user, pumped 2.05 Mgal/d (7.760 m^3/d) of ground water from the Wilcox during 1980. The average per capita consumption of ground water from the five largest communities was 190 gal/d (0.7 m^3/d). The 24 rural water-supply corporations serving the smaller communities furnished about 0.97 Mgal/d (3,670 m^3/d) or about 23 percent of the water used for public supply during 1980. The approximate area served by all 29 public water-supply systems in Rusk County is shown in figure 23. Elderville Water Supply Corporation, which uses surface water from Lake Cherokee, is the only public supply system that does not use ground water.

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Table 10.--Approximate withdrawals of ground water during 1960, 1970, and 1980 in Rusk County

(Mgal/d, million gallons per day; acre-ft, acre-feet)

Use	1960		1970		1980	
	Mgal/d	Acre-ft	Mgal/d	Acre-ft	Mgal/d	Acre-ft
Industrial	1.20	1,344	1.15	1,288	0.50	504
Mining1/	--	--	.04	45	.55	616
Public supply	1.40	1,568	2.25	2,520	4.20	4,705
Rural domestic	.50	560	.08	90	.15	224
Totals	3.10	3,472	3.52	3,943	5.40	6,049

1/ Includes slightly saline water.

Table 11.--Municipal use of ground water in Rusk County

Municipality	1980 Population	1980 Per capita consumption (gallons)	1942	1943	1970	1980
			(million gallons per day)			
Henderson	11,473	178	0.36	1/0.38	1.27	2.05
Mount Enterprise	485	365	--	--	.07	.18
New London	942	400	--	--	.22	.38
Overton	2,430	178	1/.20	2/.20	.29	.43
Tatum	1,614	120	--	.01	--	.19
Totals	16,944	3/190	0.56	0.59	1.85	3.23

1/ November and December estimated on 1941 basis.
2/ Estimated.
3/ Average per capita consumption.

NOTE: Some figures may vary slightly due to rounding.

Industrial Use

Industrial use during 1980 was estimated to be about 0.50 Mgal/d (1,892 m^3/d), a decline of more than 50 percent from 1970. Nearly all of the industrial use is for cooling at gasoline plants and refineries. Increased energy costs have caused some operators to replace ground water with more economical sources of cooling, such as air and liquid hydrocarbons. Other industrial users have abandoned their wells and now obtain water from public-supply sources.

Mining Use

Withdrawals of water for mining (fuels) are reported to the Railroad Commission of Texas. During 1980, about 0.550 Mgal/d (2,082 m^3/d) of water was withdrawn from the Wilcox aquifer for pressure maintenance. One example of such a project, Mobil's T. O. Mason lease, is pictured in figure 24. Here, slightly saline water from the Wilcox is treated and mixed with produced brine from the Woodbine. This fluid is then injected underground in secondary recovery of oil at East Texas Oil Field. Pressure maintenance operations (water flooding) are or have been underway at eight oilfield sites in East Texas, two in Tatum, one in Henderson, one in South Henderson, one in Pone, and one in Shiloh.

Changes in Water Levels

Most water levels in Rusk County were measured during three periods: During 1936, between 1937 and 1940, and from about 1972 through 1981. Most of the observation wells before 1972 were concentrated near the city of Henderson. During 1972, the Texas Department of Water Resources initiated a network of observation wells that included the entire county. Practically no water-level data are available prior to the discovery of East Texas Oil Field in 1930.

Water-level measurements (three or less) are listed in the records of wells, springs, and test holes (table 1). Other measurements (four or more) are tabulated in the list of water levels in wells (table 3). Hydrographs depicting water-level fluctuations in selected wells are shown in figure 25.

Many of the water levels measured are in wells that show no particular change. These water levels rise and fall due to changes in season and variations in rainfall. Sustained long-term declines in water levels are evident in two places, near the city of Henderson and in the area of East Texas Oil Field. In both areas there is a concentration of wells producing an average of over a million gallons per day. Most of the wells withdraw water from the middle and lower Wilcox sands.

At the city of Henderson, a moderate cone of depression (fig. 18) has resulted from ground-water withdrawals of about 2.0 Mgal/d (7,570 m^3/d). The water level in well WR-35-50-901, near Henderson, declined about 134 feet (41 m) between 1935 and 1981 (fig. 25).

Water levels in well WR-35-41-703 declined 29 feet (9 m) between 1941 and 1979; water levels in well WR-35-41-901 declined about 17 feet (5 m) between 1949 and 1981; and water levels in well WR-35-49-702 declined 67 feet (20 m)

Figure 24.-Water-storage tank at Mobil's T.O. Mason pressure-maintenance project in East Texas Oil Field

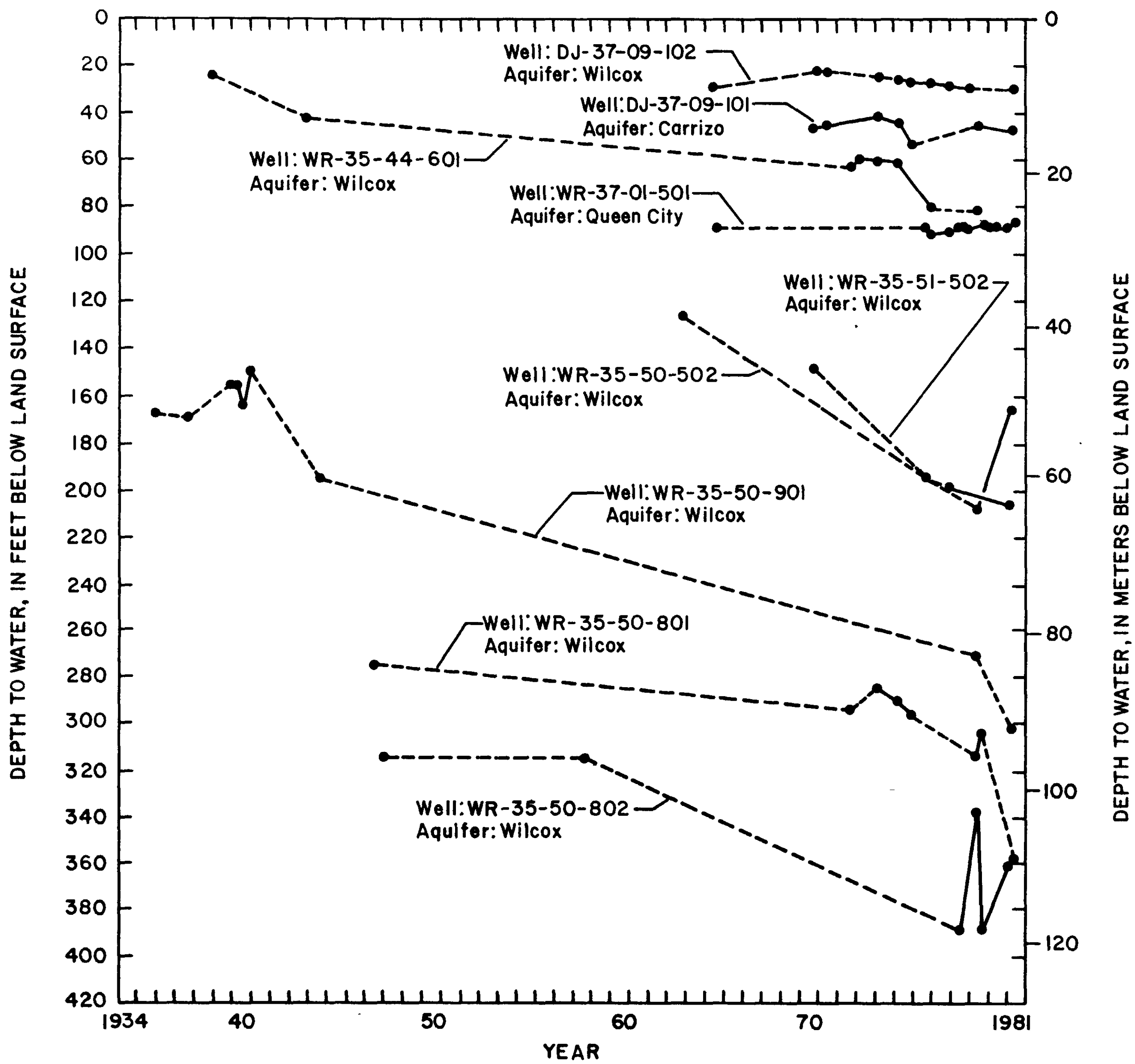

Figure 25.-Fluctuations of water levels in selected wells in Rusk and Cherokee Counties

between 1938 and 1979. However, not all water levels in Rusk County declined. The water level in well WR-35-41-501 rose 43 feet (13 m) between 1947 and 1979. The water level in well WR-35-44-601, tapping the Wilcox, declined about 54 feet (16 m) between 1938 and 1979. Elsewhere in Rusk County, water levels in most wells have not declined appreciably. For example, the water level in well WR-37-01-501 (fig. 25), tapping the Queen City, shows no long-term change.

Well Construction

Well construction depends on several factors such as the desired capacity of the well, intended use, allowable cost, methods of drilling, and quality of the water desired. Some information on the well construction used in the county is tabulated in table 1. Except for shallow-dug wells, wells are cased and have slotted screen opposite water-bearing sands.

Large-capacity wells such as those used for industrial and municipal supply are drilled by hydraulic rotary methods. First, a test hole (usually 6 inches or 152 mm in diameter) is drilled to total depth and logged for thickness of sand intervals. Water samples are collected to determine water quality in the different sands. If the data indicate that sufficient quantities of suitable quality water can be developed, a well is constructed. Test drilling is necessary in much of Rusk County, but particularly in the Mount Enterprise Fault Zone or in areas where the Wilcox sands contain water that varies in quality.

In a typical large-capacity well, the upper part of the test hole usually is reamed to 14-20 inches (355-510 mm) in diameter. A slightly smaller surface casing is set and cemented in place to form the pump pit or housing. The remaining part of the test hole is then reamed to a diameter slightly less than that of the surface casing. The interval to be screened is then underreamed as desired, usually to 30 inches (760 mm) in diameter, and 8-12 inch (205-305 mm) diameter wire-wrapped screens and blank casing are installed. Next, the annular space between the screen or casing and the wall of the hole is filled with sorted gravel. This gravel pack stabilizes the hole and effectively increases the diameter of the well. Large-capacity wells are developed and tested with large-capacity pumps. The wells then are fitted with deep-well turbine pumps, usually powered by electric motors. Porperly constructed wells in the Wilcox or Carrizo aquifers yield about 500 gal/min (32 L/s).

Most of the drilled wells used for stock and domestic purposes in Rusk County have 2- to 4-inch (51- to 102-mm) casing. Generally, jet pumps are used for the smaller-diameter wells if the water level is near the surface, and submersible pumps are used in the deeper 4-inch (102-mm) wells. Plastic (PVC) casing is often used due to its lower cost and ability to resist corrosion from water having a low pH or high iron content. Often the 4-inch (102-mm) wells are completed with a smaller-diameter single screen placed at the bottom of the well. Sometimes a wire-wrapped screen is used. More frequently, however, the last joint of pipe is slotted or perforated and possibly gravel packed.

AVAILABILITY OF GROUND WATER

Some freshwater is available from every formation above the Midway Group. Only the Carrizo and Wilcox aquifers, however, are capable of producing substantial quantities of water. The Sparta and Queen City Sands, as previously mentioned, are limited in thickness and extent and only rarely are tapped by large wells in Rusk County. Although basal sands of the Reklaw furnish some water, they are hydraulically connected with the underlying Carrizo and should not be considered a source of water apart from the Carrizo. Moreover, the Reklaw, Queen City, Weches, and Sparta also overlie the Carrizo and Wilcox aquifers. Consequently, there is almost always a higher-yielding, but deeper, source of ground water available from the Carrizo and Wilcox sands.

It is not known if the current level of freshwater withdrawal will be maintained for the foreseeable future. If it is, a continued but moderate lowering of the potentometric surface is expected. With withdrawal of ground water, the lowering of water levels continues until the area of influence from the well fields becomes large enough so that the recharge equals the discharge. While water levels are lowered, water is taken from storage. The potentiometric surface of the Wilcox aquifer (fig. 18) indicates that the area of influence already extends past the Rusk County line. There are not sufficient withdrawal or water-level data to determine if the general water-level declines shown in figure 25 will continue permanently because of continued increases in pumpage or only be temporary because of recent increases in pumpage. Data are insufficient to construct a water-level decline map for Rusk County.

In the case of the Wilcox and Carrizo aquifers in Rusk County, the recharge may be effectively increasing as the water levels are drawn down. Additional drawdown causes an increase in the head differences between the water table, which is expected to remain reasonably stable, and the potentiometric surface of the major water-bearing zones. Thus, the vertical hydraulic gradient is increased, thereby proportionally increasing the vertical leakage or movement of water.

One unknown aspect of continuing or increasing the ground-water withdrawals from the Wilcox is the possibility of increasing the water's salinity. As the water levels are lowered, water movement from nearby zones occurs. If these zones contain water of a higher salinity, the dissolved-solids concentrations in the major freshwater zones would be expected to eventually increase.

Wilcox and Carrizo Aquifers

Fresh to slightly saline water is available from the Wilcox aquifer throughout the entire 939 square miles (2,432 km^2) of Rusk County. The average thickness of sand in the Wilcox containing freshwater in Rusk County is about 245 feet (75 m). Based upon a porosity of 30 percent, the Wilcox contains about 40 million acre-feet (49,300 hm^3) of water; however, it is economically impractical to recover more than a small percentage of this water. Assuming a specific yield of 0.15, about 20 million acre-feet (24,660 hm^3) of water is available from storage. Water in storage is not a good measure of availability in Rusk County because it is not economically practical to recover more than a moderate amount of the total water stored in the aquifer system.

Also, because the slightly saline water-bearing sands are interbedded with the freshwater-bearing sands, chemical quality may be a deterrent to development.

Freshwater is available from the Carrizo wherever it is present in Rusk County. Based on an area of 656 square miles (1,699 km^2), a porosity of 30 percent, and an average sand thickness of 70 feet (21 m), the aquifer contains about 8 million acre-feet (9,864 hm^3) of water. Assuming a specific yield of 0.15 and an overall average sand thickness of 70 feet (21 m), about 4 million acre-feet (4,932 hm^3) of water is available from storage in the Carrizo. The Carrizo is in hydraulic continuity with and serves as an avenue of recharge to the Wilcox throughout much of Rusk County.

Moderate amounts of ground water are available for development. The amount that is available perennially is not known, but is greater than that being withdrawn. Assuming a pre-development hydraulic gradient of about 8 ft/mi (1.5 m/km), a hydraulic conductivity of 14 ft/d (4.3 m/d), and an average freshwater sand thickness of 245 feet (74.7 m), at least 12 Mgal/d (45,420 m^3/d) of fresh ground water is being transmitted through the Wilcox and about 3 Mgal/d (11,350 m^3/d) through the Carrizo.

Other Aquifers

The Queen City aquifer, present in about 10 percent of the county, is practically undeveloped. Maximum thickness of the Queen City is about 132 feet (40 m). The aquifer is capable of producing ample supplies of ground water for stock and domestic use. The Sparta Sand aquifer, which only occurs locally in the vicinity of the Mount Enterprise Fault system, is practically undeveloped. Because of their limited extent and near-surface occurrence, neither the Sparta nor Queen City is an important aquifer in Rusk County.

Areas Most Favorable for Future Development

Areas most favorable for future development of ground water are shown in figure 26. These areas have been designated as follows: I, most favorable; II, favorable; III, moderately favorable; IV, moderately unfavorable; and V, most unfavorable.

Representative criteria useful in classifying the favorability of areas for additional freshwater development include: 1, hydraulic conductivity; 2, average thickness of freshwater-bearing sands; 3, amount of ground water being withdrawn; 4, thickness or amount of slightly saline water-bearing sands interbedded with freshwater sands; 5, possible effects of faulting; and 6, possibility of freshwater sands being mineralized by oilfield brines.

The most favorable region for future development, shown as area I in figure 26, is located in southwestern Rusk County. The area has one of the thicker sections of freshwater-bearing Wilcox sands, and the Carrizo is present in about 95 percent of the area. Also no significant ground-water withdrawals occur in the area.

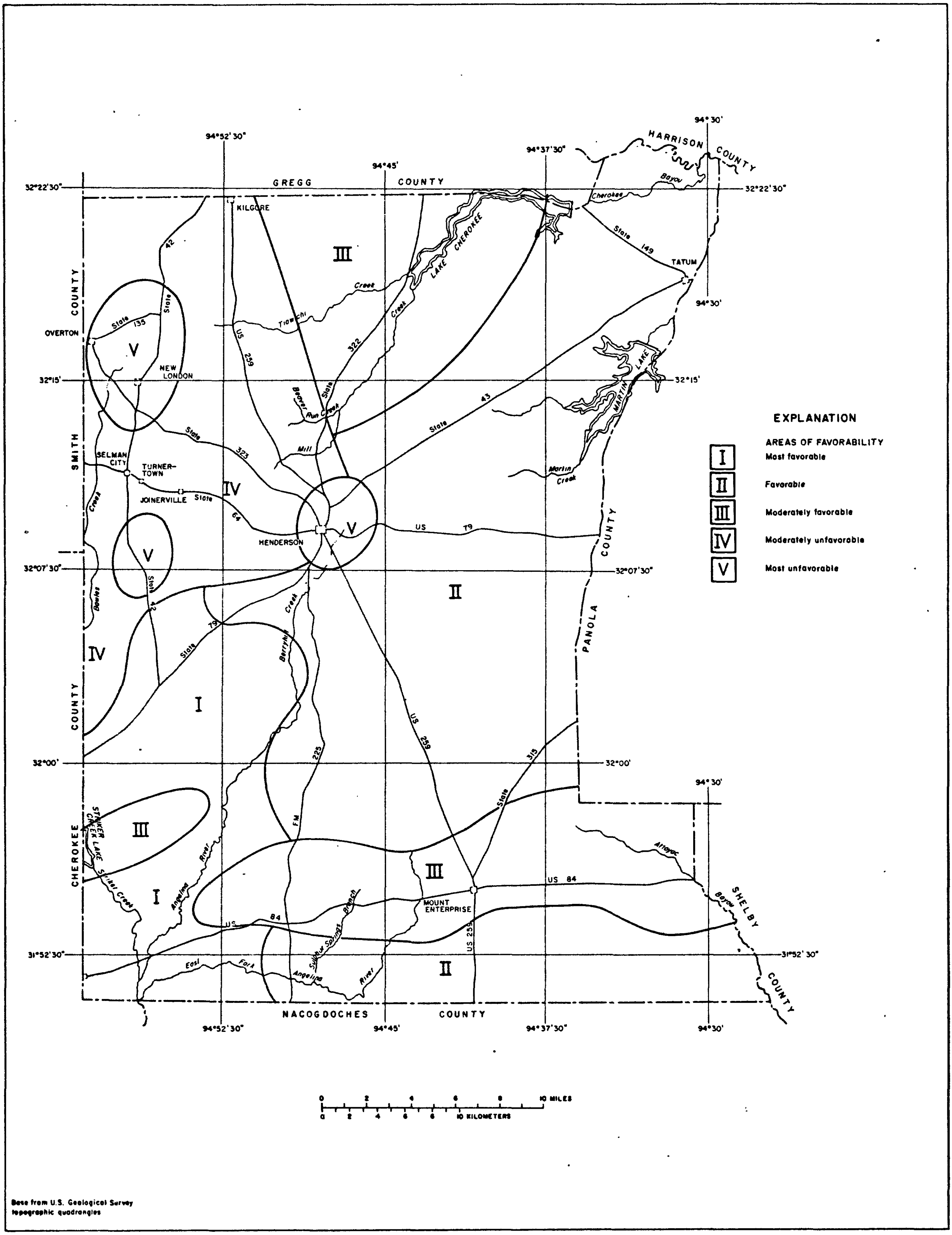

Figure 26.-Locations of areas favorable for future development of ground water

Two favorable areas, shown as area II, are present. One lies in the east-central part of the county east of Henderson and another is present south of the Mount Enterprise Fault System. Although some Carrizo crops out on the surface in both areas, the largest ground-water supplies could be developed from the Wilcox aquifer.

Three moderately favorable areas, shown as area III, are present. Two of these areas are located in the southern section of the county and are associated with the Mount Enterprise Fault System. Outliers of both the Queen City and Sparta are preserved in the downdropped blocks of the system. Consequently, these are the places where the most complete geologic section is developed. Although there could be considerable amounts of available freshwater in this area, development of individual wells should be considered carefully because faulting may have interrupted the lateral continuity of a producing zone. The other moderately favorable area is located in the north-central part of the county where the freshwater-bearing Wilcox sands are relatively thin.

The moderately unfavorable area, shown as area IV, extends from about the city of Henderson northwestward to the county line. The area has experienced a substantial decline in water levels and has encountered some brine pollution.

Three most unfavorable areas, shown as area V, are present. One of the areas, about 30 square miles (78 km^2) near the city of Henderson, accounts for about 40 percent of all ground water withdrawn in the county and may be considered moderately developed. Two other areas are located between Overton and New London and at Price in the area of East Texas Oil Field. This is an area where there are two cones of depression and considerable interfingering of slightly saline water-bearing sands with freshwater sands.

NEEDS FOR CONTINUING DATA COLLECTION

Collection of withdrawal, water-level, and water-quality data in Rusk County should be continued and expanded. During about 1972, the Texas Department of Water Resources initiated a program of measuring water levels and collecting water-quality data in the area. The data-collection program should be continued and could be expanded to include a few wells that tap the deeper Wilcox sands outside of the more heavily pumped areas. Water-quality data also could be collected at Henderson to monitor saltwater encroachment.

A ground-water program to investigate contamination of freshwater sands by oilfield brines could be initiated in the East Texas and Henderson Oil Fields. Emphasis of such a program should be placed on investigating the deeper sands of the Wilcox as well as the shallow sands in areas of recharge.

CONCLUSIONS

The Wilcox aquifer is the major source of ground water in Rusk County. It yields both fresh and slightly saline water. Water can also be obtained from the Carrizo, Queen City,and Sparta aquifers and from the Reklaw Formation. The Carrizo, the most extensive of the other sources, is in hydrologic continuity with the underlying Wilcox.

Numerous facies changes are present within the Wilcox, which consists of thin but sometimes massive beds of fine to coarse grained sand, silt, and clay. The aquifer ranges in thickness from about 750 feet (229 m) to more than 1,200 feet (366 m). The Wilcox is the only freshwater-bearing unit that is present throughout all of Rusk Conty. No freshwater occurs below the base of the Wilcox. In places, however, slightly saline water-bearing beds are interbedded with and sometimes overlie freshwater-bearing sands. Although some of these relationships are natural, others may result from the mineralization of water by oilfield brines.

Daily withdrawal of ground water for all purposes increased from 3.1 Mgal/d (11,750 m^3/d) during 1960 to 5.4 Mgal/d (20,450 m^3/d) during 1980. Daily withdrawal for municipal purposes has increased from 1.4 Mgal/d (5,300 m^3/d) during 1960 to 4.2 Mgal/d (15,900 m^3/d) during 1980. About half of the municipal and about 38 percent of the total ground-water withdrawal (1980) is from a small area around the city of Henderson. Consequently, water levels at Henderson have declined about 135 feet (41 m) or an average of about 2.9 feet (0.9 m) per year between 1935 and 1981.

Additional supplies of fresh ground water can be developed throughout nearly all of Rusk County. About 20 million acre-feet (24,660 hm^3) of freshwater is available from storage, and a total of 12 Mgal/d (46,650 m^3/d) is being transmitted through the Wilcox aquifer. Slightly saline water also is available from the Wilcox aquifer. About 4 million acre-feet (4,932 hm^3) of freshwater is available from storage, and a total of about 3 Mgal/d (11,200 m^3/d) is being transmitted through the Carrizo aquifer. Wells that are properly constructed should yield about 500 gal/min (32 L/s) from the Wilcox and possibly the Carrizo aquifers; a few wells have been constructed that yield as much as 1,000 gal/min (63 L/s).

Much of the variation in the quality of the ground water in the Wilcox aquifer is natural. Three areas in which variations are likely to occur are near the city of Henderson, in the East Texas Oil Field, and along the Mount Enterprise Fault System. Because drastic water-quality changes occur between zones, it is essential that the water from each sand be analyzed during a test-drilling operation to make certain that it is of acceptable quality.

Poor-quality ground water occurs in the vicinity of the city of Henderson. The withdrawal of 2.05 Mgal/d (7,760 m^3/d) of ground water from the Wilcox during 1980 created a cone of depression into which the poor-quality water could migrate.

Ground water has been contaminated by oilfield brine at Henderson field. In addition, oilfield brine has contaminated Bowles Creek and Beaver Run Creek in two separate instances.

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SUPPLEMENTAL INFORMATION

Table 1.--Records of wells, springs, and test holes in Rusk County and adjacent areas
(gal/min - gallons per minute; Mgal/d - million gallons per day; mg/L - milligrams per liter; °C - degrees Celsius)

Water-bearing unit: Tc - Carrizo aquifer; Tcw - Carrizo-Wilcox aquifer; Tq - Queen City aquifer; Tr - Reklaw Formation; Twi - Wilcox aquifer; Qal - alluvium.
Water levels: Reported water levels listed in feet, measured levels in feet and tenths; F - flows, head unknown.
Method of lift: A - air; E - electric motor; J - jet; N - none; S - submergible; T - turbine. Numbers indicate horsepower.
Use of water: D - domestic; C - commercial; Ind - industrial; Irr - irrigation; P - public supply; S - stock; U - unused; WF - waterflood.

Well	Owner or name	Driller	Date completed	Depth of well (feet)	Casing: Diameter (inches)	Casing: Depth (feet)	Water bearing unit	Altitude of land surface (feet)	Water levels: Above (+) or below land surface (feet)	Water levels: Date of measurement	Method of lift	Use of water	Remarks
Rusk County													
WR-35-41-101	W. P. Moore	--	--	35	--	--	Tq	440	22.5	6- 9-36	N	U	--
102	John Lipe	Key Drilling Co.	1981	273	4	273	Tc	465	198.6	7-16-81	SE,0.75	D	--
201	Exxon Peterson No. 2	W. B. Hamilton	1934	835	--	--	Twi	330	80.3	10-16-41	N	U	--
202	M. R. Terrell	Walt Loftus	1934	435	--	--	Twi	420	36	6-10-36	N	U	1/
304	White Oak Water Supply Corp.	Layne-Texas Co.	1937	444	16 10 3/4 8 5/8	300 337 444	Twi	470	230 230	5-29-37 5- 5-39	TE	P	Screened 340-440 feet. Reported drawdown 72 feet after pumping 300 gal/min for 24 hours when drilled for Gulf Oil Co. as M. E. Peterson No. 3. 1/2/
305	Exxon (Humble) No. 9 Ben Peterson	Exxon (Humble)	1949	3,655	--	--	--	400	--	--	--	--	Oil test used in cross section 3/
306	Exxon No. 1 Peterson	Benson	1931	448	6 4 1/2	404 448	Twi	395	--	--	TE	U	Screened 397-446 feet.
307	Star Bailey School	--	1937	25	72	--	Tr	450	7.5	1-21-42	N	U	1/
308	Magnolia Dick Wells	Layne-Texas Co.	1931	862	12 1/2 6	318 862	Twi	445	190	1931	N	U	Screened 378-445, 740-762, and 775-797 feet. Reported drawdown 97 feet after pumping 293 gal/min when drilled. Drilled to 1,009 feet, plugged back to 862 feet. 1/
309	Humble No. 2 B. F. Laird lease "A"	do.	1940	889	8 5/8	889	Twi	475	269	3- -40	--	--	Screened 319-342, 385-407, 429-452, 730-752, and 841-872 feet; underreamed and gravel packed. Reported drawdown 96 feet after pumping 182 gal/min when drilled. 1/
401	T. H. Beall	G. H. McAfee	--	27	--	--	Tr	380	21.0	6-15-36	N	U	1/
501	Leveretts Chapel School	Layne-Texas Co.	1947	449	10 3/4 6 5/8	175 449	Twi	478	222 179.0 178.4	3- 7-47 5- 9-79 3-19-81	TE,15	U	Screened 169-205, 215-227, and 382-447 feet. Reported drawdown 118 feet after pumping 60 gal/min when drilled. 3/4/
502	Leveretts Chapel School No. 2	do.	1955	843	10 3/4 5 1/2	785 843	Twi	482	286 287	8-19-55 5- 9-79	TE,25	P	Screened 796-831 feet. 1/3/
503	White Oak Water Supply Corp.	do.	1949	540	16 8 5/8	347 540	Twi	425	231	11-18-49	--	U	Screened 374-404, 414-424, 434-454, and 489-530 feet. Reported drawdown 46 feet after pumping 229 gal/min for 24 hours when drilled for Gulf Oil Co. as No. 3 C. M. Jernigan. 3/
504	Exxon (Humble) American Gas Plant No. 3	do.	1950	864	12 3/4 7	691 864	Twi	418	244	2-15-50	N	U	Screened 696-701, 716-731, 751-797, and 823-852 feet. Reported drawdown 101 feet after pumping 225 gal/min for 24 hours when drilled. 3/
505	Gulf Pipeline Co.	Benson Drilling Co.	1931	1,033	8 5 3/16	693 1,032	Twi	420	--	--	N	U	Screened 895-1,032 feet. 1/2/

See footnotes at end of table.

Table 1.--Records of wells, springs, and test holes in Rusk County and adjacent areas--Continued

Well	Owner or name	Driller	Date completed	Depth of well (feet)	Casing: Diameter (inches)	Casing: Depth (feet)	Water bearing unit	Altitude of land surface (feet)	Water levels: Above (+) or below land surface (feet)	Water levels: Date of measurement	Method of lift	Use of water	Remarks
WR-35-41-506	Exxon (Humble) H. Sexton A-18	--	1950	3,841	--	--	--	503	--	--	--	--	Oil test used in cross section. 3/
507	Brock Oil Co. Murphy & Roberts	Patterson	1930	900	7	900	Twi	--	144.8	10- 8-41	N	N	1/
508	Rusk Co. Highway R.O.W.	Works Progress Admin.	1936	31	--	--	Tr	--	26	6-15-36	N	N	Works Progress Admin. test hole.
509	Shell Oil Co. W. P. Moore	Layne-Texas Co.	1931	369	12 1/2	269	Tcw	420	50 53.1	1931 10- 6-41	N	N	Screened 165-247 feet. Reported drawdown 65 feet after pumping 490 gal/min when drilled. Drilled to 369 feet, plugged back to 269 feet. 4/
510	W. P. Moore	--	--	33	36	33	Tr	440	13.5 12.9	8-25-37 11-26-40	N	N	Dug well. 4/
601	Maria Redic	Allen Lumber Co.	1969	90	30	90	Tc	440	71.4 69.4	9-21-72 3-19-81	JE,1	D	Dug well. 1/4/
602	TYOPCO Inc. Harvey Unit No. 1	Gibson Drilling Co.	1962	463	--	463	Twi	395	157.0	7-16-81	JE,7.5	WF	--
603	TYOPCO Inc. Harvey Unit No. 2	SW Equipment Co.	1967	648	16	648	Twi	395	127.1	7-16-81	JE,10	WF	--
702	City of Overton No. 4	Layne-Texas Co.	1947	327	18 10 3/4	222 327	Twi	505	135	6-14-47	N	N	Screened 240-303 feet. Reported drawdown 58 feet after pumping 247 gal/min when drilled. 1/
703	City of Overton No. 3	do.	1941	340	20 10 3/4	219 340	Tcw	498	158 186.7	2- -41 5- 9-79	TE	P	Screened 247-288 and 309-330 feet. Reported drawdown 45 feet after pumping 350 gal/min when drilled. 1/
704	Gulf Oil Gas Plant T. B. Cashen No. 3	do	1937	328	16 8 5/8	265 327	Tc	512	179	4- 3-37	N	U	Screened 260-325 feet. Reportedly pumped 220 gal/min when drilled.
705	City of Overton No. 1	do	1931	889	10	887	Twi	489	148.8 141.4	3-19-36 11-26-41	N	U	Screened 247-268, 283-328, 484-505, and 841-863 feet. 1/4/
706	A. O. Alford	Clay Rankin	1932	20	--	--	Tq	480	9	6-11-36	N	U	Dug well.
707	Overton Ice Co.	J. W. Cude	1932	360	10 8 6	50 296 360	Tcw	498	145.7 149.5	11-25-31 11-26-40	N	U	1/4/
708	Missouri Pacific Railroad	Pomeroy Drilling Co.	1931	771	6 5/8 6	705 770	Twi	518	--	--	N	U	Completed in sand 705-770 feet. 1/2/
802	Exxon (Humble) New London Gas Plant No. 1	Fred Fielder	1936	517	10	517	Twi	520	--	--	--	U	Screened 414-503 feet. Reportedly pumped 90 gal/min when drilled. R.E.L. Silvey "A" lease.
803	Exxon (Humble) New London Gas Plant No. 2	Layne-Texas Co.	1940	562	13 3/8 8 5/8 7	426 452 562	Twi	530	307 310.8	1940 9-21-72	TE,40	Ind	Screened 452-535 feet. Reported drawdown 80 feet after pumping 82 gal/min when drilled. R.E.L. Silvey "A" lease. Measured temperature 39°C 9-21-72. Drilled to 599 feet; plugged back to 562 feet. 1/

See footnotes at end of table.

Table 1.--Records of wells, springs, and test holes in Rusk County and adjacent areas--Continued

Well	Owner or name	Driller	Date completed	Depth of well (feet)	Casing: Diameter (inches)	Casing: Depth (feet)	Water bearing unit	Altitude of land surface (feet)	Water levels: Above (+) or below land surface (feet)	Water levels: Date of measurement	Method of lift	Use of water	Remarks
WR-35-41-804	Exxon (Humble) New London Gas Plant No. 3	Layne-Texas Co.	1952	552	20 10 3/4	406 552	Twi	525	384	9- 9-52	TE,75	Ind	Screened 406-540 feet. Reported drawdown 86 feet after pumping 215 gal/min for 24 hours when drilled. Highly mineralized water reported at 220-280 feet. Drilled to 650 feet; plugged back to 552 feet. 1/3/
807	City of Overton No. 6	do.	1968	815	14 8 5/8	740 815	Twi	498	281 288	5-22-68 5- 9-79	TE,50	P	Screened 745-750 and 760-800 feet. Reported drawdown 127 feet after pumping 285 gal/min for 24 hours when drilled. Drilled to 908 feet; plugged back to 815 feet. 1/3/
808	City of New London No. 2	do.	1963	591	16 10 3/4	430 591	Twi	546	323 334.2 332.2	6-15-63 5- 8-79 3-19-81	TE,100	P	Screened 436-446, 468-482, 490-516, and 534-583 feet. Reported drawdown 107 feet after pumping 402 gal/min for 24 hours when drilled. Originally drilled for White Oak Water Supply Corp. Drilled to 653 feet; plugged back to 591 feet. 1/3/
809	City of Overton	do.	1980	805	14 8 5/8	710 805	Twi	500	333	1-31-80	TE,60	P	Screened 718-789 feet; gravel packed and underreamed. Reported drawdown 140 feet after pumping 300 gal/min for 24 hours. Drilled to 900 feet; plugged back to 805 feet. 1/2/3/
810	Exxon 1B Holt	do.	1931	317	10	317	Tc	490	194.0	10-17-41	N	U	Screened 235-315 feet. Reported drawdown 28 feet after pumping 550 gal/min when drilled. Reported pumped about 0.075 Mgal/d during 1931-34.
901	City of New London No. 1	do.	1949	657	20 10 3/4	417 655	Twi	482	285 294.2 301.6	12-21-49 5- 8-79 3-18-81	TE,50	P	Screened 427-441, 461-471, 521-557, and 578-642 feet. Reported drawdown 97 feet after pumping 500 gal/min for 24 hours when drilled. Originally drilled for Humble Oil and Refining as Joe Williams No. 3. 1/3/
902	Romie Holt	--	1934	39	--	39	Tr	460	16.7	6- 2-36	N	U	Dug well.
903	J. W. McDavis	--	1927	12	30	12	Tr	470	6.7	6- 4-36	N	U	Dug well.
904	W. J. H. Clamp	--	1900	25	--	25	Tr	452	15.0	6- 4-36	N	U	Dug well. 1/
42-202	Crossroads Water Supply Corp.	--	1966	750	8 5/8 4 1/2	580 620	Twi	428	157.7 159.5 158.6	10- 1-76 12- 7-76 12-16-77	TE	P	Screened 578-620 feet; for standby use only. Reported pumping level 294 feet when drilled. Drilled to 750 feet; plugged back to 620 feet. 1/3/
301	New Hope School	--	--	18	32	18	Tr	398	17.5	3- 4-81	N	U	Dug well.
302	New Hope Church	--	1935	22	36	22	Tr	397	18.5	12- 3-36	N	U	Dug well. 1/5/
303	Rusk Co. Highway R.O.W.	Works Progress Admin.	1936	16	--	--	Tr	382	13.9	6-22-36	N	U	Works Progress Admin. test well. 1/5/

See footnotes at end of table.

Table 1.--Records of wells, springs, and test holes in Rusk County and adjacent areas--Continued

Well	Owner or name	Driller	Date completed	Depth of well (feet)	Casing: Diameter (inches)	Casing: Depth (feet)	Water bearing unit	Altitude of land surface (feet)	Water levels: Above (+) or below land surface (feet)	Water levels: Date of measurement	Method of lift	Use of water	Remarks
WR-35-42-401	Jacobs Water Supply Corp. No. 2	Layne-Texas Co.	1965	552	8 5/8 4 1/2	521 552	Twi	420	188.5 197.4	6- -65 5- 9-79	SE	P	Screened 527-547 feet. Reported drawdown 54 feet after pumping 100 gal/min for 24 hours when drilled. Drilled to 614 feet; plugged back to 552 feet. 1/2/3/
402	J. E. Bickley	--	--	24	36	24	Tc	422	22.1	11-27-36	N	U	Dug well. 5/
403	Cyrus Harvey	--	--	21	--	--	Tr	480	17.6	11-27-36	N	U	Do.
501	Rusk Co. Highway R.O.W.	Mid Continent Petroleum Co.	1936	55	--	55	Tc	322	F	12- 4-36	N	U	Do.
601	C. T. Moore	--	1921	31	36	31	Tr	380	19.6	12- 3-36	N	U	Do.
602	C. J. Barton	--	1916	30	--	30	Tc	422	20.7	6-19-36	--	--	Do.
701	Jacobs Water Supply Corp. No. 1	Layne-Texas Co.	1965	799	8 5/8 4 1/2	583 675	Twi	432	210	2-15-65	N	U	Screened 592-602, 612-640, and 651-661 feet. Reported drawdown 187 feet after pumping 48 gal/min for 52 hours when drilled. Water quality unacceptable, well capped off. Drilled to 799 feet; plugged back to 675 feet. 1/3/
801	Kenneth Smith	Allen Lumber Co.	1969	67	36	67	Tc	440	62.3 60.7	9-21-72 3-19-81	JE	D	1/4/
901	Crims Chapel Water Supply Corp. No. 1	Triangle Pump & Supply Co.	1965	402	8 5/8 4 1/2	358 402	Twi	432	146 209.7	11-29-65 5- 2-79	SE,10	P	Screened 360-402 feet. Reported drawdown 142 feet after pumping 75 gal/min for 24 hours when drilled. 1/3/
902	Crims Chapel Water Supply Corp. No. 2	Lanford Drilling Co.	1977	610	8 5/8 4 1/2	560 610	Twi	442	195 222.2	7- 1-77 5- 2-79	SE	P	Screened 560-610 feet. Reported drawdown 113 feet after pumping 100 gal/min for 24 hours when drilled.
903	Falvey Waller	Moyer	1962	25	30	25	Tc	398	15.7	3-24-81	SE	Irr	Dug well.
904	J. H. Freeman	--	1918	36	--	36	Tc	400	28.5	6-19-36	N	U	Do.
43-201	Elderville Water Supply Corp.	C. C. Innerarity	1967	565	10 7	441 556	Twi	320	69.5	3- 3-81	TE,20	P	Screened 441-451 and 460-556 feet. Reported drawdown 25 feet after pumping 160 gal/min for 23 hours when drilled. For standby use only. Drilled to 595 feet; plugged back to 565 feet. 3/
301	National Weather Service	White Drilling Co.	1975	115	4	115	Tc	401	80	1-21-75	SE	C	Screened 105-115 feet.
302	Otis Wishon	Frye Drilling Co.	1979	25	--	--	Tc	320	21.8	7-12-79	JE	D	Dug well. 1/
401	J. G. Hearn	J. G. Hearn	1912	20	--	--	Tc	380	10.4	6-19-36	N	U	Dug well. 5/
501	R. C. Walling	Howeth Water Well Service	1972	220	4	211	Twi	398	54.2 56.1	10- 1-76 3- 3-81	SE,3	D	Screened 179-211 feet. 1/2/4/
601	Francis Wheeler	Allen Lumber Co.	1970	54	30	54	Tc	400	49.8 47.0	9-26-72 3- 3-81	JE	D	1/4/

See footnotes at end of table.

Table 1.--Records of wells, springs, and test holes in Rusk County and adjacent areas--Continued

Well	Owner or name	Driller	Date completed	Depth of well (feet)	Casing: Diameter (inches)	Casing: Depth (feet)	Water bearing unit	Altitude of land surface (feet)	Water levels: Above (+) or below land surface (feet)	Water levels: Date of measurement	Method of lift	Use of water	Remarks
WR-35-43-602	Glenn W. Rogers	Newman	1950	475	4	475	Twi	440	131.0	4-23-81	SE	D	Screened 455-475 feet.
701	Millville Baptist Church	--	1955	50	--	50	Tc	475	19.6	4-23-81	N	U	Dug well.
702	do.	Howeth Water Well Service	1965	105	2	105	Twi	475	59.1	4-23-81	N	U	--
801	John Monlie	--	--	14	36	14	Tr	480	10.1	11- 5-36	N	U	Dug. well.
901	Elizabeth Strozier	--	1933	73	--	73	Tc	460	70.2	11- 4-36	N	U	--
44-101	Boy Scouts of America, Camp Kennedy	Layne-Texas Co.	1947	421	6 5/8 4 1/2	343 421	Twi	343	70 88.2	5-30-47 6- 7-79	N	U	Screened 361-391 feet. Camp abandoned. 1/2/
302	McNaughton	--	1935	43	--	--	Tc	360	36.9	1-12-37	N	U	Dug well.
401	Greer & Snow (Mayflower School)	--	--	--	--	--	Twi	354	94.0 91.1	9-26-72 2-12-75	TE,5	Ind	Originally supplied water for Mayflower School. 1/4/
402	James M. Forgotson	White Drilling Co.	1971	295	4	295	Twi	360	100 81.7	10-12-71 6- 5-79	N	U	Casing slotted 228-295 feet. 4/
403	C. E. Williams, A. J. Williams	--	--	21	--	--	Tc	405	16.4	11-30-36	N	U	Dug well. 5/
404	Tipco Crane Unit	--	1960	400	--	--	Twi	370	--	--	TE,20	WF	Screened 360-400 feet.
501	Crystal Farms Water Supply Corp.	Frye Drilling Co.	1968	418	7 2 1/2	369 406	Twi	360	131.5	5- 3-79	SE,3	P	Screened 364-384 and 391-406 feet. 1/2/
502	Hopkins & Tate C. O. Christian No. 1	Texaco	1943	7,110	--	--	--	370	--	--	--	--	Oil test used in cross section. 3/
503	C. L. Cook	--	--	31	--	--	Twi	380	32.1	12- 2-36	N	U	Dug well. 1/
601	City of Tatum No. 1	Layne-Texas Co.	1938	438	10 3/4 5 1/2	387 438	Twi	305	39 93	3- 4-39 5-17-79	TE,10	P	Screened 387-428 feet. Reported drawdown 82 feet after pumping 140 gal/min when drilled. 1/4/
604	I. F. York Est.	--	1930	22	--	--	Twi	335	20.8	11- 5-36	N	U	Dug well.
605	Granville Nero	--	--	17	--	--	Twi	330	16.8	10-29-36	N	U	Do.
701	Dirgin Water Supply Corp.	--	1966	555	--	--	Twi	375	123.4	4- 2-81	SE,10	P	1/3/
702	Tom Mann	Tom Mann	1932	26	36	26	Tc	385	21.3	1-14-37	N	U	Dug well.
801	Texas Utilities Services, Inc., No. 1 Martin Lake Plant	Layne-Texas Co.	1973	715	14 8 5/8	530 715	Twi	321	65.10 108	8- 6-73 5-17-79	TE	Ind	Screened 540-590 and 645-695 feet. Reported drawdown 50 feet after pumping 406 gal/min for 12 hours when drilled. Drilled to 739 feet; plugged back to 715 feet. 1/2/3/

See footnotes at end of table.

Table 1.--Records of wells, springs, and test holes in Rusk County and adjacent areas--Continued

Well	Owner or name	Driller	Date completed	Depth of well (feet)	Casing: Diameter (inches)	Casing: Depth (feet)	Water bearing unit	Altitude of land surface (feet)	Water levels: Above (+) or below land surface (feet)	Water levels: Date of measurement	Method of lift	Use of water	Remarks
WR-35-44-802	Texas Utilities Services, Inc., No. 2 Martin Lake Plant	Layne-Texas Co.	1975	449	14 8 5/6	290 449	Twi	387	120.0 109.4 127.5	8-25-75 5-17-79 4-21-81	TE	Ind	Screened 300-442 feet. Reported drawdown 69 feet after pumping 401 gal/min for 24 hours when drilled. Drilled to 833 feet; plugged back to 449 feet. 1/3/
803	Harmony Hill Cemetary Assoc.	Bell Water Well Service	1964	202	2	202	Twi	370	98	5-30-64	SE,1.5	Irr	Screened 184-200 feet.
49-101	E. F. Wheeler	--	--	21	30	21	Tr	510	14.5	6-11-36	N	U	Dug well. 1/5/
102	I. R. Thrash	V. and E. Thrash	1933	18	24	18	Tq	450	11.7	6-11-36	N	U	Dug well. 5/
103	D. C. Joiner	--	1922	29	--	29	Tr	470	17.4	6-11-36	N	U	Dug well. 1/5/
201	West Rusk High School (New London School)	Layne-Texas Co.	1937	538	13 3/8 7	456 538	Twi	552	220 294	10- 4-37 8-14-42	TE,25	P	Screened 456-576 feet. Reported drawdown 80 feet after pumping 72 gal/min when drilled. 1/
202	Jeffrey Sheppard	do.	1947	500	7 5	426 500	Twi	530	308	11-27-47	N	U	Screened 425-460 and 480-495 feet. Reportedly pumped 15 gal/min when drilled. Drilled for New London Water Supply Corp. Drilled to 610 feet; plugged back to 500 feet. 3/
203	Exxon (Humble) No. 4 Ida Holt "B" lease	do.	1939	592	24 13 12 3/4	438 446 582	Twi	538	301 319.5	6- 9-39 3-19-81	N	U	Screened 447-578 feet. Reported drawdown 79 feet after pumping 385 gal/min when drilled. 1/
204	Exxon (Humble) No. 5 Ida Holt "B" lease	do.	1944	611	16 10 3/4	415 611	Twi	551	--	--	N	U	Screened 415-608 feet. Reported pumping level 400 feet after pumping 280 gal/min when drilled.
205	Tide Water Assoc. No. 1 L.J. Pinkston "A" lease	L. W. Little	1931	738	8 1/4 7	13 738	Twi	570	--	--	N	U	Screened 508-708 feet. Well destroyed.
206	Cities Service Co. Water WSW No. 1 Wheelis lease	Layne-Texas Co.	1978	940	8 5/8 4 1/2	850 940	Twi	495	250	7-31-78	SE	Ind	Screened 860-900 and 914-926 feet. Reported drawdown 79 feet after pumping 108 gal/min for 20 hours when drilled. Drilled to 1,021 feet; plugged back to 940 feet. 1/2/3/
207	Exxon (Humble) J. E. Arnold No. 8	--	1949	3,735	--	--	--	484	--	--	--	--	Oil test used in geologic section. 3/
208	Aston Greenaway J. R. Alford No. 5	--	1932	412	6 5/8	412	Twi	427	62.9	5- 7-40	N	U	--
209	D. B. Malernee E. B. Alford	--	1932	880	10 8 7 4 1/2	-- 500 840 880	Twi	495	165 225.8 225.6	1932 5- 8-40 5- 8-44	N	U	Screened 835-880 feet. 1/
301	Pleasant Hill Water Supply Corp. No. 1	Key Drilling Co.	1965	460	--	460	Twi	545	--	--	SE	P	Screened 346-356, 388-410, and 432-458 feet. Drilled to 900 feet; plugged back to 460 feet.

See footnotes at end of table.

Table 1.--Records of wells, springs, and test holes in Rusk County and adjacent areas--Continued

Well	Owner or name	Driller	Date completed	Depth of well (feet)	Casing Diameter (inches)	Casing Depth (feet)	Water bearing unit	Altitude of land surface (feet)	Water levels Above (+) or below land surface (feet)	Water levels Date of measurement	Method of lift	Use of water	Remarks
WR-35-49-302	Pleasant Hill Water Supply Corp. No. 2	Lanford Drilling	1974	650	8 5/8 4 1/2	550 650	Twi	510	230	5- 8-74	SE	P	Screened 550-590 and 630-650 feet. Reported drawdown 50 feet after pumping 75 gal/min for 21 hours when drilled. Drilled to 740 feet; plugged back to 650 feet. Sand between 200-240 feet reportedly contains water with unusually high dissolved solids. 1/3/
303	A. M. Russell	A. M. Russell	1935	24	--	--	Tr	460	22.6	5- 6-36	N	U	5/
304	Lee Poole	--	1900	36	--	--	Tq	525	23	6- 1-36	--	--	5/
401	Arco Gas Plant No. 19	Layne-Texas Co.	1944	620	18 5/8 10 3/4	398 620	Twi	380	100	12-18-44	TE,30	Ind	Screened 404-483 and 556-618 feet. Reported drawdown 75 feet after pumping 440 gal/min when drilled. Drilled for Sinclair Prairie. Drilled to 885 feet; plugged back to 620 feet. 3/
402	Arkansas Fuel Oil Co. G. Ferguson	--	--	400	--	--	Twi	400	118.2	5- 7-40	N	U	1/
403	Lone Pine Oil Co. Pinkston	--	1940	126	6	126	Tc	395	40.0	5- 6-40	N	U	1/
501	Parade Gasoline Plant Giles No. 2	Layne-Texas Co.	1947	444	18 10 3/4	340 444	Twi	498	308	8- 5-47	TE,50	Ind	Screened 350-431 feet. Reported drawdown 52 feet after pumping 137 gal/min when drilled. Reportedly pumped 113 gal/min on 1-14-76. Main well. 1/3/
502	Dan Kerr	--	1945	585	6	585	Twi	455	150 173.0	2-28-59 11-30-78	SE	S	Perforated casing 530-550 feet. Previously used as a public supply well. 1/4/
503	Parade Gasoline Plant Giles No. 1	Layne-Texas Co.	1937	466	20 10 3/4	352 466	Twi	520	228 274	7-30-37 5- 1-40	TE	Ind	Screened 360-443 feet. Reported drawdown 48 feet after pumping 92 gal/min when drilled. Pumped 360 gal/min on 8-23-37, 110 gal/min on 1-15-76. Standby well. Drilled to 600 feet; plugged back to 406 feet. 1/
504	Baldwin Sultan Oil. Co. M. L. Thompson	--	1931	360	8	360	Twi	475	180.0	10- 9-41	N	U	5/
505	Ohio Oil Co. No. 2 S. H. Moore	--	1931	284	6 5/8	233 284	Tc	450	73.7	10-14-41	N	U	Screened 223-284 feet. 5/
506	Stuart - Dr. Deason	--	--	250	--	--	Tc	485	125.5	5- 8-40	N	U	5/
507	Miller Production D. Bradford "B"	Walter Meller	1934	355	8	355	Twi	375	103.7	5- 8-40	N	U	5/
508	Shell Oil Co., Inc. H. Brooks	--	--	700	10	700	Twi	465	87.0	5- 9-40	N	U	5/
509	W. C. McClian	--	1908	18	--	18	Tc	415	10.6	5-30-36	N	U	Dug well. 1/
510	Exxon (Humble) No. 1 M&R Kangerga "A"	Layne-Texas Co.	1931	260	20 12 1/2	138 260	Tc	482	101	1931	N	U	Screened 139-199 feet. Reported drawdown 60 feet after pumping 400 gal/min when drilled. 1/

See footnotes at end of table.

Table 1.--Records of wells, springs, and test holes in Rusk County and adjacent areas--Continued

Well	Owner or name	Driller	Date completed	Depth of well (feet)	Casing Diameter (inches)	Casing Depth (feet)	Water bearing unit	Altitude of land surface (feet)	Water levels Above (+) or below land surface (feet)	Water levels Date of measurement	Method of lift	Use of water	Remarks
WR-35-49-601	Gaston Water Supply Corp. No. 1	Edington Drilling Co.	1965	781	8 5/8 4	655 778	Twi	500	236 288	4-29-65 3-12-81	TE,15	P	Screened 655-690 and 738-788 feet. Reported drawdown 94 feet after pumping 120 gal/min for 24 hours when drilled. 1/2/
602	Gaston Water Supply Corp. No. 2	Lanford Drilling Co.	1974	697	8 5/8 4 1/2	605 697	Twi	500	226	1- -75	SE	P	Screened 605-625 and 657-697 feet. Reported drawdown 100 feet after pumping 104 gal/min for 24 hours when drilled. Drilled to 822 feet; plugged back to 697 feet. 1/3/
603	Gaston School	Walter Sallee	1938	415	8	415	Twi	460	120	1938	TE	U	Screened 395-415 feet. 1/
604	John Glass	Fred Fielder	--	168	7	168	Tc	468	50.5	8-24-37	N	U	Formerly supplied Joinerville. Screened 141-168 feet.
605	Gibson Worrel No. 1	--	1957	3,628	--	--	--	435	--	--	--	--	Oil test used in cross section. 3/
702	Arco Gas Plant No. 21 Kinney No. 2	Layne-Texas Co.	1938	926	18 5/8 10 3/4	482 926	Twi	420	133 178.9 200.2	2-28-38 5- 3-40 6-21-79	TE,60	Ind	Screened 483-504, 754-795, and 811-911 feet. Reported drawdown 111 feet after pumping 460 gal/min when drilled. 1/
801	Carlisle Public School	do.	1940	275	13 3/8 7	213 275	Tc	368	57 49.2	1-16-41 6- 4-79	TE,5	U	Screened 225-237 and 241-260 feet. Reported drawdown 140 feet after pumping 45.5 gal/min when drilled. Drilled to 291 feet; plugged back to 275 feet. 1/4/
802	Marathon Oil No. 3	G. L. Cobb	1952	870	4 1/2	870	Twi	420	--	--	N	U	Plugged. Drilled for Ohio Oil Co. 1/
803	Price Water Supply Corp. No. 1	Key Drilling Co.	1965	405	8 5/8 4	355 405	Twi	420	270	2-13-65	SE,15	P	Screened 335-405 feet. Drilled to 853 feet; plugged back to 405 feet.
804	Price Water Supply Corp. No. 2	do.	1968	832	8 5/8 4	730 832	Twi	410	216	9-10-68	SE,20	P	Screened 730-765 and 777-822 feet. Reported drawdown 105 feet after pumping 126 gal/min for 24 hours when drilled. Drilled to 870 feet; plugged back to 832 feet. 1/3/
805	Arco No. 1 Kinney WSW	Layne-Texas Co.	1978	1,225	10 3/4 6 5/8	710 965	Twi	368	144 200	1-23-78 6-21-79	SE	WF	Screened 719-784 and 830-945 feet. Reported drawdown 119 feet after pumping 295 gal/min for 24 hours when drilled. Drilled to 1,225 feet; plugged back to 965 feet. 1/3/
806	Marathon Oil Co. No. 1 Price WSW	Strata Drilling, Inc.	1980	1,300	8 5/8 4 1/2	780 838	Twi	420	222	8-25-80	TS,30	WF	Screened 736-740 and 782-833 feet. Reported drawdown 98 feet after pumping 125 gal/min for 14 hours when drilled. Pumping level 313.5 feet by airline 3-3-81. Drilled to 1,300 feet. 3/
807	J. E. Strickland	Works Progress Admin.	1936	27	--	27	Tc	400	20	5- 5-36	N	N	Works Progress Admin. test hole. 5/
808	Getty W. P. Moore	--	1939	300	5	300	Tc	415	80 95.7	1939 7-15-81	SE,7.5	WF	Originally owned by Tide Water.

See footnotes at end of table.

Table 1.--Records of wells, springs, and test holes in Rusk County and adjacent areas--Continued

Well	Owner or name	Driller	Date completed	Depth of well (feet)	Casing: Diameter (inches)	Casing: Depth (feet)	Water bearing unit	Altitude of land surface (feet)	Water levels: Above (+) or below land surface (feet)	Water levels: Date of measurement	Method of lift	Use of water	Remarks
WR-35-49-809	Burk Royalty No. 3 Strickland & others unit	Allen Lumber Co.	1971	772	7 3	694 772	Twi	382	110 175.4	6-26-71 7-16-81	SE,15	WF	Screened 707-767 feet.
810	Burk Royalty No. 1	do.	1971	672	7 4	465 672	Twi	382	65	1-15-71	N	U	Casing slotted 500-672 feet. Casing collapsed.
811	Burk Royalty No. 2	do.	1971	681	7 4	500 681	Twi	380	70 80.9	1-27-71 7-16-81	SE,5	WF	Casing slotted 481-681 feet.
812	Mobil Price Unit WSW No. 1	Layne-Texas Co.	1980	1,100	8 5/8 4 1/2	880 1,050	Twi	402	197 269.3	10-15-80 7-15-81	SE	WF	Screened 888-898, 900-918, 964-983, 986-1,005, 1,007-1,026, and 1,028-1,035 feet. Reported drawdown 57 feet after pumping 167 gal/min for 24 hours when drilled. Drilled to 1,100 feet; plugged back to 1,050 feet. 1/3/
901	Great Expectations No. 1 Amos Alexander	--	1953	3,592	--	--	--	420	--	--	--	--	Oil test used in cross section. 3/
902	Redwine	Works Progress Admin.	1936	23	--	--	Tc	430	22.5	3-12-36	N	U	Works Progress Admin. test hole.
50-101	D. R. Sartain	--	1921	20	--	20	Tc	440	19.0	11-27-36	N	U	Dug well. 1/5/
102	John Green	--	1866	43	--	43	Tc	432	31.4	11-29-36	N	U	Dug well. 5/
103	Farmers Institute School Dist.	--	--	30	--	--	Tr	492	27.4	5-27-36	N	U	Dug well. 3/5/
104	J. S. Dorsey	--	--	80	--	--	Tc	450	--	--	N	U	--
201	T. V. Bennett	--	--	20	36	20	Tr	435	17	8- 2-62	N	U	Dug well.
202	W. F. Simmons	--	1952	82	4	82	Tc	465	52 56.1	8- 2-62 4-21-81	JE,1	D	Originally reported to be 100 feet deep.
203	V. High	--	1911	34	--	--	Tc	420	26.6	6-18-36	N	U	Dug well. Well collapsed.
204	Burris Dorsey	W. A. Hunt	1955	85	4	85	Tc	418	20 19.2	1955 8- 2-62	N	U	Total dissolved solids increased from 1,870 to 2,475 mg/L after pumping 5 hours on 8-1-62. 1/
205	H. C. Thrasher	--	1899	38	--	--	Tc	400	33.6	6-16-36	N	U	Dug well.
206	Burris Dorsey	White Drilling Co.	1963	214	4 2 1/2	198 214	Tc	438	75.0	9-16-64	SE	D	Screened 199-214 feet. 2/
302	Jerome Rhoden	--	1971	49	30	49	Tc	402	28.0 18.4	9-21-72 3-19-81	JE	D	Dug well. 1/4/
303	B. A. Grant	--	--	32	--	32	Tc	--	28.2	11-24-36	N	U	Dug well. 1/
401	Jacobs Water Supply Corp. No. 3	Lanford Drilling Co.	1974	684	8 5/8 4 1/2	612 684	Twi	450	221	5- 9-79	SE,15	P	Screened 612-682 feet. Drilled to 802 feet; plugged back to 802 feet. 1/3/
402	Charlie Lloyd	--	1860	39	30	39	Tc	470	24.1	5-26-36	N	U	Dug well.

See footnotes at end of table.

Table 1.--Records of wells, springs, and test holes in Rusk County and adjacent areas--Continued

Well	Owner or name	Driller	Date completed	Depth of well (feet)	Casing: Diameter (inches)	Casing: Depth (feet)	Water bearing unit	Altitude of land surface (feet)	Water levels: Above (+) or below land surface (feet)	Water levels: Date of measurement	Method of lift	Use of water	Remarks
WR-35-50-403	W. Z. Ranfro	--	1866	20	30	20	Tc	440	11.4	5-27-36	N	U	Dug well. 1/
404	J. W. Flanning	Leroy Thompson	1934	28	--	28	Tc	450	22.9	5-26-36	--	--	Dug well. 5/
501	Joe L. Hartman	Allen Lumber Co.	1971	48	36	48	Tc	460	32.8 33.2	9-21-72 12- 1-78	JE	D	1/4/
502	City of Henderson No. 16	Layne-Texas Co.	1963	372	16 10 3/4	291 372	Twi	420	128 168.7	9-29-63 3-17-81	TE,40	P	Screened 292-364 feet. Reported drawdown 132 feet after pumping 350 gal/min for 24 hours when drilled. Drilled for White Oak Water Co. 1/2/3/4/
503	City of Henderson	do.	1979	874	--	869	Twi	460	--	--	N	U	Test hole. 3/
504	White Oak Water Co.	do.	1963	542	--	540	Twi	420	--	--	--	--	Do.
601	Texas Highway R.O.W.	Works Progress Admin.	1936	31	--	--	Twi	470	23	7-31-36	--	--	Works Progress Admin. test hole. 2/5/
602	Bert Fields, Jr. R. M. Ballenger Unit	Rehkop Drilling Co.	1973	510	7 3	455 510	Twi	395	213	11-28-73	--	WF	Drilled to 663 feet; plugged back to 510 feet.
701	Henderson Co. R.O.W.	Works Progress Admin.	1936	18	--	--	Twi	450	15	3-12-36	N	U	Works Progress Admin. test hole. 5/
702	Z. D. Stone	--	--	27	30	27	Twi	448	19.2 21.5	3-17-36 11-27-40	N	U	Dug well. 4/5/
703	J. J. Colwell	--	--	20	6	20	Twi	416	14.6 12.8	3-17-36 11-27-40	N	U	Do.
801	City of Henderson No. 7	Layne-Texas Co.	1947	624	16 10 3/4	522 624	Twi	452	275 359.6	7-19-47 4-22-81	TE,75	P	Screened 531-611 feet. Reported drawdown 117 feet after pumping 335 gal/min for 18 hours when drilled. 1/3/4/
802	City of Henderson No. 8	do.	1948	747	16 10 3/4	520 746	Twi	512	315 361.3	1-23-48 3-17-81	TE	P	Screened 548-598, 638-648, and 676-736 feet. Reported drawdown 159 feet after pumping 402 gal/min for 8 hours when drilled. 1/3/4/
803	City of Henderson	do.	1942	794	--	--	Twi	435	--	--	N	U	Test hole 4-2. 1/3/
804	Do.	do.	1942	759	--	--	Twi	405	--	--	N	U	Test hole 5-3. 1/3/
805	A. F. Wright	--	1930	15	36	15	Twi	405	8.1	10-23-36	N	U	Dug well. 1/5/
806	City of Henderson	Layne-Texas Co.	1946	703	--	--	Twi	498	--	--	N	U	Test hole No. 6. 3/
901	City of Henderson No. 4	do.	1936	583	20 12	430 560	Twi	419	168.5 302.8	12-19-35 4- 1-81	TE,75	P	Screened 419-474 and 479-551 feet. Reported drawdown 70 feet after pumping 360 gal/min for 5 hours 8-21-44. 1/2/4/
902	City of Henderson No. 5	do.	1938	879	16 7	492 879	Twi	410	2D6 148.7	8-11-38 11-27-40	N	U	Screened 500-572, 594-654, and 824-854 feet. Reported drawdown 64 feet after pumping when drilled. Well plugged with cement. 3/4/

See footnotes at end of table.

Table 1.--Records of wells, springs, and test holes in Rusk County and adjacent areas--Continued

Well	Owner or name	Driller	Date completed	Depth of well (feet)	Casing: Diameter (inches)	Casing: Depth (feet)	Water bearing unit	Altitude of land surface (feet)	Water levels: Above (+) or below land surface (feet)	Water levels: Date of measurement	Method of lift	Use of water	Remarks
WR-35-50-903	City of Henderson No. 6	Layne-Texas Co.	1942	609	16 10 3/4	484 603	Twi	415	247 287	8-23-42 3- -81	TE,75	P	Screened 488-592 feet. Reported drawdown 92 feet after pumping 350 gal/min when drilled. 1/3/4/
904	City of Henderson No. 10	do.	1954	698	20 12 3/4	505 698	Twi	455	355 330	2- 8-54 3- -81	TE,150	P	Screened 510-560, 594-614, 620-630, 650-665, and 676-686 feet. Reported drawdown 94 feet after pumping 544 gal/min for 48 hours when drilled. 1/3/4/
905	City of Henderson No. 11	do.	1955	668	20 12 3/4	405 668	Twi	480	301	2-19-55	TE,100	P	Screened 410-470, 484-539, 554-584, and 618-658 feet. Reported drawdown 104 feet after pumping 610 gal/min for 48 hours when drilled. 1/3/
906	City of Henderson No. 12	do.	1957	752	20 10 3/4	590 752	Twi	495	250 320 390	6-23-57 6-28-57 5- 2-79	TE,100	P	Screened 592-674, 678-688, 699-704, and 715-740 feet. Reported drawdown 237 feet after pumping 578 gal/min for 48 hours when drilled. 1/3/
907	City of Henderson No. 13 (James Owen well)	do.	1964	712	20 12 3/4	520 712	Twi	465	233 319	2- 3-64 3- -81	TE,150	P	Screened 530-570, 592-682, and 692-702 feet. Reported drawdown 79 feet after pumping 754 gal/min for 48 hours when drilled. 1/2/3/4/
908	City of Henderson No. 14	do.	1969	725	20 12 3/4	500 725	Twi	510	321 348.6	11-13-69 4-23-81	TE,250	P	Screened 510-570, 580-615, and 632-697 feet. Reported drawdown 75 feet after pumping 900 gal/min for 24 hours when drilled. Drilled to 762 feet; plugged back to 725 feet. 1/3/
909	City of Henderson No. 15	do.	1969	405	16 10 3/4	303 405	Twi	510	244 250.5 241.7	12-22-69 5- 2-79 5-17-81	TE,60	P	Screened 317-372 feet. Reported drawdown 95 feet after pumping 200 gal/min for 48 hours when drilled. 1/3/
910	City of Henderson No. 2	do	1931	558	12 1/2 8 1/4 6 5/8	443 456 558	Twi	404	178.0 161	10- 7-38 11-27-40	N	U	Casing slotted 448-558 feet. Drilled to 680 feet; plugged back to 558 feet. Well abandoned in 1942. 1/4/
911	B. Harris	Rice Sammons	--	31	--	31	Twi	460	17.3	7-14-36	N	U	Dug well. 5/
912	O. F. Burt	--	1937	130	4	51	Tc	482	6.0 1.8	8-24-37 2- 8-39	N	U	Geophysical test hole. 4/
913	Rosa Burt	O. E. Burt	1935	14	28	14	Tc	468	2.5 4.4	7-15-36 11-27-40	N	U	Dug well. 1/3/4/
51-101	New Prospect Water Supply Corp. No. 2	Layne-Texas Co.	1977	634	8 5/8 4 1/2	405 540	Twi	480	200 215.7	6- 8-77 5- 9-79	SE	P	Screened 411-419, 423-446, 455-468, 474-484, and 497-520 feet. Reported drawdown 54 feet after pumping 195 gal/min for 23 hours when drilled. 1/2/3/
102	L. T. Burton	Willie Burnett	1934	27	--	--	Tc	450	24.2	11-17-36	N	U	Dug well. 5/
201	Conoco F. Lewis No. 1	--	1951	7,606	--	--	--	420	--	--	--	--	Oil test used in cross section. 3/

See footnotes at end of table.

Table 1.--Records of wells, springs, and test holes in Rusk County and adjacent areas--Continued

Well	Owner or name	Driller	Date completed	Depth of well (feet)	Casing Diameter (inches)	Casing Depth (feet)	Water bearing unit	Altitude of land surface (feet)	Water levels Above (+) or below land surface (feet)	Water levels Date of measurement	Method of lift	Use of water	Remarks
WR-35-51-401	New Prospect Water Supply Corp. No. 1	Layne-Texas Co.	1968	585	8 5/8 4 1/2	460 585	Twi	500	250 255 307	7- 4-68 7-29-68 5- 9-79	SE	P	Screened 470-490 and 505-572 feet. Reported drawdown 66 feet after pumping 183 gal/min for 24 hours when drilled. 1/3/
501	W. H. Hunt Trust Est. Leopard No. 1	--	1948	7,505	--	--	--	405	--	--	--	--	Oil test used in cross section. 3/
502	Church Hill Water Supply Corp. No. 2	Howeth Water Well Service	1971	490	7 2	406 490	Twi	452	150 207.7	10- 7-71 3-19-81	SE	P	Screened 410-490 feet. Drilled to 610 feet; plugged back to 490 feet. 1/2/3/4/
503	Fairfield Baptist Church	--	1930	18	36	19	Twi	400	12.0 11.1	12- 1-36 4- 1-81	N	U	Dug well. 1/3/
601	Church Hill Water Supply Corp. No. 1	Innerarity Drilling Co.	1968	582	6 5/8 4	542 582	Twi	460	260	9- 5-68	N	U	Screened 542-582 feet. Plugged and abandoned due to poor water quality. 3/
602	--	Justis Mears	1981	410	4	410	Twi	420	105.0	4- 1-81	A	Ind	Drilled to serve drilling rig.
603	O. V. Bennett	Brazier	1918	21	36	21	Tc	430	20.6	11- 4-36	N	U	Dug well. 5/
801	Oakland Water Supply Corp.	--	1965	710	--	--	Twi	440	240.6	5- 9-79	SE,7.5	P	1/
802	L. K. Ballow	--	--	22	36	22	Twi	440	19.6 10.7	12- 2-36 11-27-40	N	U	Dug well. 4/5/
901	Pinehill Chapman Water Supply Corp.	Triangle Pump & Supply Co.	1966	738	8 5/8 3 1/2	670 738	Twi	480	175 227	1-17-66 5-10-79	TE,7.5	P	Screened 675-738 feet. Reported drawdown 60 feet after pumping 75 gal/min for 24 hours when drilled. 1/3/
902	J. Russell Smith	--	1911	26	40	26	Twi	385	23.3 6.4	12- 2-36 11-12-40	N	U	Dug well. 4/5/
903	E. F. Posey	--	1923	48	30	48	Twi	442	40.2 37.9	12- 2-36 11-27-40	N	U	Dug well. 1/4/5/
52-101	Evel Faulkner	Howeth Water Well Service	1966	192	4	189	Twi	340	50 55.5	2- 8-66 4- 2-81	JE,1	D	Screened 173-189 feet. 1/2/4/
102	Elizabeth Fitzgerald	--	1981	394	4	394	Twi	370	115.3	4- 2-81	A	Ind	--
401	Jack Murphy	--	1900	22	28	22	Twi	360	16.4	3-20-81	JE	D	Dug well.
701	H. H. Truelock	Howeth Water Well Service	1967	302	4	302	Twi	440	120 110.4	9-20-67 6-30-77	SE,1	D	Casing slotted 270-302 feet. 1/2/
702	Citizens National Bank	--	1936	29	--	29	--	340	23	10-30-36	N	U	Dug well. 1/5/
57-201	Amoco Production Co. No. 1 Siler lease	Layne-Texas Co.	1974	835	10 3/4 6 5/8	650 835	Twi	365	166	6-29-74	N	U	Screened 660-710, 727-752, 762-802, and 810-820 feet. Reported drawdown 294 feet after pumping 77 gal/min for 24 hours when drilled. Plugged. Originally drilled to 1,141 feet. 1/3/

See footnotes at end of table.

Table 1.--Records of wells, springs, and test holes in Rusk County and adjacent areas--Continued

Well	Owner or name	Driller	Date com-pleted	Depth of well (feet)	Casing Diameter (inches)	Casing Depth (feet)	Water bear-ing unit	Altitude of land surface (feet)	Water levels Above (+) or below land surface (feet)	Water levels Date of measure-ment	Method of lift	Use of water	Remarks
WR-35-57-202	Amoco Production Co. No. 2 Siler lease	Layne-Texas Co.	1974	1,120	10 3/4 6 5/8	1,015 1,120	Twi	335	73.8 150.4	8-19-74 5-17-79	SE	WF	Screened 1,025-1,105 feet. Reported drawdown 204 feet after pumping 525 gal/min for 12 hours when drilled. 1/3/
203	Amoco Production Co. No. 3 Siler lease	do.	1974	1,135	10 3/4 6 5/8	985 1,135	Twi	325	80 118.6	10- 2-74 5-17-79	SE	WF	Screened 995-1,105 feet. Reported drawdown 313 feet after pumping 480 gal/min for 24 hours when drilled. 1/2/3/
204	Great Expectations Oil A.W. Nicholas No. 1	--	1953	3,748	--	--	--	399	--	--	--	--	Oil test. 3/
205	Exxon	Century Geophysical Co.	1978	88	2	82	Tc	408	32 33 31.7	8- 4-78 2- 1-79 7-14-81	A	U	Casing slotted 10-82 feet.
206	do.	do.	1978	180	2	169	Tc	408.1	35 36 39.4	8- 4-78 2- 1-79 7-14-81	A	U	Casing slotted 103-169 feet.
207	do.	do.	1978	445	2	434	Twi	409.6	75 75 81.9	8- 4-78 2- 1-79 7-14-81	A	U	Casing slotted 205-434 feet.
301	Chris Redwine	--	--	23	36	23	Tc	430	21.8	12- 8-36	N	U	Dug well. 5/
401	Big Springs School	--	--	179	4	179	Tc	345	56.4	3-31-81	N	U	--
402	do.	--	--	21	24	21	Tc	345	--	--	N	U	Well is dry, 3-31-81, 7-14-81.
403	Exxon	Century Geophysical Co.	1978	50	2	50	Tc	366	41 40 41.5	4-26-78 3-29-79 7-14-81	A	U	Casing slotted 30-50 feet.
404	do.	do.	1978	133	--	133	Tc	366	55 54 54.5	4-26-78 3-29-79 7-14-81	A	U	Casing slotted 73-133 feet.
405	do.	do.	1978	215	2	215	Twi	366	77 75 77.1	4-26-78 3-29-79 7-14-81	A	U	Casing slotted 135-215 feet.
406	Big Springs	--	Spring	--	--	--	--	318	--	--	--	--	Spring encased in wooden box. Reported discharge 2.2 gal/min, 1978 (Gunnar Brune). 1/
503	Marcus Spence	--	1920	23	30	23	Tc	420	17.2 12.3	3-31-81 7-14-81	N	U	Dug well at abandoned home site.
504	George Dukes	--	1930	23	36	23	Tr	450	21.0	11-14-36	N	U	Dug well. 5/
505	G. E. Childress	Gibson Drilling Co.	1978	510	4	510	Twi	398	100.3	3-31-81	A	U	--
506	do.	--	1900	60	--	60	Tc	382	25.1	3-31-81	N	U	Old dug well, rock curb.
507	Exxon	Century Geophysical Co.	1978	53	2	44	Tr	448	6 22 26.8	4-26-78 2-24-79 7-14-81	A	U	Casing slotted 18-44 feet.

See footnotes at end of table.

Table 1.--Records of wells, springs, and test holes in Rusk County and adjacent areas--Continued

Well	Owner or name	Driller	Date completed	Depth of well (feet)	Casing: Diameter (inches)	Casing: Depth (feet)	Water bearing unit	Altitude of land surface (feet)	Water levels: Above (+) or below land surface (feet)	Water levels: Date of measurement	Method of lift	Use of water	Remarks
WR-35-57-508	Exxon	Century Geophysical Co.	1978	153	2	145	Tcw	448	78 78 78.5	8- 4-78 2-24-79 7-14-81	A	U	Casing slotted 64-145 feet.
509	do.	do.	1978	259	2	250	Twi	448	98 99 83.7	8- 4-78 2-24-79 7-14-81	A	U	Casing slotted 173-250 feet.
510	do	do	1978	495	2	484	Twi	449	98 130 134	8- 4-78 2-24-79 7-14-81	A	U	Casing slotted 280-484 feet.
601	H. T. Whitehead	--	1885	32	36	32	Tc	405	31.0	11-12-36	N	N	Dug well. 1/5/
701	Gulf Oil & Refining Pump Station	Layne-Texas Co.	1937	114	16 8 5/8	69 114	Tc	320	35	10- 8-37	N	U	Screened 69-112 feet. Reported drawdown 46 feet after pumping 156 gal/min when drilled. Drilled to 411 feet; plugged back to 114 feet.
702	Exxon R. O. Gant	Century Geophysical Co.	--	190	2	190	Tcw	312	5.4	7-14-81	A	U	Casing slotted 150-190 feet.
703	do.	do.	--	300	2	300	Twi	313	12.2	7-14-81	A	U	Casing slotted 210-230 feet.
704	do.	do.	--	130	2	130	Tc	310	+2	7-14-81	A	U	Casing slotted 60-130 feet. Measured discharge 2 gallons in 1 minute, 5 seconds 7-14-81.
802	Goodsprings Water Supply Corp.	Edington Drilling Co.	1965	413	8 5/8 4 1/2	350 413	Twi	440	135 153.0	9- -65 9-27-76	TE,7.5	P	Screened 350-413 feet. Reported drawdown 23 feet after pumping 65 gal/min when drilled. Drilled to 658 feet; plugged back to 413 feet. 1/3/
803	Dr. Deason	Works Progress Admin.	1936	14	--	14	Tc	420	11	4-17-36	N	U	Works Progress Admin. test hole. 1/5/
901	W. A. Whitehead	White Drilling Co.	1971	315	3	315	Twi	330	F +1.5	10-15-71 9-25-72	N	S	Casing slotted 273-315 feet. Estimated to flow at rate of 0.5 gal/min 9-25-72. 1/2/
902	Apache Drilling Co. No. 1 Roquemore	--	1956	3,940	--	--	--	352	--	--	--	--	Oil test used in cross section. 3/
58-101	Lonnie Lockridge	Allen Lumber Co.	1972	31	30	31	Tc	380	18.0 18.1	9-20-72 3-17-81	JE	D	Dug well. 1/4/
102	Goodsprings Water Supply Corp.	Edington Drilling Co.	1965	550	8 5/8 4 1/2	500 550	Twi	440	141 190.6	9- -65 5- 2-79	SE,10	P	Screened 500-550 feet. Reported drawdown 97 feet after pumping 60 gal/min for 24 hours when drilled. Drilled to 656 feet; plugged back to 550 feet. 1/2/3/
103	Robbins Petroleum Co. Benton Moore	Innerarity Drilling Co.	1969	442	6 4	296 442	Twi	410	163 117.4	1-28-69 7-14-81	SE,7.5	WF	Screened against sands 296-442 feet. Reported drawdown 85 feet after pumping 35 gal/min for 24 hours when drilled.
201	Lynn Simmons	Allen Lumber Co.	1972	47	36	47	Twi	360	18.0 16.4	8-19-72 12- 2-75	JE	D	Dug well. 1/3/4/

See footnotes at end of table.

Table 1.--Records of wells, springs, and test holes in Rusk County and adjacent areas--Continued

Well	Owner or name	Driller	Date completed	Depth of well (feet)	Casing: Diameter (inches)	Casing: Depth (feet)	Water bearing unit	Altitude of land surface (feet)	Water levels: Above (+) or below land surface (feet)	Water levels: Date of measurement	Method of lift	Use of water	Remarks
WR-35-58-202	Cross and Sons	Allen Lumber Co.	1973	825	7 3	725 825	Twi	485	245 271.6	6-28-73 5-16-79	SE	P	Screened 725-754 and 769-819 feet. Reportedly pumped 65 gal/min 5-16-79.
301	Ebenezer Water Supply Corp. No. 1	Triangle Pump & Supply Co.	1965	600	7 3 1/2	500 600	Twi	490	237	4-21-65	SE	P	Screened 500-600 feet. Reported drawdown 25 feet after pumping 60 gal/min for 24 hours when drilled. 1/3/
302	J. L. Anderson	--	1911	29	36	29	Twi	398	15.9	11-26-36	N	U	Dug well. 1/5/
401	Elmer Parker	Allen Lumber Co.	1971	82	30	82	Twi	500	67 70.0	7-15-71 3-19-81	JE	D	1/4/
402	Compton McKnight Water Supply Corp.	Key Drilling Co.	1979	500	6 5/8 3 1/2	450 490	Twi	528	208.1	3-19-81	SE,7.5	P	Screened 450-490 feet. Measured pumping level 243.5 feet 3-18-81. Drilled to 720 feet; plugged back to 500 feet. 1/3/
403	W. V. Wiggins	Lawrence Hunter	1920	60	36	60	Tc	495	43.0	3-18-81	N	U	Dug well.
501	Freewill Baptist Church	Howeth Water Well Service	1969	95	4	95	Twi	350	30 26.3	8-23-69 12- 2-75	SE,1	P	Screened 71-95 feet. 4/
502	Ebenezer Water Supply Corp. No. 2	do.	1970	658	7 3 1/2	500 600	Twi	415	237	4-21-65	SE	P	Screened 500-600 feet. Reported drawdown 25 feet after pumping 60 gal/min for 24 hours when drilled. Drilled to 658 feet; plugged back to 600 feet.
601	C. T. White	do.	1967	292	4	292	Tc	380	94.5 97.8	9-19-72 12- 8-76	SE,1	D	Casing slotted 276-292 feet. 1/4/
701	F. G. Berry	--	1896	51	36	51	Tc	480	49.5	11- 6-36	N	U	Dug well. 5/
702	N. Leo Marwill	--	1900	19	--	19	Tc	385	16.9	11- 6-36	N	U	Do.
801	Jim Hart	Judge Spencer	--	24	36	24	Twi	352	19.4	10-23-36	N	U	Dug well. 1/5/
59-101	H. B. Flannagan	Howeth Water Well Service	1969	351	4 2	331 351	Twi	458	180 147.5	3-18-69 12- 2-75	SE,1.5	S	Casing slotted 331-351 feet. Drilled to 351 feet; plugged back to 351 feet. 4/
102	Minden Brachfield Water Supply Corp.	Andrews & Foster Drilling Co.	1973	615	4 1/2	615	Twi	562	264 348.2	10- 3-73 5-11-79	SE	P	Screened 509-551 and 572-593 feet. Reported drawdown 96 feet after pumping 71 gal/min for 24 hours when drilled. Drilled to 642 feet; plugged back to 615 feet. 1/
201	Mrs. H. A. Gosset	Allen Lumber Co.	1966	36	30	36	Tc	430	17.0 14.4	9-25-72 12- 2-75	JE	D	Dug well. 1/4/
202	JPG Oil Co. No. 1 Michael Kangera	--	1966	6,284	--	--	--	440	--	--	--	--	Oil test used in cross section. 3/
203	F. L. Gary Est.	--	1900	40	--	39	Twi	400	36.4	10-27-36	N	U	Dug well. 5/
302	J. R. Worley	--	1912	34	--	34	Tc	540	29.5	10-27-36	N	U	Do.
401	H. E. Adair	Howeth Water Well Service	1966	143	4	143	Twi	420	60	8-27-66	N	U	Casing slotted 127-143 feet. Well destroyed.

See footnotes at end of table.

Table 1.--Records of wells, springs, and test holes in Rusk County and adjacent areas--Continued

Well	Owner or name	Driller	Date completed	Depth of well (feet)	Casing Diameter (inches)	Casing Depth (feet)	Water bearing unit	Altitude of land surface (feet)	Water levels Above (+) or below land surface (feet)	Water levels Date of measurement	Method of lift	Use of water	Remarks
WR-35-59-402	George T. Dulaney	--	Spring	--	--	--	Tc	485	--	--	--	--	Spring, estimated flow 2 gal/min 10-19-36. 1/5/
501	W. T. Arnold	Claude Brooks	1935	14	--	14	Tc	518	11.2	11-26-36	N	U	Dug well. 5/
601	Boyd Patrich	Howeth Water Well Service	1964	242	4 1/2	242	Twi	380	92.6 91.8 98.0	7- 1-77 12-12-77 11-30-78	SE	D	Screened 224-242 feet. 1/
602	JPG Oil Co. No. 1 Troy Welch	--	1966	7,390	--	--	--	557	--	--	--	--	Oil test used in cross section. 3/
603	A. R. Rosseau Est.	--	1900	26	30	26	Twi	439	19.2	10-19-36	N	U	Dug well. 5/
701	J. M. Maul	--	1866	28	36	28	Twi	442	21.2	11-26-36	N	U	Dug well. 1/5/
801	Minden School	Joe Gillispie	1956	412	4 2 1/2	310 412	Twi	521	182.5 185.5	9-22-72 3-19-81	SE	U	Screened 382-412 feet. 1/4/
802	Minden Bachfield Water Supply Corp. No. 1	Key Drilling Co.	1966	611	8 5/8 4	530 601	Twi	460	185	10- 1-66	SE,10	P	Screened 530-540, 561-581, and 591-601 feet. Reported drawdown 60 feet after pumping 80 gal/min for 24 hours when drilled. Drilled to 689 feet; plugged back to 611 feet. 1/
803	Mobil Oil Corp. No. 3	Edington Drilling Co.	1968	716	8 4	656 716	Twi	500	197 184.7	8-27-68 7-24-79	N	U	Screened 650-716 feet. Reported drawdown 180 feet after pumping 52 gal/min for 4 hours when drilled. 2/3/
901	Ohio Oil Co. Leona Pinkerton No. 2	--	1954	7,405	--	--	--	519	--	--	--	--	Oil test used in cross section. 3/
902	J. G. Spradlin	Howeth Water Well Service	1970	480	4 2	448 480	Twi	512	178.3 182.1	9-22-72 11-30-78	SE,1.5	D	Screened 448-480 feet. 1/2/4/
903	Mobil Oil Co. WSW No. 1 Shiloh Upper Pettit Unit	Lanford Drilling Co.	1965	750	7 5/8 4 1/2	704 746	Twi	580	272.7	7-15-81	SE,15	WF	Screened 706-746 feet.
904	James N. Brown	Geophysical Co.	1936	80	--	--	Twi	380	F	10-12-36	N	U	Flows, 10-12-36. 5/
60-101	J. J. Wylie	Howeth Water Well Service	1961	190	4	190	Twi	442	--	--	--	--	1/
102	Agnes O'Kelley	--	1905	27	30	27	Twi	405	23.9	3-20-81	N	U	Dug well.
701	Mrs. N. E. Barnes	N. E. Barnes	1900	32	36	32	Twi	360	23.2	10-19-36	N	U	Dug well. 1/5/
37-01-102	L. O. McMillan Fred Hamilton No. 1	--	1945	4,230	--	--	--	315	--	--	--	--	Oil test used in cross section. 3/
103	A. D. Conner	R. S. Jimmerson	1930	23	36	23	Tr	372	21.2	11- 2-36	N	U	Dug well. 1/
201	W. E. Richardson & Assoc. W. H. Alexander No. 1	--	1957	4,180	--	--	--	417	--	--	--	--	Oil test used in cross section. 3/
202	J. R. Jones	--	1936	22	--	22	Tq	405	21.1	11- 2-36	N	U	Dug well. 5/

See footnotes at end of table.

Table 1.--Records of wells, springs, and test holes in Rusk County and adjacent areas--Continued

Well	Owner or name	Driller	Date completed	Depth of well (feet)	Casing: Diameter (inches)	Casing: Depth (feet)	Water bearing unit	Altitude of land surface (feet)	Water levels: Above (+) or below land surface (feet)	Water levels: Date of measurement	Method of lift	Use of water	Remarks
WR-37-01-203	L. H. Evans	--	1930	20	36	19	Tr	455	19.3	11- 2-36	N	U	Dug well. 5/
301	Leo Roberts	Allen Lumber Co.	1960	43	36	43	Tr	390	23.3 30.9	9-29-76 12- 1-78	JE	D	Open-hole completion. Reported depth 45 feet. 1/4/
401	Hall Wood	Stuart & Egan Oil Co.	1933	4,365	--	--	--	315	F	10- 2-33	N	N	Flows; discharge unreported, 1933.
501	New Salem Water Supply Corp.	Triangle Pump & Supply Co.	1965	280	8 5/8 4	216 280	Tq	428	90 88.4	9- 1-65 3-19-81	SE	U	Screened 217-280 feet. Reported draw down 70 feet after pumping 60 gal/min for 24 hours when drilled. Continuous water-level recorded installed 9-29-77. 1/2/3/4/
502	Signet Oil Co. Nora Walker No. 1	--	1961	4,392	--	--	--	436	--	--	--	--	Oil test used in cross section. 3/
601	Abi Anderson	--	1910	38	60	38	Tr	362	34.3	10-22-36	N	U	Dug well. 5/
701	Leonard Sanger	Leonard Petroleum Co.	1932	4,100	--	--	--	270	F	1936	N	U	Flows; discharge unreported, 1936. 1/5/
802	Carlon Oil Co. No. 1 B. B. Johnson	--	1963	4,267	--	--	--	282	--	--	--	--	Oil test used in cross section. 3/
803	R. R. Buckner	--	1910	30	36	30	Tr	370	25.1	10-22-36	N	U	Dug well. 1/5/
901	W. B. Moore	--	1930	23	36	23	Tr	302	18.8	10-22-36	N	U	Do.
02-101	J. F. Lowe	Smelley	1933	202	--	202	Twi	369	32	1933	N	U	1/5/
102	J. T. Lowe	Griffith Brothers	1931	152	6	152	Tc	360	F	10-23-36	N	U	Flows "2-inch stream" 10-23-36. 1/
201	J. H. Walker	Norris Langford	1956	144	7	144	Tc	400	25 19.8	1956 7-14-81	N	U	Casing slotted 104-144 feet. 1/
202	Laneville Water Supply Corp.	Innerarity Drilling Co.	1965	500	6 5/8 3 1/2	408 491	Twi	433	144.9 148.7	5-10-79 3-30-81	SE,7.5	P	Screened 421-491 feet.
203	J. S. Sprague	--	1930	16	60	16	Tr	440	6.8	3-31-81	JE	Irr	Dug well used for watering garden.
204	Robert Guy	--	--	14	30	14	Tr	420	5.4	4-24-81	N	U	Dug well.
205	do.	Clovis Glenn	1980	156	2	156	Tc	418	19.9	4-24-81	N	U	Pump not installed at time of inventory.
206	S. E. Johnson	Mr. Fox	1920	280	6	280	Twi	395	F	10-23-36	N	U	Made "good flow" until early 1930's when well was "shut off." 1/
301	Pine Springs Baptist Camp	Key Drilling Co.	1973	280	4	280	Twi	492	125.1 130.9	9-29-76 6- 6-79	SE	P	Screened 230-280 feet. 1/2/4/
302	John C. Robbins Williams No. 1	--	1972	6,849	--	--	--	450	--	--	--	--	Oil test used in cross section. 3/
401	J. D. Blanton	--	1918	16	24	16	Tq	495	11.8	10-22-36	N	U	Dug well. 5/
501	J. D. W. Riddle	--	--	32	36	32	Tr	395	29.0	10-27-36	N	U	Dug well. 1/5/
601	D. C. Garrett	W. Bryan	1900	24	60	24	Tr	425	15.1	10-23-36	N	U	Dug well, contains highly mineralized water. 1/5/

See footnotes at end of table.

Table 1.--Records of wells, springs, and test holes in Rusk County and adjacent areas--Continued

Well	Owner or name	Driller	Date completed	Depth of well (feet)	Casing: Diameter (inches)	Casing: Depth (feet)	Water bearing unit	Altitude of land surface (feet)	Water levels: Above (+) or below land surface (feet)	Water levels: Date of measurement	Method of lift	Use of water	Remarks
WR-37-02-602	J. M. Bryan	--	1880	20	36	20	Tr	415	13.0	10-22-36	N	U	Dug well. 5/
603	Arch Bane Est.	Buford Wolverton	1980	16	36	16	Tc	408	6.8	11- 2-36	N	U	Do.
604	J. M. Johnson	--	1900	38	36	38	Tc	530	36.1	10-22-36	N	U	Do.
701	South Rusk Co. Water Supply Corp.	Frye Drilling Co.	1975	1,075	8 5/8 4	962 1,067	Twi	411	150 164	7- -77 5-17-79	TE,25	P	Screened 962-1,067 feet. Reportedly pumped 220 gal/min when drilled. 2/
801	Marvin L. Gunter	Allen Lumber Co.	1970	820	4 1/2	820	Twi	600	265 250.1 252.8 178.3	12-17-70 9-22-72 2-17-73 7-14-81	N	U	Screened 630-820 feet. For emergency use only. 1/4/
802	J. W. Davis	Key Drilling Co.	1975	430	4	430	Twi	500	142.5 146.6	9-29-76 3-19-81	--	--	Screened 410-430 feet. 1/4/
803	Crawford Heirs	--	--	64	36	64	Tq	392	63.3	10-27-36	--	--	Dug well. 5/
902	Exxon No. 1 N. E. Trawick Gas Unit No. 2	--	1973	8,397	--	--	--	508	--	--	--	--	Oil test used in cross section. 3/
903	Exxon No. 1 N. E. Trawick Gas Unit No. 3	--	1973	7,813	--	--	--	578	--	--	--	--	Do.
904	Sulphur Springs (Penny Est.)	--	--	--	--	--	Tq	505	--	--	--	--	Spring. Deussen (1914) reported "large flow." Reported discharge 28 gal/min 1-11-78 (Gunnar Brune). Measured discharge 8.5 gal/min and measured temperature 13.8°C on 7-14-81. 1/
03-101	J. T. Melton	--	--	55	36	55	Tc	500	54.1	10-22-36	N	U	Dug well. 1/5/
201	Mt. Enterprise Water Supply Corp. No. 2	Key Drilling Co.	1979	370	10 3/4 6 5/8	310 370	Twi	480	120 118.6 158.4	4-17-79 5-16-79 4- 1-81	SE,20	P	Screened 310-360 feet. Reported drawdown 170 feet after pumping 160 gal/min for 24 hours when drilled. Drilled to 510 feet; plugged back to 370 feet. 1/3/
202	Mt. Enterprise Water Supply Corp. No. 3	do.	1979	484	10 3/4 6 5/8	414 484	Twi	480	175 118.6 158.8	4-16-79 5-16-79 4- 3-81	SE,20	P	Screened 414-474 feet. Reported drawdown 150 feet after pumping 175 gal/min for 24 hours when drilled. 1/2/3/
301	Minden School	Joe Gillispie	1960	192	4 2 1/2	148 192	Twi	502	56 58.4	4- -60 6- 7-79	SE,1.5	P	Screened 148-192 feet.
302	J. J. Thompson	--	1930	34	36	34	Tc	540	--	--	JE	D	Dug well. 1/
401	J. S. Sprague	Peterson	1900	15	60	15	Tr	440	12.2	11- 2-36	N	U	Dug well. 5/
402	Abe Franklin Est.	Wyatt Venson	1918	16	36	16	Tr	385	11.2	11- 3-36	N	U	Do.
403	Stockman's Spring (Thelma Cormier)	--	Spring	--	--	--	--	360	--	--	--	--	Spring. Deussen (1914) reported "large flow;" Gunnar Brune (1978) reported 10 gal/min.
501	Crompton Water Co.	Burnett	1950	210	6	210	Tr	462	F	7- 5-61	N	U	Measured flow 37 gal/min 7-5-61. Destroyed. 1/

See footnotes at end of table.

Table 1.--Records of wells, springs, and test holes in Rusk County and adjacent areas--Continued

Well	Owner or name	Driller	Date completed	Depth of well (feet)	Casing: Diameter (inches)	Casing: Depth (feet)	Water-bearing unit	Altitude of land surface (feet)	Water levels: Above (+) or below land surface (feet)	Water levels: Date of measurement	Method of lift	Use of water	Remarks
WR-37-03-502	Mt. Enterprise Water Supply Corp. No. 1	Triangle Pump & Supply Co.	1965	470	8 5/8 5	375 470	Twi	557	200 198.5	10- 9-65 4- 3-81	SE,20	P	Screened 390-470 feet. Reported drawdown 55 feet after pumping 200 gal/min for 24 hours when drilled. Drilled to 666 feet; plugged back to 470 feet. 1/3/4/
503	Mrs. J. E. McCrary	--	--	22	36	22	Tq	525	16.6	10-20-36	N	U	Dug well. 5/
504	Mt. Enterprise Gin	--	1934	200	11	200	Tc	525	10 6.7	1936 3-30-42	N	U	Used for about 1 year. 5/
601	Gulf Oil No. 1 W. F. Ross	--	1963	12,309	--	--	--	579	--	--	--	--	Oil test used in cross section.
701	D. W. Varden	D. W. Varden	1908	35	--	35	Qal	342	29.4	10-21-36	N	U	Dug well. 5/
901	W. G. Ross	--	--	54	36	54	Twi	530	48.6	10-20-36	N	U	Dug well. 1/5/
04-103	Ridley, Locklin & Agar No. 1 Alford-Markey	--	1962	3,210	--	--	--	541	--	--	--	--	Oil test used in cross section. 3/
201	Peter Fletcher	--	--	24	--	24	Twi	480	22.4	10-19-36	N	U	Dug well. 5/
301	W. T. C. Anderson	W. Anderson	1928	37	36	37	Tc	425	35.1	10-19-36	N	U	Do.
401	Arlam-Concord Water Supply Corp. "A"	Triangle Pump & Supply Co.	1965	435	8 5/8 4	375 435	Tc	585	98	7- -65	N	U	Screened 375-435 feet. Reported drawdown 100 feet after pumping 80 gal/min for 24 hours when drilled. 1/2/3/
402	Ben Starling	Ben Starling	1916	31	48	31	Tc	425	27.8	10-19-36	N	U	Dug well. 1/5/
601	Fred Anderson	Allen Lumber Co.	1973	315	4 1/2 2 1/2	273 305	Tc	394	29.1 31.6	10- 1-76 11-30-78	SE	D	Screened 285-305 feet. 1/2/4/
801	Arlam-Concord Water Supply Corp.	Lanford Drilling Co.	1977	610	--	--	Twi	502	--	--	N	--	Plugged and abandoned. 3/
901	Arlam-Concord Water Supply Corp. No. 4	do.	1977	267	8 5/8 4 1/2	220 267	Twi	398	--	--	SE	P	Screened 220-262 feet. 1/3/
09-201	Anna Schultz	Texas Co.	1924	3,000	12	3,000	--	258	F	10-26-36	N	U	Flows 1 foot above land surface, 1936; has hydrogen sulfide odor. 1/5/
10-101	John Hightower	--	1916	60	36	60	Tc	370	58.4	10-26-36	N	U	Dug well. 1/5/
11-103	Atlantic Pipeline Co.	Layne-Texas Co.	1933	395	6 4 1/2	361 395	Twi	390	F F	5- 1-33 8-14-79	--	--	Screened 372-395 feet. 1/2/
201	H. L. Hickman	Allen Lumber Co.	1973	59	36	59	Tc	584	47.1 52.0	9-28-76 3-19-81	JE	D	Formerly WR-37-11-101. 1/4/
202	Hickman "in-laws"	--	1975	65	36	65	Tc	584	49.8	9-28-76	JE	D	Formerly WR-37-11-102. 1/
203	Ben Langford	Ben Langford	1900	37	--	37	Twi	460	36.9	10-20-36	N	U	Dug well. 5/
301	J. W. Seelback	J. W. Seelback	--	33	36	33	Tc	480	30.9	10-20-36	N	U	Do.
12-201	Alice Kane	Dick Wallace	--	44	--	--	Tc	540	41.2	10-16-36	N	U	Do.

See footnotes at end of table.

Table 1.--Records of wells, springs, and test holes in Rusk County and adjacent areas--Continued

Well	Owner or name	Driller	Date completed	Depth of well (feet)	Casing: Diameter (inches)	Casing: Depth (feet)	Water bearing unit	Altitude of land surface (feet)	Water levels: Above (+) or below land surface (feet)	Water levels: Date of measurement	Method of lift	Use of water	Remarks
WR-37-12-302	Arlam-Concord Water Supply Corp.	Triangle Pump & Supply Co.	1965	310	8 5/8 4	260 310	Twi	400	90	8-10-65	SE,5	P	Screened 260-310 feet. Reported drawdown 70 feet after pumping 80 gal/min when drilled. 1/2/3/
303	Mrs. S. F. Garrison	--	1900	46	--	46	Twi	380	43.0 42.1	10-13-36 4-20-81	N	U	Dug well.
304	Joyce Dorris	Snap Cotton	1936	48	26	48	Twi	400	40.8	4-20-81	N	Irr	Do.
13-101	T. M. Pittman	Key Drilling Co.	1970	365	4	365	Twi	380	101.8	7-13-81	SE,0.75	D	Screened 347-365 feet.
102	Jessie Lowe	do.	1979	385	4	385	Twi	340	180	12-29-79	--	D	Screened 365-385 feet. 5/
Cherokee County													
DJ-37-09-101	Reklaw Water Supply Corp. No. 2	Innerarity Drilling Co.	--	138	8 5/8 5	82 138	Tc	300	47.7 48.4	12-15-70 4- 2-81	TE,10	P	Screened 86-138 feet. Reported drawdown 9,4 feet after pumping 43 gal/min 5-18-71. 1/4/
102	Reklaw Water Supply Corp. No. 1	West Texas Tool Co.	1965	639	8 5/8 4 1/2	530 639	Twi	300	30 31.8	5- -65 4- 2-81	SE	P	Screened 530-624 feet. Reported drawdown 10.5 feet ater pumping 75 gal/min 5-18-71. 1/4/
Gregg County													
KU-35-33-912	Magnolia L. A. Griffin No. 30	--	1946	3,605	--	--	--	360	--	--	--	--	Oil test used in cross section. 3/
36-702	Carter Jones Drilling Co. No. 1 T. B. Stinchcomb	--	1955	7,165	--	--	--	343	--	--	--	--	Do.
Nacogdoches County													
TX-37-11-504	Exxon (Humble) No. 1 Mary R. Saner, Hole 2	--	1949	8,264	--	--	--	391	--	--	--	--	Do.
601	Exxon (Humble) Trawick Gas Unit No. 46	--	1953	8,166	--	--	--	--	--	--	--	--	Do.
Panola County													
UL-35-44-602	City of Tatum No. 2	Tranham Drilling Co.	1957	567	10 3/4	567	Twi	280	36 67.0	5-17-79 4- 1-81	TE,40	P	One of two industrial wells originally owned by TIPCO. One was purchased by the City of Tatum and converted to public supply.
603	TIPCO	do.	1959	567	10 3/4	567	Twi	280	--	--	N	N	Do.
Smith County													
XH-35-41-701	City of Overton No. 5	R. I. Clifford	1956	290	16 10	190 290	Twi	458	120.6 142.3	1-13-60 5- 9-79	TE	P	Screened 200-280 feet. Drawdown 51 feet after pumping 350 gal/min when drilled. 3/

1/ For chemical analyses of water from wells, see tables 4a or 4b.
2/ For drillers' logs of wells, see table 2.
3/ Electrical logs in files of the U.S. Geological Survey and Texas Department of Water Resources, Austin, Texas.
4/ For additional water levels, see table 3.
5/ Originally inventoried by Lyle (1937); location and altitude are approximate.

Table 2.--Drillers' logs of selected wells in Rusk County

	Thickness (feet)	Depth (feet)
Well WR-35-41-304 Owner: White Oak Water Supply Corp. Driller: Layne-Texas Co.		
Surface soil	4	4
Clay	3	7
Sand	15	22
Clay	32	54
Shale	5	59
Sand	8	67
Shale	33	100
Rock	2	102
Shale	16	118
Sand	18	136
Shale	4	140
Rock	1	141
Shale	13	154
Sandy shale	9	163
Rock	2	165
Shale and boulders	25	190
Shale and layers of sand	23	213
Hard shale	20	233
Shale and lignite	29	262
Sand	15	277
Sandy shale	8	285
Sand	16	301
Sandy shale	45	346
Sand	94	440
Shale	4	444
Well WR-35-41-505 Owner: Gulf Pipeline Co. Driller: Benson Drilling Co.		
Surface soil	20	20
Sand	25	45
Shale	13	58
Sandy shale	17	75

	Thickness (feet)	Depth (feet)
Well WR-35-41-505--Cont.		
Rock	1	76
Sticky shale	27	103
Rock	2	105
Sand and boulders	9	114
Hard sand rock	9	123
Rock	2	125
Sandy shale	8	133
Rock	1	134
Sandy shale	7	141
Rock	1	142
Sand	64	206
Sandy shale	14	220
Hard shale	7	227
Shale and boulders	23	250
Hard sand rock	15	265
Sand	15	280
Lignite and sand streaks	10	290
Lignite	23	313
Sandy shale	23	336
Lignite	4	340
Sandy shale	48	388
Hard sand rock	6	394
Shale	14	408
Sandy shale	10	418
Sand and shale	112	530
Gumbo	10	540
Shale	20	560
Sticky shale	20	580
Packsand	8	588
Gray sand	17	605
Hard Sand	25	630
Sand	60	690

Table 2.--Drillers' logs of selected wells in Rusk County--Continued

	Thickness (feet)	Depth (feet)
Well WR-35-41-505--Cont.		
Rock	4	694
Gumbo	10	704
Sandy shale	64	768
Sand and lignite	22	790
Lignite	16	806
Sand	12	818
Broken sand and lignite	32	850
Gumbo	5	855
Rock	5	860
Sand and lignite	20	880
Rock	6	886
Sand	144	1,030
Gumbo	3	1,033
WR-35-41-708 Owner: Missouri Pacific Railroad Driller: Pomeroy Drilling Co.		
Surface clay and sand	18	18
Water sand	17	35
Clay	15	50
Packed sand and boulders	27	77
Clay	34	111
Rock	2	113
Packed sand	18	131
Sand and shale	7	138
Shale	15	153
Rock	2	155
Packed sand	4	159
Hard sandy shale	10	169
Rock	1	170
Sand and boulders	33	203
Sandy shale	16	219
Sand	30	249
Sand and boulders	51	300

	Thickness (feet)	Depth (feet)
Well WR-35-41-708--Cont.		
Fine sand	10	310
Sand and boulders	17	327
Packed sand	5	332
Sand	13	345
Sand and shale	11	356
Sand and boulders	5	361
Hard shale	10	371
Packed sand	9	380
Sand and boulders	23	403
Shale	14	417
Sand and boulders	23	440
Sand and lignite	20	460
Hard shale	38	498
Sand, boulders, and lignite	32	530
Gumbo	7	537
Rock	1	538
Hard shale	22	560
Sand and shale	20	580
Sand and boulders	20	600
Sand and shale	10	610
Sand and boulders	13	623
Shale	15	638
Sand	5	643
Shale	19	662
Hard sand	22	684
Sand	10	694
Packed sand	11	705
Sand	65	770
Gumbo	1	771

Table 2.--Drillers' logs of selected wells in Rusk County--Continued

	Thickness (feet)	Depth (feet)
Well WR-35-41-809 Owner: City of Overton Driller: Layne-Texas Co.		
Topsoil	2	2
Red clay	20	22
Sand	3	25
Shale	10	35
Sandy shale and sand streaks	9	44
Sand and sandy shale streaks	10	54
Sandy shale with sand and shale streaks	58	112
Rock	1	113
Shale	6	119
Rock	1	120
Shale	23	143
Rock	1	144
Sandy shale	2	146
Rock	2	148
Shale	6	154
Lignite	1	155
Rock	1	156
Sandy shale	1	157
Rock	1	158
Sandy shale	2	160
Rock	1	161
Shale	3	164
Sand	2	166
Rock	1	167
Sand	9	176
Rock and sandy shale	2	178
Sand with lignite streaks	18	196
Shale, sandy shale with lignite streaks	4	200
Sand	16	216
Sand with shale streaks	7	223
Well WR-35-41-809--Cont.		
Sand	75	298
Shale and sandy shale streaks	12	310
Rock	1	311
Sandy shale with sand and lignite streaks	24	335
Shale, sandy shale with lignite streaks	26	361
Shale with lignite streaks	63	424
Sand	5	429
Shale, sandy shale with lignite streaks	34	463
Sand, sandy shale with shale streaks	93	556
Sandy shale with shale streaks	44	600
Shale	8	608
Sandy with shale streaks	9	617
Rock	3	620
Shale	12	632
Sand	2	634
Sandy shale	3	637
Shale and sandy shale	29	666
Sand with shale streaks	3	669
Sandy shale with shale layers	20	689
Hard shale	1	690
Rock	1	691
Hard shale	6	697
Sand and sandy shale	105	802
Shale with sandy streaks	6	808
Shale with lignite streaks	24	832
Shale with sandy shale	4	836
Shale with sandy shale layers	50	886
Rock	1	887
Shale	13	900

Table 2.--Drillers' logs of selected wells in Rusk County--Continued

	Thickness (feet)	Depth (feet)
Well WR-35-42-401 Owner: Jacobs Water Supply Corp. No. 2 Driller: Layne-Texas Co.		
Surface soil	2	2
Sandy clay	18	20
Sand and sandstone streaks	8	28
Sandy clay	38	66
Sandy clay	19	85
Sand (good)	90	175
Lignite	3	178
Sandy clay and lignite streaks	58	236
Sandy clay and sand streaks	42	278
Clay	47	325
Sand (fair)	73	398
Shale and sandy shale	34	432
Sand (poor)	10	442
Sandy shale and sand streaks	33	475
Sandy shale and sand streaks	43	518
Sand (broken)	6	524
Sand (good)	27	551
Rock	3	554
Sandy clay and rock streaks	10	564
Sand (broken)	21	585
Sand and clay streaks	14	599
Clay	15	614
Well WR-35-43-501 Owner: R. C. Walling Driller: Howeth Water Well Service		
Red clay	12	12
White clay	8	20
Gray clay	12	32
Sandy	8	40
Sand	47	87
Clay	3	90
Sand	3	93

	Thickness (feet)	Depth (feet)
Well WR-35-43-501--Cont.		
Clay	87	180
Sandy	30	210
Clay	10	220
Well WR-35-44-101 Owner: Boy Scouts of America, Camp Kennedy Driller: Layne-Texas Co.		
Surface sand	2	2
Clay and sandy clay	19	21
Sand and some gravel	31	52
Fine quicksand	16	68
Gray clay and sand	27	95
Shale and sand	77	172
Sand and shale	24	196
Shale and sand streaks	23	219
Gray sand rock	2	221
Soft gray shale and sandy shale	19	240
Sand rock	1	241
Gray shale, few sand and rock layers	59	300
Shale and sand	23	323
Sand, shale, and sandy shale	11	334
Sand, broken, with shale layers	12	346
Coarse gray sand and few shale breaks	15	361
Sand, soft shale, and lignite breaks	30	391
Sand, soft shale, and lignite breaks	27	418
Hard sand rock	3	421
Well WR-35-44-501 Owner: Crystal Farms Water Supply Corp. Driller: Frye Drilling Co.		
Topsoil and white sand	22	22
Rocky shale and lignite	18	40
Shale, thin rocks	40	80

	Thickness (feet)	Depth (feet)
Well WR-35-44-501--Cont.		
Gray shale	21	101
Blue shale	20	121
Blue shale, lignite	41	162
shale and sand	21	183
Sand, shale, and rock	25	208
Shale and sand	16	224
Sand and shale	82	306
Rock sand and shale	20	326
Shale and rock	21	347
Sand	20	367
Rock and good sand	21	388
Shale and good sand	20	408
Good sand and rock	10	418
Well WR-35-44-801 Owner: Texas Utilities Services, Inc., No. 1 Martin Lake Plant Driller: Layne-Texas Co.		
Iron rock and red sandy clay	7	7
Gray sandy clay	16	23
Lignite	2	25
Sandy shale, sand streaks, and lignite streaks	41	66
Lignite	7	73
Sand with lignite and shale	2	75
Sandy shale	3	78
Sand, lignite streaks, and shale	11	89
Shale, sandy shale, and lignite streaks	34	123
Shale with sand streaks	29	152
Sand and shale layers	25	177
Rock	1	178
Sand (cut good)	16	194
Rock	1	195
Sand (cut good)	35	230
Well WR-35-44-801--Cont.		
Rock (hard)	4	234
Sand	8	242
Sand and shale streaks	13	255
Rock (hard)	1	256
Sand	3	259
Rock (hard)	6	265
Sand and shale streaks	56	321
Sandy shale, shale streaks, and lignite	11	332
Sand with shale layers	62	394
Sand and shale layers	66	460
Sand, lignite, and shale streaks	14	474
Sand	114	588
Sand and shale (broken)	12	600
Sand with shale streaks	41	641
Sand	28	669
Sand with streaks of shale lignite (cut good)	31	700
Sandy shale	39	739
Well WR-35-49-206 Owner: Cities Service Co. water supply well No. 1, Wheelis Lease Driller: Layne-Texas Co.		
Top sand	6	6
Red clay and shale	7	13
Sandy shale, shale streaks, and gravel	35	48
Rock (hard)	1	49
Shale	32	81
Sandy shale	17	98
Rock (hard)	1	99
Sand shale and shale	10	109
Rock	1	110
Sandy shale	3	113

Table 2.--Drillers' logs of selected wells in Rusk County--Continued

	Thickness (feet)	Depth (feet)
Well WR-35-49-206--Cont.		
Sand, sandy shale streaks, and shale layers	48	161
Sand (cut good, coarse)	77	238
Shale, lignite, and sandy shale	52	290
Fine sand and sandy shale	11	301
Sand shale, lignite	28	329
Rock (hard)	4	333
Sandy shale and sand (broken)	25	358
Sandy shale and shale streaks (cut good)	25	383
Sandy shale and lignite, mixed	61	444
Sand and sandy shale (cut good)	37	481
Sandy shale and sand streaks	42	523
Sand and sandy shale streaks	16	539
Shale and sandy shale (cut hard)	86	625
Sand	5	630
Rock (hard)	2	632
Sand and shale streaks	19	651
Sandy shale	6	657
Sand	8	665
Sandy shale and sand streaks	9	674
Sand and shale streaks	27	701
Sandy shale	9	710
Sand and sandy shale	19	729
Sandy shale and lignite streaks	8	737
Sand	4	741
Sandy shale and lignite streaks	29	770
Sand and sandy shale (broken layers)	32	802
Sandy shale and lignite streaks	15	817
Sand and sandy shale and lignite	6	823
Sand	8	831
Sandy shale, lignite, and sand streaks	9	840

	Thickness (feet)	Depth (feet)
Well WR-35-49-206--Cont.		
Sand, sandy shale, and lignite (broken)	21	801
Sand and lignite streaks (cut good)	27	888
Sandy shale, sand, and lignite streaks	29	917
Sand	14	931
Shale and sandy shale	14	945
Sand and shale streaks	11	956
Sandy shale and lignite streaks	7	963
Rock	1	964
Sandy shale, shale, and lignite streaks	24	988
Rock	1	989
Sandy shale, sand layers, and lignite streaks	22	1,011
Sand	5	1,016
Sandy shale	5	1,021
Well WR-35-49-601 Owner: Gaston Water Supply Corp. No. 1 Drilling: Edington Drilling Co.		
Clay	22	22
Shale	41	63
Sand	20	83
Shale	21	104
Sand	28	132
Shale	34	166
Sand, 185 - rock	20	186
Shale rock	21	207
Shale	102	309
Sand shale	21	330
Shale	21	351
Sand	15	366
Shale	66	432
Sand	20	452

	Thickness (feet)	Depth (feet)
Well WR-35-49-601--Cont.		
Sand shale	21	473
Shale	9	482
Rock	18	500
Sand	18	518
Shale	16	534
Shale rock	21	555
Shale	61	616
Shale rock	21	637
Shale	21	1/658

	Thickness (feet)	Depth (feet)
Well WR-35-50-206 Owner: Burris Dorsey Driller: White Drilling Co.		
Red, white, and yellow clay	7	7
Tan shale	20	27
White sand, some shale streaks	37	64
Lignite	12	76
Gray sticky shale	4	80
Sandy shale	4	84
Gray sticky shale	11	95
Gray brittle shale	6	101
Gray sticky shale	15	116
Gray sandy shale with heavy lignite	11	127
Gray sticky shale	10	137
Brown shale and lignite	14	151
Gray sand	2	153
Brown and gray shale with some lignite	5	158
Sandy shale	10	168
Brown sticky shale	8	176
Gray sticky shale	20	196
Shale with thin lignite streak	2	198
Sandy shale	3	201
Gray sand	14	215

1/ Well is deeper, but driller omitted bottom portion of log.

	Thickness (feet)	Depth (feet)
Well WR-35-50-502 Owner: City of Henderson No. 16 (formerly White Oak Water Co.) Driller: Layne-Texas Co.		
Surface soil and sand	10	10
Gray clay	18	28
Gray sand and lignite	9	37
Gray shale and lignite streaks	19	56
Gray sand and lignite streaks	14	70
Shale, sand, and limestone streaks	18	88
Sandy shale	6	94
Sand and shale	3	97
Shale, sand streaks, and lignite	25	122
Sand and shale	12	134
Shale and lignite	30	164
Sand and shale layers	14	178
Sand, thin shale layers	11	189
Sand and shale	9	198
Shale	15	213
Sand and shale streaks	30	243
Sand and shale layers (cut good)	12	255
Shale and sand layers	18	273
Shale and sandy shale	14	287
Sand and shale streaks (cut good)	15	302
Sand (cut good)	62	370
Sandy shale and shale layers	6	370
Shale and sand streaks	22	392
Sand and sandy shale	10	402
Shale and sandy shale	8	410

	Thickness (feet)	Depth (feet)
Well WR-35-50-601 Owner: Texas Highway R.O.W. Driller: Works Progress Administration		
Surface soil	3.5	3.5
Sand rock	.5	4
Yellow and red clay	2	6
Yellow clay	1	7

Table 2.--Drillers' logs of selected wells in Rusk County--Continued

	Thickness (feet)	Depth (feet)
Well WR-35-50-601--Cont.		
Red clay	1	8
Yellow sandy clay	2	10
Yellow and red sandy clay	1	11
Yellow sandy clay	1	12
Orange sandy clay	1	13
Yellowish-orange sandy clay	6	19
White clay	1	20
Red and white clay	1	21
White sandy clay	2	23
Red and white sandy clay	1	24
White sandy clay	1	25
Gumbo	2	27
Yellow sandy clay	1	28
White sandy clay	1	29
Yellow and white sandy clay	1	30
White sandy clay	1	31
Well WR-35-50-901 Owner: City of Henderson No. 4 Driller: Layne-Texas Co.		
Clay	10	10
Yellow sand	10	20
Sandy shale	80	100
Shale and lignite	45	145
Fine-grained sand	15	160
Sandy shale and lignite	92	252
Fine-grained sand	10	262
Shale and lignite	33	295
Sand	20	315
Rock	1	316
Sandy shale	49	365
Shale	35	400
Gray sand	12	412
Shale	15	427
Well WR-35-50-901--Cont.		
Sand	52	479
Shale	3	482
Sand	78	560
Brown shale and lignite	23	583
Well 35-50-907 Owner: City of Henderson No. 13, James Owen well Driller: Layne-Texas Co.		
Sandy soil	2	2
Sandy clay	10	12
Sand	5	17
Clay and lignite	53	70
Sand	6	76
Gray shale, sand and lignite	111	187
Sand and shale layers	36	223
Shale and sand layers	27	250
Brown and gray shale and lignite	38	288
Sand and shale streaks	8	296
Shale and sandy shale	8	304
Sandy shale	12	316
Shale and sand streaks	58	374
Sand and shale	9	383
Rock	1	384
Shale and sandy shale	17	401
Sandy shale	10	411
Shale and sand streaks	27	438
Sand	6	444
Shale and sandy shale	29	473
Sand and shale layers	22	495
Sand, thin shale layers	20	515
Rock	5	520
Sand and hard streaks	51	571
Shale and lignite	19	590
Sand and shale streaks	91	681

Table 2.--Drillers' logs of selected wells in Rusk County--Continued

	Thickness (feet)	Depth (feet)
Well WR-35-50-907--Cont.		
Shale	11	692
Sand and shale streaks	8	700
Shale and sandy shale	14	714
Well WR-35-51-101 Owner: New Prospect Water Supply Corp. No. 2 Driller: Layne-Texas Co.		
Topsoil	1	1
Clay	15	16
Rock	2	18
Clay and sand streaks	3	21
Clay, sandy shale and rock	12	33
Sand and shale streaks	20	53
Rock	3	56
Sand and shale layers	10	66
Rock	2	68
Shale	4	72
Sand, sandy shale and lignite	15	87
Rock	1	88
Sand	5	93
Lignite	2	95
Shale and sandy shale	17	112
Shale and sandy shale	16	128
Shale	8	136
Shale and sandy shale	17	153
Lignite	6	159
Shale and sandy shale	23	182
Sand and shale	12	194
Shale and sandy shale	40	234
Rock	1	235
Sand and shale (hard)	38	273
Rock	1	274
Sand and shale (hard)	21	295
Sand, lignite, and shale	39	334
Well WR-35-51-101--Cont.		
Shale	30	364
Sand (fine)	12	376
Sandy shale and sand layers	4	380
Sand, shale, and lignite	61	441
Rock	1	442
Sand, shale, and lignite streaks	50	492
Shale	2	494
Sand and shale streaks (coarse)	22	516
Sandy shale and sand layers	18	534
Sand and shale layers	10	544
Shale, sandy shale, and sand streaks	29	573
Sand, shale, and lignite streaks	11	584
Shale and rock layers (hard)	34	618
Sand (fine)	7	625
Lignite	3	628
Shale and lignite	6	634
Well WR-35-51-502 Owner: Church Hill Water Supply Corp. No. 2 Driller: Howeth Water Well Service		
Red and white clay	20	20
Sand	20	40
Clay	76	116
Sand	24	140
Clay	40	180
Sand	12	192
Clay	208	400
Sand	40	440
Coal, clay, and sand	24	464
Sand, streaked	44	508
Clay	42	550
Sandy	30	580
Clay	30	610

	Thickness (feet)	Depth (feet)
Well WR-35-52-101 Owner: Evel Faulkner Driller: Howeth Water Well Service		
White-yellow clay	21	21
Sand clay	3	24
Clay	4	28
Sand clay	7	35
Dark clay	13	48
Coal	7	55
Clay	7	62
Sand	6	68
Clay	33	101
Coal	2	103
Clay	7	110
Sand	3	113
Clay	61	174
Sand	14	188
Clay	4	192
Well WR-35-52-701 Owner: H. H. Truelock Driller: Howeth Water Well Service		
Clay	30	30
Sand, streaked	15	45
Clay	30	75
Coal	9	84
Clay	16	100
Sand, streaked	15	115
Clay	155	270
Sand	26	296
Clay	6	302
Well WR-35-57-203 Owner: Amoco Production Co. No. 3, Siler Lease Driller: Layne-Texas Co.		
Topsoil	2	2
Sand	22	24

	Thickness (feet)	Depth (feet)
Well-WR-35-57-203--Cont.		
Sandy shale and lignite	38	62
Sand	5	67
Sand and gravel	35	102
Sand and shale streaks	18	120
Sand	5	125
Sandy shale and sand layers	35	160
Sand	13	173
Shale	11	184
Sand and lignite	10	194
Sandy shale	74	268
Sand, lignite, and shale streaks	33	301
Shale and sandy shale	25	326
Sand and shale streaks	39	365
Rock	1	366
Sandy shale	19	385
Sand	6	391
Shale	13	404
Shale and sandy shale	26	430
Sand and shale streaks	23	453
Shale and sand streaks	18	471
Sand	8	479
Shale and sandy shale	25	504
Sand	8	512
Rock	1	513
Sand with shale streaks	5	518
Sandy shale	17	535
Sand and shale layers	15	550
Rock	1	551
Sand	34	584
Rock	2	586
Shale	2	588
Rock	2	590

	Thickness (feet)	Depth (feet)
Well WR-35-57-203--Cont.		
Sand	16	606
Shale	7	613
Sand and shale layers	39	652
Shale	3	655
Sand and lignite layers	23	678
Rock	1	679
Shale	5	684
Sand and shale streaks	15	699
Shale	12	711
Sand	38	749
Shale	11	760
Sandy shale with lignite	60	820
Sand and shale layers	60	880
Shale	19	899
Sand	6	905
Rock	1	906
Shale	2	908
Sand	2	910
Shale	9	919
Sand	19	938
Sandy shale	11	949
Shale	14	963
Sand and sandy shale	22	985
Sand	23	1,008
Shale	5	1,013
Rock	2	1,015
Sand and shale streaks	25	1,040
Sandy shale	12	1,052
Sand and shale streaks	15	1,067
Rock	3	1,070
Sand and shale layers	34	1,104
Sandy shale and sand streaks	21	1,125
Shale	10	1,135

	Thickness (feet)	Depth (feet)
Well WR-35-57-901 Owner: W. A. Whitehead Driller: White Drilling Co.		
Brown, tan, and yellow clay with gravel	20	20
Brown and gray shale	35	55
Gray sand	45	100
Gray shale and lignite	50	150
Lignite	15	165
Gray sand	5	170
Gray shale with heavy lignite	40	210
Gray sand with heavy lignite	20	230
Gray shale and lignite	40	270
Gray sand	45	315
Well WR-35-58-102 Owner: Goodsprings Water Supply Corp. Driller: Edington Drilling Co.		
Clay	22	22
Sand	48	70
Shale	70	140
Sandy shale	41	186
Shale	9	195
Sand	11	206
Shale	61	267
Sand	8	275
Shale	54	329
Sand	20	349
Shale	41	390
Shale and rock layers	20	410
Shale	82	492
Sand	82	574
Shale	20	594
Shale	14	608
Sand	7	615
Shale and sandy shale	20	635
Shale	7	642

Table 2.--Drillers' logs of selected wells in Rusk County--Continued

	Thickness (feet)	Depth (feet)
Well WR-35-58-102--Cont.		
Sand	8	650
Shale	6	656
Well WR-35-59-803 Owner: Mobil Oil Corp. No. 3 Driller: Edington Drilling Co.		
Surface clay and sand	25	25
Gray shale	108	133
Rock	1	134
Gray shale	13	147
Gray sand	43	190
Gray shale	161	351
Gray sand	41	392
Gray shale	263	655
Fine white sand	65	720
Gray sandy shale	44	764
Gray shale	11	775
Well WR-35-59-902 Owner: J. G. Spradlin Driller: Howeth Water Well Service		
Red and yellow clay	20	20
Clay	20	40
Sandy	19	59
Clay	47	106
Sand	14	120
Clay	178	298
Sandy bed	77	375
Clay	73	448
Sand streaks	32	480
Well WR-37-01-501 Owner: New Salem Water Supply Corp. Driller: Triangle Pump & Supply Co.		
Clay and sand	5	5
Clay and rock, red	25	30
Sand, fine, white	50	80
Well WR-37-01-501--Cont.		
Sandy shale and shale	100	180
Sand, brown and yellow	28	208
Shale, blue, hard	22	230
Sandy shale and sand, fine	16	246
Sand, white and gray, coarse	24	270
Sandy shale and sand	30	300
Sand streaks and sandy shale	100	400
Sand, fine	20	420
Shale	10	430
Shale, blue and black	83	513
Well WR-37-02-301 Owner: Pine Springs Baptist Camp Driller: Key Drilling Co.		
Clay	30	30
Sand	41	71
Shale	14	85
Sand	25	110
Shale	5	115
Sand	25	140
Shale	20	160
Sand	35	195
Sandy shale	35	230
Sand	50	280
Well WR-37-02-701 Owner: South Rusk County Water Supply Corp. Driller: Frye Drilling Co.		
Topsoil, sandy clay, shale	60	60
Blue shale	320	380
Broken shale, blue	24	404
Sand	34	438
Tight shale, blue	68	506
Sand and rocky sand	4	510
Hard shale, some rock	88	598

	Thickness (feet)	Depth (feet)
Well WR-37-02-701--Cont.		
Hardpacked sand	12	610
Sand, shale, hardpacked	74	684
Sand	70	754
Shale	86	840
Hardpacked sand	30	870
Streaky sand and shale	90	960
Good sand	110	1,070
Shale	5	1,075
Well WR-37-03-202 Owner: Mount Enterprise Water Supply Corp. No. 3 Driller: Key Drilling Co.		
Sand	126	126
Shale	18	144
Sand	10	154
Sandy shale	48	202
Sand	36	238
Shale	72	310
Sand	50	360
Sandy shale	54	414
Sand	60	474
Sandy shale	10	484
Well WR-37-04-401 Owner: Arlam-Concord Water Supply Corp. "A" Driller: Triangle Pump & Supply Co.		
Sand and clay	20	20
Sandy shale, clay	26	46
Rock, red	3	49
Rock	54	103
Lignite	25	128
Sand	32	160
Shale	38	198
Rock	1	199
Shale and sand streaks	101	300
Well WR-37-04-401--Cont.		
Sand, fine, white, gray	170	470
Shale	30	500
Sand	20	520
Shale	20	540
Sand, fine, white	20	560
Shale, black and dark blue	65	625
Well WR-37-04-601 Owner: Fred Anderson Driller: Allen Lumber Co.		
Red clay	3	3
Gray clay	4	7
Brown shale	13	20
Gray shale	37	57
Dark sand	3	60
Shale	3	63
Dark sand	7	70
Shale	13	83
White sand	17	100
Shale	80	180
Sand	9	189
Shale	29	218
Sand stringers	44	262
Sand	23	285
Sand stringers	25	310
Shale	5	315
Well WR-37-11-103 Owner: Atlantic Pipeline Co. Driller: Layne-Texas Co.		
Sand	3	3
Clay	22	25
Blue shale	45	70
Rock	1	71
Shale	23	94

Table 2.--Drillers' logs of selected wells in Rusk County--Continued

	Thickness (feet)	Depth (feet)
Well WR-37-11-103--Cont.		
Rock	3	97
Blue shale, hard streaks, sand and lignite	100	197
Hard shale	73	270
Shale	54	324
Rock	1	325
Shale	47	372
Sand	23	395
Well WR-37-12-302 Owner: Arlam-Concord Water Supply Corp. Driller: Triangle Pump & Supply Co.		
Clay and sand	7	7
Sand, white, fine	63	70
Sandy shale	40	110
Shale	20	130
Sand, real fine, white	90	220
Sand streaks and sandy shale	50	270
Sand, coarse gray and white	60	330
Shale	40	370
Sand	60	430
Sand and shale streaks	178	608

Table 3.--Water levels in wells in Rusk and Cherokee Counties

(Water levels in feet below land surface;
total depth indicates depth to which well is drilled or depth to which casing is set, if known)

RUSK COUNTY

Well WR-35-41-501
Owner: Leveretts Chapel School
Altitude: 478 feet
Total depth: 449 feet
Aquifer: Wilcox

Date	Water level
Mar. 3, 1947	222
Sept. 21, 1972	175.2
Feb. 7, 1974	174.9
Feb. 12, 1975	175.0
Dec. 12, 1975	174.8
Dec. 7, 1976	174.9
Dec. 16, 1977	176.0
Mar. 9, 1979	179.4
Mar. 19, 1981	178.4

Well WR-35-41-509
Owner: Shell Oil Co., W. P. Moore
Altitude: 420 feet
Total depth: 369 feet
Aquifer: Carrizo-Wilcox

Date	Water level
1931	50
Aug. 25, 1937	71.0
Jan. 27, 1938	61.4
June 10, 1938	63.8
Oct. 6, 1938	65.8
Feb. 7, 1939	60.0
May 5, 1939	61.3
July 19, 1939	61.3
Dec. 11, 1939	61.2
Apr. 4, 1940	57.9
July 12, 1940	57.6
Nov. 26, 1940	54.0
Oct. 6, 1941	53.1

Well WR-35-41-510
Owner: W. P. Moore
Altitude: 440 feet
Total depth: 33 feet
Aquifer: Reklaw Formation

Date	Water level
Aug. 25, 1937	13.5
Jan. 27, 1938	12.0
June 10, 1938	10.3
Oct. 6, 1938	13.0
Feb. 7, 1939	11.3
May 5, 1939	10.0
July 18, 1939	13.0
Dec. 11, 1939	14.1
Apr. 4, 1940	13.0
July 12, 1940	13.2
Nov. 26, 1940	12.9

Well WR-35-41-601
Owner: Maria Redic
Altitude: 440 feet
Total depth: 90 feet
Aquifer: Carrizo Sand

Date	Water level
Sept. 21, 1972	71.4
Feb. 17, 1973	46.1
Feb. 7, 1974	30.9
Feb. 12, 1975	17.1
Dec. 2, 1975	66.3
Dec. 7, 1976	39.1
Dec. 16, 1977	64.4
Nov. 30, 1978	69.3
Mar. 19, 1981	69.4

Well WR-35-41-705
Owner: City of Overton No. 1
Altitude: 489 feet
Total depth: 889 feet
Aquifer: Wilcox

Date	Water level
Mar. 19, 1936	148.8
Aug. 25, 1937	164.8

Well WR-35-41-705--Cont.

Date	Water level
June 10, 1938	165.7
Feb. 7, 1939	147.8
May 5, 1939	148.0
July 19, 1939	153.5
Dec. 11, 1939	148.5
Apr. 5, 1940	144.0
July 12, 1940	148.5
Nov. 26, 1940	142.9
Nov. 26, 1941	141.4

Well WR-35-41-707
Owner: Overton Ice Co.
Altitude: 498 feet
Total depth: 360 feet
Aquifer: Carrizo-Wilcox

Date	Water level
Nov. 25, 1931	145.7
Mar. 18, 1936	161.5
Jan. 27, 1938	166.6
Dec. 11, 1939	156.0
Mar. 5, 1940	151.7
Nov. 26, 1940	149.5

Well WR-35-42-801
Owner: Kenneth Smith
Altitude: 440 feet
Total depth: 67 feet
Aquifer: Carrizo

Date	Water level
Sept. 21, 1972	62.3
Feb. 18, 1973	61.6
Feb. 7, 1974	56.3
Feb. 12, 1975	55.7
Dec. 2, 1975	55.7
Dec. 7, 1976	57.4
Dec. 16, 1977	57.8
Mar. 19, 1981	60.7

Table 3.--Water levels in wells in Rusk and Cherokee Counties--Continued

Well WR-35-43-501
Owner: R. C. Walling
Altitude: 398 feet
Total depth: 211 feet
Aquifer: Wilcox

Date	Water level
Oct. 1, 1976	54.2
Dec. 7, 1976	54.2
Dec. 16, 1977	54.8
Mar. 3, 1981	56.1

Well WR-35-43-601
Owner: Francis Wheeler
Altitude: 400 feet
Depth: 54 feet
Aquifer: Carrizo

Date	Water level
Sept. 26, 1972	49.8
Feb. 16, 1973	48.7
Feb. 7, 1974	43.9
Feb. 12, 1975	43.8
Dec. 2, 1975	45.1
Dec. 7, 1976	46.5
Dec. 16, 1977	47.8
Nov. 29, 1978	48.7
Mar. 3, 1981	47.0

Well WR-35-44-401
Owner: Greer and Snow (Mayflower School)
Altitude: 354 feet
Aquifer: Wilcox

Date	Water level
Sept. 26, 1972	94.0
Feb. 16, 1973	79.9
Feb. 7, 1974	91.9
Dec. 12, 1975	91.1

Well WR-35-44-402
Owner: James M. Forgotson
Altitude: 360 feet
Total depth: 295 feet
Aquifer: Wilcox

Date	Water level
Oct. 12, 1971	100
Sept. 26, 1972	81.8
Feb. 16, 1973	80.1

Well WR-35-44-402--Cont.

Date	Water level
Feb. 7, 1974	80.8
Feb. 12, 1975	79.8
Dec. 2, 1975	79.6
Dec. 7, 1976	79.1
Dec. 16, 1977	79.8
Nov. 29, 1978	81.1
June 5, 1979	87.7

Well WR-35-44-601
Owner: City of Tatum No. 1
Altitude: 295 feet
Total depth: 438 feet
Aquifer: Wilcox

Date	Water level
Mar. 4, 1939	39
Nov. 3, 1943	43.6
Sept. 25, 1972	64.2
Feb. 16, 1973	61.0
Feb. 7, 1974	61.9
Feb. 20, 1975	62.6
Dec. 7, 1976	82.0
May 17, 1979	93

Well WR-35-49-502
Owner: Dan Kerr
Altitude: 455 feet
Total depth: 585 feet
Aquifer: Wilcox

Date	Water level
Feb. 28, 1959	150
Sept. 20, 1972	182.3
Feb. 7, 1974	174.0
Feb. 12, 1975	155.5
Dec. 2, 1975	174.5
Dec. 7, 1976	171.4
Nov. 30, 1978	173.0

Well WR-35-49-801
Owner: Carlisle Public School
Altitude: 368 feet
Total depth: 275 feet
Aquifer: Carrizo

Date	Water level
Jan. 16, 1941	57
Sept. 18, 1972	59.3
Feb. 17, 1973	52.3
Feb. 7, 1974	60.9
Feb. 12, 1975	74.3
Dec. 2, 1975	79.8
Dec. 7, 1976	53.5
Dec. 16, 1977	52.1
Dec. 1, 1978	50.3
June 4, 1979	49.2

Well WR-35-50-302
Owner: Jerome Rhoden
Altitude: 402 feet
Total depth: 49 feet
Aquifer: Carrizo

Date	Water level
Sept. 21, 1972	28.0
Feb. 18, 1973	11.0
Feb. 7, 1974	8.6
Feb. 12, 1975	9.8
Dec. 2, 1975	18.2
Dec. 7, 1976	15.4
Dec. 16, 1977	18.4
Dec. 1, 1978	12.1
Mar. 19, 1981	18.4

Well WR-35-50-501
Owner: Joe Hartman
Altitude: 460 feet
Total depth: 48 feet
Aquifer: Carrizo Sand

Date	Water level
Sept. 21, 1972	32.8
Feb. 17, 1973	31.2
Feb. 7, 1974	25.4
Feb. 12, 1975	28.0

Table 3.--Water levels in wells in Rusk and Cherokee Counties--Continued

Well WR-35-50-501--Cont.

Date	Water level
Dec. 2, 1975	29.6
Dec. 7, 1976	30.6
Dec. 16, 1977	31.5
Dec. 1, 1978	33.2

Well WR-35-50-502
Owner: City of Henderson No. 16
Formerly White Oak Water Co.
Altitude: 420 feet
Total depth: 372 feet
Aquifer: Wilcox

Date	Water level
Sept. 29, 1963	128
Apr. 14, 1979	215
May 16, 1979	210.5
Mar. 17, 1981	168.7

Well WR-35-50-702
Owner: Z. D. Stone
Altitude: 448 feet
Total depth: 27 feet
Aquifer: Wilcox

Date	Water level
Mar. 17, 1936	19.2
Aug. 24, 1937	18.5
Jan. 26, 1938	7.3
Oct. 7, 1938	23.1
Feb. 8, 139	22.7
May 5, 1939	21.9
July 19, 1939	23.0
Dec. 11, 1939	24.1
Apr. 5, 1940	23.8
July 12, 1940	23.1
Nov. 27, 1940	21.5

Well WR-35-50-703
Owner: J. J. Colwell
Altitude: 416 feet
Total depth: 20 feet
Aquifer: Wilcox

Date	Water level
Mar. 17, 1936	14.6
Aug. 24, 1937	18.3

Well WR-35-50-703--Cont.

Date	Water level
Jan. 26, 1938	6.0
Oct. 7, 1938	17.6
Feb. 8, 1939	17.8
May 5, 1939	18.2
July 19, 1939	18.4
Dec. 11, 1939	18.1
Apr. 5, 1940	16.7
July 12, 1940	16.1
Nov. 27, 1940	12.8

Well WR-35-50-801
Owner: City of Henderson No. 7
Altitude: 452 feet
Total depth: 624 feet
Aquifer: Wilcox

Date	Water level
July 19, 1947	275
Sept. 22, 1972	294.4
Feb. 7, 1974	285.8
Feb. 12, 1975	291.4
Dec. 2, 1975	297.0
May 2, 1979	314.9
Aug. 1979	305
Apr. 22, 1981	359.6

Well WR-35-50-802
Owner: City of Henderson No. 8
Altitude: 512
Total depth: 747
Completion interval: 547-736 feet
Aquifer: Wilcox

Date	Water level
Jan. 23, 1948	315
Aug. 17, 1958	317
July 11, 1978	390
May 2, 1979	338.7
Aug. 1979	390
Mar. 17, 1981	361.3

Well WR-35-50-901
Owner: City of Henderson No. 4
Altitude: 419 feet
Total depth: 583 feet
Aquifer: Wilcox

Date	Water level
Dec. 19, 1935	168.5
Aug. 24, 1937	170.4
Dec. 12, 1939	156.8
Apr. 4, 1940	156.4
July 13, 1940	164.9
Nov. 27, 1940	150.8
Aug. 21, 1944	196
May 2, 1969	271.9
Apr. 1, 1981	302.8

Well WR-35-50-902
Owner: City of Henderson No. 5
Altitude: 410 feet
Total depth: 879 feet
Aquifer: Wilcox

Date	Water level
Aug. 11, 1938	206
Dec. 11, 1939	153.1
Apr. 4, 1940	144.0
July 12, 1940	157.4
Nov. 27, 1940	148.7

Well WR-35-50-903
Owner: City of Henderson No. 6
Altitude: 415 feet
Total depth: 603 feet
Screened interval: 488-592 feet
Aquifer: Wilcox

Date	Water level
Aug. 23, 1942	247
Aug. 21, 1944	207
Mar. 12, 1979	257.1
May 2, 1979	265.6
Mar. 1981	287

Table 3.--Water levels in wells in Rusk and Cherokee Counties--Continued

Date	Water level
Well WR-35-50-904	
Owner: City of Henderson No. 10	
Altitude: 455 feet	
Total depth: 698 feet	
Screened interval: 510-686 feet	
Aquifer: Wilcox	
Feb. 8, 1954	355
July 11, 1978	380
Mar. 12, 1979	291.5
May 2, 1979	318.1
Aug. 1979	286
Mar. 1981	330
Well WR-35-50-907	
Owner: City of Henderson No. 13, James Owen well	
Altitude: 465 feet	
Total depth: 712 feet	
Aquifer: Wilcox	
Feb. 1, 1964	233
Mar. 13, 1979	302.1
May 2, 1979	291.2
Aug. 1979	302
Mar. 1981	319
Well WR-35-50-910	
Owner: City of Henderson No. 2	
Altitude: 404 feet	
Total depth: 558 feet	
Completion interval: 445-558 feet	
Aquifer: Wilcox	
Oct. 7, 1938	178.0
Feb. 8, 1939	163.4
Dec. 12, 1939	167
July 13, 1940	174
Nov. 27, 1940	161
Well WR-35-50-912	
Owner: O. F. Burt	
Altitude: 482 feet	
Total depth: 51 feet	
Aquifer: Carrizo	
Aug. 24, 1937	6.0
Well WR-35-50-912--Cont.	
Jan. 27, 1938	1/
June 11, 1938	2.2
Oct. 7, 1938	1/
Feb. 8, 1939	1.8
Well WR-35-50-913	
Owner: Rosa Burt	
Altitude: 468 feet	
Total depth: 14 feet	
Aquifer: Carrizo	
July 15, 1936	2.5
Jan. 1, 1938	1.0
June 11, 1938	4.3
Oct. 7, 1938	10.1
Feb. 8, 1939	3.0
May 6, 1939	4.0
July 19, 1939	7.6
Dec. 12, 1939	11.4
Apr. 5, 1940	3.5
July 13, 1940	4.5
Nov. 27, 1940	4.4
Well WR-35-51-502	
Owner: Church Hill Water Supply Corp. No. 2	
Altitude: 452 feet	
Total depth: 490 feet	
Aquifer: Wilcox	
Oct. 7, 1971	150
Oct. 7, 1971	178.5
Dec. 7, 1976	196.5
Dec. 16, 1977	202.7
May 3, 1979	209.4
Mar. 19, 1981	207.7
Well WR-35-51-802	
Owner: L. K. Ballow	
Altitude: 440 feet	
Total depth: 22 feet	
Aquifer: Wilcox	
Dec. 2, 1936	19.6
Aug. 24, 1937	18.9
Jan. 23, 1938	2/2.2
June 11, 1938	9.6
Oct. 7, 1938	20.4
Feb. 8, 1939	2/1.8
May 6, 1939	8.3
July 19, 1939	19.0
Dec. 12, 1939	22.2
Apr. 5, 1940	13.1
July 13, 1940	12.9
Nov. 27, 1940	10.7
Well WR-35-51-902	
Owner: J. Russell Smith	
Altitude: 385 feet	
Total depth: 26 feet	
Aquifer: Wilcox	
Dec. 2, 1936	23.3
Aug. 24, 1937	23.5
Jan. 23, 1938	2/5.4
June 11, 1938	20.2
Oct. 8, 1938	25.6
Feb. 8, 1939	2/6.2
May 6, 1939	24.0
July 19, 1939	23.0
Dec. 12, 1939	26
Apr. 4, 1940	25.9
July 13, 1940	24.6
Nov. 12, 1940	6.4

1/ Water seeping into well, actual water level unknown. 2/ Measured in rain.

Table 3.--Water levels in wells in Rusk and Cherokee Counties--Continued

Well WR-35-51-903
Owner: E. F. Posey
Altitude: 442 feet
Total depth: 48 feet
Aquifer: Wilcox

Date	Water level
Dec. 2, 1936	40.2
Aug. 24, 1937	40.2
Jan. 23, 1938	39.8
June 11, 1938	40.1
Oct. 8, 1938	39.6
Feb. 8, 1939	39.1
May 6, 1939	39.5
July 19, 1939	39.9
Dec. 12, 1939	39.5
Apr. 5, 1940	39.3
July 13, 1940	39.4
Nov. 27, 1940	37.9

Well WR-35-52-101
Owner: Evel Faulkner
Altitude: 340 feet
Total depth: 189 feet
Aquifer: Wilcox

Date	Water level
Jan. 8, 1966	50
Sept. 25, 1972	49.7
Feb. 16, 1973	48.3
Feb. 12, 1975	48.3
Dec. 2, 1975	46.5
Dec. 7, 1976	49.3
Dec. 16, 1977	52.2
Nov. 30, 1978	53.2
Apr. 2, 1981	55.5

Well WR-35-58-101
Owner: Lonnie Lockridge
Altitude: 380 feet
Total depth: 31 feet
Aquifer: Carrizo

Date	Water level
Sept. 20, 1972	18.0
Feb. 17, 1973	15.4
Feb. 8, 1974	11.4

Well WR-35-58-101--Cont.

Date	Water level
Feb. 12, 1975	11.8
Dec. 2, 1975	14.1
Dec. 8, 1976	14.1
Dec. 12, 1977	15.5
Mar. 17, 1981	18.1

Well WR-35-58-201
Owner: Lynn Simmons
Altitude: 360 feet
Total depth: 47 feet
Aquifer: Wilcox

Date	Water level
Aug. 19, 1972	18.0
Feb. 17, 1973	15.3
Feb. 8, 1974	11.8
Dec. 2, 1975	16.4

Well WR-35-58-401
Owner: Elmer Parker
Altitude: 500 feet
Total depth: 82 feet
Aquifer: Wilcox

Date	Water level
July 15, 1971	67
Sept. 20, 1972	69.4
Feb. 17, 1973	68.6
Feb. 8, 1974	67.1
Feb. 12, 1975	66.3
Dec. 7, 1976	67.0
Dec. 12, 1977	67.6
Dec. 1, 1978	68.6
Mar. 19, 1981	70.0

Well WR-35-58-501
Owner: Freewill Baptist Church
Altitude: 350 feet
Total depth: 95 feet
Aquifer: Wilcox

Date	Water level
Aug. 23, 1969	30
Sept. 29, 1972	28.3
Feb. 17, 1973	23.4

Well WR-35-58-501--Cont.

Date	Water level
Feb. 12, 1975	20.8
Dec. 2, 1975	26.3

Well WR-35-58-601
Owner: C. T. White
Altitude: 380 feet
Total depth: 292 feet
Aquifer: Carrizo

Date	Water level
Sept. 19, 1972	94.5
Feb. 17, 1973	94.0
Feb. 12, 1975	96.0
Dec. 2, 1975	96.7
Dec. 8, 1976	97.8

Well WR-35-59-101
Owner: H. B. Flannagan
Altitude: 458 feet
Total depth: 410 feet
Aquifer: Wilcox

Date	Water level
Mar. 18, 1969	180
Sept. 22, 1972	192.3
Feb. 16, 1973	186.3
Feb. 7, 1974	179.8
Feb. 12, 1975	180.6
Dec. 2, 1975	147.5

Well WR-35-59-201
Owner: Mrs. H. A. Gosset
Altitude: 430 feet
Total depth: 36 feet
Aquifer: Carrizo

Date	Water level
Sept. 25, 1972	17.0
Feb. 16, 1973	12.6
Feb. 7, 1974	9.0
Feb. 12, 1975	9.9
Dec. 2, 1975	14.4

Table 3.--Water levels in wells in Rusk and Cherokee Counties--Continued

Date	Water level
Well WR-35-59-801 Owner: Minden School Altitude: 521 feet Total depth: 412 feet Aquifer: Wilcox	
Sept. 22, 1972	182.5
Feb. 16, 1973	182.2
Feb. 8, 1974	183.0
Feb. 12, 1975	181.8
Dec. 2, 1975	182.8
Dec. 8, 1976	182.9
Nov. 30, 1978	184.0
Mar. 19, 1981	185.5
Well WR-35-59-902 Owner: J. G. Spradlin Altitude: 512 feet Total depth: 480 feet Screened interval: 448-480 feet Aquifer: Wilcox	
Sept. 22, 1972	178.3
Feb. 16, 1973	79.0
Feb. 12, 1975	83.2
Dec. 2, 1975	179.0
Dec. 8, 1976	178.3
Dec. 12, 1977	177.4
Nov. 30, 1978	182.1
Well WR-37-01-301 Owner: Leo Roberts Altitude: 390 feet Total depth: 43 feet Aquifer: Reklaw Formation	
Sept. 29, 1976	23.3
Dec. 8, 1976	26.0
June 30, 1977	25.4
Dec. 12, 1977	28.6
Dec. 1, 1978	30.9
Well WR-37-01-501 Owner: New Salem Water Supply Corp. Altitude: 428 feet Total depth: 280 feet Aquifer: Queen City	
Sept. 1, 1965	90
Sept. 28, 1976	90.2
Dec. 8, 1976	93.9
Dec. 12, 1977	92.1
May 10, 1978	90.1
June 25, 1978	90.3
Oct. 13, 1978	90.7
Dec. 1, 1978	90.4
Apr. 10, 1979	89.8
Aug. 15, 1979	90.0
Mar. 15, 1980	90.1
Dec. 14, 1980	90.3
Mar. 19, 1981	88.4
Well WR-37-02-301 Owner: Pine Springs Baptist Camp Altitude: 492 feet Total depth: 280 feet Aquifer: Wilcox	
Sept. 29, 1976	125.1
Dec. 8, 1976	125.4
Dec. 12, 1977	126.3
June 6, 1979	130.9
Well WR-37-02-802 Owner: J. W. Davis Altitude: 500 feet Total depth: 430 feet Aquifer: Wilcox	
Sept. 29, 1976	142.5
Dec. 8, 1976	144.9
July 1, 1977	144.0
Well WR-37-02-802--Cont.	
Dec. 12, 1977	151.5
Nov. 30, 1978	148.1
Mar. 19, 1981	146.6
Well WR-37-03-502 Owner: Mount Enterprise Water Supply Corp. No. 1 Altitude: 557 feet Total depth: 470 feet Aquifer: Wilcox	
Oct. 28, 1965	200
Sept. 28, 1976	205.0
Dec. 8, 1976	204.3
Dec. 12, 1977	213.0
May 16, 1979	212.4
Mar. 19, 1981	219.9
Apr. 3, 1981	198.5
Well WR-37-04-601 Owner: Fred Anderson Altitude: 394 feet Total depth: 315 feet Aquifer: Carrizo	
Oct. 1, 1976	29.1
Dec. 8, 1976	29.8
Dec. 12, 1977	28.8
Nov. 30, 1978	31.6
Well WR-37-11-201 Owner: W. L. Hickman Altitude: 584 feet Total depth: 59 feet Aquifer: Carrizo	
Sept. 28, 1976	47.1
Dec. 8, 1976	51.3
Dec. 12, 1977	50.8
Nov. 30, 1978	51.3
Mar. 19, 1981	52.0

Table 3.--Water levels in wells in Rusk and Cherokee Counties--Continued

CHEROKEE COUNTY

Well WR-DJ-37-09-101
Owner: Reklaw Water Supply Corp. No. 2
Altitude: 300 feet
Total depth: 138 feet
Completion interval: 86-138 feet
Aquifer: Carrizo

Date	Water level
Dec. 15, 1970	47.7
May 18, 1971	46.9
Feb. 6, 1974	43.2
Feb. 19, 1975	45.7
Dec. 5, 1975	54.7
June 20, 1979	47
Apr. 2, 1981	48.4

Well DJ-37-09-102
Owner: Reklaw Water Supply Corp. No. 1
Altitude: 300 feet
Total depth: 639 feet
Completion interval: 530-624 feet
Aquifer: Wilcox

Date	Water level
May 1965	30
Dec. 15, 1970	23.6
May 18, 1971	23.7
Feb. 6, 1974	26.0
Feb. 19, 1975	26.9
Dec. 5, 1975	28.0
Dec. 9, 1976	28.8
Dec. 16, 1977	29.7
Dec. 1, 1978	30.6
Apr. 2, 1981	31.8

Table 4a.--Water-quality data for ground-water samples collected from wells in Rusk and Cherokee Counties
(mg/L - milligrams per liter; µg/L - micrograms per liter; µmhos - micromhos per centimeter at 25°C; °C - degrees Celsius)

Note: When no potassium (K) is reported, sodium and potassium are calculated and reported as sodium (Na).
Water-bearing units: Tc - Carrizo aquifer; Tcw - Carrizo-Wilcox aquifer; Tq - Queen City aquifer;
Tk - Reklaw Formation; and Twi - Wilcox aquifer.

Well	Depth or producing interval (feet)	Water-bearing unit	Date	Dissolved silica (SiO_2) (mg/L)	Dissolved iron (Fe) (µg/L)	Dissolved manganese (Mn) (µg/L)	Dissolved calcium (Ca) (mg/L)	Dissolved magnesium (Mg) (mg/L)	Dissolved sodium (Na) (mg/L)	Dissolved potassium (K) (mg/L)	Bicarbonate (HCO_3) (mg/L)	Carbonate (CO_3) (mg/L)	Dissolved sulfate (SO_4) (mg/L)	Dissolved chloride (Cl) (mg/L)	Dissolved fluoride (F) (mg/L)	Nitrate (NO_3) (mg/L)	Dissolved solids (sum of constituents) (mg/L)	Hardness (Ca, Mg) (mg/L)	Percent sodium	Residual sodium carbonate (RSC)	Sodium adsorption ratio (SAR)	Specific conductance (µmhos)	pH (units)	Temperature (°C)
Rusk County																								
R-35-41-202	435	Twi	6-10-36[1]	--	--	--	3	5	167	--	458	--	<10	11	--	--	411	28	--	--	--	--	--	--
304	337-440	Twi	8-28-41[2]	--	--	--	8	1.5	140	--	354	--	27	8	--	--	359	26	--	--	--	--	--	--
307	25	Tr	1-21-42[2]	--	--	--	2.8	3.6	9	--	18	--	10	5.5	--	4.0	44	17	--	--	--	--	--	--
308	378-797	Twi	11-28-31[1]	--	--	--	--	--	--	--	--	--	20	330	--	--	--	15	--	--	--	--	--	--
			8- 8-41[2]	--	--	--	2.8	2.4	163	--	421	--	15	8	--	--	398	17	--	--	--	--	--	26
309	319-872	Twi	10- 4-41[2]	--	--	--	<5	1.5	259	--	573	--	31	48	--	0	622	6	--	--	--	--	--	--
401	27	Tr	6-15-36[1]	--	--	--	14	6	18	--	18	--	2.8	21	--	--	86	34	--	--	--	--	--	--
502	796-831	Twi	8-20-55[3]	15	--	--	1.4	.4	243	--	544	30	18	12	--	--	644	5	--	--	--	--	8.8	--
505	895-1,032	Twi	6- 5-36[1]	--	--	--	25	5	555	--	634	--	20	535	--	--	1,452	83	--	--	--	--	--	--
			10- 6-41[2]	--	--	--	4.4	1.2	564	--	500	--	18	575	0.3	2.0	1,411	16	--	--	--	--	--	--
507	900	Twi	10- 8-41[2]	--	--	--	2.8	3.6	164	--	439	--	15	.5	1.2	0	403	22	--	--	--	--	--	--
601	90	Tc	9-21-72[4]	46	--	--	157	40	25	--	273	--	323	37	.3	.4	762	560	8.90	0.0	0.4	1,022	7.2	--
			7-29-77[4]	82	--	--	73	6	13	--	77	--	133	26	.1	.4	371	207	12.02	.0	.3	475	7.2	--
702	240-303	Twi	4- -55[4]	--	230	--	15	4	42	--	49	--	64	28	--	--	180	54	62.90	.0	2.4	--	6.7	--
			5-23-56[3]	18	80	--	2	0	332	--	605	--	20	112	--	--	782	6	99.31	9.8	64.4	--	8.5	--
703	247-330	Tcw	10- 7-41[2]	--	--	--	11	3.6	32	--	24	--	61	20	0	0	140	42	--	--	--	--	--	--
			4- -55[4]	--	22	5	7	3	46	--	37	0	58	28	.2	<.4	167	31	--	--	--	--	6.7	--
			8-23-83	11	44	3	1.2	.2	190	1.0	480	0	22	12	.5	--	493	4	99	--	45	780	8.7	--
705	247-863	Twi	3-18-36[1]	--	--	--	--	27	107	--	293	--	60	28	--	--	366	110	--	--	--	--	--	--
707	360	Tcw	3-18-36[1]	--	--	--	36	6	46	--	134	--	67	24	--	--	245	114	--	--	--	--	--	--
708	705-770	Twi	6- 1-36[1]	--	--	--	3	4	52	--	49	--	62	22	--	--	167	22	--	--	--	--	--	--
803	452-535	Twi	10-10-41[2]	--	--	--	14	0	114	--	317	--	16	5	--	--	306	35	--	--	--	--	--	--
			9-21-72[4]	14	--	--	2	1	142	--	348	--	22	8	.3	2.0	362	9	97.13	5.5	20.4	557	8.3	--
			8-26-77[4]	17	3	11	2	1	128	2.0	327	--	19	5	.2	2.7	337	7	95.98	5.1	18.4	522	8.2	--
804	406-540	Twi	7- 6-61[4]	15	2	10	1	0	122	2.0	296	--	16	6	.1	.0	305	3	99.06	4.8	33.6	497	7.9	--
807	745-800	Twi	8-23-83	12	28	4	<2	.2	220	.9	540	19	14	12	.8	--	546	2	99	--	65	910	8.9	26.5
808	436-583	Twi	8-23-83	--	--	--	.7	.1	120	1.1	280	4	36	7	.3	--	320	--	99	--	37	320	8.4	24.5
809	850-870	Twi	9-10-79[5]	14	87	<100	2	.2	339	--	720	24	10	70	1.3	.7	841	6	--	--	--	--	8.5	--
	750-770		11-15-79[5]	12	<40	<50	1	0	175	--	396	18	21	5	.3	.7	[6]434	3	--	--	--	697	--	--
	720-790		2- 6-80[5]	11	240	<50	2	0	166	--	399	10	20	1	.2	.3	407	4	--	--	--	673	8.4	--

See footnotes at end of table.

Table 4a.--Water-quality data for ground-water samples collected from wells in Rusk and Cherokee Counties--Continued

Well	Depth or producing interval (feet)	Water-bearing unit	Date	Dissolved silica (SiO_2) (mg/L)	Dissolved iron (Fe) (µg/L)	Dissolved manganese (Mn) (µg/L)	Dissolved calcium (Ca) (mg/L)	Dissolved magnesium (Mg) (mg/L)	Dissolved sodium (Na) (mg/L)	Dissolved potassium (K) (mg/L)	Bicarbonate (HCO_3) (mg/L)	Carbonate (CO_3) (mg/L)	Dissolved sulfate (SO_4) (mg/L)	Dissolved chloride (Cl) (mg/L)	Dissolved fluoride (F) (mg/L)	Nitrate (NO_3) (mg/L)	Dissolved solids (sum of constituents) (mg/L)	Hardness (Ca, Mg) (mg/L)	Percent sodium	Residual sodium carbonate (RSC)	Sodium adsorption ratio (SAR)	Specific conductance (µmhos)	pH (units)	Temperature (°C)
WR-35-41-901	427-642	Twi	7- 6-61[4]	13	1	--	1	0	154	--	366	--	21	8	0.4	0.4	379	1	99.26	5.9	42.4	607	--	--
904	25	Tr	6- 4-36[1]	--	--	--	60	29	--	--	--	--	60	146	--	--	315	269	--	--	--	--	--	--
42-202	578-620	Twi	5-17-66[7]	--	180	--	.8	--	262	--	586	41	4	13	.4	--	[6]609	2	--	--	--	--	8.9	--
			10- 1-76[4]	10	--	--	4	1	214	--	580	--	4	8	.4	.4	520	12	97.06	9.2	24.8	828	8.2	--
302	22	Tr	12- 3-36[1]	--	--	--	--	--	--	--	12	--	44	9	--	--	86	--	--	--	--	--	--	--
303	11	Tr	6-22-36[1]	--	--	--	3	12	--	--	--	--	--	35	--	--	50	58	--	--	--	--	--	--
401	527-547	Twi	4-13-65[8]	10	.7	--	2	0	243	--	533	32	27	10	--	--	586	--	--	--	--	970	8.5	--
701	592-661	Twi	2- 1-65[8]	9	<50	--	2	0	357	--	832	26	0	39	--	--	853	5	--	--	--	1,360	8.3	--
801	67	Tc	9-21-72[4]	39	--	--	16	2	3	--	40	--	12	6	.2	.4	98	48	11.93	.0	.1	115	6.5	--
			7-29-77[4]	41	--	--	27	1	3	--	73	--	7	3	.1	4.1	122	68	8.36	.0	.1	155	7.3	--
901	360-402	Twi	7-11-79[4]	11	--	--	.7	11	140	1.1	340	12	7.2	2.7	.2	--	354	47	99	--	8.9	520	8.6	24.0
43-302	25	Tc	7-12-79[4]	10	--	--	5.1	1.6	4.1	1.0	16	0	9.1	7.4	.1	--	46	19	30	--	.4	87	5.8	23.0
501	179-211	Twi	10- 1-76[4]	31	--	--	23	6	31	3.0	127	--	34	9	.1	.6	200	80	43.97	.4	1.4	295	7.9	--
601	54	Tc	9-26-72[4]	15	--	--	3	1	1	--	9	--	4	5	.1	.4	33	14	15.79	.0	.1	35	6.0	--
			7-29-77[4]	19	100	--	22	1	2	--	3	--	4	3	.1	2.3	84	57	6.86	.0	.1	119	7.1	--
44-101	361-391	Twi	8-10-49[4]	15	--	--	2	--	250	4.0	628	--	4	22	--	3.0	608	5	--	--	--	1,020	8.5	--
401	--	--	7-12-79	--	--	--	2.6	1.0	--	--	530	8	7.8	9.4	--	--	--	11	--	--	--	740	8.5	23.0
501	364-406	Twi	10- 1-76[4]	31	--	--	23	6	31	3.0	127	6	13	57	--	--	--	4	--	--	--	1,200	8.5	24.0
503	31	Twi	12- 2-36[1]	--	--	--	4	6	18	--	6	--	12	40	--	--	87	34	--	--	--	--	--	--
601	387-428	Twi	3- 6-39[2]	19	--	--	3	5	362	--	--	--	87	117	.8	.4	882	28	96.56	9.0	29.7	--	8.6	--
			11- 3-43[4]	12	--	--	2	1	336	7.4	--	--	7	143	1.0	3.2	832	6	97.52	10.4	48.4	--	8.3	--
			9-25-72[4]	12	--	--	3	1	328	--	--	--	5	141	1.0	.4	801	10	98.4	10.0	41.9	1,270	8.3	--
			7-29-77[4]	13	230	--	1	1	404	--	--	--	4	216	1.4	.4	982	4	99.25	11.2	68.3	1,630	8.0	--
			7-12-79[2]	10	--	--	1	23	350	1.2	610	20	9.7	150	1.0	--	867	97	99	--	15	1,530	8.6	24.0
701	--	Twi	10- 3-66[7]	--	130	--	20.0	2.9	144.3	--	266	40.8	34.4	21	--	.1	[6]394	62	--	--	--	590	8.5	--
			8-24-83	--	--	--	12	2.3	120	2.2	340	0	34	18	.4	--	371	--	86	--	8.7	548	8.5	23.0
801	540-695	Twi	9-10-73[5]	11	190	<20	1	<.5	298	--	516	31	12	112	1.0	1.5	719	3	--	--	--	1,250	8.6	--
802	300-442	Twi	8-25-75[5]	18	<50	.3	20	3	74	--	195	0	29	23	.2	.6	255	62	--	--	--	424	7.9	--
49-101	21	Tr	6-11-36[1]	--	--	--	--	--	--	--	73	--	67	41	--	--	219	--	--	--	--	--	--	--
103	29	Tr	6-11-36[1]	--	--	--	16	18	35	--	--	--	181	18	--	--	268	116	--	--	--	--	--	--

See footnotes at end of table.

Table 4a.--Water-quality data for ground-water samples collected from wells in Rusk and Cherokee Counties--Continued

Well	Depth or producing interval (feet)	Water-bearing unit	Date	Dis-solved silica (SiO_2) (mg/L)	Dis-solved iron (Fe) (µg/L)	Dis-solved man-ganese (Mn) (µg/L)	Dis-solved cal-cium (Ca) (mg/L)	Dis-solved magne-sium (Mg) (mg/L)	Dis-solved sodium (Na) (mg/L)	Dis-solved potas-sium (K) (mg/L)	Bicar-bonate (HCO_3) (mg/L)	Car-bonate (CO_3) (mg/L)	Dis-solved sul-fate (SO_4) (mg/L)	Dis-solved chlo-ride (Cl) (mg/L)	Dis-solved fluo-ride (F) (mg/L)	Ni-trate (NO_3) (mg/L)	Dis-solved solids (sum of constit-uents (mg/L)	Hard-ness (Ca, Mg) (mg/L)	Per-cent sodium	Resid-ual sodium car-bonate (RSC)	Sodium ad-sorp-tion ratio (SAR)	Specific conduct-ande (µmhos)	pH (units)	Tem-pera-ture (°C)
WR-35-49-201	456-516	Twi	5- 7-38[3]	80	200	--	4	--	71	--	152	--	9	21	--	--	385	10	--	--	--	--	7.8	--
	456-576		10- 9-41[2]	--	--	--	8.4	1.2	84	--	122	--	81	17	0.1	--	252	26	--	--	--	--	--	--
			8- 9-49[4]	14	170	--	1	--	97	8.4	142	--	77	18	.1	2.2	287	25	--	--	--	--	7.6	--
203	447-578	Twi	10-17-41[2]	--	--	--	6.8	2.4	109	--	262	--	38	7.0	--	--	293	27	--	--	--	--	--	--
206	860-926	Twi	7-31-78[5]	12	<50	<50	2	0	367	--	710	30	0	11.9	1.3	<.1	881	6	--	--	--	1,340	8.7	--
209	835-880	Twi	1-19-42[2]	--	--	--	2.0	7.3	112	--	299	--	23	5.5	.8	--	[6]/298	35	--	--	--	--	--	--
302	550-650	Twi	4-26-74[7]	--	100	.0	2.4	.5	141	--	320	21.6	5	8.0	.2	.0	336	8	--	--	--	540	8.5	--
			5-10-74[7]	--	300	.0	2.4	.0	149	--	332	26.4	.0	9.0	.3	.0	[6]/350	6	--	--	--	600	8.8	--
402	400	Twi	1-20-42[2]	--	--	--	8.0	7.3	63	--	140	--	56	9.5	--	.5	213	50	--	--	--	--	--	--
403	120	Tc	1-20-42[2]	--	--	--	18	7.3	3.0	--	0	--	56	16	--	.5	101	75	--	--	--	--	--	--
501	350-431	Twi	7- 6-61[2]	15	240	--	1.5	.4	108	--	172	0	79	12	.2	0	301	5	98	0	21	481	7.5	--
			7-29-61[2]	15	<50	--	2.0	.3	121	--	180	0	104	9.5	.1	0	340	6	93.13	2.8	23.5	540	7.0	--
			9-18-72[4]	14	--	--	3	<1	115	--	215	0	70	9	.2	<.4	317	7	--	--	--	528	7.2	--
502	530-550	Twi	9-20-72[4]	13	--	--	2	2	190	--	478	--	32	7	.2	1.5	482	13	96.90	7.5	22.7	735	7.8	--
503	360-433	Twi	1-21-42[2]	--	--	--	<3	2.4	124	--	159	--	124	14	0	.5	343	10	--	--	--	--	--	--
509	18	Tc	8-30-36[5]	--	--	--	32	26	35	--	--	--	260	22	--	--	375	186	--	--	--	--	--	--
510	139-199	Tc	6-20-42[4]	--	--	--	22	9.7	25	--	12	--	109	19	0	.5	201	96	--	--	--	--	--	--
601	655-778	Twi	7-19-55[7]	14	400	Trace	2.4	Trace	209.1	--	412	38.4	6.0	37.0	.1	--	[6]/510	6	--	--	--	--	8.7	--
			6- 7-65[7]	18	300	<.5	6.4	.5	185.2	--	232	100.8	19.3	30.0	.9	--	592	18	--	--	--	--	9.5	--
			7-13-79[2]	--	--	--	1.8	31	350	--	390	0	7.5	36.0	--	--	--	130	--	--	--	800	8.2	25
602	605-697	Twi	12-10-74[7]	--	200	30	9.6	.6	66.7	--	149	12.0	8.0	15.2	.1	.0	186	26.3	--	--	--	300	8.2	--
603	395-419	Twi	5- 8-40[2]	--	--	--	--	--	62	--	142	--	10	9.0	--	.0	145	4.0	--	--	--	--	--	--
			9-18-41[2]	--	--	--	2.4	2.7	54	--	134	--	13	8	.1	--	146	17	--	--	--	--	--	--
702	483-911	Twi	6-20-42[2]	--	--	--	.4	1.2	346	--	781	--	15	69	1.4	2.0	819	6	--	--	--	--	--	--
801	225-260	Tc	9-10-40[3]	41	300	--	1.9	.4	209	--	508	15.6	1.2	11.5	.95	--	[6]/573	6.4	--	--	--	--	8.6	--
			9-18-41[2]	--	--	--	2.4	2.7	199	--	531	--	5	6	1.2	--	477	17	--	--	--	--	--	--
			8- 9-49[4]	12	--	--	1	1	204	14	543	--	4	10	.4	2.5	515	4	94.76	8.3	34.5	--	8.7	--
			9-18-72[4]	11	--	--	1	1	207	--	520	--	5	12	1.0	.4	404	5	98.55	13.3	35.0	763	8.3	--
802	870	Twi	7- 6-61[4]	13	100	--	1	.0	349	--	816	22	8.4	55	1.6	1.8	830	2	99.67	13.3	96.1	1,360	8.3	
804	730-822	Twi	9-12-68[7]	--	50	--	.8	.5	335	--	661	60	14	53	1.0	.0	[6]/789	4	--	--	--	1,180	8.6	--
			7-13-79[2]	--	--	--	.9	12	--	--	730	26	18	46	--	--	--	52	--	--	--	1,460	8.7	27
805	750-950	Twi	1-26-78[5]	11	<50	<50	2	<1	602	--	844	24	0	411	1.9	<.1	469	6	--	--	--	2,490	8.6	--

See footnotes at end of table.

Table 4a.--Water-quality data for ground-water samples collected from wells in Rusk and Cherokee Counties--Continued

Well	Depth or producing interval (feet)	Water-bearing unit	Date	Dissolved silica (SiO_2) (mg/L)	Dissolved iron (Fe) (µg/L)	Dissolved manganese (Mn) (µg/L)	Dissolved calcium (Ca) (mg/L)	Dissolved magnesium (Mg) (mg/L)	Dissolved sodium (Na) (mg/L)	Dissolved potassium (K) (mg/L)	Bicarbonate (HCO_3) (mg/L)	Carbonate (CO_3) (mg/L)	Dissolved sulfate (SO_4) (mg/L)	Dissolved chloride (Cl) (mg/L)	Dissolved fluoride (F) (mg/L)	Nitrate (NO_3) (mg/L)	Dissolved solids (sum of constituents) (mg/L)	Hardness (Ca, Mg) (mg/L)	Percent sodium	Residual sodium carbonate (RSC)	Sodium adsorption ratio (SAR)	Specific conductance (µmhos)	pH (units)	Temperature (°C)
WR-35-49-812	890-1,035	Twi	10-22-80[5]	11	1.8	<0.5	3	0.5	852	--	976	0	0	746	3.9	<0.1	2,137	10	--	--	--	3,090	8.2	--
50-101	20	Tc	11-27-36[1]	--	--	--	14	6	13	--	43	--	36	11	--	--	101	59	--	--	--	--	--	--
103	32	Tr	11-29-36[1]	--	--	--	487	292	33	--	33	--	2,385	110	--	--	3,481	2,442	--	--	--	--	--	--
204	85	Tc	8-14-62[4]	18	--	--	261	46	609	--	7	--	15	1,499	.2	20.4	2,475	--	--	--	--	4,430	5.6	--
			10- 1-64[4]	17	--	--	430	89	920	--	74	--	13	2,410	.5	39	3,960	1,440	--	--	--	6,800	6.4	--
302	49	Tc	9-21-72[4]	53	--	--	37	9	43	--	87	--	23	73	.4	27	308	129	41.96	0.0	1.6	475	6.9	--
			2-12-75[4]	46	--	--	33	3	48	7	12	--	8	102	.4	61	314	93	50.18	.0	2.1	472	6.1	--
			7-29-77[4]	58	--	--	26	5	48	7	28	--	16	90	.3	28.9	287	85	49.77	.0	2.0	438	6.6	--
303	32	Tc	1-24-36[1]	--	--	--	5	4	21	--	31	--	22	17	--	--	84	27	--	--	--	--	--	--
401	612-682	Twi	2- 8-74[7]	--	1.5	.0	1.6	.0	236.8	--	509	19.2	5.0	45.6	1.0	.0	[6]560	4	--	--	--	900	8.2	--
403	20	Tc	5-27-36[1]	--	--	--	23	4	20	--	49	--	40	25	--	--	136	72	--	--	--	--	--	--
501	48	Tc	9-21-72[4]	15	--	--	19	2	4	--	55	--	4	9	.1	2.5	82	55	13.52	.0	.2	127	7.0	--
502	292-364	Twi	9-25-63[3]	15	2	--	3.6	.8	57.1	--	143	0	5.7	9	--	--	174	12	--	--	--	--	7.7	--
			8-22-83	21	<3	2	4.3	.8	48	1.6	130	0	16	8.3	.2	--	164	14	87	--	5.8	240	7.5	26.5
801	531-611	Twi	4-26-47[3]	14	400	--	3.3	1.2	140.4	--	344	14.0	.4	8.0	--	--	380	13.2	--	--	--	--	8.6	--
			11- 3-59[4]	--	60	--	4	<1	97	--	210	0	222	15	.1	1.1	249	9	--	--	--	415	8.3	--
			9-22-72[4]	14	--	--	2	1	88	--	207	0	12	16	.2	<.4	235	11	94.46	3.2	12.6	367	7.6	--
			6-30-77[4]	13	1	--	2	1	109	--	250	0	8	18	.2	.5	275	8	96.30	3.9	15.7	437	8.3	--
			8-22-83	13	--	--	1.7	.3	130	--	340	0	3.2	12	.3	--	328	5	98	--	25	540	8.5	24.7
802	548-736	Twi	--[4]	--	--	--	2	1	240	--	363	--	7	40	.9	.4	950	6	98.28	5.7	34.6	950	8.8	--
803	577-588	Twi	1- -42[2]	--	--	--	--	--	282	--	571	--	0	55	0	--	982	--	--	--	--	--	--	--
	704-715		1- -42[2]	--	--	--	1.3	--	309	--	673	--	0	45	1.6	--	1,112	3.2	--	--	--	--	--	--
804	246-257	Twi	2- -42[2]	--	--	--	4.7	1.1	66	--	172	--	2.5	11	.7	--	292	16	--	--	--	--	--	--
	493-504		2- -42[2]	--	--	--	--	0	308	--	688	--	0	23	1.7	--	1,116	--	--	--	--	--	--	--
	600-611		2- -42[2]	--	--	--	2.8	.4	230	--	483	--	6.2	40	1.8	--	845	8.6	--	--	--	--	--	--
	683-694		2- -42[2]	--	--	--	2.3	.6	202	--	512	--	1.9	8.5	1.4	--	795	8.2	--	--	--	--	--	--
805	15	Twi	10-23-36[1]	--	--	--	8	--	28	--	73	--	8	9	--	--	89	20	--	--	--	--	--	--
901	419-551	Twi	6-19-36[1]	--	--	--	3	2	63	--	171	--	<10	10	--	--	162	17	--	--	--	--	--	--
			2-21-47[1]	15	.7	<.5	4	4	63	--	171	0	8	11	.1	<.4	200	27	--	--	--	--	8.1	--
			11- 3-59[4]	--	.4	<.5	2	1	69	--	160	--	18	12	.1	<.4	181	7	94.28	2.4	9.9	305	8.5	--
903	488-592	Twi	8- -42[2]	--	--	--	5	2	88	--	201	--	6	7	.4	.4	230	21	--	--	--	--	--	--
			2-21-47[4]	13	.4	<.5	4	1	97	0	250	--	5	11	.4	<.4	264	14	93.73	3.8	11.2	--	7.9	--
			11- 3-59[4]	--	3.2	<.5	2	<1	100	--	250	--	17	10	.1	<.4	252	7	95.98	3.9	14.4	420	8.5	--

See footnotes at end of table.

Table 4a.--Water-quality data for ground-water samples collected from wells in Rusk and Cherokee Counties--Continued

Well	Depth or producing interval (feet)	Water-bearing unit	Date	Dis-solved silica (SiO_2) (mg/L)	Dis-solved iron (Fe) (µg/L)	Dis-solved man-ganese (Mn) (µg/L)	Dis-solved cal-cium (Ca) (mg/L)	Dis-solved magne-sium (Mg) (mg/L)	Dis-solved sodium (Na) (mg/L)	Dis-solved potas-sium (K) (mg/L)	Bicar-bonate (HCO_3) (mg/L)	Car-bonate (CO_3) (mg/L)	Dis-solved sul-fate (SO_4) (mg/L)	Dis-solved chlo-ride (Cl) (mg/L)	Dis-solved fluo-ride (F) (mg/L)	Ni-trate (NO_3) (mg/L)	Dis-solved solids (sum of constit-uents (mg/L)	Hard-ness (Ca, Mg) (mg/L)	Per-cent sodium	Resid-ual sodium car-bonate (RSC)	Sodium ad-sorp-tion ratio (SAR)	Specific conduct-ande (µmhos)	pH (units)	Tem-pera-ture (°C)
WR-35-50-904	510-686	Twi	2- 8-54[3]	14	1	--	1.4	0.5	105.3	--	232	18	0.0	10	--	--	[6]304	6	97.18	4.2	17.7	--	8.8	--
			2- 9-54[4]	13	1.6	<0.5	1	1	107	--	250	6	4	14	0.5	<0.4	270	7	--	--	--	--	8.3	--
			11- 3-59[4]	--	2.8	<.5	2	1	144	--	345	10	9	12	.9	<.4	336	5	97.17	5.4	20.7	560	8.7	--
905	410-658	Twi	2-19-55[3]	18	100	--	3	1	98	--	207	6	21	16	.1	<.4	262	12	94.84	3.2	12.5	--	8.0	--
			11- 3-59[4]	--	100	<.5	4	1	92	--	198	5	22	14	.1	<.4	246	14	93.42	2.9	10.6	410	8.5	--
906	592-740	Twi	6-22-57[3]	15	400	--	1	3	115	--	256	--	9	10	--	--	278	5	94.40	3.8	12.9	434	8.5	--
			11- 3-59[4]	--	--	--	2	1	99	--	249	--	15	--	--	--	239	--	95.94	3.8	14.2	--	--	--
			9-22-72[4]	14	--	--	1	1	104	--	256	--	11	8	.2	.4	265	7	97.16	4.0	17.6	410	7.7	--
			6-30-77[4]	15	400	--	4	1	109	--	271	--	10	6	.2	.4	279	13	94.39	4.1	12.6	432	8.2	--
907	530-700	Twi	2- 1-64[3]	19	800	--	1.3	.3	107.4	--	268	--	7.7	7.0	--	--	[6]298	4.5	--	--	--	--	8.2	--
908	510-695	Twi	11-10-69[5]	13	160	--	3	1	84	--	198	--	13	13	--	--	224	12	--	--	--	367	8.4	--
	640-665		9-19-69[5]	13	70	--	4	1	84	--	204	--	11	12	--	--	211	13	--	--	--	356	8.5	--
			8-22-83	--	--	--	1.4	.4	77	--	200	--	13	11	.2	--	217	5	96	--	16	360	8.5	25.1
909	317-372	Twi	1- 2-70[5]	12	<50	--	3	1	84	--	183	--	20	17	--	--	229	13	--	--	--	374	7.2	--
910	448-558	Twi	6-19-36[1]	--	--	--	3	1	90	--	238	--	<10	9	--	--	220	11	--	--	--	220	--	--
913	14	Tc	6-15-36[1]	--	--	--	27	4	12	--	110	--	<10	13	--	--	110	82	--	--	--	--	--	--
51-101	411-520	Twi	6- 3-77[5]	10	60	<20	2	.5	148	--	376	0	8	8	.2	.1	353	7	--	--	--	600	8.8	--
401	470-490	Twi	7- 4-68[5]	12	11	--	1	.5	114	--	251	14	12	7	--	--	283	4	--	--	--	455	8.5	--
	470-570		7-30-68[5]	11	<30	--	1	.5	133	--	325	0	11	9	.4	.5	317	3	--	--	--	515	8.1	--
			8-24-83	13	23	9	.8	.2	140	1.3	330	6	12	6.1	.3	--	342	3	99	--	40	560	8.9	24.8
502	410-490	Twi	9-30-76[4]	27	--	--	32	6	65	--	210	--	36	22	.1	<.4	291	105	57.49	1.3	2.7	465	8.6	--
			7-29-77[4]	26	44	15	31	6	70	--	229	--	38	23	.1	<.4	307	101	59.87	1.7	3.0	477	7.8	--
			7-11-79[2]	--	--	--	29	6.2	--	--	230	0	39	24	--	--	--	98	--	--	--	573	8.0	26.0
503	60	Twi	12- 1-36[1]	--	--	--	3	5	14	--	37	--	<10	20	--	--	60	28	--	--	--	--	--	--
801	710	Twi	7-12-79	13	--	--	.9	.2	120	.8	300	14	10	5.7	.2	--	313	3	99	--	30	549	8.7	25.0
901	675-738	Twi	2-10-66[7]	14	100	--	2.4	1.0	245.2	--	504	43	9.3	34.0	0	--	[6]598	10	--	--	--	--	8.7	--
			7-12-79[2]	13	--	--	.7	.1	270	1.0	610	14	6.8	52	.7	--	659	2	99	--	80	1,080	8.7	25.0
903	48	Twi	12- 2-36[1]	--	--	--	219	159	146	--	342	--	312	650	--	--	1,654	1,203	--	--	--	--	--	--
52-101	192	Twi	9-25-72[4]	11	--	--	1	1	184	--	470	--	15	10	.2	.4	453	9	98.37	7.5	31.1	716	7.8	--
			6-30-77[4]	11	.0	--	1	1	188	--	449	--	17	9	.2	3.2	451	4	98.41	7.2	31.8	725	8.6	
			8-24-83	10	20	5	1.2	<.4	190	1.3	450	14	18	9.5	.4	--	466	5	99	--	42	740	9.1	21.5
701	270-302	Twi	6-30-77[4]	24	500	--	47	8	91	--	181	--	152	37	.1	2.3	450	153	56.86	.0	3.2	699	7.8	--
702	29	Twi	10-30-36[1]	--	--	--	9	5	21	--	85	--	<10	14	--	--	91	43	--	--	--	--	--	--
57-201	660-820	Twi	6-28-74[5]	11	120	<20	1	<.5	374	--	783	37	1	64	2.2	1.2	[6]870	4	--	--	--	1,600	8.2	--

See footnotes at end of table.

Table 4a.--Water-quality data for ground-water samples collected from wells in Rusk and Cherokee Counties--Continued

Well	Depth or producing interval (feet)	Water-bearing unit	Date	Dissolved silica (SiO_2) (mg/L)	Dissolved iron (Fe) (μg/L)	Dissolved manganese (Mn) (μg/L)	Dissolved calcium (Ca) (mg/L)	Dissolved magnesium (Mg) (mg/L)	Dissolved sodium (Na) (mg/L)	Dissolved potassium (K) (mg/L)	Bicarbonate (HCO_3) (mg/L)	Carbonate (CO_3) (mg/L)	Dissolved sulfate (SO_4) (mg/L)	Dissolved chloride (Cl) (mg/L)	Dissolved fluoride (F) (mg/L)	Nitrate (NO_3) (mg/L)	Dissolved solids (sum of constituents) (mg/L)	Hardness (Ca, Mg) (mg/L)	Percent sodium	Residual sodium carbonate (RSC)	Sodium adsorption ratio (SAR)	Specific conductance (μmhos)	pH (units)	Temperature (°C)
WR-35-57-202	1,025-1,105	Twi	8-20-74 5/	12	210	<20	7	2	1,349	--	867	29	3	1,550	3.4	0.7	6/ 3,430	25	--	--	--	7,170	8.2	--
203	995-1,105	Twi	10- 3-74 5/	12	190	<20	5	1	1,157	--	888	43	0	1,224	2.6	1.0	6/ 2,914	17	--	--	--	4,920	8.2	--
406	Spring	--	8-23-83	29	130	12	1.8	.7	11	1.7	8	0	2	17	.1	--	67	7	72	0	2.0	74	5.3	--
601	32	Tc	11-12-36 1/	--	--	--	11	6	4	--	49	--	8	10	--	--	63	54	--	--	--	--	--	--
802	350-413	Twi	5-31-65 7/	18.4	<300	--	4.0	.8	61	--	124	12.0	10	10.0	--	--	6/ 165	13	90.39	1.7	7.0	--	8.5	--
			9-30-76 4/	28	--	--	3	1	62	--	151	--	11	10	.1	.4	189	10	92.08	2.2	7.9	281	7.7	--
803	14	Tc	4-17-36 1/	--	--	--	105	78	51	--	--	--	700	106	--	--	1,040	583	--	--	[illegible]	--	--	--
901	315	Twi	9-19-72 4/	11	--	--	4	1	178	--	432	--	29	17	.6	.4	453	14	96.48	6.7	20.6	716	8.4	--
			6-30-77 4/	13	100	--	2	1	185	--	388	--	33	13	.6	.4	438	6	97.78	6.1	26.6	716	8.9	--
58-101	31	Tc	9-20-72 4/	11	--	--	33	4	11	--	84	--	4	19	.1	27.0	150	97	19.49	.0	.4	247	7.1	--
			6-30-77 4/	11	100	--	37	2	7	--	104	--	4	12	.1	19.3	143	101	13.15	.0	.3	238	7.6	--
102	500-550	Twi	5-31-65 7/	16	170	--	3.2	.3	204.6	--	495	24	.6	5.0	--	--	6/ 498	9.4	--	--	--	--	8.5	--
201	47	Twi	9-19-72 4/	14	--	--	12	2	2	--	34	--	4	5	.1	6.0	61	39	10.23	.0	.1	92	6.7	--
			7- 1-77 4/	12	100	--	12	1	3	--	29	--	4	6	.1	8.9	61	36	16.08	.0	.2	95	6.8	--
301	500-600	Twi	4-23-65 7/	12	80	--	4.0	Trace	95.3	--	195	19	10.7	10.0	--	--	6/ 247	10.0	--	--	--	--	8.7	--
302	29	Twi	11-26-36 1/	--	--	--	28	6	28	--	110	--	18	33	--	--	167	94	--	--	--	--	--	--
401	82	Twi	9-20-72 4/	30	--	--	43	3	3	--	73	--	58	7	.1	1.5	181	121	5.7	.0	.1	254	7.2	--
402	450-490	Twi	8- 3-79 2/	--	100	.0	2.4	1	91	--	170	9.6	22	20	.1	.1	246	10	--	--	--	380	8.1	--
			8-25-83	15	--	--	1.8	.3	81	1.9	150	0	23	16	.2	--	228	6	96	--	15	390	8.4	23.8
601	276-292	Tc	9-19-72 4/	13	--	--	3	1	150	--	353	--	33	11	.1	.4	385	12	96.56	5.5	19.1	606	7.9	--
			7- 1-77 4/	13	0	--	5	1	155	--	362	--	36	9	.6	.4	397	17	95.31	5.6	16.5	626	8.2	--
801	24	Twi	10-23-36 1/	--	--	--	--	--	--	--	120	--	52	100	--	--	335	--	--	--	--	--	--	--
59-102	509-593	Twi	-- 7/	--	60	0	2	.5	213	--	408	31	61	15	.3	.2	6/ 524	8	--	--	--	730	8.7	--
201	36	Twi	7- 6-61 2/	18	130	--	16	2.8	5.4	1.6	58	0	8.4	5.0	.2	.0	--	51	--	--	.3	136	5.8	--
			9-25-72 4/	46	--	--	29	1	6	--	96	--	4	6	.1	.4	139	77	14.57	.0	.2	173	7.1	--
			7- 1-77 4/	48	100	--	33	1	7	--	111	--	4	5	.1	2.4	155	85	14.97	.0	.3	193	7.5	--
402	Spring	Tc	10-19-36 1/	--	--	--	3	2	11	--	31	--	<10	11	--	--	42	17	--	--	--	--	--	--
601	224-242	Twi	7- 1-77 4/	11	100	--	1	1	195	--	388	--	60	16	.2	.4	475	5	98.46	6.2	33.0	766	8.7	--
701	28	Twi	11-26-36 1/	--	--	--	1	10	42	--	67	--	26	35	--	--	147	41	--	--	--	--	--	--
801	382-412	Twi	7- 6-61	21	--	--	36	13	57	--	266	--	19	19	.1	1.2	297	144	46.38	1.4	2.0	499	7.0	--

See footnotes at end of table.

Table 4a.--Water-quality data for ground-water samples collected from wells in Rusk and Cherokee Counties--Continued

Well	Depth or producing interval (feet)	Water-bearing unit	Date	Dis-solved silica (SiO_2) (mg/L)	Dis-solved iron (Fe) (µg/L)	Dis-solved man-ganese (Mn) (µg/L)	Dis-solved cal-cium (Ca) (mg/L)	Dis-solved magne-sium (Mg) (mg/L)	Dis-solved sodium (Na) (mg/L)	Dis-solved potas-sium (K) (mg/L)	Bicar-bonate (HCO_3) (mg/L)	Car-bonate (CO_3) (mg/L)	Dis-solved sul-fate (SO_4) (mg/L)	Dis-solved chlo-ride (Cl) (mg/L)	Dis-solved fluo-ride (F) (mg/L)	Ni-trate (NO_3) (mg/L)	Dis-solved solids (sum of constit-uents (mg/L)	Hard-ness (Ca, Mg) (mg/L)	Per-cent sodium	Resid-ual sodium car-bonate (RSC)	Sodium ad-sorp-tion ratio (SAR)	Specific conduct-ande (µmhos)	pH (units)	Tem-pera-ture (°C)
WR-35-59-802	530-601	Twi	10- 1-66 7/	--	130	--	2.4	1.5	175.2	--	339	46	19.8	13.0	0.6	0.6	6/421	12	--	--	--	620	8.9	--
902	448-480	Twi	9-22-72 4/	13	--	--	1	1	115	--	298	--	10	5	.1	.4	292	6	97.42	4.7	19.4	460	7.9	--
			7- 1-77 4/	12	100	--	3	1	118	--	298	--	12	5	.1	1.9	299	10	95.67	4.6	15.0	467	8.3	--
60-101	190	Twi	7-29-61 4/	13	0	--	9	4	76	--	202	--	20	10	.1	2.2	233	38	80.95	2.5	5.3	390	7.3	--
701	32	Twi	10-12-36 1/	--	--	--	--	--	--	--	73	--	851	790	--	--	2,500	--	--	--	--	--	--	--
37-01-105	23	Tr	11- 2-36 1/	--	--	--	5	4	10	--	24	--	16	9	--	--	56	27	--	--	--	--	--	--
301	43	Tr	9-29-76 4/	24	--	--	5	9	10	--	1	--	4	20	.3	56.0	128	50	30.53	.0	.6	180	5.9	--
			6-30-77 4/	20	100	--	3	6	7	--	1	--	4	14	.1	35.9	90	33	32.13	.0	.5	124	5.3	--
501	217-280	Tq	10-12-65 7/	16	160	--	7	2	97	--	156	0	80	17.0	.2	.3	6/297	26	89.14	2.0	8.3	--	7.3	--
701	4,100	--	10-12-36 1/	--	--	--	--	--	--	--	73	--	851	790	--	--	2,500	--	--	--	--	--	--	--
803	30	Tr	10-22-36 1/	--	--	--	7	4	14	--	61	--	<10	9	--	--	64	32	--	--	--	--	--	--
901	23	Tr	10-22-36 1/	--	--	--	21	64	38	--	281	--	40	90	--	--	391	315	--	--	--	--	--	--
02-101	202	Twi	10-23-36 1/	--	--	--	7	4	8	--	49	--	<10	6	--	--	49	32	--	--	--	--	--	19.5
102	152	Tc	10-22-36 1/	--	--	--	2	1	10	--	31	--	21	6	--	--	34	11	--	--	--	--	--	20
201	144	Tc	7- 6-61 4/	18	4,600	--	16	3	5	1.6	58	0	8	5	.2	0	89	51	16.68	0	.3	136	5.8	--
206	280	Twi	10-23-36 1/	--	--	--	17	11	38	--	183	--	<10	13	--	--	169	87	--	--	--	--	--	19.5
301	230-280	Twi	9-28-76 4/	16	--	--	3	1	80	1.0	205	--	11	5	.1	2.0	219	12	93.11	3.1	10.2	344	8.7	--
			7- 1-77 4/	14	1,900	--	3	1	82	--	201	--	11	5	.1	<.4	217	9	93.89	3.0	10.4	342	8.4	--
501	33	Tr	10-27-36 1/	--	--	--	29	28	--	--	183	--	<10	12	--	--	159	187	--	--	--	--	--	--
601	24	Tr	10-23-36 1/	--	--	--	257	93	10	--	--	--	967	46	--	--	1,373	1,022	--	--	--	--	--	--
701	962-1,067	Twi	8-25-83	14	--	--	<1	.2	380	1.2	820	23	<4	92	2.0	--	920	3	99	--	101	1,460	8.9	28.0
801	630-820	Twi	9-27-72 4/	12	--	--	2	2	230	--	590	--	4	10	.3	.4	550	11	97.42	9.4	27.5	870	8.6	--
802	410-430	Twi	9-28-76 4/	18	--	--	5	3	52	--	135	--	16	7	.1	3.0	170	22	82.01	1.7	4.5	259	8.0	--
			7- 1-77 4/	16	4	--	4	2	52	--	127	--	16	7	.1	3.0	163	18	86.13	1.7	5.3	255	7.5	--
904	Spring	--	8-25-83	52	1,700	21	6	4	8	--	21	0	30	6	.1	--	121	30	31	0	.7	137	5.9	18.7
03-101	55	Tc	10-22-36 1/	--	--	--	11	4	11	--	67	--	<10	7	--	--	66	42	--	--	--	--	--	--
201	414-474	Twi	4-17-79 7/	--	20	0	8.0	.7	107	--	214	11.4	40.9	13.5	.3	0	6/287	23	--	--	--	420	8.2	--
202	310-360	Twi	4-17-79 7/	--	20	0	20.0	2.9	76.7	--	135	18.6	57.6	19.2	.05	0	6/262	62	--	--	--	400	8	--
			8-26-83	14	7	42	17.0	2.4	65	22	180	0	40	23	<.2	--	243	5	72	--	4.1	400	8.3	22.4

See footnotes at end of table.

Table 4a.--Water-quality data for ground-water samples collected from wells in Rusk and Cherokee Counties--Continued

Well	Depth or producing interval (feet)	Water-bearing unit	Date	Dissolved silica (SiO_2) (mg/L)	Dissolved iron (Fe) (μg/L)	Dissolved manganese (Mn) (μg/L)	Dissolved calcium (Ca) (mg/L)	Dissolved magnesium (Mg) (mg/L)	Dissolved sodium (Na) (mg/L)	Dissolved potassium (K) (mg/L)	Bicarbonate (HCO_3) (mg/L)	Carbonate (CO_3) (mg/L)	Dissolved sulfate (SO_4) (mg/L)	Dissolved chloride (Cl) (mg/L)	Dissolved fluoride (F) (mg/L)	Nitrate (NO_3) (mg/L)	Dissolved solids (sum of constituents) (mg/L)	Hardness (Ca, Mg) (mg/L)	Percent sodium	Residual sodium carbonate (RSC)	Sodium adsorption ratio (SAR)	Specific conductance (μmhos)	pH (units)	Temperature (°C)
WR-37-03-302	34	Tc	9-29-76 4/	14	--	--	11	8	8	4.0	68	--	6	13	0.1	2.0	99	60	21.00	0.0	0.4	172	8.1	19
			7- 1-77 4/	12	300	--	7	1	7	--	23	--	7	10	<.1	1.2	56	21	41.37	.0	.6	94	6.4	19
501	210	Tr	7- 5-61 4/	54	0	--	5	3	6	5.0	6	--	26	7	.1	--	109	24	29.48	.0	.5	107	4.9	--
502	390-470	Twi	10-26-65 7/	8	190	--	10	4	27	--	42	--	40	17	--	--	128	42	58.65	.0	1.8	--	6.2	--
			9-29-76 4/	19	--	--	19	5	24	5.0	52	--	62	15	.1	.4	175	66	41.24	.0	1.2	266	7.1	--
			7- 1-77 4/	16	590	--	11	5	24	5.0	26	--	66	14	.1	.7	160	49	48.96	.0	1.5	242	6.3	--
			7-13-79 2/	17	--	--	10	5.9	55	4.7	84	0	64	20	.1	--	218	49	68	--	3.4	402	6.9	25.0
901	54	Twi	10-20-36 1/	--	--	--	33	30	1	--	244	--	<10	7	--	--	191	208	--	--	--	--	--	--
04-401	375-435	Tc	8-18-65 7/	10	500	--	34.4	15.1	31.9	--	95.2	0	100	25	.1	--	6/263	148.0	--	--	--	--	6.7	--
			10-11-65	--	--	--	--	--	--	--	--	--	--	--	--	.25	--	--	--	--	--	--	--	--
402	31	Tc	10-19-36 1/	--	--	--	3	4	13	--	31	--	<10	18	--	--	53	22	--	--	--	--	--	--
601	--	Tc	9-29-76 4/	14	--	--	2	1	115	--	265	--	18	10	.1	1.4	292	7	96.48	4.1	16.5	472	8.5	--
			7- 1-77 4/	13	0	--	2	<1	117	--	271	--	16	10	.1	1.0	293	6	96.54	4.2	16.8	462	8.3	--
901	220-262	Twi	6- 3-77 7/	--	120	0	15.2	7.9	139.3	--	322.1	9.6	24.5	48	0	0	6/403	70.3	--	--	--	675	8.3	--
09-201	3,000	--	10-26-36 1/	--	--	--	4	18	416	--	1,042	--	<10	95	--	--	1,046	86	--	--	--	--	--	27
10-101	60	Tc	10-28-36 1/	--	--	--	7	4	35	--	45	--	2	51	--	--	118	32	--	--	--	--	--	--
103	372-395	Twi	3-30-42 2/	--	4.5	--	--	--	--	--	281	--	71	25	--	--	9/310	--	--	--	--	--	--	--
11-201	59	Tc	9-27-76 4/	14	--	--	42	1	4	--	122	--	4	9	.1	.4	134	109	7.39	.0	.1	234	7.2	--
202	65	Tc	9-29-76 4/	17	--	--	24	1	3	--	74	--	6	5	.1	.4	92	67	9.25	.0	.1	153	7.2	--
			7- 1-77 4/	18	500	--	15	1	3	--	41	--	4	6	.1	.8	68	40	13.57	.0	.2	104	6.8	--
12-302	260-310	Twi	8-18-65 7/	11	100	--	33.6	7.8	92.8	--	302.6	0	20.6	34.0	.05	.025	6/349	116.0	--	--	--	--	8.0	--
Cherokee County																								
DJ-37-09-101	86-138	Tc	10-18-65 4/	--	5	<.5	8	4	8	--	13	--	33	6	<.1	<.4	10/66	38	--	--	--	130	6.5	--
			12-15-70 4/	20	6.1	<.5	3	2	8	--	--	--	22	7	<.1	<.4	10/62	14	--	--	--	83	5.1	--
102	530-624	Twi	4-22-65 4/	--	.8	<.5	2	1	510	--	990	24	5	170	2.6	<.4	10/1,218	10	--	--	--	2,189	8.6	--

1/ Chemical analyses by Works Progress Administration.
2/ Chemical analyses by U.S. Geological Survey.
3/ Chemical analyses by Curtis Laboratories.
4/ Chemical analyses by Texas State Department of Health.
5/ Chemical analyses by Edna Wood Laboratories.
6/ The bicarbonate reported is converted to carbonate and the carbonate figure is used in the calculation of this sum.
7/ Chemical analyses by Pope Laboratories.
8/ Chemical analyses by Microbiology Laboratories.
9/ Estimated.
10/ Calculated or estimated.

Table 4b.--Concentrations of metals and trace elements in water from wells and springs in Rusk County

(in micrograms per liter)

Well or spring number	Depth or producing interval (feet)	Date	Dis-solved arsenic (As)	Dis-solved barium (Ba)	Dis-solved cadmium (Cd)	Dis-solved chro-mium (Cr)	Dis-solved copper (Cu)	Dis-solved lead (Pb)	Dis-solved lithium (Li)	Dis-solved mercury (Hg)	Dis-solved sele-nium (Se)	Dis-solved silver (Ag)	Dis-solved zinc (Zn)
WR-35-41-703	240-330	8-23-83	1	5	<1	<10	10	2	24	0.7	<1	<1	8
807	745-800	8-23-83	1	16	<1	<10	1	2	24	.7	<1	<1	5
808	436-583	8-23-83	--	--	--	--	--	--	19	--	--	--	--
44-701	555	8-24-83	--	--	--	--	--	--	34	--	--	--	--
50-502	292-364	8-22-83	--	--	--	--	--	--	19	--	--	--	--
801	531-611	8-22-83	--	--	--	--	--	--	20	--	--	--	--
57-406	Spring	8-23-83	<1	67	8	60	40	28	19	<.1	<1	<1	300
37-02-904	Spring	8-25-83	1	38	3	<10	1	13	--	.1	<1	<1	17
03-202	484	8-26-83	<1	170	<1	<10	<1	1	21	.01	<1	<1	9

Table 8.--Source and significance of selected constituents and properties commonly reported in water analyses 1/

(mg/L, milligrams per liter; µg/L, micrograms per liter; micromhos, micromhos per centimeter at 25° Celsius)

Constituent or property	Source or cause	Significance
Silica (SiO_2)	Silicon ranks second only to oxygen in abundance in the Earth's crust. Contact of natural waters with silica-bearing rocks and soils usually results in a concentration range of about 1 to 30 mg/L; but concentrations as large as 100 mg/L are common in waters in some areas.	Although silica in some domestic and industrial water supplies may inhibit corrosion of iron pipes by forming protective coatings, it generally is objectionable in industrial supplies, particularly in boiler feedwater, because it may form hard scale in boilers and pipes or deposit in the tubes of heaters and on steam-turbine blades.
Iron (Fe)	Iron is an abundant and widespread constituent of many rocks and soils. Iron concentrations in natural waters are dependent upon several chemical equilibria processes including oxidation and reduction; precipitation and solution of hydroxides, carbonates, and sulfides; complex formation especially with organic material; and the metabolism of plants and animals. Dissolved-iron concentrations in oxygenated surface waters seldom are as much as 1 mg/L. Some ground waters, unoxygenated surface waters such as deep waters of stratified lakes and reservoirs, and acidic waters resulting from discharge of industrial wastes or drainage from mines may contain considerably more iron. Corrosion of iron casings, pumps, and pipes may add iron to water pumped from wells.	Iron is an objectionable constituent in water supplies for domestic use because it may adversely affect the taste of water and beverages and stain laundered clothes and plumbing fixtures. According to the National Secondary Drinking Water Regulations proposed by the U.S. Environmental Protection Agency (1977b), the secondary maximum contamination level of iron for public water systems is 300 µg/L. Iron also is undesirable in some industrial water supplies, particularly in waters used in high-pressure boilers and those used for food processing, production of paper and chemicals, and bleaching or dyeing of textiles.
Calcium (Ca)	Calcium is widely distributed in the common minerals of rocks and soils and is the principal cation in many natural freshwaters, especially those that contact deposits or soils originating from limestone, dolomite, gypsum, and gypsiferous shale. Calcium concentrations in freshwaters usually range from zero to several hundred milligrams per liter. Larger concentrations are not uncommon in waters in arid regions, especially in areas where some of the more soluble rock types are present.	Calcium contributes to the total hardness of water. Small concentrations of calcium carbonate combat corrosion of metallic pipes by forming protective coatings. Calcium in domestic water supplies is objectionable because it tends to cause incrustations on cooking utensils and water heaters and increases soap or detergent consumption in waters used for washing, bathing, and laundering. Calcium also is undesirable in some industrial water supplies, particularly in waters used by electroplating, textile, pulp and paper, and brewing industries and in water used in high-pressure boilers.
Magnesium (Mg)	Magnesium ranks eight among the elements in order of abundance in the Earth's crust and is a common constituent in natural water. Ferromagnesian minerals in igneous rock and magnesium carbonate in carbonate rocks are two of the more important sources of magnesium in natural waters. Magnesium concentrations in freshwaters usually range from zero to several hundred milligrams per liter; but larger concentrations are not uncommon in waters associated with limestone or dolomite.	Magnesium contributes to the total hardness of water. Large concentrations of magnesium are objectionable in domestic water supplies because they can exert a cathartic and diuretic action upon unacclimated users and increase soap or detergent consumption in waters used for washing, bathing, and laundering. Magnesium also is undesirable in some industrial supplies, particularly in waters used by textile, pulp and paper, and brewing industries and in water used in high-pressure boilers.
Sodium (Na)	Sodium is an abundant and widespread constituent of many soils and rocks and is the principal cation in many natural waters associated with argillaceous sediments, marine shales, and evaporites and in sea water. Sodium salts are very soluble and once in solution tend to stay in solution. Sodium concentrations in natural waters vary from less than 1 mg/L in stream runoff from areas of high rainfall to more than 100,000 mg/L in ground and surface waters associated with halite deposits in arid areas. In addition to natural sources of sodium, sewage, industrial effluents, oilfield brines, and deicing salts may contribute sodium to surface and ground waters.	Sodium in drinking water may impart a salty taste and may be harmful to persons suffering from cardiac, renal, and circulatory diseases and to women with toxemias of pregnancy. Sodium is objectionable in boiler feedwaters because it may cause foaming. Large sodium concentrations are toxic to most plants; and a large ratio of sodium to total cations in irrigation waters may decrease the permeability of the soil, increase the pH of the soil solution, and impair drainage.

Table 8.--Source and significance of selected constituents and properties commonly reported in water analyses--Continued

Constituent or property	Source or cause	Significance
Potassium (K)	Although potassium is only slightly less common than sodium in igneous rocks and is more abundant in sedimentary rocks, the concentration of potassium in most natural waters is much smaller than the concentration of sodium. Potassium is liberated from silicate minerals with greater difficulty than sodium and is more easily adsorbed by clay minerals and reincorporated into solid weathering products. Concentrations of potassium more than 20 mg/L are unusual in natural freshwaters, but much larger concentrations are not uncommon in brines or in water from hot springs.	Large concentrations of potassium in drinking water may impart a salty taste and act as a cathartic, but the range of potassium concentrations in most domestic supplies seldom cause these problems. Potassium is objectionable in boiler feedwaters because it may cause foaming. In irrigation water, potassium and sodium act similarly upon the soil, although potassium generally is considered less harmful than sodium.
Alkalinity	Alkalinity is a measure of the capacity of a water to neutralize a strong acid, usually to pH of 4.5, and is expressed in terms of an equivalent concentration of calcium carbonate ($CaCO_3$). Alkalinity in natural waters usually is caused by the presence ob bicarbonate and carbonate ions and to a lesser extent by hydroxide and minor acid radicals such as borates, phosphates, and silicates. Carbonates and bicarbonates are common to most natural waters because of the abundance of carbon dioxide and carbonate minerals in nature. Direct contribution to alkalinity in natural waters by hydroxide is rare and usually can be attributed to contamination. The alkalinity of natural waters varies widely but rarely exceeds 400 to 500 mg/L as $CaCO_3$.	Alkaline waters may have a distinctive unpleasant taste. Alkalinity is detrimental in several industrial processes, especially those involving the production of food and carbonated or acid-fruit beverages. The alkalinity in irrigation waters in excess of alkaline earth concentrations may increase the pH of the soil solution, leach organic material and decrease permeability of the soil, and impair plant growth.
Sulfate (SO_4)	Sulfur is a minor constituent of the Earth's crust but is widely distributed as metallic sulfides in igneous and sedimentary rocks. Weathering of metallic sulfides such as pyrite by oxygenated water yields sulfate ions to the water. Sulfate is dissolved also from soils and evaporite sediments containing gypsum or anhydrite. The sulfate concentration in natural freshwaters may range from zero to several thousand milligrams per liter. Drainage from mines may add sulfate to waters by virtue of pyrite oxidation.	Sulfate in drinking water may impart a bitter taste and act as a laxative on unacclimated users. According to the National Secondary Drinking Water Regulations proposed by the Environmental Protection Agency (1977b) the secondary maximum contaminant level of sulfate for public water systems is 250 mg/L. Sulfate also is undesirable in some industrial supplies, particularly in waters used for the production of concrete, ice, sugar, and carbonated beverages and in waters used in high-pressure boilers.
Chloride (Cl)	Chloride is relatively scarce in the Earth's crust but is the predominant anion in sea water, most petroleum-associated brines, and in many natural freshwaters, particularly those associated with marine shales and evaporites. Chloride salts are very soluble and once in solution tend to stay in solution. Chloride concentrations in natural waters vary from less than 1 mg/L in stream runoff from humid areas to more than 100,000 mg/L in ground and surface waters associated with evaporites in arid areas. The discharge of human, animal, or industrial wastes and irrigation return flows may add significant quantities of chloride to surface and ground waters.	Chloride may impart a salty taste to drinking water and may accelerate the corrosion of metals used in water-supply systems. According to the National Secondary Drinking Water Reguations proposed by the Environmental Protection Agency (1977b), the secondary maximum contaminant level of chloride for public water systems is 250 mg/L. Chloride also is objectionable in some industrial supplies, particularly those used for brewing and food processing, paper and steel production, and textile processing. Chloride in irrigation waters generally is not toxic to most crops but may be injurious to citrus and stone fruits.
Fluoride (F)	Fluoride is a minor constituent of the Earth's crust. The calcium fluoride mineral fluorite is a widespread constituent of resistate sediments and igneous rocks, but its solubility in water is negligible. Fluoride commonly is associated with volcanic gases, and volcanic emanations may be important sources of fluoride in some areas. The	Fluoride in drinking water decreases the incidence of tooth decay when the water is consumed during the period of enamel calcification. Excessive quantities in drinking water consumed by children during the period of enamel calcification may cause a characteristic discoloration (mottling) of the teeth. According to the

Table 8.--Source and significance of selected constituents and properties commonly reported in water analyses--Continued

Constituent or property	Source or cause	Significance
Fluoride--Cont.	fluoride concentration in fresh surface waters usually is less than 1 mg/L; but larger concentrations are not uncommon in saline water from oil wells, ground water from a wide variety of geologic terranes, and water from areas affected by volcanism.	National Interim Primary Drinking Water Regulations established by the Environmental Protection Agency (1976) the maximum contaminant level of fluoride in drinking water varies from 1.4 to 2.4 mg/L, depending upon the annual average of the maximum daily air temperature for the area in which the water system is located. Excessive fluoride is also objectionable in water supplies for some industries, particularly in the production of food, beverages, and pharmaceutical items.
Nitrogen (N)	A considerable part of the total nitrogen of the Earth is present as nitrogen gas in the atmosphere. Small amounts of nitrogen are present in rocks, but the element is concentrated to a greater extent in soils or biological material. Nitrogen is a cyclic element and may occur in water in several forms. The forms of greatest interest in water in order of increasing oxidation state, include organic nitrogen, ammonia nitrogen (NH_4-N), nitrite nitrogen (NO_2-N) and nitrate nitrogen (NO_3-N). These forms of nitrogen in water may be derived naturally from the leaching of rocks, soils, and decaying vegetation; from rainfall; or from biochemical conversion of one form to another. Other important sources of nitrogen in water include effluent from wastewater treatment plants, septic tanks, and cesspools and drainage from barnyards, feed lots, and fertilized fields. Nitrate is the most stable form of nitrogen in an oxidizing environment and is usually the dominant form of nitrogen in natural waters and in polluted waters that have undergone self-purification or aerobic treatment processes. Significant quantities of reduced nitrogen often are present in some ground waters, deep unoxygenated waters of stratified lakes and reservoirs, and waters containing partially stabilized sewage or animal wastes.	Concentrations of any of the forms of nitrogen in water significantly greater than the local average may suggest pollution. Nitrate and nitrite are objectionable in drinking water because of the potential risk to bottle-fed infants for methemoglobinemia, a sometimes fatal illness related to the impairment of the oxygen-carrying ability of the blood. According to the National Interim Primary Drinking Water Regulations (U.S. Environmental Protection Agency, 1976), the maximum contaminant level of nitrate (as N) in drinking water is 10 mg/L. Although a maximum contaminant level for nitrite is not specified in the drinking water regulations, Appendix A to the regulations (U.S. Environmental Protection Agency, 1976) indicates that waters with nitrite concentrations (as N) greater than 1 mg/L should not be used for infant feeding. Excessive nitrate and nitrite concentrations are also objectionable in water supplies for some industries, particularly in waters used for the dyeing of wool and silk fabrics and for brewing.
Dissolved solids	Theoretically, dissolved solids are anhydrous residues of the dissolved substance in water. In reality, the term "dissolved solids" is defined by the method used in the determination. In most waters, the dissolved solids consist predominantly of silica, calcium, magnesium, sodium, potassium, carbonate, bicarbonate, chloride, and sulfate with minor or trace amounts of other inorganic and organic constituents. In regions of high rainfall and relatively insoluble rocks, waters may contain dissolved-solids concentrations of less than 25 mg/L; but saturated sodium chloride brines in other areas may contain more than 300,000 mg/L.	Dissolved-solids values are used widely in evaluating water quality and in comparing waters. The following classification based on the concentrations of dissolved solids commonly is used by the Geological Survey (Winslow and Kister, 1956). Classification — Dissolved-solids concentration (mg/L) Fresh — <1,000 Slightly saline — 1,000 - 3,000 Moderately saline — 3,000 - 10,000 Very saline — 10,000 - 35,000 Brine — >35,000 The National Secondary Drinking Regulations (U.S. Environmental Protection Agency, 1977b) set a dissolved-solids concentration of 500 mg/L as the secondary maximum contaminant level for public water systems. This level was set primarily on the basis of taste thresholds and potential physiological effects, particularly the laxative effect on unacclimated users. Although drinking waters containing more than 500 mg/L are undesirable, such waters are used in many areas where less mineralized supplies are not available without any obvious ill effects. Dissolved solids in industrial water

Table 8.--Source and significance of selected constituents and properties commonly reported in water analyses--Continued

Constituent or property	Source or cause	Significance
Dissolved solids--Cont.		supplies can cause foaming in boilers; interfere with clearness, color, or taste of many finished products; and accelerate corrosion. Uses of water for irrigation also are limited by excessive dissolved-solids concentrations. Dissolved solids in irrigation water may adversely affect plants directly by the development of high osmotic conditions in the soil solution and the presence of phytoxins in the water or indirectly by their effect on soils.
Specific conductance	Specific conductance is a measure of the ability of water to transmit an electrical current and depends on the concentrations of ionized constituents dissolved in the water. Many natural waters in contact only with granite, well-leached soil, or other sparingly soluble material have a conductance of less than 50 micromhos. The specific conductance of some brines exceed several hundred thousand micromhos.	The specific conductance is an indication of the degree of mineralization of a water and may be used to estimate the concentration of dissolved solids in the water.
Hardness as $CaCO_3$	Hardness of water is attributable to all polyvalent metals but principally to calcium and magnesium ions expressed as $CaCO_3$ (calcium carbonate). Water hardness results naturally from the solution of calcium and magnesium, both of which are widely distributed in common minerals of rocks and soils. Hardness of waters in contact with limestone commonly exceeds 200 mg/L. In waters from gypsiferous formations, a hardness of 1,000 mg/L is not uncommon.	Hardness values are used in evaluating water quality and in comparing waters. The following classification is commonly used by the Geological Survey. Hardness (mg/L as $CaCO_3$) — Classification 0 - 60 — Soft 61 - 120 — Moderately hard 121 - 180 — Hard >180 — Very hard Excessive hardness of water for domestic use is objectionable because it causes incrustations on cooking utensils and water heaters and increased soap or detergent consumption. Excessive hardness is undesirable also in many industrial supplies. (See discussions concerning calcium and magnesium.)
pH	The pH of a solution is a measure of its hydrogen ion activity. By definition, the pH of pure water at a temperature of 25°C is 7.00. Natural waters contain dissolved gases and minerals, and the pH may deviate significantly from that of pure water. Rainwater not affected significantly by atmospheric pollution generally has a pH of 5.6 due to the solution of carbon dioxide from the atmosphere. The pH range of most natural surface and ground waters is about 6.0 to 8.5. Many natural waters are slightly basic (pH >7.0) because of the prevalence of carbonates and bicarbonates, which tend to increase the pH.	The pH of a domestic or industrial water supply is significant because it may affect taste, corrosion potential, and water-treatment processes. Acidic waters may have a sour taste and cause corrosion of metals and concrete. The National Secondary Drinking Water Regulations (U.S. Environmental Protection Agency, 1977b) set a pH range of 6.5 to 8.5 as the secondary maximum contaminant level for public water systems.

1/ Most of the material in this table has been summarized from several references. For a more thorough discussion of the source and significance of these and other water-quality properties and constituents, the reader is referred to the following additional references: American Public Health Association and others (1975); Hem (1970); McKee and Wolf (1963); National Academy of Science, National Academy of Engineering (1973); National Technical Advisory Committee to the Secretary of the Interior (1968); and U.S. Environmental Protection Agency (1977a).