TEXAS WATER COMMISSION

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OCCURRENCE AND QUALITY OF GROUND WATER IN YOUNG COUNTY, TEXAS

By

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FOREWORD

Ground-water studies that are currently being conducted by the staff of the Texas Water Commission in a block of counties in north-central Texas were begun in March 1962 to meet a growing need for more detailed and more accurate ground-water information in this area than was available from other sources. As initially planned, the investigations that are underway will be conducted in the following counties: Archer, Clay, Montague, Throckmorton, Young, Jack, Jones, Shackelford, Stephens, Palo Pinto, Taylor, Callahan, Eastland, Coleman, and Brown Counties. As work progresses on this project, it is probable that other counties adjoining the initial block selected will be added to the scope of the project.

In the 15 counties that are included in the present study, several towns with municipal water supplies are served by ground water or have water wells as a standby source of water supply. In addition to meeting municipal needs for water, ground water is often the sole source supplying domestic, farm, and ranch needs for water in much of the area. In recognizing the significance of ground water as a water resource in this area, the Water Commission was aware also of the vital need for obtaining information on the depth to which usable-quality water occurs, as the basis for providing adequate and equitable protection for these water supplies in the extensive petroleum development that continues in the area.

The area under study is underlain by Pennsylvanian and Permian rocks that either crop out at the surface or underlie Cretaceous and alluvial sediments at shallow depths. Ground water occurs erratically in most of the area in shallow discontinuous zones of low permeability in Pennsylvanian and Permian rocks, in sands and fractured limestones in the relatively thin Cretaceous sediments, and in Pleistocene to Recent alluvial sediments that are found at the surface in parts of most of the counties included in the study. Initially these investigations were to provide additional data for use by the Water Commission in making recommendations to the Railroad Commission and oil industry on the depth to which usable-quality water should be protected. It was recognized early in the course of the investigations, however, that the scope of the programs should be enlarged to provide information for landowners and others interested in water-resources development. Sufficient information should be provided to assure optimum development of the ground-water supplies available.

The Texas Water Commission has been considering the present program for several years, although personnel have not been available to initiate such a long range study. The scope, objectives, and methods of study to be employed have been part of the planning of the Texas Water Commission, and when funds become available the investigations were included in the Agency's ground-water program. In January 1962, funds allocated to the Texas Water Commission by the Texas Water Pollution Control Board for the purpose of investigation and prevention of ground-water pollution made possible the beginning of the present program. These funds were allocated to the Water Commission by the Pollution

Control Board under provisions of the Act that created the Pollution Board and that directs the Texas Water Commission to "... investigate and ascertain those situations in which the underground waters of the State are being polluted or are threatened with pollution, and it shall report all findings to the Board together with its recommendations in regard thereto."[1]

It was determined that these studies could be most feasibly conducted on a county-by-county basis, and the initial investigations were begun in Stephens, Young, and Brown Counties. Reports from the results of the investigations in each of the 15 counties will be prepared and published by the Texas Water Commission as the field studies are completed.

TEXAS WATER COMMISSION

John J. Vandertulip

John J. Vandertulip
Chief Engineer

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[1] 57th Legislature, 1961, Article 7621d.

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ABSTRACT

Young County is located within the outcrop area of upper Pennsylvanian and lower Permian formations in north-central Texas. The availability of usable water from shallow subsurface zones in these formations is limited in different areas of the county. The development of ground-water resources by water wells is variably affected by factors other than availability. Population trends, quality impairment of existing wells, and the sometimes marginal quality of native water has, in local areas of the county, inhibited water-well development. Approximately 80 percent of the water wells in Young County are completed in zones of the Cisco Group (upper Pennsylvanian).

The comparison of chemical analyses of ground water in Young County shows that the constituents of the water vary in concentration. Trends in the variation of constituents were used to establish the base quality of ground water in different areas of the county. The sharp increases in chloride content of some analyses do not coincide with normal variation or base quality changes of ground water. Water wells having this high chloride content are treated in this report as contaminated wells.

The disposal of oil-field brine is an important prominent source of chloride impairment of ground water in Young County. Reported brine production for 1961 in Young County was 16,038,180 barrels; injection-well disposal accounted for approximately 94 percent of this amount.

OCCURRENCE AND QUALITY OF GROUND WATER IN YOUNG COUNTY, TEXAS

INTRODUCTION

Purpose and Scope

The economic vitality of north-central Texas, coupled with the lack of readily obtainable surface-water supplies of good quality, has made it apparent that additional information regarding the occurrence and availability of ground water was essential to a clear evaluation of the area's potential water-resources development. Thus, the purpose of the study in Young County was two-fold: to obtain, through field study, information regarding the occurrence and chemical quality of ground water for use by landowners and others interested in water-resources development in the county; and to provide sufficient information for the Texas Water Commission and other agencies responsible for protection of water quality in the county so that water-quality-protection programs can be both adequate for protection of the water available and equitable when applied to industries operating in the county.

The objectives of the Young County study were to obtain supplementary basic data to better delineate underground formations containing usable water, the depth of this water, and its chemical quality; to supplement available data on brines produced with oil and gas and the location and method of their disposal, with field observations and spot quantitative and qualitative checks; to review surface casing and brine disposal regulations of this agency in the light of field observation to determine where revisions are needed; to evaluate the results of chemical analyses of water from wells and springs in the county in order to establish a base condition of water quality where possible and to pinpoint areas of contamination where it has occurred; and to prepare a report for the use of landowners, the Texas Water Commission, and other State and Federal agencies.

The project was planned to accomplish the following: the collection of records in the field regarding water wells and springs; the study of subsurface data from wells where available; the measurement of elevations above sea level and establishment of topographic control by selected means; obtaining information on brines produced with oil, and methods of brine disposal; the study of surface and shallow subsurface geology significant to the understanding of the occurrence of ground water; and preparation of a report presenting the results of the study, together with pertinent basic data and illustrations reflecting ground-water occurrence in the county.

The study was made during the period 1962-63 under the administrative direction of John J. Vandertulip, Chief Engineer, and L. G. McMillion, director, Ground Water Division, and under the direct supervision of Donald C. Draper, coordinator of the Quality Protection Program.

Method of Investigation

In conducting the detailed ground-water investigation of Young County the following items of work were performed.

A virtually complete inventory of wells and springs was conducted in 1962 to determine the manner in which water wells were constructed and, where possible, to determine the depth and aquifer in which the wells were completed. A total of 447 wells and springs were scheduled, and elevations were established on all with the aid of topographic maps and altimeter from grade elevations furnished by the Texas Highway Department. These elevations together with water levels that were reported or measured in wells were used, where possible, to determine the direction of ground-water movement in subsurface formations.

In order to determine the water-quality characteristics of ground water in Young County, 440 chemical analyses were obtained. The laboratory analyses of water samples were made by the State Department of Health and the U. S. Geological Survey under interagency and cooperative agreements with the Commission. Approximately 350 electric logs were studied as an aid in understanding the subsurface geologic conditions pertinent to the occurrence of ground water in the county. Oil-field brine disposal practices were observed, and brine analyses were studied to determine their chemical characteristics.

Information regarding brine production was taken from the 1961 salt water inventory conducted by the Railroad Commission of Texas in cooperation with the Texas Water Commission and the Texas Water Pollution Control Board.

Previous Investigations

Several reports containing general information on the geology of north-central Texas are available; however, no detailed ground-water investigation of the entire county has been made prior to this study. The Texas Board of Water Engineers, now the Texas Water Commission, published a report on contamination by R. T. Littleton in 1956. This report covers only a small portion of southeastern Young County.

A preliminary report of the ground-water conditions in north-central Texas was made by Gard and others (1956, unpublished report) with the then Texas Board of Water Engineers.

A recent reconnaissance investigation of ground-water resources of the entire Brazos River Basin was made by Cronon and others (1963), but coverage within Young County was generalized as would be expected on a study of this type. Other reports relating to the geology of the area are listed at the end of this report in the References. These include Plummer and Moore (1921), Lee (1938), Cheney (1929), and Brown (1959, 1960).

Well-Numbering System

The numbers assigned to wells and springs in this report conform to the statewide well-numbering system used by the Texas Water Commission. This system is based on the division of the State into quadrangles formed by degrees of latitude and longitude, and further division of these quadrangles into smaller ones as shown in Figure 1.

The largest quadrangle, a 1-degree quadrangle, is divided into sixty-four 7-1/2 minute quadrangles, each of which is further divided into nine 2-1/2 minute quadrangles. Each 1-degree quadrangle in the State has been assigned a number for identification. The 7-1/2 minute quadrangles are numbered consecutively from left to right beginning in the upper left-hand corner of the 1-degree quadrangle, and the 2-1/2 minute quadrangles within the 7-1/2 minute quadrangle are similarly numbered. The first two figures of a well number identify the 1-degree quadrangle, the third and fourth numbers identify the 7-1/2 minute quadrangle, the fifth number identifies the 2-1/2 minute quadrangle, and the last two numbers designate the order in which the well was inventoried within the 2-1/2 minute quadrangle.

Young County lies within the 1-degree quadrangles numbered 20 and 31 shown in Figure 1.

Acknowledgements

Appreciation is expressed to the many farmers and ranchers, water well drillers, and oil operators in Young County who generously contributed time and information that aided in this investigation.

GEOGRAPHIC SETTING

Location

Young County comprises an area of 888 square miles in north-central Texas (Figure 2). Graham, the county seat, is 60 miles south of Wichita Falls and 90 miles northwest of Fort Worth. The county lies between 32°57' and 33°24' north latitude and 98°25' and 98°57' west longitude.

Climate

Young County has a warm subhumid climate with an average annual rainfall of 27 inches as based on 30-year normals supplied by the U. S. Weather Bureau for the period 1931-60. The maximum recorded yearly rainfall in Young County was 48.99 inches at Graham in 1957, and the minimum recorded was 14.12 inches in 1956. The average monthly distribution of rainfall expressed as a percent of the average annual rainfall is tabulated on following page.

Month	Rainfall Distribution in percent
January	5
February	5
March	5
April	10
May	17
June	11
July	9
August	7
September	10
October	10
November	5
December	6

The average annual air temperature in Young County based on a 50-year record is 64°F. The range of temperature is from a minimum of -1°F to a maximum of 110°F.

The average annual potential net evaporation depth from a free water surface in Young County is 49 inches. This figure is based on the annual gross evaporation minus annual rainfall for an 18-year period. The average effective net evaporation (net depth of water actually evaporated) for the county ranges from 50 inches on the eastern edge of the county to 52 inches on the western edge.

Topography and Drainage

Young County lies within parts of three major drainage basins, those of the Brazos, Trinity, and Red Rivers (see Plate 1). The topographic divide between the Brazos and Trinity River drainage basins obliquely bisects the northeast quarter of the county between elevations of 1,200 and 1,300 feet. North of this divide, topography is broken to hilly with decrease in elevation to about 1,050 feet at the north county line. The topographic divide between the Brazos and Red River drainage basins is about 3 miles northwest of Olney, and occurs at an elevation of approximately 1,250 to 1,275 feet. Drainage north of this divide is toward Mesquite Creek in Archer County, on which is located a lake supplying municipal water to Olney. Drainage throughout the remainder of the county is in the Brazos River Basin.

The Brazos River enters Young County in the northwestern quarter of the county, and meanders in a broad belt to its exit at the headwaters of Possum Kingdom Reservoir in the southeast corner of the county. Because of this meandering, the intermittent secondary drainage is diversified in development of direction of flow; however, stream and creek development within the county has a dendritic pattern.

Salt Creek, Crooked Creek, Oak Creek, and Flint Creek form a broad, triangular-shaped, drainage basin in the north-central and east-central part of the county. These creeks drain into Lake Graham, which is owned by the city of Graham and has a capacity of 52,500 acre-feet. Elevations within this area, referred to as the Salt Creek Watershed, vary from about 1,100 to 1,250 feet. Topography of this watershed is gentle to rolling with elevations increasing northward and greatest relief to the northeast.

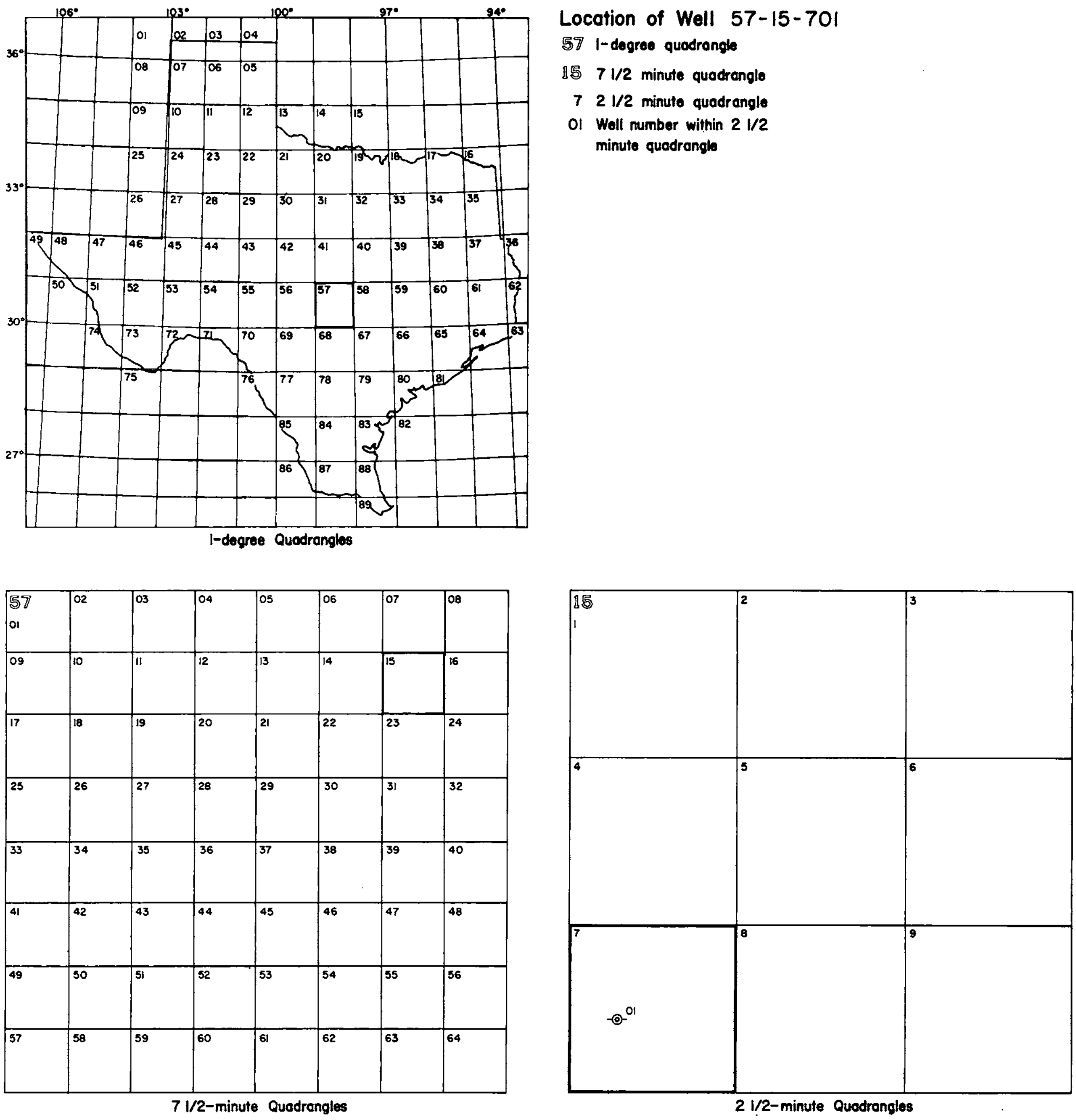

Figure 1

Well-Numbering System

Texas Water Commission in cooperation with the
Texas Water Pollution Control Board

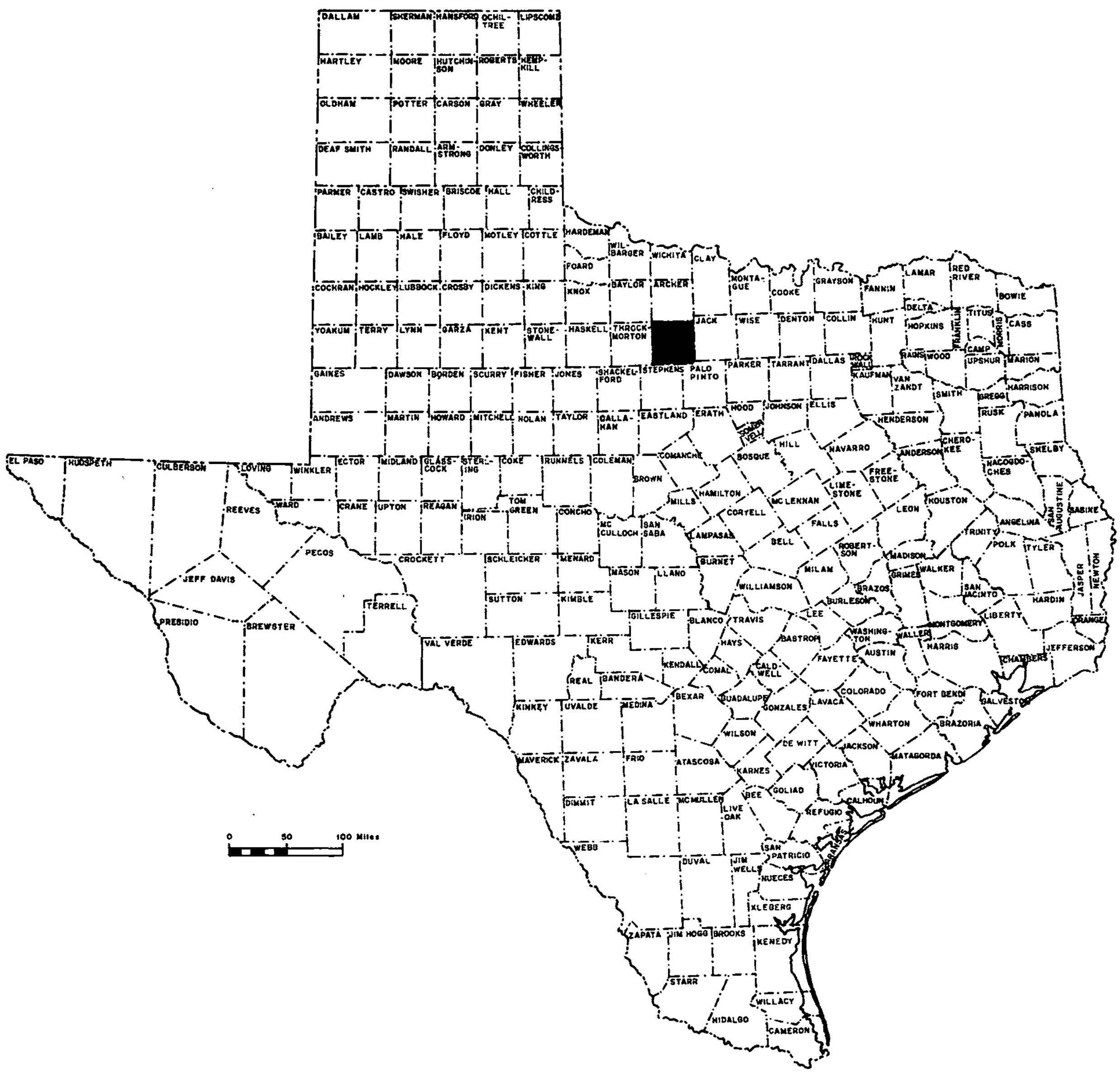

Figure 2

Map of Texas Showing Location of Young County

Texas Water Commission in cooperation with the Texas Water Pollution Control Board

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Bitter, Cotton, Paint, Rabbit, and Whisky Creeks drain the area west of the Salt Creek Watershed. Newcastle has a small lake on Whisky Creek with a capacity of 12 acre-feet, which serves its public water-supply needs. Hunt Creek and Dry Creek drain the area east of the Salt Creek Watershed. Other secondary drainage north of the Brazos River includes Flatrock Creek and Conners Branch, both located in the southeast quarter of the county. The maximum relief in Young County occurs in this area, where elevations range from less than 1,000 feet along the Brazos River to over 1,300 feet in the vicinity of Haynes Mountain.

Secondary drainage in Young County south of the Brazos River varies in direction of flow with its proximity to the Brazos River or Clear Fork of the Brazos. The Clear Fork is the only other perennially flowing stream in the county. It flows northward from Stephens County into the Brazos near South Bend in the south-central part of the county. Cages and Reveler Creeks and unnamed creeks drain into Clear Fork in this area. On one of these unnamed creeks, Eliasville has a small lake that furnishes the town's public water supply. The Eliasville-South Bend area is generally flat, but there are occasional erosional remnants with relief of over 100 feet. Average elevation above mean sea level is about 1,050 to 1,100 feet. In the southwest quarter of the county, Hulf Creek drains southward into Clear Fork and Fish Creek drainage has an eastward development to the Brazos River. Elevations decrease eastward from 1,230 to 1,100 feet in a distance of about 10 miles.

Elm, Cribb Station, and Six Mile Creeks drain the west-central area of the county in an eastward trend to the Brazos River. Elevations range from about 1,100 to 1,200 feet, and topography is rolling. In the southeast quarter of Young County, drainage south of the Brazos River includes Davis Creek and Cove Creek. The topography of this part of the county varies from broad alluvial flats to rolling hills, and elevations range from 1,000 feet to 1,150 feet in a southerly trend.

Population and Economy

The 1960 population of Young County was 17,254. The population of the cities and towns within the county, depending on surface water as public supply water, totals about 13,000, which is over 75 percent of the county population. The remaining 25 percent of the population living in rural areas and small communities is served by ground water or by surface water collected in small tanks.

Young County was organized in 1854 and repartitioned in 1874. Fort Belknap was established in 1851 as a frontier outpost, and served as a station for the Butterfield Overland Stage route. The Texas Cattle Raisers Association was organized in this county in 1877.

The principal sources of income in the county are from agriculture and the petroleum industry. Coal was once mined extensively in the south-central portion of the county, but has been replaced as a source of fuel by oil and gas. In 1961 over 6 million barrels of oil was produced in the county.

Of the total acreage of farms and ranches in Young County, about 25 percent is cultivated acreage and 75 percent is used for grazing. The county is known for its fine cattle, principally Herefords. Black Angus and Brahma cattle, sheep, and mohair goats are also raised. The largest cultivated crop is wheat; nearly half a million bushels is produced annually. Cotton production averages about 3,000 bales per year. Other crops include pecans, peanuts, watermelons, and grain and sweet sorghum for silage.

Industry within the county includes bottling plants; small oil and gasoline refineries; grain, cotton, and flour mills; and public utility plants.

OCCURRENCE AND QUALITY OF GROUND WATER

Ground water of usable quality occurs in Young County in formations of Pennsylvanian and Permian age and in alluvial deposits on the surface. The complexity of the rock sequences makes the zones in which ground water occurs difficult to trace. These complexities result from the irregular and discontinuous patterns of deposition in the area, discussed in more detail in the Appendix. The cyclic pattern of deposition and the lateral variations in lithology within the formations restrict both the area development and the recharge of the sands in which ground water generally occurs, and inhibits the interpolation of well data between points.

In Young County, the limestones that define formation boundaries are generally traceable over considerable distances whereas the water-bearing sands are not continuous and in local areas are referred to the limestone units for purposes of identification. Three geologic groups of rocks are discussed in the following sections: the Canyon and Cisco Groups of the upper Pennsylvanian System and the Wichita Group of the lower Permian System (see Figure 3). In Figure 4 is shown the generalized outcrop patterns of these rock units. In general, the principal occurrence of ground water of usable quality in Young County is in unnamed sands of the Cisco Group. Geologic sections illustrating the stratigraphic relationship of the principal marker horizons in Young County are shown in Figures 5 through 8. These geologic sections were drawn along lines that either traverse or coincide with water-well concentrations shown on Plate 1.

The mode of occurrence of ground water in the county is discussed by group and formation where possible in the following sections. Certain general hydrologic principles that govern the occurrence and movement of ground water are discussed in the section titled Ground-Water Hydrology in the Appendix. This discussion may be helpful in understanding the problems both of finding and developing ground-water resources in Young County.

Just as there is a wide range in the depth and mode of occurrence of ground water in the county, so is there a wide range in the chemical character of the water in the various formations in which it is found. The quality of water particular to each of the geologic units defined is discussed in detail in the following sections; and in the Appendix there is a discussion of water-quality criteria for beneficial uses, which will be helpful in interpreting the data on chemical analyses from wells in different parts of the county discussed in this text and tabulated in Table 2. Although the water-quality criteria contained in the Appendix provides useful guidelines, this investigation has shown use being made of ground water with mineral concentrations exceeding these criteria.

The principal constituents of ground water in Young County are: silica, calcium, magnesium, sodium, bicarbonate, sulfate, chloride, fluoride, and nitrate.

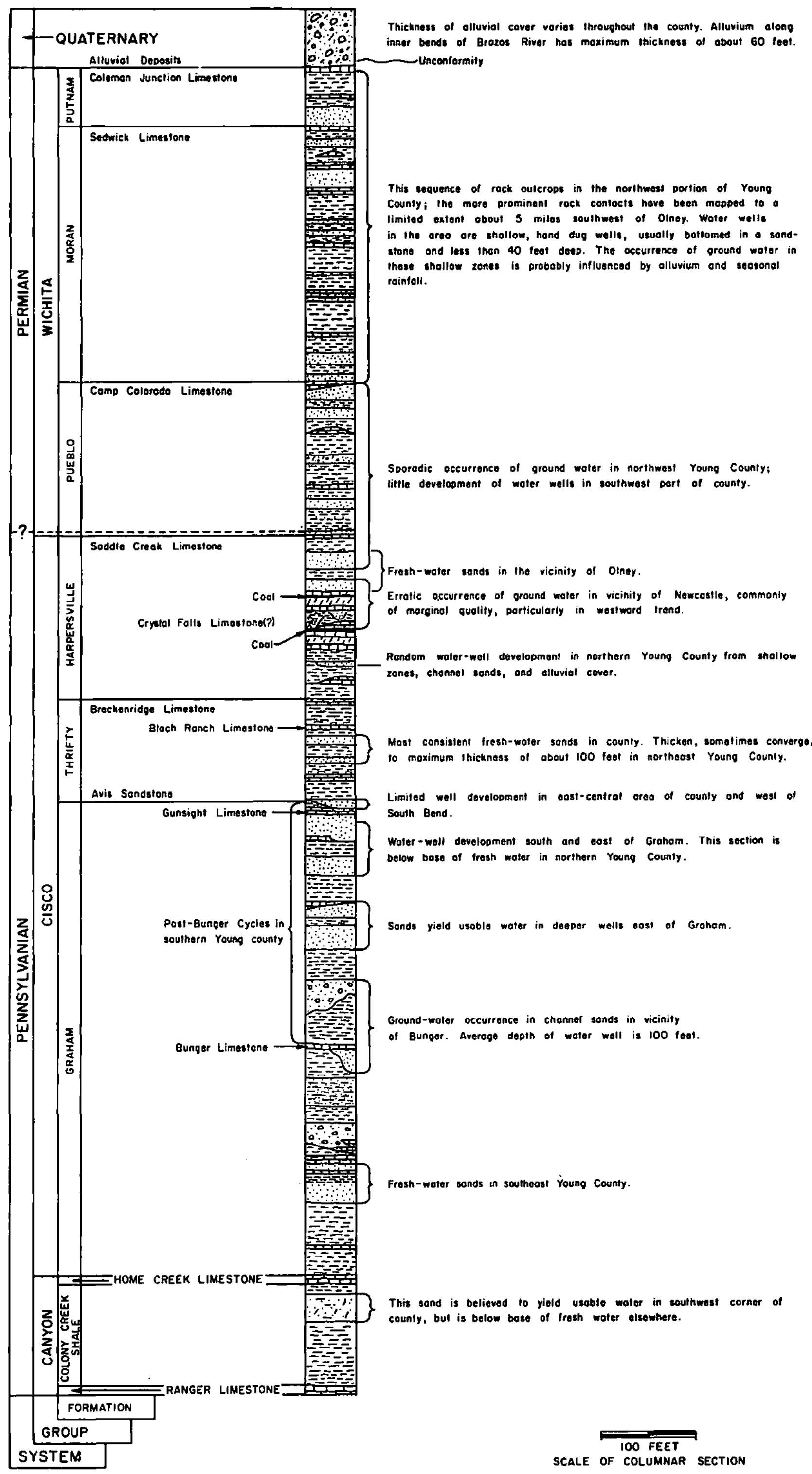

Figure 3

Geologic Formations in Young County

Texas Water Commission in cooperation with the Texas Water Pollution Control Board

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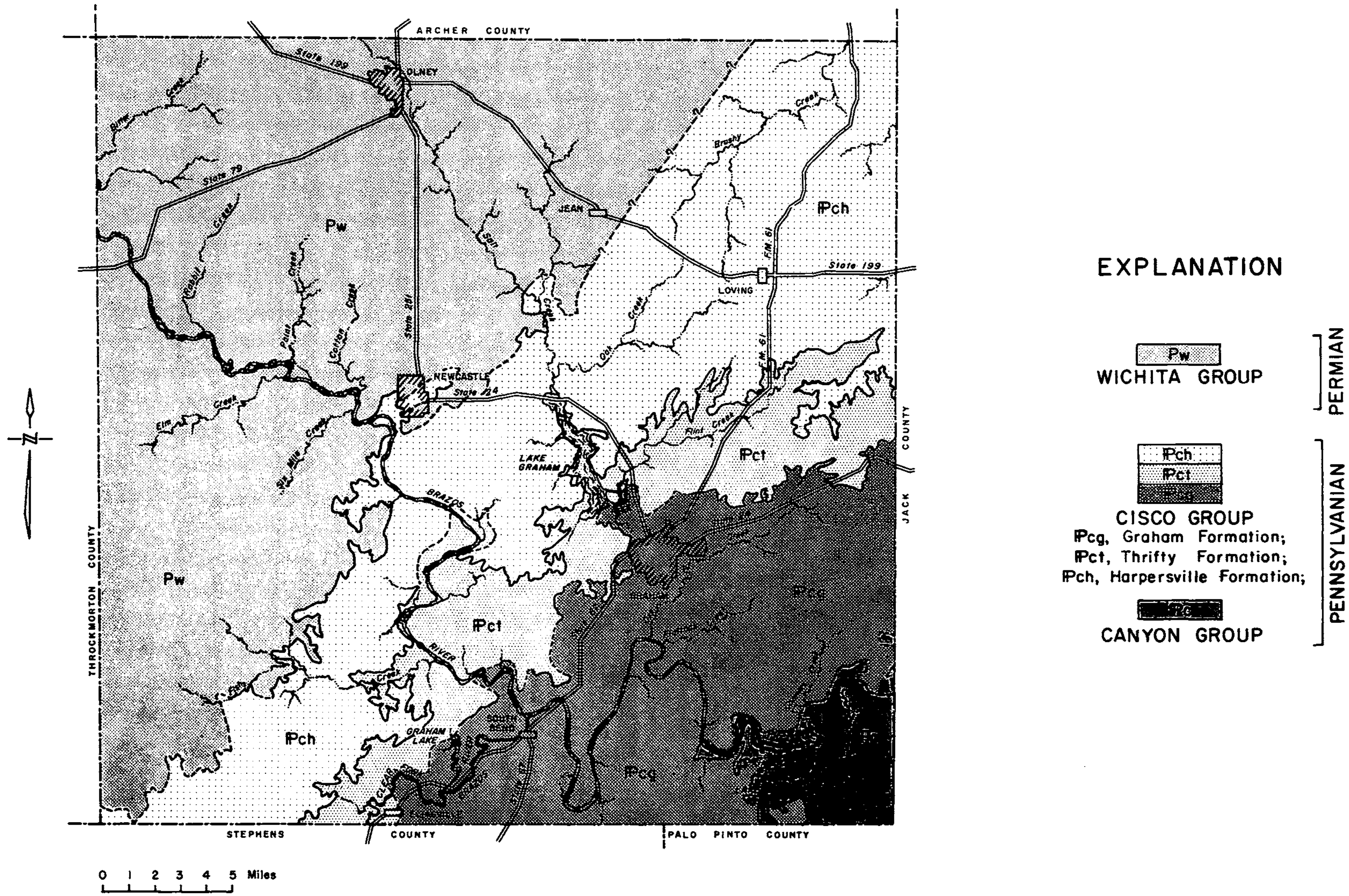

Figure 4

Geologic Map of Young County

Texas Water Commission in cooperation with the Texas Water Pollution Control Board

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The silica and bicarbonate content are relatively constant throughout the county. The silica content is low, seldom exceeding 25 ppm (parts per million), whereas the bicarbonate content is always relatively high, and has a usual range of 200 to 700 ppm. This range in bicarbonate content is proportional to the increase in the subsurface depth of water-bearing zones. The sodium content of ground water also increases with depth. In contrast, however, calcium is present in greater concentrations in shallow zones than in the deep zones. The magnesium content increases with the calcium content, but only nine analyses showed magnesium in excess of 125 ppm.

The average fluoride content of all analyses of ground water in Young County was 0.9 ppm and 69 percent of the analyses had less than this average.

In 66 of the water analyses, about 15 percent of the total, the nitrate content exceeds 45 ppm. Eighteen of these 66 analyses were from wells over 100 feet in depth; however, the highest nitrate content occurs in the 48 wells less than 100 feet in depth.

The average sulfate content of ground-water analyses in the county is 172 ppm. Seventy-one percent of the analyses were less than this average concentration, and 18 percent of the analyses exceeded 250 ppm.

The widest range in concentration of a particular constituent in the ground-water samples in the county was found in chloride content. The average chloride content for the 434 analyses was 310 ppm. Chloride concentrations in 331 analyses (76 percent) were lower than this average.

The range in chloride content in the analyses is shown below:

Range in chloride (ppm)	Number of analyses	Percent of total analyses	Cumulative percent
less than 100	189	43.5	43.5
101 - 300	139	32.0	75.5
301 - 500	35	8.1	83.6
501 - 700	19	4.3	87.9
701 -1,000	14	3.2	91.1
1,001 -2,000	23	5.3	96.4
over 2,000	15	3.4	100.0

Range in values for total dissolved solids for 436 analyses is given below. These ranges in ppm were arbitrarily selected, and do not reflect criteria for use. The average TDS (total dissolved solids) from these analyses was 1,137 ppm, and 309 of the analyses (71 percent) were lower than this average value.

Range in dissolved solids (ppm)	Number of analyses	Percent of total analyses	Cumulative percent
0 - 600	122	28.0	28.0
601 - 1,200	194	44.5	72.5
1,201 - 2,000	67	15.3	87.8
2,001 - 3,000	28	6.4	94.2
over 3,000	25	5.8	100.0

Pennsylvanian System

Canyon Group

The Home Creek and Ranger Limestones of the Canyon Group outcrop in the southeast corner of Young County and, where traceable, form the upper boundary of the Canyon Group (see Figure 3). The interval between these limestone beds is about 125 to 150 feet and consists of sand, shale, and limestone lentils; however, outcrops in this part of the county have been obscured by channel deposition and erosion. The Kisinger Channel, which is a wide, deep, post-Canyon channel, has eroded through the Home Creek Limestone and into the Ranger Limestone in this area, and it seems probable that water wells located in this part of the county (see Plate 1) yield ground water from sediments deposited in this channel rather than from the formations of the Canyon Group.

Cisco Group

The Cisco Group is composed of the Graham, Thrifty, and Harpersville Formations, and outcrops over about 50 percent of the surface of Young County (see Figure 4). Previous geologic studies and surface mapping of the county have generally been restricted to investigations of these formations because the most persistent stratigraphic markers occur in the Cisco Group. Eighty percent of the water wells found in the county are productive from sands of the Cisco Group. The principal ground-water resources of Young County are in unnamed sands of the Cisco Group in the north and north-central part of the county. A discussion of the three principal formations of the Cisco group follows.

Graham Formation

The Graham Formation outcrops in a northeasterly trend in the southeastern quarter of Young County, and dips to the northwest. The formation extends over about 20 percent of the surface area of the county, and has an outcrop width of about 10 miles (see Figure 4).

The Graham Formation is normally about 600 feet thick in Young County except in the area of the Kisinger Channel, where it may reach a thickness of 750 feet. Lee (1938), who has mapped the Graham Formation in the county, defines several members that are prominent marker horizons in the Graham Formation. Lee described the lowermost Graham deposition as the deep-channel deposition in the Kisinger Channel, followed by alternating periods of deposition of marine limestones and shales and sandstones below the Bunger Limestone. Above the Bunger Limestone, Lee defined nine separate cycles of deposition. These cycles of deposition are marked by unconformities, irregular sedimentation, and channel deposits important to the occurrence of ground water. The interval between the Bunger Limestone and the Wayland Shale, which marks the top of the Graham Formation, is about 175 feet, and the Wayland Shale has a maximum known thickness in the county of about 110 feet. Many unconformities mark this section, and channel deposits are found in many areas, as deposition of sand and gravel alternating with marine invasion followed the periods of extensive erosion.

The Brazos River alluvium obscures much of the bedrock outcrops in the area. The alluvium is probably related to the occurrence of ground water in certain underlying channel sands through recharge, and possibly through discharge, but the areas in which this occurs cannot be delineated with present data. Thickness of channel-sand deposition varies from 20 feet to more than 100 feet in measured sections of the Graham Formation. The range in depths of water wells in local areas tends to confirm that these local channel-sand deposits are a primary source of ground water from the formation.

Eighty-four wells and 2 springs yield usable ground water from the Graham Formation. These wells are mostly in the areas of grid sections 20-60, 20-61, 31-03, and 31-04, as shown on Plate 1 and noted in Table 1. Thirty-seven of the wells produce water from sands within the post-Bunger cycles of deposition, and 40 produce water from intervals below the Bunger Limestone. The seven wells nearest the southeast corner of Young County are believed to yield water from shallow zones of the Kisinger Channel. Ground water in the Graham Formation has not been developed by wells in some areas of Young County because of the erratic nature of the channel sand, which sometimes does not yield water, and the limited need for water in sparsely populated areas. Water wells producing from the Graham Formation are used for domestic and livestock purposes.

The quality of water from the Graham Formation is highly variable. The average chloride content of water sampled from the formation is 353 ppm, but chlorides in 77 percent of the analyses were below this average, and chlorides in 43 percent of the analyses were below 100 ppm. The average total dissolved solids was 1,115 ppm in analyses of all the samples of water from the Graham Formation, and 74 percent of the analyses were below this average. Although the percentages of samples that were below average for chloride content and total dissolved solids (77 versus 74) are similar, only 22 percent of the samples had total dissolved solids less than 500 ppm. Thus the variation in total dissolved solids in the water from this formation does not seem to be related to chlorides alone, but also to the wide range of the other principal constituents such as calcium, magnesium, bicarbonate, and sulfate.

Water wells completed in the Graham Formation range in depth from about 30 feet to over 100 feet, but the average depth of wells completed in the formation is between 60 and 80 feet. The base of fresh water probably does not exceed 100 feet in most areas where water-well data was obtained; however, local variations in the depth to the base of fresh water occur, and are probably the result of changes in topography and the erratic occurrence of channel sands.

Well yields from the Graham Formation are generally very low, and the wells can be pumped dry with a jet pump or by a windmill. Water wells are generally cased to the bottom, commonly about 30 feet below the water-yielding zone in order to provide some water storage in the bottom of the well. Casing material is galvanized tin or steel, 5 to 7 inches in diameter. Generally only the top few feet of the casing is cemented to the bore hole so that seepage from various horizons can enter the well at perforations.

Thrifty Formation

The Thrifty Formation outcrops in a northeasterly trend through the center of Young County. The outcrop pattern of the formation is 1 to 6 miles wide and extends from the south-center to the east-center of the county (Figure 4).

The Thrifty Formation is defined as the sequence of rocks from the base of the Avis Sandstone to the top of the Breckenridge Limestone. This interval is generally about 110 feet thick in Young County. However, the Graham-Thrifty contact is obscured in surface mapping by channel-sand deposition, and the Avis Sandstone is not recognized in subsurface correlations in Young County.

Water wells a few miles west from South Bend (Plate 1) yield ground water from the Avis Sandstone. In a northeasterly trend toward Graham, the principal source of ground water is from the Avis and overlying channel sands.

In the central portion of Young County, water wells are completed in sands that are 50 to 100 feet below the Breckenridge Limestone. Subsurface depth of these sands ranges from 100 to 200 feet. The controlling factors are the dip of the beds to the northwest and the increase in surface elevation northward.

In the northeast quarter of Young County the fresh-water-bearing sands below the Breckenridge Limestone thicken locally to over 100 feet. Two miles northwest of Loving these sands nearly merge, forming an almost continuous fresh-water zone at a subsurface depth of 280 to 390 feet. About 3-1/2 miles northwest of Loving the base of these sands occurs at subsurface depths of 450 to 550 feet. Westward from Jean these sands are below the base of fresh water.

There appears to be a shale-to-sand facies change in the Thrifty Formation from central areas of the county to the vicinity of Loving. Several water-bearing sands occur north of Graham in the vicinity of Flint Creek at subsurface depths near 100 feet. Maximum thickness of the sands is about 20 feet, and locally there may be 2 or 3 different sands. Surface mapping of the Thrifty Formation in the east-central part of Young County indicates the presence of channel-sand deposition, which may be the ground-water source of shallow wells in this area.

There are 216 water wells and 1 spring that yield water from sands of the Thrifty Formation in Young County. This represents about 50 percent of the water-well development in the county. Wells completed in the Thrifty Formation are located in grid sections 20-36, 20-37, 20-43, 20-44, 20-45, 20-51, 20-52, 20-53, 20-58, 20-59, and 20-60 on Plate 1.

The best source of ground water in Young County is in sands of the Thrifty Formation from Loving to the north and east county lines. This area is generally sparsely populated, and there are only local concentrations of water wells in the area--used primarily for domestic and livestock needs. Some wells in this area obtain water from the Thrifty Formation for waterflooding on oil leases. These wells are shown on Plate 1 by industrial well symbols. Property owners in the vicinity of Loving and Markley report that water levels in their wells have been lowered over the past several years because of pumpage of water for waterflooding.

In other areas of the county where water-well development is lacking in the Thrifty Formation, the erratic nature of occurrence of usable ground water makes surface tanks a more practical supply for livestock needs.

The chemical quality of ground water from the Thrifty Formation is better than that of any other formation in Young County. The average chloride concentration and total dissolved solids from analyses of ground water of the formation was 217 ppm and 974 ppm respectively. In 76 percent of the chloride analyses the chloride was less than the average of 217 ppm, and 70 percent of the total dissolved solids analyses showed less than the average of 974 ppm. Water from shallow zones in the Thrifty has a high calcium and magnesium content, and water from the deeper zones of the formation has a high sodium content. It seems probable that some wells produce a mixture of these two groundwater types.

The depth of water wells completed in the Thrifty Formation increases from about 100 feet in south-central Young County to over 700 feet in the northeast. This change in depth of wells corresponds to the change in the depth to the base of fresh water shown on Figure 5.

There is an increase in well depth and depth to the base of fresh water in the northeast quarter of the county, but this increase is not uniform. Interpretation of electric logs from oil tests reveals pinching out or convergence of these Thrifty sands locally within the area, resulting in irregularities in the base of fresh water.

The maximum yield of ground water from wells completed in the Thrifty Formation is about 20 to 25 gpm (gallons per minute). This figure is based on reported information from oil lease pumpers who were familiar with fresh-water wells used in waterflooding operations. Generally the water wells in the Thrifty Formation adequately supply domestic or livestock needs if the well depth exceeds 200 to 300 feet. Wells that produce from shallower depths do not always have desired yields under prolonged pumpage. Overhead tanks and pressure tanks are frequently used to meet supply requirements in these instances.

Water-well construction in the formation generally consists of a 5- to 7-inch casing of steel or galvanized tin, bonded to the bore hole by concrete near the surface. Concrete slabs at the surface are used to stabilize foundations for pumps or windmills. Shale catchers are reportedly inserted above the casing perforations in some wells. A few wells were observed to have two strings of casing.

Harpersville Formation

The Harpersville Formation crops out in a northeasterly trend in a near diagonal from the southwest corner to the northeast corner of Young County. The formation dips to the northwest, and has an outcrop pattern that is about 2 to 8 miles wide (Figure 4).

The Harpersville Formation is defined as the sequence of rock from the top of the Breckenridge Limestone to the top of the Saddle Creek Limestone. The average thickness of the Harpersville is about 175 to 200 feet in Young County. The formation consists of alternating beds of shale, sandstone, and lenticular limestone. Carbonaceous and ferruginous shale and coal beds occur near the middle of the formation.

Productive fresh-water zones occur in sandstones near the top of the formation. Water-well development from these zones is deepest in the vicinity of Olney and south and southeast of Olney.

Shallow dug wells in north-central Young County are productive from channel sands and sandstones within the Harpersville. Depth of these wells is generally less than 40 feet, and the availability of water from these wells may be influenced by alluvial cover and abundance of rainfall. Although detailed geologic mapping of the area has not been made, correlation with deeper water wells indicates that productive zones are in the upper and lower zones of the Harpersville.

About 3 miles south of Newcastle fresh-water sands occur near the top of the Harpersville Formation. There is an erratic occurrence of ground water in deeper zones, which is often of marginal quality, particularly west from the outcrop.

There has been little development of ground-water resources in the Harpersville in northeast and central Young County where better supplies of usable ground water can be obtained from the Thrifty Formation. The erratic occurrence of ground water is the Harpersville Formation in other areas of the county has further restricted well development. Ground-water supply from zones within the Harpersville is used locally for domestic and livestock purposes.

Ground water from different zones of the Harpersville varies in chemical quality in the same manner as that of other formations in the county. Where usable water from the Harpersville occurs at depths over 100 feet, the sodium content is high and calcium-magnesium content is low. The converse is true of production from shallow zones. The average chloride concentration of 60 samples of ground water from the Harpersville is 328 ppm with 80 percent of the analyses below this average. The average total dissolved solids is 1,172 ppm, and 70 percent of the analyses had a lower total dissolved solids content. Excessive sulfate and nitrate content of some analyses from shallow zones, especially in dug wells, has increased the average of the total dissolved solids content.

The depth of water wells completed in zones of the Harpersville Formation ranges from less than 50 to nearly 200 feet. The base of fresh water in the formation is generally within 100 feet of the surface, but in certain areas there may be a total absence of any usable ground water. Figures 6, 7, and 8 illustrate the base of fresh water in east-west geologic sections of the county.

Well yields from the Harpersville Formation are generally low and some water wells can be pumped dry with fairly low capacity jet pumps. Hand dug wells are masonry lined with fieldstone. Drilled wells have 5- to 7-inch casing with the top few feet of the casing cemented to the well bore.

Permian System

Wichita Group

The Wichita Group outcrops over an extensive area of Young County that generally can be described as the area northwest of a diagonal from the southwest to the northeast corner of Young County (Figure 4). About 40 to 45 percent of the surface area of the county is within the outcrop area of the Wichita Group. Formations of the Wichita Group that outcrop in Young County are the Pueblo, Moran, and Putnam Formations, which strike to the northeast and dip to the northwest. The Pueblo Formation includes the rock interval from the top of the Saddle Creek Limestone to the top of the Camp Colorado Limestone, a thickness of about 160 to 180 feet in Young County. The Moran and Putnam Formations comprise the rock interval from the top of the Camp Colorado Limestone to the top of the Coleman Junction Limestone (Figure 3).

The geology of the Wichita Group has not been studied in detail, and many of the rock contacts defining formational boundaries are inferred or questionable on available geologic maps of Young County. Therefore, wells drawing from the Moran and Putnam Formations and questionable zones near the Pueblo-Moran contact are shown in Table 1 as producing from the Wichita Group.

Water-bearing zones of the Wichita Group in Young County consist of channel-sand deposits and thin sandstone units. These units are generally thin and yield water over a limited areal extent.

Water wells about 2 miles west of Newcastle are productive from sands near the base of the Pueblo Formation. Further west, across the Brazos River, wells are completed in middle to upper zones of the Pueblo.

Fresh-water zones near the top of the Pueblo Formation occur at depths of 60 to 75 feet about 5 miles southwest of Olney. The water wells located about 4 miles west of Olney yield ground water from sandstone and sand near the top of the Pueblo Formation or near the base of the Moran Formation.

Water wells in grid 20-41 on Plate 1 are hand-dug wells completed at shallow depths in the Moran and Putnam Formations. The wells are bottomed in sandstone or limestone, but since these beds are relatively thin it seems probable that the ground-water supply is in part from unconsolidated overlying strata.

Development of water wells in western areas of Young County is limited because of the sporadic occurrence of ground water in the Wichita Group. The 80 wells and 1 spring that are in zones of this group in Young County are in grids 20-34, 20-35, 20-36, 20-41, 20-42, 20-43, 20-49, 20-50, 20-51, 20-57, and 31-01 on Plate 1.

There is an absence of water-well development in most of the southwest quarter of the county. Residents of the Murray area report that information from drilling and seismic operations indicates the occurrence of usable ground water is uncommon.

Ground water from the Wichita Group is used for domestic and livestock purposes, but poor water quality in some areas precludes drinking and cooking uses.

The 80 chemical analyses of ground water from the Wichita Group indicate an average chloride concentration of 408 ppm and total dissolved solids of 1,447 ppm. Sixty-six percent of the analyses were below these averages. In most of the analyses, an above-average chloride concentration does not alone account for the corresponding high value of total dissolved solids. As shown in Table 2, high chloride concentrations are generally accompanied by high sulfates, whereas the sodium concentrations may correspond less closely to the chlorides. The calcium content from analyses of samples from shallow wells is variable over local areas and increases are accompanied by an increase in magnesium content. Nitrate content in ground water from the Wichita Group varies greatly, but is generally higher from shallow wells than deeper wells.

Water wells completed in the Wichita Group are generally less than 100 feet in depth, and a large number are hand dug wells that do not exceed 50 feet in depth. Where well depths exceed 100 feet, it is probable that the base of fresh water does not exceed 100 feet.

The yield of wells completed in the Wichita Group is low and commonly does not meet supply demands. Most of the wells can be pumped dry with low-capacity jet pumps, which necessitates limited pumpage.

Drilled wells are cased, usually with galvanized casing that is cemented to well bores near the surface. Hand dug wells have some type of stone masonry or concrete reinforcement. Wooden lids generally seal the top of the well structure.

Quaternary System

Alluvium

Thick alluvial deposits occur along the inside bends of the Brazos River in Young County. The development of secondary drainage, soil profiles, and other erosional features has resulted in scattered, surficial sandy deposits throughout other areas of the county. The thickness of the alluvium is about 60 feet along the Brazos River, but probably less than 20 feet elsewhere in the county. The geologic age of the alluvium is designated as Quaternary in Figure 3 as published references to more exact age could not be found.

On the basis of interviews with landowners, water wells whose supply source is thought to be restricted to alluvial deposits are: 20-50-404, 20-50-605, 20-50-901, 20-59-102, 20-60-501, 20-60-804, and 31-03-302 (Plate 1).

Ground water is supplied to these wells by unconsolidated sediments, principally sand and sandy loams. Ground water from these wells is used for domestic and livestock purposes. The water from these wells has such a wide range of quality that no trend could be established for comparison.

The depth of wells that produce from alluvial deposits ranges from 20 to 80 feet. In the deeper wells that are of smaller diameter there is some allowance for a storage reservoir in the casing below the productive horizons. Well yields from alluvial deposits vary seasonally, being largely influenced by rainfall.

SURFACE CASING

The function of the Surface Casing Section in the Ground Water Division of the Texas Water Commission is to recommend to members of the oil and gas industry and the Railroad Commission of Texas the depth to which ground water should be protected in drilling tests for oil and gas. The authority for participation by the Texas Water Commission in the surface casing program is derived from rules promulgated by the Railroad Commission under authority given that agency by the statutes dealing with regulation of drilling and production activities of the oil industry.

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

In carrying out its duties under Rule 12a, the Texas Water Commission created the Surface Casing Section in the Ground Water Division. The staff of the Surface Casing Section is responsible for maintaining technical-data files upon which to base fresh-water-protection recommendations in all areas of the State, and for preparing these recommendations on application by operators contemplating drilling test wells. The depth to which ground water of usable quality should be protected in a given area is based on all pertinent information available to the Surface Casing Section staff at the time the recommendation is given. Recommended depths in any one area may therefore be revised from time to time as additional subsurface information becomes available. Known depths of water wells being used or depths of wells known to contain water of usable quality, such as domestic, municipal, industrial, livestock, or irrigation wells, are of primary value. Electric or gamma-ray neutron logs run on oil and gas tests are used in many areas of the State to determine the depth to which the base of usable-quality ground water occurs. Surface elevation is considered when a recommendation is given in an area that has moderate to high surface relief, as is common in the north-central Texas counties. This consideration is imperative when the area is dissected by streams because of the danger that poor-quality water will cause contamination of surface and ground water by moving along the dip of the beds to emerge at lower elevations. All of this information is interpreted in the light of the best knowledge of the geology and ground-water hydrology available on the area involved.

Because of the erratic occurrence of ground water in Young County, which was described in the preceding section of this report, known depths of water wells are given special weight in preparing surface-casing recommendations in the county. Electric logs are also useful in portions of the county where continuous zones in the shallow subsurface can be correlated over the area. This was noted especially in the Farmer, Jean, and Loving communities in the northeastern portion of the county, and to some extent in the central portion of the county near the community of Newcastle. The Surface Casing Section gives particularly close attention to surface elevations in addition to information on water wells and electric logs because of the dissection of the surface rock in the area by the Brazos River.

In Young County a county-wide depth recommendation is not feasible because the depth of surface-casing protection, which would be required in those areas of the county where deep water wells are found, would be an excessive requirement in many other parts of the county. The preceding section of this report describes the occurrence of ground water of usable quality in a number of formations at depths ranging from the surface to 750 feet. Thus, the results of this study confirm that surface-casing recommendations in this county should be made on a well-to-well or lease-to-lease basis in order to provide adequately for water protection without imposing unnecessary burdens for excessive protection in those areas where deep protection is not needed.

During the 5-year period from 1958 through 1962, the Surface Casing staff prepared 1,377 recommendations for protection of usable-quality ground water for oil and gas tests. Two-hundred-twelve recommendations were prepared during 1963. The depths of these recommendations range from 100 to 800 feet.

OIL-FIELD BRINE PRODUCTION AND DISPOSAL

Quantity and Distribution of Produced Brine

In January 1962, the Railroad Commission of Texas and the Texas Water Commission collected information from the oil industry concerning salt-water production and disposal for the previous calendar year. A summary of this salt-water inventory for Young County shown on Table 3 shows a reported production of 16,038,180 barrels of salt water. Of this amount 93.4 percent was reported to have been disposed of by injection into the subsurface. In Table 3, the total brine production and disposal has been subdivided to show totals for the principal watersheds in the county. These figures show that brine production in barrels for watersheds of the county during 1961 was: Brazos River Basin 10,587,161; Trinity River Basin 5,421,019; Red River Basin 30,000.

Field inspections were made during the course of this study to ascertain the accuracy of reported salt-water data. The comparison of reported data with field observation of brine production and disposal is not favorable. However, field inspections were made at random throughout the county without detailed observation of individual oil fields. Therefore, discrepancies between reported data and observed practices were used only in evaluating the accuracy of total brine production and disposal within the county.

Reported data from the 1961 salt water inventory on production and disposal of brine that was found to be inaccurate by field inspection are listed as follows:

1. In interviews with pumpers, gaugers, and field supervisors at lease sites, the current reported or observed brine production always exceeded production reported on the 1961 inventory.

2. For some leases that reported disposal of brine by injection well, inspection showed that disposal was actually into surface pits and no injection well existed.

3. Dual methods of brine disposal (pits and injection well) were observed on leases where reported data showed 100 percent disposal to injection wells. Salt water attributed to injection wells on the questionnaire is commonly placed in surface storage pits prior to injection. Many cases were observed, however, where the tendency was to use the storage pit as the primary means of disposal.

4. A few disposal wells were observed where surface injection pressures exceeded the reported maximum injection pressure.

Plate 3 shows the amount of brine production for various areas as compiled from the 1961 salt water inventory, without regard to producing horizon. Area totals are subdivided into surface-pit disposal and injection-well disposal, and are tabulated in Table 3.

Chemical Quality of Produced Brine

Selected chemical analyses of brine produced in Young County are shown in Table 4. In these brine analyses the ratio of chloride to sodium is about 2 to 1, and these two constituents comprise about 90 percent of the total mineral content of the samples analyzed. Calcium and magnesium are the remaining significant constituents. Mississippian brines sampled were less concentrated than Pennsylvanian brines, but the notable difference is a lower percentage of calcium among the dissolved solids and a corresponding greater sulfate concentration in the Mississippian brines. Chloride concentrations in the Pennsylvanian brines ranged from 63,650 to 112,600 ppm, and sodium concentrations from 31,100 to 47,395 ppm. Mississippian brines had a chloride content ranging from 47,750 to 77,600 ppm, and of sodium from 25,280 to 39,500 ppm. The range in total solids in Pennsylvanian brines was 1C2,787 ppm to 179,000 ppm, and the range in Mississippian brines was 78,850 to 126,714 ppm.

A sharp contrast is apparent between chemical analyses of samples of fresh ground water and those of oil-field brines in Young County. Chloride and sulfate occur in relatively small concentrations in fresh ground water; bicarbonate, sodium, and calcium are the principal constituents as shown on Plate 2. Brine analyses show sodium and chloride as the principal constituents.

ALTERATION OF NATIVE CHEMICAL QUALITY OF WATER

Thirty-seven water wells, apparently brine contaminated, and 59 surface-kill areas where no vegetation is present and that apparently resulted from discharge of brine onto the surface or overflow of disposal pits are shown on Plate 3.

The size of kill areas observed in this study ranged from less than an acre to several acres. Water wells are indicated as apparently contaminated if the following criteria were met: excessive increase in chloride concentrations above average chloride content of ground water in the local area, proximity of possible contributing sources, and quality changes reported by landowners.

Figure 9 compares diagrams for many of these apparently contaminated wells with native quality ground water and a typical oil-field brine. Chemical analyses of samples representing a native-quality water, brine, and the apparently contaminated wells were converted from parts per million to equivalents per million for purposes of constructing these diagrams. An average Strawn brine was selected as a typical brine, and was plotted on a scale of 1 inch equals 500 epm--25 times smaller than the scale used to illustrate the native quality of water and the contaminated wells--in order to plot the pattern diagram for the brine on standard-size paper. The pattern for the brine analysis was repeated throughout Figure 9, because this pattern is representative of brines from other horizons (Table 4).

The diagrams in Figure 9 illustrate by comparison the diagnostic change of native quality water to contaminated water by mixing with oil-field brine. These changes may be noted by examining the chemical analyses in Table 2 and the locations shown on Plate 1, but the pattern diagrams consolidate the data and make visual interpretation possible.

One large area of Young County that is considered a contaminated area of both ground water and surface water is the South Bend-Eliasville area. R. T. Littleton of the then Texas Board of Water Engineers made a report on this area in June 1956. The conditions of brine disposal into surface pits on alluvial surfaces noted by Littleton were found in the present investigation. Reported locations concerning unplugged wells in this area could not be verified by Littleton or in the present study. Joint reports made by the Texas State Department of Health and the Texas Game and Fish Commission (1952a, 1952b) indicate that the Clear Fork, the principal stream draining the area, is a prime contamination source of the Brazos River. Water analyses of the Clear Fork ranged in chloride content from 1,060 to 10,200 ppm in 1956 (Littleton).

Littleton further stated that in this area salt water has invaded near-surface strata via old improperly plugged wells. Interviews with drilling operators during the course of this study confirm that salt water in this area and in southwest Young County rises in well bores to within 100 feet of the surface during drilling.

The following discussion points out a typical example of the alteration of ground-water quality found in numerous areas during the present investigation. The pattern diagrams of analyses for wells 20-42-301 and 20-42-306 (Figure 9), 2 to 3 miles southwest of Olney, indicate that the quality of ground water in that area has been altered. Native quality water in the area is illustrated by well 20-42-304. The diagram for well 20-42-301 appears to be an admixture of brine and fresh water. The diagram for well 20-42-306 shows a sharp increase in calcium and magnesium as well as in chloride. The increase in chloride is indicative of contamination, although this does not necessarily account for the increase in calcium and magnesium. However, it was noted throughout this study that an increase in sodium chloride was commonly accompanied by increase in sulfate and calcium-magnesium content. This may be explained by variations in chemical quality of brines and chemical processes such as the reduction of low-pH brines at aerated shallow depths. When this occurs, however, it is noted that the sodium content of the analysis of the contaminated water does not increase in proportion to the chloride, and that the chemical balancing of cations is reflected in an increase in calcium-magnesium content.

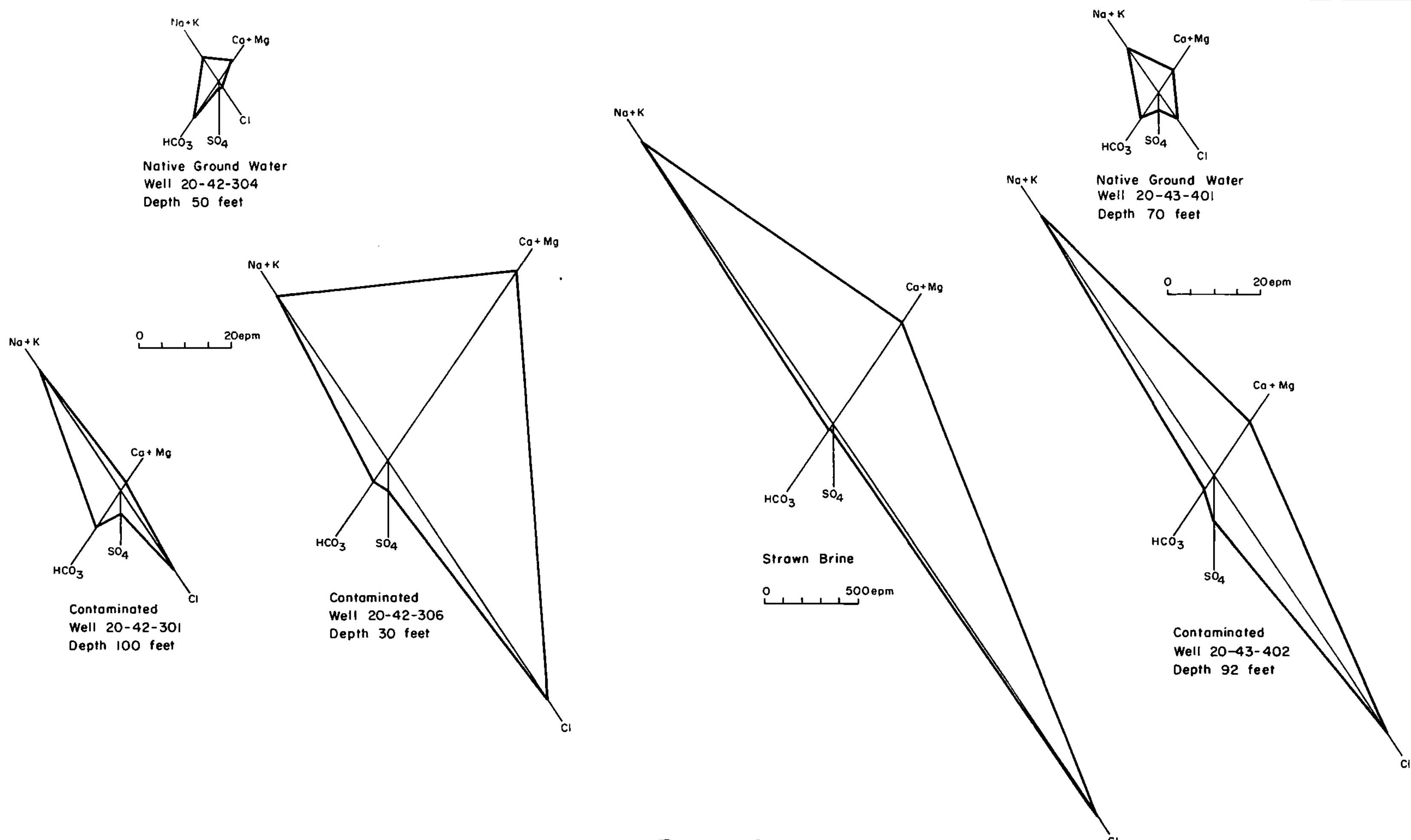

Figure 9

Diagrams of Chemical Analyses of Water from Contaminated Wells, Showing Comparison with Native-Quality Ground Water and a Typical Oil-Field Brine

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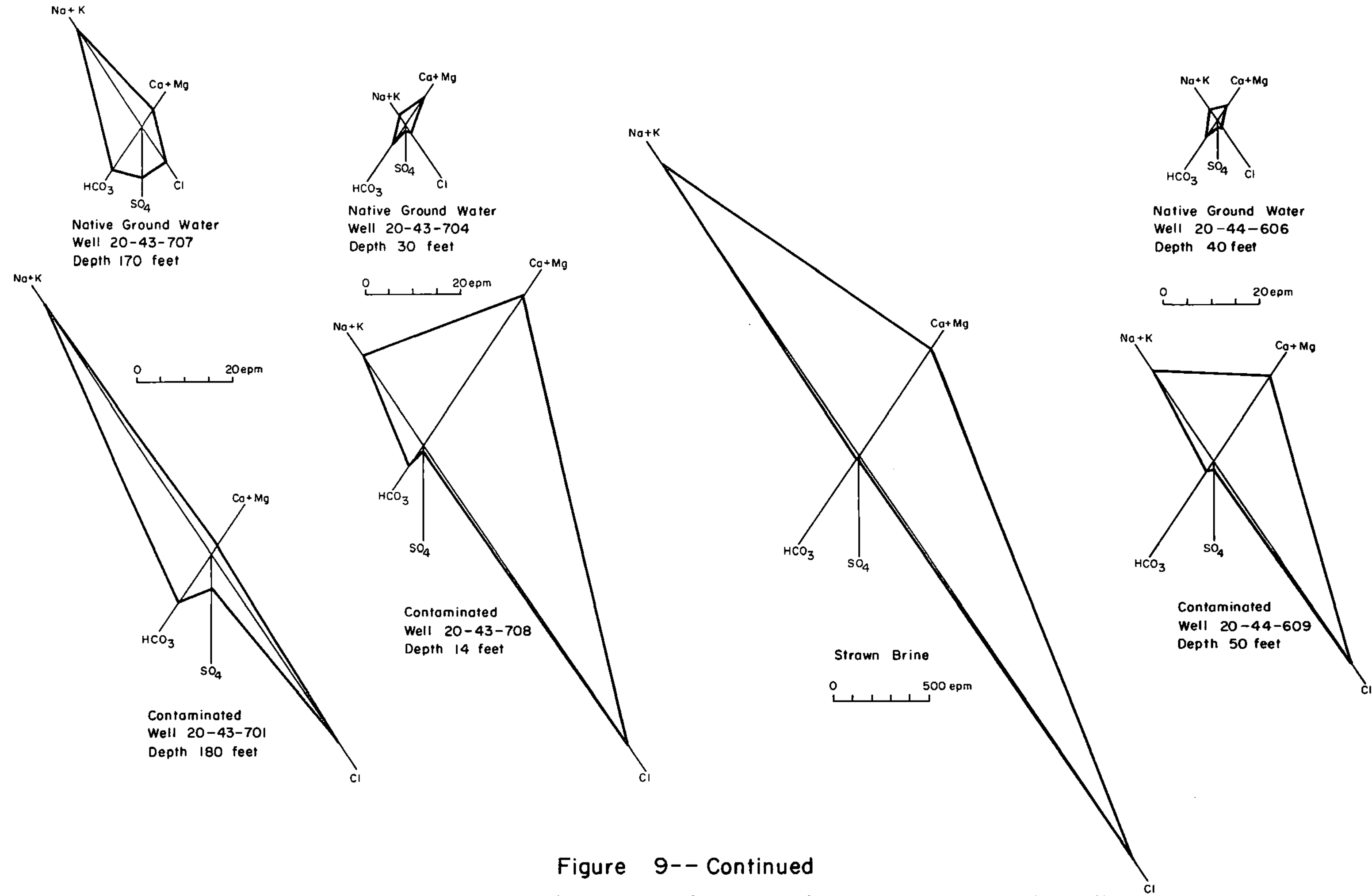

Figure 9-- Continued

Diagrams of Chemical Analyses of Water from Contaminated Wells, Showing Comparison with Native-Quality Ground Water and a Typical Oil-Field Brine

Texas Water Commission in cooperation with the Texas Water Pollution Control Board

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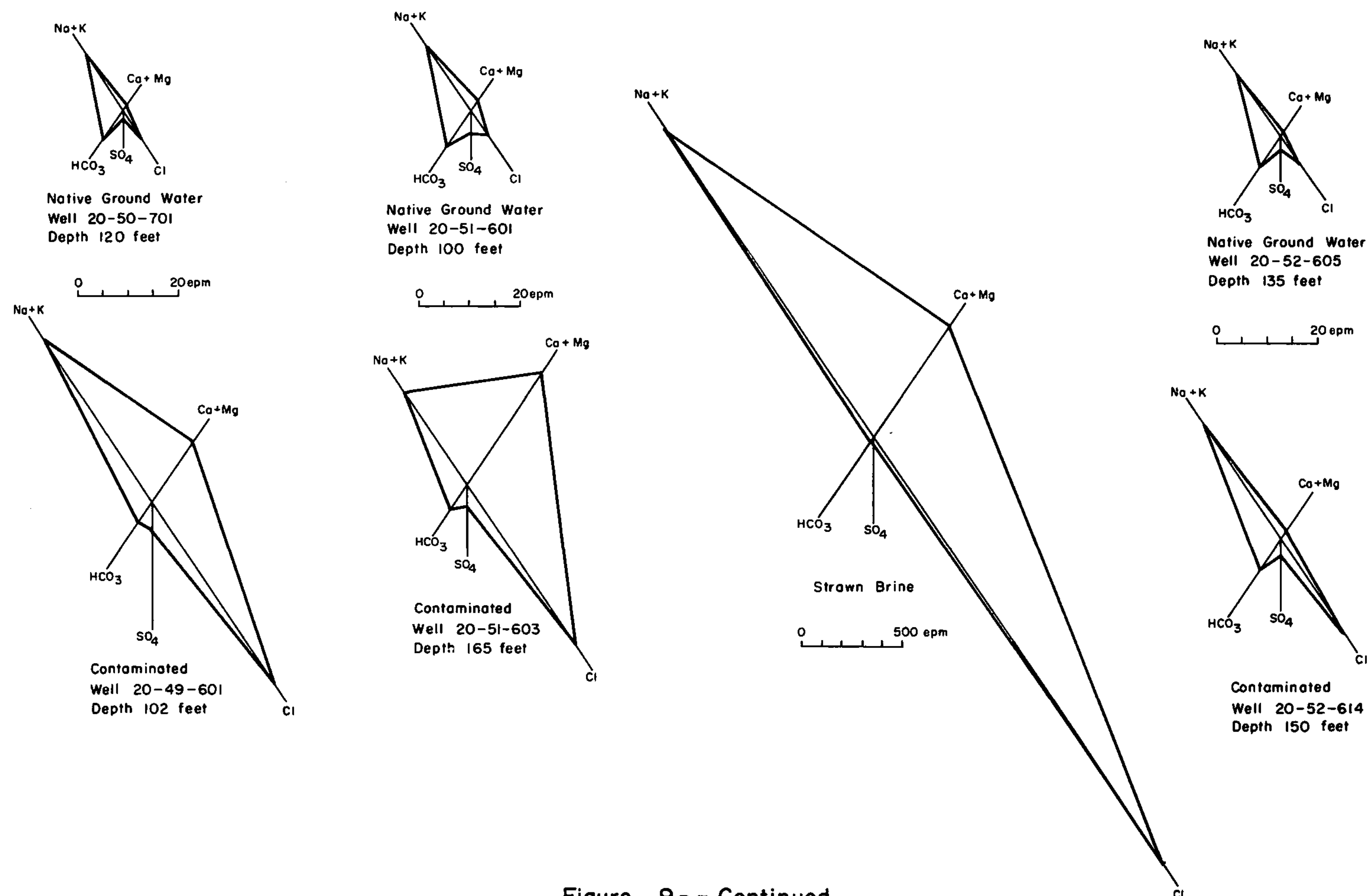

Figure 9-- Continued

Diagrams of Chemical Analyses of Water from Contaminated Wells, Showing Comparison with Native-Quality Ground Water and a Typical Oil-Field Brine

Texas Water Commission in cooperation with the Texas Water Pollution Control Board

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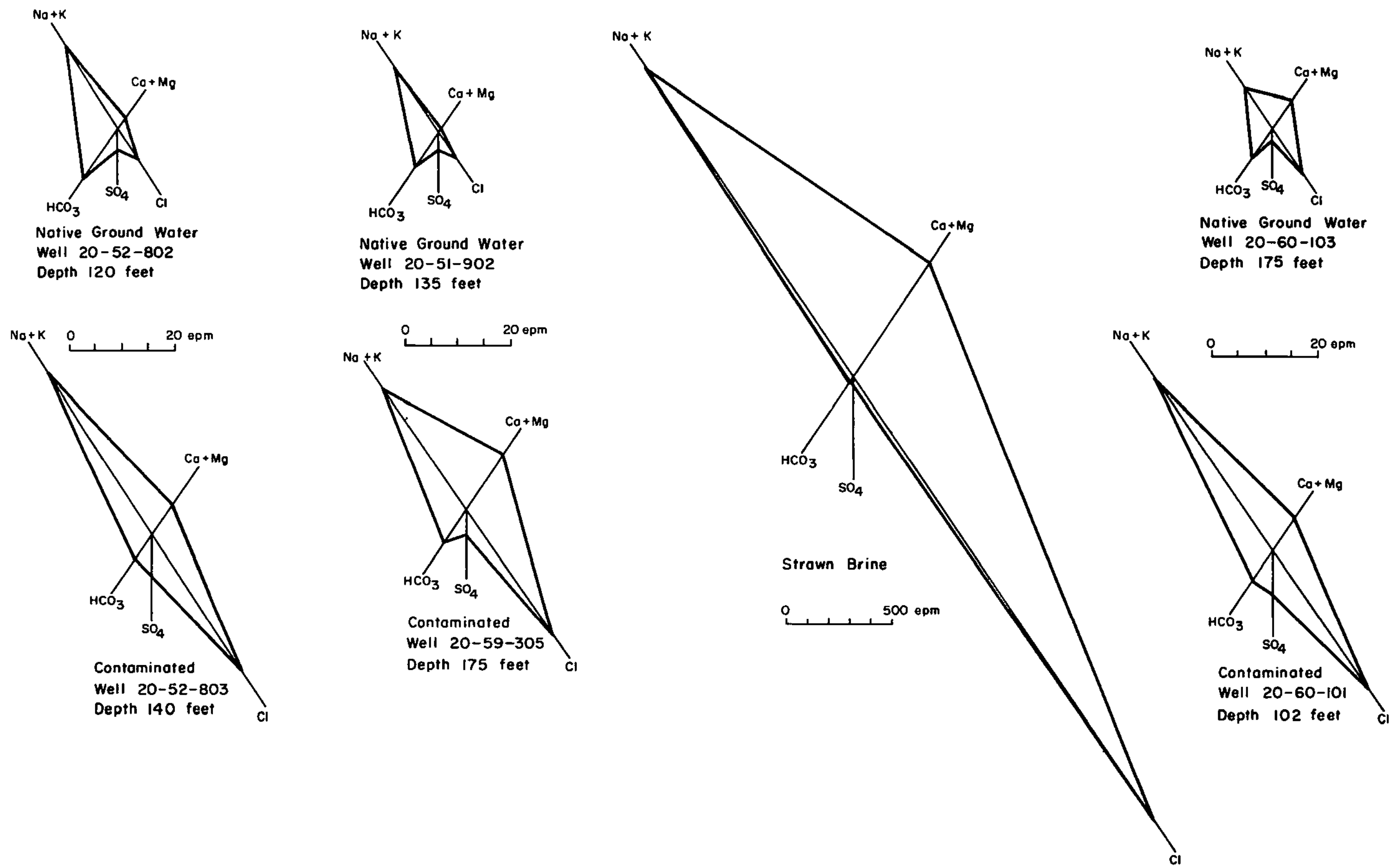

Figure 9-- Continued

Diagrams of Chemical Analyses of Water from Contaminated Wells, Showing Comparison with Native-Quality Ground Water and a Typical Oil-Field Brine

Texas Water Commission in cooperation with the Texas Water Pollution Control Board

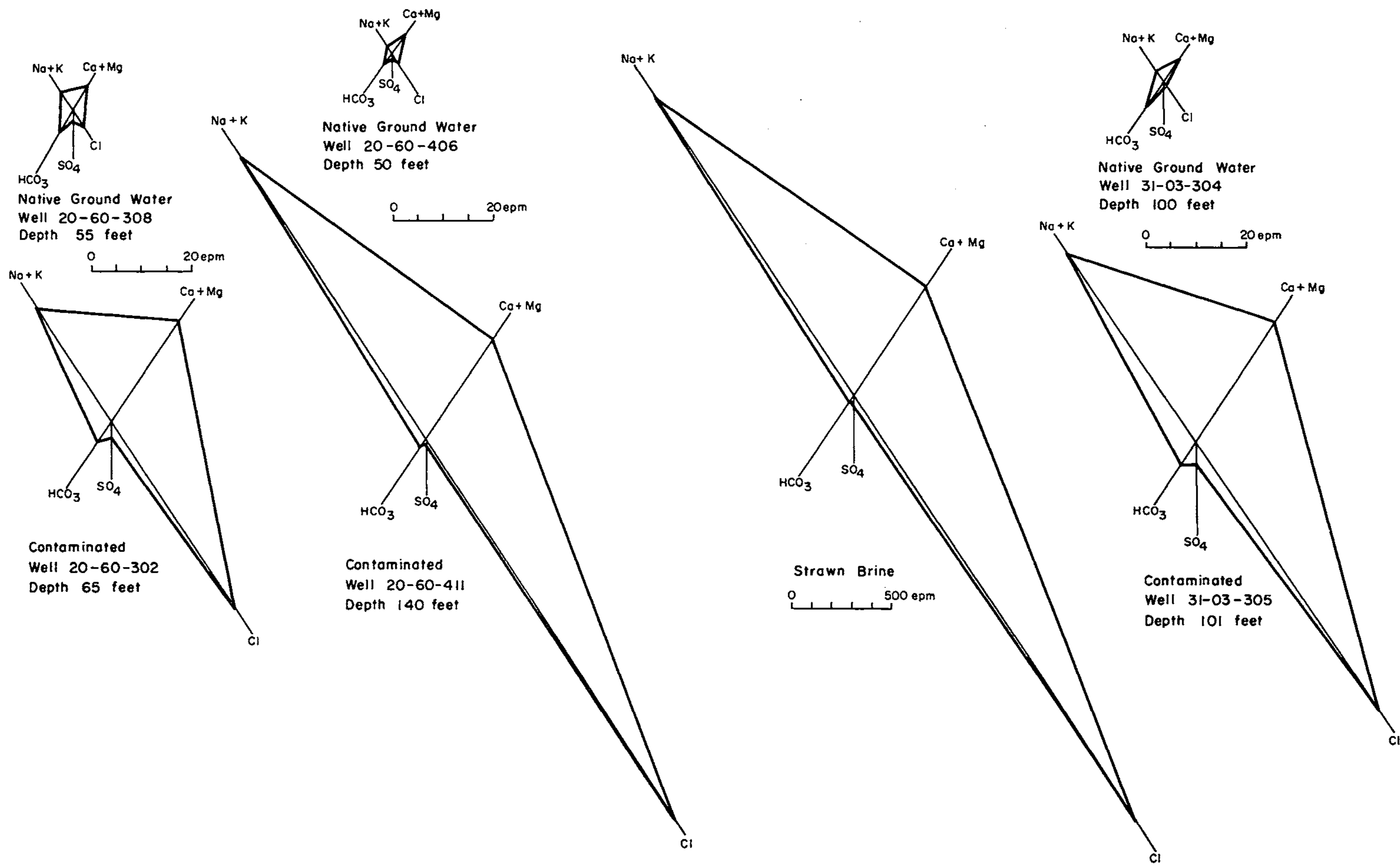

Figure 9--Continued

Diagrams of Chemical Analyses of Water from Contaminated Wells, Showing Comparison with Native-Quality Ground Water and a Typical Oil-Field Brine

Texas Water Commission in cooperation with the Texas Water Pollution Control Board

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Surface-kill areas have resulted from former surface disposal of brine in the vicinity of wells 20-42-301 and 20-42-306 (Plate 3). Although disposal pits are no longer used, they should be filled and mounded to restrict capture of rainfall and surface runoff. A Mississippian oil test, lost due to blow-out a few hundred feet from well 20-42-306, was reported by the landowner and residents of this area. Two improperly completed salt-water disposal wells were also found in the immediate area of the contaminated wells during the course of this study. The oil operator corrected the construction of these disposal wells, which had no surface casing, by abandoning and plugging one well and by circulating cement from the injection zone to the surface in the other well. These operations were witnessed by field representatives of the Railroad Commission and Water Commission. It seems probable that these factors--surface disposal, blow-out, and improperly completed disposal wells--have contributed to ground-water contamination.

Other subtle changes were observed in the chemical quality of ground water in Young County that are not included in Figure 9 and Plate 3. These changes may be suggestive of salt-water contamination, but did not meet the criteria listed above for classification as contamination. The quality changes illustrated represent some of the more gross instances of contamination. The comparison of native quality to contaminated water in Figure 9 is not one of the best quality versus poorest quality, but rather of average quality and maximum change in average quality. The ratio of chloride content of the contaminated wells to that of native quality water, illustrated in Figure 9, ranged from 2:1 to nearly 100:1. The average for this chloride-increase ratio is more than 10:1.

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Table 1.--Records of wells and springs, Young County

Water-bearing unit : All, Alluvium; G, Graham Formation; Har, Harpersville Formation; Pu, Pueblo Formation; Th, Thrifty Formation; Wi, Wichita Group.
Water levels : Reported levels given in feet; measured water levels given in feet and tenths.
Method of lift and type of power : B, bucket or bailer; C, cylinder; Cf, centrifugal; E, electric; G, natural gas, butane or gasoline; H, hand; J, Jet; N, None; : S, submersible; T, turbine; W, Windmill; Number indicates horsepower.
Use of water : D, domestic; Ind, industrial; Irr, irrigation; P, public supply; S, stock; N, none.

Well	Owner	Driller	Date completed	Depth of well (ft.)	Casing: Diameter (in.)	Casing: Depth (ft.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Below land-surface datum (ft.)	Water level: Date of measurement	Method of lift and type of power	Use of Water	Remarks
*20-34-801	J. J. Darilek	--	1952	80	7	80	Wi	1,279	19.8	Aug. 13, 1962	N	N	Oil test plugged at 80 ft.
* 901	Emma Wiechman	--	1927	19	--	--	Wi	1,219	10	Sept.11, 1962	C,W	D	40-in. diameter stone-lined dug well.
* 35-901	Joe Campbell	--	1900	96	5	96	Pu	1,163	45.4	Aug. 3, 1962	C,E 3/4	D	
* 902	Underwood Oil Co.	--	1935	100	7	100	Pu	1,147	65	do	C,G 2	D	
* 903	C. W. Boydston	--	1925	60	5	60	Pu	1,175	53.5	do	C,W	D	
* 36-701	Oil Tex Supply Co.	T. C. Graham	1959	100	7	100	Pu	1,160	20	Aug. 2, 1962	C,E 2	D	
* 702	C. B. King Oil Co.	--	1959	220	5	220	Har	1,131	176.3	do	C,G 2	D	
* 703	Clyde Benson	--	1935	45	5	45	Pu	1,170	14.6	Aug. 3, 1962	C,E 1/4	S	
* 704	Lester Lee	B. C. Gilliam	1950	80	5	70	Pu	1,191	53.9	do	C,E 1/3	D	
* 801	Crenshaw & Whitehill Oil Co.	--	1961	587	7	587	Th	1,176	311.5	July 31, 1962	S,E 2	Ind	Used for waterflood supply.
* 901	Tenneco Oil Co.	--	--	375	7	375	Th	1,138	225	Aug. 20, 1960	C,G 2	Ind	1/
* 37-806	J. McDonald	Cable Oil Co.	1935	360	7	360	Th	1,032	210	July 9, 1962	C,G 2	Ind	Used for waterflood supply.
807	do	--	1935	350	7	350	Th	1,038	209.1	do	N	N	1/
* 808	Birdwell Oil Co.	--	1935	350	7	350	Th	1,040	209.9	do	C,E 3/4	D	
* 41-201	S. B. Young	T. L. Brumley	1926	25	--	--	Wi	1,155	11.1	Sept.10, 1962	C,W	S	36-in. concrete-lined dug well.
* 202	do	Owner	1935	29	--	--	Wi	1,166	22.5	do	J,E 1/2	D	
* 501	J. F. Daniels	--	1934	25	--	--	Wi	1,215	13.2	Sept. 4, 1962	C,W	D	40-in. diameter dug well.
* 502	Oscar Abbott	--	1927	30	--	--	Wi	1,167	25	Sept.10, 1962	C,W	D	Do.

See footnote at end of table.

Table 1.--Records of wells and springs, Young County--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Casing: Diameter (in.)	Casing: Depth (ft.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Below land-surface datum (ft.)	Water level: Date of measurement	Method of lift and type of power	Use of water	Remarks
*20-41-801	V. Foster	--	1941	20	--	--	Wi	1,132	13.6	Sept. 4, 1962	J,E 1/2	D	40-in. diameter dug well.
* 802	do	--	1956	27	16	27	Wi	1,127	11.6	do	N	N	
* 803	Mark Campbell	--	1945	30	--	--	Wi	1,126	18.4	do	J,E 1/2	D	36-in. diameter concrete-lined dug well.
* 804	J. F. Daniels	--	1945	10	--	--	Wi	1,162	7.7	Sept. 4, 1962	C,W	S	
* 901	R. M. Carr	--	1950	42	--	--	Wi	1,211	32.4	Aug. 30, 1962	C,W	D	40-in. diameter stone-lined dug well.
* 902	J. G. Robinson	--	1930	35	--	--	Wi	1,202	25.4	do	J,E 1/2	D	Do.
* 903	Coy Eddleman	--	1912	32	--	--	Wi	1,212	22.6	do	C,W	D	Do.
* 904	Adele Furr	--	1912	25	--	--	Wi	1,148	9.3	Aug. 31, 1962	J,E 1/2	S	36-in. diameter stone-lined dug well.
* 905	do	--	1934	27	--	--	Wi	1,159	8.1	do	J,E 1/2	D	40-in. diameter stone-lined dug well.
* 906	T. J. Eddleman	--	1900	40	--	--	Wi	1,224	33.5	Sept. 4, 1962	J,E 1/4	D	Do.
* 42-201	H. E. Neeley, Jr.	Dardon Drilling Co.	1952	210	5	210	Pu	1,275	113.2	Sept.10, 1962	S,E 1/2	S	
* 202	do	--	1906	50	--	--	Wi	1,280	37.5	do	J,E 3/4	D	48-in. diameter brick-lined dug well.
* 203	S. J. Carter	--	1935	22	--	--	Wi	1,255	13.0	do	J,E 1/2	D	42-in. diameter brick-lined dug well.
* 204	Alfred Johle	--	1955	70	5	70	Wi	1,256	19.4	do	J,E 1/2	D	
* 205	E. A. Kunkel	--	1920	15	--	--	Wi	1,279	3.1	do	B,H	D	40-in. diameter brick-lined dug well.
* 301	W. A. Roenfeldt	--	1940	100	5	100	Pu	1,223	85.0	Aug. 16, 1962	C,W	D	
* 302	Fred Millican	--	1930	65	5	65	Pu	1,213	47.3	Aug. 17, 1962	C,W	D	
* 303	L. Alexander	--	1961	100	5	100	Pu	1,205	43.4	Aug. 16, 1962	J,E 1	D	
* 304	R. O'dell	--	1958	50	5	50	Pu	1,204	28.8	do	J,E 1/2	D	
* 305	do	--	1962	103	5	103	Pu	1,204	41.4	do	J,E 1/2	D	
* 306	C. F. Kunkel, Est.	--	1943	30	5	30	Pu	1,236	6.5	do	N	N	

See footnote at end of table.

Table 1.--Records of wells and springs, Young County--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Casing: Diameter (in.)	Casing: Depth (ft.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Below land-surface datum (ft.)	Water level: Date of measurement	Method of lift and type of power	Use of water	Remarks
*20-42-501	Homer Dunn	--	1953	50	5	50	Pu	1,252	8.7	Aug. 17, 1962	J,E, 1/3	D	
* 502	W. E. Stowe	--	1927	110	5	80	Wi	1,227	82.0	Sept.10, 1962	B,H	D	Caved at 100 ft.
* 503	Bert Dunigan	--	1941	115	4	80	Wi	1,225	79.3	do	C,E, 1/2	D	
* 504	Luther Wright	--	1925	85	5	85	Wi	1,225	72.8	Sept.11, 1962	C,W	D	
* 505	J. F. McCauley	--	1920	165	5	165	Wi	1,255	100	do	C,E, 1	D	Plugged oil test.
* 601	R. O'dell	--	1930	80	5	80	Pu	1,207	54.4	Aug. 16, 1962	C,W	D	
* 602	Sid Bailey	--	1900	50	--	--	Pu	1,221	20	Aug. 14, 1962	C,W	S	48-in. diameter stone-lined dug well.
* 603	-- Allison	R. Farmer	1954	86	5	86	Pu	1,226	56.0	do	C,W	S	1/
* 604	J. W. Harvey	--	1930	100	7	100	Pu	1,196	20	Aug. 15, 1962	C,E, 1/2	D	
* 605	L. H. Davidson	--	1955	140	5	140	Pu	1,214	40	do	C,E, 1/2	D	
* 606	R. E. Daily	--	1956	80	4-1/2	80	Pu	1,181	29.2	Aug. 16, 1962	C,E, 1/3	D	
* 607	Dennis Herring	--	1950	90	8	90	Pu	1,175	30.8	do	J,E, 1/2	D	
* 901	M. H. Williams	--	--	55	5	55	Pu	1,176	25.2	Aug. 9, 1962	C,W	S	
* 902	W. T. Thresher	--	1928	28	--	--	Pu	1,218	24.2	do	C,W	D	36-in. diameter stone-lined dug well.
* 903	G. W. Hilterbrand	--	--	30	5	30	Pu	1,237	28.3	Aug. 14, 1962	C,E, 3/4	D	Reported weak well.
* 904	Sid Bailey	--	1900	150	5	150	Pu	1,276	73.3	do	C,W	D	
* 43-101	G. D. Rothell	--	1928	50	5	50	Pu	1,176	20	Aug. 7, 1962	J,E, 1/2	D	
* 102	Dan Johnson	--	--	37	5	37	Pu	1,181	23.3	Sept.11, 1962	J,E, 1/2	D	Below surface elevation--well in 2.55 ft. cellar.
* 201	John Parsley	B. C. Gilliam	1941	25	7	9	Pu	1,207	10.8	Aug. 6, 1962	J,E, 1/2	D	
* 202	W. P. Easley	--	1947	16	--	--	Pu	1,200	8.4	do	J,E, 1/4	D	36-in. stone-lined dug well.
* 203	H. G. Pringle	--	1900	20	--	--	Pu	1,200	10	do	J,E, 1/2	D	36-in. diameter dug well.

See footnote at end of table.

Table 1.--Records of wells and springs, Young County--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Casing		Water-bearing unit	Altitude of land surface (ft.)	Water level		Method of lift and type of power	Use of Water	Remarks
					Diameter (in.)	Depth (ft.)			Below land-surface datum (ft.)	Date of measurement			
*20-43-204	Virgil Heard	Bill Crossweight	1960	90	5	90	Har	1,200	70	Aug. 6, 1962	J,E, 1/2	D	
* 401	C. C. Burton	--	1908	70	7	70	Pu	1,200	.9	Aug. 7, 1962	C,W	S	
* 402	M. Killian	--	1942	92	7	92	Pu	1,200	64	do	C,W	S	
* 403	Margaret Meadows	--	1943	30	5	30	Pu	1,145	12	Aug. 8, 1962	C,W	D	
* 404	J. R. Lindsay	Owner	1961	265	7	265	Th	1,138	120.9	do	C,E, 2	Ind	Waterflood supply.
* 405	S. B. Jeter	--	1956	80	6	80	Har	1,127	14.3	do	J,E, 1/2	D	
* 501	Frank Thomas	--	1954	30	5	30	Har	1,205	7.2	Aug. 3, 1962	J,E, 1/2	D	
* 502	Weldon Smith	--	1932	60	5	60	Har	1,195	20	do	C,W	D	
* 503	E. B. Clayton	--	1938	88	5	--	Har	1,159	35	do	C,H	D	Casing has collasped.
* 504	W. B. Wilson	--	1945	20	--	--	Har	1,177	10.3	Aug. 8, 1962	C,W	S	48-in. stone-lined dug well.
* 505	C. H. Rogers	--	1938	174	5	174	Th	1,197	160	Aug. 6, 1962	C,W	D	
* 601	W. L. Simmons	G. C. Glover	1953	400	7	400	Th	1,190	241.2	Aug. 3, 1962	S,E, 1	D	
* 602	Carl Wilson	--	1945	105	5	105	Har	1,176	66.4	do	J,E, 1	D	
* 603	Mrs. Deming	--	1945	200	5	180	Har	1,221	110	Aug. 4, 1962	C,E, 1/2	D	
* 701	S. A. Morris	--	1947	180	5	180	Har	1,214	100	Aug. 8, 1962	C,W	S	
* 702	Mildred Taack	Bill Brazelton	1945	270	5	270	Th	1,212	150	Aug. 9, 1962	C,W	S	Used only occasionly for stock.
* 703	do	B. C. Gilliam	1956	170	5	170	Har	1,211	120	Aug. 8, 1962	C,E, 3/4	D	
* 704	Chartye Lowe	--	1930	30	5	30	Har	1,215	26.0	Aug. 9, 1962	C,W	D	
* 705	Gene Lowe	--	1900	30	--	--	Har	1,189	13.8	do	J,E, 1/2	D	36-in. diameter stone-lined dug well.
* 706	Mrs. E. R. Riggs	--	--	200	7	--	Th	1,204	150	do	C,G, 2	Ind	Located on Oil lease.
* 707	Woodrow Taack	B. C. Gilliam	1930	170	5	170	Har	1,206	120	Aug. 8, 1962	C,W	D	
* 708	S. A. Morris	--	1931	14	--	--	Har	1,161	4.2	Aug. 9, 1962	N	N	36-in. diameter stone-lined dug well.
* 901	B. W. King	--	1945	108	5	108	Har	1,172	53.2	Aug. 6, 1962	C,E, 1/2	S	

See footnote at end of table.

Table 1.--Records of wells and springs, Young County--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Casing: Diameter (in.)	Casing: Depth (ft.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Below land-surface datum (ft.)	Water level: Date of measurement	Method of lift and type of power	Use of Water	Remarks
*20-43-902	Don McClathehy	B. C. Gilliam	1955	423	5	423	Th	1,179	178.4	Aug. 6, 1962	C,E, 1/2	D,S	
* 44-101	G. C. Glover	--	1910	26	--	--	Har	1,244	15	July 30, 1962	J,E, 1/2	D	30-in. diameter stone-lined dug well.
* 102	Ethan Johnson	--	1934	128	5	128	Har	1,227	62.9	Aug. 1, 1962	C,W	D	
* 103	R. L. McGee	--	--	106	5	106	Har	1,233	11.6	do	C,W	D	
* 104	Bill Cooper	--	--	207	5	207	Har	1,259	83.5	do	C,W	S	
* 105	R. R. Cope	T. C. Graham	1961	130	5	130	Har	1,215	80	Aug. 2, 1962	C,E, 1/2	D	
* 106	W. P. Foster	--	1930	150	5	150	Har	1,225	90	do	C,E, 1	D	
* 107	A. A. Bernhardt	-- Gilliam	1945	24	10	24	Har	1,260	6.9	do	C,W	D	
* 108	Lem Groves	--	1917	48	5	48	Har	1,258	12.0	do	C,E, 1/4	D	
* 109	Jake Edwards	Owner	1933	20	--	--	Har	1,276	13.2	do	C,W	D	40-in. diameter stone-lined dug well.
* 110	L. T. Burns Est.	--	1937	315	77	315	Th	1,262	263.1	do	C,G 2	D	Located on oil lease.
* 111	W. B. Howard	R. Farmer	1954	100	5	100	Har	1,260	57.7	Aug. 3, 1962	C,W	D	[1]
* 201	F. H. Green	--	1961	146	4-1/2	146	Har	1,167	116	July 11, 1962	C,E,	D	Water sands at 90 ft. and 135 ft.
* 202	Mrs. Olive Garvey	--	1938	90	5	90	Har	1,165	58.4	Apr. 1962	C,E, 1/2	D	
* 203	W. H. Casey	--	1926	90	4	90	Har	1,197	38	July 31, 1962	C,W	D	
* 204	J. B. Garvey	Owner	1960	259	4	259	Har	1,262	224	Aug. 1, 1962	C,E, 1	D	
* 301	R. M. Hall	G. C. Glover	1951	525	4	525	Th	1,189	342.9	July 11, 1962	C,E, 1/2	D	[1]
* 302	A. N. Lunsford	--	1900	45	--	--	Har	1,170	29.4	July 10, 1962	J,E, 1/3	D	36-in. diameter stone-lined dug well.
* 303	Mrs. K. Gragg	--	1944	77	5	77	Har	1,162	20.2	July 11, 1962	C,W	D	
* 304	Crenshaw & Whitehill Oil Co.	--	1932	420	7	420	Th	1,141	363.9	July 10, 1962	C,G, 2	D	
* 305	do	--	1959	460	7	460	Th	1,160	365	do	C,G, 2	Ind	Used for waterflood supply.
* 306	do	--	1959	465	7	460	Th	1,158	365	do	C,G, 2	Ind	Do.

See footnote at end of table.

Table 1.--Records of wells and springs, Young County--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Casing: Diameter (in.)	Casing: Depth (ft.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Below land-surface datum (ft.)	Water level: Date of measurement	Method of lift and type of power	Use of water	Remarks
*20-44-401	City of Jean	--	--	--	7	360	Th	1,210	--	--	S,E 3	P	
* 402	J. M. Elmore	--	1900	30	--	--	Har	1,154	17.4	July 27, 1962	J,E, 1/4	D	36-in. diameter dug well.
* 403	Claude Sims	--	1900	165	5	160	Har	1,176	40	July 30, 1962	C,W	D	
* 404	James Gathings	G. C. Glover	--	125	7	125	Har	1,231	38.7	do	J,E, 1/2	D	Plugged oil test.
* 405	O. B. Barron	-- Cullers	1947	57	5	55	Har	1,226	35.7	Aug. 1, 1962	J,E, 1/2	D	
* 406	W. J. Haygood	--	1945	60	5	60	Har	1,227	30	do	C,W	D	
* 407	H. F. Haygood	--	1900	60	5	60	Har	1,232	35.4	do	C,W	D	
* 408	John Edwards	--	--	90	5	90	Har	1,247	16	do	C,W	S	
* 409	T. M. Elmore	R. Farmer	1960	40	5	40	Har	1,156	18.7	July 27, 1962	J,E, 1/2	D	1/
* 501	Kleiner, Fiske, Turner & West Oil Co.	--	1953	425	7	425	Th	1,131	150	July 30, 1962	S,E, 3	Ind	Used for waterflood supply.
* 502	do	--	1935	425	7	425	Th	1,177	150	do	C,G, 2	D	
* 503	do	--	1935	425	7	425	Th	1,183	125	do	C,G, 2	D	Used for waterflood supply and stock use.
* 504	do	--	1953	425	7	425	Th	1,142	130.4	do	C,G, 2	Ind	Do.
* 505	do	--	1953	425	7	425	Th	1,147	114.6	do	C,E, 3	Ind	Do.
* 506	G. F. LeBus Oil Co.	--	1953	435	7	435	Th	1,213	100	July 28, 1962	C,E, 3	Ind S	Used for waterflood supply and stock use. 1/
* 507	Jack Q. Neal	--	1930	300	5	300	Th	1,141	157.6	July 30, 1962 Sept.14, 1962	C,E, 3/4	D	
* 508	Dennis French	Marvin Nall	1957	334	7	291	Th	1,157	210	July 30, 1962	C,E, 1/3	D	1/
* 509	Sam Hawkins	--	1945	248	7	248	Th	1,220	138.7	July 31, 1962	S,E, 1/2	D	
* 510	W. H. Casey	--	1923	330	7	330	Th	1,219	130	do	C,E, 3/4	D	
* 601	Phillips Petroleum	--	1962	--	--	733	--	1,190	--	--	--	--	Oil test; sampled at 724-733 ft.

See footnote at end of table.

Table 1.--Records of wells and springs, Young County--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Casing: Diameter (in.)	Casing: Depth (ft.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Below land-surface datum (ft.)	Water level: Date of measurement	Method of lift and type of power	Use of water	Remarks
*20-44-602	Joe D. Beard	G. C. Glover	1955	409	7	409	Th	1,155	237.3	July 28, 1962	S,E, 1	D	
* 603	LaBrea Oil Corp.	--	1945	435	7	300	Th	1,179	190	do	C,G, 2	D	
* 604	Homer Lee	--	1950	375	7	375	Th	1,149	300	do	C,G, 2	D	
* 605	Hawkins Chapel Cementary	--	1948	38	5	--	Har	1,229	14.8	Aug. 4, 1962	C,W	Irr	
* 606	Mary Newman	--	1910	40	--	--	Har	1,225	12.8	do	J,E, 1/3	D	36-in. diameter stone-lined dug well.
* 607	W. C. Bishop	--	1900	25	5	4	Har	1,226	.9	do	C,W	D	
* 608	B. F. Barrett	--	1928	155	5	50	Har	1,196	23.3	do	C,W	D	Well has caved at 40-50 ft.
* 609	Glyn Loftin	--	1942	50	7	50	Har	1,210	15.7	Apr. 18, 1962	N	N	Plugged oil test.
* 701	L. C. Brooks	--	1938	236	5	236	Th	1,169	65	July 15, 1962	C,E, 1/2	D	Water sand reported at 226 ft.
* 702	C. E. Poole	--	1922	320	6	320	Th	1,178	74.5	July 19, 1962	C,E, 1/2	D	Water sand reported at 290-320 ft. [1]
* 703	R. U. McCaghren	--	--	385	4	385	Th	1,182	168.6	--	C,E, 1/2	D	
* 704	B. W. King	--	1935	240	5	240	Th	1,163	200	July 19, 1962	C,E, 3/4	D	
* 705	L. C. Brooks	--	--	--	--	--	Th	1,169	--	--	N	N	Plugged oil test.
* 801	A. A. Kunkel	--	1945	320	5	320	Th	1,187	201.0	July 31, 1962	C,W	D	
* 802	E. R. Senkel	--	1936	309	5	309	Th	1,181	180	do	C,W	D	
* 803	W. L. Hawkins	--	1945	330	5	330	Th	1,179	200	do	C,W	D	Two strings of casing; water sand at 330 ft.
* 804	Sam P. Ligon	Howard Peterson	1962	165	7	165	Th	1,230	101.7	do	J,E, 3/4	D	Water sand reported at 130-146 ft.
* 805	Mrs. Minnie Shatto	--	1961	305	5	300	Th	1,180	180	Jan. 17, 1963	C,W	N	Reportedly contaminated by oil-field brine.
* 901	O. L. Purselley	--	1954	264	7	210	Th	1,240	166.2	July 27, 1962	S,E, 1-1/2	D	Water sand reported at 210-264 ft.
* 902	G. E. Boyle	J. Pemberton	1949	114	5	114	Th	1,207	25	do	C,W	D	
* 45-204	D. O. Logan	--	1945	113	5	113	Har	1,082	95	July 9, 1962	C,E, 1/2	D	
* 205	Markley Community Center	--	1950	350	7	350	Th	1,108	265	July 10, 1962	C,E, 1/2	D	

See footnote at end of table.

Table 1.--Records of wells and springs, Young County--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Casing: Diameter (in.)	Casing: Depth (ft.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Below land-surface datum (ft.)	Water level: Date of measurement	Method of lift and type of power	Use of water	Remarks
*20-45-206	V. W. Young	--	1945	400	7	400	Th	1,115	271.2	July 10, 1962	C,E, 1/2	D	
* 207	Myra Connally	--	1933	392	7	392	Th	1,125	300.3	July 6, 1962	C,E, 1/2	D	
* 208	J. F. Cox	--	1925	380	7	380	Th	1,106	284.5	July 9, 1962	C,W	D	
* 209	Harwell and Robertson Oil Co.	--	1930	360	7	350	Th	1,087	230	July 6, 1962	C,E, 2	Ind	Used for waterflood supply.
* 210	do	--	1930	350	7	350	Th	1,102	234.0	do	C,E, 2	Ind	Do.
211	do	--	1930	350	7	350	Th	1,092	230	do	C,E, 2	Ind	Do.
* 212	Charles Self	--	1945	70	5	65	Har	1,108	45.2	July 10, 1962	C,W	D	
* 213	Fanin McGatta	Owner	1955	320	7	320	Th	1,076	180.2	July 31, 1962	C,E, 1/2	D	
* 501	Graham Stewart	--	1955	330	5	330	Th	1,092	200	July 2, 1962	C,E, 1/2	D	
* 502	L. T. Burns, Est.	-- Roberts	1955	310	5	310	Th	1,103	200.9	June 30, 1962	C,E, 1/2	D	
* 503	Mrs. G. Wilton	--	1945	100	5	100	Har	1,109	75	July 2, 1962	C,W	D	
* 504	O. B. Peterson	G. Gilmore	1937	380	7	380	Th	1,117	230.5	June 30, 1962	C,W	D	
* 701	Sam Millican	--	1945	215	5	200	Th	1,303	180.0	June 29, 1962	C,W	D	
* 702	Kenneth Mobley	--	1943	210	5	210	Th	1,253	180	do	C,E, 1/2	D	
* 703	A. C. Dragoon	--	1939	54	5	54	Har	1,286	35	July 11, 1962	C,W	D	
* 704	L. B. Creel	--	1935	300	5	300	Th	1,274	280	Aug. 4, 1962	C,W	D	
* 801	H. B. Perkins	--	1905	110	5	110	Th	1,189	27.8	June 29, 1962	J,E, 1/2	D	Well has caved--depth measured at 67 ft.
* 802	Ralph Harvey	--	1940	220	7	220	Th	1,209	60	do	C,W	D	
* 803	do	Owner	1955	260	7	220	Th	1,221	122.1	do	S,E, 1	D	Drilled to 385 ft., plugged back to 260 ft. Water sand at 220 ft.
* 49-501	Geo. Wilkinson	--	1939	66	5	66	Pu	1,142	41.5	Sept.12, 1962	H,B	D	
* 502	do	--	1939	66	10	10	Pu	1,139	35.2	do	C,E, 1/3	S	
* 601	W. W. Bruton	R. Farmer	1959	102	5-1/2	102	Pu	1,117	40	do	C,W	D,S	1/

See footnote at end of table.

Table 1.--Records of wells and springs, Young County--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Casing: Diameter (in.)	Casing: Depth (ft.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Below land-surface datum (ft.)	Water level: Date of measurement	Method of lift and type of power	Use of Water	Remarks
*20-49-602	W. B. Bellomy	--	1945	65	55	65	Pu	1,135	50	do	J,E, 1/3	D	
* 50-101	G. W. Clifton	Owner	1921	10	--	--	Pu	1,143	3.4	Aug. 30, 1962	J,E, 1	D	Stone-lined spring; wet weather springs nearby.
* 201	E. A. Morgan	--	1918	60	5	60	Pu	1,154	45.9	Aug. 29, 1962	C,W	D	
* 202	L. L. Tate	Owner	1921	30	--	--	Pu	1,101	7.1	Aug. 30, 1962	J,E, 3/4	D	36-in. diameter stone-lined dug well.
*20-50-203	Doyle Davis	Owner	1948	21	--	--	Pu	1,129	16.4	Aug. 30, 1962	J,E, 1/2	D	Do.
* 301	Mrs. E. R. Riggs and Sons	--	1930	200	7	200	Har	1,144	100	Aug. 10, 1962	C,G, 2	S Ind	
* 302	R. P. Doran Oil Co.	--	1930	200	7	200	Har	1,187	105.4	do	C,G, 2	D,S Ind	1/
* 303	Morgan Bros. Oil Co.	--	1930	110	7	110	Har	1,202	70	Aug. 17, 1962	C,G, 2	D	1/
* 304	H. Williams	--	1928	140	5	140	Har	1,187	106.9	Aug. 29, 1962	C,W	S	
* 305	Dr. Myers	--	1930	103	5	103	Pu	1,186	50	do	C,W	D	
* 306	Guy Hearne	--	1955	90	5	90	Pu	1,165	77.2	do	J,E, 1	D	
* 307	E. C. Crouch	--	--	122	5	122	Pu	1,132	45.5	Aug. 28, 1962	J,E, 3/4	D	
* 308	Horace Pounds	--	1944	140	5	140	Pu	1,156	69.6	do	C,W	D	
* 401	Harvey Creel	--	1915	72	5	72	Pu	1,150	50	Sept.12, 1962	J,E, 1/2	D	
* 402	R. I. Gilmore	--	1942	150	5	115	Pu	1,163	56.6	do	C,W	S	
* 403	H. R. Strother	--	1942	110	5	110	Pu	1,122	24.2	do	C,W	D	Gravel and sand at 42-43 ft.
* 404	W. T. Creel	R. Farmer	1960	35	7	35	All	1,104	17	Sept.13, 1962	J,E, 1/2	D	1/
* 501	T. M. Blanton	--	1910	70	5	70	Pu	1,155	43.7	do	J,E, 3/4	D	
* 601	Lola Remington	--	1940	112	5	112	Pu	1,151	11.1	Aug. 27, 1962	C,E, 1/2	D	
* 602	Mrs. Jeff Barnett	--	1900	52	5	52	Pu	1,174	15.8	do	J,E, 1	D	
* 603	do	--	1900	110	5	110	Pu	1,162	20.3	do	C,W	S	

See footnote at end of table.

Table 1.--Records of wells and springs, Young County--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Casing: Diameter (in.)	Casing: Depth (ft.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Below land-surface datum (ft.)	Water level: Date of measurement	Method of lift and type of power	Use of Water	Remarks
*20-51-703	Ft. Belnap Park	--	1956	40	5	40	Har	1,173	18	Aug. 23, 1962	C,E, 1/2	D	
* 704	Roy Veal	R. Farmer	1955	50	7	50	Har	1,175	30	do	C,W	S	1/
* 705	R. L. Sullivan	--	1900	40	--	--	Har	1,175	22.8	do	J,E, 1/2	D	24-in. diameter stone-lined dug well.
* 706	Bern Parkinson	--	1935	35	5	35	Har	1,157	19.6	do	J,E, 1/2	D	
* 801	Jimmy Wray	--	1961	230	4	230	Th	1,176	119	Aug. 21, 1962	C,E, 1	D	Water sand at 170-230 ft.
* 802	do	R. Bullock	1955	120	7	120	Th	1,141	72.1	do	S,E, 1/2	D	Water sand at 87-107 ft.
* 803	Robert Bullock	do	1955	160	7	160	Th	1,165	69.2	do	N	N	Water sand at 75 ft. and 125 ft.; plugged oil test.
* 901	Louis Pitcock	--	1950	85	5	85	Th	1,096	45	Aug. 22, 1962	J,E, 1/2	D	
* 902	J. L. Burch	J. Pemberton	1960	135	5	135	Th	1,147	91.8	do	J,E, 1/2	D	
* 52-101	R. C. Lindley	--	1945	104	5	104	Th	1,168	69.5	July 16, 1962	C,W	S	
* 102	C. M. Gibson	R. Farmer	1951	92	5	92	Th	1,127	42.3	July 17, 1962	J,E, 1/2	D	1/
* 103	E. W. Geis	--	1939	100	5	100	Th	1,127	70.4	do	C,W	D	
* 104	Mary Bradshaw	--	1937	190	7	190	Th	1,181	75	July 18, 1962	S,E, 1/2	D	
* 105	F. C. Walker	J. Pemberton	1951	105	4	105	Th	1,189	47.4	do	J,E, 1/2	D	
* 106	L. C. West	--	1937	100	5	100	Th	1,146	60	July 19, 1962	C,W	D	
* 107	J. G. Slater	R. Farmer	1953	169	5	169	Th	1,155	71.5	do	C,E, 1/2	D	1/
* 108	C. R. Rutherford	J. Pemberton	1952	140	5	140	Th	1,164	87.5	July 21, 1962	J,E, 3/4	D	
* 109	J. C. Hays	Kay Oil Co.	1937	185	7	185	Th	1,128	68.1	Aug. 15, 1962	S,E, 3/4	D	Drilled to supply oil rig.
* 201	C. E. Caskey	J. Pemberton	1948	104	5	104	Th	1,200	75	July 13, 1962	C,E, 1/2	D	
* 202	Mrs. M. Thigpen	R. Farmer	1955	160	7	160	Th	1,171	105.5	do	S,E, 1/3	D	1/

See footnote at end of table.

Table 1.--Records of wells and springs, Young County--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Casing: Diameter (in.)	Casing: Depth (ft.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Below land-surface datum (ft.)	Water level: Date of measurement	Method of lift and type of power	Use of Water	Remarks
*20-50-604	Mrs. Jeff Barnett	--	1950	120	5	120	Pu	1,150	95.6	do	C,W	S	
* 605	M. J. Phillips	--	1900	35	--	--	All	1,107	25.5	Sept.13, 1962	J,E, 1/3	D	36-in. diameter stone-lined dug well.
* 701	R. T. Wells	--	1928	120	5	120	Pu	1,161	89.0	Sept.12, 1962	C,E, 1/2	D	Water sand at 60-70 ft.) ft.
* 901	J. E. Moore	--	1954	20	26	20	All	1,123	8.1	Aug. 23, 1962	J,E, 1/2	D	26-in. diameter galvanized tin lined dug well.
* 51-101	R. P. Ward	J. Pemberton	1940	220	5	220	Th	1,205	150	Aug. 13, 1962	J,E, 1	D	
* 102	do	-- Myra	1956	243	8	243	Th	1,191	154.6	Aug. 14, 1962	C,W	N	Plugged oil test.
* 103	L. C. Larrimore	do	1920	106	5	106	Th	1,202	25.5	Aug. 10, 1962	J,E, 3/4	D	
* 104	O. H. Colley	--	1936	245	5	228	Th	1,196	30.9	Aug. 14, 1962	N	N	
* 105	J. T. Ellis	--	1930	30	--	--	Pu	1,185	12.9	Aug. 17, 1962	C,W	D	36-in. diameter stone-lined dug well.
* 201	L. C. Larrimore	--	1958	300	7	300	Th	1,192	100	Aug. 10, 1962	C,E, 3/4	S	
* 202	Jack Rux	--	1941	272	7	272	Th	1,203	90	do	C,W	D	
* 203	J. F. Hays	J. Pemberton	1954	285	5	285	Th	1,118	113.5	Aug. 14, 1962	S,E, 1/2	D	
* 301	J. B. Hoggard	--	1945	100	5	100	Th	1,117	35	July 17, 1962	C,E, 3/4	D	
* 302	C. Langford	--	1939	220	5	200	Th	1,122	62.9	July 18, 1962	C,W	D	
* 303	T. Lewelling	--	1937	110	5	110	Th	1,099	45.4	do	C,W	D	
* 304	G. W. Hays	--	1930	65	5	65	Th	1,088	20	do	J,E, 1/2	D	
* 401	Willis Wage	Owner	1948	57	5	57	Har	1,181	40	Aug. 27, 1962	C,W	D	Gravel at 50-56 ft.
* 402	J. C. Chapel	--	--	107	5	107	Har	1,169	35.0	Aug. 28, 1962	C,W	S	
* 601	R. J. Bryan	J. Pemberton	1943	100	5	100	Th	1,101	75	Aug. 11, 1962	C,W	D	
* 602	H. Kinley	--	1935	160	5	160	Th	1,098	40	do	C,E, 1/2	D	
* 603	R. J. Bryan	J. Pemberton	1943	165	5	165	Th	1,108	30	do	C,W	D	
* 701	H. W. Barrett	R. Farmer	1959	160	5	160	Har	1,147	92.5	Aug. 23, 1962	N	N	[1]
* 702	Ft. Belnap Park	--	1853	--	--	40	Har	1,173	19.8	do	J,E, 1/2	P	74-in. diameter stone-lined dug well.

See footnote at end of table.

Table 1.--Records of wells and springs, Young County--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Casing: Diameter (in.)	Casing: Depth (ft.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Below land-surface datum (ft.)	Water level: Date of measurement	Method of lift and type of power	Use of Water	Remarks
*20-52-203	E. B. Petty	--	1905	160	5	160	Th	1,208	135.5	July 13, 1962	C,W	D	
* 204	R. L. Tiffin	R. Farmer	1956	192	5	192	Th	1,216	132.8	do	C,W	D	1/
* 205	T. L. Shepard	do	1932	105	5	105	Th	1,182	85.2	do	J,E, 1	D	1/
* 206	A. B. Tiffin	do	1957	175	5	175	Th	1,173	82.1	do	J,E, 1	D	
* 207	O. L. McGee	--	1922	160	5	160	Th	1,198	143.7	July 15, 1962	C,W	D	
* 208	L. G. Bills	--	1917	200	5	200	Th	1,222	134.4	July 16, 1962	C,W	D	
* 301	W. G. Shepard	J. Pemberton	1961	150	5	150	Th	1,237	96.7	June 25, 1962	S,E, 3/4	D	
* 302	do	do	1960	333	5	333	Th	1,241	89.0	June 26, 1962	C,W	S	No water sands reported below 150 ft.
* 303	W. W. Prather	--	1949	150	5	150	Th	1,246	100	June 25, 1962	C,W	D	Water sands reported at 135-150 ft.
* 304	Joe Shepard	J. Pemberton	1948	130	5	130	Th	1,238	70	June 26, 1962	C,W	D	
* 305	Mrs. W. R. Sanders	--	1946	120	5	120	Th	1,232	82.4	do	C,W	D	
* 306	Arthur Burdick	J. Pemberton	1950	27	5	27	Th	1,291	15	June 28, 1962	C,W	D	
* 307	E. B. Dickson	do	1960	90	5	88	Th	1,284	54.6	June 29, 1962	J,E, 1	D	
* 308	E. W. Oatman	--	1905	40	5	40	Th	1,209	13.5	July 12, 1962	J,E, 1/2	D	
* 309	L. C. Oliver	C. Gilmore	1957	40	5	40	Th	1,242	17.5	July 27, 1962	J,E, 1/3	D	"Wet weather" springs located 100 yds. to North.
* 310	J. F. Oliver	L. Hart	1943	76	5	76	Th	1,273	39.1	do	J,E, 1/2	D	
* 401	L. C. Young	--	1941	120	5	120	Th	1,138	90	July 17, 1962	C,E, 1	D	
* 402	Hoyle Fitzgerald	R. Farmer	1955	115	5	115	Th	1,154	60	do	C,E, 1/2	D	1/
* 403	Harold Elliott	--	1930	100	5	100	Th	1,150	57.3	do	J,E, 3/4	D	
* 404	A. L. Reece	--	1934	179	5	179	Th	1,168	80	do	C,W	N	
* 405	do	--	1903	105	5	105	Th	1,189	85	do	C,W	D	
* 406	H. T. Barrett	--	1907	129	5	129	Th	1,199	100	do	C,W	D	
* 501	J. K. Jefferies Est.	--	1947	350	7 4	35 350	Th	1,179	67.2	July 12, 1962	C,G 2	D	

See footnote at end of table.

Table 1.--Records of wells and springs, Young County--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Casing: Diameter (in.)	Casing: Depth (ft.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Below land-surface datum (ft.)	Water level: Date of measurement	Method of lift and type of power	Use of Water	Remarks
*20-52-502	Mary Riddle	R. Farmer	1946	160	5	160	Th	1,177	40	July 12, 1962	C,W	D	[1]
* 503	Frank Slater	--	1925	135	5	135	Th	1,166	53.7	do	J,E, 3/4	D	
* 601	C. E. Taylor	J. Pemberton	1953	135	5	135	Th	1,186	52.0	June 11, 1962	J,E, 1/2	D	
* 602	Melvin Dollins	--	1959	150	5	135	Th	1,187	35.9	do	J,E, 1	D	
* 603	H. D. Partin	--	1955	140	5	140	Th	1,187	56.1	do	S,E, 1/2	D	
* 604	W. H. Peterson	--	1940	149	5	149	Th	1,225	53.7	do	J,E, 1/2	D	
* 605	W. B. Wragg	--	1944	135	5	135	Th	1,188	55	June 12, 1962	C,E, 3/4	D	
* 606	Eva Guinn	N. Harlan	1938	65	5	68	Th	1,184	28.6	June 13, 1962	J,E, 1/2	D	
* 607	Homer Brashears	J. Pemberton	1931	71	5	71	Th	1,212	46	do	J,E, 1/3	D	
* 608	G. A. Bills	--	1949	110	8	110	Th	1,231	87.0	do	C,W	D	
* 609	J. H. Taylor	--	1906	101	5	101	Th	1,209	60	June 14, 1962	C,W	D	
* 610	George Birdell	--	1950	127	5	127	Th	1,194	53.4	do	C,W	D	
* 611	O. B. Taylor	R. Pemberton	1958	84	5	84	Th	1,194	55	do	J,E, 1	D	
* 612	R. H. Taylor	--	1942	153	5	153	Th	1,171	65	do	J,E, 3/4	D	
* 613	E. E. Atwell	--	1928	157	5	157	Th	1,192	69.5	June 15, 1962	J,E, 1	D	
* 614	General American Oil Co.	--	1935	150	8	150	Th	1,161	30.3	do	J,E, 1/2	D	
* 615	Jack Burkett	--	1959	150	5	150	Th	1,180	44.2	do	B.H	D	
* 616	do	Crabtree & Pickett	1957	147	5	147	Th	1,174	38.1	do	J,E, 3/4	D	
* 617	Mrs. D. F. Ford	--	1955	80	5	80	Th	1,199	13.4	June 25, 1962	J,E, 1/2	D	
* 618	Don Horn	B. Thedford	1947	160	6	160	Th	1,231	78.5	July 12, 1962	C,E, 3/4	D	
* 619	B. W. King	--	1939	150	5	150	Th	1,219	75	do	C,W	D	

See footnote at end of table.

Table 1.--Records of wells and springs, Young County--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Casing: Diameter (in.)	Casing: Depth (ft.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Below land-surface datum (ft.)	Water level: Date of measurement	Method of lift and type of power	Use of Water	Remarks
*20-52-701	J. Hawkins	--	1945	131	5	131	Th	1,117	80	Aug. 31, 1962	C,W	S	
* 801	L. C. Grant	--	1945	75	5	75	Th	1,114	21.4	June 11, 1962	C,W	S	
* 802	M. R. Richards	--	--	120	5	120	Th	1,174	103.4	do	N	N	
* 803	O. W. McSpadden	--	1945	140	5	140	Th	1,129	95.0	July 12, 1962	J,E, 3/4	D	
* 804	R. Casburn	--	1945	75	5	75	Th	1,140	50	do	C,E, 1/4	D	
* 901	J. H. Robertson	--	1935	256	6	256	Th	1,249	126.6	June 19, 1962	N	N	Open cased hole; drilled to supply water for drilling operations.
* 902	J. T. Robertson, Jr.	B. C. Gilliam	1959	195	5	195	Th	1,254	135	do	C,E, 3/4	D	
* 903	Mrs. J. H. Robertson	--	1900	60	5	60	Th	1,206	20	do	C,W	D	
* 904	Bill Robertson	--	1933	17.5	--	--	Th	1,194	13.6	do	J,E, 1/4	D	36-in. diameter stone-lined well.
* 905	J. T. Robertson, Sr.	R. Farmer	1960	125	5	125	Th	1,224	87.0	do	C,E, 1/2	D	1/
* 906	Walter Rehders	J. Pemberton	1955	76	5	76	Th	1,239	56	June 20, 1962	J,E, 1/2	D	
* 907	Annie Brashears	R. Farmer	1956	100	5	100	Th	1,210	30.2	June 19, 1962	J,E, 1	D	1/
* 908	Walter Rehders	J. Pemberton	1956	40	5	40	Th	1,229	20	do	J,E, 1/3	D	
* 909	Earl Rhoades	R. Farmer	1956	100	5	100	Th	1,219	75	June 20, 1962	C,E, 1/2	D	
* 53-101	J. O. McCluer	--	1904	160	5	160	Th	1,276	110	June 26, 1962	C,W	D	
* 102	W. L. Holder	--	1910	200	5	200	Th	1,218	100	June 25, 1962	C,W	D	
* 103	J. R. Day	--	1932	123	5	123	Th	1,224	74.4	do	C,E, 1/2	D	
* 104	W. R. Shepard	--	1959	160	5	160	Th	1,253	97.3	June 22, 1962	C,W	S	
* 105	Joe Shepard	J. Pemberton	1956	160	5	160	Th	1,245	80	June 26, 1962	C,W	D	
* 106	R. H. Burdick	C. Gilmore	1960	125	5	125	Th	1,232	55	June 22, 1962	C,W	D	
* 108	Ardis Reeves	--	1944	148	5	148	Th	1,235	120	June 25, 1962	C,W	D	
* 109	H. O. Minkley	--	1903	280	5	280	Th	1,237	67.4	do	C,W	D	

See footnote at end of table.

Table 1.--Records of wells and springs, Young County--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Casing: Diameter (in.)	Casing: Depth (ft.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Below land-surface datum (ft.)	Water level: Date of measurement	Method of lift and type of power	Use of Water	Remarks
*20-53-110	Mrs. A. Sanders	--	1935	54	5	40	Th	1,242	25.7	June 25, 1962	C,W	D	
* 111	J. E. Dalrymple	--	1920	180	5	180	Th	1,266	104.6	do	C,W	D	
* 112	E. B. Dickson	--	1950	220	5	220		1,282	157.3	June 29 1962	C,W	S	
* 201	Charles Minkley	--	1909	160	5	160	Th	1,264	120	June 21, 1962	C,W	D	
* 401	Peary Realty Co.	J. Pemberton	1955	130	5	100	Th	1,217	75.6	June 8, 1962	S,E, 1/2	D	
* 402	Tom Colley	--	1900	10	--	--	Th	1,207	5.0	June 7, 1962	J,E, 1/3	D	10-ft. diameter stone-lined dug well.
* 403	Leroy Schlittler	--	1900	30	--	---	Th	1,226	11.0	do	S,E, 1/2	D	4-ft. diameter stone-lined dug well. 1.
* 404	A. D. Moore	J. Pemberton	1959	140	5	140	Th	1,286	120	do	J,E, 3/4	D	
* 405	Leroy Schlittler	--	1955	40	5	40	Th	1,304	28	do	J,E, 1/3	D	
* 406	H. Rubenkoneig	--	1930	185	6	180	Th	1,306	151.2	do	S,E, 1/2	D	
* 407	Mary Gahagan	-- Gnalls	1955	400	5	350	Th	1,284	335	June 8, 1962	C,E, 1	D	
* 408	Allen Cearley	Jack Stansell	1961	205	5	205	Th	1,286	190	do	C,E, 1/3	D	
* 409	Beatrice Long	J. Harlan	1940	227	5	227	Th	1,270	125	do	C,W	D	
* 410	F. B. Cearley	--	1935	150	5	150	Th	1,272	135	June 12, 1962	C,E, 1/2	D	
* 411	Mrs. A. R. Carter	--	1900	60	5	60	Th	1,203	37.2	do	C,W	D	
* 412	D. F. O'Rourke	--	1937	68	7	68	Th	1,199	40	do	J,E, 1/2	D	
* 413	C. W. Hinson	J. Pemberton	1956	165	5	165	Th	1,280	106.1	do	J,E, 1	D	
* 501	M. K. Graham	--	1950	165	5	165	Th	1,244	56.5	June 7, 1962	C,W	D	
* 701	Blanche Logan	--	1935	85	5	85	Th	1,268	35.9	May 29, 1962	C,G 2-1/2	D	
* 702	J. F. Blunt	--	1943	50	5	50	Th	1,208	33.1	do	C,W	D	
* 703	Clarence Blunt	--	1900	40	--	--	Th	1,140	30.3	do	C,E, 1/2	D	36-in. diameter stone-lined well.
* 704	Glen York	--	1948	125	5	125	Th	1,204	74.3	June 20, 1962	C,W	D	

See footnote at end of table.

Table 1.--Records of wells and springs, Young County--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Casing: Diameter (in.)	Casing: Depth (ft.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Below land-surface datum (ft.)	Water level: Date of measurement	Method of lift and type of power	Use of water	Remarks
*20-53-705	Walter Rehders	--	1950	90	5	90	Th	1,204	55.2	June 19, 1962	C,W	S	
* 801	C. R. Blunt	--	1870	70	5	60	Th	1,271	57.9	May 29, 1962	C,W	D	
* 802	J. E. McEntire	J. Pemberton	1950	110	5	110	Th	1,277	75	do	C,E, 3/4	D	
57-901	J. R. Reedy	R. Farmer	1955	110	--	--	Pu	--	--	--	--	--	1/
* 58-901	Norman Burnett	--	1945	72	5	70	Th	1,130	49.5	May 16, 1962	C,W	D	
* 902	D. Brisco	J. Pemberton	1960	70	5	70	Th	1,125	37.8	May 15, 1962	J,E, 1/3	D	
* 903	Bill Akers	--	--	71	5	70	Th	1,132	55.0	May 16, 1962	J,E, 1/2	D	
* 59-101	Ed Reeves	--	1900	55	5	55	Th	1,130	14.6	May 21, 1962	C,W	D	
* 102	G. I. McCallister	M. Porter	1910	25	--	--	All	1,070	22.7	May 22, 1962	C,W	S	36-in. diameter stone-lined dug well.
* 103	V. Holcomb	J. Pemberton	1949	105	5	105	Th	1,175	89.6	May 24, 1962	C,W	D	
* 201	do	--	1947	177	5	177	Th	1,181	100	do	C,W	S	
* 202	C. H. Reddy	J. Pemberton	1960	255	5	255	Th	1,226	169.7	May 7, 1962	S,E, 3/4	D	
* 203	H. E. Grove	--	1935	270	5	270	Th	1,226	150	do	C,W	D	
* 204	W. R. Sawyer	J. Pemberton	1959	175	5	175	Th	1,215	139.6	do	C,E, 3/4	D	
* 205	Don Jobe	R. Farmer	1954	252	5	252	Th	1,218	134.0	May 8, 1962	S,E, 3/4	D	1/
* 206	Ross Clark	--	1943	200	7	200	Th	1,190	133.2	Aug. 22, 1962	N	N	
* 301	P. K. Deats	--	1950	200	5	200	Th	1,136	99	May 28, 1962	C,E, 3/4	D	
* 302	do	--	1950	165	5	165	Th	1,141	60.7	do	C,W	S	
* 303	J. L. Clark	--	1958	172	5	172	Th	1,173	118.4	Aug. 22, 1962	J,E, 3/4	D	
* 304	Ted Clark	--	1950	165	7	165	Th	1,161	100.1	Aug. 21, 1962	J,E, 1	D	
* 305	R. D. Mote	Tom Watkins	1960	175	5	175	Th	1,156	75	Aug. 22, 1962	S,E, 1	D	Reportedly contaminated by surface runoff.
* 401	Joe Grimes	--	1945	100	8	100	Th	1,100	47.6	May 21, 1962	C,W	S	
* 402	do	R. Farmer	1950	117	5	117	Th	1,151	81.7	May 24, 1962	S,E, 1/2	D	1/

See footnote at end of table.

Table 1.--Records of wells and springs, Young County--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Casing: Diameter (in.)	Casing: Depth (ft.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Below land-surface datum (ft.)	Water level: Date of measurement	Method of lift and type of power	Use of Water	Remarks
*20-59-403	Joe Grimes	--	1945	100	5	100	Th	1,147	83.0	May 22, 1962	C,W	S	
* 404	L. W. Brooks	--	1933	123	5	123	Th	1,170	98.1	May 21, 1962	C,W	D	
* 501	O. Strickland	--	1945	235	8	235	Th	1,167	109.6	May 7, 1962	S,E, 3/4	D	Drilled by oil company for water supply for drilling operation.
* 502	John Robertson	--	1949	175	5	175	Th	1,185	122.0	May 4, 1962	C,W	D	
* 503	Sam Ragland	--	1907	190	5	190	Th	1,188	70	May 22, 1962	C,W	D	
* 504	Myrl Martin	M. Martin	1944	219	5	219	Th	1,163	190	May 21, 1962	C,E, 3/4	D	Reported upper water sand at 71 ft. was cased off.
* 601	J. W. Hill	T. Watkins	1939	80	5	80	Th	1,077	40	May 3, 1962	C,E, 1/2	D	
* 602	Jack Frazier	T do	1950	40	5	40	G	1,059	17.3	do	J,E, 1/2	D	
* 603	A. W. Dollar	--	1945	45	5	45	G	1,098	23.7	May 4, 1962	J,E, 1/2	D	
* 604	J. N. Petty	R. Choat	1947	25	8 5	3.5 25	G	1,100	16.5	do	J,E, 1/2	D	
* 605	W. W. Hidgon	--	1942	193	6	193	G	1,155	100	do	C,E, 1/2	D	
* 606	W. A. Morris	J. Pemberton	1952	136	5	136	G	1,161	130	do	C,E, 1/3	D	
* 607	Edgar Ragland	--	1957	80	5	80	Th	1,203	50	do	C,E, 3/4	D	
* 701	L. W. Burnett	--	1946	30	5	30	Th	1,161	16.8	May 15, 1962	C,W	S,D	
* 702	Carl Evans	Carl Evans	1935	120	5	120	Th	1,181	98	May 14, 1962	C,E, 1/2	D	
* 703	F. V. White	--	1910	125	5	120	Th	1,172	99.5	May 15, 1962	C,W	S	
* 704	do	--	1910	125	5	124	Th	1,175	96.6	do	C,W	D	
* 801	Stovall Hot Wells	--	--	--	7	--	--	1,030	--	Aug. 9, 1961	--	--	Oil test. Brine used for bathing at Health resort.
* 901	J. N. Boozer	--	1940	45	6	45	G	1,030	40	May 8, 1962	C,E, 1/2	D	
* 60-101	Gene Borden	--	1942	102	5	102	G	1,050	30.0	May 1, 1962	J,E, 1-1/2	D	
* 102	Gene Dunlap	--	1959	40	5	40	G	1,070	18.8	do	B,H	D	

See footnote at end of table.

Table 1.--Records of wells and springs, Young County--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Casing: Diameter (in.)	Casing: Depth (ft.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Below land-surface datum (ft.)	Water level: Date of measurement	Method of lift and type of power	Use of Water	Remarks
*20-60-103	S. E. Craig	--	1937	175	5	175	G	1,115	100	May 1, 1962	C,W	D	
* 201	W. G. Tullis	R. Farmer	1954	50	5	50	G	1,050	6.1	Feb. 14, 1963	J,E, 1/2	D	
* 202	Max Roberts	do	1954	115	5	100	G	1,070	47.0	Feb. 13, 1963	N	N	
* 301	Mrs. J. B. Hazelton	--	1936	80	8	80	G	1,177	54.8	Apr. 26, 1962	J,E, 1/2	D	
* 302	W. O. Cencebaugh	T. Watkins	1950	65	5	65	Th	1,129	19.5	Apr. 27, 1962	J,E, 1/2	D	
* 303	Asa Smith	do	1961	155	5	155	Th	1,130	135	June 7, 1962	C,W	S	
* 304	W. E. Ramsey	-- Dixon	1961	120	5	120	G	1,188	70.0	Apr. 26, 1962	J,E, 3/4	D	
* 305	Jesse Martin	--	1945	90	5	90	G	1,168	70	May 9, 1962	C,W	D	
* 306	R. W. Wallace	B. Thedford	1946	50	5	50	G	1,206	14.7	Apr. 30, 1962	J,E, 1/2	D	
* 307	Iola Hazelton	--	1932	90	5	90	G	1,151	69.8	do	S,E, 1/2	D	
* 308	Asa Smith	R. Farmer	1953	55	5	55	Th	1,134	31.0	May 10, 1962	J,E, 1/4	D	1/
* 309	R. A. Garrett	--	1900	45	8	45	Th	1,139	27.5	Apr. 30, 1962	J,E, 1/3	D	
* 310	N. E. Cox	J. Pemberton	1945	132	5	132	Th	1,158	65	do	J,E, 3/4	D	
* 311	C. Cochran	R. Farmer	1955	63	5	63	Th	1,136	39.7	do	J,E, 1/2	D	1/
* 312	G. M. Singletary	--	1945	65	5	65	Th	1,128	34.4	Apr. 27, 1962	J,E, 1/4	D	
* 401	J. E. Rowan	--	1910	60	5	60	G	1,035	27.9	Apr. 17, 1962	C,W	D	
* 402	O. L. Cude	--	1948	41.5	8	41.5	G	1,017	18.8	Apr. 18, 1962	J,E, 1/3	D	
* 403	Roy Ribble	J. Pemberton	1962	91	5	91	G	1,021	33	May 8, 1962	C,W	S	
* 404	L. Davidson	--	1935	40	--	--	G	1,030	33.6	May 2, 1962	C,W	N	36-in. diameter stone-lined dug well.
* 405	Alton Stovall	R. Farmer	1960	128.5	5	128.5	G	1,110	115	do	J,E, 3/4	D	1/
* 406	R. J. Wood	-- Martin	1945	50	5	50	G	1,110	34.5	do	J,E, 1/3	D	

See footnote at end of table.

Table 1.--Records of wells and springs, Young County--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Casing: Diameter (in.)	Casing: Depth (ft.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Below land-surface datum (ft.)	Water level: Date of measurement	Method of lift and type of power	Use of Water	Remarks
*20-60-407	W. Ray Brown	--	1947	45	5	45	G	1,095	22.6	May 2, 1962	J,E, 1/2	D	
* 408	W. R. Brown	--	1955	40	5	40	G	1,100	14.9	do	J,E, 1/2	D	
* 409	F. M. Atchison	--	1930	135	8	135	G	1,110	27.0	May 1, 1962	C,W	D	
* 410	Gordon Brown	--	1951	40	5	40	G	1,087	17.1	May 3, 1962	J,E, 1/2	D	
* 411	John Knight	--	1932	140	5	140	G	1,119	128.8	May 1, 1962	C,W	D	
* 412	T. Watkins	--	1941	140	5	140	G	1,105	85.2	May 2, 1962	C,E, 1/2	D	
* 413	J. Watkins	T. Watkins	1943	150	5	150	G	1,122	112.2	May 1, 1962	S,E 3/4	D	
* 414	J. Nantz	J. Pemberton	1959	60	5	60	G	1,038	12	May 29, 1962	C,W	S	
* 415	J. Skidmore	do	1962	43	5	43	G	1,087	17.4	Aug. 14, 1962	J,E, 1/2	D	
* 501	Hugh Ribble	--	1945	55	5	55	All	1,030	45	Apr. 18, 1962	J,E, 1/4	D	
* 502	C. M. Birdwell	J. Pemberton	1947	66	5	66	G	1,134	35.5	Apr. 26, 1962	B,H	D	
* 601	R. G. Hutto	do	1955	85	5	85	G	1,141	50.7	do	S,E, 1/2	D	
* 602	V. G. Hazelton	--	1940	90	5	90	G	1,162	50	do	C,E, 1/2	D	
* 603	G. W. Millett	R. Farmer	1956	95	5	95	G	1,180	60.8	Apr. 24, 1962	J,E, 1/3	D	1/
* 604	Elmer Cates	--	1938	60	5	60	G	1,153	39.0	do	S,E, 1/3	D	
* 605	Ben Andrew	--	1935	36	--	--	G	1,147	29.2	Apr. 26, 1962	C,W	S	36-in. diameter stone-lined dug well.
* 701	R. D. Berry	--	1906	85	5	85	G	1,066	51.5	Apr. 13, 1962	C,W	S	
* 702	J. B. Lisle	--	1925	135	5	90	G	1,088	67.4	do	C,W	S	
* 703	Ben Burgess	J. Pemberton	1960	105	6	105	G	1,103	49.0	do	J,E, 1/3	D	
* 704	E. York	-- Dixon	1962	84	5	84	G	1,100	47.8	do	J,E, 1/2	D	
* 705	T. W. Mahaney	--	1921	65	5	65	G	1,091	40.1	do	J,E, 1/2	D	

See footnote at end of table.

Table 1.--Records of wells and springs, Young County--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Casing: Diameter (in.)	Casing: Depth (ft.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Below land-surface datum (ft.)	Water level: Date of measurement	Method of lift and type of power	Use of Water	Remarks
*20-60-706	J. Hawkins	--	1910	75	5	75	G	1,093	42.1	Apr. 13, 1962	C,W	S	
* 707	Sam Lewis	--	1927	--	5	--	G	1,027	19.0	do	B,H	D	
* 708	Mrs. F. G. Wiley	--	1920	60	--	--	G	1,067	39.3	do	J,E, 1/4	S	40-in. diameter stone-lined dug well.
* 709	W. M. Barnhardt	--	1950	44	5	44	G	1,045	39.9	Apr. 17, 1962	J,E, 1/3	D	
* 801	I. L. Thedford	--	1935	90	5	90	G	1,082	44	do	C,W	D	
* 802	W. P. Steadham	R. Farmer	1959	80	5	80	G	1,084	42.1	Apr. 12, 1962	C,W	D	1/
* 803	Lee Jeffrey	--	1952	90	5	85	G	1,080	24.1	do	C,W	D	
* 804	H. Banks	--	1938	42	--	--	All	1,018	33.6	Apr. 18, 1962	J,E, 3/4	D	42-in. diameter stone-lined dug well.
* 805	Kay Estate	--	--	--	--	--	G	1,140	--	--	N	S	Spring on limestone outcrop.
* 901	H. D. Criswell	--	1920	69	--	--	G	1,079	63.1	Apr. 19, 1962	J,E, 3/4	D	36-in. diameter stone-lined dug well.
* 902	M. W. Carter	--	1905	82	--	--	G	1,067	51.3	Apr. 18, 1962	J,E, 3/4	D	Do.
* 903	C. D. Jones	Owner	1961	225	--	--	G	1,061	12.1	do	J,E, 1/2	D	40-in. galvanized tin-lined dug well.
* 904	J. J. Jones	--	1958	42	6-3/8	42	G	1,066	22.5	do	J,E, 1/3	D	
* 905	T. C. Murphy	--	1950	66	5	66	G	1,049	50.7	do	J,E, 1/3	D	
* 61-101	M. E. Martin	--	1931	175	5	175	G	1,267	141.9	Apr. 23, 1962	C,W	D	
* 102	C. L. Clinton	--	1942	32	5	32	G	1,239	11.0	do	J,E, 1/3	D	
* 103	W. Padgett	--	1910	100	5	100	G	1,255	51.7	May 30, 1962	J,E, 1/2	D,S	
* 104	H. Willis	R. Farmer	1956	312	5	312	G	1,351	173.2	May 29, 1962	C,W	N	1/
* 201	B. S. Bennett	J. Pemberton	1943	180	5	180	G	1,197	139.9	June 8, 1962	N	N	
* 401	V. H. Martin	Owner	1950	25	--	--	G	1,241	16.6	May 9, 1962	H,B	D	36-in. diameter stone-lined dug well.
* 402	Edgar Steel, Jr.	J. Pemberton	1950	35	5	35	G	1,247	14.4	Apr. 24, 1962	C,E, 1/3	D	
* 501	Edgar Steel	--	--	--	--	--	G	1,175	flows	--	--	S	Spring, masonry-lined

See footnote at end of table.

Table 1.--Records of wells and springs, Young County--Continued

Well	Owner	Driller	Date completed	Depth of well (ft.)	Casing: Diameter (in.)	Casing: Depth (ft.)	Water-bearing unit	Altitude of land surface (ft.)	Water level: Below land-surface datum (ft.)	Water level: Date of measurement	Method of lift and type of power	Use of Water	Remarks
*20-61-701	H. C. Gilmore	--	1935	42	5	42	G	1,170	21.1	Apr. 19, 1962	J,E, 1/4	D	
* 801	C. D. Sealy	--	1949	155	5	155	G	1,141	135	Apr. 23, 1962	C,W	S	
* 802	H. C. Gilmore	--	1905	90	5	90	G	1,126	34.0	Apr. 19, 1962	C,W	D	
* 803	L. Chestnut	--	1945	115	5	115	G	1,148	86.6	Apr. 23, 1962	J,E, 1	D	
* 804	H. C. Gilmore	J. O. Kimbell	1961	108	5	100	G	1,156	67.4	Apr. 19, 1962	J,E, 3/4	D	1/
* 805	E. Burgess	E. Shahand	1945	60	5	60	G	1,133	35.4	Apr. 25, 1962	C,W	D,S	
31-01-301	J. W. Cloud	--	1950	80	5	80	Pu	1,200	40	May 15, 1962	--	--	Not used for several years.
* 03-101	Jenny Martin	Carl Evans	1938	90	5	90	Th	1,217	76	May 14, 1962	C,W	D	
* 301	G. U. Phillips	--	1948	125	5	105	G	1,070	96.7	May 3, 1962	C,W	S	
* 302	J. B. Fore	-- Wise	1962	80	5	80	All	1,040	58.2	do	J,E, 1/2	D	
* 303	Roy Ribble	--	1940	100	5	100	G	1,060	89.2	May 8, 1962	C,E, 1/2	D	
* 304	L. H. Martin	J. Pemberton	1950	100	5	100	G	1,060	79.8	do	C,E, 1/2	D	
* 305	W. G. White	R. Farmer	1959	101	5	101	G	1,060	92.5	do	C,W	S	1/
* 04-101	Claude Lynn	do	1954	105	5	105	G	1,134	74.1	Apr. 16, 1962	C,W	D	
* 102	A. G. Owen	--	1909	82	5	82	G	1,127	30	Apr. 17, 1962	C,W	D	
* 201	C. R. Funk	--	1939	90	5	90	G	1,040	45	Apr. 12, 1962	C,W	D	
* 202	Claude Lynn	--	1949	82	5	82	G	1,155	49.3	Apr. 16, 1962	C,W	S	
* 203	A. P. Pugh	--	1956	140	5	140	G	1,209	133.7	Apr. 17, 1962	C,W	D	
* 05-201	N. E. Majors	--	1946	95	5	95	G	1,171	44.2	Apr. 19, 1962	N	N	Measured depth was 95 ft.

* See Table 2 for chemical analysis.
1/ Drillers log available in files of Texas Water Commission.

Table 2.--Chemical analyses of water from wells and springs, Young County

(Analyses given are in parts per million except specific conductance, pH, percent sodium, and SAR)

Well	Owner	Depth of well (ft.)	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium* (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Total hardness as $CaCO_3$	Percent sodium	Specific conductance (micromhos at 25°C.)	pH	SAR
[a] 20-34-801	J. J. Darilek	80	8-13-62	7	--	32	41	486	472	156	530	1.0	<0.4	1,485	249	--	2,480	7.3	--
[a] 901	Emma Wiechman	19	9-11-62	21	--	125	84	700	465	280	1,014	2.0	59	2,514	659	--	3,960	8.3	--
[a] 35-901	Joe Campbell	96	8- 3-62	13	--	72	24	195	298	279	100	.2	< .4	829	280	--	1,290	7.8	--
[a] 902	Underwood Oil	100	do	17	--	56	22	216	480	132	106	.3	< .4	885	230	--	1,404	7.5	--
[a] 903	C. W. Boydston	60	do	15	--	62	20	83	254	50	72	.5	63	790	238	--	748	8.1	--
[a] 36-701	Oil Tex Supply	60	8- 2-62	15	--	57	16	134	322	168	26	.3	< .4	575	208	--	870	7.8	--
[a] 702	C. B. King	220	do	10	--	4	1	529	715	220	195	2.0	< .4	1,324	15	--	2,100	8.4	--
[a] 703	Clyde Benson	40	8- 3-62	13	--	68	20	55	212	46	58	.05	71	435	250	--	680	8.1	--
[a] 704	Lester Lee	80	do	15	--	64	23	134	346	69	119	.3	21	615	253	--	990	8.1	--
[a] 801	Crenshaw & Whitehill	587	8- 2-62	15	--	38	8	931	546	494	843	4.0	< .4	2,602	128	--	4,100	7.4	--
[a] 901	Tenneco Oil	375	8-20-62	9	--	10	--	551	765	370	173	3.0	< .4	1,493	26	--	2,250	8.1	--
[a] 37-806	McDonald Oil	360	7- 9-62	12	--	5	2	610	610	126	493	2.4	< .4	1,550	21	--	2,900	7.8	--
[a] 808	Bridwell Oil	350	do	13	--	4	1	540	595	126	371	2.4	< .4	1,350	16	--	2,470	8.0	--
[a] 41-201	S. B. Young	25	9-10-62	22	--	113	42	206	416	265	198	.6	< .4	1,050	453	--	1,620	7.6	--
[a] 202	do	29	do	19	--	82	29	291	412	301	201	.6	11	1,143	325	--	1,750	7.4	--
[a] 501	J. F. Daniels	25	9- 4-62	23	--	55	12	9	205	13	7	.2	23	243	189	--	382	7.3	--
[a] 502	Oscar Abbott	30	9-10-62	25	--	57	33	235	560	121	118	2.0	35	902	277	--	1,400	7.6	--
[a] 801	Virble Foster	20	9- 4-62	17	--	42	72	135	563	193	29	1.7	9	776	442	--	1,170	7.6	--
[a] 802	do	27	do	17	--	101	94	256	705	417	118	.9	< .4	1,450	639	--	1,900	7.3	--
[a] 803	Mark Campbell	30	do	19	--	228	213	1,279	561	1,940	1,100	1.3	56	5,062	1,446	--	6,250	7.5	--
[a] 804	J. F. Daniels	10	do	23	--	64	37	320	558	184	229	.7	36	1,167	312	--	1,820	7.5	--
[a] 901	R. M. Carr	42	8-30-62	27	--	37	19	104	376	40	15	1.7	23	451	170	--	690	7.4	--
[a] 902	J. G. Robinson	35	do	25	--	52	18	87	364	37	25	1.2	16	440	203	--	696	7.6	--
[a] 903	Coy Eddleman	32	do	20	--	85	30	57	375	41	59	.5	13	490	337	--	830	7.4	--
[a] 904	Adele Furr	25	8-31-62	17	--	111	69	1,111	710	898	1,011	1.0	51	3,618	560	--	5,110	7.4	--
[a] 905	do	27	do	26	--	19	80	197	456	75	28	3.7	35	688	91	--	925	7.6	--

See footnotes at end of table.

Table 2.--Chemical analyses of water from wells and springs, Young County--Continued

Well	Owner	Depth of well (ft.)	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium* (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Total hardness as $CaCO_3$	Percent sodium	Specific conductance (micromhos at 25°C.)	pH	SAR
a/20-41-906	T. J. Eddleman	40	9- 4-62	24	--	48	16	106	359	62	18	1.0	14	466	185	--	748	7.7	--
a/ 42-201	H. E. Neeley	210	9-10-62	11	--	52	23	1,429	489	988	1,210	1.7	< .4	3,956	224	--	5,560	7.4	--
a/ 202	do	50	do	18	--	175	38	86	304	43	143	.4	363	1,016	594	--	1,500	7.3	--
a/ 203	S. J. Carter	22	do	17	--	58	19	61	289	45	33	.5	18	393	223	--	645	7.4	--
a/ 204	Alfred Johle	70	do	15	--	70	40	221	452	75	163	1.6	162	968	339	--	1,510	7.5	--
a/ 205	E. A. Kunkel	15	do	25	--	64	57	230	498	107	220	2.5	48	996	394	--	1,610	7.7	--
a/ 301	W. A. Roenfeldt	100	8-16-62	13	--	23	12	728	564	226	710	1.5	< .4	1,991	108	--	3,250	7.7	--
a/ 302	Fred Millican	65	8-17-62	14	--	25	23	284	537	63	145	.5	< .4	941	159	--	1,380	8.7	--
a/ 303	L. Alexander	100	8-16-62	17	--	27	17	184	536	26	54	.6	< .4	589	140	--	958	7.6	--
a/ 304	R. O'Dell	50	do	16	--	45	38	140	563	37	50	.8	5.1	603	267	--	986	7.5	--
a/ 305	do	103	do	15	--	130	118	329	509	209	445	.6	321	1,818	812	--	2,700	7.5	--
a/ 306	C. F. Kunkel	30	do	21	--	682	181	985	318	291	2,190	.5	1,019	5,526	2,450	--	7,700	6.9	--
a/ 501	H. R. Dunn	50	8-17-62	20	--	134	45	240	355	94	295	1.0	288	1,292	523	--	1,970	7.4	--
a/ 502	W. E. Stowe	110	9-10-62	9	--	58	32	581	727	141	440	2.0	170	1,789	277	--	2,800	7.3	--
a/ 503	Bert Dunigan	115	do	9	--	8	6	653	763	243	375	3.0	2.7	1,676	35	--	2,580	8.1	--
a/ 504	L. Wright	85	9-11-62	11	--	14	19	468	437	143	428	.9	1.6	1,306	113	--	2,150	8.5	--
a/ 505	J. F. McCauley	165	do	13	--	69	36	573	414	141	310	1.5	49	1,396	322	--	1,810	8.3	--
a/ 601	R. O'Dell	80	8-16-62	16	--	45	39	246	504	121	215	1.0	< .4	931	275	--	1,500	7.6	--
a/ 602	Sid Bailey	50	8-14-62	15	--	68	11	9	264	13	6	.2	5.3	257	216	--	435	7.3	--
a/ 603	-- Allison	83	do	15	--	181	102	338	353	280	684	.9	80	1,855	871	--	2,950	7.6	--
a/ 604	J. W. Harvey	100	8-15-62	12	--	37	32	670	405	83	870	1.5	5.8	1,919	223	--	3,250	7.7	--
a/ 605	L. H. Davidson	140	do	15	--	143	67	323	420	121	600	.4	40	1,515	632	--	2,510	7.4	--
a/ 606	R. E. Daily	80	8-16-62	13	--	25	27	306	588	153	143	1.7	< .4	959	185	--	1,550	7.9	--
a/ 607	D. Herring	90	do	14	--	81	119	570	486	223	880	1.5	< .4	2,127	690	--	3,500	7.7	--
a/ 901	M. H. Williams	55	8- 9-62	15	--	68	24	70	260	33	49	.6	146	533	270	--	820	7.7	--
a/ 902	W. T. Thresher	28	do	17	--	99	32	77	218	90	95	.4	204	721	380	--	1,080	7.3	--
a/ 903	G. W. Hilterbrand	30	8-14-62	10	--	215	182	2,345	303	1,468	3,284	.8	< .4	7,653	1,287	--	10,150	7.4	--

See footnotes at end of table.

Table 2.--Chemical analyses of water from wells and springs, Young County--Continued

Well	Owner	Depth of well (ft.)	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium* (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Total hardness as $CaCO_3$	Percent sodium	Specific conductance (micromhos at 25°C.)	pH	SAR
a/ 20-42-904	Sid Bailey	150	8-14-62	10	--	16	12	463	425	83	455	1.0	11	1,260	91	--	2,150	7.8	--
a/ 43-101	G. D. Rothell	50	8- 7-62	17	--	77	22	69	257	51	60	.4	124	546	283	--	820	7.4	--
a/ 102	Dan Johnson	37	9-11-62	21	--	83	37	387	511	158	440	.7	6	1,383	359	--	2,300	8.3	--
a/ 201	John Parsley	25	8- 6-62	16	--	115	34	120	207	137	102	.6	299	925	427	--	1,300	7.4	--
a/ 202	W. P. Easely	16	do	19	--	113	36	69	189	69	174	.8	146	719	433	--	1,125	7.2	--
a/ 203	H. G. Pringle	20	do	13	--	72	28	99	337	50	80	.7	78	586	292	--	915	7.7	--
a/ 204	Virgil Heard	90	do	16	--	87	52	138	345	84	131	1.4	244	922	433	--	1,350	7.5	--
a/ 401	C. C. Burton	70	8- 7-62	13	--	59	31	265	420	157	227	.3	< .4	958	275	--	1,507	7.7	--
a/ 402	M. Killiam	92	do	12	--	161	72	1,525	222	463	2,410	1.2	< .4	4,753	698	--	7,000	7.3	--
a/ 403	M. Meadows	30	8- 8-62	18	--	110	40	469	370	216	635	.9	38	1,708	437	--	2,850	7.8	--
a/ 404	J. R. Lindsay	265	do	11	--	63	27	1,091	476	524	1,280	1.2	9	3,240	268	--	5,130	7.7	--
a/ 405	S. B. Jeter	80	do	27	--	96	36	594	736	684	255	.2	35	2,090	388	--	3,020	7.7	--
a/ 501	Frank Thomas	30	8- 3-62	15	--	89	30	76	183	68	103	.3	187	658	347	--	1,010	7.4	--
a/ 502	Weldon Smith	60	do	14	--	86	38	175	375	199	165	.5	< .4	861	373	--	1,360	7.8	--
a/ 503	E. B. Clayton	88	do	8	--	92	112	572	446	315	855	.3	< .4	2,174	690	--	3,550	7.8	--
a/ 504	W. B. Wilson	20	8- 8-62	11	--	211	70	48	148	168	205	.1	421	1,207	815	--	1,900	7.1	--
a/ 505	C. H. Rogers	174	8- 7-62	10	--	58	14	197	449	102	111	.6	< .4	713	202	--	1,100	7.3	--
a/ 601	W. L. Simmons	400	8- 3-62	11	--	4	1	640	974	113	321	4	< .4	1,572	14	--	2,480	8.2	--
a/ 602	Carl Wilson	105	do	18	--	41	30	155	427	61	92	.9	< .4	607	225	--	965	8.0	--
a/ 603	Mrs. Deming	200	8- 6-62	7	--	18	9	801	470	877	360	1.6	< .4	2,303	82	--	3,350	7.9	--
a/ 701	S. A. Morris	180	8- 8-62	15	--	27	11	1,443	497	307	1,690	1.8	< .4	3,837	110	--	6,200	8.0	--
a/ 702	M. Taack	270	8- 9-62	15	--	9	5	758	672	199	680	2.5	< .4	1,999	44	--	3,400	8.0	--
a/ 703	do	170	8- 8-62	9	--	40	21	248	456	118	178	1.1	4.4	843	186	--	1,480	7.9	--
a/ 704	C. Lowe	30	8- 9-62	16	--	91	25	53	250	44	57	.6	151	559	329	--	855	7.4	--
a/ 705	G. Lowe	30	do	22	--	86	24	217	321	126	218	.9	106	957	316	--	1,540	7.5	--
a/ 706	Riggs (Oil op.)	--	do	11	--	36	15	758	672	315	690	3.0	< .4	2,159	151	--	3,590	8.0	--
a/ 707	W. Taack	170	do	11	--	54	19	560	660	494	300	1.3	7	1,771	212	--	2,700	7.8	--

See footnotes at end of table.

Table 2.--Chemical analyses of water from wells and springs, Young County--Continued

Well	Owner	Depth of well (ft.)	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium* (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Total hardness as $CaCO_3$	Percent sodium	Specific conductance (micromhos at 25°C.)	pH	SAR
a/ 20-43-708	S. A. Morris	14	8- 9-62	20	--	857	174	516	306	38	2,685	0.1	<0.4	4,441	2,853	--	7,150	7.1	--
a/ 901	B. W. King	108	8- 6-62	9	--	24	14	460	598	235	271	1.4	< .4	1,307	119	--	2,100	7.9	--
a/ 902	D. McClathchy	423	do	11	--	15	5	980	638	173	1,020	3.5	4.2	2,525	60	--	4,100	7.8	--
a/ 44-101	G. C. Glover	26	7-30-62	19	--	66	37	84	259	46	127	.8	88	594	318	--	1,112	7.5	--
a/ 102	Ethan Johnson	128	8- 1-62	9	--	4	4	380	559	80	189	2.0	< .4	952	25	--	1,500	8.4	--
a/ 103	R. L. McGee	106	do	20	--	134	43	146	388	69	232	1.1	115	951	510	--	1,510	8.0	--
a/ 104	Bill Cooper	207	do	10	--	133	30	86	261	61	126	.4	266	840	457	--	1,220	8.3	--
a/ 105	R. R. Cope	130	8- 2-62	10	--	8	6	422	539	198	213	2	< .4	1,124	48	--	1,840	8.1	--
a/ 106	W. P. Foster	150	do	9	--	16	12	903	673	582	616	3.0	< .4	2,472	88	--	3,800	8.2	--
a/ 107	A. A. Bernhardt	24	do	17	--	78	32	113	298	71	116	.4	35	609	285	--	960	8.0	--
a/ 108	Lem Groves	48	do	17	--	178	38	165	266	100	224	.2	381	1,234	600	--	1,770	7.9	--
a/ 109	Jake Edwards	20	do	17	--	60	22	305	359	135	270	.5	71	1,057	243	--	1,750	8.1	--
a/ 110	L. T. Burns Est.	315	do	9	--	2	1	435	648	167	119	2.0	3.3	1,105	10	--	1,750	8.9	--
a/ 111	W. B. Howard	100	8- 3-62	11	--	68	15	72	298	51	49	.3	32	445	233	--	692	7.9	--
a/ 201	F. H. Green	146	7-11-62	14	--	1	1	295	547	71	83	1.6	2	737	8	--	1,300	8.3	--
a/ 202	Olive Garvey	90	do	13	--	4	1	185	373	34	45	1.2	1	468	16	--	839	7.8	--
a/ 203	W. H. Casey	90	7-31-62	19	--	66	26	67	386	74	32	.4	< .4	474	271	--	730	8.0	--
a/ 204	J. B. Garvey	259	8- 1-62	10	--	8	4	268	452	97	70	.8	< .4	696	36	--	1,065	8.6	--
a/ 301	R. M. Hall	525	7-11-62	13	--	3	1	385	534	45	243	1.0	< .4	954	12	--	1,800	7.9	--
a/ 302	A. N. Lunsford	45	do	22	--	96	42	82	315	84	131	1.2	62	675	413	--	1,200	7.2	--
a/ 303	Mrs. K. Gragg	77	do	14	--	80	28	63	146	66	115	.4	102	540	316	--	990	7.8	--
a/ 304	Crenshaw & Whitehill Oil	420	7-10-62	12	--	4	2	760	1,057	162	445	4	< .4	1,908	19	--	3,340	8.1	--
a/ 305	do	420	do	13	--	5	2	750	1,037	116	445	4	< .4	1,845	19	--	3,340	8.0	--
a/ 401	City of Jean	360	8- 9-61	10	--	5	1.5	609	720	204	382	4.1	3.8	1,580	18	--	2,630	7.9	--
a/ 402	J. M. Elmore	30	7-27-62	18	--	86	28	102	265	100	68	1.0	177	710	317	--	1,005	7.6	--
a/ 403	Claude Sims	165	7-30-62	19	--	130	38	138	273	82	232	.4	186	959	480	--	1,580	7.8	--
a/ 404	James Gathings	120	do	24	--	63	18	36	154	26	56	.3	101	400	232	--	620	7.3	--

See footnotes at end of table.

Table 2.--Chemical analyses of water from wells and springs, Young County--Continued

Well	Owner	Depth of well (ft.)	Date of collection	Silica (SiO_2)	Iron (Fe)	Cal-cium (Ca)	Magne-sium (Mg)	Sodium* (Na)	Bicar-bonate (HCO_3)	Sul-fate (SO_4)	Chlo-ride (Cl)	Fluo-ride (F)	Ni-trate (NO_3)	Dis-solved solids	Total hard-ness as $CaCO_3$	Per-cent so-dium	Specific conduct-ance (micromhos at 25°C.)	pH	SAR
a/ 20-44-405	O. B. Barron	57	8- 1-62	21	--	78	18	56	317	33	78	0.4	3.8	444	268	--	720	8.0	--
a/ 406	W. J. Haygood	60	do	18	--	67	23	102	354	56	93	.7	23	656	262	--	879	8.2	--
a/ 407	H. F. Haygood	60	do	18	--	48	33	130	410	62	97	1	< .4	591	254	--	925	8.2	--
a/ 408	John Edwards	90	do	17	--	200	90	336	246	190	643	1.2	275	1,873	870	--	2,900	8.0	--
a/ 409	T. M. Elmore	40	7-27-62	18	--	40	44	87	346	67	71	1.1	14	647	280	--	852	7.7	--
a/ 501	Kleiner, Turner, Fiske & West Oil Co.	425	7-30-62	14	--	20	16	534	476	45	632	.8	< .4	1,495	115	--	2,580	8.0	--
a/ 502	do	425	do	14	--	2	1	246	525	64	27	1	< .4	621	6	--	982	8.5	--
a/ 503	do	400	do	14	--	2	--	258	517	66	40	.8	< .4	745	7	--	--	8.5	--
a/ 504	do	425	do	14	--	2	1	258	483	69	54	.9	1.6	659	8	--	1,027	8.5	--
a/ 505	do	425	do	14	--	3	1	246	473	64	56	.9	< .4	624	9	--	994	8.5	--
a/ 506	Lebus Oil Co.	435	7-28-62	14	--	2	.7	210	488	41	16	.6	< .4	524	7	--	835	8.1	--
a/ 507	J. Q. Neal	300	7-31-62	8	--	7	1	211	383	66	62	1	3.8	595	24	--	875	8.4	--
a/ 508	D. French	334	7-30-62	14	--	2	1	258	537	64	38	1.0	< .4	649	7	--	1,008	8.5	--
a/ 509	Sam Hawkins	248	7-31-62	9	--	15	6	159	354	48	45	.9	5	461	62	--	783	8.3	--
a/ 510	W. H. Casey	330	do	5	--	2	1	285	527	74	48	1.2	< .4	692	9	--	1,057	8.5	--
a/ 601	Phillips Petroleum Co.	733	7- -62	11	--	18	8	1,302	573	325	1,486	1.3	< .4	3,445	79	--	5,600	8.4	--
a/ 602	J. D. Beard	409	7-28-62	14	--	2	.5	240	527	51	41	.9	< .4	608	6	--	1,040	8.3	--
a/ 603	LaBrea Oil Corp.	435	do	14	--	2	--	246	515	66	29	.8	< .4	610	6	--	935	8.3	--
a/ 604	H. Lee (Oil op.)	375	do	14	--	2	1	204	517	63	22	.8	< .4	561	8	--	960	8.3	--
a/ 605	Hawkins Chapel Cementary	38	8- 4-62	18	--	32	12	28	137	37	23	.4	10	227	131	--	375	7.1	--
a/ 606	Mary Newman	40	do	15	--	47	18	67	212	80	51	.2	15	397	194	--	650	7.3	--
a/ 607	W. C. Bishop	25	do	17	--	60	31	63	172	57	61	.8	182	556	277	--	820	7.4	--
a/ 608	B. F. Barrett	50	do	11	--	398	134	523	146	73	1,770	.2	16	2,997	1,547	--	5,100	7.0	--
a/ 609	Glyn Loftin	50	4-18-62	17	--	450	133	1,100	192	117	2,680	--	--	4,590	1,670	--	7,920	6.5	--
a/ 701	L. C. Brooks	236	7-16-62	14	--	130	132	405	693	726	238	.8	63	2,050	870	--	3,150	7.8	--
a/ 702	C. E. Poole	320	7-19-62	14	--	4	1	411	634	130	163	2.2	< .4	1,037	14	--	1,870	8.3	--

See footnotes at end of table.

Table 2.--Chemical analyses of water from wells and springs, Young County--Continued

Well	Owner	Depth of well (ft.)	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium* (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Total hardness as $CaCO_3$	Percent sodium	Specific conductance (micromhos at 25°C.)	pH	SAR
a/20-44-703	R. U. McCaghren	385	7-19-62	14	--	3	1	384	691	123	106	0.3	<0.4	971	11	--	1,570	8.3	--
a/ 704	B. W. King	240	do	9	--	8	4	880	647	327	735	3	< .4	2,304	35	--	4,450	8.4	--
a/ 705	L. C. Brooks	90	8-21-62	11	--	80	76	364	730	528	140	.8	1.7	1,560	513	--	2,200	7.4	--
a/ 801	A. A. Kunkel	320	7-31-62	6	--	13	13	869	508	542	654	1	< .4	2,364	85	--	3,600	8.5	--
a/ 802	E. R. Senkel	309	do	11	--	4	2	292	535	90	68	1	< .4	743	20	--	1,175	8.5	--
a/ 803	W. L. Hawkins	330	do	11	--	2	1	262	535	66	33	.9	< .4	650	8	--	977	8.4	--
a/ 804	S. P. Ligon	165	do	9	--	25	17	359	578	268	118	1.2	< .4	1,081	133	--	1,620	8.3	--
a/ 805	Mrs. Shatto	305	1-17-63	6	--	44	18	1,414	442	1,083	1,246	1.3	< .4	4,028	184	--	6,070	8.1	--
b/ 901	O. L. Purselley	264	8- 9-61	9	--	40	20	111	300	104	46	.7	.8	480	182	55	799	7.0	3.4
a/ 902	G. E. Boyle	114	7-27-62	14	--	32	15	261	500	175	98	1.0	< .4	851	140	--	1,360	7.8	--
a/ 45-204	D. O. Logan	113	7- 9-62	12	--	24	14	495	654	390	162	.4	< .4	1,419	120	--	2,400	7.8	--
a/ 205	V. W. Young	350	7-10-62	13	--	2	1	365	571	78	169	1.6	< .4	910	11	--	1,700	7.9	--
a/ 206	do	400	do	13	--	2	1	370	561	66	189	1.2	< .4	918	11	--	1,720	8.0	--
a/ 207	M. L. Connally	392	7- 6-62	14	--	3	1	400	595	103	205	1.6	< .4	1,020	11	--	1,820	8.0	--
a/ 208	J. F. Cox	380	7- 9-62	13	--	4	1	350	554	52	161	1.2	< .4	854	12	--	1,570	7.9	--
a/ 209	Harwell & Robinson Oil Co.	360	7- 6-62	17	--	1	1	298	527	53	114	1.0	< .4	804	8	--	1,350	8.1	--
a/ 210	do	350	do	13	--	2	1	330	537	55	142	1.0	< .4	808	8	--	1,820	8.0	--
a/ 212	Charles Self	70	7-10-62	16	--	58	25	57	188	57	73	.8	89	468	250	--	--	8.0	--
a/ 213	McGaha Oil Co.	320	7-31-62	11	--	3	1	292	447	71	115	.7	< .4	730	12	--	1,115	8.6	--
b/ 501	G. Stewart	330	7- 2-62	10	1.2	14	5.8	276	476	178	57	1.1	.0	776	59	91	1,240	7.6	16
b/ 502	L. T. Burn Est.	310	6-30-62	11	--	1.5	.6	250	488	59	60	1.0	1.2	624	6	99	1,020	8.2	44
b/ 503	G. Wilton	100	7- 2-62	9	2.0	23	8	285	492	210	57	1.0	5.3	840	90	87	1,330	7.5	13
b/ 504	O. B. Peterson	380	6-30-62	11	.63	1.5	.7	279	524	45	94	1.1	1.2	692	6	99	1,140	8.1	50
b/ 701	Sam Mullican	215	6-29-62	19	1.6	91	38	123	380	239	61	.5	3.8	762	384	41	1,170	7.3	2.7
b/ 702	Ken Mobley	210	do	8.7	.65	33	20	276	394	256	120	1.3	2.2	911	165	78	1,460	7.0	9.3
a/ 703	A. C. Dragoon	54	7-11-62	18	--	80	28	94	210	71	156	.4	47	597	315	--	1,100	6.9	--
a/ 704	L. B. Creel	300	8- 4-62	19	--	109	50	127	375	365	52	.7	< .4	908	477	--	1,257	7.5	--

See footnotes at end of table.

Table 2.--Chemical analyses of water from wells and springs, Young County--Continued

Well	Owner	Depth of well (ft.)	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium* (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Total hardness as $CaCO_3$	Percent sodium	Specific conductance (micromhos at 25°C.)	pH	SAR
b/ 20-45-801	H. B. Perkins	--	6-29-62	18	1.8	108	35	109	316	130	181	0.5	0	736	414	37	1,250	6.9	2.3
b/ 802	Ralph Harvey	220	do	19	.36	91	23	64	324	117	50	.5	1.8	525	322	30	841	7.4	1.5
b/ 803	do	260	do	17	--	69	31	94	324	136	65	1.0	2.8	575	300	41	925	6.9	2.4
a/ 49-501	Geo. Wilkinson	66	9-12-62	11	--	171	70	417	338	217	786	.4	63	1,901	715	--	3,100	8.0	--
a/ 502	do	66	do	16	--	228	57	417	337	211	840	.1	< .4	1,929	804	--	3,220	8.0	--
a/ 601	W. W. Bruton	102	do	14	--	156	79	893	306	282	1,510	.3	2.6	3,087	713	--	4,960	8.2	--
a/ 602	W. B. Bellomy	65	do	15	--	67	36	455	709	206	313	.7	72	1,513	313	--	2,300	8.3	--
a/ 50-101	G. W. Clifton	10	8-30-62	15	--	90	46	152	388	149	156	1.2	44	844	415	--	1,350	7.6	--
a/ 201	E. A. Morgan	60	8-29-62	15	--	102	29	69	277	107	90	.5	66	614	374	--	965	8.2	--
a/ 202	L. L. Tate	30	8-30-62	24	--	33	25	352	574	95	278	2.0	6.0	1,098	188	--	1,800	7.7	--
a/ 203	Doyle Davis	21	do	21	--	37	66	189	586	92	116	3.7	21	833	364	--	1,330	7.7	--
a/ 301	E. R. Riggs & Son Oil Co.	200±	8-10-62	9	--	16	21	1,114	776	372	1,170	2.2	< .4	3,087	128	--	4,510	7.9	--
a/ 302	R. P. Doran Oil	200	do	10	--	15	7	763	759	26	585	3.0	< .4	1,872	65	--	3,260	8.2	--
a/ 303	Morgan Bros. Oil Co.	110	8-17-62	11	--	14	8	206	402	48	83	1.9	< .4	570	68	--	939	7.8	--
a/ 304	H. Williams	140	8-29-62	7	--	11	11	258	377	95	172	1.0	< .4	741	74	--	1,250	7.6	--
a/ 305	Dr. Myers	103	do	13	--	35	23	433	524	312	282	1.0	2.7	1,358	183	--	2,130	7.7	--
a/ 306	Guy Hearne	90	do	10	--	166	76	486	368	644	533	.7	< .4	2,097	727	--	3,060	7.2	--
a/ 307	E. C. Crouch	122	8-28-62	12	--	20	10	388	533	256	170	1.7	5.8	1,126	89	--	1,750	7.8	--
a/ 308	Horace Pounds	140	do	10	--	24	41	615	477	312	595	.9	2.2	1,835	228	--	2,920	7.7	--
a/ 401	Harvey Creel	72	9-12-62	20	--	137	47	117	321	84	145	.3	331	1,039	533	--	1,500	8.2	--
a/ 402	R. I. Gilmore	150	do	11	--	113	20	233	227	75	396	.3	75	1,034	412	--	1,800	8.2	--
a/ 403	H. R. Strother	110	do	18	--	99	46	117	417	127	124	.6	27	764	438	--	1,180	8.2	--
a/ 404	W. T. Creel	35	9-13-62	19	--	137	115	893	636	708	936	.8	198	3,320	814	--	4,710	8.2	--
a/ 501	T. M. Blanton	70-75	do	16	--	65	23	155	416	69	118	.5	7	658	255	--	1,095	8.3	--
a/ 601	Lola Remington	112	8-27-62	29	--	21	55	315	965	95	60	4.5	5.8	1,060	277	--	1,580	8.0	--
a/ 602	Mrs. Jeff Barnett	52	do	27	--	72	41	117	528	61	50	1.2	40	669	349	--	1,022	7.6	--

See footnotes at end of table.

Table 2.--Chemical analyses of water from wells and springs, Young County--Continued

Well	Owner	Depth of well (ft.)	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium* (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Total hardness as $CaCO_3$	Percent sodium	Specific conductance (micromhos at 25°C.)	pH	SAR
a/20-50-603	Mrs. Jeff Barnett	110	8-27-62	13	--	53	31	620	438	317	655	0.4	4.2	1,909	260	--	3,060	7.5	--
a/ 604	do	110	do	17	--	46	23	167	443	69	64	1.7	37	643	208	--	990	7.8	--
a/ 605	M. J. Phillips	35	9-13-62	13	--	26	73	32	437	42	7	1.7	33	444	363	--	721	8.3	--
a/ 701	R. T. Wells	120	9-12-62	12	--	13	7	315	405	66	235	1.5	9	863	64	--	1,470	8.5	--
a/ 901	J. E. Moore	20	8-23-62	26	--	77	72	121	547	105	114	.9	10	795	490	--	1,260	7.7	--
a/ 51-101	R. P. Ward	220	8-13-62	10	--	37	18	323	439	219	160	.9	< .4	983	170	--	1,630	7.6	--
a/ 102	do	243	8-22-62	6	--	7	6	23,750	1,025	1,500	32,300	12.0	--	59,730	42	--	12,000	9.5	--
a/ 103	L. C. Larrimore	106	8-10-62	15	--	114	27	94	360	70	103	.3	133	733	395	--	1,115	7.5	--
a/ 104	O. H. Colley	245	8-14-62	15	--	92	30	154	465	70	165	.6	< .4	755	355	--	1,250	7.1	--
a/ 105	J. T. Ellis	30	8-17-62	27	--	517	251	844	351	1,270	1,325	1.2	842	5,249	2,325	--	6,370	7.1	--
a/ 201	L. C. Larrimore	300	8-10-62	3	--	2	4	1,360	282	137	1,465	1.8	< .4	3,362	21	--	5,350	9.8	--
a/ 202	Jack Rux	272	do	9	--	68	48	507	433	389	488	.7	< .4	1,722	366	--	2,820	7.8	--
a/ 203	J. F. Hays	285	8-14-62	10	--	16	7	965	647	156	1,014	2.5	< .4	2,488	68	--	4,050	7.8	--
a/ 301	J. B. Haggard	100	7-17-62	13	--	6	2	305	459	213	83	1.75	< .4	850	26	--	1,600	8.1	--
a/ 302	C. Langford	220	7-18-62	--	--	5	2	234	415	96	62	.7	2.9	606	22	--	1,100	8.3	--
a/ 303	T. Lewelling	110	do	13	--	4	2	258	486	109	52	.8	< .4	577	18	--	1,190	8.1	--
a/ 304	G. W. Hays	65	do	13	--	4	2	294	542	96	72	1	1.5	750	19	--	1,400	8.2	--
a/ 401	Willis Wages	57	8-27-62	25	--	145	38	97	494	141	94	.1	41	824	518	--	1,250	7.3	--
a/ 402	J. C. Chapel	107	8-28-62	8	--	116	88	91	499	311	64	.1	< .4	923	652	--	1,360	7.5	--
a/ 601	R. J. Bryan	100	9-11-62	12	--	37	9	364	521	211	200	2.0	< .4	1,092	130	--	1,700	8.3	--
a/ 602	Harry Kinley	160	do	11	--	6	1	569	605	148	375	3.3	< .4	1,422	20	--	2,270	8.6	--
a/ 603	R. J. Bryan	165	9-12-62	13	--	378	96	507	337	192	1,356	.7	37	2,745	1,340	--	4,490	8.0	--
a/ 701	H. W. Barrett	160	8-23-62	9	--	48	18	207	397	61	194	.9	< .4	733	196	--	1,250	7.1	--
a/ 702	Ft. Belnap Park	40	do	23	--	81	37	102	456	63	74	.7	25	629	355	--	995	7.5	--
a/ 703	do	40	do	20	--	75	52	100	480	63	94	.8	33	674	403	--	1,050	7.7	--
a/ 704	Roy Veal	50	do	29	--	218	75	283	653	332	368	.1	37	1,663	853	--	2,500	7.2	--
a/ 705	R. L. Sullivan	40	do	34	--	127	43	265	702	227	171	.3	17	1,230	497	--	1,810	7.6	--

See footnotes at end of table.

Table 2.--Chemical analyses of water from wells and springs, Young County--Continued

Well	Owner	Depth of well (ft.)	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium* (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Total hardness as $CaCO_3$	Percent sodium	Specific conductance (micromhos at 25°C.)	pH	SAR
a/ 20-51-706	B. Parkinson	35	8-23-62	36	--	131	30	47	475	61	49	0.1	20	608	451	--	966	7.3	--
a/ 801	Jim Wray	230	8-21-62	13	--	9	3	223	455	100	28	.8	< .4	600	33	--	956	8.0	--
a/ 802	do	120	do	12	--	40	18	355	414	408	155	1.0	4	1,193	174	--	1,840	7.5	--
a/ 803	Robert Bullock	160	do	20	--	66	30	108	390	95	78	.5	< .4	589	287	--	960	7.2	--
a/ 901	L. Pitcock	45	8-22-62	14	--	74	21	73	375	81	27	.4	< .4	475	270	--	753	7.6	--
a/ 902	J. L. Burch	135	do	12	--	10	4	335	467	115	200	1.0	2.2	909	43	--	1,520	7.8	--
a/ 52-101	R. C. Lindley	104	7-16-62	16	--	26	39	210	338	250	109	1.0	< .4	817	227	--	1,470	8.1	--
a/ 102	C. M. Gibson	92	7-17-62	23	--	114	29	86	373	193	49	.4	< .4	677	405	--	--	7.9	--
a/ 103	E. W. Geis	100	do	19	--	27	14	170	381	68	75	.75	2.9	564	125	--	1,090	8.1	--
a/ 104	Mary Bradshaw	190	7-18-62	15	--	3	0	258	532	62	41	.7	< .4	640	8	--	1,085	8.1	--
a/ 105	F. C. Walker	105	do	16	--	91	22	70	334	88	59	1.0	< .4	511	319	--	980	8.0	--
a/ 106	L. C. West	100	7-19-62	23	--	50	29	130	395	118	56	.6	6.4	606	242	--	1,050	8.0	--
a/ 107	John G. Slater	169	do	17	--	30	51	162	337	266	42	.7	< .4	734	285	--	1,250	7.9	--
a/ 108	C. R. Rutherford	140	7-21-62	17	--	36	20	135	390	90	50	.7	< .4	540	172	--	882	8.3	--
a/ 109	J. C. Hays	185	8-15-62	20	--	7	1	294	449	54	165	.7	< .4	762	22	--	1,250	8.0	--
a/ 201	C. E. Caskey	104	7-13-62	13	--	25	12	210	405	106	103	.4	< .4	668	112	--	1,135	8.3	--
a/ 202	Mary Thigpen	160	do	11	--	9	5	279	442	153	77	1.0	< .4	763	43	--	1,230	8.5	--
a/ 203	E. B. Petty	160	do	11	--	4	2	234	417	105	37	1	3.1	610	19	--	1,005	8.5	--
a/ 204	R. L. Tiffin	192	do	19	--	63	21	170	366	180	86	.4	2.2	719	245	--	1,250	7.9	--
a/ 205	T. L. Shepard	105	do	20	--	55	24	190	412	240	36	.8	< .4	767	235	--	1,250	8.0	--
a/ 206	A. B. Tiffin	175	do	14	--	35	20	147	378	85	55	.8	1.8	551	170	--	929	8.4	--
a/ 207	O. L. McGee	160	7-16-62	12	--	6	2	420	573	312	81	.25	5.5	1,125	25	--	1,950	8.4	--
a/ 208	L. G. Bills	200	do	19	--	23	12	185	395	124	55	.6	< .4	612	108	--	--	8.0	--
b/ 301	W. G. Shepard	150	6-25-62	12	4.6	171	50	86	632	190	72	.4	1.0	893	632	23	1,420	6.8	1.5
b/ 302	do	333	6-26-62	8.4	--	102	33	294	352	84	460	.5	2.5	1,160	390	62	2,060	7.6	6.5
b/ 303	W. W. Prather	150	6-25-62	11	1.5	114	31	116	400	109	152	.4	8.4	739	412	38	1,270	7.0	2.5
b/ 304	Joe Shepard	130	6-26-62	11	--	108	31	90	386	86	132	.4	.0	648	397	33	1,110	7.0	2.0

See footnotes at end of table.

Table 2.--Chemical analyses of water from wells and springs, Young County--Continued

Well	Owner	Depth of well (ft.)	Date of collection	Silica (SiO_2)	Iron (Fe)	Cal-cium (Ca)	Magne-sium (Mg)	Sodium* (Na)	Bicar-bonate (HCO_3)	Sul-fate (SO_4)	Chlo-ride (Cl)	Fluo-ride (F)	Ni-trate (NO_3)	Dis-solved solids	Total hard-ness as $CaCO_3$	Per-cent so-dium	Specific conduct-ance (micromhos at 25°C.)	pH	SAR
b/ 20-52-305	Mrs. W. R. Sanders	120	6-26-62	10	--	92	13	35	340	33	32	0.5	0.0	382	283	21	679	6.9	0.9
b/ 306	Arthur Burdick	27	6-28-62	15	.13	54	18	48	216	36	53	.6	28	359	208	33	616	7.0	1.4
b/ 307	E. B. Dickson	90	6-29-62	10	3.3	112	55	99	536	59	154	.7	.0	754	506	30	1,320	6.8	1.9
a/ 308	E. W. Oatman	40	7-12-62	11	--	6	2	534	456	141	454	1.5	1.3	1,398	25	--	2,400	8.6	--
a/ 309	L. C. Oliver	40	7-27-62	15	--	30	13	35	129	43	39	.3	1.9	257	127	--	418	7.1	--
a/ 310	J. F. Oliver	76	do	16	--	49	22	37	265	24	37	.6	< .4	315	215	--	540	7.3	--
a/ 401	L. C. Young	120	7-17-62	20	--	58	88	200	449	428	97	.4	2.9	1,115	795	--	1,900	8.0	--
a/ 402	Hoyle Fitzgerald	115	do	19	--	72	27	200	427	275	78	.5	10	891	290	--	--	7.9	--
a/ 403	Harold Elliott	100	do	16	--	150	41	120	515	200	137	.4	4.2	921	542	--	1,700	7.6	--
a/ 404	A. L. Reece	105	do	19	--	92	15	315	427	410	137	1.2	1.8	1,202	293	--	2,100	8.1	--
a/ 405	do	105	do	19	--	92	15	315	427	410	137	1.2	1.8	1,202	293	--	2,100	8.1	--
a/ 406	H. T. Barrett	129	do	26	--	62	35	94	251	162	77	.2	< .4	579	300	--	926	8.3	--
a/ 501	J. K. Jefferies	350	7-12-62	18	--	94	19	60	234	54	93	.6	58	511	315	--	902	8.3	--
a/ 502	Mary Riddle	160	do	11	--	3	1	222	420	47	67	.9	< .4	571	10	--	975	8.5	--
a/ 503	Frank Slater	135	do	11	--	2	1	240	442	57	70	.8	< .4	609	7	--	995	8.5	--
b/ 601	C. E. Taylor	135	6-11-62	15	--	132	19	47	300	77	115	.5	26	580	408	20	991	6.8	1.0
b/ 602	Melvin Dollins	135	do	15	--	315	38	149	428	576	220	.4	4.7	1,530	942	26	2,120	6.5	2.1
b/ 603	H. D. Partin	140	do	15	--	352	153	556	448	698	940	.7	366	3,300	1,510	45	4,830	6.6	6.2
b/ 604	W. H. Peterson	149	do	16	--	139	30	72	398	85	135	.6	25	699	470	25	1,190	6.7	1.4
b/ 605	W. B. Wragg	135	6-12-62	11	--	12	3.6	327	396	120	214	1.0	1.2	885	45	94	1,430	7.6	21
b/ 606	Eva Guinn	65	6- 1-62	12	--	122	30	100	408	168	90	.8	8.4	732	428	34	1,190	6.9	2.1
b/ 607	Homer Brashears	71	6-13-62	19	--	94	17	64	364	43	70	.4	.0	486	304	31	868	7.1	1.6
b/ 608	Mrs. G. A. Bills	110	do	14	--	92	22	81	402	68	67	.4	.0	542	320	35	897	7.0	2.0
b/ 609	J. H. Taylor	101	6-14-62	14	--	70	20	96	394	42	69	.5	1.5	507	257	45	845	7.0	2.6
b/ 610	George Birdell	127	do	15	--	82	19	90	402	47	69	.5	1.5	522	282	41	872	7.1	2.3
b/ 611	O. B. Taylor	84	do	13	--	254	50	301	406	464	480	.3	.5	1,760	839	44	2,730	6.7	4.5
b/ 612	R. H. Taylor	153	6-13-62	11	--	11	4.6	244	332	74	158	1.0	1.8	668	46	92	1,140	7.4	16

See footnotes at end of table.

Table 2.--Chemical analyses of water from wells and springs, Young County--Continued

Well	Owner	Depth of well (ft.)	Date of collection	Silica (SiO_2)	Iron (Fe)	Cal-cium (Ca)	Magne-sium (Mg)	Sodium* (Na)	Bicar-bonate (HCO_3)	Sul-fate (SO_4)	Chlo-ride (Cl)	Fluo-ride (F)	Ni-trate (NO_3)	Dis-solved solids	Total hard-ness as $CaCO_3$	Per-cent so-dium	Specific conduct-ance (micromhos at 25°C.)	pH	SAR
b/ 20-52-613	E. E. Atwell	157	6-15-62	11	--	8.8	2.3	286	368	49	210	1.1	1.2	750	32	95	1,310	7.4	22
b/ 614	General American Oil Co.	150	do	9.9	--	20	8.6	640	456	111	700	--	1.0	1,710	86	94	3,040	7.5	30
b/ 615	Jack Burnett	150	6- 1-62	9.6	--	38	8.0	201	406	28	130	.8	21	636	128	77	1,040	7.2	7.7
b/ 616	do	147	6-15-62	14	--	402	105	459	368	576	1,060	--	45	2,840	1,440	41	4,460	7.0	5.3
b/ 617	Mrs. D. F. Ford	80	6-25-62	17	--	530	62	384	286	39	1,500	--	26	2,700	1,580	35	4,880	6.5	4.2
a/ 618	Don Horn	160	7-12-62	15	--	69	32	66	354	77	51	.7	9.7	494	308	--	840	8.3	--
a/ 619	B. W. King	150	do	14	--	39	58	84	429	65	78	.4	2.2	549	339	--	973	8.3	--
a/ 701	J. Hawkins	131	8-31-62	10	--	10	4	860	633	375	714	2.7	1.5	2,290	39	--	3,560	7.5	--
b/ 801	L. C. Grant	75	6-11-62	10	--	51	24	256	260	112	320	.3	.5	902	226	71	1,610	6.5	7.4
b/ 802	M. R. Richards	120	do	6.3	.92	13	23	429	680	178	222	.4	3.0	1,210	127	88	1,950	7.8	17
a/ 803	O. W. McSpadden	140	7-12-62	11	--	77	32	832	332	350	1,118	1.2	< .4	2,584	327	--	4,380	8.3	--
a/ 804	R. Casburn	75	do	15	--	136	65	159	276	202	322	.2	44	1,078	609	--	1,900	8.2	--
b/ 901	J. H. Robertson	256	6-19-62	7.7	--	20	5.3	22	110	15	9.5	.2	.2	134	72	40	238	6.9	1.1
b/ 902	J. T. Robertson, Jr.	195	do	8.9	--	14	4.2	504	360	217	440	1.4	4.8	1,370	52	95	2,330	7.4	30
b/ 903	Mrs. J. H. Robertson	60	do	17	1.9	355	108	625	460	784	900	--	280	3,300	1,330	51	4,820	7.1	7.4
b/ 904	Bill Robertson	17.5	do	14	--	80	20	46	270	43	72	.8	14	423	282	26	755	6.9	1.2
b/ 905	J. T. Robertson, Sr.	125	do	18	--	64	13	192	454	75	126	.5	1.8	713	213	66	1,190	7.0	5.7
b/ 906	Walter Rehders	76	6-20-62	15	--	83	11	45	278	39	46	.3	19	395	252	28	667	6.7	1.2
b/ 907	Annie Brashears	100	6-19-62	14	--	63	15	55	240	45	59	.7	13	383	218	36	671	6.6	1.6
b/ 908	Walter Rehders	40	do	12	--	85	14	71	304	56	58	.4	42	487	270	37	806	6.9	1.9
b/ 909	Earl Rhoades	100	6-20-62	13	2.3	107	21	44	280	74	77	.7	40	515	354	21	921	6.9	1.0
b/ 53-101	J. O. McCluer	160	6-26-62	16	--	132	34	88	374	229	81	.6	.2	765	470	29	1,200	7.4	1.8
b/ 102	W. L. Holder	200	6-25-62	13	14	65	29	56	322	72	44	.6	.0	438	282	30	744	7.1	1.5
b/ 103	J. R. Day	123	do	15	--	76	39	70	348	69	72	.9	52	565	350	30	947	7.2	1.6
b/ 104	W. R. Shepard	160	6-26-62	12	4	75	25	44	292	77	45	.9	.2	423	290	25	737	7.2	1.1
b/ 105	Joe Shepard	160	do	15	--	113	32	60	352	149	70	.8	.2	613	414	24	1,010	6.9	1.3
b/ 106	R. H. Burdick	125	6-25-62	18	--	74	29	63	352	73	53	.7	.0	484	304	31	816	6.8	1.6

See footnotes at end of table.

Table 2.--Chemical analyses of water from wells and springs, Young County--Continued

Well	Owner	Depth of well (ft.)	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium* (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Total hardness as $CaCO_3$	Percent sodium	Specific conductance (micromhos at 25°C.)	pH	SAR
b/ 20-53-108	Ardis Reeves	148	6-25-62	11	--	54	22	94	304	57	84	0.7	1.0	473	225	48	820	7.5	2.7
b/ 109	H. O. Minkley	280	do	11	14	40	16	100	246	91	61	.6	.0	441	166	57	746	6.9	3.4
b/ 110	Mrs. Arthur Sanders	54	do	16	--	185	54	182	414	266	320	.6	11	1,240	684	37	2,010	7.3	3.0
b/ 111	J. E. Dalrymple	180	do	11	--	26	11	166	272	144	67	.6	2.8	562	110	77	926	7.5	6.9
b/ 112	E. B. Dickson	220	6-29-62	11	--	32	19	76	216	74	48	.6	1.2	368	158	51	619	7.9	2.6
b/ 201	Charles Minkley	160	6-21-62	14	1.6	90	33	85	384	106	83	.4	3.0	603	360	34	1,000	6.9	1.9
b/ 401	S. H. Peavy	130	6- 8-62	9.1	--	96	40	529	396	328	560	--	121	1,880	404	74	3,030	7.4	11
a/ 402	Tom Colley	10	6- 7-62	18	--	196	27	91	390	175	188	.6	2.4	890	600	--	1,490	7.9	--
a/ 403	L. Schlittler	30	do	18	--	166	27	76	278	150	89	.3	208	871	525	--	1,340	8.0	--
a/ 404	A. B. Moore	140	do	15	--	136	30	106	461	150	103	.2	.4	767	465	--	1,225	8.1	--
a/ 405	L. Schlittler	40	do	17	--	150	38	54	190	97	68	.8	399	917	530	--	1,320	8.0	--
a/ 406	H. Ruben Koneig	185	do	11	--	6	2	465	525	127	360	1.0	.4	1,230	25	--	2,260	8.2	--
a/ 407	Mary Gahagan	400	6- 8-62	18	--	110	23	62	381	51	78	.2	.4	510	335	--	902	7.7	--
a/ 408	Allen Cearley	205	do	14	--	71	12	262	464	97	230	.8	15.8	931	225	--	1,610	8.0	--
a/ 409	Beatrice Long	227	do	15	--	92	23	62	395	56	40	.8	.4	484	325	--	808	8.0	--
b/ 410	F. B. Cearley	150	6-12-62	12	2.6	90	14	57	412	32	24	.3	.2	432	282	31	717	6.9	1.5
b/ 411	A. R. Carter	60	do	11	.86	170	36	174	256	141	300	.6	208	1,170	572	40	1,880	7.0	3.2
b/ 412	D. F. O'Rourke	68	do	12	2.1	98	19	67	396	75	46	.3	.0	512	322	31	841	7.1	1.6
b/ 413	C. W. Hinson	165	do	11	--	150	45	133	320	205	258	.6	9.2	969	559	34	1,750	7.0	2.4
a/ 501	M. K. Graham	165	6- 7-62	11	--	8	4	400	559	150	212	1.6	.4	1,062	35	--	1,810	8.1	--
a/ 701	Blanche Logan	85	do	17	--	55	9	13	193	21	14	.3	.4	224	175	--	391	8.1	--
b/ 702	J. F. Blunt	50	5-29-62	16	.99	98	8.1	67	390	25	54	.5	1.3	462	278	34	782	6.9	1.7
b/ 703	Clarence Blunt	40	do	21	1.6	85	20	29	356	24	24	1.3	4.1	383	294	18	657	6.9	.7
b/ 704	Glen York	125	6-20-62	15	1.9	57	33	227	404	138	208	.7	2.0	880	278	64	1,470	7.2	5.9
b/ 705	Walter Rehders	90	6-19-62	14	1.4	73	8	43	270	30	34	.3	8.9	344	215	30	586	7.1	1.3
a/ 801	C. R. Blunt	70	5-29-62	16	--	126	12	37	332	24	92	.5	19	490	364	18	891	6.6	.8
a/ 802	J. E. McEntire	110	do	15	--	58	23	179	536	54	92	.5	.9	686	239	62	1,170	7.2	7.2

See footnotes at end of table.

Table 2.--Chemical analyses of water from wells and springs, Young County--Continued

Well	Owner	Depth of well (ft.)	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium* (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Total hardness as $CaCO_3$	Percent sodium	Specific conductance (micromhos at 25°C.)	pH	SAR
b/20-58-901	N. Burnett	72	5-16-62	18	--	82	24	223	346	77	298	0.5	4.0	896	303	62	1,560	7.1	5.6
b/ 902	D. Brisco	70	do	20	--	88	15	38	334	36	36	.3	.0	397	281	23	664	6.8	1.0
b/ 903	Bill Akers	71	do	18	--	46	15	272	368	52	288	.8	5.5	878	176	77	1,530	7.2	8.9
b/ 59-101	Ed Reeves	55	5-21-62	17	--	86	26	123	416	61	115	.7	26	660	322	45	1,110	7.4	3.0
b/ 102	G. I. McCallister	25	do	17	--	590	165	1,480	356	1,210	2,700	--	--	6,340	2,150	60	9,520	7.0	14
b/ 103	V. Holcomb	105	5-24-62	--	--	--	--	--	--	378	118	--	--	--	--	--	1,440	--	--
b/ 201	do	177	do	10	--	6.2	1.7	575	575	728	475	2.0	.8	1,430	22	98	2,510	7.8	53
b/ 202	C. H. Reddy	255	5-28-62	9.4	--	6.5	2.2	289	480	49	146	1.0	0	739	25	96	1,270	7.5	25
b/ 203	H. E. Grove	270	do	10	--	10	3.2	282	476	53	144	1.1	.0	737	38	94	1,240	7.3	20
b/ 204	W. R. Sawyer	175	do	15	--	44	12	134	376	43	68	.8	.0	502	160	65	844	6.8	4.6
b/ 205	Don Jobe	252	do	17	--	34	9.8	183	420	60	82	.8	.0	594	126	76	991	6.7	7.1
a/ 206	Ross and Ted Clark	200	8-22-62	8	--	55	15	57	270	6	77	.4	< .4	351	200	--	654	7.3	--
b/ 301	P. K. Deats	200	5-28-62	9.6	--	21	7.3	514	472	288	360	1.7	.0	1,430	82	93	2,320	7.1	25
b/ 302	do	165	do	17	--	134	24	71	406	186	42	.6	.0	675	433	26	1,020	6.9	1.5
a/ 303	J. L. Clark	172	8-22-62	11	--	76	30	62	229	66	103	.76	40	501	313	--	876	7.5	--
a/ 304	Ted Clark	165	do	14	--	14	6	225	471	121	38	.8	< .4	651	61	--	1,005	7.8	--
a/ 305	R. D. Mote	175	do	14	--	159	54	637	463	195	1,010	.6	< .4	2,297	618	--	3,760	7.6	--
b/ 401	Joe Grimes	100	5-22-62	18	--	63	27	71	350	43	60	.5	4.8	459	268	36	776	7.0	1.9
b/ 402	do	117	5-24-62	21	--	128	33	61	424	89	88	.3	27	655	455	22	1,100	6.8	1.2
b/ 403	do	100	do	20	--	95	12	92	256	18	182	.2	.0	545	286	41	1,000	6.9	2.4
b/ 404	L. W. Brooks	125	do	22	--	90	11	57	294	16	66	.3	51	458	270	31	775	7.0	1.5
b/ 501	O. Strickland	235	5-23-62	10	--	3.5	1.0	315	584	42	123	1.0	.0	782	12	98	1,310	7.8	40
b/ 502	J. McClanahan	175	5-24-62	8.9	--	14	4.9	277	392	73	182	1.1	.0	754	55	92	1,310	7.3	16
b/ 503	Sam Ragland	190	5-22-62	20	--	220	116	384	452	546	435	--	360	2,320	1,030	45	3,410	6.8	5.2
b/ 504	Myrl Martin	219	5-24-62	--	--	--	--	--	--	87	219	--	--	--	--	--	1,390	--	--
b/ 601	J. W. Hill	80	5-17-62	18	--	140	30	104	386	139	156	.5	21	798	473	32	1,310	6.9	2.1
b/ 602	Jack Frazier	40	5-21-62	15	--	110	19	58	372	40	88	.6	9.0	523	352	26	919	6.7	1.3

See footnotes at end of table.

Table 2.--Chemical analyses of water from wells and springs, Young County--Continued

Well	Owner	Depth of well (ft.)	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium* (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Total hardness as $CaCO_3$	Percent sodium	Specific conductance (micromhos at 25°C.)	pH	SAR
b/ 20-59-603	J. A. Cheatwood	45	5-24-62	14	--	74	20	46	264	46	65	0.7	10	406	267	27	786	7.0	1.2
b/ 604	J. N. Petty	25	do	13	--	280	73	233	386	160	660	.6	112	1,720	998	34	2,940	6.7	3.2
b/ 605	W. W. Hidgon	193	5-23-62	12	--	129	21	52	398	133	40	.6	.0	584	408	22	936	6.9	1.1
b/ 606	W. A. Morris	136	do	11	--	164	18	52	450	145	54	.4	.0	665	483	19	1,050	7.2	1.0
b/ 607	Edgar Ragland	80	5-24-62	20	--	192	24	79	440	214	117	.2	.0	862	578	23	1,330	6.6	1.4
b/ 701	L. W. Burnett	30	5-15-62	15	--	83	5.6	15	256	18	20	.3	7.4	290	230	13	492	7.5	.4
b/ 702	Carl Evans	120	5-14-62	19	--	116	43	329	510	106	460	.7	1.8	1,330	466	60	2,260	7.8	6.6
b/ 703	F. V. White	125	5-15-62	15	--	111	14	46	358	68	44	.5	7.1	482	334	23	785	7.0	1.1
b/ 901	J. N. Boozer	45	5-16-62	17	--	83	48	212	538	187	150	.5	20	982	404	53	1,570	7.7	4.6
b/ 60-101	Gene Borden	102.2	5- 9-62	9.6	--	64	48	916	440	416	1,100	1.4	.5	2,770	357	85	4,650	7.4	21
b/ 102	Gene Dunlap	40.2	do	14	--	117	13	38	366	99	16	.8	--	478	346	19	744	7.1	.9
b/ 103	S. E. Craig	175	5-16-62	13	--	98	19	217	386	70	285	.6	2.5	895	322	59	1,650	7.1	5.3
a/ 201	W. G. Tullis	50	2-14-63	9	--	70	16	186	285	76	257	.6	2	757	244	--	1,560	7.7	--
a/ 202	Max Roberts	115	do	13	--	128	25	39	88	31	294	.1	5.9	579	424	--	1,110	6.7	--
b/ 301	Mrs. J. B. Hazelton	80	4-26-62	10	--	132	17	178	428	19	295	.3	.0	861	400	49	1,560	6.9	3.9
b/ 302	W. O. Cencebaugh	65	4-27-62	14	--	327	102	603	246	98	1,580	.7	16	2,860	1,240	51	5,090	6.8	7.4
a/ 303	Asa Smith	155	6- 7-62	11	--	80	27	1,638	322	300	2,450	.5	.4	4,665	330	--	7,640	7.8	--
b/ 304	W. E. Ramsey	120	5- 9-62	14	--	120	20	80	512	72	43	.3	1.2	602	382	31	974	6.9	1.8
b/ 305	Jesse Martin	90	do	15	--	94	14	64	258	59	99	.4	23	495	292	32	849	6.9	1.6
b/ 306	R. W. Wallace	50	do	13	--	91	39	79	290	58	148	.6	62	634	388	31	1,120	6.9	1.7
b/ 307	Iola Hazelton	90	do	11	--	64	17	29	240	37	38	.5	3.8	318	230	--	561	6.5	--
b/ 308	Asa Smith	55	5-10-62	16	--	90	25	94	314	75	123	.5	27	604	328	38	1,030	6.8	2.3
b/ 309	R. A. Garrett	45	5-30-62	13	--	94	30	88	224	132	152	.8	15	635	358	35	1,110	6.9	2.0
b/ 310	N. E. Cox	132	5-10-62	17	--	74	14	72	308	31	66	.4	25	450	242	39	764	6.7	2.0
b/ 311	Claude Cochran	63	5-30-62	15	--	290	56	381	440	584	570	--	12	2,120	954	46	3,240	6.6	5.4
b/ 312	G. M. Singletary	65	do	13	--	182	29	77	568	148	82	.3	1.0	813	574	22	1,350	6.6	1.4
b/ 401	J. E. Rowan	60	4-17-62	13	--	97	64	164	372	430	75	1.3	.2	1,030	505	41	1,490	7.2	3.2

See footnotes at end of table.

Table 2.--Chemical analyses of water from wells and springs, Young County--Continued

Well	Owner	Depth of well (ft.)	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium* (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Total hardness as $CaCO_3$	Percent sodium	Specific conductance (micromhos at 25°C.)	pH	SAR
b/20-60-402	O. L. Cude	41.5	4-18-62	18	--	59	69	63	386	91	99	0.7	20	610	431	24	1,030	8.0	1.3
b/ 403	Roy Ribble	91	5-19-62	14	--	54	82	72	374	54	180	1.1	10	651	472	25	1,190	7.9	1.4
b/ 404	L. Davidson	43.3	5-14-62	21	--	154	29	161	574	154	152	.4	9.9	963	504	41	1,550	6.9	3.1
b/ 405	Alton Stovall	128.5	5-16-62	8.6	--	208	54	1,550	172	7.8	2,800	.8	--	4,710	741	82	8,220	6.9	25
b/ 406	Roy Wood	50	do	12	--	67	17	45	138	42	71	.4	97	419	237	29	716	7.0	1.3
b/ 407	W. Ray Brown	45	6-14-62	13	--	98	30	74	288	63	130	.7	51	602	368	30	1,060	6.6	1.7
b/ 408	W. R. Brown	40	5-16-62	19	--	151	29	156	476	155	200	.4	1.8	946	496	41	1,540	7.1	3.0
b/ 409	F. M. Atchison	135	do	11	--	66	19	44	200	37	59	.5	64	398	242	28	675	6.9	1.2
b/ 410	Gordon Brown	40	do	13	--	154	25	143	386	109	260	.2	.8	895	487	39	1,530	7.2	2.8
b/ 411	John Knight	140	do	7.6	--	348	78	1,580	128	11	3,200	.7	--	5,290	1,190	74	9,280	6.8	20
b/ 412	Tom Watkins	140	do	20	--	96	10	29	326	32	30	.3	.0	377	280	18	644	6.6	.8
b/ 413	Jim Watkins	150	5-17-62	12	--	101	23	313	376	166	382	.4	6.9	1,190	346	66	2,010	7.6	7.3
b/ 414	Johnny Nantz	--	5-29-62	12	--	88	18	25	328	46	20	.8	.0	371	294	15	624	7.0	.6
a/ 415	James Skidmore	43	8-14-62	16	--	71	19	73	266	53	95	.5	17	475	256	--	790	7.4	--
a/ 501	H. Ribble	45	4-18-62	19	--	218	37	369	278	31	820	.1	99	1,730	696	--	3,110	7.2	--
a/ 502	C. M. Birdwell	66	4-26-62	16	--	103	26	35	140	98	70	.4	153	570	364	--	900	6.9	--
b/ 601	H. G. Hutto	85	do	15	--	103	19	46	404	54	33	.5	1.0	470	335	23	790	6.7	1.1
b/ 602	V. G. Hazelton	90	do	15	--	134	22	52	432	80	68	.4	2.8	586	425	21	972	6.8	1.1
b/ 603	G. W. Millett	95	do	13	--	126	26	47	428	113	39	.6	--	575	422	20	897	7.5	1.0
b/ 604	Elmer Cates	60	5- 9-62	13	--	168	32	60	458	206	63	.4	--	767	550	19	1,160	7.0	1.1
b/ 605	Ben Andrew	36.5	do	14	--	115	28	46	366	98	70	.5	.2	552	402	20	927	6.9	1.0
b/ 701	R. D. Berry	85	4-13-62	12	--	215	47	137	330	574	92	.5	35	1,270	730	29	1,720	6.9	2.2
b/ 702	J. B. Lisle	135	do	19	--	335	104	239	428	1,060	230	.9	2.8	2,200	1,260	29	2,810	6.7	2.9
b/ 703	Ben Burgess	105	do	15	--	350	56	319	302	257	908	.5	1.5	2,060	1,100	39	3,530	6.6	4.2
b/ 704	Ernest York	84	do	16	--	58	11	276	294	29	365	.7	1.0	902	190	76	1,650	7.1	8.7
b/ 705	T. W. Mahaney	65	do	16	--	265	37	394	328	152	872	.4	13.0	1,910	813	51	3,370	6.6	6.0
b/ 706	J. C. Hawkins	75	do	15	--	255	24	198	294	85	590	.1	4.8	1,320	734	37	2,400	7.0	3.2

See footnotes at end of table.

Table 2.--Chemical analyses of water from wells and springs, Young County--Continued

Well	Owner	Depth of well (ft.)	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium* (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Total hardness as $CaCO_3$	Percent sodium	Specific conductance (micromhos at 25°C.)	pH	SAR
b/ 20-60-707	Sam Lewis	40	4-13-62	16	--	176	24	121	438	251	126	0.3	0.5	930	538	33	1,430	7.1	2.3
a/ 708	Mrs. F. G. Wiley	60	8- 1-62	9	--	364	100	166	256	1,200	126	1	< .4	2,092	1,320	--	--	7.8	--
b/ 709	W. M. Barnhart	44	4-17-62	25	--	63	18	23	224	70	12	.3	8.8	330	231	18	518	7.4	.7
b/ 801	I. L. Thedford	90	do	15	--	116	20	222	414	141	260	1.0	.0	979	372	57	1,640	6.9	5.0
b/ 802	W. P. Steadham	80	4-12-62	16	--	68	14	131	320	42	142	.5	6.3	577	227	56	1,020	6.9	3.8
b/ 803	Lee Jeffrey	90	do	17	--	198	41	191	476	408	180	.5	9.9	1,280	662	39	1,880	7.2	3.2
b/ 804	Henry Banks	42	4-18-62	19	--	72	28	29	294	23	46	.2	34.0	396	294	18	680	7.2	.7
a/ 805	Kay Estate	Spring	2-13-63	12	--	226	21	495	504	40	911	.1	1.1	1,954	650	--	3,450	7.3	--
b/ 901	H. D. Criswell	69	4-19-62	23	--	144	26	163	394	77	288	.4	14	929	466	43	1,610	6.9	3.3
b/ 902	M. W. Carter	82	4-18-62	19	--	74	20	60	360	27	37	.8	24	439	267	33	729	7.4	1.6
b/ 903	Chas. D. Jones	25	do	13	--	84	47	91	524	67	56	2.0	21	639	403	33	1,060	7.3	2.0
b/ 904	J. J. Jones	42	4-25-62	15	--	109	51	129	474	128	125	1.5	75	866	482	37	1,400	7.4	2.6
b/ 905	T. C. Murphy	66	do	27	--	98	23	83	312	68	126	.3	17	595	339	35	1,010	6.8	2.0
b/ 61-101	M. E. Martin	175	5- 9-62	14	--	38	15	309	398	251	168	.5	2.8	994	156	81	1,570	7.6	11
b/ 102	C. L. Clinton	32	do	14	--	39	13	39	158	30	35	.5	29	278	151	36	471	7.0	1.4
b/ 103	Walter Padgett	100	5-30-62	14	--	88	19	77	356	49	78	.3	15	515	298	36	898	6.8	1.9
b/ 104	Willis Estate	312	do	12	--	28	11	205	420	136	52	1.0	.0	652	115	80	1,050	7.2	8.3
a/ 201	B. S. Bennett	180	6- 7-62	11	--	26	11	745	700	7	835	.8	< .4	1,981	110	--	3,775	7.6	--
b/ 401	V. H. Martin	25	5- 9-62	24	--	47	9.4	292	736	76	73	.6	4.2	888	156	80	1,390	7.7	10
b/ 402	Edgar Steel	35	do	14	--	74	27	82	208	56	162	.4	20	537	296	38	971	6.9	2.1
a/ 501	do	Spring	2-13-63	12	--	67	16	36	101	20	152	.1	1.3	354	236	--	698	6.8	--
b/ 701	H. C. Gilmore	42	4-19-62	19	--	198	29	37	386	331	22	.4	.0	826	614	11	1,140	6.8	.6
b/ 801	C. D. Sealy	155	4-23-62	11	--	56	34	894	442	804	720	1.5	6.9	2,740	280	87	4,300	7.3	23
b/ 802	H. C. Gilmore	90	4-19-62	17	--	126	17	46	348	24	88	.3	60	549	384	20	947	6.8	1.0
b/ 803	L. Chestnut	115	4-25-62	18	--	94	14	23	322	32	30	.3	.0	369	292	14	626	6.8	.6
b/ 804	H. C. Gilmore	108	4-20-62	15	--	78	31	108	388	150	56	1.0	1.8	632	322	42	986	7.2	2.6
b/ 805	E. Burgess	60	4-25-62	13	--	75	17	37	212	27	78	.5	29	380	257	24	680	6.8	1.0

See footnotes at end of table.

Table 2.--Chemical analyses of water from wells and springs, Young County--Continued

Well	Owner	Depth of well (ft.)	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium* (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Total hardness as $CaCO_3$	Percent sodium	Specific conductance (micromhos at 25°C.)	pH	SAR
a/ 31-03-101	Jenny Martin	90	5-14-62	18	--	122	20	84	416	99	89	0.3	0.2	638	387	32	1,040	7.0	1.9
b/ 301	G. U. Phillips	125	do	15	--	323	58	776	246	596	1,350	.4	5.5	3,240	1,040	62	5,240	6.9	10
b/ 302	J. B. Fore	80	do	14	--	120	27	68	336	151	88	.4	.5	634	410	26	1,020	7.1	1.5
b/ 303	Roy Ribble	100	do	12	--	165	26	178	498	221	188	.3	.8	1,040	518	43	1,660	6.9	3.4
b/ 304	L. H. Martin	100	do	18	--	81	15	52	354	46	25	.5	.8	412	264	30	682	6.9	1.4
b/ 305	W. G. White	101	do	9.6	--	405	100	1,040	338	184	2,280	.3	--	4,180	1,420	61	7,180	6.5	12
b/ 04-101	Claude Lynn	105	4-16-62	18	--	164	18	73	528	114	64	.3	.0	711	483	25	1,130	6.7	1.4
b/ 102	A. B. Owen	82	4-17-62	22	--	141	34	209	442	109	332	.5	.8	1,070	492	48	1,830	7.0	4.1
b/ 201	C. R. Funk	90	4-12-62	17	--	110	35	324	434	171	415	.5	3.2	1,290	418	63	2,190	7.0	6.9
b/ 202	Claude Lynn	82	4-16-62	14	--	175	37	210	324	75	495	.5	1.5	1,170	588	44	2,120	6.9	3.8
b/ 203	A. P. Pugh	140	4-17-62	12	--	85	34	456	400	132	620	.6	1.5	1,540	352	74	2,690	7.0	11
b/ 05-201	N. E. Majors	122	4-19-62	10	--	82	29	80	268	57	84	.4	122	596	324	35	1,040	7.0	1.9

a/ Analysis by Texas Department of Health Laboratories.
b/ Analysis by United States Geological Survey, Quality of Water Branch.
*Includes Sodium + Potassium (Na+K) on analyses by b/.

Table 3.--Reported brine production and disposal in 1961, Young County

Watershed Totals Within the County

Watershed and type of disposal	Barrels daily		Barrels in 1961	
BRAZOS RIVER BASIN				
Injection wells	33,133	91.9%	9,665,587	91.3%
Open surface pits	2,791	7.7%	878,107	3.3%
Surface watercourse	3	0.0%	1,100	0.0%
Miscellaneous	93	0.3%	33,162	0.3%
Unknown	29	0.1%	9,205	0.1%
Total Salt Water	36,049		10,587,161	
TRINITY RIVER BASIN				
Injection wells	14,330	97.3%	5,281,957	97.4%
Open surface pits	395	2.7%	136,872	2.5%
Miscellaneous	6	0.0%	2,190	0.0%
Total Salt Water	14,731		5,421,019	
RED RIVER BASIN				
Injection wells	100	100%	30,000	100%
Total Salt Water	100		30,000	

Young County Totals

Type of disposal	Barrels daily		Barrels in 1961	
Injection wells	47,563	93.5%	14,977,544	93.4%
Open surface pits	3,186	6.3%	1,014,979	6.3%
Surface watercourse	3	0.0%	1,100	0.0%
Miscellaneous	99	0.2%	35,352	0.2%
Unknown	29	0.1%	9,205	0.1%
Total Salt Water	50,880		16,038,180	

Totals for Areas Shown on Plate 3

Area	Injection wells (bbl)	Pits (bbl)	Other disposal (bbl)	Total salt water (bbl)
1	1,478,217	51,086	10,000	1,539,403
2	1,324,345	72,740	1,800	1,398,885
3	227,315	2,365	--	229,680
4	670,274	4,815	1,800	676,889
5	4,664,571	125,459	4,980	4,795,010
6	942,676	47,513	13,740	1,003,929
7	202,055	59,700	--	261,755
8	542,358	24,302	8,280	574,940
9	384,632	55,074	--	439,706
10	643,187	65,759	720	710,062
11	806,808	287,624	1,800	1,096,232
12	2,037,637	43,124	1,705	2,082,466
13	393,406	47,355	730	441,491
Other	660,063	128,063	2	788,128
Total	14,977,544	1,014,979	45,657	16,038,180

Table 4.--Chemical analyses of oil-field brines, Young County

(Constituents are given in parts per million)

Compiled by Rowland Laxson, et al., 1960, Resistivities and chemical analyses of formation waters from the West Central Texas area: West Central Texas Section of the Society of Petroleum Engineers of A.I.M.E.; and BJ Service Inc., 1960, The chemical analyses of brines from some fields in North & West Texas.

Stratigraphic horizon	Average depth (feet)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Specific gravity	pH
AREA 1									
Strawn*	2,760	11,210	1,796	44,300	114	14	93,200	1.122	5.2
Caddo*	4,490	10,610	2,771	47,500	92	28	100,100	1.129	6.4
AREA 2									
Cisco*	860	6,460	1,550	31,100	23	4	63,650	1.078	5.7
Mississippian	4,927	5,950	1,221	35,230	166	457	68,000	1.086	7.2
AREA 4									
Strawn*	3,100	13,305	2,348	44,950	9	14	99,800	1.129	6.6
Caddo*	4,000	11,925	3,430	46,880	43	7	103,350	1.136	7.2
Bend*	4,000	12,835	2,304	45,170	30	16	98,950	1.126	6.8
AREA 5									
Caddo*	3,597	11,170	1,881	45,590	76	14	96,800	1.123	4.7
Caddo*	4,277	12,050	2,770	49,580	68	28	105,600	1.137	6.5
AREA 6									
Strawn*	2,930	10,475	1,706	42,830	104	14	89,500	1.114	4.8
Caddo*	4,100	13,890	2,249	47,500	19	62	104,300	1.136	6.7
AREA 7									
Strawn*	2,345	12,300	2,430	43,420	81	10	95,800	1.124	6.4
Mississippian	4,300	6,525	1,179	33,000	183	696	65,200	1.092	7.5
AREA 9									
Strawn*	2,500	9,875	1,786	38,910	11	309	84,220	1.107	6.4
AREA 10									
Strawn*	2,750	12,090	1,698	37,110	101	7	83,520	1.109	7.3
L/Strawn*	--	11,100	2,040	50,700	91	--	103,300	1.108	6.8
AREA 11									
Strawn*	2,370	9,290	1,521	34,440	46	9	74,100	1.096	5.8
Mississippian (20-59-801)	--	3,460	625	30,300	568	1,000	54,500	--	--
AREA 12									
Strawn*	2,912	12,080	1,757	40,690	4	9	89,200	1.115	4.9
Bend*	4,300	16,500	3,315	47,395	104	204	112,600	1.149	5.8
AREA 13									
Strawn*	2,590	12,425	1,966	43,260	36	4	94,400	1.123	5.5

* In the Pennsylvanian System.

APPENDIX

SUPPLEMENTARY DISCUSSIONS OF QUALITY OF
WATER, GEOLOGY, AND HYDROLOGY

SUPPLEMENTARY DISCUSSIONS OF QUALITY OF WATER, GEOLOGY, AND HYDROLOGY

Geology of North-Central Texas

Regional Structure

The counties included by the Texas Water Commission in the study of ground-water resources in north-central Texas are in the Grand Prairie and Osage Plains geographic provinces of Texas. The Grand Prairie region is defined as a belt of counties west of the Balcones fault zone and north of the Llano uplift, and has been described as a modified northeastward continuation of the Edwards Plateau. At the surface in the Grand Prairie region are Cretaceous rocks of the Comanche Series dipping gently to the east and southeast. Some faulting is exhibited in the Cretaceous formations near the Balcones zone, but in general no major structural features are reflected by these beds other than the regional eastward dip. To the west of the Grand Prairie region is the Osage Plains province extending from the Edwards Plateau and Llano uplift northward to the Red River. Surface formations in the Osage Plains of north-central Texas are of Pennsylvanian and Permian age except where these rocks are overlain locally by remnants of Cretaceous sediments or Recent alluvial deposits. Pennsylvanian and Permian beds of the region form a westward dipping homocline with an average dip of 50 feet per mile. Formations significant to the occurrence of ground water under study in the Osage Plains have not been affected by major structural deformation. The principal, large, buried structural features, illustrated in Figure A1, include the Bend flexure, the Red River uplift, eastern Midland shelf, and the Concho arch and developing Concho foreland.

Depositional History

The geologic environment in which the rock units underlying north-central Texas were laid down and the stratigraphic relationship of these units one to another determine the character of the water-bearing formations, which are the sources of ground water. Structural movement and crustal settling and shifting, which followed the deposition of the rocks in the area, influenced the mode of occurrence of ground water. An understanding of these complex historical events is important to a comprehension of how ground water occurs and how it can best be developed.

The sequence of geologic events significant to the occurrence of ground water in north-central Texas began in Pennsylvanian times, and continued through the deposition of Permian rocks throughout most of the area, Cretaceous sediments over a large part of the area, and Pleistocene to Recent alluvial sediments found at the surface in local areas and along most of the streambeds.

The Pennsylvanian and Permian seas that deposited sediments in the north-central Texas area were shallow--probably less than 100 feet deep. This is

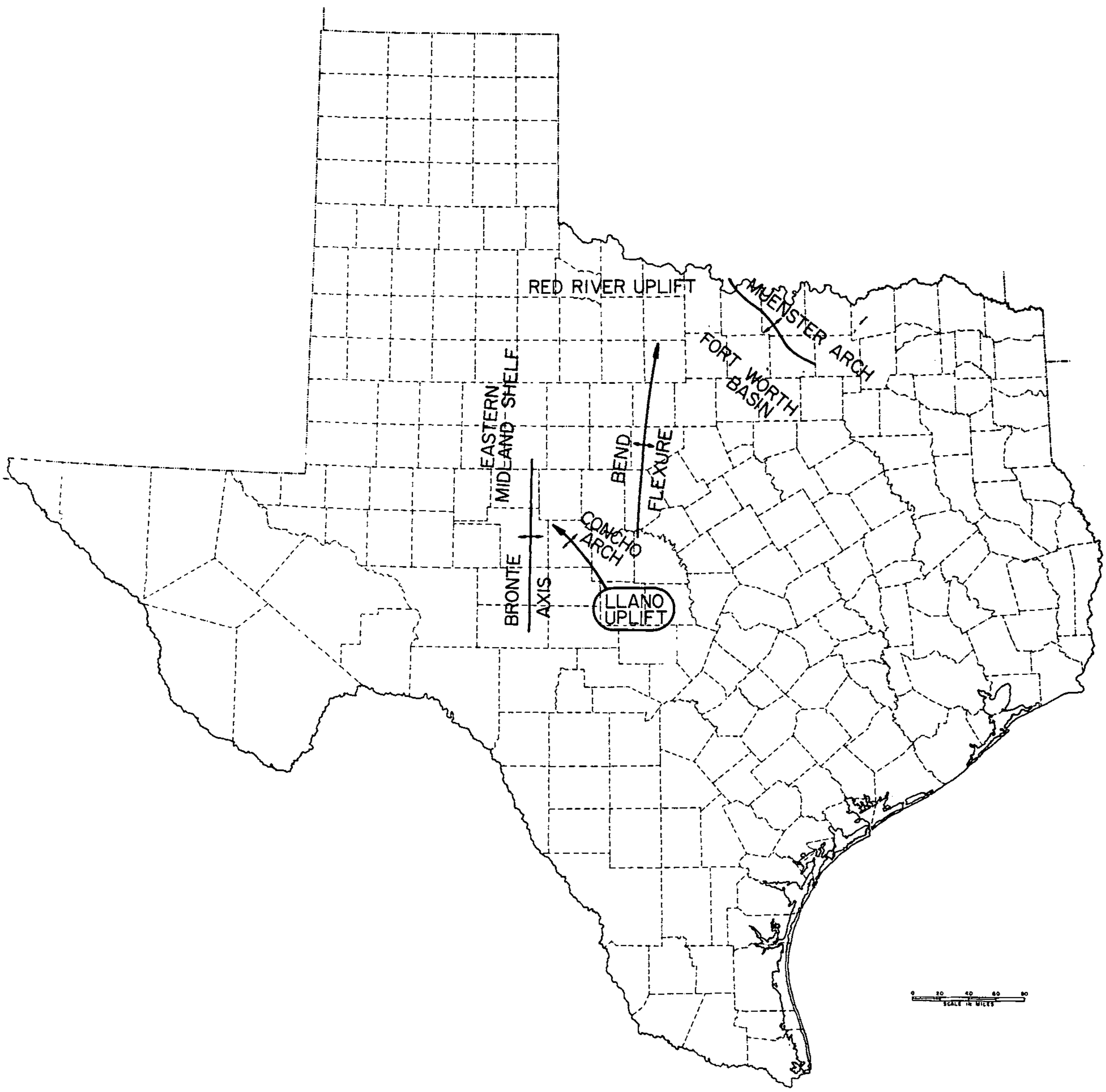

Figure A 1

Major Structural Features in North-Central Texas

Texas Water Commission in cooperation with the Texas Water Pollution Control Board

evidenced by the large amounts of sandstone, the repetition and extent of coal deposits, and the presence of frequent local unconformities. Present also are conglomerates, mud cracks, ripple marks, cross-bedding, and fossils that are found in a shallow-water environment. Thus, ground water occurs in this area in formations of sediments deposited very nearly horizontally in shallow seas that were alternately advancing and retreating. Such a depositional environment resulted in a complex system of lateral and vertical changes in the character of the materials deposited. Few widespread continuous mantles of sediments such as those that characterize the Gulf Coast region of Texas are found. However, in contrast to the local, discontinuous, highly variable, shallow-water, clastic deposits characteristic of these periods, certain limestone units are relatively widespread. These limestones were deposited in extensive shallow seas advancing from the north and east, and are traceable as continuous units throughout much of the area under study. Thus, these limestone beds, while only locally significant as water-bearing units, are extremely important as horizon markers in identifying the age and character of the intervening sediments.

Pennsylvanian Deposition

The upper Pennsylvanian rocks of north-central Texas include the Strawn, Canyon, and Cisco Groups, each of which has been subdivided into several formations and members. In the Colorado River Basin the Strawn Group is composed principally of alternating beds of sandstone and shale, probably representing near-shore deposits with the source area for the sediments being a land mass to the east and northeast, which is now concealed under younger strata. Beds of the Strawn Group overlap to the west so that the total thickness of the group is probably not greater than 1,200 feet at any one point. Cretaceous rocks overlying these older beds in the area of the Bend flexure prevent tracing individual units of the Strawn on the surface from the Colorado River Basin into the Brazos River Basin. In general, the Strawn of the Colorado River Basin contains coarser sediments than in the Brazos River Basin, although beneath the Cretaceous sediments to the north in Wise County the Strawn again assumes a near-shore facies marked by coal beds and lenses of sand and sandy shale.

The Canyon Group in north-central Texas is characterized by thick limestone beds alternating with shale, and contains relatively little sandstone. The source of the sediments in the Canyon was again from the east, and was lower than during Strawn deposition as shown by the decrease of terriginous clastic material, which marked much of the Strawn deposition. Sandstone lenses occurring in the Canyon Group, of extreme importance to the occurrence of ground water in local areas, probably were deposited in channels formed during periods of nonmarine occurrence. In Jack and Wise Counties the character of Canyon sediments--conglomerates, irregular sands, and several coal beds--indicates an approach to the shoreline. Also in the southern region of the Colorado River Basin some conglomerates are found in the basal Canyon. The surface expression of the Canyon Group in the Brazos River Basin is separated by Cretaceous rocks from Canyon beds in the Colorado River Basin, and no definitive stratigraphic correlation of individual formations has been traced from one basin into the other.

There was no widespread erosion of Canyon deposits except perhaps in the western Llano area. Tectonic activity to the north included the gradual uplift of the Red River arch, possible folding in the Wichita system, and other disturbances in the mid-continent area. Canyon sedimentation was also affected by the continued development of the eastern Midland shelf and the subdued, but still prominent, Concho arch and the Bronte axis.

Sedimentation continued into Cisco time, as evidenced by the lack of a marked unconformity between the Canyon and Cisco strata. Local disconformities and channeling are apparent in both the outcrop areas of these beds and in the subsurface, indicating that the shelf environment of late Canyon time became more and more deltaic locally during Cisco time. The Cisco Group in the north-central Texas region is comprised chiefly of shale, sandstone, conglomerate, and limestone, with local coal beds. Eastward the sand and conglomerate deposits increase in thickness while to the west the conglomerate and the coal disappear. In the northern part of the area the limestone disappears from the Cisco Group as deposition occurred in a nonmarine or partially marine facies.

Deposition in the late Pennsylvanian was affected by uplift in the Llano area as the initial westward tilting of the Concho foreland began toward the Midland basin. This westward tilting was to continue throughout Permian time. The Bend flexure, previously called the Bend arch, which extends from the Llano area to the Red River uplift, came into existence during late Pennsylvanian and early Permian times as a result of the differential subsidence of the Midland basin and the eastern Midland shelf, and the consequent westward tilting of the Concho foreland.

Permian Deposition

No major unconformity marks the contact between Pennsylvanian and Permian rocks, indicating relatively continuous deposition from the Cisco of the upper Pennsylvanian into the Wichita of the lower Permian. Local disconformities and channeling are apparent both in the surface and the subsurface, however, with the shoreline of the Permian sea having oscillated back and forth while it continued its slow migration toward the west as the tilting of the Concho foreland into the Midland basin progressed. The extensive Permian sea was shallow over north-central Texas, resulting in deposition of sediments under widely varying conditions.

Rocks of the Wichita Group have been mapped at the surface from the Red River to the Llano uplift. In the Colorado River Basin the Wichita Group, representing the oldest Permian deposition, is characterized by a marine shale and limestone facies, while northward the marine beds decrease in importance and red beds become more prominent. Near the Red River, deposition of the Wichita Group was in a marginal marine environment marked chiefly by a red-bed facies of shale and sandstone. Deposition was apparently continuous in the Wichita, and no pronounced unconformities have been found in the Group.

Mesozoic (Cretaceous) Deposition

The close of Wichita deposition marked the end of Paleozoic time in north-central Texas, and great changes in the position of the land masses in Texas were to characterize the beginning of the Mesozoic in the State. The early Mesozoic was a period of continental elevation, and no Triassic deposition is known to have occurred in the area included in this study. This period of non-deposition continued through the Jurassic, and the first marine deposition that occurred in north-central Texas after the close of the Permian was in early Cretaceous times. As a result of the massive change in land-surface elevation in the first half of the Mesozoic, however, drainage in the Texas area had been reversed by the time Cretaceous deposition began. Instead of northwesterly drainage into inland Paleozoic seas, drainage from the earliest Cretaceous period onward was toward the southeast in the direction of what is now the Gulf of Mexico. Thus the regional dip of Cretaceous rocks overlying the Pennsylvanian and Permian sediments of north-central Texas is toward the southeast.

West of an irregular, northeast-trending line through Brown, Eastland, Jack, Wise, and Montague Counties, the only Cretaceous rocks remaining after extensive periods of erosion are remnants and outliers that, although not extensive, are locally significant as sources of ground water and as recharge areas for underlying older rocks. East of this irregular line Cretaceous beds are found at the surface in a continuous band eastward to the outcrop of Eocene sediments.

All of the known Cretaceous deposition in the area of study belongs to the Comanche Series. The Comanche has been divided into the Trinity, Fredericksburg, and Washita Groups, and both the Trinity and the Fredericksburg are found in this area. Generally, all of the Comanche sediments belong to a near-shore or shallow-water environment.

Quality of Ground Water

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

The chemical quality of ground water that has not been artificially altered is relatively constant, as is the temperature of ground water, which makes it highly desirable for many uses.

In addition to the natural mineralization of water that occurs in its environment, the quality of ground water can also be affected by man. Municipal and domestic sewage systems (including septic tanks), industrial waste, and oil-field brine that is improperly disposed of can enter into ground-water bodies and render them unfit for most uses.

Included among the factors determining the suitability of ground water as a supply are the limitations imposed by the contemplated use of the water. Criteria have been developed to cover most categories of water quality, including bacterial content, physical characteristics, and chemical constituents. Water-quality problems associated with the first two categories can usually be alleviated economically, but the removal of undesirable chemical constituents can be difficult and expensive. For many purposes the dissolved solids content constitutes a major limitation on the use of water. One general classification of water based on dissolved-solids content (Winslow and Kister, 1956, p. 5) 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

The United States Public Health Service has established standards of drinking water to be used on common carriers engaged in interstate commerce. The standards are designed primarily to protect the traveling public, and are often used to evaluate public water supplies. According to these standards, chemical constituents should not be present in the water supply in excess of the listed concentration shown in the following table, except where other more suitable supplies are not available. Some of the standards adopted by the U. S. Public Health Service (1962, p. 2152-2155) are as follows:

Substance	Concentration (ppm)
Chloride (Cl)	250
Fluoride (F)	(*)
Iron (Fe)	0.3
Manganese (Mn)	0.05
Nitrate (NO_3)	45
Sulfate (SO_4)	250
Total dissolved solids	500

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

Annual average of maximum daily air temperatures (°F)	Recommended control limits of fluoride concentrations (ppm)		
	Lower	Optimum	Upper
50.0 - 53.7	0.9	1.2	1.7
53.8 - 58.3	.8	1.1	1.5
58.4 - 63.8	.8	1.0	1.3
63.9 - 70.6	.7	.9	1.2
70.7 - 79.2	.7	.8	1.0
79.3 - 90.5	.6	.7	.8

Water having concentration of chemical constituents in excess of the recommended limits may be objectionable for many reasons. Water containing an excess of 45 ppm of nitrate has been related (Maxcy, 1950, p. 271) to the incidence of infant cyanosis (methemoglobinemia or "blue baby" disease). The high concentrations of nitrate may be an indication of pollution from organic matter, commonly sewage. Iron and manganese in excessive concentrations cause reddish-brown or dark gray precipitates, which stain clothing and plumbing fixtures. Sulfate in water in excess of 250 ppm may produce a laxative effect, and water containing chloride exceeding 250 ppm may have a salty taste. Fluoride is concentrations of about 1 ppm may reduce the incidence of tooth decay, but excessive concentration may cause teeth to become mottled (Dean, Arnold, and Elvove, 1942, p. 1155-1159).

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

Hardness range (ppm)	Classification
60 or less	Soft
61 - 120	Moderately hard
121 - 180	Hard
More than 180	Very hard

Water that is suitable for industrial use may not be acceptable for human consumption, and different standards may apply. Ground water used for industry may be classified into four principal categories: cooling water, boiler water, process water, and water used for secondary recovery of oil by water injection.

Although cooling water is usually selected on the basis of its temperature and source of supply, its chemical quality is also significant. Any characteristic that may adversely affect the heat-exchange surfaces is undesirable.

Substances such as magnesium, calcium, iron, and silica may cause the formation of scale. Another objectionable feature that may be found in cooling water is corrosiveness caused by calcium and magnesium chloride, sodium chloride in the presence of magnesium, acids, and the gases oxygen and carbon dioxide.

The production of steam requires high quality-of-water standards. Under the extreme temperature and pressure conditions the problems of corrosion and incrustation are intensified. Under these conditions the presence of silica becomes undesirable as it forms a hard scale or incrustation.

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

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

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

Both the concentration and the composition of the dissolved constituents should be considered in appraising quality of water for irrigation. The chemical characteristics that appear to be most important in evaluating the quality of water for irrigation are: (1) relative proportion of sodium to the other cations, (2) total concentration of soluble salt, (3) amount of residual sodium carbonate, and (4) concentration of boron.

The U. S. Salinity Laboratory staff (1954, p. 69-82) proposed a system of classification commonly used for checking the quality of water for irrigation. The classification is based on the salinity hazard as measured by the electrical conductivity of the water and the sodium hazard as measured by the sodium adsorption ratio (SAR). Figure A2 illustrates this classification system.

The importance of the dissolved constituents of water to be used for irrigation depends upon the degree to which the constituents accumulate in the soil. Kelley (1951, p. 95-99) cited areas having an average annual precipitation of

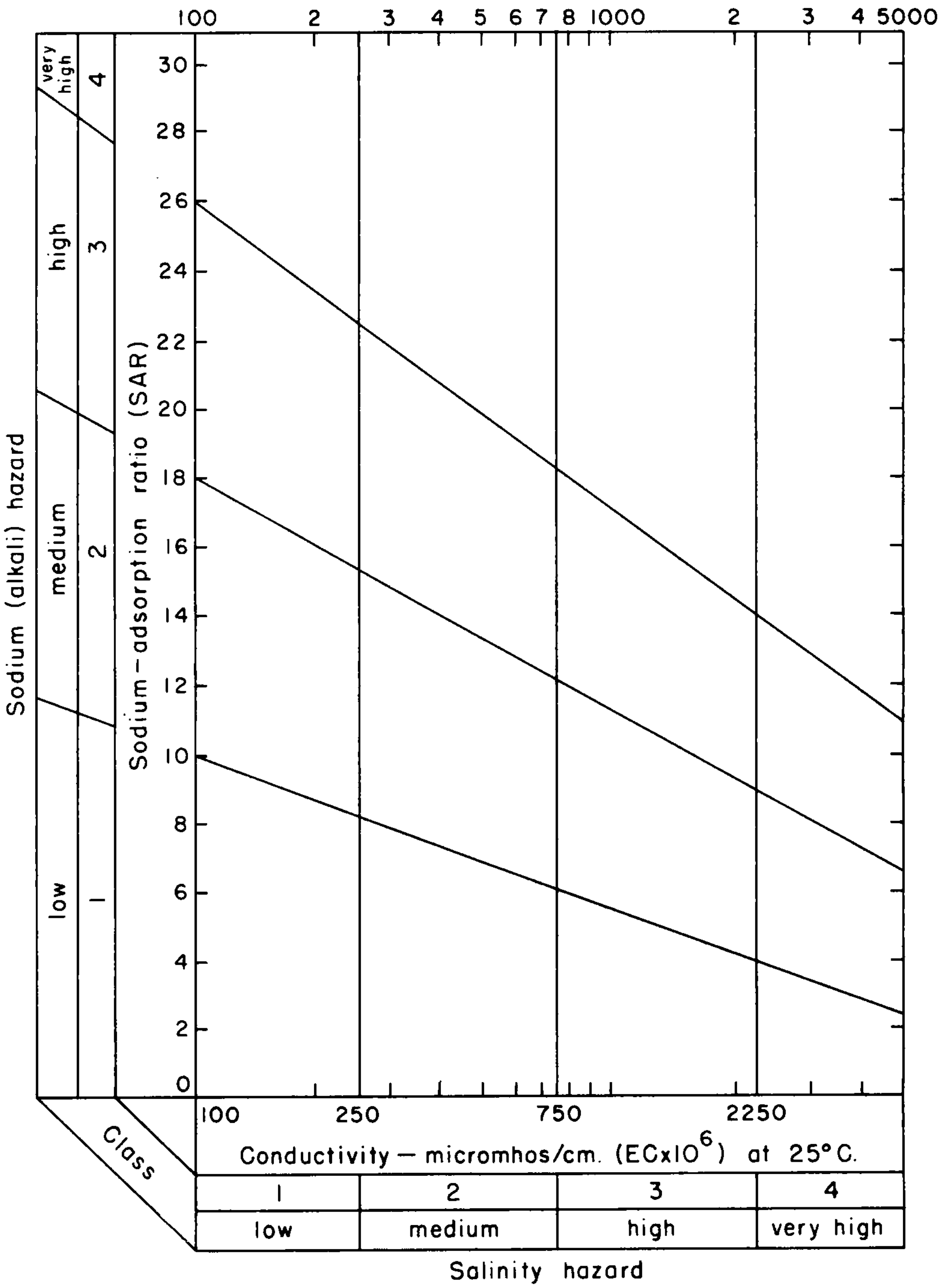

Figure A2

Diagram for the Classification of Irrigation Waters

(After United States Salinity Laboratory Staff, 1954, p. 80)

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about 18 inches in which the salts did not accumulate in the irrigated soil. It has been suggested (Wilcox, 1955, p. 15) that the system of the classification of irrigation water proposed by the salinity laboratory staff is not directly applicable to the supplemental waters used in areas of relatively high rainfall.

Boron in excess will also make water unsuitable for irrigation. Scofield (1936, p. 286) has indicated that a boron concentration of as much as 1 ppm is permissible for irrigating sensitive crops, and as much as 3 ppm is permissible for tolerant crops. His suggested permissible limits of boron for irrigation waters are shown in the following table:

Classes of water		Sensitive crops (ppm)	Semitolerant crops (ppm)	Tolerant crops (ppm)
Rating	Grade			
1	Excellent	0.33	0.67	1.00
2	Good	0.33 to .67	0.67 to 1.33	1.00 to 2.00
3	Permissible	.67 to 1.00	1.33 to 2.00	2.00 to 3.00
4	Doubtful	1.00 to 1.25	2.00 to 2.50	3.00 to 3.75
5	Unsuitable	1.25	2.50	3.75

Ground-Water Hydrology

In north-central Texas the occurrence of ground water is erratic, and there are no large, continuous, prolific ground-water aquifers such as those found in the High Plains region of Texas and in the Gulf Coast. However, ground-water occurrences in north-central Texas conform to the same fundamental principles as those in other areas of the State.

Hydrologic Cycle

The water available for use by man--whether as rain, streamflow, water from wells, or spring discharge--is captured in transit, and after its use and reuse is returned to the hydrologic cycle from which it came. This cycle is illustrated in Figure A3. Graphically, Figure A3 shows the continuing movement of water from the oceans through evaporation to precipitation and its return either directly or ultimately to the ocean.

Ground-Water Occurrence and Movement

The geologic history of sedimentary deposition and erosion are primary factors controlling the occurrence and movement of ground water in the north-central Texas area. The rocks found in the shallow subsurface range from sporadic, uncemented, clastic beds to the more widespread, continuous, cemented or compacted shales, sandstones, and limestones. In uncemented rocks such as sand, gravel, and clay, water occurs in the spaces between individual particles,

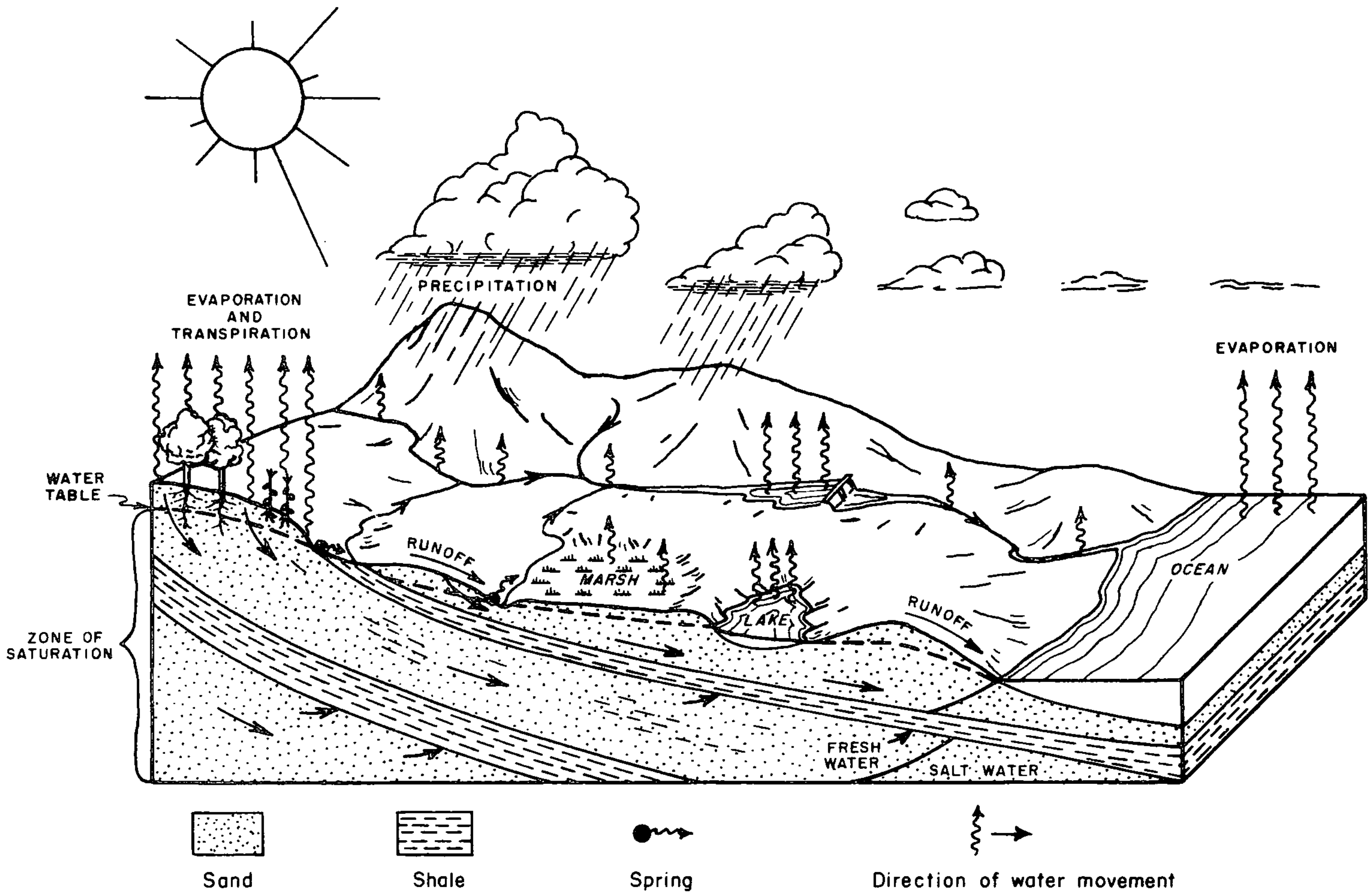

Figure A3

Hydrologic Cycle

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whereas in well cemented or compacted sedimentary rocks it occurs chiefly in cracks and fissures produced by earth movement or contraction, and in openings formed by solution where the rocks are soluble. If these openings are isolated, the movement of ground water is hindered. However, most openings are interconnected so as to permit ground water to move through them. The essential factor is that ground water of usable quality is continually moving from the point at which it entered the ground-water body, called the recharge area, to points of discharge, generally at lower elevations, either in stream drainage or through wells.

Recharge is the process by which water is added to an underground water-bearing formation, whether by precipitation on the outcrop of the formation or by seepage losses from surface streams or lakes on the outcrop. Factors that limit the amount of recharge received by a formation are the amount and frequency of precipitation, the area and extent of the outcrop, the topography, the type and amount of vegetation, the condition of the soil in the outcrop area, and the capacity of the formation to accept recharge. Discharge is the process by which water is removed from the formation, either through surface drainage or through wells.

The direction and rate of movement of water through a porous medium, such as an underground geologic formation, is influenced by a variety of factors, which include the nature of the formation itself and the external pressures applied on it as well as the fundamental physical laws of gravity and momentum. These factors include surface tension, friction, atmospheric pressure where the formation encounters the earth's surface, paths of differential permeability, effects of heavy local withdrawals or injection of water, and climatic changes affecting rates of recharge. In north-central Texas, ground-water movement is not constant in either direction or rate. The environment through which it moves is a heterogeneous complex of sedimentary deposits varying in porosity, permeability, and angle of repose. Thus it is not easy, and frequently not even possible in the light of present knowledge, to determine precisely the route water will take from the point of recharge to the points at which it is once again discharged at the surface to re-enter the hydrologic cycle. In the area of this study, however, this route generally is circuitous and probably of relatively short geographic extent. As a consequence, a landowner whether private or public has a particular need for understanding the hydrologic factors affecting the occurrence of ground water. Only by a carefully discriminating study of the geological environment of his immediate locality can he determine the availability of ground water for beneficial use, or the means required to protect available ground water from pollution.

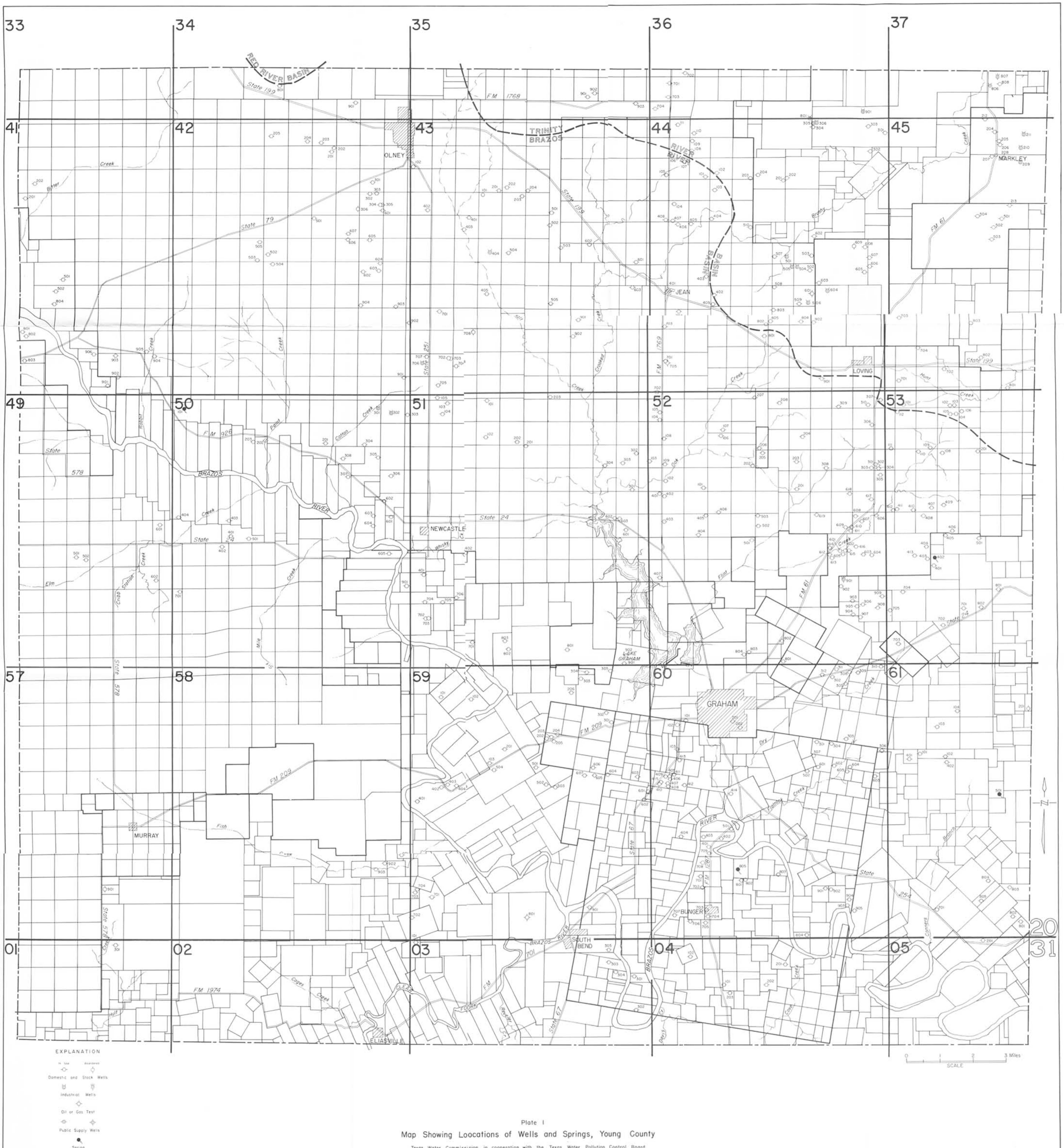

Plate I

Map Showing Loocations of Wells and Springs, Young County

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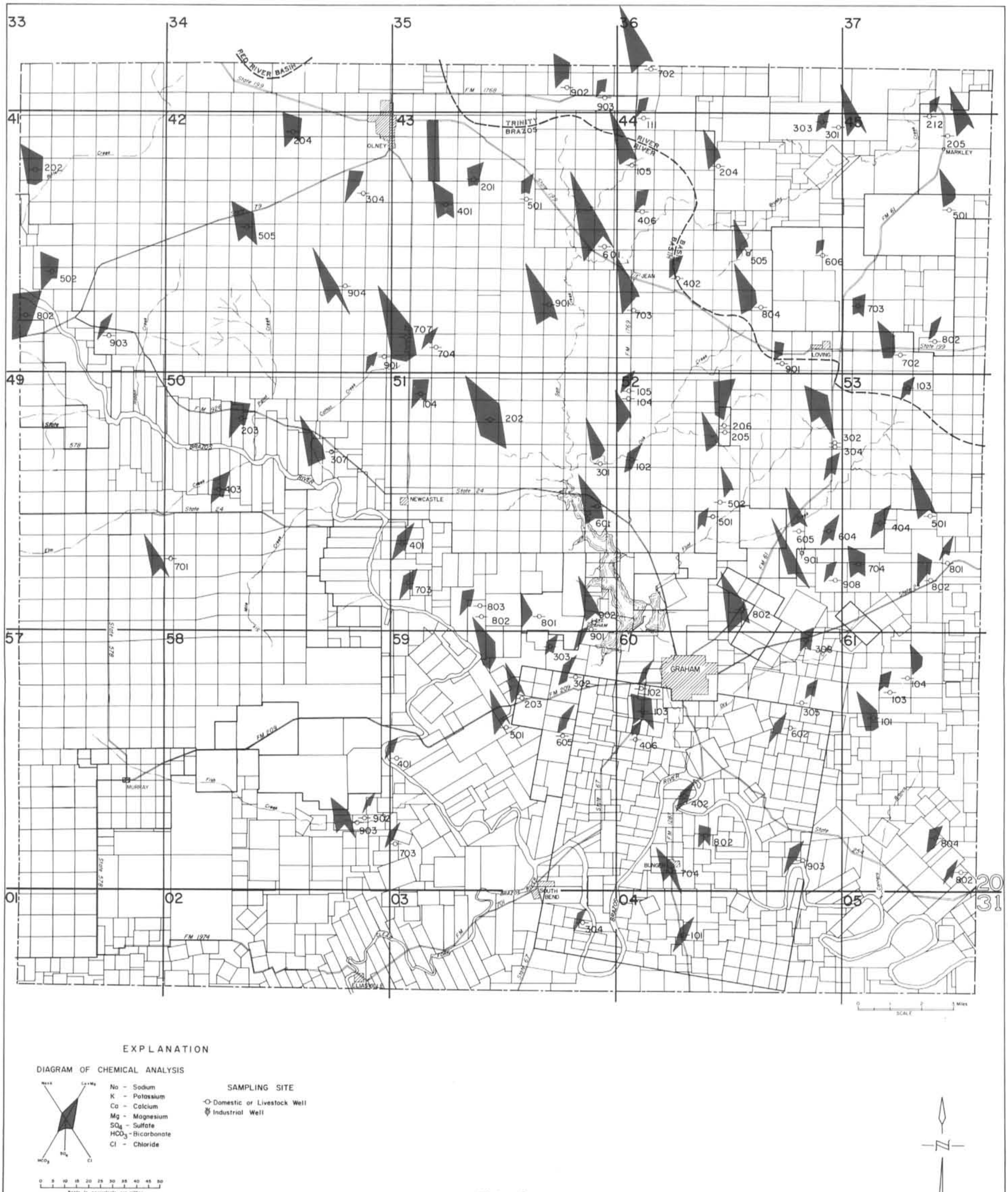

Plate 2

Map Showing Base Chemical Quality of Ground Water in 1962, Young County

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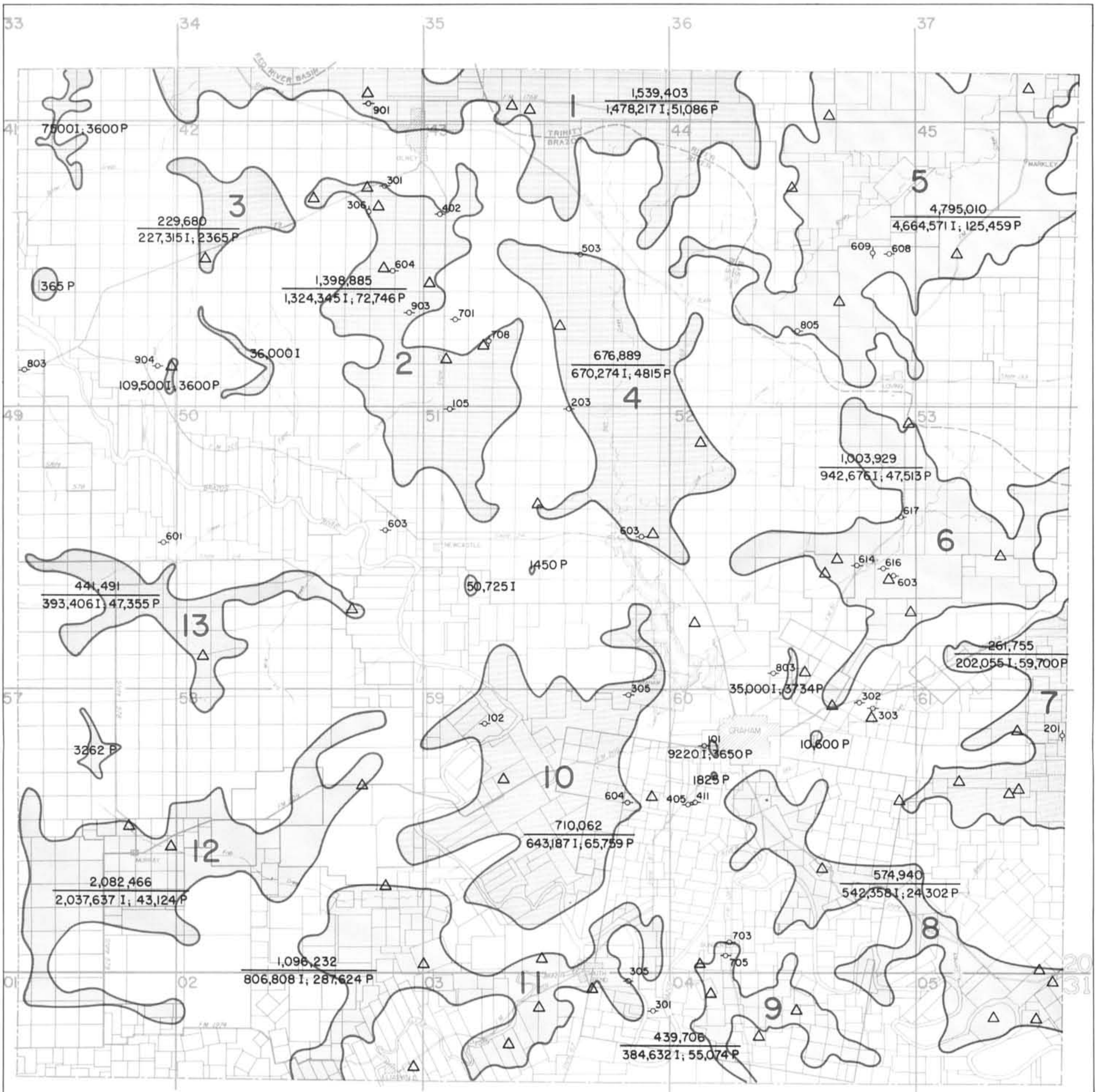

EXPLANATION

△ Surface-Kill Area

-o- Apparently Contaminated Water Wells

◊ Unused Wells

(shaded outline) Area of Oil Production

229,680 — Total Reported 1961 Brine Production, in Barrels

227,315 I; 2365 P — Reported 1961 Brine Disposal, in Barrels: Into Pits (P), and Injected into Wells (I). For additional amounts disposed of by miscellaneous methods, see Table 3.

Plate 3

Map Showing Location and Amounts of Reported 1961 Brine Disposal, Surface-Kill Areas, and Contaminated Water Wells, Young County

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Base adapted from map of the General Land Office

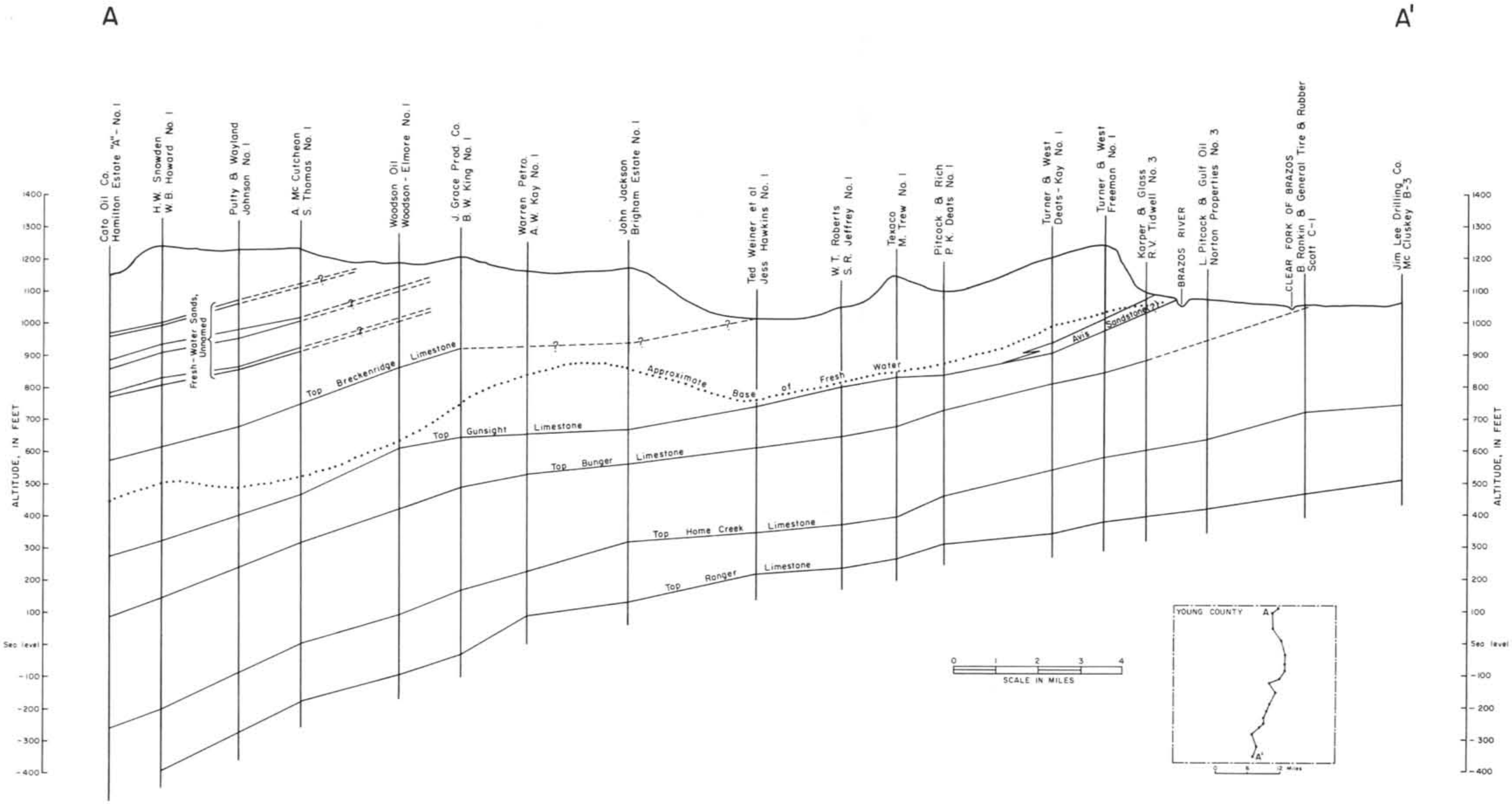

Figure 5

Geologic Section A-A', Young County

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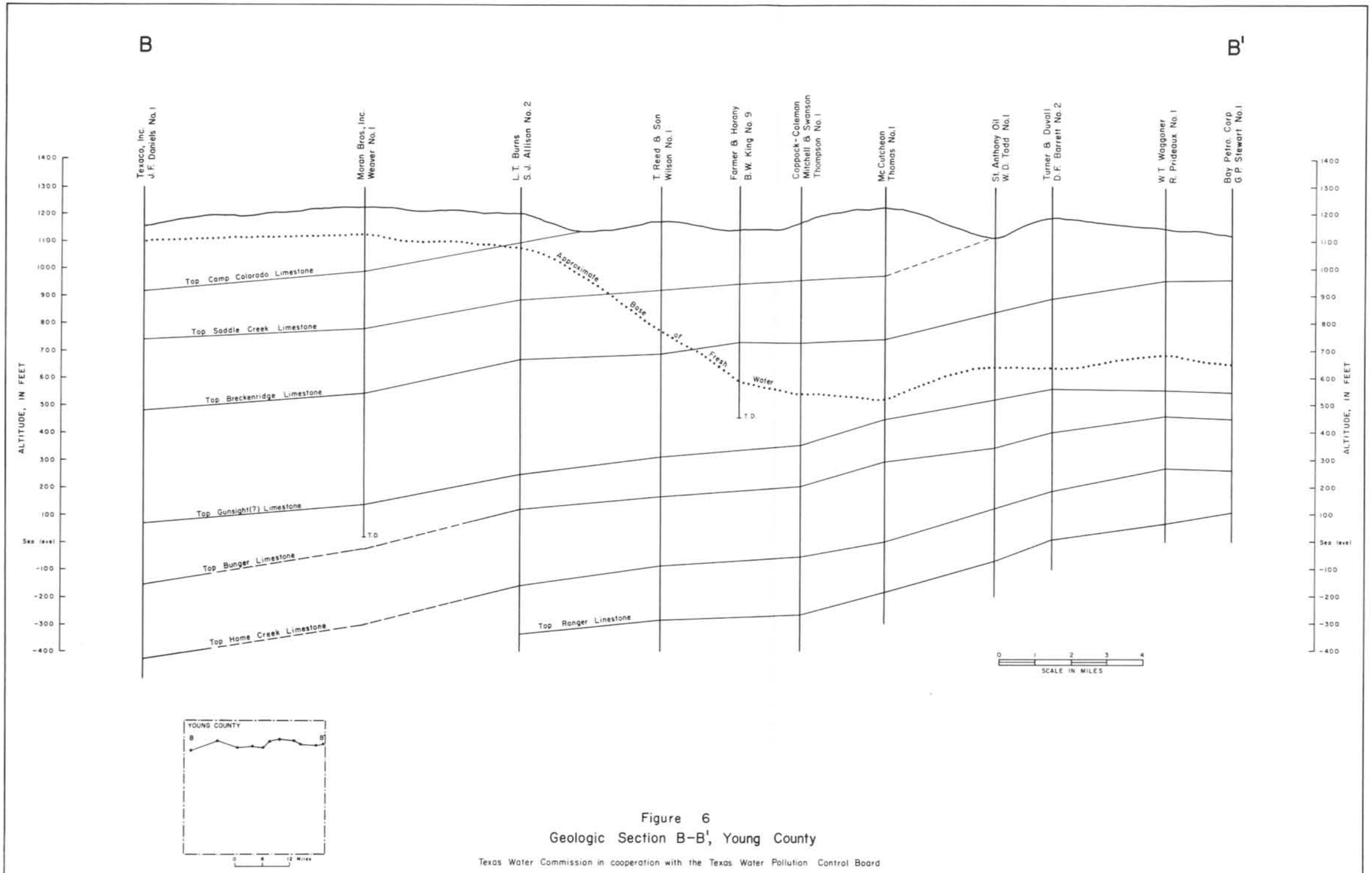

Figure 6

Geologic Section B–B', Young County

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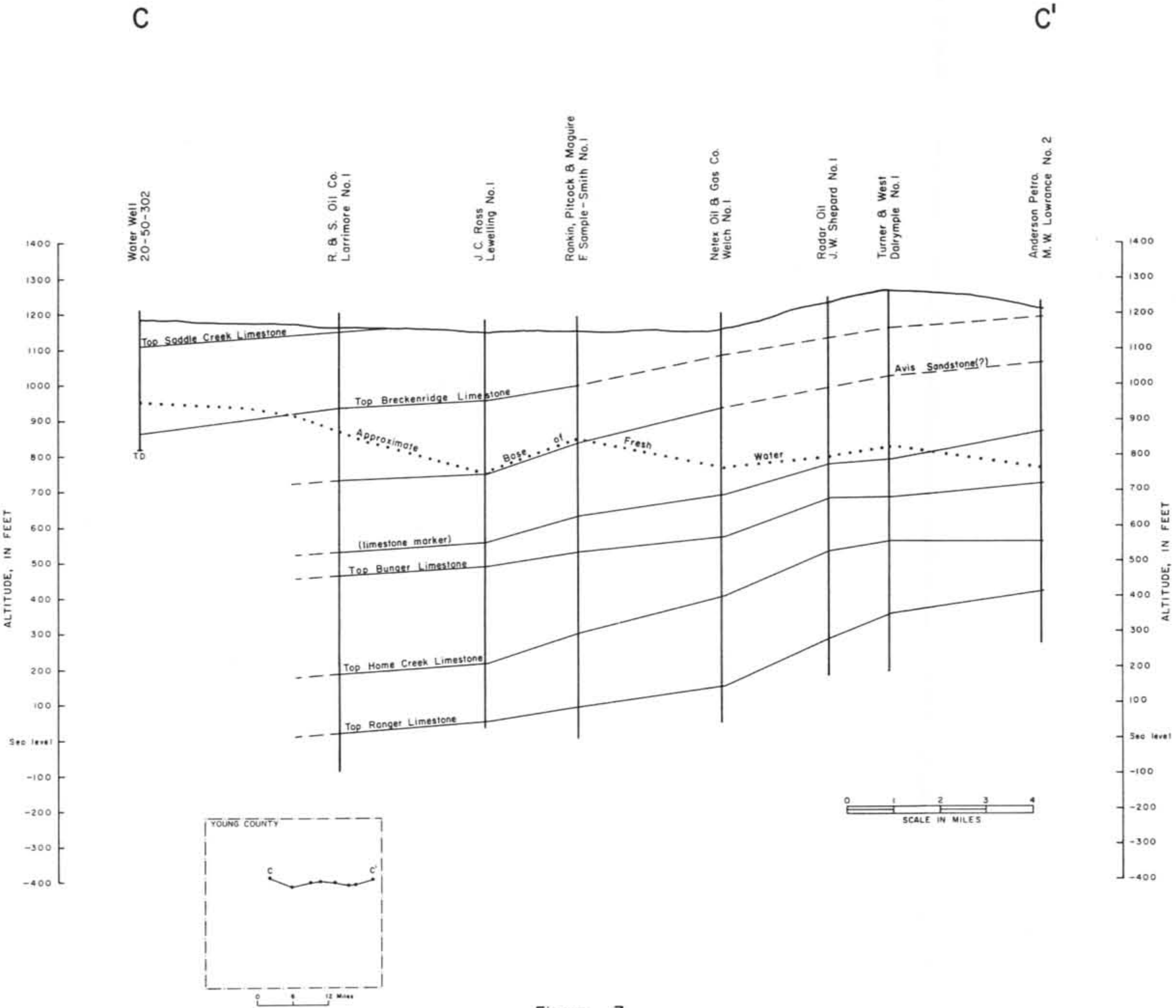

Figure 7
Geologic Section C-C', Young County

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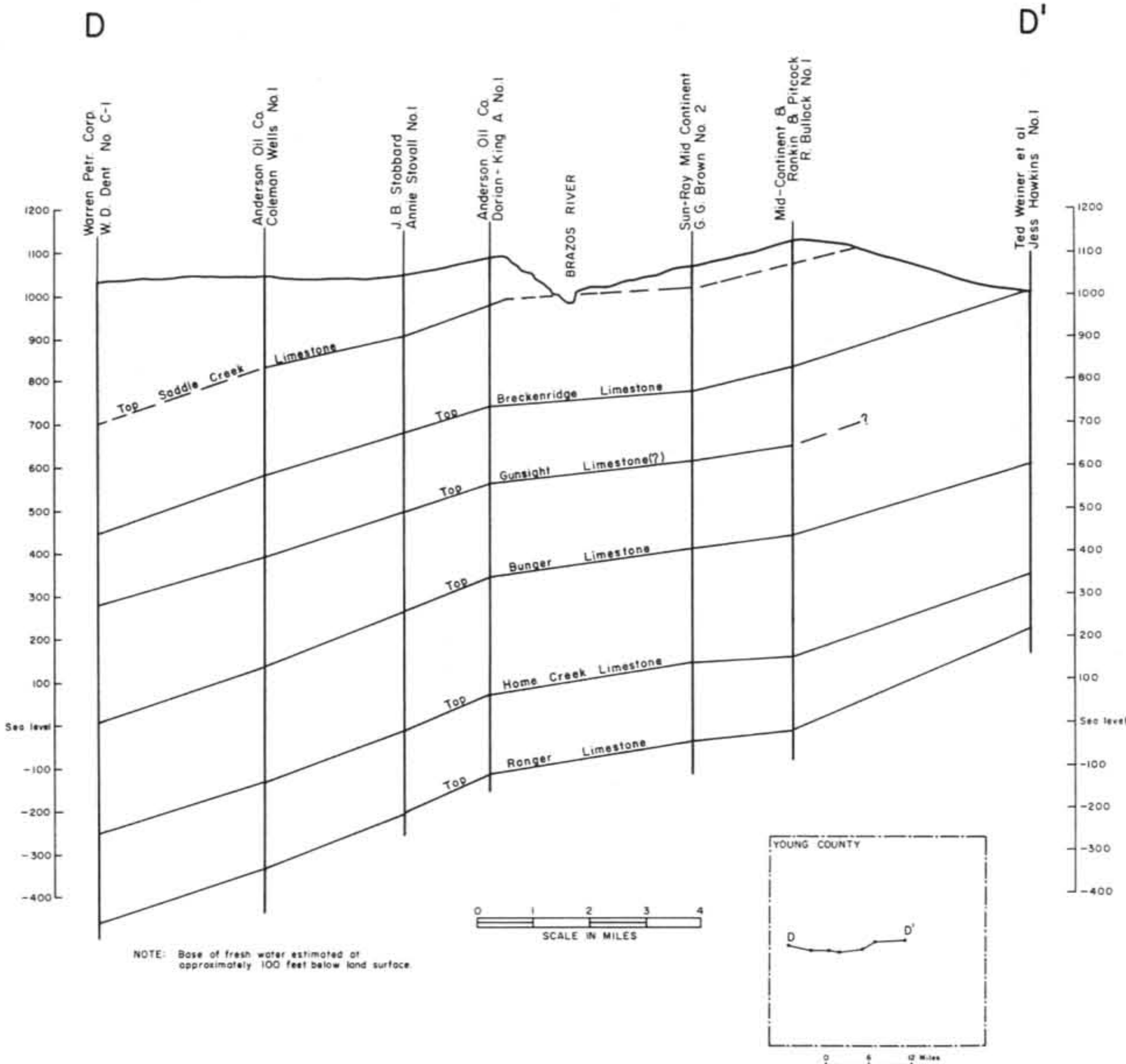

Figure 8

Geologic Section D-D', Young County

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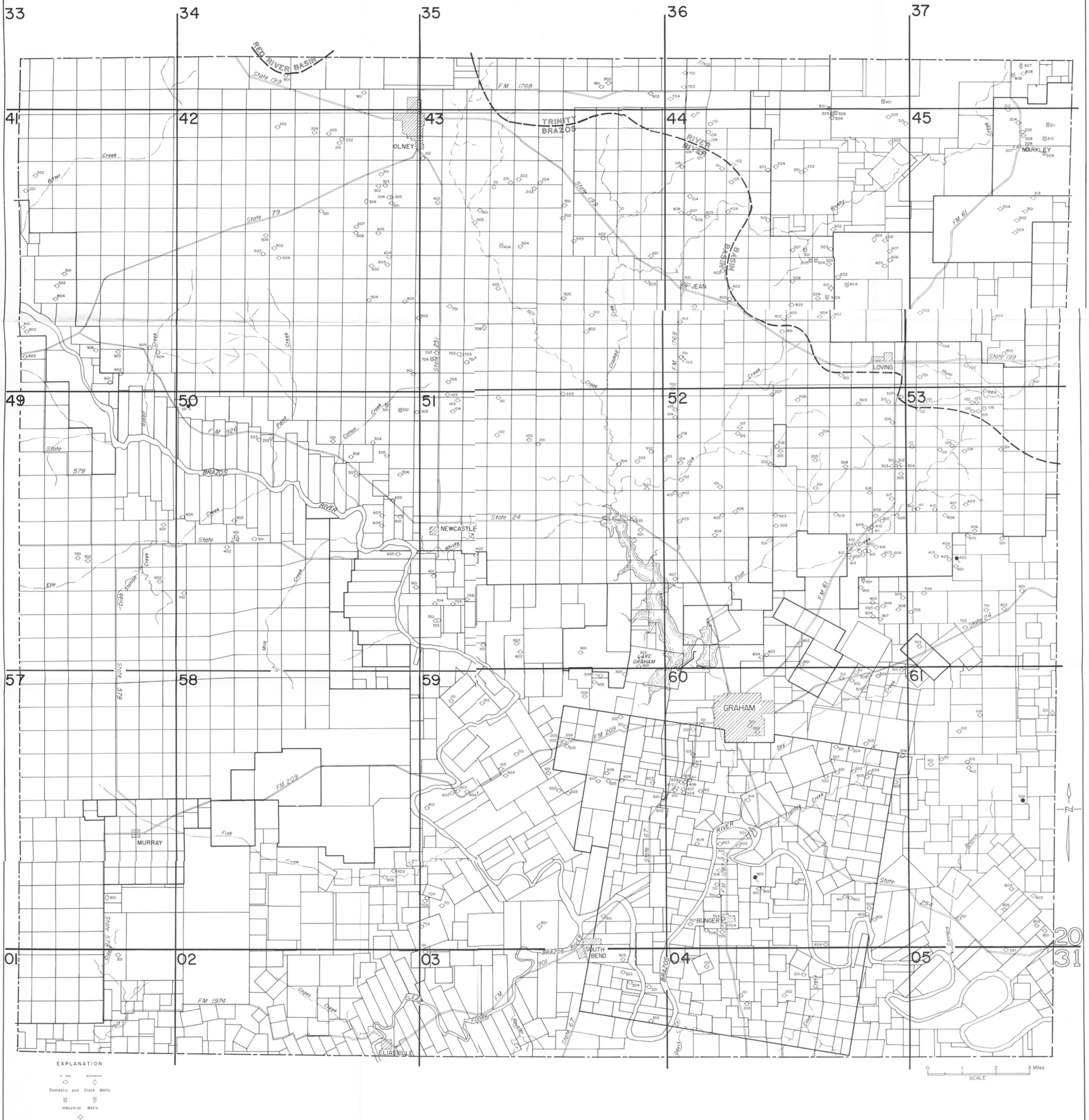

Plate I

Map Showing Loocations of Wells and Springs, Young County

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