GROUND-WATER CONDITIONS IN THE TRIASSIC AQUIFER IN DEAF SMITH AND SWISHER COUNTIES

By

Gail L. Duffin, Geologist
Texas Department of Water Resources

Prepared Under Contract for the
Governor's Nuclear Waste Programs Office

LP -196

Texas Department of Water Resources

December 1984

Published and distributed
by the
Texas Department of Water Resources
Post Office Box 13087
Austin, Texas 78711

ABSTRACT

In April 1984, the Texas Department of Water Resources initiated a study of the ground-water conditions of the Triassic aquifer in Deaf Smith and Swisher Counties. Data gathered during the study indicate that a limited number of water wells are completed in the Triassic aquifer.

A comprehensive pumping test was conducted in Deaf Smith County using two wells completed in the Triassic aquifer. The test results showed a well yield of 788 gallons per minute and an average transmissivity of 22,000 gallons per day per foot. However, these values should not be accepted as applying to the Triassic aquifer everywhere in the study area. Ground water in the Triassic aquifer occurs under both water-table and artesian conditions, and water-level measurements suggest that the potentiometric surface of the aquifer generally dips to the east and southeast.

The chemical quality of ground water from Triassic aquifer wells that are used for municipal, irrigation, and domestic and livestock purposes ranges from fresh to slightly saline.

No information was available on ground-water pumpage from industrial, irrigation, and domestic and livestock wells. However, during 1983, approximately 1,555 acre-feet of ground water was pumped from the Triassic aquifer by the cities of Happy, Hereford, and Tulia for municipal purposes.

TABLE OF CONTENTS

TABLES

FIGURES

GROUND-WATER CONDITIONS IN THE TRIASSIC AQUIFER IN DEAF SMITH AND SWISHER COUNTIES

SUMMARY AND CONCLUSIONS

A study of the ground-water conditions in the Triassic aquifer in Deaf Smith and Swisher Counties was undertaken in April 1984 by the Texas Department of Water Resources at the request of the Director of Nuclear Waste Programs of the Governor's Office. This report presents the ground-water conditions in the study area along with a tabulation of the basic data obtained during the investigation.

The Triassic aquifer is composed of the Dockum Group of upper Triassic age. As used in this report, the Dockum is further subdivided, from youngest to oldest, into the Chinle Formation, the Santa Rosa Sandstone (and its approximate equivalent, the lower portions of the Trujillo Formation), and the Tecovas Formation. The aquifer yields small to moderate amounts of ground water in locally developed areas from sands of the Santa Rosa and the Trujillo.

Information was collected on approximately 133 wells, test holes, and oil tests. Four geologic cross-sections were constructed for Deaf Smith, Oldham, and Swisher Counties to show the lithologic character and depth and thickness of formations based on correlations of geophysical logs. Some 62 water samples from wells in Deaf Smith, Randall, and Swisher Counties were examined for chemical constituents. A limited number of water-level measurements were obtained from drillers' logs and observation wells.

All data gathered throughout the study area indicated that a limited number of water wells are completed in the Santa Rosa and Trujillo sands. A

comprehensive pumping test conducted on two wells completed in the Triassic aquifer in Deaf Smith County showed a well yield of 788 gallons per minute (gal/min) and an average transmissivity of 22,000 gallons per day per foot (gal/day/ft). However, these values should not be accepted as applying to the Triassic aquifer everywhere in the study area. Ground water in the Triassic aquifer occurs under both water table and artesian conditions, and water-level measurements taken at various times suggest that the potentiometric surface of the aquifer generally dips to the east and southeast. Water-level data are insufficient to establish a definite trend in water-level fluctuations. During 1983, approximately 1,155 acre-feet of ground water was pumped from the Triassic aquifer by the cities of Happy, Hereford, and Tulia for municipal use. Although ground water from the Triassic aquifer was used in the study area for industrial, irrigation, and domestic and livestock purposes, no information was available on the amounts of ground water pumped for these purposes. Generally, the dissolved-solids concentrations in ground-water samples collected throughout the study area indicated that the water ranged from fresh to slightly saline in quality.

INTRODUCTION

Purpose and Scope

In April 1984, the Director of the Nuclear Waste Programs of the Governor's Office requested a study be undertaken by the Texas Department of Water Resources on the ground-water conditions in the Triassic aquifer in Deaf Smith and Swisher Counties. The need for the study was prompted by the U.S. Department of Energy's (DOE) announcement that consideration was being given to locating high-level nuclear waste repository sites in these counties and by the concern over what impacts operation of such sites might have on the ground-

water resources in the area. The results of the study, including a discussion of the occurrence of ground water and a tabulation of basic data obtained during the investigation are presented in this report.

The objectives of this study were to: (a) research, collect, and evaluate all available Triassic well data in the Texas Department of Water Resources files; (b) tabulate all well data including depths, completion intervals, casing records, performance tests, and aquifer characteristics; (c) tabulate water-levels, and chemical quality data; (d) construct various illustrations including hydrographs, geologic cross-sections, maps of the altitude of the top and base of the Triassic aquifer, a map of the potentiometric surface of the Triassic aquifer, and a map showing chemical quality of water in the Triassic aquifer; and (e) prepare a final report.

Location and Extent

Deaf Smith and Swisher Counties are located in the Southern High Plains of Texas as shown in Figure 1. Deaf Smith County has an approximate area of 1,510 square miles. It is bordered on the north by Oldham County, on the east by Randall County, on the south by Parmer and Castro Counties, and on the west by the State of New Mexico. Swisher County has an approximate area of 896 square miles. It is bordered on the north by Randall and Armstrong Counties, on the east by Briscoe County, on the south by Floyd and Hale Counties, and on the west by Castro County.

Previous Investigations

Drake's (1891) report presented information gathered from a field trip around the Southern High Plains that followed the escarpment on the east, the

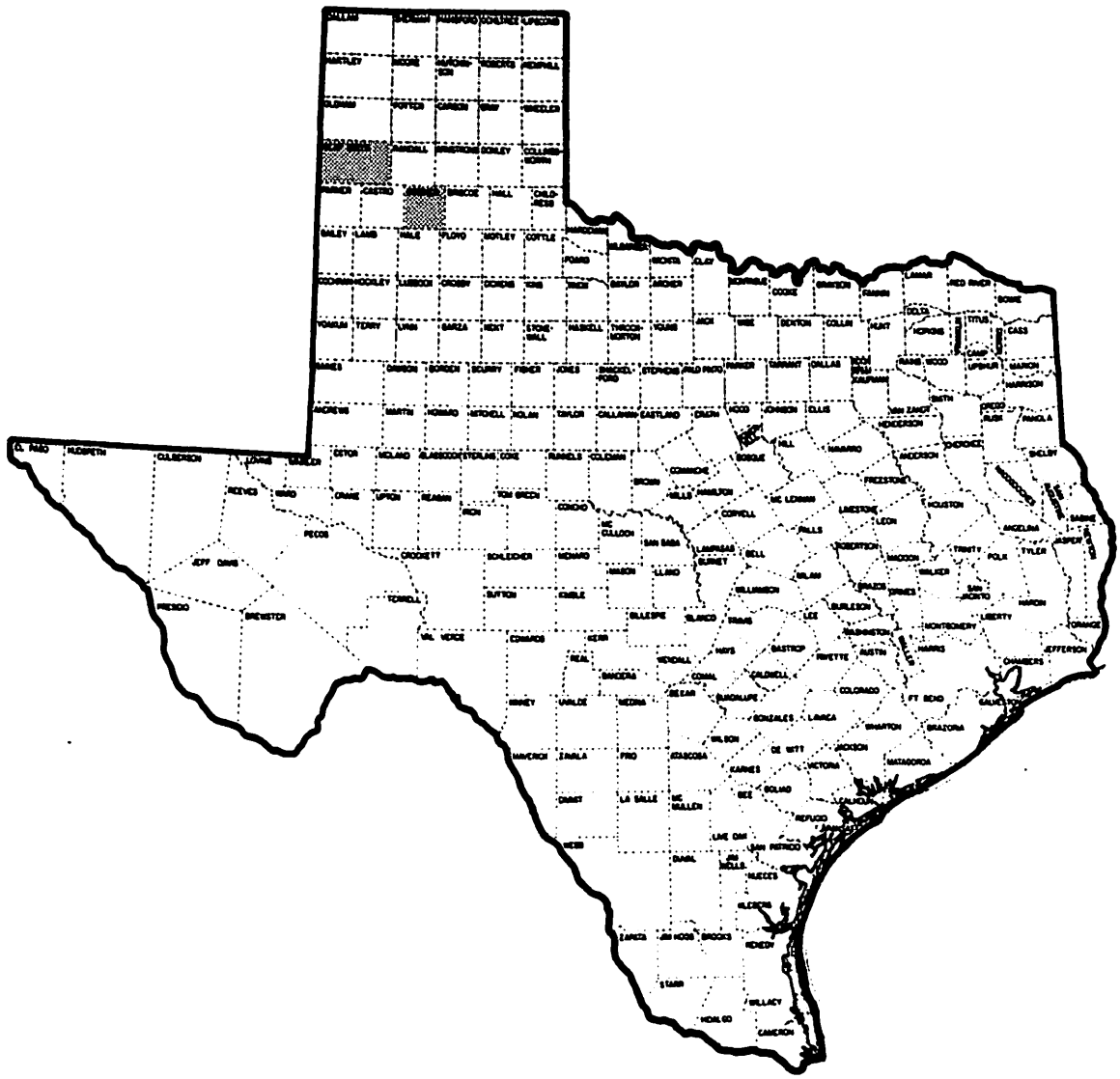


Figure 1
Location of Deaf Smith and Swisher Counties

Canadian River on the north, and the Pecos River on the west. Gould (1906) made an investigation in the Texas Panhandle, subdividing the Dockum Group into a basal shale named the Tecovas Formation and upper sandstone and shale called the Trujillo Formation. Adams (1929) and Hoots (1925) reported on studies of Triassic deposits in the southern part of the Southern High Plains. Sidwell (1945) studied Triassic materials to determine the source areas of Triassic deposits. Follett (1953) compiled records of water-level measurements in Deaf Smith and Swisher Counties. Fink (1963) reported on the geology and ground water of Triassic deposits in the northern part of the Southern High Plains of Texas. Fink's (1963) report includes structural cross-sections, records of wells, and drillers' logs along with selected chemical analyses of ground water in the Triassic aquifer. Stone & Webster Engineering Corporation (1981) reported on the geologic history, structures, and stratigraphy of the Palo Duro and Dalhart basins. Knowles, Nordstrom, and Klemt (1984) included Deaf Smith and Swisher Counties in their evaluation of the ground-water resources of the High Plains of Texas. Other investigations dealing with the geology of the Triassic and related subjects are listed in the references at the end of this report.

Methods of Investigation

During this study, an attempt was made to collect all available information on wells, test holes, and oil tests penetrating the Triassic aquifer. Well records were obtained from drillers' reports on file with the Texas Department of Water Resources and the High Plains Underground Water Conservation District No. 1. Figure 10 shows the locations of water wells, test holes, and oil tests and information on each is listed in Table 2. A total of 133 wells, test holes, and oil tests were inventoried.

Water-level measurements from 1959 through 1984 were used in the construction of the approximate potentiometric surface of the Triassic aquifer as shown in Figure 8. Water levels were measured in the field wherever possible. Records of past measurements from drillers' reports and historical data were also used to determine the water levels in many wells. Wells currently or historically used as water-level observation wells are shown in Table 3.

Chemical analyses of water samples collected from wells in Deaf Smith, Randall, and Swisher Counties during this study and previous investigations were compiled and are listed in Table 5. These data were used to construct a map (Figure 7) showing the total dissolved-solids concentration in water from wells completed in the Dockum Group aquifer and from those completed in both the Dockum Group and Ogallala aquifers.

The lithologic character, depth, and thickness of the formations as presented in this report are based largely on studies and correlations of geophysical logs. Copies of these logs are on file with the Texas Department of Water Resources.

Well-Numbering System

The well-numbering system used in this report is one adopted by the Texas Department of Water Resources for use throughout the State and is based upon the divisions of latitude and longitude. This system facilitates the location of wells and prevents duplication of well numbers in present and future studies.

Under this system, each 1-degree quadrangle in the State is given a number consisting of two digits, from 01 to 89. These are the first two digits in the well number. Each 1-degree quadrangle is divided into 7½-minute quadrangles which are given 2-digit numbers from 01 to 64. These are the third and fourth digits of the well number. Each 7½-minute quadrangle is divided into 2½-minute quadrangles which are given single digit numbers from 1 to 9. This is the fifth digit of the well number. Finally, each well within a 2½-minute quadrangle is given a 2-digit number in the order in which it is inventoried, starting with 01. These are the last two digits of the well number.

On the well-location map in this report (Figure 10), the 1-degree quadrangles are numbered with large digits. The 7½-minute quadrangles are numbered in the northwest corners where possible. The 3-digit number shown with the well symbol contains the number of the 2½-minute quadrangle in which the well is located and the number of the well within that quadrangle.

In this report, all wells that could be accurately located on the ground have been given a State well number. Other control points have been given a partial number.

The number given Well 10-14-154 indicates that it is within Deaf Smith County; within 1-degree quadrangle 10; within 7½-minute quadrangle 14; within 2½-minute quadrangle 1; and is the fifty-fourth (54) well in that quadrangle to be numbered.

The number assigned to Well 07-63-1A (Q-6) is a partial number for an oil test within Deaf Smith County (Figure 12). The Q-6 indicates the file number in the Texas Department of Water Resources' Surface Casing Unit.

Personnel

This report was prepared under the general direction of Tommy R. Knowles, Director of Data and Engineering Services Division, and Henry J. Alvarez, Chief of Data Collection and Evaluation Section, and under the direct supervision of Richard Preston, Head of Ground Water Studies Unit. Data were collected and assembled by Department staff members Gene Couch and Douglas Coker.

Acknowledgements

The author is indebted to the many property owners who supplied information about their water wells and permitted access to their property; to the well drillers who supplied information on wells; and to the municipalities and High Plains Underground Water Conservation District No. 1 for supplying data on their wells. Acknowledgement is also extended to the various oil companies and to Stone & Webster Engineering Corporation for contributing valuable drillers' and geophysical logs of test holes and oil and gas tests.

GENERAL GEOLOGY

Stratigraphy as Related to Ground Water

Stratigraphic units considered in this report and which underlie Deaf Smith and Swisher Counties, range in age from Permian to Quaternary. These

rocks are composed of sand, clay, shale, conglomerate, caliche, gypsum, dolomite, and anhydrite (Table 4). Triassic rocks are exposed at the surface in the northwestern part of Deaf Smith County and the east-central part of Swisher County as shown in Figures 2 and 8. The lithologic characteristics, maximum thickness, and water-bearing properties of these units are summarized in Table 1.

The oldest rocks considered in this study of the Southern High Plains are of Permian age. They underlie all the Southern High Plains and are exposed at the surface in the northern part of Oldham County along the Canadian River valley and at the eastern escarpment of the Plains. Permian rocks on the outcrop consist mainly of brick-red clay, shale, fine-grained sandstone, gypsum, and dolomite. The Permian rocks underlie the High Plains in a broad syncline. As ground water percolates through these rocks, it dissolves large amounts of various mineral salts causing it to become unsuitable for most uses.

The Triassic strata overlying the Permian beds are of primary concern in this study. These are discussed under the Triassic System.

Tertiary rocks within the study area are represented by the Ogallala Formation of Pliocene age. Ogallala rocks were deposited on the eroded surface of the Triassic rocks throughout the northern part of the Southern High Plains. The Ogallala Formation is the principal water-bearing unit in Deaf Smith and Swisher Counties and yields large supplies of water. However, since the Ogallala Formation was not of primary concern, it is not included in this study and the

Table 1. Stratigraphic Units and Their Water-Bearing Properties

(Modified From Fink, 1963)

System	Series or Group	Formation	Approximate Maximum Thickness (Feet)	Lithologic Character	Water-Bearing Characteristics
Quaternary	Recent Series		0-30	Windblown sand and silt	Yields some water to wells
	Pleistocene Series		0-100	Sand, clay, conglomerate, terrace deposits	Yields small supplies of water to livestock and domestic wells
Tertiary	Pliocene Series	Ogallala Formation	0-400	Fine- to coarse-grained sand, gravel, clay, silt, and caliche	Yields large supplies of water to irrigation, municipal, and industrial wells
Triassic	Dockum Group	Chinle Formation	0-850	Varicolored clays, shales, and thin sand zones	Yields small supplies of water to livestock and domestic wells
		Trujillo Formation	0-400	Varicolored siltstone, claystone, conglomerate, fine-grained sandstone and limestone	Yields small to moderate amounts of water in local developed areas
		Santa Rosa Sandstone	0-550	Fine-to coarse-grained sands, conglomerate, and interbedded shales	Yields moderate supplies of water in local developed areas
		Tecovas Formation	0-250	Varicolored sandy clay and shale	Not known to yield water to wells
Permian	Upper Permian	Dewey Lake	180-200	Siltstone, clayey and sandy	Not known to yield water to wells
		Alibates	25-30	Red clay, shale, and fine-grained sandstone; gypsum, dolomite, anhydrite, and salt	May yield small supplies of mineralized water
		Rustler	500-1,000		

Yield of Wells: Small, less than 100 gal/min; moderate, 100-1,000 gal/min; large, more than 1,000 gal/min.

reader is referred to Texas Department of Water Resources Report 288 (Knowles and others, 1984) for a detailed discussion of this aquifer.

The Quaternary System is represented by deposits of Pleistocene and Recent age. These sediments occur in Deaf Smith and Swisher Counties as lake and stream deposits, residual gravel terraces, and wind deposits. They are generally thin and yield some water to wells in locally developed areas.

TRIASSIC SYSTEM

Dockum Group

Cummins, in 1890, named the Dockum Group of upper Triassic age for the community of Dockum in Dickens County, Texas (Sellards and others, 1932, p. 242). The Dockum and Permian strata are differentiated by contrasting depositional environments, and in some areas the strata are separated by an unconformity. Elsewhere, sedimentation was probably continuous from Permian into Triassic time (McGowen and others, 1979, p. 3), resulting in a gradational contact. Dockum beds are overlain unconformably by strata of Tertiary and Quaternary age and are exposed at the ground surface along the High Plains escarpment, in the erosion-cut canyon "breaks," and in inliers of small areal extent. Table 1 shows the stratigraphic relationship of these systems. These beds were laid down in a basin structure called the Permian basin. Regional dip of the beds, as shown on Figures 3 through 6, is toward the center of the basin which is located approximately in the center of the Southern High Plains.

Depending on its location within the High Plains, the Dockum Group has been subdivided into two or three formations by authors of the many publications dealing with the Triassic rocks in the area. In the northern part of the Southern High Plains, the Dockum Group is readily subdivided into three formations consisting of, from oldest to youngest, the Tecovas, Santa Rosa, and Chinle.

Gould named the basal Tecovas Formation from outcrops along Tecovas Creek in Potter County, Texas. The Tecovas Formation can be subdivided into two members, a lower variegated sandy shale sequence and an upper unit of dark red or magenta shale. Lower Tecovas sediments lie directly upon the eroded surface of the Quartermaster Group which on the outcrop forms a vivid color contrast. The Tecovas Formation consists of calcareous sandy shales which are more or less cross-bedded and lenticular (Gould, 1906, p. 22). In some local areas, the Tecovas is interbedded with variegated shales and thin lenses of white, yellow, or light brown friable sandstone. The sand is usually poorly cemented and easily weathered. The lithology, thickness, and relationship of the Tecovas Formation to other formations within the study area are shown on the geologic sections (Figures 11, 12, 13, and 14). Within Deaf Smith and Swisher Counties, Tecovas beds have a maximum thickness of 250 feet and are not known to yield water to wells.

The Santa Rosa Sandstone is the middle member of the Dockum Group and is the major water-bearing unit in the study area. Darton (1921, p. 183) gave the name Santa Rosa Sandstone to the resistant sandstone outcrops along the Pecos River at Santa Rosa, New Mexico. The outcrops are also prominent in the mesas

of Guadalupe County, New Mexico. The subcrop lithology, thickness, and relationship to other formations and the Santa Rosa Sandstone are shown on the geologic sections (Figures 11, 12, 13, and 14). The Santa Rosa within the study area has a maximum thickness of 550 feet and consists of gray, tan, white, and brown, fine- to coarse-grained, crossbedded sandstone and conglomerate. Petrified wood and mica are common with local areas of mudstone and siltstone.

The youngest member of the Dockum Group is the Chinle Formation. It overlies the Santa Rosa Sandstone and Trujillo Formation in Deaf Smith and Swisher Counties. In the extreme northwest portion of Deaf Smith County, Chinle beds are exposed at the surface (Figure 2). Chinle beds consist of red, blue, and reddish-brown clays and shales. Thin-bedded micaceous sandstones and sandy clays occur as lenses of local extent. Thin streaks of conglomerate and green clays are also present in the formation as well as siltstones with thin zones of limestone nodules. The Chinle's maximum thickness of 850 feet occurs in the southwest part of Deaf Smith County. Sand zones within the Chinle rarely exceed 30 feet in thickness and yield small quantities of water for domestic and livestock use.

Lower portions of the Trujillo Formation are approximately equivalent to the Santa Rosa Sandstone. The approximate location of the facies change between Chinle-Santa Rosa-Tecovas sands and clays and Trujillo-Tecovas sand and clays are shown on Figure 2. These facies changes, as represented in the subsurface, are shown on the cross sections (Figures 11 and 12). The Trujillo Formation was named by Gould (1906) from outcrops along Trujillo Creek in Oldham County, Texas. The Trujillo consists principally of fine- to medium-grained crossbedded sandstone, massive light-gray to reddish-brown sandstone, and thin lenticular

quartzose conglomerate. Gould (1906, p. 26) divided the Trujillo into lower, middle, and upper units based on the number of sandstone ledges. The basal sandstone is gray to greenish gray and contains channel deposits of coarse sand and an abundance of mica. The middle portion consists of red, maroon, and gray shale overlain by a coarse-grained, crossbedded sandstone. An upper unit of red and green shale tops the section. The Trujillo beds have a maximum thickness of 400 feet and yield small to moderate amounts of water in local developed areas.

GROUND WATER IN THE TRIASSIC AQUIFER

Source, Occurrence, and Movement

The primary sources of ground water for the Triassic aquifer are rainfall which falls on its outcrops and infiltration of surface water from lakes and streams on or crossing its outcrops. Some of the locations offering possible sources of recharge are: (a) southwest Oldham County where the Trujillo sands are exposed; (b) along the Canadian River in Quay County, New Mexico, where the Trujillo sands are at the surface; (c) the north-central portion of Oldham County where the Ogallala and Trujillo sands may be in hydraulic continuity; and (d) the east-central part of Swisher County along Tule Creek where the Dockum Group beds are at the surface. Seepage from the overlying Ogallala Formation may contribute small amounts of recharge in some areas of Deaf Smith and Swisher Counties. Some of these locations are shown in Figures 2 and 8. A study conducted by the Bureau of Economic Geology (1983b) on the isotopic composition of ground water from the Dockum Group in Swisher County suggests an origin of Triassic recharge to the west at higher elevations.

Ground water occurs in the Santa Rosa and Trujillo sands in Deaf Smith and Swisher Counties generally under artesian conditions (Figures 11 and 13). The sands are confined by the overlying, relatively impervious beds in the Chinle Formation. A well drilled through the Chinle Formation allows the potentiometric surface of ground water in the Santa Rosa and Trujillo sands to rise in the well. Hydrostatic pressure forces the water to rise because the head of water in the recharge area is at higher elevations in the Santa Rosa and Trujillo sands. The rate of movement is directly related to the porosity and permeability of the aquifer. In sand formations, the limiting factor is the transmissivity of the formation, which controls the amount of head loss, or drawdown of the potentiometric surface, caused by water moving from the recharge area to the well. Generally within Deaf Smith and Swisher Counties, ground water in wells in the Triassic aquifer does not rise as high as the base of the Ogallala Formation. A limited number of water-level measurements are shown in Tables 2 and 3. These water-level measurements were used to determine the approximate potentiometric surface of the Triassic aquifer shown in Figures 11 and 13.

Ground water in the Triassic aquifer moves generally in an easterly and southeasterly direction. The direction of the ground-water movement is perpendicular to the potentiometric surface contour lines and toward lower elevations as shown in Figure 8. A low exists directly to the northwest of Hereford with two possible highs north and east of Hereford. This low may be caused by pumpage. Water-level measurements indicate the hydraulic gradient of the potentiometric surface is about 50 feet per mile.

Hydraulic Characteristics

Water-producing capabilities of an aquifer depend upon its ability to recharge, transmit, and store water. Formulas have been developed to show the relationship of the yield of a well and shape and extent of the cone of depression to the properties of the aquifer, including specific yield and coefficients of storage, transmissivity, and permeability. These formulas indicate that, within limits, the discharge from a well varies directly with the drawdown; that is, doubling the drawdown will nearly double the amount of discharge. The discharge per unit of drawdown or specific capacity is of value in estimating the probable yield of a well and the required pump setting. However, the type of well construction and thoroughness of well development also affect the specific capacity.

Coefficients of storage and transmissivity of an aquifer may be determined from pumping tests, which involve pumping a well at a constant rate for a period of time and making periodic measurements of water levels in the pumping well and, if possible, in one or more observation wells. The recovery of the water level is also measured after pumping stops. From the data obtained, the coefficients of transmissivity and storage are calculated and used in computing the effects that pumping will have on water levels in an aquifer at various times and distances from a pumped well. In addition to providing a means for computing the quantity of water that will flow through a given section of the aquifer, the coefficients can also be used in estimating the availability of ground water in storage.

A pumping test was conducted in 1963 by the High Plains Underground Water Conservation District No. 1 in Deaf Smith County on wells 10-06-802 and 10-14-202. Well 10-06-802 was pumped for 96 hours with an average pumping rate of 788 gal/min. Well 10-14-202 was the observation well in which water-level measurements were taken during recovery. Calculated transmissivity values ranged from 19,330 to 24,180 gal/day/ft, while storage coefficients ranged from 9.59×10^{-5} to 1.77×10^{-4}. Reapplying selected transmissivity and storage coefficients to known drawdown conditions determined during the pumping cycle indicated an average transmissivity of 22,000 gal/day/ft and an average storage coefficient of 0.0001 are most nearly representative of the aquifer's hydraulic properties in the immediate vicinity of the test well. These values should not be accepted as applying to the Triassic aquifer everywhere in the study area because of the differences in thickness and character of the formation.

Change in Water Levels

Approximate altitudes of water levels in selected wells completed in the Triassic aquifer are shown in Figure 8 for the period 1959-1984. A selected number of water-level measurements in Deaf Smith and Swisher Counties are shown in Tables 2 and 3. The hydraulic gradient of the potentiometric surface is generally to the east and southeast at about 50 feet per mile. The fluctuation of water levels in wells 11-25-502 and 11-36-109 in Swisher County, both of which are completed in the Dockum Group, indicates no definite trend (Figure 9). The fluctuations are probably caused mostly by changes in pumping of the wells.

Chemical Quality

The types and concentrations of dissolved minerals carried in ground water are determined mainly by the soil and rocks through which the water percolates. As the water moves through its environment, it dissolves some of the minerals from the surrounding rocks. The concentration of the various dissolved-mineral constituents depends upon the solubility of the minerals in the formation, the length of time the water is in contact with the rock, and the concentration of carbon dioxide present within the water. Therefore, the chemical character of the water mirrors the general mineral composition of the earth through which it has passed. Additionally, dissolved-mineral concentrations usually increase with depth and temperature.

Table 5 is a tabulation of 62 chemical analyses of water from wells in Deaf Smith, Randall, and Swisher Counties. The sampled wells are indicated on Figure 10 by a bar over the well's number. Concentrations of dissolved solids in samples taken from selected wells in Deaf Smith, Randall, and Swisher Counties are shown on Figure 7.

The degree and type of mineralization of ground water determine its suitability for municipal, industrial, irrigation, and other uses. Several criteria for water-quality requirements which serve as guidelines in determining the suitability of water for various uses have been developed through the years. Subjects covered by the guidelines are bacterial content; physical characteristics, including color, taste, odor, turbidity, and temperature; and chemical constituents. Water-quality problems associated with the first two

subjects can usually be alleviated economically. However, the neutralization or removal of most of the unwanted chemical constituents is usually difficult and often costly.

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

Description	Dissolved-Solids Content (ppm)
Fresh	Less than 1,000
Slightly Saline	1,000 to 3,000
Moderately Saline	3,000 to 10,000
Very Saline	10,000 to 35,000
Brine	More than 35,000

In recent years, most laboratories have begun reporting analyses in milligrams per liter (mg/l) instead of parts per million. These units, for all practical purposes, are identical until the dissolved-solids concentration reaches or exceeds 7,000 units (either ppm or mg/l).

The dissolved-solids concentrations throughout the study area ranged from fresh to slightly saline (Figure 7); however, two water samples listed in

Table 5 for wells 11-18-103 and 11-25-502 showed dissolved-solid concentrations of 5,820 and 13,292 mg/l, respectively.

Utilization and Development

During the late 1960s, several land owners in Deaf Smith and Swisher Counties drilled test wells into the Triassic beds with only limited success. Some wells were completed and initially produced moderate amounts of good quality water but, after continued use, these wells deteriorated in both quality and yield. The water from some of these wells had an adverse effect on the soil. This adverse effect on soil structure, caused by the high sodium concentration in irrigation water, is called the sodium hazard. An index used for predicting the sodium hazard is the sodium adsorption ratio (SAR). A high SAR in irrigation water causes the soil to form a hard, impermeable crust that results in cultivation and drainage problems. Some wells completed in the Triassic beds became contaminated because poor-quality waters from the sands in the Chinle were not sealed off.

A total of 133 wells, test holes, and oil tests were inventoried in Deaf Smith, Oldham, Randall, and Swisher Counties as shown on Table 2. Of this total, 78 wells and test holes were completed in the Triassic aquifer, and 31 wells and test holes were completed in both the Ogallala Formation and the Dockum Group. Of the 78 wells and test holes completed in the Triassic aquifer, 21 were used for irrigation, 3 for industrial supply, 6 for public supply, and 5 for domestic and livestock supply. Approximately 13 of the 78 wells were unused, and 30 were test holes which were either abandoned or destroyed.

Water superintendents were contacted in the cities of Happy, Hereford, and Tulia to obtain the percentage of total ground-water use which came from municipal wells completed in the Triassic aquifer. During 1983, approximately 103 acre-feet (33,609,600 gallons) of ground water from the Triassic aquifer was used by the city of Happy; approximately 223 acre-feet (72,750,000 gallons) was used by the city of Hereford; and approximately 829 acre-feet (269,965,600 gallons) was used by the city of Tulia.

Recommendation

Data in this report have shown that waters in the Triassic aquifer generally range from fresh to slightly saline in quality and are being used beneficially for irrigation, public supplies, and industries, and also locally for domestic and livestock purposes. Based on these findings, and particularly in view of the generally declining availability of ground-water supplies in the High Plains, it is recommended that all reasonable precautions be taken to protect these water supplies from contamination.

SELECTED REFERENCES

Adams, J. E. 1929, Triassic of West Texas: Am. Assoc. Petr. Geologists Bull. no. 8, v. 13, p. 1045-1055.

Bureau of Economic Geology, 1968, Geologic atlas of Texas, Plainview sheet: Univ. of Texas, Bur. Econ. Geology map.

———— 1983a, Geologic atlas of Texas, Tucumcari sheet: Univ. of Texas, Bur. Econ. Geology map.

———— 1983b, Annual report, Univ. of Texas, 40 p.

Cronin, J. G., 1961, A summary of the occurrence and development of ground water in the Southern High Plains of Texas: Texas Board of Water Engineers Bull. 6107, p. 9-21.

Dante, J. H., 1946, Records of wells, drillers' logs, water analyses and well location map in Swisher County, Texas: U.S. Geol. Survey Misc. Publ. 275, 90 p.

Darton, N. H. 1921, Geological structure of parts of New Mexico: U.S. Geol. Survey Bull. 726-E, p. 173-275.

Drake, N. F., 1891, Stratigraphy of the Triassic formations of Northwest Texas: Third Annual Report of the Geol. Survey of Texas, p. 227-247.

Fink, B. E., 1963, Ground-water geology of Triassic deposits, northern part of the Southern High Plains of Texas: High Plains Underground Water Conservation District No. 1, 76 p.

Follett, C. R., 1953a, Records of water-level measurements in Deaf Smith County, Texas: U.S. Geol. Survey Bull. 5305, 22 p.

———— 1953b, Records of water-level measurements in Swisher County, Texas: U.S. Geol. Survey Bull. 5307, 24 p.

Gawloski, T., 1983, Stratigraphy and environmental significance of the continental Triassic rocks of Texas: Baylor Geological Studies Bull. 41, 48 p.

Gould, C. N., 1906, The geology and water resources of the eastern portion of the Panhandle of Texas: U.S. Geol. Survey Water-Supply Paper 154, 64 p.

Hoots, H. W., 1925, Geology of a part of Western Texas and Southeastern New Mexico with special reference to salt and potash: U. S. Geol. Survey Bull. 780, p. 33-126.

Knowles, T. R., Nordstrom, P. L., Klemt, W. B., 1984, Evaluating the groundwater resources of the High Plains of Texas: Texas Department of Water Resources Rept. 288, 177 p.

Matthews, W. H., III, 1969, The geologic story of Palo Duro Canyon, Texas: Texas Bur. Econ. Geology Guidebook 8, 51 p.

McGowen, J. H., Granata, G. E., and Seni, S. J., 1979, Depositional framework of the lower Dockum Group (Triassic), Texas Panhandle: Univ. of Texas, Bur. Econ. Geology Report of Investigations 97, 60 p.

———— 1979, Depositional framework of the lower Dockum Group (Triassic) Texas Panhandle: Rept. of Inv. 79, 60 p.

Patton, L. T., 1923, The geology of Potter County: Univ. of Texas Bull. 2330, 18 p.

Rayner, F. A., 1965, The ground-water supplies of the Southern High Plains: Unpublished paper presented to the Third Annual West Texas Water Conference, 23 p.

Sellard, E. H., Adkins, W. S., and Plummer, F. B., 1932, The geology of Texas v. I - Stratigraphy: Univ. of Texas Bull. 3232, p. 239-253.

Sidwell, Raymond, 1945, Triassic sediments in West Texas and Eastern New Mexico: Jour. Sed. Petrology, v. 15, no. 2, p. 50-54.

Stone & Webster Engineering Corporation, 1981, Area geological characterization report for the Palo Duro and Dalhart Basins, Texas: Technical Rept., DOE/CH/10140-1, 326 p.

White, W. N., Lang, J. W., and Follett, C. R., 1938, Records of wells, drillers' logs, water analyses, and well location map in Deaf Smith County, Texas: U. S. Geol. Survey Misc. Publ. 68, 52 p.

Winslow, A. G., and Kisler, L. R., Jr., 1956, Saline-water resources of Texas: U. S. Geol. Survey Water-Supply Paper 1365, 105 p.

Table 2.--Records of Wells, Test Holes, and Oil Tests in Deaf Smith, Oldham, Randall, and Swisher Counties

Water Levels : Reported water levels given in feet; measured water levels given in feet and tenths.
Method of lift and type of power: C, cylinder; CF, centrifugal; E, electric; G, natural gas, butane, diesel, or gasoline; N, none; S, submersible; T, turbine; W, windmill.
Use of water : D, domestic; Ind, industrial; Irr, irrigation; N, none; P, public supply; S, livestock.
Water-bearing unit : To-Trd, Ogallala Formation-Dockum Group; Trd, Dockum Group (Undifferentiated); Trdc, Chinle Formation; Trdsr, Santa Rose Sandstone; P, Permian System.

DEAF SMITH COUNTY

Well	Latitude	Longitude	Owner	Driller	Date Completed	Depth of Well (ft.)	Water-bearing Unit	Altitude of Land Surface Datum (ft.)	Water Level		Method of Lift	Use of Water	Remarks
									Below Land-Surface Datum (ft.)	Date of Measurement			
07-49-8A	35-09-26	102-56-26	Mike Moser	High Plains Irrigation Service	1966	620	Trd	4,002	--	--	N	N	Test hole water too salty. Abandoned and plugged. 1/
9A	--	--	Ira Scott	Hubble Water Well Service	1973	112	Trd	4,150	35	Dec. 13, 1973	S,E	D	Perf. from 96 to 110 ft. 1/
9B	--	--	Ira Scott and Malcolm Moser	B. A. Reddell	1962	705	Trd	4,320	--	--	N	N	Test holes. SM. 1/ 3/
* 50-702	35-08-51	102-51-55	D. Pinnell	A & A Drilling Co.	1980	420	Trdc	4,290	180	May 20, 1980	S,E	D,S	Perf. from 330 to 420 ft. Drawdown of 240 ft. while pumping 5 gal/min on May 20, 1983. 1/
51-501	10-26	41-27	--Snodgrass	High Plains Irrigation Service	1969	341	To-Trd	4,177	278.4	June 1, 1976	C,W	S	Perf. from 285 to 333 ft. 1/
52-4A	--	--	A. G. Flippen	Walco Drilling Inc.	1971	740	Trd	4,127	550	Apr. 1971	N	N	Test hole. Plugged back to 350 ft. 1/
4B	--	--	do	do	1971	800	Trd	4,127	550	Mar. 1971	N	N	Do.
9A	--	--	Jerry Montgomery	High Plains Irrigation Service	1971	860	Trd	4,087	--	--	N	N	Test hole. 1/
9D	--	--	Sam Lynch	do	1967	840	Trd	4,093	--	--	N	N	Do.
* 902	35-07-40	103-30-07	Richardson Seed Farms	W. D. Jones Drilling Co.	1977	872	Trdsr	4,055	635	Feb. 27, 1984	T,E	Irr.	Perf. from 606 to 666 ft. and from 742 to 862 ft. Reported yield 900 gal/min with 79 ft. of drawdown. 1/
* 903	09-59	31-22	Bob Thruett	Walco Drilling Inc.	1967	805	Trd	4,079	600	Dec. 2, 1967	T,G	N	Cemented from 250 to 540 ft. 1/

See footnotes at end of table.

Table 2.--Records of Wells, Test Holes, and Oil Tests in Deaf Smith, Oldham, Randall, and Swisher Counties--Continued

DEAF SMITH COUNTY

Well	Latitude	Longitude	Owner	Driller	Date Completed	Depth of Well (ft.)	Water-bearing Unit	Altitude of Land Surface Datum (ft.)	Water Level		Method of Lift	Use of Water	Remarks
									Below Land-Surface Datum (ft.)	Date of Measurement			
* 07-53-935	35-08-42	102-23-26	Glen Wagner	Water Industries Inc.	1973	451	To-Trd	3,995	215	Mar. 27, 1973	T,G	Irr.	Gravel packed. 1/
54-4A	--	--	--Coffee	Frankfort Oil Co.	1958	8,179	--	3,969	--	--	N	N	Oil test. 2/
8A	--	--	Allison-Hayes	do	1957	8,372	--	3,927	--	--	N	N	Do.
57-2A	--	--	Mike Moser	High Plains Irrigation Service	1966	840	Trd	4,338	--	--	N	N	Test hole. 1/
* 58-602	35-03-44	102-45-18	Frances Glenn	--	--	800	Trd	4,224	--	--	T,N	N	Abandoned.
59-1A	--	--	A. C. Brorman	Walco Drilling Inc.	1971	920	Trd	4,165	600	Jan. 18, 1971	N	N	Test hole. 1/
7M	--	--	Taft McGee	do	1971	810	Trd	4,175	600	1971	N	N	Test hole. Plugged at 350 ft. 1/
60-3A	--	--	Richardson Seed Farms	High Plains Irrigation Service	1968	865	Trd	4,061	--	--	N	N	Test hole. 1/
402	35-02-51	102-36-35	Cate's Farm	Big T Pump Co., Inc.	1974	383	To-Trd	4,112	302.4	Apr. 26, 1984	T,G	Irr.	Slotted from 263 to 383 ft. Reported yield 400 gal/min with 350 ft. of drawdown. 1/
5A	--	--	--Overstreet	N. B. Hunt	1952	7,510	--	4,087	--	--	N	N	Oil test. 2/
5B	--	--	--Rose	Texas Crude Oil Co.	1953	7,020	--	4,090	--	--	N	N	Do.
* 602	35-03-33	102-31-20	T. E. Vestal	Green Machinery Co., Inc.	1967	412	To-Trd	4,046	--	--	T,G	Irr.	Slotted from 212 to 412 ft. 1/
* 603	04-10	32-06	do	do	1971	395	To-Trd	4,062	--	--	T,G	Irr.	Well Caved in. 1/
61-5Z	--	--	J. Friemel	Stone & Webster Engineering Corp.	1982	1,216	Trd	4,012	--	--	N	N	Test hole. 2/
62-2A	--	--	Harry Friemel	Walco Drilling Inc.	1971	880	Trd	3,900	450	May 18, 1971	N	N	Test hole. Plugged at 350 ft. 1/
4Z	--	--	--Detten	Dept. of Energy	--	1,124	Trd	3,995	--	--	N	N	Test hole. 1/
* 713	35-00-41	102-21-49	Herb Brasher	Big T Pump Co., Inc.	1975	387	To-Trd	3,911	174	Nov. 26, 1975	T,G	Irr.	Slotted from 147 to 387 ft. Reported yield of 850 gal/min. 1/
63-1A	--	--	--Muse	Frankfort Oil Co.	1959	7,988	--	3,756	--	--	N	N	Oil test. 2/

See footnotes at end of table.

Table 2.--Records of Wells, Test Holes, and Oil Tests in Deaf Smith, Oldham, Randall, and Swisher Counties--Continued

DEAF SMITH COUNTY

	Well	Latitude	Longitude	Owner	Driller	Date Completed	Depth of Well (ft.)	Water-bearing Unit	Altitude of Land Surface Datum (ft.)	Water Level		Method of Lift	Use of Water	Remarks
										Below Land-Surface Datum (ft.)	Date of Measurement			
	07-63-8A	--	--	R. E. Gill	Franfort Oil Co.	1959	8,227	--	3,755	--	--	N	N	Oil Test. 2/
*	08-64-301	35-07-08	103-01-14	Rall's Ranch	Hubble Water Well Service	1971	80	Trd	3,952	--	--	C,W	S	Perf. from 68 to 75 ft. 1/
*	601	04-46	00-50	J. S. Bridwell	do	1975	125	Trd	4,076	60	Jan. 9, 1975	S,E	N	Perf. from 113 to 123 ft. 1/
	09-08-301	34-59-42	01-14	do	Tom E. Muncy	1966	200	Trd	4,432	103.0	Apr. 25, 1984	C,W	S	Perf. from 100 to 122 ft. 1/
	16-3A	--	--	R. J. Hyslop	Humble Oil and Refining Co.	1944	2,652	--	4,450	--	--	N	N	Oil Test. 2/
	3B	--	--	--Stambaugh	do	1948	6,675	--	4,415	--	--	N	N	Do.
	9A	--	--	--Reinaver	do	1958	8,074	--	4,375	--	--	N	N	Do.
	10-01-201	34-58-24	102-56-53	Charlie Hale	Hereford Irrigation and Well Service	1968	215	To-Trd	4,283	196.8	Apr. 25, 1984	C,W	S	Slotted from 190 to 215 ft. 1/
*	701	54-47	59-37	Bobby Ridley	W. T. Watson Drilling Co.	1974	155	To-Trd	4,331	141.1	Apr. 25, 1984	C,W	S	Perf. from 130 to 155 ft. 1/
	02-6C	--	--	Ewing Halsell	B. A. Reddell	1959	975	Trd	4,272	--	--	N	N	Test hole EH-2. 1/ 3/
	03-4Z	--	--	do	do	1955	960	Trd	4,199	--	--	N	N	Test hole EH-1. 1/ 3/
	402	34-56-44	102-42-51	Homer Hill	L. T. Davis Drilling Co.	1967	353	To-Trd	4,178	288.7	Apr. 25, 1984	T,N	N	Slotted from 283 to 353 ft. 1/
	403	56-44	43-22	do	do	1967	354	To-Trd	4,184	--	--	T,N	N	Slotted from 277 to 354 ft. 1/
	7Z	--	--	Phillip Miller	B. A. Reddell	1955	1,077	Trd	4,180	--	--	N	N	Test hole PM. Hole caved. 1/ 3/
	06-1Z	--	--	John Gallagher	John Gallagher	--	1,055	Trd	3,864	--	--	N	N	Test hole JG. 1/ 3/
	431	34-56-15	102-21-00	Taft McGee	Walco Drilling Inc.	1969	833	Trd	3,832	540	Feb. 23, 1969	T,N	N	Perf. from 625 to 833 ft. Cemented from 180 to 600 ft. 1/
	432	56-03	22-07	Stone & Webster Engineering Corp.	Hi Plains Drilling Inc.	1983	1,325	P	3,855	--	--	N	N	Test well. Screened from 1,305 to 1,325 ft. Cemented from surface to 1,305 ft. Gravel packed from 1,300 to 1,325 ft. Reported no water 1/ 2/

See footnotes at end of table.

Table 2.--Records of Wells, Test Holes, and Oil Tests in Deaf Smith, Oldham, Randall, and Swisher Counties--Continued

DEAF SMITH COUNTY

	Well	Latitude	Longitude	Owner	Driller	Date Completed	Depth of Well (ft.)	Water-bearing Unit	Altitude of Land Surface Datum (ft.)	Water Level		Method of Lift	Use of Water	Remarks
										Below Land-Surface Datum (ft.)	Date of Measurement			
*	10-06-802	34-52-44	102-17-53	V. J. Owens	Howard Fish	1956	767	Trd	3,776	385	Feb. 22, 1963	T,G	Irr.	Open hole from 680 to 767 ft. Cemented from 470 to 680 ft. Test well O-1. 1/ 3/
*	804	53-11	18-57	do	Big T Pump Co., Inc.	1969	807	Trd	3,784	557 489.1	Jan. 17, 1969 Jan. 11, 1972	T,G	Irr.	Historical water level observation well. Slotted from 627 to 807 ft. Cemented from surface to 600 ft. 1/
*	828	53-38	19-59	E. C. Reinauer	Walco Drilling Inc.	1968	806	Trd	3,805	619	July 28, 1972	T,G	Irr.	Cemented from 240 to 600 ft. ft. 1/
*	832	53-37	18-25	F. W. & W. W. Hill	Big T Pump Co., Inc.	1968	780	Trd	3,786	490	Feb. 12, 1968	T,G	Irr.	Perf. from 592 to 768 ft. Reported yield 1,000 gal/min with 210 ft. of drawdown. 1/
	837	53-01	18-41	do	do	1969	807	Trd	3,782	557	Jan. 17, 1969	T,G	Irr.	Perf. from 627 to 807 ft. Reported yield 1,000 gal/min with 91 ft. of drawdown. 1/
	839	52-44	18-57	Edgar Telchick	Walco Drilling Inc.	1968	803	Trd	3,782	570	Oct. 3, 1968	T,G	Irr.	Perf. from 623 to 803 ft. Reported yield 1,050 gal/min. 1/
	853	53-38	18-57	E. C. Reinauer	Big T Pump Co., Inc.	1969	807	Trdsr	3,789	545	June 20, 1969	T,G	Irr.	Slotted from 573 to 783 ft. Cemented from surface to 541 ft. 1 /
	854	52-45	19-59	Glen Hamilton	Walco Drilling Inc.	1968	808	Trd	3,795	540	Apr. 26, 1968	T,G	Irr.	Cemented from 240 to 600 ft. 1/
	9J	--	--	C. P. Norton	Kenny Gearn Machine Works	1971	254	To-Trd	3,778	--	--	N	N	Perf. from 144 to 254 ft. Owner reports well destroyed due to low yield. 1/
	07-1A	--	--	Gaylon Friemel	Stone & Webster Engineering Corp.	1982	2,712	Trd	3,816	--	--	N	N	Test hole. Sample log in TDWR files.
*	704	34-52-36	102-12-50	Stewart Bros.	West Texas Drilling Co., Inc.	1965	747	Trd	3,784	--	--	T,G	Irr.	Cemented from surface to 634 ft. Not used at present. 1/
*	803	53-47	11-04	Transwestern Pipeline Co.	Wall & Son's Drilling, Inc.	1982	737	Trdsr	3,779	566	Dec. 4, 1982	S,E	D	Slotted from 624 to 737 ft. 1/

See footnotes at end of table.

Table 2.--Records of Wells, Test Holes, and Oil Tests in Deaf Smith, Oldham, Randall, and Swisher Counties--Continued

DEAF SMITH COUNTY

Well	Latitude	Longitude	Owner	Driller	Date Completed	Depth of Well (ft.)	Water-bearing Unit	Altitude of Land Surface Datum (ft.)	Water Level		Method of Lift	Use of Water	Remarks
									Below Land-Surface Datum (ft.)	Date of Measurement			
* 10-07-804	34-53-43	102-11-00	Lois Miller	West Texas Drilling Co., Inc.	1966	760	Trdsr	3,772	470	Mar. 20, 1966	T,G	Irr.	Perf. from 642 to 760 ft. Reported yield 700 gal/min 150 ft. of drawdown. 1/
09-1A	--	--	--Collett	Gardner Bros. Drilling Co.	1954	6,639	--	4,393	--	--	N	N	Oil test. 2/
11-3A	--	--	--Ponder	Honolulu Oil Co.	1949	9,090	--	3,985	--	--	N	N	Oil Test. 2/
12-2X	--	--	N. O. Bartlett	J. T. Reed	1955	1,250	Trd	3,947	--	--	N	N	Test hole NB-2. Dry hole. 1/ 3/
13-2E	--	--	John Pitman	Kenny Gearn Machine works	1971	460	To-Trd	3,829	--	--	--	Irr.	Perf. 238 to 428 ft. Gravel packed. 1/
* 229	34-51-32	102-26-43	Griffin & Brand	Big T Pump Co., Inc.	1983	490	To-Trd	3,818	210.9	July 18, 1983	T,N	Irr.	Slotted and screened from 219 to 487 ft. Reported yield 425 gal/min with 100 ft. of drawdown. 1/
* 230	50-07	26-27	Edwin Axe	Kenny Gearn Machine works	1972	512	To-Trd	3,888	--	--	T,E	Irr.	Perf. from 264 to 514 ft. 1/
* 231	50-56	27-26	Walterscheid Bros.	West Texas Drilling Co., Inc.	1976	466	To-Trd	3,850	--	--	T,E	Irr.	Slotted from 153 to 435 ft. Gravel packed. Flow meter on discharge read 600 gal/min on April 30, 1984.1/
4X	--	--	Griffin & Brand	B. A. Reddell	1956	900	Trd	3,884	--	--	N	N	Test hole GB. 1/ 3/
5X	--	--	Holly Sugar Co.	do	1962	950	Trd	3,853	--	--	N	N	Test hole HS. 1/ 3/
* 503	34-45-10	102-25-22	City of Hereford	McDonald Drilling Co.	1967	955	Trd	3,793	468.0 476.3	Apr. 23, 1970 Jan. 12, 1971	T,E	P	Historical water level observation well. Slotted from 683 to 944 ft. Cemented from surface to 650 ft. 1/
6E	--	--	do	B. A. Reddell	1962	990	Trd	3,828	--	--	N	N	Test hole H-1. Destroyed. 1/ 3/
6X	--	--	do	do	1962	840	Trd	3,826	--	--	N	N	Do.
908	34-46-43	102-23-13	Robert Wagner	Wolfe Drilling Co.	1964	365	To-Trd	3,839	102	-- 1964	T,G	Irr.	Perf. from 183 to 365 ft. 1/
* 14-107	52-13	20-32	Henry Brorman	Walco Drilling Inc.	1968	825	Trdsr	3,796	560	Aug. 26, 1968	T,N	Irr.	Slotted from 600 to 820 ft. Cemented from 260 to 600 ft. Reported yield 900 gal/min. 1/

See footnotes at end of table.

Table 2.--Records of Wells, Test Holes, and Oil Tests in Deaf Smith, Oldham, Randall, and Swisher Counties--Continued

DEAF SMITH COUNTY

Well	Latitude	Longitude	Owner	Driller	Date Completed	Depth of Well (ft.)	Water-bearing Unit	Altitude of Land Surface Datum (ft.)	Water Level		Method of Lift	Use of Water	Remarks
									Below Land-Surface Datum (ft.)	Date of Measurement			
10-14-154	34-51-15	102-20-50	Southwest Feed-yards	Walco Drilling Inc.	1971	823	Trdsr	3,781	608	June 27, 1971	T,E	Ind.	Slotted from 551 to 804 ft. Cemented from surface to 554 ft. 1/
155	50-52	21-05	H. V. Crawford	West Texas Drilling Co., Inc.	1965	844	Trd	3,792	420	March 1965	T,G	N	Cemented from surface to 690 ft. 1/
2V	--	--	W. G. Russell	J.J. Merrifield	1953	770	Trd	3,767	--	--	N	N	Test hole R-1. Well caved and abandoned. 1/ 3/
2X	--	--	H.G. Beauchamp	B.A. Reddell	1953	855	Trd	3,783	--	--	N	N	Test hole HB. 1/ 3/
2Y	--	--	J. H. Fish	J. H. Fish	1953	860	Trd	3,766	--	--	N	N	Test hole JF. Reported yield 750 gal/min. 1/ 3/
202	34-52-19	102-17-20	V. J. Owens	Walco Drilling Inc.	1959	779	Trdsr	3,773	385.1	Jan. 16, 1959	T,G	Irr.	Cemented from surface to 650 ft. See pumping test data. 1/
* 237	51-00	18-17	W. G. Russell	West Texas Drilling Co., Inc.	1962	803	Trd	3,766	--	--	N	N	Test hole R-2. Cemented from surface to 671 ft. Reported yield 900 gal/min. 1/ 3/
308	51-36	16-52	Ernest Sluder	Walco Drilling Inc.	1966	744	Trdsr	3,760	490	Nov. 1966	T,G	N	Perf. from 592 to 744 ft. Cemented from surface to 250 ft. Reported yield 750 gal/min. 1/
* 442	49-42	20-41	Champion Feeders, Inc.	Water Industries Inc.	1973	827	Trd	3,760	544	Mar. 12, 1973	T,E	Ind.	Cemented from 50 to 630 ft. 1/
5X	--	--	Hereford Salt, Inc.	Astro Drilling Co., Inc.	1967	1,952	Trd	3,780	--	--	T	Ind.	Cemented from surface to 1,430 ft. Santa Rosa sandstone from 935 to 970 ft. 1/ 2/
* 511	34-47-33	102-19-51	Denzil Pulliam	Walco Drilling Inc.	1967	940	Trd	3,819	520	Feb. 13, 1967	T,G	Irr.	Cemented from 200 to 600 ft. Reported yield 1,000 gal/min. 1/
512	47-39	18-06	Charlie Packard	Wolfe Drilling Co.	1966	910	Trdsr	3,811	485	Feb. 2, 1966	T,G	N	Perf. from 650 to 910 ft. Cemented from surface to 178 ft. 1/
8Z	--	--	Wilbur Axe	B. A. Reddell	1957	810	Trd	3,855	--	--	N	N	Test hole A-1. 1/ 3/
* 802	34-46-38	102-19-30	G. W. Newson Estate	Water Industries Inc.	1974	945	Trd	3,840	670	Jun. 14, 1974	T,G	Irr.	Slotted from 745 to 945 ft. Cemented from surface to 674 ft. 1/

See footnotes at end of table.

Table 2.--Records of Wells, Test Holes, and Oil Tests in Deaf Smith, Oldham, Randall, and Swisher Counties--Continued

DEAF SMITH COUNTY

	Well	Latitude	Longitude	Owner	Driller	Date Completed	Depth of Well (ft.)	Water-bearing Unit	Altitude of Land Surface Datum (ft.)	Water Level		Method of Lift	Use of Water	Remarks
										Below Land-Surface Datum (ft.)	Date of Measurement			
*	10-14-803	34-45-45	102-18-25	Wilbur Axe	West Texas Drilling Co., Inc.	1967	910	Trd	3,855	510	Feb. 4, 1967	N	N	Cemented from 200 to 600 ft. 1/
*	804	45-47	17-55	do	do	1963	1,023	Trd	3,854	--	--	N	N	1/
*	15-201	51-18	14-11	John Stribling	Wall & Son's Drilling, Inc.	1975	154	To-Trd	3,691	58.3	Jul. 21, 1983	S,E	Irr.	1/
	202	51-18	14-05	do	do	1975	150	To-Trd	3,693	52.4	Jul. 21, 1983	S,E	Irr.	1/
	4A	--	--	R. Cocanougher	Hubble Drilling Co.	1966	292	To-Trd	3,830	220	Oct. 12, 1961	--	D	1/
*	803	34-46-32	102-10-33	Kent Cabel	Les Taylor Drilling Co.	1981	420	To-Trd	3,883	341.2	May 30, 1984	S,E	S	Perf. from 100 to 140 ft. and from 360 to 390 ft. 1/
*	804	45-28	11-25	W. N. Hall	--McDade	1917	396	To-Trd	3,888	--	--	C,E	D,S	
					OLDHAM COUNTY									
	07-52-1A	--	--	D. Whaley	Pan American Petroleum Co.	1965	7,645	--	4,073	--	--	N	N	Oil Test. 2/
					RANDALL COUNTY									
*	11-10-736	34-45-34	101-52-00	City of Happy	Billy Wall	1971	920	Trdsr	3,620	540	Apr. 1971	T,E 100	P	Perf. from 625 to 800 ft. Reportedly pumps 400 gal/min. 1/
					SWISHER COUNTY									
	11-17-9A	--	--	--Culton	Frankfort Oil Co.	1960	8,555	--	3,580	--	--	N	N	Oil test. 2/
	18-102	34-44-04	101-51-56	City of Happy	Walco Drilling, Inc.	1971	840	Trd	3,613	530	Mar. 4, 1971	N	N	Plugged back to 225 ft. 1/
*	103	43-37	50-39	Bogart & Goode	Green Machinery Co., Inc.	1969	926	Trdsr	3,598	--	--	T,G	Irr.	Perf. from 676 to 926 ft. Cemented from surface to 668 ft. 1/
*	104	44-02	51-51	City of Happy	W. D. Jones Drilling Co.	1978	830	Trdsr	3,614	496.2	Apr. 24, 1984	T,E	P	Slotted from 576 to 821 ft. Cemented from surface to 551 ft. 1/

See footnotes at end of table.

Table 2.--Records of Wells, Test Holes, and Oil Tests in Deaf Smith, Oldham, Randall, and Swisher Counties--Continued

SWISHER COUNTY

Well	Latitude	Longitude	Owner	Driller	Date Completed	Depth of Well (ft.)	Water-bearing Unit	Altitude of Land Surface Datum (ft.)	Water Level		Method of Lift	Use of Water	Remarks
									Below Land-Surface Datum (ft.)	Date of Measurement			
11-18-105	34-44-50	101-51-20	City of Happy	Green Machinery Co., Inc.	1965	877	Trdsr	3,617	--	--	N	N	Perf. from 707 to 877 ft. Destroyed. 1/
605	41-25	47-07	Henry Hinton	do	1967	224	To-Trd	3,547	--	--	T,G	Irr.	Cased from surface to 20 ft. Reported yield 70 gal/min. 1/
838	39-00	48-35	Stone & Webster Engineering Corp.	Hi Plains Drilling Inc.	1983	1,218	Trd	3,534	--	--	N	N	Test well. Screened from 1,157 to 1,187 ft. 2/
19-2A	--	--	--Wesley	Frankfort Oil Co.	1960	8,781	--	3,457	--	--	N	N	Oil test. 2/
540	34-40-31	101-41-58	H. B. Pyeatt	Frank Hunt	1964	235	To-Trd	3,488	--	--	T,G	Irr.	Open from 200 to 235 ft. 1/
20-5A	--	--	--Harris	L. A. Helms	1948	5,514	--	3,430	--	--	N	N	Oil test. 2/
7A	--	--	D. M. Grabbe	Gruy Federal, Inc.	1978	4,216	--	3,435	--	--	N	N	Oil test. 2/
* 25-502	34-33-46	101-55-42	O. V. Morris	Black & Jenson Drilling Co.	1963	1,002	Trd	3,622	359.4	Jan. 4, 1984	T,G	Irr.	Perf. from 700 to 1,000 ft. Reported yield 800 gal/min with 163 ft. of drawdown. Water level observation well. 1/ 2/ 3/
26-1A	--	--	Clyde Bradford	Frankfort Oil Co.	1958	8,670	--	3,530	--	--	N	N	Oil test. 2/
* 611	34-32-45	101-46-07	City of Tulia	Hi Plains Drilling Inc.	1967	840	Trdsr	3,489	364	Jul. 24, 1967	T,E	P	Perf. from 620 to 820 ft. Performance test July 24, 1967: Pumping 2,000 gal/min with 124 ft. of drawdown after 72 hours. 1/ 2/
* 612	33-32	46-35	do	do	1978	801	Trdsr	3,496	405.9	Apr. 25, 1984	T,E	P	Slotted from 625 to 800 ft. Reported yield cf 600 gal/min with 311 ft. of drawdown after 24 hours. 1/
8A	--	--	Delbert Bivens	H. L. Hunt Oil Co.	1952	9,021	--	3,521	--	--	N	N	Oil test. 2/
916	34-30-55	101-45-45	City of Tulia	Water Industries	1973	860	Trd	3,476	424 460.1	Jul. 21, 1973 Apr. 25, 1984	T,E	P	Perf. from 636-816 ft. Cemented from surface to 606 ft. Development test by Water Industries pumping 100 gal/min with 276 ft. of drawdown. 1/ 2/

See footnotes at end of table.

Table 2.--Records of Wells, Test Holes, and Oil Tests in Deaf Smith, Oldham, Randall, and Swisher Counties--Continued

SWISHER COUNTY

	Well	Latitude	Longitude	Owner	Driller	Date Completed	Depth of Well (ft.)	Water-bearing Unit	Altitude of Land Surface Datum (ft.)	Water Level		Method of Lift	Use of Water	Remarks
										Below Land-Surface Datum (ft.)	Date of Measurement			
	11-27-607	34-32-48	101-37-56	O. B. Barnes	Hi Plains Drilling Inc.	1975	640	Trd	3,377	376.1	Apr. 24, 1984	N	N	Slotted from 520 to 640 ft. Cemented from the surface to 390 ft. 1/
	710	31-33	43-52	Wyle Byrd	do	1975	750	Trd	3,415	402.5	Apr. 25, 1984	T,G	Irr.	Cemented from surface to 590 ft. 1/
	8A	--	--	--Zeeck	Stone & Webster Engineering Corp.	1982	1,028	Trd	3,410	--	--	N	N	Oil test. 2/
	28-2A	--	--	--Johnson	Standard Oil Co. of Texas	1952	9,233	--	3,386	--	--	N	N	Oil test. 2/
*	409	34-33-30	101-35-26	Roy Blankenship	Langston Drilling Co.	1971	650	Trdsr	3,387	--	--	T,G	N	Perf. from 404 to 644 ft. Cemented from the surface to 390 ft. 1/
	410	34-45	35-13	Paul Irlbeck	do	1973	658	Trd	3,391	400.9	Apr. 24, 1984	T,G	N	Perf. from 400 to 658 ft. Cemented from the surface to 400 ft. 1/
	4N	--	--	Roy Blankenship	do	1972	650	Trd	3,387	--	--	N	N	Perf. from 400 to 644 ft. Cemented from the surface to 399 ft. Destroyed. 1/
*	508	34-34-20	101-34-53	Lawrence Ludeman	do	1971	643	Trd	3,391	407.9	Apr. 25, 1984	N	N	Perf. from 423 to 643 ft. Cemented from the surface to 230 ft. 1/
*	33-610	26-22	52-51	Bob Gaylor	J. B. Thrush Drilling Co.	1970	600	Trd	3,577	--	--	S,E	Irr.	1/
	34-607	26-49	46-16	Larry Nelson	Hale Center Drilling	1976	281	To-Trd	3,475	165	Apr. 25, 1984	T,E	Irr.	Perf. from 231 to 281 ft. 1/
*	909	22-37	45-06	James Vineyard	Green Machinery Co., Inc.	1969	322	To-Trd	3,480	--	--	T,E	Irr.	Slotted from 222 to 322 ft. 1/
	36-109	27-42	36-20	Johnny Miller	do	1973	631	Trd	3,362	364.14	Jan. 6, 1984	T,G	Irr.	TDWR observation well. 1/ 3/
	41-1A	--	--	A. B. Nanny	Humble Oil and Refining Co.	1949	8,030	--	3,591	--	--	N	N	Oil test. 2/
	42-1A	--	--	M. A. Patton	Consolidated Gas & Equipment Co.	1956	7,459	--	3,547	--	--	N	N	Oil test 2 /
*	308	34-20-49	101-45-26	Claude Harris	Green Machinery Co., Inc.	1968	368	To-Trd	3,467	196.2	Jan. 7, 1984	T,G	Irr.	Perf. from 168 to 368 ft. TDWR Observation well. 1/ 3/

See footnotes at end of table.

Table 2.--Records of Wells, Test Holes, and Oil Tests in Deaf Smith, Oldham, Randall, and Swisher Counties--Continued

SWISHER COUNTY

Well	Latitude	Longitude	Owner	Driller	Date Completed	Depth of Well (ft.)	Water-bearing Unit	Altitude of Land Surface Datum (ft.)	Water Level		Method of Lift	Use of Water	Remarks
									Below Land-Surface Datum (ft.)	Date of Measurement			
11-42-312	34-20-27	101-45-29	A. G. Bontke	J. B. Thrush Drilling Co.	1967	385	To-Trd	3,481	--	--	T,G	Irr.	Perf. from 182 to 385 ft. 1/
313	21-43	45-04	City of Kress	Green Machinery Co., Inc.	1969	350	To-Trd	3,466	--	--	T,E	P	Slotted from 150 to 350 feet. Cemented from surface to 20 feet. Reported yield 170 gal/min. Not used. 1/
43-104	21-36	42-48	H. W. Axtell	--Fox	1937	400	To-Trd	3,451	104.2	Jan. 6, 1954	T,G	Irr.	Reported yield 990 gal/min with 26 feet of drawdown after 4 hours. Historical TDWR observation well. 1/
110	21-23	44-44	Bobby Sizemore	Gaylen Drilling Co.	1965	317	To-Trd	3,457	119.6	Apr. 26, 1984	N	N	1/
* 111	22-12	44-59	City of Kress	Green Machinery Co., Inc.	1972	345	To-Trd	3,476	205.1	Apr. 26, 1984	T,E	P	Slotted from 170 to 205 feet and from 275 to 345 feet. Cemented from surface to 60 feet. Reported yield of 250 gal/min. 1/
2A	--	--	--Sweatt	Frankfort Oil Co.	1958	5,488	--	3,409	--	--	N	N	Oil test. 2/
45-4A	--	--	Oliver Savage	Sinclair Oil & Gas Co.	1954	4,704	--	3,302	--	--	N	N	Oil test. 2/

Footnotes: * For chemical Analyses of water, see Table 5.

1/ For driller's log, see Table 4.

2/ Mechanical log in file of the TDWR.

3/ Water well in Ground-Water Geology of Triassic Deposits, Northern Part of the Southern High Plains (Fink, 1983).

Table 3.-Water Levels in Selected Wells in

Deaf Smith and Swisher Counties

Water-level measurements, in feet, above (+) or below land surface.

Date	Water level
Deaf Smith County	
Well 10-06-804	
Jan. 17, 1969	557.00
Jan. 11, 1972	489.08
Well 10-13-503	
Apr. 23, 1970	467.95
Jan. 12, 1971	476.25
Swisher County	
Well 11-25-502	
Apr. 28, 1970	454.10
Jan. 7, 1971	450.92
Jan. 12, 1972	444.16
Jan. 17, 1973	444.62
Jan. 14, 1974	453.58
Jan. 7, 1975	456.63
Jan. 13, 1976	485.50
Jan. 5, 1977	438.44
Jan. 6, 1978	391.27
Nov. 6, 1979	394.60
Jan. 15, 1981	382.50
Jan. 4, 1984	359.40
Well 11-36-109	
Jan. 12, 1976	357.60
Jan. 7, 1977	352.08
Jan. 5, 1978	350.16
Jan. 8, 1979	358.32
Jan. 13, 1982	369.47
Jan. 6, 1984	364.14

Table 4. - Drillers' Logs of Wells in Deaf Smith County

Well: 07-49-8A
Owner: Mike Moser
Driller: High Plains Irrigation Service

	Thickness (feet)	Depth (feet)
Caliche	3	3
Red Clay	92	95
Red and Blue Clay	55	150
Gray shale, cemented sand with red clay streaks	10	160
Blue shale	8	168
Red and blue clay	12	180
Red Clay	70	250
Red clay with blue and red shale streaks	30	280
Red and blue shale	22	302
Blue rock and cemented sand	3	305
Red clay with blue shale streaks	15	320
Red clay	40	360
Blue shale with red clay and blue rock streaks	30	390
Soft red clay	10	400
Red clay with blue shale and soft blue rock streaks	40	440
Brown and gray shale with grayish-brown silty sand	20	460

Well: 07-49-8A-Continued

	Thickness (feet)	Depth (feet)
Soft gray sandy clay and gray shale with fine streaks of gray sand, loose	20	480
Red and blue clay	5	485
Fine gray loose sand	10	495
Hard red and blue shale	5	500
Red and blue clay with sand streaks	20	520
Soft red and blue clay	8	528
Fine light brown sand with red and blue clay streaks	12	540
Red and blue clay with sand streaks	10	550
Fine to medium sand and small gravel with streaks of blue shale	10	560
Coarse sand and gravel with red and blue clay streaks	20	580
Red and blue clay with streaks of fine brown sand	20	600
Soft brown, red and blue clay, tight	20	620

Table 4. - Drillers' Logs of Wells in Deaf Smith County - Continued

	Thickness (feet)	Depth (feet)
Well: 07-49-9A		
Owner: Ira Scott		
Driller: Hubble Water Well Service		
Soil and caliche	11	11
Sand and caliche rock	4	15
Shale and clay	97	112
Well: 07-49-9B		
Owner: Ira Scott and Malcolm Moser		
Driller: B. A. Reddell		
Soil, clay, caliche	26	26
Rock	9	35
Caliche rock and clay	45	80
Rock	6	86
Red bed rock	464	550
Shale, blue	5	555
Red beds	150	705
Well: 07-50-702		
Owner: Donald Pinnell		
Driller: A & A Drilling Co.		
Surface	200	200
Red and white clay	20	220
Soft and hard red clay	20	240
Soft red clay	20	260
Dry red clay	40	300
Red and gray clay	20	320
Red and blue clay, little sand	20	340
Red and gray clay, little sand	20	360
Well: 07-50-702-Continued		
Red and blue clay, little sand	20	380
Blue clay, little sand	20	400
Red clay, little sand	20	420
Well: 07-51-501		
Owner: -- Snodgrass		
Driller: High Plains Irr. Service		
Surface	280	280
Fine brown sand, caliche and sandstone streaks	20	300
Fine, loose sand, some caliche	10	310
Red sand and shale	23	333
Red bed	7	340
Well: 07-52-4A		
Owner: A. G. Flippen		
Driller: Walco Drilling, Inc.		
Top soil	3	3
Clay, caliche	57	60
Caliche, rock	20	80
Clay, sand	40	120
Clay, sand, sandrock	20	140
Sand, sandrock	100	240
Sand, some clay	40	280
Sandy clay	10	290
Red clay, green and yellow shale	170	460

Table 4. - Drillers' Logs of Wells in Deaf Smith County - Continued

	Thickness (feet)	Depth (feet)
Well: 07-52-4A-Continued		
Red clay, sand	20	480
Red, yellow shale	60	540
Red shale and sand streaks	50	590
Red shale	10	600
Santa Rosa sand	20	620
Red shale	30	650
Santa Rosa sand	10	660
Red shale	4	664
Santa Rosa sand	42	706
Rock	4	710
Santa Rosa sand	25	735
Rock	5	740
Well: 07-52-4B		
Owner: A.G. Flippen		
Driller: Walco Drilling Inc.		
Top Soil	3	3
Clay	17	20
Caliche, clay	38	58
Rock, hard	4	62
Sand, clay	38	100
Sand, sandrock	60	160
Sand	60	220
Sand, some sandrock	20	240
Sand	40	280
Red and green shale	144	424
Red shale, sand	8	432
Red shale	28	460
Rock	2	462
Red shale	90	552
Santa Rosa sand	22	574
Red shale	16	590
Rock	10	600
Red shale	10	610
Rock	4	614
Santa Rosa sand	46	660
Red shale	30	690
Santa Rosa sand	32	722
Rock	2	724
Santa Rosa sand	28	752
Red shale	48	800
Well: 07-52-9A		
Owner: Jerry Montgomery		
Driller: High Plains Irrigation Service		
Surface	230	230
Brown sand and sandstone	50	280
Fine brown sand	32	312
Red and green clay	8	320
Red and blue clay	80	400
Brown and blue clay	20	420
Red, blue and brown clay	20	440
Red and blue clay	40	480
Red clay	20	500
Red and blue clay	30	530
Red, blue, and brown clay	30	560
Blue sandy clay and streaks of red	40	600
Fine, white sand with blue and red shale	40	640
Fine sand, lots of clay	20	660

Table 4. - Drillers' Logs of Wells in Deaf Smith County - Continued

	Thickness (feet)	Depth (feet)
Well: 07-52-9A-Continued		
Red and blue shale	40	700
Red and blue shale with streaks of sand	40	740
Red and blue shale with streaks of sand and gravel	20	760
Sand and gravel	50	810
Brown shale	10	820
Red and brown shale with a little gravel	40	860
Well: 07-52-9D		
Owner: Sam Lynch		
Driller: High Plains Irrigation Service		
Surface	200	200
Fine sand, clay streaks, caliche	60	260
Brown and blue shale and red bed	20	280
Red bed	280	560
Fine sand, red and blue clay	180	740
Fine sand, fine gravel, red and blue clay	60	800
Fine sand, red and blue clay	20	820
Red bed	20	840

	Thickness (feet)	Depth (feet)
Well: 07-52-902		
Owner: Richardson Seed Farms		
Driller: W.D. Jones Drilling Co.		
Surface	280	280
Fine sand with clay strips	40	320
Fine sand and sandy clay	20	340
Brown and blue clay with shale	14	354
Brown clay and shale	26	380
Red clay and shale	15	395
Brown and blue clay with shale strips	233	628
Blue clay and shale with hard sand and stone streaks	22	650
Red and blue shale, hard	10	660
Blue clay with hard, fine, gray sand	15	675
Brown clay	10	685

Table 4. - Drillers' Logs of Wells in Deaf Smith County - Continued

	Thickness (feet)	Depth (feet)
Well: 07-52-902-Continued		
Brown clay with blue clay strips and brown shale	32	717
Gray and blue clay with shale strips	35	752
Fine sand with blue clay	28	780
Medium sand with small gravel and clay-hard	20	800
Fine sand with clay and shale-hard	10	810
Medium sand with small gravel and clay-hard	46	856
Blue and red clay	10	866
Well: 07-52-903		
Owner: Bob Thruett		
Driller: Walco Drilling, Inc.		
Top soil	3	3
Caliche, clay	77	80
Clay, sand, sandrock	189	269
Red, blue, brown clay and shale	313	582
Sand, clay sandrock	42	624
Hard sandrock	16	640
Clay	15	655
Sand	5	660
Clay	2	662
Sand, sandrock, clay	79	741
Well: 07-52-903-Continued		
Rock	7	748
Sand, rock, gravel	31	779
Red bed	26	805
Well: 07-53-935		
Owner: Glen Wagner		
Driller: Water Industries, Inc.		
Topsoil	3	3
Caliche	57	60
Sand, clay, sandrock	30	90
Sand, sandrock, some clay	30	120
Sand and sand rock	90	210
Sand and some sandrock layers	90	300
Sand	20	320
Sand, sandrock clay layers	25	345
Red clay	15	360
Clay, shale, sand	82	442
Red bed	9	451
Well: 07-57-2A		
Owner: Mike Moser		
Driller: High Plains Irrigation Service		
Surface clay	50	50
Caliche and mineral rock	13	63

Table 4. - Drillers' Logs of Wells in Deaf Smith County - Continued

	Thickness (feet)	Depth (feet)
Well: 07-57-2A-Continued		
Owner: Mike Moser		
Driller: High Plains Irrigation Service		
Sand, sandy clay, sandstone	52	115
Red clay	5	120
Soft red clay	70	190
Red and blue clay	40	230
Purple and blue shale	5	235
Red and brown shale with red and blue clay streaks	105	340
Hard, red and brown shale	80	420
Soft red and blue clay	180	600
Red clay with hard red shale	100	700
Red clay with streaks of brown and blue shale	140	840
Well: 07-59-1A		
Owner: A.C. Brorman		
Driller: Walco Drilling, Inc.		
Topsoil	3	3
Caliche	37	40
Clay	40	80
Clay, sand	40	120
Sand, some sandrock	70	190
Rock	2	192
Sand, streaks of red clay	126	318
Rock	2	192
Sand, streaks of red clay	126	318
Red bed	112	430
Rock	2	432
Red bed	208	640
Sand	40	680
Sand with shale layers	60	740
Sand	20	760
Sand and shale layers	70	830
Red clay	90	920
Well: 07-59-7M		
Owner: Taft McGee		
Driller: Walco Drilling, Inc.		
Topsoil	3	3
Clay	33	36
Rock	10	46
Sand, clay, sandrock	74	120
Sand, sandrock, some clay	40	160
Sand, sandrock	20	180
Sand, sandrock, clay	20	200
Rock	3	203
Sand, sandrock, some clay	17	220
Sand, sandrock	10	230
Sand	40	270
Rock	2	272
Sand	70	342
Redshale, blue and red clay	28	370

Table 4. - Drillers' Logs of Wells in Deaf Smith County - Continued

	Thickness (feet)	Depth (feet)
Well: 07-59-7M-Continued		
Rock	2	372
Red shale, blue and red clay	28	400
Sand, red and blue shale	20	420
Red shale, blue and red clay	182	602
Sand, red and blue shale streaks	118	720
Santa Rosa sand	54	774
Red shale, blue and red clay, some sand streaks	36	810
Well: 07-60-3A		
Owner: Richardson Seed Farms		
Driller: High Plains Irrigation Service		
Surface clays	80	80
Sandy clay and sandstone	140	220
Sand with streaks of sandstone and sandy clay	50	270
Soft red and blue clay	30	300
Red, yellow, blue clay and shale	280	580
Red and blue shale and rock streaks with a little silty sand	76	656
Fine brown sand	4	660
Soft red and blue shale with streaks of fine silty sand	205	865
Well: 07-60-402		
Owner: Cate's Farm		
Driller: Big T Pump Co., Inc.		
Topsoil	5	5
Caliche	35	40
Sandy clay	30	70
Sand	80	150
Sand and sandstone	60	210
Sand	60	270
Sand, some hard sandstone	30	300
Sand	30	330
Sand, some clay	30	360
Red bed clay	5	365
Sand	13	378
Red bed	5	383

Table 4. - Drillers' Logs of Wells in Deaf Smith County - Continued

	Thickness (feet)	Depth (feet)
Well: 07-60-602		
Owner: T.E. Vestal		
Driller: Green Machinery Co., Inc.		
Top soil	4	4
Caliche	26	30
Sandy clay	60	90
Sand, sandrock	70	160
Fine sand, sandrock, clay layers	50	210
Sandy clay, fine sand	80	290
Coarse sand, gravel	25	315
Blue clay	5	320
Red clay	5	325
Clay	10	335
Sandy clay	55	390
Coarse sand	15	405
Red bed	7	412
Well: 07-60-603		
Owner: T.E. Vestal		
Driller: Green Machinery Co., Inc.		
Top soil	3	3
Caliche and clay	37	40
Hard sand rock	15	55
Clay, layers of sand rock	25	80
Sandy clay, strips of sand	35	115
Fine, loose sand	30	145
Broken sandrock and sand	55	200
Sandy clay	25	225
Medium coarse sand	120	345
Clay	10	355
Coarse gravel	10	365
Blue and red clay	10	375
Medium coarse sand and gravel	12	387
Red bed	8	395
Well: 07-62-2A		
Owner: Harry Friemel		
Driller: Walco Drilling, Inc.		
Topsoil	3	3
Clay, red	17	20
Clay, red and caliche	40	60
Sand, sandrock, clay	80	140
Sand	40	180
Sand, clay streaks, sandrock	70	250
Red bed, shale, yellow, green	50	300
Shale, hard red	240	540
Sand, shale, red	50	590
Santa Rosa sand	18	608
Shale, red	4	612
Santa Rosa sand	21	633
Rock, hard	2	635
Santa Rosa sand	21	656
Rock	2	658
Santa Rosa sand	9	667
Santa Rosa sand, streaks of blue clay	16	683
Rock	2	685
Santa Rosa sand	5	690
Shale, red, blue	190	880

Table 4. - Drillers' Logs of Wells in Deaf Smith County - Continued

	Thickness (feet)	Depth (feet)
Well: 07-62-4Z		
Owner: -- Detten		
Driller: Dept. of Energy		
Topsoil	68	68
Sand, fine to medium grained, clear, tan to orange limestone, white, yellow	82	150
No sample	20	170
Sand, tan to orange grading to silty sand or sandy siltstone	196	366
Siltstone, light gray to red	20	386
Sand, light gray to red	52	438
Shale, light gray, grading to shaley sand	18	456
Sand, light gray to orange	104	560
Shale, light gray	20	580
Shale, red	36	616
Sand, light gray to orange	30	646
Shale, red to brown	8	654
Limestone, brown to tan grading to silty sandstone or siltstone	22	676
Siltstone, light to medium gray	24	700
Limestone, brown to light gray, silty to sandy	20	720
Well: 07-62-4Z-Continued		
Sand, brown to gray	12	732
Shale, red to brown	34	766
Sand, light brown to brown	8	774
Chert, tan to cream, light to medium gray, associated with limestone, light to medium gray	146	920
Sand, tan, red, brown	72	992
Siltstone	18	1010
Sand, orange brown	30	1040
No log	82	1122
Well: 07-62-713		
Owner: Herb Brasher		
Driller: Big T Pump Co., Inc.		
Topsoil	3	3
Caliche and clay	77	80
Rock	5	85
Sand	15	100
Sand and sandstone	95	195
Sand	55	250
Sand and some rock	60	310
Sand, white	10	320
Clay, red	20	340
Shale, clay, sand	43	383
Red bed	4	387

Table 4. - Drillers' Logs of Wells in Deaf Smith County - Continued

	Thickness (feet)	Depth (feet)
Well: 08-64-301		
Owner: Rall's Ranch		
Driller: Hubble Water Well Service		
Soil and clay	20	20
Sand and gravel	6	26
Clay	34	60
Clay, sandy	8	68
Sandstone, sandy clay shale	7	75
Clay	5	80
Well: 08-64-601		
Owner: J.S. Bridwell		
Driller: Hubble Water Well Service		
Soil	5	5
Clay with gravel	3	8
Sand, medium, loose	14	22
Red bed	38	60
Shale, tight, with caliche rock	30	90
Shale, tight with clay	35	125
Well: 09-08-301		
Owner: J.S. Bridwell		
Driller: Tom E. Muncy		
Soil	3	3
Caliche	3	6
Clay, yellow	20	26
Sandy lime	4	30
Sandy clay, light	6	36
Sandy clay, red	6	42
Limerock	4	46
Well: 09-08-301-Continued		
Red beds, assorted red, blue, yellow	24	70
Red bed	32	102
Clay, yellow	5	107
Clay, soft, red, (water)	6	113
Red bed	12	125
Clay, yellow	7	132
Clay, red and blue	18	150
Red bed, hard	50	200
Well: 10-01-201		
Owner: Charlie Hale		
Driller: Hereford Irrigation and Well Service		
Topsoil	3	3
Caliche	8	11
Clay and shale	55	66
Clay and rock ledges	14	80
Sand and clay, brown	15	95
Sand, brown with clay ledges	50	145
Rock	5	150
Clay, red and white	15	165
Clay, red, with fine red sand	20	185
Sand, fine, with clay	15	200
Red bed	15	215

Table 4. - Drillers' Logs of Wells in Deaf Smith County - Continued

	Thickness (feet)	Depth (feet)
Well: 10-01-701		
Owner: Bobby Ridley		
Driller: W.T. Watson Drilling Co.		
Top soil	15	15
Caliche rock, gray	8	23
Sand, brown	22	45
Sand and rock stringers	47	92
Clay, red	8	100
Sand, red	12	112
Clay, yellow	7	119
Sand, yellow	11	130
Clay, blue	2	132
Sand, blue	18	150
Clay, red	5	155
Well: 10-02-6C		
Owner: Ewing Halsell		
Driller: B.A. Reddell		
Soil, clay, caliche	35	35
Caprock	30	65
Sand and clay	10	75
Sand, loose, dry	35	110
Sand, loose	140	250
Clay	10	260
Sand, loose	45	305
Clay, white	5	310
Sand, gray, tight	625	935
Red beds	20	955
Rock, hard	10	965
Shale, red, blue	10	975

	Thickness (feet)	Depth (feet)
Well: 10-03-4Z		
Owner: Ewing Halsell		
Driller: B.A. Reddell		
Soil and clay	56	56
Caprock	2	58
Clay and caliche	27	85
Sand, loose, dry	155	240
Sand, loose, loose	55	295
Clay and sand	20	315
Sand and coarse gravel	27	342
Red beds	288	630
Sand, coarse, blue gray	60	690
Clay, red	10	700
Sand, blue gray	5	705
Red beds	45	750
Sand, fine, blue gray	20	770
Clay, blue	5	775
Sand, white, coarse, some blue clay	15	790
Sand, white, coarse tight	70	860
Sand, blue gray, loose	10	870
Rock, hard	5	875
Sand, white, coarse	30	905
Sand, hard and rock	15	920
Shale, red and blue	10	930
Sand, blue gray, fine, rock, hard	30	960

Table 4. - Drillers' Logs of Wells in Deaf Smith County - Continued

	Thickness (feet)	Depth (feet)
Well: 10-03-402		
Owner: Homer Hill		
Driller: L.T. Davis Drilling Co.		
Topsoil	4	4
Caliche	61	65
Rock	3	68
Clay	17	85
Sand, coarse	85	170
Sand	35	205
Sand, hard shell	60	265
Sand	15	280
Sand, gravel, boulders	15	295
Clay, red	15	310
Sand, coarse and gravel	41	351
Red bed	2	353
Well: 10-03-403		
Owner: Homer Hill		
Driller: L.T. Davis Drilling Co.		
Top soil	4	4
Caliche	61	65
Caliche rock	2	67
Clay, shell	43	110
Sand, coarse	70	180
Sand, fine	25	205
Rock, white, hard	3	208
Sand, white, shell	57	265
Rock, hard	5	270
Sand	20	290
Rock, red	6	296
Sand, some gravel	14	310
Clay, red	8	318
Sand, coarse; gravel and boulders	34	352
Red bed	2	354
Well: 10-03-7Z		
Owner: Phillip Miller		
Driller: B.A. Reddell		
Soil	3	3
Clay	24	27
Caliche rock	7	34
Caliche	26	60
Sand, loose, dry	10	70
Clay	8	78
Clay, sandy	12	90
Sand, tight and clay	148	238
Sand, loose	18	256
Sand, loose and tight	42	298
Clay	7	305
Red beds	555	860
Sand, blue, gray	105	965
Rock, hard, blue gray sand	12	977
Sand, blue, gray, loose	88	1065
Red beds	12	1077
Well: 10-06-1Z		
Owner: John Gallagher		
Driller: John Gallagher		
Soil	8	8
Caliche	37	45
Sand	20	65
Shale	45	110
Sand	25	135
Rock	19	154
Sand	66	220
Clay, red	30	250

Table 4. - Drillers' Logs of Wells in Deaf Smith County - Continued

	Thickness (feet)	Depth (feet)
Well: 10-06-1Z-Continued		
Rock	5	255
Clay	50	305
Shale, blue	10	315
Clay, red	95	410
Shale	73	483
Rock	9	492
Shale and clay	97	589
Rock, white	7	596
Shale	134	730
Sand	10	740
Rock	5	745
Sand	20	765
Rock	7	772
Shale	13	785
Sand	35	820
Shale	10	830
Sand	35	865
Rock	2	867
Shale	8	875
Rock	27	902
Shale	73	975
Sand	45	1020
Shale	35	1055
Well: 10-06-431		
Owner: Taft McGee		
Driller: Walco Drilling, Inc.		
Topsoil	3	3
Caliche	67	70
Sand	80	150
Rock	1	151
Well: 10-06-431-Continued		
Sand	129	280
Sand and clay	80	360
Clay	25	385
Clay, red	165	550
Sand, clay, and shale	130	680
Clay	20	700
Sand, gravel, clay	110	810
Clay, red	21	831
Well: 10-06-432		
Owner: Stone and Webster Engineering Corp.		
Driller: Hi Plains Drilling, Inc.		
Soil	3	3
Clay and caliche	51	54
Sand, fine and sandstone	110	164
Sandstone and fine sand	84	248
Sandstone	6	254
Sandstone, sandy clay and sand	116	370
Clay, brown	5	375
Clay, green and red	7	382
Sandstone, green	1	383
Sandstone, red	12	395
Sandstone, blue	153	548
Clay, blue and white rock	167	715

Table 4. - Drillers' Logs of Wells in Deaf Smith County - Continued

	Thickness (feet)	Depth (feet)
Well: 10-06-432-Continued		
Clay, blue and red anhydrite	403	1118
Anhydrite, hard	49	1167
Shale, red and anhydrite	138	1305
Shale, red and siltstone	20	1325
Well: 10-06-802		
Owner: V.J. Owens		
Driller: Howard Fish		
Top soil	4	4
Caliche and caliche rock	166	170
Sand	45	215
Red bed shale, blue shale, blue clay	305	520
Rock	17	537
Rock layers, red and blue shale	78	615
Rock	6	621
Rock layers, blue shale, red shale	59	680
Gravel and rocks	41	721
Multicolored gravel and red bed	46	767
Well: 10-06-804		
Owner: V.J. Owens		
Driller: Big T Pump Co., Inc.		
Topsoil	4	4
Caliche	56	60
Well: 10-06-804-Continued		
Sand and caliche	65	125
Sand and some clay	35	160
Sand and some stone	40	200
Sand	60	260
Red bed	360	620
Brown clay and some sand	5	625
White sand, some clay	30	655
Red bed	35	690
Coarse sand and gravel	10	700
Rock	1	701
Coarse sand and gravel	59	760
Blue clay	8	768
Gravel	27	795
Red bed	12	807
Well: 10-06-828		
Owner: E.C. Reinauer		
Driller: Walco Drilling, Inc.		
Topsoil	2	2
Clay	18	20
Caliche	35	55
Sand and sandrock	60	115
Sand, clay, sandrock	15	130
Sand, little sandrock	25	155
Rock, hard	1	156
Sandy clay and little sand	24	180

Table 4. - Drillers' Logs of Wells in Deaf Smith County - Continued

	Thickness (feet)	Depth (feet)
Well: 10-06-828-Continued		
Sand	80	260
Sand, sandy clay, sandrock	10	270
Clay, sandy	30	300
Clay, red; shale, blue	30	330
Clay, red	80	410
Clay, red; shale, blue	10	420
Clay, red	60	480
Clay, brown	50	530
Sand, clay layers	38	568
Rock	2	570
Clay, red	15	585
Sand, sandy clay	50	635
Shale, blue	10	645
Sand, gray; clay layers	45	690
Sand, coarse; gravel and clay layers	32	722
Clay, red	2	724
Sand, coarse and gravel	11	735
Clay, blue	2	737
Sand, coarse; gravel	13	750
Sand, tight; clay	23	773
Rock	1	774
Sand, coarse		
Sand, tight; clay	20	800
Red bed	6	806

	Thickness (feet)	Depth (feet)
Well: 10-06-832		
Owner: F.W. and W.W. Hill		
Driller: Big T Pump Co., Inc.		
Topsoil	4	4
Caliche	16	20
Rock	5	25
Sand and clay, some stone	115	140
Sand and sandstone	20	160
Sand and clay	45	205
Sand	25	230
Sandy clay	20	250
Red bed (first)	350	600
Blue shale, fine gray sand	40	640
Blue shale, medium coarse gray sand	31	671
Santa Rosa sand	30	701
Santa Rosa sand and gravel	60	761
Some clay; gray sand	14	775
Red bed (second)	5	780
Well: 10-06-837		
Owner: F.W. and W.W. Hill		
Driller: Big T Pump Co., Inc.		
Topsoil	4	4
Caliche	56	60
Sand and clay	65	125
Sand and some clay	35	160
Sand and some stone	40	200

Table 4. - Drillers' Logs of Wells in Deaf Smith County - Continued

	Thickness (feet)	Depth (feet)
Well: 10-06-837-Continued		
Sand	60	260
Red bed	360	620
Brown clay and some sand	5	625
White sand, some clay	30	655
Red bed	35	690
Coarse sand and gravel	10	700
Rock	1	701
Coarse sand and gravel	59	760
Blue clay	8	768
Gravel	27	795
Red bed	12	807
Well: 10-06-839		
Owner: Edgar Telchick		
Driller: Walco Drilling, Inc.		
Topsoil	4	4
Caliche and rock	56	60
Fine sand	30	90
Sandy clay and clay	130	220
Coarse sand	60	280
Red, blue, green shale, red clay	300	580
Brown sand and clay	44	624
Sand, clay layers	85	709
Coarse sand and gravel	53	762
Clay, red	3	765
Gravel	11	776
Clay, red	4	780
Gravel	15	795
Red bed	8	803
Well: 10-06-853		
Owner: E.C. Reinauer		
Driller: Big T Pump Co., Inc.		
Topsoil	5	5
Caliche	43	48
Sand, fine and clay	72	120
Sand, fine and clay, white	70	190
Clay, sandy	60	250
Sand and sandstone	35	285
Red bed	285	570
Shale, blue	65	635
Rock	50	685
Santa Rosa sand	50	735
Gravel, heavy	39	774
Rock, cemented gravel	33	807
Red bed		807
Well: 10-06-854		
Owner: Glen Hamilton		
Driller: Walco Drilling, Inc.		
Topsoil	2	2
Caliche; limestone	53	55
Sand, sandrock, sandy clay	250	305
Clay, red; shale	60	365
Sand, clay, sandy clay	10	375
Clay, red; shale, sandy clay	135	510
Sandrock, fine sand, sandy clay rock	185	695
Rock	2	697
Sand, sandy clay	28	725

Table 4. - Drillers' Logs of Wells in Deaf Smith County - Continued

	Thickness (feet)	Depth (feet)
Well: 10-06-854-Continued		
Gravel	10	735
Sand, gravel	15	750
Shale	25	775
Gravel	25	800
Rock, hard	3	803
Red bed	5	808
Well: 10-06-9J		
Owner: C.P. Norton		
Driller: Kenny Gearne Machine Works		
Surface	4	4
Caliche	16	20
Sand and sandrock	130	150
Red clay	70	220
Blue sand and clay	20	240
Blue clay	10	250
Red bed	4	254
Well: 10-07-704		
Owner: Stewart Bros.		
Driller: West Texas Drilling, Inc.		
Topsoil	4	4
Caliche and rock	36	40
Sand and stone	105	145
Red bed and blue clay	73	218
Hard shale	7	225
Red and blue clay	356	581
Rock	4	585
Red and brown clay	55	640
Well: 10-07-704-Continued		
Fine white sand	100	740
Clay	5	745
Rock	2	747
Well: 10-07-803		
Owner: Transwestern Pipeline Co.		
Driller: Wall and Son's Drilling, Inc.		
Topsoil	1	1
Caliche	14	15
Caliche, caliche rock, sand	15	30
Sand, some sand rock	15	45
Sand, some clay layers	15	60
Sand, clay	15	75
Sand, sandrock, clay	15	90
Sand, sandrock layers	15	105
Sand, some clay layers	15	120
Red clay	15	135
Red and green clay	15	150
Red clay	10	160
Sand, sandrock streaks	30	190
Rock	5	195
Sand	25	220
Rock	2	222

Table 4. - Drillers' Logs of Wells in Deaf Smith County - Continued

	Thickness (feet)	Depth (feet)
Well: 10-07-803-Continued		
Blue clay, rock streaks	18	240
Blue clay	60	300
Red clay, shell	150	450
Red clay, some blue clay, shell	30	480
Red clay, brown shell	15	495
Brown shell, white clay	15	510
Brown and blue shell	15	525
Brown shell, sandrock layers	15	540
Brown clay, sandy clay	15	555
Sandy clay, brown clay	15	570
Blue clay	75	645
Clay, some sandy clay	15	660
Sand, sandy clay	15	675
Sand, gravel layers	50	725
Clay, some shell layers	8	733
Rock, shell	4	737
Well: 10-07-804		
Owner: Lois Miller		
Driller: West Texas Drilling Co., Inc.		
Topsoil	4	4
Caliche	26	30
Rocky sand and stone	55	85
Sand and stone	35	120
Red and blue clay	100	220
Hard shale	1	221
Red bed	29	250
Hard blue shale	15	265
Red bed	230	495
Some gravel, shale, very little sand	25	520
Red clay	20	540
Sandy clay	25	565
Red and blue clay, shale	20	585
Red bed	70	655
Medium coarse white sand	30	685
Sand and shale	10	695
Medium to coarse sand and gravel	40	735
Shale and gravel	20	755
Red bed	5	760
Well: 10-12-2X		
Owner: N.O. Bartlett		
Driller: J.T. Reed		
Surface	3	3
Caliche	35	38
Dry sand	49	87
Sandstone	6	93
Sand	7	100
Red bed	220	320
Blue clay	15	335
Red bed	350	685

Table 4. - Drillers' Logs of Wells in Deaf Smith County - Continued

	Thickness (feet)	Depth (feet)
Well: 10-12-2X-Continued		
Blue shale	45	730
Red shale	40	770
Sand	3	773
Red shale	17	790
Blue shale	30	820
Red shale	270	1090
Red bed and shale	160	1250
Well: 10-13-2E		
Owner: John D. Pitman		
Driller: Kenny Gearn Machine Works		
Surface	4	4
Clay	8	12
Rock and shell	48	60
Sand, rock and shell	43	103
Medium sand and shell	122	225
Medium sand	87	312
Fine sand	110	422
Clay and rock	6	428
Red bed	7	435
Sand and clay	25	460
Well: 10-13-229		
Owner: Griffin and Brand		
Driller: Big T Pump Co., Inc.		
Topsoil	4	4
Caliche	16	20
Sandy clay and caliche	70	90
Sand and stone	150	240
Rock	1	241
Sand and sandstone, some clay	176	417
Rock	2	419
Green sand and shale, some rock stringers	67	486
Red bed	4	490
Well: 10-13-230		
Owner: Edwin Axe		
Driller: Kenny Gearn Machine Works		
Surface	4	4
Sandrock	36	40
Sand and sandrock	160	200
Fine sand and sand rock	100	300
Sand and sandy clay	100	400
Sand and clay	100	500
Clay	12	512
Well: 10-13-231		
Owner: Walterscheid Bros.		
Driller: West Texas Drilling Co., Inc.		
Topsoil	4	4
Caliche	123	127
Fine sand, sandy clay thin sandstone streaks	31	158
Fine sand, sand-stone	19	177
Fine, loose sand	11	188
Fine, muddy sand, sandstone streaks	20	208
Hard sandstone	3	211
Fine sand, sand-stone streaks	8	219

Table 4. - Drillers' Logs of Wells in Deaf Smith County - Continued

	Thickness (feet)	Depth (feet)
Well: 10-13-231-Continued		
Fine sand, muddy	16	235
Sandstone	3	238
Fine, loose sand	12	250
Fine, loose sand, clean, thin sandstone streaks	22	272
Sandstone, fine sand, white clay streaks	9	281
Fine, loose sand, clean, thin, sandstone streaks	31	312
Fine, muddy sand, thin sandstone streaks	31	343
Fine sand, cleaner sandstone streaks	31	374
Fine red sand	16	390
Fine, green sand sandy clay, blue and red clay	15	405
Green sandy clay, loose sand streaks	26	431
Red clay	4	435
Red clay, green sandy clay, loose streaks	31	466
Well: 10-13-4X Owner: Griffin and Brand Driller: B.A. Reddell		
Soil, clay, caliche rock	78	78
Sand and rock ledge	12	90
Sand, medium loose	10	100
Sand, loose	45	145
Sand with some clay	25	170
Sand, tight and clay	45	215
Red beds	245	460
Sand rock, soft	15	475
Red beds	235	710
Sand, bluish gray	15	725
Rock, hard	10	735
Sand, coarse, hard	25	760
Clay	10	770
Sand, gray, coarse	60	830
Clay, brown	10	840
Rock, hard	4	844
Sand, greenish, loose	16	860
Clay, brown, hard and shale	40	900
Well: 10-13-5X Owner: Holly Sugar Co. Driller: B.A. Reddell		
Soil, caliche, clay, limerock	30	30
Sand, tight and sandrock	28	58
Sand, medium-coarse, loose	24	82

Table 4. - Drillers' Logs of Wells in Deaf Smith County - Continued

	Thickness (feet)	Depth (feet)
Well: 10-13-5X-Continued		
Sandrock	7	89
Sand, medium-coarse, loose with some sand rock	79	168
Sand, tight with soft sand rock	7	175
Sand, coarse, med. loose	35	210
Sand, tight w/loose streaks	25	235
Sand, fine, loose, w/clay streaks	65	300
Clay, sandy	30	330
Sand rock, soft	10	340
Clay, brown, sandy w/short sand streaks	65	405
Clay, red and blue	35	440
Sandrock	5	445
Clay, brown and red	25	470
Clay, green, soft w/sandrock streaks	34	504
Rock	2	506
Clay, red and blue	14	520
Rock	3	523
Clay, red w/lime shell streaks	221	744
Lime, rock, hard	3	747
Clay and shale, blue, red, hard	14	761
Sand, blue, gray, coarse, loose	39	800
Shale, brown w/fine sand streaks	15	815
Rock	2	817
Clay, red	18	835
Sand, gray, fine	20	855
Sand rock, gray, hard w/streaks of shale	13	868
Clay	7	875
Rock, very hard	5	880
Clay	5	885
Sand, gray, medium fine, medium hard	53	938
Clay, solid	12	950
Well: 10-13-503		
Owner: City of Hereford		
Driller: McDonald Drilling Co.		
Topsoil	4	4
Clay	16	20
Sand and sandrock	20	40
Caliche and sand	24	64
Sand and sand rock stringers	36	100
Sand, sandrock, some clay	50	150
Sand, sandrock stringers	90	240
Sand, sandrock, clay stringers	20	260

Table 4. - Drillers' Logs of Wells in Deaf Smith County - Continued

	Thickness (feet)	Depth (feet)
Well: 10-13-503-Continued		
Sand, sandrock stringers	25	285
Sand, some clay	24	309
Sand, a little red clay	16	325
Red clay	90	415
Sand, sandrock, clay streaks	41	456
Red clay	29	485
Hard streak	2	487
Red shale, blue shale streaks	146	633
Red and blue shale, sand stringers	10	643
Red and blue shale	19	662
Blue shale, sandstone stringers	31	693
Blue and red shale, blue and red sandy clay	40	733
Shale, sandrock, red and blue clay, fine gray sand	10	743
Fine gray sand, red and blue clay	35	778
Soft red and blue clay, a little sand	5	783
Soft sand, sandstone stringers	25	808
Hard sand, fine to coarse softer sand, hard streaks	22	830
Hard fine sand	4	834
Soft sand, hard streaks, a little red clay	44	878
Blue and red clay with sand stringers	27	905
Sand, hard streaks, some red and blue clay	18	923
Red and blue shale, a few sand stringers	32	955
Well: 10-13-6E Owner: City of Hereford Driller: B.A. Reddell		
Caliche and clay	40	40
Sand, fine, loose	40	80
Sand, tight	20	100
Clay, white, tight sand	10	110
Sand, medium loose, fine	15	125
Sand, tight and shell	15	140
Clay, sandy, very little sand	40	180
Sand, clean, white, medium fine	20	200
Sand, medium-coarse, loose, clean	105	305
Clay, red and blue	95	400

Table 4. - Drillers' Logs of Wells in Deaf Smith County - Continued

	Thickness (feet)	Depth (feet)
Well: 10-13-6E-Continued		
Sandrock, tan, soft, fine	15	415
Sandrock, hard	29	444
Clay, red	26	470
Clay, w/streaks of tight coarse sand	30	500
Clay, red and blue	144	644
Rock, hard	3	647
Clay and sand rock	33	680
Sandstone, tan, soft, medium coarse	18	698
Rock, hard	2	700
Sand, tan, gray, medium and coarse, hard streaks	80	780
Sand, gray, coarse and very coarse	20	800
Sand, tan, coarse and clay	10	810
Sand, tan, medium w/some clay	15	825
Rock and clay	35	860
Rock, hard, loose streaks	12	872
Clay, red and blue, some shale	118	990
Well: 10-13-6X Owner: City of Herford Driller: B.A. Reddell		
Soil, caliche and clay	65	65
Clay	25	90
Sand, medium loose and shell	35	125
Sandrock, soft, honey comb	15	140
Sand, medium loose, coarse, rock streaks	40	180
Clay, sandy, soft	95	275
Sand, red, coarse, clean, some clay	50	325
Sand, fine much clay	15	340
Clay, red, soft, very little sand	15	355
Red beds	70	425
Sand, coarse	20	445
Clay, red and blue	153	598
Red beds	74	672
Rock, hard	4	676
Sand, gray, tight	9	685
Clay, blue	36	721
Rock, hard	3	724
Clay, red and shale	71	795
Sand rock, hard	45	840

Table 4. - Drillers' Logs of Wells in Deaf Smith County - Continued

	Thickness (feet)	Depth (feet)
Well: 10-13-908		
Owner: Robert D. Wagner		
Driller: Wolfe Drilling Co.		
Caliche and clay	36	36
Red sand with shells	164	200
Red sand and clay streaks	36	236
White sand and shells	64	300
Coarse sand	50	350
Red shale	7	357
Sand and gravel	5	362
Red bed	3	365
Well: 10-14-107		
Owner: Henry Brorman		
Driller: Walco Drilling, Inc.		
Topsoil	4	4
Caliche	26	30
Clay and caliche	170	200
White sand and gravel	60	260
Coarse sand	40	300
Rock	90	390
Red and blue clay	8	398
Rock	2	400
Red bed	120	520
Red and blue clay	47	567
Sand, some blue clay	16	583
Sand and clay streaks	105	688
Sand	40	728
Clay, some sand	6	734
Sand, gravel; clay at 816'	91	825

	Thickness (feet)	Depth (feet)
Well: 10-14-154		
Owner: Southwest Feedyards		
Driller: Walco Drilling Inc.		
Topsoil	3	3
Caliche	57	60
Sand, sandrock, clay	60	120
Sand and clay	30	150
Sand, sandrock, clay	60	210
Rock	2	212
Sand and clay layers	73	285
Redbed	115	400
Rock	2	402
Red bed	168	570
Gray clay and sand	140	710
Sand, gravel and clay layers	45	755
Rock	2	757
Sand and gravel	58	815
Red bed	8	823
Well: 10-14-155		
Owner: H.V. Crawford		
Driller: West Texas Drilling, Inc.		
Topsoil	4	4
Caliche	16	20
Rock	1	21
Sand and stone	64	85
Sandy clay	120	205

Table 4. - Drillers' Logs of Wells in Deaf Smith County - Continued

	Thickness (feet)	Depth (feet)
Well: 10-14-155-Continued		
Sand, stone, clay mixed	60	265
Red bed	135	400
Sand and clay	8	408
Shale, sand and stone	12	420
Red bed	180	600
Rock, shale and some sand	35	635
Shale and some sand	30	665
Red clay	20	685
Sand and some clay	78	763
Hard rock	5	768
Sand, some gravel rock	76	844
Well: 10-14-2V		
Owner: W.G. Russell		
Driller: J.J. Merrifield		
Ogallala	170	170
Triassic shale	495	665
Triassic sand	105	770
Well: 10-14-2X		
Owner: H.G. Beauchamp		
Driller: B.A. Reddell		
Soil	3	3
Caliche	32	35
Caliche and sand	17	52
Sand, red and soft	8	60
Clay, soft, sandy	70	130
Sand, loose	90	220
Red beds	340	560
Rock	10	570
Red beds	60	630
Sand, hard and rock	15	645
Red beds	30	675
Sand, gray and loose, gravel	60	735
Sand and some clay	45	780
Gravel, tight gray sand	30	810
Shale, hard, clay, some rock	45	855
Well: 10-14-2Y		
Owner: J.H. Fish		
Driller: J.H. Fish		
Surface	5	5
Caliche	25	30
Clay	30	60
Caliche, sandy	35	95
Clay, sandy	70	165
Red bed	505	670
Red bed rocks	100	770
Red bed	90	860

Table 4. - Drillers' Logs of Wells in Deaf Smith County - Continued

	Thickness (feet)	Depth (feet)
Well: 10-14-202		
Owner: V.J. Owens		
Driller: Walco Drilling Inc.		
Clay, chocolate	4	654
Sand and gravel	6	660
Gravel	5	665
Clay and sand	5	670
Clay, gravel	14	684
Gravel and sand	6	690
Gravel	5	695
Gravel and sand	8	703
Sand and gravel	5	708
Gravel, coarse sand	7	715
Gravel, small rock	6	721
Gravel, coarse sand	10	731
Clay, gravel	5	736
Gravel	15	751
Sand, coarse, gravel	5	756
Gravel, sand	5	761
Rock, hard, solid	6	767
Gravel, clay mixed	8	775
Bottom of hole	4	779
Well: 10-14-237		
Owner: W.G. Russell		
Driller: West Texas Drilling Co., Inc.		
Topsoil	4	4
Caliche	105	109
Sand, shale, rock	31	140
Shale and clay	30	170
Shale and red bed	12	182
Red bed	48	230
Well: 10-14-237-Continued		
Clay, shale, blue, red	361	591
Clay, sandy, shale	79	670
Rock, hard	3	673
Clay and hard rock	22	695
Shale and gravel strips	15	710
Shale, red, blue	10	720
Sand and gravel	26	746
Rock, hard	2	748
Gravel and some clay	52	800
Red bed	3	803
Well: 10-14-308		
Owner: Ernest Sluder		
Driller: Walco Drilling, Inc.		
Topsoil	3	3
Caliche, clay	127	130
Clay, sand	10	140
Red clay	30	170
Red bed	290	460
Red bed, blue clay	20	480
Red and blue clay	140	620
Tight, fine sand layers	40	660
Tight sand, coarse	30	690
Sand, tight with gravel	10	700

Table 4. - Drillers' Logs of Wells in Deaf Smith County - Continued

	Thickness (feet)	Depth (feet)
Well: 10-14-308-Continued		
Red, white, blue, clay	18	718
Coarse sand, gravel, clay layers	22	740
Hard rock, clay layers	4	744
Well: 10-14-442		
Owner: Champion Feeders, Inc.		
Driller: Water Industries, Inc.		
Topsoil	3	3
Caliche rock and caliche	27	30
Sand, sand rock, clay	60	90
Sand, sandrock	60	150
Sand, sandrock, clay	20	170
Red bed	400	570
Sand and clay	30	600
Red clay and sand	67	667
Sand, hard	42	709
Sand	29	738
Coarse sand	31	769
Coarse sand and clay	49	818
Clay and red bed	9	827
Well: 10-14-5X		
Owner: Hereford Salt, Inc.		
Driller: Astro Drilling Co., Inc.		
Caliche	40	40
Red bed	185	225
Flint rock	25	250
Red bed	350	600
Hard rock	335	935
Santa Rosa	35	970
Red clay and anhydrite	460	1430
Salt and anhydrite	522	1952
Well: 10-14-511		
Owner: Denzil Pulliam		
Driller: Walco Drilling, Inc.		
Topsoil	5	5
Caliche	25	30
Sandrock	90	120
Sandy clay sand	19	139
Clay, sandrock	25	164
Red bed, sandrock	131	295
Red, blue clay with sandrock shale streaks	417	712
Light sand, shale	28	740
Sand with hard streaks	100	840
Gravel	15	855
Sand, gravel, shale mixed with hard streaks	65	920
Rock	16	936
Clay	4	940

Table 4. - Drillers' Logs of Wells in Deaf Smith County - Continued

	Thickness (feet)	Depth (feet)
Well: 10-14-512		
Owner: Charlie Packard		
Driller: Wolf Drilling		
Surface and clay	50	50
Sandrock and caliche	25	75
Sand shells	55	130
Hard sand shells w/clay	15	145
Clay	7	152
Red bed	48	200
Shale and clay	20	220
Red bed shale and clay	70	290
Sandy shale and clay	40	330
Shale	275	605
Clay	27	632
Hard sand	188	820
Shale	30	850
Sand	32	882
Shale and sand	18	900
Lime shell	10	910
Well: 10-14-8Z		
Owner: Wilber Axe		
Driller: B.A. Reddell		
Soil, clay and caliche	85	85
Tight sand, some soft rock	25	110
Sand, medium loose	15	125
Sand, tight	10	135
Sand, loose	15	150
Sand, tight and sandy clay	25	175
Rock, trace of gravel	3	178
Red beds	2	180
Red beds, all colors, rock	530	710
Rock, solid, hard	2	712
Clay and shell	35	747
Rock, hard	3	750
Hard shale, clay, rock streaks	60	810
Well: 10-14-802		
Owner: G.W. Newson Estate		
Driller: Water Industries, Inc.		
Topsoil	3	3
Caliche	77	80
Sand, rock and clay	30	110
Sand, sandrock	30	140
Sand, sandrock and clay	86	226
Red bed	474	700
Green, red clay, some gravel	20	720
Clay and some sand	20	740
Clay	20	760
Sand and clay	20	780
Sand, gravel, clay	20	800
Clay, some sand	20	820

Table 4. - Drillers' Logs of Wells of Deaf Smith County - Continued

	Thickness (feet)	Depth (feet)
Well: 10-14-802-Continued		
Clay sand	40	860
Clay, gravel, sand	40	900
Sand and clay	40	940
Red bed	5	945
Well: 10-14-803		
Owner: Wilber Axe		
Driller: West Texas Drilling Co., Inc.		
Top soil	4	4
Sandy clay, sandrock	104	108
Sand	62	170
Tight sand, sandrock	54	224
Red, blue clay	186	410
Hard clay, shale, rock	190	600
Shale streak, red clay	114	714
Rock	2	716
Sandy clay, tight sand	69	785
Clay	25	810
Sand shale, rock streaks	30	840
Clay	14	854
Sand, sandrock, gravel	52	906
Shale, clay	4	910
Well: 10-14-804		
Owner: Wilber Axe		
Driller: West Texas Drilling Co., Inc.		
Topsoil	4	4
Caliche	31	35
Sandy clay	45	80
Sand and stone	30	110
Medium coarse and stone	70	180
Coarse sand and gravel	18	198
Hard red bed	52	250
Soft red bed	30	280
Blue shale	13	293
Red bed	67	360
Blue shale and red bed mixed	40	400
Red bed	25	425
Blue shale and red bed mixed	25	450
Red bed	50	500
Blue and red bed and blue clay	247	747
Hard shale	29	776
Red and blue clay, hard shale	30	806
Rock	30	836
Red bed, blue clay	14	850
Rock	5	855
Sand, stone, shale mixed	30	885
Rock	2	887
Sand, gravel, clay, shale mixed	23	910
Hard blue shale, red bed mixed	15	925
Blue clay, red bed	98	1023

Table 4. - Drillers' Logs of Wells in Deaf Smith County - Continued

	Thickness (feet)	Depth (feet)
Well: 10-15-201		
Owner: John Stribling		
Driller: Wall and Son's Drilling, Inc.		
Topsoil	3	3
Caliche	17	20
Sand	25	45
Red clay	35	80
Sand, clay layers	50	130
Rock	3	133
Sand	12	145
Red bed	9	154
Well: 10-15-202		
Owner: John Stribling		
Driller: Wall and Son's Drilling, Inc.		
Topsoil	3	3
Caliche	17	20
Sand	25	45
Red clay	35	80
Sand, sandrock	45	125
White sand	1	126
Sand, sandrock	14	140
Red bed	10	150
Well: 10-15-4A		
Owner: R. Cocanougher		
Driller: Hubble Drilling Co.		
Soil	2	2
Caliche and caliche rock	10	12
Sandy clay with sandrock streaks	58	70
Well: 10-15-4A-Continued		
Tight sand with sandrock streaks	35	105
Limestone	7	112
Red beds	148	260
Tight sand	32	292
Well: 10-15-803		
Owner: Kent Cabel		
Driller: Les Taylor Drilling Co.		
Surface caliche clay and sand	100	100
Sandy clay	40	140
Red clay	200	340
Red clay and sandstone	40	380
Red clay	40	420

Table 4. - Drillers' Logs of Wells in Randall County

	Thickness (feet)	Depth (feet)
Well: 11-10-736		
Owner: City of Happy		
Driller: Billy Wall		
Topsoil	2	2
Caliche	18	20
Caliche, some streaks of clay	20	40
Caliche and caliche-rock, hard	8	48
Rock, very hard	5	53
Caliche, with layer of hard rock	7	60
Caliche	20	80
Caliche, sandrock, with some sand	60	140
Sandrock, clay with some sand	40	180
Sandrock, clay, sand	20	200
Red bed	255	455
Sand with layer of sandrock, red clay	25	480
Red bed with layer of sand and sandrock	26	506
Rock	2	508
Red bed with layer of sand and sandrock	52	560
Red bed, some streaks of fine sand	88	648
Rock	2	650
Red bed with layer of fine sand	20	670
Red clay	20	690
Santa Rosa sand	48	738
Santa Rosa sand with clay layer	12	750
Santa Rosa sand with rock layer	42	792
Clay, some streaks of sand with shale	128	920

Table 4. - Drillers' Logs of Wells in Swisher County

	Thickness (feet)	Depth (feet)
Well: 11-18-102		
Owner: City of Happy		
Driller: Walco Drilling, Inc.		
Topsoil	3	3
Clay, caliche	52	55
Sand	5	60
Sand, sandrock	27	87
Rock, very hard	2	89
Sand, sandrock, clay	96	185
Rock	2	187
Sand, clean	5	192
Sand, white clay	3	195
Red bed, black shale, some layer of rock	245	440
Sand, blue red shale	66	506
Rock	2	508
Red bed, blue and red shale	112	620
Sand, red shale in streaks	20	640
Rock	5	645
Shale, some sand	37	682
Sand, red shale streaks	68	750
Santa Rosa sand, some small streaks of red shale	63	813
Rock, very hard	4	817
Sticky clay	23	840

	Thickness (feet)	Depth (feet)
Well: 11-18-103		
Owner: Bogart and Goode		
Driller: Green Machinery Co., Inc.		
Topsoil	3	3
Caliche	15	18
Clay	14	32
Rock	9	41
Sandy clay	26	67
Sand	7	74
Clay, layers of sandrock	29	103
Clay	25	128
Finesand, clay strips	9	137
Clay, layers of sandrock	26	163
Medium coarse sand	8	171
Clay, sandstrips, small gravel	25	196
Red bed, blue clay	90	286
Rock	7	293
Red bed, layers of rock	164	457
Blue clay, layers rock	62	519
Red bed, blue clay, layers of sand	46	565

Table 4. - Drillers' Logs of Wells in Swisher County - Continued

	Thickness (feet)	Depth (feet)
Well: 11-18-103-Continued		
Blue clay, layers of sandrock	100	665
Sand, small gravel	95	760
Rock, layers of sand	67	827
Clay, layers of sand	15	842
Coarse sand	7	849
Clay, layers of sand	51	900
Blue, red clay, sand strips	16	916
Red bed	10	926
Well: 11-18-104		
Owner: City of Happy		
Driller: W. D. Jones Drilling Co.		
Surface	560	560
Brown clay and shale	58	618
Blue clay w/fine sand streaks	31	649
Brown and gray clay and shale	41	690
Clay and shale w/fine sand streaks	50	740
Medium sand w/clay and shale streaks	66	806
Rock	2	808
Clay	22	830
Well: 11-18-105		
Owner: City of Happy		
Driller: Green Machinery Co., Inc.		
Topsoil	3	3
Caliche	57	60
Caprock	10	70
Clay - rock ledges	25	95
Fine sand, layers of clay	28	123
Sand rock	10	133
clay, sandrock and layers of clay	64	197
Medium coarse sand and gravel	18	215
Cemented gravel	5	220
Blue clay, red bed	105	325
Red bed, shale	10	335
Blue clay, red bed shale	65	400
Blue clay	17	417
Red clay, shale	38	455
Red shale, strips of fine sand	25	480
Fine, tight sand	10	490
Red shale, strips of tight sand	80	570
Medium gray tight sand	20	590
Red and blue clay	12	602
Rock	2	604
Red and blue clay rock ledges	16	620
Shale, layers of sandrock	67	687
Rock, hard	7	694

Table 4. - Drillers' Logs of Wells in Swisher County - Continued

	Thickness (feet)	Depth (feet)
Well: 11-18-105-Continued		
Shale, sand layers	34	728
Coarse sand and gravel	12	740
Cemented gravel	10	750
Coarse sand and gravel	25	775
Rock, hard	35	810
Coarse sand	10	820
Red and blue clay	50	870
Coarse sand	5	875
Rock, hard	2	877
Well: 11-18-605		
Owner: Henry Hinton		
Driller: Green Machinery Co., Inc.		
Topsoil	5	5
Caliche, clay	23	28
Rock and clay	27	55
Sandrock, layers of sandy clay	80	135
Red and blue clay	10	145
Green clay	54	199
Hard, porous rock and layers of green clay	19	218
Blue clay and red bed	6	224
Well: 11-19-540		
Owner: H. B. Pyeatt		
Driller: Frank Hunt		
Topsoil	5	5
Caliche	15	20
Sand clay	30	50
White sand and clay	40	90
Rock	10	100
Water and sand	10	110
Red shale	70	180
Water and sand	10	190
Red and blue shale	45	235
Well: 11-25-502		
Owner: O.V. Morris		
Driller: Black and Jenson Drilling Co.		
Caliche	100	100
Sand and gravel	85	185
Sand rock	10	195
Red shale	325	520
Fine white sand	60	580
Red shale	120	700
White sand, sandrock	50	750
Red sand, shale streaks	120	870
Gravel, coarse sand	50	920
Red shale	20	940
Coarse gray sand	60	1000
Red shale	2	1002
Well: 11-26-611		
Owner: City of Tulia		
Driller: Hi Plains Drilling Co.		
Topsoil	2	2

Table 4. - Drillers' Logs of Wells in Swisher County - Continued

	Thickness (feet)	Depth (feet)
Well: 11-26-611-Continued		
Caliche	15	17
Caliche, with a little sand	73	90
Sand, with a little caliche	30	120
Sandrock, sand streaks, hard clay streaks	10	130
Sand, sandrock, brown clay	20	150
Sand, sandrock, a little red clay	15	165
Red sandy clay	5	170
Gray clay	5	175
Red and brown clay	25	200
Gray clay	10	210
Red and gray clay	10	220
Hard gray clay, gray sandstone	25	245
Brown clay and shale	15	260
Red and brown clay, blue shale	75	335
Hard rock	2	337
Red and blue shale	8	345
Red and blue shale, brown clay	154	499
Red and blue shale, gray sandrock	18	517
Blue and gray clay	29	546
Hard gray sandstone	4	550
Gray sandstone, blue and gray clay	20	570
Gray shale, brown clay	31	601
Gray sandstone, brown shale	2	603
Gray sand, sandstone, clay	34	637
Sand, sandstone, clay	23	660
Hard gray sandstone	91	751
Sandstone	3	754
Sand and sandstone	37	791
Hard sand, clay	22	813
Clay, sand, sandstone	15	828
Well: 11-26-612		
Owner: City of Tulia		
Driller: Hi Plains Drilling Inc.		
Surface	20	20
Clay and caliche	31	51
Sandstone	29	80
Sandy clay, fine sand	46	126
Clay and sandstone	23	149
Gravel, yellow clay, sand	6	155
Red and blue clay	64	219

Table 4. - Drillers' Logs of Wells in Swisher County - Continued

	Thickness (feet)	Depth (feet)
Well: 11-26-612-Continued		
Sandrock	1	220
Blue clay and sandrock	18	238
Red bed	264	502
Blue clay, strips of sandrock	52	554
Sandrock, hard shale, a little tight sand	9	563
Red and blue shale	39	602
Sand and a little shale	38	640
Fine sand	26	666
Coarse sand, hard shale, small gravel	14	680
Sand, layers of red and blue shale	20	700
Sand, small gravel and sandrock	21	721
Conglomerate, with loose breaks	5	726
Tight sand, gravel and shale	5	731
Gravel, sand, rock and some shale	46	777
Hard shale, tight sand and sandstone	9	786
Tight sand, shale, gravel	12	798
Hard shale	3	801

	Thickness (feet)	Depth (feet)
Well: 11-26-916		
Owner: City of Tulia		
Driller: Water Industries Inc.		
Topsoil	3	3
Caliche	107	110
Sand and sandrock	10	120
Rock	1	121
Sand and sandrock	49	170
Sand and gravel	5	175
Red bed	445	620
Sand and clay	30	650
Sand, clay, hard sandrock	120	770
Sand, gravel, clay	30	800
Sand, gravel, shale	30	830
Clay and shale	30	860
Well: 11-27-607		
Owner: O.B. Barnes		
Driller: Hi Plains Drilling Inc.		
Soil, sand, sandstone	153	153
Blue and red clay	367	520
Sandstone	80	600
Clay and sandstone	40	640
Well: 11-27-710		
Owner: Wylie Byrd		
Driller: Hi Plains Drilling, Inc.		
Soil, caliche, caprock	60	60

Table 4. - Drillers' Logs of Wells in Swisher County - Continued

	Thickness (feet)	Depth (feet)
Well: 11-27-710-Continued		
Sand and sandy clay	120	180
Clay and red shale	410	590
Sand and gravel	140	730
Clay and sandy clay	20	750
Well: 11-28-409		
Owner: Roy Blankenship		
Driller: Langston Drilling Co.		
Topsoil	3	3
Caliche and rock	37	40
Sandstone	30	70
Red sand	20	90
Sandstone	15	105
Sand, sandstone	55	160
Sandstone	20	180
Gravel	5	185
Red bed	205	390
Blue sandstone, hard	15	405
Brown clay	10	415
Sandstone, hard	10	425
Shale, red and blue	35	460
Sandstone	130	590
White sandstone	40	630
Sandstone	10	640
Red bed	10	650
Well: 11-28-410		
Owner: Paul Irlbeck		
Driller: Langston Drilling Co.		
Topsoil	3	3
Caliche	67	70
Well: 11-28-410-Continued		
Sandstone	15	85
Sand	10	95
Sandstone	106	201
Red bed	54	255
Blue sandstone and clay	35	290
Red clay	40	330
Sandstone	5	335
Sandstone and clay	70	405
Rock	4	409
Blue hard shale	41	450
Blue sandstone with clay streaks	5	455
Blue sandstone	17	472
Sandstone	28	500
Gray clay	4	504
Shale, sandy	21	525
Sandstone	35	560
Sand	10	570
Sand, blue clay	30	600
Red shale	15	615
Red sandstone	20	635
Red clay	23	658
Well: 11-28-4N		
Owner: Roy Blankenship		
Driller: Langston Drilling Co.		
Topsoil	3	3
Caliche and rock	37	40
Sandstone	30	70
Red sand	20	90
Sandstone	15	105

Table 4. - Drillers' Logs of Wells in Swisher County - Continued

	Thickness (feet)	Depth (feet)
Well: 11-28-4N-Continued		
Sandstone streaks	55	160
Sandstone	20	180
Gravel	5	185
Red bed	205	390
Blue sandstone, hard	15	405
Brown clay	10	415
Sandstone, hard	10	425
Shale, red and blue	35	460
Sandstone, sand streaks	130	590
White sand	40	630
Sandstone	10	640
Red sand	10	650
Well: 11-28-508		
Owner: Lawrence Ludeman		
Driller: Langston Drilling Co.		
Topsoil	5	5
Caliche and rock	35	40
Caliche	10	50
Sandstone and rock	70	120
Sand	5	125
Brown sand	35	160
Sand clay	20	180
Gravel	2	182
Red bed and clay	218	400
Blue sand	20	420
Rock	10	430
Brown clay	46	476
Sandstone and sand streaks	129	605
Sandstone and small gravel	38	643
Well: 11-33-610		
Owner: Bob Gaylor		
Driller: J.B. Thrush Drilling Co.		
Clean out	410	410
Sandy shale	90	500
Shale and red bed	100	600
Well: 11-34-607		
Owner: Larry Nelson		
Driller: Hale Center Drilling		
Topsoil	8	8
Caliche	7	15
Caliche and sandstone	10	25
Sandstone and white sand	10	35
Red and white sand	10	45
White water sand	20	65
White sand and red sandy clay	15	80
White water sand	40	120
Sand and red sandy clay	30	150
White water sand	30	180
White sand and sandstone	15	195
Green clay and red bed	10	205
Red sand	35	240
Red sand and sandy clay	30	270
Green clay	5	275
Red bed	6	281

Table 4. - Drillers' Logs of Wells in Swisher County - Continued

	Thickness (feet)	Depth (feet)
Well: 11-34-909		
Owner: James Vineyard		
Driller: Green Machinery Co., Inc.		
Topsoil	4	4
Caliche	26	30
Hard caliche	15	45
Sandy clay, thin strips of fine sand	15	60
Fine, loose sand	10	70
Hard sandstone	4	74
Tight sand	21	95
Clay, sandrock ledges	13	108
Hard rock	7	115
Fine, loose sand	25	140
Clay	29	169
Hard rock	5	174
Tight sand, gravel	16	190
Clay, shale	85	275
Broken sandrock, strips of fine sand	30	305
Hard rock	5	310
Red bed, blue clay	12	322
Well: 11-36-109		
Owner: Johnny Miller		
Driller: Green Machinery Co., Inc.		
Top soil	3	3
Caliche	37	40
Rock	15	55
Sandstone	15	70
Well: 11-36-109-Continued		
Sand	5	75
Sandstone	60	135
Sand	5	140
Clay	20	160
Red and blue clay	80	240
Brown clay	20	260
Red blue clay	128	388
Sandstone	37	425
Clay	5	430
Shale	20	450
Rock	11	461
Brown clay	59	520
Santa Rosa Sand	111	631
Well: 11-42-308		
Owner: Claude Harris		
Driller: Green Machinery Co., Inc.		
Top soil	6	6
Caliche and sandy clay	22	28
Sandy clay, rock, clay streaks	70	98
Hard rock	5	103
Sandy clay, sand streaks	29	132
Sand	21	153
Sandrock, sand streaks	19	172
Sand, coarse	23	195
Sand and gravel, clay streaks	17	212

Table 4. - Drillers' Logs of Wells in Swisher County - Continued

	Thickness (feet)	Depth (feet)
Well: 11-42-308-Continued		
Sand, gravel, blue clay	36	248
Blue clay	22	270
Red clay	20	290
Sand and sandrock	60	350
Sandrock and sandy clay	10	360
Red and blue clay	4	364
Red bed	4	368
Well: 11-42-312		
Owner: A.G. Bontke		
Driller: J.B. Thrush Drilling Co.		
Clean out	10	210
Sandy clay	20	230
Sand	15	245
Red clay	5	250
Sand and gravel	20	270
Red and green shale	15	285
Fine sand	65	350
Fine sand and some gravel	30	380
Blue and dark red shale	5	385
Well: 11-42-313		
Owner: City of Kress		
Driller: Green Machinery Co., Inc.		
Top soil	7	7
Caliche	23	30
Caprock	12	42
Clay	18	60
Hard rock	3	63
Sand	10	73
Hard rock	4	77
Sand, fine, broken sandstone	18	95
Clay	20	115
Sand, coarse	10	125
Clay	20	145
Sandstone, broken	28	173
Sand, coarse, strips of cemented sand	19	192
Blue clay, strips of red clay	88	280
Sand, fine with strips of sandstone	15	295
Sand, coarse, small loose gravel	35	330
Sandstone, broken, thin strips of blue clay	10	340
Blue clay	5	345
Red bed	5	350
Well: 11-43-104		
Owner: H.W. Axtell		
Driller: -- Fox		
No drillers' log	0	45
Sand, dry	29	74
Flint rock	5	79
Caliche	61	140
Sand, water	3	143
Caliche	13	156
Sand, water	234	390
Red bed	10	400

Table 4. - Drillers' Logs of Wells in Swisher County - Continued

	Thickness (feet)	Depth (feet)
Well: 11-43-110		
Owner: Bobby Sizemore		
Driller: Galyen Drilling Co.		
Lake bed	14	14
Blue clay	14	28
Caliche	47	75
Sandy rock	25	100
Sandstone	77	177
Red and blue clay	93	270
Sand, fine and bits of red clay	30	300
Sand, fine blue	17	317
Well: 11-43-111		
Owner: City of Kress		
Driller: Green Machinery Co., Inc.		
Top soil	3	3
Caliche	13	16
Rock	4	20
Clay and rock	38	58
Rock	12	70
Sandrock thin strips of fine sand	45	115
Sandy clay and sandrock	65	180
Sand, layers of sandrock	25	205
Red and blue clay	65	270
Black shale, traces of sand	6	276
Black and blue shale	24	300
Sandrock, porous, strips of sand	35	335
Rock and red bed	10	345

Table 5.--Chemical Analyses of Water From Selected Wells and Test Holes in Deaf Smith, Randall, and Swisher Counties

Water-bearing units: TRD, Dockum Group Undifferentiated; TRDC, Chinle Formation; TRDSR, Santa Rosa Sandstone; TO-TRD, Ogallala Formation-Dockum Group Undifferentiated.

Dissolved Solids: The bicarbonate "reported" is converted by computation (multiplying by 0.4917) to an equivalent amount of carbonate, and the carbonate figure is used in the computation of this sum.

Analyses by Texas Department of Health unless indicated by footnote.

Deaf Smith County

WELL	07-50-702	07-50-702	07-52-902	07-52-902
DATE OF COLLECTION	7/20/83	4/25/84	7/19/83	4/26/84
AQUIFER CODE	TRDC	TRDC	TRDSR	TRDSR
WELL DEPTH (feet)	420	420	872	872
TEMPERATURE (^{o}F)	63	--	--	--
TEMPERATURE (^{o}C)	17	20	22	20
SILICA (MG/L)	12.0	12.0	11.0	11.0
CALCIUM (MG/L)	15.0	14.0	9.0	12.0
MAGNESIUM (MG/L)	9.0	8.0	5.0	3.0
SODIUM (MG/L)	345.0	342.0	236.0	243.0
POTASSIUM (MG/L)	3.0	2.0	3.0	2.0
MANGANESE (MG/L)	--	--	--	--
BORON (MG/L)	--	--	--	--
BICARBONATE (MG/L)	206.0	205.0	401.0	423.0
SULFATE (MG/L)	460.0	427.0	110.0	117.0
CHLORIDE (MG/L)	133.0	119.0	62.0	62.0
FLUORIDE (MG/L)	1.1	1.2	3.4	3.4
NITRATE (MG/L)	7.5	8.6	0.0	0.1
IRON (MG/L)	--	--	--	--
pH	8.4	8.6	8.4	8.3
DISSOLVED SOLIDS (MG/L)	1,099.9	1,042.0	644.6	413.4
PHENOL. ALK. CACO3	4.0	6.0	7.0	0.0
TOTAL ALK. CACO3	177.0	180.0	343.0	347.0
TOTAL HARD. CACO3	75.0	68.0	44.0	44.0
% SODIUM	90.8	91.0	91.6	91.5
SAR	17.8	18.0	15.6	15.9
RSC	2.0	2.2	5.9	6.1
SPECIFIC CONDUCTANCE (micromhos at 25^{o}C)	2,016.0	1,890.0	1,168.0	1,176.0

Table 5.--Chemical Analyses of Water From Selected Wells and Test Holes in Deaf Smith, Randall, and Swisher Counties--Continued

Deaf Smith County

WELL	07-52-903[1/]	07-53-935	07-58-602	07-60-602
DATE OF COLLECTION	1/9/84	4/26/84	8/9/68	7/19/83
AQUIFER CODE	TRD	TO-TRD	TRD	TO-TRD
WELL DEPTH (feet)	805	451	800	412
TEMPERATURE (^{o}F)	--	64	--	--
TEMPERATURE (^{o}C)	--	--	--	18
SILICA (MG/L)	--	25.0	9.0	28.0
CALCIUM (MG/L)	5.0	33.0	13.0	37.0
MAGNESIUM (MG/L)	5.0	15.0	8.0	27.0
SODIUM (MG/L)	202.0	87.0	279.0	50.0
POTASSIUM (MG/L)	--	4.0	--	5.0
MANGANESE (MG/L)	0.0	--	--	--
BORON (MG/L)	--	--	--	--
BICARBONATE (MG/L)	444.0	309.0	493.0	270.0
SULFATE (MG/L)	58.0	52.0	191.0	41.0
CHLORIDE (MG/L)	33.0	12.0	55.0	33.0
FLUORIDE (MG/L)	1.5	1.8	0.7	2.3
NITRATE (MG/L)	0.0	9.3	0.0	13.9
IRON (MG/L)	0.01	--	--	--
pH	8.2	8.3	8.0	8.2
DISSOLVED SOLIDS (MG/L)	523.0	391.0	798.1	370.0
PHENOL. ALK. CACO3	0.0	0.0	0.0	0.0
TOTAL ALK. CACO3	364.0	253.0	402.0	221.0
TOTAL HARD. CACO3	32.0	145.0	65.0	207.0
% SODIUM	--	54.9	--	34.2
SAR	--	3.1	--	1.5
RSC	--	2.2	--	0.3
SPECIFIC CONDUCTANCE (micromhoms at 25^{o}C)	980.0	685.0	1,250.0	670.0

See footnotes at end of table.

Table 5.--Chemical Analyses of Water From Selected Wells and Test Holes in Deaf Smith, Randall, and Swisher Counties--Continued

Deaf Smith County

WELL	07-60-603	07-62-713	08-64-301	08-64-601
DATE OF COLLECTION	4/26/84	4/25/84	4/25/84	7/20/83
AQUIFER CODE	TO-TRD	TO-TRD	TRD	TRD
WELL DEPTH (feet)	395	387	80	125
TEMPERATURE (^{o}F)	66	--	--	--
TEMPERATURE (^{o}C)	--	18	20	--
SILICA (MG/L)	28.0	27.0	10.0	28.0
CALCIUM (MG/L)	30.0	38.0	2.0	35.0
MAGNESIUM (MG/L)	23.3	25.0	1.0	20.0
SODIUM (MG/L)	63.0	29.0	636.0	54.0
POTASSIUM (MG/L)	6.0	5.0	2.0	5.0
MANGANESE (MG/L)	--	--	--	--
BORON (MG/L)	--	--	--	--
BICARBONATE (MG/L)	275.0	276.0	730.0	222.0
SULFATE (MG/L)	45.0	19.0	389.0	51.0
CHLORIDE (MG/L)	14.0	10.0	200.0	38.0
FLUORIDE (MG/L)	2.4	2.1	5.0	0.9
NITRATE (MG/L)	13.4	8.8	0.4	6.0
IRON (MG/L)	--	--	--	--
pH	8.2	8.0	8.8	8.1
DISSOLVED SOLIDS (MG/L)	360.0	299.6	1,640.4	347.1
PHENOL. ALK. CACO3	0.0	0.0	30.0	0.0
TOTAL ALK. CACO3	225.0	226.0	658.0	182.0
TOTAL HARD. CACO3	169.0	200.0	10.0	172.0
% SODIUM	42.6	22.8	98.9	40.0
SAR	2.1	0.6	87.4	1.8
RSC	1.1	0.5	12.9	0.2
SPECIFIC CONDUCTANCE (micromhos at 25^{o}C)	630.0	544.0	3,024.0	620.0

Table 5.--Chemical Analyses of Water From Selected Wells and Test Holes in Deaf Smith, Randall, and Swisher Counties--Continued

Deaf Smith County

WELL	10-01-701	10-06-802[2/]	10-06-804	10-06-804
DATE OF COLLECTION	4/25/84	10/5/56	7/16/75	4/27/84
AQUIFER CODE	TO-TRD	TRD	TRD	TRD
WELL DEPTH (feet)	155	767	807	807
TEMPERATURE (^{o}F)	--	--	--	68
TEMPERATURE (^{o}C)	18	--	--	--
SILICA (MG/L)	27.0	12.0	9.0	10.0
CALCIUM (MG/L)	45.0	4.4	5.0	5.0
MAGNESIUM (MG/L)	21.0	2.2	2.0	2.0
SODIUM (MG/L)	28.0	275.0	276.0	289.0
POTASSIUM (MG/L)	5.0	4.2	3.0	2.0
MANGANESE (MG/L)	--	--	--	--
BORON (MG/L)	--	0.4	--	--
BICARBONATE (MG/L)	253.0	440.0	458.0	454.0
SULFATE (MG/L)	26.0	177.0	185.0	187.0
CHLORIDE (MG/L)	12.0	37.0	40.0	38.0
FLUORIDE (MG/L)	1.0	1.4	1.5	1.1
NITRATE (MG/L)	21.4	0.4	<0.4	0.04
IRON (MG/L)	--	<0.4	--	--
pH	8.1	8.6	8.4	8.6
DISSOLVED SOLIDS (MG/L)	310.8	746.0	752.0	764.4
PHENOL. ALK. CACO3	0.0	--	4.0	6.0
TOTAL ALK. CACO3	207.0	--	383.0	384.0
TOTAL HARD. CACO3	200.0	20.0	21.0	20.0
% SODIUM	22.2	96.0	96.1	96.1
SAR	0.9	27.0	26.3	28.1
RSC	0.1		7.2	7.28
SPECIFIC CONDUCTANCE (micromhos at 25^{o}C)	544.0	1,190.0	1,350.0	1,320.0

See foot notes at end of table.

Table 5.--Chemical Analyses of Water From Selected Wells and Test Holes in Deaf Smith, Randall, and Swisher Counties--Continued

Deaf Smith County

WELL	10-06-828	10-06-832	10-07-704	10-07-803
DATE OF COLLECTION	4/27/84	4/23/70	8/6/68	4/27/84
AQUIFER CODE	TRD	TRD	TRD	TRDSR
WELL DEPTH (feet)	806	780	747	737
TEMPERATURE (^{o}F)	71	--	--	--
TEMPERATURE (^{o}C)	--	--	--	15
SILICA (MG/L)	11.0	12.0	10.0	6.0
CALCIUM (MG/L)	7.0	6.0	5.0	3.0
MAGNESIUM (MG/L)	4.0	3.0	3.0	1.0
SODIUM (MG/L)	226.0	243.0	231.0	238.0
POTASSIUM (MG/L)	3.0	--	--	3.0
MANGANESE (MG/L)	--	--	--	--
BORON (MG/L)	--	--	--	--
BICARBONATE (MG/L)	448.0	442.0	479.0	386.0
SULFATE (MG/L)	96.0	146.0	90.0	87.0
CHLORIDE (MG/L)	27.0	32.0	30.0	30.0
FLUORIDE (MG/L)	1.1	1.4	1.1	1.3
NITRATE (MG/L)	<0.1	<0.4	<0.4	<0.1
IRON (MG/L)	--	--	--	--
pH	8.4	8.2	8.2	9.2
DISSOLVED SOLIDS (MG/L)	597.4	661.0	605.6	601.1
PHENOL. ALK. CACO3	2.0	0.0	0.0	35.0
TOTAL ALK. CACO3	371.0	362.0	393.0	386.0
TOTAL HARD. CACO3	32.0	27.0	25.0	14.0
% SODIUM	92.5	95.1	--	96.0
SAR	17.4	20.2	--	27.7
RSC	6.8	6.6	--	7.4
SPECIFIC CONDUCTANCE (micromhos at 25^{o}C)	1,040.0	1,144.0	1,078.0	1,080.0

Table 5.--Chemical Analyses of Water From Selected Wells and Test Holes in Deaf Smith, Randall, and Swisher Counties--Continued

Deaf Smith County

WELL	10-07-804	10-13-229	10-13-230	10-13-231
DATE OF COLLECTION	8/6/68	7/19/83	4/30/84	4/30/84
AQUIFER CODE	TRDSR	TO-TRD	TO-TRD	TO-TRD
WELL DEPTH (feet)	760	490	512	466
TEMPERATURE (^{o}F)	--	--	--	62
TEMPERATURE (^{o}C)	--	19.0	--	--
SILICA (MG/L)	10.0	29.0	48.0	27.0
CALCIUM (MG/L)	5.0	37.0	60.0	52.0
MAGNESIUM (MG/L)	3.0	24.0	53.0	27.0
SODIUM (MG/L)	224.0	82.0	49.0	43.0
POTASSIUM (MG/L)	--	6.0	7.0	5.0
MANGANESE (MG/L)	--	--	--	--
BORON (MG/L)	--	--	--	--
BICARBONATE (MG/L)	453.0	329.0	323.0	311.0
SULFATE (MG/L)	93.0	68.0	148.0	53.0
CHLORIDE (MG/L)	31.0	23.0	32.0	18.0
FLUORIDE (MG/L)	1.3	1.3	2.5	1.6
NITRATE (MG/L)	<0.4	3.0	6.7	5.9
IRON (MG/L)	--	--	--	--
pH	8.2	8.2	8.1	8.2
DISSOLVED SOLIDS (MG/L)	590.0	435.0	565.0	385.4
PHENOL. ALK. CACO3	0.0	0.0	0.0	0.0
TOTAL ALK. CACO3	371.1	270.0	265.0	255.0
TOTAL HARD CACO3	26.0	192.0	368.0	244.0
% SODIUM	--	47.3	21.6	26.6
SAR	--	2.5	1.1	1.2
RSC	--	1.5	0.0	0.2
SPECIFIC CONDUCTANCE (micromhos at 25^{o}C)	1,050.0	780.0	1,008.0	700.0

Table 5.--Chemical Analyses of Water From Selected Wells and Test Holes in Deaf Smith, Randall, and Swisher Counties--Continued

Deaf Smith County

WELL	10-13-503	10-13-503	10-13-503	10-14-107
DATE OF COLLECTION	7/15/75	7/13/80	4/30/84	7/18/83
AQUIFER CODE	TRD	TRD	TRD	TRDSR
WELL DEPTH (feet)	955	955	955	825
TEMPERATURE (^{o}F)	--	--	68	--
TEMPERATURE (^{o}C)	--	--	--	24
SILICA (MG/L)	11.0	10.0	10.0	11.0
CALCIUM (MG/L)	6.0	6.0	6.0	4.0
MAGNESIUM (MG/L)	3.0	2.0	1.0	1.0
SODIUM (MG/L)	870.0	869.0	909.0	313.0
POTASSIUM (MG/L)	3.0	--	3.0	2.0
MANGANESE (MG/L)	--	--	--	--
BORON (MG/L)	--	--	--	0.7
BICARBONATE (MG/L)	1,000.0	997.0	999.0	449.0
SULFATE (MG/L)	346.0	354.0	356.0	240.0
CHLORIDE (MG/L)	510.0	491.0	508.0	56.0
FLUORIDE (MG/L)	7.2	6.5	6.4	1.2
NITRATE (MG/L)	<0.4	<0.1	<0.1	0.04
IRON (MG/L)	--	--	--	--
pH	8.5	8.4	8.4	8.5
DISSOLVED SOLIDS (MG/L)	2,260.3	2,236.8	2,306.6	857.7
PHENOL. ALK. CACO3	8.0	7.0	14.0	7.0
TOTAL ALK. CACO3	840.0	831.0	847.0	382.0
TOTAL HARD. CACO3	26.0	23.0	21.0	857.7
% SODIUM	98.4	98.8	98.5	97.6
SAR	72.4	78.4	86.2	36.7
RSC	16.2	16.1	16.8	7.3
SPECIFIC CONDUCTANCE (micromhos at 25^{o}C)	4,340.0	4,185.0	4,340.0	1,568.0

Table 5.--Chemical Analyses of Water From Selected Wells and Test Holes in Deaf Smith, Randall, and Swisher Counties--Continued

Deaf Smith County

WELL	10-14-237[5/]	10-14-442	10-14-511	10-14-802
DATE OF COLLECTION	10/11/62	4/30/84	4/27/84	7/21/83
AQUIFER CODE	TRD	TRD	TRD	TRD
WELL DEPTH (feet)	803	827	940	945
TEMPERATURE (^{o}F)	--	67	70	--
TEMPERATURE (^{o}C)	--	--	--	--
SILICA (MG/L)	--	10.0	10.0	10.0
CALCIUM (MG/L)	8.0	3.0	3.0	4.0
MAGNESIUM (MG/L)	2.0	<1.0	<1.0	<1.0
SODIUM (MG/L)	120.0	382.0	457.0	560.0
POTASSIUM (MG/L)	--	2.0	2.0	3.0
MANGANESE (MG/L)	--	--	--	--
BORON (MG/L)	--	--	--	--
BICARBONATE (MG/L)	--	597.0	700.0	777.0
SULFATE (MG/L)	150.0	201.0	221.0	269.0
CHLORIDE (MG/L)	89.0	70.0	108.0	208.0
FLUORIDE (MG/L)	1.3	2.6	3.4	3.9
NITRATE (MG/L)	--	<0.1	<0.1	<0.1
IRON (MG/L)	.04	--	--	--
pH	8.2	8.7	8.5	8.5
DISSOLVED SOLIDS (MG/L)	--	980.1	1,161.6	1,467.0
PHENOL. ALK. CACO3	--	14.0	11.0	22.0
TOTAL ALK. CACO3	--	517.0	596.0	681.0
TOTAL HARD. CACO3	--	12.0	11.0	15.0
% SODIUM	93.0	97.9	98.4	98.6
SAR	--	47.9	59.9	64.8
RSC	--	10.1	11.7	13.2
SPECIFIC CONDUCTANCE (micromohos at 25^{o}C)	--	1,760.0	2,080.0	2,730.0

See footnoes at end of table.

Table 5.--Chemical Analyses of Water From Selected Wells and Test Holes in Deaf Smith, Randall, and Swisher Counties--Continued

Deaf Smith County

WELL	10-14-803	10-14-804[2/]	10-15-201	10-15-803
DATE OF COLLECTION	8/2/68	8/2/68	7/21/83	4/30/84
AQUIFER CODE	TRD	TRD	TO-TRD	TO-TRD
WELL DEPTH (feet)	910	1,023	154	420
TEMPERATURE (^{o}F)	--	--	--	66
TEMPERATURE (^{o}C)	--	--	18	--
SILICA (MG/L)	10.0	10.0	54.0	10.0
CALCIUM (MG/L)	3.0	3.0	41.0	9.0
MAGNESIUM (MG/L)	6.0	2.0	39.0	4.0
SODIUM (MG/L)	570.0	540.0	81.0	306.0
POTASSIUM (MG/L)	--	--	8.0	2.0
MANGANESE (MG/L)	--	--	--	--
BORON (MG/L)	--	--	--	--
BICARBONATE (MG/L)	840.0	820.0	278.0	392.0
SULFATE (MG/L)	280.0	252.0	101.0	190.0
CHLORIDE (MG/L)	213.0	174.0	79.0	100.0
FLUORIDE (MG/L)	4.0	3.8	3.4	2.6
NITRATE (MG/L)	<0.4	<0.4	4.6	2.8
IRON (MG/L)	--	--	--	--
pH	8.3	8.3	8.1	8.8
DISSOLVED SOLIDS (MG/L)	1,500.0	1,390.0	547.7	835.1
PHENOL. ALK. CACO3	0.0	0.0	0.0	14.0
TOTAL ALK. CACO3	690.0	670.0	228.0	349.0
TOTAL HARD. CACO3	34.0	18.0	263.0	42.0
% SODIUM	--	--	39.2	93.3
SAR	--	--	2.1	20.5
RSC	--	--	0.0	6.1
SPECIFIC CONDUCTANCE (micromhos at 25^{o}C)	2,720.0	2,624.0	976.0	1,518.0

See footnotes at end of table.

Table 5.-Chemical Analyses of Water From Selected Wells and Test Holes in Deaf Smith, Randall, and Swisher Counties-Continued

Deaf Smith County

WELL	10-15-804	10-15-804
DATE OF COLLECTION	3/10/58	4/30/84
AQUIFER CODE	TO-TRD	TO-TRD
WELL DEPTH (feet)	396	396
TEMPERATURE (^{O}F)	62	--
TEMPERATURE (^{O}C)	--	17
SILICA (MG/L)	9.6	10.0
CALCIUM (MG/L)	12.0	12.0
MAGNESIUM (MG/L)	4.7	5.0
SODIUM (MG/L)	441.0	464.0
POTASSIUM (MG/L)	--	2.0
MANGANESE (MG/L)	--	--
BORON (MG/L)	--	--
BICARBONATE (MG/L)	453.0	440.0
SULFATE (MG/L)	302.0	311.0
CHLORIDE (MG/L)	222.0	237.0
FLUORIDE (MG/L)	3.2	3.1
NITRATE (MG/L)	0.0	0.04
IRON (MG/L)	--	--
pH	8.4	8.4
DISSOLVED SOLIDS (MG/L)	1,220.0	1,263.5
PHENOL. ALK. CACO3	--	3.0
TOTAL ALK. CACO3	--	367.0
TOTAL HARD. CACO3	50.0	50.0
% SODIUM	95.0	94.7
SAR	27.0	28.5
RSC	--	6.3
SPECIFIC CONDUCTANCE (micromhos at 25^{O}C)	1,980.0	2,352.0

Table 5.--Chemical Analyses of Water From Selected Wells and Test Holes in Deaf Smith, Randall, and Swisher Counties--Continued

Randall County

WELL	11-10-736
DATE OF COLLECTION	4/24/84
AQUIFER CODE	TRDSR
WELL DEPTH (feet)	920
TEMPERATURE (^{o}F)	60
TEMPERATURE (^{o}C)	--
SILICA (MG/L)	27.0
CALCIUM (MG/L)	31.0
MAGNESIUM (MG/L)	13.0
SODIUM (MG/L)	166.0
POTASSIUM (MG/L)	4.0
MANGANESE (MG/L)	--
BORON (MG/L)	--
BICARBONATE (MG/L)	376.0
SULFATE (MG/L)	95.0
CHLORIDE (MG/L)	49.0
FLUORIDE (MG/L)	2.0
NITRATE (MG/L)	9.7
IRON (MG/L)	--
pH	8.3
DISSOLVED SOLIDS (MG/L)	581.5
PHENOL. ALK. CACO3	0.0
TOTAL ALK. CACO3	308.0
TOTAL HARD. CACO3	130.0
% SODIUM	72.0
SAR	6.3
RSC	3.6
SPECIFIC CONDUCTANCE (micromhos at 25^{o}C)	1,016.0

Table 5.--Chemical Analyses of Water From Selected Wells and Test Holes in Deaf Smith, Randall, and Swisher Counties-Continued

Swisher County

WELL	11-18-103[3/]	11-18-103[3/]	11-18-103[3/]	11-18-104
DATE OF COLLECTION	4/7/69	2/17/70	2/17/70	4/24/84
AQUIFER CODE	TRDSR	TRDSR	TRDSR	TRDSR
WELL DEPTH (feet)	926	926	926	830
TEMPERATURE (^{o}F)	--	--	--	70
TEMPERATURE (^{o}C)	--	--	--	--
SILICA (MG/L)	--	--	--	10.0
CALCIUM (MG/L)	14.0	128.0	2.0	5.0
MAGNESIUM (MG/L)	1.0	94.0	6.0	2.0
SODIUM (MG/L)	288.0	1,557.0	337.0	329.0
POTASSIUM (MG/L)	3.0	16.0	3.0	2.0
MANGANESE (MG/L)	--	--	--	--
BORON (MG/L)	--	--	--	--
BICARBONATE (MG/L)	317.0	244.0		490.0
SULFATE (MG/L)	240.0	1,600.0	415.0	192.0
CHLORIDE (MG/L)	135.0	2,305.0	240.0	70.0
FLUORIDE (MG/L)	--	--	129.0	3.1
NITRATE (MG/L)	--	--	--	0.04
IRON (MG/L)	--	--	--	--
pH	8.6	6.9	--	8.6
DISSOLVED SOLIDS (MG/L)	837.0	5,820.0	7.3	864.1
PHENOL. ALK. CACO3	--	--	921.0	9.0
TOTAL ALK. CACO3	--	--	--	420.0
TOTAL HARD. CACO3	--	--	--	20.0
% SODIUM	--	--	--	96.5
SAR	--	--	--	32.0
RSC	--	--	--	8.0
SPECIFIC CONDUCTANCE (micromhos at 25^{o}C)	--	--	--	1,573.0

See footnotes at end of table.

Table 5.--Chemical Analyses of Water From Selected Wells and Test Holes in Deaf Smith, Randall, and Swisher Counties--Continued

Swisher County

WELL	11-25-502	11-25-502	11-25-502	11-25-502
DATE OF COLLECTION	7/24/68	7/9/70	4/7/78	3/20/81
AQUIFER CODE	TRD	TRD	TRD	TRD
WELL DEPTH (feet)	1,002	1,002	1,002	1,002
TEMPERATURE (^{o}F)	--	--	86	64
TEMPERATURE (^{o}C)	--	--	--	--
SILICA (MG/L)	9.0	10.0	9.0	62.0
CALCIUM (MG/L)	5.0	40.0	370.0	46.0
MAGNESIUM (MG/L)	5.0	29.0	174.0	28.0
SODIUM (MG/L)	1,020.0	1,060.0	4,234.0	40.0
POTASSIUM (MG/L)	--	--	--	--
MANGANESE (MG/L)	--	--	--	--
BORON (MG/L)	--	--	--	--
BICARBONATE (MG/L)	990.0	830.0	117.0	284.0
SULFATE (MG/L)	409.0	500.0	2,778.0	49.0
CHLORIDE (MG/L)	750.0	920.0	5,472.0	20.0
FLUORIDE (MG/L)	7.0	6.1	0.4	3.0
NITRATE (MG/L)	< 0.4	< 0.4	< 0.4	4.0
IRON (MG/L)	--	--	--	--
pH	8.2	8.1	7.4	8.0
DISSOLVED SOLIDS (MG/L)	2,690.0	2,970.0	13,292.0	395.0
PHENOL. ALK. CACO3	0.0	0.0	0.0	0.0
TOTAL ALK. CACO3	810.0	680.0	96.0	233.0
TOTAL HARD. CACO3	34.0	219.0	1,639.0	228.0
% SODIUM	--	--	--	--
SAR	--	--	--	--
RSC	--	--	--	--
SPECIFIC CONDUCTANCE (micromhos at 25^{o}C)	5,301.0	5,740.0	25,480.0	648.0

Table 5.--Chemical Analyses of Water From Selected Wells and Test Holes in Deaf Smith, Randall, and Swisher Counties--Continued

Swisher County

WELL	11-26-611[1/]	11-26-611	11-26-611	11-26-611
DATE OF COLLECTION	6/15/67	8/9/68	10/17/68	10/23/69
AQUIFER CODE	TRDSR	TRDSR	TRDSR	TRDSR
WELL DEPTH (feet)	840	840	840	840
TEMPERATURE (^{o}F)	--	--	--	--
TEMPERATURE (^{o}C)	--	--	--	--
SILICA (MG/L)	--	9.0	--	--
CALCIUM (MG/L)	6.0	6.0	4.0	5.0
MAGNESIUM (MG/L)	4.0	1.0	2.0	2.0
SODIUM (MG/L)	345.0	367.0	372.0	364.0
POTASSIUM (MG/L)	--	--	--	--
MANGANESE (MG/L)	--	--	<0.05	<0.05
BORON (MG/L)	--	--	--	--
BICARBONATE (MG/L)	480.0	495.0	488.0	488.0
SULFATE (MG/L)	180.0	216.0	232.0	228.0
CHLORIDE (MG/L)	140.0	144.0	141.0	127.0
FLUORIDE (MG/L)	--	1.5	1.9	1.3
NITRATE (MG/L)	--	<0.4	<0.4	<0.4
IRON (MG/L)	2.5	--	0.04	0.06
pH	8.3	8.3	8.4	8.4
DISSOLVED SOLIDS (MG/L)	914.0	987.5	995.0	971.0
PHENOL. ALK. CACO3	--	0.0	2.0	3.0
TOTAL ALK. CACO3	396	406.0	404.0	406.0
TOTAL HARD. CACO3	32.0	21.0	20.0	22.0
% SODIUM	--	--	--	--
SAR	--	--	--	--
RSC	--	--	--	--
SPECIFIC CONDUCTANCE (microhoms at 25^{o}C)	--	1,804.0	1,815.0	1,769.0

See footnotes at end of table.

Table 5.--Chemical Analyses of Water From Selected Wells and Test Holes in Deaf Smith, Randall, and Swisher Counties--Continued

Swisher County

WELL	11-26-611	11-26-611	11-26-611	11-26-611
DATE OF COLLECTION	9/16/70	3/24/71	9/18/72	4/25/84
AQUIFER CODE	TRDSR	TRDSR	TRDSR	TRDSR
WELL DEPTH (feet)	840	840	840	840
TEMPERATURE (^{o}F)	--	--	--	70
TEMPERATURE (^{o}C)	--	--	--	--
SILICA (MG/L)	--	--	--	11.0
CALCIUM (MG/L)	5.0	5.0	5.0	4.0
MAGNESIUM (MG/L)	3.0	2.0	4.0	2.0
SODIUM (MG/L)	364.0	351.0	364.0	372.0
POTASSIUM (MG/L)	--	--	--	2.0
MANGANESE (MG/L)	< 0.05	--	< 0.05	--
BORON (MG/L)	--	--	--	--
BICARBONATE (MG/L)	499.0	489.0	495.0	479.0
SULFATE (MG/L)	216.0	219.0	223.0	229.0
CHLORIDE (MG/L)	128.0	123.0	128.0	116.0
FLUORIDE (MG/L)	1.5	1.6	1.7	1.5
NITRATE (MG/L)	< 0.4	< 0.4	< 0.4	< 0.1
IRON (MG/L)	< 0.02	--	< 0.02	--
pH	8.3	8.4	8.4	8.6
DISSOLVED SOLIDS (MG/L)	963.0	946.0	970.0	982.0
PHENOL. ALK. CACO3	0.0	3.0	1.0	8.0
TOTAL ALK. CACO3	409.0	407.0	408.0	409.0
TOTAL HARD. CACO3	26.0	21.0	26.0	18.0
% SODIUM	--	--	--	97.1
SAR	--	--	--	38.1
RSC	--	--	--	7.8
SPECIFIC CONDUCTANCE (micromhos at 25^{o}C)	1,738.0	1,705.0	1,742.0	1,782.0

Table 5.--Chemical Analyses of Water From Selected Wells and Test Holes in Deaf Smith, Randall, and Swisher Counties--Continued

Swisher County

WELL	11-26-612	11-28-409[4/]	11-28-508[4/]	11-33-610
DATE OF COLLECTION	4/25/84	10/11/71	10-11-71	4/25/84
AQUIFER CODE	TRDSR	TRDSR	TRDSR	TRD
WELL DEPTH (feet)	801	650	643	600
TEMPERATURE (^{o}F)	70	--	--	64
TEMPERATURE (^{o}C)	--	--	--	--
SILICA (MG/L)	10.0	--	--	42.0
CALCIUM (MG/L)	4.0	4.0	6.2	47.0
MAGNESIUM (MG/L)	1.0	1.5	3.0	22.0
SODIUM (MG/L)	308.0	414.0	351.9	52.0
POTASSIUM (MG/L)	2.0	1.6	1.9	7.0
MANGANESE (MG/L)	--	--	--	--
BORON (MG/L)	--	--	--	--
BICARBONATE (MG/L)	462.0	474.0	402.0	321.0
SULFATE (MG/L)	174.0	264.5	217.4	20.0
CHLORIDE (MG/L)	65.0	163.3	169.0	21.0
FLUORIDE (MG/L)	1.6	--	--	1.3
NITRATE (MG/L)	< 0.1	--	--	6.4
IRON (MG/L)	--	--	--	--
pH	8.6	8.3	8.3	8.2
DISSOLVED SOLIDS (MG/L)	804.8	1,082.0	947.1	376.6
PHENOL. ALK. CACO3	10.0	--	--	0.0
TOTAL ALK. CACO3	399.0	--	--	263.0
TOTAL HARD. CACO3	16.0	--	--	208.0
% SODIUM	96.9	98.0	96.2	33.3
SAR	33.5	45.0	28.9	1.6
RSC	7.7	--	--	1.1
SPECIFIC CONDUCTANCE (micromhos at 25^{o}C)	1,431.0	1,838.0	1,555.0	645.0

See footnotes at end of table.

Table 5.--Chemical Analyses of Water From Selected Wells and Test Holes in Deaf Smith, Randall, and Swisher Counties--Continued

Swisher County

WELL	11-34-909	11-42-308	11-43-111
DATE OF COLLECTION	4/26/84	8/16/74	4/26/84
AQUIFER CODE	TO-TRD	TO-TRD	TO-TRD
WELL DEPTH (feet)	322	368	345
TEMPERATURE (^{o}F)	64	64	64
TEMPERATURE (^{o}C)	--	--	--
SILICA (MG/L)	42.0	44.0	27.0
CALCIUM (MG/L)	30.0	5.7	58.0
MAGNESIUM (MG/L)	16.0	24.0	34.0
SODIUM (MG/L)	123.0	58.0	38.0
POTASSIUM (MG/L)	6.0	--	8.0
MANGANESE (MG/L)	--	--	--
BORON (MG/L)	--	--	--
BICARBONATE (MG/L)	386.0	346.0	312.0
SULFATE (MG/L)	29.0	24.0	45.0
CHLORIDE (MG/L)	42.0	44.0	46.0
FLUORIDE (MG/L)	1.8	2.8	2.0
NITRATE (MG/L)	1.7	0.8	11.92
IRON (MG/L)	--	--	--
pH	8.1	7.6	8.2
DISSOLVED SOLIDS (MG/L)	481.3	424.6	423.3
PHENOL. ALK. CACO3	0.0	0.0	0.0
TOTAL ALK. CACO3	316.0	284.0	256.0
TOTAL HARD. CACO3	141.0	243.0	288.0
% SODIUM	63.1	--	21.0
SAR	4.5	--	0.9
RSC	3.5	--	0.0
SPECIFIC CONDUCTANCE (micromhos at 25^{o}C)	834.0	765.0	800

1/ Chemlab Service of Amarillo.

2/ U. S. Geological Survey.

3/ Plains Laboratory.

4/ Texas Agricultural Extension Service.

5/ Deaf Smith County Research Lab.

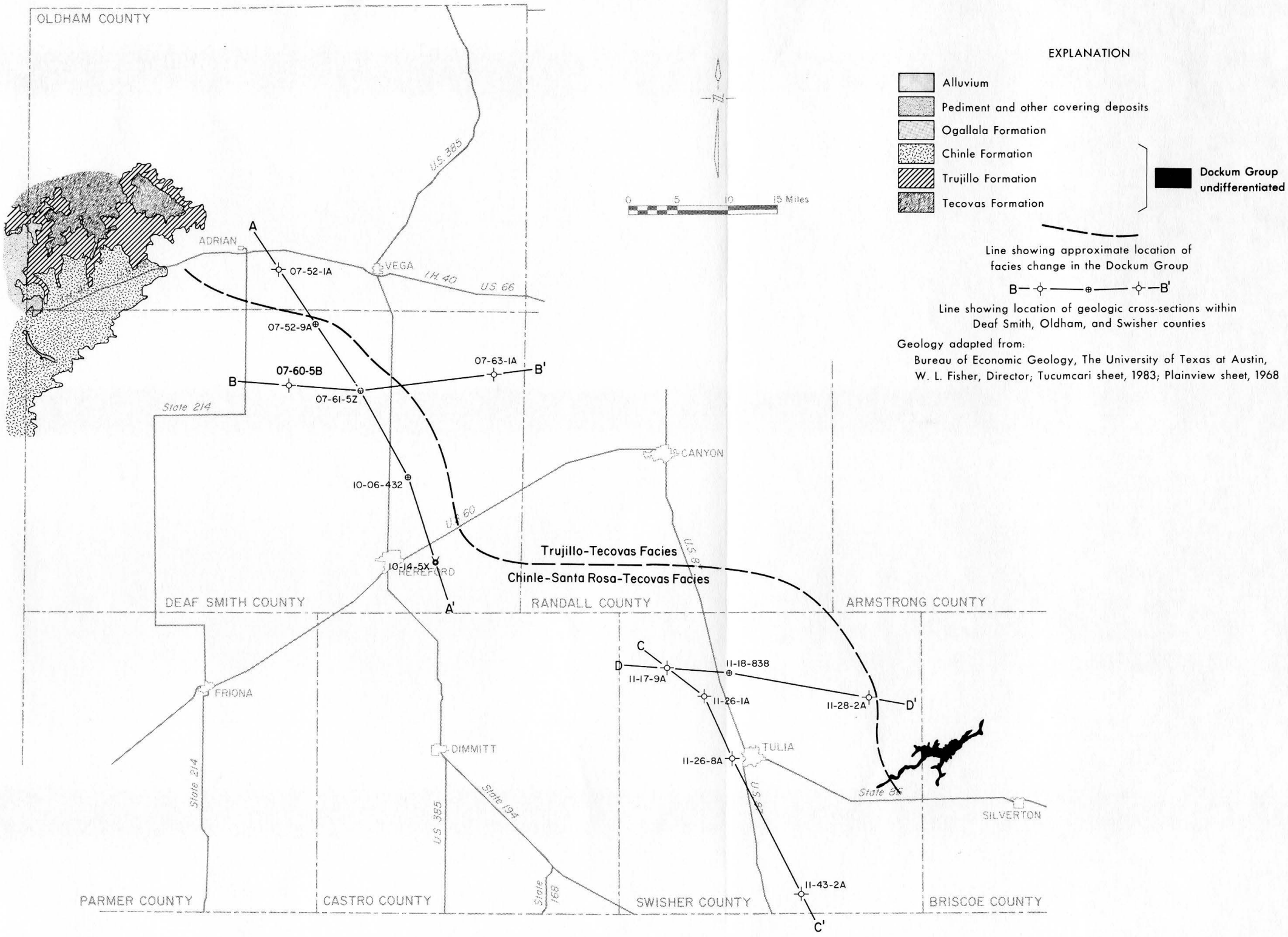
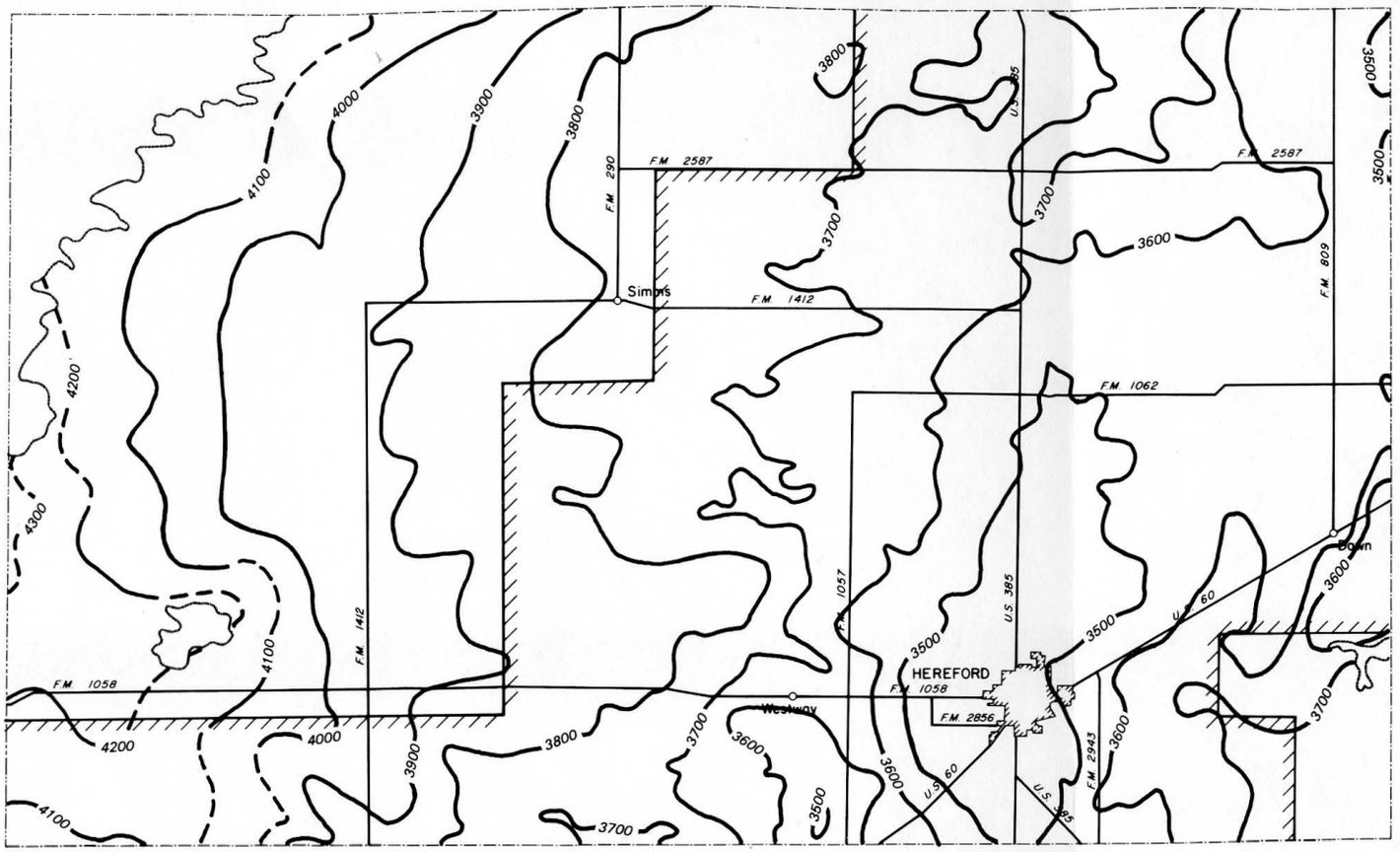


Figure 2

Approximate Location of Facies Change Occurring Within the Dockum Group



EXPLANATION

3700

Line showing approximate altitude of the top of the Dockum Group

Dashed where control is limited

Interval 100 feet

Datum is mean sea level

Note: Map modified from TDWR Report 288

Boundary of High Plains Underground Water Conservation District No. 1. The District prepared that portion of the map within this area

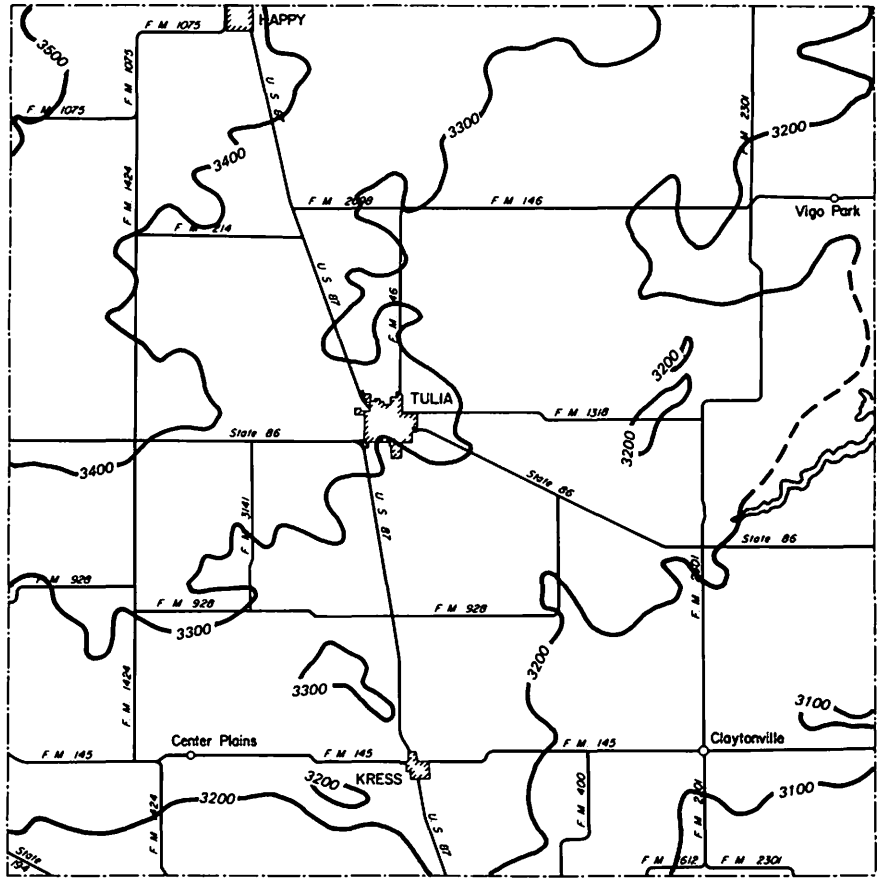
N

0 5 Miles

Base adapted from county highway maps by the Texas Department of Highways and Public Transportation

Figure 3

Approximate Altitude of the Top of the Dockum Group, Deaf Smith County



EXPLANATION

3300

Line showing approximate altitude of the top of the Dockum Group

Dashed where control is limited

Interval 100 feet

Datum is mean sea level

Note: Map modified from TDWR Report 288

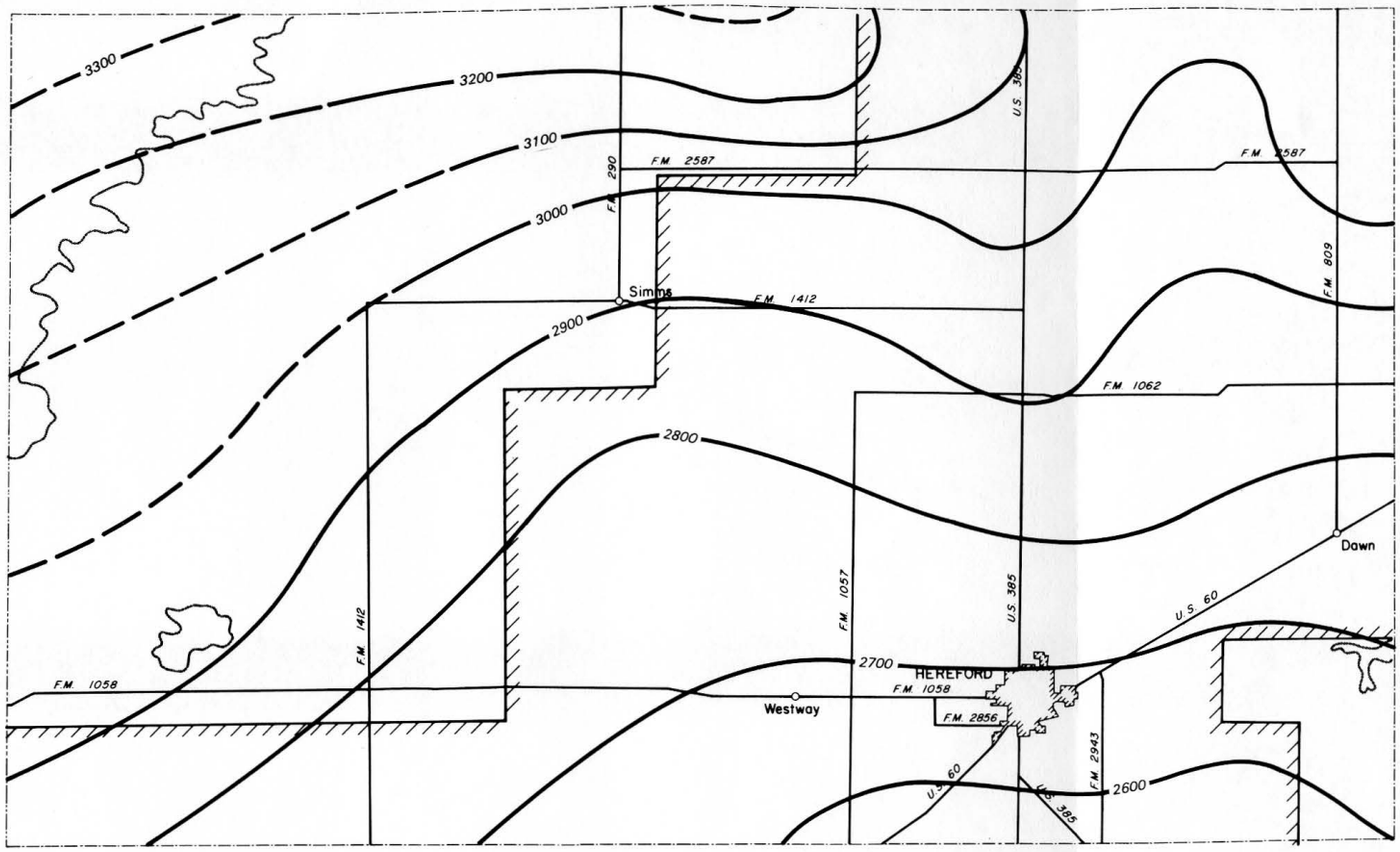
N

0 5 Miles

Base adapted from county highway maps by the Texas Department of Highways and Public Transportation

Figure 4

Approximate Altitude of the Top of the Dockum Group, Swisher County



EXPLANATION

2900

Line showing approximate altitude of the base of the Dockum Group

Dashed where control is limited

Interval 100 feet

Datum is mean sea level

Note: Modified from Figure 5, McGowen, Granata, and Seni, 1977

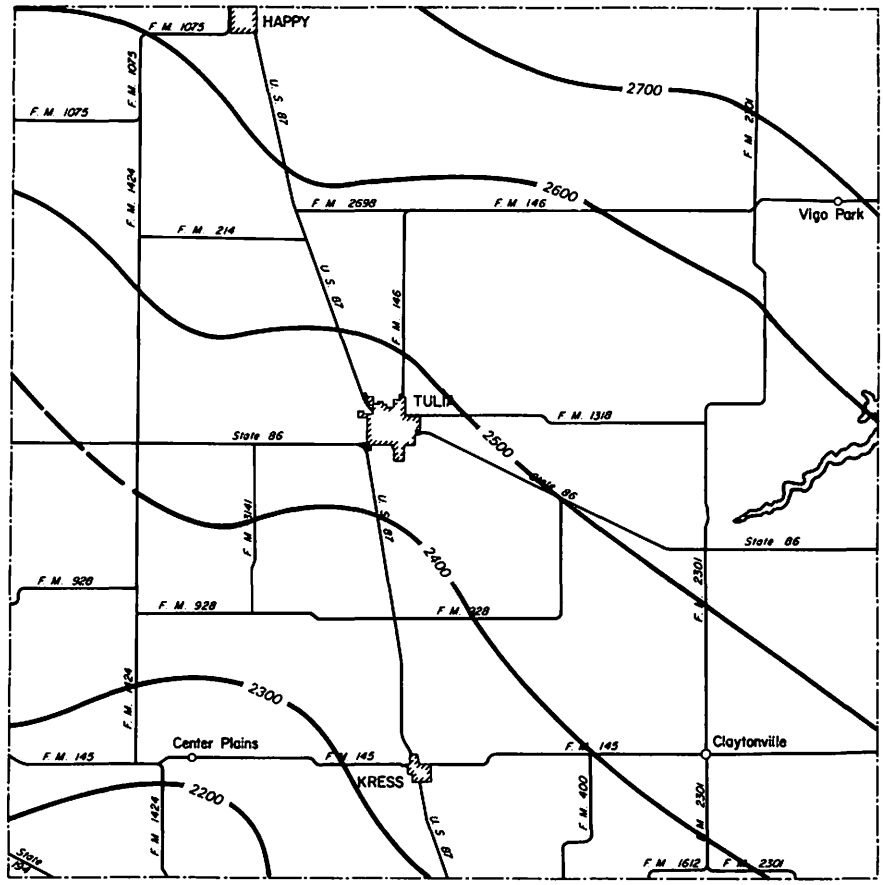
Boundary of High Plains Underground Water Conservation District No. 1.

0 5 Miles

Base adapted from county highway maps by the Texas Department of Highways and Public Transportation

Figure 5

Approximate Altitude of the Base of the Dockum Group, Deaf Smith County



EXPLANATION

2500

Line showing approximate altitude of the base of the Dockum Group

Dashed where control is limited

Interval 100 feet

Datum is mean sea level

Note: Modified from Figure 5, McGowen, Granata, and Seni, 1977

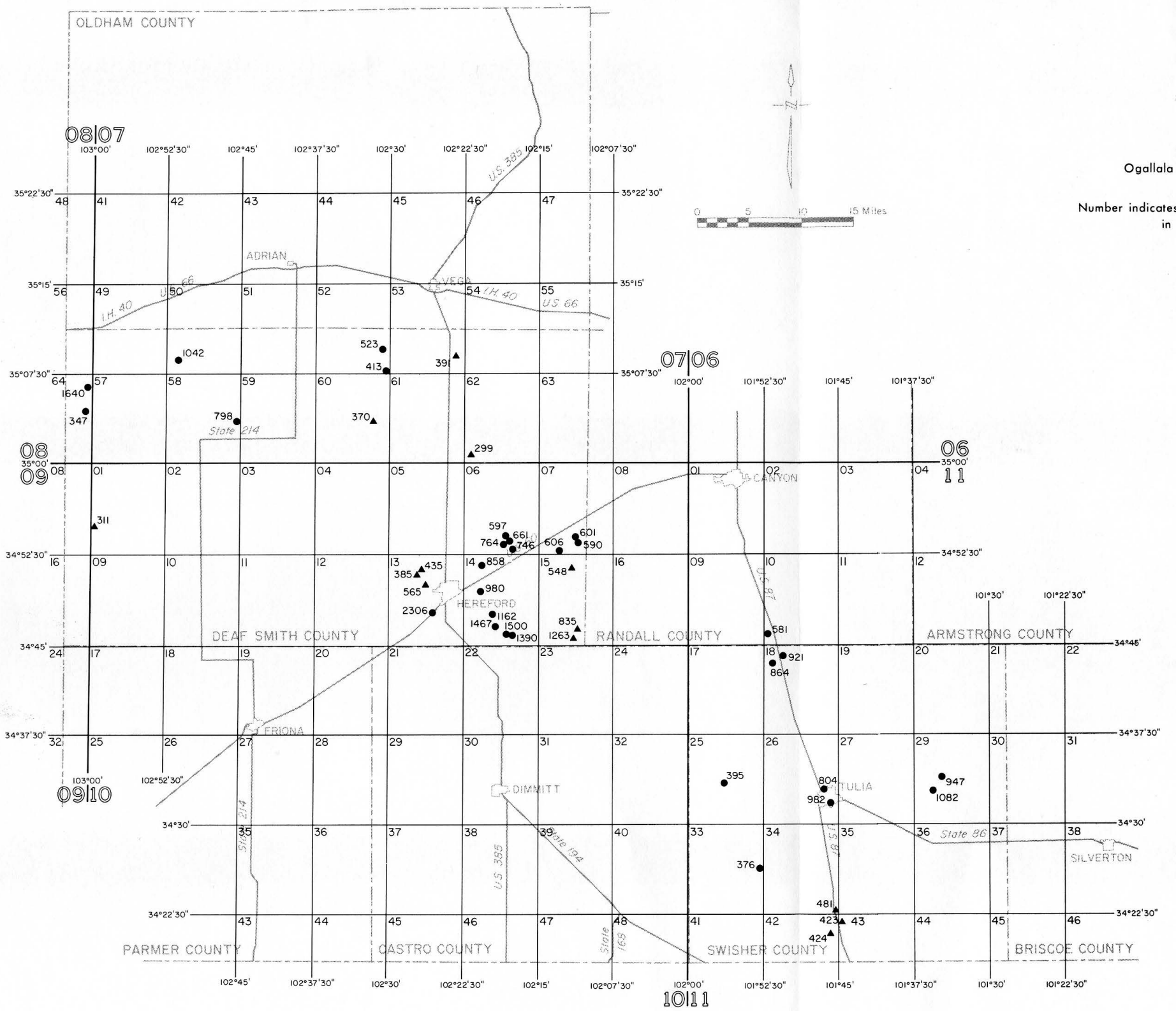
N

0 5 Miles

Base adapted from county highway maps by the Texas Department of Highways and Public Transportation

Figure 6

Approximate Altitude of the Base of the Dockum Group, Swisher County



EXPLANATION

Source of Water

● Dockum Group

▲ Ogallala Formation-Dockum Group

1500

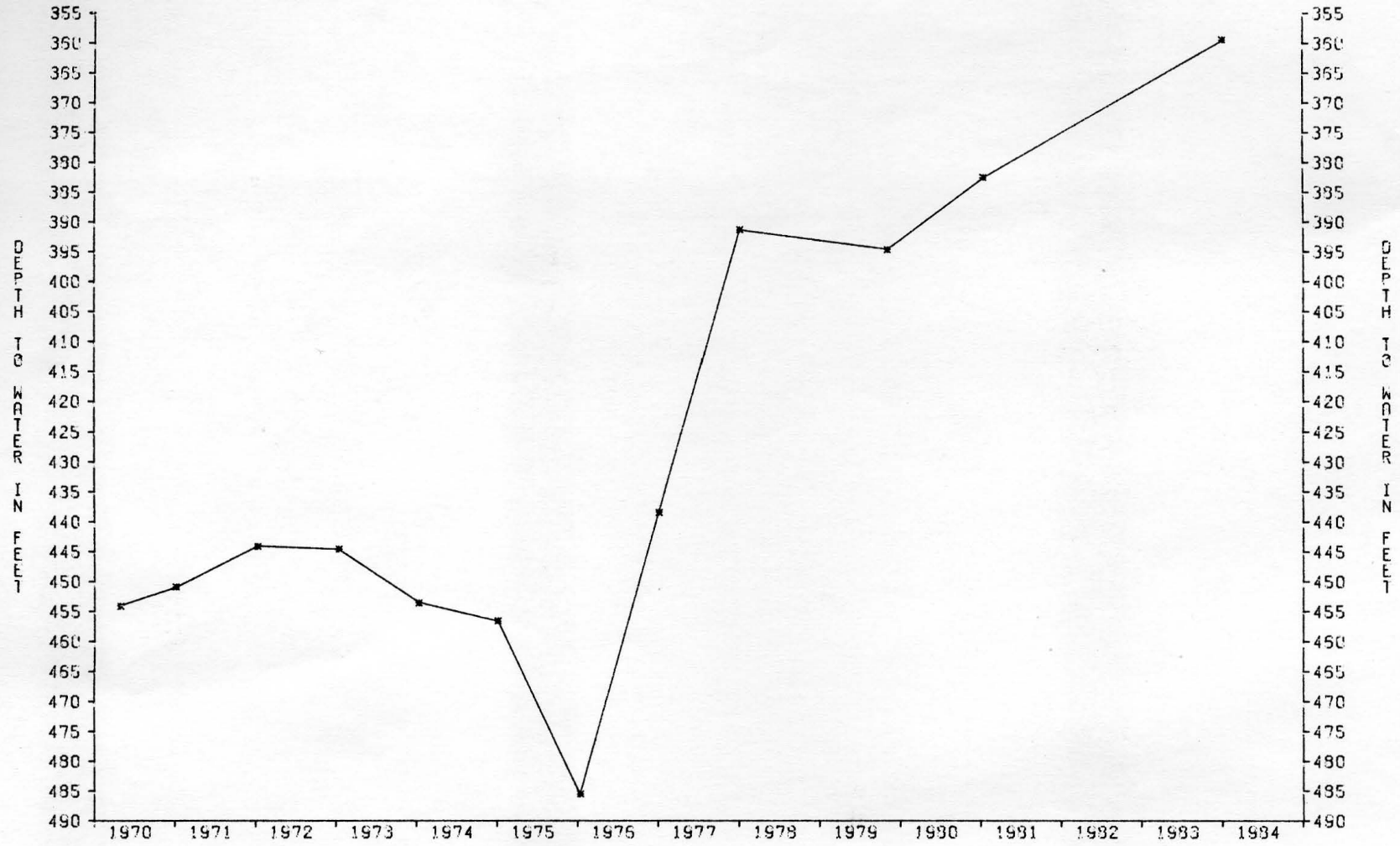
Number indicates TDS concentration from analysis in milligrams per liter

Figure 7

Dissolved-Solids Content in Water From Wells in the Ogallala Formation-Dockum Group and Dockum Group Aquifers in Deaf Smith, Randall, and Swisher Counties

Swisher
Aquifer: Dockum Group

11-25-502
Well Depth: 1000 feet
Elevation: 3622 feet



Swisher
Aquifer: Dockum Group

11-36-109
Well Depth: 631 feet
Elevation: 3362 feet

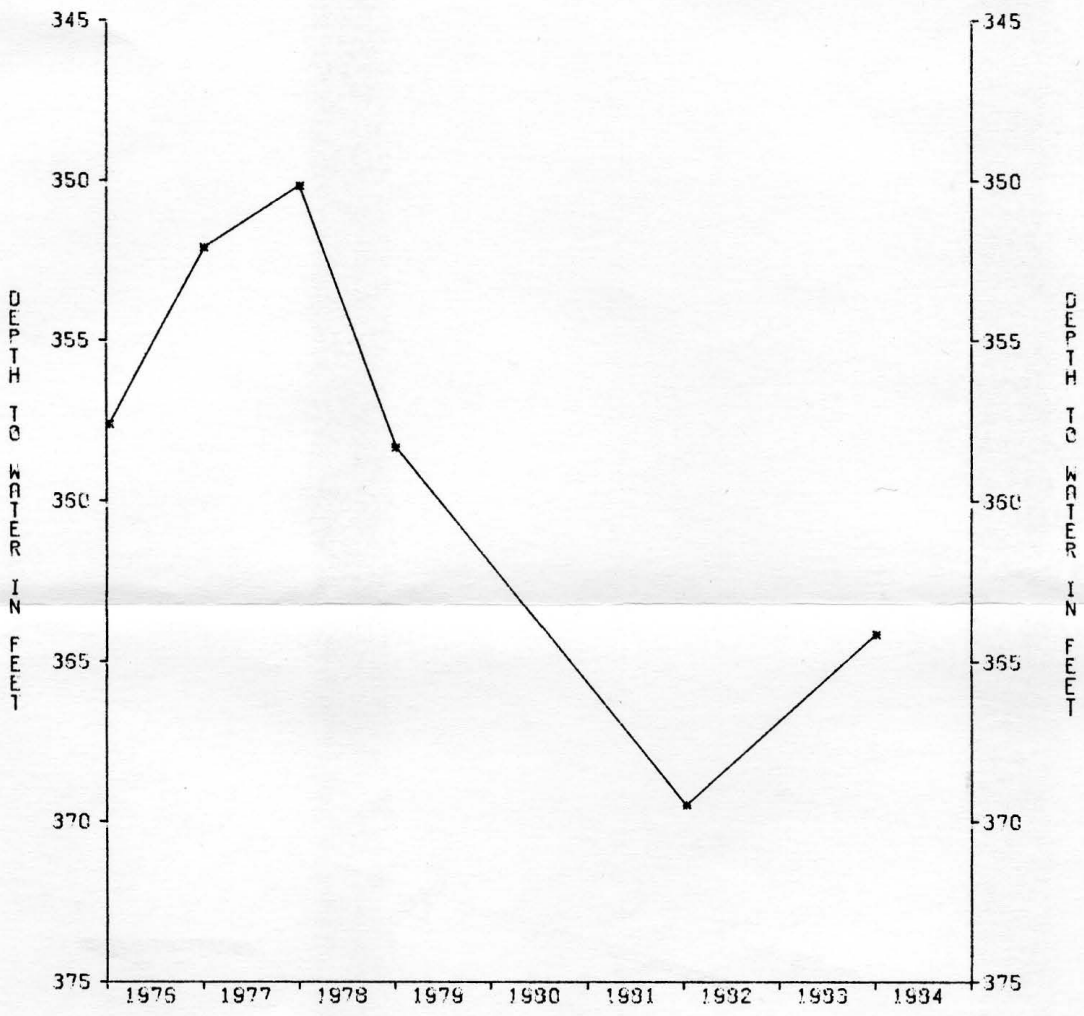


Figure 9
Hydrographs of Water Wells in Swisher County

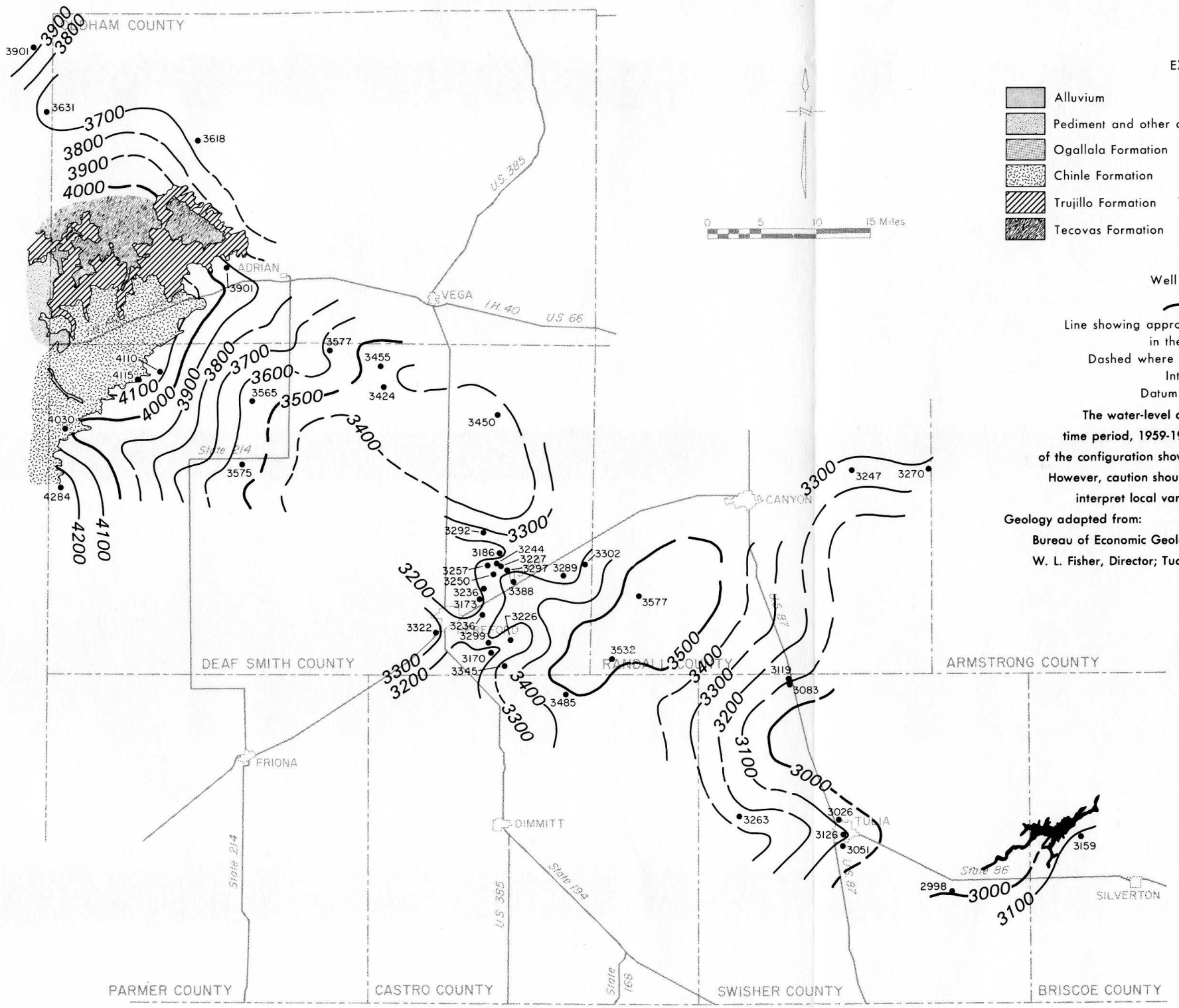


Figure 8

Approximate Potentiometric Surface of the Triassic Aquifer, Based on Various Dates of Measurement, 1959-1984

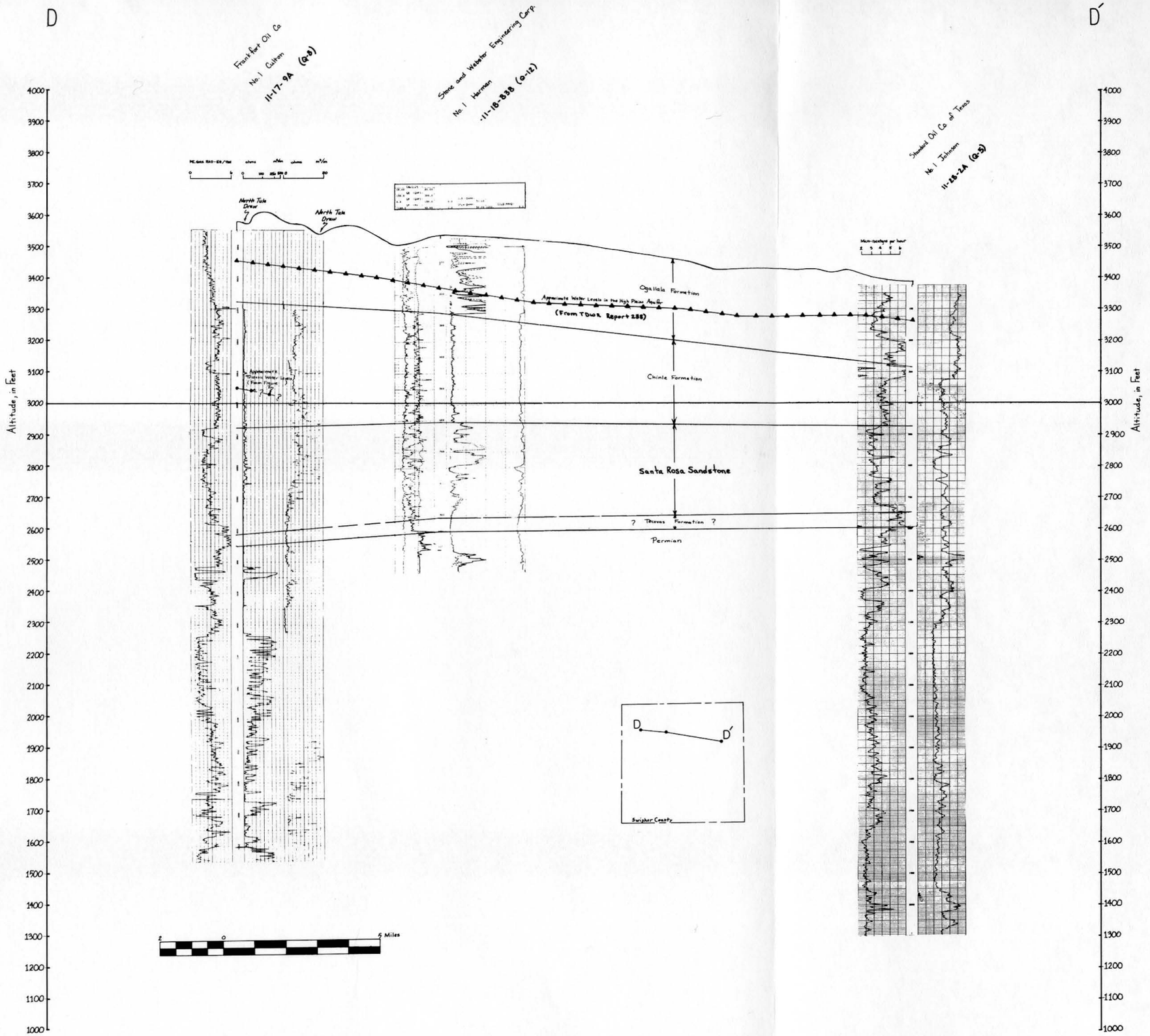


Figure 14

Geologic Cross Section D-D', Swisher County

C

C'

Frankfort Oil Co
No 1 Culton
11-17-9A (a-8)

Frankfort Oil Co
No 1 Bradford
11-26-1A (a-3)

H. L. Hunt Oil Co
No 1 Bivins
11-26-8A (a-4)

Frankfort Oil Co
No 1 Sweatt
11-45-2A (a-9)

North Tule Draw

Middle Tule Draw

South Tule Draw

Rock Draw

Approximate Water Levels in the High Plains Aquifer (From TDWR Report 288)

Approximate Triassic Water Levels (From Figure 8)

Ogallala Formation

Chinle Formation

Santa Rosa Sandstone

Tecovas Formation

Permian

Altitude, in Feet

4000 3900 3800 3700 3600 3500 3400 3300 3200 3100 3000 2900 2800 2700 2600 2500 2400 2300 2200 2100 2000 1900 1800 1700 1600 1500 1400 1300 1200 1100 1000

2 0 5 Miles

Swisher County

C C'

Figure 13
Geologic Cross Section C-C', Swisher County

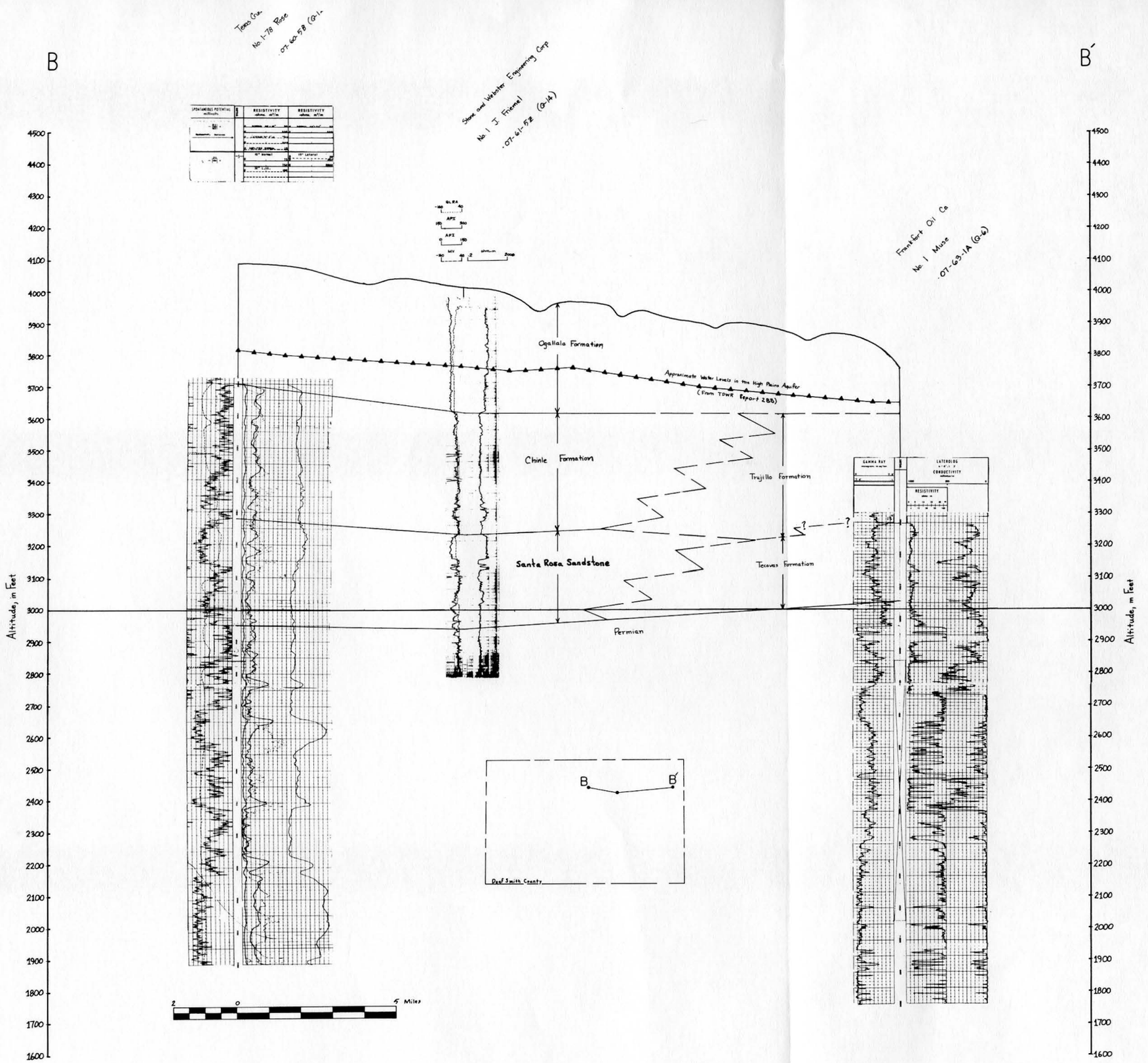


Figure 12
Geologic Cross Section B-B', Deaf Smith County

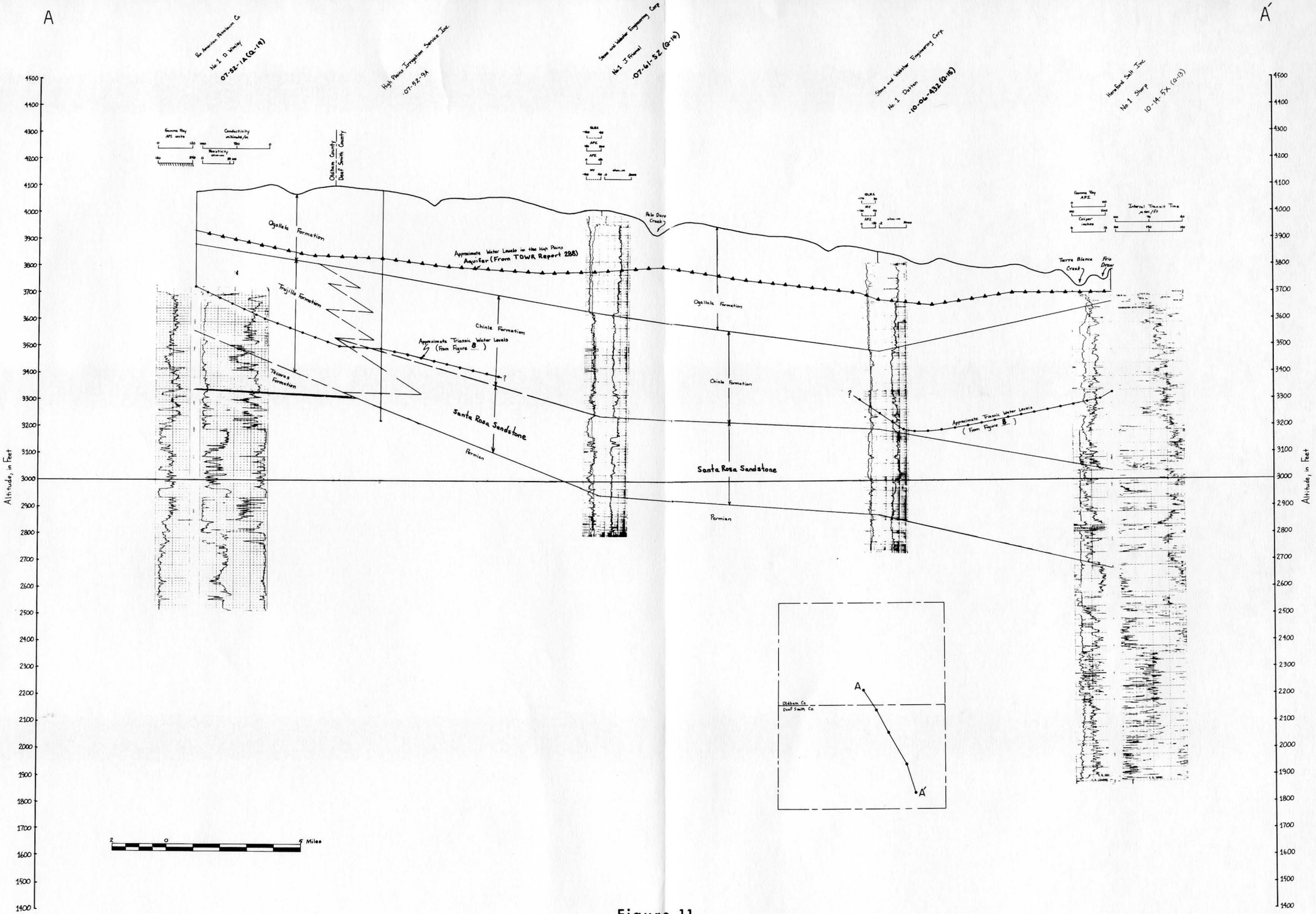


Figure 11

Geologic Cross Section A-A', Oldham and Deaf Smith Counties

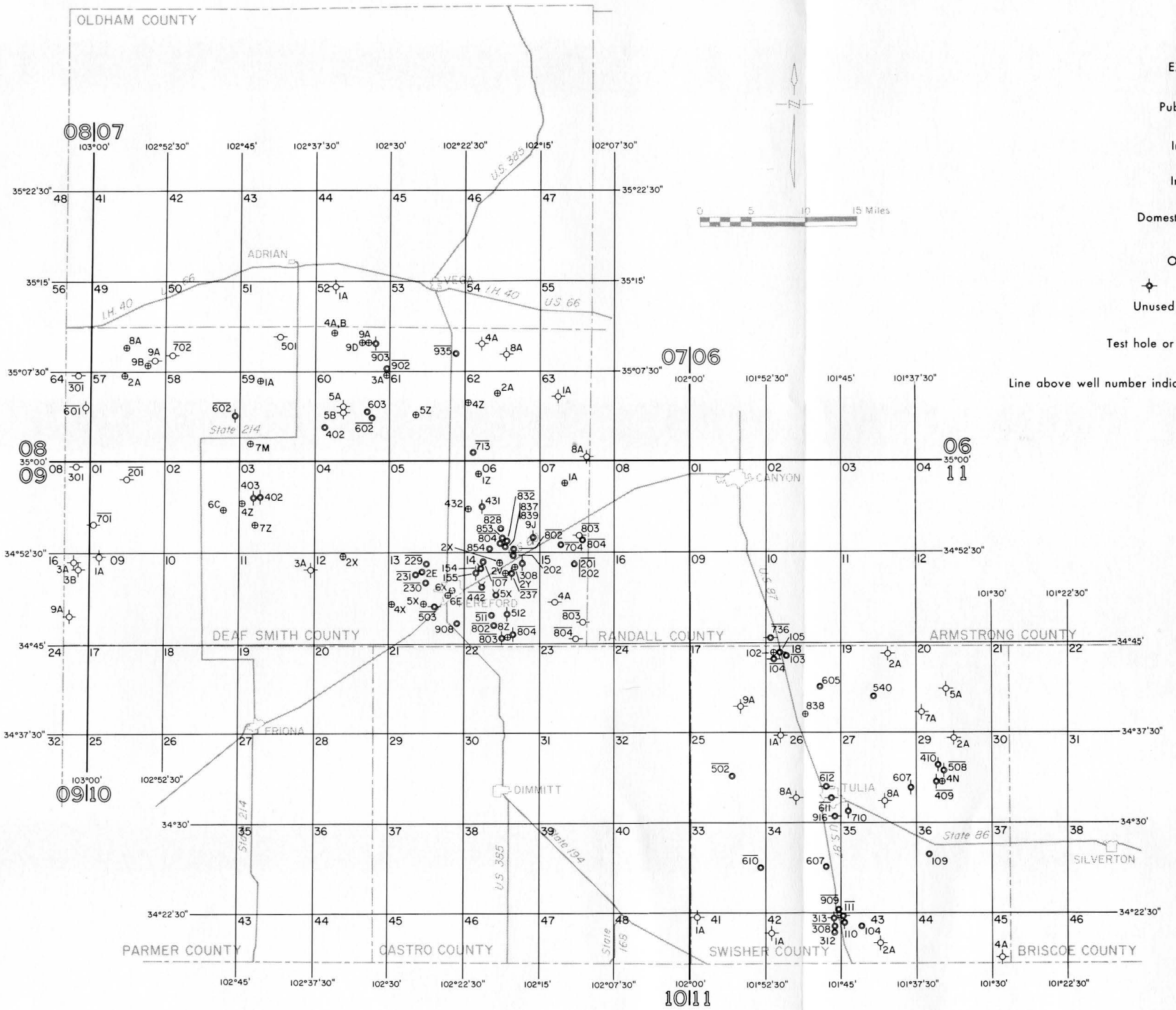


Figure 10

Location of Wells, Test Holes, and Oil Tests in Deaf Smith, Oldham, Randall, and Swisher Counties