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WATER RESOURCES OF MARION COUNTY, TEXAS

By

W. L. Broadhurst and S. D. Breeding

Prepared in cooperation with the Geological Survey,
United States Department of the Interior

September 1943

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ILLUSTRATIONS

Water resources of Marion County, Texas

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FOREWORD

This report is concerned mostly with ground water and is based on an investigation made in Marion County in March and April 1942 by the Texas Board of Water Engineers in cooperation with the Geological Survey, United States Department of the Interior. It includes a chapter on the supply of surface water available in the county from Cypress and Black Cypress creeks, which consists essentially of analyses of runoff based on measurements of the discharge of Cypress Creek made in cooperation with the Geological Survey at a gaging station about 8 miles west of Jefferson from 1925 to 1941 inclusive.

INTRODUCTION

Location and extent of area

Marion County is in the timbered region of northeast Texas adjacent to the western border of Louisiana. It is bounded on the south by Harrison County, on the west by Upshur County, and on the north by Morris and Cass counties, Texas. The county is approximately rectangular, averaging about 10 miles from north to south and about 40 miles from east to west, and has an area of 391 square miles. The land surface is rolling to hilly and in general rises from east to west. The minimum elevation is about 200 feet above sea level and the maximum about 500 feet. According to the census of 1940, the county had a population of 11,475, an average of 29.3 persons per square mile; and Jefferson, the county seat and trading center, had a population of 2,797. Smaller villages in the county are Lassater, Lodi, and Smithland.

Economic development

The economic development of Marion County is diversified. The timber, consisting of loblolly and short-leaf yellow pine and hardwood, supports a thriving lumber industry. The principal farm crops are cotton, corn, grain-sorghums, and sweet and Irish potatoes. Stock raising is important and is devoted mostly to beef cattle and hogs. The mineral resources include oil, gas, lignite, brick-clay, and iron ore.

Precipitation

According to records of the United States Weather Bureau, the average annual precipitation at Jefferson during 33 years was 48.51 inches. The precipitation is not evenly distributed during the year, being almost twice as high in the winter and spring as in the late summer and fall. Among the wettest years were 1905, with 86.32 inches; 1919, with 56.71 inches; 1922, with 57.36 inches; 1926, with 66.25 inches; and 1931, with 59.22 inches. The driest year was 1936, with only 31.14 inches. Other dry years were 1916, 1917, and 1918 with an average of 35.77 inches a year; and 1924 with 37.91 inches. The following table gives the U. S. Weather Bureau records of precipitation at Jefferson.

Precipitation, in inches, 1904 to 1906 and 1913 to 1942, inclusive, at Jefferson, Texas

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1904	2.12	2.81	3.07	4.98	2.69	7.11	2.21	2.16	1.64	0.13	2.43	8.15	39.50
1905	4.11	5.74	7.49	7.92	12.38	15.33	10.14	2.29	3.49	3.48	4.42	10.53	86.32
1906	4.11	2.59	4.92	2.43	6.34	4.62	8.66	2.65	2.29	2.95	1.54	7.67	50.77
1913	*4.90	4.59	5.32	3.35	3.21	0.60	2.40	1.30	11.26	2 91	1.30	6.15	47.29
1914	1.35	4.85	6.00	4.53	1.51	0.35	1.43	6 30	0.85	0.35	4.35	8.25	40.12
1915	4.45	4.52	2.85	6.88	0.86	5.62	3.15	10.42	1.40	1.30	8.21	2.44	52.10
1916	6.33	0.05	1.50	2.53	6.55	5.45	3.24	0.28	1.63	2 23	2.73	3 07	35.59
1917	3.29	1.65	3.66	3.22	1.50	0.61	8.14	8.14	2.95	0 54	1.92	1.70	37.32
1918	2.95	0.96	0.38	10.47	0.44	1.45	0.08	4.25	1.35	2.70	6.37	3.00	34.40
1919	3.50	4.58	4.38	4.83	3.89	6.10	5.27	4.75	1.69	11.19	5.05	1.46	56.71
1920	6.99	1.35	3.91	3.12	4.65	3.94	3.76	3.74	1.09	4.89	5.46	5.35	48.25
1921	3.18	2.14	4.47	14.18	1.23	7.62	3.58	T	0.50	0.66	1.14	3.69	42.39
1922	4.59	6.19	8.10	9.63	4.09	4.39	6.15	2.05	1.09	1.03	5.46	4.59	57.36
1923	4.82	5.60	4.34	5.01	3.74	5.20	0.82	0.86	2.84	3.11	2.91	11.50	50.75
1924	5.51	3.47	4.42	4.03	8.40	1.53	0.17	0.80	2.80	0.02	2.15	4.61	37.91
1925	5.59	1.46	4.86	3.93	2.34	1.64	6.37	2.36	2.85	9.11	9.46	3.81	53.78
1926	5.04	1.49	10.05	3.43	3.09	6.82	9.72	3.44	2.81	8.37	1.74	10.25	66.25
1927	2.88	3.73	5.04	7.80	4.85	1.70	5.07	0.92	2.79	5.15	0.99	3.62	44.54
1928	2.01	2.59	3.29	10.47	3.44	5.54	2.42	0.32	1.77	7.08	6.79	6.56	52.28
1929	5.55	3.62	3.78	5.71	6.45	2.97	1.74	0.04	1.74	2.74	4.79	5.12	44.25
1930	7.00	5.45	1.98	0.62	11.67	0.88	0.62	1.15	2.41	6.10	5.91	3.69	47.48
1931	24.6	7.07	3.90	4.23	2.67	2.11	7.24	4.71	5 69	2.01	5.33	11.80	59.22
1932	10.22	5.69	3.35	1.17	0.90	2.15	2.57	2.79	1.91	0.93	3.05	6.96	41.69
1933	4.21	4.93	4.58	5.27	6.26	0.06	9.56	1.67	1.58	1.31	0.87	9.22	49.52
1934	3.76	3.93	6.96	6.46	2.41	1.68	0.48	0.46	2.29	0.27	7.81	2.69	39.20
1935	3.47	4.00	3.80	3.10	12.09	3.38	1.58	1.47	2.10	4.22	4.35	3.84	47.40
1936	1.46	1.48	1.22	2.09	8.68	0.72	2.37	1.12	1.32	3.89	1.66	5.12	31.14
1937	7.83	2.26	5.04	3.55	0.40	3.11	2.86	4.62	5.45	3.05	8.18	8.36	54.71
1938	4.26	2.65	3.64	4.48	2.76	4.29	6.07	2.68	3.81	0.90	3.49	2.76	41.79
1939	4.82	7.02	1.95	2.26	4.22	1.57	6.25	1.40	0.84	0.53	5.36	5.37	41.59
1940	1.02	3.17	1.43	6.34	4.18	7.25	3.20	4.54	1.41	1.69	11.06	7.42	52.71
1941	2.82	4.41	4.69	5.17	5.67	6.46	4.41	2.61	3.55	5.58	3.60	3.34	52.31
1942	2.75	0.80	4.49	8.34	6.38	4.65	1.57	10.93	2.84	2.80	1.64	4.71	51.90

* Estimated from surrounding stations.

GROUND WATER

By

W. L. Broadhurst

Acknowledgments

The writer is indebted to many persons who have contributed information for this report. Valuable information was obtained from maps compiled by members of the East Texas Geological Society showing the thickness of the geologic formations in northeast Texas. The officials of several oil companies furnished well logs and other important well data. The friendly cooperation of the manager of the Jefferson Chamber of Commerce and the farmers of the county made possible the gathering of a part of the well data. The work was done under the general direction of W. N. White, engineer in charge of ground-water investigations in Texas.

OCCURRENCE OF GROUND WATER

General principles

For discussions of the fundamental principles of the occurrence and movement of ground water, the reader is referred to papers by Meinzer and Wenzel 1/. Most of the ground water in this region occurs in sands and sandstones that are interbedded with clays and shales which are generally inclined at an angle with the land surface. Each formation appears at the surface in a band of outcrop from which it dips beneath younger beds to increasingly greater depths beneath the surface. In Marion County and adjacent counties on the north and south the beds dip toward the northwest, into the trough of the East Texas syncline.

Ground water has been defined as the water in the zone of saturation below the surface of the earth. It is derived chiefly from precipitation that enters the outcrop of the permeable beds. A part of the precipitation runs off directly in streams, a part is returned to the atmosphere by evaporation and transpiration of trees and other plants, and a part sinks to the zone of saturation, in which all of the interstitial openings are filled with water. After entering the zone of saturation the water moves slowly down the dip of the water-bearing beds until it is either intercepted by wells or is discharged through some natural outlet, or it may escape by slow movement into underlying and overlying beds.

On the outcrop of the aquifers, or water-bearing beds, the water is unconfined and does not rise in wells above the water table which is the upper surface of the zone of saturation. Down the dip, where the water-bearing beds are

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1/ Meinzer, O. E., The occurrence of ground water in the United States: U. S. Geol. Survey Water-Supply Paper 489, 321 pp., 1923; Outline of ground-water hydrology: U. S. Geol. Survey Water Supply Paper 494, 71 pp., 1923; Outline of methods for estimating ground-water supplies: U. S. Geol. Survey Water-Supply Paper 638C, pp. 99-145, 1931.

Wenzel, L. K., Method for determining permeability of water-bearing materials: U. S. Geol. Survey Water-Supply Paper 887, 192 pp., 1942.

Meinzer, O. E., and Wenzel, L. K., Physics of the Earth, vol. 9, Hydrology, pp. 385-478, McGraw-Hill, 1942.

confined between relatively impermeable strata, the water is usually under sufficient hydrostatic pressure to rise in wells above the level at which it is encountered. If the altitude to which the water will rise is greater than the altitude of the land surface flowing wells may be obtained. In Marion County the general slope of the land surface is toward the east and southeast, or approximately opposite to the direction of the dip. Hence, although the water in the confined aquifers rises above the levels at which it is struck, the conditions are not favorable for producing flowing wells, the land surface in most places being at a higher altitude than the outcrops of the underlying confined beds. No flowing wells were found in the county but it is reported that wells at Jefferson formerly had a flow.

In most places ground water is slowly but steadily moving under the influence of gravity from areas of intake toward areas of discharge. In the more permeable rocks, such as coarse sand and gravel, the water moves with comparative freedom although at a rate that is very slow as compared with the flow of a stream. Such rocks are capable of yielding abundant supplies of water to wells. In less permeable rocks, such as shale or clay, molecular attraction holds most of the water and greatly retards the movement of the rest. Such rocks yield little or no water to wells.

When a well is pumped the water level in the well drops and a hydraulic gradient toward the wells from all directions is developed in the surrounding water-bearing material. It is this hydraulic gradient that causes water to flow toward the well. Within limits the amount of water that will enter a well varies directly with the amount the water level is lowered. For example, if a pumped well in fairly permeable material will yield 50 gallons a minute when the water level is lowered 10 feet, it will yield about 100 gallons a minute when the water level is lowered 20 feet. This ratio between the drawdown and the yield of the well is called the specific capacity and is expressed as yield in gallons a minute per foot of drawdown. The ratio is the most accurate known gage of the productivity of a well.

GEOLOGIC FORMATIONS AND THEIR WATER-BEARING PROPERTIES

Most of the information given in this section of the report is based on recent field investigations by the writer, maps compiled by the United States Geological Survey and the East Texas Geological Society, and the reports by Stephenson 2/, and Sellards and others 3/ of the Texas Bureau of Economic Geology to which the reader is referred for more detailed descriptions of the rock formations.

Marion County lies in the Gulf Coastal Plain of northeast Texas. It is on the northwest flank of the Sabine uplift and extends westward into the East Texas syncline. Except for thin deposits of alluvium and terrace silts and sands of Quaternary age, all the rocks that crop out in the county are of Tertiary age (see fig. 1). The outcropping formations or groups of formations from older to younger are as follows: Wilcox group (undifferentiated); Carrizo sand; Mount Selman formation (Reklaw member, Queen City sand member, and Weches greensand member); and Sparta sand. This is also the order in which the rock outcrops are successively crossed as one travels over the county from east to

2/ Stephenson, L. W., The larger invertebrate fossils of the Navarro group of Texas, Texas Univ. Bull. 4101, pp. 6-33, 1941.

3/ Sellards, E. H., Adkins, W. S., and Plummer, F. B., The geology of Texas vol. 1, Stratigraphy: Texas Univ. Bull. 3232, pp.480-665, 1932.

west. The formations strike approximately northeast and dip northwestward at the rate of 15 to 30 feet or more to the mile. The Wilcox group is underlain by the Midway group of the Paleocene series and by rocks of Cretaceous age. These older rocks do not appear at the surface in Marion County, but they crop out on the opposite side of the East Texas syncline in Titus and other counties (see fig. 1).

The principal aquifers, or water-bearing beds in Marion County are sands of the Wilcox group, the Carrizo sand, and the Queen City sand member of the Mount Selman formation.

The approximate depths to the different formations or groups of formations in a line across the county from southeast to northwest are shown in the generalized geologic section comprising figure 3.

Cretaceous system

Upper Cretaceous (Gulf series)

Navarro group

The Navarro is the uppermost group of the Upper Cretaceous rocks in northeast Texas. It ranges in thickness from 375 to 1,000 feet in this area. It is undifferentiated on the geologic map of Texas in this area, but according to L. W. Stephenson 4/, the group has been divided into four formations, which in ascending order are: Neylandville marl, Nacatoch sand, Corsicana marl and Kemp clay.

According to the writer's interpretations of drillers' logs and electrical logs of oil tests, the Nacatoch sand ranges in thickness from 100 to 200 feet or more and is encountered about 1,000 feet below the land surface in eastern Marion County and about 2,000 feet at the western end of the county. No analyses of water from the Nacatoch sand in Marion County are available, but the logs of several oil tests in the eastern part of the county indicate that the water is salty. Moreover, the sand is known to yield brackish and salty water at shallower depths near the outcrop in Bowie, Titus, Franklin, and Hopkins counties. No fresh water is believed to occur in the Nacatoch sand nor in rocks below this formation anywhere in Marion County.

Tertiary system

Paleocene series

Midway group (undifferentiated)

The term Midway has been generally adopted by geologists for the Paleocene series in the Gulf Coastal Plain. The Midway is of marine origin and in northeast Texas, according to Plummer 5/, it consists mostly of clay, silt, glauconitic sand,

4/ Stephenson, L. W., op. cit. pp. 6-33.
5/ Sellards, E. H., Adkins, W. S., and Plummer, F. B., op. cit., p. 531.

and lentils of limestone. Deposition appears to have been continuous from Midway into Wilcox times, the sediments indicating a gradual transition from one group into the other. However, the contact is most frequently drawn where the marine silty clays of the Midway are overlain by fine-grained deltaic sands and non-marine deposits of the Wilcox. The Midway is a poor water bearer practically everywhere in Texas, and it is not likely to yield appreciable quantities of good water in Marion County.

Eocene series

Wilcox group (undifferentiated)

The rocks of the Wilcox group in this area consist mostly of interbedded clay, sandy clay, shale and sand but contain sandstone concretions and lentils of lignite. The sands are medium to fine-grained, and in some places 50 feet or more in thickness. In general, however, the individual beds of sand are lenticular and it is difficult to correlate them between wells, even wells that are only a fraction of a mile apart.

The rocks of the lower part of the Wilcox group crop out in the southeastern part of the county (see fig. 1), the upper beds having been removed by erosion. Along the Louisiana boundary in this area the rocks of the Wilcox are about 200 feet thick, but they increase in thickness westward and northwestward. At Smithland, in the east central part of the county they are between 400 and 500 feet thick, and in the extreme western end of the county near the axis of the East Texas syncline they are 750 feet or more thick (see fig. 3). According to maps compiled by the East Texas Geological Society, the top of the Wilcox should be encountered about 150 feet above sea level in the vicinity of Jefferson, and about 150 feet below sea level at the western end of the county.

Wells that yield from only a few gallons to as much as 200 gallons a minute have been developed in sands of the Wilcox group in the central part of the county. Most of the wells have 6-inch casings. It is possible that somewhat more than 200 gallons a minute could be obtained from properly constructed wells. As a rule the water is potable but somewhat highly mineralized and unsuitable for some uses. The dissolved solids, mostly sodium, bicarbonate, and chloride, range from about 600 to 2,000 and average about 1,000 parts per million.

Claiborne group

Carrizo sand

The Carrizo sand rests unconformably on the Wilcox group and crops out in a belt about one mile wide extending across the eastern part of the county. It is for the most part a continental deposit and consists mostly of fine to medium-grained quartz sand but contains some yellowish clay and ferruginous cementing material. The sand grains are somewhat coarser than those of the Wilcox. In wells, however it is difficult to distinguish the sands of the Carrizo from those of the Wilcox group below and the Reklaw member of the Mount Selman formation above. The Carrizo sand varies considerably in thickness within short distances, and in some places it may be absent. This is due in part to the uneven surface on which it was deposited. The average thickness of the Carrizo probably does not exceed 50 feet. According to maps of the East Texas Geological Society, however, it may reach a thickness of about 150 feet in the western end

of the county. These maps indicate that the top of the sand crops out about 200 feet above sea level at Jefferson, and is about at sea level in the western end of the county.

In parts of south, central and east Texas large quantities of water of good quality are obtained from wells in the Carrizo sand for municipal and industrial purposes and for irrigation. In Marion County, however, only a few wells draw from the Carrizo, and according to the evidence that these wells afford the formation is less important as an aquifer than the underlying Wilcox group.

Mount Selman formation

In northeast Texas the Mount Selman formation consists of three members, which, from bottom to top, are the Reklaw, Queen City sand, and Weches greensand.

Reklaw member -- The Reklaw member overlies the Carrizo sand and crops out in a belt about 2 miles wide extending from Little Cypress Creek in the southern part of the county, to the northeastern corner of the county. (See fig. 1). It consists principally of clay with thin beds of glauconitic sand and lignite. The outcrop is characterized by bright red clay soils. Locally the Reklaw yields water of good quality to shallow dug wells in the outcrop area, but where it is under cover it yields only small quantities of mineralized water.

Queen City sand member -- The outcrop area of the Queen City sand member occupies most of the western and northern parts of the county. The member consists mostly of light-gray cross-bedded medium to fine-grained quartz sand but contains some silt, clay, bentonite, greensand, and impure lignite. At the outcrop it weathers into a light-colored sandy loam. According to well logs it has a thickness of about 200 feet in the central part of the county but is probably somewhat thicker near the western end. Shallow dug wells on the outcrop of this member yield water of low mineralization and of low hardness in sufficient quantities for domestic use and stock. No deep water wells have been reported in the Queen City in Marion County.

Weches greensand member -- The Weches greensand member crops out in the northern and western parts of the county. It consists essentially of glauconite and glauconitic clay, containing beds of black and brown iron ore and probably does not exceed 50 feet in thickness. Wells in the Weches yield only small quantities of rather highly mineralized water.

Sparta sand

Only the basal part of the Sparta sand is present in Marion County, and it occurs on the high ridges and some of the isolated hills. However, in these local areas the sand yields small quantities of good water to shallow dug wells.

Quaternary system

Recent series

The stream valleys contain Recent alluvial deposits of sand, silt, and clay, which in general are relatively thin but yield small quantities of water to shallow domestic wells.

PRESENT DEVELOPMENT OF WATER SUPPLIES FROM WELLS

(See well map)

Practically all the domestic, industrial and public water supplies in Marion County are obtained from wells. Most of the farm, school, and small-town domestic supplies are obtained from dug wells less than 50 feet in depth. Such supplies can be obtained almost anywhere in the county from wells in Eocene sands or alluvial deposits. The industrial supplies, in the oil field areas of the central and eastern parts of the county, are obtained mostly from drilled wells that range in depth from 200 to 800 feet. Jefferson, the only town in the county that has a public water system, is supplied with water from a well 780 feet in depth.

The position of the water-bearing sands and the development of ground water in different parts of the county are briefly discussed below.

Southeastern part of county
(Outcrop area of Wilcox group)

In this part of the county the Carrizo sand and the Queen City sand member of the Mount Selman formation are absent and the sandy part of the Wilcox group is relatively thin, being for example, about 220 feet thick in well 71. The Upper Cretaceous Nacatoch sand is encountered at about 1,000 feet but it carries salty water.

Most of the wells recorded in this area are oil tests but the list includes a few water wells that were put down for domestic use or to supply water for the drilling and operation of oil wells. The wells used for oil operations are equipped with cylinder pumps and have a maximum yield of about 30 to 50 gallons a minute. Some of the wells yield water that is relatively low in dissolved minerals; wells 60, 64, and 73, respectively 170, 370, and 240 feet in depth, for example. Other wells yield rather highly mineralized water. The water from unused wells 66 and 67 respectively 170 and 148 feet deep, for example, is said by the owner to be unfit for drinking. The records indicate that no good water is to be expected below a depth of about 400 feet anywhere in this part of the county. In some localities none is likely to be found below about 200 feet.

Central part of county

Jefferson-Lodi area

The Queen City sand member of the Mount Selman formation, the Carrizo sand and the Wilcox group underlie this part of the county.

Approximately 30 wells, ranging in depth from about 200 to 800 feet, were recorded in the area between Jefferson and Lodi. These wells were drilled in 1937 and 1938 and yield from about 10 to 200 gallons a minute to supply water for the drilling of oil wells and for the operation of oil refineries and gasoline plants. The drillers' logs of several of the wells (see table) show an aggregate thickness of sand ranging from about 125 to 250 feet, a large part of which occurs between 390 and 650 feet below the land surface. No important sands were recorded below 665 feet.

The public water supply of Jefferson is obtained from a well (no. 15) which is 780 feet in depth. The well is cased with 12-inch and 8-inch casing and is screened from 742 to 780 feet. It is reported to have had a natural flow of 50 gallons a minute when drilled in 1926, but it stopped flowing in 1937. It is now equipped with a deep-well turbine type pump driven by a 15-horsepower electrical motor and is reported to yield 200 gallons a minute with a drawdown of 57 feet. On this basis the specific capacity of the well is about 3.5 gallons a minute per foot of drawdown.

The mineral character of the water from the different wells varies materially. In most of the shallow wells and a few of the deeper ones the water is exceptionally low in dissolved solids. In general the deeper wells yield water that is moderately mineralized to rather highly mineralized, the total solids ranging from about 700 to 2,000 parts per million. The water from the Jefferson well contains 960 parts per million of dissolved solids, chiefly sodium, bicarbonate and chloride.

No important supplies of water of good quality are to be expected below a depth of about 800 feet in this part of the county.

Western part of county

The Queen City sand member of the Mount Selman formation, the Carrizo sand and the Wilcox group underlie the western as well as the central part of the county. All of the water wells visited in the western part of the county are dug wells less than 60 feet in depth and as far as could be learned no deeper water wells have been put down in the area. Two oil tests nos. 6 and 7, respectively 11 and 10 miles west of Jefferson, were located. Partial logs of these tests are given in the table of drillers' logs. The log of well 6 shows sands at 210 and 271 and 890 to 1,080 feet. In well 7, the individual beds of sand are not recorded but sand and shale are logged in one entry from 218 to 802 feet. Partial electrical logs of wells 7 and 11 are shown graphically in figure 2. Well 7 shows sandy zones at 200 to 240, 280 to 380 and 850 to 1,000 feet. Well 11 shows several fairly thick sands between 100 and 500 feet and sandy zones from 700 to 900 feet.

In this part of the county the prospects should be fairly good for developing wells that will yield water in the order of magnitude of 200 to 300 gallons a minute. The water in the shallow sands is low in dissolved minerals. Very little is known regarding the character of the water in the deeper sands. Conditions appear sufficiently favorable, however, to justify drilling and testing the water in the sands down to a depth of 900 or 1,000 feet. No good water is to be expected below 1,000 feet.

SURFACE WATER

By

S. D. Breeding

Marion County is drained by Cypress and Black Cypress creeks and tributaries thereto. Continuous records of the flow of Cypress Creek have been obtained since July 1924 at a gaging station in the county 8 miles west of Jefferson. The drainage basin above the gaging station has an area of 848 square miles in Marion, Upshur, Morris, Camp and Titus counties. Records of runoff at the station are summerized in the following table:

Runoff in acre-feet of Cypress Creek near Jefferson, Texas
(Drainage area, 848 square miles)

Calendar year	Maximum day	Minimum day	Average daily	Maximum month	Minimum month	Total yearly
1925	3,610	0.	397	43,200	33	145,000
1926	11,700	8.7	1,200	81,100	1,880	437,000
1927	13,530	22	1,540	162,000	3,230	562,000
1928	25,590	10	1,660	176,000	756	609,000
1929	9,540	5.2	1,260	116,000	422	460,000
1930	43,830	2.2	1,480	319,000	126	541,000
1931	7,930	2.4	1,060	89,800	344	244,000
1932	28,360	.8	1,480	255,000	211	542,000
1933	6,470	6.0	1,197	122,000	2,080	438,000
1934	9,380	.2	946	114,900	38	345,300
1935	24,600	7.5	1,240	202,000	613	452,900
1936	3,530	.4	296	39,310	72	108,400
1937	30,100	2.8	1,259	122,500	771	459,800
1938	47,600	1.0	1,550	271,500	49	563,700
1939	10,400	0	676	85 440	0	246,600
1940	5,790	3.4	670	70,260	266	245,300
1941	7,380	32	1,390	95,120	3,170	506,300
1925-41	47,600	0	1,140	319,000	0	406,000

The records show an average annual runoff of 406,000 acre-feet. This represents a runoff of 479 acre-feet per square mile, or the equivalent of a depth of 8.98 inches per square mile. (An acre-foot is the quantity of water required to cover one-acre to a depth of 12 inches and amounts to about 326,000 gallons). The minimum runoff during a calendar year occurred in 1936 and amounted to 108,400 acre-feet, representing 128 acre-feet per square mile, or a depth of 2.40 inches. The minimum total flow during 12 consecutive months occurred from May 1939 to April 1940 and amounted to 91,500 acre-feet, representing 108 acre-feet per square mile or a depth of 2.02 inches. The minimum total flow during 6 consecutive months occurred from July to December 1939, when the runoff was 4,330 acre-feet, representing 5.1 acre-feet per square mile or a depth of 0.10-inch. There were periods of no flow in 1925 and 1939 - the longest being 45 days, from September 24 to November 8, 1939. During the 17-year

period, the flow was less than 20 acre-feet per day at times in every year except 1927, 1928, and 1941.

No other continuous records of the flow of streams in the county have been obtained, but the runoff per unit area in the basin above the Cypress Creek gage should give a good indication of the runoff to be expected from other areas in the county under the same conditions of rainfall, as the soil, vegetation, and topography, on the average, do not differ materially.

During the period of record at the gaging station the average annual precipitation over the basin, according to records at Jefferson, Mount Pleasant and Naples (Finley) was about 45 inches. (See p. 4 for precipitation records at Jefferson). A study of the records indicates that the relation between the annual precipitation and runoff in the basin above the gaging station was about as follows:

Relation between precipitation and runoff in Cypress Creek Basin, 1925 to 1941

Annual precipitation (in inches)	Annual runoff	
	Depth in inches	Acre-feet per sq. mi.
25	1.2	64
30	2.4	128
35	4.0	213
40	6.2	331
45	9.0	480
50	12.4	656
55	15.9	848
Average 1925-41 45.0	8.98	479

The runoff resulting from a given amount of precipitation depends to a large extent upon the distribution and intensity of the precipitation whereas the above figures are based on the average annual runoff resulting from varying amounts of precipitation during the 17-year period. However, the figures are believed to give a fairly good indication of the annual surface-water yield that may be expected per square mile from areas in Marion County.

The data indicate that abundant supplies of surface water are available in Marion County from Cypress Creek and its tributaries but storage will have to be provided if a dependable continuous supply of good water is to be obtained.

The records of the flow of Cypress Creek at the gaging station near Jefferson that have been collected since July 1924 were obtained by the Surface-Water Division of the U. S. Geological Survey in cooperation with the Texas Board of Water Engineers, and have been published annually in Geological Survey Water-Supply Papers which are available at the Government Printing Office, Washington, D. C. Copies of these records may be obtained at the Washington office of the Geological Survey or at the Austin office of the Survey and Texas Board of Water Engineers.

SUMMARY

Marion County is in the Gulf Coastal Plain of northeast Texas adjacent to the Louisiana boundary. Three geologic formations or groups of formations containing extensive fresh-water sands crop out in the county. They are of Tertiary age and from older to younger consist of the Wilcox group, the Carrizo sand, and the Mount Selman formation in which the Queen City sand member is the principal aquifer (see fig. 1). This is the order in which the outcrops of the formations are successively crossed as one travels over the county from east to west. The beds in these formations dip northwestward into the East Texas syncline at the rate of 15 to 30 feet or more to the mile. The Wilcox group is underlain by a thick section of rocks of Midway (basal Tertiary) age consisting chiefly of clays and shales that cannot be expected to yield much water. The Midway group is underlain by rocks of Upper Cretaceous age which include from 100 to 200 feet or more of sand belonging to the Nacatoch formation. This sand is believed to contain brackish or salty water everywhere in Marion County.

The depth to the base of the important fresh water-bearing sands which is about 200 feet in the southeastern part of the county increases toward the west and is about 800 feet at Jefferson and about 1,000 feet at the western end of the county. These sands are underlain by about 800 feet of rocks consisting mostly of clays and shales.

Water wells ranging from 200 to 800 feet in depth, which yield as much as 200 gallons a minute, have been drilled in the central part of the county in the vicinity of Jefferson. In the western part of the county no attempts have been made to develop wells of large capacity, although conditions are believed to be favorable for obtaining relatively large supplies of ground water of good quality in that part of the county, as the sands of the Wilcox group, the Carrizo sand, and the Queen City sand member of the Mount Selman formation are all present. Conditions are less favorable in the southeastern part of the county where the sands of the Wilcox group alone are present and are not very thick, but where adequate supplies nevertheless are available for domestic use and stock.

Surface water is available from Cypress Creek and some of its large tributaries but storage will have to be provided if a dependable supply of water of considerable magnitude is to be obtained. In some areas, if requirements are not too high, it may be possible to develop a combination supply of ground water and surface water.

Records of wells in Marion County, Texas
All wells are drilled unless otherwise stated in remarks

Well	Distance from Jefferson	Owner	Date completed	Depth of well (ft.)	Diameter of well (in.)	Height of measuring point above ground (ft.)
1	18 miles northwest	Pleasant Valley School	1933	34	36	3.0
2	19 miles northwest	Rock Wall School	1926	29	30	2.5
3	16 miles northwest	Warlock School	Old	30	36	3.5
4	18 miles west	Murry League School	--	19	36	3.0
5	13 miles west	Rocky Springs School	Old	25	36	2.5
6	11 miles west	Dean Brothers (Fee No. 2)	1941	3,771	--	--
7	10 miles west	Dean Brothers (Fee No. 1)	1941	3,690	--	--
8	10 miles northwest	Lassater Junior High School	1941	52	60	0.5
9	6½ miles west	D. L. Wright	Old	46	40	3.0
10	13 miles west	Jackson School	Old	19	36	3.0
11	13 miles west	Helmerich and Payne	1940	5,004	--	--
12	10 miles southwest	Macedonia School	1922	28	36	3.5
13	7 miles southwest	New Zion School	1933	32	36	2.0
14	2 miles southeast	Cypress Chapel	1939	32	36	2.0
15	In Jefferson	City of Jefferson	1926	780	12,8	--
16	1½ miles northwest	Arkansas Fuel Oil Co.	1938	715	6	--
17	do.	do.	1938	716	6	2.0
18	2¾ miles northwest	United Gas Co.	1937	599	10,6	--
19	2½ miles northwest	Holcomb-Thomason	1937	620	6	--

a/ Pump or lift: T, turbine; A, air lift; C, cylinder; B, rope and bucket. Power: E, electric; G, gasoline engine; W, windmill; H, hand. Figure indicates horsepower.

Chemical analyses of water from most of these wells are in the table of water analyses

Well	Water level: Below measuring point (ft.)	Water level: Date of measurement	Method of lift a/	Use of water b/	Remarks
1	34.89	Mar. 19, 1942	B,H	P	Dug. Temperature 63° F.
2	29.53	do.	B,H	P	Dug. Temperature 62° F.
3	29.28	do.	B,H	P	Dug. Temperature 60° F.
4	17.51	do.	B,H	P	Dug. Temperature 56° F.
5	22.08	do.	B,H	P	Dug. Temperature 62° F.
6	--	--	--	--	Oil test. See log.
7	--	--	--	--	Oil test. Electrical log in files of Texas Board of Water Engineers shows a sandy zone from 280 to 380, shale, sandy shale and thin sands from 380 to 850 feet, a sandy zone from 850 to 1,000 feet and mostly shale or clay from 1,000 to 1,550 feet. See figure 2. See driller's log.
8	47.74	Mar. 19, 1942	J,E	P	Dug.
9	37.17	May 5, 1942	B,H	D,S	Dug. Temperature 65° F.
10	13.76	Mar. 17, 1942	B,H	P	Dug. Temperature 61° F.
11	--	--	--	--	Oil test. T. W. Hook lease. Electrical log in files of Texas Board of Water Engineers shows several thick sands with shale breaks from 100 to 500, shale, sandy shale and some sand from 500 to 900 and mostly shale or clay from 900 to 1,750 feet. See figure 2.
12	26.16	Mar. 17, 1942	B,H	P	Dug. Temperature 63° F.
13	13.20	do.	B,H	P	Dug. Temperature 62° F.
14	32.39	Mar. 16, 1942	B,H	P	Dug.
15	--	--	T,E, 15	P	Reported to have flowed 50 gallons a minute when drilled. Pump yield 200 gallons a minute with drawdown of 57 feet in 1942. Supplies City of Jefferson.
16	--	--	A	Ind	Formerly furnished three 110-horsepower boilers. Temperature 63° F.
17	29.88	Mar. 26, 1942	None	N	
18	--	--	C,T, 12	D	Screen from 552 to 594 feet. Small flow when drilled. With gas lift yielded 150 gallons a minute with drawdown of 140 feet. Temperature 65° F. See log.
19	--	--	A	Ind	Temperature 67° F.

b/ D, domestic; Ind, industrial; P, public supply; S, stock; N, not used.
c/ Water level reported by driller or owner.

Records of wells in Marion County--Continued

Well	Distance from Jefferson	Owner	Date completed	Depth of well (ft.)	Diameter of well (in.)	Height of measuring point above ground (ft.)
20	2½ miles northwest	Gulf Oil Corp.	1938	566	4	--
21	2¾ miles north	Shell Oil Co., Inc.	1937	3,150+	--	--
22	3 miles north	do.	1937	6,026	--	--
23	do.	Heyser-Heard	1938	625	6	--
24	do.	Gulf Oil Corp.	--	190	8	2.0
25	do.	Fohs Oil Co.	1938	650	4	--
26	4½ miles north	C. J. Richardson	1940	450	4,2½	--
27	2½ miles northeast	Arkansas Fuel Oil Co.	1938	210	6	--
28	4 miles northeast	do.	1937	438	4	--
29	do.	do.	1937	655	4	--
30	do.	do.	1938	865±	7,4	--
31	do.	do.	1941	815	5	--
32	5 miles northeast	do.	--	--	6-5/8	3.0
33	5½ miles northeast	do.	1938	707	6-5/8	--
34	do.	do.	1938	--	6-5/8	--
35	do.	do.	1938	6,131	--	--
36	do.	The Ohio Oil Co.	1938	698	6	0.5
37	6 miles northeast	Gulf Oil Corp.	--	600+	6	4.5
38	6½ miles northeast	Phillips Petroleum Corp.	--	--	6	1.0
39	do.	Union Production Co.	1938	--	6	--
40	do.	Fohs Oil Co.	1937	658	4	1.5
41	7 miles northeast	The Hunter Co., Inc.	1937	700	6	--
42	do.	Mid-Continent Petroleum Corp.	1937	598	6	1.0

Well	Water level: Below measuring point (ft.)	Water level: Date of measurement	Method of lift a/	Use of water b/	Remarks
20	--	--	C,E, 1½	D	Casing perforated from 499 to 566 feet. Reported yield 100 gallons a minute with gas lift in 1938. See log.
21	--	--	--	--	Oil test. L. Henderson lease.
22	--	--	--	--	Oil test. Lizzie Henderson lease. See log.
23	--	--	A	D	Measured yield 7 gallons a minute in 1942. Temperature 72° F.
24	88.71	Mar. 26, 1942	None	N	
25	--	--	C,G, 1½	D	Supplies water for seven families. Temperature 67° F. See log.
26	--	--	C,E, ¾	D	Sands at 135, 270, and 370 feet. Water at 135 feet is reported high in iron and cased off. Present supply from sand at 370 feet.
27	--	--	C,E, 1/6	D	
28	--	--	A	Ind	Casing perforated from 375 to 438 feet. Reported yield 10 gallons a minute. Temperature 71° F. See log.
29	--	--	A	Ind	Casing perforated at 490-511 and 612-654 feet. Reported yield, 55 gallons a minute. See log.
30	a/160	Oct. 3, 1940	A	Ind	Reported yield 100 gallons a minute. Temperature 76° F. See log.
31	--	--	A	Ind	Reported yield 110 gallons a minute. Temperature 78° F. Average combined discharge of wells 28, 29, 30, and 31 reported about 117,000 gallons a day.
32	89.98	Apr. 17, 1942	None	N	
33	--	--	A	Ind	Yield estimated 200 gallons a minute on March 24, 1942. Temperature 70° F.
34	--	--	None	N	
35	--	--	--	--	Oil test. R. C. Holland lease. See log.
36	122.9	Apr. 16, 1942	A	Ind	Measured yield 7 gallons a minute with drawdown of 12.8 feet after pumping 48 hours. Temperature 67½° F.
37	128.05	Apr. 17, 1942	A	Ind	Large yield reported.
38	119.08	do.	A	N	
39	--	--	A	Ind	Temperature 65° F.
40	62.39	Apr. 16, 1942	C,G, 1½	D	Casing perforated at 231-279 and 586-658 feet. See log.
41	--	--	A	N	Reported yield 30 gallons a minute.
42	89.65	Apr. 16, 1942	C,G, 1½	D, Ind	Casing perforated from 296 to 586 feet. Formerly supplied two oil drilling rigs. Temperature 64° F. See log.

Records of wells in Marion County--Continued

Well	Distance from Jefferson	Owner	Date completed	Depth of well (ft.)	Diameter of well (in.)	Height of measuring point above ground (ft.)
43	7 miles northeast	Arkansas Fuel Oil Co.	1937	620	4	3.0
44	do.	Holcomb-Thomason	1937	600	6	2
45	do.	Arkansas Fuel Oil Co.	1937	687	6	1.0
46	do.	do.	1937	6,132	--	--
47	do.	do.	1937	612	4	--
48	7½ miles northeast	do.	1938	792	6	2.0
49	8½ miles northeast	Phillips Petroleum Corp.	1937	190	6	--
50	9 miles northeast	Arkansas Fuel Oil Co.	--	--	6	--

Well	Distance from Smithland	Owner	Date completed	Depth of well (ft.)	Diameter of well (in.)	Height of measuring point above ground (ft.)
51	4½ miles northwest	Arkansas Fuel Oil Co.	1937	538	--	--
52	3 miles northwest	Midway School	1938	36	36	2.0
53	2 miles west	Logan Chapel School	1939	17	36	4.0
54	4½ miles southwest	Judea School	1937	24	30	0.5
55	4½ miles south	E. E. Miller	1938	13	36	--
56	½ mile east	Hollingsworth Drilling Co.	1941	3,505	--	--
57	½ mile northeast	Arkansas Fuel Oil Co.	1937	539	4	--
58	2¼ miles east	Jim Parsons et al.	1939	2,700	--	--
59	5½ miles east	Hollingsworth Drilling Co.	1940	2,535	--	--
60	7 miles east	M. Rosenbloom	1912	170	6	1.0
61	6 miles east	A. F. Anding	1939	2,374	--	--

Well	Water level: Below measuring point (ft.)	Water level: Date of measurement	Method of lift a/	Use of water b/	Remarks
43	80.40	Apr. 16, 1942	A	N	
44	76.54	do.	A	D	Temperature 66° F.
45	91.60	do.	A	N	
46	--	--	--	--	Oil test. Wade Houston lease. See log.
47	--	--	A	N	
48	61.91	Apr. 16, 1942	A	N	
49	c/30	--	A	Ind	Measured yield 40 gallons a minute April 17, 1942. Temperature 65° F.
50	--	--	A	N	

Well	Water level: Below measuring point	Water level: Date of measurement	Method of lift a/	Use of water b/	Remarks
51	--	--	None	N	Abandoned.
52	31.18	May 5 1942	B,H	P	Dug. Temperature 63° F.
53	7.7	do.	B,H	P	Dug.
54	3.0	May 1 1942	J,E, 1/6	P	Do.
55	c/11	--	H	D	Dug. Temperature 64° F.
56	--	--	--	--	Oil test. W. G. Bailey lease. Electrical log in files of Texas Board of Water Engineers shows a sandy zone from 100 to 370 and mostly shale or clay from 370 to 1,250 feet. See figure 2.
57	--	--	A	D, Ind	Reported yield 85 gallons a minute. See log.
58	--	--	--	--	Oil test. Gus Ney lease. Electrical log starting at 200 feet in files of Texas Board of Water Engineers shows a sandy zone from 200 to 500 and mostly shale or clay from 500 to 1,300 feet. See figure 2.
59	--	--	--	--	Oil test. J. D. Hartzo lease. Electrical log in files of Texas Board of Water Engineers shows a sandy zone from 35 to 330 and mostly shale or clay from 330 to 1,150 feet.
60	31.50	May 5 1942	C,G	D	
61	--	--	--	--	Oil test. Duke Hart lease. Electrical log in files of Texas Board of Water Engineers shows thin sands interbedded with clay from 100 to 350 and mostly shale or clay from 350 to 1,100 feet.

Records of wells in Marion County--Continued

Well	Distance from Smithland	Owner	Date completed	Depth of well (ft.)	Diameter of well (in.)	Height of measuring point above ground (ft.)
62	6 miles east	A. F. Anding	1941	2,350	---	---
63	4½ miles southeast	J. D. Reynolds	1939	2,526	---	---
64	4¼ miles southeast	do.	1939	370	6	1.0
65	4 miles southeast	do.	1939	2,456	---	---
66	6 miles southeast	Tom G. Allen	1930	160	6	---
67	6½ miles southeast	do.	1930	148	6	0.5
68	7 miles southeast	W. C. Toadvin	1937	1,139	---	---
69	7½ miles southeast	Davis, Hanner, and Wells	1941	2,667	---	---
70	7½ miles southeast	Roy I. Davis	1941	2,398	---	---
71	do.	Sloan Wells	1940	1,578	---	---
72	8 miles southeast	Morefield and Thompson	1937	969	---	---
73	8½ miles southeast	United States Government (In Caddo Parish, La.)	1938	240	6	---

a/ Pump or lift: T, turbine; A, air lift; C, cylinder; B, rope and bucket. Power: E, electric; G, gasoline engine; W, windmill; H, hand. Figure indicates horsepower.

Well	Water level: Below measuring point (ft.)	Water level: Date of measurement	Method of lift a/	Use of water b/	Remarks
62	--	--	--	--	Oil test. A. S. Hart lease. See log.
63	--	--	--	--	Oil test. -- Terry "B" Lease. Electrical log in files of Texas Board of Water Engineers shows thin sands between 300 and 400 feet and mostly shale or clay from 400 to 1,200 feet.
64	9.99	May 4, 1942	C,G	Ind	
65	--	--	--	--	Oil test. -- Terry "A" lease. Electrical log in files of Texas Board of Water Engineers shows some sand between 100 and 150 and mostly shale or clay from 150 to 1,150 feet. See log.
66	c/15	--	None	N	Reported unfit for drinking.
67	33.79	May 1, 1942	None	N	do.
68	--	--	--	--	Oil test. W. G. Gray Estate. Salty water reported in sand from 1,125 to 1,139 feet. See log.
69	--	--	--	--	Oil test. Ida Burr lease. Electrical log in files of Texas Board of Water Engineers shows a thin sand between 100 and 150 and mostly shale or clay from 150 to 1,030 feet.
70	--	--	--	--	Oil test. -- Rives lease. Electrical log starting at 200 feet in files of Texas Board of Water Engineers shows mostly shale or clay to 950 feet.
71	--	--	--	--	Oil test. T. B. Donnell lease. Electrical log in files of Texas Board of Water Engineers shows a thin sand at about 200 feet and the remainder mostly shale or clay to 1,100 feet. See figure 2.
72	--	--	--	--	Oil test. Gulf Oil Corp. lease. Salty water reported in sand from 961 to 969 feet. See log.
73	--	--	--	D	

b/ D, domestic; Ind, industrial; P, public supply; S, stock; N, not used.
c/ Water level reported by driller or owner.

Table of Drillers' Logs, Marion County, Texas

	Thickness (feet)	Depth (feet)
Well 6, partial log		
Dean Brothers (Fee No. 2), 11 miles west of Jefferson.		
Sandy clay	20	20
Sand and shells	190	210
Sand	61	271
Sand, shale and shells	529	800
Shells and shale	90	890
Sand	190	1080
Shale and shells	161	1241
Hard lime	3	1244
Shale and shells	836	2080
Chalk	38	2118
Broken shale	132	2250
Shale and chalk	177	2427
Shale	33	2460
Hard chalk	50	2510
Broken chalk and shale	53	2563
Chalk	37	2600
Broken chalk	110	2710
Shale and chalk	73	2783
Hard chalk	169	2952
TOTAL DEPTH		3771
Well 7, partial log		
Dean Brothers (Fee No. 1), 10 miles west of Jefferson.		
Shale	45	45
Shale, shells	173	218
Sand and shale	584	802
Shale, shells	552	1354
Lime	3	1357
Shale, shells	151	1508
Shale	57	1565
Sandy shale	31	1596
Shale, shells	143	1739
Shale	521	2260
Soft chalk and shale	31	2291
Broken chalk	684	2975
Shale	75	3050
TOTAL DEPTH		3690
Well 18, partial log		
United Gas Co. 2¾ miles northwest of Jefferson.		
Sand	3	3
White clay	23	26
Red sand	10	36
Sandy clay and boulders	39	75
Hard shale and boulders	147	222
Fine-grained sand	34	256
Gumbo and shale	79	335

	Thickness (feet)	Depth (feet)
Well 18, partial log--Continued		
Dirty sand	15	350
Hard shale	36	386
Sandy shale	12	398
Hard shale	72	470
Fine-grained sand	24	494
Hard gumbo	29	523
Fine-grained gray sand	17	540
Sandy shale	4	544
Fine-grained gray sand	48	592
TOTAL DEPTH		599
CASING RECORD: 538 feet of 10-inch, cemented; 110 feet of 6-inch. Screen; 6-inch from 552 to 594 feet. Under-reamed and gravel-walled.		
Well 20		
Gulf Oil Corp. 2½ miles northwest of Jefferson.		
Shale	135	135
Rock, shale and boulders	165	300
Rock	16	316
Sandy shale	44	360
Sand	30	390
Sticky shale	4	394
Sand	172	566
CASING RECORD: 566 feet of 4-inch, perforated from 499 to 566 feet. Gravel-walled.		
Well 22, partial log		
Shell Oil Co., Inc. 3 miles north of Jefferson. Altitude reported 231 feet.		
Surface sand	20	20
Shale and shells	605	625
Sand	25	650
Shale and shells	954	1604
Sand	44	1648
Shale and shells	264	1912
Chalk	58	1970
Chalk and shale	125	2095
Chalk	315	2410
Shale	180	2590
Sand	40	2630
Shale	380	3010
TOTAL DEPTH		3026
Well 25		
Fohs Oil Co. 3 miles north of Jefferson.		

(Continued on next page)

Table of Drillers' Logs, Marion County--Continued

	Thickness (feet)	Depth (feet)
Well 25--Continued		
Surface sand and clay	31	31
Sand	46	77
Sand and shale	23	100
Shale and boulders	24	124
Gumbo	22	146
Sandy shale	87	233
Hard shale	23	256
Gumbo	22	278
Sand and lignite	22	300
Shale	183	483
Sandy shale	67	550
Sand	100	650
CASING RECORD: 650 feet of 4-inch. Gravel-walled.		
Well 28		
Arkansas Fuel Oil Co., 4 miles northeast of Jefferson.		
Surface sand and clay	19	19
Sand	3	22
Broken sand and boulders	15	37
Sand	3	40
Sandy shale	84	124
Sand and gravel	12	136
Gummy shale	15	151
Rock	1	152
Sandy shale	7	159
Packsand	8	167
Sand rock	1	168
Sand	2	170
Gummy shale	8	178
Rock	1	179
Gummy shale and boulders	96	275
Sand	13	288
Gummy shale	9	297
Hard sand	15	312
Rock	1	313
Shale and boulders	45	358
Hard sand	2	360
Gummy shale and streaks of sand	15	375
Water sand and gravel	63	438
CASING RECORD: 438 feet of 4-inch, perforated from 375 to 438 feet.		
Well 29		
Arkansas Fuel Oil Co., 4 miles northeast of Jefferson.		
Surface sand and clay	17	17
Sand and gravel	3	20
Broken shale and boulders	15	35
Sand	3	38
Sandy shale	84	122
Sand and gravel	12	134
Gummy shale	15	149
Rock	1	150
Sandy shale	7	157
Packsand	8	165
Rock	1	166
Gummy shale	10	176

	Thickness (feet)	Depth (feet)
Well 29--Continued		
Rock	1	177
Sandy shale and boulders	96	273
Sand	13	286
Gummy shale	11	297
Hard sand	13	310
Rock	1	311
Shale and boulders	45	356
Hard sand	2	358
Gummy shale and streaks of sand	15	373
Water sand and gravel	63	436
Gummy shale	6	442
Sand and gravel	12	454
Gummy shale	6	460
Sand and gravel	10	470
Shale with streaks of sand	43	513
Shale and boulders	18	531
Sandy shale	67	598
Sand	15	613
Shale	12	625
Sand and gravel	31	654
Gummy shale	1	655
CASING RECORD: 654 feet of 4-inch, perforated at 490-511 and 612-654 feet.		
Well 30, partial log		
Arkansas Fuel Oil Co., 4 miles northeast of Jefferson.		
Surface sand and clay	20	20
Water sand	12	32
Gumbo and sand	44	76
Hard sand	45	121
Hard sand and gumbo	22	143
Hard sandstone	41	184
Hard sand and gumbo	25	209
Sandstone and boulders	21	230
Sand and gumbo	23	253
Gumbo	44	297
Gumbo and sand	22	319
Hard sandstone	20	339
Sandstone and gumbo	21	360
Gumbo	35	395
Blue water sand	30	425
Gumbo and sandy shale	20	445
Sandy shale	20	465
Gumbo and sandstone	25	490
Gumbo	20	510
Shale and gumbo	40	550
Soft shale	30	580
Gray water sand	80	660
Hard sand	5	665
TOTAL DEPTH		665+
CASING RECORD: 665 feet of 7-inch.		
Well 35, partial log		
Arkansas Fuel Oil Co., 5½ miles northeast of Jefferson. Altitude of derrick floor 315.7 feet.		
Clay	20	20
Sand, gravel, shale and boulders	130	150

(Continued on next page)

Table of Drillers' Logs, Marion County--Continued

	Thickness (feet)	Depth (feet)
Well 35, partial log--Continued		
Shale and boulders	570	720
Shale and sand	130	850
Shale and boulders	730	1580
Gummy shale	48	1628
Sand	52	1680
Shale and streaks of sand	40	1760
Gummy shale	45	1805
Shale, streaks of sand and boulders	70	1875
Shale and sand	50	1925
Gummy shale	73	1998
Chalk	500	2498
Sandy shale	137	2635
Sand and streaks of shale	75	2710
Shale	360	3070
TOTAL DEPTH		6131

Well 40

Fohs Oil Co., 6½ miles northeast of Jefferson.

Surface soil	49	49
Sand and gravel	30	79
Shale and boulders	15	94
Sandy shale	92	186
Gumbo	23	209
Shale and boulders	22	231
Sand	48	279
Sandy shale	108	387
Shale and lignite	86	473
Sandy shale and boulders	22	495
Sandy shale	68	563
Sandy shale and rock	46	609
Sand	49	658

CASING RECORD: 658 feet of 4-inch perforated at 231-279 and 586-658 feet. Gravel-walled.

Well 42

Mid-Continent Petroleum Corp. 7 miles northeast of Jefferson. Altitude reported 305 feet.

Surface sand	80	80
Rock and sand	10	90
Sand	15	105
Shale	5	110
Sand	22	132
Rock and sand	14	146
Sandy shale	94	240
Rock and shale	97	337
Shale	23	360
Sand	15	375
Shale and gumbo	95	470
Sand	20	490
Shale	10	500
Sand	10	510
Gumbo	35	545
Sand	15	560
Sand	38	598

	Thickness (feet)	Depth (feet)
Well 42--Continued		
CASING RECORD: 586 feet of 6-inch, perforated from 296 to 586 feet. Gravel-walled.		

Well 46, partial log

Arkansas Fuel Oil Co. 7 miles northeast of Jefferson. Altitude of derrick floor 323 feet.

Sand and clay	40	40
Sand	50	90
Sand and boulders	186	276
Sand and shale	300	576
Shale and boulders	500	1076
Shale and shells	400	1476
Gummy shale	144	1620
Broken sand	100	1720
Shale and shells	192	1912
Gummy shale	63	1975
Chalk rock	550	2525
Shale	109	2634
Sand	86	2720
Sandy shale	141	2861
Shale and shells	200	3061
Shale	59	3120
Lime	56	3176
TOTAL DEPTH		6132

Well 57

Arkansas Fuel Oil Co. ½ mile northeast of Smithland.

Surface sand	30	30
Blue sand	68	98
Sandstone	32	130
Red water sand	12	142
Sandstone	65	207
Gummy shale	53	260
Red sand	10	270
Gummy shale and red sand	10	280
Sandstone	10	290
Shale	24	314
Gummy shale	23	337
Clay	22	359
Clay and sand	21	380
Sandstone	22	402
Blue water sand	58	460
Red sand and shale	7	467
Sand and shale	38	505
Water sand	30	535
Shale	4	539

CASING RECORD: 539 feet of 4-inch.

Well 62

A. F. Anding 6 miles east of Smithland. Altitude 271 feet.

Clay and sandy clay	147	147
Water sand	10	157
Clay	35	192

(Continued on next page)

Table of Drillers' Logs, Marion County--Continued

	Thickness (feet)	Depth (feet)
Well 62--Continued		
Sand	16	208
Sandy clay	120	328
Sand	23	351
Shale	88	439
Hard rock	1	440
Sandy shale	263	703
Shale	37	740
Marl and shale	406	1146
Sand	60	1206
Shale	30	1236
Shale and sandy shale	68	1304
Sandy shale	178	1482
Marl and chalk	462	1944
Shale	133	2077
Streaks of lime and sand	100	2177
Gumbo and sandy shale	101	2278
Sandy shale	29	2307
Sand	6	2313
Shale	2	2315
Sand	4	2319
Sandy shale	31	2350
Well 65		
J. D. Reynolds 4 miles southeast of Smithland.		
Surface clay	42	42
Shale, lignite and rocks	166	208
Shale, sand and shells	62	270
Sand	28	298
Shale and hard shells	317	615
Shale and boulders	259	874
Shale and shells	216	1090
Shale	40	1130
Sand	225	1355
Shale and boulders	85	1440
Sticky shale	25	1465
Shale and chalk	15	1480
Chalk	462	1942
Shale	138	2080
Shale and boulders	26	2106
Sand	44	2150
Shale	135	2285
Shale and sand	5	2290
Shale	20	2310
Sandy shale	20	2330
Shale	103	2433
Streaks of lime and sand	23	2456

	Thickness (feet)	Depth (feet)
Well 68		
W. C. Toadvin 7 miles southeast of Smithland.		
Surface soil	6	6
Sand and clay	66	72
Lignite	13	85
Sandy shale	155	240
Water sand	153	393
Sandy shale and boulders	85	478
Shale and boulders	147	625
Sticky shale	37	662
Shale and boulders	228	890
Shale and shells	90	980
Sandy shale and shells	114	1094
Hard lime and sandstone	4	1098
Sand	1	1099
Hard lime and sandstone	2	1101
Sand	23	1124
Hard lime and sandstone	1	1125
Sand (bailed salty water)	14	1139
Well 72		
Morefield and Thompson 8 miles southeast of Smithland.		
Clay	20	20
Sand	20	40
Sandy shale and boulders	40	80
Shale and boulders	25	105
Hard shale	35	140
Water sand	50	190
Rock	1	191
Shale and boulders	56	247
Rock	1	248
Streaks of shale and rock	216	464
Rock	2	466
Shale	129	595
Gumbo	61	656
Shale	44	700
Shale and boulders	85	785
Hard shale	51	836
Shale and boulders	120	956
Hard sand and rock	4	960
Rock	1	961
Sand (salty water)	8	969

Partial analyses of water from wells in Marion County, Texas

Analyzed at The University of Texas under the direction of W. W. Hastings, Chemist, U. S. Department of the Interior Geological Survey, and Dr. E. P. Schooch, Director of the Bureau of Industrial Chemistry. Results are in parts per million. Well numbers correspond to numbers in table of well records.

Well	Owner	Depth of well (ft.)	Date of collection	Total dissolved solids	Calcium (Ca)	Magnesium (Mg)	Sodium and Potassium (Na + K) (calc.)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Total hardness as $CaCO_3$ (calc.)
1	Pleasant Valley School	34	Mar. 19, 1942	16	a/	0	6.0	6	2	2.5	0.4	2.0	0
b/ 2	Rock Wall School	29	do.	32	0	0	12	6	4	10	0.2	3.0	0
3	Warlock School	30	do.	29	2.8	2.4	8.7	6	4	8.0	0.1	3.0	17
4	Murry League School	19	do.	41	0	0	14	6	15	6.0	-	3.0	0
b/ 5	Rocky Springs School	25	do.	34	4.4	1.2	5.5	12	5	3.0	0.5	9.0	16
b/ 8	Lassater Junior High School	52	do.	88	10	16	0.9	85	12	5.5	0.2	1.0	90
9	D. L. Wright	46	May 5, 1942	58	2.0	2.9	13	6	3	15	0.2	19	17
10	Jackson School	19	Mar. 17, 1942	82	4.8	2.4	21	6	12	32	0.3	6.0	22
b/ 12	Macedonia School	28	do.	21	2.4	1.2	3.0	6	3	4.0	0.3	4.0	11
13	New Zion School	32	do.	36	a/	1.2	11	12	3	5.0	0.2	10	5
14	Cypress Chapel	32	Mar. 16, 1942	22	0.8	2.4	2.8	0	3	6.5	0.3	6.0	12
b/ 15	City of Jefferson	780	Mar. 24, 1942	960	11	2.2	381	531	2	302	0.6	0	36
16	Arkansas Fuel Oil Co.	715	Mar. 26, 1942	662	2.8	2.2	270	464	3	156	1.0	0	16
b/ 18	United Gas Co.	599	Apr. 30, 1942	905	2.8	a/	371	512	2	276	1.0	0	7
19	Holcomb-Thompson	620	Mar. 26, 1942	88	4.8	0.7	29	49	10	19	0.2	0	15
b/ 20	Gulf Oil Corp.	566	do.	878	2.8	2.2	357	519	2	258	0.7	0	16
23	Heyser-Heard	625	do.	909	0.8	2.2	374	598	3	235	-	0	11
25	Fohs Oil Co.	650	do.	80	2.0	5.8	23	79	3	7.0	-	0	29
b/ 26	J. C. Richardson	450	do.	841	4.8	1.0	349	708	2	133	1.6	2.0	16
b/ 27	Arkansas Fuel Oil Co.	210	Apr. 17, 1942	968	0.8	a/	404	671	4	228	1.6	0	2
28	do.	438	do.	994	2.8	2.2	408	677	3	244	-	1.0	16
30	do.	865±	do.	1,988	4.8	1.0	796	592	4	890	1.2	-	16
b/ 31	do.	815	do.	2,119	2.8	1.0	849	567	2	985	-	-	11
33	do.	707	do.	813	4.8	a/	332	506	5	221	1.1	0	12
b/ 36	The Ohio Oil Co.	698	Mar. 26, 1942	323	0.8	2.2	133	305	7	30	-	0	11

a/ Less than three parts per million.

b/ Analyses of water from selected wells are given in equivalents per million on page 27.

Partial analyses of water from wells in Marion County--Continued

Results are in parts per million.

Well no.	Owner	Depth of well (ft.)	Date of collection	Total dissolved solids	Calcium (Ca)	Magnesium (Mg)	Sodium and Potassium (Na + K) (calc.)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Total hardness as $CaCO_3$ (calc.)
37	Gulf Oil Corp.	600+	Apr. 20, 1942	1,114	1.2	1.9	455	610	3	353	-	0	11
39	Union Production Co.	-	Apr. 17, 1942	178	13	3.4	52	140	30	9.0	0.2	1.0	47
b/ 44	Holcomb-Thomason	600	Apr. 16, 1942	1,061	6.4	a/	430	567	4	342	-	0	16
b/ 49	Phillips Petroleum Corp.	190	Apr. 17, 1942	71	1.2	3.4	21	43	20	4.5	0.1	0	17
b/ 52	Midway School	36	May 5, 1942	26	3.2	1.9	2.8	12	2	2.5	0.3	7.0	16
53	Logan Chapel School	17	do.	41	1.2	1.9	11	12	3	11	0.1	7.0	11
b/ 54	Judea School	24	Apr. 1, 1942	94	16	4.4	14	67	11	13	0.4	2.0	53
b/ 55	E. E. Miller	13	May 1, 1942	71	7.6	0.2	19	24	10	22	0.2	0	20
b/ 57	Arkansas Fuel Oil Co.	539	do.	1,371	11	0.7	545	561	2	530	1.2	4.0	30
b/ 60	M. Rosenbloom	170	May 5, 1942	547	15	9.2	196	336	2	157	1.0	1.5	76
b/ 64	J. D. Reynolds	370	May 9, 1942	288	14	3.2	99	250	30	18	0.3	0	47
b/ 73	U. S. Government	240	May 5, 1942	444	5.2	1.9	177	317	2	101	-	0	21

a/ Less than three parts per million.

b/ Analyses of water from selected wells are given in equivalents per million on page 27.

Chemical Analyses--Continued

Equivalents per million

Well	Owner	Depth of well (ft.)	Date of collection	Calcium (Ca)	Magnesium (Mg)	Sodium and Potassium (Na + K) (calc.)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Total hardness as $CaCO_3$ (calc.)
2	Rock Wall School	29	Mar. 19, 1942	0	0	2.05	0.10	0.08	0.28	0.01	0.05	0.00
5	Rocky Springs School	25	do.	0.22	0.10	2.00	0.20	0.10	0.08	0.03	0.15	0.32
8	Lassater Junior High School	52	do.	0.52	1.28	1.40	1.40	0.25	0.16	0.01	0.02	1.80
12	Macedonia School	28	Mar. 17, 1942	0.12	0.10	2.00	0.10	0.06	0.11	0.02	0.06	0.22
15	City of Jefferson	780	Mar. 24, 1942	0.54	0.18	1.95	8.70	0.04	8.52	0.03	0	0.72
18	United Gas Co.	599	Apr. 30, 1942	0.14	.08	2.05	8.40	0.04	7.78	0.05	0	0.14
20	Gulf Oil Corp.	566	Mar. 26, 1942	0.14	0.18	1.95	8.50	0.04	7.28	0.04	0	0.32
26	J. C. Richardson	450	do.	0.24	0.08	2.00	11.60	0.04	3.75	0.08	0.03	0.32
27	Arkansas Fuel Oil Co.	210	Apr. 16, 1942	0.04	-	2.10	11.00	0.08	6.43	0.08	0	0.04
31	do.	815	Apr. 17, 1942	0.14	0.08	2.00	9.30	0.04	27.78	-	-	0.22
36	The Ohio Oil Co.	698	Mar. 26, 1942	0.04	0.18	1.95	5.00	0.15	0.85	-	0	0.22
44	Holcomb-Thomason	600	Apr. 16, 1942	0.32	-	2.05	9.30	0.08	9.65	-	0	0.32
49	Phillips Petroleum Corp.	190	Apr. 17, 1942	0.06	0.28	1.90	0.70	0.42	0.13	0.01	0	0.34
52	Midway School	36	May 5, 1942	0.16	0.16	1.95	0.20	0.04	0.07	0.02	0.11	0.32
54	Judea School	24	Apr. 1, 1942	0.80	0.36	1.85	1.10	0.23	0.37	0.02	0.03	1.16
55	E. E. Miller	13	May 1, 1942	0.38	0.02	2.10	0.40	0.21	0.62	0.01	0	0.40
57	Arkansas Fuel Oil Co.	539	do.	0.54	0.06	2.00	9.20	0.04	14.95	0.06	0.06	0.60
60	M. Rosenbloom	170	May 5, 1942	0.76	0.76	1.95	5.50	0.04	4.43	0.05	0.02	1.52
64	J. D. Reynolds	370	May 9, 1942	0.68	0.26	1.90	4.10	0.616	0.51	0.02	0	0.94
73	U. S. Government	240±	May 5, 1942	0.26	0.16	1.95	5.20	0.04	2.85	0.02	0	0.42

Geologic formations in northeast Texas

System	Series	Group	Subdivisions	Approximate thickness (feet)	Character of rocks	Water-bearing properties
Quaternary	Recent		Alluvium	0- 25	Sand, silt and clay, confined to stream valleys.	Yields small quantities of water to shallow domestic wells.
Tertiary	Eocene	Claiborne	Sparta sand	0- 50	Chiefly unconsolidated sand.	Yields water of good quality to shallow wells.
			Mount Selman formation: Weches greensand member	0- 50	Greensand and glauconitic clay containing iron ore.	Yields only small quantity of mineralized water.
			Mount Selman formation: Queen City sand member	0-480	Light-gray fine-grained massive and cross-bedded sand with interbedded clay and lignite.	Yields water of good quality to many domestic wells.
			Mount Selman formation: Reklaw member	0-130	Consists mostly of clay, glauconitic sand and impure lignite.	In general yields only small quantities of rather highly mineralized water.
			Carrizo sand	0-100±	Fine to medium-grained quartz sand interbedded with clay.	Yields moderate to large quantities of water in some areas.
		Wilcox	Wilcox group (undifferentiated)	0-900±	Medium to fine-grained massive and lenticular sands interbedded with clay or shale. Thin beds of lignite.	Yields large quantities of water to wells. Lower sands generally yield somewhat highly mineralized water.
	Paleocene	Midway	Midway group (undifferentiated)	400-600	Clay, silt, glauconitic sand and lentils of limestone.	Not know to yield water in material quantities.

Figure -1-

GEOLOGIC MAP OF EIGHT COUNTIES IN NORTHEAST TEXAS

SCALE
10 0 10 MILES

— LEGEND —

- Q — Alluvium
- Es — Sparta sand
- Ew — Weches greensand member } Mt. Selman formation
- Eqc — Queen City sand member } Mt. Selman formation
- Er — Reklaw member } Mt. Selman formation
- Ec — Carrizo sand
- Ewi — Wilcox group undifferentiated
- Ewp — Midway group "

Sulphur River
Talco
Ewp
Ewi
TITUS
MT. PLEASANT
Ec
Er
Eqc
CASS
Atlanta
MORRIS
DAINGERFIELD
Hughes Springs
LINDEN
Ew
Es
PITTSBURG
CAMP
Cypress Creek
MARION
JEFFERSON
GILMER
UPSHUR
Little Cypress Creek
Karnack
Big Sandy
Sabine
Gladewater
LONGVIEW
Hallsville
MARSHALL
HARRISON
Waskom
GREGG
Kilgore
River

From geologic map of Texas, U.S. Geological Survey, 1937.

—K—
9-16-42.

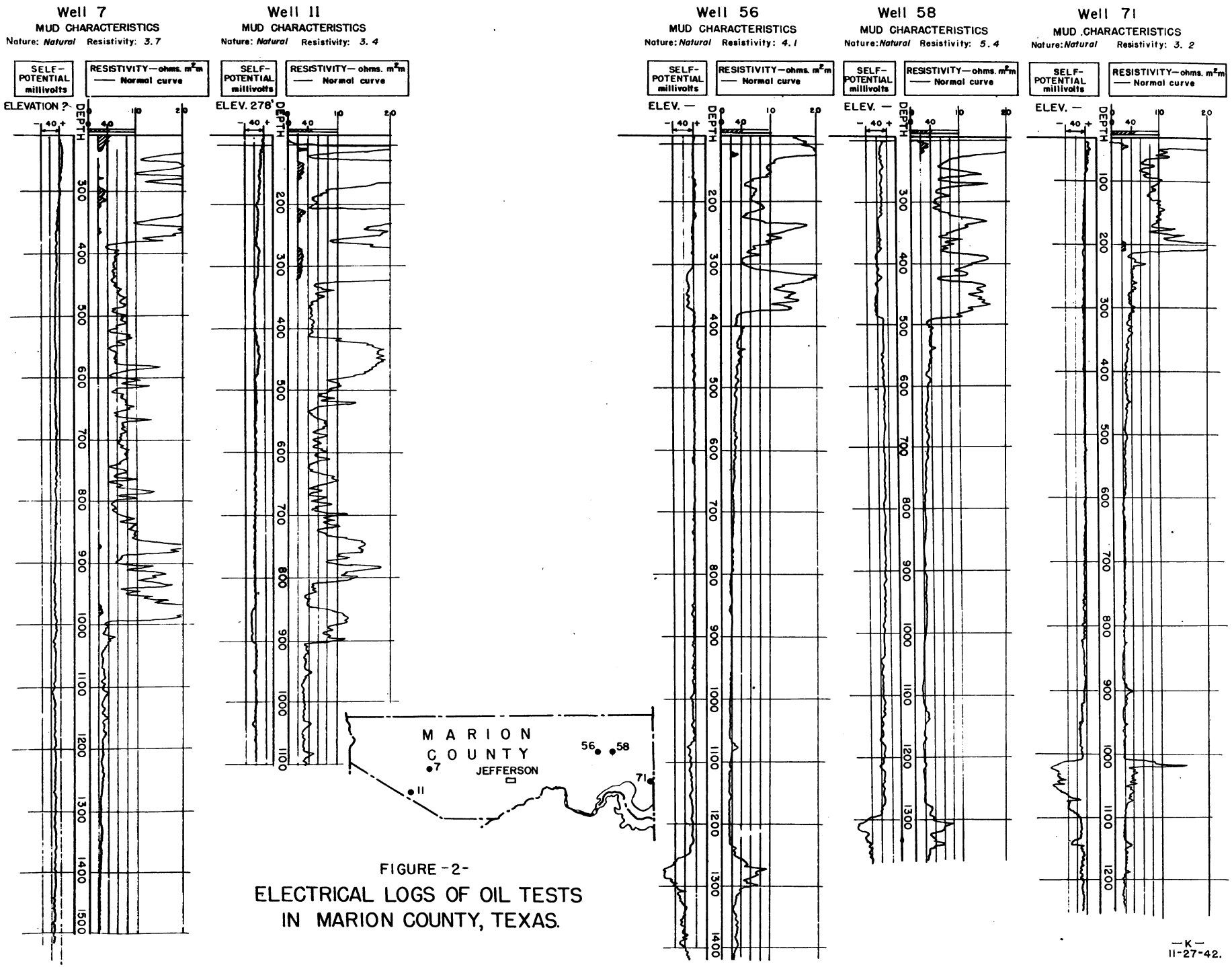


FIGURE -2-

ELECTRICAL LOGS OF OIL TESTS IN MARION COUNTY, TEXAS.

—K—
11-27-42.

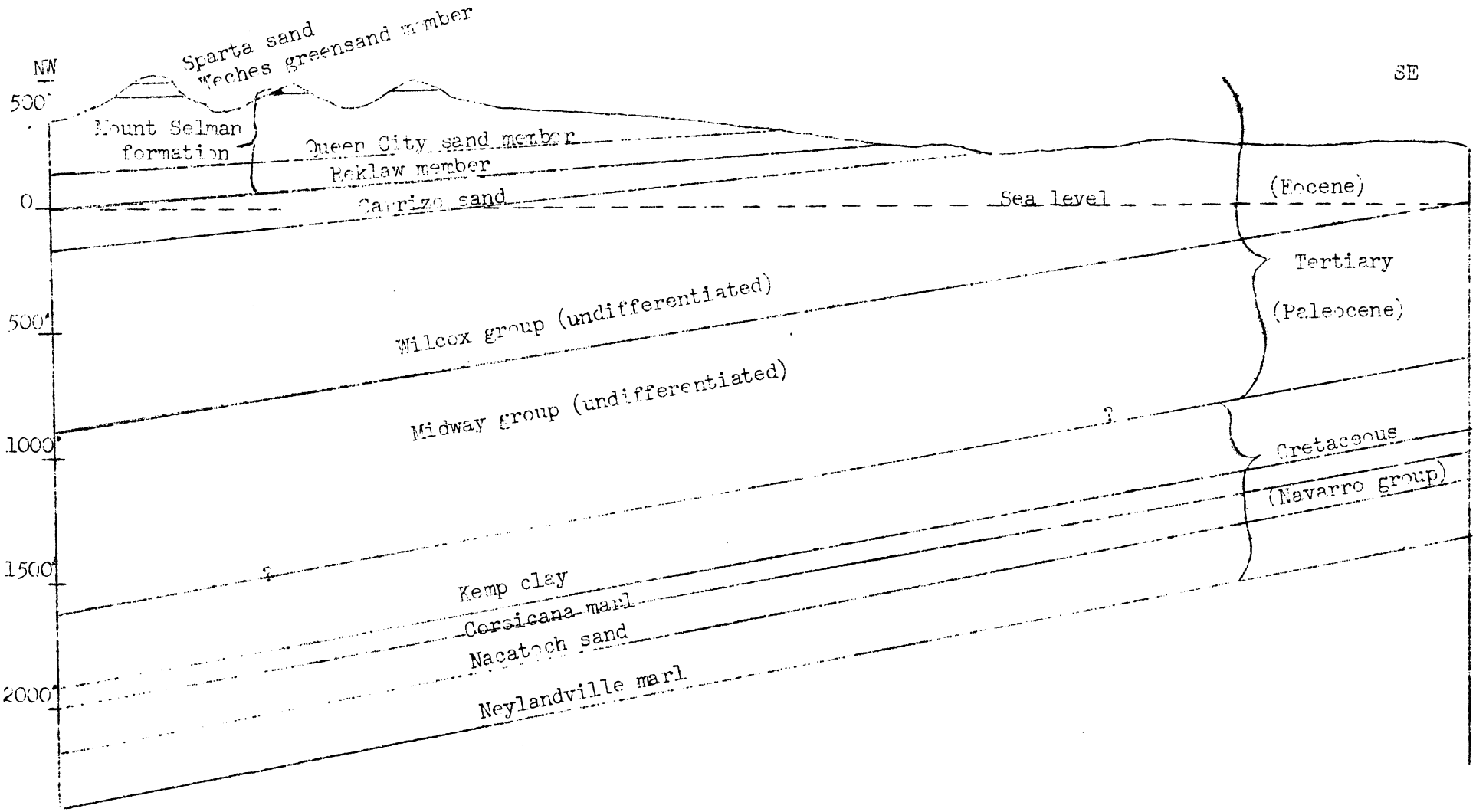
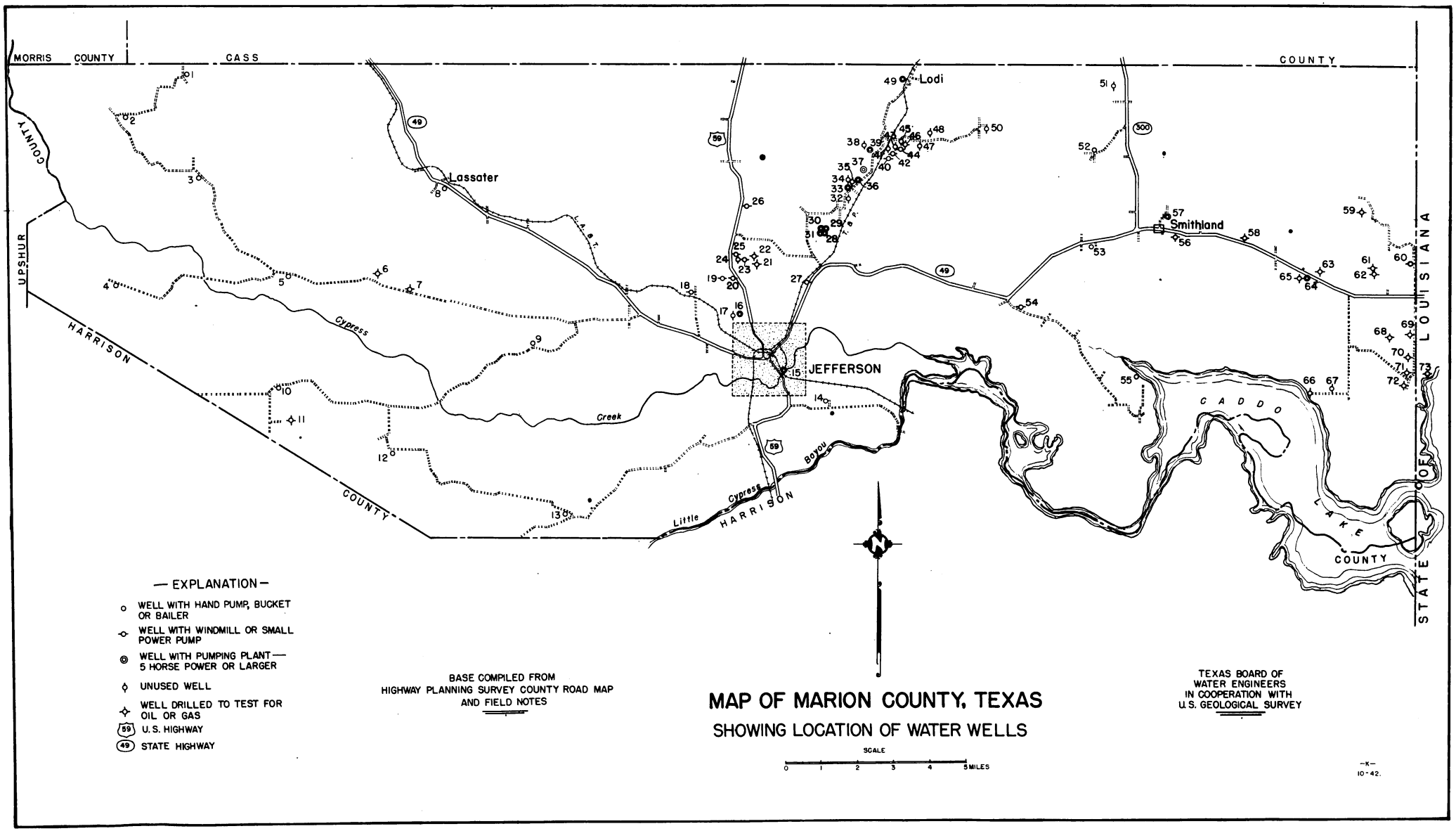


Figure 3. - Generalized geologic section across Marion County, Texas


MORRIS COUNTY
CASS
COUNTY
UPSHUR
COUNTY
HARRISON
COUNTY
STATE OF LOUISIANA
Lodi
Lassater
Smithland
JEFFERSON
Cypress
Creek
Little
Cypress
Bayou
HARRISON
C A D D O
L A K E
COUNTY
L. & T.
T. P.
— EXPLANATION —
WELL WITH HAND PUMP, BUCKET OR BAILER
WELL WITH WINDMILL OR SMALL POWER PUMP
WELL WITH PUMPING PLANT — 5 HORSE POWER OR LARGER
UNUSED WELL
WELL DRILLED TO TEST FOR OIL OR GAS
59 U. S. HIGHWAY
49 STATE HIGHWAY
BASE COMPILED FROM HIGHWAY PLANNING SURVEY COUNTY ROAD MAP AND FIELD NOTES
MAP OF MARION COUNTY, TEXAS
SHOWING LOCATION OF WATER WELLS
SCALE
0 1 2 3 4 5 MILES
TEXAS BOARD OF WATER ENGINEERS IN COOPERATION WITH U.S. GEOLOGICAL SURVEY
-K-
10-42.