TEXAS
WATER
DEVELOPMENT
BOARD

Report 110

GROUND-WATER CONDITIONS IN ANGELINA AND NACOGDOCHES COUNTIES, TEXAS

MARCH 1970

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GROUND-WATER CONDITIONS IN ANGELINA AND NACOGDOCHES COUNTIES, TEXAS

By

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GROUND-WATER CONDITIONS IN ANGELINA AND NACOGDOCHES COUNTIES, TEXAS

ABSTRACT

Angelina and Nacogdoches Counties are in the rolling hills, piney woods portion of East Texas. The population of Angelina County in 1967 was estimated at about 47,000 and of Nacogdoches County, about 31,000. Major cities are Lufkin and Nacogdoches.

The geologic formations which constitute the principal aquifers are the Carrizo Sand, Wilcox Group, Yegua Formation, and Sparta Sand. Of these the Carrizo is by far the most productive.

Each of the formations crops out in the area and dips to the south. Recharge is received by the aquifers from precipitation and streamflow on the outcrops. Because the aquifers are full to overflowing, most of the recharge is rejected in the outcrops as evapotranspiration and seepage in the stream valleys. For each aquifer, the principal factor controlling the amount of water which can be obtained from wells is the ability of the aquifer to transmit water from its recharge area to points of withdrawal.

Fresh water exists in the Carrizo Sand over an area extending from its outcrop in northeastern Nacogdoches County to a line running generally from west to east through the northern part of Lufkin. The maximum depth of occurrence of fresh water in this formation is about 1,500 feet. The Carrizo Sand has been extensively developed by large well fields belonging to the cities of Lufkin and Nacogdoches and Southland Paper Mills. Total pumpage from Carrizo wells in 1968 is estimated at 26.7 million gallons per day. Yields of individual wells range from a few gallons per minute to nearly 1,500 gallons per minute, depending on location and type of construction. The pumpage from the large well fields has drawn the static water levels in Carrizo wells down nearly 500 feet near the center of pumping. The estimated total supply available from Carrizo wells under practical conditions, without causing the failure of some of the present well fields and drying up portions of the aquifer, is 32 million gallons per day. Thus, the estimated supply available for additional development is only about 5 million gallons per day. This estimate is based on the assumption that there will be no interference as a result of increased pumping outside of Angelina and Nacogdoches Counties.

Fresh water occurs in the Wilcox Group over an area covering all of northern Nacogdoches County and extending southward to a line running generally from west to east between Lufkin and the Angelina River. The maximum depth of occurrence of fresh water in the Wilcox is about 1,700 feet. Much of the Wilcox water, though fresh, is considerably more mineralized than the water in the overlying Carrizo Sand. Pumpage from the Wilcox Group was only 0.5 million gallons per day in 1968. The estimated potential yield of the Wilcox sands to wells is 8 million gallons per day. The estimated maximum yield of an individual well ranges from zero to 500 gallons per minute, and the estimated maximum yield of an individual well field ranges from zero to 5 million gallons per day, depending on location. The best location for additional development is believed to be in eastern Nacogdoches County.

Fresh water occurs in the Yegua Formation over an area lying between the northern edge of its outcrop north of Lufkin and a line passing generally from west to east across Angelina County between Huntington and Diboll. The maximum depth of occurrence of fresh water in the Yegua is about 1,150 feet. The quality of the fresh water in the Yegua varies considerably from place to place in an unpredictable manner. Estimated pumpage from the Yegua Formation in 1968 was 2.8 million gallons per day. Much of this pumpage was in the vicinity of Diboll. The static water level in at least one well at Diboll has declined nearly 300 feet as a result of pumping. The estimated potential yield from wells in the Yegua Formation is 7 million gallons per day. Depending on location, the estimated maximum yield of an individual well ranges from zero to 500 gallons per minute, and the estimated maximum yield of an individual well field ranges from zero to 3 million gallons per day.

Fresh water occurs throughout the outcrop of the Sparta Sand in southern Nacogdoches County and northwestern Angelina County, and downdip in two relatively small localities on the west and east sides of the two-county area. The maximum depth of occurrence of fresh water in the Sparta Sand is about 750 feet. Estimated pumpage in 1968 from the Sparta Sand was

only 0.1 million gallons per day. The estimated potential yield of this sand to wells is 7 million gallons per day. Depending on location, the estimated maximum yield of an individual well ranges from zero to 500 gallons per minute, and estimated maximum yield of an individual well field ranges from zero to 4 million gallons per day.

No evidence has been found of any serious contamination of ground water from oil-field brines. There is some possibility of future encroachment of brackish water in the Carrizo and Yegua Formations toward the southernmost centers of pumping, but it should be many years before any such encroachment becomes a serious problem.

When maximum supplies of water are desired, or developments are in areas of borderline quantity or quality, test drilling programs and the use of pilot production wells are recommended. A thorough continuing program of observation of pumpage, water levels, and chemical quality is recommended for the Carrizo and Yegua aquifers, with partial coverage for the Wilcox and Sparta aquifers until they become more fully developed.

GROUND-WATER CONDITIONS IN ANGELINA AND NACOGDOCHES COUNTIES, TEXAS

INTRODUCTION

Purpose

The purpose of this report is to describe the occurrence, availability, and quality of the ground-water resources of Angelina and Nacogdoches Counties. The report is particularly concerned with sources of moderate to large supplies of water suitable for public supply, industrial, and irrigation uses. Data have also been included, however, which will benefit persons desiring smaller supplies for domestic and livestock use.

It is believed that the report will be helpful as a guide in developing and obtaining the maximum benefits from the available ground-water supplies. In addition, the report is designed to provide information for use by regulatory agencies in protecting the fresh ground water from contamination.

Scope

This investigation has included, insofar as practicable with available data, a complete evaluation of the ground-water resources of each of the aquifers in the two counties. The geology of the water-bearing formations has been studied, together with the quality of water in each formation. A quantitative evaluation has been made of the water available for development from each principal aquifer.

The first phase of the investigation was to compile and study all available reports and records on the ground-water resources of the area. In addition to obtaining reports by the U.S. Geological Survey, the Texas Water Development Board, and others, this work included compilation and analysis of voluminous unpublished records on water wells and oil tests, primarily from the files of the Texas Water Development Board, the U.S. Geological Survey, and this firm.

A new inventory was then made in the field to locate and obtain additional data where necessary on all wells which have been drilled for municipal, industrial, and irrigation purposes, and representative wells used for domestic and livestock supplies. Information on the various wells was obtained from well owners, drillers, and consultants. For each well a determination was made of the formation supplying its water, as indicated by available well records, the geologic map (Bureau of Economic Geology, 1968), and nearby well logs. Depth to water measurements were made in wells where this was practicable, and water samples were taken from numerous wells for chemical analyses. Pumping tests to determine the hydraulic characteristics of the water-bearing formations were made of nearly all wells for which satisfactory tests could be obtained and which had not previously been tested.

Additional electric logs of water wells and test holes and oil tests were obtained to supplement the logs already in the files of the Texas Water Development Board and this firm. Every available log was obtained except in areas where logs are closely spaced in oil fields.

Records of total pumpage were obtained from major ground-water users as well as from the Texas Water Development Board's files. Records of past water levels in wells were obtained from the Texas Water Development Board and U.S. Geological Survey files and from well owners, drillers, and consultants.

All of the available information on the geology and hydrology of the ground-water resources has been analyzed, and the results have been tabulated and/or plotted on maps, cross sections, and graphs and are presented in this report.

The character, thickness, and depth of the water-bearing formations are described, and estimates have been made of the quantities of water which can be developed from each of the principal water-bearing formations, and the amounts of water which can be obtained from individual wells and well fields.

The construction and operating characteristics of existing wells are presented, and records are given to illustrate the relationship between pumpage and water levels. Rainfall, streamflow, natural recharge, and natural discharge are described and discussed in the context of their relationship to the available ground-water resources.

The chemical quality of water in each formation is discussed and presented by means of chemical analyses of water from wells. In addition, interpretations of electric logs have been made to present estimates of the quality of water in each principal water-bearing formation in areas where chemical analyses of water from wells are not available. A review has been made of possible contamination problems, and the results of this review are discussed.

Finally, recommendations have been made with respect to a continuing observation program on pumpage, water-level fluctuations, and quality of water and on methods for further investigation, especially test drilling, to determine optimum locations and yields of new wells and well fields.

The detailed records on which this report is based have been placed on file with the Texas Water Development Board. These include especially the well schedules on the individual wells and the drillers' and electric logs. Tables 7 and 8 give the most important information on all of the wells, but the well schedules for some of the wells give additional information which may be of help in particular problems. All of the drillers' and electric logs are identified in Tables 7 and 8 and their locations are shown on Figure 27, but because of space limitations the only electric logs which are actually presented in the report are those in the cross sections in Figures 29, 30, 31, and 32, and the only drillers' logs presented in the report are the representative logs included in Tables 9 and 10.

Location

The location of Angelina and Nacogdoches Counties is shown on Figure 1. These counties are in the rolling hills, piney woods of East Texas. The principal streams are the Angelina River, which separates the two counties, and the Neches River, which flows along the southwestern side of Angelina County. Sam Rayburn Reservoir on the Angelina River covers portions of eastern Angelina County and southeastern Nacogdoches County (Figure 27).

Population

According to the Texas Almanac, the population of Angelina County in 1967 was about 47,000, and the population in 1960 was 39,814. The major city is Lufkin, with an estimated population in 1967 of about 20,300. The largest other towns and their estimated populations in 1967 are Diboll, 3,300; Herty (a suburb of Lufkin), 1,400; Huntington, 1,100; Keltys (a suburb of Lufkin), 1,100; Zavalla, 900; and Pollok, 400.

The estimated population in 1967 of Nacogdoches County, according to the Texas Almanac, was about 31,000, and the population in 1960 was 28,046. The major city is Nacogdoches, with an estimated population in 1967 of about 16,100. The largest other towns in

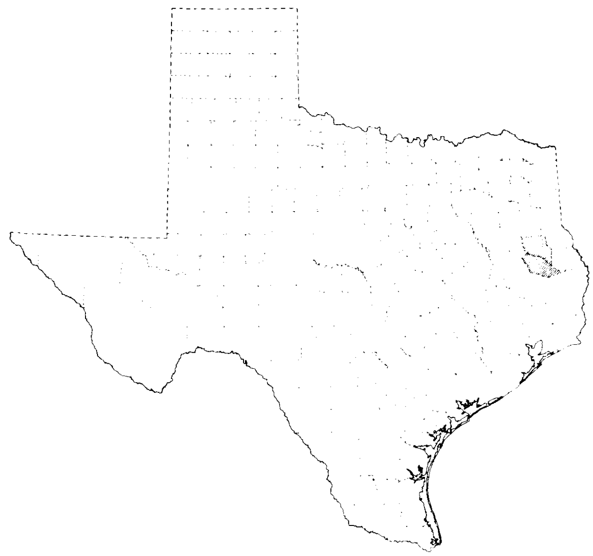


Figure 1.—Location of Angelina and Nacogdoches Counties

Nacogdoches County and their estimated populations in 1967 are Garrison, 1,000; Cushing, 600; Chireno, 500; and Appleby, 300.

Climate

The annual precipitation at Nacogdoches from 1921 through 1968, inclusive, is shown on Figure 2. Normal precipitation (1931-60) is about 48 inches per year. Figure 2 also shows the average monthly precipitation and the average monthly temperature at Nacogdoches. Average annual temperature is about 66 degrees Fahrenheit.

The average precipitation at Lufkin is about the same as at Nacogdoches, and the average temperature is a fraction of a degree warmer.

Previous Investigations

The first reasonably complete study of ground-water resources of this area was made by White, Sayre, and Heuser during the period 1937-40. The results of their investigation were published in 1941 as U.S. Geological Survey Water-Supply Paper 849-A, entitled "Geology and Ground-Water Resources of the Lufkin Area, Texas." Just prior to that investigation, in 1936 and 1937, G. H. Cromack made a thorough inventory of water wells and springs in Nacogdoches County. His inventory was published as a mimeographed report by the Texas Board of Water Engineers in 1937.

In 1941, the U.S. Geological Survey established an office at Lufkin to make additional studies of ground water in the area, with particular reference to the

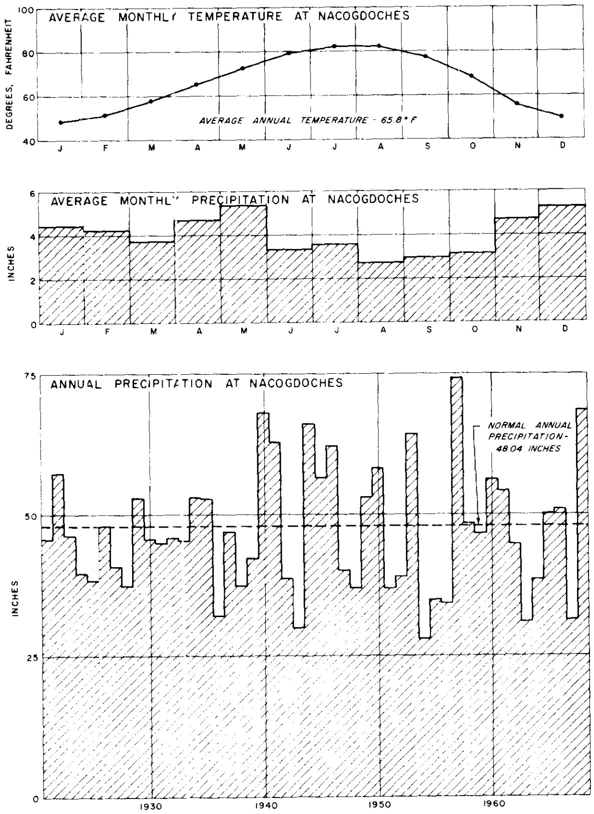


Figure 2.—Temperature and Precipitation at Nacogdoches

availability of water from the Carrizo Sand for industrial purposes. During 1942 and 1943, quantitative studies were made of both the Carrizo Sand and the Sparta Sand. These studies were based in part on test holes drilled by Southland Paper Mills and on pumping tests of production wells belonging to Southland Paper Mills.

Since 1943, various consulting studies have been made in the area, the more general ones being for Southland Paper Mills and the city of Nacogdoches. Also, a reconnaissance investigation of the principal aquifers in the Neches River basin, which includes Angelina and Nacogdoches Counties, was made by the Texas Water Commission and reported on by Baker and others (1963). In addition, Southland Paper Mills, the U.S. Geological Survey, and the Texas Water Development Board have maintained a program of observation of water levels in wells. Nearly all of the observation wells are screened in the Carrizo Sand.

A bibliography is included at the end of the text of this report. This bibliography lists the principal reports available on the geology and ground-water resources of Angelina and Nacogdoches Counties and adjoining counties.

Well-Numbering System

The well-numbering system (Figure 3) used in this report is one adopted by the Texas Water Development Board for use throughout the State and is based on latitude and longitude. Under this system, each well is assigned a seven-digit number and a two-letter county designation prefix. Each 1-degree quadrangle in or overlapping into the State is given a two-digit number from 01 to 89. These are the first two digits of a well number. Each 1-degree quadrangle is further divided into sixty-four 7½-minute quadrangles which are each assigned a two-digit number from 01 to 64. These two digits constitute the third and fourth digits of a well number. Finally, each 7½-minute quadrangle is subdivided into nine 2½-minute quadrangles which are numbered 1 to 9 (fifth digit). Within these 2½-minute quadrangles, each well is assigned a two-digit number beginning with 01 (the last two digits).

Angelina and Nacogdoches Counties are entirely within 1-degree quadrangle number 37. The 7½-minute quadrangles in these counties are shown on the well location map, Figure 27. For reasons of space, the 2½-minute quadrangles are not gridded or numbered. However, their notation occurs as the first digit of the three-digit number beside each well location.

In this report, each seven-digit well number has a two-letter prefix to identify the county in which the well is located. The prefix for Angelina County is AD, and for Nacogdoches County it is TX. For convenience each complete well number is dashed as follows: AD-37-44-801. In this number, the "AD" is the county prefix; the "37" is the 1-degree quadrangle number; the "44" is the 7½-minute quadrangle number; and the "801"is the 2½-minute quadrangle number (8) and the well designation number (01). Well AD-37-44-801 is in the town of Huntington in Angelina County.

This numbering system is different from that used by White, Sayre, and Heuser (1941) and Cromack (1937). Table 1 is a list of the wells and springs listed both in this report and in those reports, and gives the corresponding well numbers.

Acknowledgements

Many persons, agencies, and companies contributed data for this investigation and made wells available for testing. Particular appreciation is expressed to the following: Texas Water Development Board; U.S. Geological Survey; the cities of Nacogdoches, Lufkin, Garrison, and Huntington; Southland Paper Mills; Southern Pine Lumber Company; Layne Texas Company, Drilling Contractor; Texas Water Wells, Drilling Contractor; C. C. Innerarity, Drilling Contractor; Roy Luebner, Drilling Contractor; and K. G. Johnson, Consulting Engineer.

Table 1.--Well Numbers Used by Cromack (1937) or White et al (1941) and Corresponding Numbers Used in This Report

ANGELINA COUNTY

Old Number	New Number	Old Number	New Number	Old Number	New Number	Old Number	New Number
3	AD-37-33-304	50	AD-37-43-101	80	AD-37-43-402	126	AD-37-51-505
4	37-33-306	52	37-42-305	85	37-43-302	128	37-51-801
5	37-34-401	53	37-42-303	92	37-44-903	131	37-51-902
13	37-34-402	54	37-42-306	93	37-44-902	132	37-51-901
14	37-34-506	56	37-34-901	94	37-44-803	133	37-51-301
17	37-34-602	57	37-34-803	97	37-44-702	136	37-52-203
19	37-35-406	58	37-34-804	100	37-44-401	145	37-52-801
20	37-35-405	59	37-34-805	103	37-43-602	147	37-61-101
21	37-35-407	64	37-42-101	106	37-43-502	150	37-61-203
39	37-35-710	68	37-42-401	107	37-43-505	152	37-53-402
43	37-35-706	69	37-42-504	108	37-43-506	153	37-53-102
45	37-35-707	70	37-42-503	111	37-43-803	158	37-45-803
46	37-35-711	74	37-42-703	114	37-51-102	159	37-53-602
47	37-35-712	75	37-42-702	120	37-50-602	161	37-53-903
49	37-35-713	77	37-42-505	125	37-51-404		

NACOGDOCHES COUNTY

Old Number	New Number	Old Number	New Number	Old Number	New Number	Old Number	New Number
5	TX-37-09-501	48	TX-37-11-806	83	TX-37-13-701	127	TX-37-19-902
6	37-09-603	50	37-11-905	84	37-21-101	128	37-19-903
7	37-09-602	51	37-11-902	85	37-21-201	131	37-19-303
9	37-09-902	52	37-11-903	86	37-21-202	132	37-19-502
12	37-17-202	54	37-11-805	87	37-21-203	134	37-19-501
14	37-18-103	55	37-11-402	88	37-21-504	135	37-19-102
15	37-10-702	56	37-11-502	89	37-21-402	140	37-19-801
16	37-10-701	57	37-11-501	90	37-21-401	145	37-19-701
17	37-10-404	60	37-12-502	93	37-21-503	146	37-19-702
18	37-10-402	61	37-11-904	94	37-21-803	147	37-19-403
19	37-10-501	62	37-12-701	95	37-21-902	148	37-19-402
20	37-10-405	63	37-12-803	96	37-29-301	149	37-19-101
21	37-10-803	64	37-12-702	97	37-21-802	150	37-18-303
23	37-10-802	66	37-12-802	98	37-21-702	151	37-18-302
24	37-18-205	67	37-20-201	101	37-20-903	152	37-18-501
25	37-18-203	68	37-20-301	108	37-20-601	153	37-18-601
26	37-18-304	69	37-12-906	110	37-20-104	155	37-18-903
27	37-10-904	70	37-12-501	111	37-20-102	156	37-18-901
31	37-10-604	71	37-12-602	113	37-19-302	158	37-18-802
33	37-10-502	72	37-12-601	113-A	37-19-601	159	37-18-703
34	37-10-301	73	37-12-301	114	37-20-402	160	37-18-402
35	37-11-403	75	37-13-406	116	37-19-905	161	37-17-606
36	37-11-702	76	37-13-403	118	37-20-705	162	37-18-403
37	37-11-703	76-A	37-13-405	120	37-27-305	163	37-18-204
39	37-11-704	77	37-13-101	120-A	37-27-306	164	37-18-404
43	37-11-705	80	37-13-704	121	37-27-302	165	37-18-102
45	37-19-201	81	37-13-802	122	37-27-301	166	37-17-304
46	37-19-202	82	37-13-801	125	37-19-802	167	37-17-605

NACOGDOCHES COUNTY -- Continued

Old Number	New Number	Old Number	New Number	Old Number	New Number	Old Number	New Number
168	TX-37-17-603	191	TX-37-26-902	241	TX-37-29-602	275	TX-37-36-206
169	37-17-303	194	37-27-102	242	37-29-303	278	37-28-701
170	37-17-602	195	37-27-203	244	37-30-502	283	37-26-806
171	37-17-604	198	37-27-501	245	37-30-402	285	37-26-805
172	37-17-802	199	37-27-502	246	37-30-703	290	37-35-106
173	37-17-903	203	37-27-307	247	37-30-702	295	37-35-311
174	37-17-904	206	37-27-308	257	37-38-201	297	37-36-603
175	37-17-905	207	37-27-309	258	37-38-101	298	37-36-302
178	37-25-301	219	37-27-602	259	37-37-301	299	37-36-601
179	37-25-601	226	37-28-305	260	37-29-902	300	37-36-602
181	37-26-102	228	37-28-306	261	37-29-903	305	37-37-802
182	37-26-101	230	37-28-603	271	37-36-301	310	37-38-801
184	37-26-403	236	37-29-203	272	37-28-903	311	37-38-701
185	37-26-402	237	37-29-502	273	37-28-802	312	37-38-702
187	37-26-502	238	37-29-503	274	37-28-804	314	37-46-402

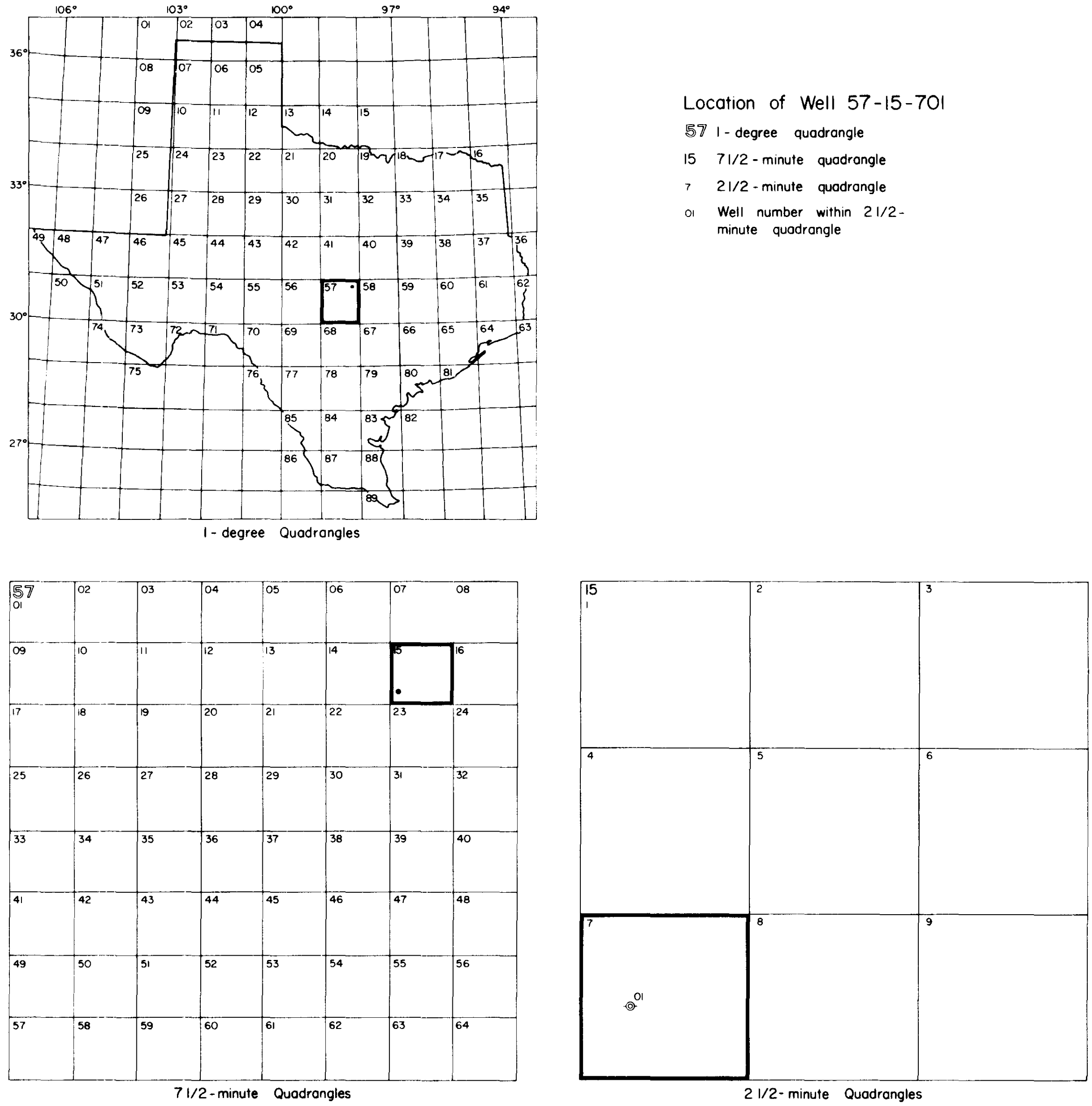


Figure 3.—Well-Numbering System

Grateful appreciation is also expressed to Mr. Hubert Guyod, Logging Consultant, Houston, Texas, for his assistance in estimating the quality of water in the principal water-bearing formations from electric logs.

INVENTORY OF WATER WELLS

As part of this investigation, an inventory was made of all existing municipal, industrial, and irrigation water wells, representative domestic and livestock wells, and major springs. In addition, records were obtained on important test holes and, insofar as possible, on previous large wells which have been abandoned and destroyed. The locations of the wells and springs are given on Figure 27 and information concerning each is listed in Tables 7 and 8.

Insofar as possible, the records obtained by White, Sayre, and Heuser and published in 1941 and those obtained by Cromack and published in 1937 have been preserved in this report. Only wells, test holes, and springs which could definitely be located on the county road maps prepared by the Texas Highway Department, however, are listed in Tables 7 and 8 and shown on Figure 27. Some could not be located because the maps used in the earlier reports were partially inaccurate or because the wells have long since been abandoned and destroyed. Special care has been taken, though, to insure that no data have been omitted from the report which would significantly affect the description of the water-bearing formations and the conclusions regarding them. Where necessary, the records on the old wells have been brought up to date.

Results of an inventory by the Texas Water Commission between 1959 and 1961, which was made as a part of the "Reconnaissance Investigation of the Ground-Water Resources of the Neches River Basin" (Baker and others, 1963), were also used in this inventory and, where necessary, brought up to date. In addition to the use which was made of the existing inventories, records were obtained from drillers' reports on file with the Texas Water Development Board, from Southland Paper Mills, the cities of Lufkin and Nacogdoches, well drillers, and consultants, and by field contacts with owners.

Representative drillers' logs of wells are presented in Tables 9 and 10. Additional drillers' logs are on file with the Texas Water Development Board. The wells for which the drillers' logs are available are identified in Tables 7 and 8.

ELECTRIC LOGS

One hundred and ninety-four electric logs of oil tests, water wells, and test holes are identified in Tables 7 and 8 and are on file with the Texas Water Development Board. In addition, about 14 electric logs in surrounding counties were used in this study. The electric logs are particularly important because of the detailed information they give on the subsurface stratigraphy of the formations and on the quality of water where actual chemical analyses are not available. The locations of the oil test logs were obtained from records of the Texas Water Development Board, from ownership maps, and from descriptions of locations on the logs.

GEOLOGY AS RELATED TO THE OCCURRENCE OF GROUND WATER

General Stratigraphy and Structure

In Angelina and Nacodgoches Counties, the rocks of importance in defining the occurrence of fresh ground water consist of a thick sequence of sands and clays, largely of Eocene age. Included are deposits of continental, deltaic, and shallow marine origin. The geologic units referred to include, from oldest to youngest: the Midway Group, Wilcox Group, Carrizo Sand, Reklaw Formation, Queen City Sand, Weches Formation, Sparta Sand, Cook Mountain Formation, Yegua Formation, Caddell Formation, Wellborn Formation, and Manning Formation, all of Eocene age; the Whitsett Formation of Eocene or Oligocene age; the Catahoula Formation of Miocene age; and terrace and floodplain deposits of Pleistocene and Recent age. The Caddell, Wellborn, Manning, and Whitsett Formations are collectively termed the Jackson Group in this report. All of these units yield some water to wells in either Angelina or Nacogdoches Counties, or both, with the exception of the Midway and Catahoula, in which no wells are known to be completed.

Table 2 summarizes the thickness, composition, and water-bearing properties of the formations. Figures 29, 30, 31, and 32 are cross sections showing the general altitude, depth, thickness, extent, and electric log character of all the geologic units, as well as the general water quality in the Wilcox, Carrizo, Sparta, and Yegua units.

Angelina and Nacogdoches Counties are about equidistant between the center of the Sabine uplift to the northeast, the axis of the East Texas embayment to the west, and the central part of the Gulf Coastal Plain proper to the south. In northeastern Nacogdoches County, the outcrop patterns trend northwest-southeast, with the dip being to the southwest. In southern Angelina County, the outcrop patterns trend nearly east-west, with the dip being to the south. The rate of dip of the formations in northern Nacogdoches County is typically about 50 feet per mile. The rate increases southward, until in southern Angelina County the formations dip at a rate of about 150 feet per mile. Due to the dip, the depth to a formation increases southward.

Several small faults have been mapped in Nacogdoches and Angelina Counties. Two are shown on Figure 28. In the report by White, Sayre, and Heuser (1941) several others are reported. Of the faults known, all appear to have only small displacement. Accordingly, it is not believed that faulting within Angelina and Nacogdoches Counties is particularly significant with respect to the occurrence or areal movement of ground water within the counties. As discussed later, however, faulting in the Mount Enterprise zone in Rusk and Cherokee Counties to the north and northwest of Nacogdoches County has a substantial effect on drawdown of water levels in wells in the Carrizo Sand, and that which will be caused in wells in the Wilcox Group.

Figure 28 shows the surface extent of each of the units cropping out in Angelina and Nacogdoches Counties. The map was prepared directly from the Geologic Atlas of Texas, Palestine Sheet, prepared and published in 1968 by the Bureau of Economic Geology, University of Texas. The oldest unit that crops out in the area is the Wilcox Group, exposed at the surface in northern and northeastern Nacogdoches County, Southward, successively younger rocks occur at the surface inasmuch as the regional dip of the formations to the south is at a greater rate than the general slope of the land surface to the south.

Table 2.--Stratigraphic Units and Their Water-Bearing Properties in Angelina and Nacogdoches Counties

Stratigraphic Unit	Approximate Range in Thickness (feet)	Approximate Thickness at Nacogdoches (feet)	Approximate Thickness at Lufkin (feet)	Composition	General Water-Bearing Properties
Alluvium	0-30	0	0	Sand, silt, and clay, with some gravel.	Locally yields small quantities of fresh water to widely scattered shallow dug wells.
Catahoula Formation	2/	0	0	Sand with some clay.	Yields no water to wells.
Jackson Group 1/	0-1,000	0	0	Mostly clay and silt.	Yields small quantities of fresh to brackish water.
Yegua Formation	0-1,050	0	150-400	Mostly thin-bedded sand, silt, and clay.	Yields small to moderate quantities of fresh to brackish water.
Cook Mountain Formation	0-500	0	410	Mostly clay.	Yields small quantities of fresh to brackish water in outcrop area.
Sparta Sand	0-290	0-70	200	Interbedded sand and clay.	Yields small to moderate quantities of fresh water in and near outcrop area.
Weches Formation	0-240	140	150	Mostly clay.	Yields small quantities of fresh to brackish water in outcrop area.
Queen City Sand	0-130	60	50	Interbedded sand and clay. Sands feather out to south and east.	Yields small quantities of fresh water, mostly in outcrop area.
Reklaw Formation	0-290	200	250	Clay and silt, typically having a basal sand.	Yields small quantities of fresh to brackish water.
Carrizo Sand	0-170	90	120	Massive sand.	Yields moderate to large quantities of fresh water.
Wilcox Group	950-3,300	2,500	2/	Interbedded sand, silt, and clay.	Yields small to moderate quantities of fresh water.
Midway Group	2/	2/	2/	Mostly clay.	Yields no water to wells .

1/ Includes Whitsett Formation of Eocene or Oligocene age and Manning, Wellborn, and Caddell Formations of Eocene age.

2/ Not determined.

Principal Water-Bearing Formations

The most important water-bearing units in Angelina and Nacogdoches Counties from a present or potential development standpoint are the Wilcox Group, Carrizo Sand, Sparta Sand, and Yegua Formation. Of the four the Carrizo is the most prolific aquifer.

Wilcox Group

The Wilcox Group underlies all of Angelina and Nacogdoches Counties and is exposed at the surface in parts of northern and northeastern Nacogdoches County, as well as in adjoining areas in Rusk and Shelby Counties. It consists mainly of thin beds of sand, silt, and clay, with minor amounts of lignite. The sands are typically gray, fine grained, and silty. The Wilcox commonly shows a very broken pattern on electric logs due to its generally thin-bedded character. Individual beds within the Wilcox Group generally cannot be correlated from well to well, due to lateral changes in character and thickness. In some local areas, however, predominately sandy zones within the Wilcox or predominately clayey zones do appear to correlate from well to well.

Figure 33 shows the depth to the top of the Wilcox Group, based on electric logs, as well as the altitude of the top of the Wilcox. The thickness of the Wilcox is about 900 to 1,000 feet in extreme northeastern Nacogdoches County. The Wilcox thickens both to the west and to the south. In southwestern Nacogdoches County the total thickness of the Wilcox is more than 2,000 feet, while in southern Angelina County the Wilcox exceeds 3,300 feet in thickness.

Not all of the Wilcox contains fresh water, and in parts of the report area it contains only brackish or salt water. Figure 29 illustrates the general distribution of fresh, brackish, and salt water within the Wilcox Group in a north-south direction across Nacogdoches and Angelina Counties. The thickest fresh water sections or zones within the Wilcox occur in the northern part of Nacogdoches County. The thickest sections of brackish water within the Wilcox Group occur in central and southern Nacogdoches County. In about the southern half of Angelina County, only salt water occurs in the Wilcox Group.

Figure 34 shows the thicknesses of the Wilcox Group containing fresh and brackish water. The thicknesses are based on interpretations of electric logs. Also shown on Figure 34 are the net sand thicknesses occurring within the fresh water and brackish water zones of the Wilcox Group.

From the data given on Figures 33 and 34, the elevation of the base of the fresh water zone within the Wilcox can be determined. This is done by subtracting the thickness of the Wilcox Group containing fresh water from the elevation of the top of the Wilcox. Similarly, by subtracting both the thickness of the Wilcox containing fresh water and the thickness of the underlying part of the Wilcox containing brackish water from the elevation of the top of the Wilcox, the elevation of the base of the brackish water in the Wilcox can be determined.

Water wells tapping the Wilcox consist mostly of shallow dug wells in the Wilcox outcrop area and moderately deep drilled wells both in and just downdip from the Wilcox outcrop, all of which are of small capacity and are used mostly for domestic and livestock purposes. A few wells of moderate capacity draw water from the Wilcox at Garrison and at other localities in northern Nacogdoches County. Also, a few Carrizo wells include some screen in upper Wilcox sands immediately underlying the Carrizo.

Carrizo Sand

The Carrizo Sand is the most important water-bearing unit in Angelina and Nacogdoches Counties. It supplies all the water used by the cities of Lufkin and Nacogdoches and many smaller users, and most of the water used by Southland Paper Mills.

The Carrizo directly overlies the Wilcox Group and crops out immediately south of the Wilcox outcrop in a band 1 to 8 miles wide trending northwest-southeast across northeastern Nacogdoches County.

The Carrizo is usually reddish in color and cross-bedded in surface exposures. The color is due to iron oxide. In wells, the Carrizo is typically found to be a white, massive, fine- to medium-grained quartz sand, normally containing a few clay lenses. It is not usual for a significant part of the formation to be clay; however, in a few localities this occurs.

The Carrizo is rather uniform in composition and also in its character on electric logs. It is normally distinguished on electric logs from the overlying Reklaw and the underlying Wilcox by markedly higher resistivity. In localities where little or no resistivity differences exist between the Carrizo and either sands of the Reklaw or Wilcox, and formation samples are not available, picking the upper or lower contacts of the Carrizo is arbitrary. This tends to be the case for the Reklaw-Carrizo contact in parts of northern Nacogdoches County, for the Carrizo-Wilcox contact at scattered locations throughout the report area, and for both the Reklaw-Carrizo contact and the Carrizo-Wilcox contact in about the southern half of Angelina County.

Figure 35 shows the depth to the top of the Carrizo Sand and the altitude of the top of the Carrizo. Figure 36 shows the total thickness of the Carrizo Sand as well as the net sand thickness within the formation. The thickness of the Carrizo ranges from 20 to 170 feet, from the data on Figure 36.

Sparta Sand

The Sparta Sand underlies southern Nacogdoches County and all of Angelina County. It is exposed at the surface in a belt trending nearly east-west across the central part of the report area. Its outcrop ranges in width from about 2 to 15 miles. The Sparta Sand consists mostly of very fine to fine-grained quartz sand, clay, and silty clay. It has some lignitic beds. Typically, about half of the formation is sand. In local areas, individual sand zones within the Sparta can be correlated from well to well; however, on an areal basis such is not the case.

The depth to and altitude of the top of the Sparta Sand are shown on Figure 37. Figure 38 shows the total thickness of the Sparta Sand, as well as the net sand thickness within the Sparta.

Present development within the Sparta consists of numerous shallow small-capacity wells in its outcrop area and a few moderately deep, drilled wells of small capacity, mostly located in northwestern Angelina County and in southeastern Nacogdoches County. In 1942 and 1943, several moderate capacity test wells were drilled by Southland Paper Mills in southern Nacogdoches County, but were not subsequently used except for water-level observations.

Yegua Formation

The Yegua Formation occurs in Angelina County and the southeastern tip of Nacogdoches County. It crops out in a belt about 9 to 15 miles wide trending east-west. The Yegua is composed mainly of thin alternating beds of sand, silt, and clay. It exhibits a very broken character on electric logs due to its typically very thin-bedded nature. The upper part of the Yegua generally contains more clay and silt and fewer and thinner beds of sand than the lower part. Most of the sand beds are composed of fine-grained quartz sand. Some of the sand zones appear to correlate locally, but none is directly correlated over large distances.

Figure 39 shows the depth to the top of the Yegua Formation, as well as the altitude of the top of the Yegua. The depth to the base of the Yegua Formation is given on Figure 40. The total thickness of the Yegua increases southward across its outcrop area. The thickness is about 500 feet in the central part of the outcrop area and about 900 to 1,000 feet along the southern edge of the outcrop area. In that part of southern Angelina County where the full thickness of the formation is present, the Yegua is believed to average about 1,000 feet in thickness.

Not all the Yegua Formation contains fresh water, and in parts of the area the Yegua appears to contain only brackish and salt water. Figures 29 and 30 portray in cross-section form the general occurrence of fresh, brackish, and salt water within the Yegua. The available electric logs indicate that in parts of the report area zones containing fresh water interfinger with zones containing brackish water. The net sand thicknesses occurring within the various quality zones, as estimated from the available electric logs, are shown on Figure 40. The total net sand thicknesses within the Yegua are typically quite small, ranging from about 70 to 130 feet for the entire formation.

Many small- to moderate-capacity wells, both shallow and deep, have been constructed in the Yegua in central and southern Angelina County.

Other Formations

Midway Group

The Midway Group occurs only in the subsurface in this area, underlying the Wilcox Group throughout Angelina and Nacogdoches Counties. The Midway consists almost entirely of clay and silt and is considered essentially impermeable. No water wells are known that tap the Midway in the two counties.

Reklaw Formation

The Reklaw Formation overlies the Carrizo Sand. The Reklaw reaches a known maximum thickness of 290 feet but typically is slightly over 200 feet in thickness on well logs showing its full thickness.

From outcrops Stenzel (1938) divided the formation into two members, with the Marquez Shale being the upper part and the Newby Sand being the lower part. In Angelina and Nacogdoches Counties, the upper part of the Reklaw is principally clay, with the lower 20 to 80 feet of the formation generally being a silty, glauconitic, fine-grained quartz sand. Distinguishing the sands of the lower part of the Reklaw from those of the underlying Carrizo is not always easy. From drillers' logs it is frequently impossible to make the distinction, and always the distinction can be more readily made from formation samples than from electric logs. It is considered important to distinguish between the basal Reklaw sands and the Carrizo sands inasmuch as the Reklaw is probably much less permeable and is generally believed to contain more mineralized water than the underlying Carrizo in the area where the Carrizo water is fresh.

Numerous shallow wells yielding small supplies exist on the outcrop of the Reklaw Formation. South of its outcrop area only a few wells tap the Reklaw Formation. Of the wells that do, all draw water from the basal sand and are of relatively small capacity.

Queen City Sand

The Queen City Sand overlies the Reklaw Formation and consists mostly of alternating beds of very fine to fine-grained quartz sand and clay. The Queen City Sand crops out in an irregular belt extending across most of Nacogdoches County.

At the surface the formation is thickest in western Nacogdoches County and thins eastward. In western Nacogdoches County, it attains a thickness of 100 to possibly 130 feet and consists of approximately half sand. In central and east-central Nacogdoches County, the Queen City is about 50 feet thick and is about one-third sand. Farther east it is even thinner and is essentially all clay. No Queen City sands are recognizable on electric logs southeast of a line trending northeast-southwest through Lufkin. Where sands are not present, it is not possible to distinguish the clays of the Queen City from the clays of the overlying and underlying formations. The changes in character and thickness of the Queen City are illustrated on the geologic sections, Figures 29, 31, and 32.

Numerous shallow wells yielding small supplies exist on the outcrop of the Queen City. Only a few wells, all of small capacity, tap the formation downdip from its outcrop area.

Weches Formation

The Weches Formation overlies the Queen City Sand and consists principally of clays and silts with some fine-grained sands. In well logs where its full thickness is present, it ranges in thickness from about 110 to 240 feet. In its outcrop area the Weches yields water to shallow dug wells, but no wells are known to tap the Weches downdip from its outcrop area.

Cook Mountain Formation

The Cook Mountain Formation overlies the Sparta Sand and underlies the Yegua Formation. It crops out in a band about 3 to 7 miles wide extending across the central part of the report area. On well logs where its full thickness is present, it ranges in thickness from about 380 to 500 feet, averaging slightly over 400 feet. It consists mostly of clay, but contains a few thin beds of sand, sandy clay, and marly clay. Some shallow wells exist in the outcrop area of the Cook Mountain Formation and yield small supplies of water. Only a few wells tap the formation downdip from its outcrop area.

Jackson Group

As used in this report, the Jackson Group refers to all of the rocks occurring above the Yegua Formation and below the Catahoula Formation. Included are rocks mapped on the surface as the Caddell, Wellborn, Manning, and Whitsett Formations (Bureau of Economic Geology, 1968). Individually, these formations are not readily recognizable in the subsurface of Angelina County from the few well logs available. For this reason, and also because they are relatively unimportant from a ground-water standpoint, they are herein lumped under the name "Jackson Group."

The outcrop of the Jackson in southern Angelina County occurs in a belt up to 14 miles in width trending mostly east-west. The Jackson dips to the south at from 100 to 150 feet per mile. On logs the Jackson appears principally as clay, with only occasional thin sand beds consisting of fine- to medium-grained quartz sand.

The thickness of the Jackson Group is shown on Figure 39, the map showing the depth to the top of the Yegua Formation. On Figure 39 the depth to the top of the Yegua Formation represents the thickness of the Jackson Group at all locations where data are available. Near the middle of the Jackson outcrop belt the thickness of the Jackson is approximately 500 feet. It is estimated that where the full thickness of the Jackson exists in southeastern Angelina County its thickness is about 1,000 feet.

The Jackson furnishes water to a few shallow dug wells and to a few moderately deep, drilled wells. The general lack of sand in the Jackson, however, essentially renders the formation valueless except as a source for very small supplies.

Catahoula Formation

The Catahoula Formation consists mostly of sand and is an important water-bearing unit in counties south of Angelina County. The occurrence of the Catahoula within Angelina County, however, is limited to a few thin outcrops, mostly forming the tops of hills in extreme southeastern Angelina County along the Angelina-Jasper County line. No wells which tap the Catahoula Formation are known to exist in Angelina County.

Alluvium

Terrace and floodplain deposits occur along the major stream valleys in Angelina and Nacogdoches Counties. The deposits are quite restricted in extent and consist of sand, silt, and clay, with some gravel. It is believed that they attain a maximum thickness of approximately 30 feet. A very few shallow dug wells at widely scattered locations obtain water from the alluvium.

RECHARGE, MOVEMENT, AND NATURAL DISCHARGE OF GROUND WATER

The water-bearing formations in this area receive recharge in their outcrops from precipitation and streamflow. Most of this recharge is rejected because the formations are full, and the water spills out of them into the stream valleys crossing the outcrops, where it is discharged by seepage or evapotranspiration. Some of the recharge, however, moves down the dips of the formations. Under natural conditions, prior to pumping, a very small amount moves generally down the dip of a formation for many miles, and along the way slowly seeps upward through confining beds and finally is discharged at the land surface through seeps and/or evapotranspiration.

Pumping from a well changes the pattern of flow nearby so that water moves into the well from all directions. Figure 4 is a diagrammatic sketch showing recharge from precipitation and streams and the position of the piezometric surface, both prior to pumping and during pumping. A gentle slope of the piezometric surface down the dip of the formation is shown prior to pumping, with a cone of depression sloping toward the well from both updip and downdip during pumping. The direction of movement is shown toward the well from both directions during pumping.

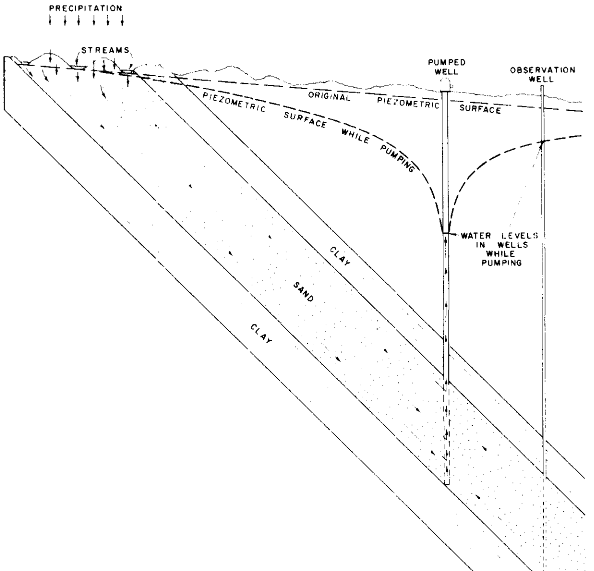


Figure 4.—Diagrammatic Sketch Showing Recharge and Drawdown in Typical Artesian Sand

Any water which is pumped from wells must be balanced by a reduction in natural discharge, an increase in the amount of recharge which is not rejected, or withdrawal of water from storage, or a combination of these. Thus, to have a perennial supply which does not continue to withdraw water from storage and eventually dry up the formation, the pumpage must be balanced by an equal amount of recharge diverted to the wells. The two major quantitative factors which limit the amount of ground water which can be obtained on a perennial basis, therefore, are the recharge available for interception by pumping and the rate at which water can flow from the recharge area to the wells.

Angelina and Nacogdoches Counties are in an area of high precipitation, and the aquifers are principally artesian and are comprised of sand. In situations of this type, it is very rare to have a shortage of recharge. Nearly always, the limiting factor in the amount of water available is the transmissibility of the formation. The transmissibility controls the amount of head loss, or drawdown of piezometric surface, which will result from pumping wells as they draw water from the recharge area. Almost always there is a surplus of available recharge and the formations continue to reject recharge in their outcrop areas by returning it to the surface or atmosphere through seepage or evapotranspiration in the major valleys.

In these two counties, the water table in the outcrop of every aquifer is above the base level of the major streams crossing the outcrop, and its position appears to be controlled by the elevations of the stream valleys. The water table is highest in the divide areas, sloping away from the divides toward the deeper valleys, where most of the evapotranspiration and seepage takes place. The water table also slopes in the direction of the dip of the formation, so that some of the water entering the outcrop can move into and through the artesian portion of the aquifer, to be discharged downdip by natural discharge or by wells.

The major streams in and adjacent to Angelina and Nacogdoches Counties are shown on Figure 41. Also given on this figure are summaries of available records of streamflow. All of the streams vary widely in flow between dry and wet periods. During very dry periods there is little base flow in any of the streams. This means that at these times only a very small part of the recharge rejected from the water-bearing formations actually is rejected as seepage into streams. Instead, by far the greatest part of the rejected recharge at these times is evapotranspiration where the water tables are shallow in and near the stream valleys.

Also shown on Figure 41 is the average annual runoff for the drainage basin above each gaging station. These figures range from about 5 to 12 inches per year out of a total precipitation of some 40 to 50 inches. Thus, about 35 to 40 inches of the precipitation is (1) consumed by evapotranspiration immediately after it falls on the ground, (2) enters the outcrops of the water-bearing formations and then is discharged back to the surface and/or atmosphere in the stream valleys, or (3) moves down the dip of the formations.

It is next to impossible, with any reasonable amount of investigation, to measure the total available recharge directly because of the stratification of the formations in their outcrops, the difficulty in obtaining average values for infiltration rates, and the difficulty of obtaining average values for evapotranspiration from the water table. About the only way reliable measurements of the total available recharge can be obtained in an area of this kind is to actually overpump the formation and then determine how much shortage occurs. When this is done, the water table is lowered below the reach of plants throughout the outcrop area, including the stream valleys, and measurements are made of the continuing rate of decline of water level with continued pumping. In Angelina and Nacogdoches Counties, the water tables are now much too high to consider any such analysis, and it appears certain that, with the exception of the Carrizo Sand, they can never be lowered to the point of salvaging all rejected recharge under any practicable arrangement of wells and well yields. In other words, the abilities of the aquifers to transmit water from recharge areas to wells is much more of a limiting factor than the availability of recharge to the formations.

The same also is probably true with respect to the Carrizo Sand, although not as certain. The Carrizo Sand has the greatest transmissibility of any of the formations in the area, and thus can transmit water more readily from recharge areas to wells. The present amount of pumpage from the Carrizo in Angelina and Nacogdoches Counties which is considered to originate from the Carrizo outcrop is about 24 million gallons per day, and the estimated total availability of water from the Carrizo alone in these counties (not considering recharge as a limiting factor) is about 29 million gallons per day. The outcrop area available to supply this water is about 230 square miles; and for all of the water to come from the outcrop on a sustained basis would require an annual interception of recharge equivalent to about 2.6 inches of water over the outcrop area. This is only about 7 percent of the 35 to 40 inches of precipitation which does not run off; and it is considered likely that it is available because of the loose sandy nature of the Carrizo outcrop. The 2.6 inches is, however, higher than the available recharge in a few other areas in the humid part of the United States, as determined by actual measurements.

At present the water table in the outcrop of the Carrizo in places is as much as 50 feet above the stream valleys cutting through the outcrop. Measurements of water levels in wells near the outcrop indicate that the water table in part of the outcrop is declining at a rate of about 2 feet per year at present. This decline is necessary to salvage some of the recharge now being rejected into the stream valleys. Whether the decline will stop before all possible recharge is salvaged and the water table drops below the stream valleys is not known, although it is believed that it probably will. It will be many years, though, before the final outcome has been measured, and if there is any continuing decline of water levels after that it is sure to be at a very slow rate.

Because of these considerations, the availability of recharge is not at this time considered to be a limiting factor for any ground-water development in Angelina and Nacogdoches Counties, including the Carrizo Sand as well as the other formations.

WELL CONSTRUCTION AND DISTRIBUTION

The types of water well construction and the distribution of wells in Angelina and Nacogdoches Counties may be determined from a study of Tables 7 and 8 and Figure 27. Except for the shallow dug wells, all of the wells are cased and have screen or slotted pipe opposite the sands from which they draw water. The larger municipal and industrial wells are gravel packed as illustrated by the drawing of the well belonging to the city of Nacogdoches on Figure 5. Smaller wells are usually not gravel packed. The largest wells belong to Southland Paper Mills and have 20-inch surface casing and 14-inch screen and liner. Small domestic wells may be as little as 2 inches in diameter.

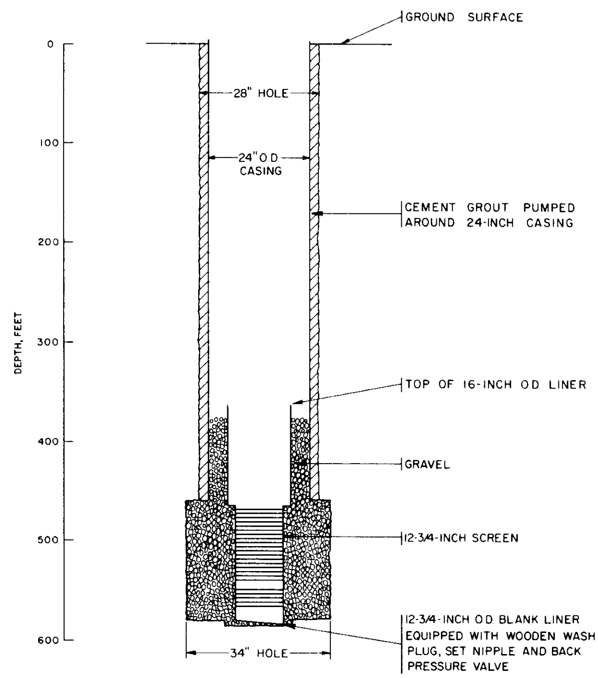


Figure 5.—Construction of Production Well

In recent years a distinctly different pattern of well use and source of supply has occurred in many of the smaller communities and much of the rural area of Angelina and Nacogdoches Counties. Rural water-supply corporations stemming from a program of the U.S. Department of Agriculture's Farmers Home Administration have been formed. They distribute water over wide areas. Twelve water-supply corporations, obtaining their supplies from wells, exist in Nacogdoches County. There are ten in Angelina County. Within the areas they serve, most of the private wells formerly supplying domestic and livestock requirements have been abandoned. Where these rural water systems exist, those users requiring smaller supplies most readily change from private wells. The users most likely to continue using private wells typically include the ones needing the larger supplies, such as dairies and broiler farms.

Fifty-four wells are listed in Tables 7 and 8 as drawing exclusively from the Wilcox Group. Of these, nine were constructed for municipal purposes and four for industrial purposes. There are no irrigation wells in the Wilcox. The deepest Wilcox well is an observation well 1,261 feet in depth. The deepest well drilled for water supply is 630 feet deep. The wells are reported to yield up to 195 gallons per minute. Most of the Wilcox wells are located in northeastern Nacogdoches County, generally northeast of a line passing through Cushing and Chireno.

One hundred and fifty-two wells are listed for the Carrizo Sand. These include a few wells which also are screened in sands of the Reklaw Formation which immediately overlie the Carrizo or sands of the Wilcox Group which immediately underlie the Carrizo. Of the 152 wells, 34 were constructed for municipal or other public supplies, 23 were constructed for industrial supplies, and 6 were constructed for irrigation purposes. All but two of the municipal wells and eight of the industrial wells were in use in 1968. Three of the six irrigation wells have been abandoned, and very little use is made of the others. The largest yielding wells in the two counties are in the Carrizo Sand and belong to Southland Paper Mills and the cities of Lufkin and Nacogdoches. Yields of these wells range up to 1,350 gallons per minute. Carrizo wells are as deep as 1,410 feet, with most of the larger wells having depths ranging from about 500 to 900 feet in Nacogdoches County and from about 900 to 1,300 feet in Angelina County. Most of the larger wells are located between Lufkin and Nacogdoches, and most of the small-capacity wells are north of State Highway 21, which traverses Nacogdoches County in a northwest-southeast direction, passing through Douglass, Nacogdoches, and Chireno.

There are 27 wells listed in Table 8 as drawing from the Reklaw Formation. One was constructed for industrial purposes and the remainder for domestic and livestock purposes. There are no public supply or irrigation wells in this formation. The wells are mostly shallow, dug wells, but a few range up to 552 feet deep. The greatest yield reported is 40 gallons per minute. The wells are generally in the northern and central parts of Nacogdoches County.

Thirty-nine wells are shown for the Queen City Sand, including one well which produced from the Queen City until it was deepened. Five are drilled wells, as much as 523 feet in depth, and the rest are dug wells. Most Queen City wells are domestic and livestock wells located west, northwest, and north of Nacogdoches.

The formation which occurs above the Queen City Sand, the Weches, is mostly clay. Shallow large-diameter wells have been constructed in the Weches to obtain water for domestic and livestock use. Of the 18 wells listed for the Weches, most are located north and west of Nacogdoches, although three are northwest of Chireno.

Sixty-seven wells are shown for the Sparta Sand, mostly in southern Nacogdoches County and northern Angelina County. These wells range in depth to about 500 feet and in yield to about 300 gallons per minute. One well is used for public supply. The remainder were either constructed as test wells or for domestic and livestock purposes.

Wells in the Cook Mountain Formation are presently used solely for domestic and livestock purposes and are mostly shallow. The total number of Cook Mountain wells listed is 19, and the deepest well is 190 feet. The Cook Mountain wells are located in a narrow east-west strip, generally on the outcrop, passing just north of Lufkin. In some places, particularly east of Lufkin, the wells in the Cook Mountain have very small yields or brackish water, and homeowners have found it desirable to use cisterns.

The Yegua Formation is one of the more widespread formations in the area and supports many small to moderate size wells. Tables 7 and 8 show 27 public-supply wells, 10 industrial wells, and one irrigation well for the Yegua. Also listed are 64 domestic and livestock wells and one test well, making a total of 103 wells shown for the Yegua. The Yegua wells range in depth up to 920 feet and in yield to more than 500 gallons per minute. Except for four wells in the southeast corner of Nacogdoches County, the Yegua wells are all located in Angelina County, generally between an east-west line just north of Lufkin and another east-west line passing through Diboll and Zavalla.

Eighteen wells are shown for the Jackson Group. Three of the wells are for public supply and the rest are used for domestic and livestock purposes. Water is difficult to develop from the Jackson Group, and a fairly large number of homeowners in the southern portion of Angelina County, where the aquifer occurs, use cisterns. The Jackson wells range in depth to 366 feet. The largest reported yield, 15 gallons per minute, is for a public-supply well.

CHEMICAL QUALITY OF GROUND WATER

Available chemical analyses of water from wells listed in Tables 7 and 8 are given in Tables 11 and 12. Some of these analyses were made as part of this investigation; some were made in connection with earlier investigations; and some were provided by well owners and others who had them made for special purposes. In addition to the analyses listed in Tables 11 and 12, the dissolved-solids contents of water from various wells are given for the different water-bearing formations in Figures 42, 43, 44, and 45. For the sake of completeness, some of the figures for dissolved solids in these illustrations have been estimated from partial analyses. These illustrations also show the dissolved solids for some wells which were inventoried in previous investigations but which could not be located in this investigation, and therefore are not included in Tables 7, 8, 11, and 12. For these wells, the approximate locations, as determined from maps in the earlier reports, are given along with the dissolved solids as reported by or estimated from the analyses in those reports.

In addition to sampling and analyzing water from selected wells and compiling all previous analyses, the quality of the ground water has been studied by means of electric logs made in water and oil wells and test holes. The available electric logs are listed in Tables 7 and 8, and their locations are shown on Figure 27. Where the logs are reasonably suitable for interpretation, the quality of the water shown by them to occur in the Wilcox Group, Carrizo Sand, Sparta Sand, and Yegua Formation has been designated as "fresh," "brackish," or "salty." The term "fresh" as used here denotes water of less than 1,000 parts per million dissolved solids. The term "brackish" means water with 1,000 to 3,000 parts per million dissolved solids, and the term "salty" denotes water having more than 3,000 parts per million dissolved solids. These interpretations were made with the help of Mr. Hubert Guyod, Logging Consultant, of Houston, Texas. Partly because of the basic limitations of electric logs, and partly because the original logs were made under a variety of conditions and with various types of equipment and because much of the data necessary for careful control of quality of water interpretations is lacking, the interpretations are considered to be approximations, generally having a possible range of error up to about 30 percent. Where chemical analyses of water are not available from wells and test holes the interpretations of the electric logs have been used to define the fresh, brackish, and salty water. These interpretations are given on Figures 34, 36, 38, 40, 42, 43, and 44.

Some fresh water can be obtained from every formation in Angelina and Nacogdoches Counties. The freshest water normally is obtained from very shallow wells in and near the outcrops. Either in or downdip from the outcrops, all the formations, however, also contain more highly mineralized water. The water normally becomes more highly mineralized with depth and with distance downdip from the outcrop, or source of recharge. At some distance downdip each formation contains only salty water. The formations which contain fresh water the greatest distances downdip are those with the greatest transmissibilities and the best hydraulic continuity. Those which contain brackish and salty water in most places are those which are generally the poorest producers of ground water and in which the sands are the most disconnected, providing for the least flushing action from recharge.

Wilcox Group

The Wilcox Group ranges in thickness from about 950 feet to more than 3,300 feet in Nacogdoches and Angelina Counties. In the northern part of Nacogdoches County, the sands in over 1,000 feet of the upper part of the Wilcox Group contain fresh water, and the sands in the underlying portion of the Wilcox contain brackish water (Figures 33 and 34). Downdip to the south the thickness of Wilcox containing feesh water becomes less, and the thickness of that portion containing brackish water becomes greater. South of a generally east-west trending line passing between Lufkin and the Angelina River, the electric logs indicate that no sands in the Wilcox contain fresh water. Similarly, electric logs indicate that south of a line trending approximately east-west south of Huntington, all of the Wilcox contains salty water.

Few Wilcox wells exist southwest of a line running approximately from Cushing to Chireno, and most water wells in the Wilcox penetrate only the upper sands, although water samples have been taken from test holes in deeper portions of the Wilcox in a few places. Accordingly, most of the available analyses of water from Wilcox wells show relatively fresh water (Figure 42). From the standpoint of obtaining the best quality of water, however, the designation "fresh" is partly misleading with respect to most of the thicknesses shown on Figure 34 as containing less than 1,000 parts per million dissolved solids. Most of this water appears to range from 500 to 1,000 parts per million dissolved solids, with the largest part probably nearer 1,000 parts per million. In contrast, the water which the city of Nacogdoches obtains from the Carrizo sands is in the order of 200 parts per million dissolved solids. Thus, although fresh from the standpoint of maximum limits, much of the water in that section of the Wilcox designated as fresh is actually considerably more mineralized than the water from the Carrizo which most people use in this area.

In a few places in the outcrop of the Wilcox, water from dug wells is very highly mineralized. These are anomalous situations, however, and do not represent the quality of the water generally in the outcrop of the Wilcox. It is believed that the water quality from these wells is due to very local conditions which have no significant bearing on the quality of water in the Wilcox as a whole.

Normally, the hardness of the water in the deep fresh water Wilcox wells is quite low, generally being less than 20 parts per million. In shallower wells it may be low or high, ranging in some wells to over 200 parts per million.

A few wells in the Wilcox show high iron contents, the amounts ranging up to several parts per million. The analyses for most wells, however, show low iron contents. Generally the wells with the high iron contents are nearer the outcrop, although some of the wells and test holes downdip also show high iron contents.

The pattern of occurrence of iron in the water from Wilcox wells, as well as from other water-bearing formations in the area, is difficult to establish from available data. This is because of the relative ease of obtaining false samples with respect to iron. Very small amounts of turbidity in water, such as from drilling mud where the samples were taken from test holes, are known to give false iron results. Also, most of the water samples collected during this study were obtained from small-diameter drilled wells from which it was only possible to sample from pressure tanks. The same is believed to be true for many of the previous analyses available on smaller capacity wells in the area. For such samples it is impossible to exclude the effects of corrosion from water standing in steel well casings or pressure tanks. In addition, samples of water from pressure tanks or other storage tanks or from dug wells may show iron contents too low because of prior precipitation of the iron. For these reasons many of the iron contents reported in Tables 11 and 12 are suspect and are not considered strictly applicable to the natural waters.

Carrizo Sand

The Carrizo Sand contains water of excellent chemical quality throughout most of Nacogdoches County and the northernmost 8 miles of Angelina County. The formation tends to be a continuous, massively bedded sand, and the quality of water is very consistent from one place to the next, as well as from top to bottom in the formation.

Figure 43 shows the dissolved-solids content of water from wells and test holes in the Carrizo Sand. The dissolved solids range from less than 100 parts per million in the outcrop area to about 200 parts per million in the city of Nacogdoches and to about 300 parts per million in the Southland Paper Mills Old Well Field in Angelina County. Figure 43 shows two lines, one indicating the approximate southern limit of water containing less than 1,000 parts per million dissolved solids and the other the approximate southern limit of water containing less than 3,000 parts per million dissolved solids. Beginning about 2 to 3 miles north of the 1,000 parts per million line and going southward, the water in the Carrizo becomes more than 500 parts per million in dissolved solids. Thus, the zone of transition from very fresh to brackish water is relatively narrow. One of the city of Lufkin wells is in this zone of transition. The next zone, within which the water changes from about 1,000 parts per million to over 3,000 parts per million in dissolved solids, is about 6 miles in width.

The hardness of the fresh Carrizo water is low everywhere south of Nacogdoches, generally being less than 20 parts per million. North of Nacogdoches toward the outcrop the hardness is somewhat spotty, ranging up to 150 parts per million.

At Nacogdoches there is an iron problem in water from the old city wells north of the center of the city. In water from the newer wells south of the city, however, the iron is low. It is also low in water from the Southland Paper Mills wells, both in the Poe Field and in the Old Field, and for the most part in water from the city of Lufkin wells. In wells west, east, and north of Nacogdoches, iron contents of water from most wells are higher than the 0.3 part per million upper limit recommended for domestic water supplies, the amounts ranging up to several parts per million or more in some wells. The city of Nacogdoches has an iron removal system for the water from its northern wells, as do some other users who have water high in iron content.

Sparta Sand

The Sparta Sand contains water which is quite fresh in its outcrop. Downdip from its outcrop the Sparta contains fresh water for several miles along both the western and eastern edges of its area of occurrence in these counties. In the middle part of the Angelina-Nacogdoches County area where the Sparta exists, however, the aquifer is highly mineralized essentially everywhere downdip from its outcrop (Figures 37 and 44). The middle portion is approximately where the Angelina River runs along the southern edge of the outcrop, and it appears probable that this is a discharge area for the Sparta Sand from both the north and the south. In other words, it appears that in both the western and eastern parts of the area water moves downdip in the Sparta from the outcrop. From there it probably moves laterally toward the center of Angelina County and thence northward toward the Angelina River where it is discharged. Along this stretch of the river, on the northern side, most of the water in the Sparta moves directly to the river valley and is discharged. This pattern of movement would cause the water to be fresh farther downdip along both the western and eastern sides of the area and to be brackish and salty in the central part of the area south of the Angelina River.

In the area where the water in the Sparta changes from fresh to salty, there is stratification of the water in the aquifer, with part of the sand containing brackish water, part fresh water, and part salty water. In some places the fresh water is on top and in some places on the bottom of the aquifer. This situation is shown by symbols on Figure 44.

As in the Wilcox and Carrizo aquifers, the water from the Sparta appears to contain varying amounts of hardness and iron. The hardness of the fresh water, as shown by the analyses, ranges from 2 to 150 parts per million, and the iron ranges from less than 0.02 to several parts per million or more. Insofar as can be determined from the records available, there does not seem to be any relationship between depths of wells and the hardness and iron.

Yegua Formation

Based on the available records, the Yegua contains fresh water essentially at all depths between the northern edge of its outcrop and about 2 or 3 miles north of the southern edge of its outcrop (Figures 17, 21, 39, 40, and 42). South of this line for about 1 to 4 miles some of the water is fresh and some brackish. From there southward, the records indicate no water containing less than 1,000 parts per million dissolved solids, and some of the water is salty. Farther south, essentially all of the water in the Yegua becomes salty.

A number of shallow wells in the Yegua outcrop area show water that is somewhat more mineralized than 1,000 parts per million dissolved solids and is classed in the brackish category. These are, however, in a small minority and are not reflected in the general quality of the water downdip.

As shown by Figure 42, the quality of the water within the fresh-water section ranges widely from place to place and from one depth to another. In this section the mineralization ranges from less than 100 parts per million dissolved solids to the fresh-water limit of 1,000 parts per million. The causes are undoubtedly related to lenticularity of the Yegua deposits and the degree of flushing which has occurred. The pattern, however, has not been worked out.

Hardness is generally low to moderate, but some wells show hardness of fresh water ranging to over 300 parts per million. Likewise, iron content is generally low to moderate, but water from some wells ranges up to several parts per million.

Other Formations

Figure 45 shows dissolved-solids contents for water from wells in the Reklaw Formation, Queen City Sand, Weches Formation, Cook Mountain Formation, Jackson Group, and alluvium. These formations are all relatively weak producers of ground water.

Analyses are available for the Reklaw from wells and test holes ranging in depth from a few feet to 767 feet. While most are for wells in the outcrop area, analyses are available at six locations downdip. Some wells in the outcrop area contain highly mineralized water, but most of the wells in the outcrop produce relatively fresh water. At the six locations downdip, at depths ranging from 308 to 767 feet, the dissolved-solids content for the lower part of the Reklaw ranges from 530 to 740 parts per million. The lower part of the Reklaw, though not a high yielding aquifer, appears to be hydraulically connected with the Carrizo Sand and, therefore, contains relatively fresh water to considerable depths. Generally, the water in the lower Reklaw is more mineralized than that in the Carrizo. It appears that wherever the Reklaw contains fresh water, the underlying Carrizo also contains as fresh or fresher water.

Analyses are available for Queen City wells ranging in depth from a few feet to as much as 523 feet. The dissolved-solids content of the water from these wells ranges from very low to nearly 3,000 parts per million for one well in northern Angelina County. The Queen City is a weak aquifer in Angelina and Nacogdoches Counties, and wherever it exists and contains fresh water, the underlying Carrizo also exists and contains fresh water. Thus, users desiring more than very small supplies would normally make no effort to develop them from the Queen City.

The Weches Fromation is essentially clay, and nearly all the wells in it are dug in the outcrop. The water from these wells is generally fresh, but in a few places is quite highly mineralized.

The Cook Mountain Formation overlies the Sparta Sand and supplies water to shallow dug wells and a few relatively shallow drilled wells. The water in the shallow Cook Mountain wells is generally fresh, although some of it is highly mineralized. The formation is a very poor aquifer.

In most of the southern part of Angelina County, the Jackson Group contains the only sands from which fresh ground-water supplies can be obtained. The few sands in the Jackson are very thin and lenticular, however, and it is difficult to develop a supply of more than a few gallons per minute. Most wells in the Jackson are relatively shallow, and the available analyses indicate a range in quality of water from less than 100 to more than 1,400 parts per million dissolved solids.

A few very shallow wells draw water from the thin alluvium which exists in places along the streams in Angelina and Nacogdoches Counties. This water is generally quite fresh, but the supplies are very small.

Surface Water

Records of chemical quality of surface water are available at a few places in Angelina and Nacogdoches Counties. Most of these are for the Angelina River, Attoyac Bayou, and Bayou La Nana near Nacogdoches, but miscellaneous analyses are available for several other streams. All of the available analyses show fresh water, and most of the water is very fresh.

TEMPERATURE OF GROUND WATER

The temperatures of water produced by three springs and 35 wells of various depths in various formations in Angelina and Nacogdoches Counties are shown on Figure 6. The data are coded by formation. Temperatures measured during the present study, as well as temperatures reported by previous investigators, are plotted against either well depth or, if known, the depth to the middle of the interval screened in the well. Most of the temperature information available is on wells tapping the Carrizo Sand. Only a few measurements are available for wells tapping the Carrizo Sand. Only a few measurements are available for wells tapping other formations, especially wells which are very deep. This is due to both the scarcity of deeper wells in the other formations and to reluctance in measuring and reporting temperatures on small-capacity deep wells because they tend to be falsely low due to cooling of the water on its way to the surface.

From the data shown on Figure 6, the estimated average temperature gradient in the area is about 2°F per hundred feet of depth. The water temperature from a depth of 200 feet averages about 70°F, from 700 feet about 80°F, and from 1,200 feet about 90°F.

OIL AND GAS FIELDS

Locations

The first oil production in the State of Texas began in 1866 in the Nacogdoches Field at a location called Oil Springs. The oil was from various zones within the Sparta Sand and the Weches and Queen City Formations at depths ranging from the surface to 400 feet. Today several of the original wells still flow a very small amount of oil, and the oil springs that led to the discovery of the field still flow minor amounts.

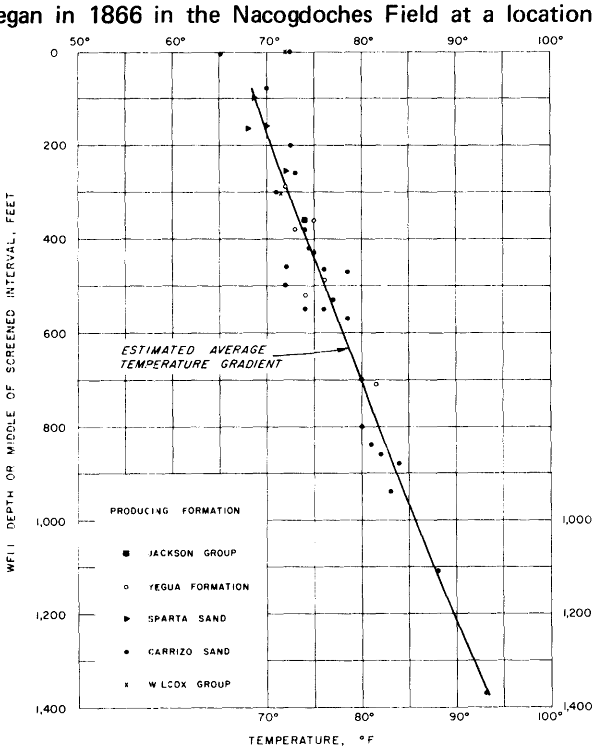


Figure 6.—Temperature of Ground Water

The total amount of oil and gas production in Angelina and Nacogdoches Counties has been relatively limited. Figure 7 shows the locations of all known oil and gas fields, both present and past. Of those shown, only the Trawick, Douglass, Douglass West, Morris Coats, Garrison, and Garrison Northeast in Nacogdoches County, and the Allentown in Angelina County are producing at present. The other fields are either non-producing or abandoned.

Surface Casing

An Act of the Texas Legislature in 1899 requires that oil and gas wells be cased to prevent all water from above from penetrating the oil and gas bearing rock. Later Acts of 1919, 1931, 1932, and 1935 gave broad powers to the Railroad Commission of Texas to prevent oil and natural gas and water from escaping from the strata in which they are found into other strata.

The Railroad Commission first handled the determination of the amount of surface casing that should be set in a well. Subsequently, the Texas Board of Water Engineers and its successor the Texas Water Commission, and in recent years the Texas Water Development Board, have made recommendations concerning the protection of water considered to be of usable quality. The protection can be by means of surface casing or one of several of the cementing techniques available to the oil and gas industry. Protection of usable water means more than simply protection of fresh water. Water with dissolved-solids concentrations up to at least 3,000 parts per million is recommended for protection by the Water Development Board. Water with higher mineral concentrations is recommended for protection if it is being used for beneficial purposes.

Some of the earliest requirements for surface casing in Angelina and Nacogdoches Counties probably were not adequate for protection of the ground-water supplies. The recommendations made in recent years, however, appear entirely adequate to protect ground water of 3,000 parts per million dissolved solids or less. At least by the middle 1950's, the recommendations were generally for protection down to the base of the Wilcox in Nacogdoches County and most of the northern half of Angelina County. In the southern half of Angelina County, the recommendations were generally to the base of the Yegua Formation. Beginning in the early 1960's, an effort was begun to gather more information so that better recommendations could be

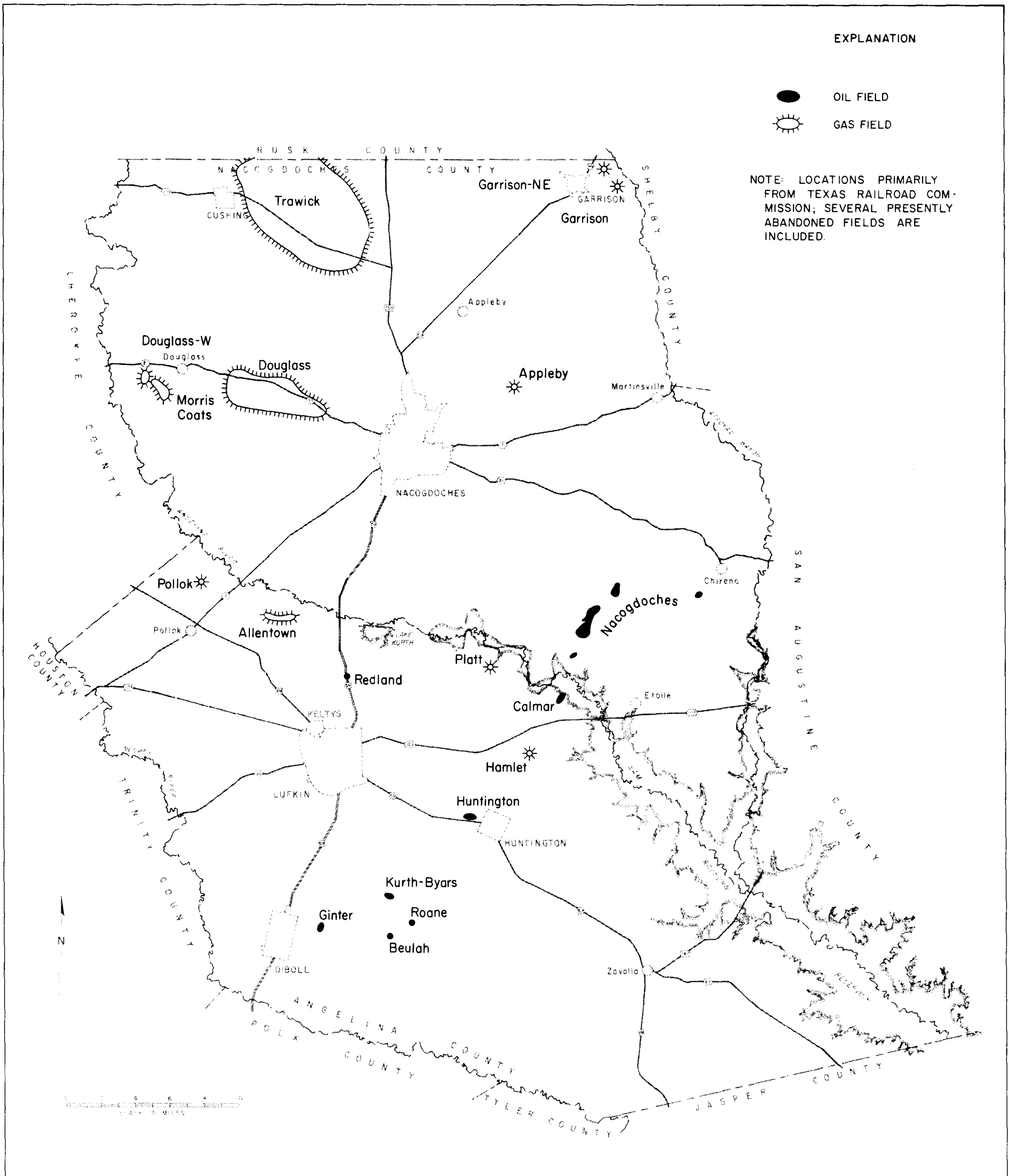


Figure 7
LOCATION OF OIL AND GAS FIELDS

Base from Texas State Highway Department county map given. Recommendations are now given to a depth and not a stratigraphic reference; and in some areas zones for protection are given, together with depths for cement plugs if the hole is abandoned.

Two fields in Angelina and Nacogdoches Counties have depth of fresh water protection included in the field rules set out by the Railroad Commission of Texas. For the Allentown Gas Field in Angelina County (which is currently comprised of four producing gas wells), the field rule states that the surface casing shall be set and cemented at a depth not less than 1,500 feet below the surface of the ground and that the amount of surface casing to be set shall be adequate to protect all fresh water sands. The 1,500-foot requirement is not deep enough, however, and when asked, the Texas Water Development Board has recommended protection to the base of the Wilcox at about 3,300 feet in this area.

The other field rule outlining fresh-water protection is for the Trawick Field in Nacogdoches County. Here surface casing is required to the base of the Wilcox Group plus 100 feet, with an estimated range in depth of 1,600 to 2,100 feet, which appears to be entirely adequate.

Plugging of Abandoned Test Holes and Wells

In recent years the plugging of abandoned test holes and wells has been supervised by the Railroad Commission of Texas, and so far as known, all such holes are adequately plugged. Undoubtedly, some of the old tests and wells were not carefully plugged, but no indication of contamination of ground-water supplies from improper plugging was found during this study.

Disposal of Salt Water

Originally all water produced from oil and gas wells was probably disposed of on the surface, either by placing it into surface drainage or into pits. At present, however, the Railroad Commission rules prohibit the use of all types of surface disposal. This field investigation has shown no evidence of surface disposal being used at this time.

The amount of salt water which has been produced in the two counties is relatively small. In 1961, an inventory was made of the salt water produced in the oil and gas fields of Texas. The inventory listed the following information on the fields in Angelina and Nacogdoches Counties. The Allentown Field, Angelina County, produced 327 barrels of salt water in 1961 and all was disposed of in surface pits. The Kurth-Byars Field produced 4,380 barrels of salt water that year and all was disposed of in pits. In Nacogdoches County, the Douglass Field produced 6,276 barrels of salt water, with 5,028 barrels to pits and 1,248 barrels to an injection well. The Trawick Field had a salt-water production of 23,340 barrels in 1961, all disposed of by injection. At present no pits are in use in the Allentown Field; the Kurth-Byars Field is abandoned; and all salt water produced in the Douglass and Trawick Fields is disposed of by injection wells. The Morris Coats and Douglass West Fields also are using injection well systems for disposal. For the Garrison and Garrison Northeast Fields, no indication of salt-water production was found, and there were no salt-water pits in use.

Only minor amounts of surface contamination were found in any of the oil and gas fields, and there are no indications that the ground water in the vicinity of any of these fields has been seriously contaminated. None of the analyses of water from wells which have been compiled indicates contamination from oil-field brines.

PUMPAGE AND WATER LEVELS IN WELLS

Pumpage

In 1968, ground-water pumpage in the area totalled an estimated 34,400 acre-feet and averaged 30.7 million gallons per day. The breakdown by use was:

Pumpage of Ground Water in 1968

USE	ANGELINA COUNTY MILLION GALLONS PER DAY	ANGELINA COUNTY ACRE-FEET PER YEAR	NACODGOCHES COUNTY MILLION GALLONS PER DAY	NACODGOCHES COUNTY ACRE-FEET PER YEAR
Public Supply	5.0	5,600	3.6	4,000
Industrial	15.6	17,500	3.6	4,000
Irrigation	0	0	0	0
Rural domestic and livestock	1.3	1,500	1.6	1,800
	21.9	24,600	8.8	9,800

The amounts of pumpage for public supply and industrial use are principally from the annual pumpage inventory conducted by the Texas Water Development Board, supplemented with data from the major users. Pumpage for irrigation use during 1968, as in prior years, was essentially nonexistent except for a very small amount, mostly for supplemental watering of cemeteries and golf courses. The pumpage for rural domestic and livestock purposes has been estimated based on conditions observed during the present study.

A breakdown of the 1968 pumpage in each county by formation is shown on Figure 8, and listed for the major formations in Table 6. Of the slightly less than 9 million gallons per day of pumpage occurring in Nacogdoches County, almost 8 million gallons per day is from the Carrizo Sand. The remainder is about half from the Wilcox Group, with the rest being from all the other formations yielding water in Nacogdoches County. On the average, nearly 22 million gallons per day is pumped in Angelina County, of which nearly 19 million gallons per day comes from the Carrizo with most of the remaining 3 million gallons per day being produced from the Yegua Formation.

The areal distribution of the major pumpage in the area is shown on Figure 9. Included are all users pumping an average daily amount of 50,000 gallons or more. The largest single user in the area is Southland Paper Mills, which obtains most of its water supply from

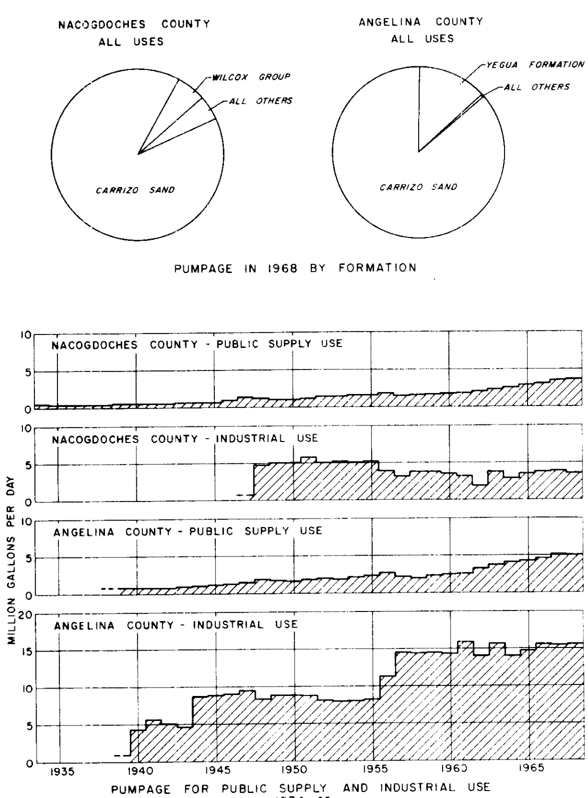


Figure 8.—Pumpage of Ground Water in Angelina and Nacogdoches Counties

two well fields in the Carrizo Sand. One field is in northern Angelina County, and the other is in the adjoining portion of southern Nacogdoches County. The next largest users include the cities of Lufkin and Nacogdoches. Both obtain their supplies entirely from the Carrizo. Next to these Carrizo fields, the largest concentration of pumpage is at Diboll, where the city of Diboll and Southern Pine Lumber Company pump about 1.3 million gallons per day from the Yegua Formation. Other users in the two-county area include the smaller cities and towns, a few industries, and numerous relatively new water-supply corporations furnishing water to rural communities and areas.

Water Levels in Wells

Altitudes of water levels in representative wells in 1968 and 1969 are shown on Figure 46. Representative water levels in wells are also listed in Tables 7 and 8.

As a result of pumping from Carrizo wells, the piezometric surface for the Carrizo Sand, as represented by water levels in wells, has been drawn down into an area-wide cone of depression. Corresponding draw-downs have developed in the piezometric surfaces for those Reklaw sands and uppermost Wilcox sands which are hydraulically connected to the Carrizo. Water levels also have been drawn down in some Yegua wells as a result of pumping from that formation. No large or regional draw-downs are noticeable in wells in any of the other formations.

Carrizo Sand

Periodic measurements have been made by the U.S. Geological Survey, the Texas Water Development Board, and Southland Paper Mills of water levels in some Carrizo wells, beginning in the late 1930's. It was then that the city of Lufkin began to draw its municipal supply from the Carrizo Sand and Southland Paper Mills started operating its Carrizo wells.

Since 1939, water levels in Carrizo wells have been drawn down throughout the area as a result of the increased pumping from the Carrizo. Drawdowns of static levels have ranged to nearly 500 feet, depending on proximity of the observation wells to the centers of pumping. In general the declines are less going northward from the Southland Paper Mills well fields toward the outcrop. The declines have been least in the outcrop area, where they have ranged from zero to about 20 or 25 feet. Static water levels now range from more than 200 feet below sea level in the center of the Southland Paper Mills Old Well Field to more than 300 feet above sea level in the outcrop area of the Carrizo. Figure 10 shows graphs of the pumpage from the Carrizo and of water levels in observation wells in various localities.

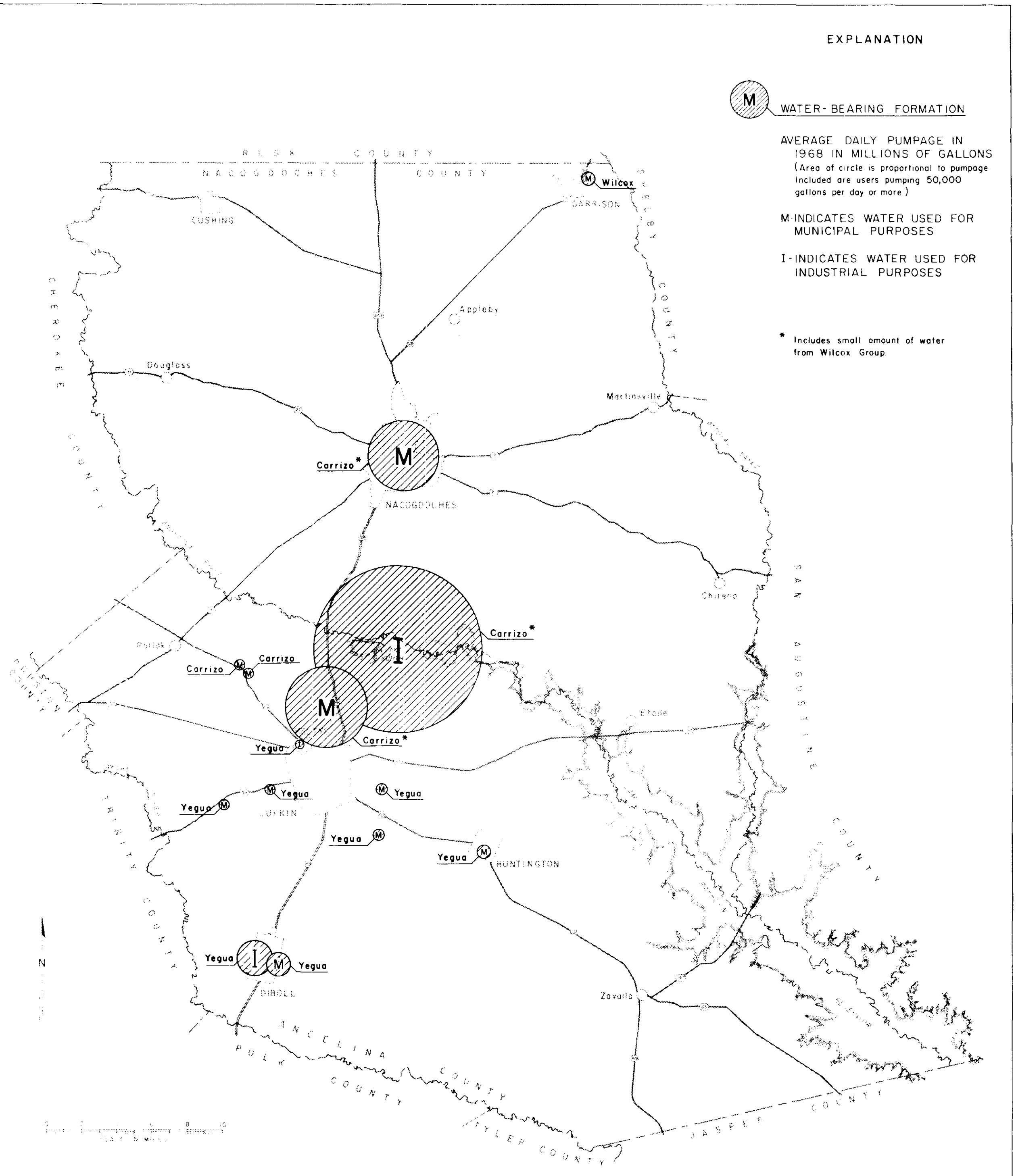


Figure 9
AREAL DISTRIBUTION OF MAJOR PUMPAGE OF GROUND WATER IN 1968

Base from Texas State Highway Department county maps

Yegua Formation

Pumpage from the Yegua Formation has resulted in local cones of depression at Diboll and at Huntington. Because of the lenticular nature of the sands in the Yegua Formation and the lack of observation wells, it is not known how far these cones of depression have spread. The water level at Huntington is deeper than appears reasonable for the pumpage at Huntington, and there appears to be some possibility that part of the decline there has been caused by the pumping at Diboll. Data are not available, though, to permit an analysis of the actual pumpage-water level relationships.

RESULTS OF PUMPING TESTS

Results of pumping tests to determine specific capacities of wells and the transmissibility and storage coefficients of the principal aquifers are given in Tables 3 and 4. Graphs of two examples of such tests are shown on Figures 11 and 12.

A pumping test is essentially a process of measuring the effect on the water level in one or more wells caused by a given change in rate of pumping. The results of the pumping test are used in determining how much water can be pumped under given conditions on a long-term basis.

Specific Capacities of Wells

The specific capacity of a well is a measure of the amount of water that the well will produce with a given amount of drawdown of water level within the well itself in a relatively short period of time. Its units are gallons per minute per foot of drawdown. The specific capacity of a well is affected partly by the hydraulic characteristics of the formation from which it obatins its water supply and partly by the type of construction and efficiency of construction of the well itself.

Specific capacities measured for the larger wells in the Wilcox Group in this area range from 1.0 to 3.6 gallons per minute per foot of drawdown (Table 3). For the Carrizo Sand they range from 4.4 to 23.2 gallons per minute per foot of drawdown. For the Sparta Sand they range from 0.5 to 7.5 gallons per minute per foot of drawdown, and for the Yegua Formation they range from 0.9 to 9.0 gallons per minute per foot of drawdown.

Coefficients of Transmissibility, Permeability, and Storage

Table 4 lists coefficients of transmissibility and storage determined from pumping tests of wells in the four principal aquifers in Angelina and Nacogdoches Counties. The coefficient of transmissibility is a measure of the amount of water that will move through an aquifer under a unit hydraulic gradient. It is expressed in gallons per day per foot of width of the formation. From the coefficient of transmissibility and the thickness of sand at the pumped well, the field coefficient of permeability may be determined. This is equal to the transmissibility divided by the thickness of sand and is expressed in gallons per day per square foot of cross-sectional area through which the water moves.

The coefficient of storage, which is obtained from a pumping test when one or more separate observation wells are used, is a measure of how much water is given up from storage when the piezometric surface is lowered. It is dimensionless and is equal to the number of cubic feet of water which is released in each column of the aquifer with a base of one square foot when the piezometric surface is lowered one foot. In an unconfined aquifer (under water-table conditions), the coefficient of storage is essentially equal to the effective porosity of the water-bearing formation and may be as large as 0.3. In a confined aquifer (under artesian conditions), the coefficient of storage is very much smaller (usually less than 0.001) and is controlled by the compressibility of the aquifer, the compressibility of water, the compressibility of clay bodies interbedded with and adjacent to the aquifer, and leakage from adjacent beds.

If a pumping test is made on a well which completely penetrates the aquifer, the coefficient of transmissibility computed from the test represents the entire aquifer. If not, it usually represents only a portion of the aquifer, and the transmissibility for the entire aquifer must be estimated from the permeability of the sand, as determined from the pumping test, and thicknesses of sand determined from logs of other wells which completely penetrate the aquifer. None of the individual pumping tests made in the Wilcox Group, Sparta Sand, or Yegua Formation was on wells which completely penetrated the aquifer, but most of the Carrizo tests were on completely penetrating wells.

The permeability of the sand determined from tests of wells in the Wilcox Group ranges from 20 to 100 gallons per day per square foot and averages about 45 gallons per day per square foot. Recorded permeabilities for the Carrizo Sand range from 99 to 336 gallons per day per square foot, and the transmissibility of the Carrizo normally ranges from about 14,000 to 36,000 gallons per day per foot. Permeabilities reported for the Sparta Sand range from 22 to 632 gallons per day per square foot. Permeabilities of sands in the Yegua Formation, as determined from the tests, range from 37 to 160 gallons per day per square foot and average about 95 gallons per day per square foot.

The areal distribution of the pumping tests and the average coefficients recorded in the various localities are shown on Figure 47.

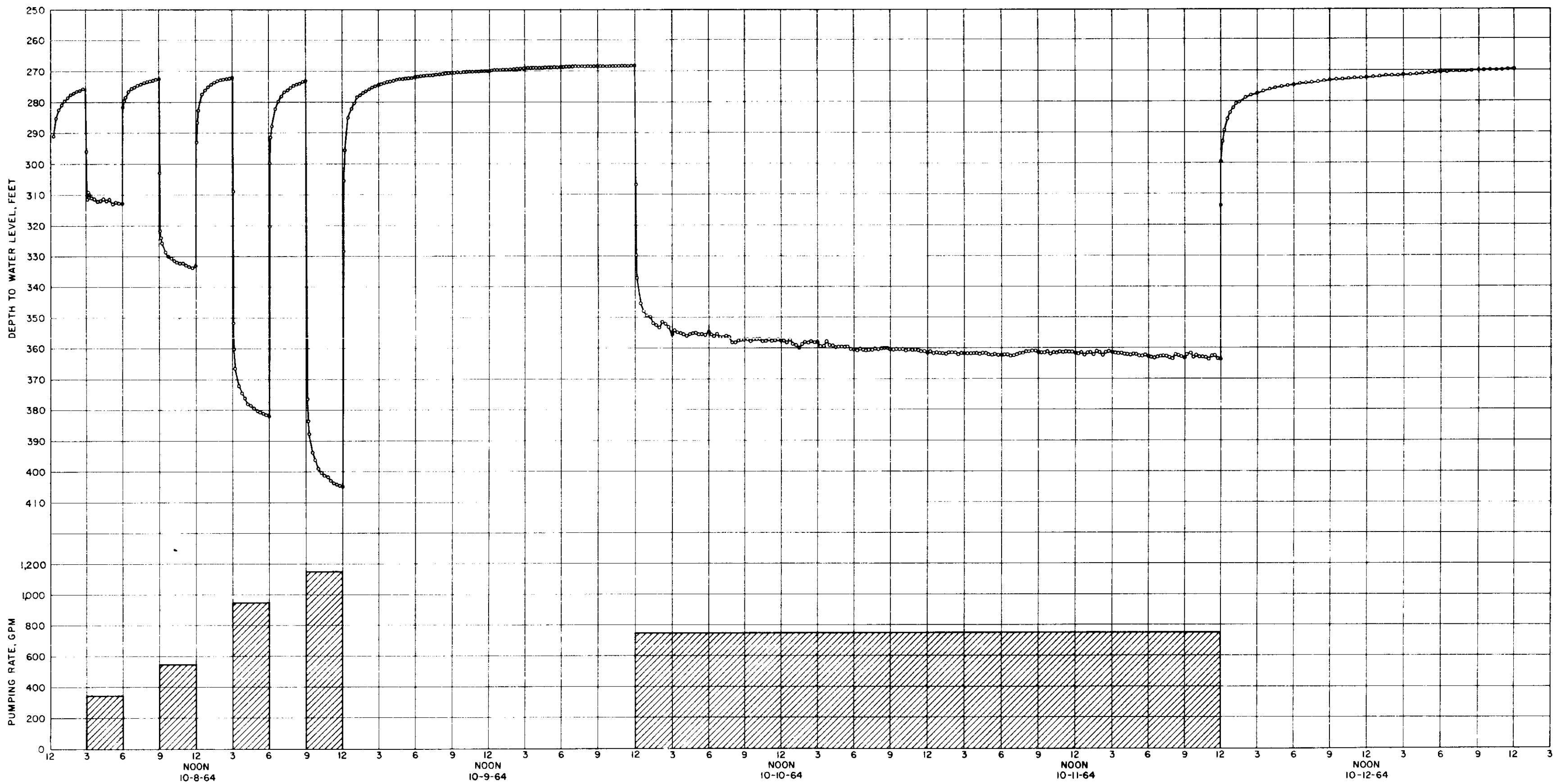


Figure 11

EXAMPLE OF PUMPING TEST OF PRODUCTION WELL

CITY OF NACOGDOCHES WELL 8 (TX-37-27-506)

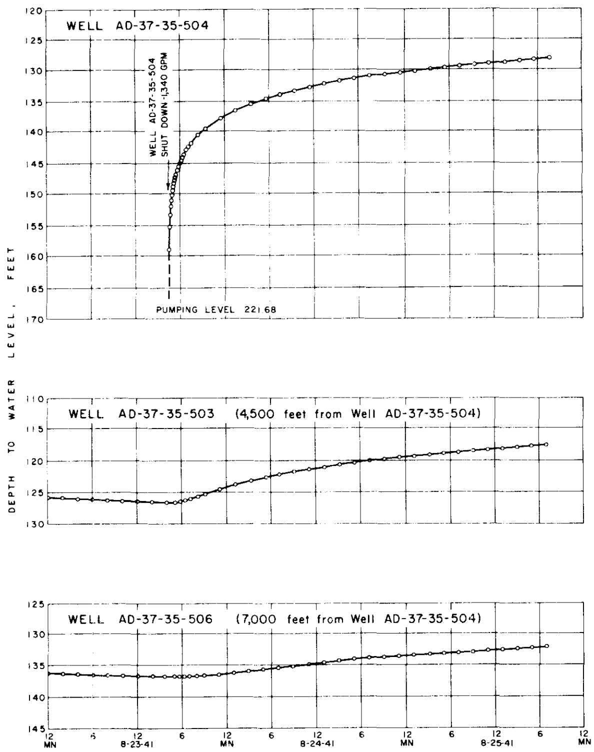


Figure 12.—Example of Interference Test

INTERFERENCE BETWEEN WELLS AND LONG-TERM DRAWDOWNS OF WATER LEVELS

Under natural conditions and prior to pumping from wells, an aquifer is in a state of approximate dynamic equilibrium. Over a climatic cycle, the natural recharge is balanced by the natural discharge, and except for temporary fluctuations the piezometric surface of the aquifer, as represented by water levels in wells, remains stable.

When a well is pumped, a cone of depression is created in the piezometric surface around the well to cause water to flow from the aquifer into the well. In the Angelina-Nacogdoches County area, the cone of depression continues to grow in all directions until it reaches the outcrop area and causes additional water to flow from the outcrop to the well essentially at the same rate at which it is pumped. At first the water from the outcrop is drawn from storage, and the water table in the outcrop slowly declines. This causes rejected recharge to be salvaged, eventually in an amount equal to the pumpage. At that time the piezometric surface again becomes stabilized, and no further decline of water levels in wells is caused by the pumping (Figure 4).

The depth and rate of growth of the cone of depression in the piezometric surface is controlled by the coefficient of transmissibility and the coefficient of storage of the aquifer. If these coefficients are known, the Theis nonequilibrium formula may be used, with time and distance as variables, to compute the cone of depression at any time after pumping begins.

After equilibrium conditions are reached, the extent and shape of the cone of depression in the peizometric surface are controlled only by the coefficient of transmissibility and the geometry of the boundaries of the aquifer, and the coefficient of storage is no longer a factor. In other words, the coefficient of storage assists in controlling the time at which equilibrium conditions are reached, but does not control the final amount of drawdown and the final shape of the cone of depression.

In making calculations of drawdowns, the outcrop (source of recharge) is considered as a line source, and a fault which completely displaces a formation is considered as a line barrier. In the calculations, the effects of both are handled mathematically by image wells, the locations of which are determined by the positions of the outcrop and/or barrier.

Cones of depression created by individual wells overlap, and under artesian conditions they are additive. This means that the effect of pumping two or more separate wells may be determined by computing the effect of each and adding them together.

Figure 13 is comprised of graphs made by means of the Theis nonequilibrium formula, showing the drawdown of water level (piezometric surface) at different times after pumping begins, assuming a pumping rate of 500 gallons per minute, a coefficient of transmissibility of 10,000 gallons per day per foot, a coefficient of storage of 0.00005, and a distance to line source (outcrop) of 15 miles. Graphs are presented of the drawdown after pumping 1 day, after pumping 1 month, and after equilibrium conditions are reached. The drawdowns shown here are proportional to the pumping rate. If the pumping rate were 1,000 gallons per minute instead of 500 gallons per minute, the drawdown would be twice as much as shown by the graph. At equilibrium the drawdown is inversely proportional to the coefficient of transmissibility, and if the coefficient of transmissibility were 20,000 gallons per day per foot instead of 10,000 gallons per day per foot, the drawdown would be one-half as much. This relationship also would apply for periods prior to equilibrium if both the coefficient of transmissibility and the coefficient of storage were changed by the same percentage from the coefficients used for the graphs.

The position of the line source determines the drawdown at equilibrium, along with the transmissibility coefficient and the pumping rate. If the line source were closer to the pumped well than 15 miles as shown, the drawdown at equilibrium would be less. If it were farther, the drawdown at equilibrium would be greater.

Table 3.--Specific Capacities of Wells in Angelina and Nacogdoches Counties

Well No.	Well Owner	Pumping Rate (gpm)	Effective Time 1/ (hours)	Specific Capacity (gpm/ft)
		YEGUA FORMATION		
AD-37-42-201	Lancewood Water Supply Corp.	38		0.9
AD-37-42-301	Owens-Illinois No. 4	226	1/2	5.1
AD-37-42-302	Owens-Illinois No. 5	119	1/2	5.6
AD-37-42-602	Hudson Water Supply Corp.	200	1	2.3
AD-37-43-501	Angelina Water Supply Corp.	201		2.3
AD-37-43-503	Fuller Springs Water District No. 1	90	1	1.6
AD-37-44-801	City of Huntington No. 7	200	1	2.3
AD-37-44-802	Four Way Water Supply Corp.	180	1/2	1.5
AD-37-50-302	Burke Water Supply Corp. No. 1	157		2.6
AD-37-50-303	Burke Water Supply Corp. No. 2	95		1.3
AD-37-50-605	Southern Pine Lumber Co. No. 4	225	1/2	3.6
AD-37-50-606	City of Diboll No. 2	310	1/2	1.7
AD-37-50-901	City of Diboll No. 1	400	1	9.0
AD-37-51-201	Natural Gas Pipeline Co. of America No. 1	150	1/2	1.2
AD-37-51-202	Natural Gas Pipeline Co. of America No. 2	116	1/2	2.1
AD-37-51-504	Beulah Water Supply Corp.	60	1	2.8
		SPARTA SAND		
TX-37-35-104	Southland Paper Mills	200	24	7.5
TX-37-35-204	Southland Paper Mills	75	48	1.1
TX-37-35-207	Southland Paper Mills	90	24	.5
TX-37-35-308	Southland Paper Mills	300	24	3.3
TX-37-36-107	Southland Paper Mills	260	1	3.1
		CARRIZO SAND		
TX-37-09-502	Sacul Water Supply Corp.	75		4.4
TX-37-17-607	Douglass Water Supply Corp.	80		7.2
TX-37-19-401	Lilly Grove Water Supply Corp.	150		6.5
TX-37-27-201	City of Nacogdoches No. 5	790	2	9.5
TX-37-27-303	City of Nacogdoches No. 3	565	2	8.8
TX-37-27-304 2/	City of Nacogdoches No. 4	530	2	12.3
TX-37-27-504	City of Nacogdoches No. 6	810	2	7.5
TX-37-27-505 2/	City of Nacogdoches No. 7	705	2	8.1
TX-37-27-506 2/	City of Nacogdoches No. 8	752	2	9.0
TX-37-27-802	City of Nacogdoches No. 9	805	2	15.1
TX-37-30-701	Chireno Water Supply Corp.	62	2	.6
AD-37-34-504	Central W. C. I. D.	150		9.4
AD-37-34-505	Lufkin State School No. 2	303		13.8
TX-37-35-301	Southland Paper Mills	633	1	7.6
TX-37-35-302	Southland Paper Mills	979	1	17.8
TX-37-35-303 2/	Southland Paper Mills	887	1	15.1
AD-37-35-401	Southland Paper Mills	1,120	1	16.1

For footnotes see end of table.

Table 3.--Specific Capacities of Wells in Angelina and Nacogdoches Counties--Continued

Well No.	Well Owner	Pumping Rate (gpm)	Effective Time (hours)	Specific Capacity (gpm/ft)
		CARRIZO SAND (Continued)		
AD-37-35-402	Southland Paper Mills	1,200	24	13.0
AD-37-35-403	Southland Paper Mills	1,200	24	22.5
AD-37-35-408	City of Lufkin No. 9	1,209	1/2	23.2
AD-37-35-502	Southland Paper Mills	1,100	1	22.4
AD-37-35-503	Southland Paper Mills	1,120	1	21.5
AD-37-35-504	Southland Paper Mills	1,110	1	20.5
AD-37-35-505	Southland Paper Mills	1,130	1	19.7
AD-37-35-601	Southland Paper Mills	1,080	1	15.6
AD-37-35-602	Southland Paper Mills	1,200	24	17.0
TX-37-35-603	Southland Paper Mills	608	1	20.3
AD-37-35-605	Southland Paper Mills	1,200	24	16.8
AD-37-35-701	City of Lufkin No. 5	900		9.7
AD-37-35-703	City of Lufkin No. 7	1,000	4	10.1
AD-37-35-705	City of Lufkin No. 3	996		14.2
AD-37-35-708	City of Lufkin No. 8	1,040	1/2	14.4
AD-37-35-709	Redland Water Supply Corp.	130	1/2	6.2
TX-37-36-102	Southland Paper Mills	920	1/2	7.6
AD-37-42-304	Woodlawn Water Supply Corp.	143		7.1
		WILCOX GROUP		
TX-37-10-403	City of Cushing No. 2	104		1.0
TX-37-11-901	Caro Water Supply Corp.	85	1	1.6
TX-37-13-401	City of Garrison No. 1	110		1.0
TX-37-13-402	City of Garrison No. 2	100	1/2	1.0
TX-37-13-404	City of Garrison No. 3	195	1/2	3.6
TX-37-20-103	Appleby Water Supply Corp.	100	1/2	2.0

1/ Where no effective time is given, the exact time is unknown and may range from a few minutes to one day.
2/ Well also screens part of Wilcox Group.

Table 4.--Results of Pumping Tests in Angelina and Nacogdoches Counties

Pumped Well	Observation Well	Pumping Rate (gpm)	Length of Test	Alignment of Data	Sand Thickness at Pumped Well	Coefficient of Transmissibility (gpd/ft)	Coefficient of Storage	Field Coefficient of Permeability[1/] (gpd/ft^2)
				YEGUA FORMATION				
AD-37-43-503		90	2 hours	Good	80	6,000		75
AD-37-44-801		200	4 hours	Good	100[2/]	4,000		40
AD-37-50-303		95	1 hour	Fair	40[2/]	3,000		75
AD-37-50-603		720	2 hours	Fair	100[2/]	16,000[3/]		160
AD-37-50-605		225	1/2 hour	Fair	70[2/]	2,600		37
AD-37-50-606		310	1/2 hour	Fair	60	8,600		143
AD-37-50-901		400	3 hours	Fair	100	10,000		100
AD-37-51-202		170	1 hour	Good	30[2/]	3,500		117
AD-37-51-504		60	2 hours	Good	40	4,800		120
				SPARTA SAND				
TX-37-35-104	TX-37-35-105	200	1 day		92[2/]	44,700	0.00038	486
TX-37-35-104	TX-37-35-105	300	6 days		92[2/]	58,100	.00047	632
TX-37-35-204		75	2 days		85[2/]	2,200		26
TX-37-35-204	TX-37-35-205	75	2 days		85[2/]	4,200	.00026	49
TX-37-35-207			1 day		45[2/]	1,000		22
TX-37-35-207	TX-37-35-203		1 day		45[2/]	1,000		22
TX-37-35-308		300	3 days	Fair	60[2/]	8,800		147
TX-37-36-107		125	6 days		35[2/]	11,000		314
TX-37-36-107	TX-37-36-108	125	6 days		35[2/]	11,000	.00017	314
				CARRIZO SAND				
TX-37-27-201		768	4 hours	Good	80	14,100		176
TX-37-27-201		790	2 hours	Good	80	15,200		190
TX-37-27-303		755	2 hours	Good	100	17,500		175
TX-37-27-304[4/]		910	2 hours	Good	90	19,700		219
TX-37-27-304[4/]	TX-37-27-201	980	14 hours	Good	90	17,800	.00007	197
TX-37-27-504		655	2 days	Good	80	7,900		99
TX-37-27-505[4/]		705	2 days	Good	110	12,800		116
TX-37-27-506[4/]		752	2 days	Good	95	17,000		179
TX-37-27-802		805	1 day	Fair	135	38,000		282
TX-37-30-701		70	2 hours	Fair	50	500		
AD-37-34-902		1,230	4 hours	Fair	120	29,000		264
TX-37-35-302	TX-37-35-301	1,400	12 hours		120	33,100	.00016	276
TX-37-35-302	TX-37-35-301	1,400	3 days	Good	120	35,600	.00013	296
TX-37-35-302	TX-37-35-303[4/]	1,400	12 hours	Good	120	25,300	.00013	210
TX-37-35-302	TX-37-35-310[4/]	1,400	12 hours	Good	120	23,200	.00013	193
TX-37-35-303[4/]	TX-37-35-301	1,400	12 hours	Good	130	30,400	.00014	234
TX-37-35-303[4/]	TX-37-35-310[4/]	1,400	12 hours	Good	130	25,100	.00013	193
AD-37-35-401 and AD-37-35-502 and AD-37-35-503 and AD-37-35-601	AD-37-35-504 and AD-37-35-506		6 days			32,300		

For footnotes see end of table.

Table 4.--Results of Pumping Tests in Angelina and Nacogdoches Counties--Continued

Pumped Well	Observation Well	Pumping Rate (gpm)	Length of Test	Alignment of Data	Sand Thickness at Pumped Well	Coefficient of Transmissibility (gpd/ft)	Coefficient of Storage	Field Coefficient of Permeability [1] (gpd/ft^2)
			CARRIZO SAND (Continued)					
AD-37-35-401 and AD-37-35-503 and AD-37-35-504	AD-37-35-502 and AD-37-35-506		14 days			31,800		
AD-37-35-401 and AD-37-35-503 and AD-37-35-504	AD-37-35-501 and AD-37-35-601		14 days			32,300		
AD-37-35-401 and AD-37-35-503 and AD-37-35-504	AD-37-35-502 and AD-37-35-601		14 days 14 days			32,600 32,600		
AD-37-35-402		1,200	2 days	Good	100	26,200		262
AD-37-35-403		1,200	2 days	Good	140	32,000		228
AD-37-35-502			2 days		130	33,400		256
AD-37-35-502	AD-37-35-503		5 days		130	31,400	0.00014	242
AD-37-35-502	AD-37-35-506		5 days		130	32,200	.00016	248
AD-37-35-502	AD-37-35-503 and AD-37-35-506		5 days		130	36,000		277
AD-37-35-503			2 days		130	32,800		252
AD-37-35-503	AD-37-35-502		2 days		130	34,100	.00015	262
AD-37-35-503	AD-37-35-504		4 days		130	32,600	.00014	250
AD-37-35-503	AD-37-35-506		4 days		130	33,500	.00014	258
AD-37-35-503	AD-37-35-504 and AD-37-35-506		4 days		130	35,400		272
AD-37-35-504			3 days		130	31,200		240
AD-37-35-504	AD-37-35-503		3 days		130	30,800	.00012	237
AD-37-35-504	AD-37-35-506		3 days		130	30,600	.00012	235
AD-37-35-504	AD-37-35-503 and AD-37-35-506		3 days		130	31,500		242
AD-37-35-505		1,200	2 days	Good	80	22,200		278
AD-37-35-505	AD-37-35-602	1,200	2 days	Good	80	26,900	.00014	336
AD-37-35-602		1,200	2 days	Good	100	28,000		280
AD-37-35-602	AD-37-35-605	1,200	2 days	Good	100	30,600	.00013	306
TX-37-35-603 [4]	TX-37-35-310 [4]	1,500	12 hours	Good	180	36,800	.00027	204
AD-37-35-605		1,200	2 days	Good	100	28,000		280
AD-37-35-703		1,000	4 hours	Good	120	26,800		220
AD-37-36-403		75	2 hours	Good	60	17,800		297
			WILCOX GROUP					
TX-37-10-403		110	2 hours	Good	55	1,100		20
TX-37-11-901		85	2 hours	Good	50	2,500		50
TX-37-13-402		123	2 hours	Good	30	1,100		37
TX-37-13-402	TX-37-13-401	123	2 hours	Good	30	1,100	.00068	37
TX-37-13-404		180	2 hours	Good	58 [2]	5,800		100
TX-37-20-103		100	1/2 hour	Fair	80 [2]	2,400		30

1/ Based on sand thickness, or length of screen if sand thickness not available.
2/ Length of screen.
3/ Average of two or more tests.
4/ Well also screens part of the Wilcox Group.

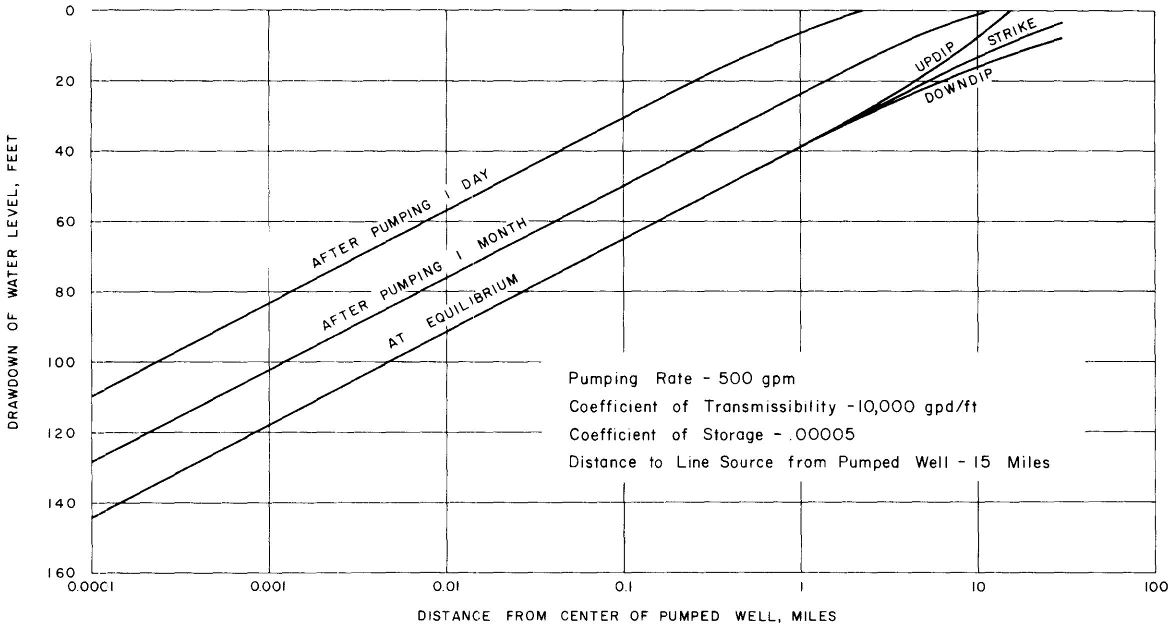


Figure 13.—Computed Drawdown of Water Levels Caused by Pumping

Drawdowns are shown on Figure 13 for distances from the center of the pumped well ranging from 0.0001 mile to 30 miles. The distance of 0.0001 mile is approximately one-half foot, representing the radius of a well about 12 inches in diameter. The drawdown shown at this distance is the theoretical drawdown in a 100 percent efficient well of that diameter.

For an aquifer such as the Carrizo Sand, which is rather uniform in thickness and character, the average coefficient of transmissibility determined from pumping tests can be applied directly in determining the cone of depression resulting from pumping a well. On the other hand, for an aquifer such as the Yegua Formation, in which the sands are lenticular and represent only a small protion of the formation as a whole, the many boundaries to the sands created by their lenticular nature must be taken into consideration in using the average coefficient of transmissibility with the nonequilibrium formula to predict drawdowns of water levels. The coefficient of transmissibility as determined from a pumping test normally represents only a short period of time during which the cone of depression extends from the well tested for no more than a few thousand feet. If the cone of depression later grows through additional, more confining boundaries, the effective coefficient of transmissibility then becomes smaller. The indications for the Yegua are that this does occur, and on that basis it is roughly estimated that the regional effective transmissibility of the Yegua is only about one-half that which may be computed by taking the average coefficient of permeability determined from pumping tests and multiplying it by the average thickness of sand in the formation.

Carrizo Sand

Because of the large changes in pumping which have occurred in the Carrizo Sand and because a large number of measurements have been made of water levels in observation wells during the period of these changes, it has been possible to measure the growth and extent of the cone of depression which has occurred in the Carrizo Sand over the past 30 years. Table 5 lists drawdowns which occurred between various dates in a number of Carrizo wells throughout the area. The table also lists computed drawdowns for the same periods of time. The assumptions on which the computations were made are given in the table. No water-bearing formation is perfectly uniform in character as required in the assumptions for the computations, and the Carrizo is no exception. It may be noted, however, that the computed drawdowns are reasonably consistent with the measured drawdowns and give faith in the use of similar computations to compute future changes in water levels that will result from additional changes in pumping from the aquifer.

For the most part, the computations given in Table 5 were made using a coefficient of transmissibility of 22,900 gallons per day per foot. The selection of this coefficient of transmissibility was originally determined by using a higher coefficient to compute drawdowns for comparison with actual drawdowns and then adjusting the coefficient downward so that the computed and actual drawdowns would more closely match, on an average, throughout the area. One of the reasons why the effective coefficient of transmissibility for the Carrizo is less than that determined from most of the

Table 5.--Actual and Computed Declines of Water Levels in Carrizo Wells in Angelina and Nacogdoches Counties [1]

Well	Period	Actual Decline (feet)	Computed Decline (feet)	Period	Actual Decline (feet)	Computed Decline (feet)	Period	Actual Decline (feet)	Computed Decline (feet)	Totals Actual Decline (feet)	Totals Computed Decline (feet)
TX-37-17-303	10-39 7-55	196	247	7-55 7-57	70	68				266	315
TX-37-19-902	1-44 8-55	78	77							78	77
TX-37-25-301	4-40 7-55	70	88				7-55 6-69	57	63	127	151
TX-37-27-301[2]							1-39 12-63	204	223	204	223
TX-37-27-504[2]							5-64 4-68	22	34	22	34
TX-37-27-505[2]							8-64 4-68	52	51	52	51
TX-37-27-506[2]							10-64 4-68	162[3]	160	162[3]	160
AD-37-34-201	1-48 7-55	64	50				7-55 6-69	132	150	196	200
TX-37-35-202	8-41 7-55	200	209	7-55 7-57	56	69				256	278
TX-37-35-303	3-48 2-55	244[3]	210	2-55 9-57	26	26	9-57 6-69	94	74	364[3]	310
TX-37-35-310	8-47 6-55	175	152	6-55 9-57	43	48				218	200
AD-37-35-401	10-39 6-55	352[3]	387	6-55 9-57	86	119	9-57 6-69	75	100	513[3]	606
AD-37-35-502	8-39 6-55	350[3]	388	6-55 9-57	112	122	9-57 6-69	60	86	522[3]	596
AD-37-35-503	9-39 6-55	357[3]	393	6-55 9-57	86	113	9-57 6-69	63	90	506[3]	596
AD-37-35-506	12-39 7-55	305	347	7-55 9-57	102	118	9-57 6-69	69	101	476	566
AD-37-35-601	8-39 6-55	363[3]	387	6-55 9-57	111	127	9-57 6-69	65	92	539[3]	616
TX-37-35-603	12-47 6-55	220[3]	198	6-55 9-57	24	30	9-57 6-69	93	97	337[3]	325
TX-37-36-202	10-41 7-55	146	142	7-55 7-57	34	38	7-57 6-69	69	61	249	241
TX-37-36-301	4-37 7-55	112	153				7-55 6-69	78	71	190	224
AD-37-36-403				8-55 7-57	50	53	7-57 6-69	80	69	130	122
AD-37-36-501				7-55 7-57	40	46	7-57 6-69	70	65	110	111

1/ Computed declines based on Theis nonequilibrium formula. Line source of infinite length assumed to exist along northern side of Carrizo outcrop. T=22,900 gpd/ft and S=0.0001 unless otherwise noted.

2/ T of 18,000 gpd/ft and S of 0.00007 used for computing that part of decline caused by Nacogdoches wells.

3/ Decline represents difference between initial static and subsequent pumping level.

pumping tests is that the sand is thinner to the east and less transmissive. Another reason is that the computations have been made in part based on a line source of infinite length along the outcrop, whereas actually the continuity of the outcrop is terminated to the northwest, near the northwestern corner of Nacogdoches County, by a series of faults. The termination of the outcrop causes the acutal drawdown to be somewhat greater than it would be if the line source were continuous as assumed in the computations.

POSSIBLE BRACKISH WATER ENCROACHMENT

Because the original slope of the piezometric surface from the outcrop down the dip of an aquifer in this area is very gentle and because the cone of depression caused by heavy pumping extends over a wide distance and is relatively deep, the cone of depression may cause brackish water to move toward a well field from downdip. Although under equilibrium conditions all the flow lines to the area of pumping originate in the outcrop, they do not all go straight to the wells, because of the radial nature of the flow to the wells. Instead, some of the flow lines pass by on each side of the area of pumping and then turn and come back to the wells from the downdip direction. Thus, if the cone of depression has extended into the brackish water portion of the aquifer to such an extent that the slope of the piezometric surface is actually toward the wells from within that portion of the aquifer, some of these flow lines pass from the outcrop into the brackish water and then turn and come toward the area of pumping. This causes some of the brackish water to move toward the wells. This situation, of course, is most severe when the pumping is very heavy and is located very close to the brackish water. Under such conditions, brackish water may be brought into the wells in sufficient quantity to substantially change the mineralization of the water pumped from the wells.

There is no question that the cone of depression in the piezometric surface of the Carrizo Sand is causing some brackish water to move toward the Lufkin and Southland Paper Mills well fields. Although no indication has yet been shown from chemical analyses that the mineralization of the water is increasing in any of the wells, it is possible that in time there will be a noticeable increase. It should be expected that the first increases will occur in those wells belonging to Lufkin which are closest to brackish water.

The mineralization of the water from the wells cannot change greatly, however, until the water between the wells and the highly mineralized water is pumped out. In the Lufkin area the amount of water in storage in the Carrizo Sand in one square mile is probably on the order of 12,000 to 25,000 acre-feet, which is equal to pumpage for a year at a rate of about 11 to 22 million gallons per day. Considering the fact that water moves radially to the center of pumping from all directions, it will take many years for water in the Carrizo to move to the well fields from great distances. Thus, any change in mineralization should be slow and occur over a long period of time; and if periodic observations of quality of water are made, there should be ample opportunity to relocate wells or develop a supplemental supply if the mineralization of the water becomes too great.

At present, pumpage from the Wilcox and Sparta sands is so small that there is no likelihood of brackish water moving into existing fresh-water wells unless the wells are already right on the edge of the brackish water. There is more likelihood that some of the existing Yegua wells will eventually show an increase in mineralization. This is especially true of the wells at Diboll, where the large wells already produce water with more than 1,000 parts per million dissolved solids. Also, because of the interbedded character of the fresh and brackish water sands in the Yegua Formation, there may be some movement of brackish water from a brackish-water sand into an overlying or underlying fresh-water sand.

AVAILABILITY OF GROUND WATER

As stated earlier in this report, some fresh ground water is available from every formation outcropping in Angelina and Nacogdoches Counties except the Catahoula Formation. Only four formations or groups of formations, however, are capable of producing large quantities. These are the Wilcox Group, Carrizo Sand, Sparta Sand, and Yegua Formation. Of the remaining formations, the Reklaw Formation and the Queen City Sand are each slightly better than the Weches Formation, the Cook Mountain Formation, the Jackson Group, or the alluvium, but all are weak producers and should be considered only for small water supplies.

The basal Reklaw sands are hydraulically connected to the Carrizo in many places and should not be considered as a source of ground water separate from the Carrizo. Wells of small to moderate yield might be obtained in some places in the basal Reklaw, however, if there were reasons to make such wells in this sand instead of in the Carrizo. With the exception of this formation, none of the "weak-producing" formations should be expected to yield more than 50 to 100 gallons per minute to a well at any place, and even this is too much to expect in most places from the Queen City and Jackson, and certainly from the Weches and Cook Mountain Formations and the alluvium.

From the standpoint of availability of a ground-water supply, it should be pointed out that wherever the Reklaw, Queen City, and Weches contain fresh water, the sands of the Wilcox Group, Carrizo Sand, and/or Sparta Sand also exist and provide a much better source of fresh ground water. Similarly, nearly everywhere that the Cook Mountain Formation contains fresh water, the Sparta and/or Carrizo also contain fresh water.

In the southern part of Angelina County, the Jackson Group and the alluvium (where it exists) are the only units which stand a chance of producing fresh ground-water supplies, and many users have had difficulty in developing even a domestic supply. In this area the availability of ground water is very limited, and the development of large supplies of ground water should not be attempted.

The following sections of the report present information on yields and the more favorable areas for development from the Wilcox, Carrizo, Sparta, and Yegua aquifers. Only water containing less than 1,000 parts per million dissolved solids is considered.

Yields of Individual Wells

In estimating yields of wells, it is necessary to establish criteria with respect to well construction and drawdown of water level. For the following discussion on maximum individual well yields, it is assumed that the screens in the wells will be at least 8 inches in diameter and of sufficient diameter so that there will be very little head loss due to turbulent flow in the wells. It is further assumed that all the sands in the producing sections will be screened and that the wells will be constructed and developed in such a manner that they are essentially 100 percent efficient. In other words, it is assumed that there will be no extra drawdown in the wells due to restriction of water movement through the faces of the wells. Finally, it is assumed that the drawdown in a well due to its own pumping is approximately 100 feet in the first day of pumping, provided this does not draw the pumping level below the top of the producing section of the aquifer. In cases where less than 100 feet of available drawdown exists to the top of the producing section, some provision has been made for partial dewatering of the formation, and also the 1-day drawdowns have been reduced to less than 100 feet as necessary.

Wilcox Group

Figure 14 shows the estimated maximum yields of individual wells producing fresh water from sands of the Wilcox Group. In addition to the assumptions described above, it is assumed with respect to the Wilcox wells that no more than 400 feet of thickness of the Wilcox will be included in the developed portion of any Wilcox well. In other words, it is assumed that the distance between the top of the top screen and the bottom of the bottom screen will be no more than 400 feet. Within this limitation, it is assumed that the well will be screened in that portion of the Wilcox having the greatest amount of sand which produces fresh water, provided there is at least 100 feet of available drawdown to the top of the producing section.

The principal reason for the relatively low estimates of maximum well yields from the Wilcox, no greater than 500 gallons per minute anywhere in the area, is the low permeability of the Wilcox sands. In making the estimates, an average permeability of 50 gallons per day per square foot is used.

Carrizo Sand

Estimated maximum yields of individual wells are shown for the Carrizo Sand on Figure 15. They range from zero to 1,500 gallons per minute. The data upon which this map is based are more complete than for other aquifers studied, and include well records, pumping tests made in different parts of the area, and thicknesses obtained from electric logs.

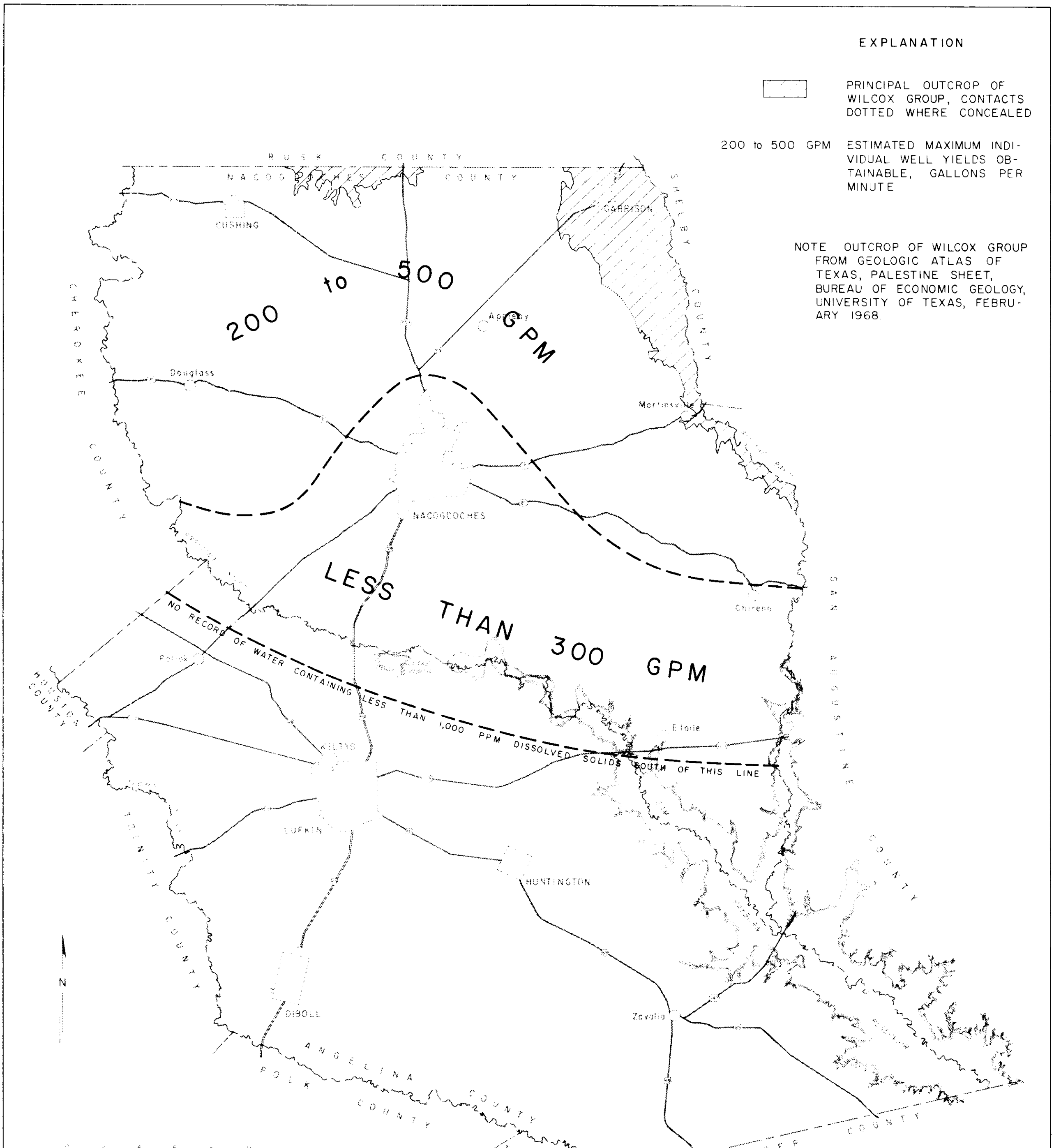
To obtain the largest yields will require gravel-walled wells with screens of at least 10 inches in diameter and preferably 12 or 14 inches. Generally the estimated maximum yields increase from northeast (near the outcrop) to the southwest. One small area just east of Southland Paper Mills' Old Well Field is shown with an estimated maximum well yield of less than 500 gallons per minute. Test drilling in this area by Southland Paper Mills showed a very thin section of Carrizo, in the range of 20 to 60 feet.

Sparta Sand

Estimated maximum yields of individual wells are shown for the Sparta Sand on Figure 16, and range from zero to 500 gallons per minute. The estimates assume an approximate effective transmissibility range of 4,000 to 10,000 gallons per day per foot for the full thickness of the Sparta. This appears reasonable in view of the wide range in transmissibility and permeability determined from the pumping tests made of Sparta wells. It discounts the greatest transmissibility determined from the pumping tests, 58,100 gallons per day per foot. That test was made on shallow wells with semi-artesian conditions, which could readily result in an apparent transmissibility that is too high, and it does not appear likely that the actual transmissibility of the Sparta Sand can be anywhere near this large at more than isolated sites.

Yegua Formation

Figure 17 shows estimated maximum yields of individual wells for the Yegua Formation. These range from zero to 500 gallons per minute. Generally they become greater from north to south until the northern edge of the zone within which the water begins to change from fresh to brackish is reached. In that zone the estimated yields then decrease to zero, inasmuch as no water is considered in these estimates which contains more than 1,000 parts per million dissolved solids.



Base from Texas State Highway Department county maps

Figure 14

ESTIMATED MAXIMUM INDIVIDUAL WELL YIELDS — WILCOX GROUP

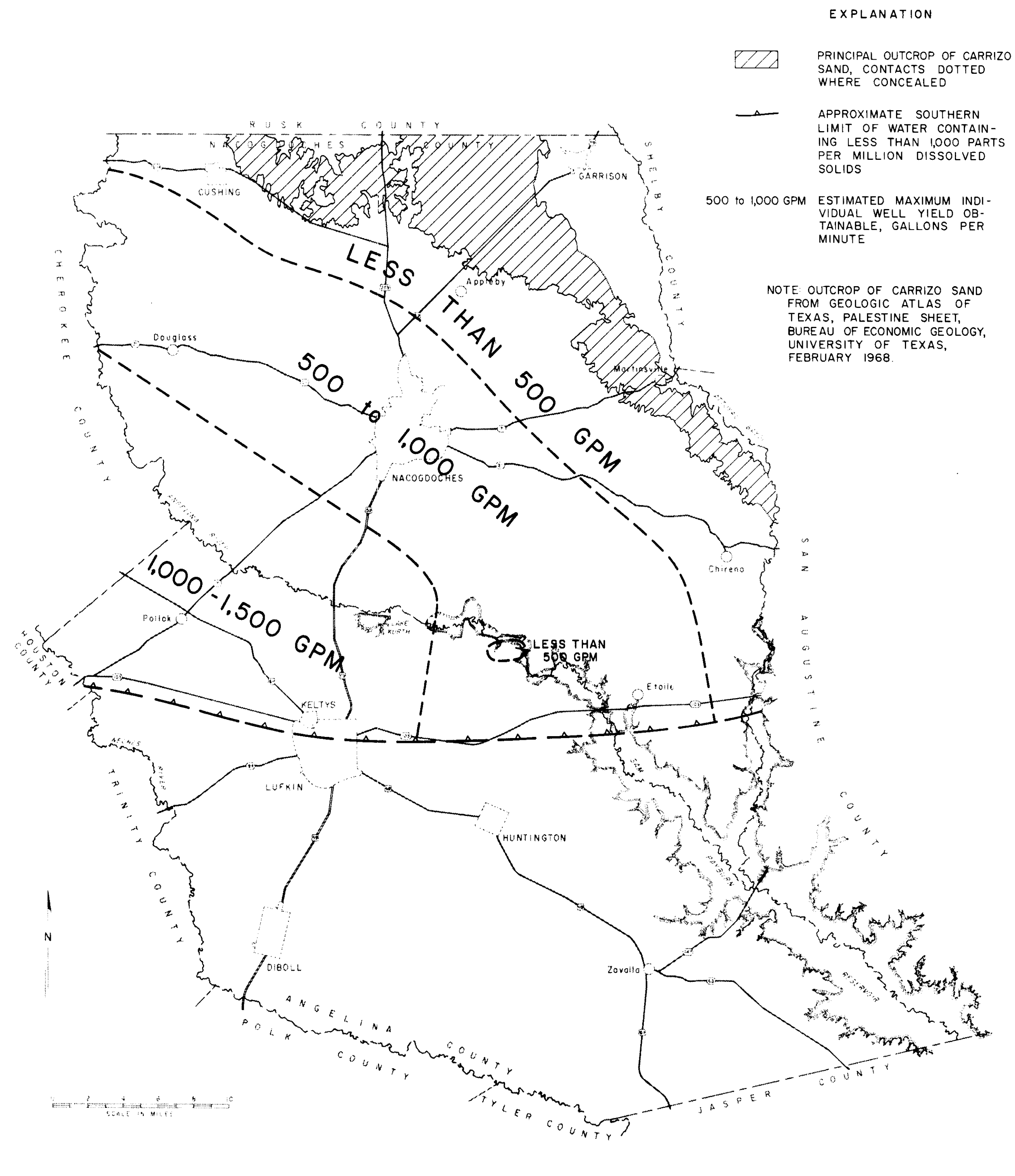


Figure 15

ESTIMATED MAXIMUM INDIVIDUAL WELL YIELDS — CARRIZO SAND

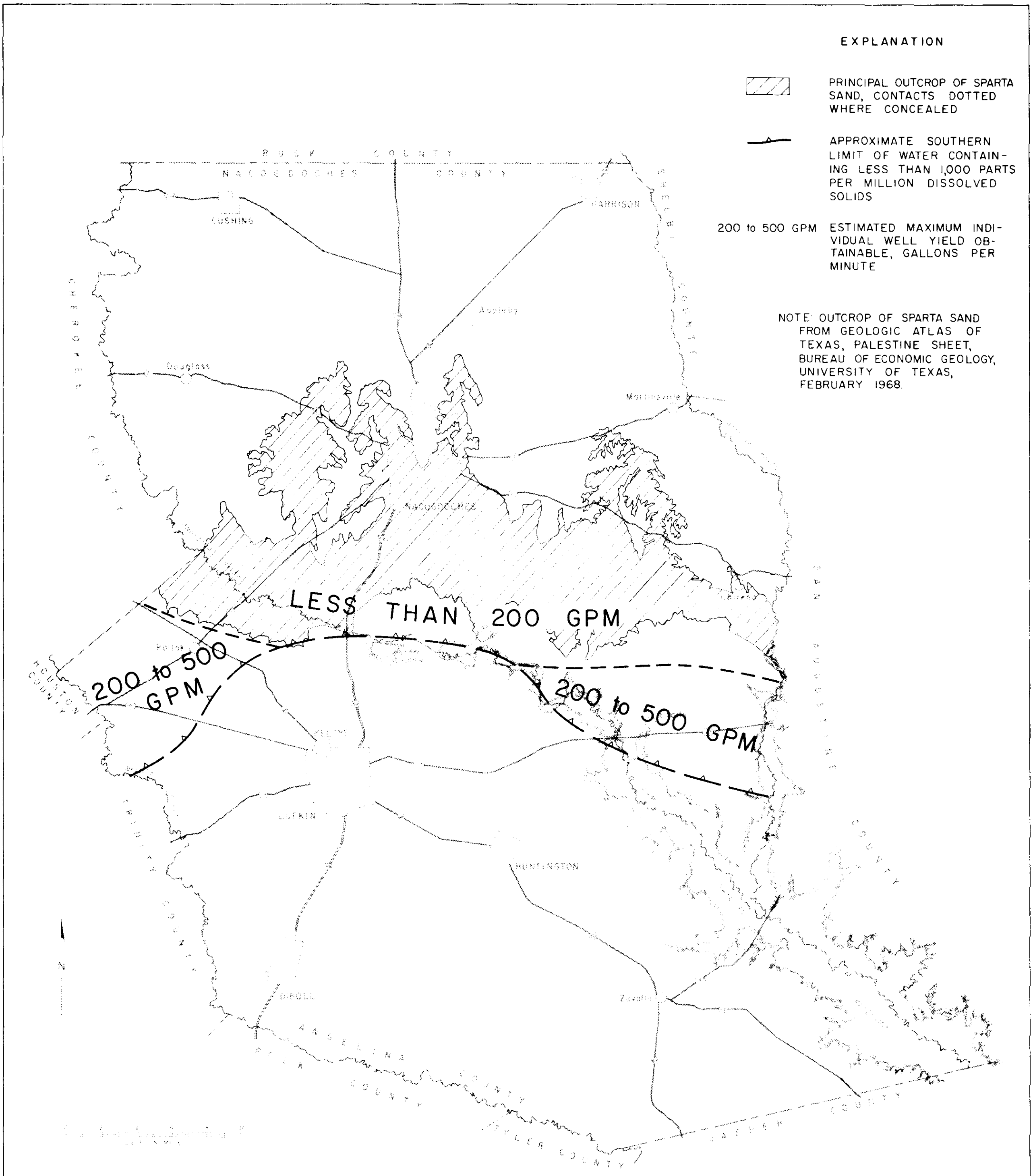


Figure 16

ESTIMATED MAXIMUM INDIVIDUAL WELL YIELDS — SPARTA SAND

Base from Texas State Highway Department county maps

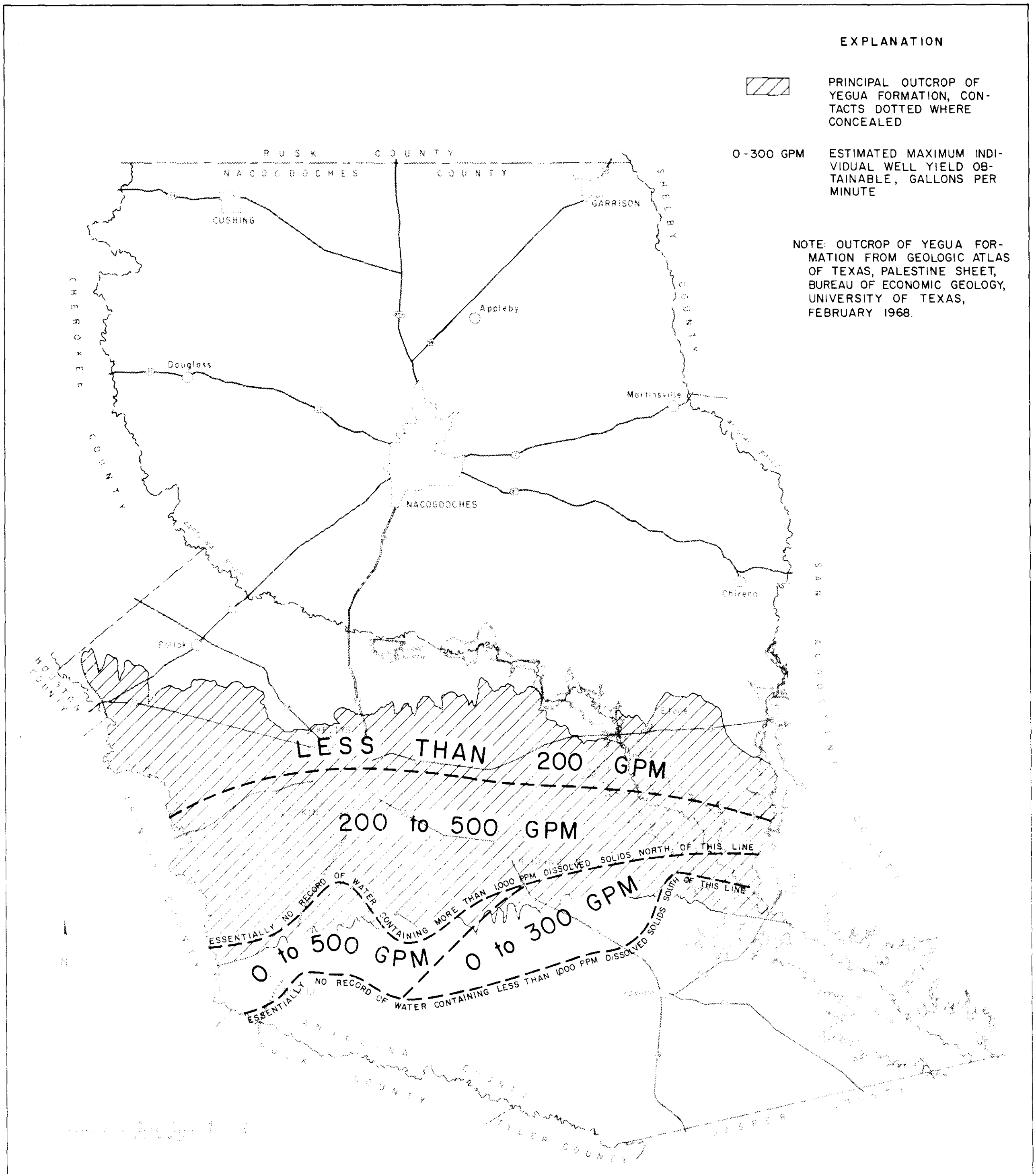


Figure 17

ESTIMATED MAXIMUM INDIVIDUAL WELL YIELDS — YEGUA FORMATION

Base from Texas State Highway Department county maps

For the Yegua Formation, as for the Wilcox, it is assumed that no well will develop a section of the aquifer with more than 400 feet between the top and bottom of the screened section. Because the Yegua is nearly 1,000 feet in total thickness near the southern boundary of its outcrop, this limits the estimated maximum individual well yield to less than the theoretical amount which could be obtained from the formation as a whole.

In making estimates of transmissibility of sands in the Yegua, an average permeability of 100 gallons per day per square foot as determined from pumping tests is used, together with thicknesses determined from electric logs. Two exceptionally high yields reported for actual wells are not considered. One is a reported 1,000 gallons per minute for a well 110 feet deep at Lufkin, abandoned many years ago and for which no actual records of measurement are available. Another is a reported yield of over 800 gallons per minute from a well at Diboll, which produces water containing slightly more than 1,000 parts per million dissolved solids. These yields are considered to be anomalous exceptions, and it is felt that they should not be considered in selecting ranges of values which are most likely to be found.

Individual Well-Field Yields

Additional criteria are necessary with respect to estimating maximum yields of individual well fields. First and most importantly, no allowance is made for interference effects between one well field and another. This means that these estimates of maximum yield are, for the most part, valid for only one well field in the aquifer at the present time. Each well field will create drawdown of the piezometric surface throughout much of the aquifer, and this will have an effect on the drawdown available for use by each additional field which may be installed. Futhermore, each additional field that is installed will have an effect on the first field which was developed, thus reducing the drawdown available for it and its maximum potential yield. The effects of interference between well fields are considered in succeeding sections of this report, but for this section, the purpose of which is to estimate the maximum available yield of any one well field, it is not practicable to consider such interference effects.

Next, in estimating the yield of a well field it has been necessary to assume a maximum number of wells, spacing between wells, and the desired yields of the wells. For the estimates, therefore, it has been assumed that no well field will contain more than 10 wells and that the wells in a field will generally be spaced in a line approximately one-half mile apart. Where practicable, the yields of individual wells have been selected so that about 100 feet of drawdown will be created in each well during the first day from its own pumping.

It has also been necessary to assume limits for allowable drawdown. Allowable drawdown, as used in this report, refers to the distance between the piezometric surface and either the top of the producing section in the wells or some other level considered to be a reasonable depth for pumping levels. The limits used for each aquifer are given in the following sections of the report.

Wilcox Group

Because the portion of the Wilcox Group containing fresh water sands is so thick in the northern part of Nacogdoches County, more than one well may be made at a single site, under the limitation imposed that no more than 400 feet of section will be taken into any one well. Therefore, in estimating the yield of the Wilcox Group, the Wilcox sands have been divided into separate sections. This has been done by first separating the sands considered to be hydraulically connected to the Carrizo Sand and then allocating the remainder of the fresh water Wilcox sands to one or two other sections, depending on the total remaining fresh-water thickness of Wilcox. The sands within the upper 200 feet of the Wilcox Group are assumed to be associated with the Carrizo Sand and to have a piezometric surface equivalent to that of the Carrizo. The remaining Wilcox sands are assumed to have a piezometric surface 250 feet above sea level. The allowable drawdown is assumed to be the distance between the piezometric surface and the top of the Wilcox section developed by the wells. The maximum drawdown allowed in the estimates is 500 feet. The recharge area for the upper portion of the Wilcox is considered to be along the northern edge of the Carrizo outcrop. For the remainder of the Wilcox, however, the recharge area to the north and northeast is partly shut off by the Mount Enterprise fault zone, and it is necessary in making estimates to take this into account by a system of image wells.

On the basis of these conditions and assumptions, the estimated ranges in maximum individual well-field yield are given on the map in Figure 18. For the northern portion of the area, the range is from 1.5 to 3 million gallons per day. In the eastern portion of Nacogdoches County is a locality where it is estimated that the maximum yield of a well field may range between 3 and 5 million gallons per day. For the southern portion of the area where Wilcox sands contain fresh water, the estimated maximum yield of a well field in the Wilcox is less than 1.5 million gallons per day. The estimate is lower in this locality because the fresh water section of the Wilcox is much thinner, and because much of that which exists is hydraulically connected to the Carrizo Sand for which the piezometric surface has already been drawn down a great deal, leaving less allowable drawdown than would otherwise be the case.

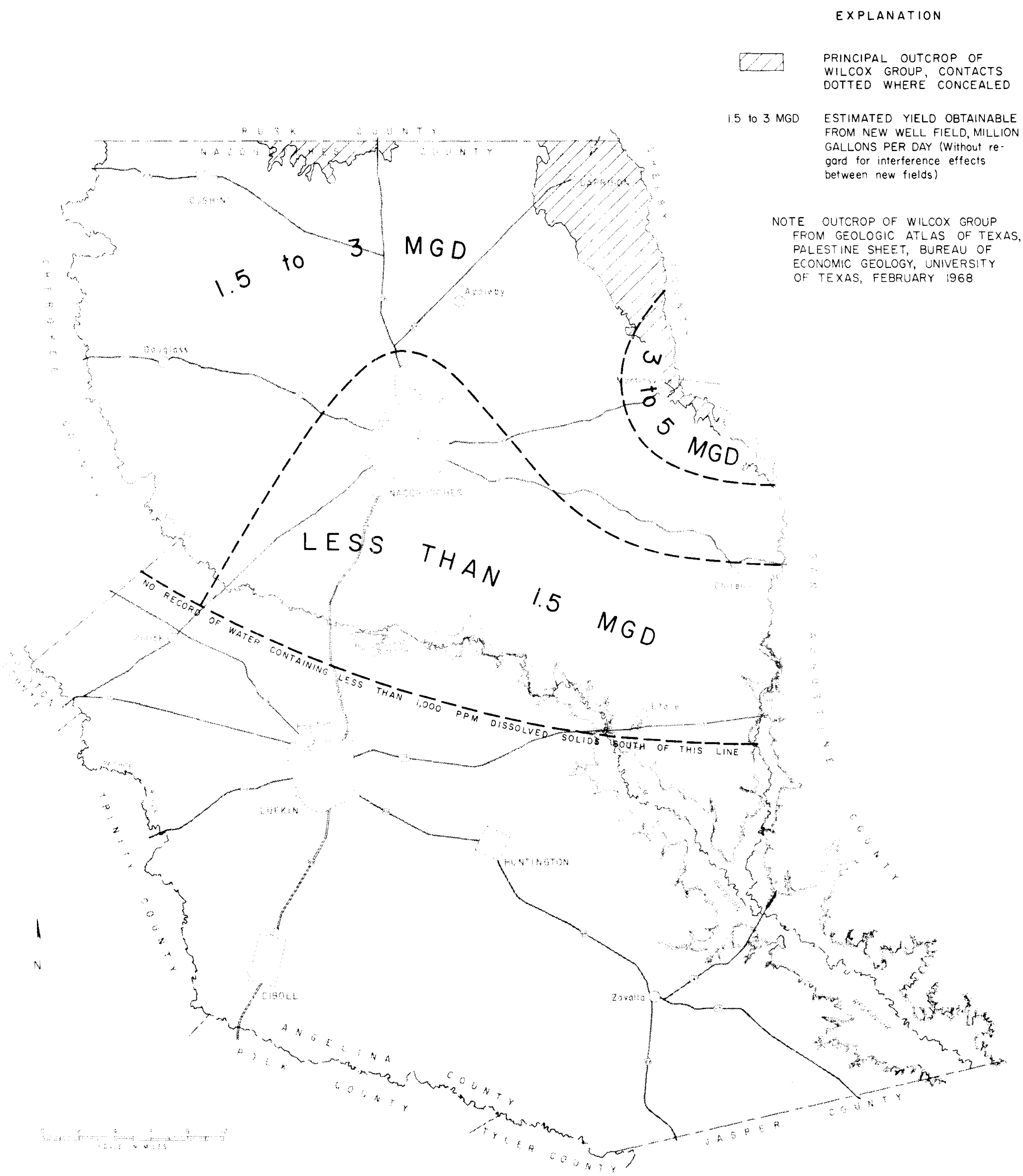


Figure 18

ESTIMATED INDIVIDUAL WELL-FIELD YIELDS — WILCOX GROUP

Base from Texas State Highway Department county maps

Carrizo Sand

The total yield of the Carrizo Sand is already nearly fully developed by pumpage from existing wells. By far the greatest portion of this pumpage comes from the well fields belonging to the cities of Lufkin and Nacogdoches and Southland Paper Mills. No large new well field can be developed in the Carrizo Sand without adversely and seriously affecting one or more of these existing fields. Yet, in order to make an estimate of the physical possibility of the yield from a new well field, Figure 19 has been prepared. This map shows the estimated maximum individual well-field yield which can be developed from the Carrizo without regard for its effects on the other fields. First, the map shows the 1968 average pumpage from each of the four principal existing fields and the estimated maximum yield which can be obtained from each of those fields without regard to the effects on other fields. Second, the map shows areas in which an additional new field might be placed and the estimated maximum yield of such an individual field without regard for its effect on any existing field or on any other new field.

Because the Carrizo aquifer is so fully developed already, a greater allowable drawdown is assumed in these estimates than for other aquifers. For this aquifer, which had an original piezometric surface slightly more than 250 feet above sea level in the vicinity of the Lufkin and Southland Paper Mills well fields, it is assumed that the pumping levels in wells can be drawn down to the top of the formation or to 400 feet below sea level, whichever is shallower, except in the Southland Paper Mills Poe Field. In that field, elevations of the tops of the liners in the wells are about 310 feet below sea level and the pumps cannot be lowered into the liners. The tops of the liners are used as the limiting depths of pumping levels. In the Nacogdoches Field all the wells are constructed and/or the pumps sized in such a manner that the pumps can be lowered to the top of the Carrizo sand. In the Southland Paper Mills Old Field and the Lufkin Field the tops of the liners are all at or below 400 feet below sea level.

The estimates of yield take into consideration the range in transmissibilities which is considered to exist in the Carrizo over the area. They also take into consideration the actual pumpage-drawdown experience over the past 30 years.

Sparta Sand

Figure 20 shows the estimated maximum individual well-field yields for the Sparta Sand. As with the other aquifers, these estimates are made for a single field without regard for interference effects between fields. The estimates range from less than 1 million gallons per day to 4 million gallons per day. The estimates are based on an allowable drawdown amounting to the distance between the present piezometric surface and the top of the Sparta Sand, up to a maximum of 500 feet.

The greatest well-field yields can be obtained in the Sparta in the western and eastern portions of that area underlain by fresh water-bearing Sparta sands. In the northern and central portion of the area, essentially comprised of the outcrop, the estimates are considerably less, partly because the allowable drawdown is less and partly because the saturated thickness of the formation becomes less going northward in the outcrop. For a well field made in the outcrop, it has been assumed that no more than 3 square miles of recharge area is available to any one field, with no more than 6 inches of salvageable rejected recharge.

Yegua Formation

Figure 21 shows the estimated maximum individual well-field yield for a new field in the Yegua Formation. The estimated yield ranges from zero to 3 million gallons per day. The estimate is somewhat lower in the southern portion of the area than it would be if development of the Yegua had not already taken place in the vicinity of Diboll.

The assumed deepest allowable pumping level is the top of the producing section of the Yegua or 500 feet below the original piezometric surface, whichever is shallower. As in the case of all of the other formations, these estimates are made without considering the effects of the new field on either the existing wells in the Yegua or on any new field, and vice versa.

In making the estimates of well-field yield in the Yegua, an allowance has been made for the effects of boundaries on the individual sands in the Yegua, which tend to reduce the effective regional transmissibility of the Yegua to an amount below that computed from the actual sand thickness times the average permeability coefficient of 100 gallons per day per square foot as determined from pumping tests. Because of these boundaries, estimated maximum well-field yields are generally about two-thirds to three-fourths of those that might otherwise be calculated.

Total Availability of Ground Water Within Angelina and Nacogdoches Counties

More important and more realistic than the preceding estimates of maximum yields of individual well fields are estimates of total availability of water from each of the principal aquifers within the two counties. A summary of these estimates is given in Table 6. The assumptions on which the estimates are based are listed in the table.

Estimates of the total availability of water from existing well fields and/or new well fields of moderate size are made on the basis of locating the new fields at reasonable distances apart in the most favorable areas

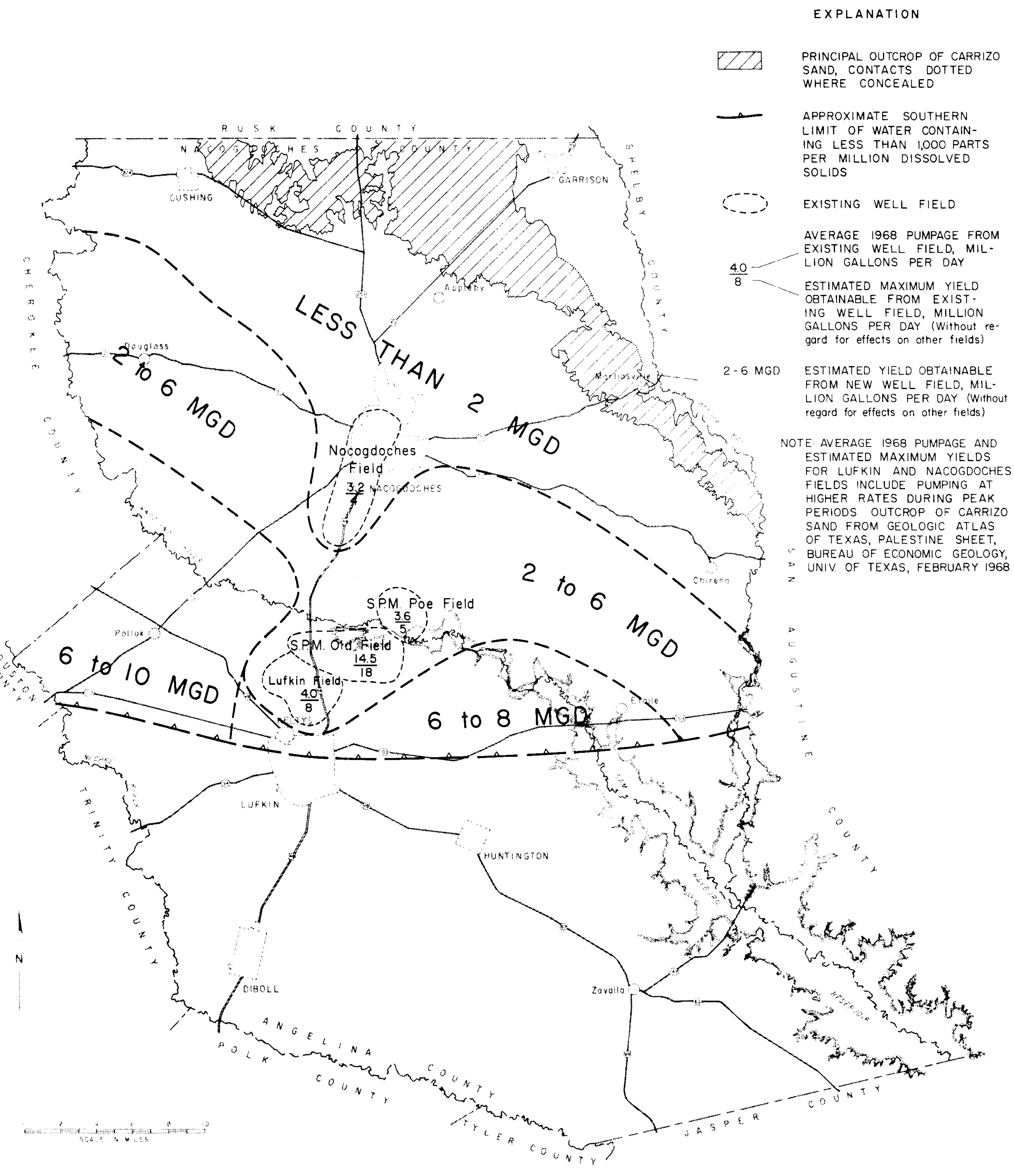


Figure 19

ESTIMATED INDIVIDUAL WELL-FIELD YIELDS — CARRIZO SAND

Base from Texas State Highway Department county maps

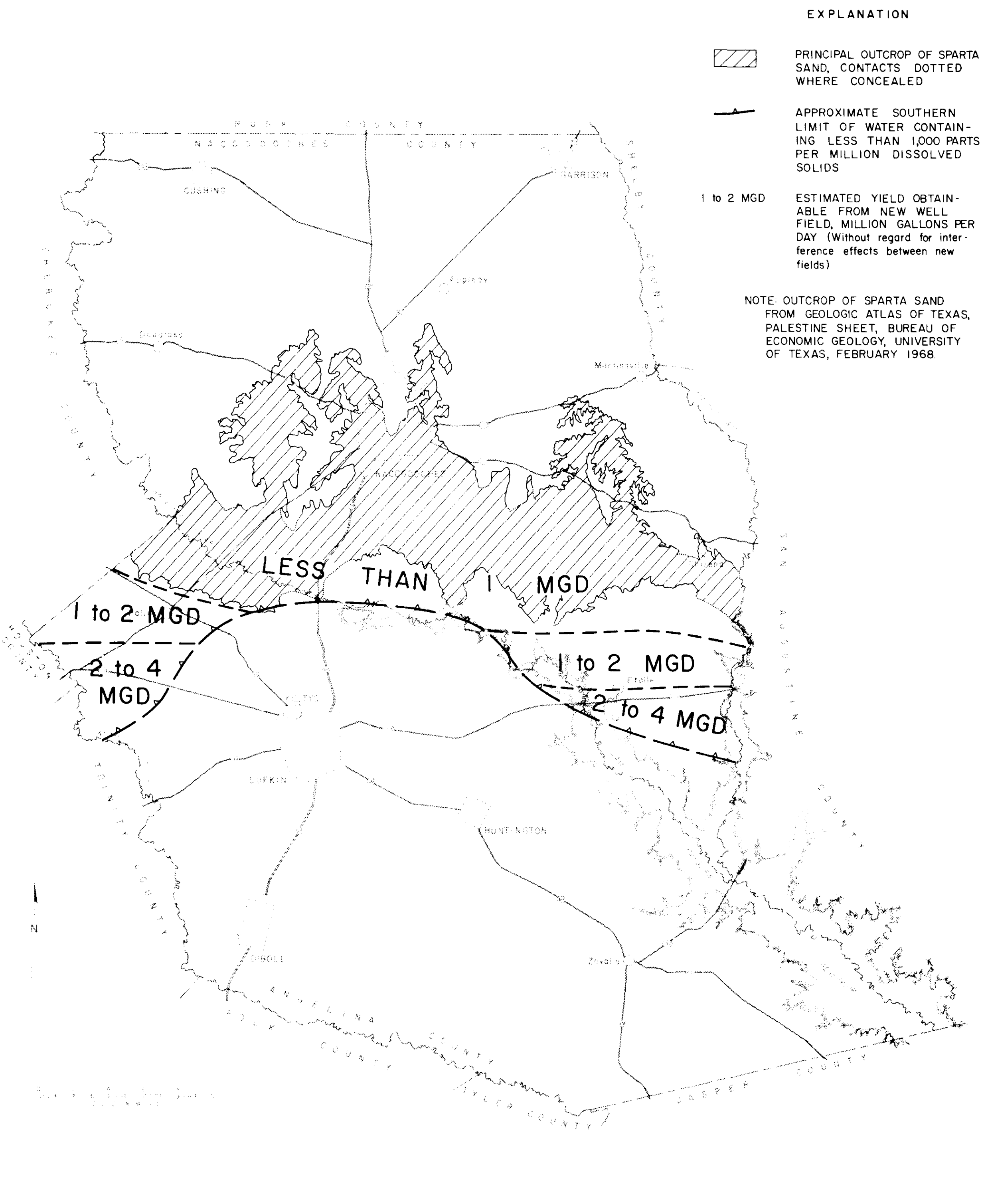
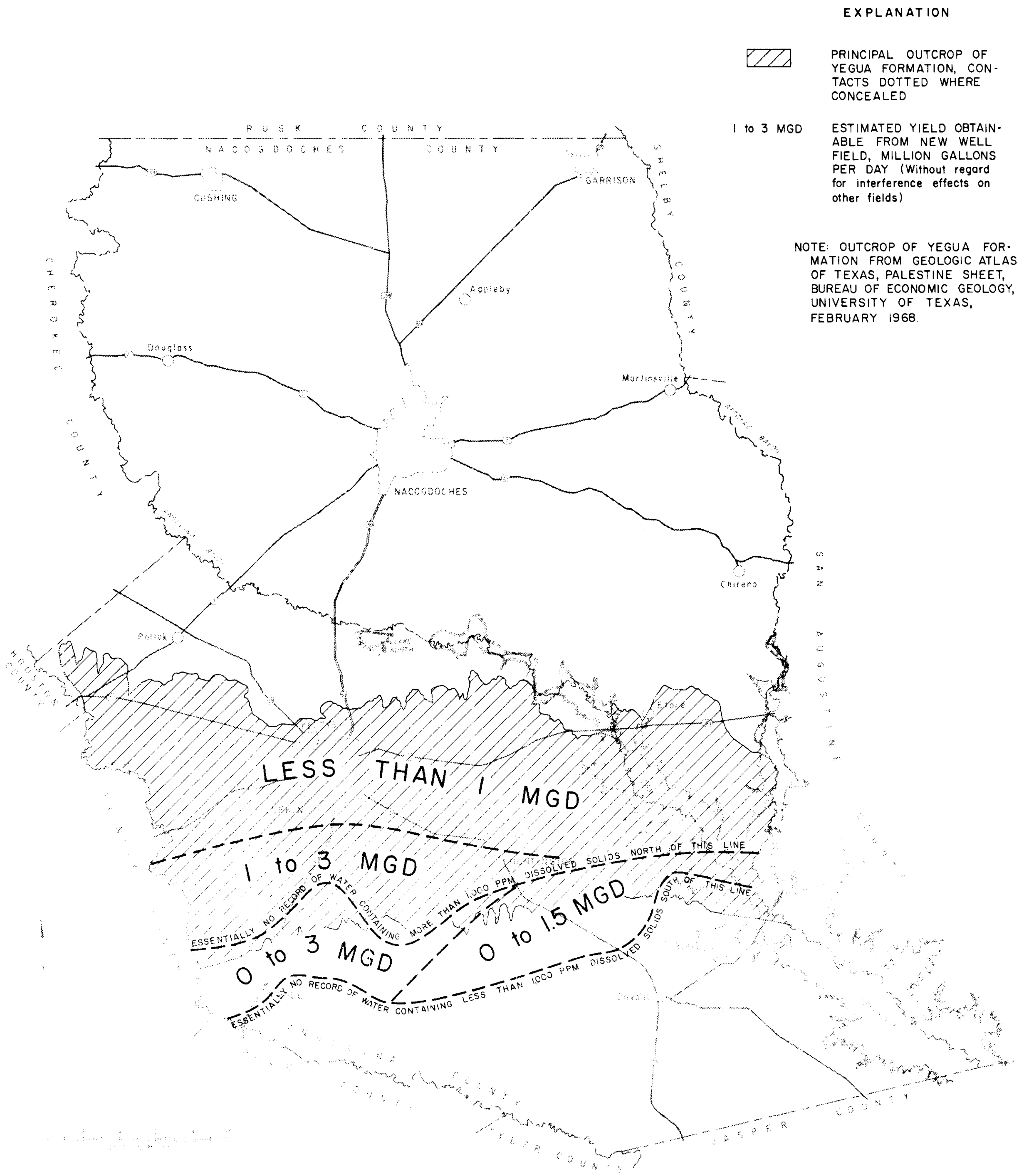


Figure 20

ESTIMATED INDIVIDUAL WELL-FIELD YIELDS — SPARTA SAND

Base from Texas State Highway Department county maps



Base from Texas State Highway Department county maps

Figure 21

ESTIMATED INDIVIDUAL WELL-FIELD YIELDS — YEGUA FORMATION

Table 6.--Estimated Total Amount of Ground Water Available in Angelina and Nacogdoches Counties

Aquifer	1968 Pumpage (million gallons per day)	Supply Available under Practical Conditions, but with No Increase in Pumpage Outside These Counties 1/ (million gallons per day)	Supply Available with Ideally Located Well Fields, with No Increase in Pumpage Outside These Counties 2/ (million gallons per day)	Supply Available from Maximum Possible Number of Wells, with Full Development Outside These Counties 3/ (million gallons per day)
Wilcox Group 4/	0.5	8	8	13
Carrizo Sand 5/	26.7 6/	32	37	28
Sparta Sand	.1	7	7	8
Yegua Formation	2.8	7	7	10

1/ Except for the Carrizo Sand, the figures in this column are the same as those in the adjacent column relating to ideally located well fields. For the Carrizo Sand the figure in this column is less because the present well fields are not ideally located to obtain the greatest total amount of water available from the aquifer throughout the two counties, and it is not practical to abandon the present fields and develop others in remote areas.

2/ The figures in this column are based on the sum of the estimated maximum yields from well fields of small to moderate size spaced uniformly in areas of greatest transmissibility and greatest allowable drawdown. The well fields in each aquifer in Angelina and Nacogdoches Counties interfere with one another, but the estimates assume that pumpage from the respective formations in adjacent counties to the east and west will remain the same as at present, so there will be no interference from these outside counties.

3/ The figures in this column represent estimates of the maximum amounts of water that will flow down the dips of the respective formations from their outcrops into and in Angelina and Nacogdoches Counties, if the aquifers are also fully developed in adjacent counties to the east and west.

4/ The figures listed here for the Wilcox Group do not include the amounts stated under footnote 5/ as originating in the Wilcox.

5/ An estimated 10% of the water shown here as pumped and available from the Carrizo Sand originates in the Wilcox. Part of it is pumped from wells screening both aquifers and part flows into the Carrizo where the two are hydraulically interconnected. In addition, a very small portion of the water available from the Carrizo originates in the Reklaw Formation. The amount is estimated to be much smaller than that contributed by the Wilcox.

6/ This figure includes a small amount of pumpage directly from the Wilcox, drawn from wells screening sand in both the Wilcox and the Carrizo -- estimated at about 1 million gallons per day.

with respect to transmissibility of the aquifer and allowable drawdown of water level. They also assume that pumpage from these aquifers is not increased in adjacent counties, as no new interference is allowed for from those counties. To this extent the estimates are perhaps unrealistic and too high, for some additional development probably will occur in adjacent counties.

Except for the Carrizo Sand, the two columns on total well-field yields in Table 6, one stated to be the supply available under practical conditions and the other stated to be the supply available with ideally located well fields, show the same values. It is considered practical at this time to locate well fields in an ideal manner in each of the formations except the Carrizo. As will be described subsequently in this report, however, it is not considered practical to do this in the Carrizo Sand because of the present fields which cannot be abandoned without great economic loss to the owners.

The second method of estimating the available supply is based on full development of each aquifer throughout its extent, both inside and outside of these counties. The figures given for the available supplies are estimates of the maximum amounts of water that will flow down the dips of the formations from their outcrops to wells in Angelina and Nacogdoches Counties, under the provision that water cannot be pulled into Angelina and Nacogdoches Counties from the sides because of full development of these aquifers in those adjacent counties to the east and west. The estimates are based on the estimated effective transmissibilities of the formations, the dips of the beds, and the widths of the areas of occurrence of the aquifers in these counties.

Wilcox Group

The 1968 pumpage from the Wilcox Group is estimated at 0.5 million gallons per day. The supply available from well fields under both practical and ideal conditions, with no increase in pumpage outside these counties, is estimated at 8 million gallons per day. This water would be taken from five well fields about seven miles apart, located in areas to obtain the maximum transmissibility and maximum allowable drawdown up to 500 feet. The estimate of the maximum amount of water that can flow from the outcrop to points of withdrawal in Angelina and Nacogdoches Counties without unwatering the aquifer is 13 million gallons per day.

In estimating the amount of water available from the Wilcox Group, the effects of the Mount Enterprise fault zone are considered. Also, the amount of water which can enter the Carrizo Sand from the Wilcox sands is not included. It is estimated that about 10 percent of the water which is now pumped or available from the Carrizo originates in the Wilcox. Some of this water is pumped from wells which screen both the Carrizo and Wilcox, and some moves into the Carrizo from the Wilcox in places where the two are in hydraulic interconnection. Thus, in Table 6 about 3 million gallons per day of water assigned to the Carrizo is believed to actually originate in the Wilcox and is not included in the figures given for the Wilcox Group. The reason for assigning this water to the Carrizo and not to the Wilcox is that the wells in the Carrizo are now making use of it, and the Carrizo is likely to become fully developed before the Wilcox. Therefore, it is considered more realistic to include this water in the Carrizo estimates in order to get a truer picture of the total amount of water which can be pumped from Carrizo wells.

Carrizo Sand

The 1968 pumpage from the Carrizo, including that obtained from combination Carrizo and Wilcox wells, is estimated at 26.7 million gallons per day. Of this, 25.3 million gallons per day was pumped from the four well fields belonging to the cities of Lufkin and Nacogdoches and Southland Paper Mills. Seven wells are now in use in the city of Lufkin Field, nine in the city of Nacogdoches Field, ten in the Southland Paper Mills Old Field, and three in the Southland Paper Mills Poe Field.

The estimated allowable drawdowns below present pumping levels are 200 feet for the Lufkin Field, 120 feet for the Southland Paper Mills Old Field, 70 feet for the Southland Paper Mills Poe Field, and less than 50 feet for the Nacogdoches Field. When these allowable drawdowns are used up by interference from one or more of the existing fields or new fields, wells will begin to fail and the total yields available from the fields will be reduced. Then it will be necessary for the users to reduce pumpage from the fields and to seek water elsewhere. On the assumption that it is impractical to pump so much water from the Carrizo Sand in Angelina and Nacogdoches Counties as to create this situation, estimates of the total availability of water under practical conditions have been made on the basis that no more than the above allowable drawdowns in the existing fields will be used up by interference from new fields or by increased pumping from any of the present fields. On this basis it is estimated feasible to increase the total pumpage from the Carrizo Sand by only about 5 million gallons per day, which results in an estimated total supply of 32 million gallons per day available from the Carrizo Sand.

If it were practical to abandon the Nacogdoches Well Field entirely and to relocate parts of the other fields, it is estimated that a total of 37 million gallons per day might be obtained from well fields in the Carrizo Sand, provided no additional development of the Carrizo occurs in adjacent counties. This estimate is based on having nine relatively uniformly spaced well fields located about five miles north of the southern boundary of that portion of the Carrizo containing fresh water, and on a maximum drawdown of piezometric surface of about 600 feet from its original position.

The estimated amount of water which will flow down the dip of the Carrizo Sand from the outcrop without unwatering part of the formation is about 25 million gallons per day. Adding about 3 million gallons per day for the water crossing into the Carrizo from the Wilcox makes a total estimated availability of water from the Carrizo produced in this manner of 28 million gallons per day. The Carrizo Sand is unique among the four aquifers considered in that this estimate is less than the estimate of the amount of water which can be developed from well fields. The primary reason for this is that the locations of the Carrizo well fields are such that they can draw a larger percentage of their water from adjacent counties than can fields in the other formations.

Sparta Sand

Present pumpage from the Sparta Sand is very low, amounting to an estimated 0.1 million gallons per day. The supply estimated to be available from well fields, with no additional development outside these counties, is 7 million gallons per day. Most of this water would be available from one well field each in the localities on the western and eastern sides of the area within which the Sparta contains fresh water, where the allowable drawdown is greatest. Only a small amount is considered available in the outcrop area north of the Angelina River. There would be essentially no interference between the well fields.

The estimated supply of water available from the Sparta, based on flow down the dip of the beds and assuming full development outside these counties, is 8 million gallons per day.

Yegua Formation

The 1968 pumpage from the Yegua Formation is estimated at 2.8 million gallons per day. The estimated supply of water available from well fields, assuming no increase in pumpage from the Yegua outside these counties, is 7 million gallons per day. This water is assumed to come from five well fields spaced more or less uniformly along the southern portion of that part of the Yegua containing fresh water in Angelina County. The relatively low yield of the Yegua can be roughly checked by the experience at Diboll, where at least one well has had a drawdown of static water level of nearly 300 feet as a result of pumping in that area of slightly more than 1 million gallons per day.

The estimated amount of water which can flow down the dip of the Yegua in Angelina and Nacogdoches Counties, assuming total development of the Yegua outside these counties, is 10 million gallons per day. In making this estimate, an allowance has been made for the effects of boundaries on the individual sands, believed to lower the effective regional transmissibility to about half that which may be computed based on the average permeability of the sand determined from pumping tests and the thickness of sand determined from electric logs.

MOST FAVORABLE AREAS FOR GROUND-WATER DEVELOPMENT

Wilcox Group

Figure 22 shows the areas which are considered to be most favorable for development of ground water from the Wilcox Group. Area 1 is the most favorable area and Area 2 the next most favorable. In selecting these areas, consideration has been given to individual well yields, well-field yields, quality of water, and interference with existing Carrizo wells. Much of the difference between Area 1 and Area 2 is the quality of water. Fresh water is available in both areas, but the water is generally less mineralized in Area 1.

Carrizo Sand

As stated earlier in this report, it is not believed that the Carrizo Sand should be developed much more in Angelina and Nacogdoches Counties. If additional development must be made, however, the areas believed to be most favorable for such development are shown on Figure 23. These areas have been selected from the standpoint of available well and well-field yields, quality of water, and the least interference with existing fields. They have been kept several miles north of the brackish-water line to minimize danger of brackish-water encroachment.

Sparta Sand

The areas considered to be more favorable for development of the Sparta Sand are shown on Figure 24. These are essentially the areas in which the water is fresh downdip from the outcrop. The areas selected have been kept north of the southern boundary of fresh water to minimize the danger of brackish-water encroachment.

Yegua Formation

The area believed to be most favorable for additional development in the Yegua Formation is shown on Figure 25. This area was selected from the standpoint of the best well yields, the best well-field yields, the best quality of water, and to some extent, to keep from interfering with the existing supply at Diboll any more than necessary.

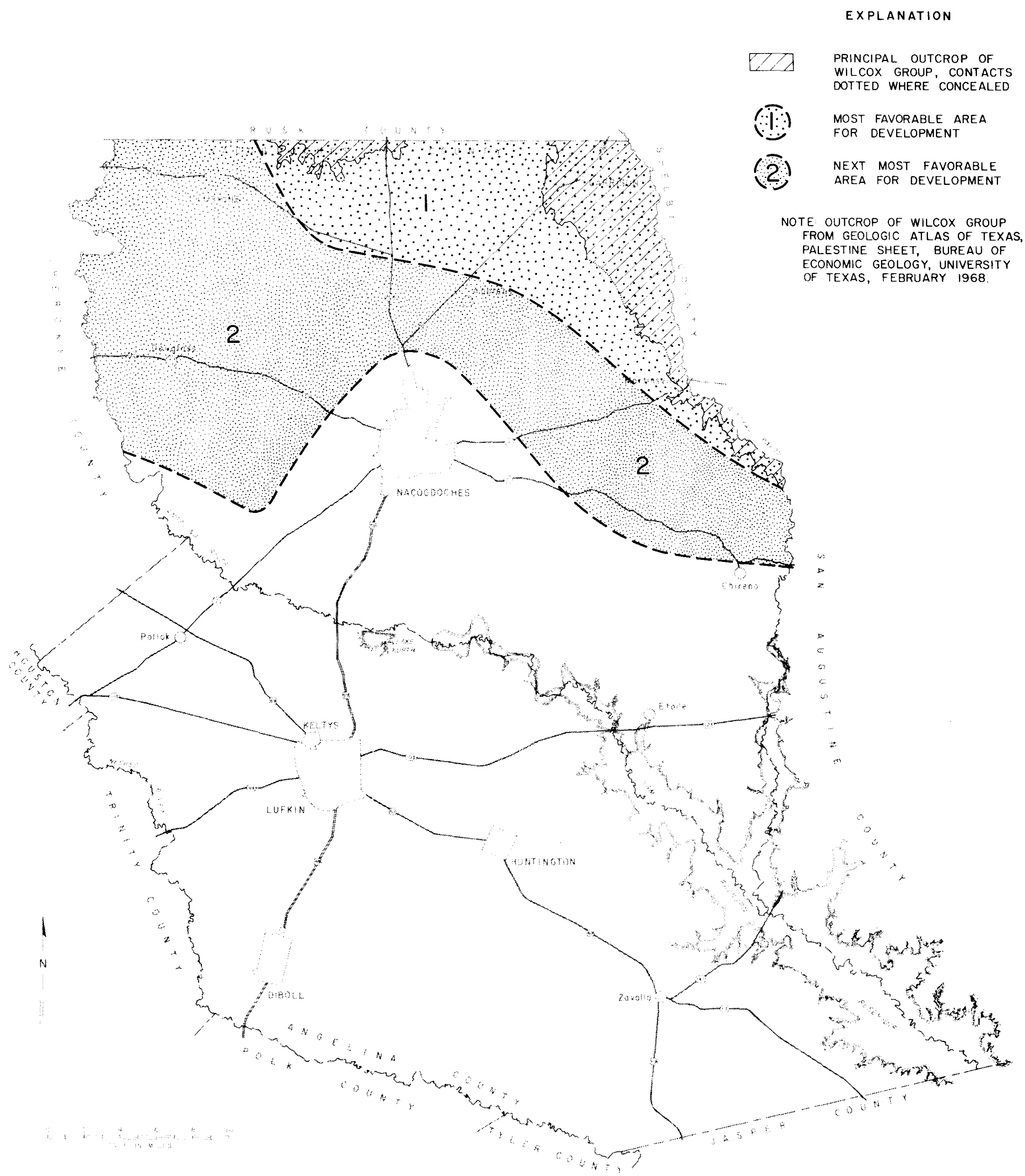


Figure 22

MORE FAVORABLE AREAS FOR DEVELOPMENT — WILCOX GROUP

Base from Texas State Highway Department county maps

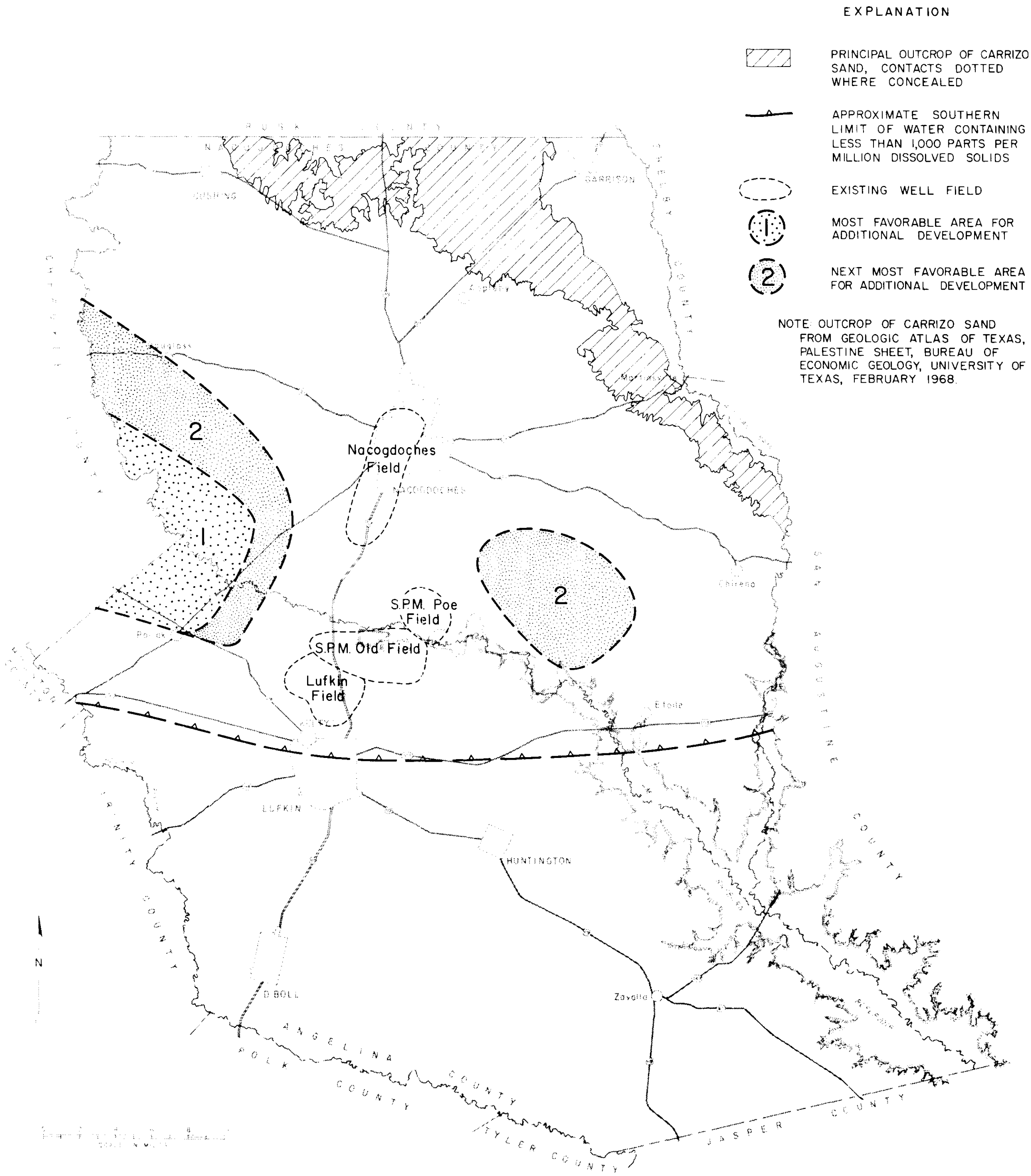


Figure 23
MORE FAVORABLE AREAS FOR ADDITIONAL DEVELOPMENT — CARRIZO SAND

Base from Texas State Highway Department county maps

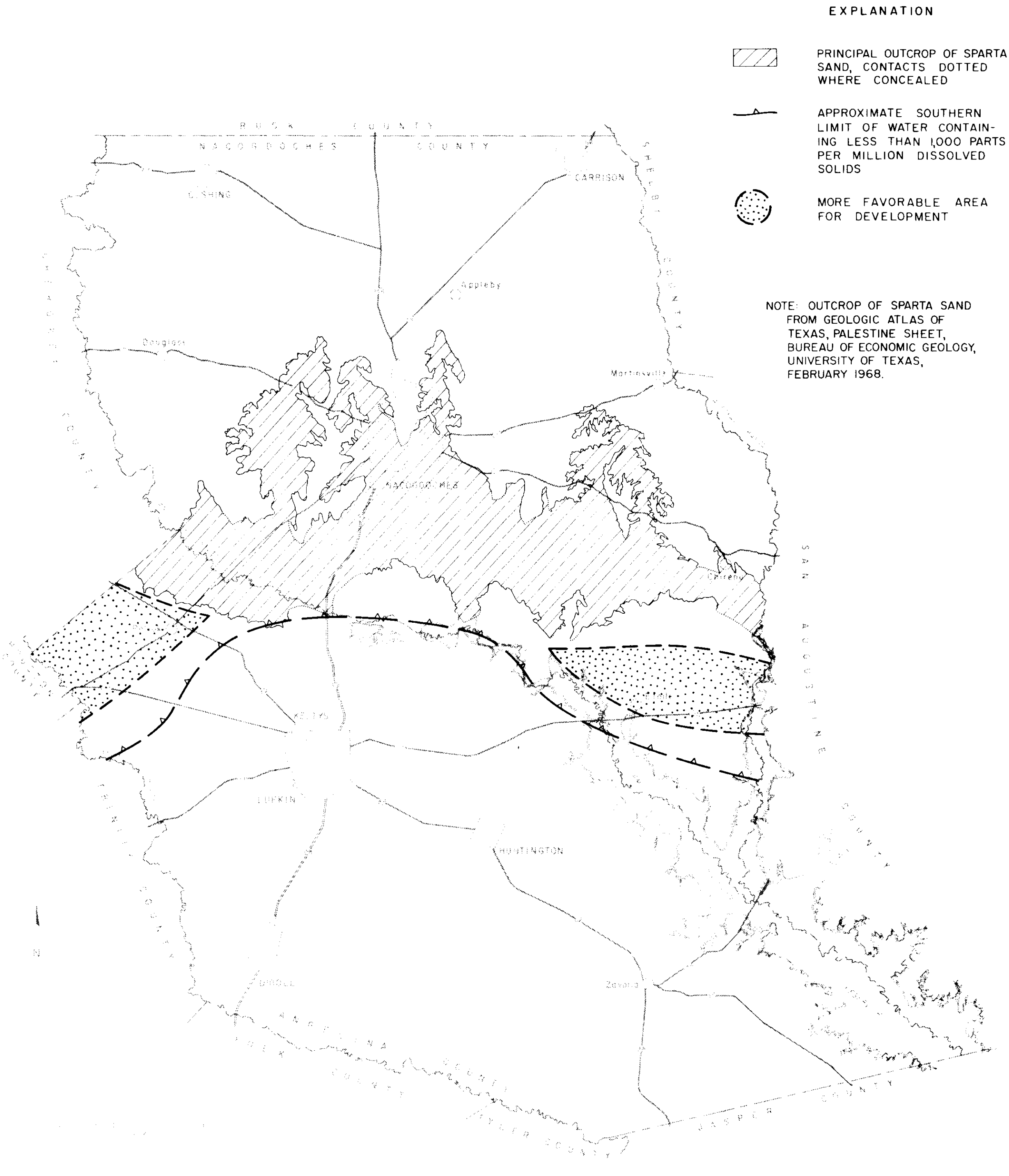


Figure 24
MORE FAVORABLE AREAS FOR DEVELOPMENT — SPARTA SAND

Base from Texas State Highway Department county maps

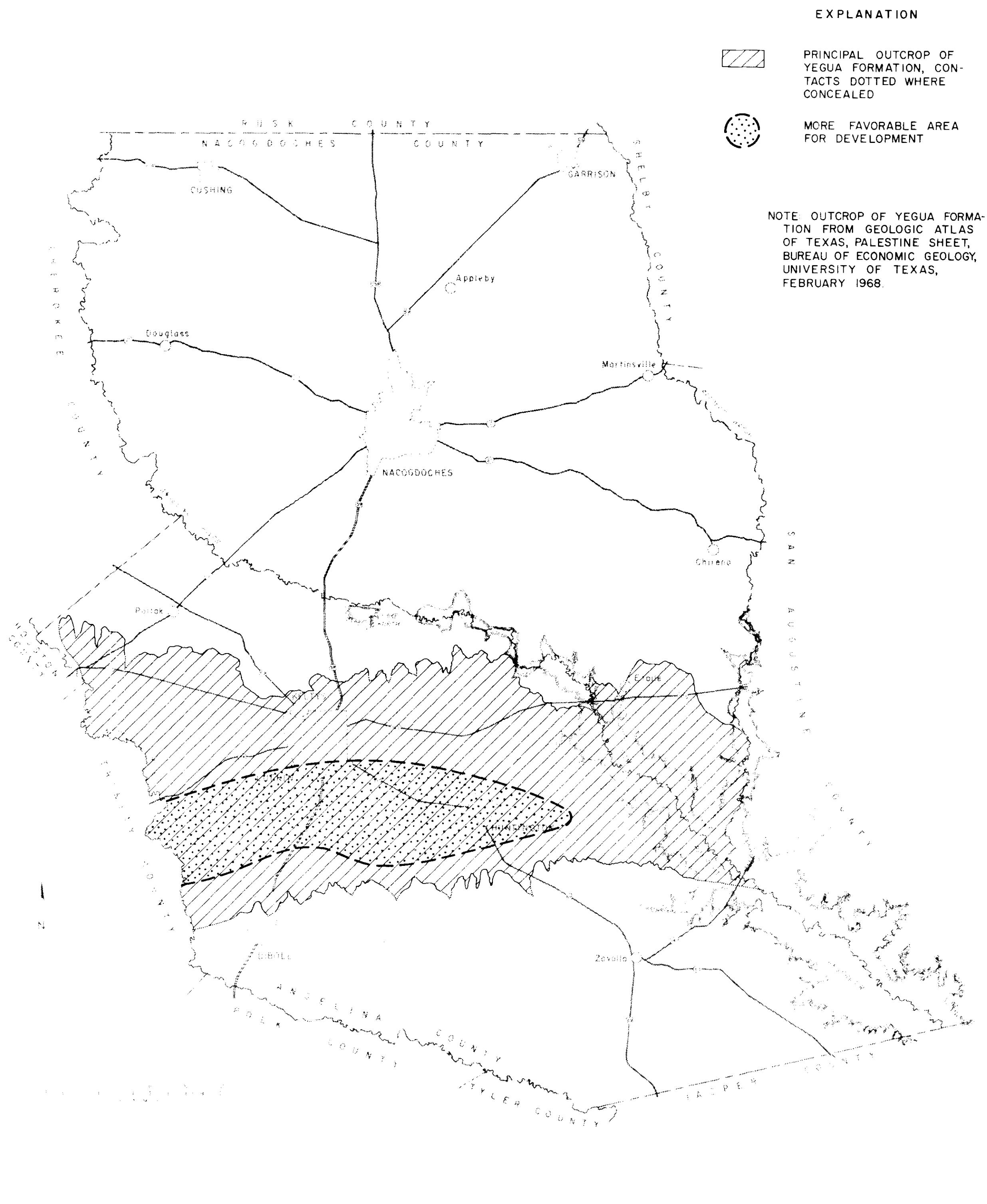


Figure 25

MORE FAVORABLE AREA FOR ADDITIONAL DEVELOPMENT — YEGUA FORMATION

Base from Texas State Highway Department county map.

TEST DRILLING

The estimates of well yields, well-field yields, total availability of water, and quality of water which are given in this report are believed to be the best which can be made based on the available data. There is always a possibility, however, that some differences from the estimates will be found in actual practice. In the case of the Carrizo, for example, the sand in several localities has been found by drilling to be much thinner than might have been expected (Figure 36).

In the construction of a large well in an area like Angelina and Nacodgoches Counties, it is common practice to first drill a pilot hole entirely through the water-bearing formation to be developed. From the information obtained from this hole, a decision is made whether to complete the well. If so, the well is then designed on the basis of that information. When the greatest possible yield is desired, or when the desired yield or quality of water is near the estimated limits of the ability of the aquifer to produce, it is desirable to precede the construction of wells with one or more test holes. These are small diameter holes which are drilled solely for the purpose of obtaining information, and then are abandoned. Several holes may be drilled in a particular locality to determine the variations in ground-water conditions which exist and to select the site or sites which appear best for construction of large wells.

Normally the test drilling program is conducted to obtain three types of information: (1) position and thickness of the water-bearing sands, (2) representative samples of each water-bearing sand, and (3) quality of the water contained in the sands.

The positions and thicknesses of the sands are obtained from drillers' and electric logs, and samples of sand are normally obtained as cuttings collected during the drilling of the hole. Cores are not usually taken because of the expense required to obtain representative coverage. It is important, however, that the drill cuttings be taken in a very careful manner so that they are as representative of the water-bearing sands as possible. This requires that the drilling mud entering the drill stem be kept as free as possible of sand and that the hole be cleaned of all drill cuttings prior to drilling the interval from which the sample of sand is desired. Then during the drilling of the interval to be sampled, a portion of the drilling fluid should be diverted through a large sampling box or other receptacle within which the sand, carried by the mud, can be caught to obtain a representative sample of the sand. After the bottom of the interval to be sampled is reached, drilling should stop, and circulation of the drilling fluid should be continued and the sampling process continued until all drill cuttings have returned to the surface. It is normal practice to take drill cutting samples at intervals of approximately 10 feet in all the water-bearing sands of interest. Sieve analyses are made of the samples of sand thus obtained in order to determine their range in grain size. This information is used, together with other data obtained, in estimating the yield of water which might be obtained from a well at the site.

Quality of water information is obtained from a test hole in two ways, one by actually taking samples of the water and the other from the electric log made in the hole. An electric log, which is made under controlled conditions with proper standardized equipment, normally can be evaluated to determine the general degree of mineralization of the water. It cannot, however, be evaluated closely enough to determine the precise degree of mineralization, nor is there any way to determine the concentration of various mineral constituents in the water. Therefore, when this information is desired, it must be obtained by taking water samples.

A standard method for taking water samples from a test hole is shown in Figure 26. In this method, the original hole drilled is 6¾-inches in diameter. When the hole penetrates about 15 to 30 feet into a sand from which a water sample is desired, drilling is stopped. The position and shape of the hole at that time is indicated by the drawing at the left side of Figure 26. Next, the hole is reamed to a diameter of 9-7/8 inches down to a point just above the zone selected for water sampling. Then the original 6¾-inch hole is washed out to its original depth. The hole at that time is illustrated by the center drawing. Then a string of pipe with packer and screen is set in the hole, as shown at the right of this figure. The pipe is usually 4 inches in diameter, and the packer is a commercial rubber cone type, with typical dimensions of 6 by 9 by 14 inches. Often a canvas "shirt tail" is wrapped on the packer to assist in sealing. The packer is set on the shoulder between the 6¾-inch and the 9-7/8-inch portion of the hole. Below the packer a commercial 4-inch water well screen 10 to 20 feet long is attached to the 4-inch pipe. After the packer is seated, the temporary well thus constructed is pumped by airlift. The well is usually pumped for several hours until the water becomes clear. If pH, hydrogen sulfide, iron, and manganese are not problems, final samples for chemical analysis are taken at the end of this airlift pumping period. Otherwise, after the water becomes clear, the airline is removed from the 4-inch pipe and a small diameter turbine or hi-lift pump is installed and the temporary well is again pumped until the water becomes clear, after which the final samples are taken. In this case, the pH and hydrogen sulfide are determined in the field at the time the sample is taken. The water normally must be pumped until it is entirely clear, because even a very small amount of mud left in the water will affect the determination of iron and manganese in the water and show falsely high contents of these constituents.

At the end of the pumping, periodic measurements are made of the recovery of the water level in this temporary well, usually for about 2 hours. By study of the rate of water-level recovery, reasonably reliable estimates can usually be made of the static water level,

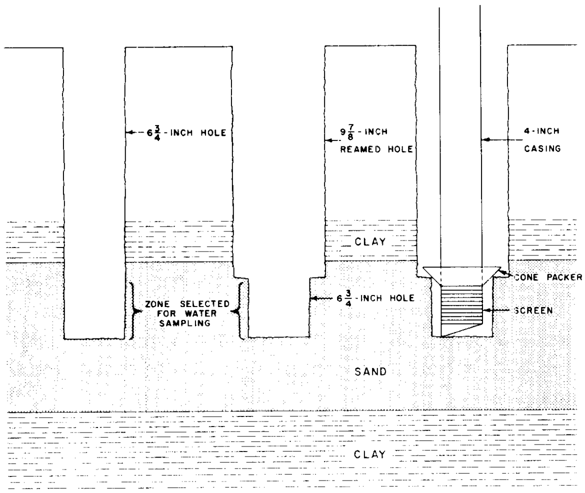


Figure 26.—Procedure for Water Sampling From Test Hole

and sometimes valuable information can be obtained concerning the transmissibility of the water-bearing sand which is screened.

The casing and screen are then pulled from the hole, and drilling of the 6¾-inch hole is resumed until a second water-bearing zone is encountered from which a water sample is desired, at which time the entire water-sampling process is repeated.

If a large well field is desired, the test-drilling program may be followed by the construction of a pilot production well. This is a well which is located and designed on the basis of the results of the test-drilling program and which is intended to serve as the first well in the proposed well field if successful. After the pilot production well is constructed, it is tested in a thorough manner to determine the operating characteristics of the well, the quality of the water, the coefficients of transmissibility and storage, and any local boundaries of the aquifer. From the tests, decisions are made as to whether the well yield and water quality are satisfactory for the proposed well field and what spacing will be desirable for other wells. Any necessary changes in design of the other wells also are made at this time. Should the pilot production well prove unfavorable, a decision can be made to abandon the project or change its scope before additional wells are constructed.

Large wells in the Angelina-Nacogdoches area may be constructed in a manner similar to well 8 belonging to the city of Nacogdoches, as shown on Figure 5. Diameters may be reduced to less than those shown for less yield than that available from the Carrizo Sand in which this well is made.

OBSERVATION PROGRAM

A reasonably thorough program of observation of ground-water conditions in the Carrizo Sand has been conducted during the past 30 years, primarily by Southland Paper Mills with assistance from the U.S. Geological Survey and the Texas Water Development Board. Observations have been made of water levels in wells, and records have been kept of the major pumpage from the Carrizo. In addition, records have been kept of chemical analyses of water from wells as these became available. This program now should be expanded somewhat to measure water levels in a few wells outside the interest of Southland Paper Mills and to take periodic water samples for chemical analyses in areas where the quality of water may change with continued pumping. In addition, a periodic inventory should be made of all important new wells which are drilled, and any new electric logs which become available should be compiled.

At present there is essentially no observation program underway with respect to the other water-bearing formations in Angelina and Nacogdoches Counties. One is particularly needed for the Yegua Formation, in which the development is beginning to be large in comparison to the potential yield of the formation and for which an observation program similar to that for the Carrizo would be valuable. In addition, periodic measurements should be made of water levels in a few wells in the Wilcox and Sparta sands, and a record should be kept of major pumpage from those formation. Occasional inventories should be made to obtain data on new wells. With these records as a base, the observation programs for the Wilcox and Sparta may be expanded as needed to observe the effects of any new well fields.

The results of such observation programs will make possible a continuing evaluation of the availability of ground water throughout the two counties, and provide for modifying estimates and/or conclusions as new data show this to be desirable.

PRINCIPAL CONCLUSIONS AND RECOMMENDATIONS

The principal water-bearing formations in Angelina and Nacogdoches Counties are the Carrizo Sand, Wilcox Group, Yegua Formation, and Sparta Sand, in that order. Other geologic formations in these counties are capable of producing only small quantities of fresh water.

The area within which the Carrizo Sand contains fresh water extends from its outcrop in the northeastern part of Nacogdoches County to a line running generally from west to east through the northern part of Lufkin. The major supplies of ground water which have been developed in Angelina and Nacogdoches Counties come from the Carrizo. Pumpage in 1968 is estimated at 26.7 million gallons per day. The total supply available from the Carrizo under practical conditions is estimated at 32 million gallons per day, with no increase in pumpage outside the two counties. Large wells in the formation generally have yields of 500 to 1,500 gallons per minute, and the water is of very good chemical quality. Static levels in existing wells range in depth to nearly 500 feet in wells near the center of pumping.

The area within which sands of the Wilcox Group contain fresh water extends from the northern edge of Nacogdoches County to a line trending generally east-west between Lufkin and the Angelina River. Pumpage from wells in the Wilcox Group in 1968 is estimated at 0.5 million gallons per day, and the total supply available under practical conditions is estimated at 8 million gallons per day. The estimated maximum yield of a single well ranges from zero to 500 gallons per minute, and the estimated maximum yield of an individual well field ranges up to 5 million gallons per day, depending on location. The greatest potential yield appears to be in the eastern portion of Nacogdoches County, some 10 to 15 miles east of the city of Nacogdoches. The quality of the water is better in the northeastern portion of Nacogdoches County than farther south, where, although termed fresh, much of it is considerably more mineralized than the water obtained in that area from the overlying Carrizo Sand.

The Yegua Formation contains fresh water between the northern edge of its outcrop just north of Lufkin and a line passing generally from west to east across Angelina County between Huntington and Diboll. The quality of water within this section of the Yegua, although fresh, varies in an unpredictable manner, ranging from less than 100 parts per million total dissolved solids to the limit of fresh water, 1,000 parts per million total dissolved solids. Estimated pumpage from the Yegua in 1968 was 2.8 million gallons per day, and the estimated supply available from the formation under practical conditions is 7 million gallons per day. Estimated maximum individual well yields range up to 500 gallons per minute, and the estimated maximum individual well-field yield ranges up to 3 million gallons per day, depending on location. The greatest yields should be obtained near the southern edge of the area containing fresh water. The most development in the Yegua at present is at Diboll, where about 1.3 million gallons per day is pumped.

Fresh water is found in the Sparta Sand throughout its outcrop, which is principally in Nacogdoches County, and in two relatively small localities downdip, one in northwestern Angelina County and one in southeastern Nacogdoches County. The estimated pumpage from the Sparta Sand in 1968 was 0.1 million gallons per day, and the estimated supply available from wells under practical conditions is 7 million gallons per day. Most of this supply is available in the two downdip localities where fresh water exists. Estimated maximum yield of individual wells in the Sparta in these localities range up to 500 gallons per minute, and the estimated maximum yield of an individual well field ranges up to 4 million gallons per day. The quality of the water is quite fresh in the outcrop and through most of the two downdip areas. It becomes more highly mineralized near the southern boundaries of these two areas.

A test-drilling program would be desirable before a large development is undertaken in any of the formations in an area where test holes and/or large wells have not previously been installed or where the conditions may be borderline from the standpoint of obtaining the desired quantity or quality of water.

Continuing programs of observation of pumpage, water levels in wells, and chemical quality of water should be conducted for the Carrizo Sand and Yegua Formation and should be initiated on a limited basis for the Wilcox Group and Sparta Sand.

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Bald Hill	1:24,000	McGee Bend	1:62,500
Broaddus	1:62,500	Mount Enterprise	1:62,500
Clawson	1:24,000	Nacogdoches	1:62,500
Cushing	1:62,500	Platt	1:24,000
Diboll	1:24,000	Pluck	1:24,000
Douglass	1:62,500	Redland	1:24,000
Huntington	1:24,000	Timpson	1:62,500
Keltys	1:24,000	Wakefield	1:24,000
Kennard NE	1:24,000	Wells	1:24,000
Lufkin	1:24,000	Wells SW	1:24,000
Lufkin	1:62,500	Wolf Hill	1:24,000
Manning	1:24,000	Zavalla	1:62,500
Manning	1:62,500		

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Table 7.--Records of Wells and Springs in Angelina County

Well Number	Well Owner	Driller	Year Completed	Altitude of Land Surface (feet) 1/	Depth of well (feet)	Casing and Screen Data: Casing or Screen 2/	Diameter (inches)	Depth in Feet (from)	Depth in Feet (to)	Indicated Water-Bearing Unit	Static Water Level 3/: Depth (feet)	Date	Pumping Rate and Level: Rate (gpm)	Depth (feet)	Date	Method of Lift and Power 4/	Use of Water 1968 5/	Logs Available 6/	Remarks
AL-37-33-301	Bennett & Sorrells Co.- McKnight #1		1946		6,472													E	Oil test.
304	Earl Ash	J. R. Acre	1936		15	C	36			Cook Mtn.	2.3 1.8	3-26-37 11-28-40					D,S		Historical water levels 1937-1940.
305	Jimmie Day	English Drilling Co.	1964	300	225	C S	2 2	0 205	205 225	Sparta	94	8-21-64	7-1/2	102	8-21-64	J,E 1-1/2	D	D	
306	Sessions- Pollock #1			308*														D	Oil test.
401	D. M. Manley	Innerarity & Leubner	1965	310	241	C S	2 2	0 231	231 241	Sparta	60	11-2-65	5	86	11-2-65	J,E 1	D	D	
501	D. H. Byrd-Angelina Lbr. Co. #1		1946		7,515													D,E	Oil test.
502	Jack Clark	Roy Leubner	1968	270	228	C S	2 2	0 218	218 228	Sparta	61.9	12-13-68	5		1968	J,E 1-1/2	D		
601	John G. Champion and Pauline G. Champion- E. A. Wendelandt et al #1		1964		10,040													E	Oil test.
602	John G. Champion- George H. Henderson #1		1964		6,534													E	Oil test.
603	Van B. Scott	English Drilling Co.	1951	250	175	C S	4 4	0 165	165 175	Cook Mtn.	40.1	12-11-68				J,E 1	D,S		
702	Anderson Bait Dist.	Roy C. White	1965	195	507	C C S	4 2-1/2 2-1/2	0 355 467	367 467 507	Sparta	Flows	12-12-68				S,E	D,S		
801	Mrs. Carrie Deen		1954		20	C S	1-1/4 1-1/4	0 17	17 20	Alluvium						C,H	D		Driven well point.
901	Humble Oil & Refining Co.- Angelina Lumber Co. #1		1944		7,207													E	Oil test.
902	Arby Seamans	C. C. Innerarity	1954	260	450	C S	2 2	0 440	440 450	Sparta						J,E	D		
34-101	Sam Trant et al- McKnight #1		1955		10,531													E	Oil test.
102	H. L. Duncan	C. C. Innerarity	1968	255	172	C S	4 4	0 152	152 172	Sparta	62	12-1-68				J,E 1	D,S		
201	Southland Paper Mills	Layne Texas Co.	1947	255*	941	C S C S C S	3-1/2 3-1/2 3-1/2 3-1/2 3-1/2 3-1/2	0 850 860 880 890 931	850 860 880 890 931 941	Carrizo	65.4 112.4 145.2 207.4 236.9 252.7	12-26-47 1-12-50 7-11-55 6-21-60 5-6-65 4-4-68						E	Observation well. Drilled to 1,077 feet. Water level measurements since 1947.
401	Town of Pollock	Works Progress Admin.	1935		50	C	72			Cook Mtn.	2.4 2.4	3-25-37 7-14-40					D,S		Historical water levels 1937-1940.
402	Mrs. N. Carson	O. B. Stevenson	1936		24	C	36			Cook Mtn.	1.0 3.8	3-26-37 11-28-40					D		Historical water levels 1937-1940.
403	Theo. Johnson	English Drilling Co.	1965	310	201	C S	4 2-1/2	0 186	186 201	Sparta	88.9	12-17-68	14	100	1965	S,E 1/2	D	E	
501	Lufkin State School No. 1	Layne Texas Co.	1956	429*	1,275	C C C S C	13-5/8 8-5/8 4-1/2 4-1/2 4-1/2	0 0 990 1,188 1,250	51 1,140 1,188 1,250 1,275	Carrizo	335 473	6-8-56 11-68				S,E 20	P	D,E	Well supplies State School. Temperature 78°F.
502	Central School	Frye Drilling Co.	1960	450	464	C C S C S	6 4 4 4 4	0 420 430 444 460	430 430 444 460 466	Sparta	294	10-7-60				S,E 3	P	D	Supplies water to school.
503	Dr. Tinkle	English Drilling Co.	1951	330	370	C S	4 2			Sparta						J,E 1	D	D	Well has 15 feet of screen.
504	Central W. C. I. D.	Texas Water Wells	1964	455	1,275	C C S C	8-5/8 4-1/2 4-1/2 4-1/2	0 1,020 1,125 1,265	1,120 1,125 1,265 1,275	Carrizo	428 490.8	10-6-64 12-18-68	150	444	10-6-64	S,E 25	P	D	Drilled to 1,320 feet.

For footnotes see end of table.

Table 7.--Records of Wells and Springs in Angelina County--Continued

Well Number	Well Owner	Driller	Year Com-pleted	Altitude of Land Surface (feet) 1/	Depth of Well (feet)	Casing and Screen Data: Casing or Screen 2/	Diameter (inches)	Depth in Feet (from)	Depth in Feet (to)	Indicated Water-Bearing Unit	Static Water Level 3/: Depth (feet)	Date	Pumping Rate and Level: Rate (gpm)	Depth (feet)	Date	Method of Lift and Power 4/	Use of Water 1968 5/	Logs Avail-able 6/	Remarks
AD-37-34-505	Lufkin State School No. 2	Katy Drilling Co.	1963	430	1,264	C C S	12-3/4 6-5/8 6-5/8	0 1,040 1,144	1,100 1,144 1,264	Carrizo	420 471.4	6-3-63 12-19-68	303	442	6-3-63	S,E 40	P	D	
506	Central School		old		40	C	60			Cook Mtn.						N	N		Destroyed.
601	Union Producing Co.- Fenley #1		1954		11,497													E	Oil test.
602	Gulf Pipeline Co.	Layne Texas Co.	1939	220	955	C C S C	6-5/8 4-1/2 4-1/2 4-1/2	0 769 908 929	790 908 929 951	Carrizo	+23.5 67.8 126.5 156.5 242.7 305.7	4-8-40 5-25-45 4-18-50 2-1-55 7-13-59 4-25-67				T,E 15	Ind.		Originally drilled to 523 feet in 1916, deepened in 1939. Water level measurements since 1939.
701	Neal Thompson	Innerarity & Leubner	1965	260	136	C S	4 4	0 126	126 136	Cook Mtn.	80	1-65	5		1-65	S,E 1/2	D	D	
801	Placid Oil Co.- Fairchild #1		1967		8,165													S	Oil test.
802	Robert Adams	English Drilling Co.	1967	375	190	C S	2 2	0 170	170 190	Cook Mtn.	90	6-67	6	110	6-30-67	J,E 1	D	D	
803	R. G. Brown		old		25	C	28			Yegua	11.2	4-16-37					N		Destroyed.
804	T. Finley		1932		20	C	36			Cook Mtn.	11.5	6-11-37					N		Destroyed.
805	B. Fagen		old		50	C	6			Cook Mtn.	38.5	6-11-37					N		Destroyed.
901	Ervin Hopper		1920		22	C	36			Cook Mtn.	13.8 16.2	3-26-37 11-28-40					D		Historical water levels 1937-1940.
902	City of Lufkin No. 10	Katy Drilling Co.	1967	370	1,258	C S	18 10-3/4	0 1,128	1,120 1,258	Carrizo			1,230		7-12-67	T,E 400	P	D,E	Drilled to 1,268 feet.
35-401	Southland Paper Mills	Layne Texas Co.	1939	237*	949	C C S C	18-5/8 10-3/4 10-3/4 10-3/4	0 704 823 944	807 823 944 949	Carrizo	56.0 89.9	10-26-39 1-17-44	1,120 1,060	424.7 502	9-15-57 1-14-69	T,E	Ind.	D,E	Water level measurements since 1939.
402	Southland Paper Mills	Layne Texas Co.	1956	218*	937	C C S C S C	20 14 14 14 14 14	0 706 818 885 893 915	809 818 885 893 915 937	Carrizo			1,230		1-14-69	T,E 250	Ind.	D,E	Temperature 84°F.
403	Southland Paper Mills	Layne Texas Co.	1956	259*	1,040	C C S C S C	20 14 14 14 14 14	0 756 869 925 949 1,020	860 869 925 949 1,020 1,040	Carrizo			1,350		1-14-69	T,E 250	Ind.	D,E	Temperature 83°F.
404	I. W. Sowell	Layne Texas Co.	1957		348	C S	4-1/2 4-1/2	0 325	325 346	Sparta						J,E 1-1/2	D	D,E	Well was drilled for Pat Griffin.
405	Lufkin Chamber of Commerce	Layne Texas Co.	1937	230	1,198													D,E	Test hole. Water samples from 6 zones.
406					25	C	36			Cook Mtn.	12.0 3.9	2-5-37 2-9-39				N			Abandoned. Historical water levels 1937-1939.
407	W. F. Athey	W. F. Athey	1931		26	C	8			Cook Mtn.	1.0 2.6	1-26-37 11-28-40				N			Abandoned. Historical water levels 1937-1940.
408	City of Lufkin No. 9	Layne Texas Co.	1966	270	1,100	C C S C	18 10-3/4 10-3/4 10-3/4	0 860 960 1,085	950 960 1,085 1,100	Carrizo	421	6-22-66	1,209	473	6-22-66	T,E	P	D,E	Drilled to 1,312 feet.
501	American Liberty Oil Co., Webb & Knapp- Cameron heirs #1-B		1955		8,960													E	Oil test.
502	Southland Paper Mills	Layne Texas Co.	1939	252*	1,004	C C S C	18 10-3/4 10-3/4 10-3/4	0 779 879 998	360 879 998 1,004	Carrizo	26.0 123.5	8-26-39 1-16-44	1,100 938	445.5 507	9-16-57 1-14-69	T,E 260	Ind.	D,E	Water level measurements since 1939.
503	Southland Paper Mills	Layne Texas Co.	1939	255*	1,024	C C S C	18 10-3/4 10-3/4 10-3/4	0 790 898 1,018	891 898 1,018 1,024	Carrizo			1,120 880	452 513	9-17-57 1-14-69	T,E 260	Ind.	D,E	Drilled to 1,049 feet. Water level measurements since 1939.

For footnotes see end of table.

Table 7.--Records of Wells and Springs in Angelina County--Continued

Well Number	Well Owner	Driller	Year Completed	Altitude of Land Surface (feet) 1/	Depth of Well (feet)	Casing and Screen Data: Casing or Screen 2/	Diameter (inches)	Depth in Feet (from)	Depth in Feet (to)	Indicated Water-Bearing Unit	Static Water Level 3/: Depth (feet)	Date	Pumping Rate and Level: Rate (gpm)	Depth (feet)	Date	Method of Lift and Power 4/	Use of Water 1968 5/	Logs Available 6/	Remarks
AD-37-35-504	Southland Paper Mills	Layne Texas Co.	1939	275*	983	C C S C	18 10-3/4 10-3/4 10-3/4	0 737 855 977	854 855 977 983	Carrizo	41.0	9-20-39	1,110 850	457 520	9-15-57 1-14-69	T,E 260	Ind.	D,E	Drilled to 1,007 feet. Water level measurements since 1939.
505	Southland Paper Mills	Layne Texas Co.	1956	222*	894	C C S C	20 14 14 14	0 653 760 874	755 760 874 894	Carrizo			1,130 1,250	425	9-16-57 1-14-69	T,E 250	Ind.	D,E	Water level measurements since 1956. Temperature 81°F.
506	Southland Paper Mills	Layne Texas Co.	1939	261*	1,000	C S	4 4	0 900	900 1,000	Carrizo	244.5 295.5 316.1 471.2 468.4	8-12-48 7-13-50 7-12-55 8-31-65 11-2-68						E	Observation well. Drilled to 1,046 feet. Water level measurements since 1941.
507	Southland Paper Mills	Layne Texas Co.	1940	170*	85	C S	2 2	0 80	80 85	Sparta	1.0 7.8	2-16-42 6-10-43						D	Observation well. Historical water levels 1942-1943.
508	Southland Paper Mills	Layne Texas Co.	1940	170*	55	C S	2 2	0 50	50 55	Sparta								D	Test well. Abandoned.
509	Southland Paper Mills	Layne Texas Co.	1940	170*	45	C S	2 2	0 40	40 45	Sparta								D	Test well. Abandoned.
510	Southland Paper Mills	Layne Texas Co.	1940	170*	175	C S	2 2	0 170	170 175	Sparta								D,E	Test well. Drilled to 355 feet. Abandoned.
511	K. L. McHenry- E. R. Bolton #1		1947															E	Oil test.
601	Southland Paper Mills	Layne Texas Co.	1939	227*	932	C C S C	18 10-3/4 10-3/4 10-3/4	0 710 823 925	780 823 925 932	Carrizo	9.0	8-18-39	1,080 760	451	9-17-57 1-14-69	T,E 260	Ind.	D,E	Water level measurements since 1939.
602	Southland Paper Mills	Layne Texas Co.	1956	215*	875	C C S C	20 14 14 14	0 629 738 853	730 738 853 875	Carrizo			1,180	490	1-14-69	T,E 250	Ind.	D,E	Water level measurements since 1956. Temperature 80°F.
605	Southland Paper Mills	Layne Texas Co.	1956	198*	927	C C S C	20 14 14 14	0 695 808 910	799 808 910 927	Carrizo			1,160 1,248	465	1-14-69 2- 4-67	T,E 250	Ind.	D,E	Water level measurements since 1956. Temperature 82°F.
606	Southland Paper Mills	Layne Texas Co.	1955		913													E	Test hole.
701	City of Lufkin No. 5	Layne Texas Co.	1946	330	1,170	C C S C S C	16 8-5/8 8-5/8 8-5/8 8-5/8 8-5/8	0 931 1,028 1,131 1,151 1,163	1,021 1,028 1,131 1,151 1,163 1,170	Carrizo, Wilcox	189.5 223.0 259.5 330 392	7-22-46 7-25-50 7-13-55 7-15-59 12-15-66	900	485	12-15-66	S,E 200	P	D,E	Historical water levels 1948-1961.
702	City of Lufkin No. 6	Layne Texas Co.	1949	330	1,221	C S	16 8			Carrizo	235.3 301.6 406.6 422.5	7-22-48 7-12-55 5-8-63 4-16-69	1,165	545	2-8-68	T,E 250	P	E	Water level measurements since 1948.
703	City of Lufkin No. 7	Texas Water Wells	1956	320	1,300	C C S C	16 10-3/4 10-3/4 10-3/4	0 1,050 1,160 1,290	1,150 1,160 1,290 1,300	Carrizo	331.2 410.5	11-16-56 4-16-69	1,000	430.8	11-16-56	S,E 200	P	D,E	Drilled to 1,445 feet. Water level measurements since 1956.
704	K. L. McHenry- Russell Estate #1		1939	355	1,036													E	Oil test.
705	City of Lufkin No. 3	Layne Texas Co.	1939	350	1,169	C C S C S	16 8-5/8 8-5/8 8-5/8	0 944 1,055 1,106 1,116	1,045 1,055 1,106 1,116 1,167	Carrizo	81 237.4 312.2 340.8 395.2	2-5-39 5-6-45 7-25-50 7-13-55 4-25-67	996	561	4-13-67	T,E 250	P	D,E	Water level measurements since 1939. Temperature 88°F.
706	W. A. Collmorgan	W. W. Miller	1922	244*							27.1 67.6	4-26-37 3-31-44					S		Historical water levels 1937-1944.
707	W. A. Collmorgan	W. A. Collmorgan	1915		19	C	36			Cook Mtn.	7.3 3.6	1-12-37 11-28-40					D		Historical water levels 1937-1940.
708	City of Lufkin No. 8	Texas Water Wells	1964	320	1,141	C C S C	16 8-5/8 8-5/8 8-5/8	0 950 1,036 1,138	1,030 1,036 1,138 1,141	Carrizo	430	7-13-64	1,040	502	7-13-64	S,E 200	P	D,E	Drilled to 1,200 feet.

For footnotes see end of table.

Table 7.--Records of Wells and Springs in Angelina County--Continued

Well Number	Well Owner	Driller	Year Com-pleted	Altitude of Land Surface (feet) 1/	Depth of Well (feet)	Casing and Screen Data: Casing or Screen 2/	Diameter (inches)	Depth in Feet (from)	Depth in Feet (to)	Indicated Water-Bearing Unit	Static Water Level 3/: Depth (feet)	Date	Pumping Rate and Level: Rate (gpm)	Depth (feet)	Date	Method of Lift and Power 4/	Use of Water 1968 5/	Logs Avail-able 6/	Remarks
AD-37-35-709	Redland Water Supply Corp.	Layne Texas Co.	1962	365	1,149	C C S C	8-5/8 4-1/2 4-1/2 4-1/2	0 978 1,079 1,139	1,075 1,079 1,139 1,149	Carrizo	420	1-2-63	130	441	1-2-63	S,E	P	D,E	Slight sulfur odor.
710	City of Lufkin	Layne Texas Co.	1935	329*	1,188													D	Test Hole No. 2. Water samples taken from two zones.
711	City of Lufkin	Layne Texas Co.	1935	266*	1,243													D	Test Hole No. 1. Water samples taken from two zones.
712	City of Lufkin	Layne Texas Co.	1918	268*	63	C	18			Yegua	+1.0	1-18-37	Flowed 2		1937		N		
713	City of Lufkin	Lester Jett	1919	269*	400	C	6	0	126	Yegua	+1.0	1-18-37					N		
801	John Henderson	Innerarity & Leubner	1967	240	287	C S	2 2	0 277	277 287	Sparta	74	1-26-67				J,E	D	D	
802	City of Lufkin	Layne Texas Co.	1966	260	1,304												D	E	Test hole.
901	M. R. Wills	Rushing	1960	235	306	C	4			Sparta	54.2	11-22-60				T,E 3/4	D		Salty taste. Gas reported. Nine feet of screen reported.
902	M & M Water Supply Corp.	Key Water Well Drilling	1966	290	1,080	C C S C	10-3/4 6-5/8 6-5/8 6-5/8	0 880 990 1,070	880 990 1,070 1,080	Carrizo			220	575	6-17-66	S,E 50	P	D,E	Drilled to 1,165 feet.
36-401	Southland Paper Mills	Layne Texas Co.	1950		971													E	Test hole.
402	K. L. McHenry-Harris #1		1937		780													E	Oil test.
403	Southland Paper Mills	Layne Texas Co.	1955	204*	847	C S	4-1/2 4-1/2	0 811	811 841	Carrizo	171.1 229.1 275.9 291.2	8-23-55 7-13-60 5-6-65 4-4-68	75		1955			D,E	Observation well. Drilled to 985 feet. Water level measurements since 1955.
404	Southland Paper Mills	Layne Texas Co.	1955	221*	1,021													E	Test hole.
405	Southland Paper Mills	Layne Texas Co.	1955	206*	965													E	Test hole.
406	Southland Paper Mills	Layne Texas Co.	1940	165*	210	C S	2 2	0 205	205 210	Sparta								D	Test well. Abandoned
407	Southland Paper Mills	Layne Texas Co.	1940	165*	150	C S	2 2	0 145	145 150	Sparta								D	Test well. Abandoned. Screen initially set 60 to 70 feet.
501	Southland Paper Mills	Layne Texas Co.	1950	198*	801	C S C S	3-1/2 3-1/2 3-1/2 3-1/2	0 758 769 790	758 769 790 800	Carrizo	104.2 131.5 189.3 215.9 236.0	7-8-50 7-1-55 6-22-60 5-6-65 4-4-68						D,E	Observation well. Water level measurements since 1950.
502	Southland Paper Mills	Layne Texas Co.	1950	188*	840													E	Test hole.
503	Southland Paper Mills	Layne Texas Co.	1950	195*	772	C S S	3-1/2 3-1/2 3-1/2	0 706 725	706 715 736	Carrizo								D,E	Test well. Casing and screen set to obtain water samples, then removed.
504	Southland Paper Mills	Layne Texas Co.		201*	960													E	Test hole.
505	Southland Paper Mills	Layne Texas Co.		212*	965													E	Test hole.
506	Southland Paper Mills	Layne Texas Co.		203*	921													E	Test hole.
701	Southland Paper Mills	Layne Texas Co.		275*	1,022													E	Test hole.
702	W. M. Berry	McCoy	1934		22	C	36			Yegua	5.5	5-6-69				N	N		
801	Southland Paper Mills	Layne Texas Co.	1950	228*	1,056	C C S C S C	4-1/2 3-1/2 3-1/2 3-1/2 3-1/2 3-1/2	0 103 897 907 1,034 1,045	103 897 907 1,034 1,045 1,056	Carrizo, Wilcox	79.3 98.5 137.6 161.0 184.6	5-1-50 7-1-55 7-13-60 5-6-65 4-16-69						D,E	Observation well. Drilled to 1,081 feet. Water level measurements since 1950.
802	Southland Paper Mills	Layne Texas Co.	1950	244*	911	C S	3-1/2 3-1/2	0 878	878 899	Carrizo	152.4 173.9 234.5 261.4 280.6	10-23-50 7-1-55 6-22-60 5-6-65 4-4-68						D,E	Observation well. Drilled to 951 feet. Water level measurements since 1950.
803	I. D. Anderson	Wall Water Well	1968	180	247	C S C	2 2 2	0 222 238	222 238 247	Sparta	32	1-13-68				A,E	D	D	Gas reported in water.
901	E. L. Kurth-L. Henderson #1		1938															E	Oil test.

For footnotes see end of table.

Table 7.--Records of Wells and Springs in Angelina County--Continued

Well Number	Well Owner	Driller	Year Completed	Altitude of Land Surface (feet) 1/	Depth of Well (feet)	Casing and Screen Data: Casing or Screen 2/	Casing and Screen Data: Diameter (inches)	Casing and Screen Data: Depth in Feet (from)	Casing and Screen Data: Depth in Feet (to)	Indicated Water-Bearing Unit	Static Water Level 3/: Depth (feet)	Static Water Level 3/: Date	Pumping Rate and Level: Rate (gpm)	Pumping Rate and Level: Depth (feet)	Pumping Rate and Level: Date	Method of Lift and Power 4/	Use of Water 1968 5/	Logs Available 6/	Remarks
AD-37-36-902	Southland Paper Mills	Layne Texas Co.	1941	174*	891	C S C S	2-3/8 2-3/8 2-3/8 2-3/8	0 860 865 886	860 865 886 891	Wilcox	+82.9 +11.2 19.5 59.9 87.0	10-22-41 4-14-50 7-1-55 5-9-63 4-4-68						D,E	Observation well. Drilled to 1,377 feet. Water level measurements since 1941.
903	Southland Paper Mills	Layne Texas Co.	1941	174*	291	C S C S	2-3/8 2-3/8 2-3/8 2-3/8	0 195 201 286	195 201 286 291	Sparta	+30	1941						D,E	Observation well.
904	Southland Paper Mills	Layne Texas Co.	1941	174*	778	C S	4 4	0 756	756 761	Carrizo	+66.9 16.3 41.3	10-22-41 4-14-50 7-1-55				N			Observation well. Historical water levels 1941-1955. Destroyed in 1956.
905	Kenneth Treadway	Wall Water Well	1967	215	297	C S C	2 2 2	0 275 281	275 281 297	Sparta	73	12-27-67				A,E	D	D	
41-201	Coastal Refining Co.-Henderson #1		1942		4,528													E	Oil test.
301	E. P. Anderson	English Drilling Co.	1967	260	189	C S	2 2	0 169	169 189	Yegua	80	8-28-67	6	100	8-28-67	J,E 1	D	D	
42-101	Humble Oil & Refining Co.-J. L. Bonner #1-A				1,305													D	Oil test.
201	Lancewood Water Supply Corp.	West & Rehkop Drilling Co.	1966	325	120	C S	6-5/8 4-1/2	0 90	81 120	Yegua	40	9-7-66	38	83	9-7-66	S,E 1-1/2	P	E	Test hole drilled to 1,160 feet.
301	Owens Illinois No. 4	Layne Texas Co.	1954	345	201	C C S C S C	14 8-5/8 8-5/8 8-5/8 8-5/8 8-5/8	0 0 150 170 175 195	142 150 170 175 195 201	Yegua	76	1-4-55	226	122	1954	S,E 25	Ind.	D	Formerly Angelina County Lumber Company.
302	Owens Illinois No. 5	Layne Texas Co.	1955	340	76	C C S	24 12 12	0 0 52	45 52 72	Yegua	32 14.1	3-17-55 4-23-69	119	53	3-17-55	T,E 10	Ind.	D	Formerly Angelina County Lumber Company.
303	J. W. Shearrard	Charles Brown			18	C	60			Yegua	7.3 12.2	1-11-37 11-28-40					D		Historical water levels 1937-1940.
304	Woodlawn Water Supply Corp.	Layne Texas Co.	1964	320	1,410	C C S C S	7 3-1/2 3-1/2 3-1/2 3-1/2	0 1,213 1,320 1,341 1,349	1,310 1,320 1,341 1,349 1,410	Carrizo	296 338	2-10-64 10-16-67	143	316	2-10-64	S,E 15	P	D,E	Some gas reported in water. Temperature 93°F.
305	Angelina Lumber Co.	Layne Texas Co.	1924		68	C S	8 8	0 47	47 68	Yegua						N	N		Destroyed.
306	City of Lufkin	Layne Texas Co.	1935	354*	1,449													D	Test hole 3. Water samples from 2 zones.
401	Sam Peavy	Sam Peavy	1930	265	195	C	8			Yegua						N	N		Destroyed.
501	Agriculture Exp. Sta.	Frye Drilling Co.	1957		254	C	4			Yegua	68	10-25-60				S,E	D,S	D	Well has 20 feet of screen.
502	Agriculture Exp. Sta.	Frye Drilling Co.	1957		312	C C S C S	4 2-1/2 2-1/2 2-1/2 2-1/2	0 255 276 286 300	273 276 286 300 310	Yegua	76.4	10-25-60				S,E 1	D,S	D	
503	Agriculture Exp. Sta.		1933		80	C	36			Yegua	9.8	5-11-37				N	N		Destroyed.
504	Hudson School	Sam Peavy	1929	265	105	C	6			Yegua						N	N		Destroyed.
505	C. A. Juergens		1932		41	C	48			Yegua	30.2	5-31-37				N	N		Destroyed.
601	Dr. Sietz	Layne Texas Co.	1946	350	327	C C S	6-5/8 4-1/2 4-1/2	0 280 302	300 302 322	Yegua	125	6-17-46				J,E 2	D	D	Formerly J. J. Collins.
602	Hudson Water Supply Corp.	Layne Texas Co.	1963	335	425	C C S C S C S C	12-3/4 7 7 7 7 7 7 7	0 238 335 355 365 385 400 415	325 335 355 365 385 400 415 425	Yegua	126	9-5-63	200	236	9-6-63	T,E	P	D,E	Reported sulfur odor and taste. Temperature 73°F.
701	Mrs. A. G. Johnson		1945	270	53	C	36			Yegua	48.5	12- 4-68				J,E	D		
702	Mrs. A. G. Johnson		1932	270	62	C	12			Yegua	50.0	5-31-37				N	N		Destroyed.

For footnotes see end of table.

Table 7.--Records of Wells and Springs in Angelina County--Continued

Well Number	Well Owner	Driller	Year Completed	Altitude of Land Surface (feet) 1/	Depth of Well (feet)	Casing and Screen Data: Casing or Screen 2/	Casing and Screen Data: Diameter (inches)	Casing and Screen Data: Depth in Feet (from)	Casing and Screen Data: Depth in Feet (to)	Indicated Water-Bearing Unit	Static Water Level 3/: Depth (feet)	Static Water Level 3/: Date	Pumping Rate and Level: Rate (gpm)	Pumping Rate and Level: Depth (feet)	Pumping Rate and Level: Date	Method of Lift and Power 4/	Use of Water 1968 5/	Logs Available 6/	Remarks
AD-37-42-703	Mrs. A. G. Johnson		old	265	18	C	36			Yegua	8.1	5-31-37					N		
801	H. L. Haleman	Innerarity & Leubner	1965	230	239	C S	2 2	0 229	229 239	Yegua						J,E 1	D		
901	J. F. Wright	C. C. Innerarity	1958	225	288	C S	2 2	0 278	278 288	Yegua	30	1958				J,E 1/2	D		
43-101	City of Lufkin	Layne Texas Co.	1924		110	C	16			Yegua	12	1-18-37				N	N		Destroyed.
201	Eulen Berry	Layne Texas Co.	1946	265	1,251	C C S C	4-1/2 2-7/8 2-7/8 2-7/8	0 1,170 1,216 1,237	1,210 1,216 1,237 1,251	Carrizo	138	2-4-46	35		3-4-46	N		D,E	Destroyed.
202	Herty Water Company	English Drilling Co.	1959	280	200	C S	8 6			Yegua	27.4	11-1-60				S,E	P		One of six wells supplying Herty Community.
203	Southland Paper Mills	Layne Texas Co.	1943	310*	264													D,E	Test hole.
204	Southland Paper Mills	Layne Texas Co.	1943	312*	190	C S		0 120	120 190	Yegua							N	E	Test well.
205	Southland Paper Mills	Layne Texas Co.	1943	300*	303													D,E	Test hole.
206	Southland Paper Mills	Layne Texas Co.	1943	302*	225													D,E	Test hole.
207	Herty Water Company	C. C. Innerarity	1965	280	838	C C	12-1/4 7-7/8	0 704	704 838									D,E	Water at 800 feet reported brackish. Well plugged back and abandoned.
301	Reynolds	White	1946	315	226	C S	4 4	0 164	164 184	Yegua	80	11-20-60				J,E 2	P		Supplies 13 homes in Reynolds Addition.
302	George Korn		1936		32	C	36			Yegua	18.7	3-22-37				J,E	D		
401	Dr. Tinkle	Taylor	1947	300	212	C C S	6 4 4	0 155 177	160 177 209	Yegua	36	7-24-47				J,E 2	D	D	
402	John Bennett		1917		20	C	36			Yegua	7.8	3-30-37				N	N		Abandoned.
501	Angelina Water Supply Corp.	C. C. Innerarity	1964	320	447	C C S	7 4 4	0 336 357	363 357 447	Yegua	70	9-30-64	201	156	9-30-64	S,E 25	P	D	
502	Lee Graham		old		28	C	36			Yegua	15.2	6-2-37					D		
503	Fuller Springs Water Dist. No. 1	C. C. Innerarity	1964	300	412	C C S	13-3/8 7 7	0 252 310	302 310 410	Yegua	73.1	4-22-69	90	132	4-22-69	S,E 15	P	D,E	Temperature 75°F.
504	Fuller Springs Water Dist. No. 2	C. C. Innerarity	1964	280	408	C C S	13-3/8 8-5/8 8-5/8	0 265 325	325 325 400	Yegua	53.8	8-28-68	42		8-68	S,E 15	P		
505	G. B. Cornell		1936		31	C	28			Yegua	27.0	6-2-37				N			Destroyed.
506	G. B. Cornell		old		55	C	8			Yegua	46.7	6-2-37				N			Destroyed.
601	J. R. Meeker et al-John Massingill #1		1943	4,794														E	Oil test.
602	E. C. Greene		1930		23	C	46			Yegua	2.0	3-31-37				N	N		Destroyed.
701	E. M. Gipson	Layne Texas Co.	1959	275	265	C C S C C S C S C S C S C	16 8 8 8 6 6 6 6 6 6 6 6 6	0 0 97 112 153 163 178 207 218 233 238 244 254	39 97 112 153 163 178 207 218 233 238 244 254 265	Yegua	54	1-13-60	25	122	1959	T,E 5	Irr.	D,E	Drilled to 887 feet. Supplies cemetery.
801	B. G. Byars & E. L. Kurth-Angelina Lumber Co. #2		1952		5,248													E	Oil test.
802	B. G. Byars & E. L. Kurth-Southern Pine Lumber Co. #1		1952		5,000													E	Oil test.
803	W. T. Harbuck		1922		23	C	36			Yegua	13.1	6-2-37				N	N		Destroyed.

For footnotes see end of table.

Table 7.--Records of Wells and Springs in Angelina County--Continued

Well Number	Well Owner	Driller	Year Com-pleted	Altitude of Land Surface (feet) 1/	Depth of Well (feet)	Casing and Screen Data: Casing or Screen 2/	Casing and Screen Data: Diameter (inches)	Casing and Screen Data: Depth in Feet (from)	Casing and Screen Data: Depth in Feet (to)	Indicated Water-Bearing Unit	Static Water Level 3/: Depth (feet)	Static Water Level 3/: Date	Pumping Rate and Level: Rate (gpm)	Pumping Rate and Level: Depth (feet)	Pumping Rate and Level: Date	Method of Lift and Power 4/	Use of Water 1968 5/	Logs Avail-able 6/	Remarks
AD-37-43-901	T. C. Murcheson	English Drilling Co.	1957	300	460	C	4			Yegua	52	8-57				S,E 1/4	D		Well has 20 feet of screen.
902	Anna Stradt	Innerarity & Leubner	1967	290	256	C S	4 4	0 236	236 256	Yegua	47	9-7-67				S,E 1-1/2	D	D	
44-101	Garland Redd	Innerarity & Leubner	1965	285	133	C S	4 4	0 123	123 133	Yegua	56.3	12-17-68				J,E 1-1/2	D	D	Drilled to 233 feet. Sand at 225 feet reported salty.
201	George Davis	Innerarity & Leubner	1965	275	220	C S	2 2	0 210	210 220	Yegua						J,E 1	D	D	
301	Southland Paper Mills	Layne Texas Co.	1950	193*	1,101													E	Test hole.
302	Humble Oil & Refining Co.- Angelina Lumber Co. #1		1964		6,800													E	Oil test.
401	J. C. Nerren		1934		42	C	48			Yegua	36.3	4-1-37				N	N		Destroyed.
501	J. R. Havard	Innerarity & Leubner	1967	280	237	C S	4 4	0 227	227 237	Yegua	87	1-28-67				S,E 3/4	D	D	
601	O. M. Knight	English Drilling Co.	1959	210	189	C S	2 2	0 167	167 189	Yegua						J,E 3/4	D		
701	J. W. Frazier- Angelina Lumber Co. #1		1942															E	Oil test.
702	Dr. H. M. Wilson	Frank Balcar			440	C	4			Yegua						N	N		Destroyed.
801	City of Huntington No. 7	Layne Texas Co.	1959	325	710	C C S C S C S C S C S C S C S C	10-3/4 6-5/8 6-5/8 6-5/8 6-5/8 6-5/8 6-5/8 6-5/8 6-5/8 6-5/8 6-5/8 6-5/8 6-5/8 6-5/8 6-5/8 6-5/8	0 425 495 505 515 525 552 562 580 600 615 625 635 665 680 690	495 495 505 515 525 552 562 580 600 615 625 635 665 680 690 710	Yegua	245 272.6	8-23-59 8-28-68	200	360	8-22-59	T,E 40	P	D,E	Drilled to 1,863 feet and plugged back. Water samples from three zones.
802	Four Way Water Supply Corp.	Layne Texas Co.	1967	330	730	C C S C	10-3/4 6-5/8 6-5/8 6-5/8	0 569 649 719	640 649 719 730	Yegua			180	386	7-27-67	T,E	P	D,E	Drilled to 785 feet.
803	V. C. Davis	F. R. Balcar	1934		300	C S	6	0 280	280 300	Yegua	110.2	2-12-37	16		1937				Abandoned.
901	Pearl Conner	Innerarity & Leubner	1966	285	228	C S	2 2	0 218	218 228	Yegua						J,E 1	D	D	
902	J. T. Forrest		1920		18	C	36			Yegua	12.0	6-3-37				J,E	D		
903	Lee Johnson		old		32	C	48			Yegua	16.2	6-3-37					D		
45-701	Lena Bitner	English Drilling Co.	1966	237	206	C S	2 2	0 196	196 206	Yegua	60	7-66				J,E 3/4	D		Gas reported in water.
801	L. O. McMillan- Long Bell Pet. Co. #1		1956		10,360													D,E	Oil test.
802	B. F. Cochran	English Drilling Co.	1960		100	C	4			Yegua	40	1-60				C,E 1	D		
803	Roy Fletcher		1925		20	C	48			Yegua	10.1	6-3-37				N			Abandoned.
50-201	Frank Horton	Innerarity & Leubner	1965	200	283	C S	2 2	0 273	273 283	Yegua						J,E 1	D	D	
202	T. L. Flowers	Innerarity & Leubner	1967	250	241	C S	2 2	0 231	231 241	Yegua	80	3-14-67				J,E 1	D	D	
301	Trans American Pet. Corp.- Ray Hambrick #1		1956		5,516													E	Oil test.
302	Burke Water Supply Corp. No. 1	Texas Water Wells	1967	265	920	C C S C	8-5/8 4-1/2 4-1/2 4-1/2	0 720? 820 875	820 820 875 920	Yegua	160	5-67	157	220	5-67	T,E 10	P	D,E	

For footnotes see end of table.

Table 7.--Record of Wells and Springs in Angelina County--Continued

Well Number	Well Owner	Driller	Year Com-pleted	Altitude of Land Surface (feet) 1/	Depth of Well (feet)	Casing and Screen Data: Casing or Screen 2/	Casing and Screen Data: Diameter (inches)	Casing and Screen Data: Depth in Feet (from)	Casing and Screen Data: Depth in Feet (to)	Indicated Water-Bearing Unit	Static Water Level 3/: Depth (feet)	Static Water Level 3/: Date	Pumping Rate and Level: Rate (gpm)	Pumping Rate and Level: Depth (feet)	Pumping Rate and Level: Date	Method of Lift and Power 4/	Use of Water 1968 5/	Logs Avail-able 6/	Remarks
AD-37-50-303	Burke Water Supply Corp. No. 2	Texas Water Wells	1967	265	347	C C S C S C	8-5/8 4-1/2 4-1/2 4-1/2 4-1/2 4-1/2	0 216 270 295 322 337	266 270 295 322 337 347	Yegua	122	4-19-67	100	201	4-19-67	T,E 10	P	D	
304	Angelina Co. Airport No. 2	English Drilling Co.	1964	285	265	C S	4 2	0 245	245 265	Yegua	87 100.9	3-23-64 7-18-68	10		3-23-64	S,E 2	P	D	
601	Southern Pine Lumber Co.- Southern Pine Lumber Co. #1		1959		2,650													E	Oil test.
602	Southern Pine Lumber Co. No. 1	Layne Texas Co.	1907	234*	704	C S	8 4-1/2			Yegua	244	10-60						D	Well deepened by F. R. Balcar to 704 feet in 1937. Has 40 feet of screen in sand from 655 feet to 704 feet. Temperature 81.5°F. Abandoned.
603	Southern Pine Lumber Co. No. 2	Layne Texas Co.	1947	234*	805	C C S	14 6-5/8 6-5/8	0 543 702	678 702 803	Yegua	260 315.2	3-30-60 4-21-69	393	164	1947	T,E 150	Ind.	D	
604	Southern Pine Lumber Co. No. 3	Layne Texas Co.	1947		808	C C S	14 6-5/8 6-5/8	0 533 698	685 698 799	Yegua	107	9-7-55	361	153	1947	T,E	Ind.	D	
605	Southern Pine Lumber Co. No. 4	Layne Texas Co.	1947		507	C C S C S C S C S C	14 6-5/8 6-5/8 6-5/8 6-5/8 6-5/8 6-5/8 6-5/8 6-5/8 6-5/8	0 230 320 340 372 382 402 422 475 495	310 320 340 372 382 402 422 475 495 507	Yegua	105	7-16-47	264	281	1947	T,E 30	Ind.	D	
606	City of Diboll No. 2	Layne Texas Co.	1965	250	535	C C C S C S C	16 10-3/4 8-5/8 8-5/8 8-5/8 8-5/8 8-5/8	0 0 436 440 445 455 520	425 436 440 445 455 520 535	Yegua	150	7-15-68	310	317	8-30-65	T,E	P	D,E	Temperature 76°F.
607	Arthur Powell	Innerarity & Leubner	1966	210	198	C S	2 2	0 188	188 198	Yegua	86	12-12-66				J,E 1	D	D	
901	City of Diboll No. 1	Layne Texas Co.	1961	257	623	C C S C S C S C	14 7 7 7 7 7 7 7	0 392 490 514 525 550 560 601	456 490 514 525 550 560 601 623	Yegua	100 80	1961 7-15-68	400	144	1961	T,E 40	D	D,E	
51-101	E. L. Kurth- Koppers Co. #1		1958		5,297													E	Oil test.
102	L. G. Capps		1930		24	C	48	0	24	Yegua	8.9	6-2-37				N			Destroyed.
201	Natural Gas Pipeline Co. of America No. 1	Layne Texas Co.	1952		307	C C S	10 6-5/8 6-5/8	0 188 275	274 275 305	Yegua	80	10-31-60	150	142	1952	T,E 15	Ind.	D	
202	Natural Gas Pipeline Co. of America No. 2	Layne Texas Co.	1952	293	305	C C S	10 6-5/8 6-5/8	0 188 273	270 273 303	Yegua	77 98	10-31-60 4-24-69	116 171	165	1952 4-24-69	T,E 15	Ind.	D	Temperature 72°F.
203	E. L. Kurth Trustee- Angelina Lumber Co. #7		1953		5,464													E	Oil test.
301	Childress (H. P. Stinson)	F. Balcar	1929	255	440	C	4			Yegua	20 16.8	6-2-37 7-17-68				J,E 1/2	D		
401	Petroleum Heat & Power Co.- Southern Pine Lumber Co. #1		1937		2,510													E	Oil test.
402	Hutson & Janner- Obid.Morris Est. #1		1948		2,330													E	Oil test.
403	Prairie Grove Water Supply Corp.	C. C. Innerarity	1967	195	572	C C S	5 2 2	0 343 512	391 512 572	Yegua	60	9-67				S,E 3	P	D,E	Reportedly pumps 35 gpm.

For footnotes see end of table.

Table 7.--Records of Wells and Springs in Angelina County--Continued

Well Number	Well Owner	Driller	Year Completed	Altitude of Land Surface (feet) 1/	Depth of Well (feet)	Casing and Screen Data: Casing or Screen 2/	Diameter (inches)	Depth in Feet (from)	(to)	Indicated Water-Bearing Unit	Static Water Level 3/: Depth (feet)	Date	Pumping Rate and Level: Rate (gpm)	Depth (feet)	Date	Method of Lift and Power 4/	Use of Water 1968 5/	Logs Available 6/	Remarks
AD-37-51-404	Havard (J. L. Russell)	Nickols	1915		156	C	8			Yegua	24.8	2-17-37							Destroyed.
501	F. W. Henderson-Weeks #1				2,492													E	Oil test.
502	E. L. Kurth Trustee-Southern Pine Lumber Co. #1		1953		4,656													E	Oil test.
503	Evlon Thompson	Atkinson	1951	255	451	C	2			Yegua	20	1951				J,E 1	D		
504	Beulah Water Supply Corp.	Lanford Drilling Co.	1965	245	560	C C S	8-5/8 3 3	0 475 517	515 517 560	Yegua	41 47.0	8-21-65 4-29-69	60	70	4-29-69	S,E 3	P	D,E	Drilled to 602 feet. Temperature 74°F.
505	Dr. Weeks		1920	200	900	C	8			Yegua	+2.0	2-17-37					N		
801	Sun Oil Co.	F. Balcar	1931		800	C S	8 6	0 760	760 800	Yegua							Ind.		
901	Strain (Olive School)		1928		13	C	36	0	13	Jackson	6.9 4.6	6-1-37 7-17-68				J,E 1/2	D		
902	Elbert Havard		1932		28	C	36	0	28	Jackson	9.6	6-1-37				N			Destroyed.
52-101	R. L. Goodman	C. C. Innerarity	1958	240	194	C S	2 2	0 184	184 194	Yegua	38	1958				J,E 1/2	D		
201	Western Hatcheries	C. C. Innerarity	1958		200	C	4			Yegua	57.7	11-30-60				J,E 1-1/2	D,S		
202	Rev. C. A. Bell	Innerarity & Leubner	1965	295	222	C S	4 4	0 212	212 222	Yegua	64.1	7-16-68				J,E 1/2	D	D	
203	Lela Hill School	F. Balcar	1934		250	C	4			Yegua	60.0	1-20-37				N			Abandoned.
301	Plus-Tex Poultry No. 1	English Drilling Co.	1957	250	135	C	2			Yegua						J,E	S		
302	Plus-Tex Poultry No. 2	English Drilling Co.	1960		135	C	4			Yegua						J,E	S		
401	K. L. McHenry et al-Southern Pine Lumber Co. #1		1941		5,565													E	Oil test.
402	Temple Industries No. 2	C. C. Innerarity	1968	210	655	C S	2 2	0 635	635 655	Yegua	20	7-68				J,E 2	D	D	
501	J. D. Johnson	C. C. Innerarity	1958		292	C	2			Yegua	2.0	12-13-60				J,E 1/2	D		
601	C. Andree III-Otis Nerrin #1		1952		5,465													E	Oil test.
602	M. M. Flournoy	F. Balcar	1936		609	C	4			Yegua	23.4	11-30-60				J,E 1-1/2	S		Casing severely corroded.
603	J. M. Wren Drilling Co.-Dew Nerron #1		1949		2,680													E	Oil test.
801	Carter-Kelly Lumber Co.	Ward Kelly	1915	198*	541	C	10	0	500	Yegua	26.2	2-12-37				N			Abandoned.
53-101	Horace Gillespie	Innerarity & Leubner	1965	250	225	C S	4-1/2 4-1/2	0 215	215 225	Yegua	44	6-1-65				J,E 1-1/2	D	D	
102	Shawnee School	Works Progress Admin.	1934		478	C	4	0	466	Yegua	65	7-15-37				N			Abandoned.
201	A. E. Forse	C. C. Innerarity	1958		147	C S	2 2	0 137	137 147	Yegua						J,E 1	D		
202	Jack Roberts		1947		27	C	36			Jackson	4.7	5-6-69				J,E 1/2	D		
301	K. L. McHenry-Long Bell Pet. Co. #1		1943		5,070													E	Oil test.
401	Atlantic Refining Co.		1941		447	C S	4	0 413	413 435	Yegua	56.9	12-2-60				J,E 2	D	D	
402	Atlantic Refining Co.		1934		452	C	6			Yegua						N			Abandoned.
601	Tex-Mo Drilling Co.-Long Bell Pet. Co. #1		1946		5,025													E	Oil test.
602	Camp Perry				Spring					Jackson							N		Estimated flow 5 gpm.

For footnotes see end of table.

Table 7.--Records of Wells and Springs in Angelina County--Continued

Well Number	Well Owner	Driller	Year Completed	Altitude of Land Surface (feet) 1/	Depth of Well (feet)	Casing and Screen Data: Casing or Screen 2/	Casing and Screen Data: Diameter (inches)	Casing and Screen Data: Depth in Feet (from)	Casing and Screen Data: Depth in Feet (to)	Indicated Water-Bearing Unit	Static Water Level 3/: Depth (feet)	Static Water Level 3/: Date	Pumping Rate and Level: Rate (gpm)	Pumping Rate and Level: Depth (feet)	Pumping Rate and Level: Date	Method of Lift and Power 4/	Use of Water 1968 5/	Logs Available 6/	Remarks
AD-37-53-801	K. L. McHenry- Humble Fee #1		1939		2,614													E	Oil test.
901	U. S. Forestry Service	Frye Drilling Co.	1958		126	C C S C	4 2-1/2 2-1/2 2-1/2	0 81 84 104	84 84 104 126	Jackson	71	3-58				J,E 3/4	D	D	
902	K. P. Coleman	Crews	1958	250	75	C	4			Jackson	58	3-58				S,E	D		Well has 10 feet of screen.
903	Texas & New Orleans R. R.				Spring					Jackson							N		
904	Zavalla W.C.I.D. No. 1	C. C. Innerarity	1964	340	693					Yegua						S,E	P	E	
905	Zavalla W.C.I.D. No. 2	C. C. Innerarity	1964	300	820	C C S	8-5/8 4-1/2 4-1/2	0 430 715	462 715 820	Yegua							N	E	Capped.
54-101	R. Y. Walker- Angelina Hardwood Co. #1		1946		3,085													E	Oil test.
401	Pleasure Point Estates No. 2	Roy Leubner Drilling Co.	1967	180	272	C S	4 4	0 262	262 272	Yegua	49	5-1-67				S,E 1-1/2	P	D	
402	Pleasure Point Estates No. 1	Dixon Water Well Service	1966	180	218	C S	4 2	0 204	204 218	Yegua						S,E 1	P		
403	Pleasure Point Estates No. 3	Roy Leubner Drilling Co.	1967	190	210	C S	4 4	0 190	190 210	Yegua	27.6	7-12-68				S,E 1-1/2	P		
404	E. T. Wilson	Dixon Water Well Service	1967	175	120	C S	2 2	0 110	110 120	Yegua	60	2-28-67				A,E 1	D	D	Gas reported in water.
901	National Forest Service No. 1	Key Drilling Co.	1967	190	233	C C S	8-5/8 4-1/2 4-1/2	0 184 205	205 205 223	Jackson	37.8	7-11-68	15	180		S,E 3/4	P	D	Caney Creek Recreation Area. Drilled to 820 feet.
902	National Forest Service No. 2	Key Drilling Co.	1967	190	233	C C S	8-5/8 4-1/2 4-1/2	0 184 205	205 205 223	Jackson			15	180		S,E 3/4	P	D,E	Caney Creek Recreation Area.
59-101	Arkansas Fuel Oil Co.- The Carter Co. #1		1940		4,013													E	Oil test.
301	The Madge Oil Co. and K. L. McHenry- Fairchild et al #1		1940		3,000													E	Oil test.
60-101	Ernest Crane	C. C. Innerarity	1955	245	244	C	4			Jackson	94.5	12-13-60				J,E 1/2	D		
201	Doyle Snelson				45	C	36			Jackson	25.4	4-25-69				J,E 1/2	D,S		
501	Charlie Havard	C. C. Innerarity	1956	200	145	C S	2 2	0 135	135 145	Jackson	65	1956				J,E 1/2	D		
61-101	Jackson Barge				14	C	48	0	14										Destroyed.
201	Macobar Corp. No. 1	Crews	1944	170	344	C	2-1/2			Jackson			Flows		11-3-60	J,E 1/4	D		Well has 12 feet of screen.
202	Macobar Corp. No. 2	T. Snowden	1955	170	344	C	6			Jackson			Flows		11-3-60	S,E 1	D		Well has 20 feet of slotted screen.
203	C. C. C. Camp 827		1915	215	300	C	8			Jackson	28.5	4-15-37				N			Abandoned.
401	L. Boykin	G. W. Boykin	1960		315	C S	2 2			Jackson						E,A	D		Gas reported in water.
601	L. R. Eubanks	Snowden	1964	140	365	C S C	2 2 2	0 345 355	345 355 365	Jackson	+6.5	7-10-68	Flows 1/2			N	D		Gas reported in water. Temperature 74°F.
62-201	K. L. McHenry- Wm. Cameron Co. #1		1941		3,512													E	Oil test.
202	Mary Frazier		1943	165	19	C	24	0	19	Jackson	4.9	7-10-68				N	N		
301	Archie Kelly	Simmons	1964	215	360	C S	2 2	0 350	350 360	Jackson	40	1967				J,E 3/4	D		
63-201	National Forest Service No. 1	Frye Drilling Co.	1962	180	366	C C S C	4-1/2 2-1/2 2-1/2 2-1/2	0 311 323 347	323 323 347 366	Jackson	52	1962				S,E 1	P	D	Sandy Creek Recreation Area.

For footnotes see end of table.

Table 7.--Records of Wells and Springs in Angelina County--Continued

1/ Altitudes which have asterisks (*) are from aneroid or differential leveling surveys. All other altitudes are estimated from USGS topographic quadrangle maps having 10-foot or 20-foot contour intervals.

2/ Identifying letters used are:

C	-	Casing or blank liner
S	-	Screen

3/ Reported water levels are given in feet; measured water levels are given in feet and tenths. + indicates water level above land surface.

4/ Identifying letters used are:

A	-	airlift	T	-	turbine	Number indicates horsepower.
C	-	cylinder	B	-	butane	
Cf	-	centrifugal	E	-	electric	
J	-	jet	H	-	hand	
S	-	submersible	N	-	none	

5/ Identifying letters used are:

D	-	domestic	N	-	none
Ind.	-	industrial	P	-	public supply
Irr.	-	irrigation	S	-	livestock

6/ D indicates drillers' log available; E indicates electric log available. Drillers' logs and electric logs are in files of Texas Water Development Board.

Table 8.--Records of Wells and Springs in Nacogdoches County

Well Number	Well Owner	Driller	Year Completed	Altitude of Land Surface (feet) 3/	Depth of Well (feet)	Casing and Screen Data: Casing or Screen 2/	Casing and Screen Data: Diameter (inches)	Casing and Screen Data: Depth in Feet (from)	Casing and Screen Data: Depth in Feet (to)	Indicated Water-Bearing Unit	Static Water Level 3/: Depth (feet)	Static Water Level 3/: Date	Pumping Rate and Level: Rate (gpm)	Pumping Rate and Level: Depth (feet)	Pumping Rate and Level: Date	Method of Lift and Power 4/	Use of Water 1969 5/	Logs Available 6/	Remarks
TX-37-09-501	Art Cranford		1928	325	30	C	42			Reklaw	26.1	9-4-36				N			Abandoned.
502	Sacul Water Supply Corp.	Lanford Drilling Co.	1965	325	285	C C S	7 3 3	0 200 240	240 240 285	Carrizo	67	5-6-65	75	104	5-6-65	S,E 3	P	D,E	Drilled to 722 feet.
503	Ida Dixon			305	18	C	30			Queen City	2.6	2-7-69				N	D		
601	Dunigan Bros.- Arken Cranford #1		1946	4,830														E	Oil test.
602	J. P. Furra		1924	345	34	C	36			Reklaw	28.2	9-4-36				N			Abandoned.
603	T. & N.O.R.R.			280	Spring					Alluvium						N	N		Estimated flow 8 gpm in 1936.
901	Coulston Drilling Co.- J. L. Dedman #1		1958		4,875													E	Oil test.
902	A. J. Mason		old	410	52	C	36			Queen City	45.3	9-8-36				N	D		
10-201	Humble Oil & Refining Co - Trawick Gas Unit #40		1953		8,280													E	Oil test.
301	Ernie Owens		1932	370	25	C	36			Wilcox	19.5	9-4-36				J,E	D		
302	Albrey Matlock	Smelley	1965	330	91	C	39			Wilcox						J,E	D		
401	Humble Oil & Refining Co.- Trawick Gas Unit #48		1954		8,861													E	Oil test.
402	City of Cushing No. 1	J. N Heard	1936	405	320	C S	6 4-1/2	0 280	280 320	Carrizo	114.9 116.4 117.3 125.5 117.8 122.8	2-24-42 2-9-45 7-11-50 7-19-55 3-25-60 4-25-67				S,E	P	D	Standby well. Rarely used. Water level measurements since 1942. Temperature 71°F.
403	City of Cushing No. 2	Layne Texas Co.	1959	405	500	C C S C S C	10-3/4 6-5/8 6-5/8 6-5/8 6-5/8 6-5/8	0 258 368 429 458 480	360 368 429 458 480 500	Wilcox	138 164.5 159.8	6-15-59 12-11-68 5-14-69	104 110	239	6-15-59 5-14-69	T,E 20	P	D,E	Drilled to 1,202 feet. Water level measurements since 1961.
404	L. S. King		1936	460	42	C	36			Queen City	32.7	9-4-36				N	N		Water reported in fine sand.
405	Ocie Denney		1900	510	39	C	36			Queen City	31.9	9-8-36				N			Destroyed. Water reported in hard gray sand.
501	L. L. Ivy		1934	360	21	C	36			Reklaw	14.7	8-21-36				N			Destroyed. Reported unfit for domestic use.
502	J. F. Ivy		1932	375	50	C	36			Carrizo	44.4	9-4-36				N			Abandoned. Water reported in white sand.
601	Humble Oil & Refining Co.- Trawick Gas Unit #22		1952		8,079													E	Oil test.
602	Humble Oil & Refining Co.- Trawick Gas Unit #8-1		1951		7,950													E	Oil test.
603	Humble Oil & Refining Co.- Trawick Gas Unit #28		1952		8,261													E	Oil test.
604	A. McMillan		1890	425	25	C	36			Reklaw	20.9	8-21-36				N			Abandoned.
605	George Lewis		1940	440	20	C	42			Carrizo	2.9	2-11-69				N	D		
701	B. A. Birdwell		1916	440	48	C	36			Queen City	43.4	9-8-36				N			Abandoned. Water in white sand under rock.
702	U. Cornelius		1931	465	41	C	42			Queen City	34.4	9-8-36				N			Abandoned.
703	Clifford C. Whitaker	Howeth's Well Service	1968	360	242	C S	4 4			Carrizo						S,E 1	S		
801	Humble Oil & Refining Co.- Trawick Gas Unit #13-1		1951		8,720													E	Oil test.
802	J. A. Brewer		old	680	30	C	36			Sparta	21.1	9-8-36				N			Abandoned.
803	T. B. Fountain		old	400	31	C	36			Reklaw	24.5	9-8-36				N			Abandoned.
901	Humble Oil & Refining Co.- Layne Texas Co.		1950	420	452	C C S C	8 4 4 4	0 305 420 440	408 420 440 452	Wilcox						T,E 5	Ind.	D,E	Drilled to 503 feet.
902	Humble Oil & Refining Co.- Thurman Crawford et al #1		1949		8,257													E	Oil test.

For footnotes see end of table.

Table 8.--Records of Wells and Springs in Nacogdoches County--Continued

Well Number	Well Owner	Driller	Year Completed	Altitude of Land Surface (feet) 1/	Depth of Well (feet)	Casing and Screen Data: Casing or Screen 2/	Casing and Screen Data: Diameter (inches)	Casing and Screen Data: Depth in Feet (from)	Casing and Screen Data: Depth in Feet (to)	Indicated Water-Bearing Unit	Static Water Level 3/: Depth (feet)	Static Water Level 3/: Date	Pumping Rate and Level: Rate (gpm)	Pumping Rate and Level: Depth (feet)	Pumping Rate and Level: Date	Method of Lift and Power 4/	Use of Water 1969 5/	Logs Available 6/	Remarks
TX-37-10-903	Humble Oil & Refining Co.-Trawick Gas Unit #10-1		1951		8,050													E	Oil test.
904	Mrs. Nellie Acrey		1921	460	20	C	36			Reklaw	16.5	9-7-36				N			Abandoned.
11-401	Humble Oil & Refining Co.-Trawick Gas Unit #14-1		1951		8,029													E	Oil test.
402	Luke Moore		1900	420	26	C	30			Carrizo	19.2	8-21-36				N			Abandoned. Water reported in hard gravel and sand.
403	A. A. Acrey	A. A. Acrey	1899	340	25	C	36			Carrizo	18.9	8-21-36				N			Abandoned.
501	Mrs. P. J. Coates	E. C. Coates		445	44	C	30			Carrizo	40.0	8-29-36				N			Destroyed. Water in white sand.
502	R. E. Muller			385	Spring					Carrizo						N	N		Estimated flow in 1936, 1 gpm from sand.
601	Humble Oil & Refining Co.-Trawick Gas Unit #43		1953		8,166													E	Oil test.
602	J. E. Blackburn	Galloway	1956	490	294	C S	4 3			Wilcox	41	1961	10			J,E 1	D		
603	A. J. Sieffert	Smelley	1960	480	42	C	30			Carrizo	15	1969				J,E 3/4	S		
604	H. J. Mings	Galloway	1950	520	345	C S	4 3			Wilcox			10			S,E	D,S		
701	Humble Oil & Refining Co.-Trawick Gas Unit #19		1952		8,024													E	Oil test.
702	S. H. Watkins			400	Spring					Reklaw									Estimated flow in 1936, 1 gpm from sand.
703	S. H. Watkins		1906	420	37	C	40			Carrizo	30.6	8-20-36				N			Destroyed.
704	T. Y. Blackburn		1906	430	31	C	42			Reklaw	18.2	8-21-36				N			Abandoned.
705	W. W. Sitton		1930	420	28	C	36			Reklaw	14.8	9-7-36				N			Abandoned.
706	R. E. Dempsey	Norris Lankford	1957	405	676	C	7			Wilcox	128.2	1-9-69				J,E 2	D,S		Temporarily shut down for repairs.
707	J. W. Caver	Dick Fenton	1959	430	30	C	36			Carrizo	22	1969				J,E 1/2	D,S		
801	Humble Oil & Refining Co.-Trawick Gas Unit #35		1953		8,340													E	Oil test.
802	Nacogdoches Industrial Foundation	Layne Texas Co.	1960		1,506											N		D,E	Test hole. Water samples collected from five zones.
803	Caro Lumber Co.	Mellar Drilling Co.	1938	400	507	C C S	6 4 4	0 240 450	266 450 500	Wilcox	94.1	2-24-42				N		D	Abandoned. Historical water levels for 1942.
804	J. L. Dedman	Merle Pretty	1941	410	240	C S	6 4			Carrizo	124.4	2-24-42					D,S		Historical water levels for 1942.
805	L. L. Stephens	M. I. Stephens	old	440	27	C	48			Carrizo	25.0 24.8	9-22-42 5-30-44				N			Abandoned. Historical water levels 1942-1944.
806	Tom Crossland		old	450	23	C	42			Reklaw	16.3	8-28-36				N			Destroyed.
807	A. E. Wilburn	Smelley		420	100	C	30			Carrizo						J,E	S		
901	Caro Water Supply Corp.	Triangle Pump & Supply	1965	415	463	C C S	8-5/8 3-1/2 3-1/2	0 371 421	421 421 463	Wilcox	139.6	5-16-69	85	195	5-16-69	S,E 7-1/2	P	D,E	Drilled to 552 feet.
902	Mrs. M. E. Reider	J. W. Randall	1931	455	20	C	36			Reklaw	13.8	8-31-36				N	N		
903	G. R. Solomon		1911	440	19	C	42			Carrizo	12.6	8-29-36				N	N		Water reported in red sandrock under 2-inch layer of iron rock.
904	John Bailey			440	73	C	36			Carrizo	67.4	8-29-36				N			Abandoned.
905	Wilmer Scroggins	Wilmer Scroggins	1931	450	27	C	36			Carrizo	18.8	8-31-36				N			Abandoned.
906	Hollis Solomon	Chambers Water Well Service		485	565	C	4			Wilcox						J,E 2	S		
12-201	T. D. Lansford			505	Spring					Carrizo						J,E 1/3	D,S		

For footnotes see end of table.

Table 8.--Records of Wells and Springs in Nacogdoches County--Continued

Well Number	Well Owner	Driller	Year Com-pleted	Altitude of Land Surface (feet) 1/	Depth of Well (feet)	Casing and Screen Data: Casing or Screen 2/	Diameter (inches)	Depth in Feet (from)	(to)	Indicated Water-Bearing Unit	Static Water Level 3/: Depth (feet)	Date	Pumping Rate and Level: Rate (gpm)	Depth (feet)	Date	Method of Lift and Power 4/	Use of Water 1968 5/	Logs Avail-able 6/	Remarks
TX-37-12-301	T. J. Williams		old	490	19	C	42			Wilcox	9.9	10-5-36				N	D		Water reported in clay.
401	Boy Scouts of America			430	Spring					Carrizo							P		Supplies Camp Tonkawa. Flow 0.5 cfs on 3-31-42. Est. flow 200 gpm on 12-4-68. Temperature 65°F.
501	A. M. Fosbee			490	24	C	36			Carrizo	22.4 16.7	10-8-36 6-17-41				N			Abandoned. Water reported in red sand. Historical water levels 1936-1941.
502	Bellevue School			460	Spring					Carrizo						N	N		Estimated flow 3.5 gpm in 1936.
503	Max Hart, Jr.			460	Spring					Carrizo						J,E 1	D,S		Reported flow 2.5 gpm.
601	J. L. Williams		1921	335	34	C	36			Wilcox	30.4	10-5-36				N	N		Water reported in black clay.
602	W. C. Lee		1890	380	19	C	42			Wilcox	13.3	10-5-36				N	N		Water reported above lignite bed.
701	J. H. Summers	J. H. Summers	1932	410	35	C	42			Carrizo	32.2	10-6-36				N			Destroyed.
702	Roy Grey		1934	405	23	C	42			Carrizo	20.2	10-6-36				N			Abandoned.
801	Mrs. G. Fitzgerald				36	C	48			Carrizo	30.0 32.5	9-22-42 10-10-44							Historical water levels 1942-1944.
802	Texas Highway Department			360	Spring					Carrizo						N	S		Estimated flow 2 gpm in 1936. Temperature 72.5°F.
803	J. G. Fredrick	J. G. Fredrick	1925	420	48	C	28			Carrizo	41.0	10-6-36				N	D		
804	Harold Chenoweth	Innerarity & Leubner	1968	480	373	C S	4-1/2 4-1/2	0 355	355 373	Wilcox						S,E 1	D,S	D	
901	Humble Oil & Refining Co.-Garrison Lumber Co. #1		1952		8,213													E	Oil test.
902	Girl Scouts of America	Layne Texas Co.	1950	500	732													E	Test hole.
903	Girl Scouts of America			470	170	C	4			Wilcox	109					S,E	P		Supplies Girl Scout Camp.
904	Dr. L. W. Snider	Howeth's Water Well Service	1965	400	237	C S	4-1/2 2	0 213	213 237	Wilcox	80	4-1-65	10			S,E, 1	D,S	D	
905	W. V. Stokes	Innerarity & Leubner	1966	520	270	C S	4 4	0 260	260 270	Wilcox	152	4-27-66	6		4-27-66	S,E 3/4	D	D	
906	W. R. Kirk		1934	505	32	C	36			Carrizo	28.0	10-8-36				N	N		Water reported in white sand.
907	Frank White	James Shoffner	1955	445	500	C S	4 2			Wilcox	290	1966				C,E 1	D,S		
13-101	H. C. Moore		1912	330	63	C	42			Wilcox	32.5	10-6-36				N			Abandoned.
401	City of Garrison No. 1	Merle R. Pretty	1939	390	340	C S	10-3/4 4-1/2	300	340	Wilcox	94.8 130.3	3-11-39 5-13-69				T,E 15	P	D	
402	City of Garrison No. 2	Layne Texas Co.	1952	390	339	C C S	8-5/8 6-5/8 6-5/8	0 276 294	293 294 334	Wilcox	120.0 105.9 127.9	6-21-52 12-4-68 5-13-69	100 123		7-10-52 5-13-69	T,E 15	P	D,E	
403	City of Garrison		old	395	23	C	48			Wilcox	15.3 4.6	10-6-36 12-4-68				N	N		Historical water levels 1936-1940.
404	City of Garrison No. 3	Layne Texas Co.	1964	380	356	C C S C S C	14 8-5/8 8-5/8 8-5/8 8-5/8 8-5/8	0 154 262 292 316 345	254 262 292 316 346 356	Wilcox	82 93.9	9-10-64 5-15-69	195	143 180	9-10-64 5-15-69	T,E 30	P	D,E	Temperature 71.5°F.
405	A. G. Jones	Wells & Montague	1937	380	280	C S	6	182	280	Wilcox						N			Abandoned.
406	K. Barton			380	Spring					Wilcox						N	N		Known as "Red Spring." Flowed 1 gpm in 1936. Red color. Temperature 72°F.
501	J. C. Bonham-Angelina Lumber Co. #1		1936		3,534													E	Oil test.
701	Wanders School		1920	300	33	C	48			Wilcox	30.8	10-12-36				N			Abandoned. Water reported in gray quicksand.
702	R. D. Williams	English Drilling Co.	1961	320	200	C	4			Wilcox						S,E	D,S		
703	Mike Edwards	Smelley	1965	310	104	C	30			Wilcox	8.3	12-4-68				J,E	D,S		Water reported in sand near bottom of well.

For footnotes see end of table.

Table 8.--Records of Wells and Springs in Nacogdoches County--Continued

Well Number	Well Owner	Driller	Year Completed	Altitude of Land Surface (feet) 1/	Depth of Well (feet)	Casing and Screen Data: Casing or Screen 2/	Diameter (inches)	Depth in Feet (from)	Depth in Feet (to)	Indicated Water-Bearing Unit	Static Water Level 3/: Depth (feet)	Date	Pumping Rate and Level: Rate (gpm)	Depth (feet)	Date	Method of Lift and Power 4/	Use of Water 1968 5/	Logs Available 6/	Remarks
TX-37-13-704	B. Weatherly	Nettie Weatherly	1931	320	27	C	36			Wilcox	23.8	9-30-36				N			Destroyed. Water reported in gray quicksand.
801	C. C. Lowrance		1926	340	19	C	42			Wilcox	14.8	10-9-36				N			Abandoned. Water reported in gray sand.
802	H. E. Irwing		1906	310	28	C	42			Wilcox	23.1	10-9-36				N			Abandoned. Water reported in clay.
803	Billy Miller	Chambers Water Well Service	1967	340	250	C S	2 2	 241	 246	Wilcox	90	10-11-67				J,E 1	D,S		
17-201	Warren Wright- N. O. Thomas #1		1949		5,077													E	Oil test.
202	Mrs C. P. Wallace		1926	340	21	C	30			Queen City	14.6	8-27-36				N	N		Water reported in clay under shell rock.
203	Deward Phillips	Chambers Water Well Service	1952	360	397	C S	2 2			Carrizo						J,E 2	D,S		
301	Sun Oil Company- Mattie Hartless #1		1950		5,080													E	Oil test.
302	O. Thomas		1947	400	375	C	4			Carrizo	135	1965				J,E 1	D,S		
303	Luther Wallace		1910	395	43	C	36			Queen City	26.1	8-26-36				J,E	D,S		Water reported in red and white clay.
304	Johnny Bradshaw		old	440	51	C	42			Queen City	33.2	8-27-36				J,E	D		Water reported in black dirt under sand rock.
501	United Drilling Company	Roy C. White	1967	300	320	C S	3 3	0 278	278 320	Carrizo	40	12-19-67	60		12-19-67	N		D	Destroyed. Supply well for oil test.
601	Hemphill & Irwin- Mrs. J. K. Crossman #1		1957		5,250													E	Oil test.
602	A. L. Self	A. L. Self	1933	340	27	C	42			Queen City	16.9	8-26-36				N			Abandoned. Water reported in bluish-green sand.
603	C. E. Grimes	C. E. Grimes	1929	345	23	C	36			Queen City	11.2	8-26-36				N	S		Water reported in black sand.
604	L. R. Tucker		old	305	28	C	36			Queen City	12.8	8-26-36				N	N		Water reported in white sand.
605	B. K. King	B. K. King	1933	320	35	C	36			Queen City	28.1	8-26-36				N	N		Water reported in white sand.
606	J. A. Tindally	J. A. Tindally	1927	380	25	C	36			Queen City	14.9	8-27-36				N			Abandoned.
607	Douglass Water Supply Corp.	Layne Texas Co.	1964	365	472	C C S C	7 3-1/2 3-1/2 3-1/2	0 320 409 460	400 409 460 472	Carrizo	152	9-26-64	80	163	9-26-64	S,E	P	D,E	Drilled to 695 feet.
608	Elmo Haltom	Smelley	1955	360		C S	2 2			Carrizo	60 180	1955 1968				C,E 1/3	D		
801	W. M. Coats- S. H. Watkins #2		1967		5,212													E	Oil test.
802	C. Watkins		old	260	28	C	36			Queen City	24.3	9-25-36				N	N		Water reported in white sand.
803	United Drilling Company	Roy C. White	1967	265	415	C S	3 3	0 352	352 415	Carrizo	75	10-15-67	50		10-15-67	N		D	Destroyed. Supply well for oil test.
901	Fain-McGaha-Peckham- Yates #1		1942		5,530													E	Oil test.
902	Service Pipe Line Company	McMasters & Pomeroy	1940	332	550	C C S	6 4 4	0 484 506	505 506 549	Wilcox	63 66.6 85.0 109.9 131.4 149.5	1940 9-18-42 7-20-48 7-12-55 9-13-61 4-15-69				T,E 7-1/2	N	D	Motor and pump still in place, but well not used since 1966. Water level measurements since 1942.
903	W. R. Barnett		old	350	31	C	48			Queen City	23.4	9-25-36				N			Abandoned. Water reported in white sand.
904	J. N. Craft		1926	280	34	C	36			Queen City	29.9	9-23-36				N			Abandoned. Water reported in red gravel.
905	W. H. Butler		old	340	31	C	42			Weches	23.6	9-23-36				N	N		Water reported in bluish-green sand.
906	Feather Crest Farms No. 1	B. G. & R. Drillers		310	308	C	4			Reklaw						S,E 1-1/2	S		
18-101	Lilbert-Looneyville Water Supply Corp.	C. C. Innerarity	1966	440	495	C	7			Carrizo						S,E	P	D,E	
102	W. T. Free		old	440	37	C	36			Weches	26.5	8-27-36				N			Destroyed. Water reported in black sand.
103	W. D. Baxter		1926	425	25	C	36			Queen City	19.8	9-3-36				N	N		

For footnotes see end of table.

Table 8.--Records of Wells and Springs in Nacogdoches County--Continued

Well Number	Well Owner	Driller	Year Com- pleted	Altitude of Land Surface (feet) 1/	Depth of Well (feet)	Casing and Screen Data: Casing or Screen 2/	Casing and Screen Data: Diameter (inches)	Casing and Screen Data: Depth in Feet (from)	Casing and Screen Data: Depth in Feet (to)	Indicated Water-Bearing Unit	Static Water Level 3/: Depth (feet)	Static Water Level 3/: Date	Pumping Rate and Level: Rate (gpm)	Pumping Rate and Level: Depth (feet)	Pumping Rate and Level: Date	Method of Lift and Power 4/	Use of Water 1968 5/	Logs Avail- able 6/	Remarks
TX-37-18-201	Mosser & Sintliff- W. B. Bates #1		1957		9,152													E	Oil test.
202	B. A. Sitton	Roy C. White	1966	460	545	C C S C S C	5 2-1/2 2-1/2 2-1/2 2-1/2 2-1/2	0 474 500 510 530 540	479 500 510 530 540 545	Wilcox	200	7-22-66	10			S,E 1	D,S	D	
203	M. D. Shofner		1934	440	17	C	36			Queen City	14.6	9-3-36				N			Abandoned. Water reported in sand and gravel.
204	Loy heirs		old	450	42	C	36			Queen City	18.3	9-3-36				N	D		Rarely used.
205	A. Birdwell			440	Spring					Queen City						N	S		Estimated flow 1/2 gpm in 1936.
206	Curtis Nance	Frye Drilling Co.	1963	460	408	C	4			Carrizo						S,E 2	D		
207	Willie Vaught	Willie Vaught	1954	610	28	C	36			Sparta	20	1968				J,E 1/2	D,S		
301	Humble Oil & Refining Co.- Trawick Gas Unit #46-1		1954		8,240													E	Oil test.
302	E. S. Bradshaw	E. S. Bradshaw	1921	440	37	C	36			Queen City	30.1	9-2-36				J,E	D,S		
303	C. Whitton		1900	460	36	C	36			Queen City	24.7	9-2-36				N			Destroyed. Water reported in white sand.
304	J. D. Birdwell		1912	450	31	C	36			Queen City	22.5	9-3-36				N			Abandoned.
401	Humble Oil & Refining Co.- Sam Stripling #1		1953		9,535													E	Oil test.
402	E. H. Croft	E. H. Croft	1929	385	17	C	36			Queen City	11.3	8-25-36				N	N		Water reported in red and gray chalky clay.
403	H. W. McCuistan		1934	380	28	C	36			Queen City	16.1	8-28-36				N	D		
404	M. F. Whitaker	M. F. Whitaker	1912	485	34	C	36			Weches	18.8	8-28-36				N			Abandoned. Water reported in black sand.
405	Feather Crest Farms No. 2	B. G. & R. Drillers		420	150	C	4			Queen City						S,E	S		Sulfur odor.
406	Don Trawick	Howeth Water Well Service	1968	445	440	C S	4-1/2 2	0 408	408 438	Carrizo	240	11-11-68	12			S,E 1-1/2	D,S		
407	Don Ryan		1935	385	500	C	4			Carrizo						S,E 1	D,S		
501	Loy heirs		1835	395	52	C	36			Queen City	47.7	9-2-36				N			Destroyed.
601	T. A. Crisp		1916	400	25	C	36			Queen City	14.7	9-2-36				N			Destroyed.
602	William Guidry	Smelley		415	80	C	30			Queen City						J,E 3/4	D,S		
701	Texas Pipeline Co.	Layne Texas Co.	1949	365	507	C C S	8-5/8 4-1/2 4-1/2	0 331 441	431 441 481	Carrizo			24		1949	N	N	D,E	Temperature 72°F.
702	Sun Pipeline Co.	Sun Pipeline Co.	1957	360	438	C S	4 4	0 405	405 430	Carrizo	145	1957				S,E 1/2	D	D	
703	Texas Pipeline Co.	W. M. Brown & Co.	1934	360	525	C S C	6 6 6	0 478 502	478 502 525	Carrizo	34.0 83.4	10-13-36 9-18-42				N		D	Destroyed. Reported sulfur taste. Historical water levels 1942-1943.
801	Humble Oil & Refining Co.- Sam B. Hayter #1		1951		9,372													E	Oil test.
802	William Scott	William Scott	1926	370	21	C	36			Queen City	14.6	8-25-36				N			Abandoned.
901	Pearl Oil Company	J. C. McNeil	1930	360	4,314	C	10		400	Carrizo, Wilcox	4.2 15.2	9-18-42 7-28-45	Flowed 35		1934	N			Destroyed. Reported sulfur odor and taste. Historical water levels 1942-1945.
902	Humble Oil & Refining Co.- Sam B. Hayter #3		1953		9,415													E	Oil test.
903	Sam Hayter		old	490	27	C	30			Sparta	23.1	8-25-36				N			Destroyed.
19-101	J. B. Burk		1882	340	36	C	42			Reklaw	24.9	9-7-36				N			Abandoned.
102	Will Murphy	Will Murphy	1885	390	21	C	36			Reklaw	14.1	8-19-36				N			Destroyed.
201	C. B. Watkins		1901	470	25	C	36			Queen City	16.7	9-7-36				N	D		Seldom used. Water reported in black sand and clay with pyrite crystals.

For footnotes see end of table.

Table 8.--Records of Wells and Springs in Nacogdoches County--Continued

Well Number	Well Owner	Driller	Year Completed	Altitude of Land Surface (feet) 1/	Depth of Well (feet)	Casing and Screen Data: Casing or Screen 2/	Casing and Screen Data: Diameter (inches)	Casing and Screen Data: Depth in Feet (from)	Casing and Screen Data: Depth in Feet (to)	Indicated Water-Bearing Unit	Static Water Level 3/: Depth (feet)	Static Water Level 3/: Date	Pumping Rate and Level: Rate (gpm)	Pumping Rate and Level: Depth (feet)	Pumping Rate and Level: Date	Method of Lift and Power 4/	Use of Water 1968 5/	Logs Available 6/	Remarks
TX-37-19-202	Mrs. J. F. Hardy		1930	510	28	C	36			Weches	17.3	8-28-36				N			Abandoned.
301	B. A. Hurst	Layne Texas Co.	1945	430	340	C C S	4-1/2 2-7/8 2-7/8	0 226 310	282 310 325	Carrizo	85 112.0	1945 1-8-69	5			J,E	D,S	D	
302	T. H. Hill		1903		24	C	36			Queen City	15.0 11.5	8-31-36 7-13-40					D,S		Water reported in gray sand. Historical water levels 1936-1940.
303	Mary Hickenbottom		old	460	27	C	48			Queen City	18.9	8-31-36				N			Destroyed.
401	Lilly Grove Water Supply Corp.	C. C. Innerarity	1965	500	591	C C S	8-5/8 3-1/2 3-1/2	0 448 490	488 490 530	Carrizo	312	8-25-65	150	335	8-25-65	S,E 15	P	D,E	Sulfur odor.
402	W. E. Ballard		old	400	36	C	36			Weches	17.6	9-2-36				N			Abandoned.
403	W. R. Birdwell		1906	460	41	C	36			Weches	34.6	9-1-36				N			Abandoned. Water reported in black dirt overlying rock.
501	W. J. Parmley		1931	560	30	C	30			Weches	23.4	9-7-36				N			Abandoned.
502	M. H. Dennard		1936	560	44	C	36			Sparta	41.6 41.2	2-28-36 11-17-40				J,E	D		Historical water levels 1936-1940.
601	H. B. Hudson	Goad & Mettaver	1937	417*	400	C	6			Carrizo	72.9 73.5 77.2 89.5 97.5 119.7	8-6-37 7-13-40 5-25-45 7-11-50 7-18-52 1-7-69				S,E	D,S	D	Historical water levels 1937-1953.
701	Sam Hayter		old	420	19	C	36			Weches	12.6	8-25-36				N			Abandoned.
702	Mrs. J. C. Miles			500	39	C	42			Sparta	33.8	9-1-36				N			Destroyed. Water reported in red clay.
703	W. E. Boozer		1956	370	50	C	30			Weches						J,E	D		
801	B. Danforth	Roy Fleniken	1936	420	22	C	42			Weches	18.0	8-19-36				N			Destroyed. Water reported in hard brown sand.
802	G. E. Norwood		1896	400	32	C	36			Sparta	25.4	8-19-36				N			Abandoned.
901	City of Nacogdoches	Layne Texas Co.	1945	430	492	C C S	6-5/8 4-1/2 4-1/2	0 357 446	402 446 492	Carrizo	150	3-29-45				N		D	Destroyed.
902	J. Thomas Hall		1914	420	2,007	C	4	0	1,400	Carrizo	142.6 161.2 196.4 218.9 242.7 242.3	1-15-43 11-17-45 7-24-50 7-13-55 7-14-60 5-9-63				N	N		Casing reported shot at 540 feet. Historical water levels 1943-1963.
903	R. L. Whitmire		1912	400	28	C	36			Sparta	21.1 9.3	8-28-36 11-27-40				N	N		Historical water levels 1936-1940.
904	C. S. Jones		1941		550	C S	6 6	0 515	515 549	Carrizo	114.3 116.4	9-17-42 6-26-43					N		Historical water levels 1942-1943.
905	A. E. Reed		old	460	33	C	30			Sparta	30.0	9-1-36				J,E	D		Water reported in white sand.
20-101	Appleby Water Company	Meller	1938	430	302	C C S	6 4-1/2 4-1/2	0 234 256	235 256 282	Carrizo	92.2 95.0 98.9 109.4 114.6 120.2	2-24-42 5-25-45 7-11-50 6-21-55 6-30-60 4-25-67				N		D	Abandoned. Water level measurements since 1942.
102	Mollie A. Troutman		1936	420	20	C	36			Reklaw	11.3 11.3	8-31-36 10-10-38				N			Abandoned. Historical water levels 1936-1938.
103	Appleby Water Supply Corp.	C. C. Innerarity	1964	445	500	C C C S	13-3/8 10-3/4 7 7	0 0	275 395	Wilcox	160	9-3-64				S,E 30	P	D,E	80 feet of screen reported between 395 and 500 feet. Test hole drilled to 717 feet.
104	Mrs. J. S. Troutman		1914	410	560	C	5-3/16			Wilcox			40		1936	N			Destroyed. Reported sulfur odor. Formerly supplied Appleby.
201	D. W. Scroggins		1912	380	36	C	36			Carrizo	30.3	10-8-36				N	N		Water reported in gray sand.
301	J. L. Scroggins	D. S. Hancock	1924	380	47	C	36			Carrizo	43.1	10-8-36				N			Abandoned.
401	J. N. Skeeters	Galloway Drilling Co.	1953	380	292	C S	4 4	0 240	240 292	Carrizo	155	1-21-69				S,E 1	N		Not used since 1967.

For footnotes see end of table.

Table 8.--Records of Wells and Springs in Nacogdoches County--Continued

Well Number	Well Owner	Driller	Year Completed	Altitude of Land Surface (feet) 1/	Depth of Well (feet)	Casing and Screen Data: Casing or Screen 2/	Casing and Screen Data: Diameter (inches)	Casing and Screen Data: Depth in Feet (from)	Casing and Screen Data: Depth in Feet (to)	Indicated Water-Bearing Unit	Static Water Level 3/: Depth (feet)	Static Water Level 3/: Date	Pumping Rate and Level: Rate (gpm)	Pumping Rate and Level: Depth (feet)	Pumping Rate and Level: Date	Method of Lift and Power 4/	Use of Water 1968 5/	Logs Available 6/	Remarks
TX-37-20-402	Ed Greer			430	22	C	36			Reklaw	17.1	9-1-36				N			Abandoned.
601	J. C. Greening		old	380	26	C	42	0	25	Reklaw						C,E 1/2	D		
602	J. C. Greening		1954	380	217	C S	2 2			Carrizo	80	1965				J,E 1	S		Sulfur odor.
701	W. A. Mize	Norris Langford	1952	360	350	C	7			Carrizo	87	1952				T,B	Irr.	D	Drilled to 682 feet.
702	E. W. Rice	Calloway Drilling Co.	1953	480	522	C S	4 3	0 507	507 522	Carrizo	215	1953				S,E	D	D	Drilled to 593 feet.
703	Wiley W. Baker	Chambers Water Well Service	1964	400	425	C	2			Carrizo						J,E 5	D,S		
704	Allen Burgess	Chambers Water Well Service	1964	350	400	C	2			Carrizo						J,E 3	D,S		
705	Tilda Parker		1933	440	42	C	42			Weches	39.7	9-1-36				N			Destroyed.
801	The Texas Company- C. W. Strahan #1		1942		9,292													D,E	Oil test.
802	Crow Drilling Co.		1942	445	535	C S S S	6-5/8 6-5/8 6-5/8 6-5/8	0 280 440 510	280 340 465 535	Carrizo, Wilcox	152.5	2-10-43					N		Supply well for oil test. Historical water levels for 1943.
803	John D. Wilson		1958	600	500	C	4			Carrizo						S,E	D		
804	Halberts, Inc.		1961	380	425	C	4			Wilcox						S,E	D,S		
901	Felix Burnaham	Innerarity & Leubner	1956	360	400	C	4			Wilcox						N	N		
902	George Haltom	Frye Drilling Co.	1964	340	630	C	4			Wilcox						S,E 2	D,S		
903	H. T. Haltom		1928	325	17	C	42			Reklaw	13.4	10-12-36				N			Destroyed.
21-101	Z. Rambin		old		24	C	36			Carrizo	18.4	10-8-36				N			Abandoned.
201	L. D. Burke		1886	300	41	C	48			Wilcox	30.6	10-12-36				N			Abandoned.
202	W. L. Burkhalter		1928	410	26	C	48			Wilcox	21.7	10-9-36					D,S		
203	Gus Young		1929	400	30	C	48			Wilcox	26.8	10-9-36				N			Destroyed.
401	Mrs. G. E. Stoker		old	390	63	C	48			Carrizo	57.5	10-12-36				N			Destroyed.
402	I. Caldwell		1935	300	32	C	36			Carrizo	28.0	9-26-36					D		Water reported in white sand.
501	Plus-Tex Poultry	English Drilling Co.	1959	320	160	C	4			Wilcox	70.0	7-5-61				J,E 1	D,S		
502	Magnolia Pet. Co.- W. L. Harrell #1		1945		8,182													E	Oil test.
503	Moss Adams				Spring					Carrizo						N	D,S		Estimated flow 1 gpm from sandy clay in 1936.
504	J. W. Burt		1902	310	62	C	36			Wilcox	56.5	9-26-36				N	N		
701	Southland Paper Mills, Inc.	Layne Texas Co.	1949	396*	235	C S	4 4	0 213	213 234	Carrizo	111.6 111.5 120.0 123.6 131.3 132.5	3-19-49 7-11-50 5-17-55 2-26-60 5-6-65 4-15-69				N	N	D,E	Observation well. Drilled to 286 feet. Water level measurements since 1949.
702	Mrs. W. B. Turner		1926	390	27	C	36			Reklaw	14.4	9-14-36				N	N		
801	B. W. Covington		1956	325	392					Wilcox	90.0	1956				J,E 1	D,S		
802	Henry Ennis		1904	325	20	C	36			Reklaw	12.8	9-14-36				N	N		Water reported in red clay. Abandoned.
803	J. D. Martin		1906	350	74	C	36			Carrizo	67.9	9-26-36				N	N		Water reported in white sand.
901	D. L. Burke	C. C. Innerarity	1963	320	264					Wilcox						S,E	D		
902	W. F. Martin		1930	290	24	C	36			Carrizo	18.6	9-14-36				N	N		

For footnotes see end of table.

Table 8.--Records of Wells and Springs in Nacogdoches County--Continued

Well Number	Well Owner	Driller	Year Completed	Altitude of Land Surface (feet) 1/	Depth of Well (feet)	Casing and Screen Data: Casing or Screen 2/	Diameter (inches)	Depth in Feet (from)	Depth in Feet (to)	Indicated Water-Bearing Unit	Static Water Level 3/: Depth (feet)	Date	Pumping Rate and Level: Rate (gpm)	Depth (feet)	Date	Method of Lift and Power 4/	Use of Water 1968 5/	Logs Available 6/	Remarks
TX-37-25-301	Shell Pipeline Co.		1936	353*		C	5			Carrizo	81.5 109.1 132.8 151.5 169.7 194.1 219.0	4-7-40 11-17-45 7-24-50 7-12-55 7-15-59 5-11-66 4-11-68				C,E	D, Ind.		Reported sulfur odor. Water level measurements since 1940. Temperature 74°F.
601	Sam Stripling		old	310	26	C	36			Weches	21.7	9-24-36				N			Destroyed. Water reported in white sand.
26-101	Homer Richards			445	27	C	36			Sparta	22.7	9-22-36				N			Destroyed. Water reported in red gravel.
102	I. C. Ferguson		1925	440	20	C	36			Sparta	14.7	9-22-36				N	N		
301	Cecil Myers		old	460	45	C	36			Sparta	41	1969				J,E 1/3	D		
401	Ben Stripling	Frye Drilling Co.	1961	300	530	C	4			Carrizo	150	5-61				S,E 1	D,S		Top of sand at 470 feet. Screen length 20 feet.
402	E. H. Johnson		1932	310	55	C	36			Sparta	49.5	9-24-36				N	N		Water reported in red gravel.
403	R. E. Tindall		1927	430	20	C	36			Weches	10.1	9-24-36				N			Abandoned. Water reported in white sand.
404	J. P. Partin	Cason & Monk	1959	290	500	C	4			Reklaw						S,E	D		
501	Humble Oil & Refining Co.- A.T. & H.R. Mast et al #1		1954		10,057													E	Oil test.
502	B. L. Johnson		old	310	25	C	42			Weches	15.2	9-22-36				N	N		
503	Ben Johnson	C. C. Innerarity	1968	370	219	C	4			Queen City	40	1968				S,E	D,S		
601	M. L. Christopher	C. C. Innerarity	1956	370	290	C	2			Queen City						J,E 1	D		
801	Humble Oil & Refining Co.- A. T. Mast #1		1957		3,520													E	Oil test.
802	A. T. Mast		1938		700	C S	4 4	0 689	689 700	Carrizo	Flows + 4.9	9-3-41 4-5-43							Historical water levels for 1943.
803	C. C. Collier- Mast #1-A		1937		1,056													E	Oil test.
804	Texas Foundries Club	Innerarity & Leubner	1964	240	137	C S	4 4	0 127	127 137	Sparta	2	11-10-64				S,E 1/2	D	D	
805	Sam Stripling		1936	260	42	C	36			Sparta	38.2	9-24-36				N	N		Water reported in sand under 3 feet of rock.
806	A. T. Mast		1935	260	48	C	36			Sparta	43.5	9-23-36				N	N		Water reported in white sand.
901	E. Blount	V. E. West	1956	220	860	C S C S	7 7 7 7	0 238 280 580	238 280 580 770	Queen City, Carrizo, Wilcox						N	N	D	Pump inoperable since 1964.
902	B. M. Matlock		1922	310	44	C	36			Sparta	40.0	9-23-36				N	N		Water reported in red gravel.
903	William J. Pitts	Chambers Water Well Service	1956	320	552	C S	2 2			Reklaw	260	1956				C,E 1/3	D		Water level reported to have dropped 60 feet since 1956.
27-101	T. F. Harvin	Smelley	1953	290	444	C	4			Carrizo						S,E 1	D,S		
102	R. V. Davidson		old	320	24	C	30			Weches	19.9	9-18-36				N			Destroyed.
201	City of Nacogdoches No. 5	Layne Texas Co.	1956	385*	512	C C C S C	30 24 16 12-3/4 12-3/4	0 0 349 441 502	30 411 441 502 512	Carrizo	292.7 321.2	7-11-57 4-11-68	790		1963	T,E 125	P	D,E	Test hole drilled to 1,061 feet. Water level measurements since 1957. Temperature 78°F.
202	Audrey King	Chambers Water Well Service			514					Carrizo						S,E	D		
203	G. W. Tillory			440	Spring					Sparta						N	N		Estimated flow 12 gpm in 1936 from sand and gravel.
301	City of Nacogdoches No. 1	Layne Texas Co.	1929	294*	426	C C S	20 10-3/4 10-3/4	0 381 391	381 391 425	Carrizo	18.6 38.8 72.4 154.4 197.5 203.8 229.3	4-28-37 7-14-40 8-13-44 7-24-50 6-2-59 5-6-65 4-11-68	465	325	8-8-68	T,E 75	P	D	Well rebuilt 1952. Water level measurements since 1937. Temperature 74.5°F.

For footnotes see end of table.

Table 8.--Records of Wells and Springs in Nacogdoches County--Continued

Well Number	Well Owner	Driller	Year Completed	Altitude of Land Surface (feet) 1/	Depth of Well (feet)	Casing and Screen Data: Casing or Screen 2/	Diameter (inches)	Depth in Feet (from)	Depth in Feet (to)	Indicated Water-Bearing Unit	Static Water Level 3/: Depth (feet)	Date	Pumping Rate and Level: Rate (gpm)	Depth (feet)	Date	Method of Lift and Power 4/	Use of Water 1968 5/	Logs Available 6/	Remarks
TX-37-27-302	City of Nacogdoches No. 2	Layne Texas Co.	1933	298*	494	C C S C	20 10-3/4 10-3/4 10-3/4	0 134 381 471	381 381 471 494	Carrizo	19.9 40.1 74.0 162.8 227.5 228.7 232.4	4-28-37 7-14-40 8-13-44 7-24-50 7-16-59 4-11-68 4-14-69	465	314	8-7-68	T,E 75	P	D	Water level measurements since 1937. Temperature 75°F.
303	City of Nacogdoches No. 3	Layne Texas Co.	1946	370*	521	C C S C	20 12-3/4 10-3/4 10-3/4	0 290 415 518	415 415 518 521	Carrizo	164.0 222.1 279.5 325.6 301.7	12-12-46 7-25-50 7-13-55 9-11-61 5-11-66	565		1968	T,E 125	P	D	Pilot hole drilled to 734 feet. Water level measurements since 1946. Temperature 76°F.
304	City of Nacogdoches No. 4	Layne Texas Co.	1949	386*	548	C C S C	20 12-3/4 10-3/4 10-3/4	0 331 440 535	436 440 535 548	Carrizo, Wilcox	245.0 286.3 328.4	7-24-50 7-14-55 5-8-63	530	368	4-11-68	T,E 150	P	D,E	Water level measurements since 1950. Drilled to 738 feet. Temperature 76°F.
305	Southern Ice Co.		1925	282*	500	C S	12 6			Carrizo	4.0 15.7 40.6 83.9	9-17-36 7-14-40 3-31-44 7-21-48				N		D	Abandoned. Historical water levels 1936-1948. Temperature 72°F.
306	Southern Ice Co.				500	C	6			Carrizo	+0.7	12-13-39				N			Abandoned. Historical water levels 1939-1943.
307	Norval Bright	Gaston Bright	1935		15	C	36			Sparta	9.1 6.2	9-16-36 7-20-39					D,S		Water reported in red sandy clay under 8-inch layer of rock. Historical water levels 1936-1939.
308	Yuba Oil & Refining Co.					C	12			Carrizo	16.9 22.9	6-17-41 6-2-42				N			Abandoned. Historical water levels 1941-1942. Temperature 74°F.
309	Frost Lumber Industries		1906		375	C	4			Reklaw	13.5 13.1	9-18-42 1-15-43	40		1936	N			Abandoned. Historical water levels 1942-1943. Temperature 74°F.
401	G. L. Henson	Smelley	1951	335	220					Queen City						Cf,E	D,S		
501	Piney Woods Country Club		1922	272*	550	C S	12 4			Carrizo	+6.8 2.3 80.2 224.0	4-30-37 7-14-40 11-17-45 5-8-63	Flowed 15 gpm		1936	T,E 10	P		Well reportedly sounded at 494 feet in 1963. Reported sulfur. Historical water levels 1937-1945. Temperature 74°F.
502	Hilliard Stone		1930	310	30	C	36			Sparta	25.1 20.6	9-16-36 11-27-40				N			Destroyed. Historical water levels 1936-1940.
503	City of Nacogdoches	Texas Water Wells	1964	386*	739													D,E	Test hole.
504	City of Nacogdoches No. 6	Texas Water Wells	1964	343*	586	C C C S C	24 16 12-3/4 12-3/4 12-3/4	0 362 471 474 571	464 471 474 571 586	Carrizo	319.2	4-11-68	810	401	8-7-68	T,E 125	P	D,E	Drilled to 675 feet. Water level measurements since 1964. Temperature 77°F.
505	City of Nacogdoches No. 7	Layne Texas Co.	1964	330*	682	C C S C S C	24 16 12-3/4 12-3/4 12-3/4 12-3/4	0 374 482 572 642 667	475 482 572 642 667 682	Carrizo, Wilcox	345.8	4-11-68	760	407	8-7-68	T,E 150	P	D,E	Drilled to 720 feet. Water level measurements since 1964.
506	City of Nacogdoches No. 8	Layne Texas Co.	1964	295*	580	C C C S C S C	24 16 12-3/4 12-3/4 12-3/4 12-3/4 12-3/4	0 360 465 470 540 550 565	460 465 470 540 550 565 580	Carrizo, Wilcox	317	4-11-68	860	396	8-7-68	T,E 150	P	D,E	Drilled to 752 feet. Water level measurements since 1964.
601	Lone Star Feed & Fertilizer Co.			290	572	C C S	6-5/8 4 4	0 305 504	460 504 570	Carrizo						S,E	Ind.		
602	Hy. Hoya			280	Spring					Sparta							N		Estimated flow 3/4 gpm in 1936.
801	Union Producing Co.-Johnson #1		1956		3,650													E	Oil test.
802	City of Nacogdoches No. 9	Layne Texas Co.	1967	367*	696	C C C S C	24 16 12-3/4 12-3/4 12-3/4	0 432 553 563 680	555 553 563 680 696	Carrizo	369	4-11-68	950	450	8-7-68	T,E 200	P	D,E	Water level measurements since 1967.
803	Ben De Witt	Chambers Water Well Service	1960	300	660	C S	4 4			Carrizo, Reklaw?						S,E	D,S		

For footnotes see end of table.

Table 8.--Records of Wells and Springs in Nacogdoches County--Continued

Well Number	Well Owner	Driller	Year Completed	Altitude of Land Surface (feet) 1/	Depth of Well (feet)	Casing and Screen Data: Casing or Screen 2/	Diameter (inches)	Depth in Feet (from)	(to)	Indicated Water-Bearing Unit	Static Water Level 3/: Depth (feet)	Date	Pumping Rate and Level: Rate (gpm)	Depth (feet)	Date	Method of Lift and Power 4/	Use of Water 1968 5/	Logs Available 6/	Remarks
TX-37-27-804	Ben De Witt	Chambers Water Well Service	1960	240	600	C S	4 4			Carrizo, Reklaw?						S,E	D,S		
901	W. A. Mize	Norris Langford	1952	240	568	C	7			Carrizo	177	9-52				T,B 30	Irr.	D	
28-301	Swift Water Supply Corp.	Westex Tool Co.	1965	280	739					Wilcox								E	Abandoned. Well reportedly screened sands between 600 and 700 feet.
302	Swift Water Supply Corp.	Westex Tool Co.	1965	310	718													E	Test hole.
303	Swift Water Supply Corp. No. 2	Key Water Wells	1966	300	300					Carrizo, Wilcox						S,E	P		
304	Swift Water Supply Corp. No. 1	Key Water Wells	1966	280	347					Carrizo, Wilcox						S,E	P		
305	H. E. Seale	R. A. Morris	1935	340	18	C	36			Queen City	8.3	9-14-36				N			Abandoned.
306	Mrs. Ernest Pleasant		old	320	21	C	42			Queen City	14.4	10-13-36				N	N		Water reported in green sand.
501	E. C. Duke	Crocket Drilling Co.	1954	320	465	C S	4 2			Reklaw, Carrizo	180	1954				S,E	D,S		
502	Maness	Frye Drilling Co.	1955	340	439	C	4			Reklaw, Carrizo						S,E	D,S		
601	Hugh Jones	Raymond Smith	1957	265	327	C S	4 4			Reklaw	180	1968				S,E	D,S		
602	Roy Eastman		1955	245	400	C	4			Carrizo	106	1964				S,E 3/4	S		Reported sulfur taste.
603	Roy Eastman		1920	245	22	C	36			Weches	11.1	9-29-36				N			Destroyed. Blue rock reported in bottom.
701	Tilford Hunt		1935	290	59	C	36			Sparta	53.5	10-2-36				N			Destroyed. Water reported from white sand.
801	De Witt's Hatchery	Chambers Water Well Service	1959	240	520	C	4			Carrizo						S,E	D,S		
802	L. L. Cheever		old	285	29	C	36			Sparta	14.3	9-29-36				N	N		Water reported in red clay.
803	E. King			240												S,E 3/4	D,S		Well reported more than 200 feet deep.
804	J. P. Hill		1908	240	30	C	36			Sparta	24.0	9-29-36				N	N		Water reported in red clay.
901	Woden Water Supply Corp. No. 1	Key Water Wells	1965	280	507	C S C	8-5/8 4 4	0 418 502	420 502 507	Carrizo			80		1965	S,E 10	P	D,E	
902	Woden Water Supply Corp. No. 2	Key Water Wells	1966	270	500	C	8-5/8			Carrizo	212.6	1-14-69				S,E	P		
903	Ben Oliver		old	265	22	C	36			Sparta	13.7	9-28-36				N			Destroyed.
29-101	Plus-Tex Poultry	English Drilling Co.	1960	370	300	C	6			Carrizo						S,E 2	D,S		
102	Tom Gilcrease	English Drilling Co.	1964	440	352	C C S	4 2-1/2 2-1/2	0 274 302	274 302 352	Carrizo			35		9-64	S,E 2	D	D	
201	Sohio Petroleum Co.-A. D. Woods #1		1952		8,716													E	Oil test.
202	J. O. Justice	Norris Langford	1953	300	274	C	7			Carrizo, Wilcox	64	1953				T,B	Irr.	D	
203	Lee West		old	520	26	C	36			Sparta	20.9	10-13-36				N	N		
301	F. F. Fuller		1890	340	27	C	36			Carrizo	19.2	9-26-36				N			Destroyed. Water reported in black sandy silt.
302	Burl Black			340	154					Carrizo						J,E	D		
303	Ancle Fuller		old	325	23	C	40			Reklaw	16.8	9-26-36				N	N		
401	Melrose Oil Corp.-Cullus N. Wilson #2		1940		2,329													E	Oil test.
402	Melrose Water Supply Corp.	Key Water Wells	1965	370	352	C C S	6-5/8 4 4	0 292 322	318 322 352	Carrizo	218.0	12-6-68	68		2-65	S,E 7-1/2	P	D,E	Drilled to 390 feet.
403	O. D. Hall		1958	390	414	C	2			Carrizo						J,E	D,S		
501	R. H. Davis	Chambers Water Well Service	1964	505	448					Carrizo						C,E	D,S		

For footnotes see end of table.

Table 8.--Records of Wells and Springs in Nacogdoches County--Continued

Well Number	Well Owner	Driller	Year Com-pleted	Altitude of Land Surface (feet) 1/	Depth of Well (feet)	Casing and Screen Data: Casing or Screen 2/	Diameter (inches)	Depth in Feet (from)	(to)	Indicated Water-Bearing Unit	Static Water Level 3/: Depth (feet)	Date	Pumping Rate and Level: Rate (gpm)	Depth (feet)	Date	Method of Lift and Power 4/	Use of Water 1968 5/	Logs Avail-able 6/	Remarks
TX-37-29-502	J. W. Kendrick	J. W. Kendrick	1911	440	32	C	36			Sparta	22.1	9-28-36				N	N		Water reported in red rock.
503	J. B. Brown		1896	355	31	C	36			Weches	13.0	9-28-36				N	N		Water reported in blue rock.
601	Elvis Green	Innerarity & Leubner	1966	320	285	C S	4 4	0 275	275 285	Wilcox	67.6	1-8-69	12		7-2-66	S,E 1	D	D	
602	O. O. Smith		1925	330	17	C	36			Reklaw	10.6	9-25-36				N	N		
603	Attoyac Water Supply Corp.	Andrews & Foster	1967	340	458	C C S C S C	8-5/8 4 4 4 4 4	0 321 365 373 396 438	350 365 373 396 438 458	Wilcox			90	250	6-12-67	S,E 7-1/2	P	D,E	Drilled to 460 feet.
801	M. M. King			360	450	C	2			Carrizo						C,E	D,S		Reportedly hit 90 feet of loose sand.
901	E. C. Wall	Newton Water Well Service	1962	400	376	C S	2 2	0 362	362 372	Carrizo	175	11-3-62				A,E	D,S	D	
902	Scott	R. C. Duke	1926	340	20	C	36			Weches	10.4	9-29-36				N	N		Water reported in blue rock with shells.
903	C. P. Little		old	340	25	C	36			Sparta	13.0	9-29-36				N	N		Water reported in white sand.
30-401	Plus-Tex Poultry Farm No. 4	English Drilling Co.	1959	310	175	C	4			Carrizo						S,E	D,S		
402	J. C. King		old	285	27	C	48			Carrizo	13.5	9-25-36				N	N		Water reported in white sand.
501	Plus-Tex Poultry Farm No. 7			300	150					Wilcox						S,E	S		
502	J. W. Burd		old	290	47	C	36			Wilcox	39.9	9-25-36				N	N		Water reported in white sand.
701	Chireno Water Supply Corp.	Layne Texas Co.	1964	320	410	C C S C S C	12-3/4 6-5/8 6-5/8 6-5/8 6-5/8 6-5/8	0 215 320 360 375 395	310 320 360 375 395 410	Carrizo	161.8	12-6-68	62		3-6-64	T,E 15	P	D,E	Drilled to 897 feet. Temperature 73°F.
702	E. M. Weeks		1872	350	37	C	36			Weches	24.7	9-15-36				N			Destroyed. Water reported in green sand and gravel.
703	D. Biggs	Thompson Bros.	1905	260	80	C	6			Carrizo			Flowed 1		9-15-36	N			Destroyed. Reported sulfur taste. Temperature 70°F.
801	Southland Paper Mills	Layne Texas Co.	1949	202*	226	C S	4 4	0 203	203 224	Carrizo	11.5 3.4 1.7 7.3 9.2	3-22-49 4-20-55 4-26-60 5-6-65 4-15-69						D,E	Test well. Drilled to 247 feet. Water level measurements since 1949.
802	Wayne Garrett		1958	240	230	C	2			Carrizo						A,E	D,S		Reported sulfur.
35-101	Southland Paper Mills	Layne Texas Co.	1941	270*	831	C S C	2 2 2	0 800 805	800 805 831	Wilcox	38.8 82.8 144.3 172.7 225.6	12-2-41 10-23-45 7-24-50 7-11-55 6-21-60	4		10-27-41	N		D,E	Observation well. Drilled to 984 feet. Historical water levels 1941-1960.
102	Southland Paper Mills	Layne Texas Co.	1941	271*	158	C S C	2 2 2	0 132 137	132 137 158	Sparta	59.1 58.8 63.0 61.8	12-2-41 11-27-45 7-11-55 7-13-60	8		10-28-41	N		D,E	Observation well. Drilled to 410 feet. Historical water levels 1941-1960.
104	Southland Paper Mills	Layne Texas Co.	1943	208*	133	C S	10 10			Sparta	30.7 25.1	7-2-43 5-30-44	200		6-19-43				Test well. Historical water levels 1943-1944. Abandoned.
105	Southland Paper Mills	Layne Texas Co.	1943	204*	120	C S	3 3			Sparta	27.3 21.7	6-21-43 5-30-44						D,E	Observation well. Drilled to 195 feet. Historical water levels 1943-1944.
106	Ed Tucker	Frank Tucker	1916	190	570	C	8			Carrizo			Flowed 35		9-17-36	N	N		After 1930 well began flowing sand thought to be Sparta. Temperature 78°F.
201	Southland Paper Mills	Layne Texas Co.	1941	203*	1,261	C S C S C S	2 2 2 2 2 2	0 978 983 1,078 1,083 1,255	978 983 1,078 1,083 1,255 1,260	Wilcox	+86.5 +81.9	10-22-41 2-9-44	Flowed 15		1941			E	Observation well. Drilled to 1,482 feet. Historical water levels 1941-1944.

For footnotes see end of table.

Table 8.--Records of Wells and Springs in Nacogdoches County--Continued

Well Number	Well Owner	Driller	Year Completed	Altitude of Land Surface (feet) 1/	Depth of Well (feet)	Casing and Screen Data: Casing or Screen 2/	Diameter (inches)	Depth in Feet (from)	(to)	Indicated Water-Bearing Unit	Static Water Level 3/: Depth (feet)	Date	Pumping Rate and Level: Rate (gpm)	Depth (feet)	Date	Method of Lift and Power 4/	Use of Water 1968 5/	Logs Available 6/	Remarks
TX-37-35-202	Southland Paper Mills	Layne Texas Co.	1941	202*	669	C S	2 2	0 664	664 669	Carrizo	6.8 59.9 181.8 206.9 159.6 176.8	8-28-41 5-25-45 7-24-50 7-1-55 7-17-60 6-24-65							Observation well. Historical water levels 1941-1968.
203	Southland Paper Mills	Layne Texas Co.	1941	202*	166	C S C S	2 2 2 2	0 92 97 160	92 97 160 165	Sparta	3.9 2.9	10-22-41 2-9-44						D,E	Observation well. Drilled to 400 feet. Historical water levels 1941-1944.
204	Southland Paper Mills	Layne Texas Co.	1943	181*	92	C S	6 6	0 5	5 92	Sparta	7.3 2.5	7-27-43 11-27-45	75	76+	1943				Test well. Historical water levels 1943-1945. Abandoned.
205	Southland Paper Mills	Layne Texas Co.	1943	201*	110	C S		0 5	5 110	Sparta	20.9 13.2	7-27-43 11-27-45							Observation well. Historical water levels 1943-1945.
206	Southland Paper Mills	Layne Texas Co.	1955	330*	902													E	Test hole.
207	Southland Paper Mills	Layne Texas Co.	1942	185*	165	C S		0 120	120 165	Sparta								E	Test well. Drilled to 207 feet. Abandoned.
301	Southland Paper Mills	Layne Texas Co.	1947	247*	810	C C S C	18 10-3/4 10-3/4 10-3/4	0 571 692 788	683 692 788 810	Carrizo						T,E 200	N	D,E	No longer used. Historical water levels 1947-1959. Drilled to 904 feet.
302	Southland Paper Mills	Layne Texas Co.	1947	246*	779	C C S C	18 10-3/4 10-3/4 10-3/4	0 559 635 760	625 635 760 779	Carrizo			935	472	1-14-69	T,E 260	Ind.	D,E	Drilled to 900 feet Water level measurements since 1947. Temperature 80°F.
303	Southland Paper Mills	Layne Texas Co.	1947	222*	800	C C S S S C	18 10-3/4 10-3/4 10-3/4 10-3/4 10-3/4	0 538 599 716 754 780	590 599 709 744 780 800	Carrizo, Wilcox			760	454	1-14-69	T,E	Ind.	D,E	Drilled to 900 feet. Water level measurements since 1947.
304	Southland Paper Mills	Layne Texas Co.	1941	322*	165	C S C	2 2 2	0 150 155	150 155 165	Sparta	99.2 102.3	12-18-41 6-23-43	6		1941			D,E	Observation well. Drilled to 418 feet. Historical water levels 1941-1943.
305	Southland Paper Mills	Layne Texas Co.	1947	240*	880													E	Test hole.
306	Southland Paper Mills	Layne Texas Co.	1947	302*	921													E	Test hole.
307	Southland Paper Mills	Layne Texas Co.	1947	324*	941													E	Test hole.
308	Southland Paper Mills	Layne Texas Co.	1947	248*	210	C C S C S C S C	18 10-3/4 10-3/4 10-3/4 10-3/4 10-3/4 10-3/4 10-3/4	0 0 120 148 157 168 177 198	99 120 148 157 168 177 198 210	Sparta	56.9	9-4-47	300	147	9-5-47	N		D,E	Test well. Temperature 68°F. Abandoned.
309	Southland Paper Mills	Layne Texas Co.	1947	247*	218	C S C S C S C S	4 4 4 4 4 4 4 4	0 92 103 150 161 182 192 207	92 103 150 161 182 192 207 218	Sparta									Test well. Drilled to 218 feet. Water samples collected by backfilling well with gravel. Temperature 70.1°F. Abandoned.
310	Southland Paper Mills	Layne Texas Co.	1947	206*	648	C S	3 3	0 638	638 647	Carrizo, Wilcox	81.3 230.9 259.4 313.5 287.4 278.4	6-17-47 7-13-50 7-26-55 4-26-60 6-24-65 11-2-68						E	Observation well. Drilled to 900 feet. Historical water levels 1947-1968.
311	B. B. Holtam		1913	260	35	C	48			Sparta	29.8	10-2-36				N			Destroyed. Water reported in white sand.
603	Southland Paper Mills	Layne Texas Co.	1947	204*	901	C C S C S C S C	18 10-3/4 10-3/4 10-3/4 10-3/4 10-3/4 10-3/4 10-3/4	0 510 618 740 779 840 851 881	615 618 740 779 840 851 881 901	Carrizo, Wilcox			935	419	1-14-69	T,E 260	Ind.	D,E	Water level measurements since 1947.

For footnotes see end of table.

Table 8.--Records of Wells and Springs in Nacogdoches County--Continued

Well Number	Well Owner	Driller	Year Completed	Altitude of Land Surface (feet) 1/	Depth of Well (feet)	Casing and Screen Data: Casing or Screen 2/	Casing and Screen Data: Diameter (inches)	Casing and Screen Data: Depth in Feet (from)	Casing and Screen Data: Depth in Feet (to)	Indicated Water-Bearing Unit	Static Water Level 3/: Depth (feet)	Static Water Level 3/: Date	Pumping Rate and Level: Rate (gpm)	Pumping Rate and Level: Depth (feet)	Pumping Rate and Level: Date	Method of Lift and Power 4/	Use of Water 1968 5/	Logs Available 6/	Remarks
TX-37-35-604	Southland Paper Mills	Layne Texas Co.	1947	246*	920													E	Test hole.
36-101	Southland Paper Mills	Layne Texas Co.	1947	224*	895													E	Test hole.
102	Southland Paper Mills	Layne Texas Co.	1946	200*	814	C C S C S C	18 10-3/4 10-3/4 10-3/4 10-3/4 10-3/4	0 479 598 727 779 810	596 598 727 779 810 814	Carrizo, Wilcox	53.8 157.6 183.1 216.6 277.6 302.1	5-6-47 7-24-50 7-1-55 7-14-60 5-6-65 4-5-68	920	207	12-46			D,E	Drilled to 900 feet. Water level measurements since 1947. Well abandoned as production well.
103	Southland Paper Mills	Layne Texas Co.	1941	231*	126	C S C	2 2 2	0 77 82	77 82 126	Sparta	44 45.2	1941 11-27-45	4		1941			D,E	Observation well. Drilled to 355 feet. Historical water levels 1941-1945.
104	Southland Paper Mills	Layne Texas Co.	1941	280*	219	C S C	2 2 2	0 209 214	209 214 219	Sparta	90.9 90.8	10-22-41 9-8-47	6		1941			D,E	Observation well. Drilled to 407 feet. Historical water levels 1941-1947.
105	Southland Paper Mills	Layne Texas Co.	1941	281*	181	C S C S C	2 2 2 2 2	0 70 75 165 170	70 75 165 170 181	Sparta	102.2 98.0	10-22-41 9-8-47						D	Observation well. Historical water levels 1941-1947.
106	Southland Paper Mills	Layne Texas Co.	1947	233*	583	C S	3 3	0 574	574 583	Carrizo	80.4 178.6 202.6 256.1	5-7-47 7-24-50 7-1-55 7-14-59						E	Observation well. Drilled to 921 feet. Historical water levels 1947-1966.
107	Southland Paper Mills	Layne Texas Co.	1943	187*	135	C S	10 10	0 10	10 135	Sparta	14.3 13.3	7-27-43 1-22-44	260	98	1943			D,E	Test well. Drilled to 227 feet. Historical water levels 1943-1944. Abandoned.
108	Southland Paper Mills	Layne Texas Co.	1943	249*	168	C S	2 2	0 2	2 168	Sparta	50.1	10-27-43							Observation well. Historical water levels 1943.
109	Southland Paper Mills	Layne Texas Co.	1947	203*	894													E	Test hole.
110	R. L. Godsey			265	25	C	36			Sparta							D		
201	Southland Paper Mills	Layne Texas Co.	1941	298*	865	C S C S C S	2 2 2 2 2 2	0 770 775 810 815 860	770 775 810 815 860 865	Wilcox	43.8 78.5	10-41 2-25-46	18		1941			D,E	Observation well. Drilled to 1,326 feet. Historical water levels 1941-1946.
202	Southland Paper Mills	Layne Texas Co.	1941	299*	670	C S	2 2	0 655	655 670	Carrizo	79.9 86.7 197.9 225.5 271.1 302.7 323.9	10-22-41 5-25-45 5-19-50 7-1-55 7-14-60 5-6-65 11-2-68							Observation well. Water level measurements since 1941.
203	Southland Paper Mills	Layne Texas Co.	1941	299*	240	C S	2 2	0 235	235 240	Sparta	101.5 101.8	10-22-41 6-22-49	7		1941			E	Observation well. Drilled to 450 feet. Historical water levels 1941-1949.
204	Southland Paper Mills	Layne Texas Co.	1941	299*	175	C S C S	2 2 2 2	0 136 141 169	136 141 169 175	Sparta	94.5 95.0	10-41 7-20-48						D	Observation well. Drilled to 190 feet. Historical water levels 1941-1948.
205	Southland Paper Mills	Layne Texas Co.	1947	190*	940													E	Test hole.
206	J. H. Beard	J. H. Beard	1930	245	28	C	36			Sparta	23.4	9-29-36				N	N		Water reported in white sand.
301	L. C. Jacobs	Elliott & Fox	1922	210*	400	C	6			Carrizo	+47.0 +41.0 +30.1 13.5 44.1 66.4 98.5 137.9	4-30-37 7-13-40 3-30-44 7-20-48 7-24-50 7-1-55 9-7-61 3-14-67				N	N		Once supplied CCC camp. Flow estimated at 40 gpm in 1936. Reported sulfur. Historical water levels 1937-1968. Temperature 74°F.
302	Anna Daniel		1871	205	34	C	36			Sparta	25.6	9-30-36				N	N		Water reported in red gravel.
303	Merit Cochran		1956	220	590	C	4			Carrizo						S,E	D,S		
507	Southland Paper Mills	Layne Texas Co.	1947	232*	940													E	Test hole.
601	Florie Daniel		old	250	19	C	36			Cook Mtn.	13.0	9-30-36				N	N		Water reported in yellow sand.

For footnotes see end of table.

Table 8.--Records of Wells and Springs in Nacogdoches County--Continued

Well Number	Well Owner	Driller	Year Com-pleted	Altitude of Land Surface (feet) 1/	Depth of Well (feet)	Casing and Screen Data: Casing or Screen 2/	Diameter (inches)	Depth in Feet (from)	(to)	Indicated Water-Bearing Unit	Static Water Level 3/: Depth (feet)	Date	Pumping Rate and Level: Rate (gpm)	Depth (feet)	Date	Method of Lift and Power 4/	Use of Water 1968 5/	Logs Avail-able 6/	Remarks
TX-37-36-602	Ben Oliver	Ben Oliver	1920	185	22	C	36			Cook Mtn.	28.3	9-30-36				N	N		Water reported in red gravel.
603	R. J. Driver		old	260	54	C	36			Cook Mtn.	47.8	9-30-36				N	N		Water reported in white sand.
37-301	J. W. Prince		1916	230	200	C	6			Carrizo	+3.0	9-15-36				N	N		Well formerly used at sawmill. Reported sulfur odor and taste. Reported flow 2.5 gpm in 1936. Temperature 72.5°F.
302	Sterling Sanders	Newton Water Well Service	1966	310	367	C S	2 2	0 357	357 367	Carrizo	134	6-9-66				S,E	D	D	
801	A. H. Munk	Chambers Water Well Service	1957	180	492	C S	2 2			Sparta	+10.7 + 5.7	5-19-61 12-10-68	Flowed 1.7 Flowed 1.0		5-19-61 12-10-68	N	D		Water-bearing sand reported from 412 feet to 490 feet.
802	Tom Parton	George E. Ginter	1931	185	252	C	6			Sparta	+ 3.0	10-2-36	Flowed 2.5 Flows		10-2-36 12-10-68	N	D		Reported sulfur taste. Water reported in fine white sand. Temperature 72°F.
803	W. P. Smith	Chambers Water Well Service	1961	210	500	C	2			Sparta	17	1961				Cf,E 1/3	D,S		
804	Etoile Water Supply Corp.	Frye Drilling Co.	1968	215	925	C C S	8 3 3	0 775 875	875 875 920	Carrizo	113.5	1-8-69				S,E	P		
38-101	R. G. Atkinson		1923	235	20	C	30			Sparta	13.6	10-1-36				N	N		Water reported in red clay.
102	H. W. Snowden-Grey Mast #1		1947		770													E	Oil test.
201	Bennie Gray		old	240	24	C	48			Sparta	18.6	9-30-36				N	N		Water reported in red clay.
401	Plus-Tex Poultry	English Drilling Co.	1960	250	165	C	4			Sparta						J,E 3/4	D,S		
403	Marie Gartman		1963	280	300	C	4			Sparta	78.5	1-8-69				J,E	D,S		
701	T. J. Wilson		1920	260	15	C	36			Cook Mtn.	10.3	10-1-36				N			Abandoned. Water reported in white sand.
702	J. T. Sowell		old	210	32	C	36			Cook Mtn.	23.2	10-1-36				N	N		Water reported in red clay.
801	Jim Still		old	180	23	C	36			Cook Mtn.	16.7	10-1-36				N			Abandoned.
45-601	Dave Patterson			200						Yegua						A,E	D		
46-101	Travis King	R. E. Dixon	1968	200	386	C S	2 2	0 376	376 386	Sparta						A,E	D	D	
401	Shirley Creek Marina	R. E. Dixon	1968	179*	230	C S	2 2	0 220	220 230	Yegua						A,E	D	D	
402	Wilmer Mast	E. L. Lowery	1911	200	24	C	40			Yegua	18.2	10-2-36				N	N		Water reported in white clay.
403	Wilmer Mast		old	205						Yegua						J,E	D,S		

1/ Altitudes which have asterisks (*) are from aneroid or differential leveling surveys. All other altitudes are estimated from USGS topographic quadrangle maps having 10-foot or 20-foot contour intervals.

2/ Identifying letters used are:

C - Casing or blank liner
S - Screen

3/ Reported water levels are given in feet; measured water levels are given in feet and tenths. + indicates water level above land surface.

4/ Identifying letters used are:

A - airlift; T - turbine; Number indicates horsepower.
C - cylinder; B - butane
Cf - centrifugal; E - electric
J - jet; H - hand
S - submersible; N - none

5/ Identifying letters used are:

D - domestic; N - none
Ind. - industrial; P - public supply
Irr. - irrigation; S - livestock

6/ D indicates drillers' log available; E indicates electric log available. Drillers' logs and electric logs are in files of Texas Water Development Board.

Table 9.--Drillers' Logs of Representative Wells in Angelina County

	THICKNESS	DEPTH
Well AD-37-34-504		
Owner: Central W. C. I. D.		
Driller: Texas Water Wells		
Red clay	30	30
Blue shale	30	60
Fine sand	15	75
Blue shale	198	273
Rock	1	274
Sand	10	284
Blue shale	106	390
Sand with hard streaks	57	447
Shale and sand	28	475
Sand	60	535
Shale	40	575
Sand	57	632
Shale	63	695
Shale	31	726
Shale	46	772
Sand	64	836
Hard	10	846
Sand	28	874
Sandy shale	36	910
Shale	10	920
Shale and rock	20	940
Shale and rock	11	951
Rock	1	952
Shale and rock	19	971
Shale and rock	83	1,054
Sand	46	1,100
Rock	2	1,102
Shale	10	1,112
Sand	156	1,268
Shale	44	1,312
Hard	8	1,320
Well Ad-37-34-902		
Owner: City of Lufkin No. 10		
Driller: Katy Drilling Co.		
Clay	252	252
Tough blue shale	23	275
Sand	11	286
Soft shale	15	301
Sand, fine	8	309

	THICKNESS	DEPTH
(Well AD-37-34-902) Continued		
Shale, soft	6	315
Shale, tough	55	370
Rock	4	374
Shale, tough	16	390
Sandy shale	13	403
Shale	5	408
Sand with shale strips	49	457
Shale, soft	26	483
Sand with shale strips	29	512
Shale, soft	9	521
Sand with shale strips	77	598
Hard shale	20	618
Sand	6	624
Shale	23	647
Sand	8	655
Shale	58	713
Sand	5	718
Shale	76	794
Sand	30	824
Shale	26	850
Shale	196	1,046
Sand	207	1,253
Shale	15	1,268
Well AD-37-35-405		
Owner: Lufkin Chamber of Commerce		
Driller: Layne Texas Co.		
Soil and red sandy shale	12	12
White clay	10	22
Brown shale	23	45
Green shale, shells and boulders	33	78
Sandy shale, shells, pyrite and glauconite	49	127
Light gray shale	47	174
Light gray sand	18	192
Gray shale	5	197
Sand, shale streaks	26	223
Sand	60	283
Shale	5	288
Sand and shale layers	9	297
Fine hard brown sandy shale	38	335
Green shale, shells	32	367

	THICKNESS	DEPTH
(Well AD-37-35-405) Continued		
Hard rock	1	368
Green shale, shells	2	370
Hard rock	1	371
Green shale, shells	112	483
Sand	35	518
Sandy shale and shale streaks	57	575
Sticky brown shale	63	638
Hard rock	1	639
Sticky brown shale	6	645
Hard rock	1	646
Sticky brown shale	19	665
Hard lime rock	1	666
Sticky brown shale	42	708
Brown shale	13	721
Green sandy shale	16	737
Sand	34	771
Sand, streaks of shale	18	789
Fine white sand	10	799
Sand, shale streaks	13	812
Coarse white sand	20	832
Coarse white sand and 3-inch streaks of shale at 880 feet	89	921
Shale	3	924
Coarse white sand	20	944
Sandy shale	3	947
Shale sand streaks	65	1,012
Very fine, hard-packed green sand	20	1,032
Hard shale	32	1,064
Hard shale sandy streaks	33	1,097
Sandy shale, sand streaks	28	1,125
Shale, sandy shale, sand streaks	29	1,154
Sandy shale	44	1,198

Well AD-37-35-710

Owner: City of Lufkin
Driller: Layne Texas Co.

	THICKNESS	DEPTH
Surface sand	2	2
Red clay	24	26
Shale	10	36
Fine green sand, shale	23	59
Soft blue shale, shells	65	124
Soft rock	1	125

	THICKNESS	DEPTH
(Well AD-37-35-710) Continued		
Soft brown shale and shells	80	205
Soft brown shale and shells	20	225
Rock	1	226
Soft shale	10	236
Rock	2	238
Shale, rock at 287 feet and 304 feet	67	305
Sticky shale, rock at 325 feet	33	338
Soft brown shale	23	361
Brown shale, thin sandy layers	20	381
Brown shale, rock at 435 feet	55	436
Sand layers, shale, some lignite	28	464
Brown shale	19	483
Fine sand	9	492
Soft shale	14	506
Fine sand	57	563
Brown shale, thin layers of rock	12	575
Sand	21	596
Brown shale, shells, lignite rock at 620 feet	26	622
Hard sticky shale	5	627
Rock	2	629
Soft shale, shells, lignite	4	633
Rock	2	635
Soft green shale and shells	11	646
Green sticky shale, shells	15	661
Soft green shale and shell, rock at 700 feet	51	712
Rock	2	714
Hard sticky shale	11	725
Soft green shale	10	735
Rock	1	736
Soft shale	19	755
Sand	5	760
Soft brown shale	11	771
Soft shale, thin layers of sand	16	787
Hard rock	1	788
Soft shale, thin layers of rock	16	804
Soft shale	10	814
Hard brown shale	42	856
Hard sticky shale	42	898
Soft shale	5	903

	THICKNESS	DEPTH
(Well AD-37-35-710) Continued		
Rock	1	904
Hard sticky shale, rock at 912 feet	8	912
Rock	1	913
Sticky shale	12	925
Hard rock	1	926
Soft blue shells and shale	53	979
Sticky shale and shells	7	986
Soft shale	35	1,021
Sand	5	1,026
Hard shale	3	1,029
Soft rock	1	1,030
Shale, thin layers of sand	26	1,056
Sand	10	1,066
Water sand	23	1,089
White water sand (static head, 43 feet)	95	1,184
Soft shale	4	1,188

Well AD-37-35-711

Owner: City of Lufkin
Driller: Layne Texas Co.

	THICKNESS	DEPTH
Surface soil and sand	10	10
Clay and some lignite	15	25
Sand	32	57
Shale	38	95
Sandy shale	18	113
Sand	8	121
Shale, small rocks	37	158
Sandy shale, few boulders	125	283
Soft rock	2	285
Sandy shale and boulders	76	361
Shale	51	412
Pack sand	2	414
Shale	18	432
Rock	2	434
Shale, rock at 459 feet	83	517
Shale	7	524
Sand and shale	21	545
Shale	10	555
Sand and shale	12	567
Soft shale	8	575
Sand, water	21	596
(Well AD-37-35-711) Continued		
Soft shale	5	601
Sand, water	63	664
Hard blue shale	26	690
Brown shale, lignite, shells, little show of gas	36	726
Rock	1	727
Black shale, shells, thin layers of rock and lignite	38	765
Soft rock, shells, and shale	8	773
Sticky shale	17	790
Shale	15	805
Soft gray shale	8	813
Rock	1	814
Soft green shale, some shell	11	825
Tough hard shale	25	850
Hard shale, thin layers of sand, thin rock	22	872
Hard shale	12	884
Hard sand, rock at 894 feet	5	889
Hard shale, broken with thin layers of rock, shell	16	905
Hard brown shale and thin layers of sand	16	921
Cored hard brown shale, thin layers of sand	5	926
Hard brown shale, layers of sand	5	931
Hard shale	19	950
Soft brown shale, showing of gas	61	1,011
Hard shale, layers of rock	10	1,021
Hard rock	2	1,023
Hard sticky shale	10	1,033
Hard rock	1	1,034
Hard shale	6	1,040
Hard rock	1	1,041
Hard shale	5	1,046
Hard brown shale	22	1,068
Soft shale	10	1,078
Hard and sticky light-blue shale	42	1,120
Fine gray sand	6	1,126
Fine sand	4	1,130
Soft shale	15	1,145
Hard shale with thin layers of sand	18	1,163
Sticky dark-brown shale	10	1,173

	THICKNESS	DEPTH
(Well AD-37-35-711) Continued		
Pack sand (water)	70	1243
Well AD-37-35-902		
Owner: M & M Water Supply Corp. Driller: Key Water Well Drilling		
Surface clay	140	140
Sand	12	152
Shale	182	334
Sand	44	378
Shale	82	460
Sandy shale	340	800
Shale	130	930
Muddy sand	40	970
Water sand	130	1,100
Sandy shale	65	1,165
Well AD-37-36-902		
Owner: Southland Paper Mills Driller: Layne Texas Co.		
Sandy clay	23	23
Gray sand	18	41
Sandy clay	14	55
Rock	1	56
Shale	27	83
Rock	1	84
Shale	5	89
Rock	1	90
Shale	22	112
Sand shale and shell	21	133
Shale	17	150
Good gray sand	85	235
Sand (thin shale layer)	43	278
Good gray sand	22	300
Shale	8	308
Good gray sand	8	316
Shale	37	353
Rock	3	356
Shale	6	362
Sandy shale, lignite, and shell	76	438
Shale, sandy shale and shell	70	508
Sandy shale	16	524
Soft rock	4	528

	THICKNESS	DEPTH
(Well AD-37-36-902) Continued		
Shale	4	532
Hard rock	2	534
Shale	35	569
Hard rock	2	571
Shale	10	581
Hard rock	1	582
Shale and sandy shale	81	663
Sand	10	673
Shale	10	683
Sand	8	691
Shale	4	695
Sand	20	715
Broken sand	13	728
Good gray sand	89	817
Shale and boulders	17	834
Shale and sand	12	846
Sand	54	900
Rock	1	901
Shale and sand layers	24	925
Rock	2	927
Sand	21	948
Rock	1	949
Shale and boulders	20	969
Shale	31	1,000
Sand	11	1,011
Rock	2	1,013
Sand	9	1,022
Shale and sandy shale	36	1,058
Rock	1	1,059
Sand	17	1,076
Rock	1	1,077
Sandy shale	13	1,090
Rock	2	1,092
Sandy shale	14	1,106
Sand	12	1,118
Sandy shale	15	1,133
Shale	18	1,151
Sand	22	1,173
Shale	2	1,175
Sand	3	1,178

	THICKNESS	DEPTH
(Well AD-37-36-902) Continued		
Sandy shale	29	1,207
Rock	2	1,209
Shale and sandy shale	80	1,289
Rock	1	1,290
Shale and sandy shale	30	1,320
Rock	2	1,322
Shale and sandy shale	35	1,357
Shale	20	1,377
Well AD-37-42-101		
Operator: Humble Oil & Refining Co. Fee: J. L. Bonner 1-A		
Surface and sand	12	12
Sand	8	20
Sandy shale and gravel	40	60
Sandy shale	36	96
Shale with streaks of sand	24	120
Hard grayish-brown shale with fossil fragments	33	153
Rock (brown clay ironstone)	1	154
Sandy shale, streaks of gray sand	62	216
Brown clay ironstone	1	217
Sandy shale	16	233
Brown clay ironstone	1	234
Sandy shale with streaks of gray sand	22	256
Hard shale	5	261
Sandy shale, greenish with some glauconite and fossils	16	277
Hard shale	19	296
Brown shale, few streaks of sand	18	314
Rock	1	315
Hard shale	13	328
Shale, greenish with some glauconite and fossils	2	330
Hard, dark sandy shale	11	341
Hard shale	16	357
Sticky gray shale	37	394
Rock	1	395
Sticky gray shale	5	400
Gray shale	5	405
Gray shale, boulders	14	419
Hard, sticky gray shale	30	449
Hard, sticky gray shale with fossils	47	496

	THICKNESS	DEPTH
(Well AD-37-42-101) Continued		
Gray-brown sticky shale, streaks of glauconite, fossils	47	543
Sandy shale, streaks of sand	21	564
Sand, rock at 564 feet	11	575
Sandy shale	20	595
Brown sand	31	626
Rock	2	628
Sandy shale	6	634
Sticky shale	15	649
Sand, streaks of lignite	19	668
Hard shale, shells	2	670
Brown sand, streaks of lignite	53	723
Hard sticky shale	15	738
Sand	41	779
Sticky shale	20	799
Brown sand	7	806
Sticky shale	16	822
Sand	8	830
Sticky shale	15	845
Green sand with glauconite	2	847
Hard shale	3	850
Green sand marl	8	858
Soft shale with glauconite	10	868
Green sand marl	1	869
Soft shale with glauconite	32	901
Green sand with glauconite	8	909
Brown shale	7	916
Rock	1	917
Green sand	2	919
Brown shale	11	930
Sandy shale, oil-bearing	4	934
Sandy shale	5	939
Dark gray shale	20	959
Shale and boulders	8	967
Shale with glauconite, boulders	9	976
Sand	71	1,047
Sandy shale	8	1,055
Gray sticky shale with streaks of sandy shale	9	1,064
Gray sticky shale	31	1,095
Sand	3	1,098

	THICKNESS	DEPTH
(Well AD-37-42-101) Continued		
Sticky brown shale, some glauconite	9	1,107
Sand	2	1,109
Sticky shale	6	1,115
Rock	1	1,116
Green sand	2	1,118
Sticky shale	7	1,125
Rock	1	1,126
Shale, streaks of green sand and fossils	15	1,141
Rock	1	1,142
Brown shale, streaks of glauconite	62	1,204
Bluish-gray shale with some lime, fossils	4	1,208
Brown sticky shale with green sand	15	1,223
Sand	41	1,264
Sandy shale	8	1,272
Sand, water	33	1,305

Well AD-37-42-306

Owner: City of Lufkin
Driller: Layne Texas Co.

	THICKNESS	DEPTH
Surface sand	1	1
Red clay	30	31
Gray sandy clay	31	62
Soft clay	3	65
Yellow sand	20	85
Thin layers of rock and sand	7	92
Fine sand, layers of shale	67	159
Fine sand and lignite	14	173
Dark-brown soft shale	73	246
Soft shale and shell	32	278
Soft blue shale and shells	21	299
Hard blue shale, thin rock rock at 304 feet	10	309
Soft blue shale	34	343
Hard blue shale	15	358
Hard blue shale and shells	20	378
Sticky blue shale and shells, thin rock at 380 feet	7	385
Soft shale, shells	4	389
Rock	2	391
Soft blue shale, shells	24	415
Hard blue shale and shells	37	452

	THICKNESS	DEPTH
(Well AD-37-42-306) Continued		
Rock	1	453
Hard shale	8	461
Sand	2	463
Soft flakes and shells	52	515
Soft flakes, shale and shells, rock at 533 feet	29	544
Rock	2	546
Hard brown shale	19	565
Rock	1	566
Hard brown shale, shells, rock at 580 and 592 feet	29	595
Fine sand, some lignite	25	620
Soft brown shale, shells	23	643
Sand	7	650
Soft brown shale, shells	13	663
Sand	28	691
Shale	8	699
Soft brown shale	23	722
Fine sand	24	746
Dark-brown shale, soft shell, rock at 830 and 850 feet	107	853
Hard sticky green shale	15	868
Soft rock	2	870
Soft green shale, layers of shell	35	905
Hard green shale	9	914
Rock	1	915
Soft green shale	9	924
Hard rock	1	925
Hard sticky green shale	23	948
Fine gray sand	20	968
Hard flaky green shale	30	998
Hard rock	1	999
Soft shale	9	1,008
Rock	1	1,009
Soft shale	11	1,020
Rock	1	1,021
Soft brown shale	18	1,039
Fine gray water sand and hard brown shale, thin layers of sand	8	1,047
Hard brown shale, rock at 1,085 feet	58	1,105
Green and brown sandy clay	3	1,108
Hard brown shale	9	1,117

(Well AD-37-42-306)
Continued

	THICKNESS	DEPTH
Rock	1	1,118
Hard shale	2	1,120
Hard rock	2	1,122
Hard shale	6	1,128
Hard rock	2	1,130
Hard shale	9	1,139
Hard rock	1	1,140
Brown shale	8	1,148
Hard rock	1	1,149
Soft brown shale	64	1,213
Hard sticky shale	11	1,224
Soft shale	6	1,230
Green sand, water	8	1,238
Soft brown shale	26	1,264
Sand	73	1,337
Soft shale	10	1,347
Sand	24	1,371
Sand, layers of shale	19	1,390
Sand	20	1,410
Soft brown shale	39	1,449

Well AD-37-42-502

Owner: Agriculture Exp. Sta.
Driller: Frye Drilling Co.

	THICKNESS	DEPTH
Top soil, clay and blue shale	22	22
Blue shale, some lignite	21	43
Green shale	21	64
Green shale and brown shale	20	84
Shale, rocky shale, sand	21	105
Shale, good sand	20	125
Shale and sand strips	21	146
Shale and sand strips	20	166
Shale and sand strips	21	187
Shale	20	207
Shale and sand strips	21	228
Shale and thin sand strips	20	248
Int. shale and sand strips	21	269
Int. sand - good sand	20	289
Int. sand - good sand	21	310
Int. sand	2	312

Well AD-37-44-801

Owner: City of Huntington No. 7
Driller: Layne Texas Co.

	THICKNESS	DEPTH
Surface	0	0
Soil	4	4
Sandy clay and gravel	16	20
Gray clay	44	64
Gray shale and sand streaks	128	192
Sand streaks, sandy shale and shale	25	217
Shale	47	264
Sand (cut good)	29	293
Shale and lignite	136	429
Sand	15	444
Shale and lignite	46	490
Sand	17	507
Sandy shale	18	525
Broken sand	18	543
Shale	25	568
Sand and shale streaks	22	590
Sandy shale	45	635
Sand (cut good)	33	668
Shale and sandy shale	232	900
Shale	157	1,057
Shale	35	1,092
Shale and sandy shale	35	1,127
Sandy shale	13	1,140
Sand and few shale breaks	56	1,196
Shale	21	1,217
Sand and shale breaks and lignite	73	1,290
Sandy shale	62	1,352
Hard shale, shale and lime	124	1,476
Hard shale	10	1,486
Rock	2	1,488
Shale and sandy shale	122	1,610
Hard shale	13	1,623
Hard shale and boulders	14	1,637
Hard shale	53	1,690
Sandy shale	16	1,706
Shale	8	1,714
Sandy shale	105	1,819
Sand and streaks of shale	37	1,856
Shale	7	1,863

	THICKNESS	DEPTH
Well AD-37-50-302		
Owner: Burke Water Supply Corp. No. 1		
Driller: Texas Water Wells		
Ground level	4	4
Surface soil	6	10
Shale	53	63
Sandy shale	9	72
Shale	33	105
Sand	5	110
Sand and shale	112	222
Sand	28	250
Shale	23	273
Sand	27	300
Shale	21	321
Sand	19	340
Sand and shale	135	475
Shale	35	510
Shale	22	532
Shale	38	570
Sand	8	578
Shale	12	590
Sand	25	615
Sand and shale	48	663
Shale	62	725
Sandy shale	75	800
Shale	18	818
Sand	64	882
Shale	38	920
Well AD-37-50-901		
Owner: City of Diboll No. 1		
Driller: Layne Texas Co.		
Shale and sand breaks	300	300
Sandy shale	25	325
Shale and sand breaks	140	465
Fine gray sand and shale breaks	154	619
Shale	7	626
Well AD-37-53-901		
Owner: U. S. Forestry Service		
Driller: Frye Drilling Co.		
Top soil, red sandy clay	22	22
Hard blue shale	21	43
Hard sandy shale	21	64

	THICKNESS	DEPTH
(Well AD-37-53-901) Continued		
Shale	20	84
Int. Sand and shale	21	105
Shale	21	126
Well AD-37-54-901		
Owner: National Forest Service No. 1		
Driller: Key Drilling Co.		
Surface soil and clay	55	55
Sandy shale	45	100
Shale	105	205
Water sand	18	223
Shale	547	770
Sand (salt water)	50	820
Well AD-37-63-201		
Owner: National Forest Service No. 1		
Driller: Frye Drilling Co.		
Top soil, clay, red sandy gravel	22	22
Blue shale	21	43
Green shale, porous rock	19	62
Blue shale	17	79
Soft green shale	21	100
Soft yellow shale	20	120
Blue and yellow shale	21	141
Yellow shale	20	161
Blue and green shale	21	182
Blue medium shale	47	229
Good sand	4	233
Shale	10	243
Blue shale, medium hard	29	272
Sand, fair	6	278
Shale	6	284
Shale, with 6-feet and 3-feet sand breaks	21	305
Shale and sand breaks	20	325
Sand with shale breaks	41	366

Table 10.--Drillers' Logs of Representative Wells in Nacogdoches County

Well TX-37-09-502

Owner: Sacul Water Supply Corp.
Driller: Lanford Drilling Co.

	THICKNESS	DEPTH
Surface sands and clay	145	145
Massive water sand	145	290
Sandy shale	90	380
Gumbo with sand streaks	70	450
Heavy gumbo	150	600
Sandy shale	60	660
Fine tight water sand	62	722

Well TX-37-10-403

Owner: City of Cushing No. 2
Driller: Layne Texas Co.

	THICKNESS	DEPTH
Surface	0	0
Red clay	20	20
Brown shale and streaks of rock	139	159
Sand	15	174
Hard shale and sand streaks	64	238
Sand	34	272
Shale and sandy shale	42	314
Sand	16	330
Shale, sandy shale and lignite	70	400
Fine gray sand and streaks of sandy shale and lignite	48	448
Shale	12	460
Shale and sandy shale and streaks of sand and lignite	95	555
Shale and streaks of lignite	66	621
Fine sand	18	639
Shale and sandy shale	24	663
Fine sand and lignite	20	683
Sandy shale, sand streaks and lignite	31	714
Shale and lignite	55	769
Shale	71	840
Sand, cuts fair	58	898
Brown shale and lignite	41	939
Fine sand	10	949
Lignite and a few shale breaks	37	986
Sand and shale breaks	31	1,017
Shale and lignite and sand streaks	76	1,093
Sand, shale and lignite	9	1,102
Not logged	100	1,202

Well TX-37-10-901

Owner: Humble Oil & Refining Co.
Driller: Layne Texas Co.

	THICKNESS	DEPTH
Top soil	4	4
Clay	8	12
Fine brown sand	19	31
Fine white sand	19	50
Fine gray sand	11	61
Fine gray sand with streaks of clay	62	123
Coarse gray sand	9	132
Sandy clay	38	170
Clay	73	243
Sandy shale	20	263
Rock	1	264
Sandy shale and streaks of sand	39	303
Fine gray sand	12	315
Clay	15	330
Fine gray sand and streaks of clay	48	378
Sandy shale	12	390
Fine gray sand	62	452
Clay and streaks of sand	23	475
Rock	1	476
Clay	27	503

Well TX-37-11-802

Owner: Nacogdoches Industrial Foundation
Driller: Layne Texas Co.

	THICKNESS	DEPTH
Top soil	3	3
Red clay	17	20
Gray sandy shale	55	75
White sand	20	95
Shale	5	100
Sand	138	238
Blue shale	38	276
Shale and lignite	68	344
Fine sand	20	364
Shale, hard streaks and lignite	47	411
Shale and hard lignite	55	466
Sand, cuts good	27	493
Shale	19	512
Shale and streaks of sandy lignite	98	610
Shale and layers of sandy shale	43	653

	THICKNESS	DEPTH
(Well TX-37-11-802) Continued		
Shale	36	689
Shale	6	695
Sandy shale and shale	50	745
Shale	12	757
Sand, cuts good	37	794
Sandy shale	46	840
Shale	20	860
Sand, broken	47	907
Shale	35	942
Sandy shale	10	952
Shale with hard layers	48	1,000
Shale and sand layers	26	1,026
Sand and streaks of sandy shale	37	1,063
Shale and sandy shale	14	1,077
Fine sand	66	1,143
Shale	5	1,148
Sand	16	1,164
Rock	3	1,167
Shale	18	1,185
Rock	2	1,187
Shale and rock layers	16	1,203
Sand and layers of shale	30	1,233
Shale and rock layers	17	1,250
Shale	6	1,256
Sandy shale	20	1,276
Hard sandy shale	16	1,292
Sandy shale	8	1,300
Hard shale and lignite	27	1,327
Sandy shale and lignite	15	1,342
Sand with shale layers	25	1,367
Shale and lignite	30	1,397
Sandy shale	19	1,416
Rock	2	1,418
Sandy shale and shale	12	1,430
Hard shale	10	1,440
Sandy shale, sand and lignite	55	1,495
Sandy shale and lignite	11	1,506

	THICKNESS	DEPTH
Well TX-37-11-901		
Owner: Caro Water Supply Corp. Driller: Triangle Pump & Supply		
Clay	12	12
Clay, red and yellow	8	20
Red sand	64	84
Sandy shale	21	105
Fine white sand	45	150
Gray and white sand	25	175
Shale	35	210
Sandy shale	40	250
Fine sand	20	270
Sandy shale	40	310
Sand	20	330
Shale and sand	20	350
Sand	10	360
Shale and sandy shale	30	390
Sand	12	402
Shale and lignite streaks	18	420
Good white and gray sand	43	463
Shaly sand	37	500
Sand	10	510
Shale	10	520
Sand	10	530
Sandy shale	22	552
Well TX-37-13-404		
Owner: City of Garrison No. 3 Driller: Layne Texas Co.		
Sand	3	3
Clay, brown and white	21	24
Blue clay	139	163
Clay and streaks of sandy clay	46	209
Sand	17	226
Clay	8	234
Sand	12	246
Rock	1	247
Sand	8	255
Rock	1	256

	THICKNESS	DEPTH
(Well TX-37-13-404) Continued		
Sand	40	296
Rock	6	302
Sandy clay	7	309
Rock	1	310
Sandy clay and sand	7	317
Sand	30	347
Sandy clay	9	356

Well TX-37-17-607

Owner: Douglass Water Supply Corp.
Driller: Layne Texas Co.

	THICKNESS	DEPTH
Surface	0	0
Surface soil and sand	8	8
Red sandy clay and iron ore	20	28
White sand	15	43
Blue shale	76	119
Sandy shale and streaks of sand	35	154
Rock	1	155
Blue shale	6	161
Rock	1	162
Blue shale	9	171
Rock	1	172
Brown sandy shale and streaks of sand	57	229
Dry sandy shale and sand	23	252
Sandy shale	53	305
Sand and layers of shale	31	336
Sandy shale	5	341
Sand and streaks of shale	15	356
Sand	13	369
Sandy shale	6	375
Sand and lignite	34	409
Sandy clay	7	416
Sand with streaks of shale	40	456
Sandy shale and streaks of sand	35	491
Shale	35	526
Shale and streaks of sand	23	549
Sandy shale and streaks of sand	86	635
Shale and lignite	21	656
Shale, sandy shale and sand	39	695

Well TX-37-18-101

Owner: Lilbert-Looneyville Water Supply Corp.
Driller: C. C. Innerarity

	THICKNESS	DEPTH
Reddish clay	20	20
Dark hard clay and soft clay	30	50
Fine gray sand	20	70
Hard dark clay	30	100
Thin sand layers	30	130
Hard blue clay	70	200
Thin rock, small sand streaks	55	255
Sand and clay streaks and soft rock	105	360
Rock, clay and sand	15	375
Sand	20	395
Blue clay	40	435
Sand	45	480
Sand and clay streaks	16	496

Well TX-37-19-401

Owner: Lilly Grove Water Supply Corp.
Driller: C. C. Innerarity

	THICKNESS	DEPTH
Reddish clay formation and rock	20	20
Dark blue clay	40	60
Somewhat lighter clay with black sand streaks	60	120
Blue clay with small sand streaks	45	165
Blue clay with small soft rock	65	230
Blue clay with few small sand streaks	130	360
Sticky blue clay	38	398
Sand	20	418
Blue clay	27	445
Sand	10	455
Blue clay	35	490
Sand and clay streaks	55	545
Sand	45	590

Well TX-37-26-804

Owner: Texas Foundries Club
Driller: Innerarity & Leubner

	THICKNESS	DEPTH
Red clay	8	8
Surface sand	9	17
Blue clay	13	30
Sand	13	43

(Well TX-37-26-804) Continued

	THICKNESS	DEPTH
Clay	12	55
Seep sand	35	90
Blue clay	29	119
Tight sand	18	137

Well TX-37-27-504

Owner: City of Nacogdoches No. 6
Driller: Texas Water Wells

	THICKNESS	DEPTH
Ground level	4	4
Yellow clay	12	16
Sand	26	42
Sandy shale	171	213
Lime and pyrite	7	220
Sandy shale	60	280
Sand	10	290
Shale	42	332
Rock	1	333
Shale	4	337
Rock	1	338
Shale	28	366
Rock	1	367
Shale	50	417
Sand and shale	13	430
Sandy shale	40	470
Sand and streaks of shale	120	590
Shale and lignite	85	675

Well TX-37-27-802

Owner: City of Nacogdoches No. 9
Driller: Layne Texas Co.

	THICKNESS	DEPTH
Surface	0	0
Sand	11	11
Red and grey clay	43	54
Clay and sandy clay	81	135
Black and brown shale	70	205
Brown shale streaks and sandy shale	62	267
Green sandy shale	31	298
Gray shale and lignite	197	495
Sandy shale	25	520
Shale and sandy shale streaks	60	580
Carrizo sand	106	686
Brown shale	10	696

Well TX-37-28-901

Owner: Woden Water Supply Corp. No. 1
Driller: Key Water Wells

	THICKNESS	DEPTH
Surface soil	18	18
Water sand	20	38
Sandy clay	80	118
Hard tight shale	222	340
Sandy shale	20	360
Water sand	145	505

Well TX-37-29-402

Owner: Melrose Water Supply Corp.
Driller: Key Water Wells

	THICKNESS	DEPTH
Surface soil	10	10
Surface sand and clay	70	80
White sand	50	130
Blue shale	25	155
Oil sand	13	168
Gray shale	32	200
Sandy shale	40	240
Blue shale	12	252
Sandy shale	28	280
Salt and pepper sand	40	320
White sand	40	360
Shale	30	390

Well TX-37-29-603

Owner: Attoyac Water Supply Corp.
Driller: Andrews & Foster

	THICKNESS	DEPTH
Shale	40	40
Blue shale and rock breaks	30	70
Brown shale	10	80
Sandy shale and rock	60	140
Sand	98	238
Shale	7	245
Sand	11	256
Shale	35	291
Rock	1	292
Shale	10	302
Sand	12	314
Shale	46	360
Sand	20	380
Shale	12	392
Sand	13	405

	THICKNESS	DEPTH
(Well TX-37-29-603) Continued		
Rock	9	414
Sand	41	455
Shale	5	460
Well TX-37-30-701		
Owner: Chireno Water Supply Corp.		
Driller: Layne Texas Co.		
Surface	0	0
Clay	25	25
Shale	51	76
Rock	3	79
Shale and streaks of rock	11	90
Shale and sandy shale	64	154
Rock	1	155
Shale	132	287
Sand and streaks of shale	23	310
Sandy shale	9	319
Sand (cut good)	37	356
Sandy shale	14	370
Sand (cut good)	21	391
Sandy shale	6	397
Sand	8	405
Sandy shale and streaks of sand	26	431
Shale and sandy shale	124	555
Shale and streaks of sand	43	598
Sand and streaks of shale	17	615
Rock	2	617
Shale	32	649
Sand	12	661
Shale	54	715
Sand and streaks of shale	10	725
Shale and streaks of sand	37	762
Lignite	6	768
Shale	6	774
Fine sand and streaks of shale	29	803
Shale and lignite	14	817
Sand and streaks of shale and lignite	26	843
Shale, streaks of rock and lignite	30	873
Sand and sandy shale	12	885
Shale	12	897

	THICKNESS	DEPTH
Well TX-37-35-101		
Owner: Southland Paper Mills		
Driller: Layne Texas Co.		
Soil	1	1
Sandy clay	15	16
Sand	89	105
Sand and sandy shale	107	212
Shale lignite and shell	54	266
Rock	3	269
Shale, sandy shale, lignite, shell	166	435
Rock	3	438
Shale	2	440
Rock	1	441
Shale	5	446
Rock	4	450
Shale	11	461
Rock	2	463
Shale, sandy shale, lignite, shell	65	528
Broken sand	50	578
Sand	148	726
Sandy shale	16	742
Sand	22	764
Broken sand	16	780
Sand	45	825
Rock	3	828
Shale	16	844
Sandy shale	6	850
Sand (good)	12	862
Shale and sandy shale	15	877
Rock	1	878
Boulders	2	880
Shale and sandy shale	13	893
Sand	35	928
Sandy shale and shale	7	935
Sand	48	983
Rock	1	984
Well TX-37-35-301		
Owner: Southland Paper Mills		
Driller: Layne Texas Co.		
Clay rocks	4	4
Sand	22	26
Clay	2	28

	THICKNESS	DEPTH
(Well TX-37-35-301) Continued		
Sand	8	36
Hard shale	23	59
Sandy shale	23	82
Sand and sandy shale and lignite	50	132
White and black speck sand	62	194
Sandy shale	16	210
Sand and sandy shale	20	230
Hard sandy shale	150	380
Shale and sandy shale	52	432
Shale and streaks of sandy shale	60	492
Hard shale and streaks of sandy shale	54	546
Sandy shale, greenish	25	571
Shale	6	577
Not logged	49	626
Sandy breaks, sandy shale	12	638
Fine gray sand (cut good)	10	648
Sandy shale and sand	21	669
Hard shale, sand-lignite	21	690
Fine gray sand (cut fair)	69	759
Sand, breaks of shale	17	776
Sand and shale	29	805
Sand, sandy shale, lignite	46	851
Shale, streaks of sandy shale	53	904

Well TX-37-36-201

Owner: Southland Paper Mills
Driller: Layne Texas Co.

	THICKNESS	DEPTH
Sand	2	2
Red sandy clay	11	13
Gray clay	7	20
Yellow clay and sand	8	28
Yellow sand	39	67
Gray shale	29	96
Gray sand	30	126
Gray shale	7	133
Gray sand	11	144
Gray shale	5	149
Gray sand	12	161
Gray shale	3	164
Gray sand	12	176
Gray shale	14	190

	THICKNESS	DEPTH
(Well TX-37-36-201) Continued		
Gray sand	14	204
Shale, sandy shale, shell	51	255
Shale and boulders	21	276
Gray shale	42	318
Rock	2	320
Shale, sandy shale and shell	28	348
Rock	1	349
Shale, lignite and shell	33	382
Rock	2	384
Shale	26	410
Boulders	3	413
Shale	6	419
Rock	1	420
Shale	18	438
Shale, lignite and shell	39	477
Rock	2	479
Rock	2	481
Shale	1	482
Rock	2	484
Shale	2	486
Rock	2	488
Shale	3	491
Rock	1	492
Shale	21	513
Rock (hard)	4	517
Shale	30	547
Sand and shale	16	563
Sand	37	600
Shale	4	604
Sand	8	612
Shale	5	617
Sand	107	724
Rock	1	725
Shale and shell	11	736
Rock	1	737
Shale	8	745
Rock	1	746
Sand	72	818
Sandy shale	10	828
Sand	9	837

	THICKNESS	DEPTH
(Well TX-37-36-201) Continued		
Shale and sandy shale	12	849
Sand	21	870
Rock	7	877
Shale and sandy shale	8	885
Sand	11	896
Shale and sandy shale	18	914
Rock	1	915
Shale	17	932
Sand	13	945
Sandy shale and shale	37	982
Rock	1	983
Shale and sandy shale	7	990
Rock	1	991
Shale, sandy shale and shell	95	1,086
Sandy shale and sand	20	1,106
Gray sand	14	1,120
Rock	2	1,122
Gray sand	14	1,136
Shale, sandy shale and shell	73	1,209
Rock	1	1,210
Shale	2	1,212
Rock	3	1,215
Sandy shale	5	1,220
Rock	1	1,221
Sandy shale	2	1,223
Rock	1	1,224
Sandy shale	26	1,250
Rock	1	1,251
Sand	21	1,272
Shale	18	1,290
Sand	26	1,316
Shale	10	1,326

Well TX-37-46-401

Owner: Shirley Creek Marina
Driller: R. E. Dixon

	THICKNESS	DEPTH
Surface sand	2	2
Hard red clay	4	6
Hard blue clay and gravel	10	16
Lignite	4	20
(Well TX-37-46-401) Continued		
Hard gray sand, shale and gravel	30	50
Hard dark gray shale	25	75
Lignite	5	80
Sandy shale, water sand, sulphur	46	126
Dark brown clay and gravel	9	135
Sandy shale	20	155
Lignite and gravel	3	158
Rock, sandy shale and gravel	22	180
Sandy shale and gravel	18	198
Lignite, clay and gravel	6	204
Rock	2	206
Water sand	24	230

Table 11.--Results of Chemical Analyses of Water From Wells in Angelina County

Well Number	Well Owner	Depth or Screened Interval (feet)	Indicated Water-Bearing Unit 1/	Date of Collection	Laboratory 2/	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) 3/	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids 4/	Total Hardness as $CaCO_3$	Specific Conductance Micromhos/cm @ 25° C.	pH
AD-37-33-305	Jimmie Day	205-225	Sp	12-11-68	TSDH	16	0.3		6	3	98			206	43	23	0.3	<0.4	291*	27	477	8.1
401	D. M. Manley	231-241	Sp	12-11-68	TSDH	10	.06		13	4	304			342	276	89	1.0	< .4	870*	48	1,400	8.1
502	Jack Clark	218-228	Sp	12-13-68	TSDH	9	4.60		8	2	304		16	477	169	79	1.6	< .4	830*	27	1,290	8.5
603	Van B. Scott	165-175	Cm	12-11-68	TSDH	10	1.0		6	6	374		5	475	267	133	1.6	< .4	1,040*	39	1,610	8.4
702	Anderson Bait Dist.	467-507	Sp	12-12-68	TSDH	15	< .02		<1	<1	88		13	154	24	16	.6	< .4	233*	2	390	9.0
801	Mrs. Carrie Dean	17-20	Al	12-11-68	TSDH	8	14.80		16	12	5			6	3	14	.1-	88	164*	89	250	6.1
902	Arby Seamans	440-450	Sp	12-11-68	TSDH	13	.15		2	1	399		20	930	10	45	2.4	2.5	950*	11	1,500	8.5
34-102	H. L. Duncan	152-172	Sp	12-12-68	TSDH	15	.3		32	9	124			220	147	34	.3	< .4	470*	119	745	8.0
201	Southland Paper Mills	850-941	Cz	12-27-47	CL	16	.5		1.6	.4	197*		13	400	56	17			522*	6		8.6
401	Town of Pollock	50	Cm	3-25-37	USGS									5	11	10				14		
402	Mrs. N. Carson	24	Cm	3-26-37	USGS									114	6	22				99		
403	Theo. Johnson	186-201	Sp	12-17-68	TSDH	12	.13		3	4	240			318	178	78	.8	2.0	675*	25	1,085	7.9
501	Lufkin State School No. 1	1,188-1,250	Cz	5-12-60	USGS	14	1.0		.8	0	187*		7	299	118	20	.3	.0	489	2	786	8.3
501	Lufkin State School No. 1	1,188-1,250	Cz	2-7-63	MSL	12	.16		.5	0	182*			310	116	16			484	1	780	8.6
502	Central School	430-466	Sp	3-7-61	USGS	11	.10		3.5	.9	435	3.0		572	336	110	1.1	.0	1,190	12	1,880	8.1
504	Central W.C.I.D.	1,125-1,265	Cz	12-13-68	TSDH	15	.04		1	<1	166		24	238	94	16	.3	< .4	432*	4		8.9
505	Lufkin State School No. 2	1,144-1,264	Cz	6-3-63	MSL	13	.1		.5	.1	186*		22	288	106	17			490	2	810	8.6
506	Central School	40	Cm	1-25-37	USGS									6	1	6				12		
602	Gulf Pipeline Co.	523	Qc	1-19-37	USGS									780	1	1,400			2,970*	33		
602	Gulf Pipeline Co.	908-929	Cz	8-2-49	USGS	14	.34		.2	.2	118	1.6	6	201	67	10	.1	1.8	333	2	519	8.7
701	Neal Thompson	126-136	Cm	12-17-68	TSDH	10	.13		10	5	230			395	163	45	.9	2.5	660*	45	1,050	8.2
802	Robert Adams	170-190	Cm	12-12-68	TSDH	55	5.20		31	14	52			173	66	32	.2	< .4	340*	135	495	6.9
803	R. G. Brown	25	Y	4-16-37	USGS									7	5	10				10		
804	T. Finley	20	Cm	6-11-37	USGS									10	35	46		1.3		26		
805	B. Fagen	50	Cm	6-11-37	USGS									32	4	9		0		81		

For footnotes see end of table.

Table 11.--Results of Chemical Analyses of Water From Wells in Angelina County--Continued

Well Number	Well Owner	Depth or Screened Interval (feet)	Indicated Water-Bearing Unit 1/	Date of Collection	Laboratory 2/	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) 3/	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids 4/	Total Hardness as $CaCO_3$	Specific Conductance Micromhos/cm @ 25° C.	pH
AD-37-34-901	Ervin Hopper	22	Cm	3-26-37	USGS									12	46	144				52		
902	City of Lufkin No. 10	1,128-1,258	Cz	7-67	MSL	14	0.16		0.4	0	175*		0	299	105	19			466	1	739	8.1
35-401	Southland Paper Mills	823-944	Cz	10-39	CL	19	.2		2.1	.2	112*			240	39	9			300*	6		7.6
402	Southland Paper Mills	818-915	Cz	5-56	CL	15	.07		.5	.2	93*		12	171	26	9			261	2		8.6
403	Southland Paper Mills	869-1,020	Cz	4-56	CL	12	.05		.5	.4	98*		12	176	37	10			285	3		8.8
404	I. W. Sowell	325-346	Sp	5-10-61	USGS	11	.12		1.2	.6	418*			918	0	108	3.1	0.5	1,030	6	1,640	8.0
405	Lufkin Chamber of Commerce	226-236	Sp	6-30-37	USGS	16	.08		2.9	1.4	416	6.1	30	830	1	134	4.0	.2	1,020*	13		
405	Lufkin Chamber of Commerce	226-236	Sp	7-1-37	USGS	15	.19		3.5	1.3	415	5.8	29	830	1	136	4.8	.1	1,020*	14		
405	Lufkin Chamber of Commerce	291-301	Sp	7-2-37	USGS	14	.09		4.8	1.6	439	7.7	41	829	1	162	4.2	.2	1,084*	19		
405	Lufkin Chamber of Commerce	757-767	R	7-7-37	USGS	14	.07		3.3	.9	263	4.3	53	592	4	10	.6	.0	645*	12		
405	Lufkin Chamber of Commerce	822-832	Cz	7-8-37	USGS	16	.09		2.1	1.0	102	1.6	16	178	44	7	.1	.0	277*	9		
405	Lufkin Chamber of Commerce	1,064-1,074	Wx	7-11-37	USGS	12	.30		4.6	1.7	344	5.8	79	752	13	16	1.5	.0	848*	18		
405	Lufkin Chamber of Commerce	1,102-1,112	Wx	7-13-37	USGS	16	.08		1.1	.7	372	5.8	47	862	1	31	1.3	.0	902*	6		
408	City of Lufkin No. 9	960-1,085	Cz	2-17-67	MSL	12	.05	0.05	.4	0	142*		14	250	60	12	.8	.1	362	1	586	8.2
502	Southland Paper Mills	879-998	Cz	7-39	CL	18	.2		.6	Tr	120*		19	217	33	12			310*	2		8.7
502	Southland Paper Mills	879-998	Cz	11-19-63	CL	9	< .05		.4	.1	120*		12	226	40	10			333	1	487	8.7
503	Southland Paper Mills	898-1,018	Cz	9-39	CL	14	.28		.9	Tr	124*		16	239	31	10			313*	2		8.7
503	Southland Paper Mills	898-1,018	Cz	8-1-61	USGS	14	.05		.2	0	118*			226	52	12	.3	.0	306	0	503	8.0
504	Southland Paper Mills	855-977	Cz	9-39	CL	16	.27		1.0	Tr	131*		19	252	32	12			335*	2		8.6

For footnotes see end of table.

Table 11.--Results of Chemical Analyses of Water From Wells in Angelina County--Continued

Well Number	Well Owner	Depth or Screened Interval (feet)	Indicated Water-Bearing Unit 1/	Date of Collection	Laboratory 2/	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) 3/ Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids 4/	Total Hardness as $CaCO_3$	Specific Conductance Micromhos/cm @ 25° C.	pH
AD-37-35-505	Southland Paper Mills	760-874	Cz	3-56	CL	9	0.1		0.0	0.0	104*	12	215	16	9			276	0		8.7
507	Southland Paper Mills	80-85	Sp		SPM								168	12	52			370	3		
508	Southland Paper Mills	50-55	Sp		SPM								7	Tr	8			105	26		
509	Southland Paper Mills	40-45	Sp		SPM								493	2	464			887	68		
510	Southland Paper Mills	170-175	Sp		SPM								342	6	116			1,361	4		
601	Southland Paper Mills	823-925	Cz	8-39	CL	22	.23		.7	Tr	108*	7	214	33	12			286*	2		8.6
602	Southland Paper Mills	738-853	Cz	2-56	CL	10	.1		.0	.1	102*	12	214	14	8			275	1		8.6
605	Southland Paper Mills	808-910	Cz	1-56	CL	12	.1		.5	.2	107*	10	224	18	11			301	2		8.8
701	City of Lufkin No. 5	1,028-1,163	Cz, Wx	12-2-46	CL	8	.2		1.3	.2	152*	17	251	69	20			392*	4		8.9
701	City of Lufkin No. 5	1,028-1,163	Cz, Wx	3-59	TSDH		.06		1	1	176			98	20	0.2	< 0.4		3	636	8.7
702	City of Lufkin No. 6	1,221	Cz	3-59	TSDH		.40		1	1	169			89	18	.2	< .4	437*	3	611	8.8
703	City of Lufkin No. 7	1,160-1,290	Cz	6-61	TSDH		.66	<0.5	1	1-	197		354	114	24	.4	< .4	516*	3	860	8.2
703	City of Lufkin No. 7	570-595	Sp	7-13-56	CL	18			5	1	427*	12	956	15	88			1,066	17		8.4
705	City of Lufkin No. 3	1,055-1,167	Cz	7-48	TSDH	16	.1	< .5	4	1	136	24	220	68	14	.3	< .4	340*	14		8.5
706	W. A. Collmorgan			1-14-37	USGS				2		272*	43	538	37	34			628*	8		
708	City of Lufkin No. 8	1,036-1,138	Cz	7-64	CL	14	< .05		.7	.2	168*	12	293	79	18			464	3	728	8.6
709	Redland Water Supply Corp.	1,079-1,139	Cz	1-3-63	CL	14	.1		1.2	.3	143*	12	249	67	15			409	4	582	8.5
710	City of Lufkin	567	Sp	10-30-35	CL	28			5.0	2.2	421*	66	743	18	141			1,143*	22		
710	City of Lufkin	1,188	Cz	11-11-35	CL	21			2.4	1.6	159*	16	274	76	17			479*	13		

For footnotes see end of table.

Table 11.--Results of Chemical Analyses of Water From Wells in Angelina County--Continued

Well Number	Well Owner	Depth or Screened Interval (feet)	Indicated Water-Bearing Unit 1/	Date of Collection	Laboratory 2/	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) 3/	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids 4/	Total Hardness as $CaCO_3$	Specific Conductance Micromhos/cm @ 25° C.	pH
AD-37-35-711	City of Lufkin	580-655	Sp	10-4-35	CL	6			7.0	Tr	614*		72	1,019	5	276			1,569*	18		
711	City of Lufkin	1,178-1,248	Cz	10-14-35	CL	4			2.9	Tr	224*		39	351	101	26			665*	7		
712	City of Lufkin	63	Y	1-18-37	USGS									36	5	15				26		
713	City of Lufkin	126-400	Y	1-18-37	USGS									314	1	30				33		
901	M. R. Willis	306	Sp	1-10-61	USGS	11	0.58		22	13	2,120*			1,100	0	2,700	0.8		5,410*	108	9,240	7.5
902	M & M Water Supply Corp.	990-1,070	Cz	6-18-66	CL	19	.1		1.2	.3	162*		18	323	28	23			441	4	696	8.7
36-403	Southland Paper Mills	811-841	Cz	8-55	CL	13	.05		1.3	.3	137*		12	305	16	10			356	4		8.6
406	Southland Paper Mills	205-210	Sp	7-13-40	CL		.6		4.6	1.5	586*		29	677	0	487			1,441*	18		8.3
407	Southland Paper Mills	60-70	Sp	7-13-40	CL		.4		11.4	3.9	971*		24	720	0	1,080			2,446*	45		8.0
407	Southland Paper Mills	145-150	Sp	7-13-40	CL		.6		2.0	.6	150*		10	312	0	49			366*	8		7.7
501	Southland Paper Mills	758-800	Cz	7-50	CL	18	.6		.7	.2	166*		24	342	22	16			417*	2		8.8
503	Southland Paper Mills	706-736	Cz	6-50	CL	24	.7		.8	Tr	132*		19	273	17	10			339*	2		8.9
702	W. M. Berry	22	Y	5-6-69	TSDH	30	.04		48	15	186			59	80	173	.8	264	830*	184	1,250	6.4
801	Southland Paper Mills	897-907	Cz	4-50	CL	22	.6		2.0	.3	281*		43	766	0	16			741*	9		8.7
801	Southland Paper Mills	1,034-1,045	Wx	4-50	CL	14	.5		2.7	.5	329*		46	644	0	8			718*	6		8.7
802	Southland Paper Mills	878-899	Cz	8-50	CL	14	2.0		.8	Tr	144*		24	281	25	12			361*	2		8.8
803	I. D. Anderson	222-238	Sp	12-17-68	TSDH	12	.13		6	4	590		12	1,130	<4	269	2.8		1,460*	34	2,300	8.5
902	Southland Paper Mills	860-891	Wx	1949	SPM									685	96	30						7.1
903	Southland Paper Mills	195-291	Sp		SPM								16	262	36	12			309			8.6
41-301	E. P. Anderson	169-189	Y	7-19-68	TSDH	29	.50		3	2	132			257	38	38	.4	< .4	368*	18	604	8.1
42-201	Lancewood Water Supply Corp.	90-120	Y	9-7-66	PTL		.3		8.8	3.4	39			73	15	32	.2	.6	135*	36	230	7.4

For footnotes see end of table.

Table 11.--Results of Chemical Analyses of Water From Wells in Angelina County--Continued

Well Number	Well Owner	Depth or Screened Interval (feet)	Indicated Water-Bearing Unit 1/	Date of Collection	Laboratory 2/	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) 3/	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids 4/	Total Hardness as $CaCO_3$	Specific Conductance Micromhos/cm @ 25° C.	pH
AD-37-42-301	Owens Illinois No. 4	150-195	Y	1-4-55		61	6.0		35.1	11.8	65*			92	75	88			387*	136		6.0
301	Owens Illinois No. 4	150-170	Y	1-8-55		61	6.0	0.4	37.4	13.5	69*			88	85	98			413*	149		6.0
301	Owens Illinois No. 4	150-195	Y	2-10-55		62	7.0		49	17	85*			67	134	130			517*	193		6.0
302	Owens Illinois No. 5	52-72	Y	2-18-55		36	.5		19	4	23*			38	35	32			168*	64		
303	J. W. Sherrard	18	Y	1-11-37	USGS				8		18*			18	14	13		22	93*	32		
304	Woodlawn Water Supply Corp.	1,320-1,410	Cz	2-13-64	MSL	10	.22		1.5	.2	338*		26	656	0	112			813	5	1,335	8.4
305	Angelina Lbr. Co.	47-68	Y	1-11-37	USGS									34	17	31		14	121*	68		
306	City of Lufkin	668-696	Sp	12-9-35	CL	20			6.1	Tr	433*		36	935	13	80			1,122*	15		
306	City of Lufkin	1,269-1,342	Cz	12-9-35	CL	14			3.3	Tr	320*		30	660	22	65			840*	8		
401	Sam Peavy	195	Y	1-18-37	USGS									324	200	55				183		
502	Agriculture Exp. Station	276-310	Y	1-11-61	USGS	21	.30		7.8	2.1	116*			233	41	32	0.2	.8	332	28	538	7.8
503	Agriculture Exp. Station	80	Y	1-18-37	USGS									204	170	84				285		
504	Hudson School	105	Y	1-18-37	USGS									200	45	60				198		
505	C. A. Juergens	41	Y	5-31-37	USGS									88	28	157		6.2		150		
602	Hudson Water Supply Corp.	335-415	Y	9-4-63	MSL	13	.05		1.5	0	156*		19	244	54	40			405	5	680	8.7
701	Mrs. A. G. Johnson	53	Y	12-4-68	TSDH	36	.86		55	11	51			85	104	92	.3	< .4	391*	184	615	6.5
702	Mrs. A. G. Johnson	62	Y	5-31-37	USGS									17	15	48		.2		93		
703	Mrs. A. G. Johnson	18	Y	5-31-37	USGS									122	40	134		68		123		
901	J. F. Wright	278-288	Y	12-6-68	TSDH	28	.13		3	0	145		4	294	18	34	.5	< .4	378*	7	580	8.5
43-101	City of Lufkin	110	Y	1-22-37	USGS									6	120	50				75		
201	Eulen Berry	1,216-1,237	Cz			12	.2		1.1	.3	213*		24	351	90	32			546*	4		8.6
202	Herty Water Co. No. 4	200	Y	12-6-68	TSDH	21	1.86		17	5	102			231	50	34	.1	< .4	342*	64	547	7.8
204	Southland Paper Mills	120-190	Y	7-20-43	USGS	62	.02		28	8.3	46*			88	51	56	.2	.2	305*	104		8.1
302	Geo. Korn	32	Y	3-22-37	USGS									70	20	50				90		

For footnotes see end of table.

Table 11.--Results of Chemical Analyses of Water From Wells in Angelina County--Continued

Well Number	Well Owner	Depth or Screened Interval (feet)	Indicated Water-Bearing Unit 1/	Date of Collection	Laboratory 2/	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) 3/ Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids 4/	Total Hardness as $CaCO_3$	Specific Conductance Micromhos/cm @ 25° C.	pH
AD-37-43-402	John Bennett	20	Y	3-30-37	USGS								82	40	68				76		
501	Angelina Water Supply Corp.	357-447	Y	10-5-64	TSDH		0.98	<0.2	2	1	100		151	50	35	0.4	<0.4	263*	9	495	7.3
502	Lee Graham	28	Y	6-2-37	USGS								74	5	44		35		110		
503	Fuller Springs Water Dist. No. 1	310-410	Y	3-22-65	TSDH		1.50	.21	29	6	95		177	93	43	.2	< .4	360*	98	672	6.8
503	Fuller Springs Water Dist. No. 1	310-410	Y	4-22-69	TSDH	57	3.90		29	7	90		176	87	51	.2	< .4	412*	101	617	6.8
505	G. B. Cornell	31	Y	6-2-37	USGS								102	8	70		25		96		
506	G. B. Cornell	55	Y	6-2-37	USGS								120	3	201		0		246		
602	E. C. Greene	23	Y	3-31-37	USGS								385	250	253				213		
701	E. M. Gipson	97-254	Y	1-13-60	MSL	29			23	5.7	126*		300	30	56			442	81	690	7.8
701	E. M. Gipson	163-254	Y	1-14-60	MSL	29	.95		25	5.5	134*		303	42	60			456	85	740	7.7
701	E. M. Gipson	97-112	Y	1-15-60	MSL	29	.45		32	8	117*		288	44	60			438	113	710	7.6
701	E. M. Gipson	97-254	Y	1-26-60	HCHD	33			30	9	151*		293	50	66	.8		484*	113		7.8
803	W. T. Harbuck	23	Y	6-2-37	USGS								462	25	142		47		159		
902	Anna Stradt	236-256	Y	12-10-68	TSDH	62	5.60		90	19	110		151	279	104	.5	< .4	740*	305	1,064	6.6
44-101	Garland Redd	123-133	Y	12-17-68	TSDH	12	.22		35	11	249		415	177	105	.5	2.0	800*	136	1,250	8.1
201	George Davis	210-220	Y	12-17-68	TSDH	12	.20		12	5	380		530	24	302	.7	< .4	1,000*	50	1,700	8.3
401	J. C. Nerren	42	Y	4-1-37	USGS								76	100	1,080						
601	O. M. Knight	167-189	Y	8-29-68	TSDH	10	.04		1	<1	171		315	43	48	.4	.5	429*	5	705	8.2
702	Dr. H. M. Wilson (P. R. Wilson)	440	Y	2-18-37	USGS								235	96	52			413*	8		
801	City of Huntington No. 7	1,772-1,797	Cz	7-3-59	CL	16	1.5		3	1	677*	36	732	0	580			1,674*	11	3,080	8.7
801	City of Huntington No. 7	1,153-1,178	Sp	7-25-59	CL	16	.1		116	63	5,433*		464	0	8,500			14,356*	549	24,500	7.9
801	City of Huntington No. 7	636-656	Y	8-5-59	CL	15	.7		1.2	.2	190*	18	360	0	64			466*	4	752	8.6
801	City of Huntington No. 7	495-690	Y	8-21-59	CL	17	.3		1.3	.3	194*	24	361	18	50			482*	4	765	8.7

For footnotes see end of table.

Table 11.--Results of Chemical Analyses of Water From Wells in Angelina County--Continued

Well Number	Well Owner	Depth or Screened Interval (feet)	Indicated Water-Bearing Unit 1/	Date of Collection	Laboratory 2/	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) 3/	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids 4/	Total Hardness as $CaCO_3$	Specific Conductance Micromhos/cm @ 25° C.	pH
AD-37-44-802	Four Way Water Supply Corp.	649-719	Y	7-26-67	MSL	14	<0.05	<0.02	1	0	158*		13	287	19	48	0.6	0.1	394	3	656	8.6
803	V. C. Davis	280-300	Y	2-12-37	USGS				30	9.2				298	275	105			800*	113		
901	Pearl Conner	218-228	Y	8-28-68	TSDH	34			3	1	211			270	174	49	.3	.5	610*	13	925	7.6
902	J. T. Forrest	18	Y	6-3-37	USGS									12	44	70		12		22		
903	Lee Johnson	32	Y	6-3-37	USGS									72	360	65		90		214		
45-701	L. Bitner	196-206	Y	8-28-68	TSDH	25	< .02		3	2	283			416	168	85	.6	< .4	770*	16	1,185	7.8
802	B. F. Cochran	100	Y	1-10-61	USGS	46	.14		112	29	420*			330	660	250	.4	2.0	1,720	398	2,480	6.9
803	Roy Fletcher	20	Y	6-3-37	USGS									94	60	450		486		518		
50-302	Burke Water Supply Corp. No. 1	820-875	Y	5-18-67	CL	19	.05	.02	1.1	.3	247*		24	500	0	63	.4	.1	632	4	1,052	8.7
303	Burke Water Supply Corp. No. 2	270-337	Y	5-20-67	CL	20	.10	.02	1.2	.4	187*		18	334	56	33	.2	.1	505	5	773	8.4
602	Southern Pine Lbr. Co. No. 1	704	Y	6-29-42	USGS		.02		4.7	1.2	491*		24	892	2	220		.0	1,235	16		
603	Southern Pine Lbr. Co. No. 2	702-803	Y	4-22-69	TSDH	20	.06		2	1	471			920	5	200	3.1	< .4	1,150*	8		8.2
605	Southern Pine Lbr. Co. No. 4	320-495	Y	1-25-55	CL	27	.1		.7	.3	214*		24	395	41	43			544*	3		8.5
606	City of Diboll No. 2	440-520	Y	8-31-65	MSL	24	.12		2	0	169*		10	343	41	23			443	5	684	8.7
606	City of Diboll No. 2	440-520	Y	6-15-66	TSDH		.26		2		173		12	360	29	27	.4		417*	6	780	8.7
607	Arthur Powell	188-198	Y	7-18-68	TSDH	28	.94		35	5	710			520	500	500	.9	< .4	2,040*	109	3,200	7.8
901	City of Diboll No. 1	490-601	Y	6-15-66	TSDH		< .02	< .05	3		190		5	371	55	40	.3	1	482*	7	880	8.4
51-102	L. G. Capps	24	Y	6-2-37	USGS									120	50	22		0		54		
201	Natural Gas Pipeline Co. of America No. 1	275-305	Y	3-21-56	O	41	.3		3.4	.5	142*		12	272	50	21	.7	1.3	404*	6		8.1
202	Natural Gas Pipeline Co. of America No. 2	273-303	Y	3-21-56	O	35	.1		3.2	.1	145*		12	293	33	20	.5	.8	397*	9		8.2
202	Natural Gas Pipeline Co. of America No. 2	273-303	Y	4-24-69	TSDH	28	.06		1	< 1	146			320	27	24	.3	.4	383*	5	603	8.1
301	Childress (R. P. Stinson)	440	Y	6-2-37	USGS									562	120	118		1.2		3		

For footnotes see end of table.

Table 11.--Results of Chemical Analyses of Water From Wells in Angelina County--Continued

Well Number	Well Owner	Depth or Screened Interval (feet)	Indicated Water-Bearing Unit 1/	Date of Collection	Laboratory 2/	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) 3/	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids 4/	Total Hardness as $CaCO_3$	Specific Conductance Micromhos/cm @ 25° C.	pH
AD-37-51-403	Prairie Grove Water Supply	512-572	Y	10-30-67	PTL		0.2	0.0	2.4	0.8	334		31	541	5	167	1.2	0.6	808*	9	1,000	8.6
404	Havard (J. L. Russell)	156	Y	2-17-37	USGS									102	200	84				105		
504	Beulah Water Supply Corp.	517-560	Y	8-27-65	PTL	13	.2		2.4	1.0	234		22	364	93	62	.5		606*	10		8.3
505	Dr. Weeks	900	Y	2-17-37	USGS									571	139	220			1,023*	12		
801	Sun Oil Co.	760-800	Y	6-30-42	USGS		.02		2.9	.7	262*		41	520	15	96		.0	762	76		
901	Strain (Olive School)	13	J	6-1-37	USGS									6	18	9		.8		38		
902	Elbert Havard	28	J	6-1-37	USGS									4	10	95		100		84		
52-101	R. L. Goodman	184-194	Y	7-17-68	TSDH	24	.11		8	3	388			483	232	160	.6	< .4	1,050*	32	1,660	7.9
202	Rev. C. A. Bell	212-222	Y	7-16-68	TSDH	33	.36		72	16	376			432	441	158	.5	1.0	1,310*	244	1,950	7.5
203	Lala Hill School	250	Y	1-20-37	USGS									298	800	202				504		
402	Temple Industries No. 2	635-655	Y	7-16-68	TSDH	17			2	1	312		2	570	79	107	1.1	< .4	800*	8	1,300	8.4
602	M. M. Flournoy	609	Y	1-11-61	USGS	18	.20		2	.9	365*		12	718	19	120	1.9	.2	904	8	1,470	8.3
801	Carter-Kelly Lbr.Co.	541	Y	2-22-37	USGS									574	210	250			1,173*	18		
53-102	Shawnee School	478	Y	2-19-37	USGS									802	4	141			899*	12		
201	A. E. Forse	137-147	Y	7-17-68	TSDH	26	.30		11	4	340			434	274	101	.6	< .4	970*	44	1,500	7.9
202	Jack Roberts	27	J	5-6-69	TSDH	28	.64		64	3	21			200	6	33	.2	< .4	253*	173	428	7.1
401	Atlantic Refining Co.	413-435	Y	4-16-42	USGS	39	.01		2.1	.8	278*			356	216	68	.1	.2	772	8	1,210	7.9
401	Atlantic Refining Co.	413-435	Y	1945	CEL	35	2.0		6.4	2.6	193*		9	256	5	152			532*	2		8.2
402	Atlantic Refining Co.	452	Y	1-20-37	USGS									516	1,200	360				123		
602	Camp Perry	Spring	J	6-5-37	USGS									8	1	4		0		30		
901	U.S. Forestry Service	84-104	J	1-10-61	USGS	58	12		47	16	125*			129	276	39	.1	.0	629*	184	892	6.2
903	Texas & New Orleans R.R.	Spring	J	1-22-37	USGS									2	2	20				6		

For footnotes see end of table.

Table 11.--Results of Chemical Analyses of Water From Wells in Angelina County--Continued

Well Number	Well Owner	Depth or Screened Interval (feet)	Indicated Water-Bearing Unit 1/	Date of Collection	Laboratory 2/	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) 3/	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids 4/	Total Hardness as $CaCO_3$	Specific Conductance Micromhos/cm @ 25° C.	pH
AD-37-53-904	Zavalla W.C.I.D. No. 1	693	Y	2-2-66	TSDH		0.46	<0.05	4	2	560			780	196	278	1.0	< 0.4	1,424*	16	2,704	8.1
54-403	Pleasure Point Estates No. 3	190-210	Y	7-12-68	TSDH	28	1.16		8	4	560			1,050	< 4	285	1.0	< .4	1,410*	37	2,300	8.0
901	National Forest Service No. 1	205-223	J	2-7-67	PTL				8	2.4	393		34	544	157	155	.3	.3	1,018*	30	1,500	8.6
901	National Forest Service No. 1 Testhole	770-820	Y	2-14-67	PTL		.1		26.4	8.8	2,016		79	1,169	10	2,400	.8	.9	5,117*	102	7,700	8.6
60-201	Doyle Snelsen	45	J	4-25-69	TSDH	69	.06		7	3	47			1	18	44	.2	59.0	247*	30	317	5.2
501	Charlie Havard	135-145	J	7-10-68	TSDH	42	.16		14	4	257			243	252	116	.3	1.0	810*	51	1,260	7.4
61-101	Jackson Barge	14	J	6-15-37	USGS									6	5	104		38		90		
203	C.C.C. Camp 827	300	J	4-15-37	USGS									45	70	36				57		
401	L. Boykin	315	J	5-6-69	TSDH	53			4	4	406			540	< 4	322	.2	2.5	1,060*	29	1,750	7.8
601	L. R. Eubanks	345-355	J	7-10-68	TSDH	44	.92		2	2	229			540	< 4	44	.9	< .4	590*	13	922	7.9
62-202	Mary Frazier	19	J	7-10-68	TSDH	12	.50		32	5	31			133	21	24	.1	1.0	192*	102	346	7.1
301	Archie Kelly	350-360	J	7-10-68	TSDH	42	.16		2	3	179			327	< 4	91	.4	< .4	478*	16	775	7.8
63-201	National Forest Service No. 1	323-347	J	12-3-62	SPM		.2								29	971						8.3

1/ Initials used to identify water-bearing units are:

Al - Alluvium
J - Jackson Group
Y - Yegua Formation
Cm - Cook Mountain Formation
Sp - Sparta Sand
Qc - Queen City Sand
R - Reklaw Formation
Cz - Carrizo Sand
Wx - Wilcox Group

2/ Initials used to identify laboratories are:

CEL - Chemical Engineering Laboratories
CL - Curtis Laboratories
HCHD - Houston City Health Department
MSL - Microbiology Service Laboratories
O - Owner
PTL - Pope Testing Laboratories
SPM - Southland Paper Mills, Inc.
TSDH - Texas State Department of Health
USGS - United States Geological Survey

3/ Asterisk (*) indicates sodium and potassium calculated as sodium.

4/ Asterisk (*) indicates value is calculated or estimated.

Table 12.--Results of Chemical Analyses of Water From Wells in Nacogdoches County

Well Number	Well Owner	Depth or Screened Interval (feet)	Indicated Water-Bearing Unit [1]	Date of Collection	Laboratory [2]	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) [3]	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids [4]	Total Hardness as $CaCO_3$	Specific Conductance Micromhos/cm @ 25° C.	pH
TX-37-09-501	Art Cranford	30	R	9-4-36	WPA									24	12	7			48*			
502	Sacul Water Supply Corp.	240-285	Cz	5-10-65	PTL	14	0.6		20.8	4.9	17			82	23	13				72		6.5
502	Sacul Water Supply Corp.	240-285	Cz	4-6-66	TSDH		.58	<0.05	9	2	18			44	23	10	0.1	<0.4	85*	33	168	6.2
502	Sacul Water Supply Corp.	240-285	Cz	7-18-66	TSDH		.70	< .05	6	3	18			28	25	10	.2	< .4	77*	25	150	6.1
502	Sacul Water Supply Corp.	240-285	Cz	12-12-68	TSDH	16	.04	< .05	6	3	18			37	20	9	.3	< .4	90*	26	147	6.9
503	Ida Dixon	18	Qc	2-7-69	TSDH	16	.24	< .05	11	2	10			43	10	9	< .1	< .4	79*	35	116	6.4
602	J. P. Furra	34	R	9-4-36	WPA									12	48	24			116*			
603	T. & N.O.R.R.	Spring	Al	9-8-36	WPA				7	2	8*			31	<10	13			45*	26		
902	A. J. Mason	52	Qc	9-8-36	WPA									18	10	15			52*			
10-301	Ernie Owens	25	Wx	9-4-36	WPA									31	12	8			54*			
302	Albrey Matlock	91	Wx	1-13-69	TSDH	20	.06	< .05	62	24	26			111	157	40	.5	1.6	387*	254	579	7.3
402	City of Cushing No. 1	280-320	Cz	6-15-44	USGS	21	1.0		12	4.3	8.0	2.2		16	37	11	.2	.2	115	48	158	6.8
403	City of Cushing No. 2	995-1,005	Wx	5-30-59		18	.7		2.1	.4	421*		30	988	0	46			1,030	7	1,626	8.6
403	City of Cushing No. 2	400-420	Wx	6-3-59		20	2.2		2.0	.5	234*		18	573	2	8			604	7	879	8.6
403	City of Cushing No. 2	368-480	Wx	6-13-59			.6						36	451		8				7	769	8.7
403	City of Cushing No. 2	368-480	Wx	6-16-59		19	.7		1.8	.4	198*		18	481	1	7			521	6	793	8.8
404	L. S. King	42	Qc	9-4-36	WPA				4		9*			24	<10	8			33*	11		
405	Ocie Denney	39	Qc	9-8-36	WPA				5	2	14*			12	12	21			60*	21		
501	L. L. Ivy	21	R	8-21-36	WPA				26	20	52*			67	12	137			280*	148		
502	J. F. Ivy	50	Cz	9-4-36	WPA				11	1	12*			31	<10	23			62*	31		
604	A. McMillan	25	R	8-21-36	WPA									6	<10	65			107*			
605	George Lewis	20	Cz	2-11-69	TSDH	9	.22	< .05	3	2	3			10	6	4	< .1	1.0	33*	16	42	6.0

For footnotes see end of table.

Table 12.--Results of Chemical Analyses of Water From Wells in Nacogdoches County--Continued

Well Number	Well Owner	Depth or Screened Interval (feet)	Indicated Water-Bearing Unit 1/	Date of Collection	Laboratory 2/	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) 3/	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids 4/	Total Hardness as $CaCO_3$	Specific Conductance Micromhos/cm @ 25° C.	pH
TX-37-10-701	B. A. Birdwell	48	Qc	9-8-36	WPA									6	21	24			72*			
702	U. Cornelius	41	Qc	9-8-36	WPA				7	9	55*			6	48	85			207*	56		
703	Clifford C. Whitaker	242	Cz	1-10-69	TSDH	16	0.55	<0.05	9	12	29	4		116	29	12	0.2	0.5	165*	72	286	7.0
802	J. A. Brewer	30	Sp	9-8-36	WPA									43	12	124			246*			
803	T. B. Fountain	31	R	9-8-36	WPA									12	< 10	14			32*			
901	Humble Oil & Refg. Co.	420-440	Wx	4-20-51	CL	20	.3		4.6	.7	124*		19	266	19	10			329*	14		8.7
901	Humble Oil & Refg. Co.	420-440	Wx	6-51	CL		.1	< .01														8.7
904	Mrs. Nellie Acrey	20	R	9-7-36	WPA				6	2	13*			12	15	16			57*	21		
11-402	Luke Moore	26	Cz	8-21-36	WPA									43	< 10	72			147*			
403	A. A. Acrey	25	Cz	8-21-36	WPA									12	< 10	17			37*			
501	Mrs. P. J. Coates	44	Cz	8-29-36	WPA				31	12	3*			31	< 10	77			138*	127		
502	R. E. Muller	Spring	Cz	8-21-36	WPA				5	1	2*			12	< 10	7			21*	16		
602	J. E. Blackburn	294	Wx	12-6-68	TSDH	11	< .02	< .05	7	4	6			34	4	5	< .1	8.2	62*	34	103	6.7
603	A. J. Sieffert	42	Cz	2-12-69	TSDH	11	.10	< .05	10	13	13			7	< 4	16	< .1	95	161*	77	239	5.0
604	H. J. Mings	345	Wx	12-6-68	TSDH	41	4.40	.16	49	9	25			178	46	16	.1	< .4	274*	160	408	7.4
702	S. H. Watkins	Spring	R	8-21-36	WPA									12	< 10	6			19*			
703	S. H. Watkins	37	Cz	8-20-36	WPA				5	3	55*			12	< 10	97			166*	27		
704	T. Y. Blackburn	31	R	8-21-36	WPA				28	24	37*			31	< 32	135			271*	170		
705	W. W. Sitton	28	R	9-7-36	WPA									18	< 10	34			68*			
707	J. W. Caver	30	Cz	2-11-69	TSDH	16	.22	< .05	15	3	7			45	< 4	15	< .1	8.0	86*	50	143	6.4
802	Nacogdoches County Industrial Foundation	187-208	Cz		MSL		2.2							17		6						7.4
802	Nacogdoches County Industrial Foundation	765-779	Wx	2-12-60	MSL	20	.5		2	.3	333*		67	732	0	13			797*	6	1,200	8.7
802	Nacogdoches County Industrial Foundation	1,105-1,126	Wx	2-13-60	MSL	23	.6		.5	.1	418*		82	893	0	30			980	2	1,565	8.7

For footnotes see end of table.

Table 12.--Results of Chemical Analyses of Water From Wells in Nacogdoches County--Continued

Well Number	Well Owner	Depth or Screened Interval (feet)	Indicated Water-Bearing Unit 1/	Date of Collection	Laboratory 2/	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) 3/ / Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids 4/	Total Hardness as $CaCO_3$	Specific Conductance Micromhos/cm @ 25° C.	pH
TX-37-11-802	Nacogdoches County Industrial Foundation	1,350-1,370	Wx	2-16-60	MSL	14	4.0		4.0	1.7	704*	48	983	0	470			1,794	17		8.5
802	Nacogdoches County Industrial Foundation	1,465-1,485	Wx	2-17-60	MSL	14	3.6		2	1	842*	67	964	0	665			2,010	9	3,515	8.6
805	L. L. Stephens	27	Cz	8-29-36	WPA								6	< 10	13			25*			
806	Tom Crossland	23	R	8-28-36	WPA				38	13	44*		12	184	29			314*	148		
807	A. E. Wilburn	100	Cz	1-9-69	TSDH	17	.10		4	1	106		245	30	10	0.1	4.4	292*	14	464	7.8
901	Caro Water Supply Corp. No. 1	421-463	Wx	8-3-65	PTL	15	.11		3.2	1.5	119	19	237	30	11	.1			14		8.4
901	Caro Water Supply Corp. No. 1	421-463	Wx	12-9-68	TSDH	16	.30	<0.05	3	2	109		256	33	7	.1	< .4	296*	15	463	7.6
902	Mrs. M. E. Reider	20	R	8-31-36	WPA									1,806	225			2,910*			
903	G. R. Solomon	19	Cz	8-29-36	WPA								6	< 10	11			22*			
904	John Bailey	73	Cz	8-29-36	WPA				8	7	1*		31	< 10	19			50*	49		
905	Wilmer Scroggins	27	Cz	8-31-36	WPA									146	239			581*			
906	Hollis Solomon	565	Wx	12-13-68	TSDH	13	.10	< .05	4	2	136		350	19	6	.2	1.0	353*	16	567	8.0
12-201	T. D. Lunsford	Spring	Cz	2-11-69	TSDH	11	.10	< .05	3	6	6		2	< 4	10	< .1	34	71*	32	107	5.5
301	T. J. Williams	19	Wx	10-5-36	WPA								12	150	60			316*			
401	Boy Scouts of America	Spring	Cz	4-2-42	USGS		0						24	2	2						5.5
401	Boy Scouts of America	Spring	Cz	12-5-68	TSDH	6	.04	< .05	1	<1	2		2	< 4	2	< .1	< .4	12*	4	15	5.7
501	A. M. Foshee	24	Cz	10-8-36	WPA								18	< 10	11			32*			
502	Bellevue School	Spring	Cz	10-6-36	WPA				8		12*		43	< 10	8			49*	21		
503	Max Hart, Jr.	Spring	Cz	2-12-69	TSDH	6	.90	< .05	2	1	3		5	< 4	4	< .1	5.0	23*	10	33	5.7
601	J. L. Williams	34	Wx	10-5-36	WPA								183	45	98			367*			
602	W. C. Lee	19	Wx	10-5-36	WPA				37	31	46*		67	11	178			336*	218		
701	J. H. Summers	35	Cz	10-6-36	WPA				4	3	2*		18	< 10	8			26*	22		
702	Roy Grey	23	Cz	10-6-36	WPA								31	< 10	11			42*			

For footnotes see end of table.

Table 12.--Results of Chemical Analyses of Water From Wells in Nacogdoches County--Continued

Well Number	Well Owner	Depth or Screened Interval (feet)	Indicated Water-Bearing Unit 1/	Date of Collection	Laboratory 2/	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) 3/	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids 4/	Total Hardness as $CaCO_3$	Specific Conductance Micromhos/cm @ 25° C.	pH
TX-37-12-802	Texas Hwy. Dept.	Spring	Cz	10-5-36	WPA				5	1	3*			18	< 10	6			24*	16		
803	J. G. Fredrick	48	Cz	10-6-36	WPA				8		12*			37	< 10	12			50*	21		
804	Harold Chenoweeth	355-373	Wx	1-8-69	TSDH	15	1.12	<0.05	2	2	135			333	11	4	0.9	< 0.4	342*	14	522	8.6
903	Girl Scouts of America	170	Wx	12-9-68	TSDH	41		.32	43	14	13			149	56	6	.3	< .4	246*	163	366	7.1
904	Dr. L. W. Snider	213-237	Wx	12-9-68	TSDH	13	.06	< .05	2	2	125			255	52	15	.2	< .4	334*	14	530	8.2
905	W. V. Stokes	260-270	Wx	12-9-68	TSDH	62		.50	38	17	16			78	126	5	.5	< .4	303*	163	398	6.6
906	W. R. Kirk	32	Cz	10-8-36	WPA									12	< 10	13			30*			
13-101	H. C. Moore	63	Wx	10-6-36	WPA				373	443	410*			634	431	1,900			3,869*	2,573		
401	City of Garrison No. 1	300-340	Wx	9-4-44	USGS	15	.08		2.2	0.5	157	1.8	24	343	7	14	.2	2.2	399	8	649	8.4
402	City of Garrison No. 2	294-334	Wx	12-4-68	TSDH	13	.46	< .05	2	2	155		10	367	9	13	.3	< .4	384*	13	622	8.5
403	City of Garrison	23	Wx	10-6-36	WPA									134	2,479	1,500			5,967*			
404	City of Garrison No. 3	262-346	Wx	9-10-64	MSL	9	.18		3	0.6	159*		16	387	0	8			390	10	649	8.7
405	A. G. Jones	182-280	Wx	6-21-37	USGS									519	46	18		0		8		
406	K. Barton	Spring	Wx	10-6-36	WPA				28	7	85*			85	15	142			319*	100		
701	Wanders School	33	Wx	10-12-36	WPA									43	52	28			153*			
702	R. D. Williams	200	Wx	12-4-68	TSDH	14	.06		19	7	175			282	172	31	.3	< .4	560*	77	870	8.1
703	Mike Edwards	104	Wx	12-4-68	TSDH	22	.20		36	5	64			228	42	20	.1	< .4	301*	112	480	7.9
704	B. Weatherly	27	Wx	9-30-36	WPA				12	5	28*			85	11	19			117*	48		
801	C. C. Lowrance	19	Wx	10-9-36	WPA									67	19	19			112*			
802	H. E. Irwing	28	Wx	10-9-36	WPA									37	< 10	10			46*			
803	Billy Miller	241-246	Wx	1-8-69	TSDH	14	.08	< .05	2	2	218		16	449	59	21	.2	< .4	550*	14	864	8.7
17-202	Mrs. C. P. Wallace	21	Qc	8-27-36	WPA									6	8	27			58*			
203	Deward Phillips	397	Cz	1-9-69	TSDH	32	.46	< .05	38	13	60			24	30	47	.5	210	443*	150	622	6.1
302	O. Thomas	375	Cz	1-9-69	TSDH	15			9	3	63			170	27	9	.1	.5	211*	37	353	7.1
303	Luther Wallace	43	Qc	8-26-36	WPA									12	< 10	30			57*			

For footnotes see end of table.

Table 12.--Results of Chemical Analyses of Water From Wells in Nacogdoches County--Continued

Well Number	Well Owner	Depth or Screened Interval (feet)	Indicated Water-Bearing Unit 1/	Date of Collection	Laboratory 2/	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) 3/	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids 4/	Total Hardness as $CaCO_3$	Specific Conductance Micromhos/cm @ 25° C.	pH
TX-37-17-304	Johnny Bradshaw	51	Qc	8-27-36	WPA				29	31	206*			37	554	29			867*	200		
602	A. L. Self	27	Qc	8-26-36	WPA										285	30						
603	C. E. Grimes	23	Qc	8-26-36	WPA				17	2	44*			49	61	30			178*	51		
604	L. R. Tucker	28	Qc	8-26-36	WPA									37	15	34			105*			
605	B. K. King	35	Qc	8-26-36	WPA									12	<10	19			40*			
606	J. A. Tindally	25	Qc	8-27-36	WPA									6	22	9			50*			
607	Douglass Water Supply Corp.	409-460	Cz	9-27-64	MSL	8	1.7		18	11	65*			99	122	18			290	92	500	6.4
608	Elmo Haltom		Cz	1-13-69	TSDH	11	.40	<0.05	5	2	188			455	52	9	0.5	2.0	494*	23	795	8.1
802	C. Watkins	28	Qc	9-25-36	WPA									24	4	8			38*			
903	W. R. Barnett	31	Qc	9-25-36	WPA									18	<10	16			40*			
904	J. N. Craft	34	Qc	9-23-36	WPA									37	11	19			75*			
905	W. H. Butler	31	We	9-23-36	WPA									43	26	64			172*			
906	Feather Crest Farms No. 1	308	R	1-13-69	TSDH	11	.10	< .05	5	2	211		5	540	23	6	.3	2.6	530*	22	845	8.4
18-101	Lilbert-Looneyville Water Supply Corp.	495	Cz	10-12-66	TSDH		.32	< .05	19	13	25			41	74	28	.1	< .4	200*	102		6.3
102	W. T. Free	37	We	8-27-36	WPA									12	48	20			109*			
103	W. D. Baxter	25	Qc	9-3-36	WPA									37	<10	19			60*			
202	B. A. Sitton	500-540	Wx	12-19-68	TSDH	13	.06	< .05	3	1	193			520	5	3	.3	2.0	476*	12	755	8.3
203	M. D. Shofner	17	Qc	9-3-36	WPA				8		12*			24	8	13			53*	21		
204	Loy heirs	42	Qc	9-3-36	WPA									6	116	71			280*			
205	A. Birdwell	Spring	Qc	9-1-36	WPA									12	<10	17			37*			
206	Curtis Nance	408	Cz	1-14-69	TSDH	11		.32	21	12	25			66	72	20	.1	.5	194*	102	332	6.5
207	Willie Vaught	28	Sp	2-11-69	TSDH	11	.16	< .05	14	9	9			9	4	19	< .1	74	140*	75	215	6.0
302	E. S. Bradshaw	37	Qc	9-2-36	WPA										31	13			62*			
303	C. Whitton	36	Qc	9-2-36	WPA				5	2	9*			12	<10	22			44*	21		
304	J. D. Birdwell	31	Qc	9-3-36	WPA									12	8	26			62*			
402	E. H. Croft	17	Qc	8-25-36	WPA				72	63	33*			24	293	132			605*	439		

For footnotes see end of table.

Table 12.--Results of Chemical Analyses of Water From Wells in Nacogdoches County--Continued

Well Number	Well Owner	Depth or Screened Interval (feet)	Indicated Water-Bearing Unit 1/	Date of Collection	Laboratory 2/	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) 3/	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids 4/	Total Hardness as $CaCO_3$	Specific Conductance Micromhos/cm @ 25° C.	pH
TX-37-18-403	H. W. McCuistan	28	Qc	8-28-36	WPA				58	34	7*			238	68	25			309*	286		
404	M. F. Whitaker	34	We	8-28-36	WPA				14	5	1*			49	< 10	11			55*	53		
405	Feather Crest Farms No. 2	150	Qc	1-13-69	TSDH	48		0.16	42	14	18			27	139	23	0.3	0.5	298*	163	420	6.2
406	Don Trawick	408-438	Cz	1-10-69	TSDH	16	1.90	.16	34	12	66			134	143	16	.5	1.0	355*	132	567	6.9
407	Don Ryan	500	Cz	1-13-69	TSDH	11	.18		4	2	108			211	66	11	.5	.4	306*	19	512	8.0
501	Loy heirs	52	Qc	9-2-36	WPA									122	62	16			213*			
601	T. A. Crisp	25	Qc	9-2-36	WPA									12	< 10	8			23*			
602	Wm. Guidry	80	Qc	2-11-69	TSDH	41	.30	< .05	9	4	10			31	18	12	< .1	< .4	109*	38	135	6.3
701	Texas Pipeline Co.	441-481	Cz	1-50	TSDH	22	.4	.2	24	22	32			92	105	25	.3	< .4	276*	151		
701	Texas Pipeline Co.	441-481	Cz	6-2-61	USGS	10	20		17	14	44*			100	85	18	.2	0	233	100	401	6.1
702	Sun Pipeline Co.	405-430	Cz	1959	MEC	12	4.1							51		15				30	190	6.1
703	Texas Pipeline Co.	478-502	Cz	10-13-36	WPA				11	1	109*			250	37	16			297*	31		
802	William Scott	21	Qc	8-25-36	WPA									6	10	10			21*			
901	Pearl Oil Co.		Cz, Wx	8-2-34	IFC				14	20	19*			64	74	22			225*	119		
903	Sam Hayter	27	Sp	8-25-36	WPA									37	15	60			145*			
19-101	J. B. Burk	36	R	9-7-36	WPA				41	27	5*			24	19	130			234*	211		
102	Will Murphy	21	R	8-19-36	WPA									31	< 10	21			58*			
201	C. B. Watkins	25	Qc	9-7-36	WPA										10	16			39*			
202	Mrs. J. F. Hardy	28	We	8-28-36	WPA									336	419	281			1,308*			
301	B. A. Hurst	310-325	Cz	6-3-61	USGS	20	15		8.2	5.0	11*			10	37	12	.2	.5	104	41	159	4.9
302	T. H. Hill	24	Qc	8-31-36	WPA									12	< 10	63			108*			
303	Mary Hickenbottom	27	Qc	8-31-36	WPA									31	8	21			69*			
401	Lilly Grove Water Supply Corp.	490-580	Cz	8-25-65	TSDH		1.76	< .05	14	5	26			92	30	10	.2	< .4	132*	57	250	6.8
401	Lilly Grove Water Supply Corp.	490-580	Cz	12-26-68	TSDH	30		< .16	11	6	26			73	34	10	.2	.5	154*	51	225	7.4
402	W. E. Ballard	36	We	9-2-36	WPA				320	387	141*				2,490	200			3,538*	2,389		
403	W. R. Birdwell	41	We	9-1-36	WPA				24	14	29*			153	17	28			187*	119		

For footnotes see end of table.

Table 12.--Results of Chemical Analyses of Water From Wells in Nacogdoches County--Continued

Well Number	Well Owner	Depth or Screened Interval (feet)	Indicated Water-Bearing Unit 1/	Date of Collection	Laboratory 2/	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) 3/	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids 4/	Total Hardness as $CaCO_3$	Specific Conductance Micromhos/cm @ 25° C.	pH
TX-37-19-501	W. J. Parmley	30	We	9-7-36	WPA									110	< 10	132			296*			
502	M. H. Dennard	44	Sp	8-28-36	WPA				18					37	< 10	8			44*	46		
601	H. B. Hudson	400	Cz	1-7-69	TSDH	10			11	10	11			68	26	8	0.1	<0.4	109*	69	199	6.5
701	Sam Hayter	19	We	8-25-36	WPA				8		1*			12	< 10	7			22*	19		
702	Mrs. J. C. Miles	39	Sp	9-1-36	WPA									24	< 10	24			58*			
703	W. E. Boozer	50	We	2-7-69	TSDH	11	0.78	<0.05	20	8	9			73	10	13	< .1	16.0	123*	82	211	6.8
801	B. Danforth	22	We	8-19-36	WPA				13	17	33*			122	12	42			177*	100		
802	G. E. Norwood	32	Sp	8-19-36	WPA									12	<10	14			32*			
901	City of Nacogdoches	446-492	Cz	12-31-45	CL	10	.6		5.2	2.3	43*			101	14	13			137*	22		6.7
902	J. Thomas Hall		Cz	9-18-36	WPA					6	78*			177	30	12			213*	23		
903	R. L. Whitmire	28	Sp	8-28-36	WPA									18	< 10	16			40*			
905	A. E. Reed	33	Sp	9-1-36	WPA				17	2				31	< 10	15			49*	51		
20-101	Appleby Water Co.	256-282	Cz	8-18-44	USGS	20	6.6		1.8	1.0	4	3.0		11	4	5	0	0	48	9	60	5.8
101	Appleby Water Co.	256-282	Cz	6-3-61	USGS	23	.63		.5	1.4	3	1.4		7	4	4	.2	.4	40*	7	36	5.9
102	Mollie A. Troutman	20	R	8-31-36	WPA				290	290	287*			12	1,958	350			3,181*	1,919		
103	Appleby Water Supply Corp.	500	Wx	7-21-64	PTL		2.2		11.2	3.9	75*		14	190	14	9	.1			44		8.7
103	Appleby Water Supply Corp.	500	Wx	12-31-68	TSDH	16	.10		4	1	74		5	178	12	10	.1	.5	211*	14	340	8.5
201	D. W. Scroggins	36	Cz	10-8-36	WPA				6		11*			18	< 10	18			44*	16		
301	J. L. Scroggins	47	Cz	10-8-36	WPA									12	< 10	8			23*			
401	J. N. Skeeters	240-292	Cz	1-21-69	TSDH	6			31	19	102			162	189	33	.2	8.0	468*	156	739	7.2
402	Ed Greer	22	R	9-1-36	WPA									6	< 10	59			97*			
601	J. C. Greening	26	R	10-9-36	WPA									18	7	21			58*			
601	J. C. Greening	26	R	1-21-69	TSDH	16			16	12	44			32	16	53	< .1	92.5	266*	91	415	6.2
602	J. C. Greening	217	Cz	1-21-69	TSDH	18	13.65	< .05	9	8	15				69	17	.2	< .4	141*	55	237	4.3
703	Wiley W. Baker	425	Cz	1-15-69	TSDH	11	.64	< .05	15	10	28			63	65	16	.1	.5	177*	80	286	7.1
704	Allen Burgess	400	Cz	1-15-69	TSDH	13	1.56	< .05	17	10	24			57	65	15	< .1	1.0	172*	85	285	7.1

For footnotes see end of table.

Table 12.--Results of Chemical Analyses of Water From Wells in Nacogdoches County--Continued

Well Number	Well Owner	Depth or Screened Interval (feet)	Indicated Water-Bearing Unit 1/	Date of Collection	Laboratory 2/	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) 3/	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids 4/	Total Hardness as $CaCO_3$	Specific Conductance Micromhos/cm @ 25° C.	pH
TX-37-20-705	Tilda Parker	42	We	9-1-36	WPA									12	< 10	10			26*			
803	John D. Wilson	500	Cz	1-15-69	TSDH	9	0.22	<0.05	6	5	159			375	55	18	0.7	2.6	440*	36	705	8.1
804	Halberts, Inc.	425	Wx	1-21-69	TSDH	13	.06		3	1	108			282	12	4	<.1	5.6	286*	13	449	7.5
902	George Haltom	630	Wx	1-15-69	TSDH	11	.10	< .05	4	1	170		5	432	9	5	.3	2.0	419*	17	664	8.7
903	H. T. Haltom	17	R	10-12-36	WPA									85	< 10	24			108*			
21-101	Z. Rambin	24	Cz	10-8-36	WPA				5	2				6	< 10	12			22*	21		
201	L. D. Burke	41	Wx	10-12-36	WPA									110	30	71			243*			
202	W. L. Burkhalter	26	Wx	10-9-36	WPA				213	1	259*			6	763	220			1,459*	536		
203	Gus Young	30	Wx	10-9-36	WPA				14	7					30	30			81*	64		
401	Mrs. G. B. Stoker	63	Cz	10-12-36	WPA				37	19				18	34	25			124*	172		
402	I. Caldwell	32	Cz	9-26-36	WPA				8	6	25*				75	13			127*	43		
501	Plus Tex Poultry	160	Wx	7-5-61	USGS	46	11		2.5	2.0	16*			45	6	4	.2	.2	107	14	102	6.0
503	Moss Adams	Spring	Cz	10-8-36	WPA									18	< 10	7			26*			
504	J. W. Burt	62	Wx	9-26-36	WPA									18	< 10	11			32*			
701	Southland Paper Mills	213-234	Cz	4-26-49	CL	20	2.8		18.0	10.8	40*		5	76	78	17			229*	90		8.0
702	Mrs. W. B. Turner	27	R	9-14-36	WPA				21	11	16*			12	91	19			164*	97		
801	B. W. Covington	392	Wx	1-9-69	TSDH	13	.22		7	3	131			218	111	16	.5	.4	389*	31	620	8.0
802	Henry Ennis	20	R	9-14-36	WPA									12	< 10	10			26*			
803	J. D. Martin	74	Cz	9-26-36	WPA				1	1	12*			12	< 10	15			35*	5		
901	D. L. Burke	264	Wx	1-9-69	TSDH	39			9	4	14			72	10	2	< .1	.4	113*	42	145	7.4
902	W. F. Martin	24	Cz	9-14-36	WPA									12	< 10	7			21*			
25-301	Shell Pipeline Co.		Cz	10-13-36	WPA				9	1	80*			177	34	14			225*	25		
301	Shell Pipeline Co.		Cz	2-8-37	USGS				9.0	4.6				154	37	9				41		
601	Sam Stripling	26	We	9-24-36	WPA				12	6				24	< 10	23			53*	53		
26-101	Homer Richards	27	Sp	9-22-36	WPA									12	< 10	7			20*			
102	I. C. Ferguson	20	Sp	9-22-36	WPA				4	4	9*			6	15	19			54*	28		

For footnotes see end of table.

Table 12.--Results of Chemical Analyses of Water From Wells in Nacogdoches County--Continued

Well Number	Well Owner	Depth or Screened Interval (feet)	Indicated Water-Bearing Unit 1/	Date of Collection	Laboratory 2/	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) 3/	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids 4/	Total Hardness as $CaCO_3$	Specific Conductance Micromhos/cm @ 25° C.	pH
TX-37-26-301	Cecil Myers	45	Sp	2-3-69	TSDH	13	0.06	<0.05	21	15	25			12	8	42	<0.1	110	240*	115	414	5.8
401	Ben Stripling	530	Cz	6-2-61	USGS	10	.62		6.2	2.8	92*		38	105	58	12	.2	.0	256	27	449	9.1
402	E. H. Johnson	55	Sp	9-24-36	WPA									12	< 10	15			33*			
403	R. E. Tindall	20	We	9-24-36	WPA									18	< 10	14			37*			
404	J. P. Partin	500	R	2-3-69	TSDH	13	.16	< .05	2	1	293			690	67	17	1.0	5.0	740*	8	1,133	8.3
502	B. L. Johnson	25	We	9-22-36	WPA									37	< 10	27			72*			
503	Ben Johnson	219	Qc	1-28-69	TSDH	11	.22	< .05	2	2	235			520	77	21	1.3	< .4	600*	14	946	7.9
601	M. L. Christopher	290	Qc	7-5-61	USGS	11	.04		1.5	.7	227*			508	51	17	1.4	3.5	573	6	908	7.8
804	Texas Foundries Club	127-137	Sp	1-29-69	TSDH	11	.13		1	2	210			540	< 4	11	.9	6.5	510*	12	817	8.0
805	Sam Stripling	42	Sp	9-24-36	WPA				3	1	10*			24	< 10	9			35*	10		
806	A. T. Mast	48	Sp	9-23-36	WPA									61	< 10	18			78*			
902	B. M. Matlock	44	Sp	9-23-36	WPA				5	2	10*			31	< 10	13			45*	21		
903	Wm. J. Pitts	552	R	1-28-69	TSDH	13	.13	< .05	4	< 1	250			600	53	11	.5	5.0	630*	13	980	8.0
27-101	T. F. Harvin	444	Cz	2-3-69	TSDH	10		.05	1	1	62			131	20	10	< .1	< .4	168*	8	274	7.0
102	R. V. Davidson	24	We	9-18-36	WPA									256	34	22			292*			
201	City of Nacogdoches No. 5	441-502	Cz	4-20-57	CL	16	.25		1.2	.3	65*			142	18	8			204	4	281	7.0
201	City of Nacogdoches No. 5	441-502	Cz	11-63	TSDH		.63	<.1	2		62			134	17	7	.2	< .4		6	280	7.2
202	Audrey King	514	Cz	12-5-63	TSDH		.04	.1	1		102		13	207	19	12	.3	< .4	249*	3	452	8.9
203	G. W. Tillory	Spring	Sp	8-20-36	WPA				19	1	10*			79	< 10	5			74*	50		
301	City of Nacogdoches No. 1	391-425	Cz	2-38	TSDH	9	1.5	.02	2.2	1	60			127	21	11	< .1	< .3	146	10		7.0
301	City of Nacogdoches No. 1	391-425	Cz	2-7-45	USGS	13	.42		3.1	1.0	55	4.3		123	22	9	.0	.2	172	12	275	6.1
301	City of Nacogdoches No. 1	391-425	Cz	4-61	TSDH		.74	<.05	2	< 1	164			383	38	15	.2	< .4		8	690	7.5
301	City of Nacogdoches No. 1	391-425	Cz	12-63	TSDH		1.02	<.1	5	2	93			211	36	11	.2	< .4		20	446	7.1
302	City of Nacogdoches No. 2	381-471	Cz	2-7-45	USGS	12	.41		2.0	.6	53	3.7		112	22	9	.2	0	161	7	329	6.1

For footnotes see end of table.

Table 12.--Results of Chemical Analyses of Water From Wells in Nacogdoches County--Continued

Well Number	Well Owner	Depth or Screened Interval (feet)	Indicated Water-Bearing Unit 1/	Date of Collection	Laboratory 2/	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) 3/	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids 4/	Total Hardness as $CaCO_3$	Specific Conductance Micromhos/cm @ 25° C.	pH
TX-37-27-302	City of Nacogdoches No. 2	381-471	Cz	2-47	TSDH	10	0.45	<0.05	4	2	57			116	24	16	0.1	< 0.4	158	18		7.2
303	City of Nacogdoches No. 3	415-518	Cz	6-25-47	CL	8	.5		1.5	.6	90*			127	22	52				6		6.8
303	City of Nacogdoches No. 3	415-518	Cz	6-47	TSDH	16	2.2	< .05	4	3	58			125	26	14	< .1	< .4	169	23		7.4
303	City of Nacogdoches No. 3	415-518	Cz	2-49	TSDH	13	.5	< .05	4	2	60			128	24	14	.1	< .4	180	18		7.7
303	City of Nacogdoches No. 3	415-518	Cz	6-54	TSDH		.72		2	3	59				26	14	.1	.4		18		7.6
303	City of Nacogdoches No. 3	415-518	Cz	11-63	TSDH		.53	< .01	2	1	58			113	28	10	.1	< .4		10	281	6.9
304	City of Nacogdoches No. 4	440-535	Cz, Wx	12-49	CL	12	.6		4.5	.6	54*			117	20	10				14		6.8
304	City of Nacogdoches No. 4	440-535	Cz, Wx	11-28-51	USGS	13	.71	.00	1.6	1.4	50	0.4		102	21	8	.2	1.5	152	10	240	6.8
304	City of Nacogdoches No. 4	440-535	Cz, Wx	7-54	TSDH	9	.66	< .05	2	2	56			110	23	14	.2	< .4	154	12		7.0
304	City of Nacogdoches No. 4	440-535	Cz, Wx	12-63	TSDH		.73	< .1	2	1	52			109	25	9	.2	< .4		10	262	6.9
305	Southern Ice Co.	500	Cz	9-17-36	WPA				3	1	58*			122	15	14			151*	10		
307	Norvel Bright	15	Sp	9-16-36	WPA				10	4				18	< 10	20			43*	43		
308	Yuba Oil & Refg. Co.		Cz	9-17-36	WPA									122	15	14			143*			
309	Frost Lbr. Industries	375	R	9-18-36	WPA				29	14	259*			818	< 10	15			719*	128		
401	G. L. Henson	220	Qc	1-15-69	TSDH	11	.55	< .05	6	3	263			670	6	32	2.4	3.5	660*	27	1,033	8.3
501	Piney Woods Country Club	500-550	Cz	9-17-36	WPA					3	72*			171	15	10			184*	13		
501	Piney Woods Country Club	500-550	Cz	10-36	CL	15			.4	.5	100*		12	189	27	11				2		
501	Piney Woods Country Club	500-550	Cz	1-12-37	USGS				1		73*			162	19	5		.0	170*	2		
501	Piney Woods Country Club	500-550	Cz	12-5-63	TSDH		.27	< .1	1		72			163	16	6	.2	< .4	175*	3	306	8.3
502	Hilliard Stone	30	Sp	9-16-36	WPA									12	< 10	13			30*			

For footnotes see end of table.

Table 12.--Results of Chemical Analyses of Water From Wells in Nacogdoches County--Continued

Well Number	Well Owner	Depth or Screened Interval (feet)	Indicated Water-Bearing Unit 1/	Date of Collection	Laboratory 2/	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) 3/	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids 4/	Total Hardness as $CaCO_3$	Specific Conductance Micromhos/cm @ 25° C.	pH
TX-37-27-504	City of Nacogdoches No. 6	471-571	Cz	5-15-64	CL	20	0.15		1.0	0.2	66*			144	18	7			202	3	270	7.2
505	City of Nacogdoches No. 7	482-667	Cz, Wx	8-20-64	MSL	7	.06		.2	.1	103*			244	16	6			247	1	407	8.4
506	City of Nacogdoches No. 8	470-565	Cz, Wx	10-12-64	MSL	8	< .05		.4	.0	92*			223	10	6			219	1	369	8.2
601	Lone Star Feed & Fertilizer	504-570	Cz	12-5-63	TSDH		.50	<0.1	2	1	50			93	33	13	0.2	< 0.4	146*	12	264	6.8
602	Hy. Hoya	Spring	Sp	10-31-36	WPA									24	< 10	14			42*			
802	City of Nacogdoches No. 9	563-680	Cz	2-15-67	MSL	10	.11		1	0	82*			200	14	2			206	3	334	7.1
803	Ben De Witt	660	Cz, R?	12-12-68	TSDH	13	.04		2	< 1	239		18	580	26	6	1.5	2.0	590*	6	940	8.7
804	Ben De Witt	600	Cz, R?	12-12-68	TSDH	13	.04		2	< 1	239		18	580	25	6	1.3	1.0	590*	6	945	8.7
28-301	Swift Water Supply Corp.	739	Wx	2-17-65	TSDH		.18	< .05	2		283		23	680	5	9	.4	< .4	658*	6	1,140	8.7
301	Swift Water Supply Corp.	739	Wx	2-18-65	PTL	18	.25		1.6	.5	278		46	625	5	12			668*	6		8.8
301	Swift Water Supply Corp.	739	Wx	9-10-65	TSDH		.08	< .05	3		258		22	610	9	6	.3	< .4	599*	7	1,045	8.8
303	Swift Water Supply Corp. No. 2	300	Cz, Wx	7-8-66	CL	18	.55		6.7	3.2	62*			162	16	11			215	30	329	7.2
303	Swift Water Supply Corp. No. 2	300	Cz, Wx	7-19-66	PTL		.7		7.2	2.9	57			142	20	12	.2	.8		30	270	7.1
303	Swift Water Supply Corp. No. 2	300	Cz, Wx	10-28-66	CL	11	.05	< .02	2.8	.8	71*			159	16	12	.1	.1	210	10	315	7.5
304	Swift Water Supply Corp. No. 1	347	Cz, Wx	6-8-66	CL	14	.4		6.6	3.0	46*			90	38	11			181	29	261	7.4
304	Swift Water Supply Corp. No. 1	347	Cz, Wx	6-28-66	CL	14	.35		5.8	2.5	42*			76	36	12			170	25	251	6.0
304	Swift Water Supply Corp. No. 1	347	Cz, Wx	7-26-66	PTL		.8		4.8	3.4	38			68	30	14	.1	.1		26	210	6.4
305	H. E. Seale	18	Qc	9-14-36	WPA									61	165	18			312*			
306	Mrs. Ernest Pleasant	21	Qc	10-13-36	WPA									12	97	33			199*			
501	E. C. Duke	465	R, Cz	1-14-69	TSDH	11			3	2	174			445	18	5	.4	.5	433*	17	680	8.1

For footnotes see end of table.

Table 12.--Results of Chemical Analyses of Water From Wells in Nacogdoches County--Continued

Well Number	Well Owner	Depth or Screened Interval (feet)	Indicated Water-Bearing Unit 1/	Date of Collection	Laboratory 2/	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) 3/ Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids 4/	Total Hardness as $CaCO_3$	Specific Conductance Micromhos/cm @ 25° C.	pH
TX-37-28-502	Maness	439	R, Cz	1-14-69	TSDH	11	0.10		5	< 1	194	1	448	48	9	0.4	<0.4	488*	14	780	8.6
601	Hugh Jones	327	R	12-11-68	TSDH	16			3	8	282	4	730	9	22	3.0	2.5	710*	39	1,050	8.4
602	Roy Essman	400	Cz	1-14-69	TSDH	11	8.00		4	3	47		106	18	12	.2	.5	148*	23	240	7.0
603	Roy Essman	22	We	9-29-36	WPA								86	56	18			178*			
701	Tilford Hunt	59	Sp	10-2-36	WPA								12	4	18			44*			
801	De Witt's Hatchery	520	Cz	8-1-61	USGS	12	.04		.8	.0	151*		361	20	8	.6	.5	372	2	609	7.9
802	L. L. Cheever	29	Sp	9-29-36	WPA				12	4	24*		61	10	35			105*	48		
803	E. King			1-14-69	TSDH	11	.2		2	2	204	23	495	14	5	.4	2.6	510*	13	818	8.8
804	J. P. Hill	30	Sp	9-29-36	WPA								146	<10	74			236*			
901	Woden Water Supply Corp. No. 1	418-502	Cz	8-16-65	CL	18	.25		4.3	.8	96*		194	47	10			299	14	435	
903	Ben Oliver	22	Sp	9-28-36	WPA								18	<10	36			71*			
29-101	Plus Tex Poultry	300	Cz	7-5-61	USGS	14	2.1		2.0	2.4	33*		50	29	10	.1	.0	118	15	190	5.8
102	Tom Gilcrease	302-352	Cz	1-9-69	TSDH	9			2	4	41		100	19	9	.2	< .4	133*	24	230	7.0
202	J. O. Justice	274	Cz, Wx	7-5-61	USGS	19	3.2		12	5.3	109*		273	48	11	.1	.0	346	52	547	7.1
203	Lee West	26	Sp	10-13-36	WPA								18	<10	15			38*			
301	F. F. Fuller	27	Cz	9-26-36	WPA				2	4	4*			<10	22			32*	23		
302	Burl Black	154	Cz	1-9-69	TSDH	16			2	1	2		10	< 4	5	< .1	< .4	31*	12	38	5.7
303	Ancle Fuller	23	R	9-26-36	WPA								12	285	48			489*			
402	Melrose Water Supply Corp.	322-352	Cz	12-6-68	TSDH	15	.70		2	< 1	66		133	22	11	.2	< .4	181*	8	285	7.5
403	O. D. Hall	414	Cz	1-14-69	TSDH	11	1.0		1	3	62		138	24	10	.3	< .4	179*	15	300	7.2
501	R. H. Davis	448	Cz	1-9-69	TSDH	11	1.00		2	2	88		150	64	11	.3	< .4	252*	15	420	7.6
502	J. W. Kendrick	32	Sp	9-28-36	WPA								12	< 10	9			24*			
503	J. B. Brown	31	We	9-28-36	WPA								31	< 10	21			58*			
601	Elvis Green	275-285	Wx	1-8-69	TSDH	11	.12		3	1	221	16	499	47	9	.3	< .4	550*	13	880	8.7
602	O. O. Smith	17	R	9-25-36	WPA				21	8	10*		73	19	20			114*	85		
603	Attoyac Water Supply Corp.	365-438	Wx	1-9-69	TSDH	16	1.30	0.16	2	1	279	30	650	17	9	.5	< .4	680*	8	1,055	8.8

For footnotes see end of table.

Table 12.--Results of Chemical Analyses of Water From Wells in Nacogdoches County--Continued

Well Number	Well Owner	Depth or Screened Interval (feet)	Indicated Water-Bearing Unit 1/	Date of Collection	Laboratory 2/	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) 3/	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids 4/	Total Hardness as $CaCO_3$	Specific Conductance Micromhos/cm @ 25° C.	pH
TX-37-29-801	M. M. King	450	Cz	1-8-69	TSDH	11	0.28		2	< 1	87			193	25	5	0.5	< 0.4	226*	5	352	8.3
901	E. C. Wall	362-372	Cz	1-8-69	TSDH	11	.16		1	1	89			181	34	9	.3	< .4	234*	5	380	8.1
902	Scott	20	We	9-29-36	WPA				62	13	80*			183	< 10	164			409*	208		
903	C. P. Little	25	Sp	9-29-36	WPA									31	8	91			168*			
30-401	Plus Tex Poultry Farm No. 4	175	Cz	7-5-61	USGS	23	2.4		.5	1.5	3.3	1.4		0	16	4	.1	.0	50*	7	73	3.6
402	J. C. King	27	Cz	9-25-36	WPA									6	< 10	26			46*			
501	Plus Tex Poultry Farm No. 7	150	Wx	1-8-69	TSDH	25	8.40		1	1	3			0	15	2	< .1	< .4	47*	7	71	4.2
502	J. W. Burd	47	Wx	9-25-36	WPA				1	2	9*			18	< 10	11			32*			
701	Chireno Water Supply Corp.	320-395	Cz	3-7-64	MSL	7	.95		1.5	0	126*		31	261	0	8			317	4	515	8.8
702	E. M. Weeks	37	We	9-15-36	WPA									6	11	45			91*			
703	D. Biggs	80	Cz	9-15-36	WPA				11		87*			208	29	11			240*	27		
801	Southland Paper Mills	203-224	Cz	3-26-49	CL	24	.4		1.1	.2	218*		17	500	12	17			536*	4		8.7
802	Wayne Garrett	230	Cz	1-9-69	TSDH	13	.12		1	1	153		4	353	15	8	.5	2.6	383*	5	605	8.8
35-101	Southland Paper Mills	800-805	Wx	10-27-41	SPM										41	8			470	14		8.4
102	Southland Paper Mills	132-137	Sp	10-28-41	SPM									98	41	8			214	19		
104	Southland Paper Mills	0-133	Sp		SPM									18	12	21			168	44		5.5
106	Ed Tucker	570	Cz, Sp	9-17-36	WPA				14	20	100*			256	34	63			357*	117		
106	Ed Tucker	570	Cz, Sp	1-12-37	USGS									466	32	133		0		10		
106	Ed Tucker	570	Cz, Sp	3-18-37	USGS									442	30	113				5-		
201	Southland Paper Mills	978-1,260	Wx		SPM										< 14	52				20		
203	Southland Paper Mills	92-165	Sp		SPM									85	58	11			172	70		6.5
204	Southland Paper Mills	5-92	Sp		SPM									91	19	10			299	63		6.4

For footnotes see end of table.

Table 12.--Results of Chemical Analyses of Water From Wells in Nacogdoches County--Continued

Well Number	Well Owner	Depth or Screened Interval (feet)	Indicated Water-Bearing Unit 1/	Date of Collection	Laboratory 2/	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) 3/	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids 4/	Total Hardness as $CaCO_3$	Specific Conductance Micromhos/cm @ 25° C.	pH
TX-37-35-207	Southland Paper Mills	120-165	Sp		USGS														232	51		
301	Southland Paper Mills	692-788	Cz	10-48	CL	14	0.2		1.6	0.5	89*		5	206	12	7			231*	6		8.05
302	Southland Paper Mills	635-760	Cz		SPM									173	48	15						
303	Southland Paper Mills	599-780	Cz, Wx	11-50	CL	10	.07		.7	.1	80*		2	184	13	4			201*	2		7.93
304	Southland Paper Mills	150-155	Sp		SPM								6	305	41	10			360	31		8.0
308	Southland Paper Mills	120-198	Sp	9-47	SPM		16							79	9	6				33		6.15
309	Southland Paper Mills	92-218	Sp	10-47	SPM		12.5							66	38	5				38		
309	Southland Paper Mills	92-192	Sp	10-47	SPM		14.5							66	43	11				40		
309	Southland Paper Mills	92-161	Sp	10-47	SPM		8							32	14	13				22		
309	Southland Paper Mills	92-103	Sp	10-47	SPM		10							42	19	13				32		
311	B. B. Holtam	35	Sp	10-2-36	WPA					3	7*			12	< 10	13			29*	13		
36-102	Southland Paper Mills	598-810	Cz, Wx	12-17-46	SPM		.23						8	244	19	15			308	4		8.6
103	Southland Paper Mills	77-82	Sp		SPM									200	34	10			170	66		7.8
104	Southland Paper Mills	214-219	Sp		SPM								11	259	34	36			290	16		8.3
105	Southland Paper Mills	70-170	Sp		SPM									42		12			120	16		7.5
107	Southland Paper Mills	10-135	Sp		SPM									191	3	52			361	15		6.2
110	R. L. Godsey	25	Sp	1-14-69	TSDH	18	1.4		7	3	2			24	5	5	0.1	0.5	53*	28	68	6.0
203	Southland Paper Mills	235-240	Sp		SPM								5	246	19	11			290	5		8.5
204	Southland Paper Mills	136-175	Sp		SPM									51	48	8			174	88		7.2

For footnotes see end of table.

Table 12.--Results of Chemical Analyses of Water From Wells in Nacogdoches County--Continued

Well Number	Well Owner	Depth or Screened Interval (feet)	Indicated Water-Bearing Unit 1/	Date of Collection	Laboratory 2/	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na) 3/ Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids 4/	Total Hardness as $CaCO_3$	Specific Conductance Micromhos/cm @ 25° C.	pH
TX-37-36-206	J. H. Beard	28	Sp	9-29-36	WPA								79	< 10	32			115*			
301	L. C. Jacobs	400	Cz	10-2-36	WPA					3	97*		232	19	10			243*	13		
301	L. C. Jacobs	400	Cz	2-9-37	USGS								222	22	4				21		
302	Anna Daniel	34	Sp	9-30-36	WPA								12	< 10	8			22*			
303	Merit Cochran	590	Cz	12-11-68	TSDH	13	0.13		< 1	2	85	0	211	14	5	0.7	< 0.4	224*	9	355	8.3
601	Florie Daniel	19	Cm	9-30-36	WPA								140	< 10	13			135*			
602	Ben Oliver	22	Cm	9-30-36	WPA					6	13*		24	8	16			55*	23		
603	R. J. Driver	54	Cm	9-30-36	WPA				1	2	24*		43	8	15			71*	11		
37-301	J. W. Prince	200	Cz	9-15-36	WPA				2		131*		317	12	12			313*	5		
801	A. H. Munk	492	Sp	6-2-61	USGS	14	.23		.2	.3	177*		446	0	12	1.4	.5	456	2	712	8.1
802	Tom Parton	252	Sp	10-2-36	WPA					36	312*		879	< 10	77			857*	151		
803	W. P. Smith	500	Sp	12-10-68	TSDH	18	.13		3	3	154	4	403	< 4	11	2.4	< .4	393*	20	640	8.4
804	Etoile Water Supply Corp.	875-920	Cz		PTL		.3		1.6	.1	260	53	505	21	33	.8	.3	618*	6		9.0
38-101	R. G. Atkinson	20	Sp	10-1-36	WPA								37	31	15			97*			
201	Bennie Gray	24	Sp	9-30-36	WPA				8	3	19*		55	4	18			79*	33		
401	Plus Tex Poultry	165	Sp	6-2-61	USGS	16			4.2	2.3	113*		161	109	12	.6	2.0	350	20	543	7.0
403	Marie Gartman	300	Sp	1-8-69	TSDH	13	.20		19	10	102		248	38	36	.7	14.5	356*	89	588	7.5
701	T. J. Wilson	15	Cm	10-1-36	WPA					3	14*		31	< 10	13			45*	13		
702	J. T. Sowell	32	Cm	10-1-36	WPA								18	< 10	110			187*			
801	Jim Still	23	Cm	10-1-36	WPA								24	10	17			47*			
45-601	Dave Patterson		Y	12-10-68	TSDH	36	.62		86	23	94		232	247	54	.6	< .4	660*	312	975	7.3
46-101	Travis King	386	Sp	1-8-69	TSDH	16			2	2	388		990	< 4	14	.1	< .4	910*	11	1,036	8.4
401	Shirley Creek Marina	230	Y	12-10-68	TSDH	30	.20		10	5	190		260	153	64	.7	2.0	580*	44	928	7.8
402	Wilmer Mast	24	Y	10-2-36	WPA					4	7*		18	< 10	13			33*	18		
403	Wilmer Mast		Y	12-10-68	TSDH	32	.34		20	6	170		301	144	40	1.0	< .4	560*	74	870	7.8

For footnotes see end of table.

1/ Initials used to identify water-bearing units are:

Al	Alluvium	Qc	Queen City Sand
Y	Yegua Formation	R	Reklaw Formation
Cm	Cook Mountain Formation	Cz	Carrizo Sand
Sp	Sparta Sand	Wx	Wilcox Group
We	Weches Formation		

2/ Initials used to identify laboratories are:

CL - Curtis Laboratories
IFC - International Filter Company
MEC - Maintenance Engineering Corp.
MSL - Microbiology Service Laboratories
PTL - Pope Testing Laboratories
SPM - Southland Paper Mills, Inc.
TSDH - Texas State Department of Health
USGS - United States Geological Survey
WPA - Works Progress Administration

3/ Asterisk (*) indicates sodium and potassium calculated as sodium.

4/ Asterisk (*) indicates value is calculated or estimated.